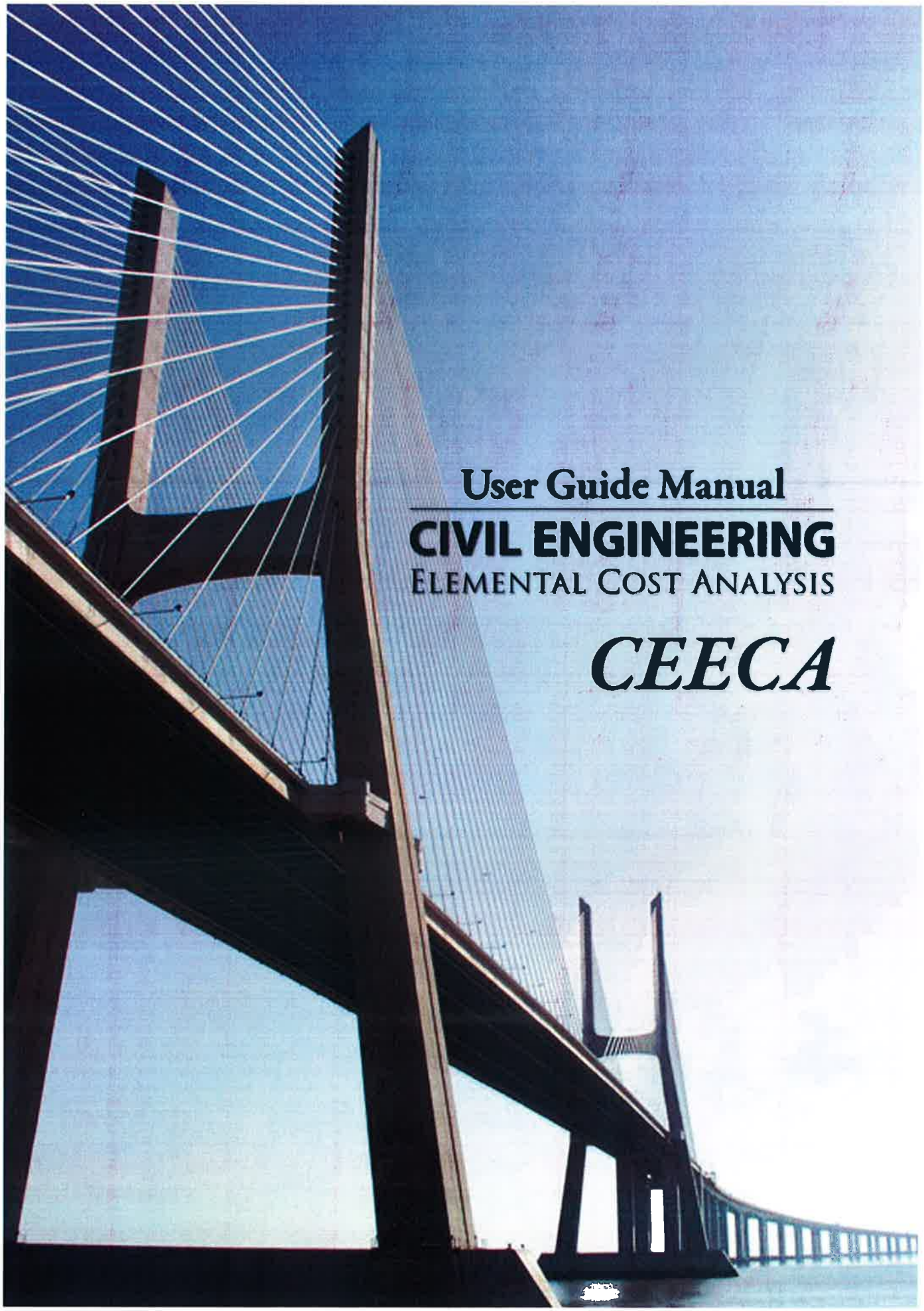

User Guide Manual

CIVIL ENGINEERING

ELEMENTAL COST ANALYSIS

CEECA

TABLE OF CONTENT

FOREWORD

This Manual for Civil Engineering Elemental Cost Analysis (CEECA) is a guide for establishing a standard elemental cost analysis preparation for civil engineering works.

Cawangan Kontrak dan Ukur Bahan recognizes the non-existence of any form of standard for civil engineering elemental cost analysis in construction industry in Malaysia. Therefore, it is pertinent to establish a standard that can help in data collection for analysis of elemental cost. The objectives of CEECA among others are, as a reference for cost information which can be used for budgeting purposes for projects of similar design and characteristics, to obtain cost distribution for each element, to evaluate whether there are balanced cost distributions amongst various elements in civil works projects of similar nature and also for cost comparison exercises.

This manual is aimed at guiding the user on the right method in preparing CEECA and it contains all essential information for the user to prepare CEECA in a systematic approach. In order to prepare CEECA, data from the Final Account certificate is used as the final re-measured quantities reflect the actual project cost since in civil engineering works, the Bill of Quantities is based on provisional quantities.

It is our hope that the methodology contained in this manual will guide user to produce CEECA which later will be beneficial to the construction industry especially in road and bridge related works during feasibility stage, pre-contract stage and post contract stage.

Pengarah Kanan
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ACKNOWLEDGEMENT

This User Guide Manual for Civil Engineering Elemental Cost Analysis (CEECA) has been prepared by a working committee comprising the following members from Cawangan Kontrak dan Ukur Bahan:-

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The committee would like to express its appreciation and gratitude to all the staff members of Bahagian Kerja Jalan dan Jambatan (year 2009 – 2014), Cawangan Kontrak dan Ukur Bahan, for their substantial contributions both directly and indirectly to the successful completion of this Manual.

1.0 PRINCIPLES OF ANALYSIS

The basic principles for the analysis of the cost of civil work are as follows:

a) The CEECA shall be prepared based on the finalised re-measured quantities from the original scope of works **ONLY**.

b) For projects with multiple structures, each structure shall be analysed separately.

c) The analysis of data shall be tabulated in the following sequence by using the standard format:

No.	Form	Title	Description
i -	Form 1	General Project Information	General information of the analysed project.
ii	Form 2	Project Cost Analysis	Total Overall Project Cost and Total Cost Analysis of each element in standard Bills of Quantities related to the project.
iii	Form 3	Analysis of Structural Elements	Bridges, Viaducts, Interchange Structure etc., shall be analysed separately.
iv	Form 4	Brief Specification	General specification of each element.
v	Form 5	Final Re-measurement of Project Cost	Cost information of the elements taking into account **ONLY** re-measured quantities.

d) The Prime Cost and Provisional Sum related to the Builder's Works (Item 2a to 2k - Form 2), if any, shall be apportioned to the particular element that is to be analysed. The remaining Prime Cost & Provisional Sum items (refer clause 3.1.11 - List and Content of Elements) shall be inserted in item 3 - Form 2 and the amount shall be as allocated in the contract.

e) Rationalised rates shall be used instead of tendered rates, (where applicable).

f) Contingency Sum to cover unforeseen expenditure shall not be included in the analysis.

g) The List and Content of Elements shall be as given in this Manual.

2.0 FORMS FOR ANALYSIS

2.1 FORM 1

CIVIL ENGINEERING ELEMENTAL COST ANALYSIS - FORM 1

PROJECT COST ANALYSIS

JOB TITLE :

LOCATION : **CLIENT** :

GENERAL PROJECT INFORMATION

Project Details and Site Condition

Project Brief Description :

Project Category :

JKR Design Standard	:			
Terrain / Geographical Condition	:			
No. of Berms	:	no		
Overall Road Length	:	km		
Road Length (Nett)	:	km		
Shoulder Width	:	m	Type of Shoulder	:
Median Width	:	m	Type of Median	:
No. of Lane	:		Type of carriageway	:
No. of Structures	:			
	:			

Contract Particulars

Contract No.	:	
Basis of Tender	:	
Type of Contract	:	
Form of Contract		
Contract Period	:	months
Date of Tender	:	
Commencement Date	:	
Completion Date (Original)	:	

Adjustment of Contract Sum

Original Contract Sum : RM

Adjusted Contract Sum : RM

Amount Increase	:	RM
% Increase	:	

Other Information

Source of Materials

i) Sand & Crusher run		km from site
ii) Asphaltic Concrete Binder Course & Asphaltic Concrete Wearing Course		km from site
iii) Imported Earth		km from site

2.1.1 NOTES TO FORM 1

2.1.1.1 INFORMATION ON CONTRACT

a) JOB TITLE

Name of project.

b) CLIENT

Example - Kementerian Kerja Raya, Kementerian Kemajuan Luar Bandar dan Wilayah, etc.

c) LOCATION

State, example - Pahang.

d) PROJECT DETAILS AND SITE CONDITION

i. **Project Brief Description**

Description of project shall include limit of project area, length of road constructed, type of work (new works/upgrading work) with specified length.

ii. **JKR Design Standard**

Example - R3, R5, U5 etc.

iii. **Terrain/Geographical Condition**

Example - flat, undulating, mountainous etc.

iv. **No. of Berms**

To specify number of berms representing the major length of the berm (refer Sketch No. 01 & Sketch No. 1+2).

v. **Overall Road Length**

Length of road is measured gross from chainage to chainage.

vi. **Road Length (Nett)**

Length of road excluding roads above elevated structure (bridges, viaduct and interchange). Refer Sketch No. 02

vii. **Shoulder Width**

Refer Sketch No. 03 for measurement of shoulder width.

viii. **Type of Shoulder**

Example - paved, earth-filled etc.

ix. **Median Width**

Refer Sketch No. 03 for measurement of median width.

x. **Type of Median**

Example - paved, earth-filled etc.

xi. **No. of Lanes**

Number of lanes constructed (refer Sketch No.03).

xii. **Type of Carriageway**

Example - four lane dual carriageway etc.

xiii. **No. of Structure**

Total number of structures constructed (for multiple structures projects).

Note :

In cases where the scope of works involves variety of types and designs (e.g. : design standard, type of shoulder/median, width of shoulder/median etc.), the major scope (in term of length) shall determine the project details

e) CONTRACT PARTICULARS

i. Contract No.

ii. Basis of tender - Open/Selective Tender or Negotiated. (Prequalification to be treated as selective tender)

iii. Type of Contract - Conventional, Design & Build, Turnkey or Cost Plus including whether tendered internationally or locally

iv. Form of Contract – e.g.: PWD 203A

v. Contract Period

vi. Date of Tender - Date of closing tender (for open/selective tender) or date of final negotiation (for direct negotiated tender)

vii. Commencement Date

viii. Completion Date (Original)

f) ADJUSTMENT OF CONTRACT SUM

i. Original Contract Sum

As stated in Letter of Acceptance.

ii. Adjusted Contract Sum

Contract Sum after taking into account final re-measured quantities excluding Variation Works and Variation of Price.

g) OTHER INFORMATION

i. Source of Materials

Haulage distance for sand, crusher run, asphaltic concrete binder course, asphaltic concrete wearing course and imported earth.

2.2 FORM 2

CIVIL ENGINEERING ELEMENTAL COST ANALYSIS - FORM 2

JOB TITLE :

PROJECT COST ANALYSIS

Ref.	Description	% of Contract Sum	Cost/km	Final Cost (RM)
1	**PRELIMINARIES**			
1a	General Item			
1b	Turnkey Elements			
2	**MAIN WORKS**			
2a	Site Clearance & Demolition Works			
2b	Earthworks			
2c	Drainage Works			
2d	Pavement Works			
2e	Road Furniture			
2f	Geotechnical Works			
2g	**Structures**			
2h	Traffic Management & Control			
2i	Environmental Protection Works			
2j	Routine Maintenance Works			
2k	**Others**			
	a			
	b			
	c			
	d			
3	**PRIME COST SUM & PROVISIONAL SUM**			

	GRAND TOTAL		
	NETT LENGTH OF ROAD =		KM
I)	**OVERALL COST / KM =**		**/KM**
	TOTAL BUILDER'S WORK ONLY (without Preliminaries & Prov. Sum)		
II)	**COST OF ROAD/KM (BW ONLY) =**		**/KM**
	TOTAL BUILDER'S WORK ONLY (without Preliminaries & Prov. Sum) **a) LESS** Structures **b) LESS** Geotechnical Works **c) LESS** Routine Maintenance **d) LESS** Others (if any)		
	TOTAL BUILDER'S WORK ONLY (without Preliminaries & Prov. Sum) less item (a) to (d) above		
III)	**COST OF ROAD/KM (without Preliminaries & Provisional Sums) less item (a) to (d) above**		**/KM**

Note:		
i)	***% for Preliminaries is over the remainder of Contract Sum***	0.0%

2.2.1 NOTES TO FORM 2 – PROJECT COST ANALYSIS

The analysis is tabulated in a format comprising of:

a) Description

b) Percentage of contract sum

c) Cost per kilometre (cost/km)

d) Total cost of element (RM)

2.2.1.1 DESCRIPTION

The elements of works shall be described as follows:

1) Preliminaries
   - a) General Item
   - b) Turnkey Elements (if applicable)

2) Main Works
   - 2a) Site Clearance & Demolition Works
   - 2b) Earthworks
   - 2c) Drainage Works
   - 2d) Pavements Works
   - 2e) Road Furniture
   - 2f) Geotechnical Works
   - 2g) Structures
   - 2h) Traffic Management & Control
   - 2i) Environmental Protection Works
   - 2j) Routine Maintenance Works
   - 2k) Others (To specify, if any)

3) Prime Cost Sum & Provisional Sum (not related to builder's work)

The Prime Cost and Provisional Sum related to the Builder's Works (Item 2a to 2k - Form 2), if any, shall be apportioned to the particular element that is to be analysed. The remaining Prime Cost & Provisional Sum items (refer clause 3.1.11 - List and Content of Elements) shall be inserted in item 3 - Form 2 and the amount shall be as allocated in the contract.

1.2.1.2 PERCENTAGE OF CONTRACT SUM

The percentage calculation is derived from cost of each element over the Contract Sum and shall be calculated to the nearest one decimal place.

However, the percentage of Preliminaries shall be based on the remainder of Contract Sum excluding Preliminaries. General Item and Turnkey Element of Preliminaries shall be analysed separately.

1.2.1.3 COST PER KILOMETRE (Cost/km)

The total cost for each element is divided by length of the road (nett) in kilometre (to the nearest Sen).

1.2.1.4 TOTAL COST OF ELEMENT (RM)

The total cost shall include the amount for the related Prime Cost Sum and Provisional Sum items that have been apportioned to that particular element. The amount is carried from Form 5 – Final Re-measurement of Project Cost.

2.3 FORM 3

CIVIL ENGINEERING ELEMENTAL COST ANALYSIS - FORM 3

JOB TITLE :

STRUCTURE ANALYSIS
(BRIDGE/ VIADUCT / INTERCHANGE/UNDERPASS/TUNNEL/CULVERT MORE THAN 3.0 M WIDE)

Item	Type of Structure	Dimension		Area of Structure (m2)	Total length of Pile (m)	Cost of Structure (RM)	Cost of Structure / m2	Component	Cost of each component (RM)	Cost of each component / Area of Structure (m2) ** except piling per meter	Percentage of Each Component = Cost of Each Component/ Cost of Structure (%)
		l	*w*	a	b	c	d = c/a	e	f	h= f/a	g = f/e*100
1	**Bridge Over Sg. Batu** *Type and size of pile (e.g. : 500mm dia. bored pile)* *Type of structure (e.g. : Post Tensioned Prestressed T-Beam)* *No. of Span (e.g. : 3 nos)*							Temporary Works Piling Substructure Superstructure Pavement			
								TOTAL			
2	**Bridge Over Sg. Titi Air Keroh** *Type and size of pile (e.g. : 500mm dia. bored pile)* *Type of structure (e.g. : Post Tensioned Prestressed T-Beam)* *No. of Span (e.g. : 3 nos)*							Temporary Works Piling Substructure Superstructure Pavement			
								TOTAL			

Note:-

a) Cost of structure (c) shall exclude temporary works and refurbishment works to the existing structures

2.3.1 NOTES TO FORM 3

The type of structures is categorised as follows:

a) Bridge
b) Viaduct
c) Interchange
d) Underpass
e) Tunnel
f) Culverts (more than 3 meter wide) (Culverts function as drainage shall be analysed under Element Drainage Works)

2.3.1.1 Type of Structure

a) Type of structure shall be stated.
b) The following shall be described :
   i. Type of pile
   ii. Type of structure (e.g. beam, box girder / segmental)
   iii. No. of span

2.3.1.2 Dimension

Bridge

a) Length (L) – measured from abutment to abutment
b) Width (W) – measured from the outer edge of parapet. (refer to Sketch No. 04).

Pedestrian Bridge / Pedestrian Bridge with Motorcycle Ramp

a) Length (L) – total length of bridge from end A to end B
b) Width (W) – measured from the outer edge of slab. (refer to Sketch No. 05).

Viaduct/ Interchange

a) Length (L) – total length of bridge from end A to end B (excluding length of ramp)
b) Width (W) – measured from the outer edge of parapet. (refer to Sketch No. 06).

Underpass/ Tunnel/ Culvert

a) Length (L) – total length of bridge from end A to end B

b) Width (W) – measured from the outer edge of wall (refer to Sketch No. 07)

2.3.1.3 Area of structure (m2)

Measured to the nearest whole number.

2.3.1.4 Total length of pile (m)

Measured from toe to cut-off level

2.3.1.5 Cost of structure (RM)

Cost excludes temporary work. Refurbishment works (if any) and bridge widening shall not be analysed.

2.3.1.6 Component

COMPONENT	ITEM
Temporary Works	Temporary work for the particular analysed structure.
Piling	The quantities shall be in accordance with the final re-measured Bill of Quantities.
Substructure	Pile caps, abutments, piers and inclusive of any related miscellaneous item but excluding temporary works.
Superstructure	i. Structure with piers - Any item above piers inclusive of any related miscellaneous item but excluding pavement.

	ii. Structure without piers – Any item above foundation inclusive of any related miscellaneous item but excluding pavement.
Pavement	Pavement on elevated structure (bridges, viaduct and interchange).

2.3.2.7 Cost of each component

The amount shall be in accordance with the final re-measured amount of the respective component.

2.4 FORM 4

CIVIL ENGINEERING ELEMENTAL COST ANALYSIS - FORM 4

JOB TITLE :

BRIEF SPECIFICATION		
REF	**BILL**	**SPECIFICATION**
2	**MAIN WORKS**	
2a	Site Clearance & Demolition Works	Nature of site clearance and type of structure to be demolished
2b	Earthworks	Type of work *(e.g. : excavation, filling, etc)* / nature of work *(e.g.: common, hard, etc.)* / quantity of respective type / nature of work
2c	Drainage Works	Type and size of drain / culvert / etc *(e.g. : Roadside Drain (RSD), Medium Drain Urban (MDU), berm drain (BF), etc)*
2d	Pavement Works	Type and thickness of base and finishing coarses
2e	Road Furniture	Major type of work i.e : type of signages, type of traffic barriers etc . *(e.g. : butterfly gantry , 1.95m single mounted guardrail etc.)*
2f	Geotechnical Works	Type and material used *(e.g. : stone column , piled embankment etc)*
2g	**Structures** i) Sub-structure ii) Super-Structure	 Type and general sizing of foundation (e.g. : bored pile etc) Type of structure *(e.g. : T-beam, box girder etc)*
2h	Traffic Management & Control	As per standard requirement
2i	Environmental Protection Works	As per standard requirement
2j	Routine Maintenance Works	As per standard requirement
2k	**Others (If any)**	State specification for the relevant works

2.4.1 NOTES TO FORM 4

2.4.1.1 BRIEF SPECIFICATION

Specification of works, material used, relevant dimensions of major components and other information pertaining to cost.

2.5 FORM 5

CIVIL ENGINEERING ELEMENTAL COST ANALYSIS - FORM 5

JOB TITLE :

FINAL RE-MEASUREMENT OF PROJECT COST

Ref.	Description of Works	Contract Cost (RM)	Allocation of Provisional Sum Items From Original Contract Cost (RM)	Adjustment Due to Remeasument of Final Quantities (Addition/ Omission) (RM)	Final Cost (RM)
1	**PRELIMINARIES**				
1a	General Item				
1b	Turnkey Elements				
2	**MAIN WORKS**				
2a	Site Clearance & Demolition Works				
2b	Earthworks				
2c	Drainage Works				
2d	Pavement Works				
2e	Road Furniture				
2f	Geotechnical Works				
2g	**Structures**				
	i				
	ii				
2h	Traffic Management & Control				
2i	Environmental Protection Works				
2j	Routine Maintenance Works				
2k	**OTHERS**				
	i				
	ii				
	iii				
	iv				
3	**PRIME COST SUM & PROVISIONAL SUM**				
	TOTAL CONTRACT AMOUNT				

Note: Adjustment **ONLY** due to remeasurement of final quantities

2.5.1 NOTES TO FORM 5

The final re-measurement of project cost is tabulated in a format comprising of:

a) Description of work
b) Contract cost (RM)
c) Allocation of provisional sum items from original contract cost (RM)
d) Adjustment due to re-measurement of final quantities (Addition/Omission) (RM)
e) Final cost (RM)

2.5.1.1 DESCRIPTION OF WORKS

The elements of works shall be stated.

2.5.1.2 CONTRACT COST (RM)

The amounts for the particular elements are derived from the original Contract Amount.

2.5.1.3 ALLOCATION OF PROVISIONAL SUM ITEMS FROM ORIGINAL CONTRACT COST (RM)

The Prime Cost and Provisional Sum related to the Builder's Works (Item 2a to 2k - Form 2), if any, shall be apportioned to the particular element that is to be analysed. The remaining Prime Cost & Provisional Sum items (refer clause 3.1.11 - List and Content of Elements) shall be inserted in item 3 - Form 2 and the amount shall be as allocated in the contract.

2.5.1.4 ADJUSTMENT DUE TO RE-MEASUREMENT OF FINAL QUANTITIES (ADDITION/OMISSION) (RM)

The nett addition/omission due to the re-measurement of quantities shall be stated for the particular element EXCEPT for works with variation due to omission and/or substitution, the original amount shall remain.

2.5.1.5 FINAL COST (RM)

The final cost for the particular element after the adjustment shall be taken to Form 2.

3.0 LIST AND CONTENTS OF ELEMENT

3.1 LIST AND CONTENTS OF ELEMENT CIVIL WORK

3.1.1 SITE CLEARANCE & DEMOLITION WORKS

a) General site clearance (including bushes, swampy land, plantation and forest).
b) Demolition and removal from site of all building and existing structure including brickwork and timber building, fences and gates, bridges, culvert, surface lined drains and sumps.
c) Dismantle and send to store for reuse as directed by S.O/P.D of fences and gates, guardrail and signboard (if any).

3.1.2 EARTHWORKS

a) Stripping of topsoil.
b) Excavate, load, haul and deposit to form embankment including common excavation in cutting, excavation of hard materials and excavation of rock.
c) Excavate unsuitable material, load, haul and dispose.
d) Spread, grade and compact suitable material, imported suitable material, suitable hard material, rock fill from rock excavation or imported rock to form embankment.
e) All type of turfing (including hydro seeding and synthetic turfing) to all areas.

3.1.3 DRAINAGE WORKS

a) Provide, erect, maintain and remove from site on completion of temporary crossing, in accordance with the relevant sub section of the specification for the proposed culverts.
b) Pipe culvert, precast box culvert, cast in-situ box culvert, surface drains, sub-surface drains, sumps and earth channels excavation.

3.1.4 PAVEMENT WORKS

a) Preparation of formation for receiving road pavement.
b) Construction of pavement (including sub base, road base and surfacing)
c) Construction of approach road to bridge (including sub base, road base and surfacing).
d) Fill material on unpaved shoulder.
e) Fill material on unpaved medium and island.
f) Treatment to existing pavement including patching, milling and regulation.
g) Reconstruction of existing pavement (including sub base, road base and surfacing).
h) Overlay (including bituminous prime coat, tack coat, asphaltic concrete).

3.1.5 ROAD FURNITURE

a) Signboard (destination signboard, gantry directional signboard, butterfly gantry, warning and regulatory traffic signs).
b) Traffic barrier (guardrails, new jersey barrier and wire rope).
c) Road marking (hot-applied superimposed reflectorized thermoplastic road markings, directional arrow for roads, bus-shelter, mild steel railing, antiglare screen, interlocking paving block for footpath, kilometer post, concrete kerb, delineator post, retroreflective raised pavement marker (road stud), chevron delineators, impact attenuator, right of way marker and permanent signboard) and the likes.

3.1.6 GEOTECHNICAL WORKS

a) Soft ground replacement/stability including non-woven and woven geotextile, placement and compaction of river/mining sand, excavated suitable material from the road way and imported suitable fill from contractor's own source.
b) Prefabricated vertical drains including mobilization/demobilization of equipment and plant from location to location, non-woven and woven geotextile, drainage blanket, placement and compaction.
c) Stone columns / soil cement columns / chemical columns / sand columns, including mobilization/demobilization of equipment and plant from location to location, non-woven and woven geotextile, drainage blanket, placement and compaction and testing.
d) Surcharge including excavation of suitable fill from roadway, imported suitable fill and removal of surplus surcharge.
e) Piling.
f) Reinforced concrete slab shall include excavation, filling of suitable material, lean and reinforced concrete, formwork and reinforcement.
g) All types of instrumentation works (supply and install), monitoring and analysing of data and preparation of monthly monitoring report.
h) Slope stabilization including all soil nailing works, guniting, rock bolt, ground anchorage, gabion and horizontal drains.
i) Reinforced soil walls and reinforced soil slopes.
j) Reinforced concrete retaining wall comprising excavation, lean concrete, formwork Class F1, UPVC pipes, draining material, construction and expansion joints, sealer, reinforcement and bituminous coating.

3.1.7 TRAFFIC MANAGEMENT AND CONTROL

a) Traffic management team.
b) Supply, install, store, maintain, replace and shift all temporary road furniture.

c) Supply, install, maintain, replace and remove upon completion temporary guardrails.

d) Supply, install in position and maintain all temporary traffic signs of fluorescent orange prismatic retro-reflective sheeting including all posts, frames, brackets and everything complete as shown in the drawing and/or as directed by the S.O/P.D including shifting at the end of each stage and removal at the completion of the road works.

e) Temporary road diversion including earthworks, pavement works, painting and removal of temporary road diversion and structures upon completion of project.

f) Traffic Management plan and report.

3.1.8 ENVIRONMENTAL PROTECTION WORKS

This shall include environmental impact assessment (EIA), environmental management plan (EMP), environmental officer (EO), environmental monitoring, audit and training, dust and mud control, erosion control, sediment control, top soil protection, fuel spillage management, waste management, management of disposal site for surplus material, noise control, flora management and wildlife management.

3.1.9 ROUTINE MAINTENANCE WORKS

This shall include all routine maintenance activities during construction period (maintain existing road, grass cutting, road furniture, bridges and culverts, road line, marking, drainage works, landscaping, litter collection and disposal of minor obstruction/debris).

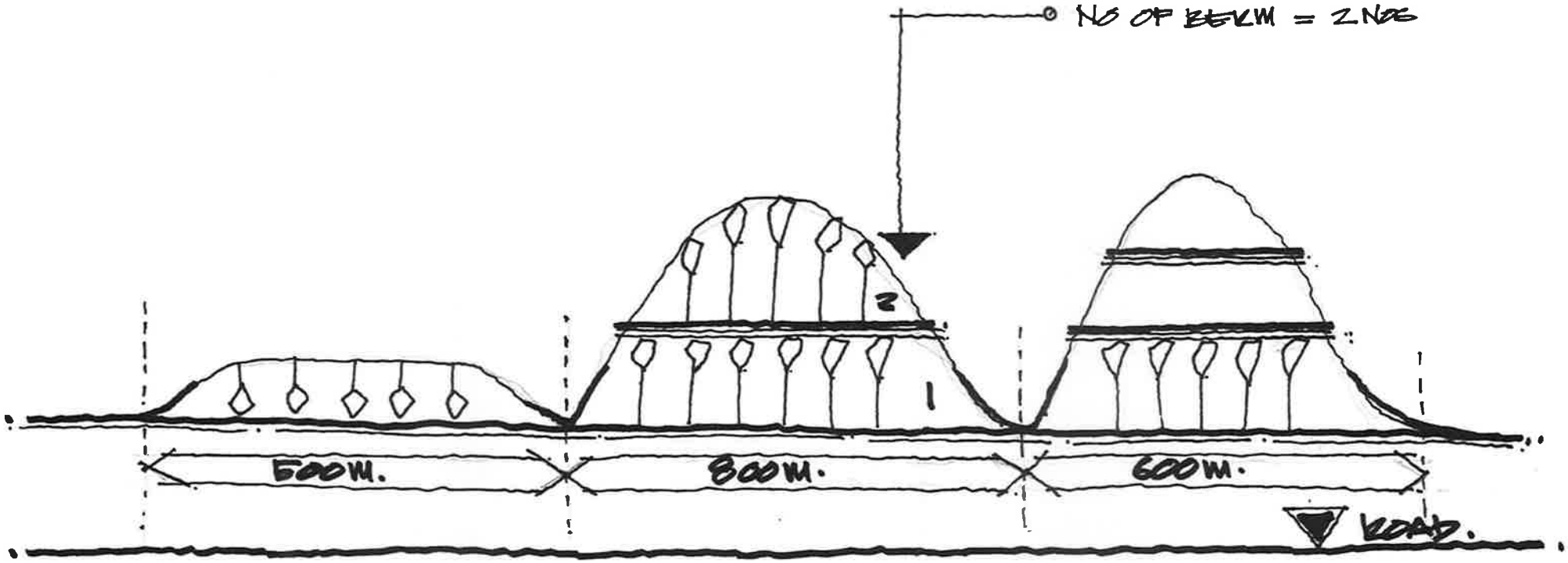
3.1.10 OTHERS

Street lighting & traffic signal system, water reticulation works, relocation utilities- water mains, relocation utilities- TNB, relocation utilities- telecommunication, relocation utilities- gas, relocation utilities- sewerage, OSHA and landscape works.

Miscellaneous works shall refer to itemised works other than the above mentioned works (item 3.1.1 to 3.1.10)

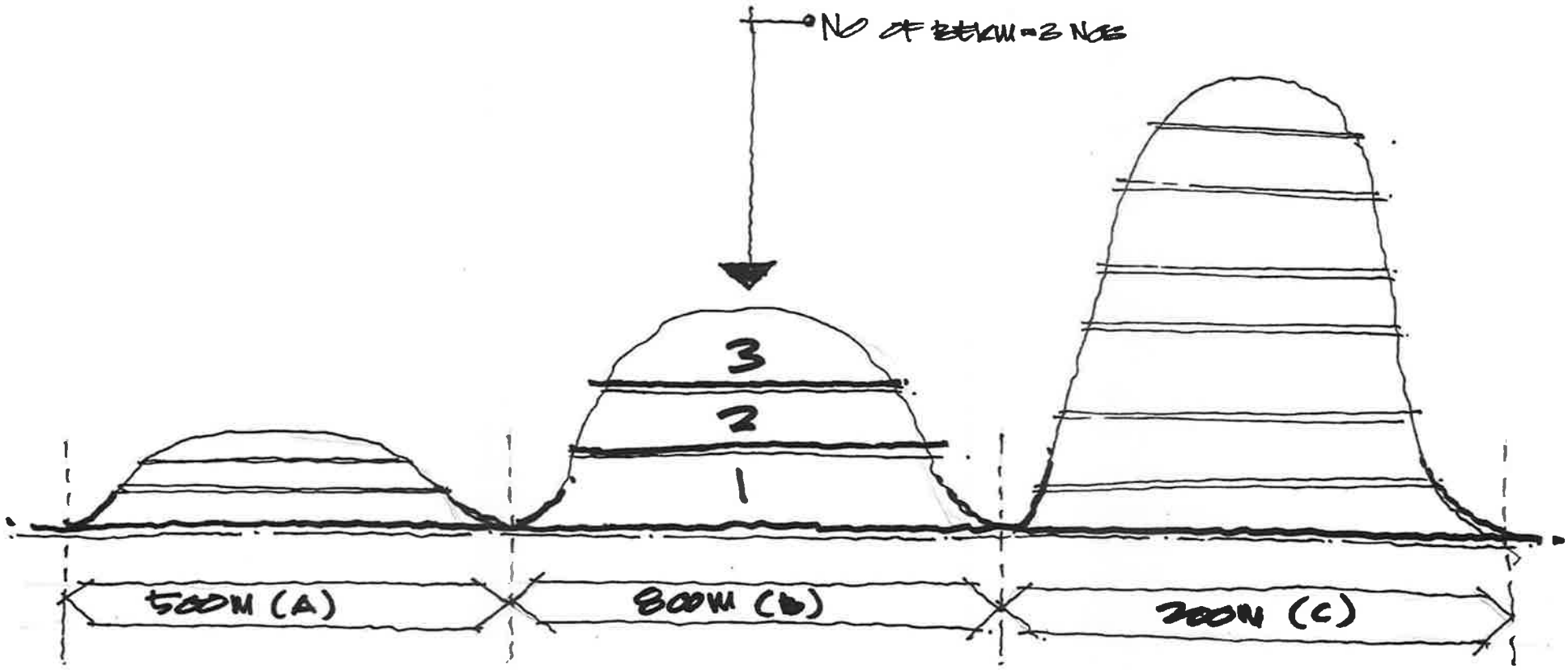
3.1.11 PRIME COST SUM & PROVISIONAL SUM

Any remaining items under Prime Cost Sum and Provisional Sum which are not categorised under item 3.1.1 to 3.1.10 e.g. telephone bills for S.O/P.D, KTMB, Additional S.I works during construction, RSA Stage 4, CIDB Levy.



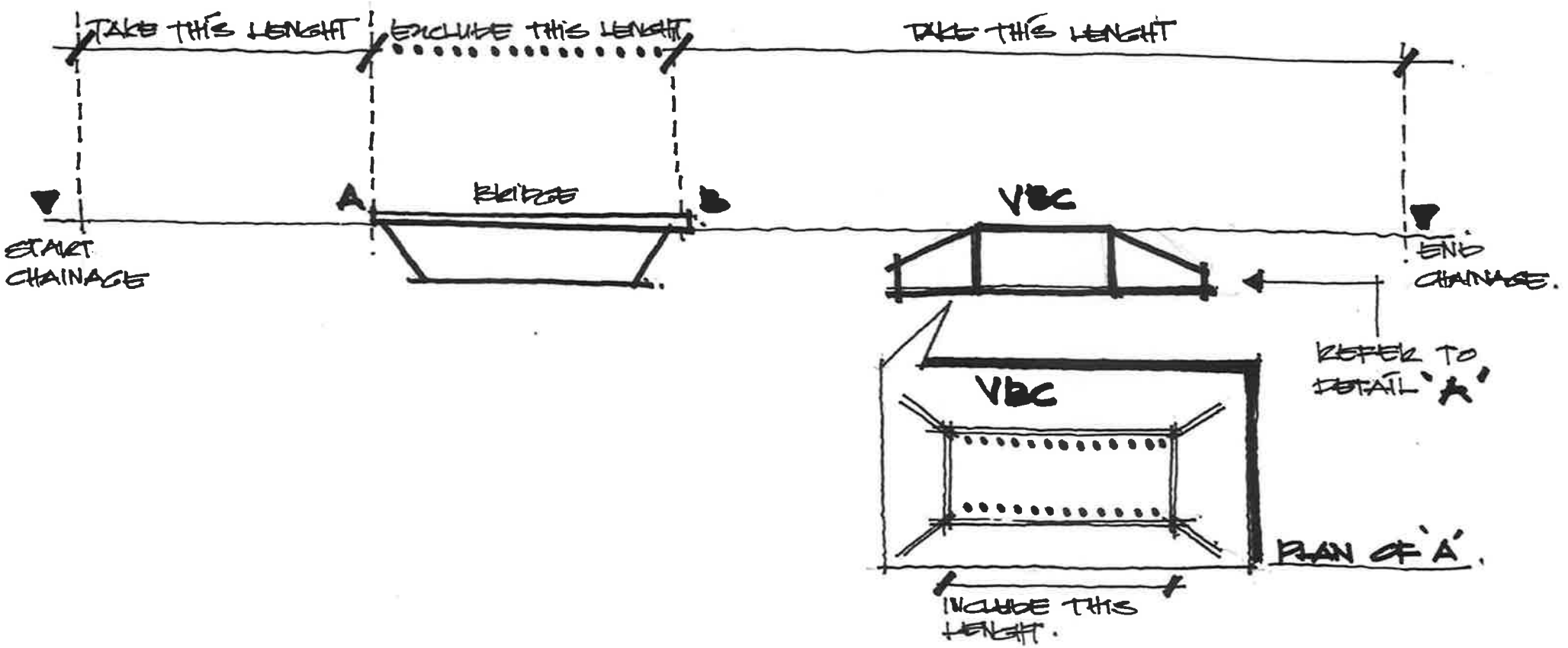
NO OF BERM DETERMINED
BY THE LONGEST BERM
CONSTRUCTED
EG : BERM B (800M),
NO OF BERM IS 2 NOS.

SKETCH 01
DETERMINING OF BERM.



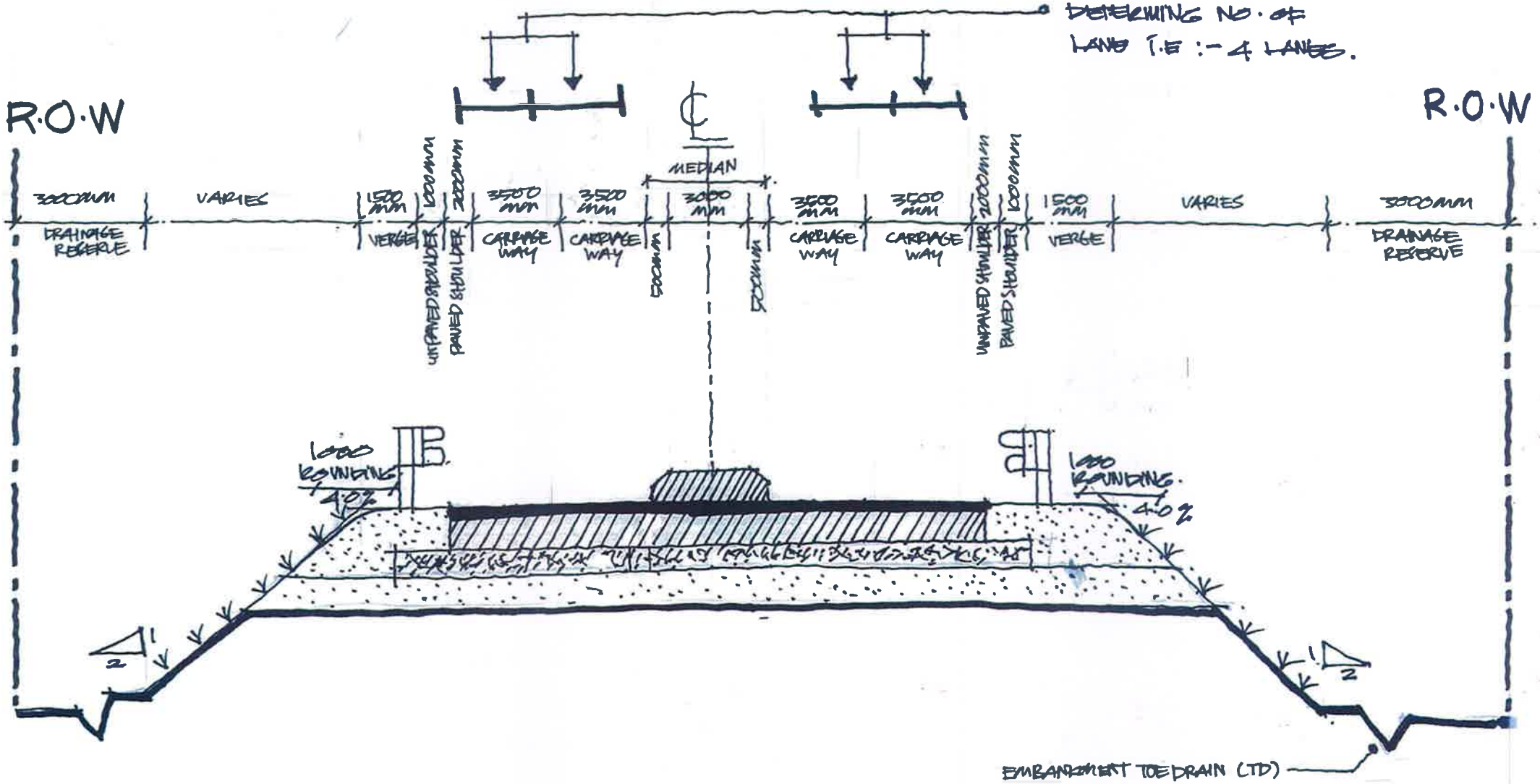
NO OF THE BEAM DETERMINED BY THE LONGEST LENGHT OF THE BEAM IE :- B.

SKETCH 1+2.



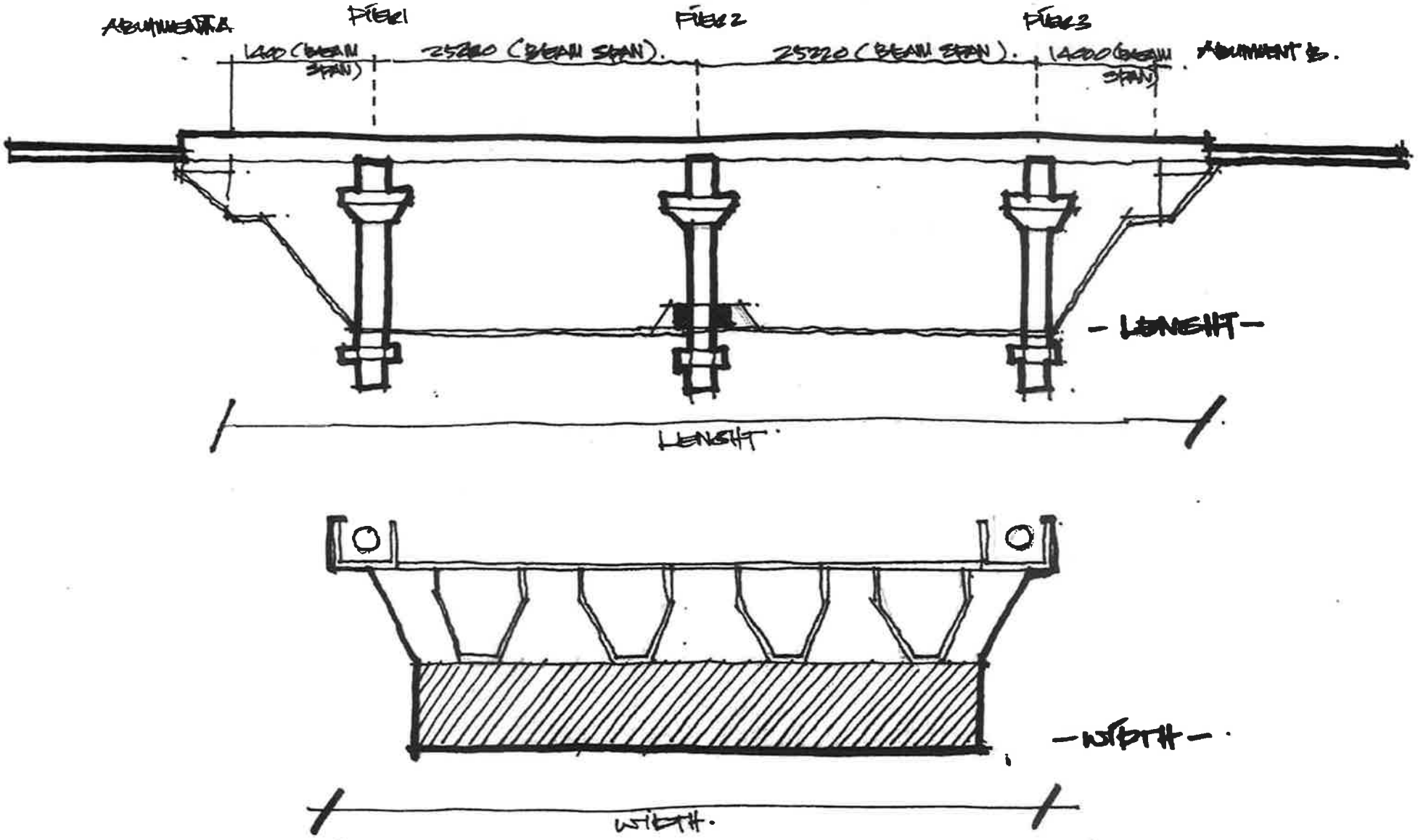
SKETCH 02.

MEASUREMENT OF ROAD LENGHT (NETT).



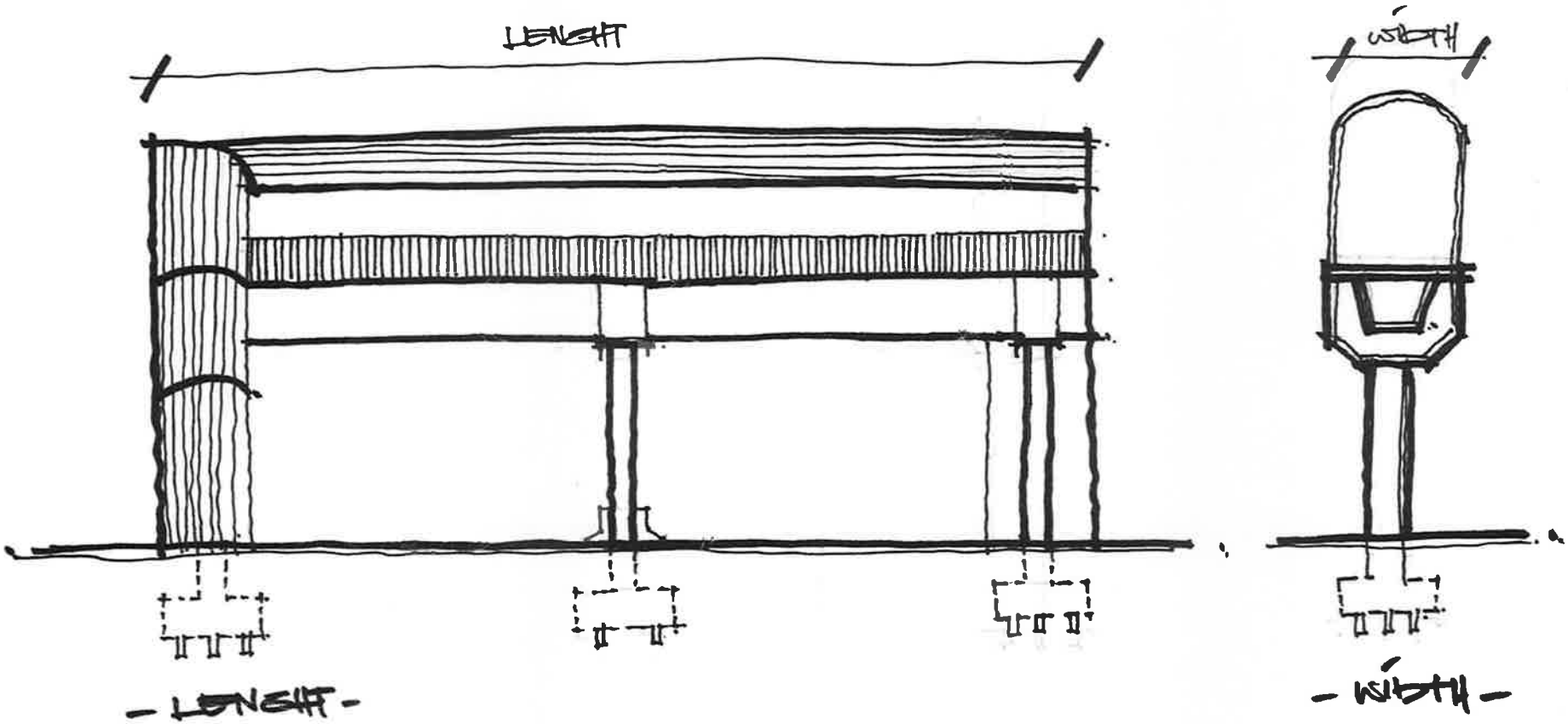
SKETCH 03

TYPICAL ROAD CROSS SECTION.

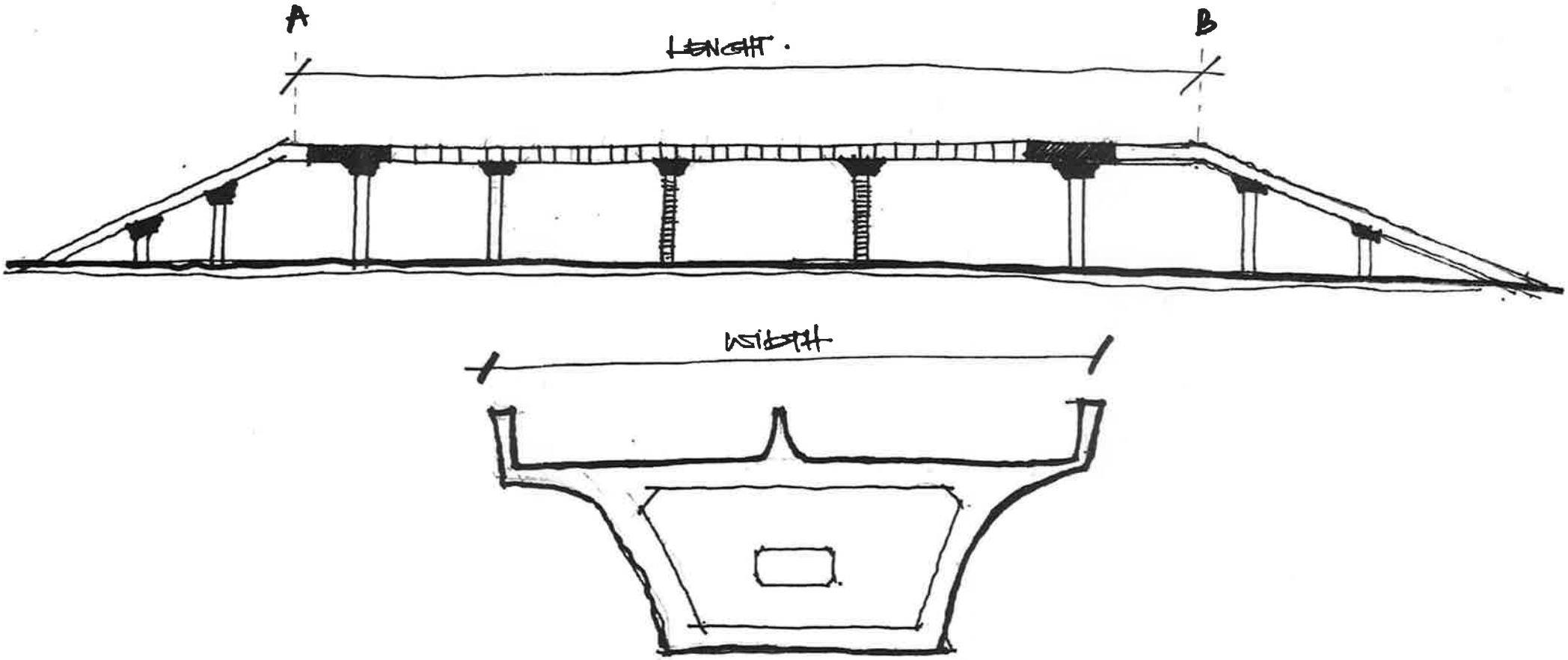


SKETCH 04

BRIDGE STRUCTURE.

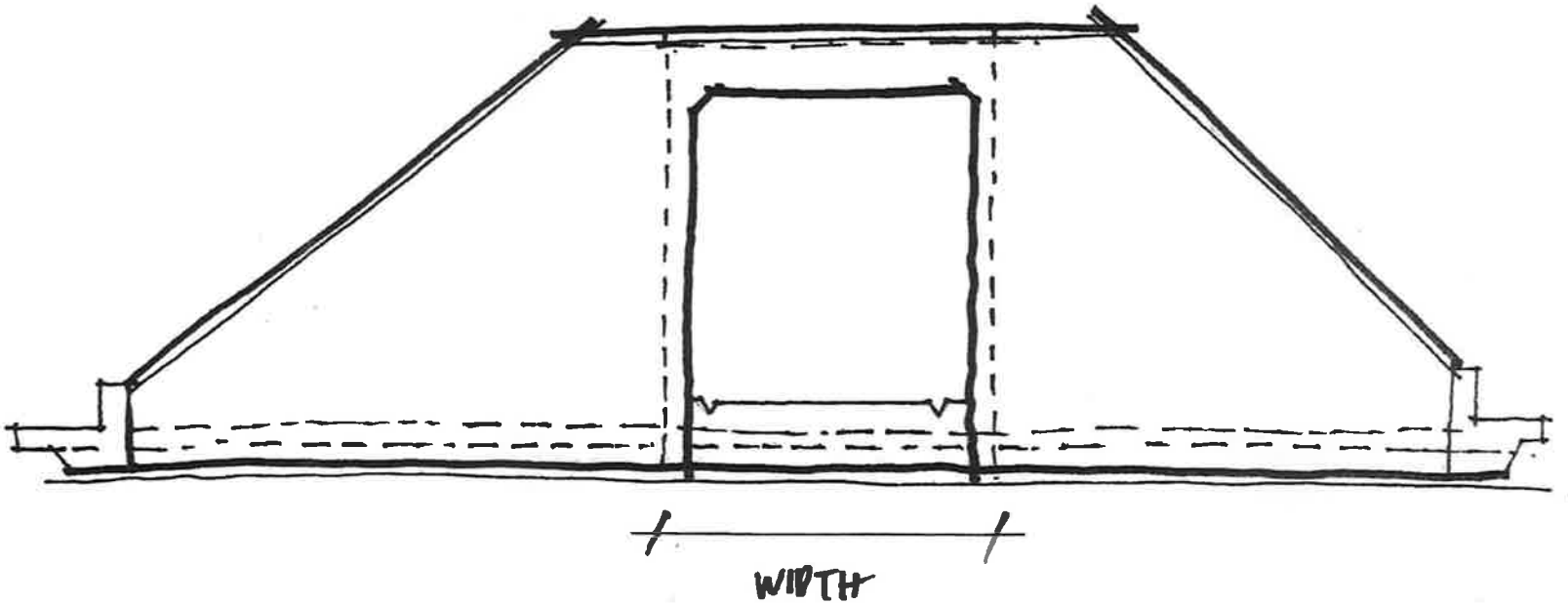


SKETCH 5
PEDESTRIAN BRIDGE.



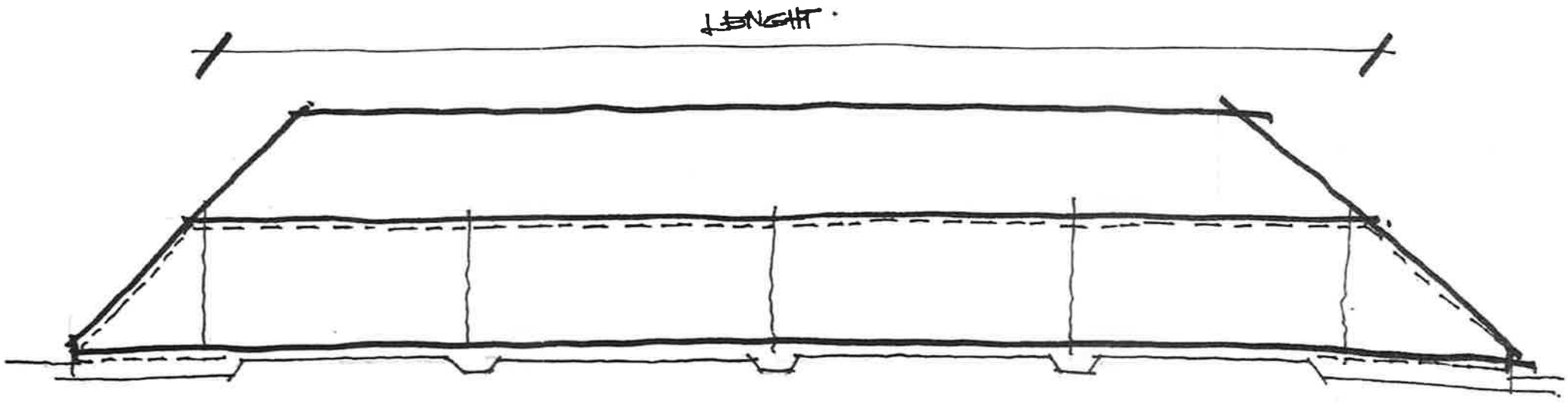
SKETCH 06

VIADUCT / INTERCHANGE



SKETCH 07

UNDERPASS / TUNNEL / CULVERT.


LENGHT