添付 8

バンガロール市高架橋建設プロジェクト関連受領資料

Consultancy Services for
"Preparation of Feasibility Report for the Construction of Proposed Elevated Corridors within Bengaluru Metropolitan Region, Bengaluru"

- **Project Preparation Activities**

➢ Envisaged Total Duration of the Assignment : 6 Months

➢ Stages of Submission

- Stage 1 : Inception Report (IR) & Quality Assurance Plan (QAP)
- Stage 2 : Preliminary Traffic cum Alignment Report
- Stage 3 : Draft Feasibility cum Preliminary Design Report
  Strip Plan and Clearances
  Land Acquisition Report
- Stage 4 : Final Feasibility cum Preliminary Design Report
  Final Feasibility Study, Detailed Engineering Design, Documents and Drawings

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Karnataka Road Development Corporation Limited
(A Government of Karnataka Enterprise)

PRELIMINARY DISCUSSSIONS

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• Salient Details of Proposed Elevated Corridors

Sl. No	Name of Proposed Corridor	Tentetive Length	Nos. of Lanes
1.	North-South Corridor connecting Hebbal to Central Silk Board Flyover (i.e. NH7 towards Hosur to NH7 towards Bellary)	10.60 Km	6
2.	East-West Corridor-1 connecting K.R.Puram to Gorguntepalya (i.e., NH-4 towards old Madras Road and NH-4 Bangalore – Pune Road)	19.70 Km	6
3.	East-West Corridor-2 connecting SH-35 to SH-17, From Varthur Kodi on SH-35 to Jnanabharathi on SH-17	27.70 Km	6
4.	Connecting Corridor-1; Connecting North-South Corridor & East – West Corridor-2 from Agra to Kalasipalya.	9.20 Km	4
5.	Connecting Corridor-2; Connecting East -West Corridor-1 & East – West Corridor-2 from Richmond Road to Ulsoor.	2.30 Km	4
6.	Connecting Corridor-3; Connecting Corridor from Kalyan Nagar Junction on Outer Ring Road to St. Johns Church Road and Wheelers Road Junction.	5.70 Km	4
	Total	75 km	

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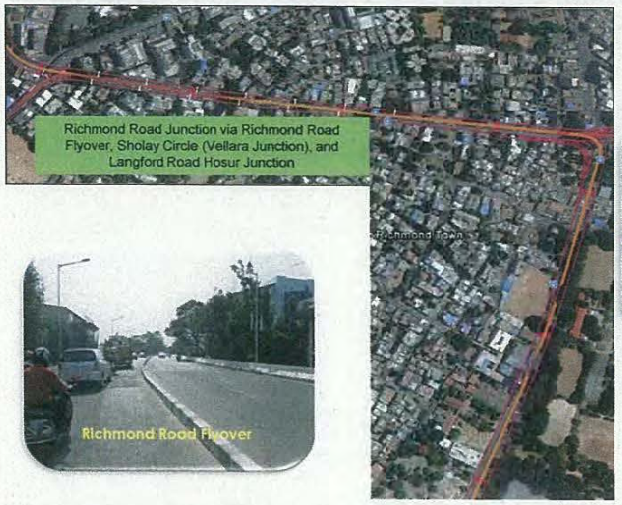

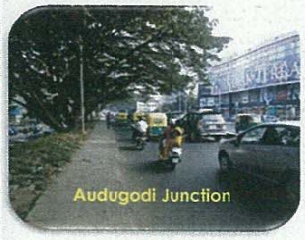

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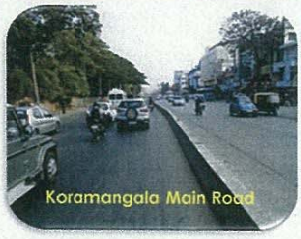

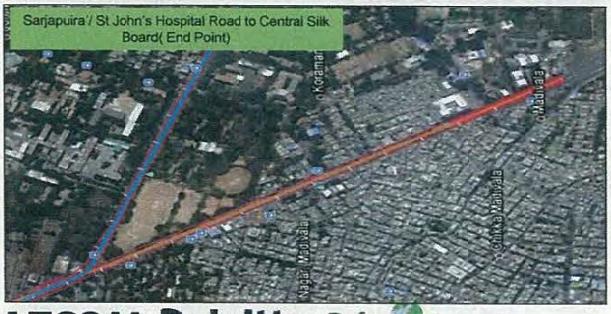

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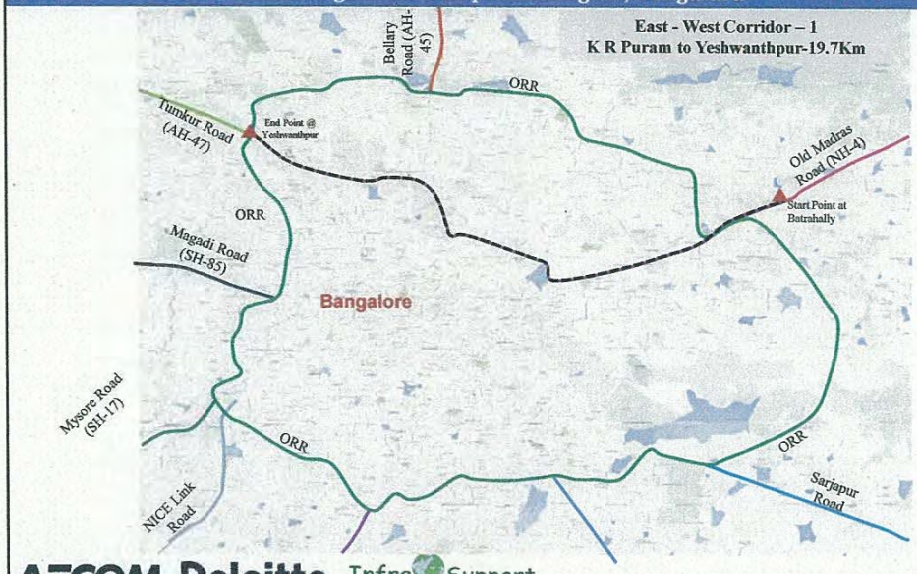

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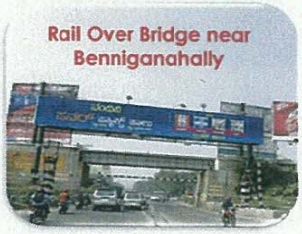

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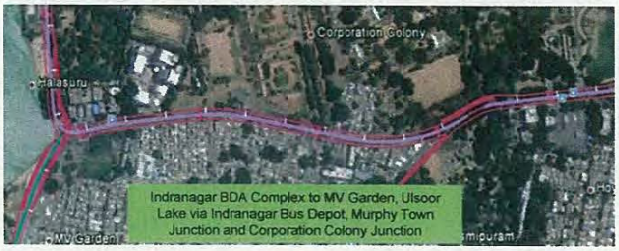

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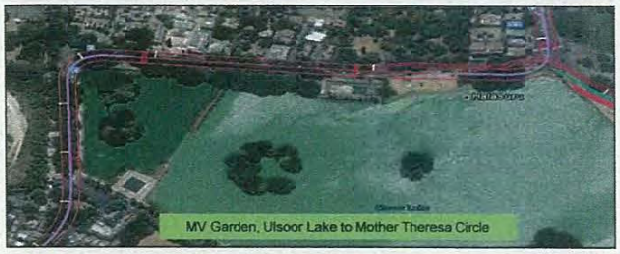

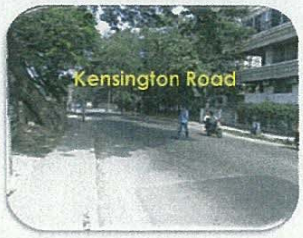

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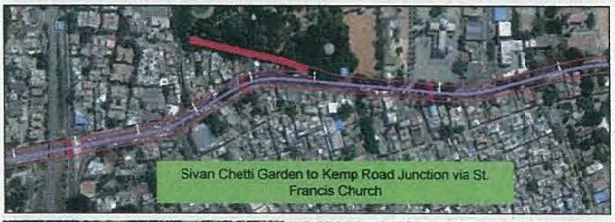

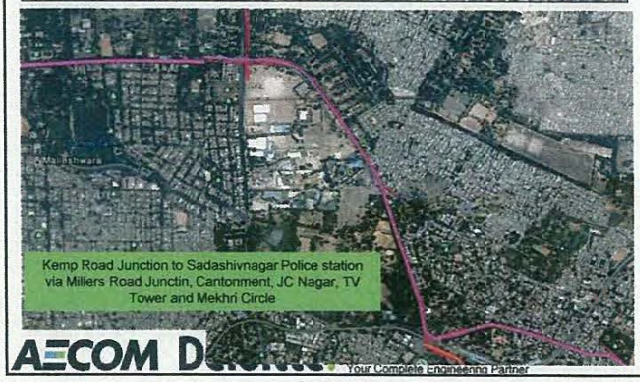

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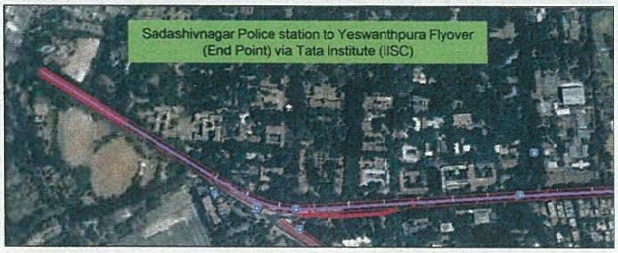

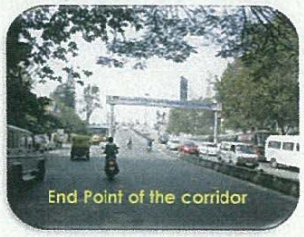

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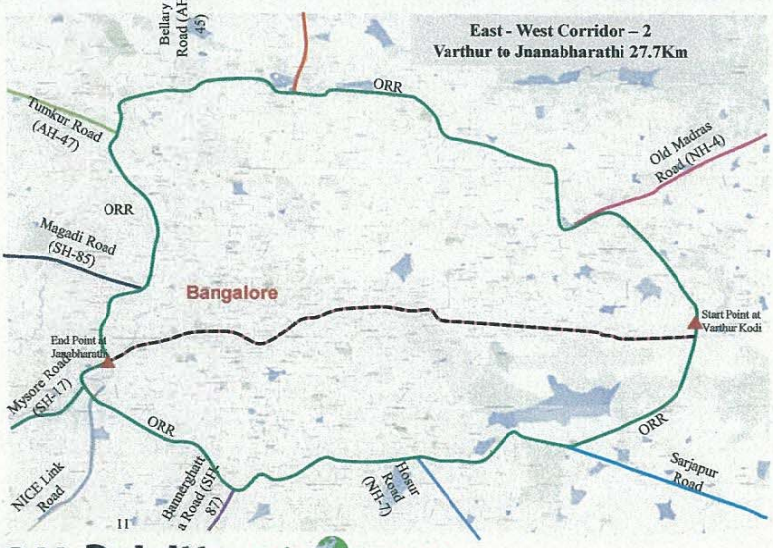

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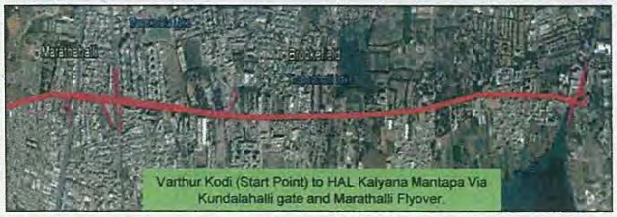

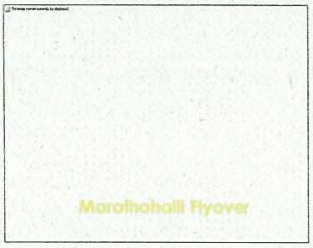

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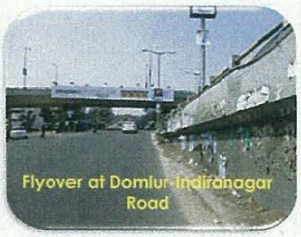

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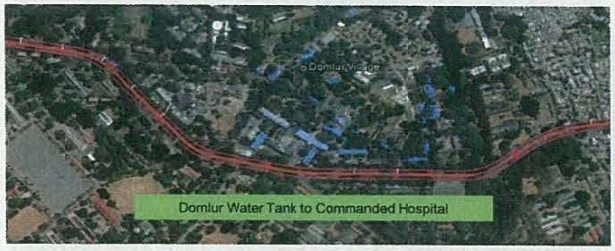

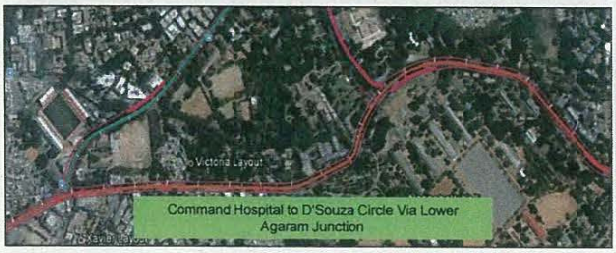

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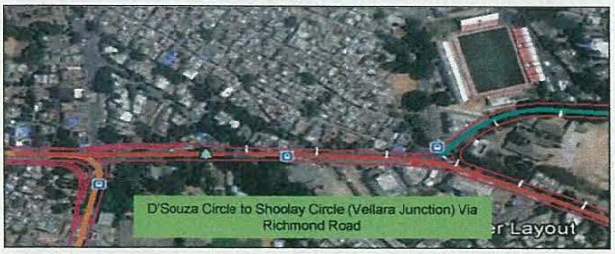

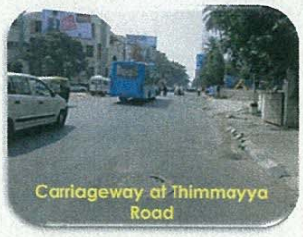

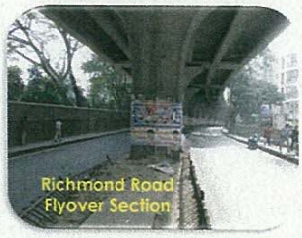

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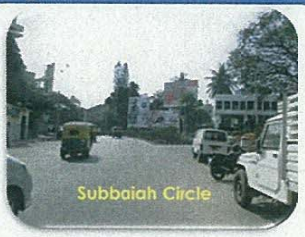

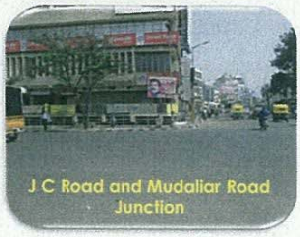

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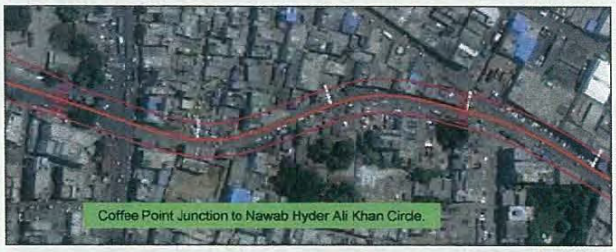

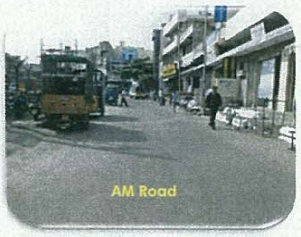

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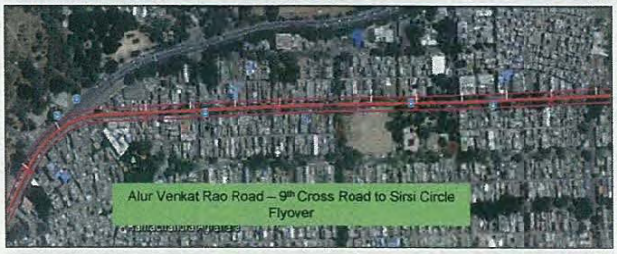

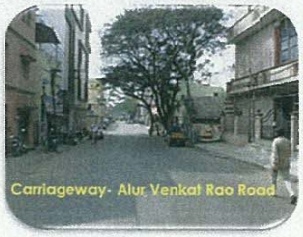

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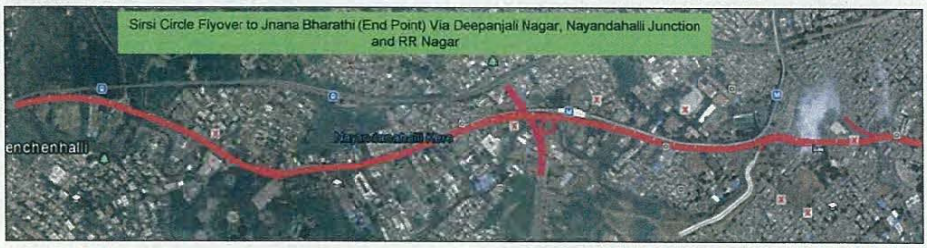

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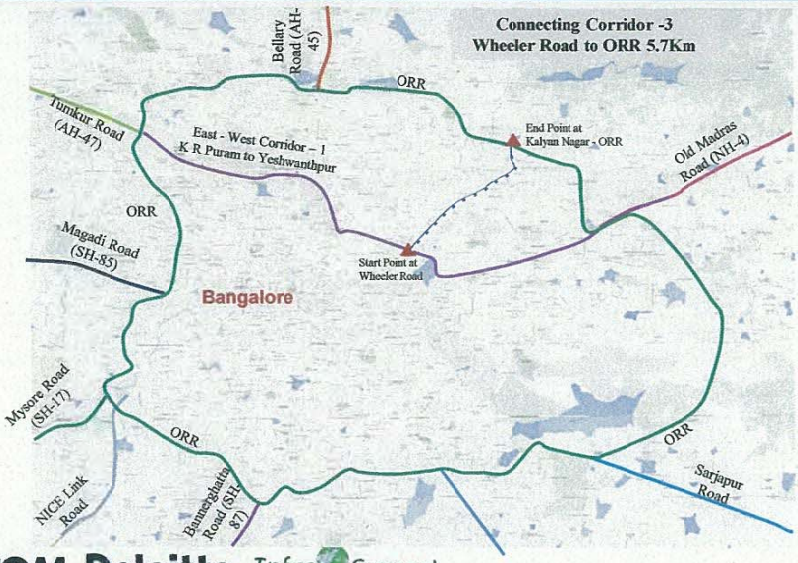

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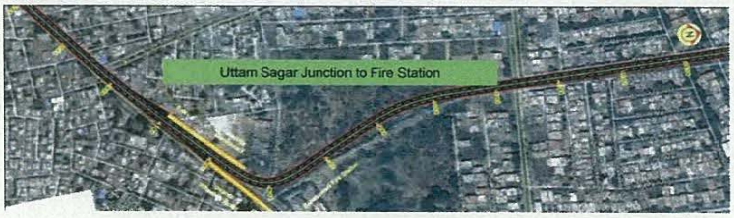

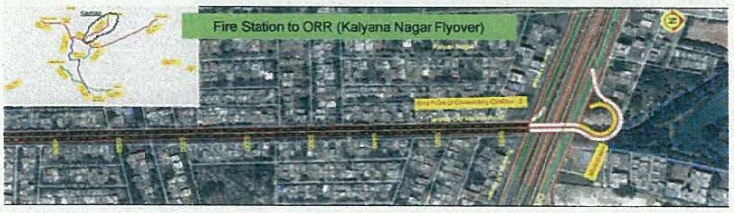

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Consultancy Services for
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• Description of Assignment

- The project is aimed to alleviate congestion and provide unhindered travel along the Proposed Corridors that are safe, reduce travel time & VOC, minimize carbon emissions and improve overall economic growth
- The overall objective of the Consultancy assignment is to assist KRDCL in developing Feasibility Study, recommend financing mechanisms, identify preferred procurement route
- The **Feasibility Study and Preliminary Engineering Design** that will demonstrate the bankable feasibility of the project from traffic, technical, economic, social, environmental and financial angles leading to preparation of detailed engineering design, tender documentation and project procurement plan.

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• Scope of Services

➢ FEASIBILITY STUDY

- Aim to prepare an implementable report relating to technical, economic, social, environmental and financial appraisal of the proposed development of elevated highway corridor.
- Study of Master Plan and Comprehensive Transport Plan, if any, prepared in order to integrate the alignment with future transport network development
- Explore the possibility of developing multi-level highways or provisioning thereof, particularly for meeting future expansion needs.
- Economic Evaluation by using VOC sub-model of HDM-IV.

➢ PRELIMINARY ENGINEERING DESIGN

- Preparation of Preliminary Engineering Design of all aspects of the Project as per relevant Design Code of Practice as applicable in India and adopt international design standards if necessary.
- Preparation of preliminary engineering drawings of the project,
- Proposals for drainage and utility shall be integrated with the existing facilities

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Detailed Tasks

- Environmental and social impact assessment
- Consultation with Public, Stake Holders and relevant government departments at different stages of assignment
- Detailed Reconnaissance, Identification of congested locations and mitigation of the problem with techno-economic consideration
- Traffic studies including traffic surveys and Axle load survey and demand forecasting for next thirty years;
- Inventory and condition surveys for existing roads along the project corridors.
- Inventory & Condition surveys for bridges, CD structures & drainage provisions;
- Detailed topographic surveys using Total Stations and GPS;
- Pavement investigations;
- Sub-grade characteristics and strength: investigation of required sub-grade and sub-soil characteristics and strength for road design and sub soil investigation;
- Identification of sources of construction materials;
- Design of complete drainage system and disposal point for storm water

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Detailed Tasks

- Preliminary design of Elevated Road, Preliminary design of Elevated Road Structure including preparation of GAD & CD structures including repair and rehabilitation of existing structures to be retained.
- Identification of the type and the design of interchanges;
- Value analysis / value engineering and project costing
- Economic and financial analyses
- Preparation of contract packaging and implementation schedule
- financial viability of project
- Procurement option analysis and recommendations for the project
- Financing study with detailed options of financing.
- Preparation of Detailed Feasibility Report, Preliminary Engineering Design, Rate analysis and Preliminary cost estimate as per current applicable PWD SoR
- Design of toll plaza (if any) and identification of their numbers and location
- Study for alternative revenue generation if tolling option is not feasible.
- Tie-in of on-going/sanctioned works of State Highways/other agencies.

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• Project Preparation Activities

- ➢ Envisaged Total Duration of the Assignment : 6 Months
- ➢ Stages of Submission
  - Stage 1 : Inception Report (IR) & Quality Assurance Plan (QAP)
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    Land Acquisition Report
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• Reports & Documents to be submitted by Consultant

Stage	Description	Period	Date
1.	Inception Report & Quality Assurance Plan	1 Month	Mar'16
2.	Initial Financial Analysis & Policy interventions report	2 Months	April'16
	Traffic cum Alignment Report	2 Months	April'16
3.	Draft Financing study and Viability Report	3 Months	May'16
	Various Survey and Investigation completion Report	3 Months	May'16
	Draft Feasibility cum Preliminary Design Report	4 Months	June'16
4.	Utility relocation Plan and Land acquisition Plan	4 Months	June'16
	Financial Feasibility Report with Value-for-money Report & Draft Procurement Options Report	5 Months	July'16
	Environmental and Social reports and clearances as outlined in Report.	6 Months	August'16
	Final Feasibility cum Preliminary Design Report	6 Months	August'16

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Project Implementation schedule:

Based on the consultant's project preparation timelines project implementation schedule is tentatively planned as follows:

Stage	Description	Date	Evaluation Period
1.	Request for Qualification (RFQ) from Contractors	May'16	3 Months
2.	Request for Proposal (RFP) from short listed Contractors	August'16	3 Months

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• Smart Plans for the Project

- The scope of work will broadly comprise design of Elevated Structures, Ramps, Loops, Roundabout Structure with provisions for traffic safety.
- Structure design life is 100 years
- Moderate Environment (recommendation of Cl:14 of IRC:112-2011)
- Aesthetically Pleasing Structures with Economical and Innovative Solution and Using Latest Technology
- Corridor resting on central pier except at unavoidable locations
- Design of ramps, loops and interchanges to fit to site conditions with ease of access
- Seamless integration with at grade major roads
- Improvement of at grade Road with provision of good footpaths

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• Smart Plans for the Project

- Design of Special Drainage Plan to keep the Project Corridor fully functional in all Seasons
- Plan the Structure Solutions with minimum disturbance to present Utilities in the Project Corridor
- Plan the Structure Solutions which causes minimum disturbance to traffic during construction in the Project Corridor
- Vertical and Horizontal Clearance Requirements for traffic passing under the Elevated Structures
- Type of structure and Innovation with use of latest cutting edge technology which involves fast track construction
- Planning latest toll collection technologies
- Use of HTMS and Safety by monitoring through cctv cameras

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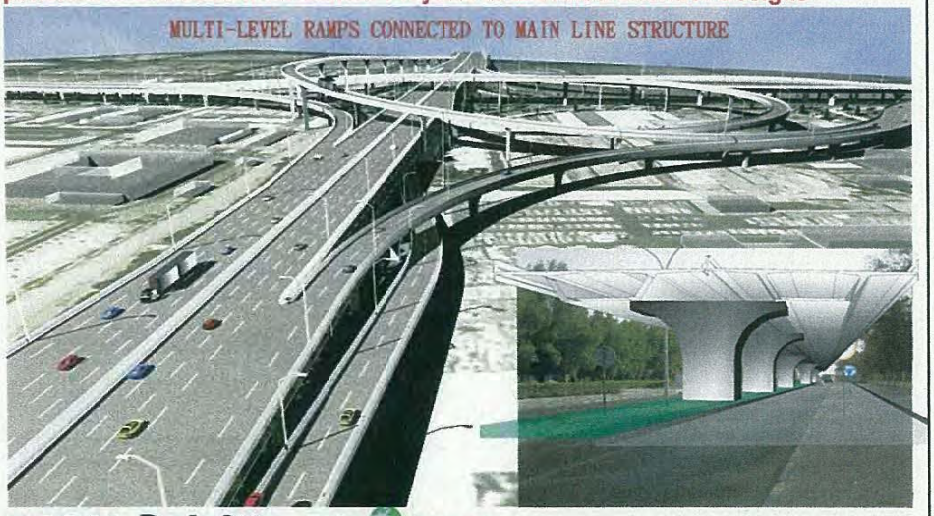
Experience of Consultant on Similar Projects of Elevated Corridor Designs



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Experience of Consultant on Similar Projects of Elevated Corridor Designs

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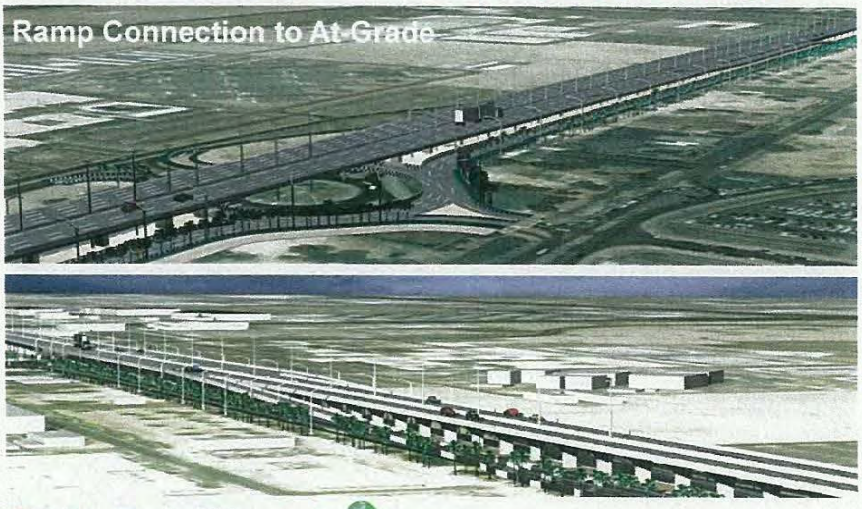

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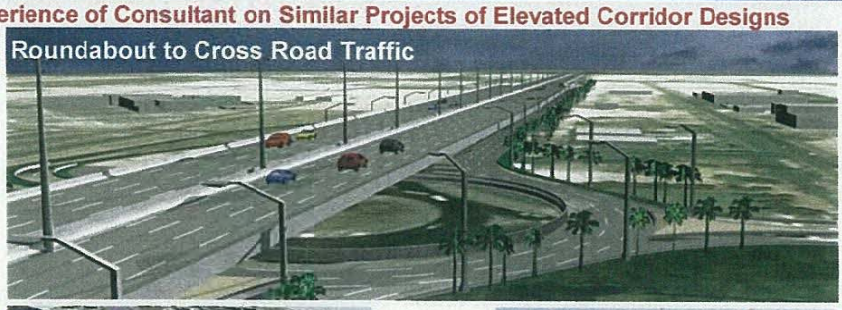
Experience of Consultant on Similar Projects of Elevated Corridor Designs

Roundabout to Cross Road Traffic



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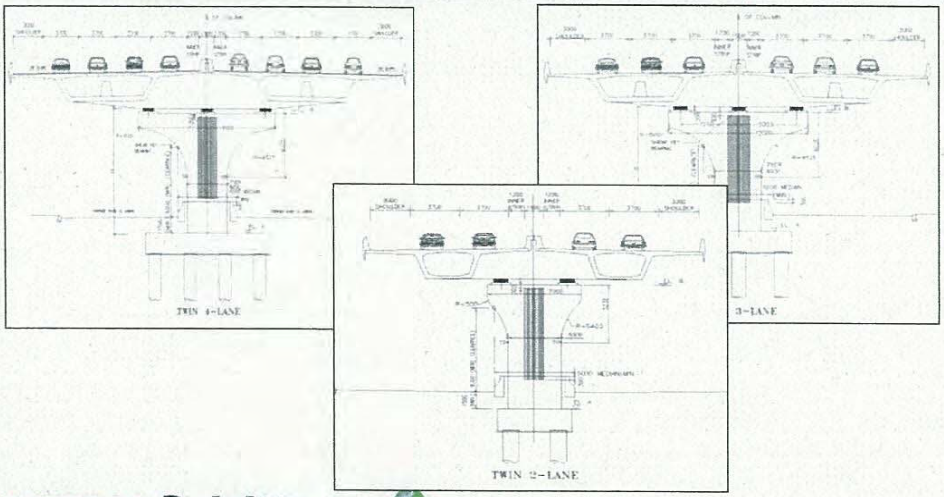
Typical Structural Solution for Main Line *(6-Lane on Single Pier)*



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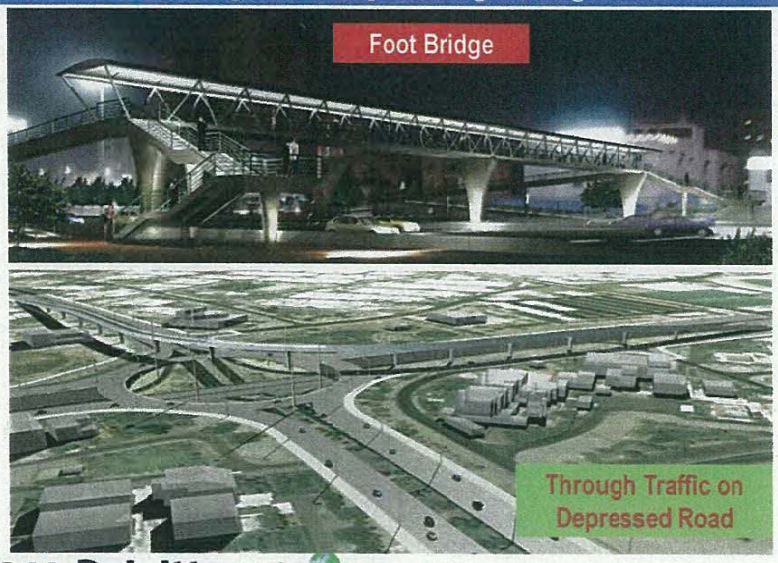

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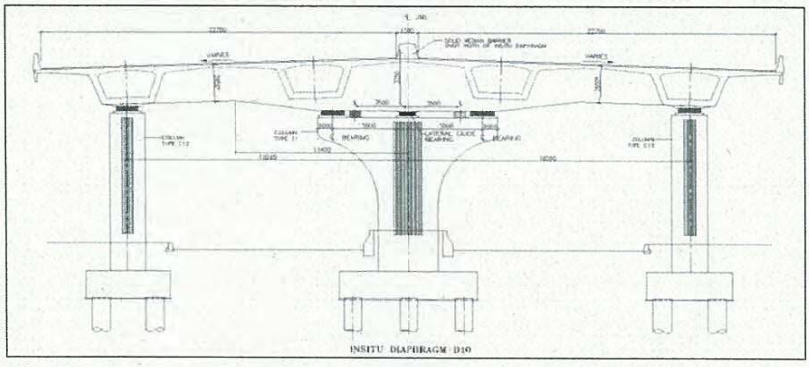
Elevated Mainline Ramp Entry and Lane Gain



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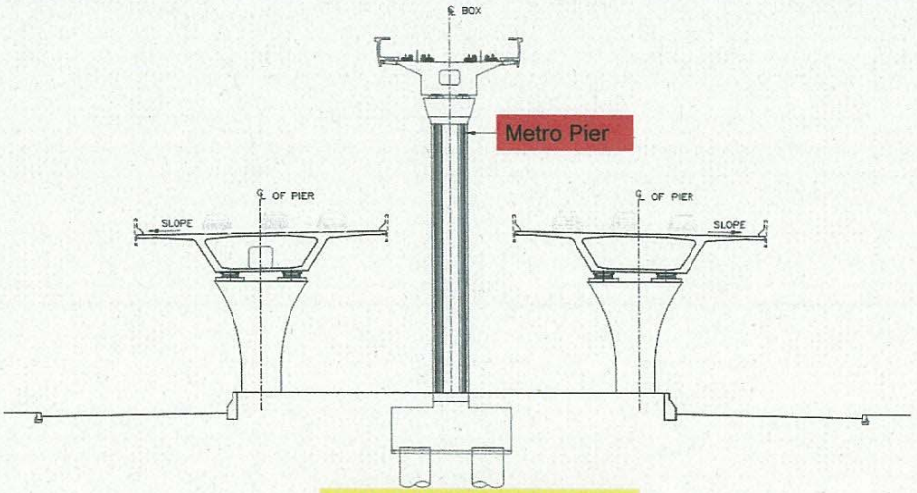

Twin Pier Situation

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Design Standards to be Followed in the Design / Checking

- ASHTO-LRFD Bridge Design Specifications (Latest Edition)
- AASHTO-Guide Specifications for Design and Construction of Segmental Concrete Bridges (1999)
- IRC:6-2014, Standard Specifications and Code of Practices of Road Bridges, Section-II, Loads and Stresses
- IRC:112-2011, Code of Practice of Concrete Road Bridges
- IRC:SP:65-2005, Design and Construction of Segmental Bridges
- IRC:SP:66-2005, Design of Continuous Bridge
- IRC:SP:67-2005, External and Unbonded Prestressing Tendons in Bridge Structures
- Recommendations for Stay Cable Design, Testing and Installation, (PTI), Phoenix, Arizona, 2001
- FIB Bulletin 30, "Acceptance of Stay Cable Systems using Prestressing Steels", Lausanne, 2005.
- ASTM 882M, "Standard Specifications for Epoxy-Coated Seven Wire Prestressing Steel Strands", 2002

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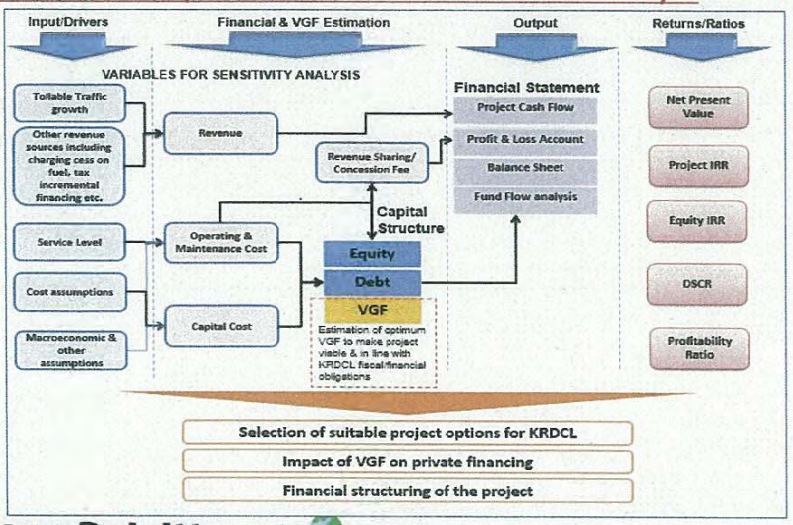
Framework for development of financial model & Financial analysis



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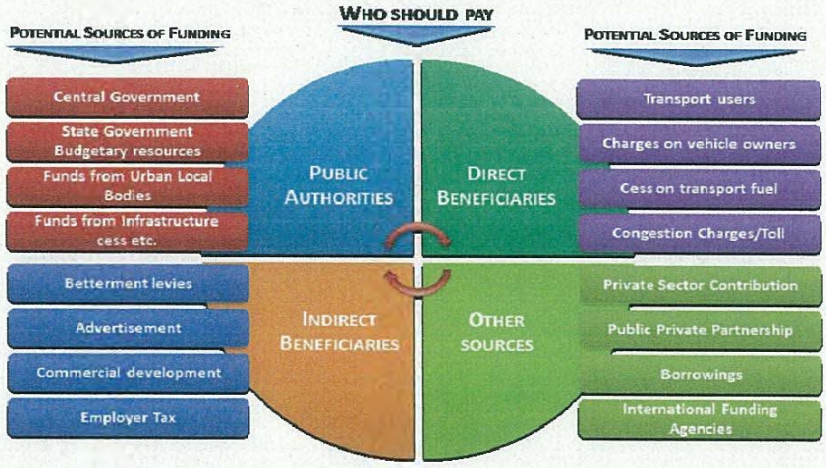
Identification of potential sources of funding



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Development of preferred mode of implementation

Evaluation & Selection of Suitable PPP Option

Traditional PPP Options

- Option I: BOT – Toll Demand risk with concessionaire
- Option 2: BOT – Annuity (No Tolling) Demand risk with Government
- Option 3: Shadow Toll Demand risk with Government
- Option 4: ..... ? other options will be explored

New/Innovative PPP options

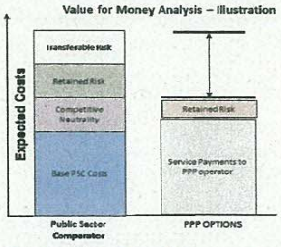
- Option 1: BOT – Toll With commercial development
- Option 2: BOT – Annuity with tolling right to Concessionaire
- Option 3: BOT – Annuity with Upfront Contribution by Government
- Option 4: ..... ? Other options will be explored

Parameters for Evaluation of PPP options

- Market acceptance
- Government acceptance
- Regulatory compliance
- Interest of stakeholders
- Project objective
- Value for Money

SELECTION OF SUITABLE PPP OPTION FOR

Value for Money Analysis – illustration



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DISCUSSION ON STRUCTURES

STRUCTURE TYPES TO BE PROPOSED FOR ELEVATED CORRIDORS

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Structural Consideration-1

Durability & Economic Issues

- 100 years design life
- Preference to use of High Strength Factory Produced Precast Segments
- Economic span exercise to identify economic span lengths
- Economic span is a function of substructure and superstructure costs. Consideration will be for existing Utilities & Cross Roads during fixing the span arrangement.

- Short spans– precast segmental using span-by-span on underslung girders or using Overhead gantry
- Long spans– precast segmental balanced cantilevers using beam and winch erection technique

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ADVANTAGES OF SEGMENTAL CONCRETE BRIDGES

- ☐ Innovative
- ☐ Reduced Cost
- ☐ Reduced Construction Time
- ☐ Environmental Protection
- ☐ Maintain Traffic
- ☐ Provide Aesthetics
- ☐ Quality Control
- ☐ Minimum Maintenance

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SPAN RANGES

PRECAST SEGMENTAL

■ Span By Span	30m to 60m
■ Balanced Cantilever	50m to 150m
■ Incremental Launching	30m to 100m

CAST-IN-PLACE SEGMENTAL

■ On Falsework	30m to 100m
■ Balanced Cantilever	60m to 180m
EXTRADOSED	90m to 200m
CABLE STAYED	200m to 600m
SUSPENSION BRIDGE	500m to 1000m

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PRECAST SEGMENTAL SPAN-BY-SPAN CONSTRUCTION BY UNDERSLUNG GANTRY

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ERECTION OF SEGMENTS BY OVER HEAD GANTRY

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ERECTION OF SEGMENTS BY BALANCED CANTILEVER TECHNIQUE USING LIFTING FRAME (BEAM & WINCH)

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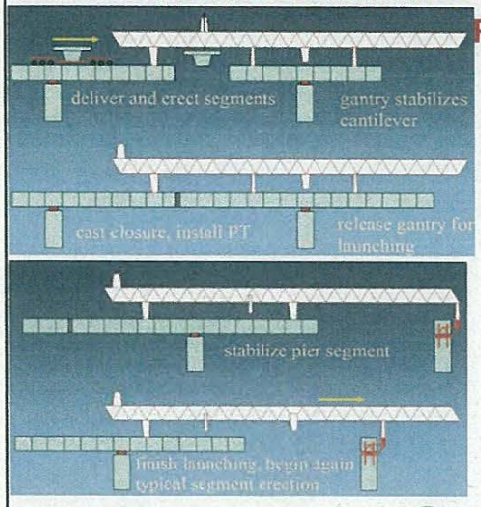
PRECAST SEGMENTAL BALANCED CANTILEVER



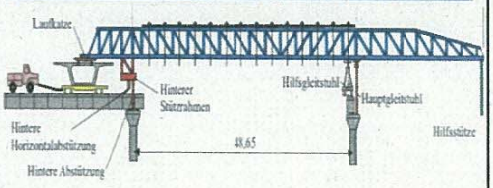


Figure 8: Oversiung Truss

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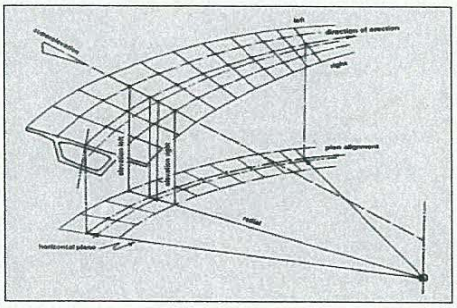
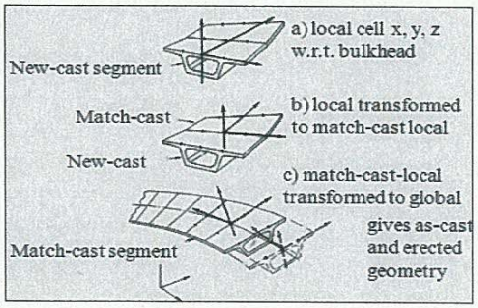
GEOMETRICAL DETAILS AND SPAN CONFIGURATION





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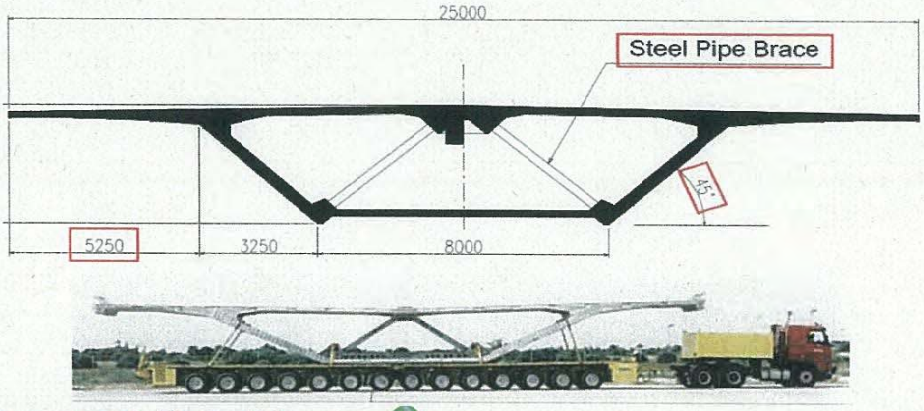
SUPERSTRUCTURE OPTIONS FOR MAINLINE STRUCTURE

Single Cell Trapezoidal Box Girder with long cantilever slab, 45⁰ inclined web and steel pipe



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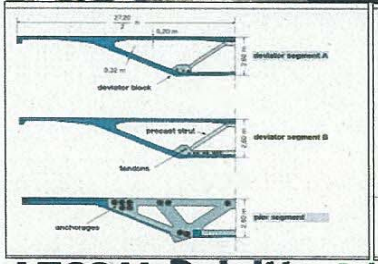

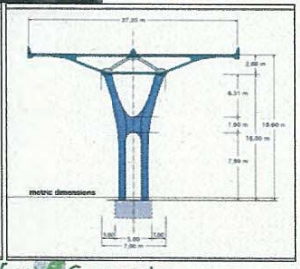

1. Bang Na Viaduct in Bangkok
2. Mainline Span 44.40m
3. Longitudinal Post Tensioning
4. Mainline Column with Superstructure

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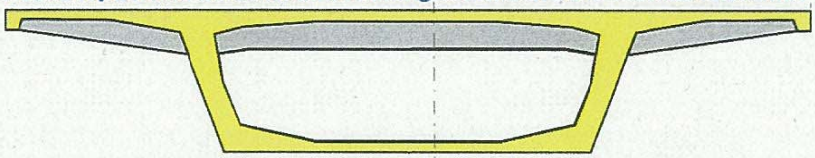
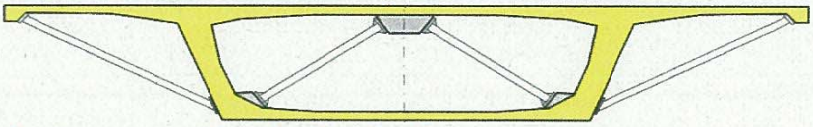
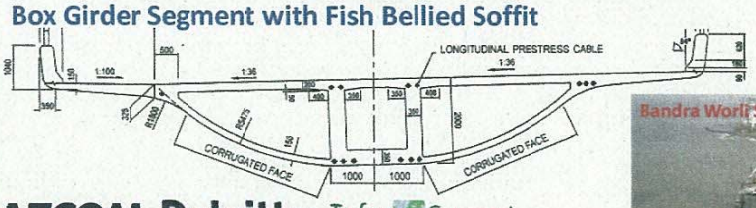
Single Cell Trapezoidal Box Girder with long cantilever slab & Transverse Rib



Single Cell Trapezoidal Box Girder with long cantilever slab, and Braces



Box Girder Segment with Fish Bellied Soffit



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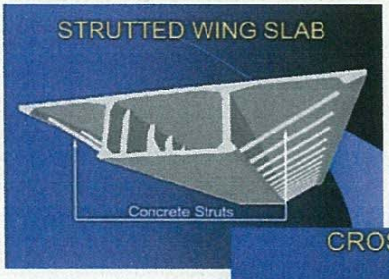
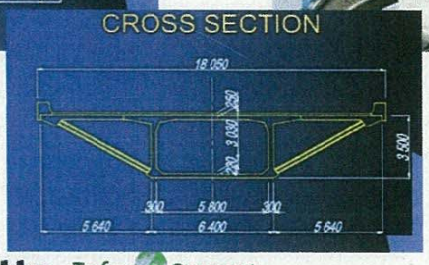
Present Trends – Core Segment • External Strut + Rib • Precast Panel (Greater Use of Combined Steel and Concrete to Reduce the Weight)





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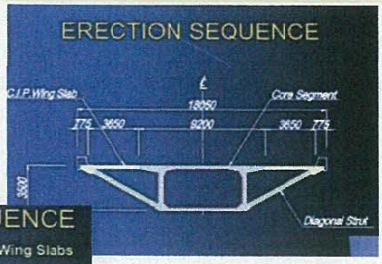

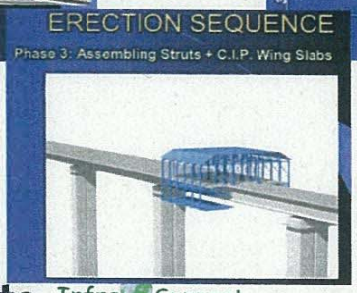

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Carriageway consists of a triple cell box girder, with cantilever wing slabs attached to both sides of the Box Core Segment

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Recently Inaugurated Project at New Delhi "Development of Elevated Corridor between Vikaspuri to Mukarba Chowk"

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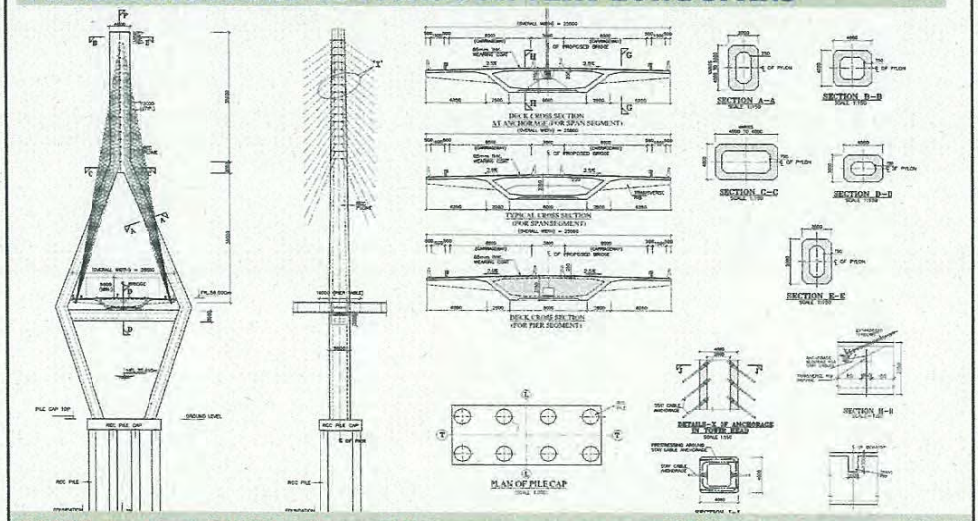
SUPERSTRUCTURE OPTIONS FOR VERY LONG SPANS



CABLE STAYED SPANS : OPTION-1 WITH TWO PLANES OF STAY CABLES

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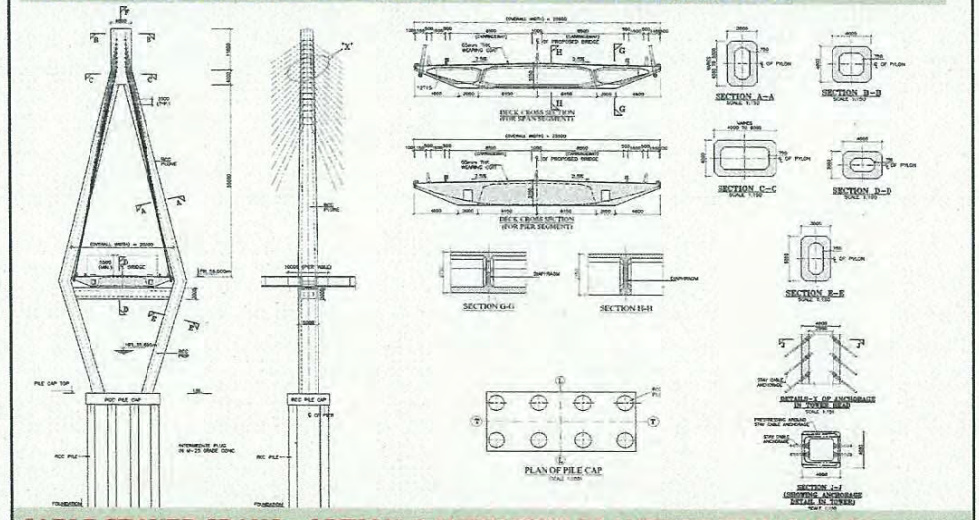
SUPERSTRUCTURE OPTIONS FOR VERY LONG SPANS



CABLE STAYED SPANS : OPTION-2 WITH TWO PLANES OF STAY CABLES

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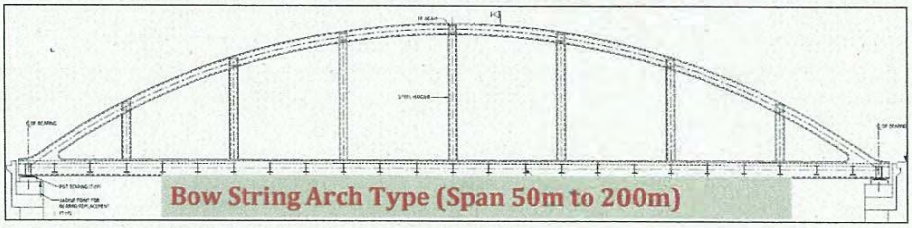
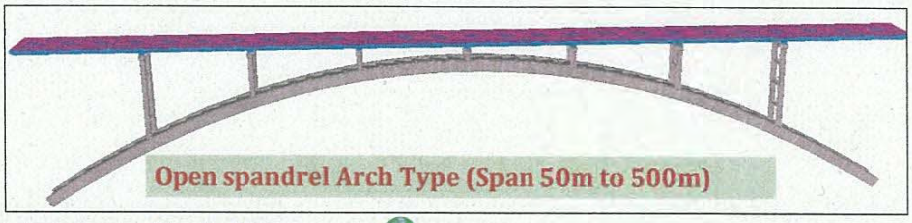
SUPERSTRUCTURE OPTIONS FOR VERY LONG SPANS

TYPICAL MODULE FOR STEEL ARCH BRIDGE SPANS



Bow String Arch Type (Span 50m to 200m)



Open spandrel Arch Type (Span 50m to 500m)

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190m Open Spandrel Steel Arch (Designed by AECOM)

Figure 8: Placing of middle precast slabs

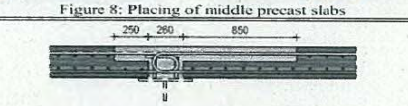

Figure 10: On site joints with reinforcement overlapping

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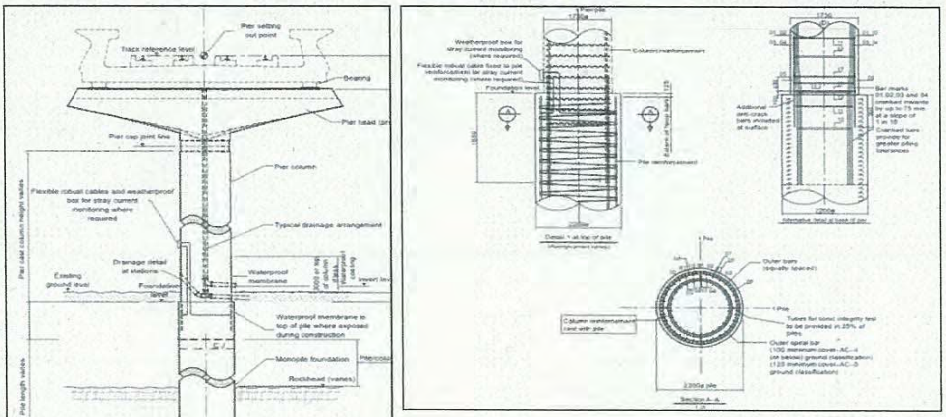
Typical Monopile Arrangement for Simply Supported Spans for Ramps



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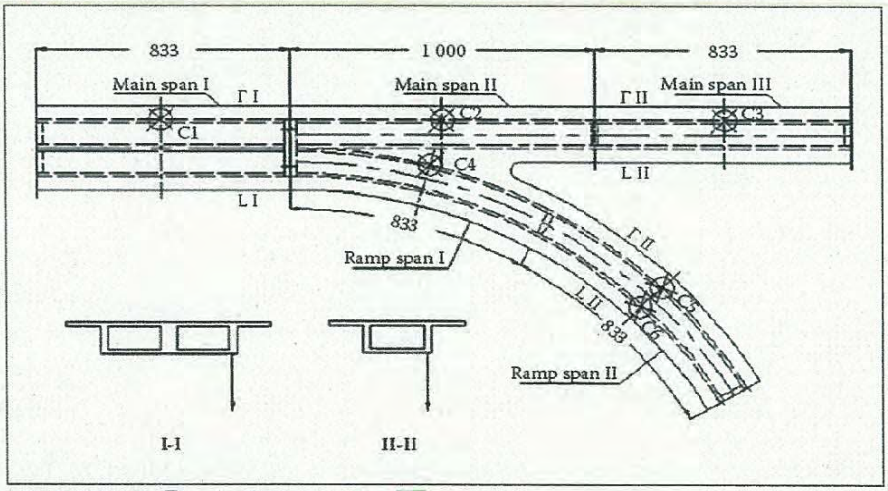
Typical Details of the Mainline & Ramp Junction



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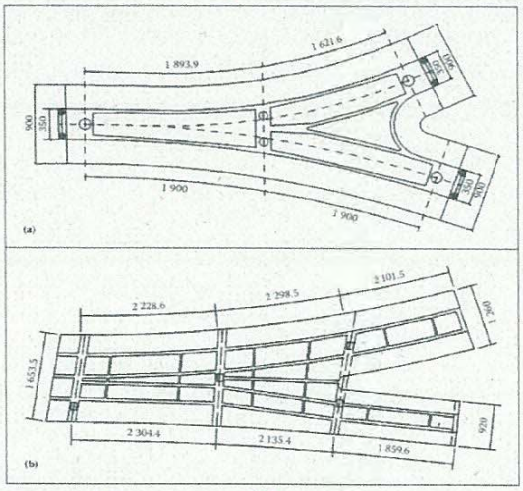
Typical Details of Y-shaped Junction of Elevated Str.



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Welcome any clarifications and feedback

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