INTERNATIONAL NORM FOR EARTHQUAKE SAFETY PROGRAMS

This document sets forth the guiding principles for and elements of an effective earthquake safety program for a community, whether that community be a nation, province, state, city or village.

Effective earthquake safety programs are based on the following guiding principles:

1. Establish clear and measurable objectives for seismic safety, based on the level of risk that can be supported by the affected public and government agencies, and provide adequate resources and realistic timelines to achieve those objectives.

2. Define the level of the earthquake hazard in order to facilitate the development and application of construction codes and standards. At a minimum, hazard zones should be established; where possible, seismic hazard maps should be developed based on probabilistic analysis.

3. Set forth expectations and objectives that define the desired ability of homes, lifelines, and critical community facilities (e.g. schools, hospitals, and emergency response centers) to resist earthquakes. All buildings should be designed and constructed to prevent collapse, partial collapse or other failure that would endanger human life when subjected to specified levels of ground shaking or to collateral seismic hazards, such as surface fault rupture, landslide and inundation from tsunami or dam failure. Some communities may require that their critical facilities be designed and constructed so that they can be occupied immediately after an earthquake.

4. Give initial priority to making new construction safe. Next, undertake efforts to identify vulnerable existing structures and to establish standards for retrofitting or replacing dangerous structures. A longer timeframe may be appropriate to eliminate seismic weaknesses of existing structures.

5. Establish the program as a long-term undertaking with a strong commitment to sustained effort rather than only a one-time action.

6. Adopt a multi-hazard approach, so that earthquake mitigation strategies complement countermeasures for other natural hazards.

7. Employ advisory committees as needed to assure that policy and technical decisions are consistent, and to provide long-term independent support and evaluation for the seismic safety effort.

Effective earthquake safety programs include the following elements:

Seismic safety policy element

A policy should be established by law with well-defined and measurable objectives. Priorities and strategies for satisfying the objectives should be established by the appropriate government authorities. The policy must be clear and should have adequate support and authority to enforce its scope and objectives and to carry out the plan over a specified number of years. In addition, the policy should:

- Recognize the government's responsibility to provide some defined, minimum standard of public safety.
- Recognize the consequential need for the safety of the built environment.
- Adopt sustainable standards to guide the design and construction for new and existing homes, lifelines, and critical community facilities, based on prescribed performance objectives, knowledge of the ground shaking severity, quantification of site specific hazards, and the ability of the community to educate, train and license its members to effectively achieve established objectives.
- Establish programs for seismic risk reduction of new and existing homes, lifelines, and critical community facilities and their components.
- Provide adequate funding and human resources for the necessarily protracted duration of the program.
- Be supported by committed and competent leaders with sufficient legal and moral authority to ensure the effectiveness, sustainability and continuity of the programs that derive from the policy.

Accountability element

There should be a legal basis for action with clear lines of accountability of the different members of society who are given responsibility for implementing earthquake safety programs. To achieve the objectives of these programs there should be:

- A clear definition of the roles and responsibilities of the various individuals, agencies and organisations involved in the community's earthquake safety.
- A process for making all planning, design, regulation and enforcement decisions transparent.
- Competency-based licensing requirements for professionals engaged in the design of critical facilities.
- An independent assessment of the proper design, construction and maintenance of new and existing homes, lifelines, and critical community facilities including.
    - Conducting assessments of existing facilities.

- Reviewing and approving construction documents prepared for new structures and the retrofit of existing structures.
- Inspecting and approving construction periodically during construction.
- Qualifying personnel based on proven competency for design, plan review and inspection, materials testing and support functions.

- A clearly identified jurisdiction in terms of the area and the type of buildings affected.

Building codes and code enforcement element

The primary objective of building codes and regulations should be to protect the life of occupants. Other objectives could include minimising damage to allow rapid occupancy of critical community facilities after earthquakes. Building codes should govern the design of new and retrofitted buildings. Retrofit standards may differ from those for new construction in recognition of the constraints imposed by existing construction. Design earthquake ground motions should be determined using probabilistic analysis, but can be based on a deterministic approach or on a map of seismic zones. The competent authorities should determine the most appropriate design criteria, based on a review of their community's seismic hazard and other pertinent factors.

An effective building code and enforcement element should establish:

- Clear building performance objectives based on:
  - Ground motion characteristics and geology of the region.
  - Collapse prevention and structural damage control criteria.
  - Secondary effects such as tsunamis, landslides and surface rupture.
  - Socio-economic impacts to the community.
- A process for periodic review and revision of codes and guidelines by knowledgeable individuals to reflect current understanding of good earthquake engineering practice.
- Enforcement procedures for the building code and construction regulations that take into account community needs but provide clear provision for:
  - Checking of design plans by qualified reviewers prior to construction.
  - Review and certification of final construction.
- A mechanism for ensuring that enforcement activities are not compromised by overt or subtle pressures due to project-specific cost, deadlines or other financial considerations.

The mere existence of a building code in a community can give the false impression that buildings are being constructed safely and that their seismic performance will be satisfactory. While essential, the writing and adoption of building codes and regulations will be ineffective unless those codes and regulations are enforced at every step of the design and construction process. Steps should be taken to ensure that codes and regulations are properly implemented and enforced.

Training and qualification element

Building safety relies on regulations and laws that require proper training and qualification of design and construction professionals, building officials, inspectors, contractors and construction tradesmen involved in all aspects of the design and construction process. Building safety training programs should be carried out within the context of each individual community. Training programs must accommodate governmental structure and division of responsibilities, perception of risk to the institution and its stakeholders, community values and economic conditions. Training and licensing should be required for design and construction professionals, code enforcement officials, plan checkers, inspectors and contractors.

- ***Engineers and architects*** should be properly trained and licensed based on proven competence by the competent authorities, and their training should include seismic design.

- ***Qualifications of contractors*** should be considered in awarding construction projects. This should involve the establishment of training programs on best constructions practices for contractors and trades.

- ***Building officials, plan-check professionals and inspectors*** should be certified through a process of adequate training and experience.

Preparedness and planning element

Effective programs should include the following measures to reduce risks and to prepare the community to react in safe ways during emergencies.

- ***Education:*** Develop and implement educational programs or curricula in schools and communities to make citizens aware of earthquake hazards and preparedness actions.

- ***Risk reduction measures for building contents and non-structural elements:*** Undertake measures to improve the safety of the physical environment by bracing and anchoring furnishings, bookcases, and equipment and building components such as lights, heaters and water heaters.

- ***Emergency plan:*** Prepare and maintain plans that identify the actions, decisions and responsibilities needed before, during and following an earthquake; the organisation and responsibilities to carry out these plans; and the equipment and supplies needed to carry out these decisions.

- ***Safety assessments:*** Establish standards, line of responsibility and procedures to assess the safety of buildings following earthquakes, and to decide on evacuation, repair and re-occupancy procedures.

- ***Training***: Provide training and materials to the public on earthquake hazards and actions to take to improve personal safety.

- ***Drills:*** Hold periodic drills simulating realistic conditions of earthquake events to reinforce training and to test the adequacy of plans and safety assessments.

Community awareness and participation element

Paramount to the success of a program to improve a community's earthquake safety is the understanding and involvement of the members of the community. All members should understand the seismic hazard of the region, the vulnerability of existing critical buildings, the consequences of not properly constructing new buildings or improving the resistance of existing buildings, the feasibility of improving seismic safety, and the responsibility of government to provide some defined minimum level of seismic safety. In particular, those members of the community who are involved in the construction of critical buildings need to understand why they are required to follow prescribed practices, and the consequences of their failing to do so. An effective community awareness effort will include:

- Programs to raise public awareness and knowledge of the risk from earthquakes and other natural hazards.

- Educational programs to transfer and disseminate technical knowledge and to explain risk in terms understandable to community stakeholders.

- Activities to empower the community to be part of and contribute to the reduction of seismic risk.

- Use of school curricula to increase awareness of earthquake hazards and preparedness actions.

Risk reduction element for <u>new</u> buildings

Procedures currently exist to ensure good seismic performance of buildings and their contents, and implementing such procedures is feasible. The following components are needed in a risk reduction element for ***new*** buildings:

- Determination of seismic hazard in the region and development of seismic hazard maps.

- Development of performance criteria and codes suitable to the culture and economic conditions of the region.

- Development of simple regulations, or best construction practices, for regions where such an approach may have an immediate impact on seismic safety (*e.g.* simple, low-cost housing facilities in rural regions of developing countries).

- Training, education and certification of professionals, technicians and the construction workforce.

- Target dates for implementation of construction standards recognizing the different levels of current practice in different countries.

- Effective building codes and regulations, and rigorous enforcement of these regulations.

Risk reduction element for existing buildings

To reduce the seismic risk of existing buildings, it is important to understand the magnitude of this risk, why this risk exists, and what actions can be taken by the community to eventually reduce the risk. Community values, economic conditions, financial capabilities and the type of building materials available in the region must be considered when developing and implementing a risk reduction plan.

Key ingredients for an effective risk reduction element for existing buildings include:

- Determination of the seismic hazard and preparation of hazard maps.

- Assessment of vulnerability to existing buildings and their contents and other important community assets.

- Evaluation of the consequences of not taking corrective action.

- Development and implementation of technical guidelines to improve performance of existing construction during earthquakes (*e.g.* methods and procedures to estimate forces and displacements of the structure and predict damage, acceptable margins of safety or confidence, proper use of building materials, and monitoring of the construction processes).

- Formulation of an action program based on availability of funding, human resources and their qualifications, existing infrastructure and the operational structure of the community.

- Prioritization and risk reduction plan implementation, considering financial and human resources and the role of the buildings in post-disaster emergency management.

- Monitoring of effectiveness of plan implementation including quantification of the reduction in risks.

Given the magnitude of the retrofitting task in many countries, several decades may be needed to complete a community's seismic retrofit program. Responsible officials should first retrofit those facilities deemed to be at the highest risk.