Reviews of Current Publications

Books

Limit State Design of Prestressed Concrete Volume 1—The Design of the Section

Y. Guyon (translated by P. Chambon and F. H. Turner)

This textbook is based on a series of university lectures given by the author. However, the text is also sprinkled with many practical design examples borrowed from the author's consulting practice.

The topics in the book include: (1) fundamentals; (2) materials; (3) equipment for post-tensioning; (4) calculation of cable losses; (5) simple examples of bending calculations; (6) design of nonrectangular beams using strength of materials; (7) displacements of center of compression, limit core–lines of thrust, limit state–section efficiency; (8) design of a section of any shape in which permanent loads cannot be compensated; (9) safety in bending of statically determinate beams; (10) design of sections on the basis of failure and limit state calculations; and (11) reinforced prestressed concrete.

(Halsted Press Division, John Wiley & Sons, Inc., New York, N.Y., 1972, 486 pp.)

Methods Improvement for Construction Managers

Henry W. Parker and Clarkson H. Oglesby

The topics include: (1) history and applications of work improvement; (2) preplanning for profit; (3) evaluating management's effectiveness by activity or work sampling; (4) recordings as techniques for analysis and for finding improvements; (6) human factors in work improvement; (7) safety and environmental health in construction; and (8) mathematical models as tools for methods improvement.

(McGraw-Hill Book Company, New York, N.Y., 1972, 300 pp., $14.50)

Foundations for Systems Building and Modular Housing

This report is the proceedings of a conference held in San Francisco, California, February 17-20, 1971. The topics include: (1) systems building; (2) foundation subsystem; (3) floor and subfloor systems (light construction); and (4) foundation think tank.

(*Conference Report* SF-71, Earth Systems, Inc., P.O. Box 820, Mountain View, California, 1972, 104 pp., $7.50)

U.S. Publications

Performance Concept in Buildings. Vol. 1 and 2

Bruce E. Foster (Editor)

These two volumes, with their 82 papers plus discussions and summaries, are believed to be the most comprehensive, penetrating–indeed, questioning–work yet produced on the application of the performance concept to the building arts and sciences. Performance in building, as elsewhere, emphasizes ends rather than means; it welcomes innovation and doubts the value of relying solely on the prescriptive building solutions of the past. It applies to all aspects of the building and, in fact, to groups of buildings.

The symposium, which was held in Philadelphia, Pennsylvania, May 2-5, 1972, was jointly sponsored by the In-

ternational Union of Testing and Research Laboratories for Materials and Structure, the American Society for Testing and Materials, and the International Council for Building Research Studies and Documentation.
(*National Bureau of Standards Special Publication* 361, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 1972, 819 pp., $8.25)

Prestressed Beams in Torsion and Bending

Hota V. S. Ganga Rao and Paul Zia

An interaction criterion for prestressed concrete beams under torsion and bending is presented. Test results for 42 rectangular specimens include properties of beams, their ultimate strengths, crack patterns, and torque-twist and bending-deflection curves. Substantial reduction in torsional stiffness due to torsional cracks was observed. However, the effect on bending stiffness is relatively small. Beams with stirrups and longitudinal steel have ample rotation capacity at failure. Having established three modes of failure by experimental observations for varying bending-to-torque ratios, a generalized skew bending theory is developed to evaluate cracking and ultimate torques. Although 150 tests by various investigators including the writers were evaluated to check the validity of the theory, only 90 tests are given in this paper. A comparison of these values with the test results is found to be satisfactory. For prestressed beams supplemented with longitudinal steel of a minimum amount of about 1 percent, the nondimensional interaction curve can be conservatively taken as a square.
(*Journal of the Structural Division,* ASCE, Vol. 99, No. ST1, Proceedings Paper 9501, January, 1973, pp. 183-198)

International Conference on Tall Buildings

These are preprints of the first international conference on the planning and design of tall buildings which was held at Lehigh University, Bethlehem, Pennsylvania, August 21-26, 1972.

Technical committees, divided into groups, each dealing with a different aspect of tall building planning and design, covered systems and criteria, tall steel buildings, and tall concrete and masonry buildings. Some 300 invited reports were given by professionals from around the world on subjects ranging from environmental limitations, internal and external transportation, land use and services, to foundation construction, soil dynamics, and masonry structures.
(*Proceedings,* Symposium, Lehigh University, Bethlehem, Pennsylvania, 1972, $50.00)

Full Scale Bridge Testing

Edwin G. Burdette and David W. Goodpasture

Four deck girder highway bridges in Tennessee, located in an area to be inundated as a part of a Tennessee Valley Authority reservoir, were tested under the actions of three types of loading: (1) vibratory loading induced by FHWA vibration generating equipment, (2) rolling loads simulating an HS20 loading with additional loads up to 132,000 lb, and (3) static tests to failure. The research was directed toward the evaluation of design criteria related to three facets of bridge design: (1) lateral distribution of load, (2) dynamic response, and (3) ultimate strength and mode of failure.

The following conclusions were reached.

1. The load distribution factors obtained were found to be in reasonably close agreement with those obtained in

other similar studies.

2. The lateral distribution of load was found to be practically independent of load level for all load levels up to yield of the steel.

3. An analytical method, based on strain compatibility relations and assuming the entire bridge with curbs to act as a wide beam, predicted the ultimate capacity of three of the four bridges within 9 percent. Each of these three bridges failed in a flexural mode. Composite action was lost in the prestressed concrete bridge prior to flexural failure, and shear failure of the two interior precast sections occurred at a load level less than that required to produce flexural failure.

4. Ultimate loads calculated on the basis of AASHO Specifications were somewhat lower in each case than the actual ultimate loads. It appears that computation methods based on AASHO Specifications give a lower bound to the actual ultimate load for each bridge.

5. The load causing "first permanent set" is less readily identifiable, either theoretically or experimentally, than is the ultimate load. The method given in the AASHO Specifications for limiting overload on the basis of first permanent set appears to be reasonable.

(*Final Report,* Department of Civil Engineering, The University of Tennessee, Knoxville, Tennessee, December 31, 1971, 166 pp.)

Torsion, Bending, and Shear in Prestressed Concrete

Priya R. Mukherjee and Joseph Warwaruk

An ultimate strength interaction criterion for web reinforced, prestressed concrete beams under torsion, bending moment, and flexural shear is presented. The principal variables considered are the level of prestress and its eccentricity, torque, bending moment ratio, and flexural shear. Test results for 54 rectangular beams include beam properties, ultimate strength, angle of twist at failure, torque-twist curves and typical crack patterns. Bending moment in moderate amounts increases the torsional strength, but the effect of flexural shear is always detrimental. Within limits, the web reinforcement provides a ductile type behavior with ample rotation capacity at failure. The initial torsional stiffness is not affected by the variables considered. Higher levels of prestress and web reinforcement increase the pure torsional strength. Torsion-bending moment interaction is represented by a second degree parabola, and a three-dimensional curved interaction surface is suggested when flexural shear is also present. Proposed interaction equations indicate good correlation with test data.

(*Journal of the Structural Division,* ASCE, Vol. 97, No. ST4, April 1971, pp. 1063-1079)

Theory of Cracking in Concrete Members

Arthur D. Edwards and Andre Picarde

A theory is presented which predicts the crack width and crack spacing in the constant moment region of a reinforced or prestressed concrete beam. The theory is based on the same assumptions as the classical theory of cracking for reinforced concrete. Instead, however, of assuming a bond stress distribution, the bond slip characteristic of the steel is used and this results in the bond distribution continually changing as the steel stress increases. The theory is used to investigate the effect of a variation of the main parameters on the crack width and crack spacing of theoretical tensile specimens reinforced with strand and deformed bar. It is shown that, for a given steel stress at cracks, the crack width depends mainly on the maximum

bond strength of the reinforcement and the crack spacing depends mainly on the tensile strength of the concrete and the maximum bond strength of the reinforcement.
(*Journal of the Structural Division*, ASCE, Vol. 98, No ST12, December 1972, pp. 2687-2700)

Bonding Properties of ½ in. Diameter Strand

A. D. Edwards and A. Picard

The bond-slip relations obtained from six pull-out specimens and six tensile bond specimens are reported. Three covers 0.5, 1.0, and 1.5 in. (1.27, 2.54, and 3.81 cm) were used, the strand being held horizontally during casting. In all cases the bond-slip curve could be idealized as elastic-plastic, there being no deterioration in the maximum bond stress with increasing slip unless a longitudinal crack occurred. For the small number of specimens tested, the shape of the curve was found to be independent of the method of testing but the maximum bond stress increased as the cover decreased. The average data obtained were used to predict the average crack width at various stresses in a tensile member. These results are compared with the average crack width obtained during eight tensile member tests. The actual scatter and the predicted scatter of results are also compared. The predictions using the most accurate formula are good.
(*Journal of the American Concrete Institute*, Proceedings, Vol. 69, No. 11, November 1972, pp. 684-689)

Control of Cracking in Concrete Structures

ACI Committee 224

This report covers the principal causes of cracking and recommended crack control provisions. It explains the basic mechanism of microcracking and fracture mechanics in concrete. Control of cracking due to various causes is dealt with in the following areas: shrinkage, reinforced concrete beams, one-way and two-way slab systems, prestressed concrete systems, long-term effects including creep and other factors, mass concrete, and construction procedures. The report gives recommended criteria and equations where necessary for use by the design engineer based on research and applied knowledge in the field of crack control in concrete. There is a fairly detailed chapter on "Control of Cracking in Prestressed Concrete."
(*ACI Journal*, Proceedings, Vol. 69, No. 12, December 1972, pp. 717-753)

Unusual Application of Prestressed Waffle Slabs and Composite Beams

C. Andrew Pretzer

A description is given of the design and construction of the two-way post-tensioned waffle slabs and the supporting steel plate girders used in the Boston Public Library Addition. The special steps required for deflection, camber control, tendon placement, installation of headed studs, and concrete shear pockets to insure composite action are presented. Unbonded tendons were used for these 60 ft (18.3 m) slab spans.
(*ACI Journal*, Proceedings, Vol. 69, No. 12, December 1972, pp. 765-769)

Construction of the Walter P. Chrysler Building, Highland Park, Michigan

Charles Novacek

The Walter P. Chrysler Building complex consists of four major buildfour buildings concrete was used imaginatively from an architectural, strucings including a domed structure. In all tural, and functional viewpoint. This paper describes the construction tech-

niques that were used. Particular emphasis is given to constructing the domed structure, the precast concrete columns, the precast-prestressed T-beams, and the exposed aggregate concrete panels. Of special interest were the close tolerances that were specified and achieved in the field.
(*ACI Journal,* Proceedings, Vol. 69, No. 12, December 1972, pp. 775-781)

Repairing Joints with Precast Slabs

J. E. Simonsen

Precast concrete slabs were used experimentally by the Michigan Department of State Highways to minimize lane-crossing during repair work. The technique developed for installation of the slabs is described. A slab without a load transfer provision was installed in 2 to 2½ hr, and the installation of slabs with load transfer required 3 to 3½ hr. These times include the removal of the deteriorated pavement but not the sawing. It is hoped that the precast slab method be developed into a standard procedure in areas where conditions warrant a speedy repair.
(*Public Works,* Vol. 102, No. 5, May 1971, pp. 74-76)

Foreign Publications

Deflections of Prestressed Concrete Bridges in Japan

Masatane Kokubu

This paper summarizes and discusses measurements made of the deflections in service of four prestressed concrete bridges in Japan. The bridges, of long-span and central-hinge type, were constructed by the cantilever method. This paper discusses a simplified formula for calculating the deflection occurring after the hinges have been joined.
(*Magazine of Concrete Research,* London, Vol. 24, No. 80, September 1972, pp. 117-126)

Moment Redistribution in Continuous Prestressed Concrete Beams

M. J. N. Priestley and R. Park

In a previous paper relations between moment and average curvature were developed for prestressed sections subjected to constant moment. The variation of stiffness due to concrete tension between cracks was taken into account. These relations are now used to determine the moment-load and load-deflection curves for continuous beams up to the onset of concrete crushing. The results of an experimental program on two-span continuous beams are presented and show close agreement with theoretical results.
(*Magazine of Concrete Research,* London, Vol. 24, No. 80, September 1972, pp. 157-166)

Strength Losses in Heat Cured Concrete

J. Alexanderson

This investigation studied the causes for strength losses at 28 days in heat-cured concrete as compared with normally-cured concrete. The experiments were designed to test the hypothesis that, if the tensile strength of the concrete is not sufficient to withstand the pressure in the air pores, the concrete will crack. The heat curing was done very rapidly, simply by submerging the specimens in a water bath having the final curing temperature. The tests showed that physical effects, rather than chemical, are the dominating causes for strength losses. One test series was conducted to find a relation between the tensile strength and the ultimate pore pressure. To avoid strength losses in heat curing, three basically different approaches are possible: (1) resisting the pore pressure; (2) eliminat-

ing the pore pressure; and (3) allowing the concrete to crack and repairing it afterward.
(*Swedish Cement and Concrete Research Institute,* Proceedings, No. 43, 1972, 135 pp).

Behavior and Design of Reinforced Concrete Corbels

G. Somerville

Reviews the available test data on corbels to determine the major parameters that influence behavior. Previous design methods, evolved separately in Germany and North America, are evluated and compared. A design approach is developed which is consistent with that in the draft unified British Code of Practice and which is capable of dealing with horizontal forces and with ratios of shear span to effective depth which are greater than 1.0.
(Cement and Concrete Association, London, August 1972, 12 pp., 50 p)

Status of the Lime and Cement Industry in France, Europe, and the World in 1970 (La situation de l'industrie de chaux et ciment en France, en Europe et dans le monde en 1970)

Anon.

This article is the report presented to the general assembly of the association of French producers of cement and hydraulic lime held in May 1971. Although the report mainly treats the French industry, it does have some data of interest to the American reader. World production of cement increased in 1970 by 5 percent. In the United States it decreased by 5 percent. The major producing countries are the Soviet Union with 95,000 metric tons (17 percent of world production) followed by the United States with 65,000 tons (11.5%). Japan is a close third. The consumption per inhabitant is much larger in the European countries (west and east) and Japan than in the United States which ranks 12th among the 20 major cement producing countries. It ranks behind all countries of the Western European community as well as Japan, Czechoslovakia, Spain, East Germany, Poland, and the Soviet Union. In all these countries the consumption per capita increased from 1969 to 1970, except for the United States (6 percent decline) and the United Kingdom (3 percent decline).
(*Ciment & Betons,* Revue de Materiaux de Construction (Paris), No. 669-70, June-July 1971, pp. 178-183)

Sliding Method: A Modern Method for Constructing Railroad Overpasses (in Dutch)

R. A. Overdiep

A detailed description is given of how railroad bridges are constructed adjacent to their sites using prestressed or reinforced concrete and are then literally pulled (not pushed) into position. Sliding speed usually is 4 to 8 m per hr, with maximum load of superstructure to date at 4000 tons. Various friction relieving methods are discussed.
(*De Ingenieur* (The Hague), V. 83, No. 24, June 18, 1971, pp. Bt24-Bt-29)

Design for Industrial Production

Anon.

The prime purpose of this report is to contribute to a sharing of such experience as exists in the field of design for industrial production. In doing so, it sets out, in general, to give the best advice at present available rather than to dogmatize in an area where ideas and techniques are continually evolving. It is addressed particularly to the young engineer and to more experi-

enced engineers relatively unfamiliar with recent developments in industrialization.

The main body of the report is divided into three parts. General considerations relevant to all forms of construction and to all types of contract come first. More detailed considerations, specific to particular forms of construction, follow. Finally, some notes are given on those approaches to industrial production known as systems building and component building. As far as possible the material has been arranged in a consistent and systematic manner to permit easy cross reference.

The specific topics include: (1) general considerations; (2) brickwork and clay products; (3) timber; (4) cast-in-place concrete; (5) precast concrete; (6) large precast concrete panels; (7) steel; (8) composite construction; (9) economics of scale of production; (10) systems building; and (1) component building.

(The Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1X8BH, England, November 1971, 36 pp., £1.50)

Feature Survey of Concrete Box Spine-Beam Bridges

R. A. Swann

A detailed examination has been made of the characteristics of 173 bridges built in the last 15 years with a view to making recommendations for the initial proportioning of spine beam bridges in the future. Data are presented in the form of graphs and histograms, which, for a particular case, will aid in the choice of the most suitable type of section and provide approximate dimensions. Consideration is also given to estimating quantities of concrete and steel required and a formula is suggested for calculating the approximate cost of the structure. Details of the bridges, from which this information is derived, are given in full in appendixes to this report. This work was undertaken in association with a CIRIA project on the design of elevated bridge structures.

(*Technical Report* 42.469, Cement and Concrete Associates, Wexham Springs, Slough SL3 6PL, England, June 1972, 76 pp., £2).

Shell Structures and Climatic Influences

P. G. Glockner and A. Ghali (Editors)

This is the proceedings of an international symposium held at the University of Calgary, Alberta, Canada, July 3-6, 1972. The conference was sponsored by the International Association for Shell Structures. The sessions were divided into the following categories: (1) general climatic factors; (2) membrane analysis and inflatables; (3) wind effects; (4) construction; (5) thermal effects; and (6) special topics. An added feature of the conference was a special session on hyperbolic cooling towers.

(Proceedings, Symposium, International Association for Shell Structures, The University of Calgary, Alberta, Canada, 1972, 540 pp.)

Study of Waste in Industrialized Building Systems

P. V. Dunning

Although for bidding purposes builders customarily allow for a waste of materials in a range of 7 to 9 percent, the actual waste during construction is considered to be well over 15 percent. The author considers (using the cases he studied) that of the total damage incurred in the system, about 70 percent occurred in the factory and the remaining 30 percent occurred either during transit or on the site.

(*Concrete*, London, Vol. 6, No. 9, September 1972, pp. 22-27)