Urban Design and Hazards

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Tornado damage, Xenia, Ohio

Despite the technological advances of the twentieth century, damage and life loss caused by natural disasters continue their unrelenting increase. Due to the rapid acceleration of urbanization, augmentation of industrialization, pressures of population growth, and accompanying effects of urban sprawl, expansion is taking place into areas which are more difficult to develop safely than those of past decades. Coupled with population increases in major metropolitan areas, many urban regions are becoming more vulnerable than ever in their exposure to natural disasters. On a projected annualized basis under 1980 conditions, it is estimated that the total cost of losses due to the occurrence of natural disasters in urban areas within the United States will approach $12 billion, representing quite a drain on the national economy.

The potential for a major urban catastrophe increases dramatically as more and more of us tend to concentrate in areas of known risk and exposure to natural hazards. For example, urban planners expect that by the year 2075 more than 20 million people will be located in the corridor area stretching from the San Francisco Bay Area to Tijuana on the Mexican border—one of the greatest seismic risk zones in the United States. A severe earthquake in this area would severely tax many resources of California by disrupting regional transportation, resource distribution, and communication systems in addition to causing life loss, economic forfeiture, and social dislocations. In 1973 the National Oceanic and Atmospheric Administration (NOAA) and the Federal Disaster Assistance Administration (FDAA) issued "A Study of Earthquake Losses in the Los Angeles, California Area" which indicated that a 7.5 magnitude earthquake along the Newport-Inglewood Fault, which runs through the Newport Beach, Compton, and Inglewood areas of Los Angeles, could result in a six-foot horizontal ground rupture along the fault and about two feet of vertical displacement. A hypothetical 7.5 magnitude earthquake on the Newport-Inglewood Fault occurring during the 4:30 PM rush-hour period, when many persons who previously occupied offices and other places of employment would now be on the streets, resulted in over 20,000 deaths and 80,000 hospitalized injuries. Control tower and terminal building damage would be expected at the Los Angeles International Airport, with surface access to all airports in the area restricted due to damaged freeways, impaired streets and collapsed overpasses.

Although the preceding emphasizes the impact of a major seismic event on an urban area located in the western United States, it must be realized that other regions in the country are equally susceptible to severe disruptions caused by earthquakes and other natural hazards. It is not a problem faced solely by the West Coast, for other major metropolitan areas in the nation are subject to hurricanes, tornadoes, floods, and urban conflagration as well as seismic activity, with equal magnitudes of life loss and property damage projections.

Table 1: Casualty & Loss

NATURAL DISASTER CASUALTY AND PROPERTY DAMAGE LOSS STATISTICS ON AN ANNUALIZED NATIONAL BASIS

Hazard	*Injuries*	*Life Loss*	*Prop. Damage in Millions of $*
Hurricane	6,755	41	448.7*
Tornado	2,091	124	180.0*
Flood	610	62	388.5*
Earthquake	112	28	102.7*
Fire	(N. A.)	6,300	4,008.0**
Totals:	9,496	6,555	5,127.9

Notes: *computed on a 3 to 5 year average period, 1975 costs.
**computed for 1978 data at 1978 costs. Includes fire of all causes.

Sources: Federal Disaster Assistance Agency (FDAA), Washington, D.C. National Science Foundation, Washington, D.C., The Greater International Disaster Book, Simon & Schuster, New York, N.Y., Insurance Information Institute, New York, N.Y., U.S. Department of Commerce, Washington, D.C.

Table 1 represents a partial listing of loss resulting from five representative natural hazards common to various regions in the United States; an indication of the severe tolls taken by natural disasters throughout the country in terms of social costs and economic disruptions. Table 2 lists the expenditures in the 1974-79 period for major disasters paid out of funds from the President's Disaster Relief Fund for "declared national disasters" and "emergencies" which overwhelmed capacities and resources of local and state governments in the affected areas. These figures represent a fraction of the total disaster costs as they only reflect costs contributed to disaster relief activity by one component of the federal government.

Urban Design

Historical evidence indicates that some simple urban planning and design principles conducive to the mitigation of outside threats and natural hazards were utilized in the development of Medieval and Renaissance cities. There are several notable examples of urban form being determined by hazards reduction motivations in which the entire three dimensional characteristic

of the city was modelled to produce optimum shapes for the mitigation of dangers to public safety. The walled cities of western and eastern cultures are but one manifestation of design attempts to form the city itself as a protective envelope. The "star shaped" fortress cities designed during the early pre-Renaissance periods represent another approach. In Stephen Tobriner's article elsewhere in this issue, examples are given which illustrate that many cities planned in the late 17th and early 18th centuries were specifically designed to mitigate losses of life and property in the event of an earthquake. A more recent example is found in the reconstruction of the city of Skopje, Yugoslavia, which was severely damaged by a major earthquake which struck the area in 1964. A "blue ribbon" international planning and design team was assembled by UNESCO to redesign the entire urban center of Skopje in recognition of the latest earthquake hazards reduction programs available. Again, height limitations and urban open spaces were utilized to limit the risks and exposure associated with seismic events.

In the United States, the form and patterns of today's cities are not arbitrary. In some cases their layouts may be unintentional or void of any consciously applied urban design and planning decisions models, but they are not accidental. Specific districts in existing urban centers of major metropolitan areas, such as Tokyo with a population of 20 million, are probably products of decisions made for single, separate purposes with physical relationships never consciously designed or even considered on a large scale. Even more revealing is the fact that the improvement of the urban environment through its physical design can be as elusive as the ultimate fulfillment of community expectations and aspirations. However, if the risks or benefits of hazards mitigation programs are to be identified and assessed, it becomes necessary to approach the problem from directions other than those used in the immediate past. Although the abstract, design quality of the built environment should never take precedence over social, ecological, economic, and public policy objectives, it should be recognized as part of the entire process that is necessary for the achievement of appropriate linkages, patterns, and forms which define a viable system.

Discounting early site selection activities which precede development of the general plan and land use management considerations, a growing awareness of the unique environmental characteristics of a region must be developed in order to identify those situations which can exacerbate or diminish the risks to which a community is exposed. Certainly, the study of hazard reduction objectives which could be achieved through urban planning and design strategies would represent a significant expansion of options available to us in limiting natural disaster losses.

Table 2: Federal Disaster Spending

Expenditures for Major Natural Disasters
from the President's Disaster Relief Fund 1974-1979

	Expenditures in Millions of $					
Disaster	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*
Hurricane**	4.0	—	53.1	—	1.9	267.0
Tornado	53.7	22.2	11.4	1.3	19.8	108.1
Flood*	130.1	153.5	105.5	348.1	240.5	89.9
Earthquake	—	0.9	—	—	—	10.1
Totals:	187.8	176.6	170.0	349.4	262.2	475.1

Notes: * Includes heavy rains, snowmelt, flash floods, severe storm and coastal tidal surge.
** Includes typhoon.

Source: Federal Disaster Assistance Agency (FDAA), Federal Emergency Management Agency (FEMA), Washington, D.C.

Urban planning and design strategies developed in conjunction with natural hazards reduction programs are simply a reiteration of Ian McHarg's "design with nature" philosophy. How we can conserve the built environment requires that we design with nature as a matter of survival. Some of the urban patterns seen across the country today appear absolutely ludicrous because they do not exhibit any expressions of accountability to the forces of nature which, at times, can be most destructive.

Microzonation techniques which pinpoint hazardous areas in localized regions through mapping procedures is an initial, potentially important tool that can be used by design professionals to identify the vulnerability of urban areas to natural hazards. Maps generated by microzonation techniques can serve as one of the determinates of the overall configuration of land use policies in metropolitan areas. Such maps may be used to provide essential information which urban planners and designers need prior to presenting recommendations to local government authorities. It is essential that these maps be prepared on a uniform basis by utilizing common techniques for interpretation on a nation-wide basis. Their use should make it possible to investigate alternative options and would allow for their analysis on a realistic basis for maximum benefit in defining hazards mitigation strategies.

Computer simulation of natural disasters can also be a tool for planners. Simulation models have been developed for disaster mitigation purposes which realistically reveal hazard and risk patterns.

There is ample evidence that planning and design strategies which create urban environments of high quality are also compatible with hazards reduction objectives. The proper distribution and utilization of structures with interior courtyards, urban open spaces, extensive yards, comprehensive environmental landscaping, wide roads, appropriate use of land use management techniques and building materials can reduce the risk of natural hazards which continue to jeopardize urban centers. As responsible members of our professional planning and design associations, we must assume leadership against counter-productive physical planning measures even when they have been determined by entrepreneurial or political expendiencies. If this leadership role is not taken through design education, research initiatives, or professional practice, it then follows that there is little justification or meaning to planning and design education at the urban scale.

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