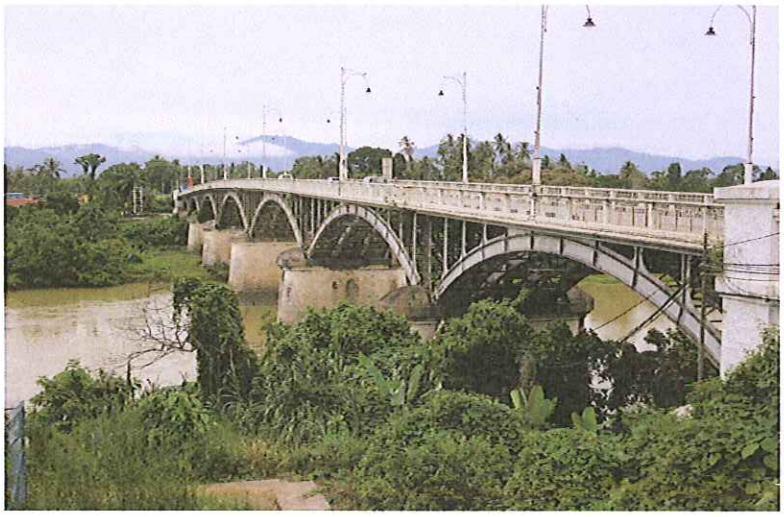
KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT001/639/90, KUALA KANGSAR, PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

July 24, 2015



VOLUME 4 OF 4
CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR

(473632-K)

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KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

- INSTRUCTIONS TO TENDERERS

1.0 INVITATION TO TENDER

1.1 Suitable qualified and registered Contractors with proven experience in Structural Repair and Rehabilitation are invited to submit their tender for the "Cadangan Membaikpuih & Memperkuatkan Struktur Jambatan Sultan Iskandar di Laluan FT001/639/90, Kuala Kangsar, Perak".

1.2 Tender documents shall be available from:-

Place :- _____

Address :- _____
_____
_____
_____
_____

Date :- _____

2.0 DESCRIPTION OF THE WORKS

2.1 In the detailed Structural Assessment as conducted, the whole Bridge Structure of Jambatan Iskandar (Superstructure, Piers and Abutments) were found to be generally in good stable condition with good structural stability and integrity.

2.2 The Bridge that was constructed in the year 1932 underwent substantial Rehabilitation and Strengthening Works for the Bridge Deck in year 1985/1986.

2.3 Over time, the Bridge Structure, particularly the steel structural components experienced minor to moderate material deterioration (mainly corrosion of steel members) and other related issues.

2.4 The Works therefore, serve to provide a full Rehabilitation & Strengthening enhancement to the various bridge components so as to enable the Bridge Structure to adequately and safely sustain the MTAL Traffic Live Loading for the years to come.

2.5 The Scope of Works are as per Provisional Bill of Quantities, relevant drawings and specific specification requirements. It shall be carried out fully in accordance to all conditions of Contract, Terms and Specifications and in accordance with the requirements as stipulated in this document. The Works shall comply to sound and safe construction practice with due care and consideration to public safety and environmental protection.

3.0 SCOPE OF WORKS

3.1 General Preliminaries such as mobilization, demobilization, site offices, site personnel, temporary works, traffic and safety management, documentations etc.

3.2 Engineering Input by Professional Engineer appointed by the Contractor to provide supervision and certification of the completed Works.

3.3 Repair works to the bridge decks such as replacement of the deteriorated expansion joints and localized patch repair of the road premix.

3.4 Structural Repair and Rehabilitation of the Bridge Steel Frames:-

a) Steel Strengthening Works Type 1 (Internal Arches - Arch B and Arch C)
- Strengthening to the identified Bridge's steel members.

b) Steel Strengthening Works Type 2 (External Arches - Arch A and Arch D)
- Repair to the crack lines on the Bridge's steel members and improvement of the identified steel member's expansion joints detail.

c) Steel Strengthening Works Type 3 (External Arches - Arch A and Arch D)
- Improvement of the identified steel member's expansion joints detail.

d) General Structural Steel Works Type A.
- Additional steel members for the identified corroded steel members of the bridge frame.

e) General Structural Steel Works Type B.
- General replacement of missing or damaged rivets/bolts/nuts.

f) General Structural Steel Works Type C.
- General overall repainting to the bridge frame's steel members.

g) General Structural Steel Works Type D.
- General overall repainting to the soffits of the bridge's metal deck.

h) General Structural Steel Works Type E.
- General maintenance works to the "rocker" type bearings for the bridge's steel arches.

3.5 Repair works to crack lines at the bridge's Piers and Abutments.

3.6 Other works such as the construction of new concrete access pathway and steps with railings from the Bridge Deck Level down to the base of Abutment 1 (Sungai Siput end).

3.7 The "as-built" structural details drawings are available for reference from JKR office.

4.0 PERIOD OF CONSTRUCTION

The whole works shall preferably be completed within _____ months from the date of site possession.

5.0 SUBMISSION OF TENDER

5.1 All completed Tender Document shall be submitted to

_____
_____
_____
_____
_____
_____

not later than 12.00 noon on _____ and it shall remain valid for _____ days from this date. The submission envelope should be marked

"Cadangan Membaikpuih & Memperkuatkan Struktur Jambatan Sultan Iskandar di Laluan FT001/639/90, Kuala Kangsar, Perak".

5.2 All prospective firms should make own their arrangement for common site visit prior to submission of the tender so as to be fully familiarised with the exact requirements of the Works. Tender Document will not be issued to those firms who have not sent their approved representative for the site visit.

5.3 The details of the compulsory site visit are

Date	:	_____
Time	:	_____
Meeting Place	:	At Abutment 2 (Kuala Kangsar end) Underpass Road of Jambatan Iskandar

6.0 CARE AND PROTECTIONS TO THE ENVIRONMENT

6.1 All works shall be carefully planned out to be carried out in safe manner so as to avoid any danger or injury to the public. Temporary supports shall be adequately provided and maintained throughout the Works.

6.2 A suitable Traffic Management Plan shall be instituted so as to ensure continued smooth and safe traffic and pedestrian movement on the bridge. Unless with the specific prior approval of the S.O., the Bridge Deck should be opened to the traffic at all time.

7.0 REPORTS

7.1 The Progress Reports shall be prepared and submitted in accordance with the Contract's requirements. Each monthly report shall include adequate captioned photographs. The Report shall include the Programmed of Works highlighting major areas of works, material testing results, quality control measures etc.

7.2 Completion Report

Upon completion of the Works, a proper Completion Report shall be prepared. It shall include at least the followings:-

a) Introduction
b) Scope of Works
c) Contractual Details
d) Implementation Sequence
e) Description of Major Works
f) List of Repair Materials
g) Summary of Quality Control Programme Testing etc
h) Relevant As-built Drawings
i) Other Issues
j) Conclusion

RPT/TC/275/TenderDocuments

APPENDIX 1

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

TENDER DOCUMENTS

APPENDIX 1

BILL OF PROVISIONAL QUANTITIES FOR THE PROPOSED WORKS

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 1: PRELIMINARIES (1 of 3)

Item	*Description*	*Unit*	*Qtty*	*Rate, (RM)*	*Amount, (RM)*
1.1	All mobilization, demobilization and conveyance of all necessary equipment, plants, tools and materials and their transportation to the site and labour in handling, assembling, connecting, erecting and dismantling, move around the site as and when necessary including providing for all running and operating costs (inclusive of idling time).	L.S.	-	-	
1.2	The Contractor shall carry out independent survey to ascertain levels/dimensions indicated in the drawings. Any discrepancies with the Drawing shall be notified to the S.O. prior to commencement of the Works.	L.S.	-	-	
1.3	All insurances, workman compensation, SOCSO etc.	L.S.	-	-	
1.4	All contribution (CIDB levy etc) as required by the Local Authority (where applicable).	L.S.	-	-	
1.5	***Site Offices and Storage***				
1.5.1	Provision of Site Offices and all office's facilities, fixtures, water, electricity, air conditioning, sanitary system etc as per JKR's Specifications for:-				
	(a) Contractor's Site Office.	L.S.	-	-	
	(b) S.O.'s Site Office.	L.S.	-	-	
1.5.2	Maintenance of Site Offices throughout the duration of the Works:-				
	(a) Contractor's Site Office.	L.S.	-	-	
	(b) S.O.'s Site Office.	L.S.	-	-	
1.5.3	Provision of Site Storage to the approval of Local Authority and JKR.	L.S.	-	-	
1.5.4	Provision for supply of water and electricity.	L.S.	-	-	
1.6	***Personnels***				
1.6.1	Provision of competent full time personnels for the work supervision and coordination throughout the duration of the Works.				
	(a) One (1) Engineer	L.S.	-	-	
	(b) Two (2) Supervisiors	L.S.	-	-	
	(c) One (1) Safety Officer	L.S.	-	-	
1.6.2	Provision of access for the Inspectors for the whole duration of the Works.	L.S.	-	-	
	Sub-total carry forward				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 1: PRELIMINARIES (2 of 3)

Item	Description	Unit	Qtty	Rate, (RM)	Amount, (RM)
	Sub-total brought forward				
1.7	***Temporary Works***				
1.7.1	Design, erection and maintenance of all Temporary Works. Such Temporary Works must be designed, supervised and duly certified by a registered Professional Engineer (P.Eng). (a) Scaffoldings and Access System. (b) All other temporary works including formworks, falseworks, shoring etc.	L.S.	-	-	
1.7.2	Provision for all necessary mobile crane, sky lifts, scaffolding and working platforms deem necessary for the Works.	L.S.	-	-	
1.7.3	Allow for suitable protection and precautionary measures to existing as-built features of the Bridge Structure during the Works.	L.S.	-	-	
1.7.4	Provision of all necessary barricades, hoardings, temporary shoring etc for the protection of the Works and the protection of the Public from the Works.	L.S.	-	-	
1.8	***Traffic and Safety***				
1.8.1	Design, provision, authority submission and maintenance of all traffic management works including signboards, night lightings, flagmen etc for the whole duration of the Works.	L.S.	-	-	
1.8.2	Provision of all necessary watching and protection of the Works as required by Local Authority or JKR for the whole duration of the Works.	L.S.	-	-	
1.9	***Documentations***				
1.9.1	Provision of ten (10) sets of progress report every month in JKR approved format for the whole duration of the Works. Such reports shall include suitable progress photographs.	L.S.	-	-	
1.9.2	Provision of ten (10) sets of Completion Reports with relevant photographic records of the completed Works.	L.S.	-	-	
1.9.3	Provision of ten (10) sets of As-Built Drawings (A1 and A3 Size) of the completed works with two (2) sets of Softcopy CDs (Autocad and PDF).	L.S.	-	-	
	Sub-total carry forward				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 1: PRELIMINARIES (3 of 3)

Item	*Description*	*Unit*	*Qtty*	*Rate, (RM)*	*Amount, (RM)*
	Sub-total brought forward				
1.10	Compliance of all the clauses and the Condition of Contracts, Specifications, Drawings etc not specifically mentioned here so that all the specified Works can be completed timely and as per requirements.	L.S.	-	-	
1.11	Keeping the Work Site including the Bridge Deck clean and tidy at all times. All debris shall be removed regularly from the site.	L.S.	-	-	
1.12	Site clearing upon completion of the Works.	L.S.	-	-	
1.13	Any other item not listed above but deem indispensably necessary to be executed by the Contractor:- (a) ---------- (b) ---------- (c) ---------- (d) ---------- (e) ----------				
	Sub-total to Summary				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 2: ENGINEERING INPUT

Item	*Description*	*Unit*	*Qtty*	*Rate, (RM)*	*Amount, (RM)*
2.1	Provision of Supervising Consulting Engineer by Contractor for the following inputs :-	L.S.	-	-	
2.1.1	Review and evaluate method statements and shop drawings prepared by the contractor.				
2.1.2	Assisting in all site technical issues by the Contractor during construction work.				
2.1.3	Provide nominal supervision during the Works to satisfy that the works are executed according to contract or otherwise in accordance to good engineering practices.				
2.1.4	Provide Final Inspection and Certification to the completed Work.				
2.1.5	Check and verify monthly progress report prepared by the Contractor.				
2.1.6	Check and verify monthly and progress claims prepared by the Contractor.				
2.1.7	Check and verify "As-built" drawings and Completion Report prepared by the Contractor at the completion of the works.				
2.1.8	Certification by a Professional Engineer on the completed Structural Rehabilitation Work.				
	Sub-total to Summary				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 3: BRIDGE DECKS

Item	Description	Unit	Qtty	Rate, (RM)	Amount, (RM)
	All Works to be carried in accordance to the Specifications and Drawings ref. JKR/JSI/TC/SW/01-06				
3.1	Removal and disposal of the deteriorated bridge deck's expansion joints near the piers and abutments.	m	85		
3.2	Supply, lay and fix approved Asphaltic Plug Expansion Joint System to replace the existing deteriorated expansion joints. The Contractor to submit sample and specification of the proposed expansion joints to the Client for approval prior to the installation on-site.	m	85		
3.3	Resurfacing of Existing Premix Surfaces of the Bridge Deck (a) Full milling of existing full premix thickness to the base of the concrete deck. (b) Cleaning of the exposed Bridge Deck concrete surface by compressed air or other means. (c) Application of bituminious tack coat to the prepared concrete surface. (d) Resurface of the Bridge Deck with at least 65mm thick asphaltic concrete with surface to match existing level.	m^2	2705		
3.4	Provision for similar resurfacing works as Item 3.3 to the Bridge's Approaches to match the Bridge Surface Level.	m^2	600		
3.5	Any other work not listed above but deem indispensably necessary to be executed by the Contractor:- (a) ..... (b) ..... (c) ..... (d)				
	Sub-total to Summary				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 4: BRIDGE STEEL FRAMES (1 of 4)

Item	Description	Unit	Qtty	Rate, (RM)	Amount, (RM)
	All Works to be carried in accordance to the Specifications and Drawings ref. JKR/JSI/TC/SW/01-06				
4.1	***Structural Steel Strengthening Work Type 1 (Internal Arches)***				
4.1.1	Supply and fix two (2) number of M.S. Channel 152x76 (17.88 kg/m) as per "***Detail 1***" in the Drawing inclusive of all weldings, stiffener plates, base plates etc. The Contractor shall allow for *Fillet Weld Magnetic Particle Test* to be carried out at the locations (three locations per each item below) specified by the S.O.:-				
	(a) Pier 1 - Sungai Siput Side	kg	300		
	(i) Member Length = 4.0 m x 2 no				
	(ii) Member Length = 4.3 m x 2 no				
	(b) Pier 2 - Sungai Siput Side	kg	370		
	(i) Member Length = 5.0 m x 2 no				
	(ii) Member Length = 5.3 m x 2 no				
	(c) Pier 2 - Kuala Kangsar Side	kg	390		
	(i) Member Length = 5.2 m x 2 no				
	(ii) Member Length = 5.5 m x 2 no				
	(d) Pier 3 - Sungai Siput Side	kg	440		
	(i) Member Length = 6.0 m x 2 no				
	(ii) Member Length = 6.3 m x 2 no				
	(e) Pier 3 - Kuala Kangsar Side	kg	450		
	(i) Member Length = 6.1 m x 2 no				
	(ii) Member Length = 6.4 m x 2 no				
	(f) Pier 4 - Sungai Siput Side	kg	450		
	(i) Member Length = 6.1 m x 2 no				
	(ii) Member Length = 6.4 m x 2 no				
	(g) Pier 4 - Kuala Kangsar Side	kg	440		
	(i) Member Length = 6.0 m x 2 no				
	(ii) Member Length = 6.3 m x 2 no				
	(h) Pier 5 - Sungai Siput Side	kg	390		
	(i) Member Length = 5.2 m x 2 no				
	(ii) Member Length = 5.5 m x 2 no				
	(i) Pier 5 - Kuala Kangsar Side	kg	370		
	(i) Member Length = 5.0 m x 2 no				
	(ii) Member Length = 5.3 m x 2 no				
	(j) Pier 6 - Kuala Kangsar Side	kg	300		
	(i) Member Length = 4.0 m x 2 no				
	(ii) Member Length = 4.3 m x 2 no				
4.1.2	Supply all labour, materials, equipments and everything else necessary to carry out Fillet Weld Magnetic Particle Test on welding at three (3) numbers per each location above.	no	60		
	Sub-total carry forward				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 4: BRIDGE STEEL FRAMES (2 of 4)

Item	Description	Unit	Qtty	Rate, (RM)	Amount, (RM)
	Sub-total brought forward				
4.2	***Structural Steel Strengthening Work Type 2 (External Arches)*** Repair to the crack line on the steel plate and to provide expansion joint to the identified steel member. The Work to be carried as per "***Detail 2***" and the construction sequences illustrated in the Drawing inclusive of all weldings, stiffener plates, base plates etc. (a) Provide temporary support frame as per Drawings. (i) M.S. SHS 150x150x8 (35.4 kg/m) ~ 3.4m/loc (ii) M.S. Channel 152x76 (17.88 kg/m) ~ 1.2m/loc (b) Other Works Description:- (i) Remove the existing splicing plate at the steel member per Drawings. (ii) Drill to form 6mm diameter holes at each end of the crack lines. Prepare the crack lines on the steel plate using grinder for Full Penetration Butt Weld later. (iii) Supply and fix 10mm thick 50mm wide M.S. plate along the crack line at the bridge's internal side using 10mm fillet weld all around. (iv) Along the prepared crack lines, perform Full Penetration Butt Weld. (v) Enlarged existing rivet/bolt holes to form the new larger bolt holes on the steel plate. (vi) Supply and fix new splicing plate as per the Drawing. (vii) Remove the temporary support frame upon completion of the work. (c) Ultrasonic Testing to the Full Penetration Butt Weld.	Loc Loc	10 10		
4.3	***Structural Steel Strengthening Work Type 3 (External Arches)*** Provide expansion joint to the identified steel member. The Work to be carried as per "***Detail 3***" and the construction sequences illustrated in the Drawings. (a) Provide temporary support frame as per Drawings. (i) M.S. SHS 150x150x8 (35.4 kg/m) ~ 3.4m/loc (ii) M.S. Channel 152x76 (17.88 kg/m) ~ 1.2m/loc (b) Other Works Description:- (i) Remove the existing splicing plate at the steel member per Drawings. (ii) Enlarged existing rivet/bolt holes to form the new larger bolt holes on the steel plate. (iii) Supply and fix new splicing plate as per the Drawing. (iv) Remove the temporary support frame upon completion of the work.	Loc	14		
	Sub-total carry forward				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 4: BRIDGE STEEL FRAMES (3 of 4)

Item	Description	Unit	Qtty	Rate, (RM)	Amount, (RM)
	Sub-total brought forward				
4.4	***General Structural Steel Work Type A*** Provision for supply and fix new steel members to replace the identified corroded steel members via welding to match existing as per the "***Detail 4***" in the Drawing. => M.S. EA 130x130x9 (17.9 kg/m)	kg	750		
4.5	***General Structural Steel Work Type B*** Provision for supply and fix new M20 Galvanized Bolts/Nuts to replace the missing rivets.	No	9		
4.6	***General Structural Steel Work Type C*** Overall repainting work to all the steel members of the Bridge's Steel Frames:- (a) Removal of all laitance, oil, grease, loose particles, rust, decayed matter, moss, algae growth or other contaminants on the steel surface. The surface preparation to be abrasive blasting in accordance to Sa 2 ½. The Contractor shall allow in his cost the necessary compliance of all Local Authority's requirements (e.g. submission, environmental protection etc) (b) Supply and apply the following products or approved equivalent to the manufacturer's specifications:- (i) *1st Coat* - 200µ (DFT) of Approved High Built Surface Tolerance Epoxy Primer. (ii) *2nd Coat* - 150µ (DFT) of Approved High Built Surface Tolerance Epoxy Primer. (iii) *Top Coat* - 50µ (DFT) of Aliphatic Acrylic Polyurethane Coating				
4.6.1	Bridge Span 1 (Sungai Siput Side)	m²	1100		
4.6.2	Bridge Span 2	m²	1300		
4.6.3	Bridge Span 3	m²	1500		
4.6.4	Bridge Span 4	m²	1600		
4.6.5	Bridge Span 5	m²	1500		
4.6.6	Bridge Span 6	m²	1300		
4.6.7	Bridge Span 7 (Kuala Kangsar Side)	m²	1100		
	Sub-total carry forward				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 4: BRIDGE STEEL FRAMES (4 of 4)

Item	Description	Unit	Qtty	Rate, (RM)	Amount, (RM)
	Sub-total brought forward				
4.7	***General Structural Steel Work Type D*** Overall repainting work to the soffit of the Bridge's Metal Deck :- (a) Removal of all laitance, oil, grease, loose particles, rust, decayed matter, moss, algae growth or other contaminants on the steel surface. The surface preparation to be abrasive blasting in accordance to Sa 2 ½. The Contractor shall allow in his cost the necessary compliance of all Local Authority's requirements (e.g. submission, environmental protection etc) (b) Supply and apply the following products or approved equivalent to the manufacturer's specifications:- (i) *1st Coat* - 150µ (DFT) of Approved High Built Surface Tolerance Epoxy Primer. (ii) *Top Coat* - 50µ (DFT) of Aliphatic Acrylic Polyurethane Coating				
4.7.1	Bridge Span 1 (Sungai Siput Side)	m²	450		
4.7.2	Bridge Span 2	m²	560		
4.7.3	Bridge Span 3	m²	650		
4.7.4	Bridge Span 4	m²	690		
4.7.5	Bridge Span 5	m²	650		
4.7.6	Bridge Span 6	m²	560		
4.7.7	Bridge Span 7 (Kuala Kangsar Side)	m²	450		
4.8	***General Structural Steel Work Type E*** Maintenance to the Bearing:- The "rocker" type steel bearing to remain in-place. The servicing will include general cleaning up around the exposed and accessible surfaces using mechanical means (for rust cleaning etc) and by using compressed air blast. All cleaned surfaces shall then be coated with a low viscosity grease.	no.	56		
4.9	Any other work not listed above but deem indispensably necessary to be executed by the Contractor:- (a) ---------- (b) ---------- (c) ---------- (d) ----------				
	Sub-total to Summary				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 5: BRIDGE PIERS AND ABUTMENTS

Item	Description	Unit	Qtty	Rate, (RM)	Amount, (RM)
	All Works to be carried in accordance to the Specifications and Drawings ref. JKR/JSI/TC/SW/01-06				
5.1	*Provisional Quantities for repair to Crack Line at the Column and Its Base at Pier 4* Pressure Grouting to fill ***crack line exceeding 2mm wide*** as per Specification.	m	30		
5.2	Carry out minor non-structural concrete surface patch repair to identified concrete surfaces of the piers (with minor concrete spalls) using hand-patch shrinkage compensating grout (minimum compressive strength 40 N/mm² in the following manner:- (a) Prepare concrete subtrate by removing all loose concrete surfaces till sound concrete using chisel or mechanical means. (b) Clean the prepared concrete surface with water jet. (c) Apply Shrinkage Compensating Grout using hand-patching method in thickness of up to 100mm. (d) Cure the repaired concrete surface with water for minimum 3 days.				
	For locations refer to Drawing ref JKR/JSI/TC/SW/02				
5.2.1	Pier 1 (Kuala Kangsar side) - Location PR1	m²	0.3		
5.2.2	Pier 2 (Sungai Siput side) - Location PR2	m²	0.5		
5.2.3	Pier 5 (Sungai Siput side) - Location PR3	m²	0.4		
5.2.4	Pier 5 (Kuala Kangsar side) - Location PR4	m²	0.5		
5.3	Any other work not listed above but deem indispensably necessary to be executed by the Contractor:- (a) _____ (b) _____ (c) _____ (d) _____				
	Sub-total to Summary				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 6: OTHER WORKS

Item	*Description*	*Unit*	*Qtty*	*Rate, (RM)*	*Amount, (RM)*
6.1	Provision for the removal and disposal from the site the unused inspection platforms.	no	7		
6.2	Any other work not listed above but deem indispensably necessary to be executed by the Contractor:- (a) _____ _____ (b) _____ _____ (c) _____ _____ (d) _____ _____ _____				
	Sub-total to Summary				

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

BILL NO. 7: PROVISIONAL SUM

Item	*Description*	*Unit*	*Qtty*	*Rate, (RM)*	*Amount, (RM)*
7.1	Provisional Sum for the construction of new concrete access pathway and steps with railings from the Bridge Deck Level down to the base of Abutment 1 (Sungai Siput end). The Contractor shall submit the proposed design to the Client for approval prior to the construction on-site.	Provisional Sum		-	100,000
	Sub-total to Summary				**100,000**

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

BILL OF PROVISIONAL QUANTITIES

SUMMARY

ITEM	*BILL NO.*	*DESCRIPTION*	*AMOUNT, RM*
1	1	Preliminaries ~ 25%	
2	2	Engineering Input ~ 5%	
3	3	Bridge Decks	
4	4	Bridge Steel Frames	
5	5	Bridge Piers and Abutment	
6	6	Other Works	
7	7	Provisional Sum	100,000
8		6% Goods and Services Tax	
9		Contigency Sum	500,000
Total			

(RINGGIT MALAYSIA : .....

.....

.....)

Duration : ..... ( ) weeks.

.....

Signature of Contractor

Name: .....

Designation: .....

Address: .....

.....

.....

.....

.....

Date: .....

.....

Signature of Witness

Name: .....

Designation: .....

Address: .....

.....

.....

.....

.....

Date: .....

RPT/TC/275/TenderDocuments

APPENDIX 2

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

TENDER DOCUMENTS

APPENDIX 2

DRAWINGS FOR THE PROPOSED STRUCTURAL WORKS

LIST OF DRAWINGS

NO	DRAWING TITLE	DRAWING REFERENCE
(1)	CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK - DRAWINGS LIST AND GENERAL NOTES	JKR/JSI/TC/SW/01
(2)	CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK - GENERAL LAYOUT FOR THE PROPOSED STRUCTURAL WORKS	JKR/JSI/TC/SW/02
(3)	CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK - PROPOSED STEEL STRENGTHENING TYPE 1	JKR/JSI/TC/SW/03
(4)	CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK - PROPOSED STEEL STRENGTHENING TYPE 2	JKR/JSI/TC/SW/04
(5)	CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK - PROPOSED STEEL STRENGTHENING TYPE 3	JKR/JSI/TC/SW/05
(6)	CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK - OTHER STRUCTURAL WORK DETAILS	JKR/JSI/TC/SW/06

GENERAL NOTES:-

1. Any discrepancies on-site shall be referred to the S.O.
2. All dimensions and levels shown in the drawings are metric and in mm unless otherwise indicated.
3. The Contractor shall carry out site survey prior to construction. Any discrepancies between the as-built structural layout/dimension/members and the Drawings shall be reported to the S.O. immediately.
4. Figured dimensions must be used at all times. Drawings are not to be scaled.
5. The Contractor shall submit Method Statements for all works to be carried out for approval.
6. Temporary works:-
   a. All temporary works shall be designed, supervised and duly certified by a registered Professional Engineer.
   b. Such design shall be submitted to the S.O. for approval prior to the work on-site.
7. In the event of discrepancy between these notes and the Specifications, these notes shall govern.
8. For any dimensions and details not shown, the Contractor can refer to "As-Built Structural Details" drawing no. JKR/JSI/TC/BR/01 to JKR/JSI/TC/BR/55.
9. The Contractor shall advise and arrange with the S.O. or its representative when the works shown on drawings are ready for inspection/approval before concealing them. All inspection records including materials certification should be properly documented at all times.

NOTES ON STRUCTURAL STEEL WORK

1. Materials:-
   a. Mild Steels (M.S.) - BS EN 10025 Grade S275, BS 5950 Grade 43 or Equivalent.
   b. High Strength Bolts - BS 3692 Grade 8.8, ASTM 325 or Equivalent.
2. Connections:-
   a. All bolts shall be high tensile bolts Grade 8.8 complying to BS 3692 unless stated otherwise.
   b. Holes for high strength bolts shall be not more than 2mm larger than the diameter of bolt.
   c. Unless otherwise specified, 20mm diameter bolts shall be provided.
   d. Welding shall comply to BS 5135.
   e. Unless otherwise specified, 10mm fillet weld (leg length = 10mm) shall be provided.
5. Prior to any welding work, the welder's Welding Performance Qualification (WPQ) Certificate shall be submitted for approval.
6. The Contractor shall prepare and submit all necessary shop drawings for the work including the erection details and connection/joint details. All shop drawings to be approved in writing by the Supervising Engineer before commencement of the work.
7. All construction shall comply with relevant British Standard, the Contractor shall be responsible for advising the S.O. concerning any discrepancies.

PROPERTIES OF THE PROPOSED STEEL MEMBERS

Member Designation	Depth (mm)	Width (mm)	Web Thickness (mm)	Flange Thickness (mm)	Section Area (mm^2)
M.S. Channel 152 x 76 (17.88 kg/m)	152.4	76.2	6.4	9.0	2280
M.S SHS 150x150 x8 (35.4 kg/m)	150	150	8.0	8.0	4510
M.S. EA 130x130x9 (17.9kg/m)	130	130	9.0	9.0	2274

NOTA

PELANGGAN

KERAJAAN MALAYSIA

PEGAWAI PENGUASA

JABATAN KERJA RAYA

PIHAK PERUNDING

T-CORP ENGINEERS SDN BHD
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PROJEK

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK
- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

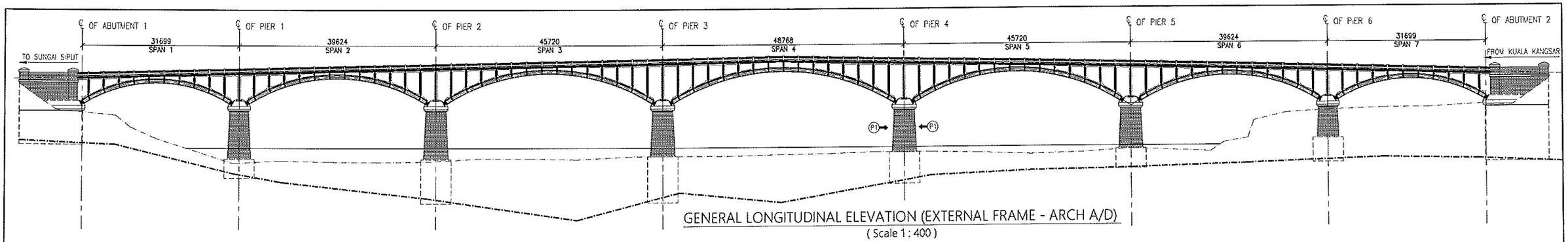
TAJUK LUKISAN

CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK
-- DRAWINGS LIST AND GENERAL NOTES

NO LUKISAN: JKR/JSI/TC/SW/01

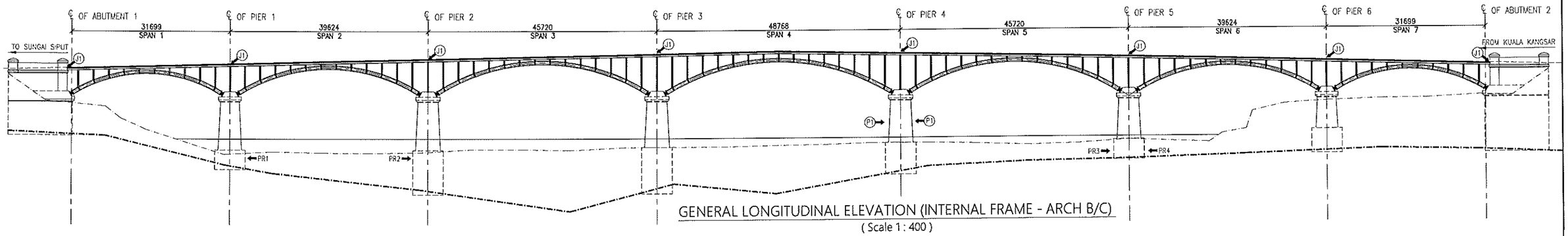
Dilukis Oleh	WMF	Skala	AS SHOWN (A1)
Tarikh	MAY 2015	Diluluskan Oleh	
Disemak Oleh	TKW	T. Tangan	

TARIKH	BUTIR PINDAAN	RUJUKAN
8/7/15	Revised as commented by JKR	A



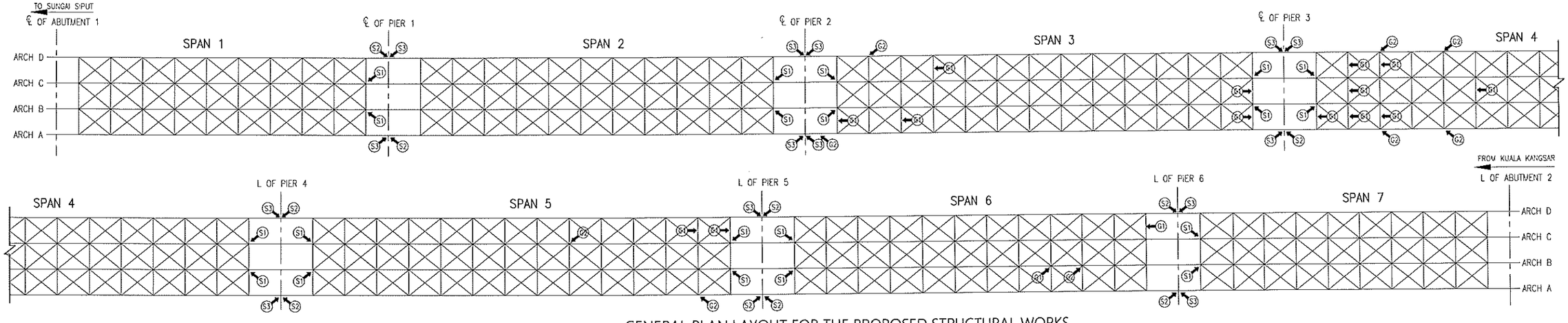
GENERAL LONGITUDINAL ELEVATION (EXTERNAL FRAME - ARCH A/D)

(Scale 1 : 400)



GENERAL LONGITUDINAL ELEVATION (INTERNAL FRAME - ARCH B/C)

(Scale 1 : 400)



GENERAL PLAN LAYOUT FOR THE PROPOSED STRUCTURAL WORKS

(Scale 1 : 200)

LEGEND

- S1 → Structural Steel Strengthening Work Type 1 (refer drawing ref JKR/JSI/TC/SW/03) ~ 20 Locations
- S2 → Structural Steel Strengthening Work Type 2 (refer drawing ref JKR/JSI/TC/SW/04) ~ 10 Locations
- S3 → Structural Steel Strengthening Work Type 3 (refer drawing ref JKR/JSI/TC/SW/05) ~ 14 Locations
- G1 → General Structural Steel Work Type A (refer drawing ref JKR/JSI/TC/SW/06) ~16 Locations
- G2 → General Structural Steel Work Type B – replacement of missing rivets/bolts/nuts ~ 9 Locations
- J1 → Replacement of Bridge Deck's Expansion Joint (refer drawing ref JKR/JSI/TC/SW/06) ~ 8 Locations
- P1 → Pressure Grouting Pier's Crack Line (refer drawing ref JKR/JSI/TC/SW/06) ~ 2 Locations

Concrete Patch Repair to Piers Locations:–

- PR1 → Pier 1
- PR2 → Pier 2
- PR3 → Pier 5
- PR4 → Pier 5

NOTA

PELANGGAN

KERAJAAN MALAYSIA

PEGAWAI PENGUASA

JABATAN KERJA RAYA

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PROJEK

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK

- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

TAJUK LUKISAN

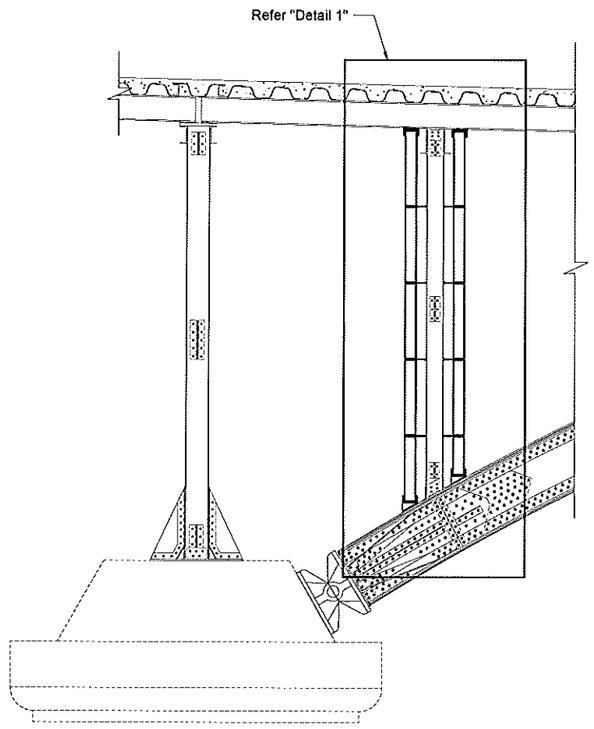
CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK

– GENERAL LAYOUT FOR THE PROPOSED STRUCTURAL WORKS

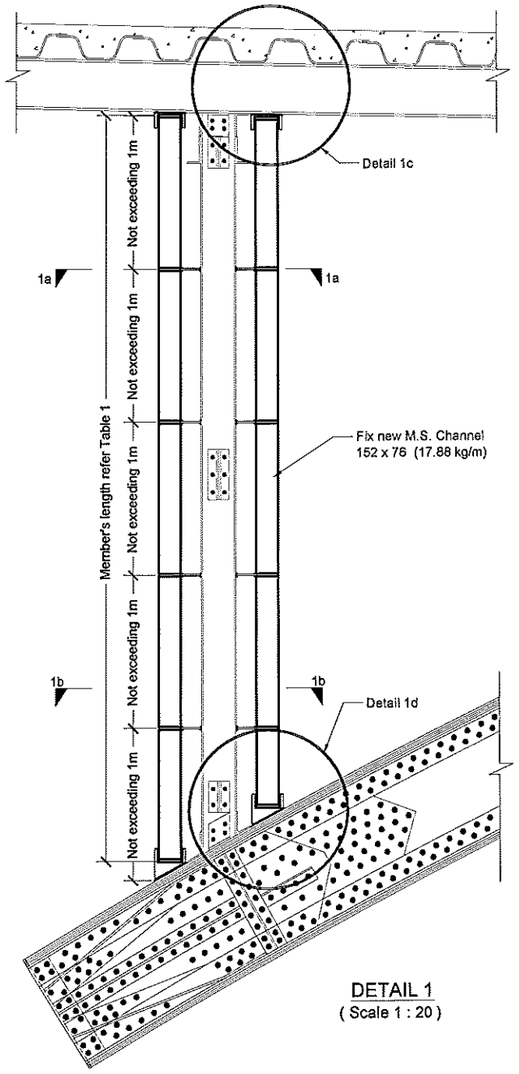
NO LUKISAN: JKR/JSI/TC/SW/02

Dilukis Oleh	WMF	Skala	AS SHOWN
Tarikh	JUNE 2015	Disemak Oleh	
Disemak Oleh	TKW	Diluluskan Oleh	T. Tangan

TARIKH	BUTIR PINDAAN	RUJUKAN
8/7/15	Revised as commented by JKR	A
23/7/15	Add Concrete Patch Repair Area	B



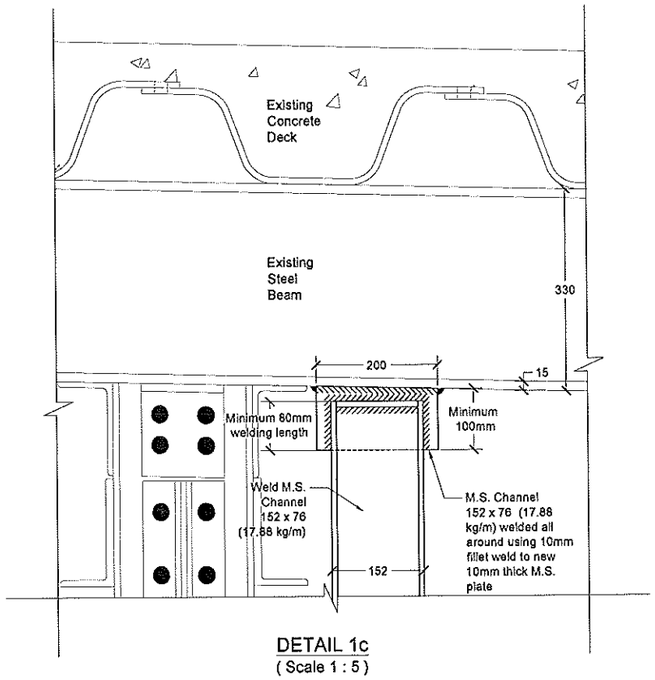
STRUCTURAL STEEL STRENGTHENING TYPE 1
(Scale 1 : 40)



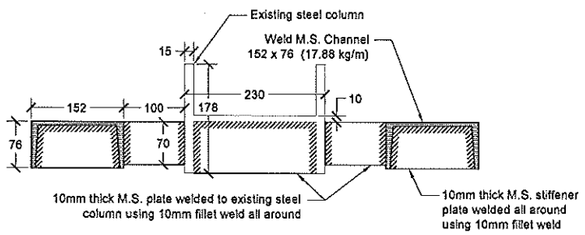
DETAIL 1
(Scale 1 : 20)

Table 1 Length of the new M.S. Channel 152 x 76 (17.88 kg/m)	
Location	Member's Length
Pier 1 - Sungai Siput Side	4.0m x 2 no , 4.3m x 2 no
Pier 2 - Sungai Siput Side	5.0m x 2 no , 5.3m x 2 no
Pier 2 - Kuala Kangsar Side	5.2m x 2 no , 5.5m x 2 no
Pier 3 - Sungai Siput Side	6.0m x 2 no , 6.3m x 2 no
Pier 3 - Kuala Kangsar Side	6.1m x 2 no , 6.4m x 2 no
Pier 4 - Sungai Siput Side	6.1m x 2 no , 6.4m x 2 no
Pier 4 - Kuala Kangsar Side	6.0m x 2 no , 6.3m x 2 no
Pier 5 - Sungai Siput Side	5.2m x 2 no , 5.5m x 2 no
Pier 5 - Kuala Kangsar Side	5.0m x 2 no , 5.3m x 2 no
Pier 6 - Kuala Kangsar Side	4.0m x 2 no , 4.3m x 2 no

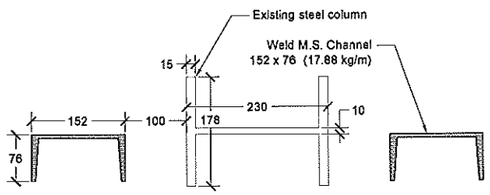
Note:-
Contractor to prepare Shop Drawings for submission to the S.O. for approval prior to the fabrication work. All dimensions stated are for reference only and must be verified on-site by the Contractor before the fabrication work.



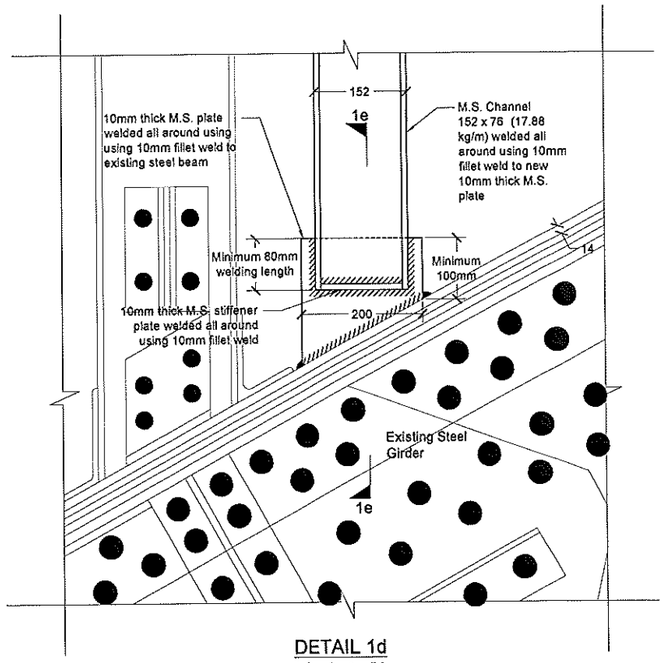
DETAIL 1c
(Scale 1 : 5)



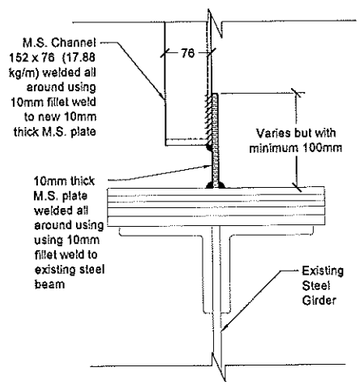
SECTION 1a-1a
(Scale 1 : 5)



SECTION 1b-1b
(Scale 1 : 5)



DETAIL 1d
(Scale 1 : 5)



SECTION 1e-1e
(Scale 1 : 5)

- All fillet weld shall be 10mm thick unless otherwise stated
- Allow Fillet Weld Magnetic Particle Test at three (3) random locations specified by the S.O. for each strengthening locations (Total = 3 x 20 = 60 numbers)

NOTA

PELANGGAN
KERAJAAN MALAYSIA

PEGAWAI PENGUASA
JABATAN KERJA RAYA

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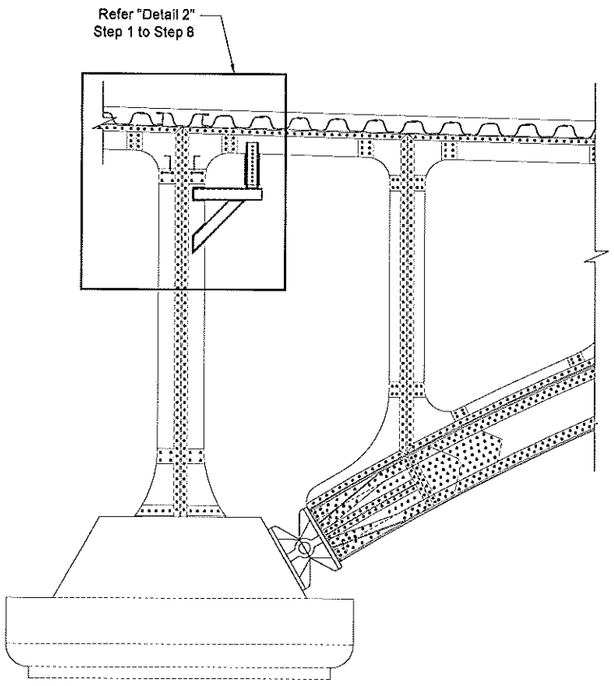
PROJEK
KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK
- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

TAJUK LUKISAN
CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK
– PROPOSED STEEL STRENGTHENING TYPE 1

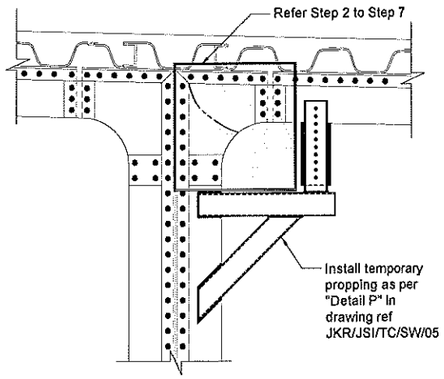
NO LUKISAN: JKR/JSI/TC/SW/03

Dilukis Oleh	WMF	Skala	AS SHOWN (A1)
Tarikh	MAY 2015	Diluluskan Oleh	
Disemak Oleh	TKW		T. Tangan

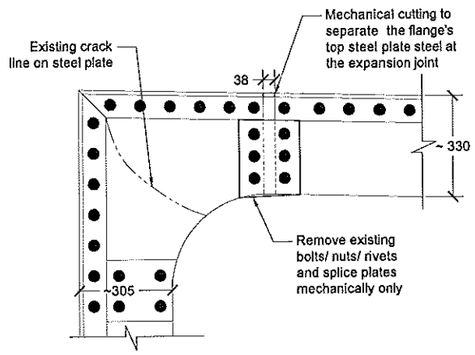
TARIKH	BUTIR PINDAAN	RUJUKAN
6/7/15	Revised as commented by JKR	A



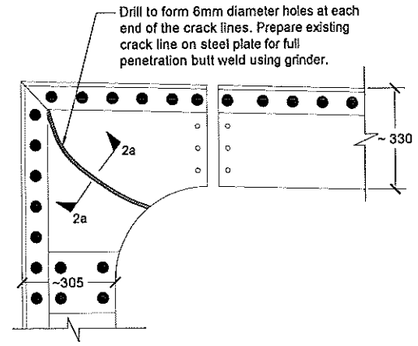
STRUCTURAL STEEL STRENGTHENING TYPE 2
(Scale 1 : 40)



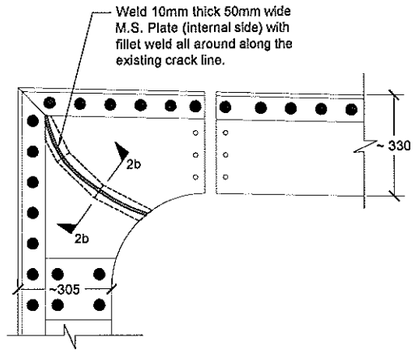
DETAIL 2 - STEP 1
(Scale 1 : 20)



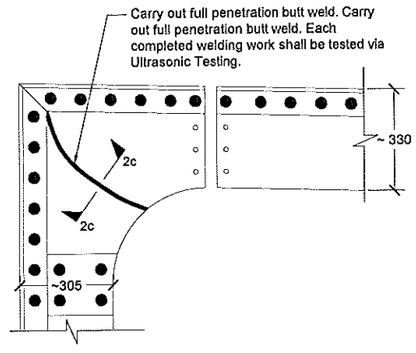
DETAIL 2 - STEP 2
(Scale 1 : 10)



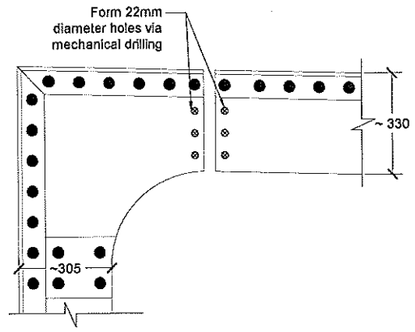
DETAIL 2 - STEP 3
(Scale 1 : 10)



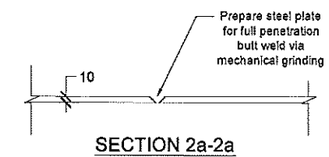
DETAIL 2 - STEP 4
(Scale 1 : 10)



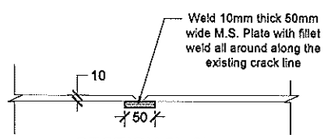
DETAIL 2 - STEP 5
(Scale 1 : 10)



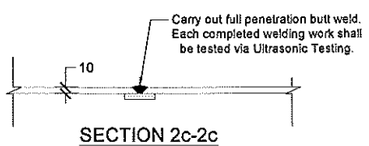
DETAIL 2 - STEP 6
(Scale 1 : 10)



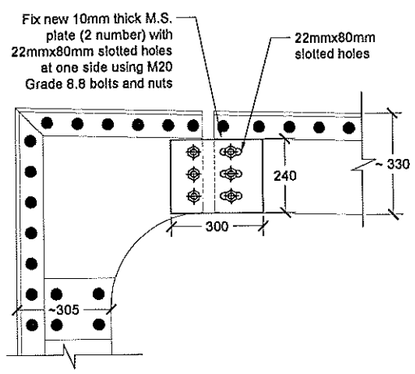
SECTION 2a-2a
(Scale 1 : 5)



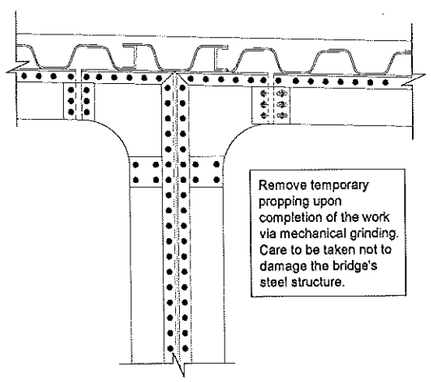
SECTION 2b-2b
(Scale 1 : 5)



SECTION 2c-2c
(Scale 1 : 5)



DETAIL 2 - STEP 7
(Scale 1 : 10)



DETAIL 2 - STEP 8
(Scale 1 : 20)

- All fillet weld shall be 10mm thick unless otherwise stated.
- Allow Ultrasonic Testing for each location of the full penetration butt weld crack line repair.

NOTA

PELANGGAN

KERAJAAN MALAYSIA

PEGAWAI PENGUASA

JABATAN KERJA RAYA

PIHAK PERUNDING

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PROJEK

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK

- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

TAJUK LUKISAN

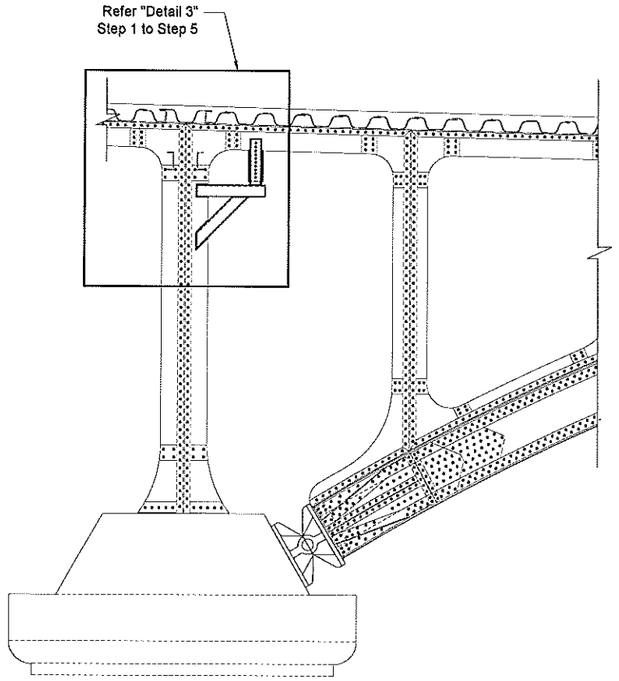
CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK

-- PROPOSED STEEL STRENGTHENING TYPE 2

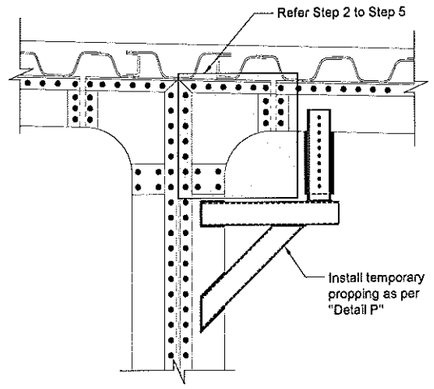
NO LUKISAN: JKR/JSI/TC/SW/04

Dilukis Oleh	WMF	Skala	AS SHOWN (A1)
Tarikh	MAY 2015	Diluluskan Oleh	
Disemak Oleh	TKW	T. Tangan	

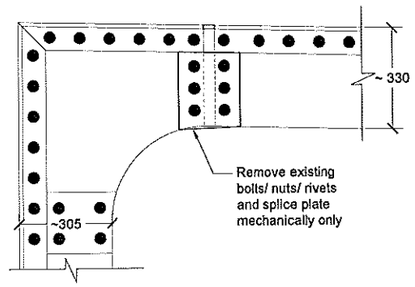
TARIKH	BUTIR PINDAAN	RUJUKAN
8/7/15	Revised as commented by JKR	A



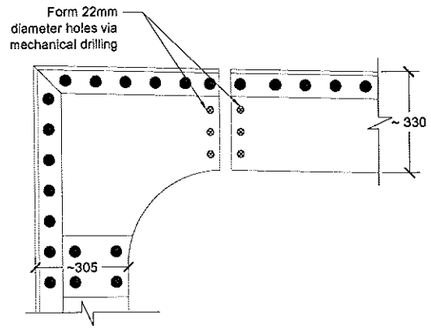
STRUCTURAL STEEL STRENGTHENING TYPE 3
(Scale 1 : 40)



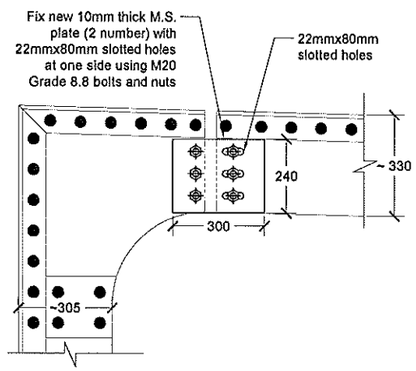
DETAIL 3 - STEP 1
(Scale 1 : 20)



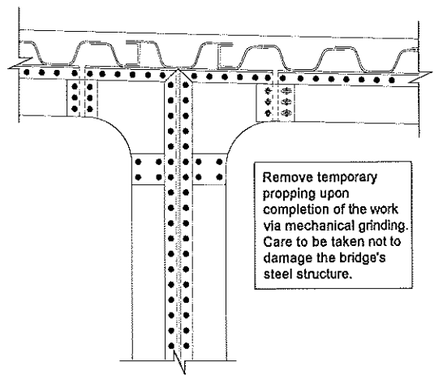
DETAIL 3 - STEP 2
(Scale 1 : 10)



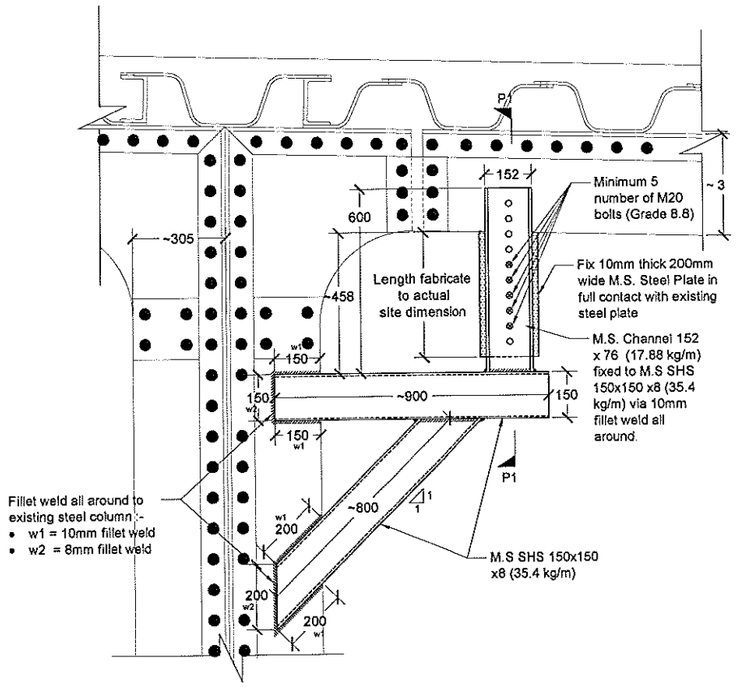
DETAIL 3 - STEP 3
(Scale 1 : 10)



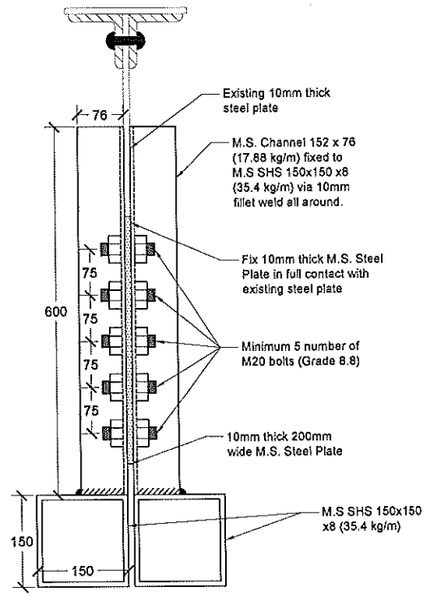
DETAIL 3 - STEP 4
(Scale 1 : 10)



DETAIL 3 - STEP 5
(Scale 1 : 20)



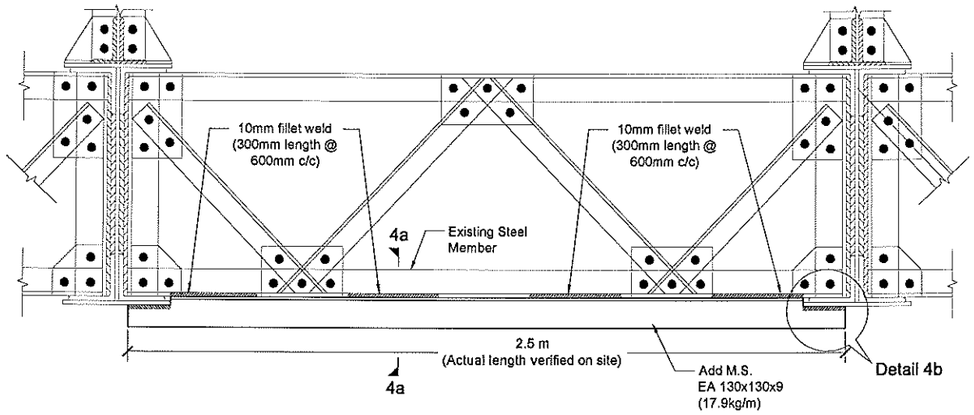
DETAIL P - TEMPORARY PROPPING DETAIL
(Scale 1 : 10)
Note:- Two (2) frames at each indicated location (one at each side).



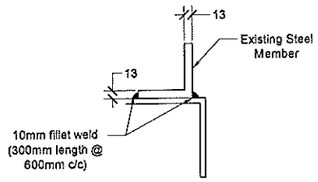
SECTION P1-P1
(Scale 1 to 5)

All fillet weld shall be 10mm thick unless otherwise stated

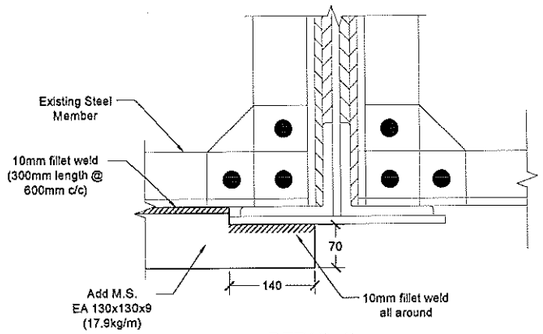
NOTA	PELANGGAN KERAJAAN MALAYSIA	PEGAWAI PENGUASA JABATAN KERJA RAYA	PIHAK PERUNDING T-CORP ENGINEERS SDN BHD NO. 80-9, JALAN SS21/39, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR TEL : 03-7710 1382 ; 03-7710 1300 FAX : 03-7710 1398	PROJEK KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK – PROPOSED STEEL STRENGTHENING TYPE 3 NO LUKISAN: JKR/JSI/TC/SW/05	Dilukis Oleh: WMF; Skala: AS SHOWN (A1) Tarikh: MAY 2015; Disemak Oleh: T. Tangan Disemak Oleh: TKW TARIKH / BUTIR PINDAAN / RUJUKAN 8/7/15 — Revised as commented by JKR — A



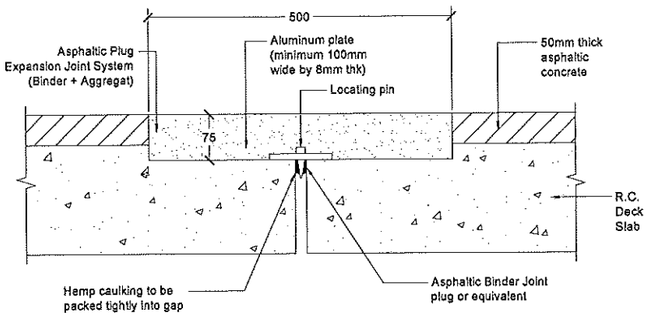
DETAIL 4 : GENERAL STEEL WORK TYPE A
- TYPICAL DETAIL FOR FIXING ADDITIONAL STEEL MEMBERS TO CORRODED STEEL MEMBERS
(Similar detail for other steel members)
(Scale 1 : 10)



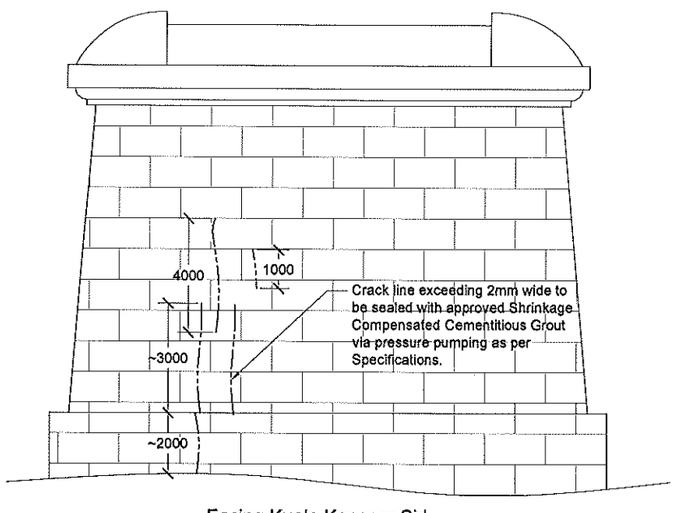
DETAIL 4a-4a
(Scale 1 : 5)



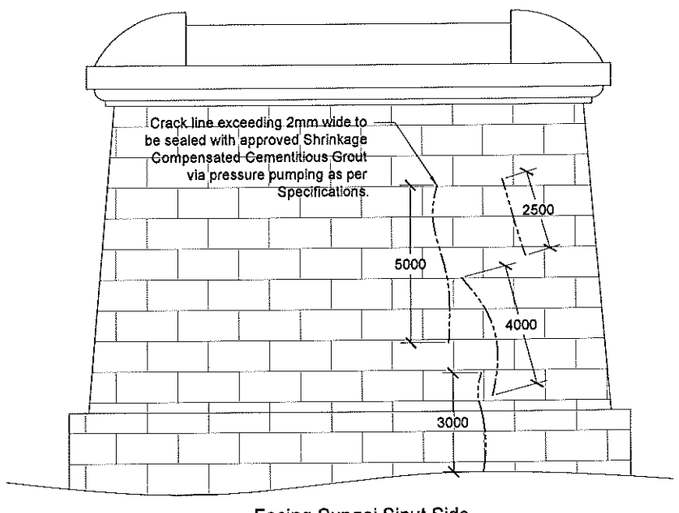
DETAIL 4b
(Scale 1 : 5)



DETAIL J1
TYPICAL DETAIL FOR BRIDGE'S DECK EXPANSION JOINT
(Scale 1 : 5)



Facing Kuala Kangsar Side



Facing Sungai Siput Side

DETAIL P1
PRESSURE GROUTING TO PIER'S CRACK LINE AT PIER 4
(Scale 1 : 80)

Note:- All dimensions are for reference only and must be verified on-site by the Contractor and submit to the S.O. for approval prior to the work on-site.

GENERAL DESCRIPTIONS ON OTHER WORKS

1. General Steel Work Type B
   Fix new M20 Galvanized Bolts/Nuts to replace the missing rivets.

2. General Steel Work Type C - Overall Repainting to All Steel Members of the Bridge's Steel Frames
   a. Removal of all laitance, oil, grease, loose particles, rust, decayed matter, moss, algae growth or other contaminants on the steel surface. The steel surface preparation to be abrasive blasting in accordance to Sa 2.5.
   b. Painting Systems:-
      - 1st Coat - 200µ (DFT) of Approved High Built Surface Tolerance Epoxy Primer.
      - 2nd Coat - 150µ (DFT) of Approved High Built Surface Tolerance Epoxy Coating.
      - Top Coat - 50µ (DFT) of Approved Aliphatic Acrylic Polyurethane Coating.

3. General Steel Work Type D - Overall Repainting to All Steel Members of the Bridge's Steel Frames
   a. Removal of all laitance, oil, grease, loose particles, rust, decayed matter, moss, algae growth or other contaminants on the steel surface. The steel surface preparation to be abrasive blasting in accordance to Sa 2.5.
   b. Painting Systems:-
      - 1st Coat - 150µ (DFT) of Approved High Built Surface Tolerance Epoxy Primer.
      - Top Coat - 50µ (DFT) of Approved Aliphatic Acrylic Polyurethane Coating.

All fillet weld shall be 10mm thick unless otherwise stated

NOTA	PELANGGAN: KERAJAAN MALAYSIA	PEGAWAI PENGUASA: JABATAN KERJA RAYA	PIHAK PERUNDING: T-CORP ENGINEERS SDN BHD, NO. 60-B, JALAN SS21/39, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR, TEL : 03-7710 1382 ; 03-7710 1390, FAX : 03-7710 1396	PROJEK: KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN: CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR JAMBATAN SULTAN ISKANDAR DI LALUAN FT 001/639/90, KUALA KANGSAR, PERAK – OTHER STRUCTURAL WORK DETAILS; NO LUKISAN: JKR/JSI/TC/SW/06	Dilukis Oleh: WMF; Tarikh: MAY 2015; Disemak Oleh: TKW; Skala: AS SHOWN (A1); Ditukarkan Oleh; T. Tangan	
						TARIKH	BUTIR PINDAAN	RUJUKAN
						8/7/15	Revised as commented by JKR	A

RPT/TC/275/TenderDocuments

APPENDIX 3

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

TENDER DOCUMENTS

APPENDIX 3

- PRESSURE GROUTING SPECIFICATIONS
- STRUCTURAL STEELWORK SPECIFICATIONS
- PROTECTIVE COATING SYSTEM TO STEEL SURFACE
- ASPHALTIC PLUG JOINT

SPECIFICATION FOR PRESSURE GROUTING

1.0 GENERAL

1.1 Submittals

The Contractor shall submit the following particulars for each of the Pumpable Shrinkage Compensated Cementitious Grout.

i. Material brand name, specification and properties stating Standards to which the materials comply.

ii. Name of manufacturer.

iii. Manufacturer's brochures on the use of the product.

iv. Mix composition of grout & sealant compound to be used.

v. Certified true copies of product Approval Certificate from a National or International Standard's Institution.

1.2 Pumpable Shrinkage Compensated Cementitious Grout Product

The Grout to be used shall be of such temperature class suitable for use in tropical climate and of such viscosity grade suitable for application using pump and shall be able to fill the void completely.

1.3 Sealant Compound

The Sealant compound shall be able to withstand the maximum grouting pressure without leak.

1.4 Quality Assurance

1.4.1 Labelling

All Grout & Sealant containers shall have the following markings:-

(a) Name of manufacturer.

(b) Manufacturer's product identification.

(c) Manufacturer's instructions for mixing.

(d) Warning for handling and toxicity.

1.4.2 Procedures for Use

The Contractor as a condition precedent to the use of any Grout & Sealant formulation, shall submit to the Engineer for his approval, the mixing and application procedures to be adopted in the Works.

1.4.3 Product Delivery, Storage and Handling

1.4.3.1 Delivery of Materials

All Grout & Sealant materials shall be delivered in manufacturer's sealed containers with labels legible and intact.

1.4.3.2 Storage of Materials

All Grout & Sealant materials shall be properly stored in weatherproof store at temperatures between 4°C - 38°C (40 - 100°F) or otherwise recommended by the manufacturer.

1.4.3.3 Handling of Materials

All Grout & Sealant products shall be handled in a safe manner and in a way that shall avoid breaking container seal.

1.5 Aggregate

The aggregate shall in general comply with MS.29. All aggregates shall be hard, storage durable, clean and free from adherent coating and shall not contain harmful materials in sufficient quantity to affect adversely the strength or durability of the concrete or to attack the reinforcement. Aggregates shall be stored in such a manner as to prevent contamination by undesirable substance. The different type of aggregates shall be stored in separate bins and not be allowed to intermingle.

1.5.1 Fine Aggregate

The fine aggregates shall be naturally occurring fresh water sand. The aggregates shall not contain silt or other fine materials exceeding 3% by volume when tested according to the Standard Method given in MS.30. Neither shall it contain organic material in sufficient quantity to show a darker colour than the standard depth of colour No. 3 when tested according to the method in MS.30. The use of crushed stone sand shall not be permitted.

2.0 Execution

2.1 Temporary Supports and Props

Before repair may be done to any structural member, the Contractor shall provide adequate supports and props to the structural members to ensure the safety and stability of the members and the structure is not impaired. The support and prop system shall be of such configuration and design approved by the Engineer. Where additional supports or props are deemed necessary by the Engineer, these shall be provided by the Contractor at his own cost.

2.2 Preparation of Concrete Surfaces

2.2.1 Removal of Unsound Concrete

The spalled, damaged or unsound concrete shall first be removed to expose sound parent concrete. The removal and surface preparation work shall be carried out using mechanical or other equipment approved by the Engineer. The removal shall be carried out in such that the remaining concrete surface does not form shape that can trap air during grouting.

2.2.2 Cleaning Existing Steel Reinforcement

The Contractor shall remove all rust, oil, scale or any other deleterious matter from the steel surfaces.

After cleaning, the Contractor shall inspect the condition of the reinforcement by measuring the diameter of each reinforcing bar. If the cross-sectional area of the reinforcement has been reduced by more than 10%, then additional reinforcement shall be install. The reinforcement shall be such that the losses in structural capacity shall be reinstated. Details and methods to be submitted to the Engineer for approval prior to the actual works.

2.2.3 Care During Works

The Contractor shall at all time during the hacking, grooving and drilling works exercise due care against cutting into any reinforcement. Where a reinforcement is cut or damaged, the Contractor shall notify the Engineer who shall decide the manner in which the reinforcement shall be repaired, these repair shall be carried out at the Contractor's own cost and no claim for extra in this respect shall be allowed.

2.3 Inspection of Concrete Surfaces Prior To Grouting

All concrete surfaces shall be inspected by the Engineer before fixing the formwork. The surface shall be free of dust, dirt, oil or any other deleterious matter.

2.4 Cement Grout and Sealant Compound Mixes

The mixing procedure of the grout and sealant compound mixes composition shall be strictly in accordance with the manufacturer's instructions.

The Grout & Sealant compound shall be mixed in a clean container free from harmful residual or foreign particles. The mix shall be thoroughly blended using mechanical mixer to a uniform and homogenous mixture. Small batches of mix not exceeding 1 quart may be hand-mixed by use of spatulas, palette knives or similar devices to obtain a uniform homogenous mixture. Where paddle type mechanical mixer is used, care shall be taken to prevent air entrapment in the mixture. Each mix shall be of such amount that in can be immediately used before the material gels. Any mix, which has been gelled, shall not be tampered for use but shall be discarded forthwith.

2.5 Installation of Port Fitting

The Contractor shall provide and install copper pipe of appropriate diameter and length complete with shut-off nipple or valve. The pipe stem shall be properly cleaned of dirt, oil and grease prior to installation. The stem shall be properly bonded using sealant compound. The Contractor shall ensure that the opening through the hole and pipe is clear from being blocked by sealant compound.

The Contractor shall also install ports for removing trapped air during the grouting.

2.6 Sealing of Formwork

The sealing compound shall be applied to the formwork using appropriate tools as directed by the Engineer.

The compound shall be properly worked into place and consolidated thoroughly so that all contact surfaces are wetted by the compound and entrained air reduced to the level recommended by the manufacturer to form well bonded and leak free seal.

The Sealant shall be allowed to cure for two days or as manufacturer's instruction prior to grouting.

2.7 Grouting

2.7.1 Grouting Equipment

The Contractor shall provide sufficient number of grouting equipment for the Works. Grout injection pump shall be of hydraulic injection type, in good working condition and capable of hydraulic injection type, in good working condition and capable of injecting the grouting material under pressure up to 0.275 N/mm^2 (40 psi). The pump shall be fitted with all necessary items including pressure gauge, pressure hose, injector and feeder tank.

A direct reading pressure gauge properly calibrated shall be fitted on the discharge hole to allow injection pressure readings to be taken.

A device capable of measuring accurately the quantity of grout injected shall be fitted to the injection system.

The meters shall have been calibrated no later than 3 preceding months by a recognised test agency. The Contractor shall furnish the Engineer such calibration certificate as proof.

2.7.2 Cleaning of Equipment

All equipment used for grout shall be thoroughly cleaned after every use. The Contractor shall ensure that equipment is dry and free from oil, dirt, solvent or other deleterious matter before each time they are to be reused.

2.7.3 Grout Injection

The Grout shall be injected into the formwork through the injection port using the injection pump fittings.

For horizontal concrete member such as slab and beam, injection proceeds from one end to the other through adjacent ports. The Grout shall be injected from the lowest level proceeding upwards.

For vertical member, the injection shall commence from the bottom upward through adjacent ports.

Injection of Grout through one entry port shall continue until grout starts to come out from the adjacent port. At this point the injection port shall be sealed off by closing the valve or nipple. Injection shall then proceed from the adjacent port where the Grout had just appeared. This sequence shall be followed until all ports are injected.

During injection, the Contractor shall ensure that the injection rate and pressure is such that all voids are completely filled without damage to the surface seal or structure. All precautions must be taken to prevent entrapment of air in the Grout. Where leak occurs in the surface seal or formwork, the injection shall be stop. All leaks shall be resealed using sealant compound and allowed to cure before injection is recommenced.

2.7.4 Record of Grouting

The Contractor shall maintain continuous record of all grouting works. The record, in duplicate, shall be in such form approved by the Engineer. At each location of the grouting work, the following data shall be provided:-

i. Identification of grouted member, stating type (e.g. slab-beam column), and reference position of grouting.

ii. General description of grouting and sketch showing configuration and total area.

iii. Grouting Works Information.
   (a) Date of grouting.
   (b) Name of the Contractor's grouting operators.
   (c) Amount of grouting and sealant material used.

   The amount of grouting and sealant material shall be the actual quantity used for grouting works only. These shall not include any quantity of grouting and sealant material, which are discarded.

The Contractor shall submit the record in duplicate to the Engineer's Site Representative immediately on completion of each grouting works for verification. Thereafter the verified record shall be jointly signature by the Contractor and the Engineer's Site Representative. A copy of the record shall be kept by the Engineer; the other shall be retained by the Contractor. The information from this record shall be the basis of computing the quantity for grouting works under the Contract.

2.8 Testing

2.8.1 Pressure Grout Samples

When requested by the Engineer, 6 numbers of 100 mm by 100 mm by 100 mm cubes shall be taken and tested as described in B.S.1881 Preparation of the samples shall comply with the following procedure:-

(a) Prepare six numbers 100 mm x 100 mm x 100 mm cube mould with top and bottom end exposed.

(b) Provide for 25 mm thick formwork at both ends.

(c) Install grout pipes at top and bottom end of the cube mould.

(d) Plug one end of the grout pipe and pump the grout under maintain pressure for 2 to 3 minutes.

(e) The plugged grout pipe is released and closed again to eliminate any air pockets in the cube.

(f) The final pressure of 0.275 N/mm² (40 psi) is then maintained for (5) minutes.

2.8.2 Preliminary Testing

Compressive Strength Test for grout material shall be in accordance to B.S.1881. The minimum compressive strength shall be 25 N/mm² at 7 days and 40 N/mm² at 28 days.

All expenses to carry out this test shall be borne by the Contractor. The test shall not be a reason for any delay on the part of the Contractor to carry out the work.

2.8.3 Testing During Construction

While the works being carried out, the Contractor shall carry out compressive strength test in accordance to B.S.1881. The sample shall have a minimum strength of 25 N/mm² at 7 days and 40 N/mm² at 28 days.

The Contractor shall provide all facilities in the sampling, making, curing and testing of the cubes.

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STRUCTURAL STEELWORK SPECIFICATIONS

1.0 DESCRIPTION

The work shall consist of supply of materials, workmanship, handling and erection for construction of steel structures all in accordance with the lines and dimensions shown on the Drawings. In addition, the protection of steelwork against corrosion shall be as specified herein.

2.0 MATERIALS

2.1 Structural Steels

Unless otherwise specified on the Drawing structural steels shall comply with BS 4360 and shall be one of the grades specified.

The grade of steel to meet the notch toughness requirement shall be as specified on the Drawings.

Steel shall be marked in accordance with BS 4360. Where steel of differing grades are used in the same work, they shall, with the exception of grade 43A, have additional markings as specified on the Drawing.

The Contractor shall supply the S.O. with a manufacturer's certificate in accordance with the requirement of BS 4360.

Hot rolled sections shall comply with the requirements of BS 4 or BS 4848 as appropriate.

2.2 Steel for Shear Connector

Steel for headed stud type shear connectors shall have a minimum yield stress of 385 N/sq.mm. Unless otherwise specified on the Drawing steel for other types of shear connectors shall comply with the requirement of BS 4360.

2.3 Bolts Nuts and Washer

2.3.1 Black Bolts

Black Bolts and nuts shall comply with BS 3692 and BS 4190.

2.3.2 High Strength Friction Grip Bolts

High strength friction grip bolts and nuts shall comply with BS 4395.

2.3.3 Countersunk Bolts

Countersunk Bolts and nuts shall comply with BS 4933.

2.3.4 Washers

Plain and taper washers shall comply with BS 4320 or BS 3410 as appropriate.

Nuts shall be at least the strength grade appropriate to the grade of bolts or other threaded element with which they are used.

2.4 Welding Consumables

Welding consumables used in metal-arc welding of grades of steel complying with the requirements of BS 4360 shall comply with BS 5135.

Welding consumables used for the fusion welding of steel casting shall comply with BS 4570.

Unless otherwise approved by the S.O. the welding consumables and procedures used shall be such that the yield and tensile strength of deposited weld metal shall not be less than the respective minimum values of the parent metal being welded.

2.5 Steel Castings and Forgings

Steel castings and forgings shall comply with BS 3100 and BS 29 respectively and shall only be used when the use of such material is unlikely to be detrimental.

2.6 Stainless Steel

Stainless steel shall comply with the requirements of either BS 970 or BS 1449 as appropriate. The quality shall normally be of the 16% to 19% chromium 8% to 12% nickel austenitic type.

2.7 Cast Iron

Grey cast iron shall comply with grade 10 of BS 1452; except that when stronger cast iron is required for special purpose it shall comply with a higher grade of BS 1452 as specified on the Drawing.

Malleable cast iron shall comply with BS 309 or grade B340/12 or B310/10 of BS 310, as appropriate.

Spheroidal or nodular cast iron shall comply with the requirements of BS 2789 for the grade specified.

3.0 WORKMANSHIP

3.1 Interchangeability of Parts

Unless specified on the Drawing, corresponding parts need not be interchangeable.

3.2 Fabrication Tolerances

All parts in assembly shall fit together accurately within the tolerance specified herein and in Table 4.

Unless otherwise agreed by the S.O., all component of rolled and built-up section (other than those curved flanges with a radius of curvature less than 25 times the spacing of cross frames) shall be fabricated within the tolerance given in Table 4.
Where a machined bearing surface is specified on the Drawing, it shall be machined within a deviation of 0.25 mm for surfaces that can be inscribed within a square of side of 0.5 m.

3.2.1 Alignment at Splices and Butt Joints

(a) Bolted Splices

Where necessary, all bolted splices shall be provided with steel packing plates of similar parent material to ensure that the sum of any unintended steps between adjacent surfaces does not exceed 1 mm for HSFG bolted joints and 2 mm for other joints.

(b) Welded Butt Joints

Any unintended deviation from planarity due only to a misalignment of parts to be jointed shall not exceed the lesser of 0.15 times the thickness of the thinner part or 3 mm. However, if, due either to different thickness arising from rolling tolerances or a combination of rolling tolerances with the above permitted misalignment, this deviation exceeds 3 mm, it shall be smoothed by a slope not steeper than 1 in 4.

3.3 Preparation of Edge, Ends and Surfaces

Any burring, abnormal irregularities or scales shall be removed.

3.3.1 Edges

Edges shall be either:-

(a) Left as rolled, sawn, machined, machine flame cut; or

(b) hand flame, cut with subsequent grinding to smooth profile; or

(c) for stiffeners and gussets, both not more than 12 mm thick, sheared and subsequently ground to a smooth profile.

3.3.2 Ends

Ends shall be either:-

(a) Sawn, machined, machine flame cut; or

(b) hand flame cut with subsequent grinding to a smooth profile; or

(c) for stiffeners, of not more than 12 mm thick, sheared and subsequently ground to a smooth profile.

If ends of stiffeners are required to be fitted they shall be ground where necessary, so that the maximum gap over 60% of the contact area does not exceed 0.25 mm.

3.3.3 Flame Cutting and Shearing

Where flame cutting or shearing, as specified in 3.3.1 and 3.3.2 is used at least one of the following requirements shall be satisfied:-

(a) the hardness of the cut edge does not exceed 350 HV 30 of BS 427;

(b) the cut edge is not subjected to applied stress;

(c) the cut edge is wholly incorporated in a weld;

(d) the material from the edge is removed by grinding or machining to the extent of either 2 mm, or the minimum necessary to demonstrate that the hardness on the edge does not exceed 350 HV 30 of BS 427;

(e) the edge is softened by a suitable heat treatment approved by the S.O. and is shown by dye penetrant or magnetic detection procedure to be free from cracks;

(f) the material is grade 43 steel and is not greater than 40 mm thick and edge preparation is by machine flame cutting.

In addition to the requirements of (a) to (f) where specified on the Drawing the flame cut edges shall be ground or machined to remove all visible signs of drag lines.

3.3.4 Machining at Butted Joints

Where machining of surfaces at butted joints is specified, the abutting ends of the parts shall be machined after the members have been fabricated.

3.3.5 Treatment of Outside Arrises

Outside arrises of plate and sections, which are to receive corrosion protection, shall be smoothed by grinding or filing.

3.3.6 Contact Surfaces for High Strength Friction Grip Bolted Connection

Unless otherwise specified on the Drawing, all contact surfaces in high strength friction grip bolted connections shall comply with the requirements of BS 4604. Where a particular treatment is specified for faying surfaces, the treated surfaces shall be adequately protected until they are brought together.

3.4 Bolts, Nuts and Washers

3.4.1 Close Tolerance Bolts

Close tolerance bolts and nuts shall comply with the tolerances specified in BS 3692, or with the tolerances specified in BS 4190 for bolts faced under the head and turned on the shank.

3.4.2 Turned Barrel Bolts

The diameter of the screwed portion of turned barrel bolts shall be at least 1.5mm smaller than the diameter of the barrel. The specified diameter of the bolts shall be the nominal diameter of the barrel.

The diameter of the turned barrel shall be within the diameter tolerances for bolts as specified in BS 3692. The length of the barrel shall be such that it bears fully on all the connected parts.

3.4.3 High Strength Friction Grip Bolts

Unless otherwise specified in the Drawing, compliance and use requirements for high strength friction grip bolts shall be as per Table 2.1.

TABLE 1
- REQUIREMENT FOR HIGH STRENGTH FRICTION GRIP BOLT

HSFG bolts	Complying with the requirements of	Use according to the requirements of
General grade	BS 4395 : Part 1	BS 4604 : Part 1
Higher grade, parallel shank	BS 4395 : Part 2	
Higher grade, waisted shank	BS 4395 : Part 3	BS 4604 : Part 3

3.4.4 Washers

Where necessary, steel washers shall be provided to prevent the nut binding on the shank of the bolt. Where the full bearing area of the shank of the bolt is to be developed, the threaded portion of the bolts shall not extend within the thickness of the connected parts.

For turned barrel bolts, steel washer with true bearing faces shall be provided under the nut. The washer shall have a hole diameter nominally 1.5 mm larger than the barrel and a thickness of not less than 6 mm.

Tapered washers of the nominally correct angle of taper shall be provided under all heads and nuts bearing on bevelled surfaces.

3.5 Holes for Bolts

3.5.1 Holes for Countersunk Bolts and Black Bolts

The diameter of holes shall be 2 mm larger than nominal diameter of the bolt as manufactured. All holes shall be drilled or shall be drilled small and reamed or sub-punched and reamed, except that for floor plates and throughing not exceeding 12 mm in thickness and elsewhere, as approved by the S.O., the holes may be punched full size.

Where several plates or sections form a compound member they shall, where practicable, be firmly connected together by clamps or service bolts and the holes drilled through all the thickness at one operation, or alternatively, and in the case of repetition work, the plates and sections may be drilled separately from jigs or templates. All burrs shall be removed.

3.5.2 Holes for Close Tolerance Bolts and Turned Barrel Bolts

The diameter of the holes shall be equal to the nominal diameter of the bolt shank or barrel, subject to a tolerance of +0.5 mm and -0 mm.

Parts to be connected with close tolerance or turned barrel bolts shall be firmly held together by service bolts or clamps. The holes shall be drilled through all the thickness at one operation and subsequently reamed to size if necessary in order to provide true holes within the specified limits of accuracy. All holes not drilled through all thicknesses at one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not practicable, the separate parts shall be drilled through hard bushed steel jigs and reamed if necessary. All burrs shall be removed.

3.5.3 Holes for High Strength Friction Grip Bolts

Unless otherwise specified on the Drawing, holes for high strength friction grip bolts shall comply with the requirements of BS 4604.

3.6 Welding

3.6.1 Welder's Certificate

Unless otherwise specified, all welders shall have satisfied the relevant requirements of BS 4871 : Part 1 and BS 4872 : Part 1.

3.6.2 Welding of Structural Steels

Unless otherwise specified on the Drawing, metal-arc welding shall comply with BS 5135. The use of welding processes other than those specified in BS 5135 shall be subject to the approval of the S.O.

Unless otherwise approved by the S.O., all welding shall be carried out in the shop. The general welding procedures for shop and Site welds, including particulars of the preparation of fusion faces, shall be submitted, in writing, in accordance with the requirements of BS 5135 for the approval of the S.O. before commencing fabrication. No departure from the approved welding procedure or from the details shown on the Drawings shall be made without the approval of the S.O.

For those areas specified on the Drawing, the method of making any temporary attachments shall be agreed with the S.O. Any scars from temporary attachments shall be made good to the satisfaction of the S.O. Where weld repairs are necessary, these shall be carried out in accordance with the requirements of BS 5153. Visible weld surfaces shall be cleaned of slag residues. All weld spatters shall be removed and affected surfaces shall be dressed and cleaned.

Where it has been specified that the butt welds are to be ground flush, the loss of parent metal shall not be greater than that allowed for the correction of minor surface defects specified in BS 4360.

To enable full throat thickness to be provided at the ends of butt welded joints, 'run-on' and 'run-off' plate extension pieces shall be used. 'Run-on' plates and 'run-off' plates shall comply with the following requirements:-

(a) One pair of 'run-on' plates and one pair of 'run-off' plates prepared to the same thickness and profile as the parent metal shall be attached, preferably by clamps, to the start and finish of all butt welds;

(b) butt welds shall extend at the full weld profile for a minimum distance of 25 mm into both the 'run-on' and 'run-off' plates;

(c) when removing the 'run-on' and 'run-off' plates by cutting, the cuts shall not be nearer than 3 mm to the sides of the parent metal and the remaining metal shall be removed by grinding or another method agreed by the S.O.

3.6.3 Welding of Steel Castings

Unless otherwise specified on the Drawing, fusion welding of steel castings shall comply with requirements of BS 4570.

The proposed welding procedures shall be submitted in writing, in accordance with the requirements of either BS 4570 : Part 1 or BS 4570 : Part 2, for approval of the S.O. before commencing welding of steel castings. No departures from the agreed welding procedures or from the details shown on the Drawings shall be made without the approval of the S.O.

3.6.4 Welding, Flame Cutting and Shearing Procedure Trials

Before commencing fabrication, welding, flame cutting and shearing shall be carried out using representative samples materials to be use d in the Work. The samples of materials shall be agreed with the S.O.

The welding, flame cutting and shearing trials shall demonstrate to the satisfaction of the S.O. the procedures to be adopted in the fabrication of the Work, which shall include the following:-

(a) welding procedures complying with the requirements of BS 5135, BS 4070 and BS 4570, as appropriate;

(b) flame cutting and shearing techniques complying with the requirements of 3.3.3.

Where primers are to be applied to the Work prior to fabrication, they shall be applied to the sample material before the procedure trials are made.

3.6.5 Stud Shear Connectors : Welding and Procedure Trials

Stud shear connectors shall be welded in accordance with the rnanufacturer's instructions, including preheating where necessary. Welding shall not be carried out when the surface is wet. The studs and the surfaces to which the studs are welded shall be free from scale and rust, metal spray, grease, oil, paint or other material which would affect the quality of the weld.

The welds shall be visually free from cracks and lack of fusion and shall be capable of developing at least the nominal ultimate strength of the studs.

Before production welding of studs commences, procedure trials shall be carried out. The trials shall be made on samples of materials and studs representative of those to be used in the Work. The samples of materials and studs shall be agreed with the S.O.

Where primers are to be applied to the Work prior to the welding of studs they shall be applied to sample material before the procedure trials are made.

3.7 Bending and Pressing

Steel may be bent or pressed to the required shape by either the hot or the cold process, provided the properties of the material are not affected beyond the limits specified in BS 4360. For cold bending, the internal radius of bents shall not be less than twice the metal thickness. For hot bending, the temperature, timing and cooling rate shall be appropriate to the particular type of steel and shall be agreed with the S.O. Accelerated cooling shall not be used without approval of the S.O.

3.8 Straightening and Flattening

Hammering shall not be permitted. Where heating is used either the temperature of the steel shall not exceed 650°C, or the temperature, timing and cooling rate shall be appropriate to the particular type of steel and shall be agreed with the S.O. Accelerated cooling shall not be used without the approval of the S.O.

3.9 Forging

Forging shall be carried out in such a manner that it will not impair the strength of the metal.

3.10 Tie Rods

Tie rods with upset ends and plus threads and tie rods with forged eyes shall be formed by being pressed up in a die or by another method approved by the S.O. Where agreed by the S.O, suitable designed flame cut of forged eyes or machined stud ends may be metal-arc welded or resistance welded to the rods. Hot forming shall be carried out in such a way that it will not impair the strength of the metal.

3.11 Parallel Barrel Drifts

The barrel shall be drawn or machined to the required diameter for a length of not less than one diameter over the combined thickness of the metal through which the drift has to pass. The diameter of the parallel barrel shall be equal to the nominal diameter of the hole subject to a tolerance of -0.05 mm to -0.20 mm. Both ends of the drift, for a length equal to 1.5 times the diameter of the parallel portion of the bar, shall be turned down with a taper to a diameter at the end equal to 0.5 times that of the parallel portion.

3.12 Pins and Pin Holes

Pins shall be parallel throughout and shall have smooth surface free from flaws. They shall be of sufficient length to ensure that all types connected thereby will bear fully on them. Where ends are threaded they shall be turned to a smaller diameter and shall be provided, where necessary, with a pilot nut to protect the thread.

The pin holes shall be bored smooth, straight and true to gauge and at right angles to the axis of the member. Boring shall be done only after the member is finally bolted or welded unless otherwise agreed with the S.O.

For pins up to and including 250 mm diameter, the diameter of the pin shall be within a tolerance of -0.25 mm to -0.40 mm and the diameter of the pin hole shall be within a tolerance of 0 mm to +0.15 mm.
For pins exceeding 250 mm diameter, the clearance between the pin and the pin hole shall be not less than 0.40 mm and not more than 0.75 mm.

3.13 Camber

Unless otherwise specified, camber may be formed by connecting straight sections of girder with change of slope at their junctions.

3.14 Marking for Erection

Every part shall be marked for erection with a durable and distinguishing mark in such a way as not to damage the material. Drawings showing the marking scheme shall be supplied to the S.O. Where parts which have been erected at the Contractor's Works are connected with the close tolerance of turned barrel bolts, the members shall be matched mark to ensure final assembly in the same position. Unless otherwise approved, hard stamping shall not be used.

3.15 Rectification of Surface Defects and Edge Laminations

Surface defects revealed during fabrication or blast cleaning shall be treated in accordance with the requirements of BS 4360. Repair by welding of any surface defect or exposed edge lamination shall only be carried out with the approval of the S.O. and using a procedure complying with BS 5135.

4.0 INSPECTION AND TESTING

4.1 Surface Defects and Edge Laminations

Steelwork shall be inspected for surface defects and exposed edge lamination during fabrications and blast cleaning. Significant edge laminations found shall be reported to the S.O. for his decision.

Following rectification of these affected areas they shall be tested for defects to the satisfaction of the S.O.

4.2 Procedure Trials

4.2.1 Testing of Welding for Structural Steels

(a) Non-Destructive and Destructive Testing

With the exception of all weld tensile tests, non-destructive and destructive testing of welding shall be carried out as specified in BS 4870. The root bend and face bend tests specified in BS 4870 shall have the weld root and the weld face respectively in tension as described in transverse bend tests of BS 709. Additionally, hardness tests shall be carried out on weld metal, heat affected zone and parent material of a macrosection from each weld procedure test sample, and the result recorded and submitted to the S.O.

(b) Weld Metal and Heat Affected Zone (HAZ) Charpy V-Notch Impact Test Requirements for Tension Areas

(i) Butt welds including corner or T-butt welds parallel or transverse to the main tension stress

The following requirements for weld metal notch ductility shall be the minimum requirements for the thinner parent plate or part of the rolled section at the joints:-

(1) For regions with tensile stress above 75 N/sq.mm the requirement shall be

$$\frac{\sigma_y}{355} \times \frac{t}{2} \text{ J, or 10 J}$$

average energy absorption, whichever is the greater at the minimum design temperature as specified on the Drawing for material selection, where

σ_y is the specified minimum yield stress (in N/sq.mm)

t is the relevant thickness in mm.

(2) Where the design stress is less than, or equal to 75 N/sq.mm the weld metal notch ductility requirements can be reduced to

$$\frac{\sigma^y}{355} \times \frac{t}{4} \text{ J, or 10 J}$$

average energy absorption, whichever is the greater, at the minimum design temperature as specified on the Drawing for material selection.

(3) For butt welds, including corner and T-butt welds transverse to and carrying the main tension stress, for which the procedure test tensile and macrosection hardness tests show the weld metal to overmatch the strength of the parent plate, the minimum requirements for weld metal, calculated in accordance with (1) and (2), may be reduced to 27 J at 20°C.

(ii) Heat Affected Zone (HAZ)

The fusion boundary region of the HAZ of butt welds, including corner or T-butt welds, which are transverse to and carry the main tension stress shall have the notch ductility requirements given in Table 2.

TABLE 2 - HEAT AFFECTED ZONE TEST REQUIREMENTS FOR NOTCH DUCTILITY IN TRANSVERSE BUTT WELDS

Heat welding input	Specified minimum yield strength of parent plate	
	Under 400 N/sq.mm i.e. grade 40, 43 and 50 of BS 4360	400 N/sq.mm and over i.e. grade 55 of BS 4360
Up to and including 5 kJ/mm	No test requirement	As given in 4.2.1(b)
Over 5 kJ/mm	As given in 4.2.1(b)	As given in 4.2.1(b)

(iii) Location and Orientation of Specimens and Orientation of Notch

For Charpy tests on weld metal, the length of specimen shall be taken transverse to the line of weld and the specimens notched so that the line of the notch root is perpendicular to the plate surface and is on the centre line of the weld joint. For symmetrical and asymmetrical double V, double J and double bevel joint preparations the specimen shall be cut so that one face is substantially parallel to, and within 3 mm of, the surface of the weld.

Additionally for the asymmetric preparation the specimen shall be taken from the side with the smaller preparation. For single V, single J and single bevel joint preparations the specimen shall be cut so that one face is substantially parallel to and within 3 mm of the root surface of the weld.

For Charpy tests in the fusion boundary region of the HAZ, specimens shall be taken with their length transverse to the line of the weld and notched so that the line of the notch root is perpendicular to the original plate surfaces. As far as possible the notch at mid-thickness of the specimen should lie on the fusion boundary of the HAZ of the weld under test. The specimen shall be cut so that one face is substantially parallel to, and within 3 mm of, the original plate surface.

(iv) Number of Specimens

Initially, three specimens for each weld or HAZ under consideration shall be taken and depending on the test results for these specimens a further three specimens may be taken from the same joint.

(v) Testing and Acceptance Criteria

The initial three specimens shall be tested. If the average of the three impact test results is less than the specified minimum average value, or if one individual result is less than 70% of the specified minimum average value, or if two results are less than the specified minimum average value, then three additional test pieces from the same sample shall be tested and the results added to those previously obtained and a new average value calculated.

For compliance purposes:-

(1) The new average value shall not be less than the specified minimum average value.

(2) Not more than three of the total of six results shall be less than the specified minimum average value.

(3) Not more than two of the total of six results shall be less than 70% of the specified minimum average value.

(4) No individual results shall be less than 50% of the specified minimum average value.

If the results fail to comply with the above requirements, the procedure concerned shall be rejected. The cause of failure shall be established. Depending on the cause, either the procedure shall be modified or a new procedure shall be established and approved by the S.O. A further test shall be carried out.

4.2.2 Testing of Welding for Cast Steel

Non-destructive and destructive testing of welding shall comply with the requirements of BS 4570.

4.2.3 Testing of Flame Cut and Sheared Edges

Where the hardness criteria of 3.3.3 (a) or (d) are adopted, hardness testing shall be carried out on the edges concerned.

4.2.4 Stud Shear Connectors

For each procedure trial, examination and testing shall be carried out on six specimens as follows:-

(a) Metallographic examination and hardness tests shall be carried out on macrosections prepared on a plane along the axis of the stud of three of the specimens. The weld shall be free from macroscopic defects visible to naked eye. The hardness of the weld metal shall lie in the range 150 HV 30 to 350 HV 30 as given in BS 427. The hardness of the HAZ shall not exceed 350 HV 30 as given in BS 427.

(b) Each of the remaining three studs of the sample shall be bent to a lateral movement of the head of approximately half of the height of the stud and then bent straight again without failure of the weld.

4.3 Production Tests

4.3.1 Requirements for Destructive Testing of Welding for Structural Steel

(a) Production Test Plates

Unless otherwise specified on the Drawing, one in five pairs of 'run-off' plates for transverse butt welds in tension flanges and one in 10 pairs for other butt welds shall be production test plates. The combined size of each pair of production test plates shall be adequate for the number and size of specimens to be tested. The material quality of the 'run-off' plates shall be the same as that of the plates to be welded. On the completion of the welds the 'run-off' production test plates shall not be removed until they have been marked in manner, agreed by the S.O., to identify them with the joints to which they are attached.

(b) Testing

The following tests as described in BS 709 shall be carried out on the production test plates and shall comply with:-

(i) Transverse Tensile Test

One transverse tensile test comprising sufficient specimens to cover the full plate thickness shall be made and the tensile strength shall be not less than the corresponding specified minimum value for the parent metal.

If any specimen fails to meet the test requirement then a further test shall be made from the same production test plate. If any specimen from this further test fails to meet the test requirement then the joint shall be rejected.

(ii) Bend Test

For material less than 10 mm in thickness one transverse root bend test and one transverse face bend test shall be made. For material 10 mm in thickness and over, one side bend test comprising sufficient specimens to cover the full plate thickness shall be made. The diameter of the former and the angle bend used in the test shall comply with the requirements of the BS 4870.

On completion of bending any defects in tension surface of the test specimen shall be investigated and their cause established before the specimen is either accepted or rejected. Slight tearing at the edges of the test specimen shall not be a cause for rejection.

If any specimen fails to meet the test requirement then a further test shall be made from the same production test plate. If any specimen from this further test fails to meet the test requirement then the joint shall be rejected.

(iii) Charpy V-notch Impact Test

Charpy V-notch impact test shall be made on weld metal in butt welds transverse to and carrying the main tension stress. Additionally where specified on the Drawing, Charpy V-notch impact tests shall be made on the fusion boundary region of the HAZ and shall comply with requirements of 4.2.1(b).

(iv) Re-welding and Re-testing

In the event of failure to meet the test requirements of (a) and (b) the Contractor shall carry out further trials using revised procedures and further tests to the satisfaction of the S.O.

Rejected joints shall be cut out in a manner approved by the S.O. rewelded and the tests repeated.

4.3.2 Non-Destructive Testing of Welding for Structural Steel

Where specified non-destructive testing of the following welds shall be carried out using X-Ray method of other approved by the S.O.

(a) all transverse butt welds in tension flanges;

(b) 10% of the length of longitudinal butt welds in tensions flanges;

(c) 5% of the length of longitudinal and transverse butt welds in compression flanges;

(d) all transverse butt welds in webs adjacent to tension flanges as specified on the Drawing.

In the case of (b) and (c) the particular length of welds to be tested shall be agreed with the S.O.

Any lamination, lamellar tearing or other defect found shall be recorded and reported to the S.O. The Contractor shall carry out the remedial action as approved by the S.O.

4.3.3 Testing of Welding for Cast Steel

The testing of welding for cast steel shall comply with the requirements of BS 4570.

4.4 Stud Shear Connectors

Stud shear connectors shall be subjected to the following tests:-

(a) The fixing of studs after being welded in position shall be tested to the satisfaction of the S.O. by striking the side of the head of the stud with a 2 kg hammer.

(b) Any stud selected by the S.O. shall be capable of being bent by striking the side of the head of the stud with 6 kg hammer until its head is displaced laterally a distance of approximately 0.25 times the height of the stud from its original position. The stud weld shall not show any signs of cracking or lack of fusion. Satisfactory studs shall not be bent back again.

Studs whose welds have failed the test given in (a) and (b) or which do not comply with the requirements of 3.6.4 shall be replaced according to a procedure approved by the S.O.

4.5 Checking of Deviation in Rolled and Built-Up Sections

4.5.1 Checking Requirements

Member/components of rolled and built-up sections shall be checked for compliance with the tolerances given in Table 4 in accordance with the requirements given in Table 3. Additionally all such member/cornponents not subjected to the checking requirements of Table 3 shall visually examined for deviations in excess of the tolerances given in Table 4 and such parts shall be quantitatively checked where necessary.

TABLE 3 – TOLERANCE CHECKING REQUIREMENT

Member / component type	Form of Construction	Percentage of total number of member / components to be checked
1, 2 and 5	Plate and box girder	5
	Orthotropic decks	5
	All other forms	10
3, 4 and 6	All forms	100

When inspecting members/components for compliance with tolerances, the checks for deviations shall be made over the fill gauge length.

In making any checks, the scanning device shall be placed so that local surface irregularities do not influence the results.

The out-of-plane deviation of a plate panel at right angles to the surface shall be checked over the full area of the panel.

The checking of the out-of-straightness deviation at right angles to the plate surface for stiffener may be checked either on the stiffener or on the plate attached to the stiffener on the line of the stiffener except in the vicinity of a site splice.

The out-of-straightness deviation parallel to the plate surface on the stiffener outstand shall be checked over the specified gauge length for the length of the stiffener.

The relative cross girder or cross frame deviation shall be checked over the middle third of the length of the cross girder or cross frame between each pair of webs. For cantilevers the relative deviation shall be checked at the end of the member.

The out-of-plane deviation of the web of a rolled beam or channel section shall be checked over a distance in the longitudinal direction equal to the depth of the section.

Member/component type 1 and 2 shall be checked at each site joint as follows:-

(a) Member/Component Type 1

Checks shall be made for a distance of 1.0 m either side of the joint centreline or to the next boundary stiffener, whichever is the minimum distance.

(b) Member/Component Type 2

Checks shall be made over the length of the stiffened panel containing the joint.

Where required by the S.O., completed parts in which deviations have apparently increased since being inspected and checked shall be rechecked.

4.5.2 Support during Inspection.

Component stiffened plate panels shall be supported either on surfaces representing their intended fabricated shape or at their boundaries in a manner to that in the completed structure.

For member/component type 4 the checks shall made with the web of the completed part in the vertical position.

They shall be no external restraint or load on any completed part or component stiffened plate panel during inspection for and checking or measurement of deviations.

4.5.3 Equipment

Scanning devices capable of making the specified checks shall be calibrated with respect to a straight line datum so that the accuracy of record is within +0.5 mm.

4.5.4 Gauge Length

The gauge lengths to be used shall be given in Table 4 for each member/component type.

Table 4 : Tolerances

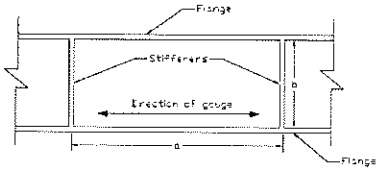
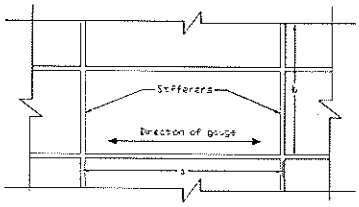
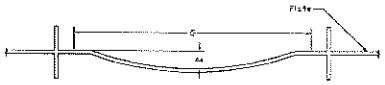
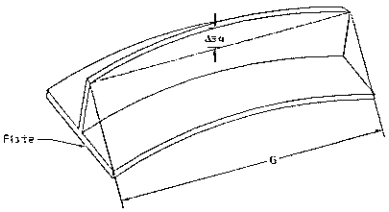
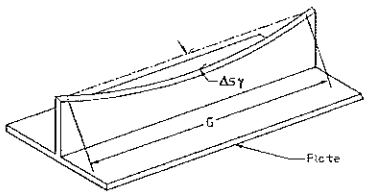
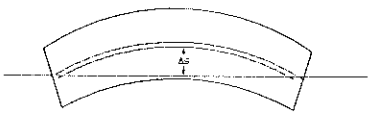
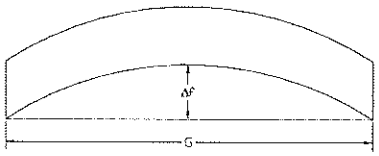
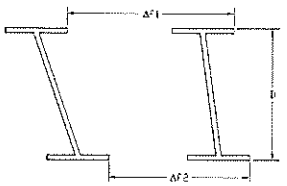
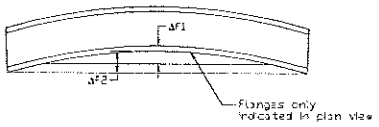
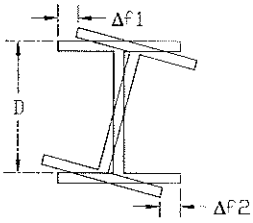
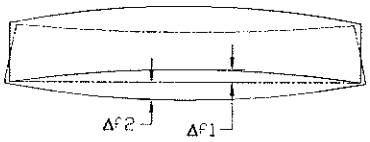
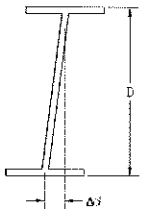
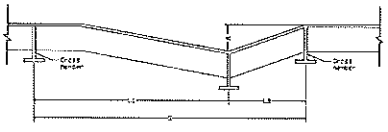
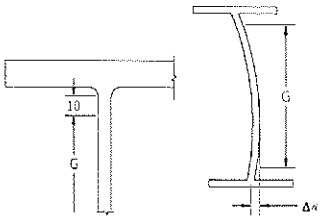
Member / Component Type	Description	Gauge Length	Tolerance	Examples
1. Plate panels in webs of plate and box girders in stiffened compression flanges and in box columns				
(a) $\frac{b}{t} > 25\sqrt{\frac{355}{\sigma_Y}}$	Flatness at right angles to plate surface, measured parallel to the longer side in either direction	G = a where a < 2b G = 2b s > 2b	$\Delta_a = \frac{G}{165}\sqrt{\frac{\sigma_Y}{355}}$ whichever is the greater (see note 4)	  
(b) $\frac{b}{t} \le 25\sqrt{\frac{355}{\sigma_Y}}$			No tolerance required unless otherwise specified by the Engineer	
2. Longitudinal compression flange stiffeners in box girders, box columns and orthotropic decks. All web stiffeners in plate and box girders	(a) Straightness at right angles to the plate surface in either direction	G = L	$\Delta_{s\alpha} = \frac{G}{750}$ or 2mm whichever is the greater	
	(b) Straightness parallel to plate surface in either direction (not applicable to closed section stiffeners)	G = 2b or L whichever is the lesser	$\Delta_{s\gamma} = \frac{G}{375}\sqrt{\frac{\sigma_\gamma}{355}}$ or 2mm whichever is the greater	
3. Columns and struts	Maximum deviation from straightness including that of individual flanges in either direction	G = L_γ and L_γ	$\Delta_s = \frac{G}{100}$ or 3mm whichever is the greater	

Table 4 : Tolerances (Continuation)

Member / Component Type	Description	Gauge Length	Tolerance	Examples
4. Rolled or fabricated girders (a) Including box sections	Straightness of individual flanges	$G = L_G$ and L_F	$\Delta_F = \frac{G}{1000}$ or 3mm whichever is the greater	
(b) Excluding box sections	Relative straightness of one flange with respect to the other for girders 750mm and over in depth	$G = L_F$	$\Delta_F = \frac{G}{1000}$ or $\frac{D}{75}$ whichever is the lesser with a minminimum of 3mm	 $\Delta_F = \Delta_{F1} - \Delta_{F2}$ (at any one section)    $\Delta_F = \Delta_{F1} - \Delta_{F2}$ (at any one section)
	Verticality of web at supports	G = O	$\Delta_G = \frac{G}{300}$ or 3mm whichever is the greater	
5. Cross girders, cross frames and cantilevers in orthotropic decks or in compression flanges of box girders or on all sides of stiffened box columns	Levels between cross girder under consideration and the two adjacent cross girders in either direction	$G = L_1 + L_2$	$\Delta_C = \frac{G}{500}$ or 3mm whichever is the greater	
6. Webs of rolled sections in the regions of the internal supports of continuous beams and elsewhere (as shown on the drawings)	Flatness at right angles to web plate surface measured over the gauge length in either direction	G = W	$\Delta_W = \frac{G}{165}\sqrt{\frac{\sigma_Y}{355}}$ or 3mm whichever is the greater	

4.5.5 Checking Stages

Checking for compliance with the tolerances given in Table 4 shall be carried out at the following stages:-

(a) For component stiffened plate panels and other completed parts, on completion of fabrication and before any subsequent operation of surface preparation, painting, lifting, transport or erection.

(b) For member/component types 1 and 2 at site joints, on completion of the site joint.

(c) For member/component type 5 (cross girder and cantilevers) and other parts in which deviations have apparently increased, on completion of site assembly.

4.5.6 Non-Compliance and Rejection

Where, on checking member/component types 1 and 2 for the deviations in respect of out-of-plane or out-of-straightness at right angle to the plate surface, the tolerances specified in Table 4 are exceeded, then the maximum deviation for the member/component shall be measured and recorded. In the case of member/component type 1 the maximum deviations in the plate panels adjoining the sides of the panel in question shall also be measured and recorded. For member/component type 2, the maximum deviation in respect of out-of-straightness at right angles to the plate surface for the stiffeners which are in line with the stiffener in question but in the adjacent bays shall also be measured and recorded.

Only the maximum deviations shall be measured and recorded for all other instances where the tolerances given in Table 4 are exceeded.

The recorded measurements shall be submitted to the S.O. who will determine whatever the member/component may be accepted without rectification, with rectification or rejected.

In the case of member/component types 1, 2, 5 and 6, where 10% or more of the checks made on any one member/component type exceed the appropriate tolerances given in Table 4 then additional checks shall be made as directed by the S.O.

4.6 Checking of Alignment at Joints

The alignment of plates at all bolted splice joints and welded butt joints shall be checked for compliance with the requirements of 3.2.1.

4.7 Temporary Erection at Contractor's Works

Where specified, steelwork shall be temporarily erected at the Contractor's Works.

5.0 HANDLING, TRANSPORT AND ERECTION

5.1 Handling and Stacking

Fabrication parts shall be handled and stacked in such a way that permanent damage is not caused to the components. Means shall be provided to minimise damage to the protective treatment on the steelwork and any damage which does occur shall be made good.

5.2 Packing for Transport

All work shall be protected from damage in transit. Particular care shall be taken to stiffen free ends and prevent permanent distortion and adequately protect all machined surfaces. All bolts, nuts, washers, screws, small plates and small articles generally shall be suitably packed and identified.

5.3 Erection

5.3.1 General

The bridge steelwork shall be erected, adjusted and completed in the required position to the lines and levels specified in the Drawing for steelwork with appropriate allowances for permanent deformations during fabrication and erection.

5.3.2 Site Connections

The structure shall be supported and site connections shall securely held in position until the joints have been completed, to ensure accurate final alignment.

All connection shall be completed as soon as practicable after assembly.

5.3.3 Service Bolts

Any connection to be bolted shall be secured in close contact by service bolts before the connections are finally bolted.

5.3.4 Drifts

Drifts of the size specified in 3.11 may be used to bring the pieces accurately into place.

6.0 PROTECTION OF STEELWORK AGAINST CORROSION

6.1 Paint System

Unless otherwise specified, minimum protection coating shall be a three coat protective system. Each coat of paint shall be of different shade or colour from the proceeding coat.

The Contractor shall submit to the S.O. his painting plan for approval two weeks before work commences. The painting plan shall include the following:-

(i) Method of Working

(ii) Work Schedule

(iii) Product and Manufacturer's name

(iv) Surface Preparation

(v) Painting System

(vi) Quality Control

(vii) Scaffolding and Site Painting (if required)

(viii) Other relevant matters.

6.1.1 Materials

All paints used in a paint system shall be compatible and supplied by one manufacturer. They shall be suitable for use in a tropical climate and shall be free of supporting fungus growth.

(a) Component of Paint System

The paint system shall consist of the following components:-

(i) Primer

The primer shall be capable of 'wetting' the steel surface and forming an adherent film on it to provide a base for the following coats.

Special primer shall be used to protect blast-cleaned steel during fabrication or until the full coating system is applied. These primers shall be sufficiently thin to weld through and in no way take place of conventional primers.

(ii) Undercoat(s)

The paint shall have formulation similar to the finishing coats. It shall be able to provide the build up to the required film thickness and act as a barrier to corrosive agents and also help to smooth out irregularities of the steel surface.

(iii) Finishing Coat

The paint shall be able to provide resistance to the environment. It shall be a freely working product with good levelling properties and shall be of such consistency that can be satisfactorily applied by airless spray. The paint, when applied, shall be in a uniform wet film, free from pin holes, drops, runs, bubble, ridges and variation in colour.

(b) Characteristic of Paint System

Characteristic of Paint System for each component shall comply with BS 5493.

(c) Manufacturer's Certificate

The Contractor shall supply manufacturer's Certificate for each consignment of paint or paint material delivered to the Work. Such manufacturer's certificate shall certify that the paint material complied with relevant Specification and in addition shall give:-

(i) Description of Material

(ii) Vendor's Reference Number

(iii) Batch Number

(iv) Quantity in Batch

(v) Date of Manufacture

(vi) Shelf Life of Material

6.1.2 Surface Preparation

Unless otherwise specified, surface preparation shall consist of the following:-

(a) Degreasing

Any grease and dirt shall be removed by emulsion cleaner followed by thorough rinsing with water or by steam-cleaning, or by controlled high-pressure water jets.

When turpentine or similar solvent is used, if necessary, detergent or emulsion cleaner shall follow and the operation shall be completed by thorough rinsing with clean fresh water.

(b) Removal of Scale and Rust by Blast Cleaning

After the removal of grease and dirt, scale and rust shall be removed by abrasive blast cleaning. Blast cleaning shall be carried out in accordance with BS 4232. Wet blasting shall not be permitted. Blast cleaning shall be a minimum of second quality to BS 4232.

The abrasive used shall be free from contamination and any recovered materials shall be cleaned to S.O.'s satisfaction before reuse. All dust, residues and debris shall be removed from the steel surface prior to painting. Unless the dust can automatically removed, separate vacuum cleaner shall be used.

Where steel is blast cleaned before fabrication, it shall be protected with a suitable blast primer. During fabrication, areas where the blast primer is damaged shall be cleaned and reprimed as soon as possible.

The surface preparation shall be approved by the S.O. prior to the application of the prime coat. The priming coat shall be applied to the surface immediately after cleaning is completed and approved in the case of Work performed outdoors, or within 4 hours for Work performed in an approved closed workshop.

(c) Removal of Scale and Rust by Other Methods

Where specified, other methods to remove scale and rust shall be carried out. Cleaning by acid pickling, flame cleaning or manual cleaning shall not be permitted except that small items only, such as bolts and nuts, may be cleaned by acid pickling. In such cases they shall comply with the following:-

(i) Acid Pickling

Steel shall be pickled by the 'Duplex' or 'Footner' process as defined in BS 5493. The first priming coat shall be applied as soon as the steel has dried and still warm.

Acid pickling shall be done by Specialist Contractor.

(ii) Flame Cleaning

Immediately after the passage of the flame across the steel, the surface shall be cleaned of all loosened materials by wire brushing. Any powdery layers that are left behind shall be removed by dusting.

The first coating shall be applied while the surface is still warm and dry. The flame cleaning of high strength friction grip bolted joints and adjoining areas are prohibited.

The sequence of operation for flame cleaning shall be properly planned and controlled to avoid the risk or distortion and buckling.

(iii) Manual Cleaning

Manual cleaning shall be carried out by means of wire brushes, hand scrapers, vibratory-needle guns and chipping hammers and other approved method.

Excessive burnishing of the metal through prolonged application of rotary wire brush shall be avoided. Surface shall be protected within 4 hours of having been mechanically cleaned.

Manual cleaning shall be carried out to a minimum standard of St 3 of Swedish Standard SIS 05 59 00 and/or to S.O.'s satisfaction.

(d) Attention to Detail

Apart from the surface preparation of the bulk or the steelwork, the Contractor shall give attention to the following details:-

(i) Sharp edges shall be removed;

(ii) Burrs shall be around flat;

(iii) Welds shall be dressed and weld spatter removed by grinding;

(iv) Nuts and bolts shall be properly treated.

6.1.3 Construction and Workmanship

(a) Reference Specimen

The Contractor shall supply prepared specimen of steel plate coated with the full coating system covered by this Specification. Plates shall be approximately 200 mm x 200 mm x 6 mm thick. Surface preparation and paint application shall be carried out in accordance with the required methods. These plates shall be available as reference pieces for colour comparisons during the applications of the coating system.

(b) Storage and Mixing of Paint

Paint shall be stored in sealed containers in a lock-up store where it is not exposed to extreme temperature. Any special condition recommended by the manufacturer shall be observed.

Paint which has not been used within the 'Pot-Life' period specified on the containers or within 12 months of the date of manufacture, whichever is the lesser shall be replaced.

Paint from painter's kettle shall be returned to store and kept in a sealed container. Before it is reissued for use, it shall be thoroughly mixed and no fresh paint or thinner shall be added.

Paint mixed on the job shall not be mixed until the Contractor is ready to use the paint. All paint shall be mixed and stored strictly in accordance with the manufacturer's instructions.

Unless otherwise recommended by the manufacturer and approved by the S.O. thinners or other addition shall not be used.

The Manufacturer's instruction for mixing and applying the paint shall be closely followed. All paint mixing shall be done in the presence of the S.O.

(c) Application of Paint

All paint shall be supplied from the store to the painters ready for application, and the addition of thinners or any material shall be thereafter prohibited. Any instructions given by the paint manufacturer shall be strictly followed.

Paint shall be applied to dry surfaces which have prepared and cleaned in accordance with this Specification. The interval between preparation for the metal surface and the application of the first priming coats of paint shall be in accordance with this Specification.

Two pack paints of the epoxide resin type shall not be applied when the temperature is below that required by the paint manufacturer.

Priming coats of paint shall be applied by brushing, rolling or airless spray. Finishing coats of paint shall be applied by airless spray.

If in the opinion of the S.O. the paint coating is unsatisfactory, then it shall be removed and the surface shall be cleaned thoroughly and repainted.

Unless otherwise agreed by the S.O. the paint system, with the exception of one final finishing coat, shall be applied under coat in controlled conditions at the fabricator's works. One final finishing coat shall be applied at Site.

(d) Working Condition

Painting may be performed during any normal working hours except as stated below.

No paint shall be applied to any surface which is wet, damp or dusty.

Paint shall not be applied when the relative humidity is greater than 85%, or when rain is falling or about to fall, unless painting is done indoors, or when the temperature of the receiving surface exceed 50°C. Material painted under cover in damp weather shall remain under cover until dry or until weather condition permits its exposure.

At least 24 hours shall elapse between applications of coats except between application of etch primer and intermediate coat which shall be applied within 8 hours of the application of the etch primer.

Each coat shall be thoroughly dry before the application of the next coat.

(e) Thickness of Paint System

The total paint film thickness of the paint system shall not less be than 0.1 mm. The dry paint film shall be measured by Elcometer or other instrument approved by the S.O. In order to obtain the dry film thickness specified the Contractor shall ensure that the coverage rate given by the paint manufacturer is followed.

Wet film thickness may be used for checking but shall not be permitted as a means of predicting the dry film thickness.

(f) Adhesion and Cohesion

The adhesion of the complete coating when applied as specified shall be continuous over the whole surface and shall be such that the coating cannot be peeled from the surface of the specimen or separated between coats when tested in the following manner:-

Two parallel knife cuts about 1.5 m apart and 50 mm long shall be scribed through the coating to the base metal at one end with sharp knife. The loosened end shall be held between the knife blade and a finger and a slow steady upward pull exerted on the paint strip normal to the coated surface.

Any lifting of the strip either at the metal-paint interface or within the paint film shall be interpreted as failure to comply with adhesion or cohesion requirements.

(g) Stripe Coats

As soon as the first priming coat and/or undercoat has dried, an extra strips coat of paint shall be applied by brush on vulnerable areas such as edges, corners, crevices, bolts heads and welds. This paint shall be of similar composition to each coat but in a contrasting shade.

(h) Coated Surfaces

Uncoated surfaces which will have concrete cast against them shall be left unpainted. The surface shall be thoroughly wire brushed so as to remove loose rust mill scale and prevent surface contamination.

(i) Storage of Painted Steelwork

Painted fabricated steelwork which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure no pool of water or dirt can accumulate on the surfaces. Suitable packing materials where cover is provided and shall be ventilated.

Prime painted steelwork which is to be stored outdoors or transported prior to fabrication or erection shall no be exposed before being overcoated for period longer than the following:-

	Outdoors
Etch primers	Nil
Etch primers on metal coating	4 weeks
Red lead primers (1 coat)	8 weeks
Metallic lead primers (2 coat)	16 weeks
Calcium plumbate primers	4 weeks
Zinc chromate primers	2 weeks
Zinc chromate/Red oxide primers	2 weeks
Zinc chromate primers (1/2 mil to 1 mil thick)	4 weeks

(j) Cleaning Equipments

Any separate cleaner consisting of suitable solvents may be furnished for the cleaning of paint equipment.

The cleaner shall be completely volatile so that a residual oily film is not deposited in the painting equipment after the cleaning operations. Separate cleaner mixture shall not be used as thinners to reduce the viscosity of the paint.

6.2 Metallic Coating

Unless otherwise specified or approved by the S.O. characteristic of Metallic Coatings shall comply with BS 5493.

6.2.1 Thickness of Metallic Coating and Its Quality Control

Sprayed metal coatings which are subsequently to be painted shall have a nominal thickness of 0.1 mm. The nominal and local thickness of coating shall comply with the BS 2569 : Part 1.

Sample and testing shall be carried out in accordance with BS 729 : Part 1, BS 729 : Part 2 and BS 2569 : Part 1 whichever is appropriate.

All metal sprayed steelwork shall be protected within 4 hours of spraying with one coat of approved etch primer.

Where a metal coating is required only on part of an assembled section it shall be applied before the rest of the section receives its first priming coat.

6.3 Treatments for Connections and Other Special Areas

6.3.1 Bolts

Bolts shall be treated in either of the following manner depending upon erection condition and S.O.'s approval:

(a) Black bolts in steelwork have been manually cleaned after weathering may be prepared and coated in the same manner as the general surfaces.

(b) Where black bolts are used for connections and all surfaces are prepared by blast-cleaning after bolting-up completed, the exposed surfaces of the bolt, nuts and washers shall be cleaned at the same time as the general surfaces. This also applies if high strength friction grip bolts are used in similar circumstances.

(c) Where general surfaces of steelwork are prepared by blast-cleaning before bolting-up and it is not practicable subsequently to utilize the same preparation method for the connector surfaces, pickling may be used to remove scale and to assist in manual preparation of the exposed surfaces for coating.

(d) High strength friction grip bolt shall not use pickling for plating or other coating without full consultation with the manufacturer and the S.O.

(e) Electroplating with zinc or cadmium shall be done in accordance with BS 3382 : Part 1 and Part 2. The thickness of the coating shall be ensured so that the protection offer is similar to that provided for the general surfaces. Additional paint shall be applied to the plated bolt when protective coating equivalent to that used on the general surfaces are available. Where the components are subsequently to be protected with a full paint system, any corrosion products visible after assembly shall be removed before primer is applied and plating shall be without 'passivation'.

Where the components are not to be painted, the plating thickness shall be 25 m minimum, plating shall be with 'passivation' and the colour to the approval of the S.O.

(f) Sherardizing shall be done in accordance with BS 4921 Class 1 with a minimum thickness of 30 m. Primers of suitable type shall be applied as soon as possible after assembly.

(g) All fixings shall be stored in such a manner as to ensure that they do not become corroded or contaminated. Exposed parts of fixing, after assembly, shall be degreased before surfaces are prepared or coating applied. Paint shall be applied with brush where access to coat the surfaces is difficult.

(h) The Contractor may used other alternative type of treatment for bolt but subject to the approval of the S.O.

6.3.2 Surfaces of Connection Joined by Bolts

Surfaces to be joined by high strength friction grip bolts shall not be painted. The treatment of interface to be joined by high strength friction grip bolt shall comply with BS 5493. The contractor shall submit his proposal for S.O.'s approval.

6.4 Repairs to Damaged Surfaces

Area of paint which have damaged during handling, storing, loading and off loading, transportation, erection and construction shall be cleaned to bare metal, or metal coating where this has been applied, and the edges of the undamaged pain bevelled with sandpaper.

Where a metal coating has been damaged, the affected area shall be rubbed down to remove excessive roughness, cleaned and an additional coat of approved zinc-rich system shall then be re-applied and the new paint shall overlap the existing paint by a least 50 mm all round the effected part.

All galvanized surfaces-damaged during construction shall be cleaned by grit-blasting and coated with organic Air-Cured Ethyl Silicate Coating.

6.5 Health and Safety

The Contractor carrying out coating shall comply with all relevant regulation which are given by the paint manufacturer and as specified in BS 5493.

PROTECTIVE COATING SYSTEM TO STEEL SURFACE

1.0 BASE COAT AND INTERMEDIATE COATS

1.1 The protective coating/paint system to the steel surfaces shall be of suitable propriety approved type with proven track record of application.

1.2 The base coat/coats shall be of polyamine cured epoxy mastic coating of high solids and high build system.

1.3 The specified dried film thickness shall be achieved before application of the next coat. In all cases, the minimum interval shall be at least 6 hours.

1.4 The paint system shall have some of the following stated properties:-

a)	Solids by Volume	80%	(ISO 3233)
b)	Flash Point	35°C	(ISO 3679)
c)	Specific Gravity	1.4 kg/l	
d)	Pot life after mixing	2 hours	

2.0 TOP COAT

2.1 The protective system shall be of similar compatible propriety system as the base coat. It shall be of Aliphatic Acrylic Polyurethane Coating system with good gloss finish and gloss retention.

2.2 It shall be of high solids systems with the following properties:-

a)	Solids by Volume	60%	(ISO 3233)
b)	Flash Point	35°C	(ISO 3679)
c)	Specific Gravity	1.2 kg/l	
d)	Pot life after mixing	1.5 hours	

ASPHALTIC PLUG JOINT

1.0 An approved proprietary "Asphaltic Plug Joint" with proven record shall be supplied and installed for the Bridge Expansion Joints as per drawing details and in accordance to all the manufacturer's recommendations.

2.0 It shall be of specially blended polymer modified asphalt and aggregate system to infill the prepared expansion joint block-out on the premix surface of the Bridge Deck.

3.0 It shall be installed by experienced Specialist Contractor so as to provide a flexible joint surface capable of accommodating expansion/contraction movement of up to 20mm.

4.0 The aggregate shall primarily consist of Granite etc which shall be crushed and washed clean to meeting the gradation of 20mm to 6mm with about 50% below 15mm aggregate size.

5.0 The asphaltic binder shall have compositions similar to the ones stated below:-

a)	Cone Penetration @ 25°C	7.5	(ASTM D5/D3407)
b)	Flow @ 60°C	3.0	(ASTM D3407)
c)	Softening Point	180	(ASTM D36)
d)	Tensile Adhesion	700	(ASTM D5329)
e)	Pouring Temperature	200°C	

RPT/TC/275/TenderDocuments

APPENDIX 4

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90, KUALA KANGSAR, PERAK (CADANGAN MEMBAIKPULIH & MEMPERKUATKAN STRUKTUR)

TENDER DOCUMENTS

APPENDIX 4

AS-BUILT "STRUCTURAL DETAILS" DRAWINGS FOR SPAN 1

AS-BUILT "STRUCTURAL DETAILS" DRAWINGS

1.0 Structural Details Drawing for Span No.1 are presented in the following drawings for the reference of the Contractor:-

a) JKR/JSI/TC/BR/01 - General Arrangement

b) JKR/JSI/TC/BR/02 - Span 1 : Vertical Bracing (1 of 2)

c) JKR/JSI/TC/BR/03 - Span 1 : Vertical Bracing (2 of 2)

d) JKR/JSI/TC/BR/22 - Middle Frame at Pier 1

e) JKR/JSI/TC/BR/28 - Outer Girder G1 & G4 of Span 1 & 7 (1 of 2)

f) JKR/JSI/TC/BR/29 - Outer Girder G1 & G4 of Span 1 & 7 (2 of 2)

g) JKR/JSI/TC/BR/30 - Inner Girder G2 & G3 of Span 1 & 7 (1 of 2)

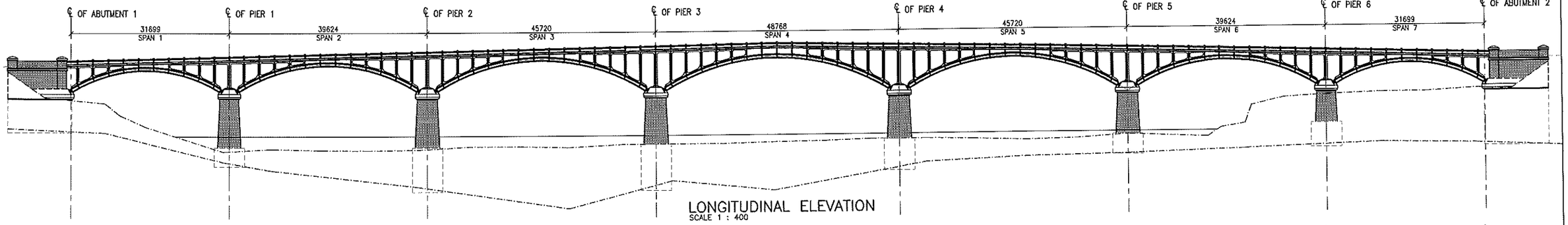
h) JKR/JSI/TC/BR/31 - Inner Girder G2 & G3 of Span 1 & 7 (2 of 2)

i) JKR/JSI/TC/BR/44 - Horizontal Bracing Between Girders for Span 1 & 7

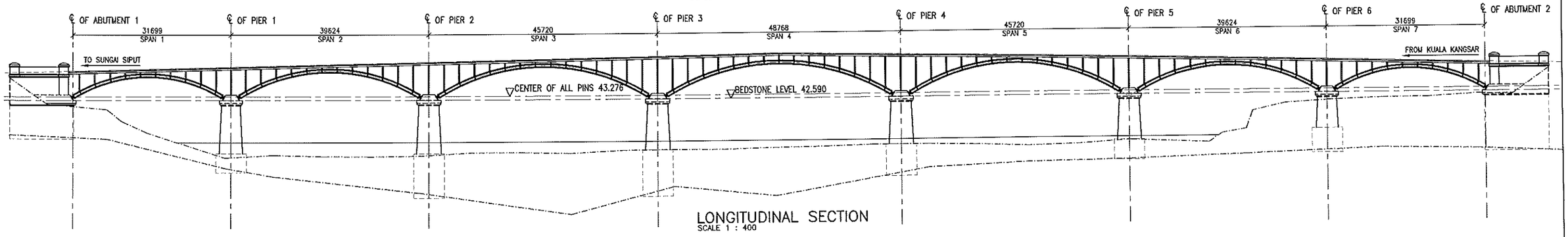
j) JKR/JSI/TC/BR/48 - Horizontal Member Below Trough for Span 1 & 7

k) JKR/JSI/TC/BR/52 - Layout of Trough for Span 1 & 7

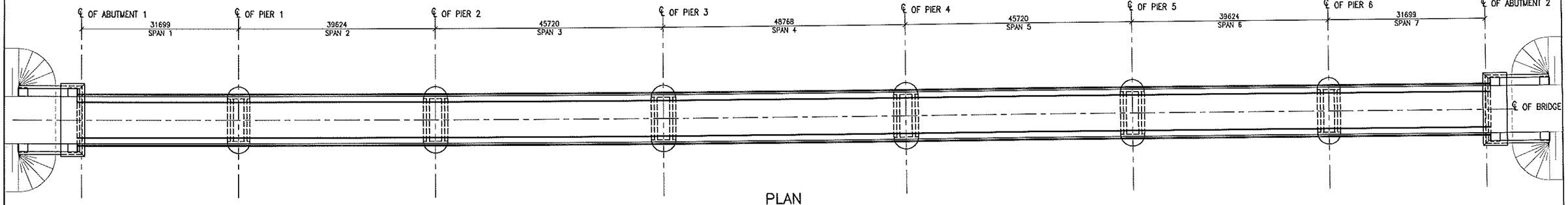
2.0 Structural Details for other spans are of similar configuration and can be viewed at JKR.



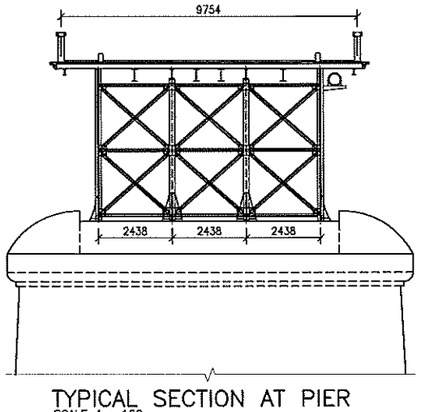
LONGITUDINAL ELEVATION
SCALE 1 : 400



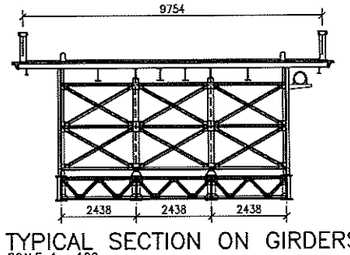
LONGITUDINAL SECTION
SCALE 1 : 400



PLAN
SCALE 1 : 400



TYPICAL SECTION AT PIER
SCALE 1 : 100



TYPICAL SECTION ON GIRDERS
SCALE 1 : 100

NOTA

PELANGGAN

KERAJAAN MALAYSIA

PEGAWAI PENGUASA

JABATAN KERJA RAYA

PIHAK PERUNDING

T-CORP ENGINEERS SDN BHD
NO. 60-B, JALAN SS21/39,
DAMANSARA UTAMA,
47400 PETALING JAYA, SELANGOR
TEL : 03-7710 1382 ; 03-7710 1390
FAX : 03-7710 1398

PROJEK

KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK

- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

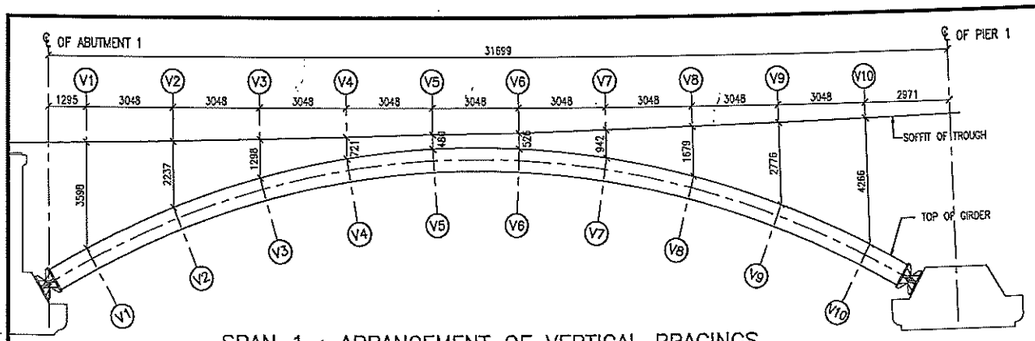
TAJUK LUKISAN

AS BUILT STRUCTURAL DETAILS
GENERAL ARRANGEMENT

NO LUKISAN: JKR/JSI/TC/BR/01

Dilukis Oleh	INA	Skala	AS SHOWN
Tarikh	APRIL 2015	Disemak Oleh	
Disemak Oleh	TKW	Tandatangan	

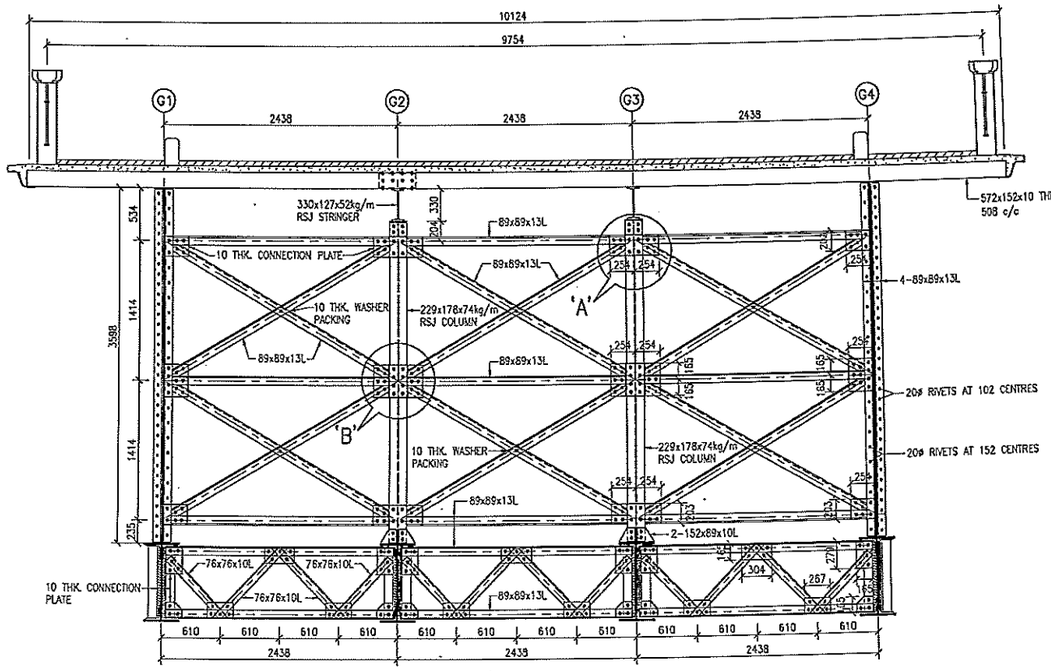
TARIKH	BUTIR PINDAAN	RUJUKAN



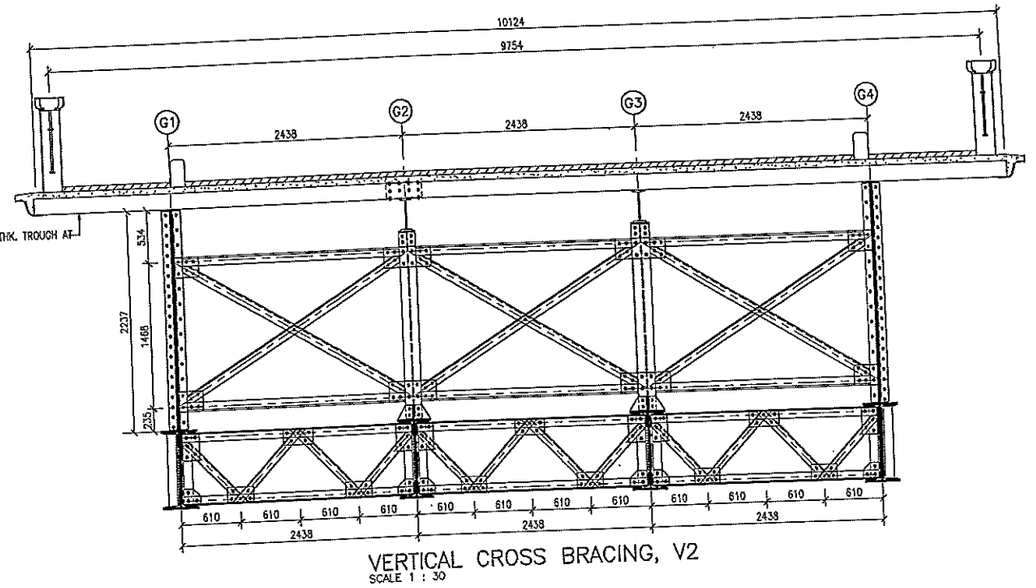
SPAN 1 : ARRANGEMENT OF VERTICAL BRACINGS
SCALE 1 : 100

NOTES:

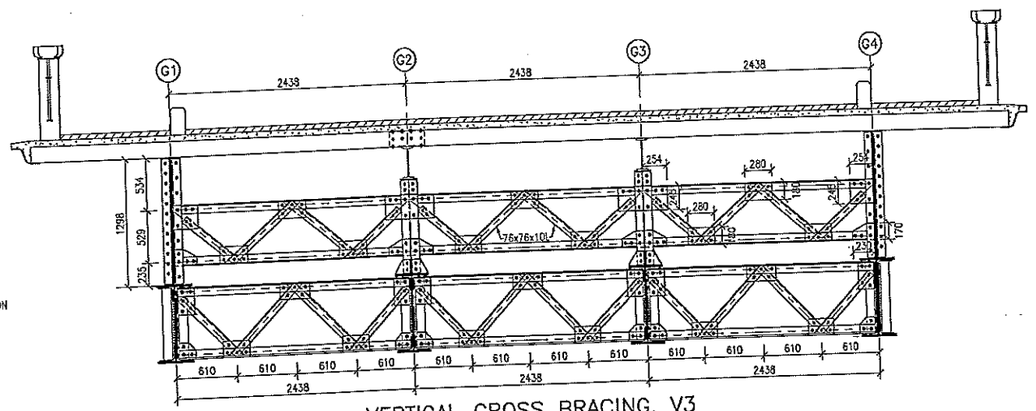
1. ALL CONNECTIONS IN THIS VERTICAL BRACING SYSTEM ARE MADE WITH 20mm DIAMETER RIVET UNLESS OTHERWISE NOTED.
2. ALL CONNECTION PLATES ARE 10mm THICK UNLESS OTHERWISE INDICATED.
3. ALL BRACING ELEMENTS ABOVE ARCHED GIRDERS ARE 89x89x13L UNLESS OTHERWISE STATED.
4. ALL HORIZONTAL BRACING ELEMENTS BETWEEN ARCHED GIRDERS ARE 89x89x13L UNLESS OTHERWISE STATED.
5. ALL INCLINED BRACING ELEMENTS BETWEEN ARCHED GIRDERS ARE 76x76x10L UNLESS OTHERWISE STATED.
6. V1 TO V10 DENOTES VERTICAL CROSS BRACING AT LOCATION 1 TO 10 RESPECTIVELY.
7. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.
8. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. JKR/JSI/TC/BR/03.
9. G1, G2, G3 AND G4 ARE THE CENTRELINE OF ARCHED GIRDER 1, 2, 3 AND 4 RESPECTIVELY.



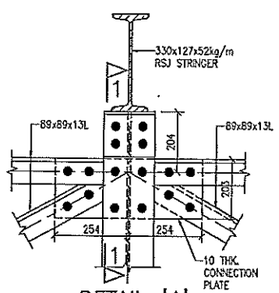
VERTICAL CROSS BRACING, V1
SCALE 1 : 30



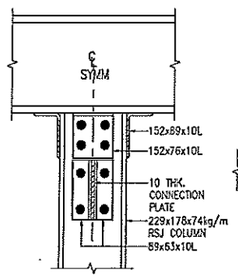
VERTICAL CROSS BRACING, V2
SCALE 1 : 30



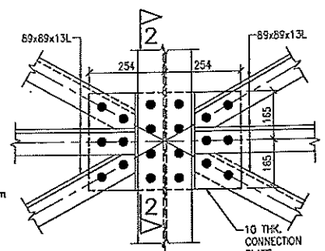
VERTICAL CROSS BRACING, V3
SCALE 1 : 30



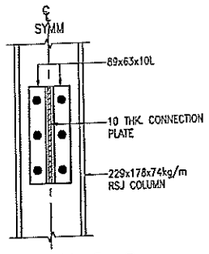
DETAIL 'A'
SCALE 1 : 10



SECTION 1–1
SCALE 1 : 10

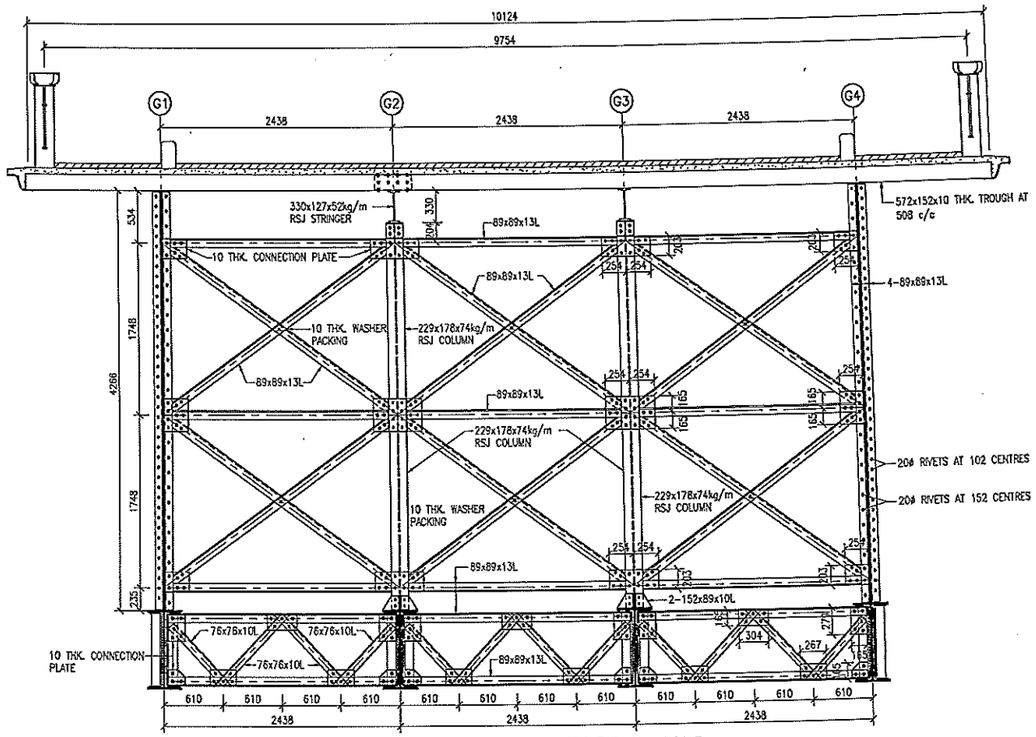


DETAIL 'B'
SCALE 1 : 10

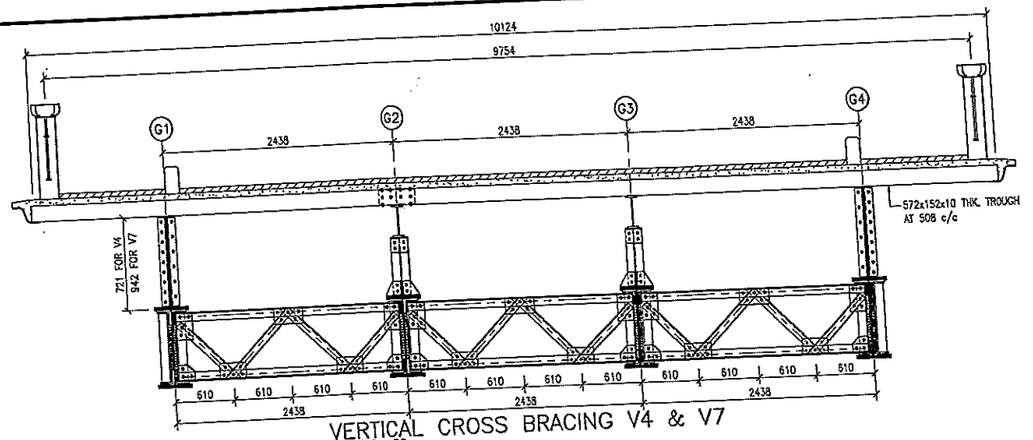


SECTION 2–2
SCALE 1 : 10

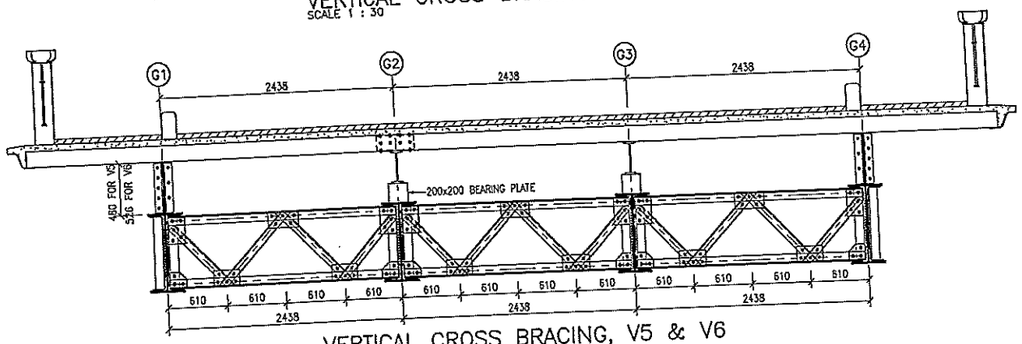
NOTA	PELANGGAN: KERAJAAN MALAYSIA	PEGAWAI PENGUASA: JABATAN KERJA RAYA	PIHAK PERUNDING: T-CORP ENGINEERS SDN BHD, NO. 80-B, JALAN 6621/05, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR. TEL : 03-7710 1332 ; 03-7710 1300 FAX : 03-7710 1505	PROJEK: KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN: AS BUILT STRUCTURAL DETAILS; SPAN 1 VERTICAL BRACING SHEET 1 OF 2; NO LUKISAN: JKR/JSI/TC/BR/02	Dilukis Oleh: INA; Tarikh: APRIL 2015; Disemak Oleh: TKW; Skala: AS SHOWN; Diluluskan Oleh: T. Tangan; TARIKH: BUTIR PINDAAN; RUJUKAN



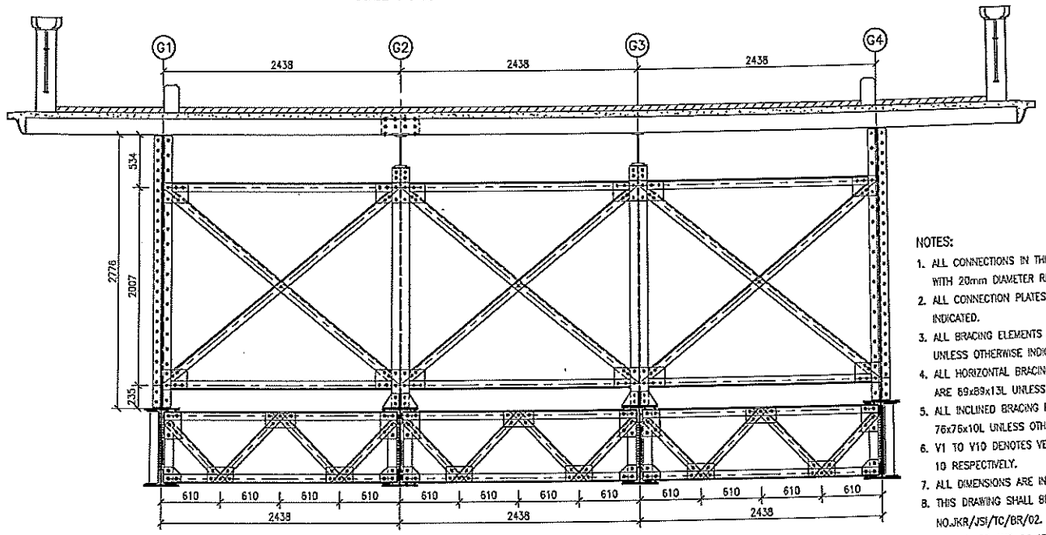
VERTICAL CROSS BRACING, V10
SCALE 1 : 30



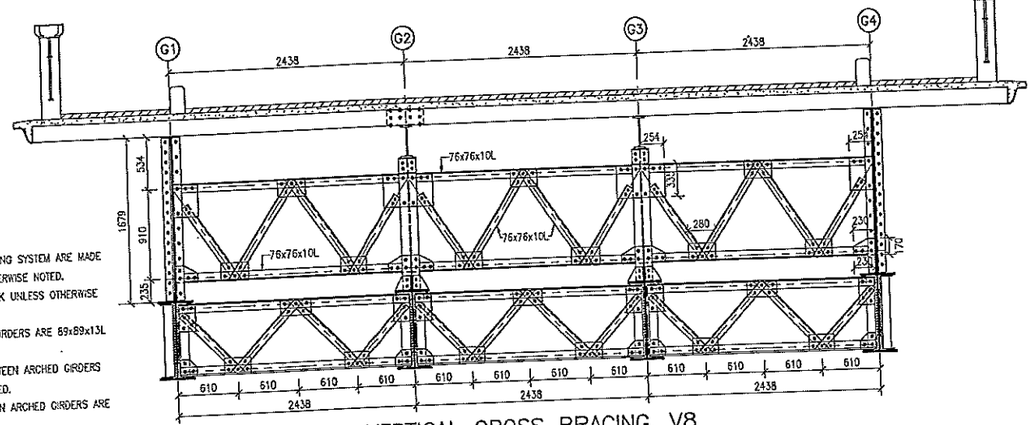
VERTICAL CROSS BRACING V4 & V7
SCALE 1 : 30



VERTICAL CROSS BRACING, V5 & V6
SCALE 1 : 30



VERTICAL CROSS BRACING, V9
SCALE 1 : 30

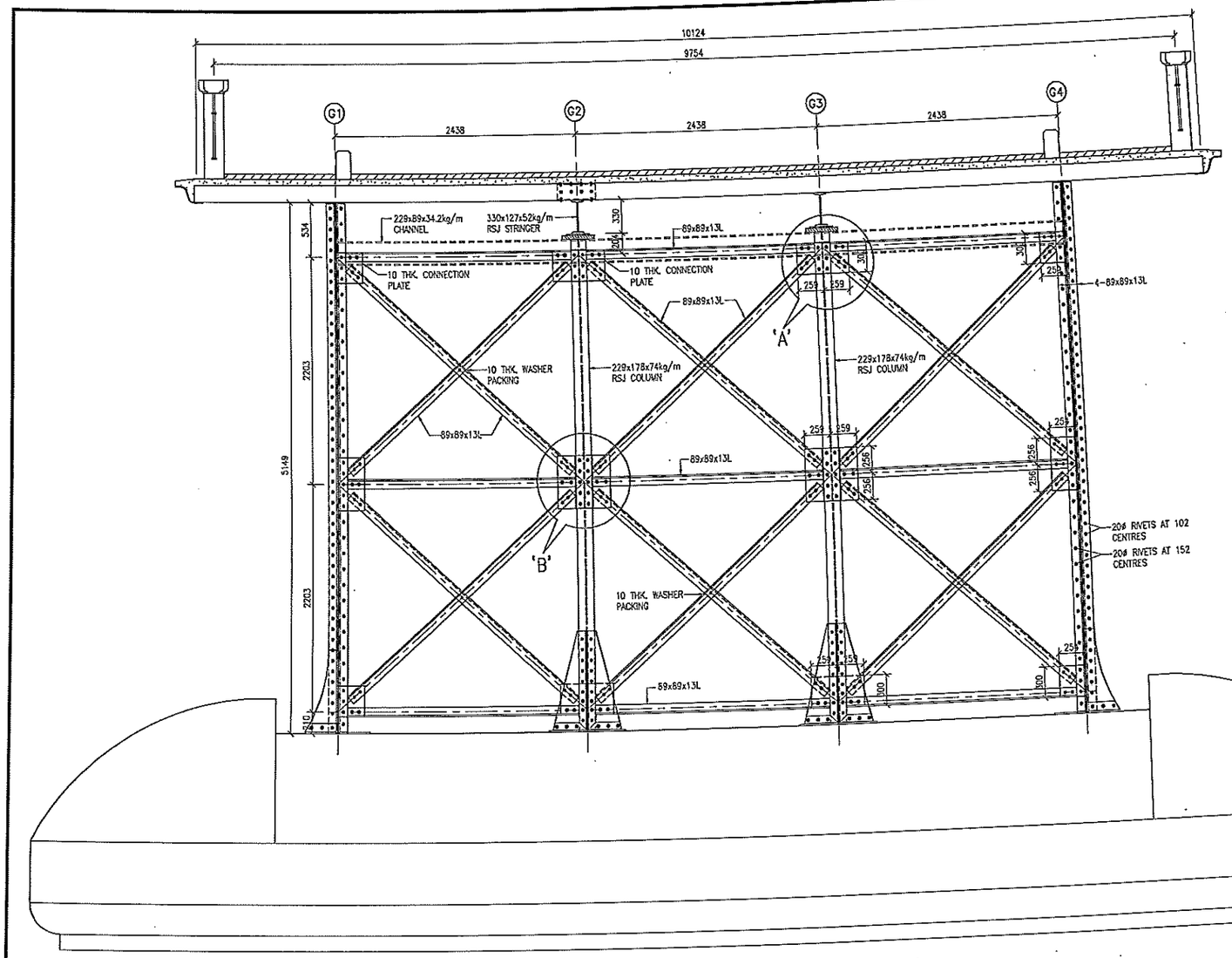


VERTICAL CROSS BRACING, V8
SCALE 1 : 30

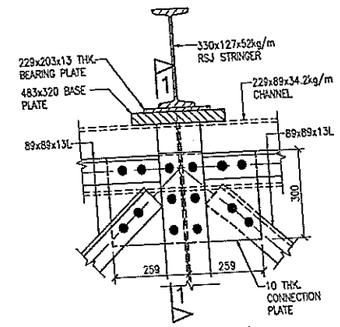
NOTES:

1. ALL CONNECTIONS IN THIS VERTICAL BRACING SYSTEM ARE MADE WITH 20mm DIAMETER RIVET UNLESS OTHERWISE NOTED.
2. ALL CONNECTION PLATES ARE 10mm THICK UNLESS OTHERWISE INDICATED.
3. ALL BRACING ELEMENTS ABOVE ARCHED GIRDERS ARE 89x89x13L UNLESS OTHERWISE INDICATED.
4. ALL HORIZONTAL BRACING ELEMENTS BETWEEN ARCHED GIRDERS ARE 89x89x13L UNLESS OTHERWISE STATED.
5. ALL INCLINED BRACING ELEMENTS BETWEEN ARCHED GIRDERS ARE 76x76x10L UNLESS OTHERWISE STATED.
6. V1 TO V10 DENOTES VERTICAL CROSS BRACING AT LOCATION 1 TO 10 RESPECTIVELY.
7. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.
8. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO.JKR/JSI/TC/BR/02.
9. G1, G2, G3 AND G4 ARE THE CENTRELINE OF ARCHED GIRDER 1, 2, 3 AND 4 RESPECTIVELY.

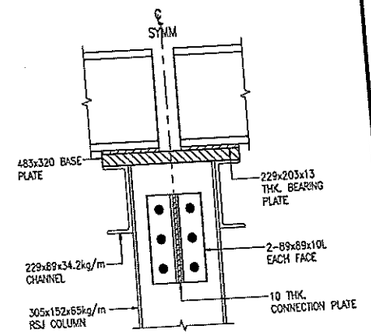
NOTA	PELANGGAN: KERAJAAN MALAYSIA	PEGAWAI PENGUASA: JABATAN KERJA RAYA	PIHAK PERUNDING: T-CORP ENGINEERS SDN BHD, NO. 60-B, JALAN BS2/59, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR. TEL : 03-7710 1952 ; 03-7710 1500 FAX : 03-7710 1505	PROJEK: KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN: AS BUILT STRUCTURAL DETAILS SPAN 1 VERTICAL BRACING SHEET 2 OF 2 NO LUKISAN: JKR/JSI/TC/BR/03	Dilukis Oleh: INA; Tarikh: APRIL 2015; Disemak Oleh: TKW; Skala: AS SHOWN; Diluluskan Oleh; T. Tangan TARIKH / BUTIR PINDAAN / RUJUKAN



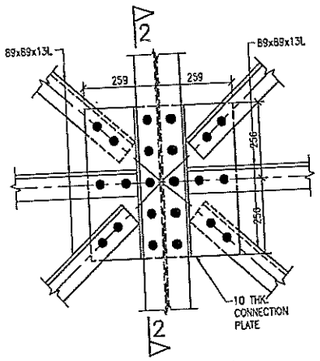
ELEVATION OF MIDDLE FRAME AT PIER 1
SCALE 1 : 25



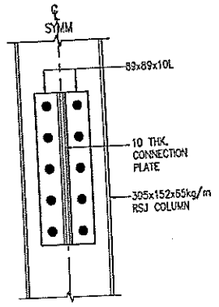
DETAIL 'A'
SCALE 1 : 10



SECTION 1-1
SCALE 1 : 10



DETAIL 'B'
SCALE 1 : 10



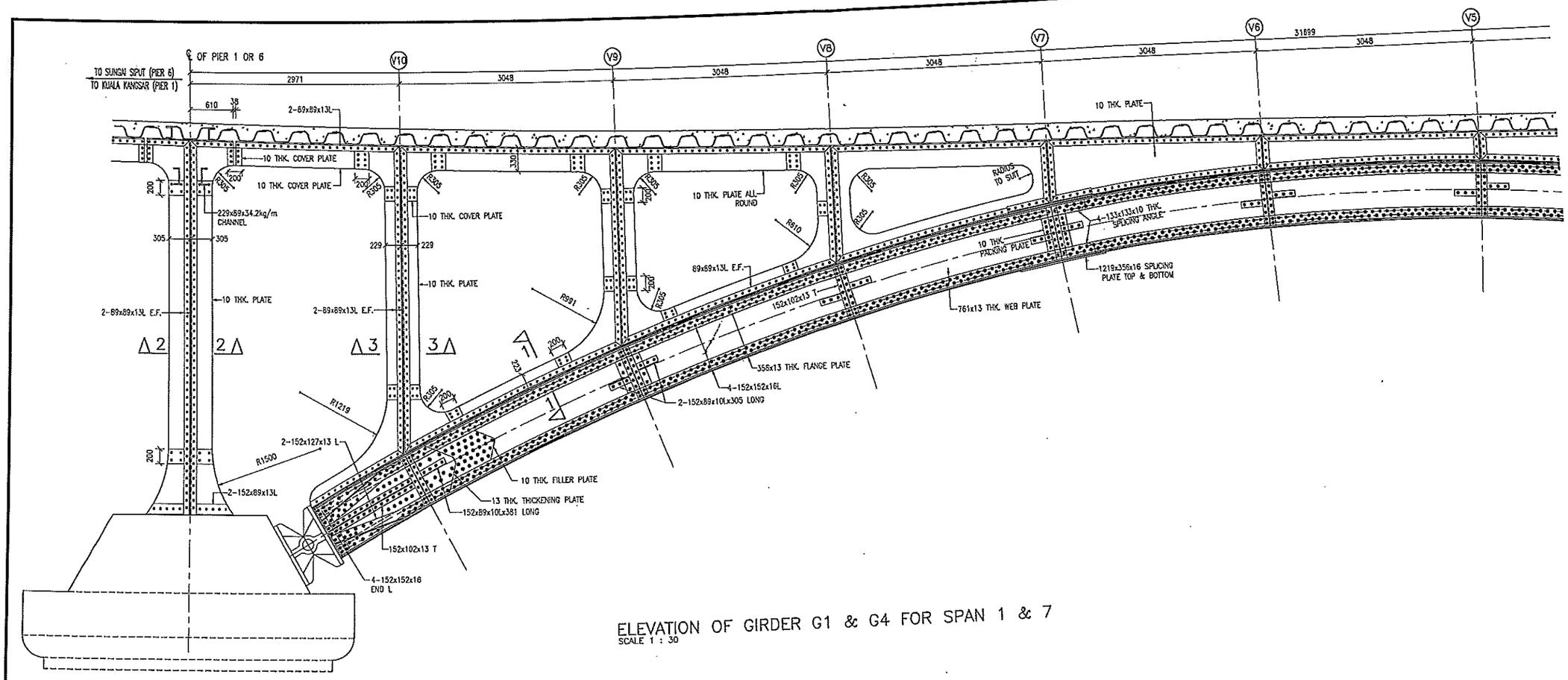
SECTION 2-2
SCALE 1 : 10

NOTES:

1. ALL CONNECTIONS OF BRACING ELEMENTS IN THIS FRAME SYSTEM ARE MADE WITH 20mm DIAMETER RIVET UNLESS OTHERWISE NOTED.
2. ALL CONNECTION PLATES ARE 10mm THICK UNLESS OTHERWISE INDICATED.
3. ALL BRACING ELEMENTS ARE MADE FROM 89x89x13L UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.
5. THE CENTRELINE G1, G2, G3 AND G4 ARE RESPECTIVELY ALONG ARCHED GIRDER 1, 2, 3 AND 4.

NOTA	PELANGGAN: KERAJAAN MALAYSIA	PEGAWAI PENGUASA: JABATAN KERJA RAYA	PIHAK PERUNDING: T-CORP ENGINEERS SDN BHD, NO. 80-B, JALAN 6621/59, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR. TEL : 03-7710 1352 : 03-7710 1300 FAX : 03-7710 1505	PROJEK: KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN: AS BUILT STRUCTURAL DETAILS MIDDLE FRAME AT PIER 1	NO LUKISAN: JKR/ISI/TC/BR/22	

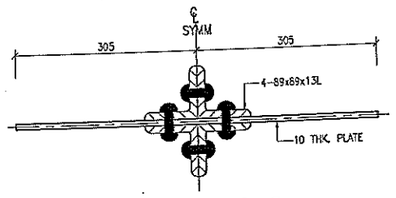
Dilukis Oleh	INA	Skala	AS SHOWN	
Tarikh	APRIL 2015	Diluluskan Oleh		
Disemak Oleh	TKW	T. Tangan		
TARIKH	BUTIR PINDAAN			RUJUKAN



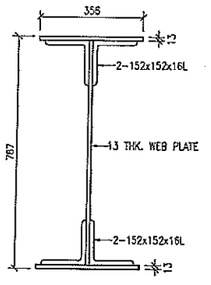
ELEVATION OF GIRDER G1 & G4 FOR SPAN 1 & 7
SCALE 1 : 30

NOTES:

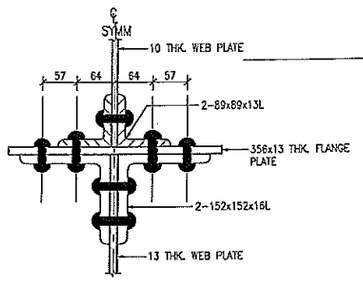
1. THE RIVETS USED TO FORM THE GIRDER ARE 24mm DIAMETER.
2. ALL CONNECTIONS ARE MADE WITH 20mm DIAMETER RIVET UNLESS OTHERWISE NOTED.
3. V1 TO V10 INCLUSIVE ARE THE LOCATION OF VERTICAL CROSS BRACING. REFER THE DRAWING OF VERTICAL BRACING FOR DETAILS.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. JKR/JSI/TC/BR/23.



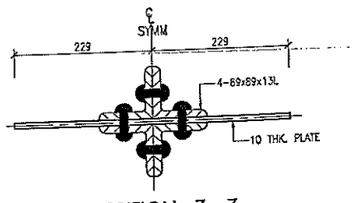
SECTION 2-2
SCALE 1 : 5



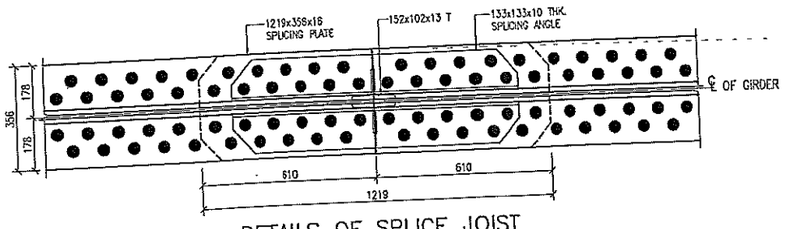
TYPICAL SECTION OF GIRDER
SCALE 1 : 10



SECTION 1-1
SCALE 1 : 5



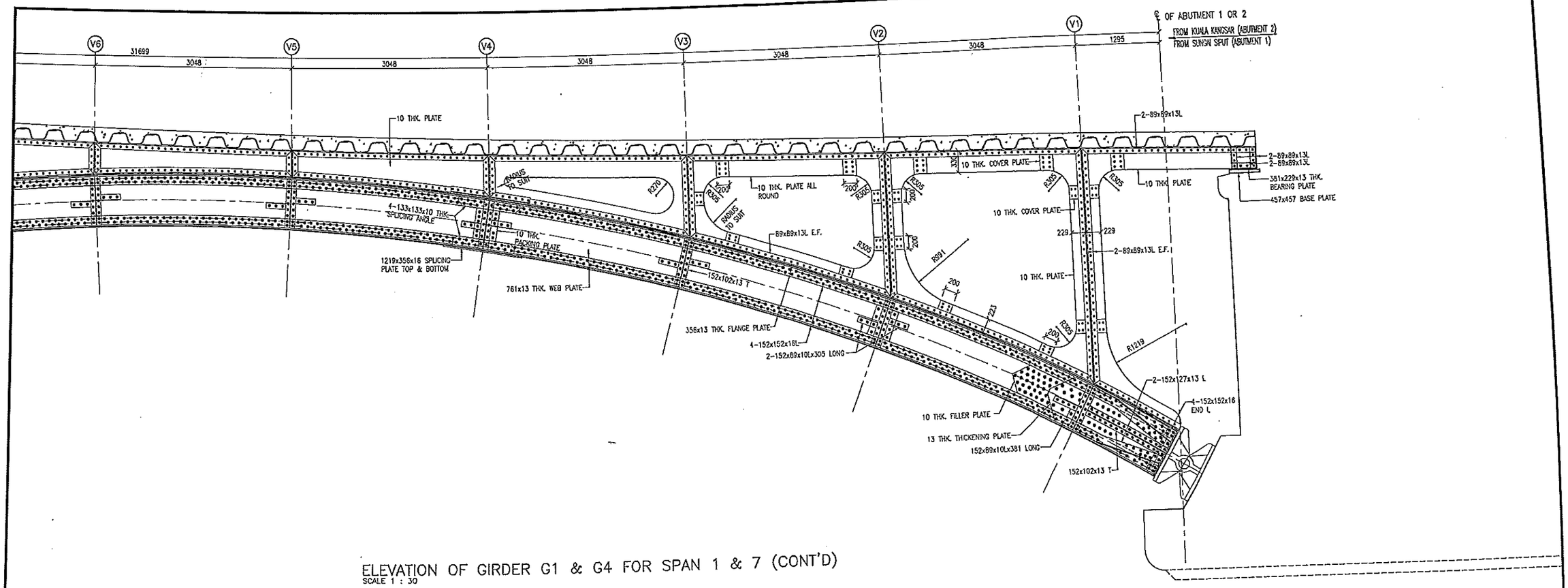
SECTION 3-3
SCALE 1 : 5



DETAILS OF SPLICE JOIST
SCALE 1 : 10

NOTA	PELANGGAN: KERAJAAN MALAYSIA	PEGAWAI PENGUASA: JABATAN KERJA RAYA	PIHAK PERUNDING: T-CORP ENGINEERS SDN BHD, NO. 80-B, JALAN SS21/39, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR. TEL : 03-7710 1552 | 03-7710 1550 FAX : 03-7710 1556	PROJEK: KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN: AS BUILT STRUCTURAL DETAILS; OUTER GIRDER G1 & G4 OF SPAN 1 & 7 SHEET 1 OF 2; NO LUKISAN: JKR/JSI/TC/BR/28

Dilukis Oleh	INA	Skala	AS SHOWN
Tarikh	APRIL 2015	Diluluskan Oleh	
Disemak Oleh	TKW	T. Tangan	
TARIKH	BUTIR PINDAAN		RUJUKAN



ELEVATION OF GIRDER G1 & G4 FOR SPAN 1 & 7 (CONT'D)
SCALE 1 : 30

NOTES:

1. THE RIVETS USED TO FORM THE GIRDER ARE 24mm DIAMETER.
2. ALL CONNECTIONS ARE MADE WITH 20mm DIAMETER RIVET UNLESS OTHERWISE NOTED.
3. V1 TO V10 INCLUSIVE ARE THE LOCATION OF VERTICAL CROSS BRACING. REFER THE DRAWING OF VERTICAL BRACING FOR DETAILS.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. JKR/JSI/TC/BR/28.

NOTA

PELANGGAN
KERAJAAN MALAYSIA

PEGAWAI PENGUASA
JABATAN KERJA RAYA

PIHAK PERUNDING
T-CORP ENGINEERS SDN BHD
NO. 80-B, JALAN SS21/39,
DAMANSARA UTAMA,
47400 PETALING JAYA, SELANGOR
TEL : 03-7710 1552 ; 03-7710 1560
FAX : 03-7710 1505

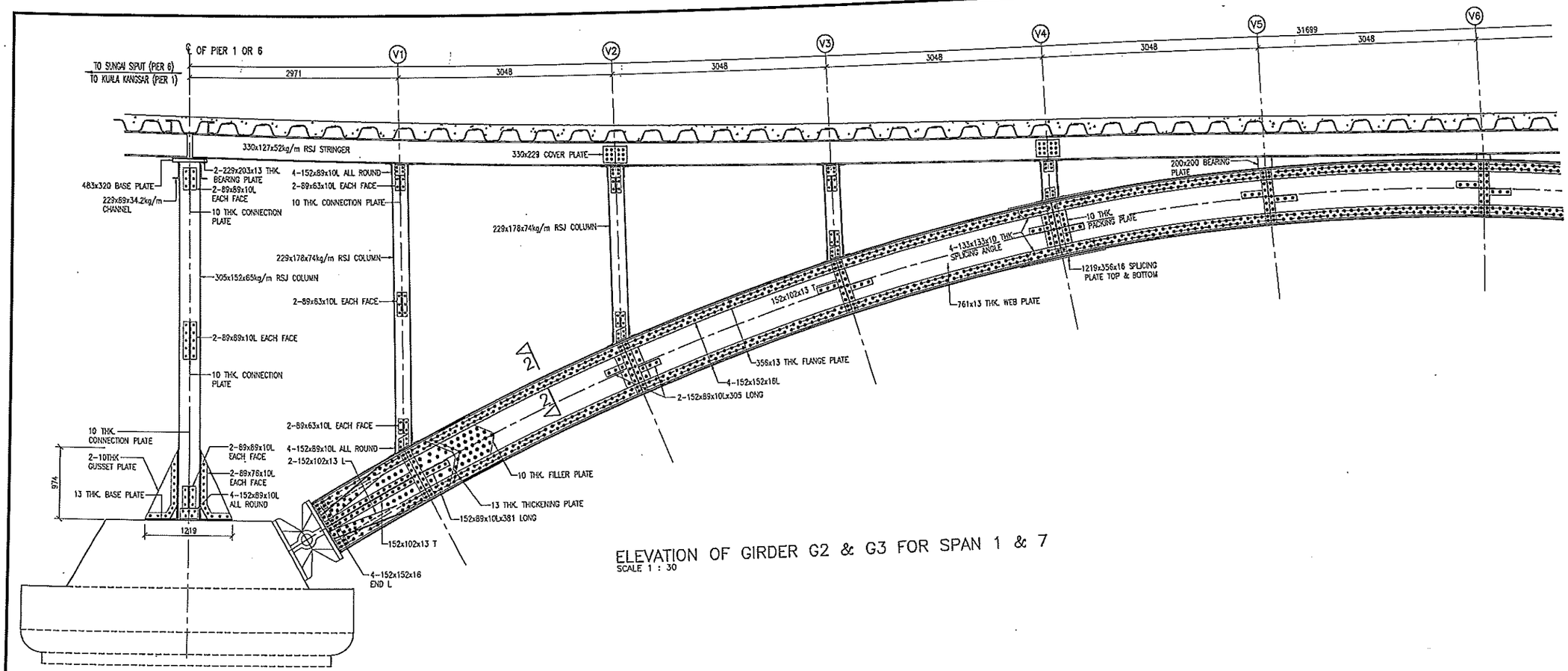
PROJEK
KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK
- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

TAJUK LUKISAN
AS BUILT STRUCTURAL DETAILS
OUTER GIRDER G1 & G4 OF SPAN 1 & 7
SHEET 2 OF 2

NO LUKISAN: JKR/JSI/TC/BR/29

Dilukis Oleh	INA	Skala	AS SHOWN
Tarikh	APRIL 2015	Disemakan Oleh	
Disemak Oleh	TKW	Y. Tangan	

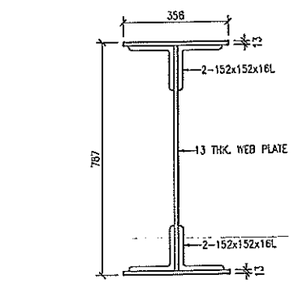
TARIKH	BUTIR PINDAAN	RUJUKAN



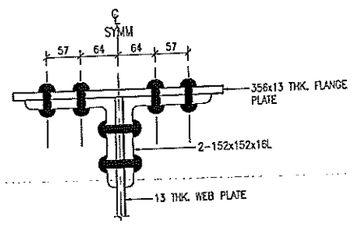
ELEVATION OF GIRDER G2 & G3 FOR SPAN 1 & 7
SCALE 1 : 30

NOTES:

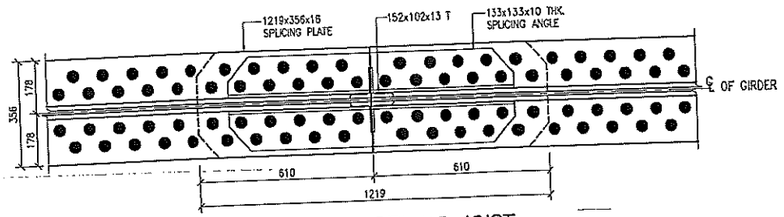
1. THE RIVETS USED TO FORM THE GIRDER ARE 24mm DIAMETER.
2. ALL CONNECTIONS ARE MADE WITH 20mm DIAMETER RIVET UNLESS OTHERWISE NOTED.
3. V1 TO V10 INCLUSIVE ARE THE LOCATION OF VERTICAL CROSS BRACING. REFER THE DRAWING OF VERTICAL BRACING FOR DETAILS.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.
5. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRAWING NO. JKR/JSI/TC/BR/31.



TYPICAL SECTION OF GIRDER
SCALE 1 : 10

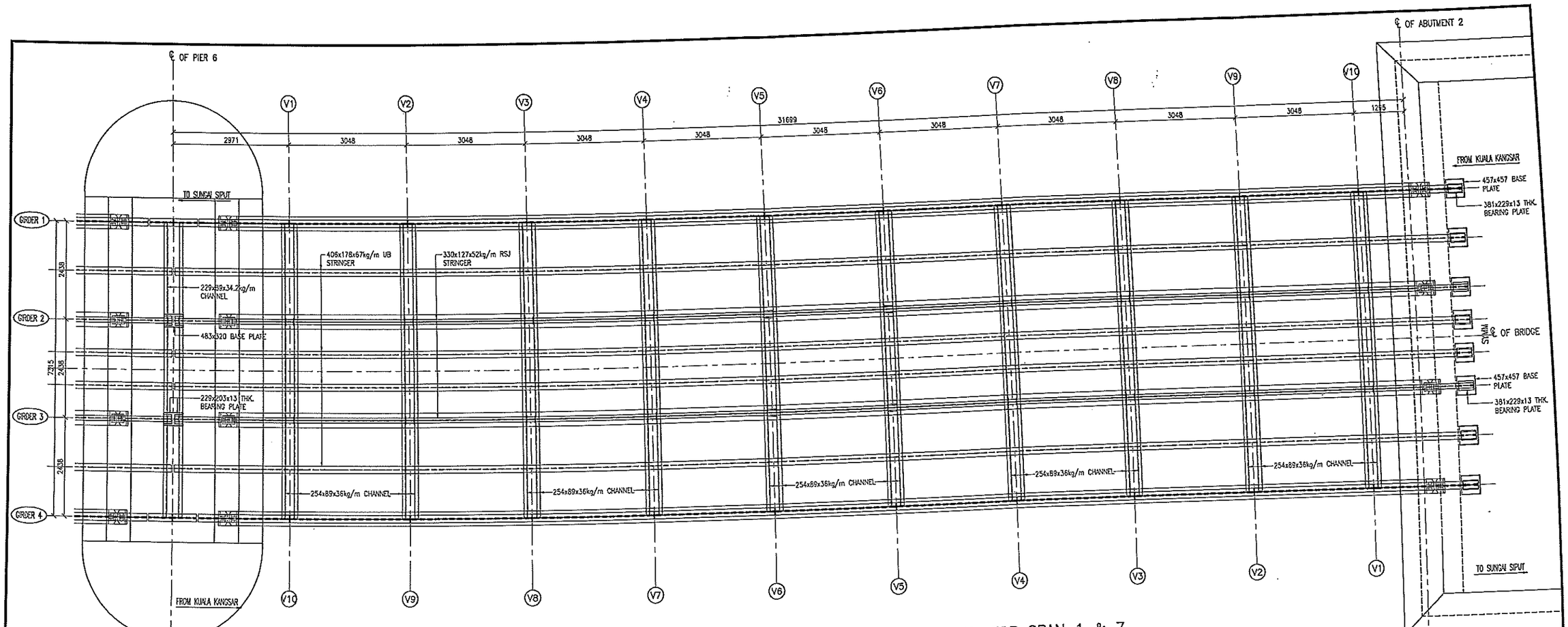


SECTION 2-2
SCALE 1 : 5



DETAILS OF SPLICE JOIST
SCALE 1 : 10

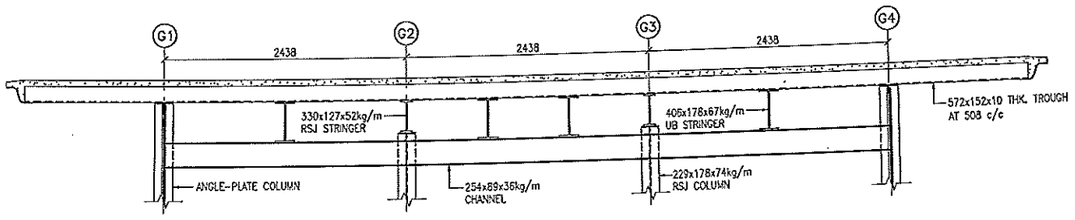
NOTA	PELANGGAN: KERAJAAN MALAYSIA	PEGAWAI PENGUASA: JABATAN KERJA RAYA	PIHAK PERUNDING: T-CORP ENGINEERS SDN BHD, NO. 80-B, JALAN 6621/5B, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR. TEL: 03-7710 1362 ; 03-7710 1300 FAX: 03-7710 1305	PROJEK: KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN: AS BUILT STRUCTURAL DETAILS — INNER GIRDER G2 & G3 OF SPAN 1 & 7 SHEET 1 OF 2 — NO LUKISAN: JKR/JSI/TC/BR/32	Dilukis Oleh: INA; Tarikh: APRIL 2015; Disemak Oleh: TKW; Skala: AS SHOWN; Ditentukan Oleh: T. Tangan; TARIKH / BUTIR PINDAAN / RUJUKAN



LAYOUT PLAN OF HORIZONTAL ELEMENT BELOW TROUGH FOR SPAN 1 & 7
SCALE 1 : 50

NOTES:

1. G1 TO G4 SHOWN IN TYPICAL SECTION ARE THE GRID LINE ALONG THE CENTRELINE OF GIRDER 1 TO GIRDER 4 RESPECTIVELY.
2. V1 TO V10 ARE THE LOCATION OF VERTICAL CROSS BRACING.
3. REFER TO DRAWING NO. JKR/JSI/TC/BR/02, 03, 20 & 21 FOR DETAILS OF VERTICAL BRACING.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.



TYPICAL CROSS SECTION
SCALE 1 : 30

NOTA

PELANGGAN
KERAJAAN MALAYSIA

PEGAWAI PENGUASA
JABATAN KERJA RAYA

PIHAK PERUNDING
T-CORP ENGINEERS SDN BHD
NO. 60-B, JALAN 8/62/1B,
DAMANSARA UTAMA,
47400 PETALING JAYA, SELANGOR
TEL : 03-7710 1382 ; 03-7710 1390
FAX : 03-7710 1365

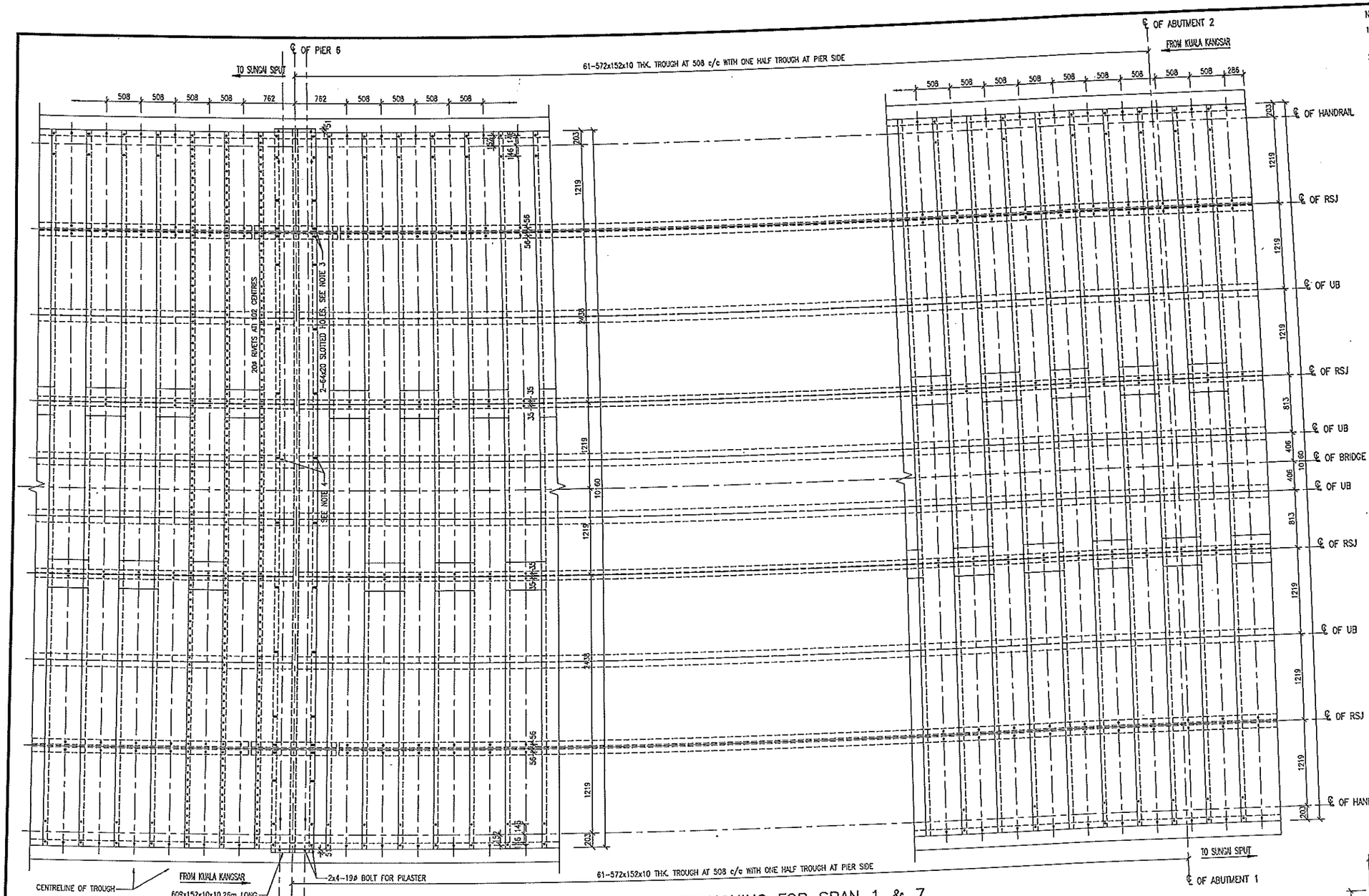
PROJEK
KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK
- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

TAJUK LUKISAN
AS BUILT STRUCTURAL DETAILS
HORIZONTAL MEMBER BELOW TROUGH FOR SPAN 1 & 7

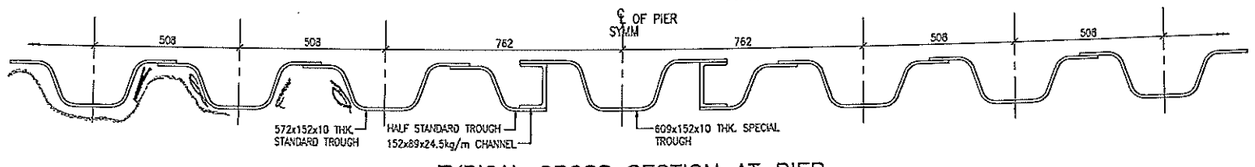
NO LUKISAN: JKR/JSI/TC/BR/48

Dilukis Oleh	INA	Skala	AS SHOWN
Terikh	APRIL 2015	Diluluskan Oleh	
Disemak Oleh	TKW	T. Tangan	

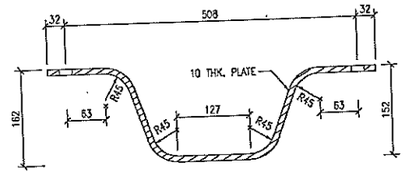
TARIKH	BUTIR PINDAAN	RUJUKAN



LAYOUT PLAN OF TROUGHING FOR SPAN 1 & 7
SCALE 1 : 30



TYPICAL CROSS SECTION AT PIER
SCALE 1 : 10



TYPICAL STANDARD TROUGH DETAILS
SCALE 1 : 5

NOTES:
1. ALL CONNECTIONS IN THIS TRUGHING SYSTEM ARE MADE WITH 20mm DIAMETER RIVET UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED.
3. AT ALL POINTS WHERE EXTERNAL GIRDER 1 & 4 MEET THE 152x89 CHANNEL AND THE 89x89x13 THK ANGLE, TOP OF GIRDER ARE SLOTTED 64x20 AND THE CHANNEL AND HALF TROUGH ARE HOLED 20ø FOR 19ø BOLTS.
4. 20ø HOLES IN SPECIAL TROUGH AND SLOTTED HOLES OF 64x20 IN TOP FLANGE CHANNEL AT 914 c/c FOR 19ø BLACK BOLTS.

NOTA	PELANGGAN: KERAJAAN MALAYSIA	PEGAWAI PENGUASA: JABATAN KERJA RAYA	PIHAK PERUNDING: T-CORP ENGINEERS SDN BHD, NO. 60-B, JALAN 8/62A/56, DAMANSARA UTAMA, 47400 PETALING JAYA, SELANGOR, TEL: 03-7710 1882 / 03-7710 1300, FAX: 03-7710 1356

PROJEK	KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK - THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR	TAJUK LUKISAN: AS BUILT STRUCTURAL DETAILS — LAYOUT PLAN OF TROUGHING FOR SPAN 1 & 7	NO LUKISAN: JKR/JSI/TC/BR/62

Dilukis Oleh	INA	Skala	AS SHOWN
Tarikh	APRIL 2015	Diluluskan Oleh	
Disemak Oleh	TKW	T. Tangan	

TARIKH	BUTIR PINDAAN	RUJUKAN