

Annex G

**Swing Bridge
Condition Assessment and Load Rating
2022**

Reference Documents

Reference Documents
Load Models

Proposed Evaluation Truck for Bermuda

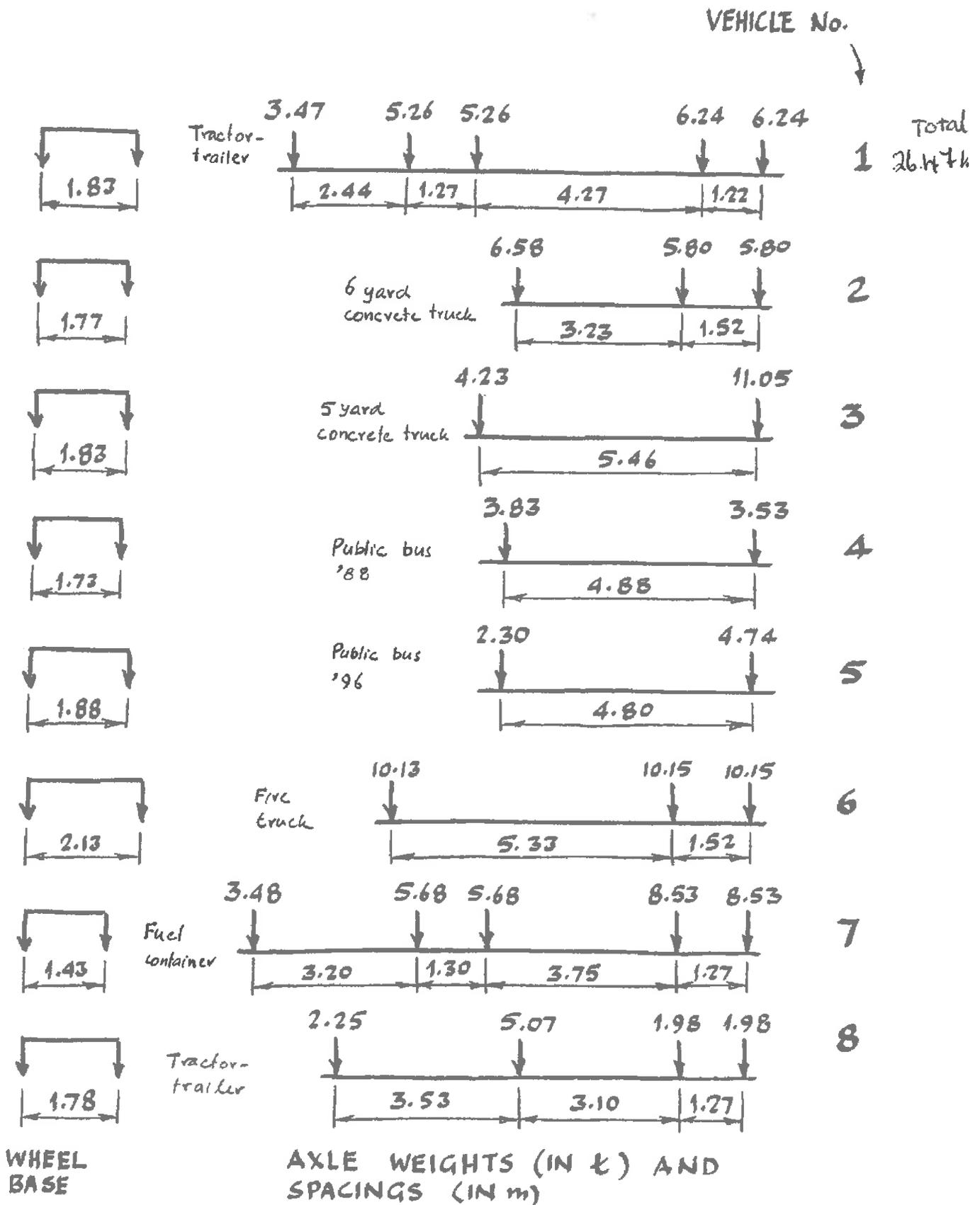


Fig. 3 Maximum observed loads in Bermuda

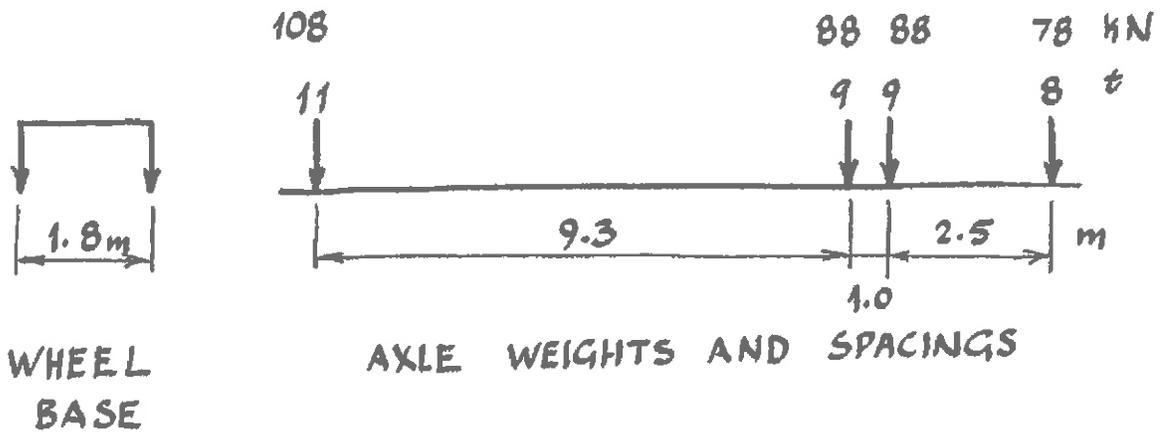


Fig. 6 Proposed Evaluation Truck for Bermuda

Evaluation Lane Load for Bermuda

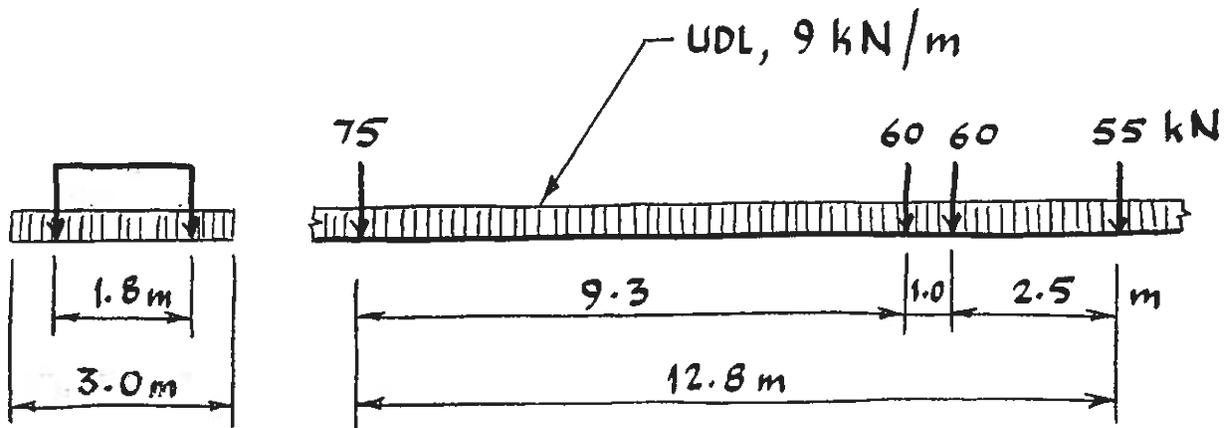


Fig. 8 Proposed Evaluation Lane Load
for Bermuda

Reference Documents
Swing Bridge Structural Drawings 2002

Reference Documents
Swing Bridge Survey Report 2014

MOTT MACDONALD,
CROYDON CR0 2EE,
UK.

23RD MAY 2016
OUR REF. WL 16615

FOR THE ATTENTION OF TIM ABBOTT AND SAM ROBINSON
(FORWARD BY EMAIL TO TIM.ABBOTT@MOTTMAC.COM AND SAM.ROBINSON@MOTTMAC.COM)

DEAR SIRs,

**RE: REPORT ON SURVEYING SERVICES IN CONNECTION WITH THE
REMEDIAL WORKS TO SWING BRIDGE, ST. GEORGE, BERMUDA**

Introduction.

We were instructed by Tim Abbott of Mott MacDonald to carry out various surveying services in connection with the remedial effort for the Swing Bridge in St. George, Bermuda. Consequently we attended site and undertook the following exercises.

Cross girder measurements.

Cross girder flanges and web steel thicknesses were measured in millimetres and recorded on the attached spreadsheet entitled "Appendix 1, Swing Bridge - Beam Readings". Photographs were taken identified by white board notes at each steel thickness measurement location. Please refer to these photographs together with other point of interest images for each of the 29 Cross girders which were forwarded to you in emails with the appropriate beam reference number in the subject line on Friday 20th May 2016.

Steel surfaces were prepared by removing loose rust and paint prior to the application of Ultrasonic Couplant UT G1104 Ultragel 11 to facilitate measuring steel thicknesses using our Ultrasonic steel thickness measuring gauge (NDK Systems, Inc. model TG-110-DL). Our gauge was calibrated and checked against readings taken with a stainless steel Ultra Tech vernier calliper manufactured by General Tools, model number 147 and by comparing our gauge readings with a similar instrument belonging to Marine and Ports Services (M&P). Please note that although M&P did assist during calibration they were unable to assist with the bridge steel measuring work.

Cross girders nomenclature and bracing details.

Locations of the Cross girders are shown on plan S.200 which also shows locations of diagonal bracing fixing plates.

Arrangement of horizontal cross-bracing which support the access catwalk under the bridge are shown on drawing S.201



Tape survey of remedial steel sections at cross girders.

The north half of the swing section has been surveyed to identify the steel added in various places in response to deterioration of the original cross girder steel sections during previous bridge strengthening exercises carry out under the auspices of the Public Works Department and more recently the Ministry of Works and Engineering.

Main girder, rusting of top flanges at cross girder bearing locations.

There is some damage to the top flanges of the main beams at the cross girder bearing locations. Your instructions are requested with respect to carrying out any further measurements you may deem necessary to detail the damage done.

Bridge Opening Mechanisms measurements.

Wedges, rams and plates forming parts of the bridge opening mechanism were measured and details shown on drawings referenced S-001 North Ram Unit, S-002 South Ram Unit, also attached herewith. Measuring wedges and plates still needs to be completed.

Deflection of Bridge During Opening.

Elevations of both ends of the swing span and of the centre points were taken in the closed, partly open and fully open positions. Details of these results are shown on drawings S-100 (closed), S-101 (partly open) and S-102 (fully open), appended.

Top of bridge topography.

A topographical survey of the top of the bridge was undertaken with the bridge closed. Measurements were extended to include the roundabout on the southern approaches and a portion of Mullet Bay Road on the northern approaches. This work was carried out by Q-Ship Ltd. The Q-Ship topographical plan is appended.

Elevations of the cantilevered ends of the undersides of the cross girders.

Q-Ship will progress with this next, once the steel here has been prepared by removing loose rust and paint from the soffits of the ends of the cross girders.

Bridge house support steel survey.

This work has been started. This work will continue this week.

Tape measure survey of "K" braces, South side.

This work is not yet complete. It is to be confirmed that the north side "K" braces match the south side ones. This work will continue to completion this week.

Completion of survey works.

Our progress has been hindered by adverse weather conditions over the last three weeks. Ross Roberts will be on vacation from 24th May returning to the office on 1st June 2016. Survey work will continue, weather permitting over the next two weeks.

We hope to complete all tasks by 3rd June 2016.



Yours faithfully,

W. M. LANG R. ENG., (BDA.).
FOR **WOODBOURNE ASSOCIATES LTD.**

Swing Bridge - Beam Readings
NOTE: All readings are in Millimeters.

Revised 20th May 2016.

	Main Girder East (Stocks Harbour)					Mid Span East					Mid Span West					Main Girder West (Ferry Reach)					Comments & Notes
	Web Point (2)	North Top	Flange North Bottom	South Top	South Bottom	Web Point (3)	North Top	Flange North Bottom	South Top	South Bottom	Web Point (4)	North Top	Flange North Bottom	South Top	South Bottom	Web Point (5)	North Top	Flange North Bottom	South Top	South Bottom	
Beam 1	7.28	8.55		9.19		7.45	9.74		9.02		7.14	8.66		9.24		7.27	8.86		7.75		Note A, F, H, J, M, O & S
Beam 2	7.42	7.27	3.83	8.28	4.45	7.25	8.16		8.58		7.45	7.57		9.19		6.61					Note B, D, E & G
Beam 3	6.72	6.01	7.54	5.26	6.27	7.43	7.43		9.73		6.1	5.24		5.32		4.97	7.46		7.29		Note A,D, & S
Beam 4	6.47	8.29	7.18	4.43		6.44	8.09		8.71		6.05	5.29		4.35		7.1	5.18		6.24		Note A,D, & S
Beam 5	6.3	8.25	6.26	5.58	8.46	6.42	6.12	7.38	9.09	6.5	6.48	8.28	4.11	7.94	4.99	6.33	9.68	6.95		7.03	Note M
Beam 6	6.3	7.16	6.26	8.25	6.57	6.95	8.18	6.98	7.83	7.38	6.47	7.34	10.1	6.49	8.57	6.52	6.75	6.79	7.68		
Beam 7	6.36	8.45				7.55	9.6				6.39	7.86				6.41	7.5				Note A, D & S
Beam 8	6.32	6.26		7.11		7.05	7.27		8.2		7.06	6.56		7.78		6.13	8.45		6.79		Note A & R
Beam 9	7.84	8.47	7.89			6.71	8.88	7.91	8.75	5.97	6.72	6.7	7.74	7.44	7.14	6.76	11.27	7.38	11.07	7.25	Note H
Beam 10	6.18	7.69	5.63	6.05	6.05	6.38	7.16	6.4	7.36	4.54	6.36	6.88		6.43		6.16	6.54		4.57		Note G, & N
Beam 11	6.64	7.72		8.48		6.57			8.2		7.09	7.03		7.86		6.83	7.67		7.49		Note B & D
Beam 12	6.89	7.82	7.56	7.66	7.69	6.69	7.91	4.82	7.59	6.67	6.75	7.85	7.83	7.4	6.82	6.93	5.37		7.39	6.92	Note D
Beam 13	6.54	5.08	6.83	7.27	7.62	6.79	7.32	8.01	7.55	7.71	6.51	4.54	7.44	7.66	7.42	6.63	5.1	7.27	7.19	5.02	Note I
Beam 14	5.85	6.59	4.36	4.93	7.92	6.51	7.78	4.16	7.59	7.75	6.05	7.05	4.43	8.16	9.1	6.44	6.7	4.44	7.62	9.02	Note B & D
Beam 15	6.25	7.21	6.71	7.72	5.34	6.08	6.95	7.02	7.31	7.42	6.78	6.98	5.55	7.93	4.86	6.05	6.84	5.86	5.64	4.5	Note D
Beam 16	5.82	7.35	5.58	7.84	9.4	6	7.95	6.59	8.05	8.98	5.8	5.2	6.37	7.11	5.66	5.36	7.2	4.74	7.21	8.53	
Beam 17	6.45	7.73	7.26	6.9	6.92	6.99	9.47	7.26	7.02	7.85	6.88	7.53	7.52	7.93	7.77	6.65	7.48	7.05	4.85	7.87	
Beam 18	6.59	4.82	7.05	7.69	7.23	6.45	7.5	6.27	7.47	7.27	6.37	7.32	6.16	7.86	6.68	6.37	6.89	4.24	5.37	7.04	
Beam 19	6.58	9.3	8.28	8.11	6.5	7.27	8.09	7.69	8.34	7.33	6.01	8.45	6.57	7.88	6.79	6.47	7.82	7.13	6.25	7.34	
Beam 20	6.53	7.62	7.34	8.15	7.5	6.72	9.7	6.93	7.81	7.8	6.69	7.5	5.39	7.87	5.5	7.25	7.55	7.06	6.09	5.08	
Beam 21	6.97	8.49	7.74	7.39	7.56	7	10.14	7.98	7.59	7.2	6.74	11.16	7.17	6.49	6.59	5.37	8.61	7.76	5.3	6.74	
Beam 22	6.17	7.33	6.68	7.25	6.38	6.63	6.97	4.28	5.3	5.11	6.02	7.12	4.45	5.28	4.61	6.19	6.21	4.28	5.62	3.15	
Beam 23	6.57	8.49	6.56	7.84	5.52	6.97	8.48	7.08	7.99	6.17	6.32	7.81	3.21	7.34	4.87	6.33	7.92	5.47	4.66	5.16	
Beam 24	6.72	6.97	6.63	7.43	6.28	6.24	7.65	7.74	6.5	6.81	6.61	5.36	8.55	5.38	9.93	6.84	7.89	7.79	6.38	8.37	
Beam 25		7.36	6.42	7.04	5.08	7.06	7.75	6.62	7.77	6.23	6.11	7.98	5.84	7.99	5.97	5.62	7.85	7.43	7.82	6.03	
Beam 26	6.34	9.18	6.23	7.77	6.88	6.67	8.39	5.95	7.69	7.07	6.36	8.99	7.26	7.73		6.39	7.72	7.1	7.45	3.8	
Beam 27	6.66	8.48	7.67	7.6	8.26	6.59	7.79	7.02	7.7	5.8	6.94	9.6	7.66	9.95	5.23	6.65	8.34	6.66	8.64	5.63	
Beam 28	6.19	7.48	4.84	7.19	3.4	6.68	7.28	7	9.2	7.18	5.15	7.55	5.8	8.36	5.35	6.4	7.41	6.43	6.39	5.26	
Beam 29	5.14			7.81		5.62	7.39		7.45		6.42	8.38		7.74		6.36	7.15		7.53		

Comments & Notes for beam findings:

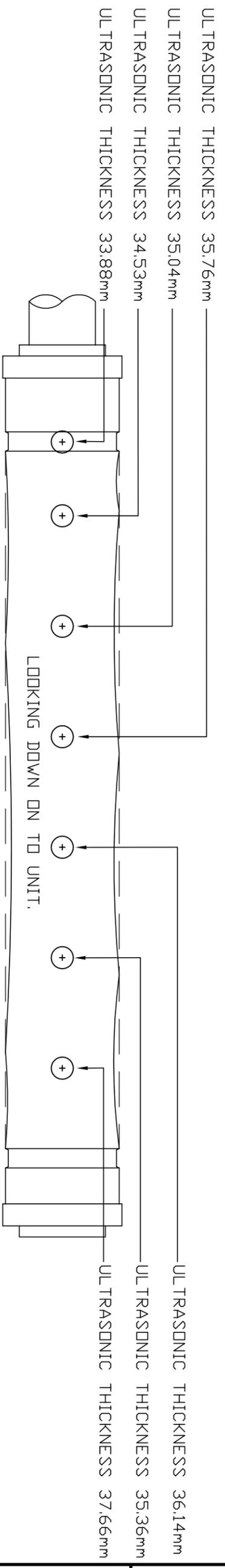
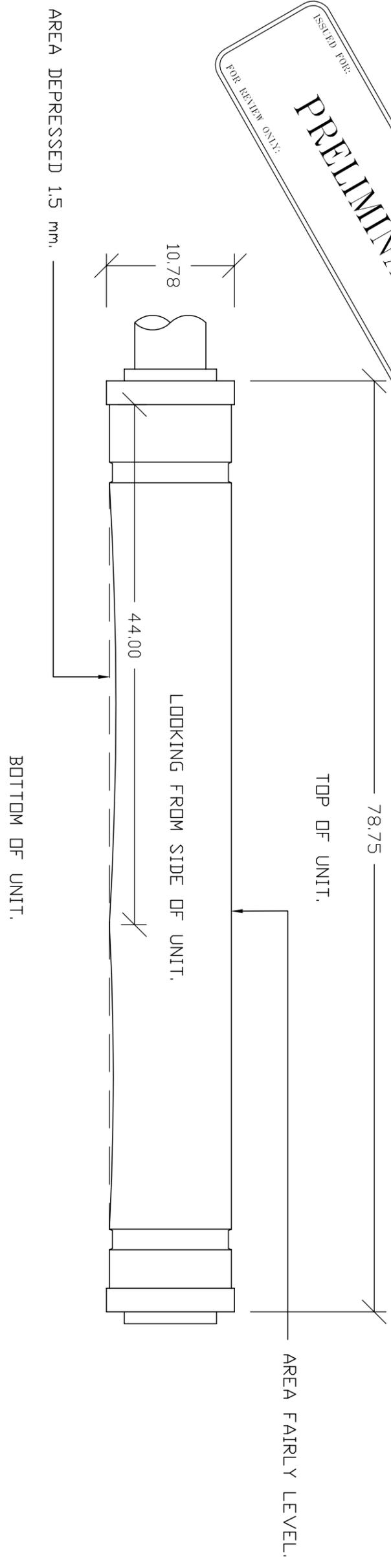
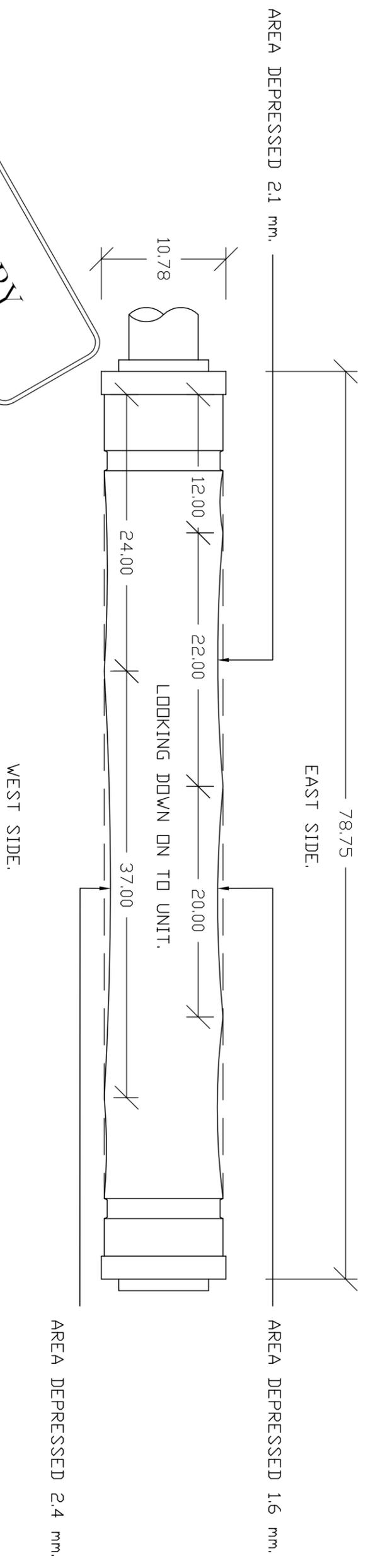
- Note A: Support plates (11 mm thick & 6" wide) full length between Main Girders bolted to underside of damaged bottom flange.
- Note B: Support plates (11 mm thick & 6" wide) full length between Main Girders bolted to underside of bottom flange & bolted to angle support (see Note C or D).
- Note C: Support plates (11 mm thick & 6" wide) between mid span supports & bolted to underside of bottom flange.
- Note D: West end - Existing bottom flange has been cut out and an angle welded to web on both sides on top of bottom flange of beam, bolted to bottom flange & Main Girder, complete with additional shims between angle & Main Girder.
- Note E: West end - Existing bottom flange has been cut out and an angle welded to web on one side of beam, bolted to bottom flange & Main Girder, complete with additional shims between angle & Main Girder.
- Note F: Extra support plate (width of new plate and old flange approx. 15mm) North side of beam / West end of beam (length 6'-3"), welded on top of bottom flange.
- Note G: Extra support plate (width of new plate and old flange approx. 15mm) North side of beam / West end of beam (length 2'-4"), welded to top flange.
- Note H: Extra support plate (width of new plate and old flange approx. 15mm) both North & South sides of beam / West end of beam (length 2'-4"), welded to top flange.
- Note I: Extra support plate (width of new plate and old flange approx. 15mm) South side of beam / East end of beam (length 2'-4"), welded to underside of top flange.
- Note J: Extra support plate (width of new plate and old flange approx. 15mm) North side of beam / between Main Girders, welded on top of bottom flange.
- Note K: Extra support plate (width of new plate and old flange approx. 15mm) South side of beam / between Main Girders, welded on top of bottom flange.
- Note L: Extra support plate (width of new plate and old flange approx. 18mm) South side of beam / between Main Girders, welded to underside of top flange.
- Note M: Extra support plate (width of new plate and old flange approx. 18mm) both sides of beam / between West end Main Girder to West mid span, welded to underside of top flange.

- Note N: West end - Over Main Girder additional web plate full height of web & welded to web of beam (8.5" x 2'-5"long) east from existing stiffener plate.
- Note O: West end - Over Main Girder additional stiffner plate half height from bottom flange of web & welded to web of beam (length 5'-0").

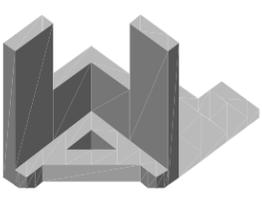
- Note P: South side of beam / West end side of beam all bolts & nuts are NO longer in place, this beam has some major deflection when heavy trucks drive over.
- Note Q: There is existing reinforcing going full length of bottom of beam, but NOT support at either end of Main Girder points (2 or 5).

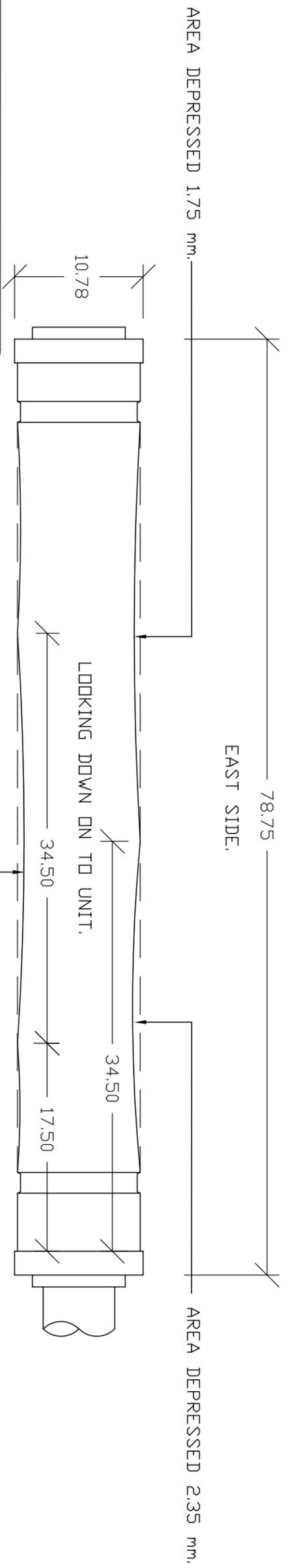
- Note R: Areas along bottom flange only 4 mm thick.
- Note S: West end - Areas along bottom flange only 0 to 5 mm thick over 2'-0" distance.

ISSUED FOR:
FOR REVIEW ONLY:
PRELIMINARY

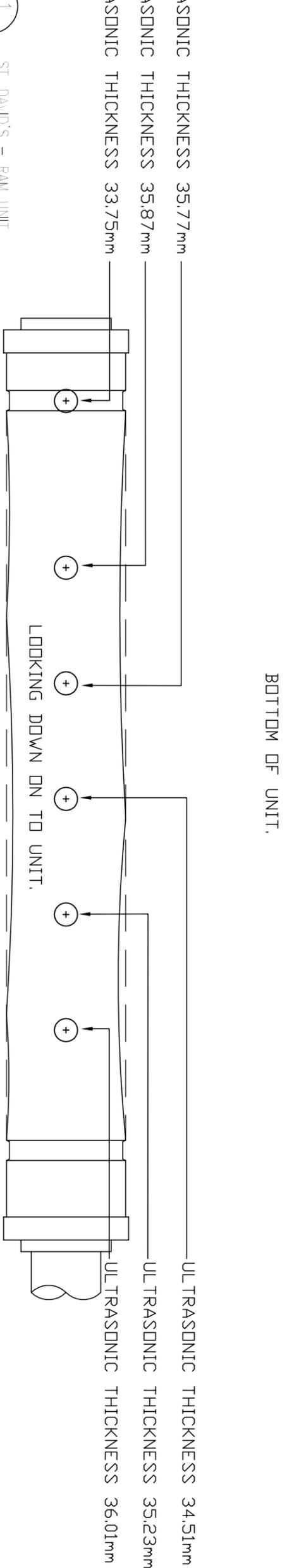
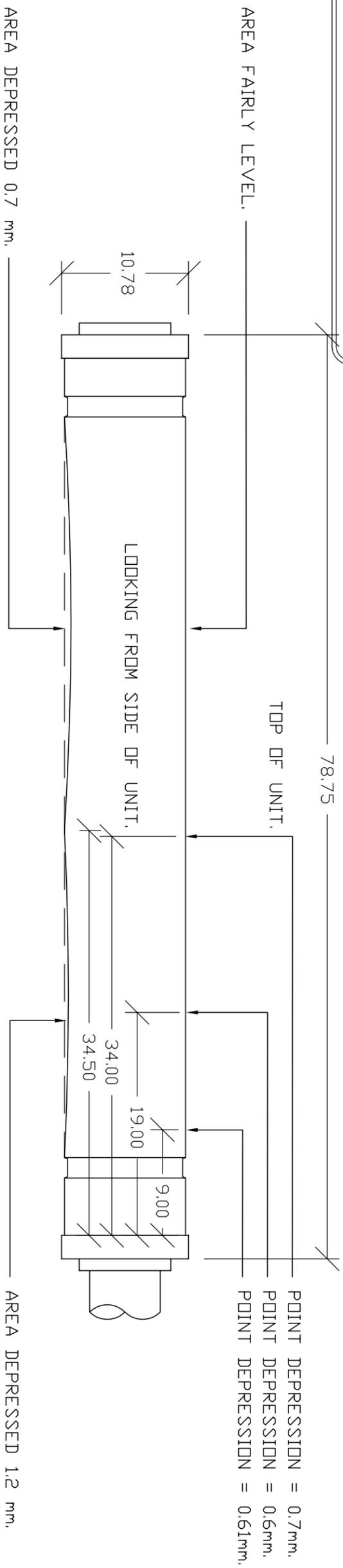


1
ST. GEORGE - RAW UNIT
SC001
1:10

	PROJECT SWING BRIDGE - REVIEW ST. GEORGE PARISH, BERMUDA		TITLE EXISTING NORTH RAM UNIT (ST. GEORGE SIDE OF BRIDGE)	
	WOODBOURNE ASSOCIATES LTD. CONSULTING ENGINEERS, SURVEYORS, DESIGNERS & VALUERS		DRAWN VPR	SCALE AS SHOWN
	P.O. BOX HM 934 HAMILTON HM DX, BERMUDA TEL. 441-295-0319 FAX.441-292-3784		CHECKED RR	JOB No. WL-16615
			DATE APRIL 28, 2016	DRAWING No. S-001



ISSUED FOR:
PRELIMINARY
 FOR REVIEW ONLY:



ULTRASONIC THICKNESS 35.77mm
 ULTRASONIC THICKNESS 35.87mm
 ULTRASONIC THICKNESS 33.75mm

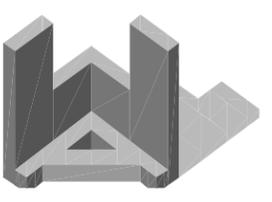
POINT DEPRESSION = 0.7mm.
 POINT DEPRESSION = 0.6mm.
 POINT DEPRESSION = 0.61mm.

1
 ST. DAVID'S - RAM UNIT
 S002
 1:10

PROJECT		SWING BRIDGE - REVIEW ST. GEORGE PARISH, BERMUDA		TITLE		EXISTING SOUTH RAM UNIT (ST. DAVID'S SIDE OF BRIDGE)			
DRAWN				VPR		SCALE		AS SHOWN	
CHECKED				RR		JOB No.		WL-16615	
DATE				APRIL 28, 2016		DRAWING No.		S-002	

WOODBOURNE ASSOCIATES LTD.
 CONSULTING ENGINEERS, SURVEYORS, DESIGNERS & VALUERS

P.O. BOX HM 934
 HAMILTON HM DX, BERMUDA
 TEL. 441-295-0319 FAX.441-292-3784





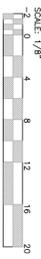
North

Stocks Harbour
East

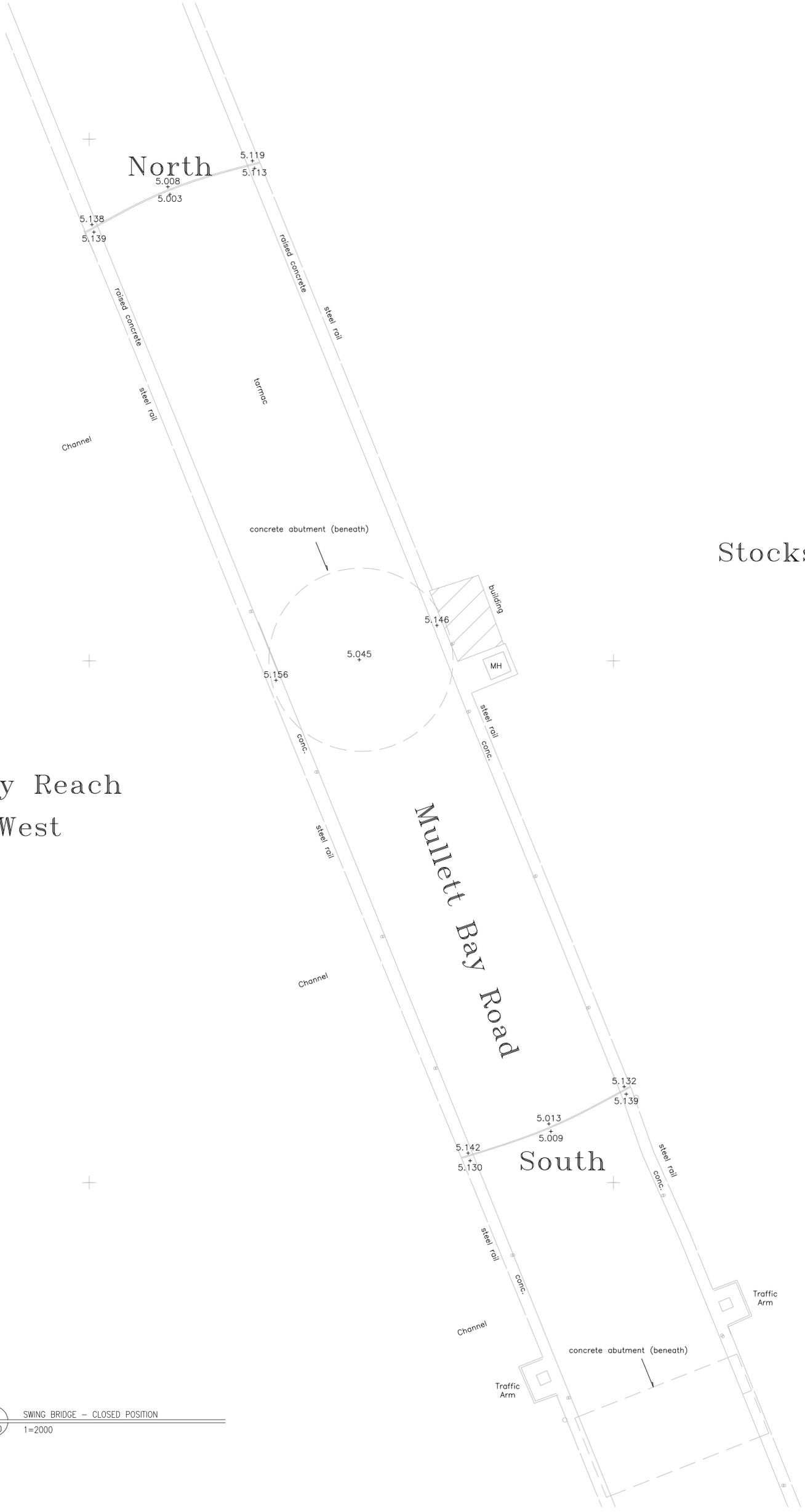
Ferry Reach
West

Mullett Bay Road

South

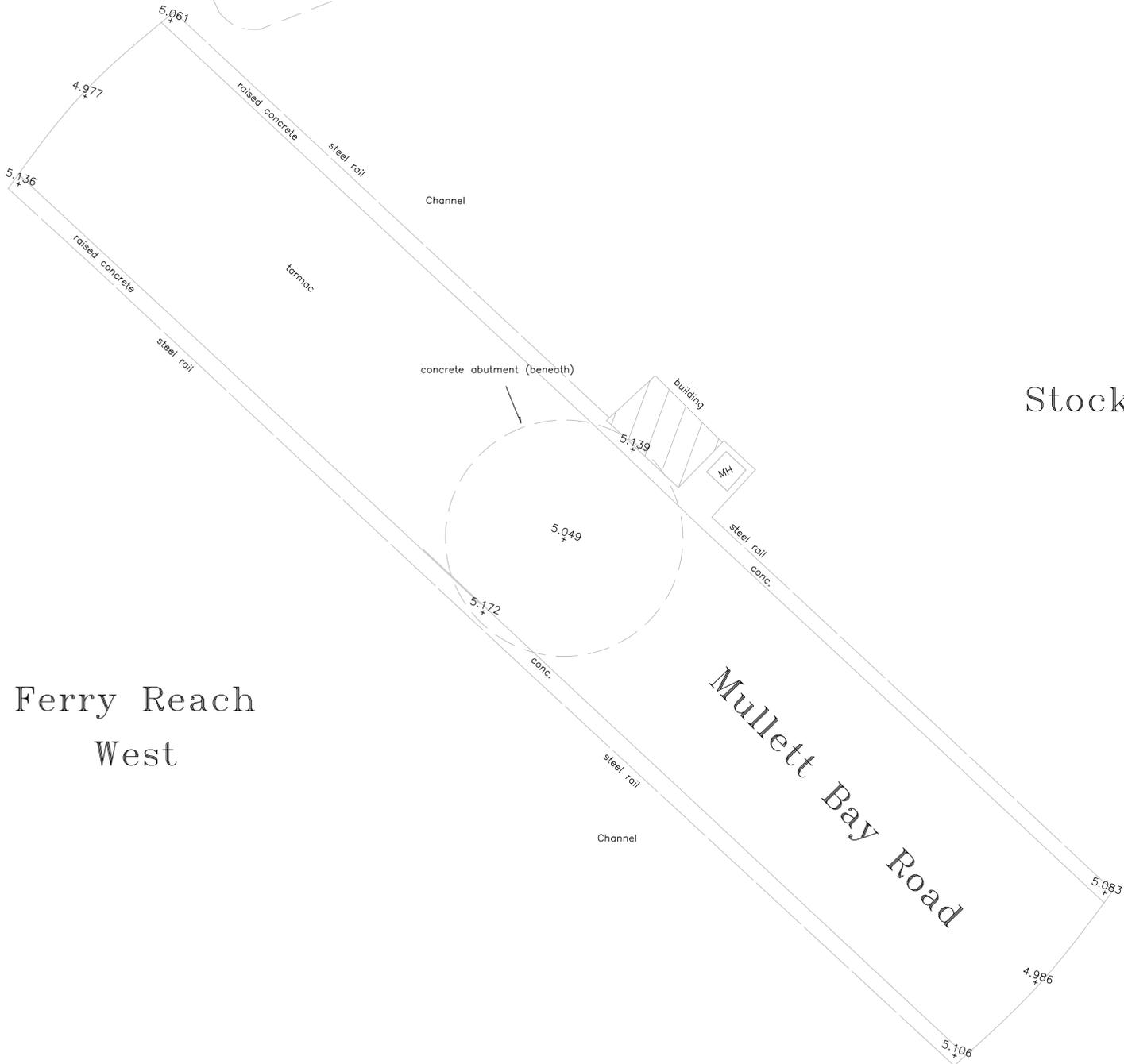


DATE	APRIL 21, 2016	DRAWING No.	S-100
CHECKED	VR	SCALE	AS SHOWN
DRAWN	VR	SCALE	AS SHOWN
 Woodbourne ASSOCIATES LTD P.O. BOX 100 334 HAMILTON, ST. GEORGE, BERMUDA TEL. 441-295-0319 FAX: 441-292-3784			
PROJECT: SWING BRIDGE ST. GEORGE, BERMUDA			
TITLE: SITE ELEVATION & DEFLECTION BRIDGE IN CLOSED POSITION			
NO.	DATE	BY	REVISION
1	APR 22, 16	VR	PRELIMINARY ISSUED FOR REVIEW



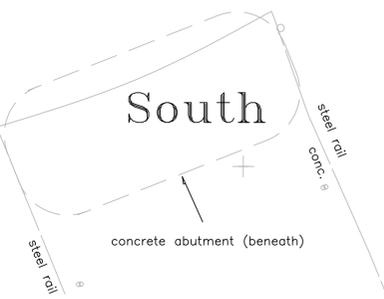


concrete abutment (beneath)
 North



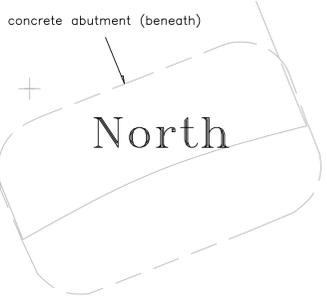
Stocks Harbour
 East

Ferry Reach
 West



1	SWING BRIDGE - HALF OPEN POSITION
S101	1=2000

NO.	DATE	BY	REVISION
A	APR22/16	YPR	PRELIMINARY ISSUED FOR REVIEW
PROJECT			
SWING BRIDGE ST. GEORGE, BERMUUDA			
TITLE			
SITE ELEVATION & DEFLECTION BRIDGE PARTLY OPEN POSITION			
 <p>Woodbourne ASSOCIATES LTD P.O. BOX 146 934, HAMILTON, BERMUUDA TEL: 441-295-0319 FAX: 441-292-3794</p>			
DRAWN	VRP	SCALE	AS SHOWN
CHECKED		JOB NO.	WL-1815
DATE	APRIL 21, 2016	DRAWING NO.	S-101

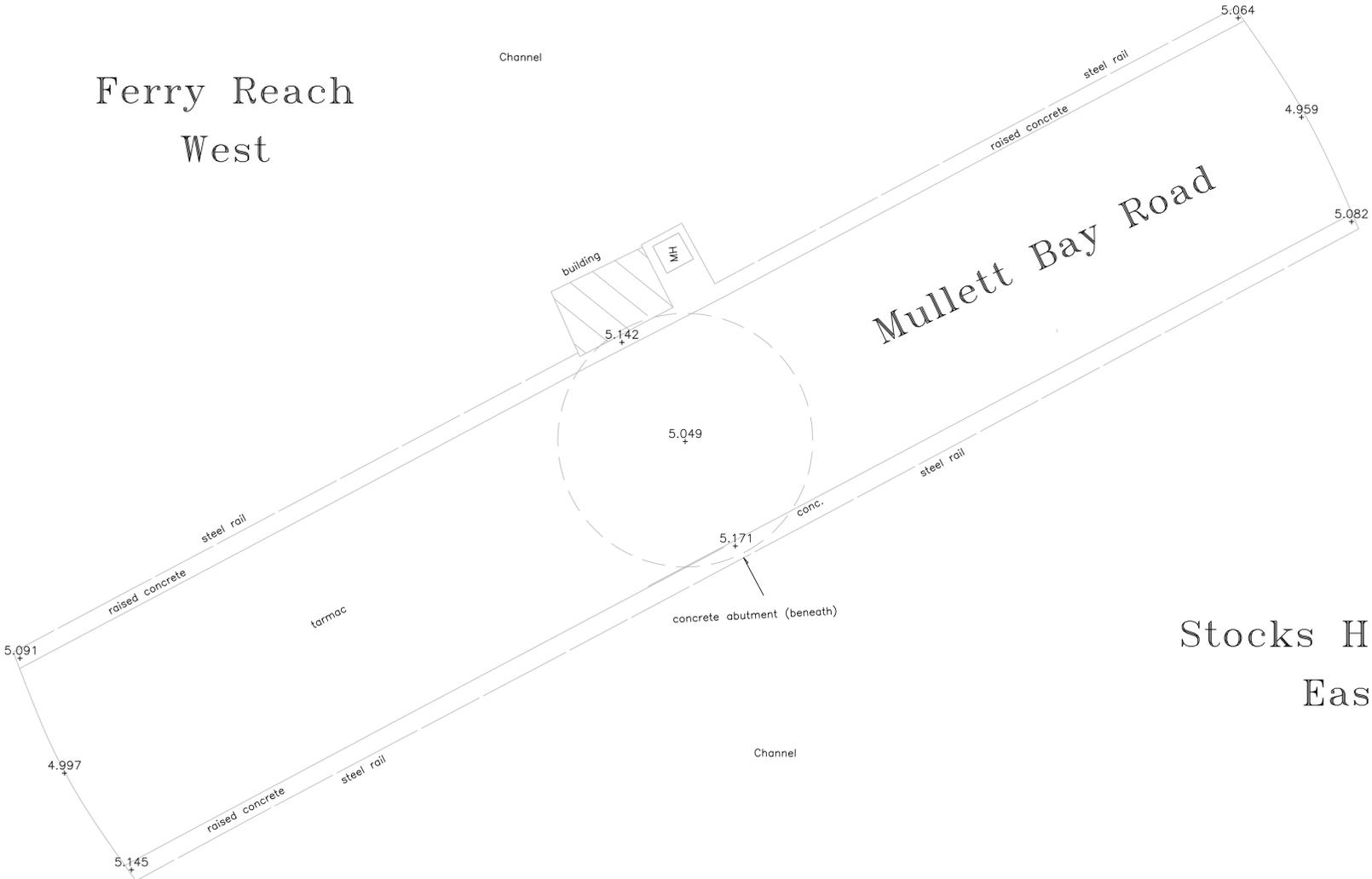


Ferry Reach
West

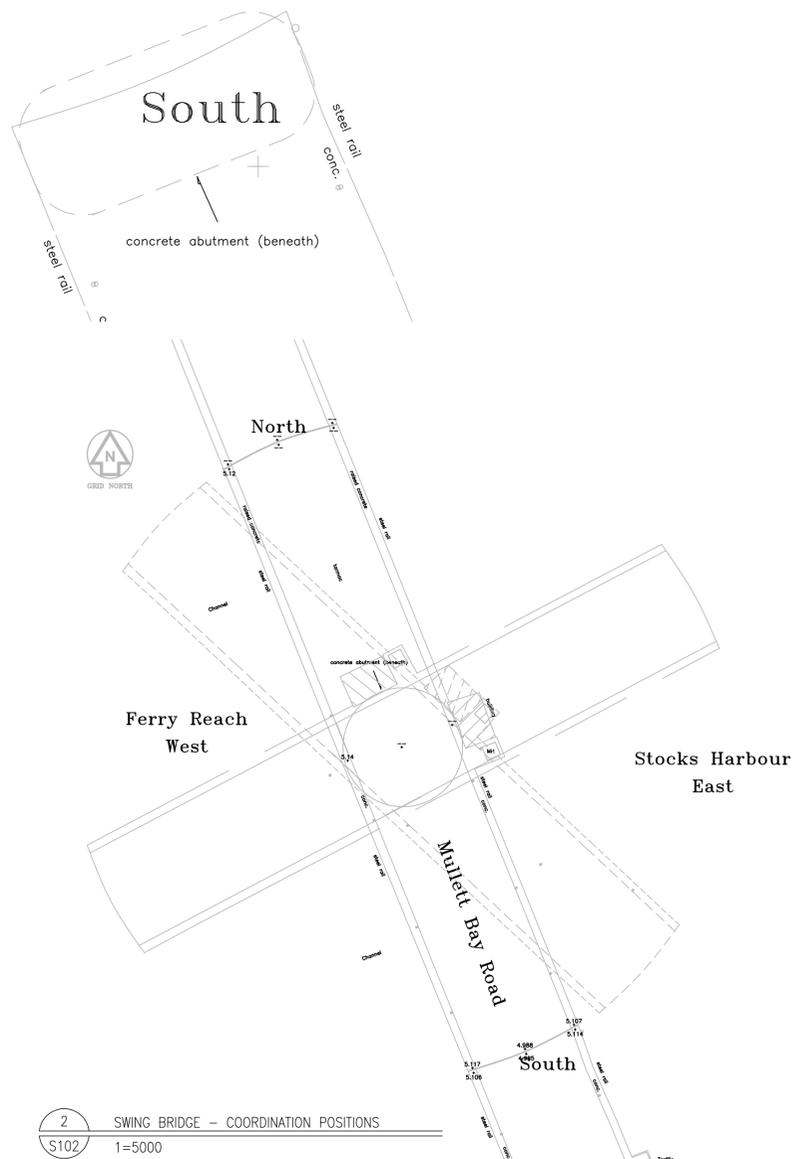
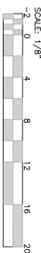
Channel

Mullett Bay Road

Stocks Harbour
East

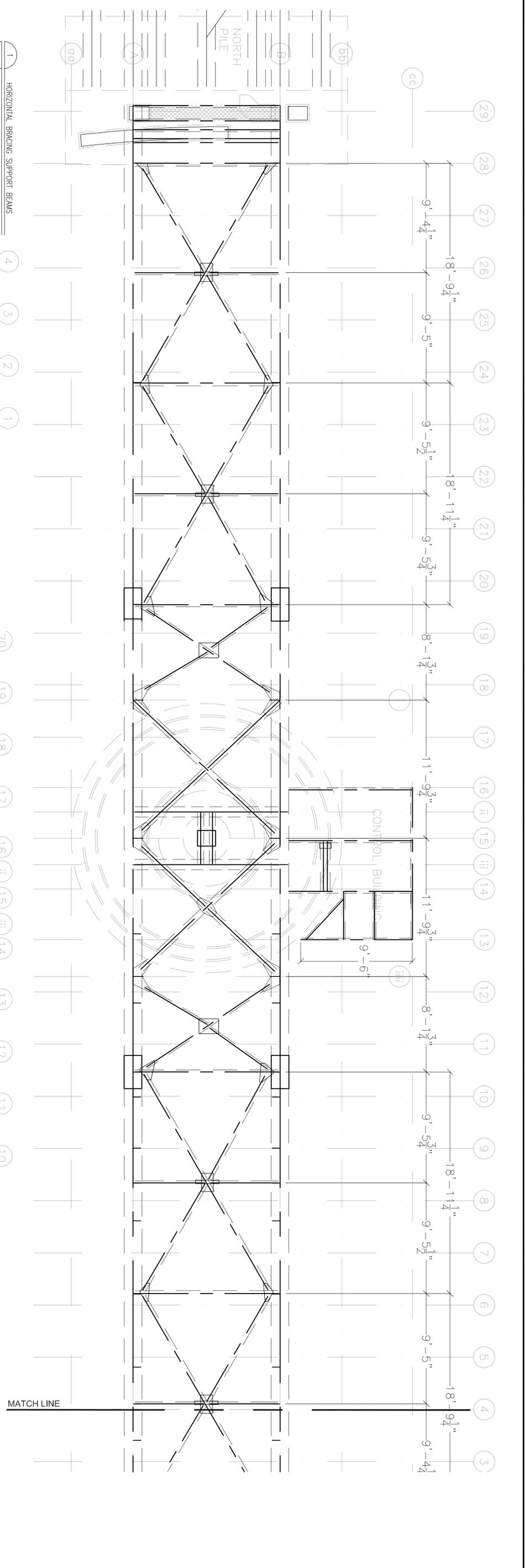


1	SWING BRIDGE - FULLLY OPEN POSITION
S102	1=2000

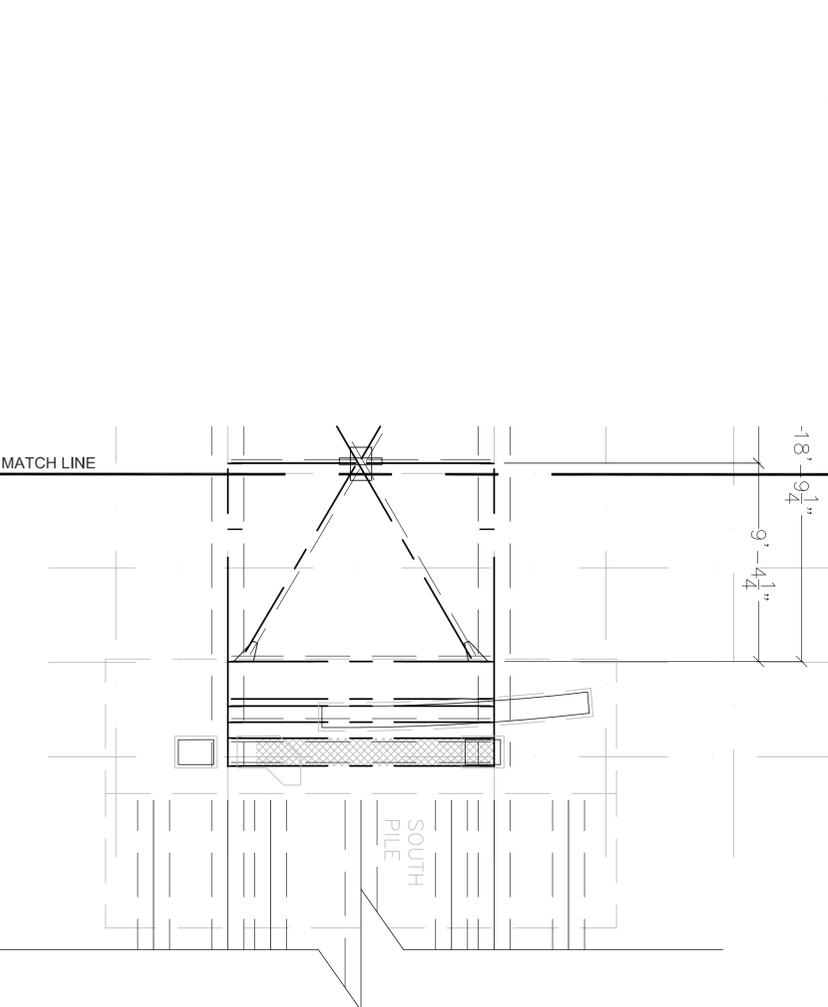


2	SWING BRIDGE - COORDINATION POSITIONS
S102	1=5000

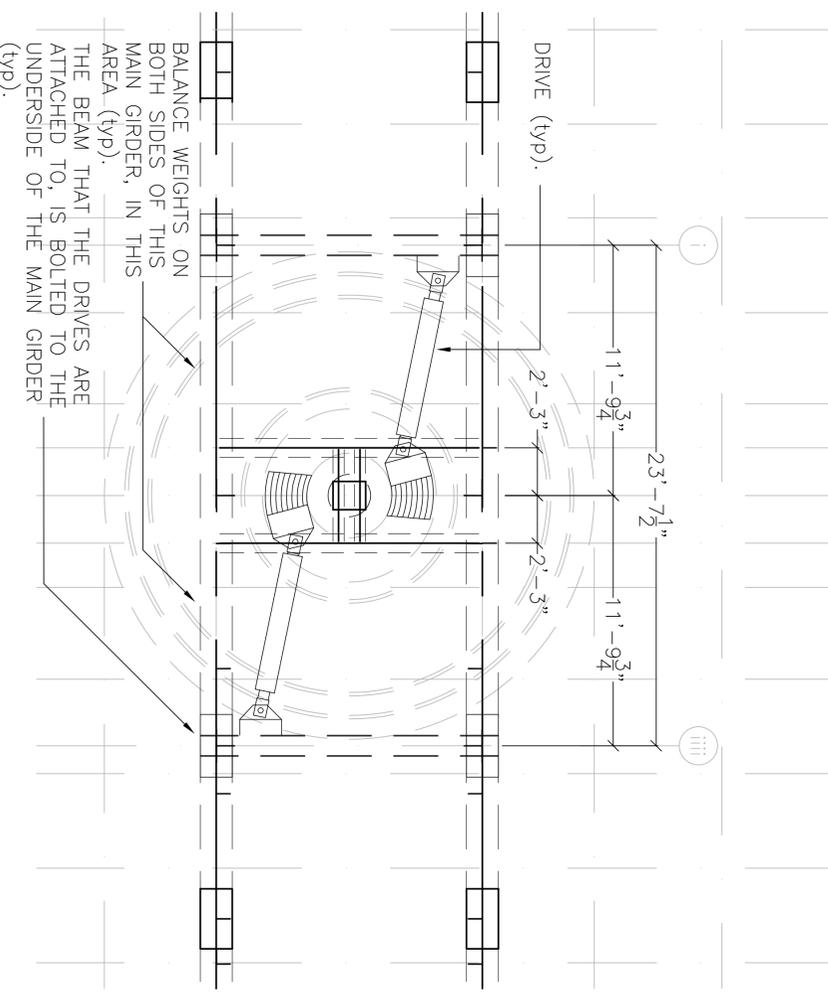
DATE	APRIL 21, 2016	DRAWING No.	S-102
CHECKED		JOB No.	WL-16815
DRAWN	VRP	SCALE	AS SHOWN
Woodbourne ASSOCIATES LTD P.O. BOX 146 334 HAMILTON, ST. GEORGE, BERMUDA TEL. 441-295-0319 FAX: 441-292-3784			
TITLE	SITE ELEVATION & DEFLECTION FULLY OPEN POSITION		
PROJECT	SWING BRIDGE ST. GEORGE, BERMUDA		
NO.	APR22/16	BY	VRP
DATE		REVISION	PRELIMINARY ISSUED FOR REVIEW



1 HORIZONTAL BRACING SUPPORT BEAMS
S201 1/4" = 1'-0"



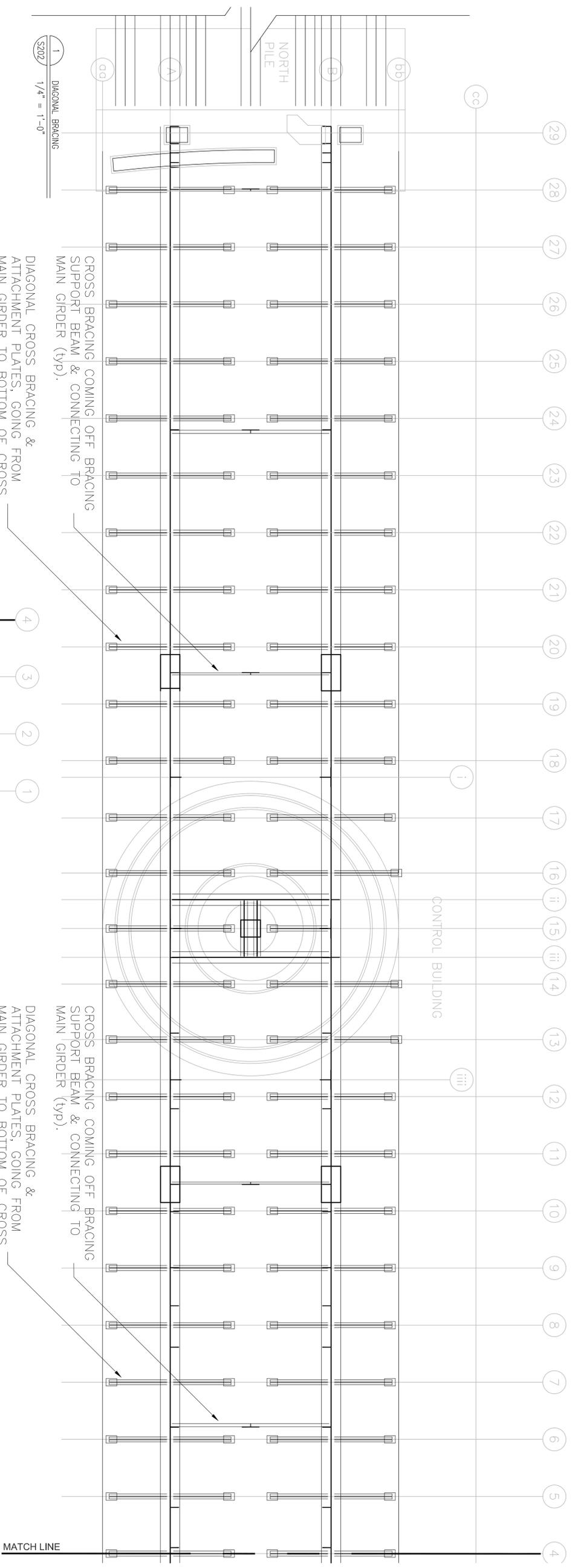
2 HORIZONTAL BRACING SUPPORT BEAMS
S201 1/4" = 1'-0"



3 DRIVE SUPPORT BEAMS - DETAILS
S201 1/4" = 1'-0"



NO.	DATE	BY	REVISION
A	MAY 26, 16	VR	PRELIMINARY ISSUED FOR REVIEW
PROJECT			
SWING BRIDGE ST. GEORGE, BERMUDA			
TITLE			
EXISTING STRUCTURAL HORIZONTAL BRACING BEAMS & DRIVE SUPPORT BEAMS			
 Woodbourne ASSOCIATES LTD P.O. BOX 104 BSA HAMILTON, BERMUDA TEL: 441-286-0319 FAX: 441-282-3784			
DRAWN	VR	SCALE	1/4" = 1'-0"
CHECKED	VR	JOB No.	WL-16815
DATE	MAY 16, 2016	DRAWING No.	S-201



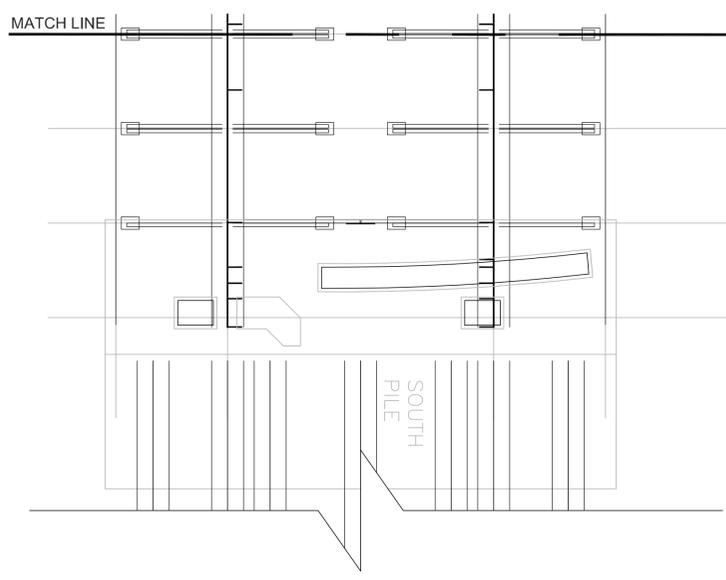
1
DIAGONAL BRACING
1/4" = 1'-0"

DIAGONAL CROSS BRACING & ATTACHMENT PLATES, GOING FROM MAIN GIRDER TO BOTTOM OF CROSS GIRDERS (typ).

CROSS BRACING COMING OFF BRACING SUPPORT BEAM & CONNECTING TO MAIN GIRDER (typ).

DIAGONAL CROSS BRACING & ATTACHMENT PLATES, GOING FROM MAIN GIRDER TO BOTTOM OF CROSS GIRDERS (typ).

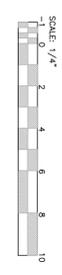
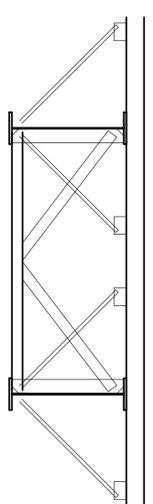
CROSS BRACING COMING OFF BRACING SUPPORT BEAM & CONNECTING TO MAIN GIRDER (typ).



MATCH LINE

SOUTH PILE

3
DIAGONAL BRACING - SECTION
1/4" = 1'-0"



A	DATE	16 MAR 2016	BY	PRELIMINARY ISSUED FOR REVIEW
NO	DATE		BY	REVISION
PROJECT				
SWING BRIDGE				
ST. GEORGE, BERMUDA				
TITLE				
EXISTING STRUCTURAL				
DIAGONAL BRACING				



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DRAWN	VR	SCALE	1/4" = 1'-0"
CHECKED		JOB No.	WL-16815
DATE	MAY 16, 2016	DRAWING No.	S-202