

行政院及所屬各機關出國報告  
(出國類別:出席國際會議)

## 參加第二十一屆世界道路會議 會議報告

服務機關:交通部運輸研究所  
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出國地區:馬來西亞  
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# 壹、會議概要

## 一、會議背景與概要

世界道路組織 (PIARC) 是1908年在巴黎召開第一屆國際道路會議後於次年成立，PIARC是國際各類道路工程組織團體中最具歷史的組織，目前有94個國家會員(national governments)及129個其它會員(包括區域組織會員(regional authorities)、團體會員(collective members)及個人會員(individual members))。該組織官方語言為法語及英語，總部現設於法國巴黎。我國因為受限於非聯合國成員，無法成為國家會員，僅爭取到成為團體會員。

PIARC是一個非官方且無政黨政治色彩及非營利為目標的組織團體，該組織成立的宗旨在於促進國際間合作，增進道路與道路運輸政策、道路科技發展的交流，並將相關知識與經驗轉移給開發中國家以及經濟轉型中國家作為發展相關政策的參考。為了達成上述目標，PIARC成立16個委員會(committees)及3個工作分組(working groups)及一個特別任務小組、籌辦四年一次的世界道路會議(World Road Congress)及不同的技術研討會(technical seminars)，並且出版包括定期季刊等多種出版品。

PIARC目前主要推動工作包括道路科技、道路管理、永續發展與道路在運輸的角色扮演、使用者感認、資金評估、技術轉移等六大領域，並再細分為36個具體的工作目標。



本次第二十一屆世界道路會議(World Road Congress)於1999年10月3-9日在馬來西亞吉隆坡市舉行。往年歷屆世界道路會議均吸引各國道路相關專家學者齊聚一堂，互相觀摩並交流學習各國與彼此經驗。本次會議主辦單位依據PIARC的技術委員會及工作分組別規劃不同的研討場次，其中部份主題例如智慧型運輸系統、電子收費、...等與本所業務密切相關，本所為全國最高之交通運輸研究機關，為汲取交通先進國家之公路建設與交通管理知識與經驗，本所經陳 奉交通部核准派綜合技術組陳副研究員賓權前往參加會議。

## 二、會議時間

- |        |             |
|--------|-------------|
| 十月二日   | 註冊          |
| 十月三日   | 開幕典禮、專題研討   |
| 十月四-五日 | 分組研討        |
| 十月六日   | 技術參觀訪問      |
| 十月七-八日 | 分組研討        |
| 十月九日   | 分組總結報告、閉幕典禮 |

## 三、會議地點

馬來西亞吉隆坡Putra世界貿易中心

Putra World Trade Centre, Kuala Lumpur, Malaysia



#### 四、與會代表組成

本次會議行前原經中華民國道路協會邀集與會代表（名單如表1）公推中興顧問公司謝總經理季壽擔任領隊，然因為受九二一震災影響，謝總經理季壽及交通部地鐵處蔣處長鑫如未能出席，最後組團成行改請由中華顧問工程司楊經理漢生擔任領隊。

表1 出席第二十一屆世界道路會議團員名單

| 姓 名 | 服 務 單 位    | 職 稱  | 備 註  |
|-----|------------|------|------|
| 蔣鑫如 | 交通部地鐵處     | 處長   | 臨時取消 |
| 謝季壽 | 中興顧問公司     | 總經理  | 臨時取消 |
| 楊漢生 | 中華顧問工程司    | 經理   | 領隊   |
| 沈觀挺 | 高速公路局工局擴工處 | 副處長  |      |
| 張清祥 | 國道新建工程局規劃科 | 科長   |      |
| 陳賓權 | 交通部運輸研究所   | 副研究員 |      |
| 曾華聰 | 台北市政府交通局   | 技正   |      |
| 蘇傳翔 | 台北市政府交通局   | 技士   |      |



## 五、行程紀要

此次參加會議期間自民國88年10月2日至9日，行程概述如下：

表2 行程紀要

| 日 期       | 起 迄    | 行 程          |
|-----------|--------|--------------|
| 10/2      | 台北-吉隆坡 | 啓程           |
| 10/3      | 吉隆坡    | 報到、開幕典禮      |
| 10/4-10/5 | 吉隆坡    | 參加第21屆世界道路協會 |
| 10/6      | 吉隆坡    | 參加技術考察       |
| 10/7-10/8 | 吉隆坡    | 參加第21屆世界道路協會 |
| 10/9      | 吉隆坡-台北 | 閉幕典禮、搭機返國    |



## 貳、會議議程

### 一、辦理報到

本次會議會場設於馬來西亞吉隆坡市中心的Putra世界貿易中心 (Putra World Trade Centre, PWTC)，報到地點位於該中心一樓，辦妥報到手續後，隨即參加10月3日在PWTC四樓舉行的開幕典禮。

### 二、參加會議

開幕典禮於10月3日下午三點在PWTC四樓舉行，有來自99個國家、超過2,500各國代表出席，典禮開始首先播放馬來西亞公路建設簡介，由馬來西亞工務部長Mr. Dato' Seri S. Samy Vellu致歡迎詞後，大會援例邀請世界道路協會 (PIARC) 主席Mr. Hiroshi MITANI致詞，原本預定宣布開幕的馬來西亞總理Dr. Hahathir Mohamad人正在國外，改由副總理Mr. Abdullah Ahmad Badawi致詞後宣布開幕，整個開幕典禮歷時約一個半小時。

開幕典禮之後緊接著在PWTC二、三樓展示館的會場舉行揭幕儀式，與會者參觀由大會所規劃之上百個各國政府單位或民間企業在運輸相關領域的研發成果的攤位，這項展示活動配合大會持續至整個會議結束。

本次會議主要依照PIARC的委員會及工作小組規劃不同的研討場次，除了10月4日上午由馬來西亞工務部長所主持的Ministers' Session



討論「道路基礎建設民營化是否為加速21世紀道路發展的唯一選擇？」議題外，大會規劃4個特殊議題場次(Special Sessions)、5個Cross-linking議題場次、15個技術委員會研討場次。其中Cross-linking五個議題場次之研討主題涵蓋道路基礎建設資產管理績效、發展規模、使用者感認、永續運輸、通信/資訊創新、道路系統績效評估，技術委員會研討場次所討論主題則包括：混凝土道路、技術轉移與發展、路面特性、公路隧道、大地工程、道路橋樑、都市區域、天然災害、柔性路面、道路/運輸/區域發展、智慧型運輸系統、環境、道路管理、財務/經濟發展、貨物運輸、道路安全、道路管理機關績效等。由於內容廣泛，且不同主題在不同場地同時進行研討，因此與會者只能依照會議程序表所提供之議程資料，選擇適當之場次參與。大會並於10月6日當天安排了13個技術參觀活動(technical tour)，供與會人員自由擇一參加。

### 三、吉隆坡交通概述

吉隆坡是馬來西亞的首都，面積243.6平方公里，居民150萬人，也是馬來西亞政治、商業和社交中心，是各充滿對比的可愛都市，既有現代大都市的氣派，也有故老的風味，殖民地時代遺留下來的優美建築物，戰前的商店，閃亮的銅頂建築物和現代摩天大廈並肩而立，相互爭輝。

吉隆坡市內有二種公車：城市公車和小型公車，城市公車首公里收費40分，以後每公里加收5分；計程車有二種，載客四人之小汽車首公里收費2元，以後每200公尺加收10分，計時部分每三分鐘加收10分，



午夜十二時至凌晨六時加五成計費，另有載五人之TAXI VAN，首公里基本費較高，其餘計費方式相同。

目前營運中之捷運系統有STAR-LINE、PUTRA-LINE等二條，可於交會點清真寺站轉乘，分屬二家BOT業者經營，票證未整合，需分別購買，可使用IC智慧卡。二條捷運系統在清真寺站轉乘時，因為一為高架、一為地下，必須先出站重新購票入站方能轉乘。

私人交通工具有小汽車及機車，離峰時間交通狀況良好，但尖峰時間交通極為擁擠，部分位於市區高架道路工程因為經費問題有停頓情形，交通秩序較台北為佳，道路有不平衡車道布設，並有公車及計程車專用道、公車停車彎及候車亭等設施。



## 參、研討心得

由於大會安排不同主題在不同場地同時舉行，所以僅能選擇與本組業務直接相關的主題參與研討，分別是使用者感認、永續運輸、智慧型運輸系統、電子收費系統，而這些議題亦是本屆大會與會者積極參與的主題。由於不斷地增加道路面積的供給，並不能因此而使得交通獲得改善，如何從現有設施中透過交通管理以及先進科技的引進提升其使用效率，為目前所關切的焦點；此外，道路興建乃至交通建設所對環境造成的衝擊，在環保意識高漲的今天，任何的交通建設計畫都必須進一步考慮其環境可行性，永續運輸的概念已經逐漸達成共識。大會綜合各場次研討結論提出總結報告整理如附件一，至於各個研討場次最後所形成的結論，由於共分六大主題，共四十五個子議題，不便臚列，可連結<http://www.piarc.lcpc.fr/kl/xxi-detat-e.htm>參觀，在此僅配合本組業務需要摘譯電子收費與智慧型運輸系統二個研討結論如后供參：

### 3.1 經濟轉型中與開發中國家的電子收費經驗

針對電子收費議題，與會各國代表提出各自發展的經驗，最後獲得初步結論，摘錄如下：

1. 對經濟轉型中國家而言，DSRC標準通常是ITS系統選擇中最先也是最難的選擇，因為該標準一經擇定，對後續ITS發展將會有深遠的影響。誠然，整體考量國家ITS的發展有其必要，但電子收



費往往是經濟轉型中或發展中國家發展ITS應用項目中規模最大者。

因此，經濟轉型中與發展中國家在推動電子收費時，首先所面臨的問題就是如何選擇適當的DSRC標準，在選擇過程中，實務上也會產生其它更重要的問題，這可從觀察那些追求永續經濟發展的國家在發展電子收費的過程得知。

最近一些包括工業化國家以及轉型經濟國家在選擇DSRC標準的過程中，已經體認到實務上的困難，新加入者應該避免低估此一問題的複雜度，並且好好學習這些具有參考價值的經驗。

2. 廣泛地仔細分析過去一些案例後發現，以「技術導向做為優先選擇」的方式是相當危險的，正確而有效率的順序應該是：

- (1)首先，應該考量最終使用者的需求及接受度以作為判斷優先順序的依據（像是我們希望透過電子收費以及其它相關ITS使用者服務來實現什麼目的？這些目的相對重要性如何？實施的時程如何安排？）

- (2)功能性的規格選擇：那些服務是確切想要發展的？有什麼限制？性能需求為何？...

- (3)關鍵組織的選擇：主管機關及其它相關單位需要具備什麼條件？可能的財源在哪裡？融資的管道？

- (4)最後才是技術解決方案的選擇。



每一個組織（包括聯邦或州層級的道路主管機關、特許公司、設備供應者等）在上述所有步驟中都扮演了某種特定而無可取代的角色。

3. 每一國家對ITS電子收費的特殊需求是選擇過程中非常重要的限制，並且往往會影響最後選擇的結果。因此這些需求應該儘速被明確確認並詳加考量，例如：

- (1)道路收費的施行是利用新措施還是既有措施？

- (2)與鄰國的邊界跨越性交通是否為重要因素？

- (3)電子收費將應用在自由車流的多車道上？還是傳統的單一車道上？

- (4)法令、電信、....等有什麼限制？

4. 一般經濟轉型中或開發中國家的特殊需求也非常重要，應該針對每一議題妥為處理，例如：

- (1)當設備被要求在當地生產製造時，將對技術的選擇的影響。

- (2)功能性的規格要求，應該考量經濟轉型中與開發中國家使用者的社經限制與需求。

- (3)應及早確認合適的組織設置，來負責掌控選擇電子收費系統的全部過程，以確保國家利益最大，並加速決策流程。



5. 追求相互連網性的需求度應該仔細評估，初步可由三個層面來釐清「相互連網性」的概念，以避免不必要的誤解或錯誤：

(1)技術相容性(technical compatibility)：不同設備製造商所提供的電子收費設備元件，對保持相互連網性而言，是必要條件而非充分條件。

(2)針對提供給使用者的服務而言，營運者應提供契約化的相互連網性(contractual interoperability)。

(3)組織間的相互連網性(institutional interoperability)也相當重要，在這裡所謂的組織間的相互連網性，所考量的是一個長期且持續的目標，包括所使用的技術、定義相關組織周邊的標的、以及可相互連網的ITS應用項目。

6. 儘管相互連網性相當重要，但也是實務上非常沈重的負擔，故進行仔細的經濟與財務分析時有助於獲得適當的妥協解。相互連網性是必要的，但是要花多少錢？何種型式？何種層級？以及何時？都是問題。

7. 只要所有的分析及決策過程，能夠依正確的順序，考量所有的關鍵限制，既有的一些DSRC標準可以提供合適的解決方案。但必須注意，現有的技術或標準也許是某個國家中的最後選擇，但不一定對其它國家也是最好的。主要的取決標準如下：

(1)既存的電子收費當地狀況：導入未來標準的可接受成本，及所有轉移時間的限制。



- (2)除了電子收費外，在所選定之技術的生命週期內，可能會設置哪些其它ITS應用項目的型式及數量？
  - (3)可能提供技術相容設備的供應商數量，這有助於促進競爭以獲得優惠的價格與服務。
  - (4)整體成本應包含完整ITS的車上單元與地面基礎設施設備，並不侷限於電子收費。
8. ITS技術的發展比傳統道路科技快速許多，因此電子收費技術的選擇需要：
- (1)注意全球性ITS的發展展望，包括ITS架構。
  - (2)應審慎注意國際間技術發展、產業趨勢及標準。(特別是ISO與ITU所發展的DSRC以及ITS相關標準)
9. 經濟轉型中或開發中國家對電子收費/DSRC的選擇，應考慮既有限制與規模大小的重要性，因此這些經濟轉型或開發中國家的代表，必須出席國際標準組織，主動收集資料，並且仔細瞭解其它國家發展的經驗。
10. 顧問公司若具有下列特性，且可以提供電子收費/DSRC系統選擇的服務，則對經濟轉型或開發中國家將是非常有用的：
- (1)除了能提供解決方案外，並且具有優勢的、客觀的與國際視野與經驗。



(2)不僅能對技術選擇提供建議，對功能規格發展需求、組織創新、以及全球ITS選擇流程管理等也具有提供諮詢的能力。

(3)在工業化以及經濟轉型中或開發中國家的ITS發展上，具有直接且實務的經驗。

11. 當轉型經濟中與開發中國家的決策者提出特殊而複雜的需求時，PIARC（國際道路協會）可以扮演召集人的角色，讓這些決策者與關鍵專家們可以和其他擁有相關經驗的道路機關主管，進行國際性、開放性、與客觀中立性的研討。

## 3.2 智慧型運輸系統

針對智慧型運輸系統議題，與會各國代表提出各自發展的經驗，最後獲得初步結論，分為給政策制訂者的建議、給運輸部門主管者的建議、給經濟轉型中國家的建議，摘錄如下：

### 給政策制訂者的建議：

1. 運輸政策應列為整體國家政策（包括經濟、環境等）之一，ITS應優先考量，並考慮其他方法以解決壅塞、安全、環保等運輸問題。
2. 運輸主管機關應發展ITS策略計畫，並與參與出資者共同合作發展包括技術與組織二方面的ITS架構，也就是所謂的系統架構（system architecture）。這項策略計畫應同時反應使用者需求與政策目標。



3. 爲了滿足交通成長的需求，除了ITS本身的發展外，結合其他基礎設施(infrastructure)的投資是最具成本效率的解決方案。
4. ITS計畫也可以僅與其他運輸經營者、使用者與相關產業共同發展，這需要新的方法來達成，並且尋求全國或全球的合作夥伴。

### 給運輸部門主管者的建議：

1. 運輸專家應該將ITS系統所有安全層面議題列入考量，包括實施ITS所涉入的安全效益與風險。
2. 爲了達成ITS所有效益，運輸專家應該積極參與、適時結合主要出資者（包括不同運具的經營者）、區域計畫主管機關、資訊提供者、車隊經營者、以及一般旅行大眾等以成立新合作同盟，簽署合適的協議。
3. 爲了提供使用者更有效率的服務，運輸專家針對連結運輸系統與ITS使用者的資訊鏈內容，應就功能性層次熟悉ITS可使用的技術。同時爲了避免技術綁標，運輸部門機構應該選擇一個開放性的系統架構以供ITS建置，並且要求廠商所提供的設備應與現有ITS標準相容。假如ITS關鍵標準尚未建立，運輸部門主管應及早處理相關議題。
4. 以ITS的本質及其系統特性爲前提，運輸主管機構不管對公、私部門，在採購上或融資上應有更開放以及創新的態度。
5. 運輸機構如果沒有相關實施ITS的經驗，建議應向有經驗的專家請教，以避免因錯誤而付出昂貴的代價。



### 給經濟轉型中國家的建議：

1. 應該對ITS各種可能的應用項目有全面性的瞭解，以便採用符合國家特定需求與需要的適合系統，達成最佳本益比。
2. 應該進行區域性的合作，因為類似的運輸需求可能有相同的需要與發展優先順序。
3. 應該擴大區域性的合作，與已開發中國家進行雙邊甚至多邊的合作計畫，以確保系統的相互連網性，使提供的服務保有相容性與持續性。



## 肆、技術參觀行程

主辦單位為展現馬來西亞在公路建設的相關交通運輸設施的建設成果，特別於10月6日當天安排了13個技術參觀活動(technical tour)，供與會人員自由擇一參加。這些技術參觀活動都位於吉隆坡市或其近郊，每一行程大概有3至4小時，下午則共同參觀馬來西亞工務部主辦的「護欄實車撞擊展示 (LIVE CRASH DEMONSTRATION -GUARDGUARD SYSTEM FABRICATED IN MALAUZIA)」，技術參觀活動內容如下表3：

### 4.1 DAMANSARA PUCHONG HIGHWAY

受限於技術參觀行程安排在同一天的同一個時段，所以只能選擇其中之一的參加DAMANSARA PUCHONG HIGHWAY行程，這個行程內容為依序參觀Lebuh Raya SPRINT (SPRINT)、Lebuh Raya Damansara Puchong (LDP)、Lebuh Raya Shah Alam(KESAS)三條公路所形成的公路網。以下分別簡要介紹三條公路：

Lebuh Raya SPRINT (SPRINT)為全長26公里、雙向六車道之公路，沿線設置13個交流道，由馬國政府以BOT方式特許Sistem Penyuraian Trafik KL Barat Sdn Bhd興建、營運，特許期間從1998年12月15日起，為期33年。詳細資料如附件三。



表3 技術參觀活動內容

| TECHNICAL VISIT SCHEDULE |   |
|--------------------------|---|
| Tour No.                 | Tours   |
| 1                        | THE NEW KUALA LUMPUR INTERNATIONAL AIRPORT & SUPPORT FACILITIES, TRAVELLING THROUTH THE NORTH – SOUTH CENTRAL LINK EXPRESSWAY |
| 2                        | KAJANG TRAFFIC DISPERSAL RING ROAD – ROCK BLASTING AT KAJANG BYPASS CLOVERLEAF INTERCHANGE                                    |
| 3                        | LIGHT RAIL TRANSIT (LRT) SYSTEM 2   |
| 4                        | THE EXPRESS RAIL LINK (ERL) AND COMMUTER RAIL SERVICE (CRS)   |
| 5                        | CYBERJAYA   |
| 6                        | DAMANSARA PUCHONG HIGHWAY   |
| 7                        | KUALA LUMPUR CITY CENTRE (KLCC) ASSESS SYSTEM   |
| 8                        | KUALA LUMPUR MIDDLE RING ROAD II  |
| 9                        | SECOND ‘EAST-WEST HIGHWAY’ – POS SELIM TO LOJING  |
| 10                       | MID VALLEY CITY DEVELOPMENT – PETALING JAYA TO BANGSAR LINKAGE  |
| 11                       | PUTRAJAYA – THE NEW FEDERAL GOVERNMENT ADMINISTRATION CENTRE  |
| 12                       | DINDING BRIDGE AND APPROACH ROAD  |
| 13                       | NATIONAL SPORTS COMPLEX   |



Lebuh Raya Damansara Puchong (LDP) 為全長40公里、雙向六車道之公路，沿線設置14個交流道，由馬國政府以BOT方式特許Lingkaran Trans Kota Holdings Berhad興建、營運，特許期間從1996年8月15日起，為期33年。與Lebuh Raya SPRINT (SPRINT)不同的是Lebuh Raya Damansara Puchong (LDP)設有電子收費車道，使用名為Fastrak的收費系統。詳細資料如附件四。

Lebuh Raya Shah Alam(KESAS) 為全長34.5公里、雙向六車道之公路，沿線設置12個交流道，由馬國政府以BOT方式特許KESAS Holdings Bhd.興建、營運，1993年11月19日簽署特許合約，特許年期28年。與Lebuh Raya Damansara Puchong (LDP)一樣，Lebuh Raya Shah Alam(KESAS)設有電子收費車道，使用名為KESAS的收費系統。詳細資料如附件五。

值得我國參考借鏡的是，馬國政府特許不同公司興建公路，由於採BOT方式，每條公路的建造期雖然預估大約是36個月，不過大都提前完成，對縮短工期而言相當有效率。此外，不同特許公司所興建的公路硬體建設儘管可以相互銜接連成公路網，不過在電子收費系統上就產生不同特許公司採用不同電子收費系統而不具相互連網性(Interoperability)，有的是紅外線系統(如SmarkTAG)，有的則採用微波系統(如Fastrak、KESAS系統)，Fastrak的電子收費站如圖1。在參觀的過程中，恰巧發現同一部車子同時裝了三個車上單元的有趣現象(如圖2)，但據主辦國接待人員說明，未來將努力整合成一個系統。



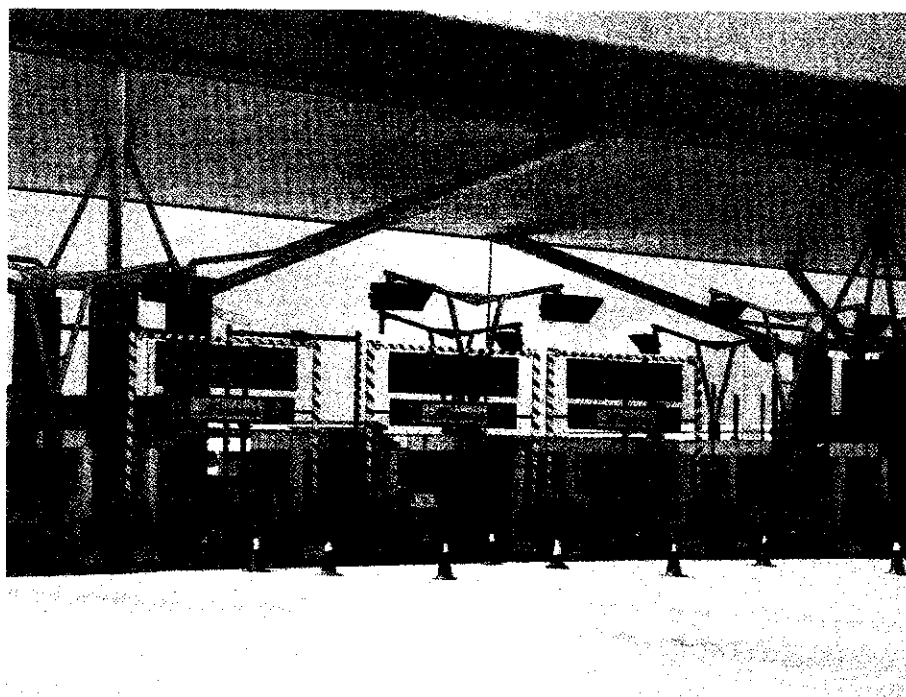


圖1 Lebuhraya SPRINT (SPRINT)公路上的 Fastrak電子收費系統

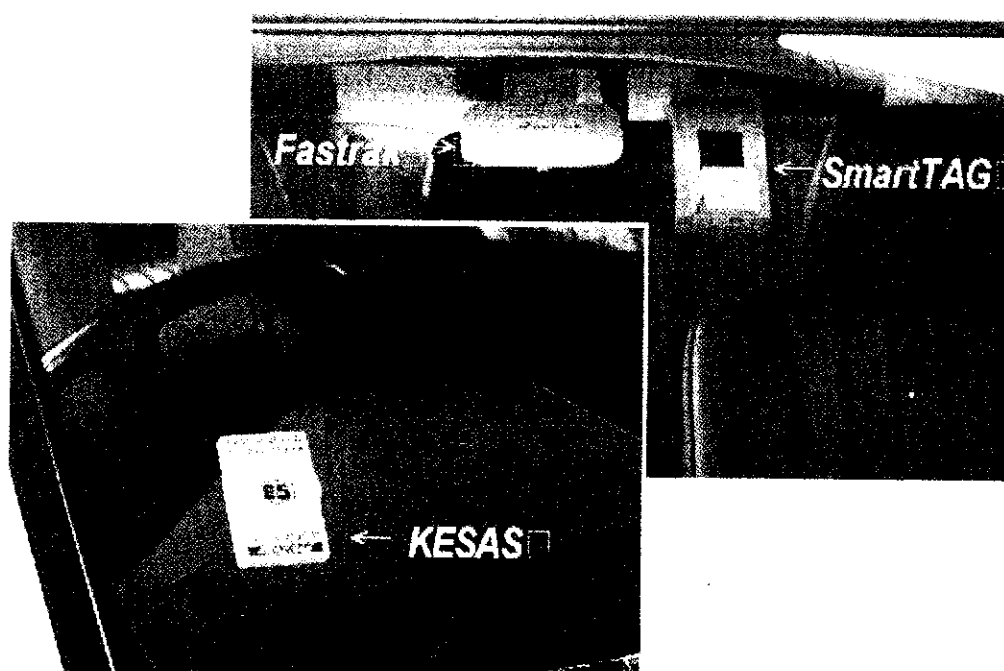


圖2 一部車子裝了三個電子收費車上單元



## 4.2 LIVE CRASH DEMONSTRATION

所有技術參觀行程下午皆安排參觀馬來西亞工務部主辦的「護欄實車撞擊展示 (LIVE CRASH DEMONSTRATION-QUARDGUARD SYSTEM FABRICATED IN MALAUYYIA)」，由工務部長Mr. Dato' Seri S. Samy Vellu主持並致歡迎詞。

這項展示首先示範實車直接撞擊混凝土，撞後的車子完全毀損，然後安排對照組另一部車子撞擊有泡棉緩衝設備，稱之為Quardguard的護欄，結果車子只有引擎蓋有部分損壞，而駕駛座、甚至擋風玻璃都沒有損傷，這項Quardguard產品是馬來西亞自行研發的產品。這項展示證明Quardguard對減輕傷亡程度有相當明顯的功效，因此工務部長Mr. Dato' Seri S. Samy Vellu隨後向各國代表說明，這項設施主要目的是為了減少事故致死率，同時也藉由此項設施希望達成在2005年減少30%道路碰撞的目標，因為，儘管無法減少事故發生次數，但透過這些安全裝置將有效減少受傷或死亡人數。馬國政府希望這項產品可以成為道路的標準設備，即使有事故發生，也可因為有這項設施而不會有人員致死。這項設施將優先設置在易肇事路段，同時未來將要求公路特許公司強制裝設。

展示過程圖片如圖3，由上而下分別為碰撞前的Quardguard system、車子高速碰撞Quardguard瞬間、碰撞後的車子與Quardguard狀況：



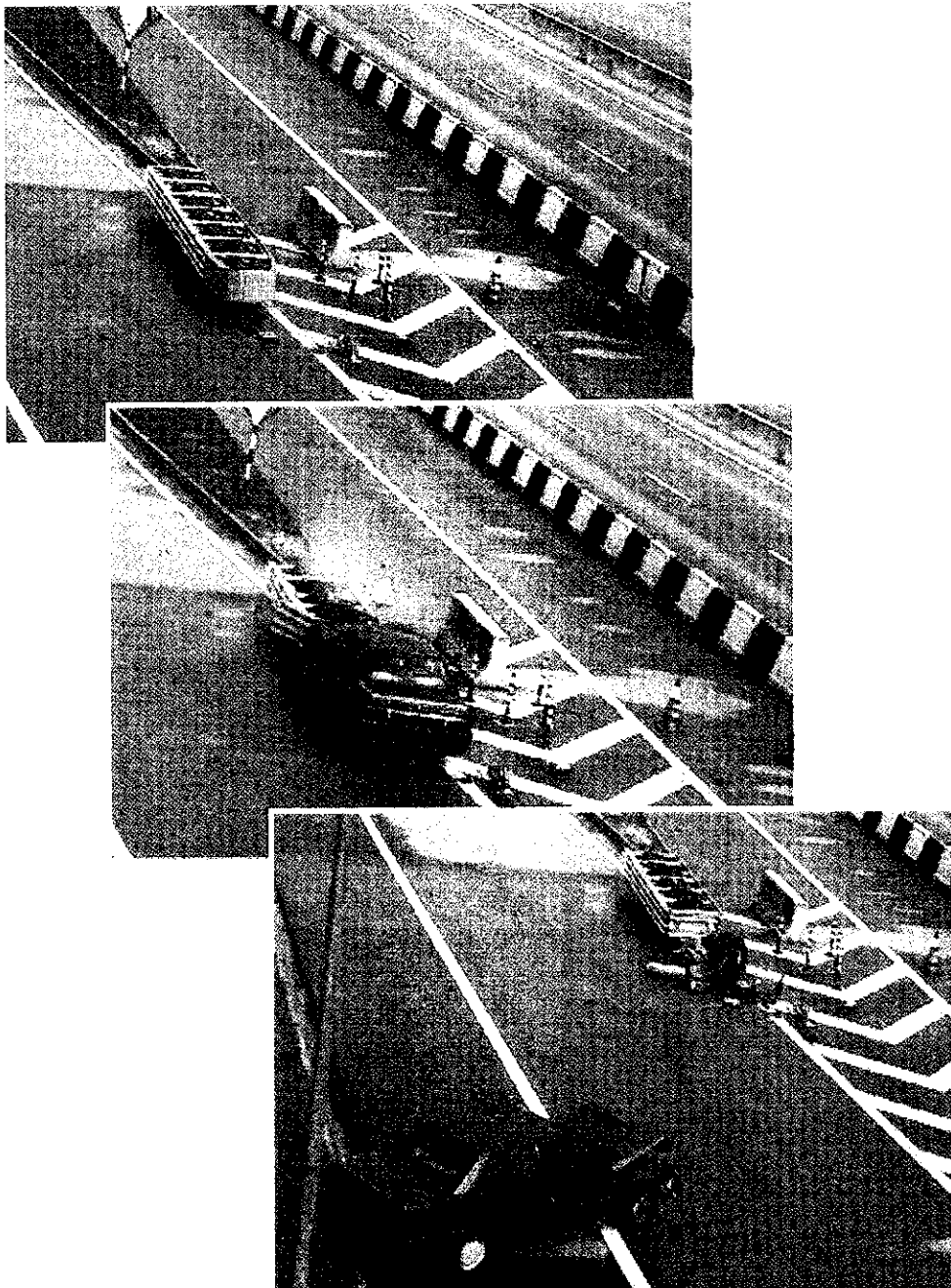


圖3 Live Crash Demonstration



## 伍、結論與建議

### 5.1 結論

1. 世界道路組織是國際道路工程組織團體中最具歷史的組織，我國因為受限於非聯合國成員，無法成為國家會員，僅爭取到成為團體會員，由於其深具交通發展經驗相互交流的意義，未來我國仍應積極主動參與相關活動。
2. 本次第21屆世界道路會議共有來自115個國家，2,778人參與盛會，大會所規劃4個特殊議題場次、5個Cross-linking議題場次、15個技術委員會研討場次，每個場次都有來自各國的專家學者共同研討。
3. 在電子收費議題研討上，各國專家學者一致認為以「技術導向做為優先選擇」的方式是相當危險的，正確而有效率的順序應該是先考量最終使用者的需求及接受度，其次是功能性的規格選擇，然後是關鍵組織的選擇，最後才是技術解決方案的選擇。
4. 在智慧型運輸系統議題研討上，與會專家則認為運輸政策應列為整體國家政策之一，運輸主管機關應發展ITS策略計畫，發展包括技術與組織的系統架構(architecture)，並同時反應使用者需求與政策目標。此外，除了ITS本身的發展外，結合其他基礎設施(infrastructure)的投資是最具成本效率的解決方案。



5. 在永續運輸的議題所獲致的結論，與會者咸認永續運輸應包括環境、經濟與社會三個層面，爲了追求永續運輸，應發展類似京都議定書的運輸政策國際協定，各種運具間者整合則應考慮相互聯運性(intermodality)與相互連網性(interoperability)。

## 5.2 建議

1. 藉由參加世界道路會議與國道道路協會年會等國際活動，可以充分蒐集世界各先進國家，在公路發展之各個領域之最新發展方向，可供國內類似問題之參考。其次，我國目前在世界道路組織(PIARC)因受限於非聯合國會員而僅爲團體會員，有鑑於我國參與國際組織空間因受中共打壓而愈來愈小的情況下，建議國內政府各公路主管單位及中華民國道路協會等民間組織，宜預先瞭解會議日程，寬編預算，持續參與相關活動。下次第二十二屆世界道路會議預計於二〇〇三年十月在南非德爾班(Durban)舉行。
2. 從這次會議可以發現，公路建設的發展除了硬體建設技術的研發外，更重視軟體管理技術的探討，ITS議題在相關道路會議已經佔有舉足輕重的地位，會議中工業化國家本身發展ITS的經驗對開發中國家以及經濟轉型中國家所提出的建議，應該足資國內參考，不過仍應依國情及本土交通特性，廣徵產、官、學、研之意見，深入瞭解使用者需求，以研擬發展計畫。
3. 馬來西亞近年來積極以BOT方式推動公共建設，特別是道路、橋樑、捷運等交通建設，而特許公司爲了營運績效，也往往能在不影響工程品質前提下，提前完成硬體建設。國內推動BOT正方興



未艾，馬來西亞的經驗似乎值得借鏡，惟類似電子收費這類界面整合問題，應由主管機關事先詳以規劃。



## 陸、附錄

- I. XXIst World Road Congress General Report
- II. Detail Conclusion of the main sessions (Electronic Fee Collection in Economies in Transition & Intelligent Transport)
- III. Lebuh Raya SPRINT (SPRINT)
- IV. Lebuh Raya Damansara Puchong (LDP)
- V. Lebuh Raya Shah Alam(KESAS)



附件一 XXIst World Road Congress General  
Report



# XXIst World Road Congress

Kuala Lumpur (3-9 October 1999)

## General Report

### INTRODUCTION

Road networks are essential infrastructures that support the economic growth in a region and provide social benefits to the people. Road infrastructure such as pavements, bridges and tunnels are thus important community assets, which have been inherited from the past and present generations. We have a duty of care for these assets in order that future generations can continue to benefit from their use.

Rapid urbanisation and development of road systems have created urban congestion, environmental and safety problems. The issue of natural disasters has always been of great concern to road engineers. There are also increasing demands on road transport by the users. In addition, road administrations are finding that the budget funding system is coming under increasing pressure as governments, confronted with growing expenditure demands, are allocating less funds to the road sector. The state of affair has indeed put much pressure on road administrations and engineers.

As an international organisation on road infrastructure and transport, PIARC has been taking the lead in responding to these challenges. Thus in 1995 PIARC formulated a Strategic Plan in order to steer its activities to address various related issues. The effort is organised through six Strategic Themes:

1. Road Technology,
2. Road Management,
3. Sustainable Development and the Role of Roads in the Transport System,



4. The User's Perspective,
5. Value for Money,
6. Technology Transfer.

Each Strategic Theme is handled by a Co-ordinator, 15 PIARC Committees and 3 Working Groups clustered around one of these themes according to their own activities. The XX1st World Road Congress in Kuala Lumpur is the first to be organised within the framework of this Strategic Plan.

The conclusions reported herein reflect not only the various aspects of the works of PIARC Committees and Working Groups during the 1996-1999 period but also the orientations and visions resulting from the open debates of the 6 Cross-Linking Theme Sessions organized during the Congress. They also take into account debates of other special sessions organised in co-operation with PIARC by other international organisations such as the World Bank, OECD, REAAA, ESCAP and ITE.

## STRATEGIC CROSS-LINKING THEMES

1999 was the first year where PIARC made a significant effort to draw a forward vision for future priorities by means of cross-linking theme sessions. There are six sessions:

- Road infrastructure assets management performance,
- Users perception,
- Sustainable transportation,
- Communication/Information revolution,
- Effective performance of the road system,
- Appropriate levels of road development.

The following are the summary reports.

### Road Infrastructure Assets Management Performance

The performance and economic efficiency of road infrastructure in relation to the needs it must fulfil should be analysed. The analysis should take into account all the costs and benefits involved. Three fundamental aspects promote economic efficiency. The first aspect is "Pavement Design Efficiency". This involves criteria and methods for design and whole life performance assessment of pavement. The second aspect on "Efficiency or Performance Indexes" deals with quality



concepts and the effect of indexes on maintenance and rehabilitation procedures. Also included are innovations concerning the indicators used in pavement management. The final aspect is "Innovations in Economically Favourable Road Techniques". This involves searching for environmentally friendly fill material, reducing areas for cuts in excavation, use of ultra thin layers in paving, use of protective devices against corrosion in bridges and use of horizontal prospecting equipment in construction of tunnels. Above all, users' perceptions and the level of satisfaction are often taken into account.

## Users Perception

In recent years, users and other stakeholders have begun to re-assert their influence in the road community. This is the global trend of users' perceptions that has changed the environment from one of the road agency knowing best what needs to be built, to one where the road agency is increasingly concerned with providing service to the customers - the customers being the users and stakeholders.

As the interests and needs of the users and stakeholders become more apparent, complexity and conflicts appear. The road administration of the 21st century will need to integrate users perceptions into road management to improve service quality. This requires a multi-disciplinary approach to road planning, construction, and management.

There are tools that have to be employed to bring users and stakeholders into the decision making process. These tools include better user surveys, partnering with the private sector and new technologies, such as Intelligent Transportation Systems (ITS). Once a mechanism is in place for incorporating users' perception into the decision making process, user constituencies can make cost-benefit comparisons for themselves and will likely be more satisfied with the end product.

## Sustainable Transportation

A very important concept to be incorporated in any transportation policy is sustainable development, which has been defined as development that allows people to meet the needs of the present without compromising the ability of future generation to meet their own needs. This includes environmental, economical and social aspects. For road engineering there is a global need for taking sustainable development into account. A proposal to achieve this would cover the following points:



- to keep the procedures and public consultations relating to policy and large-scale programmes separate from the procedures relative to the actual achievement of a road project;
- to rank the various issues at stake rather than put them on the same level; to study into detail the various issues on a rational, scientific and economic point of view, including the environment;
- to develop and improve communication and interdisciplinary skills;
- to take account of the global nature of sustainable development, for example, to develop strategies to implement international protocols in transport policies, such as the Kyoto Protocol;
- to develop linkages between the different transport modes, in terms of intermodality and interoperability, without compromising the continuity of routes, times and services.

### Communication/Information Revolution

There is a considerable challenge facing road administrations in exploiting the technological advancement. A number of these issues are considered important for PIARC's future activities:

- to make rapid progress on the monitoring of network performance in real time;
- to understand what affects driver behaviour in response to intermodal information flows and demand management issues;
- to facilitate systems for the intelligent management of road infrastructure, in a wide range of integrated management areas, such as incident detection, emergency response, recovery and police, as well as network operation;
- to encourage much greater institutional co-operation and co-ordination;
- to fully understand the safety responses to the inevitable advances in this area and to ensure adequate testing procedures.

The only way to succeed is for all the various players to progress as a fully integrated partnership, with road administrations taking the lead in setting a clear vision. This is particularly important in the development of technology standards where users must be fully involved.

An extremely valuable contribution was provided by one of the Essay Competition winners whose longer-term vision of a major road network operated to service standards and slot booking in the same way as rail, air and sea services presents a vision that could lead road administrations towards a fully integrated transport network operator role.



## Effective Performance of the Road System

Another important area that PIARC addressed is the financing, organising and measuring of the effective performance of the road system in the 21st century. Ten key recommendations were made which give guidance for future initiatives to take road administrations and PIARC into the next millennium. These covered both major roads and local roads embracing rural and remote areas.

In addressing effective performance of the road system, there is a need to:

- develop management and technology systems and processes;
- explore new forms of road infrastructure financing including through public-private partnerships and public-public partnerships;
- develop sustainable funding mechanisms for the provision and maintenance of roads in rural and remote areas;
- develop guidelines for community consultation and participation;
- promote the deployment of ITS measures;
- continue to develop effective performance management frameworks and associated tools.

Such issues need to be examined in the context of integrated transport and its interaction with land use planning and social and economic development.

## Appropriate Levels of Road Development

The assessment for a project prioritisation process is more formalised and quite complex where multi-criteria analyses are used. Even for countries with a mature road system, there exists a gap between current levels of provision for road infrastructure and demand. Thus it is necessary for each country to adopt a road funding and management system, which is best suited to its own political, economic, social and geographical needs. In the near future there will be sufficient international experience of different models of road management to determine objectively the anticipated efficiency gains of recent changes, which have been realised.

Roads must not be seen only in economic aspects but also as essential to people's role in society. Road access must be seen as a fundamental need for all human beings and must be available to the whole population.

The concept of appropriate development is defined through people's need to analyse solutions, which are adapted to relevant countries, and in particular to developing countries, accounting for prevailing constraints and taking advantage



of local opportunities. This concept needs to be studied in greater depth and in parallel to the concept of sustainable development because it is an issue for developing countries.

## THE CHALLENGES OF THE ROAD SECTOR

### Urban Transport/Land Planning

Urban congestion is a phenomenon and a perennial problem in every city. Many cities have thus taken various efforts to alleviate this problem. This topic was the main agenda of discussion in the Major Cities Session of the Congress. Some cities hold the opinion that it would be wise to adopt traffic restraint measures to ameliorate the situation because it is cost-effective and easy to implement. Examples of the traffic restraint measures include restraining the usage of private vehicles and promoting greater use of public transport.

Conversely, other cities are of the opinion that building more roads is the basic and constructive solution to the urban congestion problem. The argument is without enough road networks, vehicles cannot be dispersed. To ensure smooth travelling, priority should thus be given to building more roads, interchanges, bridges and other road related infrastructure. This is especially so in cities where the road network has yet to be improved. Regardless of whether traffic measures are used, or a policy of building more roads is adopted, it is difficult to dismiss the use of ITS in urban roads.

Another important issue is the lack of integration between the transportation system and land use. This would cause an increase in the journey of vehicles, which result in congestion, delays, higher vehicle operating costs, poorer air quality and health problems. The pre-requisites for improving the integration between transport system and urban development are: a national enabling authority/ system; a strong local planning/ implementation authority; an integrated land use, transportation and environmental planning system; as well as support from the public and the politicians. Authorities should have visions that recognise the relationship between transport and spatial planning, and it needs to be supported by the organisations that are managing the public transportation systems.

One aspect is by increasing the number of inter-modal trips with interchanges between modes with smooth and comfortable journey, thus improving the



accessibility and liability of the urban environment. To achieve this, it requires traffic and transport policy that involves "pull and push" measures. These are supported by other policy measures, which consider the environmental, or urban planning issues related to transport systems. Traffic management devices such as variable message signing and advanced systems can reduce congestion. Besides that, traffic planners should also take interest in the environmental aspects and quality management as this can influence road behaviour. The cost and time involved in implementing these approaches are marginal when compared to the added value from a properly planned programme of project consultation.

Relationships between three main levels of government: municipal, regional and national will determine how well the decision-making and implementation of transport policies function. However, in recent years new mechanisms have been introduced for public involvement in the decision making process, which paves the way for better future development and planning of new urban road projects.

## Environmental Issues

The environment is an open system resulting from Man-Nature interaction. It is affected in all its aspects by the selected means of transport and their increased demand for mobility. Increasing demand for mobility on existing road networks, however, involves a much sharper definition of impacts and their constant evolution, of possible consequences on health, comfort and way of life. Environmental factors such as soil and water protection, contaminated land and others should be considered in road construction.

Measures for finding a remedy for real damages, seeking a balance between transfers and quality of life for roadside residents should be further investigated. Technical, financial and political commitments are to be made at once, in order to make the existing network acceptable for citizens, users and roadside residents, in spite of constant increase in traffic. Strict standards and consistent measures should be provided, as in the European Directive.

Environmental concerns have always put strong pressure on road projects and earthwork experts. To improve the efficiency and lower the cost of environmental protection, these experts are nowadays confronted with new and burdensome requirements. Major advancement seems possible on the part of the earthwork engineers and examples of improvements include the rate of recycling of excavation materials or waste material embankments.



## Safety Issues

Road safety is a major concern for the society and particularly for the road transport sector. A million people die world-wide each year and we can do something about this. Every country can set up a road safety policy and share its experiences and in addition, it can evaluate all the measures taken, to ensure that this bloodshed is reduced.

In this perspective, road safety audits are part of this systematic endeavour. It is an approach during its design stage to prevent accidents from planning to the operation of any road. Besides contextual issues, there is a common theoretical based background of exchanging experiences in this field.

A road safety-engineering manual has been drafted and will be completed during the forthcoming PIARC work cycle. It is aimed at the education and for the use of engineers and technicians to get all the consolidated and updated knowledge to be applied in an interactive manner when solving road safety problems by safe road design within a system that is fully accountable and traceable versus appropriate performance indicators.

The planning, design and operation of road tunnels would lead to opportunities for the reduction in operating costs without safety, environment and level of comfort being compromised. The comparison of operational costs of tunnels has been constrained by the number of variables involved. However, work of tunnel classification has started with possible progress attained.

The admissible level of nitrogen oxide (NO<sub>2</sub>) in tunnels has yet to be fully resolved with regards to the impact of NO<sub>2</sub> on health requirements. Presently, the provision of acceptable sized ventilation systems based on traffic level will satisfy the health requirements.

A review of current national and international regulations by PIARC/OECD in the field of transportation of dangerous goods through tunnels have issued recommended measures to reduce the risks towards users and possibly protection to the tunnel itself. The decisions on the authorisation or refusal of such transport in each tunnel will be based on a rational basis.

The recent disastrous fire in the Mont Blanc tunnel has shown the very serious consequences of a fire involving goods such as margarine which are not classified as dangerous but can easily become liquid and be ignited when heated and have a high calorific potential. This raises the question of their



possible classification as dangerous goods. The field of fire and smoke control is very sophisticated and despite what has already been achieved is still being developed, in particular, taking into account the recent Mont Blanc and Tauern tunnel fires.

An issue that should be looked at with regard to safety and environment is freight transport. Five freight transport items are important. These are: logistic organisations, intermodality, weight and dimension in transportation, technical and social aspects of road transport and freight transport of the future. The number of unsolved problems with regard to environmental damage and safety is still very large and requires world-wide creative solutions. This is because the relative importance of the freight transport sector is likely to increase. The potential of technological innovations within the freight transport sector is immense but the implementation often requires smart financing schemes and public-private partnership.

### Natural Disaster Reduction

Natural disasters are yet another problem facing the road administrations. Road planners, designers, engineers and management staff should have ample knowledge of the types of disasters that may cause disruption to the road networks. It is well recognised that development of better road networks capable of providing detours in case of road blockage and construction of safer roads against possible natural events are of great importance in promptly reopening road traffic and saving communities attacked by natural incidents.

Exchange of experiences and technical information on road disasters among various countries should be continued and enhanced which reduces catastrophic life loss, property damage, and social and economic disruption. Codes and guidelines for dealing with natural disasters should be prepared by road management agencies, which should emphasise individual situations and conditions. A new PIARC Committee should be established to further emphasise the importance of risk management of roads.

### Users Perception in Roads, Transport and Regional Development

Users are always concerned with getting appropriate value for money. To achieve this, issues such as evaluation of the quality of service roads, quality of service as perceived by users and impact of the quality of service on the behaviours of users are important. This involves the identification of the criteria, measuring and overall quantifying methods. Quantitative measurements are well



established in road engineering practice but they have the drawback of not giving a true picture of the states of mind of the users and how they perceive the quality of service; nor of giving a good explanation of their behavioural patterns. For this reason, other quality indicators gathered from opinion polls are also considered. The quality of service may affect the behaviour of users in terms of the choice of transport mode, route and speed. The trend constantly highlighted by surveys on users, is their desire for the trip to go as planned, with fewer contingencies. As long as they are clearly informed, users are quite willing to adapt to an intermediate quality level. It is up to road designers and operators to identify the nature of these expectations through qualitative surveys.

### Financial and Budgetary Constraint

Governments world-wide are challenged to provide better roads and improved road infrastructure services. Due to escalating costs, new forms of road financing and tolling of roads must be found. To the administrators, tolling to new or improved roads is an efficient option. Road users, however, suffer the additional cost and double charging due to taxes already paid for their vehicles and fuel.

Involvement of the private sector in the provision, and operation of public roads is growing. This is because public expenditure is facing severe constraints whereas the private sector can raise the immense capital needed for infrastructure projects. Another reason is that the private sector seems efficient in managing such companies and services. Also, advancement in electronic tolling based on the "users pay" concept is slowly being accepted.

However, infrastructure projects are difficult to set up due to the lengths of the projects and the huge risks involved. Only a small share of the private financing on infrastructure is invested in the road sector because the road concession is in direct competition with other types of investments, which are less risky and have a shorter return period. There is also always a problem with public resistance to tolling especially where roads that were previously free are then tolled or when the toll is increased.

On the other hand, the massive investments involved in the so-called toll-free roads are borne entirely by the taxpayers. The road sector has to compete with equally important sectors such as health, education and other development schemes. Competitions between regions and between urban and rural roads are also a problem due to the limited resources. Full public financing of the highway is thus not equitable as it only benefits those in the immediate vicinity.



Normally, beneficiaries of a new or improved road are the potential road users, road transport groups, local communities and the society at large. Direct beneficiaries like the road users should pay first. Indirect beneficiaries who enjoy better service, opportunity and higher property value should also pay but quantifying this amount is more difficult. This follows the "users pay" principle where payment is proportionate to the benefits enjoyed. A reasonable and equitable pricing policy could be based on special taxes, in addition to toll. The actual toll should be lower than the individually perceived benefit derived to make it more attractive. This reduces public resources in financing the provision whilst maintaining social and economic balance.

Tolling cannot be implemented successfully without considering the social impacts. Tolls may influence the road users' behaviour. For example, the users may change routes, reschedule or cancel trips, which compromises personal freedom of movement. Route changing creates rat running at the boundaries of the tolled road causing social intrusion. Degradation in the environment for local residents such as noise, vibration and exhaust emission will be suffered. Money values placed on these issues to enable them to be included in cost-benefit analysis are questionable. Road safety and environmental problems to affected residents should also be included and these are easily quantifiable. Social intimidation and severance, however, are difficult to define and analyse.

The decision to toll and the choice of financing must be justified. Low-income road users must be considered which might lead to specific tariff arrangements or possibly a free alternative to the tolled road. If an existing free road is to be tolled, it should only be done after the improvements to service are noticeable. Under a direct tolling system, users become clients and deserve to expect a service corresponding to the price paid.

## THE SOLUTIONS

Challenges previously mentioned can be overcome with improved road technology, better road management tools and the adoption of appropriate policies.

### Road Technology

Road Technology can be classified under Engineering and Information Technology. Performance measurement of infrastructure is a popular topic of



research, which has led to the Second PIARC International Experiment to compare measurement methods of the evenness of road surface used throughout the world. This experiment has been completed and the results are currently being analysed by member countries.

The development of specific indices related to the different functional characteristics of the road surface is presented in this Congress. However, there are two issues, which are still at the research level. One is the traffic induced vibration problem, which is rather complex. Another is the use of pavement condition data in pavement management with the inclusion of criteria for homogeneity to be fulfilled for maintenance sections from the point of view of condition data (surface characteristics).

Representative traffic and climatic surveys and robust performance-based specifications, together with validated in-service performance should be developed. Optimal decisions with regard to appropriate forms of construction and maintenance should be made. This can be achieved by carrying out whole-life performance assessments. Highway engineering should make a significant contribution to sustainable development. Recycling, particularly in the conservation of primary aggregates can help achieve this. There are extremes of traffic and climate found world-wide and flexible pavements have shown potential in meeting these wide-ranging requirements for satisfactory in-service performance.

The Technical Committee on Earthworks, Drainage, Subgrade, deliberated on three issues: geotechnical ground reinforcement techniques in widening of existing highways; risk assessment and management techniques for slope and issues related to impact of earthworks on the environment. There are a variety of established techniques to widen highways. There may be a role for wider application of the technology to other transportation systems in support of integrated transport. Recommendations on risk management of existing slopes have been discussed.

It is plausible that knowledge and expertise in road pavements can be transferable with those in airfield pavements. The PIARC Working Group on Airfield Pavements has initiated a workshop to discuss this matter in the Congress. The main objectives were to compare road and airfield pavements and to consolidate, update and complete the results of the seminar held in Montreal in 1995.



To fully appreciate the benefits concrete pavements can bring through reduced maintenance costs compared with alternative materials, the use of whole life costing techniques to determine the benefits to society is worth considering. On the main network, the maintenance management involves adopting the right choice of pavement. Factors resulting from different climatic, traffic and environmental conditions are to be developed based on performance predictions. Existing pavements should be monitored and all available capabilities for databases exploited. Also, the potential of composite pavements that include a concrete base and a bituminous wearing course or a concrete surfacing over a bituminous material should be studied.

Technically we can conclude that concrete pavements are a potential alternative. Low rolling noise and high skid resistance can be obtained using available techniques such as exposed small aggregates, longitudinal texture and porous concrete. Also, placing a 5-cm thick bituminous layer between the foundation and the surface quality concrete improves the durability of continuous reinforced concrete pavements, especially in the case of erodable subbase or aggressive climatic conditions. Finally, the technique of ultra-thin concrete overlays of flexible pavement is promising, provided that its use is limited to solutions where the condition of the underlying asphalt is sound, and it should be studied further.

#### Information Technology

Effectiveness of transport systems can be improved further through ITS which may save time and lives, enhance the quality of life and environment, and improve the commercial activity of an area. Concerted efforts from all parties involved are necessary to ensure effective implementation. Policy and decision makers must ensure that ITS is included in transportation policies as one measure to solve transportation problems. It is important that ITS strategic plan, ITS architecture and role of the private sectors be included and developed. To be cost-effective, new ITS development should try to leverage on existing infrastructure, especially the costly telecommunications infrastructure that is continually changing with new technologies.

As for transportation professionals, they must develop and implement a user friendly ITS. International organisations are recommended to consider a phase process of ITS development, which includes forming coalitions of relevant stakeholders in developing a formal strategic plan. Investments on ITS technologies should not be delayed and must be as cost-effective as possible.

#### Road Management



Road management includes maintenance, which is a vital key to the performance of road structures. The value of good maintenance must be rediscovered with emphasis on precaution and planning. Maintenance management systems will be required to enable priorities to be set and economic viability to be demonstrated. A culture of quality systems and training is essential in road management if the concept of service and value to the customer is to be achieved, and thus training for road maintenance should be recognised as a specific activity in road management. It is essential to provide an adequate compromise between the customers' expectation of a comfortable journey and the engineers' requirement to give technical value for money.

There have been a large number of very durable bridges and other structures built through past centuries, which had ensured a low rate of rehabilitation and replacement. It is therefore essential to maintain the overall long-term durability of the structures so that such benefits can be enjoyed by future generations. The use of whole life costing for bridges shall take into account the future maintenance costs. In the case of projects involving the road network, the road user delay costs arising from any traffic disruptions need to be considered. In this respect, test interest rates, maintenance cost data, and the use of long life as well as replaceable bridge elements should be considered in the whole life costing analysis.

An international project to develop new road investment analysis tools, known as the Highway Development and Management system (HDM-4), has been continuing since 1993. The World Bank, the UK Department for International Development, the Asian Development Bank, the Swedish National Road Administration and other sponsoring organisations, including PIARC member governments and PIARC itself, have sponsored this project.

HDM-4 is a decision support software system for assisting road managers to predict future economic, technical, social and environmental outcomes of possible investment decisions concerning road assets. The HDM-4 system will assist managers in making effective investment choices at all levels. The possibilities may range from policy or strategic planning studies, through programmed allocation of funds to maintenance or improvement works on a network, to the detailed economic and environmental assessments of project options at the project level.

PIARC has assumed the role of leading the management and co-ordination of international HDM-4 implementation activities since 1998. These activities include completing system testing, release and commercial distribution,



co-ordinating training standards and programmes, information dissemination, promoting effective applications of the system, and identifying and co-ordinating continuing research and development efforts for road management information support. PIARC has established a full-time Project Secretariat to direct the HDM-4 activities, together with a strategic management team having wide international representation.

## Performance of Road Administrations

The performance of road administrations is increasingly being criticised by the users. Two areas have been identified for improvement. One is the use of performance indicators to help evaluate and improve their operations. Performance indicators are very useful in helping to detect weaknesses in the functions of an organisation or inefficiency in operation processes. Used properly, this will lead an organisation to question the reasons for those "deficiencies" highlighted by the performance indicator and most importantly ways in which to put things right. The process must be iterative and it must lead to a new enterprise culture, which requires support from all levels of the hierarchy within an organisation. Road administrations face similar problems across the world. It is important that we learn from each other and performance indicators have a key role to play in that process. They help to define priorities and, used properly, will become embedded in the culture of the organisation. Road user views are fundamental in guiding this process.

Secondly, quality systems can be defined from a number of perspectives. Traditionally, value for money and fitness for purpose have been the drivers. Increasingly, customer satisfaction is playing its part. Quality systems can be applied to the management of roads and road administrations as well as to project management. To be effective, quality systems need to adopt a process of continual improvement and involve all levels of the organisation. In particular visible commitment of senior management is vital. Some form of audit process is required to support the process. The benefits which flow from quality management systems include: an improved customer focus; improved accountability; less need to rework solutions; greater efficiency; better decisions on the level of quality and the development of methodical corrective action programmes.

## Technology Transfer and Regional Co-operations

Technology transfer lies at the very heart of PIARC's reason for being. It is important for member countries, especially less developed ones, to identify and



express their needs in the area of technology transfer. PIARC must play a major role in facilitating the expression of these needs. This can be done through closer co-operation with regional organisations and organising seminars in emerging countries. A more intensive use of the PIARC Special Fund can help achieve this.

The PIARC reserve funds will help to promote the formation of technology transfer centres, which will create technology transfer networks in developing countries. This will promote activities such as those of the World Interchange Network (WIN). Although WIN has grown since its founding in 1994, many countries remain unaware of WIN and its potential as a human network for resolving technical problems.

With regard to regional co-operations, the session organised during the Congress with REAAA on rural roads has shown that secondary road systems are an important, but often overlooked, part of the total transport system of a country or region. The wide-ranging benefits and the variety of roles that secondary rural roads play in the economic and social development in the Asian and Australasian region are undeniable. Successful experiences and good practice in provision, funding and management of secondary road networks have been shown in countries in the region. Rural secondary roads must also be sustainable at reasonable costs.

There has been no consistent policy between primary and secondary road network management. Decision-making procedures for primary roads are not appropriate for secondary road networks. New funding, investment prioritisation, involvement of the private sector, maintenance, quality standards and professional support from international organisations are all needed in the planning process of secondary road networks.

Equally, the Asian Highway reflects the importance of regional co-operations realising the dream of linking Europe and Asia. The Asian Highway was a rallying point for countries in the region especially in its early days as roads provided a means of contact between the people and their cultures. From its launching in 1959, the idea of a highway stretching across Asia from Ho Chi Minh City in Vietnam to the Turkish border has steadily developed over the years.

To date, route selection criteria that include minimum standards and highway classifications for road connections between capitals, infrastructure terminals, and other important economic and industrial centres have been agreed upon.



Highway design and safety standards have been set to comply with the growing national and international traffic and to reflect the changes in road construction technology.

Trade, regional business and tourism in the Asian region has increased dramatically placing increasing demands on the transport infrastructure. Strategic routes, new highways and expressways were built and incorporated into the latest Asian Highway network in member countries to address these demands. There is increasing need to raise the awareness of the availability of the Asian Highway for tourism development and freight transport.

Implementing such a project involves overcoming hurdles such as the lack of bilateral agreements between neighbouring countries. Even today, some countries have not acceded to the major international land transport conventions, which are crucial for landlocked countries. Efforts are underway to resolve these problems through plenary meetings organised by PIARC at the ministerial and policy levels.

## **VISIONS AND CHALLENGES AHEAD**

Important messages will be drawn from the fruitful debates that took place during the seven days of the XX1st World Road Congress, completed with the analysis of a First Delegates issues survey conducted through PIARC member governments. They will be reflected in the 2000 - 2003 Strategic Plan as agreed from the meeting of the Strategic Plan Commission and the Strategic Theme Co-ordinators.

Our attention should be drawn to the common message expressed by the winning teams of the essay competition. Following an initiative by the British National Committee, the PIARC Council launched an Essay Competition on the theme of "Infrastructure and Transportation in the 21st century" in association with the World Road Congress. The aim of the competition was to stimulate new ideas in response to the challenge of the global transportation demands in the 21st century. The ideas are sought from multi-disciplinary teams of young professionals, who will themselves be the managers in the 21st century.

The winning papers dealt with issues such as ITS, decentralisation of the governments, communicating vehicles and communicating infrastructure, higher



efficiency in public transport, sustainable road system and use of information technology.

As mentioned by Mr. John Kerman, Director of the British Highways Agency and PIARC Strategic Co-ordinator, "the underlying message in all essays is the imagination and optimism of youth. They are aware of the difficulty of the problems we face, but combined with great vision and a keen eye for what is possible ... an exceptional result to take PIARC forward in its own thinking".

## CONCLUSION

The road sector is constantly challenged to provide solutions to global problems. To meet these challenges PIARC Committees and Working Groups have dealt with issues relating to regional co-operation, users' perception, whole life performance, disaster reduction, alternative sources of funding, technology advancements, safety and environment and others. However, there are issues like traffic-induced vibration, which is still at a research level at the moment. Other issues like transport of dangerous goods through road tunnels is scheduled for completion and dissemination by the year 2000.

The XX1st World Road Congress has provided a forum for experts and other interested parties to deliberate the results of PIARC Committees and Working Groups as well as other specific issues. We look forward to your continued support in PIARC's future activities.



**附件二**    Detail Conclusion of the main sessions  
(Electronic Fee Collection in Economies  
in Transition & Intelligent Transport)



# **Electronic Fee Collection in Economies in Transition (C3, C16)**

## **Introduction**

The special session on Electronic Fee Collection (EFC) in countries in transition was cosponsored by C3 and C16. Attended by some 70 people including speakers and active participants, the session was organized to include three parts:

1. Reporting of EFC experience in countries in transition from three continents (South America, Asia and Africa),
2. Reporting on EFC standards developed in three regions (North America, Europe and Japan), and
3. Putting EFC choices in a global ITS perspective,

which set the stage for interactive discussions between the audience and the speakers. The following conclusions emerged from the special session.

## **Conclusion for Decision Makers**

DSRC standard choice, for a transitional country, is often one of the first and most difficult ITS decisions: the decision has relatively long-lasting consequences, it necessitates the consideration of the entire intelligent transport system in the whole country, and EFC is often the first large-scale ITS application in EIT/DC. Therefore, there is a case here for government leadership.



Thus, this initial question, concerning the choice by an EIT/DC country of an appropriate DSRC standard for electronic fee collection, raises in reality several other even more important questions, especially when a true listening process focuses on sustainable economic development of the concerned country in the long run.

Recent processes for choosing DSRC standards in both industrialised and transitional countries/continents have testified to difficulty of the exercise; "new-comers" are encouraged to avoid underestimating the complexity of the problem and to utilise the highly valuable lessons of the past/current experience. New-comers have here an opportunity to get ahead of industrialized countries, because of less constraints by large capital investment and institutional inertia. Based on market considerations and user needs, decision makers should put EFC and even ITS in a broader "information technology perspective" (for example do not prematurely exclude the application of smart cards to both transport and non-transport sectors).

Careful analyses based on a wide range of case studies show that a "technology-driven choices first" approach is hazardous; the right order for effectiveness would be:

- a. first: need priorities determination (what do we want to accomplish through EFC and other related ITS user services? what are their relative importance and adequate timing sequences?) taking into account end-users' needs and acceptability; and definition of the relevant institutional scope (motorways alone or with public transport? etc.),
- b. then: functional specification choices (which services do we want exactly to develop, what are the constraints, the performance requirements, etc.),
- c. then: institutional choices (what are the relevant stakeholders involved in getting these needs satisfied? which are the possible financing sources? need for a clearinghouse? etc.),
- d. and then: technology solutions choices. Experience in certain countries testified the risk of hasty decisions on EFC technology.

Each organisation (road directorates at federal and state levels, concessionaire companies, suppliers, etc.) has its specific and irreplaceable role to play in all of the above steps.

The special requirements in each specific national context are very important constraints and may have large impacts on the final choices, they should be explicitly identified and weighted as early as possible for example:

- Is the practice of road tolling new or already existing?



- Is the border-crossing traffic with neighbour countries an important factor?
- Will EFC be conducted on free-flow multilane or traditional one-lane traffic?
- Which motorway segments are actually concerned and what is the present/future EFC situation on those segments?
- What are the legal, telecommunication, etc., constraints?

The special requirements in general EIT/DC contexts are also important and could be best dealt with by addressing each main requirement, for example:

- a. Where equipment is requested to be manufactured locally, it may have consequences on technology choices;
- b. Functional specifications should take into account the relevant EIT/DC users' socio-economic constraints/needs; for example users affordability of EFC units.
- c. Early identification of the right institutional setting in charge of managing the whole process for choosing the EFC-system to maximise national benefits could accelerate decision making to secure the final results.

## Technical Conclusions

The necessary degree of interoperability sought must be carefully assessed, starting by clarifying the concept of "interoperability" in three aspects (in order to avoid costly misunderstandings or mistakes):

- a. "technical compatibility", between EFC equipment components from various vendors, is necessary for overall interoperability but is not sufficient;
- b. "contractual interoperability" at operators level, focusing on services to users, is also needed;
- c. "institutional interoperability" is needed as well. This aspect of interoperability is concerned with the longer-term-vision objectives, whatever the technology used, and defines the relevant institutional perimeter target, and the families of interoperable ITS applications.

In spite of the importance of overall interoperability, it can also be an expensive burden in practice. Therefore a careful economic and financial analysis is necessary to identify the appropriate compromise: "interoperability, yes, but how much, of what type, at which level, and when?"



The various existing DSRC standards can offer appropriate solutions, as long as the whole process of analysis and decision takes into account the key constraints in the right order. A given technology/standard can be the best choice available now for one country, without being the best for another country/situation. Main criteria for such choices are:

- o Existing EFC local situation, acceptable costs of migration to future standards, and total transition-time constraints,
- o Type and number of other than EFC ITS applications which will be actually deployed during the life cycle of the chosen technology,
- o Number of possible "technically-compatible" suppliers, thus facilitating competition and favourable prices and services,
- o Total costs including on-board units and ground infrastructure equipment for the entire ITS, including but not restricted to EFC.

ITS technologies evolve much faster than traditional road technologies, therefore EFC technology choices need:

- a. a global national ITS perspective, including ITS architecture;
- b. a careful international watch on techniques, industrial trends and standardisation (especially continuing development of DSRC and ITS-related standards by ISO and ITU).

## **Conclusions for PIARC and other International organisations**

The significance of existing constraints and the size of the issue at stake concerning EFC/DSRC choices in EIT/DC are such that EIT/DC representatives in international standard organisations have a challenge in being present, collectively active and carefully listened to. The rapidly growing EIT/DC market for EFC may provide additional incentives for international harmonization of EFC standards. At the same time, EIT/DC should develop their own action plan in spite of the lack of current full international harmonization.

It would be useful for EIT/DC decision makers if the consulting industry could offer services on EFC/DSRC system choices with all the following characteristics:

- o Independence from solutions, and therefore with a strong, objective and international perspective/experience,



- Ability to advise not only on technology choices but also on functional specifications development, institutional innovation, and global ITS choices process management,
- Direct and operational experience of both industrialised and EIT/DC ITS development.

When EIT/DC decision makers express specific complex needs, PIARC can act as a convenor and facilitate an international, open and neutral dialogue between these decision makers and key experts at the appropriate level of synthesis, and road sector managers from other countries with relevant experience. An immediate step that PIARC should take is to develop and distribute a "Special Report" on the basis of this session of the XXIst World Road Congress.



**XXIst World Road Congress**

**Kuala Lumpur, 3-9 October 1999**

**Detailed Conclusions  
of the main sessions**

# **Intelligent Transport**

## **(C16 Plenary Session)**

### **ITS Handbook Recommendations**

#### **Recommendations for the policy makers \***

1. Transportation policies should be developed in the context of overall national (economic, environment, etc.) policies putting ITS in the mainstream to be considered along with other measures for solving transportation problems in congestion, safety, productivity, and environmental protection.
2. Transportation agencies should develop an ITS Strategic Plan and work with key stakeholders to develop an ITS framework, a so called architecture, that includes both technical and institutional components. This Strategic Plan should reflect both user needs and policy goals.
3. To meet the traffic demand growth, ITS in its own right, or even better in combination with other infrastructure investments, is a most cost effective solution.
4. ITS programs can be developed only in co-operation with other transport operators, users, and industry. This demands new approaches to procurement and working in partnership, nationally and internationally.

#### **Recommendations to transportation officials \***

1. Transportation professionals should take into account all safety aspects of ITS systems including safety benefits and risks involved in the implementation of ITS.
2. To achieve full benefits of ITS, transportation professionals should participate, and be champion when appropriate, in building new alliances and appropriate agreements with key stakeholders including operators in different transport modes,



regional planning authorities, information providers, fleet operators, and the general travelling public.

3. To accomplish effective delivery of its user services, transportation professionals should be familiar with ITS enabling technologies at the functional level in the context of the information chain linking transportation systems to ITS users. To avoid getting locked into a single supplier, transportation agencies should opt for an open system architecture in ITS deployment and to acquire equipment that is compatible with established ITS standards. Where ITS standards of critical importance do not exist, transportation officials should proactively raise the issue with the proper standardization bodies.
4. Given the nature of ITS and its systems characteristics, transportation agencies should be open toward, and be innovative about, new forms of public, private, or public-private procurement and financing arrangements.
5. Transportation agencies without relevant prior experience are recommended to take note of the lessons learned from experienced experts so that precautions can be taken to avoid expensive mistakes.

### **Recommendations to Transitional Countries \***

1. To have an overview of the different international ITS applications possibilities to adapt systems to the specific needs and requirements of the countries to achieve the best cost-benefit ratio.
2. To have regional co-operation because similar transportation needs to define the common requirements and priorities.
3. To enlarge the regional co-operation with bilateral and multi-lateral co-operation with developed countries to ensure the requirements of inter-operability compatibility and continuity of services.



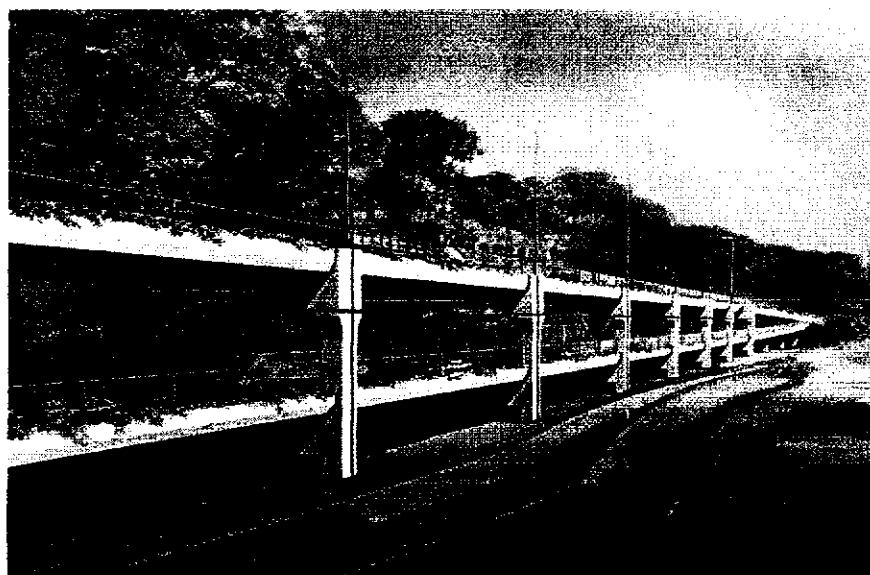
### 附件三   Lebuh Raya SPRINT (SPRINT)



# **BRIEFING NOTES**

## **TECHNICAL SITE VISIT**

### **WORLD ROAD CONGRESS**



### **PROJECT LEBUH RAYA SPRINT**

**6 October 1999**





## BRIEFING NOTES ON LEBUH RAYA SPRINT

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## 1.0 INTRODUCTION

### 1.1 BACKGROUND

Lebuh Raya SPRINT is a Government project privatised by the Government through a BOT (build, operate and transfer) contract agreement awarded to Sistem Penyuraian Trafik KL Barat Sdn Bhd.

Lebuh Raya SPRINT is a **26-km, 6-lane dual carriageway free-flow highway** with three much-needed links to ease congestion in the west of Kuala Lumpur. It is designed to

- Serve as a dispersal road system to allow traffic to disperse or move out from congested areas
- Ease traffic congestion and provides for increased road capacity in the west of Kuala Lumpur
- Serve as a critical spine road network supporting infrastructure and catalysing growth and development west of Kuala Lumpur

Lebuh Raya SPRINT provides three links in its alignment to meet with these objectives. These three links are the Kerinchi Link, the Damansara Link and the Penchala Link.



- Kerinchi Link

The Kerinchi Link connects the NKVE and the KL North East Expressway in the north, and the East-West Link and the Federal Highway in the south. The Kerinchi Link will be the critical intermediate ring road between MMR I and MRR II, needed to relieve city congestion by allowing motorists another ring road to bypass the city roads.

- Damansara Link

The Damansara Link upgrades and widens the existing Jalan Damansara by replacing 6 nos. of existing traffic light junctions with multi-tier interchange systems. This will substantially increase traffic capacity and significantly reduce travel time.

- Penchala Link

The Penchala Link is a new link that will connect the Lebuhraya Damansara-Puchong (LDP) in the west to Jalan Bukit Kiara at Mont Kiara in the east. The Penchala Link will provide motorists a new direct link to Kuala Lumpur and will no longer need to commute along the congested Jalan Damansara or Jalan Kepong, or the NKVE route to Kuala Lumpur. It will serve as a main spine road and catalyst for growth in the west of Kuala Lumpur.



The Lebuhraya SPRINT **free-flow concept** will provide for **congestion-free** and convenient travel with its **multi-tiered interchange system** for through and direct access and **at-grade dispersal** for local traffic.

## **1.2 CONCESSION COMPANY**

The Concession Company for the Lebuhraya SPRINT project is Sistem Penyuraian Trafik KL Barat Sdn Bhd (SPRINT). On 23 October 1997, the concession agreement was signed between the Government of Malaysia and SPRINT for the privatisation of the improvement, upgrading, design, construction, maintenance, operations and management of Lebuhraya SPRINT. A Supplementary Agreement was subsequently signed on 4 September 1998 to defer the construction of the Penchala Link.

The Concession Period is for 33 years and commenced on the Effective Date on 15 December 1998.

## **1.3 AWARD OF THE TURNKEY CONTRACT**

SPRINT awarded a Turnkey Contract to Gamuda Mujur Minat Joint Venture for the design, supervision and execution of the works, for the Kerinchi Link, Package A and the Damansara Link, Package B. The construction Period is 36 months effective from 1 January 1999 to 31 December 2001. The design and supervision are being carried out by



Zaidun Leeng Sdn Bhd for Package A (part) and B and by Tahir Wong Sdn Bhd for Package A (part).

#### **1.4 THE INDEPENDENT CONSULTING ENGINEER (ICE)**

SPRINT has appointed SYMONDS TRAVERS MORGAN (MALAYSIA) SDN. BHD as the Independent Consulting Engineer (ICE). The ICE is to provide an impartial opinion on the design and construction of Lebuhraya SPRINT. The scope of the ICE's appointment for the design stage is compliance checking of the Concession and Turnkey Contracts and conceptual level review of detailed design drawings. The ICE's scope during the construction stage is the monitoring of the performance of the Turnkey Contractor.

### **2.0 HIGHWAY FEATURES**

#### **2.1 INTERCHANGES**

There were 13 interchanges on Lebuhraya SPRINT at the following locations: -

1. Penchala
2. Taman Tun Dr. Ismail
3. Mont Kiara
4. Duta
5. Sri Hartamas



6. Intan
7. Kayu Ara
8. Section 17
9. Taman Tun Dr. Ismail Bypass
10. Kiara
11. Maarof
12. Semantan
13. Kerinchi

## 2.2 TOLL PLAZAS

There are three Toll Plazas on the Lebuhraya SPRINT, one on each of the Links at the following locations: -

- |                |  |
|----------------|--|
| Kerinchi Link  | - Pantai Toll Plaza (Between Jalan Bukit Kiara Interchange and Kerinchi Interchange, near Taman Bukit Pantai) Located on new alignment.  |
| Damansara Link | - Jalan Damansara Toll Plaza (Between Jalan 17/21 junction and Jalan Dato' Abu Bakar junction.) Toll in one direction only with a parallel one-way two-lane toll free road provided. |
| Penchala Link  | - Bukit Penchala Toll Plaza (Between Kg. Sg. Penchala and Mont Kiara) Located on new alignment.  |



## 2.3 LANDSCAPING

Lebuh Raya SPRINT will be landscaped in line with the Government's "Landscaping The Nation" guidelines, the purpose of which is to green and beautify the highway. Upon completion, Lebuh Raya SPRINT will be planted with trees and shrubs on side-shoulders, medians, and around interchanges and toll plazas.

Lebuh Raya SPRINT's landscaping programme will be implemented on a relocate-and-grow during construction concept. This method is adopted to maximise the relocating and transplanting of the existing greenery and landscaping and also to minimise disruption to the environment during construction. Only 6% of the existing trees have to be removed and will not be relocated based on the guidelines of the authorities.



### 3.0 PHYSICAL PROGRESS

#### 3.1 EXECUTIVE SUMMARY SHEET

##### KERINCHI LINK (PACKAGE A)

#### I. GENERAL CONTRACT DATA

1. Period Ending : 31 August 1999
2. Supervising Consultant : Zaidun Leeng Sdn Bhd (Part)  
Tahir Wong Sdn Bhd (Part)
3. Independent : Symonds Travers Morgan (M) Sdn Bhd  
Consulting Engineer
4. Turnkey Contractor : Gamuda Mujur Minat Joint Venture
5. Contract Period : 36 Months
6. Commencement Date : 1 January 1999
7. Completion Date : 31 December 2001
8. Defects Liability Period : 12 Months
9. Time Elapsed : 19% (7 months)
10. Physical Progress :
  - Actual 23.81 %
  - Scheduled 13.86%



### 3.2 EXECUTIVE SUMMARY SHEET

#### DAMANSARA LINK (PACKAGE B)

##### I. GENERAL CONTRACT DATA

1. Period Ending : 31 August 1999
2. Supervising Consultant : Zaidun Leeng Sdn Bhd
3. Independent : Symonds Travers Morgan (M) Sdn Bhd  
Consulting Engineer
4. Turnkey Contractor : Gamuda Mujur Minat Joint Venture
5. Contract Period : 36 Months
6. Commencement Date : 1 January 1999
7. Completion Date : 31 December 2001
8. Defects Liability Period : 12 Months
9. Time Elapsed : 19% (7 months)
10. Physical Progress :
  - Actual 28.39 %
  - Scheduled 20.44%



#### **4.0 HIGHWAY INNOVATION**

##### **4.1 DOUBLE DECK AT KERINCHI LINK**

This will be the first double deck highway structure in Malaysia with the northbound traffic on the lower deck and the southbound traffic on the upper deck with a toll plaza on each deck. The toll plaza will be staggered to provide for additional toll lanes. The Kerinchi Link adjacent to University Malaya will be on elevated structures for approximately 3 kilometres with the double deck structure approximately 1 kilometre in length. Both the lower and upper deck will be supported on portals forming the superstructure. The substructure will be supported on bored piles (900 mm – 1350 mm diameter) of lengths varying from 15 metres to 25 metres. The average span of the portal structures is 30 metres and U-beams will be used.

The double deck structure and the staggered toll plaza will reduce the amount of land take on the Kerinchi Link that skirts along the boundary of University Malaya. Sound barriers of the absorptive type will be installed to reduce the noise levels to adjacent developments.

##### **4.2 PENCHALA TUNNEL**

There will be a 700 metre long twin bore, three-lane carriageway tunnel at the Penchala Link. The tunnel will provide direct access from the LDP



(Penchala) to Mont Kiara at Sri Hartamas. The clearance envelope for the tunnel shall provide a 10.5 metre wide carriageway with 0.5 metre wide margin strips and a clear height of 5.4 metres above the finished pavement. There will be one cross passage for the tunnel. A computerised control and monitoring system will be provided which will monitor the levels of atmosphere pollution, control the ventilation system, monitor the levels of luminance, power supply system, fire fighting system, M&E equipment, traffic surveillance and control, communications, etc. An emergency telephone system will also be provided.

This tunnel will minimise the land take and minimise the disruption to the environment during construction, i.e., the best way to preserve the ecology and environment in the area.

#### **4.3 TRAFFIC CONTROL AND SURVEILLANCE SYSTEM**

Lebuh Raya SPRINT will be equipped with a Traffic Control and Surveillance System, which consist of Closed Circuit Television (CCTV) cameras to monitor traffic flow and detect incidents and other circumstances that require immediate response. Variable Message Signs (VMS) will also be available to provide information to motorists on any abnormal traffic situation and road conditions on the highway; further adding to travelling convenience on Lebuh Raya SPRINT. The equipment



will be installed at the strategic and designated locations along the Highway.

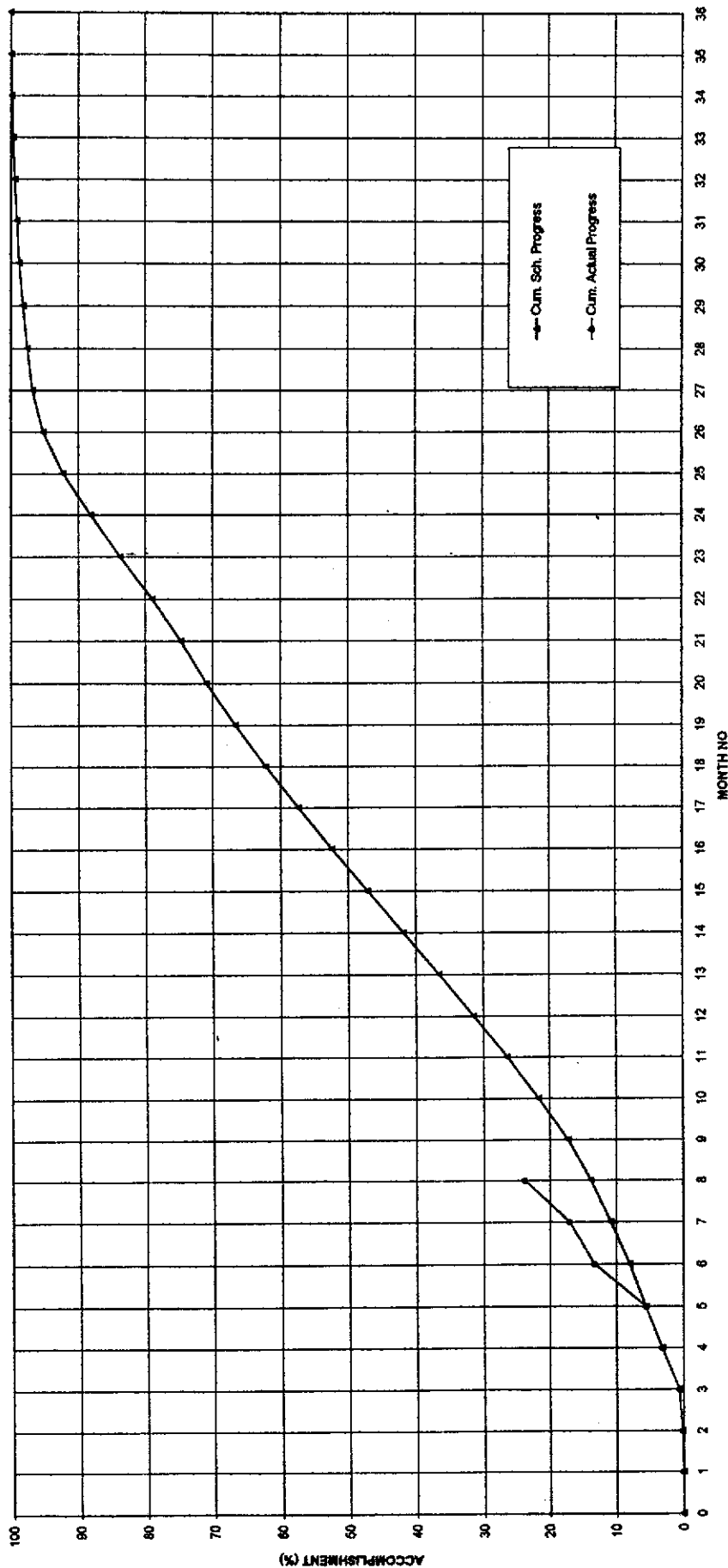
## **5.0 CONCLUSION**

With the completion of Lebuhraya SPRINT, the much needed road network to relieve congestion and to cater for increased traffic in the west of Kuala Lumpur will be available. It will also spur growth and developments in the west of Kuala Lumpur.



**PERIOD ENDING : 31-AUGUST-98**

## OVERALL CONSTRUCTION PROGRESS AGAINST PROGRAMME

**ACTUAL PROGRESS AGAINST SCHEDULED PROGRESS**

| Item | Description        | Year  |      |        |      |      |      |      |      |      |      |      |      | Total |      |      |      |        |      |        |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |
|------|--------------------|-------|------|--------|------|------|------|------|------|------|------|------|------|-------|------|------|------|--------|------|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
|      |                    | 1898  |      |        |      |      |      |      |      |      |      |      |      |       |      |      |      |        |      |        |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |
|      |                    | Month | Dis  | Months | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  |       | Oct  | Nov  | Dec  | Months | Dis  | Months |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |
| 1    | Sea-Wing for Mch   | 0     | 0.07 | 0.19   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 2    | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 3    | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 4    | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 5    | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 6    | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 7    | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 8    | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 9    | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 10   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 11   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 12   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 13   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 14   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 15   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 16   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 17   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 18   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 19   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 20   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 21   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 22   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 23   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 24   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 25   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 26   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 27   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 28   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 29   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 30   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 31   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 32   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 33   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 34   | Adapt Wing for Mch | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.32 | 4.39 | 4.28 | 4.08 | 2.98 | 1.84 | 0.74 | 0.98 | 0.62 | 0.34 | 0.28 | 0.24 | 0.10 | 0.06 | 13.86 |
| 35   | Sea-Wing for Mch   | 0     | 0.07 | 0.18   | 0.44 | 2.81 | 2.41 | 2.61 | 3.04 | 3.38 | 4.43 | 4.77 | 4.82 | 5.18  | 5.27 | 5.30 | 5.31 | 4.97   | 4.80 | 4.40   | 4.10 | 3.81 | 4.25 | 4.   |      |      |      |      |      |      |      |      |      |      |      |      |      |       |

Revision A (12/2009) : Changes in weightages, retaining structures added, Federal Highway Extension omitted.

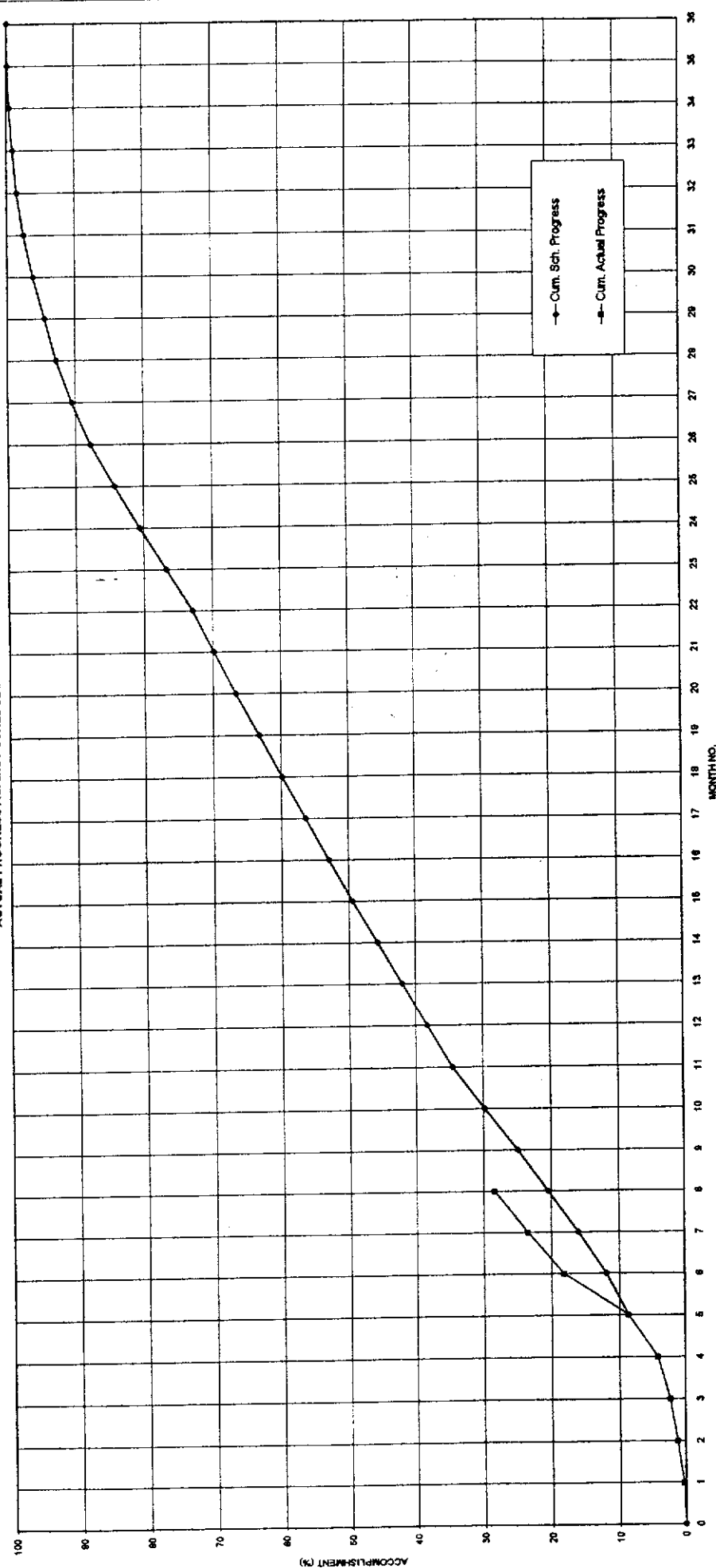


# LEBUHRAYA SPRINT PACKAGE B

PERIOD ENDING : 31-August-78

OVERALL CONSTRUCTION PROGRESS AGAINST PROGRAMME

ACTUAL PROGRESS AGAINST SCHEDULED PROGRESS

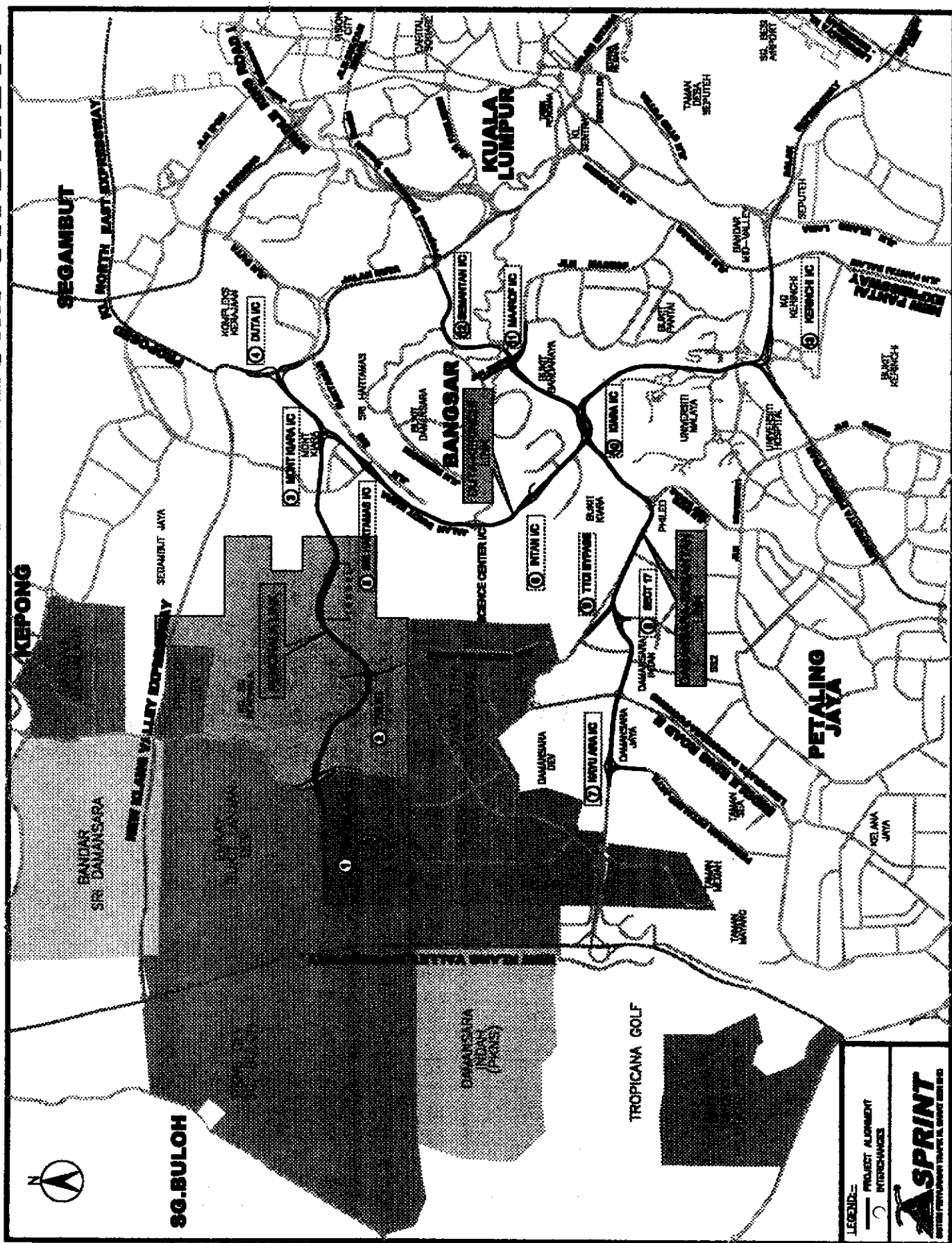


| Item | Description                   | Year | Month | Month No | 1978 |      |      |      |      |      |       |       |       |       |       |       | 1979  |       |       |       |       |       |       |       |       |       |       |       | Total |       |       |       |       |       |       |       |       |       |       |       |        |
|------|-------------------------------|------|-------|----------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|      |                               |      |       |          | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   | Jan   | Feb   | Mar   | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct   | Nov   | Dec   |       |       |       |       |       |       |       |       |       |       |       |       |        |
| 1    | Sch. Wks for Mth              |      |       | 0        | 0.32 | 0.61 | 1.07 | 1.65 | 4.42 | 3.25 | 4.16  | 4.40  | 4.44  | 4.84  | 4.76  | 3.77  | 3.71  | 3.70  | 3.53  | 3.43  | 3.49  | 3.88  | 3.44  | 3.21  | 3.04  | 3.63  | 3.81  | 3.72  | 3.61  | 2.73  | 2.76  | 1.76  | 1.68  | 1.34  | 0.88  | 0.88  | 0.43  | 0.32  | 0.08  | 20.44 |        |
| 2    | Actual Wks for Mth            |      |       | 0        | 0.32 | 0.61 | 1.07 | 1.66 | 4.42 | 3.60 | 4.24  | 4.48  | 4.48  | 4.84  | 4.76  | 3.77  | 3.71  | 3.70  | 3.53  | 3.43  | 3.49  | 3.88  | 3.44  | 3.21  | 3.04  | 3.63  | 3.81  | 3.72  | 3.61  | 2.73  | 2.76  | 1.76  | 1.68  | 1.34  | 0.88  | 0.88  | 0.43  | 0.32  | 0.08  | 20.44 |        |
| 3    | Cum. Sch. Progress            |      |       | 0        | 0.32 | 0.93 | 1.60 | 2.24 | 6.66 | 9.91 | 14.07 | 18.47 | 22.91 | 27.75 | 32.51 | 36.28 | 39.99 | 43.69 | 47.22 | 50.65 | 53.98 | 57.16 | 60.20 | 63.04 | 65.65 | 68.08 | 70.33 | 72.40 | 74.28 | 75.99 | 77.49 | 78.75 | 79.81 | 80.69 | 81.37 | 81.85 | 82.17 | 82.52 | 82.90 | 83.28 | 100.00 |
| 4    | Cum. Actual Progress          |      |       | 0        | 0.32 | 0.93 | 1.60 | 2.24 | 6.66 | 9.91 | 14.07 | 18.47 | 22.91 | 27.75 | 32.51 | 36.28 | 39.99 | 43.69 | 47.22 | 50.65 | 53.98 | 57.16 | 60.20 | 63.04 | 65.65 | 68.08 | 70.33 | 72.40 | 74.28 | 75.99 | 77.49 | 78.75 | 79.81 | 80.69 | 81.37 | 81.85 | 82.17 | 82.52 | 82.90 | 83.28 | 100.00 |
| 5    | Variance                      |      |       | 0        | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |
| 6    | Ahead/Behind Schedule (Weeks) |      |       | 0        | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   |

Revision A (15/8/78) : Changes in weights & retaining structures added



# SKIM PENYURAIAN TRAFIK KUALA LUMPUR BARAT









#### 附件四   Lebuh Raya Damansara Puchong (LDP)





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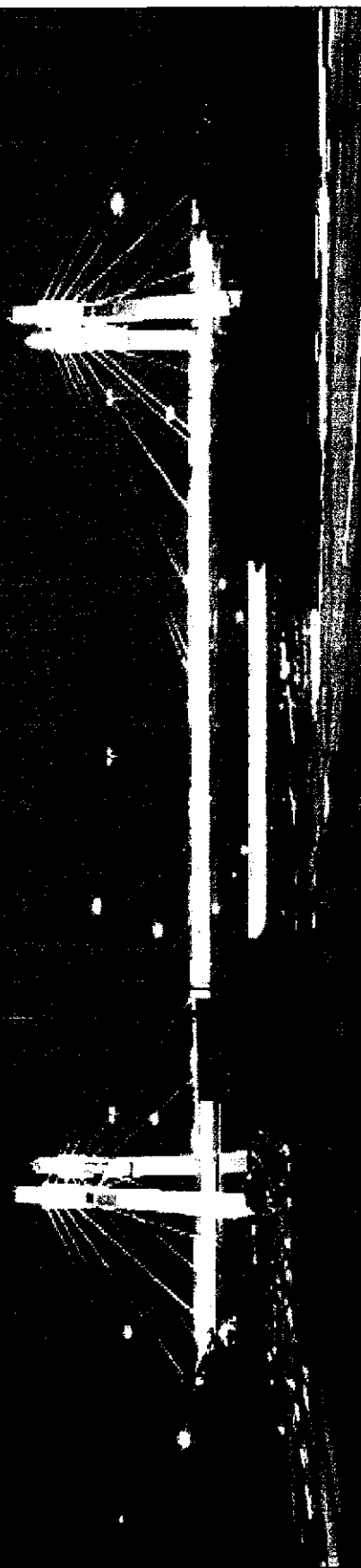
*Engineering & Traffic Safety Dept*

**Lebuhraya Damansara - Puchong**

E11

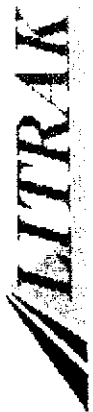
# CABLE STAYED BRIDGE

## Lebuhraya Damansara - Puchong



*Presented By :                      Sazally Saidi*  
*Engineering & Traffic Safety Dept*





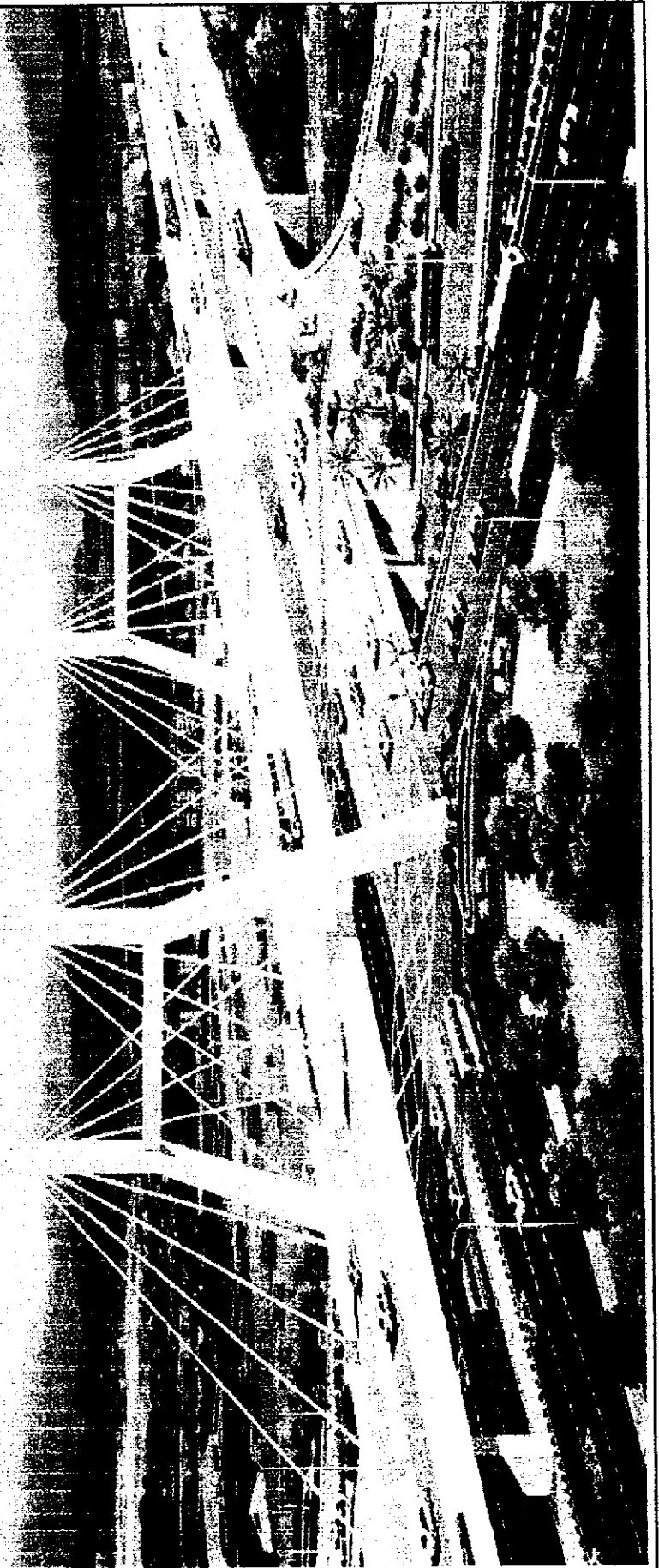
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## Lebuhraya Damansara - Puchong

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Artist Impression





## DESIGN AND FEATURES OF THE LDP CABLE STAYED BRIDGE

The LDP Cable Stayed Bridge is the seventh interchange on the Lebuhraya Damansara - Puchong (LDP), a 40 - km long, 6 lane dual carriageway highway which runs from Sri Damansara in the north, through Petaling Jaya to Puchong in the south.

The LDP Cable Stayed Bridge is one of 14 grade - separated interchanges on the LDP route, designed with the purpose of allowing free-flow traffic and thus alleviating traffic congestion.

The LDP Cable Stayed Bridge design, similar to the design of the Penang Bridge, is the first of its kind built on land in the country.

The LDP Cable Stayed Bridge is an interchange on the third level of the previous overhead bridge at the Motorola junction above the Federal Highway.



## DESIGN AND FEATURES OF THE LDP CABLE STAYED BRIDGE

It is 680 m in length, including its northern and southern approaches, 34m in height atop the previous level (second level) of the Motorola junction.

The outstanding feature of the LDP Cable Stayed Bridge is its 4 pylons which were firmly entrenched at the second level by a complex system of piles to support the bridge.

The cables, made of steel, were designed to support the bridge deck.



## REASONS FOR THE DESIGN AND CONSTRUCTION METHODS OF THE LDP CABLE STAYED BRIDGE

A careful study was carried out to come up with the best possible design and type of works for an interchange at the Motorola junction. This was in view of the high volume utilizing the intersection as a main dispersal point; records show that 100,000 vehicles ply this route daily.

It was imperative that, the required interchange not only must serve the very purpose of alleviating traffic congestion upon completion, construction works must also be efficiently implemented.

The LDP Cable Stayed Bridge design was chosen for these reasons :  
The design was chosen so as the LDP Cable Stayed Bridge will be a landmark achievement as it will be the first cable stayed land bridge in the country.

Construction works minimised traffic disruption on the Federal Highway.





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## Lebuhraya Damansara - Puchong

### **Free-flow, Separated Traffic Dispersal System Alleviating Congestion at Motorola and Bandar Sunway**

#### **Traffic on the Through, North South Route**

With the two interchanges, the LDP facilitates free-flow traffic; thus reducing traffic congestion at the areas of Motorola and Bandar Sunway. 50% of traffic in the area is through traffic and with the completion of the LDP, through traffic travelling north towards Kelana Jaya is being segregated from east and west bound traffic.

This allows for un-interrupted free-flow traffic on the LDP Cable Stayed Bridge and Bandar Sunway Interchange.



**Free-flow, Separated Traffic Dispersal System Alleviating Congestion at Motorola and Bandar Sunway**

**East and West Bound Traffic**

East and west bound traffic travelling along existing levels ; these are the existing Motorola junction level for travel in to Kuala Lumpur, Shah Alam and Klang; and Jalan Subang Utama and Jalan PJS 8/1 under the Bandar Sunway Interchange for internal traffic in the Bandar Sunway township.

Motorist travelling on these routes is enjoying improved green time for right turns.

Local residents is therefore enjoying less traffic congestion within their township.



## **HOW THE LDP CABLE STAYED BRIDGE ALLEVIATE AND EASE TRAFFIC CONGESTION**

### **The Previous Traffic Dispersal System at Motorola Junction**

The previous traffic dispersal system at the Motorola junction provides for through, left and right turn traffic on a 3-lane dual carriageway with traffic lights at the intersections of the Federal Highway Route II and Jalan SS 8/1.

### **The LDP Traffic Dispersal System at Motorola Junction Upon Completion of the LDP Cable Stayed Bridge**

The LDP Cable Stayed provides for a free-flow, through traffic solution to reduce the number of vehicles and thereby, alleviating traffic congestion. This is carried out by its grade - separated system whereby traffic is regulated at different levels.



## HOW THE LDP CABLE STAYED BRIDGE ALLEVIATE AND EASE TRAFFIC CONGESTION

### The LDP Traffic Dispersal System at Motorola Junction Upon Completion of the LDP Cable Stayed Bridge

Upon completion, the LDP Cable Stayed Bridge allows for free-flow and direct access for motorist on a north-south route; i.e. in to Bandar Sunway and areas south of it (Puchong, Serdang, Putra Jaya, KLIA) and north towards areas of Kelana Jaya, Taman Megah, Damansara Jaya, Damansara Utama, Bandar Utama, Taman Tun Dr Ismail and Jalan Damansara.

The Bandar Sunway Interchange, which is No.8 interchange on the Lebuhraya Damansara-Puchong (LDP) is connected to the LDP Cable Stayed Bridge providing for free-flow, north-south traffic flow.



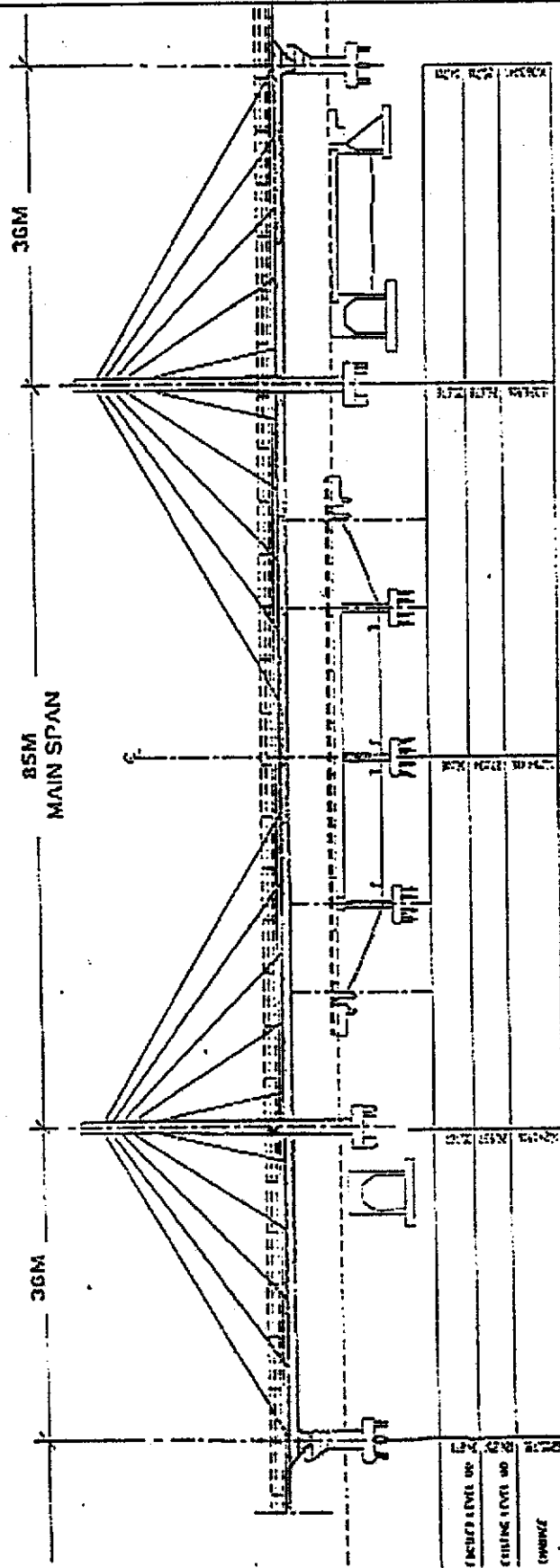


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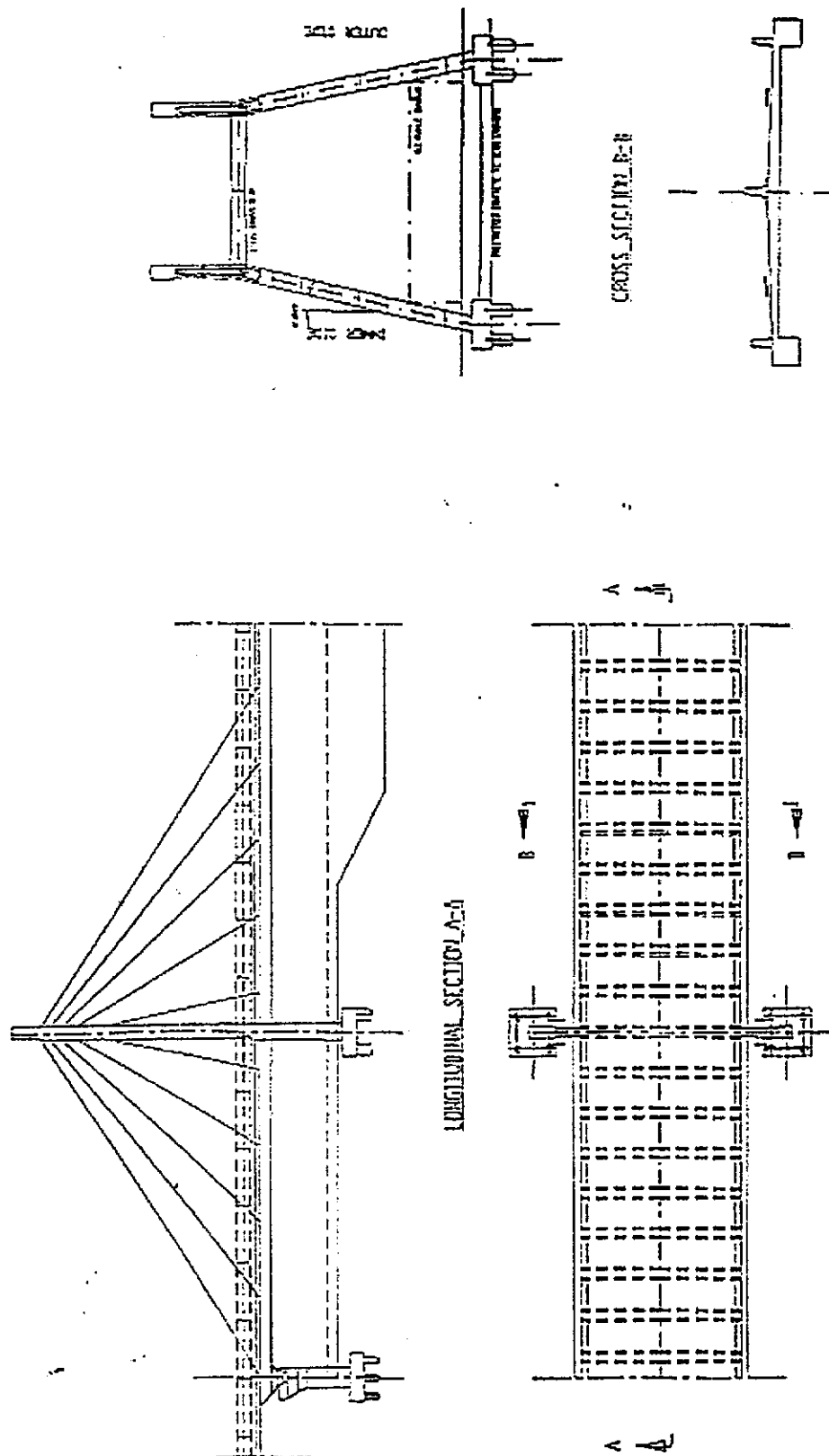
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## LDP CABLE STAYED BRIDGE



ELEVATION









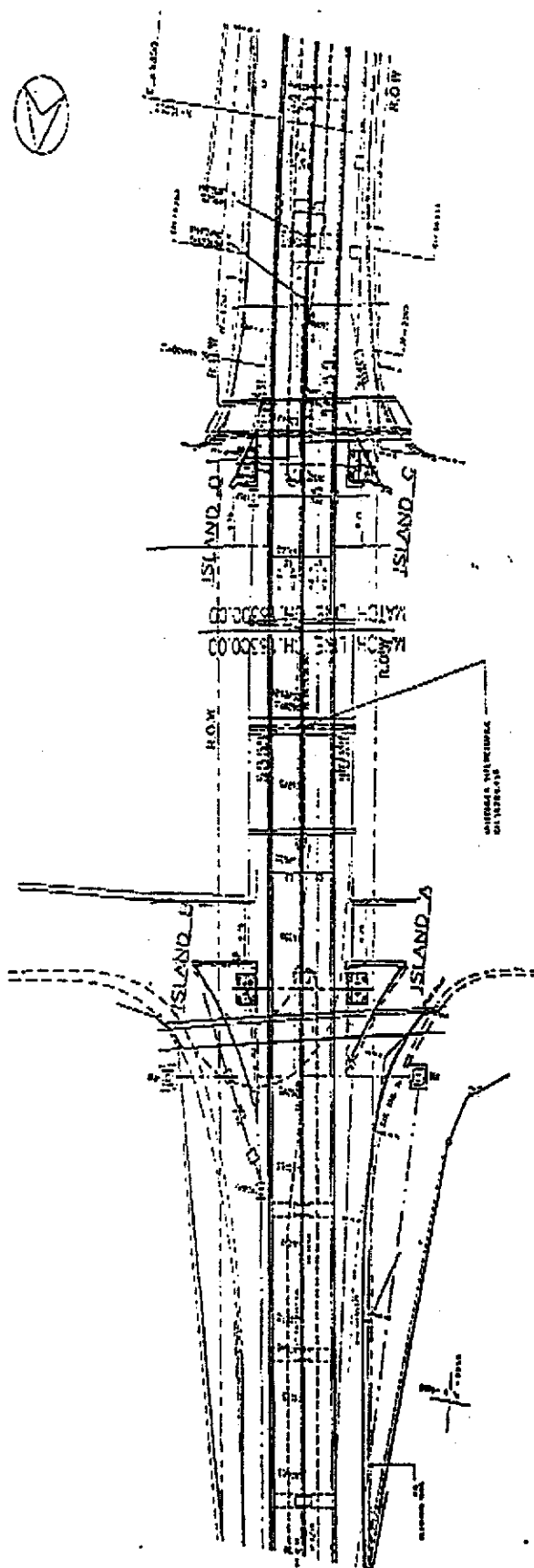
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**E11**

## MOTOROLA INTERCHANGE



## PILING WORKS

### NOTES

1. H PILES FOR ISLANDS A AND B (GRANITE)
2. MICROPILES FOR ISLANDS C AND D (CAVITIES IN LIMESTONE AREAS)



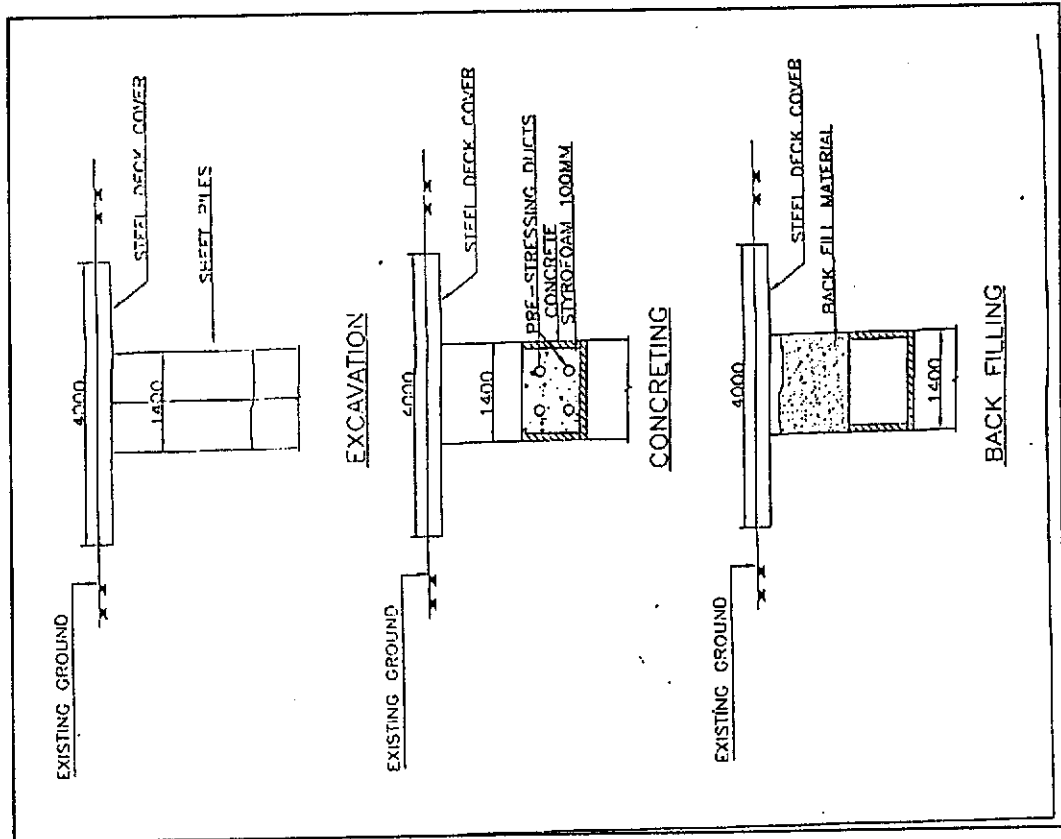
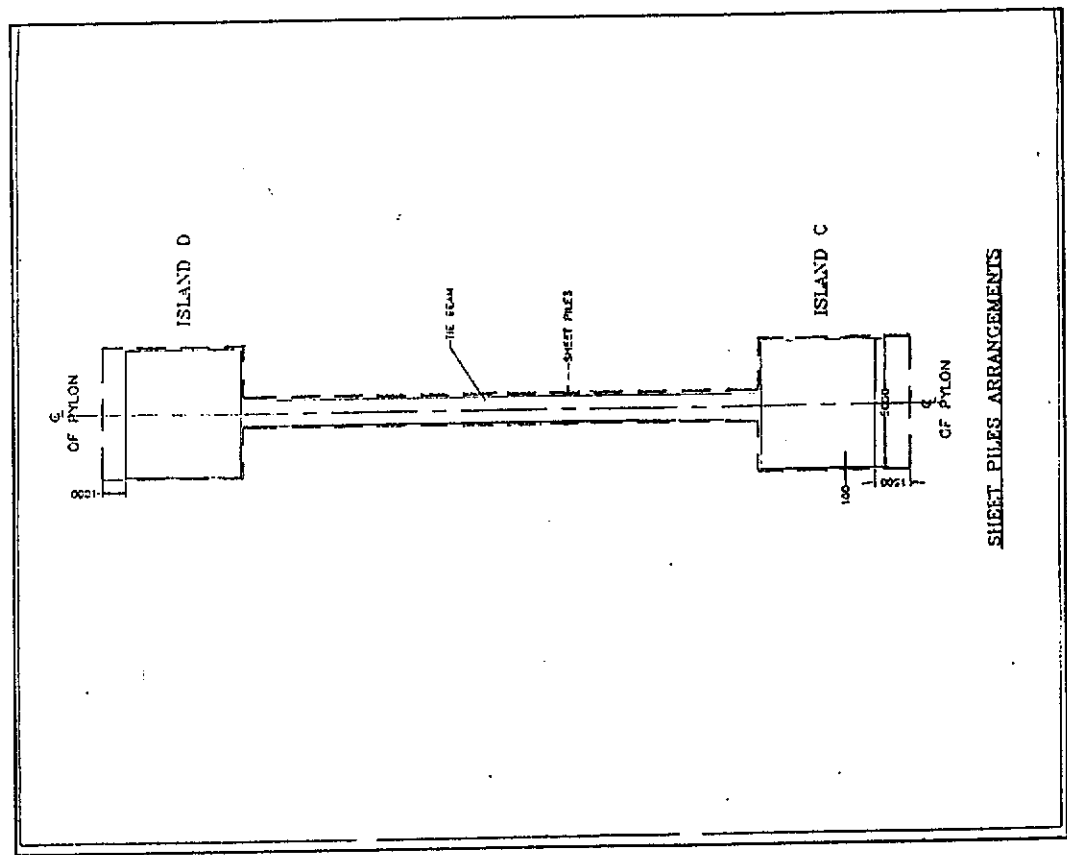


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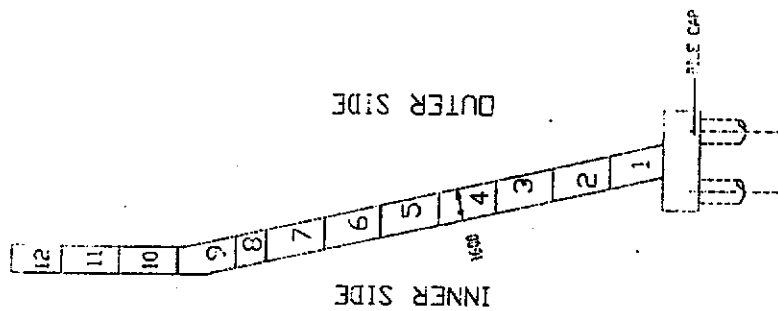




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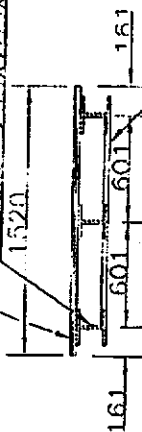


## NOTES

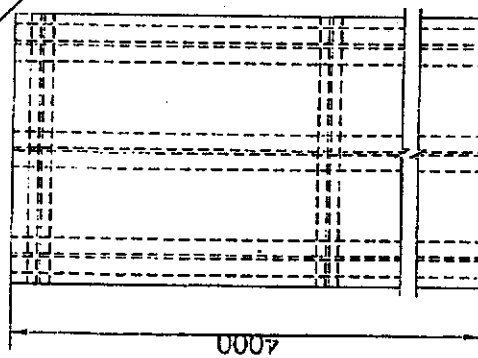
1. BOTH LEGS WILL BE CONSTRUCTED SIMULTANEOUSLY
2. DOKA CLIMBING FORMWORK WILL BE USED
3. THERE WILL BE 12 LIFTS OF 3 METERS EACH.

## PYLON WORKS

15MM THK. M.S. PLATE (CHECKERED)  
3 Nos. @ 201X203X52.06 KG/M

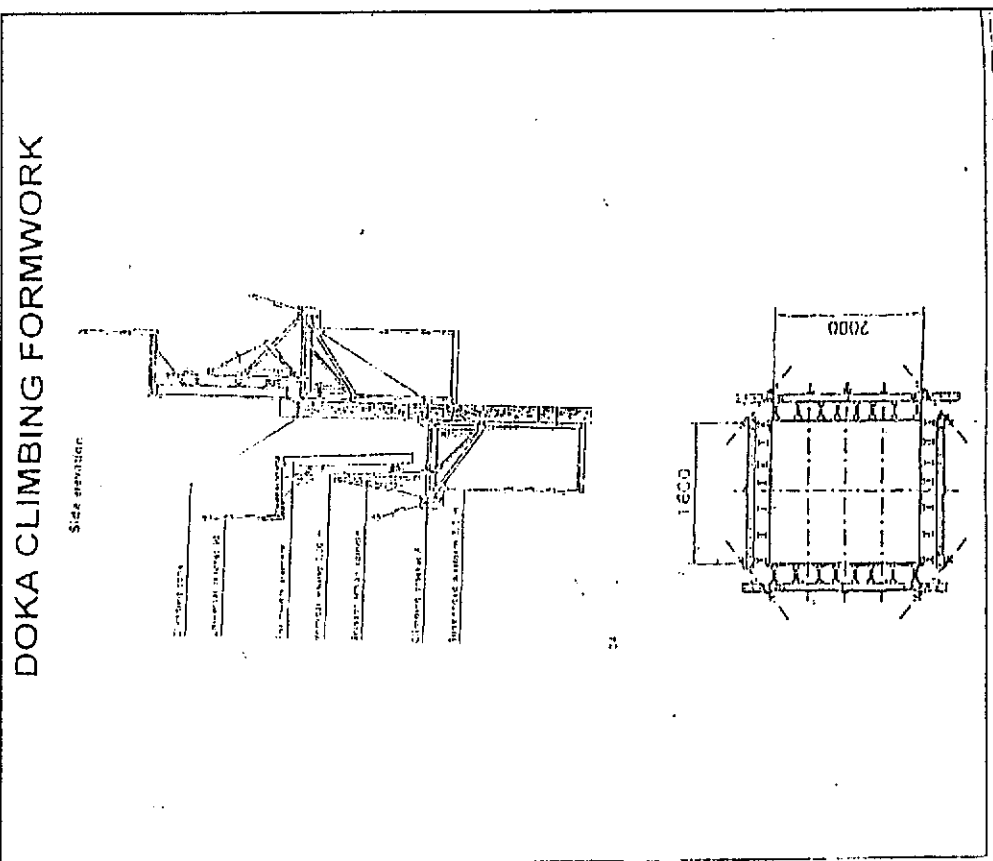


133X203X25 KG. @2200 C/C



## STEEL DECK COVER









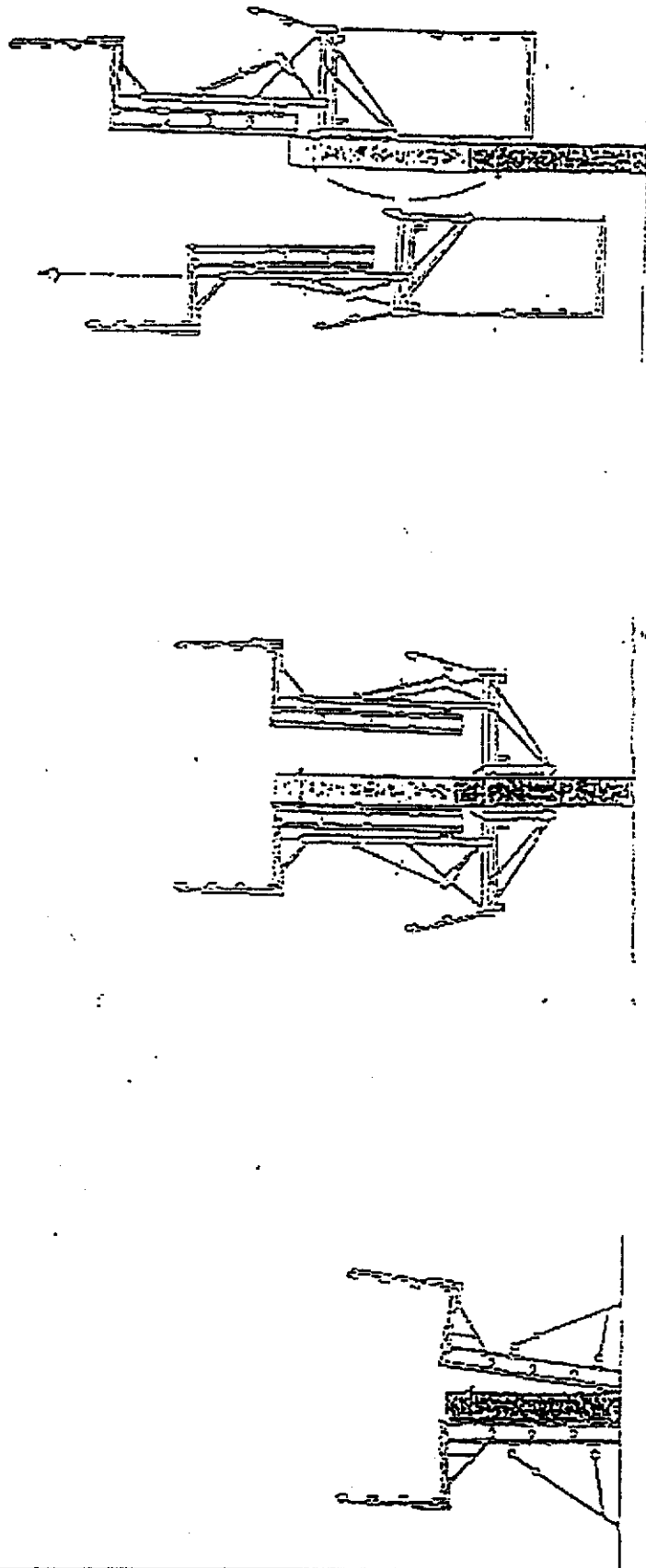
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## CLIMBING FORMWORK SEQUENCE







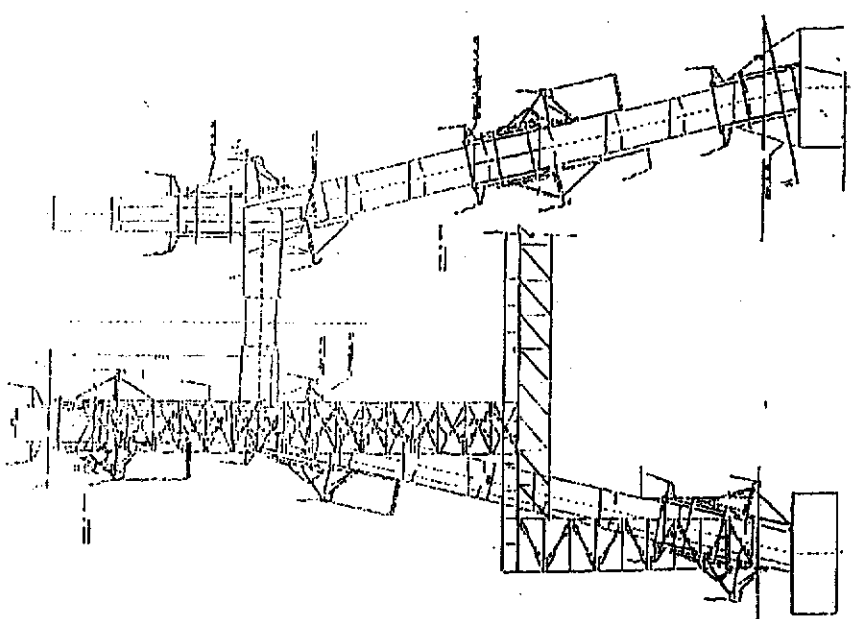
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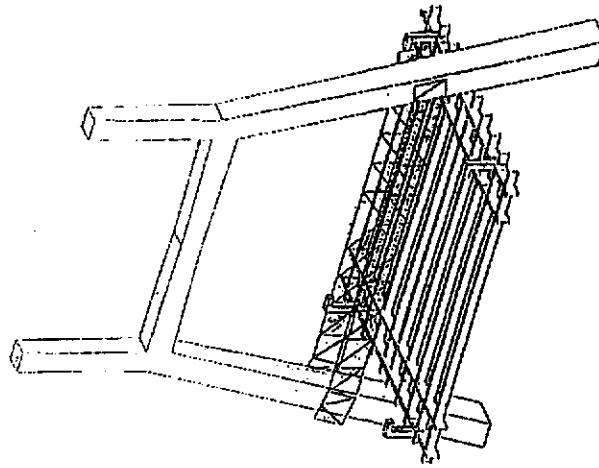
# Lebuhraya Damansara - Puchong

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STAIRCASE TOWER  
FOR ACCESS TO  
CLIMBING FORMWORK



DECK CONSTRUCTION  
USING TRAVELLER PLATFORM

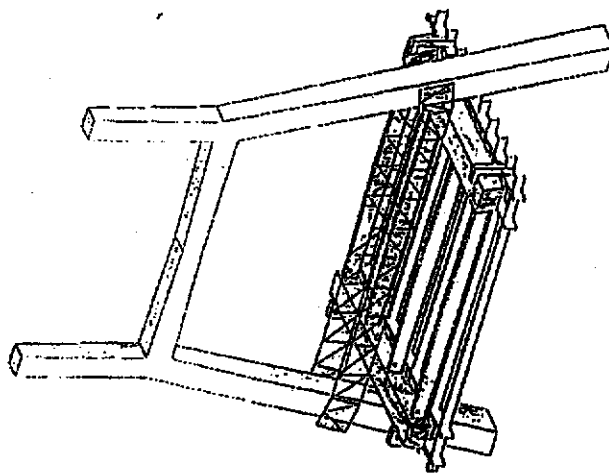


LEGEND:-

- 1. INSTALLATION OF TRAVELLER PLATFORM
- 2. CONNECTION TO PORTAL TRUSS

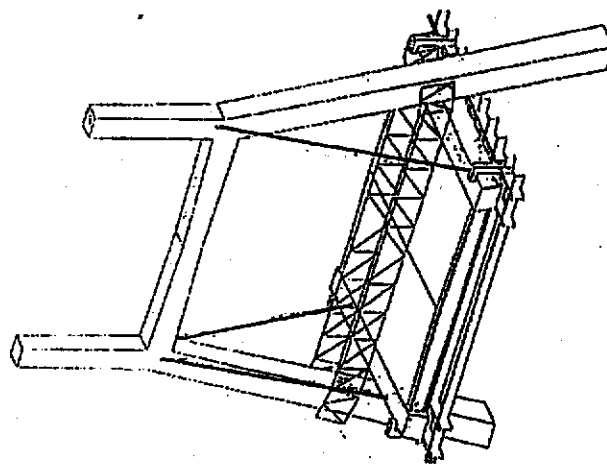


DECK CONSTRUCTION  
USING TRAVELLER PLATFORM



- LEGEND:-**
- 3. INSTALLATION OF EDGE BEAM FORM/  
DIAPHRAGMS
  - 4. CASTING OF EDGE BEAM

DECK CONSTRUCTION  
USING TRAVELLER PLATFORM



- LEGEND:-**
- 5. INSTALLATION OF STAY CABLES
  - 6. POURING OF DECK SLAB





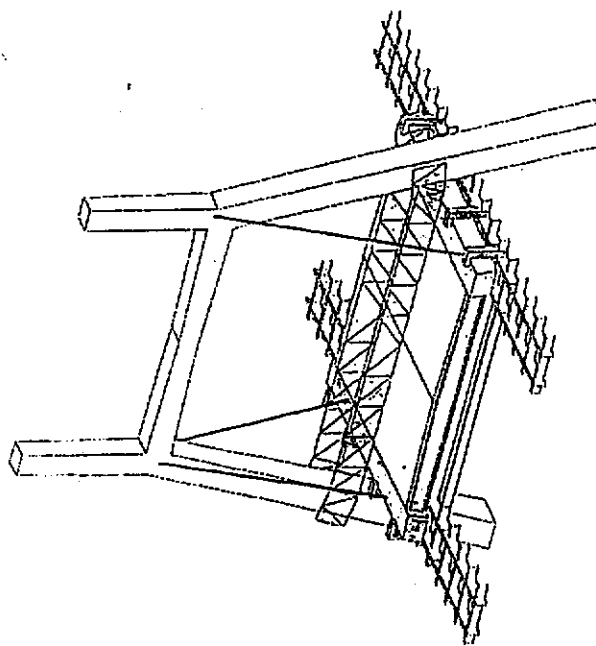
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# Lebuhraya Damansara - Puchong

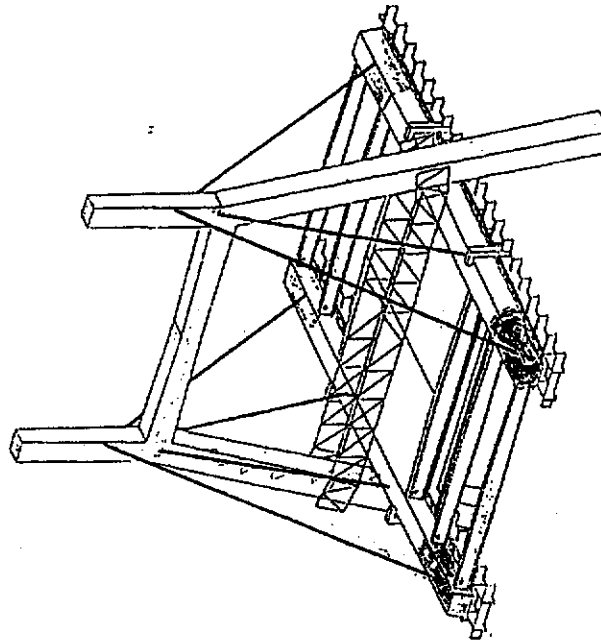
## DECK CONSTRUCTION USING TRAVELLER PLATFORM



### LEGEND:-

7. INSTALLATION OF FRONT PART OF TRAVELLER

## DECK CONSTRUCTION USING TRAVELLER PLATFORM



### LEGEND:-

8. INSTALLATION OF EDGE BEAM FORM/  
DIAPHRAGMS

9. CASTING OF EDGE BEAM

10. INSTALLATION OF STAY CABLES





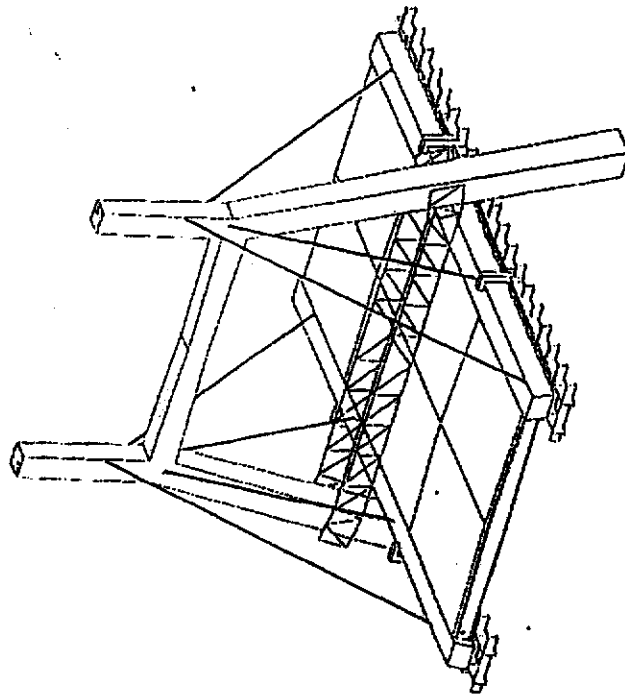
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# Lebuhraya Damansara - Puchong

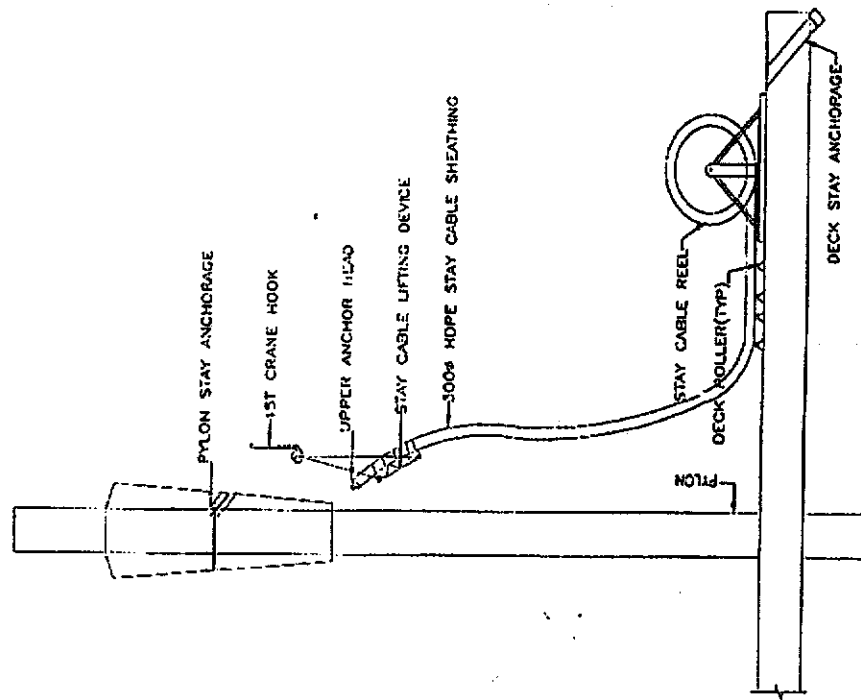
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## DECK CONSTRUCTION USING TRAVELLER PLATFORM



LEGEND: -

11. POURING OF DECK SLAB





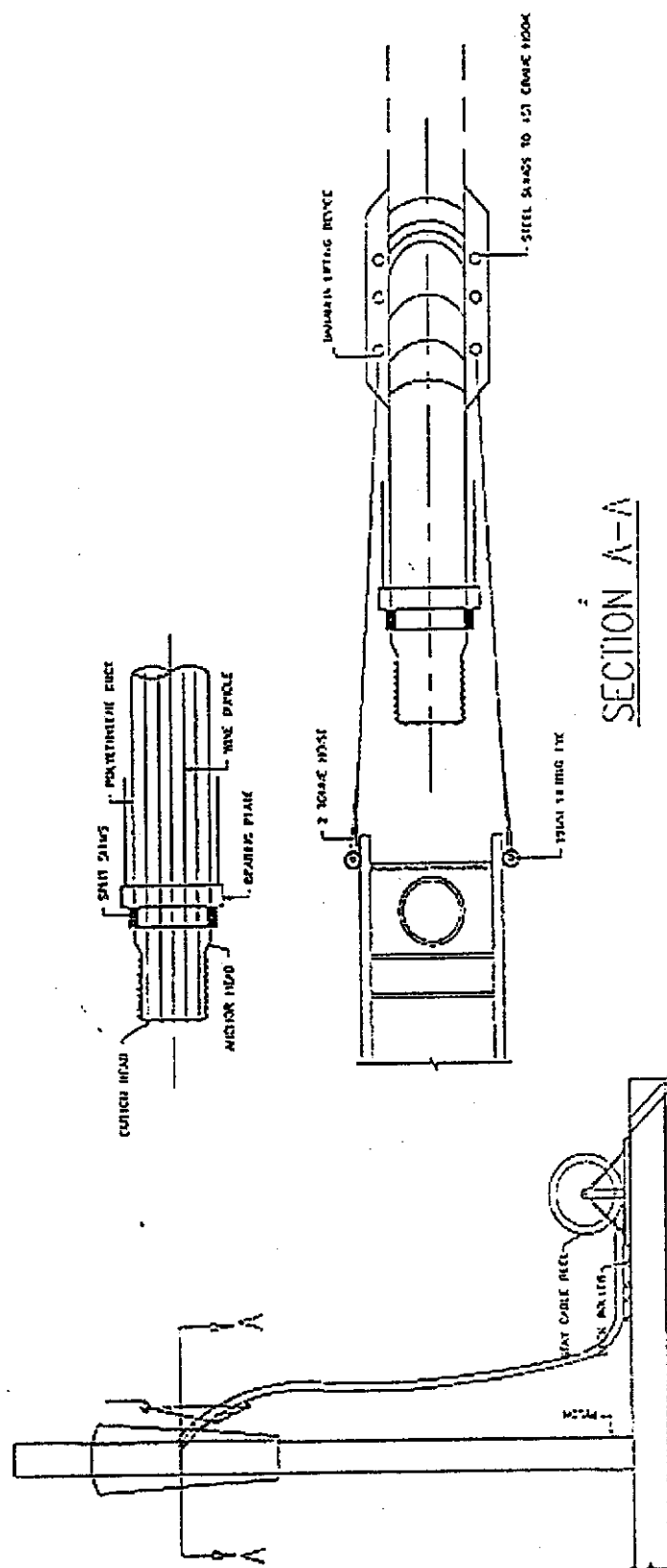


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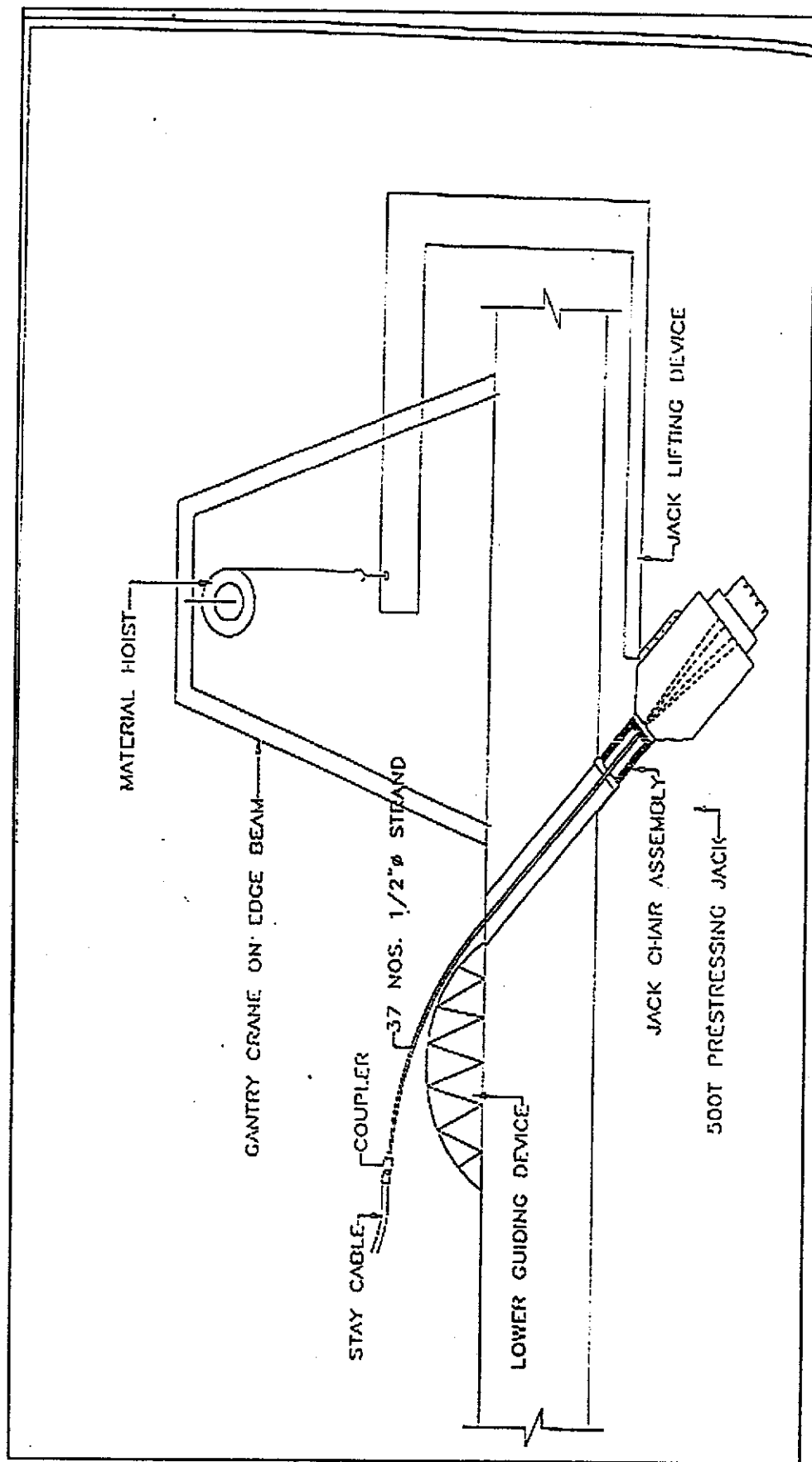


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**Lebuhraya Damansara - Puchong**



**TTRAK**



**附件五**    **Lebuh Raya Shah Alam(KESAS)**



# **KESAS**

**E 5** LEBUH RAYA SHAH ALAM

## **BRIEFING NOTES**





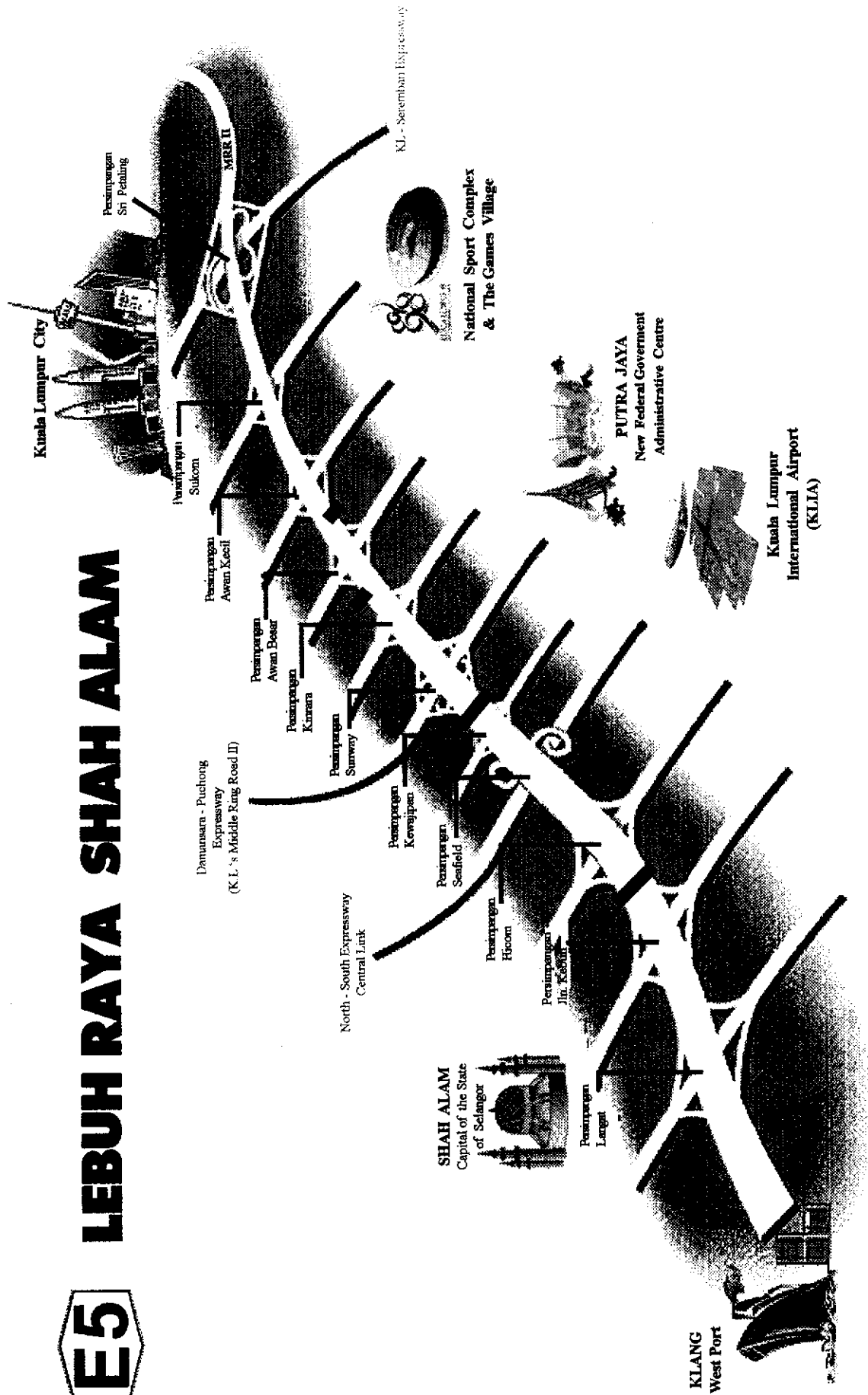
## **BRIEFING NOTES ON LEBUH RAYA SHAH ALAM**

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# LEBUH RAYA SHAH ALAM





## 1.0 INTRODUCTION

- In line with the privatisation policy, the Government of Malaysia decided to privatise the design, construction, operation and maintenance of the Lebuhraya Shah Alam.
- The Lebuhraya Shah Alam serves as a major inter-urban expressway connecting the major industrial and residential areas within the Klang Valley namely, Kuala Lumpur, Petaling Jaya, Subang Jaya, Shah Alam and Klang, terminating at the access road to West Port.
- On 28th April 1993, a consortium comprising Gamuda Berhad (Gamuda), Perbadanan Kemajuan Negeri Selangor (PKNS), Arab-Malaysia Development Berhad (AMDB) and Percon Corporation Sdn Bhd (Percon) received a Letter of Intent which in principle awarded the privatisation of the expressway to the Consortium.
- The members of the Consortium formed KESAS (Konsortium Expressway Shah Alam Selangor) Sdn Bhd, to undertake the Project. The Concession Agreement was signed on the 19th November 1993 between the Government of Malaysia and KESAS, for KESAS to design, construct, operate, maintain and collect toll for a Concession Period of 28 years and nine months from the date of execution of the Concession Agreement.
- Apart from the acquisition of land, there was no other financial support or other forms of assistance under the Concession Agreement.



- The original period of construction based on the Concession Agreement is 7 years i.e. from 1<sup>st</sup> April 1994 to 31<sup>st</sup> March 2001 with :-

(i) Package A completing by 31st March 1997.

(ii) Package B completing by 31st March 2001.

By a supplementary agreement signed between the Government and KESAS Sdn Bhd on 14 April 1995 the completion dates for the completion of Package A and Package B were changed to 31 March 1997 and 14 March 1998. However KESAS completed the projects ahead of schedule and the opening dates of the Lebuhraya Shah Alam were 1 December 1996 for Package A and 6 April 1998 for Package B.



## 2.0 KESAS HOLDINGS BHD.

KESAS Holdings Bhd. (KESAS Holdings) is a consortium comprising of four (4) shareholders namely GAMUDA, PKNS, AMDB and PERCON. KESAS Holdings has a paid up capital of RM5 million ordinary shares and has issued preference shares amounting to RM449 million.

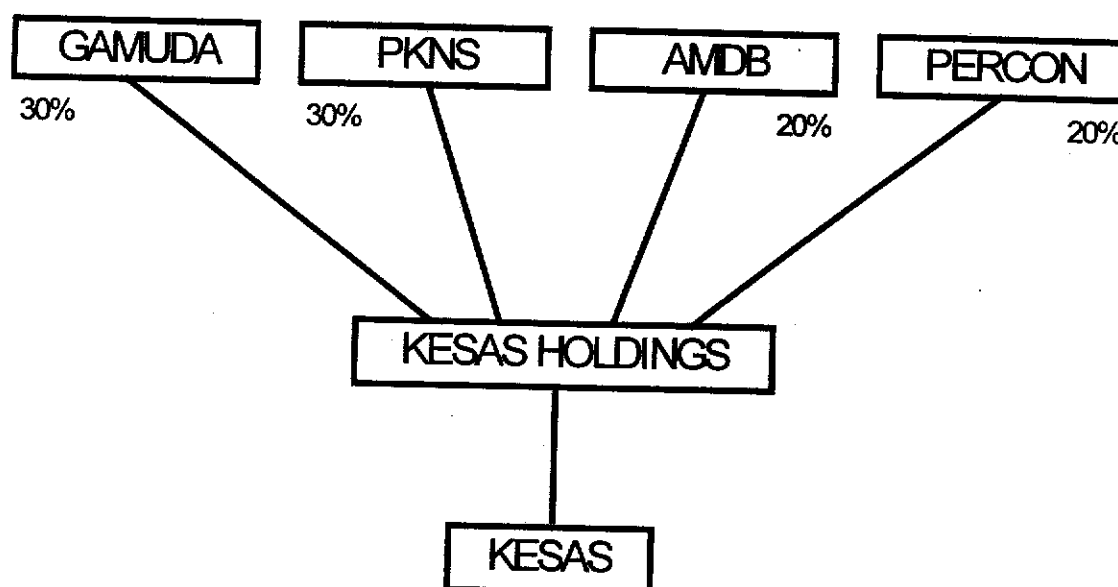
The ordinary share capital and preference shares of KESAS Holdings are as follows:

|        |   |     |
|--------|---|-----|
| GAMUDA | - | 30% |
| PKNS   | - | 30% |
| AMDB   | - | 20% |
| PERCON | - | 20% |

The shareholding and shareholder funding structures of KESAS Holdings is shown below:

### *Shareholder and Funding Structures*

*(Maximum Commitment)*





### **3.0 KESAS SDN BHD**

Konsortium Expressway Shah Alam Selangor (KESAS) Sdn Bhd is a wholly owned subsidiary of KESAS Holdings Berhad.

KESAS Sdn Bhd (KESAS) is a single purpose company which was awarded by the Government of Malaysia to design, construct, operate, maintain and collect toll for the Lebuhraya Shah Alam for a concession period of twenty eight (28) years and nine (9) months from 19 November 1993.

KESAS was incorporated on 3 September 1993 as a Malaysian private limited company and has a paid up capital of RM5 million. The share capital is wholly owned by KESAS Holdings Berhad.

The Board Of Directors of KESAS comprises 10 members with 3 representatives from Gamuda Berhad, 3 from Perbadanan Kemajuan Negeri Selangor (PKNS), 2 from Arab-Malaysian Development Berhad (AMDB) and 2 from Percon Corporation Sdn Bhd. The Chairman of the Board of Directors is Yg. Bhg. Dato' Azlan Hashim.

KESAS is managed by highly qualified and experienced professionals and personnel, headed by the Chief Operating Officer. KESAS is divided into two (2) divisions namely the Finance and Corporate Division and the Engineering and Operations Division.



## 4.0 FINANCIAL STRUCTURE

### 4.1 FINANCING OF THE PROJECT

The total funding requirement of the Project including design and construction costs, professional fees, start-up costs and capitalised interest on commercial loans is RM1.5 billion. This was met by a combination of the Finance Facilities, Shareholders' Investment and internal cash generation.

#### KESAS HOLDINGS

|                   | <u>RM million</u> |
|-------------------|-------------------|
| Ordinary Shares   | 5                 |
| Preference Shares | 466               |
|                   | <hr/>             |
|                   | 471               |
|                   | <hr/>             |

#### KESAS

|                           |       |
|---------------------------|-------|
| Ordinary Shares           | 5     |
| Loan Stock                | 459   |
| Shareholders Investment   | <hr/> |
|                           | 464   |
| Finance Facilities        | 845   |
| Government Support Loan   | 80    |
| Internally Generated Fund | 128   |
| Other Funding             | 28    |
|                           | <hr/> |
|                           | 1,545 |
|                           | <hr/> |



The Shareholders may elect to provide further funding beyond that committed as Shareholders' Investment. The rights of KESAS Holdings under the undertaking from the Shareholders and the rights of KESAS under the undertaking from KESAS Holdings both have been assigned to the Lenders.

#### 4.2 PROJECT COST

|                              |           | <u>RM million</u> |
|------------------------------|-----------|-------------------|
| Construction Cost and Capex  |           |                   |
| - Turnkey Contract           |           | 1,142             |
| - Rest and Service Area      | 15        |                   |
| - Less : License Fees        | <u>14</u> | 1                 |
| - TCSS                       |           | 9                 |
| - Other Civil Works          |           | <u>31</u>         |
|                              |           | 1,183             |
| Professionals Fees           |           | 39                |
| Interest during construction |           | 126               |
| Operating Cost               |           | <u>7</u>          |
|                              |           | <u>1,355</u>      |



## 5.0 PROJECT DESCRIPTION

- The 34.5 KM Lebuhraya Shah Alam starts from Sri Petaling Interchange and ends towards Westport at Pandamaran Interchange.
- The **LSA** serves as a **major inter-urban expressway** connecting the major industrial and residential areas in the **Klang Valley**, namely Kuala Lumpur, Petaling Jaya (KL's Satellite township), Subang Jaya, **Shah Alam** (state capital of Selangor) and **Klang** (the National Port).
- It lies to the south of, and broadly parallel to, the Federal Highway Route II, an expressway that is **presently extremely congested**.

The stretch between Sri Petaling Interchange and Sunway Interchange forms part of the **Middle Ring Road II**, Kuala Lumpur's traffic dispersal scheme.

- System Interchanges connect the **LSA** to (three) 3 major Expressway Systems
  - (i) the **North South Expressway (NSE)** at Seri Petaling Interchange continuing south to Singapore.
  - (ii) the **Puchong - Damansara Expressway** at Sunway Interchange leading to **PUTRAJAYA** (the New Federal Government Administrative Centre).
  - (iii) the **North - South Expressway Central Link** at Seafield Interchange continuing north to Thailand via the NSE and south to the **new Kuala Lumpur International Airport** and Singapore.
- It is also the **international gateway** to the **National Sports Complex** and the **Games Village**, venue of the **Kuala Lumpur COMMONWEALTH GAMES 1998**.



### PROJECT FACT SHEET

| FEATURES                 | PACKAGE A    | PACKAGE B    |      |
|--------------------------|--------------|--------------|------|
| • Length                 | 18.5 km      | 16.0 km      | 34.5 |
| • Interchanges - System  | 3            | -            | 3    |
| • Interchanges - Service | 5            | 4            | 9    |
| • Toll Plazas            | 3            | 1            | 4    |
| • Toll Booths            | 40           | 16           | 56   |
| • Bridges & Overpasses   | 16           | 10           | 26   |
| • Vehicular Underpass    | 3            | -            | 3    |
| • Pedestrian Bridges     | 1            | -            | 1    |
| • Rest & Service Area    | 2            | -            | 4    |
| • Motorcycle Lane        | 2            | 2            |      |
| • No of Lanes            | 6            | 6            |      |
| • Emergency Telephone    | 1.5 km apart | 1.5 km apart |      |
| • Lighting               | Throughout   | Throughout   |      |

The width of the various elements of LSA are as follows:-

| ELEMENTS                          | WIDTHS  |
|-----------------------------------|---|
| • Traffic lane                    | 3.75 m  |
| • Emergency lane (paved shoulder) | 3.00 m  |
| • Median                          | 3.00 m<br>(inclusive 0.5 m hardstrip to each carriageway) |
| • Verge (min)                     | 1.20 m  |



## PROJECT INFORMATION

| PROJECT TITLE                   | PRIVATISATION OF LEBUH RAYA SHAH ALAM  |  |
|---------------------------------|--|--|
| Employer                        | KESAS Sdn Bhd                          |  |
| Independent Consulting Engineer | Hyder Consulting Sdn Bhd               |  |
| Turnkey Contractor              | Gamuda-Percon Joint Venture            |  |
|                                 | PACKAGE A                              | PACKAGE B                              |
| Supervising Consultant          | 1. Jurutera Perunding Kemajuan Sdn Bhd | 1. Jurutera Perunding Kemajuan Sdn Bhd |
|                                 | 2. Hashim & Neh Sdn Bhd                |  |
|                                 | 3. Zaidun - Leeng Sdn Bhd              |  |
| Contract Sum                    | RM538,055,000.00                       | RM587,708,000.00                       |
| Commencement Date               | 1 April 1994                           | 15 March 1995                          |
| Completion Date                 | 31 March 1997                          | 14 March 1998                          |
| Construction Period             | 36 months                              | 36 months                              |
| Date of Operation               | 1 December 1996                        | 6 April 1998                           |

- Package A was completed and opened to traffic in December 1996, 4 months ahead of Schedule.
- Package B was accelerated to be completed by March 1998 instead of the year 2001 originally.

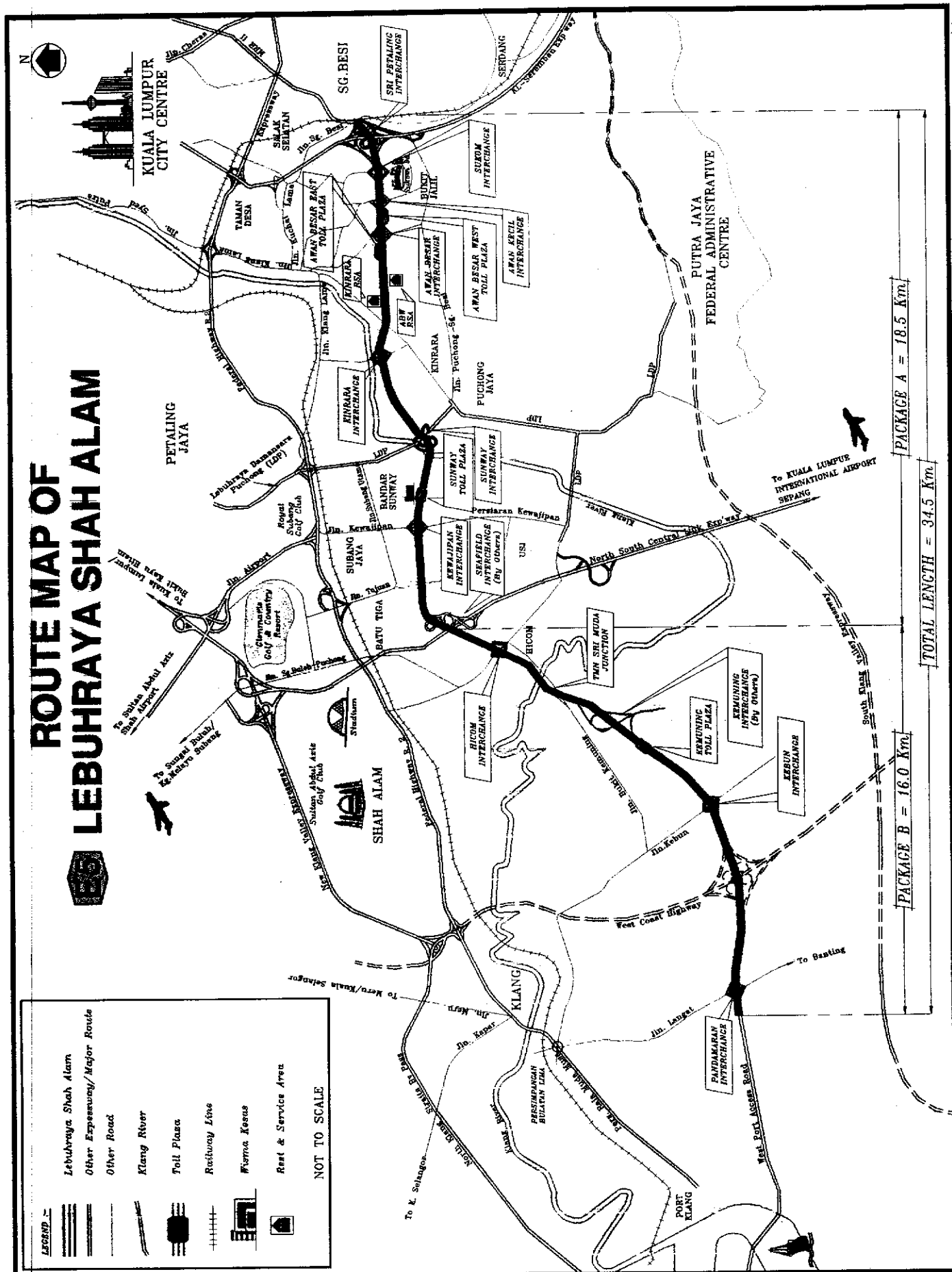


# ROUTE MAP OF LEBUHRAYA SHAH ALAM

**LEGEND**

- Lebuhraya Shah Alam
- Other Expressway/Major Route
- Other Road
- Klang River
- Toll Plaza
- Railway Line
- Warma Kosus
- Rest & Service Area

NOT TO SCALE





## 6.0 SPECIAL FEATURES OF THE LEBUH RAYA SHAH ALAM

As described earlier KESAS was awarded the job to construct Lebuhraya Shah Alam in 1993. The construction of the expressway was under-taken by the joint venture between two (2) shareholders namely PERCON and GAMUDA. The construction was completed ahead of schedule and opened to traffic in December 1996.

### 6.1 Traffic Control And Surveillance System (TCSS)

KESAS has the first fully integrated, state-of-the art intelligent system being implemented in this region.

- Functional

The Traffic Control And Surveillance System (TCSS) control centre is KESAS's nerve centre for the collection of all transportation information on Lebuhraya Shah Alam. KESAS manages traffic through electronics, fiber optics and an extensive computer network. By relaying the information to motorists, alternate routes can be used to avoid traffic congestion and re-establish normal traffic flow.

The overall functions of TCSS Control Centre are:

- ~ Information collection
- ~ Information processing
- ~ Information dissemination
- ~ Execution and enforcement.

- Operational

The TCSS team monitor a continuous flow of traffic data and responds to expressway traffic and road conditions 24 hours a day. The system is based on real-time computer assisted traffic management, communication and control strategies.

Information about congestion's, accidents, road closures and emergency notifications are fed into this information hub to be disseminated to expressway users and the public. The response plan includes:



- ~ Automatic activation of Variable Message Signs
- ~ Dispatch of expressway patrolling team, local emergency authorities such as Police, Fire Brigade, Ambulance etc.
- ~ Notification to media and Local Authorities.
- ~ Alternative route coordination with local Police.

- Integrational

The integrated Traffic Control and Surveillance System provide and facilitates the following functionality's:

a) Computer Link to other TCSS

The **TCSS** computer will have communication link to other **TCSS** Centers in the future for interworking functions.

b) KESAS Hotline

A dedicated line manned 24 hours for receiving and transmitting information to the expressway users and the public (03-733 7188).

c) Variable Message Sign (VMS)

VMS of amber coloured LEDs provide the operator the means of informing the expressway users of any 'traffic advice or messages' which helps the users to avoid any inconvenience or incidents and in general to facilitate the flow of traffic.

These 'advice or messages' are relayed from the **TCSS** Center via Fiber Optic Communication System.

d) Emergency Telephone System (ETS)

At every 1.5km distance on each bound of the expressway located a set of Emergency Telephone which is linked to the **TCSS** Computer System to provide the expressway users easy access for emergency assistance.

e) Expressway Patrol/Emergency Response

These services will be provided by KESAS round the clock to ensure the security of the users at all times. They can be contacted via the **TCSS** Center through ETS, and can be dispatched to the callers location within the shortest response time.



f) Traffic Signals

Traffic Signals at the interchanges will be automatically controlled by the **TCSS** Computer System using the processed data received from the Vehicle Detection System (Camera & Video Processing) which in turn provides the control signals to the Traffic Signal Controller to vary the traffic lights according to the presence of vehicles.

g) Local Emergency Authorities (Police, Fire Brigade, Ambulance)

The **TCSS** Center has been planned for links with Emergency hotlines to local authorities to facilitate immediate assistance during emergencies.

h) The Media

The **TCSS** Centre provides the current status of the expressway traffic especially on any congestion to the media to be aired for public information.

i) Closed Circuit Television System (CCTV)

Further confirmation of any detected incident can be accomplished through the use of Pan, Tilt and Zoom cameras which can be remotely controlled from the **TCSS** Centre.

The CCTV System provides real time video images captured at the interchanges and displayed on Video Terminals and large screen projection at the **TCSS** Centre.

j) Vehicle Detection (using video image processing)

The Vehicle Detection Cameras mounted on high poles at interchanges provide real time video images of the traffic movement within the areas.

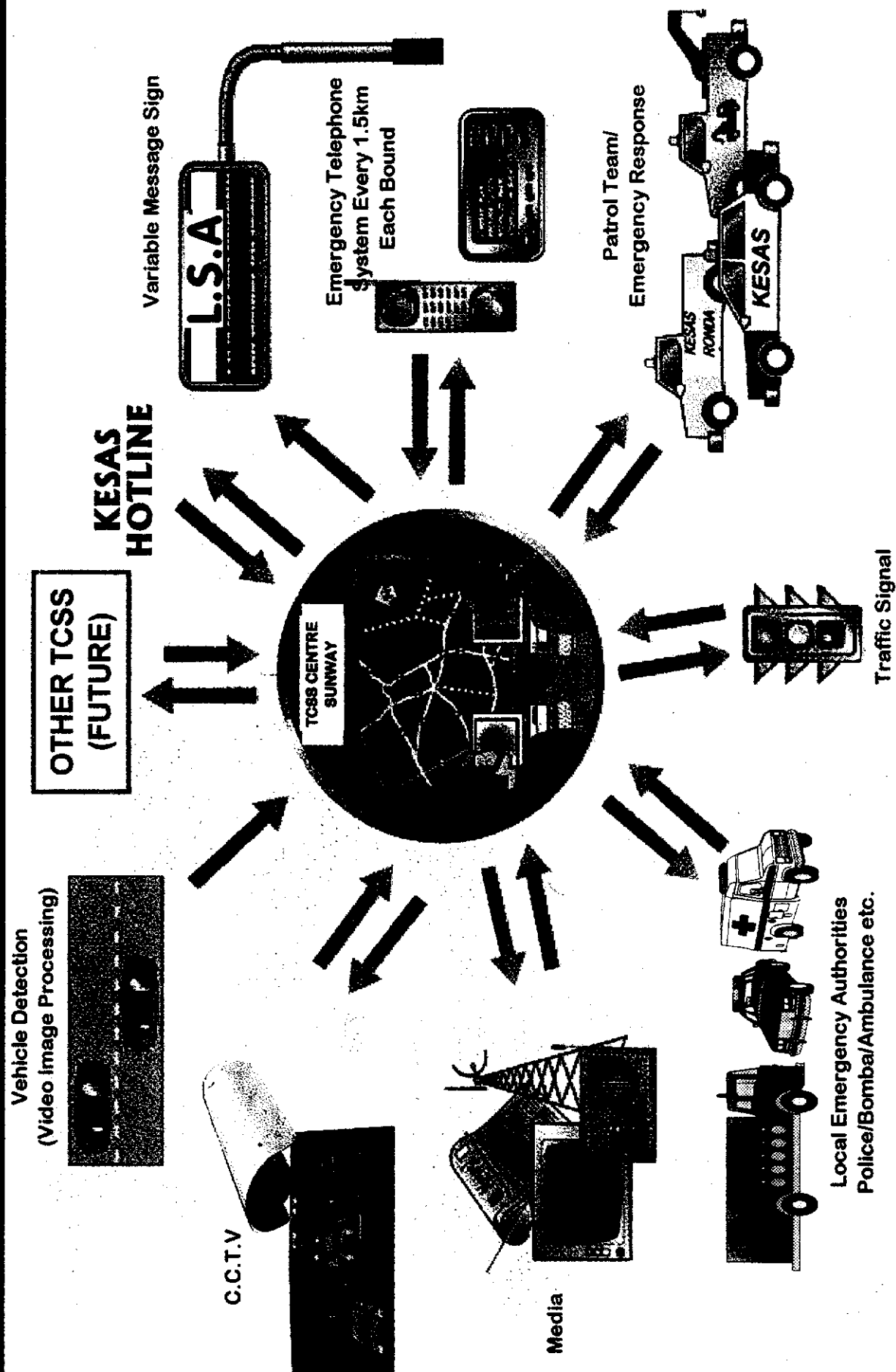
The State-of-Art Video image processing Vehicle Detection generates triggering mechanism as well as information through the following desired parameters:

- Vehicle Counts/Volume
- Vehicle Speed
- Vehicle Classification
- Traffic Data Collection etc.

These data enable the computer to detect any incident through the sudden drop in vehicle speeds and headways.



# **E5 LEBUH RAYA SHAH ALAM** **TRAFFIC CONTROL & SURVEILLANCE SYSTEM**



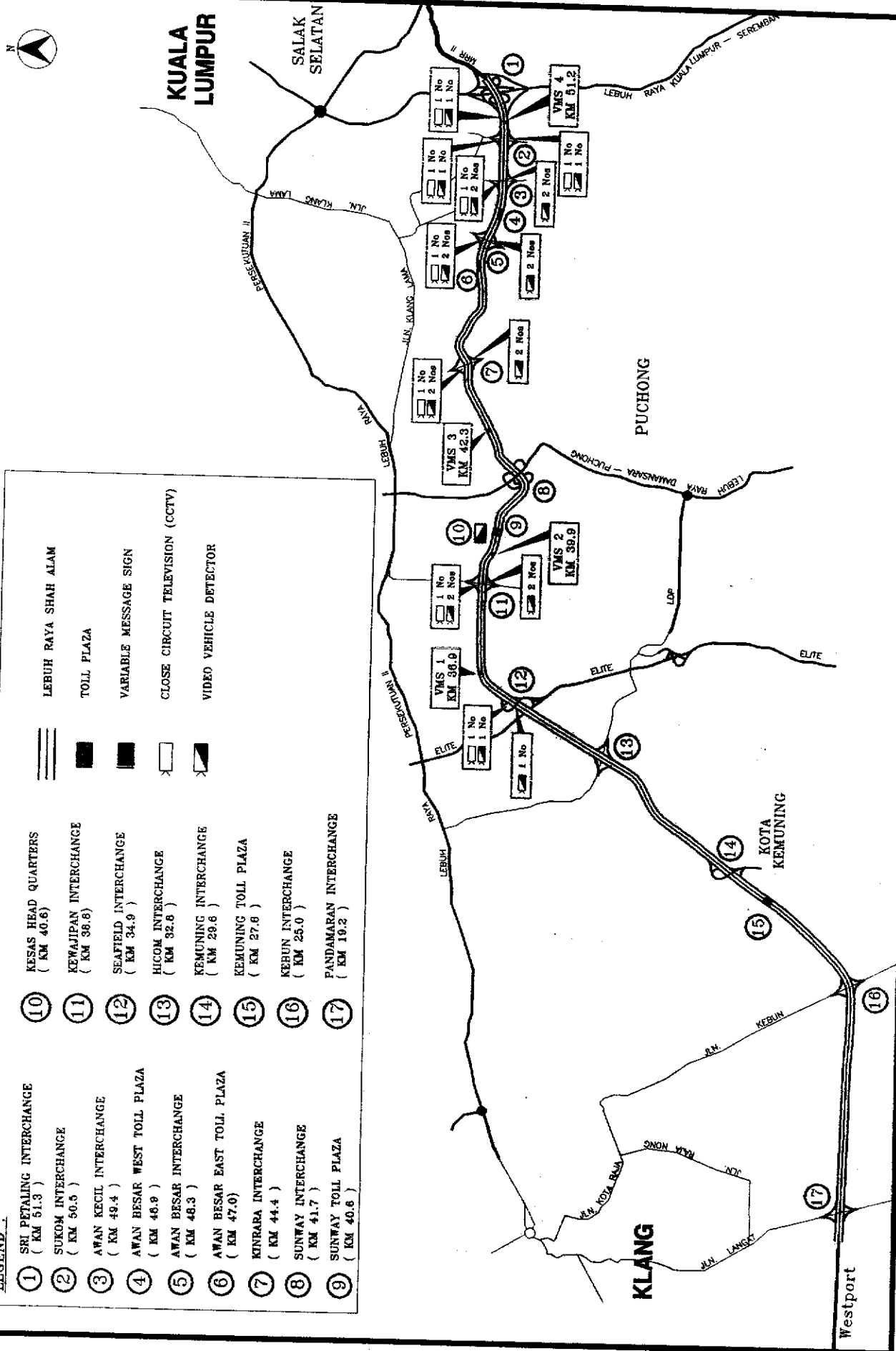


# **E5 LEBUH RAYA SHAH ALAM**

## **System Intergration Of The Traffic Control And Surveillance System**

### **LEGEND :**

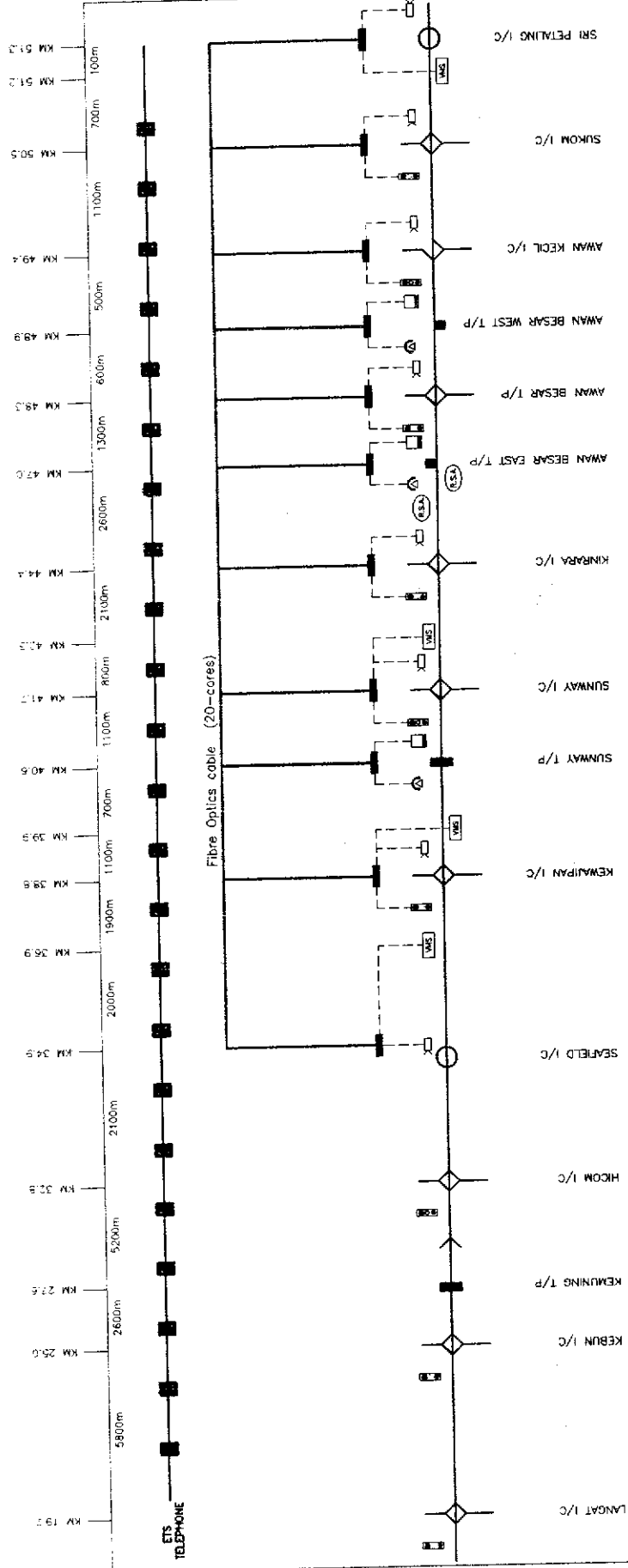
|   |   |                                 |
|---|---|---------------------------------|
| ① SRI PETALING INTERCHANGE<br>( KM 51.3 )   | ⑩ KESAS HEAD QUARTERS<br>( KM 40.6 )    | LEBUEH RAYA SHAH ALAM           |
| ② SUKOM INTERCHANGE<br>( KM 50.5 )          | ⑪ KEWASIPAN INTERCHANGE<br>( KM 38.6 )  | TOLL PLAZA                      |
| ③ AWAN KECIL INTERCHANGE<br>( KM 49.4 )     | ⑫ SEAFIELD INTERCHANGE<br>( KM 34.9 )   | VARIABLE MESSAGE SIGN           |
| ④ AWAN BESAR WEST TOLL PLAZA<br>( KM 46.9 ) | ⑬ HICOM INTERCHANGE<br>( KM 32.6 )      | CLOSE CIRCUIT TELEVISION (CCTV) |
| ⑤ AWAN BESAR INTERCHANGE<br>( KM 48.3 )     | ⑭ KEMUNING INTERCHANGE<br>( KM 29.6 )   | VIDEO VEHICLE DETECTOR          |
| ⑥ AWAN BESAR EAST TOLL PLAZA<br>( KM 47.0 ) | ⑮ KEMUNING TOLL PLAZA<br>( KM 27.6 )    |                                 |
| ⑦ KINRARA INTERCHANGE<br>( KM 44.4 )        | ⑯ KEBUN INTERCHANGE<br>( KM 25.0 )      |                                 |
| ⑧ SUNWAY INTERCHANGE<br>( KM 41.7 )         | ⑰ PANDAMARAN INTERCHANGE<br>( KM 19.2 ) |                                 |
| ⑨ SUNWAY TOLL PLAZA<br>( KM 40.6 )          |   |                                 |





# **LEBUH RAYA SHAH ALAM**

## **System Intergration Of The Traffic Control And Surveillance System**



### **LEGEND :**

- System Interchange
- Service Interchange
- Toll Plaza
- Rest and Service Area
- Telephone Extension
- Plaza Computer Network
- Variable Message Sign
- CCTV/Video Vehicle Detector
- Traffic Signal
- Interfacing Unit/Multiplexer with 2 Mbps transmission
- 20 cores Fibre Optic ( Spare 4 Cores )
- Emergency Telephone, Located at 1.5 km Apart on both bounds
- 10 pairs 0.9mm Copper Cables

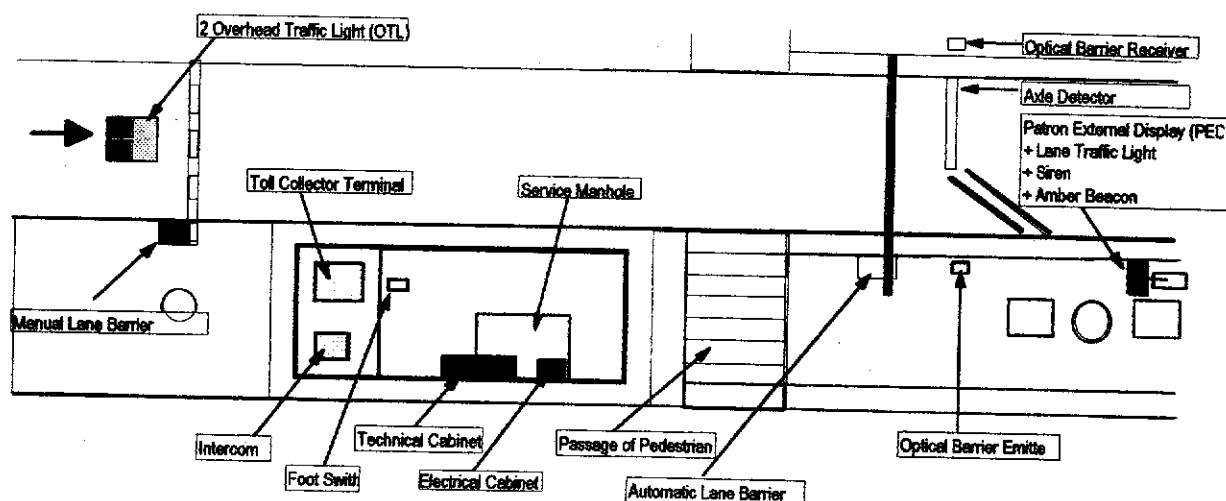


## 6.2 Toll System

- Lane Equipment are configured in two different lanes configurations.

| Type Of Lane                                    | Type Of Transaction | Managed By  |
|---|---------------------|-------------|
| Manual lane for all vehicles<br>(Standard Lane) | Cash & SMART Card   | Toll Teller |
| Automatic lane class one<br>Vehicle (ETC Lane)  | Express TAG         | Automatic   |

### Manual Lane



### Electronic Toll Collection Lane

