

#65-F-89

W.P. #177-64

Hwy# 35

OX NARROWS

BRIDGE

KUSHOG LAKE

MEMORANDUM

CC: FOUNDATIONS
OFFICE (RM. 110)
23-67-84

Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: October 5, 1965

OUR FILE REF.

IN REPLY TO

OCT 19 1965

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Proposed New Structure at Relocated
Hwy. #35 (Line 'F') and Kushog Lake,
Co. of Haliburton, Twp. of Stanhope,
Con. X, Lot 1, Dist. #11 (Huntsville).

W.J. 65-F-89 -- W.P. 177-64

Attached, we are forwarding to you, our detailed
foundation investigation report on the subsoil conditions
existing at the above structure site.

We believe that you will find the factual data
and recommendations contained therein, adequate for your
design requirements. Should additional information be
required, please do not hesitate to contact our Office.

KYL/MdeF
Attach.

cc: Messrs. B. R. Davis (2)

H. A. Tregaskes

D. W. Farren

E. H. Jones

T. J. Kovich

A. Watt

H. McArthur

Foundations Office ✓

Gen. Files

KYL
K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed New Structure at Relocated
Hwy. #35 (Line 'F') and Kushog Lake,
Co. of Haliburton, Twp. of Stanhope,
Con. X. Lot 1, Dist. #11 (Huntsville).
W.J. 65-F-89 -- W.P. 177-64

1. INTRODUCTION:

A request was received from Mr. J. C. McAllister, Bridge Planning Section, in a memo dated July 25, 1965, for a foundation investigation to be carried out at the new structure site where relocated Hwy. #35 (Line F) crosses Kushog Lake.

In order to determine the soil properties and decide on the type of foundations, an investigation was carried out by this Section. Presented in this report are the results of this investigation, together with the recommendations pertaining to the design of structure foundations and approach embankments.

2. DESCRIPTION OF SITE:

The site is located on Kushog Lake, where Hwy. #35 crosses it at its narrowest juncture, called Ox Narrows. The topography is hilly and covered with thick forests and huge masses of exposed rock. Physiographically, the site is located in the "Canadian Shield" region.

3. DESCRIPTION OF FIELD AND LABORATORY WORK:

Field work consisted of 7 sampled boreholes and 2 dynamic cone penetration tests. The borings were carried out by means of

3. DESCRIPTION OF FIELD AND LABORATORY WORK: (cont'd.) ...

conventional diamond drilling equipment adapted for soil sampling purposes.

Samples were recovered at required depths by means of a 2-in. O.D. split-spoon sampler and by a 2-in. I.D. Shelby tube sampler. Rock core samples were obtained by means of an AXT core barrel. The dimensions of the split-spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. Dynamic cone penetration tests were carried out adjacent to boreholes #2 and #3. Driving energy to advance the 2-in. cone was 350 ft.-lb. per blow.

The locations and elevations of all boreholes are shown on Dwg. 65-F-89A, which accompanies this report.

Samples were visually examined and identified in the field as well as in the laboratory. Tests were carried out in the laboratory on a selection of samples to determine:

- 1) Natural Moisture Contents.
- 2) Bulk Densities.
- 3) Atterberg Limits.
- 4) Grain Size Distributions.
- 5) Undrained Shear Strengths.

Laboratory and field test results have been summarized and are included under Appendix I of this report.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1) General:

The subsoil at the site was found to be quite variable. The exact boundaries of the various layers as revealed by the investigation, are shown on the appended borehole logs. The estimated stratigraphical profile of Dwg. 65-F-89A is based upon this information.

From ground level downward, the different soil types encountered are as follows:

4.2) Silty Sand and Organics:

This surface deposit, approximately 2 ft. to 3 ft. thick, was encountered immediately below the lake bed in boreholes #5, #6 and #7 (West side of the lake). The silty sand contains organic materials, such as traces of shells and decaying pieces of wood.

4.3) Silt to Clayey Silt with traces of Organics:

Extending downward from the above stratum in B.H.'s #5, #6, and #7 (West side of the lake), is a 2-ft. to 10-ft. thick deposit of layered silt and clayey silt with traces of organics. The individual layers are approximately 1/4" to 1/2" thick. Within this deposit traces of organic material were observed in the upper portion. The 'N' values in the stratum varied from 4 blows/ft. to 12 blows/ft. One undrained shear strength measurement on a sample from borehole #6 gave a value of 1,100 p.s.f. Based on these values, it is estimated that the consistency of the deposit ranges from firm to stiff.

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.4) Silty Sand and Gravel:

Following the silt to clayey silt on the West side of the lake and underlying the lake bed, silty sand and gravel was found in all boreholes. The thickness of the layer ranges from 8 ft. in borehole #5 to 26 ft. in borehole #1. The deposit mainly consists of well-graded sand and gravel. Boulders, up to 24 in. size were encountered below elevation 1,071 in boreholes #2 and #4 and below elevation 1,066 in boreholes #6 and #7 within the stratum. Standard Penetration Test ('N') values within the deposit vary between 14 blows/ft. to 100 blows/1 in., indicating a relative density of compact to very dense.

4.5) Granite-Gneiss Bedrock:

Underlying the stratum of silty sand and gravel with boulders is the granite-gneiss bedrock with schist intrusions. The bedrock was proven by obtaining 4 ft. to 5 ft. of core in all boreholes. Recovery was 100% in all boreholes, indicating that the bedrock was in sound condition. The bedrock was contacted between Elev. 1,067 and Elev. 1,057.

5. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a three-span structure (50' - 85' - 50') where the relocated Hwy. 35 (Line 'F') crosses Kushog Lake (Ox Narrows). The new structure will replace the existing structure located some 50 ft. north of the proposed one.

The subsoil at the new structure site generally consists of deposits of silty sand and organics, silt to clayey silt with

5. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

traces of organics and silty sand and gravel with boulders. The bedrock was encountered between Elev. 1,067 and Elev. 1,057 immediately below the stratum of sand and gravel with boulders. This some 24 to 34 ft. below lake water level.

Structure Foundations:

The subsoil conditions vary considerably over the entire site and, therefore, foundations for each pier and abutments are discussed separately as follows:

Abutments - The abutments may be supported on piled foundations driven through the fill material. In this case, the fill below the footings must consist of a material other than rock fill to allow penetration by the piles. The fill material should be blanketed by rock fill to provide some protection against scour. The most suitable type of piles would be steel H-piles driven to bedrock. The maximum allowable load for the pile section may be used. The presence of boulders some 10 ft. above the bedrock may create difficult driving conditions. In view of this, the steel H-piles should be equipped with driving shoes.

East Pier - At this location the subsoil conditions are generally favourable for spread footing type of foundations. The proposed East pier can be founded in the silty sand and gravel stratum as high as frost and hydrological requirements will permit. A safe bearing pressure of 3 t.s.f. may be used for design purposes.

cont'd. /6 ...

5. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

Structure Foundations: (cont'd.) ...

West Pier - Due to the presence of organic deposits in the upper portion of the subsoil, adequate bearing capacity cannot be achieved for an economical spread footing design. The West pier should, therefore, be supported on end-bearing piles driven to bedrock. Design loads to be used are dependent on the pile section selected, and may be 93 tons per pile in the case of 12 BF 74 steel H-piles. The piles should be equipped with driving shoes since driving through boulders to bedrock may be difficult.

A dewatering scheme will be required if pier caps or footings are constructed below lake water level.

Due to hydrological requirements, if the East pier footings cannot be located at a reasonable depth in the sand and gravel stratum, an alternative scheme adopting a piled foundation may be chosen. The details should be as outlined for "West Pier".

Approach Fills - The proposed grade of relocated Hwy. 35 (Line 'F') will be at approximate Elev. 1,102. In most of the cases, the fill height will be in the order of 10 ft. No stability problems are anticipated for 2:1 standard slopes provided any surface organic material is removed prior to placing the West approach fills. The sub-excavation of organic material should be carried out according to current D.H.O. methods.

6. SUMMARY:

A three-span structure is proposed at the crossing of relocated Hwy. 35 (Line 'F') and Kushog Lake.

cont'd. /7 ...

6. SUMMARY: (cont'd.) ...

The subsoil at the site generally consists of deposits of silty sand and organics, silt to clayey silt with organics, sand and gravel with boulders and granite bedrock. The maximum and minimum depth to bedrock is some 34 to 24 ft.

The proposed structure can be supported on end-bearing steel H-piles driven to bedrock. Due to the presence of boulders above bedrock, the piles should be fitted with shoes. The maximum allowable load for the pile section, may be used. However, the East pier can be supported on spread footings in the sand and gravel stratum, as discussed in "Discussion and Recommendations".

A dewatering scheme will be required at the pier footing locations if they are constructed below lake water level.

All surface organic material should be removed prior to placing the West approach fills as per current D.H.O. methods. No stability problems are anticipated for standard 2:1 slopes.

7. MISCELLANEOUS:

The field work, performed Aug. 6 - 27, 1965, together with the preparation of this report, was undertaken by Mr. V. Korlu, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

Equipment was owned and operated by Dominion Soil Investigation, Limited of Toronto.

October 1965

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
C_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{C_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_r	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

LOCATION Hwy 35 @Ox Narrows 541/91 34' Lt.

ORIGINATED BY V.K.

BORING DATE Aug 10, 1965

COMPILED BY V.K.

BOREHOLE TYPE Drive BX Casing and Wash.

CHECKED BY M.D. *[Signature]*

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT % 10 20 30			
1090.5	Waterlevel											
0.0	water					1090						
1086.0												
4.5												
	Silty sand and gravel. (Dense to v. dense)		1	SS	88	1080						Gr 52% Sa 40% Si 8%
			2	SS	36							
			3	SS	42	1070						
			4	SS	47							Gr 54% Sa 42% Si 4%
1059.5			5	SS	161	1060						
31	Granite-gneiss											
1056.0	Bedrock		6	AXT	100% Recovery							
34.5	End of borehole.											
						1050						

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-89

LOCATION Hwy 35 @ Ox Narrows 542408 15' Rt.

ORIGINATED BY V.K.

W. P. 177-64

BORING DATE Aug 11, 1965

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Drive BX Casing and Wash.

CHECKED BY M.D. *AK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
							20 40 60 80 100		WP ——— WL	WATER CONTENT % 10 20 30		
1090.5	Waterlevel											
1085.8	Water											
2.0	Silty sand and gravel. (Compact to v. dense)		1	SS	16	1090						Gr1%Sa75% Si 24%
			2	SS	100							Gr33%Sa63% Si 4%
1071.0					for 5.5"							
19.5	Boulders		3	SS	100	1080						
					for 2"							
			4	SS	100							
					for 1"							
1061.5												
29.0	Granite-gneiss				100%	1070						
	Bedrock		5	AXT	recovery							
1055.2												
35.0	End of borehole.											
						1060						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 65-F-89LOCATION Hwy 35 @ Ox Narrows 542/58 15' Rt.ORIGINATED BY V.K.W. P. 177-64BORING DATE Aug 16, 1965COMPILED BY V.K.DATUM GeodeticBOREHOLE TYPE Drive BX Casing & Wash.CHECKED BY M.D. *AK*

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W Wp — W — WL WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.			
1090.5	Waterlevel					1090					
0.0	Water										
1078.0						1080					
12.5	Silty sand with traces of gravel. (Compact)		1	SS	28	1070					Gr 3% Sa 51% Si 44% Cl 2%
1067.6											
23.5	Granite-gneiss										
1062.0	Bedrock		2	AXT	100% recovery	1060					
23.5	End of borehole.					1050					

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 65-F-89LOCATION Hwy 35 @ Ox Narrows 543+64 15' Lt.ORIGINATED BY V.K.W. P. 177-64BORING DATE Aug 20, 1965COMPILED BY V.K.DATUM GeodeticBOREHOLE TYPE Drive BX Casing and Wash.CHECKED BY M.D. *MR*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WP	W	WL		
1090.5	Waterlevel					1090									
0.0	Water														
1084.0															
6.5	Silty sand and organics														
8.5	Silt to clayey silt. (Firm to stiff)		1	SS	4	1080									
			2	SS	12										
1072.5															
18.0	Silty sand and gravel.		3	SS	14	1070									
1064.5	(Compact to v. dense)		4	SS	81										
26.0	Granite-gneiss		5	AXT	100%										
1060.0	Bedrock				recovery	1060									
30.5	End of borehole.														
						1050									

Sa2%Si195%
Cl 3%
Sa62%Si138%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 65-F-89LOCATION Hwy 35 @ Ox Narrows 543/14 15' Lt.ORIGINATED BY V.K.W.P. 177-64BORING DATE Aug 23, 1965.COMPILED BY V.K.DATUM GeodeticBOREHOLE TYPE Drive BX Casing & Wash.CHECKED BY M.D. *dk*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WP	W	WL		
1090.5	Waterlevel						500	1000	1500	2000	2500	10	20	30		
0.0	Water					1090										
1080.0						1080										
10.5	Silty sand & organics															
1078.0																
12.5	Silt to clayey silt. (Firm to stiff)		1	SS	6											
			2	TW	P											
			3	SS	6	1070										
1065.5			4	SS	15											
25.0	Silty sand and boulders. (Max. 24")			BXT		1060										
1056.5																
34.0	Granite-gneiss				100%											
1052.5	Bedrock		5	AXT	recovery											
38.0	End of borehole.					1050										

Sa1%Si99%

Sa3%Si90%
Cl 7%
Gr2%Sa75%
Si 23%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-89

W P 177-64

DATUM Geodetic

LOCATION Hwy 35 @ Ox Narrows 543+43 15' Rt.

BORING DATE Aug 24, 1965.

BOREHOLE TYPE Drive BX Casing & Wash.

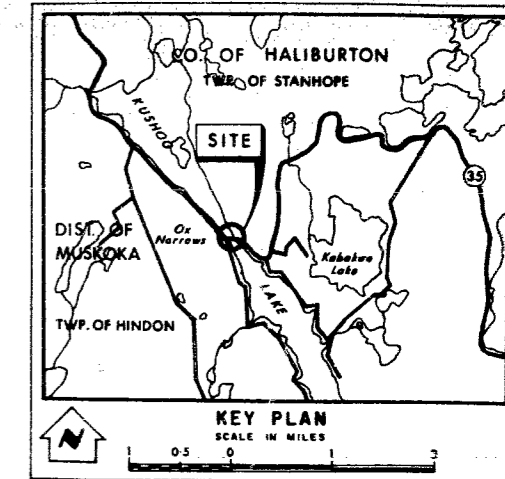
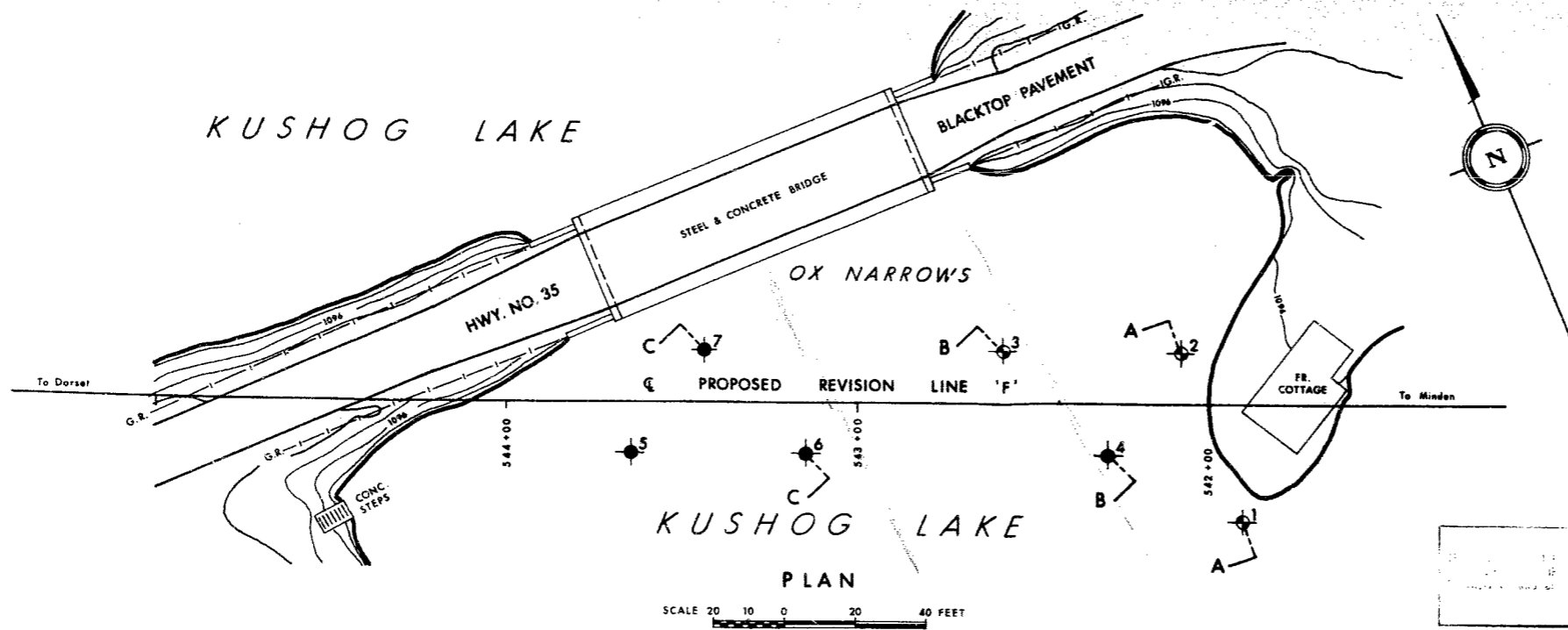
FOUNDATION SECTION

ORIGINATED BY V.K.

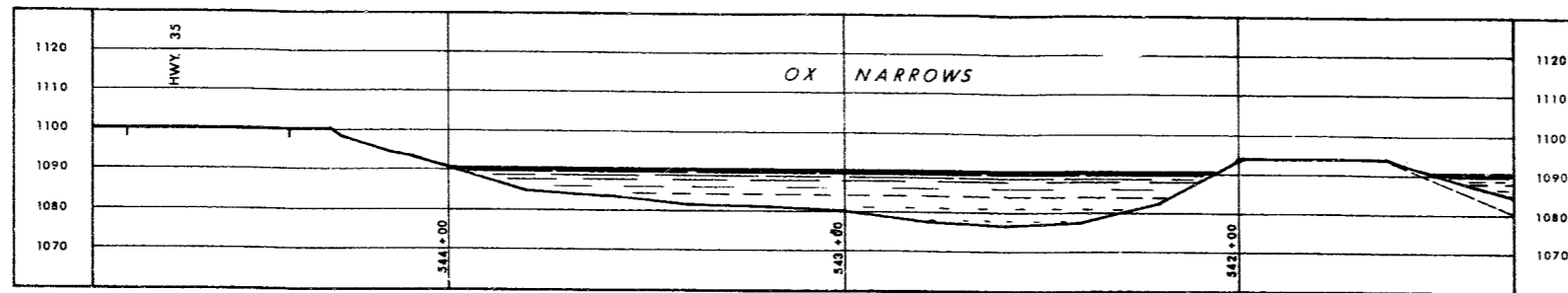
COMPILED BY V.K.

CHECKED BY _____ M.D. *AK*

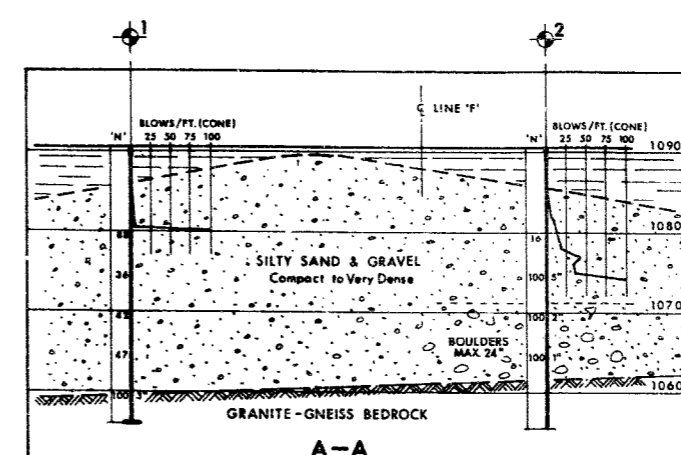
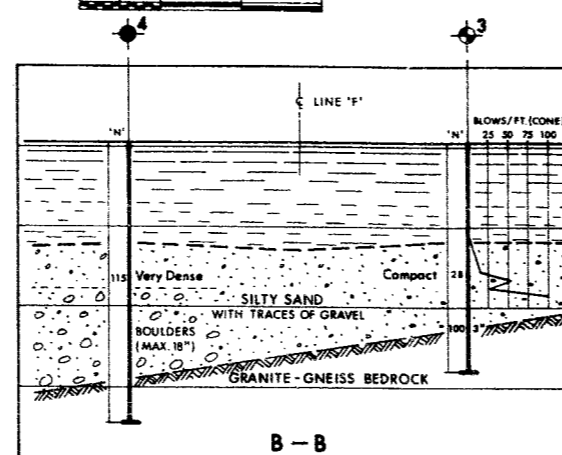
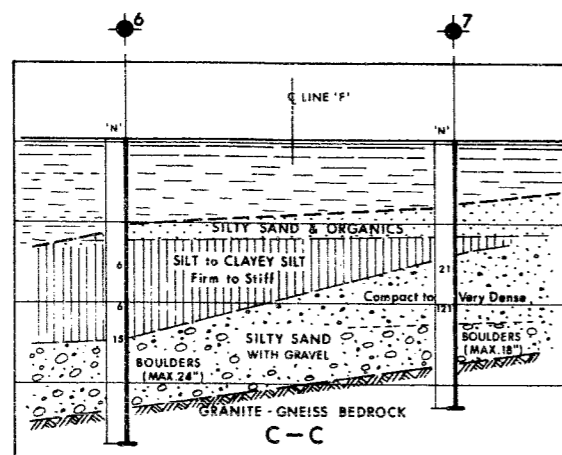
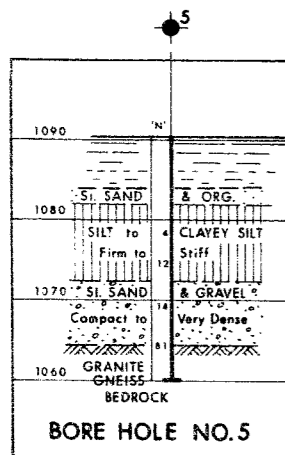
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LEGEND	
	Bore Hole
	Cone Penetration Hole
	Bore & Cone Penetration Hole
	Water Levels established at time of field investigation. AUG. 1965



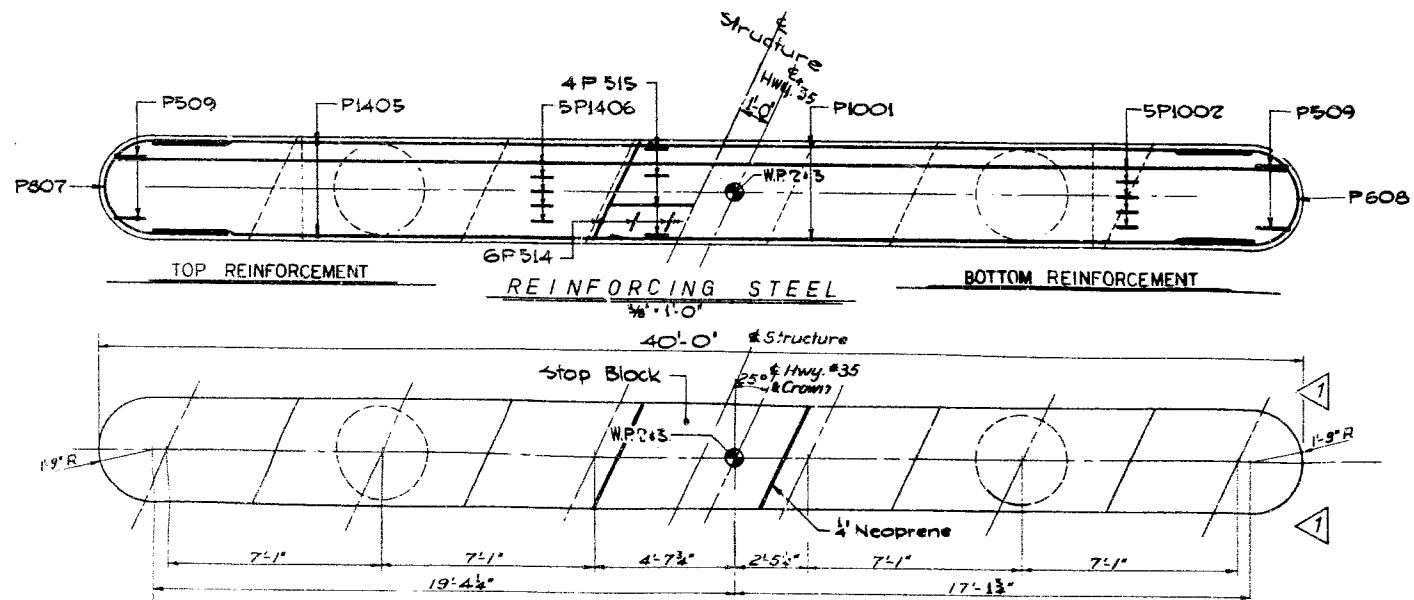
PROFILE - LINE 'F'



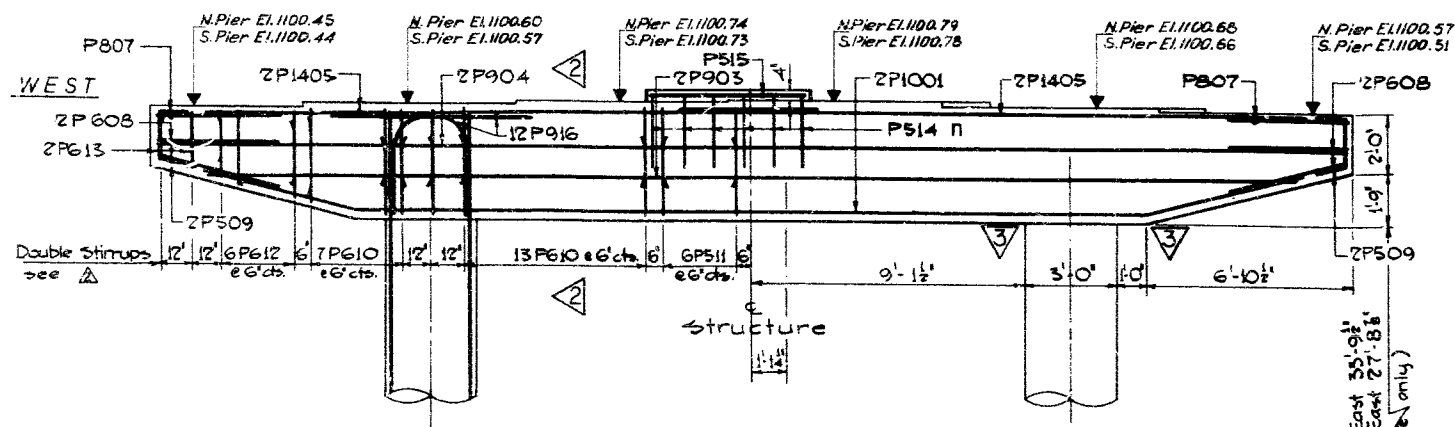
NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & TESTING DIVISION - FIELD SECTION			
OX NARROWS - KUSHOG LAKE			
KING'S HIGHWAY NO. 35 LINE 'F'		DIST. NO. 11	
CO. HALIBURTON		TWP. STANHOPE	
LOT 1		CON. X	
BORE HOLE LOCATIONS & SOIL STRATA			
SUBM'D. V.K.	CHECKED V.K.	W.P. NO. 177-64	M.B.T. DRAWING NO.
DRAWN I.M.	CHECKED V.K.	JOB NO. 65-F-89	65-F-89A
DATE 10 SEPT. 1965	SITE NO. 40-6	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO. 67-154	D 5823-2	

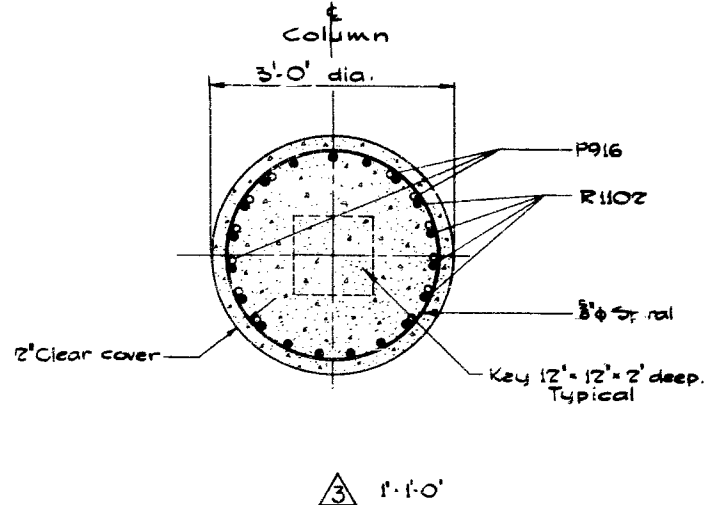
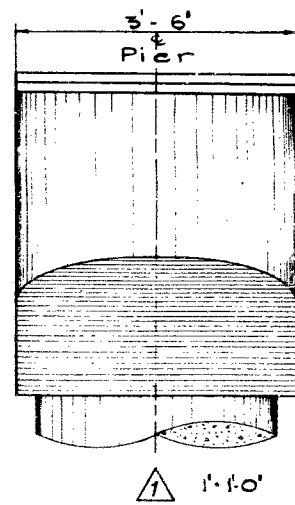


P L A N



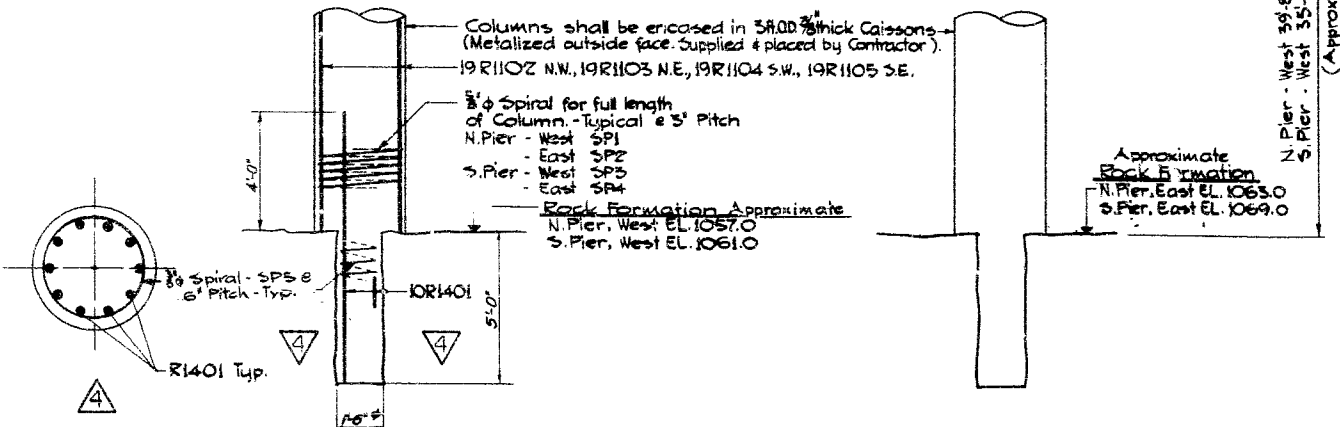
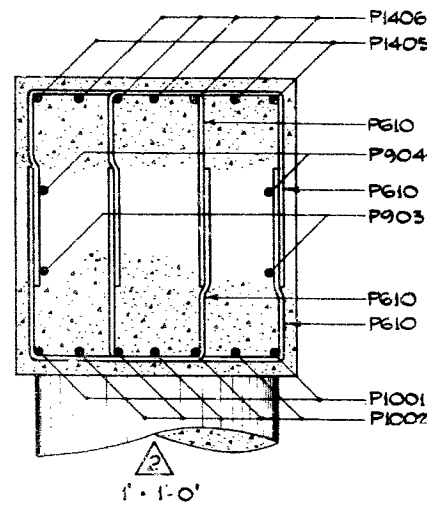
E L E V A T I O N

3/8" x 1'-0"



NOTE

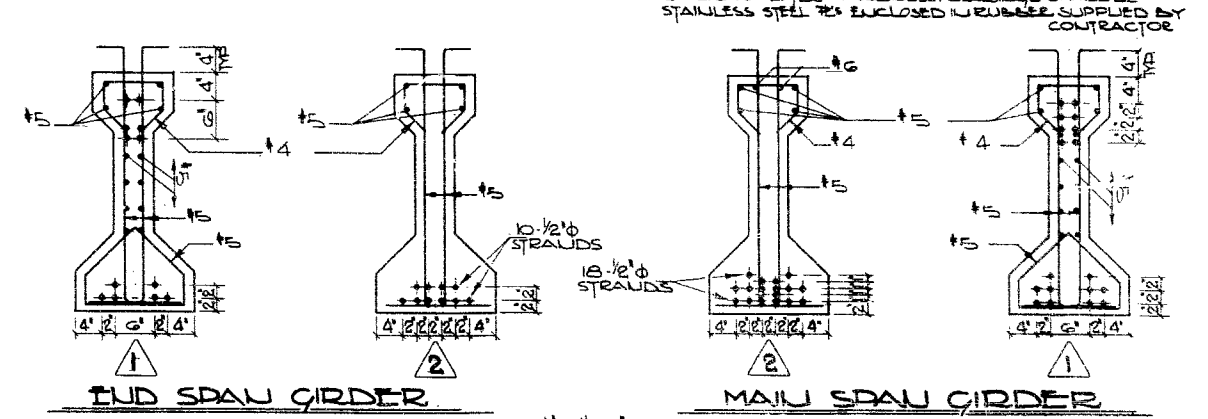
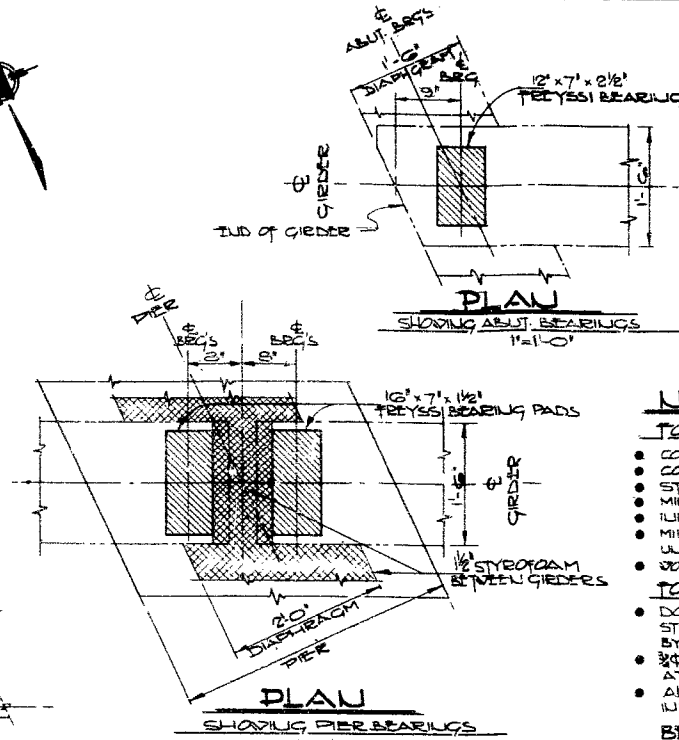
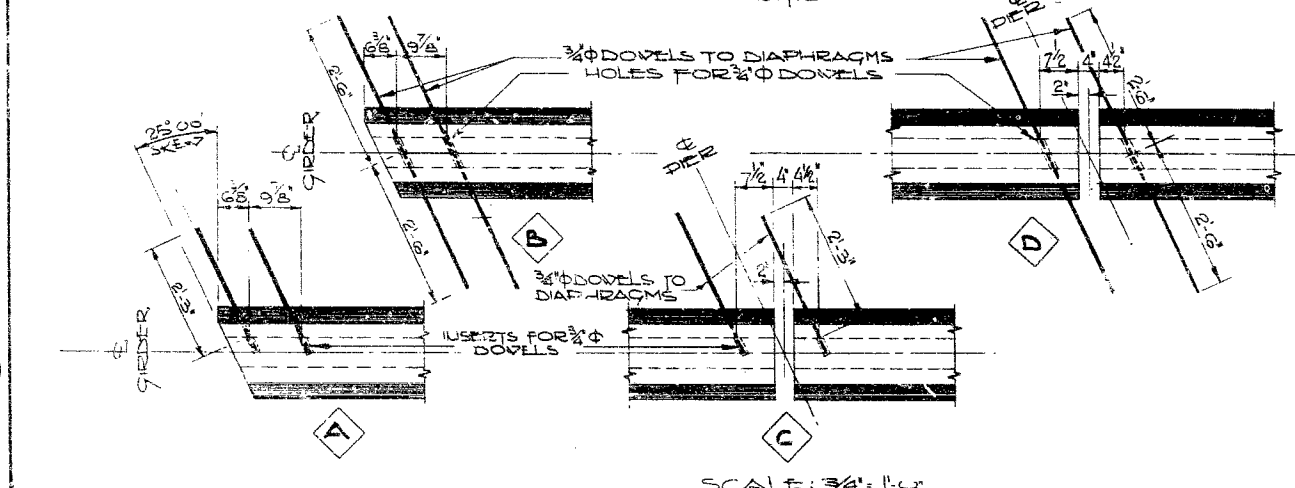
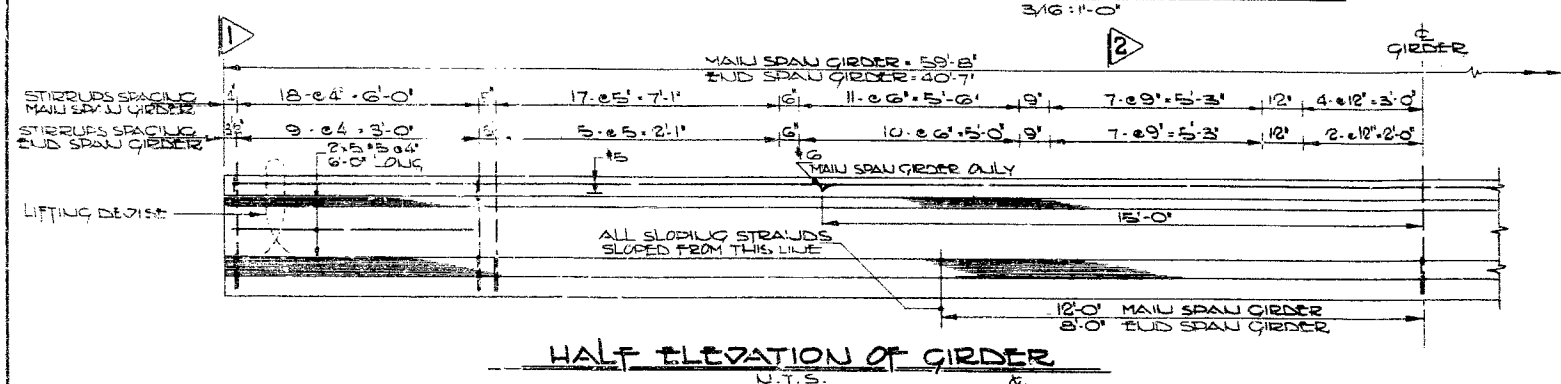
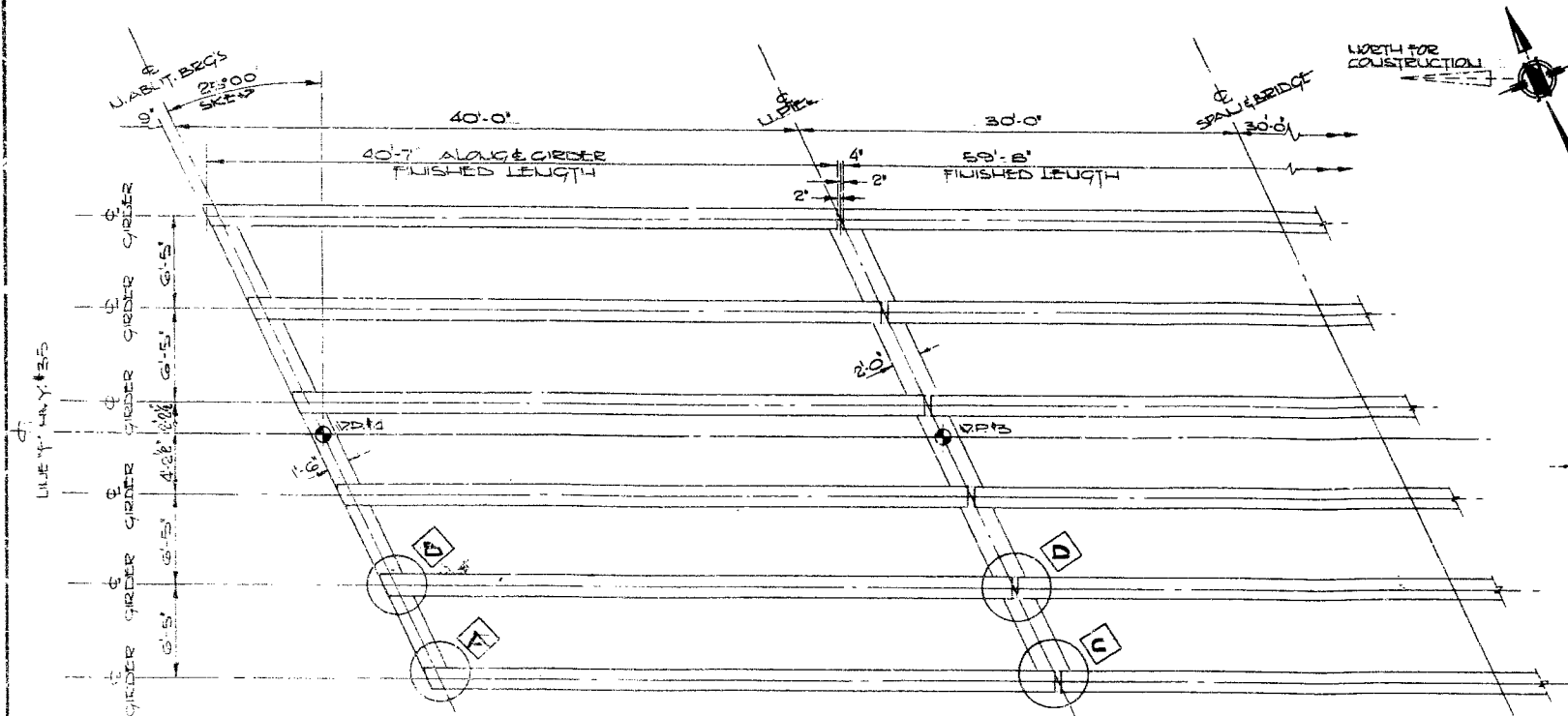
Stop Blocks to be cast after Girders are in place.



REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
OX NARROWS BRIDGE KUSHOG LAKE			
KING'S HIGHWAY No. 35		DIST. No. 11	
CO. HALIBURTON		TWP. STANHOPE LOT 1 CON. X	
P I E R S			
APPROVED	DATE	CONTRACT No.	W.P. No.
70	4-10-6	777-84	67-154
DESIGN	CHECK	DATE	DRAWING No.
CH	CH	APR 10 1966	D-5823-5





- NOTES**
- FOR PRESTRESSED GIRDERS**
- CONCRETE STRENGTH AT 28 DAYS - 5000 P.S.I.
 - CONCRETE STRENGTH AT TRAVERSE - 4500 P.S.I.
 - STRAUD TYPE 1/2" NOMINAL DIA. 7 WIRE EXTRA HIGH STRENGTH
 - MINIMUM ULTIMATE STRENGTH OF STRAUD - 41300 LBS.
 - INITIAL FORCE PER STRAUD - 28.0K
 - MINIMUM CLEAR COVER TO REINFORCING STEEL - 1 1/2" EXCEPT AT UNDERSIDE OF BOTTOM FLANGE WHERE THE MIN. COVER SHALL BE 1"
 - WORKING FORCE PER STRAUD AFTER ALL LOSSES - 22.7K
- FOR DOVELS**
- DOVEL INSERTS SHALL BE CAPABLE OF DEVELOPING FULL STRENGTH OF DOVELS AND SHALL BE SUBJECT TO APPROVAL BY THE ENGINEER
 - 3/4" DOVELS FOR EXTERIOR GIRDERS SHALL BE THREADED AT ONE END TO MATCH INSERTS
 - ALL DOVELS AND INSERTS SHALL BE SUPPLIED AND INSTALLED (OR GROUTED) BY THE PRESTRESSED CONC. CONTRACTOR
- BEARINGS**
- PREYSSI BEARINGS ON ABUTMENTS AND PIERS TO BE 50 DUROMETER HARDNESS. BEARINGS SHALL BE STAINLESS STEEL 7/8" ENCLOSED IN RUBBER SUPPLIED BY CONTRACTOR

REVISIONS		DATE		BY		DESCRIPTION	

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

OX NARROWS BRIDGE
KUSHOG LAKE

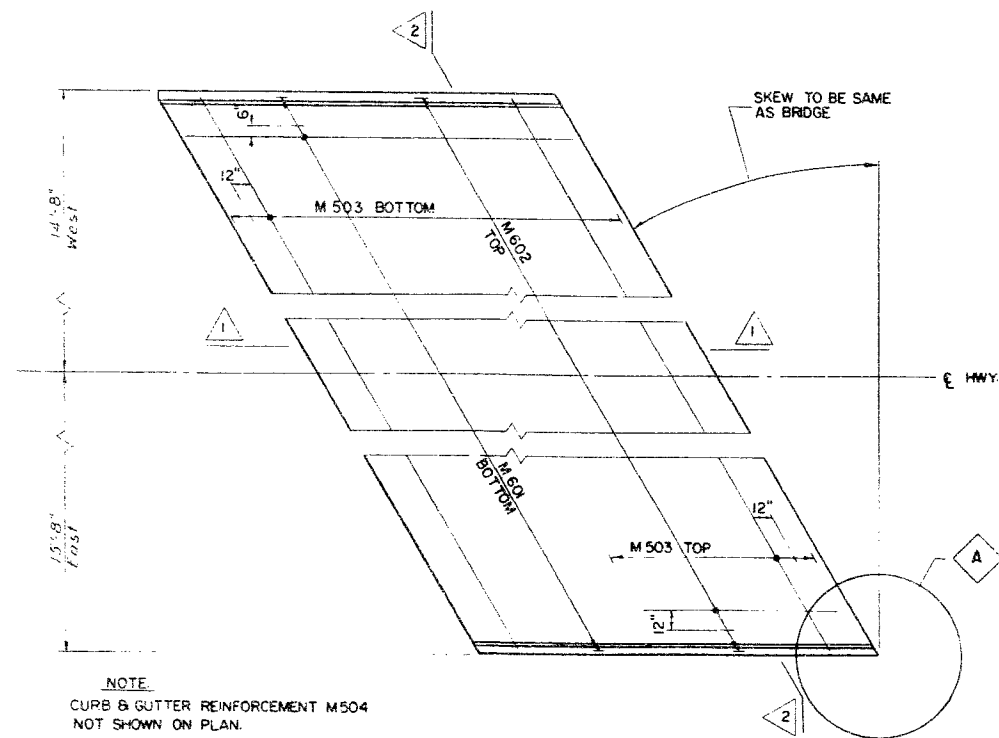
KING'S HIGHWAY No. 35 DIST. No. 11
CO. HALIBURTON
TWP. STANHOPE LOT 1 CON. X

PRESTRESSED GIRDERS & BEARINGS

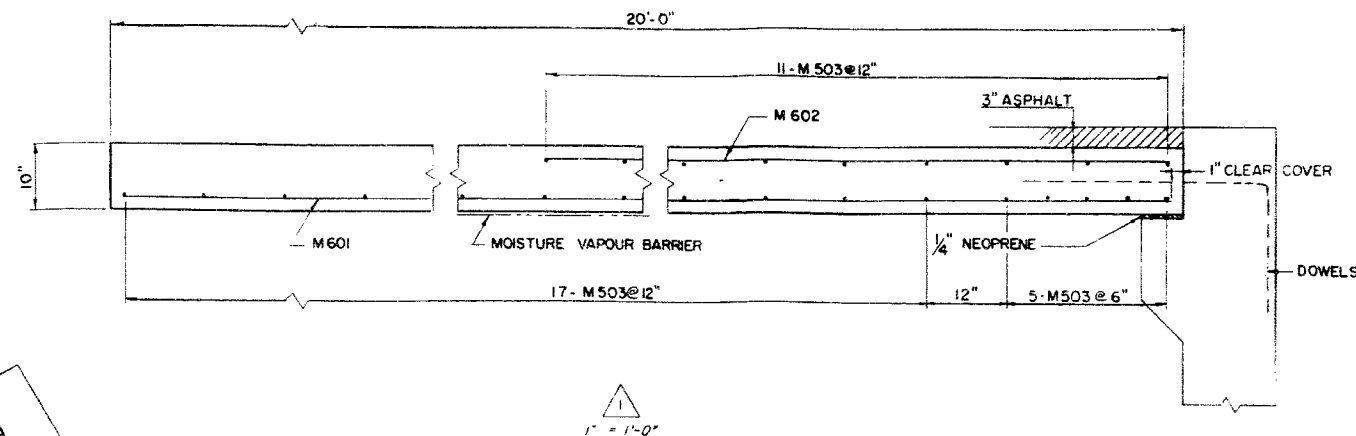
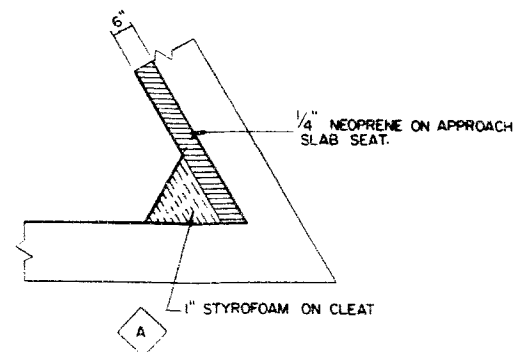
APPROVED: *[Signature]* SITE No. 40-G W.P. No. 177-6A

DESIGN	CHECK	DATE	CONTRACT	No.
DESIGN				
DRAWING				
DATE				

67-154
D-5823-6

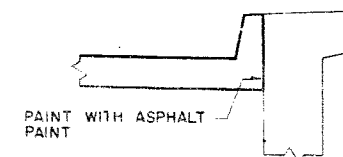


PLAN
1/2" = 1'-0"

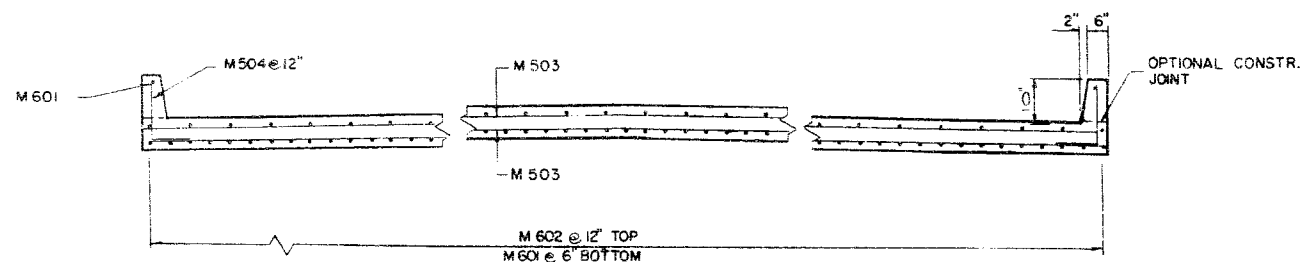


NOTES

CLASS OF CONCRETE 3000 P.S.I.
CLEAR COVER TO REINFORCING 2"
LAYOUT OF REINFORCING STEEL WILL BE
SIMILAR FOR RIGHT HAND AND ZERO
DEGREE SKEWS.



TYPICAL CURB DETAIL
EAST ONLY



TYPICAL SIDEWALK DETAIL
WEST ONLY

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

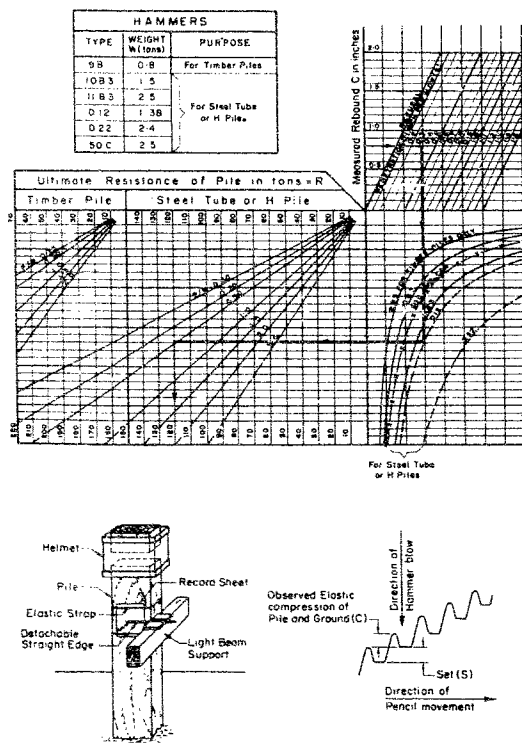
OX NARROWS BRIDGE KUSHOG LAKE

KING'S HIGHWAY No. 35 DIST. No. 11
CO. HALIBURTON
TWP. STAUHOPE LOT 1 CON. X

APPROACH SLABS

APPROVED *[Signature]*
BRIDGE DESIGN ENGINEER

DESIGN	CHECK	DATE	LOADING	W.P. No.	CONTRACT	No.
DRAWING	6-4	APR 66	172-516	40-6	177-64	67-154
DATE	APR 66	LOADING	172-516	DRAWING	No.	D-5823-9



No. DD-1219
Date _____ Rev. _____

$R = \frac{nWh}{S+C}$ (Hiley formula)

where R = Ultimate load in tons.
S = Measured penetration of pile per blow of hammer in inches.
C = Measured rebound of pile per blow of hammer in inches.
Wh = Gross energy of hammer blow with a reduction due to the effect of single action or double action as against a perfect free fall, this reduction is included in plotting of the curves.
 $n = \text{Efficiency of blow} = \frac{W+P}{W+P}$
where $n = 0.32$ for steel (These values of n have been found by experiment)
 $n = 0.25$ for timber
P = Weight of pile + 0.25 ton for helmet.
W = Weight of hammer in tons.
The P/W curves form the required reduction of total energy (Wh) of the hammer blow according to the ratio of P/W.
 $L = R/Q$ tons
where L = Working load on pile in tons
Q = Factor of safety
Use Q = 3 unless otherwise authorized by the Bridge Engineer.

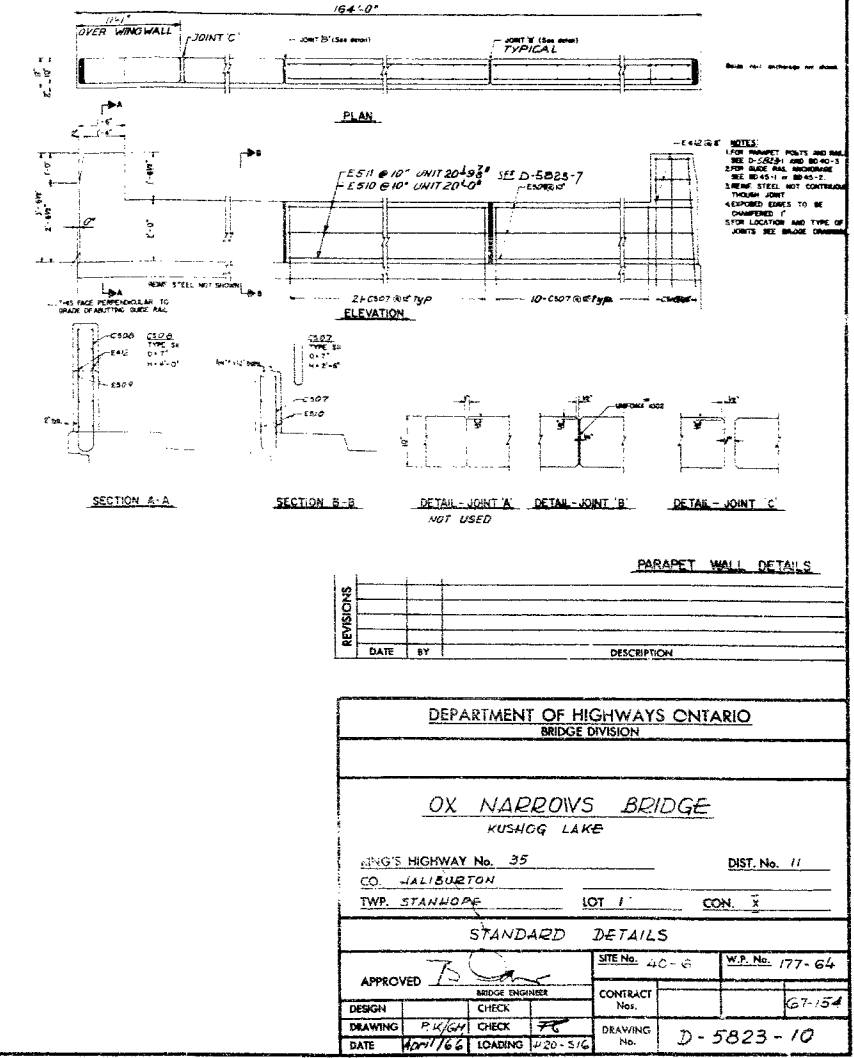
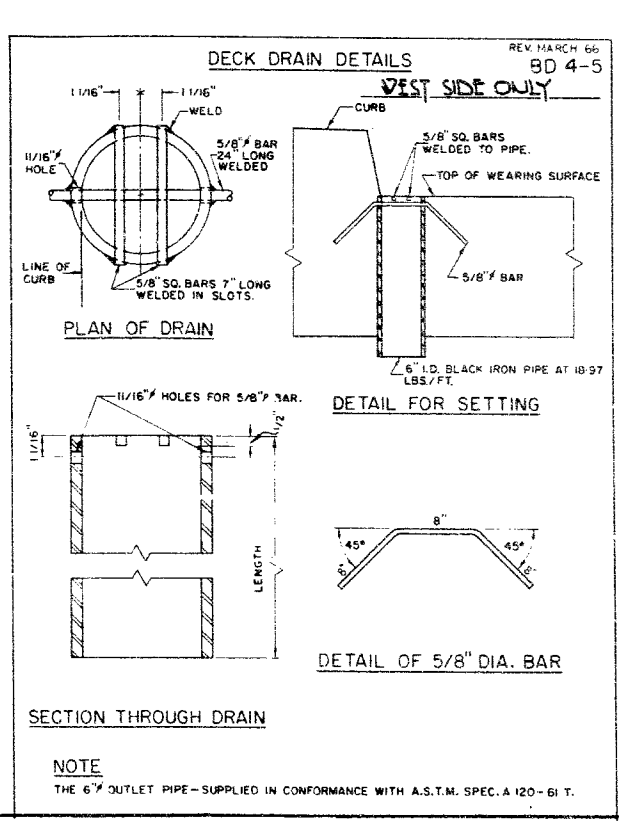
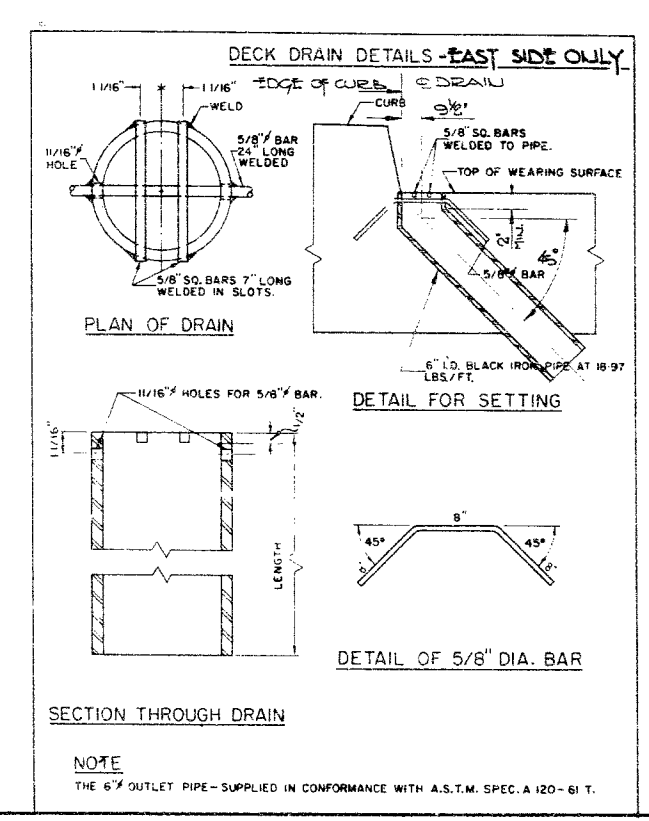
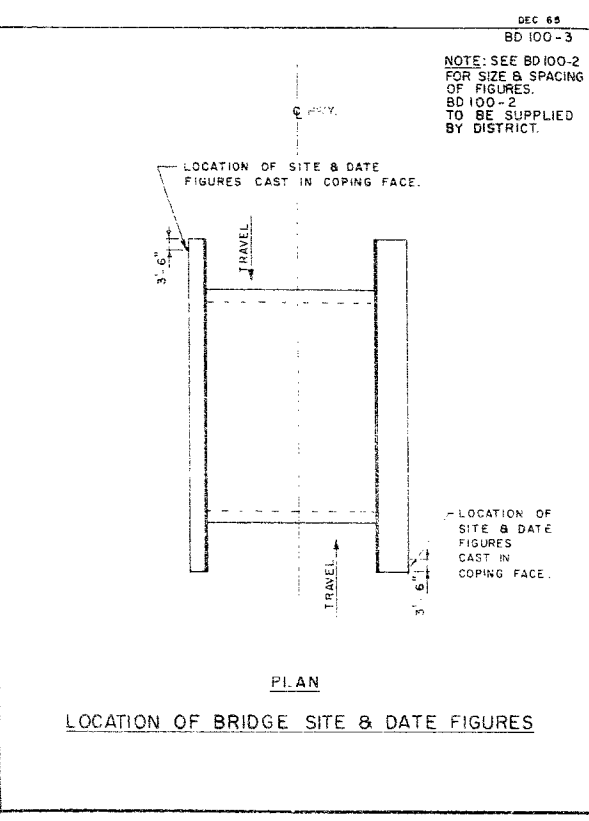
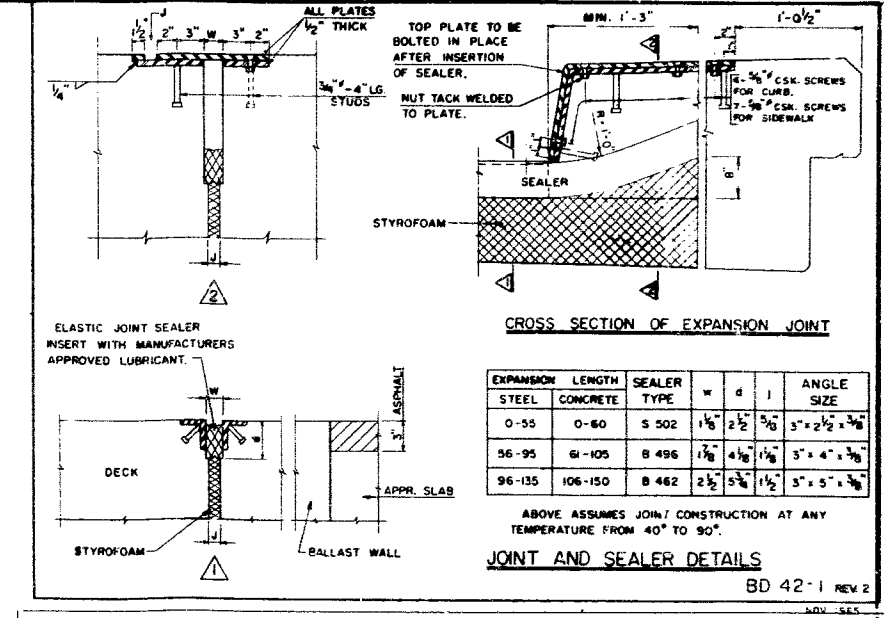
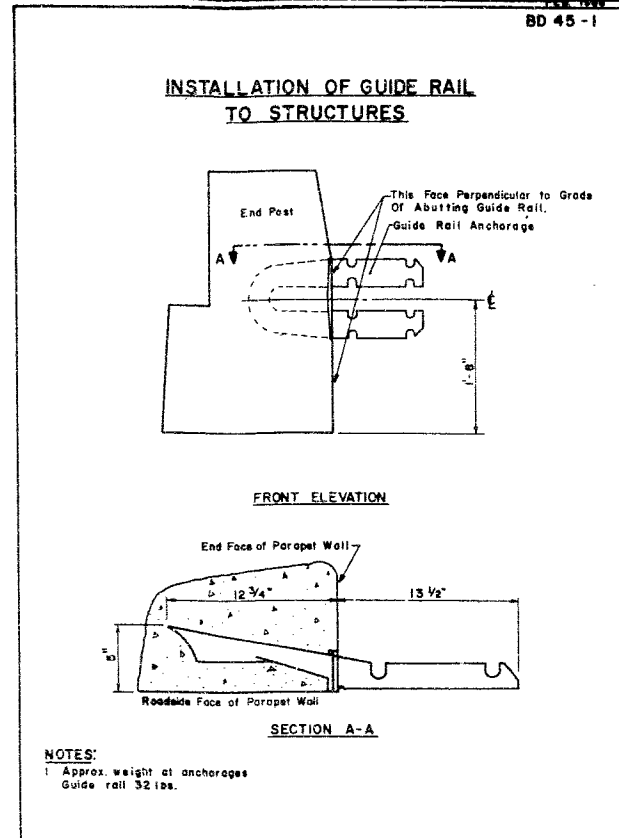
Example 1:
Observed measured rebound = C = 0.8 in.
Observed measured set per blow = S = 0.33 in.
12 in steel tube at 28 lb per ft. 30 ft. long plus helmet weighing 0.25 ton giving P = 0.67 ton. Delmag D12 hammer, W = 1.38 tons, P/W = 0.485.
Chart:
With C = 0.8 in. proceed horizontally to the right to cut line S = 0.33 in. and vertically down to cut curve D12 then horizontally to the left to cut P/W = 0.485 and read ultimate load R = 120 tons approximately.

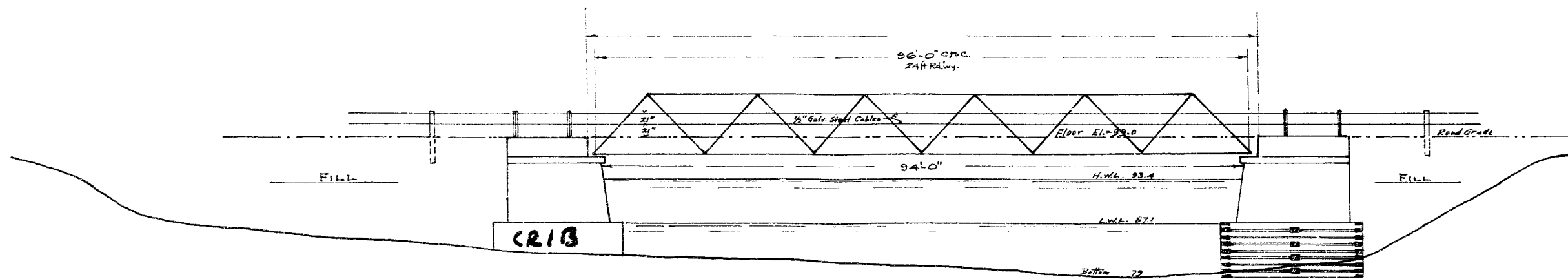
Example 2:
Working load on pile is 20 tons, pile is 12 in. tube, 40 ft. long, D/A Mackerran Terry hammer 10B3, W = 1.5 tons, P = 0.54 + 0.25 = 0.79 ton, P/W = 0.525. Assume Q = 3, then R = 60.
Chart:
With R = 60 tons trace up to cut P/W = 0.525 and horizontally to the right to cut curve 10B3 then vertically up. The range of reading will now be between C = 0 in. and S = 0.72 in. and C = 1.45 in. and S = 0 (refusal). A test pile must be driven of a length compatible with the soils branch recommendation (if any). The driving must continue until a pair of readings is obtained corresponding to a pair on the chart, the required pair being decided upon by the Bridge Engineer.

DEPARTMENT OF HIGHWAYS-ONTARIO

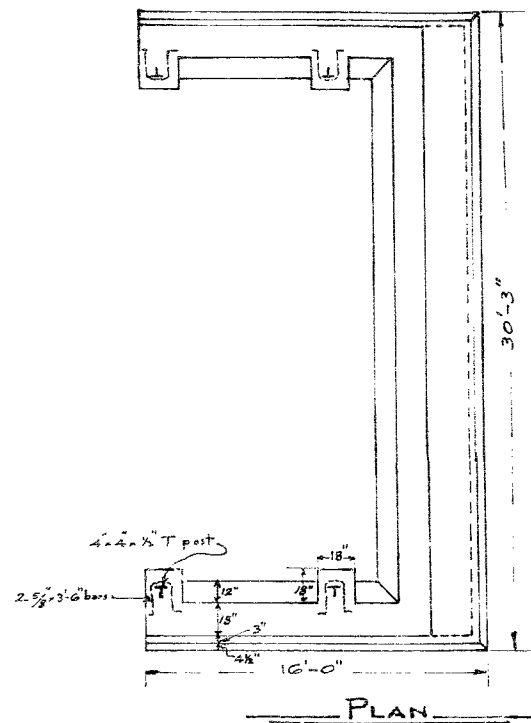
**PILE DRIVING
STEAM AND DIESEL HAMMERS**

APPROVED _____
Aug 4/59 Date _____
Bridge Engineer

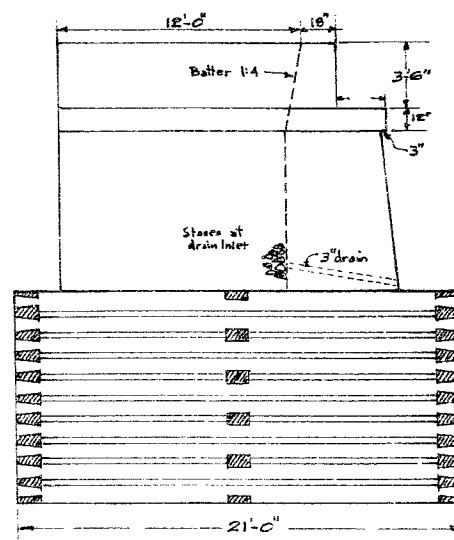




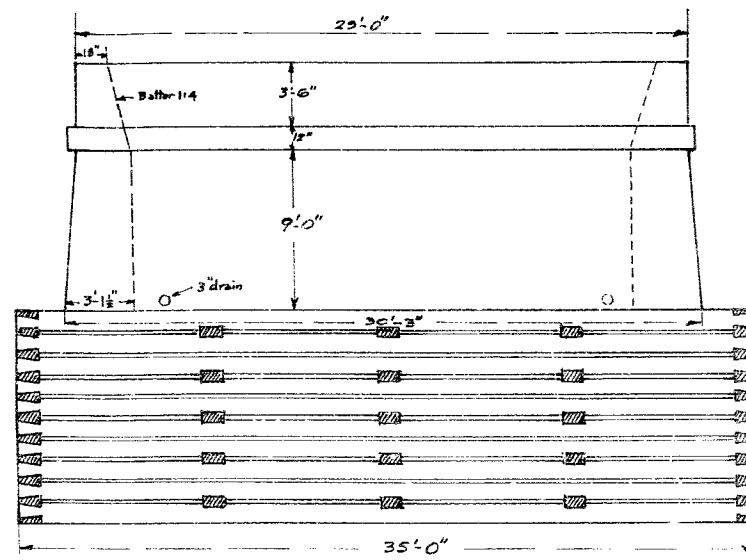
PROFILE
1/8 in. Scale.



PLAN



END VIEW



FRONT ELEVATION

1/4 in. Scale.

Ox Narrows Bridge Lot 1, Con. 13 Stanhope Twp.

DEPARTMENT OF PUBLIC WORKS ONTARIO
TORONTO NOV. 3rd 1933.

Deputy Minister of Public Works

Engineer of Public Works

2-Std. Name Pls L232

Connect Name Plates to A14 - B14

holes in A1
3 slots in B1

1-Pl 16 x 1.5 Ap16
1-Pl 16 x 1.5 Ap17 for A1
1-Pl 16 x 1.5 for B1

2-BED PLATES-H1
(Fixed Ends)

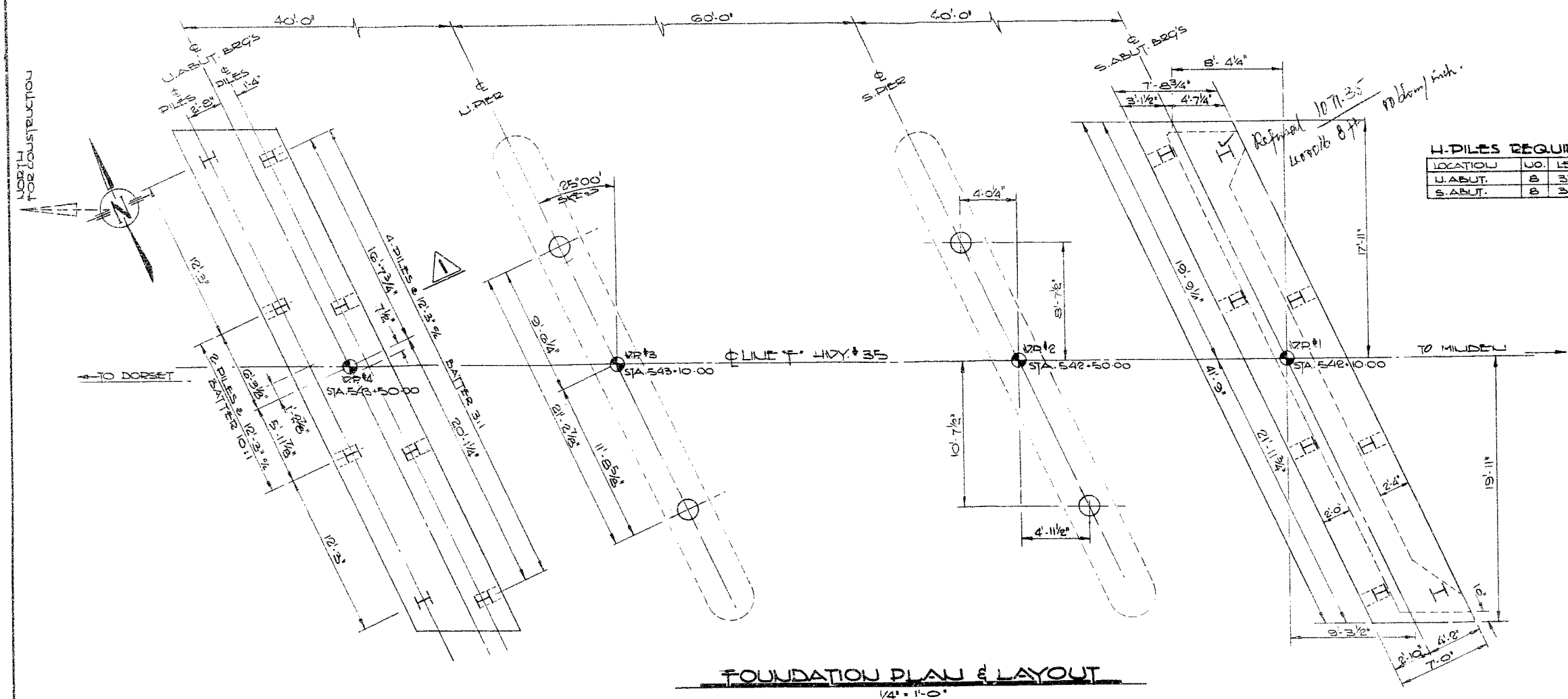
2-BRONZE PLATES-J1
(Fasten to G1 with 4-3/8" flathead screws x 14)

L TRUSS SECTION-AIR-Right
L- A14-Left
L- B14-Right
L- B14-Left

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DATE 2/10/20	REVISION 1-10-20	CUSTOMER Dept. of Public Works 76'0" Truss Span
LOCATION EX. Harris Endon, Ontario Truss	LAST PREPARED HAMILTON	CONTRACT 1-10-20
HAMILTON BRIDGE COMPANY, Ltd. HAMILTON, ONTARIO		WORK ORDER 1-10-20
MADE BY TRACED BY CHECKED BY APPROVED BY		DATE 2/10/20

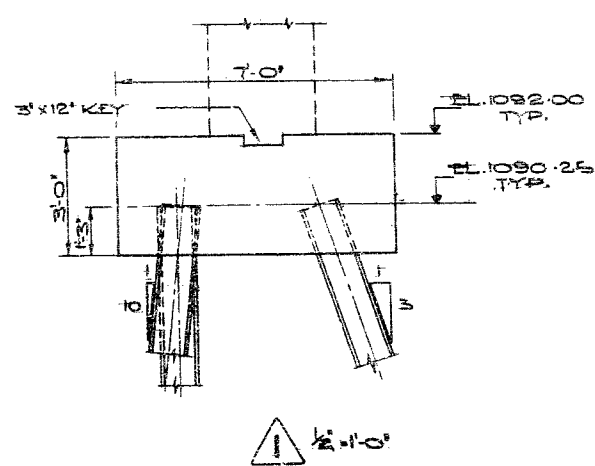
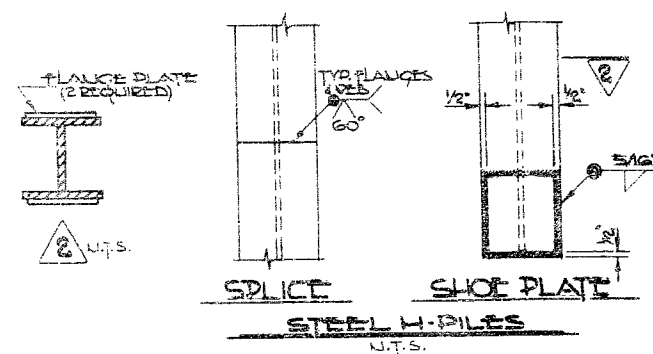
B1337-5



H. PILES REQUIRED

LOCATION	NO.	LENGTH	SHOE 2	TYPE
U. ABUT.	8	37'-0"	8	12.5D53
S. ABUT.	8	38'-0"	8	12.5D53

FOUNDATION PLAN & LAYOUT
1/4" = 1'-0"



REVISIONS

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

OX NARROWS BRIDGE
KISHOG LAKE

KING'S HIGHWAY No. 3/5
CO. HALIBURTON
TWP. STALWODE

DIST. No. 1
CON. Y

FOOTING & PILE LAYOUT

APPROVED: *[Signature]*
DESIGN: *[Signature]*
CHECK: *[Signature]*
DATE: 10/22/03

CONTRACT No. 67-154
DRAWING No. D-5823-3

FILE No. 40-6
W.P. No. 177-68

Sub: Structure at Relocated Hwy 25 (Line F)
and Kashog Lake, Dist #11 (Huntsville)

WJ 65-F-89

WP 177-64

Mr. T. McCall has called the foundation section ^{on Nov 25/65} and requested to review the foundation report for the following proposal:

Abutments on spread footings supported on rock fill.

This section reviewed the subsoil conditions and submitted the following comments on Nov 25/65 by telephone.

The presence of compressible clay layer at the abutment location will create settlement problems. In view of this in our opinion this scheme should not be considered.

M. Devata

Nov 25/65

Mr. S. McCombie,
Bridge Planning Engr.,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attn: Mr. J. C. McAllister

January 27, 1966

Your Memo -- Jan. 21/66

W.P. 177-64,
Ox Narrows Bridge,
Hwy. #35, Dist. #11 (Huntsville).

We have reviewed the Preliminary Plan D-5823-P1 for the above mentioned structure, and submit the following comments:

(1) Reinforced tips are recommended for steel H-piles in the foundation report. These are not shown on the drawing.

(2) Consideration should be given to the use of concrete caissons to support the abutments as well as the piers. It is believed that a more economical design may be achieved.

MD/MieF

cc: Foundations Office
Gen. Files

Devata
M. Devata,
SENIOR FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario.

DATE: January 21, 1966.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 177-64,
Ox Narrows Bridge,
Hwy. #35. Dist. #11

Attached please find one print of preliminary
plan D-5823-P1 showing the proposed structure at
Ox Narrows.

Please let us have your comments and approval
of this proposal.



J.C. McAllister,
for S. McCombie,
Bridge Planning Engineer.

JCMcA/eb

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

February 25, 1966

Your Memo -- Feb. 23/66

W. F. 177-64,
Ox Narrows Bridge,
Highway #35,
District #11 (Huntsville).

With reference to your memo of February 23, 1966, we wish to make the following comments:

Two types of piles are being used for the foundations of the bridge: steel H-piles for the support of the abutments, and drilled-in caissons for the support of the piers. Since the mobilization cost for the equipment for the caissons has to be paid irrespective of the number of caissons to be drilled, the use of the same type of support could conceivably be more economical under certain conditions than the use of two different types. Our suggestion should not have been considered as a positive statement but, rather, as a recommendation to be taken into consideration.

It is indeed alarming to hear that the General Contractor for the Gray's Creek Bridge has submitted a bid that is more than double the price contained in the D.H.O. estimate which was based on a written estimate by Western Caissons Ltd. The matter of price was again checked with Western Caissons and they still maintain that their price estimate was correct, and that this particular job could be done for the quoted price.

It is hard for us to understand the reasons which could lead to such an abnormal situation. We were also told by Western Caissons that they have not been contacted by anybody regarding the foundation supports for the Gray's Creek Bridge. It is possible that the General Contractor proposes to carry out the work by himself, using perhaps, manual methods which would certainly be more expensive. We are viewing such a possibility with certain concern because we feel quite strongly about the Contractor having the right equipment to do the job and also a fair amount of experience. In soils, surprises and encountering the unexpected are frequent happenings. It takes knowledge, skill, and certainly the right equipment to cope with such situations.

cont'd. /2

Mr. C. S. Gretski,
Bridge Division.

- 2 -

February 25, 1966

In view of the foregoing, we wonder if it wouldn't be the right thing to ask the Contractor to provide proof or evidence of his or the sub-contractor's ability to complete the job satisfactorily. This type of work should be regarded as 'special' and, therefore, special requirements should apply.

AGS/MdeP

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office
Gen. Files

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: Bridge Division,
Downsview, Ontario

Attn: Mr. M. Devata

DATE: February 23, 1966

OUR FILE REF.

IN REPLY TO


SUBJECT: W.P. 177-64
Ox Narrows Bridge
Hwy. #35, District #11

I have received a copy of your letter regarding Preliminary Plan D-5823-P1 and have the following comments:

1. We will call for reinforced pile tips on the final plans as you suggest.
2. We would like cost estimates to show that caissons are more economical than H-piles. On a recent job, namely Gray's Creek Bridge, an estimate was received by the Department from Western Caissons at the design stage. Recently the bids came in for this job and the price quoted by the General Contractor was more than double the price we originally received, hence we are somewhat skeptical about your statement.

We would be pleased to have your further comments on this matter.

CSG:rd


C.S. Grebski,
Bridge Design Engineer.

Mr. M. Stoyanoff,
Bridge Contract Engineer,
Bridge Division.

Attention: Mr. J. Banyay

Foundation Section,
Materials and Testing Div.,
Room 107, Lab. Bldg.

June 16, 1966

Ox Narrows Bridge
Kuskog Lake; W.P. 177-64

65-F 89

Below, please find our comments regarding caissons for the support of piers of the above mentioned bridge:

Bedrock at the pier sites is overlain by overburden of various composition and depth (Foundation Report - W.J. 65-F-89). It is proposed to lower caissons of 3-ft. diameter down to bedrock and key them into the rock by drilling (or chopping) a 1.5-ft. dia. hole 5 ft.

It is our opinion that the above described operation should not present any difficulty or problem for a contractor with adequate experience and the right type of equipment for this kind of job.

From the drawing D-5823-5, it is not clear what kind of connection is contemplated between the 3.0-ft. dia. caisson and the 1.5-ft. dia. key. We would suggest that the use of a 9-ft. long H-pile section be given consideration.

Should you have any additional questions you would like to discuss, please feel free to contact this Office.

AGS/MdeF

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office

Gen. Files

00166

1968 JUL 30 AM 11:28

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DOWN HUNT 5 JULY 30/68 11:22 AM

A G STERNAC PRINCIPAL FOUNDATION ENGR MATERIALS AND TESTING

ATTENTION: M DEVATA

RE: CONTRACT 67-154, HIGHWAY 35

OX NARROWS BRIDGE AISSENS

I AM STILL WAITING FOR YOUR MEMO RE YOUR MEETING AT THE ABOVE SITE
WITH THE CONTRACTOR ON JULY 18/68. ALSO, PLEASE INCLUDE THE DISCUSSION
WITH THE CONTRACTOR IN YOUR OFFICE ON JULY 25 OR 26 CONCERNING THEIR
SCHEME FOR USING THE TREMIE TUBE, CORE DRILLING, ETC. WHAT WAITING
PERIOD WILL BE REQUIRED BEFORE THE CORE DRILL IS USED AND WHAT SIZE OF
DRILL? LAST INFORMATION IS REQUESTED BY RETURN TELETYPE.

W D WAMPTON CONST ENGR

FOR

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

W S AITKEN DIST ENGR

JK

{ Santa pier }

South East Caisson

● Solid Rock Elev 1069.2

Bottom of Keyhole Elev 1066.6

(from our B.H. plot we feel
that sand rock elev 1065.5)

The Drawing shows 1069.0

16 ft away B.H. #3

Santa pier

South West Caisson

Solid Rock Elev 1064.0

Bottom of Key hole 1060.7

B.H. information 1060.75

Drawing shows 1061.0

(4 ft away is B.H. #4)

(no sill at all)

SIMCOE EQUIPMENT & SUPPLIES LIMITED

SALES AND RENTALS

No. 11 HIGHWAY NORTH, P.O. BOX 700, ORILLIA, ONTARIO

TEL. 705 326-6422

PUMPS

HOSE

GENERATORS

COMPRESSORS

AIR TOOLS

MIXERS

SAWS

HEATERS

TARPS

SCAFFOLDING

FLASHERS

HAND TOOLS

WELDERS

FLOOD LIGHTS

CONVEYORS

COMPACTORS

DUOMATS

JUMPING JACKS

CONC. VIBRATORS

INDUST. VACUUM

CHAIN FALLS

BUCKETS & CLAMS

LOADERS

DRAGLINES

PILE DRIVERS

BACKHOES

SWAMP MATS

BREAKER BALLS

TRAILERS & SHACKS

WEIGH SCALES

PORTABLE STEAMER

FORM HARDWARE

EXPANSION JOINT

WATER STOP

MASONRY REINF.

FORM COATING

SONOTUBE

SAFETY SUPPLIES

ADDITIVES

CULVERTS

Mr. M. J. Kemp.

Project Supervisor.
766-2357 (Dorset)

I've cant get a pump.

Vacuum

Suction Boring Bucket.

ASK FOR OUR COMPLETE FOLDER

WESTERN CAISSONS LTD.

FOUNDATION
SPECIALISTS

46 Credit Stone Road
Maple, Ontario

July 25th, 1968

Ontario Department of Highways
PO Box 790
Huntsville, Ontario

Attention: Mr. W. Hamm

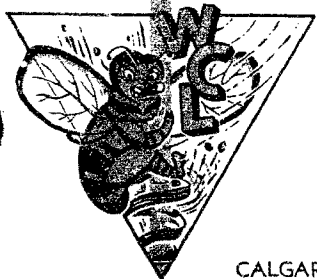
Dear Sir:

Re: Caissons
Ox Narrows Ontario
Contract No. 67-154

Due to the difficulty in obtaining a watertight seal at the surface of the bedrock on the above project, we wish to propose the following method of tremieing the concrete in order to complete the work.

- (1) The bottom of the hole will be pumped with our jet pump to be certain that any cuttings, if these exist, will be removed.
- (2) A tremie tube will be lowered to the bottom of the caisson.
- (3) Concrete consisting of a 7 bag mix minimum slump 7-8 inches will be placed through the tremie tube. The end of the tremie tube will be submersed at all times in the concrete for a depth of at least .5'.
- (4) After 15' of tremie concrete have been placed, the water remaining in the caisson will be pumped out and the remainder of the concrete poured by tremie method still keeping the tube submersed in the concrete.
- (5) Concrete will be poured up to a level above cut off elevation so that all laitance may be cleaned off.

...../2



WESTERN CAISSONS LTD.

FOUNDATION
SPECIALISTS

46 Credit Stone Road
Maple, Ontario

July 26th, 1968

Ontario Department of Highways
PO Box 790
Huntsville, Ontario

Attention: Mr. W. Hamm

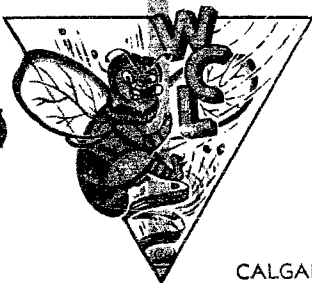
Dear Sir:

Re: Caissons
Ox Narrows Ontario
Contract No. 67-154

Due to the difficulty in obtaining a watertight seal at the surface of the bedrock on the above project, we wish to propose the following method of treming the concrete in order to complete the work.

- (1) The bottom of the hole will be pumped with our jet pump to be certain that any cuttings, if these exist, will be removed.
- (2) A tremie tube will be lowered to the bottom of the caisson.
- (3) Concrete consisting of a 7 bag mix minimum slump 7-8 inches will be placed through the tremie tube. The end of the tremie tube will be submersed at all times in the concrete for a depth of at least 5'.
- (4) Concrete will be poured up to a level above cut off elevation so that all laitance may be cleaned off.
- (5) We feel that the concrete placed with the tremie will be satisfactory, however, should the Department feel they would like to confirm this, then coring of the concrete would be required. This would be at an additional charge to the contract. Should the concrete prove to be unsatisfactory then the caisson will be pressure grouted at an additional charge to the contract.

...../2



As the above procedure is different than that originally outlined in the specifications, due to the impossibility of obtaining a seal, it is our intention to present an extra claim for all costs associated with this method of placing concrete.

We trust the above methods will meet with your approval. If any questions should arise, please do not hesitate to contact this office.

Yours very truly,

WESTERN CAISSONS LIMITED



J.C. Brownell, P. Eng.

JCB/jc

CC Mr. M. Devata
D40 - Downsview

W.P. 177-64 65-F-89 CONTR NO 67-154
HWY 35 OX NARROWS-KUSHOG LAKE BRIDGE
DISCUSSION WITH AL McKIM
NOTE:

BECAUSE OF BOULDERS CONTRACTOR HAD TO
CHURN DRILL TO SINK THE CAISSONS. THE BIT
IS 3 FT DIA.

HAVING A 3 FT BIT THE CONTRACTOR
PROCEEDED TO PENETRATE BEDROCK [GRAVITE-GNEISS]
WITH THE SAME BIT BUT FOUND GOING EXTREMELY
HARD. [CONTRACT CALLS FOR 1'6" HOLES 5 FT
INTO ROCK].

Q: CAN 3 FT HOLES BE TERMINATED
2-3 FT IN BEDROCK

A: YES. MAKE 2 FT MINIMUM AND CHANGE
REINFORCING FROM 1'6" TO 3' DIA TO
FIT THE LARGER HOLE.

REASON:

IT IS CONSIDERED ADEQUATE IN VIEW
OF THE SOUNDNESS OF THE ROCK
[100% RECOVERY]

JULY 11, 1968,

AGS

MEMORANDUM

To: Mr. W. S. Aitken,
District Engineer,
District #11 (Huntsville).

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. W. D. Ham,
Construction Engr.

DATE: July 31, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT: Re: Caisson Foundation Problem at Ox Narrows Bridge
District No. 11 -- Highway #35
W.P. 177-64 -- W.J. 65-F-89 -- Cont. 67-154

This memo summarizes the main points of discussions which took place recently between District personnel and the writer with reference to the installation of concrete caissons at Ox Narrows Bridge on Hwy. #35. Discussions were held during a site visit on July 18, 1968, and subsequently by telephone with Mr. Wes. Ham, Construction Engineer.

Problems had arisen during the installation of the caissons for the East pier, in that the Contractor was unable to dewater the drilled holes. During our site visit all the available data was reviewed and the conclusions reached, that the caisson liners were not in actual fact driven to the sound bedrock surface. The Contractor was therefore advised to advance his liners a few more feet and deepen the holes. This was done and the South-east liner is now successfully installed. In the case of the South-west liner the Contractor was still unable to achieve a watertight seal. It is believed that this is due to the unevenness of the rock surface, or to an excessive overbreak in the rock below the liner. The Contractor has now proposed a scheme involving the use of tremie concrete. This scheme is acceptable to the Department provided that a 1-1/2" ϕ concrete core recovered at the Contractor's expense after installation shows the tremie concrete to be satisfactory for the entire length of the caisson. This drill hole shall then be filled with suitable grout.

MD/MdeF

cc: Messrs. C. S. Grebski
A. McKim
H. A. Tregaskes
D. M. Hopper

Foundations Files ✓
Gen. Files

M. Devata
M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

Materials & Testing Office
Mr. Rutka
Mr. A. Rutka,
Materials & Testing Engineer,
Materials & Testing Office.

Materials & Testing Office,
Central Region,
Room 134, Lab. Bldg.

January 30, 1969.

Your action slip, Jan. 27/69.

Contract 67-154, Highway 35
Ox Narrows Bridge
Huntsville District

As requested in the letter (with appended claim data) to you dated January 15, 1969, I have reviewed the details of the claim where it effects the Materials & Testing Office. Since M. Devata of our Foundations Office was involved in the problem I have consulted with him. Our consensus of opinion is included in the following pertinent comments:

- (1) The design called for two caissons at each of the two piers. The piers are referred to as east and west, and the caissons as north and south at each pier. Design calls for three foot diameter caissons with keying five feet deep by 18 inches in diameter into the bedrock.
- (2) The Foundation Report indicates the rock to be a granite gneiss with schist intrusions. Although the rock surface is not particularly irregular it does fall from north to south. The rock is overlain by a thick layer of compact to very dense, silty sand and gravels with occasional boulders up to 24 inches in diameter in the lower portion of this deposit.

For the following reasons it is easily understandable why the contractor would have difficulty in obtaining a seal at the caisson liner rock contact:

- (a) Slope of rock could be steep enough that one side of the liner would be bearing on rock whereas the other would be hanging free in the overburden.
- (b) The boulders in the overburden could have damaged the liner tip during the driving.

continued:-

Mr. A. Rutka,
Materials & Testing Engineer,
Materials & Testing Office.

January 30, 1969.

Re: Contract 67-154, Highway 35

- (c) Since churn drilling was used to advance the liner it is quite possible that the bedrock was broken such that a ragged contact area was left.
- (d) Almost any type of rock could have fracture planes large enough to permit movement of water. On this particular job the head of water at the rock surface varied between 20 and 35 feet. This would result in high pressures at the point where a watertight seal was required.
- (3) Apparently early in July, 1968, Mr. A. McKim of the Bridge Office was advised by the district that the contractor was having difficulty in seating the liners. He got in touch with our Foundations Office, and as a result, M. Devata made a field trip to the site on July 18, 1968. During his visit he advised the field people that the liners were not seated properly and that they should be driven further. Between the interval of July 18, 1968 and July 31, 1968 the contractor managed to place three of the liners with watertight seals. The southwest one still remained a problem.
- (4) Subsequently, because water could not be kept out of the southwest liner the contractor proposed to use tremie concrete (see letters from Western Caissons Limited, dated July 25 and 26, 1968, to Mr. W. Ham, District Construction Engineer). Because of our previous experience with tremie concrete - e.g., Grand River Bridge at Paris - where very serious segregation and voids were discovered, it was decided that the concrete would have to be cored to ensure that it was sound. (Refer to M. Devata's memorandum of July 31, 1968.)
- (5) Subsequently, a meeting was held in Mr. R. A. Panter's office in early August, 1968 to discuss the various

continued:-

Mr. A. Rutka,
Materials & Testing Engineer,
Materials & Testing Office.

January 30, 1969.

Re: Contract 67-154, Highway 35

problems that had occurred and also the question of the extra costs involved. No conclusions were reached as to any extra payment and the contractor was apparently left with the impression that his only recourse would be to submit a formal claim. Present at this meeting were Messrs. R. A. Panter and M. Devata of D.H.O., a representative from Keystone, the general contractor, a representative from Looby, the bridge contractor and two representatives from Western Caissons.

I believe that Mr. Panter should be contacted by the Claims Engineer to give his version of the events since he had been involved quite intimately.

(6) To summarize, the points of contention are as follows:

- (a) One of the four liners could not be seated to give a watertight seal and permit pouring of concrete "in the dry". The possible reasons for this are outlined in section (2). As a result, the contractor had no option but to pour tremie concrete and the extra cost involved forms part of his claim.
- (b) D.H.O. requested the contractor to prove out the soundness of the concrete placed by tremie methods (refer to section (4)). This, of course, required coring and grouting of the core holes. The coring and grouting form the major part of the claim.

TJK/js.

T. J. Kovich,
Regional Materials Engineer.

cc: M. Devata ✓

- 2 -

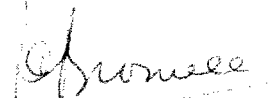
- (6) The concrete will be cored by a diamond drill to ascertain if suitable placing occurred, if required by the BHO.

As the above procedure is different than that originally outlined in the specifications, due to impossibility of obtaining a seal, it is our intention to present an extra claim for all costs associated with this method of placing concrete.

We trust the above methods will meet with your approval. If any questions should arise, please do not hesitate to contact this office.

Yours very truly,

WESTERN CAISSONS LIMITED



J.C. Brownell, P. Eng.

JCB/-3

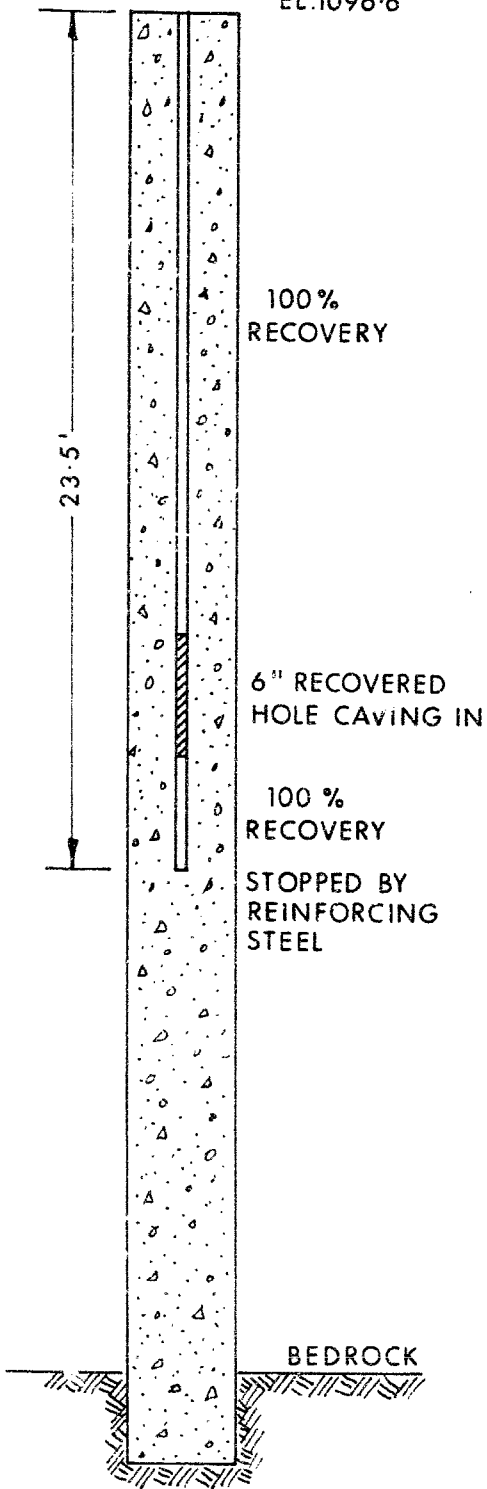
CC Mr. M. Devata
DHO - Downsview

S-W CAISSON

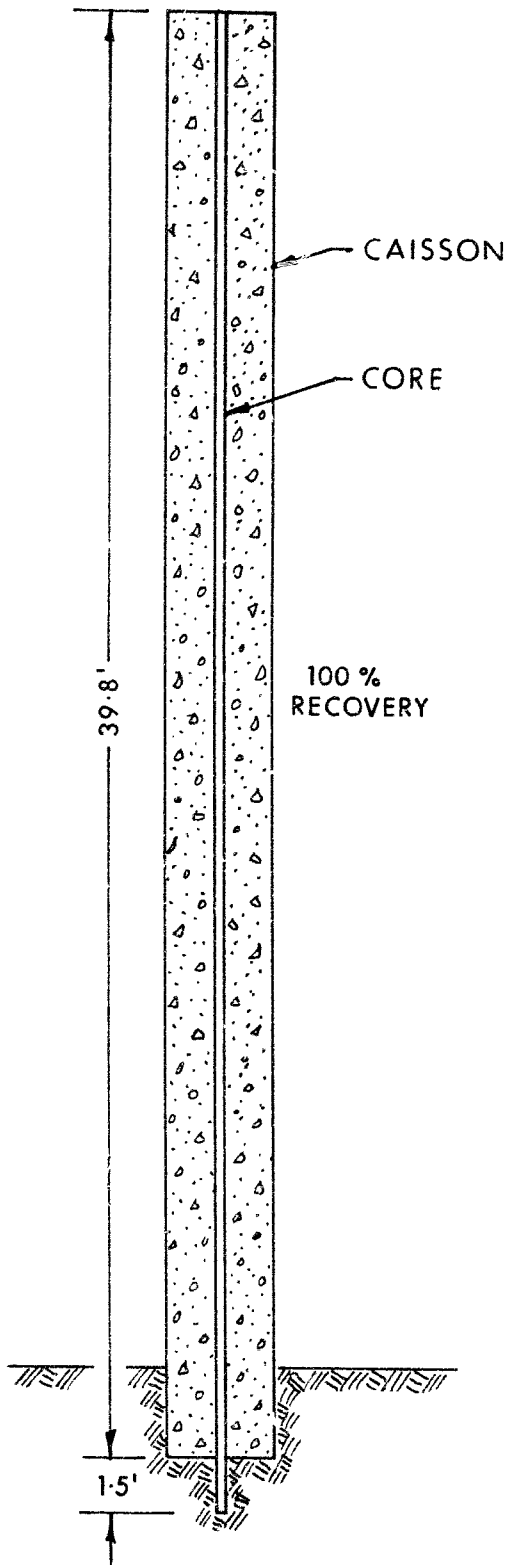
CONCRETE CORING TESTS

TEST No 1

EL.1096-6



TEST №2

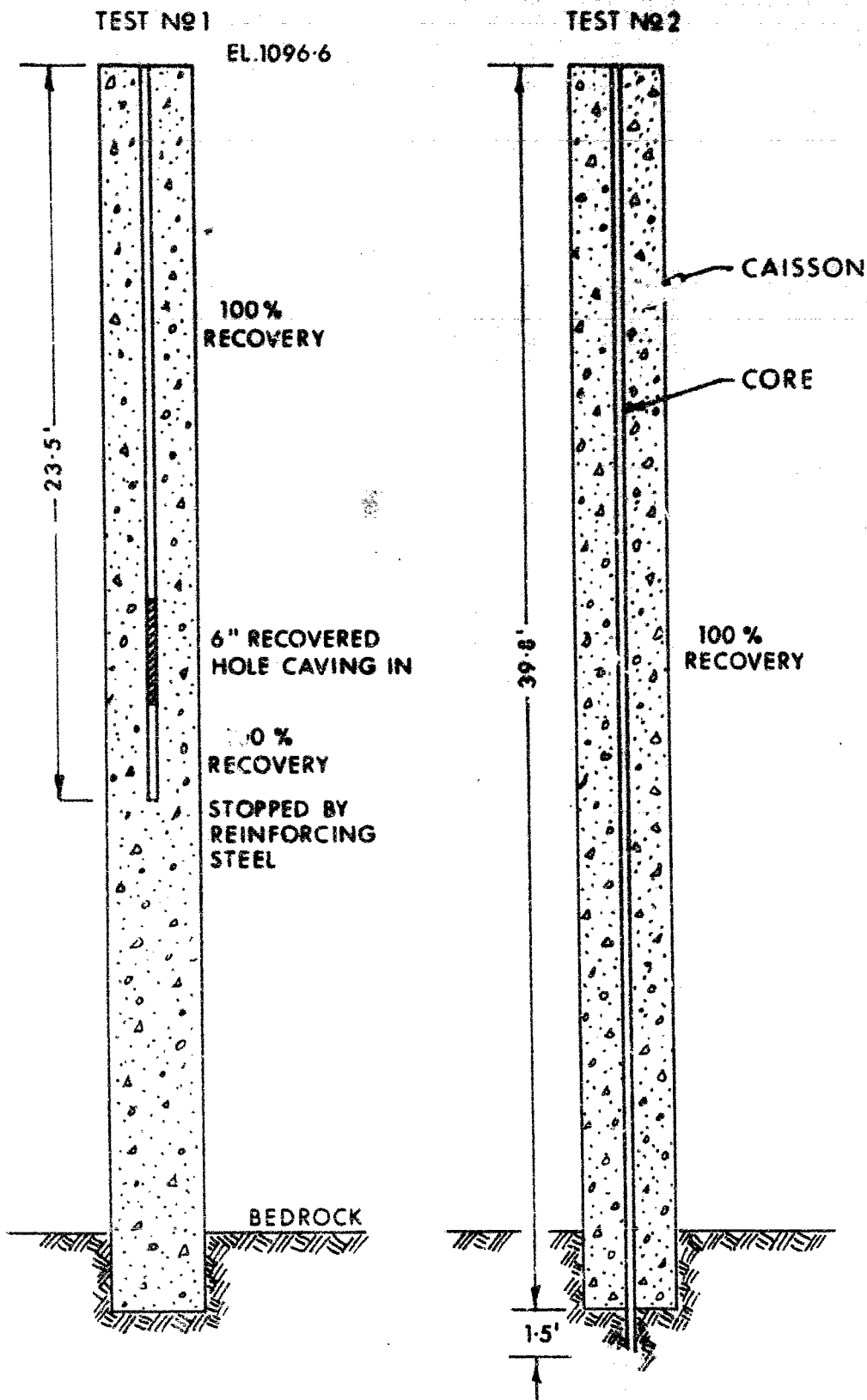


SCALE 1" = 5'

65-F-89

S-W CAISSON

CONCRETE CORING TESTS



SCALE 1" = 5'

65-F-89

Mr. G. Martens,
Assistant Claims Engineer.

A. Lutka

February 3, 1969

Your memo Jan. 15/69

Highway 35, Contract 67-154,
Claim for extra work associated with the
Caisson installation at Ox Narrows

Mr. Kovich has presented the factual information regarding the problem with the southwest caisson in his memorandum to me dated January 30, 1969. A copy of this memorandum is attached.

The contractor did run into some tough luck because of the water seepage into the liner. The exact reason for the seepage was not determined. It could have been caused by any of the factors outlined in Item 2 of Mr. Kovich's memorandum.

The problem as I see it is whether the liner could have been sealed; the other three liners, with some additional effort, were eventually sealed satisfactorily. If the southwest liner could not have been sealed because of fissures in the rock or for some other reason not connected with the contractor's methods, then I think the Department has some responsibility because the contract stipulates that the caissons were to be constructed in the dry. Construction in the dry would not be economically feasible under some conditions.

The Foundation drawings, included in the contract documents, indicated the conditions as they were encountered, i.e., boulders 18 - 24" in diameter in the silty sand and gravel above the bedrock. The original Foundation Report dated October 5, 1965, recommended steel H piles, however upon further discussion with the bridge designer it was considered that the caissons might be cheaper and suitable and as a result we were requested to discuss this site with a Caisson and Piling contractor. Coincidentally, Western Caissons were consulted and they indicated that this was a good site for caissons. They eventually turned out to be the sub-contractors. When the contractor ran into difficulty with the seepage, he requested permission to use tremie concrete.

In view of our previous difficulties at Paris we indicated that this method would be suitable but that we would have to be assured that there were no voids in the concrete in view of the importance of the foundation to this structure. As the tremie concrete was the only alternative left to the contractor, we had to go along with it

/cont'd.....

and he had to prove to our satisfaction, through coring, that suitable concrete would be produced. After the concrete was placed, two drill holes were made; the first drill hole drifted and had to be terminated at a depth of 23 1/2 ft. below the surface; however before the core hole was terminated, it was discovered that there was a cavity in the concrete. The other hole drilled to the bottom of the caisson for a depth of about 40 ft., showed good concrete all the way. The contractor was therefore asked to grout the poor concrete, which he did. The Bridge Office, as I understand, wanted to be sure that the grouting job was done satisfactorily and another core hole was requested. I understand this other core was made and the concrete proved to be satisfactory.

Whether the claim is justified depends upon whether the contractor did all that he was reasonably expected to do in trying to obtain a watertight liner. If he did, then I believe we should give this claim further consideration. Tremie concrete is a well established practice but we have had trouble in the past on some jobs in obtaining uniform concrete throughout. I think the Department is justified in asking for proof by way of coring but I do not believe the contractor should be expected to pay for the coring if it was not possible to seal the liner. If it was possible, then the contractor should bear the expense.

I would suggest you contact Mr. Panter for further information as he was in on all of the discussions and decisions to go to tremie concreting on this job.

AR

A. Rutka,
Materials and Testing Engineer.

ar/jm
encl.

cc: R. A. Panter
T. J. Kovich
A. Stermac

Mr. A. Rutka,
Materials & Testing Engineer,
Materials & Testing Office.

January 30, 1969.

Re: Contract 67-154, Highway 35

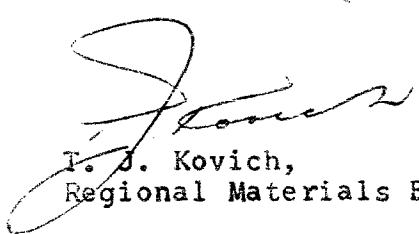
problems that had occurred and also the question of the extra costs involved. No conclusions were reached as to any extra payment and the contractor was apparently left with the impression that his only recourse would be to submit a formal claim. Present at this meeting were Messrs. R. A. Panter and M. Devata of D.H.O., a representative from Keystone, the general contractor, a representative from Looby, the bridge contractor and two representatives from Western Caissons.

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TJK/js.


T. J. Kovich,
Regional Materials Engineer.

cc: M. Devata

Mr. A. Rutka,
Materials & Testing Engineer,
Materials & Testing Office.

January 30, 1969.

Re: Contract 67-154, Highway 35

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continued:-

MEMORANDUM

To: Mr. A. Rutka,
Materials & Testing Engineer,
Materials & Testing Office.

FROM: Materials & Testing Office,
Central Region,
Room 134, Lab. Bldg.

ATTENTION:

DATE: January 30, 1969.

OUR FILE REF.

IN REPLY TO Your action slip, Jan. 27/69.

SUBJECT:

Contract 67-154, Highway 35
Ox Narrows Bridge
Huntsville District

As requested in the letter (with appended claim data) to you dated January 15, 1969, I have reviewed the details of the claim where it effects the Materials & Testing Office. Since M. Devata of our Foundations Office was involved in the problem I have consulted with him. Our consensus of opinion is included in the following pertinent comments:

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- (a) Slope of rock could be steep enough that one side of the liner would be bearing on rock whereas the other would be hanging free in the overburden.
- (b) The boulders in the overburden could have damaged the liner tip during the driving.

continued:-

46 Credit Stone Road
Maple, Ontario

July 25th, 1968

Ontario Department of Highways
PO Box 790
Huntsville, Ontario

Attention: Mr. W. Rams

Dear Sir:

Re: Caissons
Ox Narrows Ontario
Contract No. 67-154

Due to the difficulty in obtaining a watertight seal at the surface of the bedrock on the above project, we wish to propose the following method of tremie the concrete in order to complete the work.

- (1) The bottom of the hole will be pumped with our jet pump to be certain that any cuttings, if these exist, will be removed.
- (2) A tremie tube will be lowered to the bottom of the caisson.
- (3) Concrete consisting of a 7 bag mix minimum slump 7-8 inches will be placed through the tremie tube. The end of the tremie tube will be submersed at all times in the concrete for a depth of at least .5'.
- (4) After 15' of tremie concrete have been placed, the water remaining in the caisson will be pumped out and the remainder of the concrete poured by tremie method still keeping the tube submersed in the concrete.
- (5) Concrete will be poured up to a level above cut off elevation so that all laitance may be cleaned off.

...../2

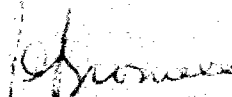
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We trust the above methods will meet with your approval. If any questions should arise, please do not hesitate to contact this office.

Yours very truly,

WESTERN CAISSONS LIMITED



J.C. Brownell, P. Eng.

JCB/jd

CC Mr. S. Devata
DHO - Downsview

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

WESTERN CAISSONS LTD.

FOUNDATION
SPECIALISTS

46 Credit Stone Road
Maple, Ontario

July 26th, 1968

Ontario Department of Highways
PO Box 790
Huntsville, Ontario

Attention: Mr. W. Hamer

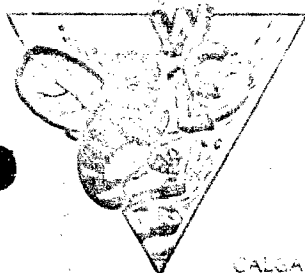
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Contract No. 67-154

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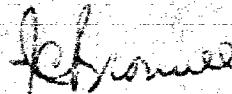
CALGARY EDMONTON SASKATOON REGINA WINNIPEG TORONTO MONTREAL
Phone 272-9531 Phone 437-2241 Phone 253-1547 Phone 568-4624 Phone 783-6283 Phone 889-7383 Phone 323-3128

DEFECTS IN NEGATIVE DUE TO

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Yours very truly,

WESTERN CARISONS LIMITED



J.C. Brownell, P. Eng.

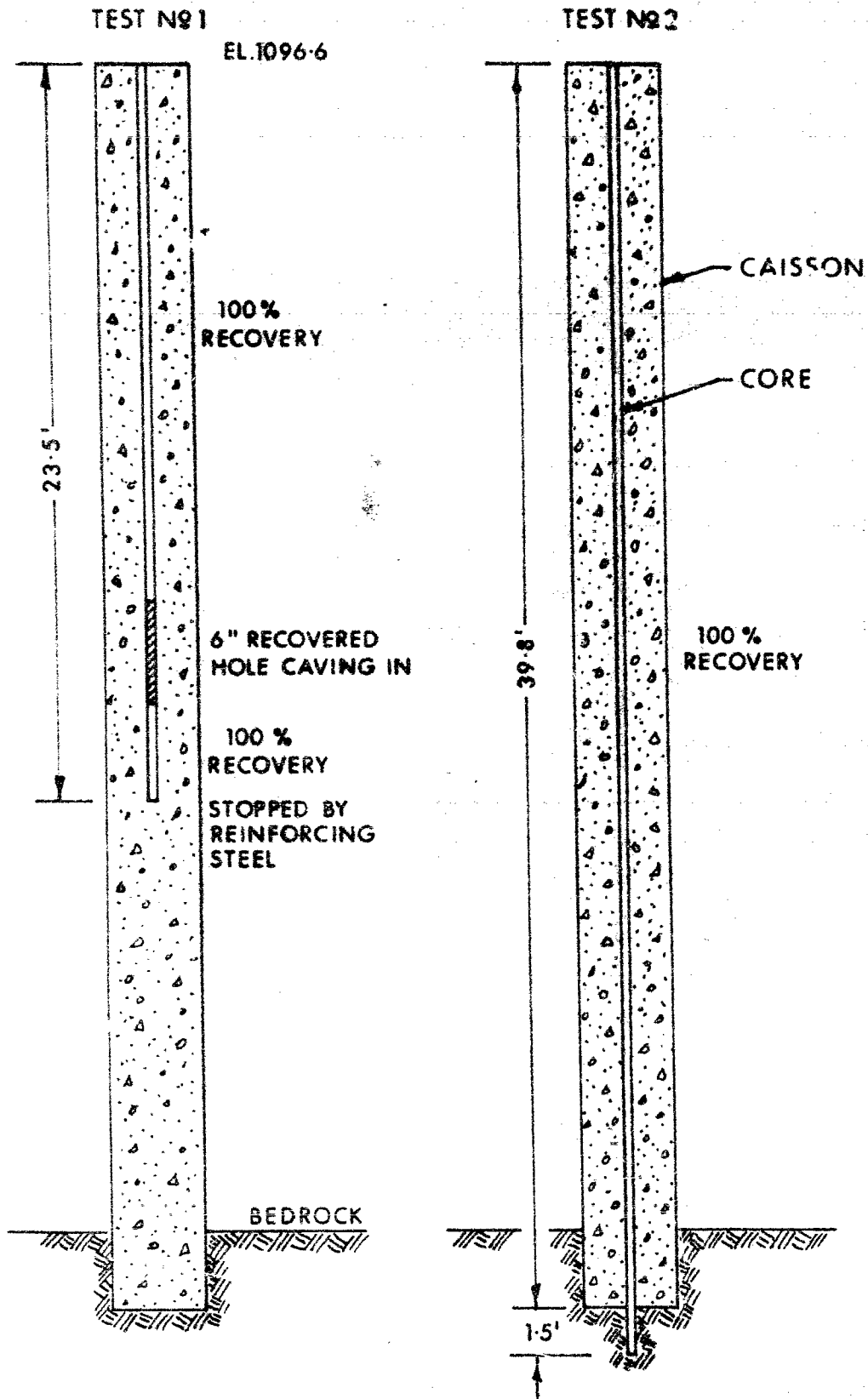
CC/yc

CC Mr. M. Devata
D4C - Downsview

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

S-W CAISSON

CONCRETE CORING TESTS



SCALE 1" = 5'

65-F-89

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario.

DATE: July 26, 1965.

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 177-64, Narrows Bridge,
Hwy. #35, District #11.

A foundation investigation is required at the above crossing.

The proposed structure will have a minimum span of 60' for navigation requirements. The grade as shown may be raised by 1 to 2 feet in order to give the required vertical clearance.

Ample accommodation is available on either side of the Narrows.

Jb.m. McAllister

JCMCA/ag
c.c. N. D. Smith
R. Fitzgibbon

J. C. McAllister,
for S. McCombie,
Bridge Planning Engineer.

65 - F - 89
Aug. 5/65