AUGUST/SEPTEMBER NEWSLETTER- MASONRY WALL COLLAPSE

There are three ways in which a masonry exterior building wall may collapse. The wall may fall straight out in a monolithic piece at a 90-degree angle, in a manner similar to a falling tree; the wall may crumble straight down in a so-called "curtain" fall collapse; or the wall may collapse in an inward/outward fashion, with the top falling inward and the bottom outward.

90-Degree-Angle Collapse

This is the most common type of masonry wall failure which occurs at fires. The wall falls straight out and the top of the collapsing wall strikes the ground, a distance equal to the

height of the failing section measured from the base of the wall. A fifty-foot section of wall collapsing in a 90-degree angle fall

will cover at least fifty feet of ground with brick. Bricks and steel linters may bounce or roll out even farther. One example of how a multistory brick exterior wall can collapse at a fire in this manner is as follows: A fire spreading uncontrolled throughout a brick-and-joist structure causes the interior collapse of all floors. The pile of compressed rubble created by the fallen interior exerts an outward or lateral force against the inside of one of the still-standing brick enclosing walls. As the wall experiences this lateral force, a vertical crack or separation appears at a corner, starting at the top and progressing downward. The wall begins to lean outward at the top, separating from the other enclosing walls, and falls straight out at a 90-degree angle.

A free-standing wall of a burning structure can also become unstable and fall outward during extremely cold weather. If the inside surface of the masonry wall is heated by the fire while the outside surface remains cold, unequal expansion of the masonry will occur; the heated inside of the wall will expand and the outside contract, causing the wall to lean outward to fall. Large accumulations of ice forming on the outside of a wall can cause it to become unstable and fall, regardless of the temperature of the inside surface. The force of a large-caliber stream of water can also be a destabilizing factor capable of causing a masonry wall to collapse. Directed from one side of a fire building against the inside of a freestanding wall, a high-pressure aerial stream can be powerful enough to cause the wall to collapse outward on to firefighters operating on the outer side of the building.

Masonry walls often separate from the other enclosing walls at corners where they intersect. If there is no brick bonding of the intersecting walls by either overlapping brick bonding or metal reinforcing rods, the wall may split apart at this point. Vertical cracks allowing walls to separate and fall at a 90-degree angle may also be the result either of structural movement caused by uneven settling of the foundation prior to the fire or of a combination of window openings and cracked spandrel walls over each window.

Curtain-Fall Collapse

In this type of collapse, the exterior masonry wall drops like a falling curtain cut loose at the top. The wall crumbles and falls straight down, with bricks and mortar forming a pile on the ground near the base of the wall. The collapse of the brick veneer, brick cavity, or masonry-backed stonewall often occurs in a curtain-fall manner. If the metal ties holding a brick veneer wall to plywood backing are destroyed by fire, or if mortar bonding between an exterior finished stonewall and a masonry backing wall is washed away by hose streams, large sections of brick or stone veneer may fall off the building's exterior. Firefighters entering, leaving, or operating near the doorways beneath the curtain-fall collapse may be killed or seriously injured by falling brick.

Another situation of potential curtain-fall collapse occurs when fire has collapsed the interior of a multi-story brick-and-joist structure and the remaining free-standing walls have many window openings with brick arches serving as linters. If one of the masonry walls starts to fall and the brick arches spanning the tops of the wall openings crumble and fall apart, the wall will fall downward rather than straight out.

Inward/Outward Collapse

When a masonry wall becomes unstable and begins to lean inward, it does not always mean that the wall will fall inward. Firefighters operating ground streams must still maintain a safe distance between themselves and the unstable wall, for when a section of the broken wall falls inward, the lower portion of the wall may kick outward, or the upper portion may initially fall inward but then slide down and outward into the street, bottom first. Known as an inward/outward collapse, this type can be caused by a force directed against the inside surface of the collapsing wall. An explosion or the outward impact caused by the collapse of a roof or several floors in a pancake fashion, the upper floors, falling on top of the lower ones can cause an inward/outward collapse of several enclosing walls simultaneously.

An example of an inward/outward collapse is a masonry wall failure caused by the collapse of a bowstring timber truss roof. When the design of the timber truss includes hip rafters sloping down from the front and rear bowstrings, one end of the hip rafters is tied into the outermost truss section and the other end into the masonry-enclosing wall. If the bowstring trusses are weakened by fire and the roof fails, the load of the falling roof is transferred from the truss supports to the front and rear masonry walls. In some instances, the load transmitted to the masonry wall through the hip rafters cracks the front wall and collapses it in an inward/outward manner. The top section falls inward and the bottom section outward, into the street. The extent of the area in front of the fallen structure, covered with tons of brick and steel linters, depends upon the amount of internal force transmitted against the inside of the enclosing wall by the failing roof.

A secondary collapse of the front masonry wall following a bowstring truss roof collapse is extremely dangerous. Firefighters anticipating a roof collapse may be caught off guard and be struck or buried by the secondary front or rear wall collapse. When planning for a bowstring timber truss roof collapse, firefighters should also consider a front or rear wall collapse. In such cases one-story enclosing walls have been driven out into the street for a distance equal to the height of the one-story wall.

A fire officer can never predict the way in which a wall will collapse, so when he establishes a safe distance between the unstable wall and the firefighters in his command, he must expect the worst: a 90-degree-angle wall collapse with chunks of bricks and steel linters thrown out farther than the falling wall. As a general rule, the so-called "collapse zone"-the area adjacent to an unstable wall that firefighters should not be allowed to enter-is a distance equal to the height of the wall.

At fires where the officer in command suspects an explosion or other factor to cause a wall to collapse out into the street for a distance greater than the height of the wall, a chief or fire officer should keep his men away from the front wall of the fire building altogether, positioning

heavy-caliber streams in a flanking position: that is, on either side of the front wall beyond the outer perimeter of the building's width.

If it is absolutely necessary to operate a master stream inside a collapse zone, and the wall appears unsafe, the portable deluge nozzle or aerial stream should be secured to direct the stream effectively and safely, and then left unattended.

Lessons Learned

1. Firefighters operating outside a burning building are exposed to the dangers of wall collapse.
2. After interior roof and floor collapse occurs because of fire, the danger of exterior wall collapse is greatly increased.
3. The collapse danger zone is defined as the distance outward from the foot of the wall equal to the height of the wall.
4. When the collapse danger zone is greater than the reach of a hose stream, the company should consider operating the hose stream from a flanking position; that is, on either side of the front wall beyond the outer perimeter of the building's width.
5. A fire officer cannot predict if a masonry wall will collapse in a 90-degree-angle, a curtain-fall, or an inward/outward type of configuration. The officer should, however, expect the worst: a 90degree-angle wall collapse with large chunks of brick and mortar thrown out farther than the falling wall.

Questions

1. Which one is not a type of wall collapse?

   A. 90-degree collapse

   B. Inward/outward collapse

C. Curtain fall collapse

D. Free fall collapse

Answer_____

2. When preparing for a possible wall collapse and setting up a collapse zone which type of collapse should you prepare for (It creates the largest collapse zone)?

A. 90-degree angle collapse

B. Inward/outward

C. Curtain fall

D. None of the above

Answer_____

3. Which one is the most common type of wall collapse?

A. 90-degree collapse

B. Inward/ Outward

C. Curtain fall

D. None of the above

Answer_____

4. Which one of the following is the definition of a collapse zone?

A. The distance equal to 1/3 the height of the wall

B. The distance equal to * the height of the wall

C. The distance equal to the height of the wall

D. None of the above

Answer_____

5. True or False - The danger of wall collapse is greatly increased after a floor or roof collapses

Answer_____

Answers

1. D 2.A 3.A 4.C 5 True.

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1. Read the newsletter.
2. Print out the newsletter. Copy for each firefighter.
3. Use bold print as keywords for training presentation.
4. Use questions for discussion.
5. Use questions to test firefighters.