Sécurité scolaire
School Safety and Security

P E B

GeoHazards International

OECD PROGRAMME ON EDUCATIONAL BUILDING (PEB) AND GEOHAZARDS INTERNATIONAL (GHI)

AD HOC EXPERTS' GROUP MEETING ON EARTHQUAKE SAFETY IN SCHOOLS

OECD, PARIS, 9 TO 11 FEBRUARY 2004

ABSTRACTS

Theme 2: Recognising the obstacles to achieving this objective

Earthquake vulnerability of school buildings in Algeria (Fouad Bendimerad, United States)

This paper describes the nature and cost of damage to school facilities in the 21 May 2003 Boumerdes earthquake and other earthquakes in Algeria. It provides statistics on the extent of damage and estimated costs of reconstruction and rehabilitation. The author discusses the factors that increase the vulnerability of school construction in Algeria, such as urban development, structural flaws in existing school building stock, and inadequacy of building codes and construction control for school buildings. Approaches to reduce the vulnerability of both existing and new school buildings are also presented.

Seismic safety of schools in Italy (Mauro Dolce, Italy)

This paper examines the possible causes of collapse of a primary school in San Giuliano, Italy, in the 2002 Molise earthquake, which killed 27 students and one teacher. It also considers the general sources of seismic vulnerability of school buildings in Italy prior to the introduction of new seismic zonation and new seismic codes in 2003. In addition to incomplete seismic zonation and inadequate seismic codes, the author cites irregular architectural and structural layout of schools, low standards of construction execution and maintenance, and dangerous structural changes implemented over the lifecycles of schools as the primary causes of vulnerability of the country's school buildings.

Obstacles to improving school seismic safety in Turkey (Polat Gülkan, Turkey)

This paper examines the process of school design in Turkey. It describes the responsibilities and authority of the government bodies involved in the construction, maintenance and repair of school buildings, as well as past and current legislation and code enforcement concerning construction practices. These elements are described within the context of the factors impeding quality construction in both public and private buildings. An appendix provides additional information on damage to school buildings during the 2003 Bingöl earthquake.

Seismic risk in schools: The Venezuelan project (Oscar Lopez, Venezuela)

This paper describes the performance of school buildings in the 1997 earthquake in north-east Venezuela, in which two schools collapsed and 46 students were killed. It provides seismic data on the region and country, and analyses two typical school structural types in Venezuela: "box-type" and "old-type" buildings. The causes of school collapse are provided for each structural type. The analysis was conducted as part of a project to reduce seismic risks in schools in Venezuela, which identifies and classifies existing schools in terms of vulnerability.

Theme 3: Defining seismic safety principles for schools

Fundamental concepts and principles for assuring acceptable performance of schools and the educational system (Dennis Bellet, United States)

This paper presents the principles of satisfactory school building design, through the use of qualified engineers, an adequate building code, independent review and hazard investigations; and satisfactory building construction, through the use of qualified builders and independent inspection and testing. It also discusses the history of school construction in California, including the adoption of the 1933 Field Act and its subsequent enforcement by the Division of the State Architect.

Theme 4: Assessing vulnerability and risks to schools and educational systems

Translating earthquake hazard mitigation measures from one country to another: A case study (Christopher Rojahn, United States)

This paper presents a collaborative programme by the Applied Technology Council in the United States and the Servizio Sismico Nazionale (National Seismic Service) in Italy to improve seismic safety in Italian hospitals. It describes how U.S. hazard mitigation measures and regulation were used in Italy. The paper also provides an overview of procedures for rapid visual screening of buildings for potential seismic hazards and for evaluating structural and non-structural components, including criteria for specifying the expected level of seismic shaking.

Building Code Effectiveness Grading Schedule: Measuring the community's commitment to adopting and enforcing building codes (Dennis Gage, Manager, United States)

Government, insurers, property owners and builders all have important roles and responsibilities to ensure that buildings are safe. However, not all communities have rigorous building codes, nor do all communities enforce their codes with equal commitment. This paper describes how the Insurance Services Office (ISO) helps distinguish between communities in the United States with effective building-code enforcement and those with weak enforcement through a comprehensive programme called the Building Code Effectiveness Grading Schedule. The ISO collects information on a community's building-code adoption and enforcement services; reviews the administration of codes, building plans and field inspections; and then assigns a Building Code Effectiveness Classification.

Theme 5: Identifying strategies and programme approaches for improving school seismic safety

Strengthening school buildings to resist earthquakes: Progress in European countries (Robin Spence, United Kingdom)

This paper reviews progress in programmes for screening, evaluating and strengthening existing vulnerable buildings, including schools, in high-risk areas in Europe. It is argued that legislation is needed to ensure the long-term financial commitment that is required for strengthening programmes. The experience of a lethal earthquake – as in Italy in 2002 and Turkey in 2003 – is the most effective catalyst for action, but computed scenarios can also motivate action. Data available on the extent and possible scope of a programme for the retrofit strengthening of school buildings for the six most at-risk countries in the European Union are presented. The costs are substantial but reasonable when distributed over a period of years with some adjustment of capital expenditure priorities.

Supporting local seismic experts: Experiences in Nepal and India (Richard Sharpe, New Zealand)

This paper discusses the development of local expertise in Nepal and India. The obstacles to the development of local expertise in Nepal are presented, in addition to the work of the National Society of Earthquake Technology, which has used local and international knowledge and experience to advance earthquake safety in Nepal. Concerning India, which has well-developed local networks of professionals in universities and the private sector, the case study of Bhuj Hospial in Gujurat is described.

Evaluating earthquake retrofitting measures for schools: A cost-benefit analysis (Andrew Smyth, United States)

Based on a cost-benefit approach for evaluating seismic mitigation options for apartment buildings in Istanbul, Turkey, this paper presents a demonstration study for a hypothetical vulnerable school building. A probabilistic cost-benefit analysis provides a useful framework for assessing seismic mitigation measures, taking into consideration limited resources and social costs. The hypothetical school is analysed over a variety of time-horizons to determine the break-even point for investments for several seismic retrofitting options.

Implementing school seismic safety programmes in developing countries (Sudhir Jain, India)

This paper discusses some of the challenges of implementing successful seismic safety initiatives in developing countries. Two Indian initiatives are presented – the National Programme on Earthquake Engineering Education and licensing of engineers – that can provide lessons for planning school seismic safety programmes in developing countries. A number of strategy issues are discussed in the light of these programmes, which focus on the need for having realistic expectations, giving priority to areas and components that are likely to succeed, focusing on new buildings first and retrofitting later, considering the broader context of education provision and infrastructure, promoting effective communication and developing local leadership.

Additional papers

Seismic risk mitigation practices school buildings in Istanbul, Turkey (Özal Yüzügüllü, Turkey)

In 1999, 820 schools were affected by the Kocaeli earthquake in Istanbul, 22 of which were subsequently demolished. This paper describes the impact of the earthquake on school buildings in Istanbul and the subsequent rehabilitation and reconstruction activities. It assesses the vulnerability of the existing school building stock in Istanbul, providing an estimated budget for strengthening buildings that predate the 1998 Building Code and a review of the methodology, criteria and priorities required to implement such a project. The paper concludes with recommendations for implementing a practical macro-project plan for improving seismic safety in schools.

Learning about seismic safety of schools from community experience in Berkeley, California (Arrietta Chakos, United States)

Following the 1989 Loma Prieta earthquake in California, the Berkeley community has worked diligently to reduce seismic hazards in its schools. This paper describes the efforts of the Berkeley community and local leaders to address the serious risk to students in its 16 public schools through persistent legislative efforts and development of multi-sectoral partnerships. The catalyst for action to improve school safety was not the discovery of improved technical standards or the financial means to correct building deficiencies; it was the fact that a small group of people decided to take action for a safer community for their children.

A brief review of school typologies in Italy: Specific vulnerability and possible strategies for seismic retrofitting (Nicola Cosentino, Italy)

This paper outlines the four main distributive typologies of school buildings in Italy, which are strongly characterised by their periods of construction: stand-alone masonry buildings, reinforced-concrete framed structures, university buildings and historical or monumental buildings. The seismic reliability of each typology – which is generally low for all school buildings in Italy – is described, and some possible retrofit strategies are outlined. A brief note about the cost-benefit balance is presented based on the experience of the Emilia-Romagna Regional Administration, which completed a vulnerability analysis of 2 700 strategic buildings, including schools, between 1989 and 1990.

Earthquakes and educational infrastructure policy in Mexico (Jaime de la Garza Reyna, Mexico)

Mexico is located in a high seismic risk zone, and today's industrial and commercial development has elevated the existing threat. This paper describes the measures that are being implemented to improve the response of Mexico's educational sector to earthquakes. Federal, state and municipal governments are acting to increase awareness in communities through civil protection; to support public infrastructure in case of disaster with the Natural Disaster Fund, Natural Preventive Disaster Fund and a seismic alarm system; and to provide updated and regional building codes.

Making schools safer: The New Zealand experience (Brian Mitchell, New Zealand)

This paper presents New Zealand's seismic risk profile, past seismic events in the country and strategies applied to reduce seismic risk. New Zealand experiences a large number of earthquakes, the most damaging of which took place in February 1931 in Hawke's Bay. Following the 1991 Building Act, which was created to regulate building design and construction, a number of strategies were implemented to ensure compliance of all school buildings constructed from 1976 onwards with the new seismic standards. Between 1998 and 2001, a structural survey of 2 361 public schools was commissioned by the Ministry of Education, and a significant investment programme was initiated to meet the recommendations of the report in terms of specific categories of buildings.

Damage in schools in the 1998 Faial earthquake in the Azores Islands, Portugal (Jorge Miguel Proença, Portugal)

On 9 July 1998, an earthquake struck the islands of Faial and Pico in Portugal, killing eight people and leaving 1 000 homeless. Following the earthquake, 21 educational buildings were inspected in an attempt to establish the correlation between general building classification factors – structure, quality, conservation condition and number of storeys – and the buildings' damage state and post-event use. This paper presents the inspection results.