

Reinforced Brick Columns Tested at Lehigh University

Results of first series of tests show strength varying from 1,500 to 4,500 lb. per sq. in., reveal importance of vertical reinforcement, superiority of cement mortar and solid over-perforated brick, and advisability of using lateral ties.

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FIFTEEN brick columns recently tested at the Fritz Engineering Laboratory at Lehigh University, and comprising a pilot series for a more extensive investigation of the use of reinforced-brick masonry for columns, furnish some interesting and significant data. The columns were 12 in. square by 12 ft. high. Three had no reinforcement, but had vertical reinforcement only, and seven had both vertical and lateral reinforcement. The bricks, of the new dovetail type, had an excellent physical appearance, showing no limitations or irregularities. Both solid bricks and perforated bricks were used. The average compressive strength of the solid bricks was 12,700 lb. per sq. in., that, 10,000 lb. per sq. in. on edge, and 10,875 lb. per sq. in. on end. Corresponding values for the perforated brick were 7,500, 5,000 and 4,000 on the gross area. The tests were carried out under the sponsorship of Hudson Vigles, representative of the National Brick Manufacturers Research Foundation and consultant to the Lehigh Brick Works, which, through Robert E. Mosser, supplied all materials and built the test columns.

Comparison of columns of reinforced brick masonry with and without lateral ties. The use of the ties was found to increase the strength, but it did not prevent crushing collapse, as shown at the top.

The program of tests and the results obtained are given in the accompanying table. Attention is called to the fact that for columns in which solid cement mortar was used the maximum strength was in no case less than 750,000 lb., or 4,500 lb. per sq. in., regardless of the amount of reinforcement or type of brick. The columns that had 1 1/4 cement-line mortar gave considerably less strength, varying from as low as 250,000 lb. to as high as 575,000 lb., or from stresses of about 1,500 to about 4,500 lb. per sq. in. One of the columns had strength in excess of the capacity of the 800,000-lb. testing machine, so that a special loading rig, which provided for the doubling of the capacity of the machine, was constructed and used.

While the results were intended only for assisting in the design of further investigations, they indicated certain relationships that may be pointed out at this time. The longitudinal reinforcement increased the strength of the columns but did not seem to contribute 25 lb. per sq. in. strength of 125,000 lb. This was particularly true for columns having no lateral ties. The workmanship of the mason affected the strength of the columns to a marked degree. A variation in strength of as much as 100,000 lb. may be attributed to the workmanship. The age of the columns did not seem to have any effect on the strength of the columns using cement mortar, but increased the strength of columns using cement-line mortar. In

general, the strength of the columns with cement mortar was about 500,000 lb. in excess of the strength of the columns in which cement-line mortar was used. The columns utilizing perforated bricks gave lower strength than those having solid bricks. With cement-line mortar the difference between the strength of perforated and solid brick columns was about 100,000 lb. With cement mortar the difference was considerably less.

While the lateral ties did not seem to have a marked effect upon the strength of the columns, the type of failure was materially affected, as shown in the accompanying illustrations. Before the

RESULTS OF BRICK COLUMN TESTS
Columns 12 in. square by 12 ft. high



* Reinforcement placed in concrete test piece.
* Reinforcement placed in concrete test piece.

maximum load was reached on any of the columns tested, cracking usually was heard, and inspection revealed that vertical cracks had appeared. These cracks followed the vertical joints and fractured the brick along the line of cracking. The reinforced-brick columns showed a much greater tendency to fail by crushing than did the plain columns. The latter collapsed completely under load. This series of tests would seem to indicate that reinforced brick columns may be so constructed that they give very high strength and ample margin of impeding failure.

Editor's Note:

1908 LYSE was produced from the Norwegian Institute of Technology in 1915. He emigrated to the United States the same year and joined the construction division of the Southern California Edison Company. When the call for the Norwegian Club Test Team was organized he became Professor W. A. Mosser's assistant on this project and remained so until the completion of the report in 1917. He then joined the Portland Cement Association Laboratory staff as an assistant to the Director, R. E. McMillan. When the American Concrete Institute's Reinforced Concrete Columns Investigation got under way Lyle was transferred to Lehigh University as the Association's representative



in 1911, as under Professor Stone's supervision. At the completion of the design investigation he joined Lehigh University in 1913, as Research Assistant Professor of Engineering Materials and was promoted to Research Assistant Professor of Engineering Materials in 1923. Since Professor Stone's death (December 1931), Professor Lyon has been in charge of the First Engineering Laboratory at Lehigh. He has published more than thirty-five papers and articles on research in concrete, steel, and brick.

Brick Incasement Increases Steel Column Strength

Tests made at the Bureau of Standards and reported in the Bureau's *Journal of Research* for January, 1933, indicate that steel columns incased in brick walls have a strength equal for practical purposes to the tensile yield point multiplied by their cross-sectional area. The tests included three 6-in., 30-lb. H-section columns 21 ft. long having flat ends, and six similar columns incased in brick walls 14 in. thick 8 ft. long and carried up to about 8 in. from the top of the steel column. The six incased columns were divided into two groups of three each, depending upon the orientation of the steel column in the brick wall. The compression readings over a 150-in. gage length measured at mid-height showed that the steel in the incased columns was stressed on the average less than 20 per cent as much as was the steel in the bare columns for the same load. The lateral deflection of the incased columns was very small, and the brickwork was not appreciably affected by the tests. In no case did the lateral deflection exceed 0.05 in. under the maximum load. The orientation of the steel column with respect to the face of the brick wall had no effect upon the strength of the incased columns.

The tests were made at the request of the engineer department, District of Columbia, Washington, D. C. They were carried out under the direction of H. L. Whittemore. The report is signed by Albert L. Harris, A. R. Stang and J. W. McFarney.

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BRICK ENGINEER'S DIGEST

The dearth of organized and collated information on brick masonry is becoming increasingly evident. It has now long been considered a subject about which there was little to learn.

The Brick Engineer's Digest will fill this lack in your technical files. Our purpose is to give you instant copies of valuable articles on brick construction, with readers' comments and authors' corrections added, thus increasing the value of the articles.

These reports will bring your files up to date, for quick reference, on the latest data on the subject.

By special arrangement with the publishers, both here and abroad, we can cover most of the technical magazines. However, suggestions of articles that have not come to our attention will be appreciated.

The first few issues will be devoted to the subject of Reinforced Brick Masonry. The series will, however, cover architectural design and construction, masonry, thus catering to the interests of all parts of the construction industry.

Comments giving additional information on the subject treated will be appreciated.

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