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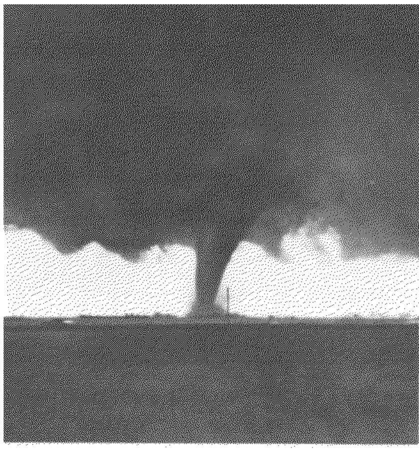
INTRODUCTION



The complexities of today's society make it more essential than ever for us to continually re-evaluate our priorities and establish new ones At the same time, they make it infinitely more difficult to do so.

Yet—regardless of who is doing the prioritizing—the manner in which most individuals and institutions make such value judgements often isn't much different than it was before any of us first heard of "risk/benefit analysis," "accountability," "tradeoffs" or "cost effectiveness."

When a loved one dies of cancer, it's suddenly our crusade. When enough cities suffer enough flood damage, dam building and flood insurance become the priorities of the day. And when a sufficiently devastating number of landslides occur, at least local building codes are likely to be strengthened and enforcement procedures tightened.

In the case of our most destructive natural hazards, however, there's mounting evidence that such an opportunistic approach is no longer either practical or acceptable.

Hazard Costs Great

According to one expert, the 30 most common natural hazards annually account for direct costs of at least one percent of our gross national product and countless millions of dollars more in related ones. Sizeable expenditures are being allocated for controlling them by government at all levels and by the private sector Nevertheless, the costs are continuing to grow at an accelerating rate There are some indications, in fact, that a few efforts targeted at minimizing or preventing them may, in the long run, lead to even greater losses

Unless fundamental changes are made, the annual cost of destruction from these hazards—even after discounting for inflation—will go up over 85 percent between 1970 and the year 2000 Further, in a not-too-far-fetched scenario based upon past history, a Chicago tornado, a Los Angeles earthquake or a Miami Beach hurricane would represent a disaster of unparalleled proportions. If two or three such events were to occur within a couple of years of each other, the toll, in terms of lost lives and impact upon our economic system, could well be catastrophic

NSF Grants Made

Recognizing the implications of this, in July, 1975, the National Science Foundation made two grants to the J. H Wiggins Company of Redondo Beach, California, and added a third in September, 1976 The firm was charged with responsibility for development of forecasts associated with our most destructive natural hazards which could be used as a basis for establishing research priorities and public policy directions. The principal study reports are listed in the references to this document

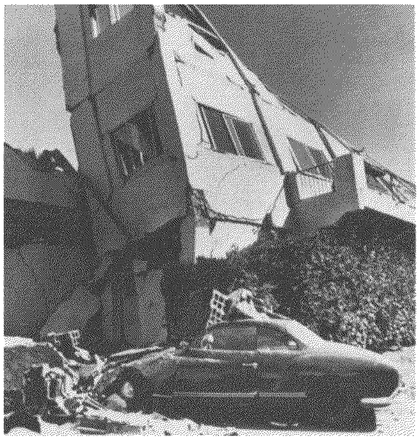
Because the studies were limited to building damage and related losses, the nine hazards examined were selected in recognition of their historic impact on such structures. They are earthquake, landslide, expansive soil, hurricane wind/storm surge, tornado, riverine flood, local wind, local flood and tsunami

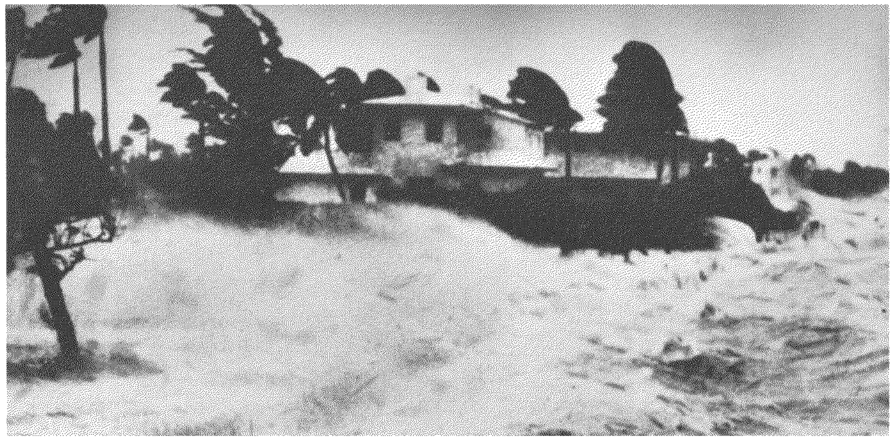
The first phase of these studies, summarized in this document, deals solely with damage to buildings The second, which is referenced, addresses other types of losses known to often increase the impact of a hazard many-fold Covered in this second phase are building contents and income losses, transportation effects due to dislocations of suppliers, homelessness and unemployment, as well as costs of applying certain mitigations.

Each of the hazards was first modeled and programmed on computers to provide estimates of annual and, in some cases, sudden catastrophic losses which might impact upon the nation's building wealth between 1970 and 2000 Computer modeling also was applied to various mitigations which conceivably could be developed and implemented to reduce loss. Potential loss reductions were then projected and evaluations made on both state and national bases.

New Models Created

Because only fragmentary information on the relationship of these hazards to economic loss had heretofore been publicly available except in the case of riverine flood, it was necessary to construct eight all-new models. Even the existing flood model failed to identify or project past losses by region, requir-





ing Wiggins to substantially expand it. A vital first step in the studies, therefore, was to estimate as accurately as possible the building losses which might have been caused by recorded past events, to provide a basis for forecasting the future.

It is likely these estimates are low in many instances because portions of the models often were based upon projections from loss experiences which frequently were inaccurate or incomplete Annual average flood losses, for example, are "officially" estimated to be less than half of what most experts agree they really are The official damage estimate within one subdivision, made just after the 1971 San Fernando Earthquake, later proved to be less than 10 percent of a later, more detailed conservative count, according to D. Earl Jones, Jr., of the Department of Housing and Urban Development.

In the case of wind, for which no base line figures existed, damage estimates were based on expectations of a panel of recognized experts who considered wind velocity and varying building strengths. Their assessments are considered to be at least as reliable as any previously available data

Many Variables Excluded

Many variables associated with each of these hazards were reluctantly excluded from the models because it was impossible to measure their influence on a long-term basis. It was impractical, for example, to determine how much more vulnerable areas which are sinking, due to water and mineral extraction, will be in future years to storm surge and riverine or local flood.

Using the completed models, the natural hazards were ranked to show both average annual loss expectancy and the potential for sudden catastrophic loss in a state or region.

Several Scenarios Created

A number of scenarios of extreme events—such as the potential cost if the 1906 San Francisco Earthquake reoccurred in 2000—were also modeled to provide additional perspective. This was felt to be necessary because potential sudden earthquake losses might well be from five to 20 times greater than those from the largest forseeable flood, even though reported annual flood losses have been from 10 to 25 times greater than losses from earthquake during this century.

With the development of computer models which include the hazard-exposure-vulnerability components of risk, it became feasible to estimate the effectiveness of various mitigations for reducing average annual and sudden catastrophic losses.

It is the intent of these studies to reveal primarily the percentage by which damage might be reduced if some of the most frequently discussed or more promising mitigations were to be applied. It is hoped this, in turn, will facilitate the establishment of research and budget priorities on a more educated basis than has to date been possible. It is always conceivable, however, that once under way, research will take unanticipated directions and uncover effective, but as yet unknown, mitigations.

It should be further noted that the potential benefits from reducing losses caused by one hazard often will reduce the impact of others. For example, employment of mitigations which increase a building's resistance to earthquake will often improve its ability to resist damage from tornado, high wind, various kinds of soil movement and landslide, which together cause annualized damage in excess of $6 billion

1978 Dollar Values

All of the monetary values cited in this study are in terms of 1978 dollars No attempt at forecasting inflation has been made.

It is hoped this document and the far more comprehensive studies it summarizes will help point the way to identifying research priorities, budgetary allocations and public policies targeted at effectively dealing with a significant national problem. It is essential that meaningful steps be taken during this decade to reduce the increasingly devastating losses America faces from earth, air and water related hazards.