Joint Reinforcement

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SYNOPSIS

This article endeavors to clarify some of the facets of the use of joint reinforcement, pointing out what it is, what the code restrictions are, how it may be used, some examples of use, and some words of caution.

There is some difficulty in establishing some of the definite facts or truths in this field of joint reinforcement. Some items are actual or real facts, some are code statements or limitations, some are interpretations or misinterpretations of the code wording and intent.

However, we will try to clarify this by:

1. Indicating the code provisions.
2. Describing types of joint reinforcing that are most appropriate in our West Coast area.
3. Discussing some examples of use.
4. Showing some details.

As a further limitation on this article, it must be emphasized that this report is too brief to cover all the facets of joint reinforcing.

We will try to cover only the major and probably most generally interesting items.

The Uniform Building Code indicates the use of joint reinforcing in several Sections e.g.

"Section 2414. (b) Construction:

(b) **Construction.** The thickness of grout or mortar between masonry units and reinforcement shall be not less than one-fourth inch (¼"), except that one-fourth-inch (¼") bars may be laid in horizontal mortar joints at least one-half inch (½") thick and steel wire reinforcement may be laid in horizontal mortar joints at least twice the thickness of the wire diameter.

This states definitely that wire type of reinforcement may be used in joints, and relates the size of wire to size of joint.

Another pertinent provision is the item of Section 2417. (m)

"Section 2417. (m) Allowable Steel Stresses:

(m) **Allowable Steel Stresses.** The unit stresses in reinforcement shall not exceed those specified for reinforcement in concrete.

The stresses listed in "concrete" are listed in Section 2615.

"Section 2615:

1964 EDITION — SECTIONS 2615-2616

Allowable Unit Stresses in Reinforcement (Continued)

In Tension:	
Intermediate- and hard-grade billet or axle steel, rail steel and cold-drawn wire	20,000 p.s.i.
Structural grade bars and structural steel shapes	18,000 p.s.i.
For one-way slabs not exceeding twelve feet (12′) in span, steel reinforcement not exceeding three-eighths inch (⅜") in diameter, 50 per cent of the minimum yield point specified in the U.B.C. Standards for the particular kind and grade of steel used, but in no case to exceed	30,000 p.s.i.
In Compression:	
Structural steel section in composite columns	16,000 p.s.i.
Cast iron section in composite columns	10,000 p.s.i.

This portion of Section 2615 indicates that 18,000 psi might be used safely for most reinforcing steel, and that for wire reinforcement the stress may be 30,000 psi, because most wire reinforcement goes well over 75,000 psi as an ultimate.

This is intrinsically sound, and well may be considered as a slab.

Also L. A. City & ACI recognize similar provisions.

Another provision regarding joint reinforcement is in Section 2417. (o) Stack Bond.

"Section 2417:

(o) **Stack Bond.** Where masonry units are laid in stack bond in plain masonry mechanical bond shall be provided by placing one continuous No. 9 gauge wire or its equivalent in the horizontal bed joint for each four-inch (4") thickness of the masonry unit and spaced not more than sixteen inches (16") on centers vertically.

Another provision for limitation of the code is in Section 2418. (f) 3. Reinforcement.

"Section 2418. (f):

3. **Reinforcement.** All walls using stress permitted for reinforced masonry shall be reinforced with both vertical and horizontal bars.

The minimum area of total reinforcement shall be not less than 0.002 times the gross cross-sectional area of the wall, not more than two-thirds of which may be used in either direction. Principal wall steel shall be limited to the maximum spacing of four feet (4′) on center. The minimum diameter shall be three-eighths inch (⅜") except that approved wire reinforcement used as temperature steel or to replace running bond may be considered as part of the required reinforcement.

This last stipulation indicates, of course,

that wire reinforcement may be used as joint reinforcement, and it may be used as temperature steel.

Also, it implies when it is there, either for temperature requirement or the anchorage requirement as in stack bond, it may be considered as part of the "arbitrary" reinforcement.

This paragraph, of course, also is referring to the reinforcement required for the stress since this is under a discussion of stress.

It is obviously reasonable, of course, to consider the steel as resisting the stress since it must resist the stress.

Also, in general, the joint reinforcement is wire and will develop much greater strength than the lower strength reinforcing bar as well as having better bond area.

Another use of joint reinforcement is not spelled out clearly in the code and that is the reinforcement of grills or screen walls. These must be referred to as "nonbearing walls" and then would come under the requirement of Section 2419. (a) General:

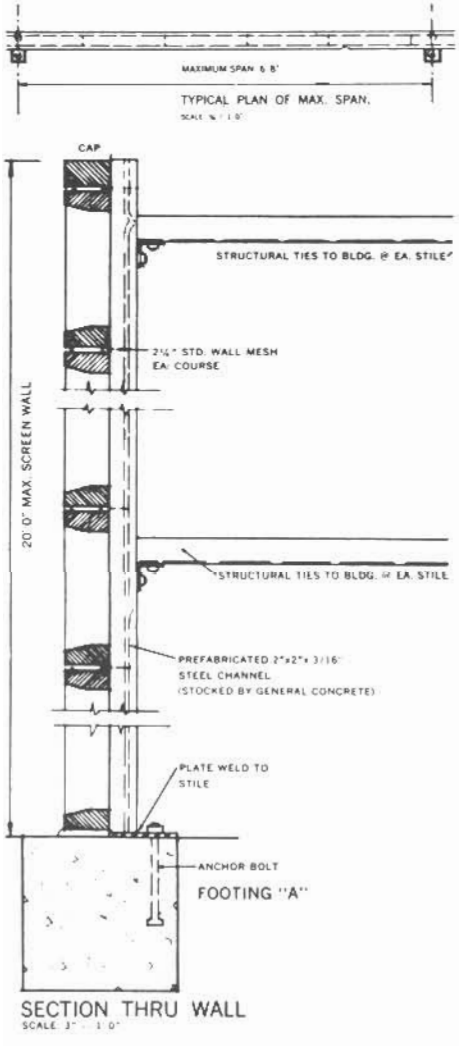


Figure 1.

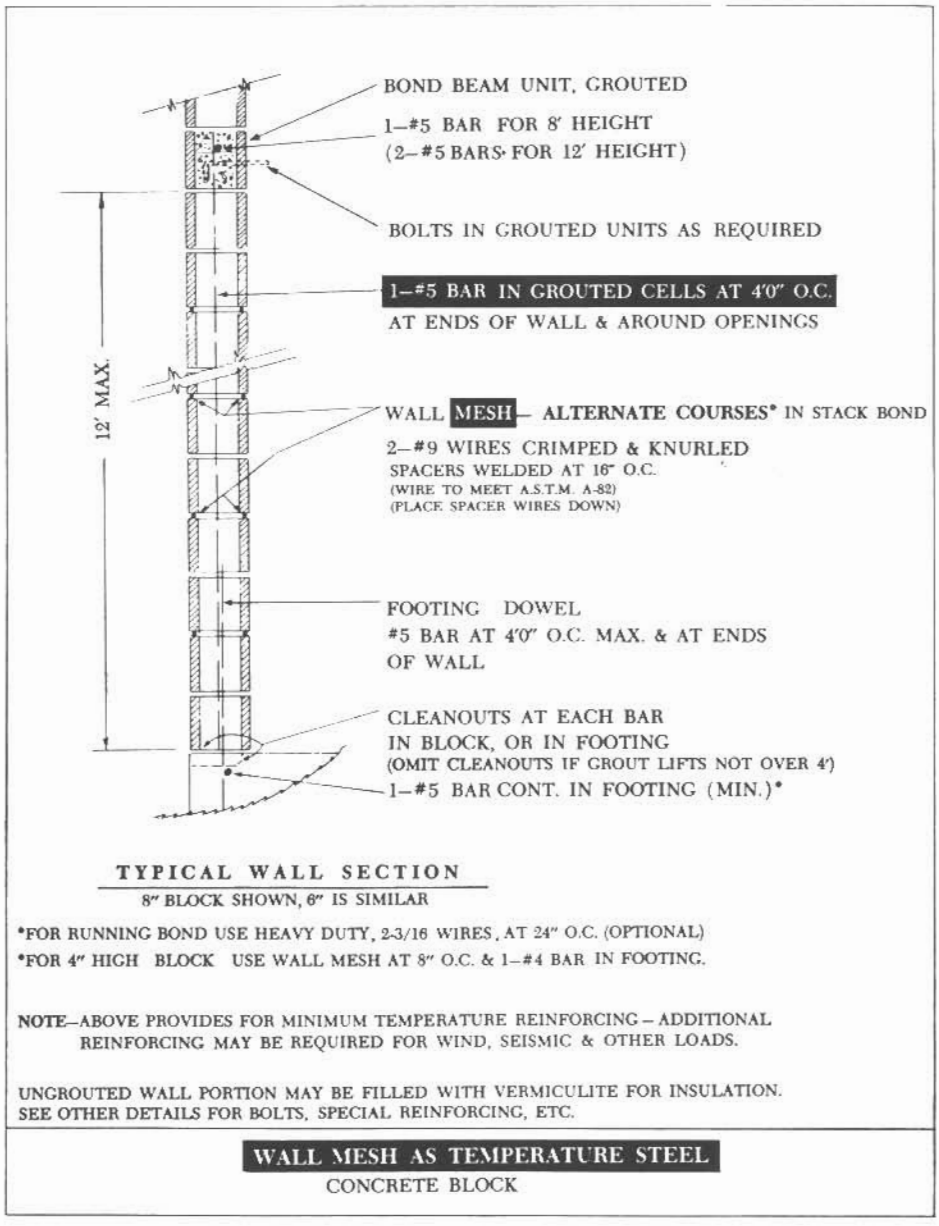


Figure 2.

Nonbearing Walls

Sec. 2419. (a) General. Nonbearing walls may be constructed of any masonry as specified in this Chapter.

The most commonly accepted method of designing these screen walls is to recognize that horizontal joint reinforcement provides the tensile strength in the wall to resist the wind and earthquake loads spanning horizontally to supports, which may be pilasters, or steel supports, and then these supports span vertically to whatever other structural support is provided as indicated in Figure 1.

The joint reinforcement is assumed in the joint to work with the two adjacent portions of the grill unit to form a small beam limited by the size of the perimeter element of the grill units, and spanning horizontally as reinforced concrete beams.

A refinement of the design might be to consider also the benefit of the steel on the compression side, as well as on the tension side.

However, if one refines calculations for higher stress it may be necessary to consider the deflections as well, since they may become excessive for architectural reasons.

An example of the use of joint reinforcement for temperature reinforcement and for stack bond reinforcement is as shown in the concrete block detail drawings in Figure 2.

Incidentally, these concrete block details have been shown to be the most economical use of reinforcement commonly used in block walls.

In addition to being economical of construction there is the possibility of instal-

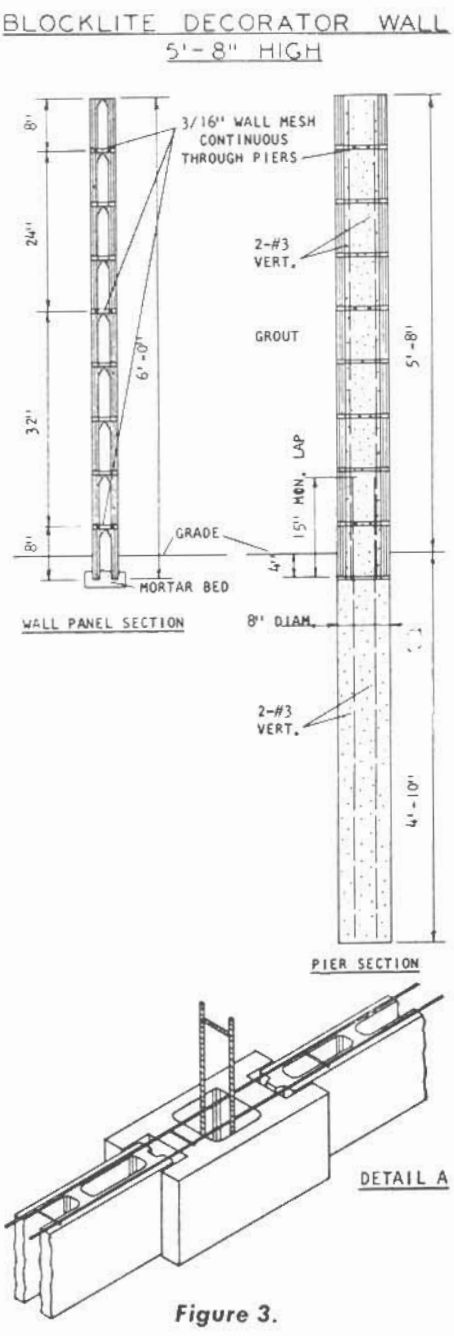


Figure 3.

ling insulating fill and doubling the insulating value or weather resistance of the walls by using this type of detail. (Some 20 per cent lower in cost than other schemes)

Also, the use of joint reinforcement in these block walls eliminates the need for the pouring of wet grout which may cause expansion of the cement units and later shrinkage, with possibility of cracking.

Another use of the joint reinforcing in horizontal span is shown in the 4 inch block wall details for fence as developed for the dry head joint decorator block scheme shown in Figure 3.

Another example of the use of joint reinforcement to resist stresses for very efficient walls is in the enclosed detail of glazed structural tile, Figure 4.

These were developed by Kraftile in Niles or Fremont, California, and have been used very successfully to provide finish walls economically that are reinforced as structural walls.

The basic principle of the joint reinforcement is that the walls span horizontally from intersecton to intersection, or from support to support.

The validity of this type construction has been proven by tests of Kraftile at Stanford, which showed that the values were much higher than might have been anticipated, probably because the tile material was of a greater strength than other hollow units.

Another example of joint reinforcement being used very effectively was in the construction of some 4 inch thick brick walls spanning some 20 feet between vertical supports, Figure 5.

Another use of joint reinforcement that is very effective is that of the combination high lift grout ties and joint reinforcement recently developed for this newer type of construction. These so-called 'ladder bars' (see figure 6), place the reinforcement out in the mortar bed joints, and leave the interior grout space clear and free for easy pouring of grout. In addition, they space the ties properly, and also reinforce the exterior wythes.

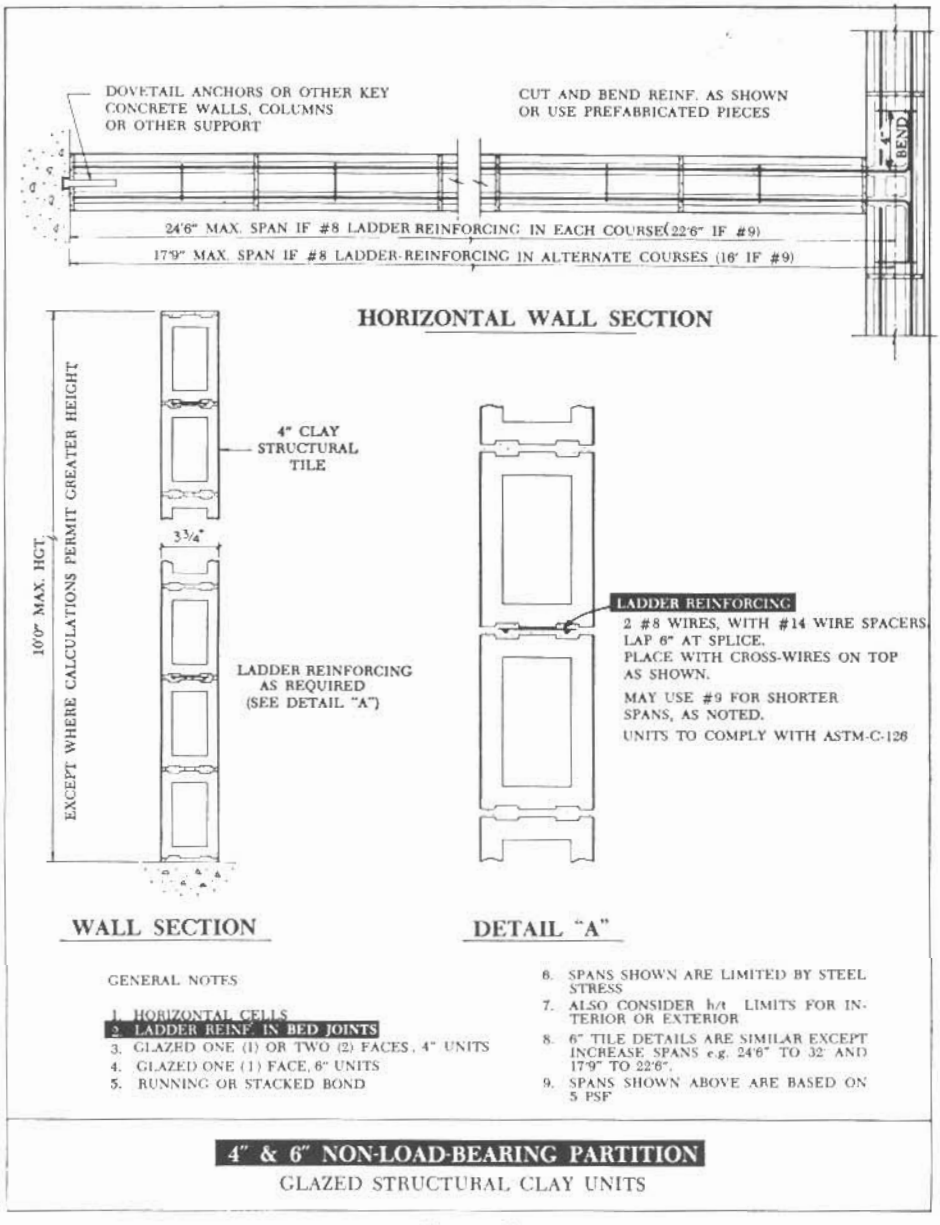


Figure 4.

Another use of joint reinforcing is illustrated in the post and beam panels which have been used in some areas. See Figure 7.

The types of reinforcement used for joint reinforcement should be the so-called 'lad-

der type of reinforcement' in which the wires are spaced properly by cross ties, either at right angles or truss type.

Single wires should not be used for joint reinforcing because of the difficulty of proper spacing and to assure good alignment. There are several manufacturers such as Wall Mesh in Los Angeles, Dur-O-Wal in the East, A. A. Products, K-Mesh, etc.

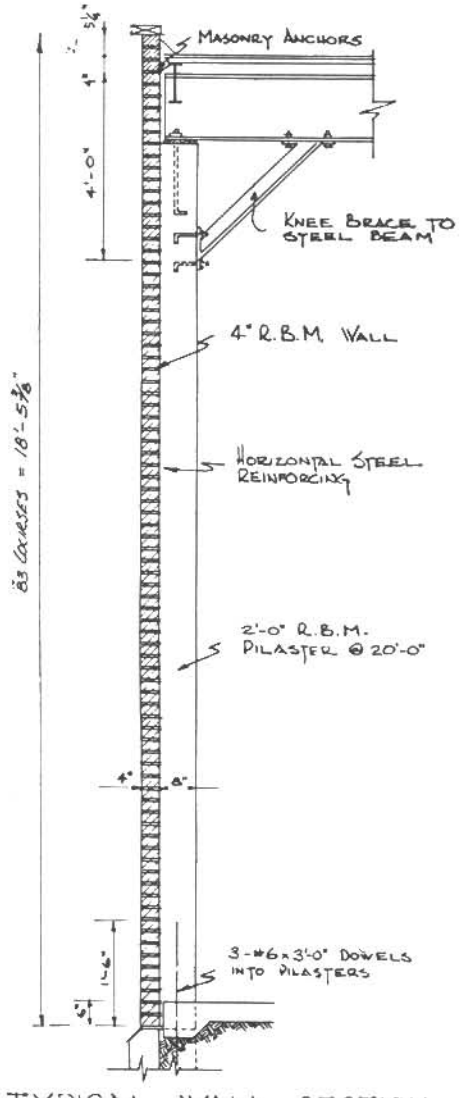
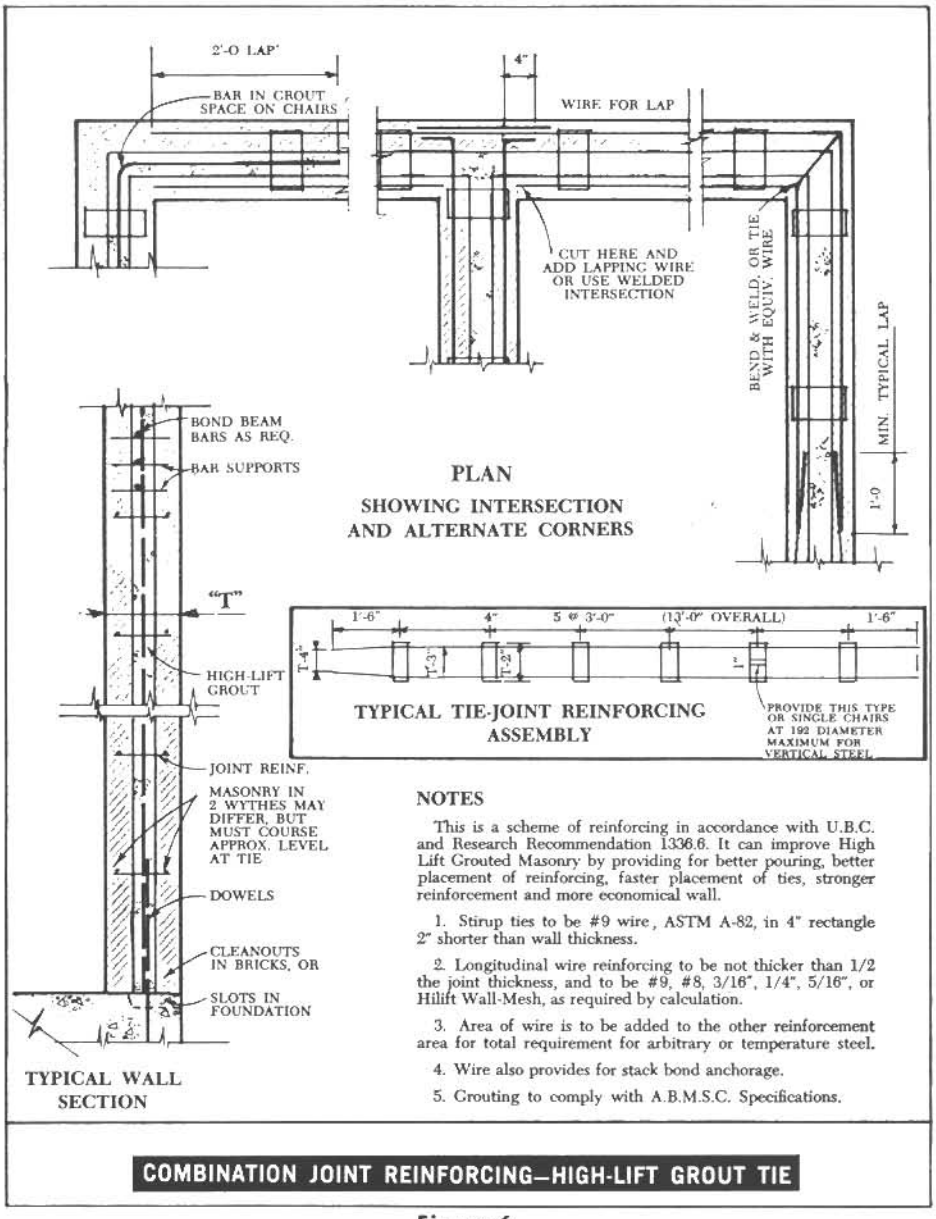


Figure 5.

One of the advantages of using joint reinforcement is that the steel will begin to function much earlier with less cracking of the masonry than if the steel is at the center in a bond beam unit.

Another advantage of the use of the "ladder or trussed" type of reinforcement is that bond is automatically developed to a high degree by the cross elements, developing what might be called "special anchorage" for assurance of the proper functioning of the reinforcement.



NOTES

This is a scheme of reinforcing in accordance with U.B.C. and Research Recommendation 1336.6. It can improve High Lift Grouted Masonry by providing for better pouring, better placement of reinforcing, faster placement of ties, stronger reinforcement and more economical wall.

1. Stirup ties to be #9 wire, ASTM A-82, in 4" rectangle 2" shorter than wall thickness.
2. Longitudinal wire reinforcing to be not thicker than 1/2 the joint thickness, and to be #9, #8, 3/16", 1/4", 5/16", or Hilift Wall-Mesh, as required by calculation.
3. Area of wire is to be added to the other reinforcement area for total requirement for arbitrary or temperature steel.
4. Wire also provides for stack bond anchorage.
5. Grouting to comply with A.B.M.S.C. Specifications.

COMBINATION JOINT REINFORCING—HIGH-LIFT GROUT TIE

Figure 6.

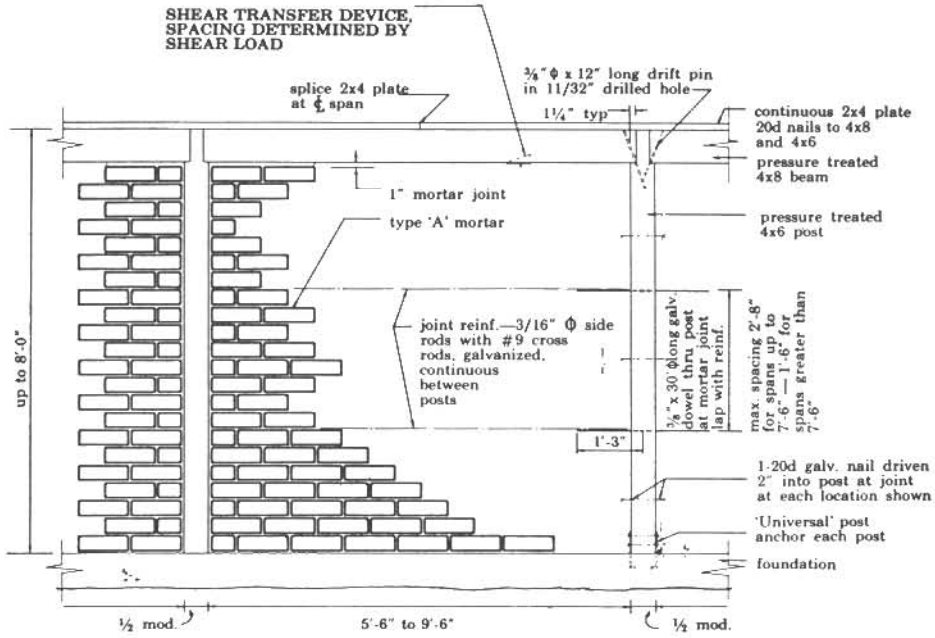


Figure 7.