FINAL REPORT

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

VOLUME 2 OF 4: FACTUAL REPORT ON MATERIAL TESTINGS

PREPARED FOR

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FINAL REPORT

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1.0 INTRODUCTION

1.1 Nominal material testings were carried out on the reinforced concrete (RC) components of the Bridge with limited testings on the steel components of the Steel Arch superstructure. These were carried out to complement the whole study on the structural assessment of the Bridge capacity and the structural material condition.

1.2 It must be stated that the structural material (concrete and steel components) strengths of the Bridge were never of suspects. The nominal testings merely served to verify and to confirm the actual material strengths and condition to be adopted for subsequent Bridge Capacity Assessment.

1.3 The complete material testing results were previously submitted in Progress Report No. 3 (23 March 2015) and Progress Report No. 4 (25 May 2015). For the sake of completeness of records, the full nominal material testings results are compiled in this Volume 2 of 4 of the main Final Report (July 2015).

2.0 NOMINAL MATERIAL TESTINGS

The following nominal material testings were carried out in the course of the study at the various test locations (Attachment 1) :-

2.1 Covermeter Survey

Covermeter survey was conducted on the Bridge Deck to determine rebar location, spacing and cover by using an electromagnetic covermeter.

2.2 Break-Out Tests

Break-out test survey was also carried out comprehensively to determine the details of rebars such as diameter, spacing, and concrete cover by exposing existing reinforcement at two (2) selected locations on the Bridge Deck slab.

2.3 Core Tests

Core samplings were carried out to determine in-situ compressive strength at selected locations. The core samples were extracted using a coring machine. Location of each core samples was scanned using an electromagnetic covermeter prior to coring to avoid coring through any reinforcement bars. After extraction, the core samples were send to the laboratory for concrete compression test. The tests were carried out in accordance to BS EN 12390-3:2009 at BS EN Sdn. Bhd.

2.4 Carbonation Tests

Carbonation test were carried out to determine depth of carbonation by spraying Phenolphthalein Indicator on the extracted core samples. The indicator solution was sprayed onto the freshly cut surface of the extracted cores. The depth of concrete, onto which the surface remained colourless after the solution was sprayed was measured as the depth of carbonation. As the pH value of cement is generally between 12 to 14, area showing pink colouration indicated the concrete was still alkaline and in good condition. The tests were carried out in accordance to BS 1881: Part 210: 2013.

2.5 Chloride Content Tests

Chloride content was determined from dust samples (obtained from drilling) by using hot dilute nitric acid and the adding with silver nitrate solution to precipitate any chloride present. The test for chloride content is very significant as when chloride is present in reinforced concrete, it can cause very severe corrosion of the steel reinforcement. The test was carried out in accordance to BS 1881: Part 124: 1988.

2.6 Sulphate Content Tests

The dust obtained from drilling was used to determine Sulphate content which involved an acid extraction and precipitation of the Sulphate as Barium Sulphate with Barium Chloride solution. The resulting Barium Sulphate was filtered and weighted to determine Sulphate gravimetrically. Exposure of concrete made with Portland cement to Sulphate salts can cause damage due to an expansive reaction between cement and the Sulphate salt to form crystals of ettringite. The test was carried out in accordance to BS 1881: Part 124: 1988.

2.7 Ultrasonic Thickness Testing

Ultrasonic thickness testings (UTT) were carried out to compare the differences in thicknesses of selected members in the steel bridge structure by using an ultrasonic thickness testing equipment (BS EN 10160:1999).

2.8 Steel Tensile Testing

a) Steel samples were extracted by oxy-cutting the steel members from the Bridge site. The steel samples were then fabricated into steel coupons of required dimensions. These cut sections were immediately reinstated using butt welding. The steel coupons were send to an independent material testing laboratory (IKRAM QA SERVICES Sdn. Bhd) for tensile testing. The test was carried out in accordance to BS EN 10002-1:2001.

b) In engineering terms, yield strength is exhibited in yield phenomenon when the stress in the steel corresponds to the point reached during the test at which plastic deformation occurs without increase in force (or a change in curvature/slope). Typical test results may be expressed in Stress Versus % Elongation plot, the graphical shape of it is similar to the plot of Force Versus Elongation which was adopted by IKRAM QA Services Sdn. Bhd. Note that Force is a function of Stress (area is constant) and Elongation is a function of % Elongation (length is constant). IKRAM QA Services Sdn. Bhd. adopted the Yield Strength as the Force at the point of change in the curvature/slope divided by the steel section area. Some other testing laboratories have also adopted this procedure.

3.0 SUMMARY OF TEST RESULTS

The test locations are as shown in the two (2) accompanying drawings TC/275/14/40/Test/01 and TC/275/14/40/Test/02.

3.1 Covermeter Survey

Covermeter Survey was conducted at selected locations to determine rebar location, spacing and cover by using an electromagnetic covermeter (Ferroscan). The results from the survey are highlighted in the photographs in the attachments.

3.2 Break-Out Tests

Two break-out tests were conducted at selected deck slabs. The results of Break-out test revealed the following details as per **Table 1**:-

Table 1 - Summary of Break-Out Test

Location	Member Type	Top Cover (mm)	Premix Thicknes	Reinforcement Bars
Span 5	Deck Slab	35	25	**BRC Mesh**: 10mm Spacing: 200mm c/c both ways
Span 7	Deck Slab	30	40	**BRC Mesh**: 10mm Spacing: 200mm c/c both ways

3.3 Core Tests

a) Core tests were initially conducted on 9 samples of 75mm nominal diameter (68mm diameter actual) extracted from various 10 locations. The following **Table 2A** shows a summary of core test results for all 9 samples.

Table 2A - Summary of Core Test Results (March 2015)

No	Care Marking	Location	Concrete density kg/m^3	Length/ Core diameter	Compressive strength, N/mm^2		
					Core	Estimated In-Situ	Estimated Characteristic, fcu
1	C216	Span 1 deck	2290	1.15	66.9	70.5	88.1
2	C217	Span 2 deck	2310	1.12	72.3	75.4	94.2
3	C218	Span 3 deck	2320	1.15	60.1	63.3	79.1
4	C219	Span 5 deck	2500	1.15	58.6	64.3	80.3
5	C220	Span 6 deck	2370	1.15	37.9	42.2	52.8
6	C221	Span 7 deck	2320	1.15	59.6	62.8	78.5
7	C222	Pier 4	2290	1.15	75.1	79.1	98.8
8	C223	Pier 5	2380	1.16	79.2	83.8	104.7
9	C224	Abutment 2	2350	1.15	36.5	38.4	48.0

b) Second Testing (April 2015)

As the results for the 75mm nominal diameter cores were observed to be very high, a second testing was next carried out on 23 April 2015 using 100mm diameter cores.

Table 2B – Summary of Core Test Results (23 April 2015)

No	Core Marking	Concrete density Kg/m Kg/m^3	Length/ Core diameter	Concrete Compressive Strength, N/mm^2		
				Core	Estimated In-Situ	Estimated Characteristic, fcu
1	C370 (Pier P4)	2350	1.05	53.9	54.9	68.6
2	C369 (Pier P1)	2360	1.05	60.8	62.0	77.5
3	C371 (Pier P5)	2380	1.07	62.1	63.8	79.8
4	C368 (Abutment 1)	2230	1.05	26.2	26.7	33.4
5	C372 (Pier P6)	2210	1.03	24.1	24.4	30.5

3.4 Carbonation Tests

Carbonation test was conducted by spraying Phenolphthalein Indicator on fourteen (14) core samples. The carbonation test results are summarised in **Table 3**.

Table 3 - Summary of Carbonation Test Results

Location	Sample Mark	Length (mm)	Depth A (mm)	Depth B (mm)	Depth C (mm)	Depth D (mm)
Span 1 Deck Slab	C 216	103.5	0	0	0	0
Span 2 Deck Slab	C 217	116.5	0	0	0	0
Span 3 Deck Slab	C 218	151.0	0	0	0	0
Span 5 Deck Slab	C 219	132.5	0	0	0	0
Span 6 Deck Slab	C 220	103.5	0	0	0	0
Span 7 Deck Slab	C 221	104.0	0	0	0	0
Pier P4 (SS)	C 222	199.0	0	0	0	0
Pier P5 (SS)	C 223	199.0	0	0	0	0
Abutment 2	C 224	141.0	0	0	0	0
***Additional Coring Samples of 100mm diameter on 6th April 2015**						
Abutment 1	C 368	187.5	0	0	0	0
Pier P1 (SS)	C 369	187.5	0	0	0	0
Pier P4 (SS)	C 370	217.0	0	0	0	0
Pier P5 (SS)	C 371	217.5	0	0	0	0
Pier P6 (SS)	C 372	190.0	0	0	0	0

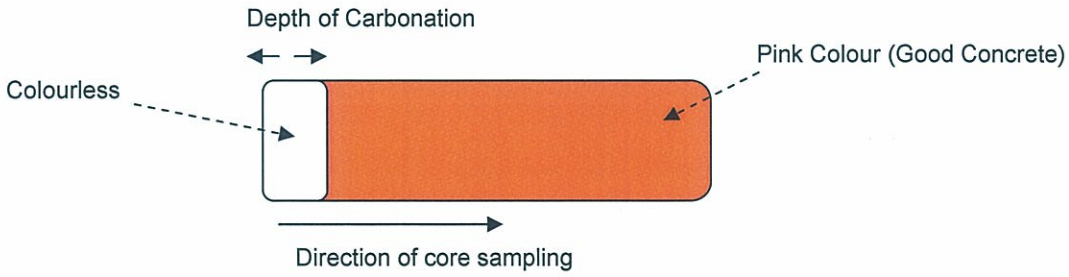

Figure 1. Depth of carbonation is measured from the surface of the core sample.

3.5 Chloride Content Tests

Testing of concrete for Chloride content was carried out on dust samples obtained by drilling from 9 test points. A summary of the Chloride content test results are highlighted in **Table 4 & Attachment 5.**

Table 4 - Summary of Chloride Content Test

Sample Mark	Chloride Content (%)			Remarks
	25mm	50mm	75mm	
Span 7	ND (<<0.01)	ND (<<0.01)	ND (<<0.01)	OK as all samples <0.07 %
Pier P4 (SS)	ND (<<0.01)	ND (<<0.01)	ND (<<0.01)	
Pier P5 (SS)	0.02	ND (<<0.01)	ND (<<0.01)	
Sample Weight Collected (g)	40g	40g	40g	
Sample Weight Used (g)	5g	5g	5g	

- ND – Not Detectable
- (SS) – Location facing towards Sungai Siput
- Result is measured by weight of dust samples

3.6 Sulphate Content Tests

Testing of concrete for Sulphate content was carried out on dust samples obtained by drilling from 9 test points. A summary of the Sulphate content test results are highlighted in **Table 5 and Attachment 5.**

Table 5 - Summary of Sulphate Content Test

Sample Mark	Chloride Content (%)			Remarks
	25mm	50mm	75mm	
Span 1	0.48	0.45	0.48	Maximum = 0.48% by weight of Concrete ≈ 3.3% by weight of Cement (JKR Limit-4%)
Span 2	0.54	0.50	0.46	
Span 6	0.43	0.41	0.41	
Span 7	0.25	0.25	0.25	
Pier P4 (SS)	0.55	0.34	0.34	
Pier P5 (SS)	0.50	0.36	0.35	
Sample Weight Collected (g)	40g	40g	40g	
Sample Weight Used (g)	5g	5g	5g	

- Result is measured by weight of dust samples.

3.7 Ultrasonic Thickness Tests

Ultrasonic thickness tests were conducted by selecting 70 different locations to verify the thickness of different members to determine their residual thicknesses. The summary of the ultrasonic thickness test results are highlighted in **Table 6**.

Table 6 - Summary of Ultrasonic Thickness Measurement

No	Span	Corrosion Condition	Member Type Description		Reference Picture	Ultrasonic Thickness Measurement (mm)			
						Reading 1	Reading 2	Reading 3	Average Reading
1	1	C1	Arch A	Top Flange	U- S 1 -P 1	13.5	13.5	13.4	**13.47**
2	1	C1	Arch B	Top Flange	U- S 1 -P 4	14	14.1	14.7	**14.27**
3	1	C1	Arch C	Top Flange	U- S 1 -P 7	13.8	13.6	13.6	**13.67**
4	1	C3	Arch A	Top Flange	U- S 1 -P 2	13.3	13.1	13.3	**13.23**
5	1	C3	Arch A	Top Flange	U- S 1 -P 3	13.3	13	13.3	**13.20**
6	1	C3	Arch B	Top Flange	U- S 1 -P 5	13.5	13.7	13.5	**13.57**
7	1	C3	Arch B	Top Flange	U- S 1 -P 6	13.1	13.3	13.1	**13.17**
8	1	C3	Arch C	Top Flange	U- S 1 -P 8	13.7	13.6	13.5	**13.60**
9	1	C3	Arch C	Top Flange	U- S 1 -P 9	13.7	13.6	13.4	**13.57**
10	1	C3	Arch D	Top Flange	U- S 1 -P 10	13.4	13.5	13.2	**13.37**
11	1	C1	Inc. Bracing	-	U- S 1 -P 11	13.7	13.6	12.7	**13.33**
12	1	C1	H. Bracing	-	U- S 1 -P 14	13.3	13.5	13.6	**13.47**
13	1	C3	Inc. Bracing	-	U- S 1 -P 12	12.4	13.6	13.8	**13.27**
14	1	C3	Inc. Bracing	-	U- S 1 -P 13	13.7	12.3	13.2	**13.07**
15	1	C3	H. Bracing	-	U- S 1 -P 15	12.7	13	12.8	**12.83**
16	4	C3	Arch A	Top Flange	U- S 4 -P 1	13.4	13.4	13.4	**13.40**
17	4	C3	Arch A	Top Flange	U- S 4 -P 2	13.6	13.2	13.1	**13.30**
18	4	C3	Arch B	Top Flange	U- S 4 -P 7	12.8	12.9	12.8	**12.83**
19	4	C3	Arch B	Top Flange	U- S 4 -P 8	11	11.6	12	**11.53**
20	4	C3	Arch C	Top Flange	U- S 4 -P 13	11.1	11.1	11.1	**11.10**
21	4	C3	Arch C	Top Flange	U- S 4 -P 14	10.8	10.9	10.8	**10.83**
22	4	C3	Arch A	Top Flange	U- S 4 -P 3	12.7	12.4	12.1	**12.40**
23	4	C3	Arch A	Top Flange	U- S 4 -P 4	13	13.2	13.4	**13.20**
24	4	C3	Arch A	Top Flange	U- S 4 -P 5	13.2	13.1	13.2	**13.17**
25	4	C3	Arch A	Top Flange	U- S 4 -P 6	13.4	13.2	13.1	**13.23**
26	4	C3	Arch B	Top Flange	U- S 4 -P 9	11	10	10.5	**10.50**
27	4	C3	Arch B	Top Flange	U- S 4 -P 10	9.8	11.5	9.9	**10.40**
28	4	C3	Arch B	Top Flange	U- S 4 -P 11	10.5	10.9	11	**10.80**
29	4	C3	Arch B	Top Flange	U- S 4 -P 12	8.9	13.5	12.7	**11.70**
30	4	C3	Arch C	Top Flange	U- S 4 -P 15	11	9.8	9.8	**10.20**
31	4	C3	Arch C	Top Flange	U- S 4 -P 16	9.8	10	11.4	**10.40**
32	4	C3	Arch C	Top Flange	U- S 4 -P 17	10.4	9.6	10.3	**10.10**
33	4	C3	Arch C	Top Flange	U- S 4 -P 18	10	10.5	10.4	**10.30**

No	Span	Corrosion Condition	Member Type Description		Reference Picture	Ultrasonic Thickness Measurement (mm)			
						Reading 1	Reading 2	Reading 3	Average Reading
34	4	C1	Inc. Bracing	-	U- S 4 -P 19	12.2	12.8	12.8	**12.60**
35	4	C1	H. Bracing	-	U- S 4 -P 23	12.6	12.7	12.8	**12.70**
36	4	C3	Inc. Bracing	-	U- S 4 -P 20	11.6	11.8	11.7	**11.70**
37	4	C3	Inc. Bracing	-	U- S 4 -P 21	11.5	11.8	11.5	**11.60**
38	4	C3	Inc. Bracing	-	U- S 4 -P 22	13	9.6	14	**12.20**
39	4	C3	H. Bracing	-	U- S 4 -P 24	12.3	12.1	12.5	**12.30**
40	4	C3	H. Bracing	-	U- S 4 -P 25	12.5	12.3	12.4	**12.40**
41	6	C1	Arch A	Top Flange	U- S 6 -P 1	13.7	13.6	13.8	**13.70**
42	6	C1	Arch B	Top Flange	U- S 6 -P 4	13.4	13.4	13.1	**13.30**
43	6	C1	Arch C	Top Flange	U- S 6 -P 7	13.4	13.4	13.1	**13.30**
44	6	C3	Arch A	Top Flange	U- S 6 -P 2	13.7	12.6	12.4	**12.90**
45	6	C3	Arch A	Top Flange	U- S 6 -P 3	13.5	13.5	13.2	**13.40**
46	6	C3	Arch B	Top Flange	U- S 6 -P 5	13.2	12.5	12.1	**12.60**
47	6	C3	Arch B	Top Flange	U- S 6 -P 6	13.3	12.5	12.3	**12.70**
48	6	C3	Arch C	Top Flange	U- S 6 -P 8	13.7	12.4	12.9	**13.00**
49	6	C3	Arch C	Top Flange	U- S 6 -P 9	13.6	12.5	12.9	**12.80**
50	6	C3	Arch D	Top Flange	U- S 6 -P 10	13	13.1	12.9	**13.00**
51	6	C1	Inc. Bracing	-	U- S 6 -P 11	13.4	13.5	13.4	**13.43**
52	6	C1	H. Bracing	-	U- S 6 -P 14	13.6	13.6	13.6	**13.60**
53	6	C3	Inc. Bracing	-	U- S 6 -P 12	12.8	12.7	12	**12.50**
54	6	C3	Inc. Bracing	-	U- S 6 -P 13	13	13.2	13.1	**13.10**
55	6	C3	H. Bracing	-	U- S 6 -P 15	13.4	13	14.1	**13.50**
56	7	C1	Arch A	Top Flange	U- S 7 -P 1	15.4	15.6	15.2	**15.40**
57	7	C1	Arch B	Top Flange	U- S 7 -P 4	15.5	16.7	16.9	**16.38**
58	7	C1	Arch C	Top Flange	U- S 7 -P 7	16.9	15.4	16.5	**16.27**
59	7	C3	Arch A	Top Flange	U- S 7 -P 2	15.3	15.2	15.4	**15.30**
60	7	C3	Arch A	Top Flange	U- S 7 -P 3	15	15.6	15.2	**15.27**
61	7	C3	Arch B	Top Flange	U- S 7 -P 5	15.1	15.4	14.2	**14.90**
62	7	C3	Arch B	Top Flange	U- S 7 -P 6	16.8	14.7	14.4	**15.90**
63	7	C3	Arch C	Top Flange	U- S 7 -P 8	16.2	15.8	15.9	**15.97**
64	7	C3	Arch C	Top Flange	U- S 7 -P 9	15.9	16.4	15.5	**15.93**
65	7	C3	Arch D	Top Flange	U- S 7 -P 10	15.2	16.5	14.5	**15.40**
66	7	C1	Inc. Bracing	-	U- S 7 -P 11	16.5	15.6	15.8	**15.97**
67	7	C1	H. Bracing	-	U- S 7 -P 14	15.8	15	15.5	**15.43**
68	7	C3	Inc. Bracing	-	U- S 7 -P 12	16.1	15.5	15	**15.53**
69	7	C3	Inc. Bracing	-	U- S 7 -P 13	14	13.6	14.2	**13.96**
70	7	C3	H. Bracing	-	U- S 7 -P 15	14.9	15.3	15.2	**15.13**

*Corrosion condition is classified as C1 (Good Condition) and C3 (Moderate Condition)

3.8 Steel Tensile Tests

Steel tensile tests were conducted on 3 selected locations where steel coupons were fabricated from extracted samples were tested for yield strength and tensile strength of the material. A summary of the steel tensile test is highlighted in **Table 7** and **Table 8**.

Table 7 - Dimension of Steel Samples

Sample No. & Location	Sample Markings	Thickness	Length (L)	W	L'ef	L'grip	W'ef
1 (Angle Plate at Span 7)	TS 1	12	400	67	170	67	38
2 (Angle Plate at Span 6)	TS 2	12	400	67	170	67	38
3 (I-beam flange at Span 7)	TS 3	10	400	60	170	67	38

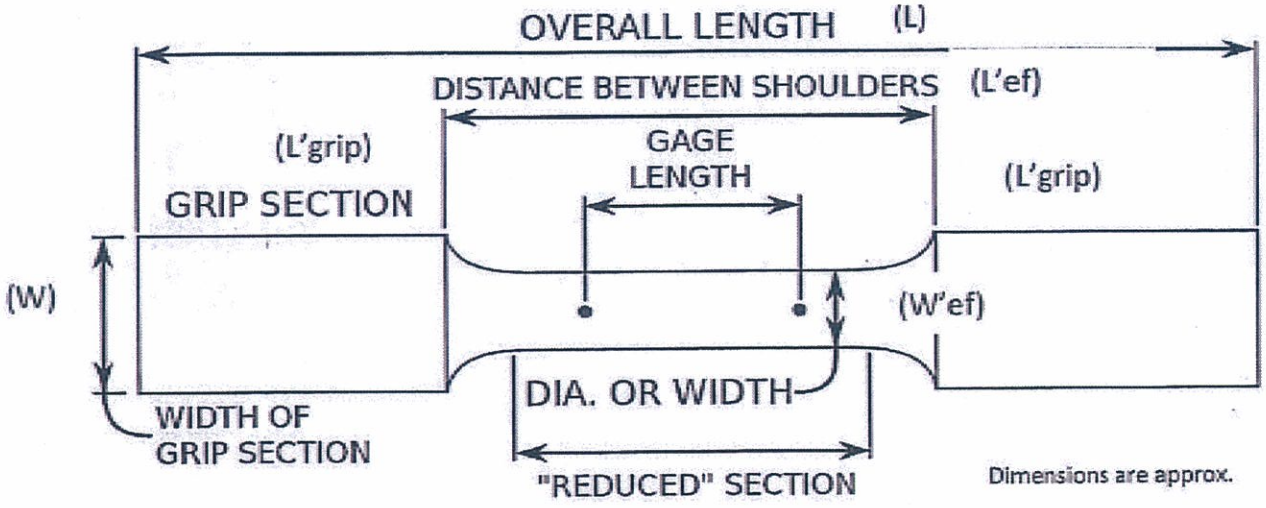

Table 8 - Steel Sample Tested Properties

Sample No. & Location	Material	Sample Markings	Yield Strength (N/mm^2)	Tensile Strength (N/mm^2)	Elongation (%)
1 (Angle Plate at Span 7)	Mild Steel	TS 1	266.2	407.1	23.8
2 (Angle Plate at Span 6)	Mild Steel	TS 2	226.4	371.7	23.0
3 (I-beam flange at Span 7)	Mild Steel	TS 3	264.2	418.5	23.7

4.0 CONCLUSION

The following material testings outcome has been adopted in the Structural Analysis & Design Check and the Engineering Assessment of the Jambatan Sultan Iskandar Bridge Structure:-

a) Concrete Deck
   i. Deck slab thickness = 225mm
   ii. Concrete Strength, fcu = 40N/mm^2
   iii. Steel trough thickness = 10mm

b) Piers & Abutments
   i. Concrete Strength, fcu = 25N/mm^2

c) Steel Superstructure
   i. Yield Strength, fy = 220N/mm^2
   ii. Steel corrosion to date = 5% total thickness

d) Material Condition of Concrete
   i. Carbonation depth = Nil
   ii. Concrete Chloride content << 0.001% by weight of concrete (Limit is 0.007%)
   iii. Concrete Sulphate content = 3.3% by weight of cement (Limit is 4.0%)

Final Report Volume 2 of 4 by

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Attachment To
RPT/TC/275/14/40-FinalReport – Vol 2 of 4

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

VOLUME 2 OF 4:
FACTUAL REPORT ON MATERIAL TESTINGS

COMPILATION OF TEST RESULTS

RPT/TC/275/14/40-FinalReport – Vol 2 of 4

ATTACHMENT 1

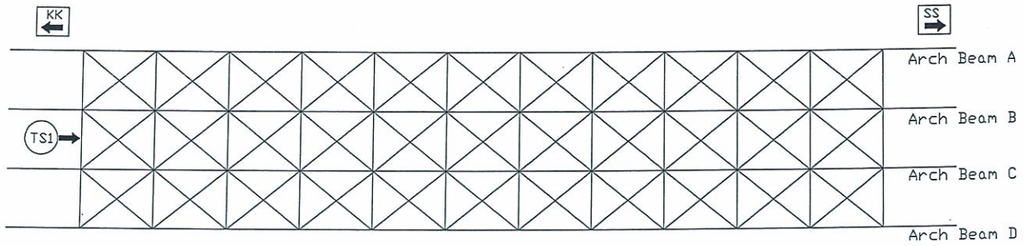
KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT001/639/90, KUALA KANGSAR, PERAK.
- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR.

FINAL REPORT

VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

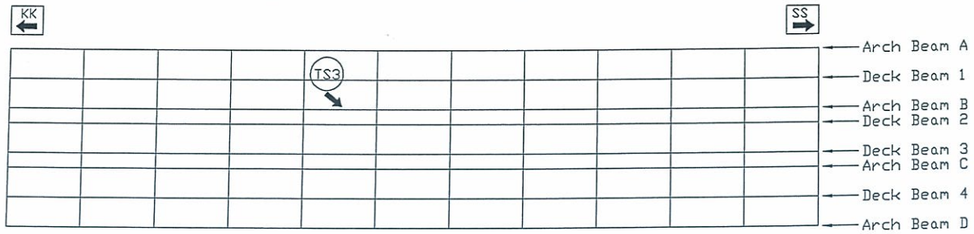
ATTACHMENT 1

Material Test Locations



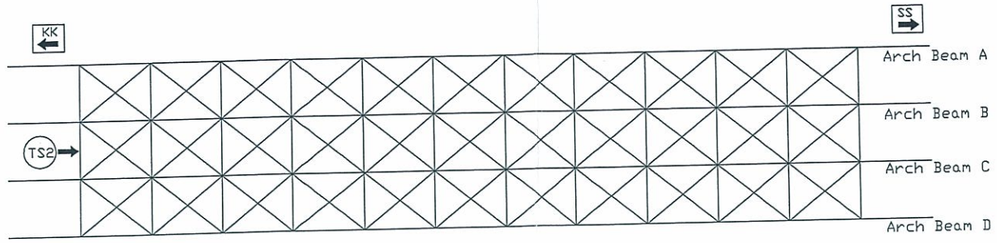
SPAN 7
ARCH BEAMS LAYOUT PLAN

Note:-
TS1 - Steel Tensile Test No. 1



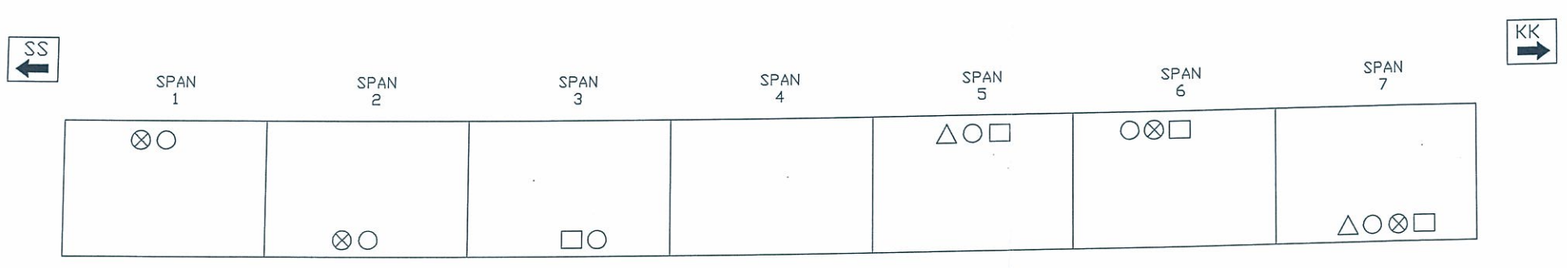
SPAN 7
DECK BEAMS LAYOUT PLAN

Note:-
TS3 - Steel Tensile Test No. 3

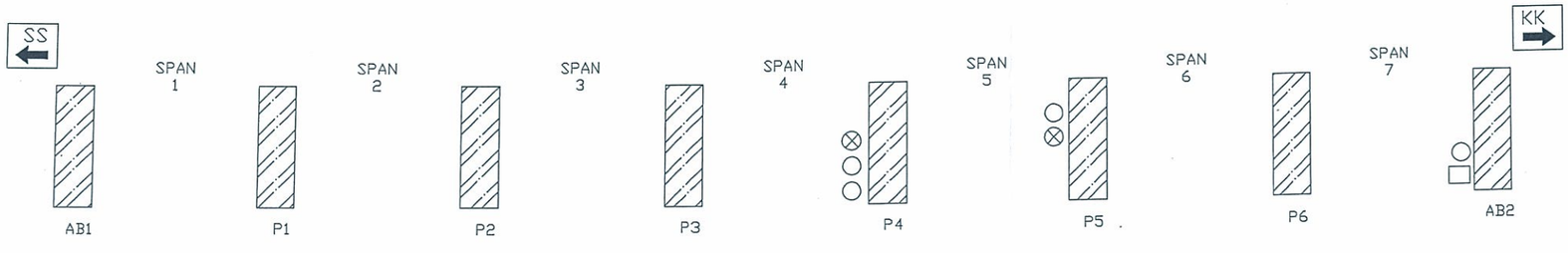


SPAN 6
ARCH BEAMS LAYOUT PLAN

Note:-
TS2 - Steel Tensile Test No. 2



BRIDGE DECK SLAB LAYOUT PLAN



BRIDGE PIERS LAYOUT PLAN

LEGEND

- ⊗ Concrete Dust Sampling
- ○ Concrete Core Extraction
- □ Ferroscan
- △ Concrete Breakout
- (TS1) Steel Tensile Test

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 1388

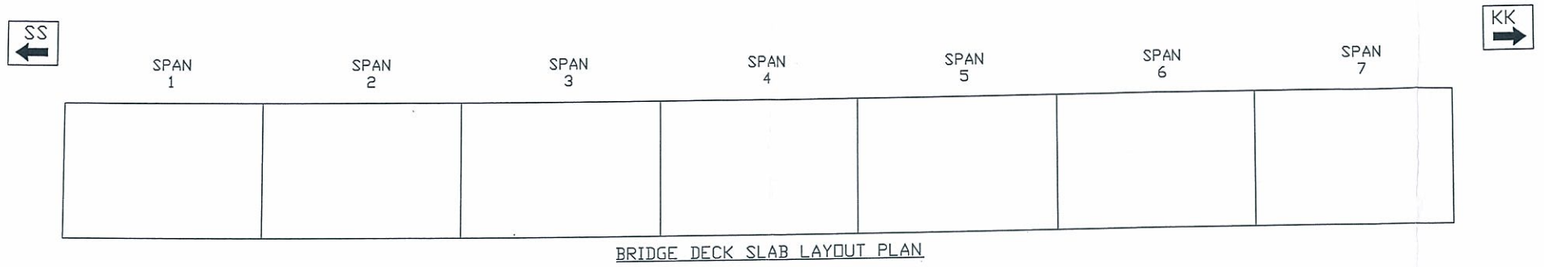
PROJEK
KAJIAN BAGI MENGGANTIKAN JAMBATAN SULTAN ISKANDAR DI FT 001/639/90 KUALA KANGSAR PERAK
- THE STRUCTURAL ASSESSMENT AND REHABILITATION OF JAMBATAN SULTAN ISKANDAR

TAJUK LUKISAN
NOMINAL MATERIAL TESTING LOCATIONS
– INITIAL MOBILIZATION (MARCH 2015)

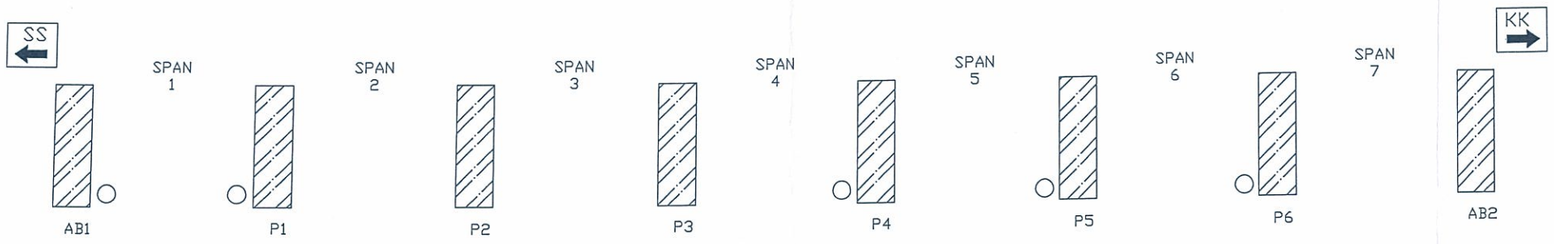
NO LUKISAN: TC/275/14/40/TEST/01

Dilukis Oleh	WMF	Skala	N.T.S.
Tarikh	MAY 2015	Diluluskan Oleh	
Disemak Oleh	TKW	T. Tangan	

TARIKH	BUTIR PINDAAN	RUJUKAN



BRIDGE DECK SLAB LAYOUT PLAN



BRIDGE PIERS LAYOUT PLAN

LEGEND

○ Additional Concrete Core Extraction

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: NOMINAL MATERIAL TESTING LOCATIONS – SECOND MOBILIZATION (APRIL 2015); NO LUKISAN: TC/275/14/40/TEST/02

Dilukis Oleh	WMF	Skala	N.T.S.
Tarikh	MAY 2015	Diluluskan Oleh	
Disemak Oleh	TKW	T. Tangan	

TARIKH	BUTIR PINDAAN	RUJUKAN

RPT/TC/275/14/40-FinalReport – Vol 2 of 4

ATTACHMENT 2

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

FINAL REPORT

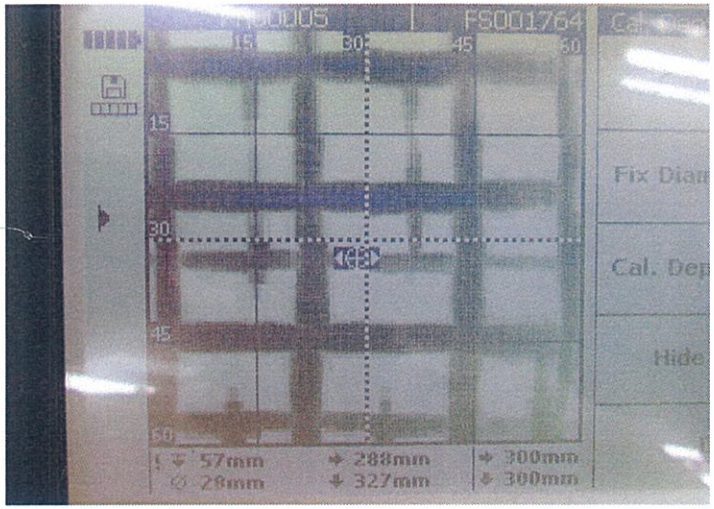
VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

ATTACHMENT 2

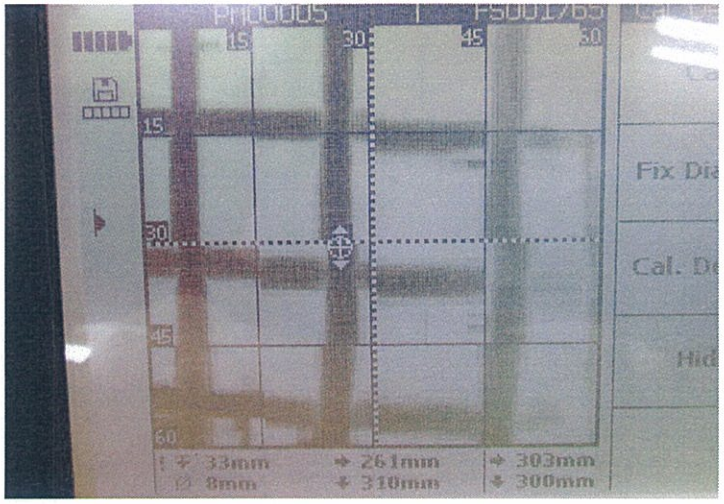
Covermeter Survey

Attachment 2

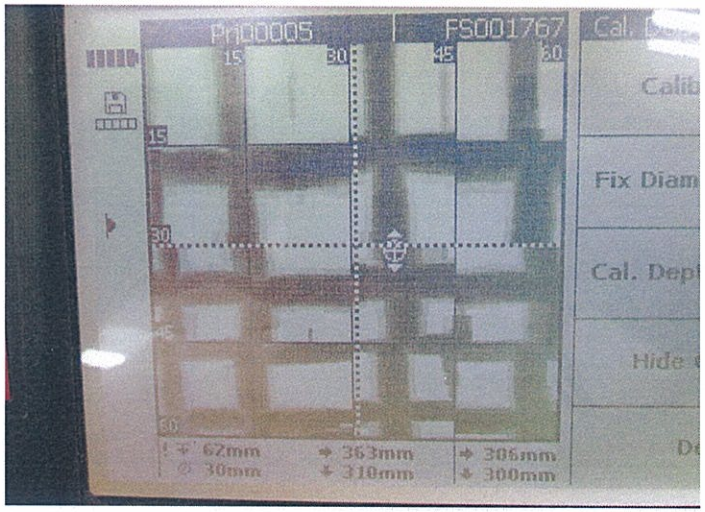
COVERMETER SURVEY



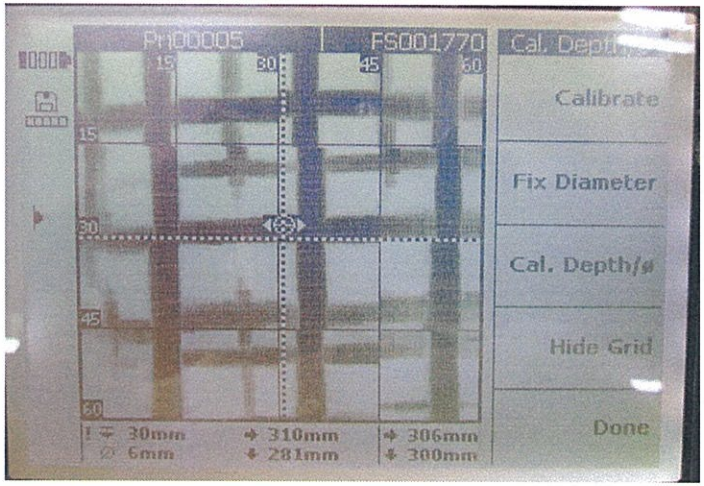
Picture 1 - Covermeter Survey at Span 3.



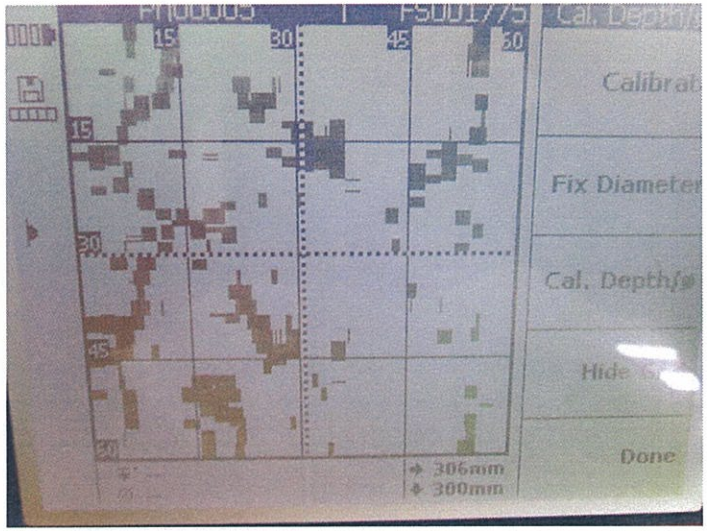
Picture 2 - Covermeter Survey at Span 5.



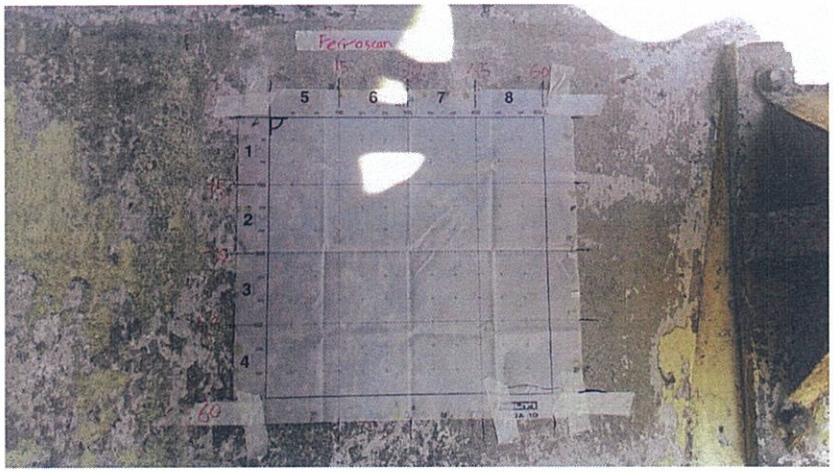
Picture 3 - Covermeter Survey at Span 6.



Picture 4 - Covermeter Survey at Span 7.



Picture 5 - Covermeter Survey at Abutment 2.



Picture 6 - Preparation of Covermeter Survey at Abutment 2.

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ATTACHMENT 3

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

FINAL REPORT

VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

ATTACHMENT 3

Break-Out Test

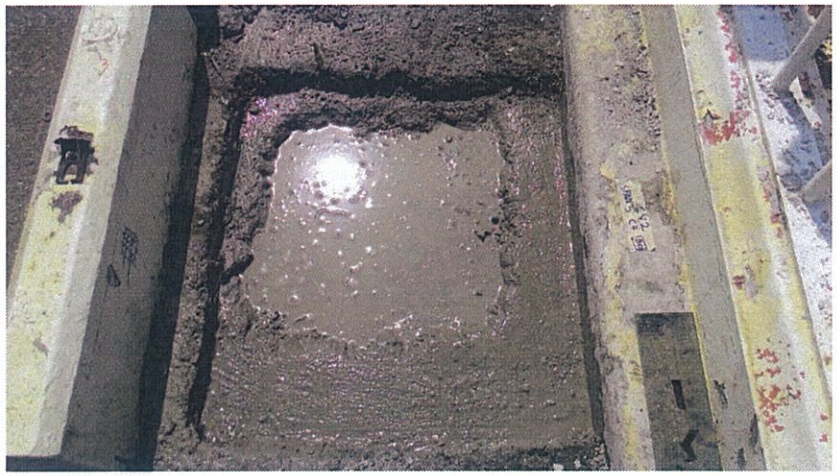
Attachment 3

BREAKOUT TESTS

Picture 1 - Breakout Survey at Span 7.

Picture 2 - Breakout Survey at Span 5.

REINSTATEMENT WORKS



Picture 1 - Reinstatement Works to Deck Slab.

Picture 2 - Reinstatement Works to Deck Slab.

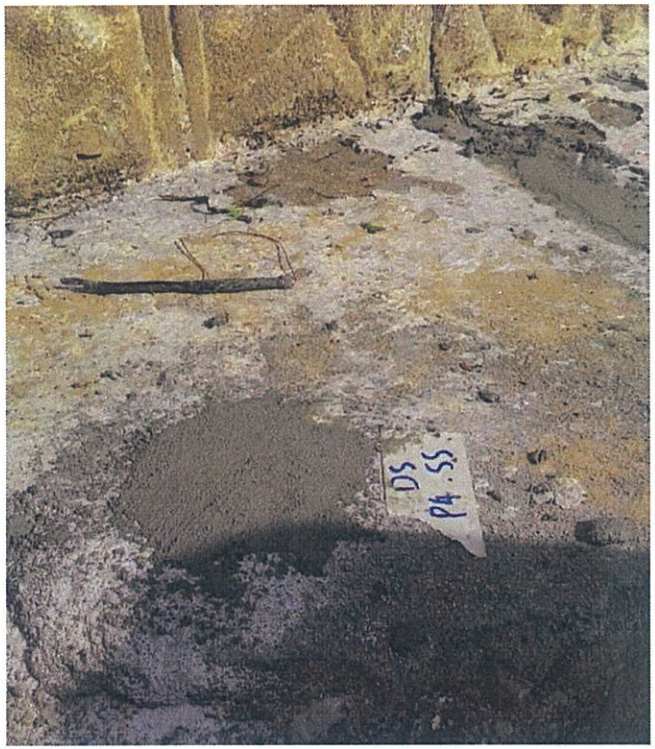
Picture 3 - Reinstatement Works to Deck Slab.

Picture 4 - Reinstatement Works to Deck Slab.

Picture 5 - Reinstatement Works to Deck Slab.

Picture 6 - Reinstatement Works to Deck Slab.

Picture 7 - Reinstatement Works to Deck Slab.



Picture 8 - Reinstatement Works to Deck Slab.

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ATTACHMENT 4a

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

FINAL REPORT

VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

ATTACHMENT 4a

Concrete Core Test - March 2015 Test

BSEN Test Sdn. Bhd. (749355-K)
3, Jalan Rajawali 3, Bandar Puchong Jaya,
47100 Puchong, Selangor Darul Ehsan
MALAYSIA
Tel: 03 - 8070 9982 Fax: 03 - 8070 9986
Email: bsentest@gmail.com
Materials • Technical • Solutions

Our Ref: BSEN/CT/15/R1923

Date Issued : 16th March. 2015

TEST REPORT

1.0 Test Requested by Client : Determination of the compressive strength of Concrete Cores

2.0 Tested For : **RNC Technology (M) Sdn Bhd**
16-1 Jalan Putra Mahkota 7/5B
47650 Subang Jaya
Selangor Darul Ehsan

3.0 Project : **Jambatan Sultan Iskandar, Kuala Kangsar**

4.0 Method of Testing : Compressive strength of concrete cores were determined in accordance with BS EN 12390-3: 2009 'Method For Compressive Strength Of Test Specimens.'

5.0 Description of Samples : A total of NINE (09) no. of 68mm Ø of concrete core samples were received and referenced as below.

Date Received	Structure	No. of Cores	No. of Specimens
06-03-2015	Deck Slab/Pilecap	9	9

6.0 Witnessed by : -

7.0 Results : Please refer to the following page.

8.0 Remarks/Exclusion : -

for and behalf of **BSEN TEST SDN. BHD.**

BSEN Test Sdn. Bhd. (749355-K)

Ricky Ting H Y
Technical Manager

Prepared by: Dira

CUSTOMER : **RNC Technology (M) Sdn Bhd**

PROJECT : **Jambatan Sultan Iskandar, Kuala Kangsar**

Determination of Core Compressive Strength

BS EN 12390-3: 2009

LAB MARKING			C 216	C 217	C 218
Sample Marking*			Span 1	Span 2	Span 3
Structure Under Test			Deck Slab		
Concrete Grade		N/mm^2	N/A		
Date of testing			13-03-2015		
Direction of drilling			Vertical		
As received density		(Kg/m^3)	2290	2310	2320
Diameter of core		(mm)	68	68	68
Average length after capped		(mm)	78	76	78
Maximum load		(KN)	242.9	262.4	218.1
Compressive core strength		(N/mm^2)	66.9	72.3	60.1
Estimated in-situ cube strength		(N/mm^2)	70.5	75.4	63.3
Estimated In-situ Characteristic Strength#		(N/mm^2)	88.1	94.2	79.1
Compaction	Excess Voidage	%	0.5	0.5	0.5
	Honeycomb	(Yes/No)	No	No	No
	Cracks	(Vi/N.Vi)	N.Vi	N.Vi	N.Vi
TYPE OF FRACTURE AFTER COMPRESSIVE TEST			Normal	Normal	Normal

Notes: 1) * - Data as furnished by client
2) # - MS 1242 clause 6.5.3 stated that characteristic strength calculated based on fcu = {1.5x(EICS)a}/1.2b
where a - ultimate strength
b - safety factor (or appropriate factor suitable in particular circumstances)

BSEN Test Sdn. Bhd. (749855-K)

CUSTOMER : **RNC Technology (M) Sdn Bhd**

PROJECT : **Jambatan Sultan Iskandar, Kuala Kangsar**

Determination of Core Compressive Strength

BS EN 12390-3: 2009

LAB MARKING			C 219	C 220	C 221
Sample Marking*			Span 5	Span 6	Span 7
Structure Under Test			Deck Slab		
Concrete Grade		N/mm^2	N/A		
Date of testing			13-03-2015		
Direction of drilling			Vertical		
As received density		(Kg/m^3)	2500	2370	2320
Diameter of core		(mm)	68	68	68
Average length after capped		(mm)	78	78	78
Maximum load		(KN)	212.7	137.6	216.3
Compressive core strength		(N/mm^2)	58.6	37.9	59.6
Estimated in-situ cube strength		(N/mm^2)	64.3	42.3	62.8
Estimated In-situ Characteristic Strength#		(N/mm^2)	80.3	52.8	78.5
Compaction	Excess Voidage	%	0.5	0.5	0.5
	Honeycomb	(Yes/No)	No	No	No
	Cracks	(Vi/N.Vi)	N.Vi	N.Vi	N.Vi
TYPE OF FRACTURE AFTER COMPRESSIVE TEST			Normal	Normal	Normal

Notes: 1) * - Data as furnished by client
2) # - MS 1242 clause 6.5.3 stated that characteristic strength calculated based on fcu = {1.5x(EICS)a}/1.2b
where a - ultimate strength
b - safety factor (or appropriate factor suitable in particular circumstances)

BSEN Test Sdn. Bhd. (749353-M)

CUSTOMER : **RNC Technology (M) Sdn Bhd**

PROJECT : **Jambatan Sultan Iskandar, Kuala Kangsar**

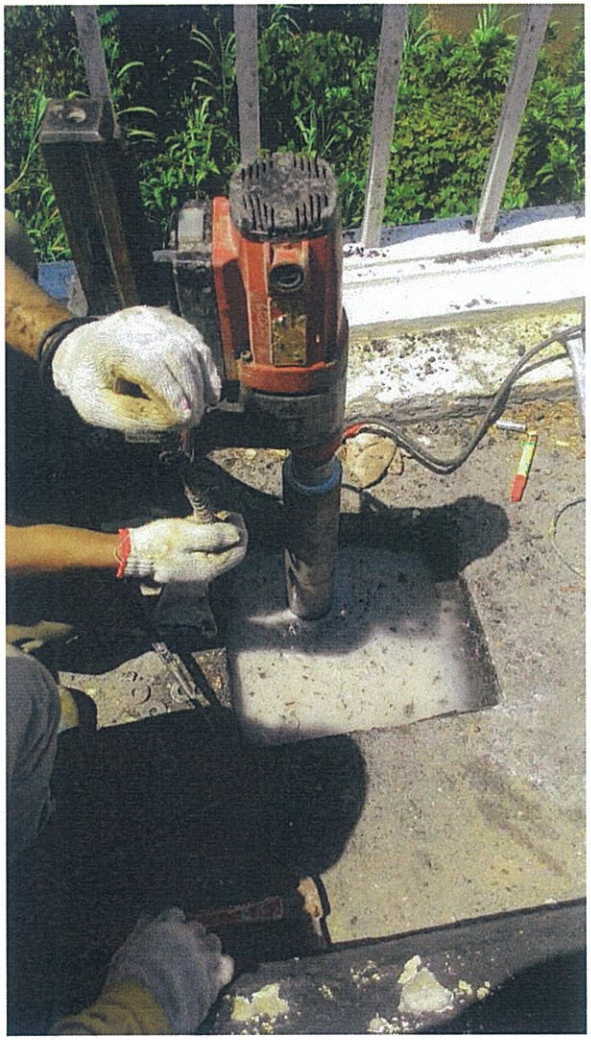
Determination of Core Compressive Strength

BS EN 12390-3: 2009

LAB MARKING			C 222	C 223	C 224
Sample Marking*			C9 (P4-SS)	C10 (P5-SS)	ABT 2
Structure Under Test			Pilecap		
Concrete Grade		N/mm^2	N/A		
Date of testing			13-03-2015		
Direction of drilling			Horizontal		
As received density		(Kg/m^3)	2290	2380	2350
Diameter of core		(mm)	68	68	68
Average length after capped		(mm)	78	79	78
Maximum load		(KN)	272.8	287.7	132.5
Compressive core strength		(N/mm^2)	75.1	79.2	36.5
Estimated in-situ cube strength		(N/mm^2)	79.1	83.8	38.4
Estimated In-situ Characteristic Strength#		(N/mm^2)	98.8	104.7	48.0
Compaction	Excess Voidage	%	0.5	0.5	0.5
	Honeycomb	(Yes/No)	No	No	No
	Cracks	(Vi/N.Vi)	N.Vi	N.Vi	N.Vi
TYPE OF FRACTURE AFTER COMPRESSIVE TEST			Normal	Normal	Normal

Notes: 1) * - Data as furnished by client
2) # - MS 1242 clause 6.5.3 stated that characteristic strength calculated based on fcu = {1.5x(EICS)a}/1.2b
where a - ultimate strength
b - safety factor (or appropriate factor suitable in particular circumstances)

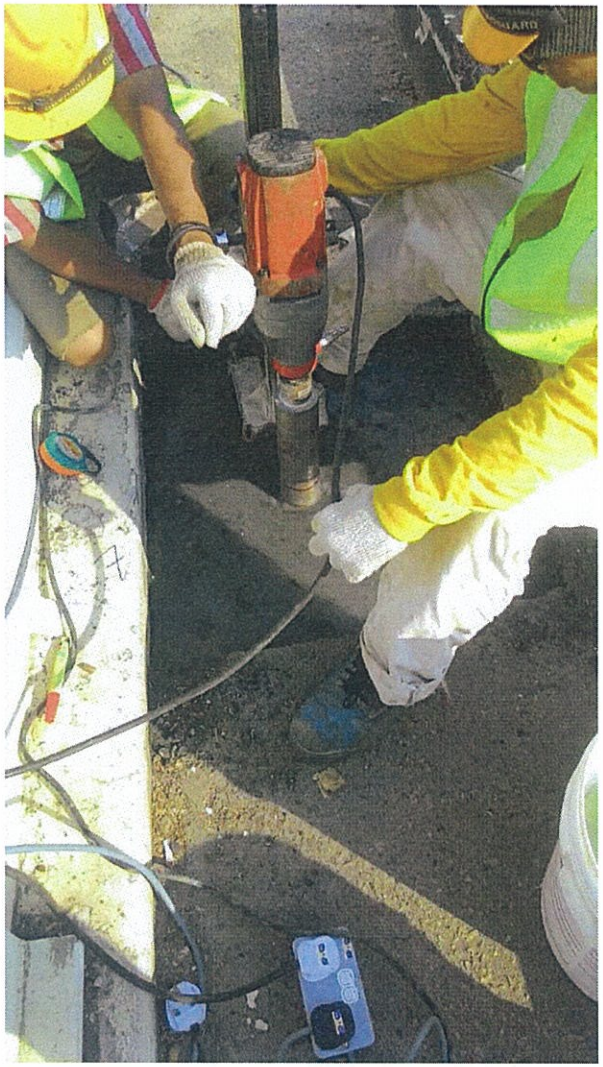
BSEN Test Sdn. Bhd. (749355-K)



Picture 1 - Core Extraction at Span 1 Slab.

Picture 2 - Core Extraction at Span 2 Slab.

Picture 3 - Core Extraction at Span 3 Slab.

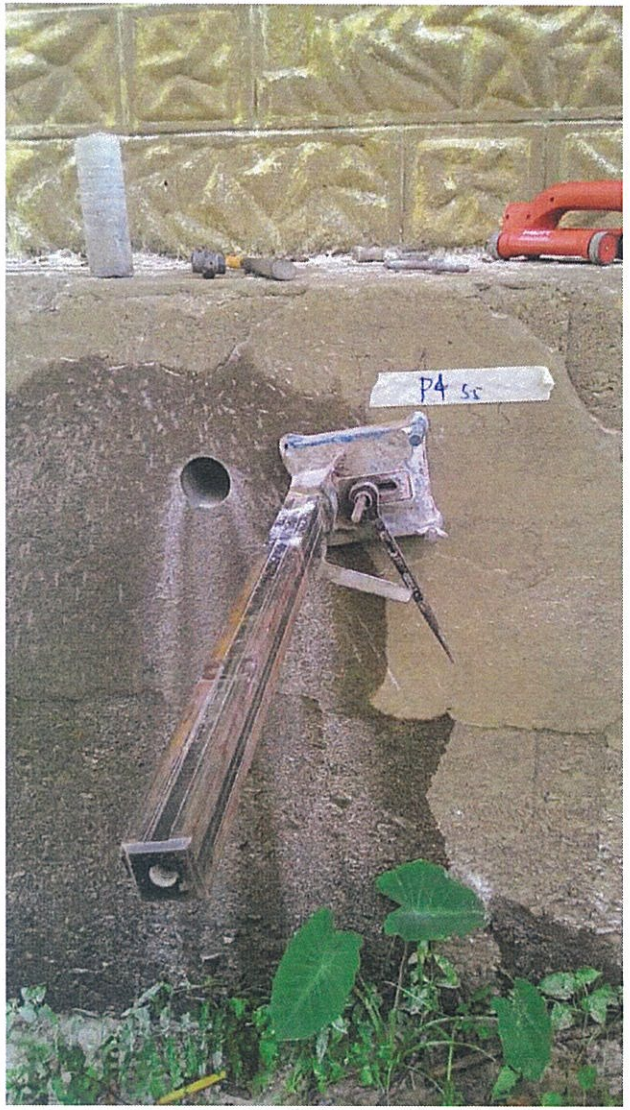


Picture 4 - Core Extraction at Span 5 Slab.

Picture 5 - Core Extraction at Span 6 Slab.

Picture 6 - Core Extraction at Span 7 Slab.

Picture 7 - Core Extraction at Abutment 2.



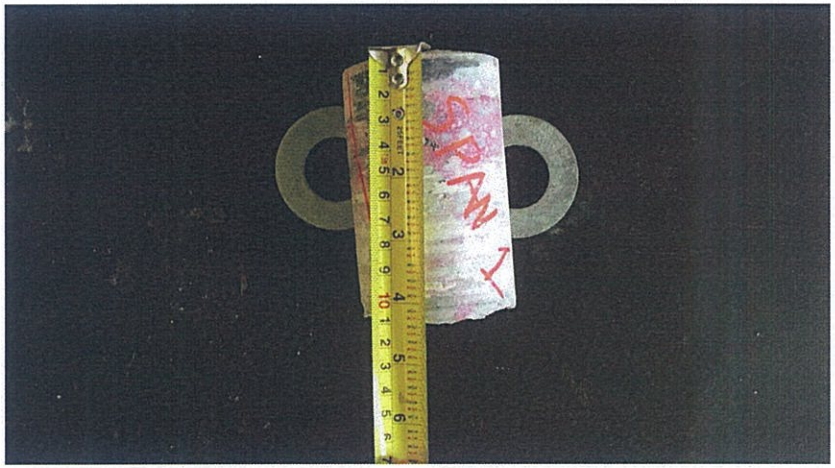
Picture 8 - Core Extraction at Pier 4.

Picture 9 - Typical picture of Core Testing.

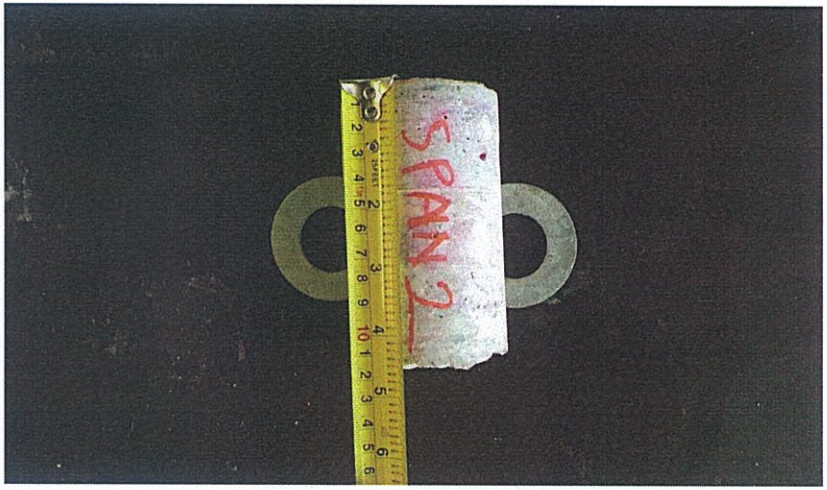
Picture 10 - Typical picture of Core Testing.

CARBONATION TEST

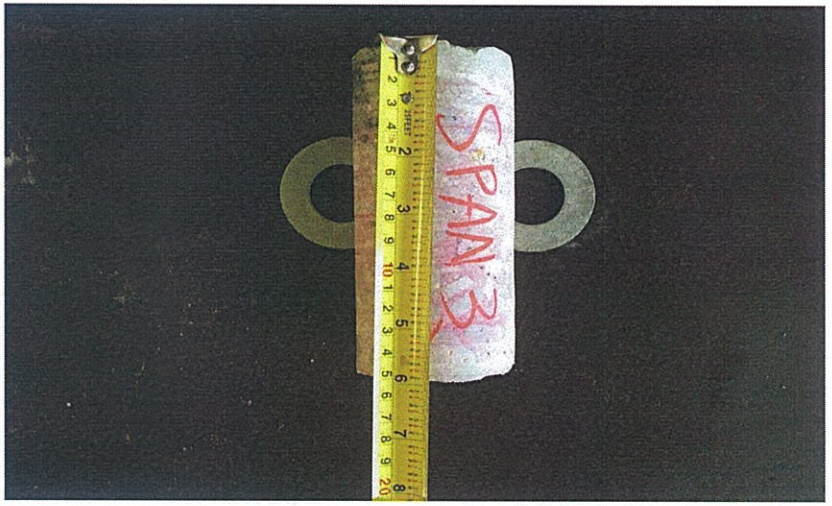
Picture 1 - Carbonation Samples Overview. (68mm ϕ)



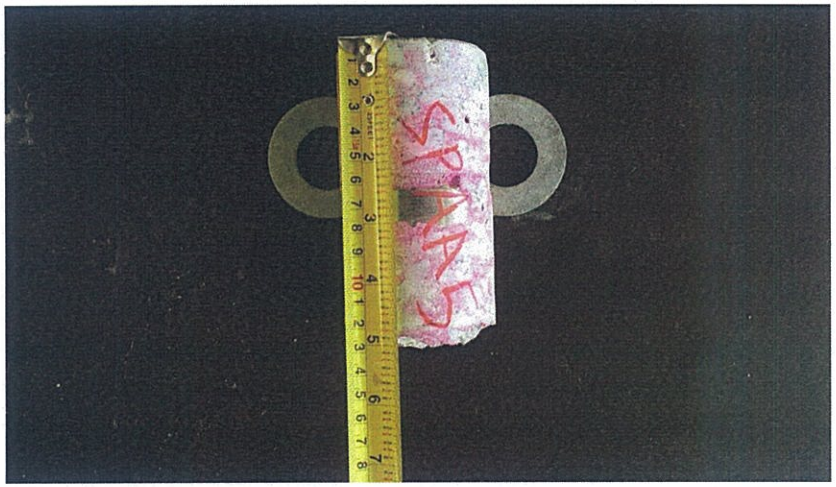
Picture 2 - Carbonation Test to sample from Span 1 Slab.



Picture 3 - Carbonation Test to sample from Span 2 Slab.

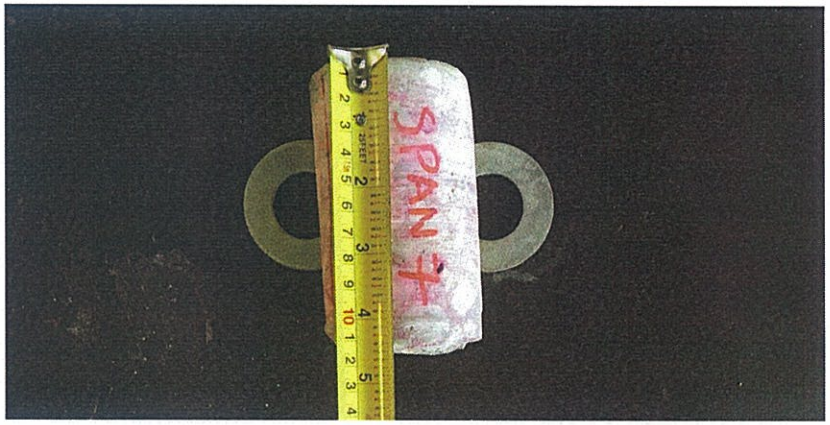


Picture 4 - Carbonation Test to sample from Span 3 Slab.



Picture 5 - Carbonation Test to sample from Span 5 Slab.

Picture 6 - Carbonation Test to sample from Span 6 Slab.

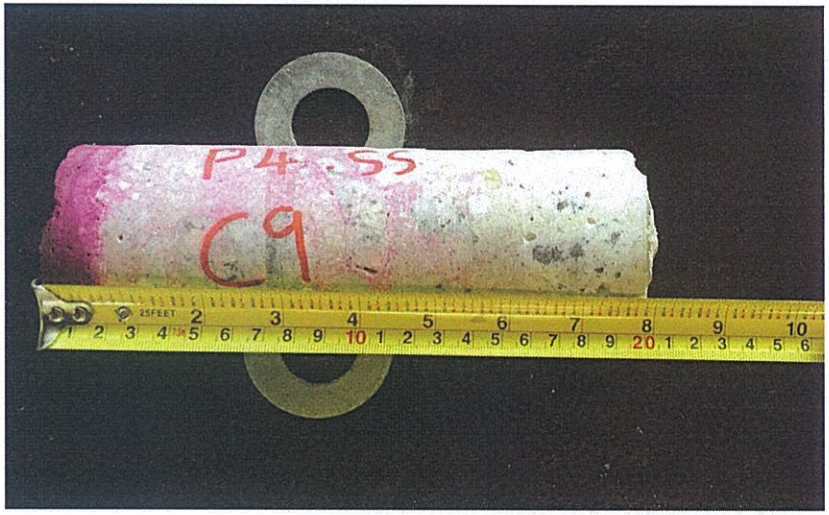


Picture 7 - Carbonation Test to sample from Span 7 Slab.

Picture 8 - Carbonation Test to sample from Abutment 2.

Picture 9 - Carbonation Test to sample from Pier 5.

Picture 10 - Carbonation Test to sample from Pier 4.



Picture 11 - Carbonation Test to sample from Pier 4.

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ATTACHMENT 4b

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

FINAL REPORT

VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

ATTACHMENT 4b

Concrete Core Test - Subsequent Test on 23 April 2015

BSEN Test Sdn. Bhd. (749355-K)
3, Jalan Rajawali 3, Bandar Puchong Jaya,
47100 Puchong, Selangor Darul Ehsan
MALAYSIA
Tel: 03 - 8070 9982 Fax: 03 - 8070 9986
Email: bsentest@gmail.com
Materials • Technical • Solutions

Our Ref: BSEN/CT/15/R1965(1)

Date Issued : 30th April. 2015

TEST REPORT

1.0 Test Requested by Client : Determination of the compressive strength of Concrete Cores

2.0 Tested For : **RNC Technology (M) Sdn Bhd**
16-1 Jalan Putra Mahkota 7/5B
47650 Subang Jaya
Selangor Darul Ehsan

3.0 Project : **Jambatan Sultan Iskandar, Kuala Kangsar**

4.0 Method of Testing : Compressive strength of concrete cores were determined in accordance with BS EN 12390-3: 2009 'Method For Compressive Strength Of Test Specimens.'

5.0 Description of Samples : A total of FIVE (05) no. of 100mm Ø of concrete core samples were received and referenced as below.

Date Received	Structure	No. of Cores	No. of Specimens
07-04-2015	Column	5	5

6.0 Witnessed by : 1) Ms. Ain Nuratiqah RNC

7.0 Results : Please refer to the following page.

8.0 Remarks/Exclusion : ***The core sample are drilled by others and BSEN TEST is <u>SOLELY</u> prepared and provide compression test of core samples.***

for and behalf of **BSEN TEST SDN. BHD.**

BSEN Test Sdn. Bhd. (749355-K)

Ricky Ting H Y
Technical Manager

Prepared by: Dira

CUSTOMER : **RNC Technology (M) Sdn Bhd**

PROJECT : **Jambatan Sultan Iskandar, Kuala Kangsar**

Determination of Core Compressive Strength

BS EN 12390-3: 2009

LAB MARKING			C 368	C 369	C 371	C 370	C 372
Sample Marking*			ABT 1	P1-SS	P5-SS	P4-SS	P6-SS
Structure Under Test			Column				
Concrete Grade		N/mm^2	N/A				
Date of testing			23-04-2015				
Direction of drilling			Horizontal				
As received density		(Kg/m^3)	2230	2360	2380	2350	2210
Diameter of core		(mm)	100	100	100	100	100
Average length after capped		(mm)	105	105	107	104	103
Maximum load		(KN)	205.8	477.7	488.1	418.2	189.1
Compressive core strength		(N/mm^2)	26.2	60.8	62.1	53.9	24.1
Estimated in-situ cube strength		(N/mm^2)	26.7	62.0	63.8	54.9	24.4
Estimated In-situ Characteristic Strength#		(N/mm^2)	33.4	77.5	79.8	68.6	30.5
Compaction	Excess Voidage	%	0.5	0.5	0.5	0.5	0.5
	Honeycomb	(Yes/No)	Yes	No	No	No	Yes
	Cracks	(Vi/N.Vi)	N.Vi	N.Vi	N.Vi	N.Vi	N.Vi
TYPE OF FRACTURE AFTER COMPRESSIVE TEST			Normal	Normal	Normal	Normal	Normal

Notes: 1) * - Data as furnished by client

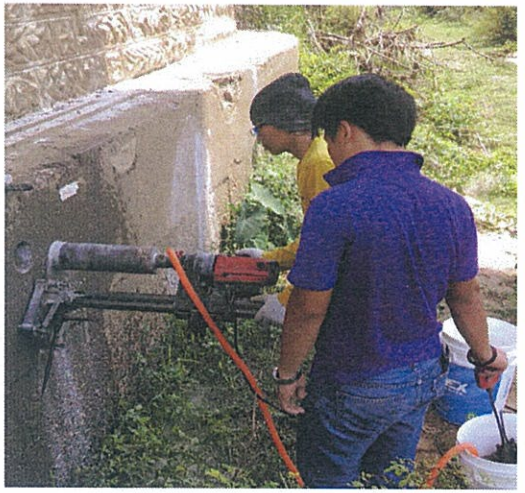
2) # - MS 1242 clause 6.5.3 stated that characteristic strength calculated based on fcu = {1.5x(EICS)a}/1.2b
where a - ultimate strength
b - safety factor (or appropriate factor suitable in particular circumstances)

BSEN Test Sdn. Bhd. (749355-K)

SUBSEQUENT 5 CORES O PIERS & ABUTMENT

Concrete Core Extraction at Pier 6.

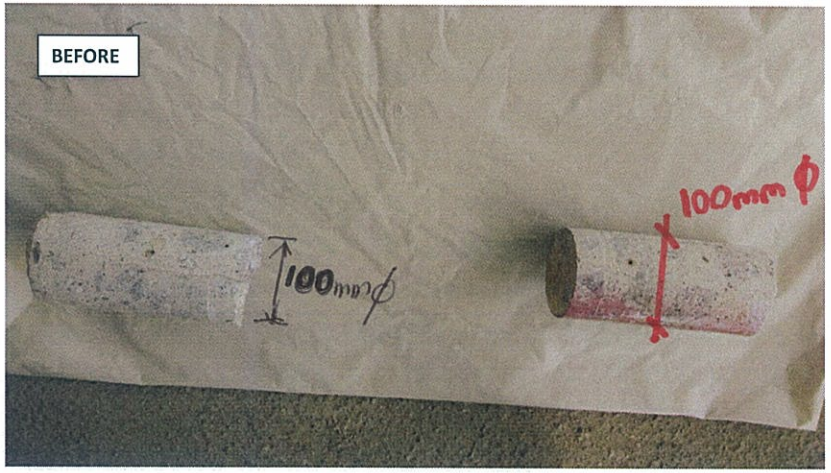
Concrete Core Extraction at Pier 5.

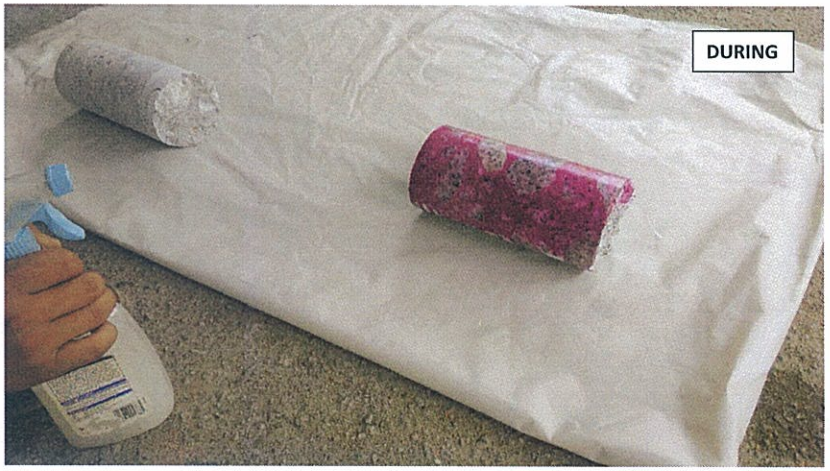


Concrete Core Extraction at Pier 4.

Concrete Core Extraction at Pier 1.

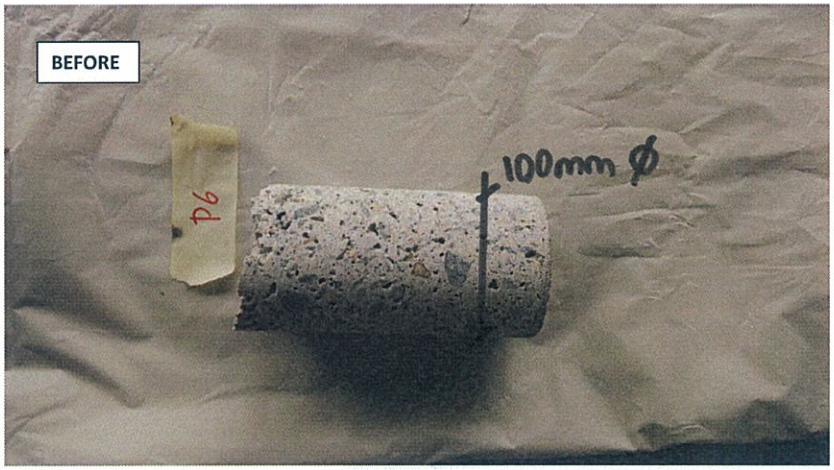
Concrete Core Extraction at Abutment 1.



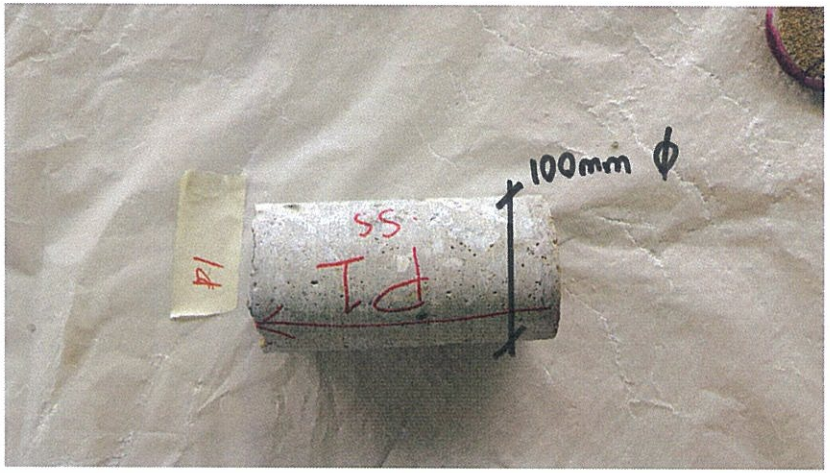


Carbonation Test to Concrete Cores extracted from Pier 5 (Left) and Pier 4 (Right).

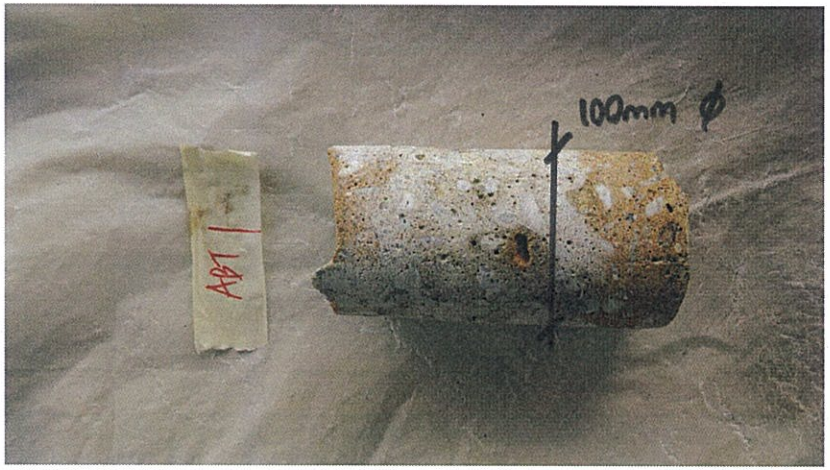
Carbonation Test to Concrete Cores extracted from Pier 4 (Left) and Pier 5 (Right).



Extracted Concrete Core from Pier 6 (Before Carbonation Test).



Extracted Concrete Core from Pier 1 (Before Carbonation Test).



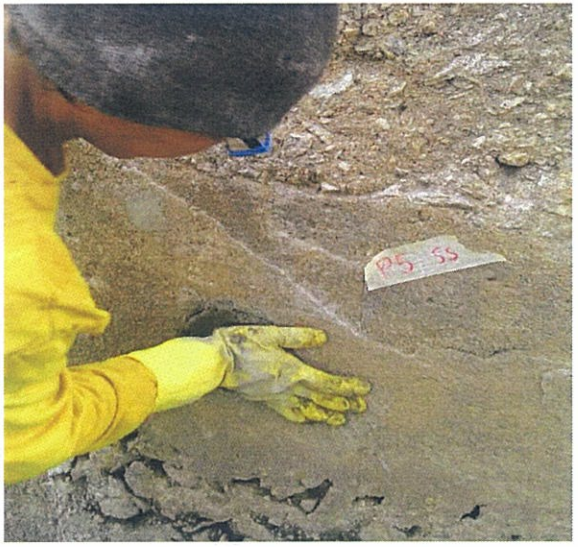
Extracted Concrete Core from Abutment 1 (Before Carbonation Test).

Carbonation Test to Concrete Core extracted from Pier 6.

Carbonation Test to Concrete Core extracted from Pier 1.

Carbonation Test to Concrete Core extracted from Abutment 1.

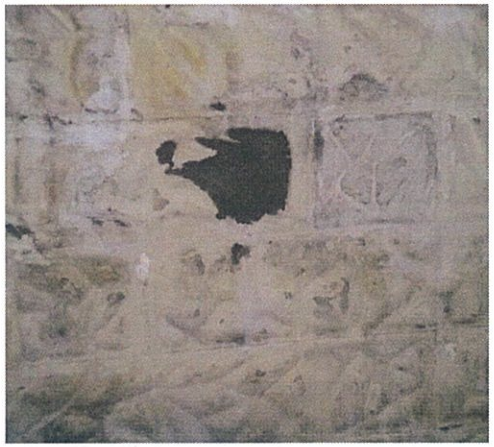
Patching Works at Pier 6.



Patching Works at Pier 5.

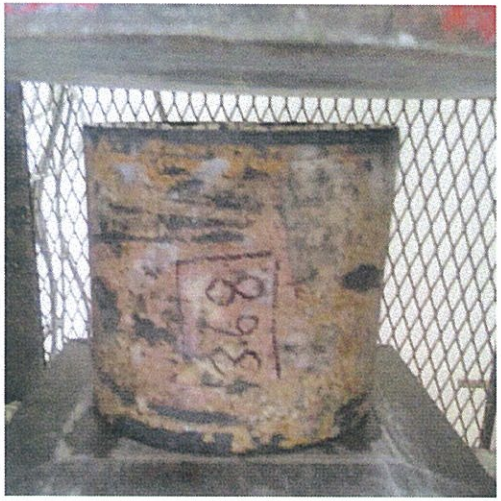
Patching Works at Pier 4.

Patching Works at Pier 1.



Patching Works at Abutment 1.

Typical picture of the preparation of the Concrete Core Sample.

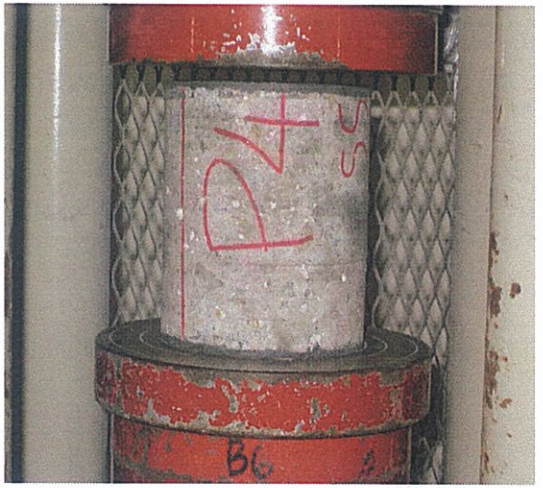


The prepared Concrete Core extracted from Abutment 1.

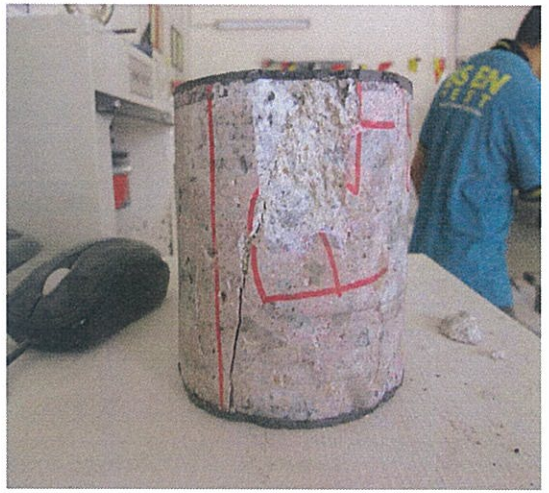
The crushed Concrete Core extracted from Abutment 1.

The prepared Concrete Core extracted from Pier 1.

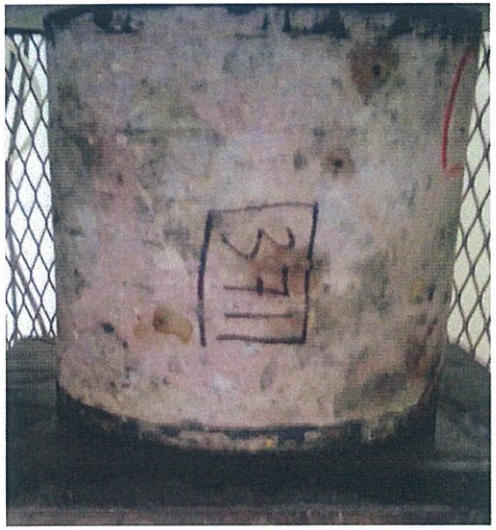
The crushed Concrete Core extracted from Pier 1.



The prepared Concrete Core extracted from Pier 4.

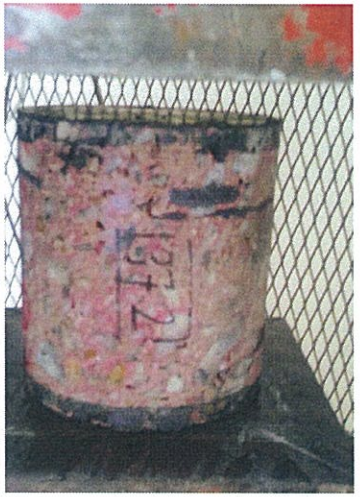


The crushed Concrete Core extracted from Pier 4.



The prepared Concrete Core extracted from Pier 5.

The crushed Concrete Core extracted from Pier 5.



The prepared Concrete Core extracted from Pier 6.

The crushed Concrete Core extracted from Pier 6.

RPT/TC/275/14/40-FinalReport – Vol 2 of 4

ATTACHMENT 5

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

FINAL REPORT

VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

ATTACHMENT 5

Dust Samplings - Chloride and Sulphate Content

DUST SAMPLINGS

FIRST LABORATORY SERVICES (SA0180127-D)

5A, Jalan Anggerik Vanilla M31/M, Kota Kemuning, Seksyen 31, 40460 Shah Alam, Selangor.

Phone / Fax : 03-5124 8379 / 012 – 229 8379

Email : firstlaboratory@gmail.com

CERTIFICATE OF ANALYSIS

DATE ISSUED	:	16 March 2015
LAB REFERENCE NO.	:	FL/1503-013
COMPANY	:	RNC Technology (M) Sdn Bhd No.16-1,Jalan Putra Mahkota 7/5B Putra Height, 47650 Subang Jaya Selangor Darul Ehsan Tel : 03-5192 3388 Fax : 03- 5192 1166
DATE SAMPLE RECEIVED	:	11 March 2015
DATE OF MEASUREMENT	:	12 March 2015 to 16 March 2015
SAMPLE DESCRIPTION	:	Eighteen concrete dusts.
PROJECT	:	Jambatan Sultan Iskandar Kuala Kangsar, Perak.
ANALYSIS RESULTS (As per sample)	:	**Refer Page 2 of 2**

FIRST LABORATORY SERVICES (SA0180127-D)

5A, Jalan Anggerik Vanilla M31/M, Kota Kemuning, Seksyen 31, 40460 Shah Alam, Selangor.

Phone / Fax : 03-5124 8379 / 012 – 229 8379

Email : firstlaboratory@gmail.com

Project : Jambatan Sultan Iskandar , Kuala Kangsar , Perak.

Sample Marking		Chloride (%)	Sulphate (%)	Method Reference
SP 1	25 mm	--	0.48	BS 1881 : Part 124 : 1988
	50 mm	--	0.45	
	75 mm	--	0.48	
SP 2	25 mm	--	0.54	
	50 mm	--	0.50	
	75 mm	--	0.46	
SP 6	25 mm	--	0.43	
	50 mm	--	0.41	
	75 mm	--	0.41	
SP 7	25 mm	ND (<0.01)	0.25	
	50 mm	ND (<0.01)	0.25	
	75 mm	ND (<0.01)	0.25	
P4 (SS)	25 mm	ND (<0.01)	0.55	
	50 mm	ND (<0.01)	0.34	
	75 mm	ND (<0.01)	0.34	
P5 (SS)	25 mm	0.02	0.50	
	50 mm	ND (<0.01)	0.36	
	75 mm	ND (<0.01)	0.35	

Notes:

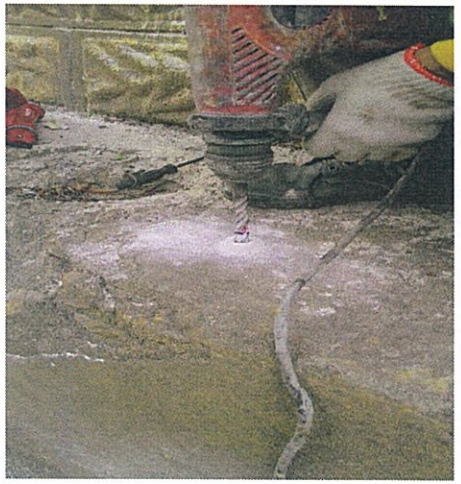
1) ND – Not Detected

Neo Pei Fern
BSc. (Hons), MSc (Chemistry), AMIC
IKM No. A2332/4915/2006
Chemist

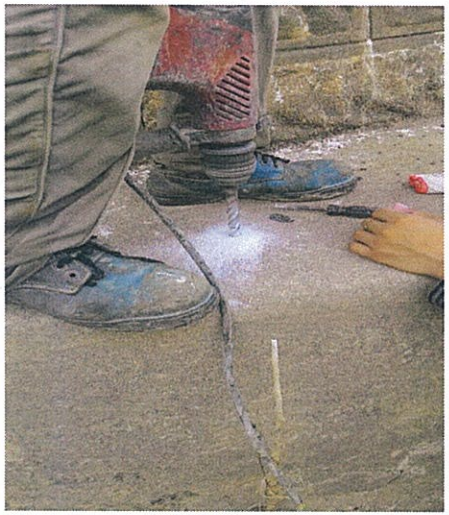
DUST SAMPLING TEST

Picture 1 - Dust Sampling at Deck Slab.

Picture 2 - Dust Sampling at Deck Slab.



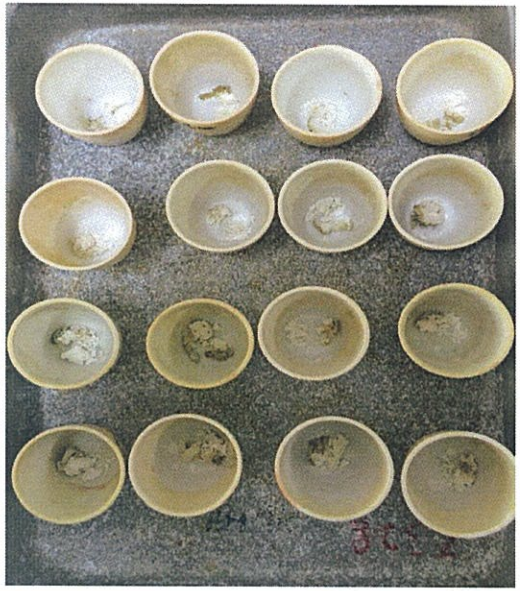
Picture 3 - Dust Sampling at Pier Pilecap.



Picture 4 - Dust Sampling at Pier Pilecap.

Picture 5 - Chloride Content Test.

Picture 6 - Chloride Content Test.



Picture 7 - Sulphate Content Test.

Picture 8 - Sulphate Content Test.

RPT/TC/275/14/40-FinalReport – Vol 2 of 4

ATTACHMENT 6

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

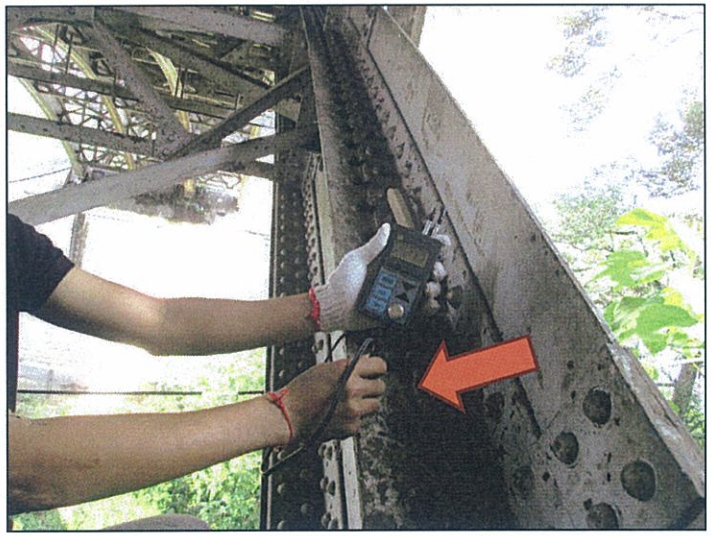
FINAL REPORT

VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

ATTACHMENT 6

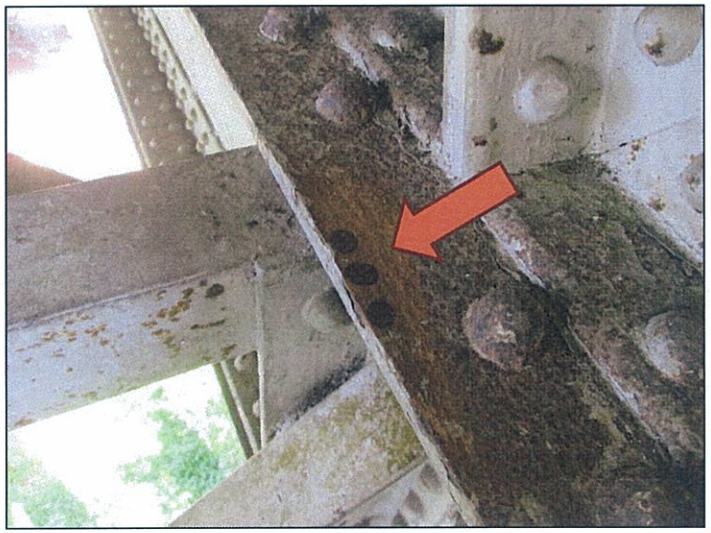
Ultrasonic Thickness Testing

ULTRASONIC THICKNESS MEASUREMENT



Picture U-S1-P1

Plate Thickness of Top Flange of Arch Beam A = 13.47mm



Picture U-S1-P2

Plate Thickness of Top Flange of Arch Beam A = 13.23mm

Picture U-S1-P3

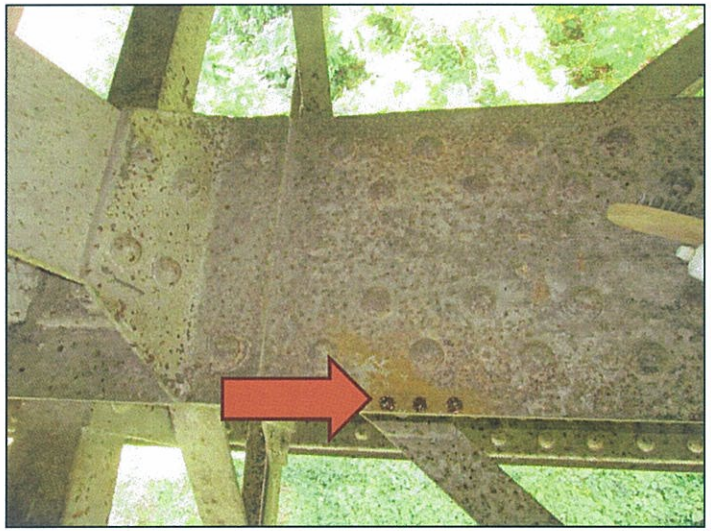
Plate Thickness of Top Flange of Arch Beam A = 13.20mm

Picture U-S1-P4

Plate Thickness of Top Flange of Arch Beam B = 14.27mm

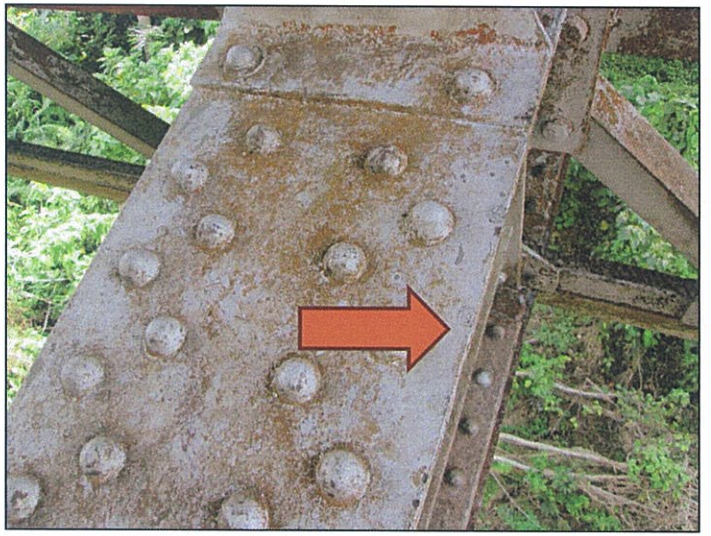
Picture U-S1-P5

Plate Thickness of Top Flange of Arch Beam B = 13.57mm



Picture U-S1-P6

Plate Thickness of Top Flange of Arch Beam B = 13.17mm

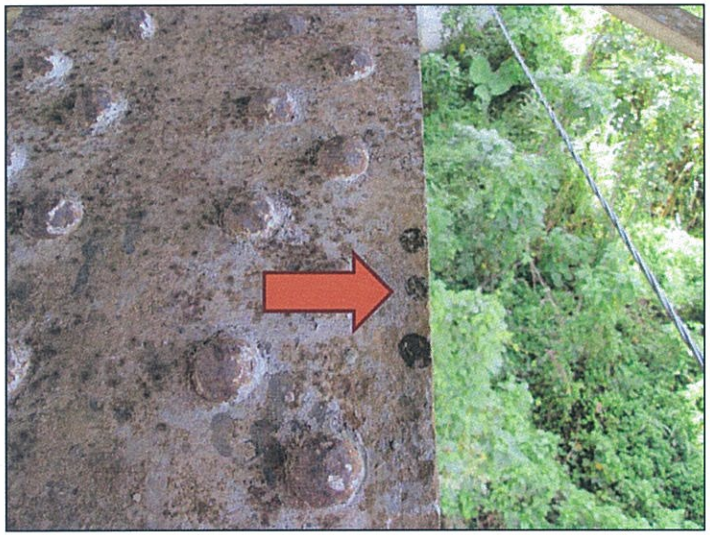


Picture U-S1-P7

Plate Thickness of Top Flange of Arch Beam C = 13.67mm

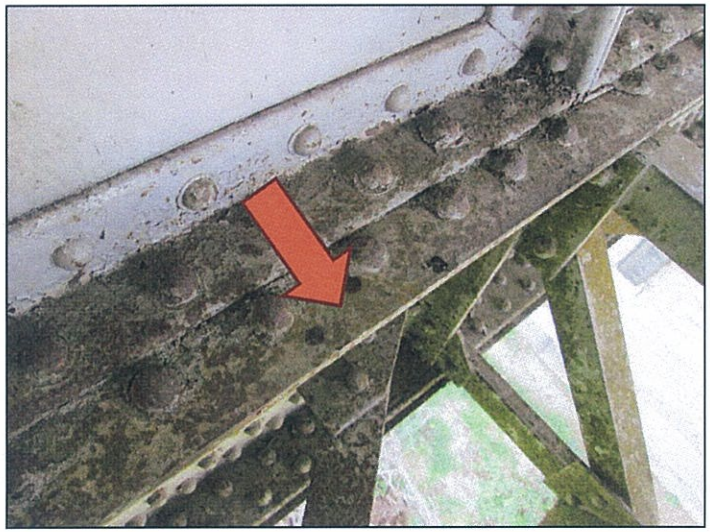
Picture U-S1-P8

Plate Thickness of Top Flange of Arch Beam C = 13.60mm



Picture U-S1-P9

Plate Thickness of Top Flange of Arch Beam C = 13.57mm



Picture U-S1-P10

Plate Thickness of Top Flange of Arch Beam D = 13.37mm

Picture U-S1-P11

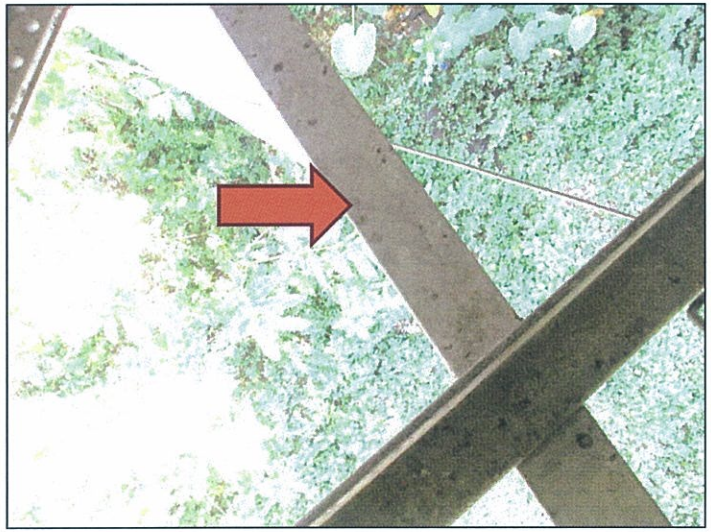
Plate Thickness of Inclined Bracing = 13.33mm

Picture U-S1-P12

Plate Thickness of Inclined Bracing = 13.27mm

Picture U-S1-P13

Plate Thickness of Inclined Bracing = 13.07mm



Picture U-S1-P14

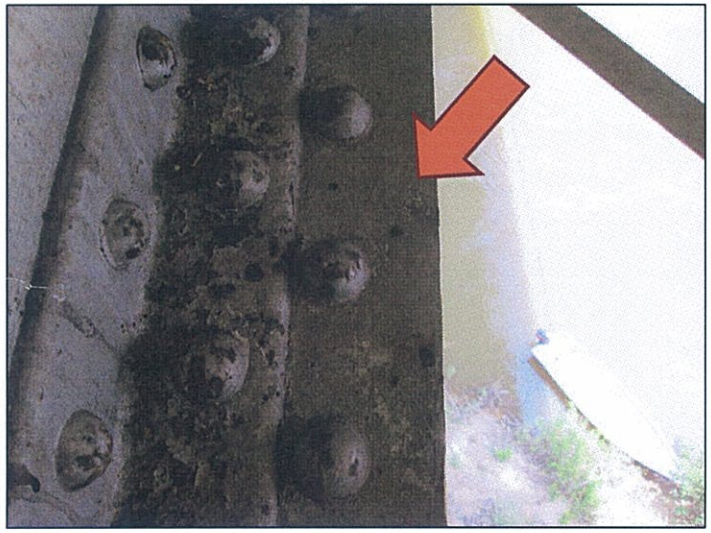
Plate Thickness of Horizontal Bracing = 13.47mm

Picture U-S1-P15

Plate Thickness of Horizontal Bracing = 12.83mm

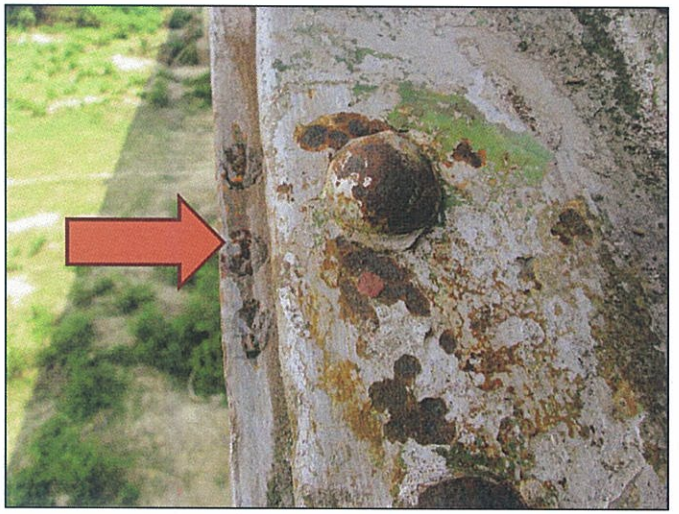
Picture U-S4-P1

Plate Thickness of Top Flange of Arch Beam A = 13.40mm



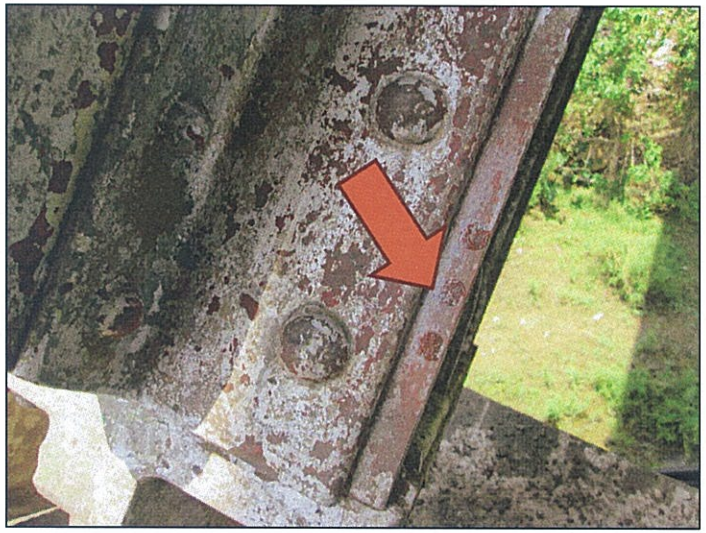
Picture U-S4-P2

Plate Thickness of Top Flange of Arch Beam A = 13.30mm



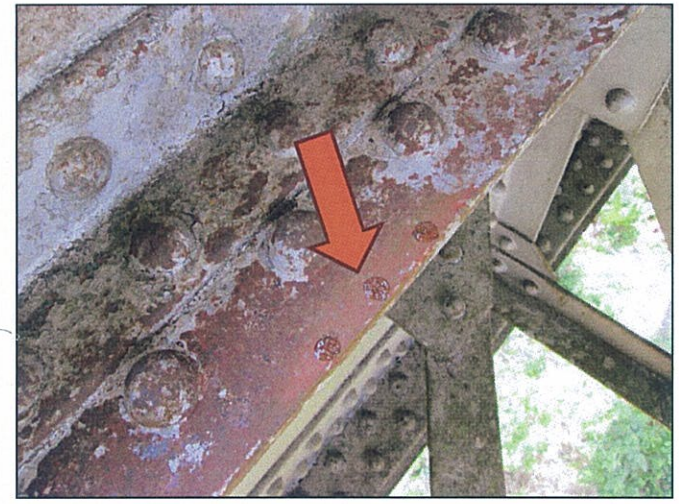
Picture U-S4-P3

Plate Thickness of Top Flange of Arch Beam A = 12.40mm



Picture U-S4-P4

Plate Thickness of Top Flange of Arch Beam A = 13.20mm

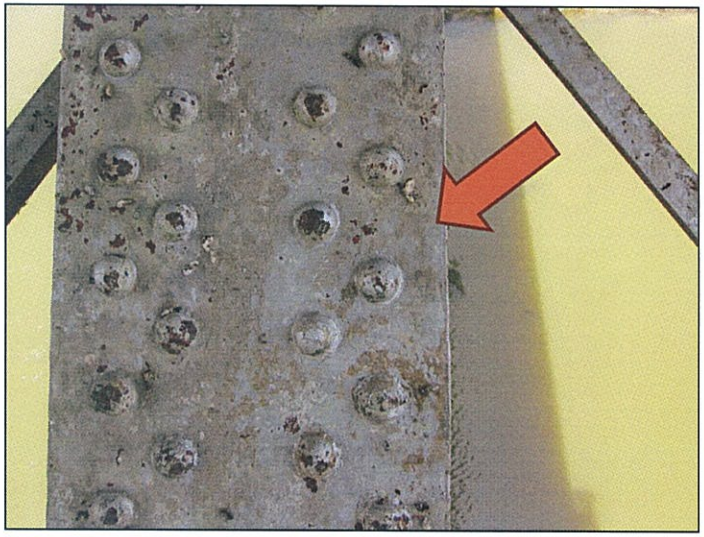


Picture U-S4-P5

Plate Thickness of Top Flange of Arch Beam A = 13.17mm

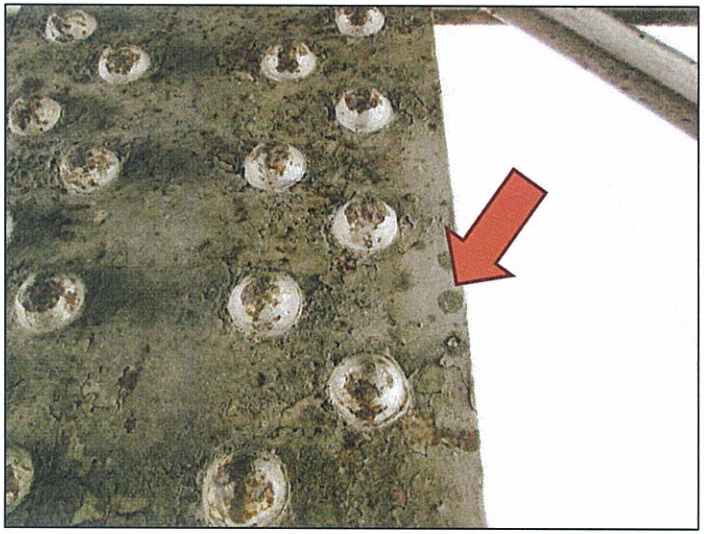
Picture U-S4-P6

Plate Thickness of Top Flange of Arch Beam A = 13.23mm



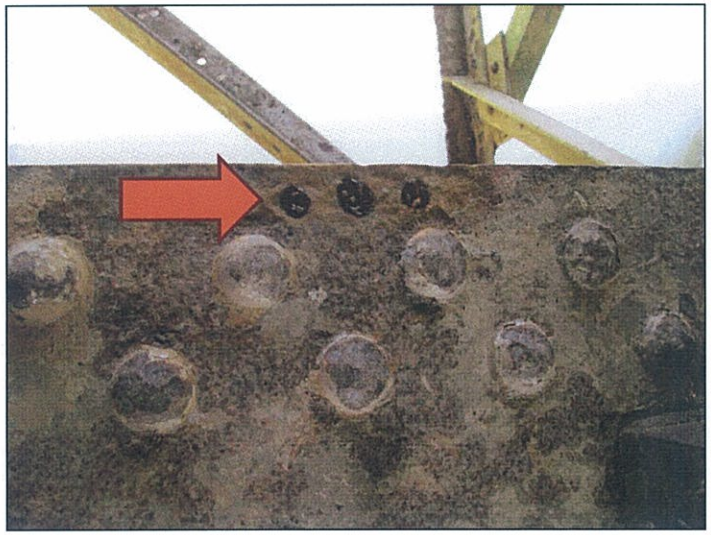
Picture U-S4-P7

Plate Thickness of Top Flange of Arch Beam B = 12.83mm



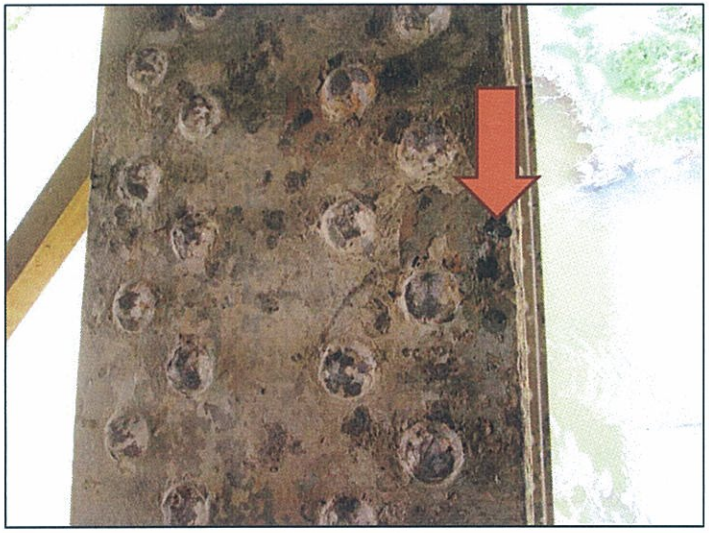
Picture U-S4-P8

Plate Thickness of Top Flange of Arch Beam B = 11.53mm



Picture U-S4-P9

Plate Thickness of Top Flange of Arch Beam B = 10.5mm

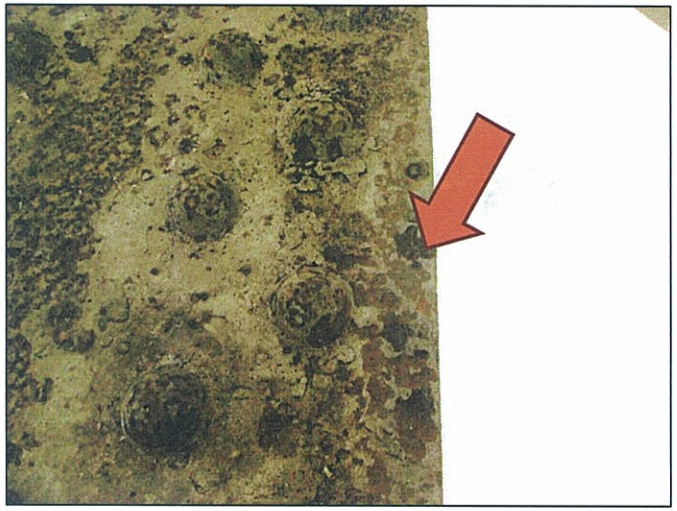


Picture U-S4-P10

Plate Thickness of Top Flange of Arch Beam B = 10.4mm

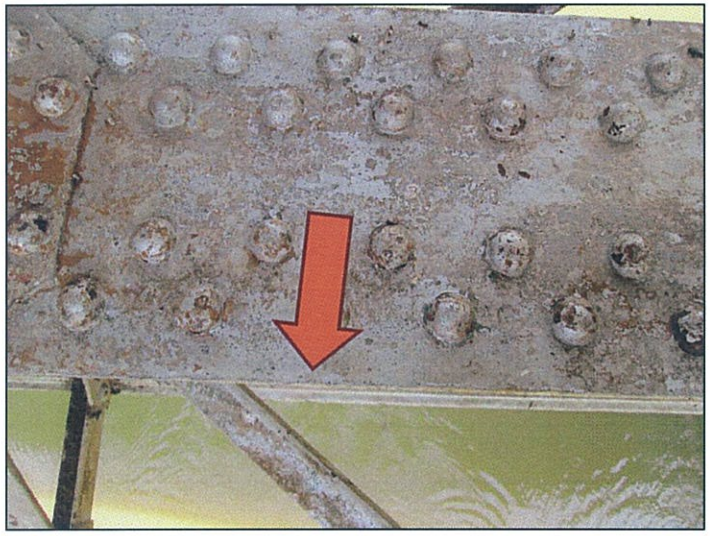
Picture U-S4-P11

Plate Thickness of Top Flange of Arch Beam B = 10.8mm



Picture U-S4-P12

Plate Thickness of Top Flange of Arch Beam B = 11.7mm

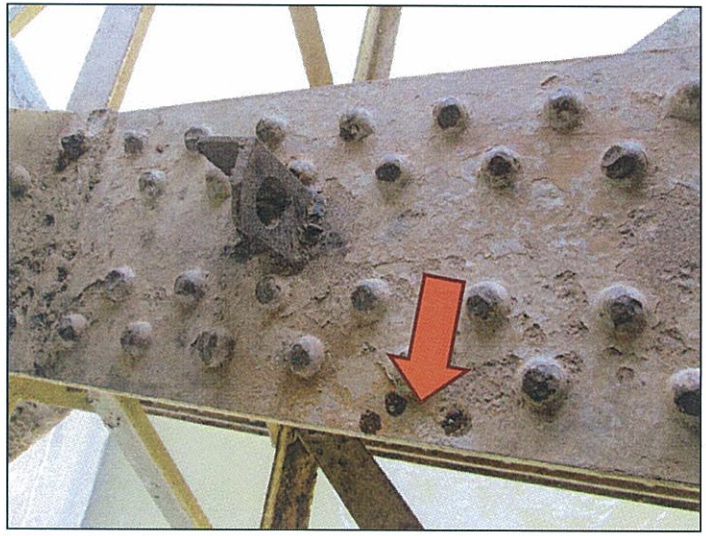


Picture U-S4-P13

Plate Thickness of Top Flange of Arch Beam C = 11.10mm

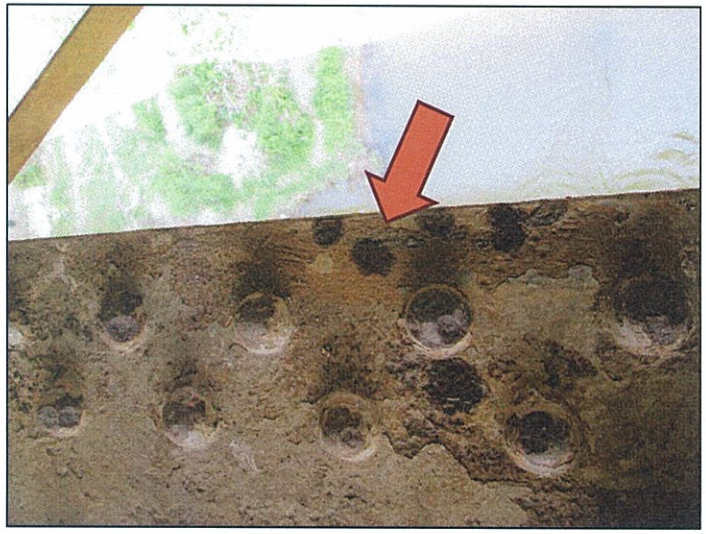
Picture U-S4-P14

Plate Thickness of Top Flange of Arch Beam C = 10.83mm



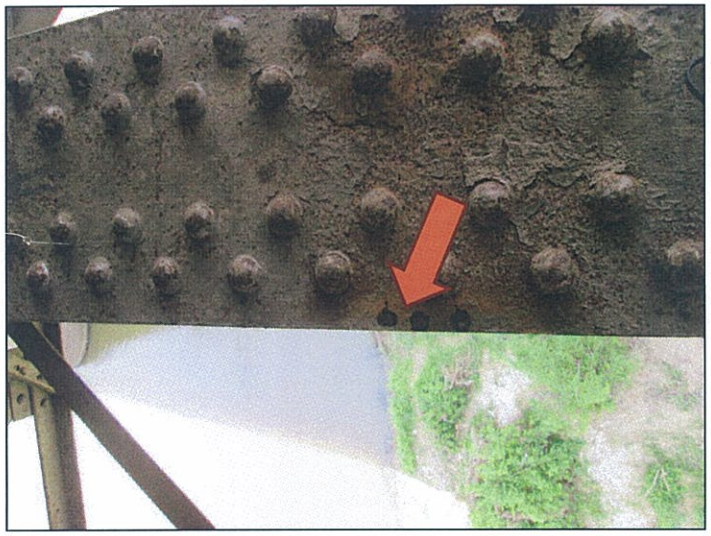
Picture U-S4-P15

Plate Thickness of Top Flange of Arch Beam C = 10.2mm



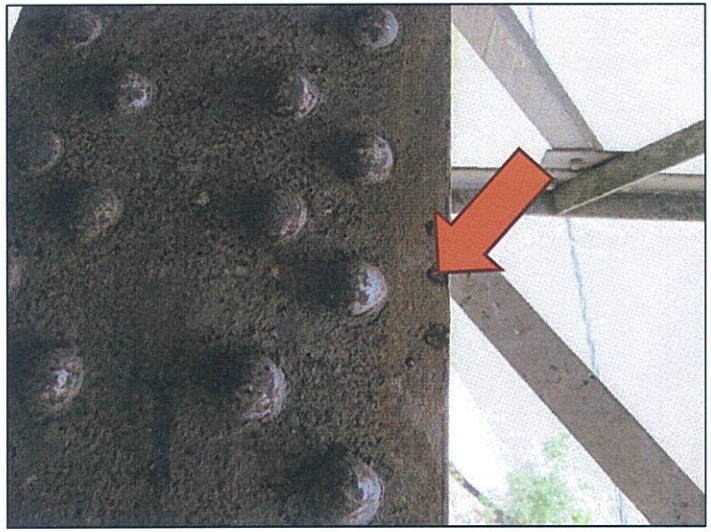
Picture U-S4-P16

Plate Thickness of Top Flange of Arch Beam C = 10.4mm



Picture U-S4-P17

Plate Thickness of Top Flange of Arch Beam C = 10.1mm

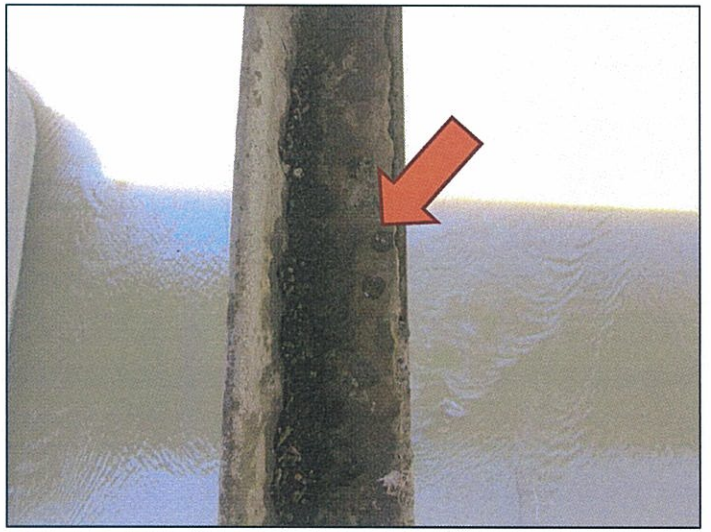


Picture U-S4-P18

Plate Thickness of Top Flange of Arch Beam C = 10.3mm

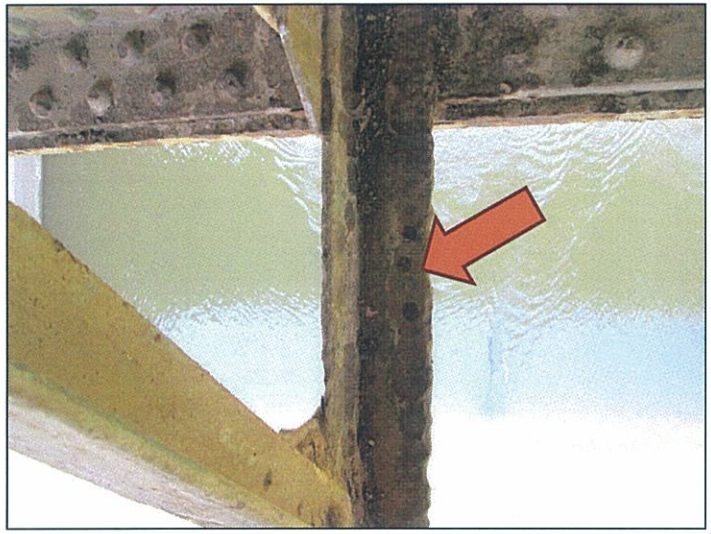
Picture U-S4-P19

Plate Thickness of Inclined Bracing = 12.6mm



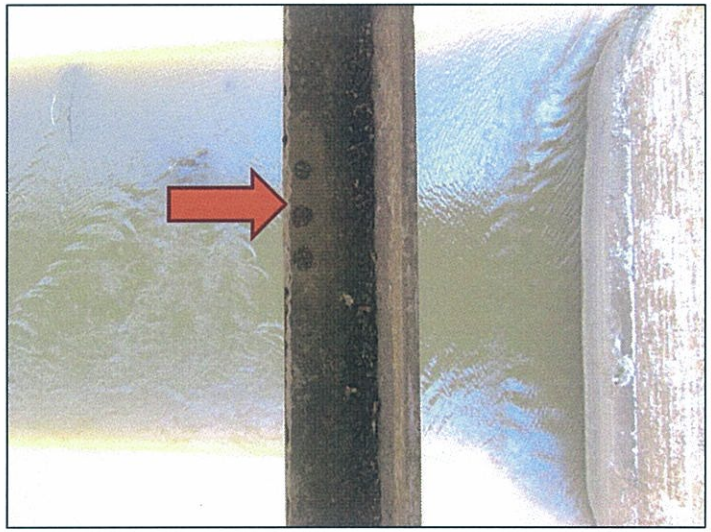
Picture U-S4-P20

Plate Thickness of Inclined Bracing = 11.7mm



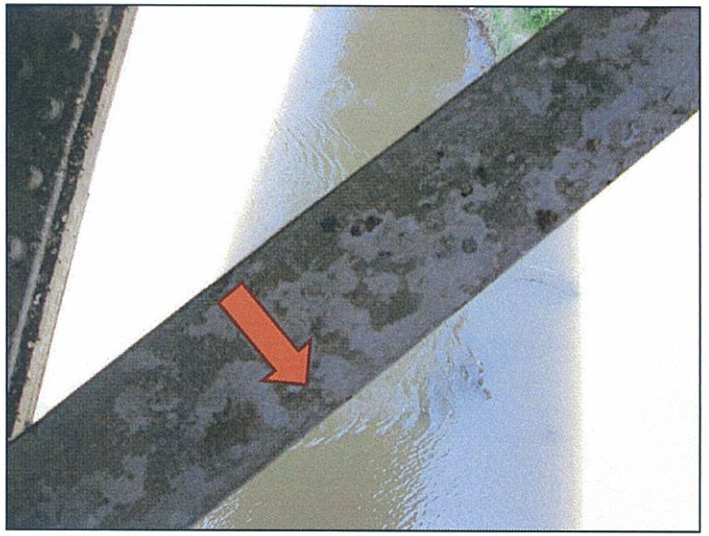
Picture U-S4-P21

Plate Thickness of Inclined Bracing = 11.6mm



Picture U-S4-P22

Plate Thickness of Inclined Bracing = 12.2 mm



Picture U-S4-P23

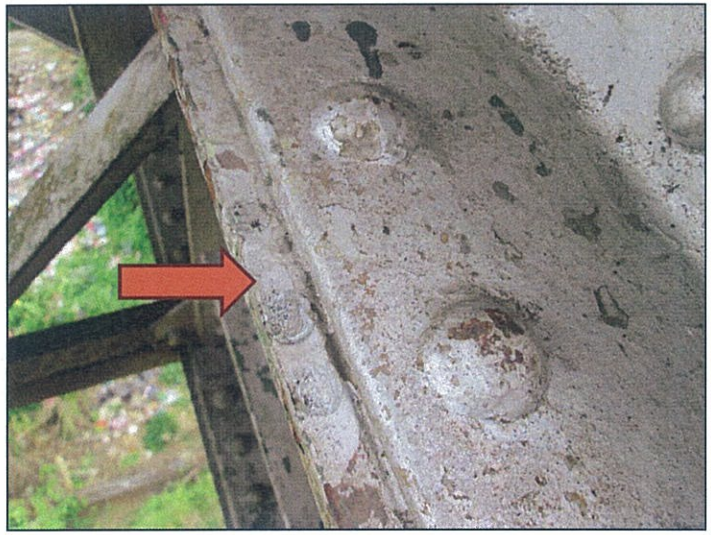
Plate Thickness of Horizontal Bracing = 12.7mm

Picture U-S4-P24

Plate Thickness of Horizontal Bracing = 12.3mm

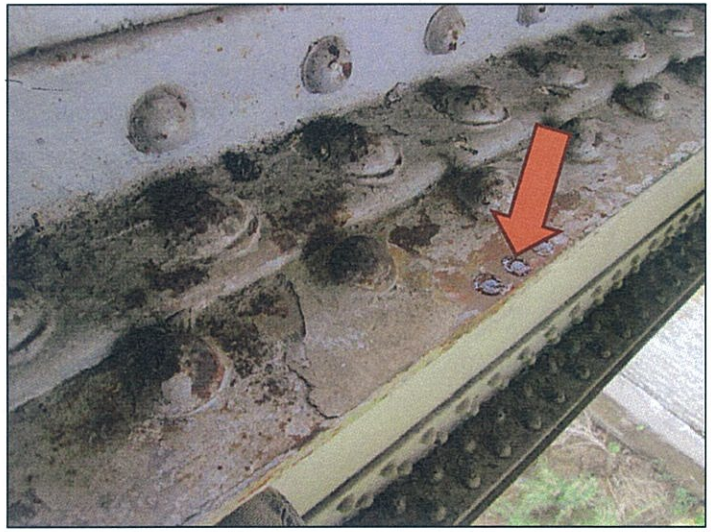
Picture U-S4-P25

Plate Thickness of Horizontal Bracing = 12.4mm



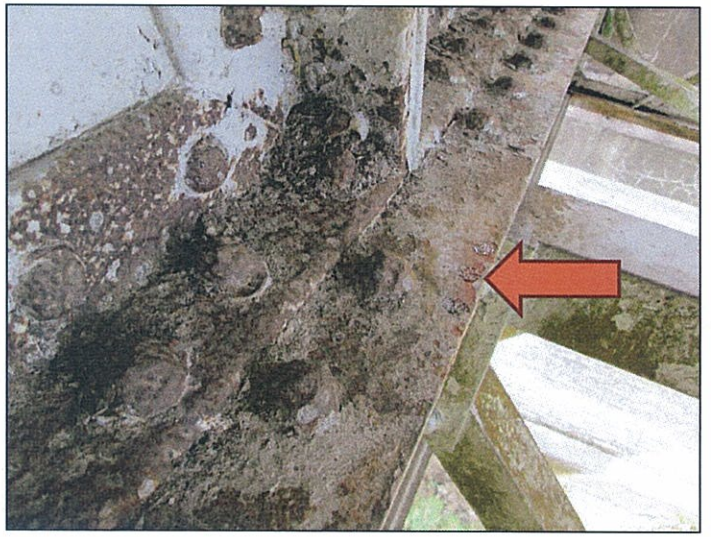
Picture U-S6-P1

Plate Thickness of Top Flange of Arch Beam A = 13.7mm



Picture U-S6-P2

Plate Thickness of Top Flange of Arch Beam A = 12.9mm



Picture U-S6-P3

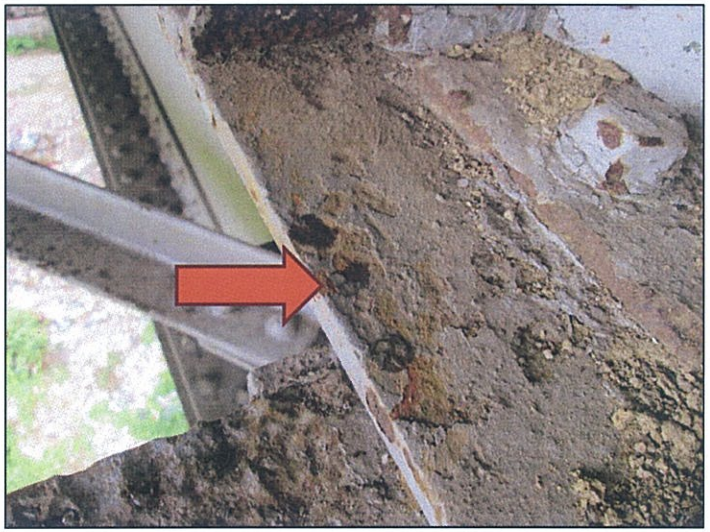
Plate Thickness of Top Flange of Arch Beam A = 13.4mm

Picture U-S6-P4

Plate Thickness of Top Flange of Arch Beam B = 13.3mm

Picture U-S6-P5

Plate Thickness of Top Flange of Arch Beam B = 12.6mm

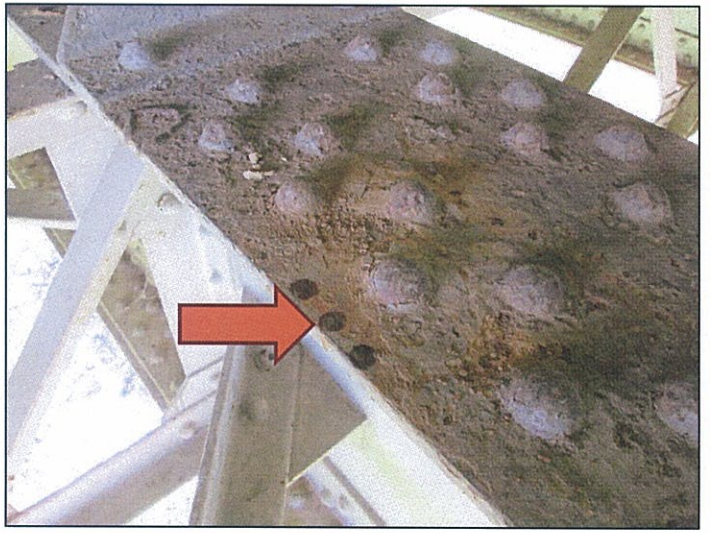


Picture U-S6-P6

Plate Thickness of Top Flange of Arch Beam B = 12.7mm

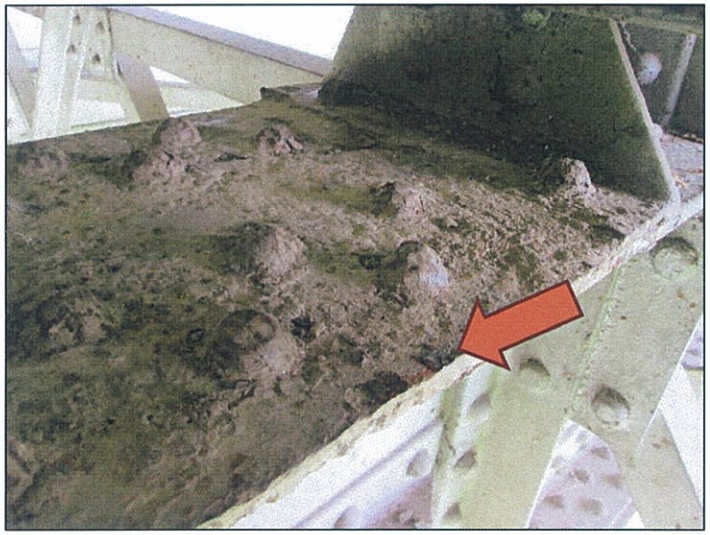
Picture U-S6-P7

Plate Thickness of Top Flange of Arch Beam C = 13.3mm



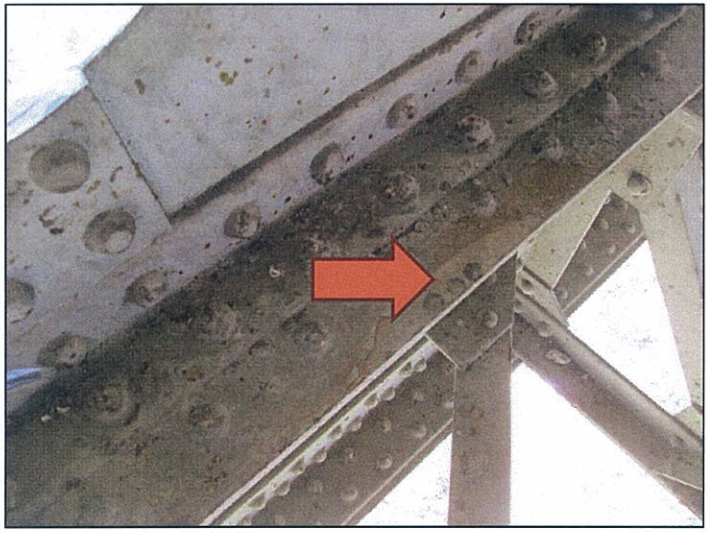
Picture U-S6-P8

Plate Thickness of Top Flange of Arch Beam C = 13mm



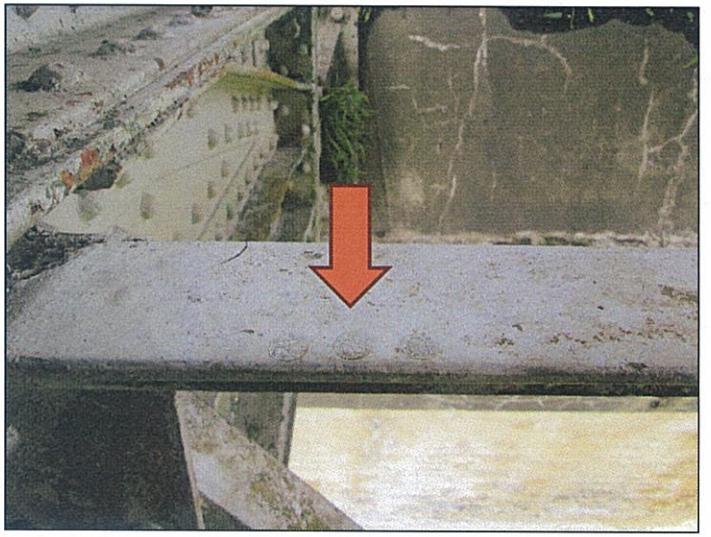
Picture U-S6-P9

Plate Thickness of Top Flange of Arch Beam C = 12.8mm



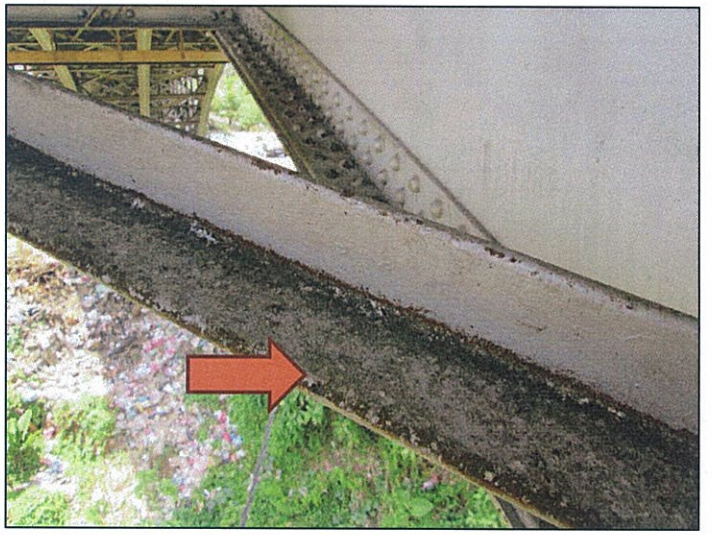
Picture U-S6-P10

Plate Thickness of Top Flange of Arch Beam D = 13mm



Picture U-S6-P11

Plate Thickness of Inclined Bracing = 13.43mm

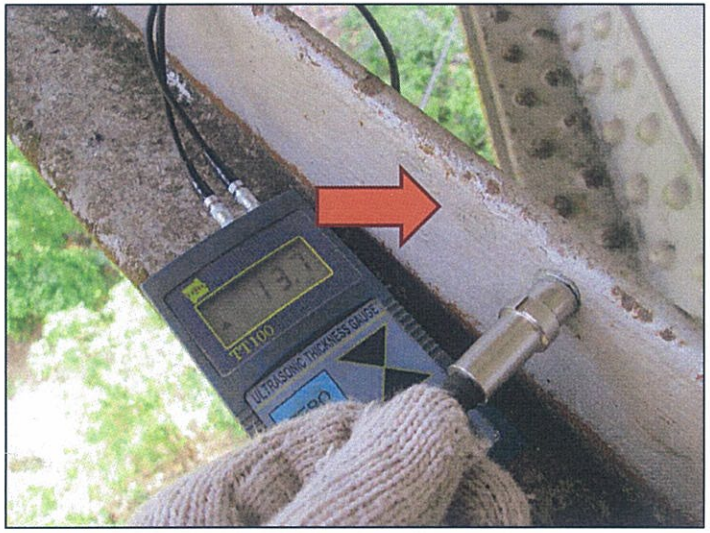


Picture U-S6-P12

Plate Thickness of Inclined Bracing = 12.5mm

Picture U-S6-P13

Plate Thickness of Inclined Bracing = 13.1mm



Picture U-S6-P14

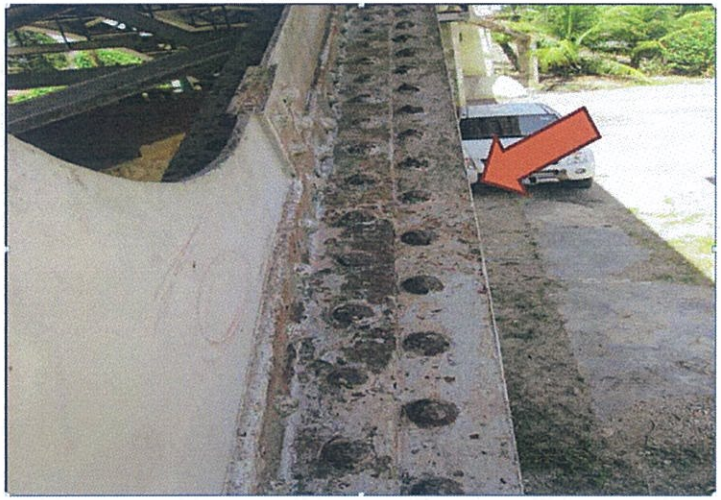
Plate Thickness of Horizontal Bracing = 13.6mm

Picture U-S6-P15

Plate Thickness of Horizontal Bracing = 13.5mm

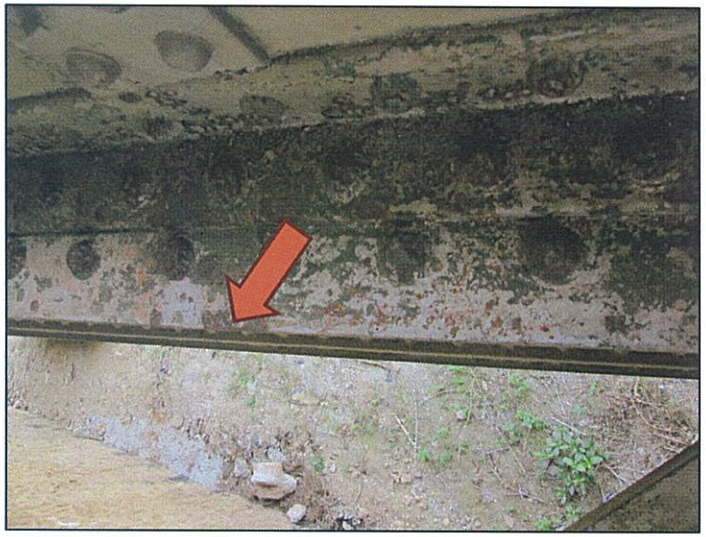
Picture U-S7-P1

Plate Thickness of Top Flange of Arch Beam A = 15.4mm



Picture U-S7-P2

Plate Thickness of Top Flange of Arch Beam A = 15.3mm



Picture U-S7-P3

Plate Thickness of Top Flange of Arch Beam A = 15.27mm

Picture U-S7-P4

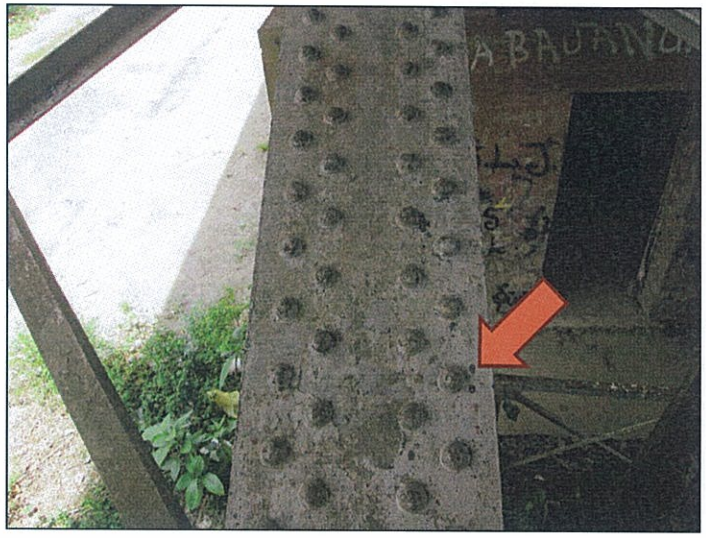
Plate Thickness of Top Flange of Arch Beam B = 16.37mm

Picture U-S7-P5

Plate Thickness of Top Flange of Arch Beam B = 14.9mm

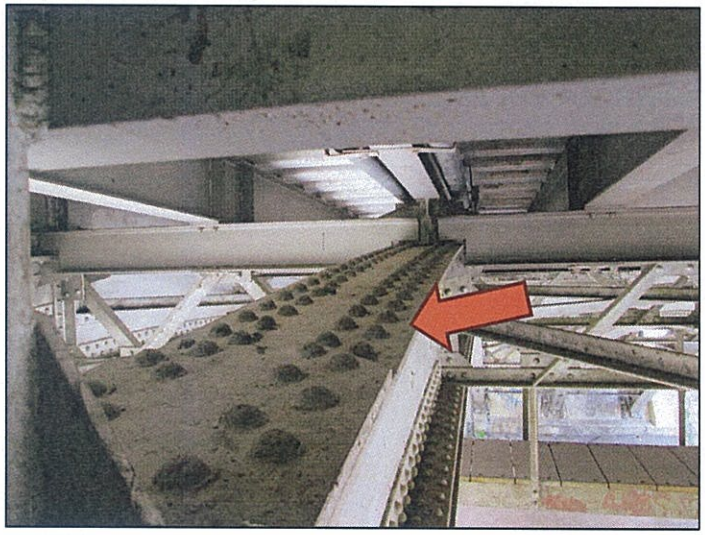
Picture U-S7-P6

Plate Thickness of Top Flange of Arch Beam B = 15.3mm



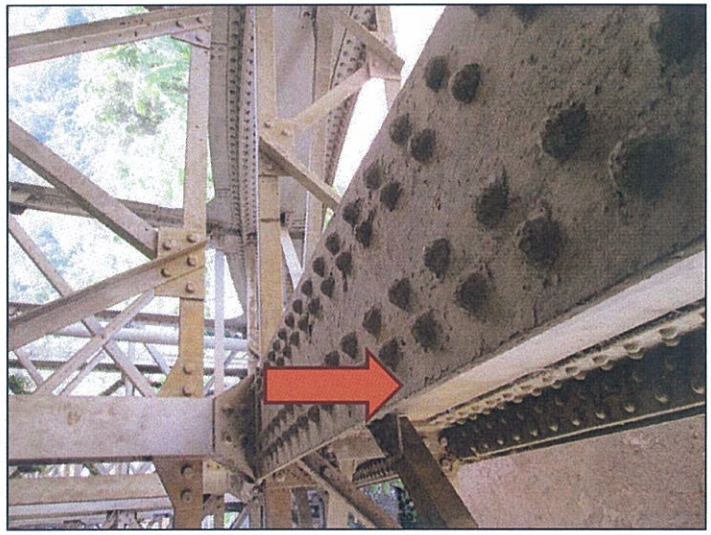
Picture U-S7-P7

Plate Thickness of Top Flange of Arch Beam C = 16.27mm



Picture U-S7-P8

Plate Thickness of Top Flange of Arch Beam C = 15.97mm

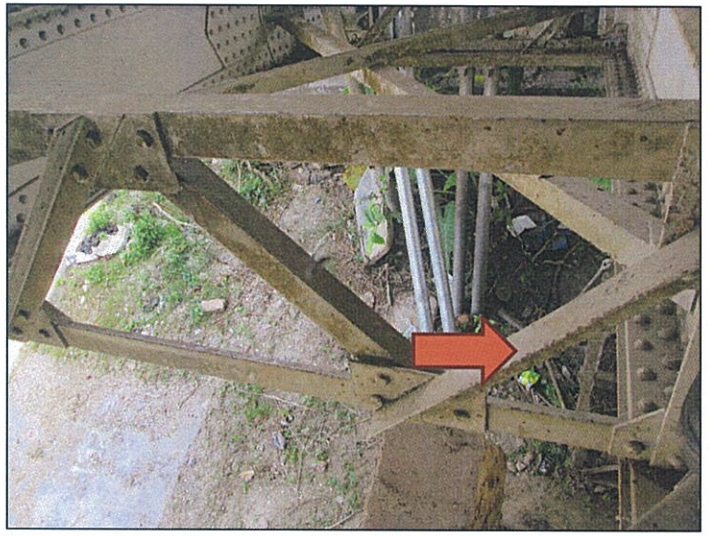


Picture U-S7-P9

Plate Thickness of Top Flange of Arch Beam C = 15.93mm

Picture U-S7-P10

Plate Thickness of Top Flange of Arch Beam D = 15.4mm

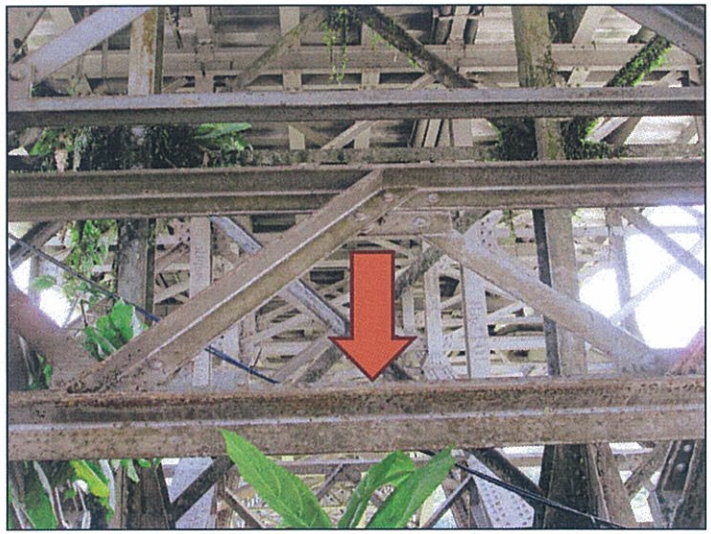


Picture U-S7-P11

Plate Thickness of Inclined Bracing = 15.97mm

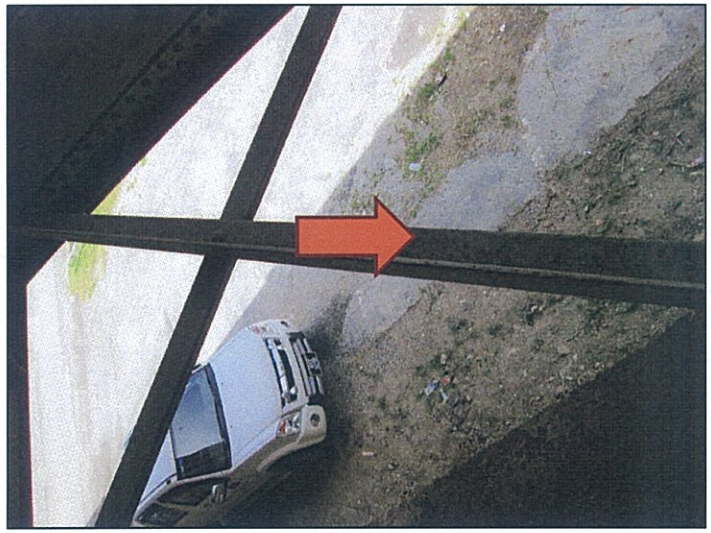
Picture U-S7-P12

Plate Thickness of Inclined Bracing = 15.53mm



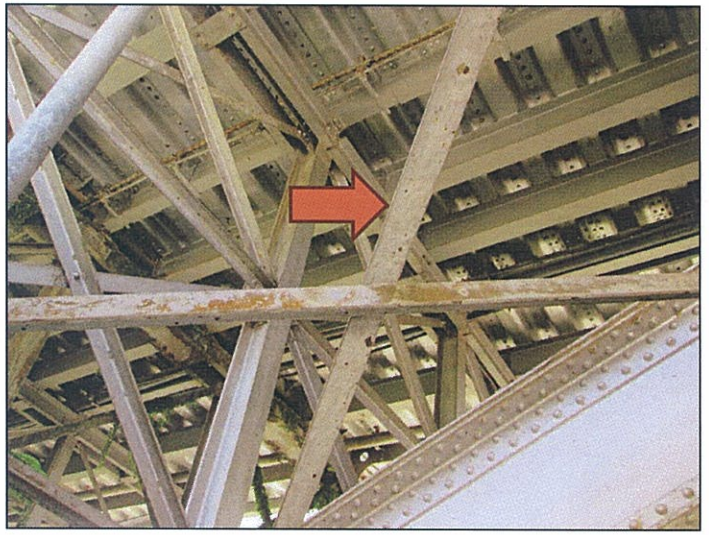
Picture U-S7-P13

Plate Thickness of Inclined Bracing = 13.93mm



Picture U-S7-P14

Plate Thickness of Horizontal Bracing = 15.43mm



Picture U-S7-P15

Plate Thickness of Horizontal Bracing = 15.13mm

RPT/TC/275/14/40-FinalReport – Vol 2 of 4

ATTACHMENT 7

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

FINAL REPORT

VOLUME 2 OF 4 : FACTUAL REPORT ON MATERIAL TESTINGS

ATTACHMENT 7

Steel Tensile Test

MATERIAL TESTING LABORATORY
IKRAM QA SERVICES SDN BHD (479565-A)
Block 7, Unipark Suria, Jalan Ikram-Uniten,
43000 Kajang, Selangor, Malaysia.
Tel: (G) +603 8738 3388 (Lab) +603 8738 3239 • Fax: +603 8736 7254
email: ikramqa@ikram.com.my
www.ikram.com.my

(A member of Kumpulan IKRAM)

MS ISO/IEC 17025
TESTING
SAMM NO. 347

TEST REPORT

Report No.	D/022/15	Date	16/03/2015
Total No of Pages	2	Page No.	1 / 2
Name And Address Of Recipient (As Given By Applicant)	General Manager, RNC TECHNOLOGY (M) SDN. BHD., No. 16-1, Jalan Putra Mahkota 7/5B, Putra Height, 47650 UEP Subang Jaya, Selangor Darul Ehsan. (Attn: Mr. Parnam Singh) CUSTOMER'S COPY		
Title of the report (As Given By Applicant)	Tensile Test On Steel Cupons Sultan Iskandar Bridge Kuala Kangsar, Perak.		
Applicant's Reference	Mr. Parnam Singh - RNC TECHNOLOGY (M) SDN. BHD.		
Application Number	ML/A/07515	Application Date	05/03/2015
Job Number	DN1A03/105/15	Tested By	Shukri Ghazali
Testing Fees References	Receipt No : 014672 - RNC TECHNOLOGY (M) SDN. BHD.		

Particulars Of Sample (As Given By Applicant)							IKRAM QA
No.	Material (s)	Grade	Size	Model	Qty.	Sample Markings	Sample References
1.	Mild Steel	-	-	-	1 No.	TS 1 (Angle)	105-S1.
2.	Mild Steel	-	-	-	1 No.	TS 2 (Angle)	105-S2.
3.	Mild Steel	-	-	-	1 No.	TS 3 (I-Beam)	105-S3.

Testing (s)	
Test Carried Out	Test Method (s)
Tensile Test & Elongation	BS EN 10002 - 1: 2001.
Remarks	Testing was witnessed by Applicant.

Approved Signatory,
IKRAM QA Services Sdn. Bhd.

MOHD HAFIZY BIN MAT ZAIN
TECHNICAL EXECUTIVE
IKRAM QA SERVICES SDN. BHD.

TEST REPORT NO: D/022/15	APPLICATION NO: ML/A/07515
Job No: DN1A03/105/15	Date Of Report: 16/03/2015
Title of the report: Tensile Test On Steel Cupons Sultan Iskandar Bridge Kuala Kangsar, Perak.	Page: 2 / 2

TEST REPORT

Tensile Test.

No.	Material	Sample References	Sample Markings	Size	Yield Strength (N/mm^2)	Tensile Strength (N/mm^2)	Elongation (%)	Uncertainty Of Yield Strength ±(N/mm^2)	Uncertainty Of Tensile Strength ±(N/mm^2)	Uncertainty Of Elongation ±(%)
1	Mild Steel	105-S1	TS 1 (Angle)	-	266.2	407.1	23.8	8.25	7.93	0.04
2	Mild Steel	105-S2	TS 2 (Angle)	-	226.4	371.7	23.0	8.47	7.98	0.04
3	Mild Steel	105-S3	TS 3 (I-Beam)	-	264.2	418.5	23.7	8.26	7.91	0.04

The reported uncertainty is based on Standard Uncertainty of confidence level not less than 95 %

Humidity/Temperature during testing (55 % / 30 °C).

Report Prepared by	Verified by
Muhamad Farhan Muhammad Tajmuddin Shah	Nik Mohd Nasarudin Nik Hasan
Farhan	

STEEL EXTRACTION & TENSILE TEST

Picture 1 - Steel Extraction for TS1 at Span 7.

Picture 2 - Reinstatement of cut section for TS1 at Span 7.

Picture 3 - Painting to the reinstated cut section at Span 7.

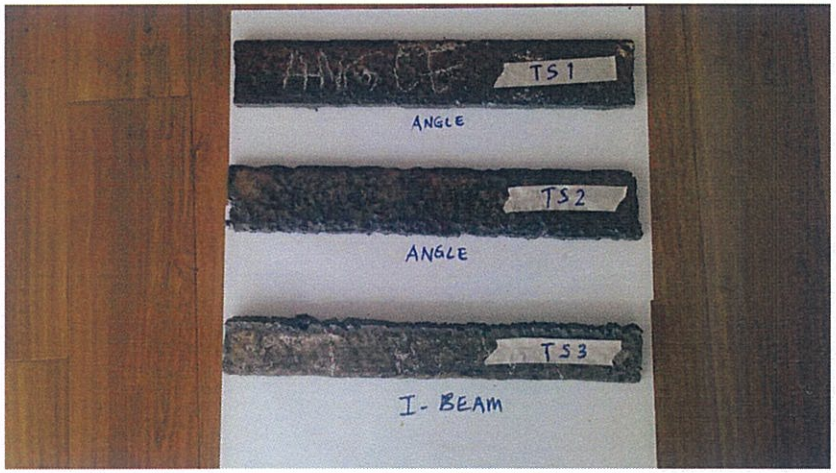
Picture 4 - Steel Extraction for TS2 at Span 6.

Picture 5 - Reinstatement of cut section for TS2 at Span 6.

Picture 6 - Painting to the reinstated cut section at Span 6.

Picture 7 - Reinstatement of cut section for TS3 at Span 7.

Picture 8 - Painting to the reinstated cut section at Span 7.



Picture 9 - The extracted samples.

Picture 10 - The prepared Steel Coupons (Before)

Picture 11 - The tested Steel Coupons (After).

Picture 12 - Steel Tensile Strength Testing Machine.