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BUILDING CONSTRUCTION UNDER SEISMIC CONDITIONS IN THE BALKAN REGION

DP/RER/79/015/H/01/37

Terminal report

Prepared for the Governments of the Balkan countries
participating in the regional project
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of J. G. Bouwkamp,
chief technical adviser

Backstopping officer. B. Der Petrossian, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

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Explanatory notes

References to dollars ($) are to United States dollars.

Besides the common abbreviations, symbols, and terms, the following have been used in this report:

CTA	chief technical adviser
NSF	National Science Foundation
SSA	special services agreement

ABSTRACT

Funded by the United Nations Development Programme (UNDP) and managed by the United Nations Industrial Development Organization (UNIDO) as executing agency, the project's Headquarters were located at the Institute of Engineering Seismology and Earthquake Engineering, Ministry of Public Works, Thessaloniki, Greece. It began in August 1981, while field work was completed in April 1984.

A major element in the project's activities was the preparation of a number of manuals which reflected the state of the art in earthquake resistant design and construction of various types of buildings, including reinforced concrete frame and shear-wall buildings; prefabricated reinforced concrete buildings; stone and brick-masonry buildings. Other manuals covered the repair and strengthening of buildings and historic monuments, post-earthquake damage evaluation and building strength assessment; and the seismic design codes of the Balkan region.

The preparation and publication of the manuals was completed by mid-1985.

CONTENTS

INTRODUCTION

This report describes the United Nations Development Programme/United Nations Industrial Development Organization project relating to building construction under seismic conditions in the Balkan region, and makes recommendations for future activities. The project was a co-operative regional effort involving the Governments of:

The People's Republic of Bulgaria
The Hellenic Republic
The Hungarian People's Republic
The Socialist Republic of Romania
The Republic of Turkey
The Socialist Federal Republic of Yugoslavia

The Mediterranean and Near Eastern regions belong to one of the world's most active seismic zones. High magnitude earthquakes occur frequently in several countries of the region, taking their toll in human lives and causing considerable losses to national economies. The major earthquakes recorded in the Balkan region during the past decades have dramatically emphasized the necessity of designing buildings and structures to resist seismic forces. After the Skopje earthquake in 1963, regional governments in the region recognized the need to study the earthquake's geology and seismicity. In addition, data on earthquake ground motion characteristics and the development of adequate standards and regulations for earthquake resistant design were considered necessary to reduce future earthquake losses to human life and property. Both the Governments and the United Nations recognized the fact that increasing numbers of specialists in engineering seismology and earthquake engineering were needed to meet these challenges.

Two UNDP projects, YUG/68/010 and YUG/75/008, helped to establish the Skopje Institute of Engineering Seismology and Earthquake Engineering. The Institute's high degree of expertise was utilized for the development of a Regional Postgraduate Training Course under project YUG/77/003. A matter of significance for the overall emphasis on earthquake hazard reduction, following the Skopje earthquake, was the creation in 1964 of the European Association for Earthquake Engineering.

Regional project REM/70/172-REM/74/009, "Survey of Seismicity in the Balkan Region", operated from 1970 to 1976; it covered Bulgaria, Greece, Romania, Turkey and Yugoslavia; with Albania participating in some of the activities. This project strengthened the existing network of seismological stations, while seismic hazard maps were prepared and published on a regional scale. It also promoted the exchange of information and data and recommended further co-operation.

The importance of seismic risk was stressed at meetings organized by intergovernmental organizations. The seminars organized at Bucharest in October 1974 on "Construction in Seismic Regions and in Regions with Difficult Ground Conditions", under the auspices of the United Nations/Economic Commission for Europe (UN/ECE), as well as the "Intergovernmental Conference on Assessment and Mitigation of Seismic Risk", organized in Paris by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in February 1976, had a bearing on this subject.

After the Vrancea earthquake on 4 March 1977, assistance was also provided to Romania through two UNDP projects, ROM/77/004, "Assistance to the National Centre of Earthquake Engineering", and ROM/77/003, "National Seismological Network". Most of the assistance was used to acquire equipment for 10 seismological stations and a central data processing base.

After the catastrophic earthquake on 15 April 1979, which struck the territory of Montenegro, the Government of Yugoslavia submitted a request to the United Nations for assistance in mitigating the seismic risk in Montenegro and for solving relevant aseismic design and construction problems. UNDP recommended that a new project should not be restricted to Montenegro but should be conceived as on a regional basis and aimed not only at meeting the immediate needs of Montenegro but also at laying the groundwork for a long-term programme of earthquake risk reduction in the Balkan region as a whole. As a result, two regional projects were developed, RER/79/014 and RER/79/015.

The first project document, "Earthquake Risk Reduction in the Balkan Region" (RER/79/014/C/01/13), was signed in mid-1980 by representatives of Bulgaria, Greece, Romania, Turkey, and Yugoslavia; and was approved by UNDP and UNESCO in September 1980. Albania joined the project in November 1981.

The second project document, developed by experts from Bulgaria, Greece, Romania, Turkey, and Yugoslavia, with the assistance of consultants from UNIDO and representatives of UNDP, "Building Construction under Seismic Conditions in the Balkan Region" (RER/79/015/D/01/37), was signed during early 1981 by representatives of Bulgaria, Greece, Hungary, Romania, Turkey, and Yugoslavia; UNDP and UNIDO signed it in April 1981.

In addition to the programmes carried out under the auspices of the United Nations, co-operative research programmes involving several universities and institutes in Yugoslavia and the United States of America were initiated by the National Science Foundation, Washington, D.C., after the Banja Luka earthquake in 1969. In this connection, a 100-unit strong-motion accelerometer network was installed in Yugoslavia in the early 1970s to obtain vitally needed earthquake ground motion data.

Finally, extensive laboratory and field studies were performed to improve design criteria for prefabricated building systems, masonry structures, and dams. Since 1973, numerous projects of this nature have been carried out under the auspices of the United States of America-Yugoslav Joint Board for Science and Technology.

RECOMMENDATIONS

The following recommendations were made:

1. Regional adoption of post-earthquake evaluation forms (annex I, volume 4).

2. Training of engineers in the use of these forms.

3. Formation of post-earthquake damage inspection teams at community, district, and national levels for immediate duty assignments in case of earthquake.

4. Formation of inspection teams for regional emergency assignments.

5. Development of a data collection and transfer centre at both the national and regional levels.

6. Instruction of engineers on repair procedures for earthquake damaged structures (see annex I, volume 5).

7. Instruction of engineers on basic aspects of earthquake damage as influenced by structural layout and design details (annex I, volumes 1, 2, and 3).

8. Instruction of construction workers on the consequences of poor workmanship (annex I, volume 1).

9. Preparation of posters for use on the job site to illustrate the above item.

10. Preparation of posters showing simplified construction procedures for single and two-storey masonry housing.

11. Instruction of engineers on structural aspects and repair procedures for historically relevant structures (annex I, volumes 5 and 6).

Dissemination of some of the above items would require translation of the manuals and certain volumes, particularly 1 and 2, needed to be reviewed and updated at regular intervals of about five years. In other cases, material should be updated when warranted by new developments.

In order to create the framework within which the recommendations could be appropriately implemented, a permanent regional Co-ordinating Committee on Earthquake Risk Reduction was essential. This Committee could direct the exchange of information and prepare such activities as joint research programmes. The Committee should have the authority to engage consultants to assist regional engineers and scientists in developing new methods and procedures to reduce seismic risk.

Half of the published manuals, approximately 500 sets, should be offered for sale. UNDP should be asked to consider distributing them among the developing countries located in earthquake-prone regions.

I. OBJECTIVES

The objectives outlined in the project document were to reduce the seismic risk to human life and property in the Balkan region and to increase the economic efficiency of building activities. Through a joint effort by the participating governments and specialized institutions in the countries of the region, the development objectives would be achieved by:

(a) Ensuring continuous co-operation in research, development, and training, and the exchange of information in the field of building construction under seismic conditions;

(b) Developing materials and components for new seismic resistant structural and building systems, employing model designs, new building technologies, and improved construction methods.

Objective 1

Establishment of a regional network of co-operating research institutions in the Balkan region capable of assisting the building sector to expand its present capacity to respond to the needs arising from seismic conditions. The project would assist in strengthening existing institutions, the development of newly established research organizations, and the familiarization of engineers and technicians with the practical tools and methods necessary for solving problems relevant to existing and planned aseismic construction. The project would develop a programme of work for the network.

Objective 2

Study of earthquake behaviour and earthquake resistant design of traditional construction, e.g. stone, brick, adobe masonry buildings (with due consideration being given to local materials and practices), steel or reinforced concrete buildings (frame- or shear-wall types), taking into consideration cast-in-situ or prefabricated construction practices, and noting the effects of ground conditions and foundation systems, including unstable soils. These studies should be performed with a view to developing model designs, design aids, regulations, handbooks, and similar documents.

Objective 3

Development of methods and techniques to assess the earthquake resistance, strengthening, and repair of undamaged or damaged constructions, as well as the proper demolition procedures for structures damaged beyond repair.

Objective 4

Development of methods and techniques for assessing earthquake resistance, strengthening and repair of cultural and historical monuments and urban nuclei.

Objective 5

Increasing the familiarity of researchers, engineers, and technicians of the participating countries with the problems and the status of research and design in earthquake engineering as well as aseismic construction practices, including innovative aseismic building technologies.

Special considerations

It was the intention of the Governments, UNDP, and UNIDO to initiate efforts to identify the means by which the experience gained during the project could be shared with other countries. While the definition of the areas of co-operation and the manner of achieving such co-operation could not be stated, efforts to this effect were to be made during the project's execution.

II. PROJECT ORGANIZATION

A. Project Co-ordinating Committee

In order to supervise and co-ordinate the project, the Governments of the participating countries appointed the following persons to serve on the Co-ordinating Committee:

Bulgaria:	Georgi Brankov, national co-ordinator
Greece:	Theodosios Tassios, national co-ordinator J. Sbokos, national co-ordinator Georgios Penelis, national representative A. Roussopoulos, national representative
Hungary:	Ferenc Hunyadi, national co-ordinator
Romania:	Radu Negru, national co-ordinator Valeriu Cristescu, national co-ordinator Silvia Hagiescu, national representative
Turkey:	Mustava Erdik, national representative
Yugoslavia:	Miladin Vucotic, national co-ordinator M. Spasojevic, national representative

Co-ordinating Committee meetings were held at Thessaloniki, Greece, from 2 to 4 November 1981; Budapest, Hungary, from 4 to 7 May 1982; Skopje, Yugoslavia, from 26 to 28 January 1983; Athens, Greece, from 12 to 14 July 1983; and Ankara, Turkey, from 3 to 6 April 1984.

B. Staffing

To ensure effective project implementation J. G. Bouwkamp was engaged as chief technical adviser (CTA). UNIDO, in consultation with the Governments, selected Thessaloniki as the duty station and appointed the CTA under a full-time, one-year contract, with effect from 1 August 1981. With the support of the Government of Greece, project offices were established in the Institute of Engineering Seismology and Earthquake Engineering.

In February 1983, N. Takada (Japan), an associate technical expert, joined the duty station for one year. Mr. Takada's services were fully supported by the Government of Japan.

Following the expiration of the CTA's initial contract, the Co-ordinating Committee asked UNIDO to retain his services on a reduced basis. Accordingly, a special service agreement (SSA), was entered into which expired on 31 July 1983. The SSA was extended twice; finally expiring on 31 July 1984.

C. Project working groups

At their first meeting, the Co-ordinating Committee agreed to form six working groups, each composed of one or more delegates from each participating country. It further decided that travel and per diem for only one national delegate, attending each of the working group meetings, would be covered from project funds.

The following working groups were formed:

Working Group A: "Frame and Shear-Wall Reinforced Concrete Buildings" (objective 2)

Ugur Ersoy, Convenor (Turkey)
Mincho Dimitrov (Bulgaria)
Dan Dumitrescu (Romania)
Vladimir Kalevras (Greece)
Boris Simeonov (Yugoslavia)
Georgy Vertes (Hungary)

Working Group B: "Prefabricated Industrialized Concrete Buildings" (objective 2)

Simeon Simeonov, Convenor (Bulgaria)
Peter Satirov (Bulgaria)
S. G. Tsoukantas (Greece)
Bela Goschy (Hungary)
Dan Constantinescu (Romania)
K. Özden (Turkey)
Drazen Anicic (Yugoslavia)

Working Group C: "Brick, Stone-Masonry and Adobe Buildings" (objective 2)

Mufit Yorulmaz, Convenor (Turkey)
Florin-Emil Dabija (Romania)
Endre Dulacska (Hungary)
S. Tercelj (Yugoslavia)
Elizabeth Vintzeleou (Greece)

Working Group D: "Damage Evaluation and Assessment of Earthquake Resistance of Contemporary Buildings" (objective 3)

G. Serbanescu, Convenor (Romania)
Nuri Akkas (Turkey)
Stavros Anagnostopoulos (Greece)
Tamas Karman (Hungary)
Branko Tozija (Yugoslavia)
L. Tzenov (Bulgaria)

Working Group E: "Redesign, Repair and Strengthening Procedures" (objective 3)

Predrag Gavrilovic, Convenor (Yugoslavia)
Nikola Ignatiev (Bulgaria)
Pavlos Kremezis (Greece)
Nicolas Laszlo (Romania)
Peter Nedli (Hungary)
Günay Ozmen (Turkey)
Costas Syrmakezis (Greece)

Working Group F: "Assessment of Earthquake Resistance, Strengthening and Repair of Cultural and Historical Monuments and Urban Nuclei" (objective 4)

George Gr. Penelis, Convenor (Greece)
Vesselin Venkov (Bulgaria)
Costas Zambas (Greece)
Bela Csak (Hungary)
Traian Popp (Romania)
Dogan Kuban (Turkey)
Drazen Anicic (Yugoslavia)

III. INPUTS

Project inputs were identified as:

(a) UNDP inputs comprising the provision of consultant services, including the services of the CTA; the award of fellowships and study tours; the supply of equipment; and financial support for meetings of project working groups;

The total UNDP input is reflected by the original project budget ($756,000). After budget revisions H, reflecting actual expenditures through 1983, UNDP inputs totalled $729,246;

(b) UNIDO inputs comprising general administrative services for project execution, other than those provided by the CTA and field office staff, and assistance in the preparation of the manuals (printing was done by UNIDO under contract);

(c) National inputs comprising field office and administrative staff (Greece); scientific, technical and administrative personnel involved in carrying out studies and research in accordance with the project work plan; and land, buildings and equipment used in conjunction with the project;

(d) Inputs from the National Science Foundation, Washington, D.C., USA, comprising advisory services through US consultants in the activities of working groups C, D, and F, and the preparation of the manuscript of working group D, using regional inputs provided by working group members and UNDP funded consultants;

The offer of participation by the National Science Foundation (NSF) was made by Dr. M. P. Gaus, Program Director, Division of Civil and Environmental Engineering, on 17 March 1982. The Co-ordinating Committee accepted the NSF offer at their second meeting, held at Budapest, from 2 to 4 May 1982.

A. Consultant services

The CTA's combined services totalled 24.5 working months and he was instrumental in developing with the working group members and consultants the basic outline of each of the manuals. He was also responsible for the final editing and preparation of the manuscripts, and played a vital role in the overall scheduling of the working group meetings.

Consultants were engaged for short periods to advise the project working groups in the formulation of their manuals and to prepare sections of the manuscripts. The specific involvement of the consultants varied among the working groups. A total of 19.5 working months of consultant services was provided for these activities. Honorarium paid amounted to about $62,000. A list is shown in annex II.

B. Fellowships and study tours

Training took the form of fellowships and study tours, totalling 16 working months during the course of the project. A list is shown in annex III.

C. Equipment

Equipment to a value of $230,299 was supplied to the participating countries in order to strengthen their national research capabilities in earthquake engineering. Details of the equipment supplied to each country are provided in annex IV.

D. Other inputs

UNDP

In addition to the costs for consultant services, individual training and equipment, UNDP project funds were used for the following purposes:

(a) Defraying the travel and subsistence costs for members of working groups (one from each country), except the host country, attending working group meetings;

(b) Defraying subsistence costs for the CTA while at the duty station;

(c) Defraying travel and subsistence costs of the CTA not only for attending meetings of the Co-ordinating Committee and project working groups, but also for consultative meetings with national co-ordinators and representatives, and with working group convenors. The costs of meetings with regional consultants and working group chairmen for guidance in the preparation of manuscripts were also paid for with UNDP project funds;

(d) Defraying the travel and subsistence costs of representatives of UNDP and UNIDO to attend meetings of the Co-ordinating Committee.

UNIDO

UNIDO inputs covered general administrative services such as contract negotiations with consultants, purchasing of equipment, accounting, and budgeting. Further inputs were reflected through advice related to the copy preparation of manuscripts.

National

The contributions of the participating countries to the project included:

(a) Provision of land and buildings needed for the installation, operation, and maintenance of the equipment supplied to each country by UNDP under the project;

(b) Provision of facilities and secretarial assistance for meetings of the Co-ordinating Committee and project working groups held in the respective countries;

(c) Provision of project field office and administrative staff by the Government of Greece, Department of Public Works;

(d) Allocation of scientific, technical, and secretarial personnel to implement project activities in each country, in accordance with the work plans of the working groups.

National Science Foundation

Inputs by the National Science Foundation (NSF) consisted of consultative services by the following experts:

Working Group C: R. Ewing
Working Group D: J. H. Wiggins
Working Group F: G. Powell

All honorariums, travel, and subsistence costs of US experts were covered by NSF. The involvement of Mr. Wiggins consisted of seven working months; he not only attended two meetings of working group D, but also prepared several parts of the working group D manual, and wrote the final manuscript.

Th. G. Toridis served as the NSF principal project co-ordinator with the CTA and participated in two working group meetings.

The total NSF contribution was estimated at about $150,000.

IV. PROJECT ACTIVITIES

A. Co-ordinating Committee

During the five meetings of the Committee the following actions were taken:

First meeting, Thessaloniki, Greece, 2-4 November 1981

The Co-ordinating Committee:

- Decided to form six working groups covering objectives 2, 3, and 4 of the project document. With the formulation of the six working group subjects, the Co-ordinating Committee deleted considering the earthquake resistant design of steel structures and focused on both reinforced concrete cast-in-situ and prefabricated buildings (working groups A and B).

- Agreed to appoint at least one national delegate to each of the six working groups.

- Agreed that each working group should hold three meetings, one each during March to April 1982; November to December 1982; and March to April 1983.

- Agreed that each working group could request the services of two consultants, one each from inside and outside the region.

- Agreed in accordance with an earlier decision by UNDP to allocate equipment funds equally to each country; and to distribute the funds available for study tours and fellowships on an equal basis.

- Instructed the CTA to prepare a revised work plan which reflected the agreed upon project execution plan which was aimed at completing the work of the working groups by August 1983.

During the first meeting, the members would present national state-of-the-art reports in the pertinent subject areas, develop a detailed outline of the manual, and decide on specific contributions to be prepared by the delegates. Finally, the members would formulate a list of possible consultants.

In the second meeting, together with the consultants, the members would review the national reports, develop a revised table of contents for the draft manual, and agree on modifications of the national contributions. At the same meeting, the members would select at least one consultant for further participation in the working group and define the consultant's task in preparing specific contributions to the manual.

In the third meeting the members would review the contributions prepared by the members and consultants and decide on final modifications to the draft manuscripts. A time-frame was set for sending the revised manuscripts to the CTA for final review, copy preparation of the entire manuscript, and its delivery to the printer.

Second meeting, Budapest, Hungary, 4-7 May 1982

The Co-ordinating Committee:

- Accepted the revised work plan.

- Endorsed the detailed outlines of the manuals which each working group had developed during the first series of working group meetings.

- Endorsed the proposal of working groups A and B to publish a seventh manual containing the national earthquake design codes as well as the CEB code (Bulletin d'information No. 160, Comité Euro-International du beton).

- Endorsed the names of the consultants proposed by the working groups.

- Accepted the NSF offer to provide advisory services on technical subjects through the participation of US engineers in the deliberations of the working groups.

- Approved the participation of working groups D and E on "Post-earthquake Damage Evaluation and Strength Assessment of Buildings under Seismic Conditions" and "Repair and Strengthening of Reinforced Concrete, Stone and Brick-Masonry Buildings", respectively, in the UNESCO-sponsored Seminar on Repair and Strengthening, to be held at Sofia, Bulgaria, from 17 to 20 May 1982.

- Approved the scheduling of two-day, public joint seminars immediately preceding the second series of working group meetings, scheduled for the period November to December 1982.

  As a result:

  Working groups A and B would offer a seminar at Thessaloniki, from 1 to 2 November 1982, on "Concrete, Frame, Shear-Wall and Prefabricated Buildings".

  Working groups D and E would offer a seminar on "Post-Earthquake Damage Evaluation, Strength Assessment and Repair Procedures", at Titograd, Yugoslavia, from 6 to 7 December 1982.

  Working groups C and F would offer a seminar on "Brick, Stone-Masonry and Adobe Buildings" and "Assessment of Earthquake Resistance, Strengthening and Repair of Cultural and Historical Monuments and Urban Nuclei", at Istanbul, Turkey, from 13 to 14 December 1982.

- Agreed to retain the services of the CTA for one additional year.

Third meeting, Skopje, Yugoslavia, 26-28 January 1983

The Co-ordinating Committee:

- Developed a proposal for post-project co-operation among the participating countries, including Albania as a participant. The project proposal was considered together with the proposal prepared for the UNDP/UNESCO project, RER/79/014, during a joint session of the two project Co-ordinating Committees. A single draft proposal to establish a Permanent Co-ordinating Committee to guide the post project co-operative efforts of earthquake risk reduction in the Balkan region was agreed upon.

The final statutes for establishing a "Permanent Co-ordinating Committee for Earthquake Risk Reduction in the Balkan Region" were presented (see annex V).

- Endorsed the activities of several working groups and allowed the scheduling of additional meetings of working group D in order to develop a manual on "Post-Earthquake Damage Evaluation and Strength Assessment of Contemporary Buildings".

Fourth meeting, Athens, Greece, 12-14 July 1983

The Co-ordinating Committee:

- Reviewed several items pertinent to the activities of the working groups, and the preparation of the manuals and their publication. It was agreed that all project participants would receive a set of the project manuals and that 50 sets would be made available to the participating countries, NSF, and Albania. A total print run of 1,000 would leave about 500 sets available for sale through a private publisher.

- Was informed that the Governments of Greece and Hungary had informally endorsed the draft statutes for the formation of a Post-Project Permanent Co-ordinating Committee, which would guide the future co-operative efforts in seismic risk reduction in the Balkan region.

- Approved the extension of the Special Service Agreement of the CTA.

Fifth meeting, Ankara, Turkey, 3-6 April 1984

The Co-ordinating Committee:

- Was informed that the Governments of Albania, Bulgaria, and Turkey had informed UNESCO of the acceptance of the draft statutes of the Permanent Co-ordinating Committee for Earthquake Risk Reduction in the Balkan region. The Government of Yugoslavia had officially informed UNDP, Belgrade, of its decision to accept the draft statutes.

- Was informed about the progress made in the preparation and publication of the manuals.

- Agreed that the convenor of working group B and the CTA should await the submittal of the consultancy report by the regional consultant. This report would form the interface between the report of the non-regional consultant and the design examples prepared by the working group members. If deemed necessary, the convenor and CTA were authorized to meet with the consultant before finalizing the manuscript of manual B.

- Approved the extension of the CTA's Special Service Agreement through July 1984.

B. Working groups

In order to meet the schedule for preparing the material for the working group manuals, each working group with the exception of working group D, met three times between March 1982 and March 1983. Working group D met on six occasions (including an ad hoc task group meeting and a consultative meeting).

The following meetings took place:

Working Group A
- Ankara (Turkey), 17 to 19 March 1982
- Thessaloniki (Greece), 3 to 5 November 1982
- Istanbul (Turkey), 21 to 25 March 1983

Working Group B
- Sofia (Bulgaria), 6 to 8 April 1982
- Thessaloniki (Greece), 3 to 5 November 1982
- Istanbul (Turkey), 21 to 25 February 1983

Working Group C
- Istanbul (Turkey), 15 to 16 March 1982
- Istanbul (Turkey), 15 to 17 December 1982
- Thessaloniki (Greece), 14 to 18 March 1983

Working Group D
- Bucharest (Romania), 2 to 4 March 1982
- Sofia (Bulgaria), 18 to 21 May 1982
- Skopje (Yugoslavia), 22 to 23 July 1982 (ad hoc task group meeting)
- Titograd (Yugoslavia), 8 to 10 December 1982
- Thessaloniki (Greece), 7 to 10 February 1983 (consultative meeting)
- Thessaloniki (Greece), 25 to 29 July 1983

Working Group E
- Titograd (Yugoslavia), 12 to 14 April 1982
- Titograd (Yugoslavia), 8 to 10 December 1982
- Thessaloniki (Greece), 7 to 11 March 1983

Working Group F
- Thessaloniki (Greece), 29 to 31 March 1982
- Istanbul (Turkey), 15 to 17 December 1982
- Thessaloniki (Greece), 14 to 18 March 1983

In addition to the above meetings, which were attended by the CTA, additional meetings took place between the CTA, convenors and consultants, as follows:

Working groups B and D, September 1983.
Working group D, November 1983 and February 1984.
Working group B, March 1985.

These meetings focused on the final formulation of the manuals and the preparation of the pertinent manuscripts. A meeting for a similar purpose took place in October 1983 between the convenor of working group F, the Yugoslav delegate to working group F, and the consultant, R. Mainstone.

The manuscripts of the manuals of working groups A, C, E, and F were completed by late 1983. The manuscript for the Working Group D manual was delayed basically because of the complexity of the subject matter. As a result, the working group required six meetings, but the actual preparation of the manuscript was delayed because editorial work on pertinent regional contributions, which had been accepted for inclusion during the last working group meeting, was not completed until early 1984. In March 1984, the NSF expert, J. H. Wiggins, who had been selected by the working group members to prepare the final manuscript, received the regional contributions. The expanded format of the manual required additional funding which was obtained from NSF by mid-1984. Subsequent review and modifications in the post-damage evaluation form caused the final publication to be delayed until early 1985.

The manuscript of working group B was initially delayed because the UNIDO consultant was unable to meet the time-schedule for preparing the necessary material. Unfortunately, despite repeated promises, the material was not

delivered. In early 1985 the convenor and the CTA decided to proceed with the publication of the manual, using only the material from the outer-regicnal consultant and the working group members.

The first manuals (working groups A, C, and E) were printed by late-1983 and early-1984. The publication of the manuals of working groups F and D followed in June 1983 and February 1985. With the publication of the working group B manual, complete sets (including the seismic design code manual) were distributed by mid-1985.

Considerable editorial work was necessary to meet publication standards, particularly for the design code manual, including retyping of major portions, integrating several contributions, and preparing the table of contents. These efforts by the CTA, together with the secretarial staff, occupied an unexpected and considerable amount of time.

The work performed by individual members fully reflected the work plan and formed a major factor in the success of the project.

V. OUTPUTS RELATED TO PROJECT OBJECTIVES

The main output of the project are the seven manuals listed in annex I. A total of 1,000 copies was printed, with volumes 1, 2, 3, and 5 presenting the state-of-the-art in earthquake resistant design, and strengthening and repair procedures for reinforced concrete and brick-masonry construction. Volume 4, which covered post-earthquake damage evaluation procedures and strength assessment methods for retrofitting earthquake damage-prone buildings, focused on the necessity to maintain regionally common damage evaluation procedures and offers guidance to engineers, building officials, and government officials in making decisions concerning the upgrading of earthquake resistance for existing structures. Strength assessment and repair procedures for historic monuments and buildings in urban nuclei, illustrated by numerous case studies, are covered in volume 6. Except for the working group D manual, the presentations were mostly aimed at the practising engineer.

In general, the immediate objectives as set out in the project document have been fulfilled. In many respects the project output is unique of its kind and coverage. It provides an insight into different national design practices and philosophies, and should aid the design engineer to obtain a better understanding about building responses under earthquake ground motions as affected by both the structural layout and detailing provisions (volumes 1, 2, and 3). Furthermore, the project output covers guidelines for both post-earthquake damage evaluation and strength assessment (volume 4). The post-earthquake damage evaluation forms, which have been developed after hours of intensive discussions, are of extreme importance for reducing earthquake risks, not only for the Balkan region but also for other earthquake regions. When used consistently, an all-important data base can be obtained with regard to the damage resulting from any earthquake, regionally as well as worldwide. This data could provide a scenario for any city or region in assessing the vulnerability of its building inventory. Information thus derived offers a sound basis for the decision process leading to strengthening and retrofitting of any buildings which could be critically susceptible to future earthquake damage. Different decision processes as well as the structural methods to be used for strengthening buildings are also presented (volumes 4 and 5).

Finally, considerations and procedures for strengthening historic monuments and buildings in urban nuclei are covered in detail (volume 6).

VI. EVALUATION OF PROJECT OUTPUTS IN TERMS OF IMMEDIATE OBJECTIVES

When assessing the extent to which the project has succeeded in achieving its immediate objectives, the following points should be recognized:

(a) The immediate objectives of the project were, although ambitious, basically realistic;

(b) Developing and implementing the objectives required the full-time efforts of the CTA, at least during the first year. Early in this period, in consultation with national experts, alternative organizational forms and work plans were developed for consideration by the Co-ordinating Committee. Subsequent discussions with the working group convenors, prior to the first working group meetings, allowed the formulation of detailed proposals for the implementation of the working group tasks. These proposals were basically followed by the working groups and required the concerted efforts of the groups, its consultants, and the CTA. The actual execution of the work plan by the different working groups during the second year required intensified efforts by everyone involved;

(c) The achievement of the objectives called for an intense concerted effort and a profound personal commitment by the scientists and engineers from the participating countries, all of whom had regular duties to perform independently of the project and none of whom could give full-time attention to the project activities. Nevertheless, the unrelenting efforts of many provided the basis for a successful project execution, and resulted in meeting the immediate objectives. The delay in formulating the manuscripts for working groups B and D manuals could possibly have been overcome with a more intense on-site effort by the CTA. However, additional funding requirements and the CTA's limited availability, were among the factors which would have made such a possibility academic. By placing the highest priority on completing the manuscripts for publication at the earliest possible date, the CTA delayed preparing the terminal report until after the publication of the manuals.

Annex I

MANUALS

Volume	Title
1	"Design and construction of seismic resistant reinforced concrete frame and shear-wall buildings"
2	"Design and construction of prefabricated reinforced concrete building systems"
3	"Design and construction of stone and brick-masonry buildings"
4	"Post-earthquake damage evaluation and strength assessment of buildings under seismic conditions"
5	"Repair and strengthening of reinforced concrete, stone and brick-masonry buildings"
6	"Repair and strengthening of historical monuments and buildings in urban nuclei"
7	"Seismic design codes of the Balkan region"

Annex II

CONSULTANTS

Name	Nationality	Working group	Days	Period
Mete A. Sozen	USA	A	22	11.03.83 to 01.04.83
Miodrag Velkov	Yugoslavia	A	56	31.10.82 to 30.04.83
Ronert Park	New Zealand	B	56	24.10.82 to 31.05.83
Emilian Titaru	Romania	B	45	01.12.82 to 31.06.83
Giorgio Macchi	Italy	C	7	11.12.82 to 18.12.82
Miha Tomacevic	Yugoslavia	C	49	12.12.82 to 31.03.83
Jakim Petrovski	Yugoslavia	D	35	01.12.82 to 10.07.83
Nicolae Laszlo	Romania	D	21	21.03.83 to 30.04.83
Horea Sawdi	Romania	D	21	01.07.83 to 15.09.83
Lo ing Wyllie	USA	E	59	01.12.82 to 30.04.83
Rowland Mainstone	UK	F	136	09.12.82 to 15.12.83
Duilio Benedetti	Italy	F	15	08.12.82 to 22.12.82

Annex III

FELLOWSHIPS AND STUDY TOURS

Fellowships

Name	Period	Country and year
R. S. Comsa (Romania)	2 months	(USA, 1983)
A. D. Kaneva-Kojuharova (Bulgaria)	1 month	(USA, 1983)
R. G. Gancheva (Bulgaria)	1 month	(USA, 1983)
P. Popescu (Romania)	3 months	(France, 1983)

Study tours

V. Kalevras (Greece)	1 week	(UK, 1983)
P. Gulkan (Turkey)	3 weeks	(USA, 1983)
P. Lenkei (Hungary)	2 weeks	(Greece, 1983)
H. M. Boncheva-Yordanova (Bulgaria)	2 weeks	(USA, 1983)
P. Z. Sotirov (Bulgaria)	2 weeks	(USA, 1983)
B. Osak and P. Nedli (Hungary)	3 weeks	(Italy, 1983)
S. A. Anagnostopoulos (Greece)	1 week	(USA, 1983)
Vujovic, Acic, Dragasevic, Vukotic (Yugoslavia)	3 weeks	(USSR, 1983)
S. Hagiescu, G. Radu (Romania)	1 week	(Greece, 1983)
Sp. Tsoukantas (Greece)	1 week	(Czechoslovakia, 1983)
K. Ersoy (Turkey)	1 week	(Czechoslovakia, 1983)
A. Polakis (Greece)	1 week	(Romania, 1983)
M. Erdik (Turkey)	1 week	(USA, 1984)
D. Erguway, T. Erdogan (Turkey)	1 week	(UK, 1984)

Annex IV

EQUIPMENT ACQUISITIONS

Country	Purchase order no./Vendor	Amount
Bulgaria	15-2-NO872 - KOSIMEX	$39,980
Greece	15-2-NO452 - Kinemetrics	$36,893
Hungary	15-2-NO417 - MTS	
	15-2-NO329 - RACAL	
	15-2-NO454 - Bruel/Kjaer	$40,033
Romania	15-2-N1045 - Digital	$39,716
Turkey	15-2-NO537 - Watanabe	
	15-2-NO533 - Kyawa	
	15-2-NO534 - H.P.	
	15-2-NO535 - SAN-EI	
	15-2-NO536 - Sprengnether	
	15-2-NO536A - H.P.	$40,292
Yugoslavia	15-3-D1118 - Staeger	
	15-3-D1119 - Huggenberger	
	15-3-D1122 - IBM	
	15-3-D1123 - Nashna	
	15-3-D1124 - Hottinger	$33,385
	Total	$230,299

Annex V

STATUTES OF THE PERMANENT CO-ORDINATING COMMITTEE FOR EARTHQUAKE RISK REDUCTION IN THE BALKAN REGION AND DRAFT WORK PLAN FOR FUTURE ACTIVITIES

PREAMBLE

Considering the necessity for continued co-operation between the Balkan countries in the field of earthquake risk reduction and taking note of the progress already made in achieving these objectives through various regional and national projects carried out in the region with the support of UNDP as well as the need and desire for the continuation of these efforts, the countries of the Balkan region have decided to create a permanent body in order to ensure the continuity of this co-operation. This co-operation is to embody the disciplines of earthquake hazard assessment, earthquake resistant design and construction, and planning for protection against earthquakes, thus contributing to overall earthquake risk reduction. The non-restricted exchange of information constitutes an integral part of this co-operation.

ARTICLE I - Name

1. The Committee shall be known as the "Permanent Co-ordinating Committee for Earthquake Risk Reduction in the Balkan Region".

2. The Committee is a regional intergovernmental committee with membership defined in article III below.

ARTICLE II - Purposes

The purposes of the Committee are:

1. To promote and encourage scientific and technical co-operation between countries of the Balkan region in action aimed at reducing the risks to life and property caused by earthquake in the region.

2. To plan, co-ordinate, and evaluate the implementation of a regional programme of research and training in the scientific and technical disciplines related to the reduction of earthquake risk.

3. To advise the Governments of the Balkan countries on the practical measures that may be taken at the regional or national level in order to reduce the risk of human and material losses in earthquakes.

4. To promote the spread of scientific and technical knowledge resulting from the above programme, particularly among the developing countries in seismic zones.

ARTICLE III - Membership

1. Membership of the Committee shall be open to the following countries:

The Socialist People's Republic of Albania
The People's Republic of Bulgaria

The Hellenic Republic
The Hungarian People's Republic
The Socialist Republic of Romania
The Republic of Turkey
The Socialist Federal Republic of Yugoslavia

2. Each member country shall be represented at meetings of the Committee by a high-ranking representative of the Government, assisted by advisers in the relevant scientific and technical disciplines, as necessary, preferably chosen from among persons actively engaged in the planning or implementation of the regional programme mentioned in article II-2 above.

3. The following international organizations shall be admitted to meetings of the Committee as observers without voting rights:

Office of the United Nations Disaster Relief Co-ordinator
United Nations Centre for Human Settlements
United Nations Development Programme
United Nations Educational, Scientific and Cultural Organization
United Nations Environment Programme
United Nations Industrial Development Organization

4. The Committee may invite, by consensus, appropriate international, regional, or national organizations to send observers to meetings of the Committee.

5. Each member country shall have one vote.

ARTICLE VI - Archives and Secretariat

1. Programme offices shall be established in each member country and shall be placed under the responsibility of the national representative. These offices shall be provided with a complete set of the relevant archives.

2. Each member country shall in turn provide the necessary secretarial services during its period of chairmanship.

ARTICLE VII - Finances

1. The cost of travel of national representatives and their advisers to meetings of the Committee, and of the travel of experts participating in meetings of the regional task groups, shall be borne by their respective governments.

2. The Government of the country in which a meeting of the Committee is held shall cover the food and accommodation expenses for the duration of the meeting of the national representative and up to two advisers from each member country attending the meeting. The same obligations shall be undertaken by the host countries with respect to the appointed experts from other member countries attending meetings of the regional task groups mentioned above, except when such expenses are met by funds from international sources.

3. The costs of travel and the living expenses of observers from international organizations attending meetings of the Co-ordinating Committee or of regional task groups, or any other meeting held under the regional programme, shall be met by the respective organizations.

4. The utilization of any financial or other assistance which may be forthcoming from international or from national organizations external to the region for the implementation of specific components of the regional programme shall be the subject of appropriate agreements or arrangements among the parties concerned.

ARTICLE VIII - Amendments

Amendments to the present Statutes shall be adopted by the Committee by consensus of its members.

ARTICLE IX - Termination

The Committee may be terminated by a simple majority vote of its members; due allowance being made for the completion of activities already undertaken.

ARTICLE X - Entry into force

These Statutes shall enter into force when five of the member countries, listed in paragraph 1 of article II, have notified UNESCO of their willingness to be bound by these Statutes.

In witness whereof, the undersigned, duly authorized by their respective governments, have signed the present Statutes.

Done in Paris this 20th February 1985 in English. The original shall be deposited in the archives of UNESCO.

Member countries	Signatures of representatives
For the Government of the People's Socialist Republic of Albania	(Signed)
For the Government of the Socialist People's Republic of Bulgaria	(Signed)
For the Government of the Hellenic Republic	(Signed
For the Government of the Hungarian People's Republic	(Signed)
For the Government of the Socialist Republic of Romania	(Signed)
For the Government of the Republic of Turkey	(Signed)
For the Government of the Socialist Federal Republic of Yugoslavia	(Signed)

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DRAFT WORK PLAN FOR FUTURE ACTIVITIES

Introduction

During the fifth meeting of the Co-ordinating Committee at Ankara from 3 to 6 April 1984, a joint meeting was held with the Co-ordinating Committee of the sister project RER/79/015, during which it was agreed that the draft statutes for the Permanent Committee defined the organizational structure for future activities. It was also agreed that scientific work should be continued along the areas defined by the working groups.

Task groups

Task groups were regarded as the most rational modes of operation for the co-operative work in synthesizing scientific achievements in the fields of interest for the Balkan countries. The preliminary groups were:

Task group	Field of interest
1	Calibration of attenuation laws
2	Standardization of dynamic soil-testing procedures
3	Vulnerability analysis
4	Harmonization of pseudo-static testing procedures of large panel structures
5	Structural performance and design criteria for large panel buildings

Among the first priority topics suggested for assignment to future task groups were:

(a) Earthquake preparedness and public education;

(b) Methodology for physical, urban, and architectural planning in seismic areas involving seismic risk elements;

(c) Harmonization of the methods and techniques for pseudo-static and dynamic testing of materials, structural elements, and structural systems;

(d) Vulnerability of modern buildings;

(e) Harmonization of procedures for the determination of earthquake parameters and analysis of seismological data (earthquake catalogue for the period 1971-1984);

(f) Repair and strengthening techniques of existing buildings;

(g) Assessment of uncertainties in seismic hazard maps;

(h) Evaluation of the effects of local soil conditions and harmonization of laboratory and *in situ* testing procedures;

(i) Behaviour of buildings under strong ground motion.

Little similarity existed between the desired areas of study and initial task group definitions. It was thought that the following task groups might be more suitable:

Task group	Areas of study
1	Vulnerability assessment of the existing building stock and repair and strengthening procedures for industrial facilities
2	Strong ground motion seismology (standardization of strong motion record processing, catalogue studies, hazard determination)
3	Analysis, design and detailing of structural systems for earthquake effects
4	Behaviour of soils and soil-structure systems
5	Earthquake preparedness, physical planning in seismic areas, and land use

Ideally, each task group should be entrusted to one participating country, and all others should be represented there in their scientific capacity. Each task group should meet at least once a year to review past work and give guidance in further activities. Each task group convenor should report to the Permanent Co-ordinating Committee regularly. If required, extra-regional consultants may be engaged for carrying out some of the group's activities, with Co-ordinating Committee approval. National representation to each task group should be limited to one person.

Regional seminars

Each task group may be charged with the task of organizing a regional seminar appropriate to its mandate. Extra-regional consultants may be engaged and be charged with the scientific preparation for these seminars. The host country should bear the cost of printing of any document related to the seminar.

Training of junior scientists and engineers

With the previous projects having already established professional ties between individuals comprising the earthquake engineering community in the Balkan region, it is important to maintain this momentum through regular exchange of younger scientists. The most reasonable form of this exchange is through short-term study tours (duration not to exceed three weeks). Each country should designate at least one institution which will act as host to visiting scholars, and should meet their local expenses on an agreed basis. Travel to and from host country should be funded by the United Nations. Details of this exchange programme should be worked out during the preliminary meeting of the Permanent Committee.

Journal/Newsletter

A quarterly or biannual publication in the form of a newsletter containing a calendar of current and forthcoming events, news regarding ongoing research activities, and abstracts of publications available to the professional community is highly desirable. This publication could be edited and distributed to designated institutions in the region; it requires a modest contribution from the United Nations to defray secretarial, reproduction, and distribution costs. The representative of the Government of Turkey wished to record its willingness to undertake this mandate.