

Masonry Advice for Structural Engineers

An Interview with Jerry M. Painter

In the arena of codes and standards, participation is dominated by engineers, architects, code officials and industry representatives. Unfortunately, there are few contractors and construction managers. However, there is one mason contractor who has been striving for improvements in both the design and construction of masonry. Mr. Jerry Painter of Painter Masonry, Gainesville, Florida, has a 40 year history as a mason and contractor. The company works throughout Florida, and has a companion firm, Painter Crane and Rigging, to service its masonry business as well as the overall construction industry.

Mr. Painter is an active member of The Masonry Society and its Executive Board, a member of the Masonry Standards Joint Committee (MSJC) that produces the *Building Code Requirements for Masonry Structures*, (TMS 402/ACI 530/ASCE 6), and serves on numerous ASTM committees. He is active in the Masonry Contractors Association of America, the Masonry Association of Florida, the Rotary Club of Gainesville, the Alachua County Code Enforcement Board, and other civic groups. He lectures at various universities. Clearly, this is a contractor that sees the big picture!

Mr. Painter sat down with STRUCTURE® magazine, and gave his thoughts on various masonry issues that might help structural engineers and architects improve the industry for which he has dedicated his professional career.

Q Can you tell us what you believe qualifies as "high quality" masonry?

Mr. Painter: High quality masonry has four distinct characteristics. It must be functional, economical, durable and aesthetically pleasing. I believe it takes all four of these to create "high quality" masonry.

Q Can you give us your thoughts on masonry workmanship?

Mr. Painter: I believe workmanship as it relates to masonry applies to all aspects of the project. It includes:

- Proper design and material selection by the architect and structural engineer. The easier it is to understand and accomplish the design, the more likely it is to be built correctly.
- Preparation for construction by the general contractor and mason that takes into account field conditions.

c) Quality craftsmanship by the mason to implement the design. This is not just the aesthetics but, more importantly, the structural function.

Remember, a masonry building is hand crafted just like it was thousands of years ago, one unit placed upon another.

Through the use of a wider variety of material and technology such as reinforced masonry, we can accomplish great things with modern masonry. But, the process of creating a building requires much more than the efforts of the mason.

Q What can structural engineers do to improve their masonry projects?

Mr. Painter: Here are several items that could be addressed:

Mixing Systems

Masonry produces an excellent load bearing system. However, we often are faced with a mixture of reinforced concrete and structural steel with the masonry walls. As an example, *Figure 1a* shows a detail with a concrete beam formed by the masonry. The beam was intended to span only 4 feet. *Figure 1b* shows the revised detail that accommodated the span and created the desired brick soffit. The beam action reverted from the concrete back to the masonry.

There has also been a growing trend to using commercially available systems for steel lintels (*Figure 2*). While effective, those systems are often expensive. Masonry lintels can often provide the structure required at lower cost.

The message here is to select one system and stick to it! Whenever possible, use the masonry without interjecting other materials. The mixing of structural systems can create coordination, scheduling and financial conflicts on a building project.

Provide Detail Adjustability

Veneer and hung masonry usually require steel support. *Figure 3* shows a standard relieving angle detail available through the

Brick Industry Association. It includes a slotted anchor in a concrete beam that provides vertical adjustability. Horizontally slotted angles allow for adjustment in that direction. Shims are needed for adjusting outward. Remember, the mason doesn't set these anchors. That's the re-

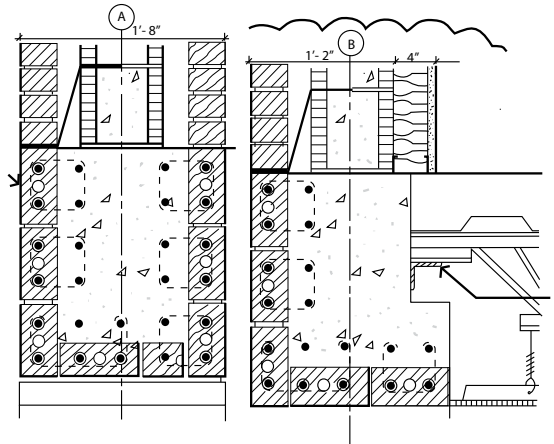


Figure 1a.

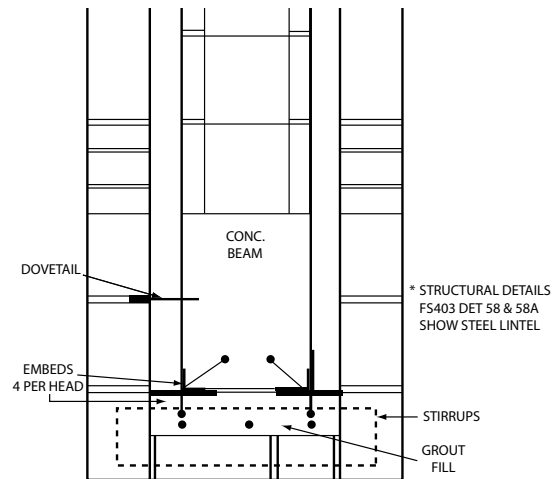


Figure 1b.

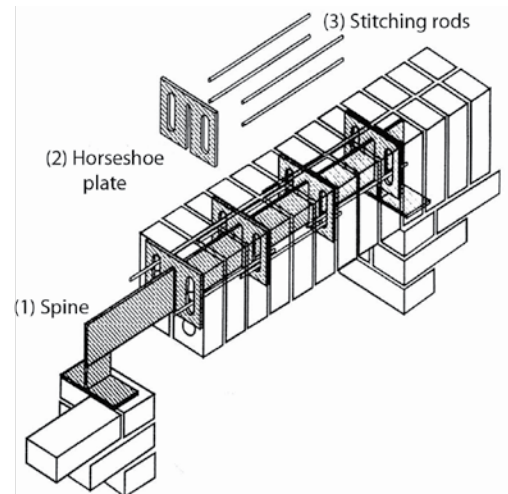


Figure 2.

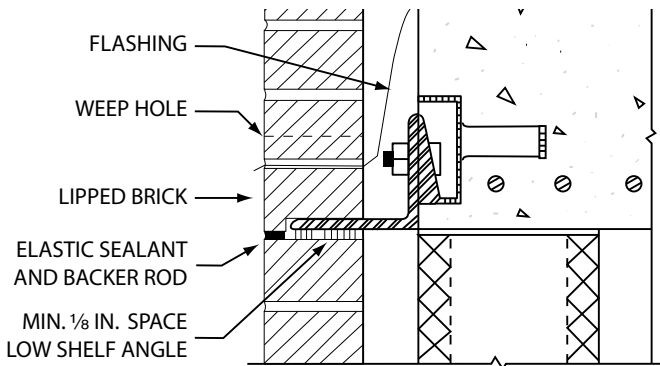


Figure 3. Courtesy of Brick Industry Association, Technical Note 18A.

sponsibility of the concrete subcontractor. The mason is forced to accommodate the installation of the embedded items.

In recent years, structural engineers have been using embedded weld plates or angles bolted with adhesive anchors to the edge beams. While these systems can adequately support the masonry, alignment and adjustability are a concern. As with the embedded anchors, embedded weld plates must be properly located in the concrete beams. They also don't easily allow the steel to be



Figure 4a.



Figure 4b.

held in place for alignment prior to welding. Shims are needed for adjustment.

Drilled in adhesive bolts have their own set of problems. Maintaining alignment during drilling is one concern. The other is the potential for drilling into the beam reinforcement. The mason has no control over the reinforcement

placement but has to make the connection.

Be aware that just because a detail is do-able does not make it right.

Accommodate Tolerances

The problems associated with the two items noted above are exaggerated by industry standards associated with different materials. Structural steel frames and concrete frames are to be constructed to the tolerances of AISC and ACI respectively. However, the masonry skin is expected to be plumb and level. This requires that the structural engineer accommodate those variations in tolerances by providing adjustability in the veneer support design.

Also, be understanding of the mason. Most do not construct the foundations but are asked to accommodate the work of other trades. Figure 4a shows a footing that was not properly formed, and the bars were mislocated. However, the mason is expected to build a plumb and level wall from this starting point. The MSJC specifications require inspection prior to placing the masonry. However, ACI 318 has tolerances for cast in place concrete. Cooperation with the mason in getting other trades to meet their own tolerances will only improve the quality of the masonry.

Figure 4b shows a foundation wall with alignment problems. Masons are good, but no mason can straighten this out. Mistakes made by other trades should not be forced upon a mason.

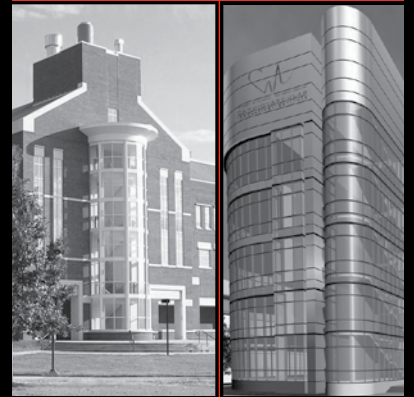
Get Your !@#%&@ Stuff Out of My Wall!

Masonry walls must serve more than structure. Figures 5a and 5b (page 16) show bond beams that were detailed with electrical conduit. The conduit prevents complete grouting of the bond beam, interferes with the reinforcement, and reduces that strength of the beams.

Figure 6 (page 16) shows a wall. What is the bearing capacity of the wall with all the pipe penetrations? The MSJC code (Section 1.15.2 of the 2005 edition) requires consideration for the lost masonry. That forced the use of

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a steel header underneath the precast plank floor to span over the openings. Further, Section 1.15.2.3 requires conduits and pipes to be separated by 3 diameters.

Finally, *Figure 7* shows a wall with so many conduits and pipes that it's hard to find the reinforcement, or identify areas where masonry could be placed. The design had to be changed to provide a chase.



Figure 5a.



Figure 5b.

Structural engineers need to advocate for relocating the utilities from the grouted masonry or creating chases. The structural capacity of bond beams must be of primary concern. In addition, Section 1.15.2.4 limits the area of vertical conduits and pipes to 2 percent of the net area of the masonry section. It's best to keep all this in the ungrouted cells of the walls.

Be Aware of Material Properties

Understand that masonry consists of "stacking pieces". Those pieces are masonry units, and each is unique with properties that vary. Understand the interaction of brick, CMU, stone and other materials. They aren't the same! Provide details to accommodate the differences. The MSJC code and specification requires the locating of control joints in concrete masonry be done by the designer, not the mason.

Shop Drawings

Reinforcement shop drawings are essential to a quality project. Structural engineers should be aware of who is preparing and checking



Figure 6.

these drawings. Contractually, it may not be the mason. In that case, the mason must be included on the review of the shop drawings. Why? Because the method of grouting is directly related to the splice locations. Low lift grouting splices must be carefully laid out and not made random. In addition, the splice locations relative to features such as floor lines are important to a mason. If the structural engineer requires specific splice locations, such as at retaining walls or shear walls, those locations must be clearly noted rather than making the rebar detailer the default designer.

Get the mason's input to the shop drawings and have them sign off.

Q *You advocate for quality craftsmanship. How can structural engineers and architects promote that on projects?*

Mr. Painter: There are two major things that can be done. Require mock-ups and provide quality assurance inspection.

Mock-ups are often specified by the architect. However, they should include architectural and structural features including anchors and ties. These should be built large enough to show all standard conditions anticipated. Once accepted, don't allow the mock-ups to be moved or destroyed until the work has been accepted.

Thorough inspection by knowledgeable inspectors is good for everyone! Structural engineers should be sure their inspectors are familiar with industry standards, testing requirements and the design documents. Work with the mason to resolve interferences or problems, whether accidental or unintended.

Q *What new efforts are underway to continue improving masonry construction?*

Mr. Painter: The masonry industry has realized that we are losing masons faster than we are replacing them. The changes in material and technology over the last 30-50 years has shown us the need for more, and better educated and trained, masons. This is evident because several states either have or are

developing masonry contractor certification programs. The Mason Contractors Association of America (MCAA) is currently developing a national certification program. There has also been a renewed interest in apprenticeship. The results of this can be seen in the classes and competitions at the local, state, regional and national levels.



Figure 7.

ASTM has embarked on an effort to develop a new standard, *The Standard Practice for Unit Masonry Workmanship*. This document will provide minimum workmanship requirements for unit masonry construction (clay and concrete masonry units) with the intent to "standardize" finished wall construction. It is to supplement the MSJC Specifications. For instance, there will be a more thorough discussion of construction tolerances as well as provisions for a first-ever tolerance for mortar joint "solidity". Joint solidity is a reflection of how full the mortar joints are constructed. Currently, there is no tolerance. This is unrealistic!

Remember, masonry is a handcrafted system constructed by people who are not perfect, with materials that are not exact and with designs that are not always exact. Please allow for tolerances and flexibility in the design and construction of the oldest and arguably still the best building system known to man.

STRUCTURE: Thank you for your comments! We hope all structural engineers will take your advice to heart and examine how they implement masonry design and construction. ■

Jerry Painter is the President for Painter Masonry, Gainesville, Florida.

Mr. Painter was interviewed by David Biggs, P.E., Ryan-Biggs Associates, NY. Mr. Biggs specializes in the design, evaluation and restoration of masonry structures, forensic engineering, and the development of new masonry products. David was a long-time member of the STRUCTURE® Editorial Board until January 2007.