APPENDIX F

DESIGN STANDARD AND DESIGN CRITERIA

DESIGN STANDARD AND DESIGN CRITERIA FOR SUPERSTRUCTURE

1 BASIC DESIGN STANDARD

The design procedures shall be, in principle, based upon the requirements of the British Standard (BS5400 , BD37/88) with some modifications which reflect the climatic conditions peculiar to the location.

2 STRUCTURAL ANALYSIS

The specific requirements for concrete bridges concerning method of analysis are given in British Bridge Standard (BS5400), Part 4, 4.4.2 and 4.4.3. The Consultant will use elastic method of analysis beam theory to determine the distribution of internal forces and deformations throughout the structure for not only serviceability limit state, but also for ultimate limit state. Because the application of elastic methods of analysis in association with the design loads for the ultimate limit state in general leads to safe lower bound solution.

3 Properties of Materials

3.1 Concrete

	Superstructure	
Concrete Used Modules of Elasticity (KN/mm^2)	Girder Grade50 34.0	Slab Grade 40 31.0
Poison's Ratio	0.2	
Temperature Coefficient (1°C)	12 x 10 - 6	
Stress-Strain Curve for Design	BS5400 - Part 4 - Figure 1	
Shrinkage + Creep	CEB - Manual on Structure Effects on Time-Dependent Behavior of Concrete (1990)	

Reinforced Concrete beam : Grade 40
Pretensioned Concrete beam : Grade 50
Posttensioned Concrete : Grade 50

3.2 Steel

Type of Steel	Ordinary Reinforcement Cold Worked Steel Bars	Prestressing Steel Wires
Minimum Strength (N/mm ²)	Y460	Ultimate T12.7 - 1860 T15.2 - 1860
Modulus of Elasticity (KN/mm ²) Relaxation Stress-Strain Curve for Design	200 BS5400 - Part 4 Figure 2	196 3% BS5400 - Part 4 Figure 4

4 Load to be Considered

4.1 Dead Loads

Material	Unit Weight (KN/m3)
Steel, Cast Steel, Forge Steel	78.5
Reinforced and Precast Concrete	25.0
Mass Concrete	23.5
Premix Pavement	23.0

4.2 Superimposed Dead Loads

Parapet and Handrail : 7.315 kg / m / one side
Pavement : average hight = 130mm

4.3 Live Loads

4.3.1 Normal HA and HB loading

The number of notional lanes for the bridges having 11.0 m or 13.0 m wide carriageway is four(4) in accordance with 3.2.9.3.1. of BD37/88.

(1) Normal HA loading,

The value to be applied for uniformly distributed load (UDL) depending on the loaded length and for the knife edge load (KEL) at 120 KN per lane shall be considered as specified in Clause 6.2.1. (Table 13) and Clause 6.2.2. respectively of BD 37/88.

(2) Abnormal HB loading

Dimensions and axle arrangements of the abnormal HB vehicle is as specified in Clause 6.3.3 Figure 12 of BD 37/88. For one unit of HB-loading, all four axle loads are to be considered equally at 10KN (2.5 KN per wheel).
Live loading consists of HA and HB loading which include impact. HA loading

represents normal traffic and HB loading is an abnormal vehicle unit loading.

4.3.2 Application of types HA and HB vehicle

(1) Type HA loading

The HA UDL and KEL shall be multiplied by the appropriate lane factors from Table 14 in Clause 6.4.1.1 of BD37/88.

(2) Types HA and HB loading combined

Types HA and HB loading shall be combined and applied in accordance with Figure 13 Clause6.4.2 of BD37/88.

4.3.3 Design Condition

Design for more severe effect of HA alone or HA with HB(120T,30units) to satisfy Class 1 condition under load combination 1 only, and it should be checked for HB(180T,45units) to satisfy Class 2 condition.

4.4 Longitudinal Load - (See cl. 6.6.)

More severe longitudinal load resulting either from HA or HB due to traction or breaking should be taken. This force acts at one notional lane and parallel to road traffic.

(1) Due to HA

$8 \times L + 250 \text{ KN} \geqq 750 \text{ KN}$

(2) Due to HB

25% of the total weight of HB vehicle

This normal load must be multiplied with rfl & rf3 for the relevant limit state in designing the substructure.

4.5 Collision Loads

When travel speed is more than 80 km per hour bridge supports should be protected with safety fences and shall be capable of resisting the load transmitted from the guard rail applied simultaneously with the resisting load above the guard rail. Loads in two directions shall be considered separately and it is given Clause 6.8 of BD37/88.

When applying this collision forces for the members supporting superstructure no live load is required to be considered on the bridge , and load factors rfl and rf3 are given in accordance with the BD37/88.

4.6 Prestressing Force

The prestressing force can be calculated by the equation :

P(X) = Pi - [Pi (x) + Pt (x)]

Where :

P (x) = Tensile forced of prestressing tendons at a design section

Pi = Tensile forced of prestressing tendons at a jack position

Pi(x) = The decrease of tensile force immediately after prestressing due to :

1) Elastic deformation of concrete
2) Friction loss between sheaths and prestressing tendons
3) Slip at anchors

Pt(x) = The decrease of tensile force due to:

4) Creep of concrete
5) Shrinkage of concrete
6) Relaxation of prestressing tendons

4.7 Effects of Shrinkage and Creep

For calculation of the effects of shrinkage and creep on the prestressing force and on the bending moments and forces of the structure, the respective coefficients and characteristics shall be determined in accordance with CEB manual on Structural Effects of the Time-dependent Behavior of Concrete (19).

4.8 Wind Load

Wind loads shall be calculated in accordance with Clause 5.3.3. as follows.

$Pt = 0.613\ Vc \times A1 \times C_D$

Where :

Vc = maximum wind gust speed (m/s).

A1 = the solid area (m)

C_D = the drag coefficient

In calculating maximum wind gust speed (Vc)

Vc = v x K1 x S1 x S2

v = mean hourly wind speed (m/s) = 40 m/s

K1 = 1.0 (for 120 years return period)

S1 = 1.0

S2 = is to be taken from T.2 corresponding to height above ground level and span of the bridge.

The height of bridge above ground level is 10 m and length is 40 m

Vc = 40 x 1.0 x 1.0 x 1.545

= 61.80 m/s

Maximum wind gust speed on bridges with live load shouldn't exceed 35 m/s.

4.9 Temperature

Effective bridge temperature shall be derived from 5.4 (Part 2) taking into account of the maximum and mininum shade air temperature.

The temperatures recorded in Malaysia are as follows :

Mean Maximum Temperature	32°C
Mean Minimum Temperature	22°C
Mean Temperature	27°C

The temperature change shall be adopted 20°C

5 COMBINATION OF LOADS

5.1 Construction Stage

During construction the following load combinations shall be investigated for ultimate limit state (Clause 5.9):

P + 1.15 (D + ER) [Lc.2]

P + 1.15 (D + ER) [Lc.2]

Where :

P = effects of prestressing including secondary time-dependent action.

D = dead load

ER = erection load

5.2 Serviceability Limit State

The combination of design loads and the corresponding verification classes for the design of the final system of the longitudinal girder and for the cross-section are given as follows.

5.2.1 Girder (longitudinal): Prestressed Concrete Member

	Load Combinations		Verification Class
1)	P + D + 1.2 (SD1 + SD2) + SH + CR + 1.2 HA	[Lc.1]	1
2)	PERMANENT LOADS + 1.1 x {HA + HB}	[Lc.1]	1
3)	PERMANENT LOADS + 1.1 x HB *	[Lc.1]	2

5.2.2 Girder (longitudinal): Reinforced concrete member

	Load Combinations		Design Crack Width
1)	P + D + 1.2 (SD1 + SD2) + SH + CR + 1.2 HA	[Lc.1]	W < 0.25
2)	PERMANENT LOADS + 1.1 x {HA + HB}	[Lc.1]	W < 0.25
3)	PERMANENT LOADS + 1.1 x HB *	[Lc.1]	W < 0.25

5.2.3 Cross beam (transverse): Prestressed Concrete Member

	Load Combinations		Verification Class
1)	Pt + D	[Lc.1]	1
2)	P + D + 1.0 SD1 + 1.2 SD2 + SH + CR + 1.0WL	[Lc.2]	2
3)	PERMANENT LOADS + HB + 1.0 WL	[Lc.2]	2
4)	PERMANENT LOADS + 1.1 HB	[Lc.1]	1
5)	PERMANENT LOADS + HB * + 1.0 WL	[Lc.2]	2

5.2.4 Slab (transverse): Reinforced concrete member

	Load Combination		Design Crack Width
1)	P + D + 1.0 SD1 + 1.2 SD2 + SH + CR	[Lc.1]	W < 0.15
2)	PERMANENT LOADS + HB	[Lc.1]	W < 0.15
3)	PERMANENT LOADS + SH + CR + 1.0 WL	[Lc.2]	W < 0.15
4)	PERMANENT LOADS + HB + 1.0 WL	[Lc.2]	W < 0.15

Where :

P = effects of prestressing including secondary and timedependent action
Pt = effect of prestressing force immediately after transfer before losses
D = dead load of structural section
SD1 = superimposed dead load except premix dead load
SD2 = premix dead load
SH = time-dependent effect due to shrinkage
CR = time-dependent effect due to creep
PERMANENT LOADS = Summary of P to CR above
HA = regular highway loading
HB = abnormal highway loading 30 units
HB * = abnormal highway loading 45 units
WL = wind load (transverse and vertical)
W = design crack width

Verification Classes in Accordance with BS 5400 Part 4, Clauses 4.1.1.1. and 6.3.2.4.

Class 1 - no tensile stress permitted except at transfer or during construction (1 N/mm^2)

Class 2 - no visible cracking however, tensile stress permitted in accordance with Table 24 (for grade 50 concrete maximum tensile stress 2.55 N/mm^2 for posttension and 3.2 N/mm^2 for pretension respectively.)

Maximum permissible compressive stresses according to Table 22 and 23 generally < 0.40 fcu (for grade 50 concrete 0.40 x 50 = 20 N/mm^2) at transfer.

5.3 Ultimate Limit State

The ultimate limit state calculations shall be executed for the load combinations presented below (individual design load effects to be increased by $\gamma 3$ = 1.10 in clause 4.2.3 except for P).

5.3.1 Girder (longitudinal)

Load Combination

1) P + 1.2D + 1.2SD1 + 1.75SD2 + SH + CR + 1.50 HA [Lc.1]
2) PERMANENT LOADS + 1.3 x (HA + HB) [Lc.1]
3) PERMANENT LOADS + 1.3 x HB* [Lc.1]

5.3.2 Slab and cross beam (Transverse) Prestressed Concrete Member

1) P + 1.2D + 1.2SD1 + 1.75SD2 + SH + CR + 1.30 HB [Lc.1]
2) PERMANENT LOADS + 1.30 HB* [Lc.1]

6 DETAILING

6.1 Concrete Cover to Reinforcement (BS5400, Part 4, Clause 5.8.2)

	Environmental	Nominal Cover
Girder (Grade 50) Slab (Grade 40)	Concrete surface exposed to driving rain; very severe	Not less than 50 mm Not less than 50 mm
Abutment ,Walls (40)	As above; very severe	Not less than 50 mm
Piers (Grade 40)	As above; very severe	Not less than 50 mm
Footing + Piles (Grade30)	Underwater structure: extreme Underground structure: extreme	Not less than 70 mm

6.2 Minimum Percentage of Main Reinforcement (cold worked steel bars) in members (BS 5400, Part 4, Clause 5.8.4 and 5.8.9).

Slabs and beams 0.15%
For Temperature As > Kr (Ac - 0.5Acor)

Where :
N = ultimate axial load
fy = characteristic strength of the reinforcement

DESIGN STANDARD AND DESIGN CRITERIA FOR SUBSTRUCTURE AND FOUNDATION

1. DESIGN CRITERIA

1.1 Types of Structures

The types of substructures and foundations selected (tentative) for the Study is as follows:-

Abutment : Inverted T wall type

Pier : Inverted T pier
Solid wall pier
Multiple column

Foundation : Pile foundation
- Prestressed concrete spun pile
- Bored cast-in-place pile

1.2 Properties of Material

(1) Concrete

Abutment and Piers

Concrete used	Grade 40
Modulus of elasticity	31 KN/mm^2

Bored cast-in-place pile

Concrete used	Grade 30 (Grade 25 for design)
Modulus of elasticity	28 KN/mm^2

(2) Reinforcement

Characteristic strength	Yield 460 (Deformed bars, type 2)
Modulus of elasticity	200 KN/mm^2
Stress-strain curve for design	BS5400 Part 4, Figure 4

(3) Prestressed concrete spun pile

PC Piles shall be adopted.

Concrete used	Grade 60

(4) Micropile

API Pile	Grade N80 (Yield 571 N/mm^2)
Anti-shirink cement grout	25N/mm^2 (Strength at 28 days)

1.3 Unit Weight of Material

Reinforced concrete	25.0 KN/m^3
Cover soil	19.0 KN/m^3
Water	10.0 KN/m^3

1.4 Load to be considered

The loads to be considered for the design of substructures and foundations shall comply with "DESIGN STANDARD AND DESIGN CRITERIA FOR SUPERSTRUCTURE". These loads shall be obtained from the design of superstructures. This clause specifies the loads which are not stated in the design criteria mentioned above.

1.4.1 Earth Pressure

The calculation of earth pressure working on the abutments shall be carried out in accordance with the JKR regulation. No consideration of the resistance by passive earth pressure working on the abutment shall be estimated.

(1) Constants of backfiring material

Unit weight	γ = 19 KN/m^2
Internal friction angle	ϕ = 30°
Cohesion	C = 0 KN/m^2
Internal friction angle at the back of wall	
for the design of wall of abutment	δ = 0°
for the verification of the safety of foundation	$\delta = \phi$ = 30°

(2) Live Load Surcharge

Intensity of surcharge load shall comply with clause 5.8.1.2 of BD37/88 as follows;

HA loading		: 10 KN/m^2
HB loading	45 units	: 20 KN/m^2
	30 units	: 12 KN/m^2

(3) γfL shall be taken in accordance with clause 5.8.1.1 of BD37/88.

(4) Effective earth pressure coefficient

Active earth pressure shall be adopted for the calculation of stability.

$$Pa = Ka * \gamma * Z * \sec \delta$$

where, Pa : Active earth pressure
Ka : Coefficient of active earth pressure(Coulom's earth pressure)
γ : Unit weight of soil
Z : Height of structure
δ : Internal friction angle

1.4.2 Vehicle Collision Load

Where the bridges over carriage way have piers, vehicle collision load shall be considered in accordance with proposed amendment to BD 37/88 Appendix A Clause 6.8 and 7.7.

1.4.3 Accidental Load due to Skidding

The accidental load due to Skidding shall be considered for the design of piers, acting in any direction on and parallel to, the surface of road in accordance with 6.11 of BD37/88.

1.4.4 Wind Load

The wind load to piers shall be considered for the design of pier in accordance with 5.3 of BD37/88. However, where the span length is less than 20m, the wind load can be ignored in accordance with Recommendation of L.A.Clark.

1.4.5 Effect of Stream Current and Floating Drift Wood

As this is not mentioned in BS, it is decided to use the formula given in JS. with necessary modifications to suit the conditions here.

1.5 Combination of Loads

The combinations of loads to be considered for the design of substructure and foundation shall comply with BD37/88 as mentioned below.

1.5.1 Serviceability Limit State

(1) Substructure : Reinforcement concrete member

	Load Combination		Design Crack Width
1)	D + 1.0 SD1 + 1.2 SD2 + γ_{fL} * LL + EP	[Lc.1]	W<0.25
2)	D + 1.0 SD1 + 1.2 SD2 + EP + TC	[Lc.3]	
3)	D + 1.0 SD1 + 1.2 SD2 + γ_{fL} * LL + TC	[Lc.3]	
4)	D + 1.0 SD1 + 1.2 SD2 + γ_{fL} * LL + WL +TP	[Lc.2]	
5)	D + 1.0 SD1 + 1.2 SD2 + γ_{fL} * SK + TP	[Lc.4]	
6)	D + 1.0 SD1 + 1.2 SD2 + LONGITUDINAL FORCE	[Lc.4]	

(2) **Foundation : (for Stability)**

Load Combination(: Nominal Load)

1) D + (SD1 + SD2) + LL + EP
2) D + (SD1 + SD2) + EP + TC
3) D + (SD1 + SD2) + LL + TC
4) D + (SD1 + SD2) + LL + WL +TP
5) D + (SD1 + SD2) + SK + TP
6) D + (SD1 + SD2) + LONGITUDINAL FORCE

1.5.2 Ultimate Limit State

The ultimate limit state investigations are executed for the structural design only (for serviceability of foundation the necessary safety margins are included in the investigations of the serviceability limit state).

Substructure : Reinforcement concrete member

Load Combination

1)	1.2 D + 1.2 SD1 + 1.75 SD2 + γ_{fL} * LL + 1.5(1.2) EP	[Lc.1]
2)	1.2 D + 1.2 SD1 + 1.75 SD2 + 1.5(1.2) EP + 1.3TC	[Lc.3]
3)	1.2 D + 1.2 SD1 + 1.75 SD2 + γ_{fL} * LL + 1.5(1.2) EP+ 1.3 TC	[Lc.3]
4)	1.2 D + 1.2 SD1 + 1.75 SD2 + γ_{fL} * LL + 1.1 WL +TP	[Lc.2]
5)	1.2 D + 1.2 SD1 + 1.75 SD2 + 1.25 SK + TP	[Lc.4]
6)	1.2 D + 1.2 SD1 + 1.75 SD2 + LONGITUDINAL FORCE	[Lc.4]
7)	1.2 D + 1.2 SD1 + 1.75 SD2 + 1.5(1.2) EP + 1.25 VCL	[Lc.4]

Where

D = dead load of structural section
SD1 = superimposed dead load except premix dead load
SD2 = premix dead load
LL = live load
γ_{fL} = load factor (in accordance with Table 1 in the BD37/88)
EP = Earth pressure - abutments only (1.5 for non-vertical load and 1.2 for vertical load
TC = temperature change
WL = wind load(transverse and vertical)
SK = skidding
TP = tidal pressure
LONGITUDINAL FORCE = traction or breaking force
W = design crack width
VCL = vehicle collision load at bridge parapets and associated primary load

1.6 Stability Analysis of Foundation

1.6.1 Stability analysis for spread foundation

(1) Design Method

The stability analysis of spread foundation shall be calculated in accordance with BS8004.

The verification of stability of spread foundation have to be considered on the following matters;

1) Allowable bearing value
2) The position of the vertical force
3) Over turning
4) Sliding

(1) Allowable bearing value

The bearing pressure at the bottom of footing does not exceed the allowable bearing value of the ground (nominal load).

(2) Position of vertical force

The position of the vertical force should be within 1/6 of the breadth of footing (nominal load).

(3) Over turning

The stability of the structure and its part against overturning shall be considered in accordance with 4.6 of BS5400.

$$Mr/Mo > 1$$

Where, Mr: Restoring Moment (nominal load)
Mo: Overturning Moment (ultimate limit state)

(4) Sliding

The sliding shall be considered in accordance with 2.3.2.4.7 of BS8400.

$$V/Pv + H/Ph < 1$$

1.6.2 Stability analysis for piled foundation

(1) Design method

The BS5400 and BS8004 do not give specific design method for analysis for pile foundation. The displacement method which is commonly used in Japan will be adopted.

The verification of stability of pile foundation have to be considered on the following matters;

1) Axial compressive force at the pile head due to external forces does not exceed the allowable axial compressive bearing capacity of pile.

2) Axial pull-out force at the pile head due to external forces is not allowed on nominal loads

3) Horizontal displacement does not exceed 15mm at the design ground surface.

The verification of the stability shall be carried out on Serviceability Limit State, nominal loads (taking γ fL = 1.0 and γ f3 = 1.0), in accordance with 4.7.1 of BS8004.

(1) Bearing capacity of a pile

1) Ultimate bearing capacity of a pile

The ultimate bearing capacity of a pile shall basically be calculated in accordance with clause 7.5.3 of BS8004.

$$Qu = f\,As + Ab\,q$$

2) Allowable bearing capacity of a pile

As the BS does not give the actual procedure to obtain bearing capacity of a pile, the formula given in JS shall be adopted with necessary modification to suit the soil condition here.

3) Negative skin friction power

Negative skin friction power shall be considered to prevent damage to the pile and ensure the power function of the structure. The consideration shall be given by using JS with modification.

- stress in the pile
- bearing capacity of a pile

(2) Structural design of pile

The BS does not gives specific design of piles. However, the forces acting on piles have beam assessed, the piles can be designed as column in accordance with 5.5 of BS5400.

No consideration of the effect of buckling shall be given to the design of a pile under the serviceability limit state. Under the ultimate limit state, the effect of buckling should be considered on the slender column.

1.7 Structural Design of Substructure

1.7.1 Pile cap

The structural design of pile cap shall be carried out in accordance with 5.7.3 of BS5400. Bending moment theory shall be applied for the structural design of pile cap.

1.7.2 Wall of abutment

The wall of abutment should be treated as cantilever slab and designed in accordance with 5.4 of BS5400.

1.7.3 Wall of pier

Where the ultimate axial load is less than 0.1 fcu Ac, the wall should be treated as cantilever slab and designed in accordance with 5.4 of BS5400. In other cases, 5.6 of BS5400 applies.

1.7.4 Column of pier

The column of pier should be designed in accordance with 5.5 of BS5400.

1.7.5 Beam on top of pier

The beam should be designed in accordance with 5.3 of BS5400.

1.7.6 Parapet wall of abutment

The parapet wall of abutment should be treated as cantilever slab and designed in accordance with 5.4 of BS5400.

The actual procedures to obtain the sectional forces at critical section is not described in BS5400. Therefore, these forces shall be calculated in accordance with JS with modification.

1.7.6 Wing wall

The wing wall of abutment should be treated as cantilever slab and designed in accordance with 5.4 of BS5400.

The actual procedure to obtain sectional forces at considering section of wing is not described in BS 5400. Therefore, the forces shall be calculate in accordance with JS with modification.

APPENDIX G

GEOLOGICAL STUDY

Geological Study

Topographical condition is one of the major factor on planning of bridges. It is concerning to length, height of structure, geometric design, crossing and so on. Geological condition is needless to say closely related to foundation design. Here, based on the existing topographical and geological data collected and studied, summary of the general information and typical conditions is presented.

(1) General Geography

Malaysia is located just north of the equator. The country can be divided into two different areas. West Malaysia i.e. Peninsular Malaysia and East Malaysia which comprises of northern part of the island of Borneo. The total land area is around 33,000 km2 and over 70% of the land is forested.

The distance of Peninsular Malaysia from north to south is 700 km and west to east is 300 km (at it widest). Topographically the land is mountainous and mountains are ranging from northern to the southern regions. The highest peak in Peninsular is Mt. Tahan with an elevation of 2178 m and is located at the bordering States of Kelantan and Pahang. There are many rivers as well and they play an important role in inland transportation.

Delta is formed near the seaside by deposits from the river and they caused mangrove swamps as found on the west coast, along the Straits of Malacca. Densely populated and industrial areas are found in the west coast. In the east coast however, ocean currents from South China Sea bring sand and dune (sand hill) is formed along the sea side.

The coastal areas of Sabah and Sarawak (East Malaysia) are low lying and most are covered with swamps. The inland terrain is generally hilly and often mountainous. Mt. Kinabalu in Sabah rises to 4100 m and is the highest mountain in Malaysia.

Fig.3.1 shows a topographical map of Malaysia

(2) Geology

1) Peninsula Malaysia

The Malay Peninsula forms the continuation of a series of mountain ranges extending from eastern Burma southward into Thailand. Almost half of the total surface area of the Peninsula consists of granite which forms the Main Range as well as lesser ridges.
The granite is believed to be mainly of the Triassic Age, and during it emplacement the older sedimentary rocks into which it was intruded folded and buckled into the ranges that make up the present topography of the Peninsula.

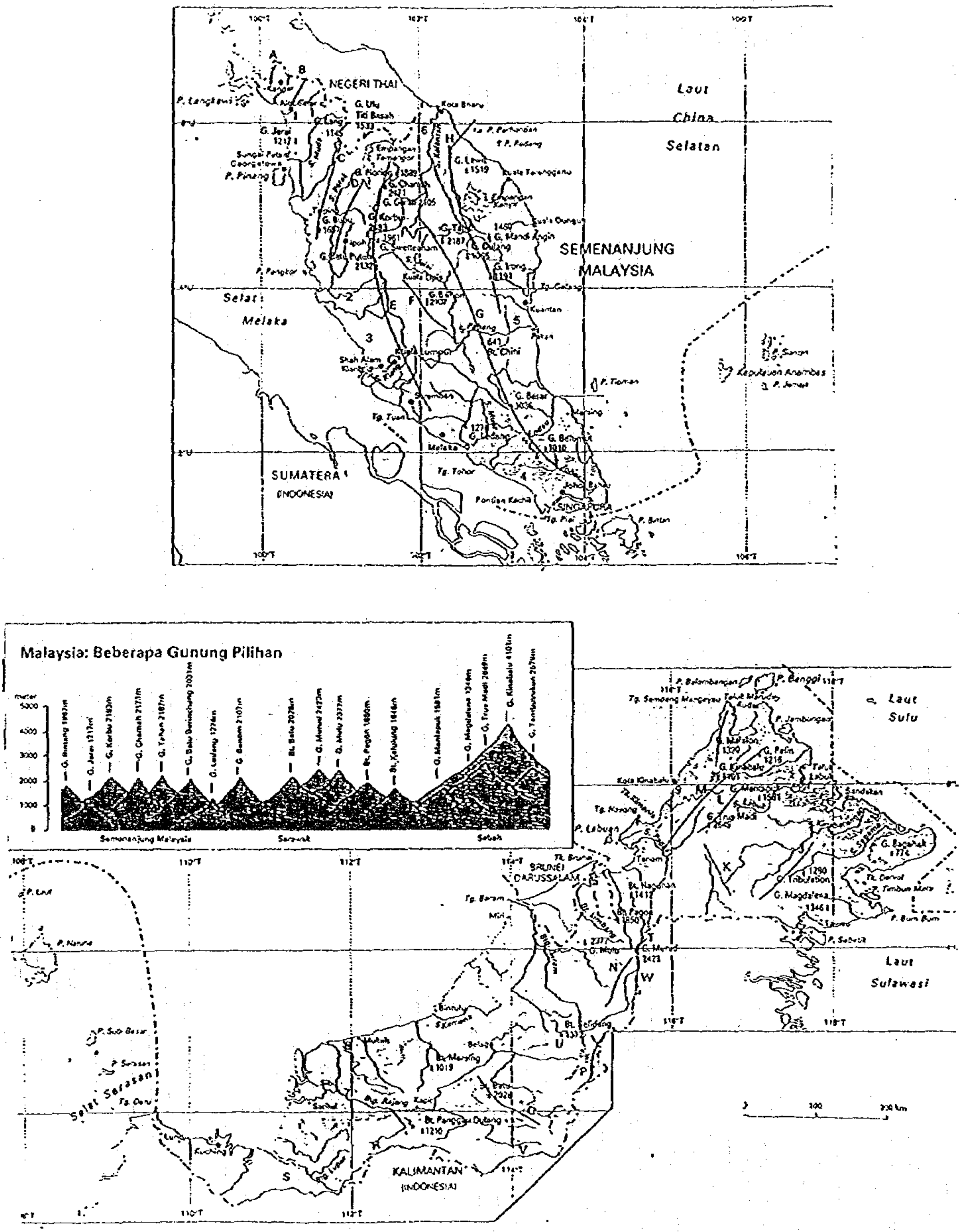


Fig.3.1 Topographical Map of Malaysia

In many periods of the geological past, it was covered by the sea. The oldest rocks of the sedimentary succession are a series of predominantly calcareous rocks (limestone), to the Ordovician and Silurian Ages. The bulk of the Peninsula's sedimentary rock groups are found most extensively in Pahang and Kelantan, with extensions into the surrounding states.

Most outstanding sedimentary rocks could be shown Malaysia is limestone. Vertical-sided limestone hills near Kuala Lumpur (Batu Caves) and Bukit Takun in the Kinta Valley near Ipoh are famous.

Another series of sedimentary rocks, the Gagau Group, consisting chiefly of sandstones, is present in the eastern portion of the Peninsula.

The youngest formations in the Peninsula are extensive tracts of Quaternary sand and clay found in river valleys and coastal plains. These alluvial deposits are not consolidated and are formed by the erosion of the older rocks over long periods of time by rivers and the sea. In many places in the Peninsula, the alluvium contains valuable concentrations of tin ore.

2) Sabah and Sarawak

In Sabah, the Crocker Range and the adjoining mountain ranges are a continuation of the Tertiary fold mountains of Sarawak, Brunei and central Kalimantan. These have a dominant NNE-trend, with a sharp twist to an ESE trend in the Kinabalu and S. Sugut area. To the east, the dominant structures of the sediments give an easterly trend and appear to be genetically related to the structure of the Sulu Archipelago.

Underlying more than nine-tenths of Sabah are sedimentary rocks, mainly shale, sandstone, chart and limestone ranging in age from Late Cretaceous to Quaternary.

Basaltic lava's and pyroclastic rocks are particularly well developed in the Segama Valley, the Kota Belud area, and on Banggi and Balambangan Islands. Hot springs, however, are the only remaining active feature of volcanic activity.

Practically all the intrusive igneous rocks in North Borneo occur in a broad discontinuous belt extending north westwards through the interior of the country from the Sempoma Peninsular and Darvel Bay to the Mount Kinabalu area, and then northwards to include the Marudu Bay area and the northern islands. Ultra basic rocks, which occupy about 1420 sq. km, occur in the Segama Valley, Labuk Valley and Mount Kinabalu area.

Gabbroic and dioritic intrusive rocks of Lower Tertiary age are best developed in the Segama Valley and Darvel Bay area, where they are closely associated with the ultra basic intrusions. Granite rock, forming the large intrusions of Mount Kinabalu and minor granitic intrusions also occur in the Lubuk and Segama River areas and in the Semporna Peninsular.

In Sarawak, the oldest formations go back only some 300 million years, and so barely one-sixth of the world's recorded geological history is represented here. The most ancient rocks in Borneo are in the west where the Sunda Shelf, a partly submerged extension of continental Asia, builds part of the island. Paleozoic sediments occur, but rocks of the Mesozoic and Tertiary Ages predominate.

Fig.3.2 and Fig.3.3 shows geological map of Peninsular Malaysia and Sabah and Sarawak respectively.

(3) Some topographical and geological observation on site

- Along R1 KL to Penang there are many limestone hills. Limestone surface beneath the ground is irregular and it causes difficulty in stabilizing foundations.

- Along R5 KL to Johor, went through swampy area. Peat soil is deeply deposited and many approach slabs behind bridge abutments are sinking.

- Along R2 KL to Kuantan (east coast), the road waved the skirts of mountains. Geometric condition is harsh.

- Along R3 KL to Kota Bahru route is very close to sea on sandy soils. These areas are noted for flood during rainy season with deep soft soil deposited.

- In Sabah and Sarawak south east part is a mountainous and forestry area. Main road is through along north west coastal area.

(4) Typical soil conditions

Typical soil conditions to be considered are as follows:-

- Soft ground
- Limestone area
- Acid soil
- Earthquake

(a) Soft ground

Along the seaside, marine clay, peat and loose sand are deposited. The depth of alluvium deposits is deeper than in the east coast where some places reached to over 100 m. Many big cities and towns are developing along the seaside and main road also located here.
(Refer Fig.3.4-Note on Geotechnics of JKR)

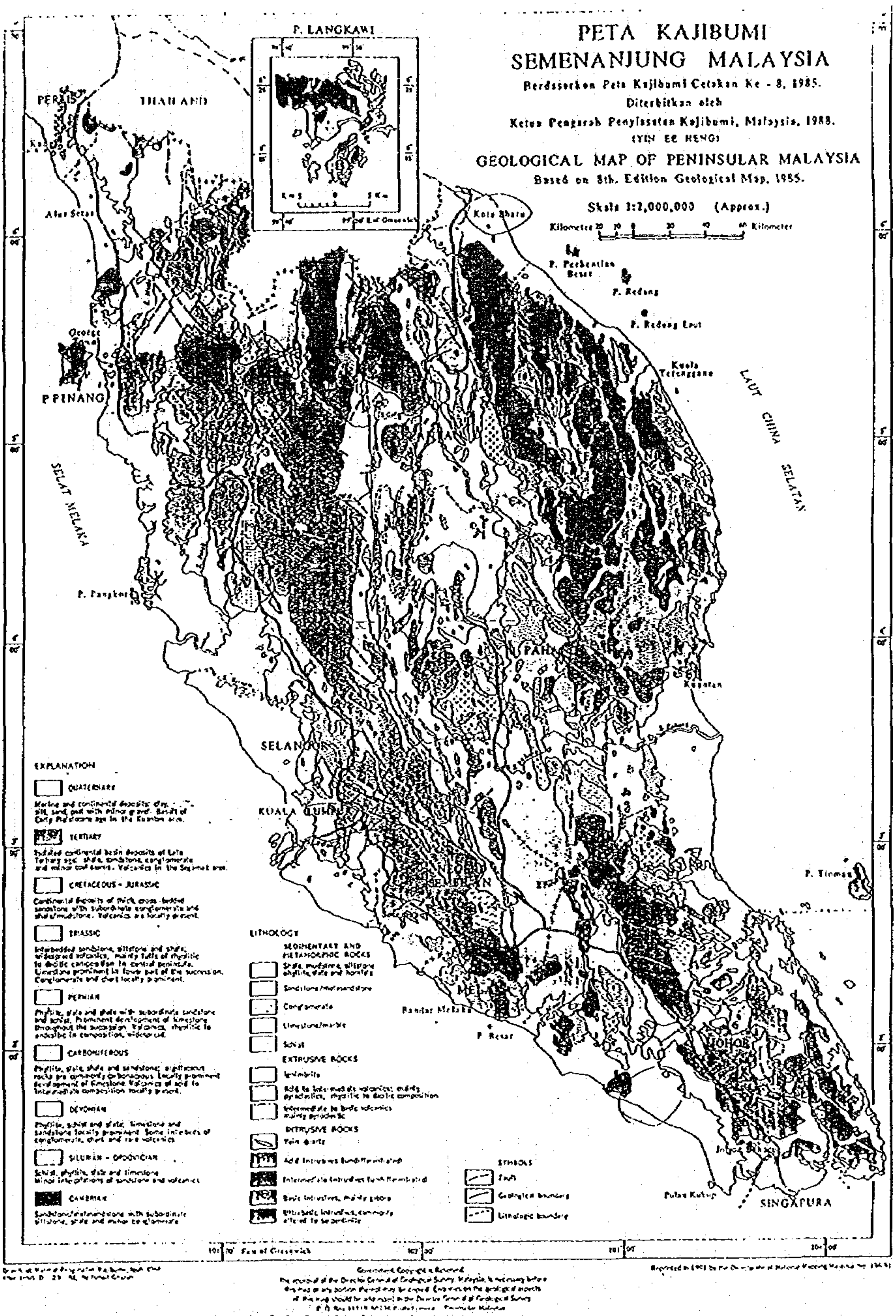


Fig.3.2 Geological Map of Peninsular Malaysia

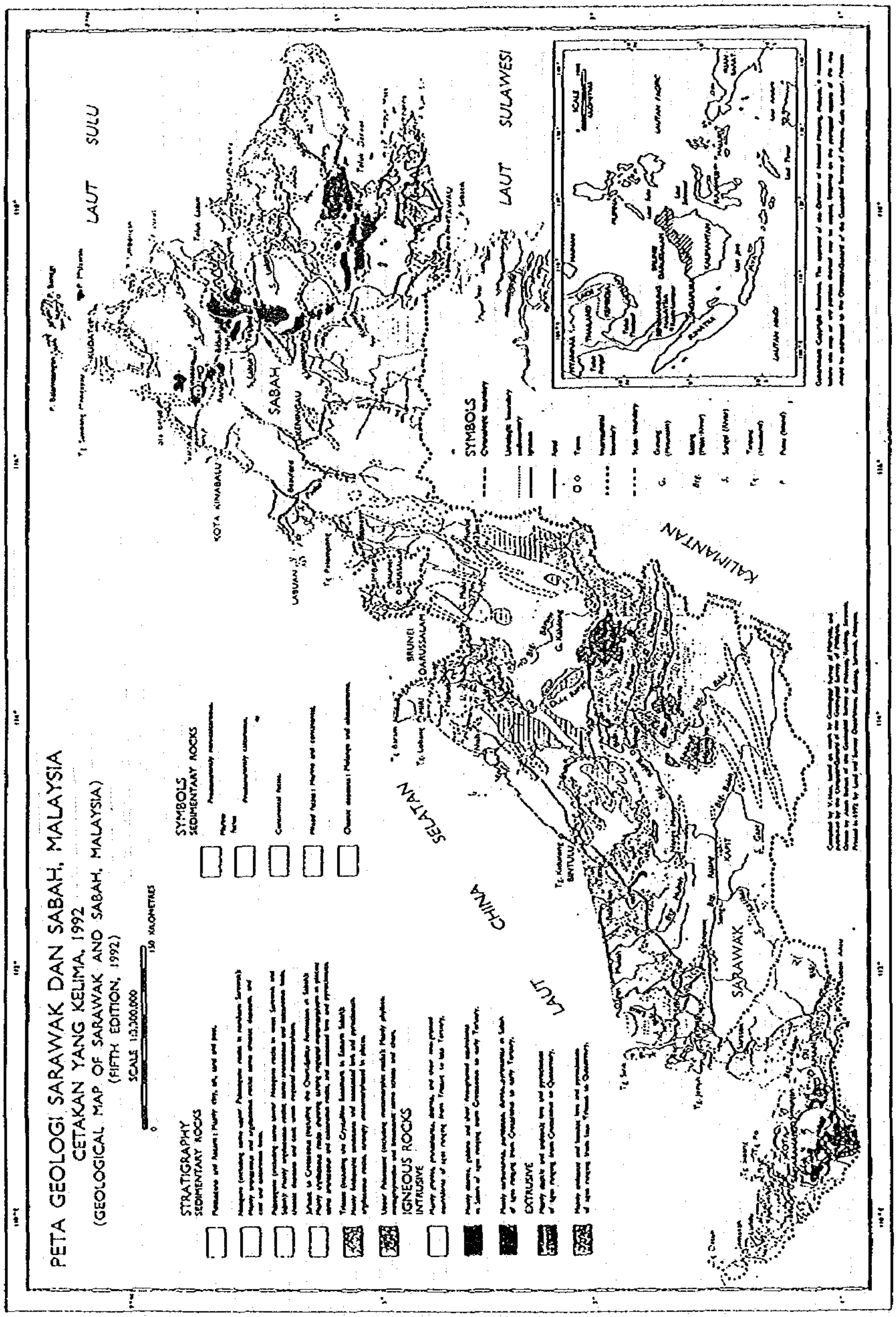


Fig.3.3 Geological Map of Sabah and Sarawak - Malaysia

(b) Limestone

Limestone contains a lot of caves and cavities in its body. Their locations vary and sometimes caused difficult foundation problem. The features are characterized by sights of cliff, overhang, pinnacle, floater, cavity, collapsed cavity and sinkhole.
(Refer Fig.3.5-Note on Geotechnics of JKR)

(c) Acid soil

Laterite is broadly distributed over the Peninsular and it is a soil residue composed of secondary oxides of iron and aluminium. Laterite contains acids and sometimes affects the concrete structure on foundation.

The effect of acid soil was tested at some bridge sites during the study of "Maintenance and Rehabilitation of Bridges in Malaysia" (JICA 1992). In the report some PH values and sulphate contents are reported.

As the conclusion of the Maintenance and Rehabilitation study, it is reported that the chemical attacks on concrete at bridge sites are not due to sulphates as originally anticipated, but more likely to be caused by acids. As a precautionary measure, it is usually satisfactory to adopt a good quality rich mix of Ordinary Portland Cement to create a well compacted low permeability concrete.

(d) Earthquake

Earthquakes occur in Sumatra, west of Peninsular and the Philippines, east of Kalimantan. Topographically these areas are unstable but fortunately most areas in Malaysia are earthquake free though some slight tremours are reported in Penang, Singapore and East Malaysia. The only seismic effects taken into consideration was during the design of Penang bridge.

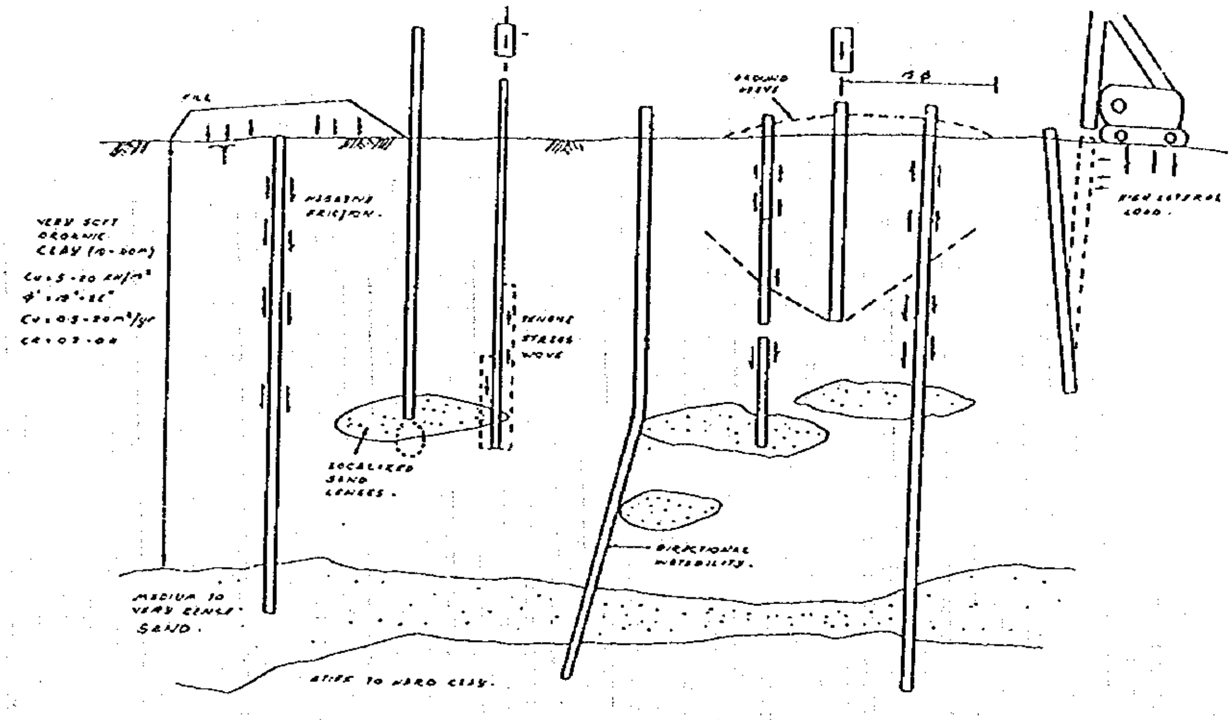


Fig.3.4 Piling Problems in Soft Ground

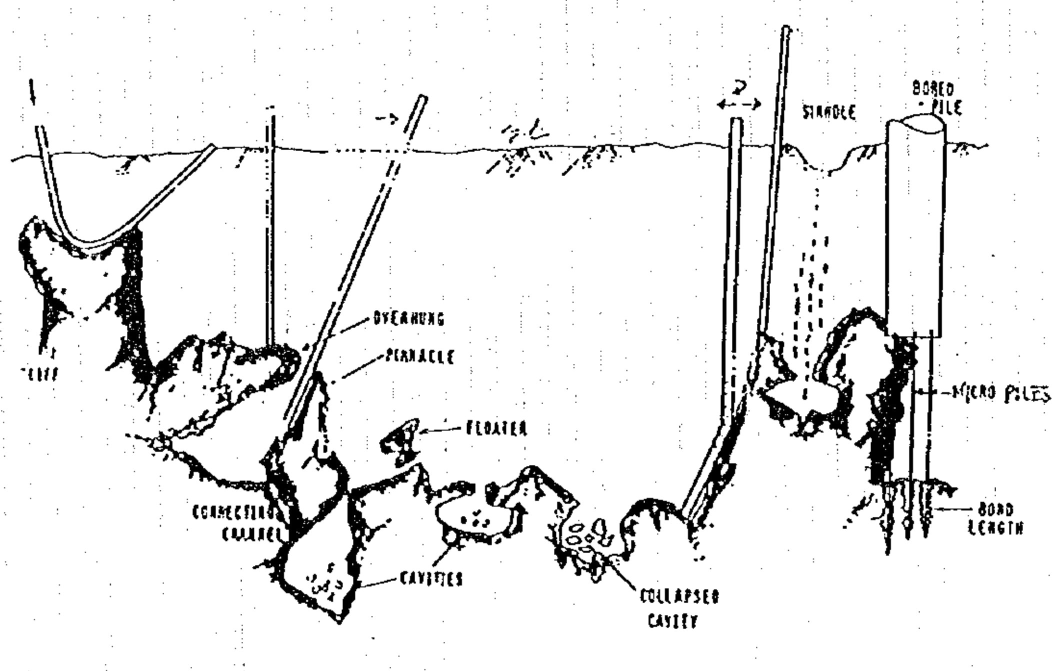


Fig.3.5 Piling Problems in Limestone Areas

APPENDIX H

THE RESULT OF COMPARATIVE STUDY

Table H.1 COMPARATIVE STUDY (for 5 - 10 m span)

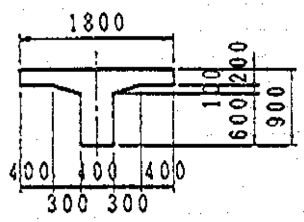
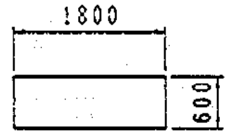
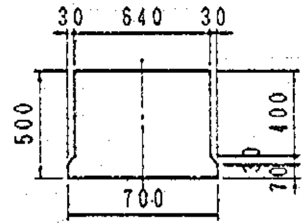
Types of superstructure	Reinforced monolithic concrete slab & T beam	Reinforced concrete solid slab	Pretensioned concrete solid slab
Beam cross section			
Preliminary cost and economical view point	42,000 RM (380 RM/m2)	45,400 RM (400 RM/m2)	82,900 RM (740 RM/m2)
Structural view point	- Can use Reinforced concrete bridge type - Effective stiffness for bending moment can be obtained	- Can use Reinforced concrete bridge type - Level slab thickness can be obtained	- Lower beam height can be obtained
Construction difficulties	- Able to execute cast in situ easily - More difficult to manufacture beams due to complicated external shape than reinforced concrete solid slab	- Able to execute cast in situ easily - Easier to manufacture beams due to simple external shape	-Able to control higher quality due to manufacture in a factory -Easier to construct as cast in situ is required only at filling area and catilever slab - Pretensioned beams can be used without scaffolding - Girder manufacturing facilities can be utilized commonly as pretensioned concrete hollow slab
Maintenance and Rehabilitation view point	Free maintenance	Free maintenance	Free maintenance
Comprehensivity	Good	Excellent This bridge type shall be adopted where it is possible to be constructed by scaffolding for a shorter span	Excellent This bridge type shall be adopted where it is impossible to be constructed by scaffolding for a shorter span

Table H.2 COMPARATIVE STUDY (for 10 - 25 m span)

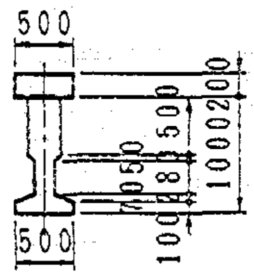
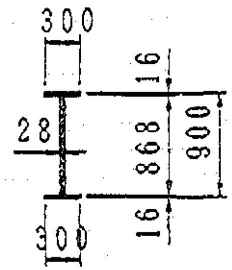
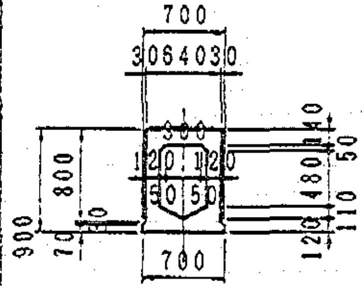
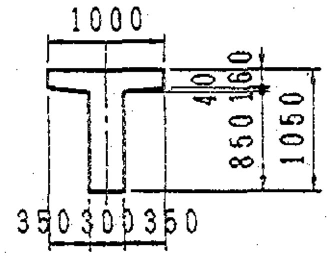
Types of superstructure	Pretensioned Inverted T beam	Steel I beam	Pretensioned concrete hollow slab	Pretensioned concrete T beam
Beam cross section				
Preliminary cost and economical view point	343,200 RM (1,360 RM/m2)		237,800 RM (940 RM/m2)	224,300 RM (890 RM/m2)
Structural view point	- Prestressing force cannot perform more effectively due to location of lower centroid		- Prestressing force can perform more effectively due to location of centralized centroid	- Prestressing force can perform more effectively due to location of upper centroid
Construction difficulties	- Able to control high quality due to manufacture in a factory - More difficult to construct a deck slab cast in situ due to need formwork for a bottom of it		- Able to control higher quality due to manufacture in a factory - Easier to construct due to cast in situ which is only required at filling area and cantilever slab - Girder manufacture facilities can be utilized commonly as pretensioned concrete solid slab	- Able to control higher quality due to manufacture in a factory - Easier to manufacture beams due simple external shape
Maintenance and Rehabilitation view point	Free maintenance	- Anti-corrosion treatment and re-paint work is necessary	Freee maintenance	Free maintenance
Comprehensivity	Good	Fair	Excellent	Excellent

Table H.3 COMPARATIVE STUDY (for 25 - 35 m span)

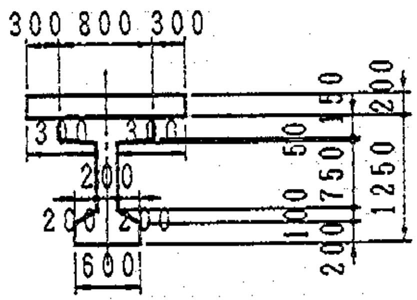
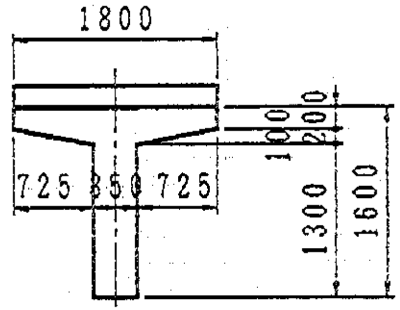
Types of superstructure	Posttensioned live load composite I beam	Posttensioned live load composite T beam
Beam cross section		
Preliminary cost and economical view point	287,100 RM (732 RM/m2)	275,600 RM (703 RM/m2)
Structural view point	- Prestressing force cannot perform more effectively dc to location of lower centroid	- Prestressing force can perform more effectively due to location of upper centroid
Construction difficulties	- More difficult to manufacture beams due to complicated external shape - More difficult to construct a deck slab (cast in situ) due to need of formwork for a bottom of it	- Easier to manufacture and high quality control due to simplification of external shape by removing a lower flange - Easier to construct due to cast in situ required only at filling area and cantilever slab - Simple external shape to ease construction works (i.e.concrete work, formwork, arrangement of reinforcement and PC tendons etc)
Maintenance and Rehabilitation view point	Free maintenance	Free maintenance
Comprehensivity	Good	Eecellent

Table H.4 COMPARATIVE STUDY (for 35 - 45 m span)

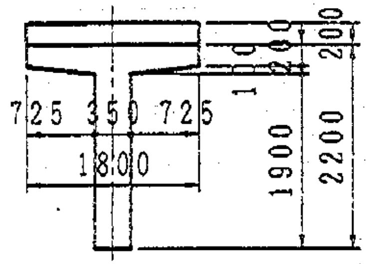
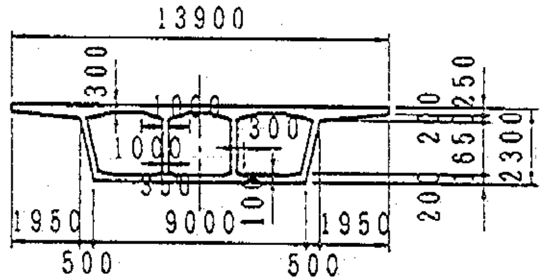
Types of superstructure	Posttensioned live load composite T beam	Prestressed concrete box girder
Beam cross section		
Preliminary cost and economical view point	534,300 RM (1,000 RM/m2)	552,600 RM (1,040 RM/m2)
Structural view point	- Prestressing force can perform more effectively due to location of upper centroid - Easier to utilize continuous girder connected only slab	- Able to resist compressive stress caused by bending moment - Possibility of arrangement of many PC tendon loads to more effective prestressing force - Able to dstribute effectively for live loading due to higher torsional stiffness
Construction difficulties	- Easier to manufacture and high quality control due to simplification of external shape by removing a lower flange - Easier to construct due to cast in situ required only at filling area and cantilever slab - Simple external shape load to ease construction works (i.e. concrete work, formwork, arrangement of reinforcement and PC tendons etc) - Sufficient attention for stability of beam is necessary due to heavier beam weight in the erection stage	- More difficult to construct a cast in situ box beam due to complicated sectional shape, especially for inner formwork and concrete work - Large sized scaffolding is necessary - More difficult to construct bridges for river
Maintenance and Rehabilitation view point	Free Maintenance	Free Maintenance
Comprehensivity	Excellent	Good

Table H.5 COMPARATIVE STUDY (for 45 m span)

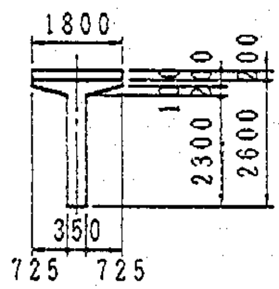
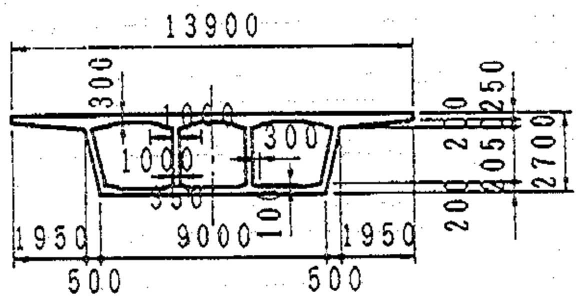
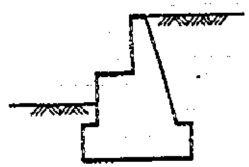
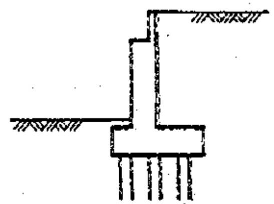
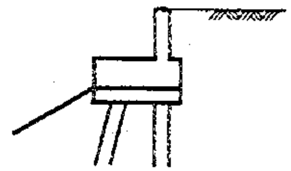
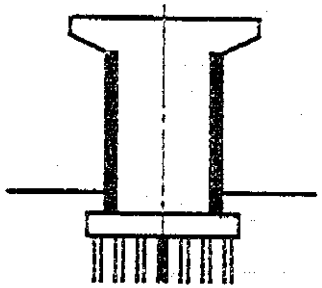
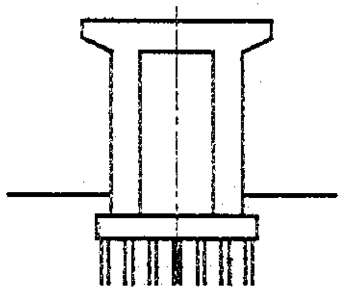
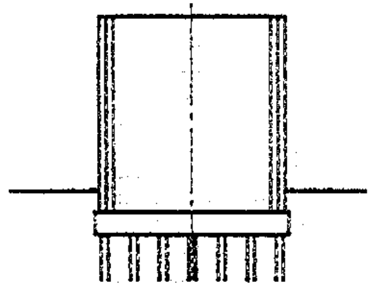
Types of superstructure	Posttensioned live load composite T beam	Prestressed concrete box girder
Beam cross section		
Preliminary cost and economical view point	703,300 RM (1,120 RM/m2)	716,200 RM (1,140 RM/m2)
Structural view point	- Prestressing force can perform more effectively due to location of upper centroid - Easier to utilize continuous girder connected only slab	- Able to resist compressive stress caused by bending moment - Possibility of arrangement of many PC tendon loads to more effective prestressing force - Able to distribute effectively for live loading due to higher torsional stiffness
Construction difficulties	- Easier to manufacture and high quality control de to simplification of external shape by removing a lower flange - Easier to construct due to cast in situ required only at filling area and cantilever slab - Simple external shape load to easier construction works (i.e. concrete work, formwork, arrangement of reinforcement and PC tendons) - Sufficient attention due to heavier beam weight is necessary for stability of beam in the erection stage	- More difficult to construct a cast in situ box beam due to complicated sectional shape, especially for inner formwork and concrete work - Large sized scaffolding is necessary - More difficult to construct bridges for river
Maintenance and Rehabilitation view point	Free maintenance	Free maintenance
Comprehensivity	Excellent	Good

Table H.6 Comparison for Types of Abutment

	Proposed 1 Gravity Abutment	Proposal 2 Inverted T Abutment	Proposal 3 Bank Seat Abutment
Sketch	 H = 2 m - 4 m	 H = 6 m - 10 m	 H = 2 m - 3 m
Maintenance	E Low maintenance cost	E Low maintenance cost	F High maintenance cost due to erosion and scouring
Construction	E Simple form of construction	E Easier than other RC structures such as Counterfort or cellular abutment	E Simple form of construction
River Control	E Enough buried depth of footing	E Enough buried depth of footing	F Erosion or local scouring occur
Structural Characteristics	G Cracks occur due to mass concrete	E OK	F Settlement or horizontal movement occur where the ground is not strong enough
Usage in Malaysia	F Seldom	E Most common	E Common
Decision	F Usage is seldom	E Best type for typical design	F Recommended not to be used

Ranking E:Excelent G:Good F:Fair

Table H.7 Comparison for Types of Piers

	Proposed 1 Inverted T Pier	Proposal 2 Multiple Column Pier	Proposal 3 Solid Wall Pier
Sketch			
Maintenance	G Crack might occure due to shear forces at the cantilever beam	G Cracks might occur due to shear forces at the cross head	E Low maintenance cost
Construction	G Complicated form work and construction relatively slow	F Most complicated form works and rreinforcement make construction is not fast.	E Most simple form of construction
River Control	E Ellipse section pier mitigate the erosion	F Multiple column occur erosion.	E Ellipse section pier mitigate the erosion
Structural Characteristics	F Reactiom from superstructure is transferred to the foundation through bending moment is not preferable.	F Reaction from superstructure is transfered to the foundation through bending moment is not preferable	E Reaction from superstructure can be transderred to foundation directory.
Usage in Malaysia	E Common	E Commonly used where the bridges cross roads	E Common
Decision	E Estetically excellent and popular type in urban area Recommended to be used	E Commonlly used for over bridge piers and is suitable for typical design	F Recommended not to be used

Ranking E:Excelent G:Good F:Fair

Table H.8 Chart for Selection of Types of Piled Foundation

Condition of Selection	Driving Pile			Bore Pile	
	RC Pile	PC Pile	Steel Pipe Pile	Cast-in-sit	Micropile
Soil Condition:					
Very soft soil	A	A	A	A	A
Hard intermediate soil	NA	C	A	A	A
Depth upto bearing stratu	5 - 15m	5 - 40m	5 - 60m	5 - 40m	5 - 15m
Structural Characteristics:					
Small vertical load (Span length < 20 m)	A	A	A	A	A
Medium vertical load (Span length 20 - 50 m)	NA	A	A	A	A
Large vertical load (Span length > 50 m)	NA	C	A	A	NA
Small lateral load	A	A	A	A	C
Large lateral load	NA	C	A	A	NA
End bearing	A	A	A	A	A
Friction bearing	A	A	A	A	A
Environment Circumstances:					
Low vibration/noise	NA	A	C*	A	NA
Construction:					
Diameter of pile	0.25 - 0.4m	0.3 - 1.0m	0.3 - 1.0m	0.8 - 1.5m	0.25 - 0.3m
Procurement of pile	Local	Local	Imported	Local	Local
Decision	It is recommended that the PC pile should be selected for typical design of substructui				

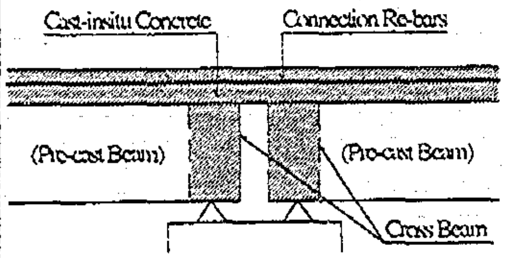
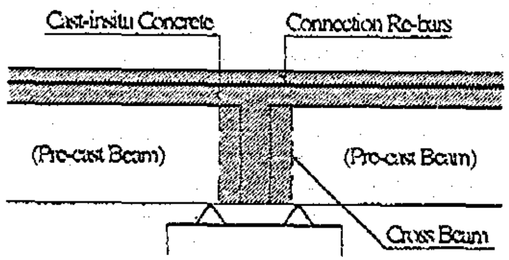
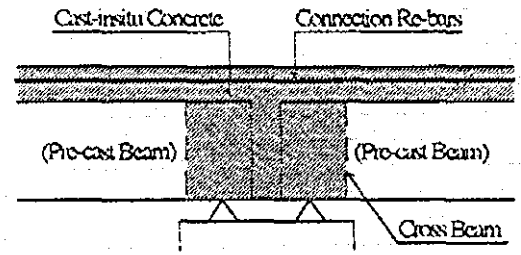
NOTE * : Applicable if hydrolic hummer is adapted.

Ranking A: Applicable, C: Considerable, NA: Not Applicable

APPENDIX I

STRUCTURAL DETAILS OF CONTINUOUS GIRDER

Table I.1 Comparison of Beam-Coupling Method

Method	 (1) Slab only connected with individual cross-beams	 (2) Both slab and beam connected with a common cross-beam	 (3) Both slab and beam connected with a common wide cross-beam
Structural Continuity	• Actually not continuous	•Continuous for post-composite dead load and live load	• Continuous for post-composite dead load and live load
Design	• Easy treating as simple beam	• Complex requiring additional stress check due to creep, shrinkage and pier settlement as continuous beam	• ditto to the left
Construction	• Easy and conventional	• Economical but insufficient space for lower reinforcement against shrinkage and settle-ment shrinkage	• Least economical and most laborous but reliable for sufficient reinforcement
Attention to Application	• Unavoidable of large cracks on slab at joint	•When use pre-tension beam with straight tendons, lower compressive stress may increase excessively	• Ditto to the left
Freeway of Application	• Often applied in Malaysia	• Recently started to apply on trial in Malaysia	• Beam-coupling standard in Japan
Recommendation	Method (1) is recommended, considering most of the past and present practice in Malaysia and taking account of simplicity and not much affection of slab cracks to beams		

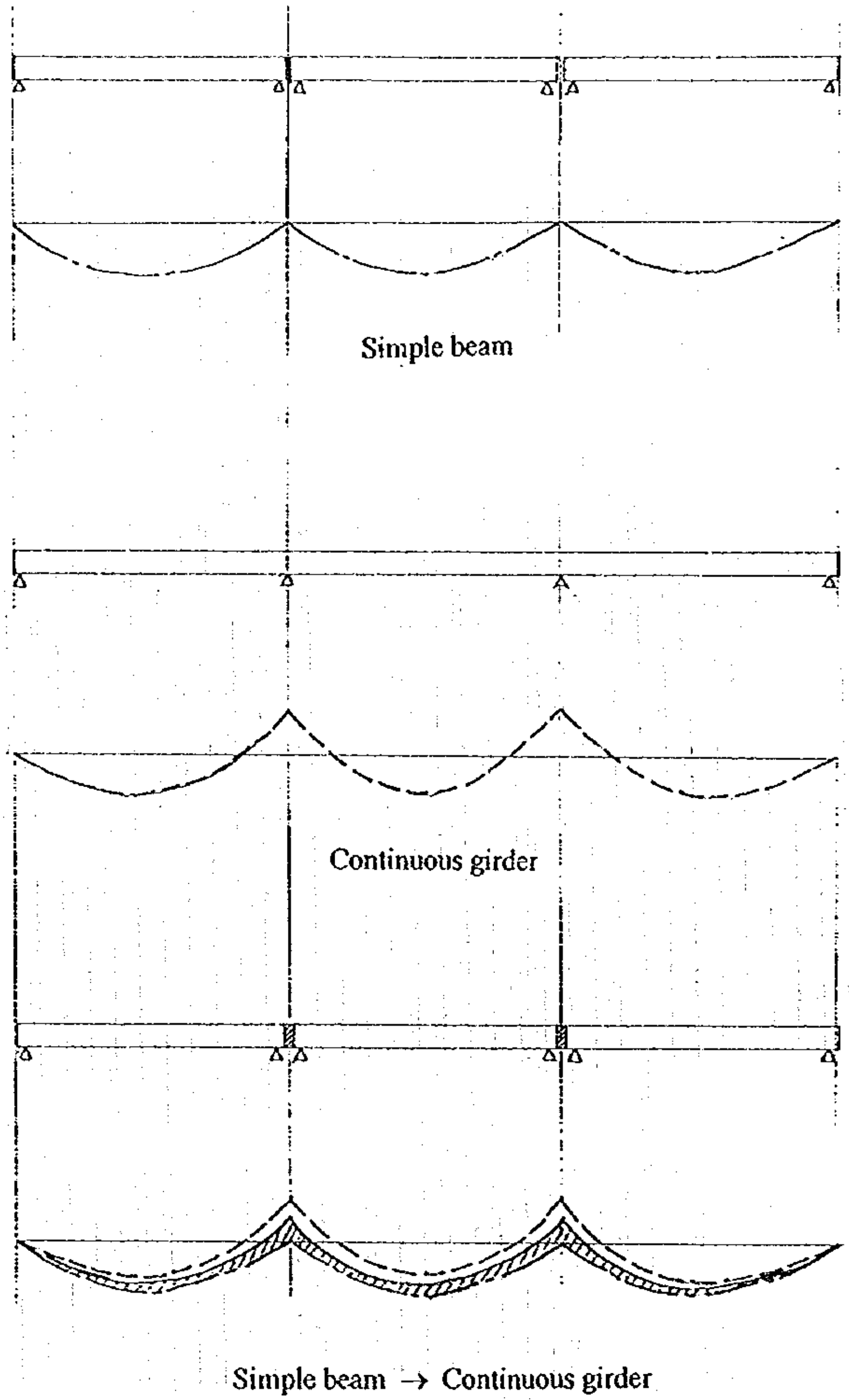


Fig. I.1 Statically indeterminate force due to creep and shrinkage

APPENDIX J

MINUTES OF MEETINGS ON THE INTERIM REPORT (1)

MINUTES OF MEETING

ON THE INTERIM REPORT (1) FOR

THE STUDY ON

THE STANDARDIZATION OF BRIDGE DESIGN

IN MALAYSIA

AGREED UPON BETWEEN

PUBLIC WORKS DEPARTMENT

ON BEHALF OF

THE GOVERMENT OF MALAYSIA

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

KUALA LUMPUR, 1 JUNE 1995

2/6/95

DATO' IR CHUA SOON POH
DIRECTOR OF ROADS BRANCH
PUBLIC WORKS DEPARTMENT
ON BEHALF OF
THE GOVERMENT OF MALAYSIA

MR. ISAMU HISADA
TEAM LEADER
STUDY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Witness

2/6/95

MR. SHAHARUZZAMAN ABDUL RAHMAN
ASST. SECRETARY (TECHNICAL)
MINISTRY OF WORKS
ON BEHALF OF
THE GOVERMENT OF MALAYSIA

Witness

猪熊 康夫

MR. YASUO INOKUMA
ADVISORY COMMITTEE
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

JICA Study Team submitted the Interim Report (1) of the Study on the Standardization of Bridge Design in Malaysia to the Public Works Department (JKR) on 2 May 1995.

Technical Committe and Steering Committee meetings were held on 30 May 1995 and the 1 June 1995 respectively. The Malaysian and the Japanese sides discussed and confirmed the following:

1. Progress Report of the Study.
   The Study Team informed the Technical and Steering Committee of the current progress of the Study. The phases of the Study which had been completed include Phase 1 (Data Collection and Survey), Phase 2 (Selection of Standard Bridge Type and Computer System) and Phase 3 (Development of Design Analysis System). The overall progress of the Study is about 40% completed.

2. Explanation of the Interim Report (1).
   The Study Team had submitted 50 copies of the Interim Report (1) to the JKR. JKR acknowledged the receipt of the Reports and agreed to the contents therein in principle. Explanation of the Interim Report (1) was given by the Study Team to the Technical and Steering Committees.

3. Computer Hardwares.
   Computer hardwares consisting of CPU, hard disk, monitor, printer, plotter and back-ups hard disk have been provided by JICA and they have been installed at the Study Office.

4. Computer Softwares.
   The Study Team has developed 4 design analysis programs for the Standardization of Bridge Design and these programs have been installed in the computer at the Study Office. Programs for Drafting is under development.

5. Training and Technology Transfer in Malaysia
   The Japanese side made a request to the Malaysian side for JKR personnel to be stationed at the Study Office for training and technology transfer. The Malaysian side has agreed in principle to

provide 5 more JKR personnel consisting of 4 engineers and 1 draughtsman to be attached to the Study Team in addition to the 2 permanent JKR Counterparts.

6. Counterpart Training In Japan.
   a) The Japanese side agreed to provide counterpart training in Japan for 1 JKR personnel for the fiscal year 1995. The duration of the training shall be confirmed later.
   b) The Japanese side agreed to convey the request of the the Malaysian side for 1 JKR counterpart to undergo a 6 weeks training in Japan for the fiscal year 1996.

7. Seminars.
   a) JKR proposed a half-day seminar to be held in November 1995 at the JKR Headquarters. The objective of the seminar is to introduce the Study on the Standardization of Bridge Design in Malaysia to the the State and District engineers. The Study Team agreed to the proposal and will support the seminar.
   b) JKR will arrange for a dialogue with the local Suppliers and Manufacturers of beams and consultant to ensure the successful implementation of the new standard bridge design in Malaysia.

Appendix 1

LIST OF ATTENDANCE

Ministry of Works:

1.	Mr. Shahruzzaman Abdul Rahman	Ministry of Works

Public Works Department:

1.	Dato' Ir. Chua Soon Poh	Director, Roads Branch
2.	Ir. Rohani Abdul Razak	Assistant Director (Bridge)
3.	Mr. Amir Ismail	Engineer (Bridge)
4.	Mr. Zainudin Jasmani	Engineer (Bridge)

Embassy of Japan:

1.	Mr. Katsuhiko Mori	Embassy of Japan

JICA Advisory Committee:

1.	Mr. Yasuo Inokuma	Member, Advisory Committee

JICA Headquarters:

1.	Mr. Hiroyuki Seki	Planning Division

JICA Malaysia Office:

1.	Mr. Yoshikazu Yamada	Deputy Resident Representative
2.	Mr. Yuzo Yamamoto	Staff, JICA Malaysia Office

Study Team:

1.	Mr. Isamu Hisada	Leader, Study Team
2.	Mr. Hajime Sakai	Member, Study Team
3.	Mr. Hiroshi Honda	Member, Study Team
4.	Mr. Hideaki Takaura	Member, Study Team

APPENDIX K

MINUTES OF MEETING ON THE INTERIM REPORT (2)

MINUTES OF MEETING

ON THE INTERIM REPORT (2) FOR

THE STUDY ON

THE STANDARDIZATION OF BRIDGE DESIGN

IN MALAYSIA

AGREED UPON BETWEEN

PUBLIC WORKS DEPARTMENT

ON BEHALF OF

THE GOVERMENT OF MALAYSIA

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

KUALA LUMPUR, 27th NOVEMBER 1995

DATO' IR CHUA SOON POH
DIRECTOR OF ROADS BRANCH
PUBLIC WORKS DEPARTMENT
ON BEHALF OF
THE GOVERMENT OF MALAYSIA

MR. ISAMU HISADA
TEAM LEADER
STUDY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Witness

MR. SHAHARUZZAMAN ABDUL RAHMAN
ASST. SECRETARY (TECHNICAL)
MINISTRY OF WORKS
ON BEHALF OF
THE GOVERMENT OF MALAYSIA

Witness

MR. HIROAKI HOASHI
ADVISORY COMMITTEE
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

JICA Study Team had submitted the Interim Report (2) of the Study on the Standardization of Bridge Design in Malaysia to the Public Works Department (JKR) on 1st September 1995.

Technical Committe and Steering Committee meetings were held on 23th November 1995 and 24th November 1995 respectively. The Malaysian and the Japanese sides discussed and confirmed on the following subjects:

1. Submission of the Interim Report 2.
   The Study Team had submitted 50 copies of the Interim Report 2 to the JKR. JKR acknowledged the receipt of the Reports and agreed to the contents therein in principle. Explanation of the Interim Report (2) was given by the Study Team to the Technical and Steering Committees.

2. Progress Report of the Study.
   The Study Team informed the Technical and Steering Committees of the current progress of the Study. The phases of the Study which had been completed include Phase 1 (Data Collection and Survey), Phase 2 (Establishment of Designs Standards and Conditions), Phase 3 (Development of Design Analysis System) and Phase 4 (Developing of Drawing System). Phase 5 of the Study (Execution of Standard Design Work and Preparation of Manuals) is currently in progress. The overall progress of the Study is according to schedule.

3. Training and Technology Transfer in Malaysia
   The Malaysian side had provided 6 extra JKR personnels consisting of 4 engineers and 2 draughtmen to the Study Team to undergo an on-the-job training from the middle of June to the end of November, 1995. The objective is to achieve the transfer of technology in the form of understanding the computations and the operation of computer programmes.

4. Dialogue with Local Manufacturers of Precast Beams.
   JKR had arranged a dialogue session between the Study Team and the local Manufacturers of precast beams with regard to the manufacturing of the new pre-tensioned beams proposed by the Study Team. The objective of the dialogue was to inform and receive

feedback from the local Manufacturers to ensure the successful implementation of the new standard bridge design in Malaysia.

5. Counterpart Trainning In Japan.
The Japanese side agreed to convey the request of the the Malaysian side for 1 JKR counterpart to undergo a 6 weeks training in Japan for the fiscal year 1996.

6. One-day Seminar.
JKR will hold a one-day seminar on the 27th November 1995 at the JKR Headquarters. The objective of the seminar is to introduce the Study on the Standardization of Bridge Design in Malaysia to the JKR State engineers, representatives from Institute of Engineers, Malaysia (IEM) and Association of Consultants Engineers, Malaysia (ACEM). The one-day seminar will be conducted by JKR with the support of the Study Team.

7. Final Seminar
The Japanese side has agreed to hold a final seminar on the Study on the Standardization of Bridge Design in Malaysia at the end of the study period. The tentative date for the final seminar shall be in July 1996.

Appendix 1

LIST OF ATTENDANCE

Public Works Department :

1.	Dato' Ir. Chua Soon Poh	Director, Roads Branch
2.	Ir. Rohani A. Razak	Senior Asst. Director (Bridge)
3.	Mr. Amir Ismail	Engineer (Bridge)
4.	Mr. Zainudin Jasmani	Engineer (Bridge)

JICA Advisory Committee :

1.	Mr. Hiroaki Hoashi	Member, Advisory Committee

JICA Malaysia Office :

1.	Mr. Kojiro Matsumoto	Staff, JICA Malaysia Office

Study Team :

1.	Mr. Isamu Hisada	Leader, Study Team
2.	Mr. Hajime Sakai	Member, Study Team
3.	Mr. Hiroshi Honda	Member, Study Team
4.	Mr. Chikao Ogiwara	Member, Study Team
5.	Mr. Hideaki Takaura	Member, Study Team
6.	Mr. Takashi Chujo	Member, Study Team

APPENDIX L

MINUTES OF MEETING ON THE DRAFT FINAL REPORT

MINUTES OF MEETING

FOR THE STUDY ON THE

STANDARDIZATION OF BRIDGE DESIGN

IN MALAYSIA

AGREED UPON BETWEEN

PUBLIC WORKS DEPARTMENT

ON BEHALF OF

THE GOVERNMENT OF MALAYSIA

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

MINUTES OF MEETING

FOR THE STUDY ON

THE STANDARDISATION OF BRIDGE DESIGN

IN MALAYSIA

AGREED UPON BETWEEN

PUBLIC WORKS DEPARTMENT

ON BEHALF OF

THE GOVERNMENT OF MALAYSIA

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

KUALA LUMPUR, 8th JULY 1996

IR DR WAHID BIN OMAR
DIRECTOR OF ROADS BRANCH
PUBLIC WORKS DEPARTMENT
ON BEHALF OF
THE GOVERNMENT OF MALAYSIA

MR. ISAMU HISADA
TEAM LEADER
STUDY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Witness

IR MAISALAN BIN IBRAHIM
ASST. SECRETARY (TECHNICAL)
MINISTRY OF WORKS
ON BEHALF OF
THE GOVERNMENT OF MALAYSIA

Witness

MR. KAZUHIRO NISHIKAWA
ADVISORY COMMITTEE
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

JICA Study Team submitted fifty (50) copies of the Draft Final Reports of the Study on the Standardization of Bridge Design in Malaysia to the Public Works Department (JKR) in March 1996. The Draft Final Reports consist of the following :

1. Executive Summary - Vol I
2. Main Report - Vol II
4. Design Manuals - Vol III
5. Standard Drawings - Vol IV

The Technical Committee and Steering Committee meetings were held on 4th July 1996 and 5th July 1996 respectively. The Malaysian and the Japanese sides discussed and confirmed on the following subjects:

1. Explanation of the Draft Final Reports.

Explanation of the Draft Final Reports were given to the Technical and Steering Committees on the 4th July 1996 and 5th July 1996 respectively.

2. Submission of Final Reports.

The Study Team shall submit 300 copies for each component of the Final Reports at the end of the study period.

3. Submission of Design Calculations Results and Bridge Site Survey Report.

The Study Team shall submit 1 copy each of the Design Calculations Results for superstructures and substructures and also the Bridge Site Survey Report at the end of the study period.

4. **Distribution of Final Reports.**

JKR shall distribute the Final Reports to the various States and Districts JKR.
JKR agreed that the Main Report shall be made available to public in Malaysia and Japan.

5. **Contents of the Final Reports.**

JKR acknowledged that the contents of the above mentioned Final Reports had been agreed to in a series of discussions and in the Technical and Steering Committee Meetings.

6. **Computer Softwares**

JKR requested that one original and three copies of the Computer Aided Design and Drafting (CADD) softwares be made available to the Bridge Unit of Roads Branch.
JKR agreed that a formal request shall be made through JICA if more copies of the above mentioned softwares are required in the future.

7. **Copyright of Computer Softwares**

JKR acknowledged that all computer softwares will be used within its own departments and shall not be distributed to the public.
JKR agreed that the above mentioned softwares shall not be modified or up-graded.
JKR also agreed to the one year liability period for the debugging of the above mentioned softwares.

8. **One-day Seminar.**

The Japanese side will organise a final seminar on the Study on the Standardisation of Bridge Design in Malaysia at the end of the study period. The date for the final seminar shall be 9th July 1996.

JICA