

Technical Notes 24 - The Contemporary Bearing Wall (June 2002)

INTRODUCTION

Historically, the structural design of masonry buildings was based on the empirical requirements of building codes for minimum wall thickness and maximum height. Bearing wall construction for buildings higher than three to five stories was uneconomical and other methods of support (steel or concrete skeleton frame) were generally used. In 1965, there was a renewed interest on the part of the design professional, architect and engineer, in modern bearing wall construction, wherein the design is based on a rational structural analysis rather than on outmoded arbitrary requirements. This interest was first stimulated by the work in Europe, where many loadbearing brick buildings exceeding ten stories in height have been constructed during the past two decades.

EXAMPLES

One of the world's tallest thin-brick bearing wall structures built in 1957, is located near Zurich, Switzerland (Fig. 1). This 18-story apartment structure utilizes interior loadbearing brick walls of 5 to 10 inches. in thickness. The exterior walls (Fig. 2) are 15-1/4 inches. in thickness; the thickness in this instance being determined by the requirements for thermal insulation rather than by structural requirements. By using cavity walls, the Swiss have found a way to provide the required thermal insulation and still maintain relatively thin exterior walls. Figure 3 shows a 16-story apartment building in Grenchen, Switzerland which utilizes cavity wall construction. The exterior walls of this building (Fig. 4) are comprised of a 6-inches. brick inner bearing wythe, a 1-1/2-inches. cavity and a 5-inches. exterior brick wythe. The floor loads are carried by the 6-inches. inner wythe and 6-inches. interior brick bearing partitions. The 5-inches. exterior wythe of the exterior wall is self-supporting on the foundation and is tied only at each floor level, with 1/4-inches. stainless steel wire anchors embedded in the edge of the slab at approximately 20 inches. on center.

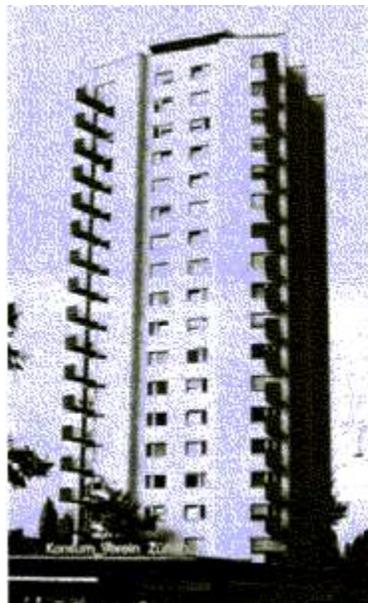
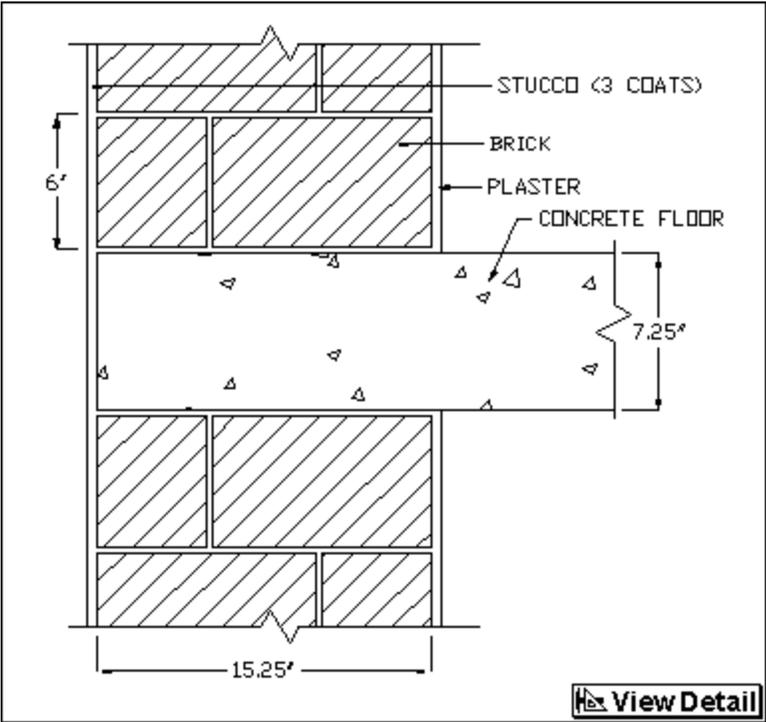


FIG. 1

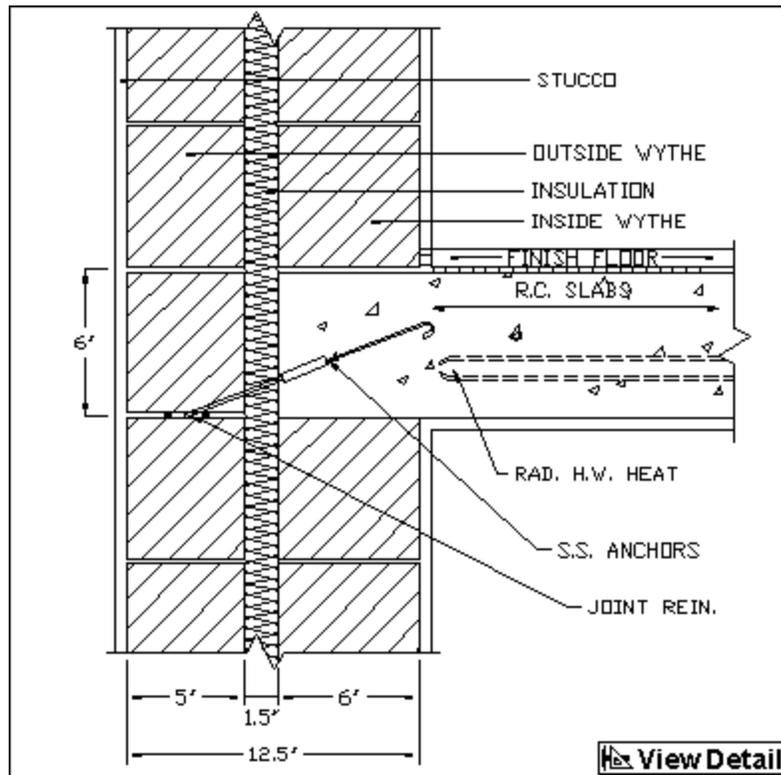


Bearing Wall @ Floor Slab

FIG. 2



FIG. 3



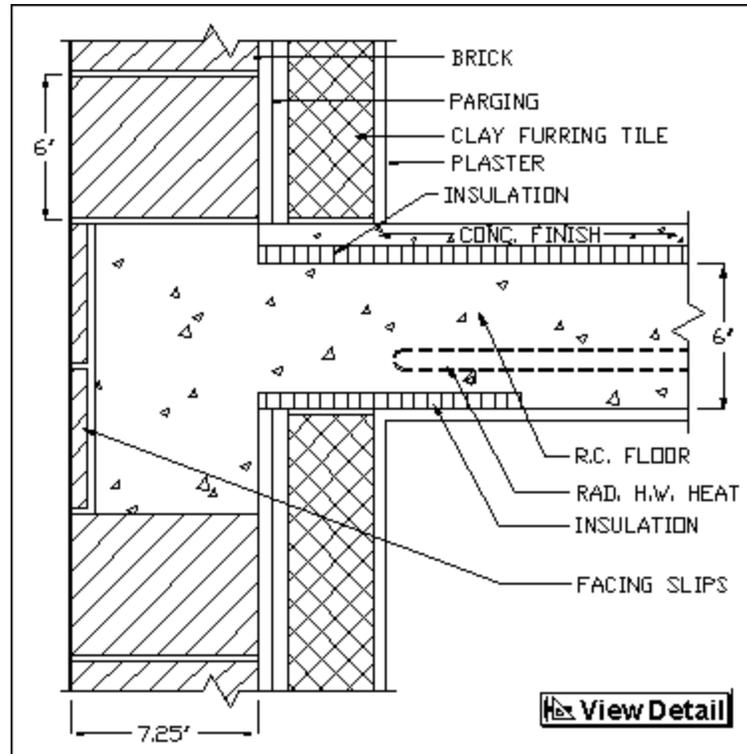
Cavity Wall @ Floor Slab

FIG. 4

Many of the high-rise brick bearing wall buildings in Switzerland are stuccoed on the exterior; this being their traditional method of building. However, there is an increasing use of exposed clay masonry units. Another example (Fig. 5) is a 14-story structure in Lucerne. The exterior bearing walls of this structure are only 7-1/4 inches. in thickness (Fig. 6). The resistance to water penetration is provided by parging on the interior of the exterior wall rather than stucco on the outside.



FIG. 5



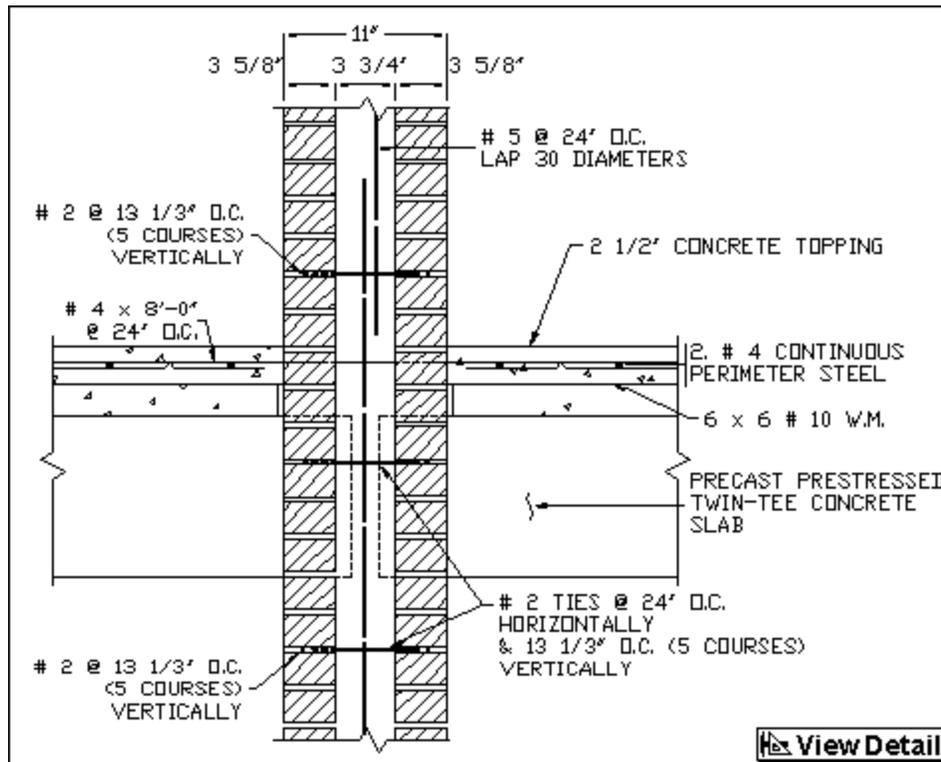
Brick & Clay Tile Cavity Wall @ Floor Slab

FIG. 6

Recent American examples of brick bearing wall construction are shown in Figs. 7, 9 and 11. Figure 7 is the 17-story Park Mayfair East building, in Denver, Colorado. The structural system in this building utilizes 11-inches. reinforced brick masonry (RBM) walls for the full building height (165 feet). Fourteen-inch prestressed concrete twin-tee slabs were used for the floor spans, which vary from 32 to 37 feet (Fig. 8).



FIG. 7



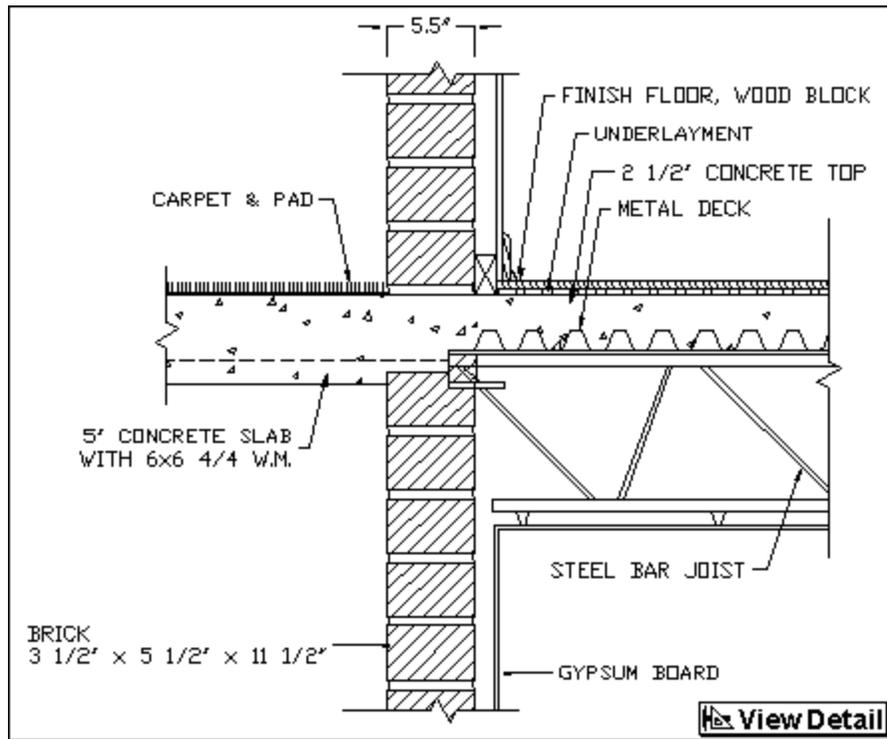
Cavity Wall @ Precast Tee Floor

FIG. 8

Figure 9 illustrates the 8-story Oakcrest Towers apartment building in Prince Georges County, Maryland near Washington, D. C. This building utilizes 8-inches. brick exterior walls for the full height of the building, and 6-inches. brick bearing corridor walls. The floor system, in this instance is steel joints with 2-1/2-inches. concrete topping over metal deck for the 24-feet. apartment span, and a 5-inches. flat concrete slab or the 6-foot corridor span. Figure 10 is the typical detail for the 8-inches. exterior and the 6-inches. corridor walls.

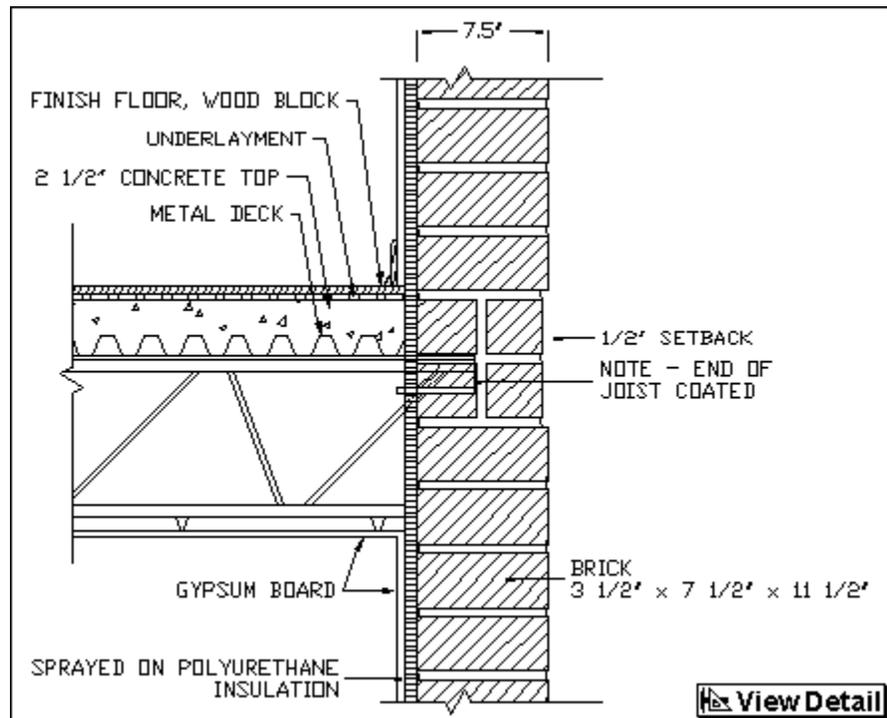


FIG. 9



Interior Bearing Wall @ Floor Truss & Concrete Slab

FIG. 10a



Exterior Bearing Wall @ Floor Truss & Concrete Slab

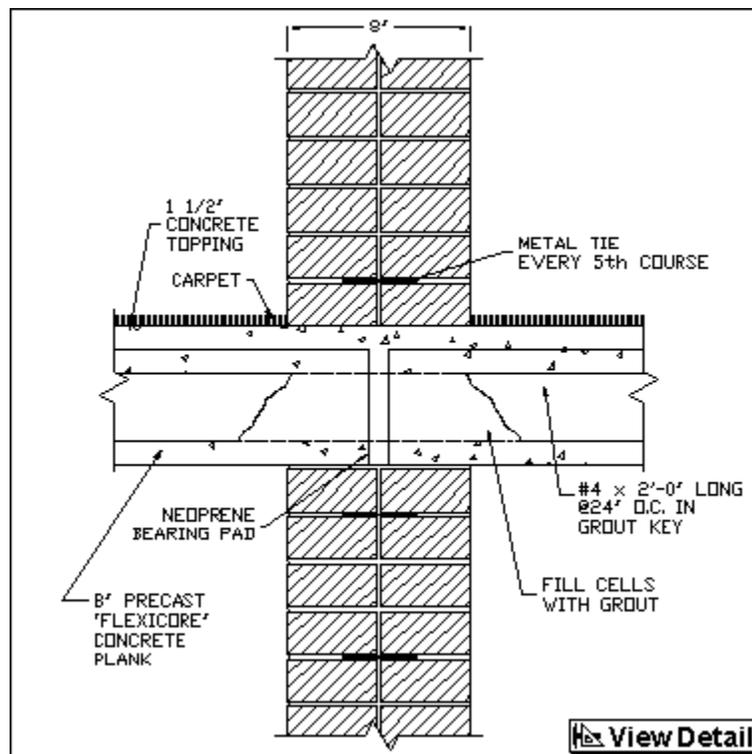
FIG. 10b

The Muskegon Retirement Apartments (Fig. 11) is an 11-story, 194-unit structure in Muskegon, Michigan. The structure consists of 8-inches. solid brick bearing cross walls which support the 8-inches. precast hollow core concrete plank floor system. Non-bearing exterior walls are 10-inches. brick cavity walls, insulated with water-

repellent vermiculite (Figs. 12 and 13). Exposed brick forms the interior finish on the bearing cross walls, which are also separation walls between units. These walls provide attractive low maintenance surfaces, fire resistance, structure, and excellent sound separation.

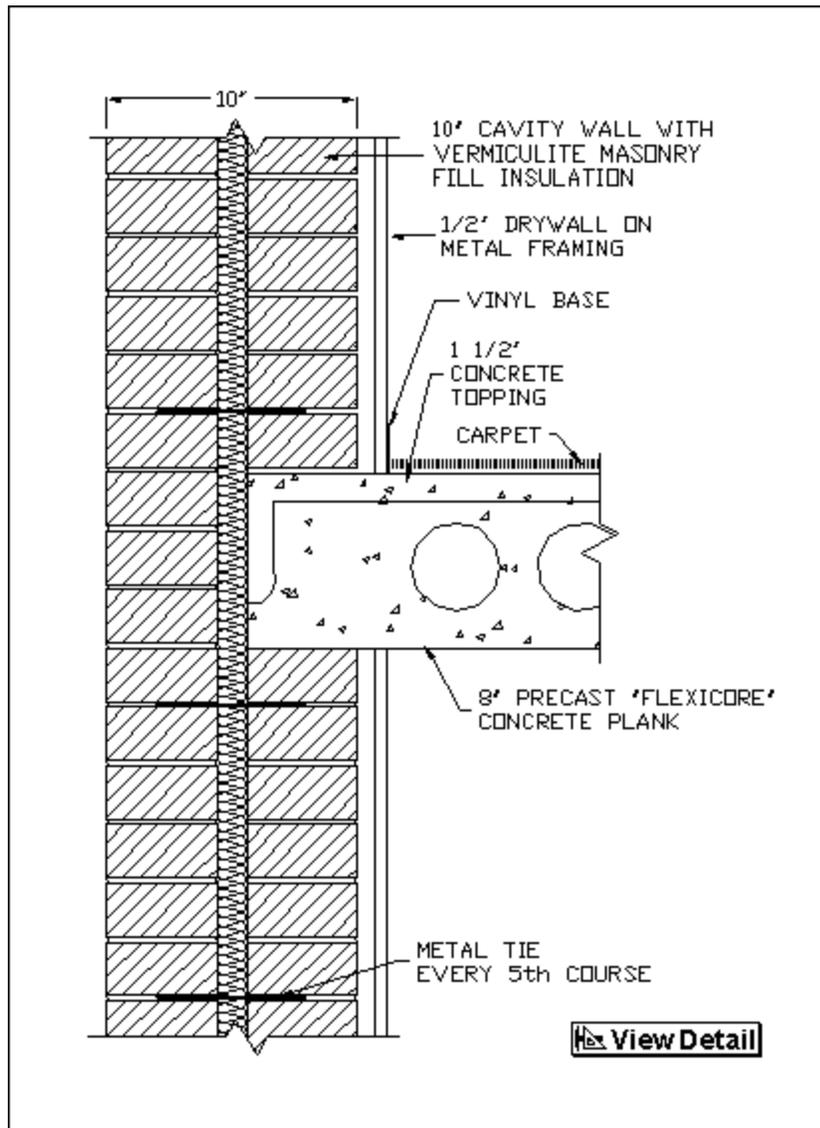


FIG. 11



Interior Bearing Wall

FIG. 12



Exterior Non-Bearing Wall

FIG. 13

BUILDING CODES

The Structural Clay Products Institute published the first edition of a rational design standard for engineered brick masonry in May of 1966. This first Standard was based on laboratory research and historical performance data. In August 1969, the Institute (now the Brick Institute of America), developed and published a second generation standard, *Building Code Requirements for Engineered Brick Masonry*,

For easy reference, the BIA Standard has been accepted in substance or by reference in the following model building codes:

Model Building Codes

1. BOCA Basic/National Building Code, 1984 Edition.
2. Standard Building Code, 1985 Edition.
3. Uniform Building Code, 1985 Edition; Chapter 24 - Masonry.

In addition to the model building codes, many local municipal sub-divisions - cities, counties and townships - have also adopted, by reference or in principle, these engineered brick masonry provisions and requirements.

ECONOMICS

Experience to date indicates that brick masonry bearing wall construction is competitive with structural frame, and for many types of buildings can be constructed at less cost. This economic advantage is due in part to the increased efficiency of the use of materials. For example, in a brick bearing wall structure, the brick walls become enclosure, separation, structure, finish and fire protection. The economic position is also the result of the simplified and faster construction process.

Mr. Harold Simpson, General Contractor and part owner of the Park Mayfair East project in Denver (see Figs. 7 and 8), stated these reasons for using the brick bearing wall structural system:

"...As an owner, the number one consideration is lower initial and future costs, which means we can charge lower rents and have lower vacancy rates. The next important single criterion of a good apartment is sound control. For this, the 11 - inches. wall of brick and grout gave us a sound resistance of 58 decibels which is excellent. Another important aspect is the shorter construction time which allows earlier occupancy. This means lower interest payments on construction loans and earlier rent payments. In fact as the building was being topped out, some of the lower floor apartments were complete with carpets and draperies, and future tenants were visiting the fully furnished display apartments.

"As a contractor, I look at this brick bearing wall structural system much the same as an owner, but with some differences. The faster erection time is very important because time is money. Brick bearing walls give me lower costs and faster erection by being the structural system as well as the enclosure walls. When the bearing walls are complete and the floor slabs have been placed, we have only to insert the windows and (1) the floor is closed in, (2) the exterior walls are complete, (3) the structure is fireproof. In addition, we have fire walls between apartments and many of the interior walls are also complete. This is not true with a steel or concrete structure. This finished building, including appliances, draperies, carpeting and landscaping, cost \$12.25 per sq. feet. of floor area. This total includes some costs that would not have to be duplicated if we constructed the buildings again, but, with labor and material cost increases expected in the future, a new building similar to this one would probably cost about the same.'

REFERENCES

1. Monk, Clarence B., Jr. and Gross, James G., *European Clay Masonry Loadbearing Buildings*, SCPI, 1964.
2. *Proceedings - The First National Brick and Tile Bearing Wall Conference*, SCPI, 1965.
3. "Contemporary Brick Bearing Wall" *Case Study*, BIA .
4. *Technical Notes on Brick and Tile Construction*, BIA (a monthly series).
5. *Building Code Requirements for Engineered Brick Masonry*, BIA, August 1969
6. Gross, James G.; Dikkers, Robert D.; and Grogan, John C., *Recommended Practice for Engineered Brick Masonry*, BIA. November 1969.