

公務出國報告（出國類別：國際會議）

參加 2018 年第 40 屆國際橋梁及結構  
工程學會研討會  
(40<sup>th</sup> IABSE Symposium)  
出國報告

服務機關：交通部高速公路局  
姓名職稱：陳宏仁 規劃組組長  
派赴國家/地區：法國南特  
出國期間：107.09.16~107.09.23  
報告日期：107.11.29



## 摘要

「國際橋梁及結構工程學會」(International Association for Bridge and Structural Engineering, IABSE) 於 2018 年 9 月 17~21 日 (計 5 日) 在法國南特之 La Cité de Nantes Events Center 辦理「2018 年國際橋梁及結構工程學會研討會」, 本次研討會主題為 Tomorrow's Megastructures (未來巨型結構物), 主要探討現有的解決方案及環境變遷的限制, 希望在服務年限能提供良好效能, 增進社會福祉。

本次專題研討內容包含建築的重建、巨型結構的研討、大跨度橋梁維護及安全等議題, 本局派員參加此次國際性工程研討會, 希望能吸取歐美等先進國家之技術新知及經驗, 提供國內基礎建設設計及施工之參考。

本次會議主辦單位安排有主題演講、論文研討、技術參訪及廠商展覽等項目, 除參與會場各項活動, 亦報名參加技術參訪行程, 希望能實地了解法國南特當地工程實際執行情形。本報告即就參加前述國際性研討會目的、過程、心得及建議等作說明。



# 目 次

一、	目的 .....	1
二、	行程紀要 .....	3
三、	參加第 40 屆 IABSE 研討會紀要.....	5
四、	心得及建議.....	40
五、	附錄.....	42



# 一、 目的

## (一) IABSE 簡介

國際橋梁及結構工程協會 (International Association for Bridge and Structural Engineering, 簡稱 IABSE) 係有關橋梁和結構工程的國際學術性組織，創立於 1929 年 10 月 29 日，永久會址設在瑞士蘇黎世，現任主席 (2016-2019) 是葡萄牙籍的 Fernando Branco(詳圖 3-1)，現有來自 100 多個國家超過 4000 名的會員，是目前會員國最多的國際土木類協會。協會設立宗旨係促進國際學術交流、結構工程技術，增進科技界、工業界和公共團體代表之間的國際合作，並提高會員對社會的自覺性和責任感。

IABSE 每年舉辦國際專題研討會，四年舉辦一次大會以及小型會議。在這些活動中，來自學界和業界的專家交流知識，會議有特定的主題及相關的科學技術。

IABSE 涉及結構工程的各個面向包括：規劃設計、施工營運、監控和維修等科學，並考慮到技術、經濟、環境、美學和社會方面。“結構”一詞包括橋梁、建築物 and 所有類型的土木工程結構，由任何結構材料組成。

此外，協會也出版相關研究成果與經驗的刊物，包括「國際結構工程」(Structural Engineering International, SEI) 季刊、專題論文(Structural Engineering Documents, SED)及各研討會文集等。該協會也建立免費網路電子學習平臺，提供有關結構工程講義、短期課程及影片等，供有興趣之專業同好線上學習相關知識及技術新知。

## (二) 參與 IABSE 研討會之目的

本次 IABSE 在法國南特舉辦第 40 屆 IABSE 研討會，主題為”Tomorrow’s Megastructures”，在 20 世紀 60 年代是作為一種建築概念而被推廣，係指一種人造的巨型結構物，在現代可以應用於任何特別大或高的建築物，包含橋梁結構物。在本次研討會中，特別邀請各國結構工程界的人士來分享對於現今巨型結構物的看法，以及未來的前景。藉由參與 IABSE 研討會，與來自世界各地之顧問、承包商、業主、研究人員及從業人員，就結構設計、施工和維護等問題來交換意見，並從中吸取技術新知及經驗，提供國內橋梁工程設計及施工之參考。



圖 3- 1 IABSE 主席致詞



## 二、 行程紀要

### (一) 行程表

本次奉派參加 IABSE 法國南特會議核定行程自 107 年 9 月 16 日至 9 月 23 日共計 8 日，其中研討會主要議程自法國時間 9 月 19 日至 9 月 21 日共計 3 日，相關行程謹彙整如表 2-1。

表 2-1 奉派參加第 40 屆 IABSE 研討會行程表

日期	起迄地點	行程紀要
9 月 16 日 (日)	臺北－法國巴黎 (去程)	桃園機場－法國巴黎機場
9 月 17 日 (一)	臺北-法國巴黎	去程及參觀巴黎地區橋梁建設
9 月 18 日 (二)	法國巴黎-法國南特	路程及報到
9 月 19 日 (三)	法國南特	參加專題研討會、論文研討會 及參觀廠商展覽
9 月 20 日 (四)	法國南特	參加專題研討會、論文研討 會、技術參訪
9 月 21 日 (五)	法國南特 法國南特－法國巴黎	參加專題研討會、論文研討會 法國南特－法國巴黎
9 月 22 日 (六)	法國巴黎－臺北 (返程)	法國巴黎機場－桃園機場
9 月 23 日 (日)	法國巴黎－臺北 (返程)	法國巴黎機場－桃園機場

## (二) 行程概述

配合航空公司航班時間晚去早回及時差，在法國實際停留時間僅有 5 天，第 1 天抵達法國後順道參觀巴黎地區橋梁建設，第 2 天自巴黎搭乘高鐵前往南特報到，參加為期 3 天的研討會，會議結束即搭乘高鐵到巴黎，隔天搭乘班機返台。

### 三、 參加第 40 屆 IABSE 研討會紀要

#### (一) 舉辦時間、地點

本次會議舉辦地點在法國南特會展中心(詳圖 3-2~3-5)，舉辦時間為當地時間 9 月 17 日(星期一)至 21 日(星期五)，南特是法國西部最大的城市，位於盧瓦爾河畔，距離大西洋海岸 50 公里。該市是法國第六大城市，擁有大約 90 萬居民。它是歷史悠久的布列塔尼省和布列塔尼古代公國的主要城市之一，曾被雜誌票選為「法國最綠的城市」、「歐洲最適合居住的城市」。



圖 3-2 法國南特市所在位置



圖 3-3 本屆 IABSE 研討會舉辦會場及附近街道地圖



圖 3-4 法國南特會展中心實景圖

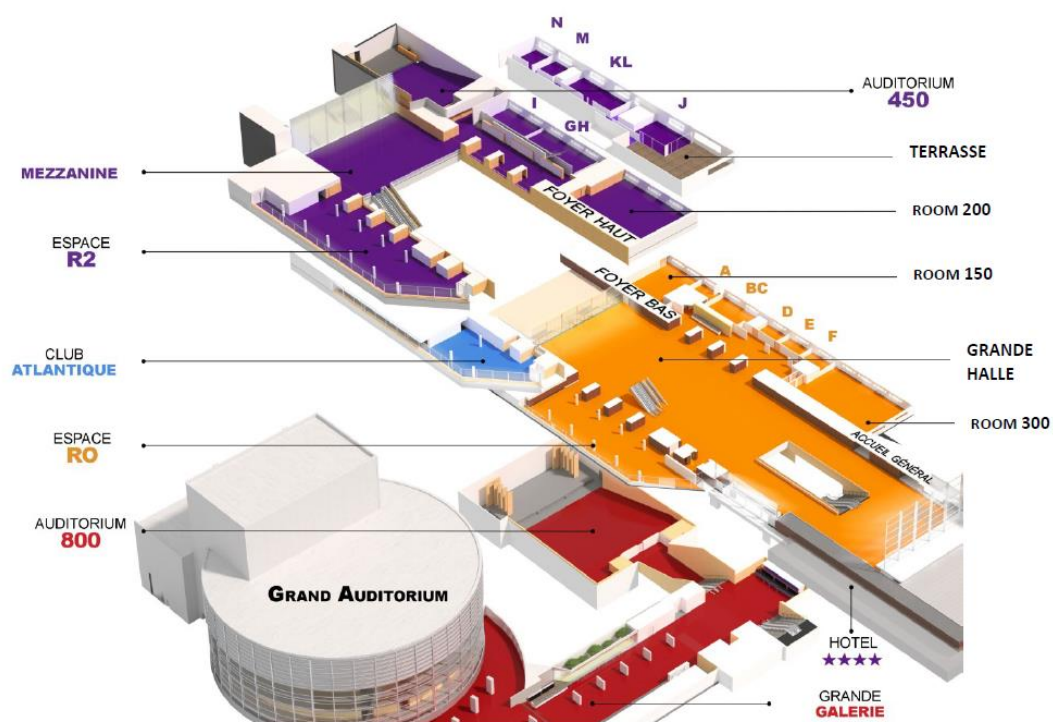


圖 3-5 法國南特會展中心會場平面圖

## (二) IABSE 研討會議程

本屆年會議程詳表 3-1 所示，共計 5 日，包含 IABSE 年度會議、工作坊(Workshops)、專題演講(Keynote Lecture)、論文研討會(Technical Program)、技術參訪(Technical Visits)、廠商展覽(Exhibition)，會議場次均可視需求自由參加。

表 3-1 IABSE 研討會議程表

日期 時間	9 月 17 日 星期一	9 月 18 日 星期二	9 月 19 日 星期三		9 月 20 日 星期四		9 月 21 日 星期五	
08:15 10:00	IABSE 年度會議	IABSE 年度會議 工作坊	開幕儀式 專題演講		專題演講		專題演講	
10:00 10:30			中場休息		中場休息		中場休息	
10:30 12:00			論文研討會	廠商展覽	論文研討會	廠商展覽	論文研討會	廠商展覽
12:00 13:30	午餐	午餐	午餐		午餐		午餐	
13:30 15:00	IABSE 年度會議	IABSE 年度會議 工作坊	論文研討會	廠商展覽	論文研討會	廠商展覽	論文研討會	廠商展覽
15:00 15:30			中場休息		中場休息		中場休息	
15:30 17:00			論文研討會	廠商展覽	論文研討會	廠商展覽	論文研討會	廠商展覽
晚會			歡迎會		晚宴		閉幕儀式	

### (三) 各類研討會議簡介

本次研討會之研討議題，涵蓋各領域範疇，內容相當廣泛，茲分別簡介說明如下。

#### 1. 專題演講(Keynote Lecture)

本次研討會安排了 6 個場次的專題演講，主題含括推動中的大型公路及建築計畫、安全議題、及大跨度橋梁等。

表 3-2 專題演講主題表：

項次	主題(中文)	講者
主題演講 1：	埃及推動中的大型計畫	Ibrahim MAHLAB
MEGA PROJECTS TOWARDS EGYPTIAN CONSTRUCTION RENASCENCE		
主題演講 2：	一公里高的 JEDDAH 塔樓	Robert SINN
THE ONE-KILOMETER TALL JEDDAH TOWER		
主題演講 3：	法國新的海岸公路：從設計過程到建築	Jean-Marc TANIS
THE NEW COASTAL ROAD IN LA REUNION ISLAND (France): From the Design Process to Construction		
主題演講 4：	安全約束的巨型結構	Denis ETIENNE
THE CHERNOBYL SHELTER: A MEGA-STRUCTURE FOR A SAFE CONFINEMENT		
主題演講 5：	摩納哥的海上延伸計畫	Régis ADELINÉ
THE PORTIER COVE SEAWARD EXTENSION PROJECT IN MONACO		
主題演講 6：	大跨度橋梁	Michel VIRLOGEUX
LONG SPAN BRIDGES		





圖 3- 6 專題演講



圖 3- 7 專題演講



圖 3- 8 專題演講



圖 3- 9 專題演講



## 2. 論文研討會(Technical Program)

論文研討會共三天，議題涵蓋橋梁及結構工程相關之各類範疇，包羅萬象，內容廣泛，本次研討會發表論文超過 300 篇以上，會議場次超過 60 場次，每日皆有不同論文議題在各會議室舉辦(各議題一覽表如表 3-3 及圖 3-10~16 所示)。

表 3-3 主要議題一覽表

主要議題名稱(英文)	主要議題名稱(中文)
Bearings and expansion joints	支承墊和伸縮縫
Composite structures and systems	複合結構和系統
Concrete behaviour and technologies	混凝土行為和技術
Damping systems	阻尼系統
Design methods	設計方法
Dynamic Monitoring	動態監控
Fatigue	疲勞
Fiber reinforced structures	纖維加強結構
Fire	火害
Focus on specific megaprojects	特定的巨型計畫議題
Innovative buildings	創新的建築
Innovative cable structures	創新的鋼索結構
Innovative designs	創新設計
Maintenance and management	維護和管理
Marine structures	海上結構物

Metro projects	地鐵計畫
Novelty in construction	新穎建築
“Nouvelle Route du Littoral” viaduct	濱海公路高架橋
Queensferry and Bosphorus bridges	跨海大橋
Railway bridges	鐵路橋梁
Retrofitting and repair	改建和維修
Risk management	風險管理
Seismic design and retrofitting	抗震設計和改建
Structural Health Monitoring	結構監測
Special session on Forensic engineering	工程特別議題
Special session on Innovations towards improved seismic resilience and upgrade of existing structures	關於提高抗震能力和現有結構升級的創新特別議題
Special session on Structural health monitoring	結構監測特別議題
Special structures	特殊結構
Steel structures and technologies	鋼結構和技術
Tall buildings	高層建築
The Mega-floating city	巨型浮動城市
Timber construction	木構造
Tunnels	隧道
Wind effects on structures	結構風力影響

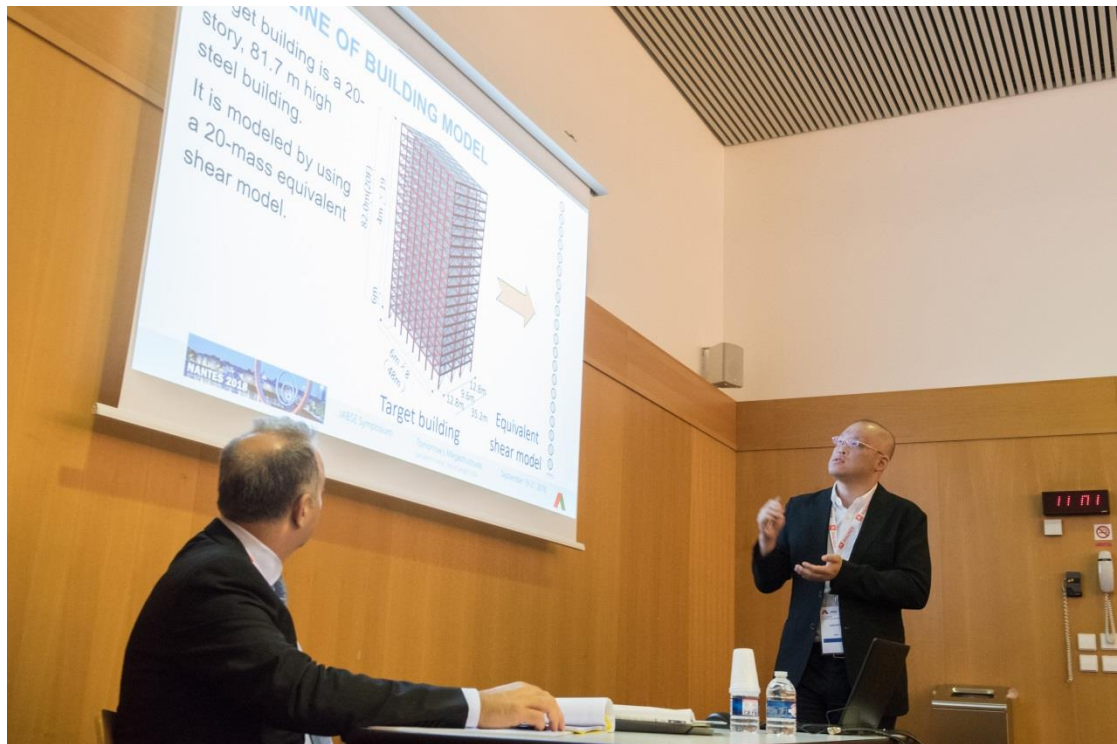


圖 3- 10 論文研討會



圖 3- 11 論文研討會



圖 3- 12 論文研討會



圖 3- 13 論文研討會

Wednesday September 19								
08:15 10:00	Auditorium 800							
	Opening ceremony Mega Projects towards Egyptian Construction Renaissance - Ibrahim Mahlab, <i>Former Prime Minister of Egypt, Egypt</i>							
10:00 10:30	Coffee break in Grande Halle (Exhibition area)							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
10:30 12:00	Bearings and expansion joints I	Innovative cable structures I	Innovative buildings	Composite structures and system I	Concrete behaviour and technologies I	Novelty in construction I	Design methods I	Damping systems I
12:00 13:30	Lunch in Grande Halle (Exhibition area)							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
13:30 15:00	Marine structures I	Railway bridges I	Special session The mega floating city	Special session Metro projects	Structural health monitoring I	Innovative designs I	Wind effects on structures I	Special structures I
15:00 15:30	Coffee break in Grande Halle (Exhibition area) 							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
15:30 17:00	Seismic design and retrofitting I	Steel structures and technologies, I	Special session IABSE Task Group 1.1 part 1	Tunnels	Structural health monitoring II	Innovative designs II	Design methods II	Retrofitting and repair I
17:15 18:15	My thesis in 180s in Auditorium 800							
18:30 22:30	Welcome reception in Machines de l'île							

圖 3- 14 論文研討會 DAY1



Thursday September 20								
	Auditorium 800							
08:30 10:00	The One-Kilometer Tall Jeddah Tower - Robert Sinn, <i>Thornton Tomasetti, Chicago, USA</i> The New Coastal Road in La Réunion Island (France) – Jean Marc Tanis, <i>EGIS-JMI, France</i>							
10:00 10:30	Coffee break in Grande Halle (Exhibition area)							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
10:30-12:00	Special session on forensic engineering	Innovative cable structures II	Composite structures and systems II	Concrete behaviour and technologies II	Novelty in construction II	Damping systems II	Design methods III	Dynamic monitoring I
12:00 12:30	Bentley Session							
12:00 13:30	Lunch in Grande Halle (Exhibition area)							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
13:30 15:00	Seismic design and retrofitting II	Maintenance and management	Focus on specific megaprojects	Special session NRL project	Fatigue	Railway bridges II	Wind effects on structures II	Retrofitting and repair II
15:00 15:30	Coffee break in Grande Halle (Exhibition area) offered by 							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
15:30 17:00	Marine structures II	Steel structures and technologies II	Special session on structural health monitoring I	Special session IABSE Task Group 1.1 part 2	Structural health monitoring III	Timber construction	Design methods IV	Special structures II
17:15 18:00				Special session				
18:30 23:00	Gala Dinner in Château de la Pigossière							

圖 3- 15 論文研討會 DAY 2

Friday September 21								
08:30 10:00	Auditorium 800							
	The Chernobyl shelter: a mega-structure for a safe confinement – Denis Etienne, <i>Bouygues TP, France</i> The Portier Cove seaward extension project in Monaco – Régis Adeline, <i>SAM, Monaco</i>							
10:00 10:30	Coffee break in Grande Halle (Exhibition area)							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
10:30 12:00	Seismic design and retrofitting III	Tall buildings	Special structure III	Special session Queensferry and Bosphorus bridges	Seismic design and retrofitting IV	Railway bridges III	Design methods V	Retrofitting and repair III
12:00 13:30	Lunch in Grande Halle (Exhibition area)							
	Room J	Rooms B+C	Auditorium 800	Room 300	Room 200	Rooms K+L	Room 150	Rooms G+H
13:30 15:00	Fire	Special structures IV	Special session on structural health monitoring II	Fiber reinforced structures	Structural health monitoring IV	Risk management	Design methods VI	Dynamic monitoring II
15:00 15:30	Coffee break in Grande Halle (Exhibition area)							
15:30 17:00	Auditorium 800							
	Closing ceremony Long span bridges, Michel Virlogeux, <i>French Academy of Technology and UK Royal Academy of Engineering, France</i>							

圖 3- 16 論文研討會 DAY3

### 3. 技術參訪

#### (1) IFSTTAR 實驗室

9月20日上午由協會帶領前往參觀法國交通發展規劃和交通網絡科技研究院(IFSTTAR)在南特的實驗室(詳圖 3-17)，IFSTTAR 研究院共有五個研究方向，分別為 MAST(Materials and Structures，材料和結構)、GERS(Geotechnics, environment, natural hazards and earth sciences，地工、環境、自然災害和地球科學)、COSYS(Components and Systems，組件和系統)、TS2(Transport health and safety，運輸健康和安全)、AME(Development, mobility and environment，發展、流動性和環境)，本次參訪實驗室的地工離心機、路面疲勞試驗軌道和鋼纜疲勞試驗設備。



圖 3- 17 IFSTTAR 南特實驗室位置示意圖



IFSTTAR 的**地工離心機**配備了地震模擬器和機器人操縱器，使用小型模型研究岩土結構的行為，如基礎擋土牆、海上錨地。結果可以直接轉換為全尺寸結構，並提供驗證數值模擬的方法。在受控的宏觀重力條件下的測試也用於航空和醫療設備的認可測試。**CEA-Cesta** 離心機是法國唯一的地工離心機，也是世界上最大的離心機之一（半徑 5.5 米，最大負荷 2 噸，最大加速度 100g）（詳圖 3-18）。

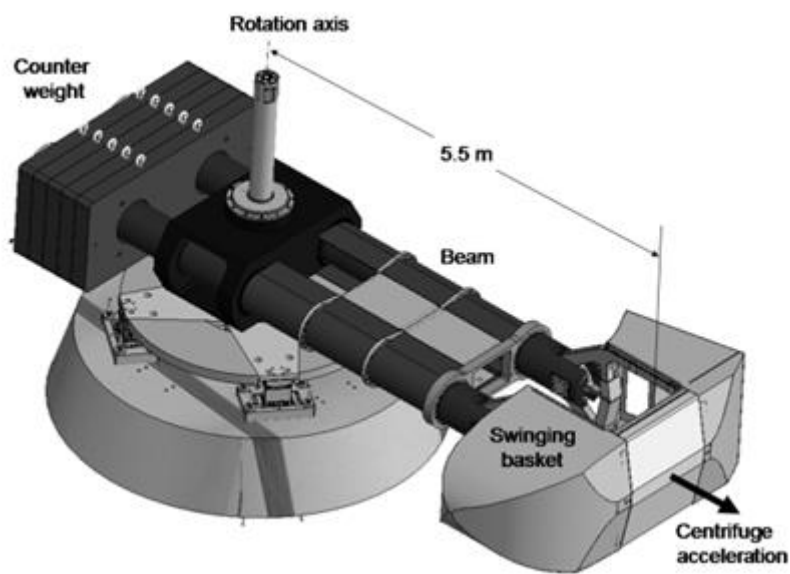


圖 3-18 地工離心機配置圖

地工離心機用於測試岩土工程問題的模型(詳圖 3-19)，例如橋梁和建築物的基礎強度、路堤的沉降、斜坡的穩定性、土方支撐結構、隧道穩定性和海堤。其他應用包括爆炸性隕石坑、地下水中的污染物遷移、凍脹和海冰。由於土壤行為的高度非線性的行為，模擬這些現象的模型非常複雜並且需要大量驗證，離心機測試的實驗數據可用於驗證計算所做的假設。如果結果顯示模型不準確，則離心機測試數據可提供對物理過程的深入了解，進而提供更好的模型建置。

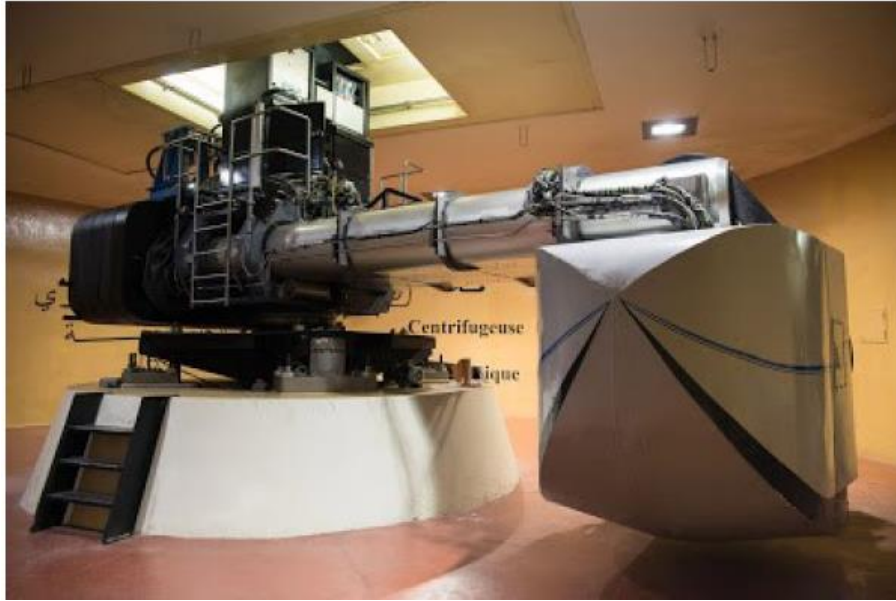


圖 3-19 地工離心機實體

路面疲勞試驗軌道提供 IFSTTAR 在重載荷下對真實路面結構進行加速試驗(詳圖 3-20)，直至達到嚴重的損壞程度。該轉盤的性能（四個 20 米臂，每個軸承載荷在 45 至 130 kN 之間，最大速度為 100 km / h），是世界上最大的此類設施之一。除圓形測試跑道外，實驗室還有兩個線性交通模擬器，用於小規模測試(詳圖 3-21)，以測量能夠承受交通負荷的能力或道路結構。



圖 3-20 路面疲勞試驗軌道



圖 3-21 小規模測試機

**鋼纜疲勞試驗設備**(詳圖 3-22~23)能夠對土木工程或其他應用（鋼絞線和錨碇設施，海上設施）使用的鋼纜進行全面測試。靜載測試由三個液壓千斤頂配有機械定位，最大張力：24,000 kN，彎曲應力由 1 個液壓缸，100 mm 衝程，最大載荷 250 kN，這些測試係確保測試產品實際操作負載（靜態拉伸應力和力、拉伸及彎曲的受力與應力循環變化）下保持其完整性，對於驗證創新工程解決方案是必要的。聲音傳測器用於檢測和定位測試期間發生的任何故障，這是法國唯一的此類設施，也是全球僅有的三家設施之一。

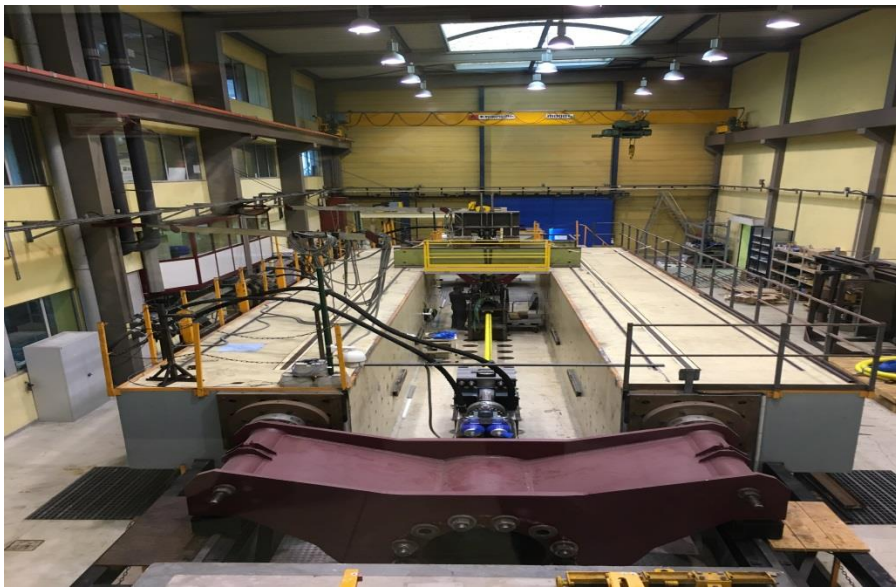


圖 3- 22 鋼纜疲勞試驗設備



圖 3- 23 鋼纜疲勞試驗設備彎曲應力試驗



## (2)Cheviré大橋

9 月 20 日下午隨著協會前往參觀法國著名的 Cheviré大橋 (詳圖 3-24)，這座橋梁歷史悠久，1991 年 4 月完工至今已有 27 年的橋齡，位於法國南特市，橫跨盧瓦爾河，全長 1563m。採雙向三車道橋面設計，橋面寬為 24.60m，主跨 242m 採鋼梁與混凝土梁接合(詳圖 3-25)，其中鋼梁跨徑為 162m，橋高 52m，主要是讓大型船隻行駛於盧瓦爾河時能夠穿越進入內陸碼頭港口，預力混凝土箱型梁採用懸臂工法建造，共 22 跨 (詳圖 3-26)。



圖 3-24 Cheviré大橋位置示意圖

由於鋼梁支撐於混凝土懸臂端處，有研究指出在混凝土懸臂端處正以緩慢地速率產生垂直變形現象。該研究在 Chevir'e 橋上安裝了結構監測系統，針對下垂的變形量進行量測並與理論值進行了比較，結果顯示其測量值超過了理論計算值，研究認為是材料的延遲行為而導致將額外的應力重新分配到結構中，使得在懸臂末端產生了高出理論值的變形。因此，為了能夠評估結構的當前狀況及預測其極限狀態，此研究進而提出了針對材料的經驗修正方法，有關研究詳細敘述可參考 J-P. Sellin, J-F. Barthélemy, G. Bondonet, B. Cauvin Delayed, J-M. Torrenti. “Delayed deformations of concrete structures: the Savines bridge and the Chevire bridge” 。



圖 3- 25 Cheviré大橋現況



圖 3- 26 Cheviré大橋施工照片

#### 4. 廠商展覽(Exhibition)

廠商展覽於會場大會堂舉行，共有 30 家參展廠商，展覽內容與本局業務較相關者包含交通規劃及交通模擬軟體、排水、交通安全設施、施工交通維持規劃、結構或地工檢測儀器設備、伸縮縫等產品展示，相關展覽成果相當豐富多元，或以實體展示，或以影片播放，更有實景模擬等方式；部分展示攤位亦提供書面簡介供與會者索取參考。





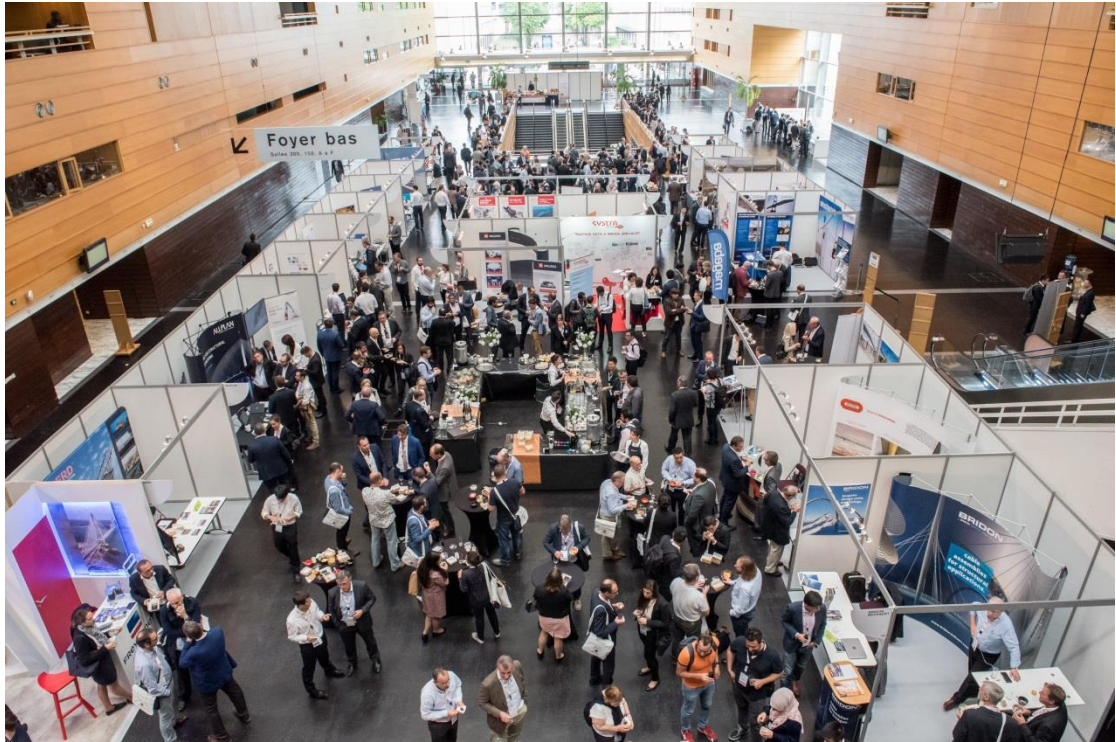


圖 3-28 廠商展覽會場

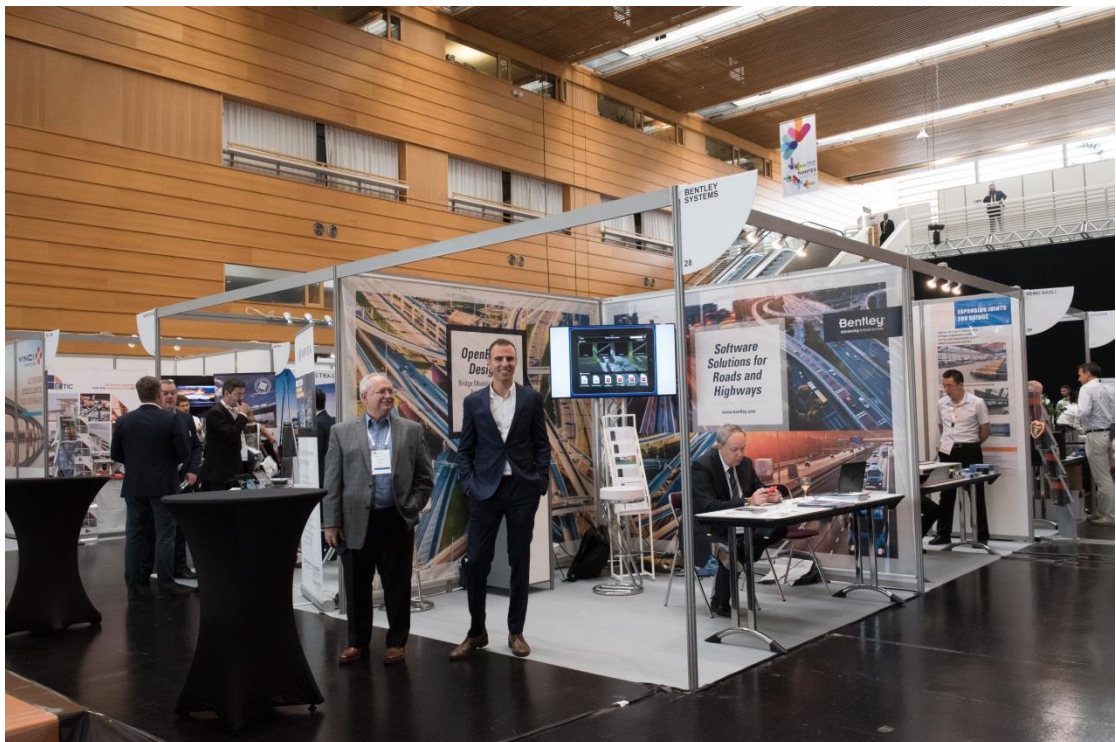


圖 3-29 BENTLEY 展覽攤位



#### (四) 研討會議題概述

本屆研討會中安排了6個場次的專題演講以及34項議題，因內容廣泛，以下擇幾篇與橋梁結構有關之論文作重點摘要介紹說明。

##### 1. 專題演講(Keynote Lecture)

論文名稱:Mega Projects towards Egyptian Construction Renaissance

作者: Ibrahim MAHLAB, CEO and President, The Arab Contractors  
Osman Ahmed Osman & Co Former Prime Minister of Egypt

道路、隧道和橋梁對於蓬勃發展的國民經濟至關重要，為了服務近1億人的國民，埃及需要更多現代化和高效率的貨運基礎設施，包括港口，鐵路和最重要的公路網絡。在這方面，埃及最近啟動了一項大型的政府計畫，旨在改善許多道路網絡的基礎設施。

本文介紹 Rod El-Farg 廊道公路其中的 Rod El-Farag 斜張橋，總長540米，及近64米的寬度(目前最寬的斜張橋)，連接尼羅河東部大橋與開羅北部的 Shubra 地區，它將為擁擠的道路提供一條替代路線，並解決了開羅大量的交通問題。

該橋由七個跨距組成，主跨距為300米，兩側邊垮長度均為3x40米(圖3-30)。

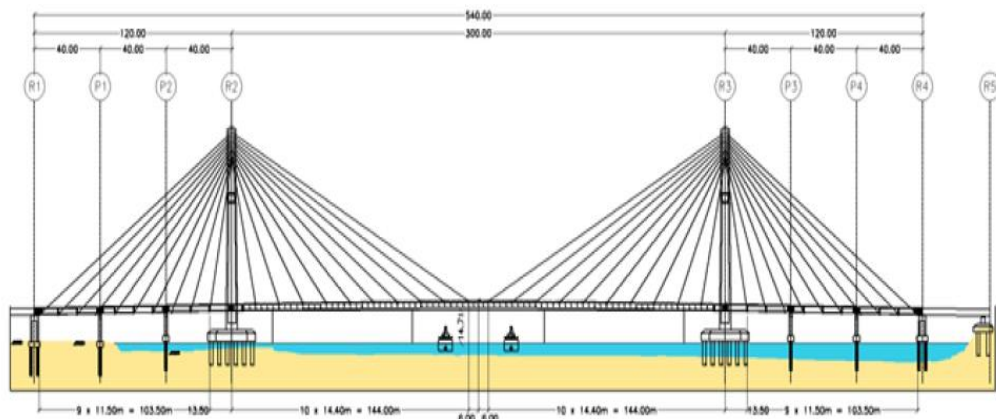


圖 3-30 Rod El-Farag 斜張橋垮徑配置

主跨由兩個主要鋼梁、橫梁、縱梁及預鑄的混凝土板的複合截面(圖 3-31)

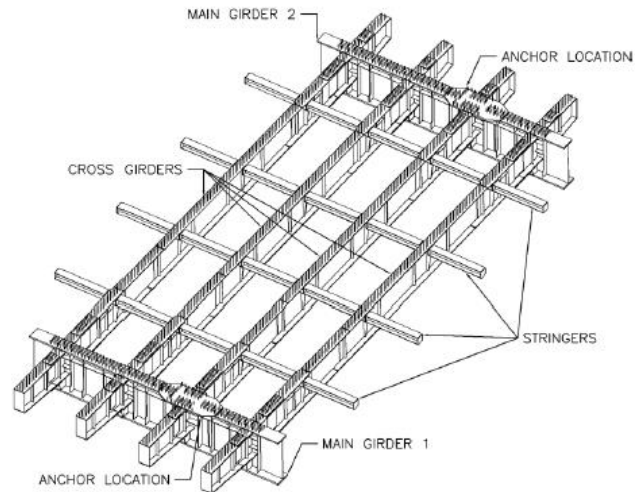


圖 3-31 主跨複合梁配置

邊跨系統為現場澆築的混凝土箱梁。主塔位於 R2 和 R3 處，高度為 95 米，每個橋塔由三根柱組成，並透過一中空的混凝土橫梁相互連接；塔柱建立在厚度為 5 米的樁帽上，樁帽下則使用 80 個直徑為 2 米的樁作為基礎(圖 3-32)。



圖 3-32 Rod El-Farag 斜張橋願景圖

95 米高的兩座橋塔具有中空的混凝土橫截面，並使用自爬升式模板進行塔柱的建構。每個塔柱被分成 20 個鑄造節塊，每個節塊的高度約為 4.5m。圖 3-33 分別顯示了橋塔橫斷面及塔柱採用的自爬升式模板。



圖 3-33 橋塔橫斷面及自爬升式模板

為了減少橋面板結構振動並承載由於地震作用而產生在橋面板上的側向荷載，在橋面版和兩個橋塔之間設置了 12 個粘滯性阻尼器。

本文介紹了埃及目前在基礎設施領域展開的的一部分。這些計畫皆在設計、施工、項目管理方面有着相當的創新，同時本計畫可以成為日後巨型結構的良好範例，並造就 Rod El-Farag 斜張橋成為世界上同類型中最寬的橋梁。目前其他幾個計畫正在埃及展開，為埃及重生之路鋪築。

## 2. 特定巨型計畫議題 (Focus on specific megaprojects)

論文名稱：Megastructures for a Long Marine Bridge in Kuwait

作者：Mohamed Akraa, Georges Mauris, Aurelie Vivier, Trinh Duong, Delphine Challant, Elodie Faivre, Serge Montens

科威特將在未來幾年內在科比特灣東北端建造一個新的城市，名為“絲綢之城”在布比延島附近的 Subiyah 地區。為了促進這個新城市與科威特城之間的交流，科威特決定在建造一條跨海大橋(圖 3-34)，一旦完成，該橋將把科威特市和 Subiyah 地區之間的行駛距離從現在的 104 公里縮短到 36 公里。



圖 3- 34 計畫示意圖

本計畫完工後，將成為世界上最長的海上橋梁之一。總長度為 48.5 公里，包括主線及多哈路段線，主線的總長度為 36 公里，其中 27 公里為跨海橋梁結構，使用預鑄節塊，每塊長 40 至 60 米、寬 17 米、高 2.5 至 4 米，主跨以斜張橋及其精緻的拱形塔將在科威特灣重要航道中作為顯著地標(圖 3-35)；多哈路段長 13 公里，主要是跨海橋梁結構。該計畫於 2013 年初開始建設，預計於 2018 年 11 月通車。





圖 3- 35 斜張橋

計畫包括 Shuwaikh 港灣方面的遊客中心管理大樓(圖 3-36)，其特殊的構造將成為科威特市的重要地標，另外包括兩個 30 公頃的人工島嶼(圖 3-37)：一個位於北側，另一個位於橋梁的南側，將容納維護和交通緊急建築，加油站和碼頭設施等，這些島嶼也具有視覺及美學作用，打破橋梁長而均勻的單調。



圖 3- 36 遊客中心管理大樓



圖 3- 37 人工島嶼

對於這個計畫，Systra 提出並設計了創新的解決方案，方案一為預鑄節塊工法，有兩種節塊尺寸，寬度皆為 17 米，40 米跨度深度為 2.5 米；60 米跨度深度為 4.0 米，並在縱向和橫向進行預力拉伸。Systra 認為從經濟和規劃角度來看，預鑄節塊的重複性是本計畫成功的關鍵。預製節塊在 Subiyah 一側的鑄造場（圖 3-38）預製，由駁船帶來，其創新解決方案二在具有足夠航行潮汐的區域中使用浮式起重機（圖 3-39），對於航行潮程較低的地區，使用龍門起重架（圖 3-40），這種施工方法顯著降低了對海洋生態系統的影響。



圖 3-38 預鑄場



圖 3-39 浮式起重機





圖 3-40 龍門起重架

創新解決方案三，Systra 提出了一個直徑為 3,0m (60m 跨度) 和 2.5m 直徑 (40m 跨度) 的單樁系統 (圖 3-41)。單樁的使用與多樁解決方案相比，減少了地震力，還減少了對海洋動物的影響，並避免了海洋環境中樁帽建造的安全問題。

在樁的施工過程中，在挖掘地面之前安裝了厚 19 mm 的永久鋼套管。這些套管允許在挖掘過程中，安裝鋼筋籠 (圖 3-42) 和混凝土澆製。

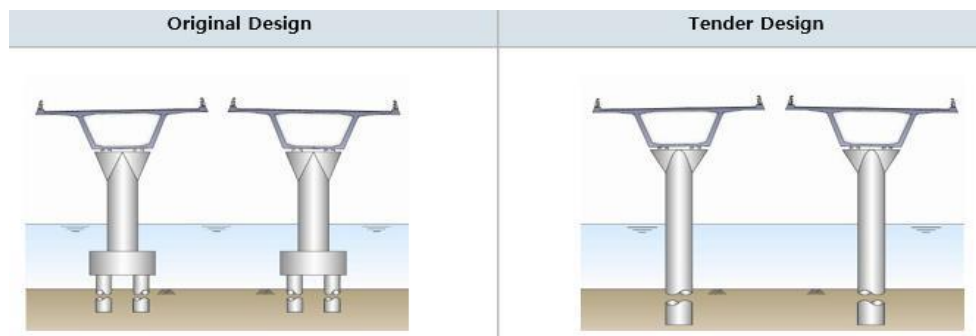


圖 3-41 單樁系統

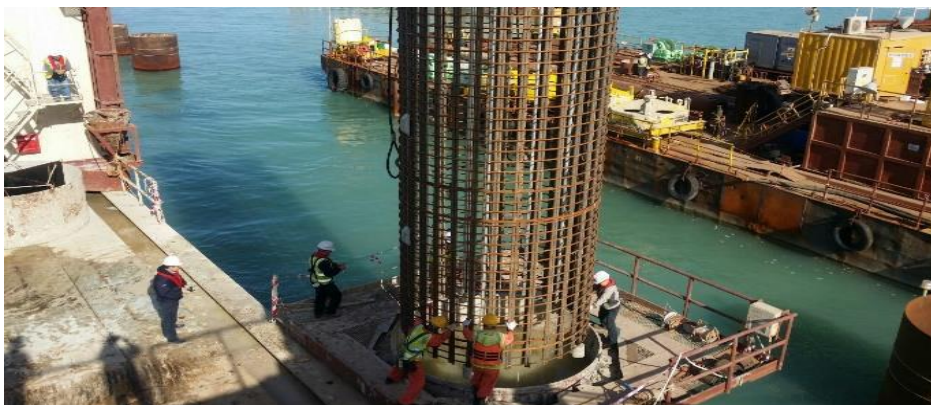


圖 3-42 安裝鋼筋籠

### 3. 創新之鋼纜結構 (Innovative cable structures)

論文名稱：Crossing the Ganges: The World's Longest  
Extradosed Bridge

作者：Brook R. Robazza, Morgan T. Trowland

隨著國家的轉型經濟持續增長，許多大型結構物將在印度完成，東北部比哈爾邦的 1.17 億人民正因 Veer Kunwar Singh 大橋橫跨恒河而受益(詳圖 3-43~3-44)。在橋梁建成之前，這條長達 400 公里的河流上僅有三座橋梁共六條公路車道。這座四車道大橋於 2017 年落成，成為世界上最長的脊背橋，同時也代表了比哈爾邦橋梁技術和建築工藝的進步。



圖 3-43 Veer Kunwar Singh 大橋





圖 3-44 Veer Kunwar Singh 大橋跨越恆河的全貌

本研究描述 4.35km 橋梁的設計和建造，其中 16 個單元，共 1920m，採用斜拉鋼索系統來承載上部結構的自重。由於箱梁是預鑄製成，與先前恒河橋上使用的現場澆鑄混凝土結構相比，可以更快速，更容易地安裝。從歷史上看，印度的主要橋梁皆是用十多年才完成，但由於採設計-施工統包採購，以及施工人員和設計師之間的合作加速施工，Veer Kunwar Singh 大橋僅用了五年時間就完成了。

脊背橋對於多跨橋梁應用具有多種好處，包括橫跨恒河洪氾平原的交叉口。多跨橋梁必須利用減少基礎數量來平衡因較長跨度所增加之成本，同時，鋼纜系統對於超過 100 米長跨度的橋梁可以顯著地提高其成本效益，因此，脊背橋在多跨橋梁的應用中越來越受歡迎，一系列重要的例子如圖 3-45 所示。

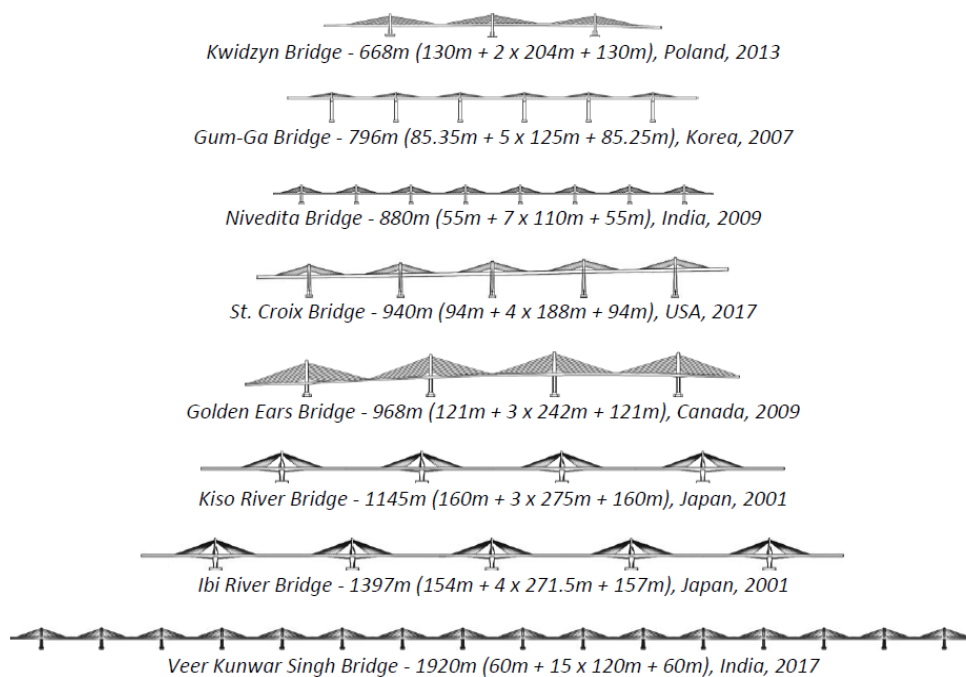


圖 3- 45 世界最長的多垮脊背橋梁

利用脊背系統來設計和建設 Veer Kunwar Singh 橋，與一般梁設計方案相較下更具有多項優勢，透過引入這種相對較新的橋梁類型及其相關的施工方法，有許多好處，進一步推進比哈爾邦的發展：

1. 安裝速度：一旦脊背橋的構件在預鑄場中製造，他們可以在 1 天內的時間到現地完成安裝。即使河流中運輸遇到困難而導致安裝速度減慢到 3 天，但這仍然比在現地場鑄澆置施工之週期快大約三倍。
2. 經濟型設備：較小的構件不需要專門的起重設備。
3. 減少材料體積：對於超過約 150 米的跨度，脊背系統可以更顯著地減少施工所需的混凝土、鋼筋及高強度鋼筋的體積。
4. 基礎設計：對於較長的跨距，由於鋼纜支撐的存在，構件尺寸可以更小，導致上部結構更輕，基礎要求比具有漸變梁深之橋梁來的更低，大大減少了基礎的施工時間和成本。

#### 4. 濱海公路高架橋（“Nouvelle Route du Littoral” viaduct）

論文名稱：Zourite, a Kraken for Maritime Works

作者：Olivier Jestin. David Compte.

為了避免岩石掉落到留尼旺島沿海公路的車道上並降低年度維護成本，當地政府決定在海上和沿海建造一座高架橋，新沿海公路由 5.4 公里的橋梁結構組成，與海岸平行，距離海岸線 100 米至 200 米。它位於法國海外領土的北側印度洋，如圖 3-46~3-47 所示。

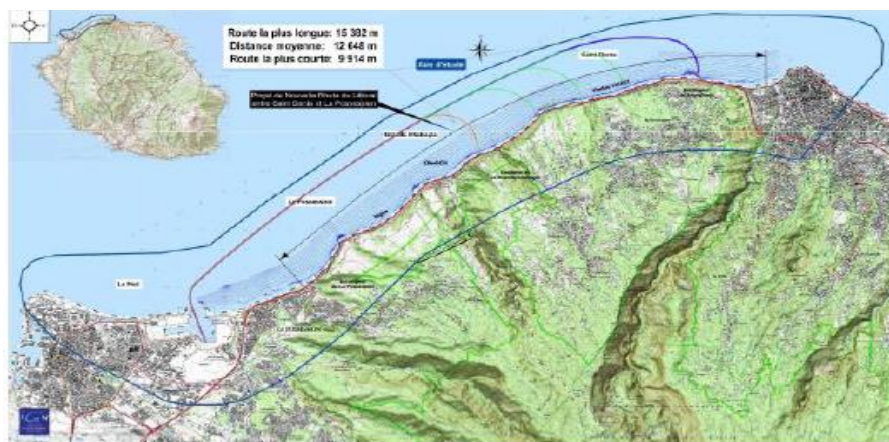


圖 3-46 留尼旺島沿海公路位置概述



圖 3-47 留尼旺島沿海公路施工示意圖

由於印度洋的天氣條件限制，團隊選擇使用預鑄段並最大限度地減少海上工程。在海上工程中，留尼旺島因其非常高的海浪和強風而以其惡劣的天氣條件而聞名，因此，該團隊不得不想像一艘新的駁船能夠承受更高的天氣條件，並提供高架橋所需的精度安裝預製構件。就在這樣的背景下，重型自升式駁船(如圖 3-48)因此而產生，能夠裝載，運輸和裝載預製段（最大重量 4600 t），動態定位系統可以準確地將駁船放置在現場，它配備了 8 千升的頂升系統，允許駁船在留尼旺島的海浪上站立，以實現分段安裝或海上土建工程。

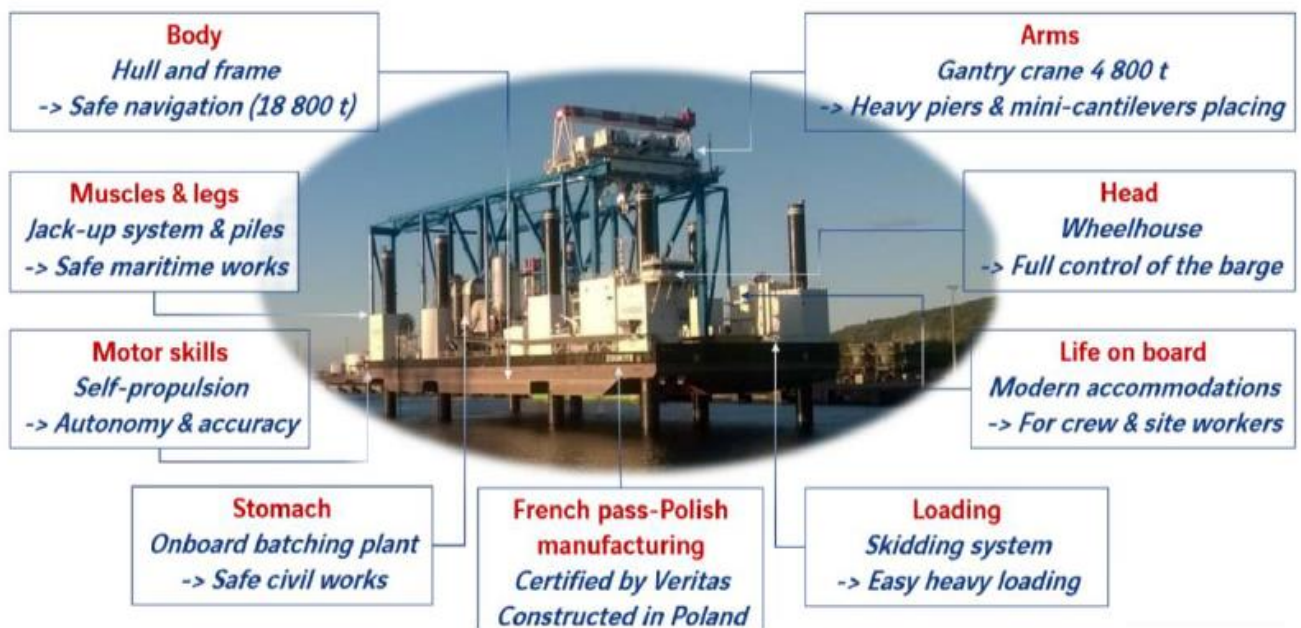


圖 3-48 重型自升式駁船



## 5. 設計方法 (Design methods)

論文名稱：Design and Construction of the New “La Unidad” Bridge, Mexico

作者：Samuel Vásquez, Manuel Martínez

La Unidad 橋位於墨西哥灣南部的墨西哥坎佩切州，該橋建於 1980 年代，這座橋位於墨西哥石油工業中心的一條非常重要的海岸公路上(如圖 3-49)，因該橋橋墩腐蝕裂化嚴重(圖 3-50)，故將新建一座新的 La Unidad 大橋將取代現有的橋梁，新的“La Unidad”大橋全長 3285 米，橫跨大海，水高 4 至 15 米。這座橋有 73 跨，每跨為 45 米;由 6 個 I 型預力梁及混凝土板組成，梁 2.2 米高，混凝土版為 22 公分厚。橋墩為樁基。橋梁所在的區域容易發生颶風和地震，橋梁的土壤相對較軟。該橋現在正在建設中，將於 2018 年底完工。

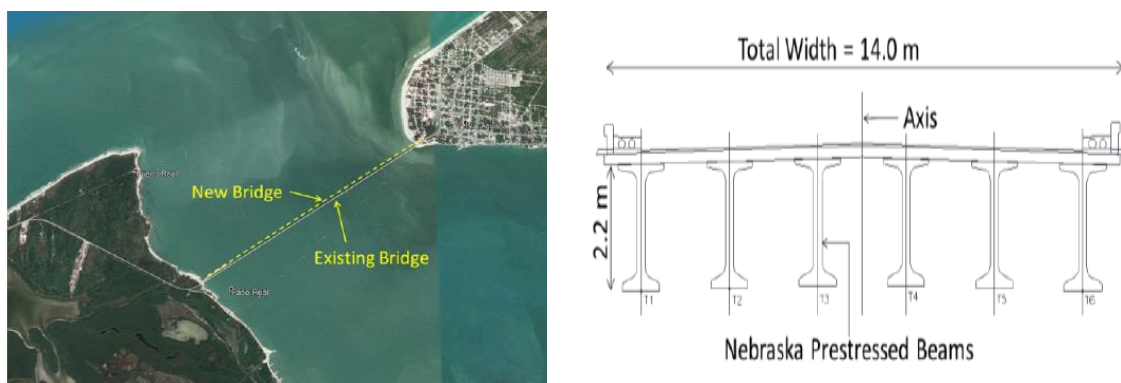


圖 3-49 La Unidad 橋位置示意圖及橋梁型式



圖 3-50 La Unidad 舊橋腐蝕情形

新的 La Unidad 橋是一座非常長的橋梁，其特點是在海上建造，其具有複雜岩石土層，且位於地震區域。本論文進行了地震風險研究，同時進行了橋梁地震響應的非線性時程計算，這些計算顯示了橋梁在強烈地震運動期間耗散能量的能力，並允許橋墩設計的優化。同時將岩土工程計算的結果與載荷試驗中的結果進行了比較。

## 四、心得及建議

- (一). 本次研討會透過專題演講者的簡報可瞭解埃及、美國、法國、烏克蘭、摩納哥等國目前推動中的幾項大型道路及建築計畫，此外研討會有超過 300 篇投稿論文發表，涵蓋橋梁、隧道、建築等領域，從設計、施工到維護、管理、監測，內容豐富可提供國內推動公共工程規設、施工、維管參考。
- (二). 本次研討會有來自世界各地產、官、學界超過 500 人參加，亞洲國家包括大陸、日本、韓國、印度、印尼等均踴躍派員積極參與研究論文成果發表，分享專業經驗，相形之下，臺灣並無其他人員參加，實值得省思，建議未來仍應多鼓勵國內顧問公司、學界、工程機關踴躍參與類似國際研討會，吸收新知，以提升工程水準及臺灣知名度。
- (三). 研討會主辦單位考慮環保、節能減碳，將所有論文資料儲存於隨身碟，不再列印書面報告。並於會場提供免費 Wi-Fi 及 APP，讓參加人員瞭解研討會相關資訊，達到無紙化會議目標，可供國內日後舉辦類似大型研討會參考。
- (四). 主辦單位安排參訪 IFSTTAR 南特實驗室的 Geotechnical Centrifuge (地工離心機)、Pavement fatigue test track (鋪面疲勞試驗軌道)、及 Cable fatigue test bench (鋼纜疲勞試驗設備) 都是世界上少有的大型實驗設備，可透過實際試驗來驗證理論及設計成果，實驗室相關資料可提供未來國內地工、路面材料、橋梁需進行相關試驗參考。
- (五). 參訪的 Cheviré 大橋主跨採 PC-鋼混合橋，高度 52 公尺，跨度 242 公尺、鋼梁長 162 公尺，在 1991 年完工。國內第一座 PC-鋼混合橋位於台 74 線大里路段，跨度 85 公尺、鋼梁長 65 公尺，

在 2011 年完工。兩項工程完工時間及規模雖有差異，不過 Cheviré 大橋的檢測、監測及維修經驗可供國內養護單位參考。

- (六). 南特市區廣設自行車友善設施(包括類似 Ubike 租車服務、停車設施、專用道設置)，並積極推動各項 BRT 及輕軌建設，提供市民便捷的公共運輸服務，有效降低私人交通工具使用，減少市區交通壅塞，值得國內類似規模之城市推動公共運輸政策參考。

## 五、 附錄

### 附錄一、南特市區街景照



附錄.圖- 1



附錄.圖- 2





附錄.圖- 3



附錄.圖- 4





附錄.圖- 5



附錄.圖- 6

## 附錄二、研討會主要議題及各場會議名稱

### Table of contents

#### Keynote lectures

Mega Projects towards Egyptian Construction Renaissance

*Ibrahim Mahlab, Fathy Saad*

K-1

The One-Kilometer Tall Jeddah Tower

*Robert Sinn, John Peronto*

K-17

The New Coastal Road in La Réunion Island (France): From the Design Process to Construction

*Jean Marc Tanis, Christophe Outteryck, Guillaume Danan, Jimmy Jacquot, Cyril Bailly*

K-25

The Chernobyl Shelter: a Mega-structure for a Safe Confinement

*Denis Etienne*

K-37

The Portier Cove Seaward Extension Project in Monaco

*Régis Adeline*

K-55

Long Span Bridges

*Michel Virlogeux*

K-65

#### Bearings and expansion joints

Experimental and Numerical Studies on the Shear Properties of Rubber Bearing Supports with Parameters of Axial Stress

*Joon-Ho Choi, Nobuhiko Hara, Takashi Imai, Kensuke Ueda, Hyunwoo Sung*

S1-1

The Modular Expansion Joints of the Sheikh Jaber Causeway in Kuwait

*Achilleas Athanasiou, Niculin Meng, Colm O'Suilleabhain*

S1-9

The Quick-Exchange Expansion Joints of the Köhlbrand Bridge in Hamburg

*Stefan Adam, Gianni Moor, Simon Hoffmann*

S1-17

The bearings and integrated SHM system of the Johan Sverdrup offshore platform facility

*Masoud Malekzadeh, Gianni Moor, Niculin Meng*

S1-25

Chernobyl new safe confinement project - steel arch permanent bearings

*Roberta Vitale, Philippe Salmon*

S1-33

## **Composite structures and systems**

A Critical Assessment of the Fatigue Verification Concept of Stud Shear Connectors in Steel-Concrete-Composite Members for Bridges

*Eric Brehm, Robert Hertle*

S2-1

Planning and Design of a Two-story Arch Bridge with Solid-spandrel Upper Arches Built with CFRP Reinforced Concrete

*Takeshi Oshiro, Makoto Nakamura, Michiaki Sakate, Tadahiro Yoshida*

S2-9

Performance Study of a Steel-Concrete Joint for Hybrid Cable-Stayed Bridge with 800m Main Span

*Xiangmin Yu, Dewei Chen*

S2-17

Experimental Studies on the Cooperative Performance of Steel-concrete Composite Large-span Bridge Tower

*Yaoyu Zhu, Jiansheng Fan, Xin Nie, Bing Cui, Liji Huang*

S2-25

Bending Mechanical Properties of Composite Bridge Deck with Bulb Flat Ribs

*Xinyi He, Qintian Su, Chen Xu*

S2-33

U-shaped Steel-concrete Hybrid Beams: an Alternative Solution for Long-span Beams

*Clémence Lepourry, Franck Palas, Piseth Heng, Hugues Somja*

S2-41

Recent Structures and Bridges built with the CL Steel-concrete Connection

*Jacques Berthelémy, Günter Seidl, Wojciech Lorenc*

S2-51

Form Optimized CFRP Reinforced and Post-tensioned Integral Concrete Bridge using Precast Girders

*Mike Schlaich, Andreas Apitz, Arndt Goldack*

## **Concrete behaviour and technologies**

Spatial Correlation Characterization using Windowing Method, Transfer through Concrete Carbonation Models

*N. Rakotovo Ravahatra, E. Bastidas-Arteaga, F. Schoefs, T. de Larrard, F. Duprat*

S3-1

Shear Tests on RC Beams without Stirrups under Uniformly Distributed Load

*Alexander Beck, Walter Kaufmann, Daniel Konradi*

S3-11

Estimation of Prestress Losses in Concrete Structures over a Long time

*Suryakantha Biswal, Ananth Ramaswamy*

S3-21

Linear Regression Analysis of the Eurocode 2 Creep Model with Bayesian Update

*Elise Zgheib, Wassim Raphael, Rafic Faddoul*

S3-29

Response of Structural Concrete Assemblages to Thermo-Mechanical Loads

*V.Svetha, D. Harinadha Reddy, Ananth Ramaswamy*

S3-37

Multifunctional Inhomogeneous Lightweight Concrete Elements – Outline and Structural Behaviour

*Claudia Löscher, Arno Richter, Mike Schlaich*

S3-45

A Decision Model for the Investment in Technology to Reduce Concrete Rework

*Tian Martin Podges, Jan Andries Wium*

S3-53

On-site Study of the Time-dependent Behaviour of Concrete: Evaluation of the Application of EC2 Prediction Models in Algeria

*Luís Oliveira Santos, Min Xu, Tiago Vieira*

S3-61

Yield Design Based Numerical Analysis of Three-dimensional Reinforced Concrete

*Hugues Vincent, Mathieu Arquier, Jérémy Bleyer, Patrick de Buhan*

S3-69

Modelling of the Long Term Behaviour of Prestressed Concrete Structures: the Case of Nuclear Power Plants

*Jean Michel Torrenti, Abdushalamu Aili*

S3-77

## **Damping systems**

Seismic Isolator, Damper and Expansion Joint System for two Viaducts of Toluca – Mexico City Intercity Train

*Luca Paroli, Peter Huber*

S4-1

New Adaptive Pendulum: Reduced Structural Acceleration, Base Shear, Displacement Capacity and Improved Rotation Capability

*Felix Weber, Florian Obholzer, Peter Huber, Christian Braun, Leopold Meier, Manfred Hartinger, Johann Distl*

S4-9

Response Prediction of Passive Controlled Building with Viscous Dampers Considering its Performance Decrement under Long-Period Ground Motion

*Daiki Sato, Kazuhiko Kasai, Nagayama Sho, Kazuhiro Matuda*

S4-19

Seismic Isolation of Greater Jakarta LRT



*Charles Cynober, Tri Suryadi, Mauro Sartori*

S4-25

Near-fault Isolation of Cable-stayed Bridge in Longitudinal Direction using Linear Friction Damper

*Junjun Guo, Wancheng Yuan*

S4-31

Experimental Investigation on Transverse Steel Damper Seismic System for Cable-stayed Bridges

*Lianxu Zhou, Aijun Ye, Xiaowei Wang*

S4-39

Characterization of Dissipative Behaviour of a Reinforced Concrete Mock-up after Soft Impact Tests through Wavelet Analysis

*Nicolas Vacca, Christophe Rouzaud, Guillaume Hervé-Secourgeon, Mathieu Galan, Pierre Argoul, Claude Rospars*

S4-47

BRB and Viscous Damper Hybrid Vibration Mitigation Structural System: Seismic Performance Analysis Method and Case Studies

*Xin Zhao, Hao Li*

S4-55

Optimized Design of Seismic Isolation Systems for Existing Bridges

*Marco Furinghetti, Simone Peloso, Igor Lanese, Simone Lenzo, Alberto Pavese*

S4-63

Seismic Performance Evaluation of Fabricated Concrete Frame with Replaceable Energy Dissipation Connectors

*Chunyu Li, Jing Wu, Luqi Xie*

S4-71

## **Design methods**

Design and Construction of the New “La Unidad” Bridge, Mexico

*Edilberto Buenfil Montalvo, Alvaro Buenfil Bermudez, José Antonio Pinto Elías Samuel Vásquez, Manuel Martínez, Alberto Patron, Eduardo Reyes, Ernesto Morales, Miguel Ibarra, Fabian Martinez*

S5-1

Chacao Bridge Foundations

*Bénédicte Pich, Emilie Cousteix, Habib Kata’a, Mathieu Muls, Aymen Cheikh-Mahmed, Svein Erik Jakobsen*

S5-9

Juan José Arenas: a Philosophy of Bridge Design

*Guillermo Capellán, Miguel Sacristán, Santiago Guerra, Emilio Merino, Javier Martínez*

S5-17

Mawaiya CLC: Technical Challenges in Design & Construction

*Shekhar Mehta, Ashutosh Kumar Singh*

S5-25

Large Span V-shaped Pier Continuous Rigid Structure Design of China-Maldives Friendship Bridge

*Xiao Haizhu*

S5-33

Variations of Safety Factors for Bridges over their Lifetime considering Changing Live Load Definitions

*Ciarán Hanley, Dan M. Frangopol, Denis Kelliher, Vikram Pakrashi*

S5-41

Increasing Planning Quality for a Project

*Peter Seitz*

S5-49

Fragility Analysis of Girder Bridges Subjected to Multi-hazards

*Jingyu Wang, Wancheng Yuan*

S5-55

Proposals to make Complex Structures Affordable

*Jean-François Caron, Olivier Baverel, Cyril Douthe, Romain Mesnil, Tristan Gobin*

S5-63

Parametric Non-linear Models for Buried Structures with Full Soil-structure Interaction

*Marcin Bulkowski, Pawel Ogonowski, Marcos Sanchez*

S5-71

From a decrease of web thickness to a reinforcement optimization

*A. Simon, T. Duclos, R. Lelonard*

S5-79

Form Dynamics at Concrete Overpass Bridges

*Michael Kleiser*

S5-87

Reliability of Pre-stressed Elliptical Paraboloidal Concrete Shells

*Gnida Sossou*

S5-95

Parametric, adaptive Design and Analysis of standardized Steel Composite Bridges

*Semjon Giebat, Andreas Bach, Markus Nöldgen, James Lim*

S5-103

Development of Simplified Analytical Model for Predicting the Time-history of Ship Impact Loading on the Bridge

*Yanchen Song, Junjie Wang, Hao Gao*

S5-111

A 3D Modelling for Transversal Analysis and Local Effects

*Jocelyn Meyer, Laurent Bailly, Fahed Chebbi, Anthony Scaramozzino*

S5-119

The design of two Large Span Arch Bridges in the Port of Rotterdam

*Arjen Steenbrink, Mark van der Burg*

S5-127

Adoption of Precast Column-Base Pocket Connections with Rough Surface Interface in Long Span Bridges

*Abdelrahman H. Farouk, Khaled H. Riad, Fathy Saad*

S5-135

Managing Data workflow from Concept to Commission – BIM for Bridges

*Jean-Pierre Chanard*

S5-143

Numerical Analysis of Pre-fabricated Reinforced Concrete Beams with Longitudinal Cavities

*Tor Gunnar Vilke, Samindi Samarakoon*

S5-149

Non-conventional Cable System in Multi-span Cable-stayed Bridges

*Clara Cid, Aitor Baldomir, Santiago Hernández*

S5-157

An Initialization Model with Reference to Finite Number of Failures

*Atsukuni Kajima, Kiyoshi Kobayashi, Kengo Obama, Kiyoyuki Kaito*

S5-165

A Novel Method for Assessing the Critical Excitation Direction of Curved Bridges

*Ruiwei Feng, Tianpeng Lao, Wancheng Yuan, Tongfa Deng*

S5-173

Skew Placement of Arches with respect to the Bridge Deck

*Hans De Backer, Amelie Outtier, Gilles Van Staen, Evy Van Puymbroeck, Zain Ul-Abdin*

S5-183

The Steel Railway Arch Bridge Behaviour under Short-time Brake and Acceleration Loading

*Pavel Ryjáček, Martin Werunský, Michal Polák*

S5-191

Experimental and Numerical Study on the Shear Performance of RC Shear Walls Confined with Welded Reinforcement Grids

*Mingzhe Cui, Jiansheng Fan, Jianguo Nie, Jun Liufu, Shengyong Li, Zhonghai Huang*

S5-199

The Arched Strut – a Tool for Modelling Column-Slab Connections

*Scott Alexander, Eva Lantsoght*

S5-207

Applying a Set-based Parametric Design Method to Structural Design of Bridges

*Alexandre Mathern, Rasmus Rempling, David Tarazona Ramos, Santiago Luis Fernández*

S5-215

Innovative Method for the Production of Deck Slabs of Steel-concrete-Composite Bridges

*Johann Kollegger, Kerstin Fuchs*

S5-223

## **Dynamic Monitoring**

Preservation of an Existing Original Building by Studying its Dynamic Properties

*Nisrine Makhoul*

S6-1

Bridge Displacement Monitoring using Acceleration Measurement and Development of Efficient Bridge Management System

*Yutaro Umekawa, Hisatada Suganuma*

S6-11

Causes of Resonance in PPC Girder when Shinkansen Passing and External Cable Reinforcement

*Keishi Chikami, Kiyotaka Sugita, Daisuke Tsukishima*

S6-19

Methodology for the Dynamic Identification of Damaged Unreinforced Masonry Walls through Vibrations Tests

*Silvia Ientile, Antonella Cecchi, Giosuè Boscato, Pierre Argoul, Franziska Schmidt, Boumediene Nedjar, Dominique Siegert*

S6-29

Multi-setup Operational Modal Testing of a Multi-span Viaduct

*Jie Zhang, Kristof Maes, Guido De Roeck, Geert Lombaert*

S6-37

Highly Sensitive Damage Detection of Reinforced Concrete Bridge Slab by “Time-Variant Deconvolution” of SHF-Band Radar Signal

*Takahiro Yamaguchi, Tsukasa Mizutani, Minoru Tarumi*

S6-45

Finite Element Modeling and Verification of a Retrofitted Member of a Long-span Truss Bridge

by Employing Stochastic System Identification

*Daiki Tashiro, Takafumi Nishikawa, Shozo Nakamura, Makoto Shimizu*

S6-55

Automatic Modal Operational Analysis of a Long-span Suspended Bridge using Pattern Recognition

*João Santos, Christian Crémona, Paulo Silveira*

S6-63

Statistical Vibration-based Damage Localization on Saint-Nazaire Bridge Mock-up

*Md Delwar Hossain Bhuyan, Yann Lecieux, Jean-Christophe Thomas, Cyril Lupi, Franck Schoefs, Michael Döhler, Laurent Mevel*

S6-71

## **Fatigue**

Evaluation regarding Fatigue for Various Types of Hangers used for Tied Arch Bridges

*Jacques Berthelémy*

S7-1

Fatigue Crack Propagation Analysis of Rib-to-deck Welded Joint in OSDs using Linear Elastic Fracture Mechanics

*Weijian Wu, Henk Kolstein, Milan Veljković*

S7-9

Fatigue Performance of Rib-to-deck Joint in Orthotropic Steel Bridge Deck with New Type of Both-Side Fillet Welded Joints

*Qinghua Zhang, Jun Li, Daoyun Yuan, Yizhi Bu, Gongyi Xu*

S7-19

An analytical Method for Evaluating the Fatigue Life of Perfobond Leisten Shear Connector Group under Cyclic Loading

*Qinghua Zhang, Donglin Jia, Lin Xiao, Yizhi Bu, Qiao Li*

S7-27

Comparison of Different Design Codes on Fatigue Assessment of Typical Welded Joints in Orthotropic Steel Bridge Decks

*Yun Huang, Qinghua Zhang, Yawen Guo, Yizhi Bu*

S7-35

## **Fiber reinforced structures**

An Update of Past Visions of Fiber Reinforced Megastructures

*Urs Meier*

S8-1

Repair of an Orthotropic Slab with UHPFRC Slab: Bridge at Illzach in France, Return from Experience after 5 years

*Grégory Génèreux, Damien Champenoy, Thibaut Perrin, Sébastien Fyon, Alain Simon,*

*Simon Pouget*

S8-9

Design and Construction of UHPFRC Deck for Replacement of Deteriorated Concrete Slab

*Yojiro Murakami, Takashi Kosaka, Akinori Sato, Seisuke Muragishi, Kimio Saito, Yasuo Kawabata*

S8-17

Crack Resistance Test and Analysis of Steel–UHPC Lightweight Composite Deck Structure

*Jun Luo, Xudong Shao, Wei Fan, Junhui Cao*

S8-25



## Negative Bending Fatigue Damage on the Steel Fiber Reinforced Concrete Composite Girder

*Chen Xu, Boyu Zhang, Qingtian Su, Hiroshi Masuya*

S8-33

## **Fire**

Performance-based Evaluation of Fire Resistance for Steel Bridges

*Di Su, Ryuta Kuniyoshi, Hiroki Kawasaki, Tomonori Nagayama*

S9-1

Analysis of the Fire Resistance of a Jack Arch Flooring System submitted to the Standard Fire Curve

*Ester García Castillo, Ignacio Paya-Zaforteza, Antonio Hospitaler*

S9-9

Performance-Based Fire Engineering for Hazard Assessment of Tall Buildings

*Pierre Ghisbain, Jenny Sideri, Reza Imani, Luciana Balsamo, Ali Ashrafi*

S9-19

Structural Analysis of the Fire Response of a Cut and Cover Tunnel

*Juan Pagan-Martinez, Ignacio Payá-Zaforteza, Antonio Hospitaler*

S9-27

## **Focus on specific megaprojects**

Railway Megaprojects: a Semi-probabilistic Approach to Windblown Sand Action

*Lorenzo Raffaele, Luca Bruno*

S10-1

The realisation of the 6.2km long Padma Multipurpose Road and Rail Bridge in Bangladesh

*V. Jones, R. Halliday, M. King, Shafiqul Islam*

S10-9

Megastructures for a Long Marine Bridge in Kuwait

*Mohamed Akraa, Georges Mauris, Aurelie Vivier, Trinh Duong, Delphine Challant,*

*Elodie Faivre, Serge Montens, Jean-Charles Vallery*

S10-19

Additive Construction of Martian Habitats

*Peter Carrato, Anne Ellis, Monserrate Román, Tony Kim*

S10-29

The New Large Space Frame - TAMA-SUDARE

*Junichi Sasaki, Tatsuya Yamada*

S10-37

## **Innovative buildings**

Construction of the Great Mosque of Algiers – A Megastructure Developing a New City District

*Jan Akkermann, Alexander Hewener, Eric Fischer*

S11-1

Multihalle Mannheim – a Contribution to the Discussion about Maintenance Ideas and

Visions

for Future Utilization

*Eberhard Möller, Joachim Fischer*

S11-11

Post Fracture Design of the NGI Sculpture Court Structural Glass Roof

*Jorge Hidalgo, Matt King*

S11-21

The Construction of a New Icon in Düsseldorf

*Ingo Müllers, Ralf Tesch, Michael Stahl, Guido Hulbert*

S11-29

Resource Efficient Multifunctional Commercial Buildings

*Richard Stroetmann, Lukas Hüttig*

S11-37

## **Innovative cable structures**

New Cable Stayed Bridge Across Storstrømmen

*Barbara MacAulay, Erik Stoklund Larsen*

S12-1

The Longest Axially Supported Cable-stayed Bridge in India: Chambal River Bridge

*Erica Calatozzo, Serge Montens, Mathieu Muls, Jean-Charles Vallery*

S12-9

High Rigidity Suspension Bridges

*Marco Novarin, Julien Erdogan, Nicolas Fabry, Michal Ambor, Sebastien Petit*

S12-17

Cable Stays – Asset Protection and Enhancement

*Andreas Schwarz, Philipp Egger, Rachid Annan*

S12-25

Analytical Study on Safety Level of Stay Cables of Cable-stayed Bridge and Extradosed Bridge under Fatigue and Ultimate Limit States

*Khawaja Ali, Hiroshi Katsuchi, Hitoshi Yamada, Haeyoung Kim*

S12-33

Exploration of Long-span Cable Truss Structures

*Namhee-Kim Hong, Hyun-Moo Koh, Sung-Gul Hong*

S12-41

Crossing the Ganges: The World's Longest Extradosed Bridge

*Brook R. Robazza, Morgan T. Trowland*

S12-49

Design of Multi-Span Extradose Bridges in India: Two Case Studies

*Morgan Trowland, Brook Robazza*

S12-57

Msikaba and Mtentu River Bridges – Large Scale Infrastructure in Rural South Africa

*Nick Fuchs, Stuart Withycombe, John Anderson*

S12-65

Design & Construction of Iconic Signature Bridge in Delhi

*Venkat Haggade, Shishir Bansal*

S12-73

## **Innovative designs**

Innovation Design for New Style Truss Bridge in China

*Gongyi Xu, Zhangong Fu, Xiaolin Liu*

S13-1

Innovative Idea and Practice of Combined-Type Bridge Building

*Shi Dong Luo*

S13-9

Reliability of Inflatable Bridge Structures: Challenge and First Results for a New Eurocode

*Jean-Christophe Thomas, Franck Schoefs*

S13-19

Bridging the Gap between 1st World Innovation and 3rd World Implementation

*Christiaan J. Jurgens, Jan A. Wium, Jean-Claude Labuschagne*

S13-27

One Single Model: a New Parametric Approach to Megastructures

*Massimo Maffeis, Andrea Biasi, Fabio Ceccato, Enrico Mazzarolo, Luca Michelini*

S13-35

Innovative bionic design of flat slabs

*Martina Schnellenbach-Held, Julian Mueller*

S13-43

Innovative Developments of Steel and Concrete Composite Plates for two Recent Bridges in

France, St Lazare Bridge and Viaduct of Guerville

*Didier Guth, Claude Remy, Boris Fabre, Régis Boutes*

S13-51

Lakeside Office Development on Dolomitic Ground

*Kim Timm, Michael Sykes*

S13-59

Optimization-driven Conceptual Design of Long Span Bridges

*Helen Fairclough, Matthew Gilbert, Andrew Tyas, Aleksey Pichugin*

S13-67

Hybrid Analytical Modeling of Bridge Structures: An Innovative Approach

*Afshin Hatami, Rakesh Pathak*

S13-75

## **Maintenance and management**

A Life-cycle Analysis Approach applied to the Strengthening of the Jarama Steel Bridge

*André Orcesi, Adélaïde Feraille, Sylvain Chataigner*

S14-1

Presentation of the French Project DéCoF-Ré

*Véronique Bouteiller, Lucas Bourreau, Laurent Gaillet, Franck Schoefs, Benoit Thauvin,  
Julien Schneider*

S14-11

Scanning of Existing Structures – an Entry into BIM

*Maximilian Garsch, Thomas Hertle, Andreas Wehner, Julian Pimpi, Norbert Gebbeken*

S14-17

Added Value of Chloride Measurement on Wharves from SHM: a Case Study of iMareco2 Project

*Franck Schoefs, Mestapha Oumouni, Yann Lecieux, Cyril Lupi, Michel Roche, Dominique Leduc, Virginie Gaillard, Dominique Follut, Pascal Lijour and Marc Labegorre*

S14-25

Condition Assessment and Maintenance Strategies for Bridges at Individual and Network Level

*Ye Xia, Peng Wang, Bin Kang, Yonghai He*

S14-33

## **Marine structures**

Lifecycle Assessment of Different Constructive Solutions in Aggressive Maritime Environments: Application to the Viaduct of the Oil Terminal of the Port of Leixões

*Carlos Miguel Gomes de Sá, José Campos e Matos*

S15-1

Case Study Analysis of Wharf Repair Projects

*Xavier Hallopeau, Nick Critchley, Olivier Lesieutre*

S15-9

Large Scale Locks (9,000 tons) in Lanaye, Ivoz-Ramet and Ampsin (Belgium)

*Michaël Bonivers, Yannis Goblet, David Monfort*

S15-19

Statistical Characterisation of Chloride Ingress Parameters from Normal and Accelerated Tests

*Thanh-Binh Tran, Emilio Bastidas-Arteaga, Franck Schoefs*

S15-27

Cost-Effective Climate Change Adaptation for Reinforced Concrete Structures Subjected to Chloride Ingress

*Emilio Bastidas-Arteaga, Mark G Stewart*

S15-35

Very Large steel-concrete Composite Offshore Pontoon-type Structure: Concept and Analysis

*Xiao-Qiang Wang, Mu-Xuan Tao*

S15-43

Durability Design of the Concrete Caissons for the Artificial Peninsula of Monaco Territory  
*Christian Crémona, Matthieu Jeusset, Christophe Vallée, Dominique Voltz, Basma Zouhny*

S15-51

FLOATGEN – Design and Construction of the First Floating Wind Turbine in France  
*Nicolas Jestin, Perceval Modiano, Régis Bigard, Christian Cremona, Bertrand Dumas*

S15-59

## **Metro projects**

Extension of Line 1 of Lille City Metro

*Aurélie Vivier, Marc Chojnacki, Charles Henry Descamps, Hervé Laproye, Julien Texier, Olivia Geneau*

S16-1

New Metro Infrastructures Projects: From Design to Long-term Reliable Operation  
*Bertrand Collin, Floriane Galléa, Pierre Carreaud, Hervé Lançon, Mickaël De Mengin*

S16-9

Structural challenges of Transit Oriented Developments above or in proximity to existing underground Metro Stations and Tunnels

*Evangelos Astreinidis, Christos Tsatsanifos, Paraskevas Patsioras, Petros Chronopoulos*

S16-17

Sydney Metro Cable Stayed Bridge, a Meeting of Precast Segmental Concrete and Cable Stayed Construction Technology

*John Anderson, David Jefferson, Derik Hanekom*

S16-25

The Railway Station Project under the CNIT in La Défense, Paris: Answers to Complex Constraints

*Michel Pré*

S16-33

## **Novelty in construction**

Erection Engineering of the Skytrain Cable Stayed Bridge

*Sameer Khan, George Kapos, Omar Nabeel, Marcin Tykocki*

S17-1

Span by Span Segmental Construction: OPS Impact in the LG50-S Laguna Case

*Pedro Pacheco, André Resende, Alberto Torres, Hugo Coelho*

S17-9

Stiffening Deck Erection Work for New Millennium Bridge, Multiple Span Suspension Bridge

*Jungin Kim, Jinhyuk Choi, Sangseung Lee, Junho Lee*

S17-17

Numerical Analysis of Wired Connections of the Reinforcement Bars of Steel Cages: the



Slashtying

Technique

*Konstantinos N. Kalfas, Alfredo Camara, Brett Mckinley*

S17-25

New Accelerated Prefab Bridge Scheme – the NRW Bridge Modules

*Abdalla Fakhouri, Katrin Baumann, Markus Gabler*

S17-33

Motsa Bridge, Israel - Design and Construction Engineering Challenges

*Jacques Combault, Jindrich Potucek*

S17-41

Structural Development of Tensile Type Bolted Connections for Temporary Emergency Bridge

Focusing on Rapid Election

*Yuma Sugimoto, Takashi Tamaguchi, Yuki Mineyama*

S17-49

Suspensions Bridge Construction with Cohestrand® – Installation in Jungle Conditions

*María Teresa Sánchez Sánchez, Nicolas Fabry*

S17-57

Volgograd Arena Stadium Roof Lifting, Volgograd, Russia

*Lucie Waechter, Giulio Maria Scotto, Gökce Kizildere*

S17-65

Building Bridges using Thin-walled Pre-fabricated Elements

*Johann Kollegger, Stephan Fasching*

S17-73

## **“Nouvelle Route du Littoral” viaduct**

The Challenges of a Cyclonic Region for the Construction of a Viaduct with a Launching Girder

*Julia Revuz, Antoine Simon, Thierry Duclos, Romain Leonard, Olivier Flamand*

S18-1

The High-performance, Height-adjustable, Load-measuring Bearings of the New Route du Littoral Offshore Viaduct in La Réunion

*Adel Yousfi, Thomas Spuler, Colm O’Suilleabhain*

S18-9

A Particular Studies Management for an Unusual Bridge Project at Sea at la Réunion Island

*Romain Léonard, Thierry Duclos, Gilles Causse, David Compte*

S18-17

Zourite, a Kraken for Maritime Works

*Olivier Jestin, David Compte*

S18-25

A New Pier Head Connection for an Uncommon Bridge

*Laurent Bailly, Brahim Djessas, Antoine Simon*

S18-33

## **“Queensferry” and “Bosphorus” bridges**

Cable Stays – Queensferry Crossing

*Simon Ruas, Rachid Annan*

S19-1

The Extraordinary Noise-reduced Modular Expansion Joints of the Queensferry Bridge

*Arno Leegwater, Niculin Meng, Max Brüninghold*

S19-9

The Third Bosphorus Bridge – Erection Sequences of the Main Span

*V. de Ville de Goyet, A. Propson, C. Peigneux, Y. Duchene*

S19-17

The Third Bosphorus Bridge: an Important Milestone on Long-span Cable Technology Development

*Julien-Erdem Erdogan, Matthieu Guesdon*

S19-25

## **Railway bridges**

Engineering structures for the CNM HSL

*Yi Zhang, Dominique Regallet, Philippe Gillet, Etienne de Boissieu*

S20-1

The Vidourle Viaduct

*Yi Zhang, Dominique Regallet, Sylvain Boireau, Christian Charpin*

S20-11

Numerical Analysis of Large Amplitude Nonlinear Vibration of High-Speed Train PRC Bridges and Design of Tuned Mass Dampers

*Atta E Mustafa, Tsukasa Mizutani, Tomonori Nagayama, Su Di*

S20-19

Design of High-Speed Railway Bridges with Earthquakes

*Yinghong Cao, Todd Ude*

S20-27

Feasibility Study for Large Span Railway Suspension Bridge in China

*Heqiang Tang, Gongyi Xu, Hanshun Liu*

S20-35

Superstructures of the CEVA Railway Stations

*Bernard Adam, Philippe Menétrey*

S20-43

Recalculation of the Railway Bridge Buggenum

*Sander van Alphen, Bert Hesselink*

S20-51

Running Safety of a High-Speed Train Through a Multi-Span Bridge under a Non-Uniform

Moderate Earthquake

*Dong-Ho Choi, Di Mu*

S20-59

Train-Bridge Dynamic Analysis Theory for Super Major Bridges and Its Engineering Applications

*Mang-mang Gao, Xiao-guang Liu*

S20-67

Train Structure Interaction during Ship Impact for the New Storstrøm Bridge

*Alexander R. Stäblein*

S20-75

Design of the Colne Valley Viaduct, a 3.4km-long HSR Viaduct in a Highly Sensitive Area

*Héctor Beade-Pereda, Martin Knight, David Smith, Tomás García*

S20-83

Preventive Maintenance on Superstructure and Pier of Aged Short-Span Steel Railway Structures

*Weiwei Lin, Nozomu Taniguchi, Teruhiko Yoda*

S20-91

Design Key Parameters for Simply-Supported Beam of High-Speed Railway in China

*Zhuo Chen, Zai-tian Ke, Mang-mang Gao*

S20-99

## **Retrofitting and repair**

Diagnosis and Restoration of Four Historical Eiffel-Type Rail Viaducts

*Cédric Lamarsaude, Renaud Leconte, Christophe Raulet, Claire Defargues*

S21-1

Widening of the 400 m Span Cable-stayed Bridge over the Rande Strait in Spain

*Álvaro Serrano-Corral, Miguel Rupérez-Astarloa*

S21-9

Stay Cable Replacement and Preservation of the Pertuiset Bridge for Strengthening

*Nicolas Kaczowski, Vanessa Buchin-Roulié, Oussama Bouchhima, Nicolas Travers*

S21-17

The Design of Strengthening and Refurbishment Works to the M4 River Usk Bridge, Wales

*Tony Harris, Richard Owen, Jason Hibbert*

S21-25

Development and Application of FASSTbridge Solution to Jarama bridge (Fast and effective Solution for Steel bridges lifetime extension)

*Sylvain Chataigner, Karim Benzarti, Gilles Foret, Jean François Caron, Marc Quiertant,*

*Maria Zalbide, David Garcia, Inigo Calderon, Ignacio Pinero, Gianluca Gemignani*

*Collanti Concorde, Vottorio Veneto, Veit Birtel, Frank Lehmann, Mazen Wahbeh,*

S21-35

*Rami Boundouki, Elena Martin, Luis Sopena, Mark Weidemueller, Michael Fischer, Concepcion Iborra*

Strengthening an Existing Low-Rise for Conversion to a New Hip Hotel with a Rooftop Swimming Pool, Bangkok

*Samard Buddée*

S21-45

Punching Shear Strength of Concrete Slabs by Overlay of UHPC with Textile Reinforcement

*Sung-Gul Hong, Hyun-Soo Youm, Namhee K. Hong*

S21-53

Reinforcement of Felix Houphouët-Boigny bridge in Abidjan

*Ludovic Picard, Nicolas Descamps, Emmanuel Simon, Frédéric Menuel, Hamadi Gabouge,*

*Amandine Chambosse*

S21-61

Application of Finite Element Methods to Masonry Bridges

*Steve Rhodes, Philip Icke, Paul Lyons*

S21-71

Strengthening of Two Major Highway Viaducts in Germany

*Balthasar Novák, Jochen Reinhard, Eberhard Pelke, Vazul Boros, Carolin Roth*

S21-79

Rehabilitation of Flon Arch Bridge

*Claude Broquet, Guillaume Fargier, Philippe Menétrey*

S21-87

Prolife: Strengthening a Steel Railway Bridge with Deck Sections

*Arjen Steenbrink, Mark van der Burg, Bert Hesselink*

S21-95

Staged Structural Assessment of a Large Concrete Box-girder Bridge

*Timo de Goede, Rob Vergoossen, Henryk Nosewicz, Henk Sliedrecht*

S21-103

Widening and Upgrading of the 77-years old Y-Bridge in Ho-Chi-Minh City

*Elie Attie, Vanessa Buchin-Roulie, Nicolas Kaczkowski, Umut Aldatmaz, Michal Ambor Alain Granet, Hoang Thang Tran*

S21-111

## **Risk management**

Influence of the Design Review Process on the Structural Design Engineer due to Human Factors

*Eric Brehm, Robert Hertle*

S22-1

A Systematic Review for the Implementation of Risk Management within Construction of Mega Housing Projects

*Mohamed Nabawy, Charles Egbu, Maged Morcos*

S22-11

Communication: Megaprojects' Biggest Risk that No-one is Talking about

*Christiaan J. Jurgens, Richard N. Matchett*

S22-21

Multi-hazard Risk Assessment of Bridges Considering Climate Change

*Omid Khandel, Mohamed Soliman*

S22-29

Risk Analysis of Vehicle on Bridge Deck During Strong Side Wind

*Se-Jin Kim, Ho-Kyung Kim, Won-Suk Park*

S22-37

Seismic Probabilistic Risk Assessment of Weir Structures considering the Earthquake Hazard in

the Korean Peninsula

*Byoungnan Choi, Jahangir Alam, Dookie Kim*

S22-43

## **Seismic design and retrofiting**

Seismic Assessment and Retrofit of the Caronte Viaduct (A55 Highway, Martigues)

*Denis Davi*

S23-1

Earthquake Countermeasures of Power Poles in Service on Railway Viaducts

*Daisuke Tsukishima, Kiyotaka Sugita*

S23-7

Contributions of Higher Modes of Tall Piers under Seismic Excitation

*Xu Chen, Jian-zhong Li*

S23-15

Seismic Performance of Composite Inverted Pendulum Light Railway Station

*Liyan Xu, Xin Nie, Liangdong Zhuang*

S23-23

Investigation of Bearings Unseating of Cable-stayed Bridges under Earthquakes

*Yong-xing Li, Wen-jing Xu, Jiang Yi, Jian-zhong Li*

S23-31

Innovative Ways of Dealing with Existing Problems: How to reliably Assess the Cause of Damage of Masonry Structures in an Area with Man-induced Earthquakes?

*Karel Terwel, Roel Schipper*

S23-39

Difficulties on Earthquake Design due to Standards Limits on an Extensive Offshore Bridge, Sheikh Jaber Al-Ahmad Al-Sabah Causeway in Kuwait

*Aur lie Vivier, Georges Mauris, Mohamed Akraa, Serge Montens*

S23-47



Experimental Study on Seismic Behaviour of Precast Piers with Combined Grouted Sleeve Splice and Grouted Central Tenon

*Zhao Liu, Gan Lu, Weiding Zhuo*

S23-57

Optimum Deck and Tower Configurations for the Transverse Seismic Response of Cablestayed Bridges

*Alfredo Camara, Eleftheria Efthymiou*

S23-65

Modelling of Structural Damping in Time History Analyses of Seismic Response of Chacao Bridge

*Lars Halvor Kaasa, Kristin Nessa, Jarle Rønvik, Svein Erik Jakobsen, Aymen Cheikh Mhamed*

S23-73

Influence of Phase Polarity of Bidirectional Seismic Ground Motion on Dynamic Response of Asymmetric Bridges

*Akira Igarashi, Subaru Gigyu*

S23-83

Effect of Accelerogram Trajectory of Bi-directional Spectrum-Compatible Waves on Nonlinear

Seismic Response of Structural Model

*Kazuma Inoue, Kazuaki Watanabe, Akira Igarashi*

S23-91

Effect of the Valley Slope on the Seismic Response of Deepwater Rigid-frame Bridge

*Jiarui Zhang, Kai Wei, Haifeng He*

S23-101

Modelling the Seismic Out-of-plane Behaviour of Rammed Earth Components

*Reza Allahvirdizadeh, Daniel V. Oliveira, Rui A. Silva*

S23-109

Reproduction of Long-span Bridge Seismic Responses Involving Tower-girder Pounding and Tower Link Failure Estimation for Large Earthquakes

*Tomoaki Takeda, Tsukasa Mizutani, Tomonori Nagayama, Yozo Fujino*

S23-117

An Experimental Study on Seismic Performance of Concrete-Filled Steel Piers

*Shinya Kanda, Takuro Matsubara, Hitoshi Tajima, Yoshiaki Okui, Kenichi Shiji, Seiji Okada*

S23-125

Investigation on Phase Lag of Bidirectional Model in Nonlinear Seismic Analysis

*Yanyan Liu, Akira Igarashi*

S23-133

Lessons Learnt from the 14th November Kaikōura Earthquake and Next Generation of Resilient Solutions for Bridges

*Brandon McHaffie, Ana Sarkis, Royce Liu, Alessandro Palermo*

S23-141

Shake Table Studies of Seismic Damage of a Kilometre-scale cable-stayed Bridge

*Wei Guo, Jianzhong Li, Zhongguo Guan*

S23-149

Numerical Seismic Assessment of Masonry Made of Compressed Earth Blocks

*Riccardo Nitiffi, Maura Imbimbo, Ernesto Grande, Daniel V. Oliveira*

S23-157

## **Structural Health Monitoring**

Design and Sustainable Management of Liquid Wastewater Treatment Network using the GIS

Tool and the Space-based Database (Geo-LD)

*Abdessalam Hijab, Hafida Boulekbache*

S24-1

Measurements and simulation of temperature in a portal frame bridge

*Erik Gottsäter, Oskar Larsson Ivanov, Miklós Molnár, Mario Plos*

S24-9

Use of low-cost GNSS receivers for Structural Health Monitoring

*Nicolas Manzini, André Orcesi, Antoine Clément, Miguel Ortiz, John Dumoulin*

S24-17

Prediction of Breakage Position and Remaining Fatigue Life of Corroded Bridge Wires using 3D

Scanner

*Kazuhiro Miyachi, Shunichi Nakamura*

S24-27

Forces in Temporary Piers in Bridge Built using Balanced Cantilever Method

*Jakub Jan Jarosz*

S24-35

An Adaptive NDT Inspection Strategy to Assess the Spatial Variability of Concrete Structures

*Mestapha Oumouni, Franck Schoefs*

S24-43

New Spatial Correlation Assessment Procedure: Application to Île-de-Ré Bridge Data

*Romain Clerc, Franck Schoefs, Mestapha Oumouni*

S24-51

Uncertainty Assessment and Decision from Concrete Electrical Resistivity Measurements on a

Coastal Large Bridge

*Lucas Bourreau, Véronique Bouteiller, Franck Schoefs, Laurent Gaillet, Benoit*

*Thauvin,*

*Julien Schneider, Samuel Naar*

S24-59

Effect of Steel Reinforcement on Electrical Measurements on Concrete

*Marie Antoinette Alhaji, Géraldine Villain, Sérgio Palma-Lopes*

S24-65

Better Understanding of Tide's Influence on Half-cell Potential Measurements for Reinforced Concrete in Marine Environment

*Lucas Bourreau, Véronique Bouteiller, Franck Schoefs, Laurent Gaillet, Benoit*

*Thauvin,*

*Julien Schneider*

S24-73

Compatible Deformation in the Condition Assessment of Beam Structures

*Jun Lei, Dong Xu, Jose Turmo*

S24-79

Improving the Reliability of On-site Concrete Strength Estimation with Non-destructive Techniques

*Denys Breyse, Jean-Paul Balayssac, Xavier Romao, Maitham Alwash*

S24-87

Monitoring Cracks on Concrete Surfaces using Multi-temporal Images

*Bruno O. Santos, Jónatas Valença, Eduardo Júlio*

S24-95

Long Term Monitoring of Millau Viaduct

*Antoine Clement, Hervé Lançon, Emmanuel Cachot, Claude Servant*

S24-103

Structural System Identification of Shear Stiffnesses in Beams by Observability Techniques

*Jose A. Lozano-Galant, Seyyed Behrad Emadi, Gonzalo Ramos, Jose Turmo*

S24-111

Potentials of Autonomous UAS and Automated Image Analysis for Structural Health Monitoring

*Jens Kersten, Volker Rodehorst, Norman Hallermann, Paul Debus, Guido Morgenthal*

S24-119

Lessons Learnt from Full-Scale Tests of Bridges in Croatia and Sweden

*Ivan Duvnjak, Marko Bartolac, Jonny Nilimaa, Gabriel Sas, Thomas Blanksvärd, Björn Täljste,*

*Lennart Elfgren*

S24-127

## **Special session on Forensic engineering**

A multilevel Approach for the Structural Vulnerability Assessment of Historical Water Tunnels.

The Case of the Apulian Aqueduct

*Fabrizio Palmisano, Pasquale Perilli, Luciano Venditti, Gianluca Casamassima, Gerardo Ventafridda*

S25-1

A Numerical Study on Prediction of Collapse Pressure of UOE Pipes

*Jiwoon Yi, Soo-Chang Kang, Jinkyoo F. Choo, Do Been Kim, Wonsuk Park, Hyun-Moo Koh*

S25-9

Merrison Revolutionised Design after 1970 UK Box Girder Collapses

*Jonathan G M Wood*

S25-17

Seismic analysis of the San Sebastian Basilica (Philippines)

*Nicole O'Hearne, Nuno Mendes, Paulo B. Lourenço*

S25-25

Knowledge Model for Forensics in Civil Engineering

*Denys Breyse, Franck Taillandier, Cedric Baudrit*

S25-33

### **Special session on Innovations towards improved seismic resilience and upgrade of existing structures**

Experimental Studies of Seismic Performance of Precast Concrete Columns with High-strength

and Conventional Steel Rebar

*Weiding Zhuo, Zhao Liu, Teng Tong*

S26-1

Seismic Upgrade of a Reinforced Concrete Building using Friction-Pendulum Isolators

*Christos Giarlelis, Dimitrios Koufalis, Panagiotis Antoniadis, Costis Repapis*

S26-9

Seismic Retrofit of Industrial Building using Damping Devices

*Devis Sonda, Marco Cossu, Andrea Pollini*

S26-17

Seismic Performance of Precast Segmental Bridge Piers with High-strength Bars based on Cyclic Loading Test and Numerical Simulation

*Teng Tong, Weiding Zhuo, Zhao Liu*

S26-25

Evaluation of Response Modification factors in moment resisting frame buildings considering Soil Structure Interaction

*Farheen Kanwal, Ahmed Munir*

S26-33

Implementing Resilience in Practice: Design for All in Anticipation of Earthquake Disaster

*Jon Moseley, Stephanos Dritsos*

S26-41

Simple Strengthening Techniques for Non-engineered Buildings against Seismic Actions

*Marina Traykova, Christos Giarlelis, Andreas Lampropoulos, Stephanos Dritsos, Jon Moseley*

S26-49

Seismic Upgrading of Reinforced Concrete Columns by FRP Jacketing

*Efstathia Liakopoulou, Sotiria Athanasopoulou, Stephanos E. Dritsos*

S26-57

Fibre Reinforced Geopolymer versus Conventional Reinforced Concrete layers for the structural strengthening of RC beams

*Mohammed Haloob Al-Majidi, Andreas Lampropoulos, Andrew Cundy, Ourania Tsioulou, Salam Alrekabi*

S26-65

Structural upgrade of deficient Unreinforced Masonry structures using Ultra High Performance Fibre Reinforced Concrete

*Andreas Lampropoulos, Ahmad Tasji, Ourania Tsioulou*

S26-75

### **Special session on Structural health monitoring**

Structural Health Monitoring of Existing Bridges using Bridge Weigh-in-motion Measurements

– Value of Information Analysis

*Dominik Skokandić, Ana Mandić Ivanković, Aleš Žnidarič*

S27-1

Condition Assessment of Timber Structures – Quantifying the Value of Information

*Mislav Stepinac, Vlatka Rajčić, Daniel Honfi*

S27-9

Value of Information in the Maintenance of a Tendon supported Large Span Roof

*Mariusz Maślak, Michał Pazdanowski, Tomasz Howiacki*

S27-19

Optimizing Monitoring – Implementation of Draft Guideline and Case Study of Roof Exposed to Snow Loads

*Dimitris Diamantidis, Miroslav Sýkora*

S27-27

Failure Probability for Extreme Load Cases evaluated by FE-calculations – A Case Study for the

Rockfall Protection Gallery Rieinertobel

*Yusuke Kurihashi, Masato Komuro, Matthias Schubert, Rocco Custer, Kristian Schellenberg*



S27-35

Rating of Prognostic Performance Indicators through the Indicator Readiness Level

*Maria Pina Limongelli, André Orcesi, Anja Vidovic*

S27-43

Bridge quality control using Bayesian net

*Dušan Isailović, Rade Hajdin, Jose Campos e Matos*

S27-51

An Overview of the European Situation on Quality Control of Existing Bridges

COST Action TU1406

*José C. Matos, Joan R. Casas*

S27-59

## **Special structures**

Ultra High-rise Building with High Seismic Performance using High Efficiency Hybrid Vibration

Control System: [Tokyo Garden Terrace Kioicho] Kioi Tower

*Yuichi Koitabashi, Seiya Kimura*

S28-1

Modern Wind Turbines - Challenges and New Design Technologies for Tower Structures

*Marion Rauch*

S28-9

Reconstructing the Iron Age in 21st Century Style

*Elana Rautenbach, Kim Timm*

S28-17

Ashalim Solar Tower

*Jean-Bernard Datry, Audrey Zonco, François Prongue, Thomas Dum, Gilles Oudin*

S28-25

Success of Dam Engineering Industry Projects in Australia: Literature Review and Theoretical Framework

*Pouya Amirsayafi, Xiaohua Jin, Sepani Senaratne*

S28-33

Design Redundancy Analysis and Optimization for Steel Frame Structure

*Xin Zhao, Jianzhe Zhao*

S28-43

The First Engineered Pedestrian Bridge using Small Diameter Indonesian Teak Woods: From Design to Project

*Ali Awaludin, Bambang Supriadi, Maris Setyo Nugroho, BuanAnshari, Zakiah Ahmad*

S28-49

Pont de l'Espace Grotte in Lourdes, Movable Footbridge upon the Gave de Pau (France)

*Christophe Peigneux, Vincent Servais*

S28-57

Numerical Analysis and Theoretical Studies on Progressive Collapse of Suspend Dome

## Structures

*Zhenyu Xu, Xianzhong Zhao, Shen Yan*

S28-65

5/6 Arches: a Megastructure becoming a land marking Monument

*Silvia Geyer, Claudio Pin, Daniela Lombardini*

S28-73

Glass Sails of the Fondation Louis Vuitton: Approach to Robustness

*Matt King, Jorge Hidalgo, Africa Garcia*

S28-81

AQUATIS – Museum and Aquarium in Lausanne above a Car Park with Metro Connection

*Verena Pierret, Michel Porcelli, Marco Bosso*

S28-89

Comparative Study of Quasi-static and Dynamic Behaviours of a Reduced Model of ASM4

Rockfall Barriers

*Romain Boulaud, Cyril Douthe*

S28-97

Roof of the Lille Stadium: Instability Phenomenon in Cover-plates of Tensed-plate

*Vincent de Ville de Goyet, Sébastien Seret, Arnaud Propson, Charles Havelange*

S28-107

Lightweight Megastructure: Design and Construction of a 100m Span Dome in Manila

*Catherine Poirriez, Yacine Bouzida*

S28-115

Building Complex Shapes with Simple Tools: Fast Track Design of “the Future of Us” Gridshell  
in Singapore

*Catherine Poirriez, Yacine Bouzida*

S28-123

Technical Issues on Construction of Cable-stayed Bridge using UHPC

*Jihoon Lim, Minjae Lee, Jun-ho Lee, Jungin Kim, Jahgeol Yoon*

S28-131

## Steel structures and technologies

Complementary Zinc Coatings

*Martin Gagné, Frank E. Goodwin, Martin van Leeuwen*

S29-1

Welded Connections in Innovative High Strength Steel Constructions

*Jennifer Spiegler, Ulrike Kuhlmann*

S29-7

Buckling of Curved Webs in Steel Box Girders

*Gilles Van Staen, Hans De Backer, Philippe Van Bogaert*

S29-15

An Innovative Fabrication Process from Rolled Helicoidal Steel Strips

*Nicolas Leduc, Jean-François Caron, Cyril Douthe, Bernard Vaudeville, Simon Aubry*

S29-23

Experimental Investigation of Shear Behavior of Cantilevered Non-Prismatic Box Girder with Corrugated Steel Webs

*Siqi Yuan, Zhao Liu, Chao Wang, Zhiqi He*

S29-31

Elastic Torsional Rigidity of Multi-cell Box Girders with Corrugated Steel Webs

*Jun He, Chuanxi Li, Chao Tan, Xiaodong Dai, Sihao Wang, Yuqing Liu*

S29-41

Newest High Performance Heavy Plates for Steel Bridges and Structures

*Cécile Merlin-Manuelli, Tobias Lehnert*

S29-49

Welds for High-Strength Steels – Development of New Design Rules

*Richard Stroetmann, Thoralf Kästner, Lars Werner*

S29-57

Performance Enhancement of High-Strength Bolted Frictional Girder Connections Focused on

Bearing Bolt Hole Deformation

*Hitoshi Moriyama, Takashi Yamaguchi, Hiroki Sugiyama*

S29-65

Low Temperature Behaviour of High-Strength Structural Bolting Assemblies of Large Diameters

*Christoph Lorenz, Natalie Stranghöner, Sandro Citarelli, Markus Feldmann,*

*Victoria Brinnel, Sebastian Münstermann*

S29-73

Fatigue and Corrosion as a Threat for Steel Heritage Bridges

*Martin Macho, Pavel Ryjáček, José Campos e Matos*

S29-81

## **Tall buildings**

TMD Systems for Increase of Damping within High-Rise Buildings

*Peter Huber, Luca Paroli*

S30-1

Innovative Prefabricated Robustness Solutions for Story High Buildings

*Thomas Cornelius, Guangli Du*

S30-9

Occitanie Tower, a City in the Tower: For an Interactive Structural Design with the Architecture and Multifunctionality of the Tower

*Youssef Jaradeh*

S30-17

New Paris Law Court, a Major Civil Engineering Structure in the City

Iari Agez , Audrey Zonco, Hermann Fagninou, Jean-Bernard Datry

S30-25

Simplified Procedure for Estimating Modified Response Modification Factor of a Complex High-Rise Building

*Ahmed Munir, Farheen Kanwal*

S30-33

## **The Mega-floating city**

The Mega-Floating City Green Float—Part I: Concept and Technological Innovations

*Masaki Takeuchi, Shuhei Ono, Masanobu Hasebe*

S31-1

The Mega-Floating City Green Float—Part II: Construction Planning

*Shuhei Ono, Masaki Takeuchi, Masanobu Hasebe*

S31-9

The Mega-Floating City Green Float—Part III: Verification by Experiments and Analysis

*Masanobu Hasebe, Masaki Takeuchi, Shuhei Ono*

S31-17

## **Timber construction**

Hybrid CLT-Based Modular Construction Systems for Prefabricated Buildings

*Cristiano Loss, Thomas Tannert*

S32-1

Feasibility Study of Mass-Timber Cores for the UBC Brock Commons Tallwood Building

*Thomas Connolly, Cristiano Loss, Asif Iqbal, Thomas Tannert*

S32-9

A Review of Structural Robustness with Focus on Timber Buildings

*Johannes A. J. Huber, Mats Ekevad, Ulf Arne Girhammar, Sven Berg*

S32-17

Seismic Design and Off-Site Construction of College Buildings for 500 Students with Timber Frame 3D Modules in Clisson (near Nantes, France)

*Rémi Thépaut, Patrice Sébille*

S32-27

Possibilities of Bamboo Construction: From Vernacular Techniques to Industrialized Solutions

*Hélder S. Sousa, Bhavna Sharma*

S32-35

## **Tunnels**

The Long Traffic Tunnels of Tomorrow

*Silvino Pompeu-Santos*

S33-1

The Submerged Floating Tube Bridge as an alternative for a crossing: pros and cons

*Mathias Eidem, Arianna Minoretti, Xu Xiang, Tale Aasland*

S33-9

Combining Bored Tunnels: Optimal Construction Order of Multiple Independent  
Shield-Driven  
Tunnels

*Hans De Backer, Amelie Outtier, Bart De Pauw, Ken Schotte, Ahsan Naseem*  
S33-17

## **Wind effects on structures**

Wind Engineering Challenges of Modern Footbridges

*Anna Bagnara, Stefano Cammelli, Eva Berbekar*  
S34-1

Nonlinear Flutter Collapse Analysis of the Tacoma Narrows Bridge with a New Nonlinear  
Aerodynamic Force Model

*Rui Zhou, Yongxin Yang, Yaojun Ge*  
S34-9

Aerodynamic and Aeroelastic Design of Long Span Bridges: Recommendations for Chile

*Matias Caram, Matias A. Valenzuela*  
S34-17

Re-Evaluation of Aerodynamic Stability of Suspension Bridges in Seto-Ohashi Bridges

*Akira Machida, Masahiro Takeguchi, Taku Hanai, Hiroshi Katsuchi*  
S34-25

Quantification of the Influence of Aerodynamic Model Assumptions for Dynamic Analyses of  
Bridges

*Igor Kavrakov, Guido Morgenthal, Ahsan Kareem*  
S34-33

Wind Loading of Legacy Infrastructure: Recent Experience from France

*Graham Knapp, Christian Barré*  
S34-43

Investigation of Long-Span Bridge Stability in Wind Tunnel

*Sergei Solovev, Viktor Sokolov, Artem Novikov*  
S34-51

Wind Performance Analysis Method Based on a Simplified Model for Tall Buildings with  
Viscous Outrigger

*Xin Zhao, Jiayue Li*  
S34-59

Multi-Modal Flutter Analysis of a Long Floating Bridge

*Martin N. Svendsen, Stian Moe Johannesen*  
S34-63

Super-long span bridge aerodynamics: first results of the numerical benchmark tests from  
TG10

*Ketil Aas-Jakobsen, Andrew Allsop, Igor Kavrakov, Allan Larsen, Ole Øiseth, Giorgio  
Diana,*



*Tommaso Argentini, Simone Omarini, Daniele Rocchi, Martin Svendsen, Guy Larose,  
Stoyan Stoyanoff, Ho-Kyung Kim, Teng Wu, Michael Andersen, Hiroshi Katsuchi*  
S34-71