Paper No. 445. (quote when citing this article)
Eleventh World Conference on Earthquake Engineering
ISBN: 0 08 042822 3

THE SOCIAL, ECONOMIC, AND POLITICAL ANALYSIS OF ENGINEERING DESIGN DECISIONS

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ABSTRACT

In order to improve the understanding of the many factors that influence the adoption of seismic policies, the Endowment Committee of the Earthquake Engineering Research Institute (EERI) has developed a white paper that focusses on the social, economic, and political aspects of such decisions. This paper summarizes the major findings of the EERI white paper. First, a discussion of the passage of the City of Los Angeles' ordinance requiring inspection and repair of damaged steel frame buildings is presented. This discussion illustrates many of the non-engineering issues that need to be resolved in policy decisions related to building safety. It is clear from the description of the process used by the City of Los Angeles that initially the problem with damaged steel frame buildings was seen as a technical problem, but as the social and political ramifications became better understood, the number of stakeholders increased, and the resolution of the problem became more complex. The paper concludes with a general discussion of the important elements in the policy-making process, presented in a checklist format.

KEYWORDS

public policy; building safety; social, economic, political impacts; LA steel frame ordinance

THE DEVELOPMENT OF THE LOS ANGELES STEEL FRAME ORDINANCE

The City of Los Angeles is a leader in seismic safety issues in California, passing one of the first ordinances requiring the retrofit of unreinforced masonry buildings, carefully analyzing the potential costs of earthquakes through various consultant studies, and developing one of the first earthquake recovery plans in the country. There have been a number of individuals inside city government who have played a strong leadership role in the development of these programs over the years, including Councilman Hal Bernson and members of the Building and Safety staff.

In immediate response to the Northridge earthquake of January 17, 1994, the Los Angeles City Council President appointed an *ad hoc* Committee on Earthquake Recovery to put all earthquake recovery issues under one large umbrella. Under Councilman Bernson's leadership, a committee of 15 members (5 Council members and their staff) was established to deal with all earthquake-related rebuilding issues. The Committee met weekly for close to a year, then moved to a monthly schedule.

The Committee's principal mission was to coordinate and direct the response by City agencies to community needs. The Committee assumed an advocacy role regarding legislation, regulatory relief, and policy direction. The support of this Committee was crucial to the ultimate passage of over thirty ordinances, designed to protect the health and safety of the citizens of Los Angeles and contribute to the recovery and reconstruction process.

On February 22, 1995, the L.A. City Council passed Ordinance 170406, relating to the repair of welded steel moment frame buildings with damage resulting from the 1994 Northridge earthquake. The passage of this ordinance amended the L.A. Municipal Code, adding section 91.8908 dealing with commercial buildings having welded steel moment frames, located in a high damage area. The ordinance requires the building owner to submit a report to the Department of Building and Safety within 180 days describing damaged welded connections and proposed repair procedures. Repairs must commence within 90 days of the submittal of the report to the Department and be completed within two years from the date the permit is issued.

The following represents a more or less chronological accounting of the process that led to the passage of this ordinance. The process involved many participants, including members of the Department of Building and Safety (B&S), the City Council (particularly Councilman Hal Bernson), structural engineers in the Los Angeles area, and building owners.

Immediately after the earthquake, it became apparent that the extent of the damage required a large effort, involving many volunteers. Within two weeks there were 800 to 1000 engineers and building inspectors conducting damage assessments in the field. Building and Safety realized early that they needed to look at every building in the city (at least with drive-by inspections) to get the true picture of the nature and extent of the problem.

In addition to technical concerns, Building and Safety had to satisfy various political constituencies. It was important for them to address these early political concerns, since these were the same constituents who would be needed later to help advocate new policies for improving earthquake safety.

Task force groups were established for all types of buildings to determine whether damage signalled the need for emergency code changes. An executive committee not only oversaw the work of the task forces but also forged technical consensus before recommendations were brought to the General Manager and City Council.

Steel frame buildings were initially presumed to have performed quite well, as witnessed by the fact that early meetings focused on unreinforced masonry buildings (URMs) and non-ductile concrete buildings. Even when the groups were established, the steel frame task force was assigned to someone who assumed it would take very little of his time.

The first indication of damage to steel frame buildings was noted in buildings under construction. Initially, it was thought that there was damage to only a handful of steel frame buildings, and as a result, there was no effort to halt projects under construction. Within the first two weeks, rumors of damaged steel buildings were confirmed; however it was only very gradually that a problem with the moment resisting frame welds began to emerge. Initial interpretations were that these cracks were anomalous.

At the time the task force groups were established, it was still unclear how serious the steel frame problem was. By late February and March, Building and Safety sent Councilman Bernson's staff early reports of steel frame damage. He asked Building and Safety to develop specific recommendations for action. From March through July, 1994, Building and Safety staff met weekly with Hal Bernson's staff, keeping them apprised of the situation.

The steel frame task force group continued to meet, and identified more and more buildings with damage. Practicing engineers sent in lists of damaged buildings. By late March or April nearly 40 damaged steel frame buildings were identified. The task force expanded in membership. Originally, the subcommittee included representatives from SEAOSC and city staff. It was gradually expanded to include the welding industry, the Building Owners and Managers Association (BOMA), testing laboratories, researchers, engineers and consultants. The Department continued to meet with the American Institute of Steel Construction.

Two serious stumbling blocks to resolution of the problem were: 1) lack of consensus from the technical community on how best to inspect and repair the cracked welds and 2) a lack of agreement on the risk posed by the cracked welds.

Reports began to be issued by the task force group in April. On April 11th, a directive on the repair of cracked moment frames and connections was issued by Building and Safety, requiring that they be returned to their pre-earthquake strength. On May 5th, a second draft was issued, providing more specific repair guidelines. On May 11th, another directive was issued, aimed at new buildings under construction. At this point, Building and Safety believed they lacked sufficient authority and information to prevent the use of prescribed welded connections.

By May, 77 steel frame buildings in the City of Los Angeles had been identified as damaged. The steel frame task force group recommended the need for an ordinance. Building and Safety realized they needed guidelines for inspection and repair.

Building and Safety talked to Bernson, and in early June the first draft of an ordinance was proposed, recommending inspection and repair of **all** the steel frame buildings in the city. About this time, a large steel frame building owner decided to support a full-scale test of connections used in his building.
The test data on the project indicated that the welded connection was not reliable. The findings suggested that the repair strategy the City of Los Angeles was proposing was not adequate. Efforts to pass an inspection ordinance temporarily came to a halt. It was decided to take a more careful look at the problem.

Simultaneously, BOMA of Greater Los Angeles was conducting surveys of members and various engineering firms regarding inspection and repair methodology and costs. BOMA requested that it be allowed to participate on Building and Safety's steel frame task force group. A BOMA Board member, a civil engineer, was appointed to serve on the task force.

BOMA's policy goals, as articulated by the BOMA Board of Directors and communicated to the *ad hoc* committee and city staff, revolved around assuring the efficacy of any potential specific method for steel frame building inspection and repair. After considerable examination, BOMA concluded that due to the complexity and individuality of virtually every building, a standard highly prescriptive approach would be ineffective. BOMA advocated that methods of inspection and repair be determined by structural engineers in concert with Building and Safety and building owners on a case by case basis, until such time as new information or research suggested clear alternatives.

Bernson's staff members were concerned that Building and Safety take into account the expense of the inspection process. The City Council was sensitive to the fact that inspection and repair work might require vacating buildings, placing a tremendous economic burden on condominium owners in particular. By summer, it was estimated that costs for inspection might be as high as $10,000 per joint, including displacement costs.

Elected officials found early drafts of the ordinance difficult to justify given the uncertainty about the scope of damage, the technical feasibility of the solution, and potential costs. At that time the conditions were not "ripe" for a political solution. Lack of expert consensus regarding the technical solution also meant some engineers were unwilling to change normal procedures. They wanted more proof. Not surprisingly, an element of the debate was what constituted adequate "proof" given the short time frame for addressing the problem.

As the city worked its way to a political solution, it is important to keep in the mind the certain sense of urgency that pervaded. All agreed that the buildings were damaged, but no one was sure how these buildings would perform in another earthquake. The city felt it did not have the luxury of time to commission studies to help make their decision. The emergency nature of the problem -- how to repair already-damaged buildings and what to do about buildings under construction -- dictated the need for an emergency ordinance. Such an ordinance passed in July, allowing projects in limbo since the earthquake to move ahead. At the same time, city officials were still debating the merits of an ordinance requiring inspection and repair.

Estimated costs for inspection continued to skyrocket as the difficulties of carrying out inspections and the number of potentially affected buildings expanded.

Realizing that the initial draft of an ordinance was politically unacceptable, the next draft narrowed the geographic area of affected buildings. In addition, an important political compromise was made at this point. Building and Safety staff agreed to drop residential buildings from the ordinance in order to preserve a policy for non-residential buildings. Some engineers have questioned the life safety trade-off in this decision, since people spend much more time in their residences than offices.

Originally Building and Safety staff considered requiring 10% of the welds in high-rises and 15% of the welds in low-rises to be investigated as a means of determining damage. However, the final ordinance does not specify the number of joints to be examined. Early on, Building and Safety was under the impression that 90 to 95% of the buildings had fractured connections. Later it turned out only 75% had fractures. The City Attorney recognized the potential for liability, especially if no damage were found. She was reluctant to advise engineers to look at a lot of welds, a very expensive procedure, that might find no damage for as many as 25% of the buildings. So the prescriptive guidelines were dropped, to protect the city from potential liability. In addition, Building and Safety officials knew that findings would begin to emerge from a large research study funded by the State of California and the Federal Emergency Management Agency (referred to as the SAC project).

The lack of prescriptive guidelines concerned the original champion of the ordinance on the City Council. He became reluctant to move forward. He wanted the ordinance to include inspection and retrofit of connections, and had to be convinced to vote for an ordinance less prescriptive than originally proposed.

To help the ordinance pass, Building and Safety staff (themselves technical experts) continued to meet with City Council members (political experts), translating the findings coming from other stakeholders in the technical community. Council members were most convinced of the need for action based on physical evidence of damage. Educating policy makers about some of the technical issues, particularly in an informal setting, proved important to the passage of the ordinance.

Costs proved to be critical. Building and Safety staff felt that inadequate information on the costs slowed the process. They didn't have the ability to develop cost figures internally, and felt they "wasted time" because the repair costs did not sound credible.

The ordinance that passed on February 22, 1995 by unanimous vote of the City Council, lacks the immediacy that Building and Safety wanted and does not address the issue of how much money it will take to enforce. The original Building and Safety recommendations were compromised into something that was politically more acceptable. A longer time frame was allowed for inspection and repairs. The ordinance was deemed to be a first step and as such focused on a more narrow geographic area of damage. This geographic limitation means that this first ordinance may miss steel buildings in other heavily damaged parts of the city, as well as steel frame buildings in areas that were lightly shaken by the Northridge earthquake. Residential buildings were also dropped from this first ordinance because of the cost of inspection and the uncertainty about what to do. Guidelines for inspection and repair were also deleted. In the end, the long-term view was taken -- this was not an emergency response action and the SAC guidelines will be followed.

The ordinance reflects both technical and political compromise and may represent the best political and technical solution possible, given limited technical consensus and high economic costs. While the ordinance does require repair, it places the burden on the engineer and the SAC guidelines to suggest the most appropriate strategies.

CHECKLIST FOR INCORPORATING SOCIAL, ECONOMIC AND POLITICAL CONSIDERATIONS IN DECISIONS ABOUT BUILDING SAFETY

The above discussion of the City of Los Angeles experience in passing a steel frame repair ordinance illustrates some of the issues that arise in resolving a new technical problem related to building safety in a political arena. Based on this and other similar experiences, the following checklist was developed to more generically identify the social, political and economic concerns that affect decisions about building safety. It can be used as a guide for translating building safety issues into new policy.

Understand the Political Environment

Recognize that the policy-making process is constrained and supported by a number of factors. These factors may vary by community, but in general the process is constrained by inadequate supply -- inadequate information, inadequate time, inadequate resources -- as well as conflict in terms of competing priorities; the process is supported by the acquisition of allies, adequate information and resources, and sometimes by time pressure. Decision makers make the best decisions they can, given this environment. Participants in the policy-making process need to recognize that these conditions exist, particularly as there are many opportunities to influence the process. The following key activities should be addressed.

Recognize allies. For every decision resolved in the political arena, there will be supporters or allies. Understanding which constituent groups may potentially support a policy or directive is important information for a decision maker.

Recognize uncertainty. The information available may never be "complete"; decision makers need to understand the limits of the available information and judge how much information is enough to proceed.

Recognize time pressures. Decision makers will almost always be working under time pressures as well as balancing many decisions and the interests of many different constituencies. Decisions about building safety may have a particular sense of urgency for a brief period. Watch for windows of opportunity and recognize when they are closing.

Acknowledge competing priorities. There are often many stakeholders, as well as decision makers, involved in decisions about building safety, and often these stakeholders and decision makers will have different and possibly competing priorities. Understand these priorities and involve all the stakeholders in the process of decision making in order to develop compromises.

Recognize lack of resources. Most jurisdictions and individual building owners work with limited resources, which means many public policy issues are competing for the same resources. Since building safety problems often require significant funds, this is a serious constraint on the choice of acceptable policy. Set the compliance requirement in a manner consistent with the available resources.

Gain Political Acceptability

One of the reasons the public policy process can be so complex is that there can be many different stakeholders, each with different backgrounds, perspectives and priorities. Work with a wide range of stakeholders to gain the political acceptability necessary to develop a public policy. The following recommendations can help gain this acceptability:

Identify stakeholders. Identify as many different stakeholder groups as possible, recognizing that the different stakeholders will approach the problem from different perspectives. Watch for common interests in order to make allies.

Involve stakeholders early in process. Make information about the problem easily accessible to the various stakeholders early in the process to gain credibility and support. Clear information combats rumors and false impressions.

Consider developing a task force of stakeholders. Decide if it would be appropriate to provide a formal mechanism for stakeholders to work together in a group to address the problem, encouraging communication as well as identification of individual priorities. This may assist the group in developing a solution that reflects as many of these interests as possible. Consider including an objective technical expert, as well as a representative of the media, in such a group.

Nurture internal champions who emerge. If an inside policy advocate emerges (inside the government level that will ultimately develop the policy), provide as much support, encouragement and technical information as possible. Internal champions are the most valuable resource.

Consider creating a standing commission to address hazards issues in the community. By creating a standing commission prior to the next earthquake, critical links among stakeholders and decision makers can be established in an atmosphere of relative calm. Such a commission could develop appropriate repair standards before the next earthquake, monitor new technical developments and recommend appropriate actions for a community, and serve as an education link between the community, various neighborhoods, special interest groups, and local policy makers. Be careful, however, that its creation does not set up the false impression that decision-making authority is delegated to such a commission.

Define the Problem

Identify if the problem is related to past or future building performance (repair or retrofit). The policy context for these two problems can be quite different. Decision makers are under tremendous pressure to act on repair issues, while there is often no pressure to act in a timely fashion on pre-earthquake rehabilitation. Understanding how quickly decisions need to be made will help identify the most suitable options.

Identify level and perception of risk. Stakeholders and decision makers need to understand the risk posed by a particular problem in order to be willing to take action. To foster this learning: individual stakeholder groups should be encouraged to think about desired performance objectives for buildings; technical experts should be used to help evaluate the risk; and risk communication techniques should be used to help explain risk.

Identify scope of the problem. Policy makers need to understand the nature and level of risk in their jurisdiction. What is the threat to life safety? What is the expected building performance in a future earthquake, and what was the building performance in previous earthquakes? What is the community context of the problem -- building occupancy, location, ownership and financing patterns, age? What is the economic risk posed by the problem?

Decide whose problem it is. Is it a problem that can be dealt with most effectively at the local government level? At the level of state government? Or at the federal level? On a voluntary basis?

Identify consequences of doing nothing. Part of understanding the risk is making sure that decision makers and other stakeholders are clear about what happens if nothing is done about the problem. What are the costs (and are there benefits) to each of the major stakeholders of "doing nothing" -- leaving the problem as a problem?

Evaluate potential for change without direct government intervention. Is it possible to achieve the desired level of change through requirements imposed by insurance or mortgage carriers, or through quick building repair, without requiring a specific governmental policy?

Identify financing requirements. In order to understand the financing requirements that are needed to address the problem, involve representatives from various financial institutions, such as banks and insurers, in discussions with the stakeholders and decision makers.

Develop critical mass. Develop policies that are acceptable to enough stakeholders to force action. It may never be possible to reach consensus among all the various stakeholders, but it should be possible to reach a sufficient level of agreement to take action. It is important to identify and balance the contradictory requirements faced by the various stakeholders.

Develop Solutions

Identify range and appropriate combinations of solutions. There can be many different approaches to a particular problem. In addition, it is likely that a combination of solutions will prove to be most effective. While a particular solution might not provide the level of safety an individual stakeholder or community is looking for, developed over time and combined with other solutions, it may ultimately contribute to an acceptable level of safety.

Should the solution be mandatory or voluntary? Mandatory approaches, such as local ordinances or state legislation, are generally considered more difficult to adopt because they require greater consensus; however, they are also likely to result in greater compliance. Voluntary approaches are most appropriate if the scope and implications of the technical problem are not fully understood.

What is the appropriate time frame for the solution? Some solutions are more appropriate in the short-term; others take more time to put in place. The immediacy of the problem will dictate which solutions can be considered.

Would any of the solutions work better as interim solutions? If the technical or political consensus does not exist for a permanent solution, a jurisdiction can consider developing interim measures until, for example, more information is developed or consensus is reached.

Evaluate impact effectiveness. It is important to determine how effective a solution will be in reducing the problem. The definition of effectiveness recommended here includes: how much of the total area at risk will be covered; the relative amount of loss reduction that can be expected if the technique is fully implemented; and the likelihood that the solution will be fully adopted and enforced.

Evaluate cost effectiveness. Each solution has a set of associated costs which can vary significantly for different stakeholders and decision makers. These costs need to be weighed against the impact effectiveness of the proposed solution in order to decide if the costs are warranted. When more stakeholders are involved, the probability of accurately reflecting community concerns increases.

Evaluate implementation feasibility. It is important to remember that even the most apparently appropriate solution, based on the most sophisticated information, will not reduce earthquake damage or vulnerability if it is not implemented. Decide which solutions have the best likelihood of being adopted and enforced

Evaluate issues of equity. One of the difficulties with many of the solutions proposed is that the benefits of taking action are spread widely but the costs are borne by a smaller subset of stakeholders. Consider mechanisms that assist in the more even distribution of costs.

Evaluate unintended consequences. Can unintended consequences of a policy action, such as rent increases, or difficulties in obtaining financing or insurance, be determined at the outset? If so, attempt to develop strategies to minimize their effects.

FINAL OBSERVATIONS

For a fuller treatment of the issues discussed above, readers are referred to the complete Earthquake Engineering Research Institute White Paper, **Public Policy and Building Safety**.

Decision makers do not create policies for earthquake safety based on engineering considerations alone. Such policies are the result of active and complex interactions among stakeholders. Constraints and supports for policy making already exist in the political environment and others arise in the course of formulating a new policy. Making a policy politically acceptable requires changing the attitudes of possibly all stakeholders toward the problem during the process of solving it, as well as educating them about the range of possible solutions. The problem itself extends well beyond its engineering aspects to social and economic implications. Technical experts and scientists must understand that the considerations discussed here are crucial in selecting a solution that is likely to be widely accepted and effectively implemented.