KAHN BUILDING PRODUCTS

Trussed Concrete Steel Co.

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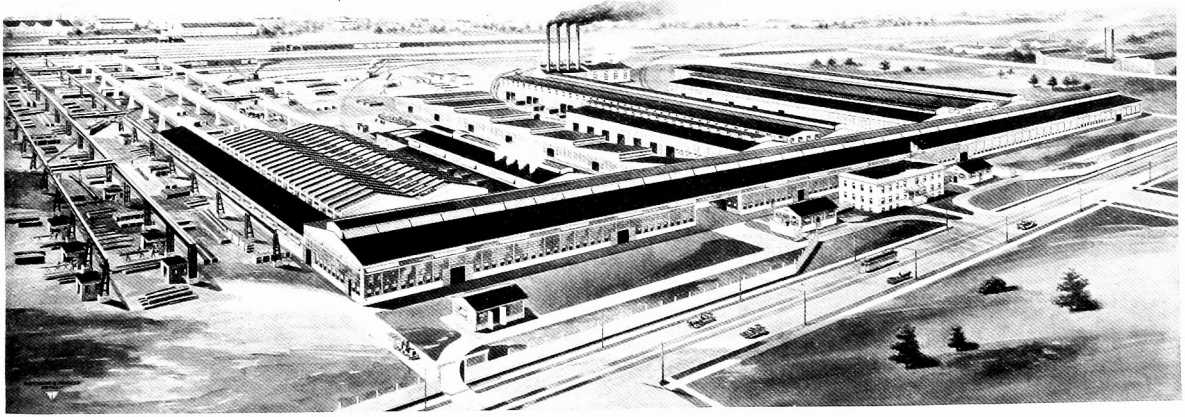

Main Plant of Trussed Concrete Steel Co., at Youngstown, Ohio, for Manufacture of Reinforcing Steel, Hy-Rib, Rib-Lath, United Steel Sash and other Steel Products.

Chemical Products Plant (The Trus-Con Laboratories) at Detroit, Mich.
Warehouses and Tile Plants in various cities.

Kahn System Standards

A Hand Book on Reinforced Concrete

Fifth Edition
Revised and Enlarged
1913

Trussed Concrete Steel Company
Detroit, Michigan, U. S. A.

Limited Edition for Special Distribution

Fifth Edition
1913

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Trussed Concrete Steel Company
Detroit, Michigan, U. S. A.

Reinforced Concrete

How First Used

WHEN, in the late 60s, Monier, a French gardener, began making flower pots, boxes and small water tanks out of concrete and imbedded wire in the material to increase its strength and decrease its weight and bulk, he little thought that forty years later the principle he employed would be used throughout the entire world in the erection of millions upon millions of dollar's worth of construction work. There has been no class of structures, no line of the building trades which has not been affected by reinforced concrete, and many of them have been revolutionized. The story of the development and growth of the use of this form of construction has filled volumes, while here it can only be touched upon briefly.

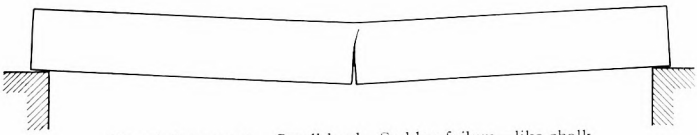
Concrete Defined

Concrete is a rock-like substance formed by the mixture of cement, sand, stone and water. It is the result of the cementing together, through chemical action between the cement and water, of various sizes of stone so proportioned with the other material that all voids within the resulting mass are filled.

Reinforced Concrete Defined

Reinforced concrete is exactly what the name implies. It is concrete in which steel has been imbedded to give additional strength and elasticity.

Plain concrete, when used in the form of pillars and posts, is capable of carrying heavy direct loads through its great compressive strength. But when it is subjected to a direct pull, that is, to tensile strains, it is weak. For example, if a



No reinforcement. Small load—Sudden failure—like chalk.

plain concrete beam is subjected to a load it will break apart at the bottom just as a piece of chalk would under like conditions, being unable to resist the tension in the lower portion of the beam. In order to overcome this, reinforcing steel is used to give proper tensile strength and elasticity. The concrete in the top of the beam takes care of the com-

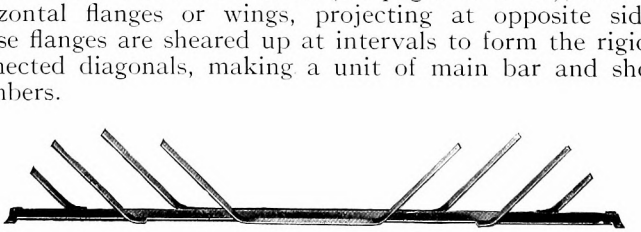
pression. A properly reinforced concrete beam has, therefore, the strength of stone in resisting compression, united with the tension resisting power of steel.

When a beam is loaded and supported at the two ends, it will have a tendency to deflect. To illustrate, assume that a beam is made up of a series of flat plates, or, in other words, like a pad of paper or a book, the difference being that in the pad of paper the leaves are not in any way connected to each other, whereas in a beam the adhesion of the various particles of the material ties the imaginary plates together. Now, when the supposed beam starts to deflect, one of two things will happen. Either the various plates separate, as when a book or pad of paper is bent, and in separating slide by one another; or, if the plates are held together and sliding is prevented, the particles in the upper plates compress and in the lower plates elongate.

It is thus seen that in addition to the compression and tensile stresses in the top and bottom of the beam, there are internal stresses of equal importance against which the concrete must also be properly reinforced. To accomplish this it will be absolutely necessary that there should be diagonal steel reinforcement extending well up into the mass of the concrete. This latter reinforcement *must be rigidly connected to the steel in the bottom of the beam* in order that all the steel may act together with the concrete in forming a properly reinforced beam. The Kahn Trussed Bar with its rigidly connected diagonals is, therefore, the ideal reinforcement.

Kahn Trussed Bar Described

The Kahn Trussed Bar is made of a special grade of medium open-hearth steel with an elastic limit up to 42,000 pounds and an ultimate tensile strength of 70,000 pounds per square inch. The cross section (see pages 15 to 17), has two horizontal flanges or wings, projecting at opposite sides. These flanges are sheared up at intervals to form the rigidly connected diagonals, making a unit of main bar and shear members.



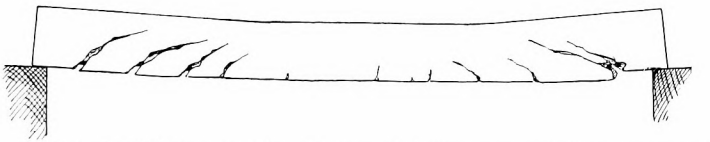
Kahn Trussed Bar—with alternating diagonals.
Note rigidly connected shear members.

General History of the Methods of Reinforcing Concrete

A BRIEF review of the general types of reinforcement used in the past, will make clear why they have been either abandoned or revised, and why the Kahn Trussed Bar is now considered the *perfect reinforcement*, incorporating all the advantages of the old forms with the more modern improvements and refinements.

Horizontal Only

It was originally thought that merely imbedding steel bars in the bottom of a concrete beam to take the tension was sufficient. This is true in some rare instances. While enough steel may be placed in the bottom of a beam, which, if pulled in a testing machine, could resist the desired amount



Horizontal reinforcement only. Method of failure when tested to destruction. Light load. Sudden failure caused by ends of reinforcement slipping and horizontal shear diagonal cracks in concrete.

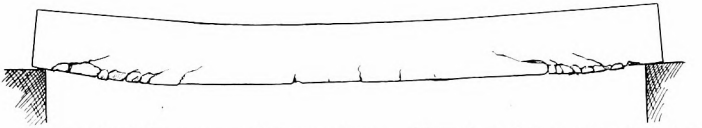
of tension, it must be remembered that it is necessary to get the stress into the steel from the concrete, and there must be some positive means of doing this. The old idea was to depend upon adhesion. This was soon found to be inadequate and unreliable, as the plain bars would slip.

In order to overcome this difficulty deformed bars of various types, such as twisted bars and bars with corrugations and lugs, were used to increase the friction between the steel and the concrete. When such bars were laid in the bottom of a concrete beam they did not slip in the concrete but the concrete would shear along a plane immediately above the bar. For this reason the strength of the bar could not be developed, and the beam was practically no stronger than if reinforced with plain bars.

Loose Stirrup

Numerous tests were made on the older form of horizontal reinforcement and it was universally observed that when a beam was tested to destruction, it failed by the breaking of the concrete along lines beginning at the reinforcement at

the ends and extending diagonally upwards towards the center of the beam. The cause was not known, but it was assumed that there were stresses in the concrete, and therefore loose vertical stirrups were placed in the mass of the

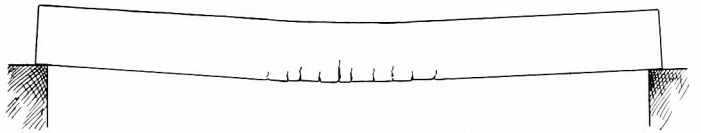


Horizontal reinforcement and loose stirrups. Method of failure when tested to destruction. Medium load. Sudden failure due to slipping of horizontal rods. Shear of concrete on horizontal plane above bars but no diagonal cracks.

beam to resist these stresses. When beams were tested to destruction it was found that the main bar slipped and that the beam failed by shearing along a horizontal plane connecting the steel with the concrete.

Rigidly Connected Web Members

It was thus demonstrated that a positive connection must be made between the main steel bar and the members taking the web stresses. This led to the invention of the Kahn Trussed Bar. In this patented bar the members in the vertical plane, being made from a part of the main tension member, transmit stress from the body of the beam directly to the main steel bar. This is the ideal reinforcement. When beams, which have been reinforced with the Kahn Trussed Bar, are tested to destruction, they fail by pulling the steel in two



Kahn reinforcement. Method of failure when tested to destruction. Maximum load. Very gradual and ideal failure. Steel stretching in center.

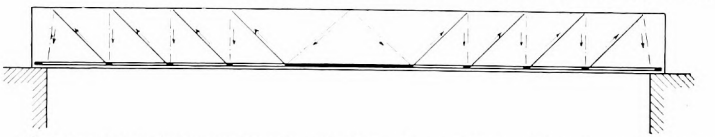
at the center, showing that there is absolutely no unknown weakness in the beam and that the full proportion of the strength of all the materials is developed. It is, therefore, the only means of reinforcing concrete that makes it possible to obtain the full value of the materials used.

Tests made by the French Government, report of which was published in "Concrete and Constructional Engineering" of London, show that beams reinforced with Kahn Trussed Bars carry 21 per cent more load than beams reinforced with horizontal rods and loose stirrups. The area of reinforcement was the same in both cases.

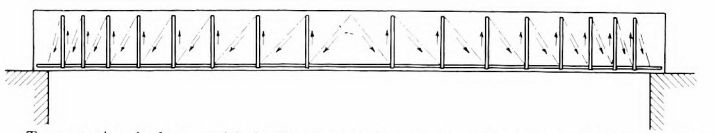
Tests made at the University of Wisconsin, Madison, Wis., show that beams with Kahn Trussed Bars carry over 33 per cent more load. Complete reports of these tests is found in Bulletin No. 197 of the University of Wisconsin. (University of Wisconsin Test Report will be gladly supplied by Trussed Concrete Steel Co.)

Internal Stress Action

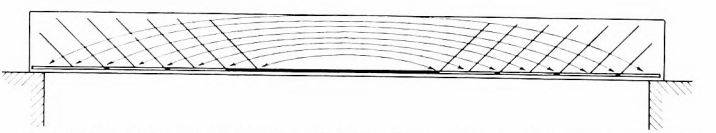
Note from the accompanying diagrams how, when a beam reinforced with the Kahn Trussed Bar is loaded, the stresses



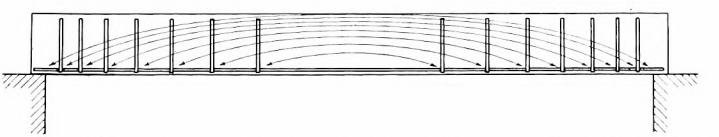
Truss action in beam reinforced with Kahn Trussed Bars. Note the action is that of a complete Pratt truss. No tendency to slip or slide.



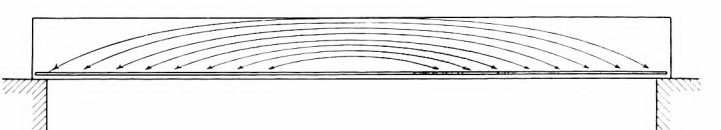
Truss action in beam with horizontal reinforcement and stirrups. Note the unbalanced horizontal component of the inclined stress and the tendency of the stirrups to slip along the horizontal reinforcement.



Arch action in beam reinforced with Kahn Trussed Bars. Note the perfect abutment for the inclined stresses. Perfectly rigid and no possibility of slipping.



Arch action in beam with horizontal reinforcement and stirrups. Note the unbalanced horizontal stress. Stirrups slip along the horizontal reinforcement, which, therefore, cannot be developed.



Beam with horizontal reinforcement only. Note arch action. Reinforcement furnishes no abutment for the inclined stresses, and will slip.

in the beam are resisted either by an arch or a truss. In the arch each individual stress is resisted by a positive abutment in the form of a diagonal. In the truss the steel diagonals form the tension web members and the compression web members are supplied by the concrete. The advantageous feature in this is that the tension in the diagonals is brought into the main tension member directly because tension member and diagonals are one. The thrust of the arch or the pull of the web member of the truss is resisted by the diagonal and main bar combined. It is just as essential to have rigid attachment of the diagonal members in a concrete beam as it is to have strong, close fitting rivets between the lower chord and web plate of a steel plate girder.

Certainty of Calculation

That the calculated strength of a beam may be developed it is necessary that the materials be distributed in such a manner that the ultimate strength of each would be attained should the beam be tested to destruction. This anticipates the prevention of slipping of the reinforcing bars and the failure by diagonal tension in the concrete. The Kahn Trussed Bar cannot slip and the concrete is reinforced against tension by the rigidly connected diagonals. It is clear, then, that beams reinforced with this bar will develop the ultimate strength of the materials, and, since these values are known, the materials can be so proportioned that each will be fully developed. In other words, the designer avoids the uncertainty of calculation caused by the sudden development of unexpected weaknesses. Absolute safety of design is assured.

Fireproofness

It is a well-known fact that concrete, when subjected to intense heat, of 1500 degrees Fahrenheit or over, for a continuous period, will lose a part of its water of crystallization. This condition will obtain for about one inch from the surface of the concrete in case of an extreme fire. Suppose the reinforcement is placed about one inch from the bottom of the beam. In case of a very extreme fire, the lower inch of concrete will be practically ruined and its adhesion or immediate connection with a plain bar in the bottom of the beam will be completely destroyed. With the Kahn Trussed Bar, the diagonals extend well up into the concrete beam and the effect of fire can be neglected, as the connection between the bar and its diagonals is still intact. (See Capt. Sewell's Report in Transactions of the Am. Soc. C. E.) This is perhaps one

of the greatest features of the Kahn System of Reinforcement. A building erected on this plan is as good after a fire as before, while a building reinforced with plain bars is apt to be a complete ruin.

Shock-Proofness

Actual tests show that the adhesion between the concrete and the steel is greatly weakened by repeated loading and unloading of the concrete beam. (See "Fatigue of Concrete" by I. D. VanOrnum, M. Am. Soc. C. E., Proceedings Am. Soc. C. E. December, 1906.) This means that in any structure subject to shock or moving loads, as in factories and bridges, it is not safe to rely on the bond of the concrete. Rigid connection of shear members to main reinforcement must be provided as in the Kahn Trussed Bar. The explosion at the Prest-O-Lite Company Factory, Indianapolis, Ind., is an example of how thoroughly Kahn Trussed Bars meet these requirements.

Workmanship

It is difficult in practical work to be sure that the concrete is so placed that all the steel is thoroughly imbedded, especially so in the bottom of beams. If for any reason the steel is so exposed, there can be no adhesion of the concrete and the strength of the beam reinforced with horizontal bars and loose stirrups is lost. With Kahn Trussed Bars this adhesion is not necessary. Beams have actually been built where the bars have been completely exposed on the underside and when tested to destruction developed the full strength of reinforcement.

Accuracy of Installation

The Kahn Trussed Bar reaches the job sheared and ready to be placed. The shear members are rigidly attached and cannot be dislocated either by careless labor or the pouring of the concrete. Each reinforcement is just where it belongs assuring greatest possible strength and efficiency.

Economy of the Kahn Trussed Bar

The Kahn Trussed Bar with its rigidly connected diagonals is designed to resist every stress in the concrete except that of direct compression. There is no waste metal at any point and proper reinforcement is provided at every place it is needed. In the central portion of the beam, where full area of metal is needed for resisting bending moment and

no shear reinforcement required, the bar is unsheared and the full area of the metal is available. At the ends of the beam, where the shear is a maximum and bending moment a minimum, the flanges of the Kahn Trussed Bar are struck up to form rigidly connected shear members. The shear members are thus made out of a part of the horizontal reinforcement and do not take extra steel, as in the case where loose stirrups and horizontal bars are used.

Economy of Installation

The Kahn Trussed Bar in reality consists of what may be considered as a large number of separate members, all rigidly connected and handled as a unit. All the field labor of attaching together many separate pieces is thus done away with. The practical builder well knows the great saving in handling a single piece compared with many separate individual parts.

Other Kahn Building Products

In the preceding pages were shown the advantages of Kahn Trussed Bars as reinforcement for beams, girders, joists, arches, etc. No one type of reinforcement, however, can be economically used in all classes of concrete work. Our many years of experience and the constant research of our engineers have enabled us to develop a complete series of products to efficiently meet every possible condition of practice.

Among the Kahn Building Products are included: Rib Metal, Built-up Column Hooping, Rib Bars, Hy-Rib, Rib Lath, Rib Studs, United Steel Sash, Trus-Con Chemical Products for waterproofing and finishing, Trus-Con Inserts, Trus-Con Curb Bars, Trus-Con Expansion Joints, Hollow Tile, Joist Hangers, Post Caps, Centering Clamps, etc. They are briefly described on pages 14 to 35, and more completely in special catalogs devoted to each product.

Kahn System Service

Kahn System represents something considerably more than the mere sale of these various products; it means an experience in over fifteen thousand important structures of all kinds in all parts of the world. It means an Engineering Department organized to give you the full benefit of this experience in the planning and construction of your building work. It means that you are dealing with a $2,000,000 organization of recognized reputation and responsibility, which can afford to

deliver only one class of service and that the best; an organization which you can be sure will only supply the very best materials, and designs which are reliable but not extravagant.

The design of a modern reinforced concrete structure requires scientific study in order to combine the various materials in the most economical and efficient manner. The conscientious designer must consider the purpose for which the structure is built, the arrangement of columns, beams and slabs, and the relative economy of different materials in various localities.

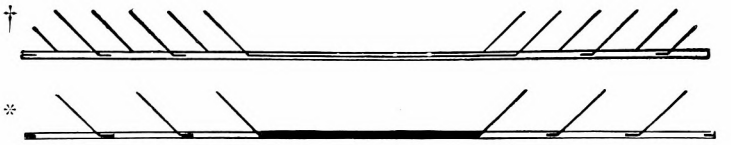
Engineering Department, Trussed Concrete Steel Co.

It is to take care of all such matters as these, to study each particular problem from every possible angle in order to get the best possible construction for each individual structure, that the Trussed Concrete Steel Co. has organized its large Engineering Department, with branches in all principal cities. In this Department are men of technical training and of wide experience in the engineering field, who are familiar with every type of construction and have specialized in reinforced concrete. This experience in reinforced concrete in all its applications places this department in a position to give expert advice on all such work. This advice, together with valuable suggestions is given without cost to all parties contemplating building. We especially invite Architects, Engineers and Builders to avail themselves of this service in connection with any work they have in contemplation.

Complete Designs of Reinforced Concrete Work

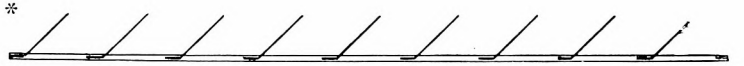
For any work in which it is decided that the Kahn System will be used, complete detailed drawings and designs of the reinforced concrete construction are prepared. These drawings show clearly the exact location of each reinforcing bar and the detailed size of all the concrete work. Each bar, when it leaves the factory, is given a distinctive mark which corresponds with its marking on the drawing. Each bar is designed for a distinct place in the structure, and the builder can tell at a glance where it belongs. The plans are prepared without cost for any structure in which the Kahn System is used. We co-operate to the fullest extent with all Architects, Engineers and Contractors.

Shearing of Kahn Trussed Bars



Standard Shear of Kahn Trussed Bar.
Middle Portion Left Unsheared.

Center Shear of Kahn Trussed Bar.
Entire Bar Sheared to Center.



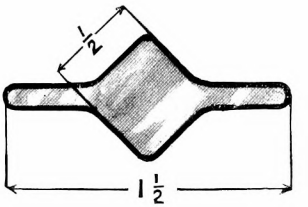
One Way Shear of Kahn Trussed Bar.
All Diagonals Sheared Inclining in one direction.

Special Shearing of Kahn Trussed Bar.
As directed by purchaser.

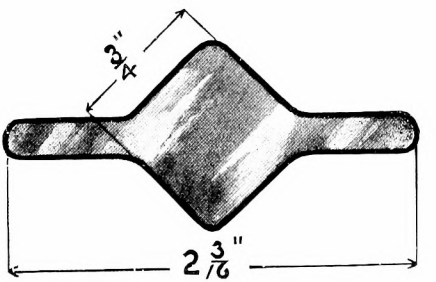
NOTE:—Sketches marked (†) shows shearing of bars with diagonals alternating as provided on 8-inch, 12-inch, 18-inch, 24-inch, 30-inch, 36-inch and 48-inch diagonals.

Sketches marked (*) shows shearing of bars with diagonals opposite as provided on 6-inch diagonals only.

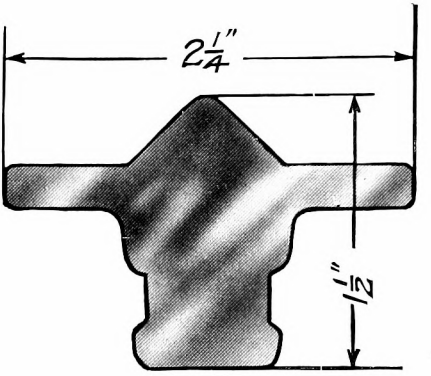
Sections of Kahn Trussed Bar



½″x1½″ Kahn Trussed Bar.
Weight—1.4 pounds per foot.
Area—0.41 square inches.
Standard length of diagonals—12 inches.
Special lengths—6 inches and 8 inches.



¾″x2 3/16″ Kahn Trussed Bar.
Weight—2.7 pounds per foot.
Area—0.79 square inches.
Standard lengths of Diagonals—12 inches, 24 inches and 36 inches.
Special lengths—8 inches, 18 inches and 30 inches.



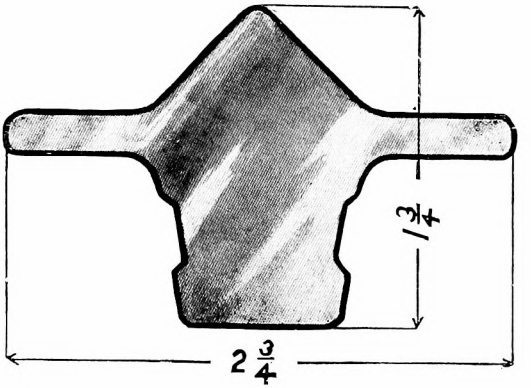
1½″x2¼″ Kahn Trussed Bar.

Weight—4.8 pounds per foot.

Area—1.41 square inches.

Standard lengths of Diagonals—12 inches, 24 inches and 36 inches.

Special lengths—18 inches and 30 inches.



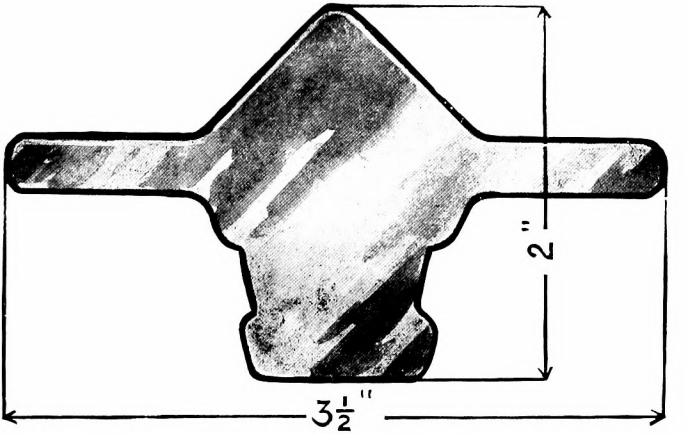
1¾″x2¾″ Kahn Trussed Bar.

Weight—6.8 pounds per foot.

Area—2.00 square inches.

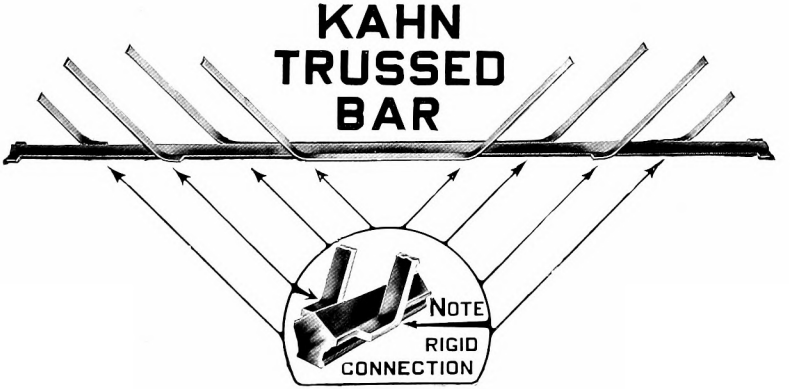
Standard length of Diagonals—36 inches.

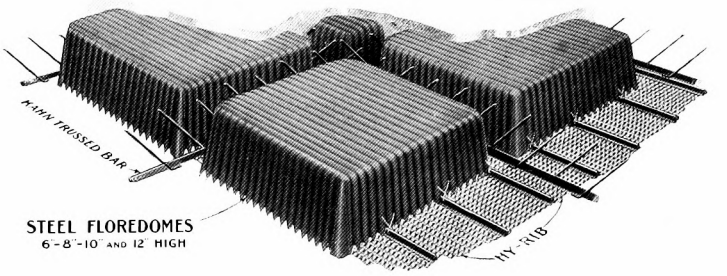
Special lengths—18 inches, 24 inches, 30 inches and 48 inches.



2″x3½″ Kahn Trussed Bar.
Weight—10.2 pounds per foot.
Area—3.00 square inches.
Standard length of Diagonals—36 inches.
Special lengths—24 inches, 30 inches and 48 inches.

Kahn Trussed Bars are manufactured from the highest grade of open-hearth steel and are shipped cut to exact length ordered. Bars up to 60 ft. in length are carried in stock at Youngstown, Ohio. Any desired length of diagonal or type of shearing can be furnished.





Steel Floredomes

Floredomes are rectangular dome-shaped steel tiles open on the under side. The deep corrugations on all sides give exceptional stiffness to the Floredomes, so as to support the trucking loads coming on them during construction. Reinforced concrete joists extend on all four sides of the Floredomes carrying the loads in two directions to the supports. A flat ceiling is obtained by the use of Hy-Rib which extends continuously underneath and produces an ideal surface for plaster. The serrated bottom edges of the Floredomes straddle the ribs of the Hy-Rib and engage in the Hy-Rib mesh. Wires attached to these ribs extend into the joists.

Steel Floredomes have many advantages over the terra-cotta hollow tile, being absolutely water-tight; light in weight; free from loss due to breakage; subject to greatly reduced freight rates; can be shipped anywhere; save in field labor; increase speed of construction; maximum economy of concrete and steel.

Properties of Steel Floredomes:

Depth—6 in., 8 in., 10 in., or 12 in.

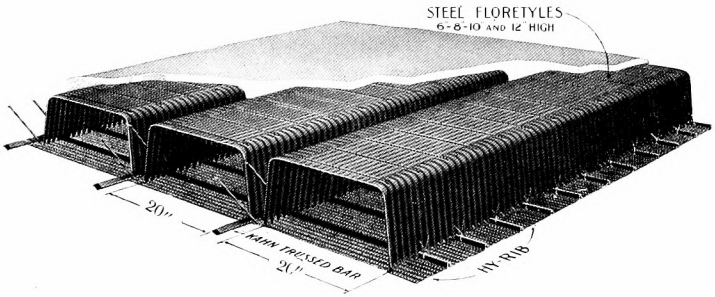
Size at Base—21½x21½ ins.

Furnished with serrated edges or straight edges.

See page 100 for Table of Safe Live Loads for Floredome Construction.

See page 83 for Illustrations of Floredome Construction.

Floredome Literature sent on request.



Steel Floretyles

Steel Floretyles are deeply corrugated steel tiles open on the under side. The bends at the corners and the deep ribs on the top provide exceptional stiffness against deformation and great rigidity in supporting loads. The narrow reinforced concrete joists between the Floretyles carry the loads to the supports. Ends of Floretyles lap with a tight joint. Floretyle Construction effects a great saving in concrete, steel, centering and weight.

For flat ceilings, Hy-Rib is used on the underside. The bottom edges of the Floretyles are serrated to straddle the ribs of the Hy-Rib and engage in the mesh. Floretyles are used with one-way reinforcement and Floredomes with two-way reinforcement. Both possess the same marked advantages over terra cotta tile.

Properties of Steel Floretyles

Depths: 6 in., 8 in., 10 in., and 12 in.

Width at Base: 20 inches.

Standard Lengths (nominal), 4 feet and 3 feet. Actual lengths are one inch greater, to allow for end lap.

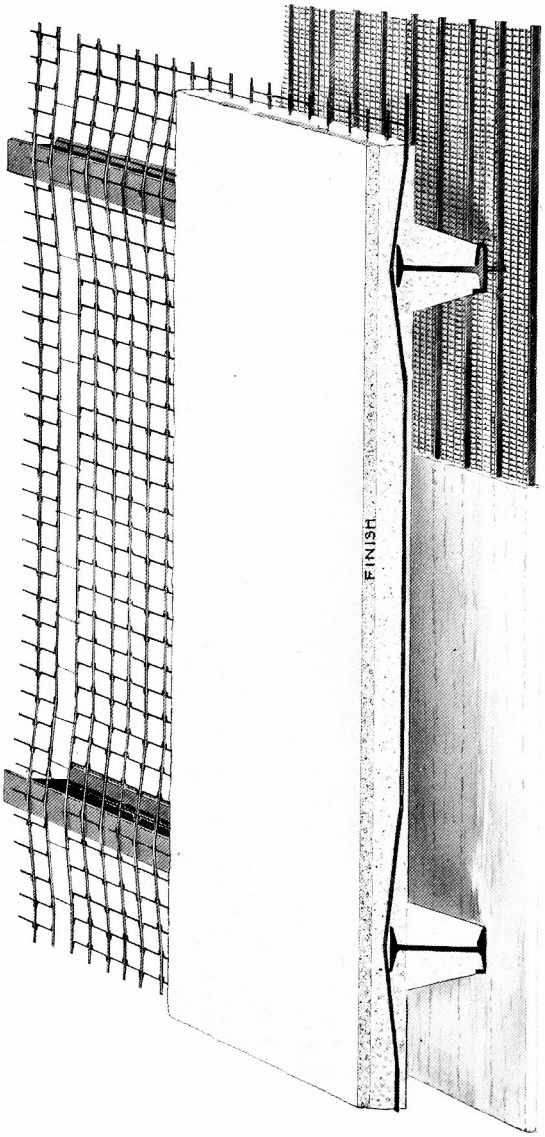
End Floretyles close the rows of Floretyles and are 2 feet (nominal) in length, actual length being 1 inch greater to allow for lap.

Furnished either with serrated edges or straight edges.

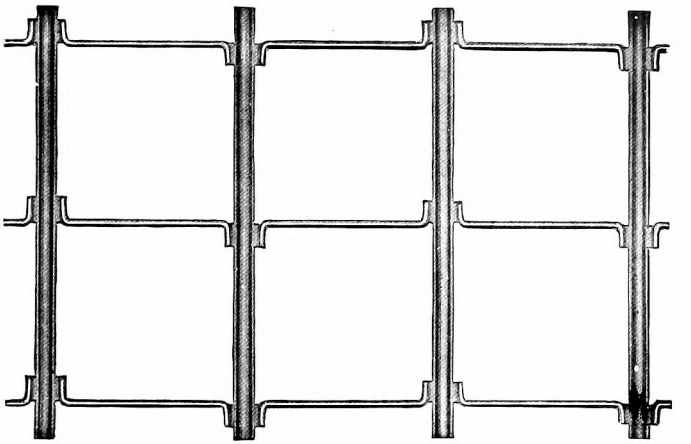
See page 101 for Table of Safe Live Loads for Floretyle Construction.

See pages 84 and 85 for Illustrations of Floretyle Construction.

Floretyle Literature sent on request.



Concrete Floor Slab Reinforced with Rib Metal
Note Hy-Rib Ceiling



Rib Metal

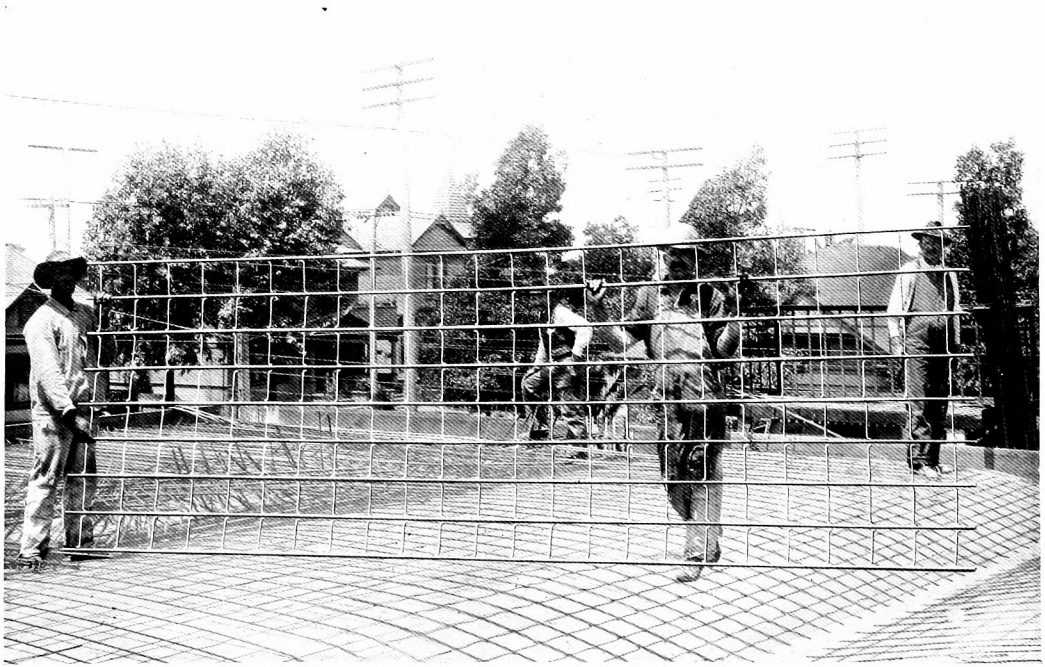
Rib Metal consists of a series of straight ribs or main tension members, rigidly connected by light cross ties formed from the same sheet of steel.

All the tension in the concrete slab is resisted by the ribs in a straight line action to the supports. The cross ties accurately space and thoroughly anchor the main ribs in the concrete, providing a perfect cross reinforcement against temperature and shrinkage strains.

Rib Metal is essentially a bar reinforcement, consisting of nine separate bars handled as one piece. Workmen can lay 100 square feet of reinforcement in the same time as would ordinarily be required to place a single bar. In this way Rib Metal saves expensive field labor, besides increasing the rapidity of construction.

The ribs are accurately spaced by the cross ties, and each rib is exactly where it belongs. There is no chance of displacing the bars by the pouring of the concrete or by careless workmen. Rib Metal is readily placed and stays in place.

The ribs span in a straight line between the supports, supplying the reinforcement in the direct line of greatest strain. Any reinforcement in the form of a diamond or triangular mesh carries the load in a long, diagonal line to the supports, and is consequently less efficient.



100 Square Feet of Reinforcement Handled as One Bar

RIB METAL Floors for the L. A. Creamery Co. Factory, Los Angeles, Cal.

Train & Williams, Architects F. L. Spaulding, Contractor

Rib Metal is stiff and rigid, not pliable and wirey. It reaches the job ready to be placed in the concrete. There is no field labor required to unroll and straighten coils into flat sheets.

The ribs being in a direct line with the strain do not tend to assume other positions when the slab is loaded. There is no straightening out of kinks and resultant deflection in the slab.

Rib Metal is furnished in flat sheets as reinforcement for floor and roof slabs, walls, vaults, etc.

Rib Metal is also supplied by our shops bent to exact curve as reinforcement for arches, conduits, sewers, reservoirs, tanks, etc. The shop-bending assures absolute accuracy of curve and does away with expensive field labor.

Rib Metal is made from the highest grade open-hearth steel and in seven sizes of mesh.

Properties of Rib Metal

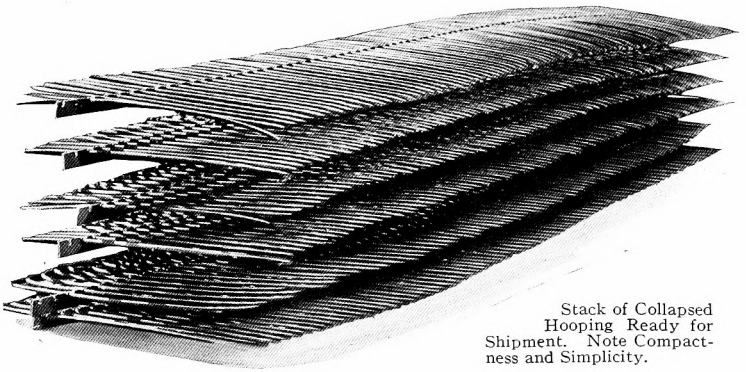
Area of one Rib=.09 sq. in. (9 Ribs in one sheet)

Size No.	Width of Standard Sheet	Square Feet per Lineal Foot	Area per Foot of Width	Weight per Square Foot
2	16 in.	1.33	.54 sq. in.	2.025 lbs.
3	24 in.	2.00	.36 sq. in.	1.340 lbs.
4	32 in.	2.67	.27 sq. in.	.997 lbs.
5	40 in.	3.33	.216 sq. in.	.792 lbs.
6	48 in.	4.00	.18 sq. in.	.655 lbs.
7	56 in.	4.67	.154 sq. in.	.557 lbs.
8	64 in.	5.33	.135 sq. in.	.484 lbs.

All lengths up to 18 feet.

Furnished in flat or curved sheets.

See page 97 for carrying capacities of Rib Metal Slabs.

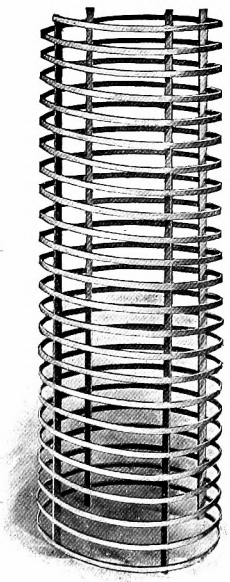


Stack of Collapsed Hooping Ready for Shipment. Note Compactness and Simplicity.

Collapsible Column Hooping

Collapsible Column Hooping, for reinforcing concrete columns is shipped in the form of flat, circular coils of exact diameter and accurately spaced by means of special spacing bars. These coils spring automatically into a complete hooped column on cutting the small fastening wires.

Collapsible Column Hooping reduces freight bills, by securing a lower freight classification; makes possible a full-weight carload, owing to its compactness; does not become damaged in transit; assures absolute accuracy of construction; increases speed of installation; and saves expensive field labor.



Rib Bars are ordinarily used as vertical reinforcement in conjunction with Column Hooping.

Sizes of Collapsible Column Hooping

Shipped complete with two spacing bars.

Sizes of wire for hooping: $\frac{1}{4}$-inch, $\frac{5}{16}$-inch, $\frac{3}{8}$-inch, $\frac{7}{16}$-inch and $\frac{1}{2}$-inch diameter.

Diameters of Coils: 9-inch to 30-inch.

Pitch: $1\frac{1}{2}$-inch to 12 inches.

Hooping, where desired, can also be furnished in bundles, coiled to the correct diameter, and with separate spacing bars, ready for assembling in the field.

See Page 68 for Pieces under Direct Compression.

See Page 117 for Table of Safe Loads carried on hooped columns.

Rib Bars

The Rib Bar for reinforcing concrete is a special rolled section with a series of cross ribs so designed as to secure maximum grip on the concrete.

The Rib Bar is used principally as an auxiliary reinforcement to the Kahn Trussed Bar, Rib Metal and Hy-Rib. It is ideal wherever direct tension or compression stresses are to be resisted, for instance—the longitudinal bars in columns and the cross bars in slabs, also in domes, tanks, etc. It has a wide application for bridge abutments and massed concrete, where temperature, expansion and shrinkage stresses are to be resisted.

See pages 116 and 117 for Safe Loads on Columns.

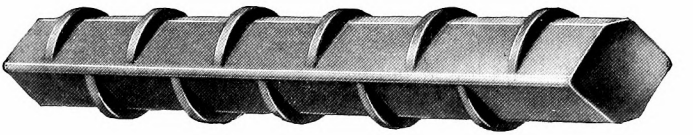


Table of Properties of Rib Bar

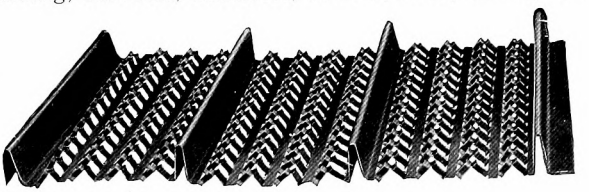
Size	Area	Weight per Lineal Foot
1/4"	.0625 sq. in.	.213 lbs.
3/8"	.1406 sq. in.	.48 lbs.
1/2"	.2500 sq. in.	.86 lbs.
5/8"	.3906 sq. in.	1.35 lbs.
3/4"	.5625 sq. in.	1.95 lbs.
7/8"	.7656 sq. in.	2.65 lbs.
1 "	1.0000 sq. in.	3.46 lbs.
1 1/8"	1.2656 sq. in.	4.38 lbs.

Hy-Rib

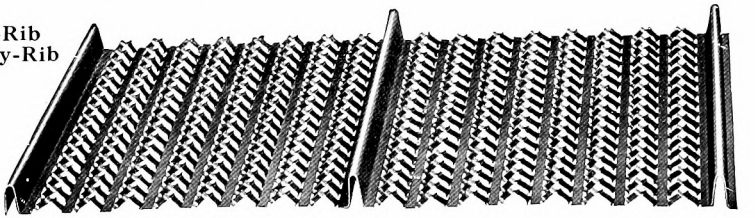
Hy-Rib is a steel sheathing, stiffened by rigid, deep ribs, formed from the same sheet of steel. Owing to the strength of these ribs, Hy-Rib does away with forms in concrete contruction. Hy-Rib is a unit of steel lath and studs.

Hy-Rib is supplied in either flat or curved sheets, for the construction of floors, roofs, walls, sidings, partitions, ceilings, furring, culverts, conduits, sewers, silos, tanks, etc.

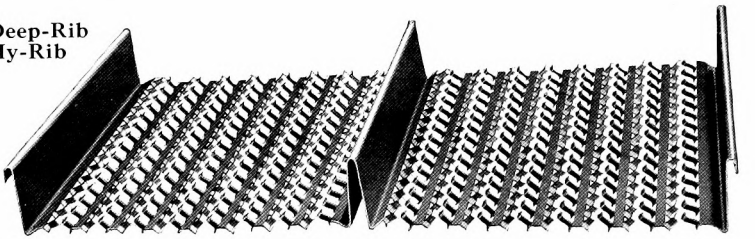
4-Rib Hy-Rib



3-Rib Hy-Rib



Deep-Rib Hy-Rib



Type of Hy-Rib	Gauge Nos. U. S. Standard	Spacing of Ribs	Height of Ribs	Width of Sheets
4-Rib Hy-Rib.....	24, 26 or 28	3½"	$\frac{13}{16}$"	10½"
3-Rib Hy-Rib.....	24, 26 or 28	7 "	$\frac{13}{16}$"	14 "
Deep-Rib Hy-Rib...	22, 24 or 26	7 "	1½"	14 "

Standard lengths: 6, 8, 10 and 12 feet.

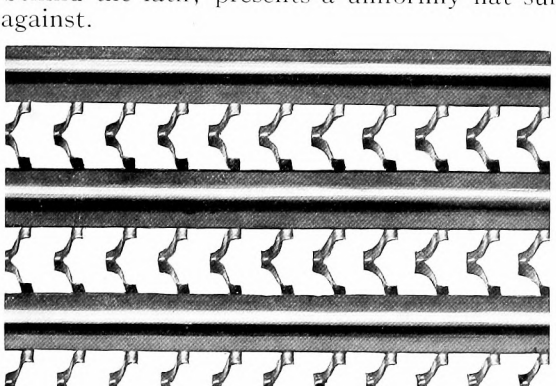
Intermediate and shorter lengths are cut without charge, but any waste is charged to the purchaser. Hy-Rib sheets interlock at sides and ends. In ordering, no allowance need be made for side laps. Allow 2 inches for end laps where splice occurs over supports; otherwise, eight inches.

See pages 98-99 for safe loads on Hy-Rib Slabs

Hy-Rib Hand-Book sent on request.

Rib Lath

Stiffest steel lath because of the beaded parallel ribs which span directly between the studs; provides a perfect clinch for the plaster owing to the improved form of expansion; requires least amount of plaster, with no dropping of plaster behind the lath; presents a uniformly flat surface to plaster against.



Beaded Plate Rib Lath

GRADE	Size of Sheets	Sheets per Bundle	Yards per Bundle	Weight per Sq. Yd.
Rib Lath No. 1A.....	15¼"x96"	16	18	3.63 lbs.
Rib Lath No. 2A.....	15¼"x96"	16	18	4.54 lbs.
Rib Lath No. 4A.....	15¼"x96"	16	18	5.45 lbs.

Standard Rib Lath

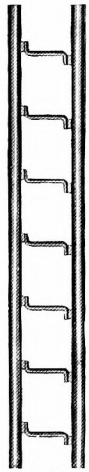
GRADE	Size of Sheets	Sheets per Bundle	Yards per Bundle	Weight per Sq. Yd.
Rib Lath No. 1.....	20¼"x96"	12	18	2.74 lbs.
Rib Lath No. 2.....	20¼"x96"	12	18	3.42 lbs.
Rib Lath No. 4.....	20¼"x96"	12	18	4.10 lbs.

"B" Rib Lath

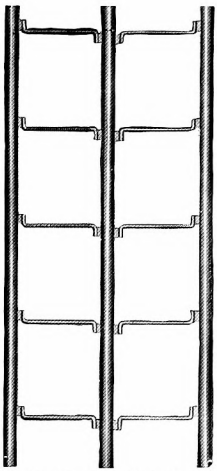
GRADE	Size of Sheets	Sheets per Bundle	Yards per Bundle	Weight per Sq. Yd.
Rib Lath No. 1B.....	$24\frac{5}{16}$"x96"	10	18	2.28 lbs.
Rib Lath No. 2B.....	$24\frac{5}{16}$"x96"	10	18	2.85 lbs.
Rib Lath No. 4B.....	$24\frac{5}{16}$"x96"	10	18	3.42 lbs.

We recommend painted lath, but we can supply it without paint if desired.

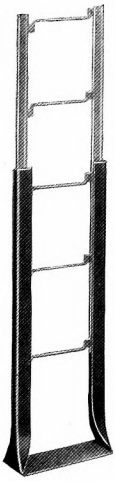
Rib Lath Catalogue sent on request.



2¼", 3¼" and 4¼" wide



6¼" and 8¼" wide Rib Studs



Rib Stud Extensions

Rib Studs

RIB STUDS—made of the highest grade of open-hearth steel—are open for the passage of conduits and pipes, and provide an uninterrupted air space between the two plaster surfaces. All lengths up to 18 feet.

RIB STUD EXTENSIONS—provide an adjustable attachment at floors and ceilings.

Steel Corner Beads

Our Corner Beads are galvanized after forming and furnished in lengths from 6 to 12 feet.

Detroit Steel Corner Bead—see illustration.

Detroit T-Rail Corner Bead—similar to Detroit Steel Corner Bead.

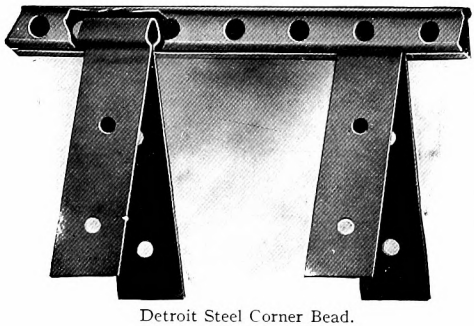
Detroit Solid Rail Corner Bead—made of special rolled section with punched web.

Rib Steel Corner Bead No. 1—see illustration.

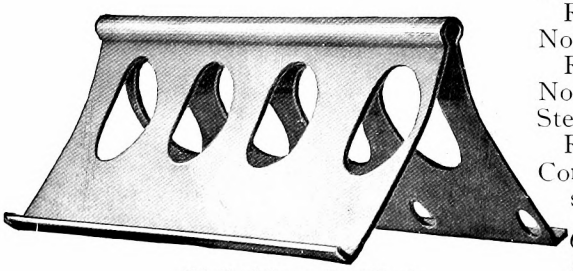
Rib Steel Corner Bead No. 2—similar to Rib Steel Bead No. 1.

Rib Feather-Edge Corner Bead—for fine, sharp corners.

Corner Bead pamphlet sent on request.



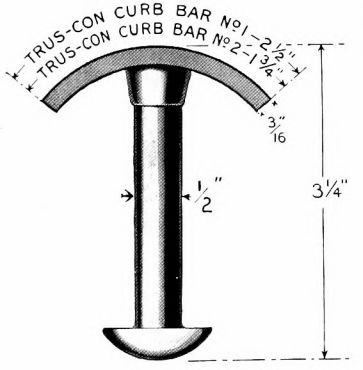
Detroit Steel Corner Bead.



Rib Steel Corner Bead No. 1.

Trus-Con Curb Bars

Trus-Con Curb Bars are used to protect concrete curbs, entrance and interior columns, shipping platforms, step nosings, or any exposed concrete edges. Trus-Con Curb Bars consist of properly shaped steel plates with heavy anchor bolts that secure an absolutely positive hold in the concrete.



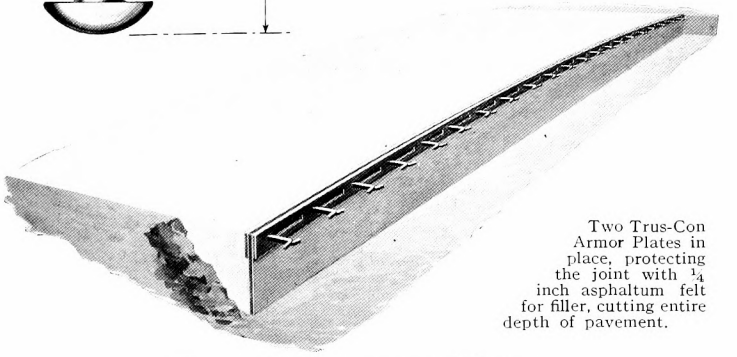
Trus-Con Curb Bars are made of highest grade open-hearth steel and heavily galvanized after forming.

Trus-Con Curb Bar No. 1

Plates $\frac{3}{16}$-in. thick, periphery $2\frac{1}{2}$ in.
Anchor bolts $\frac{1}{2}$ in. x $3\frac{1}{4}$ in.
Standard lengths 8, 10 and 12 feet.

Trus-Con Curb Bar No. 2

Plates $\frac{3}{16}$-in. thick, periphery $1\frac{3}{4}$ in.
Anchor bolts $\frac{1}{2}$-in. x $3\frac{1}{2}$ in.
Standard lengths 8, 10 and 12 feet.



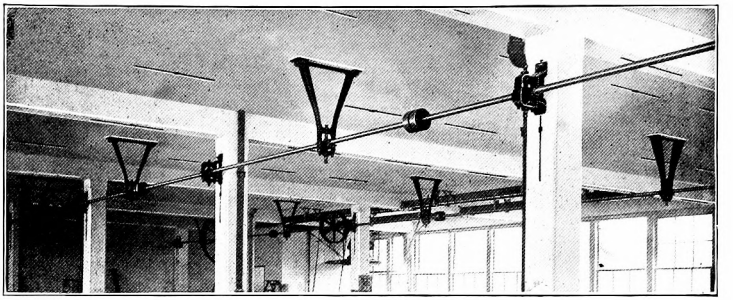
Two Trus-Con Armor Plates in place, protecting the joint with ¼ inch asphaltum felt for filler, cutting entire depth of pavement.

Trus-Con Armor Plates

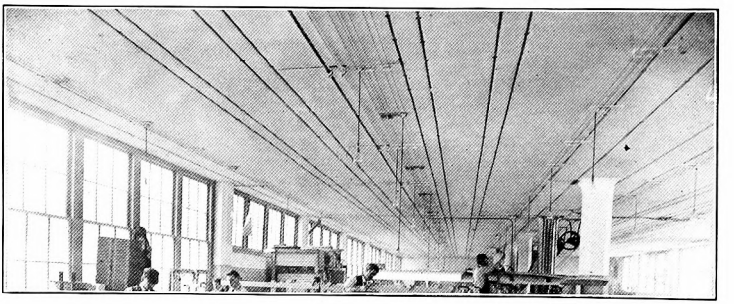
Trus-Con Armor Plates protect the expansion joints in concrete roads from chipping off and breaking down. The prongs formed from the plates are sheared at the ends to provide lugs for the positive anchorage of the plates to the concrete.

Trus-Con Armor Plates are made of highest grade open-hearth steel and are curved to pitch or crown of the pavement. Standard size of plate is $2\frac{1}{2}$ inches wide by $\frac{3}{16}$ inches thick, in all reasonable lengths.

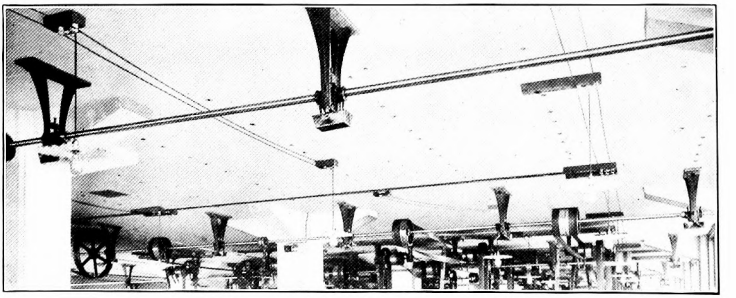
Catalogue on Bridges, Roads and Curbs sent on request.



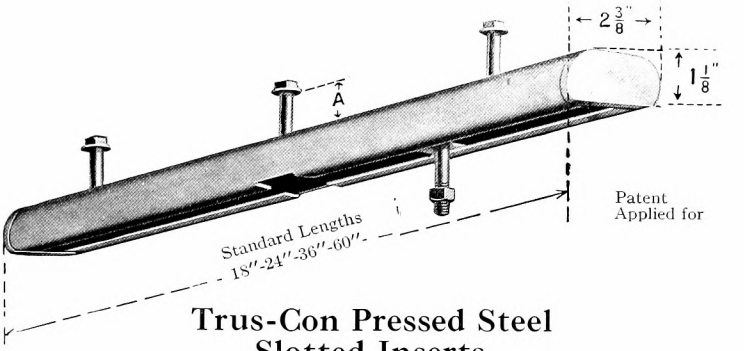
Trus-Con Slotted Inserts in Ceilings, Beams and Columns.
Burroughs Adding Machine Co., Detroit.



Continuous Lines of Slotted Inserts in Kahn System Flat Ceiling.
Truck Dept., Packard Motor Car Co., Detroit.



Trus-Con Socket Inserts at Brown, Lipe, Chapin Co., Syracuse.
Note Kahn System Flat Ceiling with Brackets at Columns.



Trus-Con Pressed Steel Slotted Inserts

Trus-Con Slotted Inserts are used in concrete slabs, beams or columns for attaching Shaft Hangers, Fixtures, Sprinkler Systems, etc. They do away with expensive drilling into concrete after completion of the building.

Trus-Con Slotted Inserts are thoroughly imbedded into the concrete during the process of construction. Only the narrow slot flush with the concrete is seen in the completed work. The bolts can be moved along this slot to any desired location and are prevented from turning by special washers.

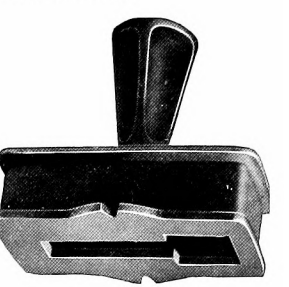
Standard lengths—18 in., 24 in., 36 in. and 60 in.

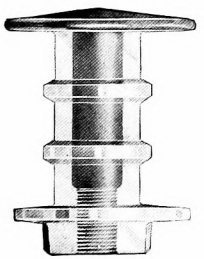
Lengths of suspension bolts (A)—2½ in. and 4 in.

Continuous Inserts of any desired lengths are formed by removing end caps and butting inserts end to end.

Kahn Adjustable Inserts

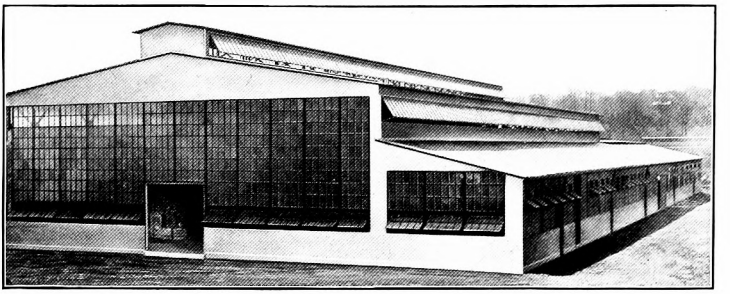
Are made of malleable iron and have the same simple method of application to concrete and adjustment for bolts as the slotted inserts, but without their wide range of adjustability. Made in three sizes to accommodate ½", ¾" and ⅞" bolts.



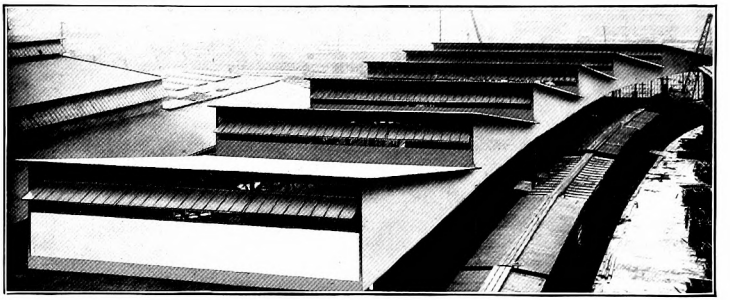


Trus-Con Socket Inserts

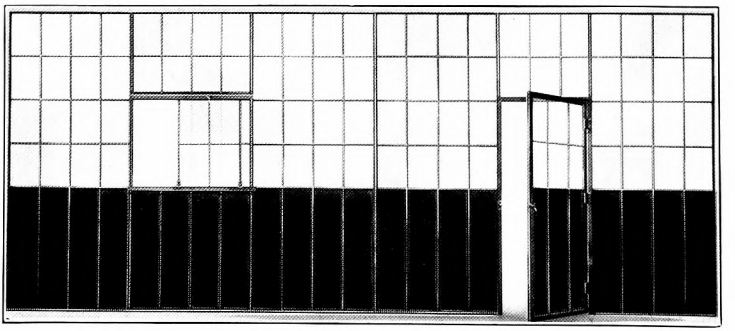
Are used for attachments which can be accurately located before occupancy. Made of malleable iron in three sizes, properly cored and threaded to receive ½", ¾" and ⅞" bolts.



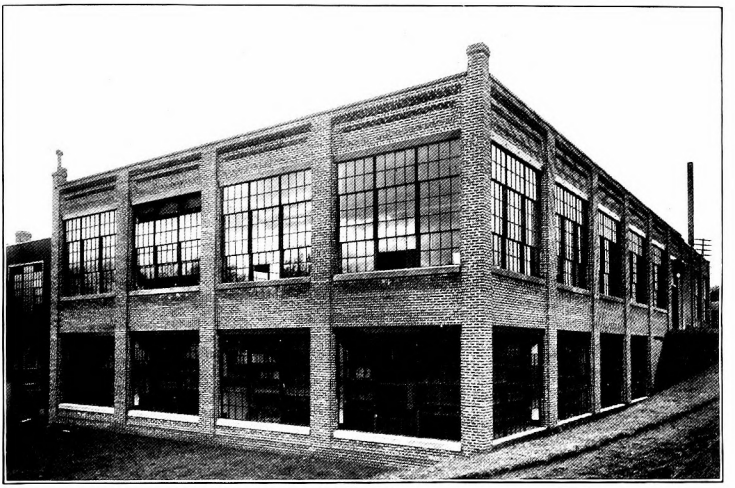
Pivoted United Sash in Side Walls.
Top-Hung Continuous United Sash in Monitors.



Center-Pivoted Continuous United Sash.
Note Increased Ventilation.



United Sash Partitions.
Movable and Save Space. United Steel Doors, (Sliding and Hinged) of all Types.



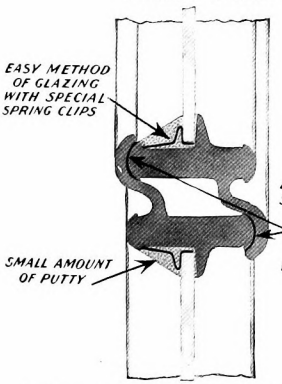
Vertical Sliding United Sash. Weber Electric Co., Schenectady, N. Y.

United Steel Sash

United Steel Sash are machine-built of deep rolled steel sections of great strength and rigidity. The joints are not weakened by cutting or punching away of the metal. Maximum daylight for interiors is assured, as there is practically no obstruction to the light at muntins, mullions, lintels or jambs. Large wide ventilators give perfect ventilation. All joints are carefully designed and fit tightly, shutting out the weather. Glazing is simplified by the use of spring clips.

United Steel Sash are manufactured in standard units, which are combined by means of mullions to fit openings of any desired size. United Steel Sash include all types of sash.

Pivoted Side Wall Sash; Vertical Sliding Sash; Horizontal Sliding Sash; Center Pivoted Continuous Sash; Top Hung Continuous Sash; Sliding and Swing Doors; Steel and Glass Partitions; Casement Sash, etc., etc.

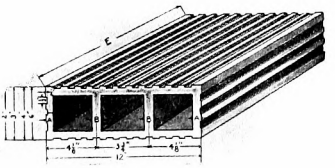


Section around Pivoted Ventilator.

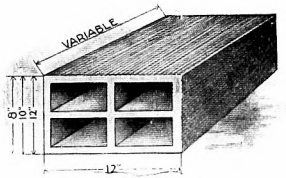
Standard units are three, four or five lights in width and any desired number of lights in height up to 15 feet. United Steel Sash are made for the following sizes of glass: Width: 10, 11, 12, 13, 14 or 15 inches. Height: 16, 17, 18, 19, 20, 21, 22, 23 or 24 inches.

United Steel Sash Handbook on request.

Hollow Terra Cotta Tile



Partition Tile
2-, 3-, 4- and 6-inch



Floor Tile
8-, 10- and 12-inch

Partition and Floor Tile

Size	Weight
2″x12″x12″	13 lbs.
3″x12″x12″	15 lbs.
4″x12″x12″	18 lbs.
5″x12″x12″	20 lbs.
6″x12″x12″	22 lbs.
8″x12″x12″	27 lbs.
10″x12″x12″	32 lbs.
12″x12″x12″	36 lbs.

Also—

Building Blocks
Hollow Building Brick
Jumbo Brick
Book Tile
Furring Tile
Flat Arch Tile
Fireproofing Tile
Hollow Brick.

Stucco Blocks of all kinds including Jamb and Corner Blocks.

See pages 102 to 107 for Safe Loads of Hollow Tile Floors.

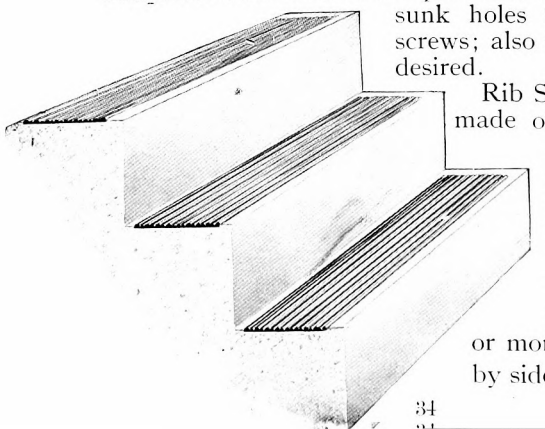
Tile catalogue on request.

Rib Steel Stair Treads

For Factories and Warehouses

Are adapted for stairways and landings, whether made of concrete, stone, slate or wood; or on structural steel frames. The deep ridges form an effective grip for the shoes and prevent slipping. The steel positively resists wear.

Rib Steel Stair Treads are provided with drilled, countersunk holes for fastening with screws; also with special lugs as desired.



Rib Steel Stair Treads are made of the highest grade open-hearth steel, in widths up to 6½ inches and in lengths up to 18 ft. Greater widths are secured by placing two or more of the treads side by side.

Trus-Con Chemical Products

Waterproofings—Dampproofings—Technical Paints

Trus-Con Waterproofing Paste: Mixed with gauging water to make concrete and cement waterproof.

Trus-Con Stone-Tex: A liquid cement coating, in colors, to dampproof and uniform exposed exterior walls of concrete, cement block, stucco and brick.

Trus-Con Por-Seal: A transparent liquid dampproofing for exposed exterior concrete, brick and cut stone walls.

Trus-Con Plaster Bond: A black dampproof coating for inside walls. Can be plastered on without furring and lathing.

Trus-Con Foundation Coat: Black hydrocarbon coating for dampproofing foundations, etc. Applied cold with a brush.

Trus-Con Stone Backing: Black coating for unexposed sides of cut stone. Protects against stain from mortar.

Trus-Con Ironite Flooring: An iron powder for finishing cement floors with an ironized wear-resistant surface.

Trus-Con Floor Enamel: A tough, dustless, washable coating for cement floors. In colors. Applied with a brush.

Trus-Con Asepticote: A flat, washable coating, in colors, for interiors of plaster, wood, concrete, brick, metal, etc.

Trus-Con Sno-Wite: Finest quality pure white enamel for interior decoration.

Trus-Con Industrial Enamel: White enamel coating for interior use in factories, power-houses, warehouses, etc.

Trus-Con Hospital Enamel: Durable, fume-proof, white gloss coating. Can be washed with antiseptic solutions.

Trus-Con Dairy Enamel: A sanitary white enamel for creamery and dairy walls and ceilings. Can be scrubbed freely.

Trus-Con Edelweiss: A weather-proof white gloss enamel for exterior walls of all kinds.

Trus-Con Packing House Enamel: A white gloss, steam resisting, sanitary coating for packing houses, laundries, etc.

Trus-Con Roof-Seal: For preserving and protecting shingle, felt and metal roofs.

Trus-Con Shingle Stains: Creosote stains for preserving and coloring shingles and wood siding.

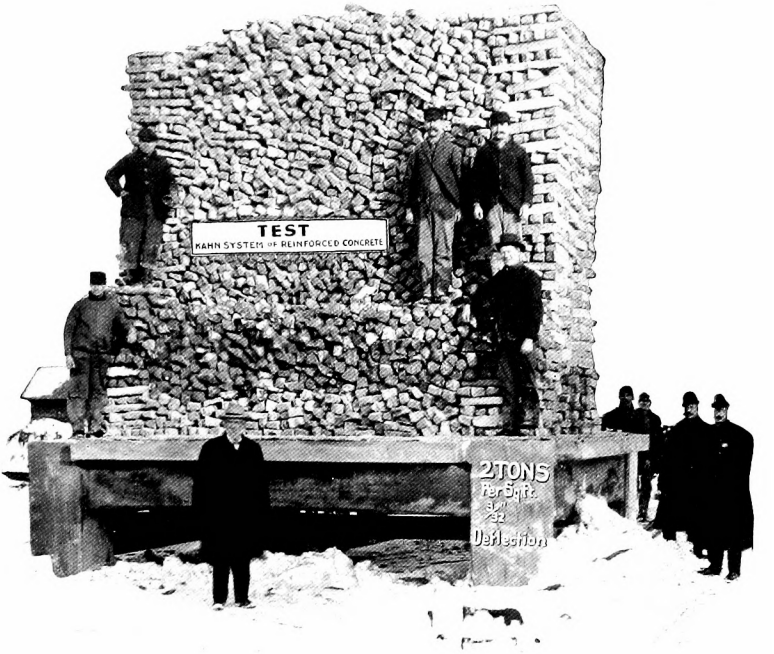
Trus-Con Bar-Ox: Protective coatings of various formulae: **No. 7** for structural steel, bridges, etc.; **No. 14** for brewing and ice making coils; **No. 21** for stacks, boilers and hot metal surfaces; **No. 28** for acid-proofing metal surfaces.

Trus-Con Hand-Book sent on request.

Fire starting in the fourth story of the concrete building, of Dayton Motor Car Co., Dayton, Ohio, was prevented from spreading to other floors by the concrete construction. Three floors of the adjoining mill-constructed building were completely destroyed. Repairs to the Kahn System concrete building amounted to less than $500.00, the cost of replacing the wooden window sash.

Fireproofness

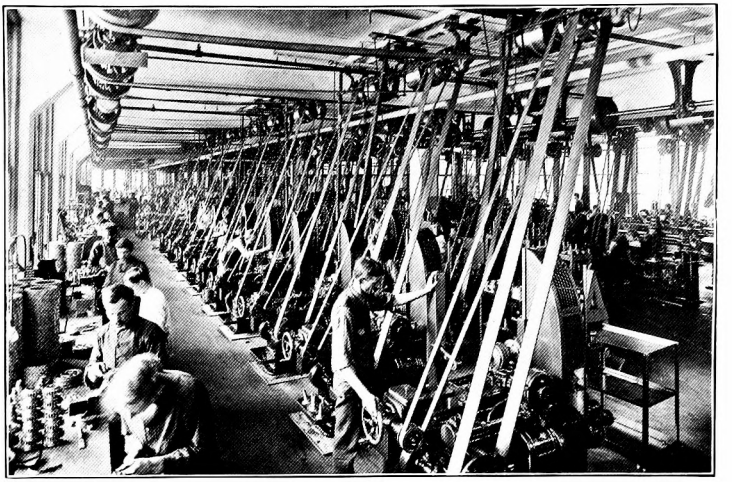
In San Francisco, Baltimore and other disastrous fires, reinforced concrete has demonstrated its superiority. In the severe tests of building departments, such as New York City, reinforced concrete floors carrying heavy loads have withstood continuous temperatures of 1700 degrees Fahrenheit, followed immediately by streams of water from a fire hydrant. In many actual fires, concrete has withstood intense heat without damage. The rigidly connected reinforcement of the Kahn System makes concrete practically immune to the effects of fire.



Load test of over two tons (4000 lbs.) on every square foot of full sized panel of Nicol, Dean & Gregg Building, St. Paul. Bar iron, standing on end, is stored on the floors of this Kahn System Building.

Strength

Rigid requirements of exacting engineers, severe tests of Government building departments, and actual use in thousands of structures have demonstrated the superior strength, rigidity and load-carrying capacity of reinforced concrete. Its additional factor of safety, beyond all allowance in calculation, has been shown in numerous examples of overloading and accidental shocks. The Kahn System with its rigidly connected reinforcement assures maximum strength and safety.



Doubling the floor space by attaching machinery to ceilings and floors. A typical example in the 38-acre plant of Packard Motor Car Co., Detroit, showing the vibration-resisting qualities of the Kahn System Reinforced Concrete.

Vibration Resistance

Reinforced concrete withstands the shocks of vibration. In hundreds of buildings, rapidly moving machinery is attached both to concrete ceilings and floors with hardly a noticeable tremor. Large, pounding printing presses are frequently located on the upper floors of high concrete buildings. Reinforced concrete bridges, carrying the modern mogul locomotives, are built by railroad companies everywhere. Authorities on earthquakes recommend reinforced concrete. The Kahn System with its rigidly connected reinforcement is essential for resisting vibration in concrete construction.

Every part of the machinery and the product is perfectly lighted by the use of United Sash in windows, assuring maximum efficiency of employees and highest quality of product. Interior of Beechnut Packing Co., Canajoharie, N. Y. This modern sanitary plant is built Kahn System Reinforced Concrete.

Daylighting

Daylighting prevents accidents in factories, as shown by carefully prepared statistics. A daylighted interior insures the use of all floor space, a greater output per man, better quality of work, less waste of material, saving of artificial light and greatest efficiency. Buildings constructed with Kahn Building Products and equipped with United Steel Sash in Windows have maximum light, making the interior like a protected portion of the great outdoors.

Attractive administration building of the Hudson Motor Car Co., built Kahn System Reinforced Concrete. Hundreds of other pleasing designs, built with any kind of material for the exterior, can be adopted.

Appearance

An attractive appearing plant bespeaks the progressiveness of the manufacturer, and reflects its character on his products. Cheerful surroundings materially increase the efficiency of the employees. A beautiful, clean cut, modern building costs no more than other kinds, but pays large dividends annually to the owner. Simple, strong, impressive designs are possible with the Kahn Building Products at nominal expense.

Economy

Kahn Buildings are low in first cost, much less than other types of fireproof construction and little if any more than burnable, short-lived structures. Kahn Buildings make money for owners every year in the saving of insurance, absence of repairs, increased life of building, greater efficiency of employees, reduction of waste and insurance against crippling of operations. Look over the accompanying table, in which a very conservative allowance is made for the various items of saving.

Reinforced Concrete More Economical than Mill Construction

(From Engineering Magazine, August, 1909)

Assume a building costing complete $100,000; contents equal to the cost of the building; and that it is used for general manufacturing purposes. The yearly charges against each building are:

Initial Cost of Building	Mill Construction $100,000	Reinforced Concrete $110,000
Interest at 6%	$ 6,000	$6,600
Taxes at 1%	1,000	1,100
Insurance on building at 75c per $100 value	750	At 25 cents, 275
Insurance on contents at $1 per $100 value	1,000	At 80 cents, 800
Depreciation on building at 1¼%	1,250	At ½% 550
Results of vibration—Assume $450	450	Chargeable to mill bldg. only
Increased light—1% increase in efficiency of labor. Assume labor equals ½ value of contents—$50,000	500	Chargeable to mill bldg. only
Vermin losses	100	Chargeable to mill bldg. only
Protection against business losses due to fire at ½% on value of 30% of building and contents, or $60,000	300	Applies to mill bldg. only.
Total Yearly Charges	$11,350	$9,325

Annual Saving of Concrete Over Mill Building—$11,350—$9,325=$2,025.00

Therefore a concrete building costing originally 10% more than a mill building saves 2% each year. Capitalize this saving at 6% and it represents $33,750. In other words a concrete building costing $143,750 is just as economical as a mill building costing $100,000, i. e., an owner could afford to pay 43¾% more for a concrete building.

Comparative Cost of Wood Mill Construction and Reinforced Concrete Buildings

Compiled by J. P. H. Perry

Kind	Place	Size	Stories	Load Lbs. Per Sq. Ft.	Cost Wood Building	Cost of Concrete Building	Concrete Per cent More or Less than Wood	Bid or Estimate
Factory	Detroit		3	300	$ 28,000	$ 28,500	1.5 more	Bid
Factory	Jersey City	60x140	5	200	52,000	56,000	7.1 more	Bid
Factory	Grand Rapids				85,300	86,000	1.3 more	Bid
Factory	Fall River	112x112	4		74,000	82,500	10.3 more	Bid
Factory	Manchester	45x100	5		52,000	72,000	27.7 more	Estimate
Warehouse	Boston	20x155	9		212,500	196,000	6.3 less	Bid
Warehouse	Jersey City	38x 94	6	200	39,000	43,000	9.3 more	Bid
Warehouse	Pittsburgh	100x120	4		61,500	63,600	3.3 more	Bid
Warehouse	Nashua	100x200	8		117,000	131,000	10.7 more	Bid
Press Building	Cincinnati						4.0 more	Bid
Bakery	Cincinnati	60,000 s. f.		300	64,000	62,500	2.3 less	Bid
Shop	Cincinnati				16,000	19,100	16.2 more	Estimate
Shop	New England				65,800	69,500	5.2 more	Estimate

Above table gives actual bids and estimates on manufacturing buildings showing comparative costs in wood mill construction and reinforced concrete.

—From "Comparative Costs of Buildings," by H. G. Tyrell, Engineering Magazine, June 1912.

Comparative Cost of Buildings in Reinforced Concrete and in Structural Steel, Fireproofed.

Kind	Place	Size, Feet	Stories	Load Lbs. Per Sq. Ft.	Cost of Reinforced Concrete	Cost of Steel	Re-Constructed More or Less than Steel Per cent.	Bid or Estimate
Factory	Des Moines	66x132	6	200	$ 60,650	$ 69,750	13.0 less	Estimate
Factory	Fairmount	50x100	3	200	25,000	28,000	10.7 less	Bid
Warehouse	Brooklyn	140x190	10	200	250,000	280,000	10.7 less	Bid
Office	St. Louis	86x120	8	70	170,000	184,000	7.6 less	Bid
Office	Cincinnati		17	70			4.0 less	Bid
Mill	Boston		3		278,000	286,400	2.8 less	Bid
Store	Indianapolis	71x120	6	125	89,500	96,000	6.8 less	Bid
Hospital	Indianapolis		6		793,000	823,000	3.6 less	Bid
Hotel	St. Louis	120x140	8	70	171,000	184,000	7.0 less	Bid
Hotel	St. Louis		11	70	290,000	304,000	4.6 less	Bid
Factory	Ohio		12	200	40,000	Less	than steel.	
Loft	Springfield	105x283	9	150	280,000	320,000	12.5 less	Bid

Above table gives actual bids and estimates showing the comparative cost between reinforced concrete construction and structural steel fireproofed. Note that reinforced concrete is considerably cheaper.

—From "Comparative Costs of Buildings," by H. G. Tyrell, Engineering Magazine, June 1912.

Specifications for Reinforced Concrete

General

Where shown on drawings or called for in the specifications, Reinforced Concrete shall be used.

No system of reinforced concrete will be considered which is not of recognized standing, and which has not been used successfully for five years on important work.

Work may be carried on only under foremen and superintendents who have had thorough experience in this class of work.

Structural Drawings

Parties submitting proposals must furnish drawings indicating their method of calculation, arrangement and nature of the steel reinforcement for the various structural members indicated, and no proposition will be considered without such calculations and drawings.

Materials

Samples of all materials must be submitted and approved by the Architects before same are used. All materials rejected for this work must be immediately removed from the vicinity.

Cement

1. All cement furnished for this work is subject to inspection and tests as hereinafter specified.

2. Inspection and tests shall be conducted by Laboratory selected by Architect and at the cost and expense of Contractor.

3. All inspection and sampling shall be made by the Laboratory at the point of manufacture, sending samples to its laboratory for tests, and only cement that has been previously accepted will be allowed on the work.

4. In cases where special conditions make inspection at factory impracticable, inspection at the job may be substituted, subject to approval of Architect. When job inspection is permitted, the cement shall be delivered at the job at least two weeks before required for use, so as to allow ample time for necessary tests by the Laboratory, and proper care taken to separate the individual cars that they can be easily identified if found unsatisfactory. A suitable place must be provided for the storage of all cements, and no cement shall be used that has absorbed sufficient moisture to cause the

cement to granulate or become lumpy when thoroughly dried.

5. The cement will be accepted at the work packed in stout paper, cloth or canvas sacks. Each package shall be plainly labeled with the name of the brand and manufacturer. Any package broken or containing damaged cement may be rejected or accepted as a fraction package at the option of the Engineer in charge of the work.

6. The cement shall be tested in strict compliance with the methods specified in the Standard Specifications of the American Society for Testing Materials, and only cement that passes all requirements of these specifications shall be used.

Fine Aggregate

The sand, or fine aggregate, shall consist of grains of any moderately hard rock passing, when dry, a screen having four meshes to the linear inch. It shall be clean, well graded from coarse to fine, with coarse particles predominating, and free from vegetable loam and other deleterious matter.

All sand, to be approved, must show when mixed with Portland cement in proportion of one (1) part of cement to three (3) parts of sand, by weight, a tensile strength of at least seventy per cent (70%) of the strength of a one to three (1:3) mortar of the same consistency made with the same sample of cement and standard testing sand.

Coarse Aggregate

Coarse aggregate shall consist of inert material such as crushed stone or gravel which is retained on a screen having one-quarter inch (¼") diameter holes. The particles shall be clean, hard, sound, free from any deleterious matter, and well graded from coarse to fine, to yield concrete of the greatest natural density. The maximum size of the coarse aggregate shall be such that it will not separate from the concrete in placing and will not prevent the concrete fully surrounding the reinforcement or filling out all parts of the forms.

All coarse aggregate shall be well wetted immediately before being used.

In case gravel is used without screening, a careful examination shall be made to determine the exact ratio of fine to coarse aggregate, separating on a number four (No. 4) sieve, and the gravel used with the cement in proportion to maintain the correct ratio of cement to fine aggregate as required for the particular work in which the concrete is to be used.

Proportions

All concrete for slabs and beams shall be proportioned of one (1) part of Portland cement, two (2) parts of fine aggregate and four (4) parts of coarse aggregate.

All concrete for columns shall be proportioned of one (1) part of Portland cement, one and one-half (1½) parts of fine aggregate and three (3) parts of coarse aggregate.

Mixing of Concrete

Proper provisions must be made to provide for the correct measurement and proper proportioning of all concreting materials, including water. All water shall be free from oil, acid, strong alkalies or vegetable matter. All concreting materials shall be mixed until the cement is uniformly distributed throughout the mass and the concrete uniform in color. Sufficient water must be added during the mixing to produce a concrete that will flow when agitated, but not so wet as to permit separation of the materials in transferring from the mixer to the work.

A competent foreman must be in constant attendance at the mixer, to approve the proportions of materials placed in the mixer and the finished batch before leaving the mixer.

Placing the Concrete

All concrete must be placed in the work immediately after mixing and churned and agitated with suitable tools in such a manner as to remove all voids and thoroughly compact and densify the mass. All concrete showing a partial set before placing shall not be used in any portion of the work, but removed from the job. When concreting is once started, it shall be carried on as a continuous operation until the pouring of the section or panel is completed. If for any reason the concreting should be stopped, the greatest care must be taken to stop the work at such a point that the joint formed will not weaken the member structurally.

All columns are to be filled a sufficient time previous to the concreting of the floor construction to allow the concrete in the columns to settle to a permanent position. The pouring of the columns must be one continuous operation to the level of the bottom of the girder or beam supported by it.

In pouring, the concrete is to be kept well stirred or puddled to prevent voids and honey-combing.

The concrete in all beams shall be placed so as to be perfectly monolithic with the adjacent slab.

When a section of the floor is once poured, it shall be left entirely undisturbed until the concrete has thoroughly set.

The surface of concrete which has set, and upon which new concrete is to be laid, shall be thoroughly cleaned to remove all foreign and latent materials, and coated with a creamy mixture of neat cement and water, immediately before placing new concrete.

The Superintendent in charge of the work shall mark in ink on the drawings, the time and date of the pouring of the different columns, girders and floor slabs.

Reinforcing Steel

Steel shall be medium, open-hearth steel to be rolled from new stock and to meet the Manufacturers' Standard Specifications.

Ultimate strength, 60,000 to 70,000 pounds per sq. inch.

Elastic limit, not less than half the ultimate strength.

$$\text{Percentage of elongation} = \frac{1{,}400{,}000}{\text{Ultimate strength of steel.}}$$

Bending test, 180 degrees to a diameter equal to thickness of piece tested without fracture on outside of bent portion.

All steel shall be free from paint, oil or heavy rust or scale.

All reinforcing steel shall be furnished by the Trussed Concrete Steel Company, Detroit, Mich., in accordance with the Kahn System of Reinforced Concrete.

The main reinforcement for joists, beams, girders, or any members subjected to combined bending moment and shear shall consist of Kahn Trussed Bars in which the shear members are inclined at an angle of 45 degrees and rigidly connected to the main tension member. There shall be sufficient shear reinforcement so that the concrete shall not be obliged to resist either direct tension or shear greater than 60 pounds per sq. in. Minimum depth of beams should not exceed 1/15 of the clear span.

Reinforcement for floor slabs shall consist of Kahn System Reinforcing Steel as indicated on plans. Minimum depth of slab shall not exceed 1/30 of the clear span.

Vertical reinforcing for columns shall consist of Rib Bars either used in conjunction with built-up column hooping or

thoroughly tied at intervals of 12 inches as required by the design. Least width of column shall not exceed 1/15 of its unsupported length.

Design of Reinforced Concrete

All reinforced concrete work shall be designed in accordance with the requirements of the Trussed Concrete Steel Company, Detroit, and shall conform to local regulations, governing building construction.

Tile and Concrete Floor Construction

When tile and concrete construction is used for floors, the tile shall be sound, hard-burned tile of uniform size. The concrete joists shall be parallel, in perfect line and of the uniform width called for on plans. The concrete on top of the tile must be poured at the same time as the concrete in the joists and be of the same mixture. The tile shall be thoroughly soaked with water before pouring the concrete.

Centering and Forms

All forms must be strong and stiff, true, out of wind, practically unyielding and sufficiently tight to hold the liquid mortar without leakage. Interior dimensions must conform to the dimensions of the concrete specifications shown upon the approved plans. All forms for beams, girders and lintels shall be so designed that at least one side may be removed without disturbing the bottom portion of the form and its supports. All posts supporting forms for slabs, beams and girders must rest upon wedges which may be loosened or removed without producing undue stress in the floor system. The forms for all columns must provide an opening at the bottom for cleaning and for adjustment of the steel. The opening is closed before pouring concrete. Columns over 14′ in height and under 18″ square shall have an intermediate opening or pocket, and the pouring started therefrom. All shavings, chips, sawdust and other forms of foreign matter shall be removed before the concrete is placed in the forms.

Removal of Centering

Centering shall not be removed until the concrete has thoroughly set and is of sufficient strength to carry its own weight together with whatever live load is liable to come on the construction. No false work shall be removed without the approval of the architect or engineer in charge.

Before removing the temporary supports of the beams and girders, at least one side of the adjacent column form and one side of the girder form shall be removed in order to expose the concrete to view and permit thorough examination and determination of the condition of soundness and hardness. Beams and girders shall remain supported for at least two weeks after all other false work has been removed during favorable conditions for hardening, and columns shall not be given their full loading in less than five weeks.

Freezing Weather

Placing concrete in freezing weather shall be avoided whenever possible and, when necessary, sufficient precaution shall be taken to prevent the concrete freezing—such as heating the building with salamanders, covering the concrete with sawdust, straw or manure, and heating the materials. All concrete which is frozen shall be removed. The centering shall not be removed until the concrete has thoroughly set and aged.

Hot Weather

All concrete laid during the hot weather shall be thoroughly wet with clean water at least twice each day during the first week after placing.

Precautions on Removing Centering and Concreting During Freezing Weather

The most exacting care must be exercised in removing centering, to be absolutely certain that the concrete is properly set and hardened. This is particularly true during the fall and winter months, when weather conditions are not favorable for the normal setting and hardening of concrete.

During summer months with warm temperatures, the hardening of concrete occurs at normal rate, and while the strength of the concrete should be fully determined before any centering is removed, the same extraordinary care is not so important as during colder months.

Concrete that will harden at normal rate above a temperature of 50° F. will be slowly retarded in setting with temper-

atures approaching freezing. At 40° F. the cement remains quite inactive and a great deal longer time must be permitted for the hardening at the much slower and retarded rate.

It is recommended in placing concrete, particularly in the colder weather, to make provisions for pouring a number of 6″ test cubes at the same time the concrete is placed. These test cubes should be left in the forms and kept under exactly the same conditions of weather exposure as the concrete, so as to be certain that the rate of hardening proceeds precisely the same as in the structural concrete.

A sufficient number of such test cubes should be made so that duplicates may be crushed at intervals, to determine by actual test the exact development of strength in the concrete. Do not consider the removing of any forms until the compressive strength of the concrete indicates that it is sufficiently hardened to permit removing the forms with perfect safety. In testing the cubes care should be taken to conduct the compressive test as soon as the cubes are brought into the laboratory and not permit them to remain in a warmer temperature for any great length of time, as this would yield results higher than the actual strength of the the concrete in the work.

In placing concrete in winter, it is highly important that the aggregate used be entirely free from frost and preferably should be heated, so as to provide with the heated water a resultant temperature in the concrete as placed of about 100° F. This initial temperature, supplemented by the heat developed in the crystallization of the cement, will insure good normal setting, provided that the concrete is so protected as to avoid too rapid radiation and loss of heat.

To keep gravel free from frost and in good working condition, perforated steam pipes should be forced at intervals into the pile of gravel and fed with a good supply of steam. When available, heavy canvas should also be placed over the gravel so as to avoid rapid radiation of the heat contributed by the inserted steam pipes.

As a further precaution, in the very coldest and most uncertain weather, it is recommended to insert in the soft concrete as poured, a small copper tube about $\frac{3}{8}$″ in diameter, to accommodate a laboratory tube thermometer. The end of the pipe inserted in the concrete should be closed with a cork to prevent the concrete running into the tube, while the

thermometer should be held in the tube through a perforated cork. A temperature reading should be taken as soon as the concrete is placed and also at regular intervals, and careful record kept of the actual temperatures of the concrete, particularly during the first 72 hours.

In any case where it is known that concrete has been frozen throughout or fairly deep into the mass, it should be removed and replaced with new concrete. If the frost has penetrated the concrete to only a depth of $\frac{1}{8}$ or $\frac{1}{4}''$, it will not be serious, but every possible method should be employed to determine that the penetration of the frost is limited to this depth.

Where the concrete has been slightly frozen it should be enclosed and heat provided with salamanders to draw the frost out of the concrete and permit very careful examination to be made to ascertain to what extent the concrete has been injured. Under no conditions remove the forms from concrete that has been at all frosted, until heat has been provided of sufficient duration and temperature to draw all frost and moisture out of the concrete, so that a fair examination can be made and its actual condition determined.

The physical examination of concrete before the forms are removed should not be confined to the top, but small sections of the forms should be removed from the underside and the exact condition of the concrete carefully observed on striking with a hammer. Concrete that is properly set and hardened should ring with the distinct clearness characteristic of a good, hard, dense mass. If there is any apparent deadness or dullness to the concrete on striking with a hammer, the removal of forms should be delayed until the concrete has sufficiently hardened to resound with a good, sharp, clear ring.

If the superintendent in charge of the work is not fully experienced in examining concrete, so as to be positively certain regarding the strength necessary for the removal of forms, the services of experienced men should be provided to carefully examine the concrete and pass upon the advisability of removing the centering.

Under no circumstances should an attempt be made to remove any centering until it is absolutely and positively determined beyond any question of doubt that the strength of the concrete has developed sufficiently to entirely avoid any sagging or deflection in the members and any possible failure.

Crushing Strength of Concrete

The compressive strength of concrete varies with the materials, the age, the mixture and climatic conditions, and where possible should be determined by tests. Otherwise the following values submitted by the Joint Committee on Concrete and Reinforced Concrete may be considered as very conservative for good materials and good workmanship.

Table of Strengths of Different Mixtures of Concrete 28 Days of Age
(In pounds per square inch)

AGGREGATE	Mixtures: Cement, Sand and Aggregate				
	1:1:2	1:1½:3	1:2:4	1:2½:5	1:3:6:2
Granite, trap rock	3300	2800	2200	1800	1400
Gravel, hard limestone and hard sandstone	3000	2500	2000	1600	1300
Soft limestone and sandstone	2200	1800	1500	1200	1000
Cinders	800	700	600	500	400

Cinder concrete should never be used in the main members of the structure, such as girders, beams, columns, and footings, because of its variation in strength and the difficulty of securing material of uniformly, satisfactory quality. Cinder concrete may be used for fire protection and sometimes for short-span slabs or arches between steel beams.

The tables throughout this book are invariably based on the use of stone concrete, with 1:2:4 *mixture for slabs, beams and footings, and* 1:1½:3 *mixture for columns.*

Modulus of Elasticity

Report of Joint Committee on Concrete and Reinforced Concrete

"It is recommended that in computations for the position of the neutral axis and for the resisting moment of beams and for the compression of concrete in columns, the value of the modulus of elasticity of concrete be assumed as :

(a) One-fifteenth of that of steel, when the strength of the concrete is taken as 2200 lbs. per sq. in. or less.
(b) One-twelfth of that of steel, when the strength of the concrete is taken as greater than 2200 lbs. per sq. in. or less than 2900 lbs. per sq. in., and
(c) One-tenth of that of steel, when the strength of the concrete is taken as greater than 2900 lbs. per sq. in.

N. B.—The value of 1/15 is used throughout this book.

Allowable Stresses, Methods of Design, Etc.

Monolithic Action

It is difficult in reinforced concrete work to adopt an arbitrary theory of design and fixed working stresses, which shall apply to structures of every class. To design correctly, each particular problem should have individual attention and methods of design adopted accordingly. Concrete work being built monolithic should be treated accordingly and not analyzed into separate units, as is done with ordinary materials where units are dealt with. The great additional strength of a monolithic construction of this kind is apparent. If any particular part of a floor is heavily loaded, the floor adjacent will come to its assistance and will distribute the concentrated loading over a large area of floor space.

Effect of Vibration

In the case of vibratory loadings, such as caused by moving machinery, actual experiments have shown that concrete absorbs the shock better than any other building material. The Kahn System has been used in many such structures and there is not the least tremor noticeable when machinery is in operation.

Strength Due to Arch Action

Reinforced Concrete, when built continuously over a large floor area, has great additional strength due to interior arch action in the concrete. This arch action will in itself carry considerable load without causing any stress in the reinforcement. This, of course, is more marked in a floor where the depth is large compared with the span, than where the reverse is true. It would, therefore, seem proper to design a deep floor, supported on all sides by similar construction, with greater working stresses than a thin, isolated panel unsupported by adjacent construction.

Other points to be considered in this connection are the quality of the materials and the grade of workmanship.

The methods of design, stresses and tables presented in this book have been purposely made very conservative to avoid misuse and may be varied to meet the special conditions or requirements of the designer. The additional strength due to monolithic construction, arch action, and tensile strength of concrete, is entirely neglected in the calculations and thus an additional factor of safety is given to all work designed on this basis.

Theory of Reinforced Concrete Work

The following theoretical analysis is based on the use of what is known as the "Straight Line" formula. This is a formula which is daily becoming more generally adopted and is embodied in the building requirements of almost all American cities and those of the Prussian Government. It is recommended by the most authoritative text books and has the advantages of simplicity and directness. It corresponds with the accepted theory of flexure as applied to other materials and is admittedly correct within allowable working stresses. If the theory errs at all, it errs on the side of safety.

This theory is based on the following assumptions:

1*st.* *A section plane before bending remains plane after bending; that is, the stress on any fibre is directly proportional to its distance from the neutral axis.*

2*nd.* *The tensile strength of the concrete is entirely neglected.*

3*rd.* *There are no initial strains in the beam.*

4*th.* *All shearing strain is cared for and there is no slipping between the concrete and the steel.*

5*th.* *The modulus of elasticity of concrete in compression is constant.*

Moment of Resistance of Simple Beam

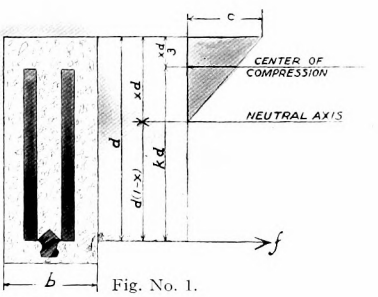


Fig. No. 1.

Referring to figure:

d =distance from extreme compressed fibre to center of steel.

x d =distance from the extreme compressed fibre to the neutral axis.

x =ratio of depth of neutral axis to depth (d) of steel.

k d =distance from center of compression of concrete to center of steel.

k =ratio of this distance to depth of beam (d).

b =breadth of beam.

$m = \frac{E_s}{E_c} = \frac{\text{modulus of elasticity of steel.}}{\text{modulus of elasticity of concrete.}}$

A_s = area of steel reinforcement.

p = ratio of area of steel to area of concrete $= \frac{A_s}{bd.}$

c = compressive stress in extreme fibre of concrete.

f = tensile stress in steel.

RM = moment of resistance of beam.

BM = bending moment.

The total compression in the beam must equal the total tension. Equating these forces:

$\frac{1}{2} c\ b\ x\ d = p\ b\ d\ f$ or

$$\mathbf{\frac{1}{2}\ c\ x = p\ f} \qquad [1]$$

According to assumption 1st above

$$\mathbf{\frac{c}{f} = \frac{x}{m\ (1-x)}} \qquad [2]$$

Combining equations [1] and [2]

$\frac{1}{2}x^2 = m\ (1-x)\ p$, whence

$$\mathbf{x = -pm + \sqrt{(pm)^2 + 2\ pm}} \qquad [3]$$

Again combining [1] and [2]

$$\mathbf{p = \frac{1}{2}\ \frac{c^2\ m}{f\ (f + cm)}} \qquad [4]$$

The stress strain curve being a straight line, the center of compression is located $\frac{2}{3} x\ d$ above the neutral plane.

Taking moments about the neutral axis:

$$\mathbf{RM = \left[\frac{1}{3}\ c\ x^2 + p\ f\ (1-x)\right] bd^2} \qquad [5]$$

Taking moments about the center of the steel:

$$\mathbf{RM = \frac{c\ x\ bd^2}{2}\left(1 - \frac{x}{3}\right) = k\frac{c\ x\ bd^2}{2}} \qquad [6]$$

Taking moments about the center of compression in the concrete:

$$\mathbf{RM = \left(1 - \frac{x}{3}\right) d\ A_s\ f = k\ d\ A_s\ f} \qquad [7]$$

From equation [7] it is at once evident that the moment of resistance of a concrete beam is dependent only on the factor (k), the area of reinforcement, the depth of the beam, and

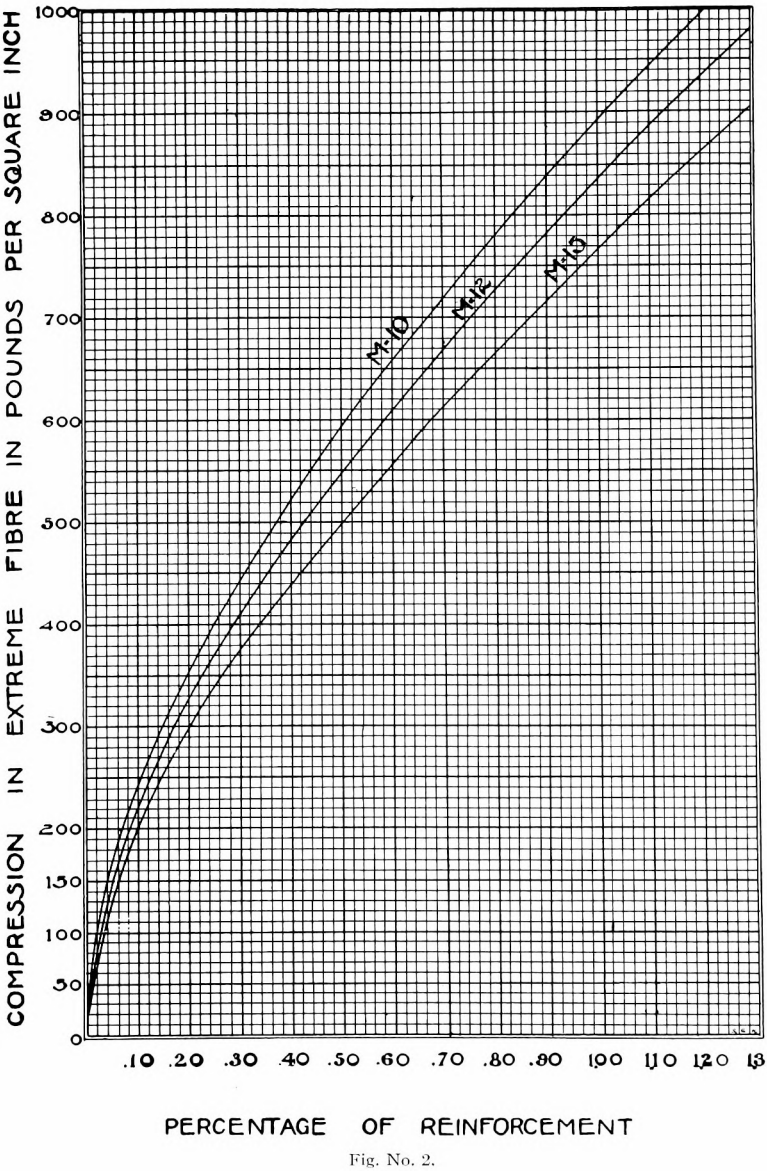

COMPRESSION IN EXTREME FIBRE IN POUNDS PER SQUARE INCH
1000
900
800
700
600
500
400
300
200
150
100
50
0
M=10
M=12
M=15
.10 .20 .30 .40 .50 .60 .70 .80 .90 1.00 1.10 1.20 1.30
PERCENTAGE OF REINFORCEMENT

Fig. No. 2.

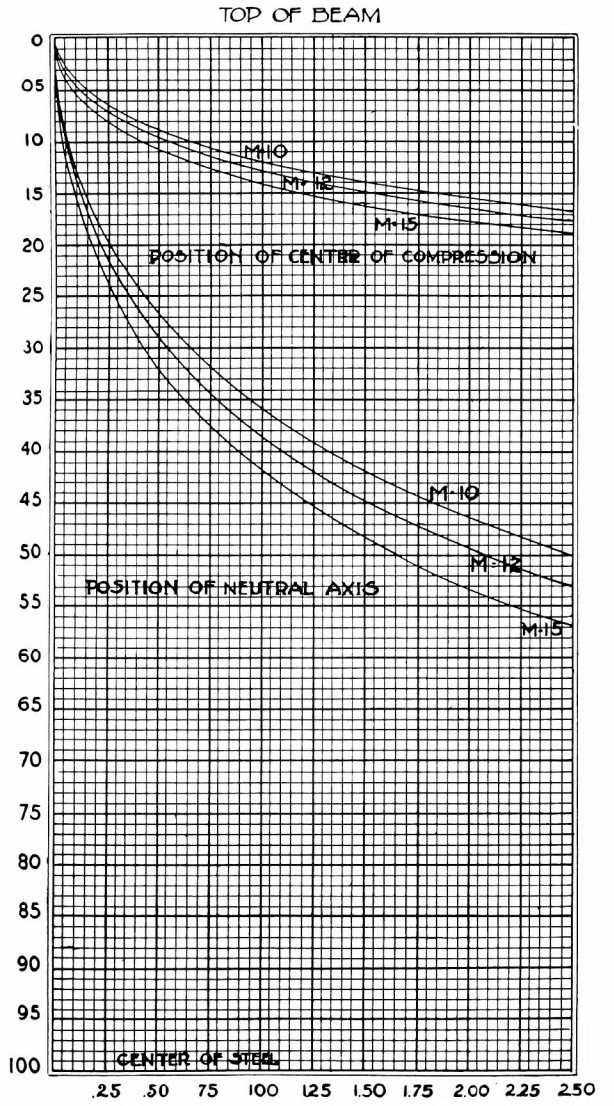

TOP OF BEAM
0
05
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
M-10
M-12
M-15
POSITION OF CENTER OF COMPRESSION
M-10
M-12
M-15
POSITION OF NEUTRAL AXIS
CENTER OF STEEL
.25 .50 75 100 125 1.50 1.75 2.00 2.25 2.50
PERCENTAGE OF REINFORCMENT

Fig. No. 3.

the allowable stress in the steel, with this important proviso —*that the allowable compressive stress in the concrete is not exceeded.* This allowable stress will not be exceeded if the percentage of steel is kept below the value as determined by equation (4). It will be seen from equation (4) that if we assume a value for (f) equal to 16,000 pounds per sq. in., and also values for (m), that curves can be plotted showing the relation between the percentage of the metal and the compressive stress in the concrete.

In Figure 2, page 56, these curves are shown for values of (m) equal to 10, 12 and 15 and based on a stress in the steel equal to 16,000 pounds per sq. in.

From these tables it will be seen that if the percentage of steel does not exceed 1 per cent. for good rock concrete, there is no danger of the concrete failing by compression.

The factor (kd) in equation (7) is the distance between the center of compression of the concrete and the center of the steel. It depends entirely for its value on the position of the neutral axis. From the equation (3) it is seen that the position of the neutral axis is dependent entirely on the percentage of the reinforcement and the values of (m).

Again assuming (m) equal to 10, 12 and 15, in equation (3), curves as shown in figure 3 on page 57 are drawn showing the position of the neutral axis for various percentages of metal. From these curves the value of the factor (k) are readily obtained and are shown properly plotted in the same figure. An inspection of these curves will show at a glance that for all ordinary practical percentages of reinforcement this factor (k) does not vary appreciably. It reduces to a value equal to .86 when the percentage of metal equals 1 per cent. For all lower percentages of metal its value is greater. It is, therefore, a very safe assumption to reduce our equation (7) to the following simple formula:—

$$\mathbf{R\,M = .86\,d\,A_s\,f} \qquad [8]$$

or for f =16,000 pounds per sq. in.

$$\mathbf{R\,M = 13{,}760\,d\,A_s} \qquad [9]$$

For isolated beams *the percentage of reinforcement must not exceed 1 per cent for good rock concrete.* This does not apply to beams with double reinforcement and T beams, which will be treated later.

Double Reinforcement

In the case of isolated beams, when the percentage of tensile reinforcement exceeds 1 per cent., it is customary to provide compressive reinforcement to take care of this excess. The formulae for design of beams with double reinforcement, as ordinarily presented in text books, are so complicated and involved as to be of little practical value. The following method of determining the amount of compressive reinforcement is simple, direct and accurate.

Assume an extreme fibre stress of 750 pounds per sq. in. It will be necessary to place the compression steel at some distance, usually about 1/10 d, below the top of the beam, and the compression in the concrete at this plane will be, say 600 pounds per sq. in. As m = 15 the compression in the steel will be about 9,000 pounds per sq. in., or somewhat more than one-half the allowable stress of steel in tension. From this it is seen that for each square inch of reinforcement in excess of the allowed percentage in an isolated beam, there should be provided about 1.75 sq. in. of compressive reinforcement. For this purpose the most convenient steel possible is the center sheared Kahn Trussed Bar, the web members of which bind the bar securely into the beam and resist every tendency to buckle.

The neutral axis in the beam remains in the same location as in the simple beam, as the allowable unit stresses are the same, and the location of the neutral axis is determined by equation (2). The steel in compression being placed above the center of compression in the simple beam, the value of the factor (k) would tend to be increased, so that equation (9) can be used with perfect safety in this case. To summarize:—

In the case of isolated beams, in which the percentage of tensile reinforcement exceeds 1 per cent., provide compressive reinforcement equal in area to 1.75 times the excess area of tensile reinforcement. Then design by equation (9).

In no case should the total area of steel in compression exceed 75% of that in tension.

T Beams

When beams or girders are built so as to form part of a floor construction, the floor slab will act with and may be considered part of the same. In the construction of such a floor the concrete in the beam and slab must be placed continuously, so that the two will be perfectly united.

In the design of "T" beams there are four considerations, which govern the width of floor slab, that may be considered

as acting as the compressive flange of the beam. It is assumed in this discussion that sufficient steel has been provided in tension and that the beams are spaced sufficiently far apart, so that the spacing of beams will not determine the width of slab available. With these assumptions the four points in the design, each of which must be investigated and satisfied, are: (See figure 4.)

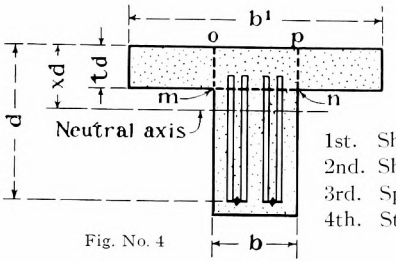


Fig. No. 4

1st. Shear along the plane *m n*.
2nd. Shear along the planes *m o* and *n p*.
3rd. Span of beam as affecting width of T.
4th. Strength in compression.

In regard to the first three of these considerations it is possible to make a complete analytic discussion, but the practical results of such an analysis are alone of value to the designer. The following conclusions are sanctioned by good authority and conservative practice.

1st. In order that the beam shall be safe in shear along the plane *m n* the width of slab computed as compression flange should not be greater than 5 times the width of the beam, i. e.,

b' must not exceed $5b$.

2nd. b' must not exceed $b + 10\ td$.

3rd. b' must not exceed 1-3 of the span of the beam.

4th. The width of flange necessary for compression is dependent on the ratio of the area of the tensile reinforcement in the bottom of the beam to the rectangular area of concrete bd.

The table given on page 61 shows the width of flange necessary in the terms of the width of beam, for various percentages of reinforcement and ratios of slab depths. This table is based on the following theoretical analysis:

Extreme fibre stress in concrete in compression, $c = 750$ pounds per sq. in.

Tensile stress in steel $= 16{,}000$ pounds per sq. in.

$m = 15$.

From equation 2, page 55 $\frac{c}{f} = \frac{x}{m\ (1-x)}$

Solving, $x = .413$.

The stress at lower edge of slab $= \frac{x-t}{x}\ c$

Ratio of Width of "T" to Width of Beam Required for Varying Percentages of Steel and Depths of Slab

Maximum Compression in Extreme Fibre = 750 Pounds per square inch.

Stress at Points Equidistant from Neutral Axis, same at all Points of T.

(t) Ratio of depth of Slab to depth of Steel	Percentage of Area of Steel, (A), to Rectangular Area of Concrete, (bd).											
	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4
.05	2.3	3.4	4.6									
.10	1.7	2.3	2.9	3.5	4.1							
.15	1.5	1.9	2.4	2.8	3.2	3.7	4.1					
.20	1.4	1.8	2.1	2.5	2.8	3.2	3.5	3.8	4.2			
.25	1.4	1.7	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.1		
.30	1.3	1.6	1.9	2.2	2.4	2.7	3.0	3.3	3.6	3.8	4.1	
.35	1.3	1.6	1.8	2.1	2.4	2.6	2.9	3.2	3.4	3.7	3.9	4.2
.40	1.3	1.5	1.8	2.0	2.3	2.6	2.8	3.1	3.4	3.6	3.9	4.1
.413	1.3	1.5	1.8	2.0	2.3	2.6	2.8	3.1	3.4	3.6	3.9	4.1

NOTE:—For all ratios greater than .413, $\frac{b'}{b}$ has same value as given for .413.

NOTE:—Table gives values of $\frac{b'}{b}$

See Figure 4, page 60.

Total compressive stress =

$$\frac{1}{2} \text{ c b x d } + \frac{1}{2} \text{ (b'-b) } \frac{\text{(2 x-t)}}{\text{x}} \text{ ctd.}$$

Total tensile stress $= 16{,}000\ p\ b\ d$,

Equating and solving for $\frac{b'}{b}$

$$\frac{b'}{b} = 1 + \frac{32{,}000 \text{ p-cx}}{\frac{\text{2x-t}}{\text{x}} \text{ c t}}$$

Substituting values of c and x above.

$$\frac{b'}{b} = 1 + \frac{32{,}000 \text{ p-310}}{\text{(.826-t) 1816 t,}}$$

When the lower edge of the slab falls below the neutral axis, the analysis of the beam is the same as for a simple beam of width b' and depth d.

An inspection of the table will show that, under ordinary conditions of design, the slab will supply sufficient compressive reinforcement. In case it does not, steel must be provided in compression, as indicated under design for "Double Reinforcement," page 59.

As the center of compression in the T beam will be relatively higher, or equally as high, as in the simple beam, the equation for moment of resistance for a simple beam may be used safely in the design of T beams, i. e.,

R M = .86 f A_sd = 13,760 A_sd.

The designer will readily see that shear plays an important part in beam design and that shear reinforcement must be provided. This shear reinforcement should be rigidly connected to the main tension member, so that its stress may be transferred directly to this member. The Kahn Trussed Bar, with its rigidly connected diagonals, accomplishes this result in a simple, adequate and economical manner.

Design of Beam Limited by Compression in Concrete

The theory of design for beams, presented up to this point, has been based on a safe working stress of 16,000 pounds per sq. in. in the steel in tension and an extreme fibre stress of 750 pounds per sq. in. in the concrete in compression. It has been shown that where the percentage of tensile reinforcement is less than 1 per cent. the compressive stress will be less than 750 pounds and therefore need not be considered.

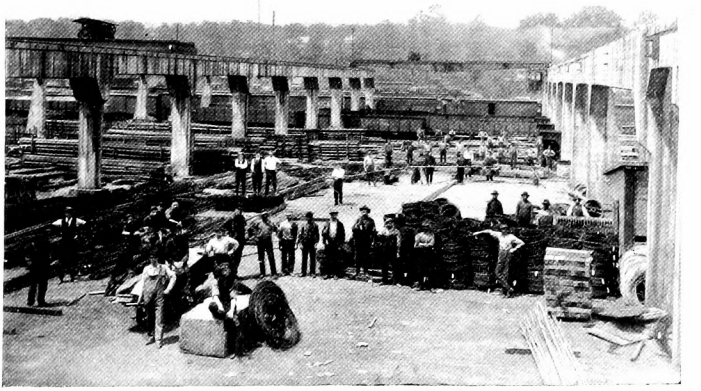
In the previous discussion, where more than 1 per cent. of reinforcement is required, the extreme fibre stress is limited to 750 pounds, either by the use of compressive reinforcement or by making the beams T section.

On rare occasions, in the case of isolated beams and floor slabs, the percentage exceeds 1 per cent. and it is not found practical to use either of the two alternatives just mentioned. Under such circumstances the moment of resistance of the beam is limited by the extreme fibre stress (750 pounds) in the concrete, irrespective of the stress in the tensile reinforcement. The moment of resistance is then determined by equation (6) page 55, i. e.:

$$\mathbf{R\,M} = \left(1 - \frac{x}{3}\right)\frac{cxbd^2}{2} = \left(1 - \frac{x}{3}\right)\frac{cx}{2}\,\frac{A_s}{p}\,d$$

The table given on page 64 gives the computed value of the moments of resistance and position of neutral axis for various percentages of reinforcement, based on this formula.

The designer should remember that it is usually decidedly uneconomical of material to design so as not to fully develop the strength of the steel reinforcement. Such a design should be avoided wherever possible.



Section of Shipping Yards at our Youngstown Shops.

Moments of Resistance of Beams

When the design is limited by the compression of the concrete and the full tensile strength of steel is not developed.

Percentage of Reinforcement	Position of Neutral Axis Values of X.	Moment of Resistance	
		Depending on Area of Steel	Depending on Area of Concrete
1.1%	0.4327	12620 dAs	139 bd^2
1.2%	0.4464	11880 dAs	142 bd^2
1.3%	0.4592	11220 dAs	146 bd^2
1.4%	0.4712	10640 dAs	149 bd^2
1.5%	0.4825	10120 dAs	152 bd^2
1.6%	0.4932	9660 dAs	155 bd^2
1.7%	0.5033	9240 dAs	157 bd^2
1.8%	0.5129	8860 dAs	159 bd^2
1.9%	0.5220	8510 dAs	162 bd^2
2.0%	0.5307	8190 dAs	164 bd^2
2.1%	0.5389	7890 dAs	166 bd^2
2.2%	0.5468	7620 dAs	168 bd^2
2.3%	0.5545	7370 dAs	170 bd^2
2.4%	0.5617	7130 dAs	171 bd^2
2.5%	0.5687	6910 dAs	173 bd^2
2.6%	0.5755	6710 dAs	174 bd^2
2.7%	0.5819	6510 dAs	176 bd^2
2.8%	0.5882	6330 dAs	177 bd^2
2.9%	0.5942	6160 dAs	179 bd^2
3.0%	0.6000	6000 dAs	180 bd^2

Columns 3 and 4 give equal values for moment of resistance. Note in column 3 the decreasing tensile stress in the steel and the consequent loss in economy.

Where percentage is 1% or less, R M = 13760 d As.

Shear in Reinforced Concrete Beams

The vertical shear at any section of a beam is the reaction at one end minus that part of the load lying between the end and the section. It is shown in mechanics that at any point in a beam the vertical unit shear is equal to the horizontal unit shear.

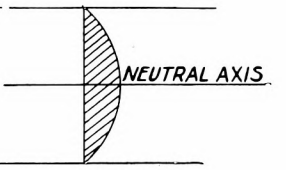


Fig. No. 5.

The distribution of the shearing stresses on the vertical section of a beam of homogeneous material is shown in figure No. 5. It will be noted that the shear varies as the ordinates to a parabola with the maximum shear at the neutral axis and equal in magnitude to 3/2 the mean unit shear.

The distribution of shearing stresses on a vertical section of a reinforced concrete beam is shown by figure No. 6. The

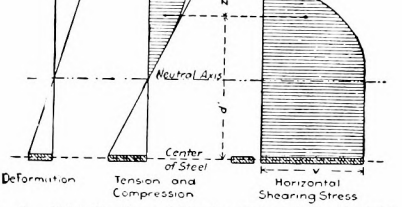


Fig. No. 6.—Distribution of Horizontal and Vertical Shear.

shear distribution in the beam of homogeneous material is similar to that of the reinforced concrete beam, except for that portion of the curve below the neutral axis. As no tension is considered as acting in the concrete there will be no change in the intensity of the horizontal and vertical shearing stresses below the neutral axis, whereas in the beam of homogeneous material the intensities vary as shown by the figure.

In the flexure of a simple beam the upper fibres are compressed and the lower fibres are stretched in amounts proportionate to the distance of these fibres from the neutral axis.

From the above it is evident that at every point of a beam there exists a horizontal and vertical shear and also a longitudinal tension or compression.

By combining the bending moment stresses with the shearing stresses at the various points in a beam lines of so-called principal stress are drawn as shown in figure No. 7. At

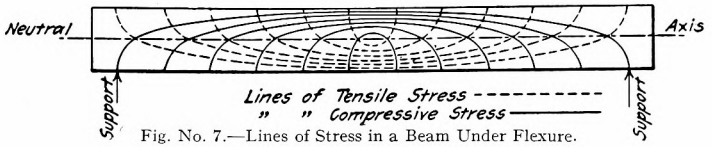


Fig. No. 7.—Lines of Stress in a Beam Under Flexure.

the center of the span the tensile and compressive stresses are horizontal; but as the ends are approached the lines of tensile stress incline upwards and those of compressive stress incline downwards, so that at all points away from the center of the span these stresses have both horizontal and vertical components. The horizontal components reach a maximum at the center of the span and the vertical at the ends.

It will be noticed from the above figure that the lines of tension stresses incline up and away from the center at an average angle of 45 degrees, while the lines of compressive stresses cross these tension lines at right angles and incline down toward the ends of the span.

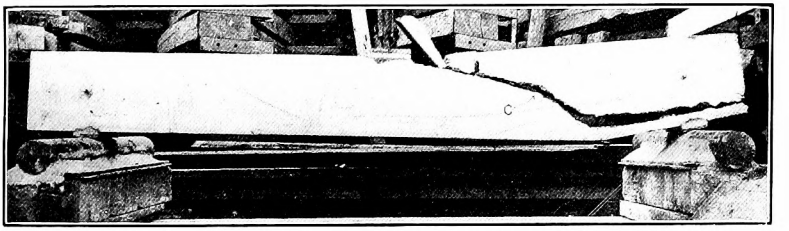
If the fundamental idea of reinforcing the concrete for tension is carried out, it is evident that steel members traversing the lines of principal tension stresses must be included in the design. If these members are to carry stresses they must be connected to some part of the structure that is capable of receiving it. The main tension member in the bottom of the beam provides such a connection, and it is only natural that this main tension member be utilized for this purpose. The web members of the Kahn Trussed Bar are rigidly connected to the main bar so that there can be no slipping at the connection. These web members extend up into the compressed area of the concrete and the upper portion is gripped and held in place not only by the adhesion to the concrete, but also by the thrust in the concrete acting at right angles to the axis of the web member. A complete truss is thus formed with tension flange of steel, compression flange of concrete and steel tension diagonals rigidly held at either end.

Merriman in his text book on mechanics gives an expression for maximum diagonal tension as $t = \frac{1}{2}s + \sqrt{\frac{1}{4}s^2 + v^2}$, where "t" is the diagonal tensile unit-stress, "s" is the horizontal tensile unit-stress existing in the concrete, and "v" is the horizontal or vertical shearing unit-stress. The direction

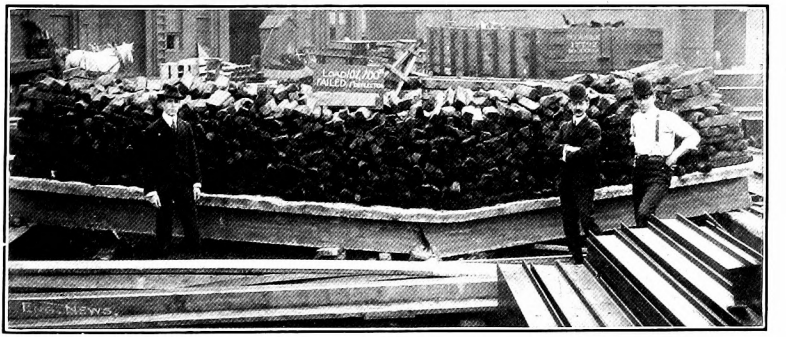
of this maximum diagonal tension makes an angle with the horizontal equal to one-half the angle whose cotangent is $\frac{1}{2}\frac{s}{v}$.

If there is no tension in the concrete, this reduces to $t=v$, and the maximum diagonal tension makes an angle of 45 degrees with the horizontal, and is equal in intensity to the vertical shearing stress.

When the diagonal tensile stresses developed becomes as great as the tensile strength of the concrete, the beam will fail by diagonal tension, provided there is no metallic web reinforcement. The accompanying cut gives the typical form which this failure takes. As the value of the maximum diagonal tensile stress developed in a beam is, by equation $(t=\frac{1}{2}s+\sqrt{\frac{1}{4}^2+v^2})$, dependent upon the horizontal tensile stress developed at the same point, it is difficult to compute its actual amount. The best method seems to be to compute the horizontal and vertical shearing unit-stress, and make all comparisons on the basis of this value.



Bessemer Steel, High Carbon, Deformed Bar.
See report of Boston Transit Commission, June 30, '04.
Fracture showing method of failure, due to shear, which occurs almost invariably when horizontal reinforcement alone is used. Steel stretched only to its elastic limit.



Beam Reinforced with Kahn Trussed Bar.
See Eng. News, vol. L. p. 349. See Eng. Record, vol. 48, p. 465.
Note that when tested to destruction the steel pulled in two.
Ultimate strength of steel developed.

Pieces Under Direct Compression

Unhooped Columns

In combining steel and concrete to resist compression, theoretically the load is borne by the two materials in a ratio determined by their relative modulii of elasticity. With this ratio 1 to 15 and a safe stress in the concrete of 500 pounds the steel will carry 7500 pounds per square inch. The natural disposition of this reinforcing steel is near the periphery of the column. In this position the reinforcing steel will take up whatever secondary stresses may occur caused by the possible eccentric application of the applied loads, or by unequal settlement of the footings.

The longitudinal reinforcing rods consisting of Rib Bars should be stayed at intervals of 12 inches with No. 3 ($\frac{1}{4}$ inch diameter) wire extending around the column.

Columns loaded unsymmetrically, and especially corner columns, should be figured with lower unit stresses. On account of the monolithic nature of construction it is somewhat difficult to say just what eccentricity a certain loading gives. In outside columns there is, undoubtedly, an eccentric load, and this should be provided for in the design by allowing a lower fiber stress.

Least width of column should not exceed 1/15 of its unsupported length.

See page 116 for safe loads on square columns.

Hooped Columns

Hooped columns, as developed by M. Considere, consist of a number of longitudinal bars arranged on the circumference of a circle with a steel band wrapped around these bars in spiral turns, varying from 1 to 3 inches apart, depending upon the design. This form of reinforcement increases the compressive strength of the concrete greatly and enables it to withstand much greater deformation and unit stresses. Considere shows that plain concrete under compressive stresses tends to fail by splitting longitudinally and bulging laterally. By enclosing it in a spiral wrapping of sufficiently small pitch the lateral bulging is resisted and the concrete will not only stand higher stresses without failure, but will also undergo much greater shortening. For a theoretical discussion of this subject the reader is referred to "Experimental Researches on

Reinforced Concrete," by Armand Considere, published by the McGraw Publishing Co. under date of 1906.

The table on page 117 is based upon the theory as developed by Considere. This theory is outlined by the following formula:

$P = A_c F_c + m F_c(A_s + 2.4 A_s^1)$.

Where P=safe load on column.

F_c=load per sq. in. on net section of core.

A_c=net area of concrete inside of hooping.

$$m = \frac{\text{modulus of elasticity of steel.}}{\text{modulus of elasticity of concrete.}}$$

A_s =Total area of cross section of vertical rods.

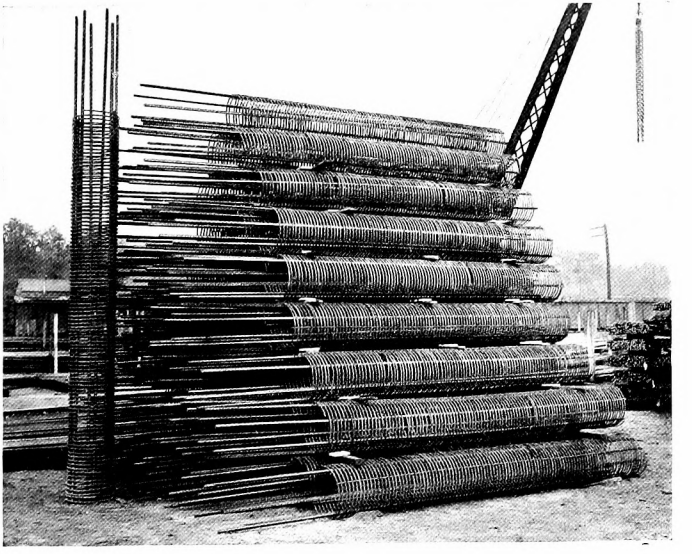
A_s^1=area of cross section of imaginary vertical rods having same quantity of steel as the hooping.

The following values are used in figuring the tables:

F_c=750 lbs.

m=15.

Least width of column should not exceed 1/15 of its unsupported length.



Shop-made Column Hooping (See page 24).

Bending Moments

Reinforced concrete differs from the ordinary types of building construction in that it is built continuous and monolithic. For this reason, girders and slabs must be designed to a large extent as continuous structures and provision must be made to take care of the negative bending moments occurring at the supports. This is done in practice by inverting Kahn Trussed Bars in the top of the concrete over the support.

It will often be found that in order to make the construction perfectly continuous in accordance with the accepted theory of continuous beams, the negative bending moment over the support will exceed the positive bending moment at the center of the span.

Theoretically, for beams uniformly loaded, the proper requirements in regard to strength will be satisfied when the bending moment at the center of the span plus one-half the sum of the negative bending moments at the supports is equal to $\frac{Wl}{8}$.

W = total uniform load on beam; l = span of beam.

The steel and concrete must be properly designed to take care of the bending moments at all points.

It is often found impractical, however, to design beams for perfect continuity, but authorities are agreed that a certain amount of continuity may be figured on.

The bending moments adapted in the various tables of this publication are purposely made conservative to prevent misuse and do not represent the minimum standards of good practice.

Rectangular Floor Slabs

When a slab is built in, or freely supported on four sides, the loads are carried in two directions to the supports and the slab is reinforced accordingly. Let,

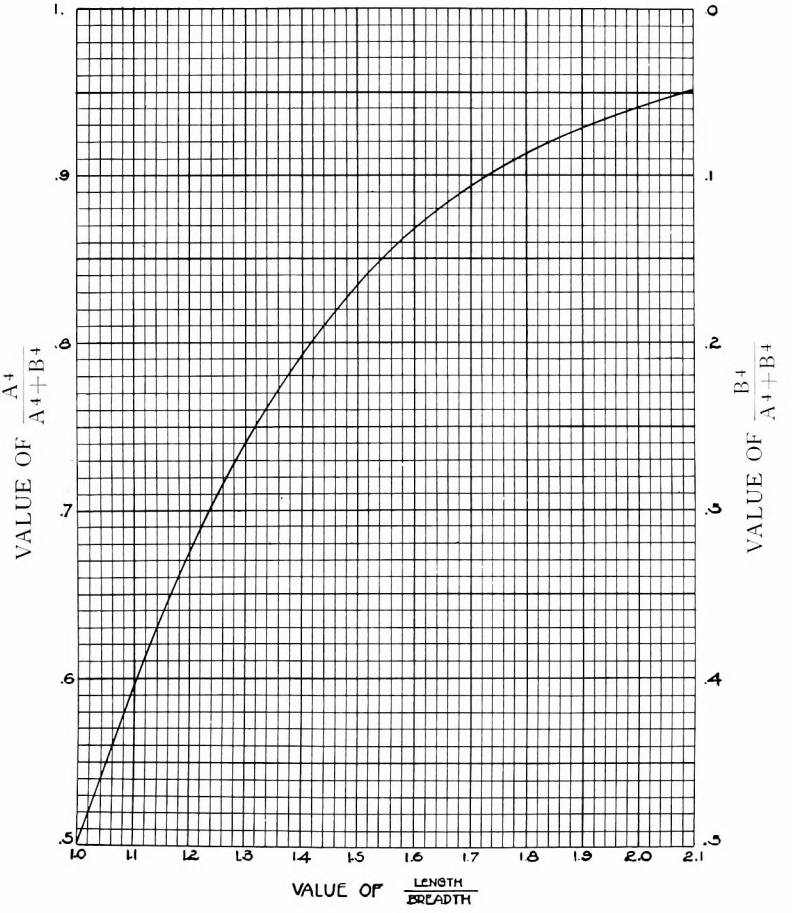
A = longer span of panel.

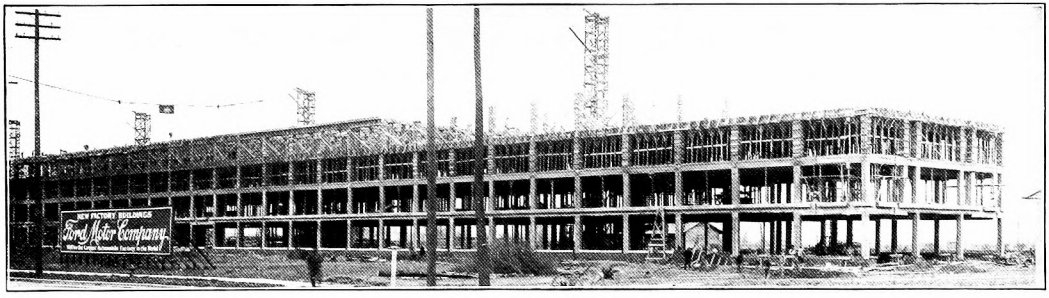
B = shorter span of panel.

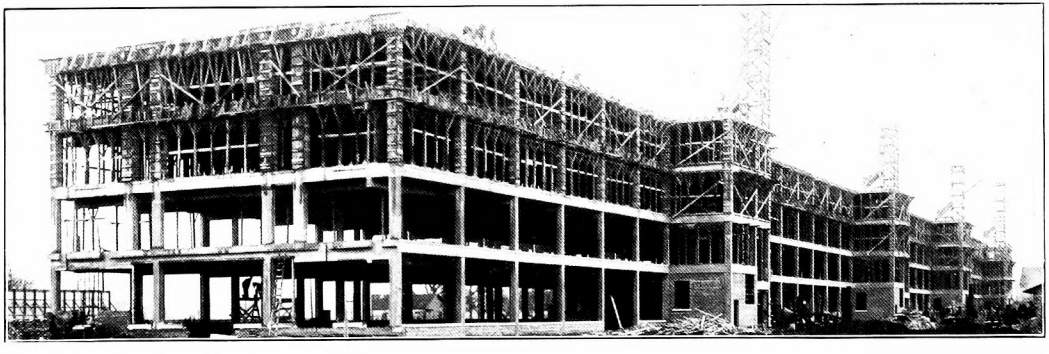
M = Bending moment for slab supported on two sides only.

Then the bending moment for longer span $=\frac{B^4}{A^4+B^4}M$ and the bending moment for shorter span $=\frac{A^4}{A^4+B^4}M$.

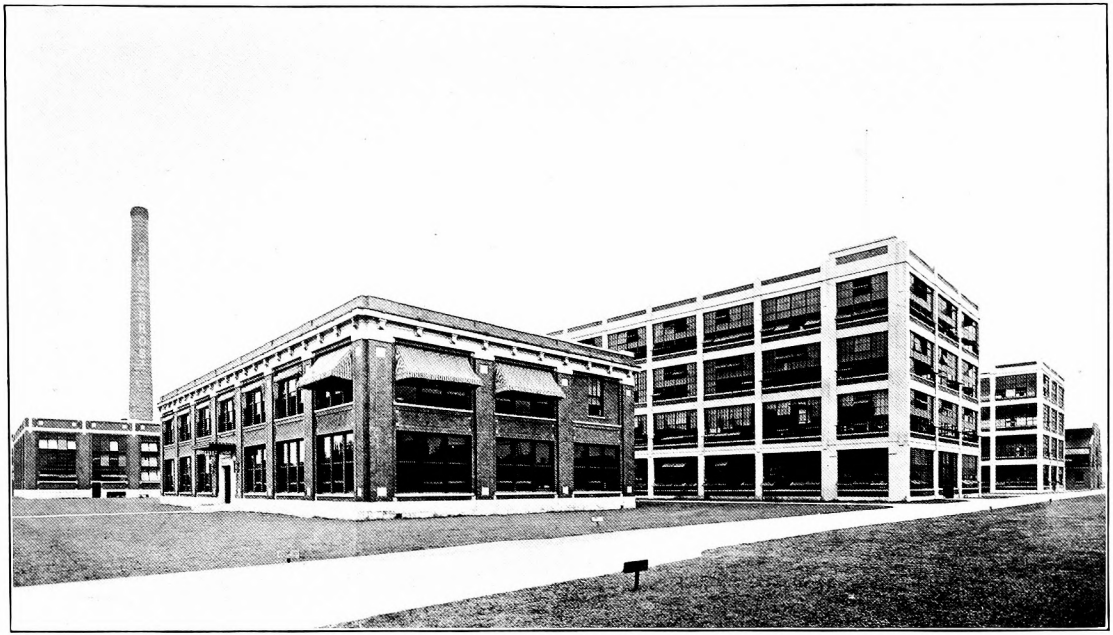
The greatest bending moment will always be that for the shorter span. The curve shown below indicates the value of these two factors for varying proportions of length and breadth of panel.





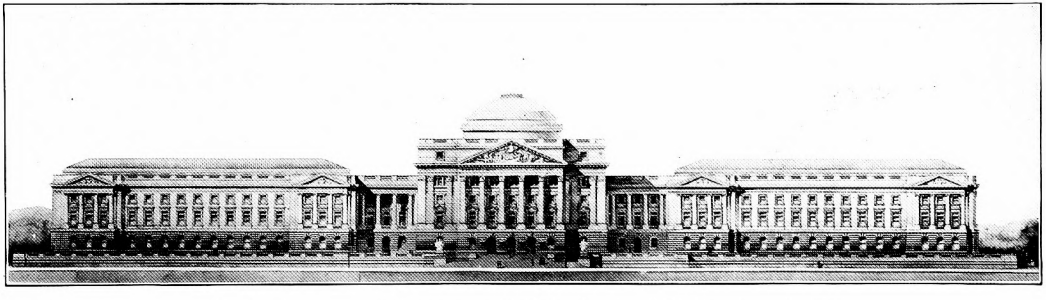


Construction of 865-Foot Building at Ford Motor Co., Detroit, showing various stages in the erection of a Kahn System Building.



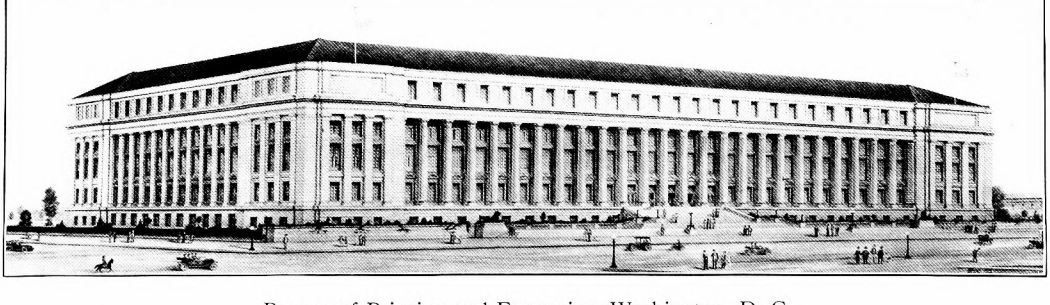
Dodge Bros. Plant, Detroit, Mich.

Administration Building, Factory, Power House, etc., Kahn System Reinforced Concrete.
Albert Kahn, Architect. Ernst Wilby, Associate.



U. S. Government Department of Agriculture, Laboratory Buildings.

Kahn System Reinforced Concrete. Rankin, Kellogg & Crane, Architects.



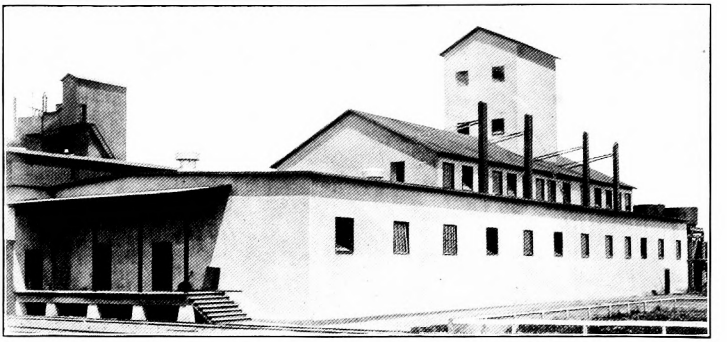
Bureau of Printing and Engraving, Washington, D. C.

Built Kahn System Reinforced Concrete—Windows of United Steel Sash.

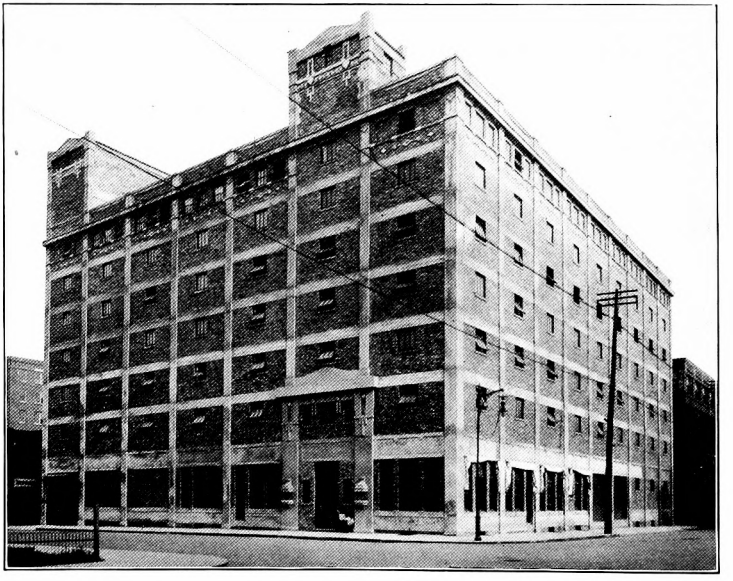
J. Henry Miller Co., Inc., Builders. James Knox Taylor, Supervising Architect.

Marlborough-Blenheim Hotel, Atlantic City, N. J.

Built throughout of Kahn System Reinforced Concrete. Price & McLanahan, Architects.



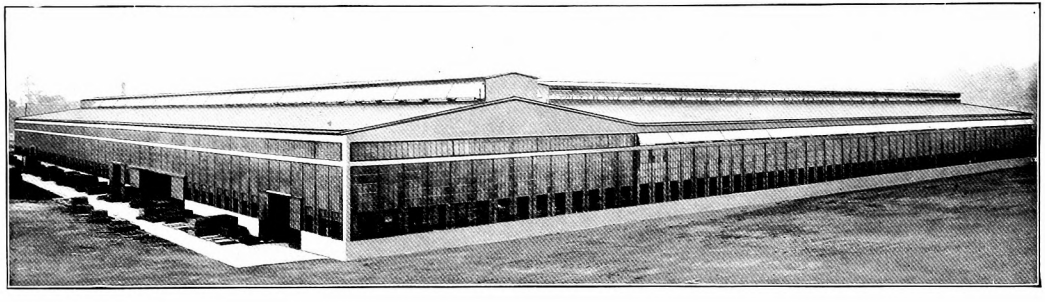
Lake Superior Iron & Chemical Co., Manistique, Mich.
Hy-Rib Concrete Sidings and Roof.



Merchants' Storage Warehouse, Des Moines, Ia.
Kahn System Reinforced Concrete. Wetherell & Gage, Architects.

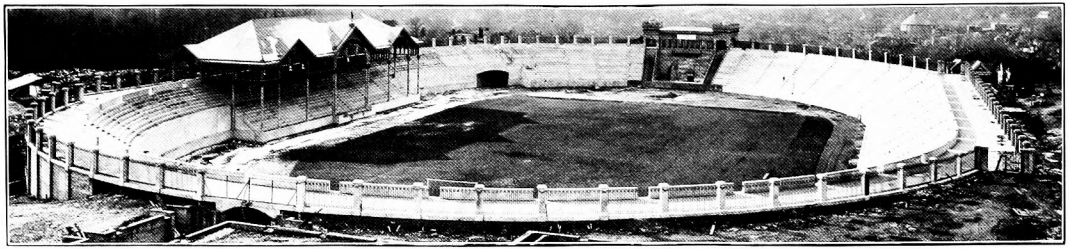
"The Daylight Store" of Owen & Co., Detroit.

Kahn System Reinforced Concrete. Albert Kahn, Architect, Ernst Wilby, Associate.



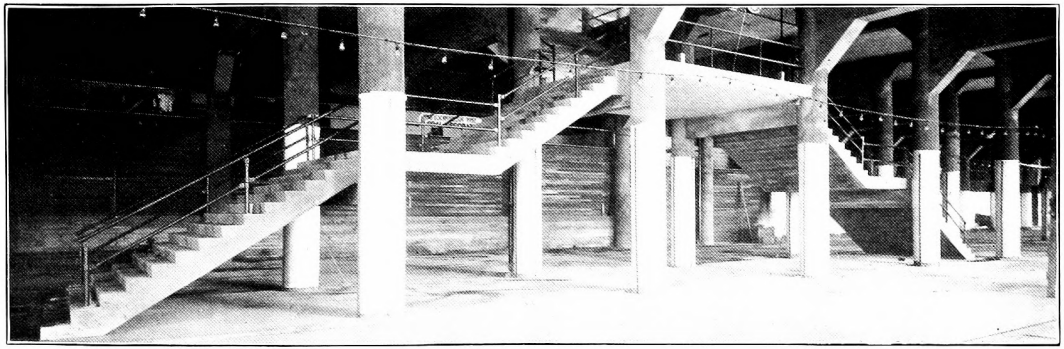
Modern, Daylight, One-Story Factory at our Youngstown Plant.
United Steel Sash for Windows and Monitors—Hy-Rib Concrete Sidings and Roofs.

Saw Tooth Roofs, Ford Motor Co., Detroit.
Hy-Rib Concrete Roofs and Sidings.



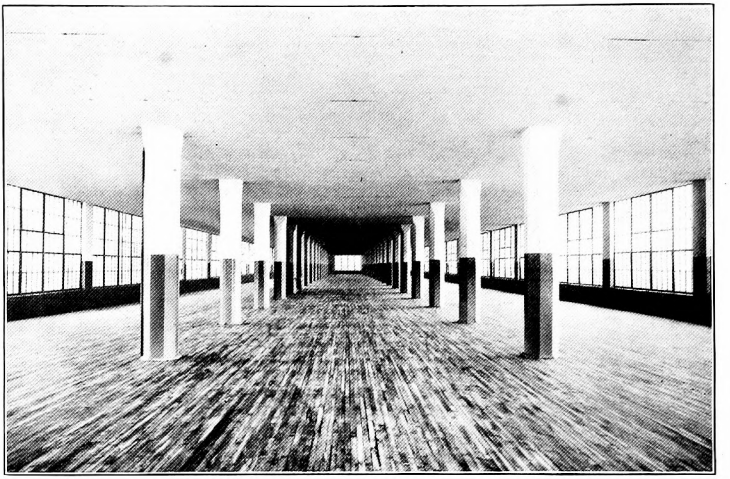
Stadium, Syracuse University, Syracuse, N. Y.

Built Kahn System Reinforced Concrete. Revels & Hallenbeck, Architects.



Stairway, Grand Stand, Minnesota State Fair, St. Paul, Minn.

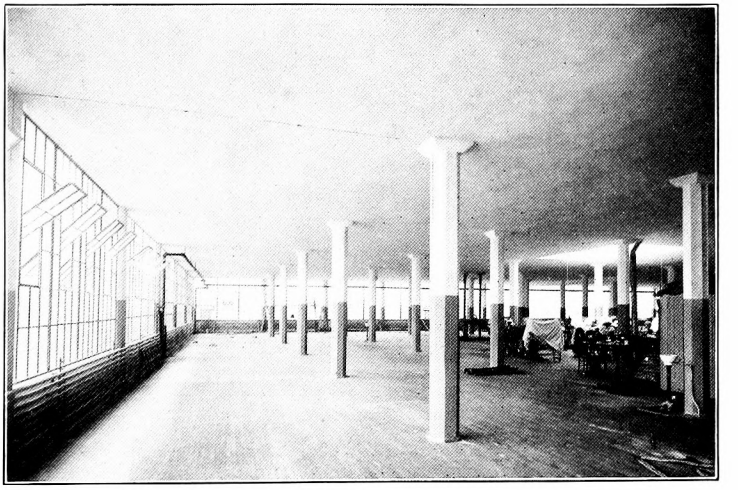
Built Kahn System Reinforced Concrete. Reed & Stem, Architects.



Kahn System Flat Ceilings, Dodge Bros., Detroit.
No projecting beams or brackets. United Steel Sash for Windows.

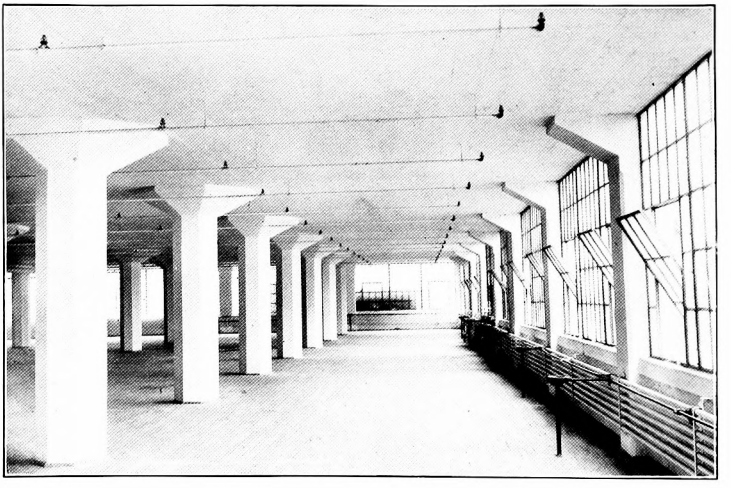
Flat Ceilings (Kahn System), Continental Motor Mfg. Co., Detroit.
Albert Kahn, Architect. Ernst Wilby, Associate.

Flat Ceilings, Burroughs Adding Machine Co., Detroit.
United Steel Sash for Windows.

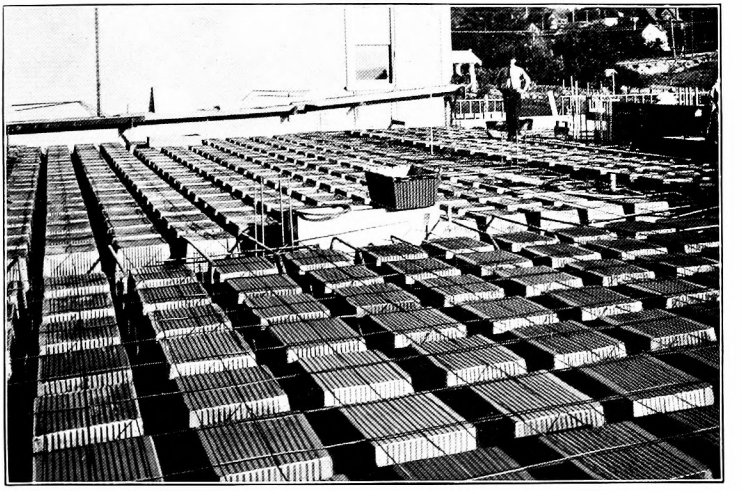


Kahn System Flat Ceilings, American Electrical Heater Co., Detroit, Mich.
Also United Steel Sash.
Albert Kahn, Architect. Ernst Wilby, Associate.

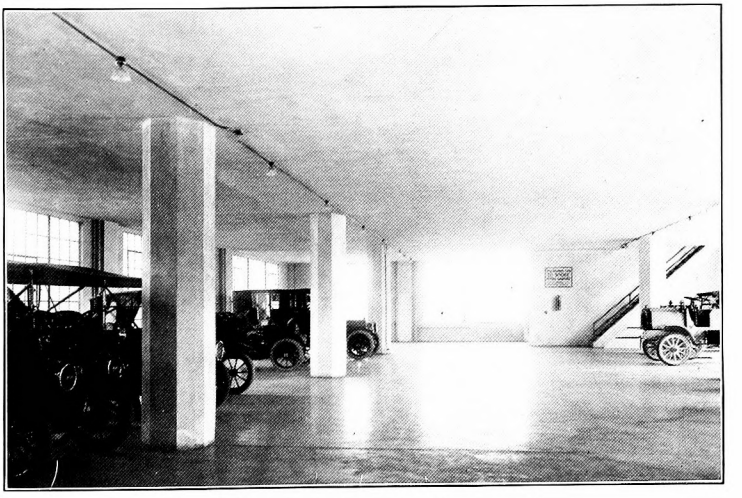
Storehouse, Portland Railway, Light & Power Co., Portland, Ore.
Kahn System Flat Ceilings with Brackets; also United Steel Sash.



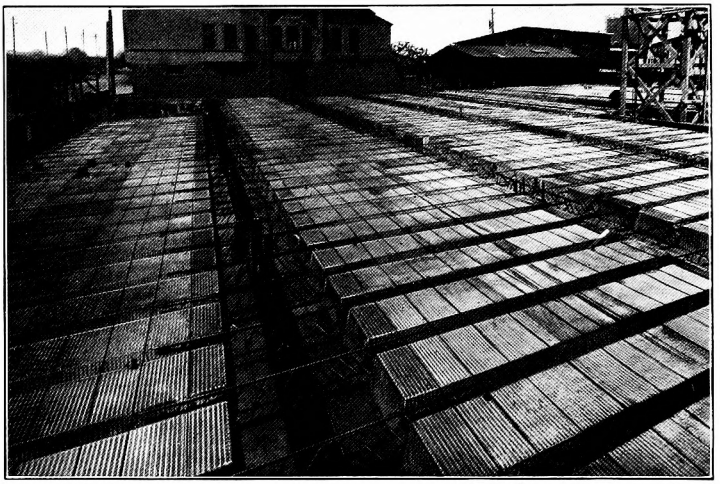
Standard Furniture Co., Herkimer, N. Y.
Kahn System Flat Ceilings with Brackets; also United Steel Sash.



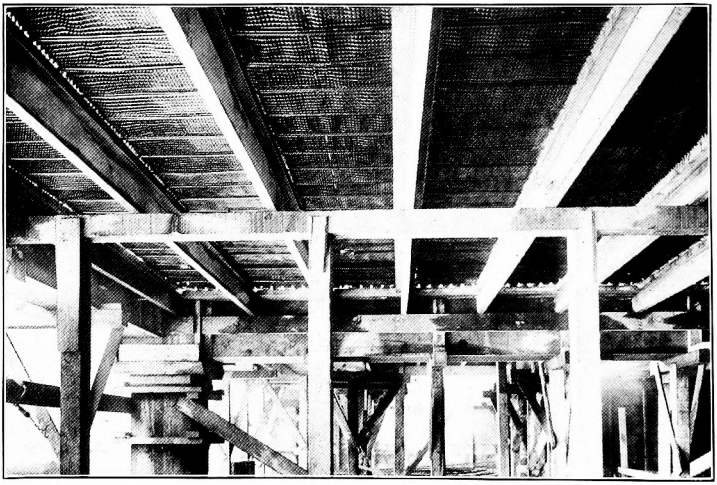
Floredome Construction, Mt. Tabor School, Portland, Ore.
Thomas Jones, Architect.



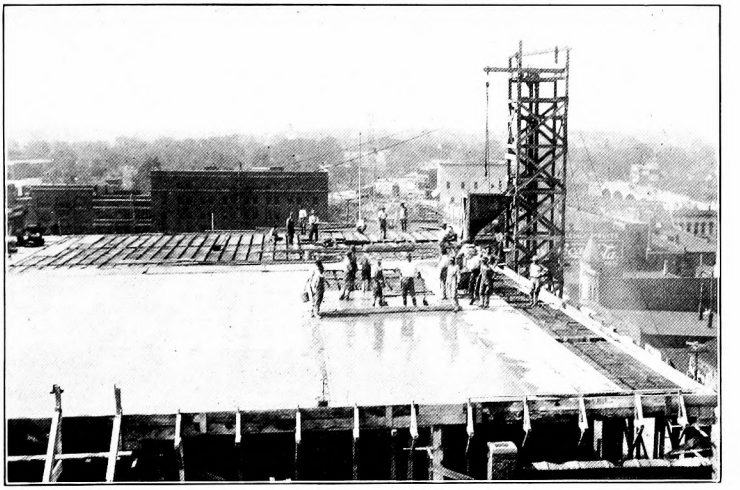
Flat Ceilings of Floredome Construction,
Packard Service Building, Los Angeles, Cal.
Parkinson & Bergstrom, Architects. F. O. Engstrum Co., Contractors.



Floretyle Construction, Alta Planing Mill, Los Angeles, Cal.

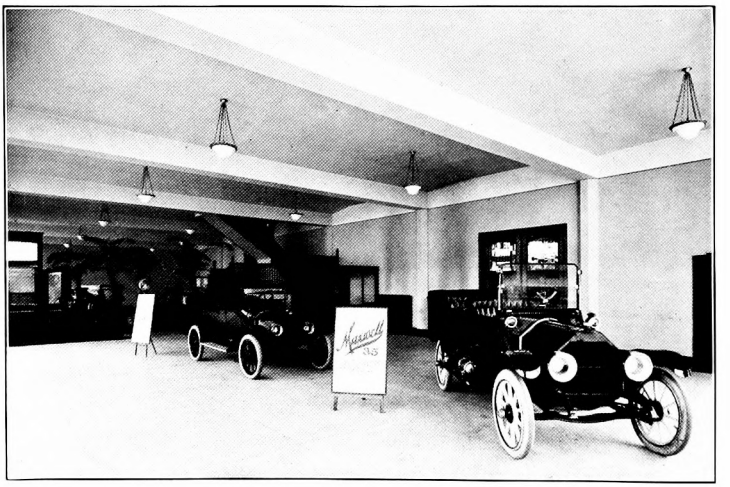


Simple Centering for Floretyle Construction.
Woodward-Clark Building, Portland, Ore.
Doyle, Patterson & Beach, Architects.



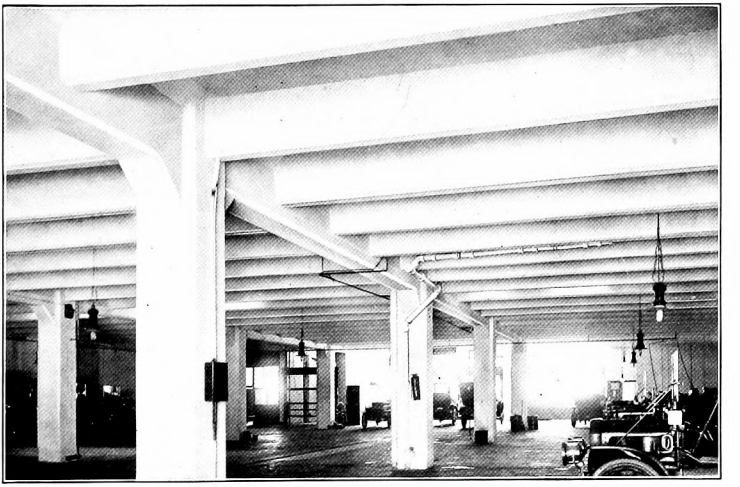
Floretyle Construction showing work partly concreted and underside before plastering, Fidelity Building, Cedar Rapids, Ia.

Kahn System Cantilever Slabs, D. Sommers & Co. Building, Indianapolis.
Robush & Hunter, Architects.



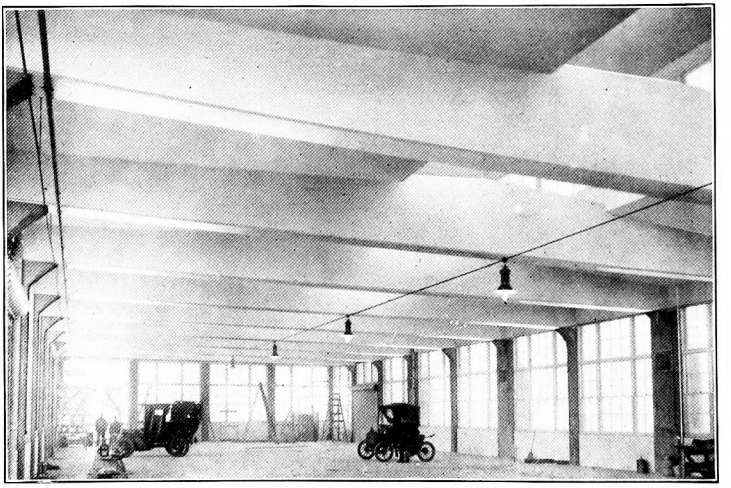
Kahn System Cantilever Slabs, Flanders Building, Detroit, Mich.
Albert Kahn, Architect. Ernst Wilby, Associate.

Reinforced Hollow Tile Floors—32 Feet Spans for Girders and Beams.
Packard Motor Car Co, Detroit.
Albert Kahn, Architect. Ernst Wilby, Associate.

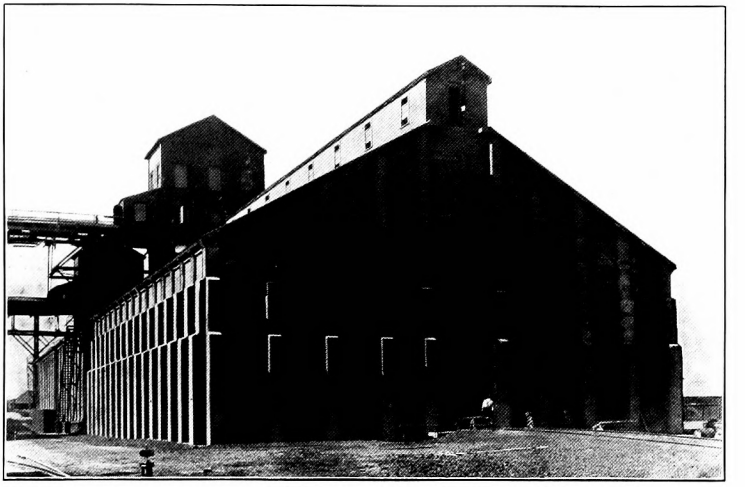


Kahn System Solid Concrete Slabs and Intermediate Beams.
White Garage, San Francisco.
McDonald & Applegarth, Architects

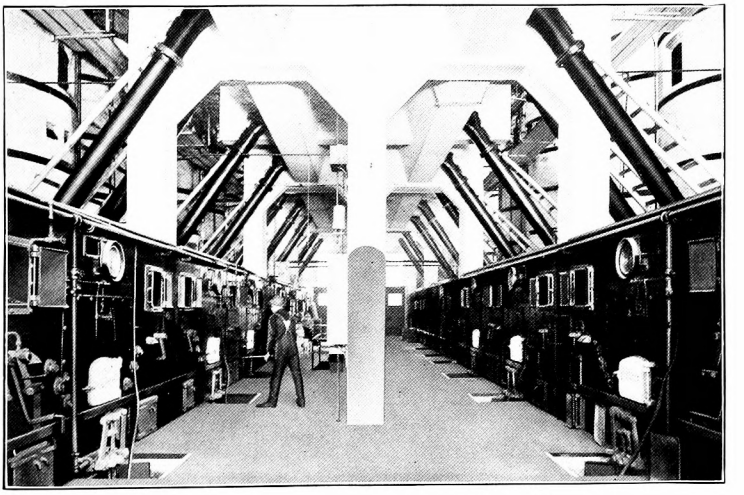
Kahn System Girders with spans of 74 feet 8 inches.
Foundry of Williams-White Co., Moline, Ill.



55-foot Spans, built Kahn System Reinforced Concrete.
Plant of Geo. N. Pierce Co., Buffalo, N. Y.
Lockwood, Greene & Co., Architects.



Bulk Soda Storage Bin, Solvay Process Co., Delray, Mich.
Kahn System Reinforced Concrete
C. E. Herbert, Engineer



Coal Bins, Diamond Crystal Salt Co., St. Clair, Mich.
Kahn System Reinforced Concrete
Weil & Shaw, Engineers

Explanation of Tables for Floor Slabs

The tables for Floor Slabs, pages 91 to 106, are computed for Bending Moments equal to $1/10\ wl^2$. To take care of this partial continuity, reinforcement must be provided in the top of the slab over the supports, equal in area to $\frac{1}{4}$ of the area of the steel in center of the span. Greater continuity can be figured on by using a smaller Bending Moment at the center and increasing the top reinforcement over the supports to take care of the increased negative Bending Moment. For slabs which merely rest on supports, the Bending Moment should be taken at $\frac{1}{8}\ wl^2$. In all such cases, where the Bending Moment is $\frac{wl^2}{K}$ (K, having any value) the safe live loads carried by the slab will then equal:

$$\frac{K}{10} \text{ x loads in table} + \left(\frac{K}{10} - 1\right) \text{ x weight of slab per sq. ft.}$$

In this way the tables may be used with any value of Bending Moment.

The loadings given in tables for slabs are safe live loads per square foot. The full dead weight of the slab has been deducted in every case in preparing the tables. All slabs are computed for stress in steel of 16,000 pounds per square inch.

All floor slabs should have a thickness equal to at least 1/30 of the clear span.

The tables given indicate only general types of design. Other arrangements of reinforcement, hollow tile, Floretyles, etc., will suggest themselves and can be readily computed. Our engineers will be glad to suggest the most economical construction in each individual case.

Note that we have not given any tables for flat ceiling designs of solid concrete. In this type of construction each individual building must be analyzed separately, so that general tables are unsatisfactory. Our Engineers have had a wide experience in flat ceiling designs of all types, including solid concrete, terra cotta tile, Floretyle, etc., and will gladly make specific suggestions for any definite construction.

Spacing of Bars in Inches for Various Safe Live Loads Per Square Foot

4″ Slab ½″x1½″ Kahn Trussed Bars, Area = 0.41 sq. in.

Load in Pounds	SPAN IN FEET					
	6	7	8	9	10	
50					18.7	
75				18.3	14.9	
100			19.4	15.3	12.4	
125			16.6	13.1	10.6	
150		18.9	14.4	11.4		
175		16.8	12.8	10.1		
200	20.5	15.1	11.5			
250	17.1	12.5				
300	14.6	10.7				
350	12.8	9.4				
400	11.4	8.3				

$B.\ M. = \frac{w\ l^2}{10}$

$R.\ M. = 0.86 \times 3.25 \times 0.41 \times 16000$

Maximum Spacing = 16″

Minimum Spacing = 12.6″

4½″ Slab ½″x1½″ Kahn Trussed Bars, Area = 0.41 sq. in.

Load in Pounds	SPAN IN FEET					
	6	7	8	9	10	11
50						16.8
75					16.4	13.6
100				17.0	13.7	11.3
125			18.5	14.6	11.8	9.8
150			16.2	12.8	10.4	8.6
175		18.9	14.4	11.4	9.2	
200		17.0	13.0	10.3	8.3	
250	19.4	14.2	10.9	8.6		
300	16.6	12.2	9.3			
350	14.5	10.7	8.2			
400	12.9	9.5				
500	10.6					

$B.\ M. = \frac{w\ l^2}{10}$

$R.\ M. = 0.86 \times 3.75 \times 0.41 \times 16000$

Maximum Spacing = 16″

Minimum Spacing = 10.9″

See explanation of tables page 90.

Spacing of Bars in Inches for Various Safe Live Loads Per Square Foot

5″ Slab ½″x1½″ Kahn Trussed Bars, Area = 0.41 sq. in.

Load in Pounds	SPAN IN FEET							
	6	7	8	9	10	11	12	
50						18.0	15.1	
75					17.7	14.6	12.3	
100				18.5	15.0	12.4	10.4	
125				16.0	13.0	10.7	9.0	
150			17.8	14.1	11.4	9.4		
175		20.8	15.9	12 6	10.2	8.4		
200		18.8	14.4	11.4	9.2			
250	21.5	15.8	12.1	9.6				
300	18.5	13.6	10.4	8.2				
350	16.2	11.9	9.1					
400	14.5	10.6	8.2					
500	11.9	8.7						
600	10.1	7.4						

$$B.\ M. = \frac{w\,l^2}{10}$$

$R.\ M. = 0.86 \times 4.25 \times 0.41 \times 16000$

Maximum Spacing = 16″

Minimum Spacing = 9.7″

6″ Slab ½″x1½″ Kahn Trussed Bars, Area = 0.41 sq. in.

Load in Pounds	SPAN IN FEET							
	8	7	10	11	12	13	14	15
50					16.8	14.4	12.4	10.8
75				16.7	14.0	11.9	10.3	8.9
100			17.2	14.2	11.9	10.2	8.8	7.6
125		18.6	15.1	12.5	10.4	8.9	7.7	
150		16.5	13.4	11.0	9.3	7.9		
175	18.7	14.8	12.0	9.9	8.3	7.2		
200	17.0	13.4	10.9	9.0	7.6			
250	14.4	11.4	9.2	7.6				
300	12.5	9.8	8.0					
350	10.9	8.7	7.0					
400	9.8	7.7						
500	8.1	6.4						

$$B.\ M. = \frac{w\,l^2}{10}$$

$R.\ M. = 0.86 \times 5.25 \times 0.41 \times 16000$

Maximum Spacing = 16″

Minimum Spacing = 7.8″

See explanation of tables p. 90.

Spacing of Bars in Inches for Various Safe Live Loads Per Square Foot

7″ Slab $\frac{3}{4}$″x2$\frac{3}{16}$″ Kahn Trussed Bars, Area = 0.79 sq. in.

Load in Pounds	SPAN IN FEET									
	8	9	10	11	12	13	14	15	16	17
50										16.8
75									16.0	14.2
100							18.1	15.8	13.9	12.2
125						18.4	15.9	13.9	12.2	
150						16.5	14.2	12.4		
175					17.5	14.8	12.9			
200				19.0	15.9	13.6	11.7			
250			19.5	16.1	13.6	11.6				
300			17.0	14.0	11.8					
350		18.6	15.0	12.4						
400		16.6	13.5	11.1						
500	17.4	13.8	11.2							
600	14.9	11.8								
800	11.5									

$$B.\ M. = \frac{w\ l^2}{10}$$

$R.\ M. = 0.86 \text{x} 6 \text{ x } 0.79 \text{ x } 16000$

Maximum Spacing = 16″

Minimum Spacing 13.2″

See explanation of tables p. 90.

Spacing of Bars in Inches for Various Safe Live Loads Per Square Foot

8″ Slab $\frac{3}{4}$″x2$\frac{3}{16}$″ Kahn Trussed Bars. Area = 0.79 sq. in.

Load in Pounds	SPAN IN FEET								
	6	7	8	9	10	11	12	13	14
250						18.2	15.3	13.0	11.2
300					19.2	15.9	13.4	11.4	9.8
350					17.1	14.1	11.9	10.1	
400				19.0	15.3	12.7	10.6		
500			19.9	15.8	12.8	10.6			
600			17.1	13.5	10.9				
800		17.3	13.3	10.5					
1000		14.2	10.9						
1200	16.3	12.0	9.2						
1400	14.1	10.4							

Load in Pounds	SPAN IN FEET								
	12	13	14	15	16	17	18	19	20
50						18.0	16.1	14.4	13.0
75					17.4	15.4	13.7	12.3	11.1
100				17.2	15.2	13.4	12.0	10.7	
125			17.6	15.3	13.4	11.9	10.6		
150		18.3	15.8	13.8	12.1	10.7			
175		16.6	14.3	12.5	11.0				
200	17.9	15.2	13.1	11.4	10.0				
250	15.3	13.0	11.2						

Maximum Spacing = 16″

Minimum Spacing = 11.2″

$B.M. = \frac{wl^2}{10}$

$R.M. = 0.86 \times 7 \times 0.79 \times 16000$

See explanation of tables page 90

Spacing of Bars in Inches for Various Safe Live Loads Per Square Foot

10″ Slab $\frac{3}{4}$″x2$\frac{3}{16}$″ Kahn Trussed Bars. Area = 0.79 sq. in.

Load in Pounds	SPAN IN FEET									
	6	7	8	9	10	11	12	13	14	15
125										17.7
150										16.1
175									16.9	14.8
200								18.1	15.6	13.6
250							18.4	15.6	13.5	11.8
300							16.2	13.8	11.9	10.4
350						17.2	14.4	12.3	10.6	9.3
400					18.8	15.5	13.1	11.1	9.6	8.4
500				19.5	15.8	13.0	10.9	9.3	8.1	
600				16.8	13.6	11.2	9.4	8.0		
800			16.6	13.1	10.6	8.8	7.4			
1000		17.8	13.7	10.8	8.7					
1200	20.6	15.1	11.6	9.2						
1400	17.9	13.1	10.1	7.9						

Load in Ponnds	SPAN IN FEET									
	16	17	18	19	20	21	22	23	24	25
50			17.7	15.9	14.4	13.1	11.9	10.9	10.0	9.2
75		17.3	15.4	13.9	12.5	11.4	10.3	9.5	8.7	8.0
100	17.4	15.4	13.7	12.3	11.1	10.1	9.2	8.4		
125	15.6	13.8	12.3	11.1	10.0	9.1	8.2			
150	14.2	12.5	11.2	10.1	9.1	8.2				
175	13.0	11.4	10.2	9.2	8.3					
200	11.9	10.6	9.4	8.5						
250	10.3	9.1	8.2							
300	9.1	8.1								
350	8.1									

Maximum Spacing = 16″ $\qquad B.M. = \frac{wl^2}{10}$

Minimum Spacing = 9″ $\qquad R.M. = 0.86 \times 9 \times 0.79 \times 16000$

See explanation of tables page 90.

Spacing of Bars in Inches for Various Safe Live Loads Per Square Foot

12″ Slab $\frac{3}{4}$″x2$\frac{3}{16}$″ Kahn Trussed Bars. Area = 0.79 sq.in.

Load in Pounds	SPAN IN FEET										
	8	9	10	11	12	13	14	15	16	17	18
75											16.8
100										16.9	15.1
125									17.3	15.4	13.7
150									15.9	14.0	12.5
175								16.6	14.6	12.9	11.5
200							17.7	15.4	13.6	12.0	10.7
250						17.9	15.5	13.5	11.8	10.5	9.3
300						15.9	13.7	11.9	10.5	9.3	8.3
350					16.8	14.3	12.3	10.7	9.5	8.4	7.4
400				18.2	15.2	13.0	11.2	9.7	8.6	7.6	6.8
500			18.6	15.3	12.9	11.0	9.5	8.2	7.2	6.4	
600		19.8	16.0	13.2	11.1	9.5	8.2	7.1	6.3		
800		15.6	12.6	10.4	8.8	7.5	6.5	5.6			
1000	16.3	12.9	10.4	8.6	7.2	6.2					
1200	14.0	11.0	8.9	7.3	6.2						
1400	12.1	9.5	7.7	6.4							

Load in Pounds	SPAN IN FFET										
	19	20	21	22	23	24	25	26	27	28	29
50	17.1	15.4	14.0	12.7	11.6	10.7	9.8	9.1	8.4	7.9	7.3
75	15.1	13.6	12.4	11.3	10.3	9.5	8.7	8 1	7.5	7.0	6.5
100	13.6	12.3	11.1	10.1	9.3	8.5	7.8	7.2	6.7		
125	12.3	11.1	10.1	9.2	8.4	7.7	7.1	6.6			
150	11.2	10.2	9.2	8.4	7.7	7.1	6.5				
175	10.4	9.4	8.5	7.7	7.1	6.5					
200	9.6	8.6	7.9	7.2	6.5						
250	8.4	7.6	6.9	6.3							
300	7.5	6.7									

$$B.\ M. = \frac{wl^2}{10}$$

Maximum Spacing = 16″
Minimum Spacing = 7.2″
R. M. = 0.86 x 11 x 0.79 x 16000

See explanation of tables page 90.

Safe Live Loads in Pounds per Square Foot for Slabs Reinforced with Rib Metal

3-Inch Slab

Span in Feet	MESH				
	4	5	6	7	8
3	824	652	537	455	394
4	447	351	286	240	206
5	273	212	170	140	119
6	179	136	107	87	71
7	122	90	69	54	43
8	85	61	45	33	25

3½-Inch Slab

Span in Feet	MESH					
	3	4	5	6	7	8
4	732	539	412	345	290	248
5	454	330	255	206	170	144
6	309	222	169	134	109	90
7	211	148	110	84	66	53
8	152	104	74	55	41	31
9	111	73	50	34	23	

4-Inch Slab

Span in Feet	MESH					
	3	4	5	6	7	8
4	856	630	494	404	339	281
5	531	386	299	241	200	169
6	354	253	193	153	124	103
7	248	174	130	98	79	63
8	179	122	88	65	49	37
9	131	86	59	41	28	19
10	97	61	39	24		
11	70	41	24			

4½-Inch Slab

Span in Feet	MESH					
	3	4	5	6	7	8
4	978	720	566	462	398	333
5	606	441	342	276	229	194
6	406	291	222	176	143	118
7	284	199	148	114	91	73
8	204	140	101	75	57	43
9	150	99	68	48	33	23
10	111	70	45	29		
11	83	49	28			
12	61	32				

5-Inch Slab

Span in Feet	MESH						
	2	3	4	5	6	7	8
4	1682	1101	811	637	521	438	376
5	1056	684	498	386	312	258	219
6	714	456	327	250	198	162	134
7	510	320	225	168	130	103	83
8	376	231	158	114	85	65	49
9	285	170	113	88	55	39	26
10	219	126	80	52	33	20	
11	171	94	56	32	17		
12	134	69	37	18			
13	105	50	22				

6-Inch Slab

Span in Feet	MESH						
	2	3	4	5	6	7	8
4	2057	1347	988	780	638	538	458
5	1292	837	610	474	383	318	269
6	877	561	403	308	244	199	165
7	625	393	277	207	160	126	102
8	460	283	194	141	105	80	61
9	349	209	139	96	68	48	34
10	269	155	99	64	42	25	
11	210	116	69	41	22		
12	165	86	47	23			
13	130	63	29				
14	102	44					
15	80	39					

B. M. = 1/10 w l^2. Stress in steel = 16,000 pounds per square inch.
See explanation of tables page 90.

Safe Live Loads in Pounds per Square Foot for Slabs Reinforced with 4-Rib Hy-Rib

(See also Table Below.)

Thickness of Slabs above base of sheathing	Gauge No. 4-Rib Hy-Rib	Moment of resistance per foot of width	SPAN IN FEET								
			3	4	5	6	7	8	9	10	11
1 " thick slab	28	965	76	38							
	26	1155	93	48	27						
	24	1540	128	68	40						
1½" thick slab	28	1838	152	77	43	25					
	26	2205	186	96	56	33					
	24	2940	254	134	80	50					
2 " thick slab	28	2675	222	115	65	38					
	26	3210	271	143	83	50	30				
	24	4280	370	198	118	74	48				
2½" thick slab	28	4125	350	184	106	65	40	24			
	26	4950	420	227	134	84	54	35			
	24	6600	578	312	188	122	82	56			
3 " thick slab	28	6150	533	284	168	106	68	44	27		
	26	7380	647	248	209	135	89	60	39	24	
	24	9840	874	476	290	192	130	92	64	44	
3½" thick slab	28	7275	633	338	199	127	82	53	33	18	
	26	8730	768	414	248	161	107	72	48	30	
	24	11640	1038	566	344	228	156	110	78	54	38

Maximum Spans for 4-Rib Hy-Rib as Centering

To support various thicknesses of wet concrete. For greater spans use temporary supports

Gauge of 4-Rib Hy-Rib	THICKNESS OF SLAB						
	1"	1½"	2"	2½"	3"	3½"	4"
No. 24	5′ 0″	4′ 0″	3′ 6″	3′ 2″	2′ 10″	2′ 8″	2′ 6″
No. 26	4′ 3″	3′ 6″	3′ 0″	2′ 9″	2′ 6″	2′ 4″	2′ 2″
No. 28	3′ 11″	3′ 2″	2′ 9″	2′ 6″	2′ 3″	2′ 1″	1′ 11″

See page 26 for description of 4-Rib Hy-Rib.

Safe Live Loads in Pounds per Square Foot for Slabs Reinforced with Deep-Rib Hy-Rib

(See also Table below)

Thickness of Slabs above base of sheathing	Gauge No. Deep-Rib Hy-Rib	Moment of resistance per foot of width	SPAN IN FEET								
			4	5	6	7	8	9	10	11	12
2 " thick slab	26	3680	168	99	61	39					
	24	4100	190	112	71	46					
	22	4520	211	127	81	53					
2½" thick slab	26	4560	207	122	76	48	29				
	24	6090	287	173	111	73	49				
	22	7080	339	206	134	90	62				
3 " thick slab	26	5790	266	157	98	62	39				
	24	7710	366	221	143	95	64	43			
	22	9630	466	285	188	128	89	63			
3½" thick slab	26	7000	323	191	120	77	49	30			
	24	9330	444	269	174	117	80	54	36		
	22	11670	564	347	228	157	111	78	55		
4 " thick slab	26	8250	382	226	142	92	59	37			
	24	10980	524	318	206	139	95	65	44		
	22	13740	667	410	270	186	131	93	67	46	
4½" thick slab	26	9450	438	260	164	107	69	43	24		
	24	12600	601	366	238	160	110	75	51	33	
	22	15750	766	471	311	214	151	107	77	55	37
5 " thick slab	26	10680	496	295	187	121	79	50	29		
	24	14220	680	414	270	182	125	86	59	38	
	22	17790	866	533	353	242	171	123	89	62	42
5½" thick slab	26	11880	552	330	209	136	89	56	33		
	24	15840	759	462	301	203	140	97	66	43	26
	22	19800	964	594	393	270	192	138	99	70	49

Maximum Spans for Deep-Rib Hy-Rib as Centering

To support various thicknesses to wet concrete. For greater spans use temporary supports.

Gauge of Deep-Rib Hy-Rib	THICKNESS OF SLAB								
	2"	2½"	3"	3½"	4"	4½"	5"	5½"	6"
No. 22	5′ 6″	5′ 0″	4′ 6″	4′ 2″	3′11″	3′ 9″	3′ 7″	3′ 4″	3′ 2″
No. 24	5′ 0″	4′ 6″	4′ 0″	3′ 9″	3′ 6″	3′ 4″	3′ 2″	3′ 0″	2′10″
No. 26	4′ 4″	3′10″	3′ 6″	3′ 3″	3′ 1″	2′11″	2′ 9″	2′ 8″	2′ 6″

See page 26 for description of Deep-Rib Hy-Rib.

Safe Live Loads in Pounds per Square Foot for Square Panels of Steel Floredome Construction of Various Thicknesses

DEPTH	6″ Dome + 2″ Concrete				8″ Dome + 2″ Concrete				10″ Dome + 2″ Concrete				12″ Dome + 2″ Concrete			
*Wt. of floor in pounds pr sq.ft	50				60				71				82			
Reinforcement	½″x1½″ Kahn Bars	½″x1½″ Kahn Bars and ⅜″ Rib Bars nested	½″x1½″ Kahn Bars and ½″ Rib Bars nested	¾″x2 3/16″ Kahn Bars	½″x1½″ Kahn Bars and ½″ Rib Bars nested	¾″x2 3/16″ Kahn Bars	¾″x2 3/16″ Kahn Bars and ⅜″ Rib Bars nested	¾″x2 3/16″ Kahn Bars and ½″ Rib Bars nested	¾″x2 3/16″ Kahn Bars and ⅜″ Rib Bars nested	¾″x2 3/16″ Kahn Bars and ½″ Rib Bars nested	¾″x2 3/16″ Kahn Bars and 5/8″ Rib Bars nested		¾″x2 3/16″ Kahn Bars and ½″ Rib Bars nested	¾″x2 3/16″ Kahn Bars and 5/8″ Rib Bars nested	¾″x2 3/16″ Kahn Bars and ¾″ Rib Bars nested	
SPAN IN FEET																
8	515	680	833	1004	1094	1322	1565	1757	1920	2160	2460		2570	2920	3360	
9	396	527	644	781	849	1027	1220	1372	1515	1700	1940		2020	2300	2650	
10	311	418	512	623	675	820	977	1100	1210	1360	1554		1620	1850	2130	
11	249	336	414	506	548	667	797	898	987	1113	1277		1337	1521	1759	
12	202	274	341	418	452	552	661	746	821	926	1061		1105	1263	1454	
13	163	225	281	347	374	460	551	624	684	772	888		922	1057	1219	
14	134	187	235	291	313	386	465	527	578	655	753		781	895	1039	
15	110	157	200	249	266	330	400	454	498	565	651		674	774	898	
16	91	132	170	213	228	284	346	394	430	490	565		585	672	783	
17	75	111	144	182	194	244	298	340	371	423	491		507	585	682	
18	61	94	123	157	167	211	259	298	324	370	430		443	514	600	
19	50	79	104	135	143	182	226	260	283	324	377		386	458	525	
20	40	67	90	118	124	159	198	228	250	287	333		344	400	470	
21	31	55	77	102	105	138	173	202	218	251	296		302	354	418	
22	25	46	66	89	92	122	154	180	195	225	266		270	317	374	
23	...	38	55	77	79	105	134	158	171	198	235		240	282	335	
24	...	31	47	66	67	92	119	140	151	178	211		212	250	299	
25	...	25	40	57	57	80	105	125	134	158	190		190	226	272	
26	...	...	33	50	50	71	94	112	120	142	171		171	205	246	

Joists are 4″ wide at base and spaced 2′-1½″ c. to c. in both directions.

Safe Live Loads for Rectangular Panels are equal to one-half the sum of loads opposite each span in above table. For instance: Panel 8 x 16 feet, 6″ Dome + 2″ Concrete, reinforced with ½″ x 1½″ Kahn bars.

$$\text{Safe live load per sq. ft.} = \frac{515 + 91}{2} = 303 \text{ lbs.}$$

*Weight of floor given above does not include weight of ceiling.

See page 18 for full description of Floredome construction.

See explanation of tables page 90.

Safe Live Loads in Pounds per Square Foot for Steel Floretyle Construction of Various Thicknesses

DEPTH	6″ Tyle + 2″ Concrete				8″ Tyle + 2″ Concrete				10″ Tyle + 2″ Concrete			12″ Tyle + 2″ Concrete		
*Wt. of floor in pounds per sq.ft	41				46				51			56		
SPAN IN FEET / Reinforcement	$\frac{1}{2}$″x1$\frac{1}{2}$″ Kahn Bars	$\frac{1}{2}$″x1$\frac{1}{2}$″ Kahn Bars and $\frac{3}{8}$″ Rib Bars nested	$\frac{1}{2}$″x1$\frac{1}{2}$″ Kahn Bars and $\frac{1}{2}$″ Rib Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars	$\frac{1}{2}$″x1$\frac{1}{2}$″ Kahn Bars and $\frac{1}{2}$″ Rib Bars Nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{3}{8}$″ Rib Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{1}{2}$″ Rib Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{3}{8}$″ Rib Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{1}{2}$″ Rib Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{5}{8}$″ Rib Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{1}{2}$″ Rib Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{5}{8}$″ R b Bars nested	$\frac{3}{4}$″x2 $\frac{3}{16}$″ Kahn Bars and $\frac{3}{4}$″ Rib Bars nested
8	213	295	355	438	467	574	679	759	842	939	1060	1123	1268	1444
9	160	224	271	337	359	444	527	589	654	732	829	874	992	1130
10	121	174	212	265	282	351	419	469	520	582	660	697	794	905
11	93	136	168	212	226	282	338	380	421	473	538	567	645	739
12	72	108	135	171	182	230	276	312	346	389	443	467	534	611
13	55	86	109	140	148	189	228	260	287	324	369	389	446	513
14	42	69	88	115	121	156	191	217	240	273	312	328	377	434
15	31	54	71	95	100	131	160	183	203	231	266	279	321	371
16	22	43	58	78	82	109	135	155	172	197	221	238	275	320
17	....	33	47	65	68	91	115	132	147	168	196	205	238	277
18	....	25	37	54	55	77	97	113	125	145	169	176	206	241
19	....	....	29	44	45	64	82	97	107	125	146	152	179	210
20	....	....	23	36	36	53	70	83	92	107	127	132	156	184
21	....	....	....	28	28	44	59	71	78	93	110	115	136	162
22	....	....	....	....	22	36	50	61	67	80	96	100	119	142
23	....	....	....	....	....	29	42	52	57	69	84	87	105	126
24	....	....	....	....	....	23	34	43	48	59	72	74	91	111
25	....	....	....	....	....	....	28	36	40	50	63	64	80	97
26	....	....	....	....	....	....	22	30	33	42	54	55	69	86

All joists are 4″ wide at base and spaced 2′-0″ c. to c.

B. M. = 1/10 wl^2.

*Weight of floor given does not include weight of ceiling.

See page 19 for full description of Floretyle Construction.

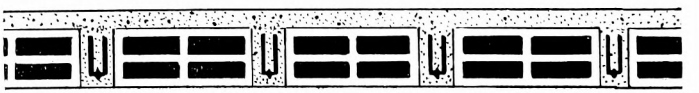
See explanation of tables page 90.

Safe Live Loads per Square Foot for Hollow Terra Cotta Tile Floors of Various Thicknesses

Reinforced with ½″x1½″ Kahn Trussed Bars

DEPTH	4″ Tile + 1″ Concrete	4″ Tile + 2″ Concrete	6″ Tile + 1″ Concrete	6″ Tile + 2″ Concrete	8″ Tile + 1″ Concrete	8″ Tile + 2″ Concrete	10″ Tile	10″ Tile + 1″ Concrete	10″ Tile + 2″ Concrete	12″ Tile	12″ Tile + 1″ Concrete	12″ Tile + 2″ Concrete
Wght. of floor in pounds per sq. ft.	38	50	47	59	56	68	54	66	78	63	75	87
Spacing	<——— 16″ C. to C ———>											
SPAN IN FEET 6	378	464	565	651	752	838	852	938	1024	1039	1125	1211
7	268	328	403	462	538	598	612	672	732	747	807	867
8	196	239	297	340	398	442	456	499	542	557	600	643
9	147	178	225	256	303	335	349	380	412	427	458	490
10	112	135	173	196	235	258	272	295	319	334	357	380
11	86	103	135	152	184	202	216	233	250	265	282	299
12	66	78	106	118	146	159	173	185	197	212	225	237
13		59	83	92	116	125	139	148	157	172	181	190
14		44	65	71	92	98	112	118	124	139	145	151
15		32	51	54	73	77	91	95	98	113	117	121
16			39	41	58	59	73	75	77	92	94	96
17			29	29	45	45	59	59	59	74	75	75
18					34	33	47	45	44	59	58	57
19					25		36	34	32	47	45	42
20							28			36	33	30
21										27		

$$\text{B. M.} = \frac{wl'}{10}$$



See explanation of tables page 90.

Safe Live Loads per Square Foot for Hollow Terra Cotta Tile Floors of Various Thicknesses

Reinforced with $\frac{1}{2}''$x$1\frac{1}{2}''$ Kahn Trussed Bars

DEPTH	4" Tile + 1" Concrete	4" Tile + 2" Concrete	6" Tile + 1" Concrete	6" Tile + 2" Concrete	8" Tile + 1" Concrete	8" Tile + 2" Concrete	10" Tile	10" Tile + 1" Concrete	10" Tile + 2" Concrete	12" Tile	12" Tile + 1" Concrete	12" Tile + 2" Concrete
Weight of Floor in Pounds Per sq. ft.	39	51	49	61	59	71	58	70	82	68	80	92
Spacing	17" C. to C.											
SPAN IN FEET 6	352	433	524	606	700	780	793	874	950	964	1046	1128
7	249	304	372	429	498	555	568	624	679	693	748	804
8	181	221	273	314	368	408	421	461	501	515	554	594
9	135	164	205	236	279	308	321	350	378	392	421	450
10	102	123	157	180	215	236	249	270	291	305	326	348
11	77	93	122	136	167	184	197	211	226	240	255	271
12	59	70	94	106	131	143	156	166	177	191	202	213
13		52	73	81	103	111	124	131	139	153	160	167
14		38	56	61	80	86	99	104	108	122	127	132
15			43	46	62	65	78	81	84	98	100	103
16			31	33	48	49	62	63	64	78	79	80
17					36	35	48	48	47	61	60	60
18						24	37	35	33	47	45	44
19									21	35	32	30

$$B.\ M. = \frac{wl^2}{10}$$

See explanation of tables page 90.

Safe Live Loads per Square Foot for Hollow Terra Cotta Tile Floors of Various Thicknesses

Reinforced with $\frac{3}{4}''$x2$\frac{3}{16}''$ and 1$\frac{1}{2}''$x2$\frac{1}{4}''$ Kahn Trussed Bars

		←——— $\frac{3}{4}''$ x 2$\frac{3}{16}''$ BARS ———→										1$\frac{1}{2}$x2$\frac{1}{4}$"
	DEPTH	6" Tile + 2" Concrete	8" Tile + 2" Concrete	10" Tile + 2" Concrete	12" Tile + 2" Concrete	12" Tile + 2" Concrete	12" Tile + 2" Concrete	6" Tile + 2" Concrete	8" Tile + 2" Concrete	10" Tile + 2" Concrete	12" Tile + 2" Concrete	12" Tile + 3" Concrete
	Weight of Floor in Pounds Per sq. ft.	59	68	78	87	98	104	61	71	82	92	108
	Spacing	←——16" C to C——→				15"	13"	←——— 17" C to C———→				18"
SPAN IN FEET	8	686	887	1090	1293	1374	1595	639	827	1018	1208	2167
	9	528	687	845	1003	1065	1238	492	638	786	935	1687
	10	416	543	669	796	844	983	387	504	621	739	1347
	11	334	437	540	643	681	795	309	404	499	595	1094
	12	271	357	441	526	556	651	250	329	406	485	902
	13	222	294	364	436	459	539	204	269	334	399	752
	14	182	244	303	363	383	451	167	222	276	332	634
	15	152	204	254	306	321	379	138	185	230	277	538
	16	127	171	214	257	270	320	114	154	193	233	460
	17	106	144	181	218	228	272	94	128	161	196	395
	18	88	121	153	185	193	231	77	107	135	165	341
	19	73	101	129	157	163	197	63	88	113	138	295
	20	60	85	109	133	137	167	51	73	94	116	256
	21	49	71	92	113	116	142		59	77	97	222
	22	39	58	76	95	97	121		48	63	80	192
	23		47	63	80	80	101		38	51	65	167
	24		38	52	66	66	85		29	40	52	145
	25			42	54	53	70			30	41	125
	26			33	43	41	57				31	107
	27				34	31	45					92
	28											78
	29											65

$$B.\ M. = \frac{wl^2}{10}$$

10" Tile on Edge	8" Tile on Edge

See explanation of tables page 90.

Safe Live Loads per Square Foot for Hollow Terra Cotta Tile Floors of Various Thicknesses

Reinforced with $\frac{1}{2}$″x$1\frac{1}{2}$″ and $\frac{3}{4}$″x$2\frac{3}{16}$″ Kahn Trussed Bars Spaced Alternately

DEPTH	4″ Tile + 2″ Concrete	6″ Tile + 1″ Concrete	6″ Tile + 2″ Concrete	8″ Tile + 1″ Concrete	8″ Tile + 2″ Concrete	10″ Tile + 1″ Concrete	10″ Tile + 2″ Concrete	12″ Tile + 1″ Concrete	12″ Tile + 2″ Concrete
Weight of Floor in Pounds Per sq. ft.	50	47	59	56	68	66	78	75	87
Spacing	16″ C. to C.								
SPAN IN FEET									
7	447	583	678	787	880	987	1080	1189	1282
8	353	435	505	589	658	740	809	893	961
9	267	334	387	454	505	571	623	690	741
10	206	262	302	357	396	450	489	544	584
11	163	208	239	285	316	360	391	437	467
12	129	167	191	231	255	292	316	355	379
13	103	135	154	188	207	239	258	291	310
14	82	110	125	155	169	197	212	241	255
15	64	90	101	128	138	163	174	200	211
16		73	82	105	113	136	144	167	175
17		60	66	87	93	113	118	139	145
18			52	71	75	93	97	116	120
19			41	58	61	77	79	97	99
20			31	47	48	63	64	80	81
21				38	37	51	51	65	65
22				29	28	41	39	53	52
23						32	29	42	40
24								32	29

$$B.\ M. = \frac{wl^2}{10}$$

See explanation of tables page 90.

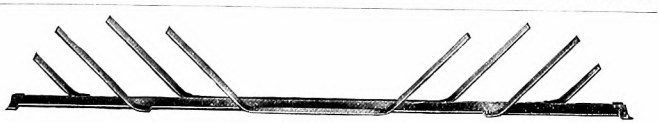
Safe Live Loads per Square Foot for Hollow Terra Cotta Tile Floors of Various Thicknesses

Reinforced with $\frac{1}{2}''$x$1\frac{1}{2}''$ and $\frac{3}{4}''$x$2\frac{3}{16}''$ Kahn Trussed Bars Spaced Alternately

Depth	4" Tile + 2" Concrete	6" Tile + 1" Concrete	6" Tile + 2" Concrete	8" Tile + 1" Concrete	8" Tile + 2" Concrete	10" Tile + 1" Concrete	10" Tile + 2" Concrete	12" Tile + 1" Concrete	12" Tile + 2" Concrete
Weight of Floor in Pounds Per sq. ft.	51	49	60	59	71	70	82	80	92
Spacing	17" C. to C.								
SPAN IN FEET									
7	445	544	635	734	821	921	1008	1109	1196
8	329	405	472	548	612	689	753	830	894
9	250	310	361	421	469	529	577	639	687
10	193	242	280	330	366	416	452	503	539
11	151	191	222	262	290	331	359	402	430
12	119	153	177	211	233	267	289	325	346
13	94	123	142	171	188	217	234	265	281
14	74	99	114	139	152	178	191	217	230
15	58	80	92	114	123	146	155	179	188
16		65	74	93	100	120	127	148	155
17		51	59	76	80	98	103	122	126
18			46	61	64	80	83	100	103
19			35	49	50	64	66	81	83
20				38	38	51	52	66	66
21				29	28	40	39	52	51
22						30	28	40	38
23								30	27

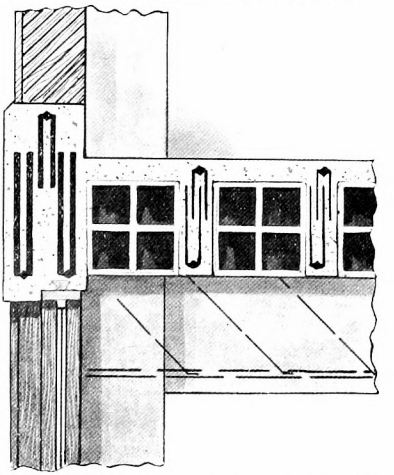
$$B.\ M. = \frac{wl}{10}$$

See explanation of tables page 90.

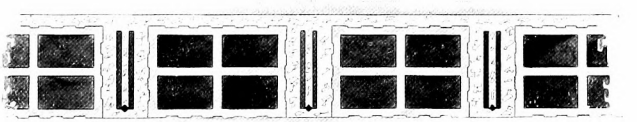


Kahn Trussed Bar

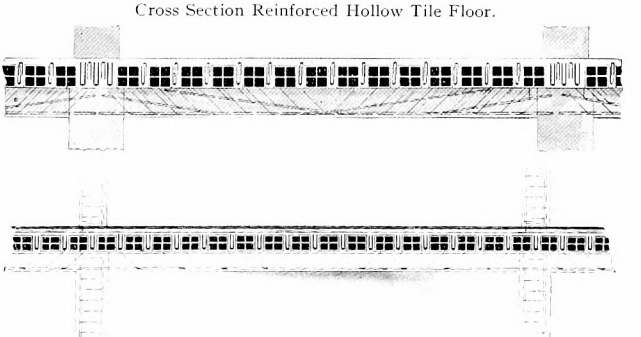
Note rigidly connected shear members.



Detail of Window Framing Into Concrete Lintel Beam.



Cross Section Reinforced Hollow Tile Floor.



Detail of Framing Reinforced Concrete Columns, Beams and Floors.

Explanation of Tables of Safe Loads for Beams

The tables for beams on pages 109 to 115, give the loads in pounds, uniformly distributed for all usual spans, based upon a fibre stress of 16,000 pounds per square inch in the steel.

These loads include the weight of the beam, which must be deducted in order to arrive at the net load which the beam will carry.

The carrying capacities in the tables are based on beams freely supported at the ends and uniformly loaded; that is, $BM = \frac{Wl}{8}$

In building construction it is usual to take advantage of continuous action and to provide reinforcement at the top of the beam over the supports.

For continuous beams, the Bending Moment at the center of the spans may be considerably reduced. If the value of this Bending Moment is taken as $\frac{Wl}{K}$, the safe loads given in tables must be multiplied by $\frac{K}{8}$ and reinforcement must be provided in top of beams over both supports at least equal in area to $\frac{K-8}{8}$ times the area of steel at center of span.

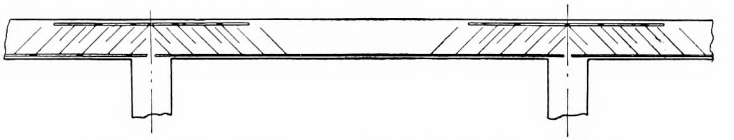
Where the area of steel reinforcement exceeds one per cent. of the area of the concrete, above the steel the beam must be made of T section. This can be readily done by using table on page 61 for ratio of width of T to width of beam.

For beams carrying plastered ceiling, it is found by experience that their depth should be at least 1-15 of the clear span; where this limit is exceeded there is danger of the ceiling cracking.

These tables show beams reinforced with two Kahn bars alone, and also with two Kahn bars with an additional Rib Bar bent over the supports. Other combinations of reinforcement will suggest themselves so that any size and condition of loading can be readily provided for. Our engineers will gladly furnish detailed suggestions on the design of reinforced concrete beams.

The web members must be bent up at an angle of at least 45 degrees with the main section and should be of sufficient length to reach nearly the top of beam. For standard and special lengths of diagonals, see pages 14 to 17.

Safe Total Loads in Hundreds of Pounds Uniformly Distributed for Concrete Beams



Reinforced with Two $\frac{3}{4}$"x2$\frac{3}{16}$" Kahn Trussed Bars
Area = 1.58 sq. in.

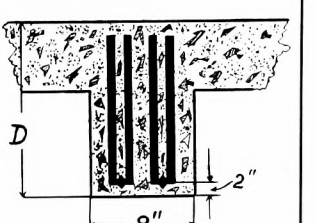
Span in Feet	Depth in Inches (*D*)					
	8	10	12	14	16	18
7	124	166	207			
8	109	145	181	217		
9	97	129	161	193	225	258
10		116	145	174	203	232
11		106	132	158	184	211
12		97	121	145	169	193
13			111	134	156	178
14			104	124	145	166
15			97	116	135	155
16				109	127	145
17				102	119	136
18				97	113	129
19					107	122
20					101	116
21					97	110
22						105
23						101

NOTE:—Make Beam of T Section.

D = Total depth of Beam in inches.

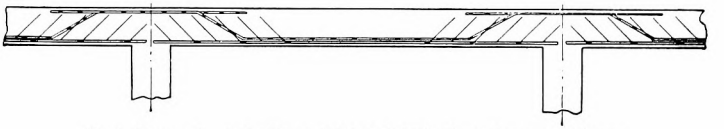
$B.\ M. = \frac{Wl}{8}$

NOTE:—For B. M. $= \frac{Wl}{K}$ above loads must be multiplied by $\frac{K}{8}$



See explanation of tables page 108.

Safe Total Load in Hundreds of Pounds Uniformly Distributed for Concrete Beams



Reinforced with Two $\frac{3}{4}$"x2$\frac{3}{16}$" Kahn Trussed Bars and One $\frac{3}{4}$" Rib Bar. Area 2.14 sq. in.

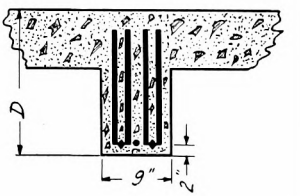
Span in Feet	Depth in Inches (D)							
	10	12	14	16	18	20	22	24
9	174	218						
10	157	196	235					
11	143	178	214	250				
12	131	164	196	229	262	294		
13		151	181	211	242	272	302	332
14		140	168	196	224	252	280	308
15		131	157	183	209	235	262	288
16			147	172	196	221	245	270
17			139	162	185	208	231	254
18				153	174	196	218	240
19				145	165	186	207	227
20				137	157	177	196	216
21					149	168	187	206
22					142	161	178	196
23						154	171	188
24						147	163	180
25						141	157	173
26							151	166
27							145	160
28							140	154
29								149
30								144

NOTE:—Make Beam of T Section.

D = Total depth of Beam in inches.

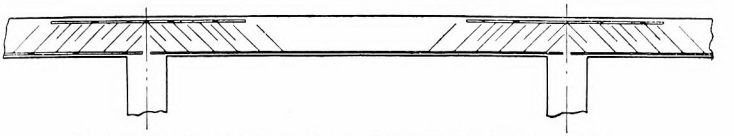
$B.\ M. = \frac{Wl}{8}$

NOTE:—For B. M. $= \frac{Wl}{K}$ above loads must be multiplied by $\frac{K}{8}$



See explanation of tables page 108.

Safe Total Loads in Hundreds of Pounds Uniformly Distributed for Concrete Beams



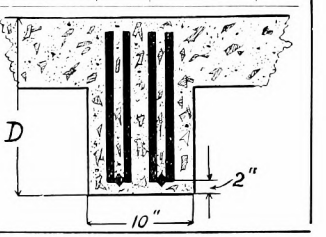
Reinforced with Two $1\frac{1}{2}$"x$2\frac{1}{4}$" Kahn Trussed Bars
Area = 2.82 sq. in.

Span in Feet	Depth in Inches (D)									
	12	14	16	18	20	22	24	26	28	30
12	216	259	302							
13	199	239	278	318	358					
14	185	222	259	296	332	370	496			
15	172	207	241	276	310	345	379	414	448	
16		194	226	259	291	323	356	388	420	453
17		182	213	244	274	304	335	365	396	426
18			201	230	258	287	316	345	374	402
19			190	218	245	272	300	327	354	381
20			181	207	233	258	284	310	336	362
21				197	222	246	271	295	320	345
22				188	212	235	259	282	305	329
23				180	202	225	247	270	292	315
24					194	216	237	258	280	302
25					186	207	228	248	269	290
26						199	219	239	258	278
27						191	211	230	249	268
28						185	203	221	240	258
29							196	214	232	250
30							189	207	224	241
31								200	217	233
32								194	210	226
33								188	204	219
34									198	213
35									192	207
36										201
37										196
38										191

NOTE:—Made Beam of T Section.
D = Total depth of Beam in inches.

$$B.\ M. = \frac{Wl}{8}$$

NOTE:—For B. M. $= \frac{Wl}{K}$ above loads must be multiplied by $\frac{K}{8}$



See explanation of tables page 108.

Safe Total Loads in Hundreds of Pounds Uniformly Distributed for Concrete Beams

Reinforced with two 1½″x2¼″ Kahn Trussed Bars and One ¾″ Rib Bar. Area 3.38 sq. in.

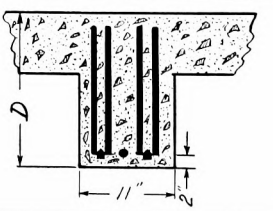
Span in Feet	Depth in Inches (D)									
	14	16	18	20	22	24	26	28	30	32
13	286									
14	266	310	354							
15	246	289	330	372						
16	232	271	310	348	387	426				
17	219	255	292	328	365	400	438	474	510	
18		241	275	310	344	379	413	448	482	517
19		228	261	294	326	359	392	424	456	489
20		217	248	279	310	341	372	403	434	465
21			236	266	295	324	354	384	413	443
22			225	254	282	310	338	366	394	423
23			216	243	269	296	323	350	377	404
24				232	258	284	310	336	362	387
25				223	248	272	298	322	347	372
26					238	262	286	310	334	357
27					229	253	276	298	321	344
28					221	244	266	288	310	332
29						235	257	278	299	321
30						227	248	268	289	310
31							240	260	280	300
32							232	252	271	291
33							225	244	263	282
34								237	255	274
35								230	248	266
36									241	258
37									234	252
38									228	245

NOTE:—Make Beam of T Section.

D = Total depth of Beam in inches.

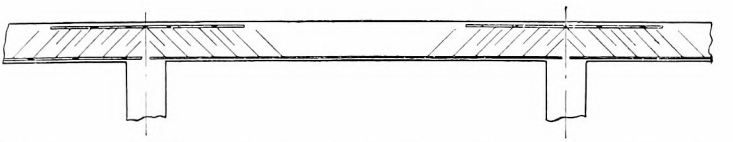
$$B.\ M. = \frac{Wl}{8}$$

NOTE:—For B. M. $= \frac{Wl}{K}$ above loads must be multiplied by $\frac{K}{8}$



See explanation of tables page 108.

Safe Total Loads in Hundreds of Pounds Uniformly Distributed for Concrete Beams



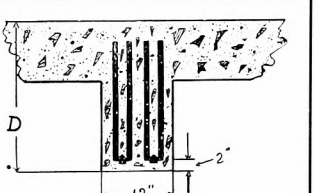
Reinforced with Two $1\frac{3}{4}$"x$2\frac{3}{4}$" Kahn Trussed Bars. Area = 4 sq. in.

Span in Feet	Depth in Inches (D)									
	16	18	20	22	24	26	28	30	32	34
18	285	326	367	408	448					
19	270	309	348	386	425	463	502			
20	257	294	330	367	404	440	477	514		
21		280	314	349	384	419	454	489	524	
22		267	300	334	367	400	434	467	500	534
23		255	287	319	351	383	415	447	479	510
24			275	306	336	367	398	428	459	489
25			264	294	323	352	382	411	440	470
26				282	310	339	367	395	423	452
27				272	299	326	353	380	408	435
28				262	288	314	341	367	393	419
29					278	304	329	354	380	405
30					269	294	318	342	367	391
31						284	308	331	355	379
32						275	298	321	344	367
33						267	289	311	334	356
34							280	302	324	346
35							272	294	314	336
36								286	306	326
37								278	298	318

NOTE:—
Make Beam of T Section.

D = Total depth of Beam in inches.

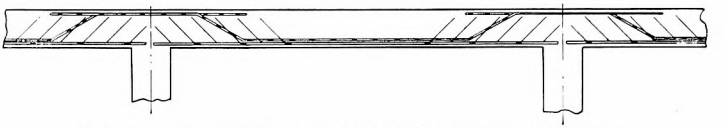
$$B.\,M. = \frac{Wl}{8}$$



NOTE:—For B. M. $= \frac{Wl}{K}$ above loads must be multiplied by $\frac{K}{8}$

See explanation of tables page 108.

Safe Total Loads in Hundreds of Pounds Uniformly Distributed for Concrete Beams



Reinforced with Two $1\frac{3}{4}''$x$2\frac{3}{4}''$ Kahn Trussed Bars and One 1″ Rib Bar. Area = 5 sq. in.

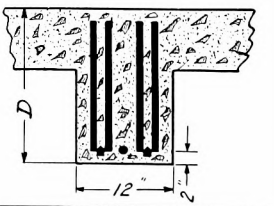
Span in Feet	Depth in Inches (D)									
	18	20	22	24	26	28	30	32	34	36
18	408									
19	386	435								
20	367	414	458							
21	350	394	436	481	524					
22	334	376	416	458	500	541	582			
23	319	360	399	439	478	518	558	599	638	
24		345	382	421	458	496	535	573	610	650
25		331	367	404	440	476	515	550	588	624
26			353	389	423	458	493	530	565	600
27			340	375	407	441	476	510	544	577
28			327	361	393	426	458	492	524	557
29				349	379	411	444	475	506	538
30				337	367	397	429	460	489	520
31					355	385	415	445	474	503
32					344	373	402	430	458	487
33					334	361	390	418	445	473
34						350	378	405	432	459
35						341	368	394	420	446
36							358	383	408	433
37							348	373	397	421
38							339	363	386	410
39								354	376	400
40								345	369	390

NOTE:—Make Beam of T Section.

D = Total depth of Beam in inches.

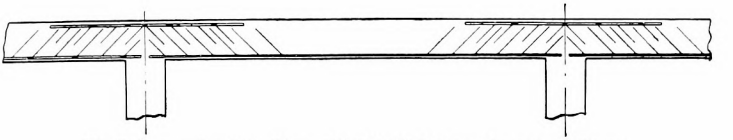
$B.\ M. = \frac{Wl}{8}$

NOTE:—For B. M. $= \frac{Wl}{K}$ above loads must be multiplied by $\frac{K}{8}$



See explanation of tables page 108.

Safe Total Loads in Hundreds of Pounds Uniformly Distributed for Concrete Beams



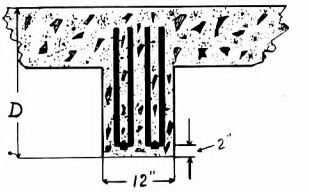
Reinforced with Two 2″x3 1/2″ Kahn Trussed Bars
Area = 6 sq. in.

Span in Feet	Depth in Inches (*D*)						
	24	26	28	30	32	34	36
25	484	528	572	616			
26	466	508	550	593	635		
27	448	489	530	571	612	652	
28	432	472	511	550	590	629	668
29	418	456	493	531	569	607	645
30	404	440	477	514	550	587	624
31		426	462	497	532	568	604
32		413	447	482	516	550	585
33		400	434	467	500	534	567
34			421	453	486	518	550
35			409	440	472	503	535
36				428	459	489	520
37				417	446	476	506
38				406	435	464	492
39					424	452	480
40					413	440	468

NOTE:—Make Beam of T Section.

D = Total depth of Beam in inches.

$$B.\ M. = \frac{Wl}{8}$$



NOTE:—For B. M. $= \frac{Wl}{K}$ above loads must be multiplied by $\frac{K}{8}$

See explanation of tables page 108.

Safe Loads in Thousands of Pounds for Square, Stayed Columns of Reinforced Concrete

No. of Verticals	4	4	6	4	6	4	6	4	6	6	8	10
Size of Rib Bars	5/8"	3/4"	5/8"	7/8"	3/4"	1"	7/8"	1 1/8"	1"	1 1/8"	1 1/8"	1 1/8"
Size of Square Columns in Inches												
12	83	88	89	93	96							
13	95	100	101	105	108	112						
14	109	114	115	119	122	126	130					
15	123	128	129	133	135	140	144	147				
16	139	144	145	149	152	156	160	163	170			
17	155	160	161	165	168	172	176	179	186			
18		178	179	183	186	190	194	197	204			
19		196	197	201	204	208	212	215	222	233		
20		216	217	221	224	228	232	235	242	253		
21		236	237	241	244	248	252	255	262	273	291	
22			259	263	266	270	274	277	284	295	313	
23				286	289	293	297	300	307	318	336	354
24				309	312	316	320	323	330	341	359	377
25					336	340	344	347	354	365	383	401
26					362	366	370	373	380	391	409	427
27						393	397	400	407	418	436	454
28						420	424	427	434	445	463	481
29							452	455	462	473	491	509
30							482	485	492	503	521	539
31								516	523	534	552	570
32									554	565	583	601
33									586	597	615	633
34									619	630	648	666
35										665	683	701
36										701	719	737

NOTE:—
Minimum Vertical Steel = 1/2%.
Middle Heavy Line indicates 1% Vertical Steel.
Maximum Vertical Steel = 2 1/4% (Steel Carrying 25% of Load.)

Above loads commuted by formulae:
Safe Load = 500 (Ac + 15 As.)
Ac = Area of Concrete. As=Area of Vertical Steel.
Stress on Concrete = 500 lbs. per sq. in. For other stresses on concrete, Safe Loads will be proportional.
Concrete mixture for columns; 1:1 1/2:3—Vertical Steel is stayed every 12 inches with No. 3 (3/8 in. diameter) wire, extending around column.
Least width of Column should not exceed 1-15 of its unsupported length.
Reduce Loads for eccentric loading, bending strains, etc.
See page 68 for Discussion of Unhooped Columns.

Safe Loads Carried by Hooped Columns

SAFE LOADS In Pounds	Outside Diameter	Core Diameter	Number of Verticals	Size of Verticals	Size of Hooping Wire Diameter	Pitch of Hooping Centers
125000	16″	12″	6	5/8″ Rib Bar	5/16″	3 1/2″
150000	18″	14″	6	5/8″ Rib Bar	5/16″	3 1/2″
175000	18″	14″	6	3/4″ Rib Bar	5/16″	3″
200000	20″	16″	6	5/8″ Rib Bar	5/16″	3″
225000	20″	16″	6	7/8″ Rib Bar	5/16″	3″
	20″	16″	6	3/4″ Rib Bar	5/16″	2 1/2″
250000	20″	16″	6	1″ Rib Bar	5/16″	2 1/2″
	20″	16″	6	7/8″ Rib Bar	3/8″	3″
275000	20″	16″	6	1″ Rib Bar	3/8″	2 1/2″
	22″	18″	6	7/8″ Rib Bar	5/16″	3″
300000	22″	18″	6	1 1/8″ Rib Bar	5/16″	3″
	22″	18″	6	1″ Rib Bar	3/8″	3″
325000	22″	18″	6	1 1/8″ Rib Bar	3/8″	3″
	22″	18″	6	1″ Rib Bar	3/8″	2 1/2″
350000	22″	18″	8	1″ Rib Bar	3/8″	2 1/2″
	24″	20″	8	1″ Rib Bar	5/16″	3″
375000	24″	20″	6	1 1/4″ Rib Bar	5/16″	3″
	24″	20″	8	1″ Rib Bar	3/8″	3″
	24″	20″	6	1″ Rib Bar	3/8″	2 1/2″
400000	24″	20″	6	1 1/4″ Rib Bar	3/8″	3″
	24″	20″	8	1″ Rib Bar	3/8″	2 1/2″
	24″	20″	6	1″ Rib Bar	3/8″	2″
425000	24″	20″	8	1 1/8″ Rib Bar	3/8″	2 1/2″
	24″	20″	8	1″ Rib Bar	3/8″	2″
450000	24″	20″	8	1 1/8″ Rib Bar	3/8″	2″
	26″	22″	8	1″ Rib Bar	3/8″	2 1/2″
475000	26″	22″	8	1 1/8″ Rib Bar	3/8″	2 1/2″
	26″	22″	8	1″ Rib Bar	3/8″	2″
500000	26″	22″	8	1 1/8″ Rib Bar	3/8″	2″
	28″	24″	8	1″ Rib Bar	3/8″	3″
525000	26″	22″	10	1 1/8″ Rib Bar	3/8″	2″
	28″	24″	8	1 1/8″ Rib Bar	3/8″	3″
550000	28″	24″	10	1 1/8″ Rib Bar	3/8″	3″
	28″	24″	8	1 1/8″ Rib Bar	3/8″	2 1/2″
575000	28″	24″	10	1 1/8″ Rib Bar	3/8″	2 1/2″
	28″	24″	8	1 1/8″ Rib Bar	3/8″	2″
600000	28″	24″	10	1 1/8″ Rib Bar	3/8″	2″
	28″	24″	8	1 1/8″ Rib Bar	3/8″	1 1/2″
625000	28″	24″	10	1 1/8″ Rib Bar	3/8″	1 1/2″
650000	30″	26″	10	1 1/8″ Rib Bar	3/8″	2″
675000	30″	26″	10	1 1/8″ Rib Bar	3/8″	2″
	30″	26″	8	1 1/8″ Rib Bar	3/8″	1 1/2″
700000	30″	26″	10	1 1/8″ Rib Bar	3/8″	1 1/2″
	32″	28″	10	1 1/8″ Rib Bar	3/8″	2 1/2″
750000	30″	26″	10	1 1/4″ Rib Bar	3/8″	1 1/2″
	32″	28″	10	1 1/4″ Rib Bar	3/8″	2 1/2″
	32″	28″	10	1 1/8″ Rib Bar	3/8″	2″
800000	32″	28″	10	1 1/4″ Rib Bar	3/8″	1 1/2″
	34″	30″	10	1 1/8″ Rib Bar	3/8″	2″
850000	34″	30″	10	1 1/4″ Rib Bar	3/8″	2″
	34″	30″	10	1 1/8″ Rib Bar	3/8″	1 1/2″

Concrete mixture for these columns should be 1:1 1/2:3.
Above table is for hooped columns loaded symmetrically; reduce loads for eccentric loading, bending strains, etc.
Least width of column should not exceed 1/15 of its unsupported length.
Due allowance must be made for eccentric loading, bending, etc.
See page 68 for Theory of Hooped Columns.

Table of Reinforced Concrete Footings

Soil Value per Sq. Foot	4000 LBS.				5000 LBS.				6000 LBS.			
Load in Lbs. on Footing	Size of Footing		Kahn Trussed Bars		Size of Footing		Kahn Trussed Bars		Size of Footing		Kahn Trussed Bars	
	Square	Depth	No.	Size	Square	Depth	No.	Size	Square	Depth	No.	Size
75000	4′–6″	0′–10″	14	½″x1½″	4′–0″	0′–10″	10	½″x1½″				
100000	5′–0″	1′– 0″	16	½″x1½″	4′–6″	0′–10″	16	½″x1½″	4′–0″	0′–10″	12	½″x1½″
125000	5′–6″	1′– 1″	12	¾″x2 3/16″	5′–0″	1′– 0″	18	½″x1½″	4′–6″	0′–10″	16	½″x1½″
150000	6′–3″	1′– 3″	12	¾″x2 3/16″	5′–6″	1′– 1″	12	¾″x2 3/16″	5′–0″	1′– 0″	10	¾″x2 3/16″
175000	6′–9″	1′– 4″	14	¾″x2 3/16″	6′–0″	1′– 2″	14	¾″x2 3/16″	5′–6″	1′– 1″	12	¾″x2 3/16″
200000	7′–0″	1′– 5″	14	¾″x2 3/16″	6′–3″	1′– 3″	14	¾″x2 3/16″	5′–9″	1′– 2″	12	¾″x2 3/16″
225000	7′–6″	1′– 6″	18	¾″x2 3/16″	6′–9″	1′– 4″	16	¾″x2 3/16″	6′–3″	1′– 3″	14	¾″x2 3/16″
250000	8′–0″	1′– 7″	22	¾″x2 3/16″	7′–0″	1′– 5″	16	¾″2x 3/16″	6′–6″	1′– 8″	16	¾″x2 3/16″
275000	8′–3″	1′– 8″	22	¾″x2 3/16″	7′–6″	1′– 6″	20	¾″x2 3/16″	6′–9″	1′– 8″	18	¾″x2 3/16″
300000	8′–9″	1′– 9″	26	¾″x2 3/16″	7′–9″	1′– 7″	20	¾″x2 3/16″	7′–0″	1′– 9″	18	¾″x2 3/16″
325000	9′–0″	1′– 9″	28	¾″x2 3/16″	8′–0″	1′– 7″	22	¾″x2 3/16″	7′–6″	1′–11″	24	¾″x2 3/16″
350000	9′–6″	1′–11″	18	1½″x2¼″	8′–6″	2′– 2″	24	¾″x2 3/16″	7′–9″	1′–11″	24	¾″x2 3/16″
375000	9′–9″	1′–11″	18	1½″x2¼″	8′–9″	2′– 2″	26	¾″x2 3/16″	8′–0″	2′– 0″	24	¾″x2 3/16″
400000	10′–0″	2′– 0″	18	1½″x2¼″	9′–0″	2′– 3″	28	¾″x2 3/16″	8′–3″	2′– 1″	26	¾″x2 3/16″
425000	10′–3″	2′– 7″	20	1½″x2¼″	9′–3″	2′– 4″	28	¾″x2 3/16″	8′–6″	2′– 2″	30	¾″x2 3/16″
450000	10′–9″	2′– 8″	22	1½″x2¼″	9′–6″	2′– 5″	16	1½″x2¼″	8′–9″	2′– 2″	32	¾″x2 3/16″
475000	11′–0″	2′– 9″	22	1½″x2¼″	9′–9″	2′– 5″	18	1½″x2¼″	9′–0″	2′– 3″	18	1½″x2¼″
500000	11′–3″	2′–10″	24	1½″x2¼″	10′–0″	2′– 6″	20	1½″x2¼″	9′–3″	2′– 4″	20	1½″x2¼″
525000	11′–6″	2′–11″	24	1½″x2¼″	10′–3″	2′– 7″	22	1½″x2¼″	9′–6″	2′– 5″	22	1½″x2¼″
550000	11′–9″	2′–11″	26	1½″x2¼″	10′–6″	2′– 7″	22	1½″x2¼″	9′–6″	2′– 5″	22	1½″x2¼″
575000	12′–0″	3′– 0″	26	1½″x2¼″	10′–9″	2′– 8″	24	1½″x2¼″	9′–9″	2′– 5″	24	1½″x2¼″
600000	12′–3″	3′– 1″	28	1½″x2¼″	11′–0″	2′– 9″	26	1½″x2¼″	10′–0″	2′– 6″	24	1½″x2¼″

Table of Reinforced Concrete Footings

Soil Value per Sq. Ft.	7000 LBS.				8000 LBS.				9000 LBS.				10,000 LBS.			
Load in Lbs. on Footing	Size of Footing		Kahn Trussed Bars		Size of Footing		Kahn Trussed Bars		Size of Footing		Kahn Trussed Bars		Size of Footing		Kahn Trussed Bars	
	Sq.	Depth	No.	Size	Sq.	Depth	No.	Size	Sq.	Depth	No.	Size	Sq.	Depth	No.	Size
100000	4′–0″	0′–10″	12	$\frac{1}{2}$″x1$\frac{1}{2}$″												
125000	4′–3″	0′–10″	14	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–0″	0′–10″	16	$\frac{1}{2}$″x1$\frac{1}{2}$″								
150000	4′–9″	0′–11″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–6″	0′–10″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–3″	0′–10″	16	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–0″	0′–10″	12	$\frac{1}{2}$″x1$\frac{1}{2}$″
175000	5′–0″	1′– 0″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–9″	0′–11″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–6″	0′–10″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–3″	0′–10″	14	$\frac{1}{2}$″x1$\frac{1}{2}$″
200000	5′–6″	1′– 4″	12	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–0″	1′– 0″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–9″	0′–11″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–6″	0′–10″	16	$\frac{1}{2}$″x1$\frac{1}{2}$″
225000	5′–9″	1′– 5″	14	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–6″	1′– 4″	14	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–0″	1′– 0″	20	$\frac{1}{2}$″x1$\frac{1}{2}$″	4′–9″	1′– 2″	18	$\frac{1}{2}$″x1$\frac{1}{2}$″
250000	6′–0″	1′– 6″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–9″	1′– 5″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–3″	1′– 4″	12	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–0″	1′– 3″	12	$\frac{3}{4}$″x2$\frac{3}{16}$″
275000	6′–3″	1′– 7″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–0″	1′– 6″	18	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–6″	1′– 4″	14	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–3″	1′– 4″	14	$\frac{3}{4}$″x2$\frac{3}{16}$″
300000	6′–6″	1′– 8″	18	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–3″	1′– 7″	18	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–9″	1′– 5″	14	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–6″	1′– 4″	14	$\frac{3}{4}$″x2$\frac{3}{16}$″
325000	6′–9″	1′– 8″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–6″	1′– 8″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–0″	1′– 6″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″	5′–9″	1′– 5″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″
350000	7′–0″	1′– 9″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–9″	1′– 8″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–3″	1′– 7″	18	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–0″	1′– 6″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″
375000	7′–3″	1′–10″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–0″	1′– 9″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–6″	1′– 8″	18	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–3″	1′– 7″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″
400000	7′–6″	1′–11″	22	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–0″	1′– 9″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–9″	1′– 8″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–3″	1′– 7″	16	$\frac{3}{4}$″x2$\frac{3}{16}$″
425000	7′–9″	1′–11″	22	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–3″	1′–10″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–0″	1′– 9″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–6″	1′– 8″	18	$\frac{3}{4}$″x2$\frac{3}{16}$″
450000	8′–0″	2′– 0″	24	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–6″	1′–11″	22	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–0″	1′– 9″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″	6′–9″	1′– 8″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″
475000	8′–3″	2′– 1″	26	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–9″	1′–11″	24	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–3″	1′–10″	22	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–0″	1′– 9″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″
500000	8′–6″	2′– 2″	30	$\frac{3}{4}$″x2$\frac{3}{16}$″	8′–0″	2′– 0″	26	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–6″	1′–11″	24	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–0″	1′– 9″	20	$\frac{3}{4}$″x2$\frac{3}{16}$″
525000	8′–9″	2′– 2″	32	$\frac{3}{4}$″x2$\frac{3}{16}$″	8′–3″	2′– 1″	28	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–9″	1′–11″	26	$\frac{3}{4}$″2x$\frac{3}{16}$″	7′–3″	1′–10″	22	$\frac{3}{4}$″x2$\frac{3}{16}$″
550000	9′–0″	2′– 3″	20	1$\frac{1}{2}$″x2$\frac{1}{4}$″	8′–3″	2′– 1″	28	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–9″	1′–11″	26	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–6″	1′–11″	24	$\frac{3}{4}$″x2$\frac{3}{16}$″
575000	9′–0″	2′– 3″	20	1$\frac{1}{2}$″x2$\frac{1}{4}$″	8′–6″	2′– 2″	30	$\frac{3}{4}$″x2$\frac{3}{16}$″	8′–0″	2′– 0″	28	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–6″	1′–11″	24	$\frac{3}{4}$″x2$\frac{3}{16}$″
600000	9′–3″	2′– 4″	22	1$\frac{1}{2}$″x2$\frac{1}{4}$″	8′–9″	2′– 2″	32	$\frac{3}{4}$″x2$\frac{3}{16}$″	8′–3″	2′– 1″	30	$\frac{3}{4}$″x2$\frac{3}{16}$″	7′–9″	1′–11″	26	$\frac{3}{4}$″x2$\frac{3}{16}$″

Quantities of Material for One Cubic Yard of Rammed Plain and Reinforced,"

PER CENT

Proportions by Parts			Proportions by Volume			Volume of Mortar in Terms of Percentage of Volume of Stone	50% Broken Stone Screened to Uniform Size		
Cement	Sand	Stone	Packed Cement	Loose Sand	Loose Stone		Cement	Sand	Stone
			Bbl.	Cu. Ft.	Cu. Ft.	Per Cent.	Bbl.	Cu. Yd.	Cu. Yd.
1	1	1.5	1	3.8	5.7	99	3.19	0.45	0.67
1	1	2	1	3.8	7.6	75	2.85	0.40	0.80
1	1	2.5	1	3.8	9.5	61	2.57	0.36	0.90
1	1	3	1	3.8	11.4	51	2.34	0.33	0.99
1	1.5	2	1	5.7	7.6	93	2.49	0.53	0.70
1	1.5	2.5	1	5.7	9.5	76	2.27	0.48	0.80
1	1.5	3	1	5.7	11.4	64	2.09	0.44	0.88
1	1.5	3.5	1	5.7	13.3	55	1.94	0.41	0.96
1	1.5	4	1	5.7	15.2	49	1.80	0.38	1.01
1	1.5	4.5	1	5.7	17.1	44	1.69	0.36	1.07
1	1.5	5	1	5.7	19.0	40	1.59	0.34	1.12
1	2	3	1	7.6	11.4	75	1.89	0.53	0.80
1	2	3.5	1	7.6	13.3	65	1.76	0.49	0.87
1	2	4	1	7.6	15.2	57	1.65	0.46	0.93
1	2	4.5	1	7.6	17.1	51	1.55	0.44	0.98
1	2	5	1	7.6	19.0	47	1.47	0.41	1.03
1	2	5.5	1	7.6	20.9	43	1.39	0.39	1.08
1	2	6	1	7.6	22.8	40	1.32	0.37	1.11
1	2.5	3	1	9.5	11.4	87	1.72	0.61	0.73
1	2.5	3.5	1	9.5	13.3	75	1.62	0.57	0.80
1	2.5	4	1	9.5	15.2	66	1.52	0.54	0.86
1	2.5	4.5	1	9.5	17.1	60	1.44	0.51	0.91
1	2.5	5	1	9.5	19.0	54	1.37	0.48	0.96
1	2.5	5.5	1	9.5	20.9	49	1.30	0.46	1.01
1	2.5	6	1	9.5	22.8	46	1.24	0.44	1.05
1	2.5	6.5	1	9.5	24.7	42	1.18	0.42	1.08
1	2.5	7	1	9.5	26.6	40	1.13	0.40	1.11
1	3	4	1	11.4	15.2	76	1.42	0.60	0.80
1	3	4.5	1	11.4	17.1	68	1.34	0.57	0.85
1	3	5	1	11.4	19.0	61	1.28	0.54	0.90
1	3	5.5	1	11.4	20.9	56	1.22	0.52	0.94
1	3	6	1	11.4	22.8	52	11.6	0.49	0.98
1	3	6.5	1	11.4	24.7	48	1.12	0.47	1.02

Concrete Based on a Bbl. of 3.8 Cu. Ft. from "Concrete, Taylor & Thompson.

AGE OF VOIDS IN BROKEN STONE OR GRAVEL

45% Average Conditions			40% Gravel			30% Scientifically G			20% raded Mixtures		
Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.
3.08	0.43	0.65	2.97	0.42	0.63	2.78	0.39	0.59	2.62	0.37	0.55
2.73	0.38	0.77	2.62	0.37	0.74	2.43	0.34	0.68	2.26	0.32	0.64
2.45	0.34	0.86	2.34	0.33	0.82	2.15	0.30	0.76	1.99	0.28	0.70
2.22	0.31	0.94	2.12	0.30	0.90	1.93	0.27	0.82	1.77	0.25	0.75
2.40	0.51	0.68	2.31	0.49	0.65	2.16	0.46	0.61	2.03	0.43	0.57
2.18	0.46	0.77	2.09	0.44	0.74	1.94	0.41	0.68	1.80	0.38	0.63
2.00	0.42	0.84	1.91	0.40	0.81	1.76	0.37	0.74	1.63	0.34	0.64
1.84	0.39	0.91	1.76	0.37	0.87	1.61	0.34	0.79	1.48	0.31	0.73
1.71	0.36	0.96	1.63	0.34	0.92	1.48	0.31	0.83	1.36	0.29	0.77
1.60	0.34	1.01	1.51	0.32	0.96	1.37	0.29	0.87	1.25	0.26	0.79
1.50	0.32	1.06	1.42	0.30	1.00	1.28	0.27	0.90	1.17	0.25	0.82
1.81	0.51	0.76	1.74	0.49	0.74	1.61	0.45	0.68	1.50	0.42	0.63
1.68	0.47	0.83	1.61	0.45	0.79	1.48	0.42	0.73	1.38	0.39	0.68
1.57	0.44	0.88	1.50	0.42	0.84	1.38	0.39	0.78	1.27	0.36	0.72
1.48	0.42	0.94	1.41	0.40	0.89	1.28	0.36	0.81	1.18	0.33	0.75
1.39	0.39	0.98	1.32	0.37	0.93	1.20	0.34	0.84	1.10	0.31	0.77
1.31	0.37	1.01	1.25	0.35	0.97	1.13	0.32	0.87	1.03	0.29	0.80
1.25	0.35	1.06	1.18	0.33	1.00	1.06	0.30	0.89	0.97	0.27	0.82
1.66	0.58	0.70	1.60	0.56	0.68	1.49	0.52	0.63	1.40	0.49	0.59
1.55	0.55	0.76	1.49	0.52	0.73	1.38	0.49	0.68	1.29	0.45	0.64
1.46	0.51	0.82	1.40	0.49	0.79	1.29	0.45	0.73	1.19	0.42	0.67
1.37	0.48	0.87	1.31	0.46	0.83	1.20	0.42	0.76	1.11	0.39	0.70
1.30	0.46	0.92	1.24	0.44	0.87	1.13	0.40	0.80	1.04	0.37	0.73
1.23	0.44	0.95	1.17	0.41	0.91	1.07	0.38	0.83	0.98	0.34	0.76
1.17	0.41	0.99	1.11	0.39	0.94	1.01	0.36	0.85	0.92	0.32	0.78
1.12	0.39	1.02	1.06	0.37	0.97	0.96	0.34	0.88	0.88	0.31	0.80
1.07	0.37	1.05	1.01	0.36	0.99	0.91	0.32	0.90	0.83	0.29	0.82
1.36	0.36	0.77	1.30	0.55	0.73	1.21	0.51	0.68	1.12	0.47	0.63
1.28	0.55	0.81	1.23	0.52	0.78	1.13	0.48	0.72	1.05	0.44	0.66
1.22	0.52	0.86	1.17	0.49	0.82	1.07	0.45	0.75	0.99	0.42	0.70
1.16	0.49	0.90	1.11	0.47	0.86	1.10	0.43	0.78	0.93	0.39	0.72
1.11	0.47	0.94	1.05	0.44	0.89	0.96	0.41	0.81	0.88	0.37	0.74
1.06	0.45	0.97	1.01	0.43	0.92	0.92	0.39	0.84	0.84	0.35	0.77

Materials for One Cubic Yard Compact Plastic Mortar Based on Barrel of 3.8 Cu. Ft.

From "Concrete, Plain and Reinforced"
By Taylor & Thompson

Relative Proportions by Parts		Relative Proportions by Volume		Packed Cement Barrel	Loose Sand Cubic Yard
Cement	Sand	Cement Barrel	Sand Cubic Yard		
1	0	1		8.31	
1	½	1	1.9	6.73	0.47
1	1	1	3.8	5.01	0.71
1	1½	1	5.7	4.00	0.84
1	2	1	7.6	3.32	0.93
1	2½	1	9.5	2.84	1.00
1	3	1	11.4	2.48	1.05
1	3½	1	13.3	2.20	1.08
1	4	1	15.2	1.98	1.11
1	4½	1	17.1	1.80	1.14
1	5	1	19.0	1.65	1.16
1	5½	1	20.9	1.52	1.18
1	6	1	22.8	1.41	1.19
1	6½	1	24.7	1.32	1.21
1	7	1	26.6	1.23	1.21
1	7½	1	28.5	1.16	1.22
1	8	1	30.4	1.10	1.24

NOTE:—Variation in the fineness of the cement and the sand, and in the consistency of the mortar, may affect the values by 10% in either direction.

Cement—as packed by manufacturer.

Sand—loose.

Estimating Table

Cubic Feet of Concrete Per Lineal Foot in Rectangular Beams and Columns

Size in Ins.	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
8	.22	.33	.44														
10	.28	.42	.56	.70													
12	.33	.50	.67	.83	1.00												
14	.39	.58	.78	.97	1.17	1.36											
16	.44	.67	.89	1.11	1.33	1.56	1.78										
18	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25									
20	.56	.83	1.11	1.39	1.67	1.95	2.22	2.50	2.78								
22	.61	.92	1.22	1.53	1.83	2.14	2.44	2.75	3.05	3.36							
24	.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00						
26	.72	1.08	1.44	1.81	2.17	2.53	2.89	3.25	3.61	3.97	4.33	4.70					
28	.78	1.17	1.56	1.94	2.33	2.72	3.11	3.50	3.89	4.28	4.67	5.06	5.45				
30	.83	1.25	1.67	2.08	2.50	2.92	3.33	3.75	4.17	4.58	5.00	5.42	5.83	6.25			
32	.89	1.33	1.78	2.22	2.67	3.11	3.56	4.00	4.45	4.89	5.33	5.78	6.22	6.67	7.11		
34	.94	1.42	1.89	2.36	2.83	3.30	3.78	4.25	4.73	5.20	5.67	6.14	6.61	7.08	7.56		
36	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00
38	1.06	1.58	2.11	2.64	3.17	3.70	4.22	4.75	5.28	5.81	6.33	6.86	7.39	7.91	8.44	8.97	9.50
40	1.11	1.67	2.22	2.78	3.33	3.89	4.44	5.00	5.56	6.12	6.67	7.22	7.78	8.34	8.89	9.44	10.00
42	1.17	1.75	2.33	2.92	3.50	4.09	4.67	5.25	5.83	6.42	7.00	7.59	8.17	8.75	9.33	9.91	10.50
44	1.22	1.83	2.44	3.06	3.67	4.28	4.89	5.50	6.11	6.72	7.33	7.95	8.56	9.17	9.98	10.39	11.00
46	1.28	1.92	2.56	3.20	3.83	4.47	5.11	5.75	6.39	7.03	7.67	8.31	8.95	9.58	10.22	10.85	11.50
48	1.33	2.00	2.67	3.33	4.00	4.67	5.33	6.00	6.67	7.33	8.00	8.67	9.33	10.00	10.67	11.33	12.00
50	1.39	2.08	2.78	3.47	4.17	4.86	5.56	6.25	6.94	7.64	8.33	9.03	9.72	10.42	11.11	11.80	12.50
52	1.44	2.17	2.89	3.61	4.33	5.06	5.78	6.50	7.22	7.95	8.67	9.39	10.11	10.83	11.56	12.28	13.00
54	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.25	12.00	12.75	13.50
56	1.56	2.33	3.11	3.89	4.67	5.44	6.22	7.00	7.78	8.56	9.33	10.11	10.89	11.67	12.44	13.22	14.00
58	1.61	2.42	3.22	4.02	4.83	5.64	6.44	7.25	8.05	8.86	9.67	10.47	11.28	13.08	12.89	13.69	14.50
60	1.67	2.50	3.33	4.17	5.00	5.83	6.67	7.50	8.33	9.17	10.00	10.83	11.67	12.50	13.33	14.17	15.00
Round Columns			.35	.55	.79	1.07	1.40	1.77	2.18	2.64	3.14	3.69	4.28	4.91	5.59	6.31	7.07

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Rigidly Connected Diagonal Shear Reinforcement

(Kahn Trussed Bars)

versus

Loose Vertical Stirrups

Report of

Tests on Reinforced Concrete Beams

made at the University of Wisconsin
Madison, Wisconsin

Trussed Concrete Steel Company
Detroit, Michigan

OFFICES IN PRINCIPAL CITIES

OBJECT OF TESTS

This series of tests was made in the laboratory for testing materials of the University of Wisconsin in the Spring of 1907, by Messrs. G. T. Newton and W. L. Rowe.

The object of the tests was to determine the relative efficiency of reinforcing bars with inclined rigidly connected shear members—Kahn Trussed Bars—and bars with loose stirrups.

The quality of reinforcing steel used in all tests is medium open hearth steel. The average tensile tests of these bars show an elastic limit of 39,650 lbs. and an ultimate strength of 67,400 lbs. per sq. in. *The comparative beams were made exactly equal in every respect,* in the size of the beams, quality of steel, area of the main reinforcement, amount of shear reinforcement and method of loading and testing.

In part of the beams, the shear reinforcement is bent up at an angle of 45 degrees and part at an angle of 90 degrees with the axis of the main bar.

The design of the beams, method of loading, reinforcement, and remarkable results of these tests are shown clearly in figures and tables which follow. Tests were made under the supervision of Martin O. Withey, C. E., Instructor of Mechanics, University of Wisconsin. Complete detailed report of these tests is published in Bulletin 197 of the University of Wisconsin, Engineering series, Volume 4, No. 2.

Similar tests are being made in various other university laboratories. Preliminary reports received from them confirm the Wisconsin tests and in some cases indicate even more remarkable results.

EXTRACT FROM REPORT OF

MARTIN O. WITHEY, C. E.

INSTRUCTOR IN MECHANICS, UNIVERSITY OF WISCONSIN

Bulletin No. 197 of the University of Wisconsin

"In the beams with loosely attached web members and straight horizontal reinforcement, no rods bent up, the final *failure occurred through slipping of rods* either *before* or just after *the yield point of the metal was passed*, when the load fell off rapidly. This did not occur in tests of the beams with rigidly attached web members. *Beams* N 1, N 3, N 6, N 7, N 10 and N 12, (all reinforced *with loose stirrups*) *failed through slipping of rods in the manner mentioned.* Beams N 2, N 4, N 5, N 8, N 9 and N 11 (*Kahn Bar Beams*) *failed in tension at the center.* In these latter beams, *the steel was stressed considerably beyond the yield point and failure was very slow*, as shown by the deflection curves.

In beams N 5 and N 9 the *prongs of the Kahn bar were bent up at an angle of 45 degrees*, while in *beams* N 8 *and* N 11 *they were bent up vertical. The former show considerably greater strength than the latter beams.* Beams reinforced with inclined loose stirrups show a small increase in strength over those in which the stirrups were set vertically."

RESULTS OF TESTS

(Compiled from Bulletin No. 197 of the University of Wisconsin)

Tensile Tests of Bars (average)..... { Elastic Limit=39,650 lbs. per sq. in. / Ultimate Strength=67,400 lbs. per sq. in.

Area of main reinforcement, quality of steel and amount of shear reinforcement is equal in all comparative beams.

KAHN TRUSSED BARS **Rigidly** Connected Shear Members				EQUAL SIZED BARS **Loose** Stirrups as Shear Members			
Beam	REINFORCEMENT	Stress in Steel Lbs. per sq. in.	Maximum Load Lbs.	Stress in Steel Lbs. per sq. in.	Maximum Load Lbs.	REINFORCEMENT	Beam
N 2	1—1-in. Kahn Trussed Bar **Rigidly connected inclined shear members**	57,400	34,600	39,400	24,000	1—1-in. Square Bar 10—⅞-in. x ¼-in. Stirrups	N 1
N 4	1—1-in. Kahn Trussed Bar **Rigidly connected inclined shear members**	49,600	37,400	34,300	26,000	1—1-in. Square Bar 12—⅜-in. Stirrups	N 3
N 5	2—¾-in. Kahn Trussed Bars **Rigidly connected inclined shear members**	62,100	32,600	45,500	24,000	2—¾-in. Square Bars 14—¼-in. W. Stirrups	N 6
N 9	2—¾-in. Kahn Trussed Bars **Rigidly connected inclined shear members**	60,200	47,200	36,700	34,000	2—¾-in. Square Bars 12—¼-in. W. Stirrups	N 10
N 8	2—¾-in. Kahn Trussed Bars **Rigidly connected *vertical* shear members**	43,700	28,000	38,800	22,000	2—¾-in. Square Bars 20—¼-in. W. Stirrups	N 7
N 11	2—¾-in. Kahn Trussed Bars **Rigidly connected *vertical* shear members**	48,300	39,000	45,000	34,000	2—¾-in. Square Bars 16—¼-in. W. Stirrups	N 12

Average of Kahn Trussed Bars (All Beams)	53,550	36,467	39,950	27,333	Average of Loose Stirrup Bars (All Beams)
Average of Kahn Trussed Bars with ***inclined*** shear members	57,325	37,950	38,975	27,000	Average of Comparative Loose Stirrup Bars

Kahn Trussed Bars (All Beams) carry	**33½%**	more load than Bars with Loose Stirrups (all beams).
Kahn Trussed Bars with *inclined* shear members carry	**40½%**	more load than Comparative Bars with Loose Stirrups.
Stress developed in Kahn Trussed Bar (All Beams) is	**80%**	of Ultimate Strength of Steel.
Stress developed in Kahn Trussed Bar (inclined shearing) is	**85%**	of Ultimate Strength of Steel.
Stress developed in Bars with Loose Stirrups is ONLY	**59%**	of Ultimate Strength of Steel.
***Inclined* shear members (Beams N 5 and N 9) carry**	**19%**	more load than *vertical* shear members (Beams N 8 and N 11).

NOTE.—Inclined shear members is standard practise of Kahn System; Loose Stirrups are almost invariably placed vertical.

CHARACTER OF FAILURES

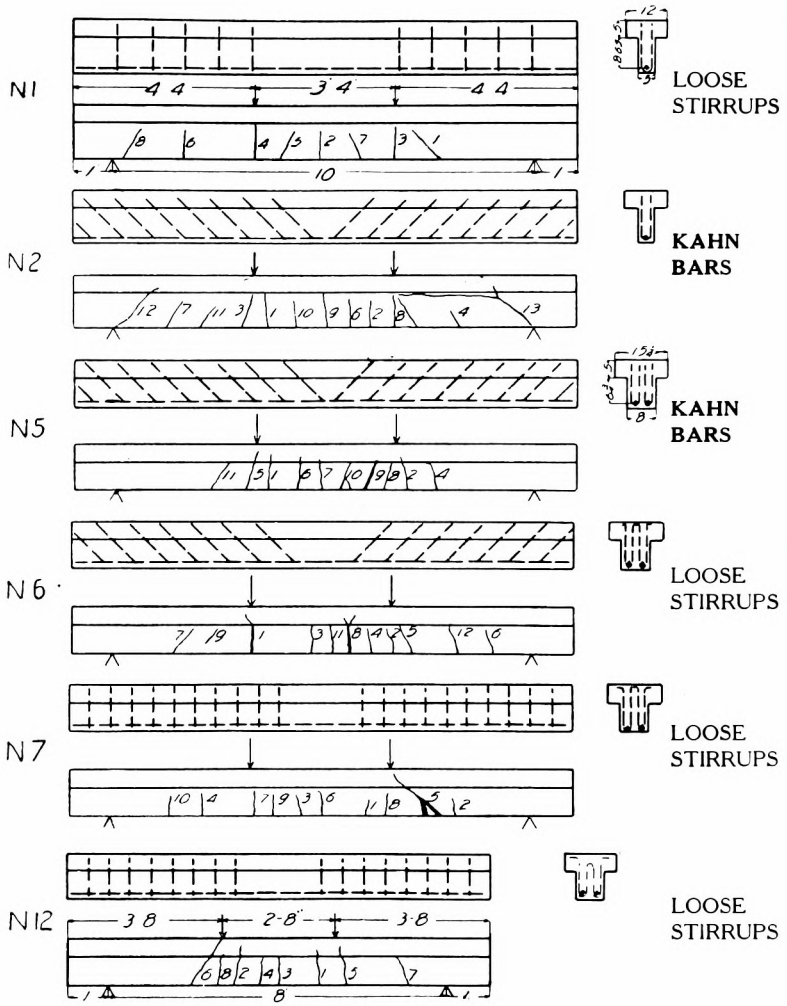
Kahn Trussed Bar Beams failed in tension at the center, showing that full strength of steel is developed.

Loose Stirrup Beams failed suddenly without warning, by slipping of rods and shear of the concrete at the supports.

With Kahn Trussed Bars, any size bar can be used and its full strength developed. With loose stirrups, the area of the metal must be divided into a number of small bars in order to develop the steel. This means greatly increased field labor in handling many loose bars.

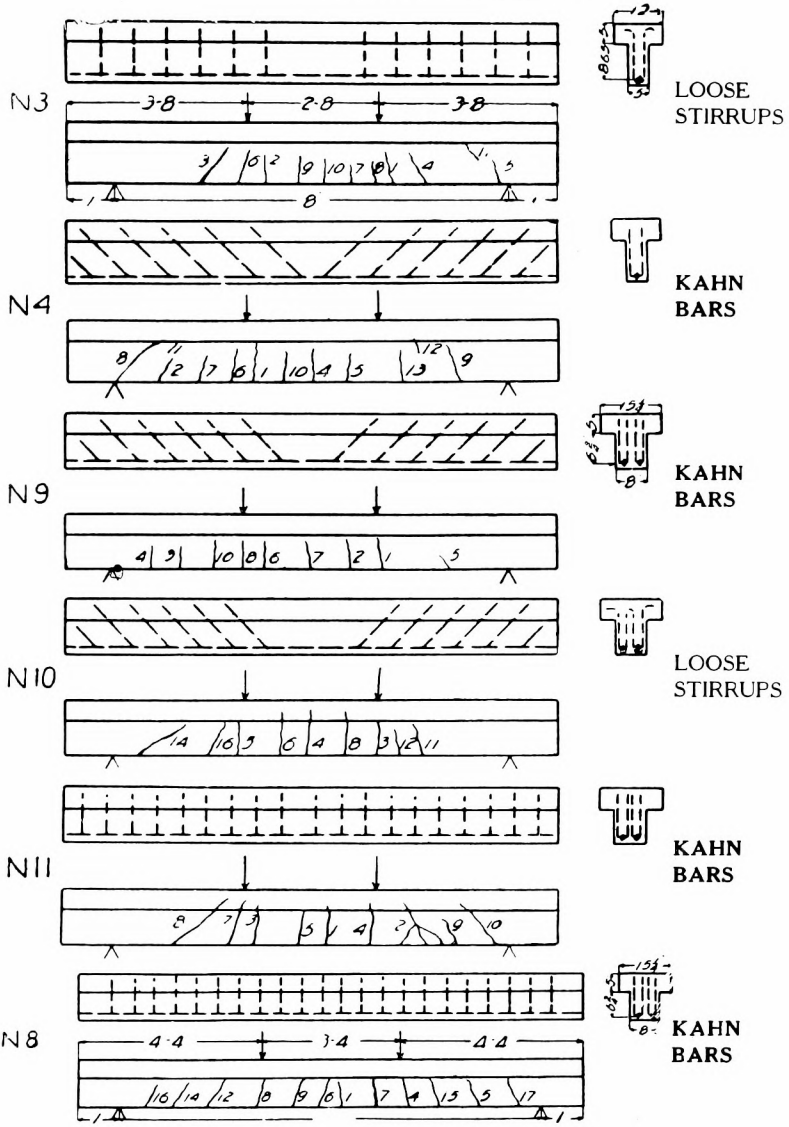
KAHN SYSTEM OF REINFORCED CONCRETE

TRUSSED CONCRETE STEEL CO.



Design of Beams, Method of Loading, and Cracks.

(From Bulletin No. 197 of the University of Wisconsin.)



Design of Beams, Method of Loading, and Cracks.

(From Bulletin No. 197 of the University of Wisconsin.)

OTHER ADVANTAGES
OF THE
KAHN TRUSSED BAR

These tests prove conclusively the necessity of *Kahn Trussed Bars with rigidly connected diagonal shear members* in any structure in which strength, stability, and general safety are a consideration.

The *rigid connection of shear members* is also necessary for fireproofness. The effect of fire on concrete is to attack the exposed portion and to weaken the bond between the concrete and the steel. This means that where loose stirrups are used, the strength of the concrete beam is destroyed. With Kahn Trussed Bars, this bond is not necessary for strength, as the shearing strains in the concrete are transferred directly to the main tension bar by the *rigid connection of the shear members.* (See Dayton Motor Car Co. Fire Bulletin.)

Tests have shown that the bond between the concrete and steel is weakened by repeated loading and unloading of a beam. This means that in any structure subject to vibration or shock, such as bridges, factories, etc., *rigidly connected shear reinforcement* should be used. The explosion in the Prest-O-Lite factory at Indianapolis furnishes an excellent example of this kind. (See Prest-O-Lite Bulletin.)

The labor expense in the field of attaching loose stirrups to main bars very greatly increases their expense. *The Kahn Trussed Bar* is a complete unit in itself, is handled in one piece, and embodies the main bar and *rigidly connected shear members,* in one bar.

Reinforced Concrete Bridges and Culverts

Expansion Joint Protector for Concrete Roads

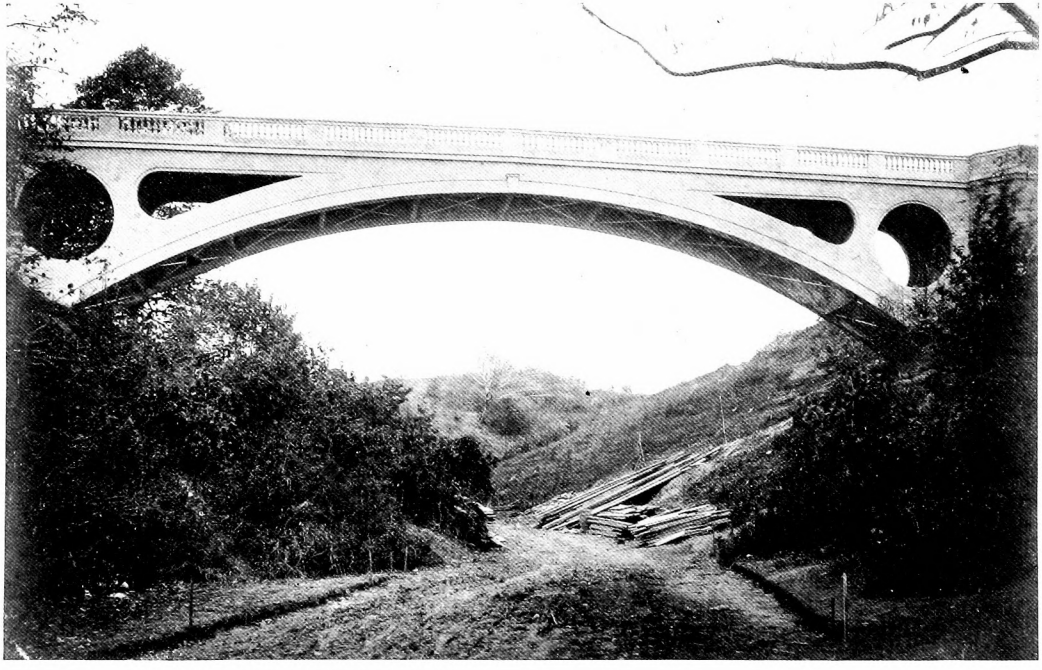
Steel Edge Protector for Concrete Curbs

Concrete Sewers, Retaining Walls and Docks

Illustrations, Theory and Designing Data

Copyright 1913
By Trussed Concrete Steel Co.
Detroit, Mich.

TRUSSED CONCRETE STEEL COMPANY
DETROIT, MICHIGAN



LAKE PARK BRIDGE, MILWAUKEE, WIS. NEWTON ENGINEERING CO., Contractors.
Span 118 feet, two arch ribs, forming spandrels, support roadway.

Concrete on the Highways

Reinforced concrete bridges are absolutely permanent, growing stronger with age, and eliminating the expense of painting and repairs. The same roadway continues over the bridge without break or change. Such bridges are free from vibration and noiseless. Their exceptional strength and rigidity practically eliminate wash-outs. The principal materials and the labor employed in the construction are secured locally, so that the tax-payers' money stays in his own community.

These exclusive features of reinforced concrete bridges, insure maximum economy and account for their great popularity. All types of designs in spans from culverts to 150 ft. arches are found in increasing numbers everywhere.

The severe conditions of bridge loading necessitate particular attention to the reinforcement of the concrete. The heavy moving loads cause great strain on the shear members, which must transfer this strain to the main tension member by a positive rigid connection, independent of the adhesion of the concrete. The rigid connection of the shear members in the Kahn Bar takes care of this strain, and insures accurate placing of all reinforcement.

This publication illustrates a few Kahn System bridges of various types and gives typical designs for all ordinary spans. We will furnish the complete, detailed design of the reinforced concrete for any bridge in which the Kahn System of Reinforcement is used.

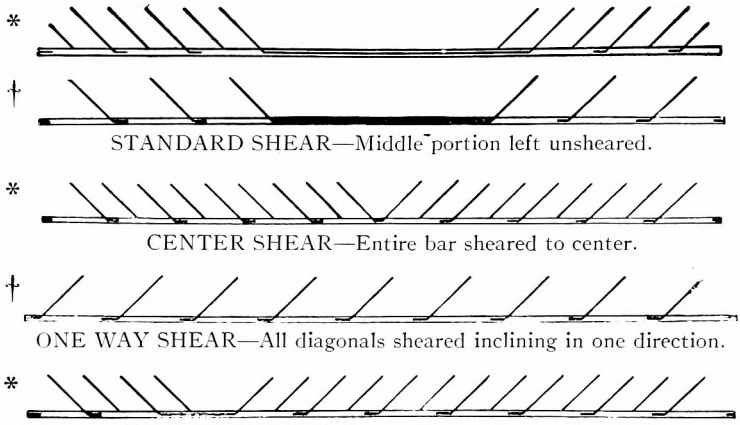
Sewers, retaining walls, docks, dams, etc., are also indicated in this book. Structures of this kind demand individual treatment, which our Engineers are in a position to furnish at all times.

Concrete roads are steadily becoming more popular, because of their low cost of construction and of up-keep. Experience has demonstrated the necessity for expansion joints properly protected with metal plates, such as the Trus-Con Armor Plate indicated on pages 40 to 43.

Concrete Curbs are low in cost, and have proven particularly efficient when the corners are protected with metal plates, such as the Trus-Con Curb Bars, on pages 44 to 47.

Kahn Building Products include everything for the reinforcement of concrete, also HY-RIB and METAL LATH for plaster and stucco, United Sash for windows, Waterproofings, Finishes, and other Building Specialties.

Shearing of Kahn Trussed Bars



* STANDARD SHEAR—Middle portion left unsheared.

CENTER SHEAR—Entire bar sheared to center.

† ONE WAY SHEAR—All diagonals sheared inclining in one direction.

* SPECIAL SHEARING—As directed by purchaser.

Sketches marked (*) show shearing with diagonals alternating, as provided on 8, 12, 18, 24, 30, 36 and 48 inch diagonals.

Sketches marked (†) show shearing with diagonals opposite, as provided on 6 inch diagonals only.

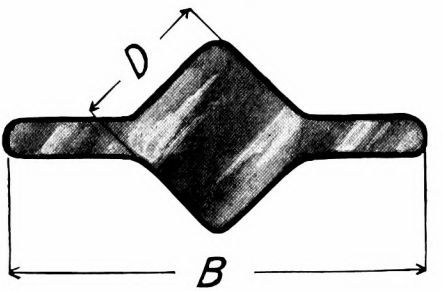
Length of Diagonals

Kahn Trussed Bars

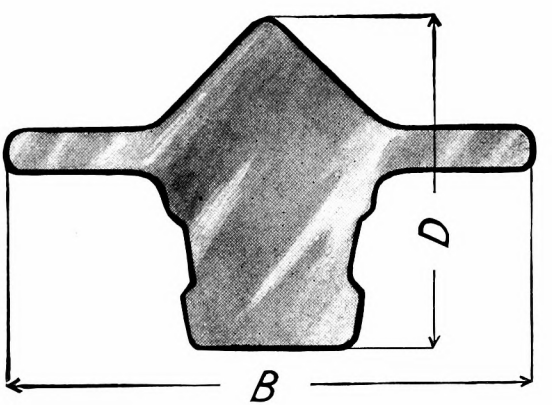
Size	Standard Lengths	Special Lengths
$\frac{1}{2}''$x$1\frac{1}{2}''$	6″	8″, 12″
$\frac{3}{4}''$x$2\frac{3}{16}''$	12″	8″, 18″, 24″, 30″
$1\frac{1}{2}''$x$2\frac{1}{4}''$	24″, 30″	12″, 18″, 36″
$1\frac{3}{4}''$x$2\frac{3}{4}''$	30″	18″, 24″, 36″
2 ″x$3\frac{1}{2}''$	30″	24″, 36″, 48″

Kahn Trussed Bars are manufactured from the highest grade of open-hearth steel and are shipped cut to exact length ordered. Bars up to 60 feet in length are carried in stock at Youngstown, Ohio. Any desired length of diagonal or type of shearing can be furnished.

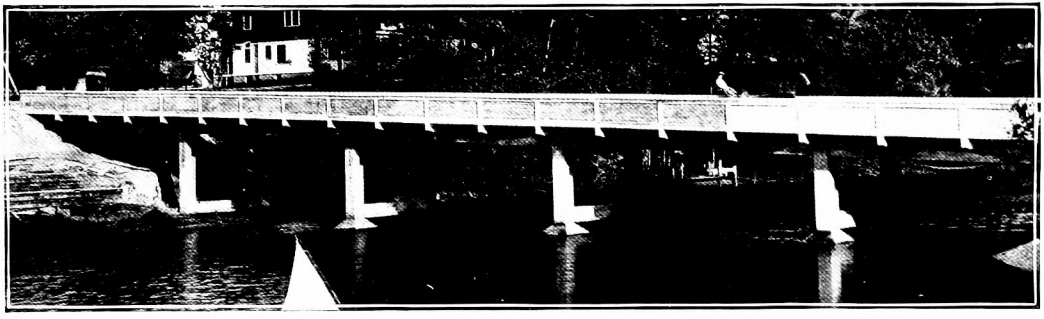
Sections of Kahn Trussed Bars



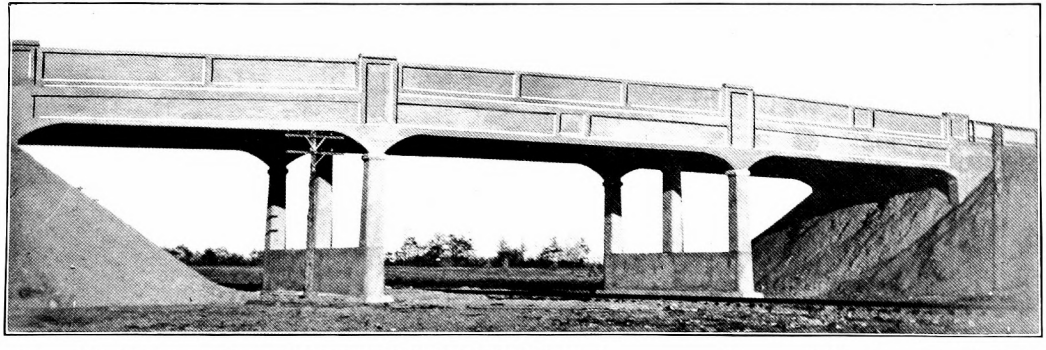
D x B	Weight per Lineal Foot	Area
$\frac{1}{2}$"x1$\frac{1}{2}$"	1.4 lbs.	0.41 sq. in.
$\frac{3}{4}$"x2$\frac{3}{16}$"	2.7 lbs.	0.79 sq. in.



D x B	Weight per Lineal Foot	Area
1$\frac{1}{2}$"x2$\frac{1}{4}$"	4.8 lbs.	1.41 sq. in.
1$\frac{3}{4}$"x2$\frac{3}{4}$"	6.8 lbs.	2.00 sq. in.
2 "x3$\frac{1}{2}$"	10.2 lbs.	2.00 sq. in.



LAYTON F. SMITH, Engineer. CHOPTANK BRIDGE, GREENSBORO, MD. BERGHAUS & MOFFITT, Contractors.



Designed by ROELKER & LEE. BROAD STREET BRIDGE, RICHMOND, VA. E. M. HASTINGS, Engineer.
Total length 148 feet, 0 inches—Center Span 58 feet, 4 inches—End Spans 44 feet, 10 inches.
Designed for heavy suburban electric cars. Built KAHN SYSTEM Reinforced Concrete.

Reinforced Concrete Bridges

Reinforced concrete bridges are built of various types depending on the length of span, the amount of loading, and the requirements of the particular locations.

Flat slabs or plates spanning directly between the abutments without any supporting beams are used over small openings.

On longer spans the girder bridge with comparatively thin concrete floor slab is used. The cantilever bridge is a variation of the girder design in which the loads are carried principally by cantilever action over the support.

The arch bridge is employed in long spans and is built in the form of a continuous section arch ring or merely a rib. Bridges of all these types have been built extensively for highway, electric car and railway traffic.

Highway Box Culverts and Girder Bridges

Flat slabs or culverts resting directly on the abutments are employed in spans of from 4 to 16 feet. The construction is simple and can be readily installed. Either of the two smaller sizes of Kahn Trussed Bars are used for reinforcement, and these bars are given a bearing of from 6 to 12 inches in the abutments. To take care of temperature and shrinkage stresses, small Rib Bars are placed over and at right angles to the Kahn Bars. On page 9 is given the tabulated design for various spans, computed for heavy highway loadings.

Girder bridges are most often used in spans of from 12 to 50 feet, although spans as great as 70 feet have been built in this way. The design usually consists of a reinforced slab supported by girders projecting underneath. Many bridges have been built, however, in which the girders are extended above the floor to form a hand rail on either side of the roadway. The floor slab would then span the width of the roadway between these girder rails.

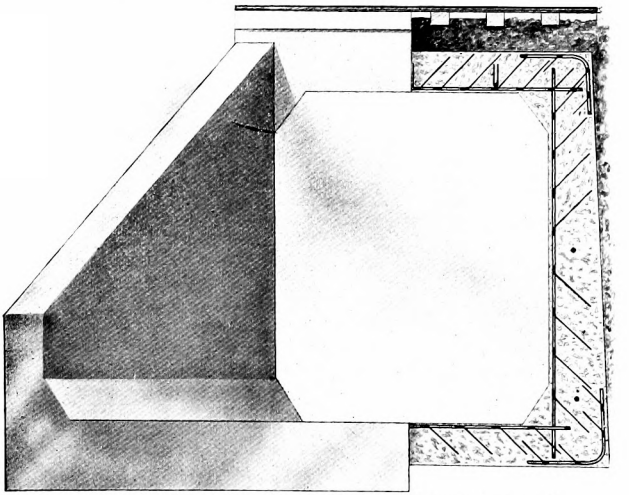
The cantilever bridge is built for longer spans than the girder bridge. The secret of its great carrying capacity lies in its great depth at the abutment. At the center of the span, the girder is shallow giving ample headroom where required. The cantilever design should not be con-

fused with an arch as there is no thrust and the reactions are all vertical.

The hand rail or balustrade for the concrete bridge can be built of reinforced concrete, ornamental iron, or plain gas pipe, as desired.

The experienced builder knows that there is no class of structure subjected to such severe conditions of loadings and rough usage as a bridge. Therefore, only the best concrete should be used and this concrete must be reinforced for the severe stresses coming upon it. The shearing stresses are very great, due to heavy moving loads and shear reinforcement must be provided. This shear reinforcement should be rigidly attached to the main tension member. The adhesion of the concrete cannot be depended upon. The bond between the concrete and steel is completely destroyed by the repeated loading and unloading of the stress in the steel.* That the Kahn Trussed Bars are especially suited for such work is evident.

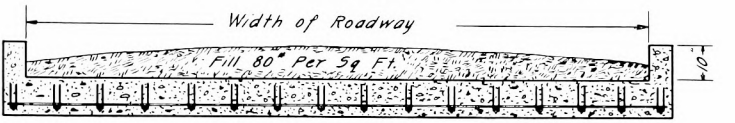
Designs of girder bridges, spans 12 to 40 feet for 16 and 18 ft. roadways, are given on pages 10 and 11.



Showing Application of Kahn Trussed Bar to Culvert Construction.

*See "The Fatigue of Concrete," by I. D. Van Ornum, M. A. S. C. E., Proceedings A. S. C. E. Dec. 1906.

Slab Highway Bridges or Culverts

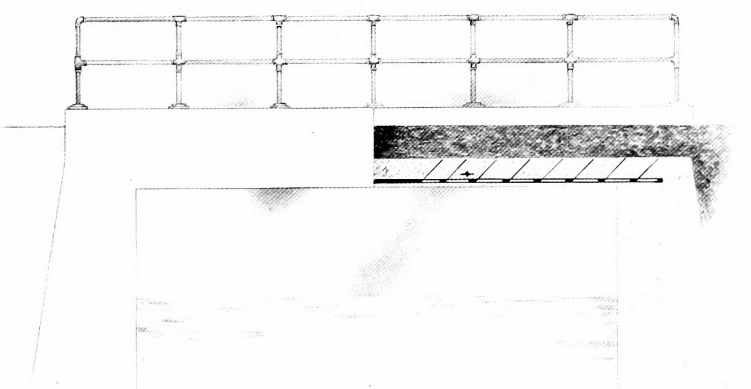


Cross Section

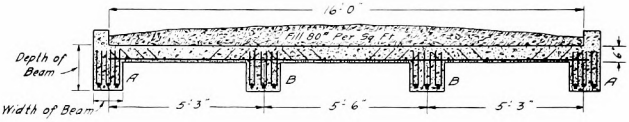
Designed to Carry Concentrated Load of 15-Ton Roller or Uniform Load of 100 Pounds Per Sq. Ft.

Span in Feet	Thickness of Slab	KAHN TRUSSED BARS		RIB BARS	
		Size	Spacing	Size	Spacing
4	6″	$\frac{1}{2}$″x1$\frac{1}{2}$″	12″	$\frac{3}{8}$″	24″
6	6″	$\frac{1}{2}$″x1$\frac{1}{2}$″	8″	$\frac{3}{8}$″	24″
8	7″	$\frac{3}{4}$″x2$\frac{3}{16}$″	12″	$\frac{3}{8}$″	24″
10	8″	$\frac{3}{4}$″x2$\frac{3}{16}$″	11″	$\frac{3}{8}$″	24″
12	9″	$\frac{3}{4}$″x2$\frac{3}{16}$″	10″	$\frac{3}{8}$″	24″
14	10″	$\frac{3}{4}$″x2$\frac{3}{16}$″	9″	$\frac{3}{8}$″	24″

Rib Bars are placed over and at right angles to Kahn Trussed Bars



Girder Highway Bridges



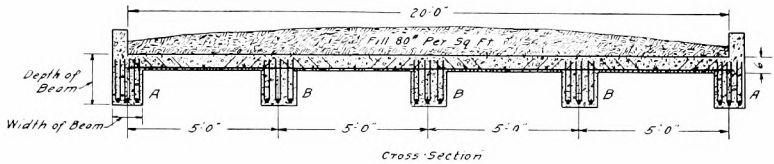
Designed to Carry Concentrated Load of 15-Ton Roller or Uniform Load of 100 Pounds Per Sq. Ft.

Span in Ft.	BEAM A					BEAM B				
		KAHN TRUSSED BARS					KAHN TRUSSED BARS			
	Size	Standard Sheared		Center Sheared		Size	Standard Sheared		Center Sheared	
		No.	Size	No.	Size		No.	Size	No.	Size
12	10″x16″	2	¾″x2 3/16″	1	¾″x2 3/16″	12″x16″	2	1½″x2¼″	1	¾″x2 3/16″
14	10″x16″	2	¾″x2 3/16″	*1	1½″x2¼″	12″x16″	2	1½″x2¼″	1	1½″x2¼″
16	10″x18″	2	1½″x2¼″	1	¾″x2 3/16″	12″x18″	2	1½″x2¼″	*1	1¾″x2¾″
18	12″x18″	2	1½″x2¼″	1	¾″x2 3/16″	14″x18″	2	1¾″x2¾″	1	1½″x2¼″
20	12″x20″	2	1½″x2¼″	1	1½″x2¼″	14″x20″	2	1¾″x2¾″	1	1¾″x2¾″
22	12″x22″	2	1½″x2¼″	1	1½″x2¼″	14″x22″	2	1¾″x2¾″	1	1¾″x2¾″
24	12″x22″	2	1¾″x2¾″	1	¾″x2 3/16″	14″x22″	2	2 ″x3½″	1	1½″x2¼″
26	12″x24″	2	1¾″x2¾″	1	1½″x2¼″	14″x24″	2	2 ″x3½″	1	1½″x2¼″
28	12″x26″	2	1¾″x2¾″	1	1½″x2¼″	14″x26″	2	2 ″x3½″	1	2 ″x3½″
30	12″x28″	2	1¾″x2¾″	1	1¾″x2¾″	16″x28″	2	2 ″x3½″	1	2 ″x3½″
32	12″x30″	2	2 ″x3½″	1	¾″x2 3/16″	16″x30″	2	2 ″x3¾″	1	2 ″x3½″
34	14″x30″	2	2 ″x3½″	1	1½″x2¼″	16″x30″	3	2 ″x3½″	2	¾″x2 3/16″
36	14″x32″	2	2 ″x3½″	1	1½″x2¼″	16″x32″	3	2 ″x3½″	3	¾″x2 3/16″
38	14″x34″	2	2 ″x3½″	1	1½″x2¼″	18″x34″	3	2 ″x3½″	2	1½″x2¼″
40	14″x36″	2	2 ″x3½″	1	1¾″x2¾″	18″x36″	3	2 ″x3½″	2	1½″x2¼″

*Bars full length.

FLOOR SLAB—6″ thick reinforced with ½″x1½″ Kahn Trussed Bars, spaced 12″ c. to c. and ⅜″ Rib Bars spaced 16″ c. to c.

Girder Highway Bridges



Designed to Carry Concentrated Load of 15-Ton Roller or Uniform Load of 100 Pounds Per Sq. Ft.

Span in Ft.	BEAM A					BEAM B				
	Size	KAHN TRUSSED BARS				Size	KAHN TRUSSED BARS			
		STANDARD SHEARED		CENTER SHEARED			STANDARD SHEARED		CENTER SHEARED	
		No.	Size	No.	Size		No.	Size	No.	Size
12	10″x16″	2	$\frac{3}{4}$″x2$\frac{3}{16}$″	1	$\frac{3}{4}$″x2$\frac{3}{16}$″	12″x16″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″	1	$\frac{3}{4}$″x2$\frac{3}{16}$″
14	10″x16″	2	$\frac{3}{4}$″x2$\frac{3}{16}$″	*1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	12″x16″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″
16	10″x18″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″	1	$\frac{3}{4}$″x2$\frac{3}{16}$″	12″x18″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″	*1	1$\frac{3}{4}$″x2$\frac{3}{4}$″
18	12″x18″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″	1	$\frac{3}{4}$″x2$\frac{3}{16}$″	14″x18″	2	1$\frac{3}{4}$″x2$\frac{3}{4}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″
20	12″x20″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	14″x20″	2	1$\frac{3}{4}$″x2$\frac{3}{4}$″	1	1$\frac{3}{4}$″x2$\frac{3}{4}$″
22	12″x22″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	14″x22″	2	1$\frac{3}{4}$″x2$\frac{3}{4}$″	1	1$\frac{3}{4}$″x2$\frac{3}{4}$″
24	12″x22″	2	1$\frac{3}{4}$″x2$\frac{3}{4}$″	1	$\frac{3}{4}$″x2$\frac{3}{16}$″	14″x22″	2	2 ″x3$\frac{1}{2}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″
26	12″x24″	2	1$\frac{3}{4}$″x2$\frac{3}{4}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	14″x24″	2	2 ″x3$\frac{1}{2}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″
28	12″x26″	2	1$\frac{3}{4}$″x2$\frac{3}{4}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	14″x26″	2	2 ″x3$\frac{1}{2}$″	1	2 ″x3$\frac{1}{2}$″
30	12″x28″	2	1$\frac{3}{4}$″x2$\frac{3}{4}$″	1	1$\frac{3}{4}$″x2$\frac{3}{4}$″	16″x28″	2	2 ″x3$\frac{1}{2}$″	1	2 ″x3$\frac{1}{2}$″
32	12″x30″	2	2 ″x3$\frac{1}{2}$″	1	$\frac{3}{4}$″x2$\frac{3}{16}$″	16″x30″	2	2 ″x3$\frac{1}{2}$″	1	2 ″x3$\frac{1}{2}$″
34	14″x30″	2	2 ″x3$\frac{1}{2}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	16″x30″	3	2 ″x3$\frac{1}{2}$″	2	$\frac{3}{4}$″x2$\frac{3}{16}$″
36	14″x32″	2	2 ″x3$\frac{1}{2}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	16″x32″	3	2 ″x3$\frac{1}{2}$″	3	$\frac{3}{4}$″x2$\frac{3}{16}$″
38	14″x34″	2	2 ″x3$\frac{1}{2}$″	1	1$\frac{1}{2}$″x2$\frac{1}{4}$″	18″x34″	3	2 ″x3$\frac{1}{2}$″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″
40	14″x36″	2	2 ″x3$\frac{1}{2}$″	1	1$\frac{3}{4}$″x2$\frac{3}{4}$″	18″x36″	3	2 ″x3$\frac{1}{2}$″	2	1$\frac{1}{2}$″x2$\frac{1}{4}$″

*Bars full length.

FLOOR SLAB—6″ thick, reinforced with $\frac{1}{2}$″x1$\frac{1}{2}$″ Kahn Trussed Bars, spaced 12″ c. to c. and $\frac{3}{8}$″ Rib Bars spaced 16″ c. to c.

Covers for Railway Box Culverts

Cooper's E 50 Loading

Span in Feet	Depth of Fill in Feet	Thickness of Slab in Inches	Size of Kahn Bars	Spacing in Inches	Span in Feet	Depth of Fill in Feet	Thickness of Slab in Inches	Size of Kahn Bars	Spacing in Inches
4	10	8	$\frac{3}{4}$″x2$\frac{3}{16}$″	10.0	12	10	19	1$\frac{1}{2}$″x2$\frac{1}{4}$″	8.5
	15	8	$\frac{3}{4}$″x2$\frac{3}{16}$″	9.0		15	20	1$\frac{1}{2}$″x2$\frac{1}{4}$″	7.5
	20	9	$\frac{3}{4}$″x2$\frac{3}{16}$″	9.5		20	22	1$\frac{1}{2}$″x2$\frac{1}{4}$″	7.5
	25	9	$\frac{3}{4}$″x2$\frac{3}{16}$″	8.0		25	23	1$\frac{3}{4}$″x2$\frac{3}{4}$″	10.0
	30	10	$\frac{3}{4}$″x2$\frac{3}{16}$″	8.0		30	24	1$\frac{3}{4}$″x2$\frac{3}{4}$″	9.0
	35	10	$\frac{3}{4}$″x2$\frac{3}{16}$″	7.5		35	26	1$\frac{3}{4}$″x2$\frac{3}{4}$″	9.0
	40	11	$\frac{3}{4}$″x2$\frac{3}{16}$″	7.5		40	27	1$\frac{3}{4}$″x2$\frac{3}{4}$″	8.0
6	10	11	$\frac{3}{4}$″x2$\frac{3}{16}$″	10.0	14	10	21	1$\frac{3}{4}$″x2$\frac{3}{4}$″	10.0
	15	11	$\frac{3}{4}$″x2$\frac{3}{16}$″	8.5		15	23	1$\frac{3}{4}$″x2$\frac{3}{4}$″	9.5
	20	12	$\frac{3}{4}$″x2$\frac{3}{16}$″	8.5		20	25	1$\frac{3}{4}$″x2$\frac{3}{4}$″	9.0
	25	13	$\frac{3}{4}$″x2$\frac{3}{16}$″	8.0		25	27	2 ″x3$\frac{1}{2}$″	12.0
	30	13	$\frac{3}{4}$″x2$\frac{3}{16}$″	7.0		30	28	2 ″x3$\frac{1}{2}$″	12.0
	35	14	$\frac{3}{4}$″x2$\frac{3}{16}$″	7.0		35	29	2 ″x3$\frac{1}{2}$″	11.0
	40	15	$\frac{3}{4}$″x2$\frac{3}{16}$″	6.5		40	32	2 ″x3$\frac{1}{2}$″	11.0
8	10	13	$\frac{3}{4}$″x2$\frac{3}{16}$″	7.5	16	10	25	2 ″x3$\frac{1}{2}$″	13.5
	15	14	$\frac{3}{4}$″x2$\frac{3}{16}$″	6.5		15	26	2 ″x3$\frac{1}{2}$″	12.5
	20	15	1$\frac{1}{2}$″x2$\frac{1}{4}$″	11.0		20	28	2 ″x3$\frac{1}{2}$″	11.5
	25	16	1$\frac{1}{2}$″x2$\frac{1}{4}$″	10.5		25	30	2 ″x3$\frac{1}{2}$″	11.0
	30	17	1$\frac{1}{2}$″x2$\frac{1}{4}$″	10.0		30	32	2 ″x3$\frac{1}{2}$″	10.5
	35	18	1$\frac{3}{4}$″x2$\frac{3}{4}$″	13.0		35	33	2 ″x3$\frac{1}{2}$″	9.5
	40	19	1$\frac{3}{4}$″x2$\frac{3}{4}$″	12.0		40	36	2 ″x3$\frac{1}{2}$″	9.5
10	10	16	1$\frac{1}{2}$″x2$\frac{1}{4}$″	10.0	18	10	28	2 ″x3$\frac{1}{2}$″	12.0
	15	17	1$\frac{1}{2}$″x2$\frac{1}{4}$″	9.0		15	30	2 ″x3$\frac{1}{2}$″	11.0
	20	19	1$\frac{1}{2}$″x2$\frac{1}{4}$″	9.0		20	31	2 ″x3$\frac{1}{2}$″	10.0
	25	20	1$\frac{1}{2}$″x2$\frac{1}{4}$″	8.5		25	33	2 ″x3$\frac{1}{2}$″	9.5
	30	21	1$\frac{1}{2}$″x2$\frac{1}{4}$″	8.0		30	35	2 ″x3$\frac{1}{2}$″	9.0
	35	22	1$\frac{3}{4}$″x2$\frac{3}{4}$″	10.5		35	37	2 ″x3$\frac{1}{2}$″	8 5
	40	23	1$\frac{3}{4}$″x2$\frac{3}{4}$″	10.0		40	39	2 ″x3$\frac{1}{2}$″	8.0

Railroad Box Culverts

Box culverts for railroad work are similar to highway culverts except that they must be built much heavier to carry the greatly increased loading coming upon them. The side walls are usually reinforced to withstand the earth pressure due to dead and live loads. If sufficient abutment is provided for this wall at the base, it may be designed as a simple slab supported at the top and bottom. In this way the walls can be greatly reduced in thickness over what would be required for a plain concrete wall.

The footings for culverts are determined by local conditions. It will often be found necessary to carry an inverted slab continuous between the side walls in order to provide ample bearing for the heavy loads coming on these foundations. Under such circumstances this floor slab would be of the same strength as the cover slab, with the bars inverted in the top of the slab.

In the calculation of moments in culverts, a live load is assumed of 50,000 pounds on axles, 5 feet centers, 10,000 pounds per foot of track. This load may be taken as distributed uniformly over ties 8 feet long. The manner in which this live load will be distributed when it reaches the culvert cover will depend on the nature of the overlying material. In this discussion it will be assumed that the line of zero stress in the embankment due to live load is much more nearly vertical than the ordinary angle of repose of the material and it will be taken to follow a slope of ½ to 1.

For a fill of less than 2 feet, the impact allowance should be 100 per cent.; between 2 feet and 4 feet, 75 per cent.; above four feet an allowance of 50 per cent, will be made.

P_L = unit pressure on cover per sq. ft. due to live load.

P_D = unit pressure on cover per sq. ft. due to dead load.

$P = P_L + P_D$.

Total load per lineal foot = 10,000 pounds, adding 50 per cent. for impact. = 15,000 pounds.

$$15{,}000 = P_L\left(8 + \frac{h}{2}\right) \text{ or } P_L = \frac{30{,}000}{h + 16}$$

$P_D = 100\ h.$

$$P = \frac{300{,}000}{h + 16} + 100\ h = \text{total superimposed load per sq. ft. on cover.}$$

On page 12 will be found table of design of culvert tops. The designs for sidewalls are determined by local conditions of soil, drainage, etc., and cannot be conveniently tabulated. When a floor slab is used continuous between side walls, its design is merely the invert of the culvert cover.

Arch Bridges

The arch bridge of reinforced concrete is built either in the form of a continuous section arch ring, or as an arch rib. The reinforcement for arches is placed in two layers, one near the intrados, the other near the extrados with the diagonals interlacing. Attention is called to the perfect lattice girder effect produced by the interlacing of the diagonals, making the entire structure act as a monolith, under any condition of loading. The reinforcement being curved into an arch form, its first tendency when under stress is to straighten, and this will occur unless it is restrained from doing so by rigidly attached diagonals extending well into the concrete. This makes the Kahn Trussed Bar especially adaptable for work of this kind.

The continuous section arch has the same thickness of rib throughout its width. The thickness is a minimum at the center, increasing in thickness to a maximum at the abutments. It is frequently possible and advantageous to build these abutments hollow instead of a solid block of concrete. The hollow abutment consists of a series of buttresses carried down to a good foundation and usually connected at the base by a thick reinforced slab. The earth fill between the buttresses tends to insure stability. As the strength of the arch is based on the immobility of its abutments, these abutments must be carefully designed and carried to a foundation of unquestioned value or founded on piles.

Usually the earth fill is placed directly on the arch ring. Occasionally in long spans, a complete superstructure of reinforced concrete columns, girders and slabs is built on

the arch ring to carry the roadway. The advantage of this design is the greatly reduced loading to be carried and the consequent reduction in the thickness of the arch ring. This is an important consideration in long span work.

The arch rib design is usually built supporting a reinforced concrete superstructure such as Broad River Bridge, page 28. Otherwise these ribs may consist of a series of spandrel sections with reinforced beams or slabs, spanning between the tops of them, such as bridges on pages 2 and 23.

There is no doubt that the best guides to the design of arch bridges are existing structures that have proven satisfactory. The use of empirical formula giving results that agree with current practice is therefore justifiable.

One method of designing an arch giving approximate results, is to determine the crown thickness (C) by the use of an empirical formula. Make the thickness of the ring at the quarter points equal from $1\frac{1}{4}C$ to $1\frac{1}{2}C$, and place steel near both intrados and extrados, the total net section of which is equal to $.\frac{3}{4}\%$ of the area of the crown section of the arch ring.

The following formula for crown thickness proposed by F. F. Weld, C. E., in Engineering Record, November 4th, 1905, based on a study of many existing arches and original designs, is inserted for the use of those who do not care to make a more thorough investigation of the proposed arch. It will be found useful in determining a trial arch ring for the more rigorous methods.

$$C = \sqrt{S} + \frac{S}{10} + \frac{L}{200} + \frac{F}{400}$$

C = Crown thickness in inches,
S = Clear span in feet,
L = Live load per square foot,
F = Weight of fill at crown per sq. ft.

Among the more elaborate methods for determining the stresses in an arch without hinges may be mentioned the graphical, of which an excellent discussion is given in Prof. Cain's "Steel Concrete Arches & Domes," and also in "Reinforced Concrete," by Chas. F. Marsh. The analytical method which follows is condensed from Prof. Chas. E. Greene's "Trusses and Arches," Part III.

Typical Highway Arch Bridges

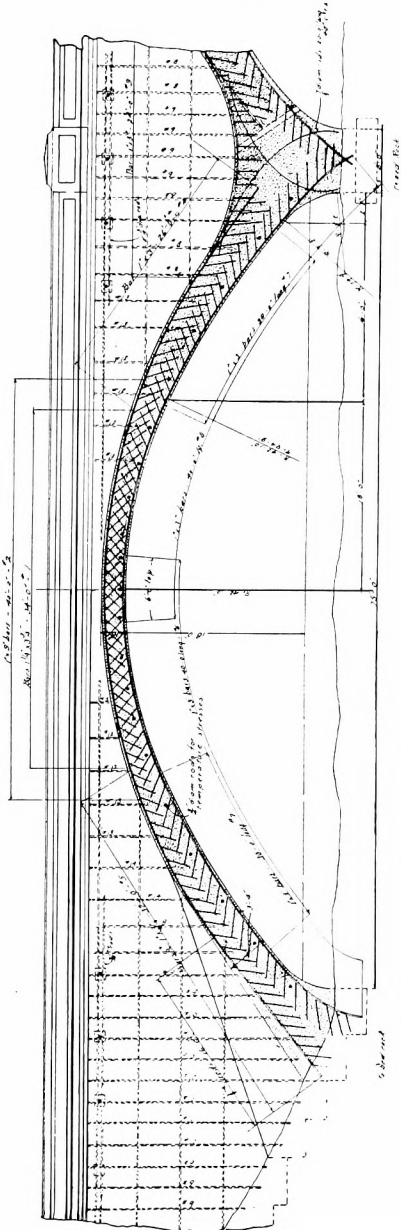
Rise = 1/10 Span

Clear Span in Feet	Crown Thickness	Steel in Intrados and Extrados		Concrete in Arch Cubic Feet	Concrete in Abutments Cubic Feet
		Kahn Bars	Spacing		
20	8″	$\frac{3}{4}$″x2$\frac{3}{16}$″	16″ c. to c.	700	2000
30	10″	$\frac{3}{4}$″x2$\frac{3}{16}$″	14″ c. to c.	1050	2800
40	12″	$\frac{3}{4}$″x2$\frac{3}{16}$″	12″ c. to c.	1600	3400
50	13$\frac{1}{2}$″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	18″ c. to c.	2250	4000
60	15″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	16″ c. to c.	3000	5000
70	16$\frac{1}{2}$″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	15″ c. to c.	3800	6000
80	18″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	14″ c. to c.	4800	7000
90	20″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	13″ c. to c.	5800	8000
100	22″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	12″ c. to c.	6900	9000
110	24″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	11″ c. to c.	8200	10000
120	26″	1$\frac{1}{2}$″x2$\frac{1}{4}$″	10″ c. to c.	9500	11000

Note—The arches in this table are designed for a rise of not less than 1-10 the span, a live load of 150 pounds per sq. ft. and a moderate earth fill over the crown.

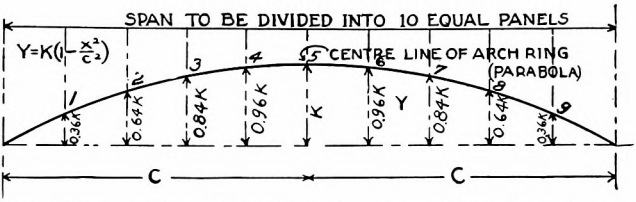
Width of roadway—16′0″ in the clear for all spans. Spandrel walls to be reinforced with $\frac{3}{4}$″x2$\frac{3}{16}$″ Kahn Bars spaced 2′0″ c. to c.

Amounts of concrete in abutments are rough approximations as local conditions govern.



Showing the use of the Kahn Trussed Bar in the Charley Creek Viaduct, Wabash, Ind.
JOHN HILLY, Engineer

Design of Parabolic Arches Without Hinges



Let the span be divided into ten equal panels and points of division numbered from one to nine.

w =load in points at point under consideration.

c =one-half span (in feet),

k =rise of arch (in feet),

m =ratio between load (w) and bending moment, taken from table,

M =bending moment due to load at point under consideration =$m\ c\ w$.

h =ratio between load and thrust produced, from table,

H =thrust produced by load = $h\frac{c}{k}w$.

—indicates tension in extrados.

+ indicates tension in intrados.

In order to make plain this method of calculation, and the use of the table, let it be assumed that it is desired to design a highway bridge having a clear span of 60 feet and a rise of 6 feet to carry a live load of 100 pounds per sq. ft.

The weight of the fill at the crown is assumed to be 200 pounds per sq. ft. Substituting these values in the empirical formula for crown thickness gives 14.7 inches.

Lay out the center line of the proposed arch for the given span and rise, divide it into ten equal parts, numbering them as shown in the figure.

In arch design it is customary to figure the loads and stresses for a section of the bridge one foot wide, for, having determined the necessary section on this basis, the bridge

Arches—Table No. 1

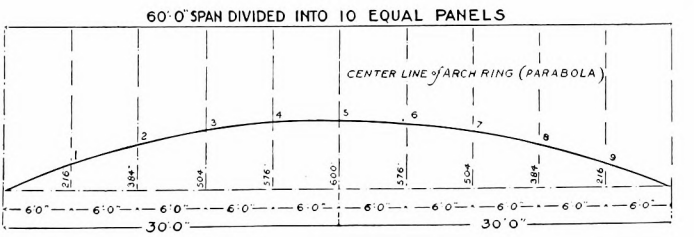
Parabolic Rib Fixed At Ends. **Values Of "*m*" At Points**

Points	POSITION OF LOAD "*W*"								
	9	8	7	6	5	4	3	2	1
0	+.022	+.064	+.095	+.096	+.062	0	—.073	—.128	—.121
1	+.006	+.016	+.019	+.011	—.006	—.026	—.036	—.018	+.051
2	—.005	—.017	—.031	—.040	—.037	—.017	+.028	+.107	+.028
3	—.012	—.035	—.054	—.056	—.031	+.026	+.119	+.048	+.011
4	—.013	—.037	—.050	—.037	+.012	+.104	+.036	+.004	—.002
5	—.010	—.024	—.020	+.016	+.094	+.016	—.020	—.024	—.010
6	—.002	+.004	+.036	+.104	+.012	—.037	—.050	—.037	—.013
7	+.011	+.048	+.119	+.026	—.031	—.056	—.054	—.035	—.012
8	+.028	+.107	+.028	—.017	—.037	—.040	—.031	—.017	—.005
9	+.051	—.018	—.036	—.026	—.006	+.011	+.019	+.016	+.006
10	—.121	—.128	—.073	0	+.062	+.096	+.095	+.064	+.022

VALUES OF "*h*" FOR VARIOUS POSITIONS OF LOAD "*W*"

Points	9	8	7	6	5	4	3	2	1
	.061	.192	.331	.432	.469	.432	.331	.192	.061

From Prof. C. E. Greene's "Trusses and Arches," Part III.



may be made as desired. This of course does not apply to bridges having arch ribs. Here the loads and stresses are determined for each rib.

Compute the loads that would come at each of these points for an arch ring one foot wide if the weight of the structure and fill were concentrated at them, and tabulate as in table No. 2.

ARCHES—TABLE No. 2

Point	Weight of Arch Ring	Weight of Fill	Total
1	1800	6000	7800
2	1600	2400	4000
3	1400	1600	3000
4	1300	1300	2600
5	1200	1200	2400
6	1300	1300	2600
7	1400	1600	3000
8	1600	2400	4000
9	1800	6000	7800

To find the bending moment at any point, as No. 7, proceed as in table No. 3.

In column No. 1 are the points in order. Column No. 4 contains the factors "*m*" found opposite No. 7 of table No. 1. The half span *c* and weights *W*, from table No. 2, are given in columns No. 2 and 5 opposite their respective points. The bending moment in foot pounds is given in column No. 6. The algebraic sum of these moments gives the bending moment at point 7 for the unloaded arch.

The moments due to the live load are computed in the same way. If a street car loading is specified it may be reduced to an equivalent uniformly distributed load by means of equivalent load diagram.

The live load is usually assumed to extend from one abutment to the center of the span, but may be placed in such positions as would give the greatest stresses at the points under consideration, if such loadings are likely to occur when the bridge is actually in use. For example, by an inspection of the signs of the co-efficients in Table No. 1 it will be seen that for the maximum negative moments at point 7 the live load should not extend quite to the center of the span.

The assumed live load of 100 pounds per sq. ft. extending from the right abutment to the center of the span gives a load of 600 pounds concentrated at each of the points 9, 8, 7 and 6 and 300 pounds at 5. These weights are entered in column 7 of table No. 3, "*m*" and "*c*" remaining the same; column 8 gives the resulting moments. This sum added to the moment of the unloaded arches

Table No. 3

Moments and Thrusts in 60 Ft. Highway Arch—Section One Foot Wide.

1	2	3	4	5	6	7	8	9	10	11	12	13
Points	c	k	Values of "m" Table 1	Dead Loads		Live Load On Right		Live Road On Left		Values of "y" Table No. 1	Total W	Horizontal Thrust $H=h\frac{\Sigma W}{k}$
				W_1	M= m.c.W_1	W_2	M= m.c.W_2	W_2	M= m.c.W_2			
9	30	6	+.011	7800	+2570	600	+200			.061	8400	2560
8	30	6	+.048	4000	+5760	600	+860			.192	4600	4420
7	30	6	+.119	3000	+10710	600	+2140			.331	3600	5960
6	30	6	+.026	2600	+2170	600	+470			.432	3200	6910
5	30	6	—.031	2400	—2230	300	—280	300	—280	.469	3000	7030
4	30	6	—.056	2600	—4410			600	—1010	.432	3200	6910
3	30	6	—.054	3000	—4860			600	—970	.331	3600	5960
2	30	6	—.035	4000	—4200			600	—630	.192	4600	4420
1	30	6	—.012	7800	—2800			600	—220	.061	8400	2560
				+2710		+3390	—3110					46730 #
						+2710	+2710					
						+6100 #	— 400 #					

NOTE—Maximum positive moment at point No. 7 = 6100 ft. lbs.

Maximum negative moment at point No. 7 = —400 ft. lbs.

Maximum horizontal thrust of section considered =46730 lbs.

gives a total positive moment due to both dead and live loads at this point.

The maximum negative moment is found by placing the live loads upon the other half of the bridge, as in columns 9 and 10, and taking the algebraic sum of the moments due to both live and dead loads.

The necessary amount of steel reinforcement may be found by the formula $RM = .86\ d\ Asf.$, where—f = allowed stress in steel, As = area of steel; d = distance from center of steel to opposite surface of arch rib, and RM = resisting moment of section which must be at least equal to the bending moment produced by the loads. The steel is assumed to take only tension and the concrete only compression. Allowance should be made for the fact that there is no tension in the arch rib unless the line of action of the resultant thrust passes outside of the middle third of the section; in other words, unless $M \div H > d \div 6$.

The horizontal thrust is a maximum when the arch is fully loaded and is found by means of the factors given at the foot of table No. 1. The results are tabulated in the last three columns of table No. 3. The sum gives the maximum horizontal thrust exerted upon the abutments by the loaded arch. This combined graphically with the dead weight of the half span and fill gives a resultant thrust which is in turn combined with the weight of the abutment and superimposed earth. This latter resultant gives the amount and direction of the thrust of the abutment upon its foundation. In order that there may be no overturning tendency this resultant should pass within the middle third of the base.

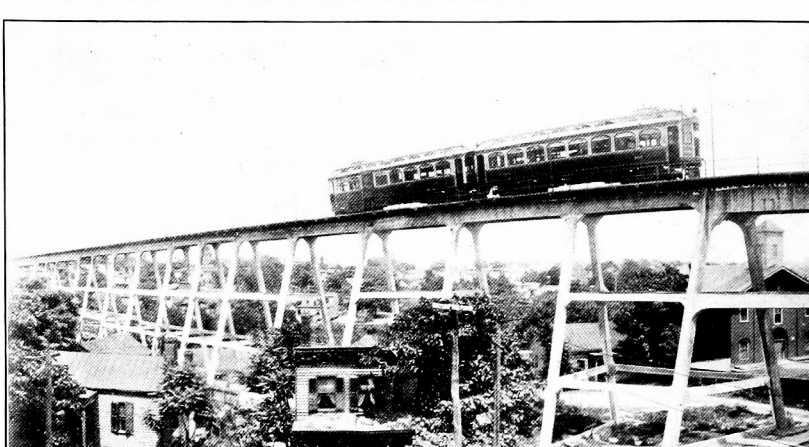
If the assumed abutment does not meet these conditions a new length of base should be assumed and the new position of the resultant determined.

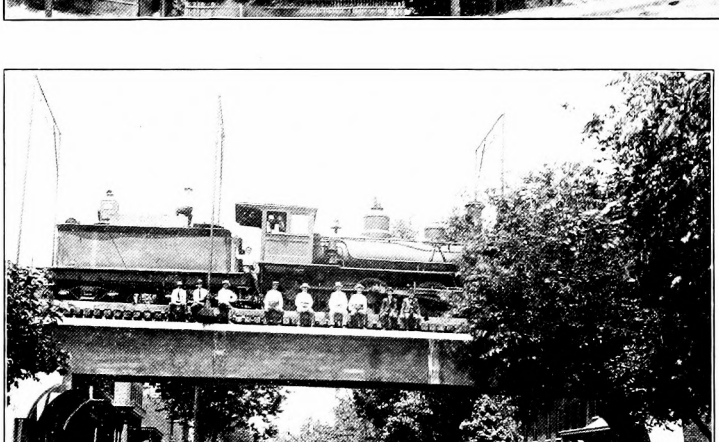
In case the arch ring is not parabolic in form, but does not depart widely from the parabola, this method of computation may be employed by determining a new span for the arch, which, with the given rise, will give the same area between the springing line and the neutral surface curve as would be included between the same elements if the curve was a parabola, or recourse may be had to one of the graphical methods where the description of the curve is of less consequence.

NELSON STREET VIADUCT OVER SOUTHERN RAILWAY, ATLANTA, GA.

D. W. LUN, Engineer. W. W. GRIFFIN, Contractor.

Length 479 feet 3¼ inches (between abutments), 10 spans from 20 to 75 feet, arched ribs supporting roadway and street railway. Cantilevered sidewalks.



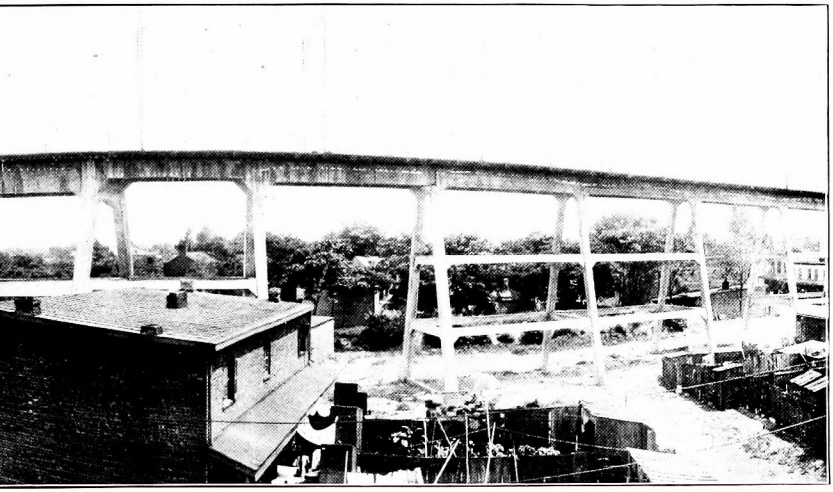


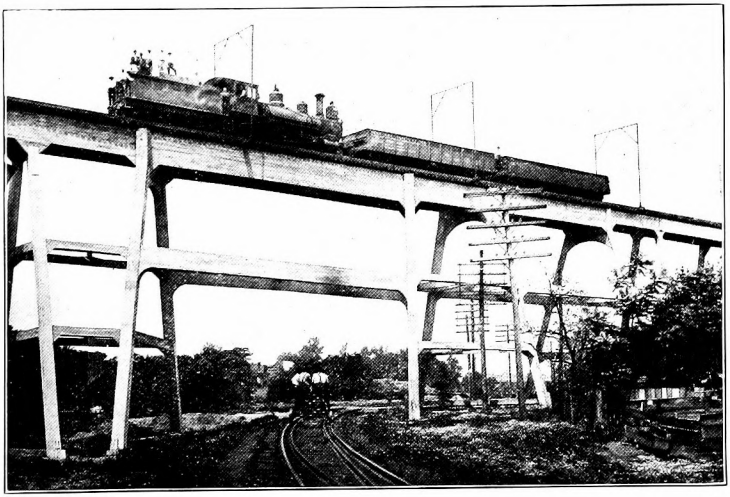
RICHMOND & CHES

HERMANN FOUGNER, Engineer. RI

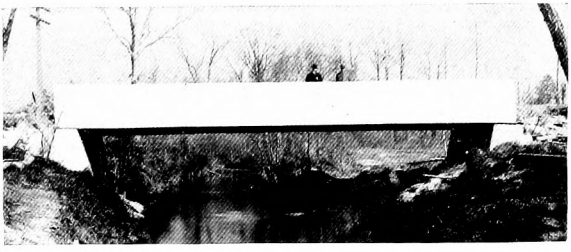
A World Famous structure.

2,800 feet long—18 to 70



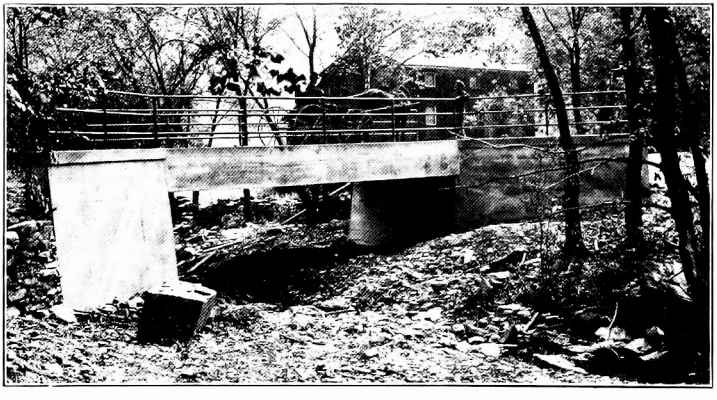


E BAY RY. VIADUCT
VA. JOHN T. WILSON, Contractor.
IN SYSTEM Reinforced Concrete.
—girder spans up to 67 feet.



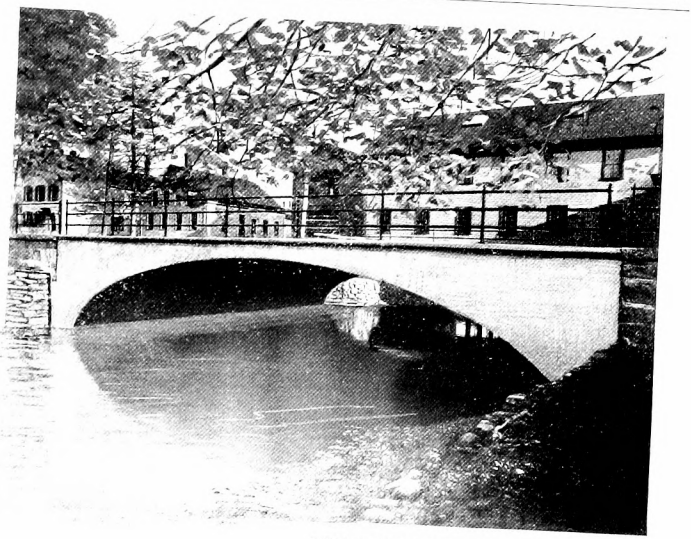
BRIDGE, HILLIARY ROAD, RICHMOND, VA.

Supporting girders extend above roadway forming railings for bridge.
Note continuous unbroken roadway through bridge.
Built KAHN SYSTEM Reinforced Concrete.

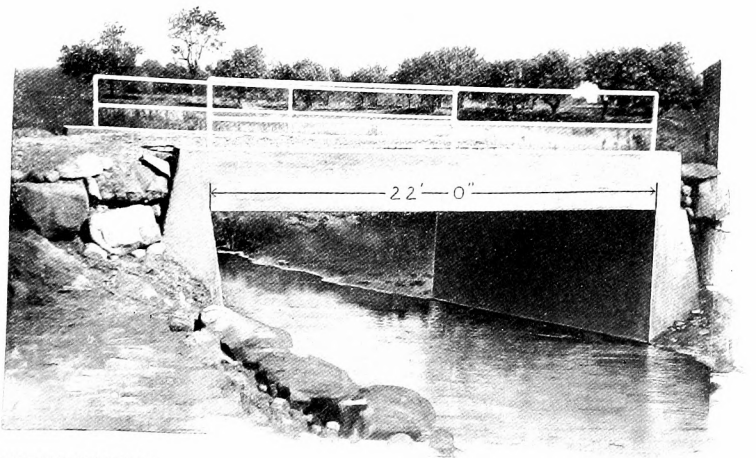


BRIDGE OVER MESHOPPEN CREEK, WYOMING CO., PA.

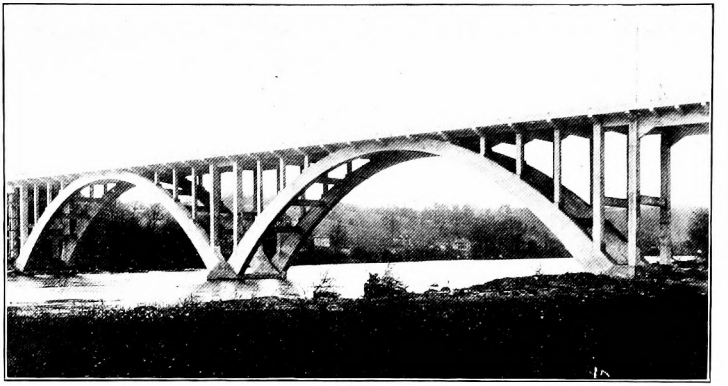
SMITH & WELLS, Engineers. F. D. BUNNELL, Contractor.
27 feet 3 inches long, 18 feet wide. KAHN SYSTEM Reinforced Concrete.

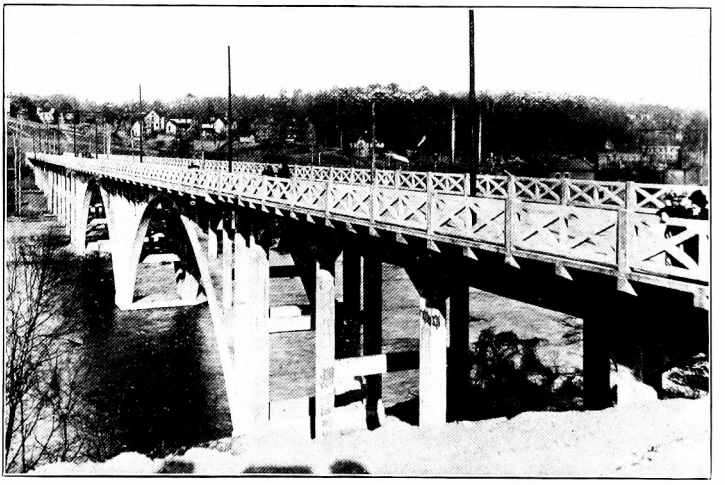


ARCH BRIDGE, WORCESTER, MASS.
Built Kahn System Reinforced Concrete.



GIRDER BRIDGE,
Elsie, Mich.
Built Kahn System
Reinforced Concrete.

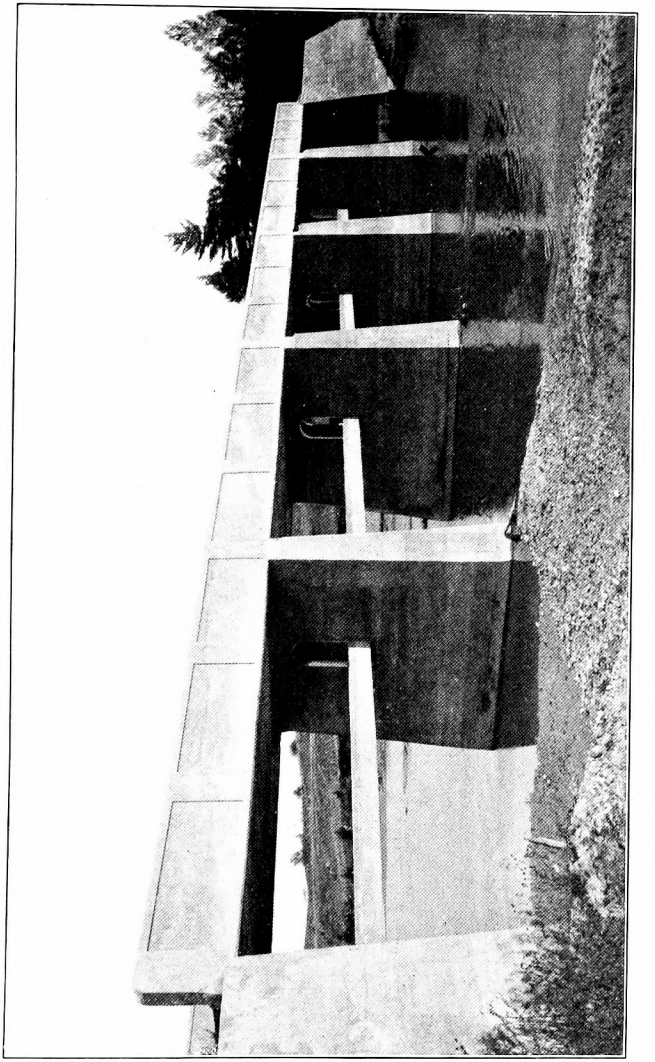




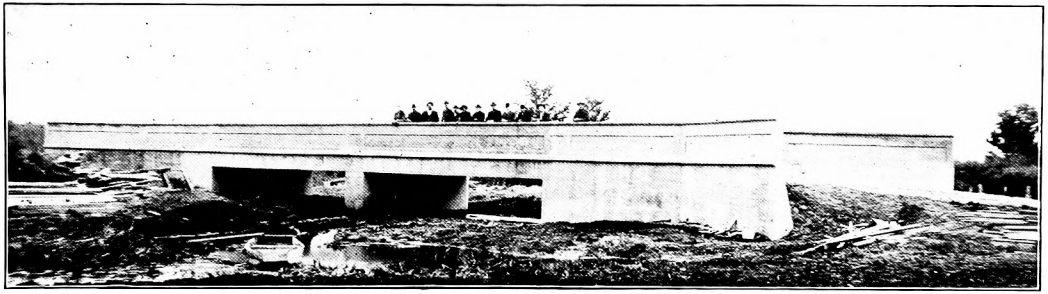
BRIDGE OVER BRANCH OF BROAD RIVER
Connecting Asheville, N. C., with West Asheville.

Total length, 931 feet (19 spans). Arch spans over river 140 feet. Girder spans of 21 to 59 feet.

Built according to KAHN SYSTEM Reinforced Concrete.

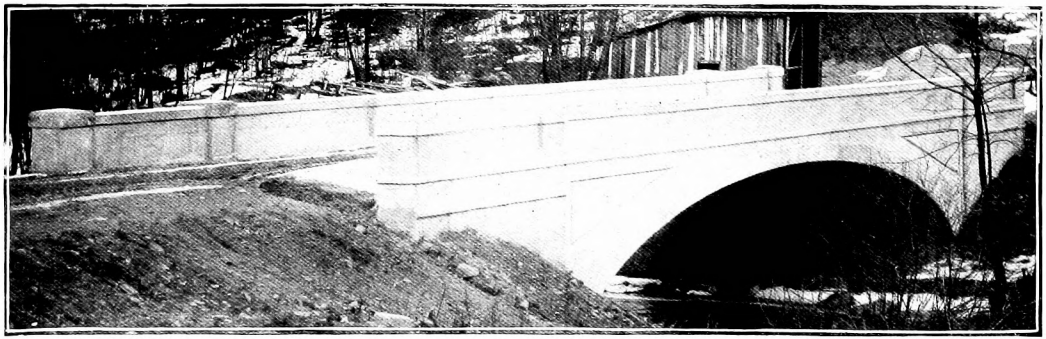


COMBINED DAM AND THROUGH BRIDGE, BEAVERTON, MICH.
Built Kahn System Reinforced Concrete, E. C. Nolan, Contractor.
Concrete Girder forms rail for Bridge—Horizontal Beams below Bridge support baffle boards for dam.



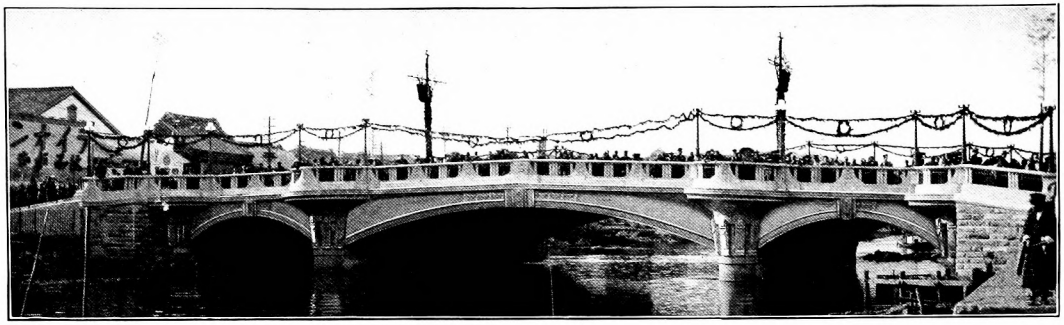
W. W. DeLong, Engineer. BRIDGE AT SEYMOUR, WIS. Hugh Garvey, Contractor.

Built Kahn System Reinforced Concrete.

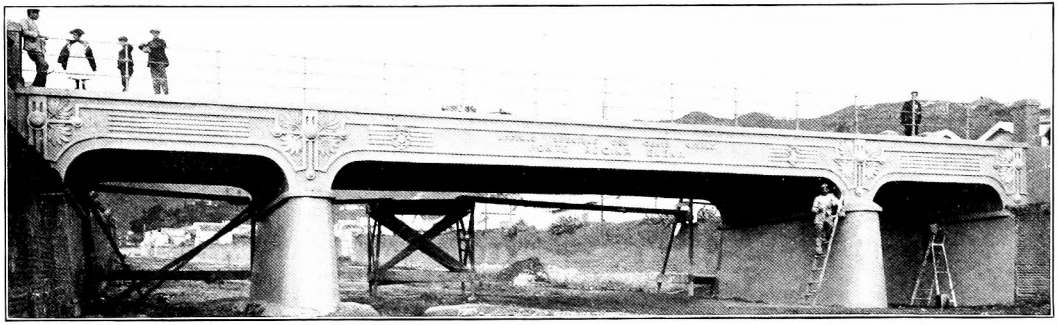


BRIDGE FOR U. S. GOVERNMENT, Fort Montgomery, N. Y.

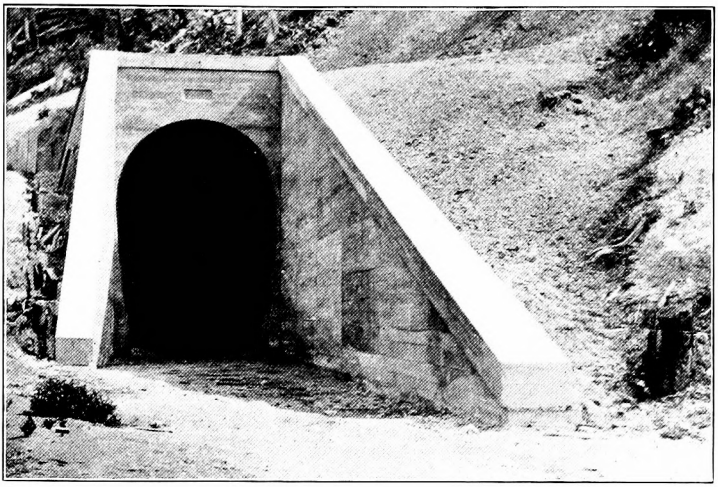
Built Kahn System Reinforced Concrete.



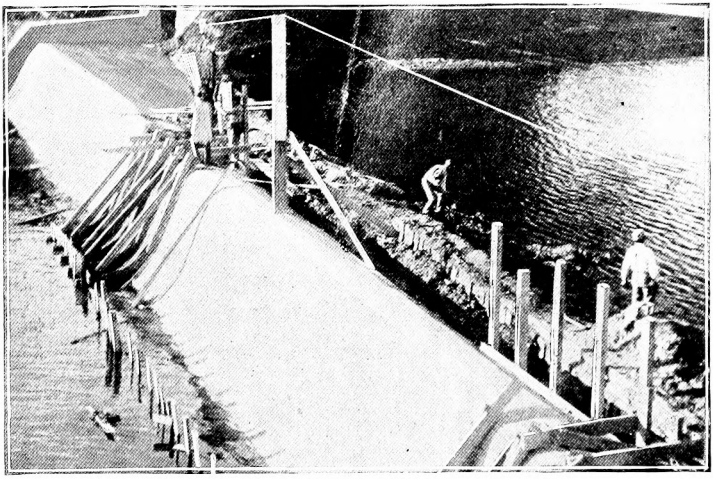
YOSHIDA BRIDGE, YOKOHAMA, JAPAN
Center Span 60 feet long, End Spans 25 feet long.
Dr. ISHIBASHI and S. AWANO, Engineers.
Built KAHN SYSTEM Reinforced Concrete.



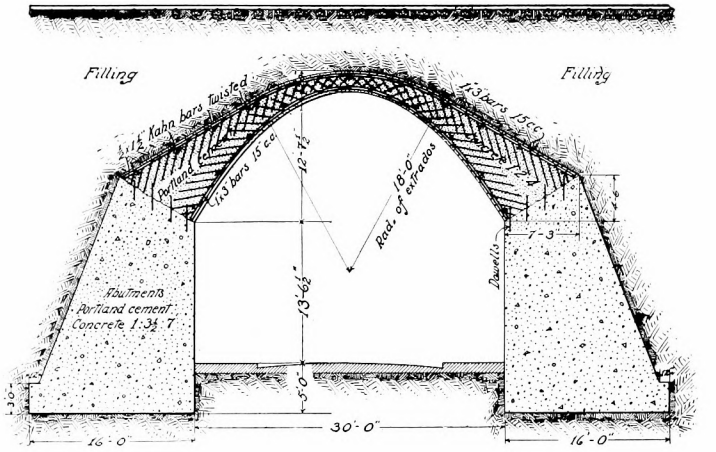
GIRDER BRIDGE IN EARTHQUAKE REGION, MESSINA, SICILY.
M. G. CERVELLO & CO., Contractors.
Central Span 39 feet, 5 inches long, End Spans 12 feet, 8 inches long. Built KAHN SYSTEM Reinforced Concrete.

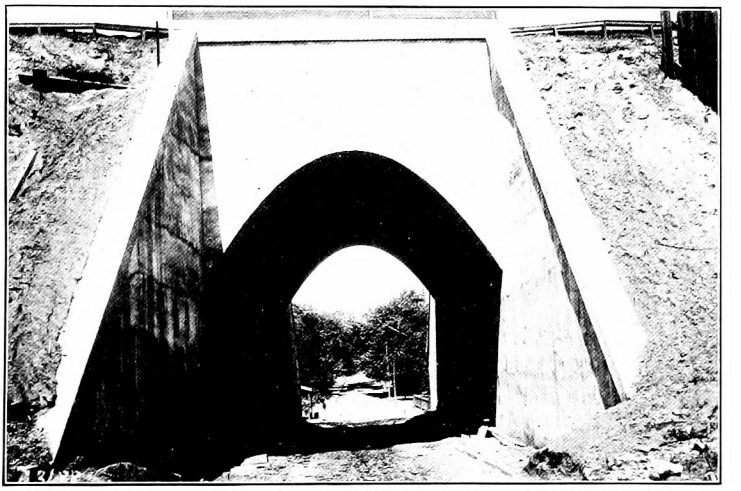


PALLISTER TUNNEL FOR CANADIAN PACIFIC R. R.
VANCOUVER, B. C.
Built KAHN SYSTEM Reinforced Concrete.



DAM ACROSS BLUE RIVER, BEATRICE, NEB.
BEARDSLEE & BROCKWAY, Engineers. Built KAHN SYSTEM Reinforced Concrete.



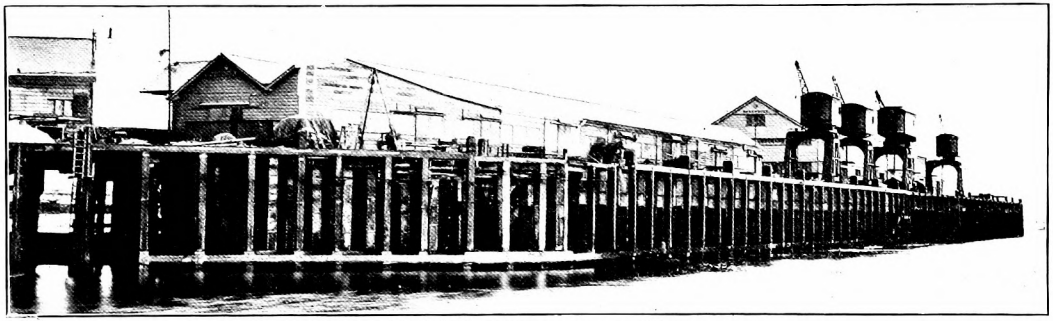


CULVERT FOR SOUTHERN RAILWAY

ATLANTA, GA.

55 feet wide and carries four tracks.

Built KAHN SYSTEM Reinforced Concrete.



CAR DOCKS, NORTHAMPTON, ENGLAND.
Built KAHN SYSTEM Reinforced Concrete

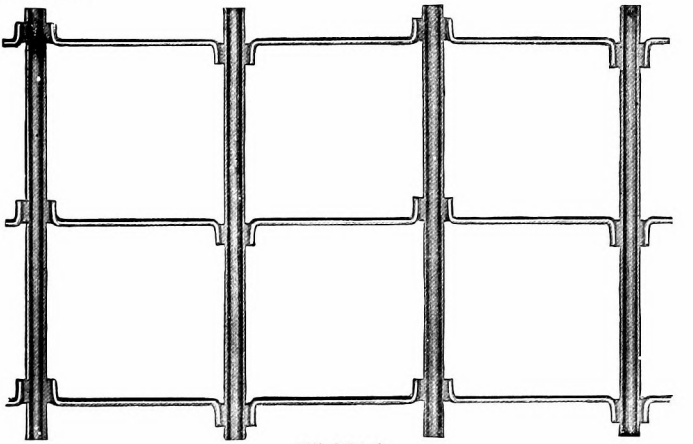
EDW. F. WARNER, Engineer. SANTA MONICA PIER, SANTA MONICA, CAL. A. STUTZER, Contractor.
Built KAHN SYSTEM Reinforced Concrete.

Rib Metal

Rib Metal consists of a series of nine straight bars or ribs rigidly connected by cross members formed from the same sheet of steel. These cross members accurately space and thoroughly anchor the main bars in the concrete, providing a perfect reinforcement against temperature and shrinkage strains.

The ribs span in the direct line of the greatest strain and are stiff and rigid, assuring their accurate location in the concrete.

Rib Metal is furnished in flat sheets for floors, roofs, walls, vaults, etc., or bent to exact curve for arches, conduits, sewers, reservoirs, tanks, etc.



Rib Metal

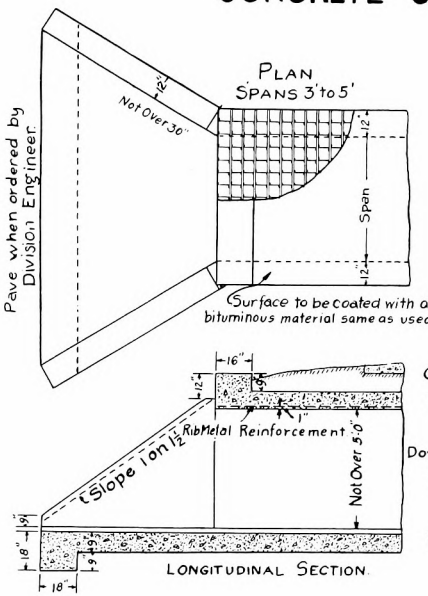
Properties of Rib Metal

Area of One Rib = .09 Sq. In. (9 Ribs in One Sheet)

Size No.	Width of Standard Sheet	Square Feet per Lineal Foot	Area per Foot of Width	Weight per Square Foot
2	16″	1.33	.54 sq. in.	1.025 lbs.
3	24″	2.00	.36 sq. in.	1.340 lbs.
4	32″	2.67	.27 sq. in.	.997 lbs.
5	40″	3.33	.216 sq. in.	.792 lbs.
6	48″	4.00	.18 sq. in.	.655 lbs.
7	56″	4.67	.154 sq. in.	.557 lbs.
8	64″	5.33	.135 sq. in.	.484 lbs.

All lengths up to 18 feet. Furnished in flat or curved sheets.

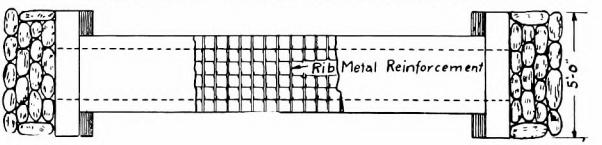
CONCRETE CULVERTS



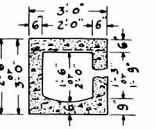
HEIGHT 1'-6" TO 5'-0"
TABLE OF DIMENSIONS

SPAN	THICKNESS OF SLAB	THICKNESS OF ABUTMENT	RIB METAL NUMBERS
2'-0"	6"	12"	No. 6
3'-0"	6"	12"	No. 3
4'-0"	6"	12"	No. 3
5'-0"	8"	12"	No. 3

CONCRETE DITCH CROSSING

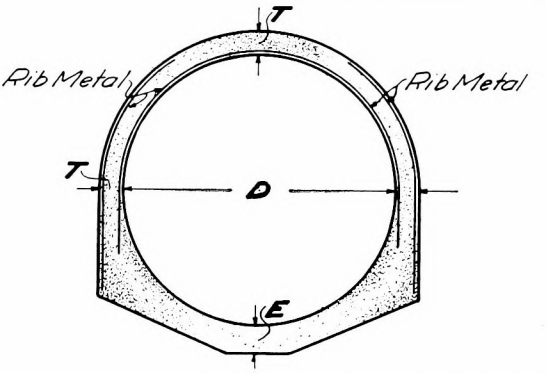


Cross Section



STATE OF NEW YORK
DEPARTMENT OF HIGHWAYS

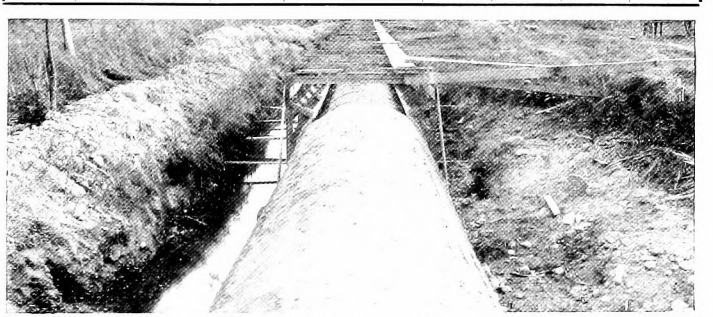
STANDARD STRUCTURES
FOR STATE AND COUNTY HIGHWAYS



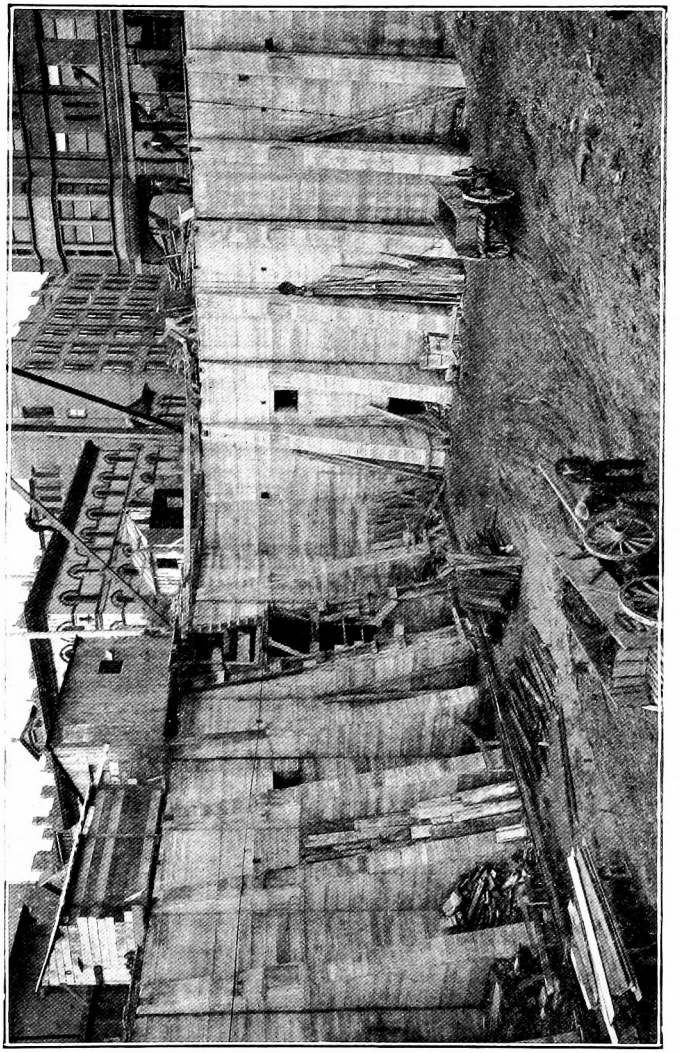
Concrete Sewers Reinforced with Rib Metal

(Table gives size of Rib Metal for various depths of fill)

Size (D)	T (in.)	E (in.)	DEPTH OF FILL OVER SEWER						
			6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.	12 Ft.	14 Ft. and over
27″	4	4	8	8	8	8	8	8	8
30″	4	4	8	8	8	8	8	8	8
33″	4	4	8	8	8	8	8	8	8
36″	4	5	8	8	8	8	8	8	8
39″	4	5	8	8	7	7	7	7	7
42″	4	5	8	7	6	6	6	6	6
45″	5	6	8	8	7	7	7	7	7
48″	5	6	8	7	6	6	6	6	6
54″	5	7	6	6	5	4	4	4	4
60″	5	7	5	4	4	4	3	3	3
66″	6	8	5	4	4	4	3	3	3
72″	6	8	4	3	3	3	3	3	3
78″	7	9	4	4	4	3	3	2	
84″	7	10	4	3	3	3	2	2	
96″	8	10	3	3	3	2	2	2	



RIB METAL SEWER, LAKE PLEASANT, MINN.
L. W. RUNDLETT, Engineer. J. H. DONAHUE, Contractor.



RETAINING WALL FOR WELLS BUILDING, MILWAUKEE, WIS.
H. C. KOCH & SONS, Architects. Built KAHN SYSTEM Reinforced Concrete.

Earth Pressures

Angle of Repose = φ = 33 Degrees

Depth	Total Inclined Press.	Total Hor. Press.	Hor. Press. per Sq. Foot	Depth	Total Inclined Press.	Total Hor. Press.	Hor. Press. per Sq. Foot
5	335	280	112	23	7080	5935	516
6	480	405	135	24	7710	6460	538
7	655	550	157	25	8365	7015	561
8	855	720	180	26	9045	7585	583
9	1085	910	202	27	9755	8180	606
10	1340	1120	224	28	10490	8800	628
11	1620	1355	246	29	11255	9435	650
12	1930	1615	269	30	12040	10100	673
13	2260	1895	291	31	12860	10780	696
14	2625	2200	314	32	13700	11490	718
15	3010	2525	337	33	14705	12220	741
16	3425	2870	359	34	15455	12960	763
17	3865	3245	381	35	16390	13745	785
18	4335	3635	404	36	17340	14540	808
19	4830	4050	426	37	18315	15360	830
20	5350	4490	449	38	19275	16200	853
21	5900	4950	471	39	20350	17065	875
22	6475	5430	493	40	21410	17950	896

Earth Level.

$$\text{Total Inclined Pressure} = \frac{\cos \varphi \; eh^2}{2(1 + \sin \varphi \sqrt{2})^2} = .1338\, eh^2$$

Total Hor. Pressure = $11.22\, h^2$ acting at depth = $\frac{2}{3}h$

Note: e = 100 lb. per cu. ft.; h = Depth.

Illustration from Sixth Annual Report of Board of County Road Commissioners of Wayne County, showing ideal country road built of concrete.

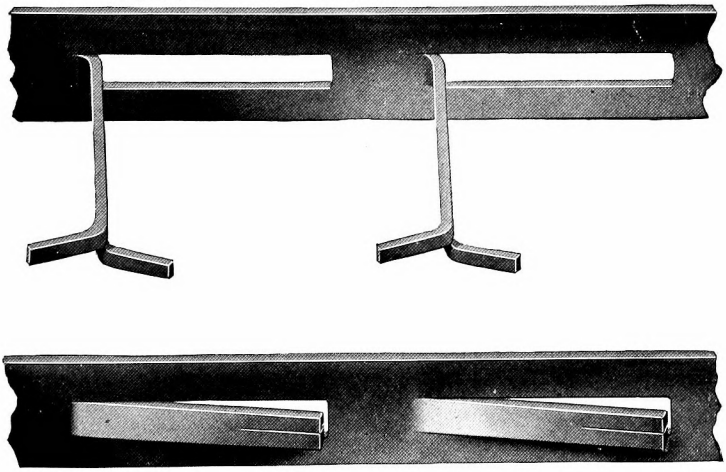
Trus-Con Armor Plate

The Expansion or Contraction Joint Protector

The plate that overcomes the only weak point in the concrete road or pavement because it is the plate that prevents rutting and chipping of the joint.

The Trus-Con Armor Plate is the high grade open-hearth steel plate that permanently protects the joint in your road from breaking down; the plate that wears with the rest of the pavement and thus provides at all times a smooth, even surface at the joint without ruts or bumps. This plate does this at a cost to you which is saved in the first repair work necessitated by the unprotected joint or by the irregular cracks caused by omission of contraction joints.

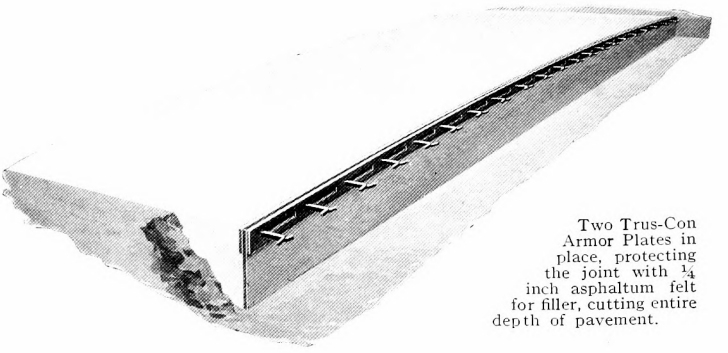
CURVED TO CROWN OF PAVEMENT



For convenience in shipping and handling, Trus-Con Armor Plates are supplied as indicated in lower illustration above. The prongs are readily transformed, on the job, to the form indicated in the upper illustration.

Our plates, manufactured from the very best grade of open-hearth steel, a good tough steel, are just the right composition to take the extra heavy wear at the joint; will not fracture and will wear down with the roadway.

Standard size of plate is $2\frac{1}{2}$ inches wide, $\frac{3}{16}$ inch thick and any reasonable length. Other sizes can be furnished. Plates are curved to pitch or crown of pavement.



Two Trus-Con Armor Plates in place, protecting the joint with ¼ inch asphaltum felt for filler, cutting entire depth of pavement.

Necessity for Joints and Their Protection

While we realize that concrete road paving is but now gaining prominence, it is a fact that this type of construction has passed through its first experimental stage and that many conclusions can be drawn relative to its use.

It is admittedly the best pavement, cost considered, so far evolved for roads and streets subjected to medium weight traffic. It can be laid for approximately $1.25 or less per square yard. The results obtained in Wayne County, where 70 miles of concrete road have now been laid, are so satisfactory that thirty miles more will be placed in 1913.

Cracks must arbitrarily be made across the roadway or else irregular, unsightly cracks will develop naturally, due to the fact that concrete contracts and expands from the action of both temperature and moisture. Not being a plastic material the pavement will either pull itself apart or else must be provided with expansion or contraction joints placed at such intervals as will allow of this constant movement without damage to the mass.

The crack or joint thus formed is, unless properly protected, the weakest point in the roadway. This is generally admitted by all who have had experience in concrete road building. Under the action of traffic the exposed edges quickly chip off continually becoming larger until a rut is formed seriously damaging the pavement.

The Trus-Con Armor Plate, used in connection with asphaltum felt or plastic asphaltum as shown in accompanying illustration, provides an elastic material to absorb the expansion or to allow of uniform contraction. This steel plate protects and insures even, gradual wear of the so-called "weakest part of the road," so that it now really becomes the strongest, since it allows the road to overcome the tendency to fracture, and eliminates the "weakness" by forcing the joint to wear uniformly without checking.

Superiority of Trus-Con Armor Plate as a Protector

The ideal expansion joint protector must combine the following features:

1st. Thick enough, deep enough and hard enough to protect the edge against which it is placed, not only for one year but for the life of the pavement.

2nd. Of the proper temper to receive blows and not fracture, and to wear evenly with the road surface.

3rd. Be simple of installation.

4th. Cheap enough to permit of common use.

5th. Provide strong enough bond with face of road slab so that it can never cleave away under traffic pressure.

The prongs, formed from the plates, are sheared at the ends so as to provide a positive lug to thoroughly anchor the plate to the concrete. Note that the plate cannot separate from the concrete without pulling the prongs in two. Compare this with other methods which depend merely on the adhesion of the concrete. Without thorough anchorage the plates separate from the concrete and the concrete at the joint chips and breaks down, the same as with the unprotected joint.

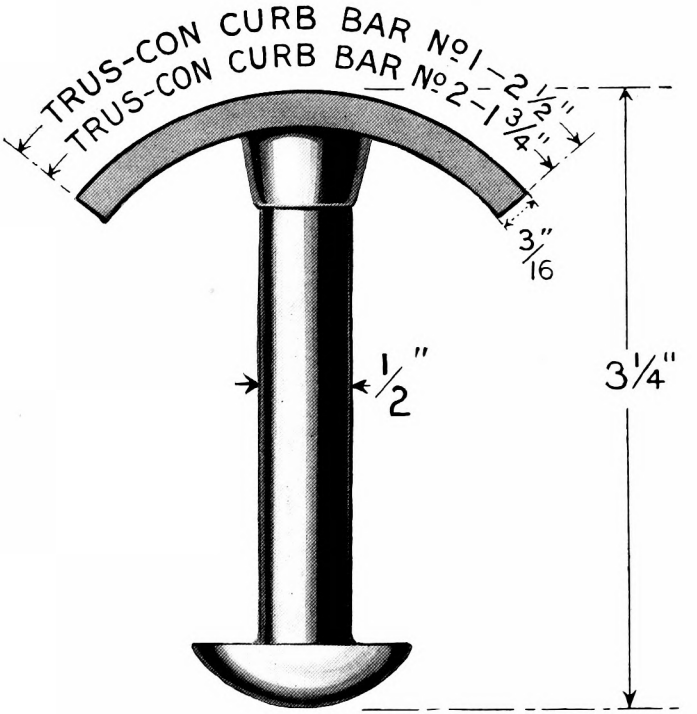
Trus-Con Armor Plates are superior to angles, and similar devices. The angle is placed with one leg extending over the pavement about 3 inches. This 6-inch surface of steel is slippery and the cost very great, which together with other objections, eliminates the angle from consideration, since a more efficient plate is at hand for less money.

Installation of Trus-Con Armor Plate is accomplished by clamping the two bars together with a layer of asphaltum felt of desired thickness between, the felt cutting entire depth of pavement. (See illustration on opposite page.) Or if preferred a steel plate is placed temporarily between the two Armor Plates and is removed after concrete is poured, the space then being filled with plastic asphaltum. Either process is satisfactory, will allow of expansion and will prevent joint filling with grit; although felt method is somewhat cheaper. The assembled plates are held in place at exact grade line by being attached temporarily to side grade boards and supported by pins driven into subgrade. Complete specific directions will be given covering entire operation.

These pages give but an outline of our method of protecting the contraction or expansion joint and show only in a general way the make-up and use of the **Trus-Con Armor Plate.** Special information covering individual requirements will be given to anyone contemplating the construction of concrete paving. Complete information, suggestions, etc., will be furnished upon request.

Trus-Con Curb Bar

The Real Concrete Edge Protector



Recognizing the demand for a really efficient concrete edge protector that could be manufactured and placed upon the market at a reasonable cost, we some time ago evolved the Trus-Con Curb Bar. We claim for this Bar the element of the best possible, most economical arrangement of every particle of steel used to protect your concrete curbs, shipping platforms, step nosings, entrance and interior columns, or in short, any concrete edges exposed to strain incident to moving bodies, or as in curbs, to the added strain of temperature.

Trus-Con Curb Bar

The Real Concrete Edge Protector

Manufactured from two pieces of highest grade open hearth steel, securely welded together and hot galvanized after forming.

Supplied in two standard sizes:

No. 1—Plate $\frac{3}{16}$ inch thick, periphery $2\frac{1}{2}$ inches wide.
Anchor Bolt $\frac{1}{2}$ x 3 inches.

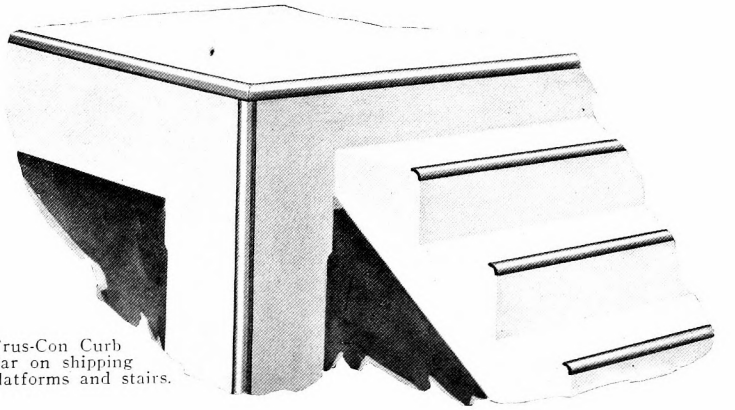
No. 2—Plate $\frac{3}{16}$ inch thick, periphery $1\frac{3}{4}$ inches wide.
Anchor Bolt $\frac{1}{2}$ x 3 inches.

Standard lengths 8, 10 and 12 feet.

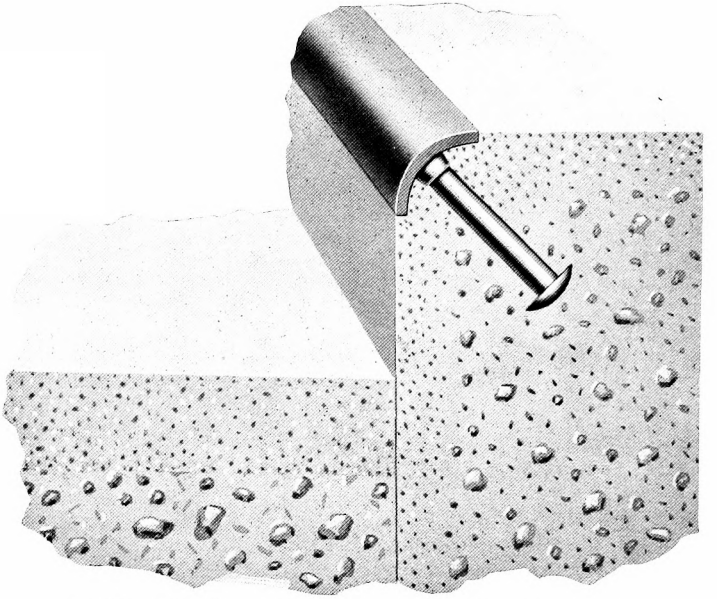
The two designs of Trus-Con Curb Bar are our standard ones. and we have found from experience that one or the other of them will satisfy practically all conditions. However, when necessary to comply with city ordinances and special conditions, we are prepared to manufacture this Bar in other sizes to meet all requirements.

Universal Application of Trus-Con Curb Bar

Trus-Con Curb Bars are recommended for all exposed corners of concrete construction, such as walls, pilasters, platforms, stairs, sidewalks, curbs, bridges, shipping rooms, freight sheds, etc., etc. We will gladly give you our recommendations and prepare details of the use of Trus-Con Curb Bar in any particular work.



Trus-Con Curb Bar on shipping platforms and stairs.



Trus-Con Curb Bar in its most important field, making possible the efficient concrete curb.

Concrete Curbs Protected by Trus-Con Curb Bars

Consider the finished, neat appearance given to a street by such a protected and finished curb. Checked, rutty curbs are unsightly; a Trus-Con Armored Curb is proof against cracking and withstands more shock and wear than the best stone or granite. A curb carefully laid and protected with these bars is mechanically perfect, and will stay exactly as placed under all conditions.

Consider the fact that this construction will cost about one-half the ordinary granite or stone curbing, where individual sections are from four to six feet long, and the ends are sure to get out of alignment.

We feel confident that every engineer and land owner in our cities appreciates the economy of a concrete curb and would advocate its use, provided they could procure a protector that would protect absolutely and yet not be exorbitant in price. The Trus-Con Curb Bar satisfies both of these conditions through its comparatively low first cost, its ease of installation and its large galvanized wearing surface.

The Trus-Con Curb Bar Protects all Concrete Edges

The Kahn System of Reinforcing and Finishing Concrete in practically all of its thousands of applications, is known the world over, and is represented by offices in practically every large city on the globe. Trus-Con Curb Bar is one of the Kahn Building Products and we submit the following reasons as its claim of superiority, for your consideration and its adoption.

1. The very best possible arrangement of a minimum amount of steel to secure most satisfactory results.

2. The very best grade of steel for the purpose, heavily galvanized, and an anchorage to the concrete that is absolute, and one that becomes an actual reinforcement in addition.

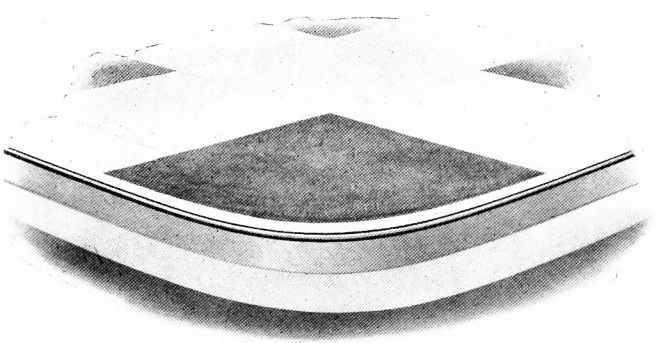
3. Simplicity of installation, as no special tools or detached parts whatever are required.

4. Ability to distribute shock throughout the whole body of concrete.

5. Low cost, occasioned by the fact that it is manufactured in our own immense factory and on our own machinery.

We invite correspondence regarding the uses of Trus-Con Curb Bar, as well as our other products. State your conditions, and we will recommend the size of Bar that, in our opinion, would give best results. We will be pleased to quote you prices and terms.

BENT TO CURVE. Our shops furnish Trus-Con Curb Bars curved to any reasonable radius to satisfy all conditions of street intersections, etc.



Note how perfectly the Trus-Con Curb Bar is adapted for curved curbs at street intersections.

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EARTHQUAKE-PROOF CONSTRUCTION

A DISCUSSION OF THE EFFECTS OF EARTHQUAKES ON BUILDING CONSTRUCTION WITH SPECIAL REFERENCE TO STRUCTURES OF REINFORCED CONCRETE

BY

LEWIS ALDEN ESTES

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EARTHQUAKE-PROOF CONSTRUCTION
INTRODUCTION

The following pages have been prepared with the purpose of presenting the opinions of some of the leading geologists, engineers and structural seismologists upon the most desirable form of construction for zones of high seismicity. While our own experience has given us very definite convictions relative to earthquake-proof and fire-proof construction, it has been our earnest aim to present in a fair and open-minded manner the conclusions of accepted authorities. It is not our purpose to condemn other forms of construction, save where the weight of evidence is so overwhelming as to make it our duty as engineers to warn against them; but rather it is our desire to emphasize the necessity for, and show the means of obtaining ideal earthquake-proof construction.

We wish to acknowledge and express our sincere appreciation of much valuable assistance rendered in the preparation of this work by Dr. W. H. Hobbs, of the University of Michigan, without whose suggestions many valuable references would undoubtedly have escaped notice.

We have given the preparation of this book our thorough attention, and have reviewed carefully the works of eminent seismologists both in this country and abroad, especially those who have studied the very able writings of the Japanese investigators to which we have not had personal access.

The italics throughout the work are ours.

BEKINS VAN AND STORAGE CO., SAN FRANCISCO, CAL.

Ralph Warner Hart, Architect.

The most prominent reinforced concrete building in the San Francisco earthquake and fire, April 18, 1906. Universally commended by seismologists and engineers.

Bulletin No. 324 of the *United States Geological Survey* on the *Effect of the San Francisco Earthquake and Fire*, says:

"The building in process of construction by the Bekins Van & Storage Company at the corner of 13th and Mission St. was the only example of the pure type of reinforced concrete in the city. Two of the six floors were erected, the walls being made of brick, laid in lime mortar, and the floors and columns of reinforced concrete. The walls were badly cracked by the earthquake but the reinforced concrte was not injured." (See page 20.)

In completing the building, the walls, as well as the interior, were built of reinforced concrete according to the Kahn System.

I.

THE CAUSE OF EARTHQUAKES

In connection with the discussion of earthquake-proof construction, it will not be out of place to review very briefiy, the causes underlying seismic activity.

Earthquakes and volcanoes are both indications of mountain-building forces which are brought into action, probably by the contraction of volume of the earth and the consequent wrinkling of the outer shell as it adjusts itself to a diminished core. The older theory that earthquakes were a direct result of volcanic action seems now untenable, as observations do not show so intimate a relationship to exist. To quote Professor Hobbs:

"Regions of volcanoes are subject to earthquakes, yet some of the heaviest earthquakes have affected a region distant from any volcanic vents. Again, great volcanic outbursts are inaugurated by light earthquakes, but great earthquakes produce as a rule, no perceptible, immediate effect upon the activity of neighboring volcanoes. * * * In short, it would appear that both earthquakes and volcanic activity are different indications of the operation of a more fundamental geological process—mountain formation with its concomitant manifestation in changes of level."

Earthquakes are then, the direct result of adjustments of the earth's crust. The faulting or slipping resultant from the internal stresses may be evident at the surface in the form of a fissure or fault trace, or may be miles below the surface, and made manifest only in the tremors of the earth. The movement along the fault line may be either vertical or horizontal or a combination of both. Native rock, although it may be profoundly shattered,

usually suffers comparatively little displacement from the temblor, but surface earth and especially "made" ground, and marshy, boggy earth are often shaken like jelly in a bowl, or made to undulate with a wave-like motion. It is this latter feature which is so destructive to buildings, bridges and underground construction, and which renders of the utmost importance a careful investigation of the features of a design which shall be ideally earthquake-proof.

The design of earthquake-proof structures is largely an empirical matter and no form of construction, however perfect it may seem in theory, should be given confidence until it has been tested by seismic disturbances of considerable magnitude, and proven its worth. Further, individual reports on the condition of structures which have passed through earthquakes should be accepted with considerable reservation, as the personal equation enters very largely into work of this character, and statements are often made by men of unquestioned veracity and professional standing which are absolutely contradictory. This implies no intentional misstatement on their part, but is merely a striking illustration of the psychological fact that judgment, uncolored by personality, is impossible, especially when judgment is largely influenced by observation.

We have endeavored, therefore, to draw the material for this work from as great a variety and as large a number of sources as possible, and will introduce for this reason, what may seem at first account to be an unnecessarily large number of references.

II.

THE ACTION OF EARTHQUAKE FORCES

The forces which act upon all forms of construction as a result of seismic disturbances are first; those resulting from the inertia of the structure and the consequent vibration, and second; direct shear, as a result of a differential movement of the ground.

Buildings:—The principal damage to buildings subjected to the first type of stress previously mentioned, that is, stress due to vibration, results from the fact that the different parts of the structure vibrate with different periods. As a clear exposition of this principle, we quote Professor Hobbs:

"A building in the throes of an earthquake tends to vibrate like an inverted pendulum, or more frequently, like a series of them, since it is usually constructed of different materials, each having its own natural period of vibration. Not only do the different materials correspond to different vibration periods, but if there are wings or extensions to the main portion of the building, these parts, in so far as they vibrate as units, will further have different periods from the main portion. It is this difference of vibration period which gives rise to differential internal or 'racking' stresses, tending to destroy the integrity of the structure. *If all parts can be so firmly joined together that the building moves essentially as a unit, it may be said to be earthquake-proof.*"

If the differential movement of the earth is large and of deep origin, as over a main fault, no structure can withstand the stresses, but if it is merely a movement of the surface layer, the probability of damage may be reduced to a minimum by proper design.

Professor Omori and Professor Milne both point out that the movement at the surface of the earth, especially in "made" ground or marshy districts, is much greater than at a short distance below the surface. In fact the experiments of Professor Milne showed, during a severe earthquake in 1885, an amplitude of motion at the bottom of a pit ten feet deep only one thirty-fourth of the movement at the surface. The liability to destruction of buildings with shallow foundations situated on unstable earth, is at once apparent. The vibration of the surface layer is often accompanied by what may be termed "secondary shear," resulting from a differential movement along a line between earth of different densities.

A rotational movement is often induced in buildings, monuments, etc., occurring through the combination of earth vibrations of different amplitude and direction, or perhaps, as Milne points out in "Seismology," caused by a rectilinear motion of the ground which is not parallel to a plane of symmetry of the structure. Distortional stresses caused in this manner are very destructive to structures not designed to withstand their effect.

Chimneys:—Chimneys of brick, tile, or masonry, in fact of all types not securely reinforced longitudinally, are almost invariably destroyed by earthquakes. This is one of the most frequent causes of the disastrous fires which usually follow temblors and in consequence, chimney design merits the most careful attention.

Bridges:—It is well known that banks of streams under seismic vibration will approach each other. As Professor Hobbs points out:—"Whether occupied by streams or not, it seems to be clear that the vicinity of valleys is marked by unusual surface compression in a direction at right angles to the valley." The effect of this movement on a bridge is to exert compression which will cause the bridge either to buckle, or to push apart the tops of the abut-

ments, or to shear the anchor bolts or the abutment itself along a plane of weakness.

Underground Structures:—The action of seismic movements upon underground structures, as tunnels, sewers and pipes is extremely difficult of prophecy. It embraces vibratory motion in hard ground or rock, undulatory motion and compacting in loose earth, and differential movement between strata of different density. Construction to withstand the above forces must be capable of undergoing tension, compression and direct shear, or else be so flexible as to be non-resistant.

Tillman & Bendel Building, San Francisco, Cal. Macdonald & Applegarth, Architects.
An excellent example of the modern, all-reinforced concrete (Kahn System) building erected since the San Francisco earthquake.

III.

EARTHQUAKE-PROOF CONSTRUCTION IN REINFORCED CONCRETE

The general action of seismic forces having been outlined, we come now to a consideration of the essentials of a construction to best withstand these forces.

Buildings.

The prime requisite for a stable building is a deep and firm foundation. Where ground solid enough for concrete footings of either the ordinary or "spread" type is not available, piles should be used. Milne emphasizes the value of a free basement to prevent damage to the building through the movement of the surface earth, which, as previously discussed, is much greater than at a short distance underground. C. G. Knott recommends trenching all around buildings, or especially on the side from which earthquake shocks usually come.

The next essential quality a building should possess is stiffness. The frame should be strong and well tied together. to obtain as nearly as possible the "monolithic" condition, so that the building will vibrate as a unit. How perfectly all-reinforced concrete construction fulfills this condition may be gathered from the following comments in the report of A. E. H. Herschel, Building Surveyor of Kingston, Jamaica, to the Colonial Secretary of Jamaica; on the effects of the earthquakes of April 13th and May 14th, 1910, on the buildings at Cartago and San José, Costa Rica, with recommendations on earthquake-resisting construction.

"This (reinforced concrete) is the only material which really satisfies all the requirements mentioned above. Its strength begins where the strength of ordinary unreinforced brick work ends, for in the reinforced concrete, no allowance is made for the strength of concrete in tension. The steel takes all the tensional stresses. So this material combines the durability and fire-resisting qualities of masonry with the tensional strength and ductility of steel, and above this it possesses certain qualities which are peculiarly its own. It has greater resilience or power to resume its original shape quickly, than any other building material and it can be bent without failing to an extent which would surprise anyone who has not seen it.

"It is *truly monolithic,* that is to say, it has no joints and it forms a light building for the loads it can carry. As regards its durability, all that can be said is that it appears to get stronger the older it is, and this process appears to go on for an indefinite period."

From Bulletin 324 of the U. S. Geological Survey on the California Earthquake; an article by Richard L. Humphrey:

"While reinforced concrete structures were few in the zone of seismic disturbances, these few stood the test by earthquake and fire in a highly satisfactory manner. Rigidity and stiffness and a high fire resistance are inherent qualities of concrete, and this material proved admirably suited to resist these extraordinary tests.

"Concrete, especially reinforced concrete, because of its great adhesive strength and reinforcing metal, proved more satisfactory than any other material. Its *solid, monolithic structure produces a successful earthquake-resisting material, inasmuch as it moves as a unit*; moreover, it offers a maximum resistance to fire."

From the same bulletin, a report by John S. Sewell:

"From the effect on the fortifications, and on monolithic and massive concrete structures elsewhere, as indi-

cated by the details taken from the report of Professors Marx and Wing, it seems justifiable to conclude that a *solid monolithic concrete structure* of any sort is secure against serious damage in any earthquake country, unless it should happen to lie across the line of slip; in that case, the damage might be fatal or it might not; depending altogether on the amount of the slip and the intensity of the forces that accompanied it."

From "La Science de Seismologique," by Comte de Montessus de Ballore, probably the leading French seismologist:

"The building (reinforced concrete) will become a *monolith* and it is justifiable to suppose that there lies the solution of the problem for construction in earthquake countries. * * * Reinforced concrete seems to be the best material in all cases. We had expressed our convictions some time ago and our opinion seems to have been borne out."

Charles Derleth, Jr., Professor of Structural Engineering in the University of California, in his report upon the San Francisco earthquake, published in "The California Earthquake of 1906," edited by David Starr Jordan, says:

"The little San Francisco evidence that one finds, considering also a few reinforced structures, or partially reinforced structures in other places, such as Oakland and Palo Alto, leads one to the conclusion that buildings scientifically designed in reinforced concrete present admirable qualifications for earthquake resistance. There is no reason why reinforced concrete cage constructed buildings of at least six or eight stories in height should not be built in San Francisco. A reinforced concrete structure, when intelligently designed, generously proportioned, and honestly built, is *a monolith of great coherence and high elasticity,* combining the very properties best able to resist earthquake vibration."

When buildings are subjected to the "racking" motion of earthquakes, the weak points of construction are at once apparent. Poorly designed, loosely constructed, and inadequately braced buildings collapse like a house of cards. Professor Derleth and other investigators mention the shearing of rivets in the tower of the Union Ferry Building and in the basement of the Flood Building at the time of the San Francisco earthquake. In the case of the Union Ferry Building, the rivets which sheared were in the tie rod and wind strut connections, and in the basement of the Flood Building a number of rivet heads were sheared off in the connections between the girder beams and column shelf angles upon which the beams rested. Soulé, in his report on the California earthquake, printed in the bulletin of the U. S. Geological Survey, mentioned the fact that after the earthquake, bolts and rivets in the Union Trust Building were found to be loose and some were sheared off. Sewell, in a report printed in the same bulletin, calls attention to the empty rivet holes in the wind strut connections in the tower of the City Hall, although he was not able to determine whether the rivets had been sheared off or omitted entirely by a careless erecting gang. To those who are prone to extol the skill with which steel frame buildings are erected, his statement that "The latter will seem a plausible supposition to anyone familiar with the way in which an average erecting gang does its work," will be of interest. In this connection, it may be pointed out that *in a reinforced concrete structure, there is not possible that concentration of shear which may occur at a riveted joint.*

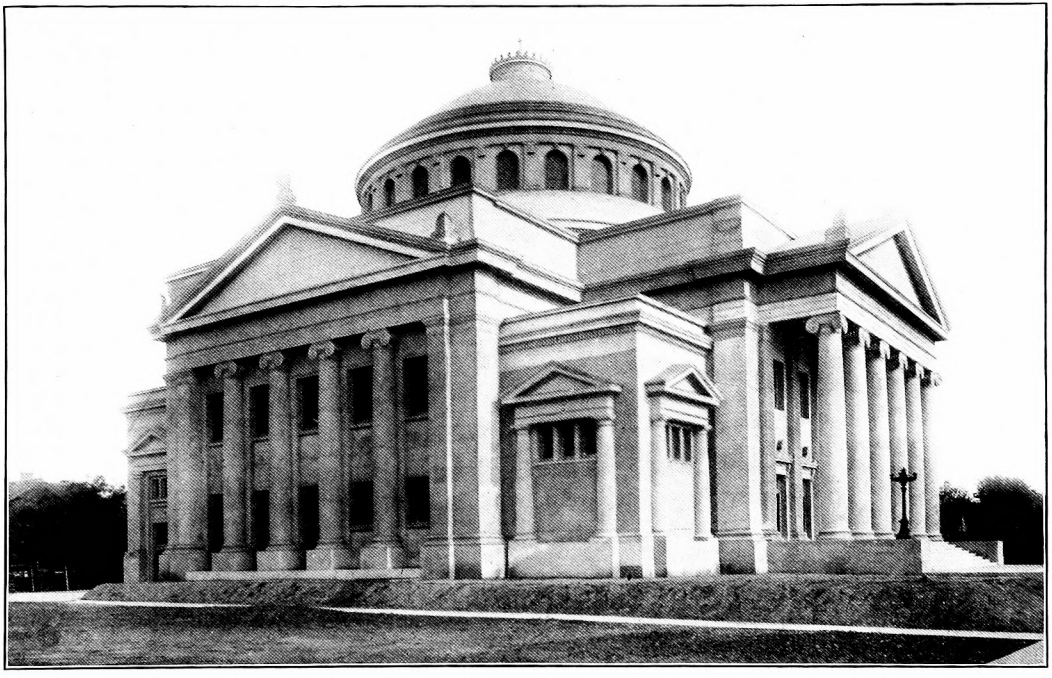
The most general cause for the failure of buildings results from the differential motion which occurs through the inadequate bonding or tying together of the various portions of the structure. The words of Professor Hobbs, in this regard cannot be improved upon.

"Where roof beams have not been properly tied at the bottom, the vertical component of the shock results in a sudden settling of the roof, causing it to spread at the base and 'kick' over the walls. When floors are not properly anchored to the walls, the horizontal component of the shock causes these heavy masses to be thrown against the walls like battering rams, so that the building is wrecked in parts. In a similar way, roofs, when not properly anchored to the walls, are slid over them, and being left without support, collapse."

Heavy roofs, as of adobe, which are unfortunately so common in earthquake countries, are a menace in times of seismic activity and are always a principal cause of damage and loss of life. The center of gravity of the building should be kept as low as possible to minimize the effect of the inertia of the structure.

In a reinforced concrete building, which is of all types of construction the most monolithic when properly built, there are especial features of design which should be carefully considered. All beams, columns and floor slabs should be thoroughly tied together and a liberal amount of steel placed in the slabs over the supports to take care of the negative moment and also to act as a safety factor in the event of reversal of stress due to shock. Careful attention should be given to the adequate bonding of the roof beams to the columns. Column reinforcement should be carried well down and anchored in the footings, which should be heavily reinforced and founded on firm ground. Outside walls and partitions should be of reinforced concrete, the reinforcement extending well into the surrounding beams and columns.

Terra cotta and hollow tile partitions and floors did not give satisfaction in the California disaster, either as earthquake-resisting or fireproof materials. Derleth says: "The earthquake certainly did very much more damage to tile partitions in San Francisco than is generally ad-



Christian Science Temple, Pasadena, Cal. Franklin P. Burnham, Architect.
An elaborate edifice of reinforced concrete (Kahn System) built subsequent to the San Francisco earthquake, showing the ornamental possibilities of concrete in exterior walls.

mitted. These partitions have little strength and are readily collapsible. *They have no elastic continuity.*"

The report of the committee of the San Francisco Association of Members of the American Society of Civil Engineers (Trans. American Society C. E., Vol. 59, 1907), states: "In the case of partitions, those of terra cotta tiling were everywhere cracked and opened. It amounted to practical destruction in most cases."

Mr. Humphrey, in the Bulletin of the Geological Survey previously mentioned, reported the failure of the terra cotta floor tiling in the Chronicle and Union Trust Company's buildings due to the falling off of the lower webs of the tile. Many other similar instances are mentioned in the same bulletin.

An essential feature of beam and girder construction is the use of rigidly connected shear members. While it is never safe to rely upon the adhesion of the concrete, as is the case when loose stirrups are used, it is doubly insecure when the building may be subjected to sudden shock. Mr. J. S. Sewell has admirably covered this point in the Proceedings of the American Society of Civil Engineers, September, 1909, in which he states:

"If it is unsafe to count on the tensile strength of the concrete to resist horizontal tension, it is equally unsafe to count on it for diagonal tension or for shearing stresses in the web. The ultimate solution is to provide a complete system of inclined web members *rigidly attached to the horizontal reinforcement* and designed and spaced to take all the tensile web stresses; and they should extend to the top of the beam and be designed so that their adhesion in the compressed part of the concrete will develop their full strength."

The basis of all conclusions, and the only way in which the truth of the foregoing remarks may be borne out, is by the citation of actual structures which have successfully passed the earthquake test, and the following ex-

amples are submitted as being typical of the behavior of reinforced concrete construction.

Bekins Van and Storage Company's Warehouse:—Among the buildings which passed through the California earthquake and fire of April 18, 1906, there is none which has been so universally mentioned and discussed as the above structure. There had been a great deal of opposition to reinforced concrete, due to the influence of the labor unions, and this structure was the only building in San Francisco which approached a true type of this form of construction. The brick walls adopted by the architect under protest, as a concession to the brick layers' union, were shattered, thus indicating the severity of the shock but otherwise the building was unharmed by the earthquake and succeeding fire. As this structure has been deemed so important by seismologists in the discussion of earthquake-resisting construction, the comments of investigators will undoubtedly be of interest.

A letter from the architect of the above building to the Trussed Concrete Steel Company, written five days after the earthquake, afterwards printed in Engineering News, Volume 55, 1906, Page 520:

"You may be interested to know that the warehouse I have under construction here, using your bars, is up two stories—the third floor slab being finished four days before the earthquake—and that not a crack of any kind is visible in the columns of first story, or the beams and slabs of second floor. I made as careful an examination as possible from the floor, and am more than delighted with its condition.

"Because of the influence of the bricklayers' union, the city authorities refused us a permit for this building until we conceded brick walls. These walls are so badly cracked that probably one-third of same must be rebuilt.

If we had had reinforced concrete outside walls, I am confident that the earthquake would have done no damage to this building.

Yours very truly,

April 23, 1906. R. W. HART, Architect."

From the same volume of Engineering News we quote from an article by Maurice Couchot, on page 622:

"The warehouse mentioned was being built of brick walls with interior columns and floors of reinforced concrete. The columns had hooped reinforcement, the beams were reinforced with *Kahn Bars,* and the floor slabs had a reinforcement of twisted bars running in both directions. The arrangement of the girders gave floor panels about 15x16 feet. The effect of the earthquake on the building was to shatter the brick walls so that something like one-half of them will have to be rebuilt, and to do no damage to the reinforced concrete work."

From Bulletin No. 324, of the U. S. Geological Survey, entitled "The San Francisco Earthquake and Fire;" a report by Richard L. Humphrey on the "Effects of the Earthquake and Fire on Various Structures and Structural Materials":

"The building under process of construction by the Bekins Van and Storage Company, at the corner of Thirteenth and Mission Streets, was the only example of the pure type of reinforced concrete in the city. Two of the six floors were erected, the walls being made of brick laid in lime mortar, and the floors and columns of reinforced concrete.

"The walls were badly cracked by the earthquake but the reinforced concrete was not injured. Considerable furniture stored in the building was burned and the heat slightly blistered the under surface of the concrete floor, which was still green at the time of the disaster."

From the same bulletin, a report by John S. Sewell on "The Effects of the Earthquake and Fire on Buildings, Engineering Structures and Structural Materials":

"The warehouse of the Bekins Van and Storage Company, in process of construction, had reinforced columns and floor construction and brick walls. The walls were badly damaged by the earthquake, but the *reinforced concrete was absolutely uninjured.*"

From the same bulletin, a report by Frank Soulé on "The Earthquake and Fire and Their Effects on Structural Steel and Steel Frame Buildings":

"There are two opposing parties in the matter of fireproofing in San Francisco—those who have favored the hollow tile system and those who believe in concrete as the best fireproofing material. The Bekins Van and Storage Company's warehouse, the only building of considerable size in the city constructed of reinforced concrete, has already been mentioned as resisting the action of the earthquake and fire. In this building the concrete acted as a perfect fireproofing protection for the steel. * * * *

"There was in San Francisco, at the time of the earthquake, only one building of considerable size constructed of reinforced concrete. This fact was due to the opposition of certain labor unions to the use of this material in place of brick and stone. The building referred to is that of the Bekins Van and Storage Company at 190 West Mission Street. This building had outside walls of brick, but was massively constructed on the interior with columns, beams and floors of reinforced concrete. It was originally intended to carry it to a height of four stories, but on account of the earthquake which occurred during construction, the building was finished to include only the second story. [It has since been fully completed to a height of six stories, as evidenced by the illustration herein reproduced]. At the time of the fire, the permanent doors of iron were not in place and the fire

gained access to the front or south room, where very slight damage was inflicted. The entire main interior and the goods stored therein were unharmed and the building has been in continuous use since completion. The brick building adjoining, however, was badly injured by the earthquake and was afterwards burned."

From the Engineering Record, Volume 53, 1906, an article by J. B. Leonard on "The Effect of the California Earthquake on Reinforced Concrete":

"Exterior and interior views are given of the Bekins Van and Storage Company's building on West Mission Street, near Thirteenth. This building is constructed of reinforced concrete columns, girders, beams and slabs, with exterior brick supporting walls. It was under construction at the time of the earthquake, there being but three of the six proposed floors completed. The concrete for the basement floor and columns was completed February 1st, the second story columns and second floor on March 25th, the third floor columns and third floor on April 12th. A careful examination of the concrete portion of the building fails to reveal any sign of injury or cracks as a result of the earthquake, while the exterior brick walls have suffered severely. One bay at the front of the building was filled with highly inflammable goods which were destroyed by the fire. The effect of the fire on the underside of the second floor was to pit the concrete only sufficiently to expose a small portion of the bars, in a few places, but did not seem to affect the strength of the floor. This concrete was less than one month old. The owner of the building intends, if the new City Ordinance permits, to replace the brick exterior walls with reinforced concrete. The conservatism of the previous building ordinances compelled him, much against his wishes, to build originally with brick exterior walls. Mr. Ralph Warner Hart was the architect."

While it was naturally a source of considerable satisfaction to the Trussed Concrete Steel Company that this structure was built Kahn System, the point to be especially emphasized is that it was a reinforced concrete structure "intelligently designed and honestly built," and that it has received the commendation of every investigator of importance.

Other Buildings—California:—Although there were no other structures of any considerable size of reinforced concrete in the district visited by the California earthquake, the comments on some of the smaller buildings are of value.

Quoting further from Mr. Leonard's article in the Engineering Record:

"In other sections near the city there were small structures built entirely of reinforced concrete. *These received the full force of the earthquake and showed no damage therefrom.* They seemed to have ridden the waves or vibrations, as one occupant describes it, as though they were so many cast-iron boxes rising and falling en bloc, with an entire absence of the rumbling and grinding noise which was prevalent in all other classes of construction.

"An inquiry among architects and engineers together with my own observations, have *failed to reveal any instance of failure on the part of reinforced concrete.* Its general behavior has been such as to make it the most favorably considered material for the rebuilding of San Francisco by the investing public."

From a letter to the Trussed Concrete Steel Co., written by one of the leading architects in San Francisco:

"Up to the present time (May 1, 1906), our examinations have shown that concrete, in any form, has stood the earthquake and fire perfectly. Terra cotta, in a few buildings where we used it, was not satisfactory. The library we have just completed out of the city, suffered

a severe shock. There is not a crack showing. It was built entirely of *Kahn* reinforced concrete.

(Signed) WILLIAM E. CURLETT."

At the Leland Stanford University there was presented a splendid proof of the superiority of reinforced concrete over brick construction. Quoting again from Bulletin 324, of the U. S. Geological Survey; J. S. Sewell's report:

"The buildings of the third class at the Stanford University were built of concrete. The girls' dormitory had concrete walls and timber interior construction, and in the central portion of the Leland Stanford Junior Museum, the oldest part of the building, the walls and interior construction were of reinforced concrete. There were two wings built of brickwork with reinforced concrete floor construction. It is reasonable to suppose that the intensity of the force applied to this building by the earthquake was nearly uniform over the entire structure. The two brick wings were practically shaken down, suffering, I should judge, more than fifty per cent damage. The reinforced concrete central portion, viewed from the exterior, seemed absolutely undamaged. In the interior a few cracks had opened up, but they were not of serious consequence. I should judge that a few thousand dollars would easily cover all the repairs to this part of the building. Its valuable contents were, to a large extent, thrown to the floors and smashed, involving a considerable loss, but the structure itself suffered almost no injury. The only damage to the girls' dormitory was caused by a chimney that toppled over and crashed down through the roof, doing some damage on the inside. The concrete wall showed one or two cracks which however, were said to be shrinkage cracks that had appeared soon after the building was finished. The earthquake apparently had caused no visible damage of any sort in the exterior walls."

Singer Sewing Machine Co., Kingston, Jamaica.
An attractive Kahn System building in a city which has adopted reinforced concrete construction for all important buildings since its disastrous earthquake.

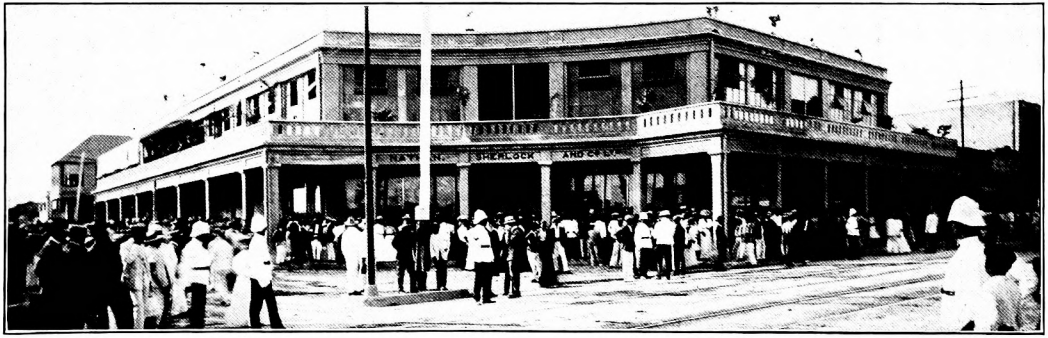
The eminent Italian engineer, M. de Palo, during his visit to Costa Rica subsequent to the earthquake in that country, made the following remarks.

"Very little had been done in San Francisco prior to 1906 in reinforced concrete, and the whole number reduced itself to two buildings: one at the Leland Stanford University and the other in the lower part of the city, a four-story building intended as a warehouse for machinery. Both constructions supported the earth movement admirably and it is interesting to note what happened at the Stanford University. The building was constructed on pilasters and footings to a height of two stories, the third terminating in a cupola. Possibly from a poorly conceived idea of economy, the spaces between the pilasters were filled with brick walls. When the shock came, the reinforced concrete remained intact, while the brick walls were totally shattered. This example in itself is sufficient to recommend this type of construction, which now has been adopted in nearly all countries, especially those in zones of high seismicity."

The discussion of the behavior of buildings in the California earthquake may well be closed by the following words from an editorial which appeared in the Engineering News, Volume 55, 1906, No. 21.

"Reinforced concrete made an enviable record in the recent California earthquake disaster. No one, we believe, will dispute this statement who reads with an open mind the accounts of the behavior of this material published in this and preceding issues of Engineering News. It is true, of course, that there was not a large amount of reinforced concrete construction within the area of greatest damage and that the buildings in which it existed were not large or lofty, but this does not remove the fact that *every reinforced concrete building in the district visited by the earthquake and fire is still standing*, with only minor damages to be repaired."

Government Rum Warehouses, Kingston, Jamaica.



Nathan, Sherlock & Co., Ltd., Kingston, Jamaica.
Kahn System Warehouses and Stores in the new "all concrete" city built since the earthquake.

Jamaica:—The disaster of January 14, 1907, in Jamaica, left standing in that city, according to the report of Comte de Montessus de Ballore, in his "La Science de Seismologique," only two structures, both of reinforced concrete. At any rate the behavior of structures of this material was such that at present practically every building in Kingston of any importance is of reinforced concrete and of these, a very large percentage are of Kahn System.

As an instance of the action of concrete structures, note the following letter written by the owner of an estate in Port Antonio, published in Cement Age, March, 1907, in connection with an article entitled "A Concrete House in the Jamaica Earthquake."

"I write you to let you know that the house at 'Folly' and all the other concrete erections upon the place have passed through the late earthquake without showing the least crack or shake. From the accounts in the papers, which are all derived from sources desirous of minimizing the violence of the shock upon the north side of the island, you will get a very false idea of it. Perhaps the relation of the following fact will enable you to appreciate the damage of movement to which we were subjected.

"Owing to misjudgment of proper time of repairs, when we arrived here we found very little water in our reservoir, which was soon consumed. An unparalleled drought followed, and we have not had a drop of fresh water since about the first of January. Consequently, we have used our bath tubs all over the house as tanks for salt water for use in flushing the water closets. At the time of the earthquake, all bath tubs put to such use were about half full of sea water. In every case a considerable part of the water was splashed over the sides or ends of the bath tubs upon the floor of the bath rooms. The rumbling noise which momentarily preceded the first and heaviest shock, and which seemed like the passage of a train of cars over the roof, drove us out of doors, and it

seemed as though the house must be shaken to pieces. But we soon returned to it to ascertain what damage had been done, and found only the bath room floors flooded, as I have stated.

"I give you this information because it is a great satisfaction to feel so much security in the strength and solidity of our house.

Very truly yours,

ALFRED MITCHELL."

The buildings on this estate, besides the main residence, which was about 246 feet in length, over all, included a ten-room house one story high, for the coachman and other white employees on the estate, a stable about 90 feet by 56 feet with a court yard in the center, two pavilions located at points commanding attractive views, power house, reservoir for domestic water supply, a bridge of 30-foot span, and a gate lodge commanding the entrance to the private grounds. All of these buildings were constructed of reinforced concrete and as the owner states, suffered no injury. No better example of successful earthquake-resisting construction can be found anywhere than this group of structures, including as it did a variety of types, and it is convincing evidence of the worth of the materials used in their construction.

Messina.—In connection with the disaster of December 28, 1908, there appeared the following statement in the Paris edition of the New York Herald.

"The *only* buildings that remain standing in the city are a lunatic asylum and four or five houses built of reinforced concrete. It is a strange sight to see these houses standing unharmed amid the ruins."

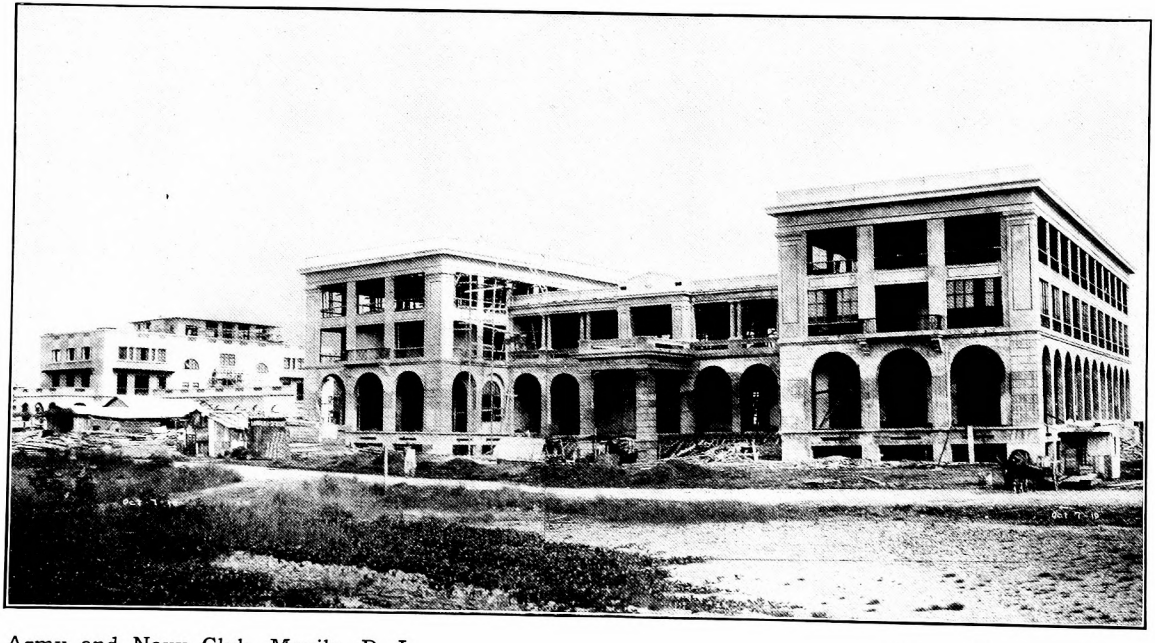
The report of Professor Nakamura on the Messina earthquake mentions that a reinforced concrete floor in a rubble masonry house fell without breaking when the

masonry wall collapsed and that a reinforced concrete reservoir at a little distance from Messina was absolutely undamaged.

The Royal Commission, appointed by the Italian Government to investigate the Messina earthquake and to prepare a set of regulations for construction in districts of high seismicity, reported that "of four reinforced concrete structures in Messina none were injured," and called especial attention to the fact that the covering or culvert of reinforced concrete over the stream Portalegni where it ran through the city, did not collapse under the weight of the debris.

As a result of the destruction of Calabria in 1905 and of Messina, in 1908, the "Società Cooperativa Lombarda di Lavori Pubblici" opened a competition for the study and application of systems of construction best adapted to localities subject to earthquakes. The awarding committee was selected by the College of Engineers and Architects of Milan, and comprised the leading seismologists, architects and engineers in Italy. Over two hundred individuals and firms from all over the civilized world competed and presented plans, specifications and models of structures. The awarding committee reported in part as follows:

"The type of structure which appears to predominate among the plans submitted for buildings of a permanent character is of 'baraccate' construction: including the simple and original structure of 'Bourbon baraccate' made of a cage of wood buried in masonry, and the later form designed in accord with modern methods, in which the steel alone or in combination with concrete, brick, or cement block, produces with equal facility, and with greater safety, the degree of stability ensured by the wood skeleton. Finally plans were submitted of a true and proper monolithic construction in reinforced concrete, which in this instance, attracted the attention of the ablest engineers on



Army and Navy Club, Manila, P. I. Harry Allyn, Architect.

One of the most pretentious buildings in the Philippines, subjected to frequent earthquake shocks. Entire construction is reinforced concrete (Kahn System). Elks' Club at left, also of reinforced concrete.

account of the ease with which this material adapts itself to the solution of every problem of construction."

The first three prizes awarded in this competition were for structures of reinforced concrete.

Mario Baratta, one of the most eminent seismologists in Europe, in his report "Le Nuove Costruzioni in Calabria," says of reinforced concrete:

"This system, in my opinion, represents where it is an economic possibility, the best solution of the complex problem of construction in countries subject to earthquakes. Walls, ceilings, and roofs of reinforced concrete make a monolithic mass which has for its especial property the ability to resist the greatest seismic shocks and to undergo deformation without endangering the safety of the inhabitants of the building."

Philippine Islands.—The large amount of reinforced concrete work that has been done in the Philippines is an indication of the confidence with which this material is regarded in an earthquake country. A letter from Mr. Harry Allyn, late Supervising Architect for the U. S. Army in the Philippines, to the Trussed Concrete Steel Co., is of interest in this connection. Mr. Allyn was also architect of the Army & Navy Club and Associate Architect of the Manila Hotel, concerning which he writes:

"Gentlemen:—You may be interested to know that the Army and Navy Club which was practically completed, and the Manila Hotel which was well under way, both withstood the effects of the recent eruption of Mount Taal in January, 1911, without any damage whatever to the buildings. During the eruption, 964 distinct shocks were recorded in Manila of which at least 40 were strongly and generally felt. Concrete construction generally throughout the city was uninjured by the shocks, but it was a source of especial satisfaction that the green concrete of these two large buildings stood up perfectly.

"Reinforced concrete is the standard form of construction in the Islands, and the behavior of the structures mentioned, both of which were built Kahn system, has gone a long way towards convincing the most skeptical.

EASTERN ENGINEERING COMPANY,
(Signed) Harry Allyn,
General Manager."

Innumerable other instances might be noted, but those given are sufficient to prove that reinforced concrete structures "intelligently designed and honestly built" will successfully resist earthquake shocks. It is a remarkable indication of the worth of the material that structures of reinforced concrete stood up where buildings of other materials failed, but the most significant fact is that there is on record, in the numerous works which have been reviewed, no instance of the failure of a reinforced concrete structure; with the exception of the Cyclorama, on Strawberry Hill, in San Francisco, which failed through the undermining of the foundation, caused by a slip of the earth amounting to five feet or more, and not through any fault of the construction itself.

Chimneys.

The falling of chimneys is one of the most dangerous and at the same time common features of seismic disturbances. The heavy masses of brick and masonry crashing through the roof and floors of a building often cause the collapse of the entire structure and heavy loss of life, whereas if the chimney had not broken off, the damage might have been of a less severe character. During the California earthquake, brick chimneys on school buildings fell upon roofs and passed through every floor to the basement. If the hour had been later and the schools filled, as usual, the loss of life would have been terrible.

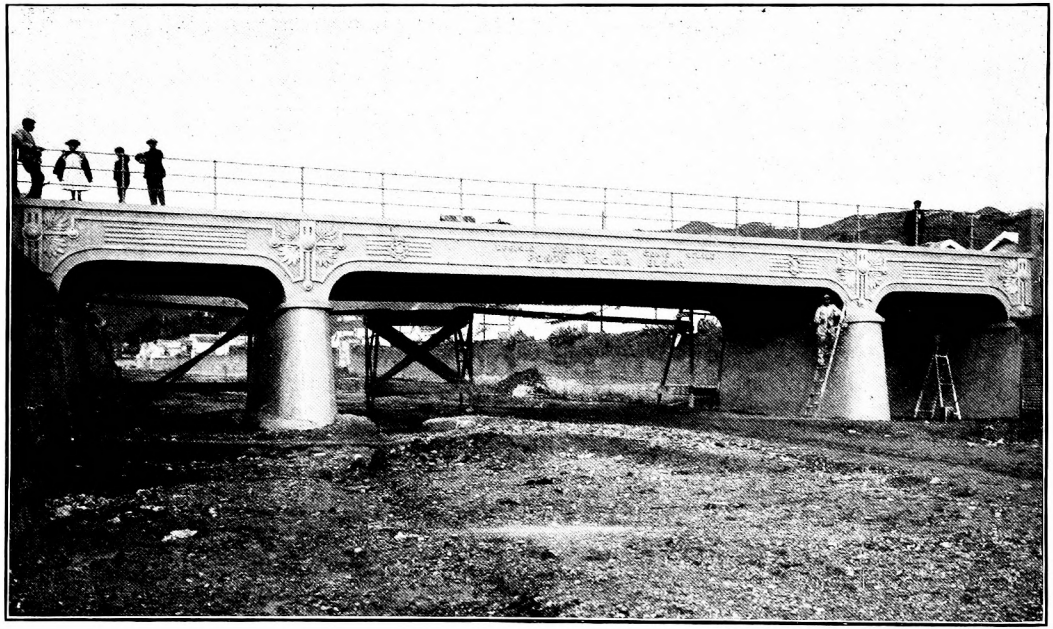
Chimneys of brick, tile and masonry are practically never reinforced adequately, and the ratio of the height to the base being large, are very susceptible to earthquake shock. A steel stack securely guyed is fairly safe against shock, but it is non-fireproof and the disastrous fires which have followed earthquakes have shown this to be quite as prime a consideration as ability to resist seismic movement.

The remarks of J. S. Sewell, in the bulletin of the Geological Survey on the San Francisco disaster, previously mentioned, are to the point.

"Chimneys seemed to be shaken down everywhere; even where there was no other damage, this result was almost universal. The chimneys, as a rule, were built of bricks laid in lime mortar, and generally broke off at a point where they came through the roof. Reinforced concrete chimneys with a terra cotta lining would be very little more expensive than the kind that were ordinarily built in San Francisco, and would have suffered very much less damage. * * * * Appearances seemed also to warrant the conclusion that in the vibration, some chimneys were brought up short against the roof framing and thus caused to break off at this point. If there had been a little more room for relative vibration between the chimney and the framing, it seems possible that some of these chimneys would not have fallen. The best way to prevent such damage is to build the chimneys of reinforced concrete or some other material that has both rigidity and great tensile strength. Such chimneys would not ordinarily break off even though they jostled against the roof timbers."

Still better results will be obtained when the roof and chimney are of the same material and tied together in one monolithic mass.

Derleth says: "Chimneys in San Francisco were built of brick and very often without cement in the mortar. With few exceptions, the chimneys were thrown down by



Ponte Regina Elena, Messina, Sicily.

One of the first permanent structures erected after the Messina earthquake. Kahn System of reinforced concrete was used throughout. Massive in character to resist earth flow and attractive in appearance.

rupture within the middle third of the height. A number of lives were lost by falling power-house chimneys. In the future, I believe chimneys should be built of reinforced concrete."

Reinforced concrete chimneys, being monolithic and adequately reinforced to resist bending, are ideal for districts subject to earthquakes, and the material safety ensured by their use should absolutely prohibit any other type.

Bridges.

Almost without exception, bridges have suffered damage through the tendency of the banks of a stream to approach each other under seismic shock. To escape destruction therefore, the bridge must be capable of resisting extraordinary compression and longitudinal shear, or must be provided with a plane of weakness at one or both abutments where a differential movement may take place without serious injury to the structure. If the latter scheme is adopted, the bridge will slide over its abutments and will be damaged to some extent, the amount depending upon the nature of the vibration in the bridge and whether the vertical component of the shock is sufficient to cause the bridge to jump from its seat, but if the structure is a monolithic mass which has sufficient strength to resist the stress caused by the earth flow, it will be uninjured. Here again a deep foundation carried well down below the region of surface movement is essential.

The damage to bridges during earthquakes has always been very heavy, although the subject has received surprisingly little attention from seismologists. In the Mino-Owari earthquake of 1891, in Japan, a brick railway bridge near the Biwajima river failed; the abutments pushed up and back and the arch broke into two quadrant-shaped masses and collapsed into the river. The great Kisogawa bridge, consisting of long span through trusses carried on

massive piers, was seriously damaged, and the foundations were sheared, as one writer says, "like sticks." Of this structure Milne and Burton say: "The lateral shifting of the foundation, by which the distances between piers has been reduced, has been the result of a permanent compression which, had the bridge been represented by a line across the river bed, would have contorted it into one or more snakelike bends."

The five-span truss bridge over the Nagaragawa river in Japan, damaged by the same earthquake, is perhaps the most remarkable example on record of the action of a bridge under earth flow. The piers at the adjacent ends of two of the trusses collapsed, letting the ends of the trusses fall into the river bed, the other piers failing partially by longitudinal displacement. Despite this, and the additional fact that the middle spans suffered considerable lateral movement, the connections between trusses were unbroken and the bridge was still continuous, thus indicating the remarkable shortening that must have occurred in the distance between banks.

In the California earthquake the Salinas highway bridge, an ordinary single-span truss, is a typical example. In this case one abutment was not disturbed, but the other was bent back at the top and the ground underneath moved out toward the river, an estimated distance of six feet.

Professor Hobbs has investigated this subject thoroughly in "A Study of the Damage to Bridges During Earthquakes," published in the Journal of Geology, Vol. 16, 1908.

The following extract from J. B. Leonard's report in the Engineering Record, previously mentioned, illustrates the action of reinforced concrete bridges in California at the time of the earthquake.

"The reinforced concrete bridge at Pollasky, consisting of ten 75-foot spans, together with wings, a total length

of 780 feet, described in the Engineering Record of February 24, 1906, shows no defect whatever from the earthquake. The 112 foot arch designed by the writer, which was built across Dry Creek in Stanislaus County, near the City of Modesto, also passed through the temblor without showing the slightest sign of crack or failure."

Professors Marx and Wing noted in the vicinity of the fault, a number of concrete bridges, all of which were uninjured. Attention has already been called to the bridge on the estate of Mr. Alfred Mitchell in Jamaica, which suffered no damage from the shock, and to the concrete covering over the Portalegni river in Messina which stood up under the weight of the debris. Mr. Humphrey, in the Bulletin of the Geological Survey, reported: "At the bottom of Strawberry Hill is a bridge crossing over Stow Lake. This bridge is made of concrete and *showed no signs of cracking although the banks of the lake slipped into the water.*

As examples of two modern and contrasted types of earthquake-resisting bridges, photographs of the "Ponte Regina Elena" in Messina, and the Yoshida bridge, now under construction in Japan, are here reproduced. In connection with the former, an article appeared in The Engineering News, June 4, 1910, entitled, "A Reinforced Concrete Girder Bridge in an Earthquake Region."

"At Messina, Sicily, where such havoc was wrought by an earthquake a year and a half ago, there has been erected recently a rather attractive bridge of reinforced concrete, shown by the photographic view herewith. This bridge, incidentally, is one of the first permanent structures to be completed in the rebuilding of the city. It is known as the Ponte Regina Elena. Special effort was made to give it an attractive finish by ornamentation of the girder faces as well as in the disposition of the general outline of the structure. The simple gas-pipe

Yoshida Bridge, Yokohama, Japan (shown during construction.)
Designed in reinforced concrete (Kahn System), with particular reference to resisting earthquake shocks.

railing is not out of harmony with the heavier appearance of the body of the bridge.

"While the bridge was constructed by Italian contractors, M. G. Cervello & Co., of Palermo and Messina, an American type of reinforcement, that of the Trussed Concrete Steel Co., of Detroit, Mich., was employed. The central span of the bridge is 39.4 ft. (12 m.) in the clear, and each of the two side spans is 12.6 ft. (3.85 m.) in the clear. The deck of the bridge is 24.6 ft. (7.5 m.) wide, of which 30 ins. on either side is represented by the overhang of the sidewalk, the main outside girders being 19.7 ft. (6.0 m.) out to out. There are five longitudinal girders, spaced 3.77 ft. (1.15 m.) apart in the clear. Each girder is 32 ins. deep (including the 5-in. floor slab); the outside girders are 10 ins. thick, the others 12 ins. The end filleting of the girders contains diagonal reinforcing bars arranged like brackets, and these are tied to the up-and-down reinforcement of the piers."

The Yoshida bridge was designed by the Trussed Concrete Steel Co., and is being erected under the supervision of Dr. Ishibashi, City Engineer of Yokohama. It consists of a central arch span of 60 feet with smaller arch spans at each end of twenty-five feet. On account of the damage from earthquakes, special precautions were taken in the design, to preserve the monolithic character of the structure when subjected to seismic shocks, by carrying the arch reinforcement well down into the piers and by changing the lapping of the steel in the intrados so as to alternate the same on either side of the crown, thereby reducing the laps by half at any one point.

Structures such as these will resist the compressive action of the banks of the stream and as the foundations are carried well down to firm ground (in the case of the Yoshida bridge, piles are used), the surface earth will flow around the abutments and will not cause serious damage.

Underground Construction.

A very serious result of the flow of surface earth, due to seismic shocks, is the destruction of gas and water mains and sewers. Aside from grave sanitary aspects, the city is practically at the mercy of the disastrous conflagrations which, following earthquakes, often do more damage than the temblor itself. Professor Derleth's words on this subject are of great value, although there is a difference of opinion as to the advisability of his plan of a flexible pipe instead of a stiff monolithic construction.

"The brick sewers (in San Francisco) were universally helpless to resist destruction in these regions, and the cast iron water and gas pipes fared no better. I believe reinforced concrete sewers in these districts would have shown much greater resisting qualities, but I am convinced that even such material could not withstand the earthquake stresses on the dividing line between made and filled ground. At such points, flexible joints might have helped the sewer and water pipes, but it is difficult to conceive of a practical means for procuring flexibility at any point in a brick or concrete sewer. Moreover, it would be requiring a power of prediction not resting in human beings to determine the proper location for flexibility. Important water pipes, wherever possible, should avoid soft ground by going around it and those that must traverse filled areas should be of riveted steel or wrought iron with flexible joints at intervals. Greater probability of resistance to rupture might be further ensured by encasing pipes traversing the most treacherous ground in tunnels of reinforced concrete with suitable clearance between the pipe and the tunnel walls. An added advantage of this scheme would be ease of inspection."

The practicability of this plan for important pipes was proven in the recent earthquake in Mexico, as the tunnels of reinforced concrete in Mexico City gave perfect protec-

tion to the pipes contained therein, while conduits outside the city failed generally.

The report of the committee on sewers of the American Society of Civil Engineers contained in the general report upon the San Francisco earthquake (Trans. A. S. C. E., Vol. LIX, 1907), states that "In San Francisco a reinforced concrete sewer, on a pile foundation where the ground does not furnish suitable support, will probably give the best satisfaction."

The monolithic character of concrete conduits is a more effectual insurance against earthquake shocks than any number of flexible joints which, however well designed, can take up only a very limited amount of differential movement. Note the behavior of a concrete culvert connected with the San Andreas dam in California, as set forth by Sewell in the Bulletin of the Geological Survey.

"A concrete culvert was connected with this dam and one of the worst transverse cracks noted ran diagonally over the culvert, but the culvert itself was uninjured."

The behavior of a flexible joint in this instance would have been at least problematical. The remarkable stiffness of concrete conduits and tunnels and the impossibility of concentration of stress as at riveted joints (according to Derleth, the Crystal Springs conduit in California was broken at the "transverse circular riveted joints" and the Pilarcitos conduit, in a distance of three miles, had nineteen ruptures, every one of which occurred at "transverse riveted joints") are convincing reasons for the employment of this material in underground structures.

IV.

FIREPROOFING

The problem of adequate fireproofing is of the most extreme importance and especially in districts of high seismicity, as disastrous fires resulting from fallen chimneys and broken electrical connections almost invariably follow earthquake shocks and frequently cause far greater damage than the temblor itself. There is so much conclusive evidence and such unanimity of opinion on the superiority of reinforced concrete as a fireproofing material, and metal window sash with wire glass as a further protection, that it is not necessary to enter upon an extended discussion. The basis of the fireproofing quality of concrete is of course, the fact that the coefficients of expansion of concrete and steel are practically the same and that there is consequently no tendency for the concrete to crack away from the steel. The necessity for metal window sash and wire glass was well demonstrated in San Francisco where many buildings which were otherwise fireproof were gutted by fires that found entrance through unprotected openings. The methods of protection against fire and the need thereof are now well understood by architects and engineers.

* * * *

The immense destruction of property and the terrible loss of life in the disasters in Calabria and Messina, California, Jamaica and Costa Rica in the last few years have shown the urgent necessity for a thorough study of the problem of earthquake-resisting construction, and have indicated the solution to be the general employment of reinforced concrete structures "intelligently designed and honestly built."

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HY-RIB

ROOFS—FLOORS—WALLS
SIDINGS—PARTITIONS
CEILINGS—FURRING

SILOS — TANKS — CONDUITS

CONCRETE WITHOUT FORMS

TENTH EDITION
April, 1913

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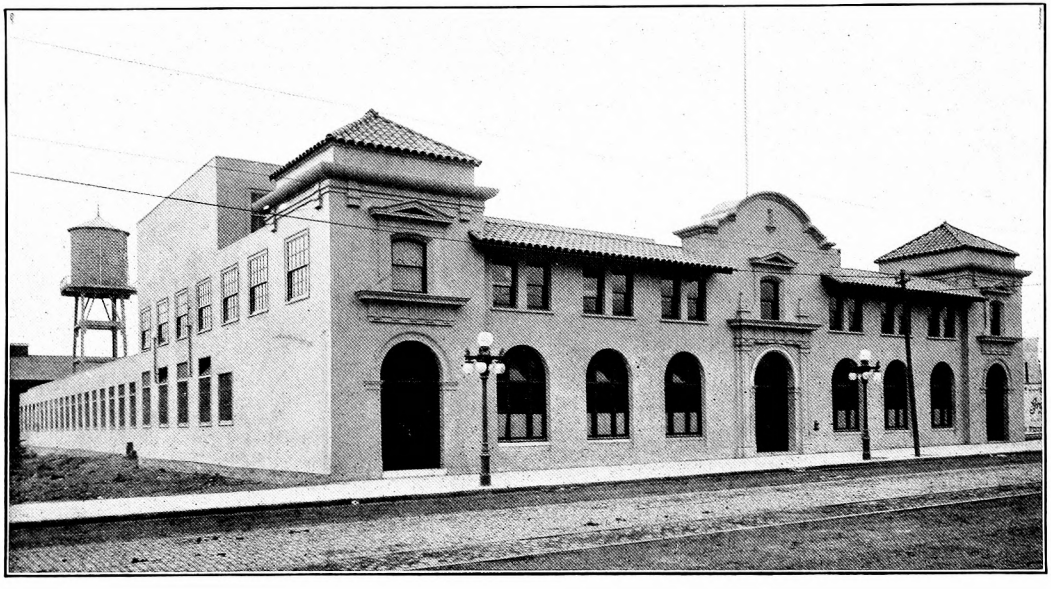

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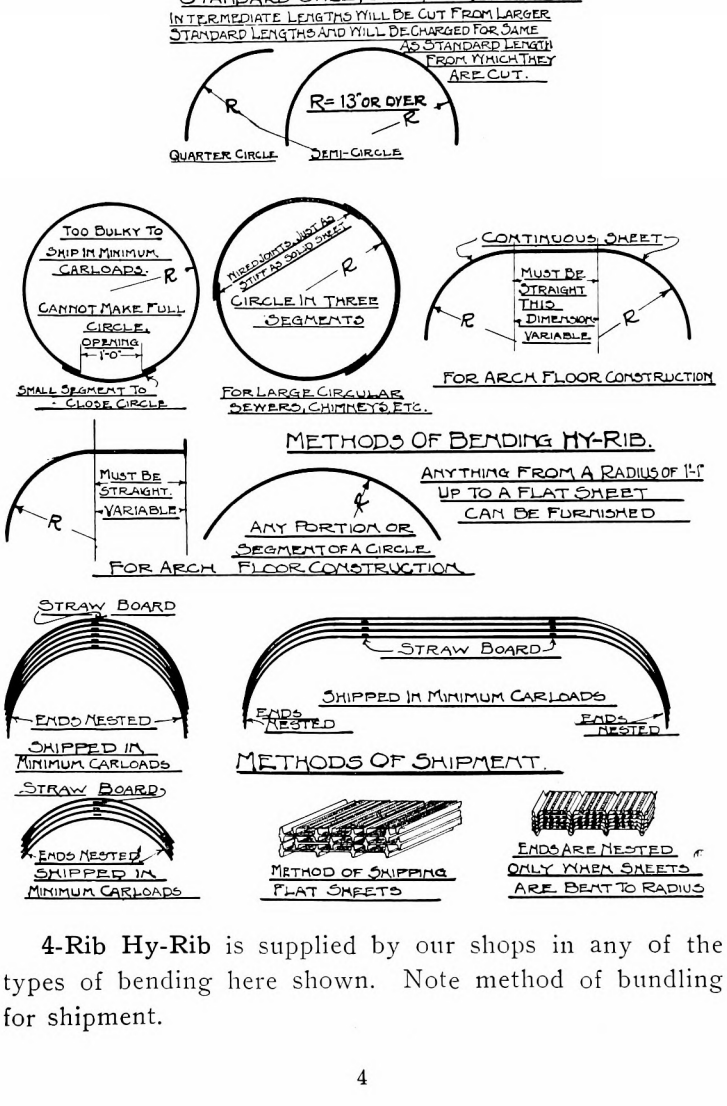

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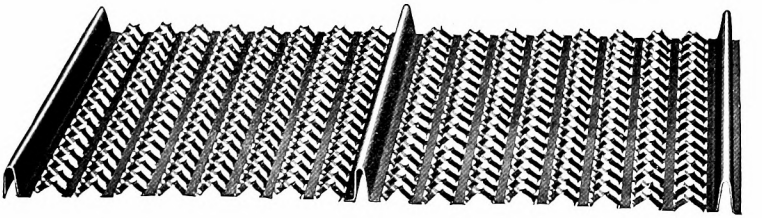
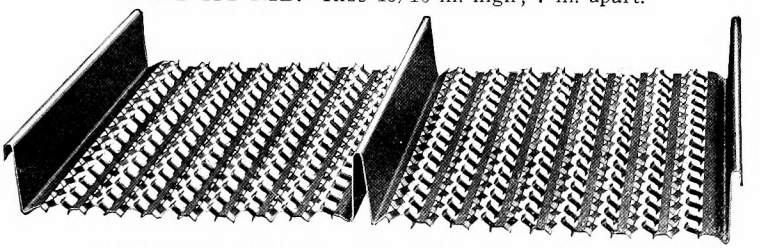


3-RIB HY-RIB. Ribs 13/16 in. high; 7 in. apart.



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Deep-Rib **Hy-Rib**	22, 24, or 26	7″	1½″	14″

Standard Lengths, 6, 8, 10, and 12 feet.

Intermediate and shorter lengths are cut without charge but any waste is charged to the purchaser. **Hy-Rib** sheets interlock at sides and ends. In ordering, no allowance need be made for sidelaps as these are provided in the **Hy-Rib.** Allow 2 inches for end laps where splice occurs over supports; otherwise, eight inches.

4-Rib and 3-Rib Hy-Rib is shipped in bundles of 16 sheets; **Deep-Rib Hy-Rib** in bundles of 8 sheets.

Hy-Rib is supplied either painted or unpainted.

HY-RIB BENT TO CURVE

Our shops are equipped with special rolls to bend **4-Rib Hy-Rib** to any desired arc of circle with radius varying from 13 inches to 20 feet. The shop bending insures absolute accuracy and smoothness of curve and avoids the necessity of expensive special field labor.

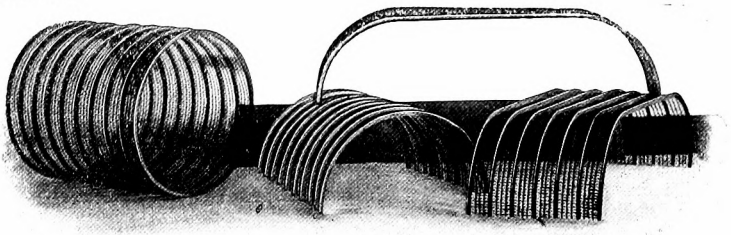
Curved Hy-Rib possesses all the advantages of straight sheets, but in a more marked degree. Circular forms of any kind are very expensive. **Curved Hy-Rib** does away entirely with these forms and provides at the same time the reinforcement for the concrete.

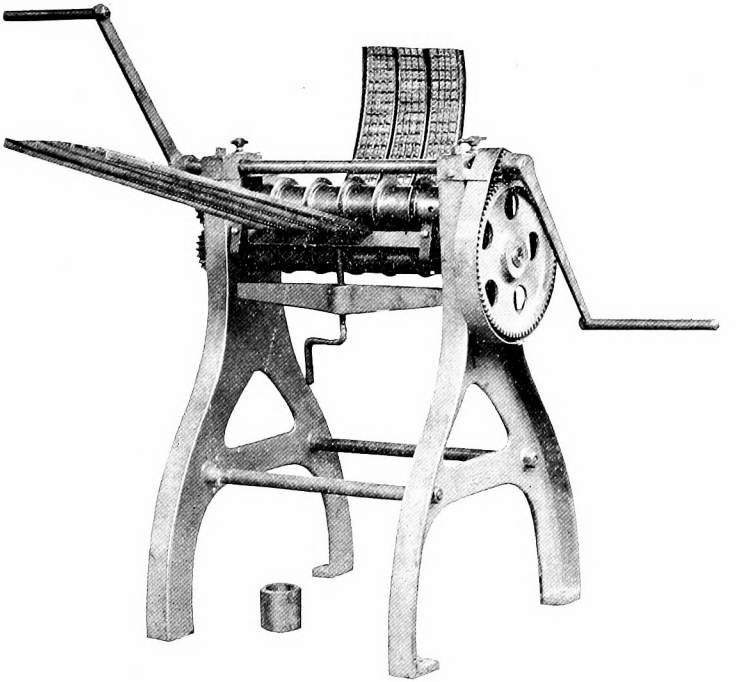
Hy-Rib is supplied at small extra charge with the following types of curve:

1st. **Circular—any arc with radius between 13 inches and 20 feet,** and covering any portion of a circle less than three-quarters of the whole circumference.

2nd. **Central portion straight and both ends curved** to the same arc.

3rd. **One end of the sheet straight, the other end curved.**





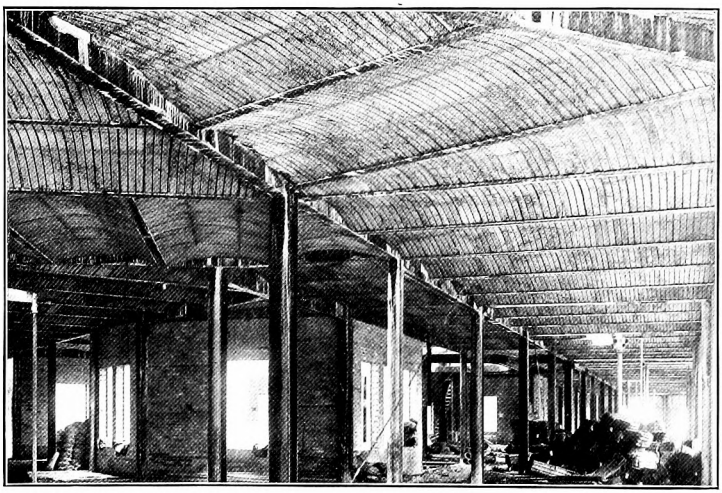
HAND-POWER HY-RIB BENDER

FOR CURVING EITHER 3-RIB OR 4-RIB HY-RIB

View shows 4-Rib Hy-Rib in Machine. By substituting filler-collars, machine is readily adapted for 3-Rib Hy-Rib.

The Hy-Rib Hand-Power Bender is readily operated by two men, so that Hy-Rib can be shipped in straight sheets and curved locally. This saves greatly in freight and crating charges, as curved Hy-Rib bulks largely and is much more expensive to pack and ship than straight sheets.

The Hand-Power Bender curves Hy-Rib to any circular arc with radius between 13 inches and 20 feet.



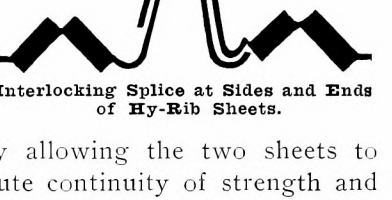
Arched **Hy-Rib** Floor for St. Mary's Hospital, Milwaukee, Wis., showing Hy-Rib ready for concreting and underside before plastering.

Esenwein & Johnson, Archts. J. D. Gregg, Supervising Archt.

FLOORS

Hy-Rib is used in floors in connection with any type of beam—reinforced concrete, steel, or wood. Its use is very simple. Lay the **Hy-Rib** over the supports with the lath side down and pour in the concrete from above. The concrete flows through the lath surface only enough to secure a perfect clinch on the steel. The plaster is applied directly to the under surface.

The **Hy-Rib** provides in itself the form work for the floors and the reinforcement for the concrete, greatly reducing costs, simplifying construction and saving time in erection.

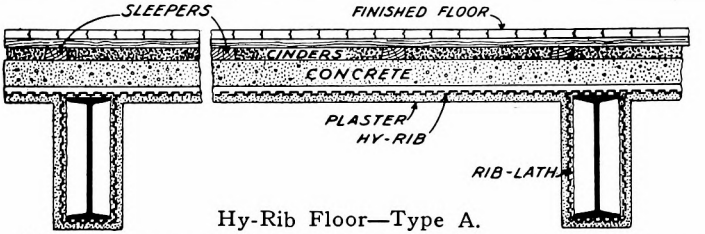


Interlocking Splice at Sides and Ends of Hy-Rib Sheets.

Hy-Rib is manufactured with a rib along each side of the sheet, making a perfect interlocking splice when two sheets are joined. A similar interlocking splice is provided at the ends by allowing the two sheets to overlap. In this way absolute continuity of strength and reinforcement is provided throughout the entire floor surface.

Floors to carry heavy loads are frequently built of concrete in the form of an arch. For such work our shops are equipped to provide 4-Rib **Hy-Rib** bent to exact curve, thus the very expensive circular form work is done away with.

Practical builders know that the form work is the expensive and troublesome part of concrete floor construction, whether straight or curved. The great economy and convenience in using **Hy-Rib**, which provides in itself the forms and reinforcement for the concrete, is thus apparent. **Hy-Rib** saves time and money.

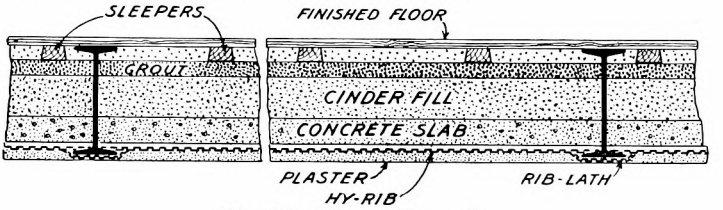


Hy-Rib Floor—Type A.

Hy-Rib sheets are laid on top of steel beam, concrete poured in and under surface plastered; no forms are used. Solid concrete or hollow tile may be substituted for fireproofing of steel beam.

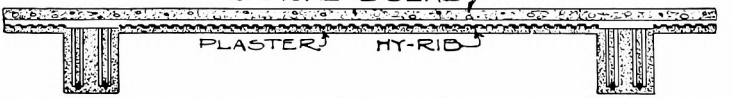
Hy-Rib Floor—Type B.

Finished concrete slab is flush with top of steel beam, giving greater head room below beams. **Hy-Rib** sheets are supported on the sides of beam boxes used as forms for the steel beam fireproofing. No other forms are necessary.



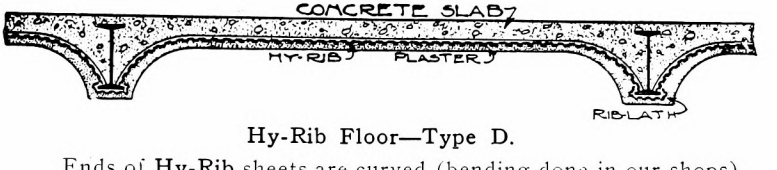
Hy-Rib Floor—Type C.

Flat ceiling is secured by constructing **Hy-Rib** slab on the lower flange of beam. A light cinder fill over the slab brings the finished floor flush with top of steel beam, and no forms are necessary.



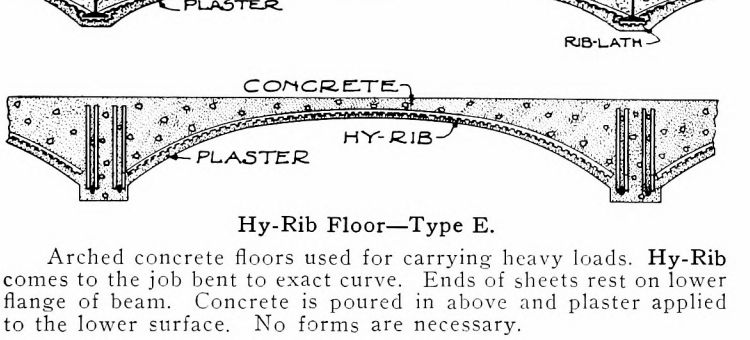
Hy-Rib Floors with Reinforced Concrete Beams—Types A, B and C.

Hy-Rib sheets are supported on the sides of the beam boxes used as forms for the concrete beams; no other forms necessary. If **Hy-Rib** extends over concrete beams, punch out the lathing between the ribs to permit filling of the beam.



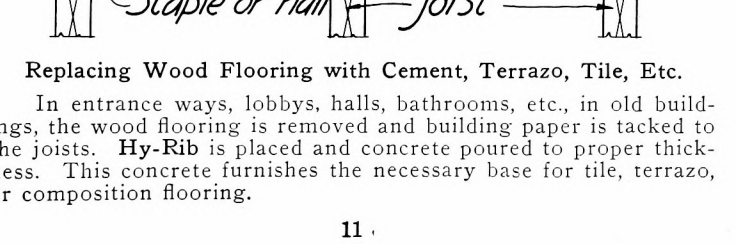
Hy-Rib Floor—Type D.

Ends of **Hy-Rib** sheets are curved (bending done in our shops) and rest on lower flange of beams. **Hy-Rib** provides the fireproofing of steel beams without the use of forms. With reinforced concrete beams the sides of the beam boxes are done away with as the ends of the **Hy-Rib** sheets rest on the bottom board.



Hy-Rib Floor—Type E.

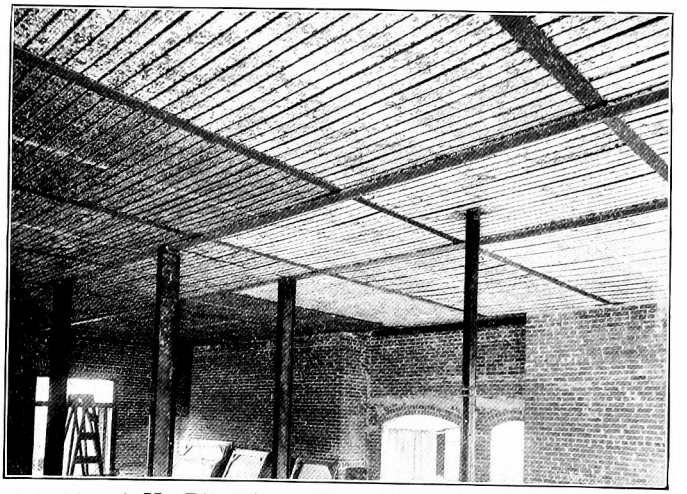
Arched concrete floors used for carrying heavy loads. **Hy-Rib** comes to the job bent to exact curve. Ends of sheets rest on lower flange of beam. Concrete is poured in above and plaster applied to the lower surface. No forms are necessary.



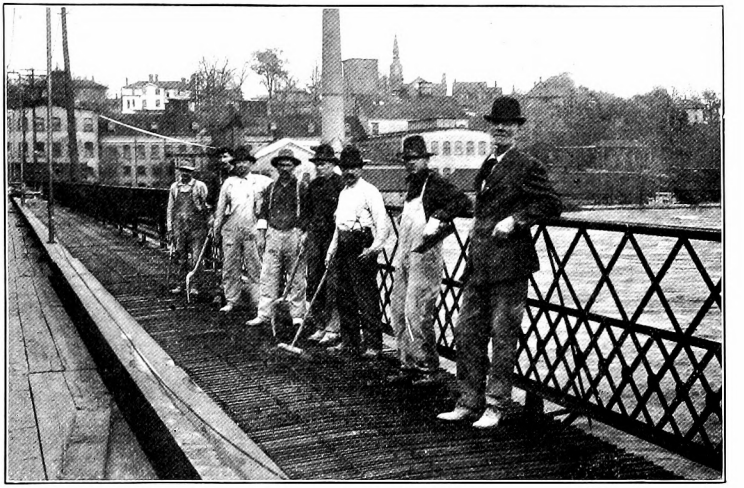
Replacing Wood Flooring with Cement, Terrazo, Tile, Etc.

In entrance ways, lobbys, halls, bathrooms, etc., in old buildings, the wood flooring is removed and building paper is tacked to the joists. **Hy-Rib** is placed and concrete poured to proper thickness. This concrete furnishes the necessary base for tile, terrazo, or composition flooring.

Under Side of **Hy-Rib** Floor (Type A) before Plastering.
Edward Ford Plate Glass Co., Rossford, O.
DeVore-McGormley Co., Engineers.

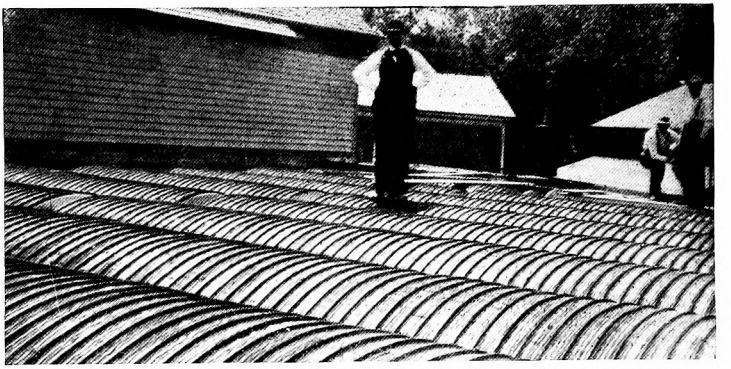


Under side of **Hy-Rib** Floor (Type C, p. 10), ready for plastering. District Court House, Fall River, Mass.

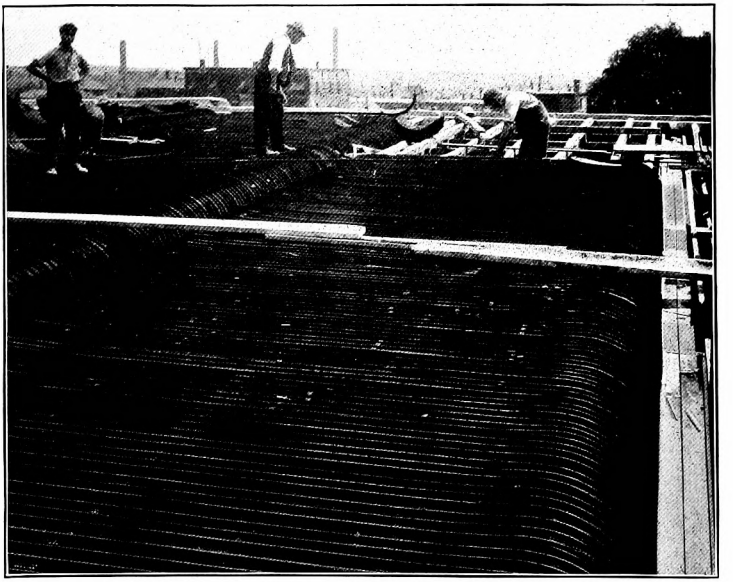


Bridge Floor of **Hy-Rib** before Concreting.
Lake Street Bridge, Appleton, Wis.

Plastering underside of Hy-Rib after being concreted above.
View taken at Hotel Tuller, Detroit.

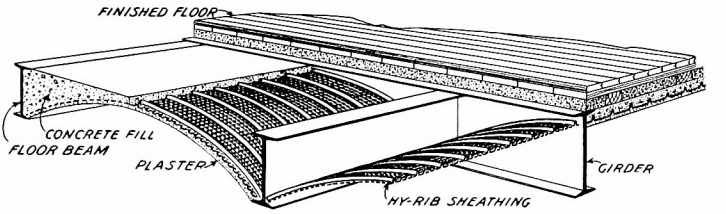


Arched **Hy-Rib** Floor in Joseph Bendt Store, Kenosha, Wis., used in conjunction with reinforced concrete beams.



Arched **Hy-Rib** Floor—Union Street Ry. Office Building and Car Barns, Boston, Mass.

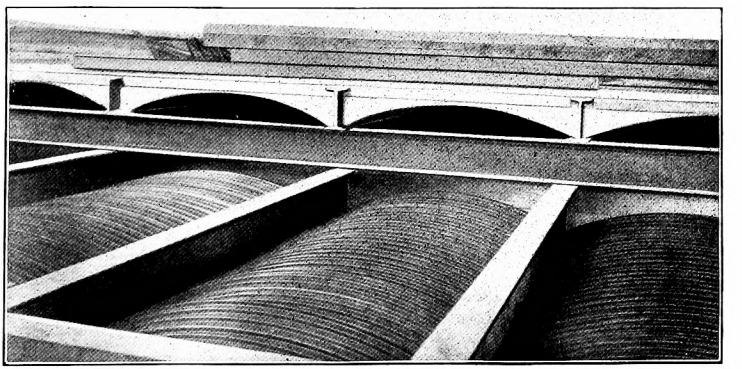
Hy-Rib provides the form work for slab and sides of beams. Only formwork required is board at bottom of reinforced concrete beam and a few lines of joists as temporary supports for **Hy-Rib.**



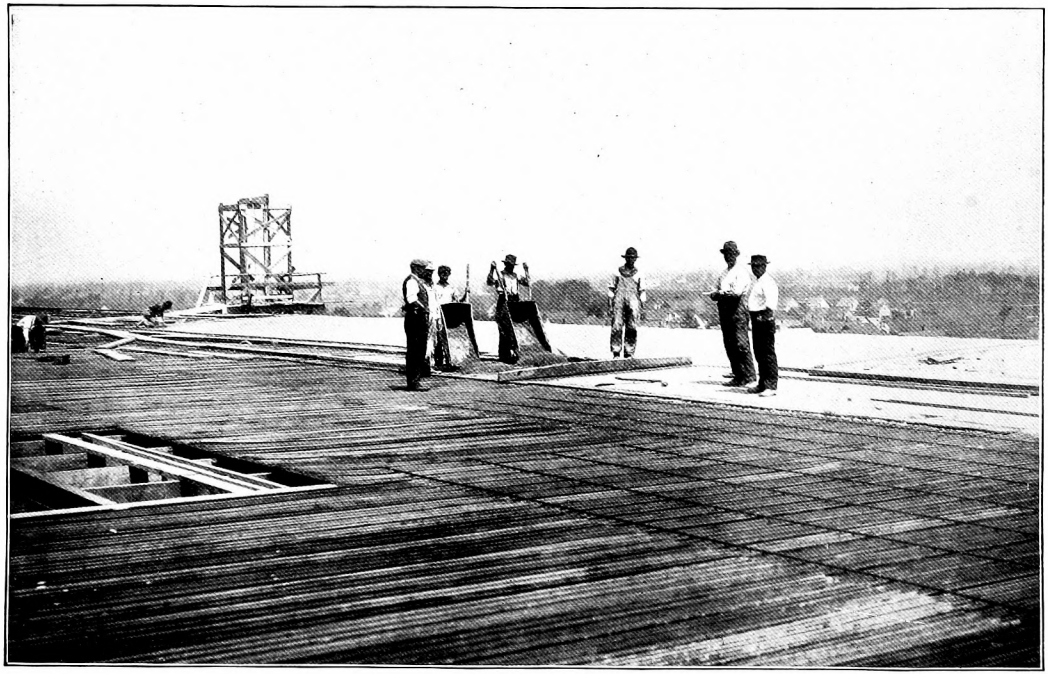
ARCHED FLOORS

Where floors are built to carry heavy loading, such as in warehouses, power plants, etc., concrete is often built in arched form. Curved **Hy-Rib** is especially useful in such floors, as it provides the forms and the reinforcement for the concrete. Only enough concrete flows through to thoroughly grip the steel and a perfect surface is provided for plastering underneath.

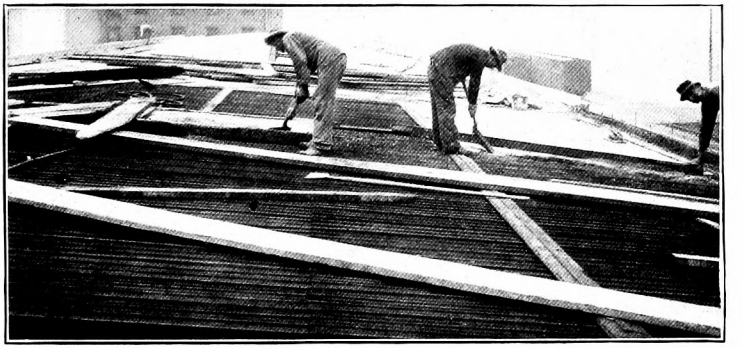
The shop bending does away with any special field labor. All that is necessary is to set the **Hy-Rib** in place.



Power Station, North Adams Power Co., Boston, Mass.



Hy-Rib Roof for Packard Motor Car Co., Detroit, Mich. Albert Kahn, Architect.



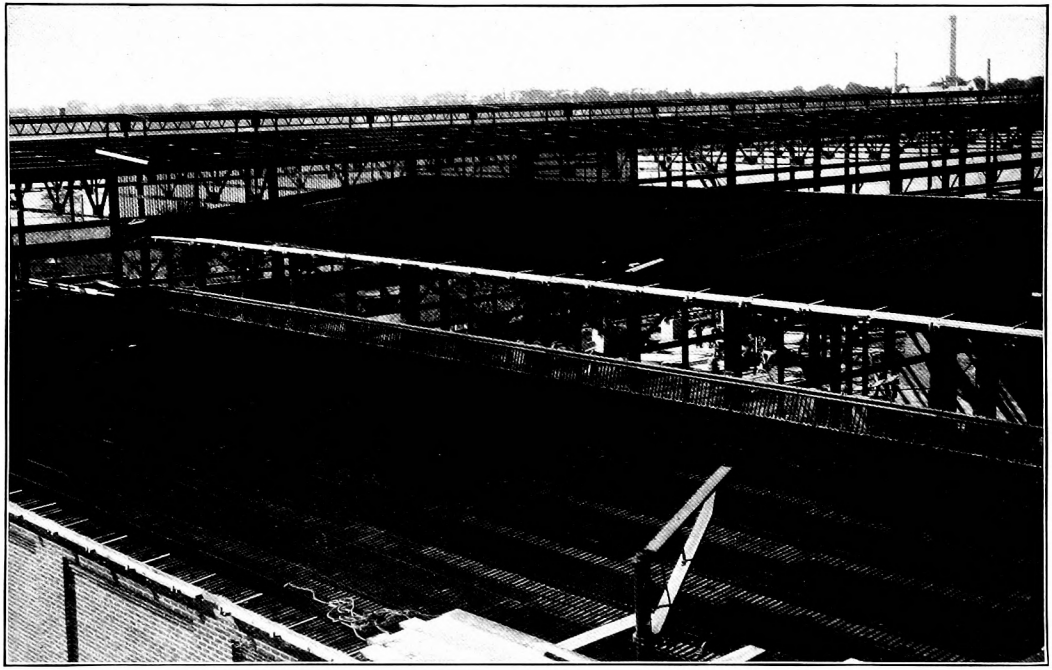
ROOFS

The construction of roofs is similar to that of floors, except that the loads are lighter and a correspondingly lighter construction is desirable. In this field **Hy-Rib** has especial advantages, because it permits the use of very thin slabs. **Hy-Rib** saves in the dead weight of the construction, and consequently reduces the weight and cost of the roof trusses.

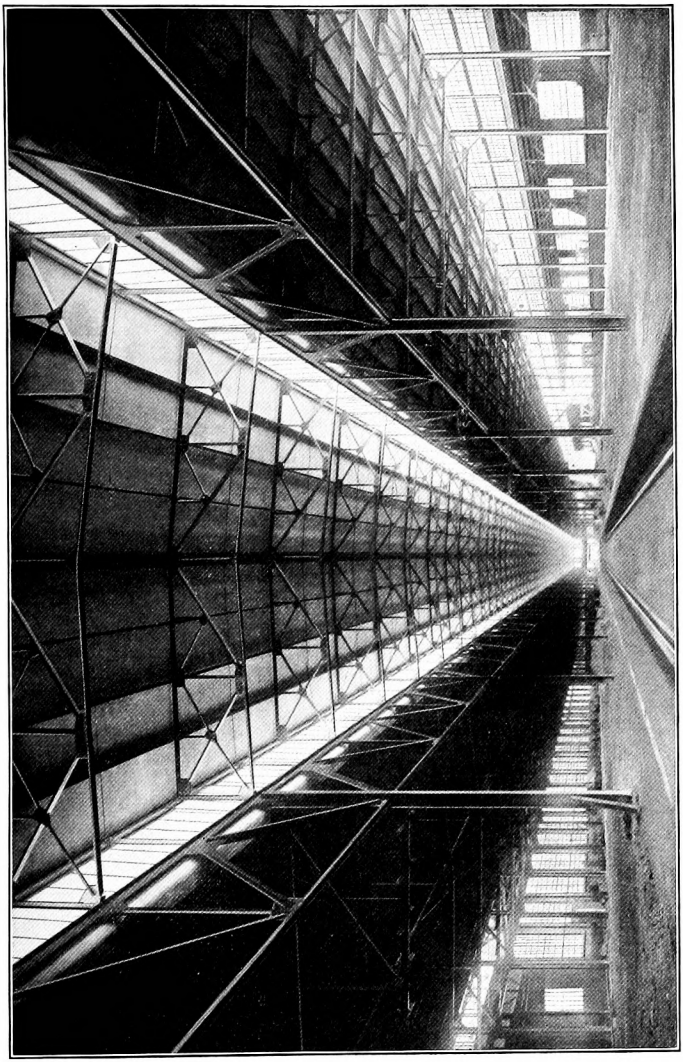
Concrete construction has at times been rejected when desired for roofs of industrial plants, solely because of the prohibitive cost of the falsework when roofs are 20 to 50 feet above the ground. **Hy-Rib** saves this expensive formwork, and can be readily and rapidly installed.

Corrugated iron sheets, frequently used in roofs and sidings of industrial buildings, are unsatisfactory as they leak, rust out in a short time, and have to be painted frequently. **Hy-Rib** embedded in cement mortar is far more economical and its initial cost complete is but little more than corrugated iron sheets.

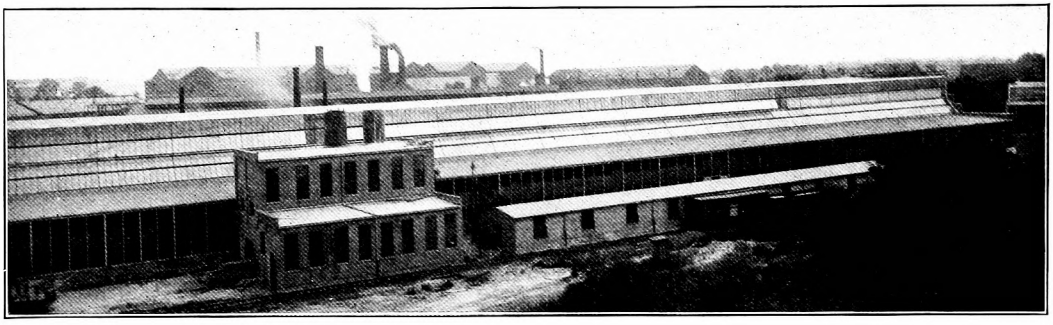
A roof built of **Hy-Rib** and concrete is fireproof, and requires absolutely no expense for maintenance.



A section of **Hy-Rib** Roofs before concreting. Edward Ford Plate Glass Co., Rossford, O. DeVore-McGormley Co., Engineers.

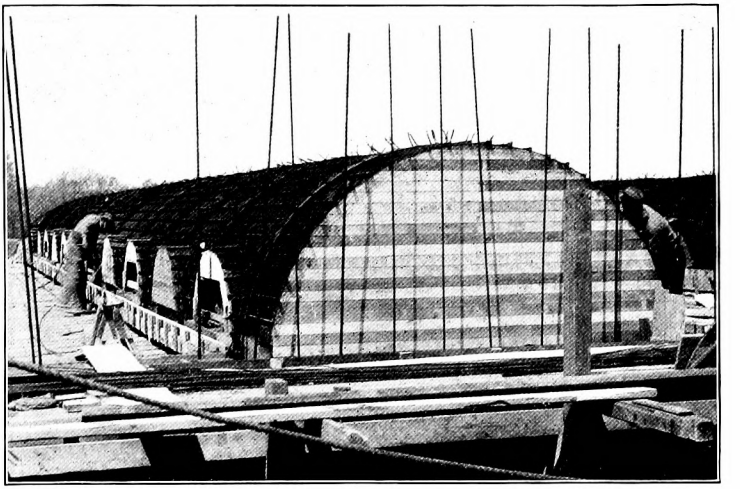


Main Building (300x1050 ft.), Edward Ford Plate Glass Co., Rossford, O. DeVore-McGormley Co., Engrs.
Over 1,000,000 square feet of **Hy-Rib** roofs in this plant. United Sash for side walls, monitors and saw-tooth roofs.



Hy-Rib Roofs, International Harvester Co., Springfield, O. DeVore-McGormley Co., Engrs.

Hy-Rib Roofs for Featherstone Foundry, Chicago, Ill. Arnold Co., Engineers.



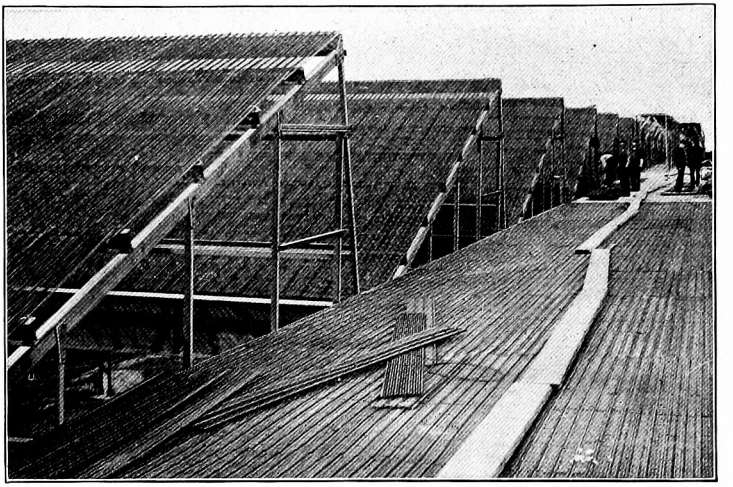
Deep-Rib Hy-Rib Roof, Wisconsin Mausoleum, Milwaukee, Wis.

Hy-Rib Roof for Soft Foundry Building, American Car & Foundry Co., Berwick, Pa.

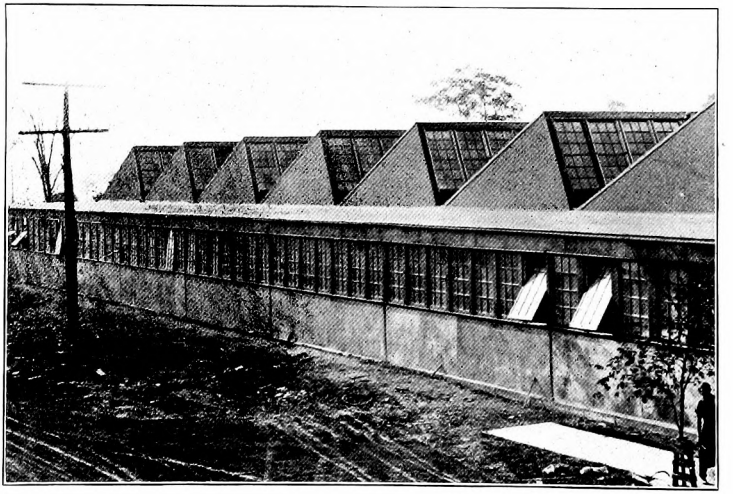
Hy-Rib Roofs for Stables, City Waterworks, Detroit, Mich.
Smith, Hinchman & Grylls, Architects.

DETAIL OF ROOF TILE SUPPORTS WITH RIBS OF HY-RIB EXTENDING HORIZONTALLY

DETAIL OF ROOF TILE SUPPORTS WITH RIBS OF HY-RIB EXTENDING IN DIRECTION OF ROOF SLOPE

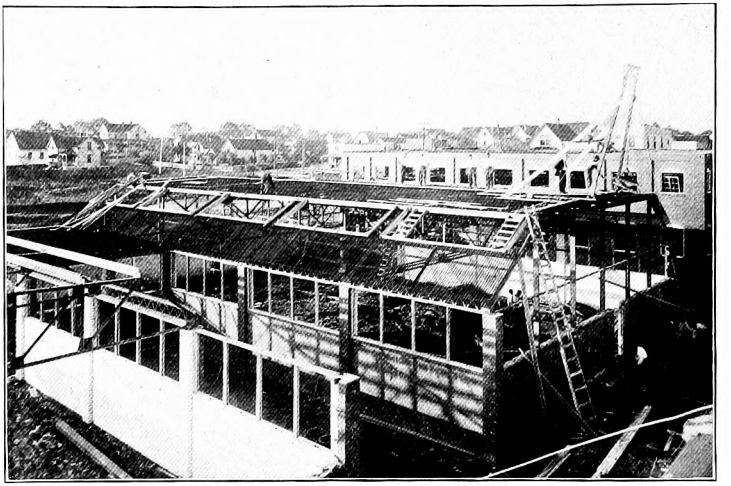


Hy-Rib Saw-tooth Roofs, Oliver Chilled Plow Co., Hamilton, Ont.
David Dickinson, Contractor. Prack & Perrine, Architects.

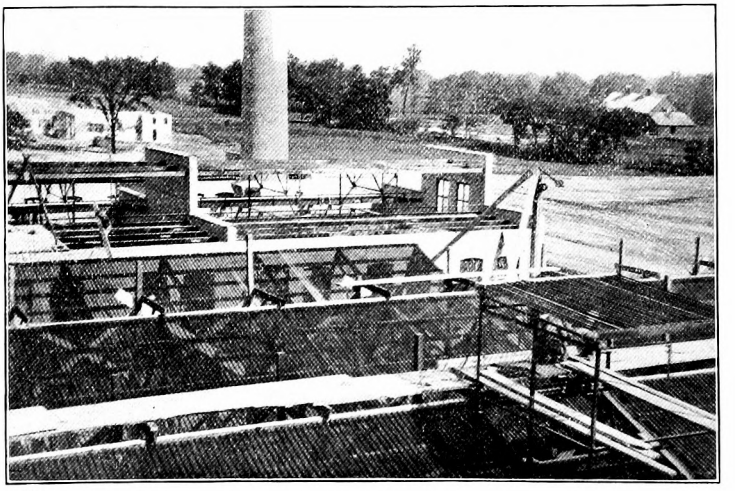


Hy-Rib Saw-tooth Roof and Siding.
Jackson Cushion Spring Co., Jackson, Mich.

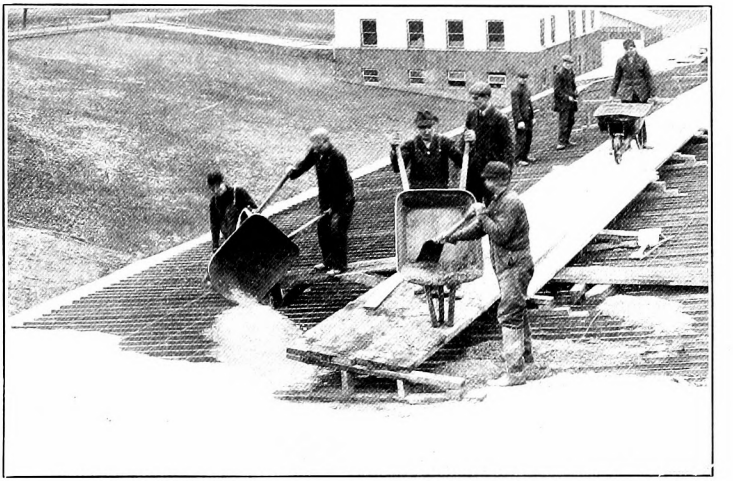
Hy-Rib Roofs and Sidings for The Ford Motor Co. Plant, Detroit, Mich. Albert Kahn, Archt.



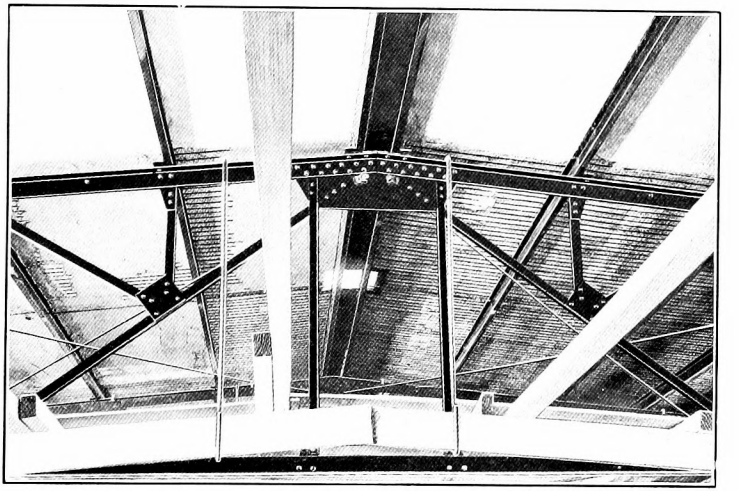
Hy-Rib Roofs, Fayette R. Plumb Tool Co., St. Louis, Mo.



Hy-Rib Roofs, Kempsmith Mfg. Co., West Allis, Wis.

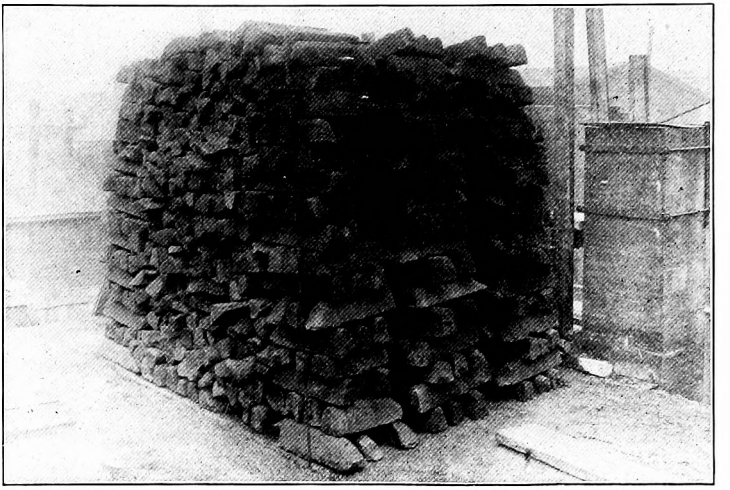


Concreting Deep-Rib **Hy-Rib** on one of the buildings at our Youngstown Plant.



Under side of **Hy-Rib** Roof, partly plastered.
Note plasterer's scaffold suspended from steel truss.

Load of 1,400 lbs. per sq. ft. after Fire Test of 1700° for Four Hours.



NEW YORK FIRE TEST ON HY-RIB ARCH

(Compiled from official report of Fire, Load and Water Test made upon cinder concrete floor arches at Columbia Fire Testing Station, New York. Test was conducted by Ira H. Woolson, E. M., in co-operation with City Building Bureaus.)

Span of segmental arch, 8 feet; thickness at crown, 4½ inches; total depth at haunches, 15 inches. Concrete—Portland cement 1 part, sand 1 part, unsifted cinders 6 parts.

The concrete floor arch reinforced with **Hy-Rib** was subjected to a continuous fire below the floor for four hours at an average temperature of 1700 degrees F., floor carrying at the same time a distributed load of 150 lbs. per square foot. At the end of the four hours the underside of floor while still red hot was subjected to a 1⅛ inch stream of cold water for five minutes. Then the upper side of the floor was flooded and afterwards the stream was again applied on the under side for five minutes.

After cooling, the arch was subjected to a load of 600 lbs. per square foot. Later a 6 ft. wide section was cut out of the floor arch and this section was loaded to 1400 lbs. per square foot. Under this severe load the deflection was only ¼ inch.

As a result of this test the Building Departments of Manhattan and Brooklyn have approved the use of cinder concrete arches reinforced with **Hy-Rib**, 4 inches thick at the crown, for loads up to 350 lbs. per sq. ft. and span of 8 feet.

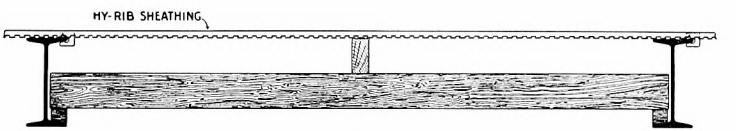
EXPLANATION OF HY-RIB SLAB TABLES

Pages 30 and 31

Upper table gives safe loads carried by slab after the concrete has thoroughly set. Safe loads include weight of slab. In floors and roofs weight of the slab must be deducted from the loads given to determine the safe live load. Lower table is used to determine the load 4-Rib **Hy-Rib** will carry as centering before the concrete has set.

Example: Given a 6 ft. span to carry a safe live load of 40 lbs. per sq. ft. Use tables on page 30. Opposite 2-inch slab reinforced with No. 26 4-Rib **Hy-Rib** read 74 lbs. load. Deduct from this load 30 lbs. (weight of 2-inch slab + ½ in. cement plaster underneath), giving safe live load of 44 lbs.

Lower table shows that No. 26 4-Rib **Hy-Rib** as centering will not support the weight of 2 inches of wet concrete on 6 ft. span, but will carry it on a span as great as 3′0″. Therefore use one temporary line of shoring down the center of the span. This shoring is removed after concrete has set.



Temporary Supports for HY-RIB as Used in Floors and Roofs—Required Only in Special Cases. See lower table, pages 30 and 31.

DESIGNING DATA FOR HY-RIB

Hy-Rib is manufactured from the highest grade of open hearth rolled steel plates, also acid resisting "Trus-Con Ingot Metal."

Cross-sectional areas of metal in **Hy-Rib** per foot of width, including side laps, are as follows:

	28 Gauge	26 Gauge	24 Gauge	22 Gauge
4-Rib **Hy-Rib**.....	.165 sq. in.	.198 sq. in.	.264 sq. in.	.....
3-Rib **Hy-Rib**.....	.110 sq. in.	.132 sq. in.	.176 sq. in.	.....
Deep Rib **Hy-Rib**.....	.....	.177 sq. in.	.236 sq. in.	.295 sq. in.

4-RIB HY-RIB TABLES

SAFE LOADS IN POUNDS PER SQUARE FOOT FOR SLABS REINFORCED WITH 4-RIB HY-RIB

(See also table below)

(Safe loads include weight of slab.)

(For safe live loads, deduct weight of slab.)

Thickness of slabs above base of sheathing	Gauge No. 4-Rib Hy Rib	Moment of resistance per foot of width	SPAN IN FEET								
			3	4	5	6	7	8	9	10	11
1" thick slab	28	965	88	50							
Wt.=12 lbs.	26	1155	105	60	39						
per sq. ft.	24	1540	140	80	52						
1½" thick slab	28	1838	170	95	61	43					
Wt.=18 lbs.	26	2205	204	114	74	51					
per sq. ft.	24	2940	272	152	98	68					
2" thick slab	28	2675	246	139	89	62					
Wt.=24 lbs.	26	3210	295	167	107	74	54				
per sq. ft.	24	4280	394	222	142	98	72				
2½" thick slab	28	4125	380	214	136	95	70	54			
Wt.=30 lbs.	26	4950	456	257	164	114	84	65			
per sq. ft.	24	6600	608	342	218	152	112	86			
3" thick slab	28	6150	569	320	204	142	104	80	63		
Wt.=36 lbs.	26	7380	683	384	245	171	125	96	75	60	
per sq. ft.	24	9840	910	512	326	228	166	128	100	80	
3½" thick slab	28	7275	675	380	241	169	124	95	75	60	
Wt.=42 lbs.	26	8730	810	456	290	203	149	114	90	72	
per sq. ft.	24	11640	1080	608	386	270	198	152	120	96	80

MAXIMUM SPANS FOR 4-RIB HY-RIB AS CENTERING

To support various thicknesses of wet concrete. For greater spans use temporary supports.

Gauge of 4-Rib Hy-Rib	THICKNESS OF SLAB						
	1"	1½"	2"	2½"	3"	3½"	4"
No. 24	5′ 0″	4′ 0″	3′ 6″	3′ 2″	2′ 10″	2′ 8″	2′ 6″
No. 26	4′ 3″	3′ 6″	3′ 0″	2′ 9″	2′ 6″	2′ 4″	2′ 2″
No. 28	3′ 11″	3′ 2″	2′ 9″	2′ 6″	2′ 3″	2′ 1″	1′ 11″

DEEP-RIB HY-RIB TABLES

SAFE LOADS IN POUNDS PER SQUARE FOOT FOR SLABS REINFORCED WITH DEEP-RIB HY-RIB

(See also table below)

(Safe loads include weight of slab.)

(For safe live loads, deduct weight of slab.)

Thickness of slabs above base of sheathing	Gauge No. Deep-Rib Hy-Rib	Moment of resistance per foot of width	SPAN IN FEET								
			4	5	6	7	8	9	10	11	12
2" thick slab	26	3680	192	123	85	63					
Wt.=24 lbs.	24	4100	214	136	95	70					
per sq. ft.	22	4520	235	151	105	77					
2½" thick slab	26	4560	237	152	106	78	59				
Wt.=30 lbs.	24	6090	317	203	141	103	79				
per sq. ft.	22	7080	369	236	164	120	92				
3" thick slab	26	5790	302	193	134	98	75				
Wt.=36 lbs.	24	7710	402	257	179	131	100	79			
per sq. ft.	22	9630	502	321	224	164	125	99			
3½" thick slab	26	7000	365	233	162	119	91	72			
Wt.=42 lbs.	24	9330	486	311	216	159	122	96	78		
per sq. ft.	22	11670	606	389	270	199	153	120	97		
4" thick slab	26	8250	430	274	190	140	107	85			
Wt.=48 lbs.	24	10980	572	366	254	187	143	113	92		
per sq. ft.	22	13740	715	458	318	234	179	141	115	94	
4½" thick slab	26	9450	492	314	218	161	123	97	78		
Wt.=54 lbs.	24	12600	655	420	292	214	164	129	105	87	
per sq. ft.	22	15750	820	525	365	268	205	161	131	109	91
5" thick slab	26	10680	556	355	247	181	139	110	89		
Wt.=60 lbs.	24	14220	740	474	330	242	185	146	119	98	82
per sq. ft.	22	17790	926	593	413	302	231	183	149	122	102
5½" thick slab	26	11880	618	396	275	202	155	122	99	82	
Wt.=66 lbs.	24	15840	825	528	367	269	206	163	132	109	92
per sq. ft.	22	19800	1030	660	459	336	258	204	165	136	115

MAXIMUM SPANS FOR DEEP-RIB HY-RIB AS CENTERING

To support various thicknesses of wet concrete. For greater spans use temporary supports.

Gauge of Deep-Rib Hy-Rib	THICKNESS OF SLAB								
	2"	2½"	3"	3½"	4"	4½"	5"	5½"	6"
No. 22	5′ 6″	5′ 0″	4′ 6″	4′ 2″	3′11″	3′ 9″	3′ 7″	3′ 4″	3′ 2″
No. 24	5′ 0″	4′ 6″	4′ 0″	3′ 9″	3′ 6″	3′ 4″	3′ 2″	3′ 0″	2′10″
No. 26	4′ 4″	3′10″	3′ 6″	3′ 3″	3′ 1″	2′11″	2′ 9″	2′ 8″	2′ 6″

SPECIFICATIONS FOR HY-RIB FLOORS AND ROOFS

REINFORCING STEEL.

Provide Hy-Rib, Type....., Gauge..... for all floors and roofs.

Place all Hy-Rib sheets with the lath surface downward. Interlock all adjoining sheets of Hy-Rib at sides and ends. Sheets shall be securely fastened together every 24 inches along the sides and at every rib at the ends by wiring or by clinching of the lapped ribs with special pincers. Where end splices occur between supports, splices in adjacent rows must be at least two feet apart. Allow a lap of 2 inches where splices occur over supports, otherwise 8 inches.

Hy-Rib shall be rigidly attached to steel framing by means of clips or strong galvanized wire, and to wood framing by staples or nails. These attachments shall be located at the interlocking side splices every 21 inches for 4-Rib **Hy-Rib** and every 28 inches for Deep Rib **Hy-Rib.**

Hy-Rib sheets shall be supported as required by lower tables, pages 30 and 31, while concrete is being poured, and, if necessary, temporary supports shall be provided.

No loads shall be placed on **Hy-Rib** before concreting and not until the concrete has throughly set. Planks for trucking shall be so arranged as to come over supports.

MATERIALS.

The materials composing the concrete or plaster shall consist of:

(a) Portland Cement which has been carefully tested and found to satisfactorily meet the requirements of the specifications of the American Society for Testing Materials.

(b) Sand which is practically free from organic matter and uniformly graded in size from coarse to fine.

(c) Broken stone or gravel which is good, hard, dense stone—clean and of such size as to pass through a half-inch ring.

(d) Hydrated Lime which is uniform in quality and perfectly hydrated.

APPLICATION.

Cover the Hy-Rib sheets with a concrete made up as follows:

Portland Cement	1 part
Sand	2 parts
Broken stone	4 parts

The surface shall be floated smooth to receive a standard roofing applied as directed by manufacturers. When the concrete has set sufficiently plaster the under side to a thickness of ⅜ to ½ inch with the following mixture:

Portland Cement	5 parts
Sand	12 parts
Lime Paste	1 part

The cement and hydrated lime, after being thoroughly mixed dry to uniform color, shall be added to the dry sand and the whole manipulated until evenly mixed. Add water to secure proper working consistency and sufficient long cow hair to key. The mortar shall be applied within 30 minutes from time of mixing.

PROTECTION.

The concrete work shall be thoroughly protected from too rapid drying and the direct rays of the sun by means of damp burlap or canvas, or by sprinkling. The concrete slab must be kept thoroughly moist in this way for at least two days after placing.

EXPANSION RODS.

Where the width of the building is over 200 feet in a direction at right angles to the main ribs of the **Hy-Rib** place 7/32 or 1/4 inch round rods, spaced 30 inches apart, on top of the high ribs and at right angles to them.

ARCHED FLOORS

Where curved sheets of Hy-Rib are used for reinforcement of concrete arches it is not necessary to interlock the sheets along the sides, but side ribs shall be thoroughly wired together, otherwise splice and place Hy-Rib as provided for under Floors and Roofs.

Hy-Rib Concrete Sidings, Mark Manufacturing Co., Evanston, Ill.
Note United Sash in walls and monitors.

WALLS AND SIDINGS

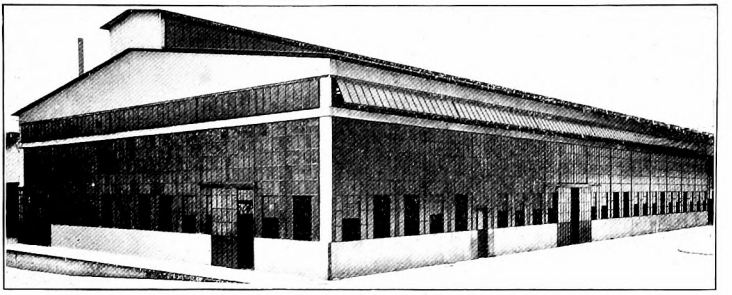
Hy-Rib plastered with cement makes a simple and economical construction for walls and sidings. Owing to its rigid high ribs no studs are necessary. Simply set up the sheets of **Hy-Rib**, apply the plaster, and the wall is complete.

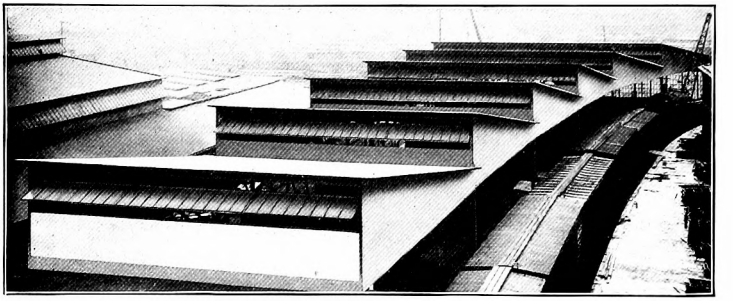
Hy-Rib walls are ideal for sidings of industrial buildings, such as factories, power plants, car barns, etc. Such a wall is much less expensive than one built of brick, tile, concrete block, or the ordinary type of reinforced concrete, besides possessing all their fireproof and permanent qualities. Owing to their permanence and absence of all cost of maintenance, **Hy-Rib** walls are much more economical than the old style corrugated iron sheets which rust out in a short time and must be painted frequently.

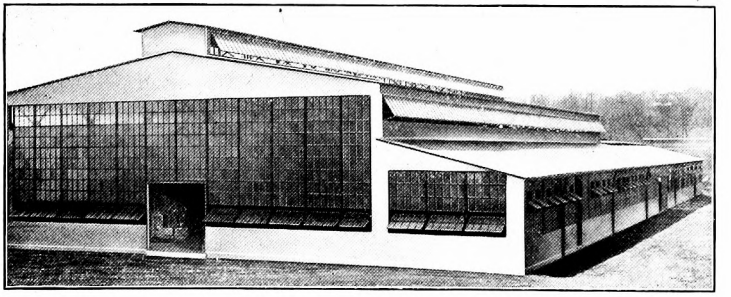
Hy-Rib is especially suited for siding of stucco houses and for wall construction of buildings of all kinds. Occasional posts to carry the weight of the floors are provided and the **Hy-Rib** is attached directly to them, supplying the entire wall construction.

Where hollow walls are desired an additional inside layer of **Hy-Rib** is applied, leaving an air space between the vertical faces. On the interior the plaster is applied directly to the face of the **Hy-Rib.** No furring is necessary, such as would be required for the ordinary brick wall. The air space between the **Hy-Rib** sheets makes a building that is easy to heat in winter and one that keeps cool in summer.

The ordinary house with wooden sidings can be given a modern appearance by applying **Hy-Rib** sheets and plastering with cement—the ribs supply the necessary furring. A complete modern stucco house can be secured in this way at little cost.

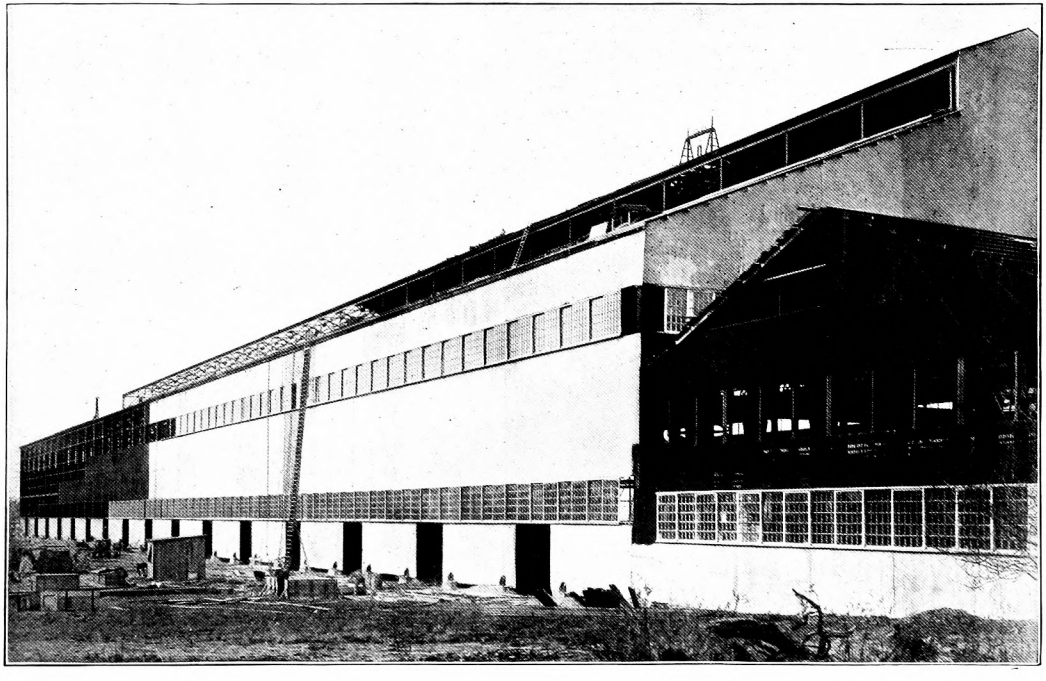




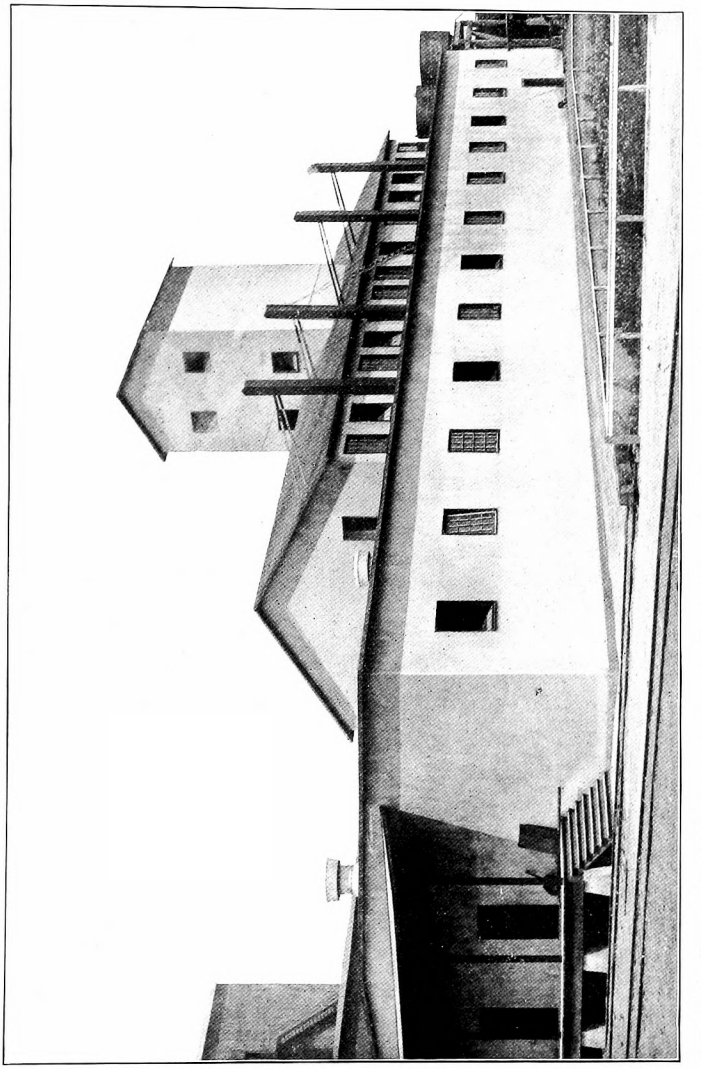


Some of the Buildings at our Youngstown Plant.
Hy-Rib for Roofs and Sidings—**United Sash** for Windows, Fireproof, Daylight, and Economical.

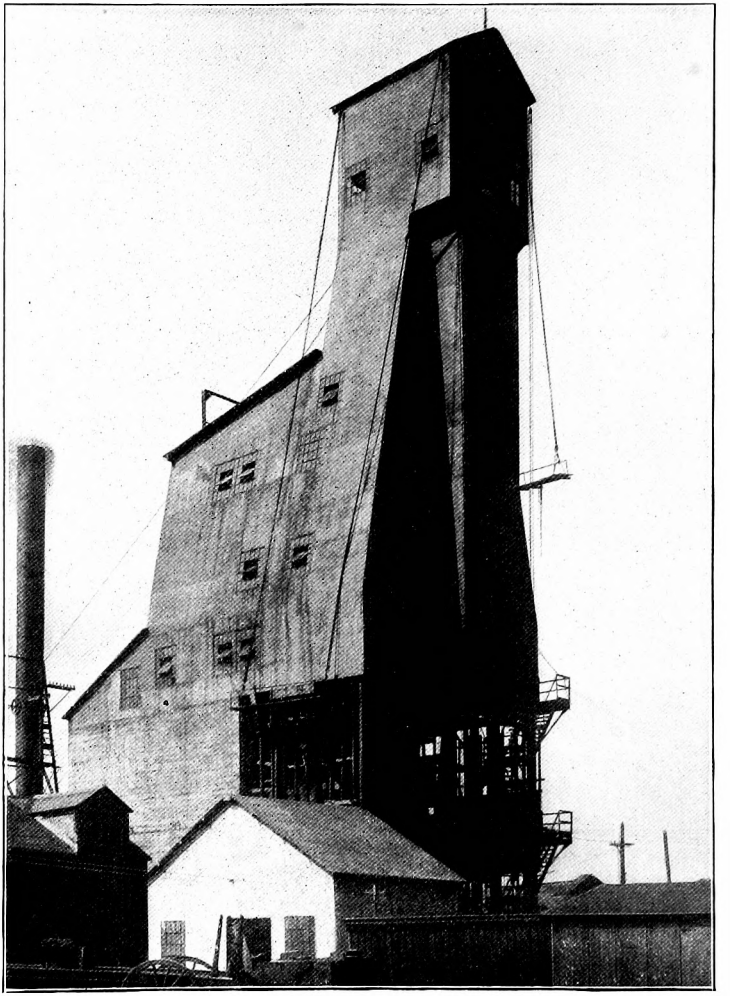
Other Buildings at our Youngstown Plant. Note **Hy-Rib** Concrete used for Roofs and Sidings. **United Sash** in Side Walls and Monitors.



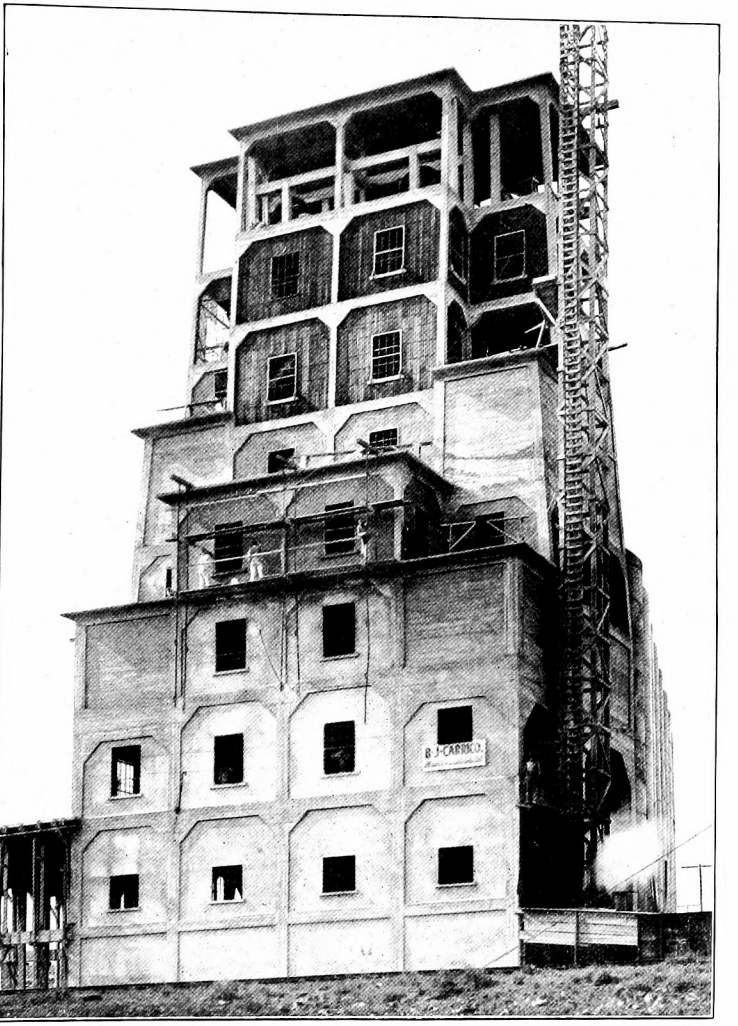
Hy-Rib siding for large steel plant, near Chicago, Ill. Julian Kennedy, Pittsburg, Engineer.



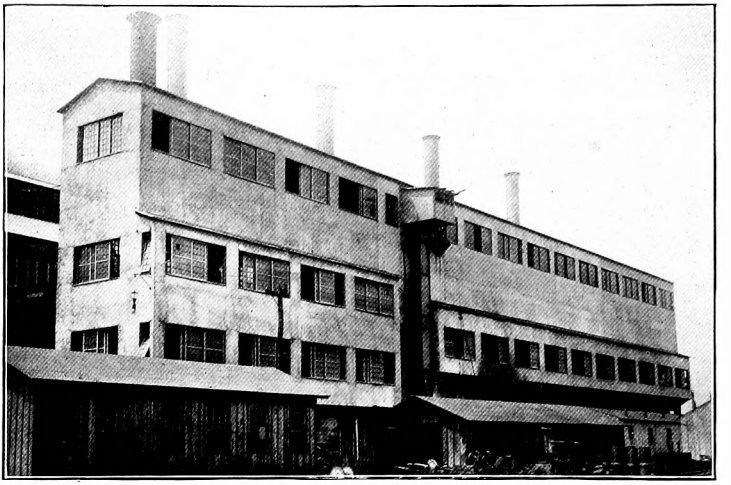
Hy-Rib Concrete Sidings and Roofs, Lake Superior Iron and Chemical Co., Manistique, Mich.



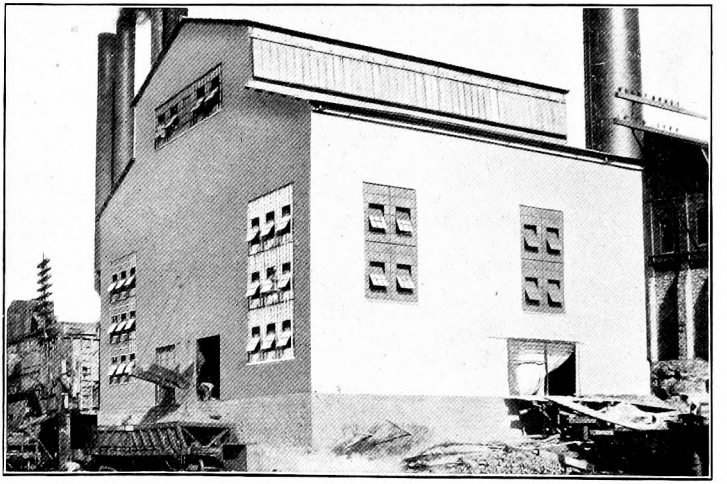
Hy-Rib Sidings for Shaft House, Detroit Salt Works, Oakwood, Mich.



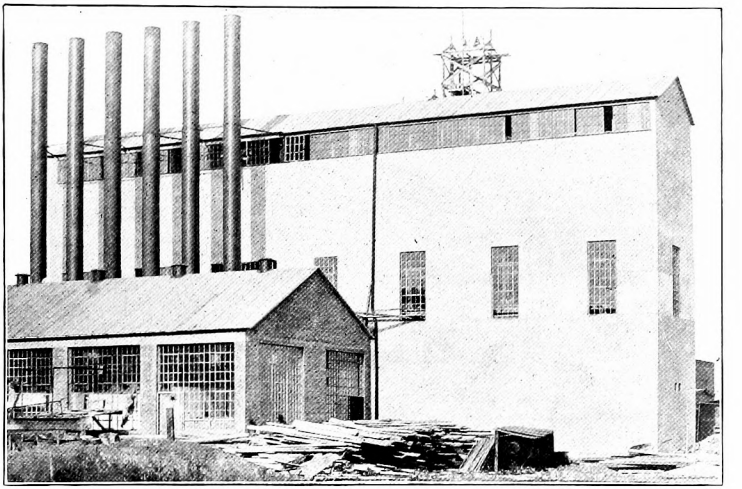
Hy-Rib Sidings, Smith Bros. Grain & Elevator Co., Ft. Worth, Tex.
Kahn System of Reinforced Concrete and **United Sash.**



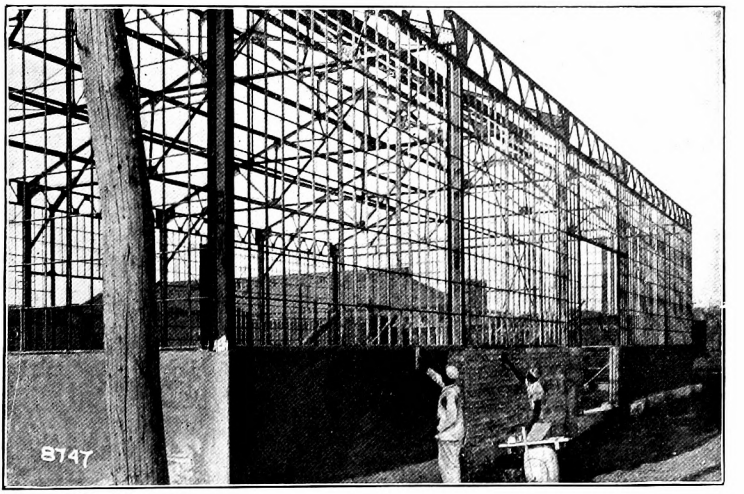
Hy-Rib Roofs and Sidings, Gas Producer Building, Open Hearth Dept., Maryland Steel Co., Sparrows Point, Md.



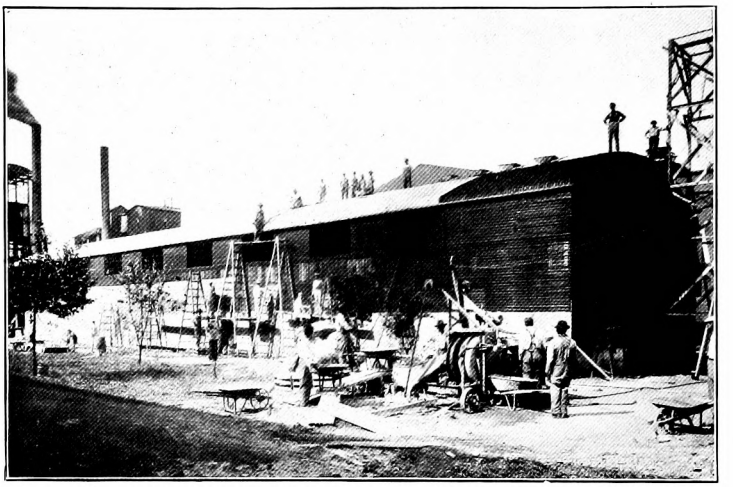
Hy-Rib Sidings, United Sash for Windows.
Quincy Gas, Electric & Heating Co., Quincy, Ill.
Smith, Hinchman & Grylls, Archts.



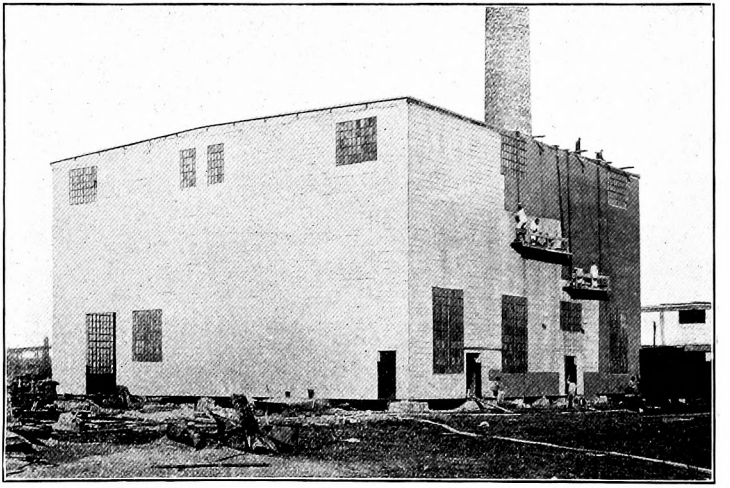
Hy-Rib Sidings, Gas Producer Bldg., Ford Motor Co., Detroit, Mich.



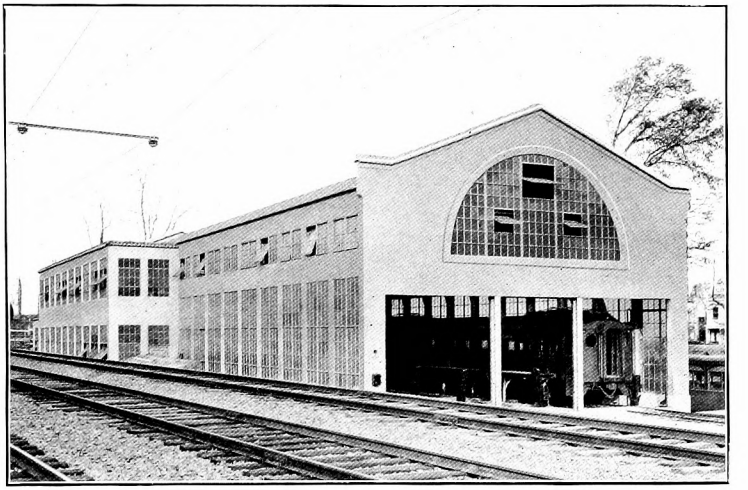
Hy-Rib Sidings, American Automatic Railway Switch Co., **Birmingham, Ala.**



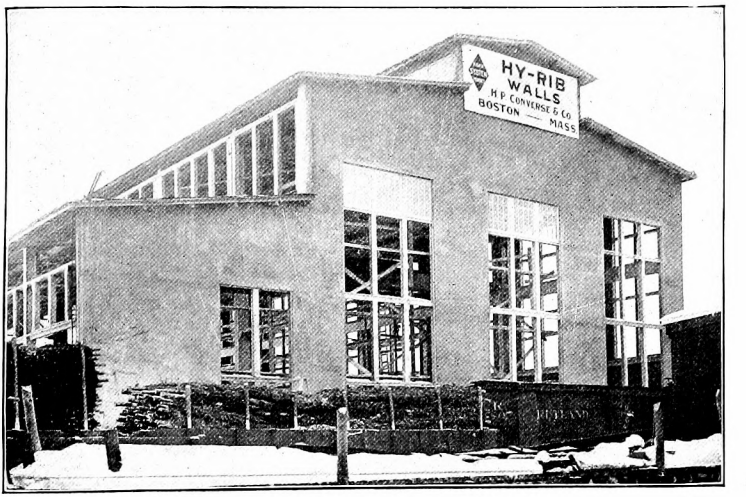
Hy-Rib Roofs and Sidings, Glenmore Distillery, Owensboro, Ky.



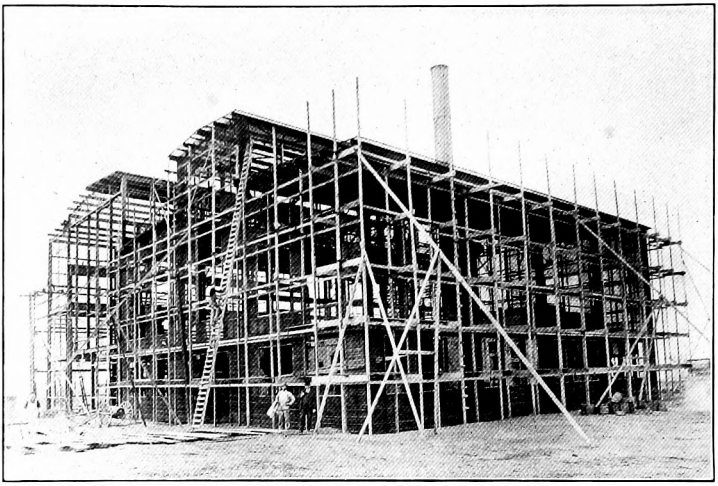
Hy-Rib Sidings and Roofs,
Great Lakes Engineering Works, Ashtabula, O.



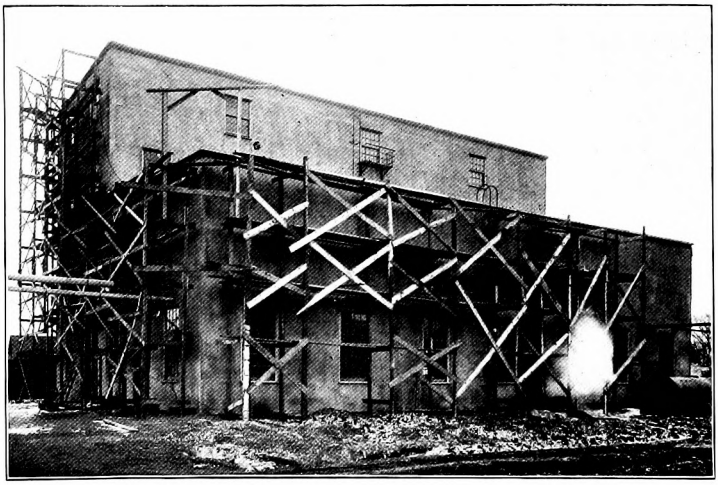
Coach Repair Shop, New York, Westchester & Boston R. R., New York City. **Hy-Rib** Concrete Sidings—**United Sash** for Windows.



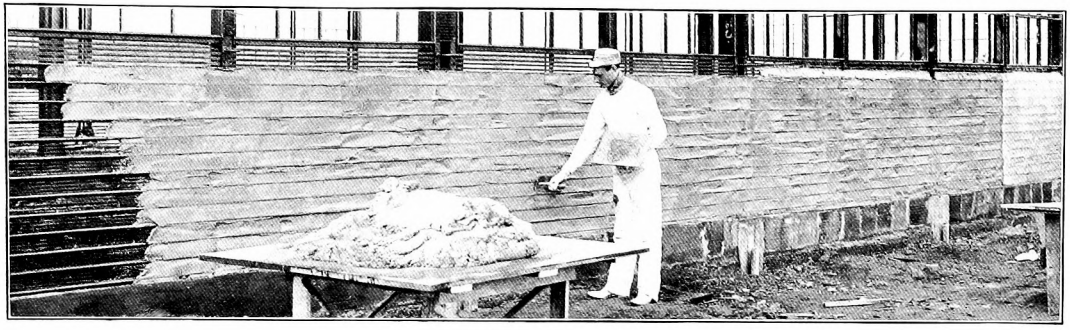
Hy-Rib Sidings, Shops, Rutland Railway Co., Rutland, Vt.



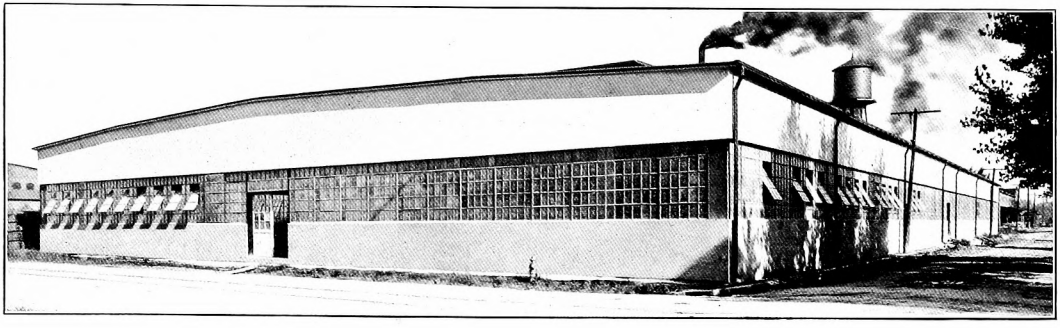
San Joaquin Light & Power Co., Bakersfield, Cal.
Hy-Rib Sidings and Roofs.



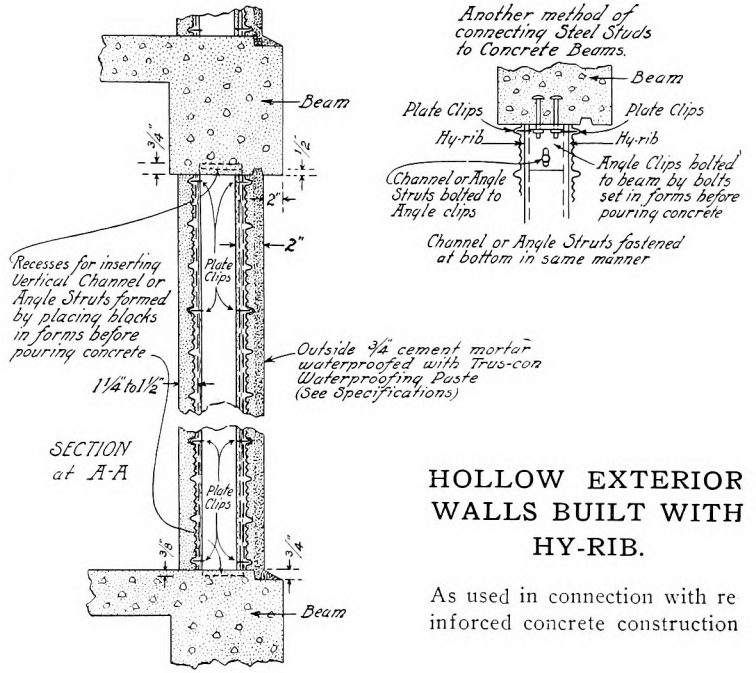
Building No. 16, Diamond Rubber Co., Akron, O. Note simple scaffolding used for plastering **Hy-Rib** sidings.



Hy-Rib Siding showing method of plastering. Note **United Sash** above.



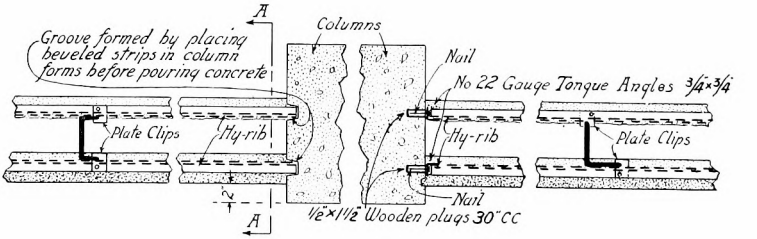
Hy-Rib Sidings, Favorite Stove & Range Co., Piqua, Ohio.



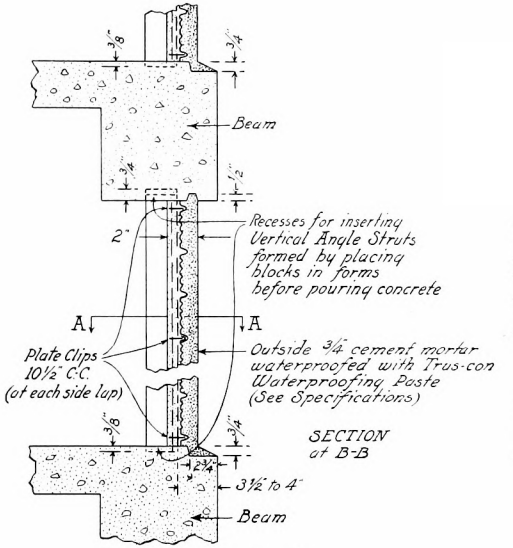
Vertical Section.

HOLLOW EXTERIOR WALLS BUILT WITH HY-RIB.

As used in connection with re inforced concrete construction



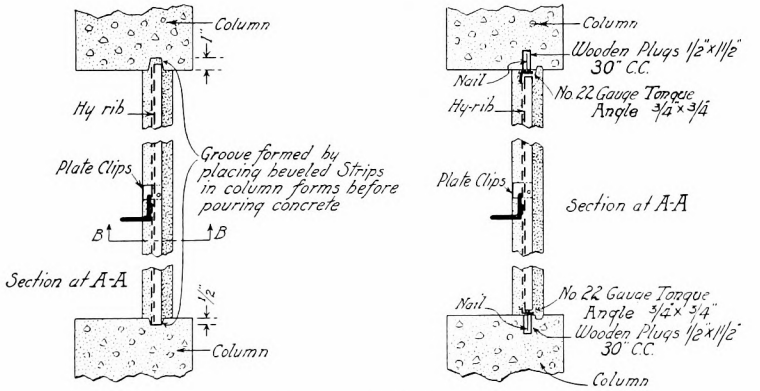
Horizontal Section.



Vertical Section.

SOLID EXTERIOR WALLS BUILT WITH HY-RIB

As used in connection with reinforced concrete construction.



Horizontal Sections.

SPECIFICATIONS FOR HY-RIB WALLS AND SIDINGS

*REINFORCING STEEL.

Provide Hy-Rib, Type....., Gauge....., for all walls and sidings.

Interlock all adjoining sheets of Hy-Rib at sides and ends. Sheets shall be securely fastened together every 24 inches along the sides and at every rib at the ends by wiring or by clinching of the lapped ribs with special pincers. Where end splices occur between supports, splices in adjacent rows must be at least 2 feet apart. Allow a lap of 2 inches where splices occur over supports, otherwise 8 inches.

Hy-Rib shall be rigidly attached to steel framing by means of clips or strong galvanized wire, and to wood framing by staples or nails. Such attachments shall be located at the interlocking side splices between sheets and shall occur at least every 14 inches for 3-Rib and Deep-Rib **Hy-Rib** and every 10½ inches for 4-Rib **Hy-Rib.** Where supports are over 6 feet apart, **Hy-Rib** sheets shall be temporarily braced before plastering.

MATERIALS.

The materials composing the plaster shall consist of—

(a) Portland Cement which has been carefully tested and found to satisfactorily meet the requirements of the specifications of the American Society for Testing Materials.

(b) Sand which is practically free from organic matter and uniformly graded in size from coarse to fine.

(c) Trus-Con Waterproofing Paste, Concentrated, as manufactured by the Trussed Concrete Steel Co.

(d) Hydrated Lime which is uniform in quality and perfectly hydrated.

APPLICATION.

The plaster for the inside wall and for the first coat of outside wall shall be made up as follows:

Portland Cement	5 parts
Sand	12 parts
Lime Paste	1 part

The cement and hydrated lime, after being thoroughly mixed dry to uniform color, shall be added to the dry sand and the whole manipulated until evenly mixed. Add water to secure proper working consistency. The mortar shall then be thoroughly worked until perfectly homogeneous. This composition shall only be made up in lots that can be immediately applied, and any material that has been mixed with water longer than 30 minutes before applying shall be rejected.

*Wherever it is possible the structure should be so designed that the main ribs of the Hy-Rib will extend horizontally. Where the ribs extend vertically place 7/39 in. or ¼ in. rods 30 ins. apart at right angles to the ribs.

PLASTERING OF WALLS.

Apply a first coat of this plaster, with the addition of long cow hair for key, to the exterior of all walls. While this coat is still wet scratch over the surface to form a key for the finish coat which shall be applied after the first coat has set sufficiently hard to hold it.

The plaster for the exterior finish coat shall be of the same proportions as scratch coat except that in mixing use water to which **Trus-Con Waterproofing Paste, Concentrated,** has been added in proportions of 1 part Paste to 12 parts water. The thickness of this waterproofed mortar shall be at least ¾ of an inch. Finish coat shall be floated free from any porous imperfections.

The interior finish shall then consist of composition above specified without the addition of waterproofing and shall be trowelled to a perfectly smooth finish. Total thickness of finished wall shall be 1¾ to 2 inches.

PROTECTION.

Thoroughly protect the finished work from too rapid drying and the direct rays of the sun by means of damp canvas or sprinkling. The finished work must be kept thoroughly moist in this way for at least two days after plastering.

EXPANSION RODS.

In walls and sidings where it is found necessary to run the main ribs of the **Hy-Rib** vertically, place 7/32 or 1/4 inch rods, spaced 30 inches apart, at right angles to the ribs.

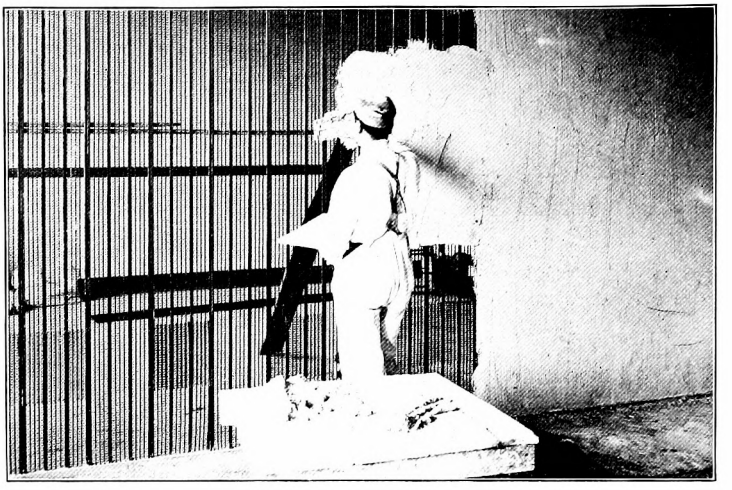
SIDE WALLS REINFORCED WITH HY-RIB

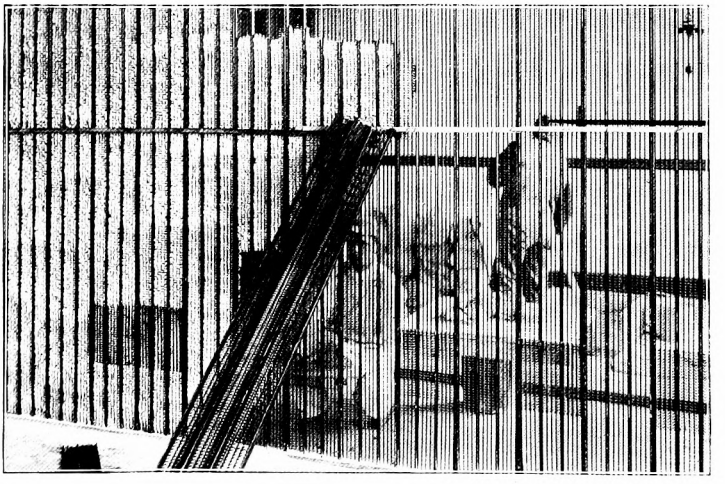
(Minimum Requirements.)

(Ribs of **Hy-Rib** running horizontally.)

Spacing of Supports	Thickness of Wall	REINFORCEMENT
3 feet	1¾″	No. 28, 3-rib **Hy-Rib.**
6 feet	1¾″	No. 26, 3-rib **Hy-Rib,** or No. 28, 4-rib **Hy-Rib.**
8 feet	2″	No. 24, 3-rib **Hy-Rib,** or No. 26, 4-rib **Hy-Rib.**
10 feet	2″	No. 26, 4-rib **Hy-Rib.**
12 feet	2½″	No. 24, 4-rib **Hy-Rib.**

Temporary brace should be used vertically where structural supports are 6′ or over.





Plastering flat side of **Hy-Rib Partition** and view from opposite side. Note perfect clinch with no dropping of plaster.

PARTITIONS

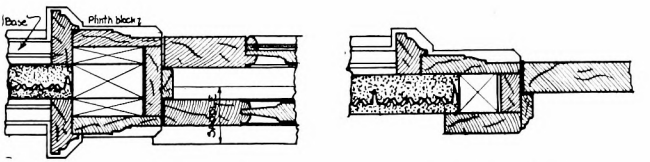
For solid partitions built either with cement, lime, or patent plaster, **Hy-Rib** is especially suitable as reinforcement. The ribs of the **Hy-Rib** take the place of the studs which are otherwise necessary, and **do away entirely with the expense and labor of attaching sheets of lath to studs.** Owing to the fact that the lath and ribs are a complete unit, made from a single sheet of steel, such partitions have extraordinary rigidity.

All that is necessary is to set up the sheets of **Hy-Rib** —plaster both sides—and the partition is complete. No centering or studs are necessary. Thin partitions of great strength and rigidity are rapidly constructed in this way.

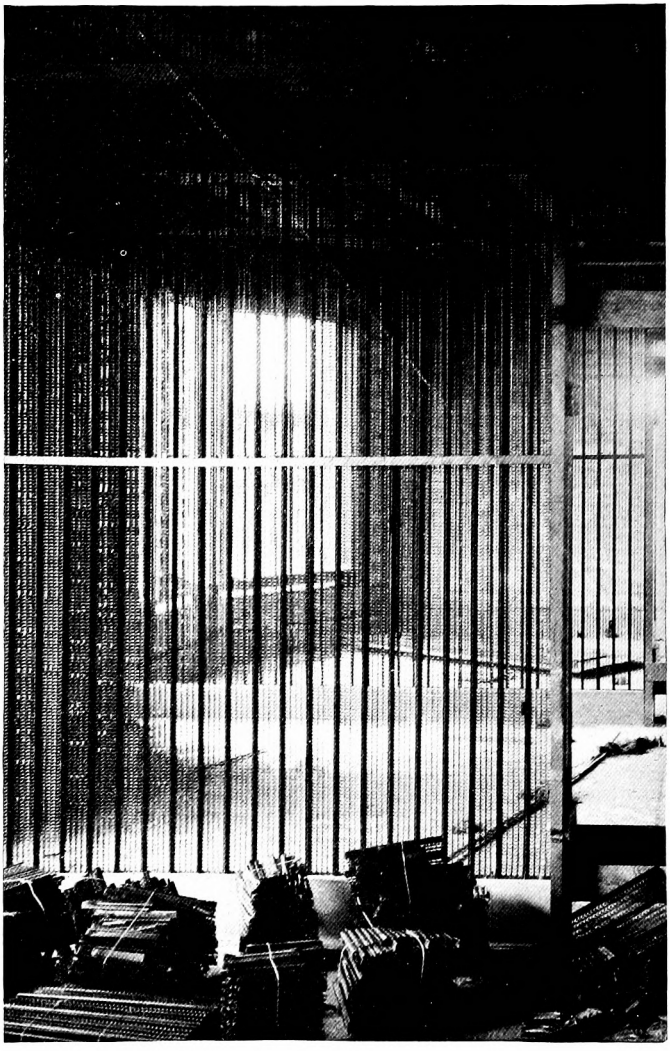
Hy-Rib presents a flat surface to work against, assuring ease and speed in plastering, and requiring a minimum amount of material.

Where hollow partitions are desired, two thicknesses of **Hy-Rib** are used, separated by means of Rib Studs. The sheets are placed with the lath side outward and the plaster is applied to the desired thickness.

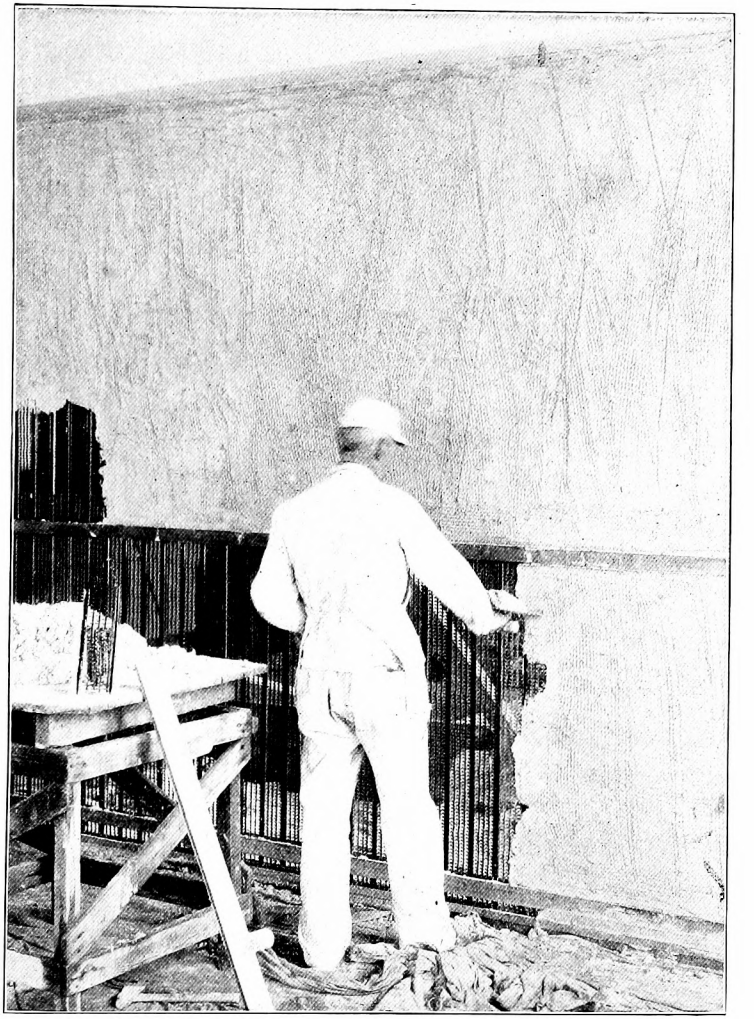
Hy-Rib is the most economical reinforcement for partition work. It does away with expensive field labor, saves plaster, and provides increased rigidity, besides saving time in erection.



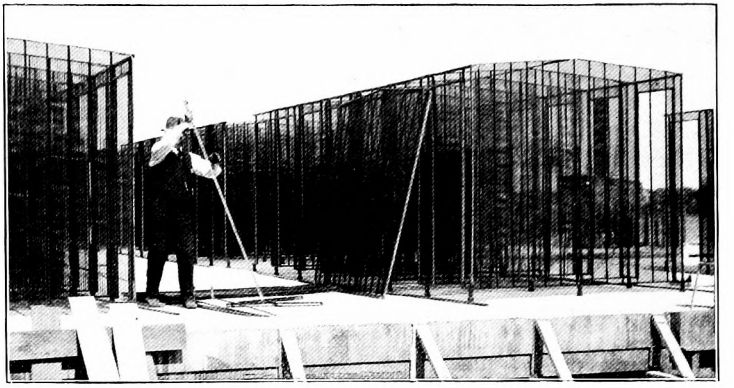
Detail of Door-Framing for Hy-Rib Partition.
(See other details, page 67.)



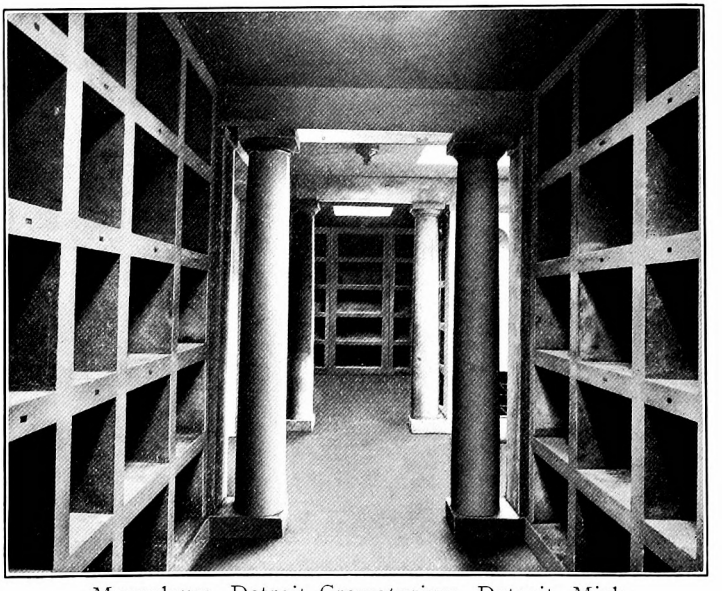
Hy-Rib Partition, Y. M. C. A. Building, Portland, Ore.



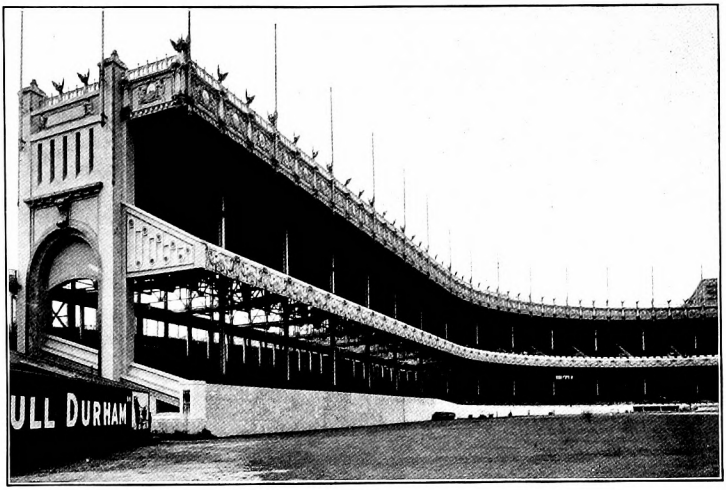
Hy-Rib Partition, Trussed Concrete Building, Detroit, Mich.
Note grounds for base-board and chair-rail.



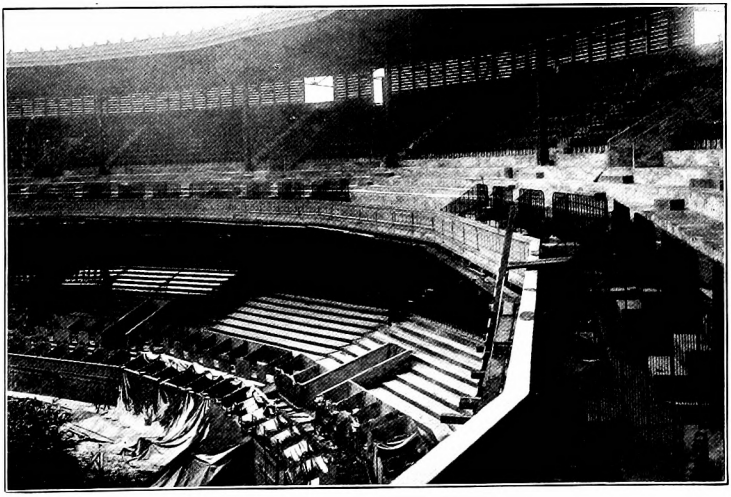
Calhoun Bath House, Minneapolis, Minn. Cecil Bayless Chapman, Architect; F. Gottlieb Magney, Associate.
Hy-Rib Partition Walls are handled as a unit.



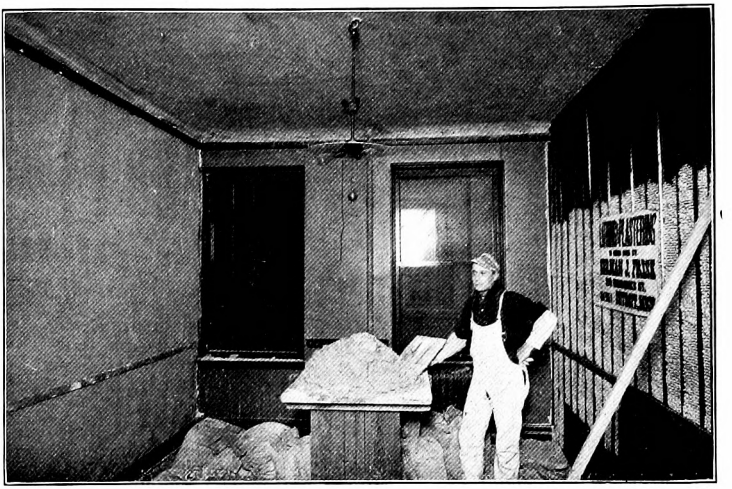
Mausoleum, Detroit Crematorium, Detroit, Mich.
Partitions and entire construction are **Hy-Rib** Concrete.



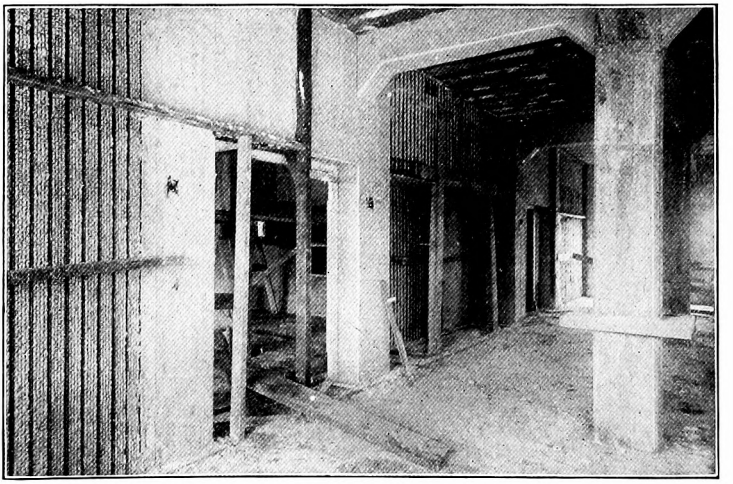
Polo Grounds, National Baseball League, New York City.
Snare & Triest Co., Erectors.
Hy-Rib used in all Sidings, Partitions, Ticket Booths, Railings, etc.



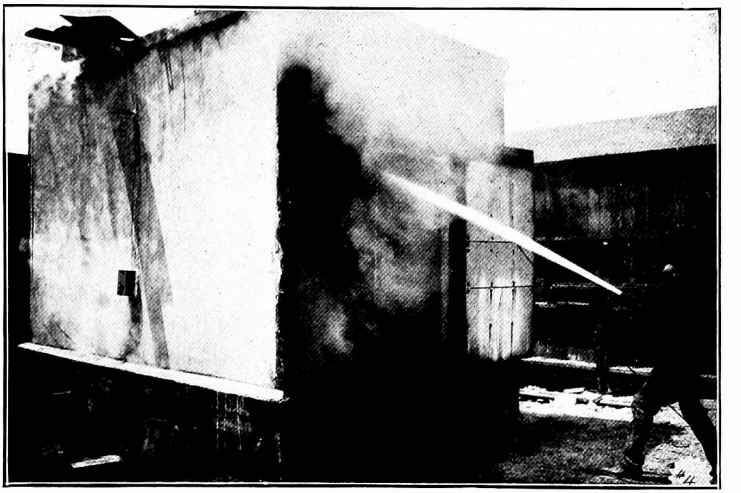
National League Baseball Grandstand, Cincinnati, O.
Hy-Rib Concrete Partition Walls around boxes, etc.

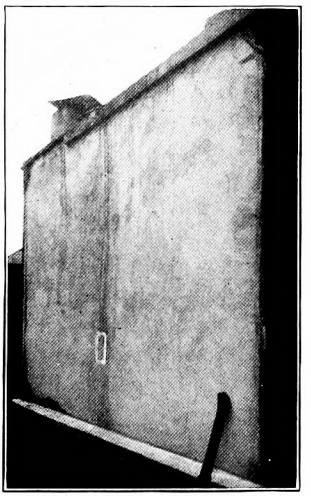


Hy-Rib Partition, Chamber of Commerce, Detroit, Mich.



Hy-Rib Partitions, Dormitory Bldg., Bishop School, La Jolla, Cali.
Richard S. Requa, Architect.





Exterior of Partition after Test.

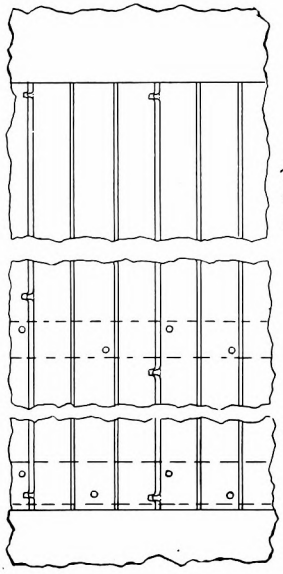
NEW YORK FIRE TEST ON HY-RIB PARTITION

(Compiled from official report of Fire and Water Test made at the Columbia Fire Testing Station, New York City, upon plaster partition reinforced with Hy-Rib. Test conducted by Ira H. Woolson, E. M., in co-operation with City Building Bureaus).

Partitions were of standard size required by the Building Specifications, 14′ 6″x9′ 6″. No. 26 Gauge **Hy-Rib** was installed in partition; plaster used was Rock Wall put on in two inside and two outside coats, the approximate total thickness of partition being two inches. The partition was subjected to a continuous fire for one hour, at an average temperature of 1700 degrees Fahr., and a 1⅛″ stream of water at hydrant pressure was then thrown against it for two and one-half minutes.

After the application of fire and water, the final maximum deflection in the **Hy-Rib** partition was only ¼″, and partition was in excellent condition.

In view of above test, No. 28 Gauge **Hy-Rib** partitions two inches thick solid, or with two thicknesses of metal for hollow partition, have been approved for use in the Borough of Manhattan.

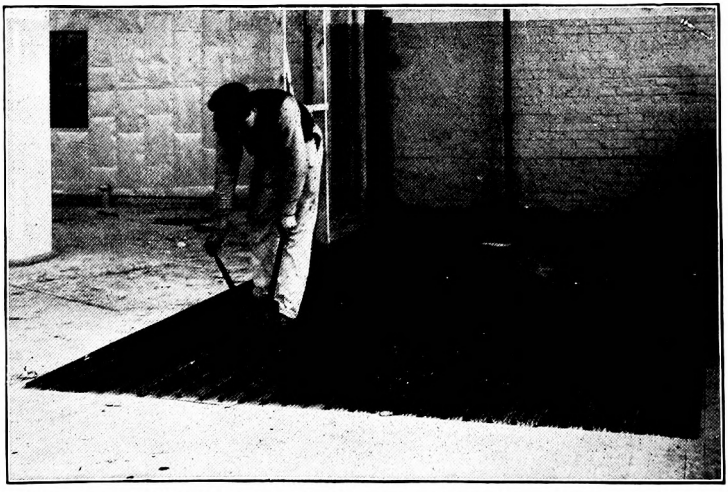


Sheets securely fastened together by punching lapped Ribs. This does away with all wiring (See Detail)

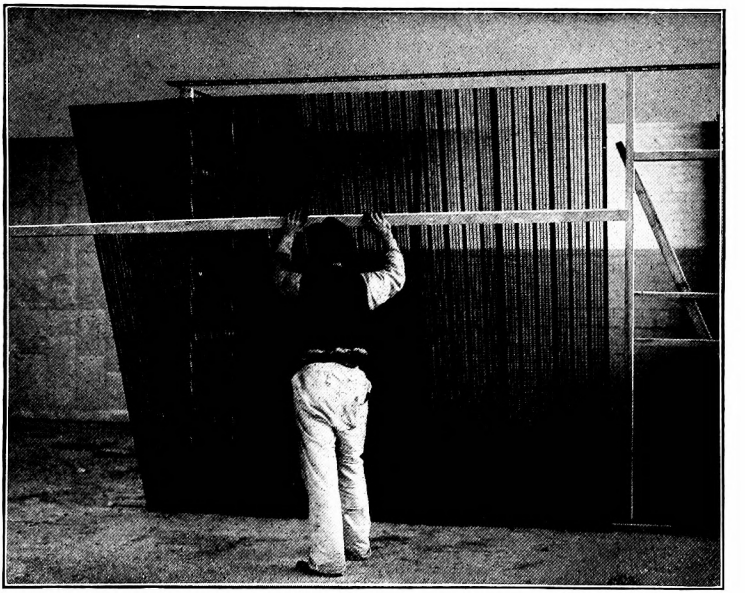
Method of Interlocking and Punching Hy-Rib Sheets. (See page 105 for Hy-Rib Punch.)

Lapped and Pressed together.

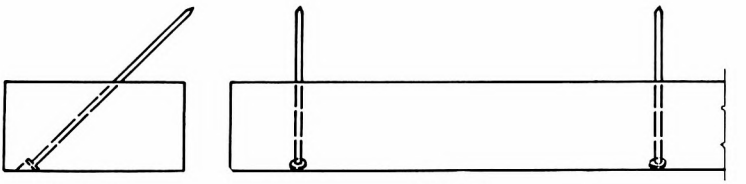
Perfectly locked together by punching with Hand Punch.



Uniting HY-RIB sheets by punching interlocked ribs.

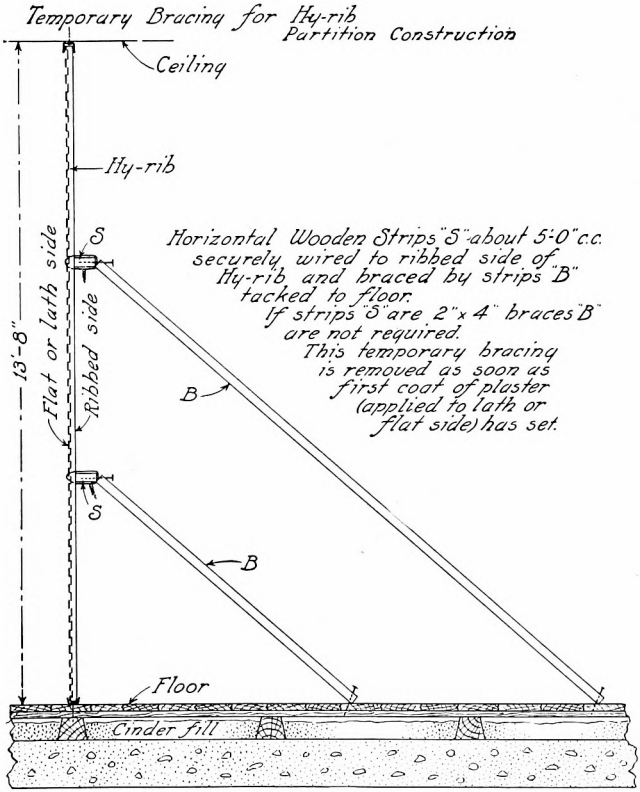


Raising Hy-Rib en masse with 2x4 wooden scantling in which spikes are driven as shown below. The ten sheets of Hy-Rib have been previously united by punching the interlocked side ribs.

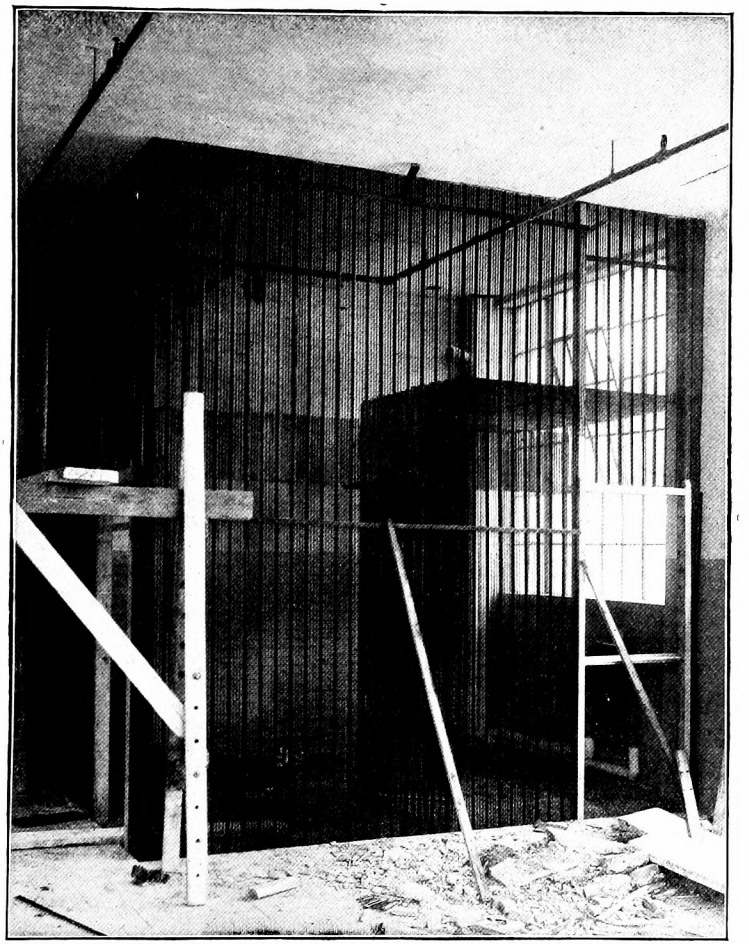


End View. Side View.

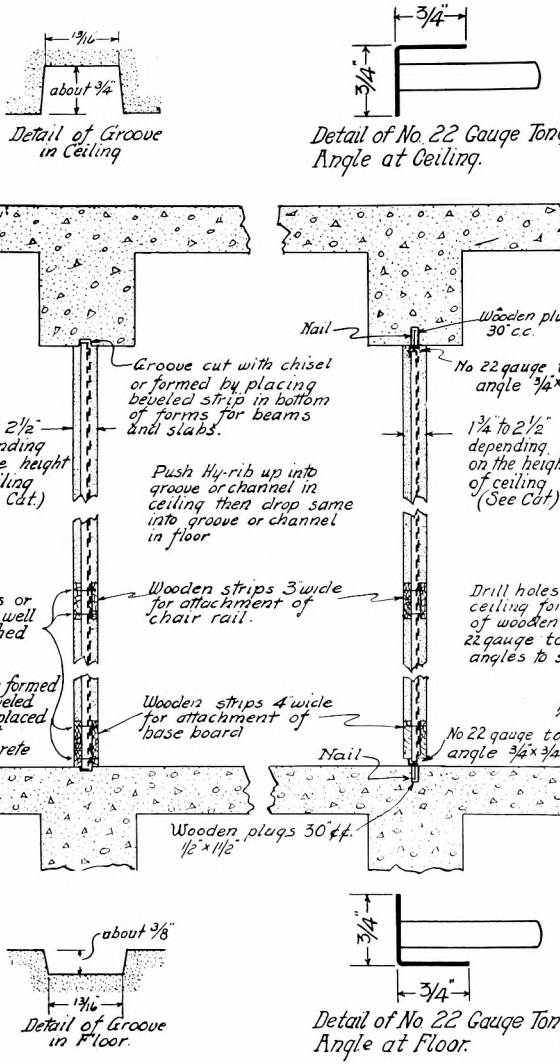
2x4 Scantling with spikes driven in slantwise. These spikes engage the Hy-Rib mesh permitting a great area of Hy-Rib to be raised or hoisted at one operation, as illustrated above.



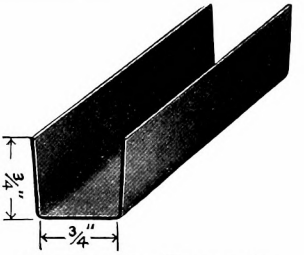
Temporary Bracing for **Hy-Rib** Partition Construction. This bracing is removed after the first coat of plaster, applied to flat side, has set. No other bracing is required.



Hy-Rib Partition—Dodge Bros. Power Building, Detroit, Mich. Note simplicity of temporary bracing.

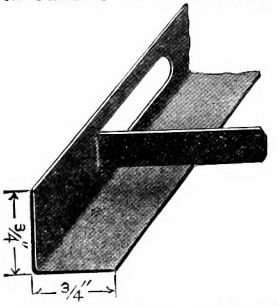


HY-RIB Partitions and Method of Attaching to Reinforced Concrete Constructon.



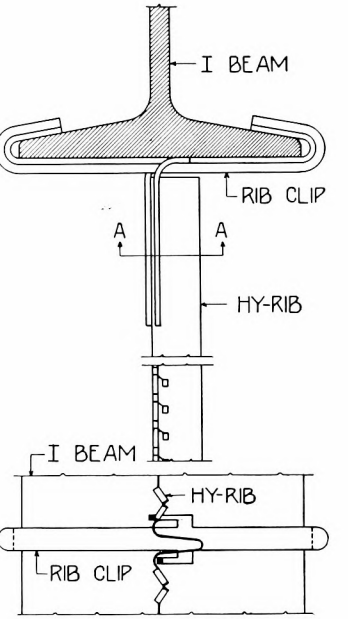
24 Gauge Channels

For attaching **Hy-Rib** in partitions and walls. Length—5 feet. Supplied in bundles of 25 channels.



22 Gauge Tongue Angles

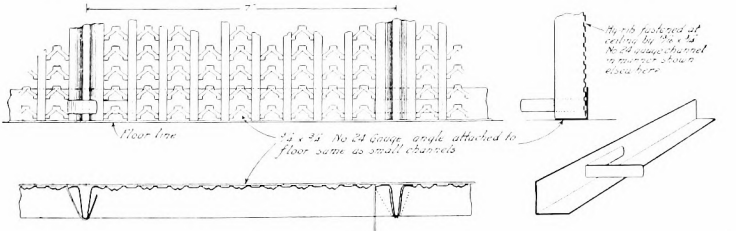
For attaching **Hy-Rib** in partitions and walls. Length, 5 feet. Supplied in bundles of 25 angles. Spacings of tongues, 3½ inches, 7 inches, 10½ inches, or 14 inches.



SECTION A-A

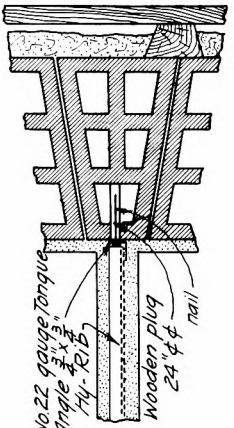
Rib Clips

For attaching top of **Hy-Rib** partition to steel beam. See also Rib Clips, page 73.

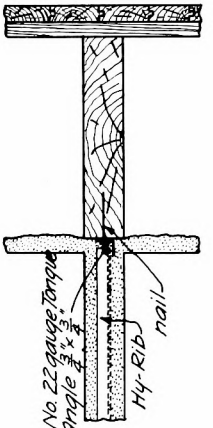


Application of 22 Gauge Tongue Angle at Bottom of Partitions and Walls.

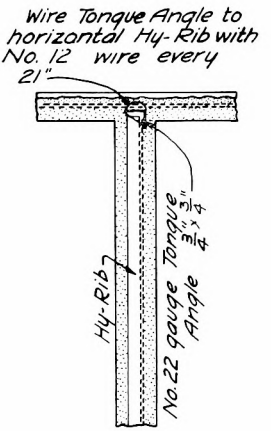
Details for application at top and sides are similar.



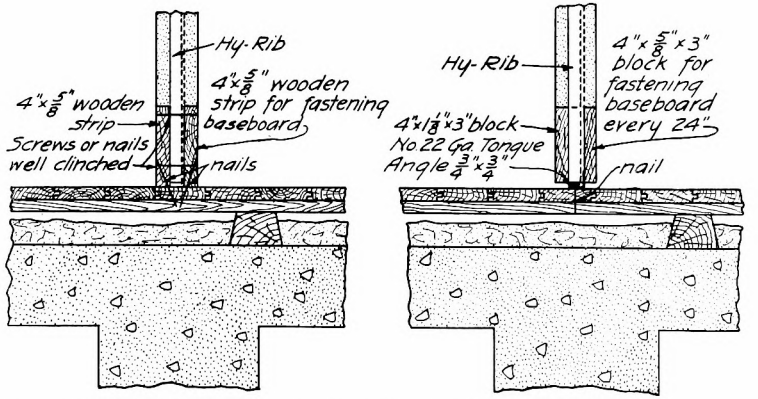
Sketch showing method of erecting Hy-Rib partition in connection with Hollow Tile floors



Sketch showing method of erecting Hy-Rib partition in connection with wood joists

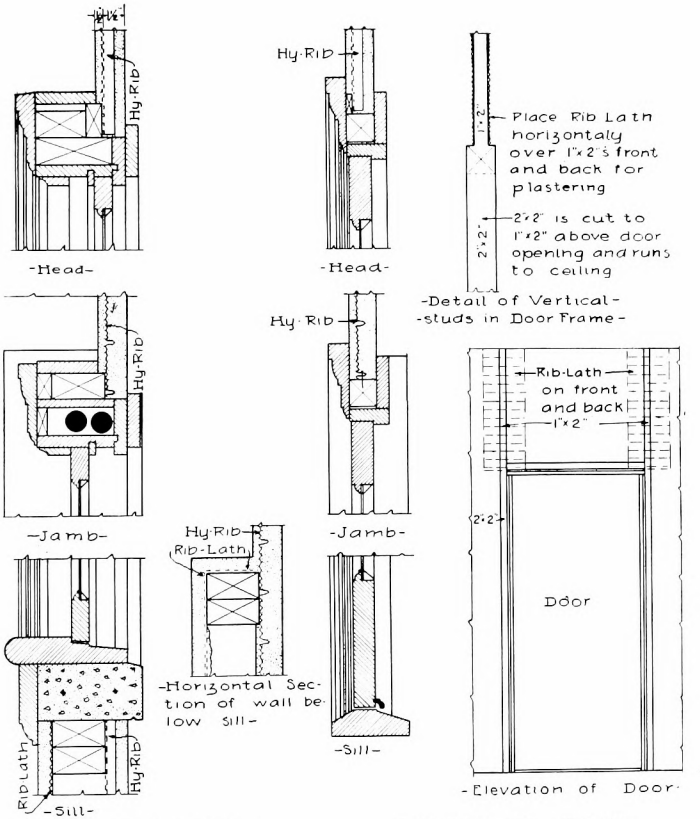


Sketch showing method of erecting Hy-Rib partitions in connection with suspended ceilings

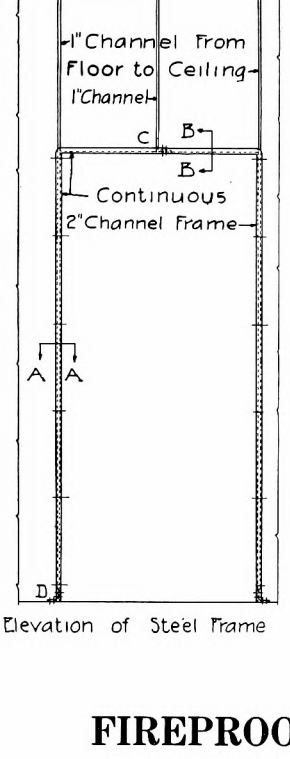


Two methods of fastening Hy-Rib Partition to wooden floors.

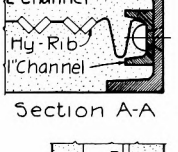
Methods of Attaching Hy-Rib Partitions at Ceiling and Floor.



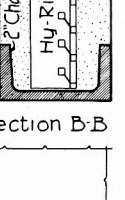
Methods of Building Wooden Door and Window Frames into Hy-Rib Partitions or Walls.



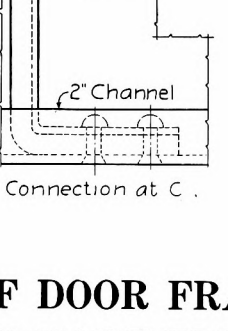
Elevation of Steel Frame



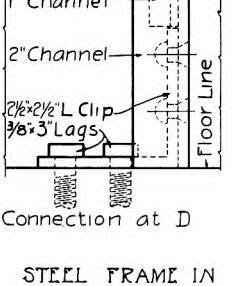
Section A-A



Section B-B



Connection at C



Connection at D

STEEL FRAME IN 2" HY-RIB PARTITIONS FOR FIRE-DOORS, STEEL DOORS, SHUTTERS ETC.

FIREPROOF DOOR FRAME IN HY-RIB PARTITIONS

The frame is all of steel, doing away entirely with wood and leaving absolutely nothing that can burn in the partition. The steel channel may be tapped, punched or drilled to attach wood or metal trim, hinges, locks, etc. This steel work can be procured from any good structural steel or ornamental iron works.

SPECIFICATIONS FOR SOLID HY-RIB PARTITIONS

Provide Hy-Rib, Type —, Gauge —, for all solid partitions. Interlock all adjoining sheets of Hy-Rib at sides and ends. Sheets shall be securely fastened together every 24 inches along the sides and at every rib at the ends by wiring or by clinching of the lapped ribs with special pincers. Where end splices occur between supports, splices in adjacent rows must be at least 2 feet apart. Allow a lap of 2 inches where splices occur over supports, otherwise 8 inches.

Hy-Rib shall be attached to floors and ceilings by means of small angles (or channels, wooden strips, or by letting into grooves according to construction of floor and ceiling) as indicated in details. Where supports are over 5 feet apart, Hy-Rib sheets shall be temporarily braced before plastering.

Where cement plaster is used provide 7/32 or ¼ inch rods. spaced 30 inches on center, at right angles to the main ribs. Where lime or patented plasters are used, rods are unnecessary.

PARTITIONS REINFORCED WITH HY-RIB

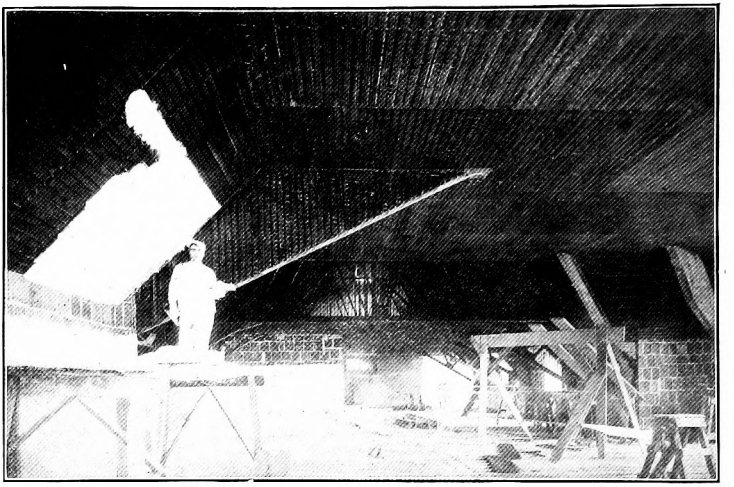
(Minimum Requirements.)

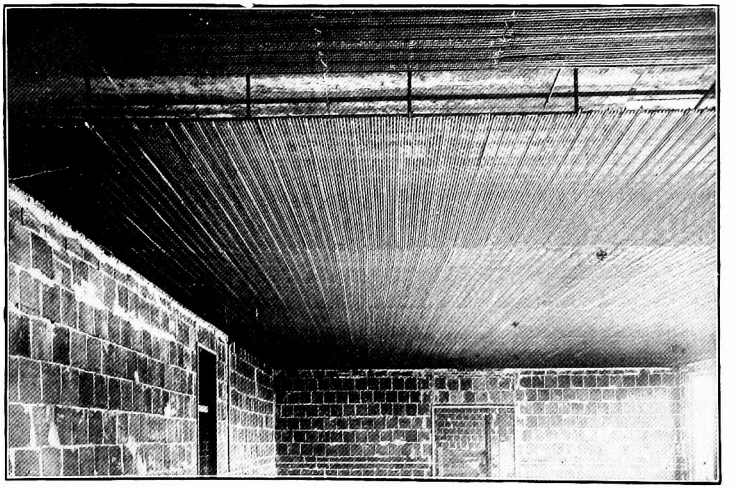
(Ribs of Hy-Rib running vertically.)

Height of Ceilings	Thickness of Partitions	REINFORCEMENT
10 feet	1¾″	No. 28, 3-rib **Hy-Rib.**
12 feet	2″	No. 26, 3-rib **Hy-Rib,** or No. 28, 4-rib **Hy-Rib.**
14 feet	2¼″	No. 24, 3-rib **Hy-Rib,** or No. 26, 4-rib **Hy-Rib.**
16 feet	2½″	No. 26, 4-rib **Hy-Rib.** or No. 26, deep-rib **Hy-Rib.**
18 feet	2¾″	No. 24, 4-rib **Hy-Rib,** or No. 24, deep-rib **Hy-Rib.**
20 feet	3″	No. 22, deep-rib **Hy-Rib.**

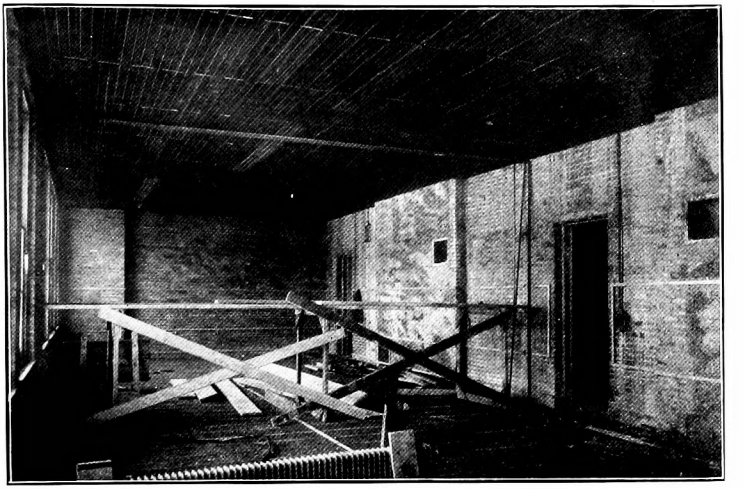
Temporary bracing should be used horizontally every 5 ft. for **3-Rib Hy-Rib,** 6 ft. for **4-Rib Hy-Rib,** and 7 ft. for **Deep-Rib Hy-Rib.**

Above 25 ft., structural supports should be erected vertically in accordance with Side Wall Table, page 51, and the **Hy-Rib** run horizontally. It may be necessary also in special cases for partitions above 12 ft., which will be subjected to constant vibration, such as in factories, to be constructed in the same manner.





Hy-Rib Ceilings, Mount St. Joseph Academy, Buffalo, N. Y.
A. A. Post, Architect.



Hy-Rib Ceilings—High School, Alliance, O.
Richards, McCarty & Bulford, Archts.

CEILINGS

Hy-Rib, as used in ceilings, does away entirely with the small channels, T's, angles, and studs necessary where the ordinary type of lath is used. The ribs of **Hy-Rib** give the necessary stiffness and rigidity. The great expense of wiring lath to a large number of separate channels is entirely done away with.

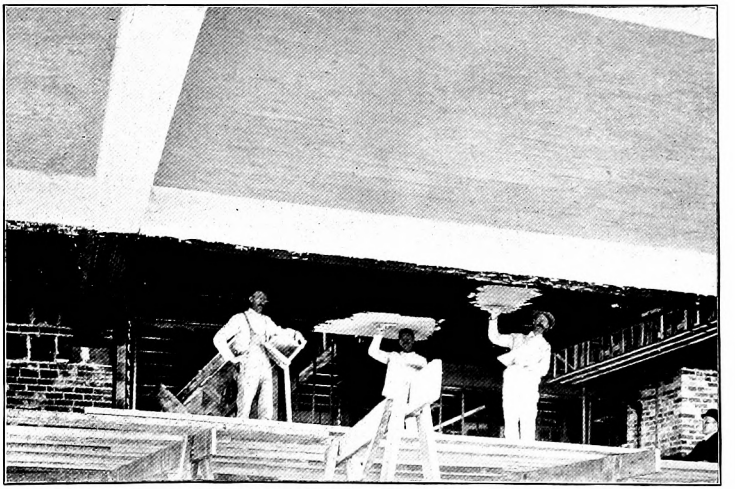
Hy-Rib is placed with the lath surface downward, presenting a straight true surface for plastering, and requires a minimum amount of material.

The improved form of lath provides a perfect key for the plaster and prevents any chance of its dropping.

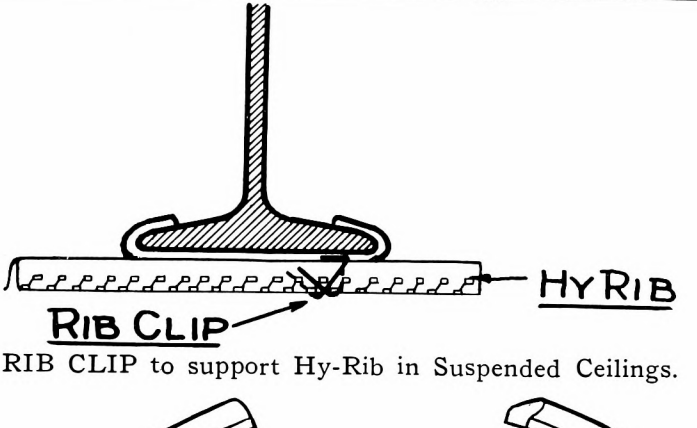
Hy-Rib sheets are supported every 4 or 5 feet either directly from the construction above or by means of lines of Rib Ceiling Joists, Channels, or T's.

Hy-Rib for ceilings saves time and labor in installation and its initial cost is lower than the ordinary lath and separate channels.

Showing Channel Supports ready for **Hy-Rib.**



Hy-Rib Ceiling, Hotel Tuller, Detroit, Mich.



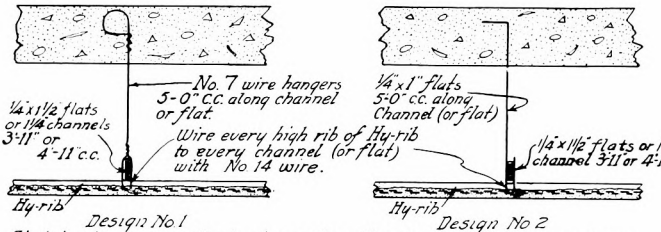
RIB CLIP to support Hy-Rib in Suspended Ceilings.

RIB CLIPS—Price, $1.00 per 100.

Rib Clips are shipped with one end bent and other end straight as shown by dotted lines. In ordering **Rib Clips**, always give width of flange upon which clips are to be used, or, if this is impossible, give size and weight of Channel or I beam to which the clips are to be attached.

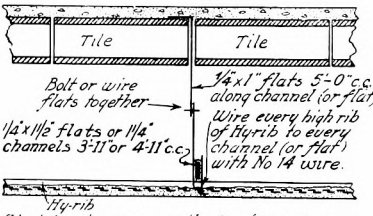
Rib Clips are particularly useful for supporting ceilings as shown above. For use in partitions, see page 65.

For walls, sidings and roofs, **Plate Clips** (see page 100) are simpler, better and more economical.



Design No 1 Design No 2

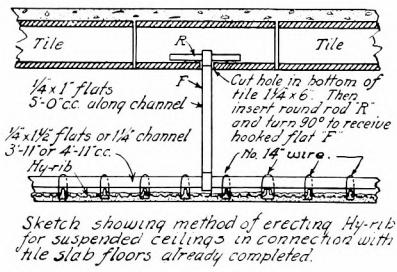
Sketch showing method of erecting Hy-rib for suspended ceilings in connection with concrete slabs



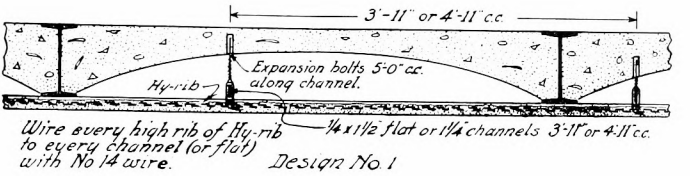
Sketch showing method of erecting Hy-rib for suspended ceilings in connection with tile slabs

HY-RIB Ceilings Suspended from Solid Concrete and Hollow Tile Floors.

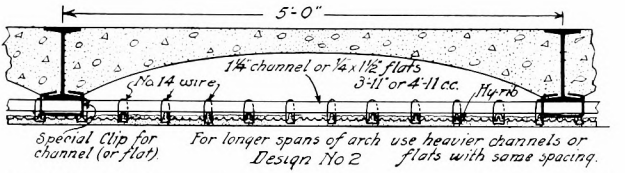
If spans are increased, or a live load is placed upon ceiling, materials of a larger size than those here specified must be used.



Sketch showing method of erecting Hy-rib for suspended ceilings in connection with tile slab floors already completed.



Design No. 1



Design No 2

Sketch showing methods of erecting Hy-rib for suspended ceilings in connection with arched soffits of floors when supporting floor is already completed.

If spans are increased, or a live load is placed upon ceiling, materials of a larger size than here specified must be used.

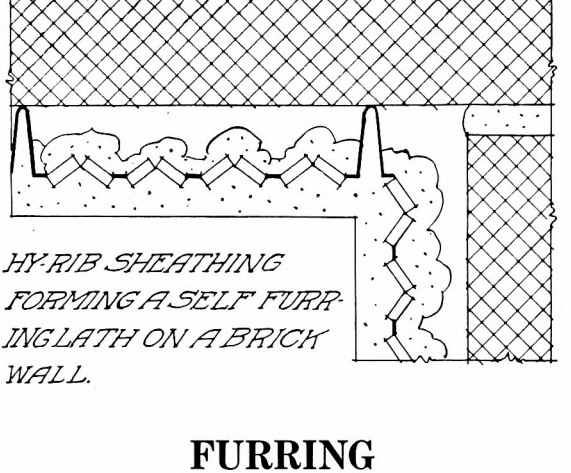
SPECIFICATIONS FOR SUSPENDED CEILINGS

Suspended ceilings shall be built of Hy-Rib attached to lines of supports, as indicated in detail; supports to be ¼"x1½" flats or 1¼" channels, with following spacing and **Hy-Rib**:

Spacing of Supports	REINFORCEMENT
2'-11"	No. 28, 3-rib **Hy-Rib.**
3'-11"	No. 26, 3-rib **Hy-Rib** or No. 28, 4-rib **Hy-Rib.**
4'-11"	No. 24, 3-rib **Hy-Rib** or No. 26, 4-rib **Hy-Rib** or No. 26, deep-rib **Hy-Rib.**
5'-11"	No. 24, 4-rib **Hy-Rib** or No. 24, deep-rib **Hy-Rib.**

Each high rib of Hy-Rib shall be attached at each support.

Interlock all adjoining sheets of **Hy-Rib** at sides and ends. Sheets shall be securely fastened together every 24 inches along the sides and at every rib at the ends by wiring or by clinching of the lapped ribs with special pincers. Where end splices occur between supports, splices in adjacent rows must be at least 2 feet apart. Allow a lap of 2 inches where splices occur over supports, otherwise 8 inches.



HY-RIB SHEATHING FORMING A SELF FURRING LATH ON A BRICK WALL.

FURRING

For furring the outside or inside of walls of buildings to insulate them against dampness and moisture, **Hy-Rib** is nailed or stapled directly to the wall with the lath side outward. The plaster is applied directly to the face of the lath. An air space of ample size is secured back of the plaster. No furring strips or studs of any kind are necessary as these are supplied by the ribs.

An air space of ¾ inch is provided by using **3-Rib Hy-Rib** and one of 1½ inches by the use of **Deep-Rib Hy-Rib.**

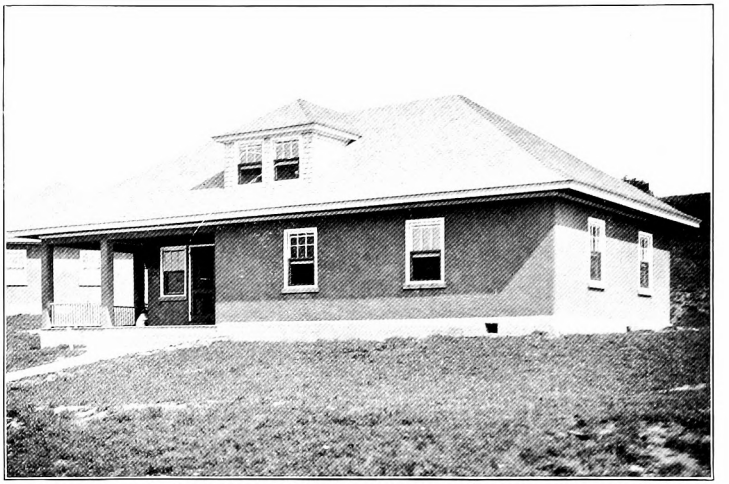
Hy-Rib is extensively used as a furring for insulation around boilers; in cold storage plants; and on roofs to prevent condensation. The air space between the ribs stops the conduction of heat, cold and moisture.

Hy-Rib does away entirely with the great labor expense of attaching loose sheets of lath to separate furring strips, and saves time in construction.

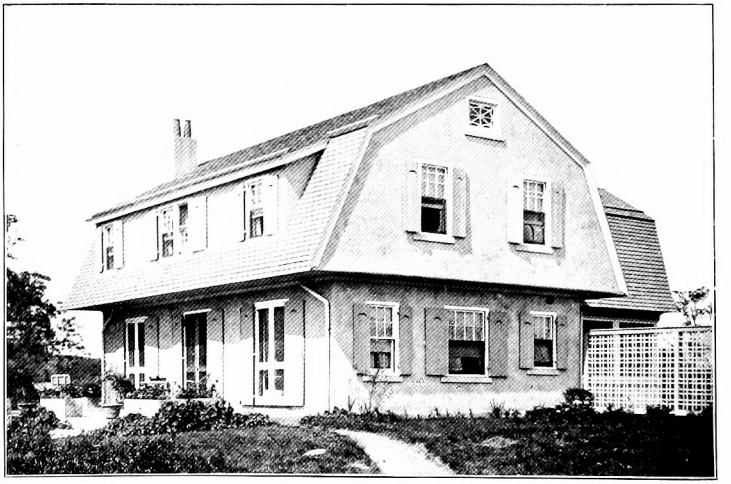
SPECIFICATIONS FOR FURRING

Three-Rib **Hy-Rib** or Deep-Rib **Hy-Rib** shall be placed with the lath side away from wall. It shall be fastened to the wall by means of staples or nails occurring at the high ribs every 28 inches across the width of sheets and every 36 inches along their length. Interlock all sheets at ends and sides and allow 1 inch end lap.

Alt Heidelberg, Fort Wayne, Ind. J. M. E. Reidel, Archt.
Stucco on **Hy-Rib** Used as Furring on Brick Wall.



Hy-Rib Concrete Cottage—E. M. & W. Ferguson, Fisher's Island, N. Y. —F. E. Hine, Architect.



Hy-Rib Concrete Residence—Dr. Terriberry, Fisher's Island, N. Y. James Sweeney, Architect.

INDUSTRIAL BUILDINGS

In Factories, Foundries, Machine Shops, Rolling Mills, Car Barns, Round Houses, Power Plants, Elevators—in fact, industrial buildings of all kinds, **Hy-Rib** is used extensively for siding and in floor and roof construction. The cement finish gives a good, clean-cut, business-like appearance to the building. The total absence of expense for repairs makes it far more economical than the old style corrugated iron sheets or wooden sheathing.

BUSINESS BUILDINGS

In Office, Store and Public Buildings, **Hy-Rib** finds its principal uses in partition, ceiling, floor and roof construction. Thin solid partitions less than 2 inches in thickness and of great rigidity are obtained by using **Hy-Rib.** Such partitions are strictly fireproof and in this way buildings can be subdivided into fireproof compartments, which prevent the spread of fire.

Partitions built of **Hy-Rib,** besides possessing greatest strength, are the lowest in cost of any strictly fireproof method of building and are built more rapidly and with less labor.

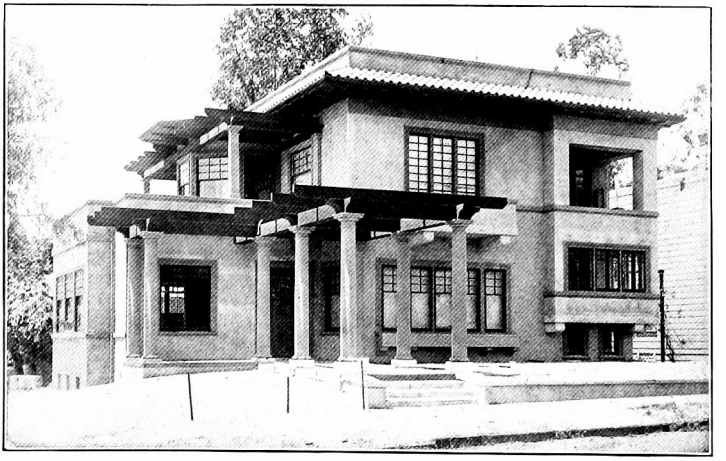
RESIDENCES, GARAGES AND SMALL BUILDINGS

(See also Special Folder on Hy-Rib Garages, sent on request.)

The building of concrete residences and smaller buildings has long been popular, owing to their permanence, fireproofness, and unusual possibilities for artistic treatment. The cost has been the one item which has hindered a more universal adoption of this type of building.

The cost of lumber, field labor, and special contrivances necessary to carry on the ordinary type of concrete con-

Hy-Rib Residence of W. Rosberry, Roslindale, Mass.

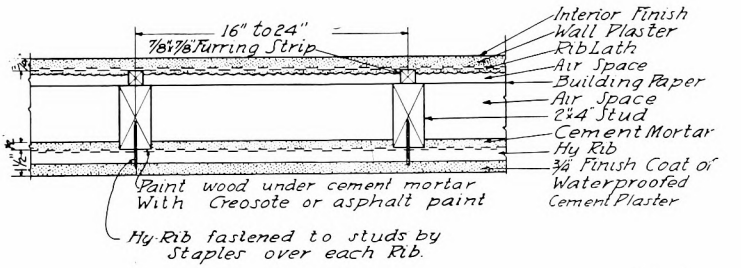


Hy-Rib Residence for Miss Alice Henck, Santa Barbara, Cal.
Thomas Nixon, Architect.

struction, makes such work expensive in small buildings. **Hy-Rib** does away entirely with all this centering and special work, greatly reducing the cost.

For small buildings such as garages, sheds, barns, etc., a single thickness wall of **Hy-Rib** plastered with cement is ample. To carry the floor and roof loads provide occasional posts built up of steel members, wooden scantling, or reinforced concrete. **Hy-Rib** is attached rigidly to the posts by means of **Hy-Rib** clips, wires, or staples.

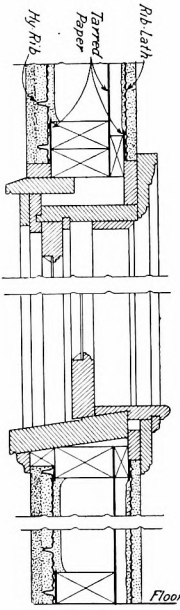
For dwelling houses an air space should be provided in the outside wall. The following method for constructing stucco walls, will give by far the best results, although the other methods outlined are satisfactory:



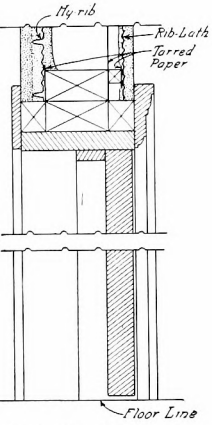
Set up an ordinary "balloon" frame structure with 2 x 4 studding spaced 16 to 24 inches apart, and put all temporary bracing on the inside. Fasten **Hy-Rib** at each rib to outside of studs with staples or nails. Use 3-Rib Hy-Rib with ribs extending horizontally, and lath surface against studs. Interlocking **Hy-Rib** sheets at side and ends, securely wiring or clinching them every 24 inches along sides and at every rib at ends. Paint the studs with creosote or asphalt paint along the entire outer face, and at least an inch back on the sides. Plaster this **Hy-Rib** on the outside with cement mortar (mixed and applied as directed on page 50) to a thickness of 1½ inches and give it any finish desired. The last ¾" of plaster finish should be waterproofed with Trus-Con Waterproofing Paste, Concentrated.

DETAILS OF EXTERIOR WALLS OF RESIDENCES.

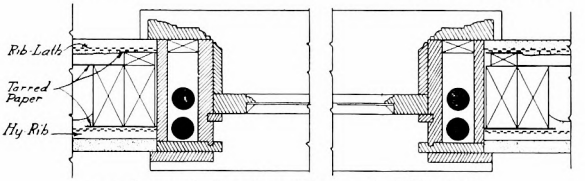
Showing Hy-Rib on outside and Rib Lath on inside.



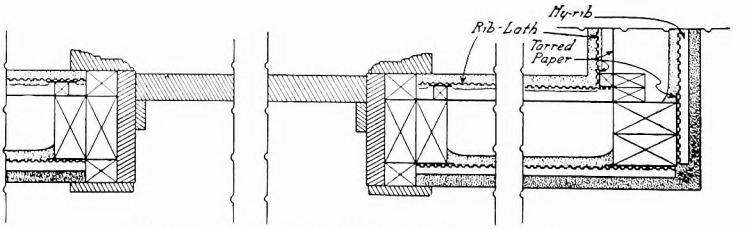
Vertical Section Through Window.



Vertical Section Through Outside Door.



Horizontal Section Through Window.



Horizontal Section Through Outside Door.

Then back plaster the **Hy-Rib** with similar mortar to a thickness of about half an inch.

This construction insures absolute protection for the steel, and when the mortar has set you have a 2-inch reinforced concrete slab, solid as rock, and much stronger and more rigid than the ordinary matched sheathing of which it has taken the place.

On the inside of the studding tack thin asbestos board or a very heavy tarred paper, then 7/8-inch furring strips, and heavy Rib-Lath on which plaster 5/8-inch of cement mortar or good plaster, and the regular finish coat.

In this way you have secured a house which possesses the following advantages:

1. Practically fireproof, due to the heat-resisting qualities of the 2-inch reinforced concrete slab on outside.

2. Absolutely waterproof and dampproof.

3. Easy to heat in winter and keep cool in summer, owing to the double air space in the wall.

4. Practically indestructible owing to the permanence of the reinforced concrete wall.

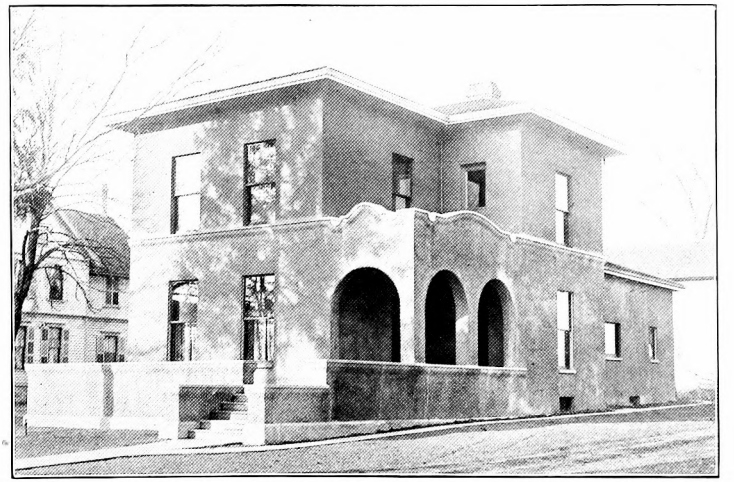
5. No expense for maintenance, such as painting, repairs, etc.

6. Unusual architectural beauty because of the artistic effects that can be secured with stucco.

7. Low first cost.

This method outlined above gives a wall of almost unlimited strength and rigidity, and is suitable for large buildings. For small cottages and for structures in which the total wind pressure will not be great, some saving may be effected by using HEAVY BEADED PLATE RIB-LATH in place of **Hy-Rib,** on the outside, plastering it in the same manner on both sides to a total thickness of 1¼ inches or more. (In this stucco construction it must be borne in mind that the only way to insure permanence is to have a real reinforced concrete slab on the

Workingmen's Cottages of **Hy-Rib** Concrete.



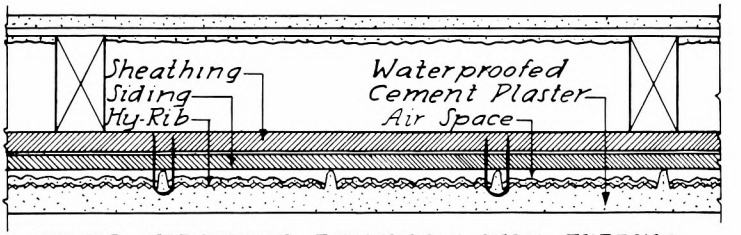
Residence of N. J. Spaulding, Ionia, Mich.

An old Wooden House Transformed into a Modern, Permanent Residence by Overcoating with **Hy-Rib** and Stucco.

outside. **Hy-Rib** is necessary for medium and large-sized residences. For smaller cottages no lath weighing less than 4½ lbs. per square yard is strong enough to properly reinforce a concrete wall.)

Another method which has been extensively used in our colder climates is to place on the outside of the studding ⅞-inch matched sheathing, heavy building paper, and **Hy-Rib** plastered with cement one inch thick and properly waterproofed. The ribs of the **Hy-Rib** do away with the necessity for furring strips, required where steel lath is used.

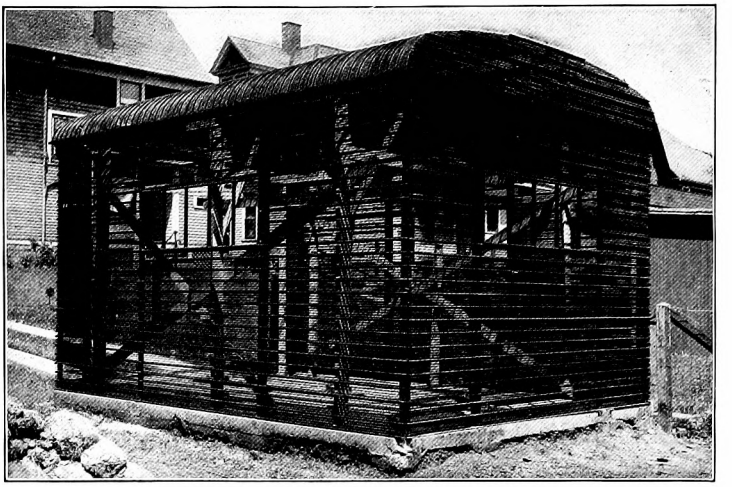
For our milder climates the furring strips may be omitted in the first two methods described and the paper sheathing may be omitted in all three cases.

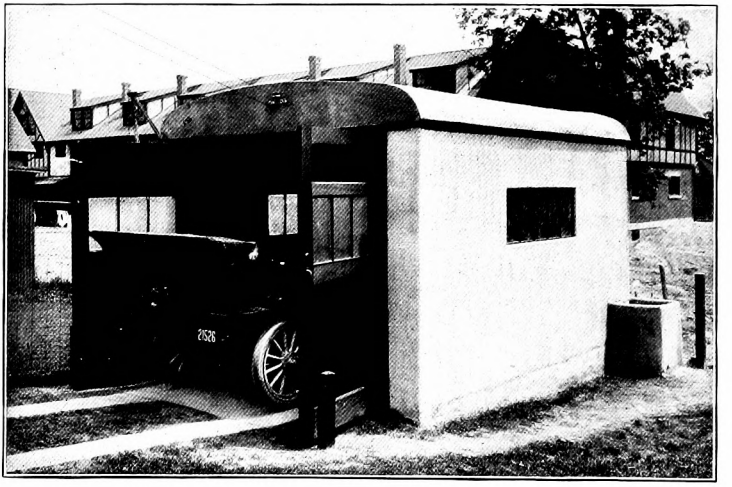


HY-RIB SHEATHING FORMING A SELF FURRING LATH ON WOOD SIDING

"OVER-COATED" HOUSES

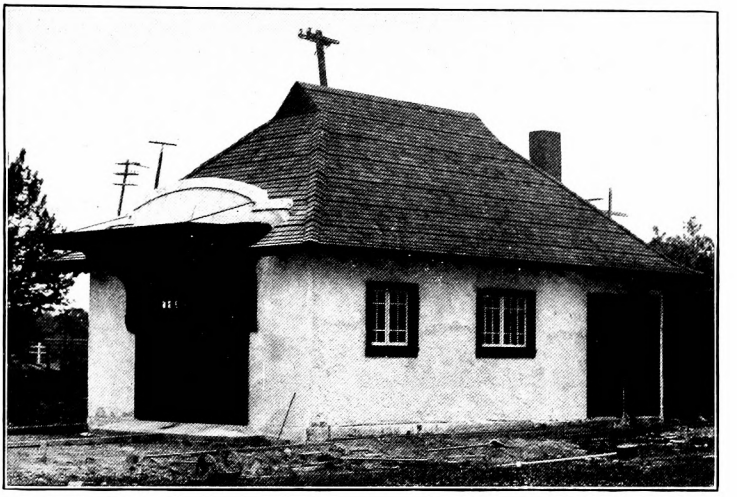
An old, wood-frame house can be readily transformed at nominal expense into a modern concrete building by the use of **Hy-Rib**. The **Hy-Rib** is placed against the wood clapboards with the ribs extending horizontally and the lath surface outward. The **Hy-Rib** sheets are interlocked at sides and ends, and securely stapled or nailed to the wood sheathing at least every 24 inches in both directions. Plaster the **Hy-Rib** with cement mortar mixed and applied as directed on page 50 to a thickness of one inch. The outside ¾" finish plaster should be waterproofed with Trus-Con Waterproofing Paste Concentrated. The transformation made in a house in this way is very wonderful, enhancing the value and the life of the property, and protecting it against fire.



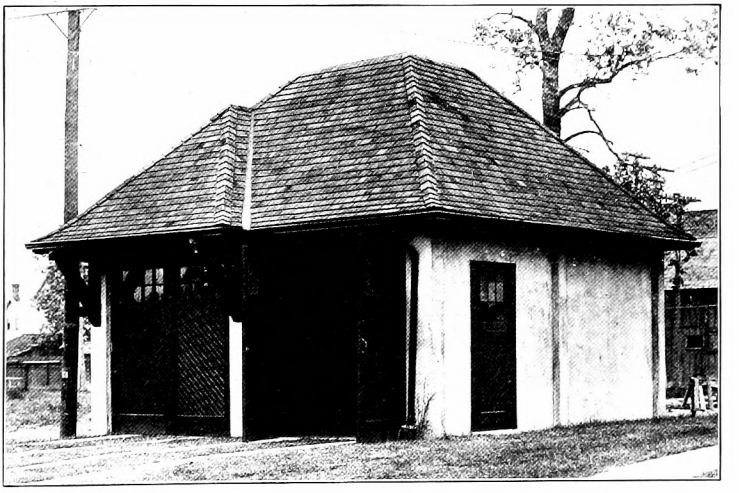


Hy-Rib Garage for T. H. Kane, Youngstown, O.
Ready for Plastering and Completed.

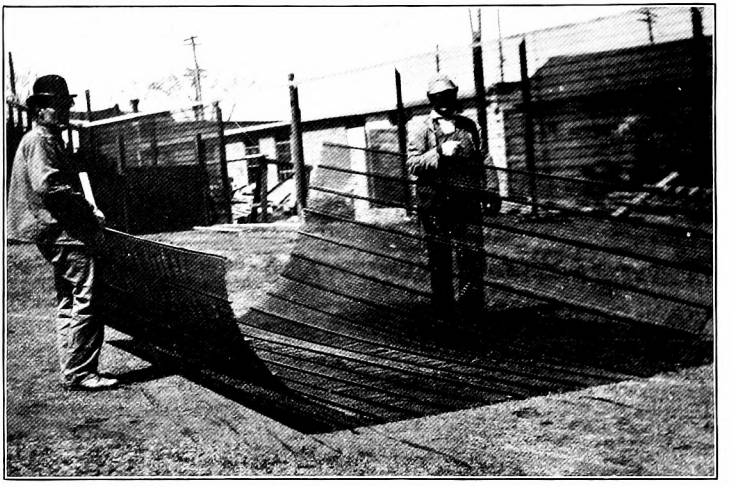
Write for **Hy-Rib** Garage Folder, containing complete details and specifications.



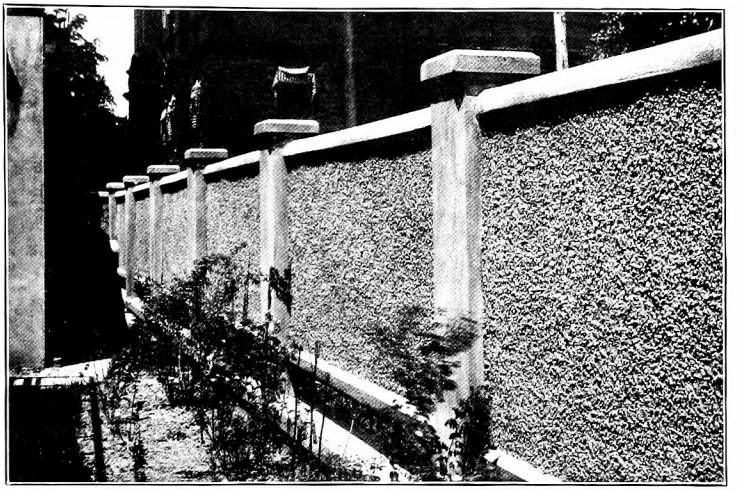
Hy-Rib Garage for W. E. Parker, Grosse Pointe, Mich.



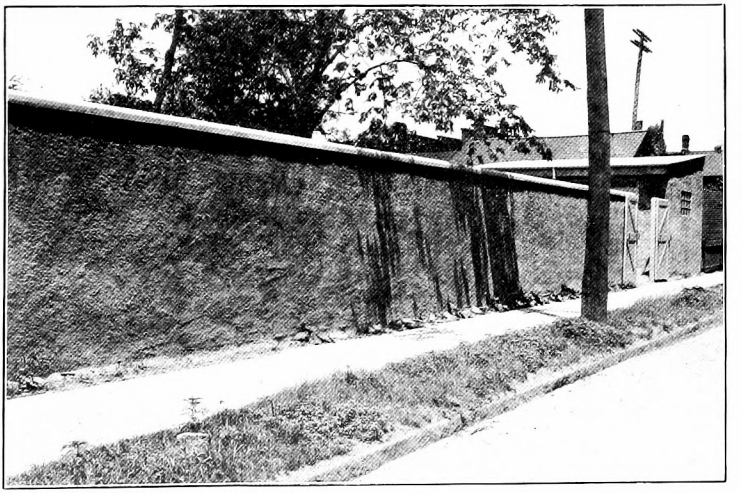
Hy-Rib Garage for Dr. Moran, Detroit, Mich.



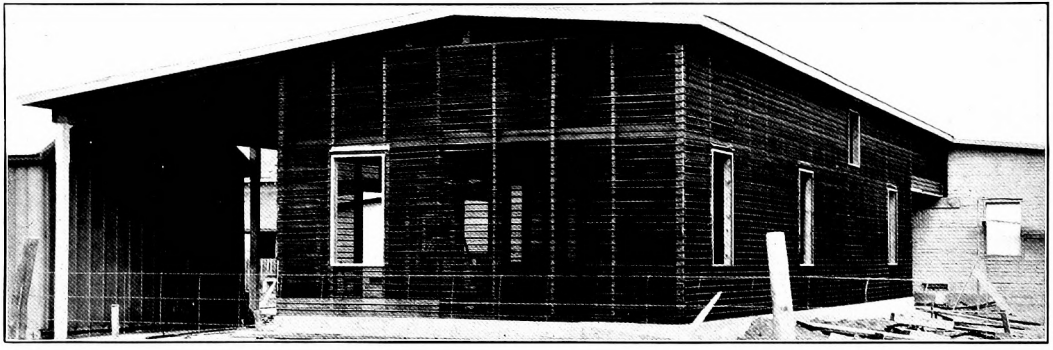
Hy-Rib Concrete Fence, Minneapolis Ball Grounds. **Hy-Rib** is united by punching and placed a panel at a time.

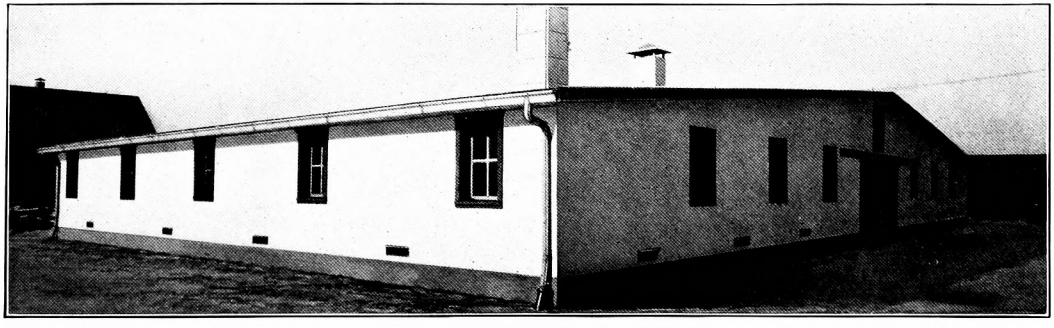


Hy-Rib Fence, E. J. Smith, Detroit, Mich.
Note fence is open below.



Hy-Rib Fence—Ernest G. Swift, Detroit, Mich.
Note **Hy-Rib** Garage at Right.





Hy-Rib Concrete Sidings on wood studs, before and after plastering.
Barns on Walker Bros.' Farm, Walkerville, Ont.

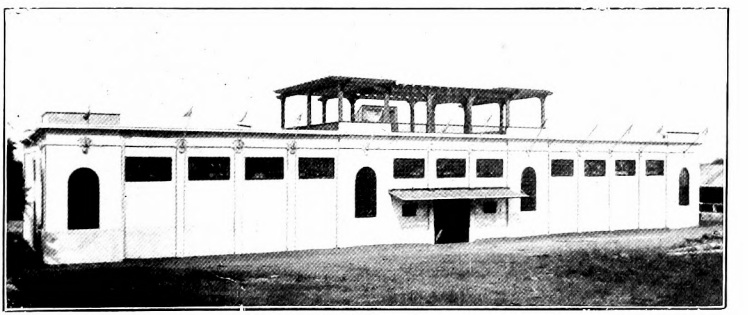
ON THE FARM

The day of the unsightly short-lived wood frame buildings is passing. In their place is coming the concrete construction. The average farm is provided with no means of fighting fire. This means that the slightest fire may cause the total loss of a large amount of property, making fireproof construction a necessity in farm buildings.

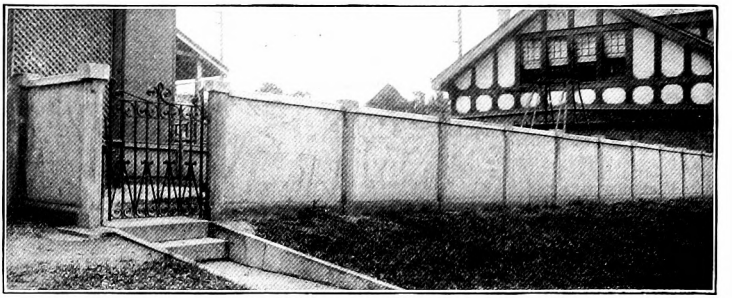
Hy-Rib, owing to its simplicity and ease of application, makes it possible for concrete construction to be carried on by the ordinary farm mechanic.

The sand and stone for the concrete are easily accessible in the neighborhood—the Portland cement is secured from local dealers. **Hy-Rib** is shipped in exact lengths, and, where desired, bent to any curve. Its uses are found in the building of houses, barns and sheds of all kinds—in constructing culverts, cisterns, tanks and silos. Fences are also built in this way.

We will gladly supply detailed information in regard to any particular work that may be contemplated.



Hy-Rib Walls, Agricultural and Horticultural Building, State Fair Grounds, Raleigh, N. C.
Frank K. Thompson, Architect and Engineer.



Hy-Rib Fence for Van Perrine Residence, Fort Wayne, Ind.
Chas. R. Weatherhogg, Architect.
Hy-Rib Spans Horizontally Between Reinforced Concrete Posts.

Hy-Rib Silos for J. R. Cross & Co.,
Jersey Farm, Fairhope, Ala.

SILOS, TANKS, RESERVOIRS, CISTERNS AND CHIMNEYS

(Write for Hy-Rib Concrete Silo Book.)

The curved **Hy-Rib** sheets are set up on edge and the plaster applied directly to the inner and outer surfaces. No forms of any kind are required. Vertical Rib Bars about 5 feet apart should be used to serve as a guide for the **Hy-Rib** sheets and to thoroughly tie the concrete work together vertically.

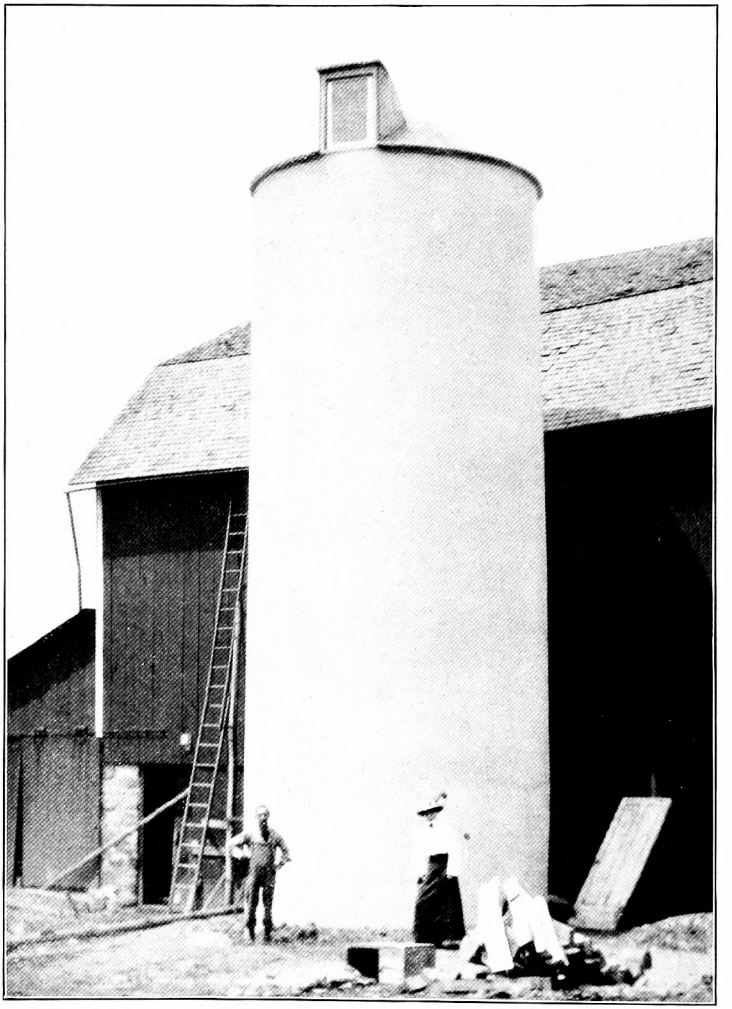
Hy-Rib sheets provide in themselves a thorough interlocking splice at the ends and sides. Lap the sheets at least 8 inches at ends and securely fasten together each spliced rib. Splices in adjacent rings should be at least two feet apart.

Follow specifications for **Hy-Rib** walls and sidings page 50 for materials and applications of plaster.

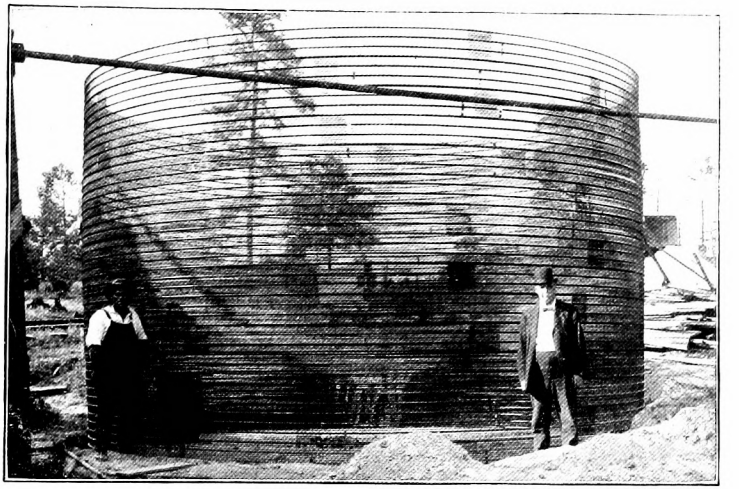
It is usually difficult to plaster a solid wall to a greater thickness than 4 inches. When heavier solid walls are required we recommend the use of a double layer of **Hy-Rib**, pouring the concrete in between the two sheets.

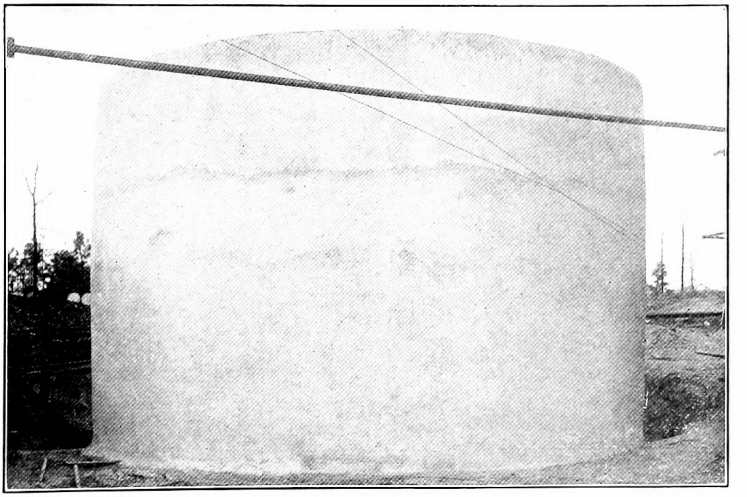
Where an air space is desired on walls of silos an inner and outer layer of **Hy-Rib** is used with Rib Steel Studs to separate them. The inner wall is plastered on both sides and the outer wall on the outside only.

The roof of a silo can also be built of concrete and in this way a permanent silo is secured at a cost but slightly in excess of the ordinary short-lived wood construction.

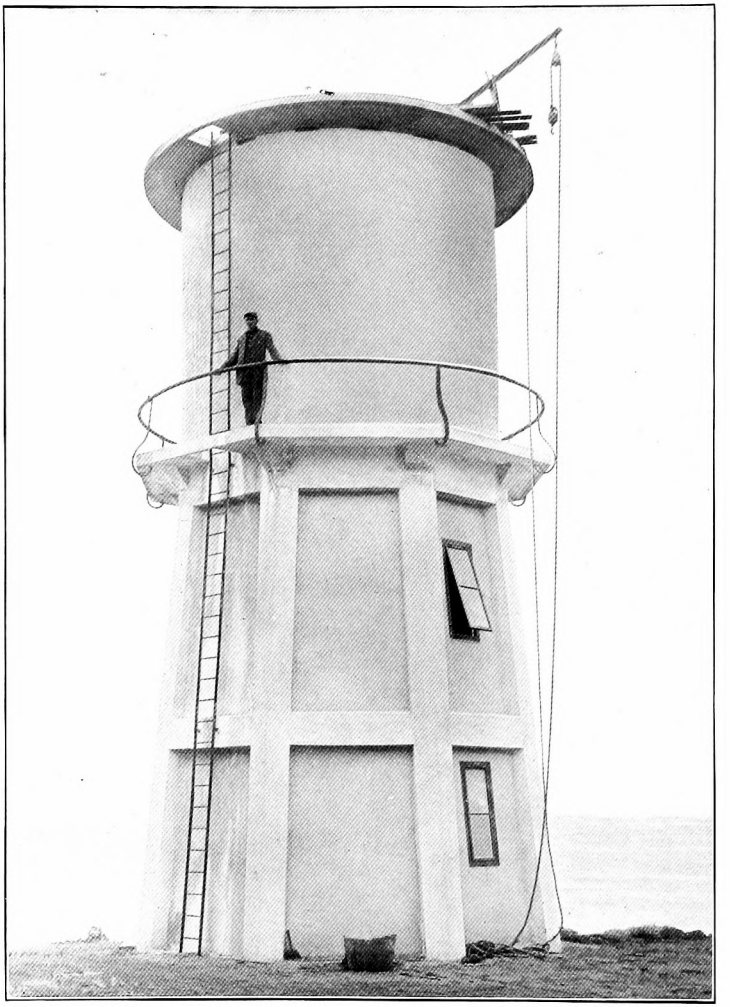


Hy-Rib Concrete Silo for I. L. Snyder, Coldwater, Mich.

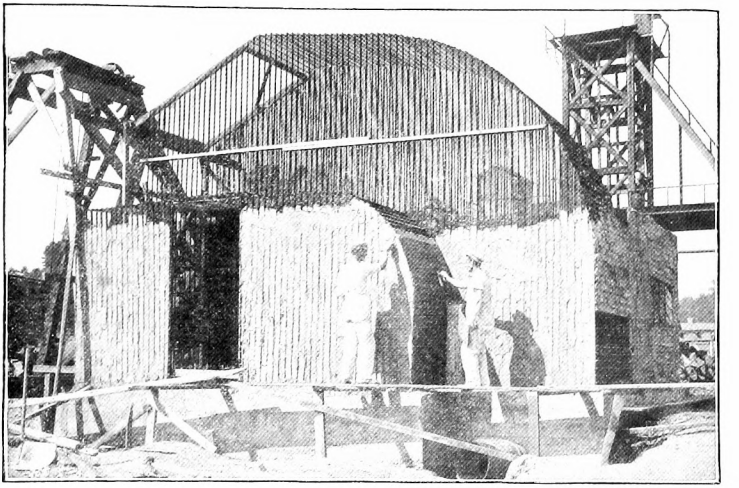


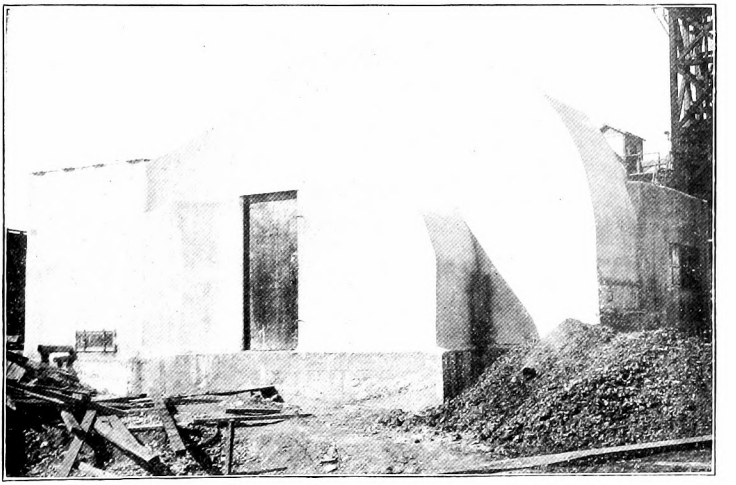


Water Tank **(Hy-Rib)**, Jefferson Powder Co., Birmingham, Ala.
Hy-Rib bent to exact curve in our shops.

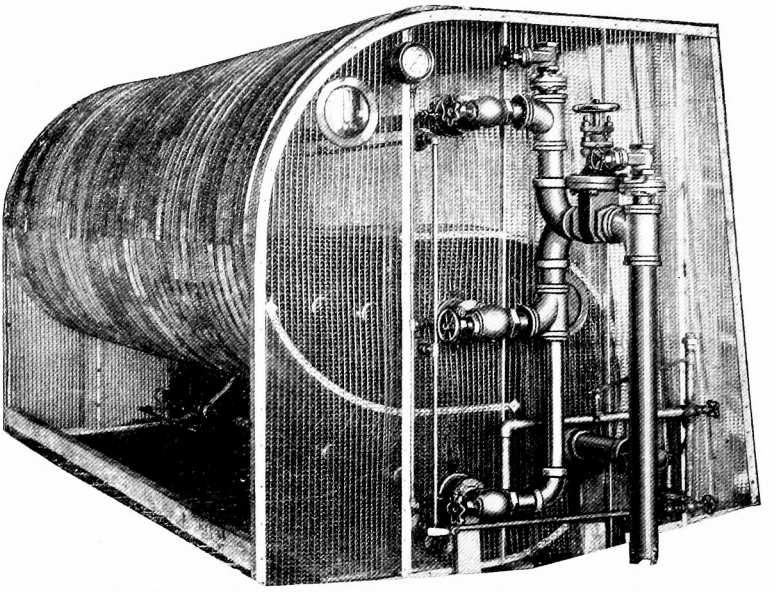


20,000 Gallon Tank, Marine Biological Station, San Diego, Cal.
Irving J. Gill, Architect.
Tank and Panels are built of **Hy-Rib**, Plastered with Concrete. Posts and Girders are Kahn System Reinforced Concrete.

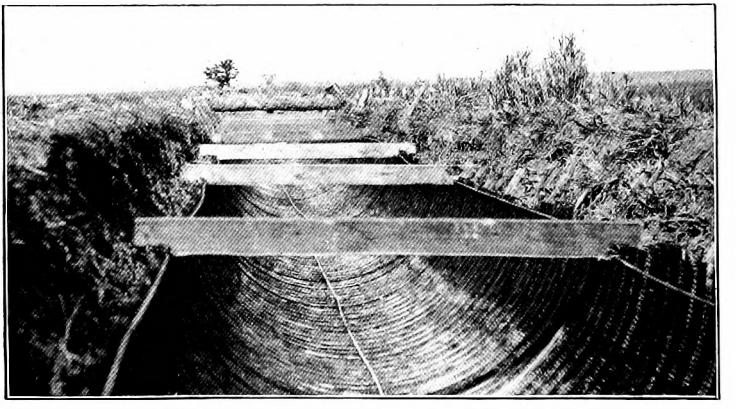




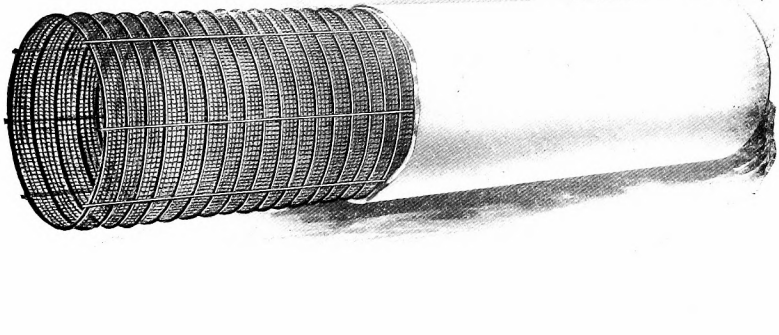
Hy-Rib Fan House, Birmingham Fuel Co., Birmingham, Ala.



Air Washer made by McCreery Engineering Co., Toledo, O.
Curved **Hy-Rib** Ready for Plastering.



Water-Flume for the Cia. Azucarera del Panuco, at El Higo, Mexico.
Hy-Rib Ready for Concreting.



CONDUITS, FLUMES AND CULVERTS

The **4-Rib Hy-Rib** is bent to perfect curve in our shops. Simply set up the curved sheets on the job, and apply the concrete as a plaster.

Absolute continuity of reinforcement is secured by the positive interlocking of the sheets at the sides and ends. No forms (the principal item of expense in conduit construction) or special field labor are required. A few rods, as shown on illustration, extending the length of the conduit, should be provided to keep the **Hy-Rib** straight in line and as an additional safeguard against any shrinkage and temperature cracks. Rib Bars are recommended for this purpose.

Either side of the **Hy-Rib** may be plastered first.

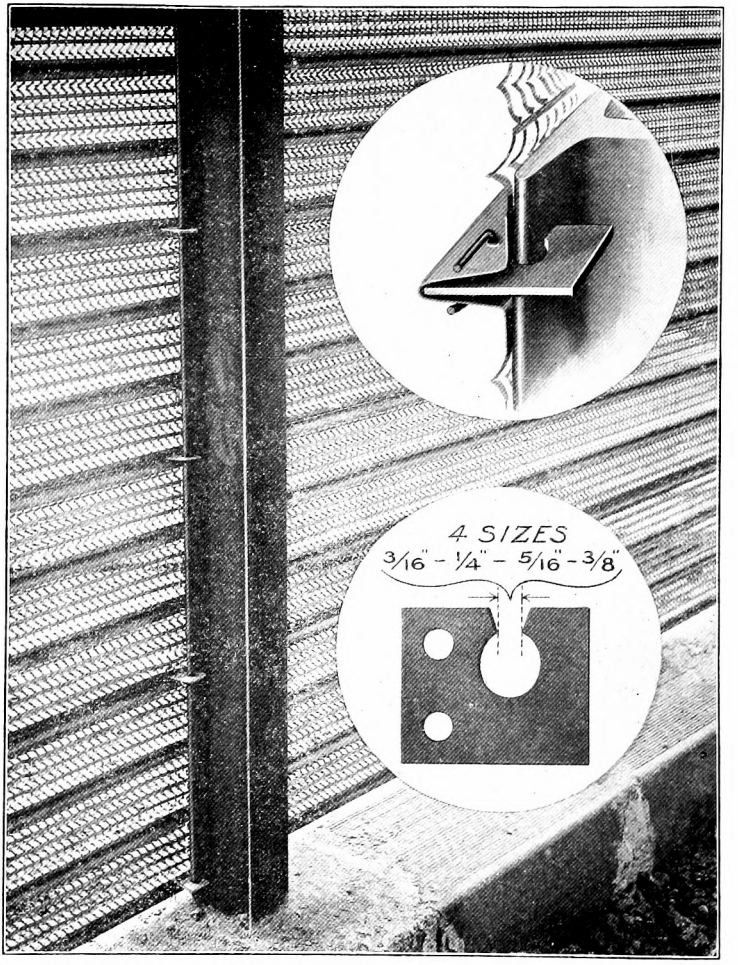
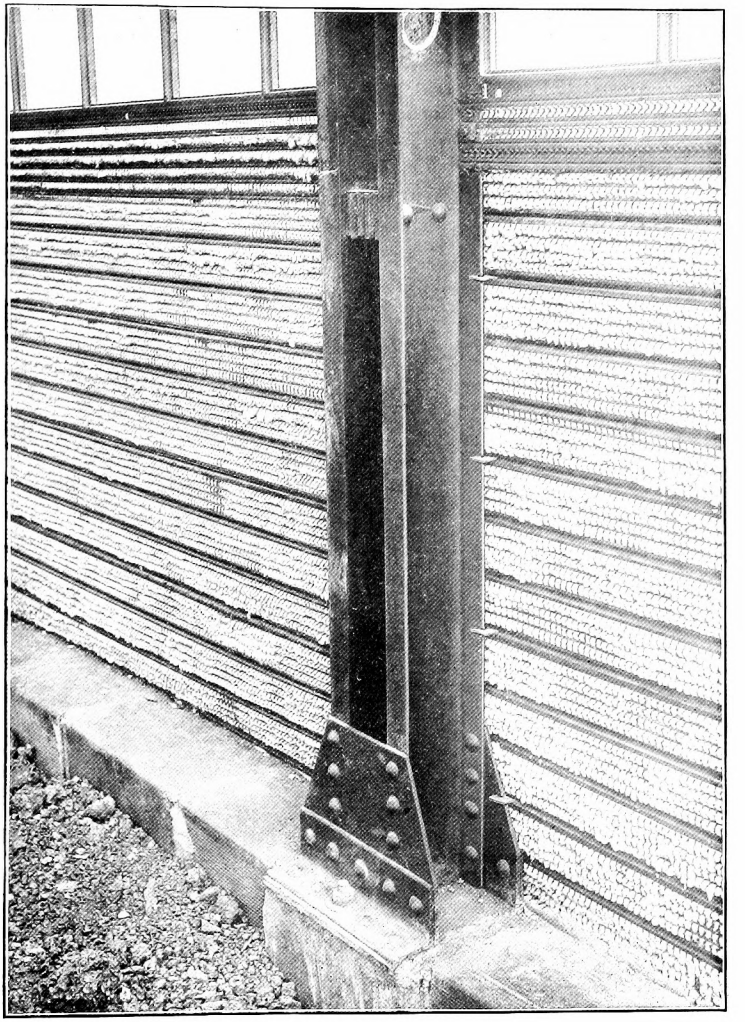


PLATE CLIPS [Patented] Price, 50c per 100.

These clips are made of spring steel, and when driven on to the flange of the steel work, bite into the steel, gripping it like the jaws of a vise. **A simple, rigid, and inexpensive method of attaching Hy-Rib to structural steel.** Plate Clips should be located at the interlocking side splice between sheets.



Interior View of **Hy-Rib** Wall after receiving one coat of plaster on outside. Note Plate Clips for attaching the **Hy-Rib** to steel frame.

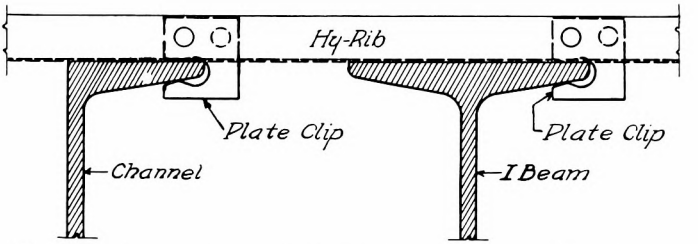


Plate Clip Connection with Hy-Rib for Floor or Roof Construction

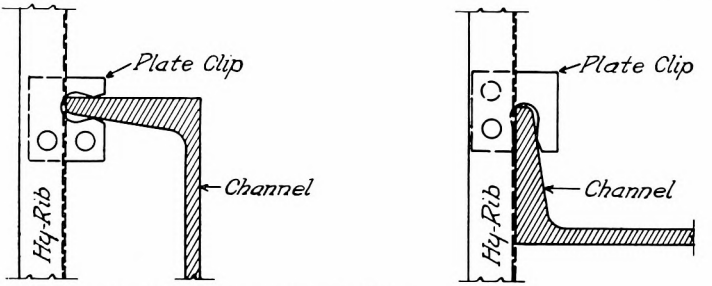


Plate Clip Connection with Hy-Rib for Wall Construction

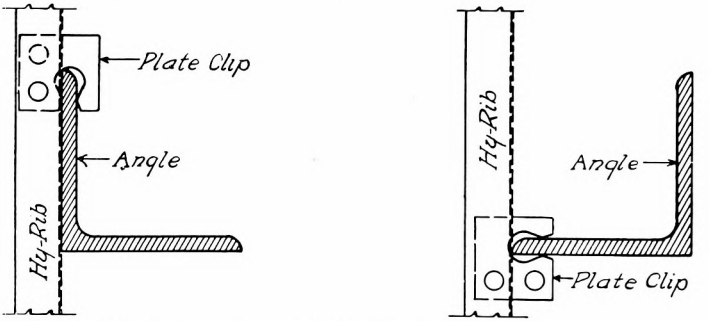


Plate Clip Connection with Hy-Rib for Wall Construction

DETAILS OF PLATE CLIP CONNECTIONS

Plate Clips Required for Standard I Beams, Channels and Angles.

Standard American Sections.

I. STANDARD I BEAMS

Size I Beam.	Weight.	Plate Clip.
12″	31.5 lbs.	3/8″
10″	25 lbs.	5/16″
9″	21 lbs.	5/16″
8″	18 lbs.	5/16″
7″	15 lbs.	1/4″
6″	12.25 lbs.	1/4″
5″	9.75 lbs.	1/4″
4″	7.5 lbs.	1/4″
3″	5.5 lbs.	3/16″

II. STANDARD CHANNELS

Size Channel.	Weight.	Plate Clip.
12″	20.5 lbs.	3/8″
10″	15 lbs.	5/16″
9″	13.25 lbs.	1/4″
8″	11.25 lbs.	1/4″
7″	9.75 lbs.	1/4″
6″	8 lbs.	1/4″
5″	6.5 lbs.	1/4″
4″	5.25 lbs.	1/4″
3″	4.5 lbs.	3/16″

III. STANDARD ANGLES

The thickness of angles governs in all cases.

Angle 3/8″ thick	3/8″ Plate Clip
Angle 5/16″ thick	5/16″ Plate Clip
Angle 1/4″ thick	1/4″ Plate Clip
Angle 3/16″ thick	3/16″ Plate Clip

Punching the **Hy-Rib** to engage the holes in the Plate Clips.

HY-RIB PUNCH

(Patent Applied for)

Length of Handles, 30 inches.

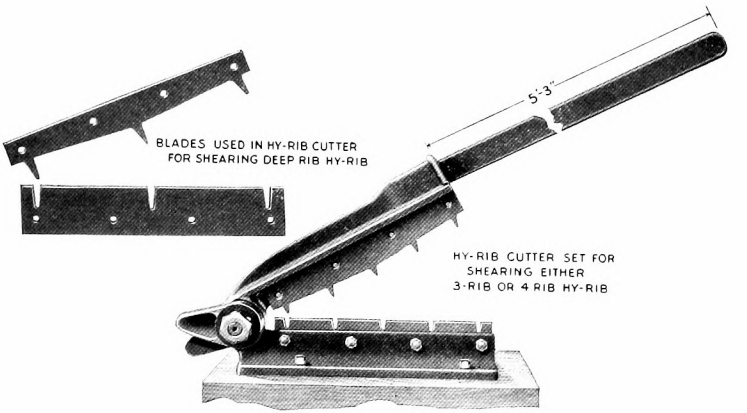
PRICE, $6.00.

The Hy-Rib Punch has two uses; 1st, for fastening the Hy-Rib sheets rigidly together, by merely clamping the interlocked ribs, doing away with all necessity for wiring; 2nd, for punching holes through the ribs, especially when Hy-Rib is attached to steel work by means of the plate clips.

The use of the punch in Hy-Rib sidings is shown on opposite page. The edge of the punch is lined up with the edge of the plate clip, which can be readily seen through the Hy-Rib mesh. The small point of the punch engages in the hole of the clip and thus perfectly aligns the hole in the Hy-Rib with that in the clip. A short piece of wire or a nail slipped through the hole fastens the Hy-Rib rigidly in place. The operation is very rapid and simple, and much less expensive than wiring Hy-Rib to steel work.

On roofs the punch is used similarly and allows the operator to stand erect while working.

Shearing a sheet of **Hy-Rib** with the **Hy-Rib Cutter.**



(Patent Applied for.)

HY-RIB CUTTER. Price $25.00.

For Shearing All Types of Hy-Rib.

For ordinary work, where **Hy-Rib** must be cut to various lengths, and fitted around openings, most builders find it is more economical to order **Hy-Rib** in standard lengths, and cut the sheets to the required size on the job.

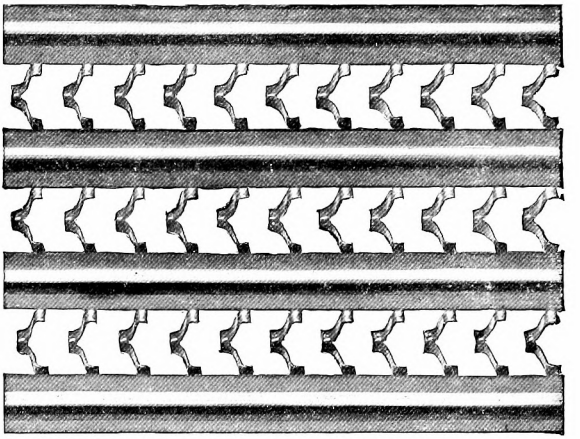
The **Hy-Rib Cutter** is a portable shear for cutting **Hy-Rib** sheets to any desired length. It weighs only 80 lbs., and can be readily carried by one man from one location to another. In jobs of any size, the **Hy-Rib Cutter** pays for itself many times over. It saves time, labor and expense over the use of the ordinary tinsmith's tools. Many of our representatives have **Hy-Rib Cutters** that they can rent for use on small-sized jobs.

Hy-Rib Cutters are furnished complete, ready for mounting on suitable base. The shear blades are detachable for sharpening.

The **Hy-Rib Cutter** is designed so as to shear either 3-Rib or 4-Rib **Hy-Rib** without any change or adjustment, and Deep-Rib **Hy-Rib** by merely substituting the other blades furnished with the cutter.

RIB LATH

Stiffest steel lath because of the beaded parallel ribs which span directly between the studs; provides a perfect clinch for the plaster owing to the improved form of expansion; requires least amount of plaster, with no dropping of plaster behind the lath; presents a uniformly flat surface to plaster against.



BEADED PLATE RIB LATH

Grade	Size of sheets	Sheets per bundle	Yards per bundle	Weight per sq. yd.
Rib Lath No. 1A	15¼ x 96 in.	16	18	3.63 lbs.
Rib Lath No. 2A	15¼ x 96 in.	16	18	4.54 lbs.
Rib Lath No. 4A	15¼ x 96 in.	16	18	5.45 lbs.

STANDARD RIB LATH

Grade	Size of sheets	Sheets per bundle	Yards per bundle	Weight per sq. yd.
Rib Lath No. 1	20¼ x 96 in.	12	18	2.74 lbs.
Rib Lath No. 2	20¼ x 96 in.	12	18	3.42 lbs.
Rib Lath No. 4	20¼ x 96 in.	12	18	4.10 lbs.

"B" RIB LATH

Grade	Size of sheets	Sheets per bundle	Yards per bundle	Weight per sq. yd.
Rib Lath No. 1B	24$\frac{5}{16}$ x 96 in.	10	18	2.28 lbs.
Rib Lath No. 2B	24$\frac{5}{16}$ x 96 in.	10	18	2.85 lbs.
Rib Lath No. 4B	24$\frac{5}{16}$ x 96 in.	10	18	3.42 lbs.

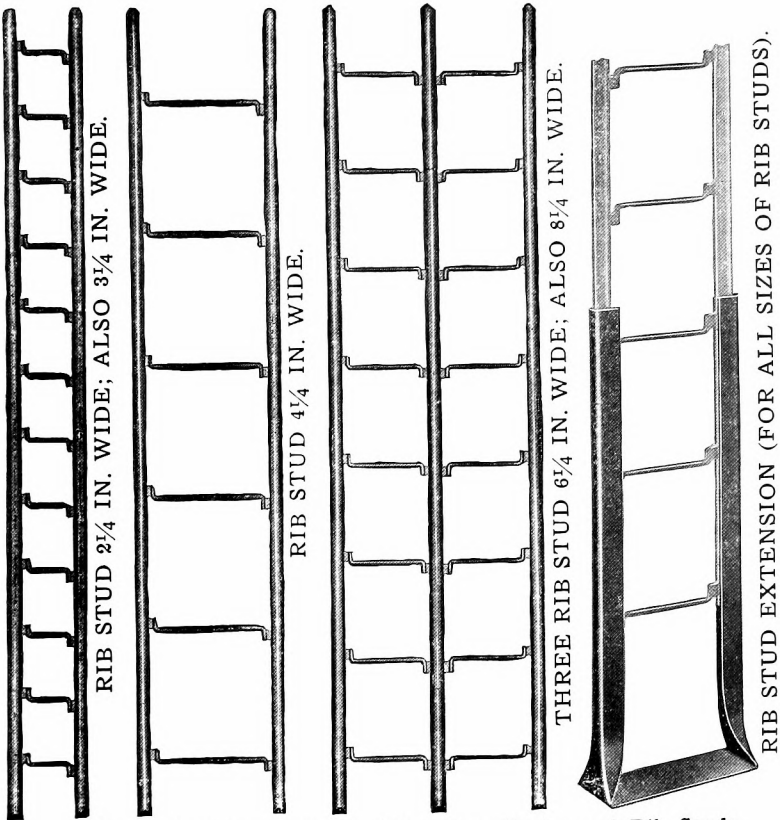
We recommend the use of painted lath, but can supply it without paint if desired.

Rib Lath Catalogue, containing complete information, sent FREE.

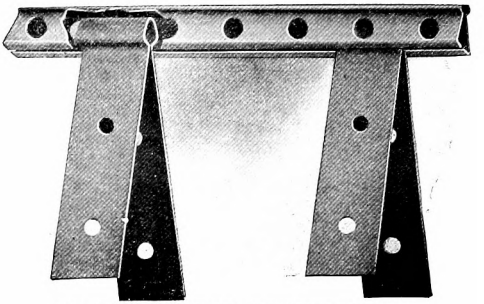
RIB STUDS

Rib Studs—made of the highest grade of open-hearth steel—are open for the passage of conduits and pipes, and provide an uninterrupted air space between the two plaster surfaces. The open mesh simplifies the wiring of lath.

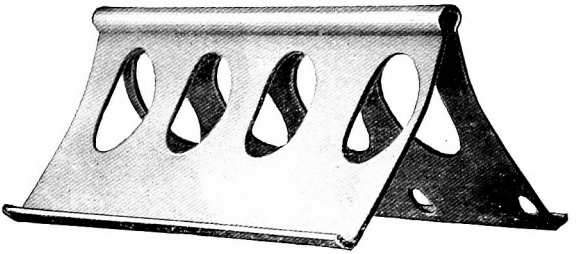
Rib Studs are made in five widths (2¼" to 8¼") and in any length up to 18 feet. (See standard stock sizes below.)



Rib Stud Extensions, furnished for all sizes of **Rib Studs,** provide an adjustable attachment at floors and ceilings, taking care of all inequalities and saving time and money in erection. They fit over the ends of the **Rib Studs** and are clamped tight with pincers or hammer.



DETROIT STEEL CORNER BEAD.



RIB STEEL CORNER BEAD NO. 1.

STEEL CORNER BEADS

All our corner beads are galvanized after forming. We furnish six different types of beads in lengths from 6 to 12 feet—to meet every requirement for the perfect protection of plaster corners.

DETROIT STEEL CORNER BEAD—see illustration above.

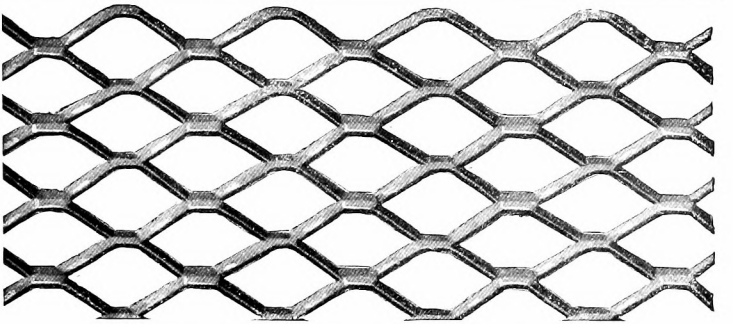
DETROIT T-RAIL CORNER BEAD—similar to Detroit Steel Corner Bead.

DETROIT SOLID RAIL CORNER BEAD—made of special rolled section with punched web.

RIB STEEL CORNER BEAD NO. 1—see illustration above.

RIB STEEL CORNER BEAD NO. 2—similar to Rib Steel Bead No. 1.

RIB FEATHER-EDGE CORNER BEAD—for fine sharp corners.



DETROIT DIAMOND LATH

Size of Sheet, 18 x 96 inches.

Gauge	Sheets per Bundle	Yards per Bundle	Weight per Square Yard PLAIN	Weight per Square Yard GALVANIZED
No. 27	15	20	2.33 lbs.	3.03 lbs.
No. 26	15	20	2.5 lbs.	3.25 lbs.
No. 25	15	20	3.0 lbs.	3.8 lbs.
No. 24	15	20	3.4 lbs.	4.3 lbs.

We recommend painted lath, but can supply it plain or galvanized after expansion.

FINISHING AND WATERPROOFING

Concrete construction when in exposed positions should be properly finished and waterproofed by the Trus-Con Chemical Products, consisting of twenty-three distinct products for this class of work. Catalogue on request.

REINFORCED CONCRETE

The Kahn Building Products, successfully used in over fifteen thousand important structures, include the following reinforcing products: Kahn Trussed Bars, Rib Bars, Collapsible Column Hooping, Rib Metal, Hy-Rib, Steel Floretyles, Floredomes and Building Specialties.

STEEL SASH FOR WINDOWS

United Sash are made of deep, rolled-steel sections of great strength and rigidity,—cannot burn or wear out—and provide increased daylighting to interiors. Catalogue on request.

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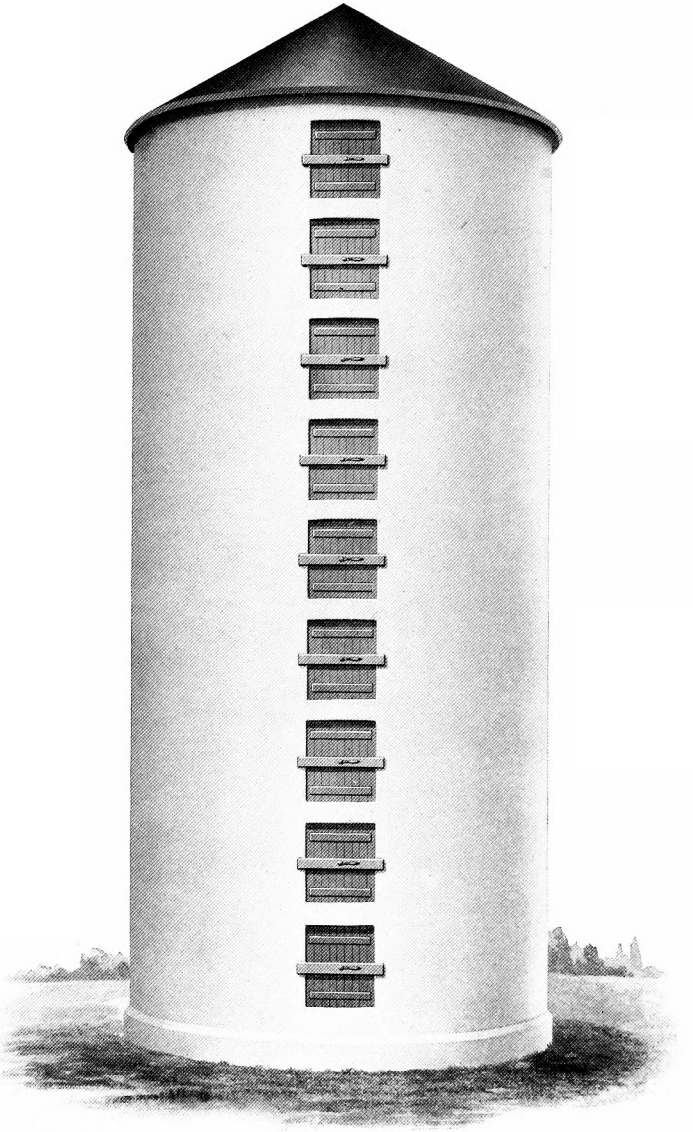
Hy-Rib Concrete Silos and Farm Buildings

Showing a Method whereby a Farmer can Build Permanent Fireproof Silos and All Farm Buildings of Concrete without the Use of Forms

THIRD EDITION
1913

Copyright, 1913—Trussed Concrete Steel Co.

TRUSSED CONCRETE STEEL CO.
DETROIT, MICH.



HY-RIB CONCRETE SILO.

BUILD YOUR SILO OF PROPERLY REINFORCED CONCRETE

In placing this little book before the Agricultural interests, we are recognizing the fact that the silo has come to be considered a necessary part of farm equipment by every progressive man who is watching each opportunity to increase the output and value of his farm.

Ensilage was introduced into this country, purely as a dairy feed. Today silage has come to be recognized by the sheep feeder, the beef man, and the general farmer as the cheapest and best meat producing food obtainable. In this connection, we wish to submit the following general statements as the consensus of opinion of practically every agricultural experiment station and silage feeder throughout the United States.

The best milk, beef, and mutton in the United States as well as those earning the greatest net profit are produced from silage. The animals are, of course, not fed exclusively on silage but it is because of the comparative cheapness, the succulence and palatability of silage, taken in connection with its actual food value, that such high quality of milk, beef and mutton can be produced so cheaply.

In 1844 there were no more than 2 dozen silos in the whole middle west. Today the number is variously estimated at around three-fourths of a million, and how many in your locality are not in use?

It is impossible to cover the whole field of ensilage and ensilage feeding in any one book intended to reach all sections of the country, because in every locality, feeding conditions vary, and the predominant crops placed in the silo are different. Therefore, we respectfully suggest that if deeply interested in learning all you can about the silo, particularly for your locality, write to your State Agricultural Experiment Station asking them for such information as you desire. Practically every experiment station in the United States has by this time issued literature on this subject adaptable to local conditions; or if you will write us stating your problems, we will give you such special information as you desire.

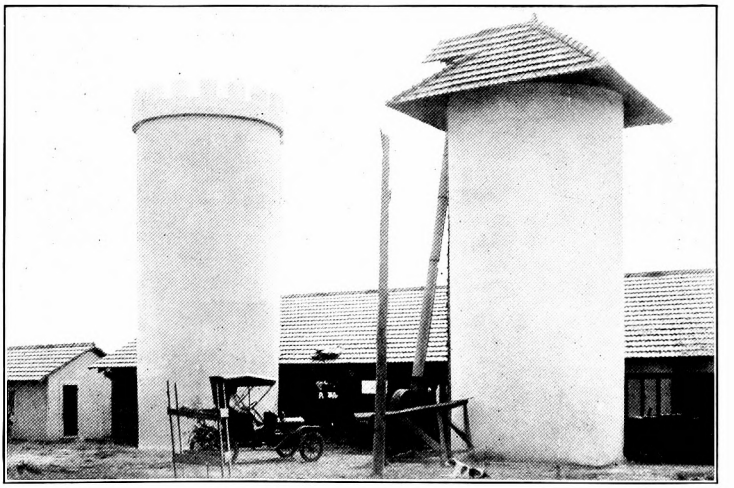
In view of the foregoing facts, we believe that the big question before the farmer today, is not so much, *"Do I need a silo?"*

as it is *"What kind of a silo should I build?"* Therefore, the following pages will deal chiefly with the particular type of silo as manufactured by the *Trussed Concrete Steel Company of Detroit,* namely the **Hy-Rib** *Concrete Silo.* A few pages are devoted to a general treatise on farm building work, using **Hy-Rib** concrete construction, and to the general method of feeding ensilage.

Any silo to be a success must combine these features: It must have perfectly air-tight, smooth and non-absorptive walls; it must be permanent and as free from necessity for repairs as possible; it must be reasonable in cost and present at all times a pleasing appearance.

The **Hy-Rib** concrete silo has been designed to meet every one of these requirements, and is fulfilling all expectations.

Our first silos were in the nature of an experiment, but they are universally proving satisfactory. Since these earlier silos were erected, we have been continually making improvements, until today we are placing on the market what is generally conceded to be by all who have seen it, the latest and best silo produced.



Hy-Rib Concrete Silos for J. R. Cross Co., Jersey Farms, Fairhope, Ala.
Silo at right erected in 1909, the other in 1910.

THE J. R. CROSS COMPANY

FAIRHOPE, ALA.

May 6, 1910.

Trussed Concrete Steel Co., Detroit, Michigan:

Dear Sirs—Replying to your request to let you know something about the result of my experience with the use of HY-RIB reinforcement, manufactured by the Trussed Concrete Steel Company, of Detroit, will state that it has been satisfactory in every respect. I built one silo with it 12 feet in diameter and 30 feet high, according to instructions received from the Trussed Concrete Steel Company, which has been used for cow-pea silage for one season with perfect results. This silo has been pronounced by all who have examined it as the best one they have ever seen. I am just beginning the construction of another silo, of about the same dimensions, and am using the same kind of reinforcement.

I have also built a milk room with this HY-RIB, using in this connection no studding, but supporting the roofs on the corner posts of the building, and it is pronounced by every one as first-class in every particular.

I have also used it in building water troughs with perfect satisfaction and great economy.

I have also constructed about 75 feet of concrete culverts, laying first a concrete floor and then placing on same, sections of HY-RIB bent to a proper curve for making an arched culvert. * * * We found this construction very cheap, no skilled labor hardly being required in connection with it.

I shall be pleased to give you any further information in regard to the matter, and will also send you a photo of the silos as soon as the new one which is being constructed is completed.

Yours very truly,

THE J. R. CROSS CO.

Per H. F. RING.

"Getting Better Every Year"

H. F. RING DAIRY COMPANY

(Successors to J. R. Cross Company)

FAIRHOPE, ALA.

November 10th, 1912.

Trussed Concrete Steel Co., Detroit. Mich.:

Gentlemen—Replying to your favor of recent date, requesting information with regard to how our silos and other farm buildings erected of HY-RIB have endured, wish to inform you that the buildings without a single exception are in first-class condition.

Our silos have been in constant use, the one now having been filled three times, and the second silo erected, having been filled twice. They show no effects whatever of the action of silage juices on the inside walls, and apparently are becoming better each year.

Our other buildings are also in perfect condition, showing no cracks or breaks whatever.

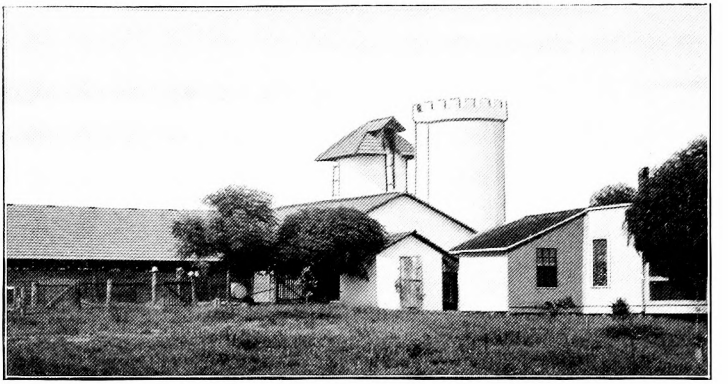
We feel that our HY-RIB construction has been ideal in every respect and can highly recommend it.

We would appreciate receiving your new literature from time to time.

We are, very sincerely yours,

H. F. RING DAIRY COMPANY,

(Signed) H. F. RING.



Jersey Farms, J. R. Cross Co., Fairhope, Ala.
A group of permanent, sanitary, dry and fireproof buildings, built of **Hy-Rib** Concrete. Note the **Hy-Rib** Concrete Silos in this picture.

WHAT THE HY-RIB SILO IS

The **Hy-Rib** silo is a concrete silo erected without the use of forms or any temporary framework whatever, except a simple square one to form the door opening and the usual scaffolding. It has a continuous steel reinforcement throughout every portion of wall, chute, and roof, so constructed as to resist all elements tending to break or crack it. The roof, side walls, chute, and foundation are thus made a complete unit with no openings except those designed for windows and doors. (See page 2).

A great deal has been said by competitive silo concerns purporting to prove that all forms of concrete silos were failures, and so persistently have these people attacked the best of all modern building materials that many people have been unduly influenced. In the next few pages we will take up and refute their principal arguments and in this way prove to you what the **Hy-Rib** Concrete Silo is: an absolutely perfect silo constructed of concrete.

It is perhaps true that occasionally concrete silos have not proven entirely satisfactory, but every one will agree that there

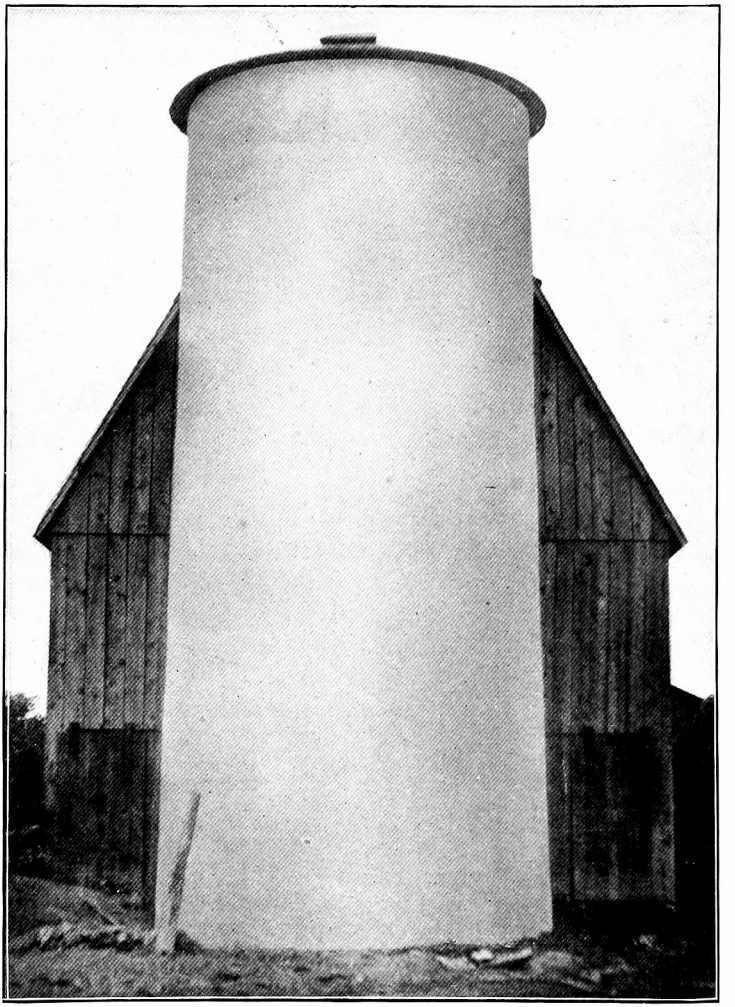
is a great amount of difference in the construction of concrete silos, just as well as there is a great deal of difference in the construction of any building. The whole difference lies as regards failure or success in the method of construction pursued and the materials selected. (See letter from Marionville, Mo., on page 23). Let us cite an example which is a very representative one, and presents in the one case, the type of construction with which the referred to criticisms deal.

At New Haven, Michigan, we had under our observation the past two winters two concrete silos constructed according to very different designs, and the results obtained are very interesting. Both of these silos are practically the same size, 14x32 feet, in the same localities and exposed to practically the same conditions.

The one, constructed of **Hy-Rib** by Mr. C. C. Corey, at no time froze enough to make the silage stick to the side walls. (See Mr. Corey's letter, page 9). It at no time froze enough to cause any inconvenience whatever, and frost was to be found present only in 8 inches of the silage around the wall. The other silo, constructed of the so-called hollow cement block, in February froze practically solid, ruining the balance of the feed and being so destructive to the side walls that they were also ruined.

Here, then, is one comparison between two silos constructed of concrete. The one a porous, improperly reinforced, absorptive wall; the other constructed of perfectly reinforced, very dense, and thoroughly waterproofed concrete.

The silo of Mr. Corey's, a **Hy-Rib** Concrete Silo, erected in the Fall of 1909, has now passed through three very severe winters, and has been perfect in every respect, thereby proving conclusively to anyone that will take the time and the opportunity to go into the matter closely, the fact that a properly constructed concrete silo as exemplified by the **Hy-Rib** Silo is perfect in every respect.



A one hundred ton **Hy-Rib** Concrete Silo on the stock farm of C. C. Corey, New Haven, Mich. Erected entirely by farm labor without forms and at an expense no greater than for the better grades of wood silos.

C. C. COREY

BREEDER OF

HOLSTEIN-FRIESIAN CATTLE
ENGLISH BERKSHIRE SWINE

Herd Bull Pieterje Hengerveld Paul Lad, 62707.
Herd Boar Premier Bacon, 123639.
Herd Boar Baron Haven, 139412.

New Haven, Mich., Jan. 14, 1913.

Trussed Concrete Steel Company,
Detroit, Mich.

Gentlemen:

Replying to yours of recent date, wish to advise you that my **Hy-Rib** Concrete Silo has proven perfectly satisfactory.

This silo has passed through three winters and at no time have we found severe freezing of the silage. During the extreme cold of 1912, we found frost in about 8 inches of the silage around the wall, however, this was not hard enough to make any silage stick to the walls, and we used only the ordinary silage fork all winter in taking out our ensilage. My neighbors have experienced considerable trouble with freezing, both with the cement block and stave silos.

This silo was erected according to your specification, farm labor was used throughout and the total cost of silo complete, foundation, side walls and roof, was $265.00.

The walls are barely three-inches thick and not a crack has developed either inside or outside of the walls, and apparently the wall is steadily becoming tougher and harder. The so-called silage acids have had absolutely no effect upon the concrete; in fact, the interior surface seems to gradually become more smooth and hard.

I feel that I now have a silo which is absolutely permanent, fireproof, and not requiring any expense whatever for painting, repairs or adjustments. The cost of building this silo was surprisingly low, and I feel that I am making a very substantial saving every year.

I am so thoroughly satisfied with the results obtained from my **Hy-Rib** Silo that I should cheerfully recommend it to all who intend building.

Yours truly,

C. C. COREY.

SUPERIORITY OF THE HY-RIB SILO

The **Hy-Rib** Concrete Silo takes its name from the material "Hy-Rib" of which it is manufactured and makes its claim for merit, briefly upon the following advantages:

1. The absence from necessity of using any forms whatever.
2. Absolute and thorough reinforcement, both against temperature changes and silage pressures.
3. Very dense and *thoroughly waterproofed* walls.
4. Nominal in cost and absolutely impervious to the action of so-called silage acids, which cannot in any way injure these walls.
5. Will never require repairs, becoming better as it ages.

The above facts have been proven already in more than 100 perfect silos without one single failure in any respect, and no one can find a single weakness in the **Hy-Rib** Silo, for it is the ideal silo from every standpoint.

Forms are entirely done away with, because **Hy-Rib** is an extremely stiff, firm steel sheathing, with a ¾″ deep rib every three and one-half inches of the width, comes in sheets (10′ or 12′ long, 10½″ wide), curved to the diameter desired, and is thoroughly locked together at sides and ends. Thus **Hy-Rib** forms a firm foundation upon which the concrete is applied in the form of a 1:2½ waterproofed cement plaster to a total thickness of from three to three and one-half inches.

Erected in this manner, a 14′x32′ silo contains approximately 1,700 lbs. of steel reinforcement, so placed that every square inch of the wall is thoroughly reinforced. The ⅝″ round hoops in a wood silo of this size, weigh about 800 lbs. and have besides the silage pressures, the swelling of the wood stave to contend with, while the **Hy-Rib** Concrete Silo has twice the amount of steel, placed in a much better manner and thoroughly imbedded in a three-inch concrete wall.

We wish to lay particular emphasis upon our ability to waterproof this wall. There seems to be a great deal of skepticism as regards the feasibility of waterproofing, because so many valueless waterproofing materials have been placed upon the market.

Trus-Con Waterproofing Paste Concentrated, perfected by extensive experimenting and practical experience is one of the Kahn Building Products, and maintains their high standard of efficiency.

Trus-Con Waterproofing Paste Concentrated is not a superficial wash; it is a creamy paste, mixed thoroughly with the water used to gauge the concrete and is used in the last inside and outside coat, thus giving a one-half to three-quarter inch thickness of waterproofing, which will never become ineffective.

Of course, it is impossible in this space to give any treatise or scientific discussion on the subject of waterproofing, but interested parties can obtain complete information by writing for the TRUS-CON HAND-BOOK in which *Trus-Con Waterproofing Paste Concentrated* is treated at some length. However, we take the occasion of copying one letter from a big, reliable institution in Pittsburg, Pa., which shows a representative result from the use of this material.

SOHO BATHS

2410 Fifth Avenue, Pittsburgh, Pa.

January 31, 1912.

Trussed Concrete Steel Co.,
15 Terminal Office Bldg.,
Pittsburgh, Pa.

Dear Sirs—Regarding the waterproofing of the Soho Baths with your TRUS-CON PASTE, will say that the same is perfectly satisfactory.

Our condition was rather extreme; the building is situated in Fifth Avenue, 3 stories above and 3 stories below Fifth Avenue. Our front wall extends down 36 feet below the street, being 12½ feet thick at bottom, composed of concrete.

The water backed up against the wall from springs in the hill and came through a dozen different places, running continually all seasons of the year at 100 gallons per hour. By applying a plaster coat ¾ inch thick 1:2, mixing the TRUS-CON Paste to the water, we have secured a water-tight job and our walls are now perfectly dry, enabling us to utilize the floors below Fifth Avenue and make a swimming pool in which we have used the TRUS-CON Paste with satisfaction.

The walls were so dry that the carpenter thinking there was no water back, drilled through the plaster coat to fasten partition, when instantly the water gushed forth in a stream with much pressure, proving conclusively that your material is a thorough waterproof, and we will always use it in our waterproofing.

Yours truly,

D. P. MARSHALL,
Superintendent.

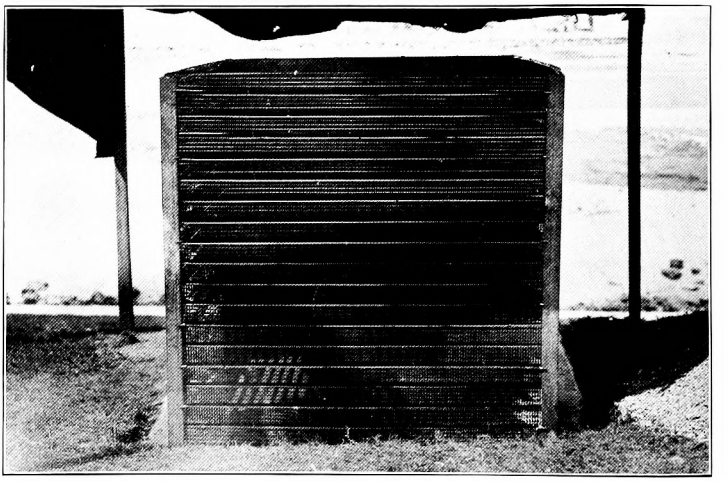
We cannot emphasize too strongly the method of reinforcement as furnished by the **Hy-Rib** and take the space to give the results of tests upon 2-inch thick **Hy-Rib** Concrete Walls, intending to show the great strength of a properly reinforced thin concrete wall.

The accompanying photographs of tests were taken at Singapore, and are similar to tests made in various European countries; also by the building departments of many of our large American cities.

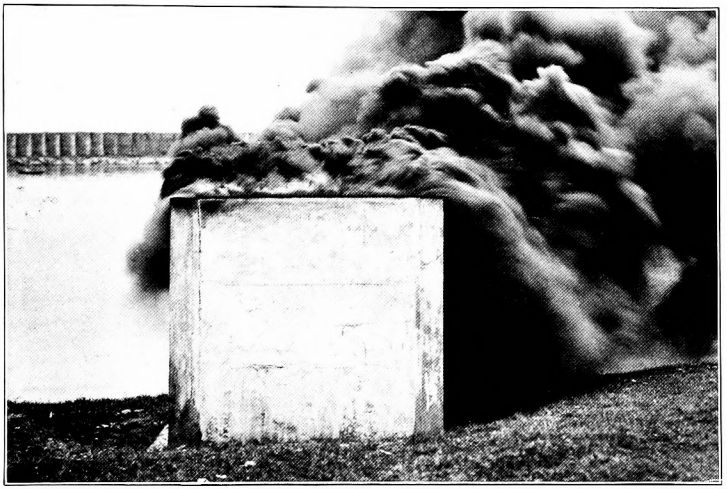
The tank shown was built 5 feet square, 5 feet deep, of Four Rib **Hy-Rib,** identically the same material as is used in the silos. Walls were plastered 2 inches thick and allowed to cure thirty days, after which 160 gallons of kerosene was poured into the tank, set on fire, and allowed to burn out.

Immediately after the oil was exhausted, water was turned upon these walls, with a hose, the walls were cooled as quickly as possible and photograph shows tank filled with water.

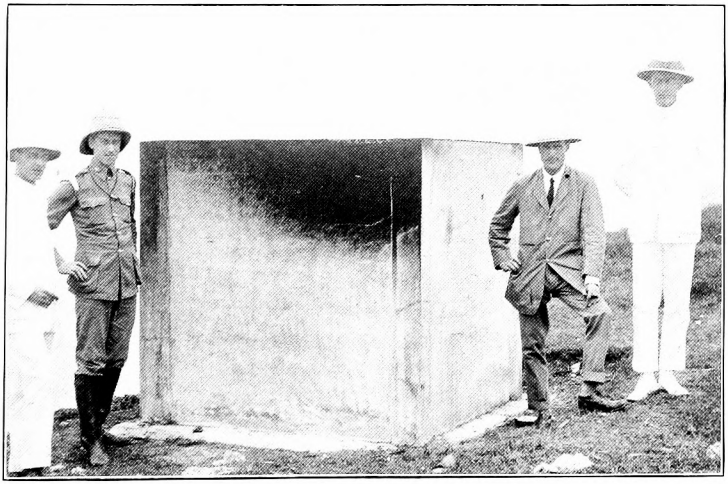
This, as previously stated, is but one example of many tests being conducted and should represent to you the great strength of three-inch **Hy-Rib** concrete silo walls.



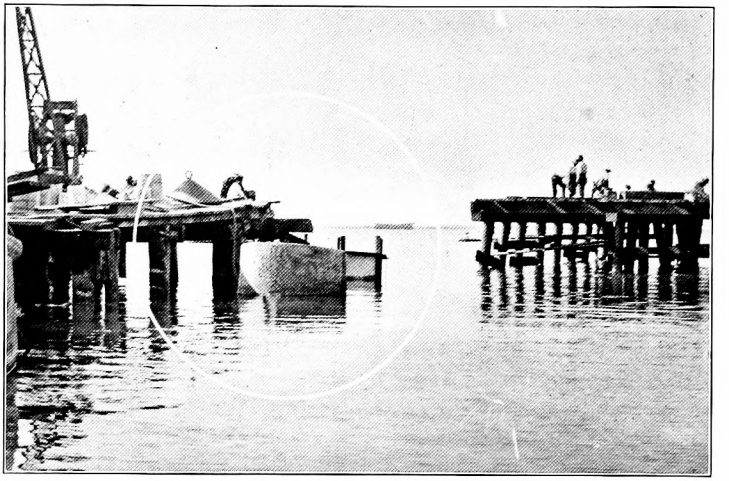
Hy-Rib Tank, ready for plastering. Fire test conducted by Howarth Erskine, Ltd., Singapore, Straits Settlements.



160 Gallons of Kerosene on Fire in Tank, Resembling a Roaring Furnace With Terrific Heat.



Tank After Fire Test. Filled with Water Within 18 Inches of Top. Fire Test on **Hy-Rib** Concrete Tank Conducted by Howarth Erskine, Ltd., Singapore, Straits Settlements.



Floating Concrete Buoys of Hy-Rib

At Kingston, Jamaica, the British Government has experimented thoroughly with the use of **Hy-Rib** in connection with concrete waterproofed with paste, for the manufacture of deep sea buoys and has found after a year's constant use that they are floating as buoyantly as at the start.

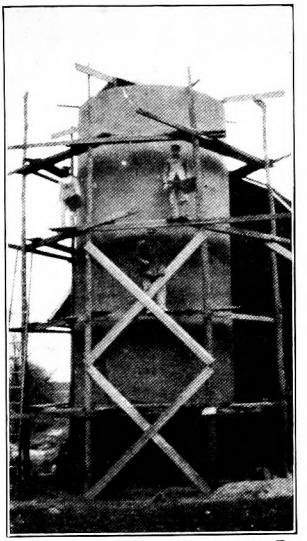
These buoys are cylindrical in shape and built of curved **Hy-Rib** plastered with concrete to a total thickness of 3 inches. The complete buoys weigh about 5 tons each. It is an interesting fact that about a ton of ballast must be placed in the bottom of each buoy in order to bring it low enough into the water to ride properly.

Thus through the use of these materials, one is enabled to erect a concrete silo at a reasonable expense (a silo not costing any more than a stave silo of equal capacity) and of materials superior in every way to all others.

We wish to call your attention to two more letters reproduced on opposite page, written to us and to submit them as examples of letters of similar nature being received from all parts of the country:

Hy-Rib Silo of J. R. Rogers, Litchfield, Mich.

This Silo is 12′x40′, 7 feet below grade to level of basement floor of barn. Pit made by first excavating and then placing **Hy-Rib** and pouring concrete in space between **Hy-Rib** and ground, making a six-inch wall. In this way one-half day was consumed in placing pit **Hy-Rib** and pouring to surface of ground. Inside of wall is perfectly smooth for the full 40 feet. This silo was erected in 10 days Forty barrels of cement were used. Note simple scaffold.



12′x40′ Hy-Rib Silo for J. R. Rogers, Litchfield, Mich.

J. R. ROGERS

Litchfield, Mich., 11-7-12.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

Our silo was completed in fine shape. We put a canvas over top and burlap over doors with a stove in bottom when it became cold last week. Several men have applied to me for territory in Lenawee County, but as I have built a silo costing around $300.00 (12x40′) which is making a very favorable impression on all who see it, I wish to see you before giving territory.

Regarding territory for next year, should like Calhoun County in addition to Hillsdale and Lenawee. Am told by many that sentiment is growing in favor of our silo here, so believe we will do a good business next year.

Yours very truly,

J. R. ROGERS.

C. P. STOUT

Ben Lomond, W. Va., Aug. 16, 1912.

Trussed Concrete Steel Co., Detroit, Mich.:

Gentlemen—Mr. C. H. Hayman has erected a HY-RIB silo purchased of you and I am enclosing check for which I wish you would send me as soon as possible a silo of the same size.

If check is not enough, kindly advise and I will remit the balance.

Mr. Hayman's silo makes a very fine appearance and I am anxious to get mine erected this fall, so kindly give me the best shipment possible.

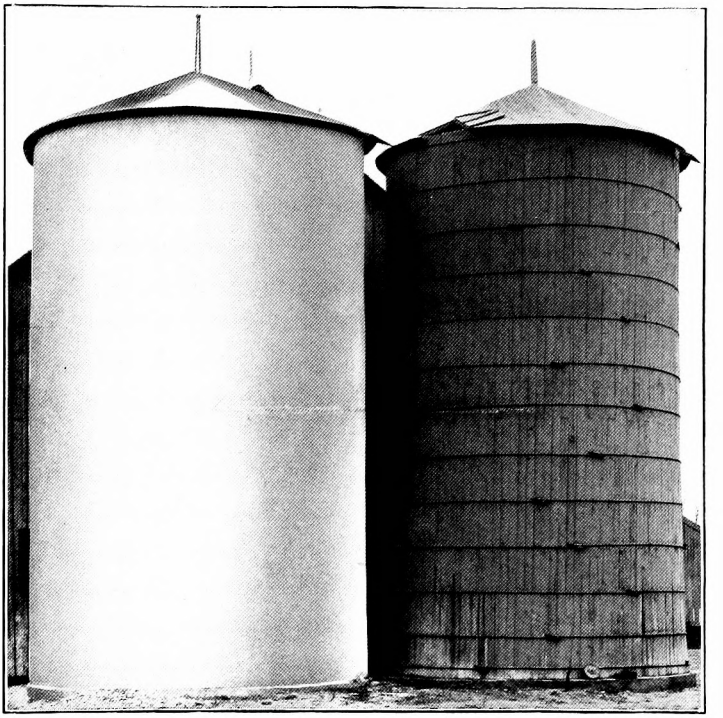
Sincerely yours,

C. P. STOUT.

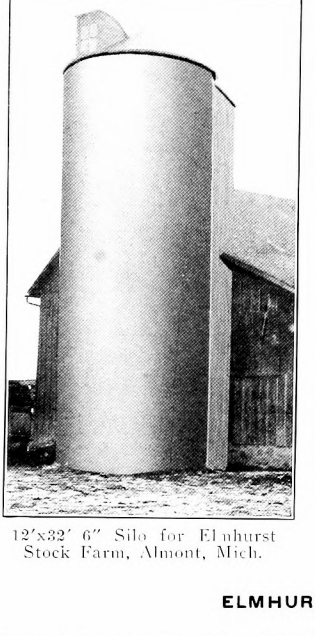
Overcomes Weakness of Wood Silos

It would be foolish for us to go into detail as advocates of other silos have done, denoting the failure of all other types of silo but their own, and we do not need to do so. The bad features of the wood silo are already too well known to the people. We present as our claim of superiority, merely the fact that the **Hy-Rib** Concrete Silo has every good feature of the wood silo and overcomes every one of its disadvantages.

A wood silo is a good investment to any farmer and will pay for itself, but our contention is that if a person can get a superior silo for the same money, and one which will of course give him greater dividends. that is the one that he wishes to buy.



Hy-Rib Concrete Silo for Walker Bros., Walkerville, Ont.
Note the attractive appearance of permanent Hy-Rib Concrete Silo (at left) compared with wood silo (at right) which is already showing signs of deterioration.



12′x32′ 6″ Silo for Elmhurst Stock Farm, Almont, Mich.

ELMHURST STOCK FARM

Almont, Mich., Nov. 26, 1912.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

I have one of the Trussed Concrete Steel Company's HY-RIB Silos, and am glad to say that I have a fully established confidence in it. It is impervious to moisture; (it keeps the silage perfectly); it is claimed to be fire-proof, and I believe it to be practically indestructible. I followed out the company's blue-print very closely in construction, and can see no possibility of its blowing down from any wind outside of a regular cyclone.

The claims made by your competitors are unfounded and cannot be proven, in my opinion.

Although it is considerable more work to erect a HY-RIB silo than the ordinary wood or stave silo, it requires no great skill, as the blue-prints furnished by the company's engineering department simplifies the work very much.

I have come in contact with silo agents and have closely examined practically every silo constructed, and am well satisfied with the merits of the HY-RIB silo, and deem it a pleasure to recommend it to you or your prospective purchasers.

Very truly yours,
CHAS. P. SCULLY,
Prop.

ELMHURST STOCK FARM

Almont, Mich., Dec. 9, 1912.

Trussed Concrete Steel Co., Detroit, Mich.:

Gentlemen—My concrete silo is 12′ in diameter and 32′ 6″ high, the wall is approximately 3″ thick, put up in 5 plaster coats, 3 coats on outside of HY-RIB and 2 coats on inside of HY-RIB. The following statement will show you very closely the cost of construction:

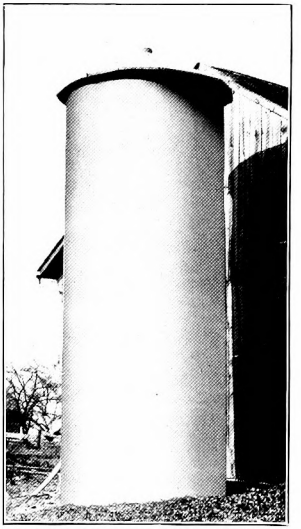
1 Day digging foundation trench 4′ deep, 18″ wide on bottom, 12″ wide on top, taper on outside, to prevent frost heaving	$ 2.00
10 Yds. sand at $1.00 per yd. delivered	10.00
2 Yds. grout gravel at same price	2.00
3 Yds. cobble stone off farm for foundation and bottom	1.50
28 Bbls. cement at $1.15	32.50
20 Sacks hydrated lime at 25c	5.00
Mason 4 days at $4.00 per day	16.00
Apprentice mason 4 days at $2.50 per day	10.00
3 Men building foundation, putting up HY-RIB, staging, tending masons, etc., 5 days at $2.00 per day	30.00
2 Men putting on roof complete, 2½ days at $2.00 per day	10.00
Matched 1″ lumber for doors	1.98
1 Man making doors, ½ day at $2.00 per day	1.00
Total cost	$121.68

The above is very close cost of construction and material used in my silo outside HY-RIB, Waterproofing, Roof-Seal, etc., furnished by Trussed Concrete Steel Company, of Detroit, Mich. Estimate includes everything, foundation, body, and roof complete.

I would say again that the silage is keeping perfectly.

Very truly yours.

CHAS. B. SCULLY, Prop.



10′x29′ Hy-Rib Silo of Milo White, Grant, Michigan.

MILO WHITE

Grant, Mich., Dec. 10, 1912.

Trussed Concrete Steel Company,
Detroit, Mich.

Gentlemen:

Under separate cover I am sending you a photo of my HY-RIB silo. I am well satisfied with it in every respect. Its durability, of course, is its most remarkable feature. My neighbors all pronounce it O. K. and like its beauty as well.

Yours very truly,
MILO WHITE.

WARNER BROTHERS

Almont, Mich., Jan. 18th, 1913.

Trussed Concrete Steel Co.,
Detroit, Michigan.

Gentlemen:

The HY-RIB Concrete Silo purchased of you last summer is giving us perfect satisfaction. The silage keeps perfectly and we consider it the best silo we could have built.

Yours very truly,
WARNER BROTHERS.

H. J. VAN ORTHWICK

Quincy, Mich., Dec. 28, 1912.

Gentlemen:

I am very well pleased with the silo which I purchased from you last September. I believe that the HY-RIB concrete silo is the best form of silo yet devised and placed on the market.

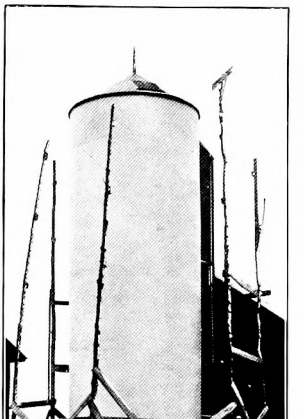
We did not commence the erection of our silo until the 13th day of September, and filled it on the second day of October, allowing no time at all for the concrete to cure; in fact, we plastered on the outside all day on the 1st of October, and removed the inside scaffold on the morning of the day that we filled the silo.

It has now been three months since the silo was filled and I can find no signs of any flaws or cracking. The water-proofing used on the inside prevents the absorption of any of the silage juices into the concrete wall and consequent drying out of the ensilage next to the wall.

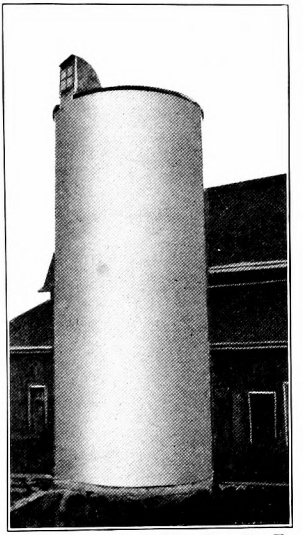
One wood silo agent who called here after the silo was completed admitted that it was the best silo he had ever seen.

In closing I will state that I would not hesitate to recommend the HY-RIB silo to anyone wishing a silo of the highest grade at a moderate price.

Sincerely yours,
H. J. VAN ORTHWICK.



12′x38′ 6″ Hy-Rib Silo of H. J. Van Orthwick, Quincy, Mich.



14′x40′ Hy-Rib Silo for J. T. Ball & Son, Hillsdale, Mich.

J. T. BALL & SON

Hillsdale, Mich., Dec. 28, 1912.

Trussed Concrete Steel Company,
Detroit, Mich.

Gentlemen:

We are more than pleased with the silo which we built last summer. It has proven satisfactory in every respect. We are also much pleased with the steel doors.

Wishing to express our satisfaction to you, we remain

Yours very truly,
J. T. BALL & SON.

Note: This silo has a concrete chute 4′ x 30″ to within 8′ of the ground where it runs into a HY-RIB concrete room 8′ x 8′ x 8′ high.

ROYAL C. LEWIS

Saranac, Mich., Dec. 10, 1912.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

Would like to say that my HY-RIB Silo, which I bought of you last spring, is proving satisfactory. It has not cracked any yet, and do not think it can. I filled it this fall and it is keeping all right. It is a marvel to all who see it as to durability and beauty. The cost of my 12 x 36-foot silo was about two hundred and twenty-five dollars ($225.00), and but a little more than a frame silo.

Yours very truly,
ROYAL C. LEWIS.

IVON L. SNYDER

Coldwater, Mich., Nov. 9, 1912.

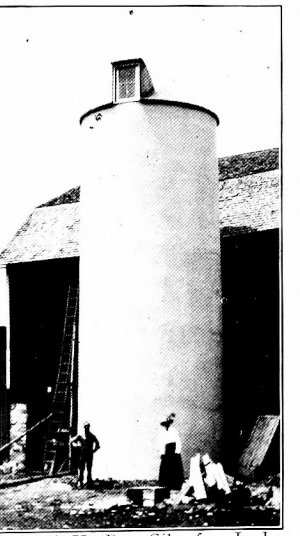
The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

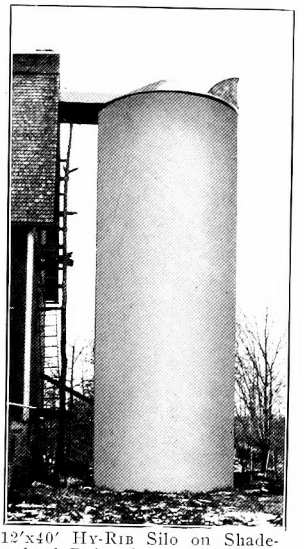
The silo which you had constructed on my farm three and one-half miles south of the City of Coldwater, Mich., has proven very satisfactory in every way, and I am very much pleased with same. All who have seen this silo agree with me that it is the best in this part of the country.

The view of this silo which your agent, Mr. Bowditch, took while here is a very good one, and it will give you a very good idea of its actual appearance.

Yours very truly,
IVON L. SNYDER.



12′x36′ Hy-Rib Silo for I. L. Snyder, Coldwater, Mich.



12′x40′ Hy-Rib Silo on Shadeland Dairy & Stock Farm, Durand, Mich.

SHADELAND DAIRY & STOCK FARM

Durand, Mich., Dec. 16, 1912.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

In reply to your inquiry in regard to my silo of concrete reinforced with Four-rib HY-RIB, would say that I built that kind because I thought it was the best for the money, and I have not changed my mind, and as far as I can judge, it comes close to silo perfection, being apparently indestructible.

The time is too short yet for me to judge of results of frost or chemical action on the walls, as this is the first year I have built my silo.

As you know this is a 12 x 40-foot silo (4′ below grade and 36′ above, steel to bottom of pit) and required 50 bbls. of cement to erect. We used common farm labor.

Yours very truly,
B. W. MATTOON.

R. M. ORCHARD

Muscoda, Wis., Oct. 31, 1912.

Trussed Concrete Steel Company,
Detroit, Mich.

Gentlemen:

I am highly pleased with the silo purchased of you and put up a year ago. The winter was a severe one last year, but the silo stood the test very well. It was filled with ensilage, but it froze no more in the cement silo than in frame silos in the neighborhood.

When I build another silo it will be of the same kind. I consider them cheaper than the frame silo.

Will send a photo as soon as I can secure one.

Yours very truly,
R. M. ORCHARD.

ANDREW SCHAAF

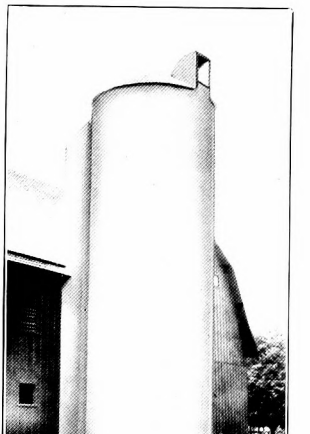
Attica, Mich., Jan. 1, 1913.

Trussed Concrete Steel Co.,
Detroit, Mich.

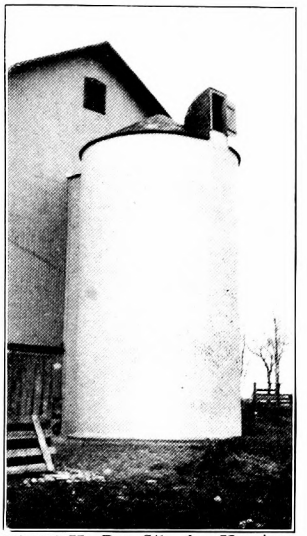
Dear Sirs:

I will let you know that I opened my silo December 28th and the silage is very fine. A good many parties are coming to see the silage for the HY-RIB Concrete Silo is something new around here, and I believe a great many could be sold in this locality.

Yours truly,
ANDREW SCHAAF.



12′x40′ Hy-Rib Silo and 4′ Chute, for D. L. Quirk, Ypsilanti, Mich.



12′x29′ Hy-Rib Silo for Herring Bros., Litchfield, Michigan.

KISSIMMEE DAIRY CO.

Kissimmee, Fla., July 20, 1912.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

We have just finished our concrete silo, and she is a "beauty." Thanking you, we are,

Yours truly,
KISSIMMEE DAIRY CO.
(Signed) W. W. Carson,
Secretary.

KISSIMMEE DAIRY CO.

Kissimmee, Fla., Nov. 25, 1912.

The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

Our silo has been in use about six months and we have been very greatly pleased with the results. If we ever have need of another Silo it will certainly be a HY-RIB one. We take pleasure in recommending it to anyone who is contemplating the erection of a silo.

Concrete silos reinforced with HY-RIB in my estimation cannot be improved upon.

Yours truly,
KISSIMMEE DAIRY CO.
By S. S. Oliver,
Pres. and Mgr.

C. H. HAYMAN

Mercer's Bottom, W. Va., Dec. 5, 1912.

Trussed Concrete Steel Co.,
Detroit, Mich.

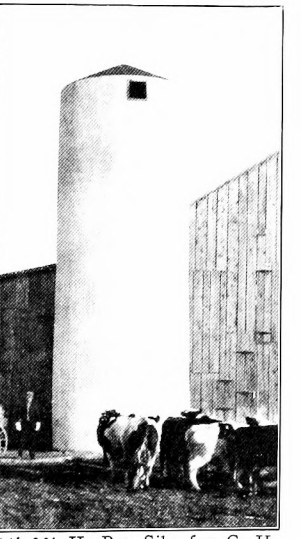
Gentlemen:

I am feeding fifty head of cattle from my silo and I must say it is the finest thing I have ever seen and everyone that has seen it is carried away with it. I do not think you will have any trouble in the spring in placing several orders in this locality since everyone that has seen my silo says it is the most complete one they have ever seen and the cost has been so reasonable and the silage keeping so perfectly that everyone here pronounces this silo a perfect one.

I shall send you photograph of my silo as quickly as I can secure one.

Thanking you for your many courtesies, I am

Very sincerely yours,
C. H. HAYMAN.



14′x36′ Hy-Rib Silo for C. H. Hayman, Mercer's Bottom, W. Va.

THE McBRIDE FARM

BURTON, MICH.

Trussed Concrete Steel Co., Detroit, Mich.:

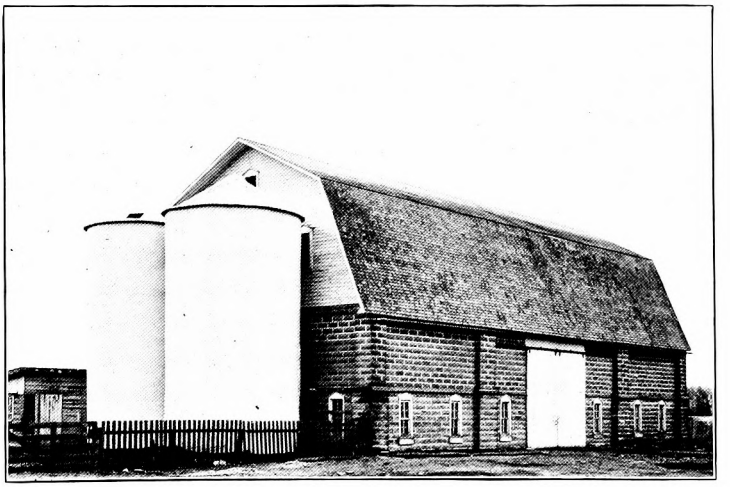
Gentlemen—I am well pleased with the HY-RIB Concrete Silo and your plan of silo construction. I have made a thorough study of silos from every point of view, in almost every county in Michigan. As a farm institute speaker I have been given the opportunity to see silos of all descriptions. The stave silo is by reason of the very nature of silage exposed to conditions of moisture when filled, therefore it swells, and contracts when dry. Decay is hastened by these conditions. A block concrete silo made of a dry concrete mix is porous and not easily held together. Its enormous weight compels a foundation rather unusual, and not generally made of sufficient strength. The vitrified clay form of silo is extremely expensive and has no feature over the HY-RIB Concrete Silo to justify the extra expense, besides being difficult to bond sufficiently strong to meet the best of mechanical requirements.

The HY-RIB plastered silo I consider is mechanically correct, comparatively light on the foundation and perfectly reinforced both perpendicularly and laterally, and besides when completed is absolutely non-porous, and is a smooth, sightly structure, as clean as a crock.

In cost the HY-RIB silo will be a trifle more than the cheaper grades of stave silo and no more than the better grades of wood silo, viz: Redwood or Cypress staves or White Pine, and will cost no more than the poured concrete. I consider the HY-RIB Reinforced Silo is one of the latest achievements of mechanical and scientific skill for the farm and compares well with the other grades of modern farm inventions.

Yours respectfully,

JAMES M. McBRIDE.



Two 14′x30′ **Hy-Rib** Silos on the McBride Farm, Burton, Mich.

A. BENJAMIN

MARIONVILLE, MO.

Dec. 12, 1912

The Trussed Concrete Steel Company, Detroit, Michigan:

Gentlemen—The HY-RIB, Steel Reinforced, Concrete Silo, constructed at Fairview Farm for Mr. F. D. Coleman, is in connection with one of the most up-to-date and very best equipped sanitary dairy barns in the United States. The HY-RIB silo is 12′ diameter and 39′ 6″ above grade and 4′ below, inside depth 43′ 6″, and is provided with eleven doors for removing the silage. The chute is of concrete and is 3′x3′, and provided with a built-in iron ladder. An outside, built-in, iron ladder is provided as shown at the left of the accompanying photographs, for convenience in erecting the pipe of the filling machine. The roof is of concrete and was finished with maroon color Roof-Seal. The exterior wall was finished with grey color Trus-Con Stonetex.

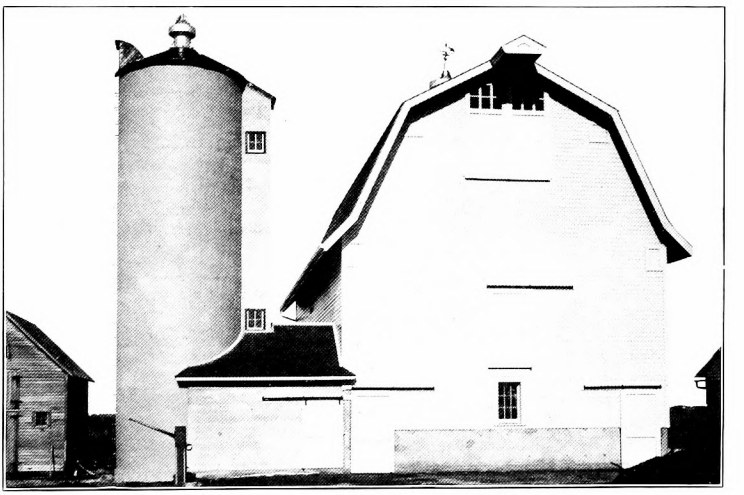
To the last coat of inside plaster was added Trus-Con Waterproofing Paste, making a complete and waterproofed and practically indestructible silo, which presents a neat and finished exterior.

The HY-RIB Steel Reinforced Concrete Silo is here acknowledged to be the very best construction, and being absolutely waterproof, the silage keeps in perfect condition. The silo was finished late in the season and was filled with corn that had been put up in shocks and was very dry, so in filling the silo, streams of water were used to soak it down. After six weeks the top of silage was taken off and the silage was found in perfect condition and is being fed regularly.

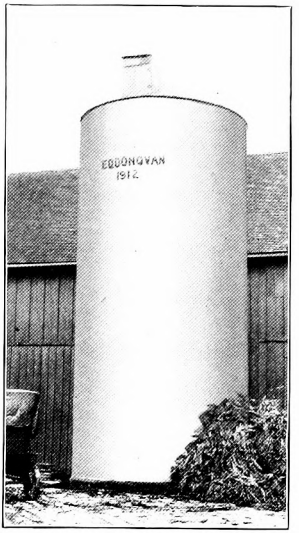
The HY-RIB construction for Silos is new in this section and is very favorably received. There has been some trouble with poorly built concrete silos, so the prospects are that there will be a number of HY-RIB silos put up here this season.

Yours very truly,

A. BENJAMIN.



12′x40′ **Hy-Rib** Silo for F. D. Coleman, Marionville, Mo.



14′x30′ Silo for Ed. Donovan, Imlay City, Mich.

CAVANAUGH & SHEA
HARDWARE & IMPLEMENT MFG. CO.

Oklahoma, Dec. 15, 1912.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen:

Have had photo taken of silo while under construction. Will have another photo taken when it is complete and forward same to you as requested. Mr. ———, the man who is putting this silo up, has succeeded in getting a perfect job, and it is the general opinion of all who see this silo that it is the only sensible one.

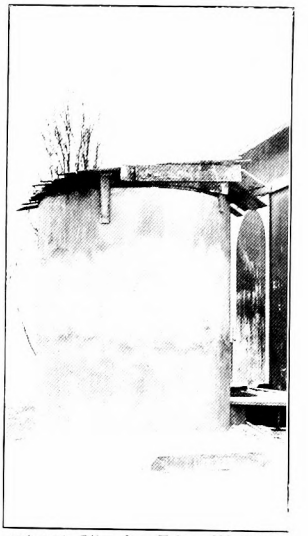
Yours truly,

CAVANAUGH & SHEA.

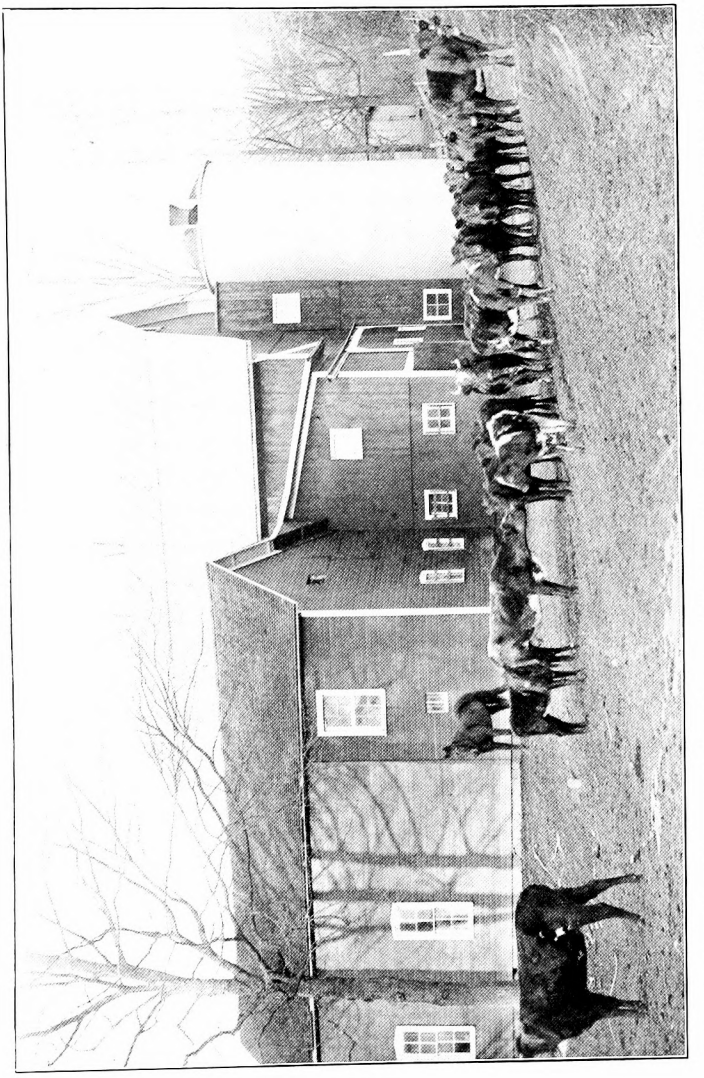
Photograph represents HY-RIB Concrete Silo, erected by Edward Watkins, Allen, Mich., and possesses many peculiar and desirable features.

This silo is 12′ in diameter, extends 9′ below grade and 15′ above grade.

Note that one rib of the HY-RIB has been left exposed clear around the silo at the top. Next year Mr. Watkins plans to secure enough more HY-RIB to make a 40′ silo, at which time he will put on his HY-RIB roof. Mr. Watkins is enthusiastic over this type of building construction and would gladly recommend it to anybody having need for this type of construction. This silo was erected in three days complete.



12′x18′ Silo for Edw. Watkins, Allen, Mich.



12′ x 29′ **Hy-Rib** Silo on Dairy Farm of Horace Snobble, Ionia, Mich.. (See pages 27 and 29 for Views During Construction.

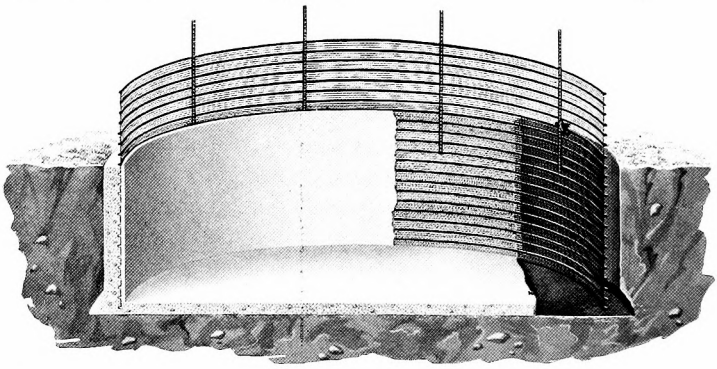
Construction of the Hy-Rib Concrete Silo

As indicated previously in this book and as shown by photographs on various pages of silos under construction, the **Hy-Rib** Concrete Silo is erected by first locking together at both sides and ends, standard 10 and 12-foot sheets of curved Four-Rib **Hy-Rib** in such a manner that the entire frame work of the **Hy-Rib** wall becomes one united piece upon which the plaster is applied with a trowel to a total thickness of from 3 to 3½ inches.

Hy-Rib as Curved for Silo and Tank Construction. Note interlocking ribs at sides.

Complete instructions are sent with each silo sold, and full detailed drawings, showing thoroughly the construction of every portion of the silo. However, to give a good general idea of the simplicity of this type of construction and to explain any questions that will at once arise in your mind, we will give herewith a very brief description of the construction.

The foundation wall should extend below frost, and in most localities it will be necessary to go at least four feet below grade.



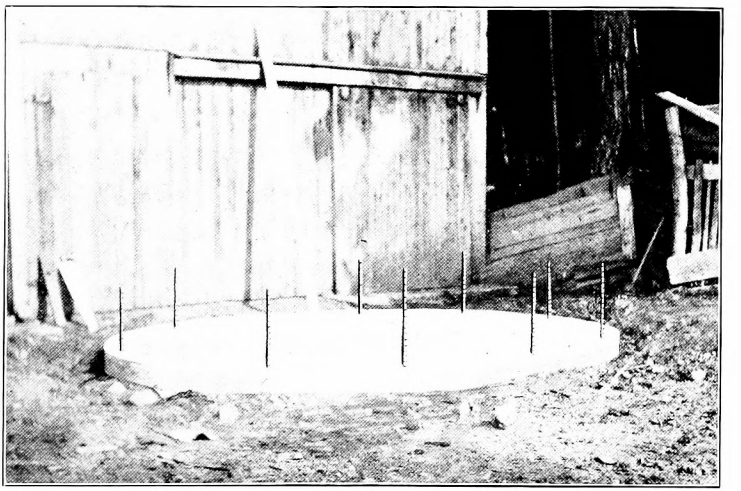
Cross Section of Foundation of Hy-Rib Silo.

Many people desire to use this four feet of sub-grade to hold ensilage. Therefore, we advise the use of **Hy-Rib** as illustrated at bottom of page 26, showing the foundation excavated 16 inches larger than the desired size for the silo, **Hy-Rib** extended to the bottom and concrete poured in behind, making an 8-inch wall. The floor is laid either before or after pouring the outside wall. The **Hy-Rib** sheets are then carried on up above grade to the desired height, and the whole inside plastered from bottom of foundation to top, thereby securing a perfectly smooth interior wall and enabling one to build foundation without the necessity of any forms whatever, and what is more important, one secures a complete finished product.

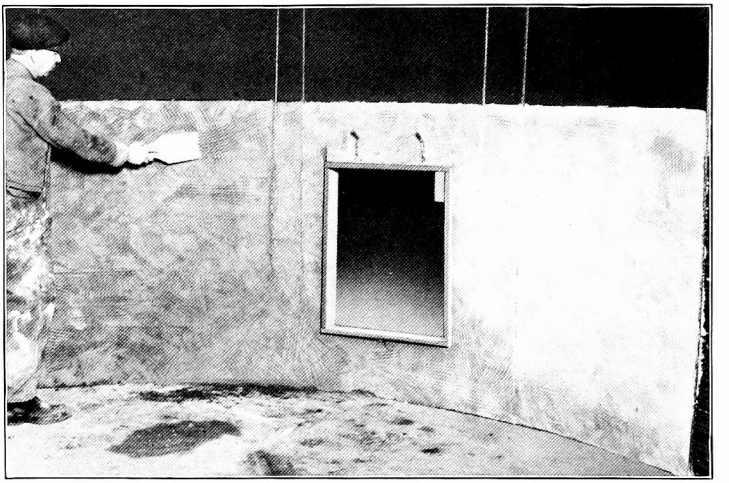
Or foundation can be poured in the usual manner, and dowel pins, as shown below, imbedded in the wet concrete at the exact circle desired for the silo wall, and after the foundation of concrete becomes set, the first rows of **Hy-Rib** sheets are wired firmly to the dowel pins, thus anchoring the silo securely to the foundation.

Erecting Hy-Rib for Side Wall. Whatever method of foundation building is followed, the erection of the side wall will be the same.

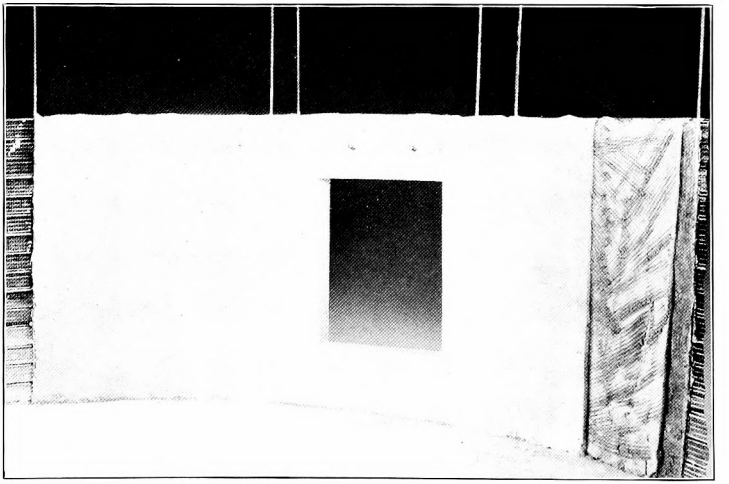
Scaffolding. It will be necessary to have a scaffold both inside and outside of the silo. The method generally used is indicated by photograph on page 29. Ordinary poles or 2x6 material are erected to which are nailed scaffold boards at any desired height. The interior scaffold may be built identically the same as the exterior, although of course, using four uprights instead of five or six.



Foundation laid to surface of ground, with dowel pins for attaching first course of Hy-Rib. Silo of Horace Snobble, Ionia, Mich.



First plaster coat on inside. Note method of roughening surface to provide bond for second coat; also collapsible door guide to be removed after finish coat is applied.



Finished coat on inside with collapsible door guide removed. Note projecting steel pins above opening to which the steel door is attached.

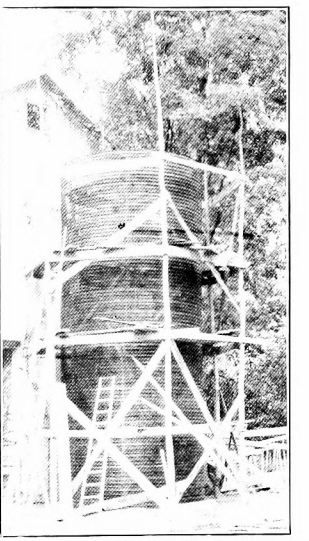
The **Hy-Rib** is now erected as indicated and at least 30 feet of **Hy-Rib** may be erected before any plastering is done. (Note photo of Snobble Silo shown below). Or a few feet of **Hy-Rib** may be erected, a coat of plaster put on and more **Hy-Rib** erected. However, it must be borne in mind that the cement plaster will require at least one-half day to set before more **Hy-Rib** is added. (Note the ⅜-inch Rib bars in view on page 26 wired vertically to the inside of the **Hy-Rib.**) Our blue prints give exact location of these bars which are designed to supply extra vertical rigidity to the **Hy-Rib** and added reinforcement around the door openings.

Doors. View, page 2, indicates the size of our door openings, which is 24x31 inches, and the spacing between doors, which is 10½ inches. In other words, you have practically a continuous door.

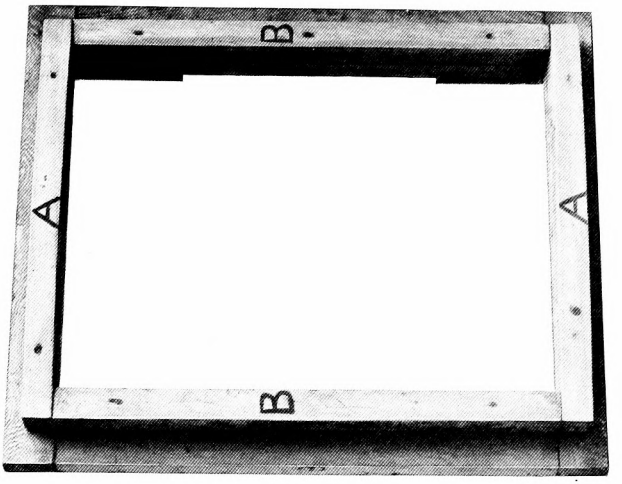
We have this year adopted a silo construction wherein heavy sheet steel is used for doors and this style is very commendable inasmuch as it simplifies the construction of a silo somewhat and we can sell doors at about the cost or even less than the purchaser can make and install wooden doors.

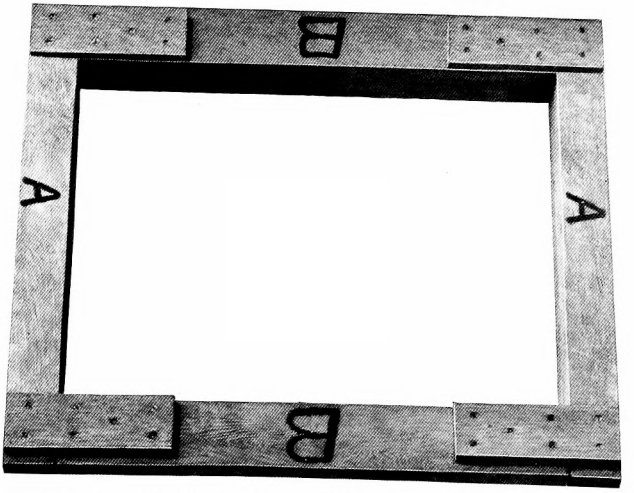
The illustrations on opposite page represent the construction of a section of a 16-foot silo at the door opening. Note the simple 1x5 inches guide at the door opening which is removed after plastering is completed. Illustrations on page 30 represent the detail of door guide which is used in the place of one in upper view on page 28 if the wooden doors are to be used. So you will note that the only difference between the construction of a silo for the steel door and for the wooden door is that in plastering for the wooden door, you leave a 2-inch shoulder in your concrete wall into which the shoulder sets, while the steel door merely hangs on the hooks above the door, as represented on opposite page and falls down over the door opening, being held in place and producing an air-tight opening by virtue of the heavy pressure of the silage against the door. From our experience, we recommend the steel door to you.

We would be pleased to give you prices with and without the steel doors.



Hy-Rib ready for first coat of plaster. Silo for Horace Snobble, Ionia, Mich.





Simple Wooden Guide to Form Silo Opening for Wooden Door Showing View from Outside and Inside.

Plastering. The cement is applied to the **Hy-Rib** in a 1:2½ mix and each coat, except the two finished coats are thoroughly scratched to produce a mechanical bond for the next coat.

Waterproofing the walls. Trus-Con Waterproofing Paste is added to the water, with which you mix up your cement mortar and is used only in the last one-half inch plaster coat inside and the last one-half inch coat outside unless Stone-Tex is used outside.

Finishing. Stone-Tex is a uniforming, exterior coating and damp-proofing product, applied to cured concrete surfaces and designed to give them a beautiful uniform color of any of a dozen shades, although we recommend either concrete or Portland Gray.

Stone-Tex, through virtue of being made particularly for concrete and brick surfaces, is very permanent and lasting and produces an exceedingly smooth, finished appearing silo.

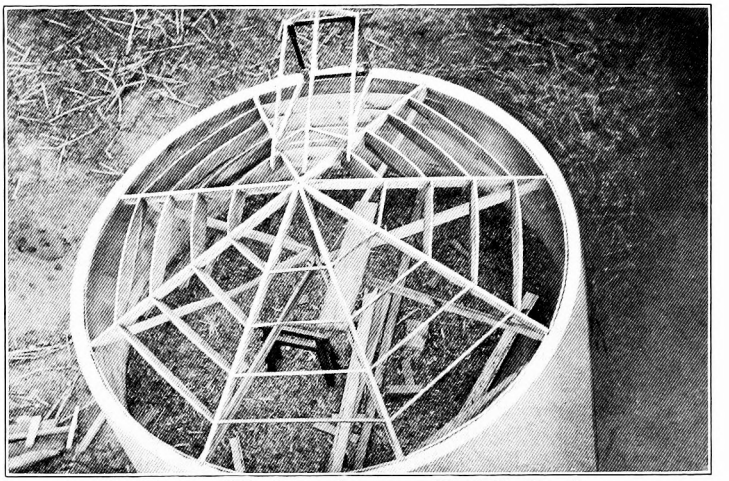
Roof. The roof of a **Hy-Rib** Concrete Silo is applied by erecting eight pieces of 2x4 as roofing joists upon which is laid **Hy-Rib** sheets covered with 2 inches of concrete back plastered underneath. (See illustration, State Agricultural College Silo, page 32.) The chute may be built in connection with the side walls using **Hy-Rib** of any desired size, thereby making your chute side walls and roof of silo one complete unit with the foundation.

As an indication of the cost of a **Hy-Rib** Concrete Silo, we would refer you to various letters in this catalogue, particularly the ones on pages 15 and 17, and for your further instructions, we would advise that an ordinary size silo, say 14x32 feet, would require approximately 35 barrels of cement, 4 barrels of hydrated lime, 12 cubic yards of sand and 5 cubic yards of gravel to erect complete, and this silo should be erected in approximately ten days by three men. Therefore, you will see that your **Hy-Rib** Concrete Silo erected of materials that are absolutely permanent will cost you no more, if as much, as the better grades of wood silos and will give you absolutely everything that can be had in any other type of silo and the added features of absolute permanence and absence from necessity of repairs.

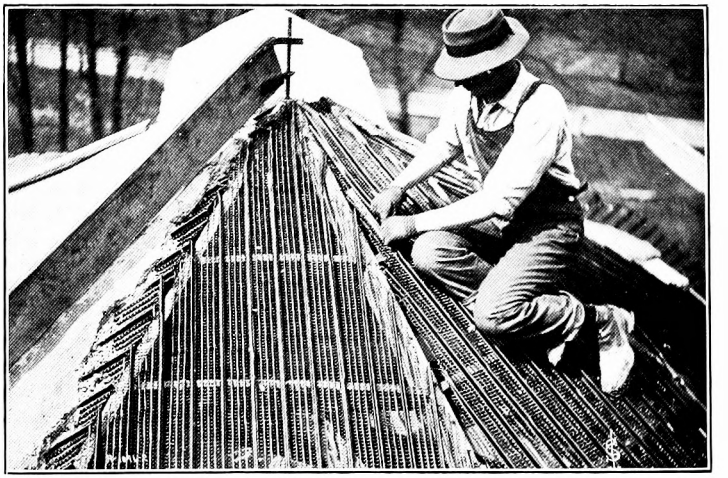
We are in a position to meet every argument that may be made against this type of construction and would appreciate it if you would correspond with us relative to any question which may occur to you.

The foregoing directions are merely suggestions to show the method of construction. Complete directions go with every sale.

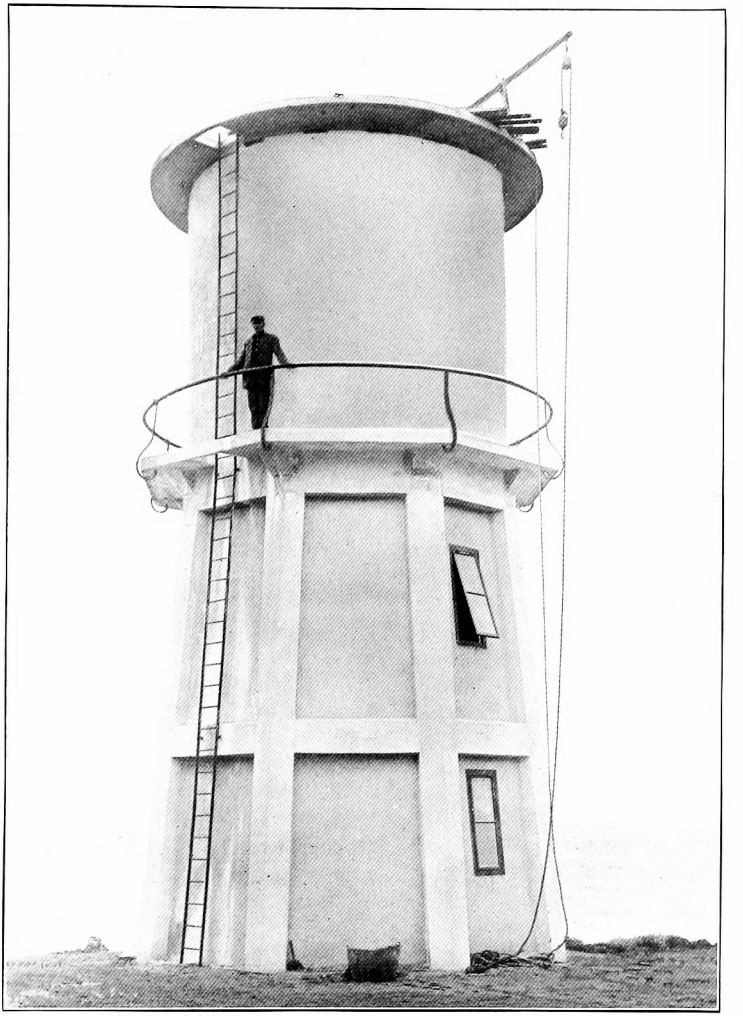
Write us for prices and estimates. Remember you have a silo without a weakness; re-read the letters on pages 5 and 9.



Frame Work to Support Hy-Rib Roof.
Removed after concrete has set if desired.
State Agricultural College, Ames, Iowa.



Hy-Rib Acts as a Form and Reinforcement for the Concrete.
Note the temporary wood frame for HY-RIB sheets. If the wood frame-work is to be removed the HY-RIB sheets must be wired together. If 2x4-inch rafters are to be left the HY-RIB may be nailed lightly to them and the cross boards only removed. This is undoubtedly the quickest and cheapest method.



20,000 Gallon Tank, Marine Biological Station, San Diego, Cal.
Irving J. Gill, Architect.
Tank and Panels are built of **Hy-Rib**, Plastered with Concrete. Posts and Girders are Kahn System Reinforced Concrete.

The following names represent some of the purchasers of Hy-Rib Concrete Silos

J. N. Fate, Red Oak, Iowa, 12x36′.
James M. McBride, Burton, Mich., (2) 14x30′.
Kissimmee Dairy Co., Kissimmee, Fla., 12x32′6″.
J. T. Ball & Son, Hillsdale, Mich., 14x40′.
B. A. Bowditch, Pittsford, Mich., 14x36′.
Dr. Kisskaden, Detroit, 12x34′.
Andrew Schaaf, Attica, Mich., 12x16′.
D. L. Quirk, Ypsilanti, Mich., 12x40′.
B. W. Mattoon, Durand, Mich., 12x40′.
Milo White, Grant, Mich., 10x29′.
I. L. Snyder, Coldwater, Mich., 12x36′.
R. O. Lewis, Saranac, Mich., 12x36′.
Spaulding & Merriett, Ionia, Mich., 12x29′.
J. C. Hostettler, Meyersdale, Pa., 12x40′.
Chas. B. Scully, Almont, Mich., 12x32′6″.
Ed. Donovan, Imlay City, Mich., 14x30′.
Warner Bros., Imlay City, Mich., 16x35′.
Anton Evanstad, Lakota, N. D., 16x35′
C. H. Hayman, Mercer's Bottom, W. Va., 14x36′.
Kavanaugh & Shea, Alva, Okla., 18x45′.
Chas. Lamb, Hillsdale, Mich., 12x29′.
J. M. Hopper, Leeksville, N. C., 18x30′.
Herring Bros., Litchfield, Mich., 12x29′.
C. E. Mitchell, Detroit, Mich., 12x25′6″.
H. J. Van Orthwick, Quincy, Mich., 12x38′6″.
C. R. Dodge, Cassopolis, Mich., 16x40′.
Edward Watkins, Allen, Mich., 12x18′.
Horton Bryan, Charlotte, Mich., 14x36.′
J. R. Rogers, Litchfield, Mich., 12x40′.
C. P. Stout, Ben Lomond, W. Va., 12x32′6″.
A. Benjamin, Marionille, Mo., 12x40′.
Dr. Edgar M. Harris, New Haven, Mich., 12x29′.
Buffalo Bldrs. Exchange, Buffalo, N. Y. 20x35′, double wall.
Louisville Cement Co., Sellersburg, Ind., 18x36′, double wall.
M. R. Tillotson, Elsie, Mich., 12x18′
C. C. Corey, New Haven, Mich., 14x32′.
Jersey Farms, Fairhope, Ala. (2), 12x32′6″.
Pres. Muscoda State Bank, Muscoda, Wis., 14x32′6″.

Capacities of Hy-Rib Concrete Silos

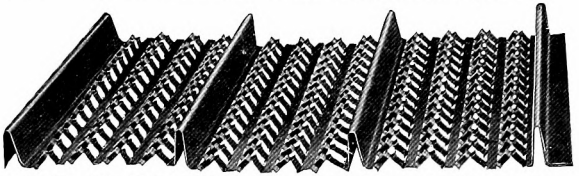
Inside Diameter	Height above Foundation	Capacity Tons	Acreage to Fill 15 Tons to the Acre	Amount that should be fed daily pounds
10	15′-0″	16	1.1	525
10	18′-3″	23	1.5	525
10	22′-0″	30	2.0	525
10	25′-6″	37	2.5	525
10	29′-0″	44	2.9	525
10	32′-6″	52	3.5	525
12	18′-6″	33	2.2	755
12	22′-0″	43	2.9	755
12	25′-6″	53	3.5	755
12	29′-0″	64	4.3	755
12	32′-6″	75	5.0	755
12	36′-0″	87	5.8	755
14	22′-0″	59	3.9	1030
14	25′ 6″	73	4.9	1030
14	29′-0″	87	5.8	1030
14	32′-6″	102	6.8	1030
14	36′-0″	118	7.9	1030
14	39′-6″	135	9.0	1030
16	29′-0″	114	7.6	1340
16	32′-6″	134	8.9	1340
16	36′-0″	155	10.4	1340
16	39′-6″	176	11.7	1340
16	43′-9″	206	13.7	1340
16	48′-3″	238	15.9	1340
18	32′-6″	170	11.3	1700
18	36′-0″	196	13.0	1700
18	40′-3″	230	15.3	1700
18	44′-9″	267	17.8	1700
18	49′-0″	301	20.0	1700
20	32′-6″	210	14.0	2100
20	36′-9″	250	16.7	2100
20	41′-3″	293	19.5	2100
20	45′-6″	335	22.3	2100
20	50′-0″	382	25.5	2100

The following amounts should be added to the above for every 1 ft. depth of foundation.

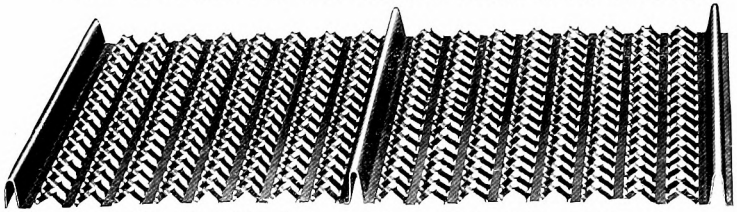
Inside Diameter	Depth	Capacity Tons	Acreage to Fill 15 Tons to the Acre
10	1 Foot	2	.13
12	1 Foot	3	.20
14	1 Foot	4.5	.30
16	1 Foot	6	.40
18	1 Foot	8	.53
20	1 Foot	10	.67

THE THREE TYPES OF HY-RIB

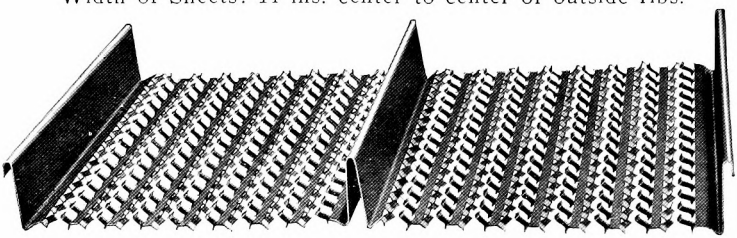
In the foregoing work on Silos we have shown but one of the numberless uses for **Hy-Rib** and treated of but one type of **Hy-Rib**, namely, 4-rib **Hy-Rib**, curved. Note the various styles.



4-Rib **Hy-Rib**—Ribs 13/16 in. high; 3½ in. apart.
Width of Sheets: 10½ ins. center to center of outside ribs.



3-Rib **Hy-Rib**—Ribs 13/16 in. high; 7 ins. apart.
Width of Sheets: 14 ins. center to center of outside ribs.



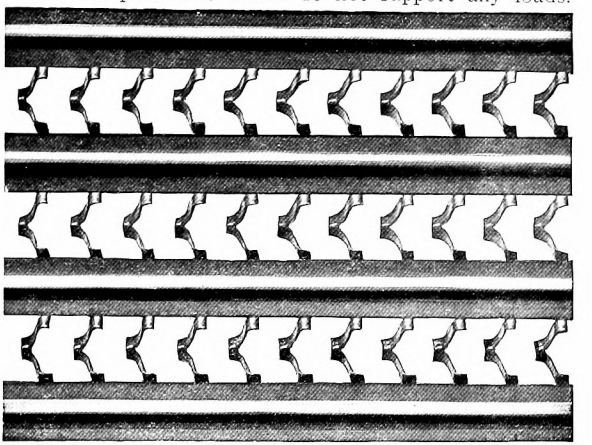
Deep-Rib Hy-Rib—Ribs 1½ ins. high; 7 ins. apart.
Width of Sheets: 14 ins. center to center of outside ribs.

Standard lengths of all types: 6, 8, 10, and 12 feet.

Intermediate and shorter lengths are cut without charge, but any waste is charged to the purchaser. It can also be cut on the job with a pair of tinner's shears. **Hy-Rib** sheets interlock at sides and ends. No allowance need be made for sidelaps, as these are provided in the **Hy-Rib.** Allow 2 inches for end laps where splice occurs over supports; otherwise, eight inches.

RIB LATH AND RIB STUDS

Rib Lath is similar to **Hy-Rib**, except that it is lighter, does not have the deep stiffening rib, and is used principally for interior work on walls and ceilings. **Rib Studs** are steel studding used in hollow walls and partitions which do not support any loads.



BEADED PLATE or "A" RIB LATH

Size of Sheets—15¼ x 96 inches.
Shipped in bundles containing 16 sheets, or 18 yards.

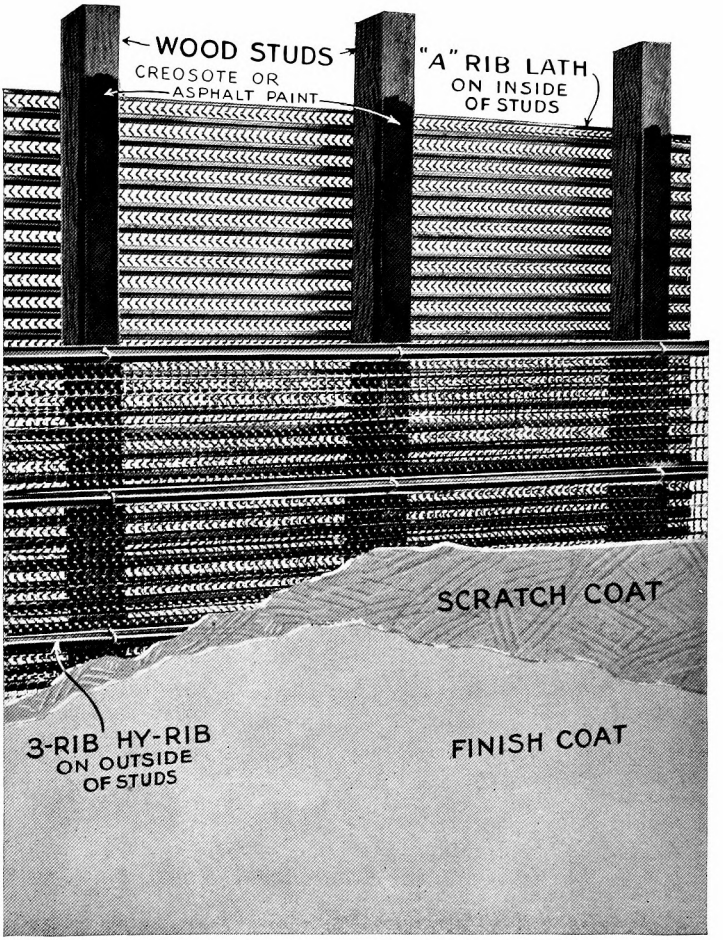
Grade	Weight per square yard	Maximum stud spacing for walls (center to center)	Maximum joist spacing for ceilings (center to center)
Rib Lath No. 1A	3.63 lbs.	18 inches	16 inches
Rib Lath No. 2A	4.54 lbs.	20 inches	18 inches
Rib Lath No. 4A	5.45 lbs.	24 inches	22 inches

STANDARD RIB LATH

Similar to Beaded Plate Rib Lath, but with narrower ribs.
Size of Sheets—20¼ x 96 inches.
Shipped in bundles containing 12 sheets, or 18 yards.

Grade	Weight per square yard	Maximum stud spacing for walls (center to center)	Maximum joist spacing for ceilings (center to center)
Rib Lath No. 1	2.74 lbs.	14 inches	12 inches
Rib Lath No. 2	3.42 lbs.	16 inches	14 inches
Rib Lath No. 4	4.10 lbs.	18 inches	16 inches

We recommend the use of painted lath, but can supply it without paint if desired.



Double wall of concrete built without forms. Hy-Rib on outside of wood studs and Rib Lath on inside.

Note: The **Hy-Rib** should be plastered on the inside between studs before applying **Rib Lath** to inside of studs.

Hy-Rib in General Use on the Farm

Hy-Rib reaches you in perfect, flat sheets or in curved sheets as required, and is handled just like a piece of lumber. All that you have to do is to place it in its proper location and apply the covering of concrete, either in the form of plaster as in walls, or poured in, as in floors and roofs. The uses for **Hy-Rib** are therefore unlimited.

In any place where you could use lumber or masonry, **Hy-Rib** will give better and more economical construction. In every structure that you erect on the farm there is a place where you can use **Hy-Rib** advantageously; in your farm-houses, barns, silos, root cellars, ice-houses, cisterns, vats, septic tanks, etc. You can use it in the outside walls, or the inner partitions, floors, roofs, ceilings, fences, enclosures, etc.

This method of construction was first applied to big city building work, where it has, in a short time, advanced to enormous proportions, and it is even better adapted to farm building work.

It is impossible for us to show all **Hy-Rib** will do, but the next few pages will explain its general application and if interested, we will gladly furnish you with all the details necessary to enable you to handle **Hy-Rib** readily and satisfactorily.

Directions for Applying Hy-Rib to Walls

It is impossible to foresee all conditions under which **Hy-Rib** will be applied to exterior walls, so the following directions are for its use in general and the prospective user can adapt them to his particular problem, or write us stating the situation, and we will advise.

FOUNDATION.

Build foundation walls as for any frame building and fasten plate in usual manner except that, where possible the foundation should extend at least two inches outside of plate in order to make the finished wall and foundation flush, or foundation slightly extending as shown in details on page 41.

Fasten plate to foundation wall, preferably with bolt imbedded while pouring wall (see page 41), or in any usual manner. Height and size of wall will of course depend upon structure being built, and the desire of the individual owners, but **Hy-Rib** construction will not demand any different design than that usually employed.

SETTING UP WOOD FRAME.

Build your wood frame much the same as for wood siding.

For Any Ordinary Barn or House

Use ordinary spacing of supports only in most cases it will be necessary to support roof entirely from the studding and, if roof is of concrete, the studding will have to be somewhat closer together.

For Barn or House With Double Wall.

When Rib Lath is used for inside walls the studding will have to be spaced according to tables on page 37.

Another thing to keep in mind is that the standard lengths of **Hy-Rib** sheet are 6, 8, 10 and 12 feet. Of course these sheets can be cut with a pair of tinner's shears or will be cut to any desired length by us, but studs can be arranged so as to save both time and material if these conditions are kept in mind.

ATTACHING SHEETS OF HY-RIB.

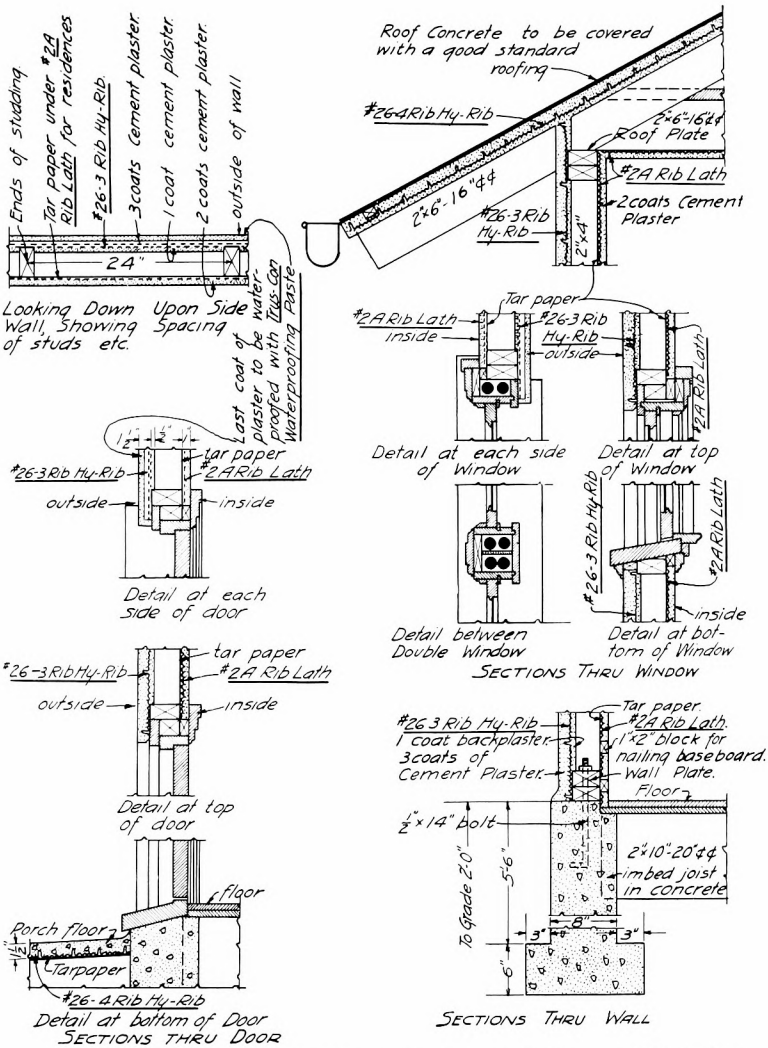
Whether for single or double wall, the outside construction is the same, and in double wall construction the coat between studs is put on before lath is placed inside.

First paint face of studding with creosote or asphalt paint, very inexpensive, to prevent stud from absorbing water from the concrete.

After rough framing is completed, commence attaching sheets of **Hy-Rib** with rib side out, nailing them to supports with ordinary two-inch staples or nails at every rib. Interlock all **Hy-Rib** sheets at sides and ends and wire or clamp sheets together every 24″ along the sides and at every rib at the ends. Allow 2 inches for end laps when splice occurs over supports; otherwise, 8 inches.

Bring ends flush at corners. At window and door openings you will, of course, have two pieces of 2x4's, nailed together, so bring the sheets to within about an inch and a half of the inside edge and nail on a square strip clear round the opening on both sides to nail the inside and outside moulding to. (See details on page 41). Proceed, in like manner, over whole exterior, remembering that this is practically your outside sheathing to be coated with concrete.

The detail of window and door jamb, page 41, is not the only design possible, but is one method and other suitable details may be adopted.



Details of Use of Hy-Rib in Walls, Roofs and Ceiling and Framing Around Doors and Windows.

Mixtures, Sand, Cement and Gravel, etc.

For all **plastering work** use the following mixture:

Sand	12 parts
Cement	5 parts
Hydrated lime	1 part

CEMENT.

Any good standard grade of cement that is of known reliability, and that will meet the standard specifications of the American Society for testing materials. Cement must be kept dry and do not attempt to use cement after it has become so hard that you must use a heavy weight to break it up. That kind of cement will give you no more service than would so much sand.

SAND.

Use a good grade of sand for plaster work. It must be sifted to remove the gravel which interferes with plastering. It must not contain over five per cent of soil. Soil weakens the mixture and makes it a poor color for exterior work. A plaster made with sand which has too much soil will not stick well or make a permanent bond with the first coat. The presence of dirt is readily detected.

HYDRATED LIME.

It is necessary to use some hydrated lime in the plaster. Ordinary lump lime slaked on the job is not so good. Hydrated lime can be obtained in sacks already to mix and makes plastering much more satisfactory.

These quantities are by volume, but it must be borne in mind that the **cement is packed in the sacks and when it is poured out bulks up until a sack becomes nearly one-third greater by volume** so mixtures should be made to include at least one sack batches. If this is not possible allow some for bulk, or better weigh the cement taken, remembering that cement and sand weigh about the same measure for measure.

Mix the cement and lime together first, add whole to the sand and thoroughly mix dry, and then add water to proper consistency.

CONSISTENCY OF PLASTER.

Make the cement mixture wet enough to handle readily as a good, sticky plaster. A very little experience will soon show what this consistency should be. If too dry the plaster will not make a good bond with previous coat. A lime plasterer will recognize the proper consistency at once.

For first plaster coat on **Hy-Rib,** add clean cow hair to mixture, before wetting. Use about one pound of hair to one sack of cement.

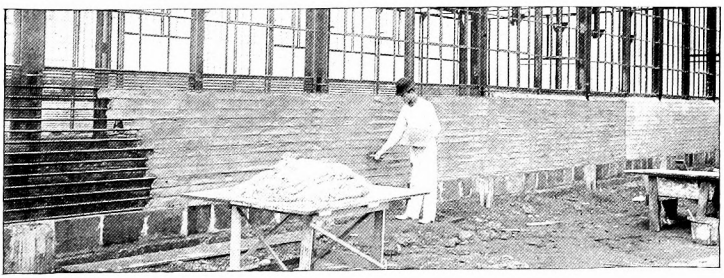
PLASTERING.

Prepare plaster according to directions given on foregoing page. Use a wood or steel trowel and apply first coat to rib side, using only enough pressure to force plaster well into the meshes, too much pressure will cause a waste on the back side which can be avoided. Aim to bring first coat only to depth of rib. The less troweling done the better.

As soon as this first coat is applied scratch it over with anything that will roughen the surface and help make a bond for the next coat. (A piece of **Hy-Rib** is good for this purpose.) Let this coat set for six hours or long enough to give it enough rigidity to hold up the next coat. The time of setting will depend to a great extent upon the weather conditions, etc. Next apply another coat to the outside, and one to the inside between the studs or vice versa. For a full two-inch wall a third coat will in most cases be necessary, as the three generally give but 1¾ inches. The last coat outside can be given any finish desired, but it must be waterproofed with TRUS-CON WATERPROOFING PASTE Concentrated in order to make it dampproof. (Directions for waterproofing on page 44.)

Whenever it is desired to apply more coats the surface of last coat should be well scratched. Do not be afraid of plaster falling off, for if you have a good grade of plastering sand and have the proper consistency it will stick like glue.

When it comes to applying the outside finish coat, plan to cover an entire surface at one time if possible, in order to overcome any distinct unsightly marks of division between applications. A good, smooth, evenly troweled surface is very attractive, especially where a good clean grade of sand has been used. For those desiring to color differently we manufacture what is known as TRUS-CON STONE-TEX, a hard surface coating for concrete that becomes a part of the concrete. It is applied with a brush much the same as paint to the dried surface. It comes in colors ranging from white to red brick. If you already have an old concrete or brick surface that you would like to re-color, send for card showing colors and describing STONE-TEX.



Hy-Rib Siding Showing Method of Plastering.

WATERPROOFING.

Cement mortar and concrete are naturally porous and in order to be sure of a tight job it is necessary to properly waterproof them. There are a number of methods recommended by this company for special conditions, but the one best adapted is what is called the **Integral Waterproofing Method.** By this method we mix what is called **Trus-Con Waterproofing Paste** Concentrated into the water that we are using for our cement in the proportions of one part **paste** to eighteen parts water. This is used only in the inside or exposed coat for silos, tanks, etc., and the outside for walls. By this method we are enabled to make a two-inch wall absolutely waterproof and damp-proof, and to a great extent frost proof. Think of the value of this in your silos, water tanks, cistern, barn walls, etc.

PURDUE UNIVERSITY
Lafayette, Ind.

The Trussed Concrete Steel Co., February 13, 1911.
Detroit, Mich.

Gentlemen—It would no doubt be of interest to you to learn that we consider your TRUS-CON Waterproofing Paste as used by us in our cement laboratory to be highly successful.

Very truly yours,
H. H. SCOFIELD,
Laboratory of Testing Materials,
Purdue University.

CONCRETE FLOORS AND ROOFS

Prepare concrete for roofs and floors with the following proportions:

Portland Cement.....1 part.
Sand .....2 parts.
Gravel or broken stone.....4 parts.

The sand and cement should be of the same quality as specified for "Plaster Work," page 42.

Broken Stone and Gravel.

This material should be hard, close-grained, and free from dust and dirt. For **Hy-Rib** construction for floors and roofs all stone should be of such size as to pass through a half-inch ring, being preferably well-graded up to this largest size. If gravel contains sand, make a proper reduction in the amount of sand used.

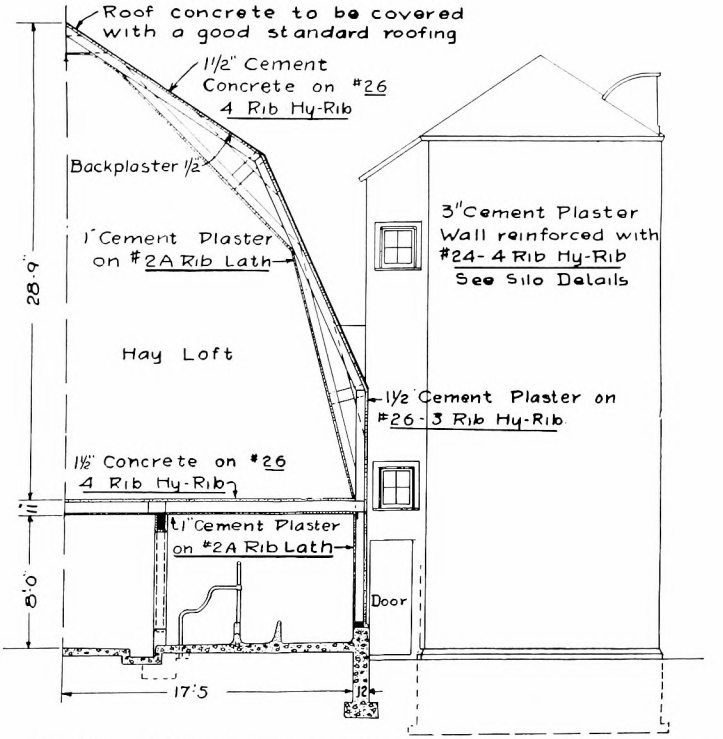
Application.

Mix the sand and cement together; then add the gravel and finally water, mixing until absolutely uniform throughout. Cover the **Hy-Rib** sheets with this mixture and float the surface smooth. When the concrete has set sufficiently, plaster the under side with the standard mixture for plastering, page 42.

A box for enough sand to make up a two-bag mixture is 2'x2' in size and 11½ inches high. Box for one-bag mixture should be one-half this size or this one filled half full. A box or barrel should be made, 3 or 4 feet by 11½ inches high for a two-bag mix.

Protect the concrete work from too rapid drying by means of damp burlap or canvas, or by sprinkling.

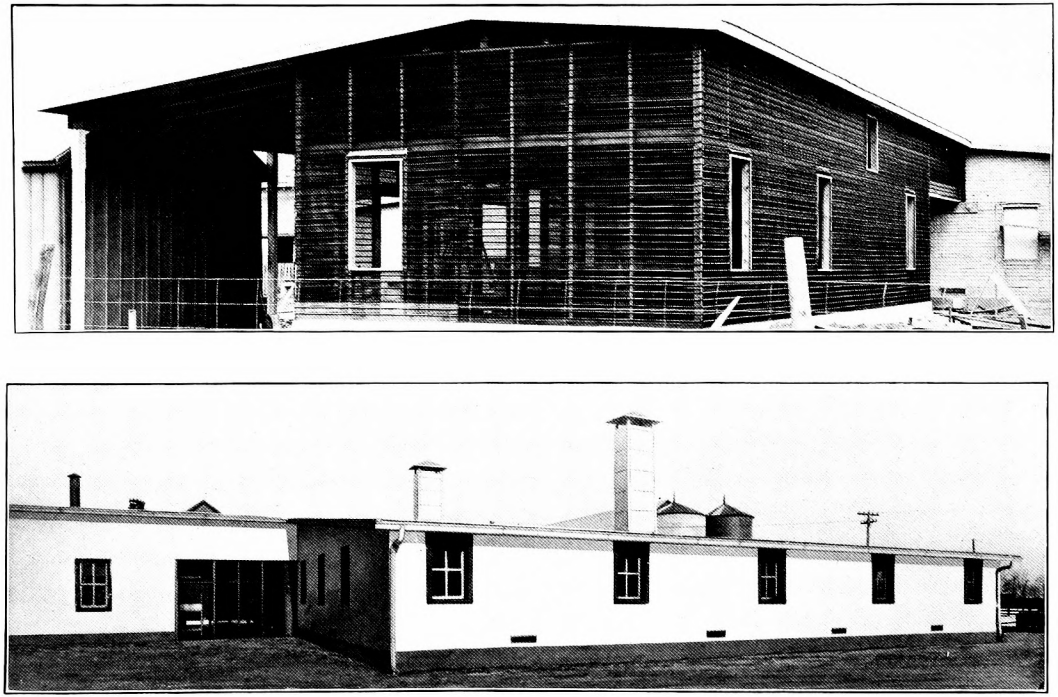
Concrete Dairy Barns



Section of Dairy Barn taken from our large plan of Concrete Dairy Barn. The balance of this design and others may be had for the asking. We make drawings for buildings in which our materials are used.

Concrete Hen Houses

A good, sanitary, concrete hen-house can always be readily kept clean and is always a good investment. The use of **Hy-Rib** and **Rib Lath** plastered with cement makes such buildings comparatively inexpensive. The walls in this case are built with studs covered with **Hy-Rib** on the outside and plastered with cement. In the same way the inside of the studs is covered with **Rib Lath** and plastered with cement. The roof is built with joists covered with **Hy-Rib** and concrete above, and **Rib Lath** and cement plaster below. This gives a complete air-space around the entire hen-house which keeps out the cold and dampness.



Dairy and Creamery Buildings, Walker Bros.' Farm, Walkerville, Ont.

Showing buildings before and after cement plaster had been applied to HY-RIB.

Note that the studs are about three feet apart, and HY-RIB is fastened to them by a two-inch staple over each rib. HY-RIB is applied with ribs running horizontally.

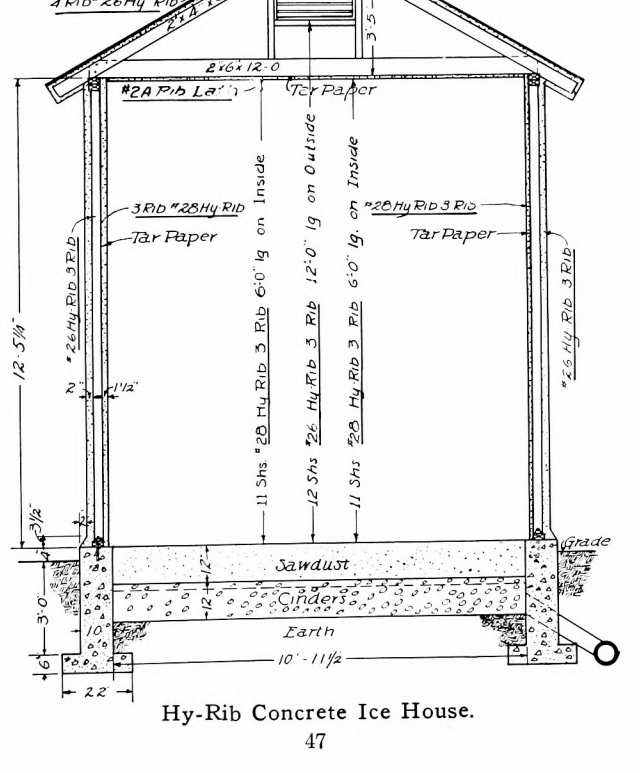
Hy-Rib Concrete Milk Houses

We have a design prepared for a good, standard milk house which is too large to show here, but will be mailed upon request.

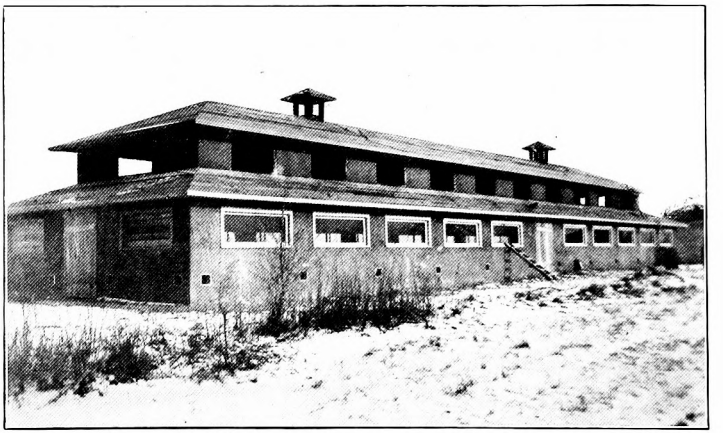
This design shows in detail a strictly modern, model milk house, easily built and at low cost. The walls consist of wood studding, covered with **Hy-Rib** and **Rib Lath** and cement plaster, as described in this book.

Hy-Rib Concrete Ice Houses

The first requirement in a properly constructed ice house is that the walls and roofs should provide a maximum insulation against heat. We have prepared drawings for two kinds of ice houses, a part of one being shown here. This type of construction provides a perfect insulation against heat.



Hy-Rib Concrete Ice House.

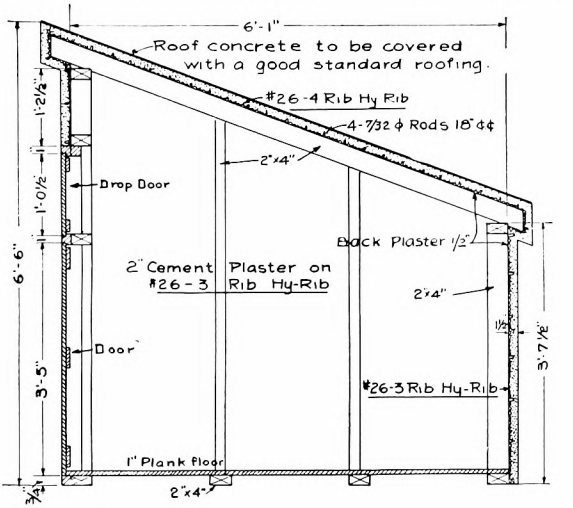


Hy-Rib Milk House and Dairy Barn on Clovercroft Farm, Lansing, Mich.

Hy-Rib Concrete Hog Barns

We have a number of complete plans of modern concrete Hog Barns, which will be sent free to those interested.

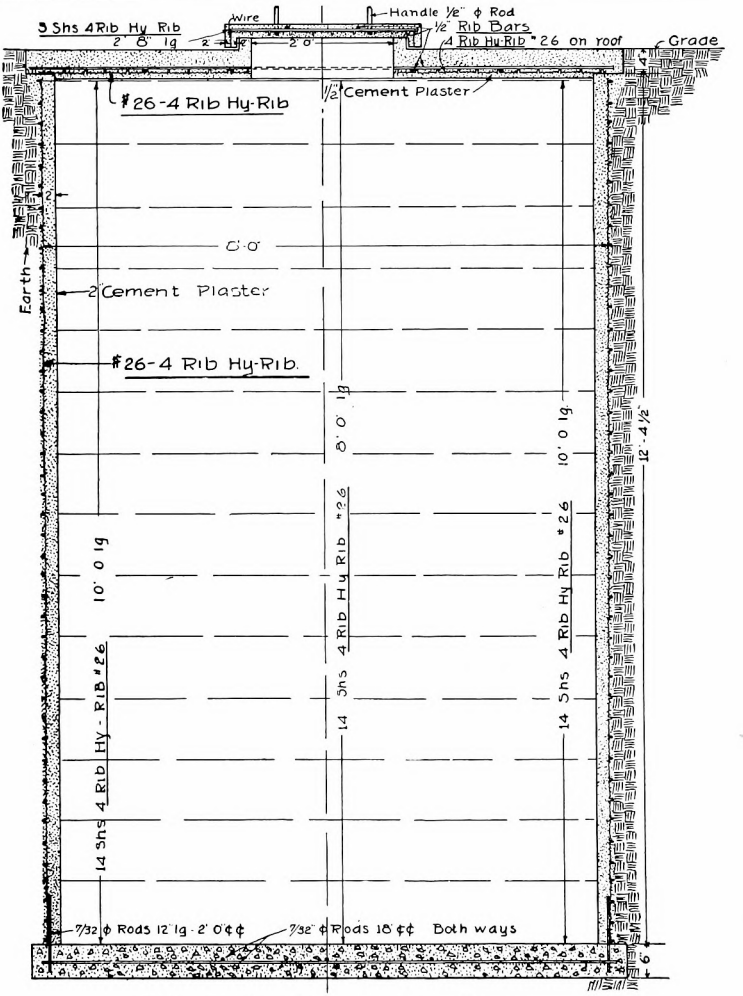
Individual Concrete Hog Houses



Part of Design of Individual Hog House.
Complete details on request.

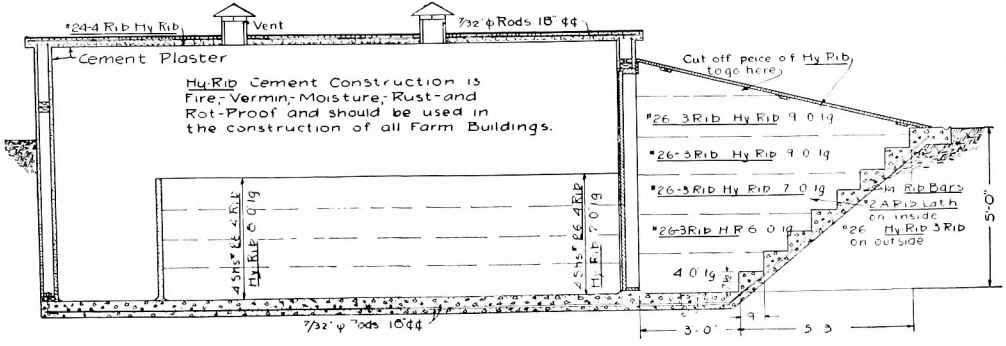
Hy-Rib Concrete Water Troughs

Concrete troughs are always more desirable than wooden troughs because they are clean and sanitary, never get sour even with wet feed, and do not rot and become infested with germs. They last forever and do not require replacing from time to time. **Hy-Rib** is especially useful in building such troughs, as no centering is required, greatly reducing their cost. We have a number of typical designs for both rectangular and circular troughs. The **Hy-Rib** is shipped bent to exact curves for round troughs. Concrete is applied in the form of a plaster directly to the **Hy-Rib** sheets. The troughs are waterproofed by the use of Trus-Con Waterproofing Paste Concentrated in the plaster coats on the inner side of the troughs.

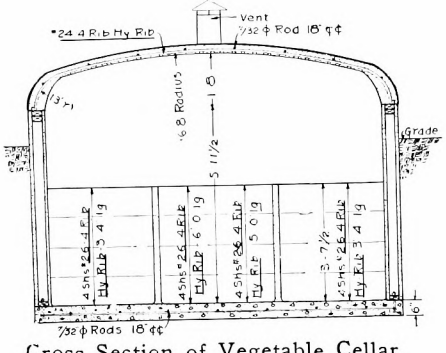


Hy-Rib Concrete Cisterns

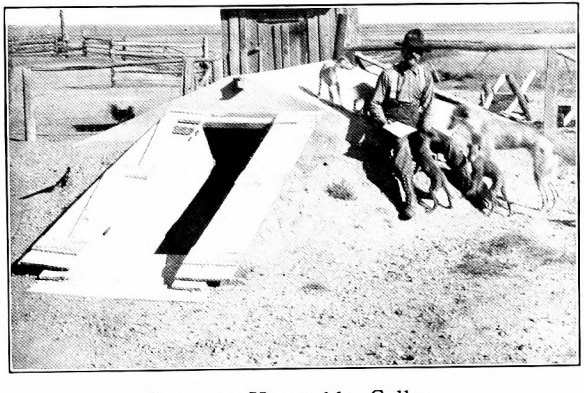
Concrete for cisterns has many advantages because it is monolithic and can be made absolutely waterpoof. It is absolutely clean and sanitary and PERMANENT in every way.



Hy-Rib Concrete Fruit, Vegetable and Root Cellar. Any one desiring the ideal cellar for storing underground should look our details over carefully. Only a portion here shown. Write for complete plan.

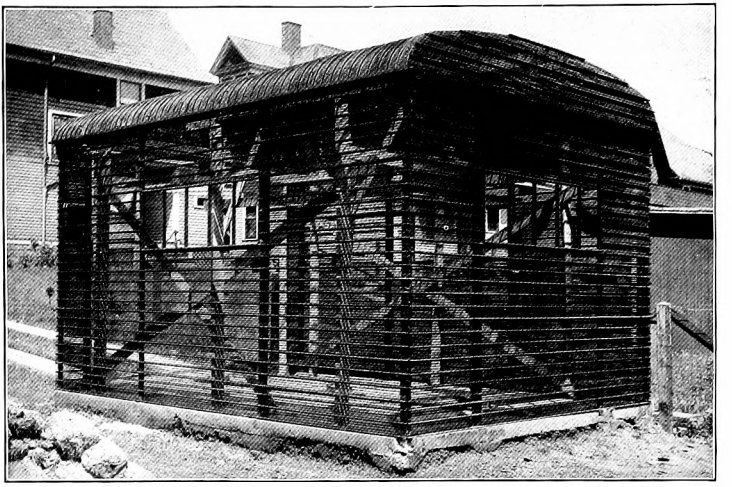


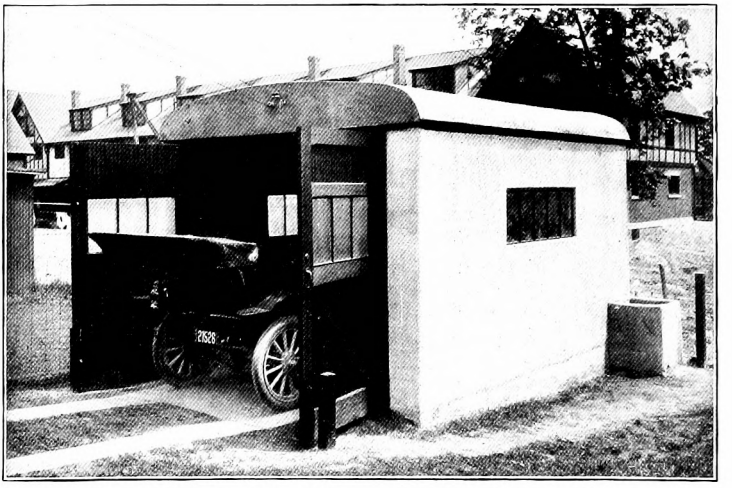
Cross Section of Vegetable Cellar.



Concrete Vegetable Cellar.

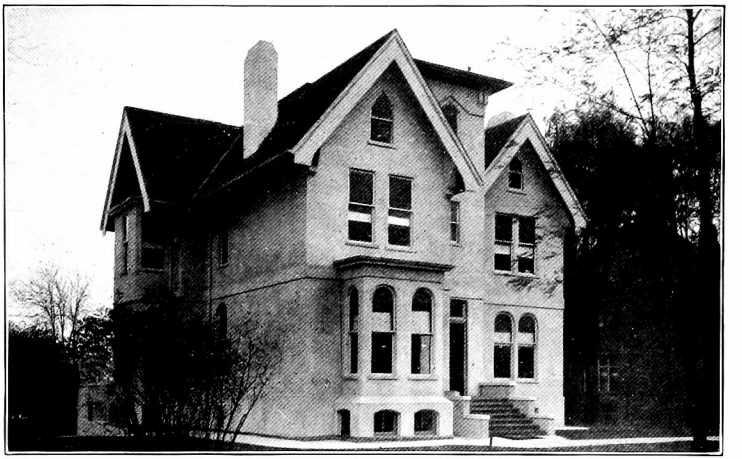
HY-RIB CONCRETE GARAGES



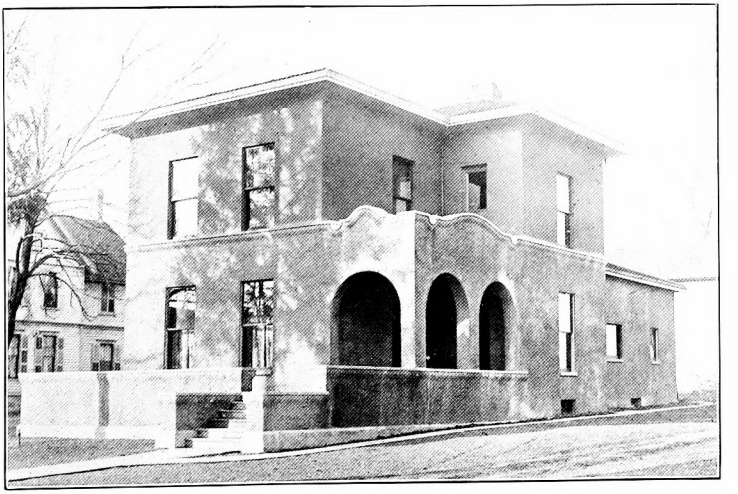


Hy-Rib Garage for T. K. Kane, Youngstown, O. Ready for Plastering and Completed. Write for **Hy-Rib** Garage Folder.

Old Wooden Houses Transformed into Modern Permanent Residences by Overcoating with Hy-Rib and Stucco



Overcoated Residence of C. Bewick, Detroit, Mich.



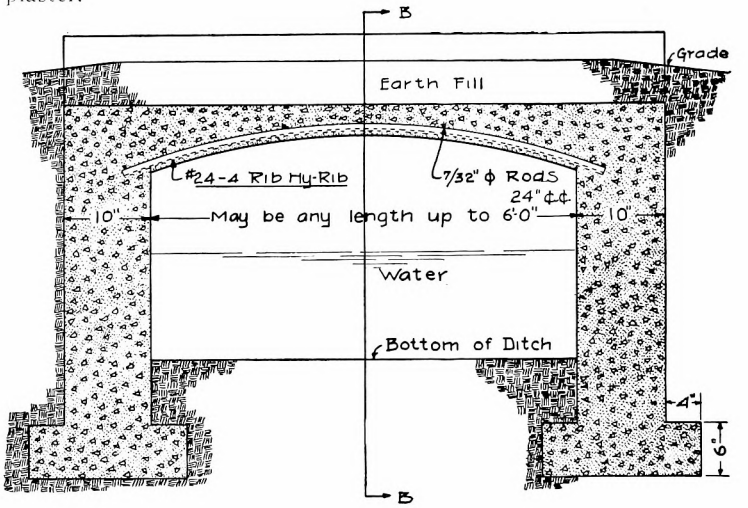
Overcoated Residence of N. T. Spaulding, Ionia, Mich.

Hy-Rib Concrete Flumes

In the irrigation districts of California, Colorado and other western and southwestern states, flumes of different sizes must be built to carry the water to the orchards and gardens.

If the water is run through ditches in the ground a large amount is lost by seepage into the earth. To save this water, flumes should be built of concrete in all sizes from the main canal to the small ditch which carries water into the orchard or garden.

These concrete flumes are easily and cheaply built by using curved **Hy-Rib** as a reinforcement and key for the concrete. No. 26 4-Rib **Hy-Rib** is bent to curve at our Shops and when received is simply placed in position in the ditch and covered with cement plaster.



Hy-Rib Concrete Farm Bridges and Culverts

The many ditches, large and small, that run through a farm must have bridges over them so the farmer will be able to go from one field to another. With **Hy-Rib** these small bridges and culverts are easily and quickly built. The footings are built of concrete and the **Hy-Rib** placed upon them, then the concrete road-bed is poured upon the **Hy-Rib,** which acts as centering and reinforcement.

Bridges and culverts up to 6 feet span are built with **Hy-Rib** as shown in drawings.

We have many designs for reinforced concrete bridges of all spans and types.

Consider that **CONCRETE** is fast coming to be the accepted material by those who **know.** Concrete means permanency and sanitary conditions, eliminating disease and vermin which result in loss of live stock. It prevents destruction of food by rats and mice, waste in feeding, and is better than insurance for it cannot be harmed by fire or flood. Concrete is more economical in the long run for farmers to use, than any other building material, for wood becomes weaker through exposure, and steel and iron become rusty through dampness, while **concrete becomes stronger as the years roll on.**

Build of concrete and you need have no fear for the future, no constant worry as to where the money is coming from to pay for this repair this month and that up-keep cost next. Once built with concrete and built right, and you have a job that will last forever.

Immense concerns like the **TRUSSED CONCRETE STEEL COMPANY** have studied the question of reinforcing and finishing concrete and brought the subject down to an exact science, as is attested by the steadily increasing number of immense structures, depending solely for their stability upon very light but exceptionally strong concrete slabs and beams. These structures are standing and will remain standing, after all others fall, because they are so constructed as to enable them to overcome all conditions tending to break or crumble them.

Concrete must have a skeleton of steel to make it enduring. A slab or wall of concrete 2 inches thick with its firmly imbedded skeleton of **Hy-Rib** is permanent. Changes in temperature do not affect it since the steel resists their destructive action, making the construction impervious both to the hottest fires and coldest degrees of frost, and better and more enduring than an 8-inch wall.

Because of the above facts, and the added fact that no forms are required for our system of farm buildings, **Hy-Rib** concrete construction becomes one that must appeal to every thinking, progressive farmer.

A few of the uses for Hy-Rib on the farm:

Residences
Walls, Partitions and Roofs
Conservatory Walls and Benches
Fences, Windbreaks, etc.
Laundry Tubs
Benches
Dairy Barns
Horse Barns
Sheep Barns
Piggeries
Outside Pig Cots
Granaries
Poultry Houses
Shops
Sheds of All Kinds
Silos
Ice Houses
Tanks—Underground, Elevated and Supply
Watering Troughs, etc.
Cisterns
Well Holes
Culverts
Bridges
Water Flumes
Cess Pools
Septic Tanks
Water Filters
Charcoal Burners
Pig Troughs, etc.
Mixing Vats

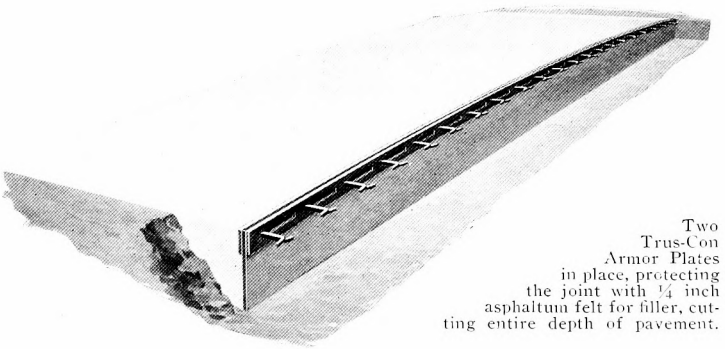
OTHER KAHN BUILDING PRODUCTS FOR THE FARM

Kahn Trussed Bar is a special rolled steel bar with rigidly connected diagonal members. These bars are used for reinforcing concrete girders, beams and arches of considerable span in bridges and building work.

Rib Bar is a special steel section with ribs extending around the bar at frequent intervals to firmly grip into the concrete mass. They are frequently used in conjunction with Hy-Rib and reinforcing work generally.

Other reinforcing steel includes **Rib Metal,** a sheet of rods rigidly connected and spaced by cross members, and **Spiral Hooping** for reinforcing columns.

United Sash are made of deep, rolled steel sections, which have greatest strength and do not obstruct the light. They give greatest possible fireproofness, daylighting, and permanency to window construction.



Two Trus-Con Armor Plates in place, protecting the joint with ¼ inch asphaltum felt for filler, cutting entire depth of pavement.

Trus-Con Armor Plate. A steel plate that protects the expansion joint, in concrete paving, from chipping and breaking down under traffic.

Trus-Con Curb Bar. A galvanized steel bar for protecting concrete curbs, columns, shipping platforms, stair nosings and all exposed concrete edges.

Trus-Con Chemical Products. A complete line of dampproofing and finishing products for concrete.

Building Specialties. Inserts for attaching equipments to concrete walls, hollow building tile, post caps, joist hangers, etc.

HY-RIB and CONCRETE ON THE FARM

Showing how to construct all farm buildings of concrete without the use of forms, making them permanent, fireproof structures at very low cost

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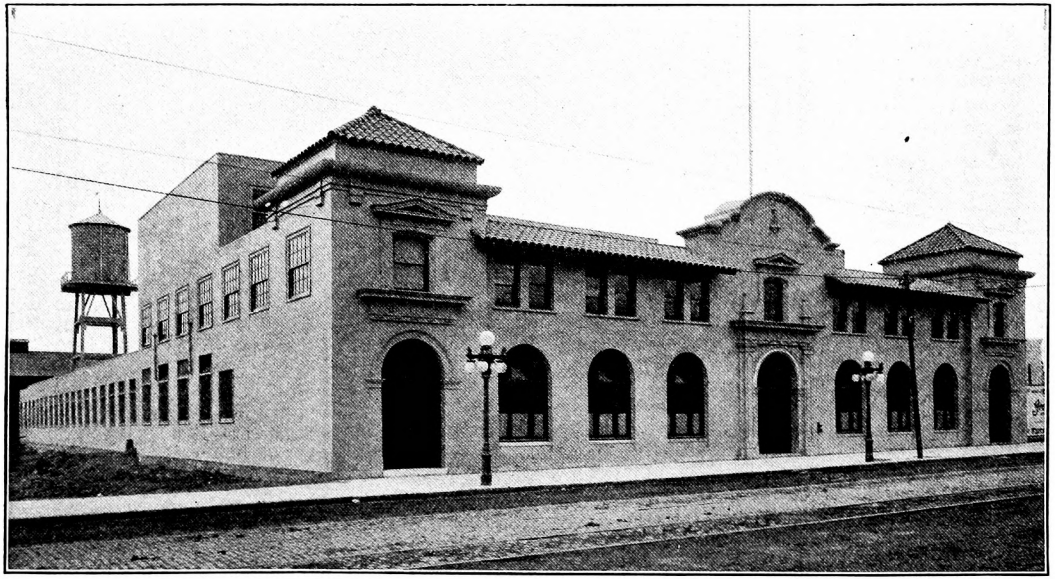
A Valuable Guide for all Building Work

SECOND EDITION
1912

Farm Building Department
TRUSSED CONCRETE STEEL CO.
DETROIT, MICHIGAN



Sunset Publishing Company's Plant, San Francisco, Cal.

The walls of this Kahn System building are of **concrete** and were built without the use of any forms whatever. Note the pleasing artistic appearance. This is an example of what can be done in concrete building work without the necessity of using forms. All your farm buildings can be erected in the same manner.

Concrete for Farm Buildings

Concrete when properly handled is recognized by the practical farmer of today as the most satisfactory material obtainable for all forms of building work, just as the most experienced builders in all places have adopted it for their immense buildings, bridges, and other structures.

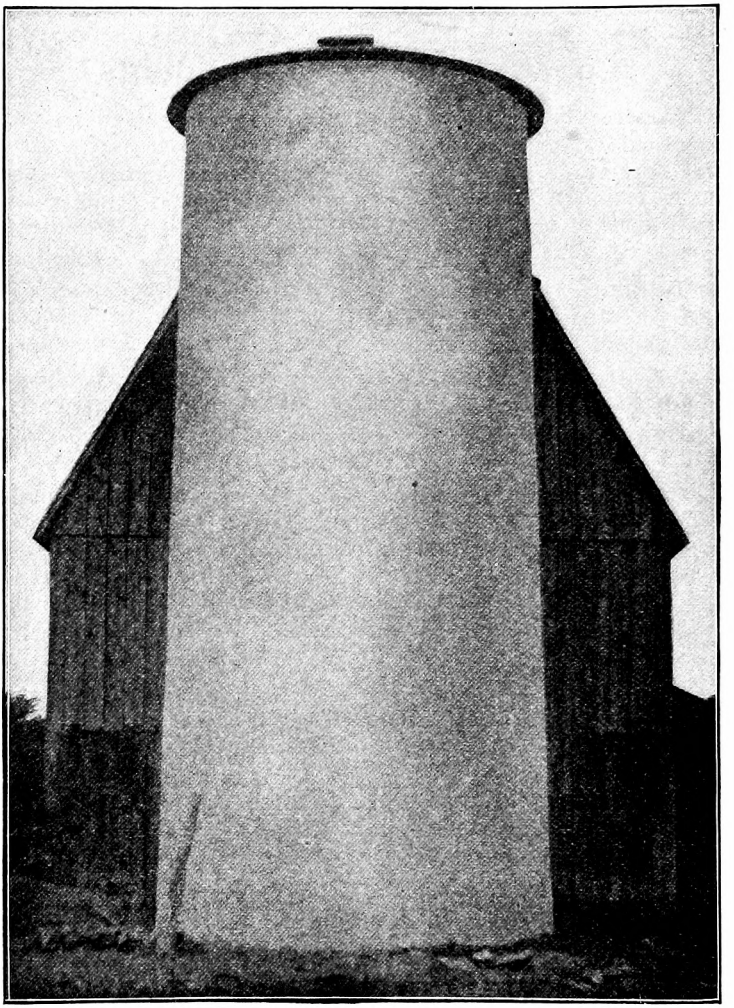
The advantages of **concrete** are well known: **Absolute** protection against fire and decay; absence of repairs; saving of insurance; practical indestructibility; cleanliness and vermin-proofness—all resulting in greatest economy.

With the awakening of the farmer to the possibilities of his business has come the desire to **build permanently.** In this work the farmer has found no better material, **when properly used,** than **concrete.**

The use of **concrete** by the farmer has grown enormously during the last decade, but it has been pretty largely restricted to the building of floors, walks, foundations, retaining walls, etc. The reason for this is found in the fact that it has been necessary to erect forms making heavy cumbersome walls, at great expense.

What would it mean to you as a progressive farmer to be able to have a poultry house, piggery, a silo or any farm building, built of **concrete** and know that you could avoid all the present objections to **concrete** for such buildings. To do away with expensive, clumsy forms, which are difficult and costly to erect and avoid damp, cold walls much thicker than necessary? To obtain permanent concrete buildings at very low cost?

The method perfected by **The Trussed Concrete Steel Company,** employed in the erection of the building on opposite page, enables you to use concrete in your building operations much the same as you would lumber. You are enabled to overcome practically all the present objections to building with **concrete. We give you a method, fully explained in this book, whereby you can erect your buildings of an everlasting material at a cost comparing very favorably with wood and much less than brick.**



100-Ton Silo for Stock Farm of C. C. Corey, New Haven, Mich.
Farm labor used exclusively in erection. No forms used. Cost no more than a stave silo. Average thickness of wall, three inches.

(*Read Mr. Corey's letter on next page.*)

C. C. COREY

BREEDER OF

HOLSTEIN-FREISIAN CATTLE
ENGLISH BERKSHIRE SWINE

Herd Bull Pieterje Hengerveld Paul Lad, 62707.
Herd Boar Premier Bacon, 123639.
Herd Boar Baron Haven, 139412.

New Haven, Mich., December 8th, 1911.

To Whom It May Concern:

My concrete silo was built over a year ago by plastering over **Hy-Rib** supplied by the Trussed Concrete Steel Company, Detroit, Mich., and is today in perfect condition. This silo has been filled the second time and is entirely satisfactory in every way.

It has given perfect service and keeps the ensilage first-class, there being no waste after the top is taken off.

It has shown no sign of cracking, regardless of the fact that I filled it before it had time to fully cure or season.

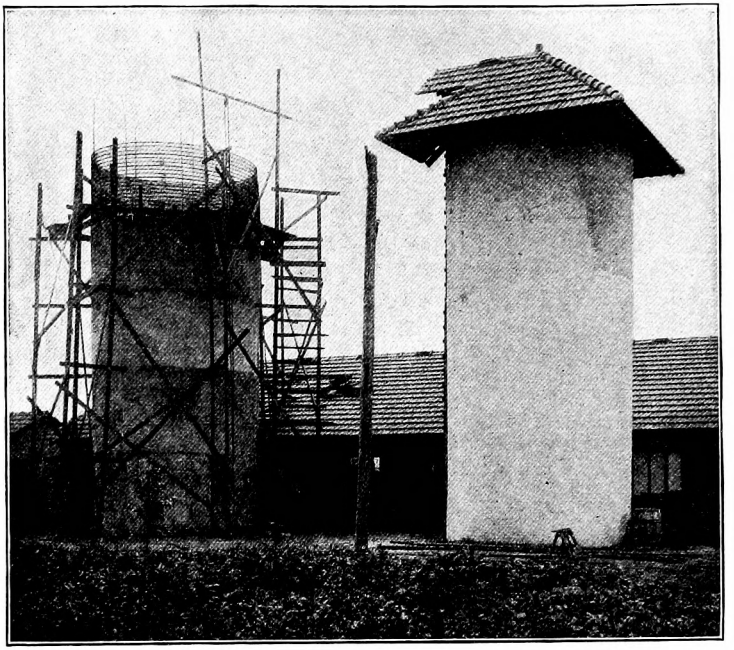
I have had absolutely no trouble with the silage freezing, while my neighbors have experienced considerable trouble with both the cement block and wood silos.

I feel that I now have a silo which is absolutely permanent, fireproof, and will not require any expense for painting, repairs or adjustments. The cost of building this silo was surprisingly low, and I feel that I am making a very substantial saving every year.

I am so thoroughly satisfied with the results obtained from my **Hy-Rib** silo that I should cheerfully recommend it to all who intend building.

Yours truly,

C. C. COREY.



Hy-Rib Silos for J. R. Cross & Co.,
Jersey Farm, Fairhope, Ala.
Erected Without the Use of Forms.

We have perfected a system of **integral waterproofing** for cement whereby a three-inch wall can be made absolutely impervious to moisture, and more frost proof than any other form of silo construction. These silos are perfect from a silo standpoint, and everlasting; are free from danger of blowing down, and do not require repairs.

Think what this means to you in your silo: your first cost is the only cost. These silos are an ornament to any farm.

Send for our Silo Book which tells you all about this form of silo construction.

THE J. R. CROSS COMPANY

FAIRHOPE, ALA.

May 6, 1910.

Trussed Concrete Steel Co., Detroit, Michigan:

Dear Sirs—Replying to your request to let you know something about the result of my experience with the use of **Hy-Rib** reinforcement, manufactured by the Trussed Concrete Steel Company, of Detroit, will state that it has been satisfactory in every respect. I built one silo with it 12 feet in diameter and 30 feet high, according to instructions received from the Trussed Concrete Steel Company, which has been used for cow-pea silage for one season with perfect results. This silo has been pronounced by all who have examined it as the best one they have ever seen. I am just beginning the construction of another silo, of about the same dimensions, and am using the same kind of reinforcement.

I have also built a milk room with this **Hy-Rib,** using in this connection no studding, but supporting the roofs on the corner posts of the building, and it is pronounced by every one as first-class in every particular.

I have also used it in building water troughs with perfect satisfaction and great economy .

I have also constructed about 75 feet of concrete culverts, laying first a concrete floor and then placing on same, sections of **Hy-Rib** bent to a proper curve for making an arched culvert. * * * We found this construction very cheap, no skilled labor hardly being required in connection with it.

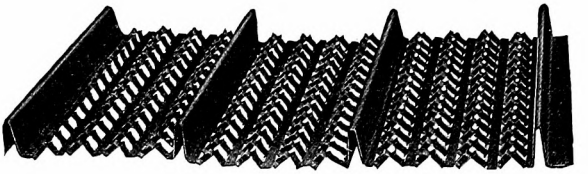
I shall be pleased to give you any further information in regard to the matter, and will also send you a photo of the silos as soon as the new one which is being constructed is completed.

Yours very truly, THE J. R. CROSS CO.

Per H. F. Ring.

NOTE.—The silo mentioned is 12′ in diameter and 30′ high. The walls are solid, 3″ thick, plastered with Portland Cement Mortar, according to our standard specifications.

24 Gauge Hy-Rib was used with ⅜″ Rib Bars running vertically, spaced 3′ 0″ center to center. The roof is of tile. The down chute is of 12″ sewer pipe. The total cost exclusive of tile roof was two hundred dollars ($200.00).



HY-RIB

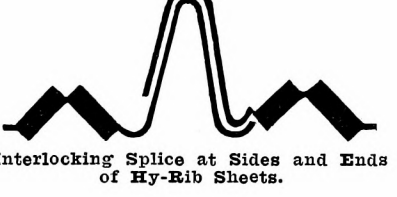
The erection of the foregoing buildings and silos, **without forms,** has been made possible through the use of a metal product called **Hy-Rib.**

Hy-Rib is made by rolling deep stiffening ribs into a flat sheet of high grade steel and so perforating and expanding the spaces between that a perfect surface is provided for the application of concrete in the form of plaster.

No forms are required where **Hy-Rib** is used to make side walls, floors, roofs, partitions, etc., as the ribs give sufficient strength and rigidity to hold the wet concrete or mortar which, when fully set, makes a thoroughly reinforced concrete slab.

The usual method for making side walls is to set up a frame work of studding, fasten the **Hy-Rib** sheets to it, and then plaster to the desired thickness. Two inches is the usual thickness for side walls, and this thickness is more serviceable, lasting and satisfactory in many ways than the old style six or eight-inch poured wall. It is dampproof and waterproof, made so by our integral method, which is practically impossible in a poured wall except at much greater expense.

Hy-Rib is manufactured with a full sized rib along each side of the sheet, making a perfect interlocking splice when two sheets are joined. A similar interlocking splice is provided at the ends by allowing the two sheets to overlap. In this way absolute continuity of strength and reinforcement is provided throughout the entire floor or wall surface.



Interlocking Splice at Sides and Ends of Hy-Rib Sheets.

Where Hy-Rib is used

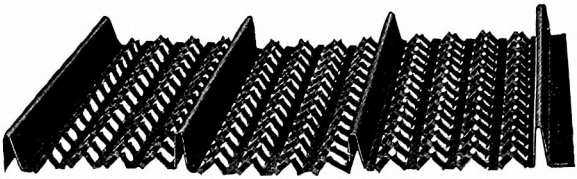
Hy-Rib reaches you in perfect, flat sheets or in curved sheets as required, and is handled just like a piece of lumber. All that you have to do is to place it in its proper location and apply the covering of concrete, either in the form of plaster as in walls, or poured in, as in floors and roofs. The uses for **Hy-Rib** are therefore unlimited.

In any place where you could use lumber or masonry **Hy-Rib** will give better and more economical construction. In every structure that you erect on the farm there is a place where you could use **Hy-Rib** advantageously; in your farm-houses, barns, silos, root cellars, ice-houses, cisterns, vats, septic tanks, etc. You can use it in the outside walls, or the inner partitions, floors, roofs, ceilings, fences, enclosures, etc.

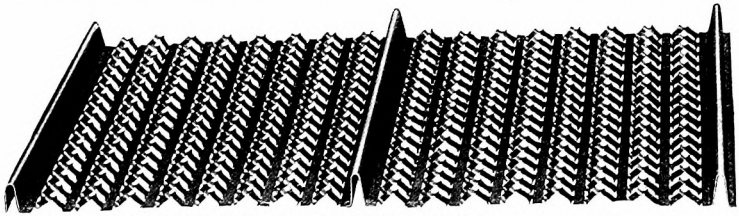
This method of construction was first applied to big city building work, where it has, in a short time, advanced to enormous proportions, and it is even better adapted to farm building work.

It is impossible for us to show all **Hy-Rib** will do, but the next few pages will explain its general application and if interested, we will gladly furnish you with all the details necessary to enable you to handle **Hy-Rib** readily and satisfactorily.

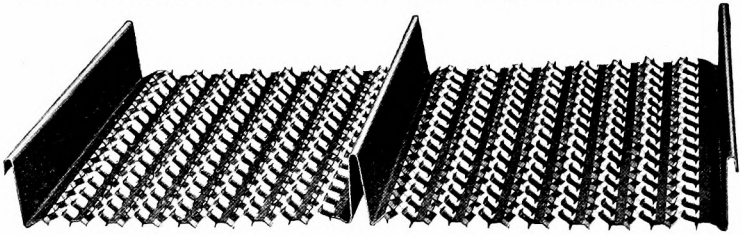
THE THREE TYPES OF HY-RIB



4-Rib Hy-Rib—Ribs 13/16 in. high; 3½ in. apart.
Width of Sheets: 10½ ins. center to center of outside ribs.
Furnished in three thicknesses of Steel—Gauge Nos. 24, 26, or 28.



3-Rib Hy-Rib—Ribs 13/16 in. high; 7 ins. apart.
Width of Sheets: 14 ins. center to center of outside ribs.
Furnished in three thicknesses of Steel—Gauge Nos. 24, 26, or 28.



Deep-Rib Hy-Rib—Ribs 1½ ins. high; 7 ins. apart.
Width of Sheets: 14 ins. center to center of outside ribs.
Furnished in three thicknesses of Steel—Gauge Nos. 22, 24, or 26.

Standard lengths of all types: 6, 8, 10, and 12 feet.
Intermediate and shorter lengths are cut without charge, but any waste is charged to the purchaser. It can also be cut on the job with a pair of tinner's shears. **Hy-Rib** sheets interlock at sides and ends. No allowance need be made for sidelaps, as these are provided in the **Hy-Rib.** Allow 2 inches for end laps where splice occurs over supports; otherwise, eight inches.

HY-RIB BENT TO CURVE

Our shops are equipped to bend **4-Rib Hy-Rib** to any desired arc of circle with radius varying from 13 inches to twenty feet. The shop bending gives absolute accuracy of curve and insures the sheets going together readily.

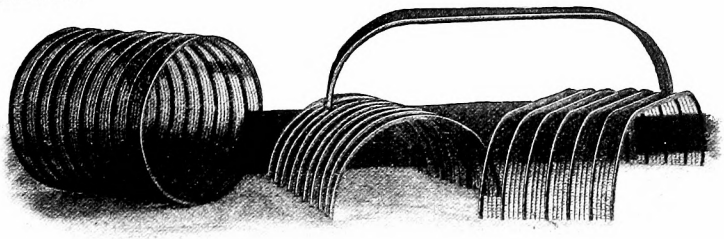
Curved Hy-Rib possesses all the advantages of straight sheets, but in a more marked degree. It is expensive to build forms for a round water tank or a circular arch for an underground cistern of any kind. Curved **Hy-Rib** does away with this necessity for forms and makes the finished product many times stronger and more durable.

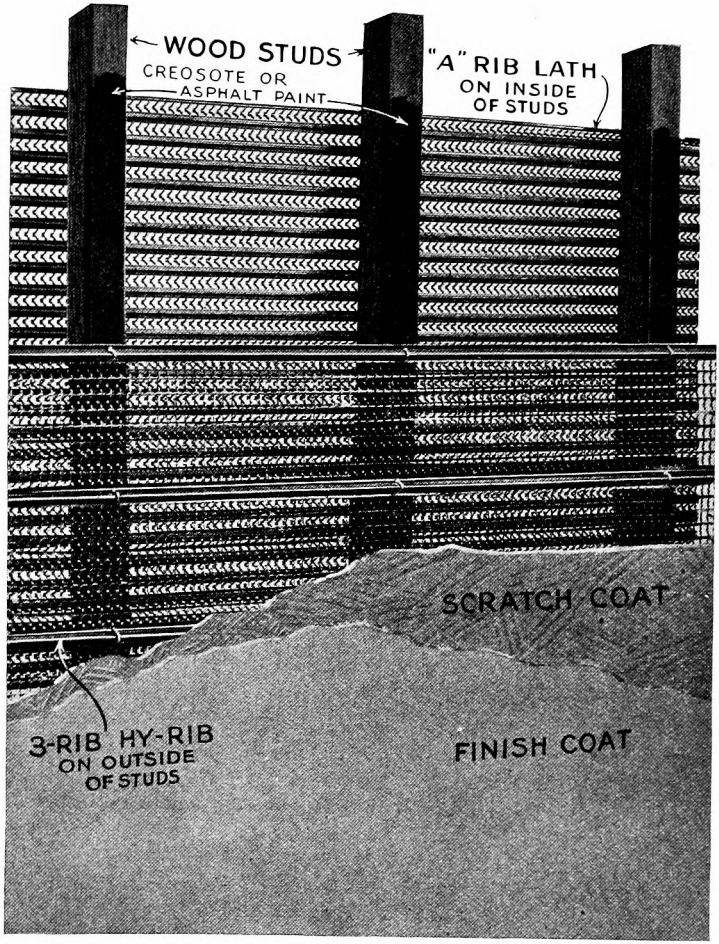
Hy-Rib is supplied with the following kinds of bending, enabling you, by connecting the sheets together, to build almost any form or size of tank.

1st. **Circular—any arc with radius between 13 inches and 20 feet,** and covering any portion of a circle less than three-quarters of the whole circumference.

2nd. **Central portion straight and both ends curved** to the same arc.

3rd. **One end of the sheet straight, the other end curved.**





Double wall of concrete built without forms. Hy-Rib on outside of wood studs and Rib Lath on inside.

Note: The **Hy-Rib** should be plastered on the inside between studs before applying **Rib Lath** to inside of studs.

Directions for Applying Hy-Rib to Walls

It is impossible to foresee all conditions under which **Hy-Rib** will be applied to exterior walls, so the following directions are for its use in general and the prospective user can adapt them to his particular problem, or write us stating the situation, and we will advise.

FOUNDATION.

Build foundation walls as for any frame building and fasten plate in usual manner except that, where possible the foundation should extend at least two inches outside of plate in order to make the finished wall and foundation flush, or foundation slightly extending as shown in details on page 14. For "over-coated" houses, where the siding already extends outside the wall, the bottom sheet can be bent underneath the siding and plastered flush with the wall.

Fasten plate to foundation wall, preferably with bolt imbedded while pouring wall (see page 14), or in any usual manner. Height and size of wall will of course depend upon structure being built, and the desire of the individual owners, but **Hy-Rib** construction will not demand any different design than that usually employed.

SETTING UP WOOD FRAME.

Build your wood frame much the same as for wood siding.

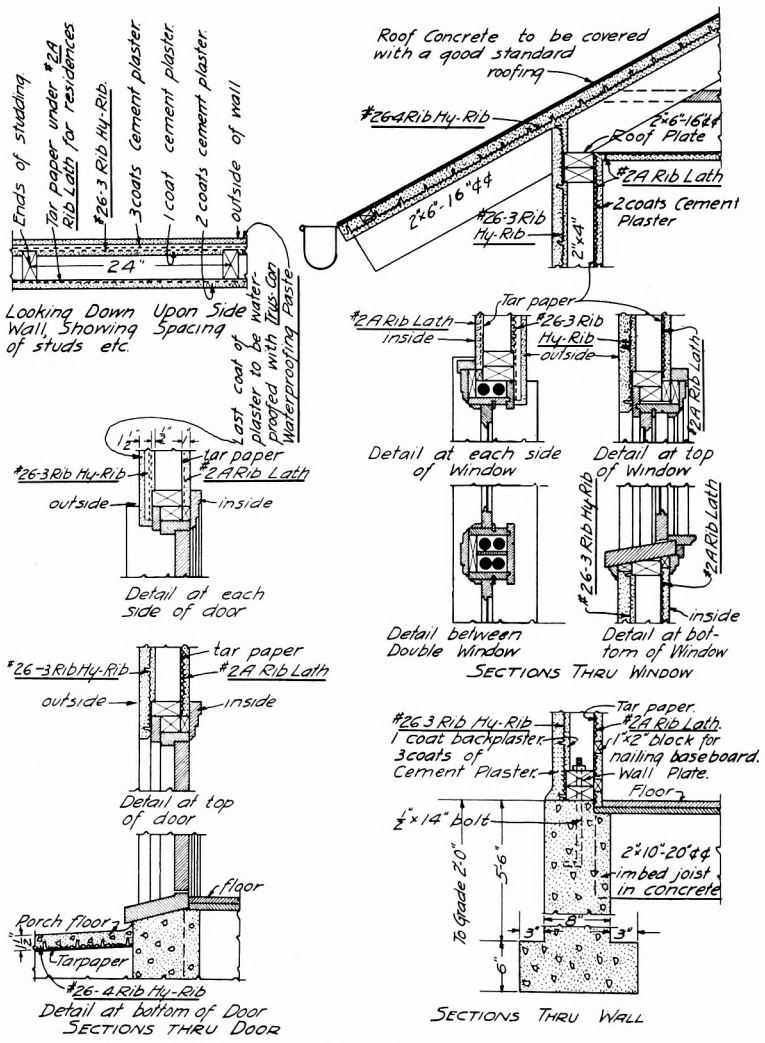
For One-Story Barns, Sheds, etc., with Single Wall.

Spacing of Supports	Thickness of Wall.	Reinforcement.
Less than 3 feet...	1¾ inches	No. 28, 3-rib **Hy-Rib**
3 feet to 6 feet....	1¾ inches	No. 26, 3-rib **Hy-Rib**

Space supports according to above table, or use 2x4's spaced according to general building practice from 16 to 24 inches apart in which case no special arrangements need be made for supporting roof.

If the studs are three feet apart in side walls a concrete roof on buildings not over sixteen feet in width can be supported with safety by using two 2x4's nailed together as top wall plate. The idea of studding is to support the **Hy-Rib** side walls and the roof, so apply your knowledge of the supports necessary to sustain ordinary roofs.

When a span greater than sixteen feet is desired, consult our engineers.



Details of Use of Hy-Rib in Walls, Roofs and Ceiling and Framing Around Doors and Windows.

For Any Ordinary Barn or House Two Stories in Height

Follow practically the same spacing of supports only in most cases it will be necessary to support roof entirely from the studding and, if roof is of concrete, the studding will have to be somewhat closer together.

For Barn or House With Double Wall.

When Rib Lath is used for inside walls the studding will have to be spaced according to tables on page 20.

Another thing to keep in mind is that the standard lengths of **Hy-Rib** are 6, 8, 10 and 12 feet. Of course these sheets can be cut with a pair of tinner's shears or will be cut to any desired length by us, but studs can be arranged so as to save both time and material if these conditions are kept in mind.

ATTACHING SHEETS OF HY-RIB.

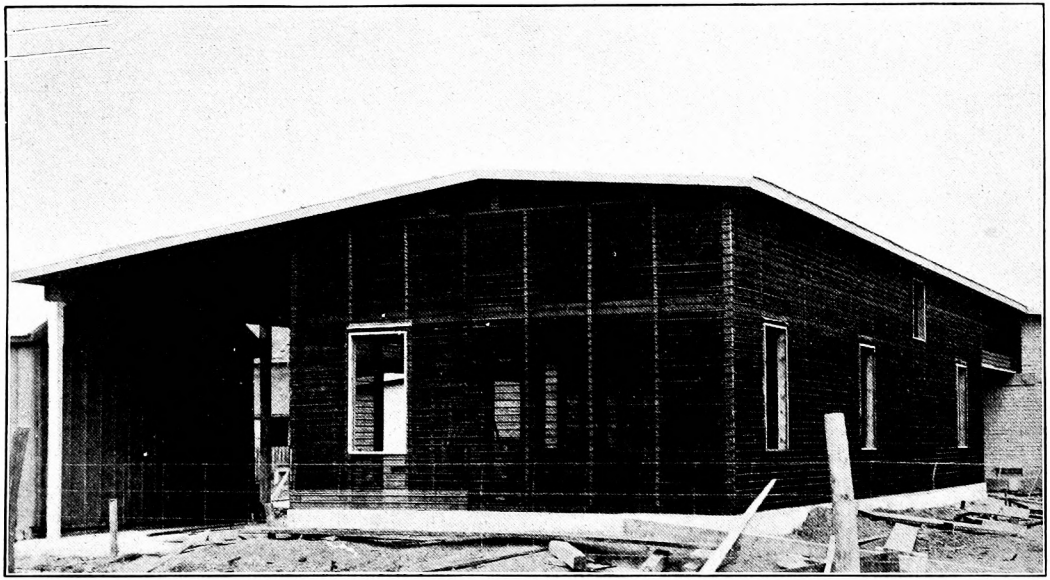
Whether for single or double wall, the outside construction is the same, and in double wall construction the coat between studs is put on before lath is placed inside.

First paint face of studding with creosote or asphalt paint, very inexpensive, to prevent stud from absorbing water from the concrete.

After rough framing is completed, commence attaching sheets of **Hy-Rib** with rib side out, nailing them to supports with ordinary two-inch staples or nails at every rib. Interlock all **Hy-Rib** sheets at sides and ends and wire or clamp sheets together every 24″ along the sides and at every rib at the ends. Allow 2 inches for end laps when splice occurs over supports; otherwise, 8 inches.

Bring ends flush at corners. At window and door openings you will, of course, have two pieces of 2x4's, nailed together, so bring the sheets to within about an inch and a half of the inside edge and nail on a square strip clear round the opening on both sides to nail the inside and outside moulding to. (See details on page 14.) Proceed, in like manner, over whole exterior, remembering that this is practically your outside sheathing to be coated with concrete.

The detail of window and door jamb, page 14, is not the only design possible, but is one method and other suitable details may be adopted.



Creamery for Walker Bros.' Farm, Walkerville, Ont.

(See illustration of dairy barn on page 24.)

Showing the general framing necessary for this type of construction, with **Hy-Rib** ready for plastering. Note that the studs are about three feet apart, to which **Hy-Rib** is fastened by a two-inch staple over each rib. Note also that the **Hy-Rib** is applied with ribs running horizontally, the proper way to apply **Hy-Rib** whenever possible.

PLASTERING.

Prepare plaster according to directions given on page 52.

Use a wood or steel trowel and apply first coat to rib side, using only enough pressure to force plaster well into the meshes, too much pressure will cause a waste on the back side which can be avoided. Aim to bring first coat only to depth of rib. The less troweling done the better. As soon as this first coat is applied scratch it over with anything that will roughen the surface and help make a bond for the next coat. (A piece of **Hy-Rib** is good for this purpose.) Let this coat set for six hours or long enough to give it enough rigidity to hold up the next coat. The time of setting will depend to a great extent upon the weather conditions, etc. Next apply another coat to the outside, and one to the inside between the studs or vice versa. For a full two-inch wall a third coat will in most cases be necessary, as the three generally give but 1¾″. The last coat outside can be given any finish desired, but it must be waterproofed with TRUS-CON WATERPROOFING PASTE in order to make it dampproof. (Directions for waterproofing on page 54.

Whenever it is desired to apply more coats the surface of last coat should be well scratched. Do not be afraid of plaster falling off, for if you have a good grade of plastering sand and have the proper consistency it will stick like glue.

When it comes to applying the outside finish coat, plan to cover an entire surface at one time if possible, in order to overcome any distinct unsightly marks of division between applications. A good smooth, evenly troweled surface is very attractive, especially where a good clean grade of sand has been used. For those desiring to color differently we manufacture what is known as TRUS-CON STONE-TEX, a hard surface coating for concrete that becomes a

Hy-Rib Roofs for Stables, City Waterworks, Detroit, Mich.
Smith, Hinchman & Grylls, Architects.

part of the concrete. It is applied with a brush much the same as paint to the dried surface. It comes in colors ranging from white to red brick. If you already have an old concrete or brick surface that you would like to re-color, send for card showing colors and describing STONE-TEX.

INTERIOR WALLS.

For the interior wall apply the lath in same manner as you did the **Hy-Rib,** and plaster inside. Apply two scratch or rough coats and one finish coat. This gives an extremely hard, durable wall. The interior walls can be given an attractive, washable, sanitary finish in several tints by using TRUS-CON ASEPTICOTE.

ROOFS.

FRAMING THE ROOF—Put up the roofing joists in much the same manner as though roofing boards were to be applied except that it will be necessary to use somewhat heavier rafters. A two by six or eight will carry on most spans. Study the details of designs which we will send you, or consult our engineers for advice in constructing large roofs.

After the joists are in place fasten on the sheets of **Hy-Rib** with rig side up in the same manner as for side walls. Follow same directions as to splicing or lapping at ends and sides. Run sheets around over the ends of joists and back under eaves until they join on to side wall. Otherwise ends of joists may be left exposed if preferred.

CONCRETING ROOFS.

Apply the mixture described under "Mixtures for roofs and floors (page 53) to the top of sheets, as shown on page 44, to a thickness of one and one-half inch. Plaster around end of rafters and underneath whole roof with plaster as used in side walls. This gives you a perfect concrete roof.

The concrete surface should be swept clean and a roofing applied in accordance with the manufacturers' standard specifications. This is important so as to prevent roof from leaking.

FLOORS.

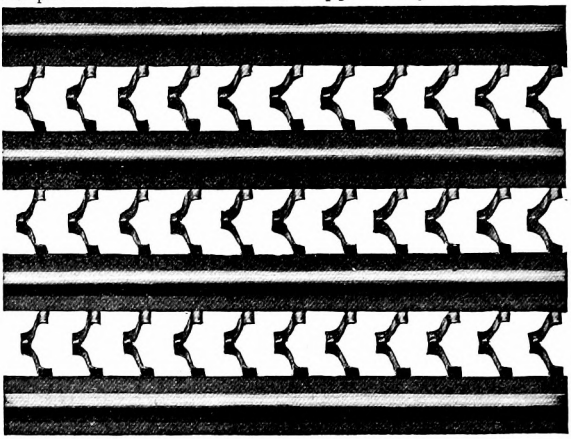
Floors are treated similarly to roofs except that you are liable to have varying weights to carry, and very heavy ones may require special designs.

More complete directions will be found on our special plans.

Write us about anything you do not understand.

RIB LATH AND RIB STUDS

Rib Lath is similar to **Hy-Rib,** except that it is lighter, does not have the deep stiffening rib, and is used principally for interior work on walls and ceilings. **Rib Studs** are steel studding used in walls and partitions which do not support any loads.



BEADED PLATE or "A" RIB LATH

Size of Sheets—15¼ x 96 inches.
Shipped in bundles containing 16 sheets, or 18 yards.

Grade	Weight per square yard	Maximum stud spacing for walls (center to center)	Maximum joist spacing for ceilings (center to center)
Rib Lath No. 1A	3.63 lbs.	18 inches	16 inches
Rib Lath No. 2A	4.54 lbs.	20 inches	18 inches
Rib Lath No. 4A	5.45 lbs.	24 inches	22 inches

STANDARD RIB LATH

Similar to Beaded Plate Rib Lath, but with narrower ribs.
Size of Sheets—20¼ x 96 inches.
Shipped in bundles containing 12 sheets, or 18 yards.

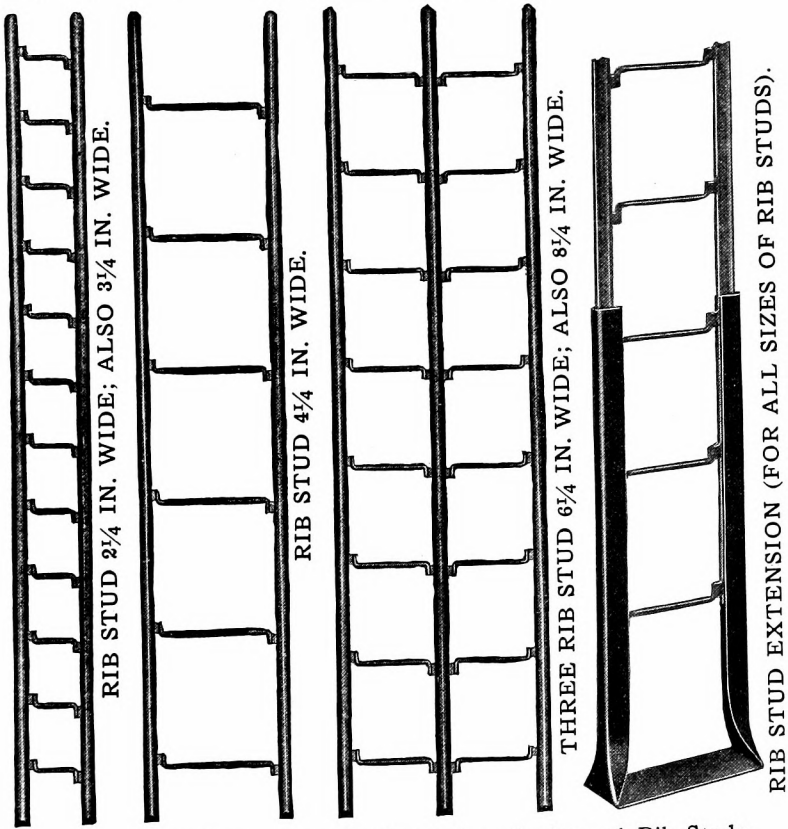
Grade	Weight per square yard	Maximum stud spacing for walls (center to center)	Maximum joist spacing for ceilings (center to center)
Rib Lath No. 1	2.74 lbs.	14 inches	12 inches
Rib Lath No. 2	3.42 lbs.	16 inches	14 inches
Rib Lath No. 4	4.10 lbs.	18 inches	16 inches

We recommend the use of painted lath, but can supply it without paint if desired.

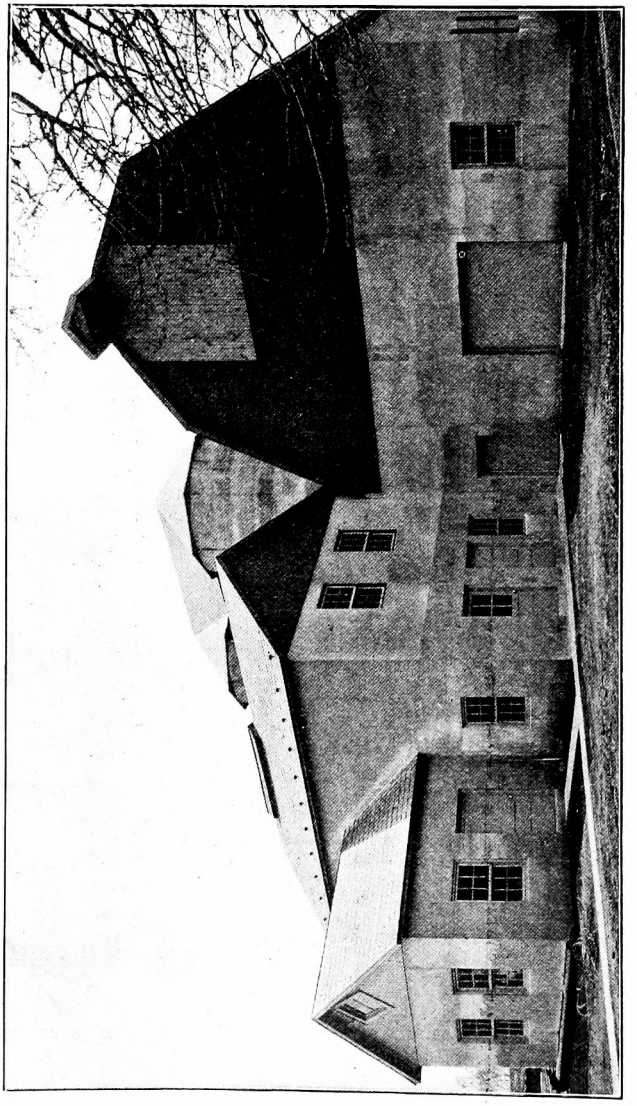
RIB STUDS

Rib Studs—made of the highest grade of open-hearth steel—are open for the passage of conduits and pipes, and provide an uninterrupted air space between the two plaster surfaces. The open mesh simplifies the wiring of lath.

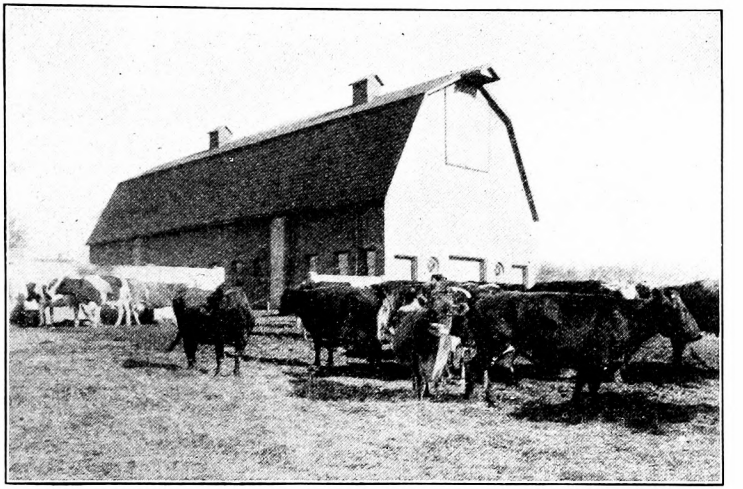
Rib Studs are made in five widths (2¼" to 8¼") and in any length up to 18 feet. (See standard stock sizes below.)



Rib Stud Extensions, furnished for all sizes of **Rib Studs,** provide an adjustable attachment at floors and ceilings, taking care of all inequalities and saving time and money in erection. They fit over the ends of the **Rib Studs** and are clamped tight with pincers or hammer.



Modern Durable Sanitary Concrete Barns.



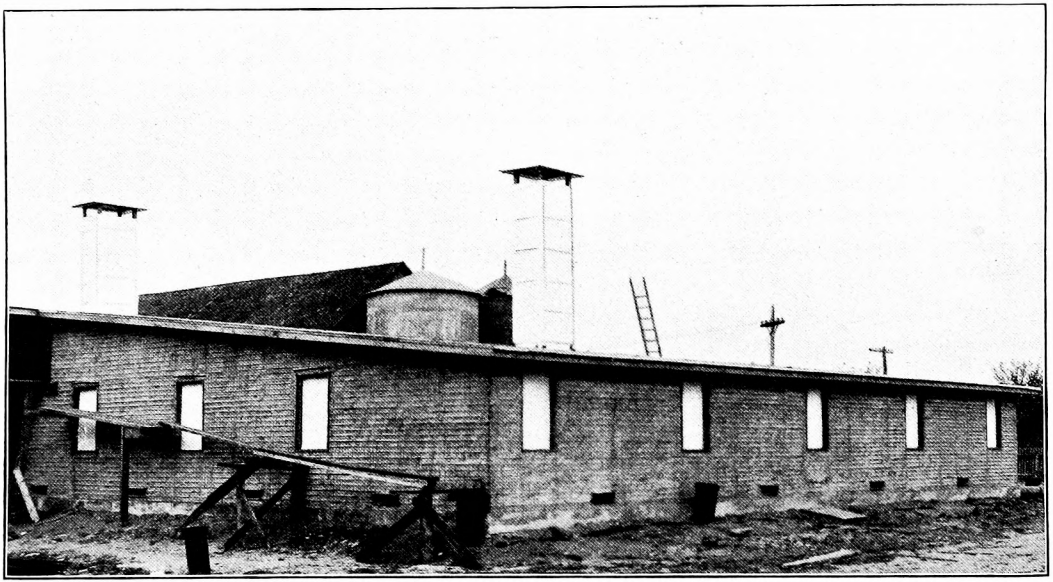
CONCRETE BARNS

Good, sanitary barns are a real economy. They provide a dry, well ventilated and uniform temperature shelter, insuring the greatest productiveness and vitality of all classes of stock. Poorly built barns are very expensive because of their dampness, lack of ventilation and constant necessity for repairs. With the improved **Hy-Rib Concrete** designs of barns, such barns can be built very inexpensively and besides giving the best possible protection to the stock, are fireproof, and no repairs are necessary. We can treat the walls so that they become damp-proof and wear resisting. Any design of barn can be readily adapted to our system of construction since the materials are handled very much like lumber.

The walls are built according to general directions for single and double walls; the roof as for general roof construction.

It is impossible for us to show many plans, but the general idea can be grasped and then applied to any particular building.

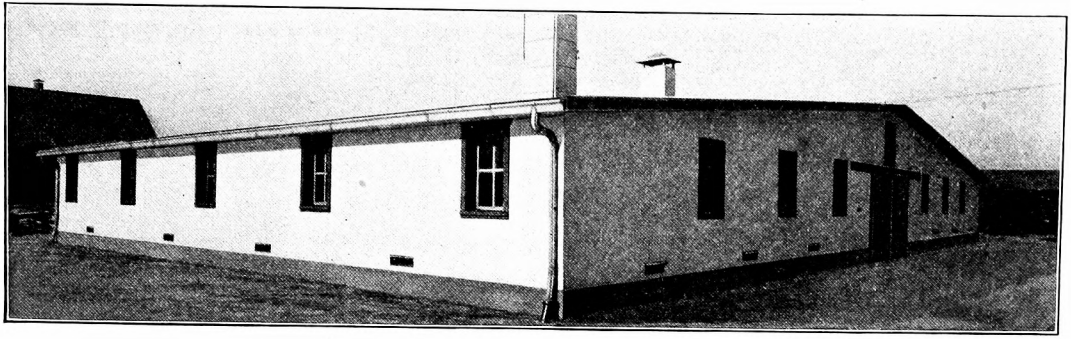
We have plans for many types of barns, and will send these if you tell us just what you are interested in.

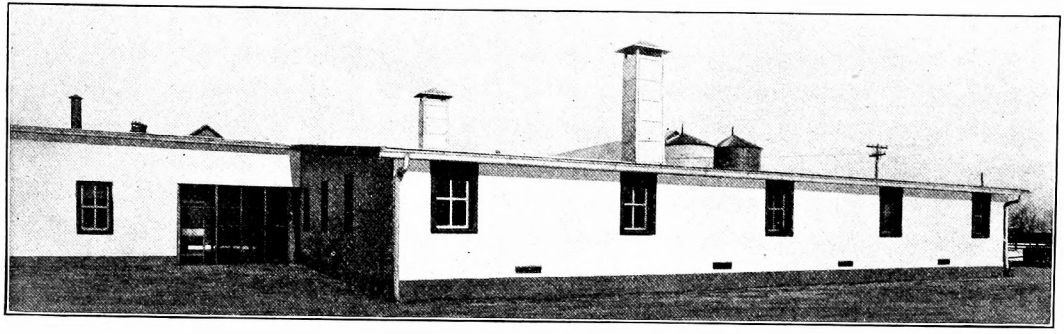


Dairy Barn, Walker Bros.' Farm, Walkerville, Ont.

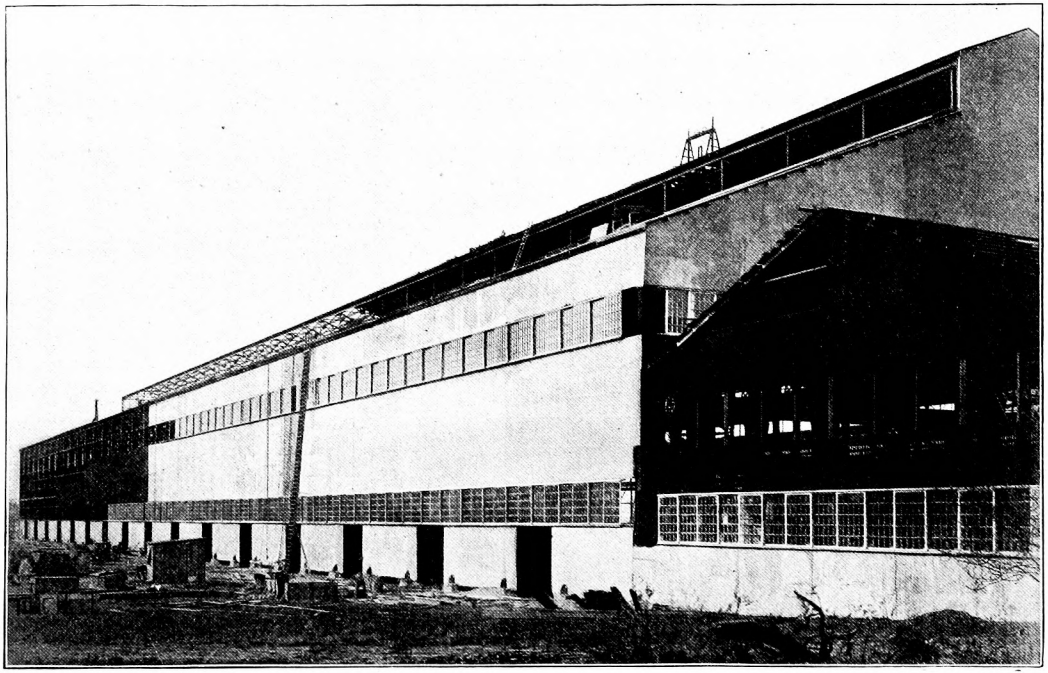
(See Creamery Building on page 16.)

One coat of concrete has been applied to the **Hy-Rib,** and outline of ribs can be distinguished through the concrete, the proper thickness of first coat. Each coat except last or finish coat should be well roughened by scratching while wet. This barn houses 120 cows. It is not an ideal type of barn, being too low.



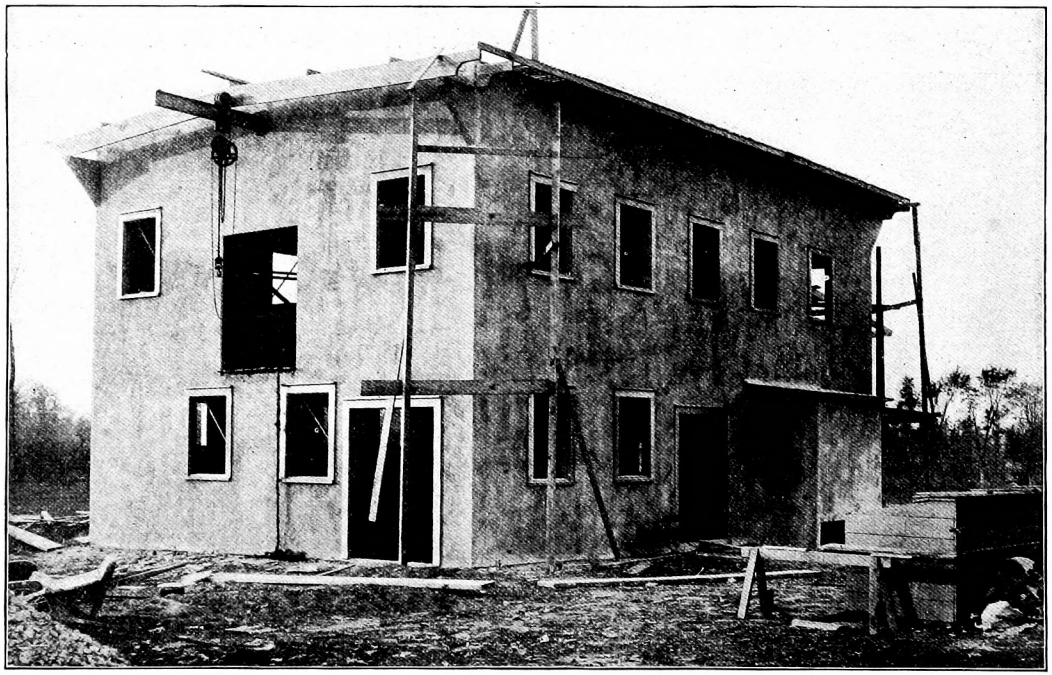


Dairy and Creamery Buildings, Walker Bros.' Farm, Walkerville, Ont.
Showing buildings after finish coat had been applied to **Hy-Rib.**

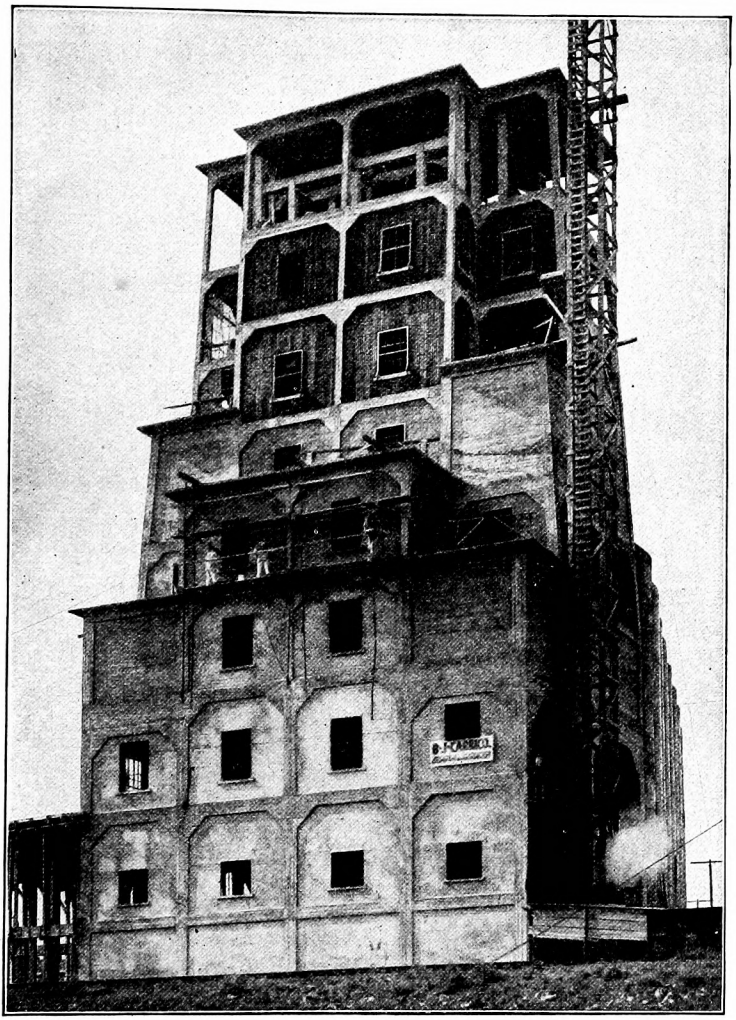


Hy-Rib Siding for Large Steel Plant, near Chicago, Ill. Julian Kennedy, Pittsburg, Engineer.

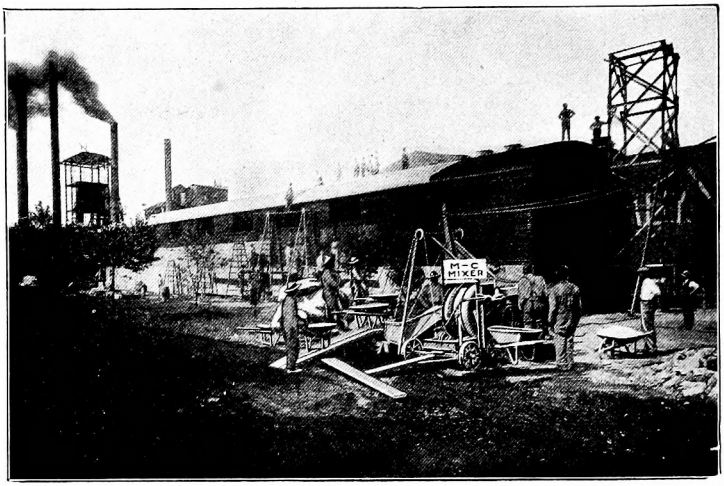
Hy-Rib Roofs and Sidings for the Ford Motor Co. Plant, Detroit, Mich. A. Kahn, Architect.



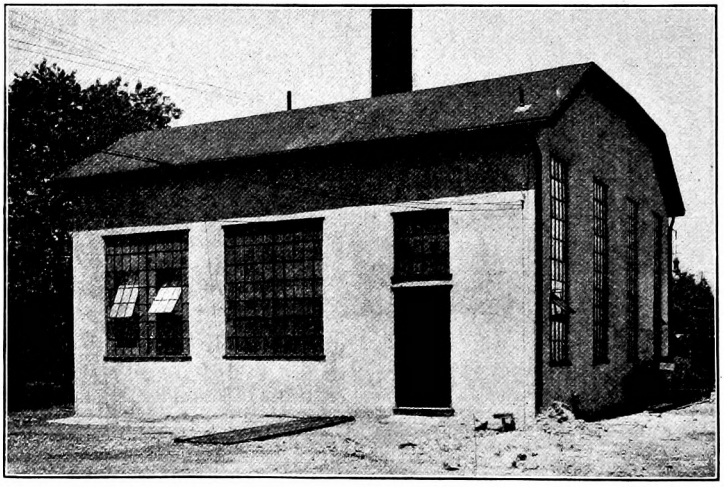
Hy-Rib Walls and Roof, Fuller Combing Gin Co., Rossville, Ga.
Note method of arranging door and window openings in **Hy-Rib** concrete sidings.



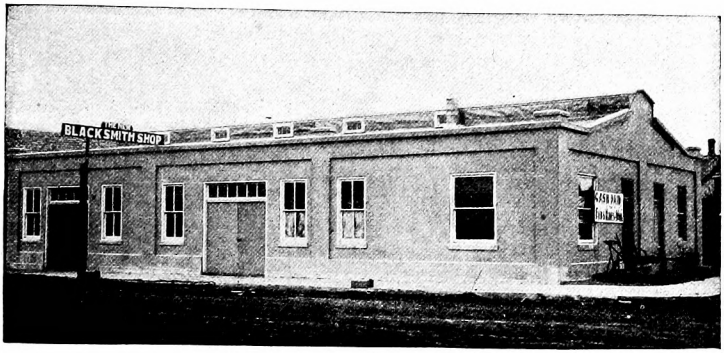
Smith Bros. Grain & Elevator Co., Ft. Worth, Texas.
All beams and supports are of Kahn System reinforced concrete. Sidings and roofs are concrete, reinforced with **Hy-Rib.** The unfinished panels at the top show the **Hy-Rib** in place ready for plastering. The windows are **United Steel Sash.**



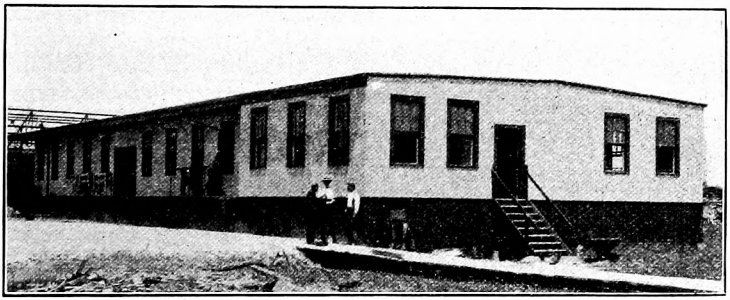
Glenmore Distillery, Owensboro, Ky.
Arched **Hy-Rib** roof and sidings shown in all stages of construction.



Hy-Rib Building at Hudson Motor Car Co. Plant, Detroit, Mich.

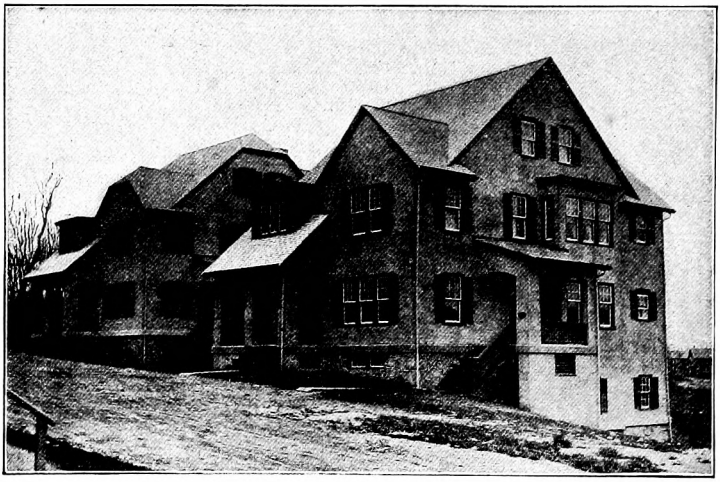


Shop for Lars Backe, Thief River Falls, Minn.

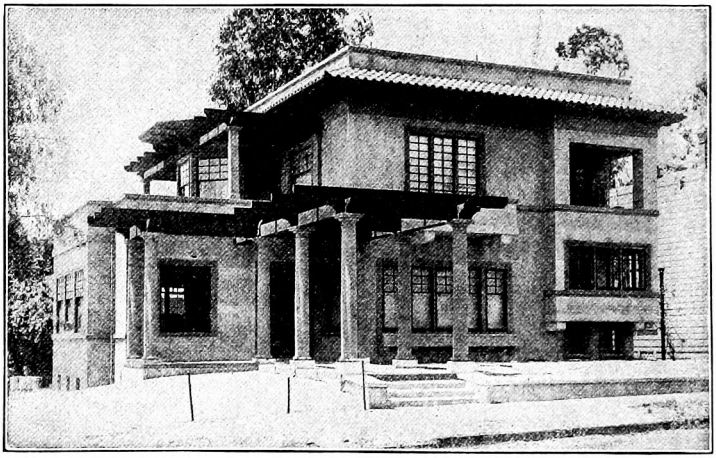


Carpenter Shop, Hudson Motor Car Co., Detroit, Mich.
Hy-Rib Roofs and Sidings.

The photographs on these two pages represent a blacksmith shop, distillery, power house, and carpenter shop respectively. They are excellent structures, giving the very best of satisfaction, and show the wide field for this method of building of concrete without forms. The buildings are attractive and efficient. Note particularly the arched **Hy-Rib** roof and side walls of the Glenmore Distillery.



Hy-Rib Residence of W. Rosberry, Roslindale, Mass.



Residence for Miss Alice Henck, Santa Barbara, Cal.
Thomas Nixon, Architect.

Any finish desired may be given the last coat of plaster. The plain natural concrete color is very pleasing, and after being waterproofed is unexcelled in durability.

RESIDENCES, GARAGES AND SMALL BUILDINGS

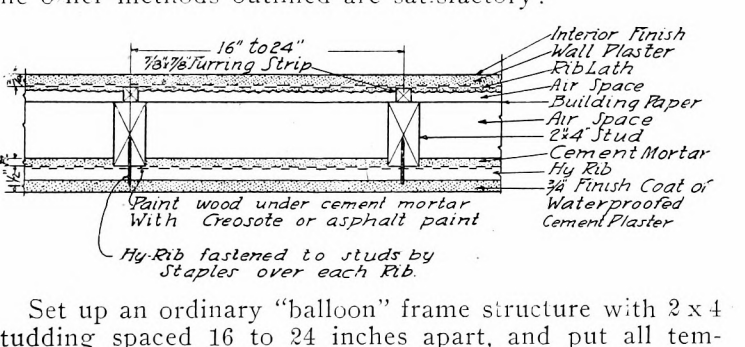
(*See also Special Folder on Hy-Rib Garages, sent on request*)

The building of concrete residences and smaller buildings has long been popular, owing to their permanence, fireproofness, and unusual possibilities for artistic treatment. The cost has been the one item which has hindered a more universal adoption of this type of building.

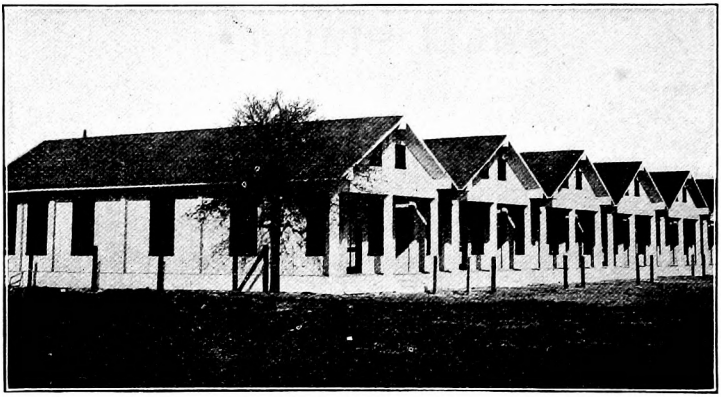
The cost of lumber, field labor, and special contrivances necessary to carry on the ordinary type of concrete construction, makes such work expensive in small buildings. **Hy-Rib** does away entirely with all this centering and special work, greatly reducing the cost.

For small buildings such as garages, sheds, barns, etc., a single thickness wall of **Hy-Rib** plastered with cement is ample. To carry the floor and roof loads provide occasional posts built up of steel members, wooden scantling, or reinforced concrete. **Hy-Rib** is attached rigidly to the posts by means of **Hy-Rib** clips, wires, or staples.

For dwelling houses an air space should be provided in the outside wall. The following method for constructing stucco walls, will give by far the best results, although the other methods outlined are satisfactory:



Set up an ordinary "balloon" frame structure with 2 x 4 studding spaced 16 to 24 inches apart, and put all temporary bracing on the inside. Fasten **Hy-Rib** to outside of studs with 2½-inch staples over each rib. Use 3-Rib Hy-Rib with ribs extending horizontally and lath surface



Workingmen's Cottages of **Hy-Rib,** Tampa, Florida.

Hy-Rib Residences, Detroit, Mich.
During Construction.

against studs. Interlock **Hy-Rib** sheets at side and ends, securely wiring or clinching them every 24 inches along sides and at every rib at ends. Paint the studs with creosote or asphalt paint along the entire outer face, and at least an inch back on the sides. Plaster this **Hy-Rib** on the outside with cement mortar (mixed and applied as directed on page 52) to a thickness of 1½ inches and give it any finish desired. The last ¾" of plaster finish should be waterproofed with Trus-Con Waterproofing Paste. Then back plaster the **Hy-Rib** with similar mortar to a thickness of about half an inch.

This construction insures absolute protection for the steel, and when the mortar has set you have a 2-inch reinforced concrete slab, solid as rock, and much stronger and more rigid than the ordinary matched sheathing of which it has taken the place.

On the inside of the studding tack thin asbestos board or a very heavy tarred paper, then ⅞-inch furring strips, and heavy Rib-Lath on which plaster ⅝-inch of cement mortar or good plaster, and the regular finish coat.

In this way you have secured a house which possesses the following advantages:

1. Practically fireproof, due to the heat-resisting qualities of the 2-inch reinforced concrete slab on outside.

2. Absolutely waterproof and damp-proof.

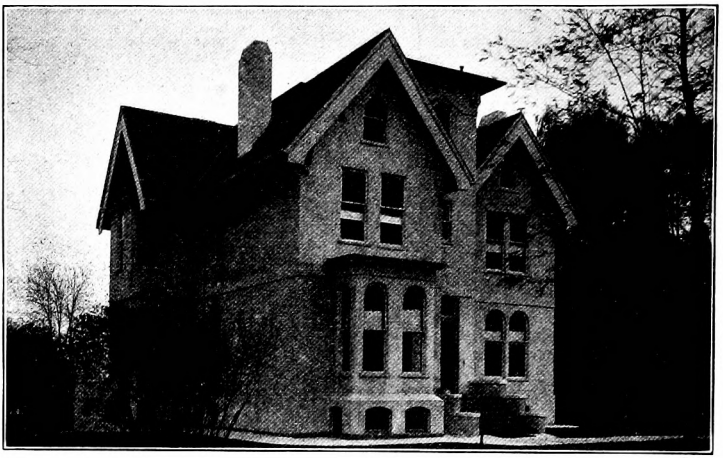
3. Easy to heat in winter and keep cool in summer, owing to the double air space in the wall.

4. Practically indestructible owing to the permanence of the reinforced concrete wall.

5. No expense for maintenance, such as painting, repairs, etc.

6. Unusual architectural beauty because of the artistic effects that can be secured with stucco.

7. Low first cost.



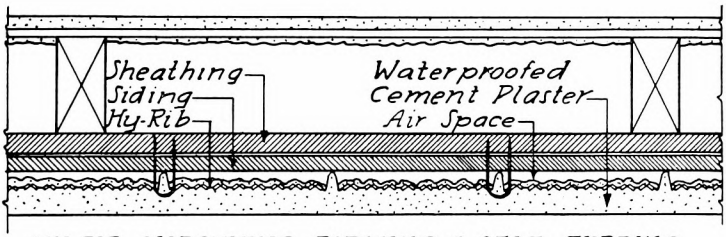
Overcoated Residence of C. Bewick, Detroit, Mich.
Cement Stucco used over old wooden house.

Old Wooden House Transformed Into Modern Permanent Residence by "Overcoating."
Cyrus E. Lothrop, Grosse Pointe, Mich., Owner.
Burrowes & Wells, Architects.

The **use** of **Hy-Rib on Exteriors** outlined on preceding pages, gives a wall of almost unlimited strength and rigidity, and is suitable for large buildings. For small cottages and for structures in which the total wind pressure will not be great, some saving may be effected by using HEAVY BEADED PLATE RIB-LATH in place of **Hy-Rib,** on the outside, plastering it in the same manner on both sides to a total thickness of 1¼ inches or more. In this stucco construction it must be borne in mind that the only way to insure permanence is to have a real reinforced concrete slab on the outside.

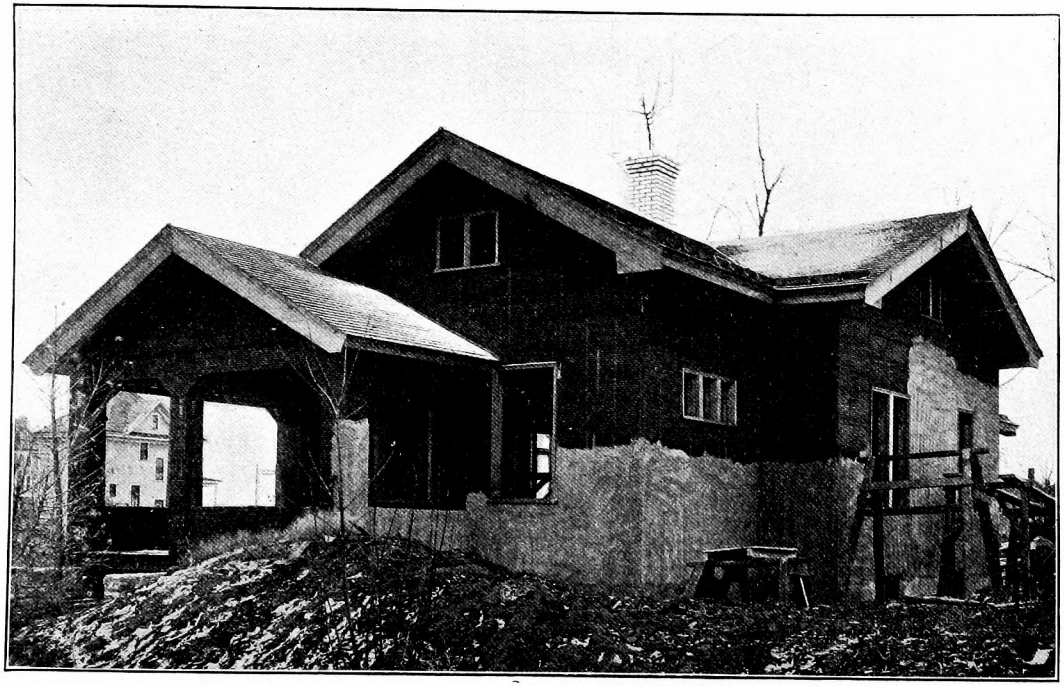
Tell us about the house you intend building, and we will send various plans.

"OVER-COATED" HOUSES

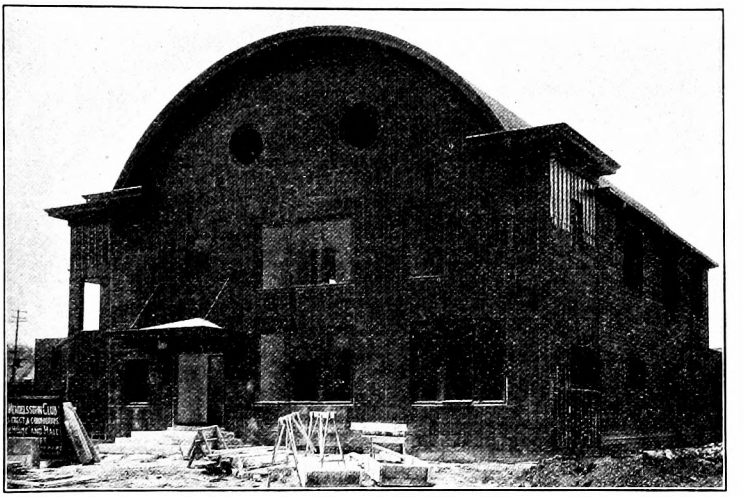


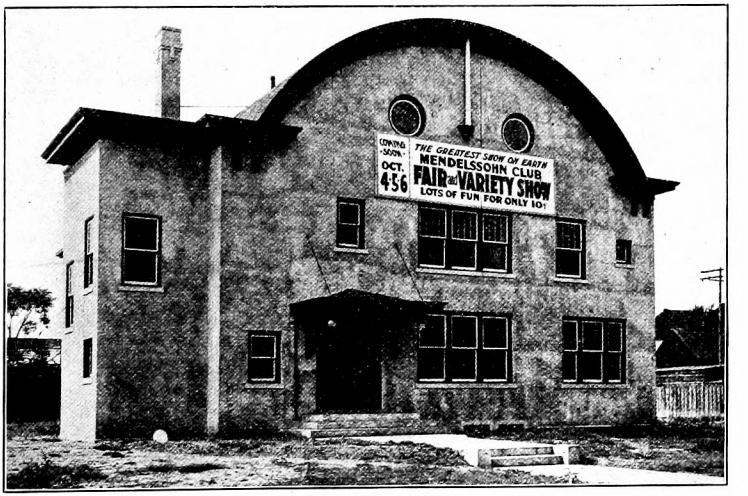
HY-RIB SHEATHING FORMING A SELF FURRING LATH ON WOOD SIDING

An old, wood-frame house can be readily transformed at nominal expense into a modern concrete building by the use of **Hy-Rib.** The **Hy-Rib** is placed against the wood clapboards with the ribs extending horizontally and the lath surface outward. The **Hy-Rib** sheets are interlocked at sides and ends, and securely stapled or nailed to the wood sheathing at least every 24 inches in both directions. Plaster the **Hy-Rib** with cement mortar mixed and applied as directed on page 52, to a thickness of one inch. The outside ¾" finish plaster should be waterproofed with Trus-Con Waterproofing Paste. The transformation made in a house in this way is very wonderful, enhancing the value and the life of the property, and protecting it against fire.

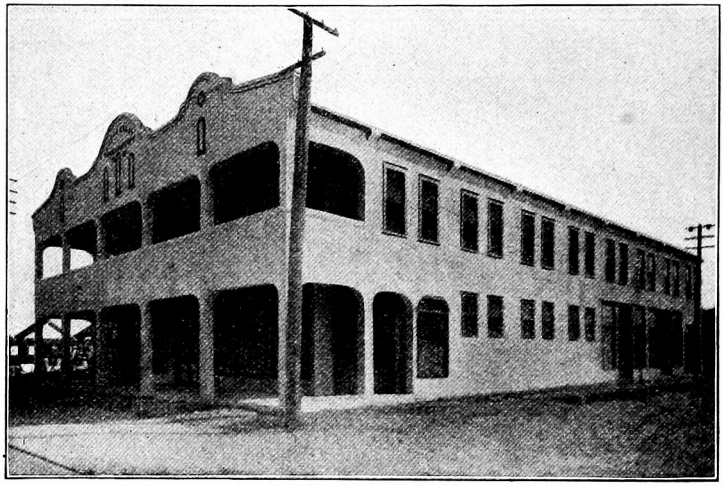


Residence of H. A. Ertz, St. Paul, Minn.
View during construction, showing Concrete Stucco for outside wall.

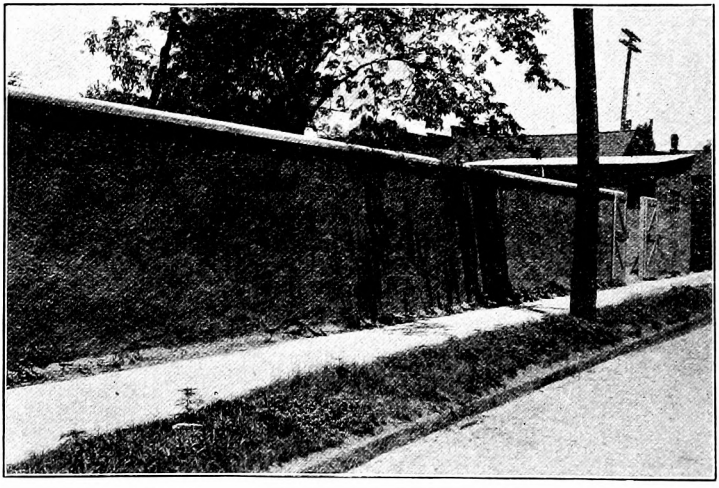




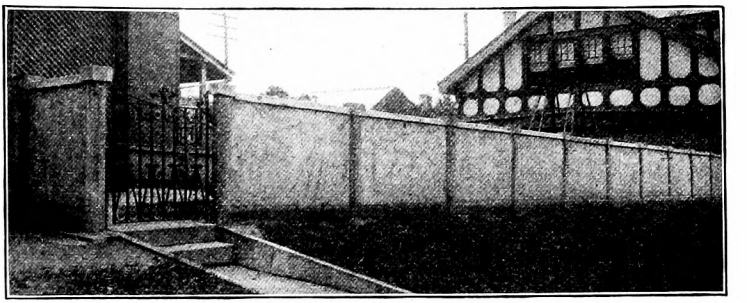
Mendelssohn Club, Detroit, Mich.
Cement Siding before and after plastering.



Hy-Rib Walls, Hotel for Sanchez & Haya Real Estate Co., Tampa, Fla.



Hy-Rib Fence—Ernest G. Swift, Detroit, Mich.
Note **Hy-Rib** Garage at Right.



Hy-Rib Fence for Van Perrine Residence, Fort Wayne, Ind.
Chas. R. Weatherhogg, Architect.
Hy-Rib Spans Horizontally between Reinforced Concrete Posts.

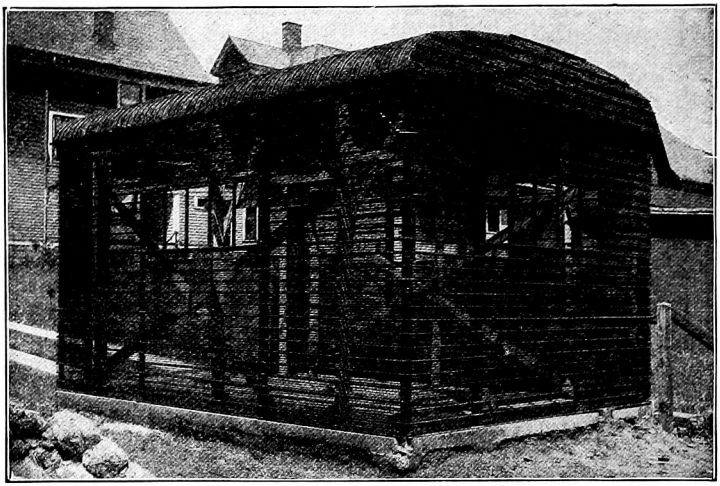
HY-RIB CONCRETE FENCES

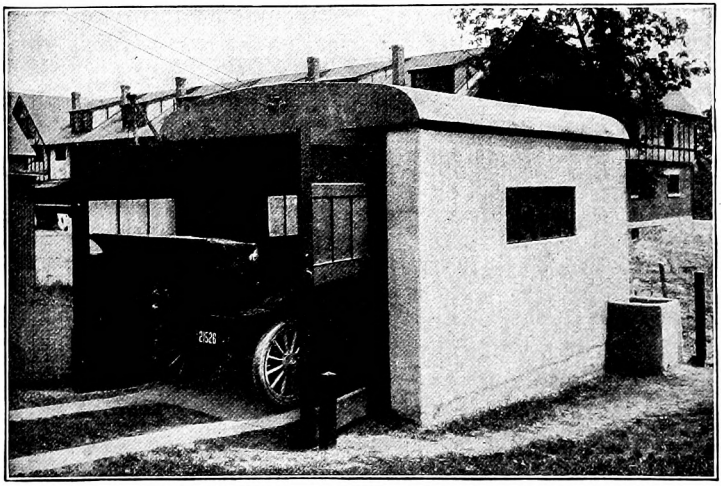
Solid concrete fences are useful on the farm to serve as wind-breaks, and also as ornamental enclosures around farm houses, etc. Their construction with **Hy-Rib** is very simple, as no centering or false-work is necessary. **Hy-Rib** fences can be built to any height desired, and are of two types; one with the entire walls solid, and the other a fence consisting of a series of concrete rails.

The former fence consists of 8 x 8 inch concrete posts, which are usually cast on the ground and set in place with panels between them. The posts are provided with narrow slots into which the **Hy-Rib** is inserted. The posts are ordinarily set so as to accommodate sheets of **Hy-Rib** from 6 to 12 feet in length. For the solid fence the **Hy-Rib** is all set in place and plastered with cement mortar on both sides to the required thickness. The fence with openings between the concrete boards is built similarly, except that the **Hy-Rib** sheets are separated the required number of inches apart.

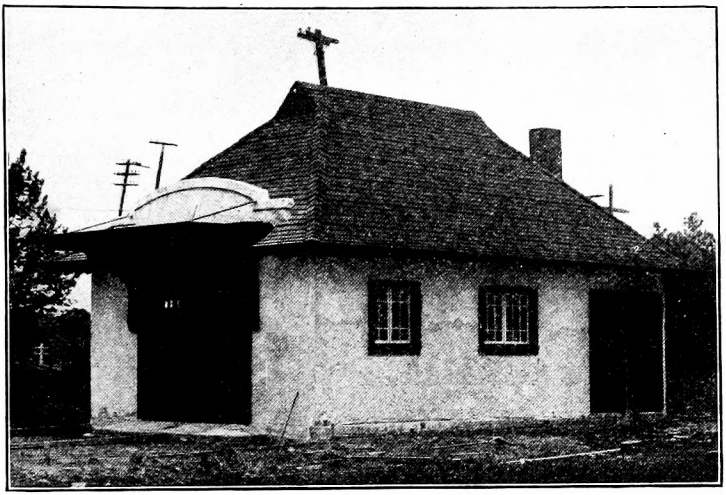
The top of the fence may be finished with a rail and cap, either built in place or cast previously, or the top of the fence may be left perfectly plain.

Write for details of fences.





Hy-Rib Garage for T. H. Kane, Youngstown, O.
Ready for Plastering and Completed.
Write for **Hy-Rib** Garage Folder, containing complete details and specifications.



Hy-Rib Garage for W. E. Parker, Grosse Pointe, Mich.
C. Howard Crane, Architect.

HY-RIB CONCRETE GARAGES

The **Hy-Rib** garage is one that should appeal to anyone desiring a fireproof neat building. The examples here shown are of steel frame work. Wood studding and joists may be used, slightly reducing the cost. We have standard drawings for the ones shown here, but will make drawings for any particular design desired.

The construction is the same as for any siding and roof, and so general directions for building sidings and roofs will apply. Each individual case will, of course, call for a little different method, but no more so than if lumber was used throughout.

Any type, design or size of garage can be economically built with **Hy-Rib** construction.

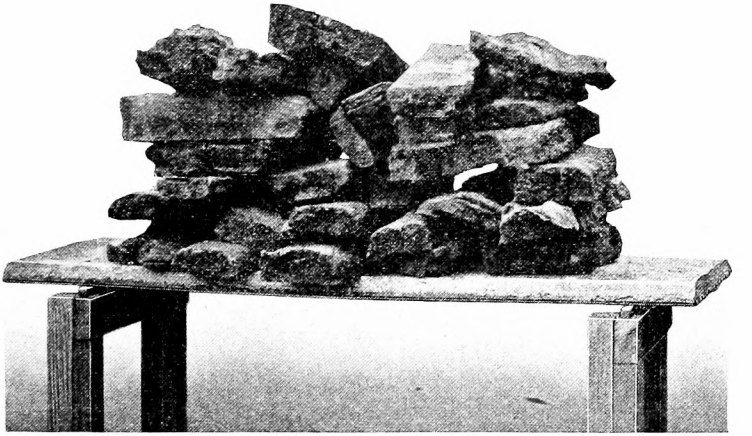
We will gladly make detail drawings of any special garage for which **Hy-Rib** is ordered.

We have distributing centers for **Hy-Rib** in nearly every section of the country or can ship promptly from our Youngstown shops.

Hy-Rib Roof for Packard Motor Car Co., Detroit, Mich. Albert Kahn, Architect.

This cut represents the general method of building **Hy-Rib** roofs. The sheets are laid on the wood or steel rafters in the same manner as are roofing boards, 7/32-inch round rods are placed two feet apart at right angles to the ribs to prevent cracks, and the cement is poured on to a thickness of one and one-half inches. The roof is then plastered underneath. In this way a comparatively thin, light roof is obtained, absolutely fireproof and permanent. Floors are constructed in the same manner. The **Hy-Rib** sheets are laid with rib side up.

Write us about your proposed roof or floor, and we will advise as to weight of supports and spacing necessary to give safety at least expense.



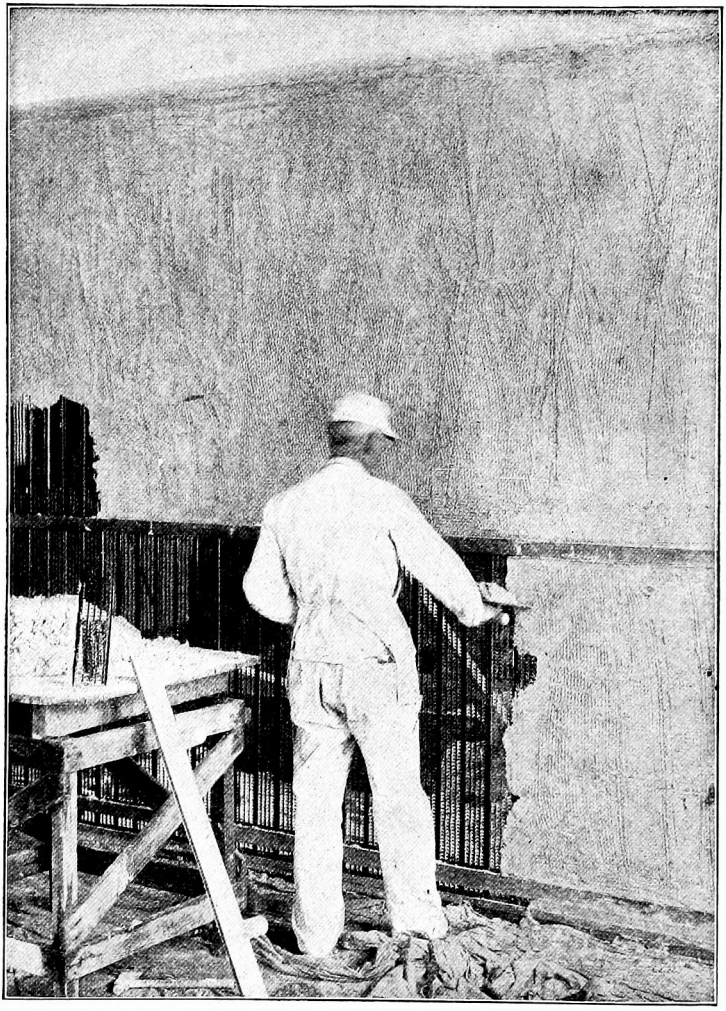
TESTS

A series of tests on concrete slabs reinforced with **Hy-Rib** were conducted at the yards of the Michigan Bolt & Nut Works by the Michigan Technical Laboratory at Detroit. These tests showed unexpected strength—more than we recommend in our tables.

The test slabs were built during cold weather, and were subjected to test loads within 21 to 28 days afterward. Test blocks of concrete, mixed at the same time, showed that the concrete had not nearly developed its full compressive strength; otherwise, even greater carrying capacities would undoubtedly have been secured. Pig iron was used on test.

Above slab is 2 inches thick, reinforced with 28 gauge **Hy-Rib,** spanning 4 feet and carrying a load 4,311 pounds equal to 613 pounds per sq. ft. of slab.

This amount of concrete without its reinforcing of **Hy-Rib** would bear practically no weight. A wall constructed in this manner is thus made extremely strong and capable of resisting very heavy pressures. Consider what this means to you in your silo, tank or other building work.



Hy-Rib Partition, Trussed Concrete Building, Detroit, Mich.
Note grounds for base-board and chair-rail.

PARTITIONS

For solid partitions built either with cement, lime, or patent plaster, **Hy-Rib** is especially suitable as reinforcement. The ribs of the **Hy-Rib** take the place of the studs which are otherwise necessary, and **do away entirely with the expense and labor of attaching sheets of lath to studs.** Owing to the fact that the lath and ribs are a complete unit, made from a single sheet of steel, such partitions have extraordinary rigidity.

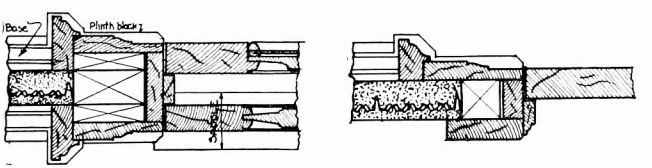
All that is necessary is to set up the sheets of **Hy-Rib** —plaster both sides—and the partition is complete. No centering or studs are necessary. Thin partitions of great strength and rigidity are rapidly constructed in this way.

Hy-Rib presents a flat surface to work against, assuring ease and speed in plastering, and requiring a minimum amount of material.

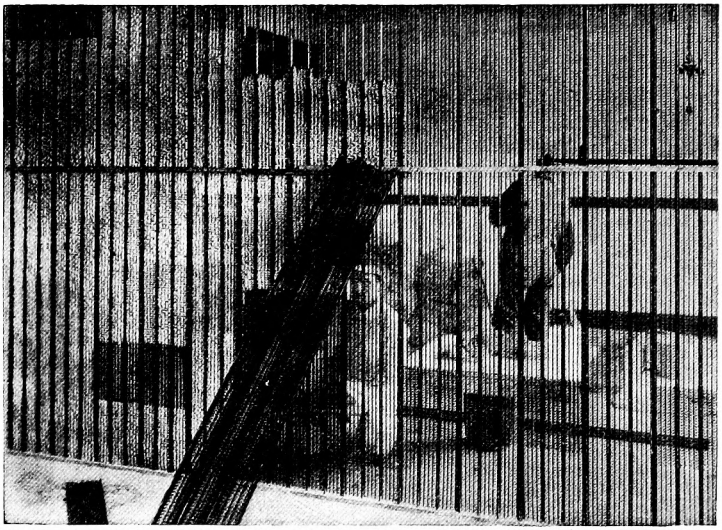
There are several methods of fastening the **Hy-Rib** sheets at the top and bottom, but we furnish light tongue angles for that purpose. Support sheets temporarily, while plaster is applied to rib side, after which plaster to a thickness varying from one and one-half to two and one-half inches.

Where hollow partitions are desired, two thicknesses of **Hy-Rib** can be used. The sheets are placed with the lath side outward and the plaster is applied to the desired thickness.

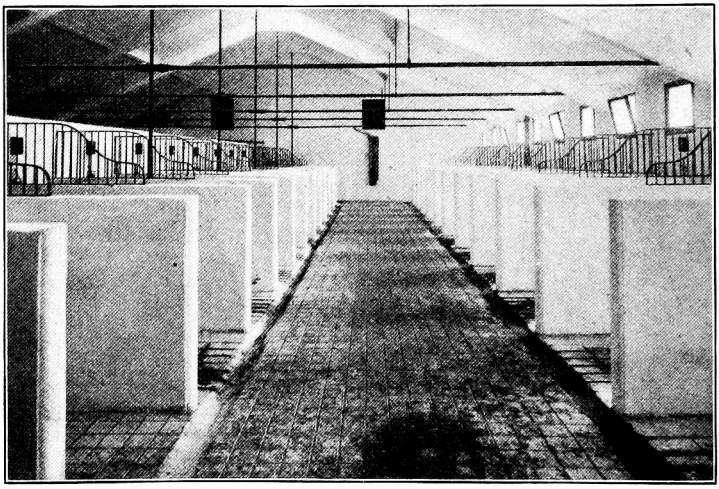
Hy-Rib is the most economical reinforcement for partition work. It does away with expensive field labor, saves plaster, and provides increased rigidity, besides saving time in erection.



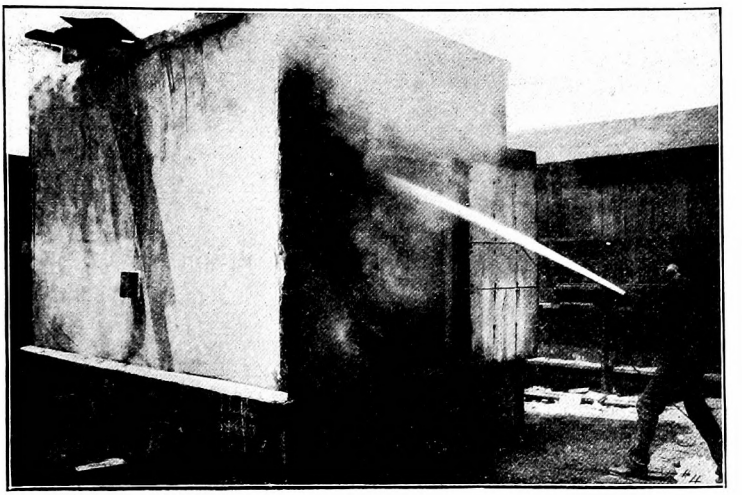
Detail of Door-Framing for Hy-Rib Partition.



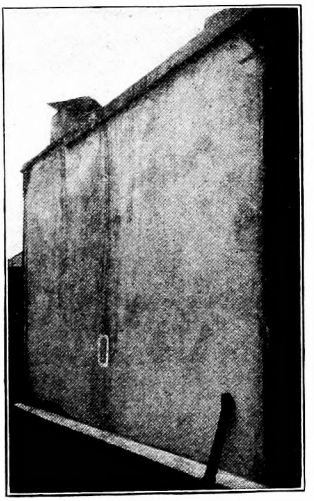
Plastering Flat Side of Hy-Rib Partition and View from Opp. Side
Note perfect clinch with no dropping of plaster.



Interior of Concrete Barn.



These photographs show the great fire-resisting qualities of a two-inch HY-RIB concrete slab.



Exterior of Partition after Test.

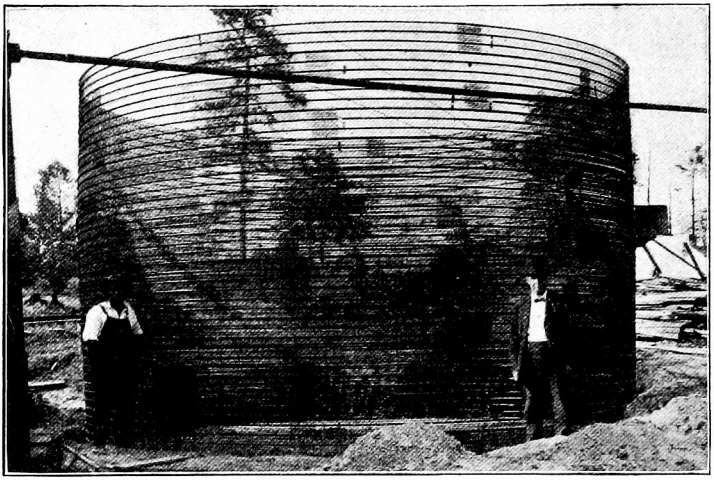
NEW YORK FIRE TEST ON HY-RIB PARTITION

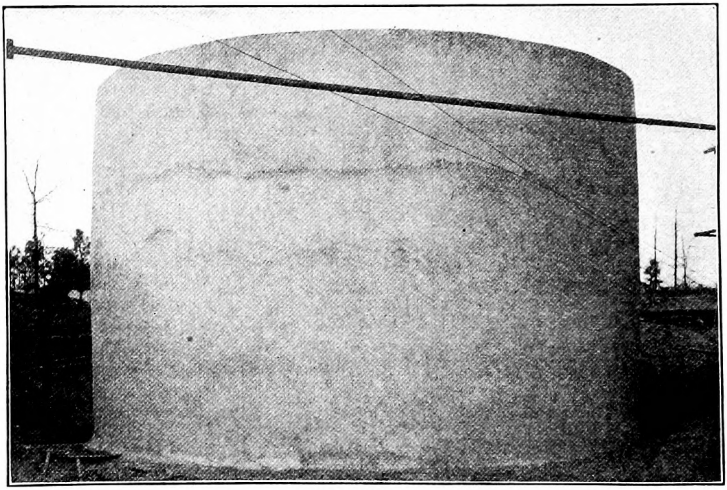
Made by Prof. Ira H. Woolson for City Building Bureaus.

Partitions were of standard size required by the Building Specifications, 14′ 6″x9′ 6″. No. 26 Gauge **Hy-Rib** was installed in partition; plaster used was Rock Wall, put on in two inside and two outside coats, the approximate total thickness of partition being two inches. The partition was subjected to a continuous fire for one hour, at an average temperature of 1700 degrees Fahr., and a 1⅛″ stream of water at hydrant pressure was then thrown against it for two and one-half minutes.

After the application of fire and water, the final maximum deflection in the **Hy-Rib** partition was only ¼″, and partition was in excellent condition.

In view of above test, No. 28 Gauge **Hy-Rib** partitions two inches thick, solid or with two thicknesses of metal for hollow partition, have been approved for use in the Borough of Manhattan.





Water Tank (Hy-Rib), Jefferson Powder Co., Birmingham, Ala.
Hy-Rib bent to exact curve in our shops.

Constructed of one section of **Hy-Rib,** plastered to a thickness of 3½", and thoroughly waterproofed with Trus-Con Waterproofing Paste.

Tanks

Build the foundation in same manner as if forms were to be used in construction. Either set the lower sheets, after having been wired together at end laps, in the wet concrete or set pieces of iron rods into the foundation every three feet at the exact line the sheets will cover and after the foundation has set, put on the **Hy-Rib** wiring it to the rods with soft wire. For small tanks, which are elevated or placed on a wood foundation or are to be moved: Set up the sheets and wire a bottom of **Hy-Rib** to them, so that sides and bottom will be formed of a continuous sheet of **Hy-Rib.** Next place a layer of cement on the floor at the spot where tank is to set, and immediately place the **Hy-Rib** on to it, working the bottom well into it, pour in a layer for the bottom and plaster up sides as per directions following. If it is desired to move the tank from this foundation, grease well the floor under the tank or place heavy paper. For comparatively small tanks, of 2 or 3 hundred gallons capacity, no additional reinforcement will be necessary, but for larger ones ¼-inch **Rib-Bars** should be placed up the inside of the tank well wired to the **Hy-Rib,** and spaced every three feet apart. Special designs should be made for large tanks, which this office will furnish.

Silos

The silo is comparatively simple of erection, and is somewhat similar in construction to that of a circular tank. **Hy-Rib** Silos have a three-inch wall, and preserve the silage much better than wood silos. They will never crack or break out either from temperature or pressure. Complete directions, specifications, etc., in our Silo Hand Book.

Underground Cisterns, Reservoirs, etc.

The steel takes the place of all bricking and form work, and so in general application the **Hy-Rib** will be built up complete, set in place in the excavation, and plastered on inside only. The foundation is first made and then follow directions as for tanks. It is usually best to excavate only enough to allow of the **Hy-Rib** setting in place, with plenty room left to fill in after the concrete, applied to inside, has set. If, however, the reservoir is a large one and it is not practicable to set the sheets up outside, dig the hole large enough to admit of a man working around the **Hy-Rib** frame while putting together.

Mixtures, Sand, Cement and Gravel, etc.

For all **plastering work** use the following mixture:

Sand	12 parts
Cement	5 parts
Hydrated lime	1 part

CEMENT.

Any good standard grade of cement that is of known reliability, and that will meet the standard specifications of the American Society for testing materials. Cement must be kept dry and do not attempt to use cement after it has become so hard that you must use a heavy weight to break it up. That kind of cement will give you no more service than would so much sand.

SAND.

Use a good grade of sand for plaster work. It must be sifted to remove the gravel which interferes with plastering. It must not contain over five per cent of soil. Soil weakens the mixture and makes it a poor color for exterior work. A plaster made with sand which has too much soil will not stick well or make a permanent bond with the first coat. The presence of dirt is readily detected.

HYDRATED LIME.

It is necessary to use some hydrated lime in the plaster. Ordinary lump lime slaked on the job is not so good. Hydrated lime can be obtained in sacks already to mix and makes plastering much more satisfactory.

These quantities are by volume, but it must be borne in mind that the **cement is packed in the sacks and when it is poured out bulks up until a sack becomes nearly one-third greater by volume** so mixtures should be made to include at least one sack batches. If this is not possible allow some for bulk, or better weigh the cement taken, remembering that cement and sand weigh about the same measure for measure.

Mix the cement and lime together first, add whole to the sand and thoroughly mix dry, and then add water to proper consistency.

CONSISTENCY OF PLASTER.

Make the cement mixture wet enough to handle readily as a good, sticky plaster. A very little experience will soon show what this consistency should be. If too dry the plaster will not make a good bond with previous coat. A lime plasterer will recognize the proper consistency at once.

For first plaster coat on **Hy-Rib**, add clean cow hair to mixture, before wetting. Use about one pound of hair to one sack of cement.

WORK OF PLASTERING.

Apply first coat, with hair, to the rib side, aiming to come only to depth of rib with this coat. While it is wet scratch over well with any tool that will cut rough grooves and ridges to

make a mechanical bond for next coat. A piece of **Hy-Rib** will do this very nicely.

As soon as first coat has set enough to hold weight of more plaster apply a second coat to the outside and one to the inside. This coat need not have any key of hair, but should be well mixed and of good, smooth working consistency, and quite wet. These three coats will make your wall about two inches thick. If a greater thickness is required, scratch over the side to which it is to be added. For water tanks, etc., the greater thickness should be on the inside—for walls of cisterns practically all on the inside —for walls of barns, etc., all but one coat on the outside or rib side.

Do not trowel the first coats much, leave them rough; it will be better for the plaster coming later, and if you have a fairly good grade of sand and a good wet mix you will get a perfect bond without troweling. The last coat should be troweled smooth and floated on, covering as much surface as possible during one job, as this will prevent streaks appearing.

Thoroughly protect the finished work from too rapid drying and the direct rays of the sun by means of damp canvas or sprinkling. The finished work must be kept thoroughly moist in this way for at least two days after plastering.

CONCRETE FLOORS AND ROOFS

Prepare concrete for roofs and floors with the following proportions:

Portland Cement.....1 part.
Sand .....2 parts.
Gravel or broken stone.....4 parts.

The sand and cement should be of the same quality as specified for "Plaster Work," page 52.

Broken Stone and Gravel.

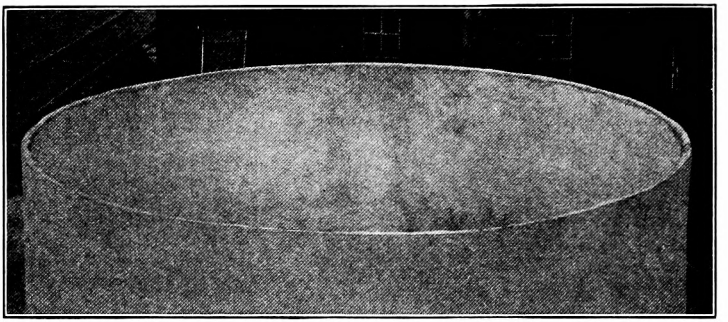
This material should be hard, close-grained, and free from dust and dirt. For **Hy-Rib** construction for floors and roofs all stone should be of such size as to pass through a half-inch ring, being preferably well-graded up to this largest size. If gravel contains sand, make a proper reduction in the amount of sand used.

Application.

Mix the sand and cement together; then add the gravel and finally water, mixing until absolutely uniform throughout. Cover the **Hy-Rib** sheets with this mixture and float the surface smooth. When the concrete has set sufficiently, plaster the under side with the standard mixture for plastering, page 52.

A box for enough sand to make up a two-bag mixture is 2′x2′ in size and 11½ inches high. Box for one-bag mixture should be one-half this size or this one filled half full. A box or barrel should be made, 3 or 4 feet by 11½ inches high for a two-bag mix.

Protect the concrete work from too rapid drying by means of damp burlap or canvas, or by sprinkling.



WATERPROOFING.

Cement, mortar and concrete are naturally porous and in order to be sure of a tight job it is necessary to properly waterproof them. There are a number of methods recommended by this company for special conditions, but the one best adapted is what is called the **Integral Waterproofing Method.** By this method we mix what is called **Trus-Con Waterproofing Paste** into the water that we are using for our cement in the proportions of one part **paste** to twelve parts water. This is used only in the inside or exposed coat for silos, tanks, etc., and the outside for walls. By this method we are enabled to make a two-inch wall absolutely waterproof and dampproof, and to a great extent frost proof. Think of the value of this in your silos, water tanks, cisterns, barn walls, etc.

Exterior Finishes.

There are a great many kinds of finishes or methods of finishing concrete work designed to fit different tastes and conditions. Smooth Finish, Rough Cast, Slap Dash, Pebble Dash, Broom Dash Finish, etc.

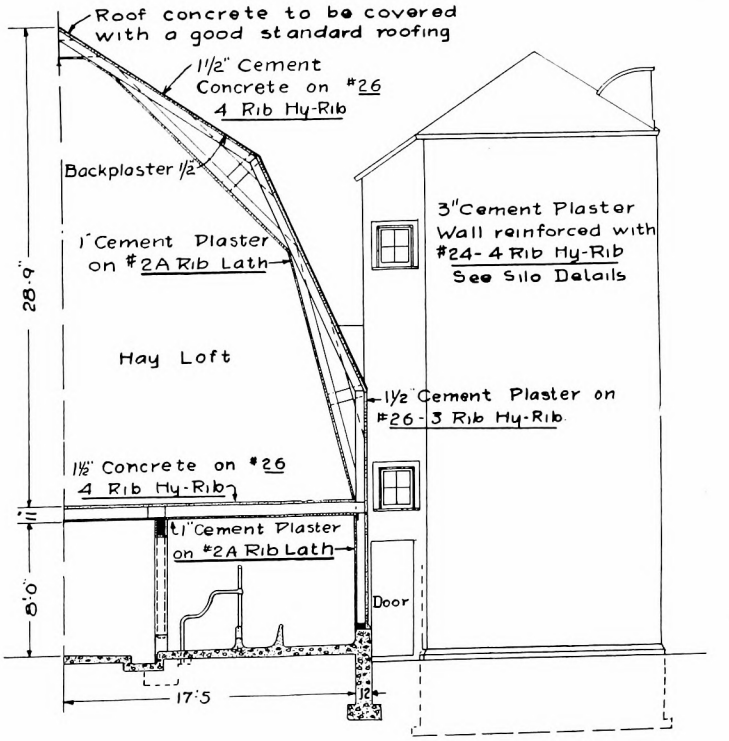
Any of the above may be given a more attractive and uniform appearance by coating with our **Trus-Con Stone-Tex** a cement coating furnished in several colors.

Interior Finishes.

Interiors of cement walls and floors can be made smooth, hard and dustless through the use of our floor and wall enamels.

Complete Building Plans are Free

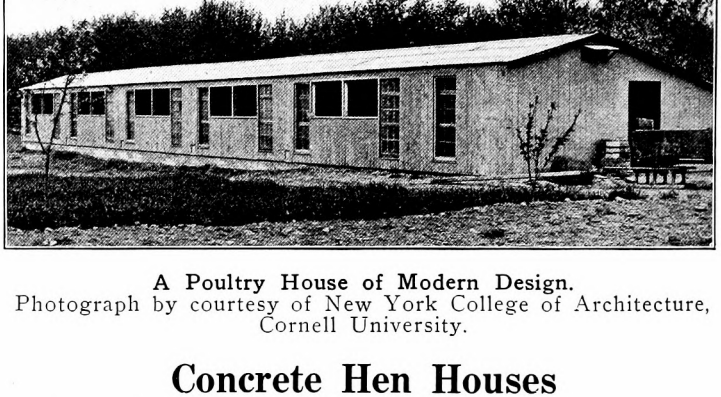
The few detail drawings in the balance of this book are only suggestions as to methods of planning and erecting various buildings using **Hy-Rib.** We have plans for other buildings and there are a great many uses for **Hy-Rib** not mentioned in this book. Write us about your plans and we will adapt **Hy-Rib** to your particular requirements.



Section of Dairy Barn taken from our large plan of Concrete Dairy Barn. The balance of this design and others may be had for the asking. We make drawings for buildings in which our materials are used.

Hy-Rib Concrete Dipping Vats

Dipping vats are now found generally on farms. Dipping animals rids them of ticks, lice, mites, fleas, and as a cure for Texas Fever, lip and leg disease and scabies. A concrete vat is absolutely permanent and is thoroughly waterproof and moisture proof, so as to prevent the loss of the liquid chemicals which are so expensive. The design of the vat we have prepared is along the lines of the recommendation of the best authorities among practical farmers.



A Poultry House of Modern Design.
Photograph by courtesy of New York College of Architecture, Cornell University.

Concrete Hen Houses

A good, sanitary, concrete hen-house can always be readily kept clean and is always a good investment. The use of **Hy-Rib** and **Rib Lath** plastered with cement makes such buildings comparatively inexpensive. The walls in this case are built with studs covered with **Hy-Rib** on the outside and plastered with cement. In the same way the inside of the studs is covered with **Rib Lath** and plastered with cement. The roof is built with joists covered with **Hy-Rib** and concrete above, and **Rib Lath** and cement plaster below. This gives a complete air-space around the entire hen-house which keeps out the cold and dampness.

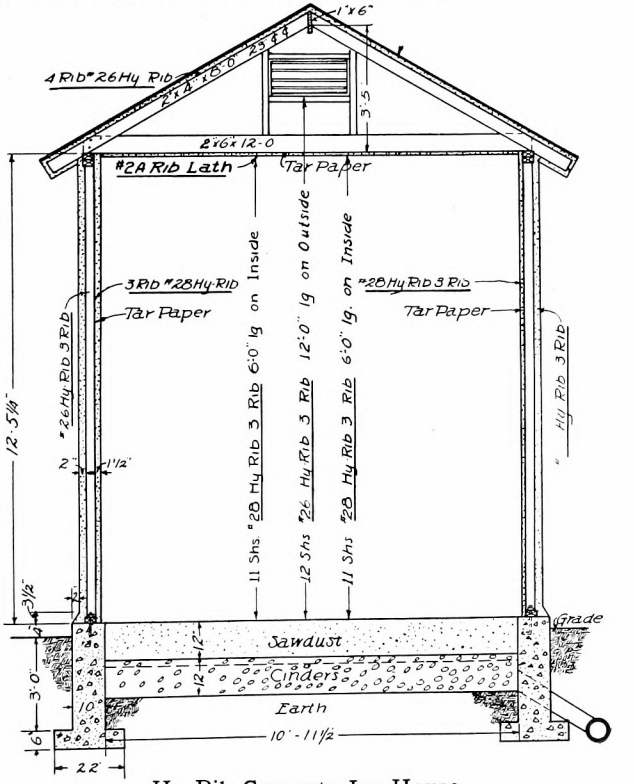
Hy-Rib Concrete Milk Houses

We have a design prepared for a good, standard milk house which is too large to show here, but will be mailed complete upon request.

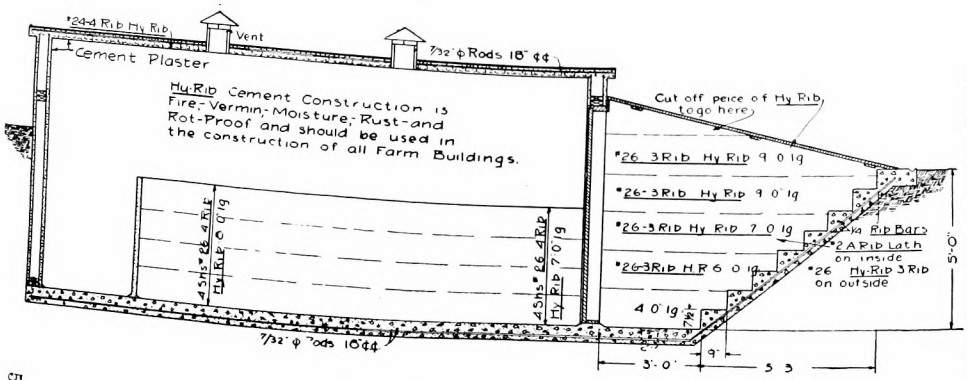
This design shows in detail a strictly modern, model milk house, easily built and at low cost. The walls consist of wood studding, covered with **Hy-Rib** and **Rib Lath** and cement plaster, as described in this book.

Hy-Rib Concrete Ice Houses

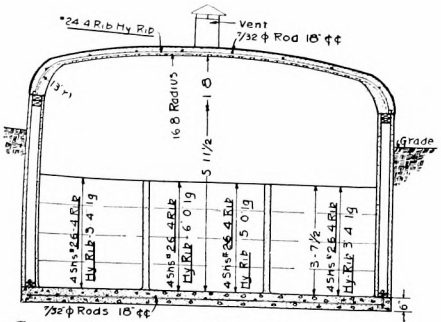
The first requirement in a properly constructed ice house is that the walls and roofs should provide a maximum insulation against heat. We have prepared drawings for two kinds of ice houses, a part of one being shown here. This type of construction provides a perfect insulation against heat.



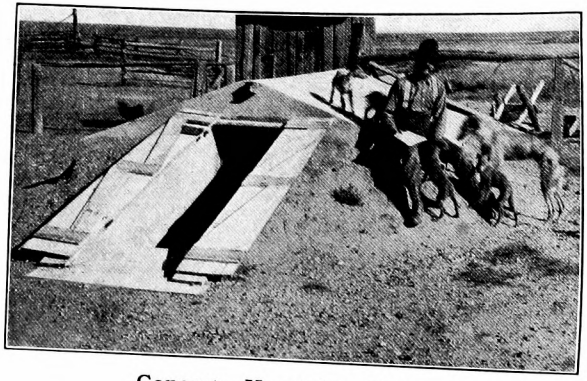
Hy-Rib Concrete Ice House.



Hy-Rib Concrete Fruit, Vegetable and Root Cellar. Any one desiring the ideal cellar for storing underground should look our details over carefully. Only a portion here shown. Write for complete plan.



Cross Section of Vegetable Cellar.



Concrete Vegetable Cellar.

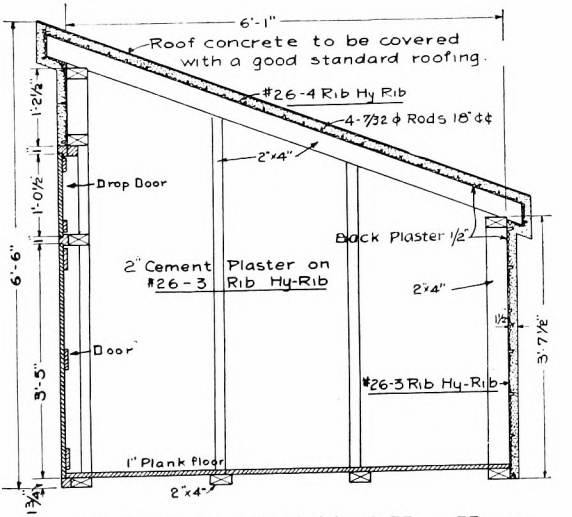
Hy-Rib Concrete Hog Barns

The swine breeder of today who wishes best returns knows that he must protect the herd in suitable buildings and not expose them to the cold blasts of winter or the glaring sun of summer. One of the most convenient designs for a hog-house is where the whole herd is sheltered under one roof and where bedding, feed, water, etc., are conveniently located.

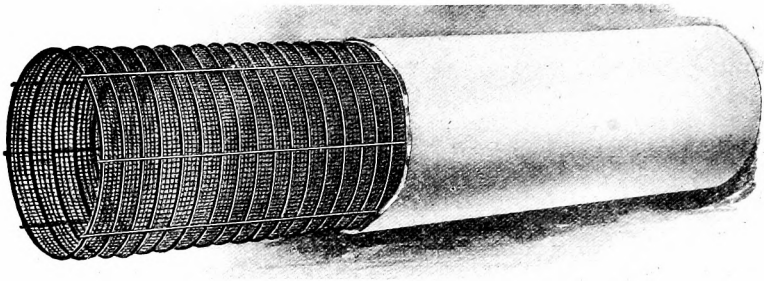
We have a number of complete plans of modern concrete Hog Barns, which will be sent free to those interested.

Individual Concrete Hog Houses

There are some breeders who prefer the outdoor individual house large enough for only one sow and her litter, with a grass lot of at least one-half acre where the sow and pigs may always be by themselves. This plan insures both abundant pasture for the sow and litter as well as plenty of room for the necessary exercise and has the advantage of always affording clean quarters for the pigs and freedom from disturbance for sows farrowing.



Part of Design of Individual Hog House.
Complete details on request.

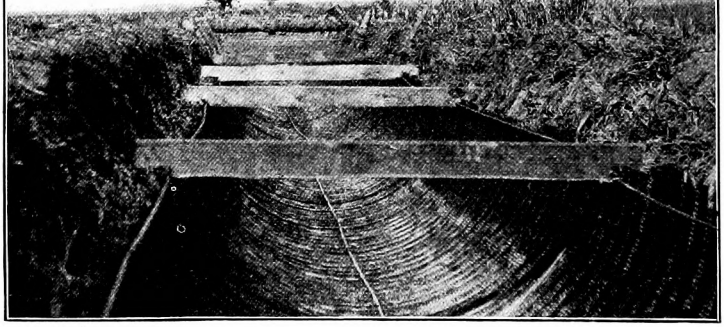


Hy-Rib Concrete Flumes

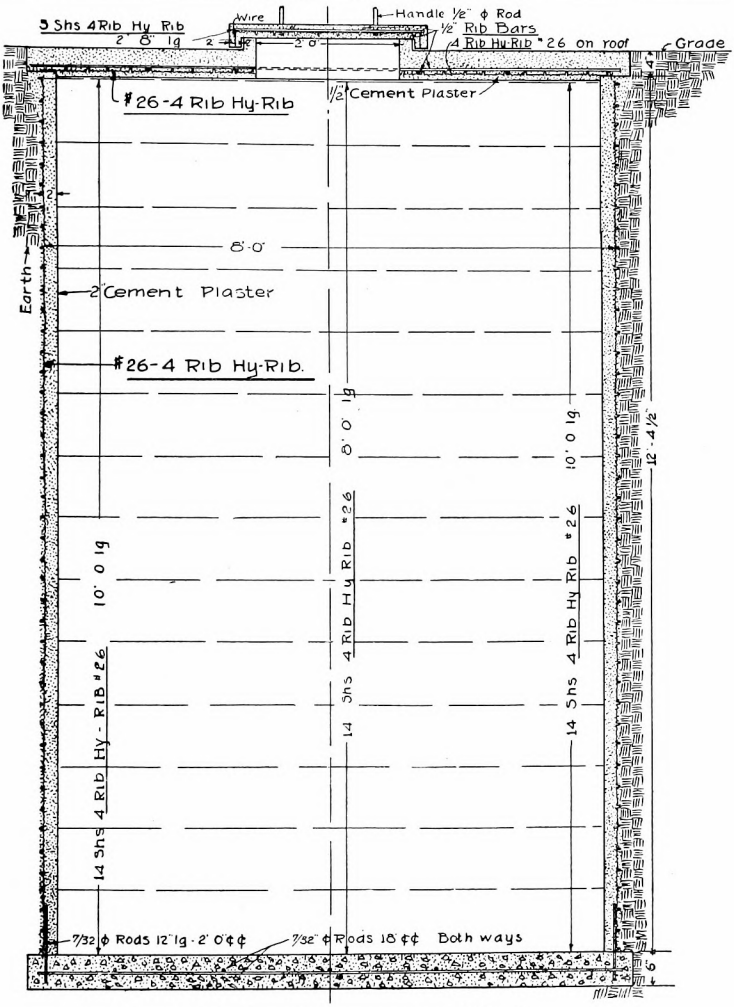
In the irrigation districts of California, Colorado and other western and southwestern states, flumes of different sizes must be built to carry the water to the orchards and gardens.

If the water is run through ditches in the ground a large amount is lost by seepage into the earth. To save this water, flumes should be built of concrete in all sizes from the main canal to the small ditch which carries water into the orchard or garden.

These concrete flumes are easily and cheaply built by using curved **Hy-Rib** as a reinforcement and key for the concrete. No. 26 4-Rib **Hy-Rib** is bent to curve at our Shops and when received is simply placed in position in the ditch and covered with cement plaster.



Water-Flume for the Cia. Azucarera del Panuco, at El Higo, Mexico. Hy-Rib Ready for Concreting.



Hy-Rib Concrete Cisterns

Concrete for cisterns has many advantages because it is monolithic and can be made absolutely waterpoof. It is absolutely clean and sanitary and PERMANENT in every way. **Hy-Rib** has many

advantages. It comes from our Shops bent to the exact circle and is merely set in place and the concrete plaster applied directly to it to the required thickness. It does away entirely with the expensive form work and the unsatisfactory plan of attempting to plaster against loose earth.

Hy-Rib Concrete Water Troughs

Concrete troughs are always more desirable than wooden troughs because they are clean and sanitary, never get sour even with wet feed, and do not rot and become infested with germs. They last forever and do not require replacing from time to time. **Hy-Rib** is especially useful in building such troughs, as no centering is required, greatly reducing their cost. We have a number of typical designs for both rectangular and circular troughs. The **Hy-Rib** is shipped bent to exact curves for round troughs. Concrete is applied in the form of a plaster directly to the **Hy-Rib** sheets. The troughs are waterproofed by the use of TRUS-CON WATERPROOFING PASTE in the plastered coats on the inner side of the troughs.

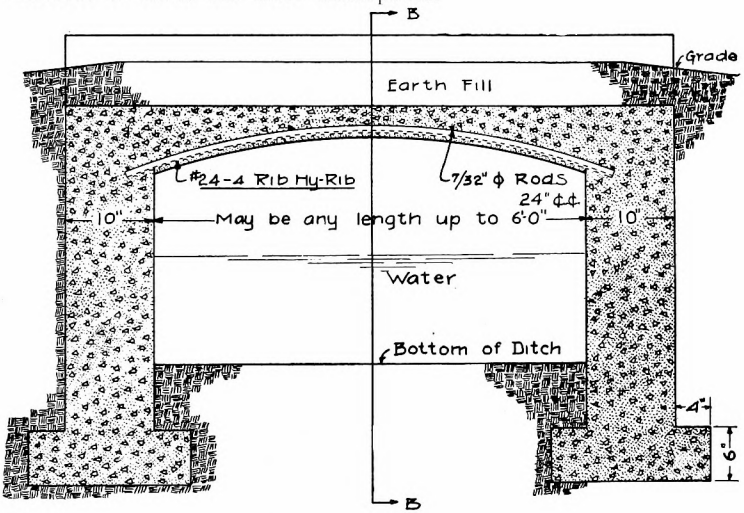
Hy-Rib Concrete Septic Tanks

Cesspools, or pits dug into the ground to take care of refuse from bathrooms, etc., are the greatest spreaders of disease on the farm. By building an inexpensive septic tank, all danger from sewage is removed. Septic tanks are nothing but long, underground, water-tight cisterns through which the sewage passes very slowly and evenly. Located underground, they are warm and dark, providing ideal conditions for development of the bacteria, little germs which eat up the sewage and render it harmless in much the same way as another kind causes cider to ferment. To prevent the bacteria (which live in the frothy sludge) from being disturbed, crosswalls, called baffle boards, are placed to break up the current of the inflowing sewage. The purified sewage, merely clean water, may be discharged into the farm drain tile.

Hy-Rib Concrete Water Filters

A concrete filter for obtaining pure water may be built of **Hy-Rib** and cement plaster. No. 26 **4-Rib Hy-Rib** is used and the sheets are wired together every 12 inches at the side laps and to the 7/32 inch round rods at each rib at the corners. This is

necessary if the filter sets above ground, as the water pressure from inside would force the sides apart. A base of concrete may be laid and the **Hy-Rib** frame set upon it or the frame turned upside down and the bottom plastered. After it has set the filter may be turned over and the rest plastered. TRUS-CON WATERPROOFING PASTE should be used in the water used in mixing the concrete to make the filter waterproof.



Hy-Rib Concrete Farm Bridges and Culverts

The many ditches, large and small, that run through a farm must have bridges over them so the farmer will be able to go from one field to another. With **Hy-Rib** these small bridges and culverts are easily and quickly built. The footings are built of concrete and the **Hy-Rib** placed upon them, then the concrete road-bed is poured upon the **Hy-Rib,** which acts as centering and reinforcement.

Bridges and culverts up to 6 feet span are built with **Hy-Rib** as shown in drawings.

We have many designs for reinforced concrete bridges of all spans and types.

Consider that **CONCRETE** is fast coming to be the accepted material by those who **know.** Concrete means permanency and sanitary conditions, eliminating disease and vermin with resulting loss of live stock. It prevents destruction of food by rats and mice, waste in feeding, and is better than insurance for it cannot be harmed by fire or flood. Concrete is more economical in the long run for farmers to use, than any other building material, for wood becomes weaker through exposure, and steel and iron become rusty through dampness, while **concrete becomes stronger as the years roll on.**

Build of concrete and you need have no fear for the future, no constant worry as to where the money is coming from to pay for this repair this month and that up-keep cost next. Once built with concrete and built right, and you have a job that will last forever.

Immense concerns like the **TRUSSED CONCRETE STEEL COMPANY** have studied the question of reinforcing and finishing concrete and brought the subject down to an exact science, as is attested by the steadily increasing number of immense structures, depending solely for their stability upon very light but exceptionally strong concrete slabs and beams. These structures are standing and will remain standing, after all others fall, because they are so constructed as to enable them to overcome all conditions tending to break or crumble them.

Concrete must have a skeleton of steel to make it enduring. A slab or wall of concrete 2 inches thick with its firmly imbedded skeleton of **Hy-Rib** is permanent. Changes in temperature do not affect it since the steel resists their destructive action, making impervious both to the hottest fires and coldest degrees of frost, and better and more enduring than an 8-inch wall.

Because of the above facts, and the added fact that no forms are required for our system of farm buildings, **Hy-Rib** concrete construction becomes one that must appeal to every thinking, progressive farmer.

A few of the uses for Hy-Rib on the farm:

Residences
Walls, Partitions and Roofs
Conservatory Walls and Benches
Fences, Windbreaks, etc.
Laundry Tubs
Benches
Dairy Barns
Horse Barns
Sheep Barns
Piggeries
Outside Pig Cots
Granaries
Poultry Houses
Shops
Sheds of All Kinds
Silos
Ice Houses
Tanks—Underground, Elevated and Supply
Watering Troughs, etc.
Cisterns
Well Holes
Culverts
Bridges
Water Flumes
Cess Pools
Septic Tanks
Water Filters
Charcoal Burners
Pig Troughs, etc.
Mixing Vats

RIB LATH

for

Stucco and Plaster in Sidings,
Partitions, Ceilings and Furring

RIB STUDS

for

Hollow Walls and Partitions

Fifth Edition
1913

Copyright 1913, Trussed Concrete Steel Co.

TRUSSED CONCRETE STEEL CO.
DETROIT, MICH.

View of Old Wooden House

Same Residence After "Overcoating" with Rib-Lath and Stucco

Old Wooden House Transformed into Modern Permanent Residence by "Overcoating" with Rib-Lath and Stucco.

Cyrus E. Lothrop, Grosse Pointe, Mich., Owner.
Burrowes and Wells, Archts.

A WORD TO BUILDERS

The advantages of durability, permanence, speedy erection, low initial cost, freedom from repairs, and fireproofness have resulted in the use of **reinforced concrete** in many thousands of buildings all over the country. It is more especially with the applications of this fireproof material to smaller buildings, such as residences, garages, etc., that the present booklet is concerned.

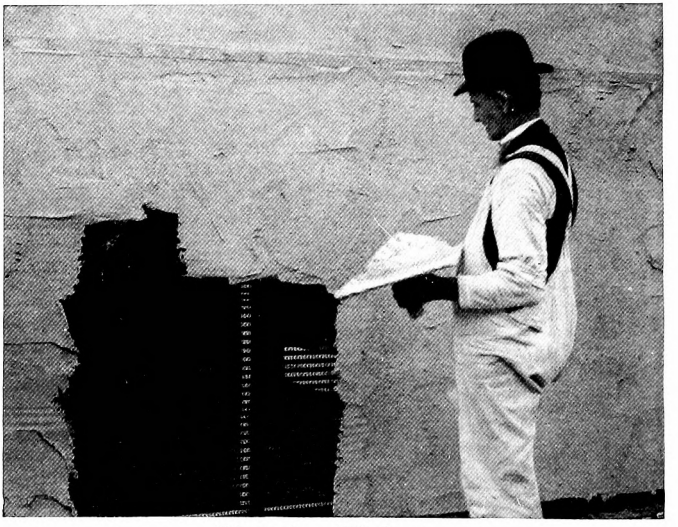
By the use of **Rib Lath** and **Hy-Rib**, concrete construction, considering its fireproofness and permanence, becomes more economical than wood. Where wood lath is inflammable and adds to the danger by communicating the flames, metal lath cannot burn and stops the spread of fire. Wood lath absorbs moisture, expands and cracks the plaster, while metal lath prevents the appearance of cracks.

Wood lath rots and becomes a breeding place for germs and insects, while metal lath does not decay, and is vermin-proof. Lastly, metal lath is more economical than wood lath because of the growing scarcity of lumber and the saving in mortar and labor of installing. These are important features not to be overlooked by the prospective builder.

Rib Lath and **Rib Studs** are used with great success in buildings of all types: schools, office buildings, stores, hotels, apartment houses, public buildings, factories, warehouses and residences, being well adapted for partitions, ceilings, furring and stucco.

Rib Lath and **Rib Studs** are included in the KAHN BUILDING PRODUCTS, which have been used in over fifteen thousand structures of all types in every part of the world. KAHN BUILDING PRODUCTS are a complete line for reinforcing concrete, fireproofing, steel sash for windows, waterproofing and finishes for concrete, building specialties, etc. Special catalogues on any of these subjects will be sent on request.

Note the great stiffness and rigidity of **Rib Lath**
Sheets shown are 8 feet long.



Plastering Rib Lath.

RIB LATH

Rib Lath consists of a series of parallel steel ribs which are deeply corrugated or beaded. In application these ribs act as small steel beams spanning between the studs and giving the lath extraordinary stiffness and rigidity. Owing to this stiffness, the studs may be placed a much greater distance apart than with the ordinary forms of lath, thus saving in the cost of studding and the labor of installation.

Rib Lath is furnished either in open hearth steel or in acid-resisting "Trus-Con Ingot Metal."

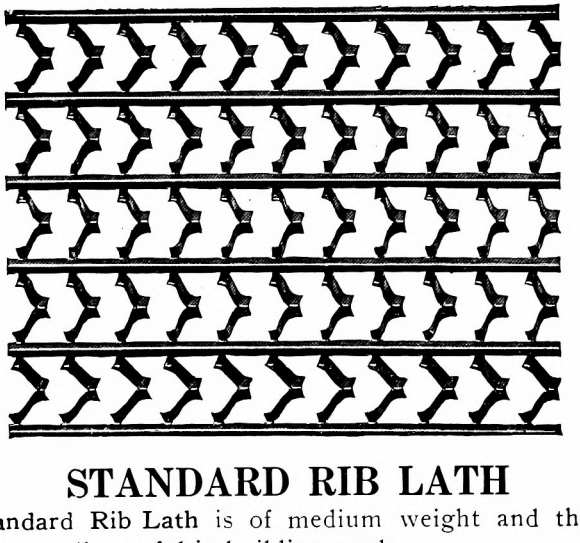
Rib Lath is so expanded as to provide a perfect clinch or key for the plaster. The key thoroughly anchors the plaster to the lath allowing only a minimum amount of plaster to flow through. No plaster is wasted by its dropping behind the lath.

Rib Lath presents a uniformly flat and rigid surface, so that plaster can be compacted against it without loosening any of the surrounding plaster.

Rib Lath is shipped flat and owing to its rigidity is very easy to handle and install. On account of its parallel ribs, **Rib Lath** is easily bent to conform to the outline of cornices, coves, and other ornamental work, and can be readily cut to any required width or length.

The side edges of **Rib Lath** are straight and true, and the ends cut square, doing away with waste of material in lapping. A double-width rib is provided along the sides, so that no allowance need be made for side laps in ordering **Rib Lath.** Other metal laths have irregular edges causing a loss of 8% to 10% of material in lapping.

Rib Lath is manufactured in three types—Standard Rib Lath, Beaded Plate Rib Lath and "B" Rib Lath. Each of these types is manufactured in three weights.



STANDARD RIB LATH

Standard Rib Lath is of medium weight and the one most generally useful in building work.

Grade	Size of Sheets	Sheets per Bundle	Yards per Bundle	Weight per Square Yard
Rib Lath No. 1	20¼″ x 96″	12	18	2.74 lbs.
Rib Lath No. 2	20¼″ x 96″	12	18	3.42 lbs.
Rib Lath No. 4	20¼″ x 96″	12	18	4.10 lbs.

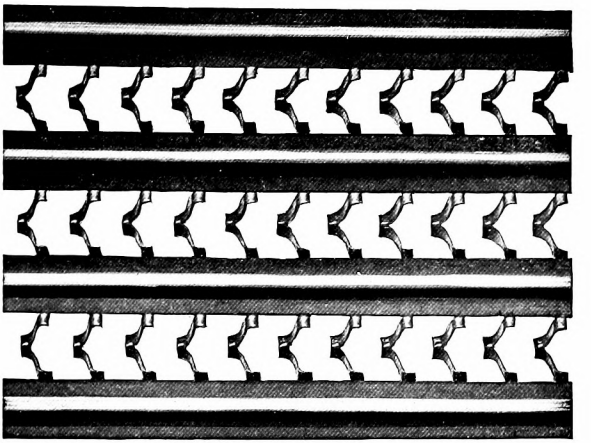
We recommend the use of painted lath, but can supply it without paint if desired.

"B" RIB LATH

"B" Rib Lath is designed the same as Standard Rib Lath, but with somewhat greater expansion.

Grade	Size of Sheets	Sheets per Bundle	Yards per Bundle	Weight per Square Yard
Rib Lath No. 1B	24$\frac{5}{16}$″ x 96″	10	18	2.28 lbs.
Rib Lath No. 2B	24$\frac{5}{16}$″ x 96″	10	18	2.85 lbs.
Rib Lath No. 4B	24$\frac{5}{16}$″ x 96″	10	18	3.42 lbs.

We recommend the use of painted lath, but can supply it without paint if desired.



BEADED PLATE or "A" RIB LATH

This is unquestionably the best lath on the market. Though somewhat heavier and, therefore, more expensive than Standard or "B" Rib Lath, all things considered it is really more economical, as it permits of wider spacing of the studs and in plastering effects a very great saving in labor and material.

Beaded Plate Rib Lath is especially well adapted for heavy work and suspended ceilings.

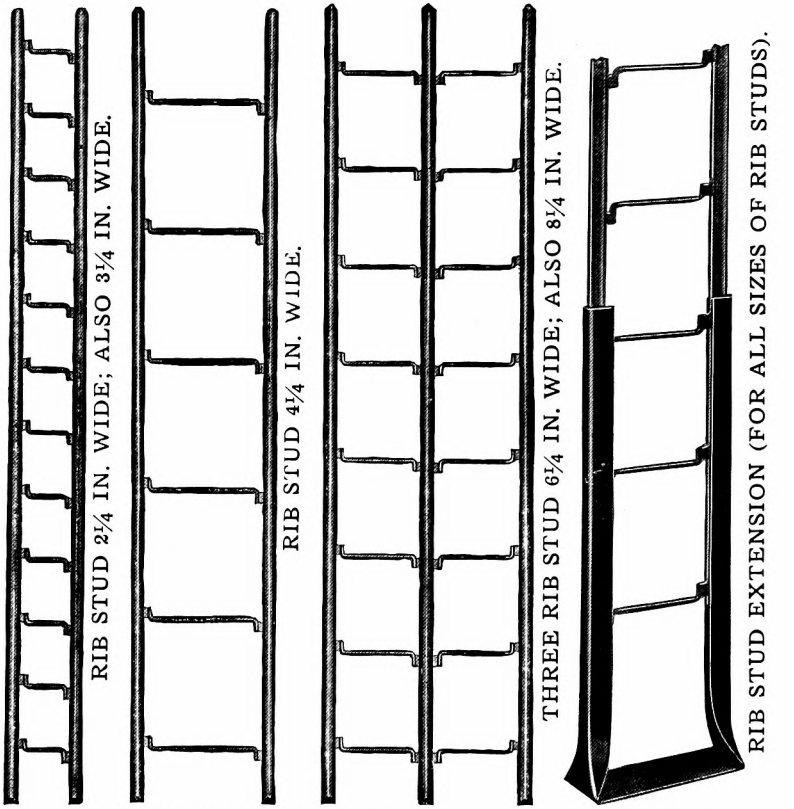
Grade	Size of Sheets	Sheets per Bundle	Yards per Bundle	Weight per Square Yard
Rib Lath No. 1A	15¼″ x 96″	16	18	3.63 lbs.
Rib Lath No. 2A	15¼″ x 96″	16	18	4.54 lbs.
Rib Lath No. 4A	15¼″ x 96″	16	18	5.45 lbs.

We recommend the use of painted lath, but can supply it without paint if desired.

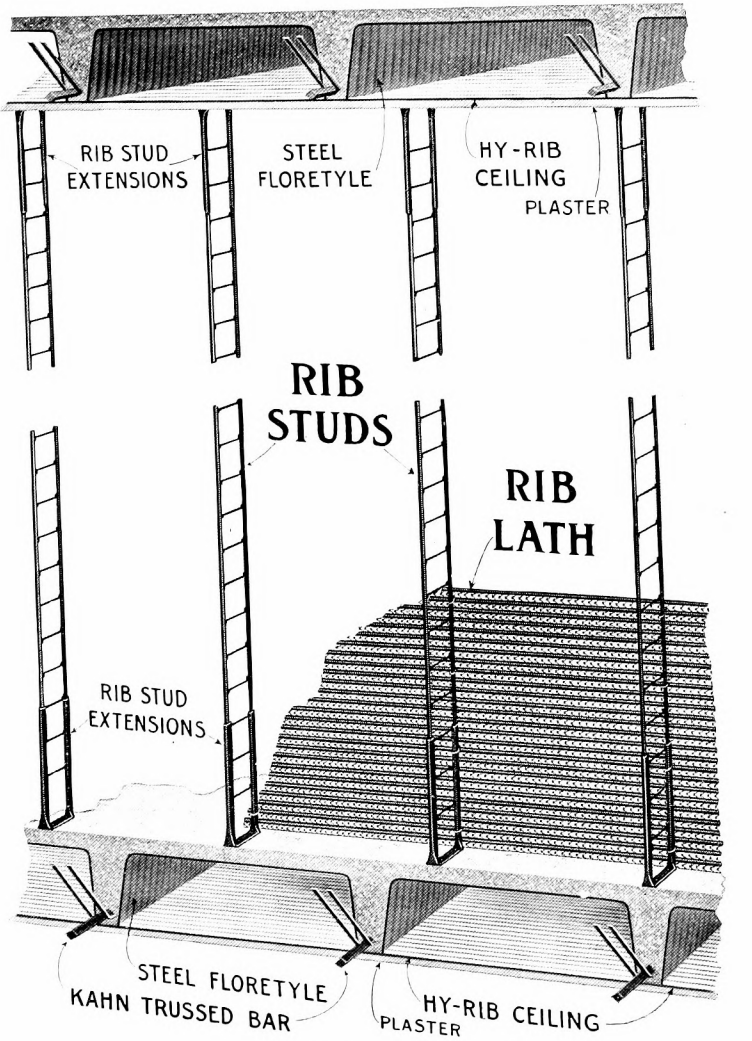
RIB STUDS

Rib Studs—made of the highest grade of open-hearth steel—are open for the passage of conduits and pipes, and provide an uninterrupted air space between the two plaster surfaces. The open mesh simplifies the wiring of lath.

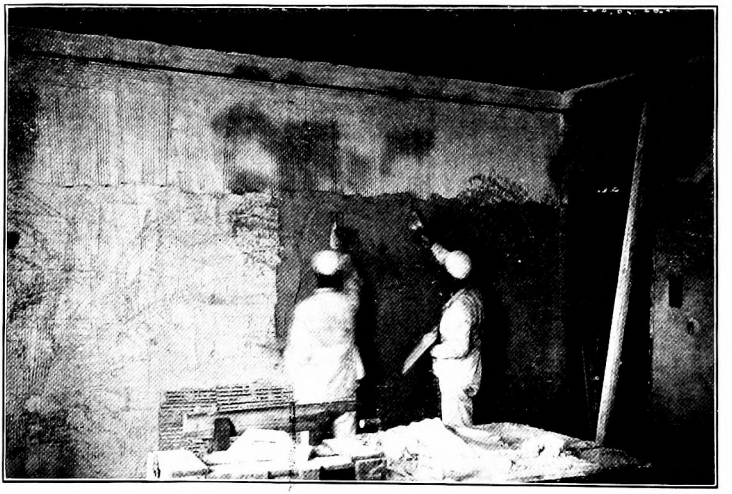
Rib Studs are made in five widths (2¼" to 8¼") and in any length up to 18 feet. (See standard stock sizes below.)



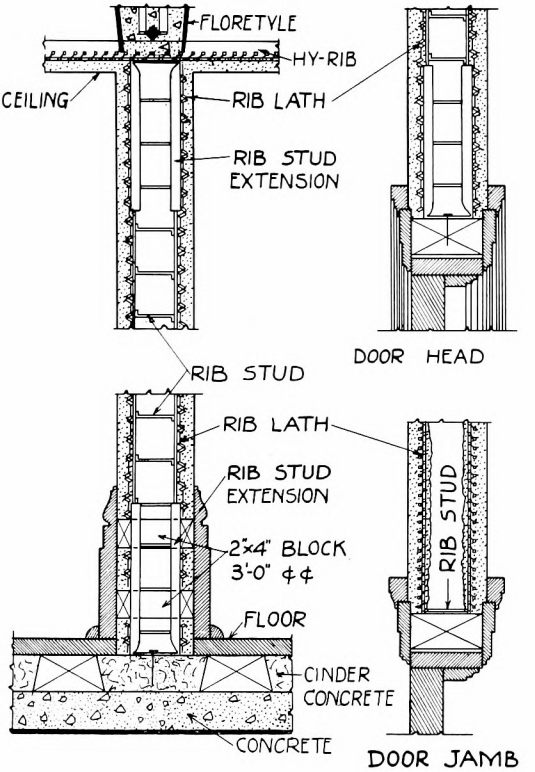
Rib Stud Extensions, furnished for all sizes of **Rib Studs,** provide an adjustable attachment at floors and ceilings, taking care of all inequalities and saving time and money in erection. They fit over the ends of the **Rib Studs** and are clamped tight with pincers or hammer.



Hollow Walls or Partitions
Rib Lath wired to Rib Studs



Residence of J. B. Book, Jr., Detroit, Mich.
Rib Lath Partitions, Ceilings and Furring.

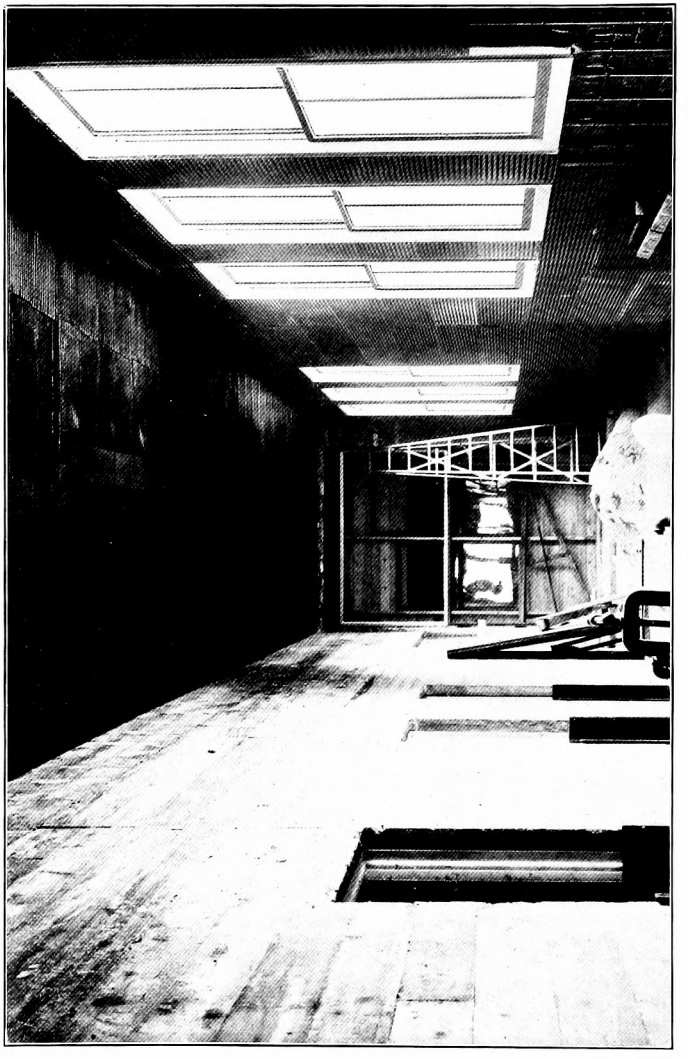


HOLLOW FIREPROOF PARTITIONS

Rib Studs are set in place, being attached to the floor and ceiling by means of Rib Stud Extensions or wooden strips. **Rib Lath** is wired directly to the studs and plaster applied to the face of the lath on both sides of partition.

Rib Lath saves 33% to 50% of cost of studding and erection of studs and lath.

Rib Lath saves at least 25% in labor and material for plastering. Plaster will not go through it and drop down behind.



Rib Lath Partitions, Ceiling and Furring, Grace Hospital, Detroit, Mich. Edward F. Stevens, Archt.
(Note straight, true lines of lath insuring a satisfactory wall.)

CEILINGS

Beaded Plate Rib Lath is exceptionally good for ceilings, as it is very stiff and prevents the plaster from dropping off or the ceiling from sagging down.

The total cost of plastering our Beaded Plate Rib Lath on ceilings is actually less than half the cost of plastering any ordinary open mesh lath, and the completed job is twice as strong and durable. Beaded Plate Rib Lath saves 25% in material and 50% in labor over ordinary light laths.

Rib Lath is either nailed or wired to the supports provided in the ceiling.

Hy-Rib is frequently used for suspended ceilings, as it combines in one sheet lath and channel supports. (See Hy-Rib Catalog.)

FURRING

Owing to the improved design, Rib Lath can be used against flat surfaces without requiring furring strips, to provide space for the clinching of the plaster. However where an air-space is required, as an insulation against dampness, heat or cold, furring strips must be applied to the wall surfaces. Rib Lath is attached directly to these furring strips.

The great stiffness of Rib Lath permits of a greater spacing of furring strips than for ordinary laths, and thus causes a very considerable saving in labor and time.

Rib Lath is especially suited to ornamental work, as it conforms readily to any desired molding and provides a rigid support for the plaster.

Hy-Rib combines in one sheet both lath and furring strips. (See Hy-Rib Catalog.)

ABOUT SPECIFYING

Architects and owners in specifying metal lath should specify the weight per square yard and not the gauge of the metal. Different laths of the same gauge have 100% variation in weight, due to difference in amount of expansion. It is the amount of metal per square yard that counts in the strength and durability of the construction, not the gauge of the metal. Insist on having a definite weight of lath, the full value of what you are paying for.

Rib Lath is manufactured in nine different weights (shown on pages 6 and 7), which include the two heaviest laths on the market. If you want to be sure of best results, specify **Rib Lath.** Beaded Plate **Rib Lath** is usually the most economical Lath to use. Its exceptional rigidity reduces the cost of plastering, often saving an entire coat of plaster. The supports may be placed a greater distance apart, saving not only in the supports themselves, but also in the labor and time necessary to attach the Lath.

Have your specifications for Metal Lath read as follows: "For all Metal Lath provide Rib Lath No. .., manufactured by the Trussed Concrete Steel Company, Detroit, the Lath to be securely fastened to supports." In specifying Rib Lath indicate the type and number desired, such as Rib Lath No. 1-A. All Lath should be dipped or painted before shipping, so as to protect it from the elements before installation in the work.

Metal Lath should be specified for all interior work—partitions, ceilings and furring in office and store buildings; schools, hotels and public buildings; factories, warehouses and industrial buildings; in fact, in any building of importance. Metal Lath cannot burn, cannot rot, and prevents cracking and staining of plaster.

Metal Lath should be specified for stucco work in residences, both for new buildings and for over-coating frame houses to secure concrete exterior. Wood Lath is not at all satisfactory in exterior work, as it absorbs moisture, expands and contracts, causing the stucco to crack. The use of Rib Lath with stucco applied as indicated in the specifications on next page will insure good results.

Metal Lath should be specified for interiors of all high class residences, and for ceilings in any house costing over $5,000.00. Wood Lath absorbs moisture from the plaster causing streaks and cracks in the finished work. Metal Lath overcomes these difficulties, and cannot burn. Also as a fire protection, Metal Lath should be specified for ceilings of basements, particularly over furnace rooms and coal bins.

Remember that **Rib Lath** will always insure the most satisfactory and economical plaster and stucco work. **Rib Lath** is preferred by all owners, architects and contractors who have had any experience with it.

SPECIFICATIONS FOR CEMENT STUCCO ON RIB LATH

1. General—All stucco shall be applied to **Rib Lath** manufactured by the Trussed Concrete Steel Co., Detroit. It is the intent of these specifications to obtain a sound, permanent and waterproof stucco.

2. Materials—The materials composing the stucco shall consist of:

(a) Portland Cement which has been carefully tested and found to satisfactorily meet the requirements of the Specifications of the American Society for Testing Materials.

(b) Sand which is practically free from organic matter and uniformly graded in size from coarse to fine.

(c) Hydrated lime that is uniform in quality and perfectly hydrated.

(d TRUS-CON WATERPROOFING PASTE CONCENTRATED as manufactured by the Trus-Con Laboratories.

3. Proportions—The proportions of the above specified materials by volume, shall be five (5) parts of cement, twelve (12) parts of sand, and one (1) part of hydrated lime. One (1) part of the TRUS-CON WATERPROOFING PASTE CONCENTRATED shall be added to every eighteen (18) parts of water used to temper the mortar.

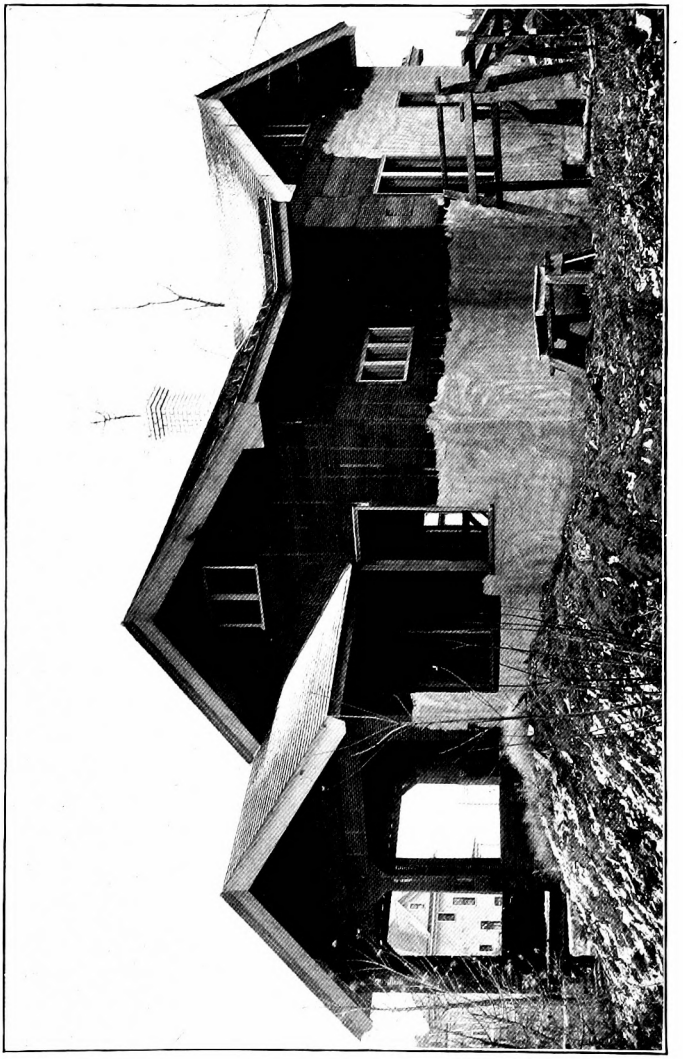
4. Mixing—The cement and hydrated lime, after being thoroughly mixed dry to uniform color, shall be added to the dry sand and the whole manipulated until evenly mixed. The dry mixture shall then be tempered to the correct working consistency with water to which TRUS-CON WATERPROOFING PASTE CONCENTRATED has been added in proportion specified. The mortar must be thoroughly worked until perfectly homogeneous. This composition shall only be made up in lots that can be immediately applied, and any material that has been mixed with water over thirty (30) minutes before applying shall be rejected.

5. Application—All walls shown on elevation for stucco finish shall be two-coat work. The first coat shall be prepared as specified above, with the addition of long cow hair for keying when applied to metal lath. The face of the first coat shall be thoroughly scratched over to form a key for the finish coat, which shall be applied to a total thickness of one inch (1″), when the first coat has set sufficiently hard to safely hold it. The finish coat shall be carefully floated free from any porous imperfections.

When plastering over a masonry surface, special care must be taken to thoroughly saturate the masonry with water and the plaster applied at once.

6. Drying—Special care shall be taken to avoid too rapid drying. If in direct rays of the sun, it shall be protected with a damp canvas or burlap, and when sufficiently resistive, shall be frequently sprinkled with water.

7. No exterior plastering shall be permitted until all interior partitions are studded up and completely braced.



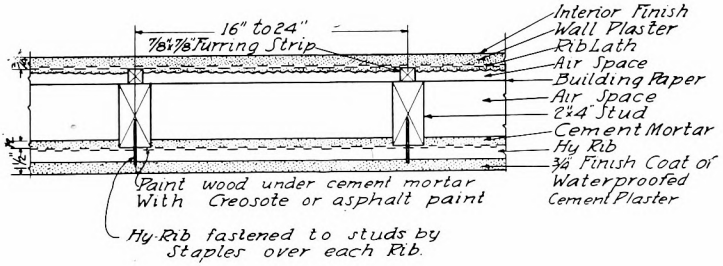
Residence of H. A. Ertz, St. Paul, Minn.
View during construction, showing **Rib Lath** for outside wall.

RIB LATH FOR STUCCO HOUSES

Whether for cottage or mansion there is no method of building which produces such an artistic, pleasing, and home-like appearance as a properly designed house with stucco walls. Such a wall is much less costly than brick or stone, and much more economical than wooden sheathing which is short lived and requires the expense of frequent painting.

A stucco wall built of cement, waterproofed with **Trus-Con Waterproofing Paste** and reinforced with **Hy-Rib** and **Rib Lath,** is fire-resisting, damp-proof and permanent.

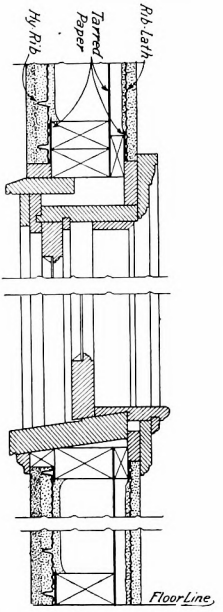
The following method for constructing stucco walls, will give by far the best results, although the other methods outlined are satisfactory.



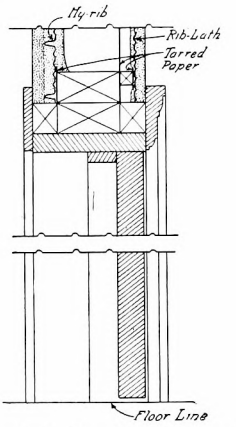
Set up an ordinary "balloon" frame structure with 2x4 studding spaced 16 to 24 inches apart, and put all temporary bracing on the inside. Fasten **Hy-Rib** at each rib to outside of studs with 2½-inch staples or nails. Use 3-Rib Hy-Rib with ribs extending horizontal and lath surface against studs. Interlock **Hy-Rib** sheets at sides and ends, securely wiring or clinching them every 24 inches along sides and at every rib at ends. Paint the studs with creosote or asphalt paint along the entire outer face, and at least an inch back on the sides. Plaster this **Hy-Rib** on the outside with cement mortar (mixed and applied as

DETAILS OF EXTERIOR WALLS OF RESIDENCES.

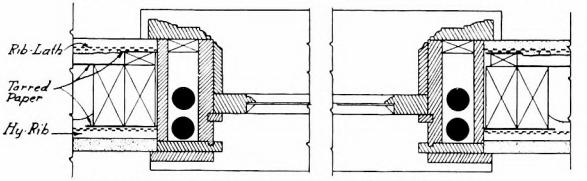
Showing Hy-Rib on outside and Rib Lath on inside.



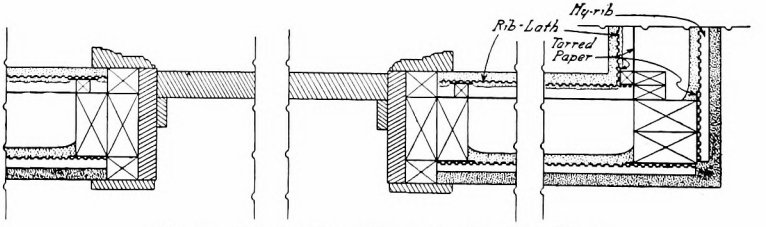
Vertical Section Through Window.



Vertical Section Through Outside Door.



Horizontal Section Through Window.



Horizontal Section Through Outside Door.

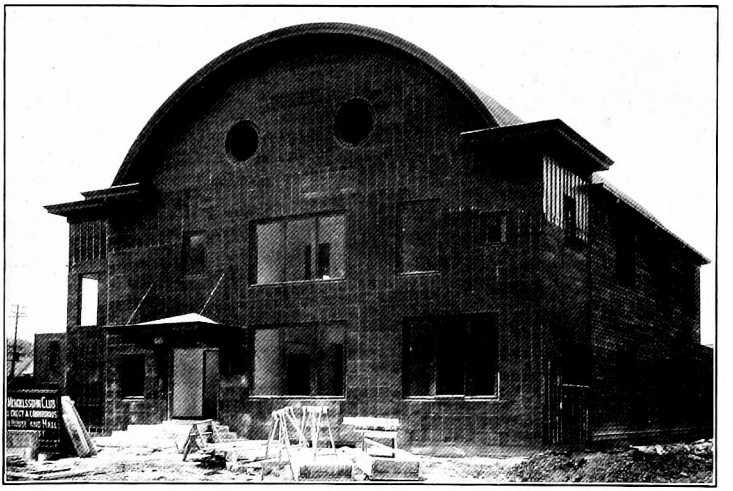
directed on page 15) to a thickness of 1½ inches and give it any finish desired. The last ¾" of plaster finish should be waterproofed with Trus-Con Waterproofing Paste Concentrated. Then back plaster the **Hy-Rib** with similar mortar to a thickness of about half an inch.

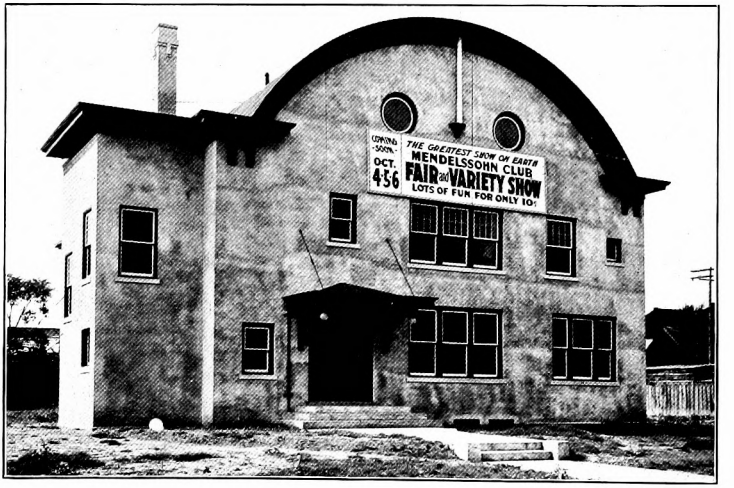
This construction insures absolute protection for the steel, and when the mortar has set you have a 2-inch reinforced concrete slab, solid as rock, and much stronger and more rigid than the ordinary matched sheathing and lap siding of which it has taken the place.

On the inside of the studding tack thin asbestos board or a very heavy tarred paper, then ⅞-inch furring strips, and Rib Lath, on which apply ⅝-inch of cement mortar or good plaster (free from pure gypsum) and the regular finish coat.

In this way you will secure a house which possesses the following advantages: 1. Practically fireproof, due to the heat-resisting qualities of the 2-inch reinforced concrete slab on outside. 2. Absolutely waterproof and dampproof. 3. Easy to heat in winter and keep cool in summer, owing to the double air space in the wall. 4. Practically indestructible, owing to the permanence of the reinforced concrete wall. 5. No expense for maintenance, such as painting, repairs, etc. 6. Unusual architectural beauty because of the artistic effects that can be secured with stucco. 7. Low first cost.

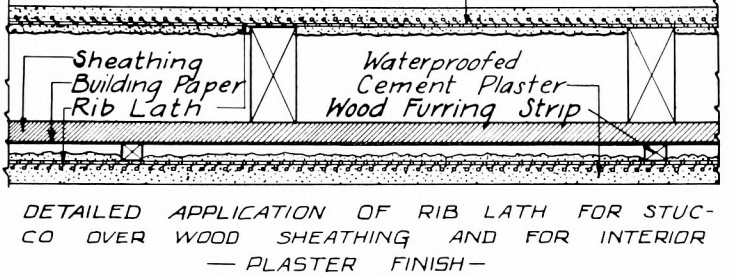
This method outlined above gives a wall of almost unlimited strength and rigidity, and is suitable for large buildings. For small cottages and for structures in which the total wind pressure will not be great, some saving may be effected by using **Heavy Beaded Plate Rib Lath** in place of **Hy-Rib**, on the outside, plastering it in the same manner on both sides to a total thickness of 1¼ inches or more. In this stucco construction it must be remembered that the only way to insure permanence is to have a real reinforced concrete slab on the outside.





Mendelssohn Club, Detroit, Mich.
Rib Lath for Siding before and after Plastering.

Hy-Rib is necessary for medium and large-sized residences. For smaller cottages no lath weighing less than 4½ lbs. per square yard is strong enough to properly reinforce a concrete wall.



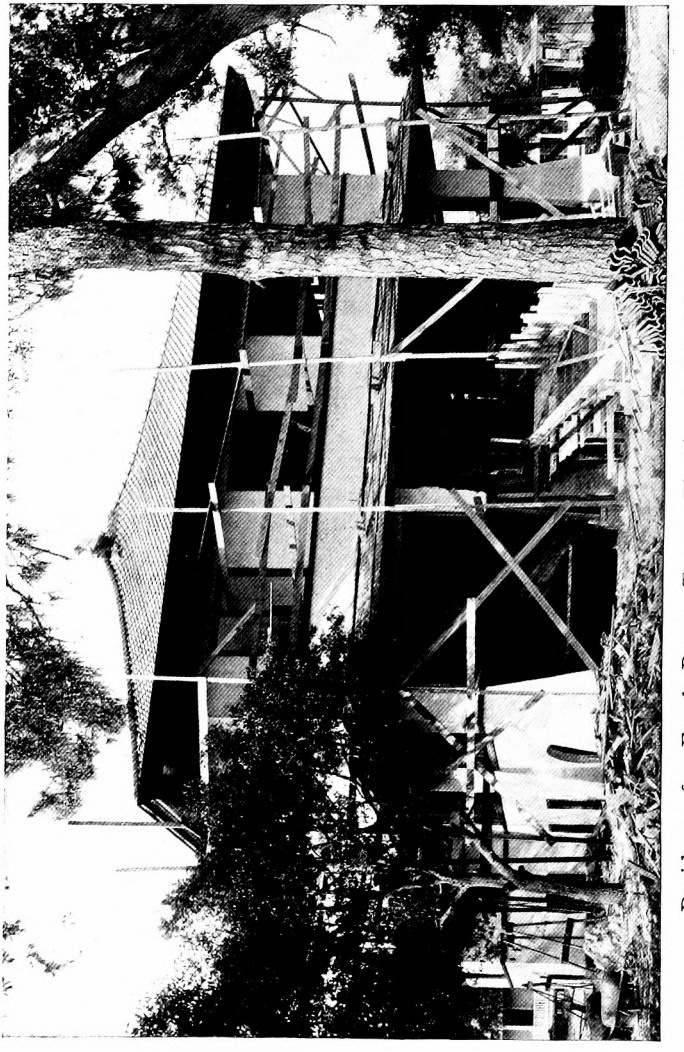
DETAILED APPLICATION OF RIB LATH FOR STUCCO OVER WOOD SHEATHING AND FOR INTERIOR — PLASTER FINISH —

Another method which has been extensively used in our colder climates is to place on the outside of the studding ⅞-inch matched sheathing, heavy building paper, furring, and **Rib Lath,** plastered 1 inch thick with cement mortar properly waterproofed. This method though more expensive, has not the strength, durability, or fireproofness of the method first described.

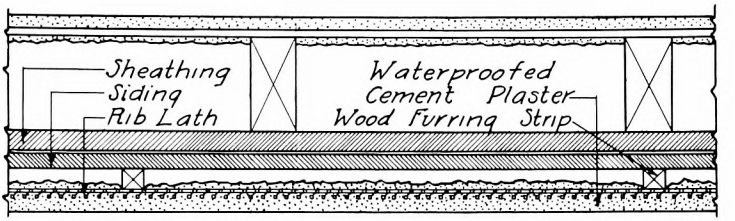
For our milder climates the furring may be omitted in the first two methods described and the paper sheathing may be omitted in all three cases. This reduces the cost still further.

RIB LATH INTERIORS

Rib Lath should be used in place of wood lath in all interior plaster work, so as to protect interior decorations from cracks and discolorations. Wood lath absorbs moisture from the plaster and in expanding causes cracks. This absorption leaves the plaster over the lath much drier than that between the lath, giving a streaked and dirty appearance to the plastered surface. In consideration of its many advantages, **Rib Lath** is the most economical material for plastering.



Residence for Frank Bruen, Tampa, Florida. A. H. Johnson, Architect.
View taken during construction. **Rib Lath** used throughout.



DETAILED APPLICATION OF RIB LATH FOR STUCCO OVER WOOD SHEATHING OR SIDING —

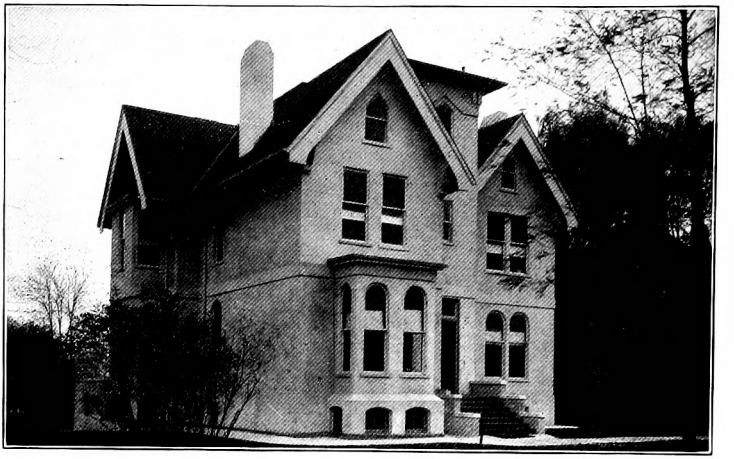
"OVER-COATED" HOUSES

An old wood frame building can be readily transformed at nominal expense into a fine, stucco-finished building by the use of **Rib Lath.** Wood furring strips are nailed vertically on the sides of the building, and the **Rib Lath** nailed to these with the ribs in a horizontal direction.

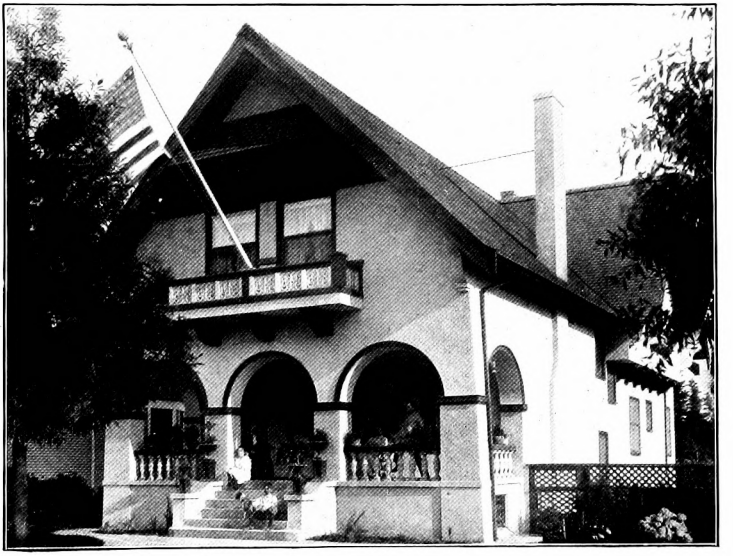
The cement stucco plaster is applied directly to the **Rib Lath.** This plaster should be the same as that indicated for building walls and sidings, and the outer three-quarter inch finish waterproofed with Trus-Con Waterproofing Paste Concentrated. The last coat may be of a smooth, rough or pebble dash finish, as desired.

It is customary to remove all ornamental and fancy wood trimmings from the house, as the beauty of the stucco lies in its plainness of line. Around the eaves and other portions which are more or less cut up, our **Rib Lath** can be readily fitted and the stucco applied. The transformation made in a house in this way is very wonderful, enhancing the value and life of the property and protecting it against fire.

An old, English half-timbered effect may be obtained by nailing a board to the sheathing that will come out flush with the finished concrete; after the plastering is finished, nail a finishing board on top of this with a lap that will extend one inch over the plaster.



Overcoated Residence of C. Bewick, Detroit, Mich.
Rib Lath used over old wooden house.



Rib Lath Residence for F. L. Spaulding,
Los Angeles, Cal. S. Munson, Architect.

SOLID PARTITIONS

Rib Lath may be used in connection with steel studs for solid cement or plastered partitions. When so used it is far more economical than the ordinary lath as it permits of a wider spacing of the studs, and supplies a straight, true surface to plaster against.

Hy-Rib, however, is the ideal reinforcement for solid partitions since it combines both lath and studs in one sheet. A wall built with Hy-Rib is much stronger and is less expensive than the ordinary method of lath and channels. (See Hy-Rib Catalogue.)

4-RIB HY-RIB

HY-RIB

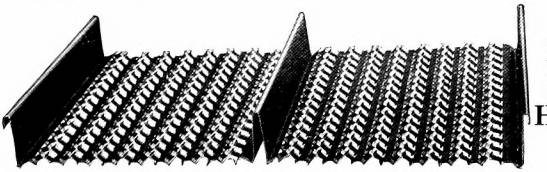
A self-centering reinforcement for concrete floors and roofs—a unit of lath and studs for walls and partitions.

Three types of **Hy-Rib** are supplied; 4-Rib **Hy-Rib,** 3-Rib **Hy-Rib** and Deep Rib **Hy-Rib.**

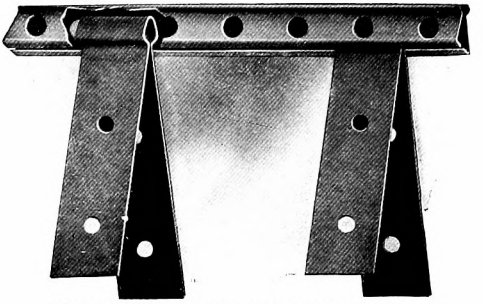
	Spacing of Ribs	Height of Ribs	Width of Sheets	Gauge Nos. U. S. Standard	Standard Lengths
4-Rib **HY-RIB**....	3½″	$\frac{13}{16}$″	10½″	24, 26 or 28	6′, 8′, 10′ and 12′
3-Rib **HY-RIB**....	7″	$\frac{13}{16}$″	14″	24, 26 or 28	6′, 8′, 10′ and 12′
Deep Rib **HY-RIB**	7″	1½″	14″	22, 24 or 26	6′, 8′, 10′ and 12′

Intermediate and shorter lengths are cut without charge, but any waste is charged to the purchaser.

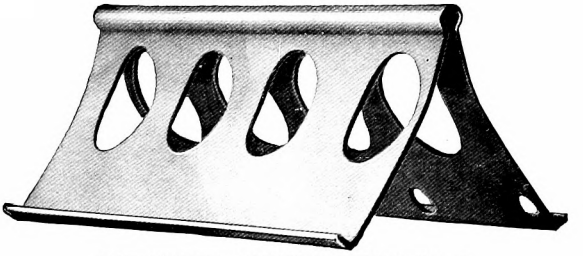
Complete Hy-Rib Catalogue mailed free on request.



DEEP RIB HY-RIB



DETROIT STEEL CORNER BEAD.



RIB STEEL CORNER BEAD NO. 1.

STEEL CORNER BEADS

All our corner beads are galvanized after forming. We furnish six different types of beads in lengths from 6 to 12 feet—to meet every requirement for the perfect protection of plaster corners.

DETROIT STEEL CORNER BEAD—see illustration above.

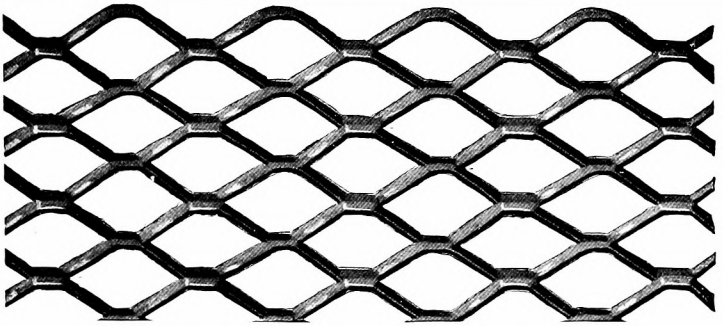
DETROIT T-RAIL CORNER BEAD—similar to Detroit Steel Corner Bead.

DETROIT SOLID RAIL CORNER BEAD—made of special rolled section with punched web.

RIB STEEL CORNER BEAD NO. 1—see illustration above.

RIB STEEL CORNER BEAD NO. 2—similar to Rib Steel Bead No. 1

RIB FEATHER-EDGE CORNER BEAD—for fine sharp corners.



DETROIT DIAMOND LATH

Size of Sheet, 18 x 96 inches.

Gauge	Sheets per Bundle	Yards per Bundle	Weight per Square Yard PLAIN	Weight per Square Yard GALVANIZED
No. 27	15	20	2.33 lbs.	3.03 lbs.
No. 26	15	20	2.5 lbs.	3.25 lbs.
No. 25	15	20	3.0 lbs.	3.8 lbs.
No. 24	15	20	3.4 lbs.	4.3 lbs.

We recommend painted lath, but can supply it plain or galvanized after expansion.

FINISHING AND WATERPROOFING

Concrete construction when in exposed positions should be properly finished and waterproofed by the Trus-Con Chemical Products, consisting of twenty-three distinct products for this class of work. Catalogue on request.

REINFORCED CONCRETE

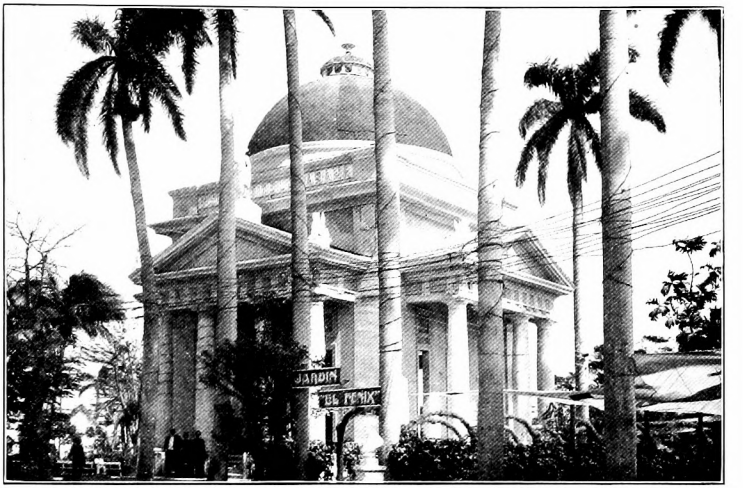
The Kahn Building Products, successfully used in over fifteen thousand important structures, include the following reinforcing products: Kahn Trussed Bars, Rib Bars, Collapsible Column Hooping, Rib Metal, Hy-Rib, Steel Floretyles, Floredomes and Building Specialties.

STEEL SASH FOR WINDOWS

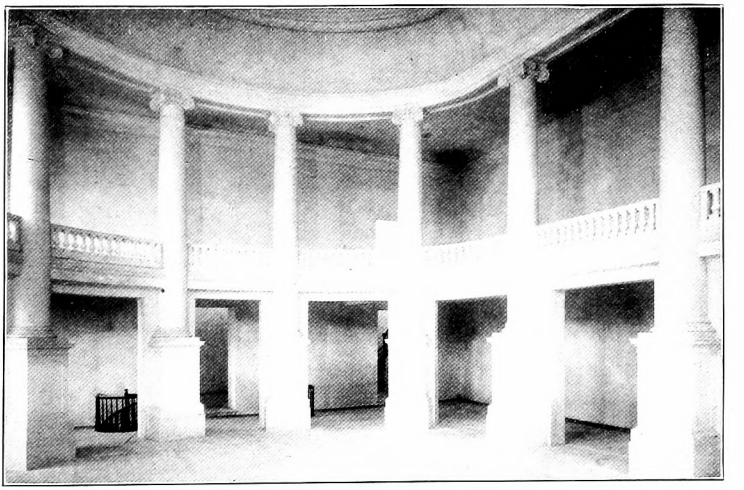
United Sash are made of deep, rolled-steel sections of great strength and rigidity,—cannot burn or wear out—and provide increased daylighting to interiors. Catalogue on request.

Instruccion Publica Bldg., Cuban National Exposition, Havana, Cuba.
Rib Lath Used Throughout.

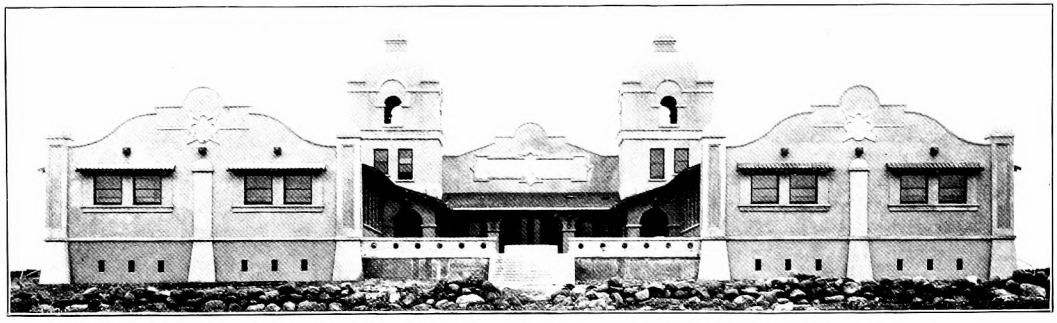
Band Stand, Cuban National Exposition, Havana, Cuba.
Dome Constructed of **Rib Lath.**



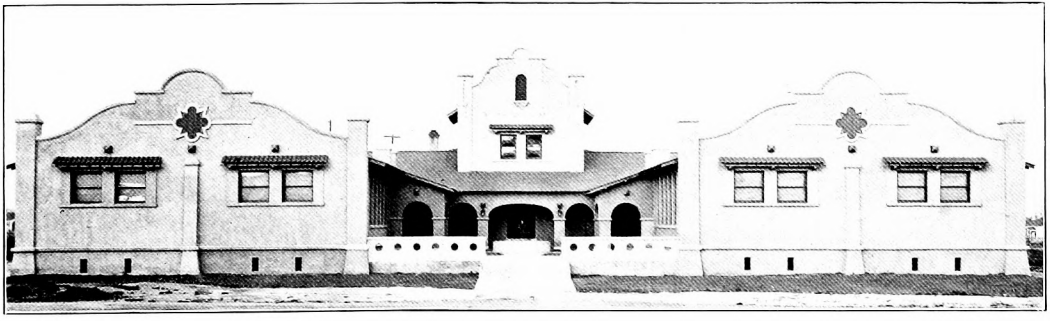
Building for Cuban National Exposition, Havana, Cuba.
Rib Lath Used Throughout.



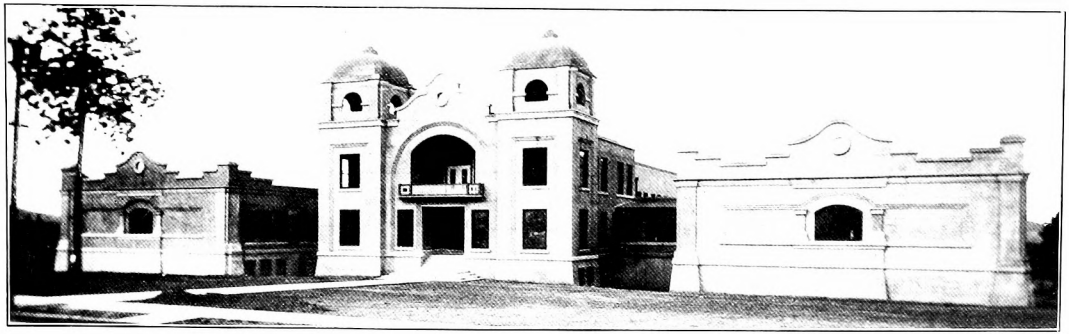
Lobby, House of Representatives, Havana, Cuba.
Steel Columns Fireproofed with **Rib Lath** and Plaster.
Floors Built KAHN SYSTEM Reinforced Concrete.



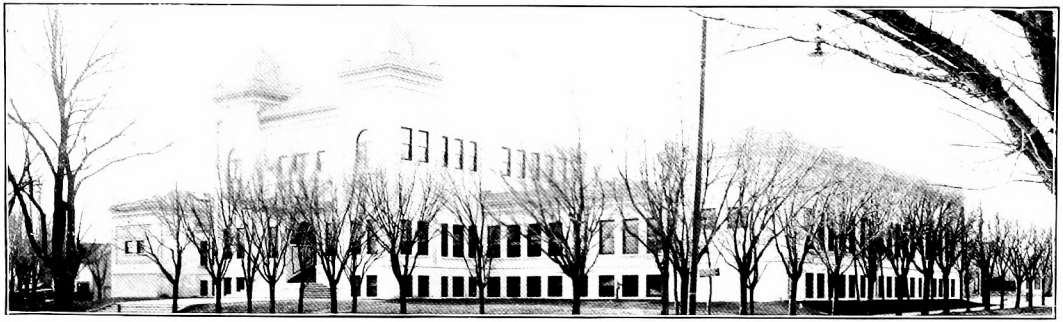
Mt. Rose School, Reno, Nev. Geo. A. Ferris & Co., Archts.
Rib Lath Used Throughout.



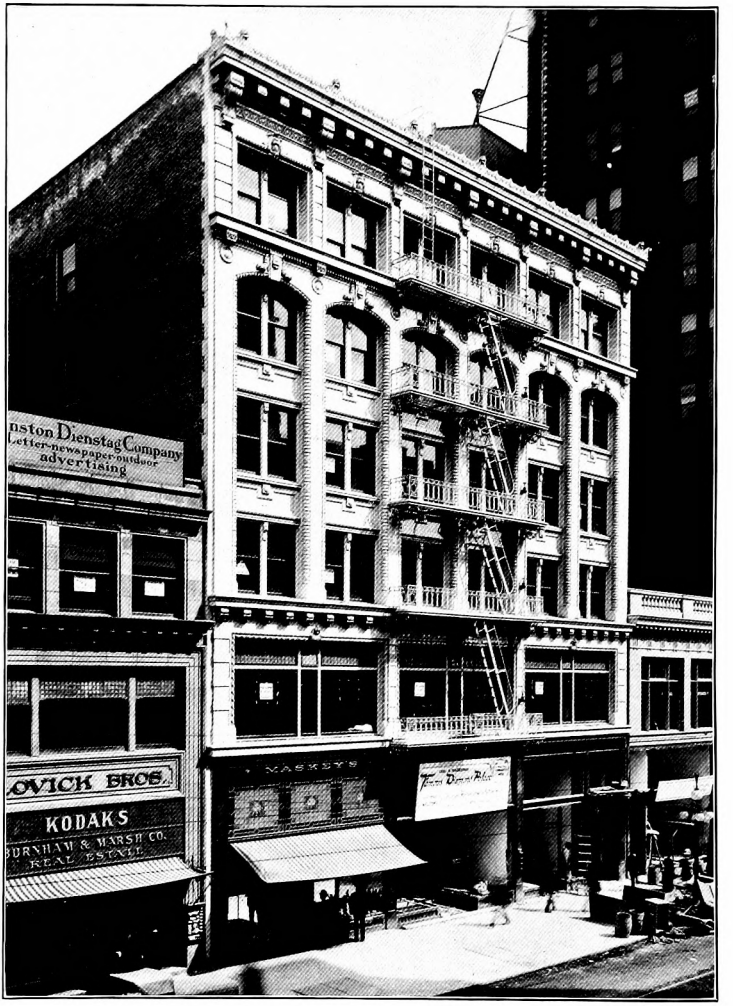
Orvis Ring School, Reno, Nev. Geo. A. Ferris & Co., Archts.
Rib Lath Used Throughout.



High School, Ashland, Ore. Geo. A. Ferris & Co., Archts.
Rib Lath Used Throughout.

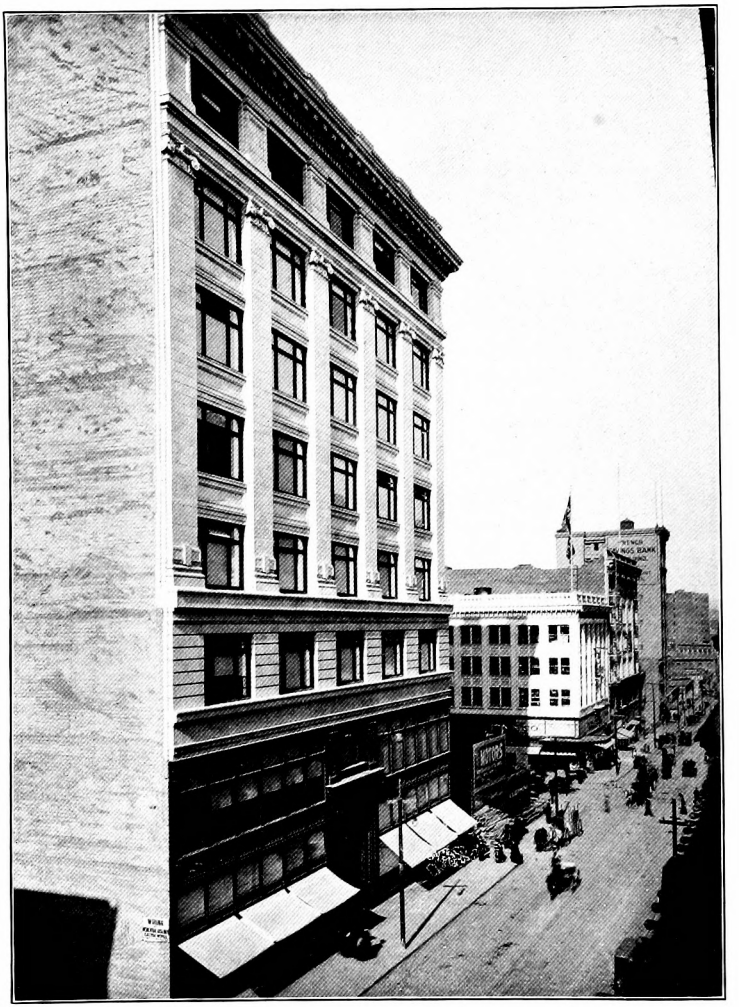


High School, Reno, Nev. Geo. A. Ferris & Co., Archts.
Rib Lath Used Throughout.

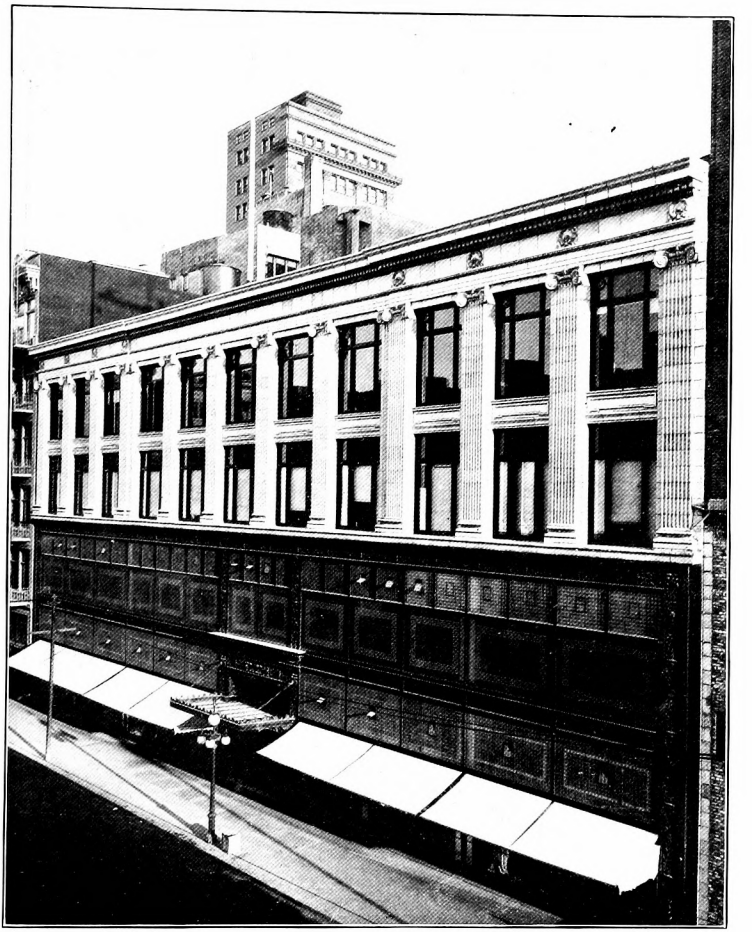


Maskey Building, San Francisco, Calif.
Havens & Toepke, Archts. Thos. H. Day's Sons, Contrs
Rib Lath used Throughout.

Rialto Building, San Francisco, Calif.
Bliss & Faville, Archts. Floodburg & McCaffery, Contrs.
Rib Lath and **Rib Studs** Partitions Throughout.



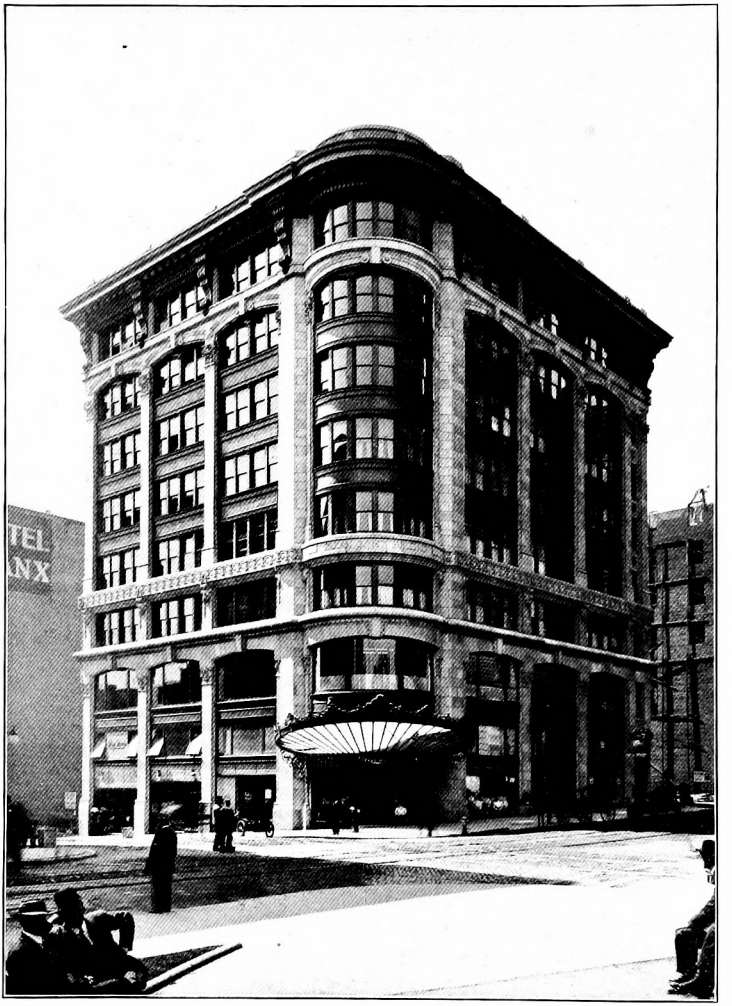
Sloane Building, San Francisco, Calif.
Reid Bros., Archts. Thompson-Starrett Co., Contrs.
Rib Lath used Throughout.



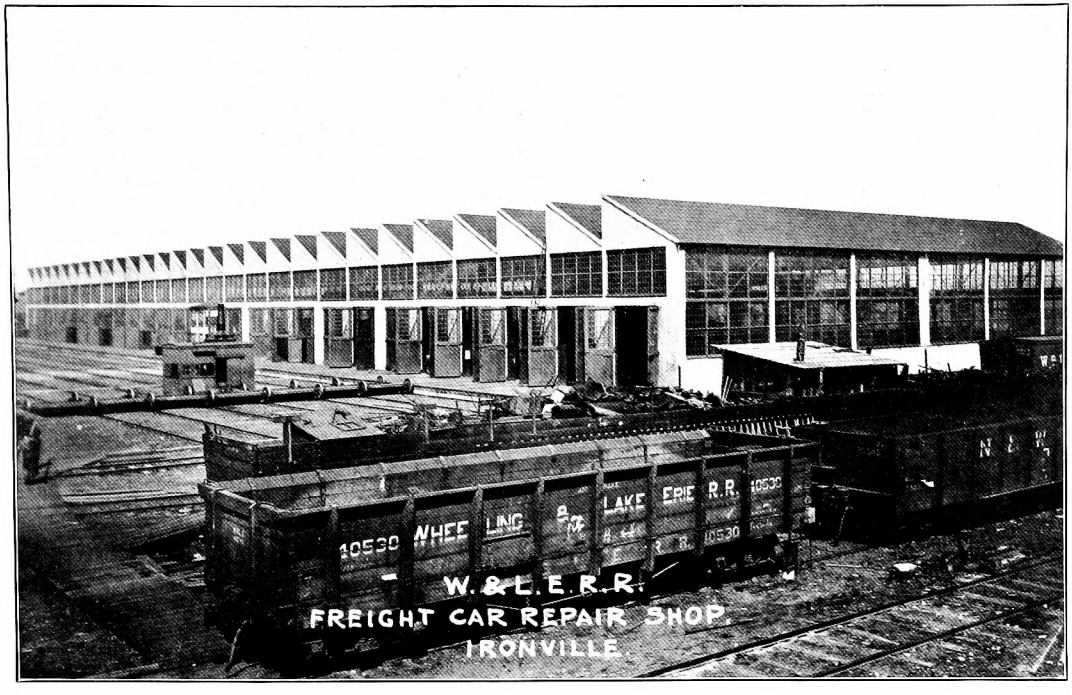
O'Connor & Moffatt Building, San Francisco, Calif.
Reid Bros., Archts.
Hy-Rib and **Rib Lath** used Throughout.

House of Providence, Detroit, Mich. Louis Kamper, Archt. Michael Finn, Plastering Contr.
Rib Lath Partitions Throughout.

Y. M. C. A. Building, Portland, Ore. Hy-Rib Partitions and Rib Lath Ceilings. MacNaughton, Raymond & Lawrence, Archts. J. D. Tresham, Contr.



Elkan Gunst Building, San Francisco, Calif.
Lansburgh & Joseph, Architects. Jas. Stewart Company, Contrs.
Rib Lath and **Rib Studs** used Throughout.



Rib Lath Sidings W. & L. E. R. R. Freight Car Repair Shops, Ironville, O.
(Also used in Sidings of Wheel Shop and Lumber Drying House.)

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TRUS-CON PRODUCTS

FOR STRUCTURAL WORK

WATERPROOFINGS
DAMPPROOFINGS
TECHNICAL PAINTS

KAHN Building Products
TRUSSED CONCRETE STEEL CO

THE TRUS-CON LABORATORIES

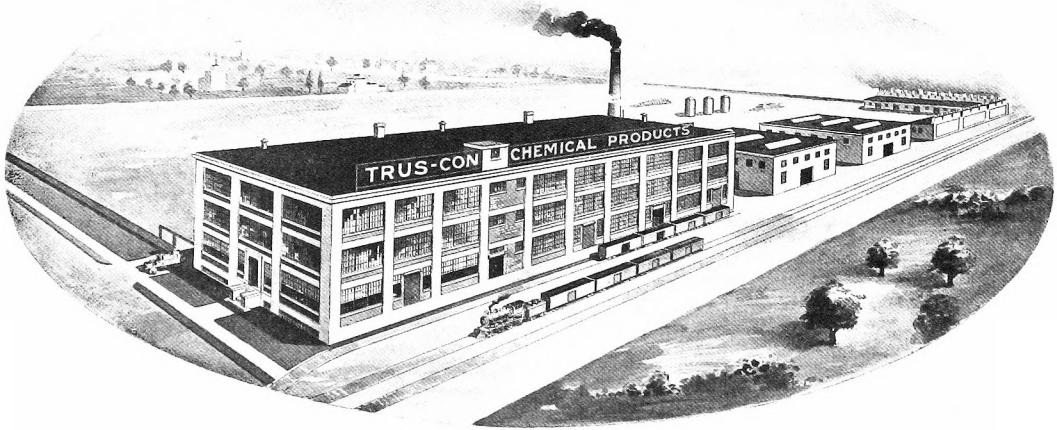
DAMPPROOFINGS—WATERPROOFINGS—TECHNICAL PAINTS

TRUSSED CONCRETE STEEL CO.

HOME OFFICE: DETROIT, MICHIGAN.

FACTORIES: DETROIT, MICHIGAN; AND CHICAGO, ILLINOIS

SALES OFFICES AND DISTRIBUTORS IN PRINCIPAL CITIES



TRUS-CON LABORATORIES Detroit, Michigan.
For exclusive manufacture of TRUS-CON PRODUCTS.

WATERPROOFING AND DAMPPROOFING

Waterproofing has an essential and important application in practically all construction work.

Water, as one of our greatest natural agencies, is not only constructive, but decidedly destructive.

The problems dealing with its perfect insulation are worthy of the same careful scientific consideration as any other important question of engineering design.

Waterproofing Engineering deals primarily with the methods and means of treating our structures so as to efficiently and effectively protect them against the discomforting and disintegrating action of water.

In the technical and practical consideration of the general subject of protecting our structures against the action of water, it is advisable to consider this large subject as divided in two separate divisions of DAMPPROOFING and WATERPROOFING.

DAMPPROOFING

Dampproofing should correctly be confined to the consideration of the methods and means of keeping water and dampness out of the superstructure of buildings. The subject of dampproofing deals with exterior exposed walls above grade line.

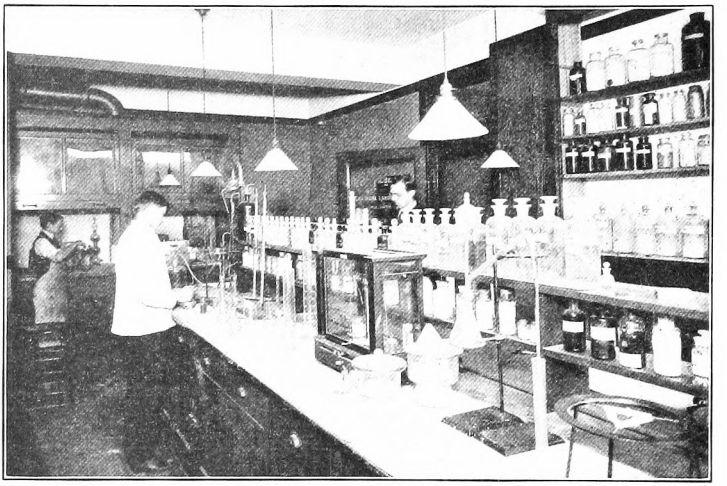
The application of correct dampproofing methods insures exterior walls which are not affected by the general disintegrating action of water, and interiors which are perfectly free from the unsanitary, disagreeable and discomforting effects of dampness.

WATERPROOFING

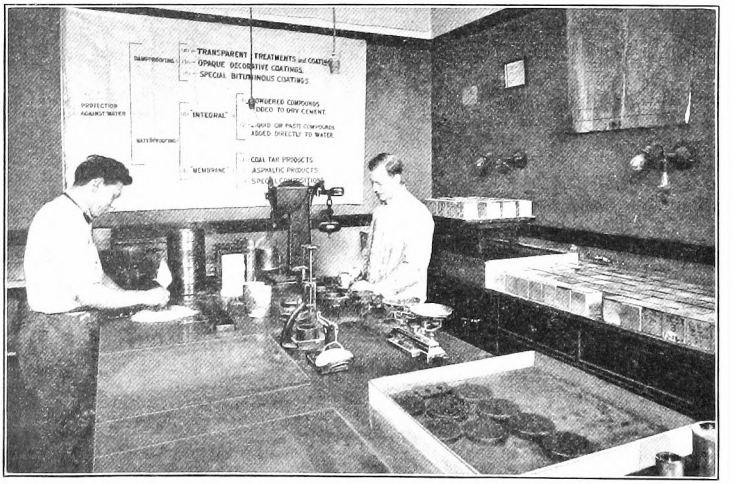
Waterproofing, in its literal interpretation, should correctly apply to methods and means of treating sub-terra construction and structures intended for retaining and containing water, under and against hydrostatic head. Consistent with this definition, waterproofing would apply directly to the treatment of foundations, tunnels, reservoirs, cisterns, standpipes and similar structures.

The following tabulation very simply indicates the two above subdivisions of the general subject of protection against water, with the most important methods in each class.

- PROTECTION AGAINST WATER
  - DAMP-PROOFING
    - (a) Transparent Coatings.
    - (b) Opaque Decorative Coatings.
    - (c) Special Bituminous Coatings.
  - WATER-PROOFING
    - (a) Integral
      - (1) Powdered Compounds added to dry cement.
      - (2) Liquid or Paste Compounds added directly to water.
    - (b) Membrane
      - (1) Coal Tar Products.
      - (2) Asphaltic Products.
      - (3) Special Compositions.

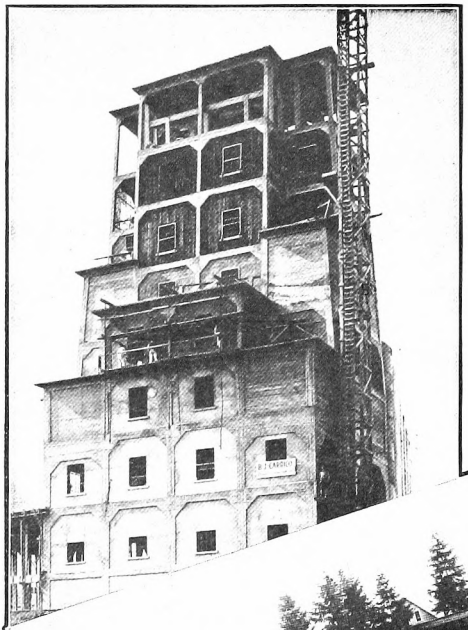


TRUS-CON Chemical Laboratory
Research and Experimental Section

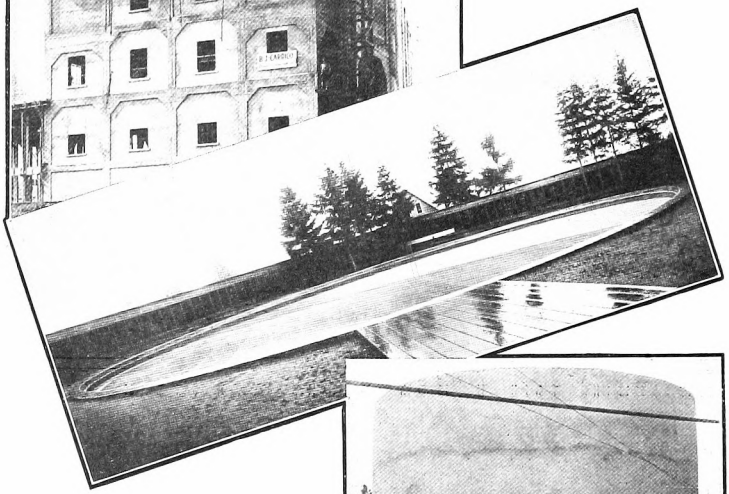


TRUS-CON Physical Laboratory
Testing Division

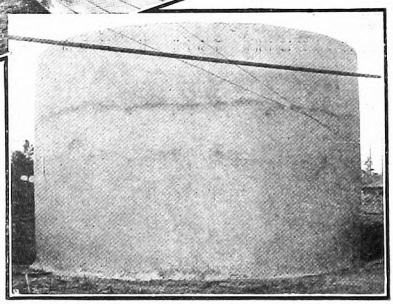
	Product	Page
DAMPPROOFING		
Transparent treatment applied to exterior exposed masonry walls	TRUS-CON Por-Seal	33
Opaque decorative coating applied to exterior masonry walls	TRUS-CON Stone-Tex	23
	Specification	86
Special bituminous coating applied to the interior of exposed walls	TRUS-CON Plaster Bond	37
	Specification	85
WATERPROOFING		
Integral method used throughout the entire concrete mass, applicable for foundations, tunnels, reservoirs, cisterns, tanks, etc.	TRUS-CON Waterproofing Paste	7
	Specification	79
Integral method applied in a waterproofed plaster coat	TRUS-CON Waterproofing Paste	7
	Specification-Stucco	77
	Specification-Foundations	81
ENAMELS AND INTERIOR FINISHES:		
For general wood, metal, brick and plaster walls	TRUS-CON Asepticote	57
	Specification	87
For highest quality enamel finish. Undercoating	TRUS-CON Asepticote	57
Enamel coating	TRUS-CON Sno-Wite	63
	Specification	88
For general industrial plants	TRUS-CON Industrial Enamel	65
	Specification	89
Hospitals, Sanitariums, etc.	TRUS-CON Hospital Enamel	67
Dairies, Creameries, etc.	TRUS-CON Dairy Enamel	67
Concrete Floors	TRUS-CON Floor Enamel	45
	Specification	91
PROTECTION OF IRON AND STEEL		
Exposed to elementary conditions	TRUS-CON Bar-Ox No. 7	69
	Specification	92
Brine and condenser pipes, coils, etc.	TRUS-CON Bar-Ox No. 14	70
Stack Enamel, Boiler Front Enamel.	TRUS-CON Bar-Ox No. 21	71
Acid Conditions	TRUS-CON Bar-Ox No. 28	71



Smith Bros.
Grain Elevator,
Fort Worth, Tex.
Foundations
and Stucco Sidings
Waterproofed with
TRUS-CON Water-
proofing Paste.



Sellwood Park
Swimming Pool,
Portland, Oregon.
TRUS-CON Paste
Used in All Concrete.



Tank, Jefferson Powder Mills,
Birmingham, Alabama.
Waterproofed with TRUS-CON Paste

TRUS-CON WATERPROOFING PASTE CONCENTRATED

TRUS-CON Waterproofing Paste Concentrated is significant in that it most efficiently combines in one product all the essentials of a perfect waterproofing.

(1) It is simple to use;
(2) Readily mixed with the gauging water;
(3) Most economical waterproofing compound;
(4) Colloidal in composition;
(5) Has a record of positive results.

1—**Simple to use. TRUS-CON Waterproofing Paste Concentrated** is added directly and simply to the water used to temper the dry mixture of cement and aggregate to be waterproofed. This method eliminates the expensive labor cost involved in the mixing of the powder waterproofings with the dry cement. The necessity of the preliminary dry mixing of the powder compounds also materially delays the work and substantially adds to the actual cost. The simplicity in the use of **TRUS-CON Waterproofing Paste Concentrated** makes this product the most economical, since practically no additional labor cost or delay in the work is necessary in its use.

2—**Readily mixed with the Gauging Water.** The reason **TRUS-CON Waterproofing Paste Concentrated** is manufactured in paste form is to permit its direct addition to gauging water so that it may be carried uniformly and evenly to every part of the mortar or concrete.

In any process endeavoring to produce a perfect mixture, it is fundamentally necessary that the body to be distributed be of such a nature that it is readily miscible with the distributing medium. A perfect mixture cannot be produced with ordinary oils and water, as the former are natural water repellents, and this property renders it impossible to obtain an even, uniform, physical distribution in water.

The greater number of dry powders offered for waterproofing purposes are chemically insoluble soaps with more or less hydrated lime. It is an inherent natural characteristic of metallic salts of fatty acids, such as these compounds, to show a distinct and marked repellent action to water. As water, to which they are repellent, must necessarily act as the distributing medium, it is quite obvious that it is practically impossible to obtain thoroughly uniform and even results, and the first

principle of integral waterproofing, namely homogeneous distribution of the compound employed, is violated.

Regardless of the careful effort that is made to mechanically mix the dry compounds throughout the dry cement and aggregate, it is certain that when the water is added to temper the mass, the waterproofing compounds, due to their repellent nature and lighter gravity, will be expelled from portions of the mass and be concentrated and stratified in other sections, entirely destroying the even, uniform distribution that may have originally been established through the careful dry mixing of the compounds with the dry cement. As the fluidity of the concrete increases, the resistance to flow throughout the mass naturally decreases, and the tendency of the dry repellent powder to be segregated is proportionately increased, making waterproof results the more impossible.

The condition is quite similar in principle to an attempt to evenly mix and hold in distribution fine pulverized cork. It is obvious that when the mass is very heavy and dry, the cork is entrapped and mechanically held, but as soon as any fluidity is produced by the addition of sufficient water to temper the concrete to normal consistency, the cork, due to its repellent nature, naturally works itself to the top of the mass, entirely destroying the original distribution.

It is to be emphasized that the very first consideration and essential in the selection of a waterproofing compound should be to determine the ease with which the product is originally miscible with the gauging water, to insure its perfect and even distribution throughout the mass to be waterproofed.

TRUS-CON Waterproofing Paste Concentrated is so treated in manufacture as to insure a product that is most readily miscible with the water, in fact, almost instantly diffuses throughout the water, in which it remains in uniform and even suspension, insuring the use of the product in a constant and fixed proportion throughout the entire work.

In the process of hardening, **TRUS-CON Waterproofing Paste Concentrated** assumes repellent properties which are even greater than the products which originally possess this property, and has the advantage of being uniformly and evenly distributed in the work, so that its effect is entirely uniform. **TRUS-CON Waterproofing Paste Concentrated** is the pioneer in the recognition of this valuable and essential principle in integral waterproofing.

PURDUE UNIVERSITY
Lafayette, Ind.

February 13, 1911.

The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—It would no doubt be of interest to you to learn that we consider your TRUS-CON Waterproofing Paste as used by us in our cement laboratory to be highly successful.

Very truly yours,
H. H. SCOFIELD,
Laboratory for Testing Materials,
Purdue University.

MOST ECONOMICAL WATERPROOFING COMPOUND

3—**The Most Economical Waterproofing Compound.** The requirement for the greatest possible economy in general waterproofing work has been fully met in the concentration of **TRUS-CON Waterproofing Paste.**

This product, when used in the proportions recommended, affords a **lower unit cost than any other integral waterproofing treatment.**

The use of this product in so lean proportions, with absolute certainty of results, is provided by the elimination from its constituency of all inert fillers such as hydrated lime, clay, silica, etc., which are the bases of most integral waterproofing pastes and powders. Only materials of the greatest activity and intensity in providing waterproofness are employed, and these are especially treated in manufacture to develop their maximum waterproofing value.

The low cost of perfect waterproofing results with this product permits the more general use of waterproofing, not only for conditions where waterproofness is the first consideration, but for all work where waterproofness is beneficial.

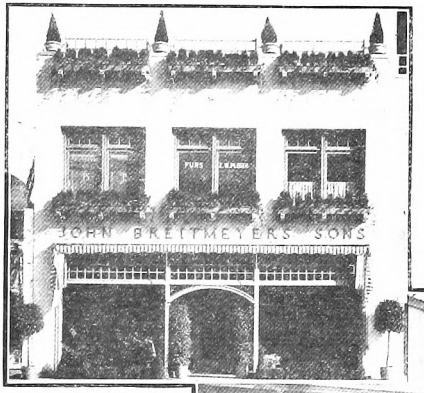
TRUS-CON Waterproofing Paste, Concentrated, is the first waterproofing to combine in one product thorough simplicity and practicability in use and the lowest unit material cost, which only justly entitles it to recognition as the standard product.

4—**Colloidal in Composition.** A careful study of the chemical and physical processes which take place when Portland cement is mixed with water, makes it clearly evident that a waterproofing compound, to give satisfactory results, must necessarily be of a colloidal nature. The process of setting and hardening of Portland cement mortar and concrete is not alone a process of solution, hydration and recrystallization, but is supplemented by the formation of a colloidal substance, which surrounds and protects the crystals of cement that bind the particles of sand and stone together.

The partial degree of waterproofness which is characteristic of Portland Cement mortar and concrete is due entirely to the presence of this colloidal body. In its absence there would be no medium to protect the crystallization against the action of water, which would tend to gradually soften, dissolve and disintegrate the mass, when subjected to actual practical exposure.

This colloidal substance, however, is never formed in sufficient quantity to entirely fill out all the voids in the mass, and it is accordingly the function of an efficient integral waterproofing not only to intensify the formation of the colloid originating from the cement itself, but to add a sufficient quantity of colloid so as to fill out the voids and impart to the concrete sufficient density to render it absolutely impermeable.

It is a further essential of an efficient integral waterproofing that the body not only be originally colloidal, but have the property of indefinitely retaining its colloidal development. Such absorbent colloids as clay, hydrated lime, aluminum hydroxide, etc., which have been used with very questionable success, have been found in time to dehydrate, losing their colloidal development, and are very slow and inactive in reverting to the colloidal condition. This behavior undoubtedly explains the very inconsistent results obtained with products of this character, as in some cases, where conditions are particularly favorable for maintaining the colloidal condition, results will be quite satisfactory, but generally, where there is any opportunity for the drying out of the colloid, the waterproofness is destroyed.



Concrete Fountain Basin shown below has been waterproofed with TRUS-CON Waterproofing Paste as specified on page 79.

Stucco on front of Flower Shop has been waterproofed with TRUS-CON Waterproofing Paste, as specified on page 77.

Breitmeyer Flower Shop, Detroit. Burrowes & Wells, Architects.

Interior Breitmeyer Flower Shop

TRUS-CON Waterproofing Paste, Concentrated, is not only a most perfect colloidal body, but is manufactured from raw materials that contribute a most permanent condition to the colloid, and the results with this product are thoroughly reliable and permanent.

In addition to the permanency of the colloidal condition of the product, it is further essential that the product be of such a nature that it will not decrease the strength of the mortar or concrete in which it is employed. No engineer can conscientiously be favorable toward sacrificing strength for waterproofness, particularly when this condition is not necessary.

TRUS-CON Waterproofing Paste, Concentrated, working in the closest conjunction with the colloid originating in the cement itself, perfectly filling out the voids, not only renders the concrete waterproof, but increases the strength rather than in any way reducing it.

Compounds containing large percentages of free fats, soluble soaps, active silicic acid compounds, etc., invariable materially reduce the strength, due to the fact that these products react seriously with the constituents in the cement and very materially interfere with the normal process of hardening that is essential to develop the full strength.

Positive in Results. TRUS-CON Waterproofing Paste, Concentrated, is no experimental product. The large number of important and extensive operations in which this product has been most successfully used, has thoroughly and unquestionably demonstrated that a product that represents the scientific perfectness and technical correctness of this material will invariable give the most dependable and satisfactory results in actual practice.

TRUS-CON Waterproofing Paste, Concentrated, has a very wide field of usefulness. In its practical application to waterproofing conditions, it can be added to the water used to temper the concrete used throughout the mass of the work, or it can be concentrated in a plaster coat in the surface of the structure.

Use **TRUS-CON Waterproofing Paste, Concentrated**, in concrete work of all kinds—in foundations, dams, tunnels, reservoirs, tanks, floors and all similar structures.

On the succeeding pages are given in complete detail general specifications for the use of **TRUS-CON Waterproofing Paste, Concentrated**, and upon request we will be pleased to furnish special specifications, giving in detail the application of this remarkable product to any special waterproofing condition. We offer you the advantages of our experience in pioneering concrete construction, together with the special study and attention which we have given to the subject of waterproofing, in solving your problems. Our suggestions and recommendations are given to you without any obligation.

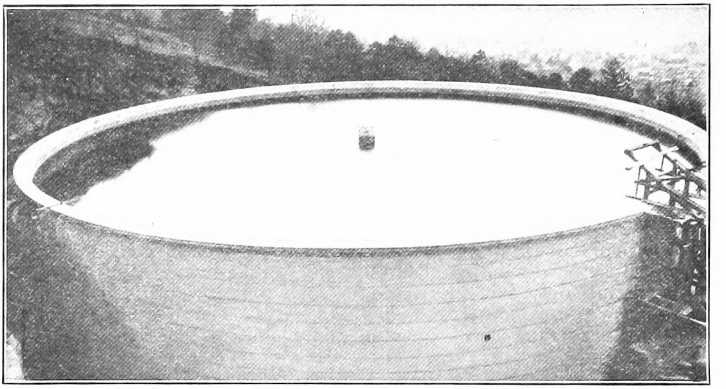
McLAUGHLIN & HULSKEN
Architects

Lima, Ohio, Sept. 14, 1910.

The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—In regard to our experience in the use of your waterproofing compound, we expect to use twelve tons of your TRUS-CON Waterproofing Paste in one of our buildings, and are pleased to state that we have no hesitancy in heartily recommending same.

Yours very truly,
McLAUGHLIN & HULSKEN.



The five-million gallon Auxiliary Reservoir, at Asheville, North Carolina. Thoroughly and permanently waterproofed by using TRUS-CON Waterproofing Paste.

A CONVINCING REPORT

"This reinforced concrete reservoir, built to insure an auxiliary or emergency supply for the water system of Asheville, N. C., has a capacity of 5,000,000 gallons of water. The reservoir is 150 feet in diameter at the bottom and is 40 feet deep. The wall is three and one-half feet thick at the bottom and tapers to a thickness of eight inches at the top.

"As originally constructed the reservoir was not satisfactory, but has been brought to stand a thorough test and has just been accepted by the city after additional work, which was done by Mr. George H. Davidson, a contractor of Asheville. The bottom of the tank, when Mr. Davidson began work on it, was from two to six inches thick with concrete filling up the crevices and the entire floor of the tank was cracked very badly. The sides of the tank were originally built in 5-foot sections, and at these seams there was a constant leakage. At some places there were cracks up and down the wall, while nearly all of the wall was porous and water seeped through. Mr. Davidson broke out all of the old bottom entirely around for a distance of two feet from the walls, going down to solid rock and cleaning out all cracks and crevices. He then filled all with good concrete mixed with **TRUS-CON Waterproofing Paste** to the level of the old floor. On top of this he laid the 8-inch floor with ½-inch reinforcing steel, filled with **TRUS-CON Waterproofing Paste** and concrete, as per **TRUS-CON** specifications, using fifteen barrels of the **Paste** in the bottom. He then cut out all joints on the wall and filled them with cement mortar mixed with **TRUS-CON Waterproofing Paste.**

"Mr. Davidson's contract was '**no pay if not water-tight' after a test of 90 days with reservoir full of water;** and at the end of 90 days the mayor and five aldermen examined the reservoir and found that he had complied with his contract and made good. Quite a number of outside firms made bids for waterproofing of this reservoir, the **lowest bid of these** being in the neighborhood of **$20,000,** while the cost **under Mr. Davidson's plan** was **$11,400,** and he made some money. A number of firms making waterproofing material solicited this business, but after demonstrations and examining the merits of the various waterproof materials, **Mr. Davidson told me that he had decided that TRUS-CON Waterproofing Paste was the best material to use; and he used it and made good.**"

N. BUCKNER,
Sec'y Asheville Board of Trade.

SOHO BATHS
2410 Fifth Avenue, Pittsburgh, Pa.

January 31, 1912.

Trussed Concrete Steel Co.,
15 Terminal Office Bldg.,
Pittsburgh, Pa.

Dear Sirs—Regarding the waterproofing of the Soho Baths with your TRUS-CON PASTE, will say that the same is perfectly satisfactory.

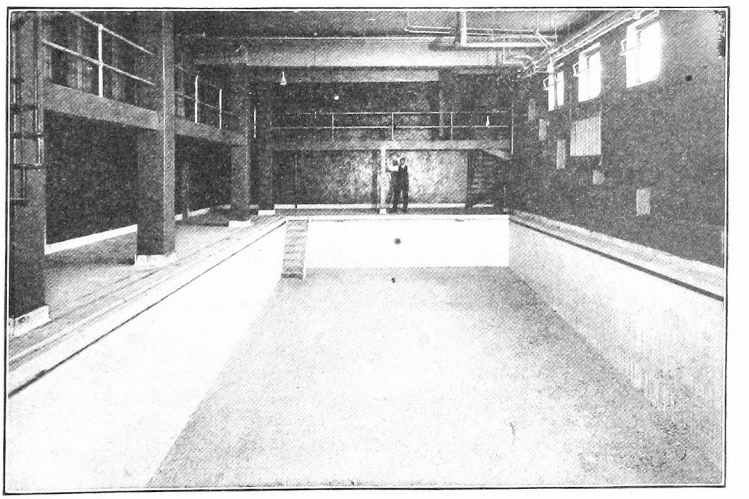
Our condition was rather extreme; the building is situated on Fifth Avenue, 3 stories above and 3 stories below Fifth Avenue. Our front wall extends down 36 feet below the street, being 12½ feet thick at bottom, composed of concrete.

The water backed up against the wall from springs in the hill and came through a dozen different places, running continually all seasons of the year at 100 gallons per hour. By applying a plaster coat ¾ inches thick 1:2, mixing the TRUS-CON Paste to the water, we have secured a water-tight job and our walls are now perfectly dry, enabling us to utilize the floors below Fifth Avenue and make a swimming pool in which we have used the TRUS-CON Paste with satisfaction.

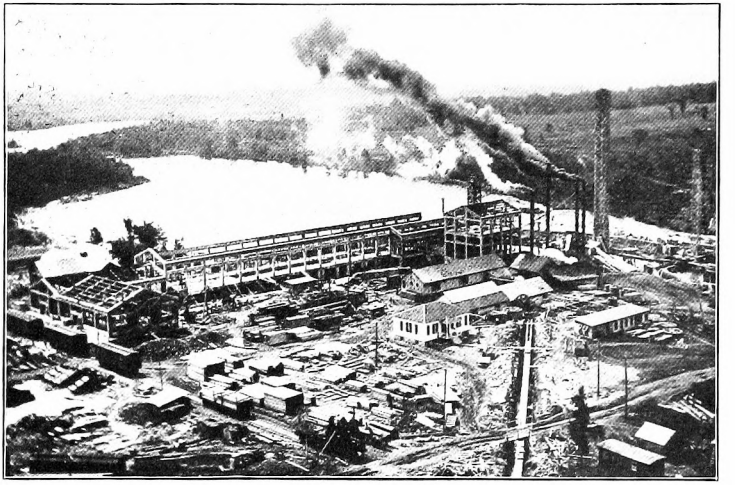
The walls were so dry that the carpenter thinking there was no water back, drilled through the plaster coat to fasten partition, when instantly the water gushed forth in a stream with much pressure, proving conclusively that your material is a thorough waterproof, and we will always use it in our waterproofing.

Yours truly,

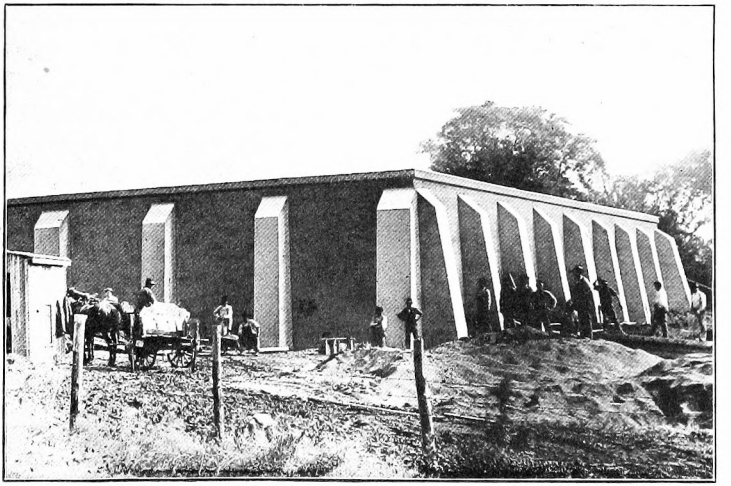
D. P. MARSHALL,
Superintendent.



Swimming Pool, Soho Public Baths, Pittsburgh
Tank, and Walls, above waterproofed with TRUS-CON Waterproofing Paste



Brunett Falls Manufacturing Co., Cornell, Wis.
All concrete subject to hydrostatic pressure waterproofed with
TRUS-CON WATERPROOFING PASTE, Concentrated.



City Reservoir, St. Charles, Mo.
Waterproofed with TRUS-CON WATERPROOFING PASTE, Concentrated.

DIRECTIONS FOR USING TRUS-CON WATERPROOFING PASTE CONCENTRATED

Only ordinary care and reasonable attention are necessary to obtain the very best results with this product.

In the general integral waterproofing of mass concrete, **TRUS-CON Concentrated Paste** should be employed in the proportion of one (1) part of **Paste** to thirty-six (36) parts of water, which provides the most economical waterproofing available. In the proportion of one (1) part of **Paste** to thirty-six (36) parts of water, *only five (5) pounds of Concentrated Paste are required per cubic yard of concrete.*

For conditions that are particularly extreme, due to small mass or especially high pressure, the **Concentrated Paste** should be used in the proportion of one (1) part of **Paste** to twenty-four (24) parts of water; but under average conditions of waterproofing the **Paste** can be employed in the proportion of one to thirty-six (1:36) as recommended above.

For a waterproofed cement plaster coat, the **Concentrated Paste** should be employed in the proportion of one (1) part of **Paste** to eighteen (18) parts of water.

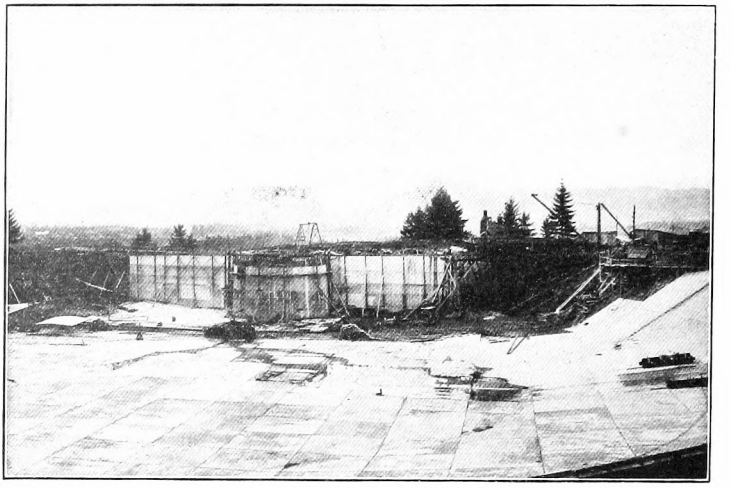
Best results are obtained by thoroughly mixing one part **Paste** with an equal volume of water and while stirring vigorously add sufficient more volumes of water to give proportions required above.

The milky solution resulting from the mixture of **Paste** and water in the above proportion should be used in place of clear water to temper the dry mixture of cement and aggregate.

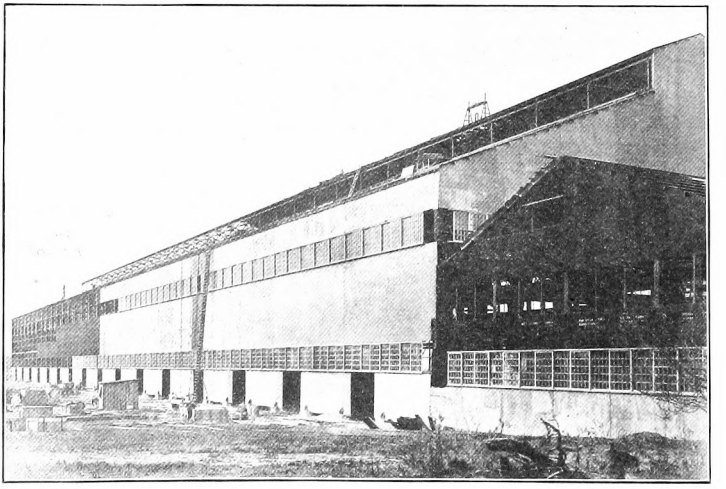
In case the mixture of **Paste** *and water is allowed to stand for any interval between using, it should be most thoroughly stirred to insure an even and uniform solution each time just before using. The* **Paste** *diffuses so readily that this imposes no additional trouble, as very little agitation will insure its perfect distribution.*

The following table gives the quantities of cement, sand and **TRUS-CON Waterproofing Paste Concentrated** required for a 1:2 waterproofed plaster coat to cover 100 square feet of surface.

PROPORTIONS	Thickness	Bbls. Cement	Cu. yds. Sand	WATER		Pounds Paste
				Lbs.	Gals.	
1 part Cement 2 parts Sand Area 100 sq. ft.	1″	1.00	.28	120	14.5	6.4
	¾″	0.75	.21	90	10.9	4.8
	½″	0.50	.14	60	7.3	3.2



Headgates Mt. Tabor Reservoir, Portland, Oregon
Waterproofed with TRUS-CON Waterproofing Paste



Inter-Ocean Steel Plant, Chicago, Ill.
Stucco Sidings Waterproofed with TRUS-CON Waterproofing Paste.

W. H. SIEVERLING, C. E.
General Contractor.

Springfield, Ohio, August 3rd, 1910.

The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—Regarding the waterproofing you furnished for the Springfield Light, Heat & Power Co.'s new consolidated power house, will say that nearly two tons of "TRUS-CON WATERPROOFING PASTE" were used.

The situation seemed hopeless, as I had not only to contend with numerous living springs, flowing through the power plant, coming up from the fissures and seams of limestone cliffs out of which the foundations were blasted, but also high waters from a turbulent creek, flowing by the plant. I had as much as eight (8) feet of water in the basements about all last winter and spring.

After much pumping and building of sheep troughs and sumps, and using plenty of TRUS-CON WATERPROOFING PASTE incorporated into the concrete for walls, floors and top coat, I succeeded in getting a PERFECTLY dry basement for their electrical machinery.

I like to use TRUS-CON Paste, because with the average common labor you can get, it is easier to use and get results than with any other waterproofing that requires intelligent, if not expert, manipulation.

I can assure you that the Light Company is more than satisfied, as we have had some high waters since, and everything proved water-tight.

Very truly,

W. H. SIEVERLING.

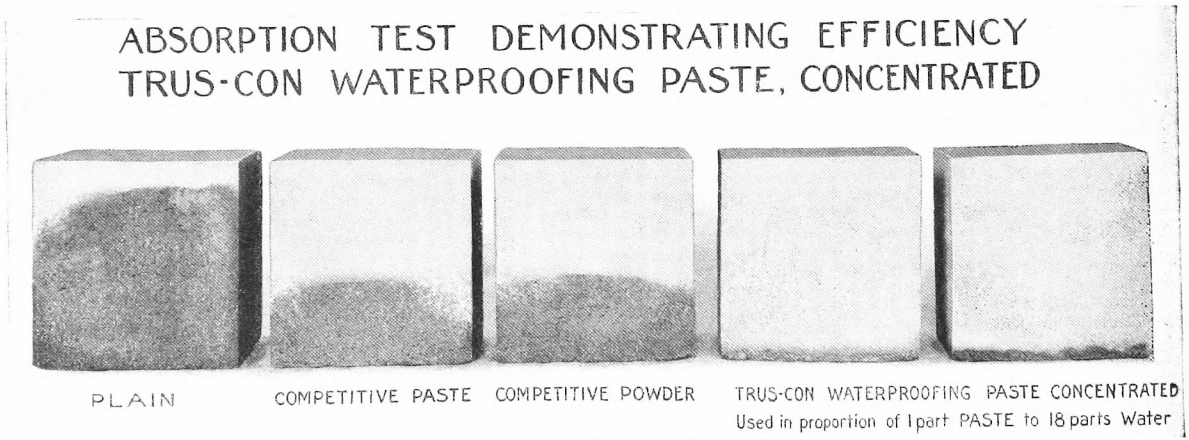
RAYMOND CONCRETE PILE COMPANY
135 Adams Street

Chicago, Sept. 27, 1910.

The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—Referring to your inquiry relative to the TRUS-CON WATERPROOFING PASTE we used in Chicago last winter, beg to say that this was used in connection with the foundation for a building for Mr. E. S. Shepard located at Fairbanks Court, Erie Street, Chicago. We had very good success indeed with your product, and found same entirely satisfactory for the purpose required.

Very truly yours,
RAYMOND CONCRETE PILE CO.
H. D. Raymond, Asst. Treasurer.



One of the many methods employed in TRUS-CON LABORATORIES for testing efficiency of waterproofings.

HARDY & ARONS
Dayton, Ohio

The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—Ever since the erection of the Colonial Building, corner of Third and Grimes Streets, the basement has been useless because of the great seepage of water through the walls and cement floor.

We contracted with the Dayton Fiber Plaster Co., of this city, to make this basement water-tight and damp-proof with your products. They applied a $\frac{3}{4}$″ coating of cement mortar on these walls and a 2″ cement floor, using your Waterproofing Paste in the water with which this material was mixed. The surface thus treated amounted to about 10,000 square feet. Our basement is now absolutely dry, and we cannot too highly recommend your products.

Respectfully yours,
HARDY & ARONS.

PALMER CONCRETE HOLLOW BLOCK COMPANY

Washington, D. C., May 18, 1910.

The Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—We think that your TRUS-CON Waterproofing Paste is the best thing that has yet come to our knowledge.

Yours very truly,
H. S. PALMER.

WAUKESHA CONCRETE BLOCK & MATERIAL CO.

Waukesha, Wis., July 21, 1910.

We believe your TRUS-CON Waterproofing Paste to be superior to other preparations we have used.

Very truly,
WAUKESHA CON. BLOCK & MAT. CO.

ARTHUR L. PILLSBURY, ARCHITECT.

Bloomington, Ill., Sept. 23, 1910.

Your shipment of TRUS-CON Waterproofing Paste duly received and have used with what seems to be good results.

We have also instructed the Davis Ewing Concrete Company to use this material on some floor work which they have for a client of mine, and I think it is going to give just the satisfaction that we want.

Yours sincerely,
ARTHUR L. PILLSBURY.

BICKES & KLUNPP,
900 E. North Street.

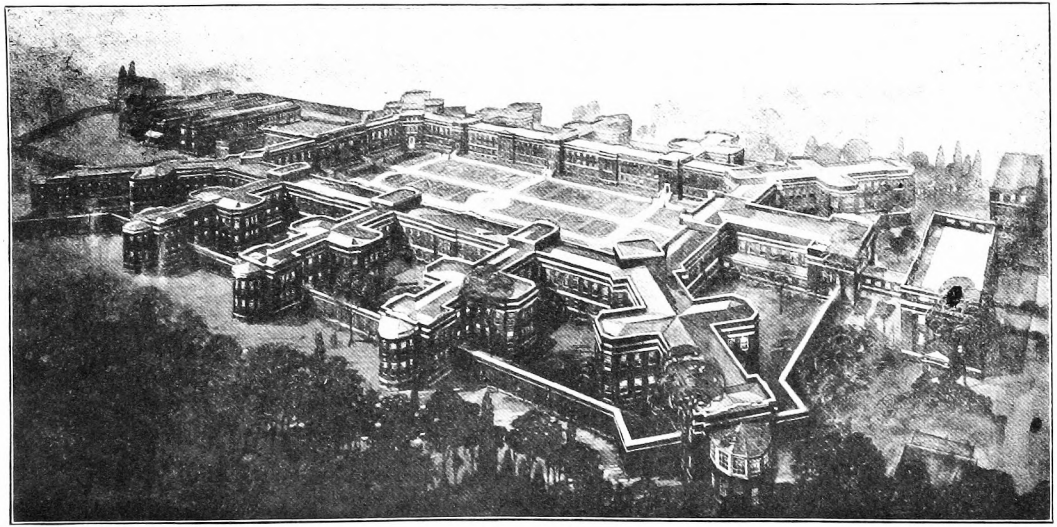
Decatur, Ill., Jan. 27, 1911.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—We are in the concrete business, and are making burial vaults. We were told that if we used ..... *Waterproofing Powder* we could make these vaults waterproof, but we find by filling the vaults with water, that they leak like sieves, and that the *waterproofing powder comes up to the top as the concrete is poured.* After the vaults have set, you can scrape the powder off with your finger, and it leaves the concrete full of soft places.

We do not care to risk any more labor or material with powder waterproofing, but want you to send us prices on your Waterproofing Paste. We have poured a box about 12 inches square, using TRUS-CON Waterproofing Paste, and upon filling same with water, note that the outside keeps perfectly dry. In using the powder waterproofing, we gave the same careful attention to the mixing. We first mixed the cement and waterproofing compound through a fine sieve, and made sure that the dry mixture was perfectly uniform.

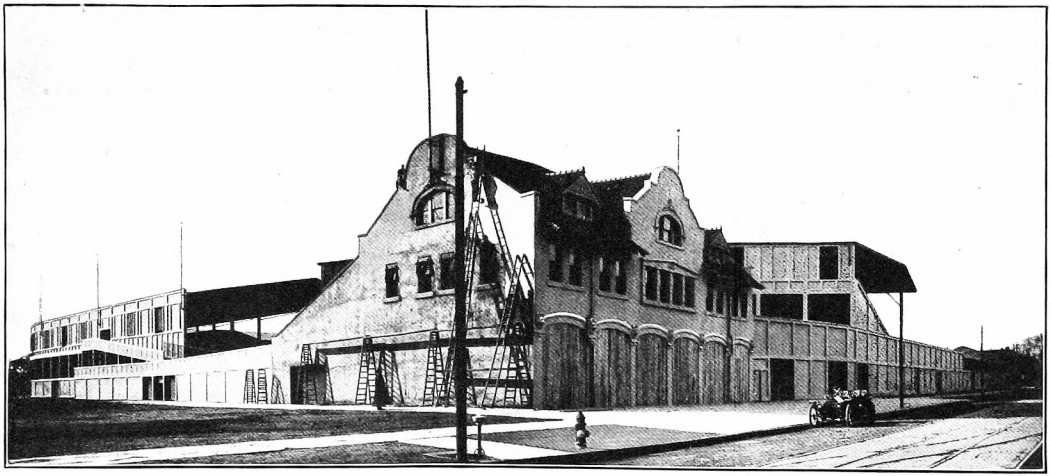
Very truly yours,
BICKES & KLUNPP.



Lima State Hospital, Lima, Ohio
Frank L. Packard, Architect; Frank Snyder, Associate; E. P. Babbitt, Engineer.
Floors and Reservoirs Waterproofed with TRUS-CON Waterproofing Paste, Concentrated.

A FEW STRUCTURES WHERE TRUS-CON WATERPROOFING PASTE HAS BEEN USED

Packard Motor Car Co., Detroit and Philadelphia.
Ford Motor Car Company, Detroit, Mich.
Lozier Motor Car Co., Detroit, Mich.
Hudson Motor Car Co., Detroit, Mich.
Gramm Motor Car Co., Lima, Ohio.
City Reservoir, Hancock, Mich.
City Reservoir, Asheville, N. C.
City Reservoir, Coffeyville, Kans.
City Reservoir, Fort Dodge, Iowa.
City Reservoir, Lafayette, Ind.
City Reservoir, St. Charles, Mo.
Reservoir, Ledbetter Mfg., Rockingham, N. C.
Lighting Plant, Springfield, Ohio.
Mexican Light & Power Co., Mexico City, Mexico.
Westinghouse Lamp Factory, Watsessing, N. J.
Grain Elevator, Fort Worth, Texas.
General Electric Co., Schnectady, N. Y.
Goldfield Milling & Transportation Co., Goldfield, Nev.
Oliver Chilled Plow Works, South Bend, Ind.
Rogers-Brown Ore Co., Deerwood, Minn.
Markham Air Rifle Co., Plymouth, Mich.
Seaboard Air Line Ry., Portsmouth, Va.
Beckett Paper Co., Hamilton, Ohio.
Western Electric Co., New York City, and elsewhere.
Inter-Ocean Steel Co., Chicago, Ill.
Jefferson Powder Co., Birmingham, Alabama.
Chicago, Rock Island & Southern Ry.
Magee Theatre, Schenectady, N. Y.
Hartman Furniture Co., Warehouse, Chicago, Ill.
Anderson Forge Co., Detroit, Mich.
Quartermaster's Department, Washington, D. C.
Kling Brewery, Detroit, Mich.
Capitol City Brewery, Montgomery, Ala.
Great Lakes Engineering Co., Ashtabula, Ohio.
Brunett Falls Mfg. Co., Cornell, Wis.
Continental Motor Car Co., Detroit, Mich.
Central Market Building, Detroit, Mich.
Government Light House Caissons, Detroit River.
Pere Marquette R. R., Detroit, Mich.
Grand Rapids & Indiana R. R., Grand Rapids, Mich.
Edward Ford Plate Glass Co., Rossford, Ohio.
Dodge Bros. Plant, Detroit, Mich.
Detroit Free Press Building, Detroit, Mich.
Press Building, Pittsburg, Pa.
Oil Well Supply Bldg., Pittsburg, Pa.
Hamburger Building, Pittsburg, Pa.
Soho Public Baths, Pittsburg, Pa.
Y. M. C. A. Building, New Castle, Pa.
Y. M. C. A. Swimming Pool, Red Wing, Minn.
Y. M. C. A. Swimming Pool, Fostoria, Ohio.
Sellwood Park, Swimming Pool, Portland, Oregon.
Water Tank, Cojimar, Cuba.
Revere Rubber Co., Chelsea, Mass.
Goodyear Rubber Co., Akron, Ohio.
Rubber Regenerating Co., Mishawaka, Ind.
Cook Brewing Co., Evansville, Ind.
Frick & Lindsay Bldg., Pittsburg, Pa.
Pres-O-Lite Bldg., Pittsburg, Pa.
Heider Manufacturing Co., Carroll, Iowa.
Lima State Hospital, Lima, Ohio.
International Time Recording Co., Endicott, N. Y.
Concordia Ice & Cold Storage Co., Concordia, Kans.
Calhoun Bath House, Minneapolis, Minn.
Panama Canal Zone, Central America.
State Fair Bldgs., Dallas, Texas.



New American League Base Ball Park, Detroit, Mich.
Concrete Grandstand, Club House, Fences, etc., dampproofed and uniformed with TRUS-CON STONE-TEX

TRUS-CON STONE-TEX

This product is a highly specialized liquid cement coating for dampproofing, protecting and beautifying exterior stucco, concrete, brick and masonry surfaces of all kinds.

TRUS-CON STONE-TEX is a remarkably fine product. It is formulated in an unusually careful manner, after exhaustive scientific investigation and many practical tests, so as to meet the most exacting physical and chemical requirements of a masonry surface. In this product there is provided a coating of maximum durability and efficiency.

TRUS-CON STONE-TEX is recommended to be used double coat.

The first coat sinks deeply into the surface, pores, hair cracks, etc., where it hardens and binds itself with the wall, so as to become a unit part of it. The second coat, applied over this, seals and conceals the pores and hair checks in a positive manner, so that there is no possible chance for further absorption of moisture. In this way the surface is rendered absolutely dampproof and moistureproof.

The dampproofing efficiency of TRUS-CON STONE-TEX is not only evident in eliminating the saturated appearance of the treated area after rain, and the tendency of the surface to become stained and unsightly, but by excluding dampness from the wall, maintains a perfectly dry and sanitary condition on the interior.

TRUS-CON STONE-TEX thoroughly uniforms and equalizes the color of the surface and imparts a finish of a stone-like texture of the most artistic and attractive nature. The integrity and distinctive appearance of a masonry surface are entirely retained by the use of TRUS-CON STONE-TEX, as this product dries to a perfectly flat, uniform finish without any tendency to gloss or give a painted appearance to the surface.

TRUS-CON STONE-TEX should not be classed with ordinary oil paints. It does not contain any linseed oil or white lead and is prepared with particular regard, not only to its toughness and durability, but with respect to its immunity to the alkalies in concrete and masonry surfaces, upon which it is to be applied. Unlike ordinary oil paints, it is not sensitive to saponification, which is the common cause of failure, disintegration, flaking and peeling on concrete, brick and masonry.

TRUS-CON STONE-TEX provides a hard weather-resisting and protecting shell, which not alone lies on the surface, but which, because of its penetrating qualities, secures a positive and cohesive bond. It is used under the most rigid exposure tests and conditions. It has stood with perfect satisfaction the ravages of the elements, for several years.

The pleasing colors in which STONE-TEX may be had, gives a splendid selection and satisfies practically any requirement in this regard.

The covering capacity of TRUS-CON STONE-TEX is about 100 sq. ft. to the gallon, for double coat work, on a surface of average porosity. The covering capacity is variable, depending largely upon the roughness and porosity of each particular piece of work. The material is shipped ready to use, and works out in a free and easy manner under the brush.

Twenty-one Barrels TRUS-CON STONE-TEX
Used on buildings Great Lakes Engineering Co., Ashtabula, Ohio

MACDONALD & APPLEGARTH, ARCHITECTS,
San Francisco, California

January 23, 1912.

Trussed Concrete Steel Company,
Chemical Products Department,
Detroit, Mich.

Gentlemen—The TRUS-CON STONE-TEX, which you shipped me from Detroit, has given such entire satisfaction that I feel it incumbent upon me to express my appreciation. We specialize in Reinforced Concrete and invariably coat the exterior to prevent the entrance of dirt in its pores. We have used all of the ites—tites and other mixtures called waterproofing. One coat of your material, however, has taken the place of two of any of these others and the result is a stone-like surface in appearance and a proof against moisture and dirt.

We hope to be able to give you many orders for this material.

Very truly yours,
KENNETH MACDONALD, JR.

Residence of W. E. Biddle, Amesbury, Mass.
Stucco treated with TRUS-CON STONE-TEX.

Referring to the two coats of Trus-Con STONE-TEX that you have applied to my stucco house, please be advised that it is my opinion that the appearance of the cement work has been greatly improved. In place of the color streaks, there is now a uniform color over the entire house of a pleasing soft shade.

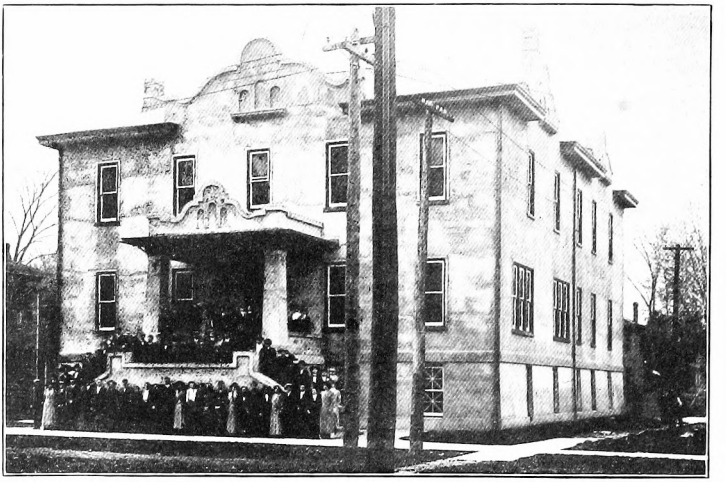
The cracks have all been filled up, and if this finish will stay on as well as I have every reason to think it will do, there is no question but what this sort of treatment of cement houses is desirable from every point of view.

W. E. BIDDLE.

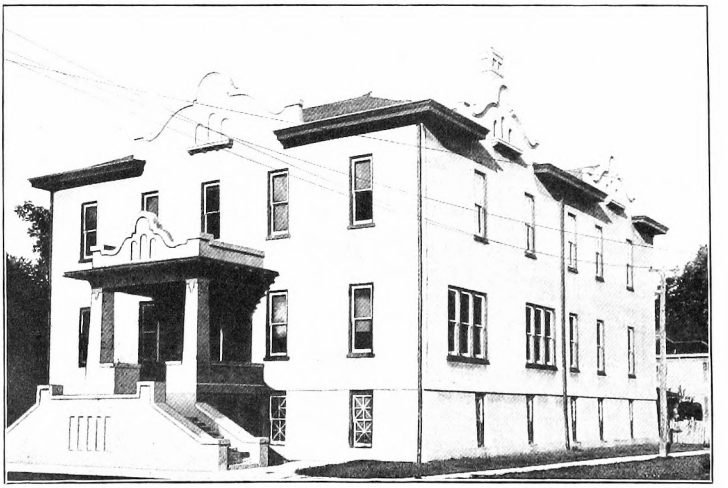
"Please ship at once another 50 gallon barrel of your TRUS-CON STONE-TEX, Pure White, for use on the Montgomery County Court House. The architects and committee are well pleased with results from the material that you have already furnished."

J. E. ANDERSON.
Painter and Decorator,
Montgomery, Ala.

Residence E. H. Brown, Grosse Pointe Farms, Mich.
TRUS-CON STONE-TEX used to dampproof and uniform stucco.



Brown Business College, Jacksonville, Ill.
Before Coating with TRUS-CON STONE-TEX



Same as above after Dampproofing and Uniforming with TRUS-CON STONE-TEX

ALL PLEASED WITH STONE-TEX

Mr. Herman Fougner,
25 Madison Square, North,
New York City.

August 23, 1912.

Dear Sir—In reply to your recent request that I permit Mr. Williams to inspect my house at Sutton Manor, New Rochelle, N. Y., recently finished with TRUS-CON STONE-TEX, I would say that it would afford me great pleasure to have Mr. Williams call, and I will certainly enthusiastically endorse STONE-TEX.

The beautiful appearance of my house is a subject of admiration of all my neighbors and is a source of more than usual satisfaction to me inasmuch as the house presented such a frightful appearance before.

If I can be of any service to you, you may call upon me at any time. You can say for me that I am very well pleased indeed with Stone-Tex.

Yours very truly,
GEO. S. MACDONALD.

Greenville, Mo., Feb. 15, 1912.

Trussed Concrete Steel Company,
Detroit, Mich.

Gentlemen—At this place the County Court House officials instructed me to test the sample of TRUS-CON STONE-TEX you sent me and let them know the result, which I did, and they have ordered the material put on the Court House.

They meet again in a few days and are going to re-construct the Jail, and expect you will receive another order for more material.

I can say this much for STONE-TEX. I have used material for painting for fifteen years, but have never gotten hold of anything that answers the purpose for brick work like STONE-TEX.

I will use all of your material I can on the County Jail, for I am more than pleased, and so is the County Court, with the work of STONE-TEX.

Very truly yours,
EDWIN PARKER.
Painter.

St. Joseph, Mo., June 29, 1912.

Trussed Concrete Steel Co.,
Detroit, Michigan.

Gentlemen—We have had such good success with the first lot of STONE-TEX that we have used, that we want to tell you about it.

On one of the fine residences of the City, two different preparations had been applied to the stucco, but in neither instance was the material applied a success.

We took this job when the house was in a very bad condition on account of the two previous coatings. We applied two coats of STONE-TEX, and it has made an elegant looking job. The owner is exceedingly well pleased and satisfied.

If your STONE-TEX gives such a good result on a job like the above, we have no fear of it working anywhere.

Very truly yours,
BENNETT & PURKETT.

Trussed Concrete Steel Company,
Chemical Products Dept.,
Detroit, Michigan.

Durango, Colo., July 3, 1912.

Gentlemen—Two years ago I painted the exterior of my cottage with your TRUS-CON STONE-TEX, Concrete Gray. I now have need for five gallons more to use on a portion of the wall that is discolored by smoke, etc., and would ask you to ship this at once.

I am very much satisfied with the effect and wearing qualities of your STONE-TEX and have recommended it to several parties.

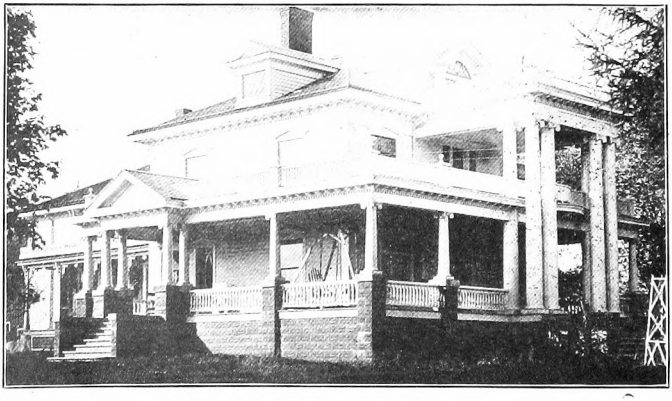
Yours truly,
K. A. GAGG, Cashier.
First National Bank.

Residence Mrs. Cora Powers, St. Petersburg, Fla.
Coated with TRUS-CON STONE-TEX

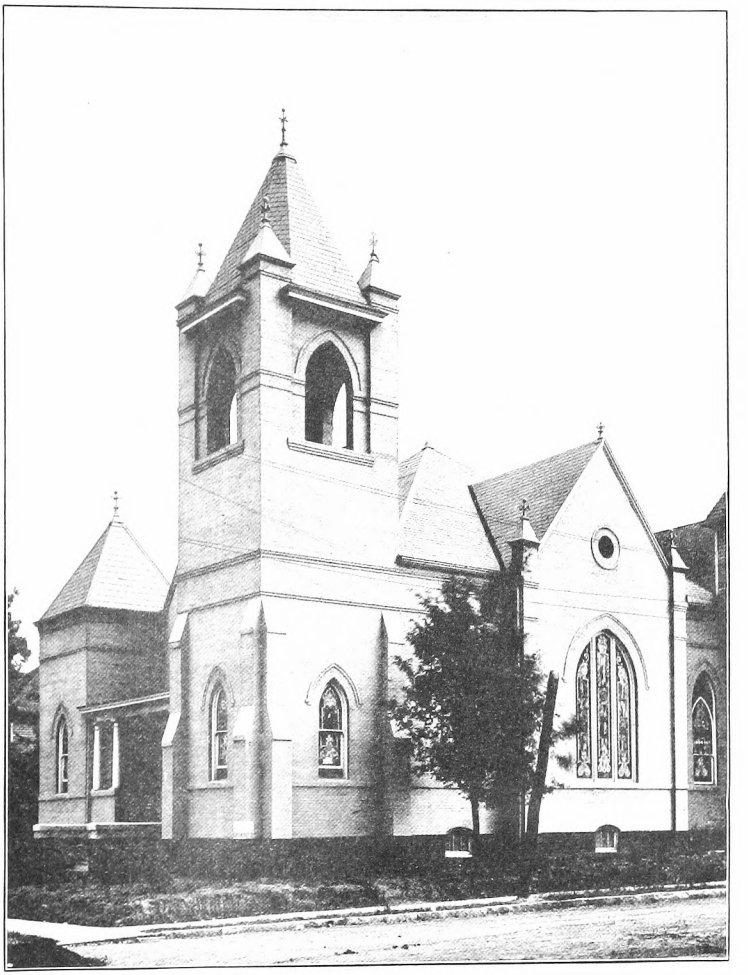
Trussed Concrete Steel Company,
Detroit, Mich.

Gentlemen—I am very much pleased with the STONE-TEX which makes a very nice stone finish of solid color and adds greatly to the beauty of the wall. I would be pleased to recommend it to any one. It adds to the appearance as much as the dampproofness of the house.

Yours very truly,
C. B. SIMONSON,
Bancroft, Mich.



Residence C. B. Simonson, Bancroft, Mich.
Masonry and Concrete Block Walls Coated with TRUS-CON STONE-TEX
(See above letter)



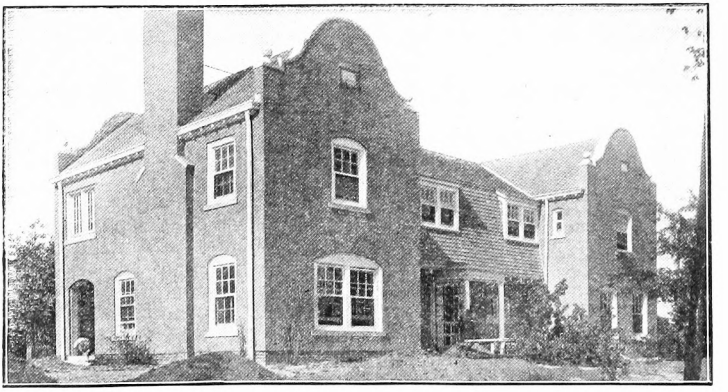
South Main Street M. E. Church, High Point, N. C.
Uniformed and Dampproofed with TRUS-CON STONE-TEX

The Times Building, Trenton, N. J.
Dampproofed and Uniformed with TRUS-CON STONE-TEX

THEY ALL USE TRUS-CON STONE-TEX

Hershey Chocolate Co., Hershey, Pa.
Illinois Glass Company, Alton, Ill.
Detroit Salt Works, Delray, Mich.
Bingham's Hotel, Harbor Springs, Mich.
Montgomery County Court House, Montgomery, Ala.
May Irwin Residence, Irwin Island, N. Y.
M. P. Moller Piano Factory, Hagerstown, Md.
American Railways Co., Philadelphia, Pa.
H. W. Hoyt Residence, Detroit, Mich.
Beech-Nut Packing Company, Canajoharie, N. Y.
University of Michigan, Ann Arbor, Mich.
Carnegie Steel Company, Pittsburg, Pa.
O. & W. Thum Co., Grand Rapids, Mich.
Princeton University, Princeton, N. J.
U. S. Government Light Houses.
Crescent Hotel, Aberdeen, Wash.
American Wire & Steel Company, Pittsburgh, Pa.
Lincoln County Court House, Carrizoza, N. M.
Rialto Building, San Francisco, Cal.
Fullerton Ave. Theatre, Chicago, Ill.
Great Lakes Engineering Co., Ashtabula, Ohio.
R. V. Kuser Residence, Trenton, N. J.
Princeton Worsted Mills, Trenton, N. J.
Elks Temple, Trenton, N. J.
Wayne County Court House, Greenville, Mo.
Brown Business College, Jacksonville, Ill.
Glenmore Distilleries Co., Owensboro, Ky.
Edison Illuminating Co., Detroit, Mich.
Portland Railway Light & Power Co., Portland, Ore.
Altoona & Logan Fuel & Electric Co., Altoona, Pa.
Boyer-Campbell Bldg., Detroit, Mich.
Childrens Hospital, Pittsburgh, Pa.
H. J. Heinz Co., Pittsburgh, Pa.
Charleston Consolidated Railway & Light Co., Charleston, S. C.
Trinity Cotton Oil Co., Dallas, Tex.
First National Bank, Taylor, Texas.
Holy Trinity Rectory, Swanton, Vt.
St. Peter's Church, Reserve, La.
Hospital for the Insane, Jacksonville, La.
Merchants and Farmers Bank, South Emporia, Va.
Marathon Paper Mills Co., Rothschild, Wis.
Massey Business College, Birmingham, Ala.
American Automatic Ry. Switch Co., Birmingham, Ala.
U. S. Army & Navy Hospital, Hot Springs, Ark.
Arctic Mining & Power Co., Emigrants Gap, Calif.
Associated Oil Co., San Francisco, Calif.
Speckles Residence, Coronado Beach, Col.
State School of Mines, Golden, Colo.
Gulf Novelty Works, St. Petersburg, Fla.
Atlanta National Bank Bldg., Atlanta, Ga.
Augusta Orphan Asylum, Gracewood, Ga.
Oakwood Cemetery, Chicago, Ill.
Mausoleum, Detroit, Mich.; Waterloo, Ia.; Mechanicsville, Ia.; Mankato, Minn.
St. Elizabeth's Hospital, Chicago, Ill.
Park Commission Power House, Dubuque, Ia.
Williamson Milling Co., Clay Center, Kans.
Loretto Academy, Loretto, Ky.
Old Prentice Distillery, McBrayer, Ky.
American Lady Corset Co., Detroit, Mich.
Detroit & Toledo Shore Line R. R. Co., Detroit, Mich.
Penn Iron Mining Co., Vulcan, Mich.
High School, Wyandotte, Mich.
Pennsylvania R. R. Co., Jersey City, N. J.
Monmouth Hotel, Spring Lake, N. J.
Jos. Fallert Brewing Co., Brooklyn, N. Y.
St. Ann's Rectory, Hornell, N. Y.
High Point Veneering Co., High Point, N. C.
Tidewater Power Co., Wilmington, N. C.

City Hall at Grand Rapids, Michigan, treated with TRUS-CON POR-SEAL



Residence of Paul Gray, Detroit, Mich. Dampproofed with TRUS-CON POR-SEAL

TRUS-CON POR-SEAL

A transparent liquid for dampproofing exterior masonry walls without changing the physical appearance and texture of the coated surface.

TRUS-CON Por-Seal is particularly adapted for dampproofing exterior surfaces above grade which are giving trouble, due to the continuous penetration of water through the wall, causing a damp and unsanitary condition on the interior. Also for treating exterior porous stone, either natural or artificial, to preserve them from superficial decay, due to the absorption of water and other atmospheric impurities which cause general disfiguration of the surface and slow, progressive disintegration resulting from expansion of the water held in the pores on freezing.

TRUS-CON Por-Seal is practically water-white and shows no tendency to stain the surface, as is generally the case with such dampproof coatings. Very special care is taken in the selection of the raw materials used in Por-Seal so as to obtain a product that will be practically free from any color that would stain the surface over which it is applied.

The remarkable efficiency of TRUS-CON Por-Seal is due to the very special synthetic, water-repellent compound which forms the basis of materials used in the manufacture of this product. The synthetic base is combined with a special combination of solvents, which afford the very maximum content of repellent base in the final product.

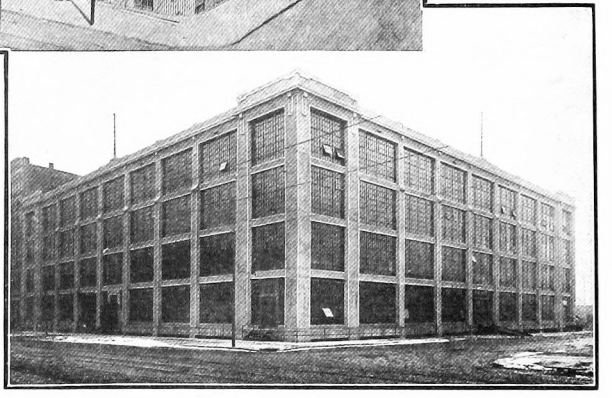
The characteristic efflorescence, or white alkali stains which so frequently occur on masonry surfaces, can be eliminated by the proper application of TRUS-CON Por-Seal. Efflorescence is a direct result of the absorption of water into the surface, with the subsequent solution of the soluble alkalies, which are in turn brought to the surface by the water and deposited as crystalline salt on the evaporation of the water. By treating the surface with TRUS-CON Por-Seal, its absorbent nature is eliminated and there is no opportunity for water to penetrate to the interior, to dissolve out the alkalies and carry them to the surface.

As a brick surface is much more dense and close in texture than the average concrete surface, it is necessary to supply a special formulation of TRUS-CON Por-Seal for treating brick. The content of solids should be adjusted to the porosity of the surface, so as to be certain that the pores are entirely filled and sealed, without leaving an excess of solids deposited on the exterior.

In ordering this product for treating brick, it is well to specify TRUS-CON BRICK Por-Seal, so as to be certain of obtaining the correct material.

TRUS-CON Por-Seal is easily applied with a brush, similar to paint, in liberal application, so as to permit the proper absorption and penetration of the product to thoroughly fill every pore of the surface. For best results two liberal coats of Por-Seal are recommended. As this product is very markedly repellent to water, it is essential that it only be applied to a surface that is absolutely dry, so as to insure the proper depth and completeness of the deposition of the repellent base in the pores of the surface. On a surface of average porosity one gallon will efficiently dampproof approximately 125 square feet, applied in two coats.

Mergentahler
Linotype
Building,
Brooklyn, N. Y.



Beaver
Power
Building
Dayton,
Ohio

All Exterior Concrete and Stucco Walls on above Buildings
Dampproofed with TRUS-CON POR-SEAL

WHAT OTHERS SAY OF TRUS-CON POR-SEAL

"About three years ago we received from you one can of TRUS-CON Por-Seal, and might say that we have experimented on our stone here and find that it keeps the moisture out of the stone.

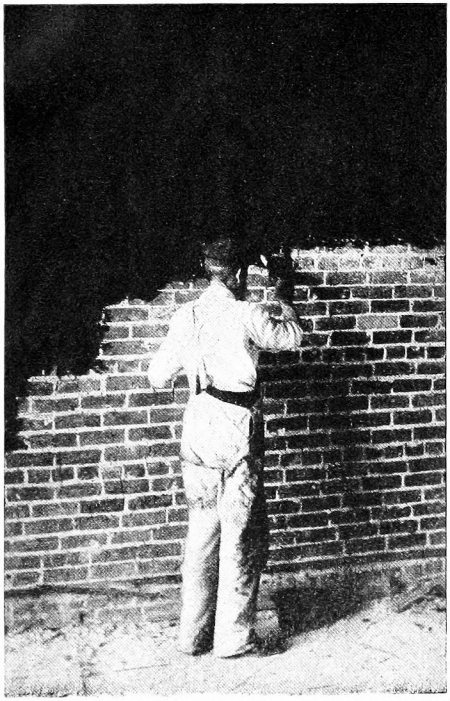
"We turn out 40,000 to 50,000 cu. ft. of stone annually and your Por-Seal has proven to be very satisfactory in retaining the color of the stone, a trouble which has proven very serious in the past." KETTLE RIVER CO., Sandstone, Minn.

"We beg to advise that we received the sample of your TRUS-CON Por-Seal and, after testing same, have found it the best we have ever used. We shall be pleased to have you ship us at once one fifty-gallon barrel of this fluid." LARSON-DANIELSON CONSTRUCTION CO., Laporte, Ind.

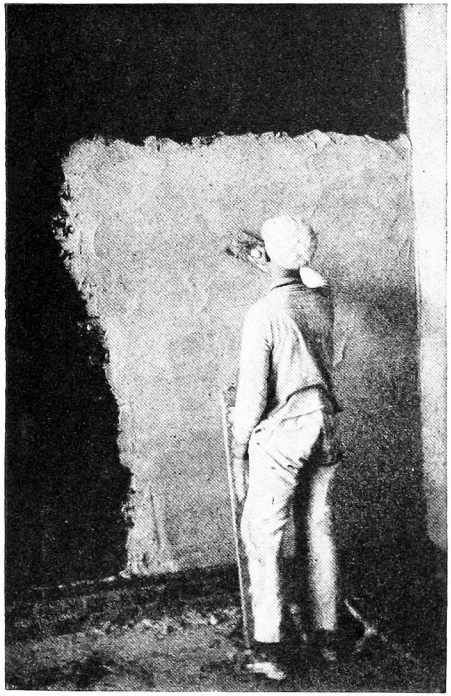
"We beg to advise you that the TRUS-CON Por-Seal, which we ordered from you, proved satisfactory and when we are in the market again for material of this kind, will be glad to favor you with our order." INDIANA SPRINGS CO., Kramer, Ind.

"We recently put in a stock of your TRUS-CON Chemical Products and so far are having very good results, waterproofing the only two contracts that have come up." (The material used was TRUS-CON Por-Seal.) E. E. NEFF & CO., El Paso, Texas.

"Would say that we have used your TRUS-CON Por-Seal as per instruction and thus far it has filled the bill." SUPERIOR ART STONE CO., Dayton, Ohio.



Showing Application of TRUS-CON PLASTER BOND to Interior of Brick Wall



Showing the Application of Plaster Directly on Wall Dampproofed with TRUS-CON PLASTER BOND

TRUS-CON PLASTER BOND

This product is a special bituminous coating for dampproofing all exposed walls. Its use provides a continuous dampproofing element in all such walls, which perfectly insulates the interior from any evidence of dampness. On application to the surface it is partially absorbed into the pores, thoroughly sealing them and establishing a most inseparable bond.

The presence of the bituminous coating deeply deposited in the pores, affords a positive and efficient bar against the continuous penetration of any moisture absorbed from the exterior exposed surface.

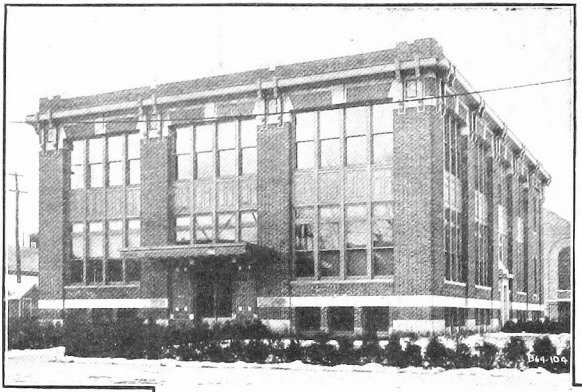
TRUS-CON Plaster Bond is so formulated as to indefinitely remain flexible and tacky after being applied to the wall, and will furnish a tenacious and permanent bond to a scratch coat of plaster trowelled directly on it. This property of Plaster Bond obviously serves the excellent and economical purpose of eliminating the necessity of furring and lathing, thereby increasing the cubic area of available space and overcoming the disagreeable features associated with such an air space. The continuous coating of TRUS-CON Plaster Bond on the interior of an exposed wall contributes a fair degree of insulation, which, although not equivalent to an air space, yet for a great number of applications, is sufficient.

It is to be emphasized that the prime function of TRUS-CON Plaster Bond is to provide a continuous dampproof coating on all exposed walls, and its special feature of holding a coat of plaster applied directly to it is a useful but distinctly secondary consideration to its dampproofing efficiency. As this product is fundamentally a dampproof coating, it is only recommended for treating interior of exposed vertical walls. It may be used on interior partitions for its bonding capacity, but we do not generally recommend it for use on ceilings and similar surfaces on a horizontal plane.

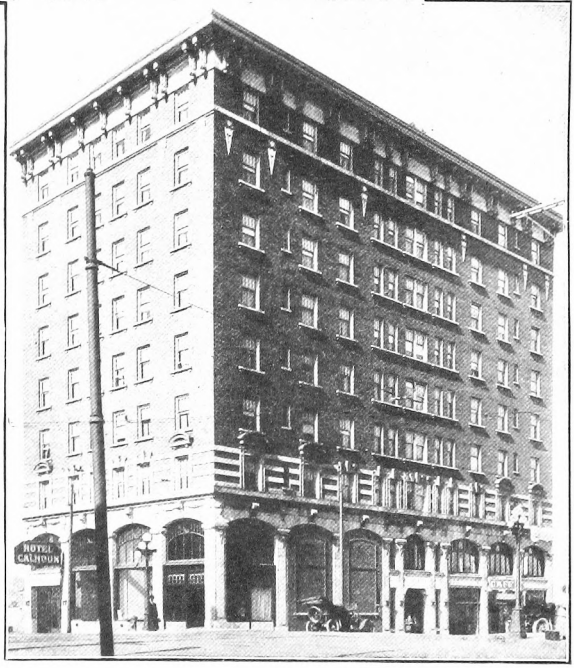
TRUS-CON Plaster Bond is applicable to any masonry surface and should correctly be applied only to a dry surface, so as to insure the proper absorption and penetration into the wall. As continuity is absolutely necessary for satisfactory results, from Plaster Bond, special care should be taken to insure a continuous coating between floor levels and the ceilings below, and in cases where this is not possible, we recommend that the coating be carried back about ten (10) inches on the ceiling before plastering.

TRUS-CON Plaster Bond is applied with a brush similar to paint and must present an even, uniform, black appearance before being coated with plaster. In cases where the first coat penetrates deeply into the surface, it is very necessary that a second coat be applied so that the entire area will have the most even, uniform, black appearance.

On surfaces of average porosity it is entirely safe to estimate the covering capacity of TRUS-CON Plaster Bond at 75 square feet per gallon.



The Industrial Works, Bay City, Mich.



Calhoun Hotel, Seattle, Wash.

Over a Thousand Gallons TRUS-CON PLASTER BOND used in these Buildings.

JUST A FEW PLASTER BOND REFERENCES

The Industrial Works, Bay City, Mich.
Free Press Bldg., Detroit, Mich.
Spellman Art Studios, Detroit, Mich.
Lipman & Wolfe Bldg., Portland, Ore.
Woodward & Clark Bldg., Portland, Ore.
Holtz Building, Portland, Ore.
Calhoun Hotel, Seattle, Wash.
Seattle Taxicab Company, Seattle, Wash.
Y. M. C. A., St. Joseph, Mo.
R. H. Page Residence, Grosse Pt. Farms, Mich.
T. M. Worcester Residence, Sarasota, Fla.
Paxton Residence, Lake Forest, Ill.
McNulty Bros., Chicago, Ill.
States Plastering Co., Chicago, Ill.
L. M. Grant Residence, Contoocook, N. H.
Princeton University, Princeton, N. J.
Public School at Fremont, Ohio.
Public School at Indianapolis, Ind.
Farmers' Bank Bldg., Sumter, N. C.
Algonquin Hotel, Dayton, Ohio.
Public School, Lima, Ohio.
Home Telephone Bldg., Kansas City, Mo.
Diesel-Wemmer Cigar Co., Delphos, Ohio.
Hydro-carbon Company Building, Wichita, Kansas.
Castle Gould Estates, Castleton, N. Y.
Rescue Mission, Sioux City, Iowa.
Library, Logansport, Ind.
Library, Middletown, Ohio.
Christian University Gymnasium, Canton, Mo.
Luna Theatre, Danville, Pa.
Howard Hotel, Sioux City, La.
Halstead Street Bank, Chicago, Ill.
Public Schools, Wellsburg, Pa.
First National Bank Building, Ebensville, Pa.
Woodward Iron Co. Buildings, Woodward, Ala.
Brown Apartment, Des Moines, Iowa.
Geo. Davidson's Buildings, Pittsburg, Pa.

OFFICE OF S. G. COOMBS, GENERAL CONTRACTOR,
524 Fifth Ave. W., Seattle.

Caine-Grimshaw Co.,
Seattle, Wash.

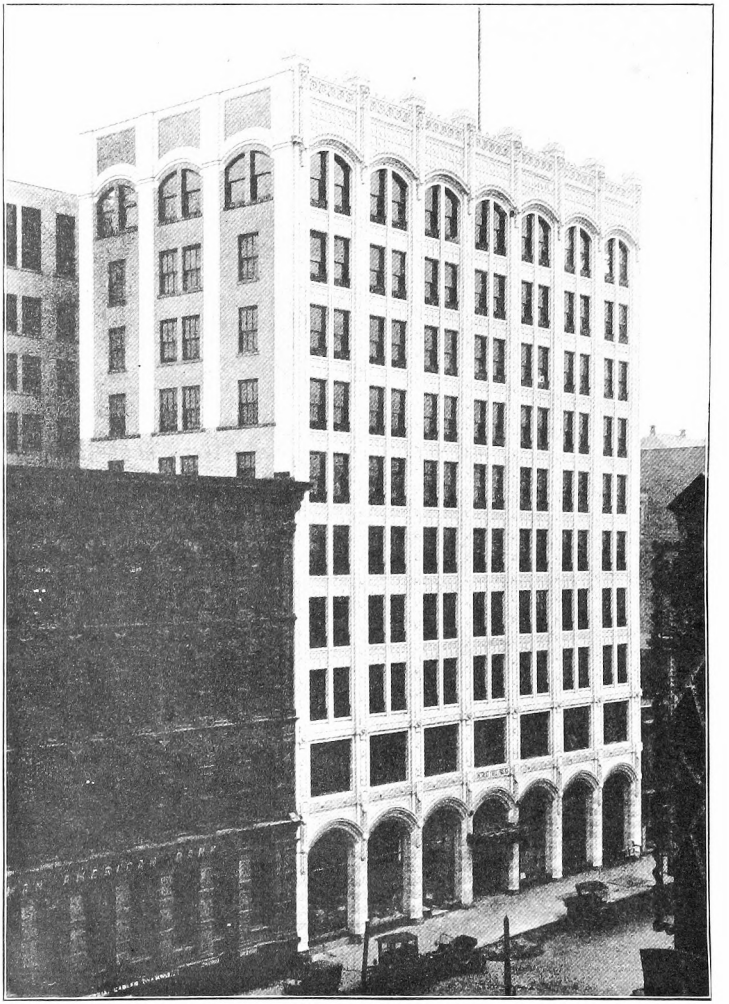
Gentlemen—For the present building which I have now under construction, a garage for the Seattle Taxicab Company, at Ninth and Pike Street, in this city, I will require at least one fifty-gallon barrel of the same black TRUS-CON PLASTER BOND, manufactured by the Trussed Concrete Steel Co., that your firm supplied in considerable quantity for the eight-story Calhoun building which I completed last spring.

This is to request that you be particular to have in stock this same TRUS-CON brand, as it gave splendid satisfaction to the architect and to the plasterer, and I believe it is entirely the best composition of its kind that I have ever used on any of my work. This material has entirely protected the plaster from discoloration on the Calhoun building, although the brick walls on which it was applied were very wet during the winter and at the time the plastering was done. The plasterer furthermore tells me that this PLASTER BOND acts as a perfect bond between the brick or concrete work and the plaster which is directly applied to these outside walls.

If the material will please the architect and owner, who look at the finished work, the plasterer, who is spreading the plaster, and the plastering contractor, who is interested in both the time and results, it is certainly good enough for me and, if you have not this same TRUS-CON in stock, be sure to get it for me.

Very truly yours,

S. G. COOMBS



The Detroit Free Press Building, Detroit, Michigan.
Inside of all exterior walls dampproofed with TRUS-CON PLASTER BOND

TRUS-CON FOUNDATION COAT

A liquid bituminous cement of heavy consistency adapted for dampproofing general substructural work under earth filling.

This product is to be used for conditions where hydrostatic pressures are comparatively light and where more complicated or elaborate waterproofing methods are not considered necessary.

TRUS-CON FOUNDATION COAT is applied with a large brush or mop over the dry masonry surface, penetrating into the pores of the surface and providing a continuous dampproof coating over the treated area. The very special penetrative and adhesive properties of this product insure the most tenacious bond to the masonry, remaining tough and elastic under wide variations in temperature.

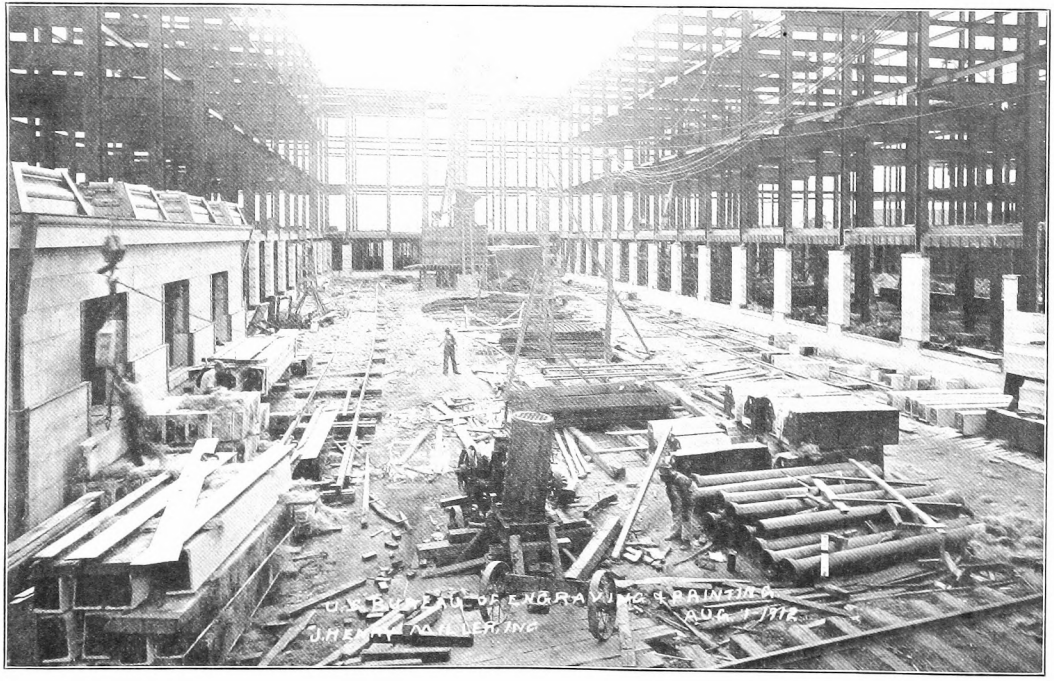
TRUS-CON FOUNDATION COAT is not only much more efficient but generally more economical than a coal tar pitch for treating exterior masonry walls under earth filling. The use of pitch requires considerable investment in apparatus and also expense in preparation, which are eliminated in the use of TRUS-CON FOUNDATION COAT. Coal tar pitch also tends to solidify in contact with the cold masonry surface and in the chilled condition cannot penetrate into the wall sufficiently to establish a satisfactory bond. TRUS-CON FOUNDATION COAT, being liquid and highly penetrative, is not affected when applied to the cold wall, but penetrates deeply and bonds itself most securely.

Under light requirements, as on basement and cellar foundations, a single coat brushed or mopped on is absolutely proof against the absorption of dampness. In cases where conditions are more severe, it is best practice to use two coats to be absolutely certain of perfect continuity. A gallon will cover approximately 100 square feet, single coat, and about 60 square feet double coat.

Just a Few Foundation Coat Jobs

Vitagraph Co. of America, New York City.
Pennsylvania Water Supply., McCalls Ferry, Pa.
American Injector Co., Detroit, Mich.
Uncle Sam Macaroni Co., Tecumseh, Mich.
State Normal Schools, Winona, Minn.
Humboldt High School, St. Paul, Minn.
Diesel-Wemmer Cigar Co., Delphos, Ohio.
Murphy - Potter Bldg., Detroit, Mich.

Howard Hotel, Sioux City, Iowa.
Public Service Station, Waukegan, Ill.
Woodward Iron Co., Woodward, Ala.
Hudson Motor Car Co., Detroit, Mich.
Packard Motor Car Co., Detroit, Mich.
Peninsular Engraving Bldg., Detroit, Mich.
Flanders Office Bldg., Detroit, Michigan.
Davies Manufacturing Co., Alliance, Ohio.
First National Bank Bldg., Ebensburg, Pa.



Bureau of Printing & Engraving Building, Washington, D. C.
All cut stone protected against staining and discoloration from mortar by coating all unexposed sides with TRUS-CON STONE BACKING

TRUS-CON STONE BACKING

TRUS-CON STONE BACKING is a black dampproof coating for treating the unexposed sides of cut stone.

In the absence of any dampproofing or insulating treatment, the sensitive stone absorbs moisture carrying elements of the mortar, resulting in serious staining and discoloration. To avoid this staining, all surfaces of the cut stone which come in contact with the masonry should be painted with TRUS-CON STONE BACKING. This applies to the top, bed, sides and back of the stone, to within one inch (1″) of the face.

TRUS-CON STONE BACKING can be used most successfully for backing all types of limestone, granite, marble or any building stone which is absorbent and which otherwise would be seriously stained when laid in cement mortar.

The product is furnished ready for use and should be applied to the stone with a paint brush. The stone should be coated at least 24 hours before being set. After the stone is erected, the mortar joints on the back should be well coated with STONE BACKING, so as to insure the thorough continuity of the dampproof course.

This product has met with remarkable success in comparative tests, having been approved by the Government for use on Government work when other competing products were rejected.

When applied in one even, uniform, heavy coat, a gallon will cover between 125 and 150 square feet.

OFFICE OF SUPERVISING ARCHITECT
Washington, D. C.

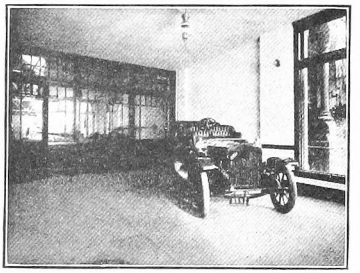
J. Henry Miller, Inc.,
106 Dover Street,
Baltimore, Md.

Sir—Referring to your letter of the 13th ultimo, submitting samples for approval in connection with your contract for the Bureau of Engraving and Printing Building, you are advised that the following is approved for use wherever material of such character is required by your contract:
TRUS-CON STONE BACKING, made by Trussed Concrete Steel Company.

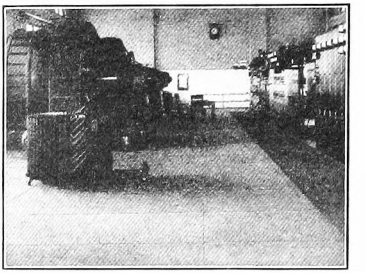
A copy of this letter will be sent to the Superintendent, who will forward to this office, for identification, samples representing the approved materials delivered on the site for use in the work.

By direction of the Supervising Architect.

Respectfully,
(Signed) GEO. O. VON NERTA,
Chief of Technical Division



Michigan Motor Sales Co., Garage,
Detroit, Mich.
Treated with TRUS-CON Floor Enamel



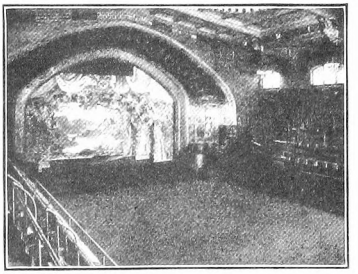
Sub-Power Station, M. C. R. R.,
Detroit, Mich.
Treated with TRUS-CON Floor Enamel

SCOTTISH RITE CATHEDRAL,
Fort Wayne, Ind.

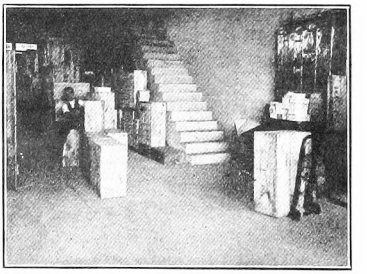
"I have used your TRUS-CON Floor Enamel on all the cement floors in the Scottish-Rite Cathedral, and will say that I am extremely pleased with the results obtained.

It not only entirely does away with the dust and gives the floors a tile-like finish, but it also seems to fuse with the cement, and hardens the floors, some of which were very soft and porous. I most cheerfully recommend TRUS-CON Floor Enamel to any one having cement floors, which need protection against dusting and staining."

W. S. SPONHAUER, Custodian.



Scottish Rite Cathedral,
Ft. Wayne, Ind.
Treated with TRUS-CON Floor Enamel



Maryland Shoe Company,
Cumberland, Md.
Treated with TRUS-CON Floor Enamel

TRUS-CON FLOOR ENAMEL

This product is especially adapted for finishing and rendering dustless cement floors in hospitals, asylums, power plants, hotels and all similar institutions, where concrete floors are common.

The natural tendency of a cement floor to continually dust is decidedly unsanitary, due to the suspension of dust particles in the air, acting as vehicles for germ distribution.

In power houses, the constant deposition of dust very seriously increases the wear of the frictional parts of the machinery, particularly electrical equipment, such as dynamos, motors, generators, etc.

TRUS-CON FLOOR ENAMEL produces a tough, hard, elastic and reasonably durable finish on cement floors. It affords a most perfect and attractive enamel finish, that insulates and protects the floor from direct contact with the friction and abrasion of traffic, which would otherwise tend to continually granulate and dust the surface.

TRUS-CON FLOOR ENAMEL perfectly protects the floor from staining, due to the absorption of oils, greases and other foreign matter, insuring the freedom of the floor from unsightly staining.

TRUS-CON FLOOR ENAMEL is applied with a brush to the floor, according to the directions appearing on page 91 of this book which should be most carefully observed, to obtain the best results.

COVERING CAPACITY 125 square feet per gallon, two coats.

GREAT WESTERN SMELTING & REFINING COMPANY
SMELTERS & REFINERS OF METALS

Chicago, Ill., November 9, 1912

Trussed Concrete Steel Co.
Peoples Gas Bldg.
Chicago, Illinois

Dear Sir:

The Trus-Con Floor Enamel and Primer which we ordered from you sometime ago has filled the bill. Instead of having a dusty, dirty and bad appearing floor we now have a nice clean maroon colored floor and our Laboratory is also free of dust which naturally comes from the ordinary cement floor.

Having some other floor which we wish to improve, we are herewith enclosing order for

7 Gal. Tile Red Floor Enamel
5 " Floor Primer.

Please deliver the material to us at our plant, 41st and Lowe Ave., and bill on Mr. David Blum, president of our Company for same, sending invoice to the address above given.

Very truly,
Great Western Smelting & Refining Co.

TRUS-CON FLOOR PRIMER

This product should be employed as a priming coat under TRUS-CON FLOOR ENAMEL when coating any floor laid directly on the ground. It penetrates into the surface, and on hardening perfectly seals the pores and INSULATES the ENAMEL from contact with any alkali brought into solution by water absorbed into the concrete from the surrounding soil.

In the manufacture of TRUS-CON FLOOR ENAMEL the greatest care is taken to so treat and manipulate the materials entering into its composition as to insure the greatest immunity to alkalis, and extensive practical tests have demonstrated that under normal conditions of use it is in no way affected by the causticity characteristic of a concrete surface.

However, in the case of a cement floor laid directly on the ground, water is absorbed into the concrete, dissolving the alkali, and in this concentrated form so intensifies its action that it is the best practice to use a material such as our FLOOR PRIMER to completely protect the ENAMEL from the action of the alkali.

TRUS-CON FLOOR PRIMER does not protect the ENAMEL by any chemical action with the alkali which would tend to neutralize and fix it, but it is considerably more efficient in providing a continuous insulation through which it is impossible for the alkali to pass and come in contact with the ENAMEL.

HIGH PRAISE FOR TRUS-CON FLOOR ENAMEL

WILLIAM EARL RUSS
ARCHITECT,
Dayton, Ohio.

Trussed Concrete Steel Co.,
Detroit, Mich.

Gentlemen—Some time since, at your solicitation I tried out your TRUS-CON FLOOR ENAMEL.

Since the first trial I have been using it on every bit of concrete floor which I have, ranging from armored concrete factory buildings to buidings of the class of the Dayton Country Club and the Montgomery County Memorial Building.

In every case I have been absolutely satisfied with it from all points of view. I find that it not only wears like iron, but that apparently it actually toughens the cement floor finish. In addition to these very valuable qualities it makes a floor look well and easily kept in a clean, sanitary condition. This is so much the case that where I have used it in my finer buildings, such as those referred to, I have felt for the first time that a concrete floor could be used in such buildings and made to appear on a par with the other better class materials which compose them.

This letter is written to express my appreciation of the product, and assist you, if possible, in interesting others in a good thing. I wish to add that it is of my own volition and not at your request.

Very truly yours,

W. E. RUSS.

KUNZELMANN-ESSER COMPANY
HOUSE FURNISHERS,
Milwaukee, Wis.

Western Lime & Cement Co.,
City.

Gentlemen—We have used the TRUS-CON CONCRETE GRAY FLOOR ENAMEL on six floors of our new building at Second avenue and Mitchell street, which is used as a furniture show room, and are certainly very much pleased with the results obtained.

The FLOOR ENAMEL, which was put down in November, 1910, shows no traces of wear and has done away entirely with the dusting of the floors and certainly gives them a pretty, finished, clean appearance and actually seems to harden the floors.

We are highly satisfied with the TRUS-CON FLOOR ENAMEL and we are pleased to say that the one coat of the TRUS-CON FLOOR ENAMEL has covered our floors better than two coats of competitive make.

I personally believe it is the best material of its kind for this use.

I have had samples of a number of different makes, but there is not another of them that has given us the wear and has covered the floor so well as the TRUS-CON FLOOR ENAMEL.

Yours very truly,
KUNZELMANN-ESSER CO.

PRINTERS LIKE TRUS-CON FLOOR ENAMEL

"Regarding the merits of your TRUS-CON Floor Enamel, we wish to say, the fact that we have been sending you new orders for the Enamel from time to time is proof positive that it is answering our purpose nicely. We have now a liberal coat over our entire pressroom floor and we find that besides protecting the concrete, it also keeps down the dust in the room to a minimum, which any one familiar with the printing business will appreciate. Incidentally, the Enamel adds to the appearance of our pressroom." AMERICAN COLORTYPE CO., Chicago.

"We have tested out your TRUS-CON Floor Enamel and apparently it has proven better than anything we have tried. As a further test you may send us 10 gallons. Should this give satisfaction, we will give you an order for all we shall require on our concrete floors and we have considerable area to cover." A. I. ROOT COMPANY, Medina, Ohio.

"Please send us ten more gallons of TRUS-CON Floor Enamel to apply on some floors. That which you have already sent is giving good results." A. I. ROOT COMPANY, Medina, Ohio.

"Having finished the floors of our printing department with TRUS-CON Floor Enamel, we wish to express our entire satisfaction with same. It gives the floor a hard smooth surface, thereby eliminating all dust. If you see fit, you may use this testimonial at your pleasure." CURTIS ADVERTISING COMPANY, Detroit, Mich.

"We have used your TRUS-CON Floor Enamel on the Crist Publishing Co.'s building, and found it very satisfactory. Previously to placing this material in the above building, we experimented with same on our cellar floor, having given same a thorough test. By the results of this test, also by the success we had with this material on the floors of the Crist Publishing Co.'s building, we feel that we can conscientiously recommend same for the purpose for which it is intended and claimed for by you." GRIFFITHS & PIERCE, Utica, N. Y.

ISAAC H. BLANCHARD COMPANY, PRINTERS,
418-426 West 25th Street, New York.

Wednesday, Sept. 24, 1912

Mr. Herman Fougner,
25 East 26th Street,
New York City.

Dear Sir—The writer while President of the Souvenir Post Card Company (a subsidiary company at that time controlled by us) used your TRUS-CON FLOOR ENAMEL on their office and shipping room floor to his entire satisfaction; so much that he has on several occasions recommended your product to others, and insofar as is known, with entire satisfaction to these various people.

We know of nothing as good and expect to continue using your product

Yours very truly,

ISAAC H. BLANCHARD COMPANY,
By A. J. Browne, Treasurer.

SCHOOLS PRAISE TRUS-CON FLOOR ENAMEL

"TRUS-CON Floor Enamel of which you furnished us 300 gals. for our new Chemical Building, gave entire satisfaction both in spreading qualities and in finish." UNIVERSITY OF MICHIGAN, Ann Arbor, Mich.

"We have used TRUS-CON Floor Enamel and it seems to be just what we want. We shall order some more of it shortly." BOARD OF EDUCATION, Rochelle Park, N. J.

"Used one half barrel Floor Enamel, concrete grey, and one half barrel of Floor Primer at the new Lewis School in Boston on the basement floors and it is very satisfactory." H. H. ATWOOD, ARCHT., Dorchester, Mass.

"Regarding the TRUS-CON Floor Enamel, would say that the five gallons received and tried on the new school building floor, seems to hold up all right and the chances are that the Board will put this on entire concrete floors of building. We believe this the best material tried to date." BOARD OF EDUCATION, Lorain, Ohio.

"We have used some of your materials on the Seymour Indiana High School, and wish to know more about same as we were well pleased with the results." W. H. ISGRIGG & SONS, CONTRACTORS, Greensburg, Ind.

"We have made a test of the TRUS-CON Floor Enamel which you so kindly sent us. I find that it gives a nice smooth finish to the floor, and, also gives a nice appearance." ONTARIO AGRICULTURAL COLLEGE, Guelph, Ontario.

"Having seen your TRUS-CON Floor Enamel on the floor of the Carroll Robins School, I am anxious to have it applied to the basement floor of the Richmond Hill High School, New York City, where I am a teacher of physical training. Practically all the New York public schools have concrete and cement basements and gymnasium floors and there is a large opening for business." MONTAGUE GAMMON.

THEY ALL USE TRUS-CON FLOOR ENAMEL

Postum Cereal Company, Battle Creek, Mich.
American Colortype Co., Chicago, Ill.
Gillette Safety Razor Co., Boston, Mass.
Packard Motor Car Company, Detroit, Albany, New York, Pittsburgh, Philadelphia.
Hudson Motor Car Company, Detroit, Mich.
Chalmers Motor Company, Detroit, Mich.
Lozier Motor Car Company, Detroit, Mich.
Grabowsky Power Wagon Company, Detroit, Mich.
Inter-State Automobile Co., Muncie, Ind.
Michigan Steel Boat Co., Detroit, Mich.
University of Michigan, Ann Arbor, Mich.
Princeton University, Princeton, N. J.
Kansas Agricultural College, Manhattan, Kans.
University of Wisconsin, Madison, Wis.
Johns Hopkins University, Baltimore, Md.
College of Physicians and Surgeons, Philadelphia, Pa.
J. L. Mott Co., Plumbing Supplies, Trenton, Pa.
American Bell Telephone Co., Bridgeport, Conn.
Y. M. C. A. Building, Detroit, Mich.
Beaver Power Building, Dayton, Ohio.
Montgomery County Memorial Bldg., Dayton, Ohio.
Byron Weston Paper Company, Dalton, Mass.
Richardson Paper Company, Lockland, Ohio.
Central Paper Company, Muskegon, Mich.
National Tube Co., Pittsburgh, Pa.
Detroit Sulphite Fibre Company, Delray, Mich.
Massachusetts State Infirmary, Tewksbury, Mass.
Minnesota School for Epileptics, Mankato, Minn.
Edison Illuminating Co., Delray and Detroit, Mich.
Shredded Wheat Company, Kansas City, Mo.
Conkey & Company, Hammond, Ind.
Speedwell Motor Car Company, Dayton, Ohio.
National Cash Register Company, Dayton, Ohio.
University School, Detroit, Mich.
Curtis Advertising Company, Detroit, Mich.
Pierce-Arrow Motor Car Company, Buffalo, N. Y.
F. I. A. T. Automobile Co., Poughkeepsie, N. Y.
Gramm Motor Car Company, Lima, Ohio.
Polk Sanitary Milk Company, Indianapolis, Ind.
King's Hospital, Detroit, Mich.
West Side Hospital, Detroit, Mich.
Hampton College, Hampton, Va.
U. S. Government Bureau of Chemistry.
U. S. Revenue Cutter Service.
U. S. Forestry Department.
U. S. Navy Department.
U. S. Post Office Department.
U. S. Engineering Service.
Nixon Theatre, Pittsburgh, Pa.
New Theatre, New York City.
National Theatre, Detroit, Mich.
Majestic Theatre, Pottsville, Pa.
Rensselaer Institute, Rensselaer, N. Y.
Ontario Agricultural College, Guelph, Ont.
Soldiers Home, Dayton, Ohio.
Chase Rolling Mills, Waterbury, Conn.
Lehigh Valley Coal Company, Wilkesbarre, Pa.

THEY ALL USE TRUS-CON FLOOR ENAMEL

Lurline Baths, San Francisco, Cal.
American Locomotive Works, Dunkirk, N. Y.
Harlan & Hollingsworth Car Shops, Wilmington, Del.
Michigan Central Railroad, Detroit, Mich.
American Tobacco Co., Clarksville, Tenn.
Johnson & Johnson, New Brunswick, N. J.
Meriwether Hospital, Asheville, N. C.
St. Louis Dairy Company, St. Louis, Mo.
Crane & Breed Manufacturing Co., Cincinnati, Ohio.
Board of Education, Trenton, N. J., Rochelle Park, N. J., South Beach, Conn., Astoria, Ore., Everett, Wash., Greensburg, Ind., Wyandotte, Mich., Lorain, Ohio, Trenton, N. J., Boston, Mass.
Foxborough State Hospital, Foxborough, Mass.
Dupont-DeNemours Powder Co., Wilmington, Del.
Rollins College, Winton Park, Fla.
American Car & Foundry Co., St. Charles, Mo.
C., R. I. & P. R. R., Chicago, Ill.
General Electric Co., Pittsfield, Mass.
New Jersey State Hospital, Trenton, N. J.
Solvay Process Company, Syracuse, N. Y.
Detroit River Tunnel Company, Detroit, Mich.
Adler Sanitarium, San Francisco, Cal.
Brownsville Paper Company, Brownsville, N. Y.
Great Western Power Company of California, Oakland, Sacramento, San Francisco, Marysville,
Crowell Publishing Co., Springfield, Ohio.
Jones Memorial Hospital, Jamestown, N. Y.
Garford Company, Elyria, Ohio.
Robert Burns Hospital, Chicago, Ill.
Allegheny Light Co., Pittsburgh, Pa.
Portland Ry. Light & Power Co., Portland, Ore.
Commonwealth-Edison Co., Chicago, Ill.
Commonwealth Power Co., Kalamazoo, Mich.
Edison Illuminating Co., Brooklyn, N. Y.
Spreckles Building, San Francisco, Cal.
Newhall Building, San Francisco, Cal.
Towle Maple Products Co., St. Paul, Minn.
Drake Marble & Tile Co., St. Paul, Minn.
Highlands Apartments, Washington, D. C.
M. A. Winter Bldg., Washington, D. C.
Washington Market Co., Washington, D. C.
N. Y. Institution for Deaf & Dumb, New York City
Episcopal Hospital, Philadelphia, Pa.
Auto Sales Corporation, Philadelphia, Pa.
Enterprise Mfg. Co., Philadelphia, Pa.
U. S. Naval Home, Philadelphia, Pa.
Coliseum, Chicago, Ill.
Peoples Gas Bldg., Chicago, Ill.
Michigan Lubricator Co., Detroit, Mich.
Speaker-Hines Printing Plant, Detroit, Mich.
Universal Motor Truck Co., Detroit, Mich.
Bronx Refrigerating Co., New York City.
Omaha Van & Storage Co., Omaha, Neb.
Ruffner Bros., Charleston, W. Va.
Home Distilling Co., Charleston, W. Va.
Odd Fellows Home, Cullman, Ala.
Waterworks Power House, Spokane, Wash.
Waterworks Power House, Detroit, Mich.

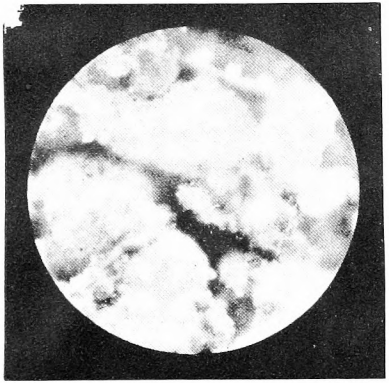


Figure No. 1.
Porous Cement
Finished Floor.

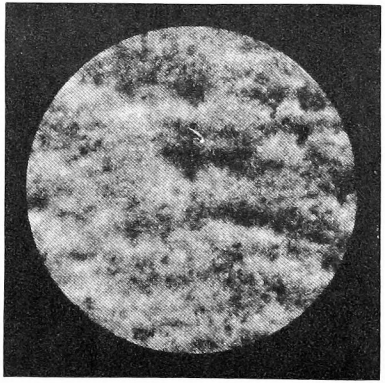


Figure No. 2.
Dense Cement
Finished Floor.

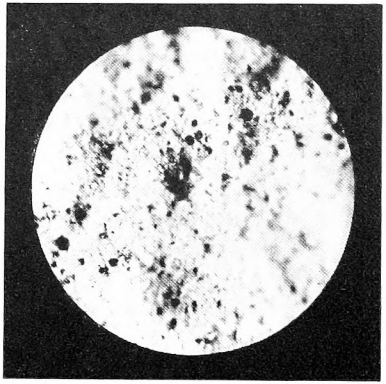


Figure No 3.
Back of Scale From
Cement Finished Floor.

THE TEXTURE OF CEMENT FLOORS INFLUENCES TREATMENT WITH FLOOR ENAMEL

The treatment that should be employed in the application of TRUS-CON FLOOR ENAMEL will vary somewhat with the texture and general physical properties of the particular surface to be treated.

The first essential to obtain satisfactory results is to insure the thorough absorption and penetration of the first coat into the surface, so as to establish a firm and inseparable bond. On surfaces which are quantitatively dry, porous and open in texture, the FLOOR ENAMEL on application is absorbed well into the surface. Under such favorable conditions of penetration, the FLOOR ENAMEL becomes practically an integral part of the surface and there is no opportunity for any scaling or peeling of the coating.

On a highly trowelled surface that is dense and close in texture, the penetration without special care and treatment is necessarily small, and instead of the coating obtaining a firm anchorage and bond by absorption, it remains as a superimposed film. The coating in the natural process of drying assumes extreme hardness, which is essential for satisfactory results, but in the absence of proper bond to the surface to support and reinforce it, the coating will soon crack and scale off under the abrasion and pressure of traffic.

Figure No. 1 shows photomicrograph made in our technical laboratory of a fairly porous cement finished surface. On a floor of this type there is no trouble experienced in obtaining proper penetration and absorption of the coating into the surface, establishing a bond that will insure most satisfactory results. From Figure No. 1 it is also easily evident that if the floor should be moist and damp, the result would be unsatisfactory, as the presence of the moisture in the pores would naturally repel the coating and make it impossible to penetrate to a depth essential to establish a firm solid key.

Figure No. 2 shows photomicrograph of a dense cement finished floor. The pores in a surface of this character are comparatively small, as the thorough trowelling of the surface concentrates the colloidal content of the cement on the surface and tends to close and seal the pores.

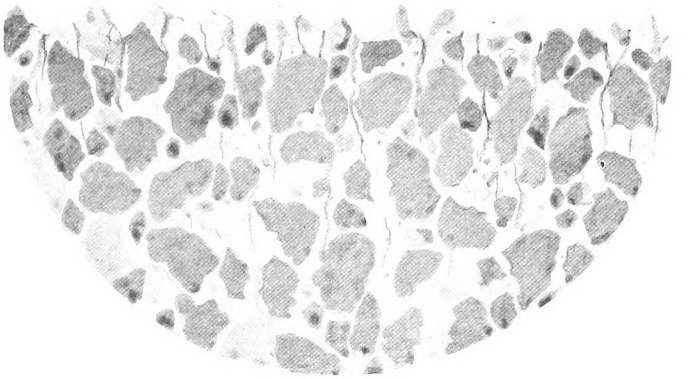
On a surface of this character TRUS-CON FLOOR ENAMEL applied in standard consistency would develop very little penetration. In the absence of penetration the coating over the surface, when subjected to service, would show more or less tendency to crack and scale.

In such conditions, where the floor is dense, the greatest care must be exercised to insure the greatest possible penetration. It is advisable in these cases to coat the floor lightly with spirits of turpentine, and follow with a first coat of TRUS-CON FLOOR ENAMEL which has been slightly thinned with the addition of turpentine, so that the presence of the thinner on the walls of the pores will tend to draw the ENAMEL deeper into the surface than would otherwise result.

Care must also be taken to avoid the application of TRUS-CON FLOOR ENAMEL over a cement finished floor that is soft and weak and not strong enough to resist the crushing pressure of traffic over the surface. In such cases, when the floor is subjected to service, particularly heavy trucking, the surface, due to its intrinsic weakness, will crush under the load and form scales, destroying the decorative effect and general efficiency of the FLOOR ENAMEL treatment.

Figure No. 3 shows photomicrograph of the back of a small scale indicating the failure of the ENAMEL, due to the superficial weakness of the surface of the floor over which the ENAMEL was applied. It is evident from the photomicrograph that the back of the scale is coated continuously with cement, which represents the surface of the floor to which the ENAMEL has very firmly and inseparably adhered and results would have been thoroughly satisfactory if the floor had been firm and sound.

We are pleased to submit special suggestions and recommendations for the use of our ENAMEL on floors of varying texture and porosity, and as a result of our extensive experience and study of this subject, assure the very best results.



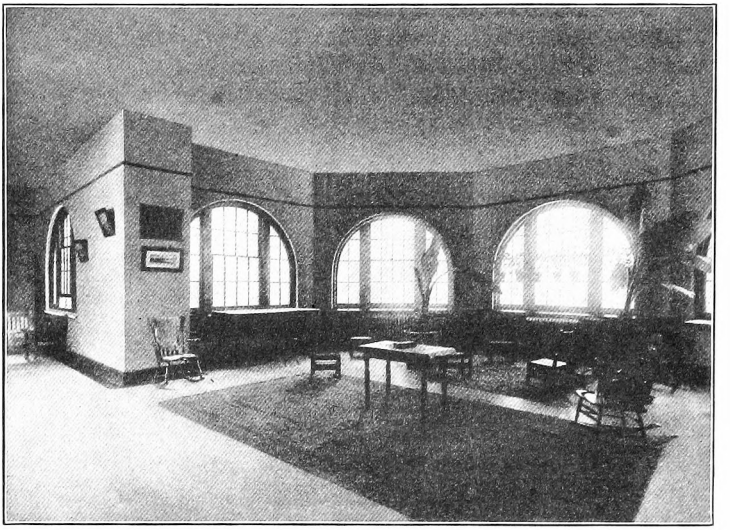
Highly magnified cross-section of a cement floor, showing the rough uneven contour that characterizes the direct wearing surface.

The small particles on the extreme projections of the surface are naturally broken off under the abrasion of traffic, continually forming dust. The pores occuring at the base of the depressions in the surface very readily absorb water in any attempt to clean the floor, with the result that the surface is saturated with moisture for some time after cleaning.

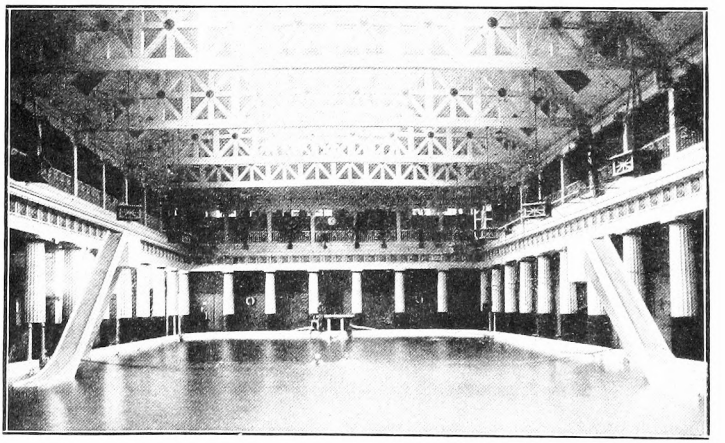
The application of TRUS-CON FLOOR ENAMEL provides the thorough sealing of all the pores of the floor, rendering it positively non-absorbent and easily cleaned and washed and kept in a thoroughly sanitary condition.

The FLOOR ENAMEL also fills the depressions, providing greater evenness to the floor and a continuous film over the projecting particles, insulating them from direct friction with traffic that would otherwise cause them to granulate.

The presence of the ENAMEL in the pores and depressions of the surface serves also to strengthen and reinforce the surface, so that the fine projecting particles will not crush and break down under the crushing strain of traffic and service over the floor.



Sun Parlor, Blair County Insane Hospital, Hollidaysburg, Pa.
Walls treated with TRUS-CON ASEPTICOTE.
Concrete Floor coated with TRUS-CON FLOOR ENAMEL.



Lurline Baths, San Francisco, California
Columns, Balconies and Girders Finished with TRUS-CON ASEPTICOTE

TRUS-CON ASEPTICOTE

This product perfectly meets all the requirements of modern hygiene, for a sanitary, washable, aseptic and durable finish for the decoration of interior walls. Modern progress in general sanitation has condemned the use of wall paper and water soluble paints, for interior decorations.

Wall paper, due to its fibrous and absorbent nature, with its attendant sizing and paste, affords a serious culture bed for the growth and multiplication of disease germs. Similarly, cold water paints due to their high content of glue, casein, dextrin and similar organic materials, offer serious nutrient media for the growth of fungi and moulds, which contribute an unsatisfactory and unhygienic environment. Wall paper cannot be washed nor fumigated, without destroying its decorative effect; while cold water paints are only temporary, very soon failing, scaling and peeling from the surface, and leaving a most unsightly and unattractive appearance.

TRUS-CON ASEPTICOTE is absolutely free from all organic matter that would offer any possible nutrition for the growth of germs, and is unquestionably the most satisfactory product for interior decoration, consistent with the requirements of modern hygiene.

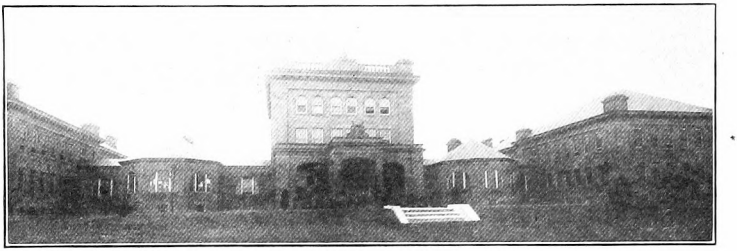
TRUS-CON ASEPTICOTE is manufactured from specially selected non-poisonous pigments which have been most carefully and thoroughly ground in a vehicle subjected to special treatments and manipulations. The absolutely inert nature of the pigments used in the manufacture of Asepticote, insures the perfect safety in the use of this product for any interior work, with no possibility of the suspension of particles of the coating in the air that might affect, and even be toxic to delicate tissues.

The special vehicle used in the manufacture of Asepticote, insures continual washing and cleaning of the coating, without affecting the general attractiveness of the finish.

The number of the soft tones in which TRUS-CON ASEPTICOTE is manufactured, offers various possibilities for obtaining the most attractive, artistic and decorative effects. The even, uniform, soft and velvety effect exceeds in its attractiveness any other method of interior finish. There are no evidences to show laps, brush marks, or the uneven finish that is so characteristic with lead and oil, and which requires stippling to eliminate. The perfect ease with which TRUS-CON ASEPTICOTE can be applied, and the uniform, opaque and dense finish, makes this product considerably more economical than a flattened lead and oil.

The perfect sanitary qualities of Asepticote, supplemented with the very even, washable and durable finish which it produces, in the minimum number of coats, makes this product the most economical and efficient coating for general use in finishing the interior of residences, schools, public buildings, sanitariums, hospitals and similar structures.

On a surface which has been properly prepared, with a sizing coat of TRUS-CON Alkali-Proof Wall Size, as stated in the directions, TRUS-CON ASEPTICOTE will cover approximately 200 sq. ft. per gallon, two coats. See complete specifications on page 87.



Blair County Insane Hospital, Hollidaysburg, Pa.
TRUS-CON ASEPTICOTE used throughout this Institution

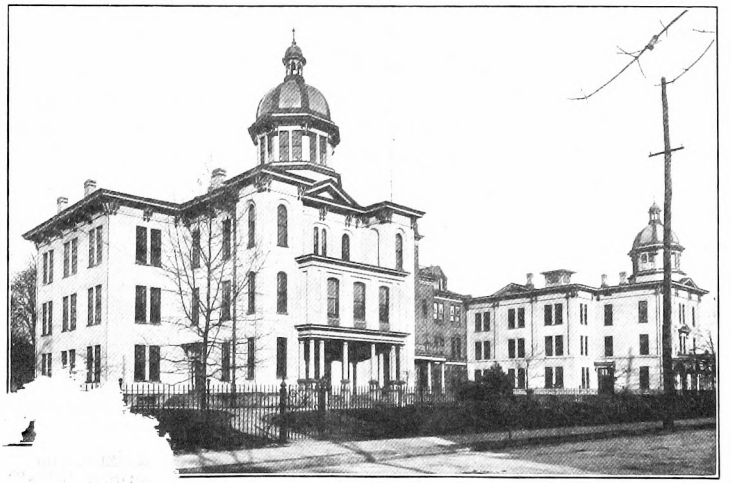
THE NEW JERSEY SCHOOL FOR THE DEAF
WILLIAM G. NEWCOMB
Storekeeper

Trenton, N. J., July 15th, 1912.

Trussed Concrete Steel Co.,
Detroit, Michigan.

Gentlemen—In order to overcome whitewashed wall conditions, I ordered 10 gallons of your Alkali-Proof Wall Size and 10 gallon TRUS-CON Aseptic-cote (white) for use as a trial in this institution. I had the walls thoroughly scraped leaving them black, scaly and rough, but I have obtained splendid results and the quantity mentioned covered 3,735 square feet, double coat, an average of 373.5 square feet per gallon. The work was done by pupils of the institution under my instruction, some of the boys never having done any painting previously.

Yours very truly,
WILLIAM G. NEWCOMB.



State Model and Normal Schools, Trenton, N. J.
Interior walls coated with TRUS-CON ASEPTICOTE

TRUS-CON ASEPTICOTE PLEASES EVERY ONE

"Our walls are made of very porous material and I think that the sample of TRUS-CON Asepticote which you sent, and which we used in the rooms as set forth, makes a good finish.

I have been slow to make up my mind just what Wall Finish to use, but it seems to me that from the walls of the rooms we have finished, yours was the most satisfactory." BLAIR COUNTY HOSPITAL FOR THE INSANE, Hollidaysburg, Pa., Dr. H. J. Sommer, Supt.

"Your TRUS-CON Asepticote proved very satisfactory to us, and we want now to apply your TRUS-CON Floor Enamel to our fourteen toilet rooms and oblige, BROAD STREET NATIONAL BANK, Trenton, N. J.

"The buff color TRUS-CON Asepticote used on the interior walls of the Prospect Street Presbyterian Church is highly satisfactory, and the committee wish to have the cement floor in basement treated with your Floor Enamel." HARRY A. HILL, ARCHT., Trenton, N. J.

"I received the Wall Size and the Asepticote which you sent me at the State Normal Schools.

These materials gave perfect satisfaction to the room I coated for a sample demonstration—came out like a piece of velvet. The heads of the school are much pleased and have ordered a barrel of Concrete Grey Asepticote and a barrel of Wall Size and an additional gallon of Wall Size. If it was not so late, they would order five barrels. They are going to let the rest of the work go over until next term. If their painter will make the material come out as nicely as I have done, no one can ever sell them anything but 'TRUS-CON.'

The head painter at the Normal told the Principal it was impossible to get such a job with oil paint and that it could only be procured with TRUS-CON.' We just show them the goods and there you are." A. J. COMPTON, Trenton, N. J.

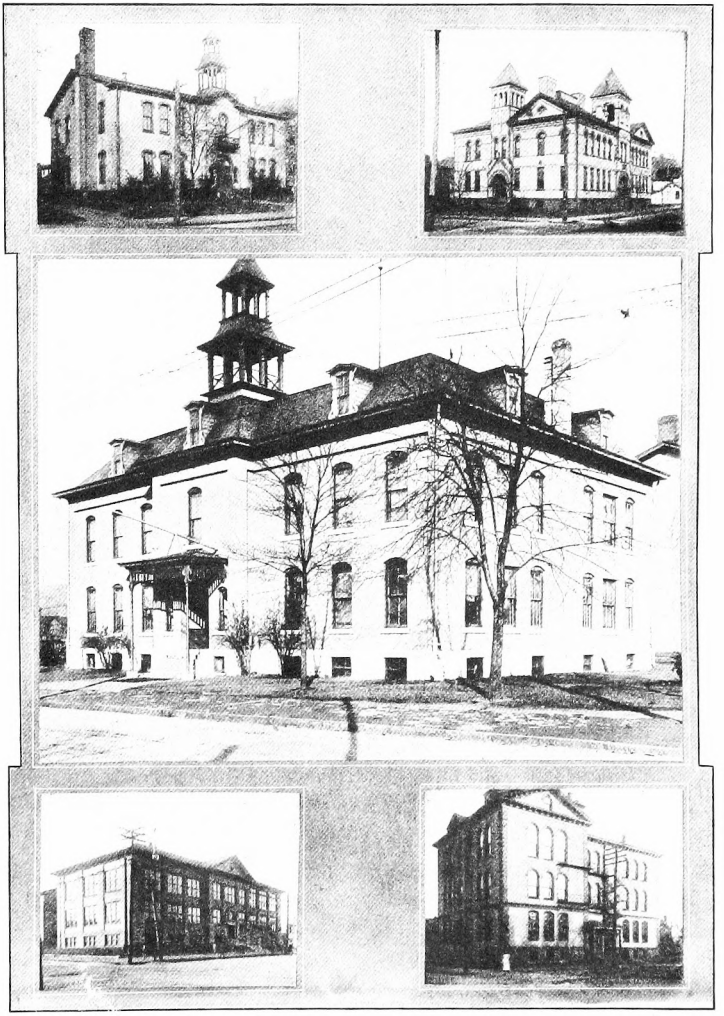
"We ordered 15 gallons of your TRUS-CON Asepticote sometime ago, and have found it very satisfactory." LAKEWOOD FARM, Chicago, Ill.

"Enclosed find order for immediate shipment of TRUS-CON Asepticote. Your materials have always given me satisfaction, and I look for good results with this Asepticote." WILLIAM J. SCALES, ARCHT., Glen Falls, N. Y.

"All rooms and floors of the Chesterfield Hotel are treated with TRUS-CON Asepticote, Floor Enamel, etc. as it is Mr. Hanrahan's intention to do all rooms throughout house and Rathskeller. It is the representative hotel of the city, it being the only Rathskeller in the city. We have also used TRUS-CON Asepticote in the Banking House of the Merchants & Farmers Bank, Emporia, Va., also the sporting goods store of D. W. Branch which is the leading establishment of the kind in the city.

I would like also to mention the handsome new residence of Mr. E. O. Wyatt, Jr., St. Andrew St., this city. I expect a lot of handsome orders in the next few days among which will be the handsome stores of A. Rosenstock & Co., Dry Goods, the leading establishment of its kind in Virginia, and the handsomest store building in Va. CHAS. R. WALSH, Petersburg,

"The TRUS-CON Asepticote has been on our Fort Worth w[illegible]me time and so far it shows no sign of scaling off. It looks as if [illegible]ng to serve the purpose." SWIFT & COMPANY, Chicago, Ill.



Public Schools, Beaver Falls, Pa.
Interior Walls Decorated with TRUS-CON ASEPTICOTE.

SOME TRUS-CON ASEPTICOTE CUSTOMERS

Princeton University, Princeton, N J.
Jackson-Walker Bldgs., Wichita, Kas.
U. S. Army and Navy Hospital, Hot Springs, Ark.
Blair County Insane Asylum, Hollidaysburg, Pa.
Board of Health Building, Detroit, Mich.
Z. & W. M. Crane Paper Mills, Dalton, Mass.
C. A. Edgarton Mfg. Co., Shirley, Mass.
Rochelle Gas Company, Rochelle, Ill.
Shirley Annex, Denver, Colo.
North Dakota Agricultural College, Fargo, N. Dak.
N. J. State Normal & Model Schools, Trenton, N. J.
Pennington Seminary, Pennington, N. J.
Postoffice, San Francisco, California.
Rialto Bldg., San Francisco, Cal.
Alder Sanitarium, San Francisco, Cal.
Western Electric Company, New York City.
Peoples Brewery, Trenton, N. J.
Sloman Fur House, Detroit, Mich.
Swift & Co., Chicago, Ill.
Broad Street Bank Bldg., Trenton, N. J.
Garford Manufacturing Company, Elyria, Ohio.
Edison Illuminating Company, Detroit, Mich.
Texas Company, St. Louis, Mo.
State Reformatory, Rahway, N. J.
Enterprise Manufacturing Co., Cornwells, Pa.
Jerseyville Telephone Co., Jerseyville, Ill.
Armour & Co., Fort Worth, Texas.
Blue Valley Creamery, Chicago, Ill.
Chicago Club, Chicago, Ill.
National Malleable Castings Co., Melrose Park, Ill
Bolivar Public School, Otterbein, Ind.
Flynn Bldg., Des Moines, Iowa.
Des Moines Club, Des Moines, Iowa.
Electric Building, Portland, Ore.
Chesterfield Hotel, Petersburg, Va.
Mausoleums, Waterloo and Mechanicsville, Ia.
Fall City Tannery, Louisville, Ky.
Central Christian Church, Shreveport, La.
Rumford Falls Power Co., Rumford, Me.
Calvert Lithographing Co., Detroit, Mich.
Grace Hospital, Detroit, Mich.
Cumberland County Hospital, Bridgeton, N. J
Johnson & Johnson, New Brunswick, N. J.
Carnegie Warehouse, Newark, N. J.
Monmouth Hotel, Spring Lake, N. J.
Fireproof Film Co., Rochester, N. Y.
Knox Gelatine Co., Johnstown, N. Y.
Loose-Wiles Biscuit Co., Chicago, Ill.
Port Huron Creamery, Port Huron, Mich.
Algonquin Hotel, Dayton, Ohio.
Bluffton Light & Water Works, Bluffton, Ohio.
Payne Motor Car Co., Cincinnati, Ohio.
Public School, Beaver Falls, Pa.
Terminal Railway Warehouses, Pittsburg, Pa
Schmidt Building, Davenport, Iowa.
Deere & Co., Moline, Illinois.
Public Schools, Beaver Falls, Pa.
Western Union Telegraph Co., Pittsburg, Pa.
Westinghouse Bldg., Pittsburg, Pa.
Commonwealth Edison Co., Chicago, Ill.
Arnfeld Building, Pittsburg, Pa.
D. K. E. Fraternity House, Hamilton, N. Y.
Raritan Hotel, New Brunswick, N. J.
Owen Building, Detroit, Michigan.

TRUS-CON ALKALI-PROOF WALL SIZE

The success of the results from the use of any interior coating, depends upon the carefulness with which the surface is prepared.

TRUS-CON ALKALI-PROOF WALL SIZE is particularly formulated to work most efficiently with TRUS-CON Asepticote, to thoroughly uniform the suction and provide the most satisfactory foundation over which TRUS-CON Asepticote can be applied, with most even and uniform results. Practically all newly finished walls are characterized by a distinctly variable suction, some portions being extremely hard, tending to minimize the absorption of any coating applied over them, while the soft parts absorb the finish and leave an uneven and mottled effect. Painters recognize the necessity of using a sizing coat, to thoroughly uniform the porosity of the surface, so as to minimize the number of coatings which are necessary to give the most even and uniform results.

Glue size, while permissible with water soluble coatings, is very unsatisfactory as a sizing coat under washable, sanitary coatings. The composition of the vehicle in the washable coatings dry hard and dense, and cause the glue to crawl and peel, resulting in the failure of the coating. Any moisture present in the wall will soften the glue and tend to destroy the bond and adhesion of the coating to the surface, with the resultant failure evidenced by scaling and peeling off the surface.

Gloss oil is equally unsatisfactory, due to its sensitiveness to the action of moisture, and its tendency to anneal with the coating applied over it, and be inefficient in uniforming the suction of the surface, for which it is intended.

For the most dependable results, a moisture-resisting and durable product such as TRUS-CON ALKALI-PROOF WALL SIZE should be employed. The additional expense involved in the use of ALKALI-PROOF WALL SIZE as compared with the cheaper sizes, is fully compensated for by the increased durability and service which will result from the finish that is applied over it.

In treating new walls, to be finished with TRUS-CON ASEPTICOTE it is recommended that all patches and cracks be thoroughly filled with Plaster of Paris, which, when hardened and set, should be given a light coat of shellac, and after treating the entire surface, sized with a coating consisting of one part of the ASEPTICOTE, of the color desired, combined with three parts of TRUS-CON ALKALI-PROOF WALL SIZE. This will give a tinted foundation over which TRUS-CON ASEPTICOTE can be applied, with most even and uniform results, and be entirely certain of its inseparable and permanent bond to the treated area.

Refer to the full directions for the use of TRUS-CON ASEPTICOTE for additional instructions to be observed in its application, page 87.

TRUS-CON ALKALI-PROOF WALL SIZE, on a surface of average porosity, will cover approximately 200 sq. ft. per gallon.

TRUS-CON SNO-WITE

This product is an enamel coating of the very highest quality, for finishing the interior surfaces of wood, metal and plaster. It produces an enamel finish with a brilliancy of tone, softness, whiteness and lustre that cannot be excelled. The extreme ease and smoothness with which Sno-Wite flows out under the brush, gives a finish absolutely free from brush marks, or grain, resembling a porcelain surface.

The very special properties of TRUS-CON SNO-WITE are the result of the extreme care taken in the particular grinding of imported pigments with a vehicle that is specially compounded from gums and oils of the very highest quality. The special fineness of the pigments and the character of the vehicle, insure a product of maximum elasticity, and one which will show no tendency to crack, craze or peel from the surface.

The formulation of TRUS-CON SNO-WITE insures the maximum brilliancy to the initial clear, pure whiteness of the finish. The very highest grade of select fossilized gums are so expertly combined with oils, to produce the vehicle used in the manufacture of this product, that the natural characteristic of white enamels to slowly yellow is practically eliminated.

Careful comparative tests, conducted by impartial master painters, have repeatedly demonstrated that the whiteness, lustre, covering capacity and free working qualities of TRUS-CON SNO-WITE excel domestic and imported enamels. The remarkable qualities of Sno-Wite to retain its whiteness, show no tendency to craze, and give no trouble from laps or brush marks in application, can only be appreciated by careful trial in comparison with other products.

TRUS-CON SNO-WITE is used for finishing the interior of residences, hospitals, hotels and similar structures.

The easy, smooth-flowing qualities of TRUS-CON SNO-WITE, insure the maximum covering capacity, and the final cost of this product is no greater than with cheaper enamels of markedly inferior quality.

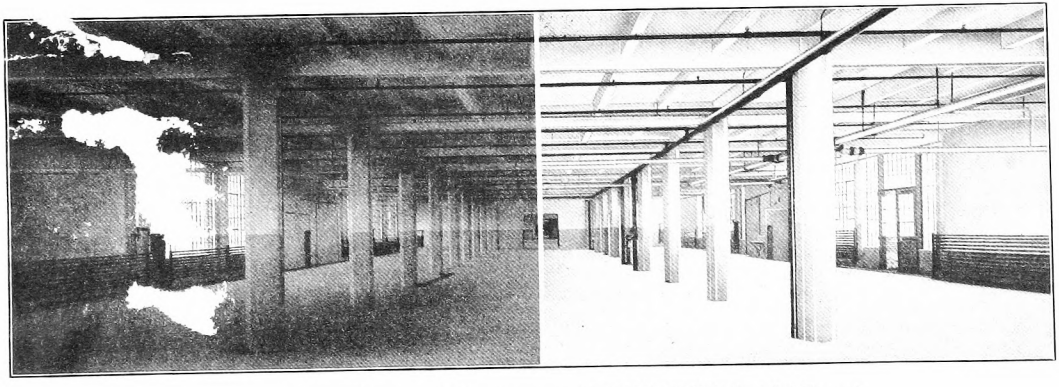
On a surface properly prepared to receive TRUS-CON SNO-WITE, one gallon will cover 500 square feet as a conservative estimate.

TRUS-CON SNO-WITE can be supplied so as to give a gloss, eggshell, or flat finish, and on orders, care must be taken to specify the character of finish desired. In all cases where the finish is not distinctly stated, the gloss will be shipped.

The best results with TRUS-CON SNO-WITE can only be obtained when the surface to be finished has been properly undercoated, so as to provide an even, uniform foundation over which the Sno-Wite can be applied and develop its full quality.

Full directions and specifications for finishing wood, metal and plaster surfaces with TRUS-CON SNO-WITE, to insure the very finest work, will be found in this book on pages 88 and 89.

Liquid and panel samples of TRUS-CON SNO-WITE will be furnished to master painters, architects and owners who are interested in the very highest quality enamel.



Showing Interior Before and After Coating with TRUS-CON Industrial Enamel

A FEW USERS OF TRUS-CON INDUSTRIAL ENAMEL

Westover School Corporation, Middeburg, Conn.
Uncle Sam Macaroni Co., Tecumseh, Mich.
Coca-Cola Bottling Works, Washington, Ga.
Street Railway Barns, Bedford, Mass.
W. J. Wilcox Lard and Refining Co., Guttenberg, N. J.
Crescent Lumber Co., Silver City, N. Mex.
Hayner Distilling Co., Troy, Ohio.
E. E. Jones, Summitsville, N. Y.

Otis Building Basement, Chicago.
Union Meat Co., Portland, Ore.
Western Meat Co., San Francisco, Cal.
Swift and Co., Seattle Washington.
Dentral Laboratories, Memphis, Tenn.
Parker Webb and Company, Detroit.
Swift and Co., Winnipeg, Manitoba.
Los Angeles Packing Co., Los Angeles, Cal.

TRUS-CON INDUSTRIAL ENAMEL

This is the modern practical finish for the interior of industrial plants. It corrects the many weaknesses of cold water paints, and adds many new advantages invaluable to the efficient treatment of factory interiors.

No progressive manufacturer can fail to appreciate the direct economy and practical advantages of TRUS-CON INDUSTRIAL ENAMEL, in providing the most sanitary, durable finish with maximum light-reflecting properties. The high enamel finish, characteristic of INDUSTRIAL ENAMEL insures the utilization of all the available light in the interior, by reflecting it directly upon the machinery and parts of the plant where it is most needed. The reduction in artificial lighting cost is a distinct and valuable economy in actual manufacturing expense.

TRUS-CON INDUSTRIAL ENAMEL shows no tendency to peel, flake and dust off the surface, tending to injure the machinery and very often the manufactured products, as is the case with cold water paints, which, under the very slightest vibration and shock of the machinery, flake and dust, causing continual annoyance and expense.

The general nature of TRUS-CON INDUSTRIAL ENAMEL insures the greatest service and durability. While with cold water paints the surface must be continually recoated, in order to retain the finish in any acceptable condition, INDUSTRIAL ENAMEL indefinitely remains in good condition. The economy in the use of INDUSTRIAL ENAMEL is evident, when consideration is given to the labor expense involved in applying frequent coatings of cold water paints, as compared with one application of TRUS-CON INDUSTRIAL ENAMEL.

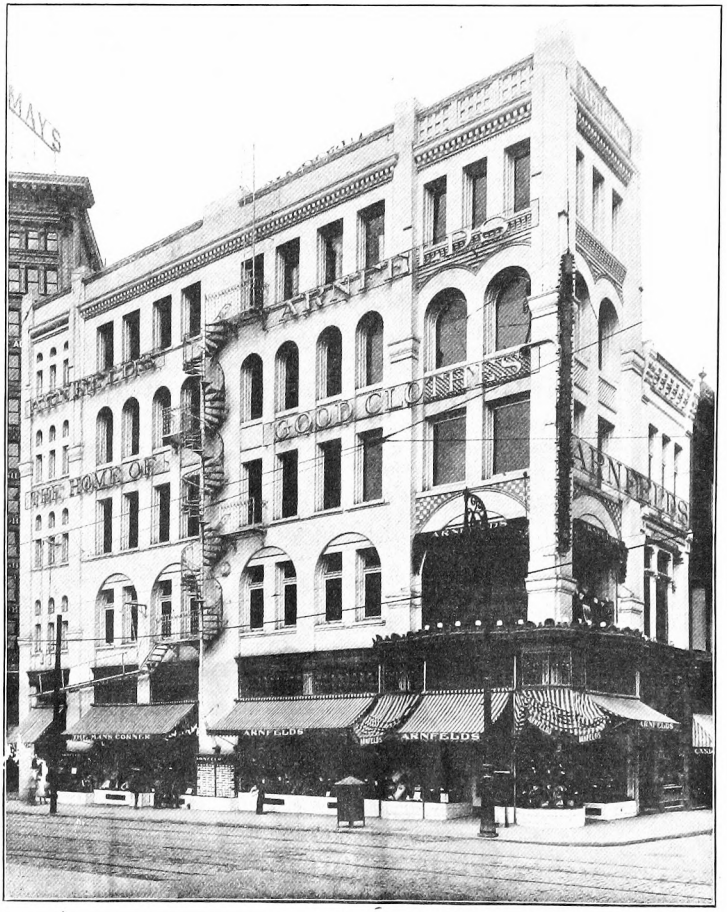
The hard, smooth, enamel surface provided by INDUSTRIAL ENAMEL, can be readily washed and cleaned, and kept in a thoroughly sanitary and aseptic condition. The product contains no organic matter, such as is always present in cold water paints, which would afford nutrition and development of dangerous germs.

The density, opacity and body of INDUSTRIAL ENAMEL, combined with its exceptional spreading capacity, makes it a decidedly economical product, as the enamel finish can be obtained with only two undercoatings on either a porous wood, or masonry surface. While a lead and oil coating soon turns distinctly yellow, due to the inherent characteristic of all drying oils to develop this property when applied to interiors, TRUS-CON INDUSTRIAL ENAMEL indefinitely retains its brilliancy and its capacity for the diffusion of natural sunlight. INDUSTRIAL ENAMEL contains no poisonous pigments, and does not present the objectionable points resulting from the use of lead and oil.

Investigation of the economy and efficiency of TRUS-CON INDUSTRIAL ENAMEL will convince any manufacturer, interested in the productiveness of his organization, that a brighter and whiter interior, flooded with sunshine and the beauty of nature's out-of-doors, can be had with TRUS-CON INDUSTRIAL ENAMEL.

Standard specifications for the treatment of interior surfaces of various nature with TRUS-CON INDUSTRIAL ENAMEL, are given completely on pages 89 and 90 in this book.

Sample panels, showing the exact nature and texture of the finish, will be furnished on request, and full recommendations, specifications and estimates of cost prepared for all special cases.



Arnfeld Building, Pittsburg, Pa.
Exterior Walls Finished with TRUS-CON Edelweiss

TRUS-CON EDELWEISS

This product is a very special white gloss enamel, for finishing exterior surfaces. In application, it flows as freely and smoothly as a long oil varnish, having no tendency to show brush marks, or laps.

TRUS-CON EDELWEISS produces a finish that will not turn yellow, scale, crack or lose its gloss under continual exposure to elementary conditions. It is applicable for finishing exterior metal, wood, brick, or concrete surfaces, and under proper manipulation, with supplementary undercoatings, produces a finish in texture and attractiveness excelling that of the very highest class terra cotta enamel.

TRUS-CON HOSPITAL ENAMEL

Applicable for providing the most attractive sanitary finish on interior of hospitals, sanitariums and similar institutions, where a perfectly washable, durable, aseptic coating is essential.

The special formulation of TRUS-CON HOSPITAL ENAMEL, insures a maximum degree of permanency on interior work, when subject to occasional washing with strong antiseptic and disinfecting solutions, together with frequent washings with soap and water.

The coating produced on the drying of TRUS-CON HOSPITAL ENAMEL is of the very closest and densest texture, so as to offer absolutely no opportunity for the lodgment of any germs. It is positively aseptic and contains no material that would offer nutrition, or media for the growth of any bacteria.

TRUS-CON HOSPITAL ENAMEL will indefinitely retain its perfectly white appearance, and under proper application with appropriate undercoatings, will permanently hold its bond to the surface, showing no indications of cracking, chipping, or peeling.

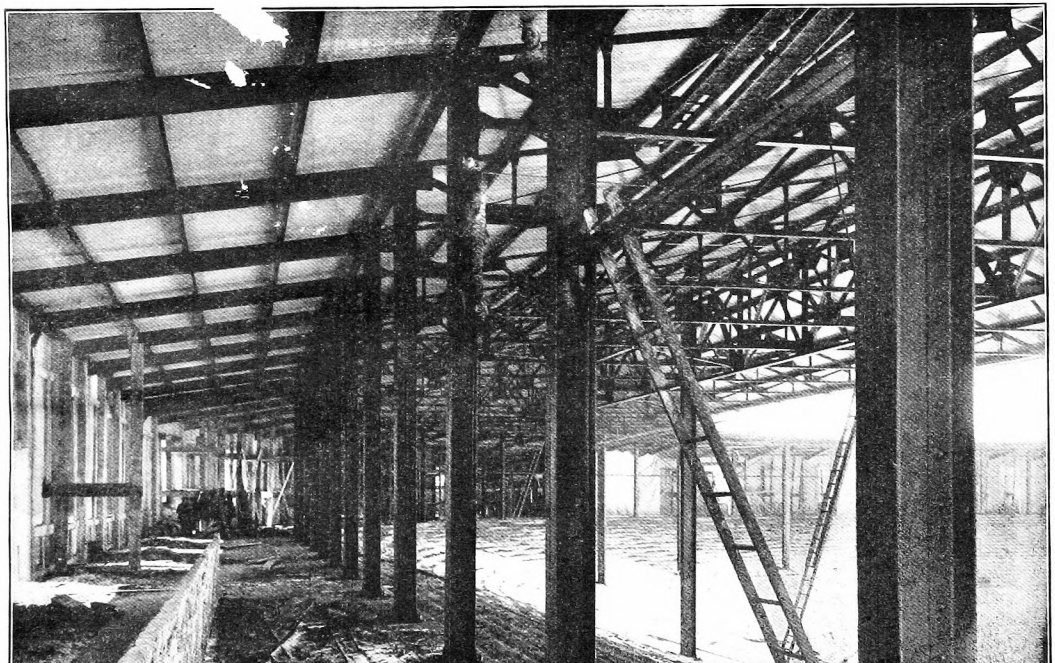
TRUS-CON HOSPITAL ENAMEL has been tested very carefully, and due to the most excellent results under trial tests, is being specified and used with most splendid results by a great number of architects who have taken opportunity to observe the special quality of this product.

TRUS-CON DAIRY ENAMEL

There are no foods that require closer care, or more sanitary environment in preparation, than dairy products. The most exacting care should be exercised by dairymen to protect the general health of the public depending upon them for their various dairy products, to insure that they are prepared under the most hygienic and aseptic conditions. This requires that the usual porosity of a wood or masonry surface may be replaced by a dense, permanent, sanitary enamel, that can be continually washed and cleaned, and maintained in the highest condition of cleanliness.

TRUS-CON DAIRY ENAMEL has been specially formulated to meet the requirements of dairymen, for finishing the interior of their buildings, to provide the most attractive and sanitary enamel finish.

This product is particularly opaque and dense, and requires a very minimum number of coats to provide a most satisfactory enamel finish. There is no product available that compares favorably with TRUS-CON DAIRY ENAMEL in providing a most attractive, sanitary and economical finish, for very general application in dairy and creamery structures.



Grandstand, American League Baseball Park, Detroit. All Structural Steel Coated with TRUS-CON BAR-OX No. 7

TRUS-CON BAR-OX NO. 7.

This product is particularly formulated as a protective coating for structural steel, bridges, and general steel and iron surfaces exposed to natural elementary conditions.

The efficiency and effectiveness of any method of protection must obviously be based on the correctness of the conception and appreciation of the principles operative in the process of corrosion.

The extensive and apparently conclusive research work conducted in connection with the conception, development and ultimate substantiation of the electrolytic theory, has resulted in this explanation of the process of corrosion being most generally accepted.

The one essential fact emphasized by the interpretation of the electrolytic theory is the absolute necessity of the presence of water to provide the hydrogen in order that the corrosion may start.

The protection of iron and steel against corrosion is simply and literally a problem of waterproofing, and its solution will depend upon providing coatings which particularly excel in their water-resisting and water-shedding qualities, so as to provide the most even, continuous and impervious insulation over the surface, positively and effectively protecting it from any possible contact with moisture.

The vehicle employed in the manufacture of TRUS-CON BAR-OX No. 7 is the acme of our experimental work on the synthesis of the most impenetrable film, and accordingly offers the most efficient and effective medium of insulating an iron or steel surface over which it is applied from contact with water.

The pigments employed in the manufacture of TRUS-CON BAR-OX No. 7 are selected in consideration of their inhibitive properties, and are so quantitively combined as to produce the maximum inhibitive capacity. In the mechanical preparation of these pigments, the greatest possible care is taken to so regulate their physical dimensions as to provide a granularmetric composition that will impart the maximum density to the film, which supplementary to the natural water-resisting qualities of the vehicles, offers the most certain protection against the possible absorption or penetration of moisture.

The formulation of TRUS-CON BAR-OX No. 7 in the strictest compliance with the most advanced principles of the protection of iron and steel against natural corrosion, makes this product the most efficient coating for treating all iron and steel surfaces, such as structural steel frames, bridges, viaducts, tanks, and similar structures which are exposed to the natural elementary conditions.

The easy-flowing qualities of this product insure the maximum covering capacity, consistent with providing a film of sufficient thickness and density to obtain thorough and dependable protection.

TRUS-CON BAR-OX No. 7 is regularly manufactured in the three standard colors, of RED, GREEN and BLACK.

PROTECTIVE COATINGS FOR IRON AND STEEL UNDER SPECIAL CONDITIONS OF EXPOSURE

The very general application of iron and steel in the several arts is so varied that no one protective coating could be efficient for the various conditions of service and exposure to which the metal is subjected.

Obviously, the properties of the protective coating applied to a steel bridge must be different from a product employed for protecting steel subject to conditions of high temperature or active chemical conditions.

It is accordingly necessary to determine accurately the conditions to which the protective coating will be subjected and treat raw materials best suited to develop the properties required by the particular conditions.

Our BAR-OX coatings include products for practically every condition to which iron and steel are subjected and require protection against natural corrosion. The great success which our BAR-OX products have given is due entirely to the great care which has been taken in determining in every case all the conditions to which the coating will be subjected and formulating the several products so as to most satisfactorily and efficiently meet every possible condition.

BAR-OX No. 14.

BRINE AND CONDENSER PIPES, COILS, ETC.

The efficient protection of iron and steel pipes when exposed to the active corrosive conditions in refrigerating plants, is a very important problem for manufacturers having such installations in connection with their plants.

TRUS-CON BAR-OX No. 14 has been very carefully formulated, with a full understanding of the exact conditions and requirements of an efficient protective coating for coils, condensers, and, in fact, all iron work in connection with brewing, ice-making and general refrigerating plants.

This product will stand a high heat, show no tendency to become brittle or lose its perfect adhesion to the metal when cold, and is thoroughly immune to the action of moisture, thereby efficiently protecting and insulating the surface from the active conditions of corrosion.

TRUS-CON BAR-OX No. 14 is regularly manufactured in black, but can be supplied in dark maroon and green.

BAR-OX NO. 21

Stack Enamel, Boiler Front Enamel

This product is particularly adapted as a protective coating for iron and steel which in practical use are subject to a comparatively high degree of heat, such as smoke stacks, boiler fronts, etc.

The product most perfectly combines in one product resistance to temperature conditions and ability to stand continual exposure to extreme conditions, without showing any tendency to peel, crack or blister.

The product flows and spreads most easily and is especially in favor for treating boiler and engine fronts, due to the very attractive appearance which it gives in addition to its remarkable durability.

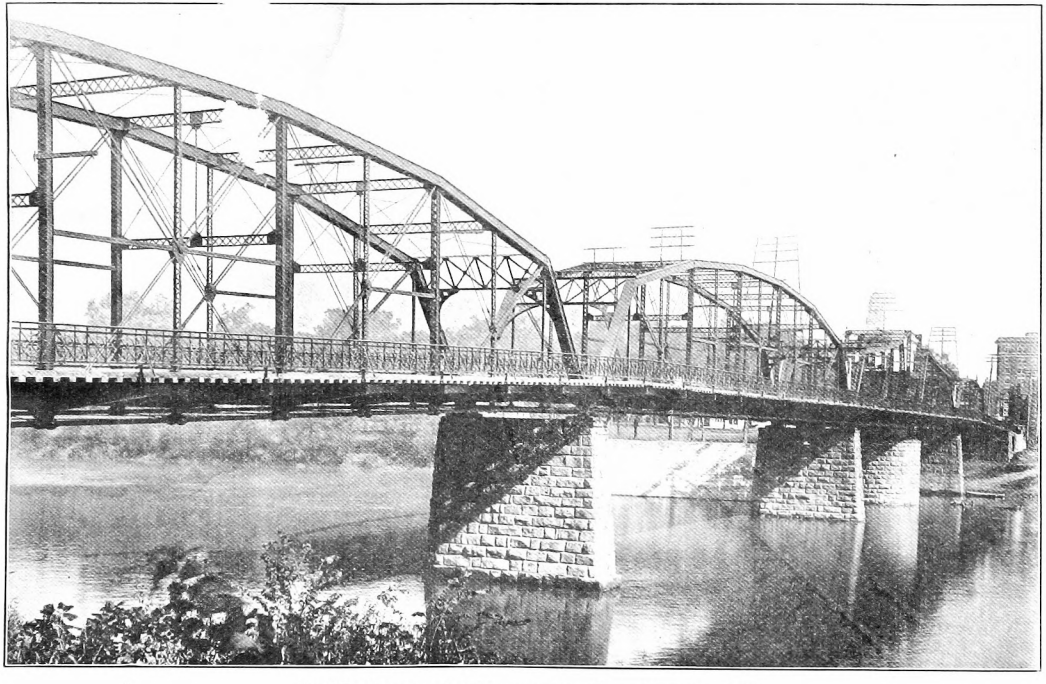
BAR-OX NO. 28

Acid and Alkaline Conditions

This product is particularly adapted for coating metal that is subject to active chemical conditions. It is efficient for treating metal tanks which are subject to the action of weak acids.

Also recommended as a final coat in painting structural steel to be embedded in concrete. The coatings most generally used for painting structural steel are sensitive to saponification when coming in contact with strong alkali, and if a final coat such as BAR-OX No. 28 is not used, the coating will be entirely destroyed in contact with the strong alkali always present in concrete.

The very best practice for treating structural steel to be embedded in concrete is to use TRUS-CON BAR-OX No. 7 for the first and second coats, to obtain the very fullest inhibitive value from this product, followed with BAR-OX No. 28 as the final coat, which will perfectly protect the BAR-OX No. 7 from any injury due to the alkali present in the concrete.



Steel Bridge over Muskingum River Near Marietta, Ohio
Coated with TRUS-CON BAR-OX No. 7.

A FEW TRUS-CON BAR-OX USERS

Pennsylvania Railroad Co., Pittsburg, Pa.
Pere Marquette Railroad Co., Detroit, Mich.
Grand Rapids & Indiana Railroad Co., Grand Rapids, Mich.
Kansas City, Mexico & Orient Ry. Co., Kansas City, Mo.
Vandalia Railroad Co., St. Louis, Mo.
Illinois Theatre, Chicago, Ill.
Baseball Grandstand, Detroit, Mich.
Several Bridges, Grosse Pointe Farms, Mich.
Large Steel Bridge, Marietta, Ohio.
Terminal Warehouse, Pittsburgh, Pa.
City Waterworks Dept., Rochester, N. Y.
Vulcan Iron Works, Chicago, Ill.
The Russell Co., Massillon, Ohio.
Board of Public Works, Battle Creek, Mich.
Missouri Pacific Ry. Co., St. Louis, Mo.
Imperial Porcelain Works, Trenton, N. J.
Star Porcelain Works, Trenton, N. J.
Robt. H. Ingersoll & Bro., Trenton, N. J.
Arctic Mining & Power Co., Emigrant Gap, Calif.
Illinois Theatre, Chicago, Ill.
Koh-I-Nor Laundry, Munsey, Indiana.
The Mutual Electric Co., Chicago, Ill.
American Foundry & Machine Co., Hamilton, Ohio.
New Port Mining Company, Ironwood, Mich.
Street Railway Co., Detroit, Michigan.
Public Lighting Plant, Detroit, Michigan.
Illinois Steel Company, Chicago.
The Morton Mfg. Co., Muskegon Heights, Mich.
The Ingalls Iron Works Co., Birmingham, Ala.

WEST VIRGINIA UNIVERSITY
Department of Chemistry.

Analytical and Physical Chemistry,
F. L. Kortright, D. S. C.

Morgantown, W. Va., June 7, 1910.

Trussed Concrete Steel Company,
Detroit, Mich.

Gentlemen—Replying to your letters of January 20th, 1910 and of earlier dates, I am pleased to inform you that your special paint (BAR-OX), was the most satisfactory of all of the samples tested, and that I have recommended its use on the work in hand.

Very truly yours,

F. L. KORTRIGHT.

TRUS-CON ROOF-SEAL

This product has a very universal application for correcting roof troubles. It stops the rusting and corrosion of tin and metal roofs, and enlivens and revives the life of any felt roof. It is, in fact, applicable to any roof that is becoming porous and requires a product that will penetrate into the pores, completely sealing them, and providing a new continuous coating over the entire roof that will be waterproof, and possess qualities which will endure against the cold and frost of our winters and the scorching sun of our summers.

TRUS-CON ROOF-SEAL is manufactured from the very best grades of natural asphaltum, blended with a special combination of oils, which insures a product that will give a coating of the greatest elasticity, toughness and durability.

The number of coats of TRUS-CON ROOF-SEAL required will depend upon the particular conditions existing on the roof to be treated. If in some places the roof is especially porous, these parts should receive a special application of a liberal quantity of TRUS-CON ROOF-SEAL, so that the unusually porous parts can be well filled up with TRUS-CON ROOF-SEAL and a continuous coating provided over the entire area.

TRUS-CON ROOF-SEAL will cover 200 square feet on metal roofs, about 150 square feet on a good felt roof, while it will require at least a gallon for every 100 square feet on a porous absorbent roof.

LEFFLER & BLAND
Contractors for
Brick and Stone Work
Setting Mantles, Etc.

Marion, Ohio, August 5, 1912

Trussed Concrete Steel Co.,
Detroit, Michigan.

Gentlemen—Your TRUS-CON Roof-Seal is all you claim for it and we are very much pleased with the results.

Yours truly,
LEFFLER & BLAND,
By C. W. Leffler.
Narberth, Pa.

Trussed Concrete Steel Company,
408 Crozer Building,
Philadelphia, Pa.

Gentlemen—For your information, desire to state that the TRUS-CON Roof-Seal which you furnished me a couple of months ago is without doubt the best roofing paint I have used in my fifteen years' experience as a painter. Your paint seems to spread farther and smoother, and closes up the pores better than anything I know of, and you can rest assured that you will get all my future orders.

Wishing you continued success, I am,
Very truly yours.
E J HOOD.

TRUS-CON IRONITE FLOORING

Nature of Material:

A finely ground metallic powder, possessing the property of combining with the oxygen of the air, expanding so as to fill out and close the pores and interstices of any cementitious composition in which it is used.

Purpose of Product:

For use in laying the top surface of cement floors, to impart a greater hardness and resistence to wear.

Directions for Use:

(1) The very first essential in the use of TRUS-CON IRONITE FLOORING is to insure a most even and uniform mixing of the dry powder with the dry cement. The quantity of IRONITE to be added to the dry cement varies from fifteen (15) to twenty-five (25) per cent., depending upon the service to which the floor will be subjected. For the very best results, twenty five (25) pounds of TRUS-CON IRONITE FLOORING should be most evenly and uniformly mixed with each bag of cement. The mixing should be continued until there is absolute certainty of obtaining the most uniform and even distribution of the powder throughout the dry cement. Good results cannot be obtained if this very essential point of thorough mixing is not carefully observed.

(2) The dry mixture of cement and TRUS-CON IRONITE FLOORING should be again thoroughly mixed with the dry sand, used in the regular proportion of 1:2.

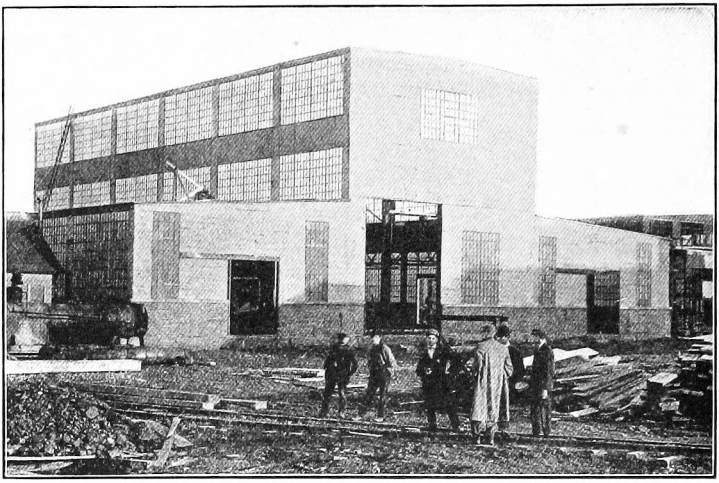
(3) After thorough mixing of the Ironized cement with the dry sand, the mixture should be thoroughly tempered with water, to the correct consistency for applying cement finish.

(4) The top surface should correctly be applied at the same time as the main body of concrete, or at least while it is still green, so as to insure a solid bond of the top finish to the concrete.

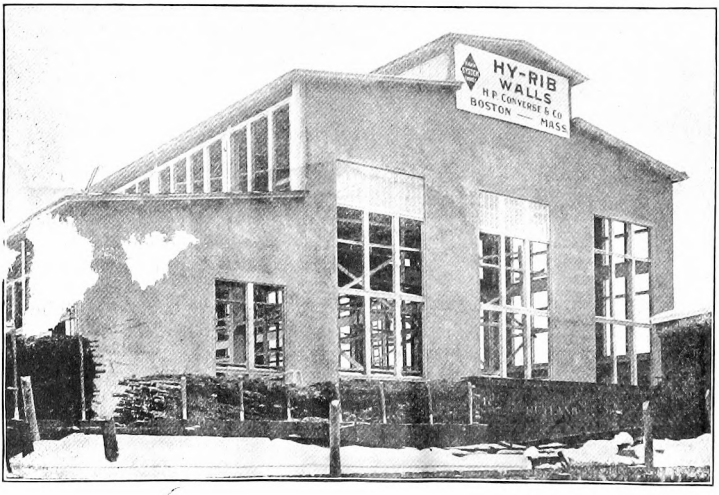
(5) The thickness of the top finish will depend upon the service to which the floor is subjected, varying between one-quarter and one inch. For general conditions, a thickness of one-half inch is the regular practice.

As the efficiency of the product is a direct result of the thorough and complete oxidation of the material, so as to fill out the pores of the mass, it is very necessary that the floor be kept thoroughly wet for a week or ten days after laying, so as to accelerate the oxidation and development of the product.

Thickness of Top Coating	Quantities Ironite Flooring to Cement Used	No. Lbs. of Ironite Flooring per 100 sq. ft.
1″	15%	57.0
	20%	76.0
	25%	95.0
¾″	15%	42.8
	20%	57.0
	25%	71.3
½″	15%	28.5
	20%	38.0
	25%	47.5



Stucco Sidings Waterproofed with TRUS-CON PASTE
Great Lakes Engineering Works, Ashtabula, O.



Stucco Sidings Waterproofed with TRUS-CON PASTE
Shops, Rutland Railway Co., Rutland, Vt.

SPECIFICATIONS FOR WATERPROOFED CEMENT STUCCO

1. Intent—It is the intent of these specifications to obtain a sound, permanent and waterproof stucco.

2. Materials—The materials composing the stucco shall consist of:

(a) Portland Cement which has been carefully tested and found to satisfactorily meet the requirements of the Specifications of the American Society for Testing Materials.

(b) Sand which is practically free from organic matter and uniformly graded in size from coarse to fine.

(c) Hydrated lime that is uniform in quality and perfectly hydrated.

(d) **TRUS-CON Waterproofing Paste Concentrated** as manufactured by TRUS-CON LABORATORIES, Detroit, Mich.

3. Proportions—The proportions of the above specified materials by volume, shall be five (5) parts of cement, twelve (12) parts of sand, and one (1) part of hydrated lime. One (1) part of **TRUS-CON Waterproofing Paste Concentrated** shall be added to every eighteen (18) parts of water used to temper the mortar.

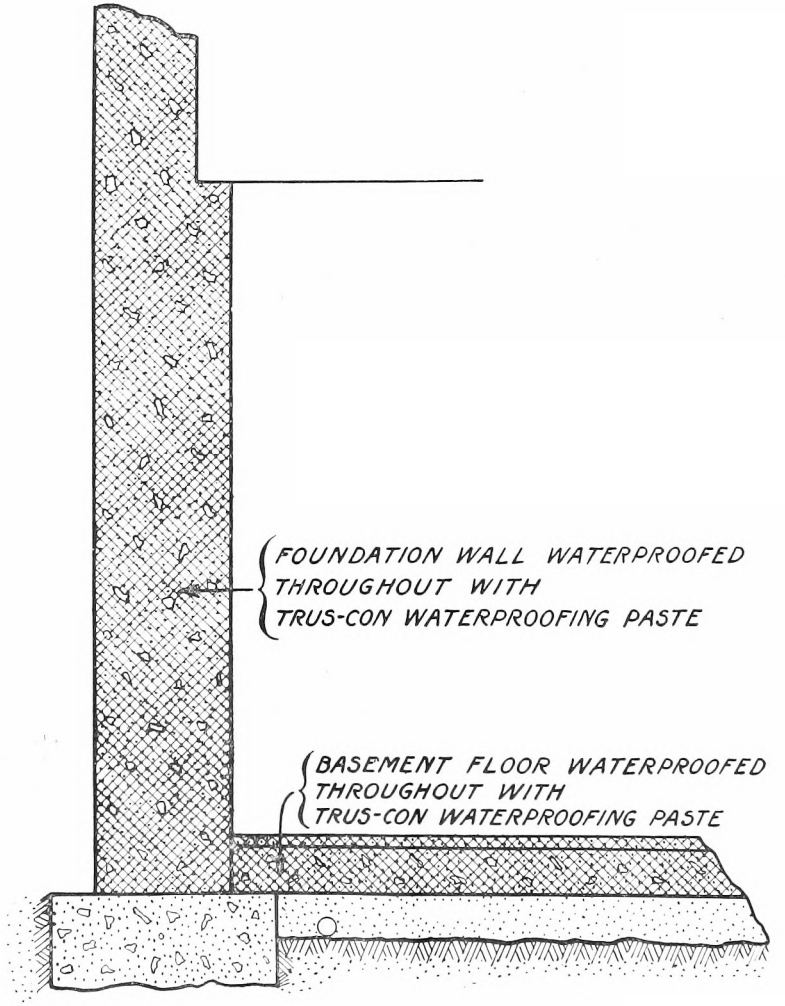
4. Mixing—The cement and hydrated lime, after being thoroughly mixed dry to uniform color, shall be added to the dry sand and the whole manipulated until evenly mixed. The dry mixture shall then be tempered to the correct working consistency with water to which **TRUS-CON Waterproofing Paste Concentrated** has been added in proportion specified. The mortar must be thoroughly worked until perfectly homogeneous. This composition shall only be made up in lots that can be immediately applied, and any material that has been mixed with water over thirty (30) minutes before applying shall be rejected.

5. Application—All walls shown on elevation for stucco finish shall be two-coat work. The first coat shall be prepared as specified above with the addition of long cow hair for keying when applied. The face of the first coat shall be thoroughly scratched over before for the finish coat, which shall be applied to a total thickness of one inch (1"), when the first coat has set sufficiently hard to safely hold it. The finish coat shall be carefully floated from any porous imperfections.

When plastering over a masonry surface, special care must be taken to thoroughly saturate the masonry with water and the plaster applied at once.

6. Drying—Special care shall be taken to avoid too rapid drying. If in direct rays of the sun, it shall be protected with a damp canvas or burlap, and when sufficiently resistive, shall be frequently sprinkled with water.

7. No exterior plastering shall be permitted until all interior partitions are studded up and completely braced.



Waterproofing Mass Concrete by Integral Method

SPECIFICATIONS FOR WATERPROOFING MASS CONCRETE BY INTEGRAL METHOD

Applicable to Standpipes, Cisterns, Reservoirs, Foundations and Similar Structures

1. Intent—It is the intent of these specifications to obtain a water-tight concrete structure.

2. Method—Water-tightness shall be secured by the addition of **TRUS-CON Waterproofing Paste, Concentrated,** as manufactured by the TRUS-CON LABORATORIES, Detroit, Michigan to all water used to temper the dry mixture of cement and aggregate in proportions and mixed as directed below.

3. Ingredients and Proportions for Concrete—The concrete composing the main body of the structure shall consist of one (1) part cement, two (2) parts of sand, and four (4) parts of stone, each to meet the following requirements:

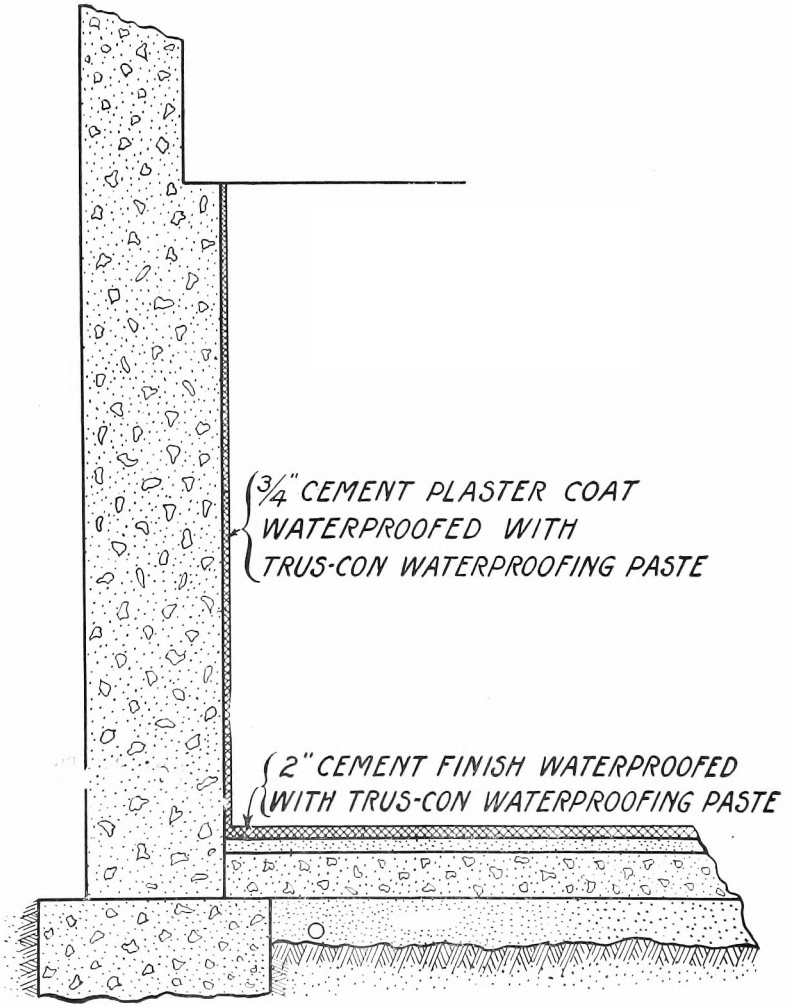
(a) The cement shall be a high grade Portland, which has been carefully tested and found to satisfactorily pass the requirements of the Standard Specifications of The American Society for Testing Materials, and preferably ground so that eighty per cent (80%) shall pass a standard two hundred (200) mesh sieve.

(b) The sand shall consist of spherical grains of any hard rock that is practically free from clay, absolutely free from organic matter, and uniformly graded in size from coarse to fine.

(c) The stone shall be screened from gravel, and shall for sixty per cent (60%) of its bulk be uniformly graded between diameters of one (1) and one and one-half (1½) inches, and for forty per cent (40%) of its bulk be uniformly graded between diameters of one-quarter (¼) and one (1) inch. A hard crushed trap rock may be substituted for gravel if screened to meet the requirements indicated.

4. Mixing—The dry mixture of cement, sand and stone in the above proportions shall be tempered to a medium wet consistency with water to which one (1) part of **TRUS-CON Waterproofing Paste Concentrated** has been added as directed by the manufacturers, for every thirty-six (36) parts of water.

5. Placing—All the concrete shall be placed in one continuous operation, each pouring being thoroughly spaded to insure uniform density. In cases where joints are absolutely unavoidable, very special care shall be taken to clean and roughen the old surface and have it thoroughly wet and slush-coated immediately before placing additional concrete.



Waterproofing Concrete or Masonry by Means of
Waterproofed Plaster Coat Applied to Interior Surfaces

SPECIFICATIONS FOR WATERPROOFING CONCRETE AND GENERAL MASONRY STRUCTURES BY MEANS OF WATERPROOFED PLASTER COAT

Applicable to Cisterns, Reservoirs, Foundations, Basements, Tunnels, Subways and Similar Structures

1. Intent—It is the intent of these specifications to obtain a water-tight structure.

2. Method—Water-tightness shall be secured by plastering the interior surface of the structure with a continuous coat of Portland cement mortar waterproofed with **TRUS-CON Waterproofing Paste Concentrated** as manufactured by the TRUS-CON LABORATORIES, Detroit, Michigan

3. Ingredients and Proportions of Waterproofed Plaster Coat—The mortar composing the plaster coat shall consist of one (1) part of cement and two (2) parts of sand, to meet the following requirements:

(**a**) The cement shall be a high grade Portland, which has been carefully tested and found to satisfactorily meet the requirements of the Standard Specifications of the American Society for Testing Materials, and preferably ground so that eighty per cent (80%) shall pass a standard two hundred (200) mesh sieve.

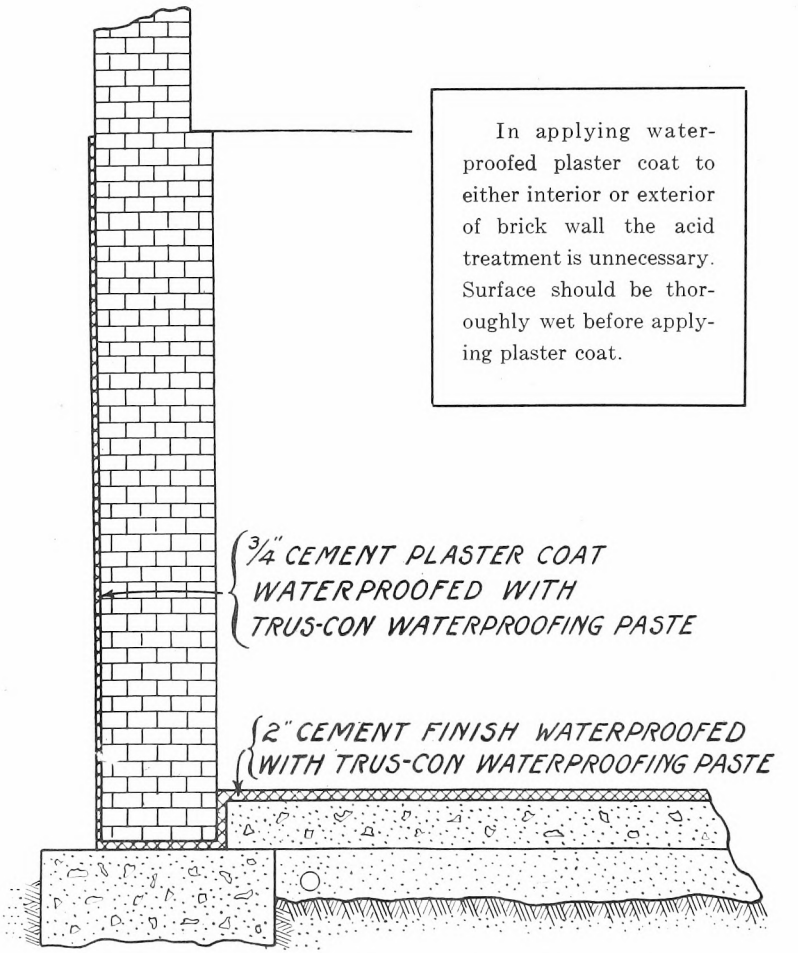
(**b**) The sand shall consist of spherical grains of any hard rock that is practically free from clay, absolutely free from organic matter, and uniformly graded in size from coarse to fine.

4. Preparation of the Coating—The waterproofed cement mortar shall be prepared by thoroughly tempering (to required consistency) a dry mixture of one (1) part of cement and two (2) parts of sand, with water to which **TRUS-CON Waterproofing Paste** [illegible] been added in the proportion of one (1) part of Paste to eighteen (18) parts of water, as directed by the manufacturers.

5. Preparation of Surface to be Coated—Before plastering the cement mortar on the hardened concrete, the surface of same shall be treated as indicated in the following:

(**a**) The hardened surface shall be mechanically roughened by chipping and very thoroughly cleaned with a heavy wire broom, so as to remove all dust and dirt. A jet of steam shall be employed to clean the wall, if available.

(**b**) To the mechanically cleaned surface apply with a large acid brush, a liberal coat of one to ten (1:10) solution of Hydrochloric Acid, (Muriatic Acid). Allow the acid to remain until it has exhausted itself,



Waterproofing Concrete or Masonry by Means of Waterproofed Plaster Coat Applied to Exterior Surface

which will require at least ten minutes. Apply a second coat of acid solution if the first does not sufficiently clean and expose the surface of the aggregate.

(c) With a hose under good pressure, slush the surface so as to remove the salts and loose particles resulting from the action of the acid. Continue the slushing until the old concrete is thoroughly cleaned and soaked to its full hydrometric capacity. Thoroughly wire-brush the surface so as to remove the particles which have been loosened by the action of the acid.

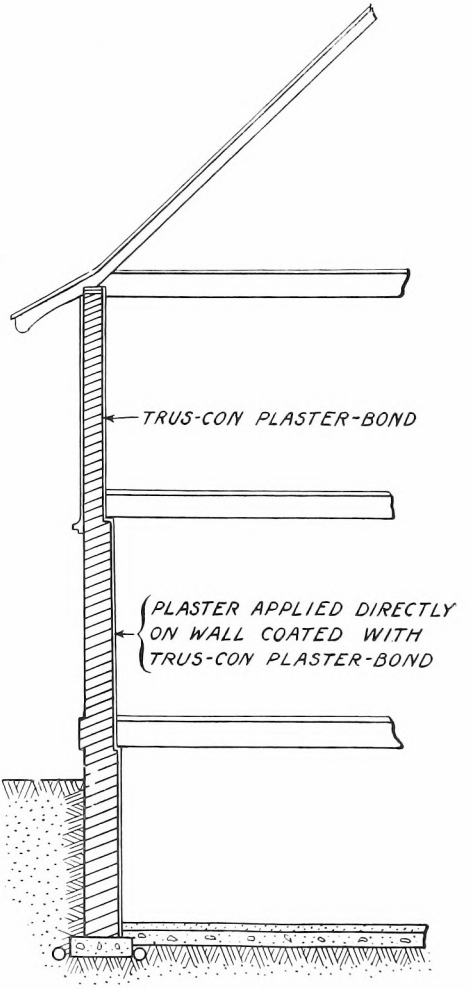
(d) To the cleaned saturated surface apply with a strong fibre brush a coating of pure cement mixed to a thick creamy consistency with water to which **TRUS-CON Waterproofing Paste** has been added in the proportion of one (1) part of **Paste** to eighteen (18) parts of water. Rub in vigorously so as to fill all crevices and cavities produced by the action of the acid.

6. Application of Coating to Sides—Immediately after applying the above slush coat, the first coat of waterproofed cement mortar shall be applied to a thickness of three-eighths of an inch (3/8") directly on the slush coat, and well trowelled and rubbed into the crevices of the surface. This first coat shall be lightly scratched before showing initial set. Before this first coat has reached its final set, the second coat shall be applied, of equal thickness, so as to give a full average thickness of three-quarters of an inch (3/4"). Most special care shall be exercised to apply this finish coat before the first coat has reached its final set. The finish coat shall be thoroughly floated to an even surface, and subsequently trowelled free from any porous imperfections.

7. Floor Coating—The floors shall be prepared and treated exactly as indicated above, and finished with a waterproofed cement mortar to a thickness of two inches (2"). Special care shall be exercised to bond the wall coating to the floor coating, so as to make the waterproofed coating continuous over the entire surface.

8. Pressure—Where water is running through the wall, proper drainage must be provided by drilling holes and inserting tubes in the wall, to concentrate the flow of water. With the pressure relieved, the waterproofed plaster coat shall be applied to the drained portions of the wall. The drainage pipes shall remain open until the waterproofed plaster coat has thoroughly set and is capable of resisting the pressure by its own adhesive strength, when the drainage pipes shall be closed with suitable plug and overcoated with waterproofed plaster coat.

9. Inspection—When hardened, the waterproofed plaster coat shall be sounded with a light hammer and all loose and defective plaster shall be cut out and replaced.



Dampproofing Exposed Walls by Continuous Coating of TRUS-CON Plaster Bond

SPECIFICATIONS FOR THE USE OF TRUS-CON PLASTER BOND

General,—

The inside surface of all exposed walls of the entire building shall be given one uniform application of TRUS-CON PLASTER BOND as manufactured by THE TRUS-CON LABORATORIES, Detroit, Michigan.

Continuous Coating,—

Special care shall be taken to make the coating of PLASTER BOND perfectly continuous over the entire surface. Where practicable, the coating of PLASTER BOND shall be run continuously between the floor and ceiling levels. In cases where the PLASTER BOND cannot be run continuously back of the floor construction, it shall be applied back on the ceiling for at least twelve (12) inches from the wall.

Portions For Re-touch Coat,—

All portions of the wall which are particularly absorbent shall be given a re-touch coat of TRUS-CON PLASTER BOND, so that the entire coated area will have an even uniform black appearance.

Coating Cut-outs,—

Special care shall be taken to coat all portions of the wall where there is any cutting out to permit the passage of pipes subsequent to the application of the PLASTER BOND.

Application Plaster,—

The plaster shall not be applied until twenty-four hours after the wall has been coated.

SPECIFICATIONS FOR DAMPPROOFING AND UNIFORMING EXTERIOR MASONRY SURFACES WITH TRUS-CON STONE-TEX

1. Condition of Surface:

(a) The surface to be coated shall be absolutely dry.

(b) The wall shall be thoroughly brushed with a stiff broom, to remove all dirt or loose particles of any nature that would interfere with the direct bond of the finish with the surface.

(c) TRUS-CON STONE-TEX shall not be applied over any surface that has been previously painted, if the old coating shows any indications of cracking, peeling or scaling from the surface. All defective paint must be entirely scraped and burnt off the surface before re-coating.

2. Preparation of TRUS-CON STONE-TEX:

(a) The top of the package shall be entirely cut out to permit the thorough stirring and mixing of the contents. The goods shall be stirred with a stiff paddle until the pigment is evenly and uniformly mixed with the liquid.

(b) No additional thinning or alteration of any nature shall be made to the goods as originally opened, as they are prepared in the correct consistency for use.

(TRUS-CON STONE-TEX is especially heavy in body and consistency, but spreads with remarkable ease, and under average conditions requires absolutely no thinning.)

(c) If, on continued standing and exposure to the air, the material becomes heavy in body, due to the evaporation of the volatile material, it shall be thinned with the minimum amount of spirits of turpentine, to give a body equivalent to the original consistency.

3. Application of Coating:

(a) The first coat of TRUS-CON STONE-TEX shall be applied in an even, uniform coating, brushing well into the pores of the surface, to insure the greatest penetration and absorption, essential for the most satisfactory bond. In rare cases, where the surfaces are exceptionally dense, a very small amount of turpentine shall be added to the first coat of STONE-TEX to intensify the penetration.

(b) After the first coat has been allowed 72 hours to become perfectly hard and dry, a second coat shall be applied, to give the most uniform and efficient dampproof finish.

SPECIFICATIONS FOR APPLYING TRUS-CON ASEPTICOTE

1. Condition of Surface:

(a) All walls to be finished shall be permitted sufficient time to become perfectly hard and thoroughly dry, before the application of TRUS-CON ASEPTICOTE.

(b) All cracks and uneven places shall be filled up with a Plaster of Paris Paste, and allowed to become perfectly set and dry.

2. Preparation of TRUS-CON ASEPTICOTE.

(a) The top of the package shall be completely cut out, so as to permit the most thorough stirring and mixing of the contents.

(b) Pour the excess of liquid on top of the pigment into a separate can, and after thoroughly stirring the pigment, return the original liquid while constantly stirring, so as to insure the most perfect mixing of the pigment with the liquid.

(c) If on continued standing and exposure to the air, the material becomes thick and heavy due to evaporation of the volatile material, it shall be thinned with the minimum amount of turpentine, to give a body equivalent to the original consistency.

3. Application of TRUS-CON ASEPTICOTE.

(a) All new walls, either smooth or sand finished, shall be given an even, uniform coating of TRUS-CON ALKALI-PROOF WALL SIZE, to which should be added ASEPTICOTE of the color to be used, in the proportion of one part of ASEPTICOTE to three parts of SIZE. This coating of SIZE should be allowed at least twenty-four hours to become perfectly hard and dry before additional coats are applied.

Old walls which have been finished with Kalsomine or Cold Water Paint must be thoroughly washed. If such walls have been sized with a glue size, this must also be removed and the wall treated the same as a new wall. In case the wall has been treated with a varnish size, it will not be necessary to apply a coat of TRUS-CON ALKALI-PROOF WALL SIZE.

(b) After the above sizing coat has dried for at least twenty-four hours, apply the first coat of TRUS-CON ASEPTICOTE. This should be flowed on with the best quality wall brush and smoothed off lightly to a uniform even coat.

(c) After the first coat has been given at least twenty-four hours to dry and harden, apply the second coat just as it is received in the package, being sure to stir thoroughly. Add no thinner or other liquid to this second coat.

SPECIFICATIONS FOR APPLYING TRUS-CON SNO-WITE

General:

With an enamel of the very special quality and properties of TRUS-CON SNO-WITE, the finest finish can only be obtained when the surface to be coated has been properly prepared with preliminary undercoatings. For the very finest enamel finish, the specifications given below, with undercoatings as indicated, are recommended.

For New Plastered Walls

Condition of the Surface:

(a) All walls shall be permitted a sufficient time to become perfectly hard and thoroughly dry before coating.

(b) All cracks and uneven places shall be filled up with Plaster of Paris paste, and when hardened, coated with shellac and allowed to dry thoroughly, before the sizing coat is applied.

Sizing Coat:

To thoroughly uniform the suction of the wall and provide a foundation over which the undercoatings can be applied, to give the most uniform and even results, the walls shall be given a uniform coating of TRUS-CON ALKALI-PROOF WALL SIZE, to which shall be added TRUS-CON ASEPTICOTE, WHITE, in the proportion of one part of Asepticote to three parts of Size. This coating of Size should be allowed at least twenty four (24) hours to become perfectly hard and dry.

Undercoatings:

(a) After the above sizing coat has dried for at least twenty-four (24) hours, a first coat of TRUS-CON ASEPTICOTE, White, shall be applied, flowing on with the best quality of wall brush and smoothed off lightly to a uniform, even coat.

(b) After the first coat has been given at least twenty-four (24) ours to dry and harden, the second coat of TRUS-CON ASEPTICOTE shall be applied in the same consistency in which it is received in the package, being sure to thoroughly stir.

(c) For the very finest enamel finish, a third coat of TRUS-CON ASEPTICOTE shall be applied after the second coat has become thoroughly hard and dry.

Finishing Coats:

(a) After the third coat has become absolutely dry and hard, sand well and apply TRUS-CON SNO-WITE in an even, uniform coat, as taken from the original can, without dilution.

(b) A second coat of TRUS-CON SNO-WITE shall be applied after the first coat has been allowed seven (7) days in which to harden, and the surface has been thoroughly sanded with OO Sandpaper.

For New Wood Work

Condition of the Surface:

(a) The surface must be absolutely clean, and free from all moisture. All cracks, nail holes, or imperfections on the surface shall be uniformed with putty in a workman-like manner.

(b) Where the wood contains knots, or shows any evidence of pitch, a coating of white shellac shall be applied.

Undercoatings:

Three coats TRUS-CON ASEPTICOTE, White, shall be applied, as specified in this specification under term of "New Plastered Walls."

Enamel Coating:

TRUS-CON SNO-WITE shall be applied in two coats, as fully specified in this specification for the enameling of "New Plastered Walls." In cases where economy is a very special consideration, the second coat of TRUS-CON SNO-WITE can be eliminated.

For Old Work

(a) In using TRUS-CON SNO-WITE for refinishing an old surface, which has been previously painted, or enameled, very special care shall be taken to be certain that the old paint is in sound condition, free from any indication of cracking, peeling, or loosening from the surface, so as to provide a dependable foundation over which TRUS-CON SNO-WITE can be applied with the best results.

(b) Before applying TRUS-CON SNO-WITE, the surface shall be thoroughly sanded with No. 1 sand paper, and in case the old coating is not uniformly and evenly finished, the surface shall be given a coating of TRUS-CON ASEPTICOTE, White, before enameling with TRUS-CON SNO-WITE.

SPECIFICATIONS FOR APPLICATION OF TRUS-CON INDUSTRIAL ENAMEL

For Brick and Masonry Surfaces

Condition of the Surface:

No coating shall be applied until the brick and concrete work has had plenty of opportunity to thoroughly harden and become perfectly dry.

The excess of mortar between the bricks shall be removed, and the surface thoroughly cleaned and made as uniform as practicable.

First Coat:

TRUS-CON STONE-TEX shall be applied in an even, uniform coating, brushing well into the pores of the surface to insure the greatest penetration and absorption essential for the most satisfactory bond.

Second Coat:

After the first coat of TRUS-CON STONE-TEX has been allowed seventy-two (72) hours to become perfectly hard and dry, a coat of TRUS-CON ASEPTICOTE, White, shall be applied, flowing on with the best quality of wall brush and smoothing off lightly to a uniform, even coat.

Third Coat:

After the coat of TRUS-CON ASEPTICOTE has had opportunity to dry and harden, a finish coat of TRUS-CON INDUSTRIAL ENAMEL shall be carefully applied in a thoroughly workman-like manner.

Materials:

TRUS-CON STONE-TEX, ASEPTICOTE and INDUSTRIAL ENAMEL, as specified in this work, shall be products manufactured under these names by THE TRUS-CON LABORATORIES, Detroit, Michigan.

All products shall be used as received from the manufacturer. If, on continued standing, the materials become a little thick and heavy, they shall be thinned with a very minimum amount of pure turpentine.

For Wood Surfaces

Condition of the Surface:

(a) All wood surfaces shall be allowed full opportunity to thoroughly season and dry out before the application of any coating.

(b) All cracks, nail holes and surface imperfections shall be puttied up to give a most uniform surface. In places where the wood contains knots, or pitch of any kind, apply one coat of white shellac.

First Coat:

TRUS-CON ASEPTICOTE, White, shall be applied, rubbing well into the pores to insure proper penetration and bond, and slightly smoothed off to uniform, even coat.

Second Coat:

After the first coat of TRUS-CON ASEPTICOTE has been given at least twenty-four (24) hours to dry and harden, a second coat shall be carefully applied, to provide an even, uniform foundation for the application of the enamel coating.

Third Coat:

After the second coat of TRUS-CON ASEPTICOTE has become thoroughly hard and dry, the surface shall be finished with a uniform coating of TRUS-CON INDUSTRIAL ENAMEL.

SPECIFICATIONS FOR ENAMELING A CEMENT FLOOR

1. The Condition of the Floor:

(a) The floor to be coated shall be ABSOLUTELY DRY.

(b) The floor shall be swept clean of all dust and loose particles with a good stiff broom or brush, WITHOUT DAMPENING.

(c) The floor shall be practically free from all oils, greases or any similar foreign matter, that would in any way interfere with the most perfect penetration of the Enamel into the pores of the surface.

2. The Preparation of TRUS-CON Floor Enamel:

(a) The top of the packages shall be completely cut out, so as to permit the most thorough stirring and mixing of the contents.

(b) Pour the excess of liquid, from top of pigment, into a separate can, and after thoroughly stirring the pigment, return the original liquid, while constantly stirring, so as to insure the most perfect distribution of the pigment throughout the vehicle.

(c) TRUS-CON Floor Enamel shall not be reduced with any thinner, when used from a freshly opened package on a floor of average porosity. In case the floor is exceptionally dense, the Enamel shall be very slightly thinned by the addition of a very small amount of turpentine, so as to insure proper penetration of the Enamel into the pores, necessary to obtain a satisfactory bond.

(d) In case the enamel shall become thick on being allowed to stand in the open package exposed to the air, it shall be reduced to brushing consistency by the addition of a small amount of strictly pure spirits of turpentine. Very special care shall be taken to cover the package, when not being used, and avoid evaporation as far as possible, so as to eliminate the necessity of thinning.

3. Application to the Floor:

(a) All floors laid directly on the ground, or in position to absorb water directly from surrounding conditions, shall be given a liberal coat of TRUS-CON Floor Primer, before applying the Enamel. The Floor Primer shall be allowed at least 24 hours to dry and harden, before coating with Enamel.

(b) TRUS-CON Floor Enamel shall be applied directly to the dried surface with a good, stiff, solid 4-inch paint brush. Special care shall be exercised to exert enough pressure on the brush in application, so as to force the Enamel into the surface pores, permitting it to bond itself most securely and inseparably with the floor.

(c) A second coat of Enamel shall be applied after the first coat has become perfectly hard and dry, which will require at least 48 hours.

(d) The finishing coat shall be allowed at least 48 hours to become dry and hard, before use, and should then not be severely used, until it has had at least a week for more perfect hardening.

SPECIFICATIONS FOR PAINTING STRUCTURAL STEEL

1. General:

All metal to be painted shall be perfectly dry and thoroughly cleaned —free from all rust, scale, grease or foreign matter of any kind.

2. Shop Coat:

(a) All surfaces riveted together at the shop shall be thoroughly coated with TRUS-CON BAR-OX No. 7 RED, before assembling.

(b) Immediately after the riveting on work is completed it shall be given one thorough, uniform coat of the above product.

(c) All surfaces which are to be riveted together in erection shall receive coat of BAR-OX No. 7 GREEN, before leaving the shop.

(d) All work shall be painted at least forty-eight (48) hours before shipment is made.

3. Field Coat:

(a) As soon as steel is erected apply the finishing coat of BAR-OX No. 7 BLACK, brushing out thoroughly, so as to provide a most uniform continuous coating.

(b) All parts which are not readily accessible after erection shall be given a coat of BAR-OX No. 7 BLACK, before placing.

(c) All portions which have been injured by abrasion in shipment or erection shall be re-coated with BAR-OX No. 7 and allowed to become perfectly dry before applying the finishing coat.

4. Bar-oX No. 7:

BAR-OX No. 7, as specified on this work, shall be the product manufactured under this name by THE TRUS-CON LABORATORIES, Detroit, Michigan.

THE PRESSURE EXERTED BY WATER BENEATH FLOORS AND AGAINST WALLS

Hydrostatic Head—Feet	Pressure per Square Inch—Lbs.	Lifting Pressure per Square Foot (Under Floor—Lbs.	Average Pressure per Square Foot on Wall Surface Affected. —Lbs.
0.5	0.21	31.2	15.6
1.0	0.43	62.5	31.2
2.0	0.86	125.0	62.5
3.0	1.30	187.5	93.7
4.0	1.73	250.0	125.0
5.0	2.17	312.5	156.2
6.0	2.60	375.0	187.5
8.0	3.47	500.0	250.0
10.0	4.34	625.0	312.5
12.0	5.21	750.0	375.0
15.0	6.51	937.5	468.7
20.0	8.68	1250.0	625.0
25.0	10.85	1562.5	781.2
30.0	13.02	1875.0	937.5
40.0	17.36	2500.0	1250.0
60.0	26.04	3750.0	1875.0
80.0	34.72	5000.0	2500.0
100.0	43.40	6250.0	3125.0

MATERIALS FOR ONE CUBIC YARD COMPACT PLASTIC MORTAR BASED ON BARREL OF 3.8 CU. FT.

Cement	Sand	Packed Cement Bbl.	Loose Sand Cu. Yd.
1	0	8.31	...
1	½	6.73	0..
1	1	5.01	0.71
1	1½	4.00	0.84
1	2	3.32	0.93
1	2½	2.84	1.00
1	3	2.48	1.05
1	3½	2.20	1.08

Note.—Variation in the fineness of the cement and the sand and in the consistency of the mortar, may affect the values 10% in either direction.

Cement—as packed by manufacturer.
Sand—Loose.

QUANTITIES OF MATERIAL FOR ONE CUBIC YARD OF RAMMED CONCRETE BASED ON A BARREL OF 3.8 CU. FT.

Proportions by Parts			PERCENTAGE OF VOIDS								
			50% Broken Stone Screened to Uniform Size			45% Average Conditions			40% Gravel		
Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
			Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.
1	1	1.5	3.19	0.45	0.67	3.08	0.43	0.65	2.97	0.42	0.63
1	1	2	2.85	0.40	0.80	2.73	0.38	0.77	2.62	0.37	0.74
1	1	2.5	2.57	0.36	0.90	2.45	0.34	0.86	2.34	0.33	0.82
1	1	3	2.34	0.33	0.99	2.22	0.31	0.94	2.12	0.30	0.90
1	1.5	2	2.49	0.53	0.70	2.40	0.51	0.68	2.31	0.49	0.65
1	1.5	2.5	2.27	0.48	0.80	2.18	0.46	0.77	2.09	0.44	0.74
1	1.5	3	2.09	0.44	0.88	2.00	0.42	0.84	1.91	0.40	0.81
1	1.5	3.5	1.94	0.41	0.96	1.84	0.39	0.91	1.76	0.37	0.87
1	1.5	4	1.80	0.38	1.01	1.71	0.36	0.96	1.63	0.34	0.92
1	1.5	4.5	1.69	0.36	1.07	1.60	0.34	1.01	1.51	0.32	0.96
1	1.5	5	1.59	0.34	1.12	1.50	0.32	1.06	1.42	0.30	1.00
1	2	3	1.89	0.53	0.80	1.81	0.51	0.76	1.74	0.49	0.74
1	2	3.5	1.76	0.49	0.87	1.68	0.47	0.83	1.61	0.45	0.79
1	2	4	1.65	0.46	0.93	1.57	0.44	0.88	1.50	0.42	0.84
1	2	4.5	1.55	0.44	0.98	1.48	0.42	0.94	1.41	0.40	0.89
1	2	5	1.47	0.41	1.03	1.39	0.39	0.98	1.32	0.37	0.93
1	2	5.5	1.39	0.39	1.08	1.31	0.37	1.01	1.25	0.35	0.97
1	2	6	1.32	0.37	1.11	1.25	0.35	1.06	1.18	0.33	1.00
1	2.5	3	1.72	0.61	0.73	1.66	0.58	0.70	1.60	0.56	0.68
1	2.5	3.5	1.62	0.57	0.80	1.55	0.55	0.76	1.49	0.52	0.73
1	2.5	4	1.52	0.54	0.86	1.46	0.51	0.82	1.40	0.49	0.79
1	2.5	4.5	1.44	0.51	0.91	1.37	0.48	0.87	1.31	0.46	0.83
1	2.5	5	1.37	0.48	0.96	1.30	0.46	0.92	1.24	0.44	0.87
1	2.5	5.5	1.30	0.46	1.01	1.23	0.44	0.95	1.17	0.41	0.91
1	2.5	6	1.24	0.44	1.05	1.17	0.41	0.99	1.11	0.39	0.94
1	2.5	6.5	1.18	0.42	1.08	1.12	0.39	1.02	1.06	0.37	0.97
1	2.5	7	1.13	0.40	1.11	1.07	0.37	1.05	1.01	0.36	0.99
1	3	4	1.42	0.60	0.80	1.36	0.36	0.77	1.30	0.55	0.73
1	3	4.5	1.34	0.57	0.85	1.28	0.55	0.81	1.23	0.52	0.78
1	3	5	1.28	0.54	0.90	1.22	0.52	0.86	1.17	0.49	0.82
1	3	5.5	1.22	0.52	0.94	1.16	0.49	0.90	1.11	0.47	0.86
1	3	6	1.16	0.49	0.98	1.11	0.47	0.94	1.05	0.44	0.89
1	3	6.5	1.12	0.47	1.02	1.06	0.45	0.97	1.01	0.43	0.92

From "Concrete, Plain and Reinforced" by Taylor and Thompson.

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