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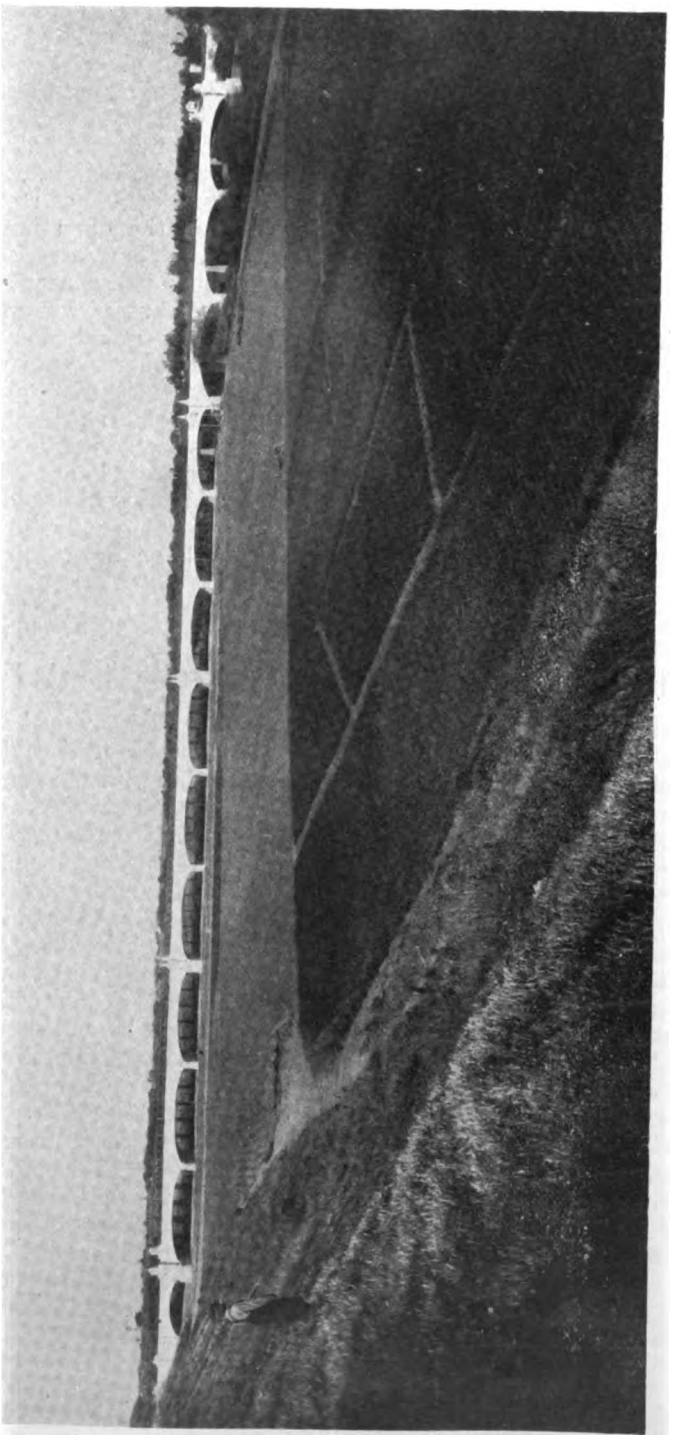

GENERAL VIEW SHOWING FULL LENGTH OF MODESTO BRIDGE (1250 feet)
E. H. ANNEAR, COUNTY ENGINEER
LEONARD & DAY, CONSULTING ENGINEERS

# Reinforced Concrete Bridges and Their Architectural Treatment

By F. G. ENGHOLM, C. E., in Contract Record*

THE influence of engineering structures upon the community life of people is of great national importance. The standards of beauty are enlarged with the growth of knowledge.

The creation of beautiful structures can only be attained by a full and true knowledge of the kind of materials used and by certain subtle distinctions born of integrity of purpose and refinement in handling them.

The use of masonry for bridges must now be regarded as a thing of the past, chiefly on account of the prohibitive cost. The longest single span in masonry in existence is 295 feet. The rise and dimensions of a masonry arch are necessarily large and are especially noticeable in spans of any appreciable magnitude. And further, the restrictions of site such as clearance and depth of construction, often limit and affect the general design, economy, etc., of the structure so as to render the use of masonry prohibitive in face of modern developments.

The graceful lines of a reinforced concrete arch bridge with a shallow rise and comparatively small dimensions of the various members, give a touch of refinement which cannot be approached in any other material.

In steel structures the aesthetic treatment assumes a different character. To attempt to ornament any steel structures of large span would be entirely false, and foreign to the fundamental principle of their design. Its application, if done at all, could only be carried out consistently by a great increase in weight and sacrifice in economy. In the case of the Forth and the Quebec bridges, for instance, no pretence is made to decorate these structures. They are too collossal in proportion, themselves, to require any such treatment. The designer of the Forth bridge stated that the design pretended nothing but to tell the truth as simply as possible and, inasmuch as it does, it is beautiful.

These massive structures are rare occurences in the history of a country and in dealing with "every-day" structures, reinforced concrete, in its dimensions and applications, gives proportions of beauty all its own.

The steadily increasing use of reinforced concrete as a structural material in the last few years thus opens up a line of thought in its architectural treatment, worthy of the best effort of the artistic as well as the practical mind. Designers, apparently, have not yet realized the structural possibilities of reinforced concrete or else they lack that special knowledge of the material to foster its more prolific use in their works. In a few cases, however, designers, mostly of the younger and more progressive element, are investigating its possibilities.

To confine myself to bridges and their particular architectural treatment in the space of a short article, it is necessary to condense and be brief. At

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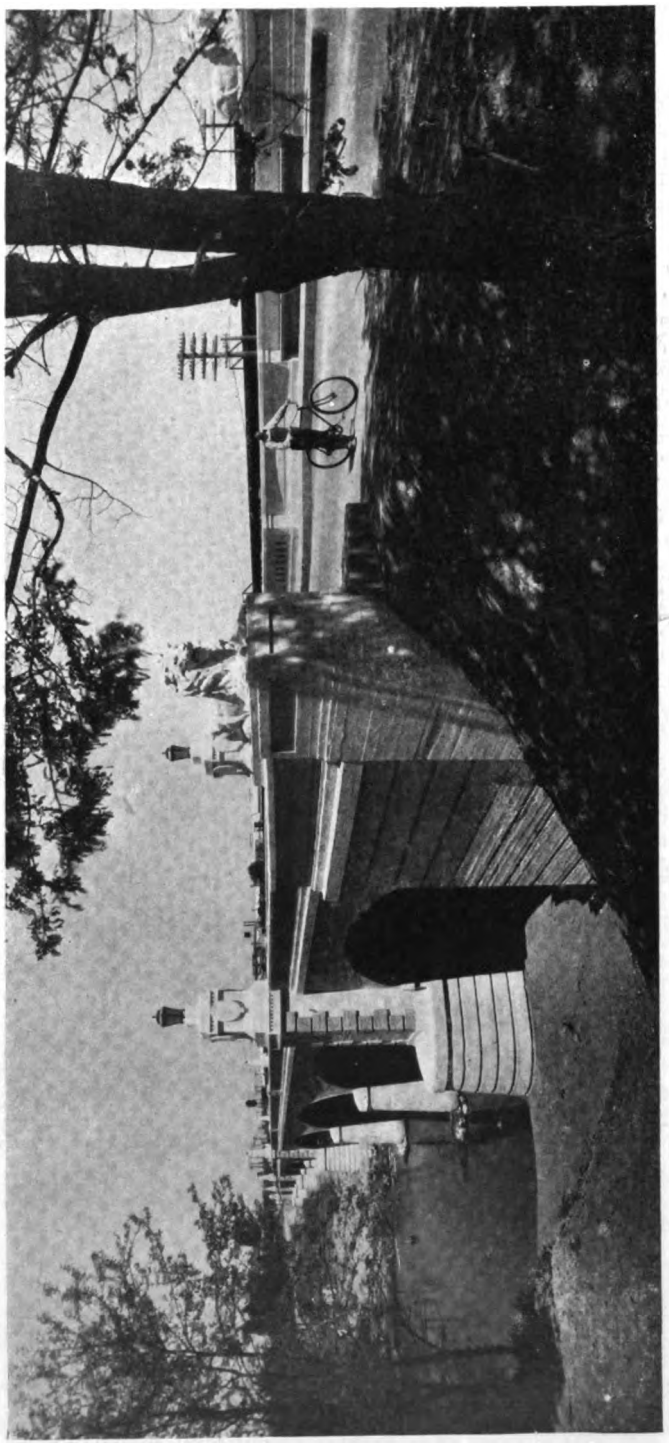
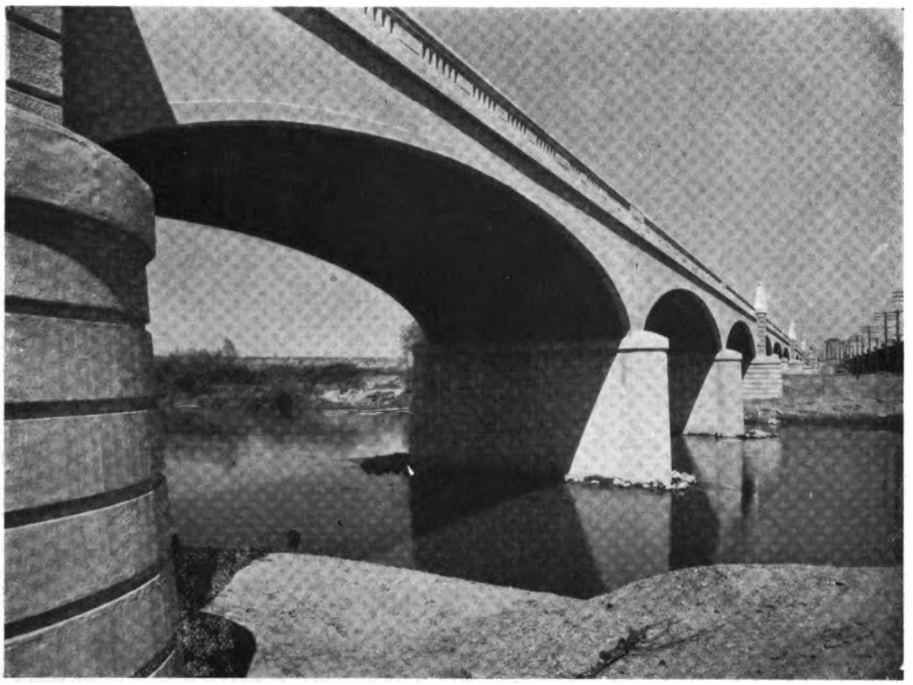
* Associated with Francois Hennebique, Paris, and L. G. Mouchel and Partners, London, Eng.

EDITOR'S NOTE.—This paper was submitted to Mr. Will P. Day of Weeks & Day, architects and engineers, Phelan building, San Francisco. Mr. Day pronounced it one of the best articles that has been written in recent years on the subject of reinforced concrete bridge construction. He agrees with the author that reinforced concrete highway bridges would, under practically all conditions, be materially improved if finished in some manner other than with the plain surfaces of ordinary concrete. Too much emphasis cannot be placed on the proper selection of the surface aggregate and the method of finishing. Likewise, the color scheme should be given careful consideration. Highway bridges, whether in cities, villages, or in rural districts, should be so designed that they will harmonize with their environments. Highway engineers, officials and bodies of laymen having supervision of the construction of highway bridges should give this article special attention, should absorb its recommendations, and, thereafter, should emphasize in public intercourse, the salient points so strongly brought out by Mr. Engholm.

The illustrations (the work of Mr. Day) show several different types of concrete bridges built in California in recent years. They are good examples of the author's idea of architecturally treated bridges.

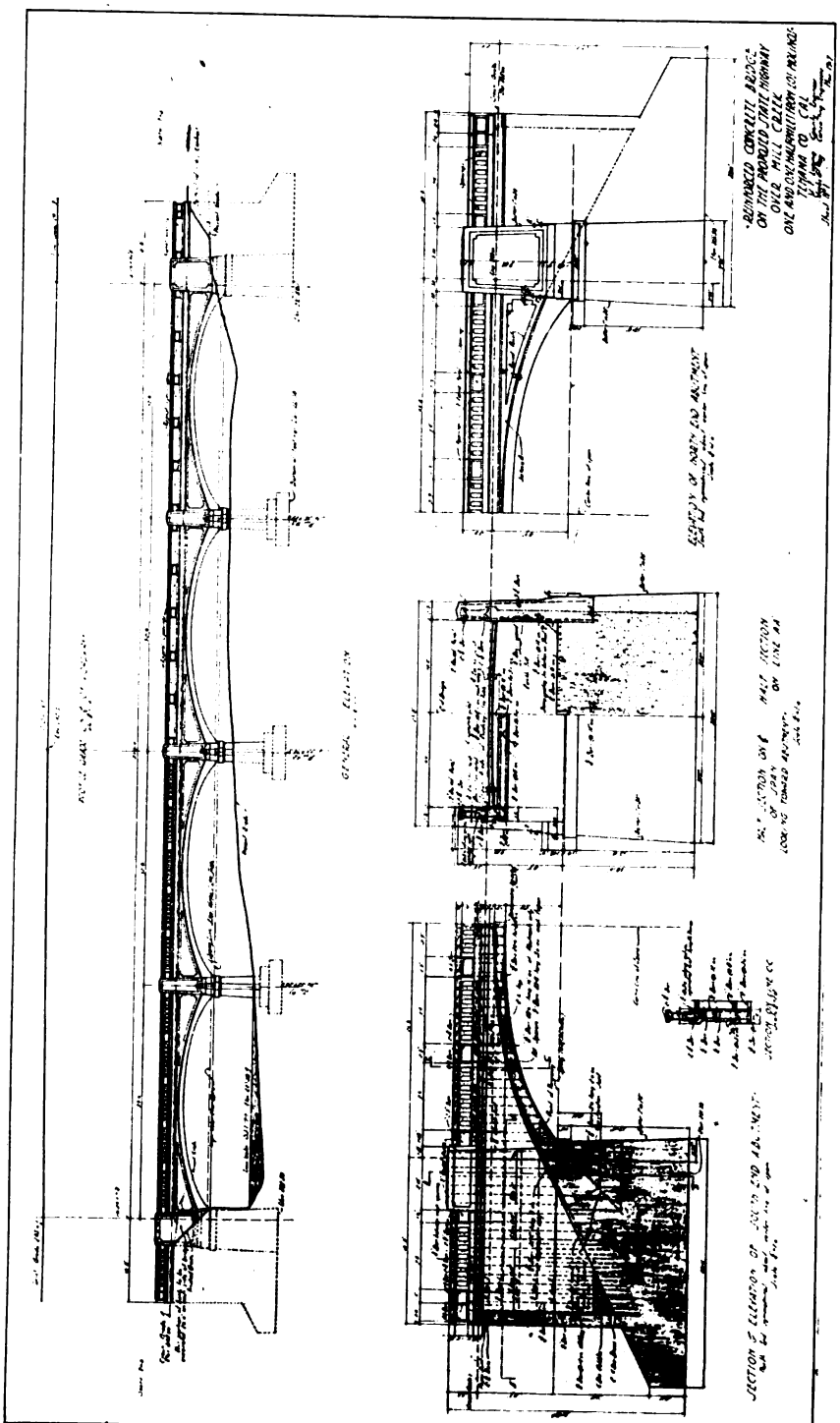


MODESTO BRIDGE OVER TUOLUMNE RIVER
LOOKING TOWARD MODESTO
E. H. ANNEAR, COUNTY ENGINEER
LEONARD & DAY, CONSULTING ENGINEERS

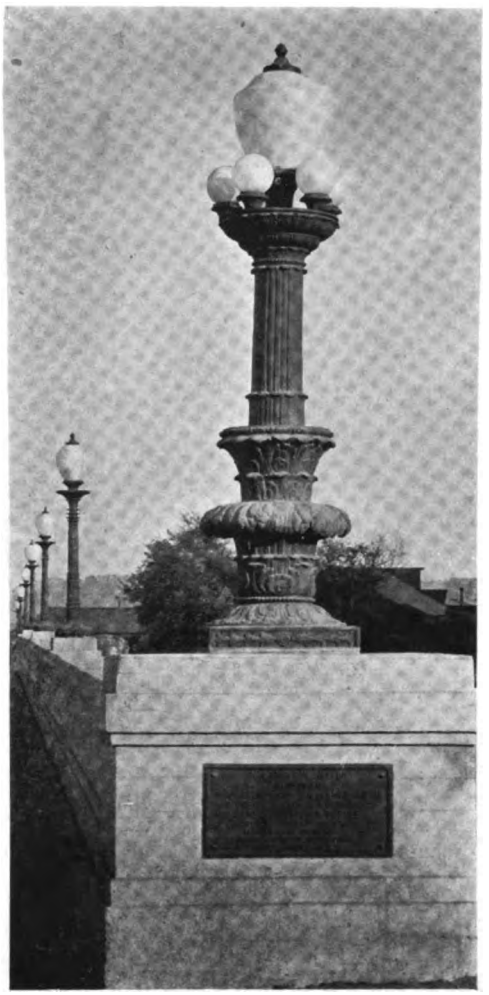


MODESTO BRIDGE, SHOWING RIVER SPANS
(Not arches, but cantilevers)

WATSONVILLE BRIDGE, OVER PAJARO RIVER, WATSONVILLE, CAL.
Leonard & Day, Consulting Engineers



ELEVATION AND DETAIL OF SECTION, REINFORCED CONCRETE BRIDGE, TEHAMA COUNTY, CALIFORNIA
W. F. LORING, COUNTY ENGINEER
WEEKS & DAY, CONSULTING ENGINEERS



ELECTROLIER, WATSONVILLE BRIDGE

the outset, it is well to realize that reinforced concrete is a material that one must have a special, practical and studied knowledge of, to create development along the right lines. No amount of collaboration of architect, artist and engineer, will create a thing of beauty if one and all do not appreciate and thoroughly understand the application of this material.

I am not condemning this collaboration of architects, artists and engineers, so long as the combination working together know the material they are assembling. For instance, take the case of the Bassano dam. Here the combination was not successful. This is a magnificent piece of reinforced concrete engineering, which is surmounted with gate houses designed by the collaborating architect in a half-timber affectation which seems altogether out of keeping with the ponderous structure beneath. The very permanence of reinforced concrete demands that its accessories be permanent also.

The art of building, generally, at the present time, seems to be at a serious crisis; look where we may nothing is seen but a hodge-podge of

PROGRESS VIEW, CANTICRETE BRIDGE OVER SOUTHERN PACIFIC TRACKS, PEYTON, CONTRA COSTA COUNTY.
Leonard & Day, Consulting Engineers

CANTICRETE BRIDGE, PEYTON, CALIFORNIA
Note expansion joint at centre.
Leonard & Day, Consulting Engineers

styles, or rather periods—Oriental freaks and French wedding cakes rub shoulders with English affectations, and only here and there does a structure seem to live and breathe the 20th Century. Reinforced concrete, when universally accepted as the great structural material it is, must, if the designers using it be true to the material and themselves, be the foundation of a great transformation in the mode of building—for the better, we believe—because the elements of concrete construction are so simple. As I have said before, with the elimination of the complexity of construction now in use, we may be confident of the evolution that will take place in the ages to come and be proud to think we were the pioneers of the great thing that will live in the generations hereafter.

We must not, as a few would have us believe, sever ourselves completely from tradition, nor is it right, in my opinion, to take as the heritage of the past merely the trimmings, as seems to be the case with most constructural works, with their burden of cornices, columns, useless porticos and other impedimenta so dear to the heart of the average architect today. Whereas in the preparation of a design in reinforced concrete, the fitness, proportion, and adaptability are the first issues that assail the designer, and the majority of them fail to create anything worth while for the following reasons:

1. Their inability to understand the scientific and working spirit of concrete.
2. The lack of that knowledge to furtherance of thought in terms of concrete, and
3. The impossibility of abandoning the knowledge they have already acquired in building with other materials.

With the perfect knowledge of these first three points a thing of beauty will result, and no amount of elaboration will remedy faults in these first three points. It is absolutely essential in reinforced concrete to keep clear of the changing whims of artistic fashion, and to evade the traditional architectural features in wood, stone and iron. Decoration on reinforced concrete bridges should be used sparingly, and only when the use of such decoration will bring out the beauties of the fundamental principles of design.

Following along this same line of thought, one thinks of some of the great bridges already constructed under the combined thought and work of engineer and architect, and if we accept our previous views we must realize that these structures, though beautiful in themselves, as specimens of studied poetry, fall short of the great idea. For the most part, they embody forms and details which we readily associate with other materials. Cannot the designer think in other terms than the five orders? To me there is only one order—"Fitness."

As a simile might I for a moment be excused a diversion: Take the automobile; the first of these modern means of locomotion were naturally very similar to the carriage, and in some very early drawings, indicating the ideas prevailing at that time, one might find the two personages, coachman and footman of the old staid carriage, mounted up high, in front of the vehicle, and even in some cases, the means of steering was illustrated as a sort of rein attachment in the hands of the coachman. In comparison, look at our modern auto, the acme of engineering perfection, bearing no resemblance to any other vehicle; this upon careful analysis, is found to be purely a matter of elimination and simplification.

Thinking of reinforced concrete bridges in a more intimate way than we have above, several phases of character present themselves, and when we realize the distinctness of concrete from all other materials, we must appreciate the opportunity that knocks at our door for a distinct expression.

BRIDGE OVER PAJARO RIVER, SHOWING CANTILEVERS BEFORE ENCASEMENT WITH CONCRETE.
Leonard & Day, Consulting Engineers

Among these characteristics is the solid purity of line, the mass, the bulk, whatever one cares to apply, should undoubtedly dictate the first steps in a reinforced concrete creation; next, probably, the thought comes of the way in which this material is assembled, i. e., poured. This seems to dictate flowing lines, continuity, and elimination of all the small distractions. A structure designed to comply with these and the other three points previously raised and truthfully dictating its function cannot but lift a new standard to the world to proclaim the progession of the 20th century.

That severe critic of the Building Art, Mr. Ruskin, whether we accept all his statements or not, was right when he said "Nothing is beautiful that first is not true."

I have dwelt above on the error of trying to produce a living structure by using forms associated with other materials, and must indulge the reader's forbearance in repeating this remark, as its importance cannot be too strongly emphasized. There is still a more intimate imitation that must strenuously be avoided, and that is the actual reproduction in concrete of some other material, such as rock-faced ashlar, rusticated stonework; these and many others are a degradation to reinforced concrete and an insult to the material it imitates. To the expert designer the treatment of the finished concrete should open up many new interesting effects. Many of those already in popular use are: the careful selection of a surface aggregate which is then either polished, producing that beautiful effect we know as terrazzo, or by sand blasting the surface marks from the interstices and leaving the aggregate free, producing an effect similar to rough cast. Then again, the aggregate may be varied by the use of either lime stone, granite or marble chips, which might all be combined or used separately at different points of the whole structure without destroying its continuity.

The one great thought that raises itself in connection with the decoration of a reinforced concrete structure is, that it must of necessity be of the structure. This is the argument of the Gothic revivalists in favor of their style, of which there is scarcely an old world example existing that

is not beautiful. The idea of precasting tons of useless features heretofore associated with stone, at present expressed in so many of the concrete structures already built, is in no way significant of progression, and as soon as we forget the cornice as it is at present detailed, and the column of ancient Greeco-Roman times, and give our more strenuous attention to such means of decoration as burnt clay, tile insertion, etc., the more readily will the ground be clear of weeds to begin ploughing through this vortex of existing affectations. At this point, I feel it would be as well to say a few words about the decorative value of iron work. Because a bridge is of reinforced concrete, it would be ridiculous to assign the material to some duty for which it was not functionally the best suited; wrought iron used carefully, and lovingly designed by an appreciative craftsman, will add greatly as an accessory to the general effect. Gates, lamps, and sometimes standards, trolley poles, coats of arms, metal weatherings, inscriptions, if properly designed, lend that touch of contrast so necessary to any work of art. Contrast and harmony are synonymous in the hands of the gifted.

Applying reinforced concrete to bridges, relieves us of one of the greatest obstacles to beautiful structures: the elimination of complexity in constructing a structure whose function is simple; the functional idea should then be the key note of all reinforced concrete bridges. The bigness and, at the same time, the smallness of the function, is such as to simply demand the elimination of trivial details, especially seeing that we cannot comprehend the beauty of a bridge except at a comparatively great distance. The human eye would fail absolutely to appreciate for instance, small heads at intervals on a string course, so it would seem as well to confine any of the smaller elaborations to the roadway itself, such as the decoration of lamp standards, seats, coats of arms, trees, shrubs, etc., etc., where the human eye can readily grasp their significance and enjoy their beauty.

It is readily seen from the foregoing remark that to make a successful project it is not necessary to spend an enormous amount of money. In point of fact, the percentage on the cost of the whole structure can scarcely be appreciated, it is so small. The ease with which these decorations can be effected is also a consideration; the majority of them can be left out without destroying the beauty of a design, and placed at some more appropriate time. Of course, there are still those first three points which should stand, and in themselves create a beautiful bridge, with the other adornments merely as furniture to the home.

In conclusion, I want to touch briefly on the subject which is far from the least important and which as yet I have refrained from talking about until this stage. I refer to color. There seems to be in reinforced concrete a chance that we shall again take up a true heritage, handed down to posterity by the ancients, which, in the last century, has gradually dwindled and waned until our surroundings are as drab as our lives. If we study classical architecture it will be found that our ancestors were partial to building in colors. The excavation of classical buildings at Var Catena, Brioni Grande, and Barbariga, has brought to light many proofs of this. We can understand, to a certain degree, in countries with temperatures such as in England, that color is not so important, but in a continent such as ours, with its brilliant sun and more brilliant snows, color is the greatest note we can strive to incorporate, and so in our bridges and great engineering works, which in so large a number of cases, are built in such close juxtaposition to nature, do not forget that God intended color to be one of the most beautiful notes that human can strike, just as He played it in the supremest creation of all.

# The American City



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There are two opposing candidates for county clerk, Smith and Jones. Smith wants the job, badly. So does Jones. They each line up their friends into opposing camps, who extol in speeches and posters their respective champions' virtues. But does Smith represent a policy to be pursued in the county clerk's office, and does Jones represent another policy? Rarely so. The office and its duties do not afford the basis of a discussion, so the talk shifts to the men themselves. The fact is, it would really not matter which of the two men got the office; either would file papers in just about the same way as the statutes dictate.

The fact is, elections under these conditions become petty sporting events when the stakes are the private fortunes of two opposing groups of men. If that is democracy, let's have more of it. If it isn't, let's send it to the scrap heap. And bear in mind, if you believe in the simplified government that the people can run, the place of all places to get busy right away is in county government.

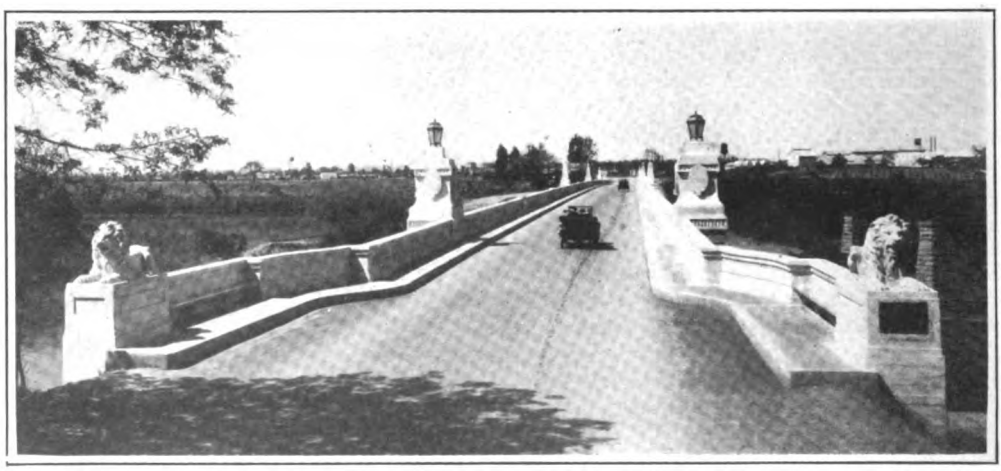
*(To be continued)*

# Concrete Arch Bridge over the Tuolumne River, near Modesto, Calif.

In the design and construction of concrete arch bridges artistic features are often omitted, and thus many structures lack poise and beauty that could have been made pleasing to the eye by a comparatively small additional expenditure.

One of the most artistic bridges exemplifying what can be done with concrete now spans the Tuolumne River just south of Modesto, Stanislaus County, Calif. This bridge was constructed by the Board of Supervisors of Stanislaus County with the design and construction under the supervision of Leonard & Day, Consulting Engineers, and E. H. Annear, County Engineer.

Besides this handsome bridge, Stanislaus County is completing a comprehensive system of modern concrete roads comprising 123 miles of highway, with Modesto, the county seat, as the hub.



**VIEW OF ARTISTIC CONCRETE ARCH BRIDGE CONSTRUCTED BY STANISLAUS COUNTY, CALIF., OVER THE TUOLUMNE RIVER**