# DEVELOPMENT OF CONSENSUS SEISMIC PROVISIONS: A UNITED STATES APPROACH

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## SUMMARY

A set of building provisions with strong seismic safety features has been under development in the United States for several years. It is now nearing completion under the aegis of the National Earthquake Hazards Reduction Program. This development represents an unusual collaborative process between the private and the public sectors. Its most distinctive feature is a broad consensus approach, with the Federal Government providing heavy funding but little technical interference. Concentrating on process rather than technical issues, this paper describes how the consensus was established and maintained, what roles the various organizations have played, and what results are expected.

## INTRODUCTION

The single most effective long-range action to mitigate both human sufferings and physical losses caused by earthquakes is to construct seismic-resistant structures. To do so, however, requires building provisions that reflect the state of the engineering art that are technically feasible, cost effective, and adequately enforced. In the United States, this process requires a consensus of many public and private organizations and individuals. This paper describes the development of one such set of seismic provisions. It stresses the process, major actors, and expected results rather than technical aspects of the topic. The final phase of this development is currently being conducted as part of the National Earthquake Hazards Reduction Program by the Building Seismic Safety Council with funding by the Federal Disaster Assistance Administration (FEMA) (Ref. 1).

The formulation of building codes, standards and practices by consensus among the design professions and other interested parties has been going on since at least the beginning of this century in the United States. The particular process that is under discussion, however, is different in one major respect: funding for the conduct of research, formulation of the provisions, and the dissemination of results is coming almost entirely from the Federal Government. The solution to the technical problems and all other technical aspects of the effort are being handled by engineers and other professionals from the private and non-Federal sectors. Close cooperation of the public and private sectors with sizeable financial commitment, but minimal technical interference by the Federal entities is therefore the interesting feature of this process.

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## BACKGROUND

Unlike many other countries of the world, the United States does not have a building code covering the whole country and enforced by the Federal (or Central) Government. Because of a strong tradition of property rights and home rule, the prescription of building materials, methods, and practices is a prerogative of the individual States. They in turn frequently delegate this authority to counties and municipalities, through general enabling legislation. Two landmark Supreme Court decisions in the 1920's sanctioned this principle (Ref. 2).

Because of cost considerations, the vast majority of local government units either adopt by reference or adapt one of a number of codes prepared by model code-writing organizations. (These groups generally comprise designers, construction officials, and regulatory personnel who voluntarily give their expertise and time.)

The preparation, adoption, and enforcement of codes take place in an adversarial environment. Owners of land and buildings, developers, and the construction trades are understandably dedicated to keeping costs down as much as possible. While more stringent building standards and practices do not necessarily increase costs, they are perceived as doing so, and sometimes actually do add to construction costs. Consumer and other similiar groups are just as interested in economy, but often place a higher value on safety of the occupants of the structure under unusual loads caused by seismic and other hazards. Elected and appointed officials are caught in the middle of this tug of war, buffeted by the almost always contradictory imperatives of development and safety. Typically at the local level the ensuing compromise favors growth and a weak or lack of seismic provisions in the code, especially in areas with slight earthquake hazard awareness or long seismic recurrence periods. A forum in which to solve these conflicting interest did not exist until the process under discussion was formulated (Ref. 3).

## INITIAL STEPS

The idea of developing a set of seismic provisions that would command national attention and widespread adoption were first informally discussed by representatives of several Federal agencies during the interagency activities surrounding the preparation of the White House Science and Technology Initiatives in late 1971. While not much resulted from these Initiatives (for reasons not relevant to our discussion), the concepts have survived to this day.

In early 1972, the National Science Foundation (NSF) and the National Bureau of Standards (NBS) took the first concrete step by creating the Cooperative Federal Program in Building Practices for Disaster Mitigation. Other agencies provided encouragement but no funding because of the restricted view of their responsibility for disaster research that they held at that time. The program's objectives were described as a synthesis of existing information, development of improved knowledge about the safety of high-occupancy new and existing buildings, and the dissemination of such

knowledge to the design and other relevant professions. The Cooperative Program covered wind as well as seismic load considerations, as exemplified by the content of its first publication, Building Practices for Disaster Mitigation (Ref. 4).

At the same time, the supporting research was being strengthened, with NSF focusing on earthquake engineering and the United States Geological Survey (USGS) stressing seismic hazard delineation. Also, all earthquake-related efforts, except for tsunami warning, were moved from the National Oceanic and Atmospheric Administration to USGS, thus reinforcing the trend toward greater concentration of earthquake-related activities. While this was happening in the Executive Departments, a number of bills to provide more specific authority for earthquake efforts was introduced in successive sessions. It was not until 1977, however, when the Administration and Congress jointly pushed for earthquake legislation that a law finally passed: the Earthquake Hazards Reduction Act of 1977 (Ref. 5).

## THE APPLIED TECHNOLOGY COUNCIL EFFORT

The first real thrust toward a consensus approach in the development of seismic building provisions came only in the mid 1970's in a subsequent product of the Cooperative Program and under the same sponsorship of NSF and NBS. This effort was managed by the Applied Technology Council (ATC), an organization associated with the Structural Engineers Association of California. The striving for consensus was evident in all aspects of this project, including objectives, approach, and organization (Ref. 6).

The objective of the effort was the formulation of a set of design provisions that would reflect a considerable body of new engineering research knowledge yet be tempered by the judgement of experienced and well recognized design and regulatory practitioners. The blending of the optimum with the possible took place in a forum that allowed careful and deliberate consideration of often conflicting points of review and reconciliation in the interest of the public good that results from improved seismic safety.

The consensus approach was reinforced by the large number of participants (90), all but a handful volunteers, selected from all parts of the United States and from Mexico, belonging to disparate organizations, and having multidisciplinary knowledge. Of the 90, the largest group (54) came from private design firms, followed by the research and academic communities (25); code-writing bodies and regulatory agency representatives numbered seven, and only four were Federal officials (Ref. 7).

The organization and management structure of the project was purposely complex to allow breadth of coverage and maximum interplay of diverse viewpoints. Headed by an ATC project director, it consisted of 14 committees under five task groups and a task group coordinating committee, a seismology review committee, a design review group, a building code consultant group, and an executive panel. To broaden further the basis of consensus, about 350 individuals who were not project participants were asked to comment on the final draft of the provisions. Representatives from the building trades, a

group that had no representation on the project, were brought into the consensus process through this review mechanism (Ref. 8).

It took three years for the project to come to fruition (a not unusual time span for broad consensus-building). The result was the report, Tentative Provisions for the Development of Seismic Regulations for Buildings. Though modestly titled, this extensive volume is the authoritative work in the field. The required funding of several hundreds of thousands of dollars came primarily from NSF, but also from NBS; other departments provided non-monetary support. There were two major factors that made the process a success. The first one was the truly incalculable amount of expertise freely contributed principally by researchers and design practitioners in the private sector. The other was the absence of Federal Government interference in technical matters despite heavy funding. If such had not been the case, the consensus process would have been aborted at the very start.

The consensus-building process used in the development of what came to be commonly known as the Tentative Provisions report (ATC 3-06) became the model for the next stage of development of seismic building measures. The next stage, however, did not follow as expeditiously as was expected at the time.

## THE BUILDING SEISMIC SAFETY COUNCIL ACTIVITY

As the Tentative Provisions was being formulated, it became evident that many new building concepts and procedures were being introduced. A serious concern arose as to "their workability, practicability, enforceability, and impact on cost," as the Preface to the document states. This concern led to a recommendation by the Directors of NSF and NBS that the Tentative Provisions be used as it was as a resource document by designers, but that it be subjected to trial designs prior to regulatory uses (Ref. 9). Technical considerations undoubtedly played a strong role in the formulation of this recommendation. Equally important were the views of those participants in the process that came from areas in the eastern portion of the United States. They were concerned about the possibly unnecessary stringency of some provisions if applied to their sections of the country. In areas of lower seismicity or long earthquake recurrence periods, unnecessarily stringent codes can lead to unnecessary higher costs resulting in lower building activity, or, worse, non-adoption of any seismic-resistant code and standards.

Trial designs call for comparing on paper two designs of the same building; in this case, one design would follow the Tentative Provisions and the other, codes and standards in force in the community in which the building is located. The two designs are then compared for a number of factors, including ease of application of the provisions, and estimated construction time and costs. It is a time-consuming and, therefore, costly process, but one that yields reliable answers for comparing different sets of building standards and practices. The cost of trial designs is increased for a nationally applicable set of provisions by the need to use a representative sample of communities and of building size, configuration, occupancy, and construction.

Since the completion of the Tentative Provisions, the leadership of the earthquake-related activities in NSF--the principal funding agent--had changed, with a resultant shift in program emphasis. This meant that NSF could no longer continue to provide funds. Since the private sector could not be expected to allocate the more than one million dollars needed for this task, the Federal Government remained as the only funding source; but a new funding agency had to be found. This search took considerable time.

Eventually, the funding responsibility was assumed by FEMA. This agency was created in April 1979 by bringing together entities from various executive departments and agencies. It inherited the leadership of the then newly authorized National Earthquake Hazards Reduction Program (NEHRP) from the Office of Science and Technology Policy, Executive Office of the President (Ref. 10). One of the main objectives of this program is the development and promulgation of earthquake-resistant building design criteria, standards, and specifications (Ref. 11).

Initially, FEMA was beset by organizational and budgetary problems, and the high cost of trial designs did not help matters. Further, there was no suitable entity to conduct them, because the constraints on the type of entity needed were rather severe. The trial designs had to be conducted in an environment free as much as feasible from any bias, including the one associated with the previous ATC effort. Ruled out, therefore, were government agencies and potential candidates, such as ATC itself, academic research groups, associations of particular design professions, or private design firms.

With strong support of selected engineers and architects from the private sector, FEMA created a new organization, the Building Seismic Safety Council (BSSC), which is an independent, voluntary body representing all components of the building industry. As its charter states, the overall objective of BSSC "encompasses seismic safety of building-type structures with considerable consideration and assessment of the social, technical, administrative, political, legal, and economic implications of its deliberations and recommendations."

The concern for achieving the broadest possible consensus of the building community is reflected in both the number and the types of organizations that are members of BSSC. They originally numbered 51 and have by now grown to 57. Of these, 23 represent materials and equipment manufacturers, 17 design professionals, and six code writers and building regulators. The remaining include a major building trade union, an insurance association, and associations of homeowners and builders and of housing and development officials. These organizations represent literally scores of thousands of individual members.

Compared to the ATC effort, participation in BSSC is different not only in numbers, but also in the interests represented by the groups. Absent, for example, is the academic community per se, but strongly represented are the various sectors of the business and communities that have a vital stake in the outcome of the process (manufacturers of materials and equipment and

homeowners and builders.) This shift is quite appropriate as the process moves toward the final goal of a resource document to be widely applied. The one feature of the process that is unchanged, however, is the role of the Federal Government. It remains largely limited to non-technical matters, while FEMA is funding over 90 percent of the costs of about $1.5 m that will be incurred before trial designs are completed and the provisions disseminated. (The remaining funds come from private industry in the form of contributions in kind.) FEMA is also funding NBS to provide expert, but unbiased technical advice on difficult problems and the secretariat for some of the BSSC technical committees. The final decisionmaking, however, rests with the BSSC and the 57 groups it represents.

At the time of this writing, BSSC is conducting the second of two series of trial designs, covering 20 representative buildings in New York, Chicago, Charleston, St. Louis, and Fort Worth. Twenty-seven additional buildings in Los Angeles, Seattle, Phoenix, and Memphis have already been similarly analyzed. In addition, private firms are studying about ten more buildings in various cities. The most extensive process of validation of complete building seismic provisions ever attempted will have been conducted by an unprecedently broad consensus-building process-- with very substantial Federal Government funding, but little Federal technical interference.

## CONCLUDING REMARKS

This consensus-building process for the development of improved seismic provisions in the United States has been as fully time-consuming and expensive as expected. On the other hand, it has fashioned a model that should prove very useful in similar undertakings in the future to effect both breadth of participation and degree of harmony. While not universally applicable, it has many features that appear adaptable to a variety of political and cultural environments. Of course, the success of this long and expensive endeavor can be judged only on the basis of the speed and extent of adoption by State and local governments once the provisions are disseminated (scheduled to start shortly after the conclusion of this Conference.) The participation of the various groups has been very willing and the contribution in time and expertise has been very extensive. When funding from the Federal Government lagged, informal mechanisms and ad hoc arrangements were created, so that progress would not stop altogether. And differences of opinions are being resolved in an atmosphere of compromise. These are all good omens.

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7. Op. Cit., pp. 501-505

8. Op. Cit., pp. 6-12

9. Op. Cit., p. iii. The trial design process is explained later in this paper.

10. Reorganization Plan No. 3 of 1978 (43 FR 41943); Executive Order 12148 of July 20, 1979; and letter from President Carter to Dr. Frank Press, Director, Office of Science and Technology Policy, dated November 4, 1977.

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ACKNOWLEDGMENT

The author gratefully acknowledges the constructive comments made on the draft of this paper by Ms. Claire B. Rubin, Program of Policy Studies in Science and Technology, the George Washington University, Washington, D.C.