出國報告（出國類別：會議）

參加國際防火研究合作會議－
2009 國際防火研究領導人論壇年會

服務機關：內政部建築研究所

姓名職稱：雷明遠約聘研究員

派赴國家：韓國

出國期間：98 年 10 月 10 日至 10 月 16 日

報告日期：99 年 1 月 15 日

摘　要

爲執行 98 年度本所預算派員出國計畫「01 參加國際防火研究合作會議」，乃指派雷明遠研究員出席位於韓國首爾市舉行之「2009 國際防火研究領導人論壇年會(The International FORUM of Fire Research Directors Annual Meeting，略稱 FORUM)」。會中除有建築性能防火法規及設計議題研討，另有亞洲 7 個會員國（紐西蘭 BRANZ、日本 BRI、CBL、NRIFD、韓國 KICT、印度 CFEES 及本所 ABRI）之防火研究及設備設施概況介紹。此外，國際合作交流議題方面，安排本所簡介建築結構防火研究成果及未來展望規劃，此行對於本所建築性能防火法規及設計相關研究，及促進國際交流合作具有顯著參考價值與助益。

目　次

壹、目的

本次出席參加「2008 國際防火研究領導人論壇年會」，除蒐集國外有關建築性能防火法規及設計最新資料，與世界各國主要研究機構之火災安全專家交流技術、經驗及研究心得，並介紹我國在此領域之發展概況，藉此國際交流機會促進國際社會對我國之充分瞭解，特別是國內有關制度規定及近來在建築結構防火研究領域辦理情形。此外，藉此參加 FORUM 年會機會，積極分享我國（本所）之研究成果及經驗，以獲得其他國家會員之肯定認同，除有助於鞏固我國（本所）在此國際組織之地位，亦可拓展國際合作研究機會。

貳、過程

一、行程表

此行 8 天活動內容概如表 1 所示。

參加 2009 國際防火研究領導人論壇(FORUM)年會行程表

日期	上午	下午	備註
10/10(六)	• 出發赴桃園國際機場 • 搭機：台北－首爾 • 到達首爾市		
10/11(日)	• 報到	• 報到 • 交誼會議	歡迎晚會
10/12(一)	第一天會議 09:00-12:00 • 宣布開會、確認議程 • 新會員介紹及會務簡報 • 亞洲會員專題報告（3 篇）	13:00-17:00 ▪ 亞洲會員專題報告（4 篇） ▪ Position Paper 討論:防火性能設計、避難逃生模擬評估…等議題	
10/13(二)	第二天會議 08:30-12:00 • Position Paper 討論 • 相關國際組織聯絡人報告	13:00-17:00 ▪ 參觀 KICT 實驗室	
10/14(三)	第三天會議 08:30-12:00 • 邀請來賓專題報告	13:00-17:00 ▪ 未來會議地點討論	

	• 目前合作研究檢討	▪ 未來研究方向討論	
10/15(四)	第四天會議 08:30-12:00 ▪ 新研究計畫討論、確定	 13:00-17:00 ▪ 自由時間	
10/16(五)	• 搭機：首爾－台北 • 返抵台北		

有關詳細 2008 FORUM 會議議程，詳如附錄一。

二、會議內容

經過漫長的三天半會議，概將本次會議重點整理如下：

（一）會員專題報告

由亞洲 7 個會員國（紐西蘭 BRANZ、日本 BRI、CBL、NRIFD、韓國 KICT、印度 CFEES 及本所 ABRI）等分別介紹近年各自研究項目及成果。有關亞洲會員之專題報告，詳如附錄二所示。

（二）會務方面事項

1. 實驗室安全管理。
2. FORUM 網站。
3. 討論有關 FORUM 補助參加 2011 年國際火災科學學術研討會(IAFSS)學生旅費事宜。

4. 明(2010)年 FORUM 會議訂於 8 月 25-25 日由芬蘭 VTT 主辦；依據 FORUM 規定，明年原來應由美洲地區會員主辦，但配合 IAFSS 將在美國舉辦，乃決定將美洲與歐洲主辦順序對調。
5. 2011 年 FORUM 會議將由美國 NIST 主辦，舉辦時間配合 2011 年 IAFSS 在美國舉辦之時間。

（三）FORUM 立場聲明報告（Position paper）

本次會議特別就防火與永續性、數值模擬不確定性、火災科學教育、學術倫理等課題進行討論。有關部份立場聲明報告，詳如附錄三所示。

（4）國際組織動態

本次會議中 ISO TC92、CIB W14、SFPE 等國際組織皆有代表出席並提出該團體最新辦理工作事項或活動介紹，另外 IAFSS、EGOLF、NAFTL、NFPA 等組織雖無法派人參加本次會議，然皆提供有關工作報告，委由其他人員代爲口頭報告，其中就火災科學教育、學術倫理、國際研究或實驗資料交換及可能合作項目等共通性問題有較多的討論。相關簡報資料如附錄四所示。

（5）國際合作研究方面

會中多數會員國代表對於結構接頭耐火性、火災鑑定調查兩項議題較有興趣，其中前項係前（2008）年本所於美國 FORUM 年會

提出「鋼構造接頭火害行爲」研究專題報告，並於前年會議決議請本所提供進一步報告供各會員參考。本所乃於去（2009）年 FORUM 會議再提出「鋼構造火害行爲研究」專題報告，並依據會議決議提供相關研究報告（國際期刊研究論文）予 NIST、BAM、SP、FM Global、BRI 等會員。本次會議中其他會員對本所後續研究動向感到興趣，因此主席希望本所能夠提供詳細報告給所有 FORUM 會員參考。本所代表表示建築結構耐火研究向爲本所研究重點之一，未來在 2011 年將有一項有關鋼骨鋼筋混凝土（Steel Reinforced Concrete，SRC）耐火性能設計研究計畫進行（本所 100 年新興個案中程計畫），本所可提供該項計畫摘要（中文版）供參考，經主席詢問各會員國後各國皆表達可自行翻譯，因此決議請本所於 2009 年 12 月底前提供。

本會議過程圓滿成功，透過此項會議的參與，共同研商國際防火研究現況、發展問題及未來策略計畫等議題，獲得了許多寶貴的資料，可作爲我國防火研究發展的借鏡與參考依據，同時也提供一舞台讓本所相關研究有國際發表機會，有助於提昇我國形象。

圖 1. 會議進行情景 1

圖 2. 會議進行情景 2

三、參觀韓國營建技術研究院(KICT)

2009 年 10 月 13 日下午由 KICT 安排前往位於首爾市郊的防火工程服務研究中心實驗室參觀，由該中心主任 Dr. Shin, Hyun-Joon (申鉉準博士)安排導覽參觀。

圖 3.FORUM 參觀團攝於 KICT 防火實驗中心入口

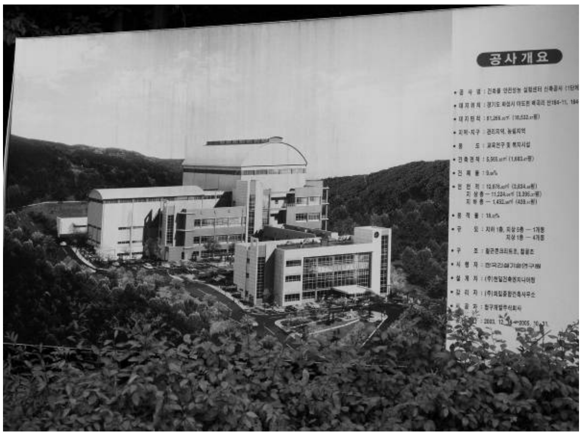

圖 4.KICT 防火實驗中心願景圖

圖 5. 10MW 大型量熱裝置

圖 6. 汽車燃燒實驗

圖 7.水平構件耐火實驗爐

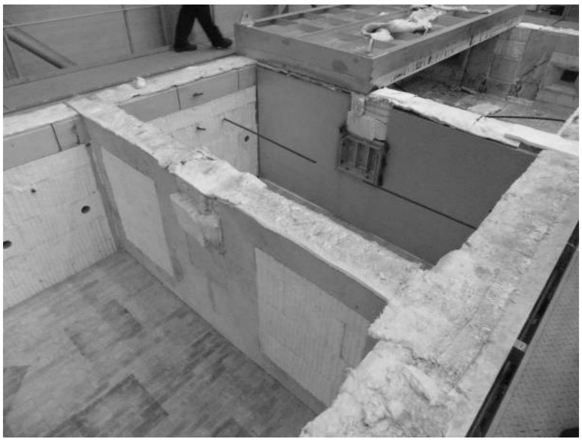

圖 8. 水平構件耐火實驗爐燃燒室及活動隔間

圖 9. ISO 房間燃燒實驗裝置

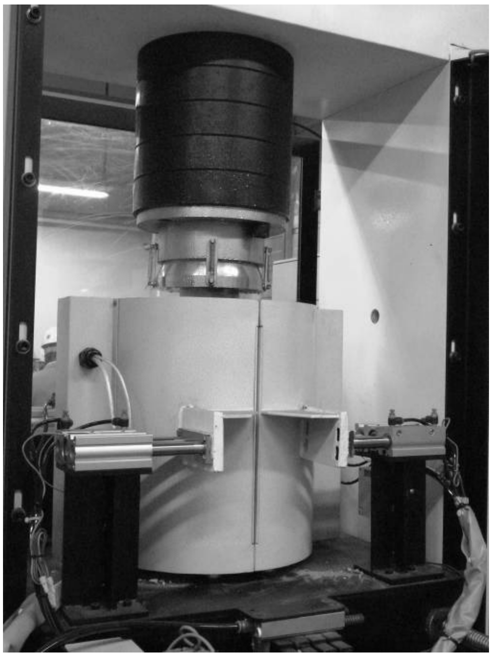

圖 10.混凝土高溫機械強度試驗裝置

圖 11.隧道火災實驗裝置(建造中)

圖 12.燃燒廢氣後處理洗滌塔

參、心得及建議

一、心得

(一)FORUM 提出特定防火議題之立場聲明報告(Position paper)，對全球各防火研究者提出呼籲，有助於國際共識之形成

FORUM 經由集體共識提出針對某特定防火議題之專業見解，可提供各國研究規劃之參考。當前 FORUM 之立場聲明報告有關於防火與永續性、數値模擬不確定性、火災科學教育、學術倫理等課題。每項主題先由會員於年會中提議，討論確定後圈定若干負責主筆會員，列入決議事項，依進度提出草案後送交主席及執行祕書，再轉傳至各會員審閱，或在 FORUM 年會中提出討論，最後彙整意見提供給主筆人修正。會中本所表示對於防火與永續性課題有興趣，將在審閱階段時提供意見。由於本所預定之 100 年防火科技計畫係以永續性爲其中內涵之一，相信從 FORUM 之有關立場聲明報告，可提供我國研究規劃之參考。

（二）參與 FORUM 年會有助於蒐集了解最新國外防火研究動態

FORUM 乃世界級防火研究實驗機構負責人的非官方、非營利組織，設立宗旨爲透過國際合作進行相關防火研究，以減少火災造成的危害（包括：人命、財物的損失、火災對於環境生態所造成的損害及影響）。該組織創立於 1991 年，由美國、加拿大、英國、日本等國

家發起，本所於 1996 年 8 月正式申請入會，目前 FORUM 已成為重要的防火科技研究國際組織，計有 16 國 21 個防火研究組織的代表參加。今年出席會議的單位會員代表除我國（本所）外，另有瑞典技術研究院防火技術中心(SP-Fire Technology)、美國國家標準技術研究院建築及防火研究所(NIST/BFRL)、山迪亞國家實驗室(SNL)、工廠互助保險全球集團(FM Global)、西南研究所(SwRI)、加拿大國家研究院火災實驗室(NRC/IRC)、英國建築研究所(BRE)、德國消防研究所(Idf Saxony-Anhalt)、聯邦材料研究試驗研究所(BAM)、芬蘭技術研究中心(VTT)、日本建築研究所(BRI)、國家消防研究中心(NRIFD)、筑波建築試驗中心（TBTL）、中國大陸科技大學火災重點實驗室(SKLFS USTU)、紐西蘭建築研究協會(BRANZ)、韓國營建技術研究所(KICT)等。此外，尚有國際建築及營建研究創新聯盟防火工作小組（CIB W14）、國際火災安全科學學會（IAFSS）、國際標準化組織防火安全技術委員會（ISO TC92）、歐洲防火試驗認證組織聯盟（EGOLF）、北美防火試驗實驗室聯盟（NAFTL）、美國防火協會（NFPA）等組織聯絡人參加會議，詳參閱附錄五。

從議程安排可知，每年會議由歐洲、北美洲、亞洲等地輪流舉辦，並由該區之會員提研究動態簡報，例如 2007 年美國 SNL 及 SwRI 主辦，2008 年 SP 主辦，2009 年 KICT 主辦。如此在會議上可以知

道別的國家正進行何種研究？應用何種技術？有何成果？此外，尚有若干友好的國際組織代表與會提報其研究近況，以上均提供了掌握世界各地防火研究動態的最佳途徑。

二、建議事項

(一)建議本所可更積極加強國際交流，利用防火實驗中心設施設備的優勢，並選擇若干研究領域發展可在國際突出之項目積極投入，以爭取在國際防火研究舞台上占一席之地。

從本次參加 FORUM 會議過程，得知各國研究單位爲求研究突破，未來概有規劃擴充或新建防火研究設施設備之舉，而本所防火實驗中心自 91 年啓用以來，若干設施設備是當今各國所稱羡者，如梁-柱-樓板耐火加熱加載爐、實驗煙塔樓等。如何把握自身優勢，發展出可在國際突出之研究項目，當是本所應有所思考的課題。以本次在 FORUM 會議中簡報本所過去數年所進行之鋼構造接頭耐火研究爲例，各國對此應用梁-柱-樓板耐火加熱加載爐及後續應用結構分析軟體之結果，均表達興趣，顯見該研究是國際少有的，其他國家也希望能獲得相關資訊。本次會議與各國代表交談得知 FM、BRANZ、SNL、TBTL、KICT 對本所實驗中心設施設備有興趣，希有機會參訪。因此，本所除可在確保智財權保障下，主動提供鋼構造耐火方面之研究成果，並歡迎國外研究機構前來交流，相信能夠獲得國際之肯定，並拓

展本所國際知名度。

(二)本所爲國內惟一參與 FORUM 之單位，建議可將 FORUM 立場聲明報告及年會會議中重要訊息分享給國內各界參考，讓國內防火產、官、學、研人士瞭解國際動態。

FORUM 雖然成員不多，無法代表全世界防火有關學術界及實務界，但成員均爲世界各國具代表性之防火研究機構單位之負責人(領導)，因此 FORUM 可說是全球防火研究領域之主流，其立場聲明報告表達對某項議題之看法，其實也代表著全球主流的見解。本所爲國內唯一 FORUM 會員(美國有 4 個會員，日本有 3 個會員，大陸有 2 個會員)，理當扮演起國內與 FORUM 之間的窗口。首先，可將 FORUM 立場聲明報告及年會會議中重要訊息傳遞提供國內建築防火、消防有關學術界及實務界參考，其次未來本所與 FORUM 之國際研究項目，本所得評估情況後亦可邀請國內研究學者參與。甚者，亦可針對某項國內研究議題介紹合適之 FORUM 會員機構爲合作夥伴。總之，本所責無旁貸應該擔負起國際研究交流之橋樑。

(三)建議我國可與日本、韓國等國結爲亞洲區域研究聯盟，促進彼此法規標準及技術之交流。

FORUM 會議中曾有討論到何以亞洲沒有類似於北美 NAFTL 聯盟及

歐洲 EGOLF 聯盟之區域研究組織。當時本所與日本、韓國會員代表均無法說明。然而，事後與日本、韓國會員代表在會議休息時間交談時，發現彼此咸認爲該構想可行性高，並不排除未來可以組織起來的可能性。台灣、日本、韓國三國不論在民情文化及建築、消防法規，乃至標準，彼此均相當類似。因此，如果在 FORUM 架構前提下，先由本所與日本 3 個會員(BRI、NRIFD、TBTL)、韓國 1 個會員(KICT)先行組織成亞太防火實驗室聯盟或類似組織，彼此進行共通性問題探討、合作研究，促進各國法規與標準之進步，應是美事一樁。未來甚至可邀請中國大陸、印度、新加坡等國加入。相信此聯盟一旦成立，對於我國及本所之國際影響力皆有正面積極的好處。

附錄一 **2009 FORUM 會議議程(英文)**

The International FORUM of Fire Research Directors

Annual Meeting

Sunday, October 11, through Thursday, October 15, 2009
Korea Institute of Construction Technology
Goyang City, REPUBLIC OF KOREA

Sunday, 11 October

1800 Welcome Reception, Sejong Hotel #61-3, Choongmuro 2 ga, Jung-gu, Seoul (Hyun-Joon Shin)

Monday, 12 October

0900 Coffee

Announcements (Hyun-Joon Shin)
New member introductions and brief statements
Review agenda (Bill Grosshandler)
Review of the minutes from September, 2008 meeting in Borås (Franco Tamanini)
Finances, Membership (Franco Tamanini)
Sjölin Award (Greg Baker)

1045 Break

Regional member presentations:

- Mr. Greg Baker, Building Research Association of New Zealand, Wellington
- Dr. Ichiro Hagiwara, Building Research Institute, Tsukuba, Japan

1200 Lunch

1300 Regional member presentations (continued):

- Dr. Ming-Chin Ho (Dr. Alec Lei), Architectural and Building Research Institute, Chinese Taipei
- Mr. Jiansheng Jing, Tianjin Fire Research Institute, People's Republic of China
- Dr. J.C. Kapoor, Centre for Fire, Explosive and Environmental Safety, Delhi, India

1500 Break

- Dr. Yoshiyuki Matsubara, National Research Institute of Fire and Disaster, Tokyo, Japan
- Dr. Shuitsu Yusa, Center for Better Living, Tsukuba, Japan
- Dr. Hyun-Joon Shin, Korea Institute of Construction Technology , Goyang City, Republic of Korea

1700 Adjourn

1800 Dinner

Tuesday, 13 October

0830 Coffee

0900 Liaison reports:

- NAFTL (Bill Grosshandler for Marc Janssens)
- EGOLF (Ulf Wickström)
- IAFSS (Craig Beyler)
- ISO TC92 (Ulf Wickström for Björn Sundström)
- CIB W14 (George Hadjisophocleous)
- SFPE (Morgan Hurley)
- *Fire Safety Journal* (Yuji Hasemi)

1200 Lunch

1300 Liaison reports:

- ASTM E05 (Bill Grosshandler for Marc Janssens)
- FPRF (Bill Grosshandler for Kathleen Almand)

Invited presentations (Myong-o Yoon, Korean Institute of Fire Science & Engineering)

Open discussion on presentations (all)

1400 Tour of KICT Laboratories (Hyun-Joon Shin)

1800 Dinner

Wednesday, 14 October

0830 Coffee

Status of action items from 2008 meeting (all)

Current position papers

New position papers (all)

Review of current collaborations (all)

New collaborations (all)

1030 Break

Open Discussion

1200 Lunch

1300 Future meeting sites

- 2010, Dr. Tuula Hakkarainen, VTT
- 2011, Dr. William Grosshandler, NIST

New business (all)
Review of Action Items (Franco Tamanini, all)

1700 Adjourn

1800 Dinner

Thursday, 15 October

0830 New plan discussion

1200 Adjourn

Saturday, 17 October – Sunday, 18 October
2009 International Symposium on Fire Science and Fire Protection Engineering, Beijing, People's Republic of China

附錄二 2009 FORUM 會議亞洲會員之專題報告(英文)

Fire Research at ABRI

Dr. Alec Ming-Yuan LEI

Senior Research Officer, Fire Research Program

2009 Oct 12 2009 FORUM / SEOUL, KOREA 1

Who we are

- ABRI established and joined in MOI in 1996（Task Office since 1989）
- Fire Lab relocated to Tainan in 2002
- Head Office of ABRI relocated to Sindian in 2006
- Around 90 research staff belong to Planning, *Disaster Prevention*, Engineering Technology, and Environment Control Divisions

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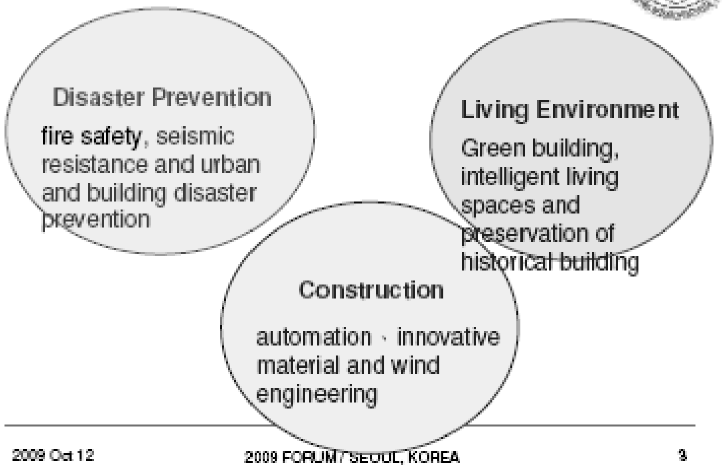
What we do



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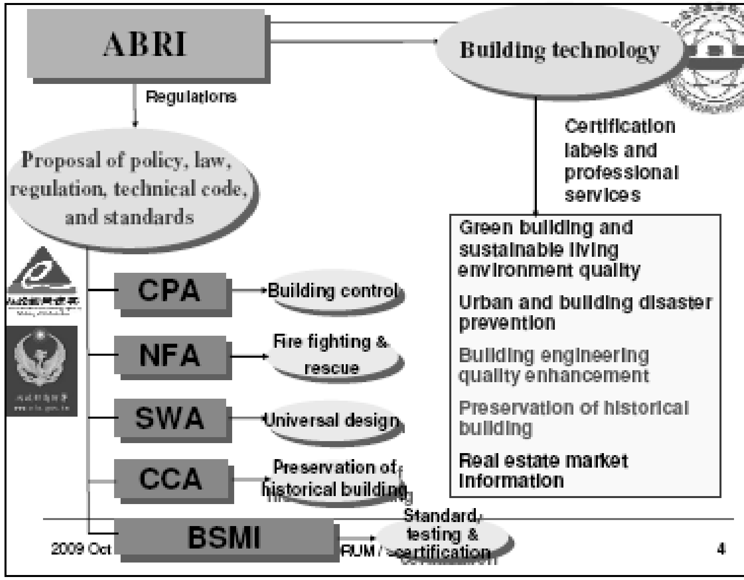

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Fire Research Team

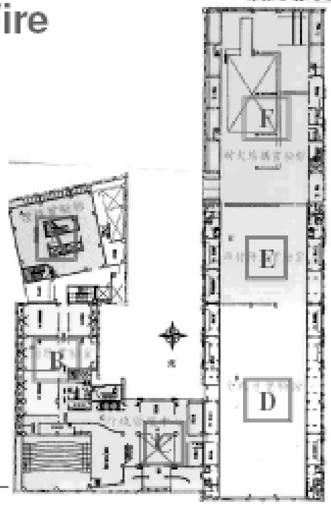
- Fire research program staff
  - ❑ Under the *Disaster Prevention Division*
  - ❑ 15 research staff, 10 in fire lab
  - ❑ 2 administrative staff
- Universities partnership
  - ❑ partners—professors and graduate students

Fire Research Scope

- Countermeasure and Scheme for Enhancing Fire Safety
- Prevention and Control of Initial Fire
- Prevention and Control of Fire Spread
- Structural Fire Performance
- Smoke Management
- Means of Escape and Assessment
- Fire Engineering Methodology and Application

Overall Layout of Fire Experiment Center

- A: Smoke Control Tower
- B: Fire Fighting Technology
- C: Administration
- D: Full Scale Experimental House
- E: Materials & Assembly
- F: Structural Elements



Fire Laboratory Facilities

- Reaction to fire
- Fire resistance
  - ❑ Structural elements
  - ❑ Non-structural assemblies
- Large-scale calorimeter
  - ❑ SBI
  - ❑ Room/furniture calorimeter
  - ❑ 10MW calorimeter
- Facilities for water-based fire suppression system
- Burning hall & smoke tower

Fire Laboratory Facilities

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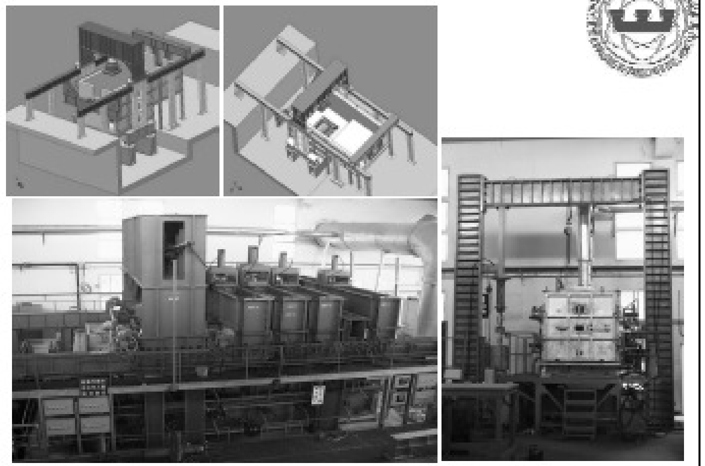

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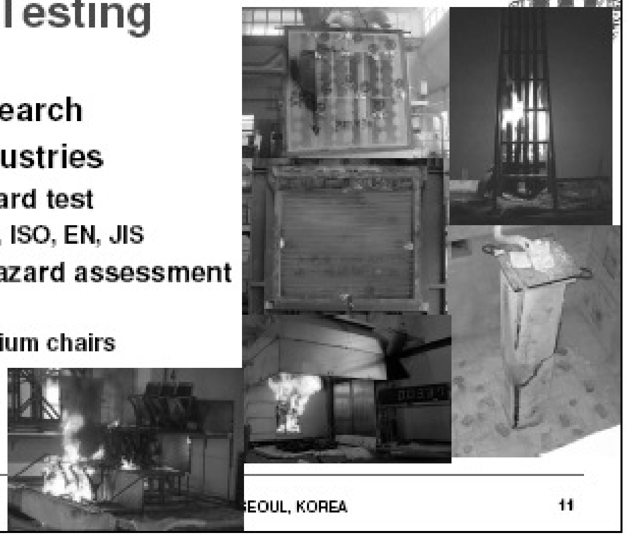
Fire Testing

- For research
- For industries
  - Standard test
    - CNS, ISO, EN, JIS
  - Fire hazard assessment test
    - Stadium chairs



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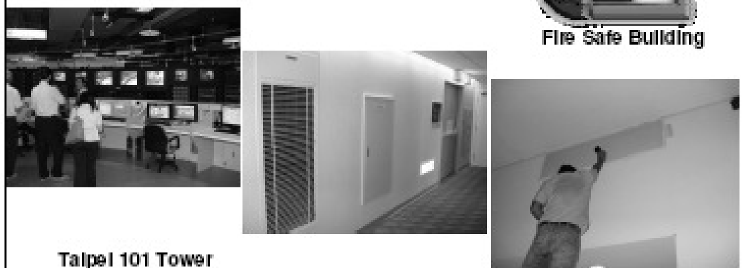
Certification and label

- Non-mandatory fire safety certification scheme

Fire Safe Building



Taipei 101 Tower

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Research—Guidance

- Technique guidance for verification of fire and evacuation safety
- Technique guidance for verification of fire resistance performance
- Technique guidance for design of smoke control of large space building

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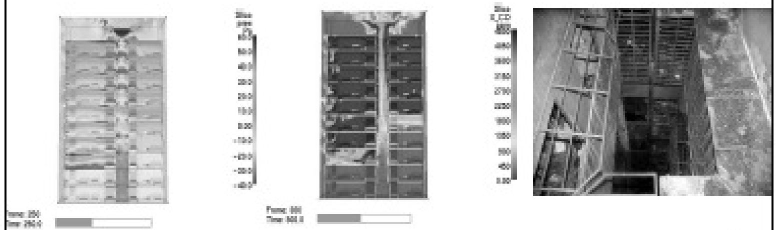
Research— Investigation and Recommendation

- 10-storey Ling-Mu residential building fire



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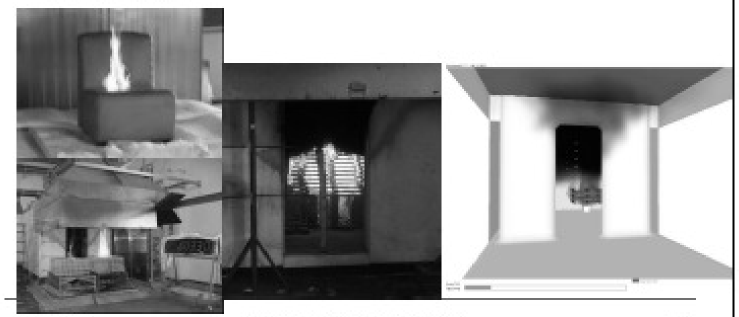
Research—Design Fire

- Simulation of burning behaviors and its validation



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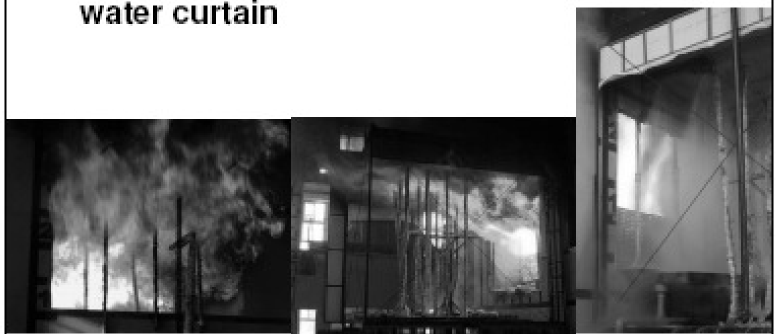
Research— External Opening Fire

- fire protection performance of water curtain



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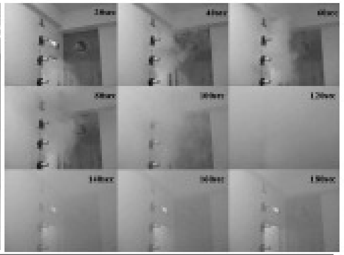
Research – Smoke Control

- Improvement of smoke exhaust performance of existed building

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Research – Smoke Control

- Integration of smoke exhaust and ventilation performance for green design

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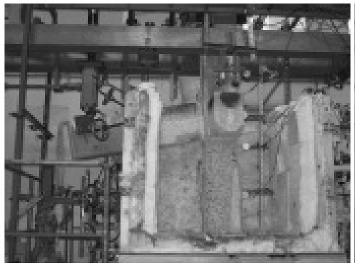
Research – Structural Fire Performance

- Behaviors of RC column and beam connection after fire exposure

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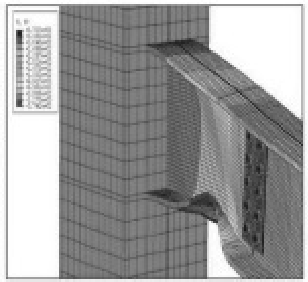
Research – Structural Fire Performance

- Numerical analysis of fire behavior of steel column and beam connection

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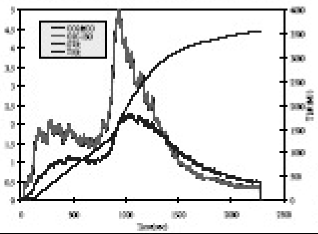
Research — Suppression Performance

- Parking lot fire



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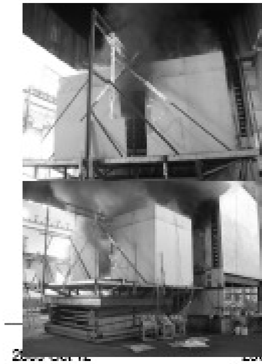
Research — Fire endurance

- Assembled open construction units



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New Direction

- Fire resistance performances of CFT
- Reliability of fire protection equipments and fire assemblies and partition
- Evaluation of evacuation and development of codes for disabled people (people weak in evacuation ability)
- Integrated intelligent system for fire protection
- Development of code of practices for improvement on fire safety of existed building

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Dep. of Fire Engineering, Building Research Institute, Status Report

FORUM 2009

Ichiro HAGIWARA

Brief History of BRI

- Dec. 1942 Founded as a Building Research Section
- Jul. 1948 Renamed as the Building Research Institute, Ministry of Construction.
- Apr. 1980 Moved to Tsukuba Science City.
- Apr. 2001 Independent Administrative Institution Building Research Institute make a start.
- Present - BRI is still same status,
  not National Research Institute.

It means that budget come from the government, but become independent and self-control.

- The first Interim goals and Interim plans were completed. (2001-05 FY)
- The second Interim goals and plans (2006-10 FY) will be finished.

Outline of the 2nd Interim plan

- Research and Development are more concentrated for quickly achieving clear results which meet social and user needs.
- 16 Priority Research Projects are selected.
  70% of total research budget are reserved for them.
- They are classified 4 categories.
  - Ensure safety and security
  - Sustainable development
  - Reconstruction/redevelopment corresponding to social changes
  - Streamlining production system by using IT

- Due to the rapid social situation changes, some Priority Research Projects are modified in April, 2009.
  - ✓ Low carbon and energy society
  - ✓ Construction and maintenance system for long life cycle of buildings & housings
  - ✓ Safety and quick recovery technology for super high-rise building after disasters (esp. earthquakes)
  - ✓ Healthy building and housing (sick house syndrome)

Organization

- Chief Executive — Deputy Chief Executive
  - Executive Director for Building Research
    Research Coordinator of Building Technology
  - •Department of General Affairs
  - •Department of Research Planning and Management
  - 7 Research groups
    1. Department of Structural Engineering
    2. Department of Environmental Engineering
    3. Department of Fire Engineering
    4. Department of Building Materials and Components
    5. Department of Production Engineering
    6. Department of Housing and Urban Planning
    7. International Institute of Seismology and Earthquake Engineering

Budget & Staff

1 April, 2009

Total budget	2,298
Budget for Management	2,011
Budget for Improving facilities	85
Commissioning income	160
Income from facility costs	42
	Unit : 1,000,000Yen

Staff :	91
Full time staff :	88 (57 researchers and 31 non-researchers)
Full time officer :	3 (and 1 part-time officer)

For Fire Research Projects: 20
(40% down since 2006)

Ref. 1,000,000 Yen = 10 ,000 dollars

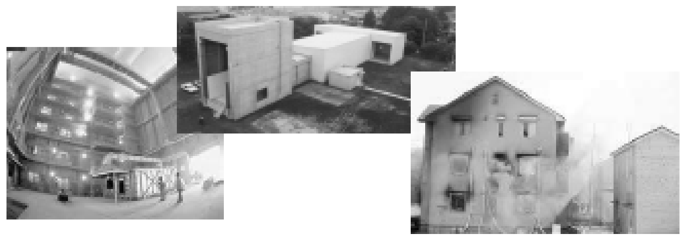
Staff : 91
(minus 10)

Dept. of Fire Eng 6
+1 GR+1 VR
(minus 1 since 2006)

Ref. 5 researchers in NILIM

Test Facilities

- **Fire Research and Test Laboratory**
- **Full-scale Fire Test Laboratory**
- **Fire Research Wind-tunnel**
- **Model Fire Experimental Field**



Organizational challenges

- Spread Rational Fire Safety Design Methods in practice.
- Continuous technical support to the Building Standard Law having performance-based provisions
  (with NILIM: Natl. Inst. for Land and Infrastructure Management).
- Promote Cooperative Research with public or private organizations through the Consortium for Building Research & Development

9

Managerial challenges

- Carry out strict "self-evaluation system" on the process and achievement of R&D, and
- put into the evaluation by external review board to improve institute's transparency and accountability.
  => *Time consuming works*
- Effective allocation of research resource
- Focus on Priority Project Research
  => *Short time return & popular projects for easy evaluation*
- Supplement of young researchers
  => *Half of staffs will be retired within 4 years*

10

R&D Strategy

- Fire safety design methods and engineering tools
- Advanced methods for estimating and preventing damage by fires during/after earthquakes
- Provide technical standards, test methods, references, guides and other documents for the BSL and related regulations.

For promoting fire safety design with engineering tools

11

Current recent research topics

- **Fire spread on exterior wall**
- **Evaluation of firebrands ignition**
- **Fire protection between wooden houses**

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Experimental Research on Fire Properties of Exterior Insulation and Finish Systems

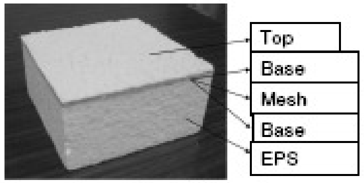
Monte Carlo Resort and Casino, Las Vegas
January 25th, 2008

TVCC, Beijing
February 9th, 2009

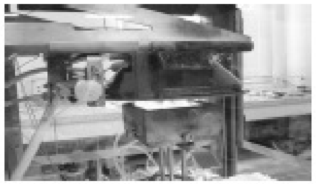
Fire Incidents Related with Combustible Cladding

Problem

- For low energy house, external insulation system is more popular for northern area of Japan.
- However, there is no requirement for fire spread on exterior wall in the BSL.
- We have little knowledge about the fire hazard of these material and wall construction systems.
- Basic research on fire properties of these material was just started.



Example of Test Specimens



Cone Calorimeter

ICAL

SBI

ISO 13785-1:2002
Reaction-to-fire tests for facades -- Part 1: Intermediate-scale test

Start of Experiment

Test Specimen: EPS Coated by Urethane

Former BRI/NIST Collaboration

RESEARCH ON
PREVENTIVE MEASURES AGAINST FIRE EXTENSION
TO ADJACENT RESIDENTIAL AREA
CAUSED BY SPARKS FROM FOREST FIRE OR THE LIKE
(2006 – March, 2009)

Successive Collaboration

EXPERIMENTAL RESEARCH ON
SPREAD OF FIRE TO ADJACENT RESIDENTIAL AREA
CAUSED BY FIREBRANDS
FROM BURNING RESIDENTIAL BUILDINGS
(2009 – March, 2012)
now in progress for the agreement

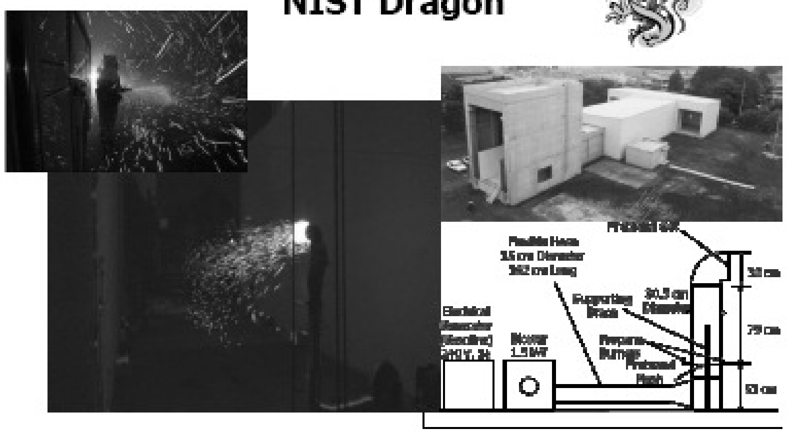
- Post-fire studies - firebrands major cause of ignition in WUI Fires (USA) and Urban Fires (Japan)
- Understanding firebrand ignition of structures – important to mitigate fire spread in Japan and USA


2007 Southern California Fire


1976 Sakata Fire

- Objective: Investigate ignition of structures to firebrand attack
- Goals: Design structures to be more resistant to firebrand ignition

NIST Dragon



Current results
Firebrand Attack to Ceramic Roofing


Firebrands coming through the gaps cause ignition penetrating the OSB board (conducted mainly by US side)

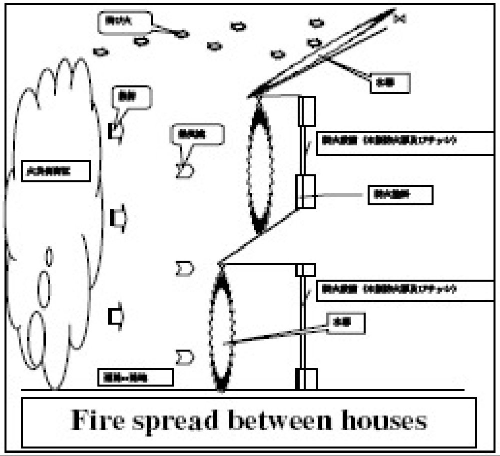

Firebrands falling on the bare board by assuming that tiles are removed by a big earthquake cause ignition (conducted by Japanese side)

Current results
Firebrand Penetration through Vents

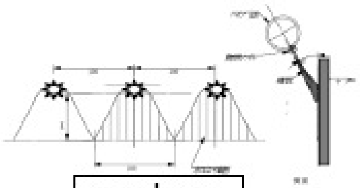
Screen Behind Vent
Three sizes tested 6 mm, 3 mm, and 1.5 mm

Firebrands becoming smaller finally go through the screen cause ignition inside (conducted mainly by US side)

Develop water curtain for preventing fire spread between wooden houses

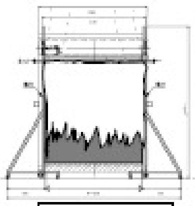


Water curtain system

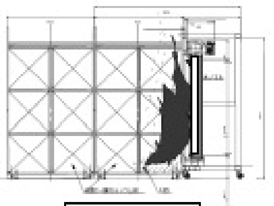


sprayed area

Exterior wall of wood board (historical area)



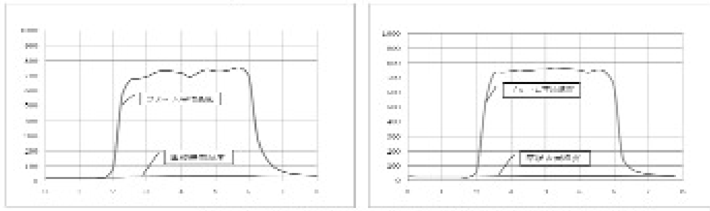
Front view



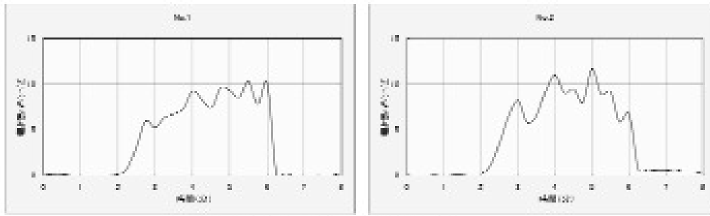
side view

Test field

Test results

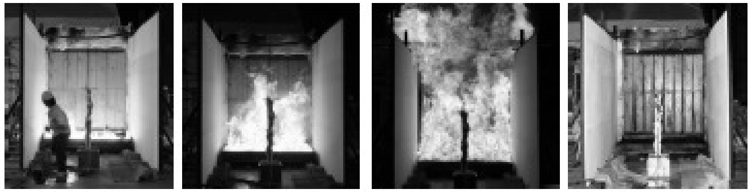


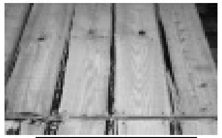
No.1, No.2 surface temperature of wood board



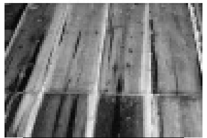
Radiation from the fire source

Test	Duration of burning	damage	Water supply (L/min·m)	evaporation (L/min·m)
No.1	4 min 05 sec	No	20	2.8
No.2	3 min 48 sec	No	20	2.9





No. 1 after test



No. 2 after test

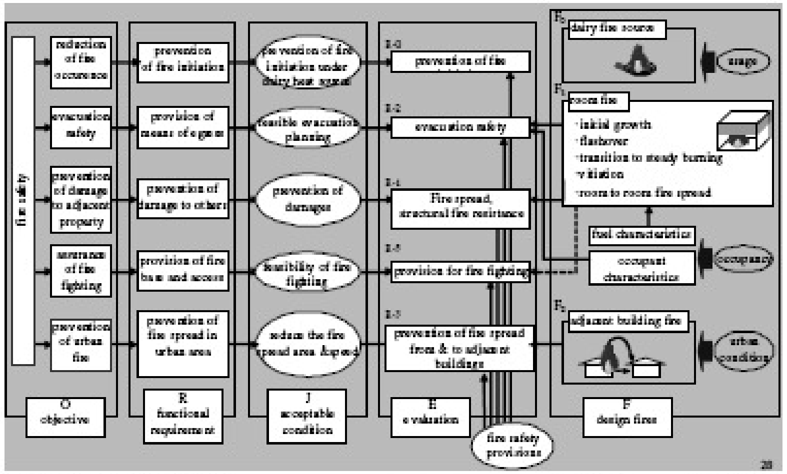
Priority Research Project

- **Development of performance-based fire safety design method**
- **To revise the Building Standard Law of Japan in near future (201x?)**

Revision of the Building Standard Law

- **Purpose:**
  - Revision of 2000 was a first step
  - Adding new verification methods
  - New buildings and new occupancy types don't fit the BSL
  - Resolving problems after introducing PBC in 2000
- **Reconstruction of framework is needed**

Framework of the evaluation



Functional requirements

F1: Escape safety
- Life safety of occupants, including structural stability of escape routes

F2: Prevention of fire effect to others
- Life safety and property of neighbors

F3: Prevention of fire outbreak
- Ex. Ordinary fire source

F4: Control of urban fire
- Ex. Fire after/during earthquake

F5: Support fire service activity
- Rescue, fire-fighting

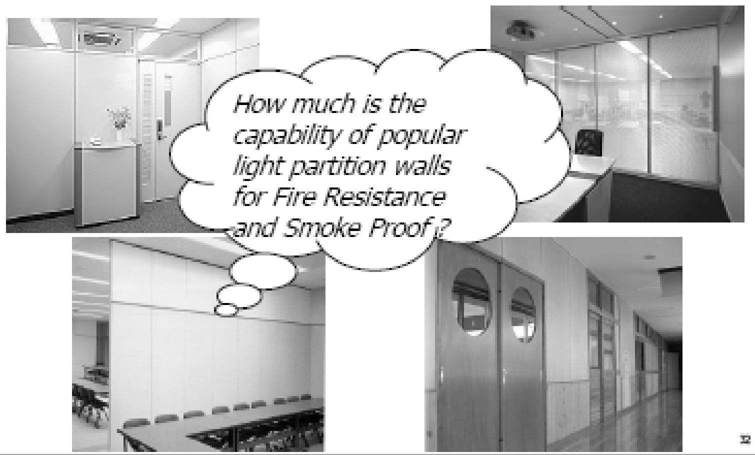
Purpose of revision of the BSL

For desirable building control regulation, it should be followed by fundamental requirements.

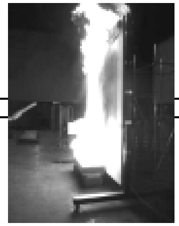
- In 2000 revision, it was done partially
  - Ex. Requirement of fire resistive building is not changed.
- Reason of regulation should be more clear and easy to understand, and described by word of performance.
  - Ex. Three story of special buildings should be fire resistive building. Two story special buildings is not required without reason.
  - If a building site is wide enough, a building may be collapsed by a fire, because no damage happen in neighbors.

- **Current works**
  - **Fire resistance of light partition wall (no fire rating)**
  - **Requirement of supporting fire service activity**

Experimental Study on Fire Resistance and Smoke Proof of Light Partition Walls



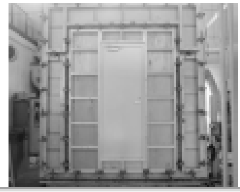
Fire Resistance Test



Burner (Max. Q=750kW)

Furnace for Fire Resistance Test

Smoke Proof Test



Air Tightness Testing Chamber

33

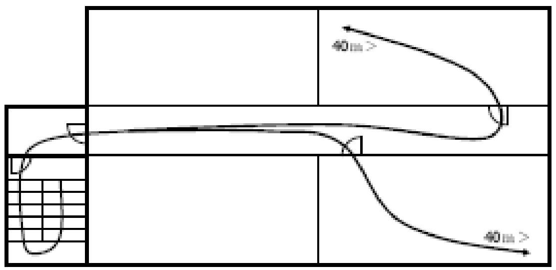
Fire compartment for fire fighting

- No area where don't covered by standard hose length
- Smoke and heat extraction for fire fighting
- Prevention of fire spread for fire fighting

34

No area is more than 40 meters* from a fire activity base.

* standard usage of hose (2*20 m)



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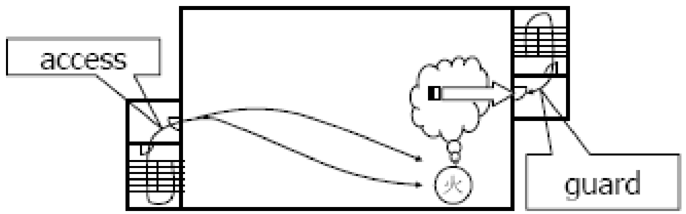
If a fire compartment filled with smoke, smoke should be removed effectively for fire fighting in the compartment.

Or, the compartment is small enough.



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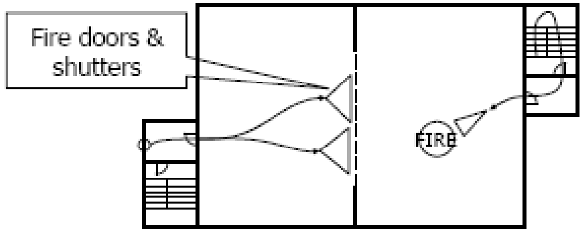
Size and number of fire doors and shutters should be limited.

They could be guarded and water sprayed by fire fighters for preventing fire spread.



Future directions

- To develop Risk-based Fire Safety Design Method

Thank you for your attention !

Round-robin test on wall furnace in Japan (partly NAFTL project)

Shuitsu Yusa
Tensei Mizukami
The Center for Better Living

The Center for Better Living

- Certification System for Quality of Housing Components
- Non-profit foundation

Japanese Fire Testing Laboratories

- The Center for Better Living
- Japan Testing Center For Construction Materials
- General Building Research Corporation of Japan
- Japan Housing and Wood Technology Center

Notable operating procedure

Geographical distance (Shipping)
Average density = 761.2 kg/m³ (47.6 lb/ft³)

Unaccustomed way
Exposed temperature measurement
Standard time-temperature curve

Linguistic barrier
Individually but with translated NAFTL paper guidance
Conversion of Units

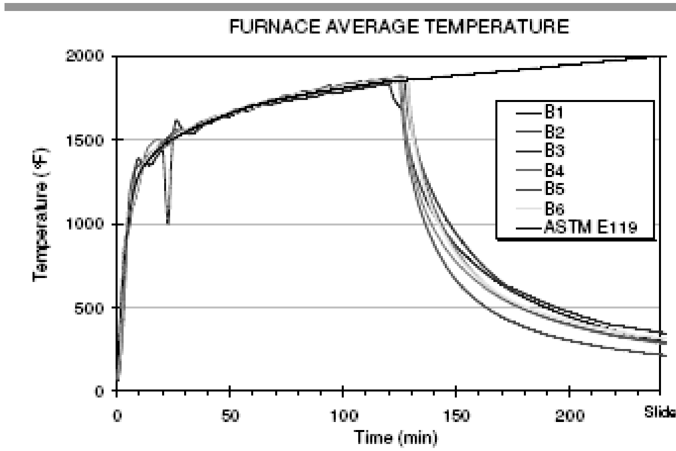
Slide 5

Objective (NAFTL project)

- Relationship between furnace test and real fire
- Determine consistency of fire testing
- Develop an understanding of ASTM E119
- Mutual recognition of fire testing

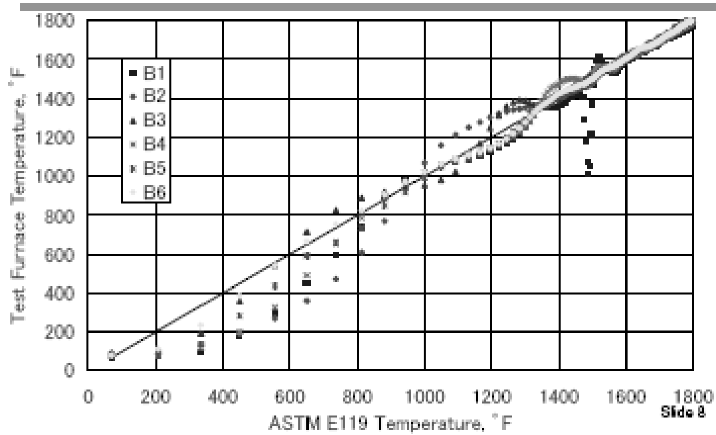
Slide 6

Results:
Average furnace temperature



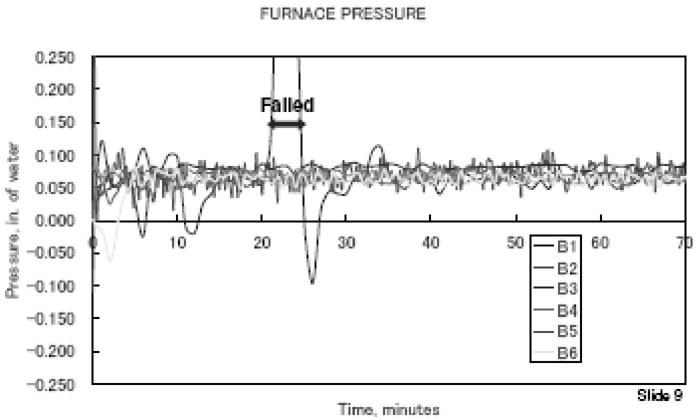
Slide 7

Furnace Temp. vs.
Prescribed ASTM E119 Temp.



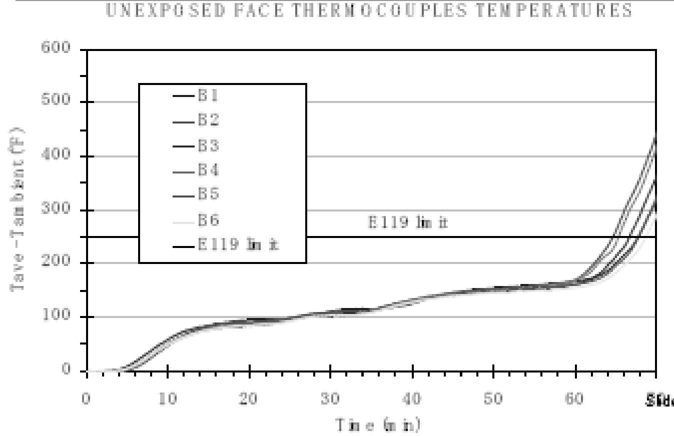
Slide 8

Furnace pressure



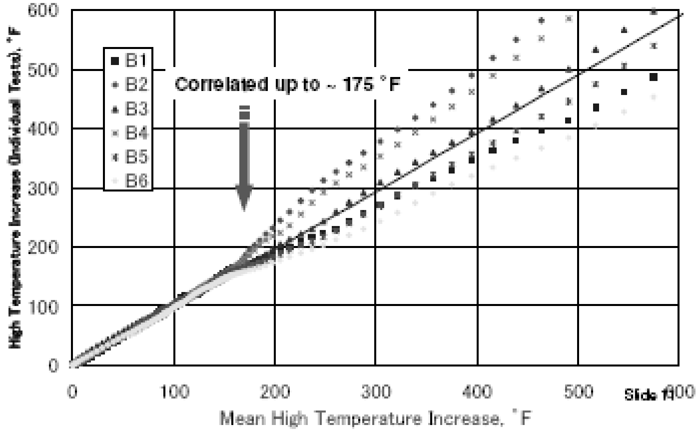
Slide 9

Unexposed temperature measuremen



Slide 10

Standard deviation
~Unexposed temperature measurement~



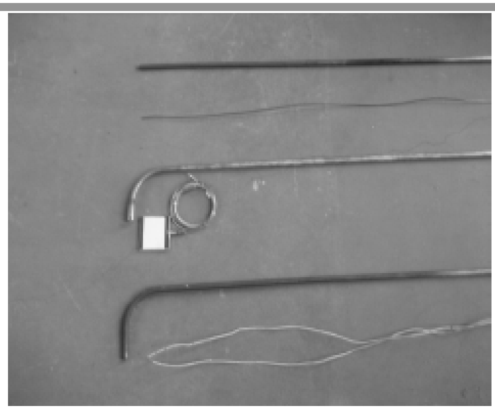
Slide 11

Summary of failure criteria

Laboratory	Fire Resistance Rating	Time To First Failure (min)	Failed Thermocouple Reading	Other TC's Failing within 1 minute
B1	1 hour	67.7	TC7	Ave., TC6
B2	1 hour	67.3	TC7	Ave., TC6
B3	1 hour	66.0	TC6	Ave.
B4	1 hour	65.5	Ave.	TC3, TC4, TC5, TC6, TC7
B5	1 hour	68.0	Ave., TC6	TC4, TC5, TC7
B6	1 hour	68.0	TC7	Ave.
average	1 hour	66.0 ± 2.0	TC7	—

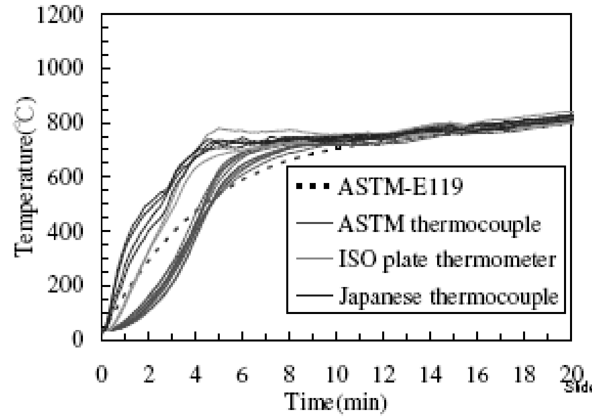
Slide 12

Technical difference: measuring probe



Slide 13

Results on each measuring probe



Slide 14

Conclusion

- Consistency of fire testing on wall furnace in Japan is reasonable as in North America
- Understanding of domestic method and ASTM E119 is improved
- Data on different measuring probe
- Mutual recognition of fire testing

Slide 15

Future

- Round-robin test on horizontal furnace
- Join in NAFTL loaded walls testing
- Collaboration with NIST
- Improve recognition of fire testing

Slide 16

1

INTRODUCTION - BRANZ

- BRANZ came into existence in 1970
- Building Research Levy Act 1969
- Bldg Research Levy
- BRANZ structure
  - Association
  - BRANZ Ltd
  - BRANZ Pty in Australia

2

TYPICAL CONSTRUCTION

3

TYPICAL CONSTRUCTION

4

BRANZ Head Office

BRANZ

5

BRANZ Ltd SERVICES

BRANZ

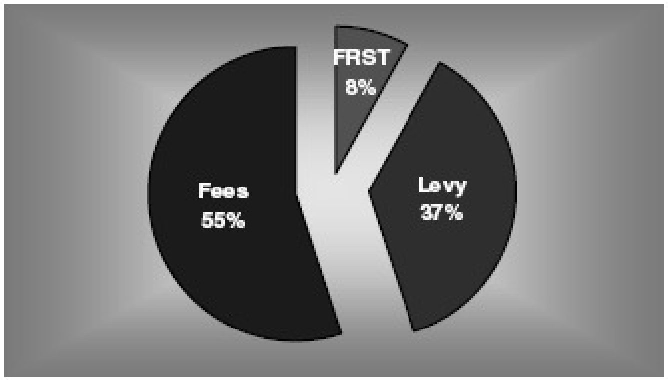
► BRANZ Ltd services

- Research
- Testing
- Consultancy
- Information
- Education

6

BRANZ INCOME

BRANZ



7

TECHNICAL AREAS

BRANZ

► Technical Areas

- Fire
- Structural Performance
- Sustainability
- Bldg Physics
- Thermal Efficiency
- Bldg Economics
- Weathertightness
- Indoor Air Quality

8

FIRE ENGINEERING

BRANZ

- Fire Engineering
  - Commercial testing
  - Research
  - Consulting

9

FIRE RESEARCH

BRANZ

- Fire research funding
- Research projects:
  - Heat Transfer
  - Designing Bldgs for Fire
  - Risk-Informed Fire Design

10

HEAT TRANSFER PROJECT

BRANZ

- Project stemmed from 2007 FORUM
- 12 month project completed March 09
- Investigate use of PT's to measure temp and radiation
- Built upon work that SP in Sweden was conducting
- Series of burns conducted and PT used to measure radiation

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HEAT TRANSFER PROJECT

BRANZ

- Comparison to Gardon HFM's
- Thermal mass aspects of PT's investigated
- PT not as responsive
- PT's however do have a number of advantages and benefits
- BRANZ very pleased to be contributing to FORUM collaboration
- Hope to have further opportunity to do so in future

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DESIGNING BLDGS for FIRE

BRANZ

- New 3 year project started April 09
- Primary aim capability development for BRANZ
- Combine fire and structural engineering disciplines
- Focus on interface between fire and structural design

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DESIGNING BLDGS for FIRE

BRANZ

- 3 major bldg materials dealt with prescriptively
- Review how design at elevated temp dealt with in concrete, steel and timber design standards
- Review provisions of structural design loadings code in relation to fire

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RISK-INFORMED FIRE DESIGN

BRANZ

- 5 year project ending in June 2012
- Major sponsor is NZ Govt. RS&T funding agency
- Project involves collaboration with University of Canterbury
- Outcome is that project aims to improve standard of FSE engineering design in NZ
- Project is in conjunction with NZ bldg regulator

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RISK-INFORMED FIRE DESIGN

BRANZ

- Project is in conjunction with NZ bldg regulator
- Regulator developing details guidance and acceptance criteria
- Option way to demonstrate compliance with Code
- Current lack of quantification results in widespread subjectivity and inconsistency

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RISK-INFORMED FIRE DESIGN

BRANZ

- ►Project will produce a probabilistic design tool
- ►New tool based on deterministic BRANZFIRE two-zone model
- ►Probability distributions for input parameters and monte-carlo sampling
- ►Cumulative distribution functions for tenability outputs rather than single-point values
- ►Comparison to risk-informed design statements

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R&D ACTIVITIES on

FIRE PROTECTION and SUPPRESSION

at CFEES

JAGDISH CHANDER KAPOOR
DIRECTOR
Centre for Fire Explosive & Environment Safety,
Defence R&D organization; Min of Defence,
Delhi, INDIA

Centre for Fire Explosive & Environment Safety

Dr Bill Grosshandler visits CFEES, Feb 09

3

Fire Safety Engineering – Global Relevance

- Large Fires occur everyday in the world, some leading to catastrophe
- Fire impinges on every aspect of human endeavour.
- Fire safety to be planned in design & implementation stage
- Fires result in (per year):
  - 10-20 casualties per million
  - Direct property losses of 0.2% of GDP (in developed countries, higher in others)
  - Total costs run upto 1.0% of GDP (includes cost incurred on emergency services, fire protection, loss of commerce & insurance).

System of standards and advanced fire safety materials & systems are required to reduce fire accidents & hence the losses & damages due to fires accidents

Closer co-operation is needed in R&D efforts

FIRE SAFETY INITIATIVES at CFEES

5

HALONS AND ALTERNATIVES

 # HALON RECLAIMATION & BANKING FACILITY

 # DEVELOPMENT of HALON ALTERNATIVES :

- Water Mist based Fire Protection Systems*
- HFCs : HFC-227ea(FM-200, FE-227)*, HFC-23(FE-13)
  HFC-125(NAFS-125, FE-125)
- PFCs : PFC-3-1-10(CEA-410), Perfluorobutane and perflouroketone*
- HCFCs : HCFC blend A (NAF-SIII)
- Inert gas-mixtures like, Inergen, Argonite etc.
- Carbon dioxide

Fire suppression performance of water mist system

(Top mist injection on 800 kW n-heptane pool fire in $40 m^3$ chamber)

Features	Comp. air at 15 bar	Water feed rate	Droplet Size		Fire-out time	Qty of water used	Mist Conc.
	Qa (lpm)	Qw (lpm)	SMD (µm)	VMD (µm)	(sec)	(litre)	(gm/m^3)
Un-obstructed fire	1600	8	26	40	22	3.2	80
Ventilated Condition (exhaust on & door open)	1600	8	26	40	26	3.5	87.5
Obstructed fire	1600	8	26	40	42	5.6	140

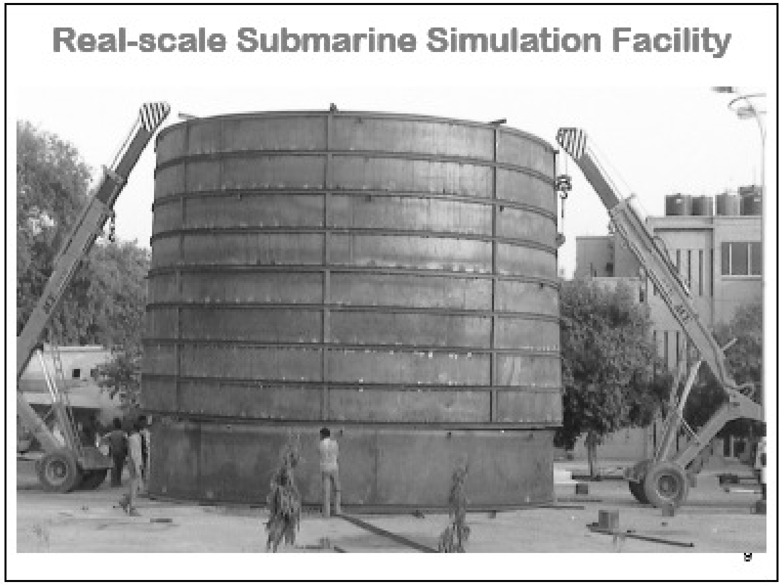
7

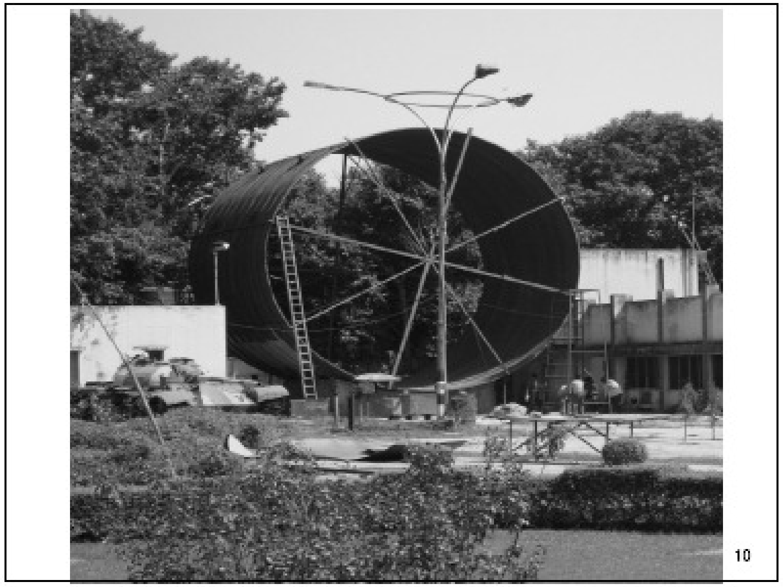
Comparison of Commercial Water based Systems with CFEES Water-mist System installed & tested in *40 m3* (3.5mx3.5mx3.2m) Fire Test Enclosure

System Types	Dg (µm)	Mode of Action	Water usage litres/ m^3	Extinguish-ment time
CFEES MIST SYSTEM	40	Total Flooding	0.08 - 0.16	~20 sec #
Commercial mist systems (NFPA-2001)	100	Suspended fine water droplets Direct impingement	1.8 - 2.7	25-50 sec
Fine Water Spray (NFPA-750)	400 - 1000	Floor coverage (1mm/min) + suspended	2.0 - 5.0	60-100 sec
Sprinkle/Spray System	>1000	Floor coverage (5mm/min)	7.2 - 17.6	60-200 sec

 # Time from initiation of mist injection

8


Real-scale Submarine Simulation Facility
9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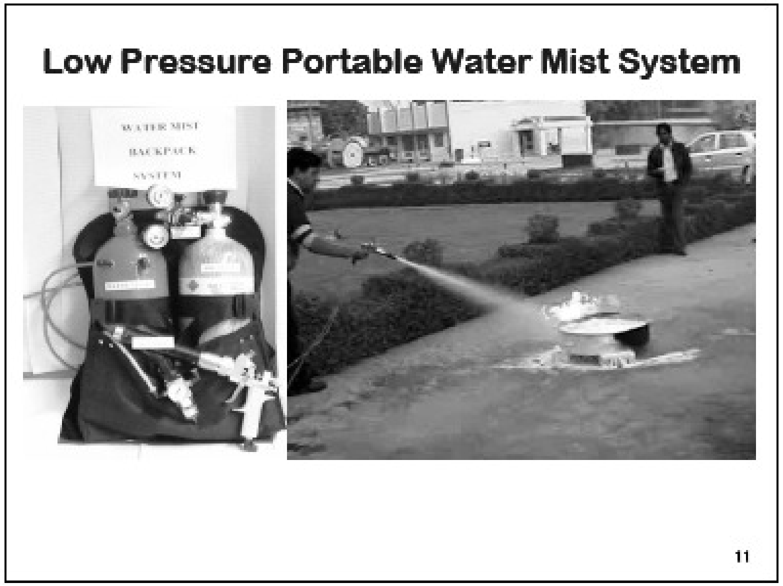
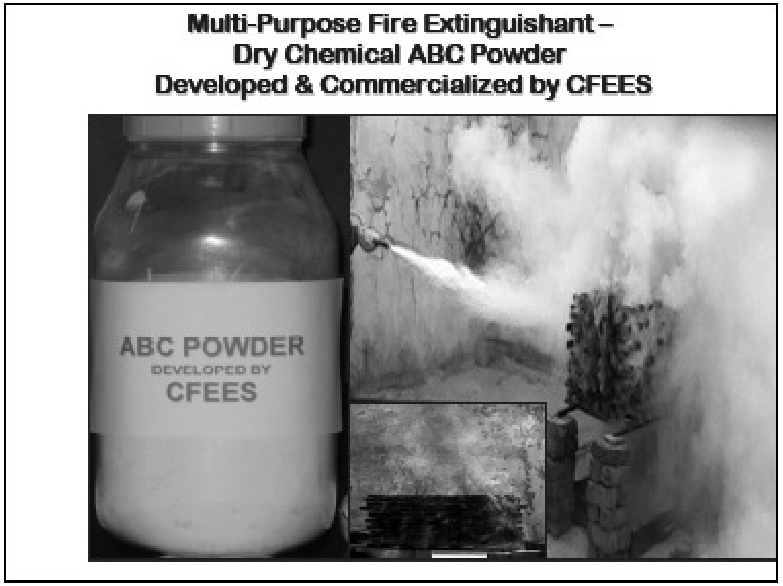
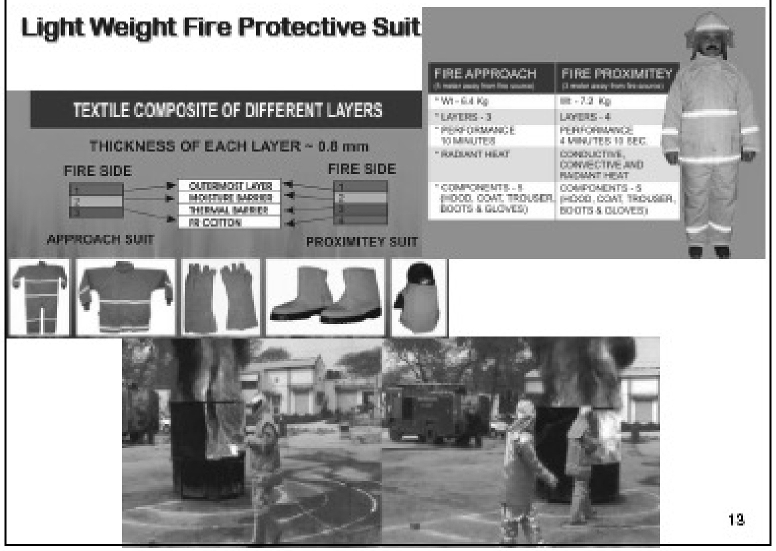

Low Pressure Portable Water Mist System
WATER MIST
BACKPACK
SYSTEM
11


Multi-Purpose Fire Extinguishant –
Dry Chemical ABC Powder
Developed & Commercialized by CFEES
ABC POWDER
DEVELOPED BY
CFEES

Light Weight Fire Protective Suit



13

Emergency Escape Chute

14

TEST FACILITIES AT CFEES

15

AVAILABLE TECHNICAL FACILITIES

1. Droplet Size Analyzer using Laser Diffraction Principle
2. Cone Calorimeter: Study of Combustion Behaviour of Materials.
3. Fourier Transform IR (FTIR) Spectrometer for Combustion Gas Analysis for Determination of Toxicity Index
4. Fire – Mist Interaction Evaluation (1 m3) Test Chamber
5. 40 m3 Instrumented Fire Test Enclosure for Studying Dynamic Interaction of Fire and Water Mist.
6. Melt Flow Index Tester & Lab Scale Film Blowing Unit of Polymers.
7. Xenon Arc Weathero-meter.
8. Simultaneous Thermal Gravimetric Analyzer (TGA), Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA) for Thermal Stability of Materials.
9. CHNS Elemental Analyzer (Model Thermo Electro flash EA 1112).
10. Tensile Testing Machine.
11. Atomic Absorption Spectrometer & ICP for trace Analysis of metals
12. Thermal Protective Performance Tester.
13. Surface Area Analyzer, TOC Analyzer, HPLC, GC-MS & GC

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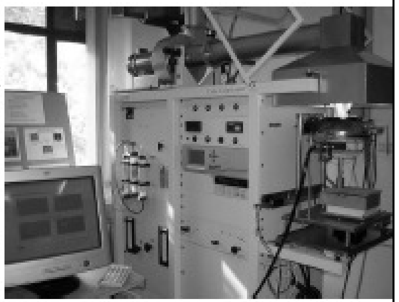
Cone Calorimeter

One of the most sophisticated & modern tool for determination of Fire Hazard Parameters:

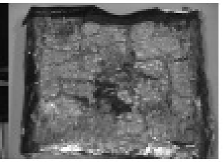
 # Heat Release Rate (HRR) , # Flammability, # Smoke toxicity # Extinction characteristics of combustion products

- A square sample of 100 x 100 mm (4 x 4 in.) is exposed to the radiant flux of an electric heater
- The heater has the shape of a truncated cone (hence the name of the instrument) and is capable of providing heat fluxes to the specimen in the range of 10-110 kW/m².
- Mass loss of material during combustion is continuously recorded.
- Tests can be conducted in the horizontal and vertical orientation.
- Materials burning behaviour in lower oxygen level or vitiated air streams can also be evaluated



17

ADVANTAGES OVER OTHER FIRE TESTS



- **Cone Calorimeter supplants LOI and UL-94 test**
- **Replaces tests for Non-Combustibility** – for **Composite Materials**
- **Replaces the vertical Cable Tray test**
- **Used for Toxic fire hazard Studies** – **not possible with other test facilities.**

<u>Most Fire Deaths are NOT Burn Victims!</u>

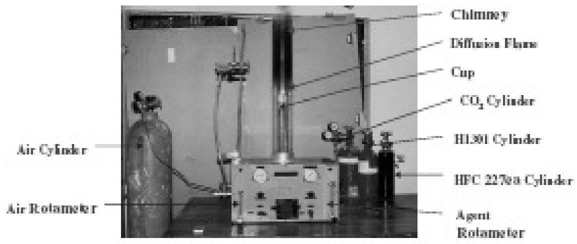
Major Cause of Death in Fires – SMOKE

- Hydrogen cyanide,
- Hydrocyanic acid
- Carbon monoxide
- Other toxic vapors
- Burns
- Trauma (non-burn).

Combustion Gas Analysis by Fourier Transform Infra Red (FTIR) Spectrometer

- FTIR is an important tool in the Fire Research arsenal for understanding the impact of different materials involved in fires on occupants and fire safety personnel
- The system can be used with cone calorimeter or test fire chambers
- The application is the determination of gaseous products of fire-agent interaction and characterization of materials for their combustion toxicity

Cup burner apparatus - Determination of MEC of gaseous extinguishing agents



Agent	CFEES	NRL	NMERI	GLCC	NIST	Investigator Fenwal
HALON 1301	2.74	3.10	2.90	3.50	3.10	3.00
HFC 227 ea	6.40	6.60	6.30	5.90	6.20	5.80

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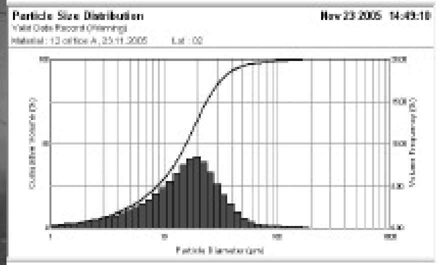
Water Mist Nozzle Characterization Facility



Standard Values:

Transmission = 75.58%	Dv(10) = 4.10 (µm)	Span = 1.98
Cv = 73.3 (PPM)	Dv(50) = 15.67 (µm)	D[3][2] = 8.37 (µm)
SSA = 0.717 (m^2/cc)	Dv(90) = 35.13 (µm)	D[4][3] = 19.10 (µm)

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1 m³ Instrumented Fire-mist Test Chamber

FIRE SAFETY R&D ; TEST & EVALUATION and FIRE TRAINING FACILITIES at PILKHUWA

- SIMULATION FACILITIES FOR DESIGN VALIDATION OF MIST BASED FIRE PROTECTION SYSTEM
- THERMO-MAN FACILITY FOR TESTING OF FIRE PROTECTIVE SUITS
- TESTING & EVALUATION LAB. FOR FIRE EXTINGUISHING MATERIALS
- FIRE – DRILL TOWER
- FIRE PITS FOR HOT FIRE TRAINING AND FIRE TESTING
- LPG TANK FARM FIRE SIMULATOR
- BREATHING APPARATUS TRAINING FACILITY
- MODEL FIRE STATION

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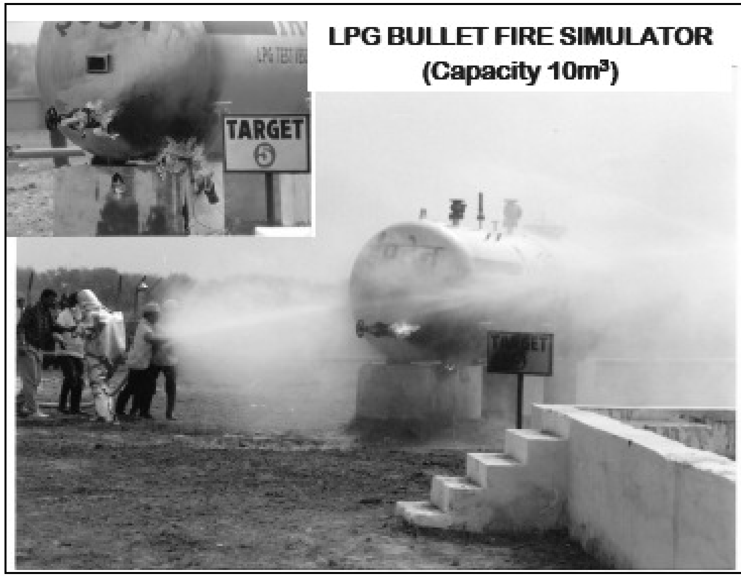
LPG BULLET FIRE SIMULATOR
(Capacity $10m^3$)



POL FIRE SIMULATOR

FIRE PITS FOR HOT FIRE TRAINING AND TESTING
ONE POOL = 60 FT X 30 FT; TWO POOLS = 30 FT X 30 FT EACH

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Tensile Testing Machine
IS-1969

Tearing Strength Tester

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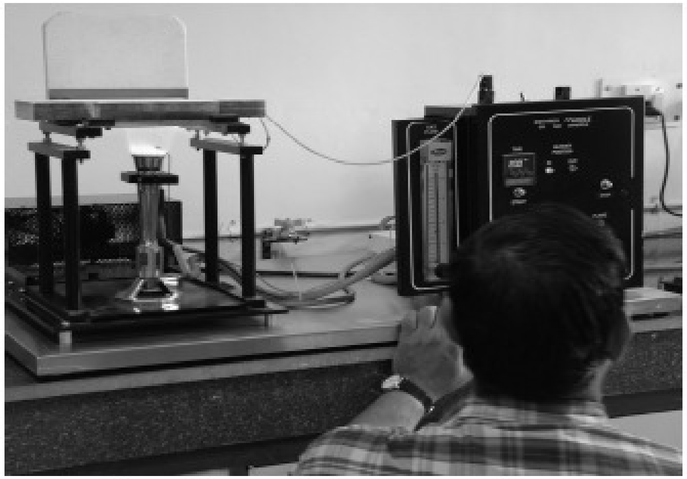
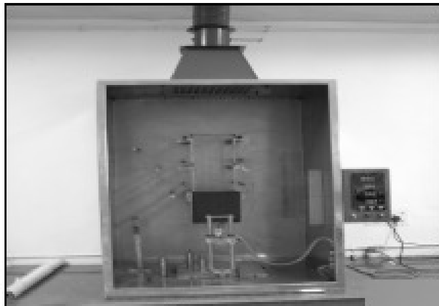


Thermal Protective Performance Tester
ASTM-4108

29

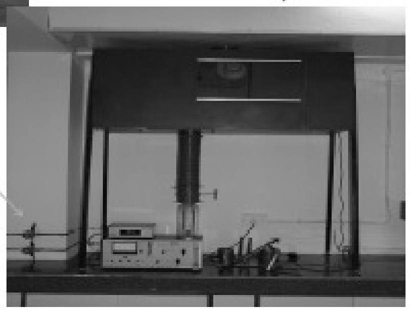


Flammability Tester
BS- 5438

Thermal Protective Index Tester
BS 3791

Heat Reflectivity Tester
US MIL 87076 A (NES 977)

Limiting Oxygen Index Tester
ASTM-2863



FIRE RESEARCH AND TRAINING FACILITIES AT PILKHUWA SITE

For carrying out large scale fire research and training facilities involving simulated hot fire, a 23 Acre site at PILKHUWA near Ghaziabad has been allotted

The following technical facilities are planned for the site:

(a) Design Validation facilities for of Mist -Fire Protection Systems.
(b) Thermo-man facility : Testing of Fire Protection Suits
(c) Material Testing and Evaluation Hall (40mX 40mX18m height)
(d) Model Fire Station and 3 Large Fire Pits for Training
(e) Fire Pump House
(f) Fire-Drill Tower
(g) LPG Tank Farm Simulator
(h) Breathing Apparatus Training Facility

Enabling works for site has commenced.

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SUGGESTED AREAS for CLOSE INTERACTIONS within FORUM

- Transfer of Technologies
- Test and Evaluation Facilities
  - Inter-lab comparison of evaluation of materials & chemicals for fire suppression and for toxicity index
  - Standard Test Materials
- Fire Training
  - Harmonization of training modules and curricullum
  - Exchange of faculty and training aids
  - Training of the trainer course content
- Joint R&D Prgrammes
  - R&D road-map for harmonization of standards
  - Setting-up of Centres of Excellence in fire research
  - Modelling and Simulation , large pool fires, fire plume transport in tunnels
  - Exchange of Expertise and Experts

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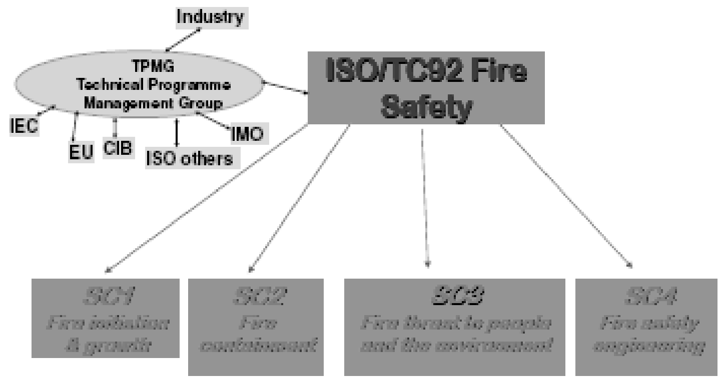
Organization of ISO Technical Committees on Fire Safety & Fire Engineering



Principal Technical Committee of ISO on Fire Safety

OBJECTIVES : TO DEVELOP CODES, STANDARDS, GUIDELINES & OTHER DOCUMENTS

- **Fire safety engineering**, design and evaluation methods used to verify that appropriate fire safety objectives are achieved.
- The performance of materials, products, elements of structure, structures and systems and their contents under fire conditions and where appropriate, in end-use conditions.
- The application of **fire safety management practices**
- Characterisation of occupant performance and behaviour when subjected to fire conditions and fire like emergency situations.

Sub Committee – 1 : Fire Initiation & Growth

To provide standards for evaluation of performance of materials and products at a fire initiation and growth stage.

- Test protocols, measuring techniques and fire scenarios in support of fire safety engineering
  - Test protocols, measuring techniques and procedures for securing data of fundamental fire properties
  - Test protocols, measuring techniques and procedures for input data to FSE models
  - Standards relating to fire scenarios and characteristic fire growth of products
- Performance codes
  - Test protocols for reference scenarios
  - Test protocols, measuring techniques and procedures for fire calorimetry
- Prescriptive codes
  - Updating tests already in use
- Test validation
  - Protocols to determine the precision of fire test procedures
  - Test protocols for validation of fire growth predictions
- Instrumentation
  - Protocols for measurement technologies used in fire test procedures

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Sub Committee – 2 : Fire Containment

To maintain and improve the existing ISO fire containment standards, develop new fire resistance standards as per the need, and integrate fire resistance tests and calculations with fire safety engineering, including:

•Generate data which allows prediction of fire performance

•Specify exposure conditions to correspond to those to which the assembly might be exposed in practice

•Provide numerical output in such a way that there can be electronic storage and access of results in a uniform manner

•Define, in measurable units, any external force, restraint, stress or pressure applied to the sample

•Account for special testing conditions (for example, edge effects), or justify the corresponding lack thereof, to enable the data to be applied to actual installation conditions

•Describe in the appendix or scope of each standard that fire safety engineering is a potential use of the standard

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Sub Committee – 3 : Fire Threat to People & Environment

To develop a set of standards that capture the state-of-the-art in the generation, transport and impact of fire effluent on people and the environment. The standards provide the basis for including the harmful effects of fire effluent in fire hazard and risk assessment.

Activities of the sub-committee include standards for:

•The role of toxic hazard in fire safety

•Analysis of fire effluent for estimation of toxic potency

•Appraisal and standardization of apparatus for accurate generation of fire effluent

•Measurement of the toxic potency of fire effluent

•Effect of fire intervention strategies on toxic potency, hazard and risk

•Characterization of airborne fire effluent that can affect the environment

•Environment implications of fireground activity

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Sub Committee – 4 : Fire Safety Engineering

To provide FSE documents for supporting performance-based design and assessment to:

- Develop and maintain ISO documents on the use of fire safety engineering
- Develop engineering design and evaluation methods for verifying appropriate objectives
- Standardize necessary calculation or other assessment methods
- Develop standards for validation procedures
- Elaborate guidance documents for best engineering practices

Current activities regarding the development of standards are:

- Fire safety engineering process regarding behaviour and safety of people and development of general principles
- Use of risk assessment models regarding selection of design fire scenarios and quantitative evaluation of hazards
- Use of accepted engineering methods for validation and verification of calculation tools
- FSE approach for the global behaviour of structures in fire
- Necessary input data to FSE methods
- Calculation methods in fire dynamics

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GENERAL TRENDS IN STANDARDISATION

•Universal Applicability
 – no regional interests

•High scientific integrity & verifiability

•Present Domain of use:
- Europe,
- IMO
- Individual countries
- International Organizations

•Technical Inputs Flow from FSE
 – continuous

•Use of test methods for FSE R&D

•Technical Content Dilution due to Market Interest

•Development of tests are largely product driven
 – shift to performance driven

•Fire calculation models needs more development
- High technology inputs
- Data for models may be un-measurable as yet

Summary sheets of test methods in ISO CD 17252

Non-Combustibility - EN ISO 1182
Calorific potential - EN ISO 1716
Ignitability for a radiant heat source - ISO 5657
Spread of flame ISO 5658-2
Spread of flame ISO 5658-4
Smoke Box ISO 5659
Cone Calorimeter - ISO 5660
Flooring test - EN ISO 9239-1
Room Corner Test - ISO 9705
Small flame test - EN ISO 11925-2
Small room fire test for sandwich panels ISO FDIS 13784-1
Large room fire test for sandwich panels ISO FDIS 13784-2
Intermediate scale test for facades ISO FDIS 13785-1
Large scale test for facades ISO FDIS 13785-2

THANK YOU

Eco-Friendly Equipment

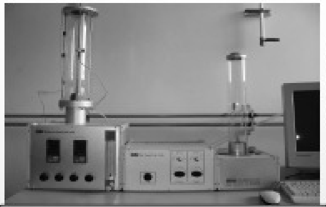
Smoke Cleaning Plant

- Capacity : 180~150,000 m³/h
- Output Temp : 60~150 ℃
- Dust Density : 4,000 mg/sm³
- Output Pressure : 0~200 mm H_2O
- Main Components : HCl, SOx, CO, CO_2

> Back Filter
> Wet Scrubber
> Chemical Supply System

KICT 37/30 FRC

Fire Testing Equipments Developing in Collaboration with a Corporation Ltd. (FESTEC, www.festi.co.kr)



Limited & Temperature Oxygen Index

❖ Standard : ASTM D 2863, ISO 4589

- Size : 350mm ×370mm ×280mm(W:D:H)
- Column Size : 75, 100mm(dia) ×450mm(H)
- Oxygen(O2) : 30psi
- Nitrogen(N2) : 30psi
- Propane for Igniter : 7 bar

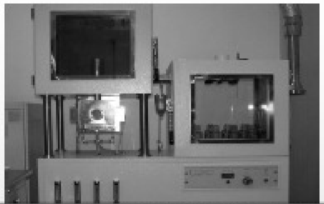
❖ Standard : ASTM E 662, ISO 5659, NES 711

- Size : 1,630mm×660mm×1,900mm(W:D:H)
- Test Room : 1.63m×0.85m×2m(W:D:H)
- Swing space : 1.1M
- Water cooling : 2 ℓ/min
- Propane dir : 1bar
- Air : 1.7± 0.3bar

Smoke Density Chamber

KICT 38/30 FRC

Fire Testing Equipments Developing in Collaboration with a Corporation Ltd. (FESTEC, www.festi.co.kr)



Toxic Gas Tester by a Mouse Activation

❖ Standard : KS F 2271

- Chamber Size : 500(w) × 500(d) × 500(h)
- Exhaust Flow : 2~ 20 l/min
- Mouse Tray : Aluminum, 75g
- Nitrogen(N_2) : 30psi
- Propane for Igniter : 7 bar

❖ Standard : ISO 1182, KS F ISO 1182, KS F 2271

- Size : 400(w) × 400(d) × 1270(h)
- Specimen centre lift : AC motor (Starting torque 500g-cm)
- Furnace Heater : 80/20 nickel/chromium tape
- Insulating wall : Magnesium oxide powder

Non-combustibility Tester

KICT 39/30 FRC

Fire Testing Equipments Developing in Collaboration with a Corporation Ltd. (FESTEC, www.festi.co.kr)

Large (Industry) Scale Calorimeter

- Quantitative : 10 MW
- Size : Hood dia (9.7m), Duct dia (1.6m)
- Flow Rate : 68 kg/sec
- Pressure drop : 1420 Pa (cold flow)
  2090 Pa (hot flow)
- Flow measurement : Bi-directional Velocity Probe by DPT
- Smoke measurement : by Helium-neon Laser

❖ Standard : prEN 13823

- SBI Duct : Size 1470(W) × 4870 (D) × 4245(H)
- Test Room Size : 3000(W) × 3000(D) × 2600(H)
- Extraction capacity : 0.05 m3/s ~ 0.65 m3/s at 298 K

Single Burning Items

KICT 40/30 FRC

附錄三 FORUM 立場聲明報告(英文)

The International FORUM of Fire Research Directors[1]

A Position Paper on the Treatment of Numerical Modeling Uncertainty in Fire Research

Sheldon Tieszen[1], Reinhard Grabski[2], and Louis Gritzo[3]
[1] *Sandia National Laboratories*
[2] *Institut der Feuerwehr Sachsen-Anhalt*
[3] *FM Global*

Background

Numerical modeling of fire dynamics has proven itself an invaluable asset to the fire research community, as it has in other engineering communities before it. Similarly, as fire modeling capabilities mature, there is an expectation that fire researchers will develop a deeper understanding of the associated uncertainties and their implications. Even if computational capability continues to double in 18 month periods as it has been for the last few decades, it will be many (~ 6 - 10) decades before fire simulations can be based solely on first principles representation. During this time, there will be inherent modeling uncertainty in fire simulations that is fundamentally different than experimental uncertainty.

Uncertainty can be divided into two major elements, aleatory and epistemic. Aleatory uncertainties are those that can be adequately described by probabilistic approaches and reflect the randomness of a system. Epistemic uncertainties are due to an inherent lack of knowledge. Both types of uncertainty are found in both experimental and numerical modeling. In fire modeling, epistemic uncertainties are prevalent in the description of the subgird (or subfilter) physics due to the inability to computationally represent more than a fraction of the length scales in a first principles manner. Aleatory uncertainties are prevalent in boundary condition descriptions such as the wind direction and amplitude.

In general, the rigor with which uncertainty is treated in any application is dependent on the societal risk incurred through its use. The modeling and simulation uncertainty quantification standards can be very high [Helton, 2009] for decisions involving high societal risk. In general within the research community, there is a well established process for limiting public risk, at the core of which is that no scientific study is considered valid until it has been independently reproduced.

Numerical modeling is almost always used, in the research context, to provide insight, not a theoretical proof and in this regard is complementary to experimentation. The coupling of M&S with experimentation can be thought of as a current expression of the scientific method. Numerical tools are the codification of theory. A simulation result is a reflection of reality with certain accuracy. In other words, a simulation results in a prediction using the codified theory, or in the language of classical science, results in a scientific hypothesis. As in classical scientific methods, proof remains firmly established in the empirical results (i.e., experimental validation).

While perhaps subtle, the expectation of a simulation as a hypothesis is important in establishing the rigor required for uncertainty treatment. As a statement of a hypothesis, numerical fire models are an invaluable assess in fire research. Quantification of uncertainty is a means of separating a valid hypothesis from pure speculation. Model results with sources of uncertainty properly identified, propagated, and communicated can be considered as a valid hypothesis. Without a treatment of uncertainty, M&S can be considered as no more than speculation, and scientific journals should avoid its publication.

In a broad sense, there are two major challenges associated with treating uncertainty in a M&S based scientific study. One is the identification and quantification of the sources of uncertainty, the other is the propagation and summation of that uncertainty for the outcome metric of interest. The sources of M&S uncertainty are highlighted in the next section, with the reader referred to more extensive text for details. Similarly, propagation and summation of uncertainty is discussed briefly in the section on Uncertainty Quantification. The FORUM position is summarized in the final section.

Sources of M&S uncertainty

The approach taken here for identification of uncertainty sources generally follows that being evolved by Pilch [Oberkampf, Pilch and Trucano, 2007] which builds on Software Engineering Institute's Capability Maturity Model Integration approach to communicating the level of rigor employed in software development. In this approach, uncertainties can be identified in six major elements, 1) Representation and Geometric Fidelity, 2) Physics and Material Model Fidelity, 3) Code Verification, 4) Solution Verification, 5) Validation, and 6) Uncertainty Quantification. The first five are sources of uncertainty. Discussion of the first two items on model fidelity follows in the next section. Verification and validation is addressed in a previous FORUM position [Gritzo et al., 2005] and will be briefly summarized. The sixth is uncertainty due to the propagation of uncertainty and will be discussed in the Uncertainty Quantification section.

Representation and Geometric Fidelity

For all but the simplest academic problems, approximations must be made in the geometry, initial, & boundary conditions in either computational simulations or experiments. The significance of the resulting uncertainty is summarized by the often used statement "Garbage in, garbage out."

Experimental uncertainty can result in experiments in simplified geometry and hence different facilities to differ by several times the measurement uncertainty from either facility. Similarly, it can be expected that geometric simplifications in analysis models can result in uncertainty in the output metric. Further, for CFD based models, there is an additional source of uncertainty due to the need to represent the geometry with a mesh that is insensitive to the discretization error associated with a numerical solution. For example, a model may require a curved surface be represented by stair-stepped grid geometry.

In theory, model results can provide a measure of the geometry uncertainty through sensitivity studies with geometric variations. However, most scenarios of interest usually involve many geometric parameters and due to the combination of geometric complexity and expense of changing geometry, this source of uncertainty is often not well characterized. Furthermore, journals rarely require geometric sensitivity studies for either experimental or modeling works.

It is for this and broader considerations that journals consider publishing independent M&S studies of important hypotheses. Independent studies will of course have differences beyond geometry, however, the manual nature of geometry creation will usually ensure that geometric & mesh differences will occur between the studies.

In a similar fashion to geometric uncertainty, a historical problem with modeling or experimental studies is the failure to report initial and boundary conditions. This problem has significantly improved over the last decade, but it should be emphasized that initial and boundary condition assumptions should be reported for each conservation equation: mass, species, momentum, and energy with appropriate fidelity in any scientific study.

In general, it is expected that fire analysts will vary the specification of boundary and initial conditions if there is reason to believe that the output metric will be dependent on the input condition. For example, fires that are wind affected, it is important that more than mean profiles are specified. Sensitivity studies to important initial and boundary conditions are often warranted. In general, journals must provide adequate page space to the description of the initial and boundary conditions to understand the effect of uncertainty in these conditions on the prediction.

Physics and Material Model Fidelity

Unlike experiments, in which nature includes the aggregation of all chemistry and physics down to the sub-atomic level, numerical fire models provide only a partial description. As a result, direct comparison between modeling uncertainty and experimental uncertainty are without meaning. At the highest level, there are two sources of uncertainty that are inherent in any model which obviously affects the uncertainty in the prediction – approximated physics/chemistry and missing physics/chemistry. Model uncertainties will be described in this section, while numerical uncertainties will be described in solution verification.

While the methods for characterizing uncertainty between models and numerics are different, it is important that both should be reported in research in order to assess uncertainties. Adequate documentation of the models and numerics employed is difficult for scientific journals due to the detailed nature of both models and numerics. A typical solution is for authors to generate a detailed report that is maintained by their university, institution, or by the author to provide upon request. Important summary statements can then be included in journal publications with reference to the details in the reports.

Characterization of missing physics is often done through parameterization of the consequence of including the physics or not. This is most easily done for discrete events, like a window breaking and allowing a backdraft or not, a spray nozzle activating or not, etc. It is far more difficult for continuously evolving physics; say the geometry change due to a progressive building collapse.

Characterization of approximated physics is usually done through sensitivity studies.
However, the means for doing the sensitivity study is not necessarily straight forward. Take turbulence for example. One can vary a model coefficient, such as the single coefficient on the Smagorinsky turbulence model over a suitable range to characterize the model uncertainty. However, there is no guarantee that the parameter variation will bound the total uncertainty represented by the turbulence model itself. Another approach is to compare two turbulence models. Unfortunately, neither of these two approaches provides the optimal solution, a quantification that bounds the uncertainty due to approximating the physics.

Thus there is an inherent risk in current approaches that use sensitivity analysis based on bounds in parameter variations, or even model/model variations, that the propagated uncertainty bounds will actually bound the true non-linearities inherent in the phenomena. The goal is typically that a prediction with uncertainty bounds will contain the actual result if conducted experimentally. However, with the methods currently available there is no guarantee of this outcome and it is recommended that the research community seriously consider developing models that can bound uncertainty in addition to producing the best estimate.

Code and Solution Verification

Numerical simulation tools have become invaluable assets to the fire research community. As such numerical they are almost always under continuous development and require continuous code verification to ensure the equations are solved as intended. It should be understood by the scientific community that there is a very broad spectrum of rigor used in simulation tool development that ranges from trying something for the first time for numerical research purposes to production code for research purposes. In this context, it should be noted that a 'research' code is not necessarily a code you want to use for fire 'research.'

The goal of solution verification is to separate out the contribution of numerical approximation uncertainty from the total model uncertainty. The value of being able to do so is to be able to identify the sources of numerical uncertainty. One of the most basic solution verification studies is grid refinement since the non linear physics in fire dynamics is particularly susceptible to numerical discretization/model coupling error. No CFD-based fire study should be published without a grid refinement study. Note that sensitivity studies of this nature do not bound uncertainty, but provide only a linear characterization of it's magnitude.

Accordingly, the practice of code verification and solution verification, as outlined in a previous FORUM position paper [Gritzo et al., 2005], requires continual diligence.

Model Validation

The fundamental question for each application of any mathematical model (also in fire research) is how you can estimate the uncertainty of the model. The best way is the comparison with experimental results, i.e., validation. For this reason it is recommended that authors cite validation studies of direct relevance to their current study so that technical reviewers may assess the uncertainties.

Uncertainty Quantification

In the previous sections, the major sources of uncertainty were identified. This section addresses how the sources of uncertainty are propagated and summed to ascertain the overall uncertainty on the output metric. Ideally, before propagation, all uncertainty sources would be identified and bounded. As noted above, this ideal is not always obtained.

For propagation and summation, the simplest and thus most common methodology used to establish uncertainty in the output metric (i.e., the hypothesis test in an analytical scientific study) due to uncertainties described in the previous section is through sensitivity studies. The most basic sensitivity study consists of varying an input or model parameter over its uncertainty range and noting the change in the output parameter.

Complexity arises due to two sources. First is the fact that there are typically more sources of uncertainty than can be handled through addition of simple variations of each parameter. Second is that aleatory and epistemic uncertainties need to be treated in different ways. Efficient methods of handling large numbers of uncertain sources with both aleatory and epistemic uncertainties are the subject of current research. To describe these methods is beyond the scope of this paper, and would require a paper of equal or greater length in any case.

In all sensitivity studies, the non-linear effects are propagated through the use of the models themselves. It is important that fire researchers document the methods that they used to propagate uncertainty so that reviewers can assess adequacy. Note that adequacy of establishing uncertainty does not speak to the adequacy of a model for an intended application. For this purpose, the robustness of the hypothesis must be greater than the uncertainty in the metric used to measure it.

For example, in complex, non-linear problems, bifurcation points are not that uncommon. Extremely small uncertainties must exist in order to predict the outcome at such a point. A specific example would be a fire in a room with two paths for smoke to escape. If the pressure drop across each path is essentially identical, then the smoke could take either path. In such a problem, the code may predict one path but not the other. If the goal of the simulation is to guide firefighters down a smoke free path, then small uncertainties in predictions could send them down the wrong path. In the same scenario, if the two smoke paths have quite different pressure drops, then the hypothesized fire fighter route would be correctly predicted even with relatively high uncertainties. The difficulty is that the results only show the single outcome and not the alternatives lying in nearby parameter spaces. If errors preclude the prediction of a path that exists in reality in a nearby space, then an inappropriate conclusion may be drawn.

FORUM Position

It is the FORUM's position that fire research requires appropriate rigor placed on uncertainty quantification in studies that include numerical modeling. When backed up by an appropriate uncertainty analysis, model results advance the state of knowledge by providing valid scientific hypotheses.

The FORUM position is for researchers to follow verification and validation with adequate uncertainty quantification including:

- vary the specification of boundary and initial conditions.
- develop models that can bound uncertainty in addition to producing the best estimate.
- vary numerical parameters to assess sensitivity.
- document the methods that they used to propagate uncertainty.

The FORUM’s position also states that journal reviewers and editors should:

- publish independent M&S studies of important hypotheses to help establish M&S uncertainties including those in geometry, etc.
- refrain from publishing CFD-based fire studies without a grid refinement study because of the sensitive of model/numerical couplings for fire.

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Oberkampf, W. L., Pilch, M., and Trucano, T. G., 2007, “Predictive Capability Maturity Model for Computational Modeling and Simulation,” Sandia National Laboratories, Albuquerque, NM, SAND2007-594

The International FORUM of Fire Research Directors[2]

A Position Paper on Sustainability and Fire Safety

Ulrich Krause
BAM Federal Institute for Materials Research and Testing

Compilation of sustainability issues that have implications on fire safety

1. Introduction

While earth's population is approaching the seven billions landmark, not only the number of people who have to be provided with housings is growing, but also the demands to the quality of housings are increasing.

In the developed countries buildings have to meet complex requirements according to static integrity, safety, reliability, usability, comfort and aesthetics. In the developing countries there is still a strong need to provide shelter fitting to minimum requirements at all for a large part of the society.

Satisfying the needs of a growing human community in the construction field means to provide sustainable and efficient solutions at a high level of technical safety.

Foreseeable shortage of natural resources, the need for reduction of pollution and wastes and increasing demands according to friendliness to environment promote the usage of alternative construction materials and concepts.
Modern buildings have to be highly energy efficient, e.g. tending towards zero heat energy use. Construction materials helping to meet this target ideally have to

- be made from renewable resources,

[2] http://www.bfrl.nist.gov/info/forum/ The International FORUM of Fire Research Directors (FORUM) was formed in 1991 with a goal to reduce the burden of fire (including the loss of life and property, and effects of fire on the environment and heritage) through international cooperation on fire research.

- keep their desired properties over the whole life cycle,
- be fully recyclable.

In addition to that, many countries have established vast programs to reduce energy losses from buildings on the basis of conventional technologies to meet the targets of the Kyoto protocol for reduction of greenhouse gases.

In relation with these initiatives a number of new heat insulation products made from renewable materials have appeared on the market. Furthermore, some traditional “natural” building materials have experienced a comeback.

While this trend has been welcomed by politicians and the environment-oriented fraction of the society, those concerned with fire protection have remained quite reluctant. The main reason is that most of the “natural” materials are flammable.
In addition, extended use is made of polymeric insulation materials like polystyrene. Though this is not a renewable material, the energy saving effect of insulation may also be considered to be part of a sustainable way of building.
Performance of structures made of these materials under fire is largely unknown also especially due to the wide range of application of these materials and technologies in the building industry.

2. Fire safety issues

Hence a number of questions arise whether the newly marketed, environmentally friendly products fit to the high level of fire safety achieved in the industrialised countries today.

In particular, the following problems emerge:

- performance in fire of formwork constructions where renewable materials (cork grit, sheep wool, paper flakes etc.) are used for heat insulation,
- fire resistance of multi-storey timber structures, remaining bearing capacity,
- failure of nail bonders in timber constructions,

- resistance of roofings from renewable materials (e.g. reed) against external fires,
- emissions from renewable materials with flame retardant additives under smouldering and flaming fire conditions,
- fire behaviour of latent heat storage systems (so called PCM devices, smartboards etc.) in fire-resistant structures, e.g. influence on time to flashover inside the fire room.

Of course, building products from renewable materials already today have to satisfy requirements of building regulations. However, a large market for such products are family homes for which the requirements to fire performance – at least in some countries – are much lower than for the public sector. On the other hand, fire statistics reveal that more than 75 % of fire victims die in their homes. Hence, fire safety in buildings with low level of regulation has obviously to be re-considered.

3. FORUM Position

It is the FORUM's position that:

- construction of sustainable, energy efficient buildings and structures is a worthwhile and necessary goal to address critial worldwide environmental concerns;
- the safety of building occupants and the protection of propety against losses due to fire cannot be compromised while pursing the goal of sustainable, energy efficient construction;
- acceptable solutions to accute fire safety concerns cannot threaten the long term health of workers, fire fighters or the general public; and
- a robust and extensive international research program on sustainable infrastructure materials, advanced fire protection technologies, the environmental and health impacts of fire and fire safety practices, and suitable economic metrics for assessing alternative approaches to sustainability is prerequisite to attaining this goal.

Hence, a knowledge-based integrated approach is needed to assess pros and cons of the application of renewable construction materials and sustainable construction technologies.

FORUM members are committed to documenting and disseminating to the international environmental community, the fire services, and building regulatory codes and standards orgainzations progress on collaborative and individual efforts to meet the increasing demand to lower the environmental impact and carbon footprint of constructed facilities while maintaining the fire safety and the health of building occupants, fire fighters, and the communities within which these structures reside.

附錄四 國際組織報告(英文)

CIB W014 Commission
Fire

George Hadjisophocleous, PhD, P.Eng, FSFPE
Coordinator

Outline

- Overview of CIB W14
- Last meeting
- Commission Projects
- Outputs

Overview of CIB W014

- CIB W14 promotes and supports science-based fire safety engineering and its use for performance based fire safety designs
- CIB W014 has 57 members from 27 countries

Overview of CIB W014

- **The Objectives of this Working Commission are:**
  - to provide an ongoing research focus and promote international collaboration for the development of a sound scientific and technical basis for fire safety engineering (FSE) methods.
  - to promote fire safety engineering methods and their use with performance based codes.
  - to provide fire safety technology input to the other CIB Commissions as appropriate.
  - to exchange fire safety engineering outputs internationally, including the standards community.

Overview of CIB W014

- **To meet the objectives W014:**
  - launches projects with well-defined scopes and limited time schedules
  - publishes the output of its work as CIB Publications, in international journals and in workshop or conference proceedings
  - provides a forum for networking among its members
  - organizes workshops
  - initiates the CIB co-sponsorship of conferences that serve the purpose of the commission
  - facilitates its members to circulate information on ongoing and completed research projects and research publications
  - liaises with organizations having similar interests

FORUM Meeting, Seoul Korea, October 2009

Last Meeting

- Lund University on April 23rd, 2009
- Meeting was held in conjunction with the ISO/TC92/SC4 Committee on Fire Safety Engineering
- 31 members and guests attended

FORUM Meeting, Seoul Korea, October 2009

April 23rd Meeting Agenda

- Reviewed of CIB and Commission Objectives
- Overview of ISO TC92/SC4
- 2005 & 2008 NIST Recommendations on WTC 9-11 Incident - Fundamental Implications for Fire Engineering Design & Practice
- CIB W14 Research program
  - Reviewed topics from Ottawa meeting, Sep 2008
  - Brainstorming on new potential research topics
  - Selection of research projects

FORUM Meeting, Seoul Korea, October 2009

Proposed Projects

- Design Fires
- Fire performance of materials
- Structural performance in fire – connections
- Structural performance in fire – fire induced progressive collapse
- Human behaviour in fire
- Performance criteria for performance based fire safety design

FORUM Meeting, Seoul Korea, October 2009

Design Fires

- **Working group:** WG1
- **Group leader:** Dr. Ehab Zalok
- **Project team:** C. Wade*, A. Poulsen, A. Bwalya, G. Hadjisophocleous
- **Preliminary task:** Review fuel loads and approach used for design fires development from different studies. Statistical data on ignition sources.
- **Preliminary deliverable:** Report on the state of the art of design fires.

FORUM Meeting, Seoul Korea, October 2009

Fire Performance of Materials

- **Working group:** WG2
- **Group leader:** Dr. Steven Craft (Interim)
- **Project team:** G. Hadjisophocleous, N. Benichou, R. Jansson, E. Guillaume, E. Zalok, with additional members to be named from the following organizations: CTICM, CERIB, EMPA, TFRI
- **Preliminary task:** Review of existing data on thermal and mechanical properties of building materials.
- **Preliminary deliverable:** Report on thermal and mechanical properties of different building materials (to be determined based on team's expertise).

FORUM Meeting, Seoul Korea, October 2009

Structural Performance in Fire - Connections

- **Working group:** WG3
- **Group leader:** Currently no group leader
- **Project team:** B. Zhao, G. Hadjisophocleous, J. Gross*, E. Zalok, with additional members to be named from the following organizations: CERIB
- **Preliminary task:** Review of existing work on connections.
- **Preliminary deliverable:** Report on existing work and knowledge gaps.

FORUM Meeting, Seoul Korea, October 2009

Structural Performance in Fire – Fire Induced Progressive Collapse

- **Working group:** WG4
- **Group leader:** C.J. Walsh
- **Project team:** J. Kruppa, with additional members to be named from the following organizations: NIST*, NRC Canada*, TFRI
- **Preliminary task:** Review of existing work on fire induced progressive collapse.
- **Preliminary deliverable:** Discussion paper.

FORUM Meeting, Seoul Korea, October 2009

Human Behaviour in Fire

- **Working group:** WG5
- **Group leader:** Currently no group leader
- **Project team:** C, Horacio, R. Fahy*, C.J. Walsh, Prof. Diaconu, E. Kuligowski*
- **Preliminary task:** Summarize data needed and data available for evacuation including people with activity limitations.
- **Preliminary deliverable:** Report on above.

FORUM Meeting, Seoul Korea, October 2009

Performance Criteria for Performance-Based Fire Safety Design

- **Working group:** WG6
- **Group leader:** Dr. Noureddine Benichou
- **Project team:** S. Leduc, C. Wade*, G. Hadjisophocleous, T. Tanaka*, A. Poulsen, J. Hall with additional members to be named from the following organizations: CERIB, TFRI
- **Preliminary task:** Review performance criteria used in different countries.
- **Preliminary deliverable:** Report on above.

FORUM Meeting, Seoul Korea, October 2009

CIB W14 Projects

- Developed template for Project statements of work
- Statements of work have been developed for 5 of the 6 projects
- Group membership not finalized yet (Group leaders are contacting potential members)

Planned Outputs

- **Publications**
  – Special Issue of Fire Technology with CIB September 3-5 meeting papers (5 papers accepted for publication)
  – Special CIB report on Future directions of CIB W014

FORUM Meeting, Seoul Korea, October 2009

Society of Fire Protection Engineers

Morgan J. Hurley

Technical Director

Membership

- ~5,000 active members
- ~80% of members are in the U.S.
- Modest growth in membership over recent years
- Changes in demographics will be a challenge

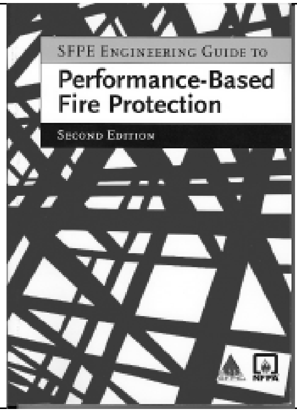
SFPE Goals

- Education & Training
- Technical Excellence
- Organization
- Membership
- Professional Practice

Technical Excellence

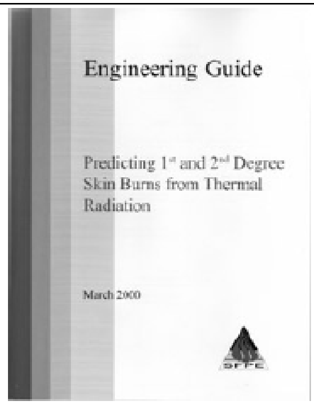
- GOAL: Establish SFPE as the primary source of fire protection engineering information and advancements

Performance-Based Design Guide

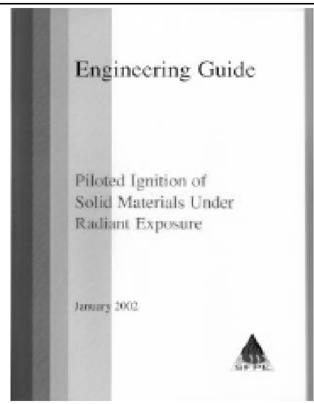


Radiation From Pool Fires

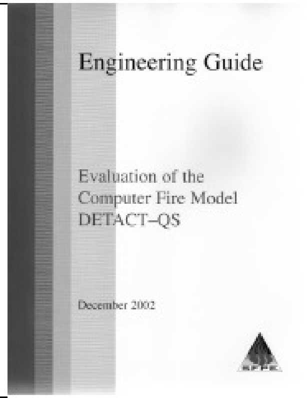
Skin Burns



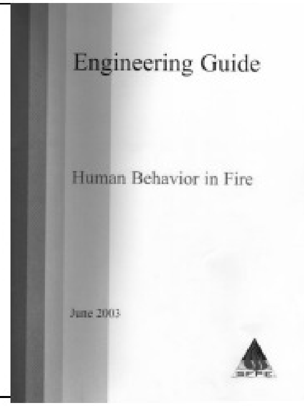
Ignition of Targets



Evaluation of DETACT-QS

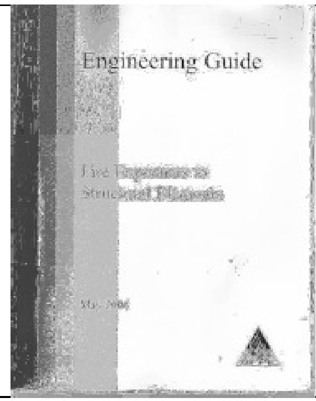


Human Behavior

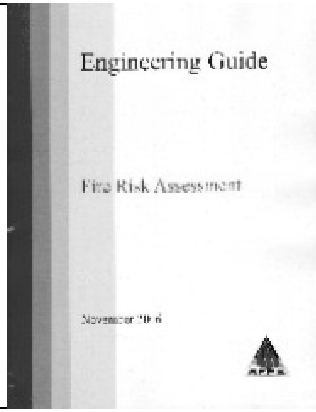


Code Official's Guide to Performance-Based Design Review

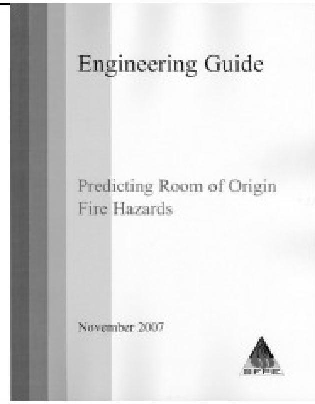
Fire Exposures to Structures



Risk Guide

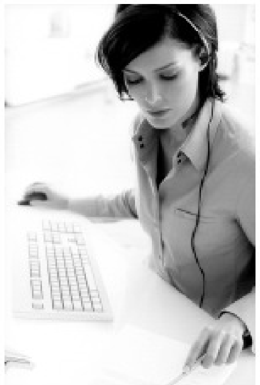


Room of Origin Fire Hazards



Substantiation of Use of a Computer Fire Model

- Will provide a framework for demonstrating that a computer fire model is appropriate for a given application

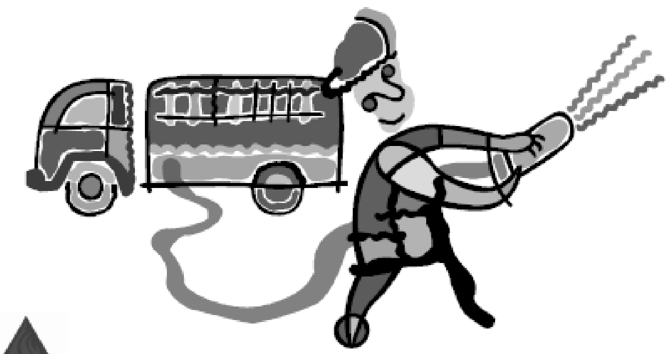


Design Basis Fires

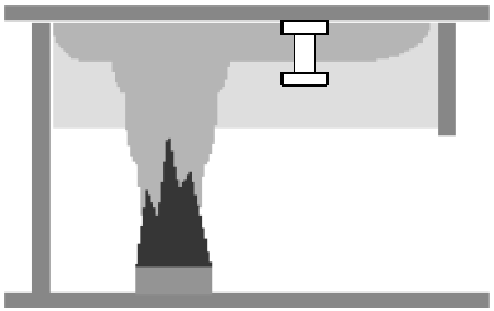
Design Performance Criteria

- Presents a methodology for developing performance criteria
- For use by code developers by engineers, or by enforcement officials

Fire Department Operations



Standards on Calculation Methods for Structural Fire Resistance Design



Research Priorities Identified in Four Areas

- Risk concepts
- Fire phenomena
- Human behavior
- Data

Risk Management

- Determination of acceptable risk
- ~~Risk management framework~~

Fire Phenomena

- Heat release rates
- Suppression system effectiveness
- Detector response
- Smoke movement from smoldering fires
- Impact of fire on the environment

Human Behavior

- Human behavior in fire
  - Response to cues
  - Decision making
  - Impact of fire products on behavior
- ~~Design methods~~

Data

- Data collection
- How installations vary from designs
- Post-fire data
- Reliability data
- Effects of aging on performance
- Monitoring of system effectiveness

Additional Needs

- Data for model validation

Fire Safety Journal
+
University View Points to Fire Research

Yuji Hasemi
Dean for Architectural Studies, Education & Practice
Professor , Environment Unit, Department of Architecture
Waseda University

Fire Safety Journal, overview

- Fire Safety Journal(FSJ) was initiated by David Rasbash, University of Edinburgh, in 1970s and has been published from Elsevier.
- FSJ's long cooperation with CIBW14 and IAFSS brought its internationally high reputation as academic journal in fire safety science and engineering.
- FSJ has Three Editors from Europe(Dougal Drysdale), America(Vyto Babrauskas) and Asia-Oceania(Hasemi).
- Fire Safety Journal became IAFSS's official magazine in 2003.

Fire Safety Journal, Recent epochs

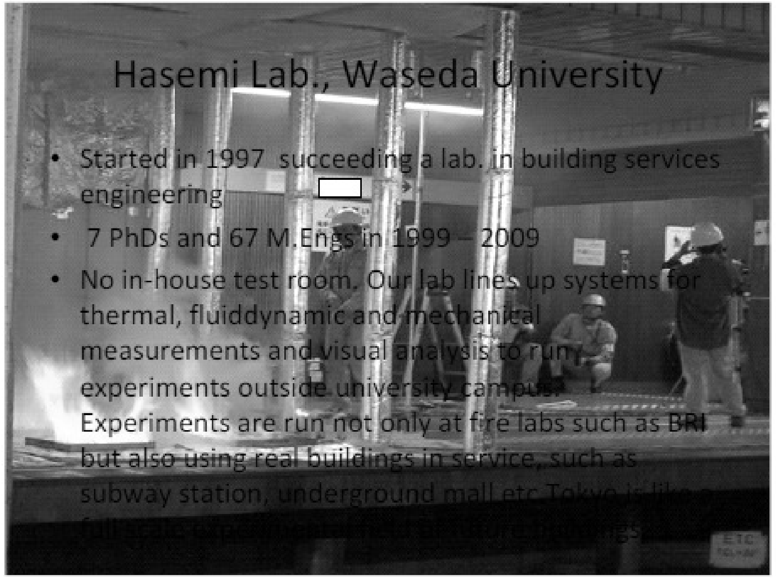
- Significant increase of paper submission from Asia since around 2005. Number of paper submissions increased by 2.5 times during 2005 – 2008. Majority of paper submissions are from Asia-Oceania.
- Electronic submission, review and editing system was introduced in 2006. Function of the system has been updated annually.

Fire Safety Journal, Sufferings

- Rapid increase of paper submission caused shortage of good reviewers.
- Increase of poor quality papers is the source of major sufferings of the Journal. 30% of the papers submitted to Hasemi in 2007 were rejected for the strong suspicion of plagiarism or double submissions. One paper was detected as plagiarism after publication and had to be cancelled.
- Electronic screening of papers has improved the situation, but there are still sophisticated plagiarisms and double submissions: translation of papers by someone else in "local language", change of title, co-authors, key-word etc.

Fire Safety Journal, Cause of sufferings

- Situation is probably similar in every journal. Hasemi has been asked for review of several papers in sprinklers or smoke control submitted to *"Building and Energy"* etc in last few years, but all were either plagiarism, obviously fake data or routine test report.
- Excessive connection of promotion of researchers with publication in SCI journals in Asian countries seems to be the background for everything. But this will produce "paper-writers" rather than scientists.
- Scope of journal may need to be revisited to make journal as a real engine for the promotion of Fire Safety Science.



Funding Sources for Fire Research, Hasemi Lab 2008

- Ministry of Education & Science(competitive) 21,000
- Other Competitive Funds 2,500
- Government's Project 5,000
- Local Governments 3,000
- Industry 5,000
- Consultancy 5,000
- In-house Projects 1,700
- In-house Fund for Research Promotion of Graduate Students 3,000

Unit: thousand Yen Total approx. \50 M = $0.5M

Job Market of Hasemi Lab Graduates 1999-2009

- PhD Students/PD Fellows 9 in total
  Research Institutes 3
  Universities 2
  Engineering Firms/Consultants 3
  Nonprofit Organizations 1
- Master Students numbers in ( ): fire/safety experts
  Large Construction Firms 30% (8%)
  Public Sector(governments/fire dept. etc) 25% (5%)
  Architectural and Building Design Firms 15% (?%)
  Urban-developing/Real Estate 15%
  Housing 10% (5%) 67 graduates, 15 fire experts

Visitors to University Lab in downtown

- University lab is not only the place for faculty and students to drink together.
- University in downtown Tokyo, next to the entrance of subway station, is often considered a kind of *refuge temple* for those who have conflicts that may not be resolved within the current social framework. They include even administrators and politicians.
- Most of them are hard to resolve in engineering or rational manner. But they are often seed for new research or new application of research.

Potential New Market for Fire Research and Fire Safety Engineers in Japan

- "Lawless" Facilities
  Railway stations, Underground, Cultural heritage
- Cultural Heritage
- Fire Investigation
- Escape from Flood, Terror Attack, Earthquake
- Business Continuity
- Nonregulatory Performance Assessment
- Safe Fire Fighting Strategy and Technology

"Lawless" Area Issue

- Underground facilities beneath public road and transportation facilities are sacred from Building Standard Law . But they should need rational fire safety performance for life safety etc.
- After the privatization of national railway and subways, big stations has become like shopping mall complex without sprinklers, smoke control or disaster control center. Some of such in-station commercial areas are large, over 3,000m2.
- There is no fire safety measures in underground passages , although they increasingly involve shops or are connected with shopping areas in general.

Few research because of the subjects out side the range of conventional fire regulatory bodies.

Fire Investigation

- Number of civil cases on the insurance nonpayment is increasing significantly. The supervising agency of the fire insurance, doubts in the validity of over 50% of the recent nonpayment cases in fire insurance. Considerable portion of the nonpayment seem to lack scientific evidence report.
- Significant fires essentially need scientific investigation for (1) prevention of reoccurrence, (2) improvement of fire fighting, (3) criminal investigation and (4) fire insurance.
- BRI and FRI do not work for civil cases. Then who?

Cultural Heritage

- Over 25,000 important historic buildings to protect

  4,500 designated important cultural property(ICP) or higher

  11,000 approved traditional buildings in 86 important preserved historic districts

  7,500 registered cultural property buildings

  2,500 unprotected buildings storing important cultural property fine art, crafts and documents.
- Recent fire loss of cultural heritage buildings

  Total loss of 1 ICP building and several other buildings every year.
- Utilization of cultural heritage buildings

  Designated 19th-20th century historic buildings are used for public or commercial purposes, but Building Regulation is not applied.

Compliance with Code Concept

- Factors to spoil fire performance of rated assemblies

  Metal-foamed plastic sandwich panel shown by FRI's Matsubara-san: Fitting to the ceiling at the upper surface caused the early failure. Other examples are .. Aging etc.
- Fire safety performance of building elements not suitably handled in building regulation or conventional tests

  Joints of structural members, panel assemblies etc,

  Roof vent
- Fire safety assessment and improvement of existing buildings(may not compliant with current regulation)
- Extra fire tests or operation might be necessary.

"Nonregulatory" Fire Performance

- BSL Rating of partition wall > 1hr Fire Resistance

  Are partition walls of 20 – 30 minutes useless from fire safety point of view?

  No. Evacuation even from a large office floor normally finish within 20 minutes. 30 minutes fire resistance must be appreciated from life safety point of view. Lack of such rating, performance-based evacuation planning often has to depend on unnatural ideas. Also without framework to evaluate such aspect, it is difficult to give incentive for industry to consider fire safety performance.

Research Need for Potential New Market

- Lawless facilities need functional evacuation and rescue, and possibly new ideas for smoke control.
  evacuation by escalators, elevators, rescue strategy, dynamic evacuation/rescue guidance
- Cultural Heritage need devices and strategies for fire detection and suppression to minimize fire damage.
  Virtually no effective research & development.
- Improvement of the assessment for code compliance may need development of extra fire test method or its operation.

Who sponsors new research?

- Conventional sponsors in fire research(MLIT, FDMA) will not pay for such research.
- Railways must not want to support any research that may reveal need of new expense not directly connected to benefit.
- Ministry of Education and Science research fund may be the only good sponsor candidate at the beginning.
- Cultural Affairs Agency and the Cabinet Office is becoming aware of the need of disaster prevention of cultural heritages. Alliance between Culture and Fire Protection is desired.

Thank you very much!

- Your cooperation to Fire Safety Journal and our lab are highly appreciated.

附錄五 2009 FORUM 會議出席人員名單 (英文)

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附錄六 2009 FORUM 會議紀錄決議事項(英文)

Summary of 2009 Action Items

1. Secretary to get new plaques made for Vince Dowling, Kjell Pedersen, Rick Tontarski, Giovanni Gallina, Dick Bukowski, Jukka Hietaniemi and Yoshiteru Murosaki. By end of this year.

2. Lou Gritzo (lead), with Marc Janssens and Reinhard Grabski to develop a draft for review of a paper on experimental uncertainty by March 1st, 2010.

3. Russ Thomas with support from Tuula Hakkarainen and Ichiro Hagiwara to develop a draft of the problem statement and the FORUM position on egress modeling and circulate to the membership by March 1st, 2010.

4. Lou Gritzo to continue to pursue IRSN (France) for possible membership in the FORUM. Marc Janssens to pursue LNE (France). Russ Thomas to pursue CSTB (France). Bill Grosshandler to contact UL to determine their willingness to join. Greg Baker to follow up with CSIRO about their situation and possible renewed interest. Franco Tamanini to contact VNIIPO (Russia) and invite their participation in the next FORUM meeting. To be done by the next meeting.

5. Greg Baker with J. C. Kapoor help in providing a list of their contacts, to investigate the activities of the Asia Fire Protection Inspection Council (AFPIC) and report back to the group by the next meeting about their activities (similar to NAFTL/EGOLF?).

6. Russ Thomas to draft a response to Craig Beyler on the availability of some members of the FORUM to contribute bibliographic references to a centralized indexing system. Russ to get approval from the members prior to submitting response. By January 1, 2010.

7. Alec Lei to distribute plans as they exist in their current form (in Chinese) for future work on structural connections in fire to the FORUM members. This is in support of ongoing interactions among FM Global, Sandia, BAM, and BRI on the response of steel to high temperatures. By January 1, 2010.

8. Marc Janssens to send information on NAFTL plans for upcoming testing (loaded walls) to FORUM members when finalized. By January 1, 2010.

9. Marc Janssens to send NAFTL testing protocol for Phase I (Open calorimeter calibration) to Secretary. Secretary to distribute to the members upon receipt. By the next meeting.

10. Ulf Wickström to report to the group when information on the EGOLF wall testing program will be available for distribution. By January 1, 2010.

11. Marc Janssens and Russ Thomas to pursue the development of a guide on inter-laboratory data transfer and make a suggestion for a workshop at either the next FORUM, at one of the other labs, etc. Distribute a working draft on how to proceed by July 1, 2010.

12. Bill Grosshandler to contact NRIFD, NRC, SP, (ATF) and NIST to gather information on the extent to which FORUM member labs are involved in fire investigations. Bill Grosshandler to provide to the members the NIST plan on fire forensics when it becomes available. Distribute to the members a summary of the information by July 1, 2010.

13. Greg Baker to work through the FORUM Secretary to circulate report and conference paper on the BRANZ project on a virtual community for fire research. By November 1, 2009.

14. Marc Janssens (with Ulf Wickström and Greg Baker) to develop a technical rationale for evaluating the need to replace obsolete standard test methods with a science-based method. By July 1, 2010.

15. Lou Gritzo to send members a survey requesting to provide their three top ideas of problems/solutions in the area of fire science/engineering education (Lou to provide examples) by Jan 1, 2010. Members to identify academic contacts in their area. Members to respond to the survey by March 1, 2010.

16. Members to communicate their comments on the draft of the paper on sustainability to Bill Grosshandler by Jan 1, 2010. Bill to incorporate the comments in the draft and forward to Ulrich Krause. By March 1, 2010.

17. Lou Gritzo, Sheldon Tieszen and Reinhard Grabski to incorporate member suggestions on the paper on modeling uncertainty by March 1, 2010.

18. Bill Grosshandler to draft a letter from the FORUM and send it to the journals to get their perspective on the extent of plagiarism and related ethical issues. Russ Thomas, with Greg Baker and Kaoru Wakatsuki, to lead the development of a position paper on ethics by carrying out a review of professional group ethical statements and past FORUM discussions. By March 1, 2010.

19. Ulf Wickström to provide the Secretary with a statement for inclusion in the meeting minutes to document the FORUM recognition of the value of the Adiabatic Surface Temperature (AST) concept to characterize the thermal environment produced by fires. By December 1, 2009.

20. Lou Gritzo to establish a sustainability working group to identify existing activities and explore possible collaborations. Possible participants to date are: Russ Thomas, Hyun-Joon Shin, Ulf Wickström, Bill Grosshandler and Ulrich Krause. By January 1, 2010.

21. Russ Thomas to contact the members by email to solicit material on difficult-to-find documents that could be posted on the FORUM website. By January 1, 2010.

22. Bill Grosshandler to contact Craig Beyler to determine the best way to provide support for student travel ($5,000) to the IAFSS meeting. By January 1, 2010.

23. Bill Grosshandler with Tuula Hakkarainen to propose an agenda including a half day workshop to be held during the next meeting. By March 1, 2010. Workshop topic to be selected by July 1, 2010.

24. Tuula Hakkarainen to provide information on the logistics of the next meeting to the members and issue invitations. By May 1, 2010.

25. Greg Baker to finalize the document detailing the procedures to be followed in the nomination of candidates and the selection of the recipient of the Sjölin award. By January 1, 2010.