Bi-Annual Meeting of CIB Commission W-14 (Fire)
May 29 - June 2, 1978

D. Gross and A. F. Robertson

Center for Fire Research
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

November 1978
Final Report

S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
BI-ANNUAL MEETING OF CIB COMMISSION W-14 (FIRE)
MAY 29 - JUNE 2, 1978

D. Gross and A. F. Robertson

Center for Fire Research
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

November 1978
Final Report

Working Committee Document
For Official Distribution
Not for Reference

U.S. DEPARTMENT OF COMMERCE, Juanita M. Kreps, Secretary
Dr. Sidney Harman, Under Secretary
Jordan J. Baruch, Assistant Secretary for Science and Technology
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>1</td>
</tr>
<tr>
<td>Report of Meeting</td>
<td>2</td>
</tr>
<tr>
<td>Appendix A – List of participants</td>
<td>12</td>
</tr>
<tr>
<td>Appendix B – Agenda</td>
<td>19</td>
</tr>
<tr>
<td>Appendix C – List of papers circulated to delegates</td>
<td>22</td>
</tr>
</tbody>
</table>
BI-ANNUAL MEETING OF CIB COMMISSION W-14 (FIRE)
MAY 29 - JUNE 2, 1978

D. Gross and A. F. Robertson

Abstract

A summary is presented of the discussions which took place during the 13th Meeting of CIB Commission W-14 on Fire in Lyngby, Denmark. A total of 57 delegates from 16 countries discussed the building fire safety question in terms of codes, fire incidence statistics, fire engineering education, structural fire protection, full scale experiments, fire growth and smoke movement. A list of papers circulated to delegates during the last two years is included as reference.

Key words: CIB; buildings; codes; Commission W-14; education; fire endurance; fire safety; fire tests; smoke movement; statistics.
BI-ANNUAL MEETING OF CIB COMMISSION W-14 (FIRE)
MAY 29 - JUNE 2, 1978

D. Gross and A. F. Robertson

Opening Plenary Session

The 13th Meeting of Commission W-14 on Fire of the Conseil International du Batiment pour la Recherche L'Etude et la Documentation (CIB) was convened on May 29, 1978 at the Technical University of Denmark in Lyngby, Denmark. There were a total of 57 delegates from 16 countries plus a representative from ECE making this the largest Commission W-14 meeting to date. The U.S. was represented by Robertson and Gross (NBS), Berl (APL), and Shaeman (NFPCA). A list of the delegates is attached as Annex 1.

Dr. Philip Oktander, the Director of the Danish Building Research Institute welcomed the delegates and indicated that his Institute was extremely concerned with fire matters although not actively engaged in research at the present time. He mentioned the two important world-wide trends which have a bearing on fire safety: (1) urbanization, and (2) industrialization. He tied these in to housing developments of high density and the increasing use of lightweight components such as wood and plastics rather than heavy precast concrete panels in order to reduce transportation and handling costs. He noted that such combustible lightweight components also increased the fire risk and he concluded by emphasizing that we must relate fire research work to these trends.

Mr. Eric Pedersen from the Danish Academy of Technical Sciences in Glostrop gave some details on the general arrangements for the meeting in terms of the business and social activities scheduled. Dr. Philip Thomas, Chairman of CIB W-14, proceeded with the agenda (Annex 2) which was approved without change. Likewise, the report of the previous meeting in Washington, D.C. was accepted without change. Since the agenda items did not always proceed chronologically, the agenda item number is given in parenthesis after the subject heading. A list of the papers circulated to delegates since the previous meeting in Washington is included as Annex 3.

Code Advisory Panel (3.1)

A brief report was made of the activities of the Code Advisory Panel. This panel, which was set up four years ago, has met twice formally and has had informal discussions amongst members as opportunities arose. Mr. Malhotra from the British Fire Research Station has served as Convenor and other members have included Mr. Mathez of CSTB France, Prof. Kordina of the Technical College in Braunschweig, Germany, Prof. Pettersson of Lund University in Sweden and Prof. Witteveen from TNO, Netherlands. The three tasks of the Code Advisory Panel have been (1) to study codes prior to their publication, (2) to advise code committees on the latest information relating to fire protection, and (3) to adopt a long term role of generating data on structural fire protection.
including philosophy. The panel has maintained liaison with the following major groups concerned with codes: The Federation International du Preconstrainte (FTP), The European Committee of Constructional Steelwork (ECCS), CIB Commission W-23A on Masonry Structures, and the Comite European de Industrie du Bois (CEIBois), as well as with the Economic Commission for Europe (ECE) and the Commission of the European Community (CEC). As a result of these discussions the Code Advisory Panel has finalized the preparation of a document entitled "Basis of Design for the Fire Protection of Building Structures," authored by Dr. P. H. Thomas, which is now available as CIB Publication No. 41. A draft document dealing with an analytical approach to the design of structures to provide specified protection against fire, has been prepared by Prof. Pettersson and Margaret Law and is designated as Document 78/81. Comments on this document are requested to be sent to the authors before August 31. In addition, the Code Advisory Panel has prepared for members of the International Engineering Society and other committees a series of principles and guidelines to be used in the preparation of international codes for structures to resist fires.

CIB 7th Congress (3.2)

A brief mention was made of the Seventh CIB Congress held in Edinburgh in September 1977, in which papers by Dr. Thomas, Dr. Harmathy, Mr. Hasemi and others were presented. Dr. Thomas indicated that the form of each meeting is structured by the CIB board, and that for the Edinburgh Congress, coordinators of the various commissions were invited to present review papers.

CIB Publications (3.3, 3.4, 3.5, 3.6)

With regard to CIB publications, it was announced that the first officially approved CIB publications on the subject of fire were CIB publication 41 by Dr. Thomas and CIB publication 42 by Jim Fry. Also CIB publication 48 is the Report of the Symposium held in Amsterdam in May 1977. These publications are available for purchase from the Secretary General of CIB, Mr. Janssen, P.O. Box 20704, Weena 704 Rotterdam. At the Amsterdam Symposium, which was entitled "Fire Safety in Buildings: Needs and Criteria" there were 160 participants and the purpose of the Symposium was to provide an international discussion on fire protection levels needed and how these may be achieved. As an outcome of the Symposium, a small working group has been formed to pursue initiatives and subsequently Mr. Witteveen made an appeal for increased interaction between fire researchers, fire brigade officers, code officials, insurance interests and users of buildings. This introduced the subject of relations with CTIF (Comite Technique contra Incendie et Feu) and CEA (Comite Europeane d'Assurance). For explanation, Mr. Howell, the Chief Fire Inspector in Denmark, indicated that CTIF, which has members in 28 countries worldwide, is a private organization with no direct funding or permanent secretary and consequently there cannot be any "official" representation. This led to a lively discussion among many delegates who debated the role of CIB in terms of problem definition, exploitation of the best available technology, roles of the building owner, the designer, the
engineer architect, the insurer, the fire brigade and the code official, as well as the acceptable levels of protection. Prof. Kordina expressed the view that since there are so many different approaches and philosophies to "fire safety" we should not expect a single definitive and acceptable level of protection. However, the general view was that more data needs to be made available to building designers on the potential benefits and reduced risks to be derived from the use of fire protection devices (detectors, sprinklers, etc.) and that this implementation of research could be utilized not only in the area of structural codes but also in terms of codes for protection against smoke, fire growth, personnel safety, etc.

With regard to relations with ISO, Dr. Thomas is looking toward the official ISO Coordinating Committee meeting to be held in the fall. He expressed the thought that if CIB is weak then ISO/TC 92 will diffuse into the research area. (Dr. Thomas is chairman of both ISO/TC 92 and CIB W-14.) A discussion evolved in which an attempt was made to clarify the areas where CIB is especially active and best fitted and those areas where ISO has special expertise. It was stated that ISO has expertise in test procedures and is reluctant to accept extensions into areas involving concepts of safety.

ECE Meeting (3.7)

At this time Mr. H. D. Clarke, representing the ECE (Economic Commission for Europe) Secretariat in Geneva, made some introductory remarks related to the recommendations and proposals for CIB action given in Document 78/36. He explained that ECE is not a legislative body and does not generate regulations. ECE consists of 34 member governments (including the U.S., Canada, and Russia) in five areas and its Committee on Housing, Building and Planning has as one of its goals the harmonization of building regulations, defined as the reduction of tariff barriers for general social betterment. One of the five divisions of the Committee on Housing, Building and Planning has published a directory of regulatory officials and is preparing a directory of product approval laboratories. In Document 78/36, Annex 1, there a list of eight proposals for CIB action. Some of these items have proposed milestone dates. Prof. Kordina was critical of the statement that "formidable barriers to trade are caused by lack of harmonized building regulations' codes and standards." He stated that lack of trade was usually due to other considerations, for example, different philosophies, estimates of safety, use of heavy building components, etc., rather than differences in standards. We questioned some of the wording of these proposals for action; in particular, the phrase "governments should" was too strong and outside the scope of CIB W-14, since CIB activities are totally voluntary by individuals and research organizations. Witteveen and Becker also stated that we (CIB W-14) can offer to help ECE but we cannot accept the responsibility of providing answers in terms of promised dates for the delivery of outputs since the problems we are trying to solve are difficult state-of-the-art problems.
General Technical Sessions

Survey of Higher Education in Fire Safety (4.1)

In Document 78/82 Professor Olesen from the Aalborg University Center provided a summary of fire engineering education throughout the world as of 1978. He prefaced this by stating that he was only able to assemble data on fire protection curricula from universities that he was aware of or had been referred to and which had replied to his questionnaire. World-wide, only three universities provide degrees in fire protection engineering: the University of Maryland, the Illinois Institute of Technology and the University of Edinburgh. It was noted, however, that Deakin University in Victoria, Australia, gives a graduate diploma in fire technology. Prof. Olesen agreed to extend his survey with a more specific questionnaire and requested that all delegates with knowledge of universities giving degrees, diplomas, or seminars and courses in fire protection to please advise.

Group Meetings

The meetings were divided into two group sessions. Group 1 dealt with codes, structural fire protection and full-scale fire tests. Group 2 dealt with smoke movement, fire loss statistics and fire growth and behavior. Rapporteurs were assigned to summarize the available literature in each of the topic areas.

Group 1 Discussion

This group was chaired by Mr. Malhotra and involved approximately 30 delegates. In the area of codes, a code for the design of concrete structures has been published by the Federation Internationale de la Precontrainte (FIP). A. H. Gustaferro, representing the Prestressed Concrete Institute, has worked closely with Prof. Kordina and has provided information on the PCI rational design method for fire resistance of concrete structural members. A draft report (Document 78/81) by Margaret Law and Prof. Ove Pettersson on the design for fire protection using analytical methods was circulated for comment and is planned for publication as a CIB document. This extensive report includes consideration of basic fire safety objectives, the assessment of risk, requirements and regulations, limitations of standard fire resistance tests, and theoretical fire engineering designs based on fire loads, ventilation effects, thermal properties of materials and compartment fire test data.

In the area of structural fire protection, Prof. Pettersson gave a comprehensive review of analytical and experimental studies dealing with concrete, steel and wood structures, and concluded that additional rationalization is required to reduce design for structural fire protection to comparable levels of fire safety. His review covered radiation characteristics in furnaces and in fires, use of radiation thermometers and pyrometers rather than thermocouples, analytical and differentiated design methods using decision trees, temperature time curves, estimated fire loads, flame patterns within enclosures and emerging from windows,
exposure of exterior columns to flames, and equivalent fire duration time. He compared the different relations for equivalent fire duration time proposed by Thomas, by Pettersson and by Schneider and Haksever. Prof. Pettersson then reviewed reports dealing with steel structures, concrete structures and wood structures.

In view of the strong interest in Pettersson's review he agreed to prepare a written summary for circulation to CIB W-14 members.

In the subsequent discussion of the review, the following points were brought out. With regard to comparability of furnace tests in different laboratories Mr. Danø from Denmark indicated that a combustible wall was tested repetitively six times in Norway and several times each in furnaces in Sweden, Denmark and Finland. The results were repeatable even though the furnaces differed in terms of fuel type (oil and gas) and thermal properties of the furnace construction. A report is expected to be available in several months. Dr. Harmathy indicated that the repeatability of a standard ASTM E-119 fire test was ± 4% while the repeatability of a natural fire test was ± 20%. Mr. Adam expressed the thought that moisture effects in fire test specimens are still imperfectly known and that this is a severe limitation on the use of the calculation method. Prof. Kordina expressed the need to perform fire endurance tests on complex load bearing structures in order to prove the ability and reliability of the very sophisticated computer programs to predict actual performance. He said that the ultimate goal of sophisticated analysis is to provide simplified engineering guides useful for engineers.

In the area of full-scale fire tests, Mr. Adam as rapporteur concentrated on full-scale structural fire tests, mainly on concrete elements conducted in France. This is a four phase program consisting of large-scale tests of components (beams, panels, etc.) in phase 1, with application to structures, and extension to partial assemblies in phase 2. In the third phase, anomalies from these partial tests are planned to take into account stress distributions, moisture movements, separation of layers,
spalling of concrete walls, etc. The fourth phase consists of an implementation phase, involving practical recommendations and regulatory use.

Mr. Adam then outlined a series of research needs for work on concrete and steel structures. The former included first of all the role of free moisture. It was noted that instrumented concrete structures show continuing changes in moisture gradient with time and are checked every six months. Mr. Knight (Australia) indicated that in Melbourne a lightweight concrete structure was not yet an equilibrium after nine years. Other needs for concrete structures included the use of pre-slabs as forms for poured-in-place concrete, the role of existing cracks in reinforced concrete, hyperstatic concrete structures, the formation of hinges, suspended ceilings, and the risks of spalling. The research areas for steel include protected columns, exterior columns, and massive sections. To obtain additional information and cooperation from other countries Mr. Adam has prepared a questionnaire requesting other laboratories who would be interested in cooperating in large-scale fire tests to advise him as soon as possible.

Mr. Malhotra indicated that the collection of high temperature properties of materials was one of the important future activities that he could foresee. Mr. Hadvig (Denmark) briefly summarized some of the activities in the Danish laboratories dealing with the charring of wood and plastic under three-sided heating. More detail is given in an unpublished report (copy requested).

Prof. Olesen indicated that at the Aalborg University Center he has set up three lightweight modular construction fire endurance furnaces in which the structural load and the fire exposure components are separated for flexibility. These furnaces have ceramic fiber interior surfaces over a base of mineral wool. This permits very rapid temperature buildup and cool down including the possibility of water spray cooling of the furnaces. He indicated that it took only four days to assemble a large beam furnace. More information is given in a report prepared by Mr. Hviid and Prof. Olesen (Report No. 7801 of the Aalborg Institute of Building Technology and Structural Engineering, March 1978).
Group 2 Discussion

The Group 2 discussion, chaired by Dr. Robertson, involved approximately 30 delegates. In the area of smoke control Mrs. Majou of the Centre Scientifique et Technique du Batiment (CSTB) reviewed the factors affecting smoke movement and behavior in residential-type buildings, available methods, advantages, problems and topics for future study. This is discussed in more detail in her paper 78/82. Since this was in French it was agreed that this would be translated and circulated for review and comment and it was further proposed that it be submitted to the CIB Journal, Building Research and Practice. In terms of suggestions for further studies consideration of the following factors are likely to influence the application and use of smoke control systems: (1) procedures for testing an installed system, (2) performance acceptability; (3) maintenance problems; (4) applications to existing buildings; (5) requirements on such systems in member countries; (6) effects of sprinklers on performance; (7) detection and operating devices; and (8) bibliography on smoke control systems.

In terms of fire loss statistics Mr. Shaenman discussed U.S. experience and compared it with international losses pointing out correlations between cigarette sales and fire loss as well as other factors. Shaenman illustrated fire fatality and economic loss data in graphical form. In terms of monetary loss Norway and Australia experienced somewhat higher losses in 1972 to 1974 compared to the $13 per capita loss in U.S. buildings. One of his findings suggests that although the unit fire loss is less in the higher wealth countries, the number of fires is greater resulting in higher dollar loss. Subsequently Shaenman offered to analyze national
fire loss experience world-wide over the next two years and requested statistical data from all participating countries.

Mr. Becker served as rapporteur for the subject "Growth and Spread of Fires." He grouped the large number of applicable papers into the following topics: Ventilation and Burning Behavior; Mathematical Modeling; Scale Modeling; and a miscellaneous group, including pool-type fires and fire spread in cable trays. Papers 77/9, 78/73 and 78/74 dealt with ventilation of fire compartments and burning behavior including computer modeling of preflashover fire behavior and comparison of charring and non-charring fuels. A group of papers from Japan, 78/38, 77/10, 78/39 and 78/40, were classified as being related to mathematical model studies. The latter report by Morishita involves a statistical analysis of fire spread behavior in actual building fires. The chairman noted that there is a sizeable program of computer modeling of fire behavior currently being coordinated in the U.S. by the National Bureau of Standards and invited those desiring information on the developments to write for this. Paper 77/14 by Quintiere (NBS) deals with the use of both physical and computer models to simulate fire behavior in building corridors. The conclusion from the paper was that scale models are useful for analysis of the early stages of fire behavior but may not properly take into account the effects of radiant heat transfer during fully developed fires. A number of other papers were discussed briefly, including 78/60 which is an experimental study of fires in electrical power plant cable trays. It was suggested that fire growth in the plastic insulation of such cables could be estimated from the ignition temperature of the polymer which varies over a considerable range. Paper 78/26 on the subject of thermoplastic pool-type enclosure fires was followed by a lively discussion on the question of the stability of such fires.

Fire Statistics (ECE) (4.2)

Dr. Kovacs attempted a survey of fire statistics and fire reporting. He received comments only from the U.K. and France. He said there were two major problems; one dealing with terminology and the second with the purpose of statistics which was in his view to get as accurate a picture as possible of fire loss experience according to building category. The U.K. suggested that it is preferable to restrict such statistics to life loss and to leave property loss to insurance interests. In Kovacs' presentation, he tried to analyze statistics in terms of the following types of questions: (a) How did the buildings and materials behave during real fires? (b) How did the people behave? (c) How did the fire protection devices perform? (d) How successful was the fire department in terms of the type of fire? (e) What was the effect of building design on fire growth?

In the discussion that followed it was noted that CSTB, with cooperation from the Building Construction Institute (UTI), have been using eight engineers as observers, some of whom go out with the fire brigade on the first call over a complete 24-hour period. The first objective is to provide facts about fire development suitable for researchers; the second objective is to train engineer/observers who will be able to
provide on-the-scene advice to the fire department; and the third objective is to secure better fire data and statistics. A similar system involving engineers as observers accompanying the fire brigade is used in Copenhagen. Mr. Nice (UK) indicated the difficulty of getting agreement with the fire brigades on the fire reporting form. In the U.K., a team is sent out to investigate fires after fire fighting is over to avoid potential obstruction of the fire department. In certain cases, e.g. school fires and residential fires involving deaths, in-depth investigations are made. Mr. Toyer (CSTB) said that in France firemen are appreciative of the help received from the engineers and do not look on their presence as interference or obstruction. Questions and comments are to be sent to Dr. Kovacs for an updated report which can be relayed to ECE.

Terminology of Basic Concepts (ECE) (4.3)

In the absence of Dr. Porgorzelski, no report was made on this subject.

International Fire Research Work (9)

In a general summary session, Prof. Witteveen made the suggestion that a task group be formed to study and develop the basic concepts of fire safety in buildings in terms of performance criteria. His approach was to encourage a strong dialogue and participation between CIB W-14 and code authorities, fire brigades, and insurance interests. Witteveen was extremely interested in the fire safety evaluation system developed in CFR for health care facilities. The task group set up under the chairmanship of Witteveen (Netherlands) included Kawagoe (Japan), Pedersen (Denmark), Kovacs (Hungary), and representatives from the U.K., France, Sweden, U.S., Germany and Russia.

A general discussion was held on how to improve the participation coordination and technical aspects of the next CIB W-14 meeting. This led to the suggestion that a preplanning session be held several weeks before the meeting to ensure coordination, preparation by rapporteurs, etc. Many delegates felt there was need to circulate the review articles before the meeting and to present the basic conclusions in clear graphic form at the meeting to overcome language problems. Several specific suggestions of topics for the next meeting were made. These dealt with mathematical modeling of fire growth, the effects of smoke and other behavioral aspects, fire safety evaluation systems including trade-offs, fire loss statistics, rules for evacuation, and a general review of research. As an extension of the CIB W-14 activities, Dr. Kawagoe indicated that a symposium was being planned on fire safety in buildings for Tokyo about September of 1979 and some suggestions were made for structuring this meeting which would correspond with the 20th year of CIB W-14 activity.

Round Table Discussion

A seminar on future fire research activity was sponsored by the Danish Society of Fire Technology. Seven short (10 to 15 minute) talks were presented and questions were addressed to the panelists by the audience.
Dr. Berl (U.S.) gave a presentation on fire fatalities over the past five years in the State of Maryland indicating what is known about the relationship between deaths, CO, smoking, etc. Mr. Becker (Germany) summarized fire growth and behavior needs and mentioned problems of the laboratories' small-scale tests with need for verification on large scale. Mr. Seeger (Germany) talked about air and smoke movement in buildings. Dr. Robertson (U.S.) talked about measurements of fire properties, those that are independent of the test method and those that depend upon the test method, and the need to collect multiple property values and to combine these to estimate hazard. Dr. Magnusson (Sweden) covered material responses, effect of the exposure levels, and options for fire hazard assessments in terms of the advantages and disadvantages of full-scale simulations, semi-natural scale testing, regression analysis of small and large scale data, and mathematical modeling. Bill Malhotra (U.K.) discussed fire and building codes and problems in international harmonization, and Prof. Witteveen (Netherlands) spoke about policies for fire safety in terms of social acceptability of fire risk, the amount of money to be spent and the optimum mix of fire prevention measures. His figures indicate that the annual loss caused by fire in Holland is approximately 800 million Dutch Florin of which 500 million are direct and indirect losses plus insurance costs and 300 million represents investments in fire prevention and fire brigade activity.

Next Meeting (12)

The date and the time of the next meeting were not firmed up but an offer was received from Mr. Kalos on behalf of the Technical University of Athens and consideration is being given to a date in April or May of 1980.

Aalborg University Center

At the invitation of Prof. Olesen, a visit was arranged to the Fire Research Laboratory of the Aalborg University Center. Olesen recently assembled three fire resistant furnaces for testing columns, beams and joints, at a total cost of $70,000, of which half was for furnaces, and half for load equipment and instrumentation. The unique features of these furnaces are: (a) modular construction which permitted rapid assembly (four days for the beam furnace) and which allows for simple changes in the size of the test specimen; and (b) the use of lightweight ceramic fiber insulation in place of fire brick. Such construction reduces the heating and cooling cycles and saves fuel. The features of the furnace are discussed more fully in an available report.
Appendix A

LIST OF PARTICIPANTS

AUS  AUSTRALIA

Mr. John Keough
Experimental Building Station
Department of Housing and Construction
P.O. Box 30
Chatswood
New South Wales 2067

Mr. Darryl Knight
BHP Melbourne Research Labs
245 Wellington Road
Clayton, Vic. 3168

BELGIUM

Mr. Henri Remagle
Institut National du Logement
Boulevard Saint Lazare 10
1030 Bruxelles

CDN  CANADA

Mr. Tibor Z. Harmathy
National Research Council of Canada
Montreal Road
K1A OR6 Ottawa
Ontario

DK  DENMARK

Mr. B. Bohm
The Technological Institute
Copenhagen

Mr. Ejnar Danø
National Institute for Testing of Materials
Statsprøveanstalten
Amager Boulevard 108
2300 Copenhagen S

Mr. S. Hadvíg
Laboratory of Heating and Air Conditioning
Technical University of Denmark
2800 Lyngby

Mr. Niels Jørgen Hviid
Institute of Building Technology
and Structural Engineering, AUC,
Danmarksgade 19
9000 Aalborg
DK DENMARK (cont.)

Mr. T. Jakobsen
Institute of Building Design
Technical University of Denmark
2800 Lyngby

Mr. B.Chr. Jensen
Axel Nielsen A/S

Mr. Frits Bolonius Olesen
Institute of Building Technology and
Structural Engineering, AUC,
Danmarksgade 19
9000 Aalborg

Mr. Erik Pedersen
The Danish Fire Research & Development Group
The Danish Academy of Technical Sciences
Park Alle 345
2600 Glostrup

Mr. H. Salmark
Laboratory of Heating and Air Conditioning
Technical University of Denmark
2800 Lyngby

Mr. J. Steffensen
The Danish Fire Research & Development Group
The Danish Academy of Technical Sciences
Park Alle 345
2600 Glostrup

F FRANCE

Mr. Michel Adam
U.T.I.
9, rue la Perouse
75784 Paris Cedex 16

Mr. Denis Cluzel
B/O U.T.I. Fonctionnement Services Financiers
9, rue la Perouse
75784 Paris Cedex 16

Mrs. Anne-Marie Majou
Centre Scientifique et Technique du Batiment
4, Ave. du Recteur Poincare
75782 Paris Cedex 16

Mr. Michel Toyer
Centre Scientifique et Technique du Batiment
4, Ave. du Recteur Spincare
75782 Paris Cedex 16
Mr. Wolfram Becker
Im Kastenbusch 15
6730 Neustadt-Hambach an der Weinstrasse

Mr. Fischer
Staatl. Materialprüfungsamt NW
4600 Dortmund 41
Marsbrushstr. 186

Mr. Karl Kordina
Institut für Baustoffkunde u. Stahlbetonbau
Beethovenstr. 52
3300 Braunschweig

Mr. U. Quast
Institut für Baustoffkunde u. Stahlbetonbau
Amtliche Materialprüfungsanstalt für das Bauwesen
der Technischen Universität Braunschweig
Beethovenstr. 52
3300 Braunschweig

Mr. U. Schneider
Institut für Baustoffkunde u. Stahlbetonbau
Amtliche Materialprüfungsanstalt für das Bauwesen
der Technischen Universität Braunschweig
Beethovenstr. 52
3300 Braunschweig

Mr. Paul Gerhard Seeger
Forschungsstelle für Brandschutztechnik
an der Universität Karlsruhe
Hertzstrasse 16
7500 Karlsruhe 21

Mr. Jurgen Stanke
Bundesanstalt für Materialprüfung
Unter den Eichen 87
45 Berlin

Mr. George Kalos
1, Gladstonos St.
Athens 141
THE NETHERLANDS

Mr. J.F. van Elteren
Institute TNO for Building Materials
    and Building Structures
P.O. Box 49
Delft

Mr. Leen Twilt
IBBC-TNO
P.O. Box 49
Delft

Mr. Jelle Witteveen
IBBC-TNO
P.O. Box 49
Delft

HUNGARY

Dr. Karoly Kovacs
Quality Control Institute of Buildings - EMI
Budapest

JAPAN

Mr. Y. Hasemi
Building Research Institute
Haykunin-cho, 3-28-8
Shinjuku-ku
160 Tokyo

Dr. K. Kawagoe
Tokyo Rika Daigawa
(Science Univ. of Tokyo)
Noda-shi, chiba-ken

NORWAY

Mr. H.A. Bakke
The Norwegian Fire Research Laboratory
7034 Trondheim - NTH

Mr. Niels Øistein Rimstad
The Norwegian Institute of Wood Working and Wood Technology
Forskningsveien 3 b
P.O. Box 337, Blindern
Oslo 3
Mr. Yngve Anderberg
Division of Structural Mechanics and
Concrete Construction
Lund Institute of Technology
Fack
220 07 Lund

Mr. Staffan Bengtson
Svenska Brandförsvars Foreningen
Kungsholms Hamnplan 3
112 20 Stockholm

Mr. Bertil Fredlund
Division of Structural Mechanics and
Concrete Construction
Lund Institute of Technology
Fack
220 07 Lund

Mr. Bengt Hagglund
National Defense Research Institute
Fack
104 50 Stockholm 80

Mr. Rolf Jansson
National Defense Research Institute
Fack
104 50 Stockholm 80

Mr. Sven Erik Magnusson
Division of Structural Mechanics
and Concrete Construction
Lund Institute of Technology
Fack
220 07 Lund

Mr. Ove Pettersson
Division of Structural Mechanics
and Concrete Construction
Lund Institute of Technology
Fack
220 07 Lund

Mr. Sven Thelandersson
Division of Structural Mechanics
and Concrete Construction
Lund Institute of Technology
Fack
220 07 Lund

Mr. Ulf Wickstrom
Division of Structural Mechanics
and Concrete Construction
Lund Institute of Technology
Fack
220 07 Lund
Mr. Michael Clarke  
United Nations  
Economic Commission for Europe  

Mr. M. Law  
Ove Arup and Partners  
13, Fitzroy St.  
London W1P 6 B Q  

Mr. H.L. Malhotra  
Fire Research Station  
Melrose Avenue  
Borehamwood  
Hertfordshire WD6 2BL  

Mr. G. R. Nice  
Head of Fire Research Station  
Melrose Avenue  
Borehamwood  
Hertfordshire WD6 2BL  

Mr. Philip Thomas  
Fire Research Station  
Melrose Avenue  
Borehamwood  
Hertfordshire WD6 2BL  

Mr. W. Berl  
Applied Physics Laboratory  
Johns Hopkins University  
Laurel, Md.  

Mr. Daniel Gross  
National Bureau of Standards  
B 64 Technology  
Washington, D.C. 20234  

Mr. Alexander F. Robertson  
Senior Scientist  
Programmatic Center for Fire Research  
U.S. Department of Commerce  
National Bureau of Standards  
Washington, D.C. 20234
USA THE UNITED STATES (cont.)

Mr. Philip Schaenman
National Fire Data Center
National Fire Administration
U.S. Department of Commerce
P.O. Box 19518
Washington, D.C.

SU THE SOVIET UNION

Yakovlev, Gosstroy
Labozin, Gosstroy

YU YUGOSLAVIA

Mr. Sprung
Head of the Division for Thermal Technology
Zavod za Zavarivanje i Toplinsku Tehnologiju s p.o.
41000 Zagreb
Folnegoviceva ul. 2
AGENDA

Monday, 29th May, 1978

08.00 - 9.30  Registration.

09.30

1. Opening of Meeting

2. Agenda

10.45 - 11.05  Coffee-break.


   3.1 Code Advisory Panel

   3.2 CIB 7th Congress

   3.3 CIB Publications and Policy


12.30 - 14.00  Lunch

14.00

3.5 Relations with CTIF and CEA.

3.6 Relations with ISO.

3.7 Economic Commission for Europe Meeting (Budapest Nov. 1977)
   (CIB W14 78/36(UK)) (see also 4.2 - 4.3 and co-ordinator's letter of 8th Dec. 1977).

4. General Technical Sessions

   4.1 Survey of Higher Education in Fire Safety Olesen

   4.2 Fire Statistics (ECE) Kovacs
   (see co-ordinator's letter 8th Dec. 1977)

   4.3 Terminology of Basic Concepts (ECE) Porgorzelski (see co-ordinator's letter 8th December 1977).
Tuesday, 30th May, and Wednesday, 31st May, 1978

5. **Group Sessions**

<table>
<thead>
<tr>
<th>Group</th>
<th>Session</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5.1</td>
<td>Codes (Codes Advisory Panel) - Malhotra</td>
</tr>
<tr>
<td></td>
<td>5.2</td>
<td>Other matters related to structural fire protection - Pettersson or Magnusson</td>
</tr>
<tr>
<td></td>
<td>5.3</td>
<td>Full Scale experiments - Adam</td>
</tr>
<tr>
<td>II</td>
<td>5.4</td>
<td>Smoke Movement - Majou, Cluzel</td>
</tr>
<tr>
<td>II</td>
<td>5.5</td>
<td>Reporting fires, fatalities and loss - Schaenman</td>
</tr>
<tr>
<td>II</td>
<td>5.6</td>
<td>Fire Growth and Behaviour - Becker (inc. contents and furnishings large scale tests).</td>
</tr>
</tbody>
</table>

**Daily meeting schedule:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.00</td>
<td>Session Meeting</td>
</tr>
<tr>
<td>10.30</td>
<td>Coffee-break</td>
</tr>
<tr>
<td>10.50</td>
<td>Session Meeting</td>
</tr>
<tr>
<td>12.30</td>
<td>Lunch</td>
</tr>
<tr>
<td>14.00</td>
<td>Session Meeting (Tuesday only; Wednesday afternoon is reserved for a bus excursion to North Zealand, see below).</td>
</tr>
<tr>
<td>14.00 - 18.00</td>
<td>Session Meeting (Tuesday only; Wednesday afternoon is reserved for a bus excursion to North Zealand, see below).</td>
</tr>
</tbody>
</table>

6. **Bus Excursion to North Zealand.**

(Frederiksborg Castle and Louisiana Museum of Modern Art).
General Sessions

Thursday, 1st June, 1978

09.00 - 7. Reports by Group Chairmen.
- 10.30 8. Discussion of Reports.
10.30 - 10.50 Coffee-break.
10.50 - 17.00 9. International Fire Research
Work and Organisation of W14.
Proposals for future Activities.
12.30 - 14.00 Lunch.
Session continued

Friday, 2nd June, 1978

09.00 - 10. Future Activities (continued)
11. Any other Business
10.30 - 10.50 Coffee-break.
10.50 - 12. Date and Place of next Meeting.
13. Closure at mid-day.
12.30 - 14.00 Lunch.

Friday, 2nd June, 1978

14.00 - Open Session with invited Guests based on
Rapporteurs' and Chairmen's reports and agreed
future Programme.
16.30 - Reception in Faculty Club.
Hosted by the Danish Society of Fire Technology.

Names of rapporteurs are shown underlined.
CIB COMMISSION W14

LIST OF PAPERS CIRCULATED TO DELEGATES

SINCE THE MARCH-APRIL 1976 MEETING IN WASHINGTON USA

*CIB/W14/160/76 (N)* Orientational model scale tests on the behaviour of fire exposed, simply supported steel and concrete composite beams.

*CIB/W14/161/76 (N)* Critical temperature conditions of fire exposed steel frames. (A theoretical approach)

CIB/W14/162/76 (UK) Fire resistance - present and future by H L Malhotra

CIB/W14/163/76 (UK) Work by the Fire Research Station on the control of smoke in covered shopping centres by P L Hinkley

CIB/W14/164/76 (UK) Some problem aspects of fully developed room fires by P H Thomas

CIB/W14/165/76 (UK) Principles of building fire safety (Draft for discussion) by P H Thomas

CIB/W14/166/76 (UK) CIB/W14 Report of the Code Advisory Panel International Structural Codes for Protection Against Fire by H L Malhotra

CIB/W14/167/76 (CA) Design of Furnaces for testing fire resistance of structures by J J Keough


*CIB/W14/169/75 (F)* On the fire behaviour of concrete beams by M Adam and a group of French engineers.

CIB/W14/170/76 (USSR) Investigation of the fire resistance of the industrial shop constructions by P Labozin and A Yakovlev

CIB/W14/171/76 (F) Incendies naturels aves des meubles et du papier by P Arnault, Ing. - Dr. Ing. H EHM - J Kruppa, Ing.

CIB/W14/172/76 (F) Resistance au feu des Systemes Hyperstatiques en Acier (Poutres & Portiques) by P Arnault, Ing - Dr. Ing. H EHM - J. Kruppa, Ing.
Report sur les Essais avec des Feux Naturels exécutés dans la Petite Installation de Maizières-les-Metz by P Arnault, Ing-Dr. Ing H Ehm - J Kruppa, Ing

Resistance au feu des Poutres Isostatiques en acier by P Arnault, Ing - Dr Ing. H Ehm - J Kruppa, Ing

Evolution des Températures dans des Poteaux Extérieurs Soumis à des Incendies by P Arnault, Ing - Dr. Ing H Ehm - J Kruppa, Ing

Resistance au feu des Poutres Mixtes (isostatiques et hyperstatiques) by P Arnault, Ing - Dr Ing. H Ehm - J Kruppa, Ing.

Report of the meeting of CIB commission W14 in Washington DC, USA 29 March - 2 April 1976

The assessment of smoke production by Building materials in fire. Part 4 - Large scale tests with wall lining materials. by P R Watts - revised by Barbara M Goldstone

Modelling and fire tests by P H Thomas - July 1976

Theory of equivalences. Application to thermoelasticity. by E Absi and M Borensztein (p 13 of the booklet)

and "On the fire behaviour of concrete beams" by M Adam (p.19 of the booklet)

(The booklet being tenth congress of the international association for bridge and structural engineering)
LIST OF PAPERS CIRCULATED TO DELEGATES
SINCE THE 1st JANUARY 1977

CIB W14/77/1 (USSR) FIRE PREVENTION IN TALL OFFICE BUILDINGS COMPARATIVE ANALYSIS OF BUILDING CODES.
By OPOCHINSKAYA.

CIB W14/77/2 (J) Japanese Association of Fire Science and Engineering Vol 26 No.1 1976

CIB W14/77/3 (C) 106/75(C) revised "Design of Buildings for Fire Safety" by T Z Harmathy.

CIB W14/77/4 (F) Prevision par la Calcul du Comportement at Feu Des Structures et Techniques Actuelles de Protection - Structures en beton arme - (Annales ITBTP Octobre 1976 - Serie Beton n° 161)

CIB W14/77/5 * (F) Temperature Dans un Solide Heterogene au Cours D'un Incendie.
par a Coin (Annales ITBTP mai 1976 - Serie Informatique Appliquee n° 26)

CIB W14/77/6 (C) Fire Resistance versus Flamé Spread Resistance
By T. Z. Harmathy

CIB W14/77/7 (J) Bulletin of JAFSE, Vol.26 No.2, 1976

CIB W14/77/8 (J) Visibility through Fire Smoke (Allowable Smoke Density for Escape from Fire) by Tadashisa JIN

CIB W14/77/9 (J) Numerical Calculation of the Natural Convection in Fire Compartment, by Yuji Hasemi

CIB W14/77/10 (J) A Mathematical Model of a Compartment Fire, by Takeyoshi Tanaka.


CIB W14/77/12 (USA) Fire Technology Abstracts Vol.1 Nos 1-2 July-October 1976

CIB W14/77/13 (USA) Studies of Fire Spread in multi-family residence the causes - the remedies.

CIB W14/77/14 (USA) A scaling study of a corridor subject to a room fire.

CIB W14/77/15 (USA) A robust bidirectional low velocity probe for flame and fire application.

CIB W14/77/16 (USA) Radiative characteristics of fire fighters coat fabrics

CIB W14/77/17 (USA) Survey results for fire loads and live loads in office buildings

*Papers selected for discussion at meeting.
*CIB W14/77/18 (USA) An investigation of fire environment in the ASTM E 84 tunnel test

*CIB W14/77/19 (USA) Fire performance under full scale test conditions - a state transition model

CIB W14/77/20 (USA) Combustion of mattresses exposed to flaming ignition sources - part

*CIB W14/77/21 (USA) Smoldering combustion of cotton and rayon

*CIB W14/77/22 (USA) Smoldering combustion of polyurethane foam


CIB W14/77/24 (UK) Behaviour of Wood Products in Fire. (Reprint from) Fire and Safety - H L Malhotra

*CIB W14/77/25 (C) Performance of Building Elements in Spreading Fires by T Z Harmathy.
CIB W14/78/1 (C) "Bestimmung der äquivalenten Branddauer von statisch bestimmt gelagerten Stahlbetonbalken bei natürlichen Bränden"  
CIB W14/78/2 (S) ANDERBERG, Y. - THELANDERSSON, S., Stress and Deformation Characteristics of Concrete at High Temperatures. 2. Experimental Investigation and Material Behaviour Model. Lund 1976, 84p. - Bulletin No. 54  
CIB W14/78/3 (S) ANDERBERG, Y., Fire Exposed Hyperstatic Concrete Structures - An Experimental and Theoretical Study. Lund 1976, 186p. - Bulletin No. 55  
CIB W14/78/4 (S) ANDERBERG, Y., Mechanical Behaviour at Fire of Concrete and Hyperstatic Concrete Structures. Lund 1976, 9p - Bulletin No. 56. - Doctor(s) thesis, comprising (a) = Bulletin 54 above, (b) Bulletin 55 above.  
CIB W14/78/5 (S) FREDLUND, B., - MAGNUSSON, S.E., - NILSSON, L., - PETTERSSON, O., - STRANDBERG, S., - THELANDERSSON, S., Skydd mot brandspridning inom småhusbebyggelse i lattbetong (Safety against Fire Spread within Dense Areas of One Family Houses in Aerated Concrete). Manual, Svenska Brandforsvarsforeningen (Swedish Fire Protection Association), Stockholm 1977, 103p  
CIB W14/78/6 (S) PETTERSSON, O., - MAGNUSSON, S.E., Fire Test Methods - Background, Philosophy, Development Trends and Future Needs, Nordtest Project 34-75, NORDTEST DOC GEN 011, Stockholm January 1977  
CIB W14/78/7 (USA) Development of a room fire test  
CIB W14/78/8 (USA) An assessment of the technical literature on emergency egress from buildings  
CIB W14/78/9 (USA) Vocal emergency alarms in hospitals and nursing facilities practice and potential  
CIB W14/78/10(USA) Urban neighborhoods and the fear of fire towards the specifice of a measure of the quality of life.  
CIB W14/78/11(USA) Psychological characteristics of fire setters  
CIB W14/78/12(USA) The determination of behaviour responses exhibited in fire situations  
CIB W14/78/13(USA) Fire death scenario and fire safety planning
CIB W14/78/14 (USA) Hazard analysis of fires involving blankets by H Tovey and A Vickers

CIB W14/78/15 (USA) The measurement of fabric flammability parameters in experiments simulating human movement in burn accidents

CIB W14/78/16 (USA) Synthesis of a general apparel flammability standard by John F. Krasny, Emil Braun and Richard Peacock

CIB W14/78/17 (USA) Hazard characteristics of combustion products in fires. The state of the art review by Merritt M. Birky

CIB W14/78/18 (USA) Philosophy of testing for assessment of toxicological aspects of fire exposure by Merritt M. Birky

CIB W14/78/19 (USA) Control of smoke in buildings a review by I A Benjamin, P Fung and L Roth

CIB W14/78/20 (USA) A new test for automatic fire detection devices by Richard G. Bright

CIB W14/78/21 (USA) Space heater involvements in fabric fires by Warren D. Hayes, Jr.

CIB W14/78/22 (USA) Development of the Standards for the Flammability of Children's Sleepwear by Emil Braun, James H Winger and James A Slater.

CIB W14/78/23 (USA) Reinforced Concrete Frames in Fire Environments by James M Becker, A. M. Asce and Boris Bresler, M Asce.

CIB W14/78/24 (USA) Cultural variations in the behavior of people in fire situations by Dr. John L Bryan.

CIB W14/78/25 (USA) Excess pyrolizate by P J Pagni and T M Shih

CIB W14/78/26 (USA) Thermoplastic pool compartment fires

CIB W14/78/27 (USA) Fire endurance of wood-frame and sandwich wall panels

CIB W14/78/28 (USA) Technical Bibliography on factory mutual fire research 1967-1977

CIB W14/78/29 (USA) Far eastern fire protection

CIB W14/78/30 (USA) Measurements of heat release rates on wood products and an assembly

CIB W14/78/31 (USA) Fire problems group [APL] books proceedings journal articles and reports
CIB W 14/78/32 (USA) Relationship of cyanide to deaths caused by fire

CIB W 14/78/33 N Theoretical and experimental analysis of steel structures at elevated temperatures. by Witteveen J, Twilt L, Bylaard F S K.

CIB W 14/78/34 N The stability of braced and unbraced frames at elevated temperatures. by Witteveen J, Twilt L, Bylaard F S K.


CIB W 14/78/38 (J) Basic Problems in Physical Understanding of Compartment Fire, by Tuji HASEMI

CIB W 14/78/39 (J) A Model on Fire Spread in Small Scale Buildings, by Takayoshi TANAKA

CIB W 14/78/40 (J) Statistical Analysis of Fire Spread Process in Houses, by Yasaburo MORISHITA

CIB W 14/78/41 (J) Main report of the symposium on human behavior in fire. by F. Saito

CIB W 14/78/42 (J) Bulletin of Japanese Association of fire science and engineering, Vol.27, No.1, 1977

CIB W 14/78/43 (J) Calculation methods for predicting smoke movement in building fires and designing smoke control systems, by T. Wakamatsu.

CIB W 14/78/44 (UK) Guide to design of cavity barriers and fire stops. by F Spiegelhalter

CIB W 14/78/45 (UK) Fire losses and the effect of sprinkler protection of buildings in a variety of industries and trade. by F E Rogers

CIB W 14/78/46 (UK) A cost-benefit analysis applied to foamed plastics sailings. by I C Appleton
CIB W14/78/47 (UK) Fires in dwellings - an investigation of actual fires. Part 1 Hazards due to ceiling and roof construction. by A Silcock, N P Savage and D Robinson.

CIB W14/78/48 (UK) Plastics in buildings - fire problems and control. by B F W Rogoeski

CIB W14/78/49 (UK) Smoke hazards in covered multi-level shopping malls; some studies using a model 2-storey mall. by H P Morgan, N R Marshall and Mrs B M Goldstone.

CIB W14/78/50 (UK) Fires in residential personal social services buildings.

by S E Chandler

CIB W14/78/51 (UK) Some trends in furniture fires in domestic premises.

by S E Chandler

CIB W14/78/52 (UK) Fire behaviour of foamed plastics ceilings used in dwellings

by W A Morris and J S Hopkinson

CIB W14/78/53 (UK) Collected summaries of fire research notes and BRE/FRS current papers - 1976

by L C Fowler

CIB W14/78/54 (UK) Collected summaries of fire research notes and current papers (FRS) 1975

by L C Fowler

CIB W14/78/55 (UK) Collected summaries of fire research notes 1974

by L C Fowler

CIB W14/78/56 (UK) Collected summaries of fire research notes 1973

by L C Fowler

CIB W14/78/57 (USA) Fire safety systems analysis for residential occupancies - Vol 1

CIB W14/78/58 (USA) Fire safety systems analysis for residential occupancies Vol 2

CIB W14/78/59 (USA) Fire fatalities a detailed appraisal

by W G Berl and B M Halpin

CIB W14/78/60 (USA) Cable tray fires - fire spread from a burning horizontal tray to other trays directly above.

CIB W14/78/61 (USA) Assessment of the potential impact of fire protection systems on actual fire incidents.

CIB W14/78/62 (USA) Fire in the United States (Synopsis)
CIRCULATION LIST (Page 5) 1978

CIB W14/78/63 (USA) Determinants of international differences in reported fire loss (Summary)

CIB W14/78/64 (USA) Factor mutual research technical Bibliography

CIB W14/78/65 (USA) Fire education programs in South East Asia (Sample)

CIB W14/78/66 (USA) Fire Deaths in the U.S. Review of the Data Sources and Range of Estimates


CIB W14/78/70 (C) Temperature distributions in Fire-Exposed building columns, J. Heat Transfer, 99C, 113 (1977) by T.T. Lie


CIB W14/78/73 (C)

CIB W14/78/74 (C)

CIB W14/78/75 (UK) Report of the Code Advisory Panel (CAP/W14) by Mr H L Malhotra

CIB W14/78/76/(D) Informationsdienst Holz by Prof Dr-Ing.K Kordina and Dr. Ing C.Meyer-Ottens

CIB W14/78/77 (UK) A combined overall and surface energy balance for fully-developed ventilation-controlled liquid fuel fires in compartments by M L Bullen
CIRCULATION LIST (Page 5) 1978

* CIB W14/78/78 (UK)* Revised - CIB/W14 Report of the Code Advisory Panel
International Structural Codes for Protection against fire by Mr H L Malhotra.

* CIB W14/78/79 (S)* Research and Development with application to Fire Protection of Steel Structures.
By Jorgen Thorn
1. PUBLICATION OR REPORT NO.  
NBSIR 78-1529

2. Gov't Accession No.  

3. Recipient's Accession No.  

5. Publication Date  
November 1978

6. Performing Organization Code

7. AUTHOR(S)  
D. Gross and A. F. Robertson


9. PERFORMING ORGANIZATION NAME AND ADDRESS  
NATIONAL BUREAU OF STANDARDS  
DEPARTMENT OF COMMERCE  
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No.  
7500900

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address (Street, City, State, ZIP)  
Same as No. 9

13. Type of Report & Period Covered  
Final Report


15. SUPPLEMENTARY NOTES

16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)

A summary is presented of the discussions which took place during the 13th Meeting of CIB Commission W-14 on Fire in Lyngby, Denmark. A total of 57 delegates from 16 countries discussed the building fire safety question in terms of codes, fire incidence statistics, fire engineering education, structural fire protection, full scale experiments, fire growth and smoke movement. A list of papers circulated to delegates during the last two years is included as reference.

17. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)  
CIB; buildings; codes; Commission W-14; education; fire endurance; fire safety; fire tests; smoke movement; statistics.

18. AVAILABILITY  
□ Unlimited

☑ For Official Distribution. Do Not Release to NTIS

□ Order From Sup. of Doc., U.S. Government Printing Office  
Washington, D.C. 20402, SD Cat. No. C13

□ Order From National Technical Information Service (NTIS)  
Springfield, Virginia 22151

19. SECURITY CLASS   
(THIS REPORT)  
UNCLASSIFIED

20. SECURITY CLASS   
(THIS PAGE)  
UNCLASSIFIED

21. NO. OF PAGES

22. Price