READERS' COMMENT

PCI'S Education Program*

By Charles H. Raths

Comments by Allen G. Thurman and Author

Allen G. Thurman†

I have read this article with considerable interest. I too feel that something must be done by the Institute to stimulate and influence engineering education, and the program outlined could provide a distinct step forward. However, I hope the Institute will quickly look forward to approaching this important subject on a much broader base and with a greater degree of involvement.

As a starter, I would like to see the Prestressed Concrete Institute become an Associate Member of the American Society for Engineering Education. Educators look at engineering education from a different view than industry—in fact, only a brief look at the *ASEE Journal* indicates that our areas of interest differ widely. But these differences create the need for PCI's involvement in ASEE—we should join the dialogue of engineering education on a firmer base than just a highly self-serving seminar. If this argument does not satisfy the PCI membership, then perhaps it should be noted that the prestressed concrete industry's associates and competitors are already Associate Members of ASEE—the American Concrete Institute, the American Institute of Steel Construction, the American Iron and Steel Institute, the American Society of Civil Engineers, and the Consulting Engineers Council, among others. Can the PCI afford to not be similarly involved in engineering education?

Second, our industry's dialogue with educators must be on a more personal basis, developing stronger ties than will occur through an occasional seminar or plant tour. Members of the faculty must be offered summer employment or, even better, a full year of employment while on leave from the university. Students could be similarly employed—initially in production, but advancing to the areas of quality control and design as they gain employment and educational experience. Such student relationships may be informal, but their effectiveness (for the student, the university, and the industry) would be greatly increased if formal co-op or part-time programs were established, particularly at the graduate level.

I am aware of the industry's concern that short-term employment of either faculty or students may not give an appropriate return for the salaries paid. Also, there tends to be concern for continuity of work functions, made more

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difficult by short-term employment or by change in employees by rotating co-op students. Personally, I believe these potential problems could be handled by good industry practices and effective management. But more important, the long-term value of the employment must be given increased consideration: the faculty member would return to his teaching and research with a greater understanding of our industry and its merits and complexities; the student would stay in our industry to become a real leader or move to consulting where he would influence the selection of construction methods and materials; and our industry would gain an increased sensitivity to engineering education.

Third, we must offer to help the university do its job better, rather than offer to do its job directly—offering a seminar tends to be interpreted as the latter. I believe my point can best be explained by two examples: (1) each year the steel fabricators in the Denver area send one faculty member from each Colorado university to the annual AISC national meeting—the faculty members are selected by the Deans of the Colleges and all expenses are paid by the local fabricators; (2) when AISC seminars are presented locally, they are usually presented at a university—they almost always include faculty speakers as well as other consultants and professionals from the steel industry. Should we not act similarly?

Fourth, the PCI membership should not assume that today's structural engineering students are not being taught at least the fundamental tools of prestressed precast concrete construction, and, further, they should never expect a specialized course in this subject to be required for either undergraduate or graduate students. Today's students are being offered increased personal choice in the selection of courses—not more required courses.

Many civil engineering graduates of the future will not have had any advanced structural courses, but we can presume that these graduates would not be entering our industry as design engineers. Bachelor of Science graduates emphasizing structural engineering will rarely have taken a prestressed concrete course, but they will have taken analysis courses through indeterminate structures and design courses in steel and concrete. They will often have had a good materials course, and they will always have had considerable exposure to the computer, either by specialized courses or by integration with courses covering analysis and design. Our industry is not so unique that it requires more than this—it requires materials, analysis and design, and it requires proficiency in the use of the computer to quickly handle repetitious or complex problems.

For those engineers in our industry who graduated more than about 10 years ago, I would like to emphasize that the fundamental mechanics of a prestressed concrete beam are the same as a regular reinforced concrete beam with an eccentric, axial load. Designing the amount of load and eccentricity, with consideration for time dependency, makes the problem much more difficult but not particularly different. This has been recognized by the codes, particularly since ACI 318-63. It has also been recognized by the engineering textbooks and instructors. The most popular concrete design text since 1963 has been *Design of Concrete Structures* by Winter, Urquhart, O'Rourke, and Nilson—the fundamental mechanics of prestressed concrete are developed in the second chapter and instructors do teach this to their students. Of course, the student doesn't graduate as an experienced engineer of prestressed concrete structures, but he doesn't graduate as an experienced engineer in anything else either.

I will support the concept of our industry offering seminars to the engineering departments of our colleges and universities, as outlined by our Education Committee—in fact, I would volunteer to be a seminar speaker. However, I believe implementation of the above points must take place if any seminar series is to be effective. This opinion is based on considerable experience from both sides of the fence—nearly 10 years with consulting and industry including 2 years with Prestressed Concrete of Colorado, Inc., and 8 years with the University of Denver as Professor, Department Chairman, and Acting Dean of the College of Engineering. The phrase, "both sides of the fence," unfortunately is a very appropriate description of the relationship which now exists between education and all industry. I hope the PCI will help find ways to break down that fence—we certainly must if we are to continue the advancement of our industry and assure ourselves of future qualified engineers.

Author's Closure

Dr. Thurman examines critically and constructively PCI's approach to education. It is rightfully pointed out that the present proposed PCI program is but a small step which should be only a part of a much broader program.

An examination of the present PCI Education Committee shows that committee members most active are either educators or professional engineers. This emphasizes, unfortunately, as set out in the discussion, that the Company, Associate, and Professional members of the PCI must become more concerned with education.

The Institute and its members should reflect in depth on ASEE, part-time employment for faculty and students, sending faculty to PCI conventions, and the view from the educator's side of the fence. Education is vital to PCI and its continued growth.

Construction of Rio Colorado Bridge*

By T. Y. Lin and Felix Kulka

Comments by Ernest Loh†

The design and construction of this Rio Colorado Bridge has led to the development of a minimum weight prestressed concrete bridge which the writer wishes to report. This upside-down suspension bridge has now been extended to include self-anchoring so as to not require external anchorages, as shown in Figs. 1 and 2.

This revised design typifies a prestressed concrete deck bridge of medium span length, say between 200 and 400 ft. It looks similar to the Rio Colorado Bridge and has the following special features which result in its most economical design:

1. The bridge floor deck is fully utilized as the main compression member thus doing away with anchorages. In other words, the deck carries the ten-

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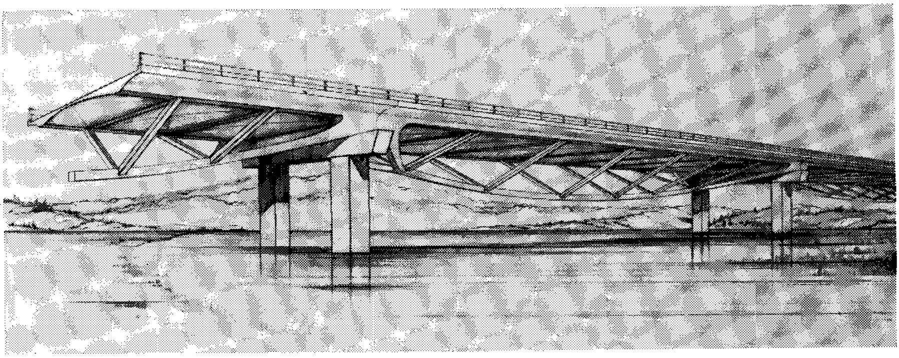

Fig. 1. Artist's sketch of proposed Shai-Dant-Shuey Bridge in Taiwan.

sion from the cables. It also serves as the vertical stiffening girder and acts as wind or earthquake bracing. The pre-compression in the deck enables it to carry local moment and shear in the floor system.

2. Only one post-tensioned cable supplies all the tension, acting like a suspension bridge.

3. The shear in the span produced by both dead and live loads is resisted by the inclination of the cable similar to a suspension bridge, thus saving a lot of web material. The web material consists only of minimum columns to transmit the load from the deck to the cable, like suspenders in an ordinary suspension bridge. They do not carry any shear. The triangular cross section of the bridge gives it great stability.

As can be observed, a medium span bridge of this type requires little more material than short spans. The additional concrete and steel is minimum, consisting only of one cable member and some small columns for the web. The floor deck arrangement can be varied using a haunched slab (see Figs. 1 and 2) or a beam and girder system such as used in the Rio Colorado Bridge.

Because of the unusual form and configuration, this bridge can not be economical unless the span is repeated many times. This unique design is now proposed to the Taiwan Highway Bureau for its Shai-Dant-Shuey Bridge, which crosses a wide and flat river for a length of 2 kms (1¼ miles).

These multiple spans of one design can be built using a set of movable forms supported on the piers. These forms will hold either in-place concrete or precast elements to be joined thereon.

If transportation permits, each span can be precast in one piece at a plant nearby and then moved to its final position by either barges or launching trusses. In the factory, each span can be prefabricated by joining a number of precast elements.

We believe that the construction of the Rio Colorado Bridge indicates the great potential inherent in prestressed concrete construction. We should look toward new concepts to achieve great savings in material, particularly if this can be coordinated with proper methods of construction which must, of course, be tailored to fit the local conditions.

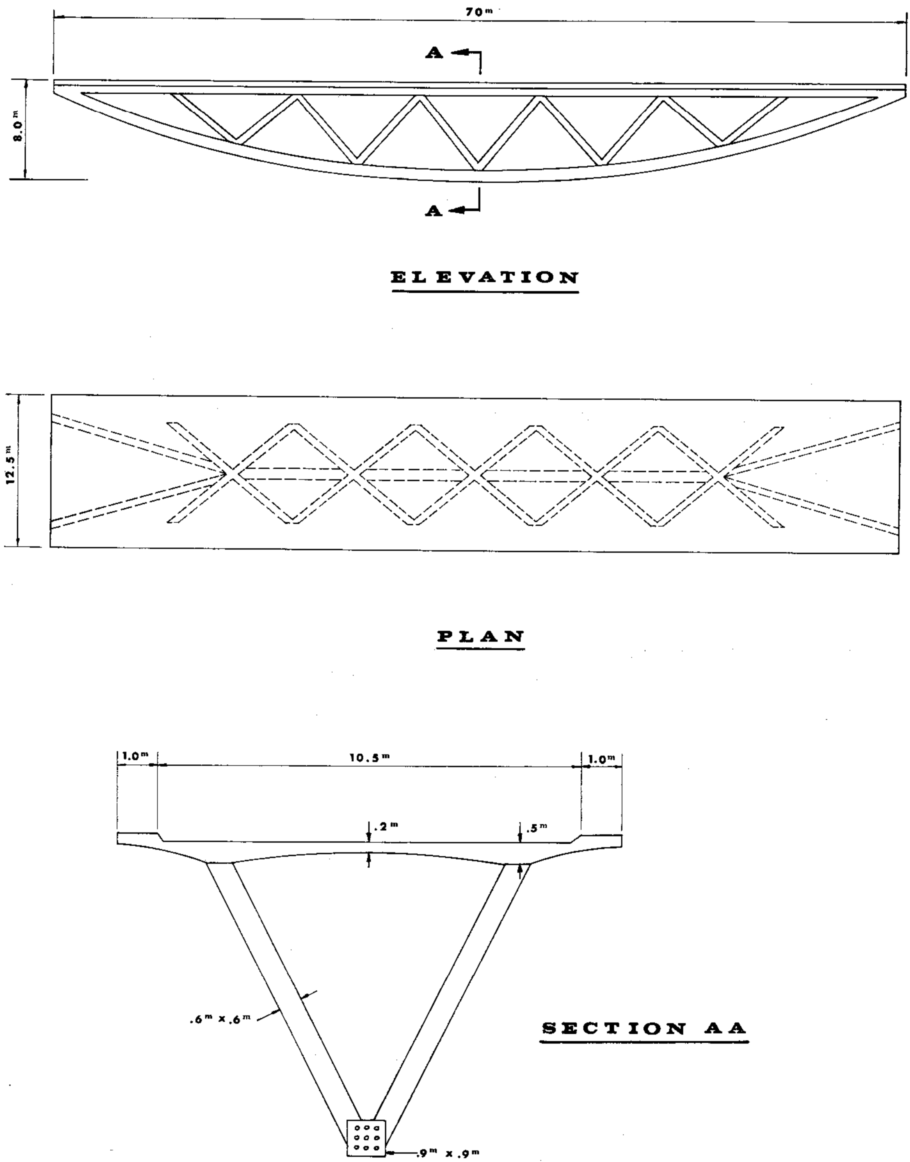

Fig. 2. Elevation, plan, and cross section of proposed Shai-Dant-Shuey Bridge in Taiwan.