EVALUATION OF CIVIL ENGINEERING TRAINING IN RESPECT TO DISASTER PREPAREDNESS IN KENYA

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ABSTRACT

Disaster results from interaction of a hazard and society. All nations on the globe are exposed to at least one kind of hazard. The major difference amongst nations is the capacity to cope. Kenya's capacity is currently undermined by a number of factors such as low economic indicators, inadequate training, lack of specialised manpower and lack of a national policy on disaster. This paper focuses on the training aspect of civil engineers as one sector of professionals whose contribution is necessary in reducing disaster impact in society. The paper identifies areas which need to be integrated in the current training of civil engineers to make them more effective in the use of engineering tools to mitigate disaster. The paper also identifies constraints and recommends the way forward for both the Government and training institutions in realising the proposed training structure.

Key words : Civil engineering, curriculum, disaster, hazards.

1.0 INTRODUCTION

Disaster management is a broad subject whose scope ranges from physical to social science, and whose containment requires a variety of specialists (e.g., engineers, armed forces, psychologists, doctors and religious leaders). The importance of the need for effective disaster management is globally acknowledged as shown by different global initiatives in the past. For example, United Nations (UN) International Decade for Natural Disaster Reduction 1990-1999 and the UN International Strategy for Disaster Reduction 2000-onwards brought to the fore the issue of disaster management as a matter countries have to give priority. Many countries, particularly in the developing world, are yet to institutionalise their disaster planning and response capabilities.

By definition, disaster is as a result of interaction of a hazard and society (ISDR, 2002). This means that occurrence of a natural hazard where there is nothing at risk does not constitute a disaster. Disaster management involve four overlapping functional phases; mitigation, preparedness, response and recovery (WMO, 1994). Recent experience in Kenya following *El nino* rains of 1997/98, the bomb blast of 1998, annual occurrence of famine in ASAL districts and that of floods in the lake basin region is enough evidence to justify classifying Kenya as a disaster prone nation. However, the national preparedness and response levels is still low due to low budgetary provisions, lack of national policy and inadequate training. Currently, national disaster management operate as a centre under the Office of the President (Wendo, 2002) . This means that Kenya should re-assess her policy and training needs in light of effective management of disaster. Other scholars have made similar observations. For example, Makhanu (2002) observed that there is need for training of the population on what to do before, during and after disaster. In Kenya, this need is even more urgent as disaster and poverty are mutually reinforcing and the fight against poverty may be lost if capacity to cope with disaster is not improved (GOK, 2001; GOK, 2002). In response to this need, Kenya is currently working towards developing official disaster policy.

2.0 BACKGROUND INFORMATION

The American Society of Civil Engineers (ASCE) Board of Directors adopted the following definition of Civil Engineering: 'Civil Engineering is the profession in which a knowledge of the mathematical and physical sciences gained by study, experience and practice is applied with judgment to develop ways to utilise, economically, the materials and forces of nature for the progressive well-being of humanity in creating, improving and protecting the environment, in providing facilities for community living, industry, and transportation, and in providing structures for the use of mankind'. If the definition is assumed as a universally acceptable attempt, the challenge is now upon educators to develop the curriculum and implement the same in such a way that the product, according to the definition, is realised. The civil engineer's role in planning and implementation of construction of major works is only complete if stability and performance of the same are rated high against anticipated disasters. This means that a civil engineer has a continuous role to play in all sequences of mitigation planning (i.e., hazard assessment, vulnerability analysis, risk assessment, preparation and implementation of mitigation plans). Civil engineering has also been seen as major tool of development and therefore developing countries like Kenya emphasise the training on design and construction, which were of immediate need in post independence period at the expense of environmental management component. Disasters were assumed to be taken care of by simplistic thinking of adoption of reasonable factor of safety as advocated for in various design codes of practice. However, recent disaster experience in Kenya, have ended up causing extensive damages to civil works. For example, Kenya's civil engineering infrastructure, especially roads, has not yet recovered from damages caused by 1997/8 *El nino* rains. Annual flood related damages in the Lake Victoria basin and power disruptions due to effect of droughts in reservoirs are common phenomena. Some of these failures could be attributed to inadequate predicting tools as classic probabilistic models on which predictions of rare events are based are sometimes out of phase with reality, particularly in the case of small data samples as in most parts of Kenya. Another reason is the minimal treatment of environmental science component in civil engineering design and maintenance. Recent theories agree with the explanation that recent increase of disasters, particularly meteorological related disasters are not due to the increase of magnitudes of causative natural hazards but due to human factors. This may require environmentally friendly design approaches which go beyond the structure itself to what may be referred to here as 'space of influence'. What these observations raise is whether civil engineering training needs improvement to adequately cope up with these challenges.

Civil engineers are currently being trained in a number of Kenya's national universities and similar institutions in the region. The curriculum has evolved in the recent times from emphasis on provision of structures for immediate use of mankind to a sustainable planning for same structures and environment. Some universities in the developed nations have in fact taken a bold step to rename civil engineering as environmental systems engineering. This thinking may be close to making civil engineering more responsive to disaster management. Effective integration of training in disaster management in civil engineering undergraduate course is one way of achieving environmentally friendly design, which will ultimately minimise the impact of natural disasters on civil structures. The only institution in the region, which has launched diploma and masters degree training in disaster management is Masinde Muliro University College of Science and Technology. Jomo Kenyatta University of Agriculture and Technology treats the subject as a unit in her masters programme in Global Environment and Arid-Semi Arid Lands Management. In undergraduate programmes of the four universities offering Bachelor of Science in Civil Engineering, disaster management is poorly captured, with only a few disaster related topics being handled under hydrologic studies. Postgraduate programmes in disaster management may only benefit civil engineers who endeavour to pursue these higher degrees, but this does not solve the weaknesses in understanding disaster management at the undergraduate level. This paper therefore intends to evaluate civil engineering curriculum in reference to its strength on hazard studies.

3.0 HAZARDS AND COVERAGE LEVEL IN CIVIL ENGINEERING CURRICULUM

Ten hazards which have direct impact on civil structures in tropical countries are identified in Table 1. Kenya has a history of occurrence of all the thirteen listed hazards. Some hazards like volcano have just remained in the history books with proofs being seen in the landscapes like Great Rift Valley and Kenya's highest mountains. Though these natural phenomena seem to be in a dormant state, studies have not ruled out future re-occurrences, as was recently witnessed in the Democratic Republic of Congo. Civil engineering designs, for example dams, are currently being done without any provision for earthquake. Organisations which are in charge of dam operations are not preparing downstream residents for response to dam failures. Landslides and mass movements are common disasters in central Kenya. Road designs have responded to this kind of disaster by applying traditional approaches like safe angle of repose. There is lack of landslide risk maps in Kenya to help designers understand the distribution of the phenomena. The dynamics and modelling of mass movements is not in the civil engineering curriculum and therefore civil engineers cannot provide effective solutions for them. Though civil engineering materials are mainly concrete, timber, steel and a few extras, the effect of fire on the behaviour of these structures is ignored in the curriculum. With dynamic global technology, civil engineers are faced with new choices of construction materials and these should be assessed in reference to disaster mitigation. Disaster mitigation can only be addressed if civil engineers learn how their field interacts with other environmentally related fields. Design should go beyond the structural element and address what has been referred to here as 'space of influence'. Civil engineers should be able to design environmental requirements of their structures, because it is them who understand them. For example, bridges have failed to cope up with floods because most bridge designs emphasise more on vehicle load capacity than flood carrying capacity. Frequently, roads are monitored for possible structural failures through limiting vehicle axle loads, but similar efforts are not put for monitoring hydraulic efficiency of bridges until they are washed away. This may require civil engineers to be interested in dynamics of the watershed, which affect their structures. Wind data network is very poor in Kenya and this may be due to lack of customers. If civil engineers treated this data as critical in their design the situation would be different. Lack of interest in wind parameters in civil engineering design is also due inadequacy in the curriculum which do not address this problem.

Table 1 shows that amongst the thirteen examples of disasters, only six are studied to a level equal to or above average (i.e., medium and high) in current civil engineering curriculum, whereas only two cases listed in the table have no serious negative impact on civil engineering structures. Failure of all examples of disasters given in Table 1 to reach excellent rating in terms of training scale is a point of concern for trainers.

4.0 DISASTER STUDIES WHICH NEED TO BE INTEGRATED IN CIVIL ENGINEERING TRAINING

Shortcomings in the current civil engineering curriculum as highlighted in the previous section need urgent intervention. Necessary additional areas of study are proposed here to make civil engineering training more responsive to disaster management. Table 2 shows a summary of recommended areas of study and reasons for their choice. Though it may appear as if there is danger of overloading the curriculum, the author is convinced that the suggested topics could be integrated in the current subjects. It is obvious that introduction of information technology in learning environment has increased delivery efficiency, and therefore, it is becoming easier to widen the scope of learning without compromising quality.

5.0 CHALLENGES IN TRAINING IN DISASTER MANAGEMENT

Some of the challenges in training in this area are:

(i) High cost of training facilities which universities' budgets need to absorb, e.g., warning systems, mapping equipments, simulation laboratories and simulation software.

(ii) Lack of specialised professionals in some areas, e.g., fire engineering and simulation of impacts.

(iii) Lack of linkage between Kenyan institutions and other global disaster monitoring centres (e.g., cause of delay of information on the 2004 Asian Tsunami in Kenya)

(iv) Weak research collaboration between physical and social scientists. This is necessary since disaster management is cross cutting all disciplines.

6.0 PROPOSED WAY FORWARD IN DISASTER MANAGEMENT TRAINING

(i) Need for a national disaster policy.

(ii) Government disaster management coordinating body to apply for affiliation to other global centres and a national centre to be linked to universities offering training.

(iii) Government and universities to establish research and information database on disaster management to improve close liaison amongst concerned institutions.

(iv) Specialised training to be sourced in developed countries for lecturers in the field.

7.0 CONCLUSION

(i) There is need for revision of civil engineering curriculum to integrate more content of structural disaster mitigation measures, and improve on understanding of environmentally friendly engineering.

(ii) This study has revealed that that current civil engineering curriculum does not prepare the students to a level that may be regarded as excellent in reference to disaster management. Knowledge acquired is inadequate for mitigating more than half of known disasters, which negatively impact on civil structures.

(iii) There is need for Kenya to formalise her disaster policy and acquire international linkages to strengthen local institutions.

(iv) Universities to acquire necessary facilities for training.

REFERENCES

1. GOK (2001). Poverty Reduction Strategy Paper for the Period 2001-2004. Vol. I and II, Ministry of Finance and Planning, Government of Kenya.
2. GOK (2002). National Development Plan 2002-2008 Vol. I and II. Government of Kenya.
3. ISDR (2002) : Living with Risk- A global Review of Disaster Reduction Initiatives, UN International Strategy for Disaster Reduction, pp. 22-67
4. JKUAT(2004). Jomo Kenyatta University of Agriculture and Technlogy Calendar (2004-2005), BSc - Civil Engineering Curriculum, Department of Civil Engineering, JKUAT, pp 161-163.
5. Makhanu K.S. (2002). Towards the Establishment of a Disaster Research Centre in Kenya. Unpublished paper presented at the Workshop on Disaster Hazards in Kenya, JKUAT, Oct.2002.
6. MOI University (1996). Moi University Calendar (1996-97), BSc - Civil & Structural Engineering Curriculum, Department of Civil and Structural Engineering, pp 600-618.
7. University of Nairobi (1988). University Calendar 1988-89, BSc - Civil Engineering) Curriculum, Department of Civil Engineering, University of Nairobi, pp 257-258
8. Wendo B. S. (2002). Status of Disaster Management in Kenya. Unpublished paper presented at the Workshop on Disaster Hazards in Kenya, JKUAT, Oct. 2002.
9. WMO (1994). The Roles of Meteorologists and Hydrologists in Disaster preparedness, pp 1-49. WMO/TD-598.
10. WUCST (2004). Graduate Diploma/Msc. Programmes , Centre for Disaster Management and Humanitarian Assistance, Western University College of Science and Technology.

Table 1: Assessment of level of training for civil engineers in reference to natural hazards commonly occurring in tropical countries and their potential negative impacts

Origin of Hazard	*Example*	*Training scale*	*Existence of any threat to performance of Civil Works*
Hydrometeorological	Floods	High	Exist
	Drought	Medium	Minimal
	Wind	Low	Exist
	Landsldes	Medium	Exisit
Geological	Earthquake	Medium	Exist
	Volcano	Low	Exist
	Mass movement	Low	Exist
Environmental degradation	Fire	Low	Exist
	Desertification	Low	Exist
	Polution	High	Exist
Biological	Epidemics	Low	None
Technological	Toxins	Low	Minimal
	Dam failures	High	Exist

Legend : Excellent - Knowledge acquired enough for effective mitigation
High - Fundamental concepts understood but inadequate for disaster mitigation using modern techniques.

Medium - Basic knowledge acquired, inadequate for disaster mitigation.
Low - Knowledge acquired is not systematic and therefore not targeted to disaster mitigation.

T*able 2: Proposed integration of disaster management in Bachelor of science degree in civil Engineering*

Type of hazard	*Necessary disaster Training*	*Areas in Civil Eng. to benefit*
Floods	Real time forecasting models Early warning systems	Reservoir regulations Disaster preparedness
Dam Failures	Dam instrumentation	Dam maintenance
Drought	Water harvesting Early warning systems	Appropriate ASAL technologies Disaster preparedness
Landslide	Prediction models	Land development planning Control of mass movements

Wind	Theoretical models & Expt.	Structural design/bridge design
Fire	Introduction to fire eng.	Material development & design
Environmental degradation	Environmental science	Environmentally friendly design Maintenance practice
Earthquake	Earthquake control	Structural design/reservoir eng.
	Computer simulation of disasters Physical model simulation	Dessign based on generated data ”