Almost all specifications make masonry contractors responsible for bracing walls under construction and liable for loss of property or life resulting from a wall collapse. And now, the Occupational Safety and Health Administration (OSHA) has tightened the liability noose around the contractor’s neck. For the first time, OSHA lists specific requirements for bracing masonry walls under construction.

Why do walls fall down? The Mason Contractors Association of America (MCAA) reviewed 20 cases of wall failures from OSHA files (Ref. 1):

- In 11 cases, the walls were unbraced.

Walls that are 10 times higher than they are thick usually should be braced. They should be braced on both sides, usually for at least 7 days.

Spacing of vertical bracing (in feet) to be less than 1 1/2 times the wall thickness in inches.
• In 4 cases, the bracing was removed too soon.
• In 4 other cases, the bracing was inadequate or poorly constructed.

Why brace?
A masonry wall that is under construction lacks the lateral support provided by intersecting roofs, floors, pilasters, and walls. It also takes time for the mortar to cure and the masonry wall to gain flexural strength. Until the mortar does gain adequate strength and floors and roof are installed, the wall usually must be braced. If it’s not braced, even 20- to 30-mph winds can topple it.

When to brace
Figure 1 shows at what height concrete masonry walls must be braced, based on the design wind speed and the weight of the wall. Weights of concrete masonry walls and brick-block composite walls can be found in Table 1.

TABLE 1  ESTIMATED CONCRETE MASONRY WALL WEIGHTS

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>Unit Weight, pounds per cubic foot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Single Wythe</td>
<td></td>
</tr>
<tr>
<td>4&quot; hollow</td>
<td>14</td>
</tr>
<tr>
<td>4&quot; solid</td>
<td>18</td>
</tr>
<tr>
<td>6&quot; hollow</td>
<td>20</td>
</tr>
<tr>
<td>6&quot; solid</td>
<td>28</td>
</tr>
<tr>
<td>8&quot; hollow</td>
<td>24</td>
</tr>
<tr>
<td>8&quot; solid</td>
<td>38</td>
</tr>
<tr>
<td>10&quot; hollow</td>
<td>28</td>
</tr>
<tr>
<td>10&quot; solid</td>
<td>48</td>
</tr>
<tr>
<td>12&quot; hollow</td>
<td>34</td>
</tr>
<tr>
<td>12&quot; solid</td>
<td>58</td>
</tr>
<tr>
<td>Composite</td>
<td></td>
</tr>
<tr>
<td>4&quot; hollow + 4&quot; brick</td>
<td>52</td>
</tr>
<tr>
<td>4&quot; solid + 4&quot; brick</td>
<td>56</td>
</tr>
<tr>
<td>6&quot; hollow + 4&quot; brick</td>
<td>58</td>
</tr>
<tr>
<td>6&quot; solid + 4&quot; brick</td>
<td>66</td>
</tr>
<tr>
<td>8&quot; hollow + 4&quot; brick</td>
<td>62</td>
</tr>
<tr>
<td>8&quot; solid + 4&quot; brick</td>
<td>76</td>
</tr>
</tbody>
</table>

Note: Weight of 4-inch brick plus 7⁄8-inch collar joint assumed to equal 38 psf. Source: Ref. 4.

Determining the appropriate design wind speed is more difficult.
Most building codes recognize that wall bracing and other temporary support structures do not have to be designed for the greatest wind speed occurring in a 50- or 100-year period. Wall bracing is exposed to wind for only a short time. Although industry experts agree on that point, not all agree on what the design wind speed should be. Suggestions range from 40 to 80 mph (Ref. 1), but no U.S. national organization recommends a design wind speed for masonry wall bracing, nor do most local building officials.

The Australians, however, have selected the wind speed for a 5-year recurrence interval (also called 5-year mean return period) as the design wind speed for temporary structures with a life of less than 6 months (Ref. 2). For most permanent structures, they base the design wind speed on a 50-year interval.

A wind speed for a 5-year recurrence interval is the maximum wind speed that occurs about once every 5 years. Figure 2 gives the wind speed for a 5-year recurrence interval for some U.S. cities. Design wind speeds for about 100 other U.S. cities can be found in Reference 3. They usually range from 50 to 70 mph for most of the United States.

Note, too, that wind speeds (and thus wind pressures) vary with chang-
ing seasons (Figure 3). Contractors should use extra bracing during the season of high winds in their area.

**Where to brace**

If the lateral spacing of the bracing is too far apart, the wall may collapse in the section between the braces. Table 2 gives the maximum horizontal spacing of vertical bracing for hollow, nonreinforced concrete masonry walls subject to wind loads. For a wind speed near 70 mph, the spacing between bracing, in feet, generally should not exceed 1 1/2 times the wall thickness, in inches.

**How to construct bracing**

For walls greater than 8 feet high, contractors should submit a bracing plan. A typical masonry wall brace includes a vertical member, an inclined strut, stakes, and if necessary a strut-brace. Scaffold planks (2x10s) are typically used for the vertical member and the inclined strut; 2x4s may be used for stakes and the strut-brace. Never use 2x4s or 2x6s for the vertical member or the inclined strut. Always make sure the lumber is in good condition.

Two 2x4s should be used as stakes. Do not use steel stakes, rebars, or 2x2s because they have less horizontal load-carrying capacity. Embed the 2x4 stakes at least 12 inches into the soil and preferably 18 inches.

**Figure 2.** Following Australian practice, bracing can be designed to withstand the wind speed for a 5-year recurrence interval. The wind speed for a 5-year recurrence interval is the maximum wind speed that occurs once every 5 years. It usually ranges between 50 and 70 mph.

For inclined struts longer than 8 feet, provide a 2x4 brace. This increases the load-carrying capacity of the strut and helps prevent failure due to buckling at low loads. No recommendations have been found indicating the angle of the strut. It's common practice, however, to place the strut at a 30° to 45° angle.

Research work at the University of Michigan suggests that a horizontal strut at the base of the wall between the vertical plank and the stake can increase the load capacity of the bracing system (Ref. 5). The system's weak link is the nailed connections to this horizontal strut. Also, some jobsite conditions may make a horizontal strut impractical to build.

**When to remove the bracing**

When does the mortar gain enough strength to remove the temporary bracing? Unfortunately, the contractor is seldom given a good answer. The Brick Institute of America (BIA), however, has summarized the results of the increase in brick prism strength with time (Ref. 6). These results show that the strength at 3 days is 80% of the strength at 28 days, and at 7 days it's about 92% of the 28-day strength (Figure 4).

A reasonable assumption is that flexural strength increases with time at about the same rate as compressive strength. Therefore, after 7 days, the wall will reach most of its flexural design strength and may resist the applied wind loads without bracing. National Concrete Masonry Association (NCMA) recommends a bracing period from 3 to 7 days depending on the curing conditions. Hot or cold weather can accelerate or delay strength gain, thus shortening or extending the time before the bracing can be removed.

Depending on how the wall is braced, at a certain age it may be pos-
TABLE 2  MAXIMUM HORIZONTAL SPACING OF VERTICAL BRACING MEMBERS

<table>
<thead>
<tr>
<th>Nominal Wall Thickness, inches</th>
<th>Design Wind Speed, mph</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>19.0</td>
</tr>
<tr>
<td>8</td>
<td>25.0</td>
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<tr>
<td>10</td>
<td>30.4</td>
</tr>
<tr>
<td>12</td>
<td>35.3</td>
</tr>
</tbody>
</table>

Note: This table is for hollow nonreinforced concrete masonry walls subject to uniformly distributed wind load with these and other assumptions: 1) wall height is equal to 30 feet or less; 2) simply supported spans; 3) walls built with Type M or S mortar and inspected workmanship. See Reference 4 for more details.

Figure 4. Brick prism strength increases with time. The strength at 3 days is 80% of the strength at 28 days, and at 7 days it’s about 92% of the 28-day strength. Thus bracing usually can be removed after 7 days. (Source: Ref. 6.)

OSHA IMPOSES NEW REQUIREMENTS FOR MASONRY CONSTRUCTION

The Occupational Safety and Health Administration (OSHA) has imposed new laws that for the first time require bracing of masonry walls. The laws became effective August 15, 1988. Two new requirements were added: a limited access zone around the wall; and for walls over 8 feet high, adequate bracing until the permanent supporting elements of the structure are in place. According to OSHA, masonry contractors with 10 or fewer employees should be able to comply with the new laws at an average yearly cost of $339.

Noncompliance is a quick invitation to a fine. And, if you have a failure, any minor violation will not be looked on favorably if the accident goes to court. So try to follow OSHA’s new requirements (Ref. 1):

(a) A limited zone shall be established whenever a masonry wall is being constructed. The limited access zone shall conform to the following:

(1) The limited access zone shall be established prior to the start of construction of the wall.
(2) The limited access zone shall be equal to the height of the wall to be constructed plus four feet, and shall run the entire length of the wall.
(3) The limited access zone shall be established on the side of the wall which will be unscaffolded.
(4) The limited access zone shall be restricted to entry by employees actively engaged in constructing the wall. No other employees shall be permitted to enter the zone.
(5) The limited access zone shall remain in place until the wall is adequately supported to prevent overturning and to prevent collapse unless the height of the wall is over eight feet, in which case, the limited access zone shall remain in place until the requirements of paragraph (b) of this section have been met.

(b) All masonry walls over eight feet in height shall be adequately braced to prevent overturning and to prevent collapse unless the wall is adequately supported so that it will not overturn or collapse. The bracing shall remain in place until permanent supporting elements of the structure are in place.

For walls 8 feet or lower, the limited access zone must stay in place “until the wall is adequately supported to prevent overturning and to prevent collapse.” OSHA considers bracing as adequate support, so once the wall is braced the limited access zone may be removed.

Walls higher than 8 feet must be braced until they are permanently supported by the structure, “unless the wall is adequately supported so that it will not overturn or collapse.” OSHA considers self-supporting walls that have reached their design strength adequately supported. Thus, it seems logical that a wall may be built higher than 8 feet without bracing if the weight of the wall can resist the wind speeds expected on the wall (Figure 1).
sible to remove half the bracing and use it elsewhere. The other half would remain until the wall could completely support itself. This frees a lot of lumber or rental products and reduces the contractor’s cost. If, however, high winds are expected and permanent lateral bracing is not in place, leave the temporary bracing in place.

References
4. “Bracing Concrete Masonry Walls During Construction,” NCMA-TEK 72, 1975, National Concrete Masonry Association, 2302 Horsepen Road, Herndon, Virginia 22070.

Hidden costs of accidents run high

Work-related accidents account for 30% of all accidents and cost $35 billion a year. But these are only direct costs. The hidden, or indirect costs, include:

- Loss of experienced or skilled workers
- Job slowdown or shutdown
- Loss of customers or new business
- Overtime to complete jobs
- Accident investigation cost
- Hiring, training, or replacing employees
- Management or supervisor lost time
- Code violations and fines

Business management studies reveal that indirect costs of accidents run from 4 to 10 times direct costs. More importantly, indirect costs are not recoverable by insurance, but come from a company’s bottom-line profit.

Walls that are 10 times higher than they are thick usually should be braced. They should be braced on both sides, usually for at least 7 days.