SUBJECT AREA 3: SOCIAL, ECONOMIC, AND CULTURAL ASPECTS

A. State of The Art

The participants noted that there is a need for more information about the inter-relationship of the social, economic and cultural aspects of indigeneous buildings in seismic areas. The failure to develop this data was cited as the principal reason why vulnerability reduction efforts have not been more successful. The participants felt that researchers and engineers have not been sensitive to this complex balance and thus many structural modifications have not been accepted by the people they were designed to help.

A number of both engineers and social scientists present felt that the technology for safe construction of earthen housing in seismic areas has been growing faster than the actual application of the various techniques. The reasons cited for this were summarized as follows:

1. A lack of understanding of the social, economic and cultural aspects of the problem.

2. A lack of cumulative and comprehensive collection of information existing about the topic.

3. A lack of interaction between social scientists and earthquake engineers.

4. Insufficient communication between all levels of a program, from the engineer/designer to the occupant.

5. A lack of understanding of the techniques of successful technology transfer and the cultural and economic obstacles which must be overcome.

It was noted that actual vulnerability reduction efforts to date have been fairly limited; thus, the existing state-of-the-art is not well defined. If adequate research is carried out within the next few years, vulnerability reduction efforts can be influenced substantially.

B. Research Agenda

1. Standardized Terminology

a. Statement

In order to facilitate coordination, research and implementation, standardized terminologies, definitions, and classifications are required.

b. Action

An international committee of the principal researchers in the field should be established to define the common terms, etc. This committee should:

(1) Establish the nature and variety of earthen buildings in worldwide use. This should be presentd as a taxonomy of building forms, types and materials.

(2) Establish the cultural context in which earthen buildings are used.

(3) Establish the social and economic relationship between earthen buildings and disaster vulnerability.

c. Implementation

These objectives should be accomplished through regional meetings of experts coordinated by a central project manager. Terminologies should be in English and Spanish.

2. Cultural Mapping

a. Statement

Detailed cultural mapping on both a macro and micro scale is required in order to further identify and define the scope of the problem.

b. Action

Research projects on a regional and country-by-country basis should be supported. Mapping should include:

(1) Popular building features which affect seismic resistance of a building.

(2) Traditional forms and their influence on seismic resistance.

(3) Cultural influences, preferences, customs, etc., which affect building construction.

(4) Legal or governmental regulations which affect building construction.

Specific topics which should be examined are:

(a) Urban building patterns

(b) Rural building patterns

(c) Local building skills

(d) Perceptions of risk and vulnerability and how they affect design and construction of housing.

c. Implementation

These objectives should be carried out in two ways. First, U.S.A.I.D., HABITAT Center and the World Bank should be encouraged to support local research and mapping efforts in countries with a high number of earthen buildings. To facilitate this work, a standardized format for such efforts should be adopted (this should be a task of the committee described in paragraph 1(b) above).

Second, NSF, U.S.A.I.D, HABITAT and the World Bank should support regional mapping efforts, compiling the work accomplished at the country level into regional and worldwide atlases.

3. Economic Factors

a. Statement

Research is required to collect data related to the economic factors involving earthen building systems.

b. Action

Research is required to determine the economic aspects and implications of earthen buildings, focusing on:

(1) An evaluation of construction costs/ maintenance costs correlated to the anticipated life of buildings in both existing and proposed earthen building types.

(2) An analysis of the relative cost benefits of improvements to earthen buildings in comparison to complete relocation of alternative methods of construction.

(3) The development of a comprehensive data base describing construction techniques which provide maximum earthquake tolerance at minimum costs.

c. Implementation

It is recommended that NSF support further research on economic factors related to housing modification and vulnerability reduction.

It is recognized that much of the needed data also pertains to other types of structures both in the U.S. and abroad. Therefore, portions of the necessary research can be non-specific to earthen buidings and earthquakes. Thus, NSF is encouraged to support a broad range of research on societal and economic factors to develop the required data. It is recommended that existing societal research be expanded to include those issues specific to earthen buildings in seismic areas.

Such studies as A.I.D., A.T.I., and HABITAT can assist in these efforts by supporting in-country efforts to develop social-economic data relating to program implementation.

It is recommended that NSF, A.I.D. and A.T.I. establish an informal liaison group to encourage broader interchange between U.S. and foreign scientists and researchers engaged in these efforts. Programs such as NSF's Science in Developing Countries (SDC), A.I.D's Invitational Travel Funds, and various foreign currency programs can provide much needed support for international interchange.

4. Defining the Urban Versus Rural Context

a. Statement

The social and economic differences between the use of earthen buildings in urban and rural settings and their influences on construction and safety should be defined.

b. Action

Research is required to determine the essential social, cultural and economic differences and similarities when earthen buildings are used in urban and rural areas. Specifically, comparative research is required on:

(1) Investment levels

(2) Differences in building costs

(3) Differences in construction and maintenance practices.

(4) Changes in the building process dictated by a change from rural to urban settings.

(5) Changes in site selection and development necessitated by changing from a rural to an urban context.

c. Implementation

It is recommended that research on these topics should be supported by the National Science Foundation, the World Bank, and HABITAT Center.

5. Psychological and Social Aspects of Intervention

a. Statement

The impetus to modify earthen buildings is normally a result of planned housing improvement programs. Little information exists concerning the psychological and social factors related to this type of intervention and the impact of such interventions on both families and the society in which they occur.

b. Action

New research on the psychological and social aspects of intervention should be conducted. In particular, research should be directed towards:

(1) Identification of the psychological and social impact of various intervention strategies.

(2) The relationship of the psycho-social impact of intervention in relation to the benefits of vulnerability reduction.

(3) The impact of the introduction of new materials and/or new or adapted technologies. This should also be viewed in terms of the impact on rising aspirations for social and economic development.

(4) The social implications and factors affecting acceptance or rejection of building codes.

c. Implementation

The impact of intervention and various intervention strategies is a vital concern not only to U.S. hazard mitigation efforts but also to foreign aid programs. Thus, research in this area should be supported by many different types of institutions. NSF can support these efforts through research on societal aspects of earthquake hazard mitigation.

Implementing agencies such as U.S.A.I.D., the World Bank and various non-governmental organizations involved in housing mitigation and vulnerability reduction efforts should be encouraged to support these efforts through evaluations and assessments of past intervention programs.

6. Longitudinal studies

a. Statement

Often a project's post-documentation and evaluation are conducted immediately after implementation. Therefore, the long-range effects of a program are not fully known.

b. Action

Longitudinal studies should be conducted to document and evaluate various implementation approaches over extended periods of time following implementation. Studies should especially identify the specific aspects of a program which are continued without support at the end of the intervention.

c. Implementation

It is recommended that an increased number of longitudinal studies be supported by NSF. It is recommended, however, that the longitudinal studies focus on various aspects

of modification efforts rather than on comprehensive assessments of all aspects of a particular disaster.

7. Cost-Benefit of Various Hazard Mitigation Strategies

a. Statement

Little information is known about the comparative cost-benefit relationship between various alternative strategies to reduce vulnerability of earthen buildings in seismic areas.

b. Action

Research should be conducted to define the trade-offs between risk reduction strategies including an examination of the potential social and economic consequences of the various alternatives. In particular, a comparative analysis should be made of:

(1) Relocation from vulnerable sites versus structural modification to reduce vulnerability.

(2) The comparative advantages and disadvantages of changing from earthen buildings to other types of materials and the social and economic consequences of such changes.

c. Implementation

Relocation is a strategy often proposed as a vulnerability reduction alternative. Several relocation programs have been attempted in the developing countries. Thus, NSF is encouraged to support research on these programs. The information can be useful to U.S. program planners for comparative purposes, and to Third World program officials for immediate application in post-earthquake reconstruction programs.

8. Social Input in Structural Research

a. Statement

Many of the techniques which have been developed to modify and strengthen earthen buildings in seismic areas have proven to be too expensive or too sophisticated to use. It

is believed that much of this reserch could have resulted in more practical applications had adequate social-science inputs been made early in the research and development process.

b. Action

When dealing with low-cost, non-engineered buildings normally built without the influence of building codes or specifications, it is imperative that social factors be considered from the very beginning of any structural or material research program. Increased interaction between social scientists, housing program implementers and structural and material researchers is required.

c. Implementation

Increased interaction between social scientists, program implementers and earthquake engineers can be effected in two ways:

(1) NSF should encourage increased participation by social scientists in earthquake engineering research programs directed at non-engineered buildings.

(2) The inter-disciplinary network which has been formed as a result of this workshop should be further supported by the sponsors of the workshop. A preliminary activity that should be encouraged is the development of a roster of qualified and experienced social scientists and program implementation personnel who can assist earthquake engineering research.

9. Perceptions of Risk

a. Statement

Information concerning people's perception of risk and the relative priority that risk and vulnerability reduction play in the lives of persons living in earthen buildings in seismic areas is generally lacking.

b. Action

Research on the concept of risk and perceptions of vulnerability is necessary in order to facilitate the planning

of vulnerability reduction efforts. Research sould be directed towards:

(1) Developing definitions of risk and vulnerability in both real and relative terms.

(2) Determining how perceptions of risk and vulnerability affect community lives.

(3) Identifying cultural adaptations to vulnerability in the local, indigineous architecture.

(4) Identifying societal and organization coping mechanisms which have developed in response to risk and vulnerability.

c. Implementation

Research on perceptions of risk and societal adaptations to risk and vulnerability should be carried out in both the United States and overseas. International efforts should be supported as lessons and information developed from abroad may provide information useful to hazard mitigation programs in this country.

SUBJECT AREA 4: PROGRAM IMPLEMENTATION

A. State of The Art

Much of the discussion about efforts to reduce vulnerability and improve earthen buildings in seismic areas focused on the lack of information about past experience and highlighted the fact that extensive program implementation activities have not yet been conducted on a large scale. With a few notable exceptions (such as efforts in Turkey and recent efforts in Guatemala by OXFAM, World Neighbors, Save the Children, and U.S.A.I.D.), few programs have been evaluated or observed over any length of time. The participants recognized that the techniques for modifying and improving earthen buildings have only been developed in the last decade; thus, information necessarily will be fragmented and minimal. However, the general lack of data and research on approaches and implementation strategies further frustrates the development of workable implementation programs in this field.

The overall scarcity of information was attributed to a lack of comprehensive research on program implementation; a failure of the operating agencies to evaluate existing projects; and a lack of long-operating agencies to evaluate existing projects; and a lack of longitudinal studies on the long-term impact and results of programs which have been carried out. Where information is available, it has tended to be compartmentalized and not disseminated widely to other practitioners.

The participants also noted that there has been little interaction between researchers and program implementers. Therefore, many of the techniques which have been developed to date to improve buildings are often impractical in actual field use. The participants noted that increased interaction between researchers and implementors needs to be effected and that linkages between the two groups should be well established prior to a disaster response.

The participants noted that most research on improving earthen buildings has concentrated on engineering solutions, and the social and cultural aspects and constraints have often been overlooked and are not fully understood by the research community. To overcome these problems, increased involvement of the engineering researchers in field level activities was urged.

Each of the work sessions on implementation noted the need for increased emphasis on developing local solutions to the problems. Several methods were proposed to bring research and implementation closer to the grassroots level. Several groups recommended that efforts should be initiated to train an intermediate group of technicians (somewhat along the "barefoot doctor" concept employed successfully in public health in China). These intermediate technician groups would serve as problem-solvers at the local level and would aid families in developing acceptable local solutions to specific vulnerability problems.

Several of the experienced practitioners noted the problems of quality control in vulnerability reduction programs. It was noted that as soon as a formal housing program ended, the application of the structural modification techniques often became irregular, and improper construction methods became widespread. To overcome this problem, participants suggested the need for increased emphasis on the trainin of local building technicians and cited quality control as an appropriate role for the "intermediate engineering group" mentioned above.

A number of discussions focused on both the need for increased public awareness and the difficulties in disseminating information about vulnerability reduction. The participants agreed that increased emphasis should be placed on documenting effective public information and housing education techniques, and that additional support is needed to develop effective communication tools and training aids for use in program implementation.

The participants discussed a number of obstacles to vulnerability reduction. It was noted that most vulnerability reduction efforts have occurred after an earthquake and had been directed towards improving the design and construction of new housing, not reduction of vulnerability of existing housing. The difficulty of intervention, except in disasters, was discussed at some length. The participants agreed that in order to carry out disaster mitigation efforts, local governments' capacities to conduct mitigation programs must be strengthened. It was also felt that research on different kinds of incentives which could be used to encourage home owners to utilize earthquake resistant construction techniques should be carried out. Among the incentives that should be explored are: financial incentives (such as loans, subsidies, etc.); material incentives (example: lightweight roofing, bracing, cement, etc.); and legal incentives (such as codes, tax reductions, etc.).

It was found that most research on reduction of vulnerability to earthen buildings has focused on the modification and strengthening of new construction. For overall vulnerability efforts to be successful, new methods for modification and strengthening of existing buildings need to be explored.

B. Research Agenda

The following topics were identified as the highest priority for future research related to program implementation and vulnerability reduction.

1. Implementation Approaches

a. Statement

More data on program implementation is needed in order to provide housing agencies with the necessary tools for vulnerability reduction efforts.

b. Action

New information must be developed about program implementation. This data should be acquired from two sources:

research and evaluation of projects. The criteria for such studies should be established and methodologies developed for general use.

c. Implementation

Research on strategies and approaches for vulnerability reduction programs should be funded by the National Science Foundation as a part of its overall hazards mitigation program. In support of this research NSF should also fund longitudinal studies of current and past programs to develop data upon which program models can be developed.

It is recognized that the majority of information on program implementation strategies may be found in the developing countries. In order to assist U.S. vulnerability reduction efforts, increased linkages between foreign and domestic researchers and program implementation personnel should be encouraged. It is recommended that joint U.S. and foreign research projects be encouraged and that U.S.A.I.D. and NSF establish a joint working group to explore ways in which research and evaluations can be complementary.

U.S.A.I.D. can support this effort by promoting evaluation and assessment of operational programs that receive support from the agency.

2. Techniques for Improving Low-Cost Housing

a. Statement

Often the techniques for anti-seismic modification of low-cost, non-engineered buidings are too costly and complicated for home builders to implement without extensive technical assistance. Recognizing cost as a major obstacle to housing modification and recognizing that only two or three modifications may be carried out by a homeowner, the most effective means of increasing seismic resistance should be identified for each particular type of structure and truly low-cost means of utilizing these techniques should be developed.

b. Action

In order to implement this approach, several activities must be carried out simultaneously. First, research is needed to develop simplified procedures for assessing a particular building and determining what the most cost-effective methods would be to strengthen that particular building. The procedure should enable the assessor to recommend a plan for modification or retrofitting taking into account the various trade-offs of time, labor, materials, etc.

The actions which are available for strengthening a house should be prioritized according to which method most reduces the relative vulnerability.

The results of this research must be presented in a non-technical form for use by implementing agencies and builders.

c. Implementation

It is recommended that the National Science Foundation should support research on:

(1) The priorization of modification techniques.

(2) The determination of which modification methods and which building features most affect or reduce vulnerability in a non-engineered structure.

(3) The development of a simple assessment procedure for field use.

(4) The development of step-by-step approaches to modification of housing which will allow homeowners/builders an opportunity to progressively upgrade housing.

It is further recommended that the National Science Foundation and the Agency for International Development continue to support joing U.S./foreign interchange and research on these topics.

It is recognized that research in related fields (such as unreinforced, low-quality masonry) could also benefit from these procedures; therefore, it is recommended that this research be carried out in conjunction with other on-going efforts.

3. Communication and Education

a. Statement

Little information exists on the process of technology transfer or means of encouraging homeowners to utilize earthquake resistant building techniques.

b. Action

Research is required to develop more information on the overall process of technology transfer, especially communication techniques and housing education. Research topics include:

(1) Identification of th most critical concepts and techniques which need to be transferred and methods for presenting the information in such a manner as not to overwhelm or confuse the audience. Especially needed is theidentification of the critical and priority structural details to be presented and methods for presenting these ideas in a non-technical manner.

(2) Information about the techniques of teaching and communicating, especially methods of presenting technical issues as well as methods for encouraging cultural acceptance of the methods being presented.

(3) Research is needed to identify what materials should be presented to each different audience, i.e., the best points of intervention for successful program implementation.

(4) Research is required on how to determine the most effective type of communicator/teacher for different situations and appropriate roles for different types of professionals and technicians in the overall vulnerability reduction efforts.

4. Special Problems of the Urban Environment

a. Statement

It is recognized that dense urban development creates unique aspects and problems for the reduction of seismic vulnerability. Most research to date has been on detached buildings which are most likely to be found in a rural environment. The special aspects of earthen buildings in urban areas and the problems in implementation of vulnerability reduction require new study.

b. Action

Research on non-structural methods of reducing vulnerability during program implementation is required. Of special concern is research on appropriate methods of siting and sub-division development in urban settings.

Structural methods of providing safety in urban settings are also required. Methods which should be explored are: in-house shelters, safe cores, and other methods of realistically addressing the problem on a cost-effective basis.

c. Implementation

It is recommended that the National Science Foundation encourage and support research on non-structural methods of reducing vulnerability in urban areas.

It is further recommended that NSF and A.I.D. place increased emphasis on research to develop methods of providing basic, minimal safety to urban dwellers living in non-engineered structures. Research in related fields (such as high wind engineering) and on related types of structures (such as low-quality, unreinforced masonry buildings) can provide useful information applicable to earthen buildings in seismic areas.

5. Acceptance of Change

a. Statement

The conditions under which familites will modify or except modification to their housing are not fully understood. The available literature on this topic is minimal.

b. Action

Increased research is required in order to determine the conditions under which modification of earthen buildings will be accepted. It is recognized that in the developing countries many of the people living in earthen buildings are those most resistant to change. In addition, these people may be the most difficult to reach due to illiteracy and unfamiliarity with related technical aspects. Research should be supported to identify the conditions under which change or modification would be accepted.

c. Implementation

This information is needed not only for modification of earthen buildings in seismic areas but for modification of all types of non-engineered structures vulnerable to earthquakes and/or windstorms. Thus, it is recommended that NSF encourage comprehensive research on societal and cultural attitudes towards housing modification as part of the current research efforts on societal response to earthquakes.

It is recommended that A.I.D. be encouraged to support parallel research on this topic by local researchers in countries with large numbers of non-engineered structures, vulnerable to either earthquakes or windstorms.

It is recommended that both NSF and A.I.D. and other organizations involved in disaster mitigation encourage further international interchange between social scientists and housing and building officials engaged in program implementation.

SUBJECT AREA 5: BUILDING CODES, SPECIFICATIONS AND STANDARDS

A. State of the Art

It was found that the problems of codes and specifications in the United States differed from the experience of the developing countries. Therefore, discussions tended to differentiate between the U.S. and international use.

The following specific observations were made:

1. Only a relatively few number of codes which permit the use of adobe or other earthen materials in residential construction have been passed in the United States. Conference participants noted that these are generally restrictive in nature and have usually been formulated in response to specific requests from builders or commercial manufacturers or adobe blocks. One notable U.S. code which permits adobe construction is the New Mexico building code and it has been recommended in the past that adobe bricks which meet its criteria be approved under the Uniform Building Code (see Report No. 1801, Nov. 1970, and Report No. 2366.1, Dec., 1968, International Conference of Building Officials). It was found that most codes only specify the quality of the adobe block and do not address structural aspects of building construction.

2. The participants noted that most comprehensive work on preparation and adoption of building codes for earthen buildings has been in the developing countries. Especially notable is recent work in Turkey and Peru.

3. Building codes were generally seen as too restrictive. In the United States, building codes were seen to be too sophisticated for use in low-cost construction as the requirements of the codes usually resulted in making the building costs too high; thus, the codes are unenforceable.

4. It was felt that building codes permitting earthen construction did not address related concerns such as energy use, social or cultural aspects of housing construction, and cost constraints in both the U.S. and the developing countries.

B. Research Agenda

The following research and activities are recommended in order to produce more effective earthen building codes, standards and specifications:

1. Review of Codes

a. Statement

A thorough compilation and review of existing building codes pertaining to earthen buildings in seismic areas needs to be undertaken.

b. Action

A panel of experts should be convened to systematically review the existing codes pertaining to earthen buildings in seismic areas the describe a common approach to developing more workable codes and standards for earthen buildings. This panel of experts should define common terminologies and approaches so that basic minimal codes and standards can become recognized on an international level.

c. Implementation

This international panel of experts should meet under the aegis of an existing earthquake engineering organization (such as the International Association of Earthquake Engineers or the Earthquake Engineering Research Institute). Meetings could be held in conjunction with recognized international conferences in order to reduce the cost. Support for this activity could be provided by NSF, UNESCO, and/or HABITAT Center.

2. Alternatives to Traditional Codes

a. Statement

Existing building codes have proved largely unworkable and overly restrictive.

b. Action

Additional research on alternative approaches to traditional codes should be explored. Priorities should be given to exploring:

(1) The feasibility of using performance standards as an alternative to traditional restrictive codes.

(2) The development of equivalencies and equivalency concept in support of (1) above.

c. Implementation

NSF and the National Bureau of Standards should host a technical meeting between code personnel, researchers and practitioners to examine existing codes and possible changes for the United States.

NSF should support research in support of the development of equivalencies.

3. Code Enforcement

a. Statement

Building code enforcement has proven difficult to put into effect in both the industrialized and developing countries.

b. Action

Additional research on implementation of building codes and standards should be undertaken. Research is needed on:

(1) Effective building inspection and code enforcement practices.

(2) Permit systems

(3) Financing mechanisms which encourage compliance with building codes.

(4) Methods of promoting public awareness and acceptance of building codes, including public information, education and training, and promotional approaches and techniques.

(5) Altenative methods of achieving basic minimum compliance with building codes and standards.

c. Implementation

NSF should encourage and support research activities on effective code enforcement as part of its ongoing

program on research on societal response to natural hazards and earthquake mitigation.

4. Dissemination of Existing Information

a. Statement

Much of the research on the building codes for earthen buildings in seismic areas has been conducted internationally. In the United States, little of this information is known to code officials.

b. Action

An effort should be made to compile and disseminate the existing data relating to earthen codes to U.S. code officials. Of special interest would be data relating to standards for earthen materials and structural research in support of the establishment of building codes.

Because much of the data overseas is in foreign languages, support may be necessary in order to translate the codes into English for use in the U.S.

c. Implementation

It is recommended that the activities of the International Working Group on Improvement of Earthen Buildings in Seismic Areas be supported so that an information exchange between codes officials in the U.S. and overseas can be further encouraged.

A.I.D. should be encouraged to support the translation of foreign codes into English.

5. Redefinition of Intent of Codes

a. Statement

In the United States, it has been found that the intent of most building codes relating to building in seismic areas has been to restrict the use of earthen materials rather than to encourage safety when earthen materials are used.

b. Action

In order to more effectively utilize earthen materials, a consensus on the intent of building codes should be developed. Additional research should be conducted to define the acceptable levels of damage in differing earthquake risk zones and codes should be designed to take into account reginal variances and different levels of seismic risk.

c. Implementation

NSF should continue to support research to determine acceptable levels of damage in earthen buildings. This research could be combined with related research on low quality, unreinforced masonry.

6. Priority Areas for Structural Research Relating to Codes

a. Statement

To support the development of earthen building codes, immediate research is necessary to define minimum structural parameters.

b. Action

Research should be conducted to describe acceptable methods for transferring static loads to dynamic loads and to establish minimum reinforcing and ductility standards for earthen buildings.

c. Implementation

NSF should support the required research on a priority basis.

III. PRIORITIES AND A RECOMMENDED WORK PLAN FOR IMMEDIATE ACTION

The following items present a recommended work plan for immediate action to continue the efforts established at the workshop. This work plan draws from each of the topic areas described in the research agenda and places the highest priority activities in a logical, progressive order for commencing research in this field.

A. Establish common terminology for all aspects of earthen building research.

B. Establish common classification for:

1. Structures
2. Materials
3. Reinforcing methods
4. Damage assessment and reconnaissance

C. Identify the range of materials commonly used in earthen buildings and methods in which they are employed.

D. Identify the range of earthen building structures commonly in use and the various materials and structural systems used to reinforce the buildings in seismic areas.

E. Establish common testing terminology.

F. Establish the relationship between various testing methods commonly used to test earthen buildings.

G. Establish the relationship between full-scale testing and model testing of earthen buildings.

H. Establish the relationship between earthen buildings and other low quality masonry under seismic loading conditions.

I. Establish common testing procedures.

J. Establish the relationship between various soils used in earthen structures and their performance under different loading conditions.