出國報告（出國類別：考察）

「2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會及耐火構造研發應用考察」報告

服務機關：內政部建築研究所

姓名職稱：蘇鴻奇副研究員

派赴國家：大陸

出國期間：102 年 11 月 15 日至 11 月 21 日

報告日期：103 年 2 月 18 日

摘　要

本計畫依據本(102）年度本所核定計畫派員出國蒐集瞭解相關防火研究與消防技術發展應用趨勢。計畫目的主要前往大陸武漢參加2013火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會，瞭解火災科學與阻燃技術研發的新趨勢，以及消防工程檢證標準之發展現況，並蒐集消防性能化設計的最新研究成果與規範制度，以瞭解國際防火研究、大陸消防工程與性能化規範發展的新趨勢。參訪上海同濟大學耐火構造研究試驗室與上海消防科學研究所消防裝備質量監督檢驗中心等研究機構，蒐集耐火試驗的相關研究成果以及消防科學與消防工程的實際應用現況資料，瞭解其防火構件與消防技術之檢證應用實務，可供我國於進行建築防火研究與未來規劃建築防火科技發展計畫之參考。

目次

壹、考察目的

本計畫依據本(102）年度本所核定計畫派員赴大陸蒐集瞭解相關防火研究與消防技術發展應用趨勢。計畫目的與內容是前往大陸參加2013火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會，以及選定參訪大陸主要建築防火研究及防火實驗研究機構上海同濟大學耐火構造研究試驗室與上海消防科學研究所消防裝備質量監督檢驗中心等研究機構參訪，瞭解火災科學與阻燃技術研發的新趨勢，以及消防工程檢證標準之發展現況，並蒐集消防性能化設計的最新研究成果與規範制度，以瞭解國際防火研究、大陸消防工程與性能化規範發展的新趨勢。藉由參訪對岸的土木工程防災國家重點試驗室與消防研究所等研究機構，蒐集耐火試驗的相關研究成果以及消防科學與消防工程的實際應用現況資料，瞭解其防火構件與消防技術之檢證應用實務，可供我國於進行建築防火研究與未來規劃建築防火科技發展計畫之參考。

獲得效益如下所述：

1.蒐集對岸室內裝修材料耐燃特性、分級與檢證技術等之執行現況，可為國內耐燃材料執行檢測時之參考。

2.藉由實質之國際研討會經驗交流，以作為本所未來規劃建築防火科技發展計畫之參考。

3.蒐集國際消防性能化與消防工程研討會相關資料及參與研討，掌握國際消防產業發展現況，提供本所建築消防工程相關研究之參考。

貳、考察過程

本次考察主要前往大陸武漢參加 2013 火災科學與消防工程國際學術研討會暨消防性能化規範發展研討會。後續行至大陸主要建築防火研究及防火實驗研究機構「上海同濟大學耐火構造研究試驗室」與「上海消防科學研究所消防裝備質量監督檢驗中心」等研究機構參訪。

本次參加會議與訪問大陸建築防火研究機構係以內政部建築研究所身分往訪，其中感謝中華消防協會趙剛理事長協助連繫安排參與研討會議事宜以及參訪防火試驗室與消防科學研究機構，本次研討會議主席武漢大學土木建築工程學院市政工程學系方正系主任安排參加研討會議事宜、上海消防科學研究所消防裝備質量監督檢驗中心周維全副主任及金雯瑋專員、上海同濟大學耐火構造研究試驗室主任樓國彪教授的接待與介紹，使本次訪問得以順利成行。

參訪「國家消防裝備質量監督檢驗中心」與上海同濟大學工程結構抗火試驗室過程中，對於資訊交流分享均以現場簡報呈現，並以口頭報告為之，書面資料以目前公開發行之文件為限。

本次考察行程至大陸湖北省武漢市與上海，活動日期從 102 年 11 月 15 日（五）進行至 11 月 21 日（四）合計 7 天，考察行程概要如下表所示。

表 1 考察行程概要表

日期	活動內容	備註
11/15(五)	1.起程、抵達武漢。 2.2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會報到。	路程
11/16(六)	3.參加 2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會，瞭解與蒐集火災科學、阻燃技術與消防工程相關資料包含下列項目： （1）火災科學研發的新趨勢。 （2）阻燃、探測、滅火與連動控制技術。 （3）消防工程檢證標準之發展現況與消防性能化設計的最新研究成果。 （4）國際防火材料與消防技術之檢證應用實務	會議
11/17(日)	4.參加 2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會（續）	會議
11/18(一)	5.武漢轉赴上海	路程
11/19(二)	6.參訪上海消防科學研究所消防裝備質量監督檢驗中心	參訪
11/20(三)	7.參訪上海同濟大學耐火構造研究試驗室	參訪
11/21(四)	8.返程	路程

參、考察心得

一、2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會

2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會，原名「消防性能化規範發展研討會」，是由大陸消防協會、中山大學工學院、清華大學公共安全研究中心、中國科技大學火災科學國家重點實驗室、香港城市大學建築系所共同發起的學術會議，會議宗旨在探索消防技術與工程學科中的物理、化學機理，消防規範發展的新趨勢，分析交流有關消防設計規範的框架和理念，推動消防新技術的發展與應用，及建置學術交流的平臺，以利推動火災科學與消防工程學科的發展與影響。本會議第一屆與第二屆由香港城市大學承辦在香港舉行，第三屆由中華消防協會及減災學會承辦在台北舉行，第四屆由大陸消防協會承辦在北京舉行，第五屆由中山大學承辦在廣州舉行，本屆則於 2013 年 11 月 16～17 日在武漢舉行由武漢大學承辦。

本次研討會議於武漢大學國際學術交流中心(弘毅大酒店)順利召開，由大陸消防協會、中國科學技術大學、清華大學、武漢大學、中山大學主辦，武漢大學承辦，湖北省消防協會、臺灣中華消防協會、香港城市大學協辦。開幕儀式由武漢大學土木建築工程學院方正教授主持，武漢大學科學技術發展研究院副院長侯祚勇、大陸消防協會秘書長高偉、湖北省消防總隊副總隊長許功出席會議並致開幕詞。

會議期間來自各大學術院校及科技研發單位共 110 多位學者專家參與會議，主辦單位特別邀請加拿大工程院院士、美國密歇根州立大學的 Venkatesh Kodur 教授，英國華威大學 Jennifer Wen 教授，中國科學技術大學火災科學國家重點實驗室副主任劉乃安教授分別在大會上做特邀報告。投稿經審查通過者共 91 篇英文論文，其中 38 位作者獲邀進行現場學術報告。

本屆研討會徵文範圍共計 27 項，可進一步彙整為火災科學與消防性能設計規範等 8 個領域，包含如下：

1.有關火災科學的領域為：

「火災科學與消防工程學科的架構與內涵」、「火災科學與消防工程學科的進步與發展」、「火災形勢與預防對策」、「火災物理學與火災化學」、「火災探測報警與滅火系統」、「火災物證鑑定技術的研究和應用」。

2.有關消防性能化規範領域為：

「消防設計規範與標準」、「建築性能化防火設計」。

3.有關火災模擬領域為：

「火災機理實驗」、「火災數值模擬」、「火災中的煙氣控制」、「數值模擬軟件應用」、「疏散模型及軟件應用」、「數值計算中的並行計算」。

4.有關防火驗證技術領域為：

「消防產品質量檢測技術與質量管理」。

5.有關防火工程技術領域為：

「古建築、文化遺產的火災防控對策」、「高層建築、地下空間、石油化工行業、人員密集場所的火災特性與防控對策」。

6.有關人員避難安全領域為：

「平安城市、應急聯動與緊急疏散的應用研究」、「三合一場所的火災防控對策」。

7.有關火災風險管理與控制措施領域為：

「政府應急救援力量的構成、建設及相關機制的探討」、「消防行業特有工種職業技能鑑定的理論與實踐」、「消防與保險、教育等社會化機制的建立與探索，保險與消防的良性互動機制，保險對火災風險的平抑作用等」、「消防監督業務信息系統的研究」。

8.有關消防工程技術領域為：

「現代化城市消防規劃」「創新滅火救援勤務模式，推進滅火救援指揮體系建設研究」、「阻燃、探測、滅火及其聯動控制等火災防治新技術研究」、「其他相關消防科學與工程技術問題」等。參與會議中外專家學者的報告對於建築防火科技、阻燃材料技術及消防工程皆有深入見解。

本次國際研討會議考察心得如後所述。

圖 1　研討會議全體合影

圖 2　與會議主辦人方正教授合影

圖 3　研討會議室

圖 4　會議專題報告

圖 5　研討會議進行

圖 6　國際研討會議邀請函

研討會議單元主題分為「火災風險評估」、「火災安全管理」、「火災模擬」、「火災動力學及其物理化學特性」、「阻火及滅火技術」、「人員避難安全」等六項，會議論文集收錄有審查通過共 91 篇英文論文。會議上報告之論文除針對建築物火災與消防議題外，還包含了森林火災與大量人員避難疏散等議題。其中「人員疏散」佔 31%，顯示人員疏散議題，在人口大量聚集之處對於火災發生時如何做好人員疏散處置，是一項最重要的研究議題；其餘研究議題分別佔有比重為「火災動力學及其物理化學特性」佔 24%，「火災風險評估」佔 13%、「火災安全管理」10 佔%、「火災模擬」佔 11%、「阻火及滅火技術」佔 10%，所以顯見大陸的都市規模大型化快速發展的結果，都市人口數異常增加，造成部分時段人員容易局部大量集中例如上下班時的交通場站，火災時成生命安全的威脅大增，此為大陸於防火安全與消防避難所急欲解決的重要問題之一。本次研討會議相關研究成果值得本所未來進行防火科技計畫規畫的參考借鏡。

此外本次會議僅接受英文論文，研討會議主辦單位與國外著名 Elsevier [註] 出版社合作，入選論文將編入會議論文集由 Elsevier 出版發行，並推薦 EI 收錄。所以參加投稿審查通過者將非常有機會被推薦收錄於 EI（工程期刊資料庫）中，因獲選刊登之論文可以提升學術地位，大大提高投稿者的參與意願，因此本次研討會議投稿論文非常踴躍，此方式可供國內為來辦理相關研討會意參考。惟此次研討會議論文集有一缺憾即因為配合 Elsevier 出版社出版，所以會場上發送之論文集僅有論文摘要部分未具全文內容。

註：Elsevier 係國際知名科學期刊出版社，該出版社總部位於荷蘭阿姆斯特丹在全球 24 個國家的 70 多個辦公室中擁有 7,000 多名員工，合作對象包括全球學術界的 7,000 名期刊編輯 70,000 名編委會成員 200,000 名審稿人和 500,000 名作者，每年出版 2,000 多種學術期刊和 2,200 種新書，其產品與服務包括期刊圖書專著教科書和參考書的紙版和電子版出版領域涵蓋醫學生命科學自然科學和社會科學等。

二、參訪「國家消防裝備質量監督檢驗中心」

「上海消防科學研究所」成立於 1965 年，是大陸公安部直屬的技術警察單位，主要負責大陸公安消防隊裝備的應用研究與消防裝備的質量監督檢驗任務和消防裝備技術。1987 年通過大陸國家審定建立的「國家消防裝備質量監督檢驗中心」是隸屬於「上海消防科學研究所」下轄之國家級的消防裝備質量監督檢驗機構，近年來又被批准為國家商檢局消防裝備認可實驗室、大陸汽車新產品定型鑑定試驗單位、上海市消防產品質量監督檢驗單位。

參訪時間：民國 102 年 11 月 19 日

參訪地點：「國家消防裝備質量監督檢驗中心」

接待人員：周維全副主任

陪同人員：「上海消防研究所」金雯瑋專員

（一）公安部「上海消防研究所」

1.「上海消防研究所」簡介

公安部「上海消防研究所」是公安部直屬的技術警察單位，成立於 1965 年，是大陸從事火災理論、消防裝備、滅火技術及火場防護技術等方面的國家級消防科學研究機構和國家級執法檢驗與鑑定機構。

「上海消防研究所」下設 7 個行政業務室以及科研開發、產品檢測、火災物證鑑定及成果推廣 4 個業務機構，其中科學研究工作主要由「科研中心」負責，檢驗工作由「國家消防裝備質量監督檢驗中心」負責，火災物證鑑定工作由公安部「消防局上海火害物證鑑定中心」負責，各類科技成果的技轉和推廣工作由「國家消防工程技術研究中心」、「上海倍安實業有限公司」等負責。「上海消防研究所」建立的公安部「消防局消防部隊裝備質量管理站」同時還坦承著大陸消防部隊使用裝備質

量抽檢、新購裝備質量控制、裝備規劃評估驗證、新裝備研發推廣以及裝備專業人才培訓等職能和任務。

「上海消防研究所」並且是國際標準化組織 ISO/TC21/SC2 和 ISO/TC21/SC14 的國內技術負責單位，是「國家級汽車新產品定型鑑定試驗和汽車產品質量監督檢驗機構」、「國家級科技成果檢測鑑定檢驗機構」、「上海市消防產品質量監督檢驗站」、「全國消防標準化技術委員會消防車泵(第四)、消防器具與配件(第五)以及消防員防護裝備(第十二)分技術委員會」、「中國消防協辦科學普及教育工作委員會、消防設備委員會、車泵行業分會」等機構或組織的依附單位。

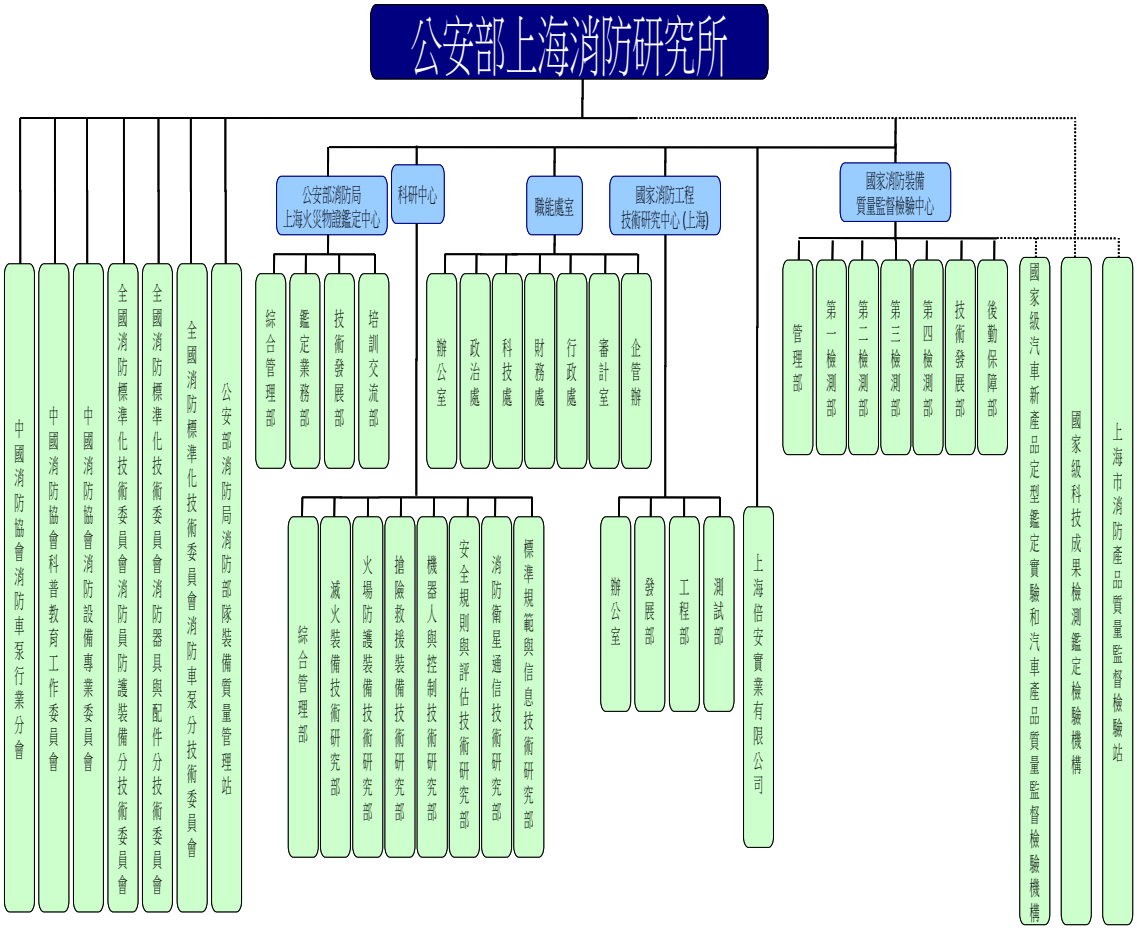

圖 7 公安部「上海消防研究所」組織架構圖

2.公安部「上海消防研究所」重要業務機構「科研中心」簡介

「科研中心」是「上海消防研究所」的科技研發主體機構，專職負責政府或公安部委託的公益性消防科學技術研究工作，研究成果主要應用於消防隊滅火救援及社會消防安全專業。

「科研中心」主要從事滅火理論、火場環境物理化學特性、消防人員火場生理心理防護理論，以及消防隊滅火裝備技術、消防人員火場防護裝備技術、搶險救援裝備技術、化學災害事故處置裝備技術、區域火災風險評估與安全規劃配置技術、海龍替代技術等新原理、新技術、新方法的研究和開發。

「科研中心」下設綜合管理部、滅火裝備技術研究部、搶險救援裝備技術研究部、火場防護裝備技術研究部、安全規劃與評估技術研究部、機器人與控制技術研究部、消防衛星通信技術研究部、消防標準規範與信息研究部等八個部門。建立有消防滅火裝備技術、消防搶險救援裝備技術、消防員個人防護裝備技術、消防機器人、消防安全評估、消防應急指揮衛星通信裝備技術等專業技術實驗室。以下就科研中心組織各部門進一步說明。

（1）滅火裝備技術研究部

主要負責大陸消防隊滅火有關的消防車、消防槍、炮、消防泵、泡沫比例混合裝置、消防船等各類消防滅火裝備以及供水管路與附件等的研究開發、各類滅火裝備器材的火場應用研究，滅火理論和火災特性研究，消防隊設計規範與裝備配置規範編制，相關滅火裝備產品國家和行業標準制修訂等科研開發和標準化工作，以及相關科技成果的推廣作用。

（2）搶險救援裝備技術研究部

主要從事包括化學災害事故、地震和水災等自然災害、重大交通事故、建築物倒塌事故、恐怖攻擊和破壞突發事件以及其它社會救助等之消防應急救援偵測、警戒、救生、拆除、堵漏、輸送、消毒、照明等特勤器材裝備的開發和相關技術的應用技術研究；負責各類應用急救人員現場處置技術研究、相配合的訓練技術研究和訓練設施的開發、特勤隊裝備配備標準與設計規範研究、各類搶險救援裝備產品的國家和行業標準制修訂以及相關科技成果的推廣工作。

（3）火場防護裝備技術研究部

主要從事消防人員安全防護有關的防護頭盔、防護服、防護手套、防護靴、防墜落裝備、呼吸保護裝具、個人照明燈具、呼救定位器具、腰斧及水下保護裝備等九大類裝備技術的研究開發，火災及其他有關災害事故現場的消防人員防護救援技術研究，相關基礎理論和技術方面的研究；負責個人防護有關的消防訓練設施和裝備技術的研究、消防員職業安全與健康研究、消防員個人防護裝備產品標準、配備標準等國家和行業標準的制修訂，以及相關技術成果的推廣應用工作。

（4）安全評估與規劃研究部

以滿足消防部門和社會消防安全需求為背景，專職負責與城市、行業以及建築等有關的消防規劃、風險管理、消防經濟學、火災基礎理論、建築消防性能化評估、消防業務與政策評估等研究，並參與相關標準制修訂及相關科技成果的推廣應用工作。

（5）機器人及控制技術研究部

主要從事各類消防機器人技術研究以及相關的電、機控制技術、信息技術裝備的開發和與之相關的應用技術研究工作，負責各類智慧化控制裝備技術的研究開發、以及此類項目的規劃、研究、申報、實施、成果技轉等工作，並負責相對應標準的制修訂以及相關科技成果的推廣應用工作。

（6）消防衛星通信技術研部

主要從事消防隊等救援隊伍專用的衛星通信裝備技術、數位化消防人員(定位、偵察、通信、呼救)裝備技術的研究開發和相關標準的制修訂工作，負責消防緊急通信衛星網路規劃設計，建設並運行「消防 VSAT 衛星通信網網管服務中心」，為網路衛星站提供衛星頻道保障護及通信技術保護。

（7）消防標準規範與信息技術研究部

主要從事與消防研究所之研究領域有關的各類國際消防科技資訊的動態追蹤、整理、分析、負責各類消防科技資訊類軟體課題的研究，負責公安消防科技與標準化輔助管理以及「建築滅火器配置設計規範」、「建築滅火器配置驗收及檢查規範」、「固定消防炮滅火器系統設計規範」、「自動跟蹤定位射流滅火系統技術規範」、「城市消防站設計規範」等國家工程建設標準的制修訂管理和宣貫工作。為消防科技界、產業界和消防監督管理部門提供消防科技資訊服務，負責研究領域內與各類國際消防業務組的聯繫與合作交流等工作。

（二）公安部上海消防研究所「國家消防裝備質量監督檢驗中心」

圖 8　國家消防裝備質量監督檢驗中心

1.「國家消防裝備質量監督檢驗中心」簡介

「國家消防裝備質量監督檢驗中心」是於 1987 年經國家技術監督局批准成立的國家級消防裝備質檢中心，現同時為消防裝備國家認可實驗室、國家級汽車新產品定型鑑定試驗機構、汽車安全法規強制檢驗機構、國家級科技成果檢測鑑定機構、上海市消防品質量監督檢驗站。

「國家消防裝備質量監督檢驗中心」位於上海市閔行區，佔地面積 18000 平方公尺，建築面積 6230 平方公尺，內設中心主任室、總工程師室、管理部、技術發展部、後勤保障部、第一檢驗室、第二檢驗室、第三檢驗室和第四檢驗室，現擁有質量體系認證國家註冊高級審核員、驗證審核員、審核員和部級審核員近 20 人，該中心依據 ISO/IEC17025 的要求，建立了完整的質保體系和嚴密的規章制度。該中心現有各種消防裝備檢驗室 30 餘間，儀器設備約 200 餘套。該中心並受香港消防處和澳門消防局的認可委託，是出口香港、澳門滅火器檢驗和工廠質保體系評審的執行機構。

主要負責的產品檢驗包含：各類手提式滅火器、簡易式滅火器、推車式滅火器、各類消防車、消防泵、消防泵組及供水設備、消防梯、消防槍砲、消防泡沫和乾粉設備、消防排煙設備、消防風機、消防船舶、消防飛機、消防水帶、消防接頭、各類消防栓及箱、水泵接合器、消防吸水膠管、消防軟管捲盤、各類消防人員個人裝備及器具、破除工具和救援設備，火場避難器材、滅火藥劑、防火阻燃材料、防火耐火構件，防火電纜、報警設備和撒水系統、汽車強制安全法規項目檢驗等。

2.「國家消防裝備質量監督檢驗中心」重要業務機構簡介

（1）第一檢測部

第一檢測部主要職責:負責各種手提式滅火器、簡易式滅火器、推車式滅火器、其他輕便滅火器、滅火劑、滅火器壓力指示器以及滅火器附屬配件、滅火器填裝設備等國產及進口產品的檢驗工作。負責新項目、新技術和專用檢驗設備的研究開發。

（2）第二檢測部

第二檢測部主要職責: 負責消防水帶、消防接頭、各類消防栓及箱、消防水泵接合器、消防吸水膠管、消防軟管捲盤、各類消防員個人防護裝備及器具、各類防火阻燃材料、防火構件、防火電纜等國產及進口產品的檢驗工作。負責新項目新技術和專用檢驗設備的研究開發。

（3）第三檢測部

第三檢測部主要職責:負責各種消防車、消防船舶、消防飛機、消防摩托車、消防泵及消防泵組、供水設備、消防泡沫和乾粉設備、自動跟蹤定位撒水滅火裝置、消防槍砲、消防梯、搶險救援器材、消防風機、火場避難逃生器材等國產及進口產品的檢驗工作。負責新項目新技術和專用檢驗設備的研究開發

（4）第四檢測部

第四檢測部主要職責:負責消防產品在溫度、溼度、震動、鹽霧腐蝕等環境性能方面的檢驗工作。同時負責各種消防人員呼救器、消防紅外線熱像儀、消防員通訊器材、消防生命探測儀及攜帶式、移動式消防照明器材等國產品的檢測。負責新項目新技術和專用檢驗設備的研究開發。

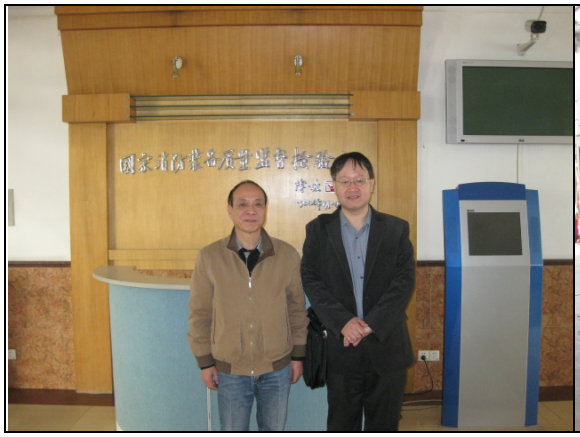

圖 8　與周維全副主任合影

圖 9 建材表面燃燒特性之試驗法測試設備

圖 10　SBI 測試設備

圖 11　地坪材料測試設備

圖 12　電纜耐火測試設備

圖 13　消防車功能測試

圖 14　消防水泵測試設備

圖 15　救難設備測式裝置

3.「國家消防裝備質量監督檢驗中心」發展過程

「國家消防裝備質量監督檢驗中心」自從 1987 年經政府主管部門正式批准建立至今，該中心的檢驗項目與檢驗業務持續增加與擴大。這些業務部分來自消防裝備企業委託檢驗、型式檢驗、認證檢驗，另一部分來自國家質量技術監督檢驗疫總局、公安部、上海技術監督局交辦的國家和地方產品質量監督檢驗以及認證檢驗等。目前檢驗的範圍有：消防車及附件、消防泵及泵組、消防供水器具及供水設備、火場防護及搶險救援避難逃生設備、滅火器及滅火劑、防火與耐火材料構件、自動滅火

系統及設備、消防員個人裝備等。除此，還負責相應檢驗業務領域的國家標準、行業標準的制修訂以及對相應企業標準的審查工作。大陸消防標準化技術委員會下屬第四、第五、第十三分技術員會秘書處也設在本中心。該中心在科技研發方面也有相當成果：1986 年「無襯裏消防水帶」國家標準、「手提式滅火器通用技術條件」國家標準項目、1988 年「消防車通用底盤系列、型式、基本參數和技術要求(GB6244-86) 」、1990 年「消防車專用底盤東風 EQP245R1、EQP245R2」、1994 年「機動車排氣火花熄滅火器標準測試裝置」、1996 年「機動車排氣火花熄滅器性能要求和試驗方法 」等項目。

除了檢驗工作外，該中心還有一項重要的工作：制定消防相關標準，20 多年來完成消防技術標準與規範修訂項目達 100 多項，許多標準的制修訂都是國家和部級重點委託項目。

在消防裝備檢驗上，檢驗範圍逐漸從國內擴展到境外，經國家進出口商品檢驗局批准為國家進出口商品檢驗局消防裝備認可實驗室，涉及與檢驗有關的各種業務，包括國內生產的產品進入境外市場的監督檢驗以及對境外企業的生產條件和品質保證體系的審查、抽樣、產品的現場檢驗；對境外企業按 ISO9001 標準進行的質量體系審核、「3C 認證」、型式檢驗、與境外檢驗機構的業務交流等。

目前，該中心依據 ISOIEC17025 的要求，建立了完整的品質保證體系和嚴密的規章制度。在檢驗過程中全面採用電腦技術，從而保證數據的準確。

三、參訪上海同濟大學工程結構抗火試驗室

上海同濟大學工程結構抗火試驗室係屬大陸土木工程防災國家重點試驗室，於1988年獲准設立，主要發展土木工程的防災與減災研究工作。近期的重要研究成果包含「長大隧道火災特性」、「防火抗爆技術專題」、「城市地下空間防災減災技術」、「約束結構構件受火性能研究」、「高強度螺栓摩擦型連接火災後的受力性能」、「高溫下鋁合金結構構件承載力研究」等。

參訪時間：民國 102 年 11 月 20 日

參訪地點：上海同濟大學工程結構抗火試驗室

接待人員：樓國彪主任（博士）

（一）上海同濟大學工程結構抗火試驗室簡介

木工程防災國家重點實驗室係歸屬於上海同濟大學土木工程一級國家重點學科及下屬防災減災工程及防護工程、結構工程、橋梁與隧道工程、巖土工程等四個二級國家重點學科，主要發展土木工程領域的防災減災研究工作。該實驗室由國家計畫委員會於 1988 年批准設立、1990 年 1 月國家教育委員會批准對外開放、1991 年 10 月通過正式驗收，直到 2009 年都是大陸土木工程領域中唯一的國家重點實驗室，1997 年國家重點實驗室評估中被評為優秀，2003 年和 2008 年兩次評估中被評為良好。

本次所參訪單位「工程結構抗火試驗室」成立於 2008 年，是大陸土木工程防災國家重點實驗室的一個分支機構。試驗室建築面積約2700平方公尺，擁有大型水平構件耐火試驗爐、中小型構件耐試驗爐、高溫力學材性試驗機、圓錐量熱儀、SBI 燃燒測試儀、建築材料燃燒性能系列測試設備、隧道及地下工程火災多功能試驗平台等試驗設備，並配置了油壓伺服加載系統、非接觸式應變位移測量系統、數位應變位移溫度測試系統等，可進行結構材料的高溫力學性

能測試、大中小型構件的抗火性能試驗、建築材料的燃燒性能測試等各種試驗，是目前大陸大學實驗室中對於結構耐火試驗能力最強的試驗室之一。

該試驗室積極促進學術交流與合作，推動研究成果的產業化與提供科研成果和技術服務。自 2008 年以來，該試驗室已執行了十多項國家級科研項目；完成了 2010 中國世博會中國館、世博中心、廣州新電視塔、浦東國際機場二期航站樓、上海閔浦大橋、新廣州火車站、新建鐵路武漢站、上海鐵路南站、上海八萬人體育場、北京奧林匹克公園國家會議中心、中國航海博物館等三十多個重大工程的結構耐火安全評估與設計。

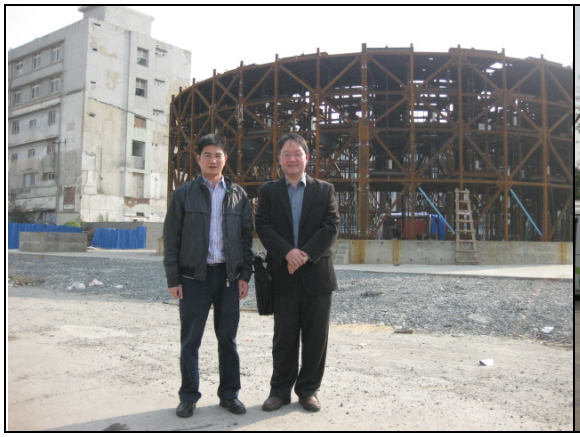

圖 16　與樓國彪主任合影

圖 17 上海同濟大學

圖 18　水平構件耐火測試設備

圖 19　小型節耐火構測試設備

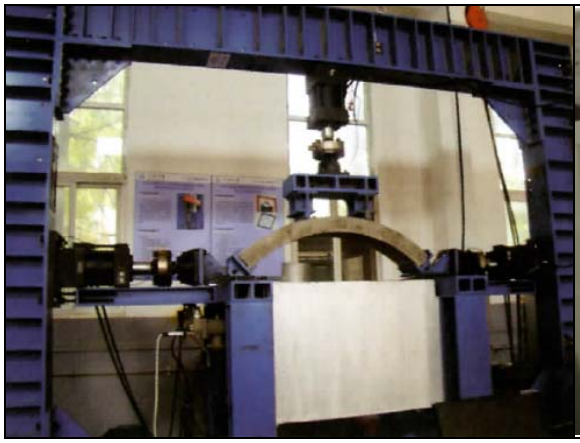

圖 20　隧道及地下工程耐火測試設備

圖 21　建築材料燃燒測試設備

（二）上海同濟大學工程結構抗火試驗室研究內容與研究成果

1.研究方向與研究內容

（1）大空間建築、隧道及地下空間火災特性模擬

（2）現代與新型結構材料高溫下雨高溫後材料性研究

（3）高層與大跨度建築結構抗火設計理論與方法

（4）隧道與地下空間結構抗火設計理論與方法

（5）火災後結構損傷檢測與可靠度評估理論與方法

2.重要研究成果

（1）2006-2008、超大特長越江盾構隧道建設核心技術研究「長大隧道火災特性、防火抗爆技術專題 」

（2）2007-2010、城市地下空間防災減災技術

（3）2008-2011、約束結構構件受火性能研究

（4）2009-2011、地震作用下鋼構件厚型防火塗層的破壞機理研究

（5）2009-2011、火災高溫下大直徑裝配室襯砌結構體系力學特性級破壞機理

（6）2010-2012、高溫下鋁合金結構構件承載力研究

（7）2010-2012、高強度螺栓摩擦型連接火災後的受力性能

（8）2010-2012、火災高溫下隧道周圍軟黏土力學行為與荷載分部研究

（9）2011-2015、高層建築鋼結構抵抗火災與爆炸下連續性倒塌的強健性（robustness）研究

（10）2008-2010、「建築鋼結構防火技術規範」制定

（11）2008-2011、公路隧道襯砌結構耐火方法研究

（12）2010-2012、鐵路客站技術深化研究－火災下大型客運站房建築鋼結構安全設計方法研究

（13）2011-2013、長大隧道火災縱向快速疏散關鍵技術研究(子題: 長大隧道火災煙氣流動特性級溫度分部研究)

（二）上海同濟大學工程結構抗火試驗室重要實驗儀器設備

1.水平構件耐火試驗爐

設備規格	內容
爐體尺寸	4.5m × 3.0m × 2.2m
爐溫控制	ISO834升溫曲線、HC升溫曲線、自設升溫曲線
加載能力	12 × 500kN

2.小型構件耐火試驗爐

設備規格	內容
爐體尺寸	1.0m × 1.0m × 1.2m
爐溫控制	ISO834升溫曲線、HC升溫曲線、自設升溫曲線

3.高溫材料特性萬能試驗機

設備規格	內容
試驗溫度	0℃~1000℃
最大試體尺寸	100mm × 100mm × 300mm
最大加載能力	1000kN

4.FTT 雙櫃式圓錐量熱儀

設備規格	內容
試體標準	GB/T 16172-2007、ISO 5660-1:2002、ASTM E 1354、BS 476 Part15
圓錐加熱器	5000W
熱輻射範圍	0~100Kw/m^2
試體尺寸	100mm × 100mm × (0~50)mm

5.FTT 單體燃燒測試儀（SBI）

設備規格	內容
試驗標準	GB/T 20284-2006、EN 13823:2002

6.隧道及地下工程火災多功能試驗平台

7.建築材料燃燒性能系列試驗設備

設備名稱	型號	試驗標準
建材不燃性試驗爐	FCB-2	GB/T 5464-2010
建材難燃性試驗爐	LZ-2	GB/T 8625-2005
建材可燃性試驗爐	FCK-2	GB/T 8626-2007
建材煙密度測試儀	SCY-1	GB/T 8627-2007
塑膠材料燃燒性煙密度測試儀	SYM-2	GB/T 8323.1-2008 GB/T 8323.2-2008
泡沫塑料水平燃燒測試儀	SPF-2	GB/T 8323.2-2008
硬泡沫塑料垂直燃燒測試儀	FPC-2	GB/T 8333-2008
水平垂直燃燒測試儀	CZF-3	GB/T 2408-2008
氧指數測定儀	SY-3	GB/T 2406.1-2008 GB/T 2406.2-2009
防火塗料(大板法)測試儀	DBF-3	GB/T 12441-2005
防火塗料(隧道法)測試儀	SDF51-2	GB/T 15442.3-1995
防火塗料(小室法)測試儀	XSF51-3	GB/T 15442.4-1995
鋼結構防火塗料小樣試驗爐	GJL-1	GB/T 9978-1999
50W 水平垂直燃燒測試儀	CZF-4	GB/T2408-2008
材料產煙毒性試驗裝置	CYD-1	GB/T20285-2006

地坪材料輻射熱通量試驗裝置	PZF-1	GB/T11785-2005
建材燃燒熱值試驗儀	JRZ-1	GB/T14402-2007
阻燃木材木堆法燃燒試驗裝置	MDF-2	GA/T42.1-92

肆、建議事項

本次考察提出以下建議事項：

（一）2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會議題趨勢，其中人員疏散是一項最重要的研究議題，可持續關注大陸對於「人員疏散」議題的研究成果，供本所未來進行防火科技計畫規畫的參考借鏡。

研討會議上報告之論文除針對建築物火災與消防議題外，還包含了森林火災與大量人員避難疏散等議題。其中「人員疏散」論文佔 31%，顯示人員疏散議題，在人口大量聚集之處對於火災發生時如何做好人員疏散處置，是一項最重要的研究議題。所以顯見大陸的都市規模大型化快速發展的結果，都市人口數異常增加，造成部分時段人員容易局部大量集中例如上下班時的交通場站，火災時成生命安全的威脅大增，此為大陸於防火安全與消防避難所急欲解決的重要問題之一。目前國內重要都會區亦有相同問題，研討會議次部分相關研究成果值得本所未來進行防火科技計畫規畫的參考借鏡，並且可持續關注大陸對於「人員疏散」議題的研究成果。

（二）大陸「強制性產品認證管理規定」其產品驗證的申辦流程中其中包含有工廠查驗的項目，此部分可供國內對於防火產品認可改進管理制度修正時參考。

大陸「強制性產品認證管理規定」中被列為 3C 強制性驗證產品目錄中的產品，例如消防或建築耐火構件，於產品驗證的申辦流程中其中包含有工廠查驗的項目，以進一步確認生產工廠之能力，並確保生產產品之品質與性能。國內建築管理有關防火產品認可申請制度，於試驗材料查核階段並未進行工廠生產條件確認。此部分可供國內對於防火產品認可改進管理制度修正時參考。

（三）大陸裝修防火材料之取樣檢驗和抽樣檢驗，此部分可供國內對於防火產品改進後市場管理制度修正時參考。

大陸為進一步規範建築工程內部裝修防火施工、消防驗收、竣工驗收，並確保公共場所的消防安全與防火安全工作。對於公共場所建築工程依相關規定於裝修防火材料進入施工現場後，按照「建築工程內部裝修防火施工及驗收規範」（GB50354－2005）規定需要進行見證取樣檢驗和抽樣檢驗，即依規定進行現場取樣，並送至符合認可的檢驗機構進行試驗，試驗合格後方可在建築工程中使用。國內建築管理有關防火產品後市場管理制度，於防火產品認可有效期限內僅進行認可廠商所提報之材料使用情形書面審查與延展認可申請時的工地現場查驗，並未執行工地現場取樣後進行試驗。此部分可供國內對於防火產品改進後市場管理制度修正時參考。

伍、附錄

「2013 火災科學與消防工程國際學術研討會暨第六屆消防性能化規範發展研討會」論文集[註]

註：此次研討會議論文集因為配合 Elsevier 出版社出版，所以會場上發送之論文集僅有論文摘要部分未具全文內容。

2013 火灾科学与消防工程国际学术研讨会暨第六届消防性能化规范发展研讨会组织架构

主办单位及承办单位

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承办单位：武汉大学

协办单位：台湾中华消防协会、香港城市大学土木及建筑工程系、湖北省消防协会

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唐　智 博士，武汉大学土木建筑工程学院

Contents

Discussion on design of egress in underground inter-city railway (UIR) station in China

Xiao-ling Xu[a], Li-li Ma[a], Da-gang Guo[a], Ying-zhao Hu[a]
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Abstract

In China, the land availability for urban development is reducing progressively. The trend of construction of inter-city railway stations is moving towards underground structures in order to save space. This paper has posed a discussion on means of egress in an underground railway station. Due to the lack of specific guidance on design of underground inter-city railway (UIR) station, current design in China mainly refers to the Code for design of metro (GB50157-2003). The design Code provides an approach for calculation of the platform evacuation time in case of an emergency; especially it requires a safe egress from the most remote point on the platform in 6 minutes or even less. As the differences between metro station and UIR station, including the type of trains, passenger flow, waiting mode, etc., this paper also discusses the validity of the approaches for calculating the egress time provided by Metro Design Code. In the meantime recommendations are given on equation for calculating the platform evacuation time when considering design of egress in an UIR station. A feasibility analysis on this engineering approach has been carried out in accordance of an under construction project, the UIR stations on an intercity express rail link in Hunan province together with STEPS evacuation model.

Keywords: underground railway station, means of egress, platform evacuation time

Numerical simulation study on characteristics of overflowing smoke under sprinkler spray

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Abstract

Aiming at the "cabin" fire safety design concept in large space buildings, and combined with a real cabin with a spray system, Large Eddy Simulation was used for simulating the flow state of cabin fire smoke under sprinkler spray. The effect of sprinkler spray on overflowing smoke layer and the characteristics of overflowing smoke under sprinkler spray were analyzed and discussed. Results showed that sprinkler spray had a good cooling effect on smoke layer, but it made smoke layer unstable at the same time, leading to the smoke congestion phenomenon. As a result, smoke spillage was added, and the characteristics of overflowing smoke were significantly changed.

Keywords: sprinkler spray, cabin, the characteristics of overflowing smoke

Experimental Study on Temperature Distribution of Concrete Filled Steel Tube Reinforced Concrete Square Short Columns

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Abstract

The temperature distribution of concrete filled steel tube reinforced concrete (CFSTRC) square short columns was analyzed. Test results of four CFSTRC square short columns were reported in this paper. The specimens exposed to the ISO-834 standard fire without initial loads. The fire test lasted 180 minutes. The influential factors included the side length of cross-section, slenderness ratio and steel tube area ratio. Finite element method (FEM) simulation was used to calculate temperature distribution of CFSTRC square short columns at elevated temperature. The test results show that the larger side length of cross-section, the lower temperature inside the specimens with the same fire exposure time and steel tube area ratio and height of specimens. Under the same fire exposure time and side length of cross-section and steel tube area ratio, the slenderness ratio was larger, and the temperature inside the specimens was lower. With the same fire exposure time and side length of cross-section and slenderness ratio, the steel tube area ratio had slight influence on temperature distribution inside the specimens. The FEM simulation results agreed well with the experimental results. The FEM simulation was capable of calculating temperature distribution of CFSTRC square short columns with an accuracy that was sufficient for design purposes.

Keywords: Concrete, Experiment, Fire, Temperature distribution

Mountain Disaster Incidents and Corresponding Emergency Rescue Measures

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Abstract

Mountain rescue is a new topic emerged after the expansion of emergency rescue function of public security fire force. This paper introduces the classification of mountain disaster incidents, analyzes mountain incidents rescue features. For Police Fire fighting Army which is the professional force and key contingent of emergency rescue, the measures of emergency rescue and the equipments used in mountain disaster incidents are presented, with the aim of offering reference for the implement of the most effective and best rescue measures in similar incidents in future.

Keywords: Mountain, Mountain Incidents, Emergency Rescue

Assessment on the risk of fire public liability and research on setting the limit of liability of the Shopping Mall

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Abstract
Fire public liability insurance is the type of the liability insurance which is encouraged and boosted positively by policies now. The paper has chosen one shopping mall as the object of study. In this study, we make use of mathematical method to build the risk assessment model of the fire public liability that is suitable for the shopping mall. Finally, in order to operate and use conveniently for the insures in the practical survey, we will turn the mathematical model into Safety Check List (SCL). Also, in this study, insures and insureds negotiate each other to set the limit of liability in the contracts based on the previous risk assessment level. Consequently, it is able to improve this type of insurance and make it more scientific and reasonable. It may boost fire public liability insurance to develop healthily. This method also can be seen as effective combinations between fire safety science and insurance science.
Keywords: shopping mall, fire public liability insurance, the risk assessment on fire, limit of liability

Analysis on the Fire Risk Existing in the Storage of Textile Materials and Textile Goods

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Abstract
Fires that broke out in the storage place of textile materials and textile goods, especially in open storage places, accounts for a relatively large proportion in the fire cases occurred in warehouses. Through analysing the fire risk hidden in the storage of textile materials and textile goods as well as the causal factors, this thesis aims to provide strong theoretical bases for doing a good job on fire control safety, improving self-help abilities and protecting our own fire safety.
Keywords: Textile Materials, Textile Goods, Fire Risk

Numerical and Experimental Study on the Diffusion Property of Difluoromethane (HFC-32) in Leakage

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[a]State Key Laboratory of Fire Science, USTC, Hefei (230027) , China

Abstract

With the development of industry in China, production and use of dangerous chemicals gradually increased, and as a result leakage accidents caused by that happen more and more frequently. In the field of refrigerants in air conditioner, because of the destruction to the environment from freon(CFC), people are looking for new refrigerants which can replace the freon. And difluoromethane(HFC-32) does no harm to the ozone layer, making it a good substitute. But it's still not widely used. One of the reasons is that difluoromethane is flammable, and its detection technology indoors is not mature. In this study, based on computational fluid dynamics theory and the CFD software FLUENT, the process of leakage of difluoromethane was simulated to study the law of HFC-32 diffusion. And then in a same proportion of entity room experiments were carried out to corroborate the results. From both simulation and experimental results above, we can see that when the leakage point is lower (cabinet air conditioners scene), the difluoromethane cannot easily diffuse to higher places. It will subside to the ground soon and diffuse from the leakage point, and then making it as the centre, spread from the near to the distant. And in the leakage process, the concentration near the leakage point is higher than that in other areas in the same plane. But when the leakage point is located higher (wall-mounted air conditioners scene), there is an obvious effect of sedimentation, in some areas there will be the lowest concentration value at intermediate height. And because of the impact of the initial velocity, the concentration in places closest to the leakage point is not higher than that of the surrounding in the same z plane that is lower than the leakage point.

Keywords: difluoromethane, leakage, Fluent, diffusion property

Application and Design Requirements of Fire Windows in Buildings

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Abstract

The window frame materials and inlaid glass of ordinary exterior window have no fire-resistant function, which makes such window become the weakest part in the fire safety design of buildings. This thesis takes the newly released Fire window Product Standards for reference, combines with several cases that caused heavy casualties and property losses for the fire spread of exterior windows in China in recent years, then proposes to widely apply fire windows into buildings and finally discusses the requirements of window frame materials and glass materials shall be met in the design of fire windows.

Keywords: Fire Safety, Fire Window, Product Standards, Window Frame, Anti-fire Glass

Research on application of Heavy Compressed Air Foam Truck Applied in High-rise Building Fires

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Abstract
By introducing the specific parameter and relevant property of a heavy compressed air foam truck and combining the situation of lacking of water supply and difficulties of the inside fire attack in high-rise buildings, the relevant data of the heavy compressed air foam truck's capability of providing extinguishants in the scene of a fire is calculated and the advantage of the heavy compressed air foam truck in the high-level fire rescue is analyzed. Finally, determine the fire combat formations of high-rise building fire in different fire grounds through investigation and qualitative analysis.
Keyword: high-rise building fire fighting, heavy compressed air foam truck, Combat formation

The Research and Analysis of Occupant Density in Wholesale and Retail Market

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Abstract
Based on the characters of wholesale and retail market, it owns larger amount of inventory, bigger fire load, larger crowds and bigger daily trading volume of the wholesale market, and lager size of the mall. Through investing the occupant density of Wuhan Financing Brand Square which used normal population mean and variance of interval estimation principle, the paper drew the occupant density interval of the wholesale and retail market, and it provided the basis for formulation and revision of the future specification. Comparing the results with the differences of data from codes and literatures of various types of commercial buildings, the paper proposed the occupant density of commercial building was timeliness, and suggested that occupant density values of future specifications can be according to the different factors for detailed classification, such as the city, the types, the scope of commercial building and so on.
Keywords: The wholesale and retail market, Occupant density, Statistical analysis

Evacuation processes of different genders in different visibility conditions -an experimental study

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Abstract
Practical data of human movement characteristics in different visibility conditions is necessary for the fire performance-based designs and evacuation calculation models. In this study, an evacuation experiment was conducted in a classroom and the evacuation processes were recorded by video cameras. The impacts of visibility and gender on walking speed were analyzed. The walking speed of young female pedestrians in good visibility conditions measured in our experiment is $0.92\,m/s$ and in conditions without visibility the mean velocity is $0.42\,m/s$. Besides, the mean velocity of males in conditions with good visibility is $0.91\,m/s$ and in zero visibility conditions the value is $0.69\,m/s$. Additionally, the distributions of velocities obtained in different visibility conditions in this study obey the Gaussian distribution. The results are similar to that of previous study. The research is helpful for devising evacuation schemes of theater, stadiums, gymnasiums etc. and also can be used in guiding regional evacuation processes, such as evacuation processes of chemical industrial parks whose building layouts and exit arrangements are similar to the classroom.
Keywords: human behavior, velocity, evacuation, gender, visibility

Study on the effect of separation approach on banquet fire

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Abstract
In order to fulfil the operation requirement and optimize the usage function, the large banquet is always separated into several banquets by using temporal walls. While it brings flexible advantages to banquet design, the instalment of temporal walls will change the smoke movement inside the banquet, and then affect the evacuation environment. Attention should be paid on the separation approach to comply with the requirement not only from the function and optimization, but also from the fire protection.
Keywords: room scale, smoke exhaust efficiency, fire model

Simulation Research on Interaction Rules between Superfine Powder Extinguishing Agent and Fire Plume

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Abstract

When the nozzle of release device directly faces the protected object, it is necessary for the superfine powder extinguishing agents (SPEA) to penetrate fire plume, so that SPEA can reach the fire source to extinguish fire effectively. Numerical simulation was used to make a comparative study on SPEA motion released at different driving pressures in fire. The simulation results indicate that the converging nozzle will enhance the capacity of extinguishing agent particles to penetrate fire plume, and its penetration capacity is directly proportional to the driving pressure value. When interacting with particles, the flame height decreases and flame width increases. The larger the driving pressure, the shorter time for particles to enter into fire source area. Particle concentration value in fire source area is relatively higherat1.2MPaandit less changes at 1.0MPa.Larger driving pressure can accelerate the motion of particles to fill the extinguishing room. Eddies, which appear more easily at lower driving pressure, can also drive particles to fill the extinguishing room quickly, but with uneven distribution.

Keywords: superfine powder extinguishing agent, particle dynamics, fire plume, driving pressure, numerical simulation

Fire Safety Assessment of China's Twelfth National Games Stadiums

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Abstract

In order to ensure fire safety of the stadiums for China's Twelfth National Games, this paper proposes measures to eliminate, prevent, or reduce fire risk, and to improve building fire safety based on qualitative and quantitative assessment and scientific analysis on fire safety, including the analysis of the major fire hazards for all the sports venues, assessment of their fire control means, and prediction of fire safety ratings. The purpose of this paper is to provide references and recommendations for fire supervision forces deployment and fire-fighting decision-making during the Twelfth National Games.

Keywords: China's Twelfth National Games, Stadiums, Fire safety

Fire Risk Assessment for Super High-rise Buildings

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Abstract

Fire risk analysis of high-rise building is of critical importance due to the reason that there still lacks efficient systematical fire extinguish method to ensure a safety evacuation process. A case study is conducted for a super high-rise building to expatiate the procedure and methodology of fire risk assessment for super high-rise buildings. Both the probability and the consequence of fires are quantified in this paper.

Keywords: fire risk assessment, reliability, fire frequency, fire consequence

Comparative Study on Heat Release Rate of High-speed Passenger Train Compartments

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Abstract

In order to analyze the influence of geometry, combustion performance of interior materials, fire load, ventilation condition on the heat release rate of high-speed passenger train compartments and help the fire protection engineers to choose the reasonable heat release rate for high-speed passenger train compartments, the first-class, second-class, dining compartments of China Railways High-speed train were taken for research objects, and the heat release rate and other thermal parameters of interior materials and component assemblies of high-speed passenger train compartments were measured and used as the input parameters of Fire Dynamics Simulator (FDS),and then 9 fire scenarios had been designed to obtain the heat release rate VS. Time curves of high-speed passenger train compartments in different ventilation conditions. The research results show that because the fire load in the first-class, dining compartments is relatively lower, and the distance between combustible materials is relatively larger, the maximum heat release rate of the first class and dining compartments increases at first, and then begin to decrease, in the range of 1.8MW-4.4MW, with vent area increasing; because there are relatively more seats in the second-class train compartment and relatively shorter distance between 2 rows of seats, most of fuel are burned out and flashover has occurred quickly, the maximum heat release rate is in the range of 1.89MW-18.40MW.

Keywords: heat release rate, high-speed passenger train, train compartment, ventilation conditions

Study of Charging Nitrogen to External Floating Roof Tank to Prevent Rim-seal Fires from Lightning

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Abstract

It is estimated that 95% of rim seal fires are caused by lightning strikes. To avoid rim-seal fires caused by lightning, the existing methods mainly focus on the use of secondary sealing to reduce volatilization of oil and the electrical connections measures such as air terminals, deflectors, grounding device, discharge shunts and scalable grounding device to avoid sparks caused by lightning current. But these devices can't eliminate the spark generation thoroughly. A new method charging nitrogen to external floating roof tank seal ring is proposed to prevent rim-seal fires from lightning. In this paper, the safe oxygen content is set as the goal to charge nitrogen. An annular nitrogen charging pipe network is designed and its reliability is verified by experiment. The time of filling nitrogen to the seal ring of an external floating roof tank with the capacity of 10×10^4 m^3 at the rate of 63.38m^3/h to reach the nitrogen charging goal is proved within the time of lightning warning through experiment. And this experiment can provide some reference to the application of nitrogen charging.

Keywords: external floating roof tank, seal ring, nitrogen charging, safe oxygen content

Study on Route Selection for Hazardous Chemicals Transportation

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Abstract

With the rapid development of the national economy, transportation of hazardous chemicals has aroused widespread concern of different fields including government, industry and academia, due to its huge demand, high frequency of accident and huge losses. The study on optimal route selection is a quite important issue for the safety of hazardous chemicals transportation. In this paper, we firstly analyzed the comprehensive factors influential in road security, such as environment, population density, emergency response time and so on. Start from the index system consists of "comprehensive factors influential in road security", "safety management level of enterprises" and "transport of hazardous materials", we defined the risk levels of goods. Meanwhile the weights of influence factor were also obtained by using analytic hierarchy process methods. Then the weighted route length were calculated by normalizing the parameters of each secondary effects. Ultimately, we successfully found out the optimal route by using Dijkstra's algorithm. This work provided a theory basis for the effective and practical use of routing model.

Keywords: Hazardous chemicals transportation, Optimal route, Weight, Risk evaluation

Study on Smoke Control Strategy in a High-rise Building Fire

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Abstract

During the high-rise building fire, it is crucial to win the time for occupant evacuation. One of the possible methods is to utilize HVAC operations to control/slow down smoke propagation on the fire floor. It is also possible to supply fresh air to the path of the evacuation so that occupants will not breathe into the poison gases. HVAC operations can control heat change and smoke conditions and change the fluid flow directionally so that it is possible to optimize the HVAC operations to make the building safer during fire. In this paper, the effects of HVAC operations, air supply system and mechanical smoke exhaust system will be studied. A smoke propagation model using the Large Eddy Simulation will be developed to study the smoke propagation under different HVAC operations. Simulation results show the temperatures at the fire room exit for different supply air quantities. Results also show that smoke propagation method is affected by the building construction, air supply and smoke exhaust system. The smoke control strategy is investigated.

Keywords: Fire Science, Fire Safety, Smoke Propagation, HVAC, Large Eddy Simulation

Numerical Simulation of Toluene Vapor Diffusion in Limited Space

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Abstract

For the toluene's characteristics of flammability, explosiveness and volatile, this paper carried out transient numerical simulation for toluene vapor diffusion in limited space. Emphatically analyzed the concentration distribution in space and the concentration change with time. The simulation result shows that in the lower plane, toluene vapor diffuse from the center to surroundings under the action of diffusion and deposition. The concentration of each position in space increases with time but the increasing rate is non-constant. So toluene vapor accumulates layer by layer during the diffusion.

Keywords: toluene vapour diffusion, concentration distribution, concentration change, numerical simulation

Numerical study on temperature distribution of structural components exposed to travelling fire

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Abstract

In order to investigate the structure behavior under travelling fire, the numerical simulation of a full-scale travelling fire test with wooden fuels was completed by using FDS. The fire development and the heat release rate (HRR) were obtained. The temperature information, including gas temperature in the smoke layer, column surface temperatures at different heights, steel beam temperature and concrete ceiling temperature, were calculated from the FDS simulation. Although the compartment was rather small, obvious differences in temperature of the upper smoke layer and the steel beam, caused by the travelling fire, were observed. The maximum gas temperature under the ceiling was close to 1000 °C.

Keywords: temperature distribution, travelling fire, structural component, FDS

A phase change storage material that may be used in the fire resistance of building structure

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Abstract

This study prepared polyethylene glycol/silicon dioxide composite, a kind of form-stable phase change material. The composites can be made into mortar which is able to adhere to the surface of building structure and absorb the fire heat. This paper aims to study the effect of the composites on the fire resistance of building structure. Scanning electronic microscope and differential scanning calorimeter were adopted to investigate the structural and thermal properties of the composites. It was found that the polyethylene glycol was well dispersed into the network of solid SiO_2. And the latent heat of PEG/ SiO_2 increased with the decrease of SiO_2 content. The required weight percentage of SiO_2 was found to be 15% at least if the composites remain solid without leakage. It was also found that a phase change of pure PEG6000 happened with an enthalpy of 158 J/g while the 80 wt% PEG composite is 133 J/g. In conclusion, the phase change storage material may be used for fire resistance of building structure.

Keywords: Fire resistance of building structure, phase change storage materials, Polyethylene glycol, Silicon dioxide

Time-clustering behaviors of urban fires

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Abstract

It has been found that many systems are characterized by scaling behavior. Time-scaling scale-invariant approaches are used to analyze the temporal distribution of urban fire sequences recorded in the city of Wuhan (China) in present paper. The results of the coefficient of variation show that there is a clustering distribution in the occurrence sequence of urban fire in Wuhan. And with the study of Fano factor and Allan factor for the urban fire sequences in Wuhan, it is found that the urban fire sequences have obviously time-scaling behaviors. These reveal that the point process of urban fires is a fractal process with a high degree of time-clusterization of the events. The results will be helpful to estimate urban fire risk.

Keywords: scaling behavior, urban fire, Allan factor, Fano factor, cluster

Flame retardant properties of polyurethane/expandable graphite composites

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Abstract

In an effort to create an environmentally-friendly flame retardant system for rigid polyisocyanurate-polyurethane foams, expandable graphite (EG) combined with aluminium hydroxide (ATH) was firstly used to effectively improve the flame retardancy. Limited oxygen index (LOI) increased to 84.2 with an incorporation of 24 phr (parts per hundred of matrix) EG and 50phr ATH into the matrix. Based on scanning electronic microscopy observation and thermo gravimetric analysis, it was speculated that ATH could effectively induce "villi" like particles on the surface of EG, which made the in tumescent char denser. The compact char layer could effectively impede the bubbles and heat transport. ATH and EG accelerated the initial degradation and fluffy char was quickly generated on the surface, which results in the slowed down degradation products of the composite and the delayed diffusion of volatile combustible fragments to flame zone.

Keywords: polyurethane, expandable graphite, aluminium hydroxide, synergistic effect, flame retardancy

Numerical Simulation of the Risk of Frame Structure in Fire

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Abstract
In this paper the fire temperature model and thermal-force performance model of composite beams has been establishment by a FORTRAN77 program, which is based on FDS simulation and the analysis of coupled relationship between thermal and mechanical performance. Through the program mentioned above, the temperature, the shear force, bending moment, deformation and displacement of two layers of composite beams in fire was simulated. The results showed that: in the single room fire, the upper beam is generally positive fire area; maximum displacement generally appear in the middle of the structure positive fire area; for two frame structure, the risk of thermal injury prone point is in the adjacent area of the fire or diagonal regional.
Keywords: multi-layer framework, composite beams, fire, thermal-mechanical coupled analysis

New Frameworkof Intelligent Evacuation System of Buildings

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Abstract
On the basis of the analysis about the traditional evacuation and lifesaving facilities, this paper adopts high-tech technological means (e.g. advanced intelligent information-monitoring technique, artificial intelligent technique, computer technology, etc.), integrates the function of building evacuation, and establishes an intelligent evacuation system. This system overcomes the disadvantages and defects of the current intelligent evacuation system, and realizes the intelligent dynamic guidance of the personnel evacuation under the real fire scene through the main control module of the intelligent evacuation system. It aims to actually realize the intellectualization according to the dynamic change of the fire scene, and make the personnel evacuation more scientific, rapid and safer.
Keywords: fire control, high-rise intelligent building, intelligent evacuation system, systematic framework, Information acquisition

Unconventional Emergency System Characteristics and Emergency Decision-making Analysis

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Abstract

Compared with conventional emergency, unconventional emergency has typical unconventional characteristics and its system characteristics and emergency decision-making processes and methods are also very special. In order to making a deeper understanding the system characteristics and emergency decision-making mechanism of unconventional emergency, based on the definition and features analysis, the principle of entropy and dissipative structure theory to explain unconventional emergency system status characteristics, this paper analysis of unconventional emergencies and emergency management in the process of entropy state changes; further analysis temporal frame of unconventional emergency decision-making. Analysis shows that the unconventional emergencies happened and management is an Open dissipative system. System entropy changing by increased entropy factors ZS, negative entropy factor FS and system bearing capacity C combined action. Corresponding unconventional emergency system in the process of incubation period, initiation period, outbreak period, evolution period or recovery period and disappeared period, emergency decision-making work of temporal framework can be divided into warning precaution, crisis identification and isolation, integrated response and disposal measures four links.

Keywords: Unconventional Emergency System, Entropy principle, Emergency Decision-making, Temporal Framework

The Research about Fire Prevention of Vehicle Refuelling Stations

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Abstract

Fuel oil and gas offered by vehicle refuelling stations have combustion and explosion characteristics, serious casualties and economic losses often caused by fire. The research about oil and gas fire risk, refuelling process and facilities, proposing appropriate fire prevention measures possess great significance for reducing refuelling stations' fire losses, and ensuring the safety of the station and surrounding environment.

Keywords: refuelling stations, explosive mixed gas, leaking, fire source

Inhibition of the premixed CH4/Air deflagration by powdered extinguishing agents

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Abstract

In order to improve the utilization rate of extracted coal-bed methane, effective safety measures for low concentration gas transmission line must be provided. In this work, suppression of gas explosion in a channel by powdered extinguishing agents (i.e. ferrocene and aluminium hydroxide) was investigated. The methane concentration in the explosive mixture was 9.5% by volume. The experimental channel is 150mm×150mm×500mm in dimensions, in which three pairs of obstacles spaced 100 mm apart was configured to enhance the flame propagation speed. The high speed camera was used to capture flame images, by which the arrival time and the propagation speed of flame would be calculated. The performance of powdered extinguishing agents on gas deflagration suppression was evaluated. The results showed that the suppression effectiveness of the powdered ferrocene is closely related with the solid concentration. For the solid concentration of 80g/m^3, the arrival time of flame to the channel exit was increased by 32.5%, and the peak flame propagation speed was declined by 15.6%. In contrast to aluminium hydroxide, ferrocene showed the better explosion suppression characteristic. The results showed the practical foundation to gas explosion suppression by ferrocene in coal mines.

Keywords: ferrocene, gas explosion, explosion suppression, powder extinguishing agent

Research on Smoke Flow in a Tunnel Fire of Subway System

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Abstract

A three-dimensional mathematical model of the smoke movement in tunnel fires was established. Finite volume method was used to discretize the governing equations and the SIMPLE algorithm was employed to solve the governing equations. A scaling model (1:8) of the subway tunnel was built up based on similarity theory. Not only different positions of fire on the train, but also the different starting times of exhaust fan in the tunnel were considered. The disciplines of smoke temperature, smoke diffusion and wind velocity have then been compared under different the fire situations. The study is useful to analyze evacuating and controlling fire in emergent project of tunnel fire in a subway system.

Keywords: tunnel fire, computation fluid dynamics, smoke, ventilation, subway

Investigation of an unsteady flame propagating in a curved duct

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Abstract
Knowledge of behaviors of flame propagating in a curved duct is of great importance to prevent damage in practical industry. In this study, the premixed propane/air flame propagating through a square cross-section duct with a 90° bend was investigated. The high video camera and schlieren image technique were used to record the development of flame front structure. Ionization probes were applied to capture the characteristics of the flow field. Two cases of ignition positions were performed in the experiments. When ignition in the horizontal section, a tulip flame was formed and transition to turbulent flame occurred in the horizontal section. A blunt flame front was kept in the bend and the turbulence intensity was enhanced. However, when ignited in the vertical section, the keen-edged flame tip moved quickly along the lower wall of the bend. The flame kept laminar in the vertical section and bend. Only some weak turbulence was formed in the horizontal section. And the fluctuation of flame velocity was suggested mainly due to the variation of flame front surface area and turbulent combustion.
Keywords: ignition positions, premixed flame, curved duct, schlieren image, turbulent combustion

Simulation of pedestrian evacuation in a room under fire emergency

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Abstract
An extended floor field model is proposed to simulate the pedestrian evacuation in a room by considering the smoke and fire effect under fire emergency. In this new model, the visibility floor field and temperature floor field are introduced, these extensions are important for evacuation simulations under fire circumstances. Through the numerical simulations, the influence of fire locations, type of burning materials, heat release rates and exit width on evacuation are analyzed. The results show these factors have great effects on evacuation, which may be useful to understand the pedestrian evacuation under fire emergency.
Keywords: Pedestrian evacuation, Fire, Floor field model

Experimental and mechanism study of electrically charged water mist for controlling kerosene fire in a confined space

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Abstract

Charged water mist has been widely used in industrial dust controlling due to its charged characteristics. But the study for controlling fire is less. Therefore, in this paper, extinguishing experiments of kerosene fire was carried out with water mist which was charged by a corona discharge in a small-scale and confined space. Water mists with different charge-to-mass ratios was obtained by changing the voltage. The effects on extinguishing time, flame temperature and flame image changes were analyzed. The experiments show that the charged water mist can effectively reduce the extinguishing time, flame temperature and inhibit flame compared with the ordinary water mist. Additionally, the extinguishing efficiency significantly increases with the increase of charge-to-mass ratio.

Keywords: Corona discharge, charged water mist, charge-to-mass ratio

Investigation of Fire Protection Status for Nanjing Representative Historical Buildings and Future Management Measures

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Abstract

The field investigations including the statuses of fire protection layout, fire hazards and fire protection facilities for Nanjing representative historical building (Yuejiang Tower, Tianfei Palace, Jiangnan Examination Institute and Confucius Temple) have been conducted. The problems of the investigated historical buildings are found to be: extensive distribution of combustibles, high fire loads, deficiency of fire separation distance, shortage of fire facilities, unreasonable fire detector and extinguisher selection, backward fire regulations etc. Taking Yuejiang Tower as an example, the design of minimum extinguisher configurations has been performed according to the code and investigated data. Finally the optimal proposals and measures to improve the fire protection and management system are presented.

Keywords: Nanjing historical building, fire hazards, fire protection Status, fire extinguisher, minimum configuration design

The Application of Cone Calorimeter on the Study of burning performance of liquorices

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Abstract
In this paper, burning performance of liquorices were tested by cone calorimeter. The results indicated that liquorices were easily to be ignited, the minimum ignition heat flux intensity theoretically can be speculated at 5.8822kW • m^{-2};during the early time of the ignition of liquorices, in view of the thick carbonized layer formed on the surface of samples, which delayed the pyrolysis of liquorices, the peak heat release rate was greater under lower heat flux than other conditions, and the average heat release rate increased with the growth of heat flux; during the early time of the ignition of liquorices, specific extinction area and CO yield was higher; with the increase of heat flux ,specific extinction area and CO yield decreased. Hence, the fire risk of liquorices can't be ignored.
Keywords: fire, liquorices, cone calorimeter, burning performance.

A Reliability Evaluation of Lifeline Systems Effects on Fire Rescue

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Abstract
In the process of actual fire rescue, the timeliness and success rate of fire rescues will be affected when only one lifeline system is considered and not considered the relationship among other lifeline systems. However, little research was paid attention to the relationship among different lifeline systems and the most of studies was focused on a single lifeline system. Therefore, it is important and significant to study on the interaction of different lifeline systems during the fire rescues. In this paper, a rescue model is built to evaluate the reliability of the effect of lifeline systems on the fire rescues. Many factors are considered including water system, traffic system, rescue workers, equipment and so on. The reliability of the influence factors are also presented. The reliability of fire rescue can be described and characterized efficiently by this model.
Keywords: lifeline system, reliability, fire rescue, evaluation

A Whole Process Prediction Method for Temperature Field of Fire Smoke in Large Spaces

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Abstract

Based on the fire development model for the whole process of localized fires in large-space buildings and assisted by the technology of FDS large eddy simulation, the temperature fields of fire smoke of localized fires in large spaces were investigated with different building heights, building areas and fire powers. It has been found that for large-space buildings with a height greater than 6 m and a building area more than 1500 m^2, factors like building height and building area can slightly affect the curve trend of fire smoke, while such factor like fire power has more significant influence on the curve trend of fire smoke. Through the analysis of temperature rise curves of fire smoke in various fire scenarios, the paper proposed a whole-process prediction model for the temperature fields of fire smoke of localized fires in large-space buildings. As long as the model uses the appropriate shape coefficient, the prediction model can accurately predict the temperature fields of fire smoke of localized fires in large-space buildings.

Keywords: Localized fire, Smoke temperature, Large Eddy Simulation Fire Development

Analysis of Security Evacuation Simulation and Optimization of a University Library

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Abstract

Taking a university library as the example, Pathfinder (trial version) was used to make a full size simulation of the library evacuation. The analysis shows that there are some problems: The imbalance in using evacuation staircases, a lack of coordination between the loading number of the north and south area, and the gap between the evacuation ability of the two areas. Schemes have been optimized to these problems. Three scenarios' escape time respectively is 428.83, 341.13 and 285.28 seconds after optimization. Then advice was put forward, such as strengthening the training for staffs, shutting down some passages reasonably between stairs and floors, and readjusting the reading seats of north and south area properly, etc.

Keywords: Library, evacuation simulation, schemeoptimization, Pathfinder.

Simulation of evacuation in a twin bore tunnel: analysis of evacuation time and egress selection

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Abstract

In this paper, an experiment performed in a twin bore tunnel is simulated with Pathfinder and FDS+EVAC. The non-intervened case and the intervened case are constructed to analyse the difference between experiment and simulation with Pathfinder. Data obtained indicate that simulation results match the experiment well. Main reasons that cause difference may be their panic, fear, time loss in information processing, unwillingness to abandon properties, and social influence (maybe the most important one). Egress selection plays an important role in influencing evacuation time, but it is impossible for all occupants to select their nearest exits for evacuation in the real circumstances influenced by other factors. After comparing evacuation time in cases of Pathfinder (intervened case) without considering delay time in advance, Pathfinder considering delay time in advance, and FDS+EVAC (including detection time and reaction time), we can conclude that the case with FDS+EVAC is better than the one with Pathfinder without considering delay time in advance, and the case with Pathfinder considering delay time in advance is better than the one with FDS+EVAC. Reasonable suggestions for a Pathfinder simulation case are changing egress selection if necessary, and taking into account delay time when the occupants don't start to evacuate at the same time.

Keywords: tunnel, experiment, simulation, evacuation time, egress selection

Numerical Simulation of Natural Gas Release and Risk Zone Forecast inUrban Areas

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Abstract

Risk zone forecast is of great importance in natural gas pipeline route choice, safe separation distances determination and disaster assistance. In this article, the risk zone after the natural gas release in urban areas was predicted under the condition of different wind directions or different release rates, with the method of computational fluid dynamics (CFD). In addition, the change tendency of the risk zone with the increase of release rate under the environment of strong winds and breeze was studied respectively.

Keywords: Natural gas release, Numerical simulation, Risk zone forecast

Experimental study of pedestrian flow in a fire-protection evacuation walk

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Abstract
As modern society develops rapidly, underground buildings are springing up all over the city, it is very essential to study pedestrian flow in the underground corridor. An evacuation experiment was conducted in a fire-protection evacuation walk in an underground market. Passing time, walking velocity, walking preference, and specific flux in the experiment are carefully analyzed. The influences of different layouts of obstacles in the corridor and pedestrian flow direction on the corridor evacuation are emphatically studied. The results include comparisons between each scene in the unidirectional and bidirectional flow, which can provide suggestions for designers and managers.
Keywords: evacuation experiment, pedestrian flow, corridor, obstacle

Study on Factors Affecting Evacuation Capability of a Fire-Protection Walk in Underground Buildings

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Abstract
To investigate the evacuation capability of a fire-protection walk in underground buildings, a typical fire district connected with a fire-protection walk and a stair was set. Evacuation time for 388 people escaping from the area was simulated numerically. Simulation results that the width of all exits in a fire district, the distance between exit of the fire district and the entrance of the stair leading to the out space (walking distance in a fire-protection evacuation walk), the width of the stairs have great effects on evacuation time when the width of the fire-protection evacuation walk was determined. The largest capacity of evacuation can be reached when the exit width is almost the same or wider than the width of the fire-protection evacuation walk. Set the stair and its doors as wide as the fire-protection evacuation walk and a reasonable walking length in a fire-protection walk can prevent forming congestions near these doors.
Keywords: Evacuation capability, Fire-protection evacuation walk, Undergrounding Buildings, Affecting factors

Investigation of human behavior in emergent evacuation from an underground retail store

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Abstract

Pedestrian evacuation from underground building in emergency situations could be influenced by the structure of buildings, characteristics of pedestrian movement and seriousness of emergency events. To understand the evacuation process of pedestrian in emergency, evacuation drills on an underground retail store and a questionnaire survey are conducted. The characteristics of human evacuation behaviour are discussed and the evacuation time and specific flow in each evacuation scenario are analyzed. The phenomenon of unbalance exit-selection is revealed, and more guidance devices are needed in the underground retail store. The results also indicate that obstacles nearby the emergency exits should be removed and the clustering places for evacuees should be far away from the emergency exits. It is concluded that the results could provide assessment of the accuracy of existing egress models, and ensure that building owners and managers have a sound basis for evacuation planning.

Keywords: Emergency evacuation, Human behavior, Fire compartment, Exit selection, Evacuation drill

The influence of common plastics on the identification of gasoline studied by GC-MS

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Abstract

The influence of 5 kinds of plastics, PVC (Polyvinyl Chloride), PE (Polyethylene), PP (Polypropylene), PS (Polystyrene), ABS (Acrylonitrile Butadiene Styrene), and their mixture on the identification of gasoline was studied by GC-MS (Gas Chromatography-Mass spectrometry). The results showed that the influences are different among these plastics. However, all the plastics studied do not cause much change to the typical constitutions of gasoline combustion residue, resulting in the little interference on the gasoline identification according to the current criterion.

Keywords: gasoline identification, GC-MS, plastics, influence

Design and Implementation of Fire Safety Evacuation Simulation Software based on Cellular Automata model

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Abstract

A fire evacuation model was developed based on cellular automata (CA) to simulate occupant evacuation behaviors in case of public place fires, which can reflect individual characteristics, herd behaviors and the environmental effects on the evacuation behavior. The fire safety evacuation simulation software based on the model was programmed by c# language on the platform of Microsoft Visual Studio 2008. The occupant evacuation process in fire scenario was displayed through the software, and the simulation came with the same result with actual situation. This software, with intuitive, flexible and extendable, has realized the anticipated functions, such as generating fire scenario, simulating evacuation behaviors and managing legal norms of fire safety. Furthermore, it provides a platform for further research on fire safety evacuation in public places.

Keywords: Occupant evacuation simulation, Cellular automata, Software design, Public place fire

Large eddy simulation of ethanol-gasoline fire

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Abstract

The multi-component fuel based eddy dissipation concept(EDC) model, PaSR based soot model and grey gas based FvDOM radiation model etc in ExfireFoam is further extended to simulate a 30cm × 30cm ethanol-gasoline square pool fire. The predictions achieved good agreement with the measurements for flame height and the radial temperature profiles at different heights, demonstrating the good potential of the ExfireFoam for predicting the combustion process of pool fires from multi-component fuels.

Keywords: Fire safety, Large eddy simulation, Multi-component fuels, Pool fire.

Fire Safety Management Strategy of Complex Developments

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Abstract
A comprehensive fire safety management strategy has been presented to demonstrate how the best practices in fire safety management can be implemented in complex developments. A holistic fire safety management approach with the consideration of fire management team plan, fire emergency procedures and maintenance plan in the fire management plan has been discussed in detail. A large scale development has been used as an example on how the fire safety management plan is being setup and implemented in the management hierarchy. Interface with the authorities is also one of the key items in effective fire safety management and has also been considered in this paper. This paper can be act as a guideline for the further development of fire safety management plan for individual building.
Keywords: Fire Safety Management, Management Plan, Fire Safety Design, Complex Development

Numerical Studies on Smoke Spread in Urban Underground Tunnel with Horizontal Junctions

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Abstract
Urban underground tunnels usually have lager traffic volumes and complex structures comparing with other kinds of tunnel. This can give higher fire risk and also make smoke control to become more difficult once the fire occurs. The effect of the fire size and intersection angle on the smoke spread and smoke mass flow distribution in underground urban tunnel with horizontal junctions are studied by the numerical simulation in this paper. The results show that the power size can affect the smoke spread heavily, but it has little effect on the smoke mass flow distributions between the downstream main tunnel and the branch tunnels. Variation of the intersection angle almost have an effect on the smoke spread in upstream main tunnel, but its effect on the smoke spread and smoke mass flow distributions in branch tunnel cannot be neglect. The results are expected to be useful for the smoke control system design in these kinds of tunnels.
Keywords: urban underground tunnel, fire, numerical simulation, smoke spread

The Introduction of Criteria Parameter in Spontaneous Combustion Problem

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Abstract
The governing equation of spontaneous combustion is a partial differential equation (PDE) of heat conduction. With the help of numerical simulation, we can get the solution of this problem. But in order to identify the risk of spontaneous combustion in engineering problem, the method of numerical simulation seems too complex and is hard to be used by engineers. So we wish that we can get a criteria parameter to identify the risk of spontaneous combustion more easily. There are two theories about the spontaneous combustion-the theory of Semenov and the theory of Frank-Ramenetskil. In this thesis, we will introduce their theories first and then we'll introduce the theory of criteria parameter in the problem of spontaneous combustion through analyzing the mathematical model and simplifying the problem. At last, we'll give our criteria to identify the risk of spontaneous combustion problem.
Keywords: spontaneous combustion, criteria parameter, Frank-Ramenetskil

Experimental Study of Pool Fire Burning Behaviors in Ceiling Vented Ship Cabins

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Abstract
Experiments were carried out in a ceiling vented ship cabin, with its inner dimension of 3 m x 3 m x 1.95 m, in order to investigate the effect of ceiling vent size ($0 \sim 0.3\ m^2$) on the burning behaviors of a D30cm heptane pool fire. Boiling burning, self-extinction, flame oscillation and ghosting flame were observed during the experiments. Results show that ceiling vent size had great influence on the fire self-extinction. A ventilation factor of ceiling vented compartment Φ was defined to determine the ceiling vent size. According to this factor, the fires can be classified into three extinction modes: Self-extinction mode, transition mode and Burn-out mode. Fuel consumed ratio, burning time and fuel mass loss rate of different modes were also analyzed in the paper.
Keywords: Ceiling Vent, Pool Fire, Ghosting Flame, Self-extinction, Ship Cabin

Research and Application of Fire Risk Assessment System for Marketplace Buildings

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Abstract

Characteristics of serious fires that have occurred in recent years at large marketplace buildings are analyzed in this paper. On the basis of the analysis, a fire risk assessment system for marketplace buildings has been established and this approach turns out to be fruitful after it has been applied to some large marketplaces in Shanghai. This approach can provide decision-making basis and technical reference for the safety management of fire control of relevant departments and specifications and improve the overall fire safety of marketplaces.

Keywords: Fire, Risk Assessment System, Marketplace Buildings, Practical Application

Fiber reinforced geopolymersfor fire resistance applications

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Abstract

This paper presents the development of fiber reinforced metakaolin-fly ash based geopolymers for fire resistance application. A series of experiments are carried out to develop optimum mix proportions of fiber reinforced metakaolin-fly ash based geopolymers with superior fire resistance properties. Bending and compression tests were conducted at ambient temperature and after exposure to elevated temperatures on geopolymers with different proportion of carbon fiber and fly ash substitution for metakaolin, and the effect of carbon fiber and fly ash content were quantified. Data from the tests showed that the addition of chopped carbon fibers in geopolymers provides effective crack control and enhances bending strength under high temperature. Further partial substitution of fly ash for metakaolin reduces the water demand in the reaction process on geopolymer preparation and microstructure damage under high temperatures due to evaporation of water present in geopolymers, thus enhance the mechanical properties of geopolymers after exposure to elevated temperatures. Based on these experiments, a geopolymer made with 50% metakaolin and 50% fly ash and reinforced by 2% chopped carbon fibers can be an effective alternative material for structures in fire resistance applications.

Keywords: Metakaolin, Fly ash, Carbon fiber, Geopolymer, High temperature

Study of personnel positioning in large area based on pseudo base station

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Abstract
To find out survivors in some disasters such as earthquake or fire hazard is an extremely important work. The faster search-and-rescue team detect them, the more possibility they could survive. This paper has proposed a new positioning technology based on pseudo base station which designed for searching the survivors under the ruins in earthquake or fire hazard. It could search survivors indirectly by finding the cell phones supposed to be with them. The result of several test shows that the technology could search cell phones in large area in short time. That means this technology will be able to find the survivors under the ruins in disaster area with quickly. That's what is needed urgently for disaster relief work.
Keywords: Pseudo base station, Personnel positioning, Disaster relief

Small Scale Experiment Study on the Fireproof Distance of Oil Tank Fires

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Abstract
Groups of small scale experiments were carried out by two stainless steel circular pans with 205mm diameter to simulate oil tank fire scenarios. The main burning pan was filled with 200ml No.0 diesel with 100ml water below acting as the fire source which was ignited by 5ml oil. Another pan was filled with 100ml diesel and acted as the pan waiting to be ignited by the main burning pan. Changing the space between the two oil pans and the wind velocity in the experiment room, temperature and heat radiation flux of different fire conditions were recorded. Representing the diameter of the main burning pan as D, the results show that, the fireproof distance between the two diesel pans is 0.6D when wind velocity is 0.2m/s; the fireproof distance increases to 0.8D when the wind velocity is raised to 0.5m/s; When the wind velocity is 1m/s, the fireproof distance changes to D. From the observation and analysis on the critical temperature and heat radiant flux received by the fuel surface of the pan waiting to be ignited, it can be seen that the radiation thermal value accumulated to about 47187.5J/m2 at the moment when the oil pan is ignited.
Keywords: Fireproof distance, Ventilation, Heat radiation flux, Temperature, Ignition

A computational study on effect of balcony on vertical spread of window spill plume along building exterior façade

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Abstract

The barrier effect of balcony is significant on vertical spread of window spill plume along building exterior facade. A series of reduced-scale fire simulation experiments were carried out in order to investigate the reduction of vertical fire spread due to the present of a balcony in different depth and width. Finally conclude:(1)the depth and width of balcony play different degrees of barrier effect on vertical spread of window spill plume along building exterior facade , (2)When the balcony width is longer enough, the balcony depth playing dominant barrier effect, (3)when the balcony depth is long enough, with the balcony width increase, the wall temperature decrease slightly. These conclusions provide fire prevention of the building exterior facade with a reference.

Keywords: window spill plume, balcony, fire spread

Experimental Study on the Thermal Hazardous Characteristics of Lauroyl Peroxide

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Abstract

In order to research the thermal hazardous characteristics of lauroyl peroxide (LPO), Accelerating Rate Calorimeter (ARC) was used to test its adiabatic decomposition characteristics, the measured data are modified by consideration of thermal inertia factor of ARC and self-accelerating decomposition temperatures (SADT) of them are calculated. The results show that in totally adiabatic condition, maximum heat release rates of LPO and LPO kept inert by dibutyl phthalate (DBP) are 218.70℃·min^{-1} and 11.61℃·min^{-1} respectively, SADT of them are 34.72℃and 43.64℃ respectively. LPO kept inert is safer, keeping it inert is meaningful to production, transport and storage of LPO.

Keywords: Lauroyl peroxide, Accelerating Rate Calorimeter, Thermal hazardous characteristic

Discussion on Existing Problems and Countermeasures of Rural Fire Control —Take Yunnan Province as an example

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Abstract
With the rapid development of the economic society and the constant improvement of the living standard, the rural fire control has already gained great improvement. The author takes Yunnan Province as an example, analyzes the current status and existing problems of the rural fire control, and puts forward countermeasures.
Keywords: Yunnan, rural fire control, problem, countermeasure

Risk Analyzing on Target Type of Arson Attack

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Abstract
An arson attack brought great social reflection in Xiamen, June 2013. In this arson, 47 people died and 34 injured on a bus. Arson is a unique category of intentional attack that results in grave consequence once occurs. This paper establishes an arson assessment model based on the particular characteristic of arson, using the risk analysis methods. 8803 arson attacks from 2000 to 2011 in Global Terrorism Database are studied. Threat, vulnerability, consequence and risk aiming at different target types are compared, so as to provide technical support against arson for defensive arrangement and macro emergency decision.
Keywords: arson, intentional attack, public safety, Global Terrorism Database, risk analysis

Large eddy simulation of fire spread

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Abstract
In order to explore and improve the applicability of FireFOAM which is a new fire modelling code on the numerical simulation of spread simulation over the solid surface, the single-wall corrugated board is selected to evaluate the influence on the flame spread with different board width, heat release rate of fire source and the board located angle. Six cases are used and the simulation results can reflect the change trend of probe temperate and the flame spread rate with the three variables, generally aligning with the rules from previous experiments. Moreover, further studies are needed to evaluate and improve the current FireFOAM code further.
Keywords: Flame spread, Fire FOAM, large eddy simulation, temperature

Study of personnel monitoring and counting in single channel based on RFID technology

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Abstract

In previous studies, the parameters of most personnel tracking and counting were obtained by artificial statistics and image processing, These two ways may be both complicated and time consuming. In this paper, we apply the RFID technology to monitor and count the persons in single channel and introduce the theory of this monitoring and counting system. For the passive tags, we analyzed the characteristics of RSSI. The conclusion that the RSSI of all the tags is inversely to the distance between tag and antenna was obtained, even when the tag is moved in the line parallel with antenna. At the same time, the parameters of pedestrian movement, that is the number of persons, the specific persons, the time and the location when the person is in front of the corresponding antenna could also be obtained according to this system. Besides, the calculation will be much faster than the video processing so the efficiency could be improved greatly.

Keywords: RFID, RSSI, tag testing, pedestrian monitoring, pedestrian counting

Numerical Simulation on the Character of Oil-pool-fire Plume

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Abstract

With the development of economy, the existing fire code can not adapt to the modern various special buildings, performance-based building fire protection analysis and design arises at the historic moment, FDS (Fire Dynamics Simulator) as the process of the development of the building fire simulation calculation of the main tool, also have been applied more and more. Based on the FDS, fire power per unit area with 57.5, 44.5, 33.0, 21.7, 14.4kW/m^2 is chosen to simulate the open space fire using numerical simulation, and the result is compared to McCaffrey model. The results show that to a certain extent the simulation result of FDS with McCaffrey model has a certain similarity, but it appears a certain difference, even opposite result.

Keywords: FDS, McCaffrey model, flame structure, numerical simulation

The Application of GIS and IOT Technology on Building Fire Evacuation

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Abstract

To improve evacuation efficiency, an evacuation system was proposed based on GIS and Technology of IOT by analyzing the influence of smoke on evacuation. Information about the building can be obtained using GIS and IOT technology. Using Matlab based on analytic hierarchy process for three evaluations, Evacuation path selection, one of the most critical problems in the system, could be solved. The article provides a new approach, a new idea, for achieving building fire evacuation. It also promotes the intellectualization of fire protection.

Keywords: firefighting, evacuation, GIS, IOT technology

Influencing factor analysis of ultra tall building elevator evacuation

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Abstract

This paper develops an elevator evacuation model for ultra tall building which is implemented by AnyLogic package. Pedestrian movement and the elevator running can be well combined into the elevator evacuation model. Theoretical analysis is conducted to explore the influencing factors of the elevator evacuation and how the elevator evacuation time is determined by these influencing factors, including the number of occupants evacuating by one elevator, the height of refuge floor, the elevator speed and acceleration speed, the elevator capacity and elevator door width etc. Simulation experiments are conducted to analyze the elevator evacuation time of ultra tall building. By theoretical and simulation analysis and the elevator evacuation time can be expressed as functions with several variables.

Keywords: ultra tall building, elevator evacuation, influencing factor, evacuation time

Application of the model based on fuzzy consistent matrix and AHP in the assessment of fire risk of subway tunnel

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Abstract

According to the defects of fuzziness of index of fire risk evaluation and the complexity of structure consistent pair-wise comparison matrix, the fuzzy consistent matrix was introduce, by doing this, the influence of subjective factors could be reduced effectively. The paper established a Fuzzy Analytic Hierarchy Process model which aimed at assessing the tunnel fire risk assessment of subway by combining the fuzzy consistent matrix and AHP. Then a subway tunnel was selected for example, considering the hierarchical model of the complex index system carefully, Firstly, building it's fuzzy consistent matrix which tolerate ambiguity and vagueness, calculating the weight of various factors with the fuzzy theory; Secondly, quantifying the fire risk of subway tunnel with the aid of the fire risk index method and the grade of the fire disaster danger grades could be drawn. Thirdly, the weak link of the system could be found by assessing the weight of various factors which can guide the fire safety work during designing, constructing, operating and so on. The inconformity of the pair-wise comparison matrix could be avoided by using this model. This model would shows greater superiority over the engineering.

Keywords: subway tunnel, fuzzy consistent matrix, AHP, fire risk assessment

A study on theoretical calculation method of subway safety evacuation

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Abstract

Taking Hang Zhou Subway as research background, this article puts forward a new theoretical calculation suitable for subway safety evacuation, which is based on theoretical calculation of Japanese safety evacuation. The theoretical calculation can not only calculate total time necessary for safety evacuation, but also work out people's retention time on the way of different evacuation width clearly to specify the direction of improvement for subway fire-safety design. In addition, the evacuation simulation software named Pathfinder is used to simulate two evacuation situations when the train is stuck in tunnel when there is a fire. In comparison with the evacuation time and simulation result of two evacuation situations by theoretical calculation, we can conclude a more accurate time necessary for safety evacuation to provide more reliable data for subway performance-based fire-protection design.

Keywords: subway fire, evacuation, theoretical calculation, numerical simulation, performance-based fire-protection

Study on Network Public Opinion Dissemination and Coping Strategies in Large Fire Disasters

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Abstract

Large fire disasters have the characteristics of unpredictability, great harmfulness and high profile, and they are easy to become a hot topic on the Internet and develop into public opinion in a short time. If not handled properly, the event may cause adverse public sentiment or even lead to mass incidents. So it is very meaningful to study the network public opinion in large fire disasters. Firstly, the paper introduces the acquisition method of network public opinion information in large fire disasters. Then, an in-depth research on large fire disasters is made from two aspects, which are dissemination of power source and the dissemination law. The dissemination of power source is divided into five types, containing netizens, media, parties, opinion leaders and the government. Several dissemination law curves are also presented. Finally, some coping strategies from the perspective of information release and power sources are put forward. The study provides references and basis for the government to understand the network public opinion in large fire disasters and make corresponding measures.

Keywords: Large fire disaster, Network public opinion, Power source, Coping strategies

A thermal degradation study of insulation materials extruded polystyrene

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Abstract

This paper presents a research on the thermal degradation of typical polymer insulation materials extruded polystyrene (XPS) under both oxidizing gas air and non-oxidizing gas nitrogen. The Kissinger-Akahira-Sunose method was employed to calculate the activation energy values according to thermogravimetic analysis (TGA) results. Thermal degradation characteristics of XPS were studied by using thermogravimetry and differential scanning calorimetry (TG-DSC) hyphenated technique. XPS follows a two-stage and three-stage weight loss during the entire process under nitrogen and air, respectively. Evolved products of XPS and thedegradation mechanism in helium were investigated with pyrolysis-gas chromatography-mass spectrometry (Py-GC-MS) method. The results reveal that styrene monomers are the dominate products of XPS degradation. Methylbenzene, α-methyl styrene, dimer and some other oligmers of styrene are also detected.

Keywords: Extruded polystyrene Thermogravimetic analysis Pyrolysis-gas chromatography Mass spectrometry

Structural Stability Analysis of Pneumatic Membrane Architecture under Influence of Internal Fire

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Abstract

A coal storage shed taking advantage of pneumatic membrane structure was taken for example to research structural stability of pneumatic membrane architecture under influence of internal fire. Combustion characteristics of the membrane material was studied experimentally and the critical temperature generating holes on the heated material was got. Then, mathematical model of the structure was established to calculate the minimum difference between internal air pressure and the external required for stability, and to critical hole area in fire. Last, full-size fire field model of the shed was built to simulate membrane surface temperature distribution, and structural stability of the pneumatic membrane shed under influence of internal fire was judged with the critical hole temperature and the area. The results show that: critical hole temperature is somewhere between 365.5 ℃ and 437.6 ℃. The minimum difference is 34.73 Pa, and the critical hole area is 19.579 m^2. In the worst fire scene, the shed collapses likely for hole area on the membrane surface is bigger than the critical hole area. In engineering applications of pneumatic membrane architecture, there should be a safe distance from internal fire loads to the membrane above them.

Keywords: Pneumatic membrane architecture, Combustion characteristics, Experiment, Structural stability analysis, Fire simulation

Pyrolysis Analysis of Brominated Flame RetardedPolypropylene (PP)

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Abstract

In this paper, the pyrolysis gas chromatography (PyGC) has been used to test the pyrolysis performances of polypropylene sample without flame retardant and polypropylene samples added with different kind and content of brominated flame retardants. The experimental chromatograms have been analyzed with normalization method. The results show that, polypropylenes with different content of flame retardant have obviously different flame retardant properties.

Key words: Brominated flame retardant, polypropylene (PP), pyrolysis gas chromatography (PyGC)

Investigation and simulation on Human Evacuation Behaviour in Large Hospital Building in Shenyang

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Abstract

As a typical crowded public place, fatal deaths are caused by ineffective evacuation action in large hospital on account of the special characteristics of occupants in hospital building, i.e., pathological, physiological and psychological behaviour, etc. Large amount of observation by camera and videos, as well asquestionnaires were carried out in a SJ Hospital, which is the one of biggest hospitals in Shenyang. Based on that, correlation analysis was carried out between special behavioural characteristics of occupants in hospital and pedestrian walk velocity, as well as the correlation with their evacuation decision behaviour. Furthermore, evacuation simulation in the hospital building was done on the base of the fire dynamics simulation software FDS+Evac developed by NIST, USA. The investigation results illustrate that occupant walks slowly in hospital buildings at a ratio of 70%~90% comparing with the healthy people in common public buildings. Occupants in hospital building tend to ask help to staffs of the hospital in way finding in the case of emergent situations. More than 1/3rd of the occupants are more likely inclined to lose their idea once emergent situation occurs. The evacuation simulation illustrates that egress width and efficient evacuation instructions are the most important strategies in the efficient evacuation in hospital buildings.

Keywords: Hospital building, Human Evacuation, Correlation Analysis, Egress Width, Evacuation Instruction

Persistence study on gasoline compound in soil matrix and its application in fire investigation

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Abstract

Adsorptivity of gasoline attached on soil matrix was discussed. Peak areas' changing trend of target compounds' and typical compounds of gasoline were proposed, by fitting peak areas and time. Results shown that retention times of different compounds in gasoline attached on soil were different. C5 alkylbenzene, Naphthalene and Methylnaphthalene had the longest retention time, next come indane and C4 alkylbenzene. C1、C2 and C3 alkylbenzenes have the shortest retention time.

Keywords: gasoline, GC-MS, volatility, fire investigation

Path Optimization Study for Vehicles Evacuation Based on Dijkstra algorithm

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Abstract

Emergencyevents, such as earthquakes, hurricanes, fires, chemical accidents, nuclear accidents, terror attacks and other events may led to injured or endanger the life and the health of human beings, andthe large scale crowds have to evacuate from a danger area to a safe area by vehicles. In this paper, through observing real-time road network and analysing three different emergency evacuation cases and the nodes, intersections delay and velocity of vehicles evacuation in the morning peak, common and evening peak. A dynamic road network model is built for vehicles evacuation based on Dijkstra algorithm. The optimal evacuation path is proposed inthree different cases. The obtained outcomes provide well predictive method and theoretical basis for optimal emergency evacuation path selection and emergency rescue decision in public places, especially for those with high population density. So it seems very meaningful for us to cope with emergency situation or to prevent and mitigate disasters from the crisis events.

Keywords: Dijkstra algorithm, Emergency event, Evacuation path, Optimization

GC/MS Analysis on Combustion Smoke of Different Flammable Liquids

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Abstract

In this paper, we adopt gas chromatography / mass spectrometry (GC/MS)to analyze respectively the smokes of 90# gasoline, 0#diesel,lacquer thinner and alkyd diluent generated from their combustions on the carpet. In our experiments, we take the smoke produced from combustion of pure carpet as a blank to eliminate the interference components generated by the carpet combustion. Then we compare the total ion chromatograms of these four flammable liquids to find out the similarities and differences of components existing in their combustion smoke, which can determine characteristic components existing in thetheir combustion smoke.

Keywords: GC/MS, combustion smoke, gasoline, diesel, paint thinner

Image System Establishment of Electrical Fire Short Circuit Melted Mark

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Abstract
Electrical fault is caused by over current, which is created by a variety of reasons, and makes loss and fever increase, further it will cause short circuit. On the basis of this essence, this paper reclassifies short circuit melted mark types. And builds a short circuit experiment platform to carry on simulation experiment based on the new classification system, and then the appearance and metallographic structure of the different melted marks are observed and analyzed in order to establish melted mark image system and offer reference for electrical fire material evidence.
Keywords: electrical fire, short circuit, metallographic structure, image system

Method of Bottleneck Identification and Evaluation during Crowd Evacuation Process

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Abstract
Accidents and natural disasters such as fire and earthquakes post more and more threats to the transportation infrastructures. Under such circumstance, the evacuation process for the crowded pedestrians in these infrastructures may be affected by the facility failure, resulting in partially damaged evacuation network, which at last forms bottlenecks and decreases the evacuation efficiency. Thus to improve the safety and comfortable level of crowd evacuation in transportation infrastructures, a new method of bottleneck identification and evaluation for evacuation network is proposed. The proposed method takes into account the facility failure induced crowd redistribution and explores the structure importance of the evacuation network component. The method of bottleneck identification is also applicable to other similar transportation networks.
Keywords: crowd evacuation, bottleneck identification and evaluation, network simulation

The Application of Image Processing in the Electrical Fire Physical Evidence Identification

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Abstract

This paper based on the images of the primary short circuited melted mark(PSM) and secondary short-circuited melted mark(SSM), set out to demonstrate the application of image processing in fire material evidence identification. Because there are few researches about the accurate description for image of different situation, it is difficult to further study the differences between PSM and SSM. therefore, in this paper, the image processing technique, as an accurate description based on quantitative analysis method is put forward, and it is found that the images can be extracted out of contour and texture characteristics, which can be processed with the statistical means, so as to classify the PSM and SSM from the morphologically point of view accurately.

Keywords: fire, melted mark, electric circuit, matlab

Experimental Research of Integrated Compressed Air Foam System of Fixed (ICAF)for Liquid Fuel

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Abstract

This article in view of the realistic requirement of fixed fire extinguishing system in the places of water-insoluble liquid, establishes stationary compressed air foam experiment platform in combination with the advantage of compressed air foam technology. Key component nozzle and mixing chamber of the system is designed. By cold spray test, obtains parameters of gas-liquid flow, pressure, foam mixing ratio which result in different types of foam. The division of different types of foam basis is put forward, and take drainage time as indicators, get the most stable foam parameter combination; by extinguishing experiment, get the better combination of dry foam and small nozzle whose extinguishing effect is best. The results can be guidance for production research of integrated compressed air foam and system application in combustible liquid places.

Keywords: Compressed Air Foam, Fixed system, 25% Drainage Time

Principal aspects regarding to the emergency evacuation of large-scale crowds: a brief review of literatures until 2010

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Abstract

As a kind of emergency evacuation, the large-scale evacuation is an effective measure to mitigate disaster in a sudden crises. Research into the emergency evacuation of crowds has been the focus of many scholars at home and abroad for some time. In this paper, four principal aspects of current research into large-scale crowd evacuation, namely evacuation theories, evacuation modelling, evacuation decision-making and evacuation risk evaluation have been summarized. Of these, evacuation modelling has attracted the greatest interest. While some evacuation models have proved effective tools in evacuation decision-making and risk evaluation, existing evacuation models have not fully considered the uncertain factors in the process of large-scale evacuation.

Keywords: Large-scale evacuation, evacuation analytical tools, contributions and limitations

Numerical Simulation on Smoke Control of City Tunnel Fire

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Abstract

In this thesis, numerical simulation was carried out on a typical city tunnel to study the smoke control effect of city tunnels allowing only cars and small buses as well as allowing large buses. According to the numerical simulation results, suggestions on smoke control of city tunnel fire were put forward. When a city tunnel is only allowed for cars and small buses through, it is recommended to use the longitudinal ventilation system. Controlling the longitudinal velocity at around 2m/s after a fire is detected can control the city tunnel fire smoke effectively. When a city tunnel is allowed for large buses, it is recommended to use the point-exhaust system with a minimum exhaust volume of 120m³/s. Opening the top exhaust ports near the fire source immediately a fire breaks out, sucking the smoke with the maximum exhaust volume, and controlling the longitudinal velocity at around 2.4m/s will have a good control on the fire smoke.

Keywords: City Tunnel, Fire, Numerical Simulation, Exhaust, Longitudinal ventilation

A Novel Conceptual Fire Hazard Ranking Distribution System based on Multisensor Technology

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Abstract
Multisensor fire detection is widely accepted as the next generation of fire detection technology. A novel conceptual fire hazard ranking distribution system is proposed based on multisensory technology with the aim to assist building managers in fire emergency management, and fire brigades in fire rescue or fire fighting. The system is consisted of a fire node network representing fire hazard ranking of the divided control units in a building plan. Concept of fire information cloud is proposed inside the system to conduct most of the calculation and storage related to fire information. The system has the potential to provide space dimension in addition to traditional time and sensor type dimensions of a fire detection system. Fire location, fire situation assessment, and fire development intensity of a building in fire can be provided by the system for emergency management reference. Some long-term significances of the proposed conceptual system are also presented.
Keywords: fire hazard ranking, multisensor information fusion, fire information cloud, fire emergency management

Summary and Discussion of Models Modelling Fire Smoke Downward Displacement Caused by Water Spray

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Abstract
With widespread use of fixed water suppressing system, it is potential risk for evacuators in fire that the possible downward smoke displacement deduced by water droplets. However, this negative impact is hardly estimated and discussed in fire safety designs of buildings, because of the possible lack of reliable models or not much attention paid on it. This paper discussed this problem by reviewing the relevant models as well as their validation works. The challenges for performing an accurate simulation of downward smoke displacement are illustrated at last.
Keywords: Water droplets, sprinkler, fire, smoke, smoke downward displacement

Experimental study of video fire detection and its applications

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Abstract

Video fire detection makes a significant contribution to the effectiveness of fire detection systems, particularly as regards fire in large spaces such as Atria, Tunnels, Hangers, Warehouses and E&M Plant rooms, as traditional fire detection systems have been shown to be ineffective in large spaces. For the development of video fire detection systems, spatial, spectral and temporal indicators are important in the identification of a fire source. In the development of video fire detection systems, flame image segmentation, recognition, tracking and predication are important areas of investigation. The multi – threshold algorithm of Otsu's method and the Rayleigh distribution analysis method (modified segmentation algorithm) can be used in the segmentation of flame images. The modified segmentation algorithm, however, can be strengthen to extract the pool fire images making use of the optimum threshold values. Following such segmentation the pool fire images centroid analysis technique can be used to recognize pool fire images by means of the Nearest Neighbor (NN) algorithm. The objective of this paper is to examine the modified segmentation and the NN algorithms.

Keywords: video fire detection, segmentation, recognition

Numerical simulation of Ultra-fine water mist extinguishing mechanism

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Abstract

Ultra-fine water mist (UMF) had good performance in extinguishing fire caused by electric or flammable liquid. This paper studied the extinguishing effect of UMF in total flooding experiment in confined space, and used FDS fire dynamics simulation software to simulate the entire process in order to explore the extinguishing mechanism of UMF. The simulation results showed that UMF could not only cooling the fire rapidly but also isolate the fire from oxygen to cause suffocation which was the main reason for extinguishment because of its characteristics.

Keywords: UMF, FDS, extinguishment, suffocation, cooling

Numerical Simulation of Fire Whirl using Computational Fluid Dynamics

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Abstract

Fire whirl is an arising free standing flame, rotating around its fix centerline, or in other words "the rotating core". Nevertheless, it is suggested by other studies that rotating core of a swirling fire can move around the boundary, forming a "revolution" motion in which greatly increase the fire size. This phenomenon is caused by the unstable nature of the flame and also the unbalanced entrainment flows. Numerical simulation utilizing Large Eddy Simulation (LES) Computational Fluid Dynamics (CFD) approach was applied on a simple fire whirl problem where the fuel bed was enclosed by four blocks with opening gaps. The fire code incorporates all essential Sub-grid Scale (SGS) models including turbulence, combustion and radiation to describe the interactive fire whirl behavior. According to the simulation results presented in this study, it was found that the occurrence of fire whirl accompany with large increment of mass flow rate. In addition, the gap size significantly affected the occurrence time and the tendency of the fire whirl.

Keywords: Fire whirl, free standing fire, fire modelling, computational fluid dynamics, large eddy simulation

Example of Simulating Analysis on LNG Leakage and Dispersion

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Abstract

The mathematic model of release and dispersion process in LNG leakage incidents is discussed in this paper. Validation of this model is made to simulate the leakage of a LNG tank in the LNG storage and distribution station of a city gas corporation of Nanjing. The result indicates that numerical simulation and analysis method presents some reliability in the prediction and analysis of accident consequences, with practical guiding significance in the safety assessment for construction of new projects and the safety management and emergency relief after the completion of project.

Keywords: fire protection, LNG, leakage and dispersion, simulation and analysis, safety assessment

Discussion about promotion of coal mine safe production levels from strengthening labour management

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Abstract

Fires, floods, gas, roof and coal dust are known as the five major disasters of coal mine, which have always been treated as the focus of prevention and control of coal mine in safety production. Taking the example of Changzhi's experience in Shanxi Province, in order to improve the security basic qualities and skills of mine workers they have reinforced the labor management of the coal industry, built the five systems and two large database, this paper introduces the method of Changzhi city and preliminary effect, it is concluded that improving the safety quality of staffs is the fundamental solution of coal mine safety production, at the same time, it confirms positive significance of the accident of heinrich causal chain theory in the coal mine accident prevention.

Keywords: Coal mine safety, labor management, human-factor, safe production

Analysis and Countermeasures of Smoke Control Effect for Large Space Buildings

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Abstract

Large space buildings have their own fire characteristics. The paper builds an ideal large space building model and uses FDS software to simulate its internal smoke control effect after a fire under different conditions. The analysis shows that heat release rate and smoke exhaust volume have a great impact on smoke control effect, which can provide reference for the design of smoke control and exhaust system.

Keywords: large space, smoke control effect, FDS, heat release rate, smoke exhaust volume

Pedestrian Flow Characteristic of Typical Metro Station near the Commercial Property

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Abstract

Guangzhou Metro has become the most important of the public transport, and bring convenient for public travel. Statistics show that the average daily passenger flow is about 4.8 million people. These easily and quickly traffic brings the big flow of people, as more and more underground commercial buildings are developed near the metro station, so these form a transport, shopping, entertainment, integrated regional connectivity, especially the situation that hub the station connected to large underground shopping malls, will be a staff extremely dense underground buildings. This paper selected three typical stations of Guangzhou Metro to determine the flow volume, and passenger characteristics of the entrance between the station and mall were researched. The results of this study will be the next step subway station subway station underground mall connected to the area of fire protection design and personnel evacuation to provide basic information.

Keywords: metro station, commercial mall, connecting channel, Pedestrian Flow

A Glimpse on Setting up and Inspecting Fire Resisting Rolling Shutters

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Abstract

Fire resisting rolling shutter is used more and more widely in the modern construction projects. Its settings shall conform to the provisions of national technical specifications and standards, and meet with the corresponding functional requirements in fire and smoke prevention. This paper discusses on how to set up fire resisting rolling shutters in actual cases to serve as references for engineering and technical personnel and fire supervision personnel.

The influence of wind on the performance of static smoke control system in atrium

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Abstract

With the development of economy and technologies, atrium becomes increasingly introduced into some large-scale infrastructural buildings due to its great visualization, excellent perspectives and comfortable environment. It is common to adopt mechanical extraction provisions or static smoke system, and the static smoke control system is preferred in buildings with open space. One of the critical factors which may have impact on the performance of static smoke system is the wind, this paper analyses the influence of wind on the smoke movement of static smoke control system in atrium using the numerical simulation technology, and the winds are constant wind which speed doesn't change with height and elevated wind which speed changes with height.

Key findings through numerical simulations show: The wind from a single direction has obvious impact on smoke movement. Fire flume inclines significantly as wind speed increases, especially in condition of constant wind; the pressure at the same height in different scenarios decreases simultaneously as wind speed increases, the indoor pressure increases uniformly with height from bottom to roof in the atrium under condition of windless. The indoor pressure under the ceiling in elevated wind is always weaker compared to the constant wind, That is not good for smoke extraction. The temperature near to the fire source decreases greatly in the wind with speed of 5m/s. The wind makes the smoke layer decrease fast, and the wind with greater speed causes the smoke decrease more quickly. Total smoke extraction rate in elevated wind with speed of 2m/s other than constant wind, increases a little but decreased when the speed is up to 5m/s. It is concluded that the wind can influence the temperature, pressure and flow rate, etc. in the fire. The wind with low speed increases the smoke extraction rate and has benefit in static smoke control, but when the wind increase, the smoke exhaust efficiency drops down obviously.

Keywords: wind, atrium, numerical simulation, smoke movement

A Dynamic Approach to ASET/RSET Assessment in Performance Based Design

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Abstract

The basic concept in the assessment of occupant safety in a building under fire conditions is the determination of the time when occupants are able to safely escape before hazardous conditions sets in. The Available Safe Egress Time / Required Safe Egress Time (ASET/RSET) concept of fire safety assessment in performance based fire safety engineering design has become widely used amongst fire safety engineering practitioners, since its inception more than thirty years ago. However, the adequacy of this approach has only been occasionally deliberated on and not well addressed in detail. Discussions were usually focused on the weaknesses and inadequacies in the assumptions and methodologies which impact upon the outcome of the ASET and RSET parameters, rather than on the ASET/RSET concept itself. The original ASET/RSET approach was derived from a simple two-zone model for a single compartment by Cooper in 1980, but is still being applied to larger and more complex buildings today. This is despite the advancement of sophisticated three-dimensional simulation models producing highly detailed results, whereby the smoke layer is no longer uniform and the extent of the area of untenable conditions is a transient state and may develop only over a portion of the compartment area. The continued application of the ASET/RSET approach in these circumstances may lead to varied interpretation of the egress terms, leading to departures from the intended purpose and scope of providing the basic measure of assessing egress safety that was originally devised by Cooper. There is also little published literature available on viable alternatives to this simplified means of assessing safe egress from fire that was originally derived from a zone model concept. This paper provides a brief review of the ASET RSET methodology, and introduces an alternative means of fire safety assessment based on the utility of a given space over time. The alternative scheme enables a dynamic approach to assessing the level of safety that is more appropriate for use with advanced simulation models providing transient three-dimensional environments in more complex building layouts.

Keywords: ASET, RSET, Dynamic Approach, Performance Based Design