EARTHQUAKE SCIENCES AND CITY PLANNING ARE STILL DISCONNECTED[1]

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It is our conviction that if city planning, and regional planning, are to contribute to disaster prevention or "mitigation", the starting points should not be in city or regional planning, but planning principles should be derived from geophysics, tectonics, structural engineering, relief and rehabilitation operations, and certain social processes. This raises the question of evaluation of each field in itself, and also the contributions they should be making to each other. In this paper the "input" from structural engineering to city planning, and certain internal characteristics of city planning will be emphasized over other relationships.

One main reason for this is that there is not a general usage at the present to rely on geophysical data for location decisions, without first having them "translated" and transformed through structural engineering.

Of the disaster phases, "prevention" and preparedness will be implicitly emphasized over relief and rehabilitation periods, even if it is clear that at the present city planning gains most significance at the rehabilitation phase, and that its major decisions are forced and formed in the relief phase. Instead of inquiring for more input from relief workers and social scientists, I prefer to leave the question open for them to express whether they see any significant role for city planning, and if so, in what phases, details, or "functions".

Still more important, do any of the earthquake sciences see the contribution of city planning through land use controls, should lifeline planning and investment be expressed through city planning, should administrative difficulties be coupled to it, or if it is to be seen mainly as a social process, could it be a good way of coordination with respect to hazard, risk, warning, disaster psychology, and relief?

The Main Thrust of Engineering Research

Japan, and the State of California possess institutions which engage in the broadest front of research with respect to earthquakes. However, much of the structural engineering research in these two leading centers seems to be removed from a broad front approach.

In California and in Japan the building codes appear to have had more success than in other areas as seismic counter-measures. Engineering practice itself may adopt new counter-measures more speedily than in other regions. In the recent, and relatively speaking, not major earthquakes of these two regions several new types of failure are analytically isolated after each earthquake. Structural engineering then addresses itself to these questions.

This type of approach neglects two major aspects of the matter: 1) site effects are not considered either statistically or analytically; 2) engineering solutions are developed which in no way can be extended to the world regions which suffer the heavier blows, nor to the structures which are likely to be built in these regions, nor to the social structures and levels of income they are likely to possess.

In my own country, in the most recent interchange between structural engineers and city planners (geophysicists also being present), the rather enlightened engineering attitude was that seismic counter-measures should be stated in terms of soil-structure interaction. Let us first observe that very few elaborate or even concede this point. Even if this is conceded in the Turkish circles, the problem still cannot be stated very much in locational or urban planning terms.

In micro-zoning approaches, which seem to have been abandoned by certain circles but are very much alive in others, it was assumed that rather small differences in the physics of the soil would lead to differences in seismic coefficients, in height and other characteristics of buildings, and particularly in construction costs.

If these various factors are taken together, and then compounded by problems of political process, social structure, control and implementation, micro-zoning and structural engineering seemed to be mainly expressible in city planning. On the other hand, even in the engineering approach which emphasizes soil-building interaction, less-than-major differences in soil physics are considered per project, and disregarded as classes of phenomena and hardly given a place in generalized research. Only the following extreme cases are constituted as classes: liquefiable ground, very soft soils, marshes.

In this type of engineering research, it is nearly impossible to follow consequences in overall costs and in incremental costs associated with any seismic coefficients. In this way the problem of costs escape comment from social groups which pay for them, or even groups which make large-scale decisions.

Urban or regional planning will have little contribution to disaster prevention measures under these circumstances, and consequently less incentive to overcome the shortcomings in their own fields.

The above exposition may be related to the experiences of the preceding several decades. At least two of the other parallel attitudes must be cited: increasingly abstract character of structural research, and neglect of the treatment of existing buildings.

Advanced structural research contains two opposite tendencies, among others. In the case of anti-seismic measures in nuclear power plants, the seriousness of the question and the relatively large funds available

make possible attention to detail and to interaction among elements. But, for nuclear plants again, and in general, there is a tendency towards increasingly abstract structural problem-positing.

In the case of the most destructive recent earthquakes, however, (Tangshan, Ciudad de Guatemala) as well as in other isoseismal microzoning work (Kumamoto) there is ample evidence that: 1) intensity measurements may be more affected by urban district than by type of structure; 2) more effort should be spent on the design of statistically predominant, "mediocre" buildings than on specialized types; and 3) more effort on strengthening or retrofitting the existing buildings than on new design[Liu and Zhang, 1980][Husid, 1980][Migita and Tanaka, 1980]. (These conclusions are ours and not those of the authors cited).

In essence and outcome for the present, then: the modal response to earthquake disaster mitigation is in the field of engineering, and tendencies towards purely structural responses not specific to sites will keep land use and/or preventive measures at uninformed and ineffective levels.

Significance of Specificity in Urban Sites

Few researchers remember that the rural areas suffer most from earthquakes. The larger cities still hold our attention most. If we should follow such a line of emphasis in this paper, the following will have to be pointed out:

1. In spite of all attempts at prediction, and our predilection for extrapolation, disaster strikes larger cities in unexpected places. Tangshan and Skopje are good examples. (Very few areas, such as the Central San Andreas fault, show any regular tendencies for a given period; if we observe other consistencies, they are over much larger areas.)

2. This suggests: a) an emphasis on predictive methods other than extrapolation for most parts of the world, especially if we wish to have our predictions in terms of location; b) more research on the effects of hypocentral distances per characteristic region; and c) less tendency to reduce causality to a single factor.

3. Improvement in predictive techniques should make many of the counter-measures expressible through city planning, especially if we keep in mind that it may be a way of concentrating supervisory or financial resources in certain areas and sub-areas.

4. In the absence of great improvement in predictive techniques, emphasis in city planning should go to existing settlements and their structures and roads and public services, and to minor rather than exhausitve intervention.

5. In the absence of more precise information input from structural engineering with respect to zoning of sites, reinforcement or retro-fitting of existing buildings will be closely allied to city planning, if not necessarily through investments, at least in terms of constituting alternatives to density decisions, or lifelines planning.

Discrete Observations on Site-Specific Research

1. The value of insurance is emphasized in various countries (U.S.A. [Sauter, McCann, and Shah, 1980] [Steinbrugge, Lagorio, and Algermissen, 1980]; U.S.S.R. [Koridze, 1980]), while it is not in others (Turkey and other countries respond by government rebuilding), and it cannot be considered a preventive measure such as city planning may become. While earthquake insurance is not widely purchased in California [Steinbrugge, Lagorio, and Algermissen, 1980] it seems to generate some funding for site-specific studies [Lev, 1980][Steinbrugge, Lagorio, and Algermissen, 1980]. Lev points out that unless information on site and other matters is detailed disaster response will be weak.

2. Even though there are attempts at definition [Lev, 1980, p. 257] [Kung, 1980, p. 98], the concepts hazard, risk, vulnerability, etc., remain fuzzy throughout the literature, especially with respect to site.

3. Parameters used in seismic risk analysis until now, and strong ground motion models raise doubts, at least in certain quarters; the impact of earthquakes on "spatially distributed systems" will be studied [Shah and Gere, 1980, pp. 133-134].

4. We must keep in mind that most of the available site-specific or zone-specific knowledge is in the form of post-earthquake iso-seismal contours. In these it is impossible to correlate precisely magnitude, intensity, strong ground motion and finer parameters. This information is further useless in practical terms for these particular epicentral zones for a long time to come, and as research goes now, no possible lessons could be drawn for other regions. It is furthermore noted that isoseismal contours are far from providing "site-by-site preciseness" because of the smoothing-out process [Ohta, Goto, Satoh, Ergunay and Tabban, 1980, p. 402].

   The need for Local Effects Arrays is recognized by the International Workshop on Strong Motion Earthquake Instrument Arrays Workshop [Iwan, 1980].

5. While even empirical research shows much tendency toward structural abstraction, the importance of site-specific research is more or less recognized, and as a minor item, only in the larger institutional programs (Berkeley, Livermore Laboratory, U.S.A. National Bureau of Standards, M.E.T.U., etc.) [Penzien, 1980] [Leydendecker, Harris, Wright, and Pfrang, 1980] [Tokarz, 1980] [Germen, 1980]. This may range towards spectral study (Livermore Laboratory), or by implication, attenuation relationships (Berkeley/Taiwan; M.E.T.U.). We find it very instructive to note the present chasm between this research, and the gross rigidities of classification adopted when governments have to produce building codes, or insurance institutions have to establish risk classess.

Discrete Observations on City Planning

1. There seem to be no grounds at the present for generalisations on "proper" planning measures against earthquakes. The cities and

their districts need case by case attention. In the absence of clear prediction or definition of risk, which will apparently change from region to region, our attention will have to focus on selection of priority for measures, case by case.

2. City planners should be rushed into disaster areas not only for reconstruction planning, but for observation and for developing new analytical approaches.

3. Perhaps a good deal of the effort now spent on prediction methodologies should be diverted into totally new instrumental techniques for zoning and micro-zoning. If new avenues are explored the need for highly precise prediction would be circumvented, and the uncertainties in risk analysis clarified.

These remarks may be derived from the preceding observations. Now certain other remarks about the field of city planning itself.

4. It is perhaps for other disciplines of prevention and mitigation to decide whether city planning is enmeshed with their own and other activities, or their activities could be better performed independently, as a "vertical" operation.

5. Some of the information input necessary for city planning is not going to be available at the present.

6. Some others are simply not thought about, or stated. This may often be the case in preparedness, relief, etc.

7. City planning and reconstruction constitute the major response by far of most countries to earthquake disasters. Furthermore, and for example, a more swift response than others in Turkey: new town "ready" in six months, reconstruction finished in three months on a sub-region, city planning teams on site one half day after the disaster.

But this significance accorded to city planning, for which ends, which results? Is there much that is satisfactory in the response we show to earthquakes?

To make city planning more useful, I should think that pressure on governments should come from the fields of preparedness and relief, if they should in turn deem that it can contribute to their fields.

8. Since city planning seems to be ineffective as a prevention or mitigation measure in its normal operation, special pressures should be exerted for another mode of operation in disaster areas.

9. The developments in city planning are not sufficiently transmitted to the "earthquake sciences": there are not enough planners concerned with this purpose, and there are few takers on the other side.

10. In the country where we are meeting, there has been lively controversy over recent practices in city planning. How much of this has percolated into planning discussions on disaster prevention and mitigation?

11. Are the dominant urban models of the twentieth century suitable for earthquake response? Many fields associated with disaster prevention, including town planning itself, seem to favor use-exclusive urban zones. This attitude has not only the backing of some three centuries of Anglo-Saxon Law, half a century of CIAM and functionalism, 15 years of Turkish sociology, but also the building of many cities to show, including New Zagreb, and the argument that mixed uses will lead to secondary disaster effects. On the other hand city planning and architecture have taken to other directions. More important, can we or should we proliferate cities without mixed uses?

12. In recent engineering work there are tendencies to find previous conclusions as too "conservative" (running in the direction of larger safety factors and therefore, costs). [Hintegraber and Jungmann, 1980] [Tokarz/Livermore Laboratory, 1980]. These findings may have only very remote effect on city planning, but provide a parallel. In much of the existing planning wisdom interchanged between the professions concerned with disasters, the proposed city design uniformly emphasizes very wide streets, low gross densities, thorough "modernization" and new construction, new towns, all of which amount to much conservatism in the same sense.

FOOTNOTES

1. This paper is not intended to be exhaustive in its scope. Quite to the contrary, I have tried to exclude subjects and arguments developed in the paper submitted to the 7th WCEE September 1980 [Germen, 1980], in the booklet prepared for UNDRO in 1975-1976 [Germen, 1976], and in other previous work.

   Instead, Volume 9 of the Proceedings of the 7th WCEE was surveyed thoroughly for the new developments. All references are to that volume. Other material recently available to the author will not be explicitly referred to.

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