

UNITED NATIONS EDUCATIONAL,
SCIENTIFIC AND CULTURAL ORGANIZATION

INTERNATIONAL ADVISORY COMMITTEE
ON EARTHQUAKE RISK

First session,
Paris, 12-16 December 1977

REPORT

1. Introduction

The Intergovernmental Conference on the Assessment and Mitigation of Earthquake Risk, held at Unesco Headquarters in February 1976, recommended (resolution 12.21) that Unesco, in consultation with the United Nations Disaster Relief Co-ordinator, set up an international committee to advise Unesco and UNDRO on the implementation of the resolutions of the Conference and on the preparation of a long-term interdisciplinary research programme in the field. It was foreseen that this committee would be able to advise on how best to engage the wide range of relevant disciplines, and on how to achieve the most effective combination of scientific and administrative action, in a concerted attack on the problem of earthquake risk and its mitigation.

The report of this Conference was transmitted to the General Conference of Unesco at its nineteenth session by the Director-General, who proposed that an "International Advisory Committee on Earthquake Risk" be set up by Unesco in co-operation with UNDRO. The General Conference approved this proposal.

The Statutes of the International Advisory Committee on Earthquake Risk were adopted by the Executive Board of Unesco at its 102nd session in May 1977. They are reproduced in Annex I to this report.

In consultation with the United Nations Disaster Relief Co-ordinator, the Director-General of Unesco convened the first meeting of the present Committee at Unesco Headquarters from 12 to 16 December 1977.

2. Participation

The following members of the Committee were present: Messrs. C. Allen, N.M. Ambraseys, D. Bensari, Ku Kung-hsu, A.A. Moinfar, T. Rikitake, J. Tomblin. Messrs. J. Cudjoe, E. Rosenblueth and S.A. Soloviev were unable to attend. The meeting was also attended by six consultants, a representative of UNDRO and by observers representing 14 international organizations. A full list of the participants is given in Annex II.

3. Opening of the meeting

The first session was opened by the Deputy Assistant Director-General for Science, Mr. M. Batisse. After introducing the members of the Committee, consultants and Observers, Mr. Batisse outlined the background to the creation of the committee and its objectives. He noted that the Committee was to advise both Unesco and UNDRO on earthquake risk assessment and mitigation. Since the Intergovernmental Meeting of February 1976, human and economic losses from earthquakes had been particularly high and had illustrated the need on the one hand for scientists to estimate the risks and, on the other, for technologists to reduce risks by developing and applying earthquake-resistant measures. Mr. Batisse underlined the need for co-operation and exchange between the disciplines involved in order to indicate priorities and develop a strategy incorporating a programme of action.

Mr. Jean-Paul Lévy, representing UNDRO, reiterated the need for a multi-disciplinary approach to earthquake problems, and a multi-hazard approach to disaster problems in general. He stated that seismic risk is often underestimated and cited the particularly high losses of the year 1976 (more than 800,000 deaths and billions of dollars of damage), which ranked earthquakes as possibly the most destructive among natural phenomena. Mr. Lévy spoke of the need for Unesco and UNDRO to take a special initiative in encouraging government authorities to make plans against earthquakes, these being one of a set of multiple risks to which many developing countries are exposed. The effect of these risks, and their negative impact on development, is more than simply cumulative and must be considered compositely. He pointed to the need to evaluate earthquake risk in as precise terms as possible, intended for direct use by planners.

The Committee adopted its Rules of Procedure, in accordance with its Statutes and with the appropriate regulations for meetings convened by Unesco.

4. Elections

The Committee elected its officers for its first session as follows:

Chairman:	Professor Tsuneji Rikitake (Japan)
Vice-Chairman:	Dr. Ali Akbar Moïnfar (Iran)
Rapporteur:	Dr. John Tomblin (Trinidad and Tobago)

5. Agenda

The meeting had before it the following agenda:

1. Opening of the session by the representative of the Director-General of Unesco
2. Address by the representative of the United Nations Disaster Relief Co-ordinator
3. Election of Chairman
4. Adoption of Rules of Procedure
5. Election of Vice-Chairman and Rapporteur
6. General review of the Final Report of the Intergovernmental Conference on the Assessment and Mitigation of Earthquake Risk

7. Seismic hazard and risk assessment
 - 7.1 The definition of seismic hazard and risk
 - 7.2 Seismic macro-zoning (regional studies)
 - 7.3 Seismic micro-zoning
 - 7.4 Field studies of earthquakes
 - 7.5 Associated phenomena and risks
 - 7.5.1 Induced seismicity
 - 7.5.2 Tsunamis
 - 7.5.3 Landslides
 - 7.5.4 Fire (urban conflagration)
 - 7.6 Earthquake prediction
 - 7.6.1 Scientific aspects
 - 7.6.2 Social and economic aspects
8. Prevention
 - 8.1 Vulnerability analysis: the basis for prevention
 - 8.2 Planning measures for prevention
 - 8.2.1 Regional development
 - 8.2.2 Physical planning and land use: the impact of vulnerability analysis on spatial planning and control
 - 8.3 Building and engineering measures for prevention
 - 8.3.1 Building codes and regulations
 - 8.3.2 Housing and related facilities
 - 8.3.3 Utilities
 - 8.3.4 Infrastructure and communications
 - 8.3.5 Industry
 - 8.3.6 The protection of historical monuments
 - 8.4 Other measures
 - 8.4.1 Financial measures and fiscal policies (e.g. mortgage policies, savings and loans, insurance, taxation)
 - 8.4.2 Administration and implementation of disaster prevention and mitigation policies and measures
9. Education and training
 - 9.1 Seismology and earthquake engineering
 - 9.2 Other relevant disciplines; public education and information
10. Priorities for action by Unesco and UNDRO
11. Adoption of report
12. Date and place of second session

6. Review of resolutions of the Unesco Intergovernmental Conference of February 1976, and progress with their implementation

The majority of the first day was spent in reviewing the resolutions of the above Conference and the action taken to implement them. The resolutions were introduced in turn by the Chairman, whilst the relevant background, and the response to date by Unesco or other agencies, was outlined by Mr. Fournier d'Albe, representing Unesco. Comments were then invited from Committee members, consultants and Observers. The review below mentions only those resolutions (numbered as in the Intergovernmental Conference report - SC/MD/53) which led to significant new discussions.

Seismic zoning and micro-zoning

8.11 On the theme of regional projects, Mr. Fournier d'Albe noted that the Balkan seismicity survey had now come to an end, and that the final report will be completed by the end of 1977. Regional meetings supported by Unesco had taken place in Kathmandu in January 1977 and in Madrid in June 1977.

On the subject of micro-zoning, the UNDR0 representative drew attention to the recently published "Composite vulnerability analysis" for the Manila area, and to the monograph on "Land use aspects of disaster prevention and mitigation" published by UNDR0.

8.12 Regarding the formation of a global seismic data bank, it was noted that IASPEI at Durham in August 1977 had formed a committee which would meet in March 1978 to study the technical aspects of this project. At present, the International Seismological Centre is processing as a matter of routine over 1,000 epicentres per month and has a data bank on historical earthquakes since 1903, containing information on about 180,000 events.

8.3 On earthquake prediction, it was noted that a working group met at Unesco in July 1977 and that its report has been distributed. Tentative plans have been made to hold a large symposium on this subject in April 1979.

8.5 With reference to tsunamis, the Committee was told that the recommendations of the Intergovernmental Conference had been passed via the IOC (Intergovernmental Oceanographic Commission) to its Co-ordination Group for the Tsunami Warning System in the Pacific, which had discussed their implementation. It was noted that the functions of the International Tsunami Information Centre in Honolulu include the stimulation of greater public awareness of this hazard.

Engineering measures for loss reduction

9.11 In response to the recommendation that Unesco Field missions continue to investigate destructive earthquakes, it was stated that three recent missions had taken place, to Guatemala after the February 1976 event, to Friuli (Italy) in May 1976, and to Bucharest (Romania) in March 1977. After the San Juan (Argentina) earthquake of November 1977, a mission was organized by CERESIS with the support of Unesco.

9.12 On building codes, it was reported that the United Nations Economic Commission for Europe, with the assistance of the European Association for Earthquake Engineering, has initiated studies on the unification of European earthquake codes, and that a report will be presented at a meeting to be held in Belgrade in April 1978. It was also mentioned that the United Nations Centre for Housing, Building and Planning had carried out work in this field.

9.42 It was reported that a questionnaire on the behaviour of large dams and their component materials had been circulated by ICOLD to all its members. This subject was identified by the present committee as an important one because of the large investments being made in dams in many parts of the world, and because of their high potential for causing catastrophic secondary effects in the event of failure.

9.43 With regard to the formulation of earthquake-resistant building codes, it was stated that Unesco was ready to help individual countries with copies of relevant documentation or with funds for short missions by consultants. For longer missions, special funding from Unesco or from the UNDP would have to be sought.

9.44 It was noted that the IAEE will hold an international workshop on strong motion arrays in Honolulu in May 1978, to which Unesco will contribute. On the subject of a proposed data centre, the ISC had recently been obliged, due to lack of funds, to withdraw its former offer to provide this service. It was suggested that the World Data Centre A in Boulder (U.S.A.) might expand its present activity in this field.

9.5 The need to improve the earthquake resistance of dwellings was identified as a high priority. The United Nations Centre for Housing, Building and Planning, UNDR0 and others have produced publications dealing with this and other subjects referred to in the resolution. The development of adequate methodologies was necessary for the assessment of damage.

Implications of earthquake risk: economic, human and social

10.1 A meeting took place at Unesco in August 1977 of a working group on the economic implications of earthquake risk. Copies of the resulting report (SC/629/2) were distributed. This report contains a proposal for a larger meeting on insurance problems, to be held possibly in Mexico in late 1978.

Field studies of earthquakes

11.2 In the past, about 20 per cent of the Unesco budget for seismology has been used for post-earthquake reconnaissance missions. Whilst these were judged to be important, it was noted that they were not always desired by a stricken country, in part because local expertise was considered adequate, or because too many foreign specialists had already descended upon the country.

Interdisciplinary education and training

11.31 Short training courses in earthquake engineering have been sponsored by Unesco in the Balkan countries, Italy and Mexico. These will be continued and possibly extended to cover seismology, seismotectonics and earthquake prediction, in 1978 and 1979.

11.34 In addition to the courses referred to in 11.31, Unesco also acts as the executing agency for the UNDP in larger training projects, such as the Institute of Earthquake Engineering and Engineering Seismology at the University of Skopje.

11.36 For the purpose of public education, use has been made in China and other countries of films, posters, booklets and film strips. Spot announcements are made on television in the U.S.A., but more extensive presentations were judged to be desirable, especially because a survey made of public information on earthquake phenomena in California showed that 95 per cent of the information received by the public came from television broadcasts. The articles in the Unesco Courier of May 1976 were cited as an example of material suitable for use in public education.

General comments

It was remarked that the resolutions of the Intergovernmental Conference were addressed in part to Unesco and UNDRO and in part to Member States. In some cases they were insufficiently clear or required more financial resources than were available. For those recommendations addressed to Member States, Unesco and UNDRO should undertake promotional activity and should amplify and interpret where necessary.

On the subject of available resources, the Unesco budget for work on earthquakes was noted to be about US. \$110,000 per annum in 1977-1978, and would probably increase by eight per cent for 1979-1980. Between one and one-and-a-half Unesco staff were occupied full time on earthquake problems. There had been no significant change in this level during the last ten years. UNDRO's resources for activities in the field of earthquake disaster prevention were likely to be reduced in the near future.

The Chairman then invited each Observer in turn to inform the Advisory Committee of the functions or interests, with respect to earthquake risk assessment and mitigation, of the organization which he represented. In addition to the verbal presentation, a written summary was submitted by each Observer and is reproduced in Annex III to this report.

A brief review was then given of the types of action which Unesco can undertake. These fall into two groups, firstly international co-operation and secondly assistance to Member States, the latter being not a planned activity but a response to individual requests. Under international co-operation, Unesco arranges its own meetings, provides assistance to other bodies to hold meetings, arranges special studies and publications, and supports training courses. It attempts to establish bridges between organizations and between disciplines, and thus to focus expertise on particular problems.

The responsibilities of UNDRO were then outlined; in the context of the Committee's activities, UNDRO's role in the field of prevention was of primary concern. It is estimated that in many developing countries, an average of between three and five per cent of the gross national product is lost through natural disasters annually, and this often results in a net backward movement of the economy. One of the most critical issues is the choice of locations for major new development. The second main line of defence against catastrophes is to ensure adequate resistance of structures. From the point of view of hazard assessment, one of the main gaps was the lack of sufficient data on the total cost of catastrophes, including indirect costs such as losses of production.

As a practical matter, it was pointed out that only a small proportion of the recommendations of the Intergovernmental Conference Report of February 1976 could be implemented or effectively supported by Unesco and UNDRO with their present funds, and that the Advisory Committee would have to be selective in establishing priorities for immediate action. In addition to fixing priorities among the various objectives, guidance was needed on methods of achieving them. It was noted that the function of Unesco and UNDRO was not so much to guide basic research, as to identify and promote actions which can profitably be taken by international bodies or individual countries.

7. Seismic hazard and risk assessment

Hazard, risk, macro- and micro-zoning

At the outset, it was decided to group together items 7.1 through 7.3 of the agenda for the purpose of discussion. For a definition of terms, reference was made to previous Unesco meetings which had defined, as a conceptual basis for discussion, risk as a function of three variables: value, vulnerability and hazard.

Questions were raised regarding the objectives of the present Advisory Committee with respect to zoning, whether the zoning studies emerging from the Unesco Balkans project had been a useful exercise, and what attention, in general urban and land-use planning, should be given to seismic risk.

From the point of view of the earth scientist, it was pointed out that many engineers and planners do not appreciate the high level of uncertainty in many basic earthquake data. There is a need for closer communication in such matters between seismologists and those who use the seismological data. An international symposium, or regional symposia, on zoning was recommended to develop greater awareness of available techniques.

In the view of engineers, the processing and presentation of geological and seismological data should be tailored carefully to match the needs of the users. It was noted that techniques for data processing had in some cases become far more sophisticated than was justified by the raw data, which often contain large uncertainties. This applied specially to the locations and magnitudes of earthquakes before 1950. It was stated that in many cases users are well aware of the limitations of present data, but cannot wait for an improvement. The conclusion was that micro-zoning methods especially are not yet very reliable and that there is an urgent need to improve and define them. This has been illustrated recently in Bucharest, in Skopje, and in an experiment using four different methods of micro-zoning in Thessaloniki, which gave widely different results. The argument was raised that with the expected large increases in urban populations in seismic areas over the next few decades, the development of an effective strategy for urban planning was very important, bearing in mind the need for a multi-hazard approach.

In China various attempts have been made to introduce the time-element into macro-zoning and to produce zoning maps for the next, say, 100 years; however, the problem is extremely complicated.

The Committee took note of the decision of IASPEI to study the feasibility of establishing a global seismological data bank. The need was also stated for carrying out searches through early historical archives for references to damaging earthquakes. However, it was pointed out that the collection of historical data was a slow and costly process, and that historical documents often contain uncertainties and exaggerations. It was noted that funding provided for investigations relating to nuclear power station sites can sometimes support local archive searches.

Field studies of earthquakes

In discussing the objectives and achievements of recent Unesco reconnaissance missions, it was noted that these continued to produce valuable results, although because of growing national expertise, the Unesco teams had in some cases been commissioned to study certain specialized aspects (e.g. schools and monuments in the Friuli, Italy, earthquake of 1976) instead of reviewing all the effects of the earthquake. As distinct from earthquake reconnaissance missions sent immediately after destructive events, study missions examining the effects of earthquakes in more detail (including also their economic and social effects) would yield valuable information. It was suggested that Unesco might encourage earthquake-prone countries to examine their present national abilities to carry out post-earthquake studies, and to establish standing arrangements with those foreign institutions which were best fitted to undertake the additional scientific investigations which were likely to be required.

A request was made that Unesco make an inventory of the human and instrumental facilities available in different countries for post-earthquake field studies. It was stated in reply that Unesco already keeps a roster of individuals who can be called upon for field missions.

Associated phenomena and risks

The phenomena included under this heading were induced seismicity, tsunamis, landslides and urban conflagration. Of these, induced seismicity related to reservoirs has received the most attention, particularly from a Unesco working group which met four times between 1970 and 1975, and during two international symposia. The Unesco group had included a representative of ICOLD (the International Committee on Large Dams), and the latter is still actively collecting and interpreting data.

The problem of tsunamis has been examined by the IOC (Intergovernmental Oceanographic Commission) and is reviewed briefly in Annex IV. Landslides have been studied by two working groups under the IAEG (International Association of Engineering Geology) and to some extent by UNDRO. The phenomenon of urban conflagration has not yet been studied by Unesco or UNDRO.

Earthquake prediction

The report of the Preparatory Committee of Experts on Earthquake Prediction (SC-77/CONF.629/2, dated September 1977) was circulated as a basis for discussion of the subject. This report represents the initial planning for an international symposium scheduled to take place in April 1979.

The main objectives of this symposium will be to review the state of scientific knowledge and the social impact of earthquake prediction. The symposium will be followed immediately by a meeting of a committee of 20 to 30 people to review the results and to make recommendations for further action. For the symposium, seven main themes have been formulated and each theme will be introduced by an invited review paper. A general call for papers will be issued early in 1978.

It was understood that in addition to the proposed Unesco symposium, another symposium on earthquake prediction, supported by the U.S. National Science Foundation, had been planned to take place in Yugoslavia in 1978. No details of this were available.

A review was given of recent progress in earthquake predictions in China. It was stated that these were essentially experiments, which had met with both successes and failures, and that no final breakthrough has yet been made. Work on prediction practice has been done in parallel with basic scientific research. It must be combined with work on earthquake-resistant structural design and with participation of the broad masses of amateurs in the observation of precursory phenomena. It was noted that there had been an unusually large number of major earthquakes in China in the last two years, which had provided opportunities for testing methods of prediction.

On the subject of the response of populations to predictions, it was stated that very little was known of this subject. It is also noted that the nature of a population's response depends significantly upon the political, social and economic structure, which varies greatly from one country to another, as also do the criteria for issuing predictions.

8. Prevention

Vulnerability analysis

Two of the main elements of earthquake disaster prevention are the implementation of careful urban and land-use planning, and appropriate standards for materials and design. For calculating expectable losses to a given type structure on which to base vulnerability analysis, two alternative approaches are possible: either to

estimate the extent of structural damage from a given input ground motion, or to use data from actual losses for comparable structures during earthquake. In any case, it is desirable to calibrate conceptual models against actual events.

Planning measures for prevention

Physical planning operates over a range of scales from a region to a city and to a single block. For each of these scales, planners need maps defining different levels of vulnerability. From these it can be shown, for example, that if a vulnerable structure has to be built in a high-risk area, special precautions must be taken. There is a need also for planners to consider secondary risks such as conflagration and to make provision for the minimization of these risks. Physical planning is needed not only for new towns, but also for the redevelopment, expansion and reconstruction of cities destroyed by natural or human activity. In all cases, dialogue between seismologists and urban planners is essential. It is also desirable to apply cost-benefit analysis in assessing different alternatives, for example the cost of additional reinforcement versus relocation of an important structure. However, cost-benefit analysis is normally subject to social, cultural and other constraints, which cannot always be expressed in economic terms.

It was suggested that Unesco's contribution might be to study certain particular cases: for example, in San Juan, Argentina, the performance in the November 1977 earthquake of structures rebuilt to existing code requirements after the destructive earthquake of 1944. Such situations provide opportunities for checking the effectiveness of modern building codes.

It was noted that to rebuild after earthquake with modern-style houses was not always acceptable to the inhabitants of rural areas with strong cultural traditions. After unsuccessful experiments in Iran in 1962, rebuilding after the destructive earthquakes of 1968 and 1972 had been carried out in a style close to the wishes of the people. For similar reasons, the relocation of a damaged town was likely to meet with strong opposition.

Newly published documents from China were presented to the Committee, including a new catalogue of historical earthquakes from 780 BC to the present, a text on earthquakes and anti-seismic construction, and a building code for dwellings and factories.

Building and engineering measures for prevention

Discussion centred first on rural houses, which in many developing countries are not subject to building codes. It was reported that the IAEE at its New Delhi meeting of January 1977 decided to formulate new guidelines in simple documents.

A second problem is the implementation of codes. An example was cited where concrete from reinforced structural elements had completely pulverized due to weak or poorly blended cement mixtures. For buildings and for infrastructures, essential services should be designed to remain operational even when some components fail, for example via dual inputs to water supplies and duplicate access roads.

With regard to building codes, it was emphasized that these have to suit local conditions, and that it is impossible to produce universally applicable regulations. Only the basic principles of earthquake-resistant codes are uniform on a world-wide scale. With this in mind, the most appropriate contribution from Unesco would be the provision of experts to assist in the development of basic concepts for national or regional building codes. In response to a suggestion that Unesco might help to distribute copies of national codes for reference, it was stated that the IAEE was already carrying out this service at regular intervals, and that the United Nations Centre for Housing Building and Planning had been active in this field for some years.

It was noted that in some countries with high seismicity, and even with advanced seismological monitoring systems, earthquake-resistant building codes still did not exist or are not effectively applied.

For the purpose of protecting historical monuments, ICOMOS (International Commission for the Protection of Monuments and Sites) has established with the assistance of Unesco a multidisciplinary subcommission which will meet for the first time in December 1977. Its purposes will be firstly to safeguard monuments, and secondly to recover early historical data on earthquakes which have affected monuments.

Financial measures and fiscal policies

The report of the Unesco Working Group on the Economic Implications of Earthquake Risk (SC/629/2, dated September 1977) was taken as the basis for discussion. It is clear that insurance and reinsurance companies are deeply involved with the financial aspects of earthquake losses. In the extreme case, the total loss in a single earthquake catastrophe affecting a large metropolis could approach the total capacity of world insurance, resulting in the possible breakdown of the system. The specific proposals of the report on economic implications were to form a permanent interdisciplinary committee of experts, and to convene an international seminar on earthquake hazards and insurance.

The representative of the International Association for the Study of Insurance Economics indicated the concern of the insurance world over its poor understanding of disaster risks and its feeling of particular insecurity with regard to the underwriting of earthquake damage. On the part of seismologists, who had received many requests in the last few years for specific data relating to insurance problems, it was stated that they were modifying certain of their methods of data collection and processing, in order to produce the required data in the shortest possible time. The fact that insurance companies are now actively supporting earthquake research means that the seismologists involved are working specifically on the collection and assessment of those data which are of primary importance to the insurance industry.

Administration and implementation of disaster prevention

An illustration was given of how systems theory could be applied to earthquake disaster prevention. In practice this entails, for example in the implementation of earthquake-resistant code requirements, enlisting the support of a group which has adequate motivation to contribute the necessary funds or promotional effort. It was suggested that insurance companies had developed considerable interest in site selection and in earthquake-resistant design.

The notion was introduced of using a computer-programme type flow diagram to illustrate the sequence of interrogations and actions required for the implementation of disaster prevention measures, and for showing the parallel, interactive roles of scientists and government authorities.

9. Education and training

The last two decades have seen the emergence of a new branch of seismology resulting from the need to apply the results of pure research, particularly in earthquake engineering. It was generally agreed that there was a need to generate closer ties between seismology and earthquake engineering, and that Unesco's aid should be enlisted wherever possible, towards attaining this objective.

It was proposed that Unesco should assist the organization of courses in engineering seismology as the essential intermediate discipline. In the design of structures, the main difficulty lies in determining the models and levels of seismic loads for which the structure should be designed economically.

The question was then raised of the need for additional standard textbooks, and a discussion followed as to whether it was preferable simply to wait for authors and publishers to take the appropriate initiatives, or whether Unesco, with its customary committee approach, might attempt to generate a text, calling upon numerous invited contributors. It was recommended that, in addition to bringing engineers and seismologists together for lectures and laboratory work, much more could be gained from joint field courses. It would also be desirable for seismologists and earthquake engineers to be introduced to the elements of economic theory.

In the field of public education and information, it was stressed that television is a most effective medium, but that public lectures, films, brochures and posters were also needed. It was suggested that some effort should be made to direct specific publicity towards those involved in making decisions in which earthquake considerations had some significance (e.g. mortgage and banking officials).

It was noted that where educational material is intended for distribution in many countries, it is easier to prepare audio-visual than written material because of the translation problems involved. It was suggested that a world map of natural catastrophes would be valuable in this context.

10. Priorities for action

The discussion of the Advisory Committee, as summarized in the report up to this point, have shown the need:

- (1) to establish stronger links and mutual understanding between the specialists in the various disciplines involved;
- (2) to provide opportunities for people from developing nations to obtain access to the mainstream of technological exchange and development;
- (3) to examine critically, as a guide to preventive action, the effects of recent destructive earthquakes on man-made structures and on the populations involved.

The Committee did not feel it appropriate to assign a precise relative priority rating to each of the recommendations which it was putting forward. Taken together, these recommendations indicate the subjects which are more important or which require most immediate attention, and suggest the appropriate modes of action.

The complexity of the effects of earthquakes on buildings, structures and the social and economic fabric of human communities, and of the human and social response to earthquake risk, means that effective action against earthquakes has to be based on knowledge drawn from many disciplines. The Committee therefore emphasized the importance of the multidisciplinary approach to the planning of both research and training. In particular, this applies to the interface between seismology and earthquake engineering (engineering seismology) and to those between natural science and engineering, on the one hand, and economics, physical planning and the social sciences on the other.

The education and information of the general public concerning earthquake risks were regarded as calling for considerable effort by governments and by international organizations such as Unesco, making use of all effective means, including especially audio-visual techniques (radio and television films, posters, etc.).

11. Recommendations

As an outcome of the discussions reported above, the Committee adopted the following recommendations for action by Unesco and UNDRO in the next two years, taking into account the resources likely to be available. These recommendations concern the promotion of international co-operation in multidisciplinary research professional training in the relevant disciplines and, last but not least, public information on earthquakes and the means of protection against them. The Committee has sought to indicate the most appropriate mode of action in each case.

A. PROMOTION OF INTERNATIONAL CO-OPERATION IN RESEARCH

1. That Unesco support IASPEI in studying the need for, and feasibility of a global seismic data bank.
2. That Unesco proceed with the organization of an international symposium on earthquake prediction in 1979.
3. That, at the request or with the agreement of the country or countries concerned, Unesco sponsor case studies of the effect of earthquake-resistant building codes and regulations in reducing damage, especially where large earthquakes have occurred in a city where a specific building code has been in effect for some time.
4. That Unesco, in co-operation with UNDRO, initiate studies of the problems of insurance against earthquake risks.

B. PROFESSIONAL TRAINING

5. That Unesco organize regional seminars on seismic zoning and micro-zoning, in order to develop wider awareness of available techniques.
6. That Unesco and UNDRO offer and provide to Member States expertise to advise on the formulation of earthquake-resistant building codes.
7. That Unesco and UNDRO promote training in relevant interdisciplinary areas, especially in the interface between earth sciences and engineering.

C. PUBLIC INFORMATION

8. That Unesco and UNDRO promote, prepare and diffuse audio-visual material (films, posters, booklets, etc.) on earthquake risks and their mitigation, for public information and for use in schools.