

出國報告(出國類別：國際會議)

**2012 年國際橋梁及結構工程學會  
(fib 主辦)“Concrete Structures for a  
Sustainable Community”研討會**

服務機關：交通部臺灣區國道新建工程局

第二區工程處

姓名職稱：張瑜超 副工程司兼嘉屏工務所

副主任

派赴國家：瑞典

出國期間：101 年 6 月 9 日~101 年 6 月 15 日

報告日期：101 年 6 月 22 日

# 摘要

2012 年國際橋梁及結構工程學會 “Concrete Structures for a Sustainable Community” 研討會係由 fib 國際結構混凝土學會主辦，於 2012 年 6 月假瑞典首都斯多哥摩爾舉行。本次研討會主題為「朝向社會永續發展的混凝土結構物」，廣徵各界提供包括永續性混凝土結構物建築美學論述(Architectural and Aesthetical Issues for Sustainable Concrete Structures)、其他膠結材(Alternative Binders)、擷取溫室氣體(Carbon Dioxide Capturing)、碳化與溫室效應(Carbonation and Carbon Dioxide Uptake)、案例研究(Case Studies)、(綠)建築分類系統(Classification Systems, e.g., LEED)、混凝土結構物耐久性與永續性設計(Designing Concrete Structures for Durability and Sustainability)、耐久性(Durability)、生命週期成本與生命週期分析(LCC and LCA)、再利用(Recycling)、增進永續性之維修、恢復及升級方法(Repair, Renovation, and Upgrading for Improved Sustainability)、永續性混凝土材料(Sustainable Concrete Materials)、永續性混凝土鋪面(Sustainable Concrete Pavements)、永續性混凝土產製(Sustainable Concrete Production)、永續性混凝土結構物(Sustainable Concrete Structures)、熱循環與能源儲存(Thermal Mass and Energy Storage)及與本研討會相關(Miscellaneous)主題或性質之研究及實務論文。

參與本研討會將可吸取先進觀念與技術，提供日後結構工程規劃設計參考，並可提昇技術與品質，本報告將就參加前述國際性研討會目的、過程、心得及建議等作一簡要說明。

# 目次

第1章 前言	
1.1 主辦單位介紹.....	4
1.2 行程目的.....	5
第2章 行程紀要	
2.1 行程規劃.....	6
2.2 斯多哥摩爾日常生活及交通系統.....	7
第3章 研討會議	
3.1 會議時間地點.....	9
3.2 會議議程.....	9
3.3 會議主題摘要.....	12
3.4 會場展覽.....	15
3.5 技術參訪.....	15
第4章 心得與建議	
4.1 心得.....	17
4.2 建議.....	18
附錄一 “fib Symposium Stockholm 2012”參與成員(依姓氏排序)	
附錄二 “fib Symposium Stockholm 2012”詳細議程及分組論文題目	

# 第 1 章 前 言

## 1.1 主辦單位介紹

fib (原文“federation internationale du béton”，英譯 International Federation for Structural Concrete，國際結構混凝土學會) 是一個非營利社團，致力增進世界混凝土結構物之技術、經濟、美學及環境成效，fib 於促進混凝土之研究、提倡使用及發展上扮演重要角色。fib 主要工作之一為傳播資訊，此係透過出版技術品、印製季刊、舉辦研討會、授課及頒發獎項來達成該目標。

fib 的出版品包括：

(1)公報：fib 的主要活動之一為發展技術文件、製作最新報告、建議、指針及模組編碼，可洽 fib 秘書處取得超過 200 份公報及報告(包含 fib 的前身 CEB 及 FIP 出版品)，範圍遍及海事結構物、防火設計、品質管理及纖維強化混凝土等，可於官方網站 [www.fib-international.org/publications](http://www.fib-international.org/publications) 取得文件目錄。

(2)期刊與通訊：fib 官方期刊「結構混凝土(Structural Concrete)」刊載經審查的高品質論文，探討混凝土結構物之設計、施工及成效，並廣涉環境影響評估等議題，約有半數論文探討實務議題例如施工方法或特定專案研究，其餘則屬研究發展論文；官方通訊“fib-news”隨 fib 期刊同時出版，可於官方網站 [www.fib-international.org/journals](http://www.fib-international.org/journals) 取用電子檔。

fib 的活動包括：

(1)研討會：fib 團體會員每年規劃 1 至 2 場與混凝土結構物相關特定議題的研討會，均係國際性會議，促進混凝土設計創新思維，施工分析、討論及展示，下一次 fib 官方研討會訂於 2013 年假以色列特拉維夫舉行；此外，fib 國際土木工程博士論文研討會係每兩年舉行一次供博士候選人相互競逐的論壇，最近一次將於 2012 年 7 月假德國卡爾斯魯厄舉行。

(2)會員大會：fib 會員大會係指標性活動，每 4 年舉行一次，世界各地從業及研究人員聚集一堂，討論並呈現混凝土結構物各項議題，最近一次將於 2014 年 2 月假印度孟買舉行。

(3)課程及工作坊：fib 通常每年至少辦理一次短期課程、討論會及工作坊，係由 fib 專家領銜並針對小群、地域性及特定專業成員辦理，可自官方網站 [www.fib-international.org/events](http://www.fib-international.org/events) 取得近期活動資訊。

fib 的獎項：fib 的重要任務之一，係透過獎勵來鼓勵精進及創新，包括褒揚終身成就的 Medal of Merit 與 the Freyssinet Medal 獎項，每兩年一次表揚年輕工程師的 Achievement Award 獎項，及每四年一次用以肯定建築/土木工程結構物表現的 Award for Outstanding Concrete Structures 獎項。

## 1.2 行程目的

誠如本研討會開宗明義所揭櫫：「國際間密集持續討論全球暖化，並已聚焦在永續性發展，所以做出任何決定前都必須考慮對未來的影響。對於社會永續發展而言，混凝土具有雙重角色：(1)混凝土是最常使用的人工建材，與(2)混凝土具有較長生命週期，故於型塑混凝土結構物過程中儘量降低對於環境的影響乃是基本概念。

然而更重要的是善用並發展混凝土的優點，於結構物服務週期中發揮其潛能。藉由混凝土配比、結構尺寸最佳化及減少材料運輸，將有助於控制碳足跡；為能於服務週期中降低對環境的衝擊，應妥善考慮耐久性、儘量減少維護作業、善用熱循環、太陽能、降低運輸過程污染及溫室效應等因素。以整體而言，分析生命週期及其成本是重要的方法，並應將維護、修繕、強化、拆除及再利用等事項納入考量。」

期許藉由參與本研討會，汲取先進觀念與技術，提供日後結構工程規劃設計參考，並可提昇技術與品質。

## 第 2 章 行程紀要

### 2.1 行程規劃

於 101 年 3 月 21 日奉交下此一任務後，首先查詢得知持中華民國(臺灣)護照可免簽證入境瑞典，故確定護照效期 1 年以上即無疑義。雖然本次研討會官方網站亦建議膳宿地點，惟基於往日出席國際性研討會所累積經驗推測不易訂得膳宿(經查詢各主要飯店網站或委託旅行社代詢結果確已訂位客滿)，復以臺灣與瑞典之間尚無直飛航班必須轉機前往，並考量公假日數及經費節用等因素，爰經檢討後於同年 2 月 29 日提報本案出國計畫，並於同年 4 月 3 日奉復同意照辦如下：

當地時間	地點(時差)	主要行程或活動紀要
101 年 6 月 9 日	臺灣、香港 (±0)、(-0)	啟程→桃園國際機場 桃園國際機場→赤臘角國際機場
101 年 6 月 10 日	香港、芬蘭、瑞典 (-0)、(-5)、(-6)	赤臘角國際機場→赫爾辛基國際機場 赫爾辛基國際機場→阿蘭達國際機場 阿蘭達國際機場→斯多哥摩爾市區 研討會報到、熟悉交通動線及生活機能
101 年 6 月 11 日	斯多哥摩爾，瑞典 (Stockholm, Sweden)	開幕式、研討會第 1 天 (晚間)迎賓餐敘(參觀瓦薩沉船博物館)
101 年 6 月 12 日	斯多哥摩爾，瑞典 (Stockholm, Sweden)	研討會第 2 天 (晚間)遊河晚宴(另行收費，未克參加)
101 年 6 月 13 日	斯多哥摩爾，瑞典 (Stockholm, Sweden)	研討會第 3 天、閉幕式、相約 <u>特拉維夫</u>
101 年 6 月 14 日	瑞典、芬蘭 (-6)、(-5)	研討會第 4 天、技術參訪 斯多哥摩爾市區→阿蘭達國際機場 阿蘭達國際機場→赫爾辛基國際機場
101 年 6 月 15 日	芬蘭、香港、臺灣 (-5)、(-0)、(±0)	赫爾辛基國際機場→赤臘角國際機場 赤臘角國際機場→桃園國際機場 桃園國際機場→返程

## 2.2 斯多哥摩爾日常生活及交通系統

瑞典位處北歐地區，夏季終日無黑夜，即便晚間 10 時至凌晨 4 時，天空仍維持灰白色；斯多哥摩爾生活水平頗高，例如於便利商店內一根香蕉售價 8 SEK (瑞典克朗 SEK 為主要貨幣，約為 1 SEK=4.5 NTD 換算之)，至於一瓶 300 毫升還原柳橙汁則售價 22 SEK；私人車輛亦稱普及，路邊停車採預繳式自助收費，駕駛人可自行決定停車時段並於自動繳費機繳費取票後，置於車內以供識別。

熟悉斯多哥摩爾交通系統，有助於研討會期間掌握時間往返機場、研討會會場、參訪地點及下榻處。為快速往返阿蘭達國際機場與斯多哥摩爾市區，可搭乘機場快鐵(Arlanda Express，如圖 2.2.1)，單程票價為 260 SEK，行車時間約 20 分鐘；若時間寬裕，亦可搭乘機場接駁公車轉乘通勤電車(Commuter Trains，如圖 2.2.2)，總行車時間則約 2 個小時。



圖 2.2.1 機場快鐵(Arlanda Express)



圖 2.2.2 通勤電車(Commuter Trains)

至於市區交通，則由地鐵(Tunnel-banan，簡稱 T-bana，相當於市區捷運 Metro，如圖 2.2.3)、有軌電車(Tram，如圖 2.2.4)、幹線公車(如圖 2.2.5)及一般公車(如圖 2.2.6)所組成，電車與公車可以共線行駛，各種交通工具均採單一票價 20 SEK 上車收費，另有預儲式(3 日內或 7 日內)無限次搭乘之定期票卡可供選用。



圖 2.2.3 斯多哥摩爾地鐵(T-bana)車站外觀及電車



圖 2.2.4 有軌電車(Tram)



圖 2.2.5 幹線公車

圖 2.2.6 一般公車



## 第 3 章 研討會議

### 3.1 會議時間地點及參與成員

fib 擇訂 101 年 6 月 11 日至 14 日假瑞典斯多哥摩爾皇家工學院(KTH Royal Institute of Technology, 如圖 3.1.1)辦理本次年研討會(以下簡稱“fib Symposium Stockholm 2012”)。依據斯多哥摩爾皇家工學院簡介,該校係瑞典最大、歷史最悠久且最具國際性之科技大學,每年超過 300 萬歐元的教研經費、來自至少 100 個國家約 1 萬 7,000 名學生及 3,000 名僱員。該校教育及研究含括自然科學及工程領域,包括建築、工業管理及都市規劃,該校並主導著名的 EIT 歐洲知識與創新共同體 3 項計畫其中 2 項: InnoEnergy 計畫與 EIT ICT 實驗室計畫。



圖 3.1.1 瑞典斯多哥摩爾皇家工學院(KTH Royal Institute of Technology)

有關本次研討會各國家或地區參與成員,請詳參文末「附錄一」所列名單。

### 3.2 會議議程

本次研討會議程概要如下:

● 星期日(6 月 10 日)

下午 3 時至 5 時 30 分: 受理報到

●星期一(6月11日)

上午8時至9時：受理報到(如圖3.2.1)

上午9時至9時45分：開幕式(如圖3.2.2)、致歡迎詞(如圖3.2.3)、會員表揚



圖 3.2.1 研討會報到情形



圖 3.2.2 開幕式會場，籌辦單位瑞典混凝土學會 Johan Silfwerbrand 主席致詞



圖 3.2.3 皇家工學院 Peter Gudmundson 校長及 fib 現任 György L. Balázs 主席致詞

上午 9 時 45 分至 10 時 30 分：專題演講-1

上午 10 時 30 分至下午 5 時 30 分：分組研討會(含休息及午餐，如圖 3.2.4)

下午 7 時至下午 10 時 30 分：迎賓餐敘(地點：瓦薩沉船博物館，如圖 3.2.5)



圖 3.2.4 中場休息及午餐

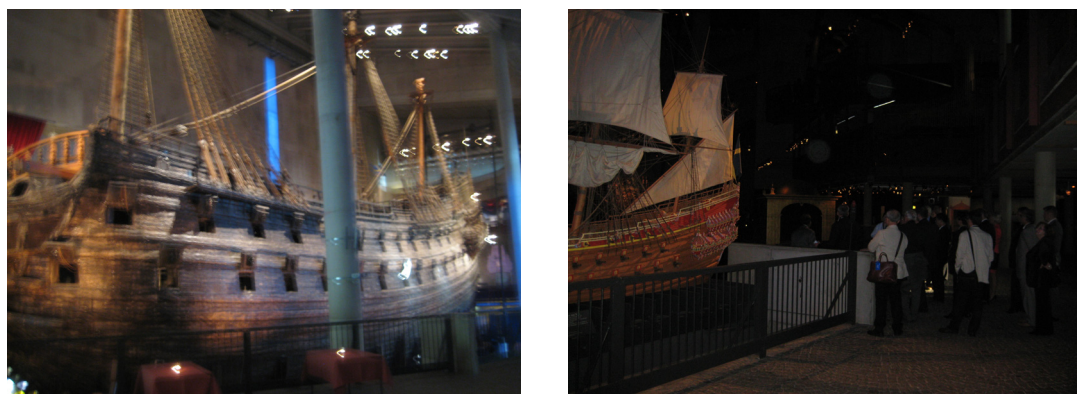


圖 3.2.5 迎賓餐敘地點：瓦薩沉船博物館(Vasa Ship Museum)及館內導覽

●星期二(6月12日)

上午 8 時至 9 時：受理報到

上午 9 時至 10 時 30 分：專題演講-2

上午 10 時 30 分至下午 5 時 30 分：分組研討會(含休息及午餐)

下午 6 時至下午 11 時：遊河晚宴(另行收費，未克參加)

●星期三(6月13日)

上午 9 時至下午 4 時 15 分：分組研討會(含休息及午餐)

下午 4 時 15 分至下午 5 時：閉幕式，相約 2013 年以色列特拉維夫再見

●星期四(6月14日)

上午8時至12時：技術參訪

(臨時增加)上午9時至12時30分：瑞典混凝土學會「永續混凝土施工」討論會

有關本次研討會議程總覽，請參考圖3.2.6。

### 3.3 會議主題摘要

本次研討會之會議主題為「朝向社會永續發展的混凝土結構物」“Concrete Structures for a Sustainable Community”，依據研討會接獲投稿論文分類如后：

- 混凝土結構物耐久性與永續性設計(Designing Concrete Structures for Durability and Sustainability)
- 增進永續性之維修、恢復及升級方法(Repair, Renovation, and Upgrading for Improved Sustainability)
- 永續性混凝土材料(Sustainable Concrete Materials)
- 耐久性(Durability)
- 熱循環、能源儲存及防火(Thermal Mass, Energy Storage and Fire Protection)
- 案例研究與專題(Case Studies and Aesthetical Issues)
- 碳化、溫室效應及再利用(Carbonation, Carbon Dioxide Uptake and Recycling)
- 永續性混凝土產製、形變及流動(Sustainable Concrete Production, Rheology and Flow)
- 生命週期成本與生命週期分析(LCC and LCA)
- 其他膠結材(Alternative Binders)
- 永續性混凝土結構物(Sustainable Concrete Structures)

茲擷錄本次研討會部分專題演講之摘要內容如后：

- (1)日本香川大學 Koji Sakai 教授主講“A New Concept Concerning Concrete Sustainability for a Sustainable Society”：

	June 10 Su	June 11 Mo	June 12 Tu	June 13 We	June 14 Th
8.00		Registration 8.00-9.00	Registration 8.00-9.00		
8.30					
9.00		Opening 9.00-10.30 Room Q1 Welcoming Addresses	Keynotes 9.00-10.30 Room Q1 Wairaven, Wight,	S19 Room Q1 Repair A 9.00-10.30	9.00-12.30 Room Q2 Seminar on Swedish Activities on Sustain- ability
9.30		Keynotes: Rönneberg, Sakai	Müller, Edwardsen	S20 Room Q2 Pavements	
10.00		Coffee 10.30-11.00	Coffee 10.30-11.00	S21 Room L1 Structures A	
10.30		S1 Room Q1 Designing A 11.00-12.45	S10 Room Q1 Designing D 11.00-12.45	S22 Room Q1 Repair B 11.00-12.45	
11.00		S2 Room Q2 Sust Mtrls A	S11 Room Q2 Sust Mtrls D	S23 Room Q2 Durability B	
11.30		S3 Room L1 Cases & Aesthetics A	S12 Room L1 LCC & LCA	S24 Room L1 Structures B	
12.00		Lunch 12.45-14.00	Lunch 12.45-14.00	Lunch 12.45-14.00	
12.30					
13.00					
13.30					
14.00		S4 Room Q1 Designing B 14.00-15.45	S13 Room Q1 Designing E 14.00-15.45	S25 Room Q1 Repair C 14.00-15.45	
14.30		S5 Room Q2 Sust Mtrls B	S14 Room Q2 Durability A	S26 Room Q2 Durability C	
15.00	Registration 15.00-17.30	S6 Room L1 Carbon & Recycling	S15 Room L1 Alternative & Binders	S27 Room L1 Structures C	
15.30					
16.00		Coffee 15.45-16.15	Coffee 15.45-16.15	Coffee 15.45-16.15	
16.30		S7 Room Q1 Designing C 16.15-17.30	S16 Room Q1 Designing F 16.15-17.30	Closing 16.15-17.00 Invitations to Tel Aviv & Mumbai	
17.00		S8 Room Q2 Sust Mtrls C	S17 Room Q2 Energy & Fire		
17.30		S9 Room L1 Production	S18 Room L1 Cases & Aesthetics B		
18.00			Banquet in Vaxholm 18.30-23.00 18.30 boat departure from Nybrokajen, Stockholm 23.00- transport by bus to Stockholm		
18.30		Reception at Vasamuseet 19.00-22.30			
19.00					
19.30					
20.00					
20.30					
21.00					
21.30					
22.00					
22.30					

### SYMPOSIUM MAIN TOPICS

- **Designing** concrete structures for durability & sustainability
  - **Repair**, renovation, and upgrading for improved sustainability
  - **Sustainable concrete materials**
  - **Durability**
  - Thermal mass, **energy storage & fire protection**
  - **Case studies & aesthetic** issues
- **Carbonation** and carbon dioxide uptake & **recycling**
  - Sustainable concrete **production**, rheology & flow
  - **LCC & LCA**
  - **Alternative binders**
  - Sustainable concrete **structures**

圖 3.2.6 研討會議程總覽

本篇論文綜覽使環境日益沉重的各種根源，並指出以科技減輕環境負擔的研發方向，且載述混凝土與營造業導入永續發展概念的重要性，以期實現永續社會。然而，結構安全與環境負擔之間的衝突，與社會永續性息息相關，除舉日本福島地震為例加以討論外，並提出未來應該努力的方向與目標。

(2)美國混凝土學會(ACI)副執行長 Ronald G. Burg 專業工程師主講“American Activities towards Development of a Unified Front to Advance Concrete Sustainability and Resilience”：

透過倡議永續性概念，美國混凝土學會支持考量經濟、社會及環境平衡之永續性準則應用於混凝土設計、材料及施工，致力發現並移除各種障礙以利採行更有永續性概念的混凝土實務、技術、標準及規範，於混凝土產業中提升認知並尋求支持以增進永續性實務及設計。本篇論文記述本學會對於混凝土永續性發展的歷史，並就混凝土永續使用提出現在與未來的倡議方向。

(3)德國 VDZ 公司 Christoph Müller 博士主講“A New Concept Concerning Concrete Sustainability for a Sustainable Society”：

永續性發展，依據聯合國 1987 年 World Commission on Environment and Development 定義，乃「達成現況需求且未妥協新世代具有能力達成其需求的一種發展方向」，個中涵括了保護環境的重要概念。然而，環境只是永續性議題的其中一個面向，其他尚有經濟、科技及社會等面向，歐洲營造產品規章 (CPR)包含了營造工項基本要求(BWR)即衛生、健康及環境，並新進引入自然資源永續性利用的概念。依據 CPR 的要求，耐久性也成為 BWR 的要求。本篇論文展示當下潮流如何影響環境產品宣言(EPDs)所涵蓋水泥與混凝土參數，以產出更少雜質的水泥供給使用，並展示這些 EPDs 參數如何影響辦公室大樓的永續性評估，本論文亦討論於製造水泥或產製耐久性混凝土過程中，如何達成溫室氣體減量。

(4)其他論文：因內容繁多，特將各篇論文題目依研討會順序列示於文末「附錄二」供參考。

### 3.4 會場展覽

本次研討會亦邀請廠商贊助及提供會場參展攤位(如圖 3.4.1)，其中不乏曾經參與本局工程的相關專業廠商，另有廠商提供混凝土鋪面掃紋機實機參展及播放操作影片(如圖 3.4.2)，可供未來道路工程應用參考。



圖 3.4.1 展覽會場



圖 3.4.2 混凝土鋪面掃紋機

### 3.5 技術參訪

#### (1) 斯多哥摩爾市區鐵道下地計畫(City-banan)

斯多哥摩爾市區鐵道系統完整，提供通勤民眾往來便利，卻也大幅佔據都市土地不利整體規劃發展，瑞典政府為此持續投入經費，預計於西元 2017 年開始將穿越斯多哥摩爾市區的幹線鐵路分批下地；本項計畫沿途路線經過市區及教堂、學校下方，必須注意控制震動、擾動、保護既有建築物及限定施工時間，至

於過河段則採用預鑄箱涵下沉工法搭配兩端築島施作地下箱涵，銜接貫通行車路廊，施工團隊並透過各種媒體及管道定期向社會大眾公布說明該計畫執行進展。本行程安排了簡報、技術交流及現地參訪，如圖 3.5.1。

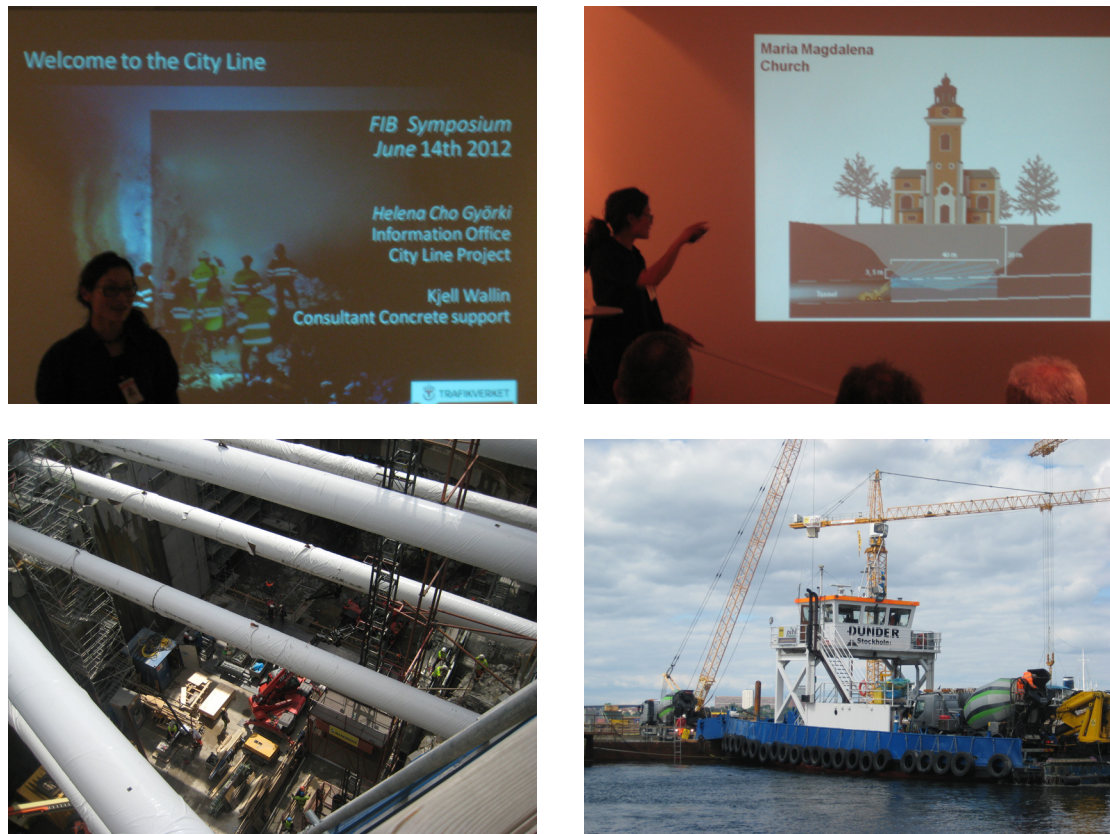


圖 3.5.1 技術參訪：斯多哥摩爾市區鐵道下地計畫

(2) 【研討會中建議自行參訪】巨蛋天景(Ericsson Globe and Sky View)

巨蛋天景係通訊業巨擘易利信公司建立企業識別暨配合瑞典政府主辦世界奧運所建造球形多功能表演會場，外掛纜車供全覽斯多哥摩爾市區，如圖 3.5.2。



圖 3.5.2 巨蛋天景(Ericsson Globe and Sky View)



## 第 4 章 心得與建議

### 4.1 心得

有關土木工程(Civil Engineering)一詞，其中 Civil 泛指民生所需，舉凡食衣住行育樂均屬之，而 Engineering 係為解決問題所採取的方法總成，所以土木工程係為解決民生問題而存在；然而，隨著社會愈益進化，民生需求層次及量能不斷提升，更多的社會及環境資源投入其中，也使地球環境日漸險峻。

早期的社會，吾人藉由預測民生需求而投入工程建設，且直接計算完工所需費用，並未相對注重項建設完工後營運過程所需維護經費或拆除成本，例如日本明石大橋是世界最長的跨海懸索橋，然而通車迄今相對偏高的通行費，促使民眾斟酌調整橫越海峽方式(搭乘渡輪或自行駕車)，導致明石大橋營運單位極度沉重的財務負擔，可為殷鑒；如今，工程界已倡議應以生命週期觀點來審視所需經費並進行分析(Life Cycle Cost and Life Cycle Analysis)，在相同服務年限及水準下，儘量採用替代材料或降低用量以降低成本，相同的概念亦於綠建築發揚光大，除善用替代建材外，亦設法儲存太陽熱能，於日常生活中落實自然能源循環再生，減緩耗用自然資源並有助於減低環境負擔。

經過本次研討會主軸「社會永續發展」觀念的洗禮，更能深刻瞭解水泥混凝土這個土木工程界至為熟悉的人工複合材料，對於自然環境的影響有多深遠。對於水泥混凝土相關規範，當不再以結構安全為唯一訴求，而應同時對於使用水泥混凝土所涉溫室效應控制、混凝土結構物耐久性與永續性、結構物生命週期成本分析、材料及能源之儲存再利用、結構物維護、修復及拆除、水泥混凝土配比、產製及運輸等議題，均應以永續性觀點加以檢討。未來除了替代水泥混凝土建材的相關研究希能有所突破外，亦期許所有工程人員導正觀念，從以往「人定勝天」昇華為未來「人與自然和平共處」，將「社會永續發展」理念融入水泥混凝土結構物從可行性研究、規劃設計、施工及營運維護的各個階段，落實善盡土木工程人員的社會責任。

## 4.2 建議

- (1)加強國際參與：出席本次研討會過程，確實感受歐美學界與實務界相當熱衷討論混凝土結構物融入社會永續發展概念相關議題，並將逐步導入各項規範及於產業界宣導配合，如此積極的社會態度，相信必然穩坐引領世界各國水泥混凝土規範的尖端角色；對照國內的規範引用，多以官方(中華民國國家標準、各部會或各工程主辦機關)規範為主，學界所訂規範為輔，至產業界參與或響應的程度不若歐美日來得熱衷。當然經濟規模及產業文化各有不同，惟若本土的水泥混凝土相關規範想要急起直追，至少應多方瞭解歐美學界的討論議題，例如此次日韓就派出相當人數參與此次研討會，建議我國政府應該重視。
- (2)增進語文能力：本次奉派參與歐美地區研討會，為期順利於規定時限內往返及全程參與相關討論，無論在航班、交通、膳宿及研討會議程方面，均利用公餘時間透過網際網路查詢相關訊息，俾使行程順遂；第一次隻身前往北歐地區，雖然不懂芬蘭語或瑞典話，尚可以簡單英文加以溝通並融入當地生活，一同趕搭公車上、下班及購買日用品，惟與研討會專業學者面對面交談及討論過程，深切感受自身語言能力仍待加強，值此政府提倡國際化及身為地球村成員之際，持續增進國際交流及語文能力乃是刻不容緩應即起身力行的工作。
- (3)公共政策或建設計畫評估過程均應納入社會永續發展理念並給予驗證：在技術參訪過程得知，瑞典政府對於斯多哥摩爾市區幹線鐵路下地的政策及預算編列，歷經各次政府改選均能持續執行不間斷，不禁對於從政者宏觀視野及延續民生政策的胸襟給予佩服與肯定；國內目前對於公共政策或建設計畫，均要求進行價值工程或財務計畫分析，已經含有永續發展的概念，建議未來從評估、建設到營運的各個過程，無論發包文件的研訂或技術規範的增修，均應無時無刻相互提醒儘量納入永續發展理念，畢竟好的民生政策或土木工程都必須靠時間來證明其合理性及存在的必要，當前政府財政捉襟見肘，人民稅收更應審慎使用，誠摯建議在做出任何決定前都應充分思考討論，方為國家社會之福。

附錄一 “fib Symposium Stockholm 2012”參與成員(依姓氏排序)



**fib Symposium**  
**STOCKHOLM 2012**  
11-14 June 2012  
Royal Institute of Technology (KTH)  
Stockholm, Sweden



<b>Lastname</b>	<b>Firstname</b>	<b>Company</b>	<b>Country</b>
Abd Elrahman	Mohamed	TU Berlin	Germany
Achmad Lubis	Kandali	PT. Penta Chemicals Indonesia	Indonesia
Adistrayana	Kadek	PT. Penta Chemicals Indonesia	Indonesia
Agaajani	Shahriar	Universite Du Luxembourg	Luxemburg
Ahmed	Lamis	KTH Concrete Structures	Sweden
Aïtcin	Pierre-Claude	Sherbrooke University	Canada
Ajdukiewicz	Andrzej B.	Silesian University of Technology	Poland
Albrektsson	Joakim	SP Technical Research Institute of Sweden	Sweden
Alimchandani	Chander	STUP Consultants Pvt. Ltd	India
Al-Jabri	Khalifa	Sultan Qaboos University	Oman
Almeida	João	DECivil	Portugal
Almoussa	Anas	High Commission for the Development of Arriyadh	Saudi Arabia
Alvarsson	Yngve	Formconsult AB	Sweden
Ansell	Anders	KTH Concrete Structures	Sweden
Araki	Hideo	Hiroshima University	Japan
Arora	Vir Vikram	National Council for Cement and Building Material	India
Assam	Peter	A/S Skandinavisk Spændbeton	Denmark
Astiz	Miguel	Carlos Fernández Casado S.L.	Spain
Aurelio	Muttoni	EPFL ENAC IIC IBETON	Switzerland
Bager	Dirch H.	DHB-Consult	Denmark
Bairán García	Jesús	Universitat Politècnica de Catalunya	Spain
Balázs	György L.	Fib - International Federation for Structural Concrete	Switzerland
Bastien	Josee	Universite Laval	Canada
Bernat	Antonio	Universitat Politècnica de Catalunya	Spain
Bevc	Lojze	Slovenian National Building and Civil Engineering	Slovenia
Biliszczuk	Jan	Wroclaw University of Technology	Poland
Blanksvärd	Thomas	Luleå University of Technology	Sweden
Boehme	Luc	KHBO - IW&T	Belgium
Bohner	Edgar	Karlsruhe Institute of Technology (KIT), IMB	Germany
Boonen	Elia	Belgian Road Research Center	Belgium
Borderon	Alexis	Valbruna	Italy
Boutillon	Laurent	VINCI Construction Grands Projets	France
Braestrup	Mikael	Ramboll	Denmark
Bryne	Lars Elof	KTH Concrete Structures	Sweden
Burg	Ronald	American Concrete Institute	USA
Bzeni	Dallshad	University of Salahaddin	Iraq
Cailleux	Emmanuel	BBRI - Belgian Building Research Institute	Belgium
Calgaro	Jean	Ministry of Environment	France
Cervenka	Jan	Cervenka Consulting Ltd	Czech Republic
Cervenka	Vladimir	Cervenka Consulting Ltd	Czech Republic
Chang	Yu-Chao	National Expressway Engineering Bureau, MOTC	Taiwan
Chrysostomou	Christis	Cyprus University of Technology	Cyprus

Clark	Gordon	Ramboll	United Kingdom
Claßen	Martin	Institut für Massivbau (IMB), RWTH Aachen	Germany
Corres	Hugo	FHECOR INGENIEROS	Spain
Cremer	Jean-Marie	Bureau d'Études Greisch SA	Belgium
Croitoru	George	Cosmote RMT SA	Romania
Curbach	Manfred	Technische Universität Dresden	Germany
Cwirzen	Andrzej	Aalto University	Finland
D'Aloia			
Schwartzentruber	Laetitia	CETU/MEDDTL	France
Dancygier	Avraham	Faculty of Civil & Env. Engineering, Technion-IIT	Israel
de Boer	Ane	RWS Centre for Infrastructure	Netherlands
Deges	Yulianhart	PT. Penta Chemicals Indonesia	Indonesia
Del Pozo Vindel	Florencio	Proes Consultores, SA	Spain
Dencsak	Tamas	University of Timisoara	Romania
Destree	Xavier	Xavier Destree Ltd	Belgium
di Prisco	Marco	Politecnico di Milano _ DIS	Italy
Doi	Toshihiko	Japan Bridge Engineering Center	Japan
Du	Guangli	Royal Institute of Technology (KTH) Stockholm	Sweden
Duan	Zhenhua	The Hong Kong Polytechnic University	China
Edwards	Ylva	CBI Swedish Cement and Concrete Research Institute	Sweden
Edvardsen	Carola	COWI A/S	Denmark
Ekblom	Jan	Omya OY	Finland
Elfgren	Lennart	Luleå University of Technology	Sweden
Eriksen	Kirsten	COWI A/S	Denmark
Faleschini	Flora	Università degli Studi di Padova	Italy
Feng	Dabin	China Academy of Building Research	China
Fennis	Sonja	Delft University of Technology	Netherlands
Ferreira	Luís	Universidade de Coimbra,	Portugal
Fjällberg	Leif	CBI Swedish Cement and Concrete Research Institute	Sweden
Flansbjer	Mathias	SP Technical Research Institute of Sweden	Sweden
Flisell	Henry	SSAB Merox AB	Sweden
Foster	Stephen	The University of new South Wales	Australia
Fröhlich	Susanne	Universität Kassel	Germany
Fujimoto	Masaki	UBE INDUSTRIES,LTD.	Japan
Gallwoszus	Joerg	RWTH Aachen, Institute of Structural Concrete	Germany
Ganz	Hans-Rudolf	VSL (International) Ltd.	Switzerland
Glad	Karin	CBI Swedish Cement and Concrete Research Institute	Sweden
Gomes	Alexandre	EDP	Portugal
Grist	Ellen	Ramboll UK	United Kingdom
Groli	Giancarlo	COMSA, S.A.U.	Spain
Gylltoft	Kent	Chalmers University of Technology	Sweden
Habert	Guillaume	IFSTTAR	France
Hackbarth	Britta	Hamburg University of Technology	Germany
Hajek	Petr	CVUT in Prague	Czech Republic
Hallgren	Mikael	KTH Concrete Structures	Sweden
Hamouz	Jan	CTU in Prague, Faculty of Civil Engineering	Czech Republic
Hansson	Lars	CEMEX AB	Sweden
Hansson	Håkan	KTH Concrete Structures	Sweden
Hayashi	Katsuhiko	Oriental Consultants Co.Ltd	Japan
Hayek	Carol	CCL	USA
Hedayatnasab	Arastoo	Kingston University London	United Kingdom

Heiberg	Siri	HRC Europe	Norway
Helland	Steinar	Skanska	Norway
Helsing	Elisabeth	Trafikverket	Sweden
Holowaty	Janusz	ZUT in Szczecin	Poland
Holt	Erika	VTT Technical Research Centre of Finland	Finland
Hooton	R. Doug	University of Toronto	Canada
Horiuchi	Tatsuto	P.S.Mitubishi Construction Co.,Ltd.	Japan
Hrnciar	Lubomir	VAHOSTAV-SK, a.s.	Slovakia
Hult	Patrik	CBI Swedish Cement and Concrete Research Institute	Sweden
Ikeda	Shoji	Hybrid Research Institute Inc.	Japan
Jeyasehar	Antony Subhashchandra	Annamalai University	India
Joglekar	Govind	STUP Consultants Pvt. Ltd	India
Jones	Allen	South Dakota State University	USA
Jung	Bastian	Bauhaus-Universität Weimar	Germany
Kaiser	Thomas	HRC Europe	Norway
Kalny	Milan	Pontex Ltd	Czech Republic
Kang	Won Hyeok	VSL Korea	Korea
Kanstad	Terje	NTNU	Norway
Kasuga	Akio	Simitomo Mitsui Construction	Japan
Kawai	Kenji	Hiroshima University	Japan United Arab Emirates
Kilada	Ihab	CCC	Emirates
Kim	Jin-Keun	KAIST	Korea
Kim	Hong Jin	Korea Expressway Corporation	Korea
Kinnunen	Jorma	Peikko Group Corporation	Finland
Kinoshita	Mitsuo	Takemoto Oil and fat Co.,Ltd.	Japan
Klein	Jean-Francois	T ingénierie sa	Switzerland
Klein	Gary	Wiss, Janney, Elstner Associates, Inc.	USA
Kluszczewicz	Alina	Silesian University of Technology	Poland
Kohl	Matthias	TU Hamburg-Harburg	Germany
Kohoutková	Alena	Czech Technical University	Czech Republic
Komura	Yutaka	P.S.Mitsubishi Construction Co.,Ltd	Japan
Kondou	Takuya	West Japan Railway Company	Japan
Kristensen	Dennis	Structural Design Software in Europe AB / StruSoft	
Krohn	Jason	Precast/Prestressed Concrete Institute	USA
Kuilboer	Cor	Ministry of Infrastructure and the Environment	Netherlands
Lagerblad	Björn	CBI Swedish Cement and Concrete Research Institute	Sweden
Lahdensivu	Jukka	Tampere University of Technology	Finland
Lang	Karin	Ernst & Sohn	
Lebrun	Marc	FIB - CERIB	France
Leivestad	Steinar	Norconsult/Standards Norway	Norway
Liang	Cunzhi	China Academy of Building Research	China
Licht	Poul	Omya AB	Sweden
Lichter	Elisabeth	VSL International	
Lindqvist	Jan Erik	CBI Swedish Cement and Concrete Research Institute	Sweden
Lindström	Gösta	Strängbetong	Sweden
Lindvall	Anders	Thomas Concrete Group	Sweden
Lionel	Linger	VINCI Construction Grands Projets	France
Ljungkrantz	Christer	Cementa AB	Sweden
Madaras	Gábor	ÉMI-TÜV SÜD Ltd.	Hungary
Magyar	János	A-HÍD ÉPÍTŐ ZRT.	Hungary

Malaga	Katarina	CBI Swedish Cement and Concrete Research Institute	Sweden
Mancini	Giuseppe	Politecnico di Torino	Italy
Margoldova	Jana	Beton TKS	Czech Republic
Martius-Hammer	Tor Arne	SINTEF Byggforsk	Norway
Masa	Peter	VAHOSTAV-SK, a.s.	Slovakia
Matos	Jose	Minho University	Portugal
Matsumoto	Norihito	Kawada Construction Co. Ltd.	Japan
May	Andreas	Universite Du Luxembourg	Luxemburg
McCarthy	Richard	Swedish Concrete Association	Sweden
Meinel	Maria	BAM Federal Institute for Materials Research	Germany
Merta	Ildiko	University of Technology Vienna	Austria
Minne	Peter	KaHo Sint-Lieven	Belgium
Misumi	Tetsuya	Fuji P.S Corporation	Japan
Mittelstädt	Jan	University of Stuttgart - ILEK	Germany
Miyagawa	Toyo	Kyoto University	Japan
Miyauchi	Katsuyuki	Fukuyama University	Japan
Morales	Gustavo	KTH Concrete Structures	Sweden
Moreno	Carlos	IPB	Switzerland
Moussard	Michel	Arcadis	France
Mueller	Urs	CBI Swedish Cement and Concrete Research Institute	Sweden
Mueller	Florian V.	Holcim Group Support Ltd	Switzerland
Müller	Harald S.	Karlsruhe Institute of Technology (KIT), IMB	Germany
Müller	Christoph	VDZ gGmbH	Germany
Nakata	Joji	Abe Nikko Kogyo Co. Ltd	Japan
Nan	Jianlin	China Academy of Building Research	China
Negro	Paolo	European Commission	Italy
Nicolaidis	Demetris	Frederick Research Center	Cyprus
Nilimaa	Jonny	Luleå University of Technology	Sweden
Nilsson	Martin	Luleå University of Technology	Sweden
Nishiyama	Minehiro	Kyoto University	Japan
Nishizaki	Takeyoshi	OSAKA GAS CO.,LTD.	Japan
Niwa	Junichiro	Tokyo Institute of Technology	Japan
Nozaki	Hiroshi	VSL Japan Corporation	Japan
Ogawa	Yuko	Hiroshima University	Japan
Ohkuma	Hikari	Taisei Corporation	Japan
Ohlsson	Ulf	Luleå university of technology	Sweden
Olsen	Tor Ole	Dr.techn.Olav Olsen	Norway
Onysyk	Jerzy	Wroclaw University of Technology	Poland
Orr	John	University of Bath	United Kingdom
Ortiz Lozano	Jose Angel	Universidad Autonoma De Aguascalientes	Mexico
Papworth	Frank	BCRC	Australia
Park	Hong-Gun	Seoul National University	Korea
Parra-Montesinos	Gustavo	University of Michigan	USA
Perez	Alejandro	FHECOR	Spain
Petrou	Michael	University of Cyprus	Cyprus
Pettersson	Dan	WSP Byggprojektering	Sweden
Pielstick	Brett	Elsman & Russo	USA
Pirringer	Stephan	Vienna University of Technology	Austria
Pries	Frens	Betonvereniging	Netherlands
Psaltis	Arthur	Pritchard Francis Pty Ltd	Australia
Pucek	Richard	VAHOSTAV-SK, a.s.	Slovakia

Punkki	Jouni	Parma Oy	Finland
Ramezaniapour	Ali akbar	Amirkabir University	Iran
Redha	Samir	City of Stockholm/Traffic Administration	Sweden
Rehn	Paul	Structural Design Software in Europe AB /StruSoft	Sweden
Roeth	Dr. Hans-Werner	Omya International AG	Switzerland
Roots	Peter	AB Strängbetong	Sweden
Rougeau	Patrick	FIB - CERIB	France
Rousseau	Jane	VSL International	Switzerland
Ruzicka	Jakub	CTU in Prague	Czech Republic
Rübner	Katrin	BAM Federal Institute for Materials Research	Germany
Rydell	Cecilia	KTH Concrete Structures	Sweden
Rüdiger	Birgit	Ernst & Sohn	Germany
Rønneberg	Hanne	SINTEF	Norway
Safi	Mohammed	KTH	Sweden
Saito	Kimio	Kajima Corporation	Japan
Sakai	Koji	Kagawa University	Japan
Sandeford	Paul	GHD Pty Ltd	Australia
Sandelin	Stefan	Cementa AB	Sweden
Sarker	Prabir	Curtin University	Australia
Satou	Michio	Electric Power Development Co., Ltd	Japan
Sawabe	Norihiko	UBE INDUSTRIES,LTD	Japan
Schumacher	Petra	Fib - International Federation for Structural Concrete	Switzerland
Schwoon	Oliver	Sika Services AG	Switzerland
Seong	Joo Yeob	Korea Expressway Corporation	Korea
Shim	Byul	VSL Korea	Korea
Sigrist	Viktor	Hamburg University of Technology	Germany
Silfwerbrand	Johan	CBI Swedish Cement and Concrete Research Institute	Sweden
Simon	Csaba	FH Kärnten Gem. PS	Austria
Sruma	Vlastimil	Czech Concrete Society	Czech Republic
Strauss	Alfred	University	Austria
Stucchi	Fernando	EGT / USP Polytechnic School	Brazil
Sykora	Miroslav	Czech Technical University in Prague, Klokner Ins	Czech Republic
Söderquist	Ann-Thérèse	CBI Swedish Cement and Concrete Research Institute	Sweden
Taerwe	Luc	Ghent University - Magnel Lab	Belgium
Tahershamsi	Mohammad	Chalmers University of Technology	Sweden
Takatsu	Hiroto	Takenaka Corporation	Japan
Takaya	Satoshi	Kyoto University	Japan
Takita	Motohiro	Shutoko Engineering Company Ltd.	Japan
Tanaka	Hirokazu	SHIMIZU Corporation	Japan
Tantipidok	Patarapol	Tokyo Institute of Technology	Japan
Theodosiou	Kyriakos	Cement & Concrete Institute	South Africa
Thommen-Vidale	Laura	Fib - International Federation for Structural Concrete	Switzerland
Thybo	Anna Emilie A.	Technical University of Denmark	Denmark
Tripathi	Bhavna	Malaviya National Institute of Technology Jaipur	India
Trägårdh	Jan	CBI Swedish Cement and Concrete Research Institute	Sweden
Turmo	Jose	UPC BarcelonaTech	Spain
Tyler	Chris	Pritchard Francis Pty Ltd	Australia
Walraven	Joost	TU Delft	Netherlands
Van Gysel	Ann	Lessius University College, Campus de Nayer	Belgium
Wasner	Jens	Hamburg University of Technology	Germany
Watanabe	Fumio	Takenaka Corporation	Japan



Vecchio	Frank	University of Toronto	Canada
Wehbe	Nadim	South Dakota State University	USA
Velasco	Francisco	Ernst & Sohn	
Wight	James	University of Michigan	USA
Wimmer	David	Vienna University of Technology	Austria
Vimmr	Vaclav	STU-K, a.s.	Czech Republic
Vitek	Jan	Metrostav a.s.	Czech Republic
Vogel	Thomas	ETH Zurich	Switzerland
Yamaga	Yoshihiro	Shinko Wire Company Ltd.	Japan
Yamamoto	Takashi	Kyoto University	Japan
Yamashita	Kazunori	Kyokuto Kogen Concrete Shinko Co, Ltd.	Japan
Yamazaki	Jun	Nihon University	Japan
Yonezawa	Toshio	Research Institute, Takenaka Corporation	Japan
Yun	Hyun Do	Chungnam National University	Korea
Zandi Hanjari	Kamyab	CBI Swedish Cement and Concrete Research Institute	Sweden
Öberg	Mats	NCC Construction Sverige AB	Sweden

附錄二 “fib Symposium Stockholm 2012”詳細議程及分組論文題目

# SYMPOSIUM STOCKHOLM 2012

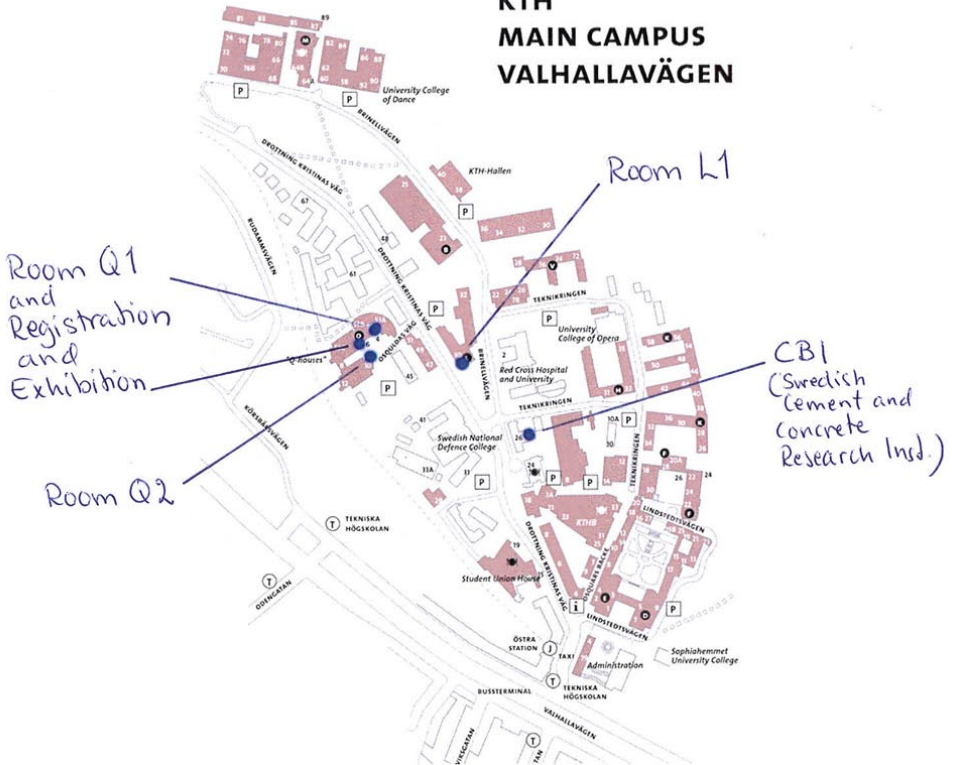
## Detailed Program



### Concrete Structures for Sustainable Community



# KTH MAIN CAMPUS VALHALLAVÄGEN



Osquldas väg 4:  
Registration  
Room Q1  
Exhibition  
Restaurang Q

Osquldas väg 6:  
Room Q2

Drottning Kristinas väg 30:  
Room L1

Drottning Kristinas väg 26:  
CBI (Swedish Cement and Concrete Research Institute)

## **Monday, June 11**

### **OPENING SESSION**

9.00 – 10.30 Room Q1

Session chair: Prof. Johan Silfwerbrand (SE)

#### *Welcome addresses*

Prof. Peter Gudmundson, President, KTH Royal Institute of Technology, Stockholm (SE)

Prof. György L. Balázs, President fib

#### *Presentation of fib Honours*

Prof. György L. Balázs, fib

#### *Keynote lectures:*

Prof. Koji Sakai, Kagawa University (JP)

#### **A New Concept concerning Concrete Sustainability for a Sustainable Society**

Dr. Hanne Rønneberg, Executive Vice President, SINTEF Building and Infrastructure, Trondheim (NO)

#### **Concrete in a Sustainable Society – A Holistic Approach**

---

## **Monday, June 11**

### **DESIGNING CONCRETE STRUCTURES – A (Session 1)**

11.00 – 12.45 Room Q1

Session Chair: Andrzej Ajdukiewicz (PL)

Patarapol Tantipidok, Koji Matsumoto, Ken Watanabe & Junichiro Niwa (JP)

#### **Experimental Investigation of Diagonal Compression Failure for High-Strength Concrete Beams with Wide Stirrup Spacing**

Mikael Hallgren (SE)

#### **Sustainable design of concrete slabs supported by steel edge and corner columns**

Ali Akbar Ramezani-pour, Ehsan Jahangiri, Babak Ahmadi & Faramarz Moodi (IR)

#### **Evaluation and Modification of the fib Service-Life Design Model for the Persian Gulf Region**

Milan Holický, Miroslav Sýkora (CZ)

#### **Probabilistic Design of Concrete Structures for Durability**

Edgar Böhner, Harald S. Müller (DE)

#### **Prediction Model for Concrete Cover Cracking due to Corrosion of Reinforcement**

---

## **SUSTAINABLE CONCRETE MATERIALS – A (Session 2)**

11.00 – 12.45 Room Q2

Session chair: Marco di Prisco (IT)

Terje Kanstad, Mette Rica Geiker, Giedrius Zirgulis & Elena Vidal Sarmiento (NO)

**Flowable Fibre Reinforced Concrete: Materials development, fibre distribution and structural properties**

Lars Elof Bryne & Anders Ansell (SE)

**Laboratory testing of the bond strength between shotcrete and rock**

Seong-Cheol Lee, Jung-Hwan Oh, Da-Hye Min & Jae-Yeol Cho (KR)

**Monotonic and Cyclic Tensile Behaviour of Steel Fibre Reinforced Concrete**

---

## **CASE STUDIES AND AESTHETICAL ISSUES – A (Session 3)**

11.00 – 12.45 Room L1

Session chair: Fernando Stucchi (BR)

John Orr, Antony Darby, Tim Ibell & Mark Evernden (UK)

**Fabric formwork for ultra high performance fibre reinforced concrete structures**

Maria F. Serrano-Guzmán, Diego D. Pérez-Ruiz & Juan-S. Ferreira-Diaz (CO)

**Paving blocks prepared with debris: Alternative for low-traffic roads**

Aurelio Muttoni, Franco Lurati & Miguel Fernández Ruiz (CH)

**Concrete shells: time for reappraisal – Case study of a 93 meter-span shell in sprayed con-crete**

Chris Tyler (AU)

**Adding 18 Storeys on Top of an Existing 10 Storey Building: A Case Study into Sustainable Development**

Xavier Destrée (BE) & Johan Silfwerbrand (SE)

**Steel Fibre Reinforced Concrete in Free Suspended Slabs: Case Study of the Swed-bank Arena in Stockholm**

---

## **DESIGNING CONCRETE STRUCTURES – B (Session 4)**

14.00 – 15.45 Room Q1

Session chair: João Almeida (PT)

Britta Hackbarth & Viktor Sigrist (DE)

**Extending Service Life of a Structure through In-depth Shear Assessment**

Jens Wasner & Viktor Sigrist (DE)

**Computation of Crack-Control for Durable Quay Structures**

Günter Rombach & Matthias Kohl (DE)

**Fatigue Strength of Concrete Members without Web Reinforcement**

Richard Malm & Anders Ansell (SE)

**Crack formation in two segmentally constructed balanced cantilever box-girder bridges**

Raphael M. Souza, Guilherme S. Melo & Ronaldo B. Gomes (BR)

**Punching in reinforced concrete flat slabs with holes adjacent to the column**

Jan L. Vitek, Robert Brož & Alexandr Tvrz (CZ)

**Construction of the network arch bridge in Prague**

---

**SUSTAINABLE CONCRETE MATERIALS – B (Session 5)**

14.00 – 15.45 Room Q2

Session chair: Andrea Prota (IT)

Carlo Pellegrino & Flora Faleschini (IT)

**Experimental Investigation on RC Beams containing Slag as Recycled Aggregate**

S.A.A.M. Fennis, S. Grünwald, J.C. Walraven & J.A. den Uijl (NL)

**Influence of Particle Packing Density on the Rheology of Low Cement Content Concrete**

Hyun Do Yun, Chang Sik Choi, Young Jae Song, Seok Jun Jang & Zhong Jie Yu (KR)

Keitetsu Rokugo (JP)

**Freeze-Thaw Effect on the Flexural Behaviour of Plain Concrete Beams with a Layer of Sustainable Strain-Hardening Cement Composite (2SHCC)**

Toshio Yonezawa, Etsuo Sakai, Kiyoshi Koibuchi & Mitsuo Kinoshita (JP)

**High-Slag Cement and Structures for Substantial Reduction of Energy CO<sub>2</sub>**

Norbert Randl & Csaba Simon (AT)

**Monotonic and Cyclic Loading of High Performance Concrete Members with High Strength Reinforcement**

---

**CARBONATION AND CARBON DIOXIDE UPTAKE & RECYCLING (Session 6)**

14.00 – 15.45 Room L1

Session chair: Harald S Müller (DE)

Corneliu Bob, Tamas Dencsak and Ionel Balcu (RO)

**Tests for the determination of carbon dioxide uptake by concrete carbonation**

Björn Lagerblad (SE)

**Carbon dioxide capture-rate and mode of carbonation**

Andrzej Ajdukiewicz & Alina Kliszczewicz (PL)

**Structural Recycled Aggregate Concrete - Instantaneous and Long-Term Properties**

Luc Boehme, Jeroen Vrijders & Ann Van Gysel (BE)

**Assessment of Recycled Concrete Aggregates in Concrete C20/25 & C25/30**

Duan, Zhen-hua; Kou, Shi-cong & Poon, Chi-sun (HK)

**Using ANNs to Predict the Mechanical Properties of Recycled Aggregate Concrete Prepared with Old Concrete with Different Strength Grades**

---

**DESIGNING CONCRETE STRUCTURES – C (Session 7)**

16.15 – 17.30 Room Q1

Session chair: Gordon Clark (UK)

Kamyab Zandi Hanjari, Mathias Flansbjerg, Jan Erik Lindqvist & Johan Silfwerbrand (SE)

**Structural analysis of concrete members with shear failure**

Katarina Malaga, Kristian Tammo, Mathias Flansbjerg, Thomas Blanksvärd & Örjan Petersson (SE)

**Textile Reinforced Concrete Sandwich Panels**

Evan C. Bentz (CA)

**Shear Behaviour of FRP-Reinforced Members without stirrups using the New Model Code**

Shahriar Agaajani & Danièle Waldmann (LU)

**Static Analysis of a New Wall System realized by Modular Concrete Blocks**

---

**SUSTAINABLE CONCRETE MATERIALS – C (Session 8)**

16.15 – 17.30 Room Q2

Session chair: Steinar Helland (NO)

Ane de Boer & Cornelis van der Veen (NL)

**Longterm behaviour of cantilever concrete bridges**

Karin Habermehl-Cwirzen, Vesa Penttala & Andrzej Cwirzen (FI), Roger Curtain, John Provis & Laura Gordon (AU)

**Sustainable Straw-based Cementitious Building Materials**

Yuko Ogawa, Kimitaka Uji & Atsushi Ueno (JP)

**Effect of Fly Ash in Low Fraction**

G.Saravanan, C. Antony Jeyasehar, S.Thirugnanasambandam & S.Kandasamy (IN)

**Development of Fly Ash Based Geopolymer Precast Concrete Elements**

---



## **SUSTAINABLE CONCRETE PRODUCTION, RHEOLOGY AND FLOW (Session 9)**

16.15 – 17.30 Room L1

Session chair: Luc Taerwe (BE)

George Croitoru & Augustin Popaescu (RO)

**Study about regularly tests for conformity on r.c. and p.c. electrical poles. Tests results and recommendations**

Christian Heese, Wolfgang Breit, Frank Schuler, Arnulf Latz & Dariusz Niedziela (DE)

**Simulation of the Flow and Form Filling Behavior of UHPC with Fibers**

Susanne Fröhlich, Christoph Glotzbach & Michael Schmidt (DE)

**Measuring Air Content and Rheological Characteristics of UHPC Mortars**

---

## **Tuesday, June 12**

### **KEYNOTES SESSION**

9.00 – 10.30 Room Q1

Session chair: György L Balázs (HU)

Prof. Joost Walraven, TU Delft (NL)

**On the way to sustainable concrete structures by defined performance concepts**

Prof. Jim Wight, Univ. of Michigan and ACI President (USA)

**American activities towards development of a unified front to advance green and resilient concrete**

Dr. Christoph Müller, VDZ (DE)

**Cement and concrete within the concept of sustainable development**

Dr. Carola Edvardsen, COWI A/S (DK)

**Concrete durability and sustainability - they go together. The Abu Dhabi STEP tunnel as an example**

---

## **DESIGNING CONCRETE STRUCTURES – D (Session 10)**

11.00 – 12.45 Room Q1

Session chair: Mikael Braestrup (DK)

Michael Vogel & Harald S. Müller (DE)

**Performance based design of hydraulic concrete structures in consideration of abrasion loads**

Giancarlo Groli, Alejandro Pérez Caldentey & Andreu Gelpi (ES)

**Use of Recycled Steel Fibres for Crack Width Control of Jointless RC Structures**

Stephan Pirringer, Johann Kollegger (AT)

**A New Approach for Small Formatted Metal-Concrete-Composite-Slabs**

Yngve K. Alvarsson (SE)

**Can Better Production Methods Improve the Resistance?**

N.Kaptijn, A.H.J.M.Vervuurt & C.P.M.Kuilboer (NL)

**Results of Monitoring large Carbon Fibre Post-tensioning Systems in a Balanced Cantilever Bridge (Dintelharbour bridge, The Netherlands)**

---

**SUSTAINABLE CONCRETE MATERIALS – D (Session 11)**

11.00-12.45 Room Q2

Session chair: Tor Arne Hammar (NO)

Ildiko Merta & Elmar K. Tschegg (AT)

**Uniaxial Fracture Energy of Natural Fibre Concrete**

Douglas Reid (EE) & Vaclav Vimmr (CZ)

**Concrete mix utilising oil shale ash**

Paolo Corvaglia & Alessandro Largo (IT)

Marios Soutsos (UK)

**Sustainable, innovative and energy-efficient concrete, based on the integration of all-waste materials: the SUS-CON Project**

Juan J. Soto-Bernal, M. Rosario Moreno-Virgen, Jose A. Ortiz-Lozano, M. Rosario Gonzalez-Mota & Iliana Rosales-Candelas (MX)

**CO<sub>2</sub> laser radiation effects on physical, mechanical and microstructural properties of Portland cement pastes**

Bhavna Tripathi, Anurag Misra & Sandeep Chaudhary (IN)

**Permeability of Concrete Containing Pyrometallurgical Slag as Partial Replacement of Sand**

Tristan Herbst, Katrin Rübner, Birgit Meng & Bruno Hauer (DE)

**Sustainable Evaluation - Concept to Assess the Applicability of Secondary Aggregates in Concrete**

---

**LCC & LCA (Session 12)**

11.00-12.45 Room L1

Session chair: Ylva Edwards (SE)

Jose Campos e Matos, Paulo Jorge Sousa Cruz, Isabel Brito Valente & Luis Canhoto Neves (PT)

**An Advanced Reliability Procedure for Lifetime Assessment of Structures: Application to Reinforced Concrete Beams**

Patrick Guiraud, Guillaume Habert & Amélie Semat (FR)

**Environmental impact comparison between 4 different bridge structures**

Michio Satou, Hiroki Arizono, Akira Hasumi, Hiroshi Minagawa & Makoto Hisada (JP)

**A study on the maintenance cost considering with the importance of facilities in an electric power plant**

Mohammed Safi, Håkan Sundquist, Raid Karoumi & George Racutanu (SE)

**Bridge Management System with an Integrated Comprehensive LCC Tool**

Andreas May & Daniéle Waldmann (LU)

**Lightweight woodchip concrete in composite constructions**

Guangli Du & Raid Karoumi (SE)

**Environmental Comparison of a Railway Bridge with Alternative Designs**

Laetitia D'Aloia Schwartzentruber, Mikaël Rabier, Catherine Cabut  
& Anne Charlotte Gasser (FR)

**LCA applied to the Evaluation of potential environmental Impacts of Tunnels**

---

## **DESIGNING CONCRETE STRUCTURES – E (Session 13)**

14.00-15.45 Room Q1

Session chair: Stephen Foster (AU)

Ioannis P. Sfikas, Antonis Kanellopoulos, Konstantinos G. Trezos & Michael F. Petrou (GR)

**Reproducibility of Self-Compacting Concrete batches between two different EU laborato-ries**

Bastian Jung & Guido Morgenthal (DE)

**Uncertainty analysis of tension stiffening approaches in reinforced concrete structures for the model quality evaluation**

Antonio Marí Bernat, Jesús M. Bairán García, Eva Oller Ibars & Ignasi Fernandez Perez (ES)

**Numerical simulation of the structural effects of the deterioration in concrete structures**

Jesus M. Bairan, Antonio R. Mari & Noemi Duarte (ES)

**Direct optimal design of partially prestressed concrete for controlled cracking or fatigue**

Steinar Helland (NO)

**New ISO 16204 on Durability Design of Concrete Structures**

Anna Emilie A. Thybo, Henrik Stang & John F. Olesen (DK)

**The Relationship between Rebar-Debonding and Cracking in Reinforced Concrete**

---

## **DURABILITY – A (Session 14)**

14.00-15.45 Room Q2

Session chair: Thomas Vogel (CH)

John Orr, Antony Darby, Tim Ibell & Mark Evernden (UK)

### **Durability enhancements using fabric formwork**

Jukka Lahdensivu (FI)

### **Durability Properties of Existing Concrete Facades**

Abdelkrim Ammouche, Christophe Carde, Nouredine Rafaï, Lionel Linger & François Cussigh (FR)

### **Overview of a two decades durability follow-up for two major bridges: Vasco de Gama (Portugal) and Rion-Antirion (Greece)**

Urs Müller, Moritz-Caspar Schlegel, Franziska Emmerling (DE) & Katarina Malaga (SE)  
**Novel techniques for studying damage mechanisms of cementitious matrices affected by sulphate attack**

Mohamed Abd Elrahman, Bernd Hillemeier (DE)

### **Ecological Concrete by Mix Design for Solar Energy Storage Water Tank**

Alexey Sidelev, Engui Liu, Weihua Jin, Gamal E. Khalil, Christian Bruckner & Masoud Ghandehari (US)

### **Sensing High pH and ASR Detection in Cementitious Materials**

---

## **ALTERNATIVE BINDERS (Session 15)**

14.00-15.45 Room L1

Session chair: Koji Sakai (JP)

Al-Jabri Khalifa, Al-Kamyani Zahran, Taha Ramzi, Baawain Mahad, Al-Shamsi Khalid and Al-Saidy Abdullah (OM)

### **Performance of Concrete Made with Spent Catalyst as Cement Replacement**

Luís Ferreira, Inês Barata, Hugo Costa, Eduardo Júlio, Jorge Coelho and Paulo Maranhã (PT)

### **Design of Alkali-Activated Mortar Mixtures**

Prabir Sarker and Karamchand Ramgolam (AU)

### **Fracture Energy of Geopolymer Concrete**

Batian Kolani, Laurie Buffo-Lacarrière, Alain Sellier, Gilles Escadeillas, Laurent Boutillon and Lionel Linger (FR)

### **Multiphase Hydration Model of Concrete Incorporating Gound Granulated Blast-Furnace Slag**

Anders Lindvall, Ingemar Löfgren and Oskar Esping (SE)

### **Properties of concretes mixed with fly ash or blast furnace slag**

Julie Piérard, Valérie Pollet, E. Cailleux and Christian Pierre (BE)  
**Strength Development and Durability Properties of High Slag Cement Based Concrete**

Ellen Grist, Dr. Kevin Paine, Dr. Andrew Heath and Dr. James Norman (UK)  
**The feasibility and potential of modern hydraulic lime concretes**

---

## **DESIGNING CONCRETE STRUCTURES – F (Session 16)**

16.15-17.30 Room Q1

Session chair: Mikael Hallgren (SE)

Fernando Stucchi, Marcelo Coelho Ungaretti & Francisco Lopes Blancas (BR)  
**Brazilian Arenas for the 2014 FIFA World Cup**

Alfred Strauss (AT) & Dan M. Frangopol (US)

**Performance assessment of existing structures using monitoring based Markov decision processes**

Johann Kollegger, David Wimmer & Susanne Gmainer (AT)

**Balanced lift method for the design of sustainable concrete bridges**

Jan Cervenka & Vladimir Cervenka (CZ), Dirk Proske & Davide Kurmann (CH)

**Pushover Analysis of Nuclear Power Plant Structures**

---

## **THERMAL MASS, ENERGY STORAGE & FIRE PROTECTION (Session 17)**

16.15-17.30 Room Q2

Session chair: Terje Kanstad (NO)

Joakim Albrektsson, Robert Jansson & Johan Silfwerbrand (SE)

**Assessment of fire exposed concrete structures**

Peter Holzer & Daniela Trauringer (AT)

**The Usage of Thermal Concrete Mass for Lowest Energy Buildings**

Peter Roots & Carl-Eric Hagentoft (SE)

**Efficient use of thermal mass in buildings**

Jonathan Karlsson, Lars Wadsö & Mats Öberg (SE)

**A conceptual model that simulates the influence of high thermal inertia in building structures**

---

## **CASE STUDIES AND AESTHETICAL ISSUES – B (Session 18)**

16.15-17.30 Room L1

Session chair: James Wight (USA)

Peter Minne, Robby Caspeele & Geert De Schutter (BE)

**Water demand predictions as key parameter for the mix design of durable concrete**

Peter Roots & Alexander Engström (SE)

**Efficient utilization of thermal mass with TermoDeck system for climate control of build-ings**

Nicolas Busquet, Julien Lamour, Michel Moussard, Emilie Luangkhot & Yannick Tardivel (FR)

**Comparative life-cycle assessment of an innovative technology repair of a steel orthotropic deck and its full replacement**

---

## **Wednesday June 13**

### **REPAIR, RENOVATION AND UPGRADING – A (Session 19)**

09.00-10.30 Room Q1

Session chair: Carol Hayek (USA)

Thomas Blanksvärd, Björn Täljsten & Gabriel Sas (SE)

**Mineral based strengthening systems for upgrading RC Structures**

Alessio Caverzan & Liberato Ferrara (IT)

**“Collapsible” concrete as a blast and impact absorber: from material concept to static characterization**

Ylva Edwards & Leif Fjällberg (SE)

**Chemical Resistance and Wear for Concrete Protection Systems to be used in Biological Treatment Plants - Laboratory Testing and Results**

Janusz Hołowaty (PL)

**Widening and Upgrading of a RC Slab Bridge for Improved Sustainability**

Katsuyuki Miyauchi, Hiroyuki Shimoeda & Yoshitaka Kuroishi (JP)

**Environment Impact Assessment of New Seismic Strengthening Method of Existing RC Piers by Dry Sprayed Polymer Cement Mortar**

---

## **SUSTAINABLE CONCRETE PAVEMENTS (Session 20)**

09.00-10.30 Room Q2

Session chair: Johan Silfwerbrand (SE)

Juan Lima (ES) & Hans-Rudolf Ganz (CH)

### **PT Slab on Ground: a Sustainable Solution**

Maria Meinel, Hans-Carsten Kühne & Wolfram Schmidt (DE)

### **Multilayer Concrete Pavers – Solutions for the Mitigation of the Urban Heat Island Effect**

Dallshad K.H. Amen Bzeni, Rafah Rasheed & Ahmed H. Mohammad (IQ)

### **Porosity, Pore Size Distribution and Permeability Evaluation of Porous Concrete Using Image Analysis**

Elia Boonen & Anne Beeldens (BE)

### **Photocatalytic concrete: purifying the air through the pavement**

Nadim Wehbe, Richard Reid, Jason Stripling & Hesham Mahgoub (US)

### **Optimization of Concrete Mixtures for Sustainable Jointed Plain Concrete Pavement**

---

## **SUSTAINABLE CONCRETE STRUCTURES – A (Session 21)**

09.00-10.30 Room L1

Session chair: Jan L Vitek (CZ)

Kenichiro Ashizuka, Kenji Miyamoto, Kenichi Kata & Akio Kasuga (JP)

### **Construction of a Butterfly Web Bridge**

Josef Hegger, Martin Claßen, Joerg Gallwoszus & Tobias Dreßen (DE)

### **Integrated and sustainable floor-slab-systems in composite construction**

Lars Elof Bryne & Björn Lagerblad (SE)

### **Texture and bond at the interfacial zone between rock and sprayed concrete**

Takashi Ishikawa, Takashi Yamamoto, Satoshi Takaya & Toyo Miyagawa (JP)

### **Bond Performance between ASR Affected Concrete and Reinforcement**

Jonas Thor Snæbjörnsson (IS)

### **Short- and long term changes in dynamic characteristics of a medium rise RC building**

---

## **REPAIR, RENOVATION AND UPGRADING – B (Session 22)**

11.00-12.45 Room Q1

Session chair: Katarina Malaga (SE)

Christis Z. Chrysostomou, Nicholas Kyriakides & Themis Demetriou (CY)

### **Retrofitting Strategies for Existing Structures for Sustainable Development**

Mathias Flansbjerg, Jan Erik Lindqvist, Gabriel Johansson & Michael Löfgren (SE)

### **Mechanical behaviour of concrete piles affected by sulphate attack**

Hideo Araki & Seiya Izaki (JP)

### **Seismic Performance of Low Strength Concrete Members Repaired by Epoxy Resin**

Antonio Marí Bernat, Jesús M. Bairán García, Rosangel Moreno González & Juan Jesús Álvarez Andrés (ES)

### **Analysis of remodelled and strengthened concrete bridge structures**

Eva Oller Ibars, Mireia Pujol Sánchez, Antonio Marí Bernat & Jesús Miguel Bairán García (ES)

### **The Contribution of FRP Laminates to the Shear Strength of Externally Bonded Reinforced (EBR) Concrete Structures**

---

## **DURABILITY – B (Session 23)**

11.00-12.45 Room Q2

Session chair: Milan Kalny (CZ)

Takuya Kondou, Takashi Yamamoto, Hideki Manabe, Ichiro Murata & Toyo Miyagawa (JP)

### **Flexural Capacity of Post-Tensioned PC Cracked Due to Corrosion**

Hirokazu Tanaka & Toyoaki Miyagawa (JP)

### **Durability improvement by low shrinkage concrete impregnated with silane water-repellent material**

Lidia Ruiz-Ripoll, José Antonio Lozano-Galant & José Turmo (ES),

Bryan E. Barragán & Sandro Moro (IT),

### **A Simple Methodology for Quantifying Early Shrinkage Cracking in Concrete**

Michael Kaffetzakis & Catherine Papanicolaou (GR)

### **Durability aspects of Pumice Aggregate Self-Compacting Concrete (PASCC): Comparison with Normal-Weight SCC (NWSCC)**

Oliver Schwoon (CH)

### **Sustainable Concrete through Admixtures**

Michala Hubertova, Rudolf Hela (CZ)

### **Durability of Lightweight Concrete**

---



## **SUSTAINABLE CONCRETE STRUCTURES – B (Session 24)**

11.00-12.45 Room L1

Session chair: Giuseppe Mancini (IT)

E.h Werner Sobek & Jan Mittelstädt (DE)

### **Development of a Sustainable Construction Method for Segmented Thin Walled Concrete Structures**

Tor Ole Olsen (NO)

### **Marine Concrete Structures for the Future**

Josef Hegger, Joerg Gallwoszus, Sabine Heinemeyer, Markus Feldmann, Max Gündel & Maik Kopp (DE)

### **New Systems for Composite Constructions – Fatigue Analysis**

Josef Knitl (DE)

### **New Generation of Wind Power Plants – Hybrid Wind Power Plants with High Perform-ance Self-Compacting Concrete**

Ann Van Gysel & Joren Andries (BE)

### **Study of the Flexural Behaviour of Reinforced Recycled Aggregate Concrete Beams**

Arastoo Hedayatnasab (IR)

Mukesh Limbachiya & Hsein Y. Kew (UK)

### **Recycled Aggregates and Reuse in Steel-Reinforced Recycled Concrete Beams Made with Equal Strength Recycled Concretetes**

---

## **REPAIR, RENOVATION AND UPGRADING – C (Session 25)**

14.00-15.45 Room Q1

Session chair: Joost Walraven (NL)

Allen L. Jones, Stephanie Klay & Nadim I. Wehbe (US)

### **Character, Extent, and Severity of Corrosion in Continuously Reinforced (CRC) Pavements for Service-Life Extension and Improved Sustainability**

E. Vesikari (FI) & R.M. Ferreira (PT)

### **Service Life Assessment for refurbishment concepts of concrete façades**

Jonny Nilimaa, Björn Täljsten & Thomas Blanksvärd (SE)

### **Post-Tensioning of Reinforced Concrete Trough Bridge Decks**

Martin C. Nilsson, Ulf Ohlsson, Mats Emborg & Lennart Elfgren (SE)

### **Fastenings (Anchor Bolts) in Concrete Structures – Influence of surface reinforcement**

Gabriel Sas, Thomas Blanksvärd, Jonny Nilimaa, Björn Täljsten, Lennart Elfgren, Anders Ben-nitz & Anders Carolin (SE)

### **Strengthening of Concrete Structures with Carbon Fibre Reinforced Polymers (CFRP) – Case studies**

## **DURABILITY – C (Session 26)**

14.00-15.45 Room Q2

Session chair: Mats Öberg (SE)

B. Erdil, U. Akyuz & I. O. Yaman (TR)

**Behaviour of CFRP confined low strength concrete columns under temperature changes**

R. Doug Hooton, Majella Anson-Cartwright & Uwe Schutz (CA)

**Improved Durability and Sustainability of Concretes Using Combined Aggregate Gradations**

R. Doug Hooton & Ester Karkar (CA)

**Evaluating Durability of Concretes Using Rapid Measurements for Fluid Penetration Resistance**

Paul Sandeford (AU)

**The Production and Use of Guidance Documents for the Development of Road Structure Durability**

Mohammad Tahershamsi, Kamyab Zandi Hanjari, Karin Lundgren & Mario Plos (SE)

**Anchorage Capacity of Naturally Corroded Reinforced Concrete Beams**

Hannele Kuosa, Markku Leivo, R. Miguel Ferreira & Jukka Piironen (FI)

**Effect of concrete frost deterioration on chloride penetration and carbonation**

---

## **SUSTAINABLE CONCRETE STRUCTURES – C (Session 27)**

14.00-15.45 Room L1

Session chair: Vladimir Cervenka (CZ)

Jan Biliszczuk, Jerzy Onysyk, Robert Toczkievicz, Robert Toczkievicz, Przemysław Prabucki, Mariusz Sułkowski & Krzysztof Sadowski (PL)

**Construction of Multi-Span Motorway Viaducts Using Various Technologies**

Demetris Nicolaidis, Pericles Savva, Antonios Kanellopoulos & Michael F. Petrou (CY)

**Static response of UHPFRCC slab specimens**

Hiroto Takatsu, Tooru Hirade, Yasuyoshi Miyauchi & Toshio Yonezawa (JP)

**Seismic Behaviour of Reinforced Concrete (RC) and Concrete Filled Tube (CFT) Columns using Energy and CO<sub>2</sub> Minimum (ECM) Cement**

Johan Silfwerbrand (SE)

**The Effect of Climate Changes on Concrete, Concrete Structures, and Concrete Construction**

Natalia Sabourova, Nikas Grip, Arto Puurula, Ola Enochsson, Yongming Tu, Ulf Ohlsson, Martin Nilsson, Lennart Elfgren & Anders Carolin (SE)

**The Railway Concrete Arch Bridge over Kalix River - Dynamic Properties and Load Carrying Capacity**

**CLOSING SESSION**

16.15-17.00 Room Q1

Session chair: Patrik Hult (SE)

Mr. C.R. Alimchandani (IN)

**Invitation to the fib Symposium Mumbai 2014**

Mr. Avi Dancygier (ISR)

**Invitation to the fib Symposium Tel Aviv 2013**

Prof. Johan Silfwerbrand, Chair of the Organizing Committee

**Thank you**

Prof. György L. Balázs, President, fib, Chair of the Scientific Committee

**Thanks and closing the Symposium**

## Thursday June 14

### SUSTAINABLE CONCRETE CONSTRUCTION – SWEDISH ACTIVITIES

09:00 – 12:30 Room Q2

Session chair: Fredrik Winberg (SE)

Seminar organised by the Council for Sustainable in the Swedish Concrete Association. The invited speakers are working actively with these issues in Sweden. This seminar is free of charge and open for the public. The seminar will be held in English.

Information and registration:

<http://betongforeningen.se/2012/05/sustainable-concrete-construction-swedish-activities>

#### The Construction Products Regulation (CPR) and Sustainability Standards

- Rutger Gyllenram (SE)  
**The framework**
- Lars-Gunnar Lindfors (SE)  
**Perspective of construction products**
- Martin Erlandsson (SE)  
**Perspective of buildings**

Martin Erlandsson (SE)

**Robust assessment of materials, buildings and structures with systems analysis tools**

Pia Öhrling (SE)

**Environmental certification systems for sustainable concrete constructions**

Coffee 10:30-10:45

Stefan Sandelin (SE)

**Cement production in Northern Europe – CO<sub>2</sub>-vision**

Christer Ljungkrantz (SE)

**CO<sub>2</sub>-uptake in concrete**

Eva-Lotta Kurkinen (SE)

**Energy-efficient buildings and communities**

Fredrik Winberg

**Discussion**