

SUMMARY OF UNESCO ACTIVITIES IN THE FIELD OF EARTHQUAKE ENGINEERING

by

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A B S T R A C T

UNESCO has undertaken a gradually increasing programme of activities in the fields of seismology and earthquake engineering, culminating in the Intergovernmental Meeting held in Paris in March 1964. The present paper gives a brief description of these activities and an indication of probable future developments.

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I. INTRODUCTION

At its Eleventh Session, held in Paris in November-December 1960, the General Conference of UNESCO adopted a resolution authorizing the Director-General to stimulate study and research on natural phenomena, particularly geological and seismological studies and their practical applications.

At its Twelfth Session, in November 1962, the General Conference authorized the Director-General to call an intergovernmental meeting to define and agree on concerted action leading to increased knowledge of the causes and effects of earthquakes and to more effective protection against them.

The action undertaken by UNESCO during the past four years, in pursuance of these resolutions, may be summarized under five headings:

- (i) Survey Missions, to the principle seismic zones of the world;
- (ii) Field Studies of Earthquakes, by experts sent out to the sites of severe earthquakes as soon as possible after their occurrence;
- (iii) Technical Assistance Missions, including missions undertaken on behalf of the United Nations Special Fund;
- (iv) Working Groups of experts on selected subjects;
- (v) The Intergovernmental Meeting on Seismology and Earthquake Engineering, convened by UNESCO in Paris in April 1964.

## II. SURVEY MISSIONS

During 1961-1963, UNESCO sent out four survey missions successively to East and South-East Asia, South America, the Mediterranean and Middle East and to East and Central Africa. These missions were each composed of from four to six experts, including one or more specialists in earthquake engineering. They were principally fact-finding missions, whose task was to collect information, in each of the countries visited, on the following subjects:

- (a) The state of the existing networks of seismological observatories with regard to equipment, staffing and facilities for the communication, analysis and publication of their observations;
- (b) the progress made in the delimitation of seismically active areas and in the preparation of national and regional maps of seismicity and of seismic and sub-soil zoning;
- (c) the extent to which special building codes exist and are enforced in seismically active areas in order to minimize the damage and loss of life due to earthquakes and seismic sea waves;
- (d) the state of research in seismology and earthquake engineering;
- (e) the existing facilities for the training of specialists in geophysics, seismology and earthquake engineering.

The reports of these missions have been published in the form of monographs by the International Union of Geodesy and Geophysics (1 - 4).

## III. FIELD STUDIES OF EARTHQUAKES

During the past few years, UNESCO has sent out several missions of experts to undertake field studies of earthquakes, at the request of the governments of the countries concerned and with the financial support of the United Nations Technical Assistance Board.

### A. THE BUYIN-ZARA (IRAN) EARTHQUAKE OF 1 SEPTEMBER 1962

This earthquake, of magnitude 7-7 1/2 and maximum intensity IX MM, caused heavy loss of life and extensive damage in northern Iran. At the request of the Government of Iran, UNESCO sent two missions to the area:

- (i) Dr. N.N. Ambraseys (UK) arrived in Iran on 25 September 1962; and during a mission of one month's duration carried out a detailed study of the geology of the epicentral area and the damage caused by the earthquake.
- (ii) Ing. J. Despeyroux and Ing. Lescuyer, of the Société de Contrôle Technique et d'Expertise de la Construction (France), made in November-December 1962 a further study of the damage and formulated recommendations regarding the adoption of a code for earthquake resistant construction in Iran, taking into account the materials available in the country.

B. THE BARCE (LIBYA) EARTHQUAKE OF 21 FEBRUARY 1963

This earthquake, of magnitude less than 5 and maximum intensity IX MM, caused severe damage and casualties to the town of Barce.

At the request of the government, UNESCO sent to Libya Dr. J. Kazuo Minami (Japan) on a mission of two months' duration, commencing 19 April 1963. Dr. Minami made a detailed survey of the damage and submitted detailed recommendations concerning the relocation and reconstruction of the city.

C. THE SKOPLJE (YUGOSLAVIA) EARTHQUAKE OF 26 JULY 1963

This earthquake, of magnitude 6.1 and maximum intensity slightly less than IX MM, caused numerous casualties and extensive damage to the city of Skoplje.

A first examination and study of the damage suffered by the city was made by Ing. J. Despeyroux (France) who was charged by UNESCO, at the request of the Government, with a mission of two weeks' duration, commencing 7 August 1963.

Subsequently, a further three experts - Dr N.N. Ambraseys (UK), Dr A.A. Sorsky (USSR) and Dr A. Zatopek (Czechoslovakia) - were sent out by UNESCO as members of the joint UN/UNESCO Technical Assistance Mission to Skoplje. This mission, commencing 8 September 1963, carried out a detailed micro-regional study of the geology, tectonics, seismicity and soil conditions of the Skoplje area, as well as making a detailed survey of the damage suffered by the buildings in the city.

#### IV. TECHNICAL ASSISTANCE

Acting as Executing Agency for the United Nations Special Fund, UNESCO is responsible for the international contribution to the establishment in Tokyo (Japan) of an International Institute of Seismology and Earthquake Engineering. This Institute is also supported by the Japanese Government, which will assume full responsibility for it when the assistance of the Special Fund comes to an end.

Under this project, UNESCO is providing the Institute with the services of experts in seismology and in earthquake engineering, whose main task is to assist the Director in planning the annual courses and to take part in the teaching. They also have ample time and facilities for carrying out research during their stay at the Institute, which is usually for one academic year. UNESCO will award a total of 55 fellowships, over a period of 5 years, to students from the countries which wish to follow the course of studies offered by the Institute. Awards have already been made to students from 14 different countries. In addition, UNESCO will provide some funds for the purchase of equipment.

#### V. WORKING GROUPS

In preparation for the Intergovernmental Meeting on Seismology and Earthquake Engineering, UNESCO set up in 1963 several working groups on various special aspects of seismology and earthquake engineering. Among these, the following dealt with subjects of special interest to earthquake engineers:

(1) Working Group on Seismic and Seismo-tectonic Maps

This Working Group of five experts, of whom one was nominated by the International Association for Earthquake Engineering, met in Moscow in December 1963 under the chairmanship of Professor V.V. Belousov (USSR). Its report has been published by the International Union of Geodesy and Geophysics (5).

(ii) Working Group on the Principles of Earthquake Resistant Design

This Working Group of five experts, set up in consultation with IAEE, met in Tokyo in December 1963, under the chairmanship of Dr. T. Hisada (Japan). The report of this Working Group was accepted by the Intergovernmental Meeting.

(iii) Working Group on the Measurement of Strong Ground Motion

This Working Group of three experts, of whom one was nominated by IAEE, met in Paris in January 1964. Its report was accepted by the Intergovernmental Meeting and has since been published by the International Union of Geodesy and Geophysics (6).

VI. INTERGOVERNMENTAL MEETING ON SEISMOLOGY AND EARTHQUAKE ENGINEERING

An Intergovernmental Meeting on Seismology and Earthquake Engineering was convened by UNESCO at its Headquarters in Paris on 21-30 April 1964. The meeting was attended by representatives of 40 Member States, by representatives of other Specialized Agencies of the United Nations and by observers from a number of international non-governmental organizations, including the International Association of Earthquake Engineering. Dr. John H. Hodgson (Canada) was elected President of the Meeting.

The meeting adopted a series of resolutions covering the following fields:

- A. Development of the scientific study of earthquakes: increase in the number of seismological stations, organization of international and regional centers, standardization of equipment, handbook for observations.
- B. Determination of dangerous zones: preparation of catalogues, maps of epicentres, maps of centres of maximum intensity, and seismotectonic and seismic zoning maps; possible methods of arriving at a solution of the problem of forecasting earthquakes.
- C. Anti-earthquake protection: measurement of ground acceleration; codes for earthquake-resistant construction; official regulations.
- D. Protection against tsunamis.
- E. Field studies of major earthquakes.
- F. Training of seismologists and engineers specializing in earthquake-resistant construction.

The resolutions relating to Earthquake Engineering were the following:

"16. Measurements of ground motion and structural vibrations caused by strong earthquakes

1. The Meeting accepts the report prepared by the UNESCO Working Group on Measurement of Strong Ground Motion and commends the Working Group for accomplishing good work.
2. The Meeting expresses general agreement with the basic characteristics desired for strong-motion accelerographs and seismoscopes as given in the report of the Working Group on Strong Ground Motion and in the reports of the UNESCO Seismological Missions.
3. The Meeting agrees on the necessity for increased numbers and improved distribution of strong-motion accelerographs and seismoscopes, both in buildings and in other structures on various soil and rock formations.
4. The Meeting recommends that UNESCO assist in the procurement and installation of strong-motion accelerographs and seismoscopes.
5. The Meeting recommends that UNESCO should assist in the collection of information on the technical characteristics of existing strong-motion instruments, in as complete a form as possible, on a continuing basis.
6. The Meeting suggests that UNESCO give assistance in a research programme aimed at improving techniques of measurement of strong motion, giving consideration to:
  - a) Improvements in accelerographs in order to increase the accuracy of response calculations, and of integrated velocity and displacement records;
  - b) The development of new types of instrument such as strain gauges and long-period displacement devices. Additional thought should be given to the portability of certain instruments, to permit studies of local conditions after strong earthquakes;
  - c) Studies of optimum location of strong-motion accelerographs and seismoscopes, in view of such variables as soils, foundation rock, type of engineering structure, etc.;
  - d) Studies aimed at widening the range of application of strong-motion accelerographs and seismoscopes to broader problems of seismology and soil dynamics.

7. The Meeting recommends that each country in seismically active regions of the world should install an adequate number of strong-motion accelerographs of the required accuracy, both on ground of different characteristics and in buildings and structures, in accordance with the recommendations of the UNESCO Seismological Survey Missions on this subject. Further, suitable centres should be established for the collection and dissemination of the seismological records obtained with these instruments, for engineering use through the mutual co-operation of different countries. In the implementation of this project, UNESCO is requested to explore possibilities of providing appropriate assistance.

"17. Formation of an Advisory Board on Earthquake Engineering

The Meeting recommends that a permanent advisory board be established to advise UNESCO on specific investigations in the field of earthquake engineering, and on the selection of consultants. This board should work in consultation with appropriate international organizations and meet at suitable intervals.

"18. Studies of Micro-tremors

The Meeting recommends that research work be carried forward by seismologists and earthquake engineers on the problem of the correlation of local effects of micro-tremors and small earthquakes with the effects of large earthquakes. Since small earthquakes are much more numerous than large earthquakes, an established correlation would be of great value for engineering applications.

"19. Codes and regulations for earthquake-resistant design and construction

1. The Meeting accepts the report prepared by the Working Group on the Principles of Earthquake Resistant Design and commends the Working Group for the skill with which a very complicated subject has been brought within a manageable size.
2. The Meeting brings to the attention of UNESCO the importance of proper detailed town and country planning in seismic areas, and suggests that future studies in this subject be sponsored.

3. The Meeting emphasizes the importance of a close co-operation between architects and structural engineers in the design of earthquake-resistant structures. It is suggested that this co-operation might begin in the early stages of the professional education of architects and engineers.
4. The Meeting brings to the attention of UNESCO the important rôle played by government officials connected with building codes and their enforcement in the whole problem of earthquake-resistant design. Availability of pertinent information on earthquake resistant design in a simple form for non-technical personnel would be of assistance.
5. The Meeting recommends that each country in seismically active regions should have or enact official codes and regulations for earthquake resistant design and construction of buildings and other structures, and also enforce such codes and regulations by means of inspection and supervision.

In formulating suitable codes and regulations, all countries should co-operate and help mutually, with appropriate assistance from UNESCO.

6. The Meeting recommends that each country in seismic regions undertake studies for the development of detailed codes and regulations for earthquake-resistant design, taking into account local characteristics of design and construction.
7. The Meeting draws the attention of UNESCO to the need for an increased programme of research on the dynamic characteristics of buildings and other engineering works. Such a subject would be appropriate for investigation at existing International or National Centres with UNESCO co-operation in support and dissemination of information.

"20. Housing of seismic zones

1. The Meeting recommends that UNESCO establish a Working Group on earthquake-resistant design and construction, to prepare recommendations on the use of local building materials and on anti-seismic measures in housing construction.

It is recommended that each country should elaborate on the basis of such recommendations, relevant regulations, taking into account local material and building methods of the country concerned.

2. With the objective of minimizing loss of life and property damage in future strong earthquakes, the Meeting recommends that existing houses and other buildings in towns and cities in each seismic country be investigated to evaluate their earthquake resistant capacity, and that proper measures be taken to improve the situation when results of investigation so indicate. Further, adequate advance planning be established, to deal with the collapse of buildings and structures, fires and flooding, and to cope with contingencies after the occurrence of strong earthquakes. In the implementation of this programme, UNESCO is requested to provide appropriate assistance and co-operation.
3. In order to minimize economic loss, it is recommended that UNESCO and/or other United Nations Agencies, sponsor the study of appropriate methods for the effective repair and strengthening of buildings damaged by strong earthquakes."

The Meeting also adopted the following two resolutions of general interest:

- "29(3) Realizing that the implementation of the recommendations made to UNESCO for the planned development of seismology and earthquake engineering will require the advice of experts, the Meeting recommends that the International Association of Seismology and Physics of the Earth's Interior, in consultation with the International Association of Earthquake Engineering, the International Union of Geological Sciences, the International Union of Geodesy and Geophysics and the International Council of Scientific Unions, name a Committee of experts, and that UNESCO recognize this Committee as its consultative body in the implementation of the resolutions of this Meeting, support its activities and provide secretarial services.
- (4) Recognizing that the implementation of the Resolutions will require substantial financial resources, the Meeting recommends that UNESCO should explore the possibility of setting up an International Fund for the Development of Seismology and Earthquake Engineering, to be supported by voluntary contributions and should, in the meantime, accept or request support for specific projects from interested Member States, Foundations, and Regional or International Organizations."

## VII. CONCLUSIONS

The report of the Intergovernmental Meeting provides the basis on which will be planned the future activities of UNESCO in seismology and earthquake engineering. The volume of these activities will obviously depend to some extent on whether or not the proposed International Fund comes into being, and the contributions received.

The recent creation of the International Association of Earthquake Engineering is a most important step forward towards increased international cooperation in the study of the means of protection against earthquakes. UNESCO welcomes this development, and looks forward to very close collaboration with the Association during the coming years.

## REFERENCES

- (1) IUGG Monograph No.15: UNESCO Seismological Survey Missions, Part I: Report of the Mission to South East Asia, Jan. 1962.
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- (3) IUGG Monograph No.18: UNESCO Seismological Survey Missions, Part III: Report of the Mission to the Mediterranean and Middle East, October 1962.
- (4) IUGG Monograph No.25: UNESCO Seismological Survey Missions, Part IV: Report of the Mission to Africa.
- (5) IUGG Chronicle (not yet published)
- (6) IUGG Chronicle (not yet published).

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QUESTION BY: B.H. FALCONER - NEW ZEALAND

There is, I believe, a need for the translation into various national languages of worthy technical reports on earthquake studies currently available only in the particular language of the country of origin. Has UNESCO any proposals or suggestions in this regard?

AUTHOR'S REPLY: The problem of translation of technical literature is indeed a difficult one. UNESCO is endeavouring to solve it insofar as its own publications are concerned, and through its scientific documentation programme is promoting the international exchange of publications. Much must still depend, however on individual initiative.

QUESTION BY: C. LEVINE - GHANA

I suggest the formation of a team of Lecturers to go round Universities to help mount post-graduate as well as refresher courses on Earthquake Engineering.

AUTHOR'S REPLY: Through the Technical Assistance programme of the United Nations it is possible for countries to request the services of experts for either long or short-term missions of this kind. The U.N. Resident Representative in each country can always advise on the procedure for formulating such requests.