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The tendency to demolish repairable structures in the name of ‘life safety’

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This discussion examines the behavior of buildings that have unreinforced masonry. This class of buildings is some of the most vulnerable in that the masonry is unique. It is brittle, low in tensile value and is often deemed to constitute a hazard when it is severely damaged. In my opinion, the damaged historic buildings do not often constitute a hazard after the earthquake event has already passed. I do not see how these can be found to present a risk and I cannot see a reason for the demolition of damaged historic buildings as a result of an earthquake. I believe that the demolition of historic buildings is often a decision made for reasons unrelated to life safety.

We have repaired many buildings damaged during the 1994 Northridge Earthquake. One modern building remained fully occupied even though twenty out of eighty of its structural columns had been broken during the earthquake. We repaired it and kept it occupied because we did not believe that it constituted a significant life safety hazard.

If we can do that to ordinary office buildings then we can certainly do the same to historic buildings. The decision to repair a historic buildings should take into account all the factors known. In my opinion, the decision to demolition a building based on life safety threats is often based on reasons that are not related to true life safety threats.

When we talk about the life safety threats posed by earthquakes, we are really talking about a threat that is so small compared to all other threats to life safety that the earthquake life safety threat is totally insignificant. In the Northridge Earthquake, the total count of lives

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lost related to building failure was twenty-eight. At the same time, 45,000 people a year are killed on our roads and we do nothing about it. Why then are we so concerned with life safety threats from earthquakes? The answer is the preservation of historic buildings.

Consider a historic building not designed for an earthquake. This building comprises a concrete frame with masonry infill cladding. It has a response in a probable earthquake that is not related to any code building. I have heard arguments about the San Francisco City Hall and whether it should it be reconstructed to today's code. The answer for it and this concrete-frame building is that these buildings were built to some prior building code.

The important difference is that building codes are primarily for the construction of a new building. It has nothing to do with the analysis and determination of life safety risks posed by an existing building. Existing buildings are analyzed to see if they constitute a significant risk for damage during an earthquake. Now an earthquake is an unusual thing; we determine the intensity of earthquake shaking on a probabilistic basis and define what is considered for new buildings as an acceptable risk. In other words, we think that some failure is to be anticipated. We think this because we do not get to control the horizontal structural loading that occurs during an earthquake. The loading is random and varies greatly with sites only a few blocks apart as observed in the overview of damage in the Loma Prieta, Northridge and San Fernando Earthquakes. This is because ground motion energy is arriving in real time at a site and this energy can combine with energy arriving from another point on the fault system or it can cancel each other out. As we record ground motions at sites a few blocks apart, the results are significantly different. Since we cannot control the loading, we do have to define the risks in a probabilistic manner. We have procedures for reducing life safety threats. How do we reduce life safety threats? We reduce them by reducing damage. The response to an earthquake of a hotel in downtown Los Angeles consisting of a steel frame building with several wings is related to its steel frame and the unreinforced masonry infill; and its response is not covered in any code whatsoever. This building has essentially little or no damage observed as a result of the recent earthquake activity in Los Angeles.

In a sense, a historic building is really the entire building including all its material. The following discussion will show how to relate the historic fabric in a building to its historic character.

Take the example of the famous flat-iron shaped building on Columbus Avenue in San Francisco. Its style and its character are totally related to its historic fabric. Another example would be the Quincy Markets in Boston, Massachusetts. It has a facade which is composed of cut stone dry laid, but it has been altered as it has concrete floors on the interior. I do not know when these interior modifications were done. The exterior is original and it is cut Vermont granite. It is an example of one of those unreinforced masonry buildings. The question is whether it is stable and the answer is “Yes, it is”. Those blocks of granite stacked on top of one another have a high potential for staying stable. The structure need not be renovated or replicated. What we have to recognize is that if we were to have an earthquake of the magnitude to damage it, it should be repaired. We repair buildings after fires, floods and all other disasters. I think that we ought to treat earthquake-damaged buildings in the same fashion and recognize that we will very likely have to repair them.

Figure 10.1. Site of the former Oddfellows Hall, Watsonville, CA. The building was damaged during the Loma Prieta Earthquake and was demolished even though it would have been repairable. Two years later the site remains vacant, a typical situation where local economies and lack of funding prevented a quick recovery and new construction to replace demolished retail buildings. (Photo: Steade Craigo 1991).

The Orange County Courthouse, as discussed by Donaldson (this volume), has been renovated to reduce its potential hazard. Its real problem was something that survived the other earthquake - namely, the very high second story. The second story walls are very tall and vary from seventeen to twenty feet in height and are only three wythes of brick thick. These walls had the potential for being unstable. The exterior facade has been preserved. Unfortunately, we could not get the restoration of the central tower which had been removed after the 1930s Earthquake. There were not sufficient funds available (as is often the case).

The idea of some potential for damage in historic buildings actually got me into trouble with the county engineer. There was a minor earthquake in Santa Ana and a newspaper reporter from the *Los Angeles Times* called to inquire if I was going to look at my building. The reporter said that there had been an earthquake in Santa Ana and that the City Hall was closed. I said that nothing would have happened to the courthouse and this remark was published. The county engineer misinterpreted my remark to infer that I was making a derogatory remark about the City Hall as compared to the County Courthouse.

A theater in Salt Lake City has a facade composed of terracotta blocks. The entire facade has recently been restored with various blocks recast. The historic character of this building is derived from its historic terracotta facade. The terracotta blocks are very brittle and the question is whether there can be anything done to protect these terracotta blocks from the potential damage resulting from an earthquake along the Wasatch Range. Can I do anything to keep these blocks from getting cracks or some damage? The answer is "no", but this does not mean that the building has to be demolished. The damaged terracotta blocks can be easily repaired. The terracotta blocks could be cast again for the third time if need be.

Consider the example of a very ornate Romanesque revival masonry structure in the eastern United States. It has tall chimneys, towers and corner elements that, together with its basic shape, make it very complex. It is a very different type of structure from what would be designed and constructed today. In this building, one has to consider the tower masses and large mass elements on the corners. It has roofs with very steep pitches that do not really constitute a tie at the top. This presents a problem in that there is the potential for some damage occurring, but we have the techniques and abilities to repair such damage. However, we hear the argument that because one cannot prevent future damage from occurring in some future earthquake, we must demolish these historic buildings now.

The Union Station in Saint Louis has been adaptively re-used to serve as a shopping mall and hotel. The building has a very complex shape with its very tall tower and its various ornamental embellishments in masonry could constitute a severe problem if we want to minimize damage. We can minimize the potential for damage to the point where the damage is repairable and that is the concept on which we have to focus.

The Bradbury Building in downtown Los Angeles is another historic building that my firm has worked on in its renovation. This is a unique building in that it has a wood floor structural system and exterior masonry walls. Its floor plan is actually a donut with a large atrium in the center. The real problem of this building is its exterior sandstone which was quarried locally in California. The stone is not holding up compared with some other sandstones such as the Arizona sandstone used in the Orange County Courthouse. Ninety years later, we have some severe problems with the Bradbury Building and the deterioration of the sandstone facade.

The Pasadena City Hall presents an interesting case: computer modeling analysis of potential earthquake risks has been executed for this building. The building's analysis indicated that it could not survive the intensity of earthquake ground motions similar to what it already has undergone in various previous earthquakes. In the computer model used, it you do not enter the proper data on the materials used you will get silly answers. In this building, its large domed tower is considered a potential hazard. I cannot really understand this hazard analysis as the tower is constructed of reinforced concrete and in the middle of the tower legs there are massive structural steel members. I do not understand how one could have a shear failure through such a piece of structural steel. I see this as an example of where the computer analysis of potential earthquake risk can grossly overestimate the potential damage that the ground motions would cause when the building has already survived such ground motions without suffering any damage.

Right now, we are repairing one of the adobes in the San Fernando Valley that was damaged in the Northridge Earthquake. It was repaired previously in 1932 by a man named Harrington. He used tractional adobe techniques and also reinforced it with barbed wire. We are following the same approach except we are not using barbed wire because it will rust so we are using stainless steel wire. I see no reason that the adobe can not be repaired again if the San Fernando Valley were to be so unlucky as to have another earthquake within the next twenty or thirty years. The adobe had been the residence of Andreas Pico. Harrington used it as his residence and now it is a historic house museum. We are going to keep using these historic buildings. Many of the buildings I discussed have been extensively rehabilitated but that their historic character still remains. There historic buildings need to be used in order to preserve them.

By way of conclusion, I wish to reiterate that we need to prevent the needless demolition of historic buildings. I cannot see why we have any arguments about why we have to demolish historic buildings. Demolish is not the type of thing that has to be accomplished within a short time immediately after an earthquake - say, within six to nine days after an earthquake. We have to recognize that we are going to repair buildings.

We seem to have developed a strange view about what is hazardous. Further, I find it curious that we will not allow the general public to walk on the sidewalks in front of some damaged historic buildings after an earthquake, but we allow construction crews to go into these buildings. Are the construction laborers expendable and the general public is not? I was told that I could not walk down Main Street after the 1989 Loma Prieta Earthquake because of the risk that the front facades of the buildings could fall over and reach the centerline of the street. When I wished to examine these buildings, I was told by a policeman that it was too dangerous. A fire captain who was present said that, in his opinion, these buildings were *not* hazardous. He was used to going into a damaged building when it is on fire. These buildings were not on fire and had survived the earthquake and he did not see the potential for hazard.

We have developed a view that we must demolish historic buildings after an earthquake, but I believe that the reasons often have to do with something other than public safety. The issue of public safety is so small for buildings from earthquake hazards presented by buildings constructed in the United States (in particular, the western United States) compared with Mexico City, the Philippines, Russia or Armenia that I do not really think that earthquake risk in historic buildings really constitutes a hazard that threatens life compared to all the other hazards we face in daily life. We need get the message across to all people and all government agencies that we need to stop this idea that we need to demolish historic buildings immediately after an earthquake because of public safety risks. I recognize that not all historic buildings will necessarily be repaired after an earthquake. The decision on whether to repair or not should be made considering all the information and that the over use of the public safety issue should be minimized.

Bibliography

Donaldson, W. (1998) *The first ten days: emergency response and protection strategies for the preservation of historic structures*, this volume.

Figure 10.2. St. Patrick's Catholic Church, Watsonville, CA. The church was partially damaged during Loma Prieta in 1989. Because the congregation could not afford the necessary repairs and seismic retrofit the church was demolished and a new church constructed on the same site. The metal steeple was removed first because emergency officials feared the structure would topple in aftershocks, blocking a nearby main traffic route. (Photo: Steade Craigo 1989).