READER COMMENTS

Friction Joints for Seismic Control of Large Panel Structures*

by Avtar S. Pall, Cedric Marsh, and Paul Fazio

Comments by Joseph Varsano and Authors

JOSEPH VARSANO†

The authors propose an interesting solution for Limited Slip Bolted (LSB) joints in large panel precast structures. The joints are designed not to slip under loads in service, but are expected to slip during severe seismic motions.

The advantage of the suggested joint for reducing the horizontal loads during earthquakes is two-fold:

1. On the one hand—increasing the joint capacity for energy dissipation in the form of friction;
2. And on the other hand—influencing by means of the joint for the modification of the rigidity of the wall, and through it on the fundamental period of the structure, with a view to reducing the seismic horizontal load.

The main subject of the article is the continuous vertical joints between coupled end walls.

In my opinion, in the calculation of the vertical joint between coupled precast walls, one should not neglect the influence of the floors which participate in the passing of the shearing of the vertical forces through the seam between the walls.

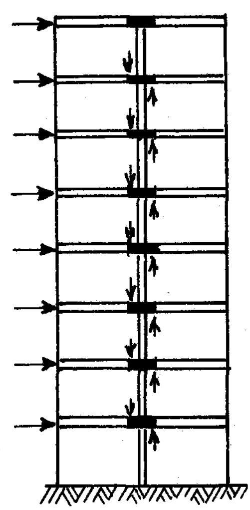

Fig. A. Wall-floor joint ("elastic locking element").

The influence of the wall-floor joint in a vertical seam between walls is best known under the French term "verrou élastique" or in its English translation "elastic locking element,"[26-28] and finds its expression in the CEB International Recommendations for Design and Con-

*PCI JOURNAL, V. 25, No. 6, November-December 1980, pp. 38-61.

†Structural Engineer, Tel-Aviv, Israel. (Also, Member of the Commission for Preparing Israeli Standards for Precast Buildings.)

struction of Large Panel Structures.[26]

Figs. A and B show sketches of the wall-floor joint and the mechanism for transmitting shear.

As long as a practical method for neutralizing forces by structural means the influence of the floors on the vertical joint of every story is not secured, their influence should be taken into consideration.

References

26. CEB, *Recommendations Internationales unifiées pour le calcutet l'exécution des structures en panneaux assemblés de grand format,* Rome, Italy, 1969.
27. Lugez, J., *La préfabrication lourde en panneaux,* Eyrolles, Paris, France, 1973.
28. Varsano, J., "Structural Stability of Precast Buildings," IABSE Tenth Congress, Tokyo, Japan, September 1976.

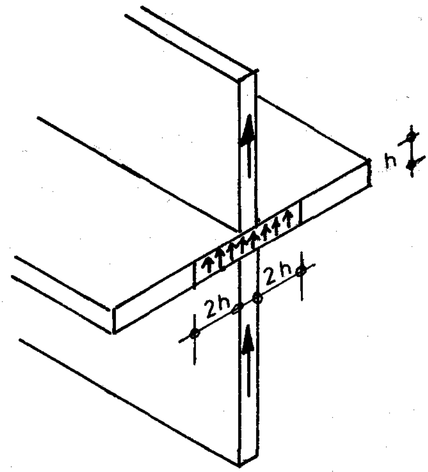

Fig. B. Mechanism for transmitting shear at wall-floor joint.

CLOSURE BY AVTAR S. PALL* CEDRIC MARSH,† and PAUL FAZIO‡

The authors wish to thank Mr. Varsano for the interest shown in the paper.

The proposed concept differs fundamentally from the conventional arrangement discussed by Mr. Varsano. The use of proposed friction joints requires an arrangement of precast walls and floor slabs so that independent movement is achieved at the vertical slip planes. This has been cautioned by us on p. 57 under the heading "Practical Applications."

This concept can be conveniently achieved in large panel structures by locating the floor joints in line with the vertical joints of the walls. However, the influence of the presence of floor joints, required for diaphragm effect, etc., will have to be lumped with that for the vertical joints to account for the overall performance. Mechanical slipping joints can be used with advantage for such floor joints.

The approach advocated for the large panel structures can also be conveniently and economically extended to cast-in-place concrete shear walls.[29] Whereas natural joints are available in large panel structures, the artificial joints are created in the cast-in-place concrete shear walls by placing the preassembled slip joints in the forms before concreting.

Conceptually, the mechanism proposed is that of a leaf spring, which remains elastic while absorbing energy in friction as it deforms. Using the proposed friction joints, much greater quantities of seismic energy can be disposed of in friction than by any method that involves the damaging process of yielding of steel or cracking of concrete. Similar to an automobile, the motion of the vibrating building is slowed down by "braking" rather than "breaking."

It is hoped that the proposed concept will raise the level of the present earthquake resistance of collapse to the control of damage.

*Senior Structural Engineer, The SNC Group, Montreal, Quebec, Canada.

†Professor, Centre for Building Studies, Concordia University, Montreal, Quebec, Canada.

‡Professor and Director, Centre for Building Studies, Concordia University, Montreal, Quebec, Canada.

Reference

29. Pall, A. S., and Marsh, C., "Friction-Damped Concrete Shear Walls," *ACI Journal,* V. 78, No. 3, May-June 1981, pp. 197-193.

READER COMMENTS

Civil Engineering Education and the Prestressed Concrete Industry*

by Lawrence F. Kahn

Comments by Kenneth A. Faulkes, David A. Sheppard, and Author

KENNETH A. FAULKES†

Professor Kahn raises some important questions regarding the guidelines and priorities used to determine what should be included in a civil engineering curriculum. Some of his arguments, however, appear to be internally inconsistent, and it is difficult to believe that the educational situation is really as dismal as it is painted.

I agree that "education must produce an individual who is a thinker and a logical problem solver;" yet it is surely inconsistent to argue that "given a major technical problem, the engineer must be able . . . to provide a complete technical solution," and later to condone an engineering education after which "engineering graduates cannot conceive how prestressed concrete products might be used to solve their problem."

If it is true that "many civil engineering students . . . never hear of prestressed concrete in a classroom;" and that decisions on course content are really based on "the historical use of structural engineering materials" rather than on what is relevant to engineering today; if only four elective courses are offered and even then "in general, undergraduates get only two of the electives they actually want because of scheduling problems," then those students are being short-changed by their engineering educators.

I would argue that prestressed concrete is an essential core subject in any civil engineering curriculum for the following reasons:

1. The concept of prestressing—imparting beneficial loads to a structure, as distinct from passively countering the applied loads—is of basic importance in all problem solving.
2. Properly presented, the theory and design of prestressed concrete is simple, rational, and a relatively minor logical extension of reinforced concrete. Prestressing steel is merely one of the options for reinforcing concrete. Therefore, reinforced and prestressed concrete should be taught together in an integrated manner.[1]

---

*PCI JOURNAL, V. 25, No. 5, September-October 1980, pp. 126-131.

†Associate Professor, School of Civil Engineering, University of New South Wales, Sydney, Australia.

3. Prestressed structures with their characteristic long spans and clean lines, tend to have an exciting quality which stimulates students' interest and enthusiasm for engineering.
4. The wide and growing use of prestressed concrete in construction compels its inclusion in the young engineer's repertoire.

Prestressing is surely the most significant civil engineering development of the last 50 years, and provides a potent means of solving many engineering problems. A structural engineer not versed in the theory and techniques of prestressed concrete is as ill-prepared for his profession as an electronics graduate who has not been told about transistors. It is frankly beyond belief that in a curriculum of 60 courses no room can be found for so vital a subject.

Reference

1. Warner, R. F., and Faulkes, K. A., *Prestressed Concrete, with Emphasis on Partial Prestressing,* Pitman, Australia, 1979.

DAVID A. SHEPPARD*

Professor Kahn indicated several reasons why prestressed concrete is not taught at the undergraduate level in 4-year civil engineering programs; they include: lack of room in the curriculum, ECPD (Engineers Council for Professional Development) accredited courses excluding prestressed concrete, and budgetary constraints in offering prestressed concrete electives.

Other reasons not stated, but real, are the lack of an adequate text covering all aspects of prefabrication and prestressing, both pretensioning and post-tensioning, and a lack of instructors familiar with precast and prestressed concrete design and construction.

Professor Kahn's observations mirror the situation generally found here in California. Out of 23 schools offering civil engineering degrees, only three offer prestressed concrete at the undergraduate level (one is taught by a visiting European lecturer, one by a practicing consulting engineer, and the third by an architect). Hence, the real problem begins with faculty that are unfamiliar with prestressing, and this becomes a major (and unstated) stumbling block to offering prestressed concrete courses at both the undergraduate and graduate levels.

It is not the intent of this discussion to alienate our friends in academia, and to this extent I want to describe briefly what we have done in California in response to this "Education Barrier."

In 1975 the Prestressed Concrete Manufacturers Association of California (PCMAC) decided to develop an instructional text for plant cast precast and prestressed concrete. PCMAC, in conjunction with California State Polytechnic University at San Luis Obispo, developed a course outline and after several extensive group meetings with industry and faculty, produced the Design Guide in 1977. The Second Edition, published by the Prestressed Concrete Institute in March 1980, was the result of an extensive editing job and the addition of 350 pages of new material.

PCMAC also organizes and conducts 2 or 3-hour seminars for senior civil engineering students. At these sessions the student attendees are presented with free copies of the Design Guide.

I personally conduct these lectures in each of the 23 California Region colleges and universities, either as a part of the Reinforced Concrete Design Course, or in co-sponsorship with the Student ASCE Chapters. In these lectures, I discuss primarily the design of pretensioned precast concrete elements, but also include portions showing the advantages and applicability of other forms of prestressed concrete construction.

*California Marketing Director, Prestressed Concrete Institute, Concord, California.

Coupling the seminar program with student plant and job site tours will result in increased student and faculty awareness of the necessity of prestressed concrete being offered as a full-time course of study. The pressure of building economics is also helping to bring this about, as it has already been done in other parts of the world.

CLOSURE by LAWRENCE F. KAHN*

I thank Professor Faulkes and Mr. Sheppard for their discussions. Initiating debate on the subject of prestressed concrete education is vitally important to our industry.

I am disappointed that more academics and practitioners did not comment on what I said in the article. I wanted some "hot" comments such as those made by Professor Faulkes. Educating students in prestressed concrete fundamentals is crucial to the advancement, even the survival of the pretensioned and post-tensioned concrete industry. If we who teach, research, design, and build prestressed structures are not concerned with improved education, no one else will be.

Professor Faulkes is correct in stating that a structural engineer is unprepared if he is not knowledgeable on the subject of prestressed concrete.

I believe that Mr. Sheppard's program of seminars *is an outstanding system* to provide some prestressed concrete education to California's engineering students. But structural, construction, and other civil engineering students also need improved educational opportunities in prestressed concrete. I hope that the PCI and its members support action, both political and monetary, to improve education for their industry.

*Assistant Professor, School of Civil Engineering, Georgia Institute of Technology, Atlanta, Georgia.

* * *

DISCUSSION NOTE

The Editors welcome discussion of papers published in the PCI JOURNAL. The comments must be confined to the scope of the article being discussed. Please note that discussion of papers appearing in this current issue must be received at PCI Headquarters by May 1, 1982.