Look Before You Renovate

by Raymond A. DiPasquale

It's always easier to start from scratch and build a building or an addition exactly the way you want it. But economic and practical considerations often dictate that we work on the creations of others.

When you remodel a building, you have to undo something that someone spent a lot of time putting together. The first challenge is to understand how the construction system was fashioned, and particularly how the loads move through that system to find their final resolution in the ground. This is essential so that, when you take the building apart or add to it, you don't upset the happy state of equilibrium that has existed for years.

Three cases in point will illustrate the precariousness of certain remodeling situations.

Too Little Bracing

The first case led to the partial collapse of a four-story building with a brick-masonry bearing wall. To make way for new, open stairways to the second floor, large sections of the second-floor wood framing were removed from both sides of the brick, interior bearing wall.

The structure was of early-1900s vintage and the general condition of the masonry was poor. Mortar had been installed carelessly, there were many voids in the joints, and some mortar had deteriorated; much of it could easily be picked out with a knife.

The removal of the second floor doubled the unsupported height of the eight-inch brick wall, which itself suffered from problems of lateral stability. The contractor had installed some light 2x4 bracing to help stabilize the wall, but it was randomly placed and undersized.

In the original wall, in the area where the new stairs were to be installed, there were two door openings—one on each floor. When the second-floor framing was removed, two 3x7-foot openings were left, one above the other, in a 20-foot-high expanse of wall.

Unfortunately, the contractor did not install adequate bracing close enough to these openings to prevent the failure, which began there. The lateral instability was greatest at the point where there was minimum material—essentially creating a free vertical edge. The reduction in dead load caused by the removal of the second floor contributed to the failure since it *unstressed* the already loose masonry, which made the wall more unstable laterally.

This is a good example of how stress can give a structure stiffness and strength. The area of the failure was confined to a 30-foot length of wall, but all floors and the roof above were seriously deformed. The interaction of partitions and framing is what saved the structure from complete collapse.

The lesson here is that one should be alert to changes in structural integrity when removing portions of existing systems. Bracing is always critical and should consist of members that are substantial, and square or round in cross section. The condition of the material may provide clues to its stability: one look at the crumbling mortar should have told the contractor that extra precautions were necessary.

Too Many Windows

In the second case, the remodeling required the contractor to cut six new window openings in an existing 12-inch-thick exterior brick wall of a historic building. Windows 3'4" wide by 5'8" high were to be added to the second and third levels of the three-story building, and were designed to match existing windows on the first level.

The overall exterior wall measured 40 feet wide by 30 feet high, so adding the windows would have severely perforated the bearing wall, which was already eight inches out-of-plumb. In an effort to solve a light-and-ventilation problem and conform to aesthetic demands, the stability of the wall system was overlooked.

Luckily, an alert masonry contractor refused to do the work, thereby waving a red flag in time to avert a likely failure. In this case, the openings were reduced in number and size.

While we're on the subject of masonry, a masonry wall can support loads in its plane, and can bridge openings due to the "arch action" that forms between units laid in a running bond. But there must be enough masonry above the opening to form the arch. If masonry is loose, units will fall and a progressive failure will move up until there is not enough masonry left to form a stable system.

Too Many Rooms

Our final case deals with life-safety or building-code violations that are created when a remodeling program substantially alters or adds to the building plan.

In this instance, a motel added several rooms, a few at a time over many years, which eventually changed the exit travel length and fire separation requirements. The violations came to light when the property was about to change hands and an inspector uncovered the problems. The original owner, who was already in financial trouble, had to spend several thousand dollars to correct the deficiencies before the property could be sold.

The contractor had installed light 2x4 bracing, but unfortunately not enough to prevent failure. The reduction in dead load caused by the removal of the second floor *unstressed* the already loose masonry.

The lesson here (and this holds true for all the cases mentioned) is to always look at the *total* picture. Don't focus just on the alteration or addition. Seek the advice of competent professionals: they can help uncover potential booby traps.

And keep in mind that almost any problem is solvable with a little imagination—and the expertise to understand what the structure wants to do. ■

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