

**BIDDING AND CONTRACT DOCUMENTS
FOR THE
BRUNSWICK COUNTY PUBLIC UTILITIES
NORTHWEST WATER TREATMENT PLANT – EXPANSION AND UPGRADES**

DOCUMENT 009104

ADDENDA

ADDENDUM NUMBER 4

DATE: February 5, 2020

PROJECT: NORTHWEST WATER TREATMENT PLANT – EXPANSION AND UPGRADES

OWNER: BRUNSWICK COUNTY PUBLIC UTILITIES

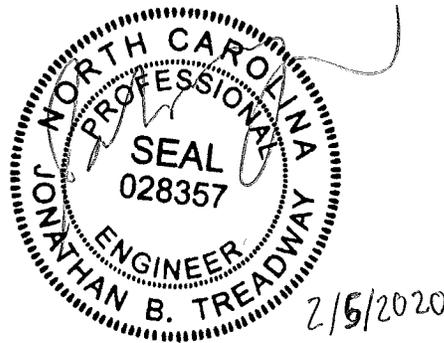
ENGINEER: CDM SMITH

TO: Project Planholders

This Addendum forms a part of the Contract Documents and modifies the Bidding Documents dated October 2019, with amendments and additions noted herein below.

Acknowledge receipt of this Addendum in the space provided in the Bid form. Failure to do so may disqualify the Bidder.

This Addendum consists of 3 pages.



GENERAL

1. This Addendum describes changes to the Bid Document set required to define the scope of Bid Alternate #4, "Delete all Low Pressure Reverse Osmosis Process Improvements from the Base Bid."

IN THE SPECIFICATIONS

SECTION 012901

1. Replace SECTION 012901 in its entirety with the respective new DOCUMENT included in the Attachments.

SECTION 034500

1. Add the attached SECTION 034500 "Precast Concrete Wall Panel Units" to the Bid Document set.

SECTION 400563

1. Ball Valve Schedule
 - a. Add footnote #1 following the heading "Supplier." Footnote #1 shall read as follows:
"1. If Alternate #4 is selected, remove all BFVs associated with the RO system, including: RO membrane units, feed system, permeate and membrane backpressure, cleaning and flushing system, concentrate control, chemical systems (carbon dioxide, lime, antiscalant, and bisulfite), cartridge filters, carrier water piping, and RO panel piping."

SECTION 400564

1. Butterfly Valve Schedule
 - a. Add footnote #4 following the heading "Supplier." Footnote #4 shall read as follows:
"4. If Alternate #4 is selected, remove all BFVs associated with the RO system, including: RO feed pumps, cartridge filters, feed and permeate isolation, tune-up system, RO tank outlets, RO flush and cleaning ports, cleaning system, and chemical eductor."

SECTION 400565.23

1. Swing Check Valve Schedule
 - a. Add footnote #1 following the heading "Service Location." Footnote #1 shall read as follows:
"1. If Alternate #4 is selected, remove all BFVs associated with the RO system, including: feed, permeate, and concentrate piping, cleaning and flushing system, carrier water piping, chemical systems (carbon dioxide, lime, antiscalant, and bisulfite), and tune-up system."

IN THE DRAWINGS

Remove the following drawings in the Bid Document set, and replace them with their respective attached drawings:

- | | |
|------------|-------------|
| 1. E-GN-10 | 8. E-GN-22 |
| 2. E-GN-11 | 9. E-GN-24 |
| 3. E-GN-12 | 10. E-GN-28 |
| 4. E-GN-13 | 11. E-GN-29 |
| 5. E-GN-14 | 12. E-GN-30 |
| 6. E-GN-15 | 13. I-YP-2 |
| 7. E-GN-21 | 14. I-RO-3 |

Add the attached drawings to the Bid Document set:

- | | |
|-------------|------------|
| 1. G-EB-1 | 22. A-EB-5 |
| 2. C-RW-3A | 23. S-EB-1 |
| 3. C-SP-10A | 24. S-EB-2 |
| 4. C-SP-13A | 25. S-EB-3 |
| 5. C-SP-14A | 26. S-EB-4 |
| 6. C-GD-1A | 27. H-EB-1 |
| 7. C-GD-2A | 28. H-EB-2 |
| 8. C-GD-4A | 29. H-EB-3 |
| 9. C-GD-6A | 30. H-EB-4 |
| 10. C-YP-1A | 31. P-EB-1 |
| 11. C-YP-2A | 32. P-EB-2 |
| 12. C-YP-3A | 33. P-EB-3 |
| 13. C-YP-4A | 34. P-EB-4 |
| 14. C-YP-5A | 35. E-EB-1 |
| 15. C-YP-6A | 36. E-EB-2 |
| 16. C-YP-8A | 37. E-EB-3 |
| 17. C-L-1A | 38. E-EB-4 |
| 18. A-EB-1 | 39. E-EB-5 |
| 19. A-EB-2 | 40. E-EB-6 |
| 20. A-EB-3 | 41. E-EB-7 |
| 21. A-EB-4 | |

ATTACHMENTS

1. SECTION 012901 "Measurement and Payment"
2. SECTION 034500 "Precast Concrete Wall Panel Units"
3. Drawings as noted above.

END OF ADDENDUM 4

SECTION 012901 - MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE

- A. This Section includes details for the measurement and payment of the various elements of the Work; with provisions applicable to lump sum prices, unit prices, alternatives and allowances, if applicable.
- B. In the case of conflict between this Section and the measurement methods specified in the individual technical Sections, the measurement methods in the technical specifications shall govern.
- C. The Contractor shall receive no payment for any portion of the work until it is installed. The only exception to this is payment for stored materials on site if the Contract provides for the payment of stored materials. Partial payment may be requested for items partially installed.

1.02 RELATED WORK

- A. Payment Procedures are included in Section 012900.
- B. Form of Proposal is included in Section 004213.
- C. General Conditions are included in Section 007200.
- D. Supplemental General Conditions are included in Section 007300

1.03 LUMP SUM ITEMS

- A. Lump Sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as indicated in the Form of Proposal. Measurement and payment for all bid items indicated as Lump Sums shall include the cost of all labor, materials and equipment necessary to furnish, install, clean, test, and place each bid item into operation; including permitting, general conditions, overhead and profit.
- B. Progress payments will be based on the Schedule of Values prepared by the Contractor and approved by the Engineer and Owner before acceptance of the first Application for Payment.
- C. In order for the Contractor to request progress payments against Lump Sum items, Contractor shall provide a disaggregation or breakdown in sufficient and measurable detail that is acceptable to the Engineer.
- D. Measurement
 - 1. Measurement shall be based on the estimated percent complete of each item of the Schedule of Values, as determined by the Engineer.

E. Payment

1. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer.

1.04 UNIT PRICE ITEMS

- A. Quantity and measurement estimates stated in the Form of Proposal are estimates for bidding purposes only. Actual payments shall be based on actual quantities installed, in-place, as measured and/or verified by the Engineer.
- B. Unless otherwise provided in the General Conditions, the bid unit prices shall be in effect throughout the contract duration, regardless of variances between the estimated quantities and the actual installed quantities.
- C. The Contractor shall make no claim, nor receive any compensation, for anticipated profits, loss of profit, damages, or any extra payment due to any difference between the amounts of work actually completed, or materials or equipment furnished, and the estimated quantities.
- D. Unless otherwise approved by the Owner, any unit quantities exceeded may not be invoiced until the estimated quantity is increased by contract change order.
- E. Contractor shall assist Engineer by providing necessary equipment, workers, and survey personnel as required to measure quantities.
- F. Measured quantities shall be rounded to the nearest whole integer, unless the value of the unit price exceeds \$100, in which case measured quantities shall be rounded to the nearest half unit.
- G. Measurement
 1. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.
 2. Unless otherwise provided in the Form of Proposal, unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.
 3. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.
- H. Payment
 1. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.
 2. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.

1.05 ALLOWANCE ITEMS

A. DEFINITIONS

1. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. SELECTION AND PURCHASE

1. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
2. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
3. Purchase products and systems selected by Engineer from the designated supplier.

C. ACTION SUBMITTALS

1. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

D. INFORMATIONAL SUBMITTALS

1. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
2. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
3. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

E. CHANGE ORDER ALLOWANCES

1. Use the change order allowance only as directed by Engineer for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
2. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the change order allowance are included in the allowance and are not already part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs

F. ADJUSTMENT OF ALLOWANCES

1. Retain this article if allowances are not used for low-cost or single-unit items. Specify requirements for maintenance materials in the Section that specifies the product covered by the allowance.

2. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
 - a. Include installation costs in purchase amount only where indicated as part of the allowance.
 - b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - d. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
3. At Project closeout, credit unused amounts of allowances remaining to the Owner by Change Order

1.06 ALTERNATES

A. Definitions

1. Base Bid: An amount proposed by bidders and stated on the Form of Proposal for the work defined in the Contract Documents, excluding the following drawings:
 - a. G-EB-1
 - b. C-RW-3A
 - c. C-SP-10A
 - d. C-SP-13A
 - e. C-SP-14A
 - f. C-GD-1A
 - g. C-GD-2A
 - h. C-GD-4A
 - i. C-GD-6A
 - j. C-YP-1A
 - k. C-YP-2A
 - l. C-YP-3A
 - m. C-YP-4A
 - n. C-YP-5A
 - o. C-YP-6A
 - p. C-YP-8A
 - q. C-L-1A
 - r. A-EB-1
 - s. A-EB-2
 - t. A-EB-3
 - u. A-EB-4
 - v. A-EB-5
 - w. S-EB-1
 - x. S-EB-2
 - y. S-EB-3
 - z. S-EB-4

- aa. H-EB-1
- bb. H-EB-2
- cc. H-EB-3
- dd. H-EB-4
- ee. P-EB-1
- ff. P-EB-2
- gg. P-EB-3
- hh. P-EB-4
- ii. E-EB-1
- jj. E-EB-2
- kk. E-EB-3
- ll. E-EB-4
- mm. E-EB-5
- nn. E-EB-6
- oo. E-EB-7

2. Alternate: An amount proposed by bidders and stated on the Form of Proposal for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

- a. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
- b. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

B. Procedures

1. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
2. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
3. Execute accepted alternates under the same conditions as other work of the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SCHEDULE OF ALTERNATIVE ITEMS

- A. Bidders are required to provide a Bid for each alternate listed below. If selected by Owner, the alternate will be subtracted (or added) from the Total Base Bid. The Bid for each alternate includes the price of the General Bidder and all selected sub-bidders.
- B. Bid Alternate No. 1: Add Low Pressure Reverse Osmosis Skid Systems No. 6 through No.8 to the Base Bid.

1. Measurement
 - a. The Base Bid includes five Low Pressure Reverse Osmosis (RO) Skid Systems to the limits shown on the drawings as “GC/MSS”. Selection of this Bid Alternative will increase the total number of RO skids (with elements) to eight paid under the Base Bid. This alternative includes RO Skid No.1 through No.8; RO Feed Pump No’s. 1 through 4 and 6 through 9, with VFDs; the local electrical and control panels; booster pump and Cartridge Filter No’s. 1 through 4 and 6 through 9.
 - b. The alternate requires RO skids No.1 through No.5 as well as feed pump with VFDs and cartridge filters No. 1, 2, 3, 6 and 7 to be installed for beneficial use by May 15, 2023 and the remaining skids, feed pumps, cartridge filters, and VFDs by August 15, 2023.
 2. Payment
 - a. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer.
- C. Bid Alternate No. 2: Delete Low Pressure Reverse Osmosis Skid System No. 5 from the Base Bid.
1. Measurement
 - a. The Base Bid includes five Low Pressure Reverse Osmosis (RO) Skid Systems to the limits shown on the drawings as “GC/MSS”. Selection of this Bid Alternative will reduce the total number of RO skids (with elements) to four paid under the Base Bid. This alternative includes removing RO Skid No.5, RO Feed Pump No. 3 with VFD; the local electrical and control panel; booster pump and Cartridge Filter No. 3 from the base bid. Conduits from the MCC to the future skids shall remain part of the Base Bid but not include power or communication wire from the MCC. Conduits from the VFD to the pump location shall remain part of the Base Bid but not include power or communication wire from the VFD.
 - b. The alternate requires four RO skids installed for beneficial use by May 15, 2023.
 2. Payment
 - a. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer.
- D. Bid Alternate No. 3: Revise Deadline for Beneficial Use of Low Pressure Reverse Osmosis Skid Systems.
1. Measurement
 - a. The Base Bid includes five Low Pressure Reverse Osmosis (RO) Skid Systems to the limits shown on the drawings as “GC/MSS”. Selection of this Bid Alternate does not adjust the scope of work defined in the contract base bid.
 - b. The alternate requires five RO skids installed for beneficial use by November 15, 2022. Final acceptance of all work is February 15, 2023.
 2. Payment
 - a. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer.
- E. Bid Alternate No. 4: Delete all Low Pressure Reverse Osmosis Process Improvements.

1. Measurement

- a. Measurement shall be for deletion, from the scope of work, of all associated RO infrastructure improvements shown with exception of the Backwash EQ Tank. An Electrical Building is added to the scope of work with this alternate.
- b. This alternate includes the drawings excluded under the Base Bid definition, Paragraph 1.06A.1.
- c. This alternate removes the following drawings from the Base Bid:
 - 1) G-GN-13
 - 2) A-RO-1
 - 3) A-RO-2
 - 4) A-RO-3
 - 5) A-RO-4
 - 6) A-RO-5
 - 7) A-RO-6
 - 8) A-RO-7
 - 9) A-RO-8
 - 10) A-RO-9
 - 11) A-RO-10
 - 12) A-RO-11
 - 13) A-RO-12
 - 14) A-RO-13
 - 15) A-RO-14
 - 16) A-RO-15
 - 17) A-RO-16
 - 18) A-RO-17
 - 19) A-RO-18
 - 20) A-RO-19
 - 21) A-RO-20
 - 22) A-RO-21
 - 23) A-RO-22
 - 24) A-RO-23
 - 25) A-RO-24
 - 26) A-RO-25
 - 27) S-RO-1
 - 28) S-RO-2
 - 29) S-RO-3
 - 30) S-RO-4
 - 31) S-RO-5
 - 32) S-RO-6
 - 33) S-RO-7
 - 34) S-RO-8
 - 35) S-RO-9
 - 36) S-RO-10
 - 37) S-RO-11
 - 38) S-RO-12
 - 39) S-RO-13
 - 40) S-RO-14
 - 41) M-RO-1
 - 42) M-RO-4
 - 43) M-RO-5

- 44) M-RO-6
- 45) M-RO-7
- 46) M-RO-8
- 47) M-RO-9
- 48) M-RO-10
- 49) M-RO-11
- 50) M-RO-12
- 51) M-RO-13
- 52) M-RO-14
- 53) M-RO-15
- 54) M-RO-16
- 55) M-RO-17
- 56) M-RO-18
- 57) M-RO-19
- 58) M-RO-20
- 59) M-RO-21
- 60) M-RO-23
- 61) M-RO-24
- 62) M-RO-25
- 63) M-RO-26
- 64) M-RO-27
- 65) M-RO-28
- 66) M-RO-29
- 67) M-RO-30
- 68) H-RO-1
- 69) H-RO-2
- 70) H-RO-3
- 71) H-RO-4
- 72) H-RO-5
- 73) H-RO-6
- 74) H-RO-7
- 75) H-RO-8
- 76) H-RO-9
- 77) H-RO-10
- 78) P-RO-1
- 79) P-RO-2
- 80) P-RO-3
- 81) P-RO-4
- 82) P-RO-5
- 83) P-RO-6
- 84) P-RO-7
- 85) P-RO-8
- 86) P-RO-9
- 87) P-RO-10
- 88) P-RO-11
- 89) E-RO-1
- 90) E-RO-2
- 91) E-RO-3
- 92) E-RO-4
- 93) E-RO-5

- 94) E-RO-6
- 95) E-RO-7
- 96) E-RO-8
- 97) E-RO-9
- 98) E-RO-10
- 99) E-RO-11
- 100) E-RO-12
- 101) E-RO-13
- 102) E-RO-14
- 103) I-RO-1
- 104) I-RO-2
- 105) I-RO-3
- 106) I-RO-4
- 107) I-RO-5
- 108) I-RO-6
- 109) I-RO-7
- 110) I-RO-8
- 111) I-RO-9
- 112) I-RO-10

- d. This alternate requires the date for beneficial use of all work to be May 15, 2022. Final acceptance of all work is August 15, 2022.

2. Payment

- a. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer.

3.02 SCHEDULE OF ALLOWANCES ITEMS

A. Change Order Allowance (BID ITEM NO. 1)

1. Measurement and Payment

- a. The Contractor will be reimbursed for costs of work defined in an approved Change Order.

2. Payment

- a. Payment will be made at the change order price proportional to the completion percentages approved by the Engineer.

B. Materials Testing Allowance (BID ITEM NO. 2)

1. Measurement and Payment

- a. The Contractor will be reimbursed for costs of work defined for Materials Testing.

2. Payment

- a. Payment will be made at the testing price proportional to the completion percentages approved by the Engineer.

3.03 SCHEDULE OF UNIT PRICE ITEMS

A. Removal and Replacement of Unsuitable Material (BID ITEM NO. 3)

1. Measurement

- a. Measurement shall be for the volume of material defined by the technical specifications as being unsuitable bedding below any new structure of the Work. For the defined volume, the unit price shall include all Work to remove and dispose of the existing material, and to furnish and install suitable materials.
- b. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.
- c. Unless otherwise provided for in the Form of Proposal unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.
- d. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.

2. Payment

- a. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.
- b. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.

B. Clarifier Concrete Repair - Prepare and Repair equal to or greater than 3/8-inch in depth (BID ITEM NO.4)

1. Measurement

- a. Definition for measurement of this bid item is provided in Section 030100.61 "Concrete Repair".
- b. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.
- c. Unless otherwise provided for in the Form of Proposal unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.
- d. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.

2. Payment
 - a. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.
 - b. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.
- C. Clarifier Concrete Repair – Prepare and Repair less than 3/8-inch and greater than 1/8-inch in depth (BID ITEM NO. 5)
1. Measurement
 - a. Definition for measurement of this bid item is provided in Section 030100.61 “Concrete Repair”.
 - b. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.
 - c. Unless otherwise provided for in the Form of Proposal unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.
 - d. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.
 2. Payment
 - a. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.
 - b. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.
- D. Clarifier Concrete Repair – Flexible Polyurethane Coating (BID ITEM NO. 6)
1. Measurement
 - a. Definition for measurement of this bid item is provided in Section 030100.61 “Concrete Repair”.
 - b. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.
 - c. Unless otherwise provided for in the Form of Proposal unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.
 - d. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.

2. Payment
 - a. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.
 - b. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.
- E. Clarifier Concrete Repair – Prepare and Repair less than 1/8-inch in depth (BID ITEM NO. 7)
1. Measurement
 - a. Definition for measurement of this bid item is provided in Section 030100.61 “Concrete Repair”.
 - b. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.
 - c. Unless otherwise provided for in the Form of Proposal unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.
 - d. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.
 2. Payment
 - a. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.
 - b. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.
- F. Clarifier Concrete Repair – Crack Repair (BID ITEM NO. 8)
1. Measurement
 - a. Definition for measurement of this bid item is provided in Section 030100.61 “Concrete Repair”.
 - b. Measurement for progress payment shall be made by, or approved by, the Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.
 - c. Unless otherwise provided for in the Form of Proposal unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground pipe installation would include trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.
 - d. The final measurement shall be based on actual quantities, jointly measured by Contractor and Engineer, complete, fully, tested and placed into service.

2. Payment
 - a. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.
 - b. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.

END OF SECTION 012901

SECTION 034500 - PRECAST CONCRETE WALL PANEL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulated precast concrete wall panel units.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing connection anchors in concrete.
 - 2. Section 071900 "Water Repellents" for water-repellent finish treatments.
 - 3. Section 079200 "Joint Sealants" for sealant and backup materials.

1.3 DEFINITIONS

- A. Design Reference Sample: Sample of approved precast concrete color, finish and texture, preapproved by Engineer.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

- C. Shop Drawings:

- 1. Detail fabrication and installation of precast concrete wall panel units.
 - 2. Indicate locations, plans, elevations, dimensions, shapes, openings, support conditions, and types of reinforcement, including special reinforcement and cross sections of each unit.
 - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.

4. Indicate inserts, weld plates, bearing plates, bolts, angles, sleeves, kickers, accessories, headers and openings.
 5. Indicate details at building corners.
 6. Indicate separate face and backup mixture locations and thicknesses.
 7. Indicate steel reinforcement, detailing fabrication, bending, and placing. Include material, grade, bar schedules, stirrup spacing, bent-bar diagrams, arrangement, and supports of concrete reinforcement.
 8. Indicate additional steel reinforcement to resist hoisting and erection stresses.
 9. Indicate locations and details of hoisting points and lifting points for handling and erection.
 10. Indicate engineering analysis data and design for steel reinforcement and hoisting and erection details, signed and sealed by the qualified Professional Engineer responsible for their preparation, registered in the State of North Carolina.
 11. Indicate welded connections by AWS standard symbols. Detail cast-in inserts, connections, and joints, including accessories.
 12. Indicate layout of wythe connectors for sandwich panels.
 13. Indicate type, size, and length of welded connections by AWS standard symbols.
 14. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 15. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 16. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
 17. Include plans and elevations showing unit location and sequence of erection for special conditions.
 18. Indicate location of each precast concrete wall panel unit by same identification mark placed on panel.
 19. Indicate relationship of precast concrete wall panel units to adjacent materials.
 20. If design modifications are needed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of precast concrete wall panel units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
 - a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.
 - b. Grout Samples for Verification: Showing color and texture of joint treatment.
- E. Delegated-Design Submittal: For precast concrete wall panel units indicated to comply with performance requirements and design criteria, including drawings and design calculations signed and sealed by the qualified professional engineer responsible for their preparation, registered in the State of North Carolina.
1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude,

and direction of loads imposed on the building structural frame and foundation from precast concrete wall panel units.

2. The connections shown indicate the concept desired. Provide final connection design and design of panel reinforcement to carry required loads.
- F. Concrete Mix Submittal: Submit all information required in Section 033000 for concrete mix submittals.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer fabricator testing agency professional engineer.
- B. Welding certificates.
- C. Material Certificates: For the following items:
 1. Cementitious materials.
 2. Reinforcing materials and prestressing tendons.
 3. Admixtures.
 4. Bearing pads.
 5. Structural-steel plates, bars, shapes and hollow structural sections.
 6. Headed studs.
 7. Insulation.
- D. Material Test Reports: For aggregates.
- E. Preconstruction test reports.
- F. Source quality-control test reports.
- G. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category S2 (Complex Structural Systems) for load-bearing members.
- B. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project and who can produce an Erectors' Post-Audit Declaration.
- C. Fabricator Qualifications: A firm that assumes responsibility for engineering precast concrete wall panel units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 1. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units.

- D. Professional Engineer Qualifications: Licensed in State of North Carolina.
- E. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- G. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
- H. Sample Panels: After sample approval and before fabricating precast concrete wall panel units, produce a minimum of two sample panels approximately 16 sq. ft. in area for review by Engineer. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
 - 1. Locate panels where indicated or, if not indicated, as directed by Engineer.
 - 2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 - 3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
 - 4. Demolish and remove sample panels when directed.
- I. Mockups: After sample panel approval but before production of precast concrete wall panel units, construct full-sized mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup as indicated on Drawings including aluminum framing, glass, sealants, and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.8 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver precast concrete wall panel units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.
- B. Support units during shipment on nonstaining shock-absorbing material.
- C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.
- E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design precast concrete wall panel units.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast concrete wall panel units indicated.
- C. Structural Performance: Provide precast concrete wall panel units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - 1. Out-of-plane wind and seismic loads in accordance with the North Carolina State Building Code, 2018 Edition.
 - 2. In-plane shear loads from roof diaphragm and roof framing loads indicated on the Drawings in addition to in-plane shear loads from the self-weight of the panels in accordance with the North Carolina State Building Code, 2018 Edition.
 - 3. Load combinations in accordance with the North Carolina State Building Code, 2018 Edition.
 - 4. Lifting, handling and other erection loads.
- D. Design units to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
- E. Seismic and Wind Design: Design and detail elements, attachments and connections to resist seismic and wind load combinations and allow for maximum permitted story drift in accordance with the North Carolina State Building Code, 2018 Edition.
 - 1. Design precast concrete wall panel units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load

deflection, shrinkage and creep of primary building structure, and other building movements as follows:

- a. Upward and downward movement of 1/2 inch.
2. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- B. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- E. Supports: Suspend reinforcement from back of mold.
 1. Use galvanized supports for galvanized reinforcement or embedded steel items in contact with galvanized reinforcement.
 2. Use epoxy-coated supports for epoxy-coated reinforcement.
 3. Use plastic protected bar supports or steel supports with plastic tips where reinforcing steel is supported on forms for a concrete surface that will be exposed to weather, high humidity, or liquid, including bottom of slabs over liquid containing areas.
 4. Use stainless steel protected bar supports in walls, beams and elevated slabs. Use stainless steel supports or plastic tipped metal supports in all other locations, unless otherwise indicated.
- F. Use annealed stainless steel tie wire. Use zinc-coated tie wire, or non-metallic-coated tie wire for galvanized reinforcing steel. Use plastic epoxy or nylon coated tie wire for epoxy coating reinforcing steel.

2.4 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416/A 416M, Grade 270, uncoated, seven-wire, low-relaxation strand.
 - 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, gray, unless otherwise indicated. Limit alkalis to 0.6%.
 - 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33/C 33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: To match design reference sample.
 - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.
- D. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330/C 330M, with absorption less than 11 percent.
- E. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
9. Corrosion Inhibiting Admixture: ASTM C 1582/C 1582M.

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Malleable Iron Castings: ASTM A 47/A 47M, Grade 32510 or Grade 35028.
- D. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30.
- E. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- F. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or Grade C.
- G. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65.
- H. Deformed-Steel Wire or Bar Anchors: ASTM A 496/A 496M or ASTM A 706/A 706M.
- I. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A or ASTM F 1554, Grade 36; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- J. High-Strength Bolts and Nuts: ASTM F 3125 Grade A325, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.
- K. Zinc-Coated Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.
 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
- L. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and

chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

- M. Welding Electrodes: AWS A5.1 E70xx.

2.7 BEARING PADS

- A. Provide one of the following bearing pads for precast concrete wall panel units as recommended by precast fabricator for application:
 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi, ASTM D 412.
 2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.8 ACCESSORIES

- A. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install precast concrete wall panel units.

2.9 GROUT MATERIALS

- A. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

2.10 INSULATED PANEL ACCESSORIES

- A. Polyisocyanurate Board Insulation: ASTM C 591, Type II, 2.5 lb/cu. ft. unfaced, with thickness of 3 inches.
- B. Wythe Connectors: Stainless steel pin connectors manufactured to connect wythes of precast concrete panels.

2.11 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Use a single design mixture for units with more than one major face or edge exposed.
 - 2. Where only one face of unit is exposed use either a single design mixture or separate mixtures for face and backup.
- B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- E. Normal-Weight Concrete Mixtures: Proportion by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi minimum.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.12 MOLD FABRICATION

- A. Procedures and tolerances shall conform to PCI MNL 117, MNL 122.
- B. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
- C. Maintain molds to provide completed precast concrete wall panel units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly 1/2" chamfered.

2.13 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast concrete wall panel units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast concrete wall panel units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces. Bend ends of tie wire away from finished surfaces.
 - 3. Place reinforcing steel and prestressing strands to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces. Install reinforcing supports of such type as to not be exposed on front face of panel.
 - 4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast concrete wall panel units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.
 - 1. Delay detensioning or post-tensioning of precast, prestressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.

2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
- H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete wall panel units.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- M. Identify pickup points of precast concrete wall panel units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast concrete wall panel units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Engineer's approval.

2.14 INSULATED PANEL CASTING

- A. Cast, screed, and consolidate bottom concrete wythe supported by mold.

- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation holes, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Ensure bottom wythe and insulation layer are not disturbed after bottom wythe reaches initial set.
- D. Cast, screed, and consolidate top wythe to meet required finish.
- E. Maintain temperature below 150 deg F in bottom concrete wythe.

2.15 FABRICATION TOLERANCES

- A. Fabricate precast concrete wall panel units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
- B. Fabricate precast concrete wall panel units to shapes, lines, and dimensions indicated so each finished unit complies with the following product tolerances:
 - 1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
 - a. 10 feet or under, plus or minus 1/8 inch.
 - b. 10 to 20 feet, plus 1/8 inch, minus 3/16 inch.
 - c. 20 to 40 feet, plus or minus 1/4 inch.
 - d. Each additional 10 feet, plus or minus 1/16 inch.
 - 2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
 - a. 10 feet or under, plus or minus 1/4 inch.
 - b. 10 to 20 feet, plus 1/4 inch, minus 3/8 inch.
 - c. 20 to 40 feet, plus or minus 3/8 inch.
 - d. Each additional 10 feet, plus or minus 1/8 inch.
 - 3. Total Thickness or Flange Thickness: Plus 1/4 inch, minus 1/8 inch.
 - 4. Rib Thickness: Plus or minus 1/8 inch.
 - 5. Rib to Edge of Flange: Plus or minus 1/8 inch.
 - 6. Distance between Ribs: Plus or minus 1/8 inch.
 - 7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch/72 inches or 1/2 inch total, whichever is greater.
 - 8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch.
 - 9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch.
 - 10. Dimensions of Haunches: Plus or minus 1/4 inch.
 - 11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch.
 - 12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch.
 - 13. Bowing: Plus or minus L/360, maximum 1 inch.
 - 14. Local Smoothness: 1/4 inch/10 feet.

15. Warping: 1/16 inch/12 inches of distance from nearest adjacent corner.
 16. Tipping and Flushness of Plates: Plus or minus 1/4 inch.
 17. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch.
- C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
1. Weld Plates: Plus or minus 1 inch.
 2. Inserts: Plus or minus 1/2 inch.
 3. Handling Devices: Plus or minus 3 inches.
 4. Reinforcing Steel and Welded Wire Reinforcement: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
 5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch of plan dimensions.
 6. Tendons: Plus or minus 1/4 inch, vertical; plus or minus 1 inch, horizontal.
 7. Location of Rustication Joints: Plus or minus 1/8 inch.
 8. Location of Opening within Panel: Plus or minus 1/4 inch.
 9. Location of Flashing Reglets: Plus or minus 1/4 inch.
 10. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch.
 11. Reglets for Glazing Gaskets: Plus or minus 1/8 inch.
 12. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch.
 13. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.
 14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch maximum over the full dimension of unit.
 15. Position of Sleeve: Plus or minus 1/2 inch.
 16. Location of Window Washer Track or Buttons: Plus or minus 1/8 inch.

2.16 FINISHES

- A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of precast concrete wall panel units to match approved sample panels and as follows:
1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
 2. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
 3. Textured-Surface Finish: Impart by form liners or inserts.
 4. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
 5. Exposed-Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
 6. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
 7. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
 8. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.

9. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
 10. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.
- B. Finish exposed top surfaces of precast concrete wall panel units to match face-surface finish.
- C. Finish exposed back surfaces of precast concrete wall panel units with smooth, steel-trowel finish.
- D. Finish unexposed surfaces of precast concrete wall panel units with as cast finish.

2.17 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C 1610/C 1610M, ASTM C 1611/C 1611M, ASTM C 1621/C 1621M, and ASTM C 1712.
- B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.
1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- C. Strength of precast concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318.
1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Engineer.
 2. Test cores in an air-dry condition.
 3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 4. Report test results in writing on same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks,

corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

- E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval. Engineer reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast concrete wall panel units to supporting members and backup materials.
- B. Erect precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
 - 1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.
- C. Connect precast concrete wall panel units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.
- D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
1. Protect precast concrete wall panel units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
 3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.
 4. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 5. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
 2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
 - a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - c. Twist-off Tension Control Bolt: ASTM F 1852.
 - d. Direct-Tension Control Bolt: ASTM F 1852.
 3. For slip-critical connections, use method and inspection procedure approved by Engineer and coordinated with inspection agency.
- F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast concrete wall panel units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.
- B. Erect precast concrete wall panel units level, plumb, square, and in alignment, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.
2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch.
3. Top Elevation from Nominal Top Elevation: As follows:
 - a. Exposed Individual Panel: Plus or minus 1/4 inch.
 - b. Non-Exposed Individual Panel: Plus or minus 1/2 inch.
 - c. Exposed Panel Relative to Adjacent Panel: 1/4 inch.
 - d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch.
4. Support Elevation from Nominal Support Elevation: As follows:
 - a. Maximum Low: 1/2 inch.
 - b. Maximum High: 1/4 inch.
5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet: 1 inch.
6. Plumb in Any 10 Feet of Element Height: 1/4 inch.
7. Maximum Jog in Alignment of Matching Edges: 1/4 inch.
8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch.
9. Maximum Joint Taper: 3/8 inch.
10. Joint Taper in 10 Feet: 1/4 inch.
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch.
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch.
13. Opening Height between Spandrels: Plus or minus 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
 1. Erection of loadbearing precast concrete members.
 2. Special Inspection as required by the North Carolina State Building Code, International Building Code – Chapter 17, and as indicated on the drawings.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

- A. Repair precast concrete wall panel units if permitted by Engineer. Engineer reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast concrete wall panel units when repairs do not comply with requirements.

3.6 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500