

出國報告（出國類別：其他 國際會議）

參加 2014 年 TRB(美國運輸研究委員會)年會 出國報告



服務機關：交通部臺灣區國道新建工程局

姓名職稱：陳國隆組長

派赴國家：美國

出國期間：103 年 1 月 10 日至 103 年 1 月 17 日

報告日期：103 年 3 月 24 日

摘要：

美國運輸研究委員會（Transportation Research Board，簡稱 TRB）每年都在 1 月期間於華盛頓特區（Washington D.C.）舉辦年會暨研討會，為全球交通運輸界最具規模之學術與實務經驗交流會議，參加人員除可吸收交通運輸研究及實務經驗資訊，並可瞭解世界各地運輸領域於過去 1 年之重大研究成果及未來發展主軸，並知悉世界各國目前交通運輸政策之發展重點，作為國家未來相關議題研究與推動之重要參考，本局往年均多次派員與會觀摩學習。

本(第 93)屆 TRB 年會自 2014 年 1 月 12 日至 16 日舉行，共吸引超過 11,900 位來自世界各國之產、官、學界人士報名參加，4.5 天期間內，會議場次多達 800 餘場，發表論文超過 4,500 篇以上，筆者有幸奉派參加本屆 TRB 年會活動，得以學習新知並開拓視野，回國後爰將本次出國所見所聞，作重點式之整理介紹，並提出與會心得及建議，供有興趣讀者參考。

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參加 2014 年第 93 屆美國運輸研究委員會(TRB)年會報告

一、參訪目的

(一)TRB 簡介

美國運輸研究委員會(Transportation Research Board，以下簡稱 TRB)，成立於 1974 年，前身為 1920 年成立之美國公路研究諮詢委員會(National Advisory Board on Highway Research)及 1925 年改制之公路研究委員會(Highway Research Board)，係隸屬於美國國家研究協會(National Research Council)之非營利私人機構，設立宗旨係提供美國國家科學學院(National Academy of Science)及美國國家工程學院(National Academy of Engineering)有關交通運輸之研究成果，同時藉由辦理重要研究、促進資訊傳播和鼓勵研究成果的實際執行等方式來推動運輸發展和升級，並透過近 200 個範圍涵蓋各運輸領域之常設技術委員會和專案小組之運作，出版及傳播各項研究成果和技術報告，管理研究計畫與進行重大運輸政策研究，以及舉辦全球性年會等會務運作方式來提供服務。

TRB 組織架構有以下 5 個部門及 1 個委員會，概述如下：

- 1.技術活動部(Technical Activities Division)：專責辦理各項研討會及工作會議等活動。
- 2.研究資訊部(Studies and Information Services Division)：主管研究與資訊服務。
- 3.管理財務部(Administration and Finance Division)：負責行政管理與財務工作。
- 4.計畫研發部(Cooperative Research Programs Division)：負責辦理合作研究計畫。
- 5.特殊計畫部(Special Programs Division)：主管各項專案計畫。

6.海洋運輸委員會(Marine Board)：主管有關港埠、內陸水運之規劃與環境相關之研究計畫。

TRB 之中心任務係藉由研究及相關從業人員之互動，促進運輸界研究之創新與進步，並鼓勵促使研究結果之推動實施。除於美國國會及政府相關單位之要求下，主導運輸政策研究及維護政府運輸研究網站資訊外，並且負責舉辦每年吸引超過 1 萬名國內外運輸專業人士參加的年會，故本次年會之舉辦亦為 TRB 之重要中心任務之一。

(二)參與 TRB 年會目的

TRB 年會係全世界交通運輸相關領域最具規模之經驗交流會議，可吸收交通運輸研究及實務經驗資訊，並可瞭解世界各地運輸領域於過去 1 年之重大研究成果及未來發展主軸，並知悉世界各國目前交通運輸政策之發展重點，故參與年會除可蒐集豐富資料外，研習心得並可作為國內未來各項相關議題研究與推動之重要參考。

二、行程紀要

(一)行程表

本次奉派參加 TRB 會議核定行程自 103 年 1 月 10 日至 1 月 17 日共計 8 日，其中年會議程自美東時間 1 月 12 日至 1 月 16 日共計 5 日舉行，相關行程彙整如表 2-1 所示。

表 2-1 奉派參加第 93 屆 TRB 會議行程表

日期	起迄地點	行程紀要
1 月 10 日 (五)	臺北－華盛頓特區 (去程)	桃園中正機場－華盛頓特區
1 月 11 日 (六)	華盛頓特區	交通建設參訪
1 月 12 日 (日)	華盛頓特區	參加專題研討會
1 月 13 日 (一)	華盛頓特區	參加論文發表會、海報研討會 及參觀廠商展覽
1 月 14 日 (二)	華盛頓特區	參加論文發表會、海報研討會 及參觀廠商展覽
1 月 15 日 (三)	華盛頓特區	參加論文發表會及海報研討會
1 月 16 日 (四)	華盛頓特區	參加專題研討會、論文發表會
1 月 17 日 (五)	華盛頓特區－臺北 (返程)	華盛頓特區－桃園中正機場

(二)行程概述

本次 TRB 會議，筆者考量直飛之交通費用甚高，係先於桃園機場搭乘長榮航空至東京轉搭達美航空至紐約入境美國，再換搭 mega bus 至華盛頓 DC，入境出關及轉搭過程尚稱順利，惟轉機行程須花費甚多時間。

1 月 11 日在華盛頓 DC 稍作休息調整時差，當天並至華盛頓 DC 市區觀摩交通相關設施。

1 月 12 日前往 Hilton Washington Hotel 會場辦理報到手續（Hilton 及 Marriott 飯店皆設有註冊處，參圖 2-1），受惠於本局人事單位提早簽辦本次出國與會事宜，使筆者有充分時間在出國前即已完成註冊程序，故年會報到手續很快即辦理完成，註冊處於參加者完成報到後提供書冊 1 本（內含本次 TRB 年會 800 多場會議之名稱、時間、地點、編號及各會議與 40 項主要議題之分類關聯等資訊，參圖 2-2）及 USB 隨身碟 1 個（含作者指引功能、論文指引功能、論文內容等，參圖 2-3），大會行政流程簡潔清楚，接待人員態度親切，可供國內借鏡。

主辦單位於 1 月 12 日即開始舉辦專題討論會(Workshops)活動，另主辦單位為利首次參與年會活動之參加者儘速進入狀況，特別於當天下午安排舉行「新人歡迎會」，主要介紹說明參與年會之各項活動竅門及注意事項。

1 月 12 日至 1 月 16 日為年會研習期間，各項研習活動包括專題研討會(Workshops)、論文發表會(Sessions)、海報研討會(Poster Sessions)、委員會議(Committees)等。本屆年會主題（Spotlight theme）為「Celebrating Our Legacy, Anticipating Our Future」（慶祝我們的傳統，預見我們的未來），旨在探討重要的交通運輸問題，例如自動化駕駛及連結性車輛（automated driving and connected vehicles），巨量資料（big data），極端氣候事件（extreme weather events）及績效管理（Performance management）等，亦反映了 TRB 之年會地點於 2015 年將拜別舉辦近 60 年康乃狄克大街（

Connecticut Ave.) 上的各處飯店而移至較靠近中國城的大型會議中心 Walter E. Washington Convention Center (參圖 3-2)。

本屆年會另有 1 個重要節目活動，也就是廠商展覽(Exhibits)，展覽場位於 Marriot Wardman Park Hotel(詳圖 2-4)大會堂，展期為 1 月 13 日至 14 日共計 2 日。

1 月 16 日中午年會活動結束後，搭車回紐約，於 1 月 17 日自紐約搭達美航空離境至東京轉機返回桃園機場，結束本次 TRB 年會觀摩學習之旅。



圖 2-1 攝於報到會場(Hilton Washington Hotel)

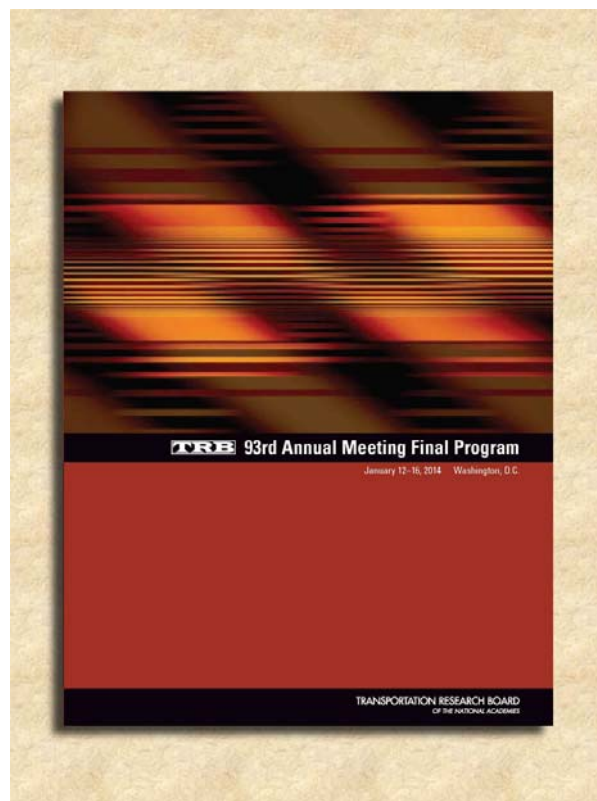


圖 2-2 研討會議程資料

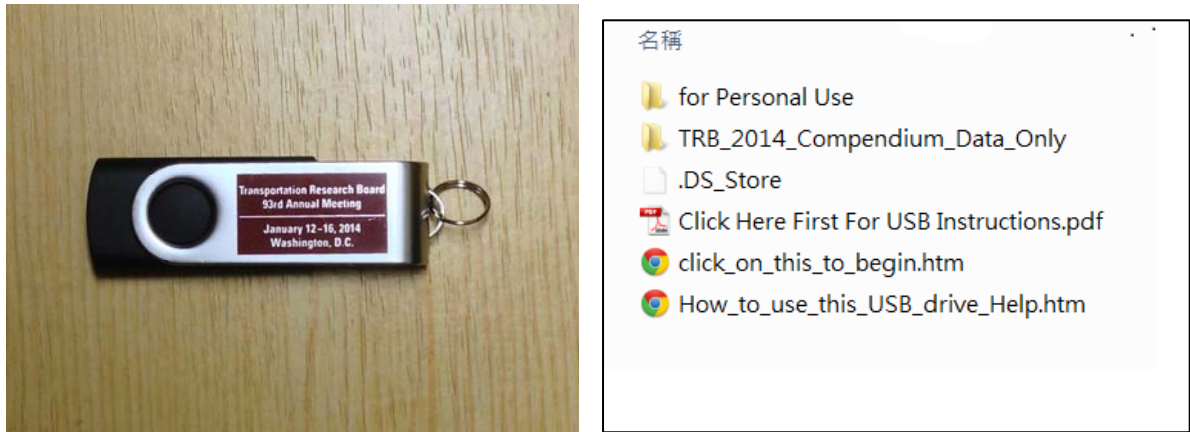


圖 2-3 會場發放 USB 隨身碟及其內含資料

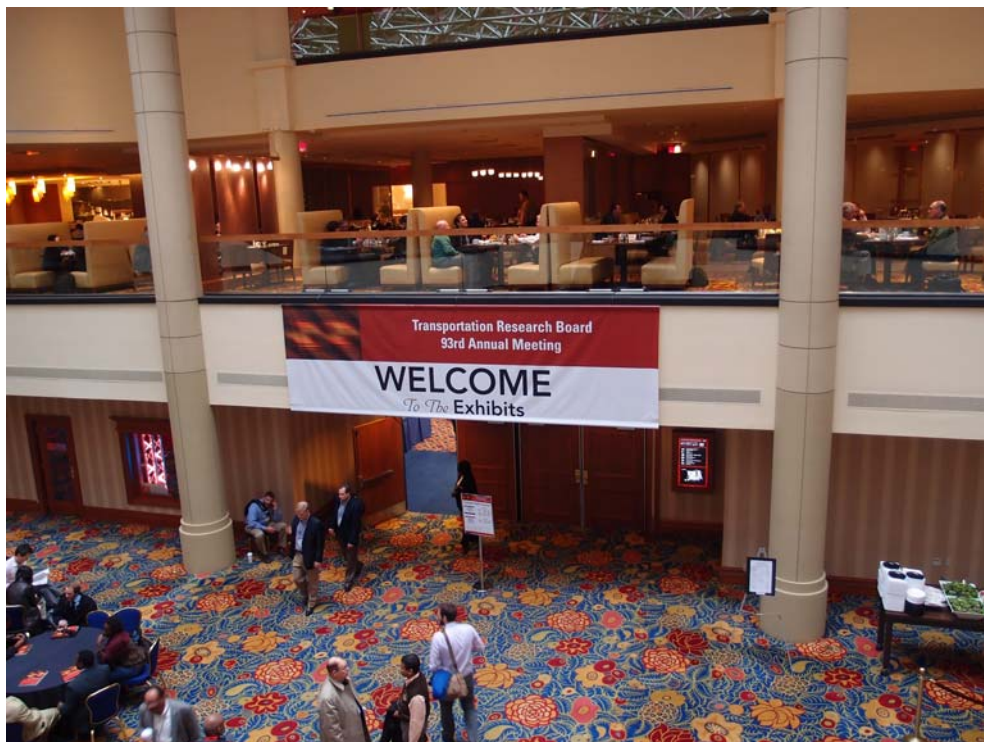


圖 2-4 廠商展覽會場入口

三、參加 TRB 年會紀要

(一)舉辦時間、地點

TRB 年會往例均於每年 1 月份在美國華盛頓特區舉行。華盛頓特區 (Washington, D.C.) 自 1800 年開始成爲美國首都 (註：1789~1790 紐約爲美國第一個首都，1790~1800 費城爲美國第二個首都)，位於美國東岸的中大西洋地區，由美國國會直接管轄的特別行政區，不屬於美國的任何一州，其又稱爲哥倫比亞特區 (District of Columbia)，或簡稱華盛頓 (Washington)、特區 (“the District”)、D.C.等，中文亦常簡稱爲華府。

華盛頓特區位於馬里蘭州和維吉尼亞州的交界處(詳圖 3-1)，兩州界河波多馬克河(Potomac River)亦爲特區與維州的界河，面積約 177 平方公里，2013 年 DC 的人口約 64.6 萬，含鄰近之大都會區人口達 570 萬。華盛頓特區是大多數美國聯邦政府機關與各國駐美國大使館的所在地，也是世界銀行、國際貨幣基金、美洲國家組織等國際組織總部的所在地，並擁有爲數眾多的博物館與文化史蹟。

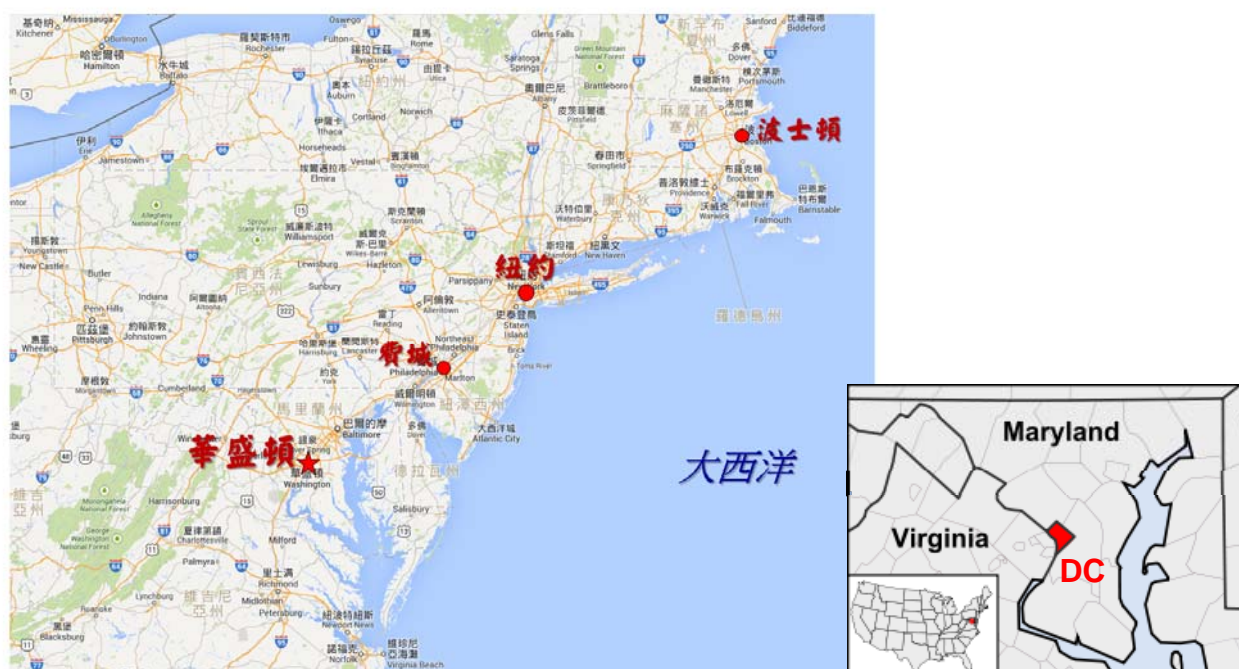


圖 3-1 美國華盛頓特區位置圖

今(2014)年第 93 屆會議於當地時間 1 月 12 日(星期日)至 16 日(星期四)中午舉行，為期 4.5 天。因會議場次多達 800 餘場，主辦單位循例分別於康乃狄克大街 (Connecticut Ave.) 上的 **Hilton Washington Hotel**、**Marriott Wardman Park Hotel** 及 **Omni Shoreham Hotel** 三處飯店(詳圖 3-2~3-6)之各會議廳舉行年會各項研習活動。

Marriott Wardman Park Hotel 為主會場，規模最大，廠商展覽 (Exhibits)之展覽會場亦在此飯店。本屆參展廠商近 200 家，佔地超過 2,500 坪，參展主題包羅萬象，軟硬體兼具，實是年會觀摩重點。主辦單位於會議期間安排有大型接駁巴士(詳圖 3-7~3-9)來回穿梭於各會場間接送與會人員，班距約 20 分鐘，往返 Hilton 及 Marriott 之車程約 5 分鐘，步行時間亦僅約 15 分鐘，而 Shoreham 與 Marriott 僅隔鄰一條街 calvert st.，往返交通可說相當便利。

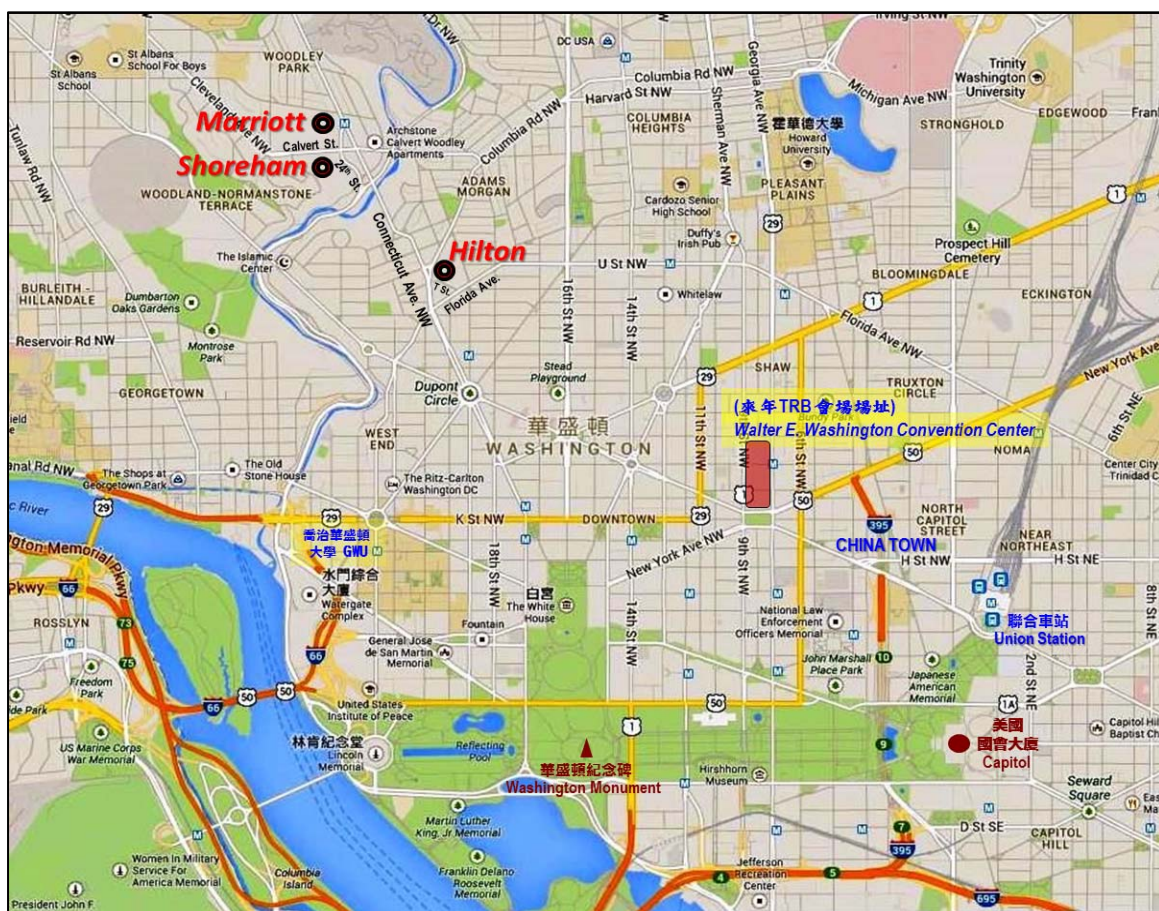


圖 3-2 第 93 屆 TRB 年會舉辦會場位置圖

三處會場均位於捷運車站附近，Marriott 與 Shoreham 緊鄰 Woodley Park Zoo 站，Hilton 靠近 Dupont Circle 站，交通四通八達，華盛頓特區捷運網路由 5 條路線組成，共 86 個車站，171 公里長度（詳細介紹資料另見本章第(五).2 節），附近景點有白宮、國家歷史博物館等，餐館、商店密佈，生活機能相當便利。（參圖 3-10）

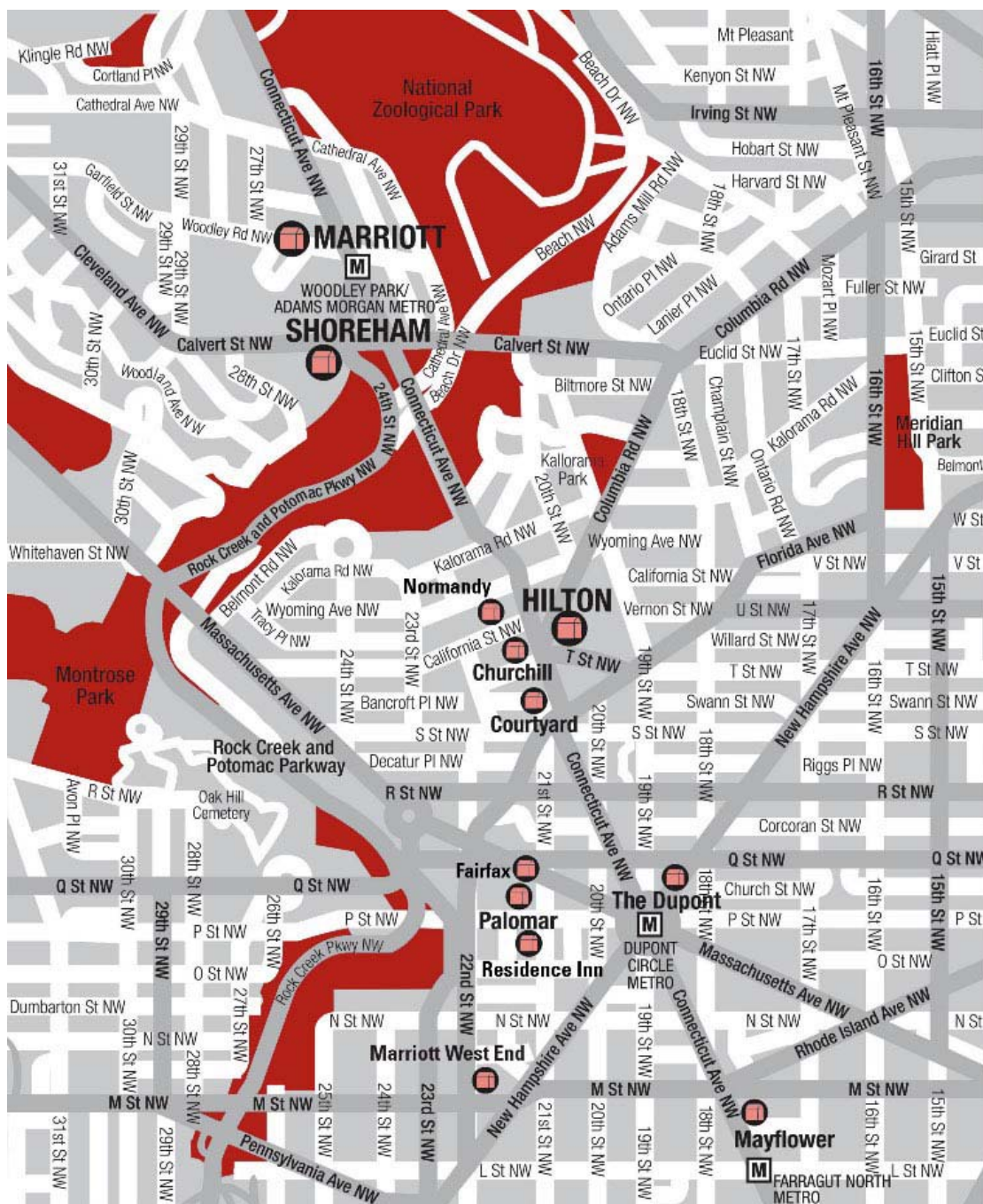


圖 3-3 第 93 屆 TRB 年會舉辦會場及附近街道地圖



圖 3-4 會場 Hilton Washington Hotel



圖 3-5 會場 Marriot Wardman Park Hotel



圖 3-6 會場 Omni Shoreham Hotel



圖 3-7 各會場間接駁巴士服務



圖 3-8 Hilton 至 Marriot 會場間接駁巴士



圖 3-9 Hilton 至 Shoreham 會場間接駁巴士



圖 3-10 華盛頓特區白宮等景點位置示意圖

(二)年會議程

本屆年會議程請詳表 3-1 所示，共計 4.5 日，包含註冊報到、新人歡迎會 (New Attendees Welcome Session)、專題研討會 (Workshops)、論文發表會 (Sessions)、海報研討會 (Poster Sessions)、委員會議 (Committees) 及廠商展覽 (Exhibits)，除委員會議需該學術委員會之委員方得參加外，其餘會議場次均可視需求自由參加。其中廠商展覽於 1 月 13~14 日上午 0930 至下午 1600 展出，海報研討會於 1 月 13~15 日，而 1 月 13 至 14 日均研習至晚間 9 點半為止，研習內容可說相當緊湊豐富，全部會議於 1 月 16 日中午結束。

本屆年會發表論文超過 4,500 篇，主辦單位將論文依屬性歸類為 40 項主要議題，分別為「經營及管理」、「航空」、「橋梁及其他結構」、「施工」、「資料及資訊系統」、「設計」、「經濟」、「教育訓練」、「能源」、「環境」、「財務」、「貨運系統」、「地工」、「歷史」、「自動化車輛」、「巨量資料」、「極端氣候事件」、「績效管理」、「水利與水文學」、「國際活動」、「法律」、「維護與保存」、「海運」、「材料」、「營運及交管」、「鋪面」、「行人及騎士」、「輸油管」、「規劃與預測」、「運輸政策」、「公共運輸」、「軌道」、「研發」、「安全與人為因素」、「保全與緊急應變」、「社團」、「年會主題」、「場站設施」、「運輸概論」、「車輛與設備」等(詳表 3-2 第 93 屆 TRB 年會主要議題一覽表)，各主要議題下安排多達 800 餘場論文發表及專題研討會等會議場次，各場會議安排數篇至 10 餘篇題目屬性相近之論文發表，每場會議並依其中論文題目訂定會議名稱，每篇約 15 分鐘發表時間，時間非常緊湊。本次 TRB 年會各主要議題之發表會議地點及其會議場次數詳表 3-3，由於會議場次甚多，又分為 3 處會議地點，參加人員可先參考表 3-3 初步過濾以其有興趣之主要議題其會議場次數較多者來選擇出席之會議地點，例如與筆者服務工作較有關係之「規劃及預測」主要會議地點在 Hilton Hotel，其他較有關係之主要議題「橋梁及其他結構」、「設計」、「施工」、「材料」、「維護及保存」、「鋪面」等主要會議地點

皆在 Marriott Hotel。本次年會主要議題及相關各場會議名稱詳附錄(一)。

表 3-1 第 93 屆 TRB 年會議程表

	Sunday January 12	Monday January 13	Tuesday January 14	Wednesday January 15	Thursday January 16
8 a.m.		COMMITTEES	COMMITTEES	COMMITTEES	COMMITTEES
9 a.m.	WORKSHOPS	SESSIONS	SESSIONS	SESSIONS	SESSIONS
10 a.m.	WORKSHOPS	POSTERS	POSTERS	POSTERS	WORKSHOPS
11 a.m.	WORKSHOPS	SESSIONS	SESSIONS	SESSIONS	SESSIONS
Noon	WORKSHOPS	POSTERS	POSTERS	POSTERS	POSTERS
1 p.m.		EXHIBITS	EXHIBITS	Chairman's Luncheon	
2 p.m.	WORKSHOPS	SESSIONS	SESSIONS	SESSIONS	
3 p.m.	New Attendee Welcome Session	POSTERS	POSTERS	POSTERS	
4 p.m.	WORKSHOPS	SESSIONS	SESSIONS	SESSIONS	
5 p.m.	Exhibit Hall Opening and Reception	POSTERS	POSTERS	POSTERS	
6 p.m.		Thomas B. Deen Distinguished Lecture			
7 p.m.					
8 p.m.		SESSIONS	SESSIONS	SESSIONS	
9 p.m.	Young Professionals Reception	POSTERS	POSTERS	POSTERS	
10 p.m.					
11 p.m.					

New Attendee Welcome Session : 新人歡迎會
 Workshops : 專題演討會 Sessions : 論文發表會
 Posters : 海報研討會 Committees : 委員會議
 Exhibits : 廠商展覽

表 3-2 第 93 屆 TRB 年會主要議題一覽表

主要議題名稱(英文)	主要議題名稱(中文)
Administration and Management	經營及管理
Aviation	航空
Bridges and Other Structures	橋梁及其他結構
Construction	施工
Data and Information Technology	資料及資訊系統
Design	設計
Economics	經濟
Education and Training	教育訓練
Energy	能源
Environment	環境
Finance	財務
Freight Transportation	貨運系統
Geotechnology	地工
History	歷史
Hot Topic : Automatic vehicles	自動化車輛
Hot Topic : Big Data	巨量資料
Hot Topic : Extreme Weather Events	極端氣候事件
Hot Topic : Performance Management	績效管理
Hydraulics and Hydrology	水利與水文學
International Activities	國際活動
Law	法律
Maintenance and Preservation	維護與保存
Marine Transportation	海運
Materials	材料
Operations and Traffic Management	營運及交管
Pavements	鋪面
Pedestrians and Bicyclists	行人及騎士
Pipelines	輸油管
Planning and Forecasting	規劃與預測
Policy	運輸政策
Public Transportation	公共運輸
Rail	軌道
Research (about research)	研發
Safety and Human Factors	安全與人爲因素
Security and Emergencies	保全與緊急應變
Society	社團
Spotlight Theme : Celebrating Our Legacy, Anticipating Our Future	年會主題:慶祝我們的傳統，預見我們的未來
Terminals and Facilities	場站設施
Transportation, General	運輸概論
Vehicles and Equipment	車輛與設備

表 3-3 第 93 屆 TRB 年會主要議題與會議地點/場次一覽表

主要議題名稱	會議地點 / 場次		
	Hilton	Marriot	Shoreham
經營及管理	31	11	3
航空	0	2	22
橋梁及其他結構	5	45	9
施工	1	35	3
資料及資訊系統	55	34	9
設計	12	39	17
經濟	21	1	6
教育訓練	9	8	0
能源	13	1	2
環境	53	10	10
財務	16	8	1
貨運系統	2	3	60
地工	0	35	0
歷史	4	0	0
自動化車輛	6	8	2
巨量資料	16	7	3
極端氣候事件	7	4	5
績效管理	8	12	0
水文與水利學	0	1	2
國際活動	13	3	3
法律	3	5	0
維護與保存	8	30	9
海運	1	0	25
材料	1	68	4
營運及交管	14	81	21
鋪面	3	49	24
行人及騎士	16	12	0
輸油管	0	0	2
規劃與預測	115	19	18
運輸政策	67	8	4
公共運輸	67	4	6
軌道	13	6	29
研發	11	6	0
安全與人為因素	24	103	16

參加 2014 年第 93 屆 TRB 年會出國報告

保全與緊急應變	2	5	12
社團	28	0	1
年會主題:慶祝我們的傳統， 預見我們的未來	11	25	5
場站設施	7	2	13
運輸概論	15	7	2
車輛與設備	8	6	6

註：部分會議場次會歸類於 2 個（含）以上之主要議題類別中。

(三)年會各類型研討會議簡介

本次年會之研討議題，涵蓋交通運輸相關之各類領域範疇，內容相當廣泛，為達最佳研討及經驗交流效果，本次年會仍循往年慣例採用以下各類型會議方式進行，茲分別簡介說明如下。

1.新人歡迎會(New Attendee Welcome Session)

TRB 年會主辦單位為幫助首次參與年會活動的新人能儘早瞭解大會作業，循例於年會首日(2014 年 1 月 12 日)下午 14：30 安排新人歡迎會，邀請首次參加者與會，說明年會特色及參與各項活動之重點及注意事項。會場以圓桌方式擺設座位，參加人員除可聽取臺上人員說明外，亦可藉此讓同桌人員增進互相認識及交流機會，可見主辦單位之用心。

2. 專題研討會(Workshops)

專題研討會形式主要係以國際上於前一年度即 2013 年之交通運輸領域重要議題及事項進行報告與討論為主，包括各國學術單位之重要研究成果及各國政府機關納入實施之交通措施等。與會人員可藉提問溝通，瞭解世界各地新推動之交通措施及其目前成果，亦為解決本身交通課題之考量方向(詳圖 3-11、3-12)。

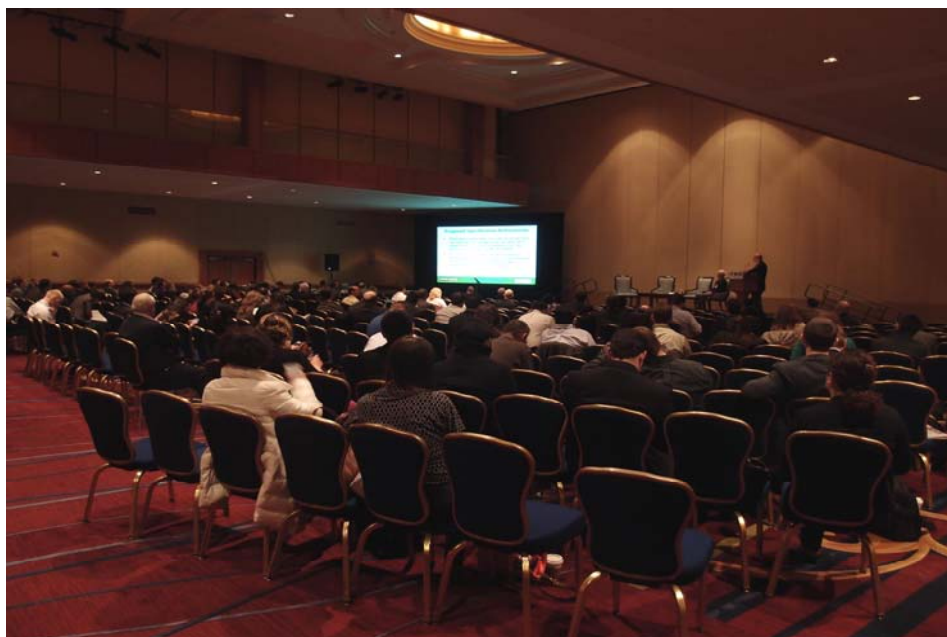


圖 3-11 專題研討會會場



圖 3-12 專題研討會會場

3.論文發表會(Sessions)

論文發表會形式主要以各國大學院校及研究單位等學術研究機構之論文發表為主，由於 TRB 年會之研討議題，涵蓋交通運輸相關之各類範疇，包羅萬象，內容廣泛，本次年會發表論文超過 4,500 篇以上，安排之論文發表會議場次多達 800 餘場，規模之盛大，令人嘆為觀止。(詳圖 3-13~3-15)



圖 3-13 論文發表會會場



圖 3-14 論文發表會會場



圖 3-15 論文發表會會場

4.海報研討會(Poster Sessions)

海報研討會係論文發表者將論文之重點以海報方式直接張貼於看板上，並於現場與對論文內容有興趣之與會者當面說明溝通，與會者可於大會手冊中找到相關場地及時段直接前往參與研討。

海報研討會為 TRB 年會之重要特色，筆者係首次參與海報研討會，由於是與論文作者面對面溝通，一問一答，提問可以馬上得到回覆答案，研討學習效果相當良好，惟仍須具備一定語文溝通能力，且熱門之論文須等候作者一一溝通說明，較為費時。惟此種形式為一相當不錯之論文發表及研討方式，直接有效果，頗值得國內大型研討會議採納(詳圖 3-16~3-19)。



圖 3-16 海報研討會會場



圖 3-17 海報研討會會場



圖 3-18 海報研討會會場



圖 3-19 海報研討會會場

5.廠商展覽(Exhibits)

廠商展覽於 1 月 13 日至 14 日在主會場 Marriott Wardman Park Hotel 大會堂舉行，共分爲 A、B、C 三個展場，佔地約 2,500 坪，參展廠商近 200 家，主題包括橋梁結構、施工、設計、環境工程、貨運、公路、交通維持、材料、鋪面、交通管理、行人及騎士、大眾運輸、軌道、車輛設備、政府部門出版品等，展示內容包含相關之交通軟、硬體及印刷出版品(參展廠商一覽表及廠商攤位平面圖詳附錄(二))。

當天走入展覽會場，參展廠商攤位種類繁多，令人目不暇已，好像走入大型百貨公司一般。展覽內容與本局業務較相關者包含規範書籍展售、交通規劃及交通模擬軟體、交通安全設施、施工交通維持規劃、碰撞緩衝設施、鋪面或結構或地工檢測儀器設備等產品展示，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資料或 CD、DVD 光碟片供與會者索取參考。(詳圖 3-20~3-37)

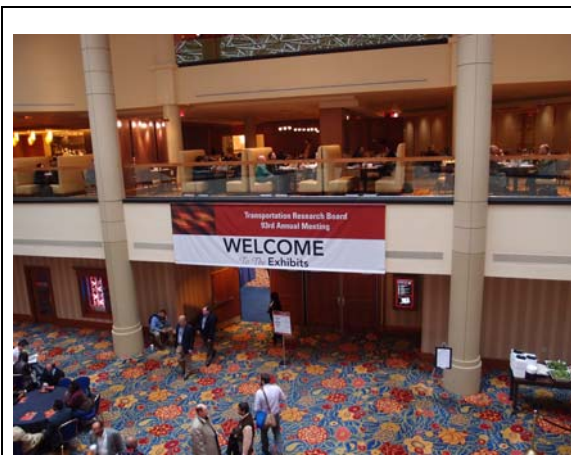


圖 3-20 展覽會場入口



圖 3-21 展覽會場



圖 3-22 展覽會場



圖 3-23 展覽會場



圖 3-24 展覽會場



圖 3-25 展覽會場



圖 3-26 鋪面標線標誌技術攤位



圖 3-27 橋梁測試監測攤位



圖 3-28 橋梁技術攤位



圖 3-29 道路設備產品攤位

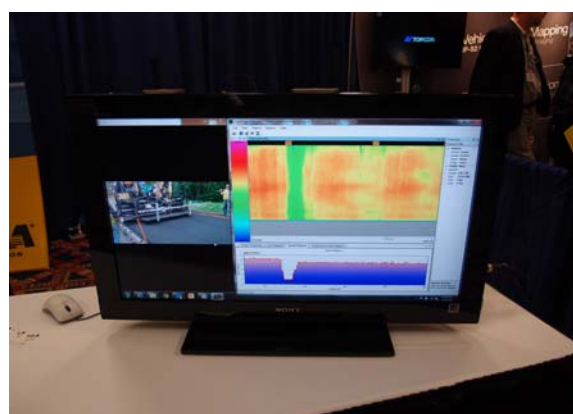


圖 3-30 鋪面技術攤位



圖 3-31 鋪面施工設備攤位



圖 3-32 ASCE 展覽攤位



圖 3-33 ASCE 展覽攤位展示資料



圖 3-34 鋪面技術攤位



圖 3-35 橋梁技術攤位



圖 3-36 橋梁技術攤位



圖 3-37 鋪面產品攤位

(四)年會主要議題概述

本屆年會中研討議題包含交通運輸相關之各類議題，主辦單位共分為 40 項主要議題，因時間內容廣泛，以下僅針對與筆者服務工作較有關係之「規劃及預測」、「橋梁及其他結構」、「設計」、「施工」、「材料」、「維護與保存」、「鋪面」等議題論文，作概略性之介紹說明。

1. 規劃及預測(Planning and Forecasting)

會議編號及名稱：777 Transportation Planning Applications

論文名稱：14-0628 Traffic Information Management System

紐約市交通局定期蒐集大量交通資料，以應不同計畫及分析所需。以往這類交通資料由不同部門依其需求辦理，或由局外單位辦理，造成資料蒐集格式不一致、後端處理及比較之困難，為了標準化資料之定義、查詢、蒐集、確認及分析等方法，紐約市交通局開發交通資訊管理系統。

此系統最早的版本是設計以圖資為基礎的互動網路應用程式，以提供車流資料供紐約市交通局及非局屬使用者查詢、顯示及下載點資料，如自動交通紀錄、車輛分類、轉向量、單車、行人、測速計等等，同時也提供授權使用者進行查詢、蒐集及確認交通量資料、或供財經人員確認工程財務可行性，並以回應「公開資訊法」(Freedom of Information Law)之要求。紐約市交通局於 2012 年 4 月成功地將此系統上線提供使用。

目前第 2 代的交通資訊管理系統在既有的應用上作了以下的擴充：

1. 加強以使用者回饋為基礎的應用。
2. 允許桌上電腦及行動裝置等二種設備線上使用。
3. 串連交通計量資料以回應交通量查詢。
4. 加入新的交通調查類型（路廊及連接段速率）。
5. 開發截取其他資料之格式。
6. 補充新的進階功能以強化使用者體驗。

在穩定的主機環境下，交通資訊管理系統為紐約市交通局在管理及維護交通計量資料之先進的應用。

2. 橋梁及其他結構 (Bridge and other structure)

會議編號及名稱：649 Special Topics for Steel Bridges

論文名稱：14-1113 Life-Cycle Design of Steel-Concrete Composite Bridges

目前橋梁設計實務上通常著眼於經濟性及施工性的最佳化，而未考量橋梁整體生命週期，尤其營運階段的維修方式可能因設計成果不同而有差異，且自 1999 年以來，持續發展經濟已被認為是歐盟重要的經濟及環境政策，並被引入包含營造業的各式產業活動中。面對交通量、興建及維修成本的增加，交通運輸結構物管理的考量已單從興建延伸到營運的全生命週期。而全生命週期的設計則從興建間段的設計施工一直延伸到營運時的檢查、維護、養護、修護。

而本文提出以橋梁全生命週期觀點，考量經濟效率、環境品質、社會議題等因素，嘗試提出創新觀點，包含：

- 1.材料：適當選擇材料可增加使用性，減少維修的頻率及對環境的影響。
- 2.設計：設計的改進可減少將來維護的工作，可有效減少經濟及環境衝擊。
- 3.檢測/維修：如何減少社會及環境直接或間接之衝擊，是訂定最佳檢測及維修策略的最大挑戰。

而本文的目的是從經濟面、環境面及社會面，重新檢視歐洲的設計，並以混凝土-鋼構複合橋梁為例，進行多準則決策分析，比較各方案之差異，提供業主設計方案之選擇比較。而經本文研究發現尚有許多問題仍待解決改進，例如在最佳方案估算及不確

定性評估方面等，然而本文已為橋梁生命週期分析的應用跨出第一步。

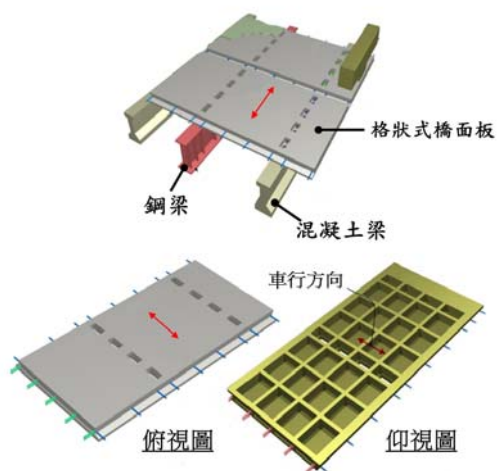
3. 設計(Design)

會議編號及名稱：344 Advancements in Accelerated Bridge Construction

論文名稱：14-3602 Design of Ultra-High-Performance Concrete Waffle Deck for Accelerated Bridge Construction

老化的基礎設施，結構有缺陷或設計規範過時的橋梁不斷增加，使的美國不斷發展能迅速改善國家的橋樑基礎設施並增加橋梁壽命的方法，但這些方法必須更加重視施工過程中的安全，價低交通影響和對環境影響。考慮到這些挑戰，美國聯邦公路管理局（Federal Highway Administration；FHWA）一直在推廣使用預製橋梁要素加速路橋梁建設（Accelerated Bridge Construction；ABC）的方法。

由聯邦高速公路管理署(FHWA)提出了一個高速公路生命程式(Highways for LIFE program；HfL)新專案，其中以一個全預鑄式（full-depth precast）、高性能混凝土(UHPC)之格狀式橋面板已成功的被研發，並成功的在實驗室進行試驗，並在愛荷華州的瓦佩洛縣成功更換安裝橋梁橋面板且已辦理載重試驗，藉以驗證高性能混凝土格狀式橋面板的理想性能。本文重點介紹已完成專案的經驗和成果，並從一系列簡單詳細的有限元素分析之格狀式橋面板發展出相關的設計準則。此設計準則可進一步說明高性能混凝土格狀式橋面板之如何導入新舊橋梁。同時也提供為了降低這種新的



預鑄高性能混凝土格狀式橋面板

橋面板的成本，以達肋梁間距最大化，並達到最小正負彎矩的相關資訊。

4. 施工(Construction)

會議編號及名稱：249 Construction Management: Selected Research Topics

論文名稱：14-4157 Selecting a Procurement Procedure for Highway Construction Projects

交通部門(DOTs)對於計畫的交付方式，包含：交付方法(Delivery Method)、採購程序(Procurement Procedure)及計價條款(Payment Provision)三部分。交通部門通常採用 DBB (Design-Bid-Build，設計-招標-建造)、DB (Design-Build，設計-建造)、或 CMCG (Construction Manager/General Contractor，營建管理/總承包)的方式交付計畫；低價得標(Low Bid)或資歷得標(Qualifications-Based)的方式作為採購程序；以及以單價計價(Unit Price)或一式計價(Lump Sum)方式作為計價條款。

雖然目前已發展出許多選擇工具和準則，以協助交通部門選擇適當的計畫交付方式組合，但據瞭解，沒有一個方法可適用於所有計畫，對多數計畫而言仍有所限制，交通部門要能作出符合計畫需求的最佳交付方式組合仍是個困難的過程。

本文建立在對計畫交付方式選擇工具的研究基礎上，提出一種考量計畫屬性、目標及限制等項目的採購程序選擇方法，該方法利用矩陣在低價得標(Low Bid)、最佳價值(Best Value)和資歷得標(Qualifications-Based)的採購程序之間作出選擇，並藉著文獻回顧、案例測試和經由專題研討會及業界專家討論所產生的回饋，為每個採購程序提出機會與阻礙的檢查清單。已經有 3 個交通機構成功的測試這個採購選擇工具，其中一個案例並可作為研究說明案例。同時測試專題研討會的參與者觀察到，本研究結果創造出一個具有一致性和可辯護性的採購程序選擇過程。

5. 材料(Materials)

會議編號及名稱：304 Innovations in Concrete for Bridge Decks and Pavement

論文名稱：14-0949 High-Volume Fly-Ash Concrete Mixture for Tennessee Bridge Decks

高劑量飛灰（HVFA）波特蘭水泥混凝土（PCC）被開發來與田納西運輸部門（TDOT）的 D 類 PCC 競爭，HVFA PCC 是以 C 類飛灰取代至少 50 % 波特蘭水泥（PC）的一種波特蘭水泥混凝土。目前 TDOT 容許以 25 % 的 C 類飛灰取代波特蘭水泥，較高的波特蘭水泥替代率不僅大為增加了工業副產品的使用，從而更有效地使用了自然資源；然而，性能與經濟性不能犧牲對環境的關注。這篇論文主要著眼在 HVFA PCC 的性能，而不是環境效益。

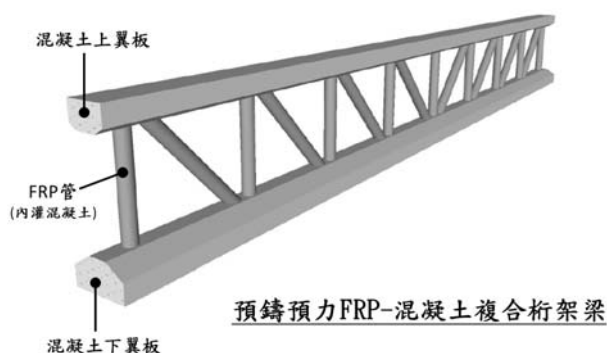
HVFA PCC 相較 TDOT 的 D 類波特蘭水泥混凝土而言，具有較低的總膠結料與含水量。HVFA PCC 的材料成本在低於 85 °F（29.4 °C）的澆置溫度與 85 °F（29.4 °C）及以上的澆置溫度時是相近的。研究結果顯示：第一，HVFA PCC 滿足所有 TDOT 604.03 D 類 PCC 的性能要求；第二，HVFA PCC 在統計上是優於 TDOT D 類 PCC 的抗壓強度（7 天到 182 天）、彈性模數（28 天至 182 天），固化混凝土吸收性（28 天至 182 天）與快速氯化物滲透性（91 天）。最後，當溫度高於 85 °F（29.4 °C）時，熱的 HVFA PCC 固化特性與快速氯化物滲透性在統計上是優於熱的 TDOT D 類 PCC（7 天至 182 天）。

6. 維護與保存(Maintenance and Preservation)

會議編號及名稱：645 Fiber-Reinforced Polymers in Highway Structures: Celebrating Our Legacy and Anticipating Our Future, Part 1 (Part 2, Session 713)

論文名稱：14-5745 Experimental Fatigue Evaluation of Hybrid Fiber-Reinforced Polymer-Concrete Bridge Truss Girders

一個具有「預鑄預力混凝土桁架梁搭配混凝土頂版」之新式的複合式橋梁系統正在逐步發展。縱梁由混凝土翼板連接垂直或斜向之 FRP 管內含混凝土構成，垂直構件承受壓力藉由 dowel 與混凝土翼板



相連；斜向構件承受張力藉由 singel-head bar 與混凝土翼板相連。當桁架結構承受剪力時，混凝土翼板則可提供彎曲應力。翼板在製造過程中有施加預力，在材質方面則採用抗腐蝕的鋼材及 FRP，因此所建議的桁架梁才會因此輕量化及耐久。輕量化會增加跨距、減少初使的花費；耐久性的提高則會減少維護費用及延長結構的使用年限。兩個單元的桁架梁在靜載重及疲勞載重下的實驗結果已提出，本次一共有七個試體，其中六個試體承受循環的疲勞載重；另一個試體成受單一靜載重，實驗結果顯示：不論在單一靜載重或反覆疲勞載重下，其行為都是非常良好。

7. 鋪面(Pavement)

會議編號及名稱：830 Tire-Pavement Noise and Quieter Pavements Structures: Celebrating Our Legacy and Anticipating Our Future, Part 1 (Part 2, Session 713)

論文名稱：14-5598 THE EFFECT OF POROUS PAVEMENT ON WAYSIDE TRAFFIC NOISE LEVELS

美國加州聖拉菲爾市 101 號高速公路 8 車道中的高承載(HOV)車道，於 2011 年採用多孔隙開放級配瀝青混凝土進行加鋪整修。由於附近居民不時向當地交通機構抱怨噪音量過大，為瞭解多孔隙瀝青鋪面減噪效果，研究單位分別採用路邊噪音量測法及現場輪胎噪音量測法，規劃兩段試驗場址進行噪音量測。試驗結果顯示，不論採用現場輪胎噪音量測方式或路邊噪音量測方式，多孔隙瀝青鋪面所量得之噪音值均較密級配瀝青鋪面之噪音值為低。另

根據過去多孔隙瀝青鋪面音波傳播相關研究可得結論，採用路邊噪音量測法額外減少的噪音量，應為多孔隙瀝青鋪面材料提供之吸音功能所致，本試驗亦實際地驗證了多孔隙瀝青鋪面之吸音及減噪效果，得到鋪面材料本身所提供之減噪量約為 3 至 4 分貝，可做為後續應用多孔隙瀝青鋪面之參考數據及實證。我國高速公路目前已全面推廣應用多孔隙瀝青鋪面，藉以提升雨天行車安全及減輕行車噪音，本篇論文可提供我國公路後續推廣多孔隙瀝青鋪面之重要參考。

(五)參觀華盛頓 DC 地區交通設施概述

筆者利用參加 TRB 年會之餘，參觀華盛頓 DC 地區交通設施，作概略性之介紹說明討。

1. Taft Bridge

本次會議地點分別於 Hilton Hotel、Marriott Hotel 及 Shoreham Hotel 三處舉行，其中 Hilton Hotel 與 Marriott Hotel 間設有接駁巴士，其必經之 Connecticut 大道，有一座歷史悠久，造型古樸之拱橋，為 Taft Bridge，茲介紹如後。

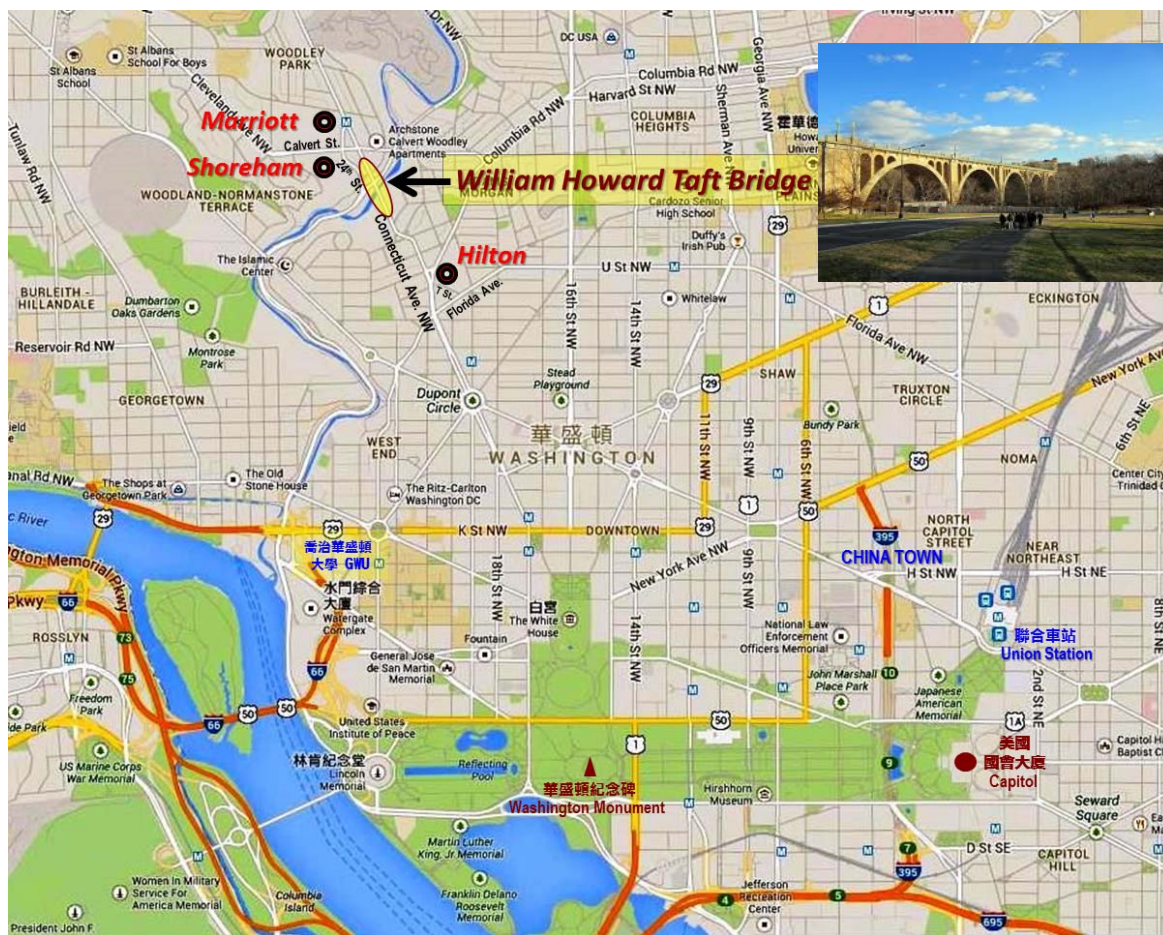


圖 5-1 Taft Bridge 及其位置圖

在 2003 年 7 月 3 日，Taft Bridge 已正式被列為國家歷史地標。Taft Bridge，也稱為 Connecticut Avenue Bridge 或 William Howard Taft Bridge

，位於華盛頓特區的西北區，是一座歷史悠久的橋梁，跨越 Rock Creek 峽谷和 Potomac 公園大道，屬於 Connecticut 大道，連接 Woodley Park 公園居民區和 Kalorama 地區，並位於 Duke Ellington 的西南方，於 1931 年改以當時的 William Howard Taft 總統命名。

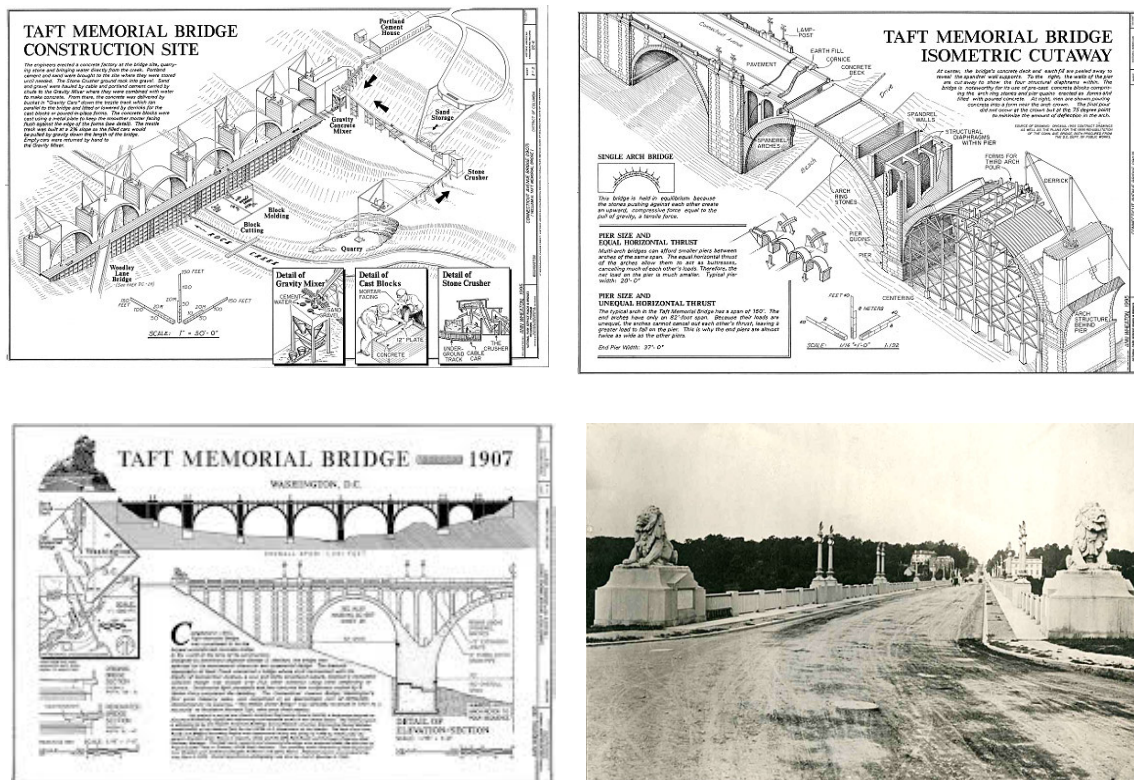


圖 5-2 Taft Bridge 1907 年興建介紹資料

這一座經典的橋梁，建立於 1897 年至 1907 年，由 George S. Morison 工程師及 Edward Pearce Casey 建築師共同設計，採 7 跨之拱橋結構，由沒有鋼筋的混凝土拱座，及有鋼筋的混凝土橋面板組成，全長 274.5m，最大跨徑 54.3m，橋面頗高，甚具規模，在施工當時是世界上最大的混凝土拱橋及最大的無筋混凝土結構，其沒有鋼筋的結構配置在當時是一項工程壯舉，其後在 1993 年進行大型修建計劃，於 1995 年完成。

這座橋由一邊有左右 2 隻共 4 座雄獅”守護”著，每隻雄獅約 7 英尺x6 英尺 6 英吋x13 英尺。這些獅子是由 Roland Hinton Perry 於 1906 年設計，並於 1907 年與橋梁結構為一體，以混凝土鑄造完成。在 1993 年，這些獅子雕像的狀況已非常糟糕，故當 Taft Bridge 在進行大型修建計劃時，這些獅子雕像亦進行進一步的修復，雕塑家 Renato Luccetti 終於在 2000 年 7、8 月利用現

有雕像及照片，鑄造新的混凝土雕像並重新安裝。另外這組模具亦被以青銅鑄造成新的獅子雕像，並於 2002 年安裝於國家動物園往北 Connecticut Avenue 大道主要行人入口處。



圖 5-3 Taft Bridge 拱橋之 Perry 獅雕像

在 Taft Bridge 共有 24 個 Bairstow Eagle Lampposts 燈柱等距的排列在橋的 2 側。這些燈柱是由雕塑家 Ernest Bairstow 於 1906 年創作，採混凝土基座(約 5 英尺 x 4 英尺 x 8 英寸)及塗漆鐵燈柱 (約 4 英尺 x 17 英尺)組成，其底座以花環裝飾，燈柱以直列式凹槽裝飾並以苔葉點綴於頂部和底部，在葉子的上方是水平支撐平台掛有 2 顆照明燈泡，每一個燈柱上方則裝飾有一隻張開雙翅的鑄鐵老鷹，整個燈柱相當具有復古特色。



圖 5-4 Taft Bridge 拱橋之 Bairstow Eagle Lampposts 燈柱



圖 5-5 Taft Bridge 現況照



圖 5-6 Taft Bridge 現況照

2. Metro 華盛頓地鐵

筆者住宿鄰近華盛頓地鐵 Foggy Bottom 車站，而本次會議地點之一在 Marriott Hotel 則鄰近地鐵紅線 Woodley Park 車站，故大都利用其地鐵路網作為交通工具。



圖 5-7 華盛頓地區地鐵位置圖

華盛頓地鐵，也就是華盛頓捷運，正式名稱為華盛頓都會區捷運系統（Washington Metrorail），由華盛頓都會區交通局（Washington Metropolitan Area Transit Authority）負責捷運系統興建，於 1969 年開始動工，於 1976 年 3 月

27 日，長 7.4 公里，5 個車站的紅線開始營運，目前已有紅線、橘線、藍線、黃線、綠線等 5 條路線，86 個車站及 171 公里長的軌道，服務範圍包含華盛頓特區及鄰近馬里蘭州（喬治王子郡、蒙哥馬利郡）及維吉尼亞州（費爾法克斯郡、阿靈頓郡、亞歷山卓市），另尚有銀線正計畫興建中。是美國第二繁忙的城市軌道交通系統，僅次於紐約地鐵。

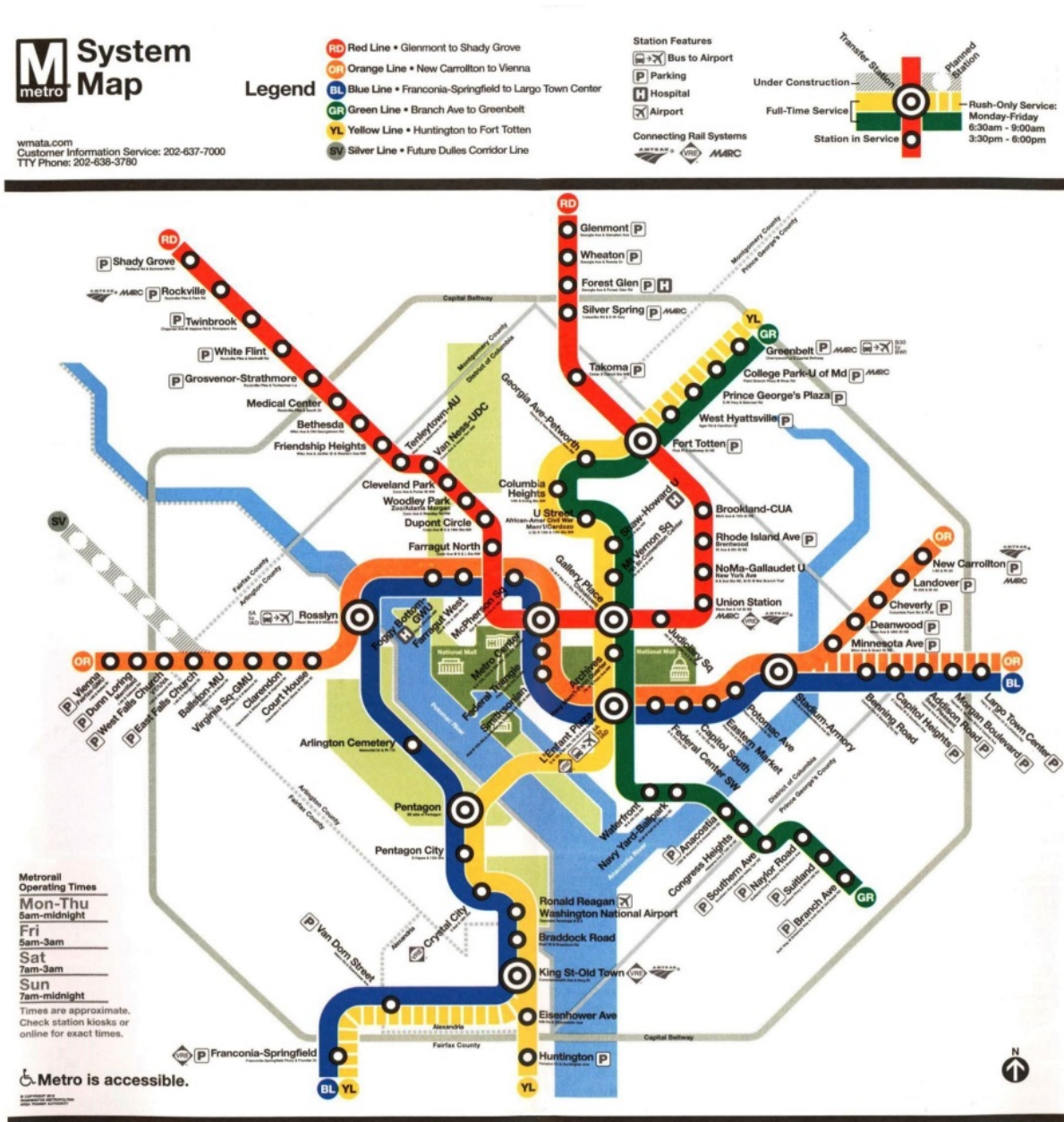


圖 5-8 華盛頓地區地鐵示意圖

華盛頓地鐵在 2009 年 1 月 20 日，美國總統歐巴馬就職禮當日創下最高的單日運量紀錄（約 112 萬人次）。2007 年 7 月則創下最高單月旅運量紀錄，總共約 1,928.2 萬人次，該年 6 月則創下最高平日（不含假日）平均客流量紀錄，約 77.3 萬人次。

(註：1996 年開始營運的台北捷運目前已發展至 11 條線路，共 103 個車站及 121.3 公里的路線長度，2013 年平均每日旅客量到達 174 萬人次(平均每月旅客量到達 5,291 萬人次)，2013 年 12 月 31 日跨年當日達 275.2 萬餘人次。行車速度最高 80 公里／小時)

線路	顏色	起迄站	日期	長度 (Km)	車站
1	紅線	涼蔭叢 (Shady Grove) ↔ 格蘭蒙特 (Glenmont)	1976	51.3	27
2	橘線	維也納／費爾法克斯 - 喬治梅森大學 (Vienna/Fairfax-GMU) ↔ 新卡羅頓 (New Carrollton)	1978	50.4	26
3	藍線	法蘭克尼亞 - 春田 (Franconia-Springfield) ↔ 拉哥鎮中心 (Largo Town Center)	1977	29.76	27
4	黃線	亨廷頓 (Huntington) ↔ 塔騰堡 (Fort Totten)	1983	26.16	17
5	綠線	布蘭奇大道 (Branch Ave) ↔ 綠帶 (Greenbelt)	1991	38.40	21
6	銀線 (計畫中)	州公路 772 (Route 772) ↔ 體育場 - 軍械庫 (Stadium-Armory)			5

圖 5-9 華盛頓地鐵路線資料表

華盛頓地鐵華盛頓地鐵地下段全長 80 公里，地下車站有 47 座，而高架段全長 14 公里，地面段全長 74 公里。最深的車站是紅線上的森林幽谷站 (Forest Glen)，深達地下 60 公尺，其鄰近的惠頓站 (Wheaton) 則有世界上第二長、西半球最長的電扶梯 (垂直高度約 70 公尺)

華盛頓地鐵的地鐵中心站 (Metro Center Station) 位於紅線、橘線及藍線三條最繁忙的路線之交會處，為地鐵系統中第二繁忙的大站，也是華盛頓都會區交通局的主要營業部所在地。地鐵也另外設計了五座可容納大量人潮的「核心車站」：畫廊 - 中國城站 (Gallery Place - Chinatown，紅、黃、綠三線

交會)、朗方廣場站 (L'Enfant Plaza, 橘、藍、黃、綠四線交會)、聯合車站 (Union Station, 地鐵系統中最繁忙的大站)、法拉格特北站 (Farragut North, 地鐵第三繁忙的大站) 及法拉格特西站 (Farragut West, 地鐵第四繁忙的大站)。為了應付換乘站之間的龐大人潮, 捷運局正評估在鄰近的核心站之間新增人行地下道的可能性, 紓解地鐵中心站的換乘需求, 使其降低約 11%。

值得注意的是, 華盛頓地鐵系統中常常有多條路線共用同一軌道的情形。

華盛頓地鐵營運時間如下表：

星期	一	二	三	四	五	六	日
開始時間	5am	5am	5am	5am	5am	7am	7am
結束時間	midnight	midnight	midnight	midnight	3am	3am	midnight

不同於紐約市、費城及波士頓地鐵系統的單一票價制, 華盛頓地鐵同時依里程及時段 (分為尖鋒、一般、折價) 計費, 較為複雜, 在尖峰時段 (週一至週五為早上開始營業時間 5 點至 9 點 30 分、15 時至 19 時, 週五及週六晚間從凌晨 12 點至歇業時間凌晨 3 點) 的車費依行駛站數, 介於 2.10 美元至 5.75 美元之間, 一般時段車費則為 1.70 美元至 3.5 美元, 學齡兒童、殘障人士及長者享有折扣優惠。

地鐵乘客使用一種稱為「智慧旅」(SmarTrip) 的智慧卡, 出站時費用會從餘額中扣除。這種卡主要是在各站的販賣機購得 (退卡時可退費 2 美元), 可儲值 45 美元, 儲值用罄可以補值重新利用。乘客也可以在大部份的售票機構買乘車證 (farecard), 這種乘車證用法同 SmarTrip, 但可以讓乘客在一定時段裡無限制地在地鐵系統內搭車, 有些乘車證會限制搭乘時間和距離。乘客可以對任何一種卡增值, 但是當車費比卡內餘額還多時, 使用 farecard 乘客必須額外支付出站費, SmarTrip 持卡者還是可以出站, 但必須在下次進站前將卡增值。需要換車的旅客無須走出驗票閘門, 可在站內換乘其他路線。SmarTrip 持卡者在地鐵和巴士間轉乘時享有折扣優惠。



圖 5-10 華盛頓地鐵站入口處
(Foggy Bottom-GWU 站)



圖 5-11 華盛頓地鐵站內部景觀
(Foggy Bottom-GWU 站)



圖 5-12 華盛頓地鐵自動售票機



圖 5-13 華盛頓地鐵 SmarTrip 卡



圖 5-14 華盛頓地鐵站內的資訊顯示器



圖 5-15 華盛頓地鐵車廂內部

三、心得及建議事項

(一)建議國內產官學交通運輸相關單位每年聯合組團擴大派員參加人數與世界各國經驗交流

本次 2014 年 TRB 第 93 屆年會參加人數達 11,900 人，打破了 2013 年參加人數 11,700 人的紀錄，同時 800 餘場論文發表會及專題研討會所發表的 4500 篇論文，內容涵蓋交通運輸領域各個層面，以及年會中近 200 家參展廠商的參展內容主題包括橋梁結構、施工、設計、環境工程、貨運、公路、交通維持、材料、鋪面、交通管理、行人及騎士、大眾運輸、軌道、車輛設備、政府部門出版品等，在年會中皆有諸多新研究或新實務的成果探討及介紹。該年會已是全球交通運輸界公認為最重要年度活動之一，每年吸引來自全世界各國政府運輸相關部門、學術機構及民間公司等產官學界參與研習。

國內每年都有相當可觀的交通運輸相關計畫在執行，如能整合國內產官學交通運輸相關單位聯合組團參加 TRB 年會，發表國內產官學交通運輸相關成果，除了可讓參加年會的眾多國家了解臺灣在交通運輸領域的發展現況，展現我國的交通運輸建設實力，增加臺灣的國際能見度，同時，國內的產官學交通運輸相關單位亦可吸取了解其他國家在交通運輸各領域的最新發展，對於提昇國內交通運輸全生命週期各層面之實務技術，亦有莫大正面助益。

(二)TRB 大會對會議相關資訊提供數位化及即時線上瀏覽與快速搜尋，方便有效率，值得國內未來若舉辦大型研討會議時參考

本屆年會中發表之論文超過 4,500 篇，研討會議達 800 餘場，論文數量龐大，發表論文場地亦散於 3 處飯店之各不同會議廳，主辦單位為了讓與會者能即時有效的掌握會議最新資訊，方便與會者選擇欲參加之場次及瀏覽論文內容，採取了幾項特別措施，包括特別開發了 TRB 2014 年會專屬 APP 供智慧

型手機下載(參圖 3.2-1)，讓參者可以隨時利用智慧型手機來搜尋與查詢會議相關資訊，如欲查詢有興趣之會議主題其論文名稱、發表之時間、地點、位置圖等，並可隨時透過該 APP 之「Latest News」了解大會最新訊息。

另外每個參加者於註冊處完成報到後，會獲得大會提供之 TRB 2014 年會專屬 USB 隨身碟，利用該隨身碟及 NoteBook 可以進行主要議題搜尋、作者搜尋，所有論文資料可透過搜尋系統(參圖 3.2-2)，找到欲參閱之論文資料。

大會同時也設置了網際網路服務 <http://amonline.trb.org/> (參圖 3.2-3)，在各會場內設置多處即時線上查詢系統，參加者打開該網頁後以註冊時之「email 住址」及「ID 號碼」做為帳號及密碼輸入(login)後即可進入網頁進行線上搜尋、查詢與瀏覽工作，這些線上功能於筆者返臺後仍能充分利用其服務。

上述種種作法充分展現對現代科技的運用，對與會者非常方便有效率且環保，可供國內舉辦類似大型研討會議時參考。

(三)多孔隙瀝青鋪面之減噪效果、快速橋梁施工(ABC 工法)及橋梁採 FRP 複合桁梁設計等發展成果，皆值得國內道路工程參考運用

年會發表論文有關美國加州針對多孔隙瀝青鋪面之減噪結果顯示，多孔隙瀝青鋪面所量得之噪音值較密級配瀝青鋪面之噪音值為低，而多孔隙瀝青鋪面材料本身所提供之減噪量約為 3 至 4 分貝，可做為後續應用多孔隙瀝青鋪面之參考數據及實證。我國高速公路目前已全面推廣應用多孔隙瀝青鋪面，藉以提升雨天行車安全及減輕行車噪音，本篇論文可提供我國公路後續推廣多孔隙瀝青鋪面之重要參考。

另外美國聯邦高速公路管理署(FHWA)提出有關全預鑄式高性能混凝土(UHPC)之格狀式橋面板(Waffle Deck)已成功研發，並成功的在實驗室進行試驗，其搭配預製(鑄)大梁的快速

施工特性值得國內工程界參考。

加拿大卡加利大學所發表「預鑄預力 FRP-混凝土複合桁架梁搭配混凝土頂版」之新型複合式橋梁系統，其縱梁由混凝土翼板連接垂直或斜向之 FRP 管(管內含混凝土)，使得桁架梁具有輕量化及耐久的特性。輕量化可增加跨距、減少初使的花費，耐久性提高則會減少維護費用及延長結構的使用年限，其後續之發展應用值得持續關注。

(四)華府與台北都會交通發展的小觀察

本次在華府停留期間亦留意了華府的交通發展，由於都市型的人口密集所產生對便捷交通的需求以及民眾對低碳生活環境的日趨重視，大眾捷運系統已是現代化國際大都會的必要交通運輸工具及先進指標，華府擁有美國第二大地鐵系統(僅次於紐約市地鐵)，先就華府及台北市在這方面作一個比較。台北捷運的興建起步晚些，相關設備較新穎且明亮乾淨，台北捷運的總服務長度約為華府的 71%，但車站總數較多，站距較密，車資相對便宜甚多，而服務總運量達華府地鐵近 3 倍之多，由此可見台北捷運系統相當成功且優質便捷，所提供之服務與華府地鐵相比毫不遜色。

其次，台北市近來來日趨風行的另一低碳措施- Ubike 腳踏車風潮，在華府亦有類似系統設置(參圖 3.4-1)，而觀察到華府的公車亦能搭載腳踏車(參圖 3.4-2)，配合市區內腳踏車專用道的設置(參圖 3.4-3)，華府市區內低碳交通概念的推廣相當用心。

再者，就國外旅客初抵一個陌生城市的通訊服務而言，筆者在華府期間深深感覺無法利用智慧型手機隨時上網查詢資料的不便，桃園國際機場在入境處即提供申辦櫃台方便國外旅客辦理在台短期之 3G 上網服務，費率與國外比較相對便宜，而台北市在許多公共區域亦提供免費 WiFi 服務，對國外旅客而言相當友善，相信在無形之中可促進國際旅客來台觀

光及商務的意願並對造就台北成爲一個國際大都會甚有幫助

。



圖 3.2-1 TRB2014 建置智慧型手機 APP

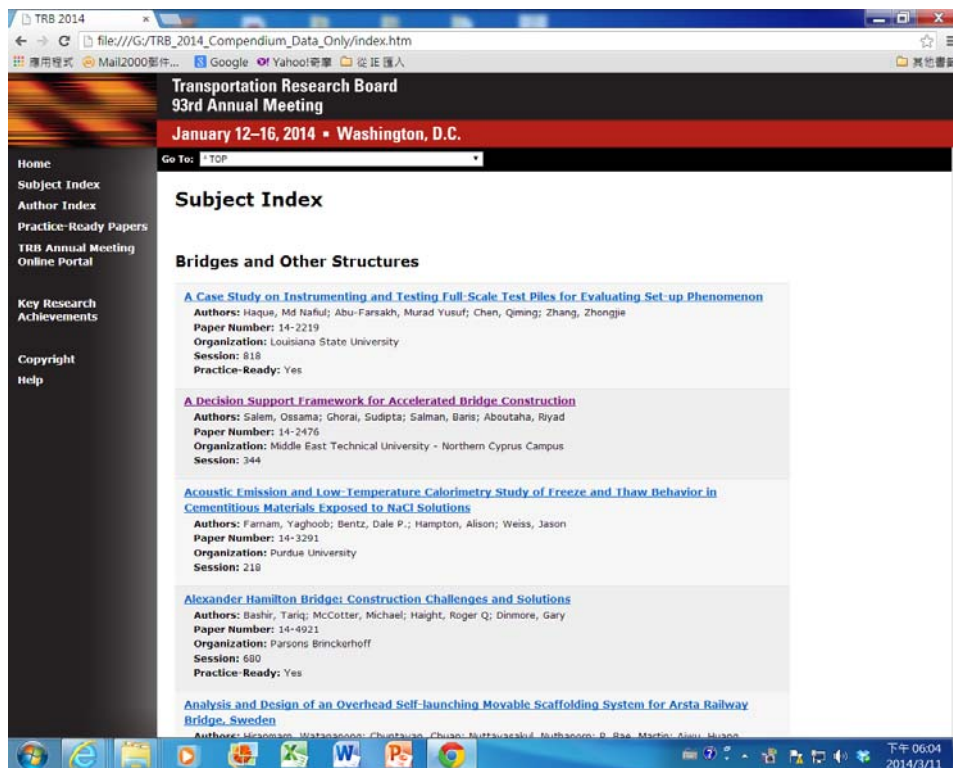


圖 3.2-2 USB 隨身碟提供搜尋功能查詢論文

參加 2014 年第 93 屆 TRB 年會出國報告



圖 3.2-3 TRB 大會設置網際網路服務之網頁



圖 3.4-1 華府之腳踏車租用系統(類似台北市 U-bike)



圖 3.4-2 華府之公車可搭載腳踏車



圖 3.4-3 賓夕法尼亞大道上之腳踏車專用道

五、附錄

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附錄(一)

TRB 年會主要議題及各場會議名稱



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- 256 Hazardous Materials Transportation Research Papers
- 766 Research and Applications in Evacuation Planning
- 770 Increasing Security, Safety, and Resiliency of Transportation Infrastructure and Systems Through Enhanced Preparedness for Disasters and Emergencies
- 771 Logistics of Disaster Response and Business Continuity
- 814 Emerging Research in Emergency Evacuation
- 837 Statewide Impact of Disasters, Transit, and Land Use: Cool New Stuff You Can

Look at Now That You Have a Statewide Travel Model

- AB000 Data Privacy, Security and Protection Policy Joint Subcommittee of AB000, AHB15, ABE25, AL040
- AT040 Transportation of Hazardous Materials Committee
- AV090 Aviation Security and Emergency Management Committee

• Society

- 258 Environmental Justice Issues
- 261 Social and Economic Factors of Transportation
- 290 Information and Communication Technologies and Travel: Adoption, Attitudes, Perceptions, and Behavioral Change
- 330 Transportation Investments, Property Valuation, and Economic Growth Effects
- 360 Residential Affordability, Access, and Mobility
- 432 Public Involvement in Transportation
- 466 Commuting, Expenditures, and Equity
- 467 Digging into Paratransit Data and Policies
- 509 Transportation and Economic Development
- 572 Emerging Research in Health and Transportation
- 719 Accessibility and Economic Well-Being
- 757 Public Acceptance Issues Related to Road Pricing
- 776 Telecommuting and E-Shopping: Further Empirical Insights
- 800 Equity Issues Associated with Road Pricing
- ABE70 Women's Issues in Transportation Committee

• Spotlight Theme: Celebrating Our Legacy, Anticipating Our Future

- 260 Past Achievements and Future Solutions in Accessible Transportation and Mobility
- 512 50 Years of Traffic Flow Theory: Achievements and Challenges (3)
- 534 Fifty Years of Traffic Flow Theory: Achievements and Challenges
- 645 Fiber-Reinforced Polymers in Highway Structures: Celebrating Our Legacy and Anticipating Our Future, Part 1 (Part 2, Session 713)

• Terminals and Facilities

- 243 Transit Station Access: Trains, Buses, Bikes, and Automobiles
- 328 Planning for Intermodal Transit Stations
- 472 Parking Tension: Perceived Neighborhood Benefits Versus Citywide Benefits
- 531 Critical Issues Affecting Maintenance Equipment in Departments of Transportation and Needed Research
- 555 Rail Transit Updates
- 627 Current Research on Container Terminal Operations
- 629 Railroad Operating Technologies
- 636 Parking Revolution from A(sset Management) to Z(oning)(11)
- 712 Contemporary Research on Intermodal Freight Transportation, Part 2 (Part 1, Session 625)
- 728 Rail Transit Passenger Congestion
- 747 Research on Improving Container Terminal Operations to Gain Supply Chain

Efficiency

- 770 Increasing Security, Safety, and Resiliency of Transportation Infrastructure and Systems Through Enhanced Preparedness for Disasters and Emergencies

• Transportation, General

- 260 Past Achievements and Future Solutions in Accessible Transportation and Mobility
- 608 Student Learning and Training: What Works and What Doesn't and Why
- 634 Innovations in Ridesharing and Other Transportation Demand Management Strategies (5)
- 668 Reducing Vehicle Trips with Demand Management: Experience from Major Cities, a College Campus, the Summer Olympics, and Hurricane Sandy
- 719 Accessibility and Economic Well-Being
- 724 Managing Information and Knowledge: Tools of the Trade
- 833 Hail! Hail! Where's My Taxi?
- 852 Benefits of Learning and Understanding Skill Set Needs in Transportation-Related Careers

• Vehicles and Equipment

- 338 Naturalistic Driving Data and Driver Behavior
- 381 Innovations in Vehicle Detection [14]
- 417 Pioneers of Autonomous Driving: Automated Guideway Transit Systems
- 440 Driver Distraction from Cell Phones, Texting, Lack of Sleep, and Aggressiveness
- 480 Controlling and Preventing Corrosion of Highway Maintenance Fleet Equipment
- 494 Innovations in the Passenger Rail Equipment Industry
- 531 Critical Issues Affecting Maintenance Equipment in Departments of Transportation and Needed Research
- 610 Impact and Implications of Autonomous Driving on Automated Transit Systems
- 694 Anger, Volatility, Decisions, Impairments, and Warnings: The Drama of Modeling Driver Behavior
- ANB45 Rollover Crashworthiness Subcommittee, ANB45(1)

附錄(二)

參展廠商一覽表及展場平面圖

Exhibits

Transportation Research Board, Booth 3601

Affiliates and Publications Services

Andrea Kisiner, Manager
500 Fifth Street NW, Keck 496
Washington, DC 20001
202-334-3214; fax 202-334-2519; TRBSales@NAS.edu
Cydni Johnson, Supervisor, Publications and Subscription Sales;
202-334-3072; fax 202-334-2519; TRBSales@NAS.edu
Kelvin Jordan, Affiliates Coordinator; 202-334-3216;
fax 202-334-2519; TRBAffiliates@NAS.edu

Stop by the TRB booth to learn about year-round benefits and services for TRB affiliates. Become a TRB affiliate to take advantage of reduced registration fees for future Annual Meetings. Benefits and services also include a complimentary subscription to TRB's bimonthly magazine, *TR News*; discounts on TRB publications; use of TRB's Library; and the option to participate in TRB's customized subscription program. The annual fee for a TRB Individual Affiliate is \$173. Student affiliation is available to full-time students of accredited postsecondary institutions, age 35 and under, for \$112. TRB student affiliates receive a special discounted Annual Meeting registration fee and a 50% discount on most TRB publications. Selected TRB publications will be available for purchase, as well as special sale items. (www.trb.org/bookstore.)

Cooperative Research Programs (CRP)

Christopher W. Jenks, Director
500 Fifth Street, NW, Keck 456
Washington, DC 20001
202-334-3089; fax 202-334-2006; CJenks@NAS.edu

The National Cooperative Highway Research Program (NCHRP), Transit Cooperative Research Program (TCRP), Airport Cooperative Research Program (ACRP), National Cooperative Freight Research Program (NCFRP), Hazardous Materials Cooperative Research Program (HMCRRP), and the National Cooperative Rail Research Program (NCRRP) are applied, contract research programs that develop near-term, practical solutions to problems facing transportation agencies. Under the sponsorship of NCHRP, TCRP, and ACRP, TRB also prepares syntheses of current practice in the respective fields. To learn more about these programs, please visit the CRP booth. (<http://www.trb.org/CRP/About/DivD.asp>.)

TRIS Databases including TRID and Research in Progress (RiP)

Lisa Loyo
500 Fifth Street NW, Keck 440
Washington, DC 20001
202-334-2990; lloyo@nas.edu

At the TRIS Booth, TRB's research databases will be demonstrated:

- TRID, the TRIS and ITRD Database (trid.trb.org) contains more than one million records of published information covering all modes and disciplines of transportation.
- The Research in Progress (RiP) website (rip.trb.org) provides a database of current or recently completed transportation research projects and an alerting service of new projects in specified subject areas. Registered users may also enter projects in the database.

- The TRB Publications Index (pubsindex.trb.org) contains records for all papers, articles, reports, and conference proceedings published by the Transportation Research Board, the Highway Research Board, the Strategic Highway Research Program, and the Marine Board from 1923 to date.
- The Practice-Ready Paper (PRP) Database (prp.trb.org) contains papers in which the research and information presented is ready for immediate implementation or requires minimal additional research or implementation effort.
- The Research Needs Statement (RNS) Database (rns.trb.org) is a searchable database of research problems or needs developed by TRB's technical committees.

Stop by the Information Services exhibit to learn more about these research tools and see demonstrations of these valuable resources.

Strategic Highway Research Program 2 (SHRP 2)

Linda Mason
500 Fifth Street, NW, Keck 233
Washington, DC 20001
202-334-3241; fax 202-334-3471; LMason@NAS.edu

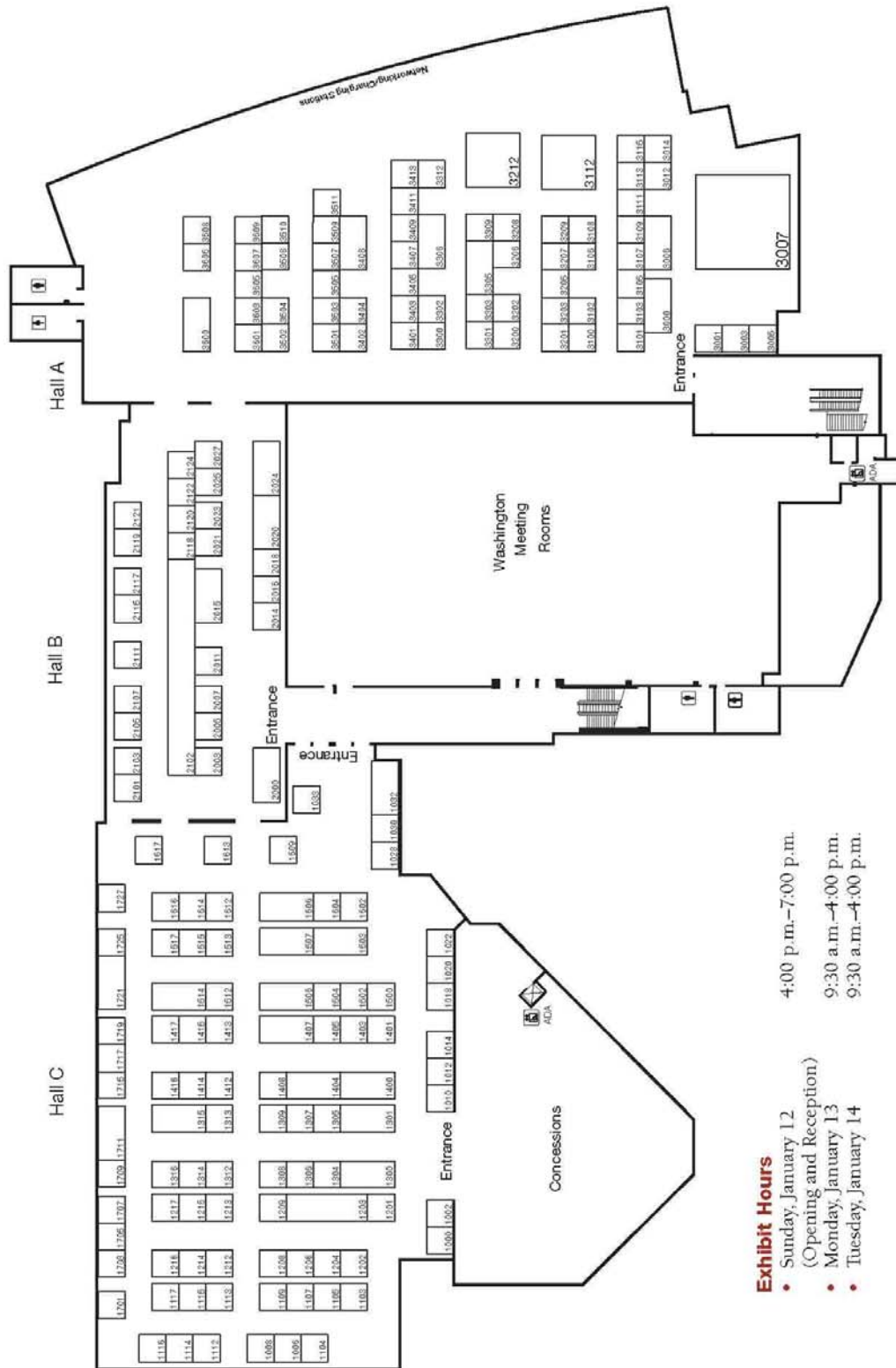
Visit the SHRP 2 section of the TRB booth to learn about new tools that speed highway project delivery times, cut costs, increase safety, and reduce congestion—meeting needs for efficient, practical solutions to complex new challenges.

IDEA Programs for Highways, Safety, and Transit

Jon Williams, Director, IDEA-Synthesis Studies
500 Fifth Street, NW, Keck 216
Washington, DC 20001
202-334-3245; fax 202-334-2081

Promising but unproven innovations in surface transportation systems may be eligible for early-stage funding through TRB's IDEA Programs. The programs' goal is to foster ingenious solutions that are unlikely to be funded through traditional means. The programs are open to everyone, and the application process is simple. Visit the IDEA booth for information on how to apply.

Exhibit Floor Plan



- Exhibit Hours**
- Sunday, January 12 (Opening and Reception) 4:00 p.m.–7:00 p.m.
 - Monday, January 13 9:30 a.m.–4:00 p.m.
 - Tuesday, January 14 9:30 a.m.–4:00 p.m.

Exhibits (continued)

EXHIBITORS AT A GLANCE

A			G		
AARP Driver Safety	3108	Engineering and Research Int'l, Inc.	1701	GCTS Testing Systems	3205
Advanced Infrastructure Design, Inc.	1215	Euroconsult	1504	Geocomp Corp.	1209
Advanced Mobile Asset Collection	3112	Evonik Corporation	1503	Geophysical Survey Systems	1609
Advitam	1212	Expanded Shale, Clay and Slate	1405	Germann Instruments, Inc	3302
AgileAssets Inc.	1308	Institute		Gibraltar Cable Barrier Systems	3408
AirSage	3300	F		Greenroads	3511
AMEC	1401	FasTrac Cement	3608	Greenwood Engineering A/S	1727
American Association of State	3000, 3006	Federal Aviation Administration	3409	Gregory Highway Products	1415
Highway and Transportation		Federal Highway Administration		H	
Officials		Building Better Bridges/HRDI	2115	Hayward Baker Inc.	1008
American Coal Ash Association	3501	Center for Accelerating	2102	Highway Care USA	3202
American Concrete Pipe Association	1412	Innovation		Huesker	3113
American Galvanizers Association	1309	Congestion Mitigation and Air	2021	Humboldt Mfg. Co.	1113
American Public Transportation	3003	Quality Improvement Program		I	
Association		Exploratory Advanced Research	2101	ICL Performance Products	1417
American Society of Civil Engineers	1107	Program		IDS North America	1517
American Transportation Research	3508	Human Factors Research	2014	Impact Recovery Systems	3509
Institute		Local & Tribal Technical	2003	Infogroup	3100
Applied Research Associates, Inc.	1306	Assistance Program		INRO	1711
Argonne National Laboratory—	1721	(LTAP/TTAP)		InstroTek, Inc.	3305
TRACC		Long Term Pavement	2111	Intergraph	3109
Arizona Chemical Company, LLC	3107	Performance		International Cybernetics Corp.	3111
ARTBA	2122	Long-Term Bridge Performance/	2117	International Municipal Signal	1010
ASCE Publications	1105	HRDI		Association	
AssetWorks, Inc.	1414	National Highway Institute	2007	International Road Dynamics Inc	1515
ASTM International	1115	Office of Corporate Research,	2118	IPS Group Inc.	1202
ATC Solutions Group	3505	Technology, and Innovation		Itasca	1022
Atkinson-Noland & Associates, Inc	1103	Management		IT Curves	2124
B		Office of Federal Lands Highway	2107	ITEM Ltd	1002
BDI: Bridge Diagnostics, Inc	1502	Office of Freight Management and	2103	Iteris, Inc.	1104
Bilat USA 2.0—European	3105	Operations		ITS America	3005
Commission		Office of Innovative Program	2000	J	
Blastrac	3411	Delivery		James Cox and Sons	1514
Boulderscape Inc	3209	Office of Operations	2024	Jewell Instruments, LLC	3303
C		Office of Planning, Environment	2023	K	
Caliper Corporation	1300	& Realty (HEP)		Kessler Soils Engineering	1604
Campbell Scientific, Inc.	1512	Office of Research, Development,	2120	Products, Inc.	
CERATECH	3413	and Technology		KSI Global Australia Pty LTD	1707
Certainty 3D	3203	Office of Safety	2020	Kwik Bond Polymers	1614
Chase Construction Products	1216	Office of Technical Services	2011	L	
Citilabs	1400	Office of Transportation	2121	LimnTech Scientific, Inc.	3106
CoVal Systems, Inc.	1301	Performance Management		Lindsay Corporation—	1204
CTS Cement Mfg. Corp.	2025	Resource Center	2015	Transportation Solutions	
D		Roadway Safety Research	2016	M	
Dayton Superior	1206	Safety Data and Analysis Tools	2018	Mandli Communications, Inc.	3212
DBi Services	3115	Sustainable Highways Initiative	2105	McTrans Center	1500
Decagon Devices, Inc.	1304	and INVEST		MetroCount	3102
Deighton Associates Limited	1214	Transportation Asset	2119	Midwest Industrial Supply	3200
Design-Build Institute of America	3507	Management		Midwestern Software Solutions	3312
Dewberry	1307	Universities and Grants Program	2005	MISTRAS Group	1201
District Department of	3012	Federal Motor Carrier Safety	3502	MOBA Corporation	1404
Transportation		Administration		N	
Dynatest Consulting Inc	1217	Federal Railroad Administration	3510	National Advanced Driving Simulator	1312
E		FP2 Inc.	1715	National Highway Traffic Safety	3306
Eco-Counter	1725	Fugro	1316	Administration	
Emerald Group Publishing	3103			NEXCO-West USA, Inc.	1109
Limited					

Exhibits *(continued)*

O		University Transportation Centers	3606	TraFFix Devices, Inc	1116
Olson Engineering, Inc.	1208	Rodel Interactive North America LLC	3206	Transmetric America Inc.	1602
OmniBond Systems L.L.C	1014	Rubber Pavements Association	3503	Transpo Industries Inc.	1513
Optech, Incorporated	2027	S		Transportation Research Board	3007
P		Schnabel Foundation Company	1413	TransTech Academy, Cardozo High School	3001
Parsons Brinckerhoff	3301	Seeing Machines	1703	TREDIS Software	1305
Pathway Services Inc.	1112	SHRP2	1203	Trinity Highway Products, LLC	1313
Pavement Technology, Inc.	1616	SINAK Corporation	1613	Troxler Electronic Laboratories, Inc.	1606
Pavemetrics Systems	1314	Siva Corrosion Services, Inc.	1000	TSS - Transport Simulation Systems	1717
Plastic Safety Systems, Inc.	1032	6 D SOLUTIONS	1416	U	
Proceq USA, Inc.	1617	Skycomp, Inc.	1012	U.S. Coast Guard	3405
PTV Group	1506, 1507	Smart Eye	3402	U.S. Environmental Protection Agency	3504
Q		South Coast Air Quality Management District	3407	uGRIDD Corporation	1028
QinetiQ North America	1407	SSL	1006	University of California, Berkeley (PATH)	3208
Quadstone Paramics	1114	Surface Systems & Instruments, LLC	3207	Uretek USA Inc	1033
R		T		USC Viterbi School of Engineering	3404
RAP Technologies LLC	3401	TAPCO	1612	V	
Realtime Technologies, Inc.	1030	Taylor & Francis Group	1315	Vector Corrosion Technologies	3201
Regional Economic Models, Inc.	1018	Terrametrix, LLC	1719	Virginia Department of Transportation	3014
Research and Innovative Technology Administration	3601	Terrasolid Ltd.	3309	W	
Bureau of Transportation Statistics	3605	The ALL Group of Companies	1709	Waylink Systems Corporation	1403
Intelligent Transportation Systems Joint Program Office	3603	The National Academies	3101	Z	
National Transportation Library	3607	The Reinforced Earth Company	1213	Zydex Inc	1020
Office of Positioning, Navigation and Timing	3609	3d-Radar	1117		
The Volpe Center	3600	Topcon Positioning Systems	1408		
		Traffax Inc	3403		
		Traffic Technology Solutions, LLC	1705		

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