The long term effects of this major innovation are still unknown; how far it has been successful in fulfilling its major objective which was of modifying people's traditional ways of construction has still to be established, but initial results are encouraging. One of the recent evaluations of the project has shown that some builders are using the system as part of their sales promotion, and that despite the departure of the agency the techniques persist. It is also apparent that many families are only now rebuilding their homes, five years after the earthquake. Their explanation for the delay is that they have been slowly buying the roofing sheets and developing their agriculture.

The success of this project appears to stem from the following:

(a) the fact that the survivors had a trust relationship with the various local co-operatives with whom OXFAM/World Neighbors were working (stemming from their pre-earthquake involvement with these communities);

(b) the modification of the traditional house was a significant change, but it attempted to retain as much as possible of the local building tradition , in effect it followed the good example of the Lisbon terraces described in my introductory case study. This is very important since many previous post-disaster housing programmes have attempted major technological advances with a different external expression,rather than a simple step forward; FIG 9

(c) the programme was able to capitalise on the all too obvious visual aid of past constructional failures;

(d) the programme was able to offer people corrugated iron roof sheeting which formed a very important emergency shelter protection in the immediate period following the earthquake and it then went on to form the roofing of the permanent house.

The experiences of Guatemala has been extensively documented by OXFAM, with independent evaluations of the housing programme. (12)

Two and a half years after the earthquake Mary MacKay described what OXFAM/World Neighbors had learned from the project. (13) She listed nine lessons and they remain as one of the most important statements relative to housing improvement programmes, therefore I will summarise them:

1. Reconstruction had been much slower than they had anticipated (a study of 20 villages showed that 18.2 of the population had rebuilt homes 2 years, 2 months, after the earthquake). She concludes that for a future post-disaster housing programme it should be based on a 3-5 year period.

2. The agency had to fully recognise that the success of this education programme could not be measured in numbers of houses built, despite some pressure to do this.

3. In areas where temporary houses had been built, there had been minimal interest in building permanent houses.

4. They found that the Guatemalan builders that they had trained had little inclination to motivate people to build safe houses. Therefore, leadership training was vital.

5. The use of timber frames in the houses required additional carpentry skills (the old houses principally required masonry skills).

6. More research is needed on educational aids to convey ideas to a rural population. (FIG 7)

7. More research is needed on unresolved technical issues (wood rot, termite attack).

8. The programme required the presence of a permanent architect or engineer to provide technical assistance.

9. The OXFAM/World Neighbors programme was concerned with adobe. However, many families had rising expectations during the reconstruction period with an appetite for concrete block buildings.

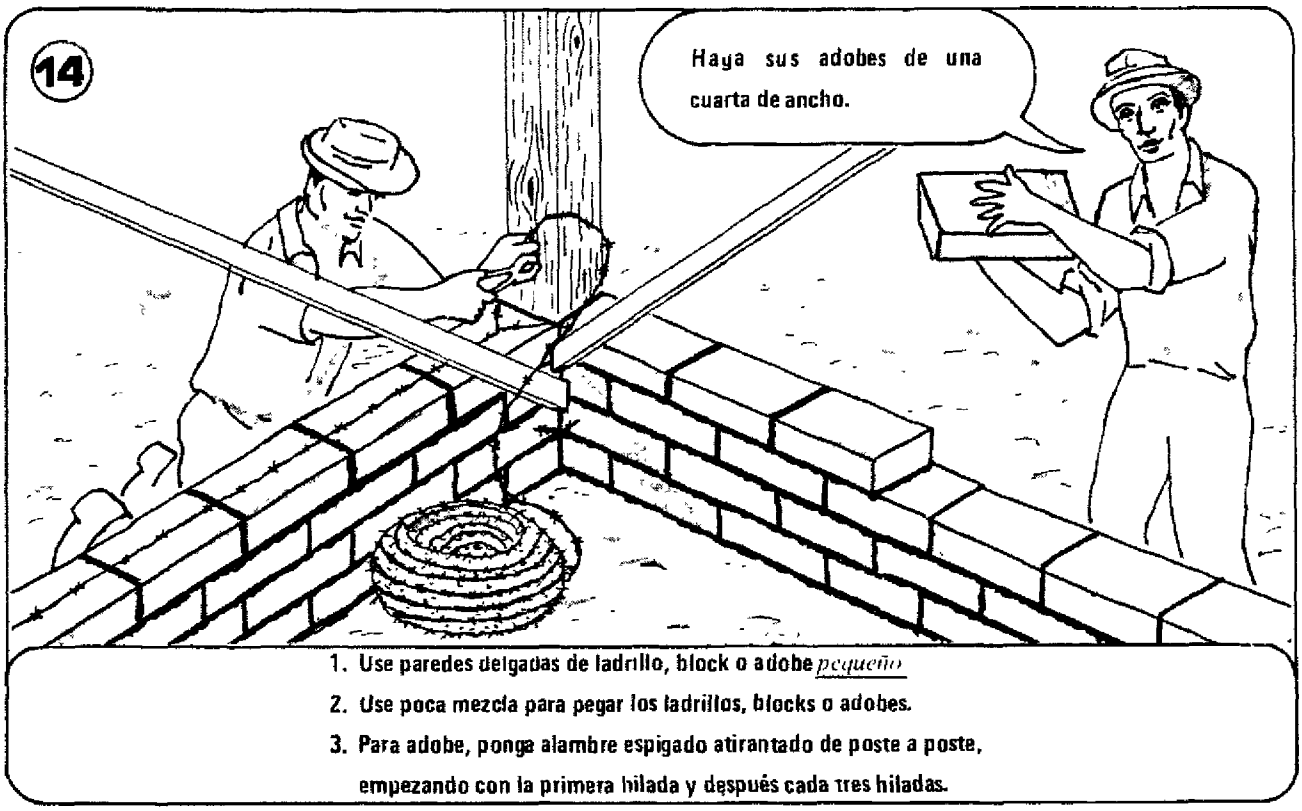
Five years after this programme was conceived we can stand back with the luxury of hindsight and reflect on an undoubted achievement, but also to raise four issues. Mary MacKay hints at one of these when she referred to the 'rising aspirations' of the local population. The question is whether the leaders of this project were right to place their committment and resources into the use of traditional materials. The reasons for this emphasis related to the logic of cost and cultural factors, but the rising aspirations may have indicated the need for a parallel programme to teach safe techniques in concrete block construction. Whether, in effect, there was more than a hint of social determinism by the agency in the decision to concentrate on adobe. (Advice was also given for walling made of bajareque, a form of wattle and daub construction.)

The other question relates to the construction technique that was adopted. Whether there is any future in the close mix of adobe blocks set immediately within a timber frame. The obvious problems are that of rot and termite attack.

Thirdly, it will be useful in future evaluations to find out whether the modified house has been fully accepted, since for all the similarities to existing houses there remain very radical changes. These are the lack of roof insulation with the CI.roofing in lieu of heavier clay tiles. It will be very interesting to find out whether local families have found the reduction in roof heights a serious problem in lieu of the smoke problem where there is internal cooking, and what substitute places are now used to dry off their corn in lieu of hanging it from beams.

Finally, the slow reconstruction is very interesting since it suggests a very low priority for housing against other needs. Or, alternatively, is this due to some hesitation about the new mode of construction, and is slow reconstruction a characteristic also of other reconstruction not using this system?

Shortly after its role in the Guatemalan programme, INTERTECT became involved with Carnegie-Mellon University in a comprehensive program for housing modification in Peru. This was for a project organised by the Peruvian Civil Defence with funding support from USAID. This project is very



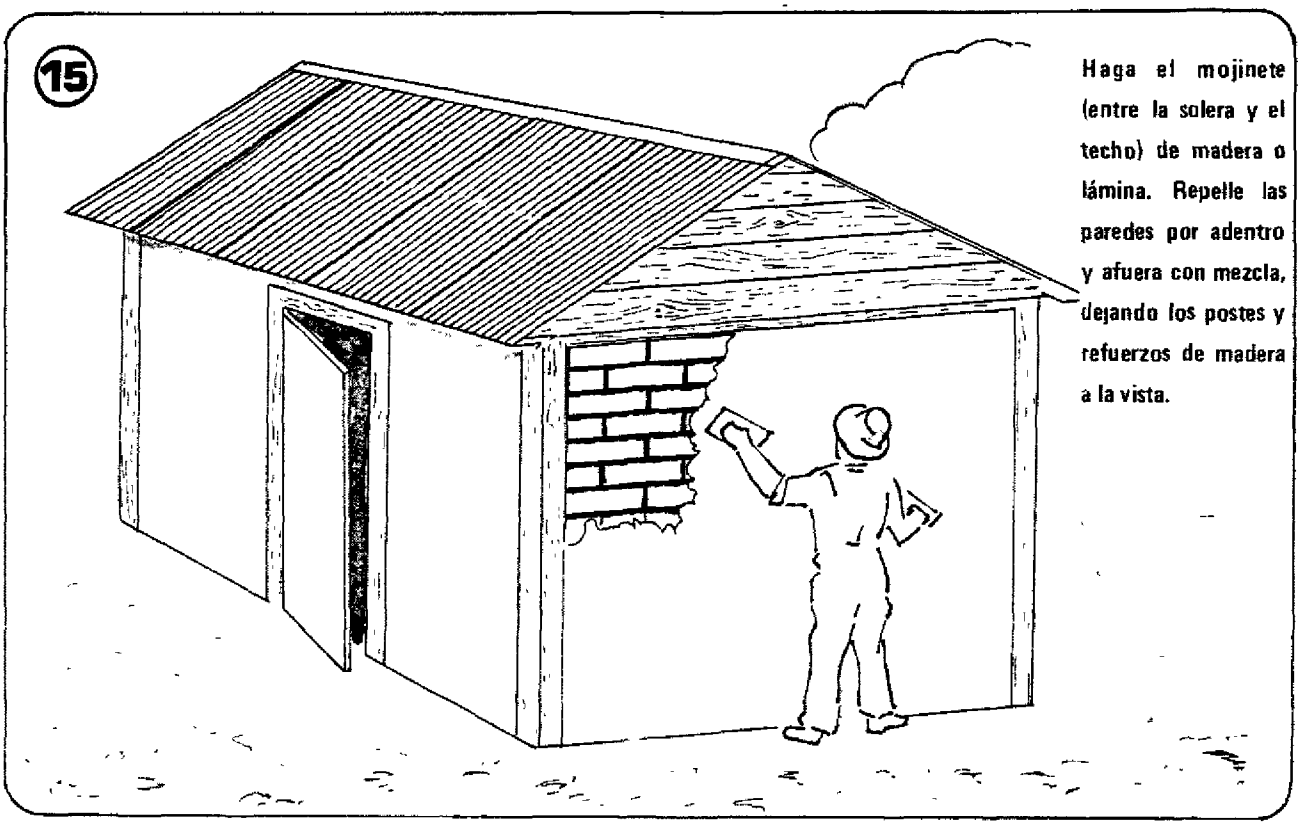


FIG 7. An excerpt from the Housing Education Booklet: 'How to Build a Safe House' (Como Hacer una Casa Segara)

important because it examined the overall risks to houses and settlements from various natural hazards and it sought to implement a pilot program to modify the most vulnerable houses, and in certain extreme instances relocate settlements. During the project Fred Cuny (who was a consultant to the project team from the Advanced Building Structures Program of Carnegie Mellon University, lead by Professor Volker Hartkopf) documented a work method or 'Scenario for a Housing Improvement Program' (14). This was largely based on the way the Peruvian project was structured. A further study has been produced which describes the findings of the project (15).

This project explored the implementation of a very interesting modification system where a bamboo frame was inserted into holes cast in the centre of adobe blocks called a 'Modern Adobe System' FIG 8.

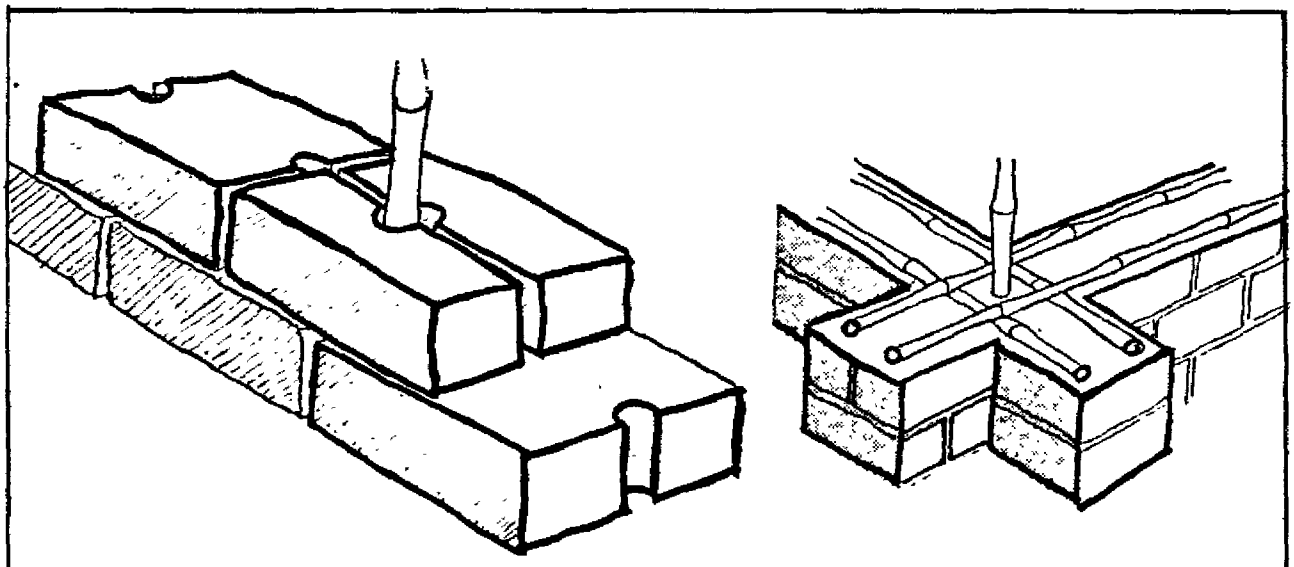


FIG 8. The adobe blocks with the central hole cast to enable the frame to be inserted. The second drawing indicates the attachment of the cane to a horizontal 'ring beam'.

This project in Peru represents part of important 'ongoing' work being undertaken in this sphere for many years. It is also apparent that the experience gained in both Peru and Mexico has not been disseminated widely, mainly as a result of language barriers.

DEFINING AN APPROACH TO CURRENT PROBLEMS

1. The Gap between Thinkers and Doers

In his seminal work on low-cost housing for the developing world, Charles Abrams wrote seventeen years ago:

> "In most places, housing does not get even the attention of a public works engineer, much less an architect. If, somehow, some houses do go up, they are most often neither flood- nor earthquake-proof; soil erosion undermines their foundations..." (16)

Abrams proceeded to catalogue a long list of defects which presumably would have been rectified if a professional was involved. With hindsight, it is apparent that this might not be the case; however the essential argument is still largely relevant.

In 1975 during the conference to mark the 10th Anniversary of the establishment of the Earthquake Engineering Research Institute in Skopje, Professor N N Ambraseys from Imperial College, London, looked round the conference room and asked for all the small builders and craftsmen amongst those of us in his audience to indicate their presence. The negative response prompted his observation that until they attended such meetings then we would see little progress, since much of what was being said in such conferences concerned with engineering seismology was a matter of preaching to the converted. A year later in 1976, Ambraseys concluded his chairman's remarks, at a Symposium on the Guatemalan earthquake, with the cryptic statement: 'Today's "Act of God" will probably be regarded as tomorrow's act of criminal negligence.' These two statements are of course linked. In any major earthquake, buildings collapse which have been built in total or partial ignorance of aseismic construction, whether it be basic structural design or general design principles of balanced design, and siting. Having just returned from a visit to the Campania earthquake site in Southern Italy, there is abundant evidence of the failure of builders to understand aseismic design (17). A further reminder of this reality came with the October 1980 El Asnam earthquake (18).

Neither of these two disasters is specifically relevant to our workshop since adobe was not the main building material in either context. But what is highly pertinent is the fact that despite our experience from numerous earthquakes, and the growth of our knowledge of aseismic design, the principles and practice are not being communicated to those who need this information.

All these issues are obvious, but what is not so clear is to see what steps can be made to bridge this yawning gap between knowledge and its application. I would suggest that a wide ranging strategy is necessary with roles being defined for all the various participants, including professionals; public officials; builders and house occupants. As far as architects are concerned, some have begun to show a belated but nevertheless genuine interest in vernacular traditions of building. However, the proof of such interest is rather like the pudding, and the eating. If architects are really committed to the development of vernacular building traditions then the acid test of this

concern is whether they will be sufficiently committed to assist this process, in what is likely to be an unremunerative, supportive role. Such a task requires that the creativity of an architect is focussed right down to resolving small scale details. Few architects have become famous from this type of work.

Similarly, there is the same gap or conflict within the engineering profession. In the same manner as architects and planners, they have concentrated their resources and energy on high investment buildings, and adobe and all forms of 'cheap' construction remain as 'cinderella' areas of concern. In his 1978 address to the Oxford Conference on Disasters and the Small Dwelling, Professor Reza Razani from Iran referred to only 5% of the engineering seismology literature being devoted to buildings consisting of adobe or unreinforced masonry construction. Yet he had calculated that 60% of all deaths from earthquakes in Iran had been caused by the collapse of such structures (19).

However, the very existance of this workshop is proof of the growing interest in this problem and this is in itself very encouraging. What is needed as a vital next step is for the subject of improving humble adobe structures to get into the curriculum of our various post-graduate schools of architecture and civil engineering. Such is the all pervasive influence of patterns within the US or industrialised Europe on the Third World (particularly in response to the influences exerted on students from these countries studying in western countries), that a change of outlook here could have rapid and far reaching consequences on attitudes in developing countries.

Aldo Norsa has presented a paper to this workshop where he comments on the enormous problem in Italy of seismic risk and the urgent measures needed to tackle the problem. He observes that 35% of the Italian population are at risk from earthquakes (57 million people) and that any attempt to prevent future disasters is concerned with no less than 40% of the country's entire housing stock. Norsa comments that this grave situation:

> 'will entail the need to train a new generation of planners, designers and builders who are expected to work in closer contact with communities and show a greater understanding of local traditions and of time-honoured techniques.' (20)

So the first approach to this problem must be an emphasis on training this new generation of designers. But perhaps even more important than this priority is the need to borrow one of the medical profession's best ideas, that of the creation of a new breed - the barefoot architect, or engineer. This occupation hardly exists at the moment, but it is probably the only really effective way to bridge the gap between appropriate knowledge and implementation. The qualities that such men or women will need are very demanding. I would suggest that they need four basic skills, and the first is probably the most important: to be able to relate to local people, certainly to possess leadership skills and to speak the same language as local builders; to be sensitive to local building traditions and construction practices; to have a working knowledge of seismic factors and seismic design principles; and finally to understand the social/political context in which they are working. Each barefoot architect must understand this broad developmental context so that he is sensitive to the need to promote self-reliance whenever possible without establishing a dependent relationship with those he helps.

Numerous problems exist on the possibility of this new occupation being formed. For example such questions as who will train them, how will they be paid, and what is their relationship to public officials? Could they be a method whereby aseismic codes are enforced?

Finally, will the engineering and architectural professions actively support the creation of barefoot designers? Or will they follow the example of many within the medical profession who regarded this innovation as a basic threat to their professional role and vigorously opposed it. This occurred despite the abundant evidence that they were too few for the task before them and that they were often overqualified for treating the vast majority of ailments. This is a pair of characteristics also applicable to this sphere.

2. The Relevance of Aseismic Building Codes

The fact that vast damage occurred in both Italy and El Asnam despite the existance in both contexts of aseismic building codes is a further reminder (if one was needed) that any implementation strategy, whilst including relevant codes backed up by laws, will not place reliance on them since their enforcement is so very rarely effective, or possibly even feasible for poorer countries. If authorities in earthquake prone countries had heeded Abram's warning on this issue a more realistic attitude might have developed:

> "Building codes are of course essential, particularly in congested areas subject to earthquakes... The tendency in a number of countries is to copy the complex codes of England, Germany or the United States, as well as their zoning and planning laws, though they are irrelevant and though the talents to enforce, construe, and adapt them may be completely lacking." (21)

Since this topic has an entire subject area devoted to it, there is no need for me to duplicate the work of others, I merely want to observe three points. Firstly, the need to devise relevant codes. So often adobe and other humble building systems have been excluded, and this is as meaningless as the refusal of public authorities in cities experiencing rapid urbanisation to recognise the existance of their vast squatter settlements. Secondly, for public authorities to use imagination in ways of ensuring that codes are followed, particularly by recognising that training programs in good safe building are a complimentary activity to code enforcement. Finally for all concerned to recognise the limitation of codes. They are not a panacea, rather just one of many strategies to reduce risk.

3. Classifying the Seismic Resistance of Structures

Scientific analysis requires an orderly structured approach to problem solving. This immediately poses a great problem relative to small dwellings, since it is difficult and often impossible to find regular patterns. For example, in the studies that were made in the Karakorams in Pakistan, our group spent much time in trying to establish what was a 'typical house'. We found a great variety of shapes, diverse siting conditions, mixtures of building materials, and continual varieties of condition, some being well maintained, others badly neglected. One classification category alone, 'unreinforced masonry' could consist of unbonded cut stones, bonded cut stones, unbonded riverbed round stones, dry stone walling, mortared walling, etc.

In a similar manner, when the focus is shifted to natural hazards again the variety is great relative to potential impact from a single hazard, let alone composite effects. These variables do not make analysis of hazard resistance impossible but they certainly indicate the need for a much better sampling method than has been adopted in the past.

4. Rising Expectations

I have already referred to this topic in considering the Guatemalan case study. Mary MacKay referred to the changing aspirations away from adobe towards concrete block houses. What stance should assisting groups take on this issue? One position is to advocate a 'small is beautiful' philosophy by advising a policy of traditional materials and skills at all costs. Against this there has been the party line of so many relief agencies - 'The traditional answer failed, so substitute a new one designed in New York and assembled from components from South Dakota'.

There are many difficulties here, which I have touched on elsewhere (22). My concern is that I believe the role of assisting groups is primarily one of response to locally expressed needs, as opposed to a socially deterministic attitude that determines peoples 'needs' for them, even if this is in the interests of the families in question. Naturally this raises the whole question of modification - who is asking for it, the occupants or some group totally remote from the economic level or value system of the society in question? The issue boils itself down to the old questions of who is helping whom, why are they doing it, with what presuppositions, on whose authority and to whom are they accountable for their actions?

5. Social Priorities and Implications

In the earlier discussion about the modification of the heavy Turkish flat roof to a lightweight pitched version, I raised the issue of the social cost of reducing earthquake risks. Paul Oliver has dwelt on this topic in his paper submitted to this workshop. (23) It would appear that officials and professionals who have been associated with modification programs have often played down the social impact of their proposals. These may not be as radical as the Turkish roof issue, but a glance through a guideline booklet such as Como Hacer una Casa Segura (How to build a safe house) (24) indicates a wide range of social/cultural implications. They include a change of walling system (keeping the adobe but inserting them into a timber frame), a totally new type of roof covering, a different 'balanced' shape of house from many irregular plan-forms, reduced ceiling height, different spaces between buildings, etc. In setting out this list I am not doubting the need to include any item; merely to observe that their cumulative effect is to propose a very different form of house from the one that failed to survive an earthquake. FIG 8 & FIG 9

The issue here is for all individuals involved in such projects to be aware of what they are doing and not to minimise the social impact of major changes with potential negative consequences. These could be a very slow reconstruction process, or rejection of the proposal by house owners.

On the subject of social priorities, the experiences of the Karakoram project indicated that given the scale of local poverty that any attempt to modify existing house construction or siting was not viable given other priorities of local families. There were far more pressing everyday needs such as better health facilities and agricultural needs. Our project therefore suggests that any investigation of risk reduction must take into account the total needs of a given community, and not presuppose that modification is desirable. (This is indicated on the chart on FIG 4 .) (25)

6. Objectives

Throughout these issues I have been questioning basic presuppositions that are frequently made, often without realising that they exist. Finally, I want to raise the question of what the aims are of housing modification. The first issue to clarify is whether it is to protect lives or property. Presumably the former is the aim and that damage is regarded as inevitable and repairable.

If our findings on FIG 5, and APPENDIX 1 are correct, then there is a major problem in protecting lives in existing buildings. The question is whether another strategy is possible in this instance, for example the idea of a safe 'core', or the four-poster bed proposed by Reza Razana to protect people when they are asleep, and don't notice foreshocks with the opportunity they offer to run out of a house.