THE BRICK INDUSTRY ASSOCIATION
TECHNICAL NOTES on Brick Construction
1850 Centennial Park Drive, Suite 301, Reston VA 20191 | www.gobrick.com | 703-620-0010

Technical Notes 17M - Reinforced Brick Masonry Girders - Examples
[July 1968] (Reissued September 1988)

INTRODUCTION

"Girder" is the name applied to a large size beam which usually has smaller beams framing into it. A Reinforced Brick Masonry (RBM) girder consists of brick masonry in which steel reinforcement is embedded so that the resulting horizontal member is capable of resisting loads which produce compressive, tensile and shearing stresses. The principles of design for RBM girders and beams are the same as those commonly accepted for the working stress design for reinforced concrete flexural members, and similar formulae may be used. These formulae may be found in *Technical Notes* 17A, "Reinforced Brick Masonry Flexural Design", Technical *Notes* 17J, "Design Tables For Reinforced Brick Masonry Flexural Members", may be consulted for design tables and illustrative examples.

APPLICATIONS

Where a design requires horizontal structural members, the RBM girder or beam is most advantageous on projects where (1) the structural medium is brick, (2) the surrounding areas are brick, or (3) the appearance of brick is desired. The main advantage of RBM girders is that the structural finish and the architectural finish are one and the same. In some cases, however, they provide economical solutions without considering the savings due to a built-in finish.

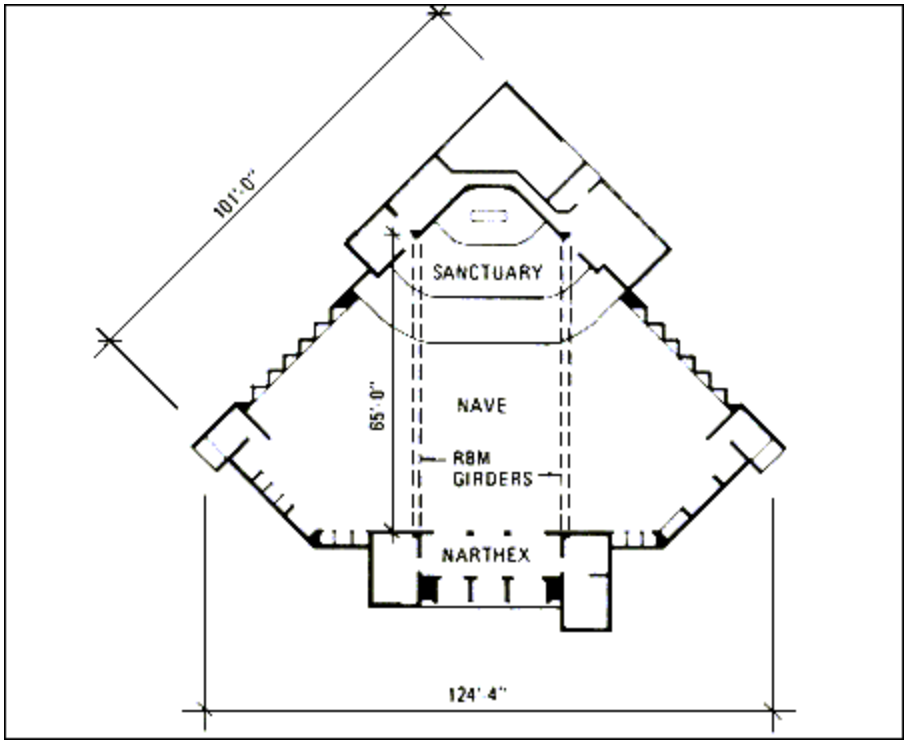
Additional advantages are that no forms are required for the erection of a RBM girder except for a work scaffold set at the bottom elevation of the girder. Brick girders are inherently fire-resistant, weather-resistant and maintenance-free. These properties, in addition to the high compressive strength of brick masonry, constitute savings in construction time and costs.

The examples of RBM girders presented in this *Technical Notes* are representative of some uses for such members. They are by no means exhaustive.

St. Hedwig's Church. Architect: J.T. Golabowski; Structural Engineer: William A. Herrmann. The design of St. Hedwig's Church (Fig. 1) in St. Louis, Missouri, built in 1957, incorporated a modified clerestory that extends the length of the church from front to rear (Fig. 2). In order to keep the nave and sanctuary clear of interior columns, the sidewalls of the clerestory were supported only at the ends. Exposed brick were used extensively both outside and inside the church. Structural members, 65 ft long, were required that would have a brick finish on both sides, and carry the roof load from above and part of the loads from the side roofs.

St. Hedwig's Church - St. Louis, Missouri

FIG. 1



Plan of St. Hedwig's Church St. Louis Missouri

FIG. 2

Three types of girders were considered:

1. Prestressed concrete girders. These were eliminated because, with masonry on both sides, they would be too thick for the desired appearance.

2. Brick-encased steel plate girders. These would have been end-supported on steel columns built into the masonry walls.

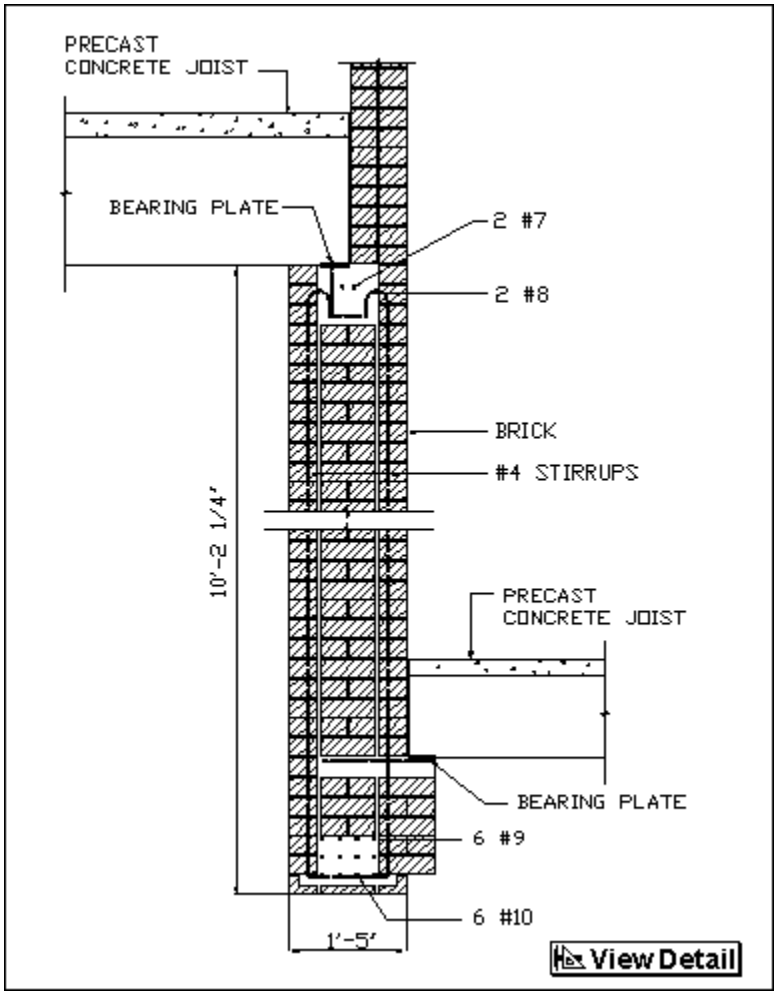
3. RBM girders. These would be supported on RBM columns built integrally with the front and rear masonry walls.

At that time, contractors in the St. Louis area were not familiar with RBM construction. Due to this, alternate bids were taken on both the brick-encased plate girder and RBM girder systems. All ten bidders indicated savings would be made with the RBM system.

The church contractor, C. Rallo Contracting Company, Inc., reported that the total cost of the two RBM girders and supporting columns was only $8000; columns alone cost $600. The bid figures show two steel plate girders and four steel columns would have cost $8200 without the brick encasing.

Figure 3 gives the overall dimensions of the RBM girder. The depth was dictated by the clerestory proportions. During the construction of the two girders, the only form needed was a work scaffold set to the bottom elevation of the girder. Soffit brick were laid out first (Fig. 4) with the bottom steel being placed next. Stirrups were then added and tied near the tops for stability. After that, it was just a matter of laying brick and placing grout in increments of three or four courses (Fig. 5).

A building permit was issued for the job with the provision that one of the girders be successfully load-tested after completion. The specification required a test load equal to the design dead load plus twice the live load, in accordance with *Building Code Requirements For Reinforced Concrete* of the American Concrete Institute.



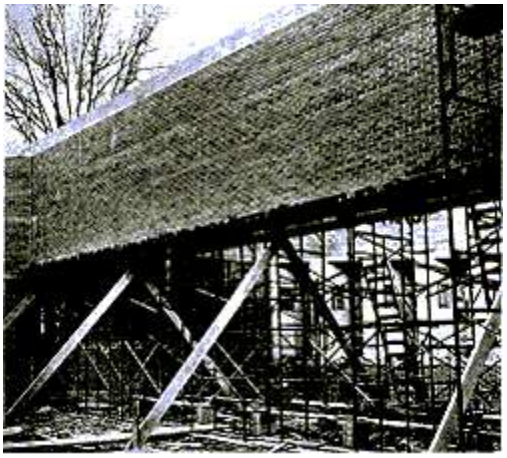
Section of RBM Girder - St. Hedwig's Church

FIG. 3

Soffit Brick in Place on Scaffold

St. Hedwig's Church

FIG. 4



Completed RBM Girder - St. Hedwig's Church

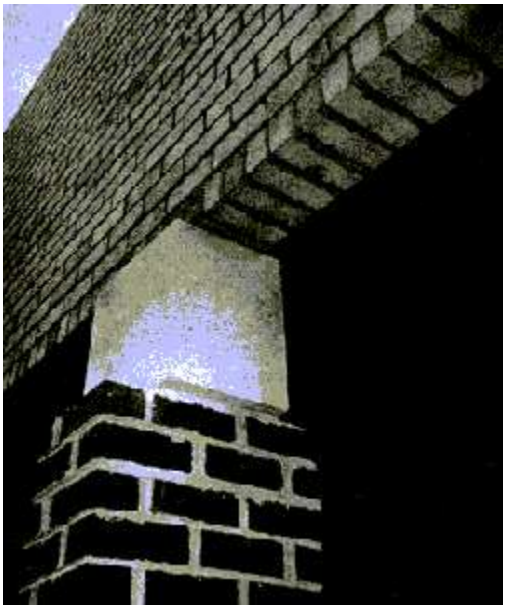
FIG. 5

Test loads of 67,500 lb were applied at each third point of the girder. This was in addition to the dead load of both the girder and the concrete roofs it supports. Pittsburgh Testing Laboratory performed the tests with calibrated hydraulic jacks through a fulcrum system.

All deflection measurements checked out within the allowable limits. After 24 hr under full load, the maximum girder deflection was only half the amount allowed by the test provisions. Recovery after load release was 94 percent.

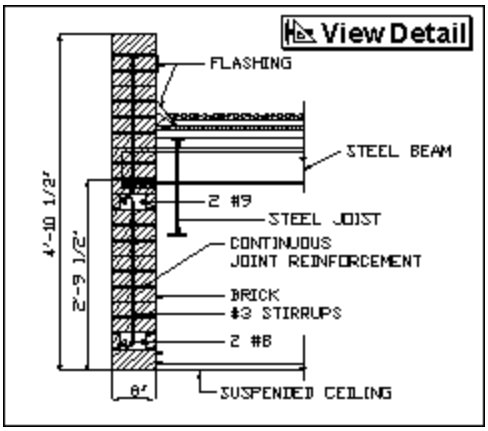
Maryland City Shopping Center. Architect: Anthony F. Musolino & Associate; Structural Engineer: Lugi Iacono. A project in Maryland City, Maryland which extensively uses RBM girders is the Maryland City Shopping Center now nearing completion. The architect is well pleased with the use of RBM girders as handsome structural facades (Fig. 6). Details of two girders are shown in Figs. 7 and 8. The RBM girder in Fig. 7 is supported on RBM

columns spaced 23 ft 4 in. on center. It carries half of the arcade roof load transmitted to it by a beam located 6 ft 8 in. from one support. Other girders are loaded similarly by beams at varying distances from the girder support.



RBM Girder as Structural Facade - Maryland City Shopping Center

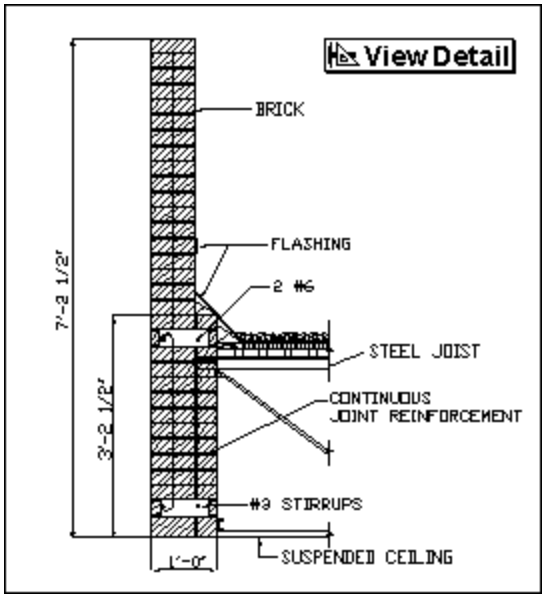
FIG. 6



Section of RBM Girder Maryland City Shopping Center

FIG. 7

Another girder is utilized above a store front which is glazed for display purposes (Fig. 8). This girder supports a roof area of 500 sq ft carried by bar joists 4 ft 2 in. on center in addition to a 4-ft masonry parapet 8 in. thick. The column spacing for the girder is 25 ft.



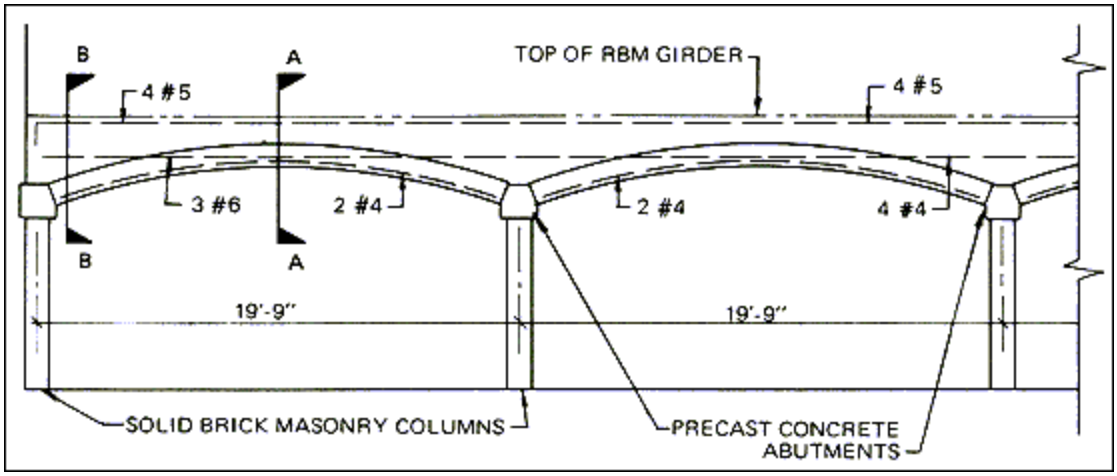
Section of RBM Girder Maryland City Shopping Center

FIG. 8

Mt. Vernon Shopping Center. Architect: Anthony F. Musolino & Associate; Structural Engineer: Peter Dragan. The architectural beauty of repeating arches with the structural capability of RBM girders is displayed at the Mt. Vernon Shopping Center, Alexandria, Virginia (Fig. 9). The reinforced arches which form the bottom of the RBM girders are not intended to be structural. The girders transmit half the covered promenade roof load to their supporting solid brick masonry columns which are spaced 19 ft 9 in. on center (Figs. 10 and I 1). The girders were constructed of 8000 psi brick units and type M mortar.

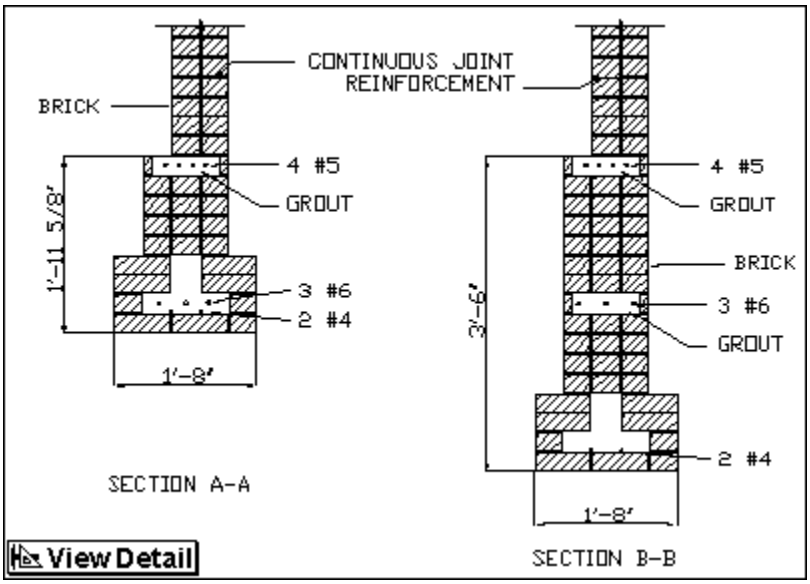
Mt. Vernon Shopping Center - Alexandria, Virginia

FIG. 9



Elevation of RBM Girder and Arches - Mt. Vernon Shopping Center

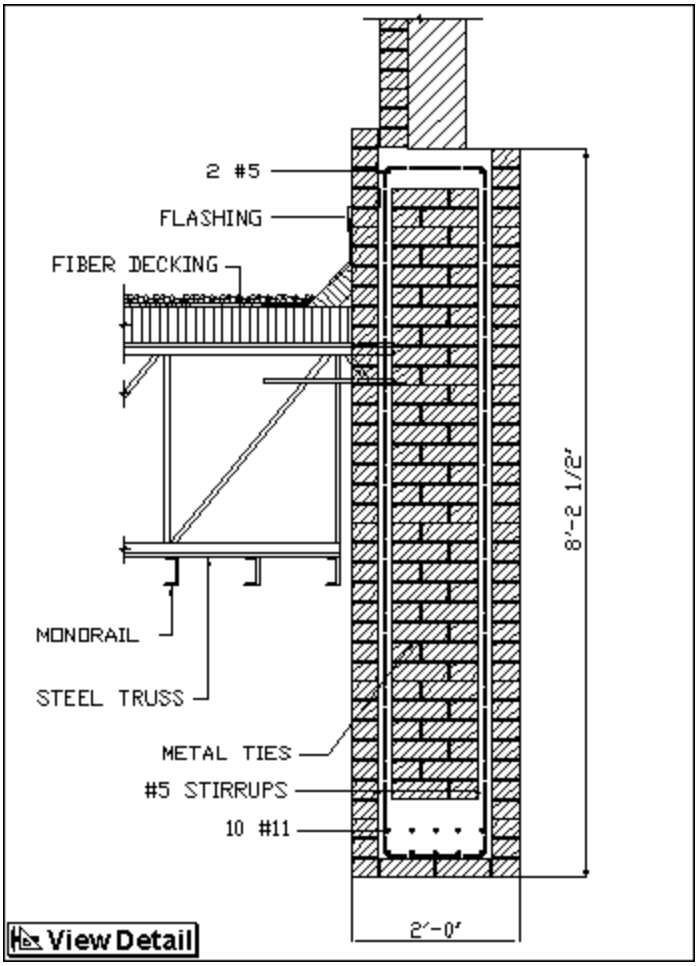
FIG. 10



Sections of RBM Girder and Arch Mt. Vernon Shopping Center

FIG. 11

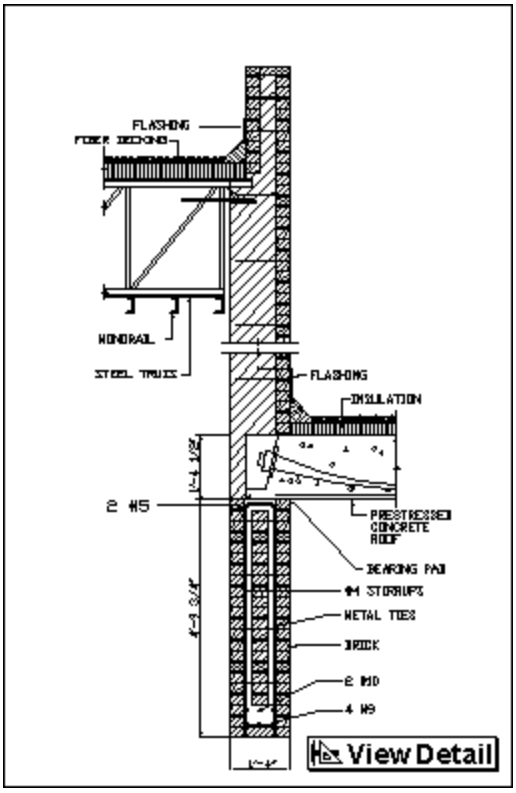
Alexander Art Center. Architect: Griffey and Stroll Associates; Structural Engineer: William Blanton. The designers of the Alexander Art Center at Athens, West Virginia were confronted with the problem of spanning over the main auditorium proscenium opening. A structural member having a fire-resistant brick finish was desired to support steel trusses which, in turn, support the roof loads over a clear span of 39 ft and a monorail system spaced 1 ft on center connected to the bottom chord of the trusses. The monorails will provide a flexible system for lighting and scenery movement. The designers felt that deflections in a brick-encased steel girder may cause cracking of the enclosing masonry. The encasing operation for the steel girder would require scaffolding similar to that used in the construction of RBM girders. Also, RBM was being utilized on the project in retaining walls and in loadbearing walls. These factors resulted in the final selection of a RBM girder spanning 50 ft 8 in. to solid brick masonry columns on either side of the proscenium. The girder section detailed in Fig. 12 is to be constructed of 8000 psi brick units and type M mortar. The total design load is 5820 lb per 1in ft of girder.



Section of RBM Girder Alexander Art Center

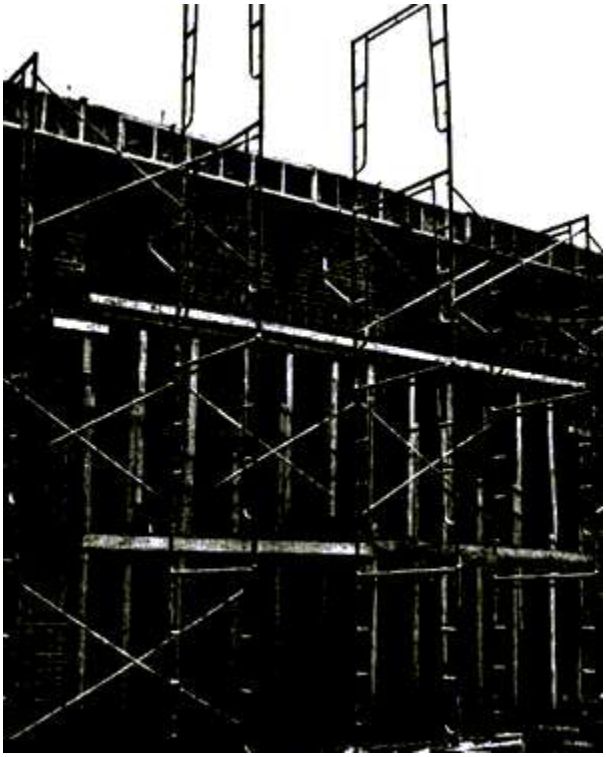
FIG. 12

The Art Center will also include a studio theater in which the 24-ft stage will be spanned by a RBM girder of the dimensions shown in Fig. 13. The loading was the same as for the larger girder plus an additional load of a prestressed concrete roof which spans 46 ft 6 in. This results in a total design load of 7064 lb per 1in ft. Figure 14 shows this girder.



Section of RBM Girder Alexander Art Center

FIG.13



Completed RBM Girder - Alexander Art Center

FIG. 14