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USAID | **AFGHANISTAN**
FROM THE AMERICAN PEOPLE

ENGINEERING SUPPORT PROGRAM

WOLT0009-001

Sagai Crossing Bridge Construction Project

Khost, Afghanistan

Project Technical Specifications – Final Design Submittal

October 8, 2011

This publication was produced for review by the United States Agency for International Development. It was prepared by Tetra Tech, Inc.

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FINAL DESIGN
SAGAI CROSSING
BRIDGE CONSTRUCTION
KHOST, AFGHANISTAN
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OCTOBER 2011

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All drawings dated 10/08/11.

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SECTION 00 11 13 - NOTICE TO BIDDERS

NOTICE IS HEREBY GIVEN, that sealed Bids, in duplicate, are sought and requested by USAID (hereinafter called "Owner"), for the Sagai Crossing Bridge Construction Project in Khost, Afghanistan.

Bids are requested for the following Contract:

General

In accordance with the Drawings, Project Manual (including Conditions of the Contract and Specifications), and other Bidding and Contract Documents prepared by:

Tetra Tech Inc.
1 Grant Street Framingham, MA 01701

A pre-bid conference for potential Bidders and other interested parties will be held at a time and location to be determined.

Sealed Bids will be received by the Owner by a date certain at a time and location to be determined.

Complete sets of Bidding Documents may be available by contacting the owner.

Partial sets or portions of the Bidding Documents may be obtained upon making a written request listing the Drawing numbers and Project Manual sections desired. Entities obtaining partial sets or portions of the Bidding Documents are advised that they remain responsible for all information contained in the complete set of Bidding Documents.

The Owner requires Bids comply with bidding requirements indicated in the Instructions to Bidders. The Owner may, at its discretion, waive informalities in Bids, but is not obligated to do so, nor does it represent that it will do so. The Owner also reserves the right to reject any and all Bids. The Owner will not waive informalities which would give one Bidder substantial advantage or benefit not enjoyed by all affected Bidders. Bids may not be withdrawn before 45 days following the Bid opening thereof, unless an error is claimed by the Bidder in accordance with the Instructions to Bidders.

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SECTION 00 21 13 - INSTRUCTIONS TO BIDDERS**ARTICLE 1**
PROJECT AND BIDDING INFORMATION

1. Project Identification: WOLT0009 PRT.
 - a. Project Location: Sagai, Khost Afghanistan
2. Owner: Khost PRT
 - a. Address: US base Camp Salerno
3. Bid Opening: Bids will be received until the following Bid opening date and time, at the following location:
 - a. Bid Opening Date and Time: To be determined.
 - b. Bid Opening Location: To be determined.
 - 1) Special Instructions: none
4. Pre-Bid Conference: A pre-bid conference for potential Bidders and other interested parties will be held as follows:
 - a. Pre-Bid Conference Date and Time: To be determined.
 - b. Pre-Bid Conference Location: To be determined.
 - 1) Special Instructions: none.
5. Agreement Form: The following will be used as the basis for the form of agreement between the Owner and the Contractor (Owner-Contractor Agreement):

ARTICLE 2
DEFINITIONS

1. Definitions in the General Conditions of the Contract for Construction or in other Contract Documents are applicable to the Bidding Documents.
 - a. "Addenda": Written or graphic instruments issued by the Owner or owner's representative prior to execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
 - b. "Bid": Complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
 - 1) "Base Bid": Sum stated in the Bid for which Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated for Alternates.
 - 2) "Alternates": Amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

- 3) “Unit Price”: Amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.
- c. “Bidder”: Person or entity who submits a Bid.

ARTICLE 3
BIDDING PROCEDURES

1. Bid Form: Complete the Bid Form provided, in duplicate, with all blank spaces for Base Bid, Alternates and Unit Prices legibly completed in ink, or typewritten, in both words and figures.
 - a. In the event of a discrepancy between amounts written in words and figures, the amount written in words shall govern.
 - b. Bid Forms without amounts expressed both in words and figures will not be accepted.
2. Bid Attachments: Complete and submit the following attachments with the Bid Form:
 - a. Attachment #1: Non-Collusive Bidding Certification.
 - b. Attachment #2: Certified Corporate Resolution.
 - c. Attachment #3: Subcontractors List.
 - 1) Submit Subcontractors List, on form provided, in a separate sealed envelope bearing the Bidder’s name, name of Contract, and title “Subcontractors List”.
3. Bid Submission: Submit each Bid, including attachments, in a sealed envelope bearing the Bidder’s name and address, name of Contract, and name of Project. **[Enclose the Subcontractors List (Bid Form Attachment #3) in a separate sealed envelope within the Bid envelope.]** Deliver Bid to location specified no later than the Bid opening date and time indicated. Any Bid received after the Bid opening date and time indicated will be returned unopened.
4. Bid Withdrawal:
 - a. Bid may be withdrawn by the Bidder up until the date and time specified for opening of Bids.
 - b. Following the Bid opening, Bid may not be withdrawn before 45 days following the Bid opening, except in the case of Bidder error, as follows:
 - 1) If the Bidder claims an error in the Bid, submit a written notice to the Owner, within three days of the Bid opening, describing in detail the nature of the error, submitting documentary evidence or proof of such error.
 - a) Failure to deliver such notice and evidence or proof, within the time frame required, constitutes a waiver of Bidder’s right to claim error.
 - 2) Upon receipt of required notice and evidence or proof, the Owner will determine if an excusable error has been made; and if so, the Owner may permit the Bid to be withdrawn. The Owner’s determination will be conclusive upon the Bidder and all who claim rights under the Bidder.
5. Subcontractors List Return: Sealed Subcontractors List (Bid Form Attachment #3) will be returned, unopened, to unsuccessful Bidders after Contract Award.

ARTICLE 4
BIDDING DOCUMENTS

1. Bidding Documents include the bidding requirements and the proposed Contract Documents, as follows:
 - a. Bidding requirements consist of the following:
 - 1) Notice to Bidders.
 - 2) Instructions to Bidders.
 - 3) Bid Form, with attachments.
 - 4) Proposed Subcontractors Form.
 - 5) Proposed Schedule of Values Form (BOQ).
 - 6) Bidder's Qualifications Form.
 - b. Proposed Contract Documents consist of the following:
 - 1) Owner-Contractor Agreement.
 - 2) Conditions of the Contract.
 - 3) Drawings.
 - 4) Specifications.
 - 5) Addenda.
2. Bidding Document Interpretations or Corrections:
 - a. Submit requests for Bidding Document interpretation to the Owner, in writing using the provided Pre-Bid Request for Interpretation Form, at least five days prior to the Bid opening.
 - b. Interpretations or corrections will be issued in the form of written Addenda. The Owner will not make oral interpretations or corrections.
 - c. Addenda will be sent to all known Bidders by certified mail, return receipt requested, no later than four days prior to the Bid opening.
 - 1) Failure of any Bidder to receive any such Addendum by reason of not having provided a proper address and responsible person to whom such Addendum should be delivered shall not relieve the Bidder from any obligation required by the Addendum.
3. Equivalents and Substitutions: The use of manufacturer's brand names, catalog numbers, and similar proprietary identifying data is intended to establish a standard of quality, appearance, and function for those items. It is not the intention of the Owner or the owner's representative to eliminate from consideration products that are equivalent in quality, appearance, and function to those identified.
 - a. Equivalents:
 - 1) On Proposed Products Form provided, as post-Bid information, identify and list proposed equivalents to specified products as follows:
 - a) Applicable Specification Section and paragraph.
 - b) Proposed manufacturer's name, product brand name, and catalog number of proposed equivalent.
 - c) Note any aspect of the specified product that the proposed equivalent cannot meet.

- 2) Failure to identify and list proposed equivalents shall be deemed to mean the Bidder will furnish the materials or products indicated in the Contract Documents without exception.
- b. Substitutions: Refer to Division 01 Specification Section “Substitution Procedures”.

ARTICLE 5
BIDDER’S REPRESENTATIONS

1. By submitting a Bid, Bidder represents that:
 - a. Bidder has visited and thoroughly inspected the Project site, and has become fully informed of the conditions relating to the Project;
 - b. Bidder has received, read, and is thoroughly familiar with the Bidding Documents, including all Addenda issued; and
 - c. Bidder has prepared its Bid based on the materials, equipment and systems required by the Bidding Documents or equivalents; **and**
 - d. Bidder has prepared its Bid based on the subcontractors identified on the accompanying sealed Subcontractors List and the corresponding subcontract amount listed, and if awarded the Contract, intends to engage the listed Subcontractors.
 - i. Owner retains its right to object to any proposed Subcontractor, in accordance with the Conditions on the Contract.

ARTICLE 6
BID CONSIDERATION

1. Opening of Bids: At the designated Bid opening date and time, Bids received will be publicly opened and read aloud.
2. Bid Rejection:
 - a. The Owner requires Bids comply with bidding requirements; however, the Owner may, at its discretion, waive informalities in Bids. The Owner is not obligated to do so and does not represent that it will do so. The Owner will not waive informalities which would give one Bidder substantial advantage or benefit not enjoyed by all affected Bidders.
 - b. The Owner reserves the right to reject any and all Bids not deemed in the best interests of the Owner, if in its judgment the public interest will be promoted thereby.
 - c. The Owner reserves the right to reject as “informal” any and all Bids which, in its opinion, are incomplete, conditional, obscure, or contain irregularities of any kind.
 - d. In rejecting a Bid, the Owner does not forfeit its right to accept the Bid for any other Contract contained in the Project; and the rejection of a Bid is not necessarily a finding by the Owner of any facts or circumstances which would preclude the Bidder from serving as a subcontractor on any portion of the Project.
3. Bid Acceptance: The Owner intends to award the Contract to the responsible Bidder whose Bid complies with conditions to render it formal, and whose Bid is the lowest number of dollars.

ARTICLE 6
POST-BID INFORMATION

1. Contractor Qualifications: The Owner may make such investigations as it deems necessary to determine the ability of the Bidder to perform the Work.
 - a. The Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request, including the provided Bidder's Qualifications Form.
 - b. The Owner reserves the right to reject any Bid if the evidence submitted, or investigation of Bidder fails to satisfy the Owner that the Bidder is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein.
2. Owner's Financial Capability: Successful Bidder may submit request to Owner for information regarding Owner's financial arrangements for this Project in accordance with the General Conditions, no later than 30 days following the Bid opening.
3. Post-Bid Submittals:
 - a. The three apparent low Bidders shall submit the following completed forms within three days following the Bid opening:
 - 1) Proposed Products Form.
 - 2) Proposed Subcontractors Form.
 - 3) Proposed Schedule of Values Form (BOQ).
 - 4) Upon request, Bidder's Qualifications Form.

Attachment: Pre-Bid Request for Interpretation Form

END OF 00 21 13

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SECTION 00 41 00 – BID FORM

BID FROM (Bidder's Name) : _____

(Address) : _____

Bidder's Telephone : _____

Bidder's Facsimile (Fax) : _____

Bidder's E-mail Address : _____
(if applicable)

**BID FORM
(Submit in duplicate)**

CONTRACT: GENERAL

PROJECT TITLE: Sagai Crossing Bridge Construction, Khost Afghanistan

DATE:

PROJECT NO.: WOLT0009-001

BID TO:

The Bidder hereby certifies that it has examined and fully understands the requirements and intent of the Bidding Documents, including the Bidding Requirements and proposed Contract Documents; and proposes to furnish all labor, materials, and equipment necessary to complete the Work on, or before, the dates specified in the Contract Documents for the **BASE BID** sum of:

(Words)

(\$ _____)

(Figures)

Show all amounts in both words and figures; in the event of a discrepancy between amounts written in words and figures, the amount written in words shall govern.

LIST OF ADDENDA RECEIVED

No. _____	Date _____	No. _____	Date _____
No. _____	Date _____	No. _____	Date _____
No. _____	Date _____	No. _____	Date _____

BID ATTACHMENTS

Enclosed with this Bid are the following attachments:

- Attachment #1 – Non-Collusive Bidding Certification.
- Attachment #2 – Certified Corporate Resolution
- Attachment #3 – Subcontractors List (in separate sealed envelope bearing the Bidder’s name, name of Contract, and title “Subcontractors List”).

EXECUTION OF CONTRACT

If written notice of the acceptance of this Bid is transmitted to the undersigned within 45 days following the Bid opening, the undersigned will, within 10 days following the Notice of Award, execute and transmit a Contract in the form as required by the Owner.

This Bid may be withdrawn at any time prior to the Bid opening.

SIGNATURE

NAME OF BIDDER (Corporate Name)

SIGNATURE (Corporate Officer)

DATE: _____

BID FORM ATTACHMENT #1

GENERAL CONDITIONS TO BID

NON-COLLUSIVE BIDDING CERTIFICATION

No bid will be accepted that does not have this form completely executed.

By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of knowledge and belief:

- (a) The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or any competitor;
- (b) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor;
- (c) No attempt has been made or will be made by the bidder to induce any other person, partnership, or corporation to submit or not to submit a bid for the purpose of restricting competition;
- (d) The person signing this bid or proposal certifies that he has fully informed himself regarding the accuracy of the statements contained in this certification, and under the penalties of perjury, affirms the truth thereof, such penalties being applicable to the bidder as well as to the person signing in its behalf;
- (e) That attached hereto (if corporate bidder) is a certified copy of resolution authorizing the execution of this certified by the signature of this bid or proposal in behalf of the corporate bidder.

(Individual)

(Corporation)

Dated: _____ by _____
(Signature of Officer)

This Non-Collusive Bidding Certificate must be submitted with the bid.

BID FORM ATTACHMENT #2

CERTIFIED CORPORATE RESOLUTION

RESOLVED THAT _____ be authorized to sign and submit the bid or proposal of this corporation for the following project:

and to include in such bid or proposal the certificate as to non-collusion required by section one hundred three-d (103-d) of the general municipal law as to the act and deed of such corporation, and for any inaccuracies or mis-statements in such certificate this corporate bidder shall be liable under the penalties of perjury.

The foregoing is a true and correct copy of the resolution and adopted by

_____ at a meeting of its board of directors held on the
_____ day of _____ 20__ .

(Secretary)

NAME OF BIDDER _____

BID FORM ATTACHMENT #3

SUBCONTRACTORS LIST

List below names of each subcontractor for any work whose figures have been used in preparing the Bid, and to whom subcontracts are expected to be awarded, should the Contract be awarded to the Bidder.

Include amount to be paid to each subcontractor.

Place list in separate sealed envelope bearing the Bidder's name, name of Contract, and title "Subcontractors List", and submit with Bid.

Any changes to this list will require the approval of the Owner upon a showing of legitimate construction need for the change.

Scope of Subcontractor's Work	Subcontractor Name	Dollar Amount of Subcontract

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SECTION 00 43 33 – PROPOSED PRODUCTS FORM

NAME OF BIDDER _____

PROPOSED PRODUCTS FORM**SUBMITTED BY THREE LOW BIDDERS WITHIN THREE DAYS FOLLOWING BID OPENING**

In accordance with Articles 4 and 6 of the Instructions to Bidders, list specified products and corresponding proposed equivalent products below. Include additional pages as necessary.

Attach additional sheet explaining any aspect of the Contract Documents that cannot be complied with by the manufacturer or supplier of the proposed equivalent product.

Specified Product**Equivalent Product**

Technical Section: _____

Manufacturer: _____

Specified Product: _____

Product

Designation:

Technical Section: _____

Manufacturer: _____

Specified Product: _____

Product

Designation:

Technical Section: _____

Manufacturer: _____

Specified Product: _____

Product

Designation:

Technical Section: _____

Manufacturer: _____

Specified Product: _____

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Product

Designation:

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Specified Product: _____

Product

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SECTION 00 45 13 – BIDDER’S QUALIFICATIONS FORM

NAME OF BIDDER _____

BIDDER'S QUALIFICATIONS FORM**NOTARIZED AND SUBMITTED BY THREE LOW BIDDERS
WITHIN THREE DAYS FOLLOWING BID OPENING
UPON REQUEST BY OWNER**

All questions must be answered and the data given must be clear and comprehensive. If necessary, questions may be answered on separate attached sheet.

1. Name of Bidder:
2. Permanent main office address:
3. When organized:
4. If a corporation, where incorporated:
5. How many years have you been engaged in the contracting business under your present firm or trade name?
6. Contracts on hand: (List these, showing amount of each contract and the appropriate anticipated dates of completion.)
7. General character of work performed by your company:
8. Have you ever failed to complete any work awarded to you?

If so, where and why?
9. Have you ever defaulted on a contract?

If so, where and why?
10. List the more important projects recently completed by your company, stating the approximate cost for each, and the month and year completed.
11. List your major equipment available for this Contract.
12. List your experience in work similar to this project.
13. List the background and experience of the principal members of your organization, including officers.
14. List the work to be performed by Subcontractors and summarize the dollar value of each Subcontract.
15. Credit available: \$
16. Give bank reference:
17. Will you, upon request, fill out a detailed financial statement and furnish any other information that may be required by the Owner?

18. The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Bidder's Qualifications Form.

Dated _____ this _____ date of _____, 20__.

(Name of Bidder)

By _____

Title _____

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Construction schedule.
 - 4. General requirements of Contract.
 - 5. Access to site.

1.3 PROJECT INFORMATION

- A. Project Identification: Khost Bridge – Sagai Crossing.
 - 1. Project Location: Khost Province Afghanistan.
- B. Owner: Khost PRT.
 - 1. Contract: EDH-I-00-08-00027-00 Task Order 01 Afghanistan Engineering Support Program
- C. Architect: Tetra Tech Inc.
 - 1. Address: Tetra Tech, Inc 1 Grant Street Framingham, MA 01701
- D. Project Representative: Project Representative will be appointed by Owner.
 - 1. Project Representative will provide assistance in administering the Contract for Construction between Owner and Contractor, according to provisions of Division 01 Section, “Project Management and Coordination”.
- E. Building Code in Effect for Project: International Building Code 2009

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Construction of a 300+ meter reinforced concrete bridge at Sagai, in Khost Afghanistan.
- B. Type of Contract: Project will be constructed under a single prime contract.

1.5 CONSTRUCTION SCHEDULE

A. The Work shall be conducted in accordance with the following schedule:

1. Commencement of construction date: To Be Determined.
2. Substantial Completion date: To Be Determined.
3. Final completion date: To Be Determined.

1.6 ACCESS TO SITE

A. General: Contractor shall have use of Project site for construction operations. A path for vehicles to cross the wadi during construction operations will be maintained if possible.

B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated. The banks of the wadi are private property. The contractor shall not have access to that property without written permission from the owner of the property.

1.7 COORDINATION WITH KHOST PUBLIC WORKS DIRECTOR

A. Owner Access: Cooperate with municipal authorities having jurisdiction over the area during construction operations to minimize conflicts and facilitate continued vehicle crossings.

1. Do not close or obstruct access to the wadi without written permission from Project Representative and approval of municipal authorities having jurisdiction.
2. Notify Project Representative and municipal authorities having jurisdiction not less than 48 hours in advance of activities that will limit or deny public crossing.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Owner.

1.4 SUBMITTALS

- A. Substitution Requests: Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles. Only one substitution request for each product will be considered.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the project that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.

- g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Evidence of compliance with building code in effect for Project.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Owner Representative Action: If necessary, owner's representative will request additional information or documentation for evaluation. Such additional information or documentation may include detailed side-by-side comparison charts of the specified product and the proposed substitution, and other data.
- a. The owner's representative will notify of acceptance or rejection of proposed substitution.
 - b. Forms of Acceptance: Change Order, Construction Change Directive, or owner's representative for minor changes in the Work.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change.

1. Conditions: The owner's representative will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, owner's representative will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution is compatible with other portions of the Work.
 - e. Requested substitution has been coordinated with other portions of the Work.
 - f. Requested substitution provides specified warranty.
 - g. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: The owner's representative will consider requests for substitution if received within 15 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of the Owner.
 1. Conditions: The owner's representative will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, owner's representative will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to the owner for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. The Owner will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, via the electronic form procedures outlined in Division 01 Section "Project Management and Coordination" and during the preconstruction conference.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Owner or owner's representative will issue a description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time, via the electronic form procedures outlined in Division 01 Section "Project Management and Coordination" and during preconstruction conference. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by the owner or owner's representative are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Unless otherwise noted, within 14 days after receipt of Proposal Request, submit a quotation listing cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Provide a BOQ, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to the Owner.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the Owner.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Provide a BOQ, with total amount of purchases and credits to be made.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use Technical Modification Request (TMR) form as provided by the Owner.

1.5 CHANGE ORDER PROCEDURES

- A. Change is approved on Owner's approval of a TMR

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: The owner or owner's representative may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Digital data files.
 - 3. USAID's Project Representative Activities.
 - 4. Electronic form procedures.
 - 5. Requests for Information (RFIs).
 - 6. Project meetings.

1.3 COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.
 - 1. Schedule construction operations in sequence required to obtain the best results where one part of the Work depends on installation of other components.
 - 2. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing to avoid conflicts and to ensure orderly progress of the Work. Such activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Installation and removal of temporary facilities and controls.
 - 3. Project meetings.
 - 4. Project closeout activities.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.4 DIGITAL DATA FILES

- A. Digital Data Files: Upon request and upon approval of the Owner, electronic copies of the Contract Drawings may be provided for Contractor's use in preparing submittals.
 - 1. The Owner makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

- a. Format: The Contract Drawings may be available in AutoCAD and .pdf formats.
- b. Contractor shall execute a use and indemnification agreement in the form included in Project Manual for any drawing files furnished in AutoCAD format.
- c. The following drawings may be furnished for the appropriate discipline:
 - 1) Site base file drawings.
 - 2) Structural plans.

1.5 USAID'S PROJECT REPRESENTATIVE ACTIVITIES

A. Project Representative (if one is assigned) shall:

1. Serve as liaison between design professionals, Contractor and Owner.
2. Perform on-site observations of the progress and quality of the Work as may be reasonably necessary to assist the Owner (if part of their contract) to determine, in general, if the Work is being performed in a manner indicating that the Work when completed will be in conformance with the Contract Documents. Notify the Owner if, in the Project Representative's opinion, Work does not conform to the Contract Documents or requires special inspection or testing.
3. Monitor the Contractor's construction schedules on an ongoing basis and alert the Owner to conditions that may lead to delays in completion of the Work.
4. Coordinate shared access to work areas.
5. Coordinate and issue written approvals for acceptable interruptions of utilities and potentially disruptive activities.
6. Receive and review suggestions proposed by the Contractor, and submit them, together with recommendations, to the Owner.
7. Attend all meetings and report to the Owner on the proceedings.
8. Notify Owner when tests required by the Contract Documents and inspections by authorities having jurisdiction will be performed. Observe tests required by the Contract Documents and inspections by authorities having jurisdiction. Record and report to the Owner on test procedures, inspections, and results. Verify testing is performed in accordance with specified requirements and at appropriate times.
9. Assist in receipt and transmittal to the Owner of documentation required of the Contractor at completion of the Work.

B. Project Representative shall not:

1. Authorize deviations from the Contract Documents.
2. Approve submittals or substitute materials or equipment.
3. Personally conduct or participate in tests or third party inspections.
4. Assume any of the responsibilities of the Contractor's superintendent or of Subcontractors.

5. Expedite the Work for the Contractor.
6. Have control over or charge of or be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work.
7. Authorize or suggest that Owner may occupy or have use of the Project in whole or in part.

1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of others.
- B. Content of the RFI: Include a detailed description of item needing information or interpretation and the following:
 1. Work Order number.
 2. RFI number.
 3. Project title.
 4. Name of Contractor.
 5. Name of Contractor's contact person.
 6. Email address of Contractor's contact person.
 7. RFI subject.
 8. Question: Fully describe question or information requested. Include:
 - a. Specification Section number and title and related paragraphs, as appropriate.
 - b. Drawing number and detail references, as appropriate.
 - c. Field dimensions and conditions, as appropriate.
 - d. Contractor's suggested resolution. If Contractor's solution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 9. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, sketches, and other information necessary to fully describe items needing interpretation.
- C. Owner's Action: Owner and/or owner's representative (if in their scope) will review each RFI, determine action required, and respond. Allow reasonable time for the Owner's response for each RFI.
 1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals or substitutions.
 - b. Requests for information already indicated in the Contract Documents.
 - c. Requests for adjustments in the Contract Time or the Contract Sum.
 - d. Requests for interpretation of Owner's actions on submittals.

- e. Incomplete RFIs or inaccurately prepared RFIs.
- 2. Architect's action may include a request for additional information.
- 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Owner and owner's representative, in writing within seven days of receipt of the RFI response.
- D. On receipt of Owner's action, immediately distribute the RFI response to affected parties. Review response and notify Owner within seven days if Contractor disagrees with response.

1.7 PROJECT MEETINGS

- A. Preconstruction Conference: Owner and/or Project Representative will conduct a preconstruction conference before starting construction, at a time convenient but no later than 15 days after date of Notice of Award. Design professional will attend if within their scope to do so.
 - 1. Attendees: Authorized representatives will include Owner, and may include owner representative's (design professional and their consultants); Contractor and its superintendent; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Designation of key personnel and their duties.
 - b. Lines of communications.
 - c. Subcontract list.
 - d. BOQ.
 - e. Payment request estimate.
 - f. Submittals.
 - g. Testing, placing, curing and finishing structural concrete.
 - h. Hot/cold weather concrete construction.
 - i. Fabrication and erection of structural steel.
 - j. Procedures for processing Change Orders and Construction Change Directives.
 - k. Quality control.
 - l. Schedules (construction and project).
 - m. Project meetings.
 - n. Project closeout procedures.
 - o. Electronic drawings.
 - p. Maintenance of public vehicle access to cross the wadi
- B. Progress Meetings: Owner and or owner representative will conduct progress meetings intervals to be determined.
 - 1. Attendees: In addition to representatives of the Owner and design professional (if within their scope to attend), each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or

performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review report of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Review present and future needs of each entity present, including the following:
 - 1) Report of progress since previous meeting.
 - 2) Architect/Engineer discussion items.
 - 3) Status of ASIs, PRs, Change Orders.
 - 4) Status of submittals.
 - 5) Status of TMRs.
 - 6) Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule.
 - a) Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b) Review schedule for next period.
 - 7) Date of Substantial Completion.
 - 8) Status of RFIs.
 - 9) Owner discussion items.
 - 10) Discussion items for Contract.
 - 11) General and administrative items, including such items as:
 - a) Project documentation.
 - b) Prohibitions.
 - c) Separation.
 - d) Egress.
 - e) Conservation.
3. Report: Owner or owner's representative will prepare and distribute the meeting report to each party present and to parties requiring information.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

Attachment: Use and Indemnification Agreement

END OF SECTION 01 31 00



TETRA TECH
ARCHITECTS & ENGINEERS

215 The Commons
Ithaca, New York 14850
Tel. (607) 277-7100
Fax (607) 277-1410

Use and Indemnification Agreement

Re: [insert name]

Tt Project No.

Whereas, _____ (hereinafter the "Contractor"), acknowledges that it has requested certain electronic files and/or media of the Drawings and/or Specifications for the above-referenced Project which are the property of Tetra Tech Engineers, Architects & Landscape Architects, P.C. d/b/a Tetra Tech Architects & Engineers (hereinafter "Tetra Tech").

Whereas, Contractor further acknowledges all requests for electronic files require a pre-payment of \$100/file (Each individual drawing in the set of Contract Documents represents 1 file), regardless of the number of files requested, prior to receiving said files from Tetra Tech.

Now, therefore, Contractor hereby warrants and covenants that it will abide by the following provisions:

A. Indemnification

1. In consideration of permission to use electronic files or media, including but not limited to electronic files of drawings created by use of computer, for the Work of this Project only, and which the Contractor has requested from Tetra Tech, the Contractor, to the fullest extent permitted by law, hereby agrees to indemnify and hold harmless Tetra Tech, its agents, employees, officers, directors and consultants from and against any and all claims, damages, losses and expenses, including any attorneys' fees, arising out of, resulting from or in connection with any and all use of said electronic materials, but only if such claim, damage, loss or expense is caused in whole or in part by the Contractor, its employees, agents, officers, directors, or any other party directly or indirectly employed by any of them or any party for whose acts any of them may be liable, regardless of whether or not it is caused by a party indemnified hereunder. Such obligation shall not be construed to reduce or negate any other right or obligation of indemnification that would otherwise exist as to any party hereto. This indemnification shall not apply to the liability of the indemnitee arising out of its own negligence. This indemnification shall not be limited in any way because of any limitation on damages, compensation or benefits under any statute, law or governmental requirement of any sort.
2. The following shall be included within the definition of "expenses" herein: (a) any time expended by the indemnified party of its employees, agents, officers and directors at their usual and customary billing rates, as well as all out-of-pocket expenses such as long-distance telephone calls, costs of reproduction, expenses of travel and lodging; (b) all costs and expenses of experts, consultants, engineers, and any other party retained by the indemnified party reasonably required to defend the claim; (c) all costs, including reasonable attorneys' fees, incurred in bringing any action to enforce the provisions of this indemnification. The following shall be included within the definition of "action" herein: any case brought in any state or federal court, any arbitration, any mediation, and any similar forum for resolution of any dispute herein, and shall also include any counterclaim or third-party action in any such forum.

B. Use and Compatibility

1. Tetra Tech' instruments of service are furnished without guarantee of compatibility with the Contractor's software or hardware, and Tetra Tech' sole responsibility for the electronic media is to furnish a replacement for defective disks within thirty (30) days after delivery to Contractor.
2. Because data stored on electronic media can deteriorate undetected or be modified without Tetra Tech' knowledge, the Contractor agrees that Tetra Tech will not be held liable for the completeness or correctness of the electronic media after an acceptance period of thirty (30) days after delivery of the electronic files. Tetra Tech does confirm the accuracy of the final sealed hard copy drawings, previously submitted pursuant to the Prime Agreement for this Project.
3. The electronic files are submitted to the Contractor for a thirty (30) day acceptance period. During this period, the Contractor may review and examine these files, and any errors detected during this time will be corrected by Tetra Tech. Any changes requested after the acceptance period will be considered additional services to be performed on a time and materials basis, at Tetra Tech's standard cost plus terms and conditions.
4. Tetra Tech retains ownership of the printed hard copy Drawings and Specifications and the electronic media. The Contractor is granted a license for their use, but only in the operation and maintenance of the Project. Use of these materials for modification, extension, or expansion of this Project or on any other project, unless under the direction of Tetra Tech, shall be without liability to Tetra Tech and Tetra Tech's consultants.

IN WITNESS WHEREOF:

Contractor: _____
Signed name: _____
Printed Name: _____
Title: _____
Date: _____

If transmission is not received as noted, kindly notify us at once.



TETRA TECH
ARCHITECTS & ENGINEERS

215 The Commons
Ithaca, New York 14850
Tel. (607) 277-7100
Fax (607) 277-1410

Use and Indemnification Agreement – Business Office

Electronic Drawing Files

Prime Contractor Name

Prime Contractor Address

Contact to Receive Invoices

Project Name

Project Number

Number of Drawing Files

(Each individual drawing in the set of Contract Documents represents 1 file)

List each Drawing # Requested

Contractor Signature _____

If transmission is not received as noted, kindly notify us at once.

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's construction schedule.
 - 2. Reports.

1.3 SUBMITTALS

- A. Informational Submittals:
 - 1. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period. Follow format outlined in attachment at end of this Section.
 - 2. Site Condition Reports: Submit at time of discovery of differing conditions.
 - 3. Special Reports: Submit at time of unusual event.

1.4 COORDINATION

- A. Secure time commitments for performing critical elements of the Work from entities involved.
- B. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, horizontal, Gantt-chart-type, Contractor's construction schedule.
 - 1. Format: Refer to accompanying "Format for Construction Schedule".
- B. Preparation: Indicate each significant construction activity separately, by Specification Section, coordinated with the schedule of values. Provide line item(s) for each Specification Section.

2.3 REPORTS

- A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- 1. Contractor's Construction Schedule Updating: At intervals TBS, update schedule to reflect actual construction progress and activities.
- B. Distribution: Distribute copies of approved schedule to the Owner (and other parties as designated by the owner), testing and inspecting agencies and other parties with a need-to-know schedule responsibility.
 - 1. When revisions are made, distribute updated schedules to the same parties.

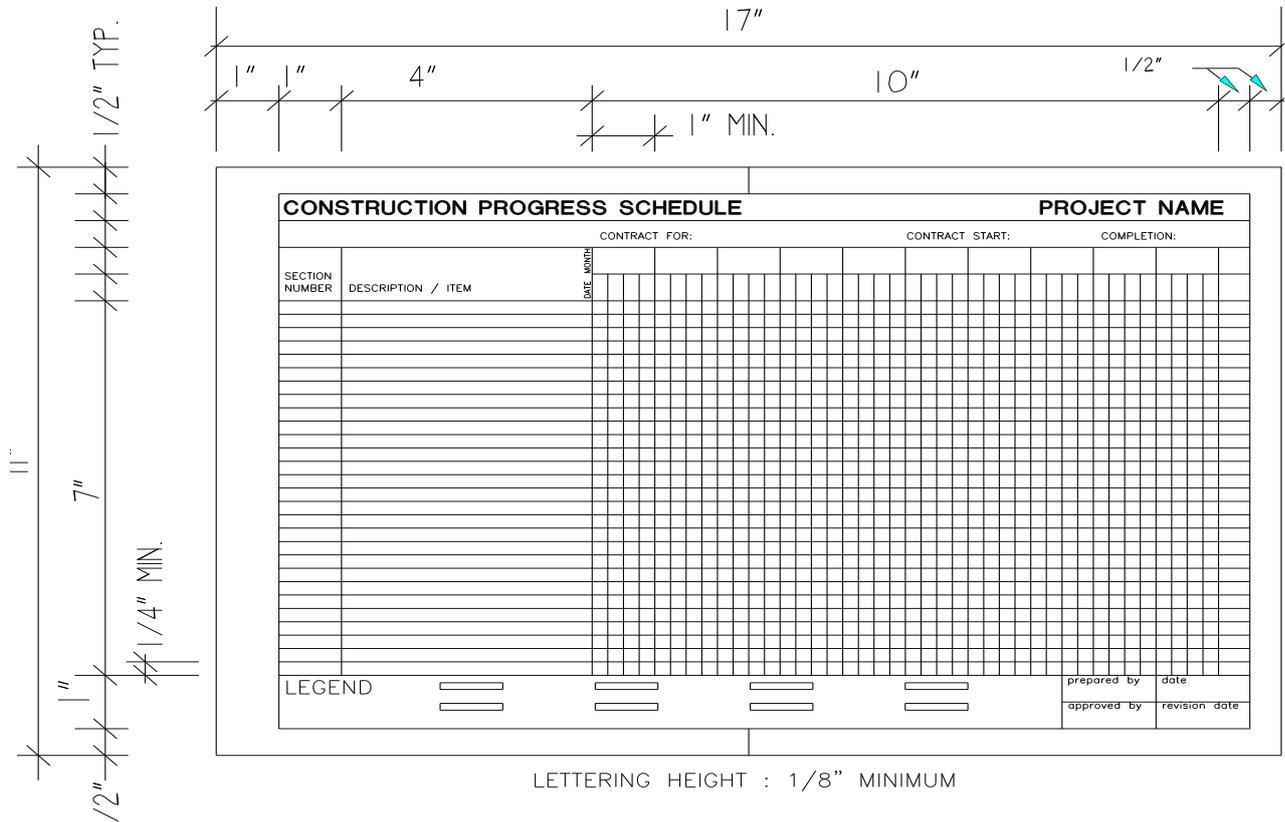
Attachment: Format for Construction Schedule

END OF SECTION 01 32 00

SECTION 01 32 00 - PROJECT SCHEDULE - Attachment #1

FORMAT FOR
CONSTRUCTION SCHEDULE

(Refer to SECTION 01 32 00, Article 2.2)



Format

Provide separate bar for each item in sequential order from beginning of Project to completion with the following information included for each item:

- Related Technical Specification number.
- Distinct graphic delineation, indicating area of building where schedule item in located.
- Shop drawing submittal date and required acceptance date.
- Product procurement date and anticipated delivery date.
- Projected start and completion dates for each item.

SECTION 01 33 00 - SUBMITTAL PROCEDURES CONVENTIONAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Owner's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Owner's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTALS

A. Action Submittals:

1. Submittal Schedule: Submit a schedule of submittals indicating scheduled date for each submission. Factor time required for review, ordering, manufacturing, fabrication, and delivery when establishing submission dates. Include additional time required for making corrections or revisions to submittals noted by the Owner and/or owner's representatives and additional time for handling and reviewing submittals required by those corrections.
 - a. Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - b. Format: Arrange the following information in a tabular format:
 - 1) Specification Section number and title.
 - 2) Project Number.
 - a) Owner and/or owner's representative will furnish Contractor with unique "Project Number" designation for each required submittal.
 - 3) Submittal category: Action; informational.
 - 4) Submittal type: Product Data, Shop Drawings, Samples, etc.

- 5) Description of the Work covered.
- 6) Scheduled date for first submittal

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Where indicated, submit all submittal items required for each Specification Section concurrently.
 3. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Owner and/or owner's representative reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Processing Time: Allow sufficient time for submittal review, including time for resubmittals. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
- C. Identification and Information: Place a cover sheet on each submittal item for identification. Do not combine different submittals under same cover sheet.
 1. Cover Sheet: Use facsimile of sample form included in Project Manual. Complete each item on form, sign and date.
- D. Transmittal: Assemble each submittal package appropriately for transmittal and handling. Transmit each submittal package using a transmittal form. Reviewer will return submittals, without review, received from sources other than Contractor.
 1. Transmittal Form: Provide locations on form for the following information:
 - a. Date.
 - b. Project name and number.
 - c. Contractor's name, address and telephone number.
 - d. List of submittals included.
 - e. Identify options requiring selection by the Owner.
 - f. Remarks.
- E. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of revision in label or title block and clearly indicate extent of revision.
 2. Resubmit submittals until they are marked with approval notation from the reviewer.

- F. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- G. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from the reviewer.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Action Submittals: Submit four paper copies of each submittal, unless otherwise indicated. Reviewer will return one copy.
 - 2. Informational Submittals: Submit three paper copies of each submittal, unless otherwise indicated. Reviewer will not return copies.
 - 3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. Mark each copy of each submittal to show which products and options are applicable.
 - 2. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Statement of compliance with specified referenced standards.
 - c. Testing by recognized testing agency.
 - 3. For equipment, include the following in addition to the above, as applicable:
 - a. Printed performance curves.
 - b. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of dimensions established by field measurement.
 - e. Relationship and attachment to adjoining construction clearly indicated.
 - f. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on letter size sheets, but no larger than Contract Documents.

3. Submit Shop Drawings in the following format:
 - a. Three opaque (bond) copies and one reproducible copy of each submittal. Reviewer will return reproducible copy.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 1. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 2. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 3. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Reviewer will return one submittal with options selected.
 4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 5. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
 6. Type of product. Include unique identifier for each product indicated in the Contract Documents.
 7. Manufacturer and product name, and model number if applicable.
 8. Number and name of room or space.
 9. Submit product schedule in the following format:
 - a. Two paper copies of product schedule, unless otherwise indicated.
- E. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Submit subcontract list in the following format:
 - a. Number of Copies: Two paper copies of subcontractor list, unless otherwise indicated.
- H. Key Personnel Names: No later than 15 days after date of Notice of Award, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including emergency, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- O. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- P. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- Q. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before

installation of product, for compliance with performance requirements in the Contract Documents.

- R. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- S. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- T. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Owner.
- B. Delegated-Design Services Certification: Attach "Delegated Design Submittal" form to each copy of Shop Drawings, Product Data, and other required submittals, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Delegated Design Submittal Form: Use facsimile of sample form included in Project Manual. Complete each item on form, sign and date.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Identify any deviations from Contract Document requirements. Mark cover sheet with approval stamp before submitting to reviewer (Owner or owner's representative).
 - 1. Sign and date statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 OWNER and/or REVIEWER (entity responsible for submittal review)

- A. General: Submittals that do not bear Contractor's approval stamp will not be reviewed and will be returned them without action.

- B. Action Submittals: Each submittal will be reviewed and marked to indicate corrections or revisions required, then returned to contractor. Each submittal will be stamped with a mark appropriate to the action required, as follows:
1. Final Unrestricted Release: Where the submittal is marked "Approved," the Work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
 2. Final-but-Restricted Release: Where the submittal is marked "Approved as Noted," the Work covered by the submittal may proceed provided it complies both with Reviewer's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.
 3. Resubmit: Where the submittal is marked "Approved, Revise and Return Corrected Copies," the Work covered by the submittal may proceed provided it complies both with Reviewer's notations and corrections on the submittal and the Contract Documents. Revise submittal according to Reviewer's notations and corrections and return corrected copies. Final acceptance will depend on that compliance.
 4. Rejected: Where the submittal is marked "Rejected," do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.
 5. Incomplete - Resubmit: Where the submittal is marked "Submit Additional Information," do not proceed with the Work covered by the submittal. Prepare additional information requested, or required by the Contract Documents, that indicates compliance with requirements, and resubmit.
- C. Informational Submittals: Reviewer will review each submittal and will not return it, or will return it if it does not comply with requirements.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

3.3 REQUIRED SUBMITTALS

- A. Provide the following submittals:
1. Shop Drawings:
 - a. Reinforcing bar installation.
 2. Samples:
 - a. Reinforcing bar samples, each size.

Attachment[s]: Cover Sheet
Delegated Design Submittal Form

END OF SECTION 01 33 00

CONTRACTOR: _____

SUBMITTAL DATE ____ / ____ / ____

Check following as applicable:

- First Submission
- Re-submission

Design Professional: _____

PROJECT IDENTIFICATION

Project No.: _____
 Proj. Name: _____
 Location: _____

PRODUCT IDENTIFICATION

Specification _____
 Section No. _____

Project Submittal No. _____

Name of Product: _____

Name of Manufacturer: _____

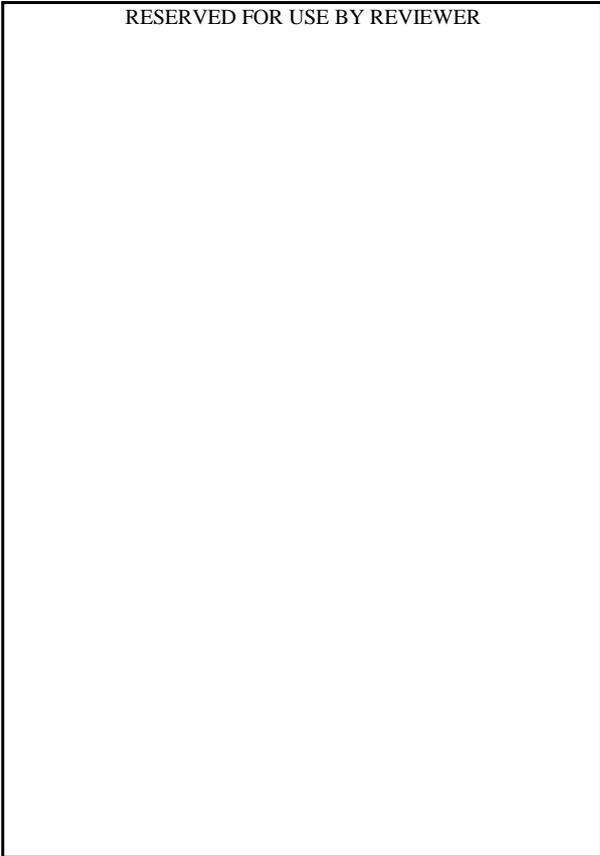
SUBCONTRACTOR

SUPPLIER

RELATIONSHIP TO STRUCTURE or BUILDING

Structure Name _____

Identifying features such as *Room # and Room Name*
 Contract Drawing No.: _____



DEVIATION FROM CONTRACT DOCUMENTS: _____

CONTRACTOR COMMENTS: _____

REVIEWER COMMENTS: _____

PRIME CONTRACTORS STAMP

CONTRACTOR'S CERTIFICATION

I CERTIFY THAT THIS SUBMITTAL HAS BEEN REVIEWED AND APPROVED BY THE CONTRACTOR IN ACCORDANCE WITH ARTICLE 3.12 OF THE GENERAL CONDITIONS.

BY _____ Date _____

CONSTRUCTION MANAGER'S CERTIFICATION

I CERTIFY THAT THIS SUBMITTAL HAS BEEN REVIEWED AND APPROVED BY THE CONSTRUCTION MANAGER IN ACCORDANCE WITH ARTICLE 3.12 OF THE GENERAL CONDITIONS.

BY _____ Date _____

DELEGATED DESIGN SUBMITTAL

CONTRACTOR: _____

SUBMITTAL DATE ____ / ____ / ____

DESIGN PROFESSIONAL: _____

Check following as applicable:

- First Submission
- Re-submission

PROJECT IDENTIFICATION

Project No.: _____
Proj. Name: _____
Location: _____

PRODUCT IDENTIFICATION

Specification
Section No. _____

Submittal No.: _____
Name of
Product: _____

Name of
Manufacturer: _____

SUBCONTRACTOR

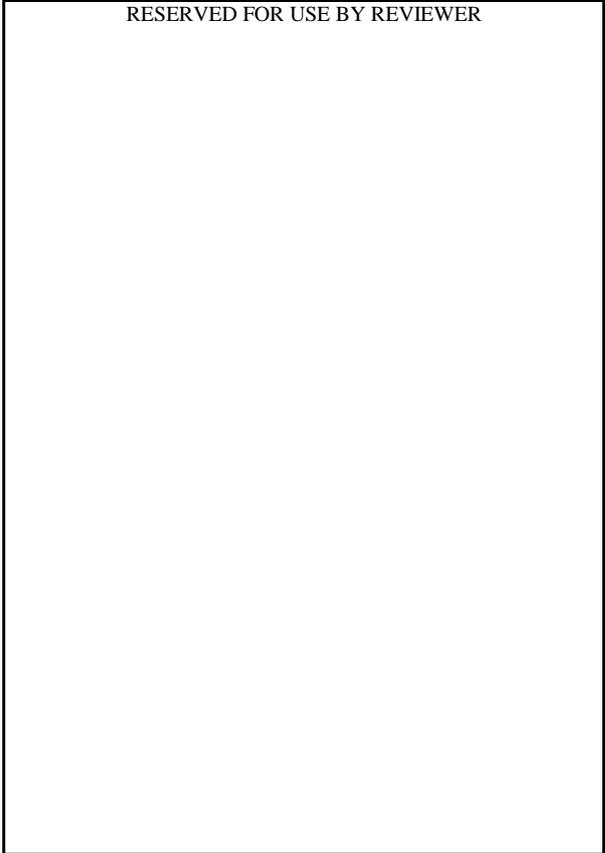
SUPPLIER

RELATIONSHIP TO STRUCTURE or BUILDING

Structure
Name _____

Identifying features such as *Room # and Room Name*
Contract Drawing No.: _____

DEVIATION FROM CONTRACT DOCUMENTS



DESIGN PROFESSIONAL'S COMMENTS: _____

CONTRACTOR COMMENTS: _____

PRIME CONTRACTORS STAMP

DESIGN PROFESSIONAL'S CERTIFICATION

I certify that I am a design professional currently licensed and confirm my responsibility for work included in this submittal in accordance with Article 3.12.10 of the General Conditions. Further, I certify that to the best of his knowledge, information and belief, the plans and specifications are in accordance with applicable requirements of the International Building Code.

BY _____

CONTRACTOR'S CERTIFICATION

I certify that this submittal has been reviewed and approved by the contractor in accordance with Article 3.12 of the General Conditions.

BY _____

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SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by the Owner and/or owner's representative, are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions before, during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by the Owner or owner's representatives.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

- E. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
- F. Experienced: When used with an entity or individual, "experienced" means having successfully completed previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to the Owner for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the Owner for a decision before proceeding.

1.5 SUBMITTALS

- A. Informational Submittals:
 - 1. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
 - 2. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - a. Specification Section number and title.
 - b. Entity responsible for performing tests and inspections.
 - c. Description of test and inspection.
 - d. Identification of applicable standards.
 - e. Identification of test and inspection methods.
 - f. Number of tests and inspections required.
 - g. Time schedule or time span for tests and inspections.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.

7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and re-inspecting.

1.7 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated using ASTM E 329 as a guide; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Owner and owner's representative, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Owner and owner's representative and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspecting equipment at Project site.
- F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner and owner's representative, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to the Owner.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Project Representative's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, accessories, placement procedures, and finishes, for the following:

1. Footings.
2. Piers.
3. Abutments.
4. Deck slabs.
5. Bridge sidewalks and barriers.
6. Approach slabs.
7. Bridge beams.
8. Culvert.

- B. Alternate Construction Methods:

1. The Contractor may cast the following items as precast concrete components for installation:
 - a. Bridge beams.
2. The Contractor shall use the same requirements for precast concrete components as specified for cast-in-place work in this Section.
3. The Contractor shall provide a casting area for the precast concrete work, unless a precast plant is available.
 - a. The casting area shall be level, adjacent to the Project site and have ready access to the Project site for transport of the precast concrete items to the installation location.
4. The Contractor shall submit a written description of his means and methods, including a list of equipment, for precasting the components, and a list of equipment to be used to transport the components.
5. The Contractor shall submit precast erection procedure.
6. If precast beam construction is used, the Contractor is fully responsible for the analysis of the beams to include the stresses during erection. This includes modifications to the beam reinforcement as well as design of the lifting devices which shall be adequate for the safety factors required by the erection procedure. The Contractor shall submit design calculations and details with the erection procedure.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 DESIGN REQUIREMENTS FOR PERMANENT STEEL BRIDGE DECK FORMS (IF USED)

- A. The following criteria shall govern the design of permanent steel bridge deck forms:
 - 1. The steel forms shall be designed on the basis of dead load of form, reinforcement and plastic concrete plus 2.4 kPa for construction loads. The unit working stress in the steel sheets shall not be more than 0.725 of the specified minimum yield strength of the material furnished, but not to exceed 250 MPa.
 - 2. Deflection under the load of the forms, the plastic concrete and reinforcement shall not exceed 1/180 of the form span or 13 mm whichever is less. In no case shall this design loading be less than 5.75 kPa total. The permissible form camber shall be based on the actual dead load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits.
 - 3. The design span of the form sheets shall be the clear span of the form plus 50 mm measured parallel to the form flutes.
 - 4. Physical design properties shall be computed in accordance with requirements of the American Iron and Steel Institute (AISI), "Specification for the Design of Cold Formed Steel Structural Members", or equivalent industry standard.
 - 5. Longitudinal reinforcement shall have minimum concrete cover, as measured from the permanent steel deck form, of 25 mm. Main reinforcement shall have minimum concrete cover, as measured from the permanent steel deck form, of 38 mm.
 - 6. The plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck shall be maintained.
 - 7. Permanent steel bridge deck form shall not be considered as lateral bracing for compression flanges of supporting structural members.
 - 8. Permanent steel bridge deck form shall not be used in panels where longitudinal deck construction joints are located between stringers.
 - 9. Welding will not be permitted to flanges in tension or to structural steel bridge elements fabricated from non-weldable grades of steel.
 - 10. Fabricator's shop and erection drawings shall be submitted to owner or owner's representative for approval. These drawings shall indicate the grade of steel deck form sheets and a clear indication of locations where the forms are supported by steel beam flanges subject to tensile stresses.

1.5 REQUIRED SUBMITTALS

- A. Provide the following submittals:
 - 1. Shop Drawings:
 - a. Formwork and Falsework Shop Drawings: Prepared by or under the supervision of a qualified structural engineer designing and detailing fabrication, assembly, falsework and support of formwork. Submit calculations and elevation views showing panel layout dimensions, joint and tie hole locations.

- b. Deck Placement Drawings: Include layout and types of deck panels, support locations, anchorage details, dimensions, panel lengths, accessories and attachments to other construction.
 - c. Steel Deck Shop Fabrication and Erection Drawings: Fabrication shop fabrication and field erection drawings, if used.
2. Product Data:
- a. For each type of product indicated.
3. Other Submittals:
- a. Certified Test Data:
 - 1) Closed cell foam joint filler.
 - b. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Pumping of concrete requires a mix design specifically prepared and previously used for pumping.
 - 1) Indicate amounts of mixing water to be withheld for later addition at Project site.
 - 2) Include compressive strength test reports.
 - 3) Include all ingredient certifications.
 - 4) Concrete Heat of Hydration Analysis and Plan: A concrete heat of hydration analysis and a detailed plan indicating how temperature differential restrictions for mass concrete are to be achieved, methods of observing and recording concrete temperatures, and methods of applying immediate corrective action should the temperature differential approach 21 deg C so as to limit the temperature differential to 21 deg C.
 - c. United States Army Corps of Engineers Review: Submit copy of the independent testing agency's latest review documentation showing a satisfactory or better rating, or similar rating status.
 - 1) Independent testing agency performing material evaluation tests and concrete mix design.
 - d. Written description of the procedures and a list of the equipment, including hand tools, to be used for the measuring, mixing, transporting, placement, finishing and curing of concrete (Placement and Curing Plan for Hot and Cold Weather Concrete Placement.)
 - e. Erection Procedure: Written description of the procedures and list of the equipment including hand tools to be used for erection of bridge components.
 - 1) Written description shall include drawings and calculations.
 - f. Falsework Procedure: Written description of the procedures and list or equipment to be used for erection of falsework.
 - 1) Written description shall include drawings and calculations.
 - g. Placement and Curing Plan: Written description of the procedures and list of equipment to be used for concrete placement and curing of bridge deck.

- 1) Include methods of observing and recording concrete temperatures.
- h. Precast Concrete Erection Procedure: Written description of the procedures and list of the equipment to be used for erection of precast concrete components. The written description shall include the following:
- 1) The procedures shall be submitted with a detailed procedure which includes drawings and calculations sufficient to enable owner or owner's representative to determine the adequacy of the proposed method. The method and all submissions shall be prepared under the supervision of a licensed qualified engineer, who is familiar with these specifications, AASHTO, the work, and experienced in this technical field. All submitted sheets shall be signed and dated by the supervising engineer. As a minimum the following information shall be included in the submittal:
 - a) Drawings showing the location of existing roadway and features in areas of erection.
 - b) The location of cranes, both horizontally and vertically, and their operating radii.
 - c) Lifting equipment information including rating data. Information shall include counter weights to be used and boom capability. The manufacturer's rated capacity of the crane and of all lifting and connecting devices shall be adequate for 125 percent of the total pick load including spreaders and other material except that in the areas within the potential influence area of the crane where vehicular or pedestrian traffic has access, the rated capacity shall be adequate for 150 percent of the total pick load. The limits of the potential crane influence area shall be taken as circular areas with radii matching the boom length and radius points located at the boom pivot point. Crane capacity rating charts and the rated capacity of all lifting and connecting devices shall be clearly shown in the submittal. The 125 percent or 150 percent factors of safety are to be used in addition to any factors of safety used by the manufacturer to calculate the rated capacity.
 - d) The type, size and arrangements of slings, shackles or other lifting and connecting devices including relative technical data.
 - e) The order of lifts, repositioning of equipment and counterweights, and location and method of attaching deadmen. Methods and materials for temporary structures or the strengthening or bracing of a member (either temporarily or permanently) for erection purposes.
 - f) The stresses shall be investigated at each stage of erection with allowance for wind pressure determined by the table shown below.

<u>Height of Members Above Ground *</u>	<u>Wind Pressure</u>
5 meters	0.9 KPa
10 meters	0.9 KPa
15 meters	1.0 KPa
30 meters	1.2 KPa
90 meters	1.5 KPa

* For heights not given wind pressure shall be interpolated.

- 2) Long span straight girders shall be stabilized with falsework, temporary braces, or holding cranes until a sufficient number of adjacent girders are erected with all diaphragms connected to provide necessary lateral stability.
 - 3) In instances where falsework is proposed as part of the erection procedure, it shall be properly designed, constructed, and maintained for the loads that it will bear. Plans for falsework along with necessary engineering data and calculations shall be submitted to owner or owner's representative for review, comment, and approval under the same guidelines as the erection procedure. The Contractor shall keep a full record of piles driven for falsework.
- i. Material Certificates: For each type of the following, signed by manufacturers:
 - 1) Cementitious materials.
 - j. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1) Aggregates, including record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
 - k. Proposed curing method for all concrete elements.
 - l. Proposed cold and/or hot weather concrete protection procedures.
 - m. Temperature log records.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on the Project a supervisor who is experienced with concrete bridge construction.
- B. Testing Agency: An independent testing agency shall perform material evaluation tests and design concrete mix designs mixtures.
 1. The independent testing agency shall have been reviewed within the last 12 months by the United States Army Corps of Engineers (USACE) and have received a satisfactory or better rating, or similar rating status.
 2. Personnel performing laboratory tests shall be Concrete Strength Testing Technicians and Concrete Laboratory Testing Technicians. Testing Agency laboratory supervisor shall have at least 5 years' experience as a Concrete Laboratory Testing Technician.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- D. ACI Publications or Equivalent Industry Publications: Comply with the following unless modified by requirements in the Contract Documents:
 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 or equivalent industry standard.
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials" or equivalent industry standard.

- E. Structural Preconstruction Conference: Attend conference at Project site.
- F. Slab Pre-Pour Conference: Attend conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Protect steel decking, if used, from corrosion, deformation, and other damage during delivery, storage, and handling.
- D. Stack steel decking, if used, off the ground on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with US Department of Commerce, DOC PS 1 "Structural Plywood" or equivalent industry standard, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips 19 by 19 mm, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 25 mm to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 25 mm in diameter in concrete surface.

2.2 NONCOMPOSITE FORM STEEL DECKING (IF USED)

A. Performance Requirements:

1. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" or equivalent industry standard.

B. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31 or equivalent, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 550 (minimum yield strength of 550 MPa), Z275 (minimum weight of coating: 275 g/sm – total both sides) zinc coating or equivalent industry standard.
2. Profile Depth: As indicated on Drawings.
3. Design Uncoated-Steel Thickness: As indicated on Drawings.
4. Span Condition: Triple span or more, unless otherwise shown on Drawings.

C. Accessories:

1. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 420 (minimum yield strength of 420 MPa), or equivalent industry standard, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 420 (minimum yield strength of 420 MPa), deformed bars, ASTM A 775/A 775M, "Epoxy-Coated Steel Reinforcing Bars" or ASTM A 934/A 934M, "Epoxy-Coated Prefabricated Steel Reinforcing Bars" or equivalent industry standards, epoxy coated, with less than 2 percent damaged coating in each 300 mm bar length.

C. Galvanized Reinforcing Bars: [ASTM A 615/A 615M, Grade 420 (minimum yield strength of 420 MPa)] [ASTM A 706/A 706M, "Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcements", (Grade 420)], or equivalent industry standard deformed bars, ASTM A 767/A 767M (610 g/sm), Class II "Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcements", or equivalent industry standard, zinc coated after fabrication and bending.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 420 (minimum yield strength of 420 MPa) or equivalent industry standard, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 420 (minimum yield strength of 420 MPa) or equivalent industry standard, plain-steel bars, ASTM A 775/A 775M or equivalent industry standard, epoxy coated.
- C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M or equivalent industry standard.
- D. Zinc repair material: ASTM A 780 or equivalent industry standard, zinc-based solder, paint containing zinc dust or sprayed zinc.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice" or equivalent industry standard, of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 or equivalent industry standard, plastic-protected steel wire or CRSI Class 2 or equivalent industry standard, stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- F. Reinforcement Mechanical Bar Splicer (if used for precast items):
 - 1. Mechanical splices shall be compatible with epoxy coated rebar. Mechanical splices shall develop 125 percent of the yield strength of the connected bars. Splices shall not have rebar stops.

2.5 MISCELLANEOUS MATERIALS

- A. Closed Cell Foam Joint Filler:
 - 1. Closed cell foam shall be used as a joint filler between different components of the bridge. Closed cell foam joint filler shall have a compact closed cell structure composed of synthetic isomeric polymers and shall be gray in color. It shall offer sufficient heat resistance so that it is compatible with hot applied sealing compounds. Closed cell foam joint filler shall meet the requirements of Section 5.1 through 5.4 of ASTM D 1752, or equivalent industry standard, with the compression requirement modified to 70 to 170 kPa (10 psi minimum to 25 psi maximum). Typical physical properties, as determined using test method ASTM D 545, or equivalent industry standard, shall be as follows:

Compression, 50%	89.6 kPa (13 psi)
Extrusion	2.5 mm (0.1 inch)
Recovery	99.21 %

Water Absorption, Volume 0.246 %

B. Tar Paper:

1. Tar impregnated felted paper shall conform to the requirements on ASTM D 227, or equivalent industry standard.

C. Expanded Polystyrene Filler:

1. Expanded polystyrene filler shall conform to the requirements of ASTM C 578, or equivalent industry standard.

D. Methacrylate Crack Sealer:

1. Methacrylate crack sealer shall consist of a high molecular weight low viscosity methacrylate monomer that when catalyzed will produce a crack-healer/penetrating-sealer that is a rapid-curing, modified-methacrylate resin. The methacrylate material shall, as a minimum, provide the following as applied properties:

<u>Property Value</u>	<u>Test *</u>
Viscosity < 25 cps	ASTM D 2393
Bond Strength >10.34 MPa (1500 psi)	ASTM C 882
Tensile Elongation > 3%	ASTM D 638

* (or equivalent industry standard)

E. Silane Crack Sealer:

1. Silane crack sealer shall consist of a clear, breathable, high-performance, 100 percent solids by weight silane sealer for protecting new and existing concrete surfaces. It shall penetrate deeply, sealing out water, chloride ions, and acids, and prevent damage from freeze/thaw cycles. Silane crack sealer material shall, as a minimum, provide the following as applied properties:

<u>Property Value</u>	<u>Test *</u>
Water Weight Gain at 6.17 sm/l (250 sf/gal), 88 percent reduction	NCHRP 244 ** Series II-Cube test
Absorbed Chloride at 6.17 sm/l (250 sf2/gal), 89 percent reduction	NCHRP 244 ** Series II-Cube test
Absorbed Chloride at 6.17 sm/l (250 sf/gal), 94 percent reduction	NCHRP 244 ** Series IV – Climate

Northern

* or equivalent industry standard

** National Cooperative Highway Research Program 244, “Condition Evaluation of Concrete Bridges Relative to Reinforcement Corrosion, Volume 5: Methods of Evaluating the Effectiveness of Penetrating Sealers”

F. Epoxy-Resin:

1. Epoxy-Resin for Cement Concrete Crack Injection shall conform to AASHTO M235, Type IV, Grade I, or equivalent industry standard.

G. Sand Filler:

1. Sand filler gradation and characteristics shall conform to sealer manufacturer's requirements. Sand filler shall be clean sand and contain no unsuitable material.

2.6 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I (special properties as provided by other types not required) or Type II (moderate sulfate resistant or moderate heat of hydration required or equivalent industry standard. Supplement with the following (optional):
 - a. Fly Ash: ASTM C 618, Class F or C or equivalent industry standard.
 - 1) Class F fly ash has pozzolanic properties.
 - 2) Class C has pozzolanic properties and some cementitious properties.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120 or equivalent industry standard.
 - 1) Performance in a slag activity test determines slag grade.
 - 2) Slag activity shall be evaluated by determining the compressive strength of both Portland cement mortars and corresponding mortars made with the same mass of 50-50 mass combinations of slag and portland cement.
2. Blended Hydraulic Cement: ASTM C 595 - Type IS, portland blast-furnace slag; Type IP, portland-pozzolan; Type I (PM), pozzolan-modified portland; or Type I (SM), slag-modified portland cement or equivalent industry standard.

B. Silica Fume: ASTM C1240, amorphous silica, or equivalent industry standard.

C. Normal-Weight Aggregates:

1. Provide aggregates from a single source.
2. ASTM C 33, or equivalent industry standard coarse aggregate.
 - a. Aggregate shall be double washed with clean water. The washed aggregate shall contain no unsuitable material.
3. ASTM C 33, or equivalent industry standard coarse aggregate for exterior concrete.
 - a. Aggregate shall be double washed with clean water. The washed aggregate shall contain no unsuitable material.
4. Maximum Coarse-Aggregate Size:
 - a. Slabs on Grade: 38 mm nominal.
 - b. All Other Concrete: 25 mm nominal.
5. Fine Aggregate: Free of materials with harmful reactivity to alkali in cement. Fine aggregate shall conform to the following gradation requirements:

- a. Fine aggregate shall be natural aggregate or manufactured aggregate or a combination of natural and manufactured aggregate.
- b. The aggregate shall consist of hard, tough grains and shall be free of organic material, clay, loam and other harmful materials.
- c. The aggregate shall conform to the following gradation:

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieves</u>
9.5 mm	100
4.75 mm	95 to 100
2.36 mm	80 to 100
1.18 mm	50 to 85
600 um	25 to 60
300 um	5 to 30
150 um	0 to 10

D. Water: Potable.

2.7 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260 or equivalent industry standards. An admixture that is used as an ingredient of the concrete, added before or during batch mixture, for entraining air in the concrete mix.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A (water-reducing admixture), or equivalent industry standard.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B (retarding admixture), or equivalent industry standard.
 3. Accelerating Admixture: ASTM C 494/C 494M, Type C (accelerating admixture), or equivalent industry standard.
 4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D (water-reducing and retarding admixture), or equivalent industry standard.
 5. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E (water-reducing and accelerating admixture), or equivalent industry standard.
 6. Mid-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A or Type F (mid-range, water-reducing admixture), or equivalent industry standard.
 - a. Water content reduction to be greater than 7 percent.
 7. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F (high-range, water-reducing admixture) or equivalent industry standard.
 8. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G (high-range, water-reducing and retarding admixture), or equivalent industry standard.
 9. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II (plasticizing and retarding admixture) or equivalent industry standard.

2.8 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572 or equivalent industry standard with factory installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BoMetals, Inc.
 - b. Greenstreak.
 - c. Approved equal.
 - 2. Profile(s) and Dimensions: As shown on the Drawings.

2.9 SEALED CONCRETE

- A. Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. L&M Construction Chemicals, Inc.; Seal Hard.
 - d. Meadows, W. R., Inc.; LIQUI-HARD.
 - e. Nox-Crete Products Group; Duro-Nox.
 - f. Approved equal.

2.10 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C 171, or equivalent industry standard, clear or white opaque polyethylene film or white burlap-polyethylene sheet, used in conjunction with potable water.
 - 1. Minimum thickness of the polyethylene film shall be 0.10 mm (4 mils).
 - 2. White burlap-polyethylene sheet shall be made of burlap weighting 305 g/sq. m (9 oz./sq. yd.) on one side with white opaque polyethylene sheet on the other side. The polyethylene sheet shall be securely bonded to the burlap. Minimum thickness of the polyethylene film shall be 0.10 mm (4 mils).
- B. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1-D (clear with fugitive dye), Class B (resin type), dissipating, or equivalent industry standard.
- C. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- D. Insulation: Blanket, batt or board insulation with a thermal conductivity of less than 0.8 w/sm for a thermal gradient of 0.02 deg C/mm.
- E. Ensure compatibility of curing materials with finish flooring and adhesives.

2.11 RELATED MATERIALS

- A. Bond breakers: Waterborne, form release agent.
- B. Bonding Agent: Liquid bonding agent specifically designed to bond fresh cementitious materials to a variety of substrates for exterior applications and provide an anti-corrosion coating for reinforcing steel.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals; Emaco P24.
 - b. Sika Corporation; Sika Armatec 110 EpoCem.
 - c. Approved equal.
- C. Nonshrink Grout: ASTM C 1107, “Packaged Dry, Hydraulic-Cement Grout (Nonshrink)” or equivalent industry standard, factory-packaged, shrinkage-resistant, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. Minimum 28 day compressive strength shall be 34 MPa (5000 psi).
- D. Epoxy Adhesive: ASTM C 881/C 881M or equivalent industry standard. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 4 deg C, Class B if placement temperature is between 4 and 16 deg C or Class C if placement temperature is above 16 deg C.

2.12 REPAIR MATERIALS

- A. Repair Mortar: Site-mixed Portland-cement mix for vertical and overhead surfaces. Mix dry-pack repair mortar, consisting of one part shrinkage-compensating, Portland cement to two and one-half parts fine aggregate passing a 1.18-mm sieve by damp, loose volume, using only enough water for handling and placing.
- B. Thin Coat Patching Mortar: Polymer modified, Portland cement, suitable exterior applications. Featheredge up to 5 mm. For thicker applications manufacturer’s recommendations to extend mix with an aggregate may apply.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals; Chemrex Levelprep.
 - b. ChemMasters, Inc.; ChemFlow HS.
 - c. Approved equal.

2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301M, “Specifications for Structural Concrete”, or equivalent industry standard.

1. Use a testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. See “Quality Assurance” article in this section for additional requirements.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
1. Fly Ash: 25 percent, but if used, a minimum of 15 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 5. Silica Fume: 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing or plasticizing admixture in all concrete. Design mix for optimum placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use a mid-range, water-reducing admixture in pumped concrete, all concrete slabs (including concrete walks), concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.14 CONCRETE MIXTURES FOR BRIDGE ELEMENTS

- A. Footings, Piers, Abutments, Approach Slabs, Bridge Sidewalks, and Barriers. Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 27.5 MPa at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 100 mm plus or minus 25 mm; or 200 mm for concrete with verified slump of 50 to 100 mm before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 25 mm.
 4. Air Content: 6 percent, plus or minus 0.5 percent at point of delivery (25-mm) nominal maximum aggregate size.
- B. Bridge Deck: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 27.5 MPa at 28 days.
 2. Minimum Cementitious Materials Content: 309 kg/cu. m.
 3. Slump Limit: 100 mm, plus or minus 25 mm.
 4. Air Content: 6 percent, plus or minus 0.5 percent at point of delivery for 25 mm normal maximum aggregate size.
 5. Maximum Water-Cementitious Materials Ratio: 0.45.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice" or equivalent industry standard.

2.16 CONCRETE MIXING

- A. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M or equivalent industry standard. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 0.76 cu. m or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 0.76 cu. m, increase mixing time by 15 seconds for each additional 0.76 cu. m.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Examination:
 - 1. Verify that subgrade conditions are satisfactory prior to forming or pouring concrete.
 - 2. Verify reinforcing is properly in place and that framework is complete and properly secured prior to placing concrete.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Footings: No concrete shall be placed until after the Contractor's engineer has confirmed the depth and dimensions of the excavation to be in accordance with the design documents, and that the character of the material and the condition of the foundation is as indicated in the geotechnical engineering recommendations. No footing shall be supported partially on rock and partially on soil. The rock shall be excavated as necessary to allow the placement of select granular material. Owner or owner's representative may direct, in writing, such changes in dimensions or elevations of footings as may be necessary to obtain satisfactory foundations.
- C. Precast concrete erection procedures shall be in accordance with submitted description, procedures and list of equipment.
- D. Transportation of Concrete:
 - 1. The concrete shall be transported from the mixer and placed in the forms by a method that will permit handling concrete of the slump required without segregation. Buggies and wheelbarrows used for this purpose shall be equipped with pneumatic tires. Chutes may be used but the use of long chutes will be permitted only on authority from owner or owner's representative. If such conveyors are allowed and the quality of the concrete as it reaches the forms or the methods of placing or working it therein are not satisfactory, owner or owner's representative may order their use discontinued

and the substitution of a satisfactory method of placing. Chutes shall be constructed of aluminum free metal or metal lined and shall extend as nearly as possible to the point of concrete placement. Long chutes shall be provided with reverse flow or remixing hoppers in order to correct for segregation. All chutes shall be kept clean and free from coatings of hardened concrete. Concrete shall not be permitted to be transported through chutes or pipes composed of aluminum.

2. Transportation of concrete by pumping will be permitted provided that the required slump or air content can be maintained at the discharge end of the hose and there is no adverse effect to the mix design.
3. Concrete shall be sampled and tested at the end of the chute or if pumping is allowed, from the discharge end of the hose. The equipment shall be suitable in kind and adequate in capability for the work. The operation shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline shall be ejected in such a manner that there will be no separation of the ingredients. Pumping through aluminum pipes will not be permitted. All pipes and chutes shall be kept clean and free from coatings of hardened concrete.

3.2 FORMS, FALSEWORK AND CENTERING

- A. Approved centers and forms shall be provided by the Contractor. Piles shall be used for falsework if required by owner or owner's representative. No extra compensation for falsework or falsework piling shall be allowed, such work shall be considered part of the form work. Falsework shall be set to give the structural camber indicated on the Drawings or as specified, plus allowance for shrinkage, shortening under load or settlement.
- B. Forms, falsework, and centering shall be designed for a liquid head, equal to the maximum height of the liquid concrete in the forms for various placing conditions assuming the load of the liquid concrete to be 2400 kg/m³, and in addition thereto a live load allowance of 2.4 kPa on horizontal surfaces.
- C. All falsework or centering shall be adequate for the type of construction involved. The Contractor shall submit all shop drawings for falsework and centering, including design computations, formally signed and sealed by the Contractor's engineer. The Contractor's engineer shall certify that the falsework system has been assembled and constructed according to the approved falsework drawings, prior to placing loads on such falsework.
- D. Unless otherwise shown on the Drawings or specified, forms for all exposed portions of bridges and structures shall be lined with approved material, or form sheathing which shall consist of five-ply water-proof plywood, approved metal sheathing or other approved material in order to give the concrete a smooth even finish and uniform appearance. This requirement shall not apply to any part of a structure that will be at least 600 mm below the surface of adjacent ground in the completed project that will not be coated with bituminous dampproofing. Any material that will provide tight forms will be acceptable for such locations.
- E. Full sheets of plywood or other approved material shall be used wherever possible and shall be placed in a regular pattern. The use of small pieces and leftovers will not be permitted except as they may be needed to complete the design. Forms in good condition may be reused, but forms for any one exposed face shall be all new or all used material and a mixture of old and new forms will not be permitted.
- F. The sheathing shall be jointed tightly to prevent leakage from the mix and it shall be of sufficient strength to hold the concrete without bulging between supports. Forms shall be

properly braced and tied so as to maintain proper dimensions. Bolts, rods, or other approved form ties shall be used for internal ties. Wire ties will not be permitted except when directed or where concrete is not exposed to view. Owner or owner's representative may require the Contractor to employ screw jacks or hard wood wedges in connection with the centering of falsework in order to take up any distortion or settlement in the form work either before or during the placing of the concrete.

- G. Approved inserts required for form and/or falsework support shall be used in connection with all ties in the region of exposed surfaces on the concrete. They shall be so designed as to permit their removal from the concrete without injury to the concrete, and the metal remaining in the concrete shall not be closer than 40 mm to the surface. The inserts shall be truly round, not more than 40 mm in outside diameter and shall be treated with non-staining mineral oil or other satisfactory material adequate for preventing any adherence to surrounding concrete. Special tools and methods shall be used to remove the inserts from the concrete in a manner to prevent damage to the concrete. All ties and embedded devices required for form and/or falsework support that are to be left in place shall be either epoxy coated or galvanized to match the reinforcement within the concrete placement.
- H. Form ties of a design with a weakened section 40 mm back from the concrete face may be used at places of minor pressure when permitted by owner or owner's representative, but such ties shall be provided with special inserts so as to assure the breaking off of the ties at the proper depth inside the face of the concrete. When such ties fail to break off at the designed depth, the tie metal shall be drilled out before the tie hole is patched. Voids and forming accessory holes shall be patched as necessary to match the surrounding texture and color to produce a uniform appearance.
- I. The use of wooden struts within forms, or of metal ties without approved inserts, as required, will not be permitted.
- J. The centers shall be true to the lines, satisfactorily supported and firmly secured. They shall remain in place as long as directed by owner or owner's representative and shall be replaced with new ones if they lose their proper dimensions and shape.
- K. Forms for the roadway deck slabs shall be so constructed that under full dead load, the thickness of the slabs shall be the required thickness shown on the Drawings and the surface of the pavement will accurately conform to the profile grades, cross sections and alignment shown on the Drawings. Allowance shall be made for the camber of the floor members as erected and for the additional dead load deflections of the floor members. Slab haunches shall be provided over steel girders, floor beams or stringers. The depth of haunches shall be variable as required to maintain the uniform thickness of slab between the steel supports.
- L. All exposed edges and corners of concrete not otherwise specified on the Drawings shall be formed with a wooden triangular 45 degree chamfer strip 19 mm on the square sides. These triangular chamfer strips shall be machine surfaced on all sides and shall be of uniform dimensions throughout the Project. Any chamfered or beveled corners of concrete specified on the Drawings of larger size shall be formed and finished as required for other parts of the adjacent forms.
- M. Bridge bearing anchor bolts shall be set accurately by a secured template prior to placing concrete.
- N. The shape, strength, rigidity, water-tightness and surface smoothness of re-used forms shall be maintained at all times. Any warped or bulged lumber shall be resized before being used. Forms that are unsatisfactory in any respect shall not be used and shall be removed immediately from the work.

- O. The inside of forms shall be coated with non-staining mineral oil or other approved material to prevent adherence of the concrete to the forms, immediately before placing the concrete. When oil is used, it shall be applied before the reinforcing steel is placed. Any material that will adhere to, discolor or affect the concrete in any manner shall not be used. Forms for bridge decks shall not be oiled but shall be dampened with water ahead of concrete placement.
- P. In the construction of copings, railings and other intricate sections, extreme care shall be taken in the construction to insure true lines.
- Q. Prior to placing concrete in the forms all foreign matter and any extraneous materials shall be removed. Forms shall be inspected immediately preceding and during the placing of the concrete. All dimensions shall be checked carefully and any errors, bulges, warping or other defects shall be remedied before any concrete is placed. Temporary openings shall be provided for inspection at the base of columns and wall forms and near the bottom of all deep members.
- R. Temporary openings shall be provided for inspection at the base of wall forms and near the bottom of all deep members.
- S. The foregoing specifications for forms as regards to design, mortar-tightness, chamfers or moldings, bracing, alignment, treatment by coating with oil or other approved material, removing and reuse, shall apply to metal forms when such forms are approved for use. The metal forms used shall be of such strength that the forms will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or which do not line up properly shall not be used. Special care shall be exercised to keep metal forms free from rust, grease or other foreign matter that will tend to discolor the concrete. Metal forms shall be provided with an adjustable metal section or occasional sections where wooden forms may be inserted to compensate for slight inaccuracies in measurement.
- T. Removable or stay-in-place forms for bridge decks may be used as alternates. Removable forms shall be used for forming end diaphragms, bays with longitudinal construction joints, and overhanging portions of decks. Material to prevent concrete from adhering to the forms shall not be used when stay-in-place forms are used.
- U. The Contractor's method of construction shall be observed during all phases of the construction of the bridge deck slab. These phases include installation of the metal forms; location and fastening of the reinforcement; composition of concrete items; mixing procedures, concrete placement and vibration; and finishing of the bridge deck. Should owner or owner's representative determine that the procedures used during the placement of the concrete warrant inspection of the underside of the deck, the Contractor shall remove at least one section of the forms at a location and time selected by owner or owner's representative for each span in the contract at no additional cost to the Project. This should be done as soon after placing the concrete as practicable in order to provide visual evidence that the concrete mix and the Contractor's procedures are obtaining the desired results. An additional section shall be removed at no additional cost to the Project if owner or owner's representative determines that there has been any change in the concrete mix or in the Contractor's procedures warranting additional inspection.
- V. After the deck concrete has been in place for a minimum period of 2 days, the concrete shall be tested for soundness and bonding of the forms by sounding with a hammer as directed by owner or owner's representative. If areas of doubtful soundness are disclosed by this procedure, the Contractor will be required to remove the forms from such areas for visual

inspection after the pour has attained adequate strength. This removal of the permanent steel bridge deck forms shall be at no cost to the Project. At locations where sections of the forms are removed, the Contractor will not be required to replace the forms, but the adjacent metal forms and supports shall be repaired to present a neat appearance and assure their satisfactory retention. As soon as the form is removed, the concrete surfaces will be examined for cavities, honeycombing and other defects. If irregularities do not justify rejection of the work, the concrete shall be repaired as owner or owner's representative may direct and shall be given an Ordinary Surface Finish, in accordance with the specifications.

3.3 NONCOMPOSITE FORM DECK INSTALLATION

A. Examination:

1. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
2. Proceed with installation only after unsatisfactory conditions have been corrected

B. Installation, General:

1. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, "Design Manual for Composite Decks, Form Decks and Roof Decks" or equivalent industry standard, manufacturer's written instructions, approved deck placement shop drawings and requirements in this Section.
2. Place deck panels on supporting beams and adjust to final position with ends accurately aligned and bearing on supporting member before being permanently fastened.
3. Place deck panels flat and square and fasten to supporting beams without warp or excessive deflection. Do not stretch or contract side lap interlocks.
4. Deck Accessories to Supporting Members: Fasten in accordance with manufacturer's recommendations.

3.4 EMBEDDED ITEMS

- #### A.
- Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagram, instructions, and directions furnished with items to be embedded.

3.5 REMOVAL OF FORMS AND FALSEWORK AND LOADING ON STRUCTURES

- #### A.
- The terms falsework and centering, as used herein, shall include all supports of the actual forms enclosing and supporting the concrete. No external loads of any kind, except as provided for herein, shall be allowed until the members reach at least the designated strengths.

B. Removal of Forms and Falsework:

1. The forms, falsework, and centering for any portion of the structure shall not be removed until the concrete is strong enough, as determined by owner or owner's representative, to avoid possible injury from such removal. Forms, falsework, and centering shall not be removed or disturbed without the prior approval of owner or owner's representative. Forms, falsework, and centering shall be removed in such a

manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

2. When test cylinders are taken from the concrete in the members of a structure for the purpose of controlling the timing of form removal operations, the forms shall be left in place until the concrete has attained the minimum percentage of the specified design strength and, regardless of the strength attained, for the minimum period of time with test cylinder testing as designated in the following table. If test cylinders are cast for this purpose, concrete cylinders shall be cast, cured, and tested as specified in "Field Quality Control" Article. When test cylinders are not taken from the concrete in the members of a structure for the purpose of controlling form removal operations, the minimum days without test cylinder testing designated in the following table shall be used as a guide. The number of days counted shall be measured from the time of the last placement of concrete in the forms or falsework supports and shall exclude days when the surrounding temperature is below 4 deg C for a total of 4 hours or more. The complete curing process shall be continued after removal of forms, falsework, or centering as required. In order to facilitate any particular finishing operations, side forms carrying no load may be removed 24 hours to 72 hours (depending on weather conditions and type of concrete) after the placing of the concrete has been completed, subject to the approval of owner or owner's representative and with the complete curing process to be continued as required.

Structural Member	Minimum Percentage of Specified Design Compressive Strength (fc)	Minimum Days with Test Cylinder Testing	Minimum Days without Test Cylinder Testing
Free Standing Walls and Piers	40 %	3 days	5 to 7 days
Slabs	80 %	10 days	14 to 28 days
Girders	90 %	14 days	21 to 28 days
Cantilevered Slabs	90 %	14 days	21 to 28 days

3. Any defective work discovered after the forms have been removed shall be immediately removed and replaced. If the surface of the concrete is bulged, uneven or show excessive voids or form joint marks that cannot be repaired satisfactorily, the entire section shall be removed and replaced. All repairs and renewals due to defective work shall be done at the expense of the Contractor. Any proposal by the Contractor to remove forms, falsework, and centering prior to the concrete attaining the specified minimum percentage of the design compressive strength shall satisfy each of the following requirements:
 4. Owner or owner's representative has reviewed and approved the Contractor's justifying calculations. The calculations shall be based upon the concrete strength from the time of the proposed early removal until the concrete has attained its design strength. The calculations shall demonstrate that the capacity of the structure shall not be exceeded by computing the loads, resultant stresses, and deformations to which the concrete and reinforcing steel will be subject to at the time of the proposed removal.
 5. Cured concrete cylinders tested immediately prior to the start of removal of forms, falsework, and centering, and all of the test results equal or exceed the anticipated strength used in the Contractor's calculations. Owner or owner's representative will accept the field curing of the test cylinders as being representative of the field curing of the production concrete in order for this approval to occur.

C. Application of External Loads:

1. Loads shall not be applied to concrete structures until the concrete has, as determined by owner or owner's representative, attained sufficient strength so that damage will not occur. Nothing, except for curing materials and related curing equipment and devices, may be carried on bridge decks until the entire 14 day wet curing operation is completed. A live load not exceeding 2,400 kg, operated at a speed not to exceed 8 km/h, may be allowed on bridge deck concrete no sooner than completion of the 14 day wet curing operation provided that the concrete has reached a compressive strength of 23 MPa. Full traffic loading shall not be allowed on bridge deck concrete until completion of the 14 day wet curing operation and until the concrete has reached its specified strength.
2. Precast concrete shall not be placed on substructure elements until the substructure concrete has attained 70 percent of its specified strength. When the placement of backfill will cause flexural stresses in the concrete, the placement shall not begin until the concrete has reached not less than 80 percent of its specified strength.

3.6 INSTALLATION OF PERMANENT STEEL BRIDGE DECK FORMS (IF USED)

- A. All forms shall be installed in accordance with approved fabrication and erection plans. Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 25 mm at each end. Form supports shall be placed in direct contact with the flange of stringer or floor beam. All attachments shall be made by permissible welds, bolts, or clips of other approved means. However, welding of form supports to flanges of steels not considered weldable and to portions of flange subject to tensile stresses will not be permitted. Welding and welds shall be in accordance with the provisions of AWS D1.3, or equivalent industry standard, pertaining to fillet welds except that 3 mm fillet welds will be permitted.
- B. Any permanently exposed form metal where the galvanized coating has been damaged shall be thoroughly cleaned and painted with galvanizing repair paint. Minor heat discoloration in areas of welds need not be touched up.
- C. If the concrete where the form is removed is unsatisfactory, additional forms, as necessary, shall be removed at no additional cost to the Project to inspect and repair the slab, and the Contractor's methods of construction shall be modified as required to obtain satisfactory concrete in the slab. All unsatisfactory concrete shall be removed or repaired as directed by owner or owner's representative.
- D. The amount of sounding and form removal may be moderated, at owner's or owner's representative's discretion, after a substantial amount of slab has been constructed and inspected, if the Contractor's methods of construction and the results of the inspections as outlined above indicate that sound concrete is being obtained through the slabs. The Contractor shall provide all facilities as are reasonably required for the safe and convenient conduct of owner's or owner's representative's inspection procedure

3.7 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" or equivalent industry standard for placing reinforcement.
 1. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

2. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
3. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
4. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
5. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
6. Clean areas where zinc coating is damaged or missing and repair zinc coating with zinc rich repair paint. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.
7. Field bending or straightening of bars partially embedded in concrete is permitted only where shown on the Drawings.
8. All openings in concrete walls with a dimension of 300 mm or greater are to have two 16 mm diameter (16 M) bars on all sides of opening, unless noted otherwise.

3.8 CONCRETE PLACEMENT OF BRIDGE SUBSTRUCTURE

A. Depositing:

1. The concrete shall be placed in the form in the approved manner to prevent stone pockets, voids or segregation and to reduce handling and flowing in the form to a minimum. The concrete shall not be dropped more than 1 m or dragged more than 3 m in the forms. Vibrators shall not be used to transport concrete. Epoxy coated steel reinforcement shall be protected from damage from dropping concrete by limiting the maximum height of concrete drop to 600 mm. Points of deposit shall be spaced not more than 6 m apart nor more than 3 m from the ends of the forms.
2. Concrete shall be distributed in the forms by hand shoveling. The forms shall be filled at a rate of 300 mm to 1 m in depth per hour unless an alternate form design is submitted and approved by owner or owner's representative. Care shall be taken to avoid splashing the forms and reinforcing above the level of the concrete as placed. Beams and slabs shall be placed in one continuous operation.

B. Consolidation:

1. Each layer shall be thoroughly consolidated by rodding and vibration. The face of the forms shall be carefully spaded, if possible, to bring a dense mortar to the face, and produce a good finish.
2. All concrete for structures, unless otherwise directed by owner or owner's representative, shall be compacted by means of approved mechanical vibrators operated within the mass of the concrete. The Contractor shall provide vibration to fully consolidate the mix. Vibrators shall be of internal type of standard make and capacity, and shall be capable of transmitting vibrations within the concrete at frequencies of not less than 5500 vibrations per minute nor more than 13500 vibrations per minute. Epoxy coated steel reinforcement shall be protected from damage from exposed steel headed immersion-type vibrators
3. Immersion type vibrators used to consolidate concrete that is reinforced with epoxy coated reinforcement shall feature heads covered with rubber or other resilient non-metallic material approved for concrete consolidation. Vibration of forms or reinforcing shall not be permitted except where internal vibration is not practicable and then only with the approval of owner or owner's representative.

4. The vibrator shall be applied directly to the concrete mass at the point and time of deposit and shall be moved throughout the mass continuously from point to point for a sufficient duration to accomplish thorough consolidation. The duration of vibration shall not be prolonged to the point where segregation, serious loss of entrained air, or excessive water bleeding occurs. Vibrators shall not be used close to the forms.
5. When concrete is placed in lifts, vibrators shall be inserted into at least half the depth of the underlying lift so as to thoroughly consolidate the two lifts into an integral mass without streaks or hardened lift lines. Vibrators shall not be used to move concrete in the forms. A sufficient number of vibrators shall be provided to obtain proper compaction in accordance with the rate of deposit. Extreme care shall be taken to prevent penetrating or disturbing previously placed concrete that has become partially set.

C. Hot and Dry Weather Requirements:

1. During hot dry weather, and as directed by owner or owner's representative, all new concrete shall be kept shaded from the sun, shielded from the wind and kept wet with water, or protected by other approved methods to retain the moisture in the concrete throughout the curing period. During concrete placement operations in hot weather, appropriate measures shall be taken in accordance the Contractor's Placement and Curing Plan to reduce the hazards of increased rate of cement hydration, flash set, loss of water due to evaporation, high concrete ingredient temperatures, and the increased difficulty of concrete placing and finishing. The following requirements shall be met during concrete placement operations in hot weather:
 - a. Concrete Temperature: The temperature of the concrete at the point of discharge shall not exceed 32 deg C.
 - b. Cooling Materials: The Contractor may reduce the temperature of the concrete by cooling one or more of several ingredients. The aggregates may be cooled by fogging, or other suitable means that will not result in a high variation of moisture content within the stockpile. Chipped or crushed ice made from potable water may be used in the mix as a portion of the mixing water on a kilogram for kilogram basis, provided such measure is determined at the time it is placed in the mix. If used, all ice shall be melted before the batch is discharged from the mixing unit. Water may also be cooled by refrigeration or other means that provide a uniform mixing water temperature.
 - c. Concrete Placing: Immediately before the concrete is placed, the forms and reinforcement steel shall be cooled by spraying with water. In no case shall there be any standing water in the concrete forms as a result of the spraying procedures. The Contractor shall have sufficient skilled men and adequate equipment to place the concrete without delays which may cause excessive slump loss and evaporation due to over-mixing or exposure before it is placed.
 - d. Finishing: To prevent shrinkage cracking resulting from moisture loss, the Contractor may be required to furnish windscreens, to use water fogging, or other approved means of supplying moisture. If the use of windscreens is required, the windscreens shall consist of canvas barriers of suitable height erected on the windward side of the concrete placement. Finishing operations shall follow as closely as practicable behind the placing operation so that curing may begin as soon as possible.

D. Rainy Weather Requirements:

1. During rainy weather all new concrete shall be properly covered, as may be necessary to prevent damage. Sufficient approved material for covering shall be available at the site of the work for immediate use as may be needed.

E. Cold Weather Requirements:

1. Cold weather is defined as any time during the concrete placement or curing period the ambient temperature at the work site drops below 5 deg C or the ambient temperature at the site drops below 10 deg C for a period of 12 hours or more. Any concrete placed during cold weather shall be placed at the Contractor's risk and any damage or unsatisfactory concrete shall be removed and replaced at the Contractor's expense. When cold weather is reasonably expected or has occurred within 7 days of anticipated concrete placement, the Contractor shall include as part of their Placement and Curing Plan detailed procedures for the production, transporting, placing, protecting, curing, and temperature monitoring of concrete during cold weather. Procedures for accommodating abrupt changes in weather conditions shall be included. Placement of concrete shall not commence until the plan is accepted by the owner or owner's representative.
2. All material and equipment required for cold weather placement and curing protection shall be available at the Project site before commencing concrete placement. All snow, ice, and frost shall be removed from the surfaces, including reinforcement and subgrade, against which the concrete is to be placed. The temperature of any surface that will come into contact with fresh concrete shall be at least 2 deg C and shall be maintained at a temperature of 2 deg C or above during the placement of concrete.
3. During the curing period, the Contractor shall provide suitable measures to maintain the concrete surface temperature which shall be monitored by continuously recording surface temperature measuring devices that are accurate within 1 deg C. One temperature measuring device shall be required to be randomly placed in an accessible location for every 140 square meters of concrete surface area being cured.
4. The minimum concrete surface temperature requirements indicated in the Table below shall be continuously maintained for a curing period of at least 7 days. The 7 day minimum curing period of time will be extended when necessary to develop satisfactory strength in the concrete.
5. Any day during which the minimum concrete surface temperature requirement is not continuously maintained shall not count as a day contributing to the curing period.

Cold Weather Concrete Surface Temperature Requirements				
	Minimum Section Size Dimension			
	Under 305 mm (Under 1 foot)	305 – 915 mm (1 – 3 feet)	Over 915 mm up to 1.830 m (Over 3 feet up to 6 feet)	Over 1.830 m (Over 6 feet)
Minimum temperature of concrete during curing period	14 deg C (57 deg F)	12 deg C (54 deg F)	10 deg C (50 deg F)	10 deg C (50 deg F)
Minimum allowable temperature drop in any 24 hour period after end of curing	28 deg C (50 deg F)	22 deg C (40 deg F)	16 deg C (30 deg F)	11 deg C (20 deg F)

6. The mixing water and/or aggregates may be heated (prior to cement being added) by methods so that the temperature of the aggregates and water mixture is not less than 20 deg C nor more than 60 deg C. The temperature of the concrete shall not be less than 15 deg C nor more than 30 deg C at the time of placing it in the forms. The heating shall be done in a manner to preclude the occurrence of overheated areas that might result in damage to the materials. Any material containing frost or lumps of hardened material shall not be used.
7. Blanket, batt or board insulation shall be applied to the forms. Insulation with breaks or tears will be rejected unless satisfactorily repaired. Openings for thermometers shall be provided where directed by owner or owner's representative.
8. Where it may be expected that considerable heat will be generated by the hydration of the concrete, and in some cases where heat is not rapidly dissipated, suitable coverings shall be used to protect concrete. Heavy footings in which the concrete is placed at a concrete temperature of 20 deg C where protection is provided by the surrounding earth, except on top, shall be protected by a tarpaulin placed over the top with an air space between the concrete and the tarpaulin and sufficient added artificial heat shall be provided to maintain the minimum required concrete surface temperature. Mass concrete, when concrete as such is so specified on the Drawings, placed at a concrete temperature of 20 deg C, shall be protected by enclosure with tight wooden forms at least 16 mm in thickness except at corners and edges and sufficient added artificial heat shall be provided to maintain the minimum required concrete surface temperature. Double sheathing, insulation board or tarpaulins with a dead air space between the covering and the forms shall be placed to equally protect such corners and edges. Supplemental enclosures and added artificial heat will be utilized when required to maintain the minimum concrete surface temperature.
9. As much as possible, any enclosure for protection shall be in place before depositing of any concrete and the remainder shall be installed as rapidly as possible in order to reduce heat losses to a minimum. Heating within the enclosure shall be attained by such means of artificial heat as will maintain the temperatures specified continuously and with a reasonable degree of uniformity in all parts of the enclosures. All exposed surfaces of concrete within the enclosure shall be kept sufficiently moist to prevent any drying of the surface concrete with possible resulting damage to the concrete in place.
10. Heating appliances shall not be placed in such a manner as to endanger the enclosure, forms or supports, or expose any area of concrete to drying out or other injury due to excessive temperatures.

F. Bonding to Concrete Already Set:

1. In bonding new concrete to concrete already set, the surface of the concrete shall be thoroughly cleaned, roughened, wetted with clean water, and then flushed with a mortar composed of equal parts of the cement and sand specified for the new concrete, before new concrete is placed adjacent thereto. New concrete shall be placed before mortar has taken initial set. In lieu of the mortar, an epoxy adhesive for bonding fresh concrete to hardened concrete for load bearing applications may be used. The epoxy adhesive shall be applied in accordance with the manufacturer's recommendations.

3.9 PRECAST CONCRETE COMPONENTS ERECTION

A. General:

1. Girders shall be stabilized, as required, with falsework, temporary braces, or holding cranes until a sufficient number of adjacent girders are erected with all diaphragms connected to provide necessary lateral stability.

3.10 FINISHING FORMED SURFACES

- A. Finishing: The requirements of “Finishing Formed Surfaces” is applicable to all concrete placements with the exception of bridge deck, bridge sidewalk, and bridge safety barrier concrete placements. Refer to those specific requirements for bridge deck, bridge sidewalk, and bridge barrier concrete placements specified separately in this Specification.
- B. The external surface of all concrete shall be thoroughly vibrated and spaded during the operation of depositing the concrete by means of hand tools. The vibrating and spading shall be such as to force all coarse aggregate away from the surface and slowly work the mortar against the forms to produce a smooth finish free from water, air pockets, and honeycombing. The use of mortar, cement water mixture, or neat cement for plastering over any concrete surface will not be permitted. Unless otherwise shown on the drawings, the final finish required on particular concrete shall be as follows:
 1. Formed Surfaces Not Exposed to View:
 - a. Immediately after forms have been removed and form ties cut back from the face of the concrete, all voids and cavities shall be filled with a stiff mortar of the same composition and air-entrainment as the mortar in the original concrete mix. The mortar for filling shall have been mixed and let set for 30 minutes and then remixed before placing in the work. In case the operation of filling is delayed, the surface of the concrete shall be thoroughly cleaned and washed with water, if necessary, before the mortar is applied.
 2. Formed Surfaces Exposed to View:
 - a. Within 48 hours after the forms have been removed and form ties cut back from the face of the concrete, all fins, projections and irregularities shall be carefully removed and all voids and cavities shall be carefully and completely filled with a stiff mortar of the same composition and air-entrainment as the mortar in the original concrete mix. The same brand and color of cement, and the same kind and color of aggregate as was used in the original concrete mix shall be used in this mortar. The mortar for filling shall have been mixed and let set for 30 minutes and then remixed before placing in the work. The surface film of all such pointed surfaces shall be carefully removed before setting of the mortar occurs. If owner or owner’s representative determines these surfaces as prepared do not present a uniformly smooth, clean surface of even texture and appearance, the surface shall be treated and rubbed to obtain a satisfactory finish.
 - b. Owner or owner’s representative shall be the sole judge of the amount of rubbing which will be required. If rubbing is required, the rubbing will start with 48 hours of notification that rubbing is required, the surface should be wetted with clean water and rubbed with a No. 16 carborundum brick or other abrasive of equal quality until even and smooth and of uniform appearance, without applying any cement or other coating. If additional finishing is necessary it shall be obtained by a thorough rubbing with a No. 10 carborundum rick or other abrasive of equal quality. Rubbing may be performed by use of satisfactory power equipment and tools, providing that the

operational procedures shall be the same as those specified above for hand rubbing.

- c. Rubbing shall be kept to a minimum to produce smooth, even surfaces of uniform appearance. Rubbing will not be required to fill very small surface air bubble holes, to remove a uniform wood grain pattern left by forms, nor to remove inconspicuous lines or marking between form panels. Patches required for form ties, if carefully and properly done, may not necessitate rubbing. If however, this work is done in such a manner that these patches are conspicuous, the entire exposed face on which they occur shall be rubbed.
- d. After the final rubbing is completed, and the mortar has set up, the surface shall be thoroughly drenched and kept wet with clean water for a period of 5 days, unless otherwise directed by owner or owner's representative. No rubbing will be permitted when the air temperature is below 5 deg C.

3. Preparation of Bridge Seat Bearing Areas:

- a. General: Bridge seat bearing areas shall be considered to be those areas of the concrete bridge seats of the abutments, and piers that support the elastomeric bridge bearing pads. The limits of the bridge seat bearing area shall extend a minimum of 75 mm outside of the perimeter of the bearing device component that is in contact with the bridge seat. Bearing devices shall not be placed upon bridge seat bearing areas that are improperly finished, deformed or irregular. Bearing devices shall be set to the required grade in the exact positions called for on the Drawings and shall have full and even bearing upon the bridge seat concrete. Satisfactory drainage shall be provided as called for on the Drawings and where necessary to prevent water accumulation at the bridge seat bearing areas.
- b. Unless otherwise shown on the Drawings, the bridge seat concrete as cast shall be finished to the exact final required elevation and to the roadway profile grade slope in the direction parallel to the centerline of construction and to the cross slope set by the bridge seat elevations in the direction parallel to the centerline of bearings.
- c. For All Other Bearing Device Installations: The surface of the concrete within the limits of the bridge seat bearing area shall be cast a minimum of 5 mm higher than the required finished elevation. This additional concrete shall be cast monolithically with the rest of the bridge seat concrete and shall be sound and free of voids and laitance. After the concrete has been cured and thoroughly hardened, these areas shall be machine dressed down using methods to provide a true even surface at the following elevations and grades:
 - 1) Elevations: For bearing devices where the elastomeric bridge bearing pad is placed directly onto the as-finished bridge seat concrete surface, the surface of the bridge seat bearing area shall be dressed down to the exact final required elevation. For bearing devices that utilize a metal masonry plate, the metal masonry plate shall be set on a system of either rubber-cotton duck bearing pads or molded fabric bearing pads and the surface of the concrete shall be dressed down sufficiently below the required finished elevation so that the bearing pad will bring the bottom of the masonry plate to the exact final required elevation.
 - 2) Grades: The bridge seat bearing areas shall be finished level, except that the bridge seat bearing area for adjacent pre-stressed concrete deck and box beams shall be finished level in the direction parallel to the centerline of construction and shall be finished to follow the cross slope set by the bridge seat elevations in the direction parallel to the centerline of bearings.

4. Bridge Approach Slabs:

- a. After concrete is placed, the top surface shall be struck off to the proper crown and longitudinal profile with an approved template. Satisfactory supports, furnished by the Contractor, shall be set and maintained in place for proper operation of the template so that the surface shall be furnished to the required elevations. These supports shall be carefully removed from the concrete before any set of the concrete occurs, and the spaces left by such removal shall be immediately filled and finished to the level of the adjacent surfaces. The surface shall be checked, by means of an approved straightedge, not less than 3 m in length, furnished by the Contractor, as owner or owner's representative may direct. Any irregularities, measuring more than 5 mm vertically, shall be corrected and the whole surface shall be made smooth and even. No load of any kind shall be placed on the concrete after setting of the concrete has begun, and any work on the concrete then required shall be performed from approved bridges furnished by the Contractor, which will not rest on the new concrete in any manner.

3.11 PLACEMENT AND CURING PLAN

A. Placement and Curing Plan Submission Requirements:

1. At least 60 calendar days prior to the proposed start of placing the concrete bridge deck, the Contractor shall submit for approval, a submission (herein called the Placement and Curing Plan) specifying the method of concrete conveyance, placement, type and number of finishing machines and work bridges, rate of pour, estimated time of completion, screed and rail erection plan, sequence of concrete pours, and the concrete curing procedure. The Placement and Curing Plan shall take into consideration weather conditions. It shall also include details and a complete description of equipment to be used in the handling, placement, finishing and curing the concrete including the number and type of personnel who will be engaged in the operation. The personnel shall consist exclusively of persons with the experience and skill appropriate to their working assignment. Approval of this plan will not relieve the Contractor of the responsibility for the satisfactory performance of his/her methods and equipment. The Placement and Curing Plan shall include, but not be limited to, the following:
 - a. Proof of the following minimum operator experience for the bridge deck finishing, or finishing machine operator experience:
 - 1) Five years of experience operating machines or similar type and manufacturer as that proposed.
 - 2) Proof of no less than five bridge decks of similar size, placed using a machine of the same manufacturer as that proposed.
 - 3) Or, as a substitute for 1) and 2): A representative of the manufacturer of the bridge deck finishing machine shall be present on the site a minimum of 24 hours in advance of the proposed deck placement to approve the set-up of the machine and rail system, and the representative shall be present for the entire duration of the placement of the deck concrete using the bridge deck finishing machine.
 - b. Curing method.
 - c. Provisions for enclosures, indicating method of holding down enclosure safely in place.

- d. When cold weather is reasonably expected or has occurred within 7 days of anticipated concrete placement, the Contractor shall include detailed procedures for the production, transporting, placing, protecting, curing, and temperature monitoring of concrete during cold weather, including a plan of heating devices, types and locations around structure.
 - e. Procedures for accommodating abrupt changes in weather conditions.
 - 1) Method of monitoring temperature of hardened concrete.
 - 2) Backup systems as required.
2. Before concrete placement operations begin, the Contractor shall make all necessary arrangements and have all materials on hand for curing and protecting the concrete deck. Concrete placement shall not proceed until owner or owner's representative is satisfied that all necessary steps have been taken to insure adequate compliance with these Specifications and that completion of the operation can be accomplished within the required scheduled time. It shall be the Contractor's responsibility to allow sufficient time to permit such an inspection by owner or owner's representative.

3.12 PLACEMENT, FINISHING AND CURING OF CONCRETE BRIDGE DECKS

- A. Placement of concrete bridge decks by using self-propelled finishing machines, all as indicated on the Drawings and in accordance with these Specifications.
- B. Limitations on Placement:
 - 1. In addition to the requirements contained herein, all weather and concrete temperature requirements contained in the Protection from Adverse Weather, provided within this specification, shall be satisfied. When placing concrete, the Contractor shall provide suitable equipment and take appropriate actions as approved by owner or owner's representative to limit the evaporation rate of the exposed concrete surface to less than 0.75 kg/m²/hr. The deck surface evaporation rate shall be determined in accordance with FIGURE 1 (below -obtained from "Plastic Cracking of Concrete" by Delmar Bloem for the National Ready Mixed Concrete Association and published in ACI 305R), or equivalent industry recommendations. To maintain the deck surface evaporation rate below 0.75 kg/m²/hr the Contractor shall take one or more of the following actions:
 - a. Misting the surface of the concrete with a triple head nozzle immediately behind the finishing machine and until the curing cover is applied. The nozzle shall be rated at 4 l/min or less and shall produce a fine fog mist that will maintain a "sheen" of moisture on the concrete surface without ponding.
 - b. Construct windscreens or enclosures to effectively reduce the wind velocity throughout the area of placement. If the use of windscreens is required, the windscreens shall consist of canvas barriers of suitable height erected on the windward side of the concrete placement.
 - c. Reduce the temperature of the concrete.

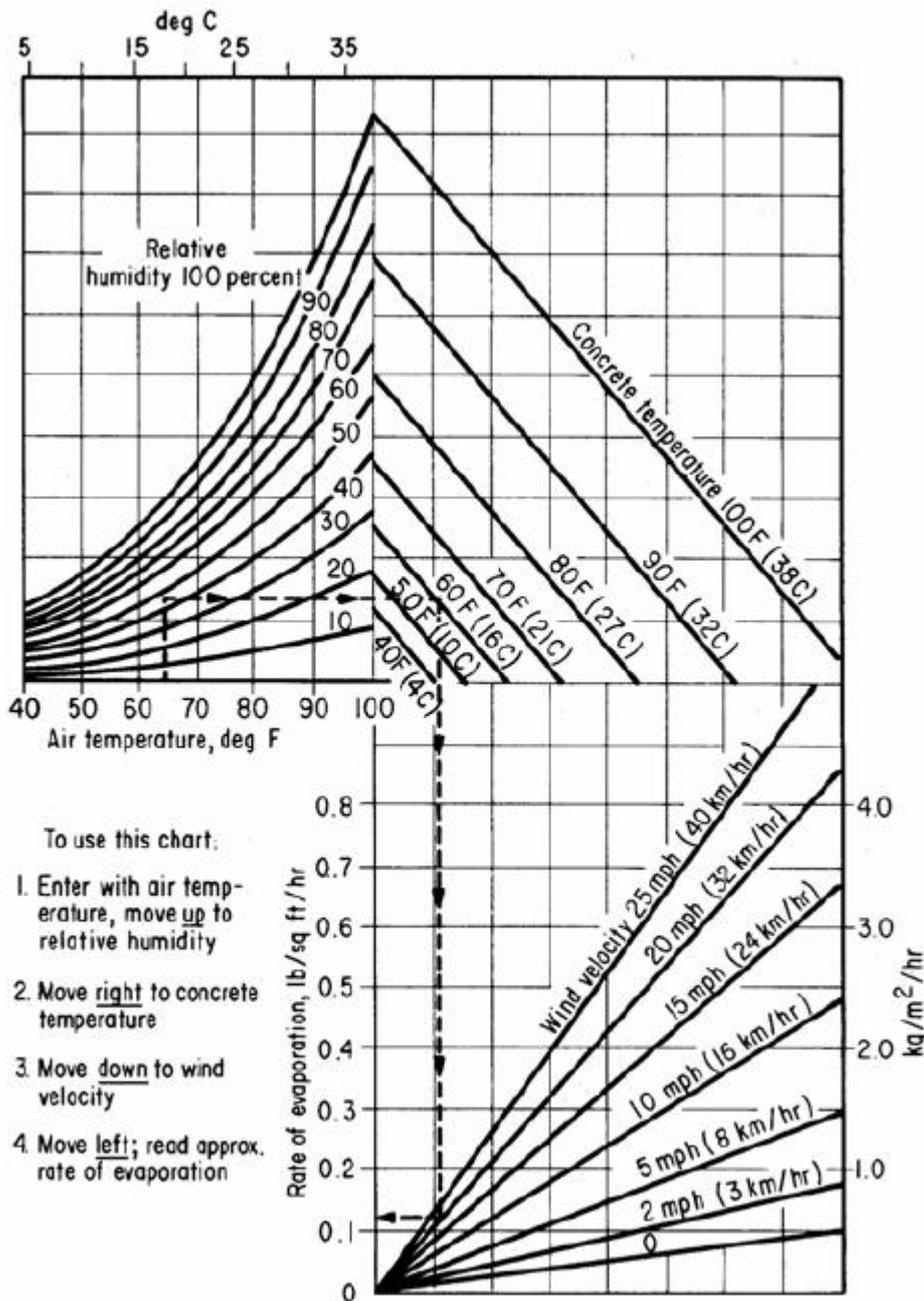


FIGURE 1

C. Placement:

1. Concrete placement shall take place during daylight and shall not begin unless the Contractor is certain that the placement can be completed and finished, to the satisfaction of owner or owner's representative, during daylight hours. Owner or owner's representative may waive this requirement if adequate and approved lighting facilities are provided by the Contractor prior to the start of the deck placement. Before concrete placement operations begin substantial bulkheads or headers shall be shaped to the required deck surface cross-section.
2. In the event of unforeseen circumstances should the concrete placement be forced to cease, sufficient bulkheads shall be installed at locations determined by owner or owner's representative and the concrete placement shall be discontinued. All

concrete in place beyond the bulkhead shall be removed. Concrete placement will recommence only with the approval of owner or owner's representative. Unless otherwise specified, the concrete shall be placed as a monolithic unit in a continuous operation between joints. A minimum rate of placement of 27m³/hr shall be maintained at each finishing machine.

D. Consolidation:

1. The concrete shall be consolidated by means of approved high frequency internal vibrators (9000 – 13500 vibrations per minute in concrete) that shall be applied in a manner to secure maximum consolidation of the concrete and by means of surface vibration from the vibrating pan(s) of the finishing machine. Consolidation shall leave the concrete free from voids and insure a dense surface texture, but not be continued so long as to cause segregation or bleeding. A small uniform quantity of concrete shall be maintained ahead of the screed on each pass. At no time shall the quantity of concrete carried ahead of the screed be so great as to cause slipping or lifting.
2. In the case where the vibratory action of the finishing machine does not provide consolidation in accordance with the rate of placement, the Contractor shall have in reserve at all times sufficient vibration equipment to guard against shutdown of the work. The Contractor shall take preventive measures to insure that the epoxy coated reinforcement is not susceptible to damage by the vibrators.

E. Finishing:

1. General:

- a. Methods, procedures, and equipment shall be used which will insure a uniform riding surface without over-vibration or segregation of the components of the concrete. Regardless of the type of equipment used, freshly placed concrete should be distributed uniformly ahead of the strike-off and finishing operation, and as close to the final position as practicable. The finishing operations operation can be accomplished with either manual or mechanical equipment. If manual strike-off methods are used, they should be accomplished with a steel or steel-shod wooden screed. Manual floating methods, along the longitudinal direction, using plow-handled floats and long-handled "bull floats", from working platforms spanning the deck transversely, are acceptable. Sprinkling the struck surface of the deck to facilitate floating will not be permitted.

2. Manual Methods:

- a. Additional concrete shall be added to honeycombed and low spots, and the concrete struck off again. Proper finishing requires the skills of an experienced pavement finisher. These areas shall not be eliminated by tamping or grouting. The surface of the finished concrete after floating is to be checked with a 3 m straightedge placed parallel to the roadway centerline and at several positions from one edge of the deck to the other before moving to the next location. Successive locations should not exceed one-half the length of the straightedge. Any depressions found shall immediately be filled with fresh concrete, revibrated, struck-off and refinished. Any areas not corrected in this manner may have to be corrected by grinding and will then lose the desired surface texture.

3. Mechanical Methods:

- a. Mechanical methods may also be used to provide the finished surface. When using a finishing machine, its weight shall not cause unaccounted deflection of the bridge members or falsework. The machine shall travel on steel rails, pipe or other approved grade control, which shall be supported by vertical supports securely fastened in place at a maximum spacing of 200 mm to prevent any appreciable deflection between rail supports. Screed rail supports may be located inside or outside of the placement width. Prior to placing the concrete, screed rails shall be completely in place, and accurately set to insure finishing of the concrete deck surface to the elevations shown on the Drawings.
- b. The supports for the rails, if embedded in the deck concrete, shall be of the type that can be removed without disturbing the concrete. Screed rails shall be set entirely above the finished surface of the concrete and shall be supported in a manner approved by owner or owner's representative. Where stud type shear connectors are available, welding to the studs will be permitted. Where no studs are available, other means of attaching the screed rail supports shall be provided. No welding will be permitted directly on stringer or girder flanges or cover plates in tension areas, nor in areas subject to stress reversal, for attaching either screed rail supports of any type. Any welding in compression areas shall be approved by owner or owner's representative.
- c. Screed rail supports set in the concrete shall be so designed that they may be removed to at least 50 mm below the surface of the concrete. Voids created by removal of the upper part of the screed rail supports shall be filled with mortar having the same proportions of sand and cement as that of the slab or wearing surface. The mortar shall contain an approved additive in sufficient proportions to produce non-shrink or slightly expansive characteristics. Screed rail supports shall not be treated with parting compound to facilitate their removal. Rails for finishing machines shall extend beyond both ends of the scheduled length for concrete placement. The extended length shall be of sufficient distance to allow finishing machine(s) to clear the concrete to be placed.

4. Finishing Machine:

- a. For concrete deck placements specified to be less than or equal to 4.5 m in width, or less than or equal to 15 m in total bridge length, the finishing machine shall be a lightweight vibrating screed with the following features:
 - 1) It shall be portable and easily moved, relocated, or adjusted by no more than four workers.
 - 2) The power unit shall be operable without disturbing the screeded concrete.
 - 3) It shall be self-propelled with controls, that will allow a uniform rate of travel and by which the rate of travel can be increased, decreased, or stopped
 - 4) It shall have controlled, uniform, variable frequency vibration, from end to end.
 - 5) It shall be fully adjustable for flats, crowns, or valleys.
 - 6) The screed length shall be adjustable to accommodate the available work area.
- b. The finishing machine shall be operated over the full length of the bridge segment to be finished prior to beginning of concrete placement operations. The test run of the self-propelled finishing machine shall be performed in the presence of owner or owner's representative at least 24 hours in advance of the concrete placement with the screed adjusted to its finishing position. During

the test run, checks shall be made of the deflection due to the finishing machine, adjustment of guide rails and required covers for slab reinforcement. The required concrete cover over the top bars shall be checked by riding the screed over the bars and measuring the cover over the slab reinforcement. Discrepancies so found, which are in excess of the tolerances shall be rectified to secure the required concrete cover. All necessary corrections shall be made before concrete placement is begun.

- c. The rate of concrete placement shall be coordinated with the initial strike-off so that the initial strike-off is never more than 3m behind the concrete placement. Sufficient depth checks shall be made behind the machine(s) and along the full length of the span to insure achievement of the required section and reinforcement cover. Improper adjustment or operation of the finishing machine(s) that results in inadequate reinforcement cover or smoothness shall be corrected immediately. Unsatisfactory performance, particularly with respect to the surface smoothness attained, shall be cause for rejection of the equipment and cement concrete placed.

5. Work Bridges:

- a. Work bridges supported on the screed rails shall be provided by the Contractor in order to permit access to the surface of the deck for the purpose of finishing, straight-edging, making corrections, and setting curing materials. The Contractor shall furnish a minimum of two work bridges behind the bridge deck finishing machine, capable of spanning the entire width of the deck and supporting at least a 225 kg load without deflection to the concrete surface. These working bridges shall be available to owner or owner's representative for inspection purposes. Workmen will not be permitted to walk in the fresh concrete after it has been screeded. All finishing work, including application of the fog spray and placement of curing mats, shall be performed from bridges supported above the deck surface.

6. Tolerances:

- a. Verification that the completed surface of the deck has been constructed in accordance with the grades and cross slopes show on the Drawings shall be made immediately after finishing and again after the deck has been cured. The Contractor shall check the surface of the concrete with a 3 m long metal straightedge operated parallel and perpendicular to the centerline of the bridge.
- b. Deck surfaces shall show no deviation in excess of 6 mm from the testing edge of the straightedge. The checking operation shall progress by overlapping the straightedge at least one half of the length of the preceding straightedge pass. Any area that requires finishing to correct surface irregularities shall be re-textured which may be performed with a hand-operated texture mat wrapped in a roll or attached to a round or curved shaped base. In the event that the tolerance is not met when tested after the concrete has hardened, variance in excess of 6 millimeters in 3 meters shall be marked and corrected at the Contractor's expense in a manner satisfactory to owner or owner's representative. The Contractor shall correct out of tolerance hardened concrete surface irregularities by the use of concrete planing or grinding equipment that does not damage the remaining concrete or violate minimum cover requirements on steel reinforcement. The straightedges shall be furnished and maintained by the Contractor. They shall be fitted with a handle and all parts shall be made of aluminum or other lightweight metal. Straightedges shall be made available for use by owner or owner's representative.

F. Curing:

1. All concrete bridge decks shall be kept wet with clean fresh water for a curing period of at least 14 days after placing of concrete. Curing shall begin by fog spraying during the placing and finishing operations. Fogging shall continue and shall be applied continuously, rather than intermittently, after the finishing operation until wet covering material has been placed over the concrete surface. Deck finishing machine mounted fogging systems shall be augmented by hand-held fogging equipment as needed.
2. All bridge decks, sidewalks, and barriers shall be water cured only and shall be kept continuously wet for the entire curing period by covering with one of the following systems:
 - a. Two layers of wet burlap.
 - b. One layer of wet burlap and either a polyethylene sheet or a polyethylene coated burlap blanket. Curing protection shall be applied within 15 minutes after the concrete is deposited and before the surface of the concrete has lost its surface "wetness" or "sheen" appearance. The burlap shall be completely saturated over its entire area by being submerged in water for at least 8 hours before the scheduled start of the placement. The burlap shall be drained of excess water prior to application. The burlap shall be free from cuts, tears, uneven weaving and contaminants. The burlap shall be placed such that the edges are lapped a minimum of 150 mm. Continuous burlap wetting shall commence 10 minutes from the time it is placed and shall be kept continuously wet and protected from displacement for the entire curing period in a manner acceptable to owner or owner's representative.
3. The covering of bridge decks, sidewalks, and barriers shall be kept continuously wet for the entire curing period by the use of soaker hoses. The soaker hoses shall circulate water continuously and shall be located to insure a completely wet surface for the entire curing period.
4. The Contractor shall make sure that adequate personnel are available at the site to carry out the placement, screeding, finishing, fogging and curing operations simultaneously. To overcome shrinkage problems, the use of wind screens and sun shades shall be used as conditions require.
5. The application of impervious liquid membrane curing compounds shall not be considered a substitute for achieving the curing of the concrete required by these Specifications. Only in the event of an unavoidable delay during concrete placement shall two coats of an approved curing compound be sprayed on to the concrete that has been deposited and not screeded.
6. Curing compounds shall not be applied to the screeded surfaces of bridge decks. The Contractor shall limit the maximum concrete temperature to 20 deg C, and control the temperature of the concrete to ensure that it does not fall below 14 deg C. Heat control shall be accomplished through a combination of proper cement concrete ingredient selection to minimize heat generated, pre-placement cement concrete ingredient cooling, post-placement cooling, cement concrete placement rate control, cement concrete surface insulation to minimize heat loss, and providing supplemental heat to prevent heat loss.
7. The Contractor shall measure and record concrete and ambient air temperatures on an hourly basis for at least the first 72 hours after placement or longer during hot or cold weather conditions. In accordance with the Placement and Curing Plan. The Contractor shall furnish temperature log records of the temperatures that are recorded at a maximum frequency of once per hour. Temperature data shall be furnished to owner or owner's representative as required, with a minimum frequency of once per day.

G. Cold Weather Requirements:

1. Cold weather is defined as any time during the concrete placement or curing period the ambient temperature at the work site drops below 5 deg C or the ambient temperature at the site drops below 10 deg C for a period of 12 hours or more. When cold weather is reasonably expected or has occurred within 7 days of anticipated concrete placement, the Contractor shall conform to the cold weather requirement of the Placement and Curing Plan. All material and equipment required for cold weather placement and curing protection shall be available at the project site before commencing concrete placement. All snow, ice, and frost shall be removed from the surfaces, including reinforcement, against which the concrete is to be placed. The temperature of any surface that will come into contact with fresh concrete shall be at least 2 deg C and shall be maintained at a temperature of 2 deg C or above during the placement of concrete.
2. During the curing period, the Contractor shall provide suitable measures to maintain the concrete surface temperature between 14 deg C and 30 deg C which shall be monitored by continuously recording surface temperature measuring devices that are accurate within 1 deg C. At least one temperature measuring device shall be randomly placed in an accessible location for every 140 square meters of concrete deck surface area being cured.
3. The minimum concrete surface temperature requirement shall be continuously maintained for the entire 14 day wet curing period. Any day during which the minimum concrete surface temperature requirement of 14 deg C is not continuously maintained shall not count as a day contributing to the curing period.
4. If the concrete surface temperature falls below 7 deg C during the curing period, the structure shall be enclosed and external heat shall be provided as directed by owner or owner's representative. If external heat is required, the following shall apply:
 - a. The time required for tenting shall not be counted as curing time.
 - b. External heat shall be maintained on and below the structure for the entire curing period and then reduced gradually such that the uniform change in temperature does not exceed 3 deg C in one hour or 10 deg C in any 24 hour period. If at any time during the curing period the concrete surface temperature falls below 2 deg C, the concrete will be inspected by owner or owner's representative for possible damage due to exposure to freezing temperatures. Concrete determined by owner or owner's representative to be damaged due to exposure to freezing temperatures will be considered as being unsatisfactory and rejected.
5. Adequate precautions shall be taken to protect the concrete deck from any damages resulting from severe weather conditions during the curing process.

H. Surface Texturing:

1. Unless otherwise shown on the Drawings, the final finish required shall be as follows:
 - a. Bridge decks shall receive an artificial turf drag finish and shall be grooved using multi-bladed self-propelled saw cutting equipment. Transverse grooves shall be saw cut no sooner than completion of the 14 day wet curing operation provided that the concrete has reached a compressive strength of 23 MPa. The grooves shall be rectangular in shape, 3 mm wide (plus 1.5 mm, minus 0 mm) and 5 mm deep (plus or minus 1.5 mm). The grooves shall be cut at a variable spacing measured from the centerline of grooves as follows: 19, 29, 16, 25, 16, 29, and 19 mm in 150 millimeter repetitions across the width to be grooved in one pass of the mechanical saw device. One 150 mm sequence may be adjusted

by one-quarter sequence increments to accommodate various cutting head widths provided the general pattern is carried out. The tolerance for the spacing of the grooves is plus or minus 1.5 mm.

- b. The groove saw cutting equipment shall have a depth control device that will detect variations in the surface profile and adjust the cutting head height to maintain the depth of groove specified. The groove saw cutting equipment shall be provided with devices to control the alignment. Flailing type grooving that is uncontrolled and erratic will not be permitted. Grooves shall be cut continuously across the roadway, perpendicular to the centerline of the roadway, and shall stop 305 mm from the curb line. Grooves shall be continuous across construction joints. No un-grooved deck surface greater than 150 mm in width shall remain. A minimum clearance of 25 mm shall exist between the first groove and the end of deck or edge of metal bridge deck expansion joint. No overlapping or repeating of grooving in the same location by the grooving machine will be permitted. The pattern of grooving will be discussed and agreed upon with owner or owner's representative before grooving begins. Debris and residue from the grooving operation shall be continuously removed and properly and legally disposed of off-site. Residue from grooving operations shall not be permitted to flow into gutters or drainage facilities. The surface of exposed concrete decks shall be left in a washed clean condition that is free from all slipperiness from the saw cutting slurry. A 305 mm wide margin shall be finished adjacent to curbs with a magnesium float.

I. Sidewalks on Bridges:

1. After being placed, the horizontal concrete surfaces shall be properly screeded and finished to true grade and surface. The finish shall be with an approved float, followed by light brushing with a fine brush but without the addition of any water to remove the cement film, leaving a fine grained, smooth but sanded texture. The surfaces shall then be cured as specified.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Weep Holes and Drains:

1. Weep holes shall be provided through all structures as indicated on the Drawings. Ends of weep holes that are to be covered by backfill shall be protected as shown on the Drawings and as follows:
 - a. Crushed stone shall conform to crushed stone No. 2 as specified in Division 31 Section "Earth Moving".
 - b. Geotextile fabric shall conform to soil stabilization fabric (woven geotextile) as specified in Division 31 Section "Riprap".
 - c. Geotextile fabric shall be installed as shown on the Drawings and in accordance with the manufacturer's instructions.
2. Drains shall be provided for bridge superstructures as indicated on the Drawings.

B. Protection of Pipes and Conduits:

1. The Contractor shall care for and protect from injury all pipes, wires and conduits encountered in the work by furnishing and maintaining suitable supports, including steel bars, on the bridge during construction. The Contractor shall provide suitable

openings in the abutments, walls, piers, and superstructures as shown on the Drawings. If required, the opening shall be filled with concrete in a satisfactory manner.

3.14 CONCRETE PROTECTION AND CURING

A. Curing:

1. All concrete shall be kept fully saturated and protected against any drying action by methods of curing specified herein or as otherwise approved by owner or owner's representative in the Curing Plan for Hot and Cold Weather Concrete in the Placement Plan, and in the Placement and Curing Plan for not less than 7 days after placing cement concrete. All surfaces of concrete which are to receive a rubbed surface finish or on which bituminous dampproofing is to be placed], and concrete at construction joints shall be cured in accordance with requirements below for water curing. All other concrete may be cured in accordance with requirements below for water curing or waterproof membrane curing.

B. Mass Concrete:

1. Concrete placements where all volumetric dimensions of the placement are 1.2 m or greater shall be considered mass cement concrete. Mass concrete shall also include concrete placements of other dimensions where measures must be taken to mitigate potential cracking caused by heat of hydration when such placements are specifically designated as mass cement on the Drawings. The Contractor shall perform the following to prevent cracking in mass concrete placements:
 - a. Limit the temperature differential between the internal (hottest) and external (coolest) temperature of the cement concrete to 21 deg C and limit the maximum concrete temperature to 20 deg C. Heat control shall be accomplished through a combination of proper cement concrete ingredient selection to minimize heat generated, pre-placement cement concrete ingredient cooling, post-placement cooling, cement concrete placement rate control, concrete surface insulation to minimize heat loss, and providing supplemental heat to prevent heat loss.
 - b. Measure and record concrete and ambient air temperatures on an hourly basis. Temperature data shall be furnished to owner or owner's representative as required, with a minimum frequency of once per day.

C. Water Curing:

1. Curing of concrete shall begin by fog spraying immediately upon the disappearance of free bleed water on concrete surfaces not protected by forms. Fog spraying shall continue until the burlap cover has been placed. The amount of fog spray shall be strictly controlled, so that accumulations of standing or flowing water on the surface of concrete shall not occur.
2. Should atmospheric conditions render the use of fog spray impractical, the Contractor shall use plastic covers of suitable weight and securely weighed down, but not directly in contact with the concrete. The covers shall be used only until the initial set has taken place. The burlap covers shall be placed immediately thereafter. On the windward side of the panel being cured, the Contractor shall erect canvas barriers of suitable height when necessary to protect the curing concrete from the direct force of the wind.

3. The area of concrete to be cured shall be covered by wet burlap blankets placed as soon after concrete finishing as owner or owner's representative determines will not cause damage to the concrete surface. However, in no case will the foregoing time period exceed 1 hour after placing of concrete. Fog spray or covers shall be used continuously during this period. The burlap shall be completely saturated over its entire area by being submerged in water for at least 8 hours before the scheduled start of the placement. The burlap shall be drained of excess water prior to application. The burlap shall be free from cuts, tears, uneven weaving and contaminants. The burlap shall be placed such that the edges are lapped a minimum of 150 mm. Burlap shall be kept continuously wet and protected from displacement for the entire curing period in a manner acceptable to owner or owner's representative.
4. The coverings shall be kept thoroughly wet by sprinkling with a fine spray of water until they may be removed. Wooden forms without liners, if left in place longer than 2 days after the placing of the concrete, shall be thoroughly wet down at least once each day for the remainder of the required curing period. Formed surfaces shall, after the removal of forms, be cured in like manner for the remainder of the required period, the entire surface of the concrete being thoroughly drenched with water and covered immediately after the forms are removed. Portions of the covering material may be removed temporarily when and as necessitated by any required finishing or waterproofing operation.

D. Impervious Liquid Membrane Curing:

1. Immediately after the free bleed water has disappeared on surfaces not protected by forms and immediately after the removal of forms, if such are removed before the end of the required curing period, the concrete shall be sealed by spraying as a fine mist a uniform application of the membrane curing material in a manner as to provide a continuous uniform, water impermeable film without marring or otherwise damaging the concrete.
2. The membrane curing shall be applied in one or more separate coats at the rate recommended by the manufacturer. If, in owner's or owner's representative's judgment, discontinuities or pinholes exist or if rain falls on the newly coated surface before the film has dried sufficiently to resist damage, an additional coat of the material shall be applied immediately to those affected areas at the specified rate. If a slight delay in application shall occur, which permits the concrete surface to dry, the surface of the concrete shall be thoroughly moistened with water, immediately prior to the application of the membrane curing material. Application of membrane curing may be delayed for 12 hours if the concrete surface is protected and kept moist by the use of wetted burlap.
3. The membrane compound shall be thoroughly agitated immediately before application. The liquid shall be applied under pressure by means of an approved pressure spray which shall be held not more than 600 mm away from the concrete surface and the spray protected from any wind by suitable means as may be necessary, so as to apply the material directly onto the concrete surface.
4. The sprayed surface film shall be protected from abrasion or damage for the duration of the required curing period. The placing of materials or unnecessary walking on the surface will not be allowed until the film is at least 2 days old; and then only if no damage is caused to the surface film during the required curing time.

E. Curing by Other Methods

1. Other methods of curing may be used only when approved in writing by owner or owner's representative prior to any use in the work.

3.15 CONCRETE SEALER

- A. Concrete sealer shall be applied to cement concrete. Clear concrete sealers, after complete application, shall not stain or discolor the concrete. Application of the sealer shall not alter the surface texture and shall be compatible with the use of surface finish coatings and/or caulking. The surface shall dry to a tack free condition. Application of the sealer shall be in accordance with the manufacturer's recommendations, including condition and preparation of surfaces to be treated and safety precautions.
- B. The preparation process shall not cause any damage to the concrete surface, remove or alter the existing surface finish, or expose the coarse aggregate of the concrete. owner or owner's representative shall approve the prepared surface prior to application of the sealer. The Contractor shall prevent the sealer from coming in contact with any joint sealers.

3.16 CRACK AND JOINT SEALING

- A. Cement Concrete crack sealing requirements defined herein are for the repair and sealing of cast-in-place cement concrete to prevent water infiltration to the steel reinforcement bars, as noted on the Drawings or as directed by owner or owner's representative. Concrete cracks shall be sealed in accordance with the sealant manufacturer's requirements. The Contractor shall be required to seal cracks even if the environmental conditions during placement and curing satisfied specification requirements.
- B. Crack sealing materials shall be applied by skilled applicators under a supervisor with proven successful experience in applications with similar scope of work. Crack sealing materials shall be applied when the concrete and the ambient air temperatures are above 4 deg C. If a heated enclosure is used to accomplish this, the heating units shall be properly vented to the outside of the enclosure to prevent products of combustion from exhausting within the enclosure.
- C. Before containers of sealing materials are opened, the labels shall be checked and the label information shall be documented. If multi-component systems are used, mixing shall be completed prior to application. Manufacturer's instructions shall be followed. An initial crack sealing application demonstration shall be satisfactorily made in the presence of owner or owner's representative before the application is continued.
- D. Before sealing, the concrete shall be clean, sound, and free of contaminants and surface moisture. Any curing compounds, sealers, oils, greases, coatings, or other impregnations shall be removed by sandblasting. Once any concrete surface contaminants are removed, the concrete shall be swept clean and blown off using oil free compressed air immediately prior to applying the sealer.
- E. Methacrylate crack sealing shall be performed in accordance with the manufacturer's instructions within the allowable ambient temperature range. The cracks shall be v-notched to a minimum depth of 12 mm and shall be cleaned with compressed air. The notch shall then be inspected to confirm that the crack was intercepted. If the crack was not intercepted, the notch shall be expanded to intercept the crack and shall then be re-cleaned with compressed air. Methacrylate shall then be poured into the crack. The crack shall then be observed for seepage of methacrylate and shall be refilled as necessary to ensure the crack is completely filled. If large quantities of methacrylate are used and the crack is not getting filled, the crack should be filled with pre-bagged dried silica sand filler and the crack shall then be re-filled with methacrylate.

- F. Epoxy injection crack sealing shall be performed in accordance with the manufacturer's instructions within the allowable ambient temperature range. The cracks shall be cleaned with compressed air. Surface mounted injection ports shall then be installed over the centers of the cracks. The spacing of these ports shall be contingent upon the material and the injection equipment chosen. Socket porting shall be allowed provided that a hollow drill bit and vacuum system is used to prevent debris from entering the cracks. Surface ports shall be mounted with rapid setting epoxy material. The crack widths shall be noted during port installation. After the ports are installed, the crack surfaces shall be sealed with high modulus, 100 percent solids, moisture tolerant epoxy paste adhesive. This material shall be capped with fine sand before it is cured. After the capping material has cured, the cracks shall be injected with an epoxy resin compound. The injection pressure used to seal the cracks shall be based upon a number of factors including crack width, crack depth, and the epoxy material used. Injection shall be accomplished using a metered system. The system shall be equipped with a pressure gauge accurate for the pressures anticipated for this work. Injection shall start at the widest point of the crack and shall continue until the narrowest portions of the crack have been filled. Injection shall continue until refusal. If epoxy is observed at adjacent ports, the adjacent port shall be capped and injection shall continue until refusal occurs. Once refusal occurs, injection shall continue at the next wet port until refusal is reached.
- G. The type of Cement Concrete crack sealing required shall be determined as a function of the surface type and maximum crack width as follows:
1. Bridge decks and other non-overhead surfaces sloped less than or equal to 15 percent:
 - a. Cracks less than 0.15 mm wide shall be ignored.
 - b. Cracks greater than or equal to 0.15 mm wide and less than 0.30 mm wide shall be sealed with an approved methacrylate.
 - c. Cracks greater than or equal to 0.30 mm wide shall be sealed using either epoxy injection or methacrylate with a sand filler.
 2. Overhead surfaces, vertical surfaces, and non-overhead surfaces sloped greater than 15 percent:
 - a. Cracks less than 0.15 mm wide shall be ignored.
 - b. Cracks greater than or equal to 0.15 mm wide and less than 0.41 mm wide shall be sealed with an approved silane sealer.
 - c. Cracks greater than or equal to 0.41 mm wide shall be sealed using epoxy injection.

3.17 BRIDGE JOINTS

A. Construction Joints:

1. Construction joints not shown on the Drawings will not be permitted except in case of emergency, when approved by owner or owner's representative. Concrete in structures shall be placed in such a manner that all construction joints shall be exactly horizontal or vertical, as the case may be, and that they shall be straight and as inconspicuous as possible. All concrete placed between construction joints, shall be placed in a continuous operation. In order to allow for initial shrinkage, concrete shall not be placed against the second side of the construction joint for at least 3 days after that on the first side has been placed.
2. When making a horizontal construction joint, care shall be taken to have the concrete below the joint as dry as possible and any excess water or creamy material shall be

removed before the concrete sets. Within 12 hours after the concrete below the joint has been placed, the top surface shall be thoroughly cleaned by the use of pressurized water blast and wire brushes and all laitance and loose material removed so as to expose clean, solid concrete. Care shall be taken not to loosen any of the coarse aggregate in the concrete. If for any reason this laitance is not removed before the concrete has hardened in place, it shall be removed using such tools and methods as may be necessary to secure the results specified above.

3. Immediately before placing concrete above the joint, the surface of the concrete below the joint that has been cleaned as specified above shall be thoroughly pre-wetted for a minimum duration of 12 hours. On all exposed surfaces, the line of the proposed joint shall be made truly straight by tacking a temporary horizontal straight edge on the inside of the form with its lower edge on the line of the joint and then placing the concrete sufficiently higher than this edge to allow for settlement. Immediately before placing the new concrete, the forms shall be drawn tightly against the concrete already in place. In construction joints, approved waterstops of plastic material shall be placed not less than 75 mm from the face of concrete and shall extend a minimum of 65 mm into the concrete unless otherwise shown on Drawings. Prior to the use of plastic waterstops, the manufacturer's installation instructions shall be furnished to owner or owner's representative.

3.18 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by owner or owner's representative. Remove and replace concrete that cannot be repaired and patched to owner's or owner's representative's approval.
- B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 13 mm in any dimension to solid concrete. Limit cut depth to 19 mm. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with repair mortar before bonding agent has dried. Fill form-tie voids with repair mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, repair mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by owner or owner's representative.

3.19 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner or owner's representative will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports, except where noted.
 1. The Contractor shall provide safe and convenient access to all areas of the Work that are reasonably required by testing and inspecting agency in the performance of their work.

2. Contractor to supply all batch tickets to owner's or owner's representative's testing agency. Batch tickets to note w/c ratio and amount of water allowed to be added at Project site.
 3. Inspections:
 - a. Steel reinforcement placement.
- B. Concrete Tests: Testing of composite samples of fresh concrete shall be performed according to the following requirements:
1. Procedures for obtaining representative samples of fresh concrete for testing shall be in accordance with the following, as a minimum:
 - a. Elapsed time shall be 15 minutes, maximum, between obtaining first and last composite samples. Sample size shall be approximately 28 L. Ensure that enough concrete is taken for the sample so that all of the tests required can be performed.
 - b. Move samples to testing location. Samples shall be combined and remixed with a shovel to provide uniformity and consistency. Do not over remixed samples when combining into one sample.
 - c. Tests for slump, temperature and air content shall be started within 5 minutes of obtaining the last composite sample. Complete these tests within 10 minutes of starting tests.
 - d. Cylinders for compressive strength tests shall be made immediately upon completion of the other tests.
 - e. Do not reuse the same concrete for different tests.
 - 1) Testing Frequency: Obtain at least one composite sample for each 76 cu. m or fraction thereof of each concrete mixture placed each day, nor less than once per each 465 square meters of surface area of walls or slabs.
 2. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - a. Include corresponding concrete mix batch tickets and design mix with each test report.
 - b. Indicate amount of water added to batch at Project site.
 - c. Slump: Perform a slump test in accordance with ASTM C 143/C 143M; "Slump of Hydraulic Cement Concrete" or equivalent industry standard, one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change. Measure after slump adjustment.
 - d. Air Content: Perform an air content test in accordance with ASTM C 231, "Air Content of Freshly Mixed Concrete by the Pressure Method" or equivalent industry standard pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - e. Concrete Temperature: Determine concrete temperature in accordance with ASTM C 1064/C 1064M, "Temperature of Freshly Mixed Hydraulic Cement Concrete" or equivalent industry standard; one test hourly when air temperature is 4.4 deg C and below and when 27 deg C and above, and one test for each composite sample.

- f. Density (Unit Weight): Perform a unit weight test in accordance with ASTM C 138/C 138M, “Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete” or equivalent industry standard, fresh unit weight of concrete. Two tests per 7 cubic meters batch or less, one at beginning of pour and one near end of pour.
 - g. Unit Weight: Perform a unit weight test in accordance with ASTM C 567, “Determining Density of Structural Lightweight Concrete” or equivalent industry standard, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - h. Compression Test Specimens: Make and cure compression test specimens in accordance with ASTM C 31/C 31M, “Making and Curing Concrete Test Specimens in the Field” or equivalent industry standard.
3. Cast and standard cure six cylinders for each composite sample.
 - a. Standard curing:
 - 1) Storage: Place cylinders on a firm level surface. Surface slope shall be no greater than 20 mm per meter. Protect cylinders from damage.
 - 2) Initial Curing: For first 48 hours, store cylinders at a temperature range of 16 deg C to 27 deg C. Prevent cylinder moisture loss. When cardboard molds are used, protect the cardboard molds from contact with wet items.
 - 3) Final curing: After 48 hours, remove the molds. Within 30 minutes of mold removal, immerse concrete cylinders in 21 deg C to 25 deg C water.
 4. Cast and field cure two standard cylinders for each composite sample.
 - a. Field curing:
 - 1) Storage: Place cylinders on a firm level surface. Surface slope shall be no greater than 20 mm per meter. Protect cylinders from damage.
 - 2) Curing: Place the cylinders near the pour from which the sample was taken and used to make the cylinders. Cure the cylinders within the curing envelope of the pour so that the cylinders receive the same curing environment as the concrete they represent.
 - 3) Compressive Strength Tests: Perform compressive strength tests in accordance with ASTM C 39/C 39M, or equivalent industry standard. The test method requires the application of a compressive axial load to molded cylinders at a predetermined rate until failure of the cylinder. The compressive strength of the cylinder is determined by dividing the load at the time of failure by the cross sectional area of the cylinder.
 5. Test two standard cured cylinders at 7 days, three cylinders at 28 days, and retain one cylinder for testing at 56 days as deemed necessary by owner or owner's representative.
 6. Test two field cured cylinders at 28 days.
 7. A compressive strength test shall be the average compressive strength from a set of two cylinders obtained from same composite sample and tested at age indicated.
 8. If one cylinder in the test shows evidence of improper sampling, molding or testing, discard the cylinder and consider the strength of the remaining cylinders to be the test result. If more than one cylinder in a test shows any defects, discard the entire test.

- a. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 - b. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive strength tests equals or exceeds specified compressive strength and no compressive strength test value falls below specified compressive strength by more than 3.4 MPa.
 - c. Test results shall be reported in writing to owner or owner's representative and Contractor within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 - d. Nondestructive Testing: Impact-echo, ultrasonic methods, or other nondestructive methods may be permitted by owner or owner's representative but will not be used as sole basis for approval or rejection of concrete.
 - e. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by owner or owner's representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M, "Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" or equivalent industry standard, or by other methods as directed by owner or owner's representative.
 - f. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. The Contractor shall correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents, at no additional cost to owner or owner's representative.

END OF SECTION 03 30 00

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cutback asphalt bituminous dampproofing applied to the back faces of the abutments, top of approach slabs and outer surfaces of the culvert.

1.3 REQUIRED SUBMITTALS

- A. Provide the following submittals:
 - 1. Product Data:
 - a. Cutback asphalt dampproofing.

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit bituminous dampproofing to be performed according to manufacturers' written instructions.
- B. Concrete surfaces shall be allowed to dry for a period of at least 5 days, after removal of forms, before applying bituminous dampproofing.
- C. Sand mortar patches shall be allowed to dry a minimum of 2 days before applying bituminous dampproofing.
- D. Dampproofing shall not be done during wet weather, nor when application temperature is outside the manufacturer's recommended application temperature range.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain bituminous dampproofing materials from single source and from single manufacturer. Provide auxiliary materials, including primer if required, recommended in writing by manufacturer of bituminous dampproofing materials.

2.2 BITUMINOUS DAMPPROOFING

- A. Bituminous dampproofing material shall be rapid curing type or medium curing type conforming to the following:
1. Cutback Asphalt Rapid Curing Type: Homogeneous blend of asphalt cements and suitable solvents free from water and conforming to the requirements of AASHTO M 81, "Cutback Asphalt (Rapid-Curing Type), or equivalent industry standard.
 2. Cutback Asphalt Medium Curing Type: Homogeneous blend of asphalt cements and suitable solvents free from water and conforming to the requirements of AASHTO M 82, "Cutback Asphalt (Medium-Curing Type), or equivalent industry standard.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Sand Mortar Patching Mix: Sand mortar patching mix shall consist of 1 part cement to 2 parts sand. Mix with water to produce a consistency suitable for application.
1. Cement shall be of the same type as used in the structure to which sand mortar patching mix is applied.
 2. Sand shall be clean and contain no unsuitable material and shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
4.75 mm	100
2.36 mm	95 to 100
1.18 mm	70 to 100
600 um	40 to 75
300 um	10 to 35
150 um	2 to 15
75 um	0 to 5

3. Water: Potable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
- B. Proceed with application only after structure construction work has been completed and unsatisfactory conditions have been corrected.
- C. Beginning installation constitutes Contractor's acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with bituminous dampproofing. Prevent bituminous dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the bituminous dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by the bituminous dampproofing manufacturer.
- C. Apply sand mortar patching mix to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for bituminous dampproofing application, cure time between coats, and drying time before backfilling.
 - 1. Apply bituminous dampproofing to provide continuous plane of protection.
- B. Concrete surface preparation shall be in accordance with bituminous dampproofing manufacturer's instructions and as specified.
- C. Surfaces to be bituminous dampproofed shall be made reasonably smooth and free from all projections and holes. All holes in concrete surfaces shall be filled with sand mortar patching mix before bituminous dampproofing is applied and allowed to dry.
- D. Surfaces to receive bituminous dampproofing shall be dry and immediately before the application of the bituminous dampproofing shall be cleaned of dust and all loose material.
- E. The bituminous dampproofing shall be mopped or sprayed in accordance with the manufacturer's instructions on the designated surfaces shown on the Drawings, and in amounts necessary to obtain a two coat coverage of not less than 2 liters of bituminous dampproofing material per 10 square meters of surface.
- F. The initial coat of bituminous dampproofing material shall be allowed to dry thoroughly before the second coat is applied.
- G. The final coat shall be thoroughly dry before backfill is placed against it

3.4 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction and in accordance with bituminous dampproofing manufacturer's instructions.

END OF SECTION 07 11 13

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SECTION 07 95 63 – ELASTOMERIC BRIDGE BEARINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Furnishing and installing elastomeric bridge bearing pads and associated plates and anchors.

1.3 REQUIRED SUBMITTALS

- A. Provide the following submittals:

1. Shop Drawings:

- a. Elastomeric bridge bearing pads.

2. Product Data:

- a. Elastomeric bridge bearing pads.
- b. Steel plates.
- c. Anchor bolts, nuts and washers.
- d. Base plate threaded studs, nuts and washers.

3. Other Submittals:

- a. Written Notification: Written notification shall be provided as required in “Quality Assurance” Article.
- b. Certificates: Certificate from manufacturer stating that elastomeric bridge bearing pads, as furnished for this Project, conform to AASHTO M 251, “Plain and Laminated Elastomeric Bridge Bearings”, or equivalent industry standard.

- 1) Submit a minimum of 30 days before scheduled date of beam erection.

- c. Shop Test Report: Submit copy of shop test results of testing as required by AASHTO M 251, “Plain and Laminated Elastomeric Bridge Bearings” or equivalent industry standard.

- 1) Submit a minimum of 30 days before scheduled date of beam erection.

1.4 QUALITY ASSURANCE

- A. The Contractor shall provide owner or owner’s representative with written notification 30 days prior to the start of bearing production. The notification shall include the contract

number, quantity, type, and size of bearing being produced, manufacturer's name, and the representative who will coordinate production, inspection, sampling, and testing with owner or owner's representative.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle elastomeric bridge bearing pads to prevent bending and damage.

1.6 SCHEDULING

- A. At least 30 days prior to the scheduled date of beam erection, the Contractor shall deliver to the Project site all elastomeric bridge bearing pads shown on the Drawings.

PART 2 - PRODUCTS

2.1 ELASTOMERIC BRIDGE BEARING PADS

- A. Elastomeric bearing pads shall consist of laminated bearings (consisting of layers of elastomers restrained at their interfaces by bonded metal laminates). The elastomeric compound shall be composed of 100 percent low temperature Grade 3 (low temperature of minus 34.4 deg C), virgin crystallization resistant polychloroprene (neoprene) meeting the requirements of AASHTO M 251, "Plain and Laminated Elastomeric Bridge Bearings", and Division II, Section 18, "Bearings" of the AASHTO Standard Specifications for Highway Bridges, or equivalent industry standards. The type of bearing, hardness, dimensions, design compressive load, design compressive stress, and whether the bearings are subject to shear deformation shall be as shown on the Drawings.
- B. All components of the elastomeric bearing pad shall be molded together as an integral unit and all surfaces of the steel laminations shall be covered with a minimum of 5 mm (3/16 inch) of elastomer.
- C. The finished pads shall be free of cuts, blemishes, and molding defects. All imperfections or exposed laminations that result in either less than 5 mm (3/16 inch) of elastomer cover over any surface of the steel laminations shall be repaired by the manufacturer at the point of manufacture.
 - 1. The repair shall consist of sealing the imperfections flush on the finished pad with a bonded vulcanized patch material compatible with the elastomeric bearing pad. Repairs employing caulking type materials or repairing the bearings in the field shall not be permitted.
- D. All bearings that are delivered to the job site with exposed steel laminations will be rejected.

2.2 STEEL PLATES

- A. Steel plates shall conform to ASTM A 36/A 36M (minimum yield strength of 250 MPa), or equivalent industry standard.

2.3 ANCHOR BOLTS, NUTS AND WASHERS

- A. Anchor bolts shall conform to ASTM A 449, (minimum tensile strength of 558 MPa), or equivalent industry standard.
- B. Nuts shall conform to ASTM A 563/A 563M, Grade A, Hex Style, or equivalent industry standard.
- C. Washers shall conform to ASTM F 436/F 436M, or equivalent industry standard.
- D. Galvanize all anchor bolts, nuts and washers in accordance with ASTM A 123/A 123M, or equivalent industry standard.

2.4 BASE PLATE THREADED STUDS, NUTS AND WASHERS

- A. Base plate threaded studs shall conform to ASTM A 36/A 36M, (minimum tensile strength of 250 MPa), or equivalent industry standard.
- B. Nuts shall conform to ASTM A 563/A 563M, Grade A, hex nuts, or equivalent industry standard.
- C. Washers shall conform to ASTM F 436/F 436M or equivalent industry standard.
- D. Galvanize all base plate threaded studs, nuts and washers in accordance with ASTM A 123/A 123M, or equivalent industry standard.

2.5 SOURCE QUALITY CONTROL

- A. All elastomeric bridge bearing pads shall be tested by the manufacturer before shipment to ensure compliance with all applicable requirements of AASHTO M 251, “Plain and Laminated Elastomeric Bridge Bearings” or equivalent industry standard.
 - 1. The manufacturer shall issue and submit a certificate stating that the elastomeric bridge bearing pads meet the requirements of AASHTO M 251, “Plain and Laminated Elastomeric Bridge Bearings” or equivalent industry standard.
 - 2. Factory test results shall be submitted.

PART 3 - EXECUTION

3.1 GENERAL

- A. Anchor bolts and base plate threaded studs shall be set accurately by a secured template prior to placing concrete.
- B. No elastomeric bridge bearing pads shall be installed until source testing results have been accepted by owner or owner’s representative. Install the elastomeric bridge bearing pads in accordance with the manufacturer’s instructions and as shown on the Drawings.
- C. Elastomeric bridge bearing pads shall not be placed upon bridge seat bearing areas that are improperly finished, deformed or irregular. Elastomeric bridge bearing pads shall be set to the required grade in the exact positions called for on the Drawings and shall have full and even bearing upon the bridge seat concrete.

- D. Preparation of concrete areas for elastomeric bridge bearing pad seats shall be as specified Division 03 Section "Cast-In-Place Concrete".

END OF SECTION 07 95 63

SECTION 07 95 65 – ASPHALTIC BRIDGE JOINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Furnishing and installation of a polymeric binder and backer rod placed into a prepared joint as shown on the Drawings. The system shall provide a flexible waterproof bridge joint capable of accommodating a total movement of up to 50 mm from maximum expansion to maximum contraction. Incidental to this system shall be the placement of the non-sag joint sealer and backing rod through the sidewalk and barrier joint as shown on the Drawings.

1.3 REQUIRED SUBMITTALS

- A. Provide the following submittals:

- 1. Product Data:

- a. For each type of product indicated.

- 2. Other Submittals:

- a. Certified Reports/Certificates of Compliance/Material Certificates:

- 1) Certified Test reports, Materials Certificates and Certificates of Compliance for the asphaltic polymeric binder and the joint sealer.
- 2) Certificates of Compliance for the backer rod.

- b. Quality Assurance Documentation:

- 1) Installer documentation showing experience on the work required by this Section.

1.4 QUALITY ASSURANCE

- A. The Installer shall have previously demonstrated the ability to have successfully produced a joint of similar nature and shall provide documentation of a working joint to owner or owner's representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Polyurethane Joint Sealer, Non-Sag, ASTM C 920, or equivalent industry standard.
 - 1. A cold applied, single component elastomeric joint sealing compound for sealing, caulking vertical joints on bridges.
- B. Asphaltic Binder for Asphaltic Bridge Joint System:
 - 1. The thermoplastic polymeric modified asphalt binder shall conform to the following physical properties based on the designated ASTM testing methods:

<u>TEST</u>	<u>ASTM TEST METHOD **</u>	<u>REQUIRED PROPERTIES</u>
Softening Point	D 36	82.2°C minimum
Tensile Adhesion	D 5329	700 % minimum
Ductility, @ 25°C	D 113	400 mm minimum
Penetration @ 25°C, 150g, 5 seconds maximum	D 3407	7.0 mm
Flow, 5 hours @ 60°C	D 3407	3.0 mm maximum
Resiliency, @ 25°C	D 3407	70% maximum
Asphalt Compatibility	D 3407	Pass
Low Temperature Penetration @ -17.8°C, 200g, 60 seconds D5 with cone*minimum		1.0 mm
Flexibility, @ -23.3°C	D 5329	Pass
Bond 3 Cycles @ -28.9°C, 50% Elongation	D 3405	Pass
Bond 3 Cycles @ -17.8°C, 100% Elongation	D 3405	Pass
Recommend Installation Range 198.9°C		182.2°C to
Safe Heating Temperature Range 215.6°C		198.9°C to

*Use Method D5, however replace the standard penetration needle with a penetration cone conforming to the requirements given in Test Method D 217, except the interior construction may be modified as desired. The total moving weight of the cone and attachments shall be 150.0 g ± 0.10.

** or equivalent industry standard.

- C. Backer Rod:
 - 1. The backer rod shall be closed cell foam expansion joint filler, compatible with polymeric binder and the elevated temperatures of the polymeric binder application. The size of the backer rod shall be in accordance with the manufacturer’s recommendations for the gap width.
 - 2. The backer rod shall meet ASTM D 1752, or equivalent industry standard, and have the following typical physical properties using a 12 mm specimen and the test method ASTM D 545, or equivalent industry standard:

- a. Compression, 50%: 91.7 kPa (13.3 psi)
- b. Extrusion: 2.54 mm (0.1 inch)
- c. Recovery: 99.21 percent
- d. Water Absorption, Volume: 0.246 percent

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Installer present, for compliance with requirements for surface conditions, and other conditions affecting performance of asphaltic bridge joint work.
- B. Proceed with installation only after concrete construction work has been completed and unsatisfactory conditions have been corrected.
- C. Beginning installation constitutes Contractor's acceptance of surfaces and conditions.

3.2 INSTALLATION, GENERAL

- A. A qualified installer approved by owner or owner's representative shall be at the job site prior to the beginning of the joint construction process to instruct the work crews in proper joint construction procedures and shall remain on the job site for the duration of the joint installation.
- B. The Contractor shall produce uniform and parallel surfaces in the forming of the bridge joint gap as detailed on the Drawings. The joint area shall be protected by the Contractor to prevent any edge damage by any site equipment throughout the on-going construction process.
- C. The Contractor shall produce the required gap width within the full depth of the joint as dimensioned on the Drawings. Immediately prior to placing any binder, the joint gap shall be inspected full depth and any debris shall be removed. The backer rod shall be installed in the sidewalk and safety curb gap to the proper depth to ensure a correct width/depth ratio as specified by the manufacturer. The backer rod shall be set in accordance with the Drawings. Splicing of the backer rod at the curb lines will not be permitted.
- D. The binder shall be melted and heated to the application temperature in a double jacketed, hot oil, heat transfer kettle, or as recommended by the manufacturer. The kettle shall be equipped with a continuous agitation system and temperature controls that can accurately maintain the material temperatures. The binder shall be poured into the joint gap. For sidewalk and curb joint gaps a non-sag polyurethane joint sealer compatible with the asphaltic binder shall be used.

3.3 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction and in accordance with asphaltic bridge joint materials manufactures' instructions.

END OF SECTION 07 95 65

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SECTION 31 10 00 - SITE CLEARING AND PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above and below grade site improvements.
 - 6. Temporary erosion and sedimentation control measures.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil and/or subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Excess cleared materials generated from clearing and/or excavation related activities not meeting Project specifications shall become Contractor's property and shall be removed from Project site.

1.5 REQUIRED SUBMITTALS

- A. Provide the following submittals:
 - 1. Other Submittals:
 - a. Documentation of existing trees or shrubs and plantings, adjoining structures and/or site features that establishes preconstruction conditions of work area.
 - b. Sufficiently photograph and videotape work area and adjacent structures, vegetation and features prior to beginning work. Provide owner or owner's

representative with digital copies of all photos and/or video(s) related to this task.

1.6 QUALITY ASSURANCE

- A. Preconstruction Conference: Conduct a preconstruction conference at Project site.

1.7 PROJECT CONDITIONS

- A. Traffic: Maintain traffic at all times.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from owner or owner's representative.
 - 2. Provide alternate routes around closed or obstructed travel ways meeting the approval of owner or owner's representative.
- B. Do not commence site clearing operations until erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 "Earth Moving."
 - 1. When satisfactory soil material(s) is not available on-site secure a source of off-site borrow material(s) for approval by owner or owner's representative.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to owner or owner's representative.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways, as directed by owner or owner's representative.
- B. Inspect, maintain, and repair erosion and sedimentation control measures during construction.

- C. Remove erosion and sedimentation controls and restore areas disturbed upon removal.

3.3 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation, including stumps and roots, to permit installation of new construction.
 - 1. Remove stumps, roots, obstructions, and debris to a depth of 450 mm below exposed subgrade.
 - 2. Dispose of all debris off-site.
- B. Remove non-hazardous trash and debris.
 - 1. If suspected hazardous trash and debris are encountered. Do not disturb, immediately notify owner or owner's representative.
 - a. Contractor shall move his operations to Project areas where there is no suspected hazardous trash or debris and continue working.
 - b. Contractor shall return to area where suspected hazardous trash and debris was encountered only upon written direction from the owner or owner's representative and complete site clearing operations.
- C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 200 mm, and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

- A. Strip topsoil to depth of 150 mm in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Dispose of topsoil.

3.5 SITE IMPROVEMENTS

- A. Remove existing above and below grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut full depth along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off the Project site.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Excavating and backfilling for structures.
2. Preparing subgrades for foundations, slabs-on-grade, and roadways.
3. Select Fill: For roadway fills.
4. Gravel Borrow: For backfill under or around foundations, and on embankments.
5. Processed Gravel: For roadway base course material and on embankments.
6. Crushed stone.
7. Geotextiles.

1.3 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed in a trench.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Any aggregate soil used on the Project.

C. Subbase: Granular aggregate layer supporting the slab-on-grade and pavement that also minimizes upward capillary flow of pore water.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

E. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 2.0 cubic meter for bulk excavation or for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 1050 mm (42 inch) wide, maximum, short-tip-radius rock bucket; rated at not less than 102907 watts (138-hp) flywheel power with bucket-curling force of not less than 127664 N (28,700 lbf) and stick-crowd force of not less than 81847 N (18,400) lbf with extra-long reach boom; measured according to SAE J-1179. (Ratings are based on: Caterpillar's "Model No. 320CL".)
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 171511 watts (230-hp) flywheel power and developing a minimum of 213479 N (47,992-lbf) breakout force with a general-purpose bare bucket; measured according to SAE J-732. (Ratings are based on Caterpillar's "Model No. 973C".)

- F. Structures: Footings, foundations, retaining walls, slabs, culverts, curbs, or other man-made stationary features constructed above or below the ground surface.
- G. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below aggregate base, structural fill, drainage fill, or topsoil materials.

1.4 REQUIRED SUBMITTALS

A. Provide the following submittals:

1. Samples:

- a. Samples for Verification: For the following products, in sizes or quantities indicated below:

- 1) Borrow Soil: Two liters by volume of material in sturdy container of each type of off-site and/or on-site borrow soil material, naming source for each material.
- 2) Geotextiles: 300 mm by 300 mm (12 by 12 inches).

2. Other Submittals:

- a. Material Test Reports: For each on site and off site borrow soil material used on the Project.

- 1) Classification according to ASTM D 2487.
- 2) Laboratory compaction curve according to ASTM D 1557 (Not required for crushed stone No.1 and No.2).

- b. Dewatering Plan:

- 1) The Contractor shall submit a dewatering plan.
- 2) The Contractor shall submit a dewatering/water control plan for the proposed drainage culvert installation.

- c. Qualification Data: For Contractor's qualified testing agency.

- 1) United States Army Corps of Engineers Review: Submit a copy of the independent testing agency's latest review documentation showing a satisfactory or better rating, or similar rating status.

- a) Independent testing agency performing soil classification, laboratory compaction curves and sieve analysis.

- d. Pre-excavation photographs or video to sufficiently document existing conditions of Project area and adjoining areas; noting site improvements, including finish surfaces, and/or other site features. Provide owner or owner's representative with digital copies of all photos and/or videos related to this task.

1.5 QUALITY ASSURANCE

A. Contractor's Soil Testing Agency:

1. Soil classification, laboratory compaction curves and sieve analyses shall be performed by an independent testing agency for both off-site and on-site soil materials.
2. The independent testing agency shall have been reviewed within the last 6 months by the United States Army Corps of Engineers (USACE) and have received a satisfactory or better rating, or similar rating status.

1.6 PROJECT CONDITIONS

- A. Traffic: Maintain vehicle and pedestrian traffic at all times.
 1. Do not close or obstruct roadways, streets, walks, or other adjacent occupied or used facilities without permission from owner or owner’s representative.
 2. Provide alternate routes around closed or obstructed traffic ways meeting the approval of owner or owner’s representative.
 3. Do not proceed with work on adjoining private property until directed by owner or owner’s representative.
- B. Do not commence earth moving operations until erosion and sedimentation control measures, specified in Division 31 Section “Erosion and Sedimentation Controls” are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide imported soil materials when sufficient satisfactory soil materials are not available from onsite excavations.
- B. Hazardous Materials:
 1. Provide materials that are not contaminated with petroleum product, hazardous waste, chemical waste, industrial waste, construction waste, sanitary waste, commercial/office waste or general household waste.
 2. Materials with a visible sheen or petroleum odor shall be rejected.
- C. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups. Satisfactory soils are to meet the additional requirements noted below and to be free of topsoil, asphalt, concrete rubble, wood, debris, clay, overburden and other deleterious materials.
 1. General descriptions (Group Name) for satisfactory soils Soil Classification Groups are as follows:

Soil Classification Group	General Description (Group Name)
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand

D. Unsuitable Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsuitable soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
2. General descriptions (Group Name) for unsuitable soils Soil Classification Groups are as follows:

Soil Classification Group	General Description (Group Name)
GC	Clayey gravel
SC	Clayey sand
CL	Lean clay
ML	Silt
OL	Organic silt
CH	Fat clay
MH	Elastic silt
OH	Organic clay
PT	Peat

E. Select Fill: Provide materials consisting of rock, stone, cobbles or gravel, free of organic matter, and substantially free of shale or other soft, poor durability particles having no particles greater than 100 mm in maximum dimension. Of the portion passing the 100 mm square sieve, the material shall have a gradation in accordance with the following Table.

SELECT FILL GRADATION	
Sieve Designation	Percentage Passing by Weight
425 um	0-70
75 um	0-15

F. Processed Gravel: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand meeting the gradation shown below.

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
75 mm	100
37.5 mm	70 to 100
19 mm	50 to 85
4.75 mm	30 to 60
75 um	3 to 10

G. Gravel Borrow: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone and natural crushed sand meeting the gradation shown below.

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
75 mm	100
12.5 mm	50 to 85
4.25 mm	40 to 75
75 um	0 to 10

H. Crushed Stone: Where indicated, provide the following fill materials, consisting of sound stone, free of slag, which is the product of mechanical crushing, having clean, durable,

sharp angled fragments of stone of uniform quality complying with following requirements:

1. No. 1 (37.5 mm) Crushed Stone Gradation Requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
37.5 mm	100
31.5 mm	85 to 100
19 mm	10 to 40
12.5 mm	0 to 8

2. No. 2 (19.0 mm) Crushed Stone Gradation Requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
25 mm	100
19 mm	90 to 100
12.5 mm	10 to 50
9.5 mm	0 to 20
4.75 mm	0 to 5

2.2 GEOTEXTILES

- A. Geotextile fabric at weep holes shall be as specified in Division 03 Section “Cast-In-Place Concrete”.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine conditions under which earthwork is to be accomplished. Notify owner or owner’s representative in writing of any deviations and/or conditions not consistent with the Drawings. Do not proceed with earthwork until owner or owner’s representative has confirmed the reported deviations and/or inconsistencies in writing which would impact the project and has provided written direction to the Contractor.

3.2 PREPARATION

- A. Protect structures and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
 1. Contractor is entirely responsible for strength and adequacy of bracing and shoring, and for safety and support of construction from damage or injury caused by lack of adequate protection or by movement or settlement.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.3 DEWATERING/CONTROL OF WATER

- A. Refer to Division 31 Section “Cofferdams” for control of water by cofferdams.
- B. Provide a written dewatering and/or water control plan.
- C. Furnish and install all dewatering pumps, wells points, sumps, suction and discharge lines and other dewatering systems as stated in the approved dewatering and/or water control plan. Maintain dewatering systems until completion of the permanent construction.
- D. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- E. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.4 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.5 EXCAVATION, GENERAL

- A. Excavation: Excavate to subgrade elevations.
 - 1. Unclassified excavation includes excavating all soil, boulders (less than 2 cm), pavements, stone walls, masonry walls and other obstructions visible on surface; underground structures, and other items indicated to be removed.
 - a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is unclassified excavation.
 - 2. Rock excavation includes removal and disposal of rock (refer to Definitions Article for definition of: “Rock”). Rock excavation beyond the specified dimensions will be considered for the Contractor’s convenience and will not be paid for separately. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 610 mm outside of concrete forms other than at footings.
 - b. 300 mm outside of concrete forms at footings.
 - c. 150 mm outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 150 mm beneath bottom of concrete slabs-on-grade.
 - f. Rock

3.6 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - a. See Structural Drawings for specific removal and replacement instructions if required.

3.7 SUBGRADE INSPECTION

- A. Notify owner or owner's representative when excavations have reached required subgrade.
- B. If owner or owner's representative determines that unsuitable soil is present, continue excavation and replace with compacted backfill or other fill materials as directed.
- C. Prior to excavation for foundations but after topsoil is stripped, proof-roll subgrade below structures, foundations and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 14 metric tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction and repeating proof-rolling in direction perpendicular to first direction with a minimum of six overlapping passes. Limit vehicle speed to 5 kmph.
 - 2. Excavate soft spots, unsuitable soils, and areas of excessive pumping or rutting, as directed by owner or owner's representative, and replace with compacted backfill or other fill materials as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices (if applicable) or changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

- A. Replace materials removed during unauthorized excavations using gravel borrow, unless otherwise directed by owner or owner's representative. Placement of the material shall be in 150 mm lifts with 95 percent of maximum dry density compaction. Compaction shall be as specified in this Section.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage and dampproofing.
 - 2. Removing concrete formwork.
 - 3. Removing trash and debris.
 - 4. Removing excess water and allowing material to dry.
 - 5. Removing temporary shoring and bracing, and sheeting.
 - 6. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows. Refer to Part 2 for material requirements and specific conditions for the use of each type of soil material. All fill materials to be approved by owner or owner's representative and shall conform to requirements specified in Part 2.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 200 mm in loose depth for material compacted by heavy compaction equipment, and not more than 150 mm in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, foundations, roadway and roadway shoulders: Scarify and recompact top 300 mm of existing subgrade and each layer of backfill or fill soil material to obtain 95 percent.

2. Under unpaved areas, scarify and recompact top 150 mm below subgrade and compact each layer of backfill or fill soil material to obtain 85 percent. (Compact all beneath the upper 610 mm to obtain at least 95percent of maximum dry density).

3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Unpaved Areas: Plus or minus 25 mm.
 2. Roadway Surfaces: Plus or minus 25 mm.

3.15 ROADWAY BASE COURSE AND SHOULDERS

- A. Place processed gravel base course on subgrades or select fill as indicated on the Drawings free of mud, frost, snow, or ice.
 1. Shape base course to required crown elevations and cross-slope grades.
 2. Place base course 200 mm or less in compacted thickness in a single layer.
 3. Compact processed gravel base course at optimum moisture content (plus or minus 2 percent) to required grades, lines, cross sections, and thickness to obtain not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.16 SUBBASE FOR CONCRETE FOUNDATIONS, FOOTINGS AND SLABS-ON-GRADE

- A. Place subbase granular materials as indicated on the Drawings on subgrades free of mud, frost, snow, or ice.
 1. Place subbase 200 mm or less in compacted thickness in a single layer.
 2. Compact each layer of subbase to required cross sections and thicknesses to obtain not less than 95 percent of the maximum dry unit weight according to ASTM D 1557.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Owner or owner's representative will engage a qualified testing agency to perform tests and inspections, and prepare test reports unless otherwise noted.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Inspections and tests:

1. Geotechnical observations: Proof rolling procedures, site preparation, unsuitable soils removal, excavations, footing/foundation bearing, fill and roadway base material placement.
2. Field Density Testing:
 - a. Footing/Foundation Subgrade: At footing/foundation subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by owner or owner's representative.
 - b. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1) Fill Under Footings/Foundations: In each compacted fill layer, one compaction test for every 10 meters of wall. Two compaction tests under each individual footing.
 - 2) Roadway Areas, Roadway Embankment Areas and Wall Backfill Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 200 square meters or less of area, but in no case fewer than three tests per work area.
 - c. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
3. Laboratory testing for on-site and off-site borrow materials:
 - a. ASTM D 1557 Modified Proctor compaction curve including sieve analysis.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them outside the limits of the Project.

END OF SECTION 31 20 00

SECTION 31 25 00 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Erosion, sediment and pollution controls as directed by owner or owner's representative.
- 2. Erosion, sediment and pollution control includes, but is not limited to, the following:
 - a. Silt fence.
 - b. Crushed stone check dams.
 - c. Clean up.

1.3 REQUIRED SUBMITTALS

- A. Provide the following submittals:

- 1. Product Data:
 - a. Silt fence.
- 2. Other Submittals:
 - a. Erosion, sediment and pollution control plan.
 - b. Inspection reports.

1.4 QUALITY ASSURANCE

- A. Contractor shall develop and submit an erosion, sediment and pollution control plan showing dewatering ponds/devices, stockpile areas and related erosion control measures.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store products according to manufacturer's written instructions.

1.6 NOTICES

- A. When the site has been finally stabilized, Contractor shall notify owner or owner's representative, in writing, that a final inspection be performed.

1.7 INSPECTIONS AND MAINTENANCE

- A. The Contractor shall inspect disturbed areas of the construction site and provide owner or owner's representative a written report of the inspection including recommended repairs or improvements. Review inspection report with owner or owner's representative for concurrence. Special attention shall be focused on areas not finally stabilized, structural control measures, and locations where vehicles enter or exit the site. Disturbed areas shall be inspected for pollutants entering the adjacent river and/or drainage culvert. Structural control measures shall be reviewed for effectiveness in preventing significant impacts to receiving waters.
- B. Provide timely maintenance of vegetation erosion and sediment control measures, and other protective measures, during construction.
- C. Perform corrective measures within two calendar days of the Contractor's report at no cost to the owner or owner's representative. Failure by the Contractor to perform corrective work within this schedule automatically authorizes the owner or owner's representative to hire others and deduct from the Contract Sum the costs incurred by the owner or owner's representative for the performance of this Work.

PART 2 - PRODUCTS

2.1 SILT FENCE

- A. Meet the following criteria unless specific type is shown on the Drawings or owner or owner's representative accepts the change in criteria.

1. Silt Fence: Polypropylene filter fabric supported by non pressure treated hardwood posts meeting the following requirements.

	Property	Unit	Test Method	Value
min	Grab Strength	kN (lbs)	ASTM D 4632	0.53 (120)
	Grab Elongation	%	ASTM D 4632	30 max
min	Trapezoid Tear	kN (lbs)	ASTM D 4533	0.27 (60)
min	Mullen Burst	kN (psi)	ASTM D 3786	1932 (280)
	Coeff of Permeability	CM/Sec	ASTM D 4491	0.005min
min	Water Flow Rate	l/min/m ² (gal/min/ft ²)	ASTM D 4491	489 (12)

2. Basis of Design Product: Subject to compliance with requirements provide Tencate Geosynthetics Mirafi 100X fabric.
3. Reinforced fence: Fabric backed with 2.1 mm diameter (14 gauge-Birmingham) by 150 mm square mesh woven wire. See plans for specific locations.

- B. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Tencate Geosynthetics (Mirafi).

2. Approved equal.

2.2 STAKES

A. One of the following

1. 50 mm by 50 mm by 1.2 m (2 inch by 2 inch by 4 feet) non pressure treated hardwood.

2.3 STONE FILTERS

A. Size shown on the Drawings and meeting the following requirements.

1. Crushed stone No. 1 or No. 2 as specified in Division 31 Section "Earth Moving".

2.4 CRUSHED STONE CHECK DAMS

A. Crushed stone check dams shall be constructed from either crushed stone No.1 and/or No. 2 as specified in Division 31 Section "Earth Moving" and as directed by owner or owner's representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine conditions under which soil erosion and sediment control is to be installed. Notify owner or owner's representative in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- B. Beginning installation constitutes Contractor's acceptance of substrate and conditions.

3.2 GENERAL EROSION CONTROL

- A. Install initial construction erosion control features, as indicated on the Drawings and Specifications or as directed by owner or owner's representative, prior to topsoil stripping, earthwork, and removal of existing vegetation and indicated in the Contractor's erosion, sediment and pollution control plan. Keep the disturbance to a minimum. Install other features as described in the sequence of erosion, sediment and pollution control shown on the Drawings.
- B. Until a disturbed area is stabilized, trap runoff sediment by the use of debris basins, sediment basins, silt traps, or other methods acceptable to owner or owner's representative.
- C. Place check dams as directed by owner or owner's representative. If check dams become plugged or partially plugged, remove and replace the stone. Cleaning of stone will not be permitted.
- D. Provide temporary erosion controls on slopes and swales traversing, bordering, or leaving the site. Limit the water flow to a non-erosive velocity.

- E. Do not store fill materials within 15 meters of the banks of any streams, wadis, channels or water bodies, intermittent or perennial.
- F. Inspect erosion and sediment control measures immediately after each rainfall and at least daily during prolonged rainfall. Make required repairs immediately.
- G. Remove sediment deposits when they reach approximately one-half of the height of the barrier.
- H. Remove all temporary measures at completion of construction.

3.3 SILT FENCE

- A. Locate in accordance with the Drawings and details and/or as directed by owner or owner's representative. Excavate trench along the lower perimeter(s) of site, along the contract limit line, and as indicated on the Drawings. The placement of silt fence shall consider drainage paths and intercept drainage prior to leaving site or entering storm system. Place excavated material on uphill side of trench for backfilling.
- B. Drive stakes securely into the downhill side of the trench. When prefabricated silt fence with fabric attached to stakes is used, drive stakes so that fabric is buried in the ground as detailed.
- C. Backfill trench with excavated material, so that fabric is securely buried in the ground to prevent undermining. Tamp soil.
- D. Join sections by overlapping fabric between two stakes. Set stakes simultaneously. Overlap by minimum 150 mm, fold, and staple to prevent sediment bypass.
- E. Attach silt fence securely to stakes spaced no more than 2.45 meters on center. Secure fence fabric to stake with minimum three 25 mm staples.
- F. Provide silt fence dikes perpendicular to swale center lines in swales one and one half percent and steeper. Locate dikes at a maximum interval of 15 meters on center unless otherwise shown on Drawings.
- G. Removal of silt and replacement of silt fence shall be on going throughout the duration of the project to maintain an effective silt removing barrier.

3.4 CLEANING

- A. During the Contract and at intervals as directed by owner or owner's representative and as erosion, sediment and pollution control procedures are completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, and neat condition.
- B. Clean storm ponding areas. Clean out contaminants, sediment, rubbish, construction debris, foreign objects and accumulated floatables from chambers and ponding areas thoroughly, immediately prior to final acceptance.

END OF SECTION 31 25 00

SECTION 31 37 00 – RIPRAP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Furnishing and installing woven geotextile fabric, bedding material, riprap and grout where shown on the Drawings.

1.3 REQUIRED SUBMITTALS

- A. Provide the following submittals:

1. Product Data:
 - a. Geotextile fabric.
2. Other Submittals:
 - a. Written description of the procedures and a list of equipment to be used for the riprap placement.
 - b. Material Source: Name and address of local riprap source.

PART 2 - PRODUCTS

2.1 SOIL STABILIZATION FABRIC (WOVEN GEOTEXTILE)

- A. Soil Stabilization Fabric (Woven Geotextile): Heavy duty, commercially manufactured woven polypropylene geotextile meeting the following properties:

Property	Unit	Test Method	Value
Grab Strength	kN (lbs)	ASTM D 4632	1.40 (315) min
Tensile Strength	kN (lbs/in)	ASTM D 4595	30.6 (175) min
Grab Elongation	%	ASTM D 4632	15 max
Trapezoid Tear	kN (lbs)	ASTM D 4533	0.53 (120) min
Mullen Burst	kN (psi)	ASTM D 3786	4134 (600) min
Permittivity	/Sec	ASTM D 4491	0.05 min
Water Flow Rate	l/min/m ² (gal/min/ft ²)	ASTM D 4491	163 (4) min

1. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Tencate Mirafi – 600X.
- b. Approved equal.

2.2 BEDDING MATERIAL

- A. Bed course material shall consist of crushed stone No. 1 as specified in Division 31 Section “Earth Moving”.

2.3 ANGULAR RIPRAP

- A. Riprap shall be rough stone, fractured to sub angular, and have a specific gravity of at least 2.65.
- B. Riprap shall consist of individual crushed angular stone fragments which shall be unweathered, dense, hard, sound, and resistant to abrasion; shall be free from cracks, seams, and other defects that would tend to unduly increase their destruction by water and frost actions. Riprap shall be nearly cubical as possible, with neither breadth nor thickness of a single piece less than one-third of its length. Slab type stones, flaking stones, rounded stones, asphalt, broken concrete, concrete slabs, or other materials not classified as stone will not be allowed for use as riprap. Riprap shall be clean, free of fines, and shall meet the following requirements:

CLASSIFICATION AND GRADATION OF RIPRAP

Riprap Designation	% Smaller Than Given Size by Weight	Intermediate Riprap Dimension (mm)	D ₅₀ * (mm)
300 mm	70 – 100	530	300
	50 – 70	460	
	35 – 50	300	
	2 – 10	100	

D₅₀ = Particle size.

- C. Stone crushed to produce riprap shall come from a local source, and shall be of the type, material, and quality typically found in that region.
 - 1. Stone shall not be taken from a waterway (river, stream or wadi) bed or bank.

2.4 ROUNDED RIPRAP

- A. If boulders or rounded cobbles are to be used as riprap, the layer shall be 50 percent thicker than shown on the Drawings. The rounded stones shall be at least 25 percent larger in diameter than angular stones. No rounded stone shall have a length on any one axis greater than 3 times the length on any other axis.

PART 3 - EXECUTION

3.1 GENERAL

- A. No geotextile fabric, bedding material, and riprap shall be placed until the subgrade has been prepared, dewatered and properly compacted, or otherwise prepared in accordance with the provisions of the Specifications and as specified on the Drawings and has been checked and approved by owner or owner's representative.

3.2 GEOTEXTILE FABRIC PLACEMENT

- A. Place the geotextile in a manner recommended by the manufacturer. At the time of installation, replace any geotextile that has defects, rips, holes, flaws, deterioration, or damage. Place the geotextile with the long dimension parallel to the centerline of the channel, and lay it smooth and free of tension, stress, folds, wrinkles, or creases. Place the strips to provide a minimum width of 1 meter of overlap for each joint. The Contractor shall secure the geotextile to the embankment or foundation soil by pins or other methods to prevent movement prior to placement of revetment materials. Securing pins shall be inserted through both strips of overlapped geotextile along the line passing through midpoints of the overlap. Securing pins shall be removed as revetment materials are placed to prevent tearing of geotextile or enlarging holes. The maximum pin spacing shall be 600 mm or less. When windy conditions prevail at the construction site, the number of pins shall be increased as directed by owner or owner's representative. The Contractor shall anchor terminal ends of the geotextile with key trench or apron at crest, toe of the slope, and upstream and downstream limits of installation as recommended by the manufacturer.
- B. Trimming shall be performed in such a manner that the geotextile is not damaged in any way.
- C. The Contractor shall secure the geotextile to the embankment or foundation soil by pins or other methods as recommended by the manufacturer.

3.3 BEDDING MATERIAL PLACEMENT

- A. Bedding material (crushed stone No. 1) shall be placed uniformly to the grades and elevations shown on the Drawings. Care shall be taken to keep the bedding material thickness uniform. Excessive rutting of the finished bedding surface shall be avoided. Bedding material shall be kept clean and free of other soils. If the bedding material is contaminated with other soils or unsuitable material, it shall be removed and replaced by the Contractor immediately.

3.4 RIPRAP PLACEMENT

- A. The Contractor shall submit a written description of the procedures and a list of the equipment to be used for riprap placement.
- B. Riprap shall be placed with a maximum drop height of 1 meter to reduce segregation of particle sizes. Placing in layers or by dumping into chutes or similar methods which may cause segregation will not be permitted. The riprap shall be placed, in one preparation, to the line, grade, and thickness as shown on the Drawings, without undue displacement of the granular filter bedding underneath.

- C. Riprap shall be placed to grade in a manner such that the larger riprap fragments are uniformly distributed and the smaller riprap fragments serve to fill the spaces between the larger riprap fragments in such a manner as will result in a well-keyed, densely placed, uniform layer of riprap of the specified thickness. Consolidation of the riprap by backhoe or other means will be necessary to insure interlocking of riprap fragments. Placed riprap shall be uniform and free from bulges, humps, or cavities. Hand placing will be required only to the extent necessary to secure the results specified above.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: owner or owner’s representative will engage a qualified testing and inspection agency to perform tests and prepare test reports.

- B. Tests:

- 1. Relative Density Testing of Bedding Material: Perform in accordance with ASTM D 4253, “Maximum Index Density and Unit Weight of Soils Using a Vibratory Table”, or equivalent industry standard.

- C. Field Test for Riprap Gradation

- 1. The Contractor shall provide personnel, tools and equipment as necessary to assist the Testing Agency, at no additional cost to owner or owner’s representative.
- 2. The field test for riprap gradation shall be performed after the first 5000 square meters of riprap is placed. Riprap placement shall not continue until after this test has been performed. The test area shall be marked for easy identification and shall be used as a reference for remaining riprap work.
- 3. Testing Frequency: One field test for riprap gradation shall be performed.
- 4. Develop detailed test procedures based on the following:
 - a. From a constructed section of riprap not exceeding 5,000 square meters of 0.5 meters thickness, designate an area 2 m by 2 m for testing.
 - 1) The field test for riprap gradation shall be performed on the first 5000 square meters of riprap placed. Riprap placement shall not continue until after the riprap gradation test has been performed.
 - b. Weight and record each stone individually in the test area. For stones that are greater than the capacity of the scale or too heavy to be managed safely, estimate the volume of the stone and calculate a weight based on a known unit weight or specific gravity supplied by the quarry. After weighting, set aside the stones weight in 10 kilograms (8% size) or less.
 - c. Individually number all stones. The set-aside 8% size stones are collectively number 1.
 - d. Prepare a table with the individual weight for each stone. The collective weight of the 8% size stones must be the first entry on the table.
 - e. Arrange the table in size order, keeping the accumulated 8% size weight as the first entry on the table. See example below.

Stone No.	Individual Weight (Kg)	Accumulated Weight (Kg)	Accumulated % Weight
33-41	51.2 (accumulated 8% size weight)	51.2	3.9*
16	10.9	62.1	4.8
27	10.9	73.0	5.6

14	51.7	618.2	47.6**
24	52.6	670.9	51.6**

3	108.9	1060.0	81.6***
5	112.0	1172.1	90.2***
4	127.0	1299.1 (W, Step g below)	100.0

- f. Calculate the collective weight (W) of all stones on the table.
- g. Calculate the 90% (0.9*W) and the 50% (0.5*W) values. For the table above:
90% = 1169.4 kg, 50% = 649.5 kg.
- h. Calculate the 8% size: (Accumulated 8% size weight ÷ W)
- i. Acceptance criteria:
 - 1) * The accumulated percent weight of stones weighing less than 10 kg shall be less than 8%.
 - 2) ** The stone at the 50% size shall be between 50-100 kg.
 - 3) *** The stone at the 90% size shall be between 130-215 kg.
 - 4) The maximum weight of any individual stone shall be less than 240 kg.

D. Field Test Reports:

1. Submit field test results of riprap gradation.

END OF SECTION 31 37 00

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SECTION 31 52 13 - COFFERDAMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Designing, furnishing, and installing cofferdams and water control systems, and maintaining and operating water control systems, and removing cofferdam structures and water control systems.

1.3 SYSTEM DESCRIPTION

A. General:

1. Based on depth of water variations and the depth of excavations required, a cofferdam may be required for the proposed construction. The Contractor has the option to propose alternative methods for providing dry conditions for the pier and abutment construction.
2. The Contractor may submit alternate temporary methods for providing pier and abutment construction in the dry.
3. Methods for the control of water are to be included in the selection and design of the temporary excavation system.
4. The Contractor shall submit drawings and design calculations showing the Contractor's proposed method of cofferdam construction or alternate temporary methods. The submittal of such drawings, methods and calculations shall not serve to relieve the Contractor of any of his responsibility for the safety of the work or the responsibility for the successful completion of the project.
5. Approval of the cofferdam / temporary excavation system will be general in character and shall not relieve the Contractor from the responsibility for the adequacy of the design, materials and workmanship to safely support the excavation.

B. Design Requirements:

1. The Contractor shall submit drawings and calculations of the proposed method for approval, stamped and signed by a qualified structural engineer. The cofferdam / temporary excavation system shall be designed according to the following criteria:
 - a. Soil properties to be used in the design shall be consistent with the Geotechnical Report.
 - b. The Contractor shall make their own evaluation of existing conditions and facilities, and of the effects of the proposed cofferdam / temporary excavation system and construction methods, and shall provide in their design for all loads and methods necessary to permit construction of the proposed pier and

abutments while maintaining public safety and protecting completed work (and all third party property) from damage caused by their operations.

- c. The Contractor should be aware that ledge/bedrock may be encountered during excavation.
- d. Steel sheet piling, if used, shall continuously interlock with adjacent sheet piling.
- e. No element of the support system shall be spliced unless approved by owner or owner's representative.
- f. The Contractor shall submit a manufacturer's sworn statement, in lieu of mill inspection, for the material furnished. Costs involved in furnishing the statement (certificate) shall be borne by the Contractor. The statement shall include the following as a minimum:
 - 1) Contract Number, Project Name, Project Location.
 - 2) Name of the Contractor to which the material is furnished.
 - 3) Kind of material supplied.
 - 4) Quantity of material represented by the certificate.
 - 5) Means of identifying the consignment, such as label, marking, seal number, etc.
 - 6) Date and method of shipment.
 - 7) Statement to the effect that the material has been tested and found in conformity with the pertinent parts of these specifications.
 - 8) Results of all required tests including the chemical analysis in the case of metal, or a statement that results of all required tests pertinent to the certificate are satisfactory.
 - 9) Signature of a person having legal authority to bind the supplier.

C. Performance Requirements:

1. Cofferdams for foundation construction shall be carried to adequate depths and heights, shall be safely designed as watertight as necessary for the proper performance of the work which must be done inside them. Sheeting shall be driven to a sufficient depth below the proposed foundation grade to permit reasonable change in depth of the proposed foundation to a maximum of 750 mm except where solid rock is encountered. The interior dimensions shall be sufficient for the unobstructed and satisfactory completion of such construction work as form building, inspection and pumping. Cofferdams which become tilted or are displaced during the process of building the substructure shall be righted, reset or enlarged as may be necessary to provide the necessary clearances and this shall be at the sole expense of the Contractor. Cofferdams shall be dewatered and the proposed work placed in the dry.
2. Cofferdams shall be constructed so as to permit excavation and construction to proceed on dry, stable subgrades, and to protect the work against damage from sudden rising of water and to prevent damage to the work by erosion. No part of the cofferdam shall be left in such a way as to extend into the work, without written permission of owner or owner's representative.

D. Control of Water:

1. The Contractor shall not restrict the flow of water in the waterway beyond the impacts of the cofferdam when flow conditions exist in the waterway.
2. A water control system within the cofferdam structure may be required for the construction of the proposed piers and abutments in the dry. The water control system shall be capable of lowering the water table to an elevation below the bottom of foundation as determined by owner or owner's representative.

3. A temporary cofferdam may be utilized to create a dry environment within the waterway for construction to occur. Documentation shall be provided which demonstrates the suitability of the proposed cofferdam design for the particular site conditions (e.g. channel bed, surficial geology and hydrology) of the crossing. Sediment laden water will be pumped to an enclosure which shall be used to filter the water prior to its return to the water course. Sedimentation enclosures shall be located in upland areas and shall be properly sized in order to provide adequate filtration so as not to impair the water quality of the receiving water.
4. Water removed from within the work area shall be routed through either sedimentation tanks or temporary filter bags to remove suspended solids including sand, silt and other materials before being discharged into the waterway. The sedimentation tanks or filter bags shall be located outside the wetlands and discharge shall be directed to a stabilized area. Discharge into the waterway shall be visibly clear of suspended solids, and shall be performed such that discharge does not result in erosion of the ground surface. The Contractor shall submit a dewatering plan. All plans, procedures and calculations shall be prepared and signed by a qualified structural engineer.
5. If filter bags are used, they are to be constructed of non-woven geotextile fabric and have a maximum of one 300 mm discharge hose per filter bag. Flow to each bag should not exceed 5680 liters per minute. To help prevent punctures, geotextile fabric may be placed below the filter bag. Hose clamps are to be used to secure the discharge hose to the bag.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the Project site.

1.5 REQUIRED SUBMITTALS

- A. Provide the following submittals:

1. Shop Drawings:

- a. For cofferdam system, prepared by or under the supervision of a qualified structural engineer. Shop drawings shall be signed and dated by the qualified structural engineer.

- 1) Method of cofferdam construction. Include plans, elevations, sections, and details.
- 2) Alternate temporary methods for providing pier and abutment construction in the dry.
- 3) Dewatering plan.
- 4) Water control system.

2. Other Submittals:

- a. Design Data: For cofferdam system, prepared by or under the supervision of a qualified structural engineer. Drawings and calculations shall be signed and dated by the qualified structural engineer.

- 1) Drawings and calculations.

- b. Certificates: For steel sheeting and structural steel, if used.

- 1) Manufacturer's sworn statement.
- c. Qualification Data: For Installer and cofferdam structural engineer.
 - 1) Installer: Submit list of projects showing a minimum of 5 cofferdam systems of the size and extent proposed for this Project.
 - 2) Cofferdam Structural Engineer: Submit list of projects showing a minimum of 5 cofferdam systems of the size and extent proposed for this Project.

1.6 QUALITY ASSURANCE

- A. Cofferdam Structural Engineer Qualifications: An experienced structural engineer that has designed a minimum of 5 cofferdam systems of the size and extent proposed for this Project.
- B. Installer Qualifications: An experienced installer that has installed a minimum of 5 cofferdam systems of the size and extent proposed for this Project.

1.7 FIELD CONDITIONS

- A. Project-Site Information: A Geotechnical Report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. The Contractor shall verify the actual subsurface conditions are consistent with the Geotechnical Report.
 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
- B. Survey Work: Engage a qualified land surveyor or engineer to set benchmarks and locate cofferdam perimeter for each pier and abutment location.
 1. Clearly identify benchmarks and record existing elevations.
- C. The water level in the waterway is influenced by the amount of precipitation during a storm event in the watershed at any time of year (dry season or rainy season) and snow melt in the spring. The water level may rise rapidly, and for extended periods of time be at high levels including top of bank and higher as a result of these rains, snow melt and other events.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials used for the cofferdam, whether new or used, shall be sound and free from strength impairing defects.

2.2 STEEL SHEETING

- A. Steel sheeting shall be a standard section, either new or used, weighting not less than 110 kg/sm and shall conform to ASTM A 328/A 328M, "Steel Sheet Piling", (minimum yield strength of 270 MPa) or equivalent industry standard.

2.3 STRUCTURAL STEEL

- A. All structural steel shall conform to ASTM A 709/A 709M, "Structural Steel for Bridges" or equivalent industry standard. Minimum yield strength shall be as required for the design.

2.4 TIMBER

- A. Timber for sheeting and structural members shall be locally available wood species suitable for the intended use. Lumber and wood sheeting shall be planed on one side and either tongue and grooved or splined. Lumber sheeting shall not be less than nominal 100 mm thick. Wood sheeting shall not be less than nominal 50 mm thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The cofferdam shall be securely and satisfactorily braced to withstand all pressures to which it may be subjected and be sufficiently tight to prevent any flow of water or material into the space in which work is to be performed. The bottom of each piece of lumber and wood sheeting shall be so sharpened to lead the toe of the sheeting away from the excavation. Jetting maybe be done only with the approval of owner or owner's representative, but it will not be permitted when excess of water may endanger other structures or work.
- B. Where sheeting is to be used as a form for placing concrete the sheeting shall be driven entirely outside the neat lines shown on the plans for the concrete.
- C. If in owner's or owner's representative's opinion a tremie seal is necessary, owner or owner's representative may require the placing of underwater concrete of such dimensions as necessary below the footing to safely dewater the foundation and place the footing concrete in the dry.
 - 1. All tremie concrete seals shall be placed as directed by owner or owner's representative.
- D. Before placing the underwater concrete, the inside walls of the cofferdam shall be thoroughly cleaned and the walls made sufficiently tight to reduce the velocity of water to less than 3 meters per minute. The elevation of the water inside the cofferdam shall be controlled during the placing and the curing of the concrete. No pumping of water shall be permitted while concrete is being placed nor until the concrete has cured a minimum of 24 hours. Once concreting has started the tremie, if required, shall not be moved laterally through the deposited concrete. When necessary to move the tremie it shall be lifted out of the concrete and moved to the new position. Unless otherwise directed by owner or owner's representative, spacing of the triemies shall be at the Contractor's option.
- E. After each excavation is completed, the Contractor shall notify owner or owner's representative and no construction shall be started until owner or owner's representative has approved the depth of the excavation and the character of the foundation material.
- F. Unless otherwise provided, all parts of the cofferdams shall be removed after the completion of the substructure, care being taken not to disturb or otherwise injure the finished work.

- G. Sheetpiling used in the construction of cofferdams may be left in place at the option of the Contractor, provided it is cut off at an elevation as may be directed by owner or owner's representative. All cut offs will become the property of the Contractor and the cut off portions removed from the site. No cut off shall be allowed to float away or left in such a manner as to obstruct the flow of water. No sheeting may be left so as to create a possible obstruction to flow of water or a hindrance to traffic of any kind.
- H. Guide wales or other devices may be used to ensure accurate driving and aligning of the sheeting. Any movement which would prevent work from being performed in a proper manner shall be corrected at the expense of the Contractor.

END OF SECTION 31 52 13

SECTION 32 32 40 – STONE MASONRY WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Stone masonry walls, laid in full cement mortar bed, in close conformity with the lines and grades shown on the Drawings. All walls shall be fully grouted with cement mortar.
 - 2. Stone walls shall be used for the approach roadway barriers, and as indicated on the Drawings.

1.3 REQUIRED SUBMITTALS

- A. Provide the following submittals:
 - 1. Product Data:
 - a. Cement mortar.
 - 2. Other Submittals:
 - a. Material Source: Name and address of local stone source.

1.4 QUALITY ASSURANCE

- A. Sample Wall: Build a sample wall to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build the sample wall of full-thickness sections to demonstrate typical joints; surface finish, texture, and color; and standard of workmanship in the location where directed by owner or owner's representative. Size shall be full height and a minimum of 3 meters in length.
 - 2. The sample wall shall be built of materials and by methods to be used in the construction of the permanent wall. Do not start construction of the permanent wall until approval of the sample wall by owner or owner's representative.
 - 3. The sample wall may be included as part of the permanent wall, when approved by owner or owner's representative.

PART 2 - PRODUCTS

2.1 STONE

- A. Stone shall come from a local source, and shall be of the type, material, and quality typically found in that region.
 - 1. Stone shall not be taken from a waterway (river, stream or wadi) bed or bank.
 - 2. Pieces of concrete will not be permitted.
- B. Stone for field stone masonry shall consist of sound durable blasted or field stone free from seams, cracks and other structural defects and of satisfactory quality and shape.
- C. The stone may consist of angular blasted or field stones having straight edges, but with flat faces not necessarily rectangular in shape.
- D. Individual stone shall have, when set in the wall, no face dimension less than 100 millimeters. Stretchers shall have a depth in the wall at least 1-1/2 times the rise, and a length on the face at least twice the rise. Headers shall have a length on the face at least equal to the rise. Headers shall hold in the heart of the wall the same size as shown on the face and shall extend at least 300 millimeters more than the stretchers into the backing.

2.2 CEMENT MORTAR

- A. Cement mortar shall be cement-lime mortar type and shall meet the requirements of ASTM C 270, Type S (12.4 MPa), or equivalent industry standard.
 - 1. Proportions shall be 1 part cement, 1/2 part lime and 2-1/2 parts aggregate. Mix with water to produce a consistency suitable for application.
 - 2. Aggregate shall be clean and contain no unsuitable material, and shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
4.75 mm	100
2.36mm	95 to 100
1.18 mm	70 to 100
600 um	40 to 75
300 um	10 to 35
150 um	2 to 15
75 um	0 to 5

- 3. Water: Potable.

PART 3 - EXECUTION

3.1 SHAPING STONES

- A. Selected stone, roughly shaped to provide suitable exposed faces, shall be used at all angles and ends of walls.

- B. All shaping of stone shall be done before the stone is laid in the wall. If a stone is loosened after the cement mortar has set, it shall be removed, the cement mortar cleaned off and the stone re-laid in fresh cement mortar.

3.2 TOP OF WALL SURFACE

- A. Top of wall surface shall receive a smooth mortar surface.

3.3 LAYING STONE

- A. The masonry shall be laid and the face pattern shall be of uniform appearance throughout.
- B. Each stone to be set in cement mortar shall be cleaned and thoroughly wetted before being set. They shall be set on full beds of cement mortar, and cement mortar joints shall be full and the stones settled in place before the cement mortar has set.
- C. The wall shall be compactly laid having all interior joints completely filled with suitable stones or spalls thoroughly bedded in cement mortar. Voids shall be filled with cement mortar.
- D. Vertical joints shall be provided at 10 meter intervals.

END OF SECTION 32 32 40

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