

ENHANCING UNIVERSITY EARTHQUAKE-ENGINEERING EDUCATION: THE GATEWAY TO EARTHQUAKE RISK REDUCTION IN DEVELOPING COUNTRIES

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ABSTRACT:

In spite of all recent advances to mitigate earthquake risk, losses from earthquakes that occurred in the last decades indicate that there is something missing in the prevailing approach. This paper presents an experience that has been achieved recently in Egypt. Few years ago the Ministry of Higher Education in Egypt has created the "Higher Education Enhancement Project Fund (HEEPF)" funded by the International Bank to help in enhancing the Higher Education System in Egypt. The Faculty of Engineering at Cairo University in collaboration with the Egyptian Society for Earthquake Engineering has succeeded to win a funded project within the framework of (HEEPF). The project was entitled "Enhancing Earthquake Engineering Education" and lasted for two years starting mid-July 2005. The aim of this project was to enhance earthquake-engineering education on both the undergraduate and graduate levels at the Faculty of Engineering, Cairo University This has been achieved through four basic objectives. The first was developing a number of earthquake engineering courses for both undergraduate and graduate levels. The second was activating a Higher Diploma in Earthquake Engineering. The third was enhancing earthquake engineering education resources. The fourth objective was to enhance earthquake engineering experimental facilities at the Faculty of Engineering. The objective of this paper is to present the activities of this project and show that there is an urgent need to establish a new bachelor degree in earthquake engineering at the faculties of Engineering.

KEYWORDS: Earthquake-Engineering Education, risk reduction, developing countries, Egypt

1. INTRODUCTION

During the last two decades Egypt has witnessed a pronounced seismic activity. During the same period large and vital structures and buildings have been constructed. However, the prevailing building codes either did not include the effect of earthquake loads in the design of structures or excessively underestimating it. Therefore, almost all structures and buildings constructed till the end of the twentieth century have doubtful capacity to resist moderate earthquakes. Cairo Earthquake of October 12, 1992 has proven that the building stock is vulnerable to moderate earthquakes. The resulting damage from this event represented a disaster for such a developing country like Egypt.

2. EARTHQUAKE RISK MITIGATION STRATEGY FOR EGYPT

A strategy for seismic risk mitigation in Egypt has been previously proposed (Sobaih, 1993). This was a strategy composed of the following ten points:

- 1- Seismic hazard assessment.
- 2- Development of seismic codes.
- 3- Aseismic design of new buildings.
- 4- Vulnerability assessment of existing structures.
- 5- Seismic risk evaluation of urban areas.

- 6- Retrofitting of existing buildings.
- 7- Earthquake engineering education.
- 8- Earthquake engineering research.
- 9- Public awareness and preparedness.
- 10- Earthquake disaster management.

The author being involved in the field for earthquake engineering for more than thirty years has covered some of the points mentioned above in many publications (Sobaih, 1992 and 1993). Besides, being involved in teaching at both the undergraduate and graduate levels at Cairo University the author has found that the subject of earthquake engineering education could be the most influential among the above-mentioned points. Therefore, efforts have been made during the past three decades to introduce earthquake engineering courses on both the undergraduate and graduate levels at Cairo University. However, due to administrative reasons students were not enthusiastic to choose these elective courses.

3. HIGHER EDUCATION ENHANCEMENT PROJECT FUND (HEEPF)

Higher Education Enhancement Project Fund (HEEPF) is a part of the loan agreement between Egypt and IBRD to support and finance priority areas of the strategic plan addressed in the Higher Education Enhancement Project (HEEP). The Amount of the loan allocated for HEEPF Grants is 12 million USD. The general objective of the HEEPF is to support improvements in the quality, relevance, and efficiency of Higher Education at Egyptian public universities and Higher Education Institutions. The goals of HEEPF Projects are:

1. Development of academic programs and curriculum.
2. Introducing new equipment and structural materials.
3. Maintaining of existing equipment and materials.
4. Improving skills of involved persons.

HEEPF has approved 159 projects submitted by different Egyptian Universities. From these projects only 23 have been approved for Faculties of Engineering. The total funding for these engineering projects was about 2 million USD.

4. ENHANCING EARTHQUAKE ENGINEERING EDUCATION PROJECT

4.1 Introduction

The present author has submitted a proposal for a project entitled “Enhancing Earthquake Engineering Education” under the acronym of (4E). On July, 2005 this project has been awarded to the Faculty of Engineering at Cairo University in collaboration with the Egyptian Society for Earthquake Engineering. The duration of the project was two years with a budget of USD 110,000.

4.2 Current Situation

The field of earthquake engineering has become an important part of the education process in the field of civil engineering. On the undergraduate level the lack of teaching tools and experimental facilities makes it difficult to students to visualize the complex dynamic behaviour of structures. The same difficulties face graduate students in structural engineering, Besides, the lack of textbooks, references and research papers discourage graduate students to select courses related to earthquake engineering.

4.3 Needs Analysis

In order to enhance education in earthquake engineering a large effort has to be done. An infrastructure has to be created in order to facilitate, encourage and upgrade education in this vital field. The large number of undergraduate students and the lack of interest of graduate students represent major difficulties.

4.4 Beneficiaries

This project was directed to the senior civil engineering students at FECU (about 350 students). Also, students of the Higher Diploma in Earthquake Engineering would benefit from the different aspects of the project.

4.5 Brief Presentation of the Partners

The Faculty of Engineering at Cairo University (FECU) submitting the proposal is the oldest faculty of engineering in Egypt and Arab countries. It was the first faculty interested in the field of earthquake engineering. This was through introducing a course on the undergraduate level and a higher diploma. Research in this field also started at FECU since the eighties and has been introduced in other Egyptian and Arab Universities. It has also organized many seminars and international conferences in this field. It has a well known research staff. Also, it hosts the Egyptian Society for Earthquake Engineering.

The Egyptian Society for Earthquake Engineering (ESEE) was established in 1983. It represents Egypt at both the International and European Associations for Earthquake Engineering. It has been very active on both the national and international levels. It has a large experience in the efforts done on the national level. It also recognizes the fields that require more effort in order to mitigate earthquake disasters. Expert members of the ESEE have been chosen to participate in the proposed project.

5. PROJECT DESCRIPTION

5.1 Assumptions

Egyptian universities do not have enough funds to support the introduction of the field of earthquake engineering both in the curricula of undergraduate civil engineering education and the graduate curricula for structural engineering education. The existing facilities at the Faculty of Engineering and the Egyptian Society for Earthquake Engineering can be combined and developed to make a pronounced step to introduce the field of earthquake engineering education and research on both the undergraduate and graduate levels.

5.2 Project Content

The aim of this project was to set out an infrastructure for education in the field of earthquake engineering. A pilot introductory course on earthquake engineering has been developed. An agreement between the FECU (submitting institute) and the Egyptian Society for Earthquake Engineering (a partner) has been previously achieved to set out a Higher Diploma in Earthquake Engineering. Therefore, a publicity campaign has to be performed to attract as many applicants as possible for the Higher Diploma. Seminars for the undergraduate students in civil engineering are to be held in order to inform these students of the importance of higher studies in earthquake engineering. A unique library is to be established to contain the most recent textbooks and

references in the field of earthquake engineering. This library will upgrade the quality of education of both undergraduate and graduate students.

To enhance higher studies in earthquake engineering four subjects are suggested in the project. First, a survey of all published research will be done and documented. A focal point would be created including information about all active Egyptian researchers in the field of earthquake engineering. This will facilitate their contacts and collaboration. Many seminars would be organized to present the results of current research. Also, the specialized library would contain proceedings of the most recent international conferences.

Finally, to enhance earthquake engineering experimental facilities at the FECU two efforts have been suggested. Firstly, existing equipments are to be upgraded. Secondly, a virtual learning unit is to be created to help both researchers and students.

6. PLAN OF WORK

6.1 Project objectives

Therefore, the project objectives can be summarized in the following points:

- 1- Development of five courses on earthquake engineering.
- 2- Promote Higher Diploma degree in earthquake engineering.
- 3- Enhance earthquake engineering education resources.
- 4- Enhance earthquake engineering experimental facilities at the Faculty of Engineering at Cairo University (FECU).

6.2 Logical Framework Matrix

A logical framework matrix has been established in order to relate each objective with the related activities in order to achieve the required output (Sobaih 2006).

6.3 Output/Outcomes

The teaching material for an introductory course on earthquake engineering has been developed. A set of seminars for both undergraduate and graduate students has been organized. A wide campaign has been done to attract stakeholders to join graduate studies in earthquake engineering.

A specialized library has been established including recent textbooks and references on earthquake engineering. The survey of earthquake engineering research done in Egypt has been conducted in order to collect and document this research work. A focal point has been established where information about the active researchers are gathered and documented. Seminars about current research were organized. Finally, the existing experimental facilities at FECU have been upgraded and a new virtual learning unit has been established.

6.4 Dissemination

The dissemination strategy involved two major activities:

- 1- On the national level:
A set of seminars were held during the implementation period of the project for different levels of audience. The first level is for undergraduate students of the third and fourth years in civil and structural

engineering. The second level is oriented towards graduate engineers working in different organizations. Also, a publicity campaign was performed in order to acquaint the public with the project objectives. Published reports have been disseminated to public and private universities, research centers and organizations interested in earthquake engineering. Training sessions on the use of experimental facilities were held to attract undergraduate and graduate students.

2- On the international level:

Many international conferences on earthquake engineering include papers on earthquake engineering education. This project represents a unique national strategy to enhance education in earthquake engineering. Therefore, it was planned that few papers will be published in such conferences. Besides, description of the project and its results was presented in different international seminars. This may set a new direction towards contribution of other countries in the United Nations “International Decade for Sustainable Development” during the period 2005-2015.

6.5 Sustainability

A) Financial Sustainability:

- 1- The upgrading of existing experimental facilities would encourage the FECU to arrange for maintenance contracts for the equipments. It will also encourage the Faculty Administration to allocate more budget to increase the capabilities of the Earthquake Engineering Research Laboratory.
- 2- The success of the Higher Diploma in Earthquake Engineering would encourage the FECU to continue the Diploma, which is partially supported by fees paid by the students.
- 3- The ESEE (the Partner) being completely committed to enhancing the field of earthquake engineering in Egypt will continue to support the outcomes of this project.

B) Sustainability at the Policy Level:

- 1- Involving the staff of the Structural Engineering Department in the project activities will encourage the Department to transform the course of earthquake engineering from an optional course to an obligatory one.
- 2- The agreement between the FECU and ESEE to organize the Higher Diploma in Earthquake Engineering could be a successful model for other Higher Diplomas.
- 3- The techniques used to evaluate and improve courses could be adopted by the FECU for other courses.

C) Institutional Sustainability:

- 1- The staff members of the project are of different ages and positions.
- 2- The process of training the staff members of the project team ensures that they will work in the same direction after the project is completed.
- 3- The upgrading of existing experimental facilities at the FECU will ensure the continuity of the work.

6.6 Courses Developed

Table 2 shows the courses that have been developed in this project. It is worthy to mention that the first course is prepared to both senior students and graduate students but with appropriate levels.

7. PROJECT ACHIEVEMENT

During the period between 15/7/2005 and 15/7/2007 all activities described above has been achieved. Special

peer committees from the funding agency have approved these achievements. Besides, an additional year from 16/7/2007 till 15/7/2008 has been assigned in order to continue the project activities but without additional

Table 2 Titles and scope of courses

No.	Course Title	Course Scope
1	Introduction to Earthquake Engineering	Earthquakes: causes, seismic waves, scales, rationalization – Experiences from past earthquakes – Earthquake- resistant design of RC buildings – Regulations and codes for aseismic design – Basics of retrofitting.
2	Seismic Design Regulations	Concept and philosophy of seismic design regulations - Minimum requirements for different categories of buildings - Development of seismic design codes- Comparison of codes- Applications.
3	Introduction to Seismic Analysis	Introduction: types of dynamic loads, basic definitions - Vibration of single-degree-of-freedom systems- Multi-degree-of-freedom systems- Seismic response of SD linear systems.
4	Seismic Risk Assessment	Review of current methods for vulnerability assessment: empirical, theoretical, and experimental methods- Vulnerability index methods- Applications to reinforced concrete buildings and urban areas.
5	Earthquake Disaster Mitigation	Types of natural disasters- World distribution of Natural disasters- Special features of earthquake disasters- Disaster management phases- Earthquake prediction and warning systems- Examples on earthquake disaster countermeasures.

funding from the funding agency. The Egyptian Society for Earthquake Engineering has covered all expenses during this additional year.

8. CONCLUSIONS

The last decade has witnessed earthquake disasters in developing countries. Usually such countries suffer from the lack of official laws and regulations that lead to mitigating earthquake disasters and/or adopting these regulations by the public. Previous experience has clearly showed that earthquake-engineering education is the gateway to mitigate earthquake disasters in such countries. Structural engineers who are well educated in this field are the first line of defense against building failures. Besides, they will be more qualified than others in the process of evaluating and strengthening of deficient buildings. The author's experience has proved that making earthquake-engineering courses optional to either undergraduate or graduate students is not an efficient solution. Students usually prefer easier courses. This results in having engineers without sufficient knowledge in earthquake engineering. Besides, these same unqualified engineers when go out to practice they encourage others to ignore earthquake-resistance regulations. This adds more societal problems. The present author would appeal to all faculties of engineering all over the world to create a new bachelor degree in earthquake engineering in order to create well-qualified earthquake engineers capable of mitigating earthquake disasters.

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