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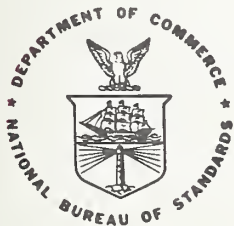
Bi-Annual Meeting of CIB Commission W-14 (Fire) May 29 - June 2, 1978

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

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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



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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

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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 Shaenman (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 Glostrup 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 Precontrainte (FIP), The European Committee of Constructional Steelwork (ECCS), CIB Commission W-23A on Masonry Structures, and the Comite Europeane 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

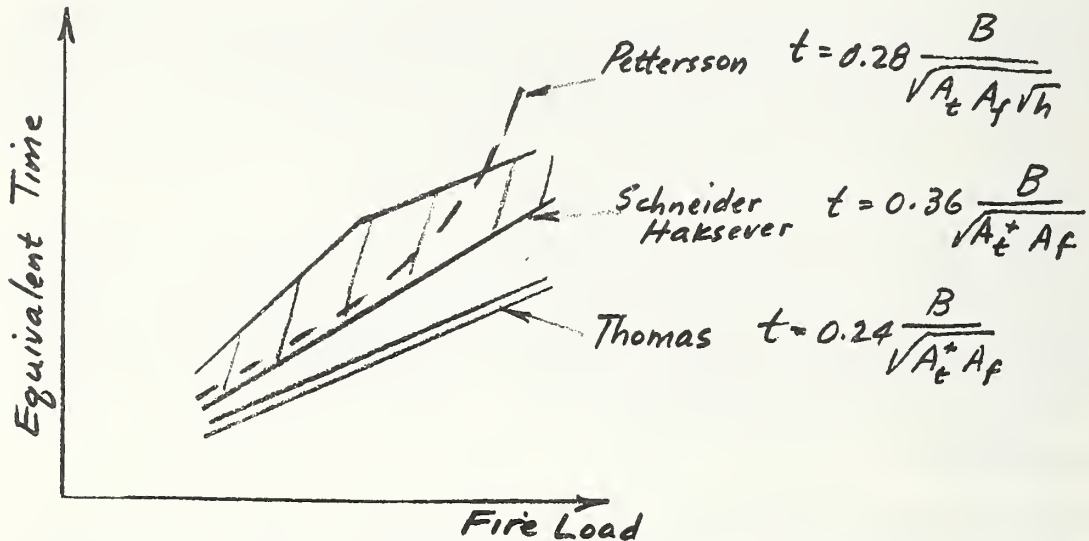
The meetings were divided into two group sessions. Group 1 dealt with codes, structural fire protection and full-scale fire tests. Group 2 dealt with smoke movement, fire loss statistics and fire growth and behavior. Rapporteurs were assigned to summarize the available literature in each of the topic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

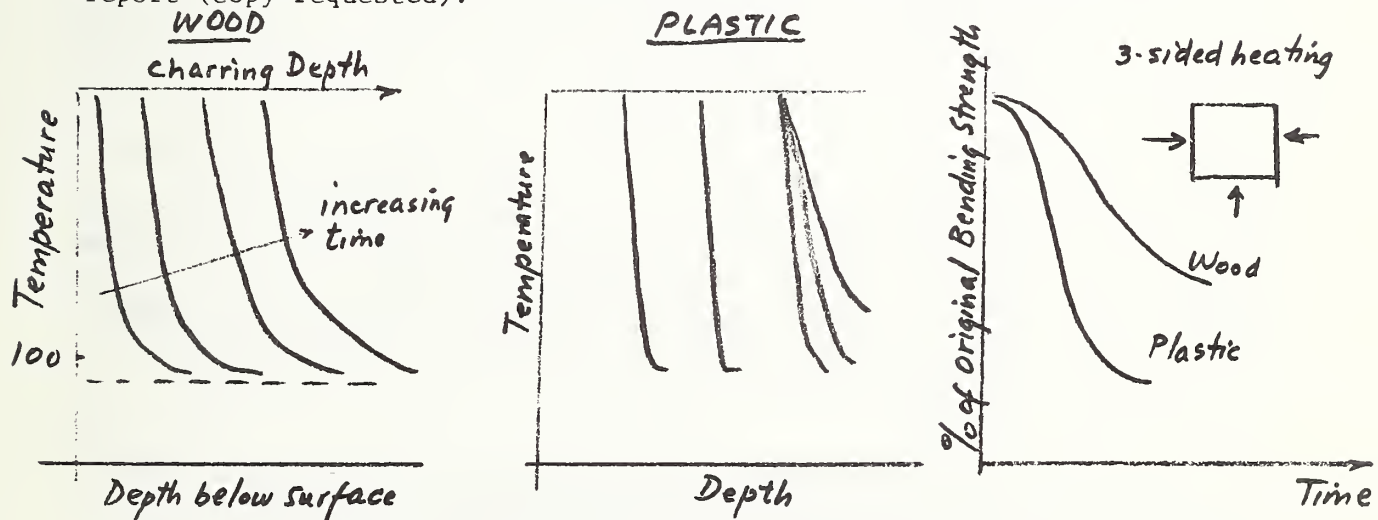
In the subsequent discussion of the review, the following points were brought out. With regard to comparability of furnace tests in different laboratories Mr. Danø from Denmark indicated that a combustible wall was tested repetitively six times in Norway and several times each in furnaces in Sweden, 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 $\pm 4\%$ while the repeatability of a natural fire test was $\pm 20\%$. 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.

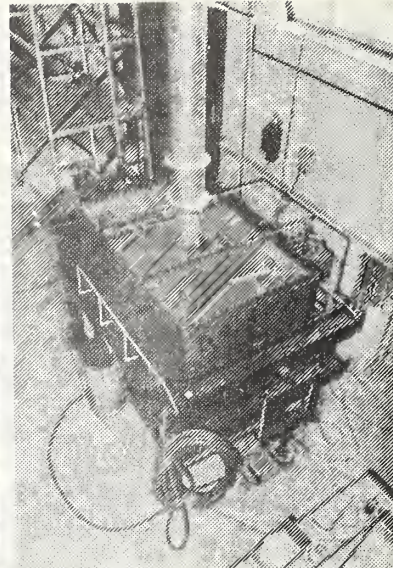
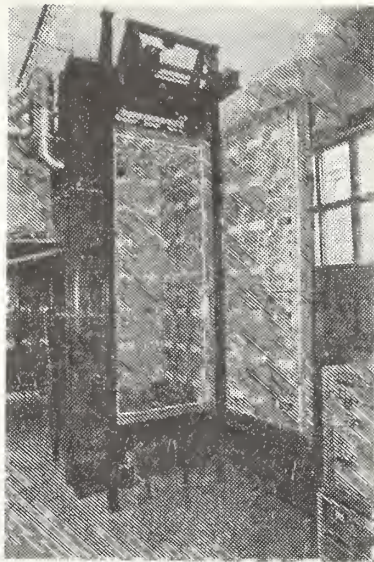
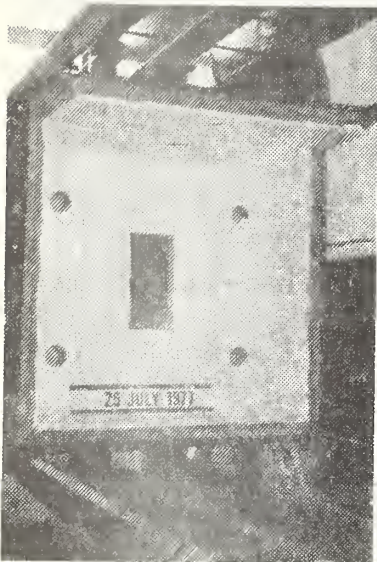
Mr. Adam then outlined a series of research needs for work on concrete and steel structures. The former included first of all the role of free moisture. It was noted that instrumented concrete structures show continuing changes in moisture gradient with time and are checked every six months. Mr. Knight (Australia) indicated that in Melbourne a light-weight 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).

Erection of furnace elements of the load equipment for beams.



Furnace of the load equipment for columns.

Combined furnace/load equipment for joints.

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.

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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. Report of CIB W14 Washington DC Meeting 1976
and CIB W14 Activity since then.
- 3.1 Code Advisory Panel
- 3.2 CIB 7th Congress
- 3.3 CIB Publications and Policy
- 3.4 Fire Safety in Buildings: Needs and
Criteria Report of Symposium in Amsterdam
1977.
- 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

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

Daily meeting schedule:

- | | |
|---------------|--|
| 09.00 - 10.30 | Session Meeting |
| 10.30 - 10.50 | Coffee-break |
| 10.50 - 12.30 | Session Meeting |
| 12.30 - 14.00 | Lunch |
| 14.00 - 17.00 | Session Meeting (Tuesday only; Wednesday afternoon is reserved for a bus excursion to North Zealand, see below). |
| 14.00 - 18.00 | 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/W14/168/76 (CA) The practicality of provisions of Australian Standard 1668 Part 1 - Fire precautions in buildings with Air-Handling Systems
by A W Moulen
- *CIB/W14/169/76 (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 avec 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.

(cont.)

CIB/W14/173/76 (F) Rapport resume sur les Essais avec des Feux Naturels
executes dans la Petite Installation de Maizieres-les-Metz
by P Arnault, Ing - Dr. Ing H EHM - J Kruppa, Ing

CIB/W14/174/76 (F) Resistance au feu des Poutres Isostatiques en acier
by P Arnault, Ing - Dr Ing. H EHM - J Kruppa, Ing

CIB/W14/175/76 (F) Evolution des Temperatures dans des Poteaux Exterieurs
Soumis a des Incendies
by P Arnault, Ing - Dr. Ing H EHM - J Kruppa, Ing

CIB/W14/176/76 (F) Resistance au feu des Poutres Mixtes (isostatiques et
hyperstatiques)
by P Arnault, Ing - Dr Ing. H EHM - J Kruppa, Ing.

CIB/W14/177/76 (UK) Report of the meeting of CIB commission W14 in Washington
DC, USA 29 March - 2 April 1976

CIB/W14/178/76 (UK) 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

CIB/W14/179/76 (UK) Modelling and fire tests
by P H Thomas - July 1976

CIB/W14/180-1/76 (F) 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)

* CIB W14 151/76 (C) *

C I B COMMISSION W14

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) * Temperatures Dans un Solide Heterogene au Cours D'un Incendie.
par a Coin (Annales ITBTP mai 1976 - Serie Informatique Appliquee n° 28)
- CIB W14/77/6 (C) Fire Resistance versus Flame 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 W14/77/11 (USA) * A Critical Review of full-scale Fire Testing
By S B Martin, S J Wierema and A Murty Kanury.
- 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 offics buildings

*Papers selected for discussion at meeting.

CIB W14 (cont) 1977

- * 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 W14/77/23 (UK) The Building fire problems (W14)
Reprinted from 'Construction Research International'
Proceedings of the Seventh Triennial CIB Congress.
Edited K Alsop Sept. 1977 by P H Thomas
- 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.

C I B COMMISSION W14

LIST OF PAPERS CIRCULATED TO DELEGATES

SINCE THE 1st JANUARY 1978

- * CIB W14/78/1 (G) * "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 lätbetong (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 specificate 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

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CIB W14/76/14 (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
I A Benjamin, F 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 Eresler, 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 pyroclizate
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 W14/78/33 N * Theoretical and experimental analysis of steel Structures at elevated temperatures.
by Wittveen J, Twilt L, Bylaard F S K.

* CIB W14/78/34 N * The stability of braced and unbraced frames at elevated temperatures.
by Wittveen J, Twilt L, Bylaard F S K.

78/35 S

* CIB W14/78/36 (UK) * United Nations Economic & Social Council Working Party on the Building Industry Ad Hoc meeting on fire protection regulations, standards and research Report. HEP/WP.2/AC.6/2 28 November 1977

CIB W14/78/37 (J) * Bulletin of Japanese Association of Fire Science and Engineering, Vol. 27 No.2, 1977

* CIB W14/78/38 (J) * Basic Problems in Physical Understanding of Compartment Fire, by Yuji HASEMI

* CIB W14/78/39 (J) * A Model on Fire Spread in Small Scale Buildings, by Takeyoshi TANAKA

* CIB W14/78/40 (J) * Statistical Analysis of Fire Spread Process in Houses, by Yasaburo MORISHITA

CIB W14/78/41 (J) Main report of the symposium on human behavior in fire.
by F. Saito

CIB W14/78/42 (J) Bulletin of Japanese Association of fire science and engineering, Vol.27, No.1, 1977

CIB W14/78/43 (J) Calculation methods for predicting smoke movement in building fires and designing smoke control systems, by T. Wakamatsu.

CIB W14/78/44 (UK) Guide to design of cavity barriers and fire stops.
by F Spiegelhalter

CIB W14/78/45 (UK) Fire losses and the effect of sprinkler protection of buildings in a variety of industries and trades.
by F E Rogers

* CIB W14/78/46 (UK) * A cost-benefit analysis applied to foamed plastic ceilings.
by I C Appleton

CIRCULATION LIST (Page 4) 1978

- * 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)

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- CIB W14/78/63 (USA) Determininants 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 W14/78/67 (C) Evaluating toxicity of decomposition products from analytical data, Proc. 1976 Intntl. Symp. Flammability and Fire Retardants, p.241 by K Sumi and Y Tsuchiya
- CIB W14/78/68 (C) Determination of hydrogen cyanide in fire gases, J. Combustion toxicology, 3, 363 (1976) by Y. Tsuchiya and K. Sumi
- * CIB W14/78/69 (C) * Structural Steel and Fire - More realistic analysis, AISC Journal, 13, 35 (1976) by T.T. Lie and W.W. Stanzak.
- * CIB W14/78/70 (C) * Temperature distributions in Fire-Exposed building columns, J. Heat Transfer, 99C, 113 (1977) by T.T. Lie
- * CIB W14/78/71 (C) * Building Design and the fire hazard, Construction specifier, June 1977, p. 21. T.Z. Harmathy.
- * CIB W14/78/72 (C) * A method for assessing the fire resistance of laminated timber beams and columns. Can. J. Civil Engng., 4 161 (1977).
- 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 6) 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

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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.) <p>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.</p>			
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.			
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