KEYNOTE PAPER SUBJECT AREA 4: PROGRAM IMPLEMENTATION

'THE PROOF OF THE PUDDING...'

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ABSTRACT

A 200 year old successful case study introduces a review of research work and aseismic adobe housing projects. Problems are identified including the gap between 'Thinkers and Doers', and cover the social/economic dimensions of improvement projects. Finally, nine priority themes are suggested which are concerned with bridging gaps between technology and social factors, privilege and poverty and the research and field context.

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Inventors, innovators and reformers are by nature an optimistic breed. They have to be, since their memories or filing cabinets are loaded with brilliant solutions that remain dormant, a part of the vast residue of unapplied knowledge. A good idea is one thing, but its application is another matter altogether. The gap between the two is so commonplace that most languages have sayings that enshrine the difference between theory and practice. There are for example a couple of English sayings that use the analogy of food - 'The proof of the pudding is in the eating'. Another describes the gap that exists between two processes of a single activity - 'There's many a slip betwixt (or between) cup and lip'.

Therefore the organisers of this workshop have been very wise to place a major emphasis with a substantial allocation of time devoted to the problems of implementation (Subject Area 4) as well as the all important social, economic and cultural aspects (Subject Area 1). If this workshop achieves nothing else (which is hardly likely) it will have established a new model for future consideration of aseismic design principles with this priority concern to bridge the divide between theory and practice - a division that we might well describe as a man-made 'fault-system'.

It is my task to briefly examine the gulf between the thinkers and the doers, as well as to review some of the work currently in progress, to suggest an approach to the problems that are presented and identify, or possibly reinforce (to use a particularly appropriate metaphor) the themes to be considered in this workshop.

As an introduction to these topics I want to pay tribute to an unsung hero of aseismic design. A Portuguese military architect, Manuel da Maia, advised the Marques de Pombal on the reconstruction of Lisbon after the 1755 earthquake. Da Maia may well be the first man to systematically analyse the changes needed in urban planning or building construction to resist earthquakes. He was also fortunate to see his reforms implemented in the rebuilt Lisbon.

These innovations have been identified in a recent excellent study by Stephen Tobriner (1). Da Maia, and his colleagues started off in a predictable manner with advice to Pombal that Lisbon be relocated. The negative response was equally predictable, and so they then suggested that all streets be widened in a newly designed city on the same site. The landowners said 'no' and therefore a compromise had to be reached. It was decided to redesign the worst affected area of the city centre known as the 'Baixa' whilst keeping the existing plan for the remainder of the city. FIG 1.

The architects made two proposals for the design of new buildings in the city centre, neither of which was implemented for reasons of expediency. The first was to limit all buildings to two stories, and the second was to ensure that road widths were the same dimension as the height of adjacent buildings to ensure there were safe escape routes. Then turning to the buildings the architects proposed that their design be modified according to aseismic principles. They suggested a radically new construction system which substituted a timber framework, a form of cage called a 'gaiola' for the pre-earthquake masonry system. This provided various forms of bracing to resist seismic ground motion, consisting of a form of stiffening at each corner, as well as cross bracing within the framework. Integral with this internal frame the engineers incorporated the external masonry cladding which was carefully mortared at its joints and attached to the internal timber cage. FIG 2

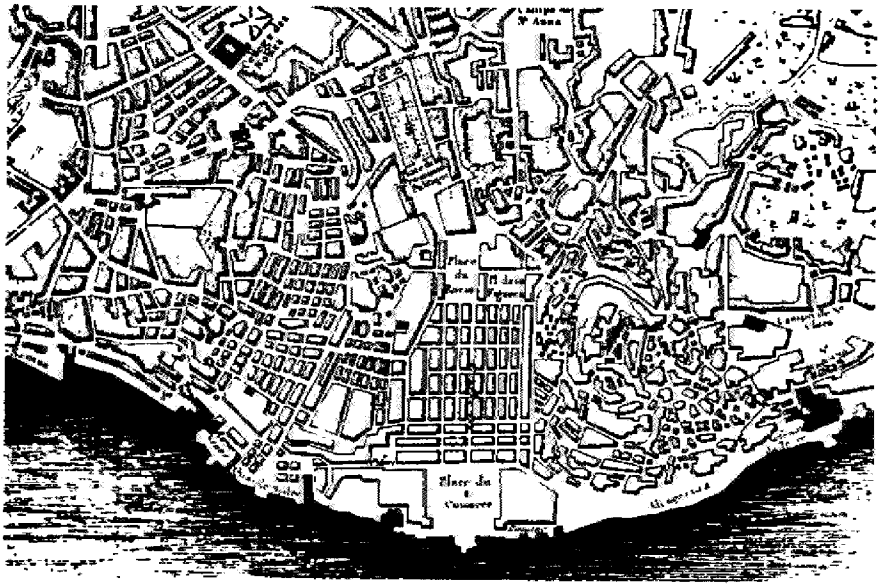

FIG 1. Map of Lisbon indicating extent of post-earthquake formal planning

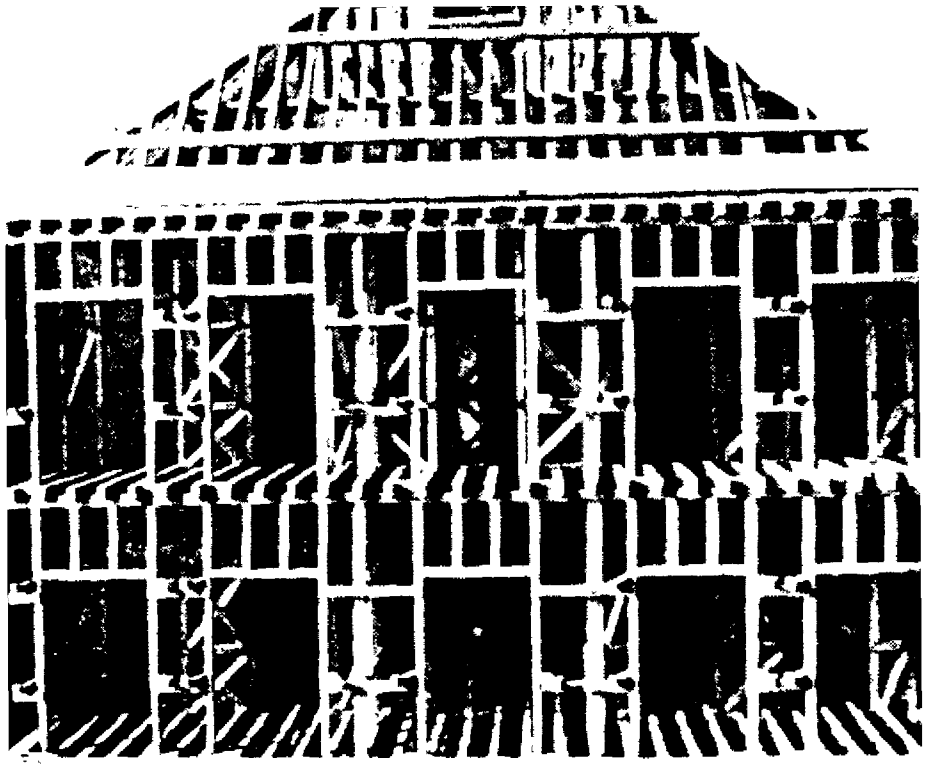

FIG 2. Model of 'Gaiola' indicating the aseismic timber frame prior to masonry infill

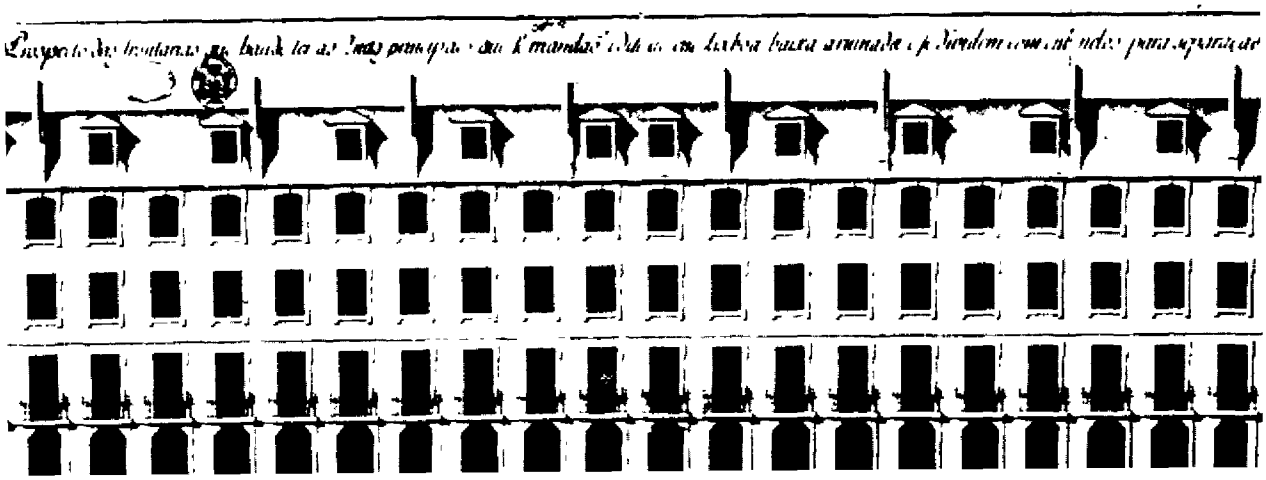

FIG 3. Elevation of reconstructed terraces indicating the fire breaks on the roof

A further mitigation device was the decision to incorporate masonry fire breaks as divisions between buildings. This was to prevent any recurrence of the fires that accompanied the 1755 earthquake. FIG 3.

No major earthquake has occurred in Lisbon since their disaster to test the overall effectiveness of the system, but the absence of any major fire is a tribute to the fire break system. Da Maia's form of construction was adopted as the normal way of building in Lisbon and persisted right up to the 1920s. There are a few pertinent lessons we can draw from this case study which are relevant to my theme. Firstly, the process of implementing aseismic design measures is by definition one of compromise; some battles may be won but others will be lost given the nature of vested interests and other priorities. Da Maia was sufficiently astute in political skills to recognise this reality in the way he presented his set of proposals.

Secondly, the modification proposal to improve the seismic resistance of traditional buildings was very subtle. The existing form of masonry building was preserved despite a totally different constructional system. Had the architects suggested a 'natural' expression of the timber cage (on the lines of an English half-timbered house) it would probably have been doomed to the dead storage drawer of an 18th century filing cabinet.

Thirdly, the implementation of the proposals was backed up by political power of Pombal. Without his absolute centralised authority it is doubtful if the reforms would have been carried out.

To summarise the lessons from a case study $2\frac{1}{4}$ centuries ago, we can see that the reasons why the modifications occurred were due to four factors: The fear of another earthquake (the city experienced no less than 500 aftershocks and 30 major tremors in the year after the earthquake); the centralised power of Pombal; the skills of the architects, and the subtlety of their proposals. And the entire process was one of compromise, the city was <u>not</u> moved, it was <u>not</u> totally redesigned and the existing architecture was <u>not</u> changed in appearance.

Of course there is a major question mark about the social implications of redesigning the street layout for the central area of the city, who gained and who lost in the process. The slender evidence suggests that the ruling property owning classes of Lisbon came out reasonably well and if anyone suffered it wasn't them. Thus a dilemma is posed. Are major planning reforms on aseismic, or any other grounds <u>ever</u> achieved without the most disadvantaged groups suffering the adverse consequences? In effect do ends justify means? Put another way, is the centralisation of power a prerequisite for major planning changes, and if so what likelihood is there within liberal democratic societies of such policies, however beneficial in the long term, being implemented?

This case study of Lisbon is instructive since it contains many of the ingredients of 'modification programmes' as we now come to know them. The two most basic elements were the linkage of knowledge about seismic factors with a sound understanding of building construction, and secondly the ability to implement the measures to reduce the risks, or put another way political determination.

The implementation of programmes to modify humble adobe buildings in seismic areas is a far cry from the proud avenidas of Lisbon, but as I hope to show later there are important points of similarity.

REVIEW OF WORK IN PROGRESS

1. Research Work

Keeping the theme of 'thinkers and doers', I want to review both some current research as well as certain implementation programmes. Then in specific instances the gap between the two has been happily bridged where research has lead to an implementation programme or has followed it as a form of evaluation.

One danger I can see in attempting this task is to confine my attention to projects that are strictly concerned with adobe in earthquake areas. This blinkered approach will ignor housing modification programmes concerned with other hazards such as designing against flooding or high winds. The dilemma is of course that in expanding into this sector this paper will be too long and lose its focus. Therefore, I want to identify some of the key literature under the following references for those anxious to pursue this study: (2,3,4) However, I am aware of the broad conclusions from some of these non adobe, non earthquake programmes and have taken these into account in my broad findings.

An additional aspect of this problem is that with knowledge being so compartmentalised, it is apparent that important lessons on attempts to change traditional patterns have a far longer history in certain disciplines than in the one under consideration. For example the field of nutrition has an extensive literature on attempts to improve the traditional diet of people suffering some form of nutritional deficiency. I understand that the broad results from these studies are sadly negative with strong evidence of failure of various attempts to introduce these changes. It is also apparent that this failure has occurred in both Third World countries as well as in industrialised societies. Numerous examples could be cited from developing countries, for example in the Phillipines the local families ground their rice so finely that the rice husks were destroyed. These contained Thiamin which is an essential vitamin source, without which people became vulnerable to the fatal disease of Beri-beri. Therefore in an attempt to rectify the deficiency, nutritionists attempted in vain to supplement Thiamin in pre-mixed grains. In Britain a well documented example was an attempt to persuade school children to increase their milk consumption. Despite intense advertising, no progress whatsoever was made. So any lesson from nutritionists must be that rapid results are unlikely to occur, despite the logic that lives may be saved by a change of habit.

I will start with a review of some of the research which is particularly relevant to the subject area of implementation. One section of this work is in the category of training programmes for builders concerned with the development of labour intensive traditional ways of building using local materials. Work in this area has been eratic and largely uncoordinated, and has of course been continually handicapped by the forces of 'modernisation' of cultures, where pressures from both within and without have consistently undervalued local traditions including building skills. One of the main areas of work has been that attempted by the 'Development Workshops' who worked in the Middle East from 1973 up to the fall of the Shah of Iran. (5) They are now working in Angola. This team comprises three architects: Allan Cain; Farroukh Afshar and John Norton. This group have been committed to the

development of local skills and the improvement of traditional ways of building, and we will await with interest the results of their work in the very different context of Angola.

Immediate Technology Development Group (ITDG) have also taken some initiatives in this area with their studies of the Management and Organisation of Small Building Contractors. These studies have largely confined themselves to administration rather than providing guidance on training programmes. (6)

The World Bank have also examined the training issue and they commissioned a research project on the training of local contractors for labour intensive road building. This was undertaken for them by a British firm of Civil Engineers, Scott Wilson Kirkpatrick and Partners. (7)

In terms of research related to earthquake resistant housing, one project has been under consideration for some years in Turkey. The Council of Europe made a grant to the Turkish Government for a housing modification programme in seismic areas. This was handled by the Turkish Ministry of Village Affairs. One aspect of this project was an education programme with wall charts being produced for use in village community halls, teashops, etc. A further aspect was to build pilot 'modified houses' in various vulnerable locations to test them in the event of future earthquakes. However, I have not heard of recent progress of this project, and to my limited knowledge the pilot project has yet to be attempted.

Following a period of field study in Turkey I was approached by one of the advisers to this project and he had several proposals which were being considered for housing modification. One of these was to substitute a light metal roof for the very heavy earthen roof of the traditional Turkish unreinforced masonry or adobe house. In our comments on this proposal we made the point that such a proposal whilst being very logical on seismic grounds would have very significant cultural and economic consequences for families concerned. We pointed out that the flat roof of the traditional Turkish house fulfilled a very wide range of uses which included a protected area inaccessible to animals; a sleeping area for warm nights in summer; an area which was used for drying fruit and corn. In addition the traditional earthen roof was a very logical type of structure for families living at subsistence levels in that it virtually costs nothing if timber was available locally, and the way in which the roofs were constructed used every part of a tree including the branches and brushwood prior to putting on the heavy mud roof. I mention this detail because it seemed that any change to make the roof aseismic had to start with the concept of a flat roof rather than substitute it for another which would have so many adverse social consequences.

A further project, one in which I participated, was the Housing and Natural Hazards Project of the Royal Geographical Society's International Karakoram Project of 1980. A unique characteristic of this project was its multi-disciplinary nature comprising eight investigators from a variety of professions: Anthropology; Engineering; Planning; Architecture, Geology, Geography and Archaeology. (8)

The objective of the proposal was to examine the vulnerability of settlements in the Northern Areas of Pakistan to natural hazards, to determine what forms of adaptation had occurred and whether the buildings could be modified to reduce the risks to the affected population. Four case studies were undertaken comprising study of diverse communities, their settlement and housing patterns as well as the risks they faced from five types of natural

hazard, and the local awareness of such risks. One of these case studies was of Pattan, an area that had been badly damaged in an earthquake in 1975. Prior to our departure the team examined the methodology of the only comparable project we could find. This was the Housing Improvement Programme undertaken by INTERTECT and Carnegie-Mellon University in Peru from 1977-79. This was a very important piece of research which was also a pilot project which I will describe later. (9) We took the list of nine topics used by INTERTECT in Peru (see column 1 of chart, FIG 4) and added two items which related to 'local awareness of risks' and 'conflicting priorities' (see column 2 of chart). One of the many conclusions from the project was that even our adapted approach of column 2 needed further change to include a detailed analysis of the local values and priorities (see column 3 of chart, FIG 4).

The overall findings of the expedition will be presented to the International Karakoram Conference in London in September 1981. However, a simple chart was developed which conveys some of the findings of the group (see Appendix 1). In addition, Dr Robin Spence, an engineer from the University of Cambridge, has presented a paper to this workshop on the vulnerability of local housing in the Karakorams to earthquakes. (10)

One of the major lessons from this project was the realisation of the very diverse contexts in which modification could be considered. There are two broad categories:

Existing Buildings - By this I am referring to the modification of existing buildings as a pre-disaster mitigation measure.

New Buildings - Here I am referring to two contexts which both require new construction, but which are totally different in nature, as I will explain. The first category of new building is the building of new structures within seismic zones. Therefore, the modification issue is the improvement of building skills or techniques. The second category is that of post-earthquake reconstruction. This relates to reconstruction work which I take to include the repair of buildings.

Studies of modification up to the present time have failed to recognise the subtle differences in these differing contexts. This is hardly surprising since the subject is still in its formative years. The main issue is that lessons learned in one situation (i.e. reconstruction) are not necessarily transferable to a pre-earthquake context or even to normal new building work. The following chart examines these different characteristics with an attempt to identify the constraints and opportunities in the different categories. (FIG 5)

Colum 1. List used by INTERTECT in Peru (9.)	Column 2. List as developed by Karakoram Project Team Prior to departure	Column 3. Tentative results of Karakoram Project
1. Identify Areas of High Risk 2. Identify Areas with concentrations of Vulnerable Structures 3. Determine Housing Demand 4. Determine Receptivity of New Ideas 5. Conduct a Sociological Profile of Community 6. Select a Community/Site 7. Study Normal Building Process 8. Develop Training Aids 9. Conduct a Pilot Project	1. What is the normal lifestyle/ economy/building process/housing tradition? 2. What are the risks from natural hazards? 3. What is the awareness of these risks? (addition to INTERTECT list, column 1) 4. What are the conflicting priorities that may make housing modification improvement impossible? (addition to INTERTECT list, column 1) 5. What are the local resources to undertake housing improvements/ risk reduction/mitigation measures?	The evidence from our seven projects indicated that it is not possible to study the question in the way we had formulated the list (as left). In our view the analysis of vulnerability must be an intrinsic part of an examination of the total values and priorities of a given community. To isolate this topic of vulnerability produces a false perspective of local needs and economic possibilities. (8.)

FIG 4. Questions to be answered as prerequisites to any housing modification program

CATEGORY			MODIFICATION PROCESS	CONSTRAINTS FOR MODIFICATION PROGRAMS	OPPORTUNITIES FOR MODIFICATION PROGRAMS
EXISTING BUILDINGS			Strengthen vulnerable existing houses by modification programs and by training programs	1. A lack of financial resources ; 2. A lack of urgency on the part of officials or building occupants; 3. The social upheaval of making any changes to existing houses; 4. The lack of any 'standard building', each building being a 'one-off' design problem requiring skills in appropriate modifications	1. Very limited for the houses of poor families, much greater for those with higher incomes; 2. A major problem is the vast proportion of vulnerable housing stock - too large for available resources; 3. Good opportunities for public buildings, especially those involving public assembly, i.e. schools, churches, mosques, etc.
NEW BUILDINGS	All new buildings in seismic zones		Modify existing skills, techniques and certain materials for construction, design and siting	1. Basic conservation of traditional societies to any change; 2. Additional costs of aseismic construction; 3. A lack of teachers to explain basic principles to local builders	1. Good, if there is the support of public authorities, if there are teachers available and institutions to implement projects
	Post earthquake reconstruction	New buildings	Modify existing skills, techniques and certain materials for construction, design and siting	1. The prevailing mentality of most reconstruction authorities and relief agencies that suggest that reconstruction should consist of (a) temporary 'stop-gap' housing; (b) a radical change of technology; (c) a contractor based activity that ignors local manpower and skills and the opportunity for training programmes	Very good for two reasons: 1. There is the visual aid of building failure, people are open to change; 2. There is an availability of cash as well as expertise from assisting groups
		Repairs to damaged buildings	Strengthen damaged houses with aseismic improvements incorporated into repair		

FIG 5. Opportunities and constraints for the modification of buildings

2. Implementation Programs

One of my reasons for attending this workshop is to find out about work in progress. Therefore, I find it impossible to fulfil this part of my assignment since I only know of a handful of modification programmes that have been implemented, and I am certain there must be others that have eluded my literature search. I am hopeful that much additional work has been attempted that resolves some of the dilemmas in the projects where I have some knowledge, and am looking forward to hearing of them from workshop delegates.

The first example I want to quote will be familiar to many delegates since it is probably the most comprehensive modification project to have been undertaken. My own part in this was minimal but it was interesting to have participated in some of the very early discussions that were held in Guatemala just a week after the 1976 earthquake when the project was being conceived. The project emerged from a combination of events and skills. The events were that OXFAM, a British development agency, had for some years been supporting World Neighbors in their work in rural areas. This had consisted of a variety of development projects, working for about ten years in close contact with local farmers through agricultural co-operatives. It was out of this context that the housing programme emerged. The skills were those of Fred Cuny of INTERTECT who was hired by OXFAM to advise them on their reconstruction programme. The Field Director of OXFAM was Reggie Norton, who had considerable previous experience of disasters, particularly in Nicaragua following the 1972 earthquake. The Project Director of World Neighbors was Mary MacKay who was another vital link in this project. Essentially the project differed from the programs of the other agencies in that it did not attempt to build lots of houses. Cuny and Norton saw little point in duplicating what people could well undertake themselves; they saw the role of an external agency as being strictly a support activity. Norton has recently described their priorities in these early stages of the project:

> "In disasters, as much as in other situations, an agency should be concerned with the development of self-reliance and the fulfilment of human potential among recipients and any programme should be consistent with this aim. It is essential, therefore, that from the beginning the people should participate fully in the decision-making process. They must have the major say in the sort of project that is pursued. The ability of the disaster victims to cope with their problems must be respected, and they must not be treated like children incapable of doing anything for themselves." (11)

The agencies recognised the well developed building skills of Indian house builders in the Guatemalan highlands and that it was therefore pointless to build large quantities of houses. What they (as an expatriate agency) could do was to provide key materials at prices which people could afford, and secondly, provide expertise to assist families in building safe houses. This was to give advice on both the safe siting of buildings and ways of making adobe houses resistant to a future earthquake. The OXFAM/World Neighbors project consisted of building model houses which incorporated safe constructional techniques in various towns and villages. These houses were then used for extension programs where classes were held to train people to build safe houses. (FIG 6)