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BIBLIOGRAPHY ON PRESTRESSED CONCRETE

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BIBLIOGRAPHY ON PRESTRESSED CONCRETE

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Prepared as a part of the First Progress Report of the
Investigation of Prestressed Concrete for Highway Bridges

Conducted by

THE ENGINEERING EXPERIMENT STATION
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In cooperation with

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BIBLIOGRAPHY ON PRESTRESSEDCONCRETE

All references included in this Bibliography are classified into six groups. The full title of references which contain material falling into several groups appears in one group only; in other groups cross-reference is made by number only.

A. Research

This group includes references on theoretical and experimental investigations of the materials for and the behavior of prestressed concrete structural members and structures.

B. Construction

This group includes references describing construction and manufacture of prestressed concrete structures; the prestressing methods; and finished structures of prestressed concrete.

C. Design

This group includes references on the design of prestressed concrete structures; it includes also specifications, economical studies and general textbooks on prestressed concrete.

D. Miscellaneous

This group includes general references on prestressed concrete and all references which do not fall into any other group.

E. Circular Structures

References concerned with circular structures, such as tanks,

pipes, pressure vessels and tunnels, are included in this group.

F. Unclassified

This group includes references which were not available to the authors of this bibliography and therefore could not be classified.

A. Research.

1896-1935

A1. Mandl, J., "Zur Theorie det Cementeisen-Constructionen", Zeitschrift des Oesterreichischen Ingenieur- und Architekten- Vereines, (Vienna), 1896, Vol. 48, Nos. 45-46, pp. 593-596, 605-609.

Section III of this paper (pp. 605-606) deals with prestressing of reinforcement for the purpose of counteracting the deficiency of concrete in tensile strength. It is suggested that prestressing may be done by stretching the wires mechanically or by heat. Historically interesting.

A2. Bach, C.; Graf, O., "Versuche mit Balken, deren Eiseneinlagen Vorspannung Besitzen, und mit Balken derselben Bauart ohne Vorspannung," Mitteilungen über Forschungsarbeiten (Berlin), 1910, No. 90-91, pp. 61-86.

Tests of 12 rectangular beams, 6 prestressed, 6 without prestressing, 3 of each with end anchorages. Steel of structural grade pre-tensioned to 600 kg/cm², the prestress transferred to concrete 6 hours before the test. Results: prestressing raised the cracking load by about 50 percent, but the ultimate was the same for both prestressed and ordinary reinforced beams. End anchored beams failed by crushing of concrete, others by bond. Measured: Deflections, some strains, loads at first cracking, ultimate loads. Data on materials given, tests description good.

A3. Moersch, E., "Der Eisenbetonbau," Vol. 1, Fifth Edition, Stuttgart 1920, pp. 371-377, (K. Wittwer).

A short summary of the Bach-Graf tests.

A4. Freyssinet, E., "Idees et Voies Nouvelles", Science et Industrie (Paris), 1933, Vol. 17, No. 1, pp. 1-17.

Freyssinet presents his theory of hardening of concrete. Description of curing concrete under pressure and steam. Discussion of the use of high strength steel in prestressed concrete and why it cannot be used in ordinary reinforced concrete. Examples of structures of prestressed concrete. Emphasis on the economy of prestressed concrete and of its applicability in the industry.

A5. Hatt, W. K., "Concrete Beam with Prestressed Bars Tested", Engineering News Records, September 13, 1934, Vol. 113, No. 11, p. 345.

Comparative test of a reinforced concrete beam and a prestressed unbonded beam. The initial prestress of the mild steel did not exceed 15,372 psi. Scant information given in form of moment-strain and moment-deflection curves.

A6. Anderegg, F. O.; Dalzell, C. L., "Prestressed Ceramic Members", Proceedings Amer. Soc. Test. Materials, 1935, Vol. 35, pp. 447-456.

Ceramic tile grouted together and prestressed with solid rods by tightening the end nuts. Beams were short and failed by diagonal tension. Test results for 8 beams. Properties of materials uncertain.

1936

A7. Freyssinet, E., "Aspects nouveaux des problemes du ciment armé", International Association Bridge and Structural Engineering, Publications, Vol. 4, pp. 265-304, 1936.

Explanation of Freyssinet's theory of hardening and deformation of concrete.

A8. Freyssinet, E., "Developments in Concrete Making," Concrete and Construction Engineering, (London), 1936, Vol. 31, No. 4, pp. 209-220.

Essentially the same as "A Revolution in the Technique of the Utilization of Concrete".

A9. Gueritte, T. J., "A New Technique of Concrete Construction", Transactions, Liverpool Engineering Society, 1936, Vol. 58, pp. 125-160.

From Freyssinet's paper "A Revolution in Technique of Concrete".

A10. Lossier, H., "Les ciments sans retrait et a expansion", Genie Civil (Paris), 1936, Vol. 109, No. 14, pp. 285-87.

This article is an extract of the paper "Les ciments sans retrait et a expansion" published by the same author in Revue Universelle des Mines, 1937.

A11. Thomas, F. G., "Cracking in Reinforced Concrete", International Association of Bridge and Structural Engineering, Second Congress, Preliminary Publications, Berlin, 1936, (W. Ernst).

Tests of cracking of the reinforced concrete - some of them conducted on prestressed members. Studies concerned with shrinkage. It was found in these tests that an original prestress of 40,000 psi is reduced by one third in 28 days.

1938

A12 Senn, A., "Die Wirksamkeit der Vorspannung im einfach und im symmetrisch bewehrten Eisenbeton-Rechteckquerschnitt", Schweizerische Bauzeitung (Zurich), 1938, Vol. 111, No. 6, pp. 61-62.

Theoretical study of the loss of prestressing due to creep of concrete.

1939

A13. Anderegg, F. L.; Weller, R.; Fried, B., "Photoelastic Analysis of Prestressed Beam", Proceedings of American Society of Testing Materials, 1939, Vol. 39, pp. 979-986.

Photoelastic analysis of the stress distribution in nonprestressed beams and prestressed beams at zero stress in top fibres, zero stress in bottom fibres and with tension in bottom fibres.

A14. Emperger, F. von, "Stahlbeton mit vorgespannten Zulagen aus Höherwertigem Stahl", Forscherarbeiten auf dem Gebiete des Eisenbetons, Heft 47, Berlin 1939, (W. Ernst).

Report of tests of reinforced concrete rectangular and T-beams with varying amounts of reinforcement added. Magnitude of prestress varied from 0 up. Principal findings: the ultimate load may be calculated by adding the yield strength of the ordinary steel and the ultimate strength of the high strength steel; the ultimate is independent of the amount of prestress; prestress is very effective in delaying and reducing cracking.

A15. Emperger, F. von, "Vorgespannte Armierungs-Zulagen in den Tragwerken aus Eisenbeton", Schweizerische Bauzeitung (Zurich), 1939, Vol. 114, No. 13, pp. 151-153.

Short summary of the material published in die Forscherarbeiten by Emperger: "Stahlbeton mit vorgespannten Zulagen aus höherwertigen Stahl".

A16. Hoyer, E.; Friedrich, E., "Beitrag zur Frage der Haftspannung in Eisenbetonbauteilen", Beton und Eisen (Berlin), 1939, Vol. 38, No. 6, pp. 107-110.

Theory of bond in wires of pretensioned beams and wires without prestress. Bond strength of a pretensioned wire on the free end is supposedly increased due to the lateral expansion of the wire. Equation is given for computing the necessary length for anchoring the wire.

A17. Mills, R. E.; Miller, W. B., "Prestressed Reinforced Joists under Loading Tests", Proceedings, American Concrete Institute, 1939, Vol. 36, No. 11, pp. 205-212.

Tests of three joist, two prestressed one of ordinary reinforced concrete. All of haydite concrete. All beams tested to failure. Comparisons between the theoretical and measured values as well as between the values measured on prestressed beam and beam without prestressing are given.

1940

A18. Abeles, P. W., "Saving Reinforcement by Prestressing", Concrete and Construction Engineering, (London), 1940, Vol. 35, No. 7, pp. 328-333.

Theory for beams at low loads. Short description of prestressing methods. Discussion by Mautner, *ibid*, 1941, Vol. 36, pp. 73-95.

A19. Opperman, R., "Grundlagen für die Ausführung von Spannbetonträgern", Beton und Eisen (Berlin), 1940, Vol. 39, No. 11, pp. 141-150.

Tests of two pre-tensioned unanchored beams with the steel on the tension side only. Both beams tested to failure; one failed by crushing, the other by breaking of wires. Measured: deflections, loads at cracking and the maximum loads. Data on materials and on dimensions of the specimen given.

1941

A20. Gueritte, T. J., "Further Data Concerning Prestressed Concrete", Journal, Institute of Civil Engineers, (London), 1941, Vol. 16, Nos. 6-8, pp. 91-136, 517-549.

Report of the tests of three prestressed concrete beams. Testing techniques, data on materials, and the test results are given. One beam is the same as reported by Opperman in 1940, the two others were built and tested in Southhall, England. The last two beams were identical, one was tested shortly after casting, the other one year later. Most of the test data and comparisons with theory made for stresses before first cracking. Ultimate loads are given. Interesting discussions by a large number of discussors.

A21. Roll, F., "Beitrag zur Wirkung einer Vorspannung auf die Korrosion von Eisen", Metallwirtschaft (Berlin), 1941, Vol. 20, No. 46, pp. 1115-1119.

Investigation of the effect of prestressing on rusting of various steels. Prestressing music wire; rusting increases somewhat with prestressing force, tensile strength is unaffected by rusting, ultimate elongation affected very considerably.

1942

A22. Bolomey, J., "Deformations elastiques, plastiques et de retrait de quelques betons", Bulletin Technique de la Suisse Romande (Lausanne), 1942, Vol. 68, No. 15, pp. 169-173.

A report of an experimental investigation conducted for the purpose of determining the effect of

1. prestress
2. length of hardening time at application of prestress
3. properties of concrete

on the magnitude of elastic and plastic deformations and on shrinkage of concrete. The results are presented in form of tables and graphs.

A23. Evans, R. H., "Relative Merits of Wire and Bar Reinforcement in Prestressed Concrete Beams", Journal, Institute of Civil Engineers, (London), 1942, Vol. 17, No. 4, pp. 315-329.

Tests were made to compare relative merits of wire and bar reinforcement. Tests were carried out on beams of 10-ft. span and various

magnitudes of initial prestressing. Central deflection and compressive and tensile strains were recorded. Because of larger losses of prestress, the cracking load of the beams with bars was much lower than that of beams prestressed with wires. It is also shown stresses in the steel and concrete as well as deflections are considerably higher for unbonded than for bonded beams.

A24. Evans, R. H.; Wilson, G., "Influence of Prestressing Reinforced Concrete Beams in Their Resistance to Shear", *The Structural Engineer* (London), 1942, Vol. 20, No. 8, pp. 109-122.

Tests were made on beams of varying length to determine (1) the effect of horizontal prestress on the diagonal tension cracking loads, (2) the effect of prestressing vertical stirrups on diagonal tension cracking loads for beams without horizontal prestress, (3) the loss of initial prestress in horizontal and stirrup reinforcement. Information on the test beams and procedures incomplete. Test results given in form of graphs and tables. Mautner's discussion in No. 12, pp. 297-299 is concerned with the very small amount of prestress used in these tests (22000 to 54000 psi.).

1943

A25. Bolomey, J., "Contribution a l'étude du béton précontraint", *Bulletin Technique de la Suisse Romande* (Lausanne), 1943, Vol. 69, Nos. 8, 9, 12, pp. 89-95, 101-109, 137-146.

A series of tests of pull-out specimens and prestressed beams. All beams pre-tensioned, of rectangular cross-section, prestressed with high-strength steel of diameter varying from 1 to 3 mm. First part devoted to studies of bond, second to flexural tests. The following test data are given: measured steel and concrete stresses, deflections at various loads, cracking loads and ultimate loads.

A26. Freyssinet, E., "L'évolution future des propriétés des matériaux", *Travaux* (Paris), 1943, Vol. 27, No. 119, pp. 179-183.

Freyssinet reviews briefly his work in prestressed concrete explaining what prestress concrete is and why high strength materials are desirable. He explains his theory of concrete hardening and how to attain high strength concretes.

A27. Panchaud, F., "Quelques aspects du calcul des ouvrages en béton précontraint", *Bulletin Technique de la Suisse Romande* (Lausanne), 1943, Vol. 69, Nos. 22-23, pp. 285-293, 302-304.

The paper starts with general discussion of prestressed concrete. The following topics are then discussed in detail: amount and position of prestressing force, shrinkage and creep, variation of the steel stress under the load, allowable stresses, factor of safety against cracking and effect of shearing stresses. Second part of this paper deals with tests and descriptions of existing structures. Tests of 4 beams are described (with and without special anchorage). Given: dimensions, amount of prestress, and cracking and ultimate loads.

A28. Ross, A. D., "Creep and Shrinkage in Plain, Reinforced and Prestressed Concrete". "A General Method of Calculation", Journal, Institute of Civil Engineers, (London), 1943, Vol. 21, No. 1, pp. 38-57.

The author presents a method for calculating creep and shrinkage most of which have not been verified by tests. The formulas are somewhat cumbersome; some cases the author presents tabulated solutions.

A29. Volterra, E., "On the Deformation of Reinforced Concrete Structures and on the Calculation of Prestressed Reinforced Beams", Structural Engineer (London), 1943, Vol. 21, No. 4, pp. 123-138.

Derivation of equations for calculation of deformation of prestressed concrete beams both before and after cracking. Formulas substantiated with test results obtained some years earlier in Zurich.

1944

A30. Lossier, H., "Les ciments expansif et leurs applications autocontrainte du béton", Génie Civil, 1944, Vol. 121, Nos. 8-9, pp. 61-65, 69-71.

In this paper the author explains the principles of prestressed concrete and presents his own method of prestressing by use of expanding cements. Description of the tests conducted on expanding cements. Properties of expanding cements given in form of graphs. This article is similar to Lossier's paper "Cements with Controlled Expansion . . ." in Structural Engineering, 1946-47.

A31. Rao, K. L., "Prestressed beams under Direct Bending and Sustained Loading", Structural Engineer (London), 1944, Vol. 22, No. 10, pp 425-454.

Tests were conducted on several small-size beams to determine the effects of prestressing. Load-deflection curves and loss of prestress with time are given. Concrete and steel strain are plotted vs. time. Both beam with and without bond were investigated. Ultimate loads and modes of failure are not given.

A32. - - - , "Compacted Reinforced Column Has Great Strength", Concrete, (Chicago), 1944, Vol. 52, No. 10, p. 40.

This test was conducted by Professor Maney. Column is constructed by placing a thin metal lining inside a spiral of steel wire and filling this with a specially compacted concrete. Water cement ratio was 1 gal. per sack of cement. One test unit withstood 83,000 psi. The purpose of the tests was to find materials to substitute for steel.

1945

A33. Lebelle, P., "Coefficients de sécurité des pièces fléchies en béton précontraint. Cas particulier des poutres à fils adhérents tendus avant bétonnage," Institut Technique du Bâtiment et des Travaux Publics, Circulaire Serie J, No. 5, 1945 (Paris).

The results of the tests are preceded by a discussion of factor of safety. The tests were conducted on an isolated I-beam, on 5 similar beams with tile fillers between the beams and one other isolated beam with 10 percent lower prestress, tests in shear on beam as above, static and dynamic tests of bond.

1946

A34. Bjuggren, U., "Den armerade betongens verkningssätt i sprickstadiet vid böjning," (The behavior of reinforced concrete during cracking in bending), Betong (Stockholm), 1946, Vol. 31, No. 3, pp 182-211.

This paper contains some results of tests of rectangular and I-section prestressed concrete beams. Very few data given.

A35. Hahn, L., "Application du cercle de Mohr calculs des contraintes et armatures des parois en béton et béton précontraint", Travaux (Paris), 1946, Vol. 30, No. 135, pp. 27-34 and No. 136, pp. 70-78.

Solution of state of stress at a point by use of Mohr's circle
Use of Mohr's circle for determining the necessary amount of prestress.

A36. Lossier, H., "Cements with Controlled Expansions and Their Application to Prestressed Concrete", Structural Engineer (London), 1946, Vol. 24, No. 24, pp. 505-534.

Description of the composition, behavior and use of the expansive cements for prestressing of concrete beams. The author admits that for prestressing of beams the expansive cement is not yet as effective as various mechanical ways of prestressing. Paper is discussed in ditto 1947, Vol. 25, p. 142.

A37. Bos, M. R., "Vorgespannter Beton", Swiss Federal Material Testing Laboratory, (EMPA), Report No. 156, Zurich 1946.

This report consists of three parts: investigation of materials for prestressed concrete beams, investigation of bond between the prestressing wire and the concrete, and investigation of prestressed concrete beams in flexure.

Materials: effect of steam curing and vibration on the compressive strength of concrete, tensile vs compressive strength, effect of prestressing of tensile compressive strength and endurance limit of concrete, creep of concrete also plastic recovery - all for high strength

concrete; tests of various types of wires, measured: tensile strength, elastic limit, limit of proportionality, contraction in area at the ultimate, ultimate elongation, endurance limit and fatigue strength. Bond: tests of both pull-out and beam specimens with various types of wire, both prestressed and unstressed. Both static and dynamic tests.

Beams: static and dynamic tests of both I- and rectangular beams, all wires pretensioned, no end anchorages used. Cracking loads, ultimate loads and deflections given for 7 I-beams together with modes of failure. The report includes large number of load-strain and load-deflection curves and pictures of several beams after failure.

A38. Staley, H. R.; Peabody, D., "Shrinkage and Plastic Flow of Prestressed Concrete", Proceedings, American Concrete Institute, 1946, Vol. 43, No. 3, pp. 229-243.

Tests of bars 4 x 4 x 24 in. made of either concrete or gunite conducted at MIT. Prestress load sustained for 400 days. Results reported in forms of figures and tables.

1947

A39. Baker, A. L. L., "Shear and Deflection in Prestressed Reinforced Concrete Beams", Concrete and Constructional Engineering (London), 1947, Vol. 42, No. 9, pp. 267-269.

Discussion of shears and deflections of prestressed concrete beams limited to the range of applicability of elastic formulas. The author suggests, that diagonal tension cracks should not take place in a prestressed concrete beams, but the formation cannot be prevented by conventional shear reinforcement.

A40. Campus, F., "La limite de fluage des aciers á la température ordinaire", Revue Universelle des Mines de la Metallurgie des Travaux Publics (Paris), 1947, 9th Series, Vol. 3, No. 12, pp. 595-605.

Report of tests of creep of steel at constant normal temperature under constant load and under constant deformation. Experimental techniques explained and the results of the tests discussed.

A41. Guyon, Y., "Poutres en béton précontraint de section uniforme a cables relevés", Institut Technique du Bâtiment et de Travaux Publics, Circulaire Serie J, No. 9, Paris, 1947.

This paper deals with beams prestressed by several cables, some of which may be curved up to resist diagonal tension. The state of stress in the beam with curved-up cables is explained.

A42. Lossier, H., "Les ciments sans retrait et a expansion", Revue Universelle des Mines (Paris), 1947, Vol. 13, No. 4, pp. 166-169.

This one of the first Lossier's articles on expanding cements. The author points out that expanding cement would tend to reduce shrinkage cracking and with large enough expansion might be used for prestressing.

A43. Magnel, G., "Essais de quelques poutres en beton pre-contraint", La Technique de Travaux (Paris), 1947, Vol. 23, Nos. 3-4, pp. 87-100.

Tests of 11 beam of I and T sections. All flexural tests with good description of materials and their properties. Deflections, cracking loads and ultimate loads calculated and compared with measured values. Both post-tensioned and pre-tensioned beams. Most of the beams failed by breaking of steel. These tests are reported also in Magnel's book.

A44. Wets, G.; Paduart, A., "Recherches experimentales sur certaines proprietes mecaniques des aciers speciaux utilises en beton precontraint", La Technique des Travaux (Paris), 1947, Vol. 123, Nos. 7-8, pp. 213-219.

Report of the tests of creep at ordinary temperatures and endurance tests under high tensions. The discussions of the test procedure and test results are good.

A45. - - -, "Comparison of Partially and Fully Prestressed Concrete Beams", Concrete and Constructional Engineers, (London), 1947, Vol. 42, No. 1, pp. 11-15.

Short report of tests of 8 T-beams made by Magnel. All beams had 24 wires of .197 in. diameter, all but one grouted. In one of the beams only half of the wires were prestressed. Total reinforcement was about 0.2 percent $f' = 6000$ psi. All failures by breaking of the wires. (See also C. Magnel text book, "Prestressed Concrete" published by Concrete Publications Limited, London, pp. 115-124.

A46. - - -, "Prestressed Reinforced Concrete Sleepers Tested as Simply Supported Beams," Concrete and Constructional Engineers, (London) 1947, Vol. 42, No.s 4-5, pp. 123-132, 155-161.

This report prepared by P. W. Abeles describes static tests of 13 prestressed concrete sleepers made by L. N. E. R. Five of the beams were in service for 2 1/2 years prior to testing (subjected to about 4×10^6 repetitions of load). The test data are reported in the form of load-deflection and load-width of crack curves for few specimens. Cracking and ultimate loads are tabulated for all specimens. The cracking load is compared with corresponding computed tensile stresses - which are rather high. The ultimate loads are discussed. Data on materials incomplete.

A47. - - -, "The Yield Stress and Creep of Steel", Concrete and Constructional Engineers, (London), 1947, Vol. 42, No. 4, pp. 105-106.

Creep of commercially obtainable wire (in Belgium) when under a constant stress of 75 percent of the yield stress was found to be very great during the first hour and was still substantial during the first 20 hours, but subsequently slackened and attained 90 percent or so of the final value in about 2 months. The final value appears to be about 16 percent of the original deformation. If an initial stress of 60 percent of ultimate stress is maintained for 2 min. and then reduced

to about 80 percent of the yield, the final apparent creep is much reduced due to the over fact that in the initial 2 min. under the higher stress the same amount of creep occurs as during first 4 or 5 hours under a constant but lower stress. These results are from tests by Magnel.

1948

A48. Anderegg, F. O., "What Will Be Prestress Loss Due to Creep?" Proceedings American Concrete Institute, 1948, Vol. 45, No. 1, p. 86. Letters from Readers Sections.

Author points out that various statements regarding creep in concrete and prestressing wire are conflicting.

A49. Fillig, K., "Research Work and Test Production of Prestressed Concrete Units at the Field Test Unit, Ministry of Works," London, Int. Assoc. Bridge and Struc. Eng., Third Congress, Final Report, Liège, 1948, pp. 367-372.

Short list of development work done by the Field Test Unit in 1947-48. This work was essentially in two groups: anchorages and bond, experimental manufacture of various structural units. Few conclusions given.

A50. Bjuggren, U., "What Will Be Prestress Loss Due to Creep?" Proceedings, American Concrete Institute, 1948, Vol. 45, No. 4, p. 343. Letters from Readers Section.

Answer to Anderegg's question in ACI Proceedings, 1948, No. 1. According to Swedish experiences the bond depends on:

1. Quality of concrete
2. Compaction of concrete
3. Strength at release
4. Type of curing before and after release
5. Amount of prestress
6. Diameter of wire
7. Surface properties of wires

A51. Dawance, M. G., "Une nouvelle méthode pour l'étude de la relaxation des fils d'acier" Annales de L'Institut Technique du Batiment et des Travaux Publics (Paris), New Series No 9 1948.

Report of tests of creep of 5mm prestressing wire. Stress-time curves are given for various amounts of prestress and for wires of various lengths. Strain in the wire was measured by frequency of vibration method.

A52. Friedrich, E., "Neuere Erkenntnisse über vorgespannter Beton" Int. Assoc. Bridge and Struc. Eng., Third Congress, Final Report, Liège, 1948, pp. 359-366.

Short report of tests of 14 types of prestressed concrete - beams, 3 beams of each type. Percentage of reinforcement, the only variable, varied from 0.128 to 0.814 percent total, where 0.086 to 0.643 percent was tensile reinforcement. Average loads for each type at first cracking and ultimate reported and compared with theoretical values. Theoretical values computed as for beams subject to combined flexure and direct compression. Good agreement at failure, computed values too low at cracking. Question of losses in prestress discussed at some length.

A53. Lossier, H., "Les ciments expansifs et l'autocontrainte du beton", Int. Assoc. Bridge and Struct. Eng., Third Congress, Final Report, Liege, 1948, pp. 335-344.

The author explains the behavior of expanding cements their composition and properties. Gives many examples of use in structures, emphasizing the ability of expanding cement to act as a prestressing agent.

A54. Magnel, G., "Creep of Steel and Concrete in Relation to Prestressed Concrete", Proceedings, American Concrete Institute, 1948, Vol. 44, No. 6, pp. 485-500.

Tests on creep of steel and on shrinkage and creep of concrete. Tests on steel were carried out with Belgian wire. Complete information and interpretation of results are given.

A55. Mautner, K. W., "Tests on Precast Prestressed Concrete Frams in Multistory Buildings", Int. Assoc. Bridge and Struct. Eng., Third Congress, Final Report, Liege, 1948, pp. 388-392.

Description of tests of frames composed of prismatic beams and columns assembled and prestressed at the site. Tests made by the Building Research Station. Freyssinet system of prestressing used.

A56. Paduart, A., "Ponts de grande portee en béton précontraint realises en belgique", Int. Assoc. Bridge and Struct. Eng., Third Congress, Preliminary Publication, Liège, 1948, pp. 325-332.

Description of two girders, one for a footbridge the other built for testing purposes. Tested first slightly above the cracking load (which was more than twice the design load) with a static load; a dynamic test followed.

1949

A57. Armstrong, W. E. I., "Bond in Prestressed Concrete", Journal, Institute of Civil Engineers, (London), 1949, Vol. 33, No. 1, pp. 19-40.

Pull-out and beam tests of prestressing wire. Both pre-tensioned and unstressed wire investigated. Wires with ripples employed, some with cleaned, some with rusted finish. Testing procedure, test specimens and test results are given.

A58. Bowman, W., "Full-Size Prestressed Girder Tested", Engineering News Record, November 3, 1949, Vol. 143, No. 18, pp 18-19.

Description of Walnut Lane Bridge girder test. Design load, ultimate load and deflections given. Describes appearance of cracks.

A59. Magnel, G., "Prototype Prestressed Beam Justifies Walnut Lane Bridge Design", Journal, American Concrete Institute, 1949, Vol. 47, No. 4, pp. 301-316.

Description of the test of Walnut Lane Bridge girder.

A60. Marshall, G., "End Anchorage and Bond Stresses in Prestressed Concrete", Magazine of Concrete Research, 1949, Vol. 1, No. 3, pp. 123-127.

Tests of bond for 0.08 and 0.2" diameter wire. All tests were made with columns made of concrete with $f_{cu} = 11,500$ psi. All specimens were pre-tensioned. The test results are given in several graphs and compared with theoretical values. The work was carried out at Leed's University.

A61. Soete, W.; Vancrombrugge, R., "La résistance à la fatigue ondulée des fils utilisés en béton précontraint", Annales des Travaux Publics de Belgique (Bruxelles), 1949, Vol. 102, No. 5, pp 513-534.

Fatigue tests of cold drawn prestressing wire are described and supplemented by the results of fatigue tests of cold drawn wire made by others. The authors state that galvanizing and decarburization seem to reduce the fatigue strength and the thermal treatment seems to improve this resistance.

Tests were made on 5 and 7 mm. wires anchored by 5 different anchorages, all of them of the frictional wedge types. All tests were made in repeated tension with min load 75 kg/mm^2 and maximum varying from 85 to 105 kg/mm^2 , while the static ultimate was about 150 kg/mm^2 . Fluctuation of load from 75 to 85 did not cause failure even at 2000000 repetitions, from 75 to 105 caused failure in nearly all specimens below 1000000 repetitions. Some of the failures occurred in grips, others outside the anchorage. The testing set up is described in detail. Bibliography of previous work on the subject is attached.

See also CACA Library Translation Cj. 25, 1951.

A62. - - -, "Philadelphia Tests First Prestressed Girder", The American City, (New York), 1949, Vol. 64, No. 12, pp. 123-125.

This article merely describes the girder being tested for Walnut Lane Bridge and shows pictures of it during the test. No test date is given.

A63. - - -, "Testing Long Prestressed Concrete Girder", Concrete, (Chicago), 1949, Vol. 57, No. 12, pp. 3-6.

Description and results of test at Walnut Lane Girder.

A64. - - -, "Tests of Prestressed Concrete Beams", Concrete and Constructional Engineering (London), 1949, Vol. 44, No. 2, pp. 52-53.

Test of two beams. Calculated load to cause comp. failure was 8.3 tons; for tension failure 9.4 tons. Cracks occurred after beam was loaded and unloaded 3 times to value of 6 tons. At 7 1/2 tons, defl. was 2"; deflection returned to 0.08 in. with no load. Beam failed by compression and shear at 8 1/4 tons. The second beam had additional unstressed wires; cracks occurred at 7 tons; at 9 tons, the deflection was 1 1/2"; the load of 9 tons was reapplied 3 times, cracks becoming visible at 4 tons. Bonded prest. both beams.

1950

A65. Abeles, P. W., "Balkenversuche mit britischen vorge-spannten Betonschwellen und eine neue Art von Strassenbrücken über Bahnen in England", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 2, pp. 36-39.

The author reports tests of railroad ties made in England. Deflection diagrams are given. I-beam bridge composed of prestressed concrete I-beams laid adjacent to each other are also discussed. This material is similar to that in Abeles' book.

A66. Abeles, P. W.; Hockley, C. H., "Small Scale Demonstration Tests in Prestressed Concrete Beams", Structural Engineer, (London), 1950, Vol. 28, No. 6, pp. 146-153.

Fourteen prestressed beams of various cross sections were tested for demonstration purposes. Part of the beams was pre-tensioned, part post-tensioned. Load-deflection curves, cracking loads and modes of failure are given, but the properties of materials are not reported.

A67. Baar, G., "Tests on Prestressed Concrete Beams in Holland", Cement (Amsterdam), 1950, Nos. 13-14. English Translation by Cement and Concrete Association (London), Translation cj. 21, 1950.

Performance tests made on one T-beam picked at random from a pile of 150 beams made for construction of office buildings at Heerlen. Post-tensioned beam, Magnel system. Static loading over the cracking load, impact test, heating test (865°C) loading to rupture. Only deflections measured. Cracking at 2 1/2 L.L. Final Failure by crushing of the compression zone at 3 (D.L.+L.L.)

A68. Campus, F., "Le béton précontraint", Annales des Travaux Publics de Belgique (Bruxelles), 1950, Vol. 103, Nos. 1-2, pp. 19-49, 295-332.

This paper is a report of static tests of four beams (one pretensioned- left-over from German fortifications, three post-tensioned) of T, rectangular and U sections, static tests of tubes, dynamic tests of railroad ties and pressure tests of pipes. Three of

the beams with static loading failed by crushing of concrete, one by rupture of steel. Ties tested with repeated loading failed in bond when pretensioned and by rupture of wires when with end anchorages.

A69 Dehan, E.; Louis, H., "Mesure des efforts et de leur variation dans les fils accessibles des ouvrages en béton précontraint", Annales des Travaux Publics de Belgique (Bruxelles), 1950, Vol. 103, No. 2, pp. 202-260.

Detail description of instruments used to measure strains in prestressing steel of the Sclayn Bridge in Belgium. Strain in "cables" were measured with the aid of tube dynamometers and strains in individual wires by vibration method.

A70. Fornerod, M., "Load and Destruction Test of 160 ft. Girder Designed for First Prestressed Concrete Bridge in U.S.A.", Int. Assoc. Bridge and Struct. Eng., Publications, Vol. 10, Zurich, 1950, pp. 11-35.

Best paper on the test of the Walnut Lane Bridge girder.

A71. Fuchs, D., "Versuche mit Spannbeton-Verbundtragern", Der Bauingenieur (Berlin), 1950, Vol. 25, No. 8, pp. 289-294.

Tests conducted on a composite steel I-beam, prestressed concrete slab floor systems are described. Test procedures and results are given. Properties of materials are given.

A72. Lazard, A., "Nouveau phénomènes de plastification concernant les I en acier doux et le béton précontraint découverts grâce aux extensomètres à résistance électrique", Travaux (Paris), 1950, Vol. 34, pp. 301-314, No. 187.

A part of this paper is concerned with prestressed concrete; it gives measurements of strain made on beams with the aid of electric strain gages.

A73. Masterman, O. J., "Prestressed Concrete Developments at the Field Test Unit. Thatched Barn", Struct. Engineer (London), 1950, Vol. 28, No. 10, pp. 246-264.

Several hundred small joists and few large members have been tested at the Field Test Unit and the results of these tests are given. The results are given for groups of specimens, not for individual specimens. Special attention was paid to anchorages and to attaining equal stress in the wires. Both bonded and unbonded types of beams were tested. Joists were tested individually and in groups supporting one slab.

A74. Mörsch, E., "Die Ermittlung des Bruchmoments von Spannbetonbalken", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 7, pp. 149-157.

A graphical method for finding the neutral axis at the ultimate load for the purpose of computing the ultimate load. The method is based on statics, Bernoulli's hypothesis and stress-strain diagrams.

for steel and concrete. In the second part of the article Mörsch reports the results of tests of 9 concentrically and two excentrically loaded plain concrete prisms. These tests were designed by Mörsch in order to investigate whether there is any "plastic flow of concrete at loads approaching ultimate. Mörsch concludes that there is no such thing; that the stress-strain diagram for concrete in concentric and excentric loading is about the same, approximately parabolic in shape. Max measured strain about 0.3 percent in 50 cm.

A75. Ritter, M.; Lardy, P., "Vorgespannter Beton," Mitteilungen aus dem Institute für Baustatik an der ETH, First Edition, Zurich, 1946, Second Edition, Zurich 1950 (Verlag Leemann).

Short historical summary and summary of present knowledge. Theory for computing stresses, cracking load and the ultimate capacity. Investigations at Lausanne, Schinznach, Zurich (EMPA). Recommendations for design. Swiss construction examples

The theory and investigations limited to pre-tensioned unanchored beams.

Investigations at Lausanne (Bolomey 1942, 1943) and at Zurich (Ros, 1946) only summarized. Investigation at Schinznach reported in more detail - tests of rectangular beams with varying amounts of prestress and of reinforcement. Both long and short time tests. Principal test results: ultimate capacity independent of prestress, behavior to first cracking practically elastic, creep depends on the age at time of application of prestress, creep practically completed after two years. The description of Swiss construction includes some tests of individual beams and study of creep of both steel and concrete.

The second edition includes all material from the first one; the chapter on construction examples somewhat enlarged in the second edition.

A76 Ros, M., "Die material technischen Grundlagen und Probleme des Eisenbetons im Hinblick auf die Zukünftige Gestaltung der Stahlbeton-Bauweise", Swiss Federal Materials Testing Laboratory (EMPA), Report No. 162. Zurich 1950, pp. 231-245.

Short summary of the results of the Swiss test reported in the EMPA Report No. 155 by Ros in 1946. Recommendations for design included same as in Report No. 155

A77. Ross, A. D., "The Loss of Prestress in Concrete", Civil Engineering and Public Works Review (London), 1950, Vol. 45, No. 527, pp. 307-309

The author discusses the need for information regarding the creep. Then he gives charts relating creep, w/c ratio and the age of concrete. Gives some equations for prediction of creep.

A78. Rüsç, H., "Bruchlast und Bruchsicherheitsnachweis bei Biegungsbeanspruchung von Stahlbeton unter besonderer Berücksichtigung der Vorspannung", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 9, pp. 215-220.

Discussion and development of formulas for ultimate load and so called critical load (max. useful load) for flexural reinforced and prestressed concrete members. The formulas are the same for both materials. They are based on Bernoulli's hypothesis, limiting ultimate concrete strain and concrete stress block characterized by two coefficients. Critical load is further limited by limiting steel strains; lower limit requires that the crack at failure be visible (warning), upper limit requires that the width of crack does not make the structure unusable.

A79. Schwarz, R., "Vorspannungsverluste und Durchbiegungen an einer vorgespannten Stahlbeton Brücke infolge Kriechen und Schwinden", Der Bauingenieur (Berlin), 1950, Vol. 25, No. 1, pp. 1-8.

Detail report of the results of field measurements made on a prestressed concrete bridge in Germany (Dischinger method of prestressing) for the purpose of determining the losses in prestressing. Total losses were rather high - about 25 percent.

A80. - - -, "A Test of Prestressed Concrete Railway Bridge" Concrete and Constructional Engineers, (London), 1950, Vol. 45, No. 8, pp. 296-299.

A girder 13 by 27 in. by 43'-6" long was tested to destruction. Properties of materials are given. Measured deflection and calculated stresses are given. The occurrence and size of cracks is given. A discussion of estimated losses of prestress is given. Test results substantiated design procedure.

A81. - - -, "Concrete Prestressed by Alloy Bars", Engineering News Record, June 22, 1950, Vol. 144, No. 22, p. 41.

Description of the properties of a newly developed alloy steel bar. Bar developed in England.

A82. - - -, "Steel-alloy Bars used in Prestressed Concrete", Concrete and Constructional Engineers, (London), 1950, Vol. 45, No. 4, pp. 127-128.

This article is a description of a high-strength steel bar available in diameters up to 1 1/8 in. Bar has threaded ends, strength of 70 t/in², no marked yield point.

A83. - - -, "20 Ton Prestressed Trestle Slab Tested To Failure", Concrete, (Chicago), 1950, Vol. 58, No. 11, pp. 3-4.

A brief explanation of the test on trestle slab made by PCA. A description of the slab and the prestressing cables is given but no significant test results.

1951

A84. Abeles, P. W., "Breaking Tests on Three Full Size Prestressed Concrete Bridge Beams", *Structural Engineer (London)*, 1951, Vol. 29, No. 5, pp. 149-160.

Description of tests to destruction of three beams, two of which had only part of the wires prestressed. Load-deflection curves are given, and the behavior of beams during testing described. The information on properties of materials is incomplete.

A85. Abeles, P. W., "How Much Prestress?", *Engineering News Record*, July 5, 1951, Vol. 147, No. 1, pp. 32-33.

Discussion of the effect of the amount of prestress on the load-deflection characteristics of prestressed concrete beams, based on the assumption of flexural failure.

A86. Abeles, P. W., "Prestressed Beams with Bond", *Engineering News Record*, April 12, 1951, Vol. 146, No. 15, pp. 42-43.

Discussion of the advantages of the presence of bond between the wires and the concrete and of the behavior of under- and over-reinforced beams at cracking and at failure.

A87. Anderson, A. R., "Field Testing of Prestressed Concrete Structures", *Proceedings of the First United States Conference on Prestressed Concrete*, Massachusetts Institute of Technology, August, 1951, pp. 215-220.

Tests on large prestressed concrete beams such as the 160 ft. Walnut Lane Bridge Girder and the 30 ft. beam for small highway bridge for Concrete Products Corporation of America are discussed. Technique of testing more than results of tests is discussed.

A88. Ashton, L. A., "The Fire Resistance of Prestressed Concrete Floors", *Civil Engineering and Public Works Review (London)*, 1951, Vol. 46, No. 545, pp. 843-845; No. 546, pp. 940-943.

The existing British fire resistant specifications are discussed and suggestions are given which would improve the code. Tests were made on seven different types of floors with prestressed concrete beams and joints. Test results are given and discussed. Test program is sponsored by Joint Fire Research Organization of the Department of Scientific and Industrial Research and Fire Offices Committee.

A89. Baker, A. I. L., "Recent Research in Reinforced Concrete and Its Application to Design", *Journal, Institute of Civil Engineers, (London)*, 1951, Vol. 35, No. 4, pp. 262-329.

A theoretical treatment of various topics pertaining to the design of reinforced concrete structures both conventional and prestressed. The sections on the ultimate strength of rectangular

sections, both prestressed and ordinary, and on plastic deformations are of interest. Both bonded and unbonded types are treated. Some test data are cited, but the author states that final results will be given in an addendum to the paper.

A 90. Baker, A. L. L., "The Ultimate Strength in Bending of Prestressed Concrete Beams," *The Reinforced Concrete Review*, (London), 1951, Vol. 2, No. 6, pp. 343-373.

The same material as in Baker's paper published in the *Journal of Institute of Civil Engineers*, 1951, No. 4, under the title "Recent Research in Reinforced Concrete and its Application to Design".

A 91. Blanks, R. F., "Concrete for Prestressing", *Proceedings of the First United States Conference on Prestressed Concrete*, Massachusetts Institute of Technology, August, 1951, pp. 136-149

This paper discusses the properties of plain concrete and the materials used in concrete with respect to their relationship on strength.

A 92. Caquot, "Precontrainte et fluage", *Travaux* (Paris), 1951, Vol. 35, No. 196, pp. 235-237.

This article describes methods of calculating creep of steel and concrete in prestressed concrete beams. Methods for partial elimination of creep are discussed.

A 93. Collins, A. R., "Research and the Development of Prestressed Concrete," *Building Research Congress*, 1951, Division 1, pp. 68-73, (England).

This paper is primarily concerned with research in England. A list of investigations conducted at various institutions in England is included.

A 94. Cooley, E. H., "Progress in Prestressed Concrete Research", *Magazine of Concrete Research* (London), 1951, No. 7, pp. 31-36.

This is a good paper on progress of prestressed concrete research in England. It lists what work has been done, is being done or planned.

A 95. Crepps, R. B., "Glass Fibers as Tensioning Element in Prestressed Concrete", *Proceedings of the First United States Conference on Prestressed Concrete*, Massachusetts Institute of Technology, August, 1951, pp. 228-230.

This paper outlines the feasibility of using glass fibers as the prestressing element in prestressed concrete with consideration of the advantages and disadvantages.

A96. Dardanelli, G., "Activité du Centre d'Etude de Turin dans le domain expérimental", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 206-207

Outline of tests of prestressing wires and of prestressed beams conducted at Turin, Italy. Test results not given.

A97. Deutsch, E., "Probebelastung eines unterspannten Betonträgers", Beton-und Stahlbetonbau (Berlin), 1951, Vol. 46, No. 3, pp. 56-59.

Two beams prestressed with steel underslung (Dischinger method) were tested. Load vs. deflection curves are drawn. Tests are described and results discussed.

A98. Evans, R. H., "Research and Developments in Prestressing", Journal, Institute of Civil Engineers, (London), 1951, Vol. 35, No. 4, pp. 231-261.

Tests of bond on pretensioned beams, investigation of steam and pressure curing, load tests of pretensioned beams. A table is given which includes ultimate loads and cracking load for 19 beams. The relative merits of partial and complete prestressing are discussed and few historical notes given.

A99. Franco-Levi, "Nouvelles recherches sur les constructions précontraintes", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 238-239.

Discussion of the prestressed concrete research carried on in Italy (creep, shrinkage, etc.) and of the problems encountered.

A100. Godfrey, H. J., "Steel Wire for Prestressed Concrete", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 150-166.

Mr Godfrey discusses the properties of wire manufactured by John A. Roebling's Sons Company, for use in prestressed concrete. Mr. Eney, and Mr. Loewer, of Lehigh University contribute to the discussion by reporting briefly on tests conducted on the wire as it was used in beams. Mr. Everling, director of research of American Steel and Wire, contributes further to the discussion of the properties of wire.

A101. Haas, A., "Essais de charge sur poutres en béton précontraint", Travaux, (Paris), 1951, Vol. 35, No. 196, pp. 204-206.

This is a discussion of some tests of large prestressed concrete beams conducted in Holland. Beams of the same type were used in an actual structure. No specific numerical test data are given, but the behavior is discussed and the factor of safety is given. Attention is called to grouting, the failure of which might result in a lower factor of safety.

A102. Habel, A., "Traglastprobleme des Stahlbetonbaues", Beton-und Stahlbetonbau (Berlin), 1951, Vol. 46, No. 1, pp. 6-10.

This paper is concerned with the ultimate load on concrete columns axially and eccentrically loaded, prestressed and non-prestressed.

A103. Jäniche, W., "Neue Erkenntnisse über Festigkeitseigenschaften und Beanspruchbarkeiten von Spannbetonstählen", Beton-und Stahlbetonbau (Berlin), 1951, Vol. 46, No. 7, pp. 161-165; No. 8, pp. 184-187.

This paper deals with the properties of steel used for prestressing concrete in Germany.

A104. Janney, J. R., "Analysis of Test of Full Scale Prestressed Concrete Railroad Trestle Slab", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 241-243.

Future tests planned by the Portland Cement Association are briefly discussed. The test on a full-sized railroad trestle is discussed and explained. A few results of this test are shown.

A105. Kennedy, H. L., "High Strength Concrete", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 126-135.

This paper deals with factors which affect the concrete strength and explains conditions for attaining high strength concrete.

A106. Lee, D. H., "High Tensile Alloy Steel Bars for Prestressed Concrete", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 167-177.

The Lee-McCall steel rod for use in prestressed concrete work is described. The ultimate strength is 157,000 psi; the creep is negligible; the ends are threaded for coupling together and anchorage; full strength of rod can be developed. Author claims a savings can be realized in use of this bar in spite of its lower strength than wires.

A107. Lee, D. H., "High Tensile Alloy Steel Bars for Prestressed Concrete," Civil Engineering and Public Works Review, (London), 1951, Vol. 46, No. 543, pp. 668-671; No. 544, pp. 770-771.

This paper appeared originally at the First U. S. Conference on Prestressed Concrete at MIT, 1951. Lee's high-alloy steel bar with ultimate strength of 70 tons/sq. in and low creep characteristics is described. Method of prestressing by coupling the rods together and stretching with special jack is described.

A108. Magnel, G., "Concrete Good Enough?" Engineering News Record, May 17, 1951, Vol. 146, No. 20, p. 44., Reader Comment Section.

Advocacy of low slump concrete for prestressing work.

A109. Meissner, H. S., "Would Glass Fibres Stand Up?" Engineering News Record, June 28, 1951, Vol. 126, No. 26, p. 44., Reader Comment Section.

Discussion of Rubinski's suggestion of the use of glass fibres for prestressing. Meissner points out the danger of alkali reaction.

A110. Munger, H. H., "Glass and Concrete Reaction", Engineering News Record, June 21, 1951, Vol. 146, No. 25, p. 47., Reader Comment Section.

Discussion of Rubinski's suggestion of the use of glass fibres for prestressing. Munger warns of violent alkali reaction of glass when in contact with portland cement.

A111. Prentis, J. M., "The Distribution of Concrete Stress in Reinforced and Prestressed Concrete Beams when Tested to Destruction by Pure Bending Moment", Magazine of Concrete Research (London), 1951, Vol. 2, No. 5, pp. 73-77.

It is shown in this paper that the stress-strain curve for reinforced concrete subject to bending may be determined from tests solely on the basis of the conditions of statics and of the following assumptions:

- (1) Linear distribution of strain
- (2) Existence of definite stress-strain relationship $f = E(e)$ independent of both the time and location.

Equations for compressive and tensile stresses are derived in terms of external forces acting on the section considered, the strains on the top and bottom of the section and the section properties. A check on the solution is provided by f_t after first cracking.

The equations are applicable to ordinary reinforced concrete beams and to prestressed beam both with and without bond. Besides strains and the moment at the section considered also the force in the reinforcement must be known.

A112. Prot, "Le résistance du béton et la sécurité en béton précontraint", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 243-244.

Discussion of quality of materials and working stresses to be used for prestressed concrete.

All3. Ross, A. D., "Shrinkless and Creepless Concrete", Civil Engineering and Public Works Review (London), 1951, Vol. 46, No. 545, pp. 853-854.

The author gives a few test results which show that the shrinkage losses in post-tensioned prestressed concrete can be eliminated if before tensioning the concrete member is vacuum cured or cured to oven dryness. The member is prestressed upon cooling and instead of shrinking will actually expand due to atmospheric humidity. Only a few pilot tests were conducted--more are scheduled.

All4. Ross, A. D., "Tests of Prestressed Concrete Beams with Alloy Steel Bars", Magazine of Concrete Research (London), 1951, No. 7, pp. 9-18.

Five beams of various spans and cross section were prestressed with alloy steel bars (Lee's system). Beams were constructed and tested at the Field Test Unit. Properties of materials, method of measuring strains and test procedure are given. From test results ultimate loads, load-deflection and load-strain curves are given. All beams were post-tensioned and grouted, 2 of them assembled from smaller units, 3 cast monolithically.

All5. Rubinsky, I. A., "Glass Fiber being Studied", Engineering News Record, July 26, 1951, Vol. 247, No. 4, p. 47., Reader Comment Section.

Answer to Meissner's comments (ENR June 28, 1951) on possible reaction between glass and the concrete in a concrete beam prestressed with glass fibres. Rubinsky remarks that IAR is conducting research at Princeton on use of glass fibres for prestressing.

All6. Ruble, E. J., "Strain Measurements in a Prestressed Concrete Slab", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 244-246.

This paper augments J. R. Janneys paper (in the same publication), "Analysis of Test of Full Scale Prestressed Concrete Railroad Trestle Slab". It discusses in particular the strain measurements made on the full-size prestressed concrete trestle tested by Portland Cement Association with respect to how these strains were measured.

All7. Siess, C. P., "Research in Prestressed Concrete", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 207-214.

This paper acknowledges the lag between practice and research in prestressed concrete. A discussion is made of the need of specifications, where they will come from, and upon what will they be based. The variables affecting behavior of prestressed concrete beams; and proposed investigations into questions of flexure, shear, diagonal tension, bond, and properties of materials are discussed.

A118. Steele, R. K.; Libby, J. R., "Preliminary Tests of Prestressed Concrete at the U. S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, California", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 231-240.

A rather inclusive series of planned tests on prestressed concrete are described. The initial tests on beams are described, but only a few results are given.

A119. - - -, "Impact Tests on Prestressed Concrete Fender Piles", Concrete and Constructional Engineering (London), 1951, Vol. 46, No. 3, pp. 89-91.

The material for this paper was taken from "The Application of Prestressed Concrete to Structural and Building Work in the Gas Industry" published by the Institution of Gas Engineers, with S. V. Gardner as author.

A performance test was conducted on prestressed concrete piles protecting a riverside of a loading crane way. Drop tests were made and records of damped oscillations, static and dynamic deflections were made.

A120. - - -, "Prestressed Concrete for Industrial Building Studied", Civil Engineering, 1951, Vol. 21, No. 9, p. 553.

Description of the tests of one 40 ft. and one 60 ft. girder designed by Freyssinet method and tested to destruction by the Austin Company in Euclid, Ohio. Only the most important data given.

A121. - - -, "Prestressed Concrete R. R. Trestle Slab", Concrete for Railways (Portland Cement Association), No. 44, 1951.

Description of the test of one railroad trestle slab of prestressed concrete. Slab prestressed with Roebling cables and tested to destruction. Design and construction are described in detail, section and material properties given and test procedure described. Some of the test data given.

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B-22, B-28, B-29, B-111, B-114, B-135, B-150, C-2, C-20, C-21, C-30,

D-14, D-23, D-40, D-67, D-70, D-90.

B. Construction.

1905-1935

B1. Lund, J. G. F., "Beschreibung der Konstruktion und Verwendung von Eisenbetonhohlblöcken armiert nach System Lund", Beton und Eisen (Berlin), 1905, Vol. 4, Nos. 6-7, pp. 143-145, 169-173.

Historically interesting proposal for making beams of concrete blocks connected by steel prestressed rods.

B2. Wuilleumier, B., "Bauten nach System Lund", Beton und Eisen (Berlin), 1906, Vol. 5, No. 9, pp. 227-229.

Description of few structures built according to the Lund system (see Lund, Beton und Eisen 1905).

B3. L'Heremite, R., "Machine de charge a haute puissance, pour essais de pieces de construction", Genie Civil, (Paris), 1935, Vol. 107, No. 2, pp. 44-45.

This article explains the construction and operation of a testing machine designed by Freyssinet. It is a compression machine built of prestressed concrete; its capacity is 2000 tons.

1936

B4. Coyne, M., "Application of Prestressing in Dams", Int. Assoc. Bridge and Struct. Eng., Second Congress, Final Report, Berlin 1936, pp. 706-713.

Anchoring of gravity dams with the aid of prestressed cables.

B5. Dischinger, F., "The Elimination of Bending Tensile Stresses in Reinforced Concrete Bridges", Int. Assoc. Bridge and Struct. Eng., Second Congress, Preliminary Publications, Berlin 1936 (publisher W. Ernst), pp. 759-781.

The author deals with a method of prestressing with cables outside the section. Examples of actual structures consisting of this type of hollow girder given.

B6. Kilgus, E. M., "Maste aus Eisenbeton mit verbesserter Ausnützung der Bewehrungseisen", Zement (Berlin), 1936, Vol. 25, No. 51, pp. 889-890.

Description of prestressing hollow concrete masts. Round bars with threaded ends are used for this purpose.

B7. Makcheeff, T., "Tensions préalables des armatures et moyens de les réaliser à peu de frais", Travaux (Paris), 1936, Vol. 20, No. 46, pp. 477-481.

This paper deals with a method of prestressing trussed members.

1937

B8. Boase, A. J., "Notes on Inspection of Structures in Europe", Proceedings, American Concrete Institute, 1937, Vol. 33, No. 5, pp. 521-540.

Brief description of prestressed piles used by Freyssinet to support a sinking building (pp. 521-526).

B9. Coyne, A., "The Construction of Large Modern Water Dams", Structural Engineer (London), 1937, Vol. 15, No. 2, pp. 70-84.

Large dams are prestressed vertically with cables anchored deep in subsoil. This method is used in France to strengthen existing dams.

B10. Wedler, "Neue Wege im Eisenbetonbau nach Freyssinet", Zentralblatt der Bauverwaltung (Berlin), 1937, Vol. 57, No. 20, pp. 506-509.

Description of various early uses of prestressed concrete.

1938

B11. Finsterwalder, U., "Eisenbetonträger mit selbsttatiger Vorspannung", Der Bauingenieur (Berlin), 1938, Vol. 19, Nos. 35-36, pp. 495-499.

Description of a prestressed concrete bridge prestressed by the Dischinger-Finsterwalder method and of a prestressed concrete truss.

B12. Finsterwalder, U., "Eisenbetonträger mit Vorspannung durch Wirkung des Eigengewichtes", Zeitschrift des Vereines Deutscher Ingenieure (Berlin), 1938, Vol. 82, No. 45, pp. 1301-1304.

This paper is a description of a method of prestressing developed by Finsterwalder and Dischinger. In this method the steel is usually placed outside of the main concrete member. The prestressing is achieved by stressing the cables which results in an upward deflection of the main concrete members. The same principle is applied to trusses.

1939

B13. Amos, H., "Stahlseitenbeton nach Hoyer", Zeitschrift des Vereines Deutscher Ingenieure (Berlin), 1939, Vol. 83, No. 11, pp. 337-338.

This short article describes the Hoyer system of prestressing. The manufacture of one I-beam is described and load-deflection curves are shown for beams with various amounts of prestress.

B14. Anderegg, F. O., "Progress in Prestressing Structural Clay Masonry", Bulletin of the American Ceramic Society, 1939, Vol. 18, No. 9, pp. 323-325.

A brief paper which describes prestressing of clay masonry units and their use as roof and deck flexural members. Tests of 6 slabs made from such units are described.

B15. Bornemann, E., "Neuere Verfahren im Eisenbeton", Zement (Berlin), 1939, Vol. 27, Nos. 46-48, pp. 727-730, 760-764, 744-747.

Various methods of prestressing are described and examples of structures given.

B16. Kleinlogel, A., "Stahlsaitenbeton", Stahl und Eisen (Düsseldorf), 1939, Vol. 59, No. 31, pp. 896-898.

This article deals mostly with the Hoyer system of prestressing although most of other works are briefly mentioned. The Hoyer method of prestressing is described in detail and the long line process of manufacture is mentioned.

B17. Meuller, P., "Brücken der Reichsautobahn aus Spannbeton", Die Bautechnik (Berlin), 1939, Vol. 17, No. 10, pp. 128-135.

Description of two concrete bridges built in Germany. Test of prestressed concrete I-beam (for more detail description see Opperman 1940) described briefly. Of the two bridges one was pretensioned by Freyssinet's method and other post-tensioned by Dischinger-Finsterwalder method.

B18. Schoenberg, M.; Fichtner, F., "Die Adolf-Hitler-Brücke in Aue (Sa.)", Die Bautechnik (Berlin), 1939, Vol. 17, No. 8, pp. 97-104.

Description of a multispan bridge in Germany with three spans of prestressed concrete (Dischinger's method). Construction procedure described briefly.

B19. - - -, "Prestressed Reinforcement of Fine Wires Gives Spring to Precast Beams", Concrete, (Chicago), 1939, Vol. 47, No. 11, p. 8.

Brief description of Hoyer's method of prestressing with

2 mm. piano wire using bond to anchor wires. Beams, joists, and planks are precast and stock piled. Cast in molds 100 m. (328 ft.) long and cut to desired length.

1940.

B20. - - -, "New Type of Hut", Concrete and Construction Engineering, (London), 1940, Vol. 35, No. 6, p. 291.

War time huts built of precast slabs prestressed with piano wire. Very brief explanation.

B21. - - -, "Prestressed 108 ft. Girders in German Bridge", Engineering News Record, March 28, 1940, Vol. 124, No. 13, p. 452.

102 ft. clear span of prestressed concrete. Girders are of I-section and are about 5 ft. deep. Both longit. steel and stirrups are prestressed. High strength steel was used. Bridge spans express highways between Ruhr and Hanover.

1941

B22. Dill, H. E., "Some Experience with Prestressed Steel in Small Concrete Units", Proceedings, American Concrete Institute, 1941, Vol. 38, No. 2, pp. 165-168.

Description of the first fence posts of prestressed concrete (1928-29) and of small slabs used for roofs and for small house construction. Load deflections curves for two beams tested - one with and one without prestress.

B23. Mautner, K. W., "Saving Reinforcement by Prestressing", Concrete and Construction Engineering (London), 1941, Vol. 36, No. 2, pp. 73-95.

This is a reply to Abeles paper of the same title. Mautner opposes partial prestressing.

1942

B24. Lossier, H., "Types de ponts en béton armé avec armatures précontraintes réglables", Genie Civil (Paris), 1942, Vol. 119, Nos. 21, 22, pp. 253-257, 269.

The author describes various large bridges of prestressed concrete. In conclusion he sums up the advantages of prestressed structures and discusses the possibility of using expanding cements.

1943

B25. Billner, K. P., "Electric Prestressing of Reinforcing Steel Used for Small House Construction", Engineering News Record, September 9, 1943, Vol. 131, No. 11, pp. 406-408.

2 1/2" thick walls prestressed with mild steel rods stretched by heating electrically; stretched rods fixed with nuts.

B26. Billner, K. P.; Carlson, R. W., "Electric Prestressing of Reinforcing Steel", Proceedings, American Concrete Institute, 1943, Vol. 39, No. 6, pp. 585-592.

Description of prestressing the steel by heating electrically and tightening the elongated rods by end nuts. Bars coated with sulphur and embedded in the concrete. Description of bond, fire and load tests with electrically prestressed structural members.

B27. Paul, A. A., "The Use of Precast Prestressed Concrete Beams in Bridge Deck Construction", Journal, Institute of Civil Engineers, (London), 1943, Vol. 21, No. 1, pp. 19-30.

Use of pretensioned beams, mostly of I-cross section, in Great Britain.

B28. Redonnet, "Une nouvelle application du beton precontraint, Les pontsdalles d'Elbeuf-sur-Andelle et de Longrov", Travaux (Paris), 1943, Vol. 27, No. 124, pp. 347-359.

A description of several prestressed slab bridges. Prestressing by Freyssinet method. A rather detailed description of construction procedures. Brief summary of the designs is presented. Some data on the test of one of the slabs are given.

1944

B29. Maney, G. A., "High Strength Reinforced Concrete Columns Developed", Civil Engineering, 1944, Vol. 14, No. 12, pp. 496-498.

A war-time development of spiral columns with prestressed spiral. High strength concrete obtained through use of low w/c ratio, vibrating and applying of pressure during hardening.

B30. Stucky, A.; Bolomey, J.; Panchaud, F., "Béton et béton précontraint", Bulletin Technique de la Suisse Romande (Lausanne), 1944, Vol. 70, No. 12, pp. 149-155.

Stucky's part is a description of the construction of a railroad bridge of prestressed concrete. Bolomey discusses the control of concrete and the third author compares the behavior of ordinary reinforced concrete with the behavior of prestressed concrete.

1945

B31. Benito, C., "Aportación al estudio de estructuras pretensados", Laboratorio Central de Ensayo de Materiales de Construcción, Publicación No. 10, Madrid 1945.

This paper gives a description of a method of determining the tension in a steel wire by measuring the frequency of vibrating wire. Tests conducted to check the accuracy of the formulas showed deviations of ± 4 percent.

B32. Benito, C., "Dispositivo de tensión en las armaduras del hormigón pretensado", Laboratorio Central de Ensayo de Materiales de Construcción, Publicación No. 3, Madrid, 1945.

Brief description of various methods of prestressing used in connection with existing structures.

B33. Marcus, H., "Prestressed Concrete Design Overseas", Engineering News Record, April 5, 1945, Vol. 134, No. 14, pp. 455-458.

Description of dams in which prestressing was used to make it possible to increase their height. Beams, bridges and caissons of prestressed concrete are also described.

1946

B34. Barber, R. S. V.; Lester, D. R., "The Development and Manufacture of Prestressed Concrete Units", Transactions, Society of Engineers (London), 1946, pp. 41-75.

Description of the manufacture of concrete sleepers at the Tallington Prestressed Concrete Factory.

B35. Billig, K., "Concrete Shell Roofs with Flexible Molds", Journal, Institute of Civil Engineers, (London), 1946, Vol. 25, No. 3, pp. 228-231.

Prestressing of shell roofs in the direction normal to the arch span. Description of this type of structure with a very brief description of the construction procedure.

B36. Lalande, M., "L'emploi du béton précontraint dans la fabrication des ouvrages d'art", Travaux (Paris), 1946, Vol. 30, No. 142, pp. 281-298.

Detailed description of the construction of the bridge Luzancy on the Marne. Bridge girders were precast in parts. Bridge was designed by Freyssinet.

B37. Mason, J., "A Report on Structural Engineering in Germany", *Structural Engineer* (London), 1946, Vol. 24, No. 6, pp. 310-314.

A very brief report of German activities in the field of prestressed concrete. Description of various methods of prestressing.

B38. Shama, R. E., "Garage in India is Built with Prestressed Concrete", *Concrete* (Chicago), 1946, Vol. 54, No. 7, pp. 22-24.

Description of an arch roof built of prestressed concrete. Freyssinet type of prestressing.

B39. Widman, M., "La passerelle publique pour pretons de Bully-Grenay en béton précontraint", *Travaux* (Paris), 1946, Vol. 30, No. 136, pp. 45-55.

A rather complete description of the construction of a pedestrian bridge prestressed by Freyssinet method. Summary of design given. Good description of prestressing operations.

B40. - - -, "A Prestressed Concrete Footbridge", *Concrete and Constructional Engineering* (London), 1946, Vol. 41, No. 5, pp. 139-140.

Very brief article giving dimensions and properties of the girders of the two span bridge built over tracks at the Bully-Grenay Station of the French National Railways. Comparison of quantities of material for prestressing and ordinary reinforced concrete is given.

B41. - - -, "Arch Roof in Prestressed Concrete," *Concrete and Constructional Engineering* (London), 1946, Vol. 41, No. 4, pp. 112-115.

This is taken from an article by R. E. Shama, "Garage in India is built with prestressed concrete", in *Concrete* 1946, Vol. 54, No. 7, pp. 22-24.

B42. - - -, "Development and Manufacture of Prestressed Concrete Sleepers", *Railway Gazette*, (London), May 17, 1946, Vol. 84, No. 20, p. 538.

This is an abstract from paper by Barber and Lester, "The Development and Manufacture of Prestressed Concrete Units". *Transactions of the Society of Engineers*, 1946, pp. 41-75.

B43. - - -, "Prestressed Concrete Sleepers", *Concrete and Constructional Engineering*, 1946, Vol. 41, No. 6, pp. 168-170.

The manufacturing of concrete sleepers at the Dow-Mac Products Ltd. in England is described step by step. Bonded prestress is used. For more complete information see Barber and Lester, "The Development and Manufacture of Prestressed Concrete Units", 1946, *Transactions of the Society of Engineers*, pp. 41-75.

B44. - - -, "Prestressed Reinforced Concrete Aeroplane Runways", Concrete and Constructional Engineering (London), 1946, Vol. 41, No. 11, p. 310.

Freyssinet is experimenting in this field. Builds runway in series of triangles. Stresses with unbonded wires (wires anchored in abutments) normal to direction of runway. Because of triangles a uniform compressive stress is induced in concrete in all directions. No results of these experiments are stated.

B45. - - -, "Reinforced Concrete Dams in France", Concrete and Constructional Engineering, (London), 1946, Vol. 41, No. 11, p. 324.

Prestressing is used in dams to conserve materials. By anchoring dam to the foundation with prestressing cables the line of pressure is altered to increase factor of safety. It is said that one ton of prestressed steel in these ties saves 450 cu. yd. of concrete.

1947

B46. Abeles, P. W., "Developments in Prestressing in Switzerland", Concrete and Constructional Engineering (London), 1947, Vol. 42, No. 12, pp. 377-378.

Short paper describing the uses of prestressed concrete in Switzerland. Both Hoyer's and Freyssinet's systems are used. Use of x indented wire and deformed strips of high strength steel.

B47. Booth, E. H., "Aerodrome Developments in India", Journal, Institute of Civil Engineers (London), 1947, Vol. 29, No. 2, pp. 154-160.

General description of a large aircraft hangar of prestressed concrete.

B48. Harris, A. J., "Prestressed Concrete Bridges", Concrete and Constructional Engineering (London), 1947, Vol. 42, No. 11, p. 327.

Description of various European bridges: small bridges with precast prestressed beams, slab bridges, girder bridges, multiple span bridges and arches.

B49. Magnel, G., "Le béton-armé aux Etats-Unis", La Technique des Travaux (Paris), 1947, Vol. 23, Nos. 1-2, pp. 17-24.

Short description of prestressed concrete tanks, of precasting techniques and other concrete construction.

B50. Moyle, R. L., "Precast Prestressed Concrete Rail Bridge," Railway Age, (New York), 1947, Vol. 123, No. 12, pp. 478-482.

Describes a railroad bridge (Adam Viaduct) in England. The

girders of Approx. 30 ft. span are prestressed apparently by the Magnel system. Gives description of the manufacture of the beams and construction processes.

B51. Roessinger, F., "Le pont sur la Medjerdah à Djédeida", Bulletin Technique de la Suisse Romande (Lausanne), 1947, Vol. 73, No. 6, pp. 69-76.

Description of the construction of a three-span continuous bridge with hinges built in prestressed concrete in Tunis. Girders were precast, then prestressed by Freyssinet method. Performance tests of various kinds were conducted to determine: 1. resistance to shear of the joints between the individual precast elements; 2. resistance to bending of the beams; 3. resistance to shear; 4. losses of prestress; 5. resistance of the grout against injection into the cable sheaths.

B52. Sexton, C. G., "Prestressed Reinforced Concrete Hangar at the Civil Airport of Karachi," Journal, Institute of Civil Engineers (London), 1947, Vol. 29, No. 2, pp. 109-130.

Description of the method of construction of large prestressed concrete girders - Freyssinet method.

B53. - - -, "A Prestressed Concrete Bridge in Tunis", Civil Engineering and Public Works Review, (London), 1947, Vol. 42, No. 491, p. 203.

Describes very briefly a precast prestressed bridge of three spans, prestressed by the Freyssinet method. For more complete information see article by M. F. Roessinger in Bulletin Technique de la Suisse Romande, 1947, Vol. 73, No. 6, pp. 69-76.

B54. - - -, "A Prestressed Concrete Railway Bridge Near Wigan", Concrete and Constructional Engineering (London), 1947, Vol. 42, No. 10, p. 305.

Short description of a viaduct bridge. Saved 15 percent headroom over regular reinforced concrete. Girders had I-beam cross-section. Two I-beams were tested with 150 percent live load-no cracks occurred-immediately resumed its original elastic curve upon removal of load.

Adam viaduct between Wigan and Pemberton.

B55. - - -, "New Road Bridge at Luzancy, France", Concrete and Constructional Engineering, (London), 1947, Vol. 42, No. 1, pp. 17-20.

Description of single span bridge of 180 ft. span designed by Freyssinet. Hollow girder precast in blocks about 8 ft. long. Each girder was erected in 3 pieces. Between hinged end of beam and abutment a form of jack is provided to regulate at any time the thrust on the abutment.

B56. - - -, "Precast Prestressed Concrete Rail Bridge", Engineering, (London), 1947, Vol. 164, No. 4259, p. 252-263.

Describes a railroad bridge (Adam Viaduct) in England. The girders of approximately 30 ft. span are prestressed apparently by the Magnel system.

B57. - - -, "Precast Prestressed Concrete Rail Bridge", The Engineer, (London), 1947, Vol. 184, No. 4771, pp. 10-11.

Describes a railroad bridge (Adam Viaduct) in England. The girders of approximately 30 ft. span are prestressed apparently by the Magnel system.

B58. - - -, "Reconstruction of Bridges in France", Concrete and Constructional Engineering (London), 1947, Vol. 42, No. 3, pp. 94-97.

Among other bridges two of prestressed concrete (the bridge of Lajout, Marseilles and Canal Bridge at Montcresson) are very briefly described. The prestressed features of the bridges are told giving quantities of wire used and savings over reinforced concrete.

B59. - - -, "The Use of Expanding Cement Concrete", Concrete and Constructional Engineering (London), 1947, Vol. 42, No. 1, p. 16.

An expanding cement (of untold content) is introduced into form and its expansion exerts compression on rest of structure. Sites 3 or 4 examples of this material used for patching and repairing war damaged structures.

1948

B60. Courty, L.; Kaleski, R., "La nouvelle cuverie a vin de Cinzano en béton précontraint", Travaux (Paris), 1948, Vol. 32, No. 165, pp. 421-429.

Description of the construction of a winery. The vats are of prestressed concrete.

B61. Freyssinet, E., "Ponts en béton précontraint", Int Assoc. Bridge and Struct. Eng., Third Congress, Final Report, Liège 1948, pp. 405-420.

Description of various types of prestressed concrete bridges with examples of actually built structures.

B62. Haggbom, I., "The Bridge at Sandö", Int. Assoc. Bridge and Struct. Eng., Preliminary Publication, Liège 1948, pp 381-392.

Only the last part of this paper - pp. 391-392 - deals

with prestressed concrete. A girder is described which was prestressed with tie rods of tensile strength 52 kg/mm².

B63. Magnel, G., "Les application du béton précontraint en Belgique", Int. Assoc. Bridge and Struct. Eng., Third Congress, Preliminary Publication, Liege, 1948, pp. 333-342.

Magnel describes his method of anchoring the prestressed wires with sandwich plates and then gives examples of several structures giving the details of the prestressed members. Some comparison of the costs of reinforced and prestressed concrete structures.

B64. Schofield, E. R., "First Prestressed Bridge in U.S.A.", Engineering News Record, December 30, 1948, Vol. 141, No. 27, pp. 16-18.

Report of the design of first prestressed concrete bridge in USA made for the City of Philadelphia (Walnut Lane Bridge). Few technical data included.

B65. Williams, W. H., "B.O.A.C. Office Extension", The Builder (London), 1948, Vol. 175, No. 5518, pp. 595.

Precast, prestressed concrete columns were used in a one story building. Freyssinet system of prestressing was used.

B66. - - -, "Concrete Sleepers in Belgium", Concrete and Constructional Engineering (London), 1948, Vol. 43, No. 6, pp. 279-281.

Describes two types of concrete sleepers used in Belgium--the Blaton sleeper designed by Magnel and the Franki--Bagon sleeper. Both have been proven in actual service. The manufacturing and prestressing operations are described.

B67. - - -, "Inducing Initial Stresses in Waterloo Bridge", Concrete and Constructional Engineering (London), 1948, Vol. 43, No. 1, p. 25.

7/8", 1", and 1 1/8" bars were used for prestressing-bars had upset ends and were tightened with nuts or turn-buckles--medium high steel was used and only stressed to 45,000 psi.--bars were elongated with steam heat, the amount of elongation being measured by number of turns of nut or turnbuckle.

B68. - - -, "Prestressed Bridge at l'Hermillon, France", Concrete and Constructional Engineering (London), 1948, Vol. 43, No. 1, p. 21.

Brief description of this bridge--single span of 163 ft.--precast beams--prestressed a la Freyssinet--beams were of solid I-section. Some difficulty was experienced in stretching the cables where these were bent up towards the ends of the beams as the wires were old and slightly rusty. The required elongation of each cable was obtained by repeating the jacking operation.

B69. - - -, "Prestressed Cast In-situ Concrete Bridge," Engineering (London), 1948, Vol. 165, No. 4300, pp. 608-609.

A description of Nunn's Brudge over Hob Hole drain at Fishtoft, near Boston, Lincolnshire. 72 ft. clear span bridge of prestressed girders cast in place. Prestressing was carried out in accordance with Freyssinet process and is explained here.

B70. - - -, "Prestressing Applied to Stregthening a Church Tower in Staffordshire," Concrete and Constructional Engineering, (London), 1948, Vol. 43, No. 9, pp. 280-283.

Describes how a tower which was settling and tilting and cracking due to a mining subsidence, was straightened up and strengthened by inserting in the walls prestressed beams of Magnel design. Other descriptions appear elsewhere in these references e.g. in Magnel's book.

B71. - - -, "Reconstruction of Nunn's Bridge, Lincolnshire", Concrete and Constructional Engineering (London), 1948, Vol. 43, No. 8, pp. 239-244.

Cast in place bridge--five girders of 74 ft. span--prestressed by Freyssinet process. Dimensions of girders, wires, etc. are given--also description of construction processes.

B72. - - -, "Reconstruction of Quay Walls, Le Harvre, Composite In-situ and Precast Prestressed Beams", Concrete and Constructional Engineering, (London), 1948, Vol. 43, No. 2, pp. 55-57.

Description of the structure which includes prestressed beams and slabs. Prestressing by Freyssinet process is explained.

B73. - - -, "Some Prestressed Concrete Buildings in Belgium", Concrete and Constructional Engineering, 1948, Vol. 43, No. 7, pp. 193-199.

A brief description of some of the buildings of Magnel's design. Hangar at Brussells Airport; textile factory at Ghent; underpinning of tower at Tournai. Better descriptions appear in Magnel's book and elsewhere in these references.

B74. - - -, "Supporting a Structure During Reconstruction", Concrete and Constructional Engineering (London), 1948, Vol. 43, No. 3, pp. 93-95.

Explains how 4th and 5th floors of a maltery were supported while 4th floor columns were removed for reconstruction. Nother here about prestressed concrete. The maltery is in Mistleu, Essex.

1949

B75. Brewster, F. R., "Concrete Building Columns Prestressed", Engineering News Record, November 10, 1949, Vol. 143, No. 19, pp. 34-36.

Precast prestressed columns for a factory hall used in order to save steel. Columns designed to take tension due to eccentric loading. Columns carried the roof and crane.

B76. Chalos, M., "Armatures souples pretendues", Travaux (Paris), 1949, Vol. 33, No. 178, pp. 330-331.

Description of flexible prestressing cable, the method of its placing and prestressing.

B77. Coff, L., "Prestressed Concrete - A New Frontier", Engineering News Record, September 1, 1949, Vol. 143, No. 9, p. 183-187.

The author describes some of the more important techniques of prestressing and gives a brief history of prestressed concrete.

B78. Coff, L., "Prestressing Increases the Uses of Precast Structural Concrete", Rock Products (Chicago), 1949, Vol. 52, No. 11, pp. 110-112, 117.

Cites examples of precast prestressed units in Europe. Explains the use of prestressing and points out that prestressing should make precast elements more economical.

B79. Dobell, C., "Design Progress in Prestressed Concrete," Progressive Architecture, 1949, Vol. 30, No. 10, pp. 84-87.

Description of construction of some recent buildings with long spans built in Europe under Magnel's direction. Short description of Preload method of prestressing tanks.

B80. Duyster, H. C., "Vliegtuiglloodsen in spannbeton", (Prestressed Concrete hangars), De Ingenieur ('s-Gravenhage), 1949, Vol. 61, No. 18, pp. 37-48. Also in Cement (Amsterdam), 1949, Vol. 1, No. 7-8, pp. 117-124.

Very comprehensive description of large prestressed concrete girders, as well as their construction and erection. Some design theory added.

This paper has been translated in English and published under the title "The Construction of Aircraft Hangars in Prestressed Concrete at the Melsbroek Airfield near Brussels", Bulletin No. 12, Cement and Concrete Association, London, 1950.

B81. Lämmlein, A.; Wichert, U., "Spannbetonbrücke Bleibach", Die Bautechnik (Berlin), 1949, Vol. 26, No. 10, pp. 300-306.

Description of prestressed concrete skew slab bridge in Germany. Prestressed by post-tensioned cables. Detail description of the structure and prestressing procedure as well as of anchoring the cables given. Strain measurements made during prestressing operations are also given.

B82. Lossier, H., "Pont sur la Seine, à Villeneuve-Saint-Georges," Travaux (Paris), 1949, Vol. 33, No. 178, pp. 327-329.

Description of the bridge with four simple spans. Each span consists of three hollow prestressed girders.

B83. Magnel, G., "Prestressed Concrete Beams Carry Record Loads in Belgium Hangar," Engineering News Record, February 10, 1949, Vol. 142, No. 6, pp. 18-19.

Framing plan for an airplane hangar is given and the heaviest girder is described. It has a span of 42 ft. and is of hollow rectangular cross section. The prestressing wires are grouted in.

B84. Ouziel, R., "Le pont a 3 travees de 35 metres sur l'oued Melah", Travaux (Paris), Vol. 33, No. 178, pp. 337-342, 1949.

Description of a bridge in Tunisia made up of prestressed concrete I-beams. The manufacture of beams and construction of the bridge are well described.

B85. Riessauw, F.; Vandepitte, D.; Doods, J.; Van Cauwenberge, M., "Le nouveau pont en béton précontraint de la rue De Smet sur la Canal de Raccordement, a Gand", Annales de Travaux Publics de Belgique (Bruxelles), 1949, Vol. 102, No. 6, pp. 687-720.

Description of a bridge built in Belgium. Bridge consists of simple span beams prestressed by Magnel system. Detailed description of construction procedures is given and the design of the bridge is also mentioned.

B86. Schofield, E. R., "Construction Starts on Prestressed Concrete Bridge in Philadelphia", Civil Engineering, 1949, Vol. 19, No. 7, pp. 32-34.

Description of the structure, the preliminary planning. The relative costs of other types of structures discussed. Essentially the same material as Schofield's article "First Prestressed Bridge in USA" (ENR December, 1948).

B87. Schofield, E. R., "Prestressed Concrete Used for Boldly Designed Structures in Europe", Civil Engineering, 1949, Vol. 19, No. 9, pp. 22-27.

A report of the present state of prestressed concrete construction with description of sample structures in France, Belgium, Sweden and England.

B88. Streblov, "Prestressed Slabs and Prestressed Walls," Concrete (Chicago), 1949, Vol. 57, No. 4, pp. 314.

Description of the fabrication of prestressed slabs and walls manufactured by the Basalt Rock Company, Mapa, California.

B89. - - -, "Bridges in Prestressed Concrete", Civil Engineering and Public Works Review (London), 1949, Vol. 44, No. 520, pp. 586-588.

Description of one overpass over railroad in England constructed with precast prestressed concrete beams. One of the precast beams was tested to failure; it failed by crushing of concrete. Description of test very incomplete.

B90. - - -, "Gauging Wire in Prestressed Tanks", Engineering News Record, October 6, 1949, Vol. 143, No. 14, pp. 33-34.

The stress in the prestressing wires of a large water tank is determined by the vibration frequency measured with a magnetic pick-up and an oscillograph.

B91. - - -, "Hormigon precomprimido. Ensayo de un tipo de entrepiso en nuestro Campo Experimental," Cemento Portland (Buenos Aires), 1949, Vol. 4, No. 21, pp. 3-8.

Description of slabs prefabricated of small precast prestressed elements combined with hollow tile fillers and monolithic concrete wearing surface. Test of one of such slabs is described.

B92. - - -, "Jointless Prestressed Warehouse Floor", Engineering News Record, January 6, 1949, Vol. 142, No. 1, pp. 68-69.

The jointless prestressed concrete slab 96' by 144' is described. Anchorage of the cables, and prestressing operation is explained.

This is the slab in the Roebling Warehouse at Cicero, Illinois.

B93. - - -, "Prestressed Cast-in-Place Concrete Bridge", Concrete, (Chicago), 1949, Vol. 57, No. 3, pp. 3-5.

A description of Nunn's Bridge over Hob Hole drain at Fishtoft, near Boston, Lincolnshire. The girders are built in the conventional manner, except they are cast in place. Freyssinet's system of prestressing was used.

B94. - - -, "Prestressed Concrete Beams in a Building at Edinburgh", Concrete and Constructional Engineering, (London), 1949, Vol. 44, No. 11, pp. 353-356.

Three story building has prestressed floor members. Main girders are of 20 ft. span are precast prestressed by Magnel system. Secondary girders are 30 ft. span are produced in factory and are bonded prestress.

B95. - - -, "Prestressed Concrete Bridges Over the River Marne, Spans of 242 ft. 9 ins," Concrete and Constructional Engineering, (London), 1949, Vol. 44, No. 12, pp. 378-385.

These bridges designed by Freyssinet process are 2-hinged arches and the arches are precast in blocks and assembled into 3 or 4 parts before placing on piers. Final assembly is completed when the arches are in place. The hinges embody a device for regulating the thrust and the span by means of a jack. The dimensions and the prestressing operations as well as the construction processes are explained.

B96. - - -, "Prestressed Concrete Sleepers," Concrete and Constructional Engineering (London), 1949, Vol. 44, No. 9, pp. 294-296.

Wires in form of links are bonded in concrete and positively anchored in molds. Ends of each pair of links pass around cast-iron anchor blocks. Block at one end of link is secured by anchor bolt to end plate of mold and at other end by bolt which passes through mold.

B97. - - -, "Two Notable New Prestressed Concrete Buildings", Civil Engineering and Public Works Review (London), 1949, Vol. 44, No. 521, pp. 660-664.

Description of the structure of an extension of a factory and of a 3 story office building in England, both in prestressed concrete. Construction procedures are also given. In the first the Freyssinet, in the second the Magnel system of prestressing were used.

1950

B98. Benjamins, Ph., "Les hangars en béton précontraint de l'aéroport de Melsbroek", Annales des Travaux Publics de Belgique, (Bruxelles), 1950, Vol. 103, No. 6, pp. 841-890.

Description of hangars at Melsbroek and of their construction with particular attention to the prestressed elements: beams and columns of various sizes and shapes.

B99. Billner, K. P., "New Prestressing Method Utilizes Vacuum Process", Proceedings, American Concrete Institute, 1950, Vol. 47, No. 2, pp. 161-176.

A prestressing method is described in which steel rods are embedded in the concrete consisting of two separate halves. The bars are bonded at both ends with hooks, the remaining portions are coated with asphalt and thus remain unbonded. After the concrete hardens, the two parts of the beams are pushed apart and fixed in position with concrete. The paper is supplemented by the results of a test of one beam - tested to destruction and with a design procedure.

B100. Birguer, A., "Reconstruction du pont de Sclayn sur la Meuse", Travaux (Paris), 1950, Vol. 34, No. 187, pp. 315-324.

Description of the reconstruction of the Sclayn Bridge in Belgium. Some design calculations are also included.

B101. Cousins, H. G., "The Application of Prestressing to Shell Roof Structures", The Reinforced Concrete Review (London), 1950, Vol. 2, No. 3, pp. 189-199.

The method of prestressing the shells is described and the construction procedure discussed.

B102. "Weitgespannte Stahlbetonbalkenbrücken mit Vorspannung durch Seile und nachtraglichem Verbund", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 5, pp. 97-99.

Description of a new method of prestressing the continuous beams over the supports. The bridge discussed consists of one large hollow girder.

B103. Feld, J., "Prestressing Cuts Homebuilding Costs", Engineering News Record, September 14, 1950, Vol. 145, No. 6, pp. 48-50.

Prestressing of precast wall, floor and roof slabs. Emphasis placed on simplicity of the prestressing method. Slabs prestressed with 1/4 in. wire with a button head on one end and a thread on the other end. Stress in wire determined by elongation and with the aid of a tuning fork.

B104. Franz, "Westeuropäische Bauten aus vorgespannten Beton", Der Bauingenieur (Berlin), 1950, Vol. 25, No. 1, pp. 27-31.

Buildings and Bridges built of prestressed concrete in Western Europe (especially Belgium) are described with respect to method of prestressing and erection.

B105. Giraud, R., "Le Pont d'Essey", Travaux (Paris), 1950, Vol. 34, No. 186, pp. 261-267.

Description of prestressed concrete arch bridge. Construction details and design features and formulas are given.

B106. Goldstein, A., "Design and Construction of Prestressed Concrete Arch Footbridge at Oxford", Concrete and Constructional Engineering (London), 1950, Vol. 45, No. 10, pp. 347-356.

A small fixed arch foot bridge prestressed with vertical, diagonal, and horizontal cables. Main arches cast in place, slab precast. Construction procedure described and illustrated. Design procedure and formulas given.

B107. Kaiser, A.; König, H., "Die Herdbrücke in Ulm und die Inselbrücke in Neu-Ulm", *Der Bauingenieur* (Berlin), 1950, Vol. 25, No. 5, pp. 153-159; No. 10, pp. 379-384.

Description of two prestressed concrete arch bridges during construction.

B108. Komendant, A. E., "Prestressed Concrete Arch Spans 353 ft.", *Engineering News Record*, December 7, 1950, Vol. 145, No. 23, p. 48.

Description of World's largest prestressed concrete span which consists of two three-hinged arches. Each arch is of the hollow box type and is prestressed with wire ropes 1 1/2" in diameter anchored in abutments. This bridge was built in Germany as replacement of a destroyed reinforced concrete bridge. It has 40 percent less steel, 16 percent less concrete and it took 15 percent less manhours to build it than for the original bridge. (Over Neckar Canal in Harbor of Heilbronn, Germany).

B109. Lämmlein, A., "Über die Wirtschaftlichkeit von Spannbeton-Strassenbrücken", *Beton-und Stahlbetonbau* (Berlin), 1950, Vol. 45, No. 3, pp. 66-68.

This article discusses the economy of prestressed concrete bridges with respect to reinforced concrete bridges and steel bridges.

B110. Lämmlein, A.; Bauer, A., "Spannbetonbrücken Emmendingen", *Beton und Stahlbetonbau* (Berlin), 1950, Vol. 45, No. 9, pp. 197-203.

Description of a three-span continuous skewed highway bridge of prestressed concrete. Prestressed according to Leonhardt-Baur system in which the wire is wrapped continuously around concrete semi-circular anchorages which are jacked apart to stretch the wire.

B111. Lee, D., "A New System of Prestressed Concrete", *Civil Engineering and Public Works Review* (London), 1950, Vol. 45, No. 527, p. 299.

Description of newly developed high tensile steel bars of diameters up to one inch. The bars are pretensioned with the aid of threaded ends. Bars may be coupled together. This steel is free of creep and fairly resistant to heat treatment. Also jack for prestressing these bars is described.

B112. Leonhardt, F.; Baur, W., "Brücken aus Spannbeton, wirtschaftlich und einfach. Das Verfahren Baur-Leonhardt," *Beton und Stahlbetonbau* (Berlin), 1950, Vol. 45, Nos. 8-9, pp. 182-188, 207-215.

Discussion of Magnel's and Freyssinet's methods of prestressing. Description of authors' method in which the prestressing wire is wrapped around half-cylindrical anchorages at the ends of the beam and prestressed by jacking the anchorages apart. Various bridges are

discussed in the second part primarily with respect to the method of prestressing.

Discussions:

Finsterwalder, U, Franz, G: dtto, 1951, Vol. 46, No. 4, pp. 90-91.
Leonhardt, F.; Baur, W.: dtto, 1951, Vol. 46, Nos. 5-6, pp. 114-116,
133-135.
Dischinger, F.: dtto, 1951, Vol. 46, No. 6, pp. 131-133.

B113. Lossier, H., "La précontraint intégral mixte", *Le Génie Civil* (Paris), 1950, Vol. 127, No. 21, pp. 412-413.

Author discusses briefly the use of expanding cements as the prestressing agent for prestressed concrete.

B114. Macerata, S., "Prestressed Concrete Conductor Masts in South Africa", *Concrete and Constructional Engineering* (London), 1950, Vol. 45, No. 1, pp. 13-19.

U-shaped tapered masts used as utility posts are described. Manufacture of these posts and tests are also described. The tests were carried to failure and the results are plotted as load-deflection curves.

B115. Magnel, G., "Longest Continuous Prestressed Girders Carry Scalyn Bridge Traffic Over Meuse River", *Civil Engineering*, 1950, Vol. 20, No. 7, pp. 450-451.

Description of two span continuous girder bridge in Belgium. Arrangements were made on this bridge which enable one to take measurements on two prestressing wires at any time. This was done in order to secure information on the effects of creep, shrinkage, relaxation and temperature.

B116. Masterman, O. J., "Process for the Manufacture of Prestressed Concrete Floor Joists", *Civil Engineering and Public Works Review*, 1950, (London), Vol. 45, No. 532, pp. 641-643.

Summary of the work aiming at the design of an inexpensive mold and at devising a commercial method of obtaining nearly high strength in the concrete of prestressed floor joists. Description of anchoring and tensioning devices for single wires.

B117. May, D. H., "The Magnel-Blaton System of Prestressing", *Reinforced Concrete Review* (London), 1950, Vol. 2, No. 2, pp. 135-139.

Description of the mechanics and operation of the Magnel prestressing jacks. Discussion of possible corrosion. Most of this material is in Magnel's book "Béton Précontraint".

B118. Nordberg, B., "Prestressed Floor and Roof Slabs of Concrete Masonry Units", Rock Products (Chicago), 1950, Vol. 53, No. 1, pp. 197-201.

Description of walls and slabs composed of masonry units connected by prestressing - work of Basalt Rock Company, of Napa, California.

B119. Panchaud, F., "Quelques ouvrages en béton précontraint construits récemment en Suisse", (Various structures of prestressed concrete recently constructed in Switzerland), Bulletin Technique de la Suisse Romande (Lausanne), September 23, 1950, Vol. 76, No. 19, pp 257-266.

The construction of a wharf (débarcadère de Nym), a railway bridge and highway bridge (le pont-rail et la pont-route de Zwingen) is described. Each of these structures utilized precast, post-tensioned girders. Freyssinet cables were used.

B120. Seegers, K. H., "Vorgespannte Betonfertigeteile bei den englischen Eisenbahnen", Der Bauingenieur (Berlin), 1950, Vol. 25, No. 12, p. 457.

A short article discussing precast, prestressed beams built in England with respect to the method of manufacture and the type of beam.

B121. Storrer, E., "Le pont de Scalyn sur la Meuse", Annales Travux Publics de Belgique (Bruxelles), 1950, Vol. 103, Nos. 2, 4, pp. 179-199, 603-622.

A description of the two-span continuous bridge of prestressed concrete designed by Magnel. The prestressed design is compared with designs in reinforced concrete. Prestressing and construction are also described briefly and reference is made to the design procedure.

B122. Sunderland, C. C.; Preston, H. K., "Americanized Prestressed Concrete Emerges From the Laboratory", Engineering News Record, March 2, 1950, Vol. 144, No. 9, pp. 34-37.

Description of the construction of prestressed concrete slabs from separate units. Prestressed in both directions with galvanized bridge cables.

B123. Tourry, G., "Reconstruction de la tour du phare de Berck en béton précontraint", Travaux (Paris), 1950, Vol. 34, No. 194, pp. 781-786.

Description of the construction of a lighthouse built of precast elements tied together by prestressing. Prestressing was done by the Freyssinet method.

B124. Wolf, W., "Das Kreuzungsbauwerk Kirchheim als Beispiel einer Spannbetonbrücke", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 6, pp. 145-146.

Description of the construction of a two-span highway crossing built of precast prestressed concrete beams in Germany near Kirchheim, Kreis Hersfeld.

B125. Wolf. W., "Verfahren und Ergebnisse der Ausschreibung 'Wilhelmsbrücke' Frankfurt-Main", Die Bautechnik (Berlin), 1950, Vol. 27, No. 9, pp. 281-288.

Various bridges along this highway from Frankfurt to Main are described--some of which are of prestressed concrete.

B126. - - -, "A Continuous Bridge in Prestressed Concrete", The Reinforced Concrete Review (London), 1950, Vol. 2, No. 2, pp. 139-144.

Description of the design and construction features of a two-span continuous prestressed concrete bridge at Sclayn, Belgium. The Magnel-Blaton system was used. Includes three photographs of the bridge under construction and two plates of design details.

B127. - - -, "A New Prestressed Concrete Sleeper", Concrete and Constructional Engineering (London), 1950, Vol. 45, No. 2, pp. 68-69.

Freyssinet designed a lighter weight sleeper for use on main lines by using higher strength concrete and reducing the cross section in the middle portion. Crimped wires are used to increase bond. Manufactured in long line to cut down prestress operation. Details for attaching rails are given.

B128. - - -, "A Prestressed Concrete Continuous-girder Bridge in Belgium", Concrete and Constructional Engineering (London) 1950, Vol. 45, No. 6, pp. 189-200.

Author describes the two span continuous Sclayn Bridge. Prestressing operations are discussed and design calculations shown.

B129. - - -, "A Prestressed Concrete Road Bridge in Lancashire", Concrete and Constructional Engineering (London), 1950, Vol. 45, No. 7, pp. 255-256.

Description of a prestressed concrete road bridge over river Tame in England.

B130. - - -, "Britain's First Prestressed Factories", Concrete Quarterly (Cement and Concrete Association, London), April, 1950, No. 8, pp. 28-32.

Description of three factories built of prestressed concrete, one by Freyssinet's, one by Magnel's and one by Strescon's system.

B131. - - -, "Cables Join Precast Beams to Form First Continuous Prestressed Bridge", Engineering News Record, August 31, 1950, Vol. 145, No. 9, pp. 30-31.

Description of the erection and prestressing processes on the 3 span continuous bridge at Neufchatel-en-Bray. Freyssinet system.

B132. "California Builds its First Prestressed Concrete Bridge", Engineering News Record, November 23, 1950, Vol. 145, No. 21, p. 42.

Description of the pedestrian bridge over Arroyo Seco Highway in Los Angeles.

B133. - - -, "Dauerbehelfsbrücken mit Spannbetonfertigträgern", Beton- und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 6, pp. 128-129.

Short article describing precast, prestressed beam bridges and their advantages.

B134. - - -, "Der Bau Von zwei Spannbetonbrücken", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 6, pp. 137-139.

Description of two prestressed concrete bridges built by Freyssinet's method in Germany; a two span continuous structure near Ulm-Dornstadt and a simple span structure near Nürnberg-Fürth.

B135. - - -, "Development Work at the Field Test Unit", Magazine of Concrete Research (London), 1950, Vol. 2, No. 4, pp. 35-37.

Very brief description of sustained load tests of floor joists made by the Field Test Unit in Great Britain. Description of development work on long line and individual unit processes of manufacture of prestressed concrete joists.

B136. - - -, "European Concrete", The Reinforced Concrete Review, (London), 1950, Vol. 2, No. 1, pp. 12-28.

This issue contains several brief illustrated articles describing: (1) The construction of a deep water quay using reinforced concrete caissons cast on shipways and floated into position and sunk. (2) The use of prestressed and precast members in the beam and girder floor of a warehouse. Abstracts of two lectures on prestressed concrete by Magnel and Freyssinet are presented at length, several pages being devoted to each.

B137. - - -, "Forspent betong i brobyggingen", (Bridge building in prestressed concrete), Betongen Idag (Oslo), 1950, Vol. 15, No. 4, pp. 79-87.

Description of bridges in Tunisia (Wadi Melah), Belgium (Sclayn), USA (Walnut Lane), France (Neufchatel) and Brazil (Galea) Same material as in the article "Multispan Prestressed Concrete Bridges", Concrete Quarterly, April 1950.

B138. - - -, "How They're Building Philadelphia's Famed Prestressed Bridge", Engineering News Record, September 21, 1950, Vol. 145, No. 12, pp. 32-34.

Brief description of the construction procedures employed at the Walnut Lane Bridge.

B139. - - -, "Multispan Prestressed Concrete Bridges", Concrete Quarterly (Cement and Concrete Association, London), April, 1950, No. 8, pp. 2-13.

Description of bridges in Tunisia (Wadi Melah), Belgium (Sclayn), USA (Walnut Lane), France (Mont de Terre and Neufchatel-en-Bray) and Brazil (Galeao).

B140. - - -, "Plant for Prestressed Concrete," Reinforced Concrete Review, (London), 1950, Vol. 2, No. 4, pp. 260-264.

Short report of the progress of the development work made by the Field Test Unit of the Ministry of Works. Anchoring devices described. Device for equalizing load on four wires stressed simultaneously. Jacks. Stress determination.

B141. - - -, "Precast Concrete in Government Buildings", Concrete and Constructional Engineering, (London), 1950, Vol. 45, No. 11, pp. 399-403.

Discussion of the use of prestressed concrete beams in buildings built for the government in England. Specific examples are discussed.

B142. - - -, "Prestressed Concrete Bridges in Yorkshire", Concrete and Constructional Engineering (London), 1950, Vol. 45, No. 3, pp. 99-100.

Description of two road bridges made up of unsymmetrical prestressed I-beams placed side by side and filled in with concrete placed in situ.

B143. - - -, "Prestressed Concrete Footbridge", Reinforced Concrete Review (London), 1950, Vol. 2, No. 4, pp. 210-211.

Description of the pedestrian bridge over the Cherwell in Oxford University parks. It is an arch bridge prestressed by Freyssinet method.

B144. - - -, "Prestressed Cradles Pick up Bridge Piers," Construction Methods, 1950, Vol. 32, No. 1, pp. 46-48.

Description of prestressed beams which support bridge piers during a construction process. Method of tensioning the 3" square rods is explained. Not very complete.

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B145. Abeles, P. W., "Bonded Wire vs. Unbonded", Engineering News Record, July 26, 1951, Vol. 147, No. 4, p. 47. Reader Comment Section.

Bonded wires preferable. Combination of prestressed and unstressed wires mentioned. Economic advantages of prestressed concrete discussed.

B146. Astapkevic, P., "Montáž průmyslových staveb z předpřijátého betonu", (Erection of industrial buildings of prestressed concrete), Stavební průmysl (Prague), 1951, Vol. 1, No. 15, pp. 357-358.

Discussion of problems of erection of prestressed concrete structures.

B147. Arribahaute, Beteille, "Pont de la Genevraye", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 230-232.

Description of the construction of a prestressed concrete bridge at Genevraye. Girders precast and prestressed with large cables. The fabrication of the girders is explained step by step.

B148. Baretts, J.; Hervet, J.; Averseng, E.; "L'Evolution de la Précontrainte Enseignements déduits de la construction de divers ouvrages Pont d'Arles-sur-Tech," Travaux (Paris), 1951, Vol. 35, No. 200, pp. 408-412; No. 202, pp. 491-496.

Pictures of several bridges of prestressed concrete built after the war are included in this article. However, the bridge (Pont d'Arles-sur-Tech) is described more completely than the others. The construction of this bridge is also described.

B149. Barton, R. A., "Prestressed Bridge", California Highway and Public Works, 1951, Vol. 30, Nos. 3-4, pp 1-5, 28.

A description of the pedestrian bridge over Arroyo Seco flood channel in Los Angeles. Simple-span girders of 110-ft. span. Detailed explanation of precasting and prestressing operations, prestressing with the help of button-type anchorages. Strain-measuring devices left in the structure for measurements under live load.

B150. Baskin, B. J., "Prestressing Applied to Manufacture of Precast Bridge Beams", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 221-223.

This paper explains the manufacturing procedure of precast, prestressed, pretensioned beams for bridges. Tests were made to determine bond characteristics in the beam under loaded conditions for single notched wires and for 7-wire cables. It was concluded that a 1/4 in. diameter cable consisting of 7 strands was satisfactory for developing the bonds.

B151. Baxter, S. S.; Barofsky, M., "Construction of the Walnut Lane Bridge", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 47-56.

Description of the Walnut Lane Bridge. The reasons for choosing a prestressed concrete girder bridge is discussed. Cost data is given. Construction is described.

B152. Billner, K. P., "Mass-Produced Prestressed Concrete Units", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 112-125.

This paper describes the different methods of precasting and prestressing concrete members in factories in France, England, Italy, Sweden, and the United States. A discussion by D. O. McCall, of the Basalt Rock Company manufacturer of prestressed concrete beams, slabs, and other units, describes in more detail the methods employed in prestressing and uses made of prestressed concrete units in the United States.

B153. Birdsall, B., "Development of End Terminals", Proceedings of the First United States Conference on Prestressed Concrete Massachusetts Institute of Technology, August, 1951, pp. 224-227.

The end connections for prestressing cables as manufactured by John A. Roebling's Sons Inc., are briefly described.

B154. Bitzan, A., "Výroba a zkušenosti s dodatečně napínaným betonem", (Manufacture and experiences with pretensioned, prestressed concrete), Stavebni prumysl (Prague), 1951, Vol. 1, No. 15, pp. 350-353.

Outline of the principles which should be followed for obtaining good prestressed concrete products.

B155. Brodsky, A., "Mechanical Prestressing", Proceedings, American Concrete Institute, 1951, Vol. 47, No. 7, p. 570. Letters from Readers Section.

Very brief description of Lossier's method precasting girders in two parts, with reinforcement embedded. Prestressing achieved by jacking the two parts of the beam apart after hardening of the concrete.

B156. Bryan, R. H.; and Dozier, C. B., "Prestressed Concrete Block Bridges", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 57-60.

A short paper outlining the use of blocks used as units in prestressed concrete beams. A series of pictures shows the manufacture of beams and their construction into a bridge in Madison County, Tennessee.

B157. de Buffevent, L., Lossier, "Villeneuve-Saint-Georges", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 210-212.

Description of cantilever prestressed concrete bridge at Villeneuve-St. George.

B158. Clarke, N. W. B., "A Flexible Mould Stop for Long Line Prestressed Concrete", Civil Engineering and Public Works Review (London), 1951, Vol. 46, No. 539, pp. 351-352.

A rubber spacer to be used between the units poured in a single mould in the long-time process of prestressing concrete has been developed. It is easy to place, does not move from its position during vibration of concrete, can be used over and over, and is economical to use. They can easily be made to any desired shape by the contractor.

B159. Coff, L., "Prestressed Concrete for Pavements", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 87-90.

This paper advocates the use of prestressed concrete for use in highway slabs; advantages are elasticity of prestressed concrete slabs, fewer expansion joints, minimum cracking, and less maintainance.

B160. Cummings, A. E., "Prestressed Concrete Piles", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 105-111.

This paper deals with the manufacture and use of prestressed concrete piles.

B161. Dumas, F., "L'evolution de la précontrainte du béton armé au cours de la reconstruction des ouvrages d'art du Nord et du Pas-de-Calais", Travaux (Paris), 1951, Vol. 35, No. 200, pp. 375-382; No. 201, pp. 419-435; No. 202, pp. 462-479; No. 203, pp. 506-514; No. 204, pp. 568-577.

This series of articles presents pictures and descriptions of various degrees of completeness of many prestressed concrete bridges built in the last few years in France. In addition various tests conducted are reported, such as: loss of prestress under load, tensile tests of wire, compressive tests of concrete.

B162. Duminy; Lebelles; Beaufil, "Tranchee couverte de Rouen", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 215-218.

Description of the structure and construction of a shed in Rouen. Beams of prestressed concrete.

B163. Fougea, E.; Cayla, M., "Nouveau mode de mise en précontrainte", Travaux (Paris), 1951, Vol. 35, No. 198, pp. 323-330.

The authors describe the method of prestressing used by "Constructions Edmond Coignet" in box girders. It consists of anchoring

the ends of the cables at the ends of beams and then deforming the cables laterally at several points along their length; this lateral deformation of the cables stretches them thus tensioning them. It is claimed that this method gives a better distribution of tension in the cable than in a curved cable which is post-tensioned. A three span bridge (Pont de Vaux-sur-Seine) was prestressed in this manner and is discussed.

B164. Franz, "Le béton précontraint en Allemagne", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 246-247.

A brief paper which enumerates some of the structures built of prestressed concrete in Germany.

B165. Friberg, B. F., "The Challenge of Prestressing for Concrete Pavements", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 91-104.

This paper treats rather thoroughly the use of prestressed concrete for highway construction. Specifically the following topics are discussed: I. Existing State of Concrete Pavement; II. Scope of Prestressing in Concrete Pavements; III. Mechanics of Prestressing; IV. Details of the Prestressed Concrete Pavement; V. Economy of the Prestressed Concrete Pavements.

B166. Gannett, J. K.; Waidelich, A. T., "Prestressed Concrete in Buildings", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August 1951, pp. 67-86.

This paper discusses the practicality and economy of prestressed concrete for buildings in part I. In part II of the paper are described the tests on bonded and unbonded prestressed concrete girders carried out by the Austin Co. - no test data is given except concerning the behavior of the girders during the test. The paper is followed by discussions by P. F. Blair who described precast, prestressed, concrete girders used in buildings in Oklahoma, and by H. Thorsen who described precast, prestressed concrete girders used in European buildings.

B167. Gooding, "The Prestressed Development Group", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 237-238.

A very short description of the development work done in Great Britain in the field of prestressed concrete.

B168. Harris, J. D., "The Application of Prestressed Concrete to Highways and Bridges", Journal, Institute of Municipal Engineers (London), 1951, Vol. 77, No. 9, pp. 733-758.

Description of shortspan prestressed concrete bridges built in England and of a few long-span bridges built in continental Europe. Description of prestressed concrete slabs for highways.

B169. Hicks, J. N., "Current Developments in Prestressed Concrete", Proceedings of the Second Annual Structural Engineering Conference, Bulletin of the Florida Engineering and Experiment Station 47, pp. 31-35, 1951.

A discussion of the current developments in prestressed concrete which have been made by Roebbling's Sons Company. Discussion of the prestressing cables and of their use.

B170. Horel, J., "Napínání a kotvení předpjaté výztuže prvku dodatečně napínaných", (Prestressing and Anchorages of Prestressed Elements), Stavební průmysl (Prague), 1951, Vol. 1, No. 15, pp. 346-350.

Description of anchorages of Freyssinet and related types.

B171. Johnson, C. L., "The John R. Bridge", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 61-64.

A short paper augmented with photographs which describes the assembling of prestressed beams using I-shaped elements. These particular beams were used in a bridge in Oakland Company, Michigan. One similar 60 ft. girder was tested - its behavior during loading is briefly described.

B172. Klett, E., "Die Spannbetonbrücke der Bundesbahn über den Neckarkanal in Heilbrunn", Beton-und Stahlbetonbau (Berlin), 1951, Vol. 46, No. 7, pp. 145-150; No. 8, pp. 180-184.

Description of prestressed concrete railway bridge over Neckar canal in Heilbrunn. Bridge is composed of continuous girders. Prestress wires were wrapped around massive concrete blocks which were jacked apart for prestressing the wires. Two small beams which were tested are discussed.

B173. Korvas, A., "Výrobní a přípravné problémy při prefabrikaci, těžké, montáži a při předpínání betonu", (Problems of manufacture for precasting, heavy erection and prestressing of concrete), Stavební průmysl (Prague), 1951, Vol. 1, No. 14, pp. 329-335.

One part of this paper is devoted to the discussion of manufacture of post-tensioned concrete elements. Special attention is paid to the problems connected with the manufacture of end blocks, to the methods of making the cable openings, and to prestressing.

B174. Leduc; Gapillout, "Usine Boneuil," Travaux (Paris) 1951, Vol. 35, No. 196, pp. 213-214.

Methods of manufacture of prestressed, precast, small beams and railway ties. Relative costs also discussed.

B175. Magnel, G., "Revolutionary Staircase Built of Prestressed Concrete", Civil Engineering, 1951, Vol. 21, No. 9, pp. 505-507.

Description of helical staircase built of prestressed concrete in Antwerp. Short summary of the design and description of the tests of a full-scale model built at the University of Ghent.

B176. Mass, M. L.; Janney, J. R., "Simple Equipment Economically Explores Prestressing", Proceedings, American Concrete Institute, 1951, Vol. 47, No. 5, pp. 361-364.

Description of a simple procedure of prestressing and anchoring the wires suitable for small laboratory research and instruction work.

B177. Middendorf, K. H.; Panhorst, F. W., "The Arroyo Seco Bridge", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 65-66.

A short paper describing the construction of the prestressed concrete girders of the Arroyo Seco Pedestrian Bridge.

B178. Mitchell, S., "Are Prestressed Bridges Cheaper?", Proceedings, American Concrete Institute, 1951, Vol. 47, No. 10, pp. 761-772.

Discussion of the construction and costs of the pedestrian bridge over Arroyo Seco in Los Angeles. High costs of prestressing are pointed out. It is pointed out also that further studies and better specifications are needed to promote the use of prestressed concrete.

B179. Morandi, R., "Sur la réalisation d'ouvrages en béton précontraint", La Ricerca Scientifica (Rome), 1951, Vol. 21, No. 2, pp. 227-231.

The author describes his method of prestressing and his patented wedging-type anchorage. Several structures built by their method are described.

B180. Neuffer, W., "Stahlbeton im Ausland", Beton-und Stahlbetonbau (Berlin), November, 1951, Vol. 46, No. 10, pp. 217-222; No. 11, pp. 247-253.

This article describes concrete bridges, most of which are prestressed, built in European countries other than Germany.

B181. Nicolle; Muller, J., "Parking souterrain," Travaux, (Paris), 1951, Vol. 35, No. 196, pp. 218-219.

Description of underground parking garage under construction. Precast and prestressed beams.

B182. Parrett, J. J., "First Prestressed Piles Carry Tank Platform", Engineering News Record, July 5, 1951, Vol. 147, No. 1, pp. 38-39.

Description of construction of concrete piles prestressed at 8 points along the circumference. Prestress accomplished by Freyssinet method. All wires grouted in and piles cut-off after hardening of the grout.

B183. Pauw, A.; Reid, R. L., "Lightweight Prefabricated Joist-Slab-Beams of Prestressed Concrete", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 247-252.

This paper discusses the problems encountered in the production of small precast prestressed concrete members. Economy, materials, anchorage, and bond are discussed. Tests made to solve some of these problems are discussed.

B184. Philippi, "Les supports caténares en béton précontraint sur la ligne électrifiée Paris-Lyon", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 233-235.

This article describes the prestressed concrete poles which are used to support the electric lines along the railroad Paris-Lyon. The poles are trussed and precast. The precasting and prestressing operations are explained.

B185. Stepanek, V., "Konstrukce předem napínané - konstrukční a výrobní zkušenosti", (Pre-tensioned Structures - Experiences from Construction and Manufacture), Stavební průmysl (Prague), 1951, Vol. 1, No. 15, pp. 353-357.

Discussion of the merits and disadvantages of longline and individual unit processes.

B186. Stöhr, W., "Die neue Kanalhafenbrücke in Heilbronn", Beton-und Stahlbetonbau (Berlin), 1951, Vol. 46, No. 2, pp. 30-32.

Description of a prestressed arch bridge over the canal in Heilbronn. End anchored cables, grouted for bond were used for prestressing.

B187. Storrer, "Le pont de Sclayn a Namur", Travaux (Paris) 1951, Vol. 35, No. 196, pp. 242-243.

Description of a two span continuous bridge in Belgium prestressed by the Magnel-Blaton system. Dimensions of the structure and quantities of materials are given.

B188. Vallette, R., "Emploi du fil a haute limite élastique et réglage des contraintes dans les constructions", Annales de L'Institut Technique de Batiment et des Travaux Publics, New Series, Theories and Methods of Design No. 14, 1951.

The author advances the idea that prestressing is a means of utilizing high strength wire without danger of excessive deflections. He gives examples of parabolic shaped prestressed concrete beams and trusses which would require the minimum amount of materials.

B189. Vasseur; Schere, "Reconstruction du hangar 1 du quai de la Garonne, dit 'Hangar aux Contons'", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 225-226.

Description of the reconstruction of a hangar damaged during the war. Prestressed concrete used in order to have a fireproof structure.

B190. Voss, W. C., "Prestressed Units", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 253.

This paper discusses the manufacture of precast prestressed units with respect to economy and efficiency.

B191. Zollman, C. C., "Survey of European Prestressed Concrete Bridge Construction", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 30-46.

A description of several large prestressed concrete bridges. The dimensions of spans, and cross-sections augmented with photographs are given. Construction techniques are discussed. Reasons for economy are discussed.

B192. - - -, "A Continuous Concrete Bridge in France", Concrete and Constructional Engineering (London), 1951, Vol. 46, No. 1, pp. 1-27.

The construction and design of this bridge is explained in this article. The beams are precast and prestressed to carry their own weight on the ground. After being placed on the piers, the beams are further prestressed in such a manner that they act as one continuous beam instead of 3 spans of simple beams.

B193. - - -, "Bridge Built of Blocks Strung Like Beads," Engineering News Record, January 18, 1951, Vol. 146, No. 3, pp. 39-42.

Description of the development of prestressed concrete block beams by Bryan and Dozier in Nashville, Tenn. Construction of a three simple span bridge and a football stadium made of such beams is described.

B194. - - -, "Cast-in-place Concrete Bridge Beams Prestressed", Engineering News Record, December 13, 1951, Vol. 147, No. 24, p. 42.

Short description of prestressed concrete bridge under construction in Austin County, Texas.

B195. - - -, "Concrete Prestressed in Tension", Engineering News Record, May 3, 1951, Vol. 146, No. 18, p. 33.

K. Billig's suggestion for relief of high compression in concrete columns and arches by embedding a steel strut precompressed by a steel cable.

B196. - - -, "Construction of a Road in Prestressed Concrete", Civil Engineering and Public Works Review (London), 1951, Vol. 46, No. 538, pp. 254-255.

400 ft. of highway was constructed of prestressed concrete at Crawley, in Sussex, in order to study the feasibility of prestressed concrete roads. Strain measurements and behavior will be observed over a period of several months. Freyssinet cables were used. Construction procedure was described. Advantages are listed as: (a) elimination of cracks; (b) reduction in number of expansion joints; (c) improvements in riding; (d) low maintenance.

Disadvantages are listed as: (a) difficulty in reinstating when one part is removed for some reason; (b) complicated nature of expansion joints.

B197. - - -, "India Begins Construction of its First Prestressed Concrete Road Bridge", Engineering News Record, December 13, 1951, Vol. 147, No. 24, pp. 51-52.

Short description of a road bridge in Madras State. The bridge will have 23 spans, beams will be prestressed by the Magnel-Blaton system. One of the beams will be tested to destruction.

B198. - - -, "New Idea for Prestressing Concrete, Apply Prestress with Glass", Engineering News Record, March 1, 1951, Vol. 146, No. 9, p. 45.

Prestressing with glass fibres is discussed. This method is suggested by Professor I. A. Rubinsky of the American University in Beirut, Lebanon.

B199. - - -, "Novel Prestress Design for Office Building", Engineering News Record, October 18, 1951, Vol. 147, No. 16, p. 38.

Discussion of a factory floor with prestressed girders and beams with a slab of ordinary reinforced concrete. The structure was in part precast and in part cast in place.

B200. - - -, "Plant for Prestressing Concrete", Ministry of Works (London), National Building Studies Bulletin No. 12, 1951, (H. M. Stationary Office).

This bulletin is of principle interest because of its descriptive photographs of anchorages for wires. Also described is the method of manufacture used by Ministry of Works in England.

B201. - - -, "Prestressed Block Beams Span 43 ft.", Engineering News Record, October 25, 1951, Vol. 147, No. 17, pp. 30-31.

Description of the manufacture of prestressed concrete bridge beams made up of precast concrete blocks in Detroit, Michigan.

B202. - - -, "Prestressed Concrete Footbridge at Oxford," Builder (London), 1951, Vol. 180, No. 5632, pp. 131-133.

Brief description of a fixed arch footbridge at Oxford prestressed by Freyssinet system.

B203. - - -, "Prestressed Concrete Road at Crawley", Concrete and Constructional Engineering (London), 1951, Vol. 46, No. 5, pp. 147-149.

Description of the construction of a 400-ft. strip of roadway built of prestressed concrete in England. Roadway is prestressed by Freyssinet cables.

B204. - - -, "Prestressed Concrete Warehouse", Concrete and Constructional Engineering(London), 1951, Vol. 46, No. 3, pp. 92-93.

Brief description of the construction of a warehouse for H. M. Stationary Office in England. Floors and roofs of this building were built of prestressed, precast concrete beams. Prestressing by Magnel's system.

B205. - - -, "Prestressed Roof Beams Get First U. S. Try-out", Engineering News Record, October 25, 1951, Vol. 147, No. 17, p. 32.

Description of two factory roofs built with prestressed concrete beams in Tulsa, Oklahoma.

B206. - - -, "Repair of an Arch Bridge with Expanding Cement", Concrete and Constructional Engineering (London), 1951, Vol. 46, No. 4, pp. 119-121.

Paper describes the procedure of using expanding cement for repair of an arch damaged by settlement of one pier. Repair was designed by Lossier.

B207. - - -, "Rigid Frame Bridge on Prestressed Concrete", Engineering News Record, March 15, 1951, Vol. 146, No. 11, p. 35.

Brief description of the footbridge over a branch of the Cherwell River in Oxford, England.

B208. - - -, "Road Prestressed to Prevent Cracks", Engineering News Record, April 12, 1951, Vol. 146, No. 15, p. 37.

400 ft. of roadway in England is prestressed as an experiment. Expected results are prevention of cracks, reduced number of expansion

joints, improve riding quality, lower maintenance costs. Construction procedure and prestressing method is given.

B209. - - -, "Simple Prestressing System for Pedestrian Bridge", Engineering News Record, May 10, 1951, Vol. 146, No. 19, pp. 40-41.

This article is concerned with the pedestrian bridge over the Arroyo Seco in Los Angeles. Prestressing was done according to Prestressed Concrete Corporation of Kansas City. Five wires stretched at a time. Consists of 2 girders 110 ft. long by 5'-8" deep I-sections. Prestressing technique, including difficulties encountered, is given. Button-heads were put on end of wire.

B210. - - -, "The Festival Exhibition Footbridges", Civil Engineering and Public Works Review (London), 1951, Vol. 46, No. 539, pp. 346-348.

Several pedestrian bridges have been built on the sight of the Festival of Britain. One such bridge is of prestressed concrete. The one single main beam supports a slab (cantilevered on both sides) about 12 ft. wide. The bridge is continuous and length of spans vary from 54 ft. to 76 ft. Freyssinet cables were used.

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A4, A9, A18, A27, A65, A107, C2, C9, C11, C20, C24, C27, C30, C51, D72, D74, D80, D81, D90, D94, D101, E44.

C. Design

1938

C1. Kilgus, E. M., "Möglichkeiten des Eiseneinsparens", Zement (Berlin), 1938, No. 23, pp. 26-28.

Prestressed hollow concrete mast is compared with one made of ordinary reinforced concrete and it is shown that the prestressed mast is more economical in the amount of steel needed.

1939

C2. Hoyer, E., "Der Stahlsaitenbeton", Band I, Träger und Platten, Berlin-Wien-Leipzig, 1939, (Otto Elsner Verlagsgesellschaft).

This book is divided into three chapters: First, general chapter is a discussion of the prestressed concrete in comparison with an ordinary reinforced concrete, description of materials suitable for prestressed concrete. Both pre- and post-tensioned types are mentioned. Hoyer stresses the increase of the cracking load. The second chapter deals with the design of pretensioned members. The third is a description of the manufacture of pretensioned concrete members. The fourth chapter is a report of 8 series of tests all on pretensioned beams or related problems:

1. beam tests; 2. beam tests; 3. beam and floor tests;
4. bond tests; 5. beam tests; 6. beam tests - effect of age; 7. sustain-load tests of steel; 8. fatigue tests of beams.

1941

C3. Fornerod, M., "Factors in Prestressed Girder Design", Proceedings, American Concrete Institute, 1941, Vol. 47, No. 6, pp. 469-480.

Discussion of a design theory in relation to the Walnut Lane Bridge. With the exception of the span length and the external load, the most important factors in the design are the ratio of the L. L. to D.L., shape of cross section, method of prestressing and erection, and the total allowance for the losses of prestress. Brief mention of the test of the Walnut Lane Bridge girder.

1942

C4. Bertin, R. L., "Saving Steel in Reinforced Concrete", Proceedings, American Concrete Institute, 1942, Vol. 38, No. 4, pp. 281-288.

In discussion of this paper concerned with economy in the use of reinforcement Shorer and Kauf point out the feasibility of saving steel by use of prestressed concrete.

1943

C5. Billig, K., "Prestressed Reinforced Concrete", Jamaica, New York, 1943, (F. Billig).

General discussion of the developments and various methods of prestressing. Section on tests gives only incomplete information. Design theory for tension and flexural members is given.

1944

C6. Guyon, Y., "Poutres et dalles précontraintes", Institut Technique du Batiment et des Travaux Publics (Paris), Circulaire Serie J, No. 3, 1944.

Design of flexural members dealt with at length. Resistance to shear discussed and examples worked out. Both cables and individual wires considered.

1945

C7. Abeles, P. W., "Fully and Partly Prestressed Reinforced Concrete", Proceedings, American Concrete Institute, 1945, Vol. 41, No. 3, pp. 181-214.

A discussion of tests conducted by others. A history of development of prestressed concrete. Relative merits of full and partial prestressing where cracks are objectionable or where maximum design load is very infrequent.

C8. Guyon, Y., "Etude sur les poutres continues et sur certains systemes hyperstatiques en beton précontraint", Institut Technique du Batiment et des Travaux Publics, Circulaire Serie J, No. 8, Paris, 1945.

The paper deals with the design of continuous beams and frames of prestressed concrete. Particular attention is given to finding the eccentricity of the prestressing cables for all points along the beam. Examples included.

1946

C9. Abeles, P. W., "Beams in Prestressed Reinforced Concrete", Concrete and Constructional Engineering (London), 1946, Vol. 41, Nos. 6-8, pp. 147-154, 191-199, 225-230.

Description of the behavior of prestressed concrete beams at low loads. Working stress design formulas given. Description of prestressed members of existing bridges. Most of the material the same as in Abeles' book "Principles and Practices of Prestressed Concrete".

C10. Magnel, G., "Béton précontraint", Annales des Travaux Publics de Belgique, April, 1946.

This article is concerned with the design of simply supported flexural members. Methods of analysis and examples are given. Beams of variable moment of inertia are discussed. Much of this material is in Magnel's book.

C11. Pacholik, L., "Konstrukce c predpjateho betonu", (Prestressed concrete structures), Series "Konstrukter" No. 22, Prague 1946, (Publisher Gregr).

Description of the basic principles of prestressed concrete, design theory and examples, construction procedures and examples of existing structures.

C12. Schorer, H., "Analysis and Design of Elementary Prestressed Concrete Members", Proceedings, American Concrete Institute, 1946, Vol. 43, No. 1, pp. 49-87.

A fairly complete derivation of formulas required for the design of simply supported members of prestressed concrete. Also formulas for ultimate resisting moment. Examples given.

1947

C13. Weinberg, V., "Le béton précontraint", Paris (Dunod, 92 Rue Bonaparte) 1947.

This book deals mostly with methods of design. Some discussion of the behavior and characteristics of prestressed concrete and materials thereof is added. Several design examples are included.

C14. - - -, "Road Bridge Design", The Reinforced Concrete Review, (London), Vol. 1, No. 7, pp. 205-206, 1947.

Abstract of a paper by J. E. Jones in which comparison was made between prestressed concrete slab bridges and similar bridges in reinforced concrete.

1948

C15. Abeles, P. W., "Examples of the Design of Prestressed Concrete Beams", Concrete and Constructional Engineering (London), 1948, Vol. 43, No. 5, p. 149.

Method of section design with examples. Discussion of prestressing the continuous beams - the present design of continuous beam is considered inadequate.

C16. Abeles, P. W., "The Behavior of Prestressed Concrete at Cracking", Int. Assoc. Bridge and Struct. Eng., Third Congress, Final Report, Liege 1948, pp. 373-378.

Discussion of the allowable stresses with reference to the cracking characteristics of prestressed concrete beams. Based on British and Swiss tests.

C17. Abeles, P. W., "The Economy of Prestressed Concrete", Int. Assoc. Bridge and Struct. Eng., Third Congress, Final Report, Liege 1948, pp. 373-378.

A comparative study based on conditions in Great Britain. Full prestress vs. partial prestress. Prestress vs. steel. Favors partial prestress.

C18. Baretts, T., "Method pour la determination rapids des diagrammes d'efforts tranchants reduits optima dans le poutres en beton précontraint a cables releves", Travaux (Paris), 1948, Vol. 32, No. 168, pp. 541-544.

A graphical method for determination of optimum spacing for curved-up cables in prestressed concrete beams.

C19. Billig, K., "A Proposal for a Draft Code of Practice for Prestressed Reinforced Concrete", (P.R.C.), London 1948.

A tentative proposal of specifications published as a pamphlet.

C20. Magnel, G., "Béton précontraint", French Edition, Ghent 1948 (published by Fecheyer). First English Edition, London 1948, (Concrete Publications Limited), Second English Edition London 1950.

General reference concerned primarily with beams. A large portion of this book is devoted to Magnel's tests.

C21. Abeles, P. W., "Principles and Practices of Prestressed Concrete", British Edition 1948, American Edition (Ungar Publ. Co.) New York 1949.

This book deals mainly with prestressed concrete beams.

1949

C22. Baker, A. L. L., "Reinforced Concrete", London 1949, (Concrete Publications Ltd.).

Chapter VI on pp. 165-196 deals with prestressed concrete; partly general discussion of the principles involved, but largely with design on the basis of working loads.

C23. Billig, K., "The Ultimate Load and Factor of Safety of Prestressed Concrete", Civil Engineering and Public Works Review (London), 1949, Vol. 44, No. 520, pp. 579-581
 No. 521, pp. 651-654
 No. 522, pp. 721-723
 1950, Vol. 45, No. 523, pp. 39-40

Design procedure based on Bernoulli's hypothesis, statics, and stress-strain diagrams for steel and concrete. Numerical values computed for a pole are compared with the test results.

C24. Dischinger, F., "Stahlbrücken im Verbund mit Stahlbetondruckplatten bei gleichzeitiger Vorspannung durch hochwertige Seile," Der Bauingenieur (Berlin), 1949, Vol. 24, Nos. 11-12, pp. 321-332, 364-376.

This paper deals with the subject of prestressing composite steel and concrete girder bridges. Typical examples of stress analysis under various conditions are given. The Dischinger-Finsterwalder method of prestressing.

1950

C25. Baker, A. L. L., "A Plastic Design Theory for Reinforced and Prestressed Concrete Shell Roofs", Magazine of Concrete Research (London), 1950, Vol. 2, No. 4, pp. 27-34.

A theory is proposed which provides a simple method for designing shell roofs, including prestressed shells. This method takes into account the plasticity and cracking of the concrete as the ultimate load is approached. The possible limits of shear stress distribution across a transverse section are considered and it is shown that the bending moment does not vary greatly between these limits. The theory is intended as a basis for experimental work to be done in the near future at Imperial College, London.

C26. Balaca, A. P., "Dimensionamientos anelásticos en hormigón pretensado", Informes de la Construcción (Madrid), October, 1950, Vol. 3, No. 24, Section 457-1, pp. 1-7

Ultimate design of prestressed concrete beams.

C27. Bruggeling, A.S.G.; Hartman, J.A.H.; Meischke, J. C., "Voorgespannen Beton", 1950, Uitgeverij Waltman, pp. 268.

This book would be of interest to both students and designing engineers. The book contains the general and basic concepts of prestressed concrete, methods of prestressing and fabrication, properties of materials, a large section on design and analysis, and a section on description of structures built.

C28. King, J. W. H., "The Design of Prestressed Concrete Beams from Fundamental Principles", Concrete and Constructional Engineering (London), 1950, Vol. 45, No. 9, pp. 307-319.

Outline of principles for design of prestressed concrete beams. This design is based on Bernoulli's hypothesis, statics, and stress-strain diagrams for steel and concrete. Pre-tensioned and post-tensioned (both bonded and unbonded) types are discussed. Numerical examples are given.

C29. Lämmlein, A., "Ueber the Wirtschaftlichkeit von Spannbeton-Strassen-Brücken", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 3, pp. 66-68.

Economic comparative study of a highway bridge design in prestressed and reinforced concrete. The prestressed concrete bridge was more economical both in quantities of materials and overall costs. The prestressed structure was built.

C30. Magnel, G., "Prestressed Concrete", London 1948 (Concrete Publications Ltd.), Second Edition, London 1950.

English edition of the book Béton précontraint by the same author.

C31. Rüsck, H., "Erläuterungen zu den Richtlinien für die Bemessung vorgespannter Stahlbetonbauteile", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 5, pp. 108-116.

Explanations to the German specifications (1950) for prestressed concrete.

C32. Silvera, V. M., "A Method of Design for Shell Concrete Roofs Using Prestressed Edge Beams", Magazine of Concrete Research (London), 1950, Vol. 2, No. 4, pp. 9-14.

Design theory described.

C33. Uziel, F. J., "Determining Optimum Cross Section for Prestressed Concrete Girders", Proceedings American Concrete Institute, 1950, Vol. 47, No. 3, pp. 197-212.

Formulas for the design of simply supported prestressed concrete girders, based on allowable stresses.

C34. - - -, "Vorgespannte Stahlbetonbauteile, Richtlinien für die Bemessung", Beton und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 4, pp. 80-90.

German tentative specifications for prestressed concrete.

1951

C35. Abeles, P. W., "The Ultimate Resistance of Prestressed Concrete Beams", Concrete and Constructional Engineering (London), 1951, Vol. 46, No. 10, pp. 295-303.

This paper discusses ultimate failures of prestressed concrete beams and offers design formulas for bonded and unbonded cases of rectangular and I-sections.

C36. Billig, K., "Pretensioned Concrete", Civil Engineering and Public Works Review (London), 1951, Vol. 46, Nos. 536, 537, pp. 96-98, 181-182.

A method is suggested for pre-tensioning compression members such as columns and arches in order to reduce the dead load.

C37. Billner, K. P., "Economical Cross Section of Prestressed I-Beams and Box Girders Determined Graphically", Proceedings, American Concrete Institute, 1951, Vol. 47, No. 7, pp. 565-567, Letters from Readers Section.

A trial and error design method. Tension is not permitted in the concrete.

C38. Bjuggren, Ulf, "The Ultimate Bending Strength of Bonded Prestressed Concrete", Congrès International du Béton Précontraint, Communication No. B-10, 1951.

This paper presents an ultimate design theory for bonded prestressed concrete beams. The method incorporates a factor of safety of 1.2 against cracking and 2.5 against bending failure. It is used in design of beams at AB Betong industri's factory in Stockholm.

C39. Brown, V. J., "How to Design a Prestressed Concrete Tee Beam", Roads and Streets, June, 1951, Vol. 94, No. 6, pp. 47-54.

This paper goes through step-by-step the design of T-beam girders of 75 ft. span for a bridge over the Rio Grande River in New Mexico. The design was made by engineers of the John A. Roebling's Sons Co. and features the Roebling cable and end anchorages.

C40. Bruggeling, A.S.G., "Coefficients pour dimensionner les constructions en béton précontraint, Constructions Isostatiques", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 247-253.

Set of tables for the design of I- and T-beams.

C41. Channey, D. L., "Design of Prestressed Concrete", Proceedings of the Second Annual Structural Engineering Conference, Bulletin of the Florida Engineering Experiment Station 47, 1951, pp. 22-26.

Fundamental principles of the design of prestressed concrete sections.

C42. Coff, L., "Fine Wires Uneconomical", Engineering News Record, May 24, 1951, Vol. 146, No. 21, p. 47. Reader Comment Section.

Discussion of Abeles' paper ENR April 12, p. 42. Coff suggests that cables are more logical and economical for the American practice.

C43. Coff, L., "Prestressed Roads Favored", Engineering News Record, June 28, 1951, Vol. 146, No. 26, p. 46. Reader Comment Section.

In this discussion of the paper "Roads prestressed to prevent cracks" (ENR April 12, 1951, p. 37) it is pointed out that crackless roadways of prestressed concrete might be an acceptable solution in spite of the higher initial costs.

C44. Devis, C. E., "Prestressed Concrete: Outline of Design for Bending Stresses", Magazine of Concrete Research (London), 1951, No. 6, pp. 123-126.

Design procedure for beams. It is recommended to use a rectangular section as a preliminary guide for the design. Simple expressions for losses of prestress. Nothing new.

C45. Feld, J., "Watchmaking Prestressing", Engineering News Record, October 11, 1951, Vol. 147, No. 15, pp. 48-51. Reader Comment Section.

General comments to the First US Conference on Prestressed Concrete. The author expresses his opinion that prestressing methods of the present day are too costly for the American market.

C46. Fornerod, M., "General Design and Economic Considerations in the Planning of Prestressed Concrete Structures", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 178-185.

This paper presents a broad outline of the problems connected with prestressed concrete. The paper is discussed with W. E. Dean of Florida Bridge Dept. with respect to factor of safety and cost.

C47. Freyssinet; Magnel; Lardy; Lossier; Baker; Abeles; Lee; Singleton-Green, "Notation for Prestressed Concrete", Concrete and Constructional Engineering (London), 1951, Vol. 46, No. 2, pp. 61-63.

Each of the authors states his views in a separate paragraph on the desirability and chance of establishing an international standard notation for prestressed concrete design. Most authors agree that such notation would be desirable but impossible; no such standardization was ever achieved even for reinforced concrete.

C48. Germundsson, T., "Prestressed Concrete Design Concepts", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 186-194.

This paper outlines the steps encountered in designing a girder and works through a design problem for illustration. Behavior at various states of loading is discussed. The paper is discussed by the late Dean Peabody who briefly discusses working stresses and design methods.

C49. Hadley, H. M., "Why Prestress?", Engineering News Record, December 20, 1951, Vol. 147, No. 25, p. 11. Reader Comment Section.

Short discussion of Feld's letter (ENR October 11, 1951, p. 49) in which Hadley concurs with the opinion that present methods of prestressing are too expensive.

C50. King, J.W.H., "A Fundamental Approach to Prestressed Concrete Design", The Structural Engineer (London), 1951, Vol. 29, No. 1, pp. 12-20.

A design procedure based on the flexure formula. All that is necessary is to know the stress-strain properties of the concrete and of the steel. Examples are worked for illustration.

C51. Kirkland, C.W.; Goldstein, A., "The Design and Construction of a Large Span Prestressed Concrete Shell Roof", The Structural Engineer (London), 1951, Vol. 29, No. 4, pp. 107-127.

Description of the design problems and procedures and of the construction of a large garage in England.

C52. Lazarides, T. O., "The Use of Unstressed Wires in Pre-tensioned Concrete Members", Magazine of Concrete Research (London), 1951, Vol. 2, No. 6, pp. 119-122.

In the serial fabrication of pre-tensioned wires odd lengths of wire are left over. These odd lengths may be used effectively as additional unstressed reinforcement on the compression side to prevent danger of breaking the beams during handling or as stirrups.

C53. Mahler, M., "Whither Prestressing?", Engineering News Record, December 27, 1951, Vol. 147, No. 26, p. 7, Reader Comment Section.

Discussion of letters by Feld (Eng., October 11, p. 48) and by Winter (ENR, Nov. 1, p. 65) in which Mahler advances the opinion

that there is nothing wrong with using European techniques at first. He also advocates teaching of prestressed concrete as a separate subject.

C54. Parme, A. L.; Paris, G. H., "Analysis of Continuous Prestressed Concrete Structures", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 195-206.

This paper deals with the analysis of continuous members of prestressed concrete. Particular attention is given to beams with continuous curved cables, discontinuous straight cables, curved and straight haunches. Tables are given for finding the moments for these various conditions.

C55. Parme, A.L.; Paris, G.H., "Designing for Continuity in Prestressed Concrete Structures", Proceedings, American Concrete Institute, 1951, Vol. 48, No. 1, pp. 45-64.

Outline of a design procedure for continuous prestressed concrete beams with numerical examples. Design is based on working loads, but factor of safety against the ultimate capacity of the design section is also considered.

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A-4, A-75, A-76, A-78, B-80, B-99, D-14, D-39, D-67, D-70, D-85, D-90,
D-93.

D. Miscellaneous

1907-1933

D1. Koenen, M., "Wie kann die Anwendung des Eisenbetones in der Eisenbahnverwaltung wesentlich gefordert werden", Zentralblatt der Bauverwaltung (Berlin), September 28, 1907, Vol. 27, No. 79, pp. 520-522.

Koenen suggests that the cracking load of a reinforced concrete beam may be increased by pretensioning the reinforcing bars. The paper contains a scheme for pretensioning (a similar scheme was used later by Bach and Graf) and gives an example of calculating the stresses before cracking.

D2. Polivka, J. J., "Wettsteinove betonové desky (prkna)", Technická encyklopedie, Vol. 15, pp. 335-336, Prague, 1933. English translation in ACI Proceedings Vol. 46, pp. 724-4--724-5, 1950.

Description of prestressed concrete planks pretensioned with piano wire. Manufacture began around 1920.

1935

D3. Freyssinet, E., "Progres pratique des methodes de traitement mécanique des bétons", Travaux (Paris), 1935, Vol. 19, No. 30, pp. 199-210.

General discussion of prestressed concrete. Detailed descriptions of some of his structures.

D4. Freyssinet, E., "Une révolution dans les techniques de béton", Bulletin de la Société des Ingenieurs Civils, Paris, 1935, pp. 643-674.

Freyssinet's theory of molecular attraction; an attempt to explain shrinkage and creep of concrete is discussed at length. The process and advantages of prestressing are described. Tests of prestressed concrete masts are compared with the results of tests of masts of ordinary reinforced concrete. Description of various applications of prestressed concrete.

1936

D5. Freyssinet, E., "A Revolution in the Technique of the Utilization of Concrete", The Structural Engineer (London), 1936, Vol. 14, No. 5, pp. 242-262.

This is the same material as in the paper "Une révolution dans les techniques de béton" Paris 1935.

D6. Freyssinet, E., "Practical Improvements in the Mechanical Treatment of Concrete", Int. Assoc. Bridge and Struct. Eng., Second Congress, Preliminary Publication, Berlin 1936 (W. Ernst), pp. 197-222.

Similar to "A Revolution in the Technique of Utilization of Concrete", except that it does not include his theory of hardening of concrete.

D7. Lossier, H., "Les fissures du beton arme", Genie Civil (Paris), 1936, Vol. 108, No. 8-9, pp. 182-186, 202-206.

Discussion of the cracking of reinforced concrete. Explanation of the principles of prestressed concrete and examples of various structures built of prestressed concrete. Discussion of the possibilities of the use of expanding cements as the prestressing medium and mention of the tests made with these cements.

D8. Mautner, K. W., "Spannbeton nach dem Freyssinet-Verfahren", Beton und Eisen (Berlin), 1936, Vol. 35, No. 19, pp. 320-324.

Discussion of the basic principles and advantages of prestressed concrete. Discussion of the test of a prestressed concrete I-beam (same as reported by Opperman in 1940 in more detail) and of tests of prestressed concrete pipes.

D9. Mautner, K. W., "The Elimination of Tension in Concrete and the Use of High Tensile Steel by the Freyssinet Method", Int. Assoc. Bridge and Struct. Eng., Second Congress, Final Report, Berlin 1936, (W. Ernst).

Brief review of Freyssinet's work in prestressing. Discussion of the necessity of using the high strength wire. It is argued that a lower factor of safety may be used for prestressing than for ordinary concrete work as prestressed concrete is free of cracks.

D10. Paris, A., "Mise en tension préalable des armatures du béton armé, son principe, son calcul, ses application", Bulletin Technique de la Suisse Romande (Lausanne), 1936, Vol. 62, No. 25, p. 303.

A preview of an article published by the same author and magazine a year later: "Mise en tension préalable des armatures du béton armé".

D11. - - -, "Une révolution dans les techniques du beton", Travaux (Paris), 1936, Vol. 20, No. 37, p. 17.

This is a resumé of the paper "Une révolution dans les techniques de béton" by E. Freyssinet (Paris 1935).

1937

D12. Kuhn, R., "Ein beachtenswerter Fortschritt im Eisenbetonbau", Die Bautechnik (Berlin), 1937, Vol. 15, No. 55, p. 738.

Short description of the basic idea of prestressed concrete and of a few works by Freyssinet and others.

D13. Lenk, K., "Herstellung und Anwendung von Spannbeton", Beton und Eisen (Berlin), 1937, Vol. 36, No. 10, pp. 161-169.

Short historical review. Description of basic principles. Manufacturing of high quality concrete discussed. Description of a test of an I-beam (same test described better by Opperman in 1940). Examples of use of prestressed concrete for pipes and beams cited. Short discussion of this paper by H. Craemer in dtto, Vol. 36, 1937, No. 18, pp. 303-304 and reply by Lenk on p. 304.

D14. Paris, A., "Mise en tension préalable des armatures du béton armé", Bulletin Technique de la Suisse Romande (Lausanne), 1937 Vol. 63, No. 1-3, pp. 2-6, 14-16, 28-34.

First part is devoted primarily to the methods of prestressing, second part to the technology of high strength concrete and third to the design principles and uses of prestressed concrete.

1938

D15. Friedrich, E., "Stahlseitenbetonträger in Hochbau", Deutsche Bauzeitung, 1938, Vol. 72, No. 39, pp. 1065-1068.

Describes some of beams built by Hoyer in Germany. Materials, method of prestressing and some tests are discussed briefly.

D16. Rosov, I. A., "Prestressed Reinforced Concrete and its Possibilities for Bridge Construction", Transactions, American Society of Civil Engineers, 1938, Vol. 103, pp. 1334-1365.

A fairly complete discussion of prestressed concrete simply supported flexural members. Formulas and design examples included. Especially interesting are the discussions by several prominent engineers who expressed their doubt as to the practicability of prestressed concrete.

D17. - - -, "Stahlseitenbeton", Schweizerische Bauzeitung (Zurich), 1938, Vol. 112, No. 8, p. 91.

Short summary of a report given by E. Hoyer at the convention of "die Deutsche Akademie für Bauforschung" in Munster (Germany) July 15-17, 1938. General description of pretensioned beams. Wire 0.5 to 3.0 mm., yield point 24000 kg/sq. cm.

1939

D18. Floris, A., "Steel String Concrete", Engineering News Record, August 3, 1939, Vol. 123, No. 5, p. 135.

Short elementary description of the behavior of prestressed concrete flexural members of Hoyer system.

D19. Kleinlogel, A., "Der Stahlseitenbeton System Hoyer", Beton und Eisen, (Berlin), 1939, Vol. 38, No. 8, pp. 141-147.

This paper gives a brief historical review of the European work on prestressed concrete and describes Hoyer's system. Tests, described in more detail in Hoyer's book, are summarized. The method of prestressing and the manufacturing process are described.

D20 - - -, "Recent Discussions of the Prestressing of Reinforced Concrete, Report of Committee on Masonry", Proceedings, American Railway Engineering Association, 1939, Vol. 40, pp. 431-432.

Very brief article which attempts to tell what prestressing concrete is; its advantages, purposes, etc. It also reviews some literature current to the time.

1940

D21. Emperger, F. v., "Ziel und Zweck der Vorspannung im Eisenbetonbau", Die Bautechnik (Berlin), 1940, Vol. 18, Nos. 22-23, pp. 253-255.

Emperger considers the elimination of cracking as the primary task of prestressing. An example is given in this paper which illustrates saving of steel by adding few prestressed wires to a beam of ordinary reinforced concrete. Problems of simplified prestressing techniques are discussed shortly.

D22. Friedrich, E., "Die Verwandung von hochwertigen Baustählen und die Wege zur Eisenersparniss im Eisenbetonbau", Beton und Eisen (Berlin), 1940, Vol. 39, No. 1, pp. 11-16.

One short paragraph in this paper deals with prestressed concrete construction. It includes some historical information and reasons for use of high strength steel in prestressed concrete.

D23. Gueritte, T. J., "Development of Prestressed Concrete - Economy in the Use of Steel", Civil Engineering and Public Works Review (London), 1940, Vol. 35, No. 409, pp. 201-204.

Basic theory and advantages of prestressed concrete. Long line manufacturing process. Test of one beam from the long line process - complete test procedure given, but data on the properties of materials incomplete. Savings of materials discussed briefly.

D24. Gueritte, T. J., "Recent Developments of Prestressed Concrete Construction with Resulting Economy in Use of Steel", Structural Engineer (London), 1940, Vol. 18, No. 7, pp. 626-642.

Short resume of Freyssinet's work. Description of manufacture of precast and cast in place beams. Test of one beam described. Mautner's appendix on design.

D25. Pistor, "Die Anwendung von Vorspannungen im Stahlbetonbau", Beton und Eisen (Berlin), 1940, Vol. 39, No. 11, pp. 150-154.

Discussion of the general behavior and basic principles of prestressed concrete. Description of various systems of prestressing, particularly of that advocated by Dischinger and Finsterwalder. Description of few structures.

1941

D26. Billig, K., "Prestressed Reinforced Concrete", Transaction, Institute of Civil Engineers of Ireland (Dublin), 1941, Vol. 68, pp. 33-90.

The author discusses briefly the cracking of reinforced concrete and the early attempts of preventing the cracking by prestressing. Short discussion of losses of prestress is followed by rather detailed description of various existing methods of prestressing. Short chapters are devoted to the description of existing structures and to discussion of tests. A rather lengthy part of the paper deals with shell structures. The paper is broad in scope, interesting and informative.

1942

D27. Campeau, C. E., "Étude du béton avec usage des précontraintes", Revue Trimesstrielle, Canadienne, 1942, Vol. 28, No. 112, pp. 444-460.

General discussion of the progress made in prestressed concrete in America. Design equations given and illustrated on an example. Means of prestressing and anchoring the wires listed. Need for tests discussed.

D28. Dodds, A. K., "Prestressed Concrete," Architect and Building News (London), 1942, Vol. 170, No. 3836, pp. 176-178.

Short discussion of the general subject of prestressed concrete.

D29. Ehlers, "Vom Stahlbeton zum Spannbeton", Der Bauingenieur (Berlin), 1942, Vol. 23, Nos. 40-42, pp. 300-302.

Discussion of the differences between the prestressed and ordinary reinforced concrete based on Freyssinet's paper "Une révolution dans l'art de bâtir: Les constructions précontraintes," Travaux 1941.

D30. Freyssinet, E., "L'emploi d'armatures précontraintes réglables dans les constructions en béton armé", Genie Civil, (Paris), 1942, Vol. 119, No. 24, p. 298.

Freyssinet reviews the work done by others in the field of prestressed concrete prior to his own work, and claims that he introduced the use of high strength wire to overcome the difficulties caused by creep. This article seems to have been inspired by a brief historical introduction to Lossier's paper "Types des pontes en béton armé avec armatures précontraintes réglables".

D31. Richart, F. E., "Prestressed Steel in Reinforced Concrete", Proceedings, American Concrete Institute, 1942, Vol. 39, No. 2, p. 126. Job Problems and Practice Section.

Richart answers the question regarding the use of prestressed concrete (in light of the knowledge and economic conditions of 1942). Used for tanks and similar structures where prevention of cracking is desirable.

D32. - - -, "Le beton precontraint", Travaux (Paris), 1942, Vol. 26, No. 108, pp. 170-171.

A brief article describing prestressed concrete and its advantages.

D33. - - -, "Prestressed Concrete", Science Library (London) Bibliography Series No. 572, 1942.

This is a list of references on prestressed concrete written between years 1936 and 1940. (All of these references are now included in this card catalogue.)

1943

D34. Abeles, P. W., "Prestressed Reinforced Concrete", Architects' Journal, (London), 1943, Vol. 97, No. 2526, pp. 410-411.

Short article on merits of partial prestressing.

D35. Evans, R. H., "Recent Developments in Structural Engineering", Engineering (London), 1943, Vol. 155, Nos. 4023-4024, pp. 155-156, 176.

A brief resume of the development of prestressed concrete.

Discussion of creep. Equations are given for principal stresses and factor of safety against cracking is discussed. A comparison of quantities of materials for a prestressed and an ordinary reinforced concrete beams is given.

D36. Freyssinet, E., "Une révolution dans l'art de bâtir; les constructions précontraints", Genie Civil (Paris), 1943, Vol. 120, No. 8, p. 95.

Freyssinet explains briefly the principle of prestressed concrete.

D37. Hajnal-Kanyi, K., "Prestressed Reinforced Concrete", Architects' Journal (London), 1943, Vol. 97, No. 2519, pp. 300-302.

Very brief resume of early attempts at prestressing. Explanation of elementary theory of prestressed concrete.

D38. Lenk, K., "Die Entwicklung des Spannbetons," Beton und Stahlbetonbau (Berlin), 1943, Vol. 42, Nos. 19-20, pp. 145-50.

Description of the evolution of prestressed concrete from conventional reinforced concrete, listing most of the early attempts made by European investigators. Credits Freyssinet with the actual development into a usable form. A few of the early prestressed concrete structures are described.

D39. Mörsch, E., "Spannbetonträger", Verlag von Konrad Wittwer in Stuttgart, 1943.

This book deals primarily with working load design of rectangular and I-cross sections. Short history and description of tests of two large beams (See Oppermann 1940) are included.

D40. Schorer, H., "Prestressed Concrete Design Principles and Reinforcing Units", Proceedings, American Concrete Institute, 1943, Vol. 39, No. 6, pp. 493-528.

General discussion of the basic concepts and various problems in prestressed concrete. Results of tests of prisms and beams are given in fairly complete form.

D41. Stucky, A., "Le béton précontraint (principes, matériaux et procédés)," Bulletin Technique de la Suisse Romande (Lausanne), 1943, Vol. 69, No. 14, pp. 161-168.

Explanation of the basic principles of prestressed concrete and discussion of such problems as cracking, creep, shrinkage. Description of prestressing methods, discussion of various tests.

1944

D42. Eteve, J., "Le beton précontraint: Technique. Utilisation. Application aux travaux coloniaux", Travaux (Paris), 1944, Vol. 28, No. 131, pp. 127-132, 136.

The author explains the disadvantages of the ordinary reinforced concrete and the theory and advantage of prestressed concrete. Description of several structures is followed by the description of Freyssinet's anchorages and of the pretensioned system without anchorages.

D43. Guyon, Y., "Theorie des poutres et dalles en béton précontraint", Institut Technique du Batiment et des Travaux Publics, Circulaire Series J, No. 1, Paris, 1944.

Discussion of the basic principles of prestressing for beams with constant cross-section. Description of Freyssinet's system of prestressing and of Freyssinet's double-acting jack. Prestressed beams are compared with beams of reinforced concrete and the savings in steel is pointed out.

D44. Murray, V. W., "Postwar Concrete Bridge Design", Roads and Bridges, 1944, Vol. 82, No. 11, pp. 56-57, 88-90.

Discussion of the possibility of using prestressed concrete for bridge construction and brief description of the fundamental principles of prestressing.

1945

D45. Magnel, G., "Prestressed Concrete - Some New Developments", Concrete and Constructional Engineering (London), 1945, Vol. 40, Nos. 11-12, pp. 221-232, 249-254, and 1946, Vol. 41, No. 1, pp. 10-21.

Some examples of comparisons between reinforced and prestressed concrete designs are given. Description of Freyssinet's and Magnel's system of anchorages. Some tests of beams are described and descriptions of several structures are also given. Most of this material is in Magnel's book "Béton Précontraint".

D46. Quintal, R., "La pénurie d'acier et le béton précontraint", Revue Trimesstrielle, Canadienne, 1945, Vol. 31, No. 122, pp. 129-138.

Behavior of concrete reinforced with high strength steel is compared with the behavior of prestressed concrete. Basic design equations are given. Losses of prestress are discussed.

1946

D47. Billig, K., "Prestressed Reinforced Concrete", Reinforced Concrete Association (London), Technical Paper No. 5, 1946.

General description of the history, behavior, prestressing operation and existing structures of prestressed concrete.

D48. Carrier, J. P., "Precompressed Concrete Design", Engineering Journal (Montreal), 1946, Vol. 29, No. 8, pp. 462-6, 466-9, 482.

This paper deals with basic concepts of prestressed concrete design. Discussion of the advantages of prestressed concrete. Example of design. Methods of prestressing. Description of a few structures.

D49. Murray, V. S., "Prestressed Concrete Bridges", Roads and Bridges, 1946, Vol. 84, No. 6, pp. 41-46.

Same material as in Magnel's book. Discussed: principle of prestressing, methods of prestressing, possible uses of prestressing other than beams.

D50. - - -, "Prestressed Concrete", The Builder (London), 1946, Vol. 170, No. 5371, p. 59.

A general, not very complete description of the basic principles of prestressed concrete, methods of prestressing and few examples of uses.

1947

D51. Coff, L., "Prestressed Concrete", American City, New York, 1947, Vol. 62, No. 9, pp. 112-113.

Brief description of the fundamental theory of prestressing. Examples of structures built in Europe. Very general, written for the laymen.

D52. Coff, L., "Prestressed Concrete for Bridges and Slabs" American Association of State Highway Officials, New York City Convention Group Meetings, Papers and Discussions, 1947, Published by AASHO, 1220 National Press Building, Washington 4, D. C., pp. 198-225.

Description of Roebling's developments, some tests and construction of their jointless slab. Gives cost data showing an advantage of using prestressed concrete.

D53. Magnel, G., "The Principles of Prestressed Concrete", Civil Engineering and Public Works Review (London), 1947, Vol. 42, No. 497, pp. 488, 490, 492.

General discussion of prestressed concrete.

D54. Magnel, G., "The Principles of Prestressed Concrete", Engineering Journal (Montreal), 1947, Vol. 30, No. 3, pp. 110-112.

This paper is a resume of several talks given by the author before various branches of the Engineering Institute of Canada in May, 1946.

The author points out the advantages of prestressed concrete, compares the designs of a reinforced and of a prestressed concrete slab bridge. Explanation of the Magnel's method of prestressing and of prestressing with outside cables, and of pretensioning.

1948

D55. Abeles, P. W., "The Development of Prestressed Concrete", Civil Engineering and Public Works Review (London), 1948, Vol. 43,

- Part 1: No. 499, pp. 26-29
- Part 2: No. 500, pp. 86-90
- Part 3: No. 501, pp. 145-150
- Part 4: No. 502, pp. 200-206
- Part 5: No. 503, pp. 248-251
- Part 6: No. 504, pp. 306-312
- Part 7: No. 505, pp. 358-364
- Part 8: No. 506, pp. 414-418
- Part 9: No. 507, pp. 464-470
- Part 10: No. 508, pp. 519-524

D56. Armstrong, W.E.I., "Prestressed and Post-stressed Concrete", Surveyor (London), 1948, Vol. 107, No. 2922, pp. 77-78.

Pretensioned and post-tensioned concrete are defined and basic principles of prestressing are explained. The advantages of prestressed concrete over ordinary reinforced concrete are discussed.

D57. Elliott, L. W., "Recent Development in Prestressed Concrete", The Builder, (London), 1948, Vol. 175, No. 5520, pp. 659-663.

This is a summary of a paper given by Elliott before ARIBA Discussion of the principle of prestressing, of pretensioning and post-tensioning. Description of Freyssinet and Magnel's methods, structures, construction and economy.

D58. Evans, R. H., "Prestressed Reinforced Concrete", Journal of the Institute of Municipal Engineers (London), 1948, Vol. 74, No. 11, pp. 565-596.

This paper has a short historical introduction; explanation of basic principles of prestressing; design formulas for working load design; discussion of present day knowledge of such subjects as creep, shrinkage and bond; and a short discussion of applications of prestressed concrete.

D59. Richart, F. E., "Advances in Reinforced Concrete During the Past Quarter of Century", Proceedings, American Concrete Institute, 1948, Vol. 44, No. 8, pp. 720-731.

Very brief statement of development and future possible uses on pp. 727-728.

1949

D60. Anderson, F., "Reinforced Concrete with Special Reference to Prestressed Concrete", Journal of the Institution of Municipal Engineers (London), 1949, Vol. 76, No. 3, pp. 257-268.

Subjects discussed: history of prestressed concrete, various systems of prestressing, losses in prestress due to creep, shrinkage and slipping of wires, quality requirements for materials, advantages of prestressing and structures built.

D61. Campus, F., "Le béton précontraint", Revue Universelle des Mines de la Metallurgie des Travaux Publics (Liege), 1949, 9th Series, Vol. 5, No. 12, pp. 421-436.

Description of the basic principles of prestressed concrete, its design, some tests and numerous examples of actually built structures.

D62. Caquot, A., "Les bases scientifiques de la précontrainte", Travaux (Paris), 1949, Vol. 153, No. 178, pp. 311-312.

This paper is based on the opening speech made before the Scientific Association of Prestress and gives some history of the development of prestressed concrete. Brief discussion of the behavior of prestressed concrete and description of some methods of prestressing.

D63. Dischinger, F., "Weitgespannte Tragwerke", Der Bauingenieur (Berlin), 1949, Vol. 24, No. 7, pp. 193-199; No. 9, pp. 275-280; No. 10, pp. 308-314.

Creep is discussed with respect to pretensioning and post-tensioning; construction of arches, domes, and shells of prestressed concrete is discussed. Prestressed trusses and girders prestressed according to Finsterwalder's principles are discussed.

D64. Freyssinet, E., "Evolution du rôle des précontraintes dans les constructions et conséquences de leur utilisation systématique", Travaux (Paris), 1949, Vol. 33, No. 178, pp. 313-321.

A good discussion of the problems of prestressed concrete.

D65. Freyssinet, E., "Observations sur le béton précontraint", Travaux (Paris), 1949, Vol. 33, No. 172, pp. 47-70.

Very good review of Freyssinet's work in development, promoting and use of prestressed concrete.

This same article can be found in U. of I. library also under q 693.5 B465 (a reprint containing both Lalande's paper "Diversité des application du béton précontraint" Travaux 1949, No. 171, and this paper).

D66. Lalande, M., "Diversité des application du béton précontraint", Travaux (Paris), 1949, Vol. 33, No. 171, pp. 2-22.

Description of Freyssinet method of prestressing and his anchorages, description of existing structures, construction and manufacturing processes.

Can be found in University of Illinois library also under number q693.5, B465 (this is a reprint containing both this and Freyssinet's paper "Observations sur le béton précontraint", Travaux 1949, No. 172.)

D67. Thomas, F. G., "Prestressed Concrete", Proceedings of the Conference held at the Institution, Institute of Civil Engineers, (London), 1949.

This paper is a review of the present day state of development of prestressed concrete. Methods of design are presented in general terms as well as the methods of prestressing and construction. Examples of existing structures are given and data on a great number of such structures compiled in tabular forms. One relatively short chapter is devoted to the experimental work.

D68. Walsh, H. V.; Cefola, A., "Prestressed Concrete", Architectural Record, 1949, Vol. 106, No. 2, pp. 136-142.

Discussion of the basic principles and behavior of prestressed concrete and photographs of European bridges and buildings. Written for architects.

D69. Walter, E., "Pioneer Overlooked", Engineering News Record, October 20, 1949, Vol. 143, No. 16, p. 100; Reader Comment Section.

In this discussion of Coff's paper (ENR, September 1, 1949) the author points out that Karl Wettstein received a patent in 1921 and manufactured prestressed concrete slabs pretensioned with piano wire. The planks were manufactured in various plants.

1950

D70. Abeles, P. W., "Further Notes on the Principles and Design of Prestressed Concrete", Civil Engineering and Public Works Review (London), 1950, Vol. 45, 1951, Vol. 46

Part 1: No. 529, pp. 443-445	6: No. 535, pp. 38-40
Part 2: No. 530, pp. 508-512	7: No. 537, pp. 187-190.
Part 3: No. 531, pp. 579-581	8: No. 538, pp. 262-264
Part 4: No. 532, pp. 657-662	9: No. 540, pp. 439-442
Part 5: No. 533, pp. 728-731	10: No. 541, pp. 524-526
	11: No. 544, pp. 775-778
	12: No. 545, pp. 861-864

Discussion of the behavior of prestressed concrete beams with reference to the sustained load tests conducted by the Ministry of Works; Discussion of the moment resisting capacity of prestressed concrete beams with procedure for calculating the ultimate capacity of such beams; Partial prestressing discussed. Design. Shear reinforcement. Composite beams. Floor systems.

D71. Dobell, C., "Patents and Codes Relating to Prestressed Concrete", Proceedings, American Concrete Institute, 1950, Vol. 46, No. 9, pp. 713-724.

A compilation of patents in US and abroad that deal with or are related to prestressing. A short discussion of Billig's proposed code.

Discussion by J. J. Polivka regarding earlier work in prestressing omitted by Dobell.

D72. Freyssinet, E., "Prestressed Concrete: Principles and Applications", Journal Inst. of Civil Engineers (London), 1950, Vol. 33, No. 4, pp. 331-380.

Brief history of Freyssinet's work in prestressed concrete. Reasons for prestressing, behavior of and properties of prestressed concrete and factors of safety are discussed. Discussion of various methods of manufacture aimed at obtaining high-strength concrete, of methods of prestressing and anchoring the wires, and of creep of steel is also included. Description of some of the structures designed by Freyssinet.

D73. Freyssinet, E., "Souvenirs", Beton-und Stahlbetonbau (Berlin), 1950, Vol. 45, No. 2, pp. 26-31.

A speech made by Freyssinet in Paris in commemoration of the invention of reinforced concrete. He reviews the work he has done in prestressed concrete

D74. Freyssinet, E., "Theory and Application of Prestressed Concrete", The Municipal Journal, London, 1950, Vol. 58.

A series of articles entitled:

1. A gamble with concrete and prestressed won (A revolution in construction work) No. 2969, pp. 31-32.
2. What makes prestressed structures different? (Novel behavior and properties of prestressed concrete), No. 2970, pp. 99-101.
3. A catechism for prestressed concrete (From theory to practice), No. 2971, pp. 170-171.
4. How prestress is created, No. 2972, pp. 241.
5. Thirty years of anchorage research (Theory and application of prestressed concrete) No. 2973, pp. 310-311.
6. Prestressing makes water leakage a thing of the past (Theory and application of prestressed concrete), No. 2974, p. 381.
7. Bridges-Harbours-Runways (Theory and Application of prestressed concrete) No. 2975, p. 455, 457.

History of prestressed concrete (Freyssinet Method), theory, method of prestressing, examples of uses, extreme possibilities and making of high strength concrete are discussed. Opinion is expressed that after permanent deformation takes place in the steel, a prestressed concrete beam behaves as an ordinary reinforced concrete beam.

D75. Germundson, T., "Prestressed Concrete Construction Procedures", Proceedings, American Concrete Institute, 1950, Vol. 46, No. 10, pp. 857-876.

History of prestressing. Explanation of various methods of prestressing. Description of plants producing precast prestressed members. Description of various structures of prestressed concrete.

D76. Hammond, R., "Basic Principles of Prestressed Concrete", Machinery Lloyd (London), 1950, Vol. 22, No. 20, pp. 68-81.

This paper includes a very good historical review of the development of prestressed concrete. Methods of prestressing are discussed as well as the future potentialities and manufacturing techniques.

D77. Hammond, R., "Prestressed Concrete", Architectural Design (London), 1950, Vol. 20, No. 1, pp. 8-9.

Brief historical review, description of a few methods of prestressing and description of some existing structures.

D78. Levi, F., "Nouvelles recherches sur les constructions précontraintes", La Ricerca Scientifica (Rome), 1950, Vol. 20, No. 12, pp. 1846-1849.

Description of an airport runway slab built of prestressed concrete in Italy. Losses in prestress discussed.

D79. Prempain, "Quelques réflexions sur les journées techniques de la précontrainte", Travaux (Paris), 1950, Vol. 34, No. 183, pp. 39-40.

A review of the work done in prestressed concrete.

D80. Roessinger, F., "Generalites Sur Differents Modes de Precontrainte du Beton", Bulletin Technique de la Suisse Romande (Lausanne), August 26, 1950, Vol. 76, No. 17, pp. 225-237.

This paper discusses the following topics: conditions of stress in prestressed beam; principles of prestressing both with bonded wires and with cables; creep and shrinkage; prestressing techniques; manufacturing prestressed elements by the long line process; manufacturing larger elements utilizing post-tensioned grouted cables; and applications of prestress in North Africa which includes bridges, pipes, and masts.

D81. Rüsç, H., "Framsteg inom betonbyggnadstekniken", Betong (Stockholm), 1950, Vol. 35, No. 4, pp. 257-289.

Short historical summary is followed by a discussion of the principles which should be considered in the design of prestressed concrete structures. Different methods of anchoring the prestressing wires are mentioned and some existing structures described.

D82. - - -, "Developments in Prestressed Concrete", Concrete and Constructional Engineering, (London), 1950, Vol. 45, No. 12, pp. 415-417.

The author discusses generally some of the developments in prestressed concrete. He thinks the notation and symbols concerning the subject should be standardized. He criticizes some of the assumptions used in design such as constant modular ratio and actual steel stresses at beam failure for bonded prestress. Expresses belief that prestressed concrete is economical and enough is known about it that it may safely be used extensively.

D83. - - -, "Prestressed Concrete", Reinforced Concrete Review (London), 1950, Vol. 2, No. 1, pp. 12-28.

This paper makes reference to several other papers and has abstracts from papers by Magnel and Freyssinet dealing with methods of prestressing and anchoring, with the behavior of prestressed concrete, with materials, and with applications. The paper is fairly good from the standpoint of presenting much general information in a condensed form.

1951

D84. Birdsall; Blair, "Prestressed Concrete", John A. Roebling's Sons Company, Trenton, New Jersey 1951, Reprint of a speech.

Discussion of the basic concepts of prestressing. Description of the jointless slab built in a Roebling's warehouse in Chicago and a suspension bridge with prestressed concrete floor over Rio Paz (El Salvador, Guatemala). Describes various model beams tested to failure.

D85. Caughey, R. A., "Wanted: Guide in Developing Prestressed Concrete", Proceedings, American Concrete Institute, 1951, Vol. 47, No. 7, pp. 561-562. Letters from Readers Section.

Request from Caughey that ACI publish progress reports on development of prestressing which may be used as a guide until enough knowledge is accumulated to write a code.

D86. Corning, L. H., "Why Prestressed Concrete?", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 2-8.

Discusses the advantages of prestressed concrete with respect to cracking, use of high strength materials, deflections, size of members, and construction economy. Expresses the desirability of having design specifications.

D87. Corning, L. H., "Why Prestressed Concrete?", Civil Engineering 1951, Vol. 21, No. 10. pp. 41-45.

A general discussion of the place of prestressed concrete in the US construction. This article is based on a paper presented before the First US Conference on Prestressed Concrete, MIT 1951.

D88. Crom, T. R., "Processes and Patents in Prestressed Concrete", Proceedings of the Second Annual Structural Engineering Conference, Bulletin of the Florida Engineering Experiment Station 47, 1951, pp. 27-30.

Short discussion of the history of prestressed concrete, of methods of prestressing, anchorage and bond. Patents mentioned briefly in general terms, field of application discussed.

D89. Freyssinet, E., "Sur le rôle et l'importance des déformations non élastiques du béton précontraint", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 200-202.

Review of Freyssinet's work which led to the development of prestressed concrete. Effect of creep is discussed. Freyssinet maintains that prestressed concrete is not related very closely to reinforced concrete.

D90. Guyon, Y., "Béton Précontraint - Etude Théorique et Expérimentale", Editions Eyrolles, 1951, 692 pp.

This book treats the following main topics: Prestressing Techniques; Materials; Influence of friction on a post-tensioned curved cable; Resistance of prestressed concrete structural parts to fire; Stresses at the end of members caused by the prestressing

force; Bonded prestress; Design of beams with pretensioned and post-tensioned steel, with straight and curved reinforcement, and with uniform or non-uniform cross-section; Tests of beams; and factors of safety. One or more chapters are devoted to each of these main topics.

D91. Harris, J. D., "The Scope of Prestressed Concrete", Journal of the Institution of Municipal Engineers (London), 1951, Vol. 77, No. 7, pp. 547-558.

A historical review is followed by description of various systems of prestressing and a list of several prestressed concrete structures built in Europe.

D92. Hirschtal, M., "Wanted: Guide in Developing Prestressed Concrete", Proceedings, American Concrete Institute, 1951, Vol. 47, No. 7, p. 562. Letters from Readers Section.

Hirschtal asks for specification regarding the strength of prestressing steel. Expresses hope that some researchers will develop a method of prestressing through reaction against abutments (instead of using steel).

D93. Lazarides, T. O., "On the Combined Use of Pre-tensioning and Post-tensioning Methods", Magazine of Concrete Research (London), 1951, Vol. 2, No. 5, pp. 79-86.

Design principles and methods of construction are described. The author explains how pre-tensioning and post-tensioning can be used together effectively in order to prestress continuous members for both positive and negative moments.

D94. Meier, H., "Die neuen Spannbetonschwellen der Deutschen Bundesbahn", Beton-und Stahlbetonbau (Berlin), 1951, Vol. 46, No. 8 pp. 174-180; No. 9, pp. 202-207.

This paper discusses the new railroad tie which is in service in the German R. R. built of prestressed concrete. Stresses under service conditions are discussed. Models were tested by photoelasticity, the results of which are discussed. Manufacturing process is described--18 mm. rods with threaded ends are used for prestressing. Ends of rod are anchored with washer anchor plate.

D95. Menefee, F. N., "Wanted: Guide in Developing Prestressed Concrete", Proceedings, American Concrete Institute, 1951, Vol. 47, No. 9, pp. 751-752.

This is an answer to Caughey and Hirschtal, (dtto, No. 7) Menefee reviews what ACI has done along these lines and discusses the properties of prestressing wire.

D96. Pacholik, L., "Předpjatý beton a zprumyslnění stavebnictví", (Prestressed Concrete and Industrialization of Building Construction), Stavební průmysl (Prague), 1951, Vol. 1, No. 15, pp. 337-346.

General paper discussing the design principles and advantages of prestressed concrete. Sketches of cross sections of prestressed concrete bridges for various span length are given and construction methods discussed shortly.

D97. Spronck, M., "Prestressed Concrete: Its Future in the United States", Contractors and Engineers Monthly, August, 1951, Vol. 48, No. 8, pp. 3, 84-91.

This article discusses the advantages, disadvantages, and the features of prestressed concrete; the various methods of prestressing; discusses the Madison Co., Tenn. Bridge and the Walnut Lane Bridge, and various European structures.

D98. Stilliman, J. W., "The Theory and Practice of Prestressed Concrete", U. S. Navy Civil Engineer Corps Bulletin, 1951, Vol. 5, No. 61, pp. 336-344.

General description of prestressed concrete, design, methods of prestressing.

D99. Veit, O., "Vorspannung im Stahlbeton," Beton und Stahlbetonbau (Berlin), 1951, Vol. 46, No. 1, pp. 13-17.

Discussion of the basic concept of prestressed concrete. Formulas are given for members subject to tension and for members subject to bending.

D100. Winter, G., "Teaching of Prestressing", Engineering News Record, November 1, 1951, Vol. 147, No. 18, p. 65. Reader Comment Section.

The author suggests that the fundamentals of the design of prestressed concrete members should be taught as a part of the general undergraduate concrete course. More detailed information might be included in an advanced course. Winter supports the ideas expressed by Feld in ENR, October 11, 1951, p. 48.

D101. - - -, "New Ways with Concrete", Fortune, August, 1951, Vol. 44, pp. 106-116.

Part of this paper is devoted to a discussion of prestressed concrete construction in the U. S. The Walnut Lane Bridge; Madison Co., Tenn., Bridge; Fayetteville, Tenn. high school stadium; and circular tanks prestressed by the Preload Corporation are mentioned.

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A75, C2, C5, C7, C20, C21, E33.

E. Circular Structures.

1923-1935

E1. Hewett, W. S., "A Method of Constructing Reinforced Concrete Water Tanks", Proceedings, American Concrete Institute, 1923, Vol. 19, pp. 41-52.

This is believed to be the original Hewett's paper on prestressing water tanks circumferentially to prevent leakage and eliminate tensile stresses in concrete. Mild steel with turnbuckles.

E2. Jensen, J. A., "Shell of Concrete Standpipe Prestressed by Steel Hoops", Engineering News Record, February 16, 1933, Vol. 110, No. 7, pp. 224-225.

110 ft. high water tower is prestressed both vertically and circumferentially by means of turnbuckles on steel rods. Prestress was only 18,000 psi.

E3. Crepps, R. B., "Investigation of Stresses in Prestressed Reinforced Concrete Pipe", Engineering Bulletin, Purdue University, Research Series No. 46, 1934.

Tests of three pipes (diameter 30", 42", 60") prestressed longitudinally and circumferentially. Tested under internal water pressure until cracks opened. Complete information given.

E4. Kuranz, A. P., "Prestressed Concrete Standpipe Built in Vertical Panels at Waukensha, Wisconsin", Engineering News Record, April 4, 1935, Vol. 114, No. 14, pp. 488-489.

Description of a water tank built by the Hewett system. It was built in vertical panels rather than in horizontal rings.

1936

E5. Crom, J. M., "Prestressed Reinforcement for Domed Concrete Tank", Engineering News Record, April 16, 1936, Vol. 116, p. 555

Domes of tanks 60 ft. in diameter carrying a central load of 20 tons. Prestressed with smooth round rods with upset ends coupled together into an endless band at the periphery of the dome.

E6. Hewett, A. L., "Water Tanks of Reinforced Concrete", Journal, American Water Works Assoc., 1936, Vol. 28, No. 1, pp. 43-49.

Describes the Hewett system of prestressing and gives examples of structures built. (This author is not the man who originated the Hewett system)

E7. Mary, M., "Pressure Pipes for the Mareges Hydroelectric System", Int. Assoc. Bridge and Struct. Eng., Second Congress, Preliminary Publications, Berlin 1936, (W. Ernst), pp. 1211-1231.

Method of prestressing of large size built-in-place pipes is described. The method described is applicable also for prestressing above the ground.

1937-1938

E8. - - -, "Schachtausbauten aus Spannbeton", Beton und Eisen (Berlin), 1937, Vol. 36, No. 17, pp. 281-282.

Description of use of prestressed concrete in tunnel construction.

E9. Kleinlogel, A., "Eisenbeton-Druckrohre als Schleuderbeton- und als Schleuderbeton-Vorspannrohre", Beton und Eisen (Berlin) 1938, Vol. 37, No. 10, pp. 161-166.

This article deals with the manufacturing of prestressed concrete pipes and compares its qualities with non-prestressed, pre-cast, concrete pipes.

1939

E10. - - -, "Prestressed Reinforcement in Reservoirs and Tanks", Concrete and Constructional Engineering (London), 1939, Vol. 34, No. 1, pp. 81-86.

The theory of prestressing as applied to circular tanks subjected to hydraulic pressure is explained. Method of calculating required stress in prestress rods is explained. Included is description of actual 62 ft. diameter tank.

E11. - - -, "Principle of Prestressed Reinforcement in Design of Dome", Concrete, (Chicago), 1939, Vol. 47, No. 2, pp. 3-4.

Hewett method was used to prestress the dome of clarifier tank in St. Paul. 21-1.365" ϕ were used to prestress the dome. They were placed around dome ring and tightened with turnbuckles. Elementary discussion of theory is included.

E12. - - -, "Reinforced Concrete Shell Dome is Intact After Terrific Explosion", Concrete, (Chicago), 1939, Vol. 47, No. 11, pp. 3-4.

A water tank 135 ft. in diameter prestressed by the Hewett system had also a prestressed dome. During construction (nearly completed) an explosion occurred inside the tank which lifted the dome 18-24 in. into the air. The dome is still structurally sound, but did develop several radial cracks and 2 annular cracks.

1940

E13. Kennedy, R. C., "Prestressed Concrete Tank Features, Special Details", Western Construction News, 1940, Vol. 15, No. 4, pp. 130-132.

Description of prestressing techniques used on construction of water tank. Tank prestressed by Hewett system.

E14. - - -, "Huge Reinforced Concrete Foundation is a Feature of Big Reservoir", Concrete (Cement Mill Edition), (Chicago), 1940, Vol. 48, No. 3, pp. 3-4, 44.

Describes design and construction of large water storage tank. Prestressed with rods in accordance with W. S. Hewett system.

1941

E15. - - -, "Prestressed Concrete Water Tanks" Engineering News Record, March 13, 1941, Vol. 126, No. 11, pp. 419-421.

Water reservoirs of prestressed concrete are described. Walls are poured in vertical panels. Every 40 ft. along circumference is a steel column to which the prestressing rods are anchored. Rods are only stressed to 25,000 or 30,000 psi. Domes are prestressed around their periphery.

E16. - - -, "Unique Features Mark Design and Erection of Mammoth Concrete Water Tower", Concrete, (Chicago), 1941, Vol. 49, No 11, pp. 2-4.

Water tank 70 ft. diameter elevated 8 ft. above ground; designed by W. S. Hewett method. Supported by 3 concentric concrete cylinders. Dome roof is not prestressed.

1942

E17. Hadley, H. M., "Concrete Storage Tanks", Pacific Builder and Engineer (Seattle), 1942, Vol. 48, No 9, pp. 30-36.

Discussion of three types of concrete tanks and of their relative merits. Type of tanks: reinforced concrete, prestressed concrete - Hewett method, prestressed type without turnbuckles.

E18. Lenk, K., "Spannbetonrohre", Beton und Eisen (Berlin) 1942, Vol. 41, Nos. 15-16, pp. 137-44.

Description of the manufacturing process of large prestressed concrete pipes and discussion of the problem of joining the section in the field.

E19. - - -, "Council Bluffs Builds Twin Reservoirs of Prestressed Reinforced Concrete", Concrete, (Chicago), 1942, Vol. 50, No. 4, p. 2.

Two prestressed concrete reservoirs of 106 ft. diameter and 30 ft. height were being built at the time of this article. They were designed by W. S. Hewett using steel rods tightened with turnbuckles. Dome ring was also prestressed. No technical information supplied.

E20. - - -, "Prestressed Concrete Water Tanks", Engineering News Record, April 23, 1942, Vol. 128, No. 17, pp. 608-609.

Two 106 ft. diameter tanks designed by W. S. Hewett are built in Council Bluffs, Iowa. Prestressed with round rods tightened with turnbuckles. Dome is prestressed with 9 rods around its ring. No technical information given.

1943

E21. Crepps, R. B., "Wire-Wound Prestressed Concrete Pressure Pipe," Proceedings, American Concrete Institute, 1943, Vol. 39, No. 6, pp. 545-555.

Tests, theory and manufacturing procedure of circumferentially prestressed concrete pipes. Stress in circumferential wire: 100,000 psi. Design theory is presented. Both hydrostatic pressure tests and 3 edge loading tests are discussed and results given.

E22. Crom, J. M., "High Stressed Wire in Concrete Tanks, Engineering News Record, December 30, 1943, Vol. 131, No. 27, pp. 947-949.

Describes the machine for wrapping of the high strength wire around a tank. Discusses failures of tanks due to loss of prestress.

E23. Garrabrant, R. B., "Navy Builds Prestressed Concrete Fuel Tanks", Engineering News Record, January 28, 1943, Vol. 130, No. 4, pp. 135-137.

During the war the Navy built several fuel storage tanks with walls prestressed with circular rods. Prestressing accomplished with turnbuckles. Minimum yield point of rods, 50,000 psi.

E24. - - -, "New Method Used to Make Prestressed Concrete Pipe (Wire-wound)", Engineering News Record, September 23, 1943, Vol. 131, No. 13, pp. 476-478.

Describes construction of wire wound concrete pipe to conduct water under pressure.

E25. - - -, "Prestressed Concrete Pipes by a New Manufacturing Method", Engineering News Record, December 16, 1943, Vol. 131, No. 25, pp. 885-887.

Process used by Lock Joint Company in manufacturing prestressed pipes. Concrete is centrifugally placed and steam cured. Wire is wrapped on from a spool while pipe is spinning. High tensile stress is used.

E26. - - -, "Prestressed Concrete Reservoirs: Concrete Poured in 8 ft. Lifts", Concrete and Constructional Engineering, (London) 1943, Vol. 38, No. 3, pp. 104-105.

Description of 106 ft. diameter tank in Iowa designed by W. S. Hewett. 1.375 in. rods with turnbuckles were used to prestress.

1944

E27. - - -, "Merry-go-round Machine Applies High Tensile Steel Wire to Prestressed Concrete Tanks", Construction Methods, 1944, Vol. 26, No. 1, pp. 60-61 and 132-134.

Describes the Preload Corporation method of prestressing cylindrical tanks with high strength wire tensioned by a die which travels around the tank wrapping it with this continuous wire.

1945

E28. Carr, J. R., "Two-way Prestressed Concrete Water Storage Tank", Engineering News Record, October 4, 1945, Vol. 135, No. 14, pp. 434-439.

Description of a 4,750,000 gal. tank prestressed both in circumferential and vertical direction. 1-3/8" diameter and 1-1/4" diam rods were prestressed to 32,000 psi with the aide of turnbuckles. These were retightened after 6 months.

E29. Crowley, J. J., "Prestressing Bands on a Concrete Tank", Engineering News Record, May 3, 1945, Vol. 143, No. 18, pp. 636-638.

3/4" square bars were used in prestressing a 300,000 gal. water tank. Some difficulty was encountered in measuring the amount of prestress - it was overcome by use of a shear wrench.

E30. Hart, P. P., "Prestressed Concrete Tank in Miami", Concrete (Chicago), 1945, Vol. 53, No. 7, pp. 18-19, 23.

A large water-tank built of prestressed concrete. Prestressed design was cheaper than other designs considered.

E31. Kennedy, R. C., "Design and Construction of Prestressed Concrete Tanks", Journal, American Water Works Association, 1945, Vol. 37, No. 1, pp. 73-83.

Description of prestressed concrete tanks built by the Hewett system. Equations for finding the amount of needed prestress. Techniques of building and prestressing are described.

E32. Longley, F. F., "Prestressed Reinforced Concrete Pipe", Journal, New England Water Works Association, 1945, Vol. 59, No. 4, pp. 335-347.

Description of the manufacture of lock-joint pressure pipes prestressed with high strength wire. Centrifugal placing of concrete.

E33. Mautner, K. W., "Prestressed Concrete in Structures of Annular Cross Section", Structural Engineer (London), 1945, Vol. 23, No. 3, pp. 117-163, No. 9, pp. 437-451.

A rather complete treatise on manufacture of prestressed concrete pipes and tanks. Several methods are explained and their relative merits discussed. Listeners to this paper took part in the discussion during which a number of questions on the general subject of prestressing were answered by Mautner.

E34. Ross, C. W., "Tests of Prestressed Concrete Pipes Containing a Steel Cylinder", Proceedings, American Concrete Institute, 1945, Vol. 42, No. 1, pp. 37-48.

Description of pressure and bending tests on prestressed concrete pipes with steel inside lining.

E35. - - -, "A Large Prestressed Concrete Water Tank", Concrete and Constructional Engineering (London), 1945, Vol. 40, No. 12, pp. 268-269.

Water storage tank in Great Falls, Montana.

Same as "Large Water Storage Tank is Prestressed", in Concrete, (Chicago, 1945, Vol. 53, No. 10, pp. 2-3.

E36. - - -, "Large Water Storage Tank is Prestressed", Concrete, (Chicago), 1945, Vol. 53, No. 10, pp. 2-3.

Water storage tank at Great Falls, Montana. Floor is prestressed to counteract radial stresses caused by horizontal expansion and elongation of walls by water pressure. Wall is prestressed with rods tightened with turnbuckles to 30,000 psi.

1947

E37. Doull, R. M., "Reconstruction of Halifax Water Reservoir," Engineering Journal (Montreal), 1947, Vol. 30, No. 5, pp. 211-215.

Description of the reconstruction of water reservoir in Halifax. New roof of prestressed concrete shell described.

E38. Doull, R. M.; Kline, J. D., "Prestressed Concrete Shell Dome Features Rebuilt Halifax Reservoir", Engineering News Record, August 7, 1947, Vol. 139, No. 6, pp. 187-191.

Description of the repair of an old reservoir.

E39. Doull, R. M.; Kline, J. D., "Reconstruction of the Halifax High Service Reservoir", Journal, American Water Works Assoc., 1947, Vol. 39, No. 6, pp. 503-514.

Similar to the article "Prestressed Concrete Shell Dome Features Rebuilt Halifax Reservoir" published by the same authors in Engineering News Record, 1947.

E40. Fornerod, M. F., "Prestressed Concrete Shell Roof Construction", Int. Assoc. Bridge and Struct. Eng., Publications Vol. 8, Zurich 1947, pp. 91-103.

Design theory and discussion of the influence of prestressing on the design of shallow spherical concrete shells. Description of the Preload method of prestressing large tanks.

E41. - - -, "New Method of Prestressing Concrete Pipes", Concrete and Constructional Engineering, (London), 1947, Vol. 42, No. 7, p. 216.

Describes the "Rocla" method of prestressing which originated in Australia. After concrete is placed centrifugally and the wire placed but not stressed, the inner form of the pipe is expanded. The outer form also expands slightly. This puts steel in tension, concrete in compression, and squeezes excess water out of concrete.

E42. - - -, "Prestressed Concrete Pipe", Concrete, (Chicago), 1947, Vol. 55, No. 9, p. 38.

Rocla method of prestressing pipe with expandable molds. Both interior and exterior molds are expandable. Pressure is applied to interior mold. This compresses the concrete and squeezes out excess water while simultaneously tensioning the wires.

1948

E43. Doull, R. M., "Big Prestressed Pipe Without Liners", Engineering News Record, June 24, 1948, Vol. 140, No. 26, pp. 1010-1015.

84" diameter concrete pipes prestressed in the same manner as a water tank.

E44. Freyssinet, E., "Ouvrages en béton précontraint destinés à contenir ou à retenir des liquides", Int. Assoc. Bridge and Struct. Eng., Third Congress, Preliminary Publications, Liège, 1948, pp. 343-360.

Freyssinet describes the manufacture of prestressed concrete pipes prestressed both longitudinally and transversally. Cubical reservoirs and vats. Application of prestressing to dams - vertical cables anchored in the subsoil. Structures subjected to exterior water pressures - tunnels, caissons, pontoons, etc.

E45. Lebelle, P., "Réservoir de 7.000 m³ destiné à l'alimentation de la ville d'Orléans en eau potable", Int. Assoc. Bridge and Struct. Eng., Third Congress, Preliminary Publication, Liege, 1948, pp. 361-366.

Description of the water reservoir at Orleans, France. Prestressed by Freyssinet process in all directions.

E46. - - -, "Laying 60 Miles of Prestressed Pipe", Engineering News Record, May 13, 1948, Vol. 140, No. 20, pp. 708-711.

Description of manufacturing and laying of pipes prestressed circumferentially.

1949

E47. Dobell, C., "Design, Construction and Uses of Prestressed Concrete Tanks", Public Works, October, 1949, Vol. 80, pp. 45-48.

General reference on prestressed concrete tanks.

E48. - - -, "Making Unique Prestressed Concrete Pipe", Construction Methods, 1949, Vol. 31, No. 12, pp. 58-61.

54" by 16'-0" pipe manufacturing process. A series of photographs tell the story. Main feature of the prestressing is that it is spirally wound into a basket weave pattern thus stressing in two directions simultaneously. Similar article appears in Engineering News Record, October 6, 1949, Vol. 143, No. 14, pp. 24-26.

E49. - - -, "New Casting and Prestressing Technique for Ultra Strong Concrete Pipe", Engineering News Record, October 6, 1949, Vol. 143, No. 15, pp. 24-26.

54" by 16'-0" pipe manufacturing process explained. Main feature is that the circumferential prestressing wire is put on spirally (or basket weave pattern) to prestress it in two directions simultaneously.

E50. - - -, "Preload Tanks", Preload Enterprises, New York, 1949.

Primarily an advertising pamphlet describing the evolution of prestressed concrete and design and construction of prestressed concrete tanks.

1950

E51. Crom, J. M., "Design of Prestressed Tanks", Proceedings American Society of Civil Engineers, 1950, Vol. 76, Separate No. 7.

This paper gives data for evaluating shrinkage and plastic flow of concrete and describes methods that make practicable the use of the high strength cold-drawn steel wire.

E52. - - -, "Prestressed Concrete Sewer Tunnels Near Paris", Concrete and Constructional Engineering (London), 1950, Vol. 45, No. 11, pp. 404-407.

This tunnel is 13'-6" diameter and was precast in small pieces. A hoop of 0.2 in stainless steel 10" wide was placed around each ring of voussoir. Then the ring was expanded with jacks until desired tension was in the steel rim and wedges inserted to hold this stress. This erection and prestressing operation is described in detail. Freyssinet was consulting engineer.

1951

E53. Dobell, C., "Prestressed Concrete Tanks", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 9-20.

Discusses the history of the development of prestressed concrete as applied to use in tanks, discusses the design, construction and methods of prestressing. Paper is augmented with several pictures.

E54. Hendrickson, J. G., "Prestressed Concrete Pipe", Proceedings of the First United States Conference on Prestressed Concrete, Massachusetts Institute of Technology, August, 1951, pp. 21-29.

Discussion of manufacturing, uses, and design of prestressed concrete pipes, augmented with historical notes.

E55. Indri, E., "La conduit forcée en béton précontraint de l'usine hydro-électrique de Soverzene", Travaux (Paris), 1951, Vol. 35, No. 196, pp. 244-246.

This paper deals with the design and fabrication of prestressed concrete pipes used at the hydroelectric plant at Severzene.

F. Unclassified.

The number in parenthesis at the end of these references corresponds to one of the following sources.

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6. "Current Reviews", ACI Journal.
7. Highway Research Board, "Bibliography on Prestressing and Precasting Reinforced Concrete For Use in Highway Bridges and Structures", 1949, Compiled by the Bridge Dept. of the California Division of Highways.
8. Baker, A. L., "Recent Research in Reinforced Concrete and its Application to Design", Journal of the Institute of Civil Engineers, 1951, Vol. 35, No. 4, pp. 262-329.

1929-1935

F1. Freyssinet, E., "Thermodynamische Theorie des Betons", Vortrag in der École des Ingenieurs in Lausanne, October, 1929. (5)

F2. Thompson, J. T., "Freyssinet Method of Arch Construction" (Baltimore Engineer, v. 5, p. 4-6, January, 1931.) (7)

F3. Freyssinet, E., "Théorie générale de la prise des liants hydrauliques, le phénomène de retrait et de déformation lente des bétons et mortiers".

Comptes rendus mensuels des séances du centre d'Études Supérieures "No. 7", 1934. (5)

F4. Abeles, Paul, "Spun Concrete Poles and Pole Sockets", (Maste und Mastfussaus Schleuderbeton), Zeitschrift des Oester. Ing. u. Arch. Ver. Nos. 25/26, 1935. (3)

1936

F5. Bukowsky, B., "Fire Resistance and Aging of Isteg Steel", (Feuerbeständigkeit und Alterung von Istegstahl; Zeitschrift des Oesterr. Ing. and Arch. Ver., Nos. 25, 26, 1936. (3)

F6. Durelli, A. J., "Contribution to the Study of Treated Concrete. Photo-elasticity experiment", Saint-Armand (Cher) 1936. (Imprimerie R. Bussiere.) (1)

F7. Scheel, C. A. G., "Deux ponts en béton armé sur l'Euphrate en Turquie", (Technique des Travaux, Vol. 12, pp. 485-492. September 1936). (7)

1937

F8. Emperger, F. V., "Erhohte Festigkeit", Deutsche Kurzpost, 1937. (5)

F9. Pacholik, L., "Napjatý beton", Zprávy reřejně služby technické, 1937 (Prague). (5)

1938

F10. Finsterwalder, U.; Dischinger, F., "New Buildings in Reinforced Concrete", Deutscher Beton Verein, Berlin 1938, pp. 18 and 24. (1)

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F14. - - -, "Application of Prestressing in Reinforced Concrete Construction", Bautechnische Mitteilungen des Deutschen Beton Vereins E. V., No. 3, pp. 1-9, October-December 1938. (7)

F15. - - -, "Steel String Concrete", T.I.Z., Vol. 62, 1938, No. 62, pp. 658-659. (1)

F16. - - -, "Steel String Concrete--Concrete of Low Steel Content", O.I.A.V., Vol. 90, 1938, Nos. 29 and 30, p. 226. (1)

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B17. Colonnetti, G., "La mova tecnica del cemento armato", Cemento Armato, Vol. 36, 1939, pp. 129-131. (1)

F18. Colonnetti, G., "Teorie e calcolo delle travi con armature preventivamente tese", Cemento Armato, Vol. 36, 1939, pp. 177-180. (1)

F19. De Simone, D., "Reinforced Concrete With High Resistance Steel Wires", Ann. Lav. Pubblici, Vol. 27, 1939, pp. 364-369. (1)

F20. Emperger, F. v., "Erste Brücke aus Spannbeton über die Reichsautobahn", Bauztg., 1939. (5)

F21. Pacholik, L., "Nosníky s napjatou výztuží", Zprávy veřejné služby technické, 1939, (Prague). (5)

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F23. - - -, "Nuova Tecnica Del Cemento Armato", (Cemento Armato, Vol. 36, pp. 129-131, 1939). (7)

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F24. Albenga, G., "A proposito di pressoflessione nelle travi ni cemento armato con armature preventivamente tese", Ric. de Ingegn., Vol. 8, 1940, pp. 1-2. (1)

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1941

F32. - - -, "Concrete Sleepers", War Emergency B. S. 986, 1941, British Standards Institution. (1)

1943

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