

A black and white photograph of a wide river flowing through a valley. The river is surrounded by dense forest on the left and right banks. In the background, a large, snow-capped mountain peak rises above the valley floor. The foreground shows a steep, forested slope.



November 1979



TO
A

Mr. G.D. Reid
Director, Transportation Program
Design and Construction
Public Works Canada
Ottawa, Ontario

FROM
DE

Manager
Highways Program
Public Works Canada
Edmonton, Alberta

SUBJECT
OBJET

LIARD HIGHWAY N.W.T.
FINAL DESIGN SUBMISSION
BLACKSTONE RIVER BRIDGE
KILOMETRE 107.4, LIARD HIGHWAY N.W.T.
PROJECT 085903

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

6220-A1-1

YOUR FILE - V/RÉFÉRENCE

DATE

1978-11-30

Enclosed are six copies each of the Final Design Submission plans and specifications for the Blackstone River Bridge.

Four copies of the plans and specifications should be forwarded to the Department of Indian and Northern Affairs in Ottawa for their review.

The distribution of the Final Design Submission is shown on the attached distribution list.

F.E. Kimball

Fev

F.E. Kimball
Manager
Highways Program
Western Region

Enclosure

Mr. A. Redshaw
Regional Manager
Water Resources Division
Department of Indian and
Northern Affairs
P.O. Box 1500
Yellowknife, N.W.T.
X1A 2R3
(2 copies specs, 1 sepia plans)

Mr. J. Ganske
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Mr. G. McKinnon, Chairman
Regional Transportation Committee
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Winnipeg, Manitoba
(6 copies plans and specs)

Mr. J. Bentley, Chief
Highways Division
Department of Public Works
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Mr. C. H. Yurchak, Edmonton
(1 copy plans and specs)

Mr. K. Barnett, Edmonton
(1 copy plans and specs)

Mr. E. Viddal, Edmonton
(1 copy plans and specs)

UNIT PRICE TABLE
BLACKSTONE RIVER BRIDGE
LIARD HIGHWAY, KM 107.4

<u>Item</u>	<u>SPEC NO</u>	<u>DESCRIPTION</u>	<u>UNIT OF MEASUREMENT</u>	<u>ESTIMATED QUANTITY</u>	<u>UNIT PRICE</u>	<u>COST</u>
1	HC02222	EXCAVATION - UNCLASSIFIED	m ³	250	50.00	12,500
2	HC02222	GRANULAR FILL	m ³	1350	8.00	10,800
3	HC02316	STEEL PIPE PILES (SUPPLY)	m	571	100.00	57,100
4	HC02316	STEEL PIPE PILES (INSTALLATION)	EACH	62	2,000.00	124,000
5	HC02411	STEEL SHEET PILING (SUPPLY AND INSTALLATION)	m ²	76	400.00	30,400
6	HC02545	RIP RAP	m ³	265	75.00	19,880
7	HC03200	REINFORCING STEEL - ABUTMENTS	kg	6,580	1.40	9,210
8	HC03200	REINFORCING STEEL - PIER	kg	3,208	1.40	4,490
9	HC03200	REINFORCING STEEL - DECK AND CURBS	kg	26,657	1.40	37,320
10	HC03315	TREMIE CONCRETE	m ³	11	200.00	2,200
11	HC03316	CONCRETE - ABUTMENTS	m ³	126	450.00	56,700
12	HC03316	CONCRETE - PIER	m ³	83	450.00	37,350
13	HC03316	CONCRETE - DECK AND CURBS	m ³	192	550.00	105,600
14	HC05121	STRUCTURAL STEEL (125 TONNES)	LUMP SUM	1	375,000.00	375,000
15	HC05121	DECK DRAINS (8)	LUMP SUM	1	2,000.00	2,000
16	HC05121	CURB EXPANSION JOINTS	LUMP SUM	1	2,500.00	2,500
17	HC05121	RAILINGS	m	178	200.00	35,600
18	HC01015	BEARINGS (12)	LUMP SUM	1	30,000.00	30,000
19	HC01015	DECK EXPANSION JOINTS	LUMP SUM	1	20,000.00	20,000
						\$972,650

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

- | | |
|------------------------------|---|
| <u>1 Description of Work</u> | .1 Work under this contract covers construction of Blackstone River Bridge including immediate approaches and incidental work as indicated. |
| <u>2 Location</u> | .1 Ft. Liard Highway km 107.4, Northwest Territories. |
| <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 Notification of Award of Contract submit for Engineer's approval, construction schedule indicating anticipated progress stages within time of completion.

.2 Take necessary measures to complete work within scheduled time. Do not change schedule without Engineer's approval. |
| <u>6 Bearings</u> | .1 General:
.1 Fabricate bearings according to details and design data as indicated.
.2 List in construction tender types of expansion bearings to be used.
.3 No alternative is permitted for fixed bearings.

.2 Acceptable expansion bearings:
.1 Goodco pot bearings by Goodco Ltd.
.2 Lubrite or Lubritef bearings by Merriman Inc.
.3 Spencer floating bearings by Andre Rubber Co. Ltd.
.4 Tetron cylindrical bearings by Conenco International Ltd.
.5 Wabo-Fyfe high load bearings by Elastometal Ltd. |

6 Bearings (Cont'd)

- .3 Common materials:
 - .1 Steel for fixed bearing indicated: to CSA G40.21-1976, Grade 50A, and to be galvanized.
 - .2 High strength bolts: to ASTM A325-76c, Type 1, and to be galvanized.
 - .3 Preformed fabric pads: to CSA S6-1974, Clause 11.18(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 S6-1974, Clause 11.11.
 - .6 Confined elastomer: to be basically 100% virgin natural polyisoprene to CSA S6-1974, Clause 11.10.3 and S6S1-1976.
- .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 details and design data as indicated.
 - .2 List in construction tender types of deck expansion joints to be used.
- .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 Materials:
 - .1 Elastomer: to CSA S6-1974, Clause 11.10.3 and S6S1-1976.
 - .2 Steel for cover plates: to CSA G40.21-1976, Grade 44W, 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.

7 Deck Expansion Joints
(Cont'd)

- .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:
 - .1 Deck expansion joints including supply and installation to be measured as lump sum price.

8 General Environmental
Guidelines

- .1 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.

1 Terms and Definitions

- .1 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, free from accumulation of waste and rubbish.

3 Measurement of Quantities

- .1 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.

3 Measurement of
Quantities (Cont'd)

.4 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.

4 Layout of Work

- .1 Engineer to set control stakes and establish bench marks to indicate location, alignment and reference elevation for work.
- .2 Complete layout work based on established bench marks, location and alignment.

5 Public Convenience
and Safety

- .1 Conduct work so as to assure safety and convenience of general public.
- .2 Regulate operations so as to protect visitors and campers on Crown lands involved.

6 Barricades and
Warning Signs

- .1 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.

7 Control of Traffic

- .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

- .1 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.

11 Project Signs

- .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.

12 Utility Line

- .1 Existing utility lines which may interfere with completed work to be removed or relocated by others.

13 Measurement for Payment

- .1 Items under Section HC01016 not to be measured for payment but to be considered incidental to contract.

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 Classification of Excavation Materials

- .1 Unclassified excavation materials: deposits of whatever nature encountered in work.
- .2 Classified excavation materials:
 - .1 Solid rock: rock in solid beds or mass in its original position which cannot be excavated without prior loosening, or boulders or rock fragments having individual volume in excess of 0.5 cubic metres.
 - .2 Common materials: deposits other than solid rock.

1.3 Requirements of Regulatory Agencies

- .1 Adhere to applicable codes when blasting is required.
- .2 Adhere to requirements relating to safety of excavations and protection of workmen.

1.4 Design of Temporary Works

- .1 Design cofferdams, sheathing, shoring, timbering and bracing required for work.
- .2 At least 4 weeks prior to commencement of work, submit four sets of design and erection drawings and supporting data to Engineer for review.
- .3 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 to be within limits bounded by horizontal planes at elevations of original ground surface and of bottom of substructure and by vertical planes 500 mm outside of outlines of substructure plan or by sheet piling.
 - .2 Materials removed from beyond limits specified to be measured only when Engineer authorizes additional excavation.
- .2 Fill materials, including supply, handling, stockpiling, placing and compaction, to be measured in cubic metres in place.

1.5 Measurement
for Payment (Cont'd)

- .3 Temporary works and dewatering to be considered incidental to excavation except steel sheet piling to be paid under Section HC02411.
- .4 Backfill of excavation with materials described in 3.5.2 to be considered incidental to excavation.

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.

3.3 Excavation
(Cont'd)

- .6 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.
- .7 Stockpile excavated materials suitable for fill at designated locations.
- .8 Separate materials containing sods, muck, frozen lumps, cinders, ashes, organic or other deleterious substances not suitable for fill.
- .9 Dispose of unsuitable and surplus material at locations and in a manner satisfactory to Engineer.
- .10 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.
- .11 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.

3.5 Fill

- .1 Do not proceed with fill operations until 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 fill adjacent to structure until concrete has been in place 14 days, and approval has been obtained from Engineer.
- .4 Install drainage system in fill as indicated or as directed by Engineer.
- .5 Place fill material in uniform layers not exceeding 200 millimetres simultaneously on all sides of structure so that loading is equalized.

3.5 Fill (Cont'd)

- .6 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%.
- .7 Deposit fill 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.

PART 1 - GENERAL

1.1 Description

- .1 This section specifies requirements for supplying and processing of aggregates to be stockpiled or incorporated into work.
- .2 For specific aggregate requirements refer to applicable section for material specified.

1.2 Related Work Specified Elsewhere

- .1 Structural Concrete: Section HC03316

1.3 Source Approval

- .1 Source of materials to be incorporated into work or stockpiled requires approval of Engineer.
- .2 If in opinion of Engineer source materials do not meet or cannot reasonably be processed to meet specified requirements, procure an alternative source satisfactory to Engineer, or demonstrate to satisfaction of Engineer, that material from source in question can be processed to meet specified requirements.
- .3 Should a change of source of material be proposed during work, advise Engineer sufficiently in advance of such change to allow samples to be taken and tests made.
- .4 Note that acceptance of material from any source does not preclude its future rejection if it is subsequently found to deviate from specifications, or if its field performance is found to be unsatisfactory.

1.4 Production Sampling

- .1 Provide Engineer with ready access to source of processed material for purpose of continuous sampling.

1.5 Measurement for Payment

- .1 No measurement to be made under this Section. Include costs in items of work that require 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.

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.

2.1 Materials
(Continued)

- .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:
 - .1 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

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.

3.3 Handling

- .1 Handle and transport aggregates properly to avoid segregation and contamination.

3.4 Stockpiling

- .1 Unless otherwise specifically authorized in writing by Engineer, stockpile aggregates on site in locations designated by Engineer.
- .2 Stockpile aggregates in sufficient quantities to meet project schedules.
- .3 Stockpile aggregates on stabilized, clean and well drained surfaces.
- .4 Provide a compacted sand base not less than 250 mm in depth to prevent contamination of material, if coarse aggregate is stockpiled on sand.
- .5 Do not incorporate bottom 250 mm of pile into work, if aggregates are stockpiled on ground.
- .6 Stockpile aggregates far enough apart or separate by substantial dividers to prevent intermixing.
- .7 Remove and dispose of intermixed or contaminated materials within 48 hours of rejection by Engineer.
- .8 Stockpile materials in uniform layers of thickness as follows:
 - .1 Maximum 1 m for coarse aggregate and base course materials.
 - .2 Maximum 2 m for fine aggregate and sub-base materials.
 - .3 Maximum 1.5 m for all other materials.
- .9 Complete each layer over entire stockpile area before beginning next layer.
- .10 Uniformly spot-dump aggregates delivered to stockpile and build up stockpile as specified.
- .11 Do not cone piles or spill aggregates over edges of pile.
- .12 Provide protection to prevent ice and snow from becoming mixed in stockpile or from material being removed from stockpile.

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
Specified Elsewhere

- .1 Steel Pipe Piles: Section HC02316

1.3 Delivery and
Handling

- .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.

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

- .1 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.

3.1 Equipment
Requirements
(Cont'd)

- .4 Followers:
 - .1 Do not use followers without Engineer's written 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.

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

- .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.

3.7 Damaged or Defective Piles

- .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.

PART 1 - GENERAL

1.1 Description

- .1 This section specifies requirements for supplying and installing steel pipe piles.

1.2 Related Work
Specified Elsewhere

- .1 Pile Foundation General: Section HC02300.

1.3 Delivery Handling
and Storage

- .1 Store pipe piles horizontally on timber sills.
- .2 Provide timber separators to avoid metal to metal contact of piles.

1.4 Test Reports

- .1 Provide Engineer with two copies of steel producer's certificates in accordance with ASTM A252-75 including chemical composition prior to fabrication.

1.5 Measurement for
Payment

- .1 Supply of piles to be measured in metres and installation to be measured in number of piles.
- .2 Pile tip reinforcement, splices and pile caps to be considered incidental to supply of piles.
- .3 No extra compensation to be made for replacement of damaged or defective piles rejected by Engineer.

PART 2 - PRODUCTS

2.1 Materials

- .1 Welded straight longitudinal seam steel pipe piles of 12.75 in. outside diameter and 0.375 in. wall thickness and plain machine cut ends to ASTM A252-75, Grade 2 with following chemical composition:

2.1 Materials (Cont'd)

.1 (Continued)

	Percent Maximum	
	Ladle Analysis	Check Analysis
Carbon	0.22	0.26
Manganese	1.10	1.15
Phosphorous	0.04	0.05
Sulphur	0.05	0.06

.1 Ratio of manganese to carbon shall not be less than 4.0.

.2 Steel pile tip reinforcement: to CSA G40.21-1976 Grade 44W.

.3 Steel pile caps: to CSA G40.21-1976, Grade 44W.

.4 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
Installation

.1 Provide and fabricate full length piles having not more than one splice per pile in accordance with ASTM 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.

.5 Do pile installation work to Section HC02300.

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 Excavation and Fill for Structures: Section HC02222.
- .2 Pile Foundations, General: Section HC02300.

1.3 Cofferdam Design and Erection Drawings

- .1 To Section HC02222

1.4 Certificates

- .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 G40.21-1976, grade 38W or equivalent.
- .2 Structural Steel: structural steel for wales, bearing plates, wales splices, capping channels, support angles and miscellaneous steel to CSA G40.21-1976 Grade 38W or equivalent.

PART 3 - EXECUTION

3.1 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.

PART 1 - GENERAL

1.1 Description

- .1 This section specifies requirements for supplying and placing stone rip-rap.

1.2 Measurement for Payment

- .1 Rip-rap to be measured in cubic metres of material incorporated into work. Excavation and preparation of foundation bed including fabric lining to be considered incidental to placing of rip-rap.
- .2 Where, in opinion of Engineer, it is impracticable to measure rip-rap in place, loads on hauling vehicles to be measured in cubic metres.

PART 2 - PRODUCTS

2.1 Materials

- .1 Stones: Hard, dense, angular quarry stone, free from seams, cracks or other structural defects, to meet following size distribution for use intended:
 - .1 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.

PART 3 - EXECUTION

3.1 Placing

- .1 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.

PART 1 - GENERAL

1.1 Description

- .1 This section specifies requirements for supplying and placing reinforcing steel.

1.2 Related Work Specified Elsewhere

- .1 Structural Concrete: Section HC03316

1.3 Reference Standards

- .1 CSA A23.1-1973, and G.30 series.

1.4 Source Sampling

- .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 Payment

- .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.

2.1 Materials
(Cont'd)

- .2 Wire ties: to CSA G30.3-1972.
- .3 Supports: approved supports and chairs of strong, durable, non-corrodible materials. Galvanized metal or plastic chairs, concrete blocks or other devices may be used provided they satisfy requirements of this section and are approved by Engineer.

PART 3 - EXECUTION

3.1 Field Bending

- .1 Do not field bend reinforcement except where indicated or authorized by Engineer.
- .2 Bend reinforcement, when authorized, with a slow and steady pressure without heat.
- .3 Replace bars which develop cracks or splits.

3.2 Placing

- .1 Accurately place reinforcing steel in positions indicated and hold firmly during placing, compacting and setting of concrete.
- .2 Tie reinforcement where bar spacing in each direction is:
 - .1 Less than 300 mm: - tie at alternate intersections.
 - .2 300 mm or more: - tie at each intersection.

3.3 Splicing

- .1 Do not splice reinforcement other than where indicated or authorized by Engineer.

3.4 Surface
Conditions

- .1 Reinforcement at time concrete is placed to be free from mud, oil, or other non-metallic coatings that adversely affect bonding capacity.
- .2 Reinforcement, except prestressing steel, with rust, mill scale, or a combination of both to be considered as satisfactory, provided minimum dimensions, including height of deformations, and mass of a hand wire brushed test specimen are not less than specified requirements in applicable CSA Standards.

3.5 Inspection

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

PART 1 - GENERAL

1.1 Description

- .1 This section specifies requirements for supply and placement of concrete underwater by tremie method.

1.2 Related Work Specified Elsewhere

- .1 Aggregates, General Section HC02225.

1.3 Reference Standards

- .1 To CSA A23.1-1973, and CSA A23.2-1973.

1.4 Definitions

- .1 Tremie concrete is concrete placed underwater through a tube called a tremie pipe. Tremie pipe may be open ended or may have a foot valve, plug or travelling plug to control flow of concrete. Concrete is placed in a hopper connected to tremie pipe and a sufficient head of concrete is maintained in tremie pipe to provide desired rate of flow.

1.5 Measurement for Payment

- .1 Concrete placed underwater to be measured in cubic metres based on quantity of concrete placed as measured by theoretical neat lines of concrete volume indicated on drawings.

PART 2 - PRODUCTS

2.1 Materials

- .1 Portland Cement to CSA Standard A5-M77, Type 10, Normal.
- .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.

2.2 Concrete Mixes

- .1 Use 45 to 50 percent fine aggregate by weight in concrete mix for workability.
- .2 Use not less than 400 kg of cement per cubic metre for concrete to be placed underwater.
- .3 For tremie concrete produce a mix with a slump of 150 to 200 mm and a water cement ratio of not more than 0.45.
- .4 Produce concrete with a minimum compressive strength of 25MPa at 28 days.

2.3 Admixtures

- .1 Admixtures will be subject to approval of Engineer. Admixtures will be permitted to correct deficiencies in mix or to improve placement of concrete as recommended by testing laboratory designated by Engineer.
- .2 Engineer may withdraw prior approval of admixture if conditions encountered during course of work indicate unsatisfactory performance.
- .3 Calcium chloride will not be permitted.

PART 3 - EXECUTION

3.1 Preparation

- .1 Where concrete must bond to concrete surfaces, rock surfaces, piling, sheet piling or anchor rods, clean thoroughly of soil and algae just prior to starting concrete placement. Use water jets and when quantities of silt or mud are present remove by air lift.
- .2 Arrange to carry out large pours so that concrete is placed in one continuous operation to full depth required. Provide sufficient supply of concrete to complete pour without interruption and supply complete equipment for every phase of operation.

3.2 Tremie Method

- .1 Provide a tremie pipe which is watertight and sufficiently large to allow free flow of concrete. Diameter of tremie pipe to be not less than 200 mm or less than eight times maximum size of coarse aggregate.

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.

PART 1 - GENERAL

1.1 Description

- .1 This section specifies requirements for supplying, placing, finishing, protecting and curing structural concrete.

1.2 Related Work Specified Elsewhere

- .1 Aggregates, General: Section HC02225
- .2 Concrete Reinforcement: Section HC03203

1.3 Reference Standards

- .1 To CSA A23.1-1973 except where specified otherwise.

1.4 Requirements of Regulatory Agencies

- .1 Conform to applicable codes relating to design and construction of formwork and falsework.

1.5 Formwork and Falsework Design

- .1 Submit at least 5 weeks prior to erection 3 sets of formwork and falsework design drawings and calculations to Engineer for review.
- .2 Clearly indicate dimensions, and details of materials, as well as design, fabrication and erection procedures.
- .3 Drawings and calculations to be signed and stamped by professional engineer responsible for their preparation.
- .4 Be responsible for accuracy of drawings, or for unsatisfactory work arising from errors of judgement, poor workmanship or faulty materials.

1.6 Source Sampling

- .1 Inform Engineer of proposed source of following materials to be supplied and provide access for sampling:

Material	Minimum Quantity	Minimum Laboratory Time (days) for Testing	Samples by
1. Aggregate for Acceptance tests			
a) Fine	45 kg	7	Contractor Submits
b) Coarse	45 kg	7	Contractor Submits
2. Aggregate for Mix Design	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. Dampproofing	4 litres	30	Contractor Submits
10. Waterstop	1 m	60	Contractor Submits

1.7 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:
- .1 Portland cement.
 - .2 Admixtures.

1.8 Storage of
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 standard A5-M77, Type 10, normal.
- .3 Admixtures:
 - .1 Air entraining admixtures: to CSA A266.1-1973.
 - .2 Chemical admixtures: to CSA A266.2-1973.

2.1 Materials (Cont'd)

.4 Curing Compounds to CGSB 90-GP-1a.

.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 and Test Methods -	Finished PVC Waterstop
	ASTM	
	Property	Test requirement
Tensile strength	D638-77a	Min 9.65 MPa
Elongation at breaking	D638-77a	Min 250 percent
Hardness (Shore)	D2240-75	60 to 75
Specific Gravity	-----	Max ± 0.02 from manufacturer's value
Resistance to Alkali	D543-67	.1 Max mass change: - 0.10% to +0.25%
(7 days, using 10% NaOH)		.2 max hardness change: ± 5 (shore)
Water Absorption (48 hours)	D570-77	Max 0.5%
Cold bending	---	No cracking
Volatile loss	D1203-67	Not more than 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 2.36 mm sieve and to CSA A23.1-1973.

.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.

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 compressive strength: 30 MPa at 28 days.
 - .2 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 7%.
 - .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 A23.1-1973.
- .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-A23.1-1973 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 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 A23.1-1973 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 A23.1-1973.

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 A23.1-1973.
- .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 A23.1-1973 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.

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 a location determined by Engineer, if corrective measures are required during concrete placement. Remove concrete in place beyond bulkhead.

3.5 Placing Concrete
(Cont'd)

.7 Place concrete in a uniform heading normal to roadway centreline. Limit rate of placing to that which can be finished before beginning of initial set.

.8 Use wooden floats to correct minor defects and irregularities exceeding 3 mm under a 3 m straightedge placed in any direction, immediately after longitudinal floating by deck finisher.

.9 Float concrete deck surface transversely with approved hand operated float board when initial set of concrete has taken place but surface is still plastic.

.10 Do not overwork concrete surface.

.7 Curbs:

.1 Clean and dry deck concrete surfaces which are to be in contact with curb concrete.

.2 Apply thin and even coating of bonding grout with stiff broom or brush to deck concrete surfaces immediately before placing of curb concrete.

.3 Remove excessive grout.

.4 Apply grout at rate such that grout does not become dry before it is covered with curb concrete.

3.6 Finishing of
Unformed Surfaces

.1 Deck slab: After transverse floating and before surface dries, give surface a uniform broom finish to produce regular corrugations not exceeding 3 mm deep by drawing broom in direction normal to roadway centreline.

.2 Curbs: After concrete has been placed, compact and strike off surface with strike board and float with wood or cork float. Use an edging tool on edges and at expansion joints. Finish surface to a granular or matte texture which will not be slick when wet.

3.7 Finishing of
Formed Surfaces

.1 To CSA A23.1-1973.

.2 Apply sack rubbed finish to exposed surfaces of abutments and side surfaces of curbs and deck to CSA A23.1-1973.

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

3.8 Protection and
Curing

- .1 To CSA A23.1-1973 and the following:
 - .1 Unformed surfaces: Cure with burlap and water. Place two layers of damp burlap on surface of concrete. Overlap each strip by at least 75 mm. Secure burlap against displacement and ensure that no part of concrete surface is uncovered at any time. Keep burlap thoroughly wet for seven days after day of placing.
 - .2 Formed surfaces: If formwork is left in place for seven days or more no additional curing will be required. If formwork is removed in less than seven days, cure in manner specified for unformed surfaces for remainder of seven day period.
 - .3 During curing period uncover only such areas as are immediately needed for finish treatment. Recover and continue curing.
 - .4 Curing compounds: use only when approved in writing by Engineer.

3.9 Linseed Oil
Treatment

- .1 Bridge deck, approach slabs and curbs:
 - .1 After concrete has cured for specified curing time and when surface of concrete is dry, apply two coats of linseed oil mixture uniformly to cleaned surfaces of deck and slabs, and inside face and top of curbs.
 - .2 Apply first coat at 135 ml per square metre and second at 90 ml per square metre.
 - .3 Do not apply linseed oil mixture to damp surface. Allow coatings to thoroughly dry prior to applying second or subsequent coatings.
 - .4 Do not apply linseed oil mixture when air temperature is below 5 deg C.

3.10 Dampproofing

- .1 Prepare surface to CSA A23.1-1973.
- .2 Do dampproofing to CGSB 37-GP-3b.
- .3 Apply dampproofing material over entire width of wingwalls and breastwalls in contact with embankment. On approach side keep dampproofing to 150 mm below lines of finished embankment. On stream side dampproof to within 300 mm of top of backfill.

3.11 Field Quality
Control

- .1 Inspection and testing of concrete and concrete materials will be carried out by Engineer to CSA A23.1-1973.
- .2 If test results indicate that quality of concrete does not meet requirements of Engineer, take measures as indicated in CSA A23.1-1973, Clause 10.6.

PART 1 - GENERAL

1.1 Description

- .1 This section specifies requirements for supply, fabrication, painting, galvanizing, delivery and erection of structural steel.

1.2 Requirement of
Regulatory Agencies

- .1 Adhere to applicable codes relating to design and construction of supporting falsework necessary for erection of steel.
- .2 Comply with Navigable Waters Protection Act and regulations.

1.3 Design Criteria

- .1 Make no changes or variations from requirements of specifications or plans forming part of this work without written approval of Engineer.
- .2 Submit to Engineer for his approval suggestions affecting improvements in design or manufacture of work under this contract.

1.4 Source Quality
Control

- .1 Materials and fabrication to be subject to physical inspection during course of work done under this contract.
- .2 Inspection to be done by inspection organization appointed by Engineer. Provide suitable facilities and cooperate fully with inspection organization in carrying out inspections and tests required in mill, shop and field.
- .3 Pay for additional inspection necessitated by faulty workmanship.

1.5 Shop Drawings

- .1 Prior to fabrication of structural steel, submit 2 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.

1.5 Shop Drawings
(Cont'd)

- .2 Attach to drawings applicable welding procedures, stamped and approved by Canadian Welding Bureau.
- .3 Regardless of review of fabrication and erection drawings by Engineer, be responsible for correctness of dimensions, fit of parts and compliance with contract plans and specifications issued by Engineer.
- .4 Do not commence fabrication and erection until Engineer has reviewed and accepted drawings. Be responsible for ordering of materials prior to acceptance of drawings.
- .5 After final review by Engineer, submit 7 sets of drawings for distribution.
- .6 Do not make changes or revisions to reviewed drawings without consent of Engineer.

1.6 Temporary
Construction

- .1 Be entirely responsible for design and adequacy of falsework, temporary bracing and strengthening required to structural elements necessary for erection of steel.
- .2 Four weeks prior to commencement of work, submit 3 sets of construction drawings and calculations to Engineer for review. Such drawings and calculations must be prepared, signed and stamped by professional engineer.

1.7 Test Reports

- .1 Prior to fabrication, provide Engineer with 2 copies of steel producer's certificates in accordance with CSA G40.20-1976.
- .2 Grade 50A steel to have minimum average absorbed energy of 27 joules at -29 deg C by Charpy V-notch impact test.

1.8 Delivery and
Storage

- .1 Perform work necessary to ensure safe delivery and storage. Provide protective blocking for lifting, transporting and storing. Exercise care during fabrication, transportation and erection so as not to damage girders and beams, and in particular to avoid notches in edges of members.
- .2 Load structural steel for shipping so that it may be transported and unloaded at its destination without being excessively stressed, deformed or otherwise damaged. Transport girders upright. Clearly mark mass on members weighing more than three tonnes.

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

- .1 Protect substructure concrete surfaces from staining due to weathering of unpainted steel as follows:
 - .1 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.

1.10 Measurement
for Payment

- .1 Materials and work required under this section, excluding items listed in 1.10.2, to be included in lump sum price bid for structural steel. Lump sum price to include following:
 - .1 Supply, cleaning, painting, galvanizing and erection.
 - .2 Supply and installation of erection bracing if indicated.
 - .3 Removal of erection bracing if specified.
 - .4 Supply, installation, maintaining and removal of rust stain protection of substructure concrete surfaces.
 - .5 Additional work as indicated or specified.
 - .6 Additional erection material not indicated.
- .2 Bid separately materials and work including galvanizing for following items not included in lump sum price bid and steel tonnage:
 - .1 Deck drains.
 - .2 Curb expansion joints.
 - .3 Railing.
- .3 Steel tonnage as shown in unit price table to be used as a measure to proportion progress payments. This tonnage is calculated on basis of contract plans and includes erection steel indicated.

PART 2 - PRODUCTS

2.1 Materials

- .1 Structural steel:
 - .1 General requirements: to CSA G40.21-1976, Structural Quality Steel and CSA G40.20-1976, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 Steel grades: to grades indicated on plans.
- .2 High strength bolts, nuts and washers: to ASTM A325-76c.
- .3 Welding electrodes: to CSA W48 series.
- .4 Material for connections, including bolts, nuts, washers and weld deposits used with unpainted Grade 50A steel: to be compatible.
- .5 Stud shear connectors: to Appendix H of CSA W59-1977.
- .6 Galvanizing: to CSA G164-1965.
- .7 Countersunk bolts for curb expansion joints: to ASTM A307-76b or equivalent, and to be galvanized.

PART 3 - EXECUTION

3.1 Marking

- .1 Mark materials in accordance with CSA G40.20-1976; 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, 1973, clauses 2.10.4 to 2.10.43 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:

<u>Centre-to-Centre</u> <u>Distance in Metres</u>	<u>Tolerance</u> <u>in + mm</u>
less than 10	1
10 to 20	2
20 to 30	3

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

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.

3.2 Fabrication
(Cont'd)

.11 Cleaning:

.1 (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 G164-1965.

3.3 Erection

- .1 Supply falsework, staging and other temporary work necessary to carry out erection.
- .2 Erect structural steel in accordance with AASHTO Standard Specifications for Highway Bridges, 1973, clauses 2.10.48 to 2.10.62 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.