

CONSTRUCTION INDUSTRY DEVELOPMENT FOR DISASTER PREVENTION AND RESPONSE

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Abstract

Disasters, both natural and human-caused, have been occurring with increasing frequency and effect in recent decades in many countries around the world. They have had a disproportionately heavy toll on developing countries both in terms of loss of lives and damage to property. The need to take action to effectively manage disasters has been highlighted at many major international conferences and measures are underway in many countries and at the international level.

The developing countries are less able to deal with the causes and impacts of disasters. It is important to develop the construction industries of the poorer nations in order to equip them to manage disasters. This paper considers how this can be done. It starts by providing examples of recent disasters and their impact on human settlements. It then considers the role construction can play in disaster management. Following a review of current initiatives, some recommendations for further action are presented.

Construction industry; disaster management, reconstruction management; technical development

OBJECTIVES OF PAPER

This paper considers the following:

- The implications of a disaster for construction, especially in developing countries
- How disasters and their effects on construction can be addressed, including their prevention and reconstruction after their occurrence
- The role of the construction industry development in disaster management
- Current actions being taken to manage disasters at the local, national and global levels
- Some recommendations for further appropriate action.

This paper examines some of the issues relating to the built environment and the construction industry through the prism of disasters and their management.

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Established, simple issues assume a different shape when they are viewed in this light.

INTRODUCTION

Disasters cause a considerable amount of damage around the world each year. The United Nations Human Settlements Programme (UNHSP) notes that in the first half of 2001 alone, natural disasters caused over US\$24 billion in damage globally. At the same time, over 60 million civilians were affected by some 30 conflicts in various parts of the world. The World Bank estimates that, in 1998, natural disasters killed over 50,000 people and destroyed \$65 billion worth of property and infrastructure. Some 95 percent of these disaster-related deaths occurred in developing countries, and affected the poorest people most severely. It would also appear that the same countries suffer from disasters repeatedly. For example, in Mexico, natural disasters claimed 10,000 lives and cost \$6.5 billion in 1980-2000. It would also appear that the occurrence of disasters, and their effects, is on the increase. It is estimated that, of the 100 most expensive natural disasters of the 20th century, 65 occurred in the 1990s, 25 in the 1980s and 10 in the 1970s, and much fewer in the previous decades (Du Plessis, 2001).

From the data, it would seem that the frequency and impact of disasters (both natural and human-caused) is greater in the developing countries. Moreover, these nations are among those which tend to be repeatedly affected by various types of disasters. Furthermore, the developing countries are less able to cope with the effects of such occurrences.

The built environment bears the brunt of the damage from disasters of all kinds. The annual hurricane and cyclone seasons in the Atlantic/Caribbean and Asia-Pacific regions respectively fill many governments, communities and people in the regions with trepidation, and bring much destruction. These storms have become increasingly significant to the sustainability of the human settlements in small island countries (Corbin, 2001). The el Niño weather phenomenon in 1997-98 caused thousands of deaths in many countries after setting off storms, fires, floods, frost and drought. It is estimated to have caused nearly \$32 billion dollars in damage to property around the world (Anderson, 2002). The earthquake in Gujarat state, India in January 2001 left 20,000 persons dead, 167,000 injured, and nearly a million families homeless (World Bank, 2001). The quake destroyed much of the area's social infrastructure – schools, health clinics, water supply systems, communications and power. In many villages and towns the destruction was nearly total. The total loss of assets was put at US\$2.1 billion, of which US\$1.1 was in the housing sector.

As Moor (2002) notes, human settlements are designed to protect their inhabitants against attack by intelligent hostile elements. At the same time, the technology of war aims to counteract such defenses. Indeed, it would appear that with socio-economic progress, settlements become more vulnerable as they become more reliant on their increasingly extended supply lines, and ever-expanding and vital

distribution networks of water, power, gas and telecommunication systems, as well as other resources such as food. They also become dependent on community networks and government agencies at various levels. Public social and security infrastructure such as health facilities, civil defense and the police also become crucial. Moreover, with globalization, the major settlements are also inter-connected and a disaster in one of them can precipitate widespread disruption in many others. Indeed, as the dramatic events of September 2001 demonstrated, while they can be symbols of national achievement and culture, particular constructed items can be the targets of attack (Warah, 2002), sometimes with devastating consequences.

From the discussion so far, disaster management with respect to human settlements, and thus, constructed items, must consider both the series of natural events which are non-selective with respect to location and target, as well as the human-made events such as wars and terrorism which specifically target settlements and constructed items. Moor (2002) suggests that as it has been difficult to design and construct items to protect them against the first group of disasters, more attention is now paid to “the more predictable and manageable disasters like earthquakes, fires, hurricanes, landslides and floods, and increasingly, to ... threats from pollution, crime and poverty” (p. 1).

IMPORTANCE OF CONSTRUCTION AND IMPLICATIONS OF DISASTERS

Construction represents most of every nation’s savings. Studies show that Gross Domestic Fixed Capital Formation in construction is 45-60 percent of the total capital formation (Ofori, 1990; Hillebrandt, 2000). Badiane (2001) estimates that investments in housing alone constitute between 2 and 8 percent of GNP; between 10 and 30 percent of gross capital formation; between 20 and 50 percent of accumulated wealth; and between 10 and 40 per cent of household expenditure.

Constructed items are vital to the pursuit of economic activity as they provide the space needed for the production of all goods and services. The physical infrastructure built through construction activity at great expense is the nation’s economic backbone as it constitutes the arteries for the facilitation of productive activity by enabling goods and services to be distributed. The items built also offer social and welfare benefits. For example, housing fulfils one of the most basic needs of people by providing shelter from the elements. Built items also offer people the opportunity to improve their living standards.

Thus, a disaster which leads to significant damage to the built stock, as many of them tend to do, can have negative consequences for the economy and for the well being of the people, often for long periods of time.

Developing Countries

Disasters have a greater impact on the built environment of developing countries than industrialized ones. The World Bank estimates that losses due to natural disasters are 20 times greater (as a percentage of GDP) in developing countries than in the industrialized nations. The damage to the economic and social

infrastructure usually takes a long time to reconstruct after a disaster, causing further suffering to the populace.

For the individual in a developing country, losses resulting from disasters can be more severe in magnitude, and take a much longer time than a person in an industrialized nation. This is best illustrated by using residential units. First, many houses in these countries are also used by families for income-earning activities. Moreover, much of the individual's sweat equity is often invested in the person's house. Thus, loss or damage of houses has both economic and psychological aspects. Second, a house represents several times each person's annual income, and it might be impossible for the owner to replace it. Third, there is usually no suitable commercial insurance scheme to ameliorate the financial losses resulting from the destruction of a house in a disaster; where these schemes are available, they may be beyond the reach of, or unfamiliar to, the ordinary citizens. Finally, the governments of these countries typically face budgetary constraints, and thus, are unable to offer any compensation for the losses suffered by the citizens.

In developing countries, the loss of property as a result of disasters can be put into sharper perspective when one considers the current problems and priorities of these nations. Poverty alleviation is a key consideration in the countries themselves, as well as the bilateral and multi-lateral aid agencies. In Ghana, the latest surveys indicate that about 23 percent of the urban population and 52 percent of the rural populace live below the poverty line², with women, children and disabled youth being disproportionately represented in this group (Bartels, 2001). Some 60 percent of Rwanda's population lives under the poverty line and 91 percent of the total population are employed in the agricultural sector which mainly produces for subsistence (Nkusi, 2001). Mozambique has launched initiatives to maintain an average growth of 8 percent per annum but this remarkable rate of growth will merely reduce the poverty head count to below 50 percent by the end of this decade (Cossa, 2001).

The poverty levels in developing countries are manifested in the physical conditions in their human settlements. Badiane (2001) observes that in most countries of Africa, the proportion of the population living under poor conditions of shelter, water supply and sanitation is rising. For example, it is estimated that 51 percent of the total population of Colombo, the capital of Sri Lanka, live in slums and shanties, while only 42 percent of the national housing stock is permanent (Samaraweera, 2001). The already unsatisfactory living conditions in the developing countries are being exacerbated by a high rate of rural-urban migration. In Bangladesh, the urbanization rate is nearly 25 percent; the capital, Dacca, is one of the 30 largest cities in the world. The rapid changes in the urban areas are causing increased social unrest and urban violence through the creation of poverty, homelessness, environmental deterioration, social exclusion, intolerable living standards and spatial segregation (Siddique, 2001). Moreover, the poor physical conditions in human settlements have

² The poverty line is defined differently in various countries. A common definition is a personal income of US\$1.00 per day. However, in East Timor, it is as low as US\$0.55 per day.

wide economic and social implications. The lack of service infrastructure such as water, sanitation and electricity is one of the reasons why the countries are being marginalized in the current process of globalization as they lack the facilities to attract significant amounts of foreign investments. While most developing countries have formulated comprehensive policies on urban and infrastructure development, implementation levels remain unsatisfactory.

Some Recent Examples of Disasters and their Impact on Constructed Items

There are many recent examples of natural disasters which have had major physical consequences. In 1989, Hurricane Hugo caused massive devastation in the Caribbean. Further damage was caused by Hurricanes Luis and Marilyn in 1995. The governments of the countries in this region have been undertaking massive post-disaster reconstruction programmes at great cost. Mozambique was affected by massive floods in 2000 and 2001. The floods swept away roads, bridges and buildings, creating a serious setback to the implementation of programmes, projects, and actions of a government which had been seen to be enlightened in its economic and social policies. The city of Goma, in Western Congo, was badly affected by a volcano on its outskirts which erupted in 2001 and led to dramatic scenes of lava flowing through its main streets.

The situation in Sierra Leone may be used to illustrate the impact of human-caused disasters on the physical assets of a developing country. The civil war in that country led to the destruction of an estimated 300,000 houses, 1700 educational facilities, 400 health posts and 300 water wells. Out of the total population of 4.5 million, the war uprooted about 1.2 million people who were either internally displaced or became refugees in neighboring countries. Koidu, the former second largest town in Sierra Leone was destroyed to its foundations. The government has made institutional changes to address the reconstruction, rehabilitation and resettlement and the demobilisation and disarmament tasks. Rwanda offers another example. The 1994 tragedy in that country is said to have resulted in the death of over a million people and “seriously disrupted the whole shelter and human settlements sector in its totality” (Nkusi, 2001). By 2001, there were still some 2 million people living in makeshift structures such as plastic sheeting.

The construction process itself can lead to disasters. Table 1 shows some of the environmental impacts of construction. For example, all construction requires land. However, the preparation of the land for construction can destabilize land formations, leading to landslides, mudslides or rockslides.

Table 1 Environmental Impact and Considerations of Construction Activity

<i>What is used</i>	<i>Where it is built</i>	<i>How it is built</i>	<i>What is built</i>
* where raw materials are obtained	* location of facility; nature of terrain, ground conditions;	* methods of construction	* planning and design of facility (e.g. potential of

	alternative uses of the land		daylighting and natural ventilation)
* how raw materials are extracted; how land is restored (if necessary)	* immediate physical environment; proximity to water sources and ecosystems	* construction project management systems (e.g. quality management systems)	* specification, its implications for materials used
* how raw materials are processed	* social disruption (e.g. displacement of inhabitants)	* site control measures	* life-cycle economic, quality, maintainability considerations
* whether, and how renewable raw materials are regenerated	* economic disruption (e.g. loss of livelihoods of previous inhabitants)	* welfare of site workers, neighbors and general public	* extent of use of energy and other resources in operation of building
* how materials are transported	* present infrastructure, need for expansion, its impact	* resource management (including waste minimization)	* ease of demolition of building
* how materials are stored	* impact on local vehicular traffic		* recycling and reuse of demolition waste

Source: Adapted from Ofori (1999)

Some disasters result directly from errors or omissions in the design and construction process. Often, dams, barrages and canals are sometimes unable to do the (flood control) work for which they were designed; the floods in China in 1998 revealed many instances of poor design and construction. As an illustration, Kazakhstan has one of the poorest water supply and sanitation systems among the former soviet states. The poor and unsafe water services which are responsible for deteriorating public health and increased expenditures on health are blamed on deficient design, use of poor construction materials and methods, and insufficient maintenance and rehabilitation (Jarbussynova, 2001). In Accra, Ghana, 126 people died in a stampede at the national sports stadium in 2001 owing to the poor location and design of egress points as well as poor crowd control. This followed soon after a similar disaster in South Africa.

MANAGING DISASTERS THROUGH CONSTRUCTION

Whereas disaster management has many dimensions, it would appear that those relating to the built environment are high in priority. The post-disaster report on the Gujarat earthquake, prepared by the World Bank and Asian Development Bank, identified the following immediate needs: *provision of temporary shelter before the onset of the monsoon season; restoration of public services such as hospitals, schools, water supply, power, communications, municipal and environmental*

infrastructure, and state administration; and, securing income earning opportunities for vulnerable people in the affected areas (World Bank, 2001).

The World Bank (2001) observes that international experience from other disaster-hit areas suggests that the recovery programme should follow principles including: revival of the economy; empowering individuals and communities; affordability, private sector participation, and equity; decentralization; and communication and transparency. Consultation with, and participation by, the affected communities must be at the heart of the recovery programme, including, as far as possible, *rebuilding of their own houses by individuals in their original location*. After studying the post-war reconstruction of villages in the Lebanon, El-Masri and Kellett (2001) also stressed community participation.

Current Awareness

Events in the last decade have pushed disaster management to the fore in the priorities of governments and international organizations where the built environment is concerned. As shown in Box 1, the topic has been incorporated into the objectives and priorities of most organizations involved in aspects relating to the built environment.

Disaster management has been high on the agenda of major international fora on development in general and human settlements in particular. The Habitat Agenda, which was passed at the City Summit in Istanbul in 1996, urged local, national and international action to enhance capabilities in disaster prevention, mitigation and preparedness. Moreover, the more recent Draft Declaration on Cities and other Human Settlements in the New Millennium signed at the Istanbul+5 Summit in 2001 states:

...committing the international community to improving prevention, preparedness, mitigation, and response capabilities with the cooperation of national and international networks in order to reduce the vulnerability of human settlements to natural and human-made disasters, and to implement effective post-disaster programmes for the effective human settlements aimed, inter alia, at meeting immediate needs, reducing future disaster risks and making rebuilt human settlements accessible for all.

Features of Constructed Items and Relationship with Disasters

Table 2 shows the features of constructed items which make them vulnerable to disasters. As an example, owing to the physical characteristics of constructed items, they cannot be moved elsewhere even if an imminent disaster could be accurately predicted. As disasters, both natural and human-made, cannot be prevented, the most effective action is in providing the constructed items with features which can limit the damage from the occurrence of disasters. The process of creating the built environment should also be viewed from this perspective.

Box 1 Integration of Disaster Management into Housing Strategies

The Countries of the Commonwealth Consultative Group on Human Settlements, launched in 1999, has the following goal (Member Countries of Commonwealth, 2001):

"Demonstrated progress towards adequate shelter for all with secure tenure and access to essential services in every community by 2015".

The Group's priority areas include:

1. Good governance and secure land tenure;
2. Access to funding through international and national agencies, together with innovative local schemes;
3. Promotion of employment opportunities in conjunction with shelter provision, particularly for the low and no-income groups, and other under-privileged sectors;
4. Catering for the special needs of children, the disabled, disadvantaged and otherwise marginalized sections of community;
5. Training and capacity building to support member countries' human settlement programmes;
6. Development of mutually supportive partnerships in order to fuse government, civil society and the private sector into a cohesive and efficient support mechanism;
7. Maintaining and improving individual and community health by providing safe, clean water supplies, adequate waste management, good air quality and dedicated campaigns against HIV/AIDS and malaria;
8. *Improving disaster preparedness and mitigating the consequences of conflict;*
9. Adequate, habitable and affordable land for shelter development; and
10. Seeking establishment of monitoring systems to assess progress and regulate against slippage.

Source: Statement by Member Countries of the Commonwealth Consultative Group on Human Settlements at The Special Session On Habitat II, New York, June 8, 2001.

Table 2 Features of Constructed Items and their Contribution to the Vulnerability of these Items

<i>Features of Constructed Items</i>	<i>Resulting Vulnerability</i>
Location specific and immobile	Items are exposed to disasters which occur where they are located; they cannot be moved as a precaution.
Highly expensive	Impossible to test the completed item by exposing it to the full force of a possible disaster. Thus, simulations and limited tests applied which may not fully reflect the real situation.

Long development process	Planning, design and construction involve multiplicity of operations, with dispersed control.
Durable	Durability both a requirement and a feature. Item is exposed to elements and wear and tear which may weaken it.
Usage	Items are occupied and utilised for various purposes. Thus, disasters affecting them can lead to loss of lives.

Another important consideration with regard to constructed items is that they are often required to provide protection (from disaster) to settlements and communities. These include flood control systems (dams, dykes and canals), and sea barrages. Moreover, disasters are followed by exercises involving construction activity, to repair or reconstruct the damaged buildings and items of infrastructure, often in the same settlements. This points to a need for adequate construction capacity and capability.

Construction Process and Disasters

The statutes which relate to buildings are formulated and enforced with the view to ensuring the safety and health of the occupants and their neighbors. Land-use planning regulations and norms are examples of these statutory provisions. They determine the location of items (zoning); the intensity of development (density); the heights of constructed items (massing); and the distances of the items from one another (setbacks). Another set of regulations relate to building design. The main intention here is to ensure the safety of the users and the neighbors. In each of these statutory provisions, established because of bitter experience, the possibility of avoiding disasters or providing protection against their effects is evident. Appropriate action in these regards sometimes involves simple regulations, decisions or processes. For instance, the World Bank observes that poorly planned development can turn a natural phenomenon into a human and economic disaster. Examples of these are allowing floodplains to be densely populated; using poor or inadequate building codes in earthquake zones; not enforcing the regulations; or allowing the degradation of natural resources.

Unfortunately, in the developing countries, there are several difficulties in these regards. First, these countries often use regulations formulated elsewhere, under different economic, physical (such as climatic) and social conditions. For example, many developing countries inherited, and continue to use (often unrevised to take current local issues into account) regulations from the former colonial powers. For example, Arimah and Adeagbo (2000: 293) note that, "In essence the urban development and planning regulations currently in force [in Nigeria] are those tailored after the 1932 British Town and Country Act which was adopted in 1946". Second, where regulatory reforms are introduced, the motivations may be a range of conflicting issues, and the balance is seldom well struck. For example, there may be conflicts between cost and quality or durability of materials, and the competence of

the contractor. In Trinidad and Tobago (which is prone to tropical storms), the government indicated (Baksh, 2001):

We are emphasizing the use of indigenous materials and technologies to lower the cost of building components and increase the housing stock. More use is being made of the skills and expertise of small building contractors, in a competitive bidding environment, to reduce the cost of constructing homes for low-income people in particular.

Finally, inadequate executive capacity means that in most developing countries, the existing urban development and planning regulations are not enforced. Arimah and Adeagbo (2000) found very low levels of compliance with such regulations in Nigeria. There are, usually, weak administrative agencies; and lack of clarity in responsibilities for enforcing and administering regulations. This has been found to be the main cause of damage to property during many disasters such as the Turkish and Gujarat earthquakes. The non-enforcement of regulations also accounts for the differences in damage, injuries and fatalities when disasters of similar intensity occur in industrialized and developing countries.

The Habitat Agenda called for the development of appropriate norms and by-laws for land use, and building and planning standards based on professionally established hazard and vulnerability assessments. The International Federation of Red Cross and Red Crescent Societies (Gospadinov, 2001) which has been involved in post-disaster situations in several countries notes that: *“there has been less understanding of the part disaster preparedness must play in the setting of housing and construction standards”*. Thus, the Federation has committed itself to *“working actively to advocate for better responses to issues like housing and construction standards [in order] ... to mobilise the power of humanity for disaster prevention, preparedness, mitigation and response at local, national and international levels”*.

The ability of a constructed facility to withstand damage, or to prevent or reduce loss of lives during a disaster can be enhanced through appropriate design. This involves the structure, installations, layout and dimensions; as well as the specified materials and construction methods. Another important aspect is the ability of the building and the settlement to support the post-disaster relief and reconstruction efforts.

No matter what quality of design or materials is specified, the way in which the construction is done determines the final quality of the completed facility. Poor construction was responsible for many of the lives lost during the Marmara earthquake in Turkey in August 1999. Again, the Habitat Agenda suggested that disaster-resistant construction methods should be developed. Another major determinant of how well a constructed item performs is the way in which it is maintained during its operation.

CONSTRUCTION INDUSTRY DEVELOPMENT

Considering the importance of planning, designing and building constructed items to reduce their vulnerability to disasters as well as the need to respond effectively to disasters in order to save and protect lives, rehabilitate vital infrastructure, and reinstate economic activities, it is necessary to provide the construction industry with the requisite capacity and capability. In particular, the construction industries in developing countries need to be equipped for these purposes, given the apparent differential frequency and severity of various types of disasters. This can only be achieved through deliberate, planned, strategic, systematic efforts.

Ofori (1993: 48-49) suggests that *construction industry development* ...refers to the pursuit of the improvement of the industry as an objective in itself ... the approach is direct and continuous ... [it] would incorporate appropriate strategies, and integrated plans and programmes under specific implementing agencies.

Ofori (1993) suggests that *construction industry development* has the following components: human resource development; materials development; technology development; corporate development; development of documentation and procedures; institution building; and development of operating environment of the industry.

The then CIB Task Group 29 on Construction in Developing Countries defined construction industry development as follows:

Construction industry development is a deliberate and managed process to improve the capacity and effectiveness of the construction industry to meet the national economic demand for building and civil engineering products, and to support sustained national economic and social development objectives.

Construction industry development promotes:

- Increased value for money to industry clients as well as environmental responsibility in the delivery process
- The viability and competitiveness of domestic construction enterprises
- Optimization of the role of all participants and stakeholders through process, technological, institutional enhancement and through appropriate human resource development.

The concept of *construction industry development* is now well understood. Even in industrialized countries with relatively mature construction industries, the need for the continuous development of the industry is being realised. There have been major studies of the UK construction industry in recent years including the Latham (1994) and Egan (1998) reports; and of the industry in Australia (Australian Procurement and Construction Council, 1997). Hong Kong and Singapore have also recently completed major reviews of their industries (Construction 21 Steering Committee,

1999). The reviews have been given impetus by both internal and external trends which indicate a challenging future for the construction industries. The trends include the needs of an increasingly sophisticated economy, client demands, technological and social change, and globalization leading to competitive pressures.

The need to prepare construction industries of developing countries for disaster management purposes brings another dimension to, and reinforces the necessity to develop the construction industries which is usually argued from the economic perspective.

CID in Disaster Management

From the above discussion, it is evident that, for a construction industry to contribute effectively to the effort to manage disasters, certain elements must be in place. First, there should be a regime of statutory regulations and codes which guides planners and designers to take preventive action, and contractors to produce items of the requisite quality and durability. Second, there must be an efficient and effective enforcement framework to give practical effect to the regulations. Table 3 shows the elaborate process adopted in Singapore with respect to the approval of plans, designs and completed items. It is pertinent to note that many of the “special features” of the Singapore system were introduced after the collapse of a hotel in 1986. Third, the construction industry must have adequate capacity and capability to undertake designs which give due cognisance to the possibility of all forms of disasters in the particular context of the locations of the items. Finally, the contractors should, simply, be able to produce sound construction.

To attain the above elements, all the components of construction industry development should be pursued in developing countries. First, human resource development should equip construction professionals with the knowledge and skills required to undertake appropriate designs and construction. It should be possible for local practitioners to keep themselves informed of developments in knowledge overseas. Second, a programme of materials development should be instituted in each region to find high-performing (disaster-resistant) materials which are suited to the local context and are of good quality, durability and affordability. Third, it is necessary to put measures in place in pursuit of the technological development of the industry to ensure that it has the capability to handle the various projects which will be required to provide protection against disasters, and those which the post-disaster reconstruction process will involve.

Table 3 Administrative Procedures for Construction Projects in Singapore

<i>Stage of Process</i>	<i>Administrative Procedures</i>	<i>Special Features of Procedures</i>
Planning	Development Planning Approval, from the Urban Redevelopment Authority	

Design	Building Plan Approval, from the Building and Construction Authority and 10 other technical agencies including Fire Services Bureau and Ministry of the Environment	Design should be by Qualified Persons, who are Registered Architects and Engineers. Accredited Checker must scrutinise submitted calculations and drawings of structural engineer.
Construction	Building Control Act and regulations and codes of practice under it specify detailed requirements for aspects of construction. For public-sector buildings, contractor must be registered, and must meet personnel, financial and track record criteria. Qualified Persons must supervise construction. Workers on the plumbing and electrical installations must be licensed.	Building activity only starts after Building Permit is given. Construction site considered as a factory for health and safety purposes. Client must pay for full-time Resident Engineer or Clerk of Works on the site to act as client's representative. Temporary Occupation Permit (TOP) after completion, given after all the installations and systems are tested. Certificate of Statutory Completion must be granted. Requirements are even more stringent than those for TOP.
Operation and Maintenance	Building can only be utilised for the approved purposes.	Annual certificate of inspection required for all buildings with lifts. Five-yearly inspections of structural efficacy for commercial buildings; and ten-yearly inspections for residential buildings.

The fourth aspect is corporate development where the companies in the construction industry are provided with the encouragement and incentives to progressively upgrade their operations and strengthen their organizations. The fifth consideration is institution building. The professional institutions and trade associations can be a powerful force for change in the industry. Thus, these organizations should be strengthened. The final component of an industry development programme in this context is a conducive operating environment. By supporting the continuous development of the companies involved in various aspects of construction, a good environment will enhance their disaster prevention and management capabilities. For example, the contract forms and project procedures should facilitate the relatively complex projects relating to disaster management.

CURRENT ACTION

Disaster management is being given serious systematic consideration at the levels of countries, regions and globally. It involves a variety of activities which address various aspects of disasters including their causes and effects. The discussion below focuses on disaster management in relation to human settlements. It is important to place this in the proper context by highlighting that there is renewed determination at the national and international levels to improve the physical living conditions of the people in developing countries. At the Millennium Summit, the world's leaders resolved to achieve, by 2020, a significant improvement in the lives of at least 100 million slum dwellers (Cossa, 2001). Indeed, Sandhu and Aldrich (1998) note that many governments are paying greater attention to, developing policies, and providing resources for housing. Providing adequate housing for the world's population is a massive long-term task. Moreover, as the Singapore government notes (Mahbubani, 2001):

The management of urban environments can never be more than a work in progress. Practices and policies have to evolve along with the individuals, and the society, that they serve. Adaptability, determination, perseverance and the careful husbanding of resources will continue to be our watchwords in this endeavor.

Individual Countries

Since 1996, Ghana has set up national and local agencies and networks to work towards preventing or minimising the risks of disasters (Bartels, 2001). Mozambique is engaged in the reconstruction and rehabilitation of its devastated roads and social infrastructure. It is also encouraging the populations to abandon areas of risk and move to more secure ones. A National Programme for Environment Management is also being implemented to control environmental degradation and create a local management capacity. In Rwanda, a ministerial decree in January 1997 instructs that in the urban areas, construction should be done only in the surveyed plots (Nkusi, 2001). Bangladesh has taken measures to protect the natural water bodies and to tighten up its planning and environmental laws and their enforcement (Siddique, 2001).

The governments of several Caribbean and Pacific countries have recently adopted legislation strengthening their construction codes as part of a comprehensive mitigation programme following the destruction caused by Hurricanes Hugo (1989), Luis (1995) and Marilyn (1995). In 2000, the Virgin Islands successfully completed a series of hazard mitigation flood control projects.

International Action

Organizations concerned with aspects of human settlements, or economic development in general have adopted disaster management as part of their activities.

UNHSP

The UNHSP is the organization within the United Nations system which works to achieve the twin goals of the Habitat Agenda: "adequate shelter for all" and "sustainable human settlements development in an urbanizing world." It provides advisory services and technical assistance to governments and local authorities to improve their policies and strengthen their institutional capacities. The operations of the UNHSP have the following focus: housing and urban development; infrastructure, water supply and basic services; environmental planning and management, *disaster management*, municipal finance and management, urban safety and security; and participatory approaches to decision-making and planning.

The UNHSP's activities relating to disaster management are undertaken by the Risk and Disaster Management Unit (RDMU) which provides local government, communities and business organizations with practical strategies for mitigating and recovering from conflicts and natural disasters. It has carried out field activities in several countries affected by disaster such as in Colombia in 1999; Venezuela in 2000; and Peru in 2001. From this experience, it is continually refining its approaches and techniques to reduce the vulnerability of human settlements to disasters. The RDMU focuses on: protection and rehabilitation of housing, infrastructure and public facilities; resettlement of displaced persons and returnees; restoration of local social structures through settlement development; land and settlements planning and management for disaster prevention; and creation of co-ordination mechanisms for improved disaster management. Most of the on-going technical co-operation projects deal with human-made disasters, for example, those in Turkey, Venezuela and China.

The Unit also endeavors to enhance knowledge and experience in countries on disaster management in order to promote sustainability and self-reliance. Apart from fielding assessment and technical advisory missions to disaster-prone countries, it assesses demands for support on disaster management and human settlements; designs and implements projects at national, regional and global level in collaboration with countries and support agencies; strengthens co-operation, co-ordination and networking among experts, communities, NGOs, governments and external support organizations in performing disaster-related activities; develops techniques and tools for the management of disaster prevention, mitigation and rehabilitation; and designs and implements training programmes.

World Bank

The World Bank is also involved in disaster management. Its \$505 million reconstruction loan to Turkey is considered “best practice” in this field. It included measures to update and enforce building codes. The reconstruction program will introduce better planning for land-use, and requires compulsory insurance for housing. Emergency response management will also be upgraded. Another example is an initiative in Central America by the World Bank, Inter-American Development Bank and the Japanese government which is assisting six governments in assessing disaster risks, setting up emergency warning and response systems, improving building codes and their enforcement, and carrying out studies to identify environmental measures that would reduce the impact of natural disasters. Finally, in the small states of the Caribbean, the World Bank is supporting efforts to protect power systems, roads and other vital services, improve emergency management, and increase the involvement of the private insurance industry in sharing disaster-related risks.

Boxes 2 and 3 present information on a regular activity, and a recent initiative of the World Bank.

RECOMMENDATIONS

Individual developing countries and regional or sub-regional partnerships of them, are making concerted efforts to achieve peace, stability and socio-economic development with a view to expanding opportunities and fostering greater wealth creation (Bartels, 2001). For example, actions are currently being taken to put Africa on the path to sustained growth and improved living conditions for its people through a partnership among African countries and the international community under the New Economic Partnership for African Development (NEPAD).

Box 2 Disaster Management Facility

An important part of the mission of the World Bank is providing assistance to prepare for and recover from natural or man-made disasters that can result in great human and economic losses. The Bank’s Disaster Management Facility (DMF) aims to reduce human suffering and economic losses caused by natural and technological disasters. It does this by promoting the integration of disaster prevention and mitigation efforts into development activities.

The DMF provides technical support to World Bank operations, promoting capacity building, and establishing partnerships with the international and scientific community working on disaster issues. Its objectives are:

- to improve the management of disaster risk in member countries and reduce vulnerability in the World Bank portfolio;
- to promote sustainable projects and initiatives that incorporate effective prevention and mitigation measures;

- to promote the inclusion of risk analysis in World Bank operations, analysis and country assistance strategies;
- to promote training in the areas of disaster prevention, mitigation and response; and
- to identify policy, institutional and physical interventions aimed at reducing catastrophic losses from natural disasters through structural and non-structural measures, community involvement and partnerships with the private sector.

The DMF fulfils its functions through education, training, support and partnerships. Its key functions include: examining the World Bank's disaster assistance portfolio to extract lessons for future operations; identifying and disseminating of World Bank and other agencies' good practices in disaster management; and offering training in the areas of disaster prevention, mitigation and response.

Source: www.worldbank.org

It is necessary for researchers in construction to help in this effort by developing means for safeguarding the progress made in terms of physical development by protecting them from damage by disasters. However, it is necessary to integrate disaster management into these strategies because as a minister of the Virgin Islands observed after outlining his country's recent progress in socio-economic development and the reconstruction effort following some hurricanes (Corbin, 2001):

But all of these efforts at the national level could be effectively neutralised due to the increasing vulnerability of our islands to natural disasters, in particular hurricanes which have become more frequent and intense as a result of climate change precipitated by excessive greenhouse gas emissions. We therefore fully support a holistic approach to the implementation of the HABITAT Agenda by also integrating the many important recommendations of Agenda 21 and the Programme of Action of the Global Conference on the Sustainable Development of Small Island Developing States (SIDS) into our thinking.

Box 3 Reducing 'Preventable' Costs of Natural Disasters Vital for Developing Countries

In 2000, the World Bank and a coalition of governments, international organizations, private insurance companies, universities, and non-governmental organizations launched the ProVention Consortium to equip developing countries with the means to better cope with natural disasters and reduce the loss of life and destruction they cause.

The main objectives of the consortium are to:

- Promote safety by raising the awareness of disaster-related risks among governments and communities so they can devise effective preventive measures;
- Support public policies that reduce the risk of natural and technological disasters in developing countries by, for example, the integration of prevention and mitigation mechanisms in development plans, the adoption of improved building codes, and more

effective management of both land use and emergency response agencies;

- Develop governments' ability to anticipate, and respond effectively, to disasters when they strike through the use of early warning systems and civil defense.

Three principles guide the consortium:

- Poverty and vulnerability are linked. As poor people are especially vulnerable to disasters, the consortium will assess the links between poverty and disasters as a first step to developing ways to increase protection.
- Environmental protection is key. The consortium will work to protect natural resources such as forests, coastal mangroves, and coral reefs that can protect human settlements from the impact of cyclones and other weather-related disasters.
- Risks can be shared. Because risk insurance is not available to most people in the developing world, the consortium will explore ways of providing low-income groups with insurance cover, safety nets and other mechanisms that reduce individual risk by spreading it wider.

Source: www.worldbank.org

The need for capacity building in disaster management with respect to the built environment in developing countries cannot be overemphasized. All the components of construction industry development highlighted above require attention from the national governments and local construction industries. Also needing immediate attention is the reform of regulations and codes, and their enforcement frameworks. The experience of the UNHSP would be useful in these regards. This effort would also benefit from financial and technical assistance from the World Bank, such as under the ProVention initiative.

There is the need for research and development (R&D) on various aspects concerning the relationship between disasters and constructed items, including: the changing patterns of the causes of disasters and their implications for construction; appropriate design in response to local knowledge on the impact of disasters on constructed items; and suitable construction materials and methods which enhance the capability of constructed items to withstand disasters. International best practices on these issues should also be compiled and disseminated. The UNHSP could lead this effort. The R&D would be informed by data on disasters. Thus, it would be suitable if such data were included among those which are collected on a routine basis and reported under the Global Urban Observatory (GUO) which monitors global progress in implementing the Habitat Agenda and monitors and evaluates global urban conditions and trends.

There is the need for a change in the mindset of governments, international agencies, companies and practitioners to recognise the need to assess the risks of disasters and take necessary precautions at all stages of the planning, design and construction processes. The professional institutions and trade associations should enhance the awareness of their members in these regards. It would also be useful if they could provide the practitioners with checklists of appropriate actions for various disasters which might happen locally. It is also necessary for the curriculums of

professional programmes to be redesigned to cover the relevant aspects of disaster management.

There would appear to be some commercial merit in some construction organizations developing a rapid-response capability in order to attend to post-disaster reconstruction in developing countries. In the medium-term, some thought should be given by the CIB to the formation of a volunteer team of practitioners for the same purpose.

CONCLUSION

The need to provide the construction industries of developing countries with the capacity and capability to prevent disasters, both natural and man-made, is clearly evident. Actions at the national and international levels are required. In many cases, the necessary interventions are simple and relatively inexpensive measures and precautions. It is important to enhance knowledge on the linkage between good planning, design and construction and disaster prevention and management. A key missing element is awareness among practitioners. The best place to start is at the universities, through appropriate curriculum design and delivery, as well as continuing professional development for practitioners.

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