Public Works Travaux publics Canada Canada

Design and Construction Transportation

Bridge Division

Liard Highway Northwest Territories

Upper Blackstone River Bridge Kilometre 108.3

Preliminary Report



Rec. trangentation Do AUG 31 1979



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UPPER BLACKSTONE RIVER BRIDGE

Liard Highway Kilometre 108.3 Northwest Territories

PRELIMINARY REPORT

July 1979

STRUCTURES (BRIDGES) DIVISION TRANSPORTATION DIRECTORATE DESIGN AND CONSTRUCTION PUBLIC WORKS CANADA OTTAWA

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INTRODUCTION

The Transportation Directorate of Public Works Canada has undertaken at the request of its Western Region, the Preliminary Design of Upper Blackstone River Bridge based on the information provided by the following:

1)Hydrological:Unies Ltd.,M.M. Dillon Ltd.,1666 Dublin Ave.,ANDBox 219, Station K,Winnipeg, Manitoba.Toronto, Ontario.

Geotechnical: Geotech

2)

3)

Geotechnical Services, Design and Construction, Western Region, Public Works Canada.

Environmental: Synergy West Ltd., 4515 Bow Trail S.W., Calgary, Alberta.

The preliminary design report includes the recommended type of substructure and superstructure as well as a cost estimate and summaries of the recommendations contained in the above reports.

SUMMARY

- 1. The Upper Blackstone River Bridge crossing is located on the Liard Highway at kilometre 108.3
- 2. The proposed superstructure consists of a single, simply supported span with an overall length of 40 m. The construction is of the composite type (steel and concrete). The substructure consists of two concrete abutments supported on closed end steel pipe piles.
- 3. The estimated cost is approximately \$530,000 as of July, 1979.
- 4. All technical data provided by other sources is considered adequate for the final design.
- 5. Sources of backfill and aggregate material are readily available at the site.
- Note: Upper Blackstone River Bridge is located only 0.6 km south of the Blackstone River Bridge. Both bridges use the same type of superstructure components, the same type abutments as well as the same railing, expansion joints and piling. For these reasons construction of the two bridges under one contract will result in lower prices.

HYDROLOGICAL DATA

The information below was provided by Unies Ltd. in June, 1974. It is considered sufficient for Final Design. In addition, the mean annual discharge has been calculated based on the formula given in the draft copy of the April, 1979 report by M.M. Dillon Ltd.

- 1. Total Drainage Area: 380 km².
- 2. Effective Drainage Area: 288 km².
- 3. Design Discharge: 65 m³/s.
- 4. Mean Annual Discharge: 25.5 m³/s (Dillon formula).
- 5. Natural Mean Main Channel Velocity (at design discharge at bridge site): 1.67 m/s
- 6. Design High Water Level: EL 120.1 (1969 severe icing).
- 7. Design Low Water Line: EL 118.3.
- 8. Estimated General Bed Scour to EL 113.0.
- 9. Waterway Opening (minimum): 19 m.

GEOTECHNICAL DATA

The information below was provided by Geotechnical Services, Western Region, Public Works Canada in April, 1979. This information is sufficient for Final Design.

Site Conditions

The crossing site is located approximately 1 km upstream from the confluence of the Upper and Lower Blackstone Rivers and only 0.6 km south of the Blackstone River Bridge. The river is located in a narrow valley that is incised into alluvial deposits consisting partially of sands and gravels. The flood plain is 4 m above stream bed. On the flood plain to the west is an infilled channel which is some 150 m from the bridge site and therefore should not cause any settlement problems.

Subsoil Conditions

The major subsoil layer is a dense basal till found from 3.4 m to 3.7 m below ground level.

The deposits above this layer consist of loose or soft layered clay silts or sandy silts over a layer of sand and gravel. Boulder pavement is evident within the channel and is roughly 0.5 m in thickness.

The basal till consists of a low to medium plastic sandy silty clay with numerous pebbles. Cobbles and boulders are also present throughout this bearing layer.

The till is stiff and increases in density and in sand and gravel content, with depth. No significant consolidation should occur in the till under the bridge loadings.

Proposed Foundations

It is recommended that both abutments be set on piles since the bearing surface is relatively deep at the abutment sites. It is necessary to utilize both shaft friction and end bearing in the load transfer. Closed end steel pipe piling may be utilized

at a depth of at least 8 m into the till with an end bearing capacity of 1250 kPa and shaft friction of 30 kPa. Since driving may be difficult it is recommended that detailed reports of all pile driving be kept.

Prebored cast in place piling may be used as an alternate method of load transfer. Shaft friction or drilled caissons may be used although belling may be difficult. Design of these piles should be based on either friction or end bearing but not both. The allowable shaft friction is 40 kPa and the bearing capacity is 350 kPa at 2 m or 500 kPa at 5 m below the till surface.

Backfill Material

Granular backfill material and concrete aggregates (with processing) can be obtained from the floodplain to the east of the Lower Blackstone.

ENVIRONMENTAL DATA

The information below was provided by Synergy West Ltd. of Calgary, in the Liard Highway Study report May, 1975 and is considered sufficient for Final Design.

Climate

The mean temperature varies between -34°C and -26°C in January and between 14°C and 22°C in July. Based on Fort Simpson readings the mean annual precipitation is 330 mm and the mean annual snowfall is 1 520 mm.

The bridge site is an alluvial flood plain of the Blackstone at the same level as the Liard flood plain. There is a relatively straight stretch in the river at this point and the site is only 0.6 km south of the Lower Blackstone River crossing. The area is relatively flat with heavy vegetation.

Vegetation

The vegetation consists mainly of white spruce forest underlain by alders and dogwood. Black spruce and balsam poplar may be scattered throughout this forest. A very dense shrub layer is in evidence throughout due to Brule vegetation formed after fires. Rose is the most common shrub.

No problems should arise from the distrubance of these vegetations except for their aestetic qualities. Large trees should be preserved for this purpose.

Wildlife

The results of construction in this area will affect wildlife the most. However actual construction will only have a short term effect. Hunting will be the major impact and must be regulated closely.

Moose are the most abundant of big game animals and are scattered throughout the Liard River Valley. They are most concentrated during the winter and near the Blackstone Rivers seem to stay during the summer due to a favourable habitat. Due to the habits of moose to move along highway lines, certain routes must be marked to avoid vehicle accidents.

Care must be exercised in camps to dispose of all garbage to avoid the occurrence of grizzly and black bear. Again use of firearms must be regulated.

The beaver is widely distributed and trapping occurs through the Liard area. The Upper Blackstone River is of sufficient size so that little concern is necessary as to beavers causing any drainage problems.

Waterfowl and raptors are evident near the Mackenzie but present little problem at the Upper Blackstone.

The general conclusion is that construction on the Liard will cause few problems. However the users of the highway should be controlled.

Fish

Four species of fish were found in the Upper Blackstone. Numerous other species may be evident at the joining of the Upper and Lower Blackstone. In the Lower Blackstone there exists a large potential spawning area which would make this a potentially important stream. The river must be protected so as to allow possible migration up the tributary.

Archeology

Evidence tends to show that the Liard Highway would run along a main aboriginal route. The Blackstone Rivers area has been designated a high priority area i.e. area with greatest probability of discovery. Paleontological sites have already been recorded in the Blackstone Rivers area along the Liard. It will be necessary to inform construction personnel as to the nature and importance of material discovery through briefing sessions.

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SELECTION OF BRIDGE STRUCTURE

A) Recommended Structure:

1. Substructure: Two cast-in-place concrete abutments on closed end steel pipe piles driven into the basal till at least 8 m.

2. Superstructure: The proposed superstructure consists of a single span, simply supported, with an overall length of 40 m. The cross section consists of four steel girders with a composite cast-in-place reinforced concrete deck. More information with respect to the superstructure and the materials can be found on page 10.

B) Reasons for these selections:

1) Substructure:

The choice of foundation was generally dictated by the soil conditions.

As recommended in the geotechnical report, piles were chosen for the abutment support. Because of a deep layer of soil overlying the basal till at the abutments a deep abutment with a long wingwall was an alternative. However, since the soil bearing capacity is rather low, it would necessitate a large footing. Also, since the Lower Blackstone Bridge utilizes piles, the same type of foundation here, provides an economical solution. It is therefore more economical to use piles and thus eliminate the use of large quantities of concrete. Steel piles where chosen over the alternate cast-inplace concrete piles because it would be difficult to excavate to a sufficient depth in the dense till at this site. Deep excavations would be necessary in order to obtain adequate friction or end bearing capacities.

STRUCTURAL DATA

1. Specifications: CSA CAN3-S6-M78. 2. Loading: A) MS-250 B) 1.20 kPa on roadway for future surfacing. A) Overall bridge length - 40 m 3. Bridge Length: B) Face to face of backwalls - 32 m C) Centre to centre bearing - 31.4 m. 4. Bridge Width: A) Overall width - 10 m B) Roadway width - 9 m. Piles for Abutments: Closed end steel pipe piles - 12.75 in. O.D. 5. Abutments: Two cast-in-place concrete abutments with wingwalls and approach 6. slabs. Embankments: 2 to 1 slope. 7. 300 mm diameter stones, 600 mm thick. Rip-rap for abutments: 8. 9. **Expansion Bearings:** Capable of providing a sliding surface for expansion as well as being capable of taking the vertical loads imposed upon it. Structural Steel: CSA G40.21, grade 350A, weathering steel (not painted). 10. 11. Cast-in-place Concrete: Deck and Approach - 30 MPa Abutments - 25 MPa. 12. Deck Expansion Joints: Strip seal rubber joints held in steel angles and (at each abutment) clamps set into concrete.

- 13. Curbs: Two 500 mm x 300 mm cast-in-place curbs.
- 14. Reinforcing Steel: CSA G30.12-M1977, Grade 400.
- 15. Railings: Galvanized HSS (CSA G40.21 Grade 350W) post and rails at 750 mm above roadway.
- 16. Clearance: Clearance above high water line to the underside of the beam is 1.5 m.
- 17. Elevations: at centreline of roadway.
 - A) North Abutment 122.85
 - B) South Abutment 122.79.

lte	m Description	Unit of Measurement	Estimated Quantity	Unit Price \$	Cost \$
SL	IBSTRUCTURE				
1	Excavation	m ³	95	30.00	2.850
- 2	Granular Fill	m ³	1.000	8.00	8,000
3	Rip Rap	m ³	275	75.00	20,630
4	Steel Pipe Piles	m ¹	330	100.00	33,000
5	Installation	Each	30	2,000.00	60,000
6	Concrete Abutment	m ³	125	450.00	56,250
7	Abutment Reinforcement	kg	6,635	1.40	9,290
				Subtotal	190,020
้รเ	JPERSTRUCTURE			•	
	Bearings	Each	8	2,500.00	20,000
	Steel	tonne	44	3,000.00	132,000
	Concrete Deck	m ³	77	550.00	42,350
	Reinforcing	kg	11,957	1.40	16,740
	Deck Drains	Each	4	250.00	1,000
	Deck Exp. Joints	m	20	1,000.00	20,000
	Curb Exp. Joints	Each	4	625.00	2,500
	Railing	m	78	200.00	15,600
				Subtotal	250,190
				Total	440,210

COST ESTIMATE

Plus Contingencies and Engineering

Approx 20% =

89,790

TOTAL \$<u>530,000</u>

Average Cost

A) \$16,563 per metre of superstructure length.

B) \$13,250 per metre of overall length.

C) \$ 1,325 per square metre of overall bridge dimensions.

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DRAWING

1. GENERAL LAYOUT

Notes: The following drawing is reduced in size. Full size prints can be obtained from the Transportation Directorate, Public Works Canada.

Appendix "A"

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Public Works Canada Blackstone Biyen Bridge	Project Requirements	Section HC01015
Upper Blackstone River Bridge	Project No. 085903	Tage i
<u>l Description of Work</u> .1	Work under this contract cover .1 Blackstone River Bridge .2 Upper Blackstone River Brid including immediate approaches indicated.	3 construction of: dge and incidental work as
<u>2 Location</u> .1	Blackstone River Bridge - Liar Northwest Territories.	d Highway Km 107.4
•2	Upper Blackstone River Bridge - Northwest Territories.	- Liard Highway Km 108.3
<u>3 Completion Date</u> .1	Complete work by	
<u>4 Engineer's Address</u> .1	Public Works Canada Western Region 9925 109th Street, Edmonton, Alberta T5K 2J8	
<u>5 Work Schedule</u> .1	Within fourteen (14) days from Contract submit for Engineer's schedule indicating anticipate time of completion.	Notification of Award of approval, construction d progress stages within
.2	Take necessary measures to com scheduled time. Do not change Engineer's approval.	plete work within schedule without
6 Bearings .1	General: .1 Fabricate bearings accordinates design data as indicated. .2 List in construction tender used. .3 No alternative is permitter Blackstone River Bridge.	ng to typical details and r types of bearings to be d for fixed bearings at
.2	Acceptable bearings: .1 Goodco pot bearings by Good .2 Lubrite or Lubritef bearing .3 Spencer floating bearings .4 Tetron cylindrical bearing International Ltd. .5 Wabo-Fyfe high load bearing	dco Ltd. gs by Merriman Inc. by Andre Rubber Co. Ltd. s by Conenco gs by Elastometal Ltd.

Public Works Canada Blackstone River Bridge Upper Blackstone River Bridge	Project Requirements	Section HC01015
	Project No. 085903	
6 Bearings (Cont'd) .3	Common materials:	

galvanized. .2 High strength bolts: to ASTM A325-76c, Type 1, and to be galvanized. .3 Preformed fabric pads: to CSA CAN3-S6-M78, Clause 11.17(a). .4 Anchor bolts: to be threaded one end and deformed shank to CSA G30.12-M1977, Grade 300, and to be galvanized. .5 TFE surfaces: to CSA CAN3-S6-M78, Clause 11.11. .6 Confined elastomer: to be basically 100% virgin natural polyisoprene to CSA CAN3-S6-M78, Clause 11.10.3. .7 Elastomer for elastomeric bearing pads to conform to Clause 6.3.6 above. .4 Shop drawings and material specifications: .1 Submit for approval of Engineer two (2) sets of shop drawings and material specifications within six (6) weeks of Award of Contract. .2 Submit five (5) sets for distribution after approval. .5 Fabrication and installation: .1 Fabrication: welding and galvanizing to Section HC05121. .2 Installation: in accordance with bearing manufacturer's instructions and recommendations. .6 Measurement for payment: .1 Supply and installation of bearings to be measured as lump sum price.

7 Deck Expansion Joints

.1 General:

.1 Fabricate deck expansion joints according to typical details and design data as indicated.
.2 List in construction tender types of deck expansion joints to be used.

.1 Steel: to CSA G40.21-M1978, Grade 350A, and to be

.2 Acceptable deck expansion joints:

.1 Goodco road and expansion joint system by Goodco Ltd.

.2 Wabo-Maurer strip-seal expansion joints by Elastometal Ltd.

.3 Acme strip-seal joints (tech-7802) by Acme Highway Products Inc.

.4 All acceptable systems include cover protection plate as shown on drawing No. 11 of 14.

Public Works Canada	Project Requirements Section HC01015
Blackstone River Bridge	Page 3
Upper Blackstone River Bridge	Project No. 085903
(Cont'd) .3	Materials: .1 Elastomer: to CSA CAN3-S6-M78, Clause 11.10.3.
	 .2 Steel for cover plates: to CSA G40.21-M1978, Grade 300W, and to be galvanized. .3 Countersunk bolts: to ASTM A307-76b or equivalent, and to be galvanized. .4 Studs: to Appendix H of CSA W59-1977.
.4	 Shop drawings and material specifications: .1 Submit for approval of Engineer two (2) sets of shop drawings and material specifications within six (6) weeks of Award of Contract. .2 Submit five (5) sets for distribution after approval.
•5	Fabrication and installation: .1 Fabrication: welding and galvanizing to Section HC05121. .2 Installation: in accordance with deck expansion joint manufacturer's instructions and recommendations.
•6	Measurement for payment: .l Lump sum price for deck joints, including joint seal, covers, supply and installation.
8 General Environmental .1 Guidelines	Exercise extreme caution during excavation due to possibility of archaeological discoveries. Any such discovery should be reported to Engineer immediately.
•2	At no time must gravel be removed from stream bed.
•3	Causeways for construction will not be permitted.
.4	Prevent entry of cement, lime or fresh concrete into stream.
.5	No construction will be permitted during period from late April to early July.
.6	All approaches, cuts, and fills adjacent to stream are to be stabilized, and ditch run-outs must be designed to prevent entry of silt into stream.
.7	On conclusion of construction, all debris must be disposed of to prevent its entry into stream, and stream bed must be returned to its original configuration.

Public Works Canada	General Requirements Section HC01016
Blackstone River Bridge	Page 1
Upper Blackstone River Bridge	Project No. 085903
<u>l Terms and Definitions</u> .l	Right-of-way: Area reserved by Department for highway purposes.
.2	Roadway: Portion of right-of-way within construction limits.
.3	Substructure: .1 Piers. .2 Abutments including approach slabs.
.4	Superstructure: All parts of structure not included in substructure.
2 Clean-up .1	During process of work and until final clean-up, keep occupied areas and access in a neat, clean and safe condition.
3 Measurement of .1 Quantities	Linear: All items which are measured by metre, such as pipe culverts, guiderail and underdrains, to be measured along centerline of installation unless otherwise shown on plans.
.2	Area: .1 All longitudinal and transverse measurements for areas except for seeding and sodding to be measured horizontally. .2 All longitudinal and transverse measurements for seeding and sodding to be made on actual flat or sloped surface seeded or sodded.
.3	Volume: .1 In computing volumes of excavation, borrow and embankment, average end area method to be used whenever possible. .2 When materials are to be measured in haulage vehicle, provide vehicle of size and type acceptable to Engineer. Unless approved vehicles are of uniform capacity, each must bear a plainly legible identification mark indicating its specific approved capacity. Level and measure loads at point of delivery; no allowance to be made for settlements of material while in transit. .3 Material specified to be measured by cubic metre may be weighed and such mass converted to cubic metres for payment purposes if approved by Engineer. Factors

of conversion to be as determined by Engineer and agreed to before such method of measurement is used.

Public Works Canada	General Requirements Section HC01016
Blackstone River Bridge	Page 2
Upper Blackstone River Bridge	Project No. 085903
3 Measurement of .4 Quantities (Cont'd)	Mass: .1 Term "tonne" means 1000 kilogram. .2 Weigh all materials which are specified for measurement by mass on scales approved by and at locations designated by Engineer. Weigh trucks used to haul material being paid for by mass, empty at such times as Engineer directs, and mark each truck with a plainly legible identification mark. .3 Provide suitable weigh scales, approved by Engineer of suitable design and of sufficient capacity to accommodate any vehicle used on work, and inspected and tested for accuracy as often as may be required by Engineer. Provide weatherproof scalehouse constructed to afford protection for recording devices of scales; of a suitable size having one sliding window facing scale platform, one end window and a shelf desk at least 0.6 m wide and 2 m long. Doors to open away from scale platform. Provide adequate lighting and heating. .4 Freightcar mass to be accepted if material is shipped by rail.
<u>4 Layout of Work</u> .1	Engineer to set control stakes and establish bench marks to indicate location, alignment and reference elevation for work. Complete layout work based on established bench marks, location and alignment.
5 Public Convenience .1 and Safety2	Conduct work so as to assure safety and convenience of general public. Regulate operations so as to protect visitors and campers on Crown lands involved.
6 Barricades and .1 Warning Signs	Provide, erect, and maintain all necessary and suitable barricades, warning lights, danger signals, and other signs; provide a sufficient number of flagpersons and watchpersons. Protect highways closed to traffic by effective barricades and illuminate obstructions at night. Provide warning signs, illuminated at night by lanterns or flares, to mark places where surfacing ends or is not compacted.

Public Works Canada	General Requirements	Section HC01016
Blackstone River Bridge		Page 3
Upper Blackstone River Bridge	Project No. 085903	

<u>7 Control of Traffic</u> .1 Maintain continuous normal highway traffic at all times and provide for safe movement of travelling public through work area in a manner approved by Engineer. Period and timing of any traffic interruption to be agreed by Engineer.

- .2 Notify Engineer at least 48 hours in advance of any period of traffic interruption expected to exceed twenty (20) minutes.
- 8 Sanitary, Health and Safety Provisions
- .l Provide and maintain in a neat condition sanitary facilities at site for use of Contractor's and Engineer's employees. Remove facilities on completion of work.
- .2 Comply with laws, rules and regulations concerning construction safety and health standards.
- .3 Obtain authorization for use of water and disposal of domestic sewage wastes prior to establishing camp.
- 9 Environmental Protection
- .1 Comply with laws and regulations controlling pollutions of environment.
- 10 Operations of Other Contractors
- .1 Fully cooperate with other contractors having business on site.
- <u>11 Project Signs</u> .1 Engineer to provide two printed vinyl overlays 1.2 m to 2.4 m for project signs. Contractor to provide all other materials and labour to satisfactorily mount signs and erect them at locations stipulated by Engineer. On completion of projects, dismantle and dispose of these sign boards.
- <u>12 Utility Line</u> .1 Existing utility lines which may interfere with completed work to be removed or relocated by others.
- 13 Measurement for .1 Items under Section HC01016 not to be measured for payment but to be considered incidental to contract.

Public Works Canada	Excavation and Fill	Section HC02222
Blackstone River Bridge	for Structures	Page 1
Upper Blackstone River Bridge	Project No. 085903	1978-08-15

PART 1 - GENERAL

1.1 Description	.1	This section specifies requirements for excavation and fill, and supply and installation of protective works necessary for constructing substructures and approaches.
1.2 Classifiction of Excavation Materials	.1	Unclassified excavation materials: deposits of what- ever nature encountered in work.
1.3 Requirements of Regulatory Agencies	.1 .2	Adhere to applicable codes when blasting is required. Adhere to requirements relating to safety of excava- tions and protection of workmen.
1.4 Design of <u>Temporary Works</u>	.1 .2 .3	Design cofferdams, sheathing, shoring, timbering and bracing required for work. At least 4 weeks prior to commencement of work, submit four sets of design and erection drawings and support- ing data to Engineer for review. Have drawings and supporting data signed and stamped by professional engineer responsible for their design.
1.5 Measurement for Payment	.1	Excavations to be measured in cubic metres in their original location. .1 Volume measured for payment to be within limits bounded by original ground surfaces and bottom of sub- structure and by vertical planes 500 mm outside of lines of substructure plan or bounded by sheet piling enclosure. .2 Backfill of excavated volume indicated above, unoccupied by substructure, to be considered incidental to excavation.
	•2	Excavation and backfill of volumes outside limits indi- cated above, when required for construction purposes,

to be considered incidental to excavation.

Public Works Canada	Excavation and Fill	Section HC02222
Blackstone River Bridge	for Structures	Page 2
Upper Blackstone River Bridge	Project No. 085903	1978-08-15

1.5 Measurement for Payment (Cont'd)

- .3 When Engineer orders additional excavation below bottom of substructure extra payment will be made for this excavation and backfill.
- .4 Fill material, including supply, handling, stockpiling, placing and compaction, to be measured in cubic metres in place.
- .5 Temporary works and dewatering to be considered incidental to excavation except steel sheet piling to be paid under Section HC02411.

PART 2 - PRODUCTS

2.1 Materials

.1 Fill material:

.1 Granular fill: pit run natural or blended sand or gravel consisting of clean, hard, durable particles, free from clay lumps, cementation or organic material, having less than 9% by mass passing 63 micrometres sieve, capable of being compacted to degree as specified herein and meeting approval of Engineer. .2 Common fill: selected materials from excavations or borrow areas, suitable to Engineer for use intended, free from frozen materials, cinders, ashes, sods, organic materials, refuse or other deleterious substances.

PART 3 - EXECUTION

3.1 Temporary Work, Cofferdams, Shoring and Bracing

- .1 Construct temporary works to depths, heights and locations as designed.
- .2 During fill operation:

.1 Unless otherwise indicated or directed by Engineer, remove sheeting and shoring from excavations.
.2 Do not remove bracing until fill has reached respective levels of such bracing.
.3 Pull sheeting in increments so that compacted fill is maintained at a depth at least 500 mm above toe of sheeting.

.3 When sheeting is required to remain in place, cut off tops at elevations indicated or at such elevations directed by Engineer.

.4 Upon completion of substructure construction:
.1 Remove cofferdams shoring and bracing.
.2 Remove excess materials from site and restore water courses to conditions indicated or directed by Engineer.

Public Works Canada	Excavation and Fill	Section HC02222
Blackstone River Bridge	for Structures	Page 3
Upper Blackstone River Bridge	Project No. 085903	1978-08-15

- 3.2 Dewatering
- .1 Provide pumps and other equipment and materials necessary to keep excavations free of water while work is in progress.
- .2 Do not pump during placing of concrete, or for a period of at least 24 hours thereafter, unless from a pump separated from concrete work by a watertight wall or other effective means.
- .3 Dispose of water in such a manner as not to be detrimental to public health, environment, public and private property, or any portion of work completed or under construction.
- .4 Provide treatment facilities to remove suspended solids or other materials before discharging to water courses or drainage areas.
- .5 Protect open excavations against flooding and damage due to surface run-off.
- .6 Submit four sets of drawings to Engineer for review when dikes, well points or other means of dewatering are proposed. Assume full responsibility for maintaining a dry excavation.
- .7 When conditions are encountered which, in opinion of Engineer, render it impracticable to dewater excavations before placing concrete, Engineer may order additional excavation and placing underwater of a concrete seal of such dimensions as may be necessary to resist any possible uplift. Do not commence pumping until seal has set sufficiently to withstand hydrostatic pressures.

3.3 Excavation

- .1 Advise Engineer sufficiently in advance of excavation operations to enable original cross sections to be taken.
- .2 Remove trees, vegetation, fences and other obstructions, ice and snow, from surfaces to be excavated and dispose of as directed.
- .3 Strip topsoil from within limits of excavation and stockpile as directed, for respreading after fill.
- .4 Excavate materials to lines, elevations and dimensions indicated or designated by Engineer.
- .5 Correct over-excavation below proposed footing elevation with granular material unless otherwise indicated.

Public Works Canada	Excavation and Fill	Section HC02222
Blackstone River Bridge	for Structures	Page 4
Upper Blackstone River Bridge	Project No. 085903	1978-08-15

- 3.3 Excavation .6 Excavation outside limits specified in clause 1.5.1 may (Cont'd) be backfilled with excavated material or other approved material. .7 Note that where, in opinion of Engineer, soil at proposed elevation of bottom of footings is unsuitable for foundations, Engineer may order, in writing, such changes in elevations and dimensions of work as may be necessary to ensure satisfactory bearing surfaces. .8 Stockpile excavated materials suitable for fill at designated locations. .9 Separate materials containing sods, muck, frozen lumps, cinders, ashes, organic or other deleterious substances not suitable for fill. .10 Dispose of unsuitable and surplus material at locations and in a manner satisfactory to Engineer. .11 Hand trim, make firm and remove loose material and debris from excavations immediately prior to placing concrete. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Engineer. .12 Do not commence further work until Engineer has inspected, measured and approved excavated surfaces. 3.4 Borrow Areas .1 Use in fills suitable materials removed from excavations before taking material from borrow areas. .2 Obtain Engineer's approval for location, extent and condition of borrow areas. .1 Do not proceed with fill and backfill operations until 3.5 Fill and Backfill Engineer has inspected and approved work in place. .2 Backfill excavation not occupied by substructure or other permanent works with granular material up to surface of surrounding ground unless otherwise indicated. .3 Do not place material adjacent to structure until concrete has been in place 14 days, and approval has been obtained from Engineer.
 - .4 Place material in uniform layers not exceeding 200 millimetres simultaneously on all sides of structure so that loading is equalized.

Public Works Canada	Excavation and Fill	Section HC02222
Blackstone River Bridge	for Structures	Page 5
Upper Blackstone River Bridge	Project No. 085903	1978-08-15

<u>3.5 Fill (Cont'd)</u> .5 Compact each layer to following percentages of maximum dry density, AASHTO T99-70 Method C. .1 Common fill to 95%.

.2 Granular fill to 98%.

.6 Deposit material in layers not exceeding 100 mm in thickness when using hand operated tamping devices.

3.6 Restoration

- .1 Remove surplus materials and debris, trim slopes, and correct defects as directed by Engineer upon completion of work.
- .2 Replace top soil as directed by Engineer.
- .3 Reinstate areas affected by equipment outside of planned area to condition which existed prior to commencement of work and leave site in rake-clean condition satisfactory to Engineer.

Public Works Canada Blackstone River Bridge	Aggregates: General	Section HC02225 Page 1
Upper Blackstone River Bridge	Project No. 085903	1978-07-25
PART 1 - GENERAL		
1.1 Description .1	This section specifies requir processing of aggregates to b ated into work.	ements for supplying and e stockpiled or incorpor-
.2	For specific aggregate requir section for material specifie	ements refer to applicable d.
1.2 Related Work .1 Specified Elsewhere	Structural Concrete:	Section HC03316
<u>1.3 Source Approval</u> .1	Source of materials to be inc stockpiled requires approval	orporated into work or of Engineer.
.2	If in opinion of Engineer sou or cannot reasonably be proce quirements, procure an altern to Engineer, or demonstrate t Engineer, that material from processed to meet specified r	rce materials do not meet ssed to meet specified re- ative source satisfactory o satisfaction of source in question can be equirements.
•3	Should a change of source of ing work, advise Engineer suf such change to allow samples made.	material be proposed dur- ficiently in advance of to be taken and tests
.4	Note that acceptance of mater not preclude its future rejec found to deviate from specifi performance is found to be un	ial from any source does tion if it is subsequently cations, or if its field satisfactory.
1.4 Production .1 Sampling	Provide Engineer with ready a processed material for purpos	ccess to source of e of continuous sampling.
1.5 Measurement for .1 Payment	No measurement to be made und costs in items of work that r	er this Section. Include equire aggregates.
PART 2 - PRODUCTS		

2.1 Materials

.1 Aggregate Quality: Sound, hard, durable material free from soft, thin, elongated or laminated particles, organic or other deleterious substances.

Public Works Canada	Aggregates: General	Section HC02225
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- .2 Flat and elongated particles are those whose greatest dimension exceeds four times their least dimension.
- .3 Particles having at least one freshly fractured face are considered as crushed material.
- .4 Fine aggregates satisfying all requirements of applicable specification to be one, or a blend of following:
 - .l natural sand
 - .2 manufactured sand

.3 screenings produced in crushing of quarried rock, boulders or gravel.

- .5 Coarse aggregates satisfying all requirements of applicable specification to be one of following: .1 Crushed rock.
 - .2 Gravel composed of naturally formed particles of stone.

PART 3 - EXECUTION

2.1 Materials

(Continued)

- 3.1 Development of Aggregate Source
- .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as directed by Engineer.
- .2 Where clearing is required, leave a screen of trees between area and roadways.
- .3 Clear, grub and strip a sufficient area ahead of quarrying, or excavating operation to positively prevent contamination of aggregate by deleterious materials.
- .4 When excavation is completed dress sides of excavation to a nominal 1.5:1 slope, and provide drains or ditches if required to prevent water standing therein.
- .5 Trim off and dress slopes of waste material piles and leave site in a neat condition.

- 3.2 Processing
- .1 Process aggregate uniformly and consistently. Use methods that prevent contamination and segregation.
- .2 Blend aggregates to increase percentage of crushed particles or decrease percentage of flat and elongated particles if required to obtain gradation requirements specified. Use methods and equipment approved by Engineer.

Public Works Canada	Aggregates: General	Section HC02225
Blackstone River Bridge	•	Page 3
Upper Blackstone River Bridge	Project No. 085903	1978-07-25
<u>3.3 Handling</u> .1	Handle and transport aggre segregation and contaminat	gates properly to avoid ion.
3.4 Stockpiling .1	Unless otherwise specifica Engineer, stockpile aggreg designated by Engineer.	lly authorized in writing by ates on site in locations
.2	Stockpile aggregates in su project schedules.	fficient quantities to meet
•3	Stockpile aggregates on st drained surfaces.	ablized, clean and well
. 4	Provide a compacted sand b depth to prevent contamina aggregate is stockpiled on	ase not less than 250 mm in tion of material, if coarse sand.
.5	Do not incorporate bottom aggregates are stockpiled	250 mm of pile into work, if on ground.
.6	Stockpile aggregates far e substantial dividers to pr	nough apart or separate by event intermixing.
.7	Remove and dispose of inte materials within 48 hours	rmixed or contaminated of rejection by Engineer.
.8	Stockpile materials in uni follows: .1 Maximum 1 m for coarse materials. .2 Maximum 2 m for fine a materials. .3 Maximum 1.5 m for all	form layers of thickness as aggregate and base course ggregate and sub-base other materials.
.9	Complete each layer over e beginning next layer.	ntire stockpile area before
.10	Uniformly spot-dump aggreg and build up stockpile as	ates delivered to stockpile specified.
.11	Do not cone piles or spill pile.	aggregates over edges of
.12	Provide protection to prev becoming mixed in stockpil removed from stockpile.	ent ice and snow from e or from material being

Public Works Canada	Pile Foundations,	Section HC02300
Blackstone River Bridge	General	Page 1
Upper Blackstone River Bridge	Project No. 085903	1978-07-25

PART 1 - GENERAL

1.1 Description	.1	This section specifies general requirements for piling.
		Specific requirements to be specified for each pile
		type in separate sections.

1.2 Related Work.1 Steel Pipe Piles:Section HC02316Specified Elsewhere

1.3 Delivery and.1 Protect piles from damage due to excessive bending
stresses, impact, abrasion or other causes during
delivery, storage and handling.

.2 Repair or replace damaged piles to satisfaction of Engineer.

- 1.4 Protection .1 Adopt safe procedures and protect public and construction personnel, adjacent structures and work of other sections from hazards attributable to pile driving operations.
- 1.5 Scheduling of
Work.1 Submit schedule of planned sequence of driving to
Engineer for approval not less than 2 weeks prior to
commencement of pile driving.
- 1.6 Measurement for Payment
- .1 No separate measurement for payment to be made under this section. For details of measurement refer to section HC02316.

Public Works Canada	Pile Foundations.	Section HC02300	
Diceletane Dimen Duides	Concerna 1		
Blackstone River Bridge	General	Page 2	
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PART 2 - PRODUCTS

- 2.1 Materials
- .1 For material requirements refer to section HC02316.
- .2 Pile lengths indicated are based on lengths estimated to remain in completed structure. Supply additional lengths as may be required for fresh heading, cut-offs, etc., and to suit method of installation.

PART 3 - EXECUTION

3.1 Equipment Requirements

- I Equipment information: Include in construction tender list of equipment to be used in pile installation. Upon award of contract supply detailed data of equipment to Engineer for review. For impact hammers give manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer and mass of driving cap. For non-impact methods of installation such as augering, jacking, vibratory hammers or other means, give full details of characteristics necessary to evaluate performance.
- .2 Hammer: Do not use drop hammers. Use impact hammers capable of developing at normal speed an energy of not less than 30 000 joules per blow. When required penetration and driving resistance are not obtained by use of hammers complying with minimum requirements, either provide larger hammer or take other measures, approved by Engineer, to achieve required result at own expense.

.3 Leads:

.1 Construct pile driver leads to provide free movement of hammer. Hold leads in position at top and bottom with guys, stiff braces or other approved means to ensure support to pile while being driven. .2 Length: Except for piles driven through water, provide length of leads such that use of a follower is unnecessary. Drive battered piles using inclined leads.

.3 Swing leads: Obtain prior approval for use. Firmly guy top and bottom to hold pile in position during driving operation.

Public Works Canada	Pile Foundations,	Section HC02300
Blackstone River Bridge	General	Page 3
Upper Blackstone River Bridge	Project No. 085903	1978-07-25

3.1 Equipment .4 Followers: .1 Do not use followers without Engineer's written Requirements (Cont'd) permission. .2 When permitted, provide followers of such size, shape, length and mass to permit driving pile in desired location to required depth and resistance. Provide followers with socket or hood carefully fitted to top of pile to minimize loss of energy and prevent damage to pile. 3.2 Preparation .1 Ensure that ground conditions at pile locations are adequate to support pile driving operation. Make provision for access and support of piling equipment during performance of work. .2 Do not drive piles until excavation has been completed or until embankment has been placed and thoroughly compacted to bottom elevation of footing. 3.3 Driving Records .1 Maintain accurate records of driving for each pile including following: .1 Type and make of hammer, theoretical and actual energy. .2 Driving equipment accessories including driving cap, cushion, etc. .3 Pile size and length, location of pile in pile group, location or designation of pile group. .4 Sequence of driving piles in group. .5 Number of blows for each 250 mm of entire pile length. .6 Final tip and cut-off elevations. .7 Other pertinent information such as interruption of continuous driving, pile damage. .2 Provide Engineer with three copies of records. 3.4 Driving .1 Co-operate with Engineer in inspecting and recording pile driving data. .2 Protect piles by use of driving caps of approved type fitted over top of pile in such a manner as to prevent damage to pile.

Public Works Canada	Pile Foundations,	Section HC02300
Blackstone River Bridge	General	Page 4
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3.4 Driving (Cont'd)

- .3 Hold piles securely and accurately in position while driving.
- .4 Deliver hammer blows in direct axis of pile.
- .5 Do not drive piles within a radius of 8 m of concrete which has been in place less than 3 days.
- .6 Redrive any piles lifted during driving of adjacent piles.
- .7 After completion of driving, remove loose and displaced material from around piles and leave clean, solid surfaces to receive foundation concrete.
- .8 Cut off piles neatly and squarely at elevations indicated on drawings. Provide sufficient length above cut-off elevation so that part damaged during driving is cut off.
- .9 Remove cut-off lengths from site on completion of work.

3.5 Termination of Driving

- .1 Install each pile to approval of Engineer. Engineer will be sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration or other criteria used to determine pile capacity.
- .2 Drive each pile to pile length indicated unless otherwise directed by Engineer.

3.6 Driving Tolerances

3.7 Damaged or

Defective Piles

- .1 Install piles to following tolerances:
 .1 Pile heads within 75 mm of locations indicated.
 .2 Piles not more than 2 percent of length out of alignment.
- .2 Provide pile driving templates to ensure that tolerances specified will not be exceeded.
- .1 Replace as directed any pile that is driven out of position, or is damaged during driving or handling, or is otherwise defective and rejected by Engineer.

Public Works Canada Blackstone River Bridge	<u></u>	Steel Pipe Piles	Section HC02316 Page 1
Upper Blackstone River	Bridge	Project No. 085903	
PART 1 - GENERAL		· · · · · · · · · · · · · · · · · · ·	
1.1 Description	1	This section specifies a driving steel pipe piles	requirements for supplying and s.
1.2 Related Work Specified Elsewhere	.1	Pile Foundation General	: Section HC02300.
1.3 Delivery Handling	.1	Store pipe piles horizon	ntally on timber sills.
and Storage	.2	Provide timber separator contact of piles.	rs to avoid metal to metal
1.4 Test Reports	.1	Provide Engineer with to certificates in accordan chemical composition pr	wo copies of steel producer's nce with ASTM A252-75 including ior to fabrication.
1.5 Measurement for Payment	.1	Supply of piles to be mainstallation to be measu	easured in metres and ured in number of piles.
	.2	Pile tip reinforcement, considered incidental t	splices and pile caps to be o supply of piles.
	•3	No extra compensation to damaged or defective pi	o be made for replacement of les rejected by Engineer.
PART 2 - PRODUCTS			
2.1 Materials	1	Welded straight longitud 12.75 in. outside diame and plain machine cut es	dinal seam steel pipe piles of ter and 0.375 in. wall thickness nds to ASTM A252-75, Grade 2.
	.2	Chemical composition to with a maximum carbon e	conform to CSA Z 245.3-1974 quivalent of 0.45.

Public Works Canada Blackstone River Bridge	Steel Pipe Piles Section HC02316 Page 2
Upper Blackstone River Bridge	Project No. 085903
2.1 Materials (Cont'd) .3	Steel pile tip reinforcement: to CSA G40.21-M1978 Grade 300W.
.4	Steel pile caps: to CSA G40.21-M1978, Grade 300W.
.5	Welding electrodes: to CSA W48 series.
PART 3 - EXECUTION	
3.2 Welding .1	Welding: to CSA W59-1977.
.2	Welding qualifications: to CSA W47.1-1973.
3.3 Fabrication and .1	Provide and fabricate full length piles having not more
Installation	A252-75, Clauses 14 and 19.
.2	Limit deviation from straightness of fabricated piles to CSA W59-1977, Clause 5.8(a).
.3	Fabricate and install pile tip reinforcement and pile caps as detailed.
.4	Repair defective welds only on authority of Engineer. Welds which show evidence of having been repaired without authorization may be rejected.
	"Terese Anter Tanaton me" as reflected

.5 Do pile installation work to Section HC02300.

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Public Works Canada	Steel Sheet Piling	Section HC02411
Blackstone River Bridge		Page 1
Upper Blackstone River Bridge	Project No. 085903	

PART 1 - GENERAL

1.1 Description	.1	This section specifies requirements for supplying and installing steel sheet piling.
1.2 Related Work Specified Elsewhere	.1 .2	Excavation and Fill for Structures: Section HC02222. Pile Foundations, General: Section HC02300.
1.3 Cofferdam Design and Erection Drawings	.1	To Section HC02222
<u>1.4 Certificates</u>	.1	At least four weeks prior to commencement of pile driving, furnish Engineer with copies of mill test data and certification.
1.5 Measurement for Payment	.1	Supply and installation of sheet piling to be measured in square metres of piling remaining in place based on maximum cutoff elevation indicated.
	.2	All other material incorporated in work to be considered incidental to supply and installation.
PART 2 - PRODUCTS		
2.1 Materials	.1	Steel sheet piles: to CSA G40.21-M1978, grade 260W or equivalent.
	.2	Structural Steel: structural steel for wales, bearing plates, wales splices, capping channels, support angles and miscellaneous steel to CSA G40.21-M1978 Grade 260W or equivalent.

Public Works Canada	Steel Sheet Piling	Section HC02411
Blackstone River Bridge		Page 2
Upper Blackstone River Bridge	Project No. 085903	. –

PART 3 - EXECUTION

<u>3.1</u>	Installation	.1	Do welding to CSA W59-1977 .	
		.2	Do pile installation work to Section HC02300 Clauses 3.4 and 3.6.	

- 3.2 Obstructions
- .1 Should an obstruction be encountered during driving, leave obstructed pile and proceed to drive remaining piles. Return and attempt to complete driving of pile later.
 - .2 Advise Engineer immediately if it is impossible to drive pile to its full penetration, and obtain direction on further steps required to complete work.

Public Works Canada	Rip-Rap	Section HC02545
Blackstone River Bridge		Page 1
Upper Blackstone River Bridge	Project No. 085903	1978-07-27
PART 1 - GENERAL		
<u>1.1 Description</u> .1	This section specifies require placing stone rip-rap.	ments for supplying and
1.2 Measurement for .1 Payment	Rip-rap to be measured in cubi incorporated into work. Excav foundation bed including fabri incidental to placing of rip-r	c metres of material vation and preparation of c lining to be considered vap.
.2	Where, in opinion of Engineer, measure rip-rap in place, load to be measured in cubic metres	, it is impracticable to is on hauling vehicles 3.

2.1 Materials

PART 2 - PRODUCTS

.1 Stones: Hard, dense, angular quarry stone, free from seams, cracks or other structural defects, to meet following size distribution for use intended: .l Class I: Nominal 300 mm diameter or 40 kg mass to have following gradation: 100% smaller than 450 mm or 130 kg 20% larger than 350 mm or 70 kg 50% larger than 300 mm or 40 kg 80% larger than 200 mm or 10 kg .2 Class II: Nominal 500 mm diameter or 180 kg mass to have following gradation: 100% smaller than 750 mm or 670 kg 20% larger than 600 mm or 310 kg 50% larger than 500 mm or 180 kg 80% larger than 300 mm or 30 kg-.3 Class III: Nominal 750 mm diameter or 670 kg mass to have following gradation: 100% smaller than 1200 mm or 2230 kg 20% larger than 900 mm or 1120 kg 50% larger than 750 mm or 670 kg 80% larger than 500 mm or 180 kg

.2 Fabric Lining: To be Synflex ISS Type II or approved equivalent.

Public Works Canada	Rip-Rap	Section HC02545
Blackstone River Bridge		Page 2
Upper Blackstone River Bridge	Project No. 085903	1978-07-27

PART 3 - EXECUTION

- <u>3.1 Placing</u>... I Prepare foundation for rip-rap to lines and grades indicated or as directed by Engineer.
 - .2 Place fabric lining to manufacturer's recommendations approved by Engineer.
 - .3 Place rip-rap to details indicated in approved manner to secure regular surface and a stable mass.

Public Works Canada Blackstone River Bridge	Concrete Reinforcement	Section HC03200 Page 1
Upper Blackstone River Bridge	Project No. 085903	1977-07-27
PART 1 - GENERAL ·		

- placing reinforcing steel.
- 1.2 Related Work .1 Structural Concrete: Section HC03316 Specified Elsewhere
- 1.3 Reference .1 CSA CAN3-A23.1-M77 and G30 series.

Standards

- <u>1.4 Source Sampling</u> .1 At least 5 weeks prior to commencement of work provide Engineer with a copy of producer's mill certificate of steel supplied, showing physical and chemical analysis.
 - .2 See Section HC03316 for quantities of samples required.

1.5 Storage

- .1 Store reinforcing steel on racks or sills that will permit easy access for identification and handling and prevent it from becoming coated with material which would adversely affect bond.
- 1.6 Measurement for <u>Payment</u> .1 Reinforcing bars to be measured in kilograms of steel incorporated into work, computed from theoretical unit mass specified in applicable CSA standards or design handbooks, for lengths and sizes of bars as indicated or ordered in writing.
 - .2 Wire ties and supports to be considered incidental to supply and placing of bars.

PART 2 - PRODUCTS

2.1 Materials

.1 Reinforcing bars: to CSA G30.12-M1977 or G30.16-M1977, grade 400, deformed bars.

Public Works Canada	Concrete Reinforcement	Section HC03200
Upper Blackstone River Bridge	Project No. 085903	rage 2 1977_07_27
opper brackstone siver bridge	10ject No. 009905	
2.1 Materials .2	Wire ties: to CSA G30.3-1	.972.
.3	Supports: approved suppor durable, non-corrodible ma plastic chairs, concrete b used provided they satisfy and are approved by Engine	ts and chairs of strong, sterials. Galvanized metal or blocks or other devices may be requirements of this section ser.
PART 3 - EXECUTION		
<u>3.1 Field Bending</u> .1	Do not field bend reinford or authorized by Engineer.	ement except where indicated
.2	Bend reinforcement, when a steady pressure without he	uthorized, with a slow and at.
.3	} Replace bars which develop	cracks or splits.
3.2 Placing .1	Accurately place reinforci indicated and hold firmly and setting of concrete.	ng steel in positions during placing, compacting
.2	<pre>? Tie reinforcement where ba is: .1 Less than 300 mm: - ti 2 200 mm on mono: tio</pre>	r spacing in each direction e at alternate intersections.
3.3 Splicing .1	Do not splice reinforcing	bars other than where
	indicated or authorized by	Engineer.
3.4 Surface .1 Conditions	Reinforcement at time conc from mud, oil, or other no adversely affect bonding c	rete is placed to be free n-metallic coatings that apacity.
.2	Reinforcement, except pres mill scale, or a combinati as satisfactory, provided height of deformations, an test specimen are not less in applicable CSA Standard	tressing steel, with rust, on of both to be considered minimum dimensions, including d mass of a hand wire brushed than specified requirements s.

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Public Works Canada	Concrete Reinforcement	Section HC03200
Blackstone River Bridge		Page 3
Upper Blackstone River Bridge	Project No. 085903	1977-07-27

3.5 Inspection

.1 Do not place concrete until Engineer has inspected and approved reinforcement in place.

Public Works Canada	Underwater Concreting	Section HC03315
Upper Blackstone River Bridge	Project No. 085903	Tage
PART 1 - GENERAL 1.1 Description .1	This section specifies require	ments for supplying and
1.2 Polated Horiz	placing of concrete underwater	by tremie method.
Specified Elsewhere	Aggregates, General	Section houzzzy.
<u>1.3 Reference Standards</u> .1	To CSA CAN3-A23.1-M77, and CAN	3-A23.2-M77.
<u>1.4 Definitions</u> .1	Tremie concrete is concrete pla tube called a tremie pipe. Tre ended or may have a foot valve to control flow of concrete. hopper connected to tremie pipe of concrete is maintained in the desired rate of flow.	aced underwater through a emie pipe may be open , plug or travelling plug Concrete is placed in a e and a sufficient head remie pipe to provide
1.5 Measurement for .1 Payment	Concrete placed underwater to a metres based on quantity of con theoretical lines of concrete drawings.	be measured in cubic ncrete measured by volume indicated on
PART 2 - PRODUCTS		
2.1 Materials .1	Portland Cement to CSA Standard	d A5-M77, Type 10,

- .2 For tremie concrete use coarse aggregate of natural gravel (not crusher material) to improve its ability to flow through a tube.
- .3 Maximum size of coarse aggregate 25 mm.

Publ	ic Works Canada kstone Biven Bridge		Underwater Concreting	Section HC03315
Uppe	r Blackstone River Bri	dge	Project No. 085903	rage 2
		<u>-0-</u>		
<u>2.2</u>	Concrete Mixes	.1	Use 45 to 50 percent fine concrete mix for workabili	aggregate by weight in ty.
		.2	Use not less than 400 kg o concrete to be placed unde	f cement per cubic metre for rwater.
		•3	For tremie concrete produc to 200 mm and a water ceme 0.45.	e a mix with a slump of 150 nt ratio of not more than
		.4	Produce concrete with a mi 25MPa at 28 days.	nimum compressive strength of
<u>2.3</u>	Admixtures	.1	Admixtures will be subject Admixtures will be permitte mix or to improve placement by testing laboratory design	to approval of Engineer. ed to correct deficiencies in t of concrete as recommended gnated by Engineer.
		.2	Engineer may withdraw prior conditions encountered dur: unsatisfactory performance	r approval of admixture if ing course of work indicate
		•3	Calcium chloride will not	be permitted.
PART	<u>3 - EXECUTION</u>			
<u>3.1</u>	Preparation	.1	Where concrete must bond to surfaces, piling, sheet pil thoroughly of soil and algo concrete placement. Use wa of silt or mud are present	o concrete surfaces, rock ling or anchor rods, clean ae just prior to starting ater jets and when quantities remove by air lift.
		.2	Arrange to carry out large placed in one continuous op required. Provide sufficie complete pour without inter equipment for every phase of	pours so that concrete is peration to full depth ant supply of concrete to ruption and supply complete of operation.
3.2	Tremie Method	.1	Provide a tremie pipe which sufficiently large to allow Diameter of tremie pipe to less than eight times maxim	is watertight and free flow of concrete. be not less than 200 mm or num size of coarse aggregate.

Public Works Canada	Underwater Concreting	Section HC03315
Blackstone River Bridge		Page 3
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3.2 Tremie Method (Cont'd)

- .2 Provide a hopper at top of tremie pipe and means to raise and lower tremie.
- .3 Provide plug or foot valve at end of tremie pipe to permit filling pipe with concrete initially.
- .4 Provide a minimum of one tremie pipe for every 300 square metres of pour plan area. Do not move tremie pipes laterally by dragging through concrete.
- .5 Start pour with tremie pipe full of concrete and keep end of pipe buried in freshly placed concrete at least 300 mm. Control rate of flow by increasing or decreasing depth of end in concrete.
- .6 If seal is lost, allowing water to enter pipe, withdraw pipe immediately.
- .7 If tremie operation is interrupted so that a horizontal construction joint has to be made, cut surface laitance by jetting, (within 24 to 36 hours) and remove loose material by pumping or air lifting before placing next lift.
- .8 Do not place concrete in flowing water. Do not vibrate, disturb or puddle concrete after it has been placed.

Public Works Canada Blackstone River Bridge		Structural Concrete	Section HC03316 Page 1
Upper Blackstone River	Bridge	Project No. 085903	1978-07-25
PART 1 - GENERAL			
1.1 Description	.1	This section specifies requir placing, finishing, protectin concrete.	ements for supplying, g and curing structural
1.2 Related Work	.1	Aggregates, General:	Section HC02225
Specified Elsewhere	.2	Concrete Reinforcement:	Section HC03200
1.3 Reference Standards	.1	To CSA CAN3-A23.1-M77 except	where specified otherwise.
1.4 Requirements of Regulatory Agencies	.1	Conform to applicable codes r construction of formwork and	elating to design and falsework.
1.5 Formwork and .1 Falsework Design		Submit at least 5 weeks prior formwork and falsework design to Engineer for review.	to erection 3 sets of drawings and calculations
	.2	Clearly indicate dimensions a as well as design, fabricatio	nd details of materials, n and erection procedures.
	.3	Drawings and calculations to professional engineer respons preparation.	be signed and stamped by ible for their
	.4	Be responsible for accuracy o unsatisfactory work arising f poor workmanship or faulty ma	f drawings, or for rom errors of judgement, terials.

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Public Works Canada Blackstone River Bridge	Structural Concret	e Se Pa	ction HC03316
Upper Blackstone River Brid	dge Project No. 085903	3 19	78-07-25
1.6 Source Sampling	.l Inform Engineer of materials to be su sampling:	proposed sourc	e of following ide access for
Material	Minimum Quantity	Minimum Laboratory Time (days) Testing	forSamples by
1. Aggregate f Acceptance	for tests		
a) Fine b) Coarse	45 kg 45 kg	7 7	Contractor Submits Contractor Submits
2. Aggregate f Mix Design	or 90 kg	30	Engineer
3. Admixtures	500 ml each	30	Contractor Submits
4. Portland Cement	35 kg	preliminary - 10 final - 30	Contractor Submits
5. Water	5 litres	30	Engineer
6. Concrete	4 150x300 mm cylinders per pour	28	Engineer
7. Reinforcing Steel	600 mm each size	28	Contractor Submits
8. Bonding Adhesive	500 ml	30	Contractor Submits
9. Dampproofin	g 4 litres	30	Contractor Submits
10. Waterstop	l m	60	Contractor Submits

<u>1.7</u> Certificates

.1 Submit to Engineer at least 5 weeks prior to starting concrete work, 2 copies of manufacturer's test data and certification that following material will meet requirements:

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- .1 Portland cement.
- .2 Admixtures.

Publ	ic Works Canada katono Biyon Bmidgo	S	tructural Concrete	Section HC03316
Uppe	r Blackstone River Bridge	ge P	roject No. 085903	1978-07-25
1.8	Storage of	.1 S	tore materials to prevent	contamination or

- Material
- .1 Store materials to prevent contamination or deterioration.
- .2 Provide adequate storage facilities for materials to ensure a continuous supply of these materials during batching operation.
- .3 Store cement in weathertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment.
- .4 Stockpile aggregates to section HC02225.
- .5 Prevent stored liquid admixtures from freezing and powdered admixtures from absorbing moisture.
- 1.9 Measurement for Payment
- .1 Structural concrete to be measured in cubic metres calculated from neat dimensions indicated or authorized in writing by Engineer. Concrete placed beyond dimensions indicated will not be measured.
 - .2 No deductions to be made for volume of concrete displaced by reinforcing steel, or structural steel, drainage openings, weepholes, piles and ducts less than 0.1 square metre in cross sectional area.
 - .3 Heating of water and aggregates; providing cold weather protection; supplying curing compounds, waterstops, bonding grout, non-shrink grout, dampproofing material, linseed oil mixture, bonding adhesive and source samples to be considered incidental to work.

PART 2 - PRODUCTS

2.1 Materials

.1 Aggregates: To section HC02225. Maximum sizes of coarse aggregates to be as follows:
.1 Substructure excluding curbs and approach slabs:
40 mm.
.2 Deck, curbs and approach slabs: 20 mm.

.2 Portland cement: to CSA CAN3-A5-M77, Type 10, normal.

.3 Admixtures:

- .1 Air entraining admixtures: to CSA CAN3-A266.1-M78.
- .2 Chemical admixtures: to CSA CAN3-A266.2-M78.

Public Works Canada	Structural Concrete	Section HC03316
Blackstone River Bridge		Page 4
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2.1 Materials (Cont'd) .4 Curing Compounds to CGSB 90-GP-la.

.5 Waterstops: .1 Waterstop material to be homogeneous, elastomeric, plastic compound of basic polyvinyl chloride and other materials which, after fabrication, will meet requirements in table below. Do not use reclaimed material.

	Required	Properties	Finished
	and Test	Methods -	PVC Waterstop
	ASTM		
	Property	Test	requirement
Tensile strength	D638-77a	Min 9.65 M	IPa
Elongation at			
breaking	D638+77a	Min 250 pe	ercent
Hardness (Shore)	D2240-75	60 to 75	
Specific Gravity		Max +0.02 f	'rom manufacturer's value
Resistance to	D543-67	.1 Max mass	change: - 0.10% to
Alkali		+0.25%	
(7 days, using		.2 max hard	inss change: +5 (shore)
10% NaOH)			
Water Absorption			
(48 hours)	D570-77	Max 0.5%	
Cold bending		No cracking	
Volatile loss	D1203-67	Not more th	an manufacturer's value

.2 Cold bend test: cool a 25 x 150 x 3 mm strip of waterstop to a temperature of -45 deg C for two hours. Immediately after, bend strip 180 degrees around a 6 mm diameter rod by applying sufficient force to hold sample in contact with rod. Examine sample for evidence of cracking. Test a minimum of three samples from each lot.

.3 Supply waterstop with uniform cross section, free from porosity or other defects, to nominal dimensions indicated.

.4 Supply certificate from manufacturer showing values for designated properties.

- .6 Bonding grout: equal parts by mass of cement and sand mixed with sufficient water to form a stiff slurry, which can be applied with stiff broom or brush to existing concrete in a thin, even coating that will not run or puddle in low spots. Sand to be 100% passing 2.5 mm sieve and to CSA CAN3-A23.1-M77.
- .7 Non-shrink grout: pre-mixed compound of non-metallic aggregate and plasticizing agents, capable of developing minimum compressive strength of 48 MPa at 28 days; or product approved by Engineer.

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2.1 Materials (Cont'd) .8	Dampproofing material: to CGSB 37-GP-2c emulsified asphalt, mineral colloid type, unfilled.
•9	Linseed oil mixture: boiled linseed oil and kerosene blended 50-50 by volume.
.10	Bonding adhesive: epoxy adhesive such as Thiopoxy 62 supplied by Grace Construction Materials or an equivalent product approved by Engineer.
2.2 Concrete Mixes .1	 Design concrete mix to produce air entrained concrete meeting following requirements: .1 Concrete in substructure excluding approach slabs and curbs: .1 Minimum compressive strength: 25 MPa at 28 days. .2 Minimum cement content: 315 kg per cubic metre. .3 Maximum water-cement ratio: 0.50. .4 Maximum aggregate size: 40 mm. .5 Slump range: 20 to 100 mm. .6 Air content range: 3 to 6%. .7 Admixtures: to manufacturer's recommendations. 2 Concrete in deck, curbs and approach slabs: .1 Minimum cement content: 370 kg per cubic metre. .3 Maximum water-cement ratio: 0.45. .4 Maximum aggregate size: 20 mm. .5 Slump range: 20 to 50 mm. .6 Air content range: 5 to 8%. .7 Admixtures: to manufacturer's recommendation.
.2	Weigh aggregates, cement, water and admixtures separately when batching. Do not use alternative methods of measuring.
•3	Do not use calcium chloride.
.4	Have plant scales approved by Engineer. Accuracy to be such that successive quantities can be measured to within one percent of desired amounts. Inspect and test scale for accuracy as directed. Exhibit test certificates to Engineer when requested.

PART 3 - EXECUTION

3.1 General

- .1 Place concrete in hot weather to CSA CAN3-A23.1-M77.
- .2 Do not place concrete without cold weather protection if air temperature may drop below 4°C during following 21 days.
- .3 Place concrete in cold weather to CSA-CAN3-A23.1-M77 and following:
 - .1 Curing and Protection:

.1 Protect concrete with windproof shelter of canvas or other material to allow free circulation of inside air around fresh concrete. Do not let walls of shelter touch formwork and provide sufficient space for removal of formwork. .2 Supply approved heating equipment capable of maintaining inside air at a constant temperature to cure concrete at following temperatures:

.1 For an initial three days, at not less than
15 deg C nor more than 27 deg C at surfaces.
.2 For substructure cure at 10 deg C for an extra four days.

.3 For superstructure at 10 deg C for an extra 18 days or keep at 20 deg C for 17 days from first day concrete was placed.

.4 Reduce temperature near end of curing period at rate not exceeding 10°C per day for substructure and 20°C per day for superstructure.

.3 Keep concrete surfaces continually moist during protection stage.

- .4 Do not commence placing concrete until Engineer has inspected and approved forms, foundations, reinforcing steel, joints; conveying, spreading, consolidation and finishing equipment; and curing and protective methods.
- .5 Wood floating, broom finishing, placing of burlap and inspection of mechanically screeded concrete to be done from transverse bridges of rigid construction free of wobbles and springing under use.

3.2 Formwork

- .1 To CSA CAN3-A23.1-M77 and reviewed formwork drawings. Maintain maximum tolerances of finished concrete work as specified in ACI Standard 347, Recommended Practice for Concrete Formwork.
- .2 Strip forms to CSA CAN3-A23.1-M77.

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3.3 Inserts

.1 Anchor bolts for bearings: .1 Set anchor bolts after girder is in position, and fill with non-shrink grout in preformed holes or in holes drilled after concrete has set. Preformed holes to be at least 100 mm in diameter. Drilled holes to be a minimum 25 mm larger in diameter than bolts used. .2 Protect holes from water and debris.

- .2 Anchor bolts for railing posts: .1 Set anchor bolts prior to placing of concrete.
- .3 Deck drains, deck and curb expansion joints: .1 Install drains and joints at locations indicated.

3.4 Construction Joints

- .1 Form and construct joints to details indicated and to CSA CAN3-A23.1-M77.
- .2 Install waterstop at locations shown.
- .3 Apply bonding adhesive as indicated and according to manufacturer's specifications.

3.5 Placing Concrete

.1 Place and consolidate concrete to CSA CAN3-A23.1-M77 and following:

.1 Do not cast concrete slabs or foundations on soil which has been allowed to dry. If soil is exposed to drying conditions, moisten as directed by Engineer before concrete is placed.

.2 Do not place concrete against frozen material. .3 Place concrete continuously from joint to joint. Vibrate plastic concrete.

.4 If authorized by Engineer pump concrete to following requirements:

.1 Arrange equipment so that no vibrations result which might damage freshly placed concrete.

.2 Provide suitable equipment where concrete is conveyed and placed by mechanically applied pressure.

.3 Operate pump such that a continuous stream of concrete, without air pockets, is produced. .4 Empty pipe line in such a manner that prevents contamination of concrete or separation of ingredients, when pumping is discontinued and concrete remaining in pipe line is to be used.

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3.5 Placing Concrete (Cont'd)

.5 Substructure:

.1 Do not place load upon finished substructure until authorized by Engineer.

.2 Allow a minimum of 7 days for hardening of concrete in substructure before any load is placed thereon.

.6 Bridge deck:

.1 Provide a smooth riding surface of uniform texture, true to required grade and cross section. .2 Cast and finish deck with an approved type of mechanical bridge deck finisher.

.3 Do not place concrete until Engineer is satisfied that rate of placing is sufficient to complete proposed placing, finishing and curing operations within scheduled time; that experienced finishing machine operators and concrete finishers are provided to finish deck; that curing equipment and finishing tools and equipment are at site of work and in satisfactory condition for use. .4 Do not place concrete until rails for support and operation of finishing machines are in place and firmly secured. Extend rails for finishing machines beyond both ends of scheduled length of concrete placement a sufficient distance that will permit float of finishing machine to fully clear concrete to be placed. Set rails or headers to elevations, with allowance for anticipated settlement, camber, and deflection of falsework, as required to obtain a bridge roadway deck true to required grade and cross section. Provide rails or headers of a type and so installed that no springing or deflection will occur under mass of finishing equipment and so located that finishing equipment can operate without interruption over entire deck. Adjust rails or headers as necessary to correct for settlement or deflection which may occur during finishing operations.

.5 Check falsework and wedges and make necessary adjustments immediately prior to placing. Provide suitable means, such as telltales, to readily permit measurement by Engineer of settlement and deflection as it occurs.

.6 Discontinue placing concrete and install a bulkhead at location determined by Engineer, if corrective measures are required during concrete placement. Remove concrete in place beyond bulkhead.

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3.5 Placing Concrete (Cont'd)	.7 Place concrete in roadway centreline. L	a uniform heading normal to imit rate of placing to that
	<pre>which can be finished set. .8 Use wooden floats irregularities exceedi straightedge placed in after longitudinal flo .9 Float concrete dec approved hand operated of concrete has taken plastic. .10 Do not overwork c .7 Curbs: .1 Clean and dry deck to be in contact with .2 Apply thin and eve with stiff broom or br immediately before pla .3 Remove excessive g .4 Apply grout at rat become dry before it i</pre>	before beginning of initial to correct minor defects mg 3 mm under a 3 m any direction immediately pating by deck finisher. A surface transversely with float board when initial set place but surface is still concrete surface. Concrete surfaces which are curb concrete. en coating of bonding grout bush to deck concrete surfaces acting of curb concrete. prout. Se such that grout does not s covered with curb concrete.
3.6 Finishing of .1 <u>Unformed Surfaces</u>	Deck slab: After transver initial curing and protect a uniform broom finish to not exceeding 3 mm deep by normal to roadway centreli	ese floating and before tion of concrete, give surface produce regular corrugations drawing broom in direction .ne.
.2	Curbs: After concrete has strike off surface with st wood or cork float. Use a expansion joints. Finish matte texture which will n	been placed, compact and rike board and float with an edging tool on edges and at surface to a granular or not be slick when wet.
3.7 Finishing of .1 Formed Surfaces	To CSA CAN3-A23.1-M77.	
.2	Apply sack rubbed finish t abutments and side surface CAN3-A23.1-M77.	co exposed surfaces of as of curbs and deck to CSA

.3 Omit sack rubbed finish, if authorized by Engineer, when special care in casting results in surface with smooth texture and uniform colour.

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Upper Blackstone River Bridge 3.8 Protection and .1 Curing	Project No. 085903 To CSA CAN3-A23.1-M77 and .1 Commence curing as so peared from concrete surf ficiently hard to prevent Place two layers of pre-w face. Overlap each strip burlap against displacement concrete surface is uncov thoroughly wet for seven .2 Formed surfaces: If seven days or more no add quired. If formwork is r days, cure in manner spec for remainder of seven day	1978-07-25 the following: on as water sheen has disap- ace and concrete is suf- damage to broom texturing. Tetted burlap on concrete sur- by at least 75 mm. Secure int and ensure that no part of ered at any time. Keep burlap days after day of placing. formwork is left in place for itional curing will be re- emoved in less than seven ified for unformed surfaces y period.
	.3 During curing period immediately needed for fin continue curing. .4 Curing compounds: us writing by Engineer.	uncover only such areas as are nish treatment. Recover and e only when approved in
3.9 Linseed Oil .1 Treatment	Bridge deck, approach sla .1 After concrete has cur and when surface of concre- minimum of one day at a tr ply two coats of linseed of cleaned surfaces of deck at top of curbs. .2 Apply first coat at 1 second at 90 ml per square .3 Do not apply linseed of Allow coatings to thorough second or subsequent coats .4 Do not apply linseed of ture is below 5 deg C.	bs and curbs: red for specified curing time, ete is allowed to dry for a emperature of 15 to 30°C, ap- oil mixture uniformly to and slabs, and inside face and 35 ml per square metre and e metre. oil mixture to damp surface. hly dry prior to applying ings. oil mixture when air tempera-
3.10 Dampproofing .1	Prepare surface to CSA CA	N3-A23.1-M77.
•2	Do dampproofing to CGSB 3	7-GP-3b.
•3	Apply dampproofing materia walls and breastwalls in approach side keep damppro of finished embankment. within 300 mm of top of ba	al over entire width of wing- contact with embankment. On oofing to 150 mm below lines On stream side dampproof to ackfill.

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3.11 Field Quality Control

- .1 Inspection and testing of concrete and concrete materials will be carried out by Engineer to CSA CAN3-A23.1-M77.
- .2 If test results indicate that quality of concrete does not meet requirements of Engineer, take measures as indicated in CSA CAN3-A23.1-M77, Clause 17.6.

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opper Blackscone River Bridge	Hoject No. 005903	1970-07-27
PART 1 - GENERAL		
<u>l.l Description</u> .l	This section specifies requir fabrication, painting, galvan erection of structural steel.	ements for supply, izing, delivery and
1.2 Requirement of .1 Regulatory Agencies	Adhere to applicable codes re construction of supporting fa erection of steel.	lating to design and lsework necessary for
.2	Comply with Navigable Waters regulations.	Protection Act and
<u>1.3 Design Criteria</u> .1	Make no changes or variations specifications or plans formi without written approval of E	from requirements of ng part of this work ngineer.
.2	Submit to Engineer for his ap affecting improvements in des under this contract.	proval suggestions ign or manufacture of work
1.4 Source Quality .1 Control	Materials and fabrication to inspection during course of w contract.	be subject to physical ork done under this
.2	Extent of welding examination .1 Visual examination of all .2 Magnetic particle examina percent of length of all fill welds. .3 Bend testing of at least connector.	: welds. tion of a minimum of 25 et welds excluding stud one in every 50 stud shear
•3	Inspection to be done by insp appointed by Engineer. Provi cooperate fully with inspecti carrying out inspections and shop and field.	ection organization de suitable facilities and on organization in tests required in mill,
.4	Pay for additional inspection workmanship.	necessitated by faulty
1.5 Shop Drawings .1	Prior to fabrication of struc	tural steel, submit 2

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sets of detailed fabrication and erection drawings to Engineer for review. Clearly indicate shapes, mass and dimensions of members, assembly relationships, materials to be used, bolts, weld types and sizes, and methods of erection.

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·	· · ·	- <u> </u>
1.5 Shop Drawings .2	Attach to drawings app	licable welding procedures,
(Cont'd)	stamped and approved h	by Canadian Welding Bureau.
•3	Regardless of review of	of fabrication and erection
	drawings by Engineer,	be responsible for correctness of
	dimensions, fit of par	ts and compliance with contract
.4	Do not commence fabric	pation and erection until Engineer
	has reviewed and accept ordering of materials	bted drawings. Be responsible for prior to acceptance of drawings.
.5	After final review by	Engineer, submit 7 sets of
	drawings for distribut	tion.
.6	Do not make changes or	revisions to reviewed drawings
	without consent of Eng	;ineer.
1.6 Temporary .1 Construction	Be entirely responsibl falsework, temporary h to structural elements	e for design and adequacy of pracing and strengthening required necessary for erection of steel.
.2	Four weeks prior to co of construction drawin for review. Such draw prepared, signed and s	mmencement of work, submit 3 sets ags and calculations to Engineer rings and calculations must be stamped by professional engineer.
<u>1.7 Test Reports</u> .1	Prior to fabrication, steel producer's certi G40.20-M1978.	provide Engineer with 2 copies of ficates in accordance with CSA
.2	Grade 350A steel for a minimum average absorb C by Charpy V-notch im	rirder web and flanges to have bed energy of 27 joules at -29 deg apact test.
1.8 Delivery and .1	Perform work necessary	to ensure safe delivery and
Storage	storage. Provide prot transporting and stori fabrication, transport damage girders and bea notches in edges of me	ective blocking for lifting, ng. Exercise care during ation and erection so as not to ms, and in particular to avoid mbers.
.2	Load structural steel transported and unload being excessively stre damaged. Transport gi mass on members weighi	for shipping so that it may be ed at its destination without ssed, deformed or otherwise rders upright. Clearly mark ng more than three tonnes.

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- 1.8 Delivery and Storage (Cont'd)
- .3 Store structural steel so as to avoid excessive stress, deformation or other damages. Store girders upright. Ensure that no portion of stockpiled steel comes into contact with ground.
- .4 Be responsible for structural steel until final acceptance in completed structure.
- .5 Provide Engineer with delivery schedules not less than 7 days prior to shipping.
- .6 Ship small parts such as bolts, nuts, washers and pins in containers not exceeding 150 kg gross mass. Clearly mark, on outside of each container, a list and description of material contained therein.

1.9 Rust Stain Protection of Concrete Surfaces

- Protect substructure concrete surfaces from staining due to weathering of unpainted steel as follows:

 Cover with two coats of approved quick drying clear co-polymer, based on methyl methacrylate formulation in accordance with manufacturer's instructions prior to erection of steel, following exposed concrete surfaces:
 - .1 Bearing seat areas.
 - .2 Front face of abutments.
 - .3 Vertical faces of piers.

.2 Provide under unpainted steel, waterproof cover or catch pan, which can be drained in such a manner that no water can reach vertical faces of piers and front face of abutments.

.1 Submit details of installation and methods of support to Engineer for approval, prior to commencement of protection work.

.2 Maintain waterproof cover or catch pan for a duration of 18 months, or as directed by Engineer until completion of bridge deck, after which remove protective material and their holding structures.

.2 Other methods of protection for concrete surfaces may be submitted to Engineer for consideration.

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	M-4	· · · · · · · · · · · · · · · · · · ·
1.10 Measurement .1 for Payment	Materials and work requ excluding items listed lump sum price bid for price to include follow	ired under this section, in 1.10.2, to be included in structural steel. Lump sum sing:
	.1 Supply, cleaning, p erection.	painting, galvanizing and
	.2 Supply and installa indicated.	tion of erection bracing if
	.3 Removal of erection .4 Supply, installatio rust stain protection o surfaces.	o bracing if specified. on, maintaining and removal of of substructure concrete
	.5 Additional work as .6 Additional erection	indicated or specified. material not indicated.
.2	Bid separately material for following items not and steel tonnage:	s and work including galvanizing included in lump sum price bid
	.1 Deck drains. .2 Curb expansion join .3 Railing.	its.
•3	Steel tonnage as shown as a measure to proport tonnage is calculated o includes erection steel	in unit price table to be used ion progress payments. This on basis of contract plans and indicated.
PART 2 - PRODUCTS		
<u>2.1 Materials</u> .1	Structural steel: .1 General requirement Structural Quality Stee Requirements for Rolled Steel. .2 Steel grades: to g	s: to CSA G40.21-M1978, 1 and CSA G40.20-M1978, General 1 or Welded Structural Quality rades indicated on plans.
.2	High strength bolts, nu A325-76c.	ts and washers: to ASTM
•3	Welding electrodes: to	CSA W48 series.
.4	Material for connection washers and weld deposi 350A steel: to be compa	s, including bolts, nuts, ts used with unpainted Grade tible.
•5	Stud shear connectors:	to Appendix H of CSA W59-1977.
.6	Galvanzizing: to CSA G	164-M1978.

.7 Countersunk bolts for curb expansion joints: to ASTM A307-76b or equivalent, and to be galvanized.

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PART 3 - EXECUTION

3.1 Marking

- .1 Mark materials in accordance with CSA G40.20-M1978; however, do not use die stamp. Place marking at locations not visible from exterior after erection.
- .2 Shop mark bearing assemblies and splices for fit and match.
- 3.2 Fabrication
- .1 Fabricate structural steel to AASHTO Standard Specifications for Highway Bridges, 1977, clauses 2.10.4 to 2.10.41 inclusive, unless otherwise specified on plans or herein.
- .2 Welding:
 .1 General requirements: to CSA W47.1-1973 and W59-1977.
 .2 Do welding in shop unless otherwise indicated on plans.
- .3 High strength bolting: to "Specification for Structural Joints using ASTM A325 or ASTM A490 Bolts" approved by Research Council on riveted and bolted structural joints of Engineering Foundation as amended February 4, 1976. Use 'turn-of-nut' tightening method.
- .4 Finish: Do shearing, cutting, chipping and machining neatly and accurately. Finish members true to line, free from twists, bends, open joints, and sharp corners and edges.
- .5 Allowable tolerance for holes: Finish holes to not more than 2 mm in diameter larger than diameter of bolt unless otherwise indicated on plans. Centre-to-centre distance between any two holes of a group of holes to vary by not more than 1 mm. Centre-to-centre distance between any group of holes to vary not more than following:

Centre-to-Centre	Tolerance		
Distance in Metres	in <u>†</u> mm		
less than 10	1		
10 to 20	2		
20 to 30	3		
.1 Do not correct	mispunched or		

.1 Do not correct mispunched or misdrilled members by welding.

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3.2 Fabrication (Cont'd)

.6 Span length tolerances: .1 Girders and beams: +6 mm .2 Centre-to-centre of bearing stiffeners or bearing plates: + 3 mm

- .7 Girder end support requirements: Do not install bearing stiffeners until top and bottom flanges of girder are at 90 deg to girder web in cross-section unless otherwise indicated. Make girder flange surfaces in contact with bearing components flat and smooth, and do not machine or grind flanges to correct irregularities unless permitted by Engineer.
- .8 Camber: Produce camber for girders to tolerances specified in CSA W59-1977. Record measurements of actual camber of each girder at points indicated on plans. Take camber measurements in plane of web with web in horizontal position. Ensure that field splices are fabricated to conform to required camber. Submit to Engineer a clear diagram of actual camber for each girder fabricated. If camber of fabricated girder is not within tolerances specified in CSA W59-1977, advise Engineer immediately with a proposal for corrective action. Do not undertake remedial measures until proposal has been approved by Engineer.
- .9 Shop Erection: Erect each girder on temporary supports at bearing locations to simulate field support conditions and grades. Measure deflection of girders at same points indicated for measurement of camber. Submit to Engineer a diagram of deflection measurements for each girder. Shop erection for simply supported girder having neither shop nor field splices is not required.
- .10 Additional Field Splices: Use of additional field splices to facilitate transportation and erection requires prior approval of Engineer. If approved provide additional field splices at no cost to Engineer.
- .11 Cleaning:

.1 Blast clean metal surface to Method 3, Commercial Blast Cleaning, to CGSB 31-GP-404a, using compressed air blast nozzles and dry sand.

.1 Remove heavy deposits of oil or grease by Solvent Cleaning to SSPC (Steel Structures Painting Council) - SP-1-63.

.2 Remove excessive rust-scale, weld spatter, slag and flex by Hand Tool Cleaning to SSPC-SP-2-63 or Power Tool Cleaning to SSPC-SP-3-63.

.3 Provide adequate separators and traps to remove detrimental amounts of water and oil from compressed air before reaching nozzle.

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3.2 Fabrication .11 Cleaning: .1 (Cont'd) (Cont'd) .4 Remove traces of blast products from surface, and from pockets and corners by brushing, blowing with clean compressed air, or vacuum cleaning. .5 Do not damage completed work adjacent to area being cleaned. .2 Degree of cleanliness of surfaces: to CGSB 31-GP-404a and Pictorial Surface Penetration Standards SIS 055900-1967 of Swedish Standard Institution, preparation grade Sa2. .12 Hot dip galvanizing: Galvanize steel where indicated to CSA G164-M1978. .1 Supply falsework, staging and other temporary work 3.3 Erection necessary to carry out erection. .2 Erect structural steel in accordance with AASHTO Standard Specifications for Highway Bridges, 1977. clauses 2.10.47 to 2.10.61 inclusive, unless otherwise specified on plans or herein. .3 Do not stain or deface steel surfaces. If stain or defacing occurs, clean surfaces to Engineer's approval. .4 Ensure that before erection of structural steel, elevations of bearing seats and location of anchor bolts are in accordance with plans and specifications. Report immediately any discrepancies to Engineer. .5 Do not disturb river banks or embankment without written permission of Engineer. If permission is granted, restore at own expense banks and slopes. .6 Take care in use of drift pins so as not to enlarge or distort holes; not to distort, kink or bend metal. Enlarge holes by reaming if permitted by Engineer. Reamed holes not to exceed size of bolt used by more than 2 mm. Obtain Engineer's permission to use pins with a diameter up to 3 mm larger than bolts specified.

.9 Remove temporary works when no longer required.

UNIT PRICE TABLE

UPPER BLACKSTONE RIVER BRIDGE

LIARD HIGHWAY, KM 108.3

SPEC NO	DESCRIPTION	UNIT OF MEASUREMENT	ESTIMATED QUANTITY	UNIT PRICE	COST
HC02222	EXCAVATION - UNCLASSIFIED	m ³	95	30.00	2,850
HC02222	GRANULAR FILL	m ³	1,000	8.00	8,000
HC02316	STEEL PIPE PILES (SUPPLY)	m	330	100.00	33,000
HC02316	STEEL PIPE PILES (INSTALLATION)	EACH	30	2,000.00	60,000
HC02545	RIP RAP	m ³	275	75.00	20,630
HC03200	REINFORCING STEEL - ABUTMENTS	kg	6,635	1.40	9,290
HC03200	REINFORCING STEEL - DECK AND CURBS	kg	11,957	1.40	16,740
HC03316	CONCRETE - ABUTMENTS	m ³	125	450.00	56,250
HC03316	CONCRETE - DECK AND CURBS	m³	77	550.00	42,350
HC05121	STRUCTURAL STEEL (44 TONNES)	LUMP SUM	1	132,000.00	132,000
HC05121	DECK DRAINS (4)	LUMP SUM	1	1,000.00	1,000
HC05121	CURB EXPANSION JOINTS	LUMP SUM	1	2,500.00	2,500
HC05121	RAILINGS	m	78	200.00	15,600
HC01015	BEARINGS (8)	LUMP SUM	1	20,000.00	20,000
HC01015	DECK EXPANSION JOINTS	LUMP SUM	1	20,000.00	20,000
	SPEC NO HC02222 HC02316 HC02316 HC02316 HC02545 HC03200 HC03316 HC03316 HC05121 HC01015 HC01015	SPEC NODESCRIPTIONHC02222EXCAVATION - UNCLASSIFIEDHC02222GRANULAR FILLHC02216STEEL PIPE PILES (SUPPLY)HC02316STEEL PIPE PILES (INSTALLATION)HC02545RIP RAPHC03200REINFORCING STEEL - ABUTMENTSHC03200REINFORCING STEEL - DECK AND CURBSHC0316CONCRETE - ABUTMENTSHC0316CONCRETE - DECK AND CURBSHC05121STRUCTURAL STEEL (44 TONNES)HC05121DECK DRAINS (4)HC05121CURB EXPANSION JOINTSHC05121RAILINGSHC01015BEARINGS (8)HC01015DECK EXPANSION JOINTS	SPEC NODESCRIPTIONUNIT OF MEASUREMENTHC02222EXCAVATION - UNCLASSIFIEDm³HC02222GRANULAR FILLm³HC02216STEEL PIPE PILESm(SUPPLY)(SUPPLY)EACHHC02316STEEL PIPE PILESEACH(INSTALLATION)m³HC02545RIP RAPm³HC03200REINFORCING STEEL - ABUTMENTSkgHC03200REINFORCING STEEL - DECK AND CURBSkgHC03316CONCRETE - ABUTMENTSm³HC03316CONCRETE - DECK AND CURBSm³HC05121STRUCTURAL STEEL (44 TONNES)LUMP SUMHC05121DECK DRAINS (4)LUMP SUMHC05121RAILINGSmHC01015BEARINGS (8)LUMP SUMHC01015DECK EXPANSION JOINTSLUMP SUM	SPEC NODESCRIPTIONUNIT OF MEASUREMENTESTIMATED QUANTITYHC02222EXCAVATION - UNCLASSIFIEDm³95HC02222GRANULAR FILLm³1,000HC02316STEEL PIPE PILESm330(SUPPLY)Installationm³275HC02316STEEL PIPE PILESEACH30(INSTALLATION)Installationm³275HC03200REINFORCING STEEL - ABUTMENTSkg6,635HC03200REINFORCING STEEL - DECK AND CURBSkg11,957HC03316CONCRETE - ABUTMENTSm³77HC03316CONCRETE - DECK AND CURBSm³77HC05121STRUCTURAL STEEL (44 TONNES)LUMP SUM1HC05121DECK DRAINS (4)LUMP SUM1HC05121CURB EXPANSION JOINTSLUMP SUM1HC05121RAILINGSm78HC01015BEARINGS (8)LUMP SUM1HC01015DECK EXPANSION JOINTSLUMP SUM1	SPEC NO DESCRIPTION UNIT OF MEASUREMENT ESTIMATED QUANTITY UNIT PRICE HC02222 EXCAVATION - UNCLASSIFIED m³ 95 30.00 HC02222 GRANULAR FILL m³ 1,000 8.00 HC022316 STEEL PIPE PILES m 330 100.00 (INSTALLATION) INSTALLATION) INSTALLATION) 2,000.00 HC02200 REINFORCING STEEL - ABUTMENTS kg 6,635 1.40 HC03200 REINFORCING STEEL - DECK AND CURBS m³ 125 450.00 HC03316 CONCRETE - ABUTMENTS kg 11,957 1.40 HC03316 CONCRETE - DECK AND CURBS m³ 77 550.00 HC05121 STRUCTURAL STEEL (44 TONNES) LUMP SUM 1 132,000.00 HC05121 DECK DRAINS (4) LUMP SUM 1 2,500.00 HC05121 CURB EXPANSION JOINTS LUMP SUM 1 20,000.00 HC05121 GOURGENS (8) LUMP SUM 1 20,000.00 HC05121 RAILINGS (8)

440,210

say \$<u>440,000</u>

Note: 1) Estimate not including Engineering, Contingencies or Engineer's Camp Costs.

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UNIT PRICE TABLE

UPPER BLACKSTONE RIVER BRIDGE

LIARD HIGHWAY, KM 108.3

Item	SPEC NO	DESCRIPTION	UNIT OF MEASUREMENT	UNIT PRICE	COST
1	HC02222	EXCAVATION - UNCLASSIFIED	m ³		
2	HC02222	GRANULAR FILL	m ³		
3	HC02316	STEEL PIPE PILES (SUPPLY)	m		
4	HC02316	STEEL PIPE PILES (INSTALLATION)	EACH		
5	HC02545	RIP RAP	m ³		
6	HC03200	REINFORCING STEEL - ABUTMENTS	kg		
7	HC03200	REINFORCING STEEL - DECK AND CURBS	kg		
8	HC03316	CONCRETE - ABUTMENTS	m ³		
9	HC03316	CONCRETE - DECK AND CURBS	m ³		
10	HC05121	STRUCTURAL STEEL (44 TONNES)	LUMP SUM		
11	HC05121	DECK DRAINS (4)	LUMP SUM		
12	HC05121	CURB EXPANSION JOINTS	LUMP SUM		
13	HC05121	RAILINGS	m		
14	HC01015	BEARINGS (8)	LUMP SUM		
15	HC01015	DECK EXPANSION JOINTS	LUMP SUM		