



**SAN ANTONIO WATER SYSTEM  
S. FLORES ST. 48-INCH AND 60-INCH OUTFALL REHAB PROJECT  
SAWS JOB NO. 13-4808  
SAWS SOLICITATION NO. B-13-CD-076-DB**

**ADDENDUM NO. 1**

November 13, 2013

Consulting Engineer: CP&Y, Inc., TBEF Registration, #F-1741



S. Flores St. 48-inch and 60-inch Outfall Rehab Project  
SAWS Job No. 13-4808  
Solicitation No. B-13-CD-076-DB  
November 12, 2013

**SAN ANTONIO WATER SYSTEM  
S. FLORES ST. 48-INCH AND 60-INCH OUTFALL REHAB PROJECT  
SAWS JOB NO. 13-4808  
SAWS SOLICITATION NO. B-13-CD-076-DB**

**ADDENDUM NO. 1**  
November 13, 2013

To: All Document Holders of Record

This addendum, applicable to work designed above, is an amendment to the bidding and specification documents and as such shall be a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the addendum number and issue date in the spaces provided on all submitted copies of the proposal.

**Addenda Purpose:**

**1.0 RESPONSE TO QUESTIONS**

- Q: If we bypass flow from both upstream lines to the manhole shown on bypass plan drawings, to allow the contractor to complete all lining of both lines & rehab manholes/structures from Pruitt to East Lubbock St. Can we then divert the flow from the 48" to the 58" using a plug at the crossover structure for the remaining 48" to be lined south of E Lubbock St?

*A: The sanitary sewer structure, structure identified as MH 14482, does not have a weir. A suggested By-pass pumping layout is provided in the plans that can be followed. The Contractor will be required to provide a By-pass pumping plan for SAWS's review and approval under all circumstances.*

- Q: If the bypass is to be sized for both pipes at full flow per SAWS spec 863 ( approx. 68,000 GPM) and we are pumping into the 58" only as shown on the bypass plan , to allow the 48" line to be lined south of East Lubbock St without bypassing the full length of the 48", the 58" cannot handle this amount of flow without overflowing where we discharge, or can we build the bypass for the capacity of the pipe we are discharging into being the 58"?

*A: The approximate flow stated in the question, 68,000 gpm, is incorrect. Contractor will be required to accommodate a full pipe in all By-pass pumping plans. A suggested By-pass pumping layout is provided in the plans that can be followed. The Contractor will be required to provide a*

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*By-pass pumping plan for SAWS's review and approval under all circumstances.*

- Q: In the pre-bid it was addressed that bypass pumping would need to be sized for the capacity of each line. The bypass Layout in the plans has the flow from both lines discharging into MH 14764. It would put the discharge flows over capacity of the 60" line. Would this be allowed?

*A: A suggested By-pass pumping layout is provided in the plans that can be followed. The Contractor will be required to provide a By-pass pumping plan for SAWS's review and approval under all circumstances.*

- Q: Can a map be provided of the existing utilities on Flores St. between Lubbock & Cass Ave.?

*A: Contractor shall verify with SAWS Counter Services located on the 2<sup>nd</sup> Floor, Tower II, for existing record drawings and system maps.*

- Q: Can the contract time be extended? We request an additional 90 days

*A: The previously mentioned work completion timeline will remain at 90 days.*

- Q: What is the type of manhole desired? We were referred to SAWS Standard Spec. 852. Specifically, is a precast base manhole or doghoused manhole acceptable? We understand that either is acceptable.

*A: The type of manhole required for this project will comply with SAWS Specification 852.*

- Q: Second the quantity for same varies from plans. Stated that in case there are manholes that SAWS does not want to rehabilitate, then this item will be used to cover additional replacements

*A: Correct, manholes that are deemed unsalvageable or inadequate for manhole rehabilitation will be replaced with a new precast manhole sections, cone and manhole rings and cover.*

- Q: Is bypass flow data indicated on plans from flow meters upstream?

*A: Information obtained from flowmeters, but the Contractor will be required to accommodate a full pipe in all By-pass pumping Plans.*

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- Q: Are obstruction removals known or just in case they are encountered?

*A: Obstruction removals will be on a case-by-case basis when they are encountered. This evaluation will be made when the pre-televising is submitted to SAWS.*

- Q: Are service reconnections known or estimated?

*A: Service reconnections will be on a case-by-case basis when they are encountered. This evaluation shall be made by the Contractor using the pre-televising, and the pre-televising shall be submitted to SAWS.*

- Q: Are they to be done by excavation or remote?

*A: Service reconnections will be done by either remote or person entry with the safety precautions paramount.*

- Q: Are there detailed or as-built drawing of the siphon and junction box structures?

*A: Contractor shall verify with SAWS Counter Services located on the 2<sup>nd</sup> Floor, Tower II, for existing record drawings and system maps.*

- Q: Is it the intent of SAWS to replace existing manhole frames and covers?

*A: The intent is to structurally rehabilitate those manholes that are assessed as salvageable. If and when the SAWS Engineer, Construction Inspector and Consultant determine that the manhole cannot be structurally rehabilitated, then the manhole will be replaced with new precast manhole sections, cone, and manhole rings and covers.*

- Q: Will the manhole reconstruction pay item be used for this purpose?

*A: Yes, the Pay Item 855 Reconstruction of Existing Manholes will be utilized for the payment of the work.*

- Q: Will alternative design be considered for CIPP liner thickness?

*A: No, alternative design will not be allowed for this project..*

- Will the manhole inverts be coated for the manhole rehabilitation?

*A: Yes, the manhole inverts will be coated for manhole rehabilitation.*

- Q: If the inverts are to be coated, then a full bypass of both lines is required to dry the junction box structures (or others if they exist) to execute the rehab.

*A: Yes, the junction structure, MH 14482, will have to remain dry in order to rehabilitate the structure.*

- Q: Does manhole and manhole rehabilitation require hydrostatic, vacuum, or Holiday testing? Answer was both Holiday testing and either hydrostatic or vacuum testing must be performed.

*A: The new precast manhole and structurally rehabilitated manholes require a Holiday testing, and either a hydrostatic or vacuum testing.*

- Q: Can the upstream siphon structure on Cass St. be used to divert flows? Answer was no – bypass pumping based on full pipe flow for both pipes is required consistent with SAWS specification 1001 (question runs concurrent with manhole invert rehab above)

*A: The upstream siphon structure on Cass St. cannot be used for diversion. Contractor will adhere to Specification 864.*

- Q: Given the answer to question 10, the by-pass pumping capacity could likely be ~ 50-60,000 GPM. The size and number of pumps and piping likely will necessitate closing S. Flores and detouring side streets in addition to creating large suction and discharge pits. Will this be allowed?

*A: The approximate flow stated in the question, 50-60,000 gpm, is incorrect. Contractor will be required to accommodate a full pipe in all By-pass pumping plans. A suggested By-pass pumping layout is provided in the plans that can be followed. The Contractor will be required to provide a By-pass pumping plan for SAWS's review and approval under all circumstances.*

- Q: Once the upstream work North of Lubbock, can the flows be diverted from one line to the other?

*A: A suggested By-pass pumping layout is provided in the plans that can be followed. The Contractor will be required to provide a By-pass pumping plan for SAWS's review and approval under all circumstances.*

- Q: Is the contractor responsible for street cut and COSA ROW permits?

*A: Per the General Conditions of the Contract Documents, the contractor is responsible for the acquisition and payment for COSA ROW permits and all associated fees.*

- Q: Are police officers required or certified flagmen for lane closures, etc. on the TCP?

*A: The traffic control plan provided by the Consultant Engineer may be followed. If the Contractor elects not to use the provided traffic control plan, it will be incumbent upon the Contractor to provide a traffic control plan for the CONSULTANT and COSA ROW's review. From their review, it will be determine if police officers will be required. Certified flagmen will be necessary for all lane closures.*

## **2.0 MODIFICATION TO CONTRACT REQUIREMENTS**

- Bid Proposal- Delete in its entirety and replace with the Bid Proposal attached to this addendum

## **3.0 MODIFICATIONS TO SPECIFICATIONS:**

- Supplemental Conditions
  - Add “Regardless of what the bypass plan in the Construction Plans indicates, the CONTRACTOR shall provide sufficient bypass operation to accommodate a full pipe sewage flows in order to complete the proposed work, as required in SAWS Specifications. Also, the By-pass Pumping plan must be approved by SAWS prior to the Contractor doing any work on this project.”
  - Add “TCEQ Chapter 217.57 and 217.58 does apply to this project. Therefore, all manholes and the newly installed sewer lines shall all be tested before acceptance by SAWS”
- Technical Specifications
  - Add, Specification 03100, Concrete Formwork
  - Add, Specification 03200, Concrete Reinforcement
  - Add, Specification 03250, Concrete Joints and Embedded Items
  - Add, Specification 03300, Cast-in-Place Concrete
  - Add, Specification 03600, Grout
  - Add, Specification 03740, Concrete Modifications and Repair

## **4.0 MODIFICATIONS TO PLANS:**

- Sheet titled BY-PASS PUMPING PLAN PHASE 2- Delete in its entirety and replace with attached sheet titled, BY-PASS PUMPING LAYOUT PHASE 2

S. Flores St. 48-inch and 60-inch Outfall Rehab Project

SAWS Job No. 13-4808

Solicitation No. B-13-CD-076-DB

November 12, 2013

- Sheet titled BY-PASS PUMPING PLAN PHASE 3- Delete in its entirety and replace with attached sheet titled , BY-PASS PUMPING LAYOUT PHASE 3
- Sheet titled BY-PASS PUMPING PLAN PHASE 4- Delete in its entirety and replace with attached sheet titled, BY-PASS PUMPING LAYOUT PHASE 4
- Sheet titled BEGIN PROJECT TO MATCH LINE B-B- Delete in its entirety and replace with attached sheet titled, BEGIN PROJECT TO MATCH LINE B-B
- Sheet titled MATCH LINE B-B TO MATCH LINE D-D- Delete in its entirety and replace with attached sheet titled, MATCH LINE B-B TO MATCH LINE D-D
- Sheet titled, MATCH LINE D-D TO END PROJECT- Delete in its entirety and replace with attached sheet titled, MATCH LINE D-D TO END PROJECT

**5.0 TO PROVIDE NOTES FROM PRE-BID MEETING:**

- Meeting Notes are attached for information only. The pre-bid meeting sign-in sheet has been posted previously on the SAWS website.

**ACKNOWLEDGEMENT BY BIDDER**

Each bidder is requested to acknowledge receipt of this Addendum No. 1 by his/her signature affixed hereto and to file same and attach with his/her bid.

The undersigned acknowledges receipt of this Addendum No. 1 and the bid submitted herewith is in accordance with the information and stipulations set forth.

\_\_\_\_\_  
DATE

\_\_\_\_\_  
SIGNATURE

END OF ADDENDUM NO. 1

PROPOSAL

PROPOSAL OF \_\_\_\_\_, a corporation a  
partnership consisting of \_\_\_\_\_  
and an individual doing business as \_\_\_\_\_

TO THE SAN ANTONIO WATER SYSTEM:

Pursuant to Instructions and Invitations to Bidders, the undersigned proposes to furnish all labor and materials as specified and perform the work required for the construction of pipelines and appurtenances, San Antonio Water System Job Number 13-4808 in accordance with the Plans and Specifications for the following prices to wit:

Item No.	Description (Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
202.1	Prime Coat  _____ Dollars and _____ Cents	GAL	106	_____	_____
203.1	Tack Coat  _____ Dollars and _____ Cents	GAL	53	_____	_____
205.4	Hot Mix Asphaltic Pavement, Type D (3" Pavement Thickness)  _____ Dollars and _____ Cents	SY	530	_____	_____
208.1	Salvaging, Hauling, and Stockpiling Reclaimable Asphaltic Pavement (3" Depth)  _____ Dollars and _____ Cents	SY	530	_____	_____



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Item No.	Description (Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
511.3	Replacing with Hot Mix Asphaltic Concrete Pavement (3" Type D & 10" Type B); _____ Dollars and _____ Cents	SY	50	_____	_____
530.1	Barricades, Signs and Traffic Handling _____ Dollars and _____ Cents	LUMP SUM	1	_____	_____
540	Temporary Erosion, Sedimentation and Water Pollution Prevention and Control _____ Dollars and _____ Cents	LUMP SUM	1	_____	_____
851	Adjusting Existing Manholes _____ Dollars and _____ Cents	EA	2	_____	_____
852.1	Sanitary Sewer Manhole (0'-6') _____ Dollars and _____ Cents	EA	2	_____	_____
852.3	Extra Depth Manholes (>6') _____ Dollars and _____ Cents	VF	6	_____	_____
855	Reconstruction of Existing Manholes _____ Dollars and _____ Cents	EA	10	_____	_____

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**Solicitation No. B-13-CD-076-DB**

Item No.	Description (Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
864	Bypass Pumping  _____ Dollars and _____ Cents	LUMP SUM	1	_____	_____
865	Sewer Main Television Inspection (42" through 48" Diameter)  _____ Dollars and _____ Cents	LF	2267	_____	_____
865	Sewer Main Television Inspection (54" through 60" Diameter)  _____ Dollars and _____ Cents	LF	598	_____	_____
868.1	Sewer Main Cleaning - Normal (42" through 48" Diameter);  _____ Dollars and _____ Cents	LF	2267	_____	_____
868.1	Sewer Main Cleaning - Normal (54" through 60" Diameter)  _____ Dollars and _____ Cents	LF	598	_____	_____
901.1	Install 48" CIPP Sanitary Sewer Pipe, all depths  _____ Dollars and _____ Cents	LF	2267	_____	_____
901.1	Install 54" CIPP Sanitary Sewer Pipe, all depths  _____ Dollars and _____ Cents	LF	33	_____	_____

**Job No. 13-4808**  
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**Solicitation No. B-13-CD-076-DB**

Item No.	Description (Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
901.1	Install 58" CIPP Sanitary Sewer Pipe, all depths _____ Dollars				
	and _____ Cents	LF	565	_____	_____
910.1	Manhole Rehabilitation _____ Dollars				
	and _____ Cents	VF	90	_____	_____
910.2	Sewer Structure Rehabilitation (Non-circular Manholes) _____ Dollars				
	and _____ Cents	SF	50	_____	_____
1103.3	Obstruction Removal by Remote Device, 48" Diameter, all depths _____ Dollars				
	and _____ Cents	EA	5	_____	_____
1103.3	Obstruction Removal by Remote Device, 58" Diameter, all depths _____ Dollars				
	and _____ Cents	EA	2	_____	_____
1103.3	Obstruction Removal by Person Entry, all depths _____ Dollars				
	and _____ Cents	EA	1	_____	_____
1109	Service Reconnection, all depths (person entry) _____ Dollars				
	and _____ Cents	EA	12	_____	_____

**Job No. 13-4808**  
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**Solicitation No. B-13-CD-076-DB**

Item No.	Description (Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
	Sanitary Sewer Structure Opening				
	_____ Dollars				
	and _____ Cents	EA	1	_____	_____

Bid Summary

LINE ITEM "A"- SUBTOTAL SAWS JOB NO. 13-4808 (SEWER): \$ \_\_\_\_\_

100 MOBILIZATION  
 Percent of the Line Item "A"  
 Subtotal Base Bid written in words

\_\_\_\_\_ Percent LUMP SUM 1 xxxxxxx \$ \_\_\_\_\_  
 (Maximum of 10% of the Line Item "A"  
 Sub-total Base Bid amount)

101 PREPARING R.O.W.  
 Percent of the Line Item "A"  
 Subtotal Base Bid written in words

\_\_\_\_\_ Percent LUMP SUM 1 xxxxxxxx \$ \_\_\_\_\_  
 (Maximum of 5% of the Line Item "A"  
 Subtotal Base Bid amount)

MOBILIZATION AND PREPARING ROW SUB-TOTAL \$ \_\_\_\_\_

**Job No. 13-4808  
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Solicitation No. B-13-CD-076-DB**

Mobilization lump sum bid shall be limited to a maximum 10% of the Line Item "A" Sub-total Base Bid amount. Preparing Right-of-Way lump sum bid shall be limited to a maximum of 5% of the Line Item "A" Sub-total Base Bid amount. The Line Item "A" Sub-total base bid is defined as all bid items EXCLUDING Item 100, Mobilization and Item 101, Preparing Right-of-Way. **In the event of a discrepancy between the written percentage and dollar amount shown for Mobilization and Preparation of ROW bid items the written percentage will govern. If the percentage written exceeds the allowable maximum stated for mobilization and or preparation of ROW, SAWS reserves the right to cap the amount at the percentages shown and adjust the extensions of the bid items accordingly.**

TOTAL BID AMOUNT (Line Item "A", Mobilization  
& Preparing Right of Way) \$ \_\_\_\_\_

\_\_\_\_\_ **DOLLARS AND**  
\_\_\_\_\_ **CENTS**

\_\_\_\_\_  
BIDDER'S SIGNATURE & TITLE

\_\_\_\_\_  
FIRM'S NAME (TYPE OR PRINT)

\_\_\_\_\_  
FIRM'S ADDRESS

\_\_\_\_\_  
FIRM'S PHONE NO. /FAX NO.

\_\_\_\_\_  
FIRM'S EMAIL ADDRESS

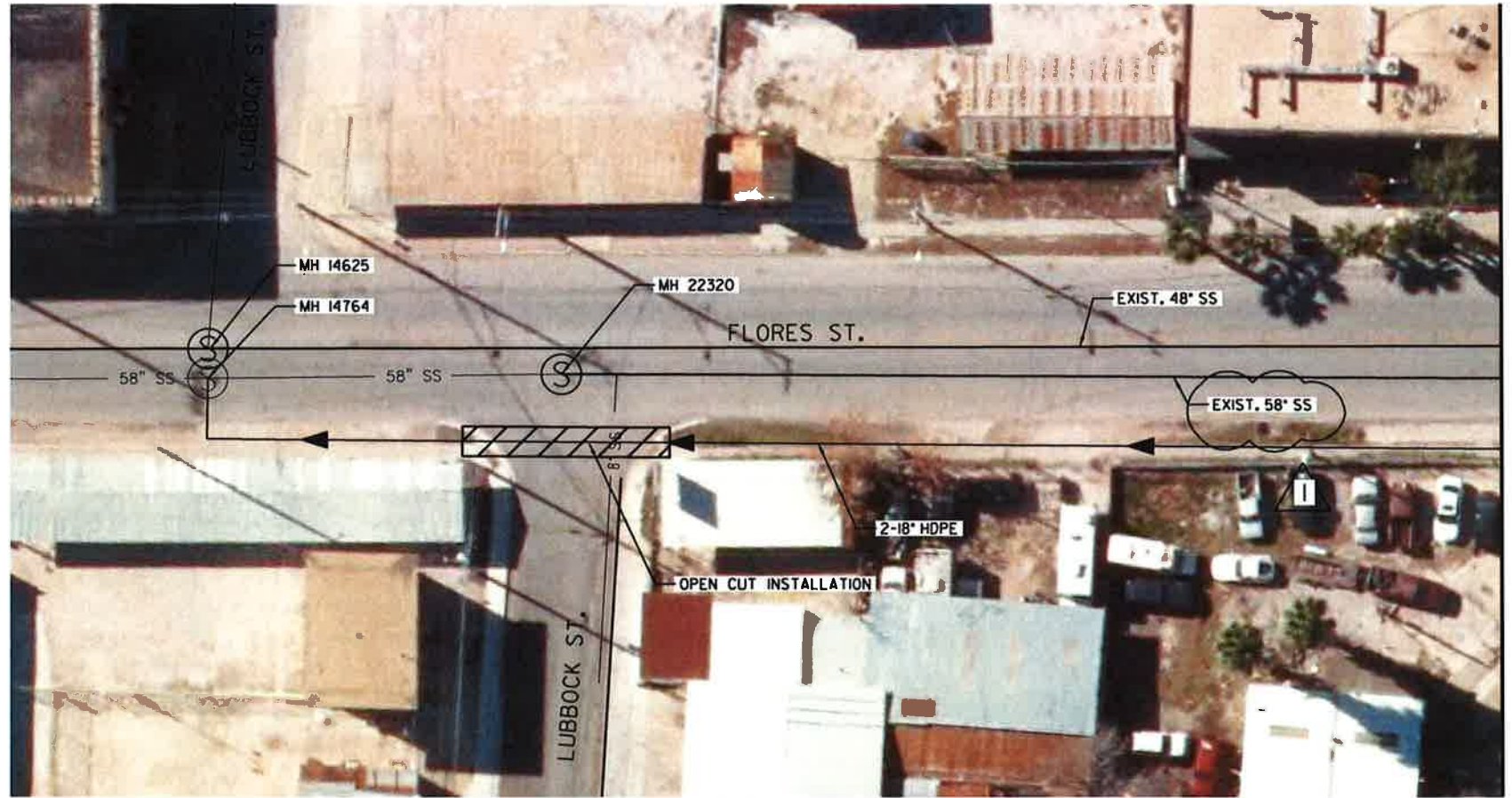
The Contractor herein acknowledges receipt of the following:  
Addendum Nos. \_\_\_\_\_ Dated \_\_\_\_\_ Signed: \_\_\_\_\_

**OWNER RESERVES THE RIGHT TO ACCEPT THE OVERALL MOST RESPONSIBLE BID.**

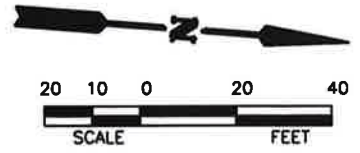
The bidder offers to construct the Project in accordance with the Contract Documents for the contract price, and to complete the Project within **90** calendar days from notice to proceed date or until funds are exhausted from the contract. **The bidder understands and accepts the provisions of the contract Documents relating to liquidated damages of the project if not completed on time.**

Complete the additional requirements of the Proposal which are included on the following pages.





MATCHLINE A-A



- SHEET NOTES:**
1. CONTRACTOR SHALL LAY 18" HDPE BY PASS LINES ON THE SURFACE UNLESS CROSSING BAYLOR AND LUBBOCK ST.
  2. CONTRACTOR SHALL INSTALL SUFFICIENT DEPTH OF MINIMUM 1 FT COVER AND 3 FT MAX.



MATCHLINE A-A



NO.	CALLOUT REV.	REVISION	HC	BY	DATE
1.					11/13

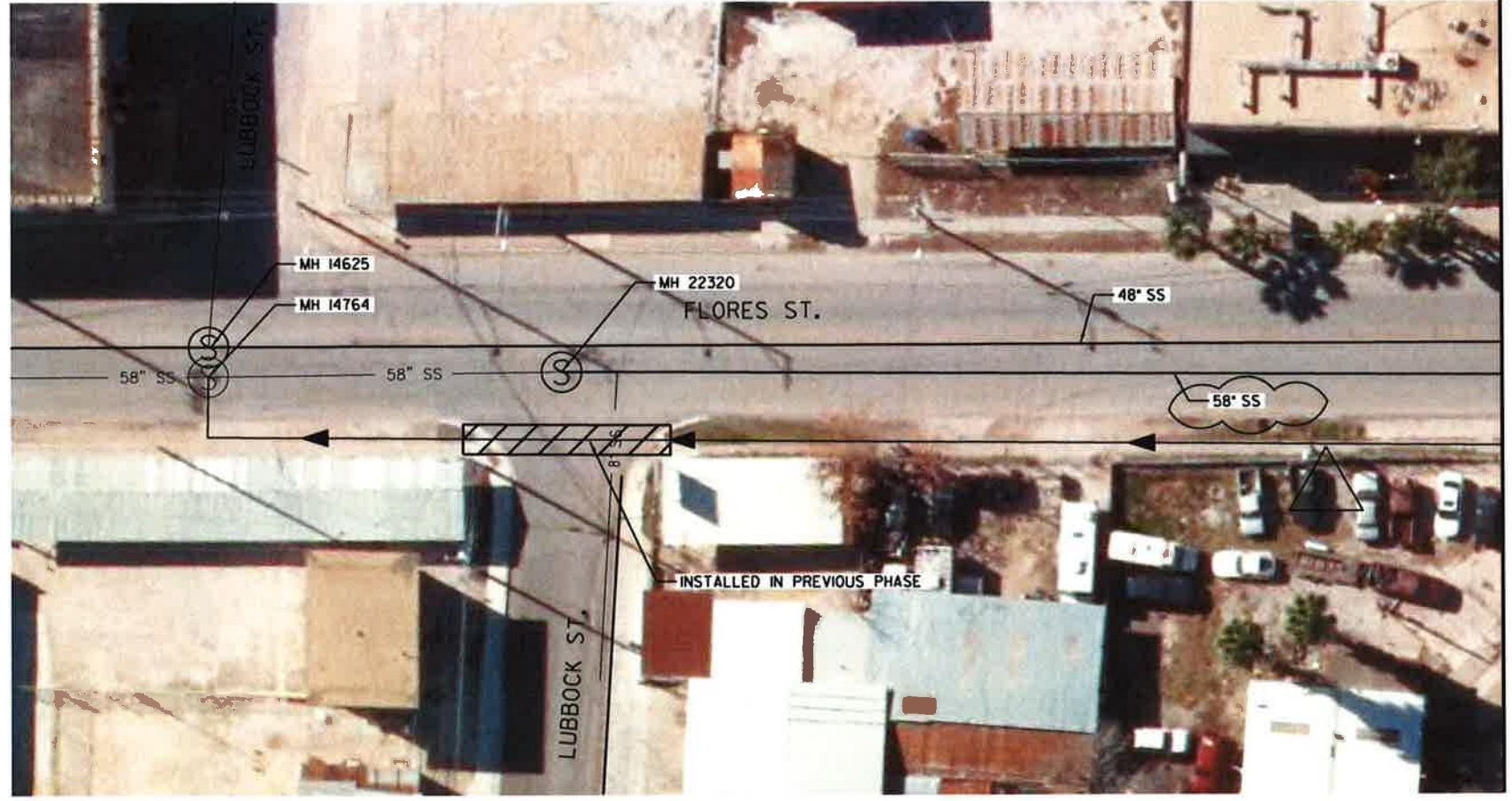
VERIFY SCALE  
 BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE.

SAN ANTONIO WATER SYSTEM  
 S. FLORES ST. DR.-127  
 48" & 60" OUTFALL REHAB. PROJECT  
 BY-PASS PUMPING LAYOUT  
 PHASE 2

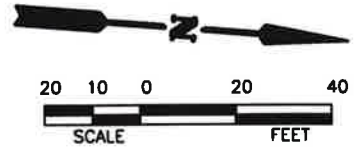
Date:	NOVEMBER 1, 2013
Designed:	EG
Drawn:	EG
Reviewed:	HJC
CP&Y Proj. No.:	SAW100054.09



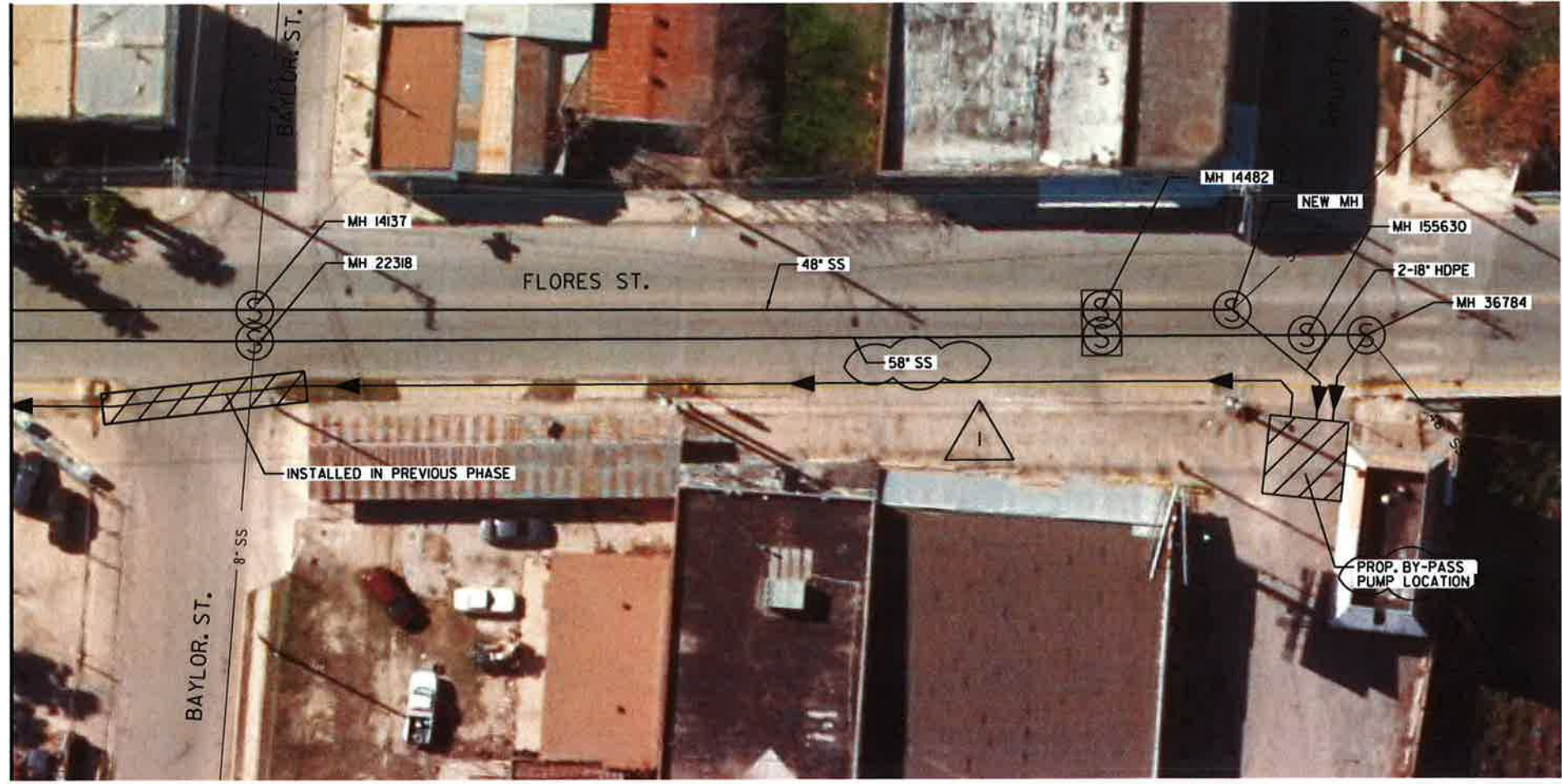
11/13/2013 5:43:14 PM hcabrera c:\Active Projects\SAW10054 - Unspecified Water Sewer Rehab\_2009\SAWS100054.09\8.00 Plans and Drawings\8\_30 Cut Sheets\10005409SCVPM02.dwg



MATCHLINE A-A



- SHEET NOTES:**
1. CONTRACTOR SHALL LAY 18" HDPE BY PASS LINES ON THE SURFACE UNLESS CROSSING BAYLOR AND LUBBOCK ST.
  2. CONTRACTOR SHALL INSTALL SUFFICIENT DEPTH OF MINIMUM 1 FT COVER AND 3 FT MAX.
  3. CONTRACTOR SHALL INSTALL STEEL PLATE OVER THE ROAD CROSSINGS.



MATCHLINE A-A



SAWS JOB NO.  
13-4808



**SAN ANTONIO WATER SYSTEM**

NO.	REVISION	BY	DATE
1	NOTE ADDED AND SIZED REV.	HJC	11/13

VERIFY SCALE: 1" = 40'  
 BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE.

**SAN ANTONIO WATER SYSTEM**  
 S. FLORES ST. DR.-127  
 48" & 60" OUTFALL REHAB. PROJECT  
 BY-PASS PUMPING LAYOUT  
 PHASE 3

Date:	NOVEMBER 1, 2013
Designed:	EG
Drawn:	EG
Reviewed:	HJC
CP&Y Proj. No.	SAW100054.05





*Hugo J. Cabrera*  
 STATE OF TEXAS  
 HUGO J. CABRERA  
 98245  
 LICENSED PROFESSIONAL ENGINEER  
 11/13/13

SAWS JOB NO.  
13-4808

**CP&Y**  
 300 E. SONTERRA BLVD.  
 SAN ANTONIO, TX 78259  
 TBPE REGISTRATION #F-1741

**SAWS**  
 SAN ANTONIO  
 WATER SYSTEM

NO.	REVISION	BY	DATE
1.	NOTE ADDED, REV. AND LINES DRAWN	HC	11/13

VERIFY SCALE 1" = 40'  
 BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE.

SAN ANTONIO WATER SYSTEM  
 S. FLORES ST. DR.-127  
 48" & 60" OUTFALL REHAB. PROJECT  
 BY-PASS PUMPING LAYOUT  
 PHASE 4

Date: NOVEMBER 1, 2013  
 Designed: EG  
 Drawn: EG  
 Reviewed: HJC  
 CP&Y Proj. No. SAW100054-09

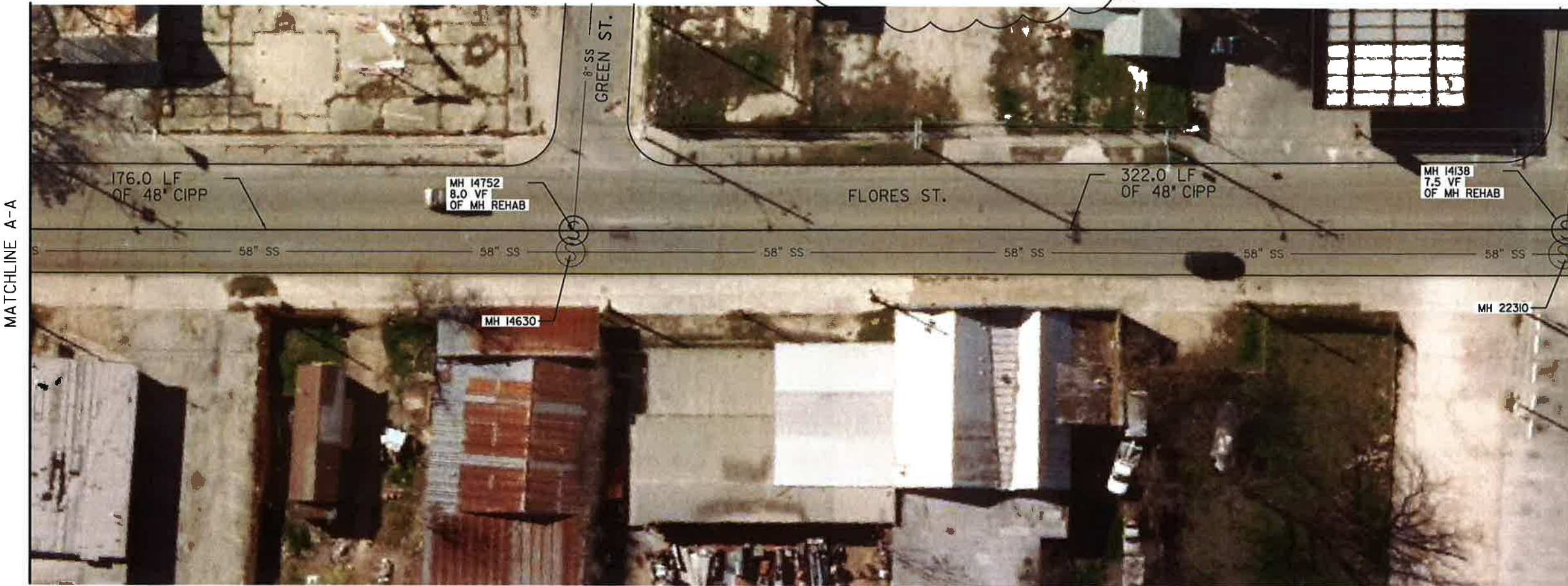




MATCHLINE A-A

**SHEET NOTE**  
 1. PARALLEL MANHOLES BETWEEN FAIRMONT AND LUBBOCK STREET ARE CONNECTED BY A SEGMENT OF PIPE. CONTRACTOR SHALL NOT REHABILITATE SAID LINES, AND TAKE INTO ACCOUNT WHEN PERFORMING BY-PASS PUMPING OPERATIONS.

*Hugo J. Cabrera*  
 STATE OF TEXAS  
 HUGO J. CABRERA  
 98245  
 LICENSED PROFESSIONAL ENGINEER  
 11/13/13



MATCHLINE A-A

MATCHLINE B-B

SAWS JOB NO. 13-4808

**CP&Y**  
 300 E. SONTERRA BLVD.  
 STE. 1250  
 SAN ANTONIO, TX 78259  
 TBPE REGISTRATION #F-1741

**SAWS**  
 SAN ANTONIO WATER SYSTEM

NO.	REVISION	DATE	BY	HC
1.	SHEET NOTE ADDED	11/13		

VERIFY SCALE: \_\_\_\_\_  
 BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE.

SAN ANTONIO WATER SYSTEM  
 S. FLORES ST. DR.-127  
 48" & 60" OUTFALL REHAB. PROJECT

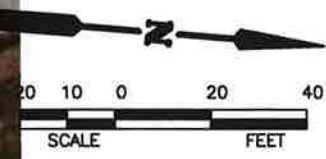
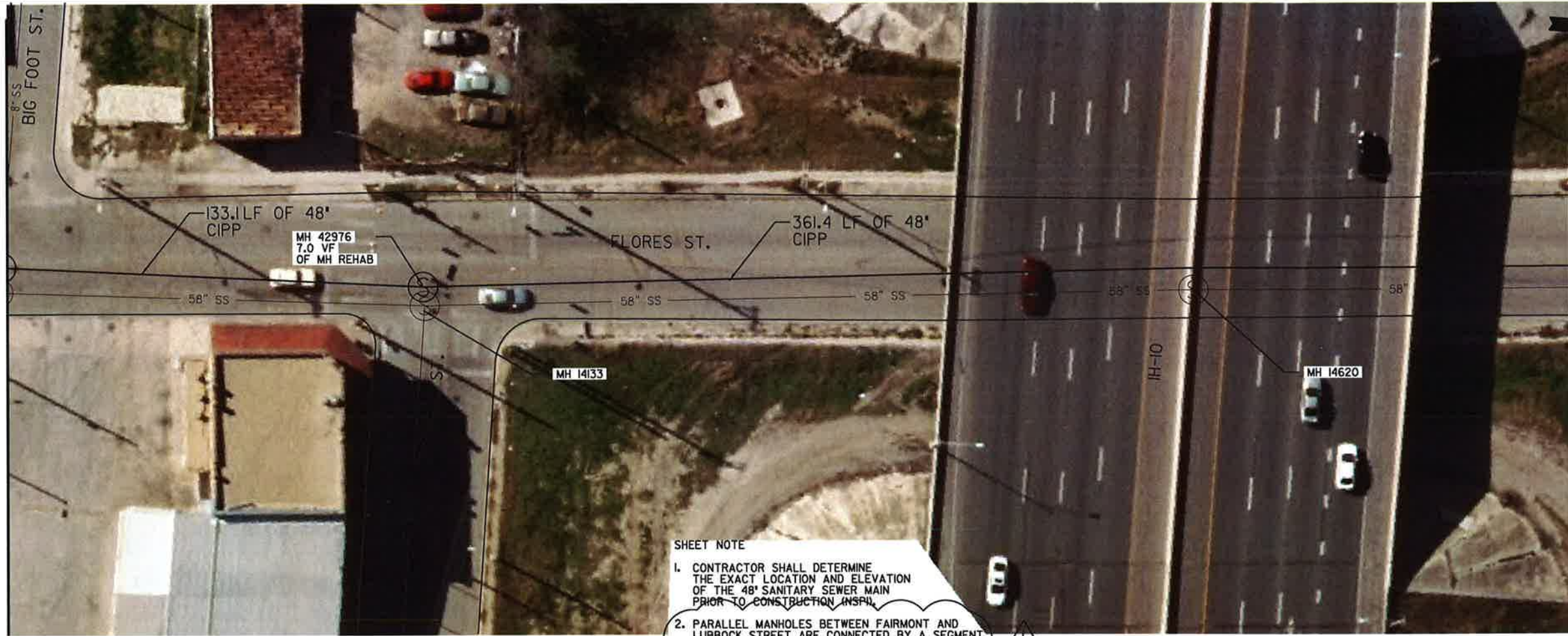
BEGIN PROJECT TO  
 MATCH LINE B-B

Date: NOVEMBER 1, 2013  
 Designed: EG  
 Drawn: EG  
 Reviewed: HJC  
 CP&Y Proj. No. SAW100054.09

SHEET - OF 27



MATCHLINE B-B



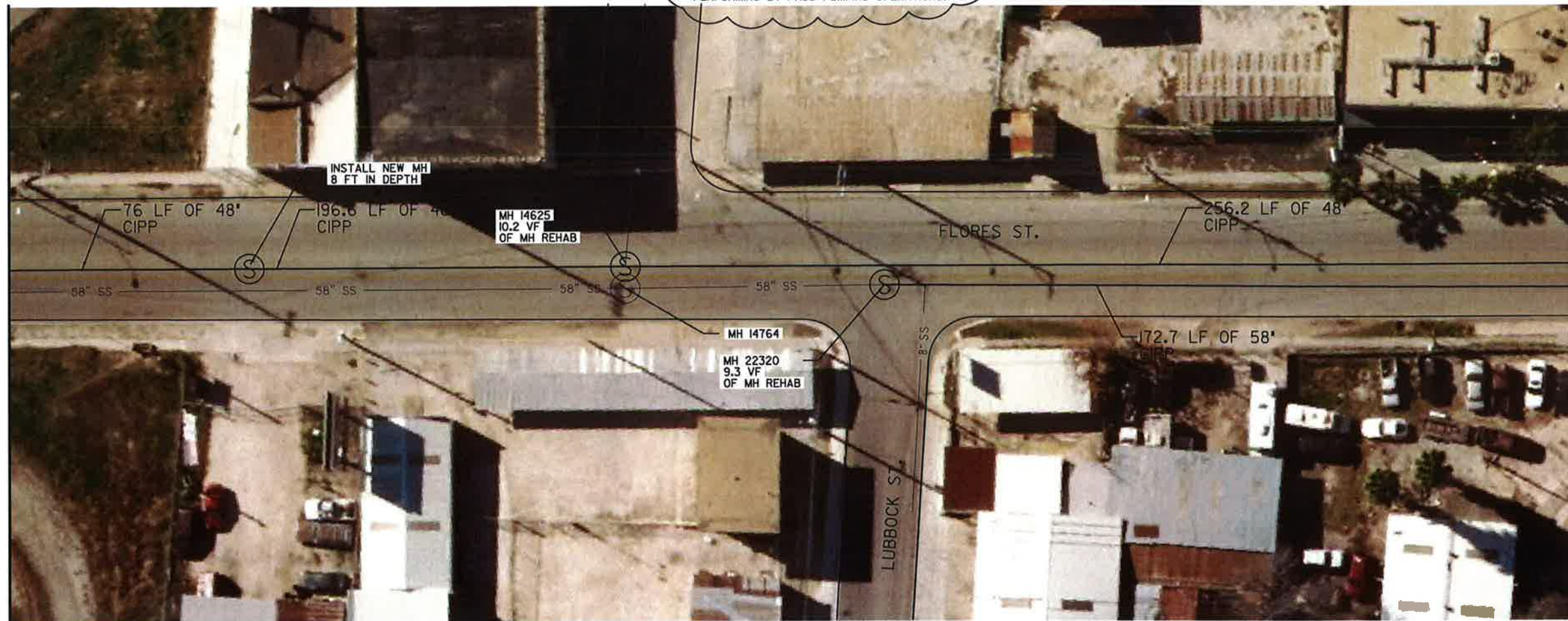
MATCHLINE C-C

**SHEET NOTE**

- CONTRACTOR SHALL DETERMINE THE EXACT LOCATION AND ELEVATION OF THE 48" SANITARY SEWER MAIN PRIOR TO CONSTRUCTION INSPN.
- PARALLEL MANHOLES BETWEEN FAIRMONT AND LUBBOCK STREET ARE CONNECTED BY A SEGMENT OF PIPE. CONTRACTOR SHALL NOT REHABILITATE SAID LINES, AND TAKE INTO ACCOUNT WHEN PERFORMING BY-PASS PUMPING OPERATIONS.



MATCHLINE C-C



MATCHLINE D-D

SAWS JOB NO. 13-4808

**CP&Y**  
300 E. SONTERRA BLVD.  
SAN ANTONIO, TX 78258  
TYPE REGISTRATION #F-1741

**SAN ANTONIO WATER SYSTEM**

NO.	REVISION	DATE	BY	HC	DATE
1.	SHEET NOTE ADDED	11/13			

VERIFY SCALE: 1" = 40' (AS SHOWN)  
DRAWING SCALE: 1" = 40' (AS SHOWN)  
THIS SHEET, AS SHOWN, IS NOT TO BE USED FOR CONSTRUCTION.

**SAN ANTONIO WATER SYSTEM**  
S. FLORES ST. DR.-127  
48" & 60" OUTFALL REHAB. PROJECT

MATCH LINE B-B TO  
MATCH LINE D-D

Date: NOVEMBER 1, 2013  
Designed: EG  
Drawn: EG  
Reviewed: HJC  
CP&Y Proj. No. SAW100054.09

**SHEET**  
SHEET - OF 27



11/13/2013 4:15:25 PM hcabrera p:\Active Projects\SAW10054 - Unspecified Water Sewer Rehab 2009\SAWS100054.09\8.00 Plans and Drawings\8\_30\_Cut Sheets\10005409SCVPP03.dgn

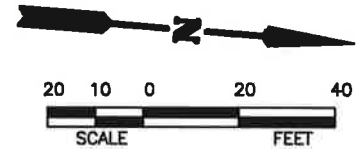
NO.	CALLOUT, SHEET NOTES, DETAIL	HC	BY	DATE
1.	CALLOUT, SHEET NOTES, DETAIL			11/13

VERIFY SCALE  
 BAR IS ONE INCH ON ORIGINAL DRAWING, NOT ONE INCH ON THIS SHEET. ADJUST SCALE

SAN ANTONIO WATER SYSTEM  
 S. FLORES ST. DR.-127  
 48" & 60" OUTFALL REHAB. PROJECT

MATCH LINE D-D TO  
 END OF PROJECT

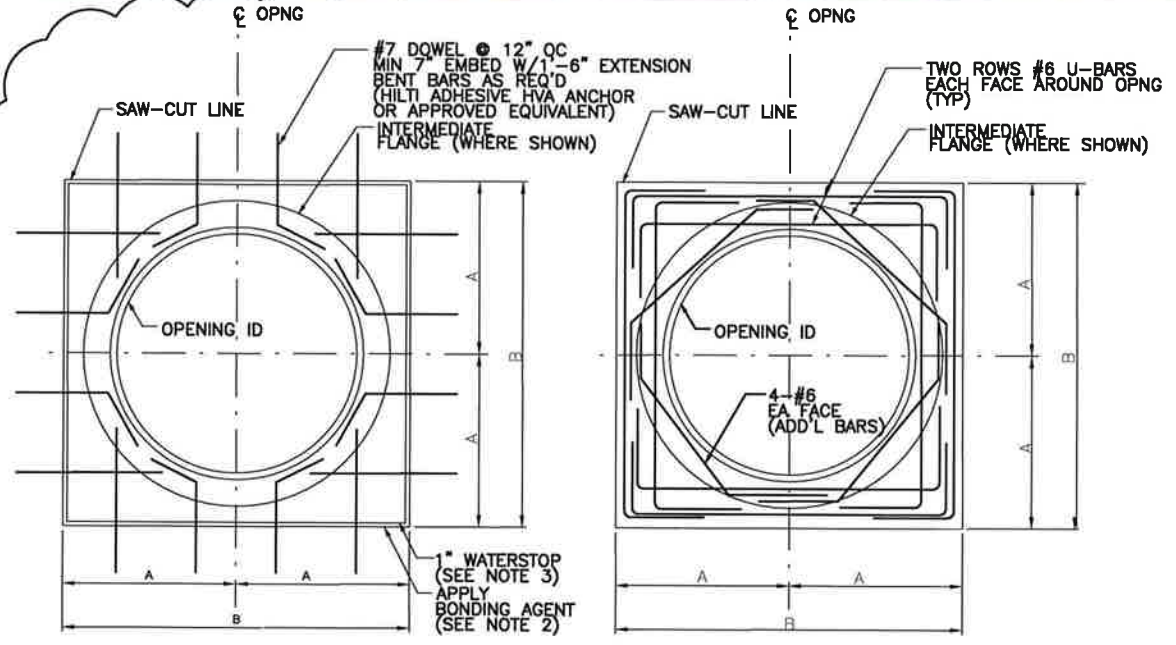
Date: NOVEMBER 1, 2013	EG	EG	HJC
Designed:			
Drawn:			
Reviewed:			
CP&Y Proj. No. SAW100054.05			



- SHEET NOTES**
- CONTRACTOR SHALL DETERMINE THE EXACT LOCATION AND ELEVATION OF THE 54" FORCE MAIN TURNS TOWARD THE CREEK CHANNEL PRIOR TO CONSTRUCTION (NSPI).
  - PRIOR TO PROVIDING AN OPENING AND REHABILITATING MH STRUCTURE 14482, CONTRACTOR SHALL VIDEOTAPE AND/OR VIDEORECORD THE EXISTING STRUCTURE FOR A STRUCTURAL CONDITION ASSESSMENT.
  - CONTRACTOR SHALL MAINTAIN EXISTING REINFORCEMENT WITHIN THE EXISTING STRUCTURE BY CUTTING THE EXISTING STRUCTURAL BARS NECESSARY FOR THE STRUCTURE OPENING.
  - PARALLEL MANHOLES BETWEEN FAIRMONT AND LUBBOCK STREET ARE CONNECTED BY A SEGMENT OF PIPE. CONTRACTOR SHALL NOT REHABILITATE SAID LINES, AND TAKE INTO ACCOUNT WHEN PERFORMING BY-PASS PUMPING OPERATIONS.

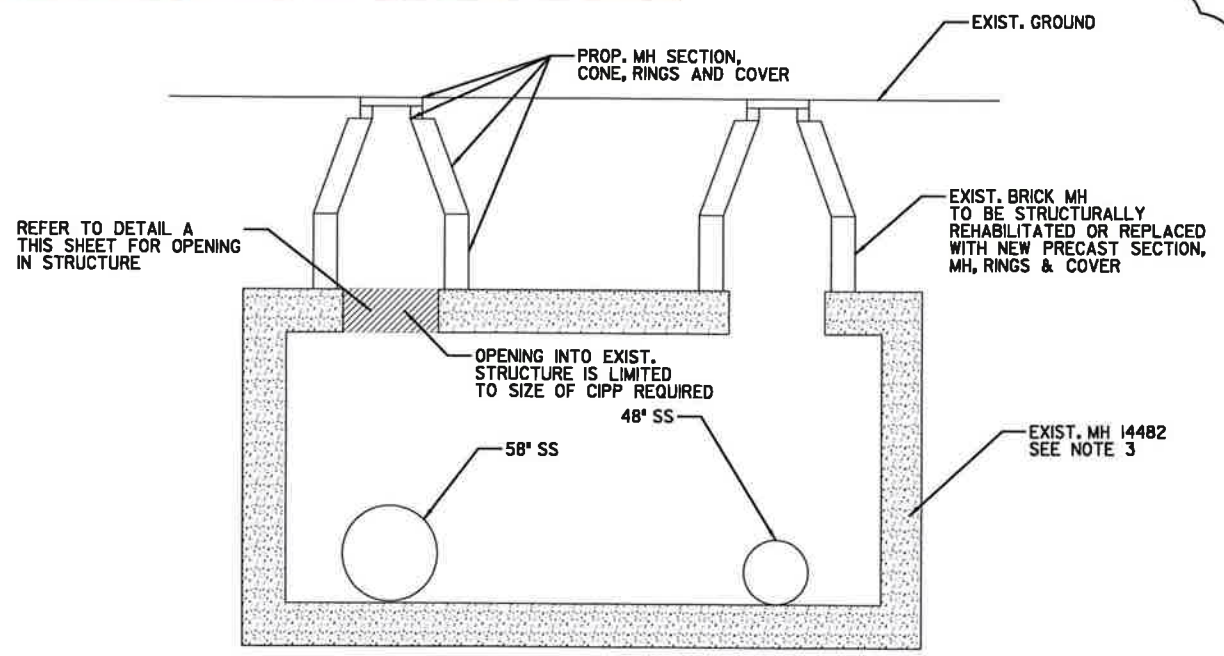


MATCHLINE D-D



- NOTES:**
- PIPE END STEEL RING OR BARS MAY BE EXPOSED TO CONNECT EXISTING WALL. REFER TO PIPE MANUFACTURER'S DETAILS AS REQ'D.
  - CONCRETE BONDING AGENT PRODUCT SHALL BE IN ACCORDANCE WITH ASTM C881 TYPE II REQUIREMENTS.
  - WATERSTOP SHALL BE PLACED AT MIDDLE OF WALL AROUND OPENING. PRODUCT MAY BE MADE BY "VOLCLAY RX101".
  - DIMENSION A = HALF PIPE OD + 3" (MIN) OR  
 A = HALF INTERMEDIATE FLANGE OD + 3"  
 B = 2 TIMES OF A
  - DIMENSION A & B MAY BE REDUCED IF PIPE END STEEL EXPOSED.

**(A) OPENING THRU EXIST WALL / FLOOR**  
 NTS



**(B) MH STRUCTURE 14482**  
 NTS

**SECTION 03100**  
**CONCRETE FORMWORK**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This section defines requirements for design, construction, erection and removal of concrete formwork.

**1.02 RELATED WORK**

- A. Coordinate the requirements of this section with all other sections of Division 3 - Concrete.

**1.03 REFERENCE STANDARDS**

- A. American Concrete Institute (ACI).
  1. American Concrete Institute; ACI 117, Standard Specifications for Tolerances for Concrete Construction and Materials.
  2. American Concrete Institute; ACI 301, Specifications for Structural Concrete.
  3. American Concrete Institute; ACI 347, Recommended Practice for Concrete Formwork.

**1.04 SUBMITTALS**

- A. Submittals shall be prepared and submitted in accordance with Section 01300 - Submittals.
- B. Submit MANUFACTURER's literature, data and installation instructions for all proprietary materials, manufactured form systems, ties and accessories.
- C. Submit proposed method of sealing form tie holes; coordinate with details shown.

**1.05 STORAGE AND HANDLING OF MATERIALS**

- A. Store materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective waterproof covering, providing for adequate ventilation. Store materials in accordance with all MANUFACTURER's recommendations.
- B. Form lumber shall be delivered to the job site as far in advance of its use as is practical, and shall be carefully stacked clear of the ground in such a manner as to facilitate air-drying.
- C. Handle materials to prevent damage in accordance with the MANUFACTURER's recommendations.

**1.06 QUALITY ASSURANCE**

- A. Design Criteria for Formwork, Falsework and Shoring
  1. The design and engineering of all concrete formwork, including all shoring, bracing and reshoring, shall be the responsibility of the CONTRACTOR and shall be performed by an ENGINEER registered in the state where the project is located.

2. Design for loads, lateral pressure, and allowable stresses as described in ACI 347. Design for all lateral loads and other applicable requirements of controlling local building codes.
3. Camber formwork to compensate for anticipated deflection during placement of concrete when required to maintain specified tolerances.
4. Design formwork to be readily removed without impact, shock, or damage to concrete surfaces and adjacent materials.
5. Design for fresh concrete as the pressure exerted by a liquid weighing 150 pounds per cubic foot. Additionally, the rate of concrete placement, concrete temperature and all other pertinent factors shall be taken into account.
6. Design for all construction loads imposed during construction.
7. Forms shall have adequate stiffness to maintain mortar-tightness and true final dimensions of member being constructed within specified construction tolerances.
8. Falsework and shoring shall be designed to provide required strength and stiffness to insure safety and that no excessive settlement or deformation occurs.
9. Falsework and shoring shall be supported on an adequate foundation to provide required strength and stiffness to support the superimposed load without settlement.

B. Alignment Control & Allowable Tolerances

1. Construct and erect formwork in accordance with ACI 117, ACI 301 and ACI 347.
2. True alignment of walls and other vertical surfaces having straight lines shall be controlled and checked. Forming shall be arranged with provisions for adjusting the horizontal alignment after the form has been filled with concrete. Establish a transit line or other reference so that adjustments can be made to an established line while the concrete is still plastic.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Lumber

1. Properly seasoned and of good quality; free from loose or unsound knots, holes, shakes, splits, decay and other imperfections that would affect its strength or adversely affect the finished concrete surface.

B. Form Linings

1. Fiberboard: Hardwood finished smooth on one side with minimum thickness of 3/16 inch.
2. Plywood: Conforming to APA HDO; exterior exposure waterproof adhesive with minimum thickness of 3/8 inch.

C. Form Release Agent:

1. A ready to use water based material formulated to eliminate or reduce surface imperfections free of kerosene, mineral oils, waxes or resins.
2. Release agent shall not discolor or injuriously affect the finished concrete surface, subsequent coatings or concrete curing.

D. Coating for Plastic Forms



1. Alkali-resistant gel-coat.

## 2.02 FABRICATIONS

### A. Forms

#### 1. General

- a. Chamfers: Provide a chamfer on all exposed edges by using either wooden or plastic chamfer strips. Chamfer strips shall be a forty-five degree right triangle in section with the two shorter sides measuring 3/4-inch.
- b. Waterproofed Surfaces: At surfaces to be waterproofed, provide formwork with sufficient anchor pattern to facilitate bond of the membrane waterproofing.

#### 2. Smooth Forms:

- a. Construct formwork with plywood; tempered, concrete-form hardboard; dressed lumber faced with plywood or fiberboard lining; metal; plastic; or metal-framed plywood-faced panel material acceptable to the ENGINEER to provide continuous, straight smooth surfaces. Form material will be free of raised grain, torn surfaces, worn edges, patches, dents or other defects. Furnish material in largest practical sizes to minimize the number of joints and, when shown on the drawings, conform to the joint system shown. Form material will have sufficient strength and thickness to withstand the pressure of newly placed concrete without bow or deflection.
- b. Smooth forms will be used on all concrete surfaces exposed to view or liquid in the completed structure.

#### 3. Rough Forms:

- a. Construct forms of dressed or undressed lumber free of knots, splits, or other defects; plywood; metal; or other material acceptable to the ENGINEER. Material shall have sufficient strength and thickness to withstand the pressure of newly placed concrete without bow or deflection.
- b. Rough forms may be used on concrete surfaces that will not be exposed to view or liquid in the completed structure.

### B. Void/Carton Forms.

1. Use new carton forms of corrugated cardboard. Forms shall be impregnated throughout with paraffin and laminated with water resistant adhesive. Do not use trapezoidal carton forms.
2. Forms of the height indicated on the drawings shall be designed to support the wet concrete plus normal construction loads.
3. Install carton forms according to the MANUFACTURER's recommendation and maintain in a dry condition prior to concrete placement. Carton forms that have not been maintained in a dry condition shall be replaced before concrete is placed.
4. Acceptable MANUFACTURERS:
  - a. VoidForm Products
  - b. Savway Carton Forms
  - c. Voidco Fiberboard Void Forms

### C. Metal Forms

1. All specified requirements for "Forms" regarding design, mortar tightness, geometry, bevels, chamfers, bracing, alignment, removal, re-use, oiling, etc. shall apply equally to metal forms.

2. Metal used for forms shall have adequate thickness to remain true to shape. Clamps, pins and other connecting devices shall be designed to hold the forms rigidly together and allow form removal without injury to the concrete.
3. Bolt and rivet heads on exposed surfaces shall be countersunk.
4. Metal forms that do not present a smooth surface free from rust, grease or other foreign materials that discolor concrete shall not be used.

D. Slip Forming

1. Slip forming is not permitted.

2.03 FORM ACCESSORIES

A. Form Ties

1. Form ties shall be of the removable end, permanently embedded body type and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.
2. Use removable cones of one-inch by one-inch minimum size on the end of the form tie.
3. Grout depressions left in concrete by the cones with non shrink grout after the ends of the cones have been removed.

B. Form Sealer

1. Surface sealer that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces when applied to most forms or form liners. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulations.

PART 3 EXECUTION

3.01 FORM CONSTRUCTION

A. General

1. All formwork, scaffolds and work platforms shall be safe and conform to OSHA Requirements.
2. Construct and maintain formwork, complying with ACI 347 and these specifications so that it will maintain correct sizes of members, shape, alignment, elevation and position during concrete placement and until concrete has gained sufficient strength. Provide for openings, offsets, sinkages, keyways, recesses, moldings, anchorages and inserts, as required.
3. Construct forms for easy removal without damage to concrete surfaces.
4. Formwork shall be sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.
5. Chamfer strips shall be placed in forms to bevel all edges and corners permanently exposed to view, except the top edges of walls and slabs which are shown to be tooled. Edges of formed joints and interior corners shall not be beveled unless shown or specified

otherwise. Equipment bases shall have formed beveled edges for all vertical and horizontal corners. Unless otherwise noted, bevels shall be 3/4-inch wide.

6. Form ties shall be employed in such places and at such intervals as to securely hold the forms in position during the placing of concrete, and to withstand the weight and pressure of the wet concrete. Ties of a type intended to be entirely removed shall be coated with an acceptable lubricant to safeguard against damaging the concrete during such removal. The use of wire ties will not be permitted.
7. Provide temporary openings at the base of column and wall forms and at other points as required to facilitate observation and cleaning immediately before concrete is placed. Temporary opening shall be 2' x 2' in size or as required by OWNER's Representative.
8. If runways are required for moving equipment, provide for support of runways with struts or legs resting directly on the formwork or structural member. Do not allow runways or supports to rest on reinforcing steel.
9. Provide openings below large pipe (over 10" diameter) or large embedments to allow adequate concrete fill and minimize honeycombs and voids.
10. Construct forms with such care as to produce concrete surfaces which will not have unsightly or objectionable form marks in exposed concrete surfaces. Forms shall have all contact surfaces thoroughly cleaned before reuse.

B. Forms for Surfaces Exposed to View or Liquid:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Form ties shall be uniformly spaced and aligned in rows.
2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
3. Form molding shapes, recesses and projections with smooth-finish materials and install in forms with sealed joints to prevent displacement.
4. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines. Provide all exterior exposed corners with 3/4-inch chamfer.
5. Arrange facing material in an orderly and symmetrical fashion. Keep the number of seams to a practical minimum. Support facing material adequately to prevent deflection in excess of allowable tolerances.
6. For flush surfaces exposed to view in the completed structure, overlap previously placed hardened concrete with form sheathing by approximately 1-inch. Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.

C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finish slab surface. Provide and secure units to support types of screeds required.

D. Surface to Receive Membrane Waterproofing: Provide chamfers for external corners in concrete surfaces that will be covered with membrane waterproofing. Provide a continuous reglet at line of top of membrane waterproofing on vertical surfaces. Coordinate location with waterproofing applicators.



### 3.02 TOLERANCES

- A. Construct formwork so that concrete surfaces will conform to tolerance limits as listed in ACI Sections 117, 301 and 347.
- B. Establish sufficient control points and bench marks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the project.

### 3.03 ADJUSTMENTS OF FORMWORK

- A. Use wedges or jacks to provide positive adjustment of shores and struts. Wedges used for final adjustment of forms should be fastened in position after final inspection and before concrete placement.
- B. Securely brace forms against lateral deflections. Prepare to compensate for settling during concrete placement.
- C. For wall openings, construct wood forms that facilitate any necessary loosening to counteract swelling of forms.

### 3.04 PREPARATION OF FORM SURFACES

- A. Before placing concrete, clean surfaces of forms and embedded materials. Remove accumulated mortar, grout, rust and other foreign matter.
- B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material used in strict accordance with the MANUFACTURER's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.
- C. Other than retained-in-place metal forms, forms for unexposed surfaces may be wet with water immediately before concrete placement in lieu of coating. One exception is that when a possibility of freezing temperatures exists, use of a coating is mandatory.

### 3.05 REMOVAL OF FORMS

- A. Forms shall not be removed until the concrete has adequately hardened and set. Clamps or tie rods may be loosened twenty-four (24) hours after the concrete is placed; ties, except for a sufficient number to hold the forms in place, may be removed at that time.
- B. Forms on vertical surfaces, when repair of surface defects or finishing is required before concrete is aged, may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed provided that concrete has

hardened sufficiently to resist damage from removal operations and provided the removal of these forms will not disturb members supporting the weight of the concrete.

- D. All forms and shoring used to support weight of concrete or any construction loads shall remain in place until concrete has reached the minimum strength specified for removal of forms and shoring. In no case shall forms be removed in less than 4 days.

### 3.06 REMOVAL STRENGTH

- A. Control Tests: Suitable strength control tests will be used as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs, and other structural members.
  - 1. Field-Cured Test Cylinders. When field-cured test cylinders reach the specified removal strength, formwork or shoring may be removed from the respective concrete placements. Strength data from field-cured test cylinders shall be furnished by the CONTRACTOR.
  - 2. Laboratory-Cured Test Cylinders. When concrete has been cured as specified for cast-in-place concrete for the same time period required by laboratory-cured cylinders to reach specified strength, the formwork or shoring may be removed from respective concrete placements. Determine the length of time that the concrete placement has been cured by totaling the number of days or fraction of days, not necessarily consecutive, during which the air temperature surrounding the concrete is above 50 degrees F and the concrete has been damp or thoroughly sealed against evaporation and loss of moisture.
- B. Compressive Strengths: The minimum concrete compressive strengths for removal of all formwork supporting the weight of concrete shall be 75 percent of the specified minimum 28 day strength of the class of concrete involved.

### 3.07 RESHORING

- A. When reshoring is permitted or required, plan operations in advance and secure acceptance of such operations. While reshoring is under way, keep live load off the new construction. Do not permit concrete beams, slab, column or other structural member to be subjected to combined dead and construction loads in excess of loads permitted for developed concrete strength at the time of reshoring.
- B. Place reshores as soon as practicable after stripping operations are complete but in no case later than the end of the working day on which stripping occurs. Tighten reshores to carry the required loads without overstressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength at time of removal of formwork supporting the weight of concrete.
- C. Floors supporting shores under newly placed concrete shall have their original supporting shores left in place or shall be reshored. The reshores shall be located directly under a shore position above unless other locations are permitted. Extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.
- D. Reshoring shall comply with ACI 301, "Specifications for Structural Concrete for Buildings".

3.08 FORM REUSE

- A. Do not reuse forms that are worn or damaged beyond repair. Thoroughly clean and recoat forms before reuse. For wood and plywood forms to be used for exposed smooth finish, sand or otherwise dress concrete contact surface to original condition or provide form liner facing material. For metal forms, straighten, remove dents and clean to return to original condition.

END OF SECTION

## SECTION 03200

### CONCRETE REINFORCEMENT

#### PART 1 GENERAL

##### 1.01 SCOPE

- A. This section specifies requirements for all concrete reinforcement.

##### 1.02 RELATED WORK

- A. Coordinate the requirements of this section with all other sections of Division 3, Concrete.

##### 1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):

1. ASTM A36: Standard Specification for Structural Steel.
2. ASTM A82: Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A184: Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
4. ASTM A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
5. ASTM A496: Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
6. ASTM A497: Standard Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
7. ASTM A615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
8. ASTM A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
9. ASTM A775: Standard Specification for Epoxy-Coated Steel Reinforcing Bars.

- B. American Concrete Institute (ACI):

1. ACI 315: Manual of Standard Practice for Detailing Reinforced Concrete Structures.
2. ACI 318: Building Code Requirements for Reinforced Concrete.
3. ACI 350: Code Requirements for Environmental Engineering Concrete Structures

- C. Concrete Reinforcing Steel Institute (CRSI)

1. CRSI Manual of Standard Practice.

##### 1.04 SUBMITTALS

- A. Submittals shall be prepared and submitted in accordance with Section 01300 - Submittals.

- B. Certificates: Submit the MANUFACTURER's certificate giving the properties of steel proposed for use. List the MANUFACTURER's test number and heat number, chemical analysis, yield point, tensile strength and percent elongation. Also identify on the certificates the proposed location of the steel in the work.
- C. Bill of Materials: Submit bills of materials to be reviewed with shop drawings.
- D. Shop Drawings:
  - 1. Show reinforcement fabrication, bar placement location, splices, spacing and bar designation, bar type, length, size, bending, number of bars, bar support type, and other pertinent information, including dimensions. Information must correspond directly to data listed on the bill of materials.
  - 2. Provide sufficient detail to permit placement of reinforcement without use of design drawings. Reproduction of design drawings for use as shop drawings will not be allowed. Do not begin fabrication of reinforcing steel until after shop drawings have been reviewed by the OWNER's Representative.
  - 3. Detail shop drawings in accordance with ACI 315.
  - 4. Rebar submittal shall include following information.
    - a. Grade of bars.
    - b. Table of bending dimensions, bar size, bar length, number of bars and spacing.
    - c. The reinforcing shall be listed separately for each structural element (wall, slab, footing, beam, etc.). Each element shall be labeled on the bar list and clearly identified on the shop drawings.
    - d. Each bar shall be identified such as corner bars, tie bars, vertical bars, etc.
- E. Quality Control Submittals.
  - 1. Mechanical Threaded Connections.
    - a. Provide verification that device threads have been checked and meet all requirements for thread quality, in accordance with MANUFACTURER's published methods.
  - 2. Mill Test Reports.
    - a. Provide certified copies, evidencing compliance with the requirements of these Specifications, shall be delivered to the OWNER with all deliveries of reinforcing steel.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Unloading, storing and handling bars on the job shall meet CRSI publication "Placing Reinforcing Bars", and the following:
  - 1. Deliver steel with suitable hauling and handling equipment.
  - 2. Tag steel for easy identification.
  - 3. Store to prevent contact with the ground.
  - 4. Protect reinforcing, as far as practicable, from mechanical injury, surface deterioration and rusting caused by exposure to the weather.

## 1.06 NOTIFICATION

- A. Notify the OWNER's Representative at least 48 hours before concrete placement so that reinforcement may be inspected and errors corrected without delaying the work.

## PART 2 PRODUCTS

### 2.01 REINFORCEMENT

- A. Deformed Bars: Use Grade 60 deformed bars conforming to ASTM A615 unless indicated otherwise in the drawings.
- B. Welded Wire Fabric:
  - 1. Welded Deformed Wire Fabric. Conform to ASTM A497 unless indicated otherwise in the drawings.
  - 2. Provide wire size, spacing and type as shown.
- C. Marking: Clearly mark all bars and welded wire fabric with waterproof tags showing the number of bars, size, mark, length and yield strength. Mark steel with the same designation as the member in which it occurs. Key marks to the concrete placement number as designated on the concrete place sequence shop drawings.

### 2.02 MECHANICAL CONNECTIONS

- A. Reinforcing steel bars shall be spliced with a mechanical connection when either called for in the drawings. Splices may also be made with a mechanical connection when permitted by the ENGINEER in writing.
- B. Mechanical Couplers
  - 1. The mechanical coupler shall meet building code requirements for developing in tension or compression. The coupler may be one of two types:
    - a. Positive locking, taper threaded type coupler manufactured from high quality steel. The bar ends must be taper threaded using the MANUFACTURER's requirements.
    - b. Mechanical butt splices utilizing lock-shear bolts and internal serrated grip rails within the coupling sleeve..
  - 2. The mechanical coupler shall develop both tension and compression to a minimum of 125 percent of the specified yield strength of the reinforcing bar.
  - 3. Product and MANUFACTURER: Provide one of the following:
    - a. LENTON taper threaded couplers as manufactured by ERICO.
    - b. Bar Lock mechanical coupler system manufactured by Dayton Superior.
- C. Metal Sleeve
  - 1. Provide with cast filler metal, capable of developing in tension or compression a minimum of 100 percent of specified ultimate tensile strength of the bar.
  - 2. Product and MANUFACTURER: Provide one of the following:
    - a. CADWELD Full Tensile Strength Splices, as manufactured by ERICO.
    - b. Or approved equal.

## 2.03 TIE WIRE

- A. 16-gauge, black, soft-annealed wire where tie wire is not closer than 1 inch from surface of form after tying in place.
- B. Provide nylon-, epoxy-, or plastic-coated tie wire to fasten noncoated reinforcing steel, unless tie wire is bent to maintain a minimum of 1 inch from surface of form.

## 2.04 BAR SUPPORTS

- A. Provide chairs, riser bars, ties and other accessories made of metal, except as otherwise specified. Bar supports and accessories shall be of the sizes required to provide concrete cover as specified. Metal bar supports and accessories shall be Class 1 or 2 conforming to the requirements of CRSI Manual of Standard Practice.

## 2.05 FABRICATION

- A. Bending: Shop fabricate bars to the shapes shown on the drawings by cold bending. Bends shall conform to the minimum bend diameters specified in ACI 318. Do not heat, straighten or rebend bars without specific written acceptance. Field bending of bars is not permitted.
- B. Splices: Locate splices as shown on the drawings. Where it is necessary to splice reinforcement at locations other than shown on the drawings, the splices shall be accepted by the ENGINEER. Use a minimum number of splices located at the points of minimum stress. Stagger splices in adjacent bars. Length of lap splices shall be in accordance with ACI 315, unless called out in the contract drawings. When there is a conflict between ACI 315 and the drawings the more restrictive provision shall apply.
- C. Fabrication Tolerances:
  - 1. Bars must conform to the fabrication tolerances listed in all reference specifications. When there is a conflict in the reference specifications the more restrictive requirement shall apply.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Meet all requirements in, "Placing Reinforcing Bars", published by Concrete Reinforcing Steel Institute (CRSI).

### 3.02 CLEANING

- A. Clean reinforcement of all scale, loose or flaky rust or other foreign material, including oil, mud or coating that will reduce the bond to concrete.

### 3.03 PLACEMENT

- A. Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to properly assemble, space and support reinforcing. Wire ties through forms and temporary spacers will not be allowed. Provide accessories of sufficient number, size and strength to adequately prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Use appropriate accessories to position and support bolts, anchors and

other embedded items. Tie reinforcing bars at each intersection and to accessories. Blocking reinforcement with concrete or masonry is prohibited.

- B. Placement for Concrete on Ground: Support reinforcement on precast concrete blocks spaced at approximately 3 feet on centers each way. Use a minimum of one block for each 9 square feet. Tie blocks to at least one reinforcing bar using tie wires embedded in the block.
- C. Placement Tolerances: Meet the placement tolerances listed in all reference specifications. When there is a conflict in the reference specifications the more restrictive requirement shall apply.
- D. Interferences: If reinforcing interferes with the location of other reinforcing steel, conduits or embedded items, bars may be moved within specified tolerances or one bar diameter whichever is greater. If greater movement of bars is required to avoid interference, notify the OWNER's Representative. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without approval of the OWNER's Representative.
- E. Bundle or space bars as accepted on shop drawings, instead of bending where construction access through reinforcing is necessary.
- F. Install in accordance with accepted shop drawings.
- G. Protection, Spacing and Positioning.
  - 1. Conform with reviewed placing drawings, design drawings, and all applicable reference specifications. When there is a conflict in the reference specifications the more restrictive requirement shall apply.
- H. Splices:
  - 1. Do not splice bars, except at locations shown on the drawings or the reviewed shop drawings, without approval of the OWNER.
  - 2. Lap Splices. Tie securely with wire to prevent displacement of splices during placement of concrete.
  - 3. Stagger splices in adjacent bars.
- I. Construction Joints.
  - 1. Place reinforcing continuous through construction joints.
- J. Reinforcement Around Openings.
  - 1. Place an equivalent area of steel around pipe or opening and extend on each side sufficiently to develop bond in each bar.
  - 2. Refer to Details on Drawings for bar extension length of each side of opening.
  - 3. Where welded wire fabric is used, provide extra reinforcing using fabric or deformed bars.

### 3.04 PLACING WELDED WIRE FABRIC

- A. Meet current ACI 318 and current Manual of Standard Practice, Welded Wire Fabric, by the Wire Reinforcement Institute regarding placement, bends, laps and other requirements.



- B. Install wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus 2 inches, or 6 inches, whichever is larger. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.
- C. Tie laps and splices securely at ends and at least every 24 inches with 16-gauge black annealed steel wire.
- D. Place welded wire fabric on concrete blocks at proper distance above bottom of slab and rigidly support equal to that furnished for typical deformed bar reinforced steel.
- E. Do not use fabric that has been rolled. Install flat sheets only.

### 3.05 FIELD BENDING

- A. Field bending of reinforcing steel bars is not permitted.

### 3.06 FIELD CUTTING

- A. Reinforcing bars cut on the job shall be cut by shearing or sawing. Do not cut bars with a cutting torch.

### 3.07 MECHANICAL SPLICES AND CONNECTIONS

- A. Use only in areas shown in the drawings or specifically accepted in writing by the ENGINEER.
- B. Install as required by MANUFACTURER.
- C. Carefully inspect each splice and verify that each component meets MANUFACTURER's requirements.
- D. Maintain minimum edge distance and concrete cover.

END OF SECTION

## SECTION 03250

### CONCRETE JOINTS AND EMBEDDED ITEMS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This section specifies requirements for all concrete joints and embedded items for all cast-in-place concrete.

##### 1.02 RELATED WORK

- A. Division 3 - Concrete
- B. Division 11 - Equipment
- C. Division 15 - Mechanical
- D. Coordinate work of this section with all other sections to obtain a proper installation. Review all drawings and specifications for additional requirements for joints and embedded items.

##### 1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
  1. ASTM A120 - Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.
  2. ASTM C881 - Standard Specifications for Epoxy Resin Base Bonding Systems for Concrete.
  3. ASTM C920 - Elastomeric Joint Sealants.
  4. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
  5. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
  6. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
  7. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
  8. ASTM D1190 - Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type.
  9. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  10. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
  11. ASTM D1850 - Standard Specification for Concrete Joint Sealer, Cold Application Type.
  12. ASTM D2240 - Standard Test Method for Rubber Property - Durometer Hardness.
  13. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

- B. American Concrete Institute (ACI)
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 503.2 - Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.
- C. U.S. Army Corps of Engineers (CRD)
  - 1. CRD-C572 - Corps of Engineers Specifications for Polyvinyl Chloride Waterstops.

#### 1.04 SUBMITTALS

- A. Submittals shall be prepared and submitted in accordance with Section 01300 - Submittals.
- B. Shop Drawings. Submit shop drawings showing all concrete joints, proposed sequences for concrete placement and type of concrete specified.
- C. Product Data.
  - 1. Submit MANUFACTURER's technical literature on all products proposed for review. The submittal shall include the MANUFACTURER's installation and/or application instruction.
  - 2. When substitutions are proposed for acceptable brands of materials specified herein, submit brochures and samples of proposed substitutions to the ENGINEER for acceptance before delivery to the project.

#### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials used for joints in concrete shall be stored and covered to prevent contact with the ground and to avoid contact with weather and direct sunlight. Follow all additional requirements of the MANUFACTURER.

### PART 2 PRODUCTS

#### 2.01 CONCRETE EXPANSION JOINTS (GENERAL)

- A. Expansion Joint Sealant
  - 1. Single or multi-component cold-applied polyurethane elastomeric joint sealant conforming to ASTM C920. Sealant must be appropriate for the specific application. Provide joint primer according to MANUFACTURER's recommendation.
  - 2. Material Properties:
    - a. Ultimate hardness (ASTM D2240, Type A, Shore): 20 to 45.
    - b. Tensile strength (ASTM D412): 200 psi minimum.
    - c. Ultimate elongation (ASTM D412): 400% minimum.
    - d. Tear strength (ASTM D624, die C): 75 psi per inch of thickness, minimum.
    - e. Color: gray.
- B. Expansion Joint Filler
  - 1. Resilient non-bituminous material conforming to ASTM D 1752. Material must be compatible with the joint sealant.
- C. Joint Accessories
  - 1. Backer Rod

- a. Extruded closed-cell polyethylene foam rod compatible with the joint sealant. Rod shall be 25% larger than the joint opening.
  - 2. Bond Breaker Tape
    - a. Polyethylene or TFE-fluorocarbon self adhesive tape, compatible with the joint sealant.
- 2.02 CONCRETE EXPANSION JOINTS (EXTERIOR ROADWAY & PAVEMENTS ONLY)
- A. Expansion Joint Sealant
    - 1. Hot-poured elastic joint sealant conforming to ASTM D1190. Sealant must be appropriate for concrete pavement. Provide joint primer according to MANUFACTURER's recommendation.
  - B. Expansion Joint Filler
    - 1. Preformed bituminous type conforming to ASTM D994. Material must be compatible with the joint sealant.
- 2.03 CONCRETE CONSTRUCTION JOINT ROUGHENER
- A. Water-soluble non-flammable surface-retardant roughener.
- 2.04 CONCRETE BONDING AGENT
- A. Concrete Exposed to Water and/or Chemicals
    - 1. ASTM C881, Type II. Grade and Class shall be as required for the project application. A field service representative of the MANUFACTURER shall be available during initial application to instruct the CONTRACTOR in the proper use of the product when so requested by the ENGINEER or the OWNER.
  - B. Concrete Not Exposed to Water or Chemicals
    - 1. Acrylic Bonding Agent. Acrylic bonding agent shall conform to ASTM C1059 latex agent for bonding fresh to hardened concrete surface not in contact with water, chlorine, ammonia etc.
- 2.05 BOND BREAKER
- A. 30-pound asphalt saturated felt.
- 2.06 EXPANSION JOINT DOWELS
- A. Smooth steel bars shall conform to the requirements of Section 03200. Cut dowels to length at shop or mill before delivery to the site. Dowels must be straight and clean, free of loose flaky rust and loose scale.
- 2.07 EXPANSION JOINT DOWEL SLEEVES
- A. ASTM A120, standard weight galvanized pipe.

## 2.08 WATERSTOPS

### A. Polyvinyl Chloride Waterstops

1. Material Requirements
  - a. Waterstops shall be extruded from virgin polyvinyl chloride compound and shall conform to the requirements of the Corps of ENGINEERS Specification CRD-C572. Waterstops shall be uniform in dimension, homogenous and free from porosity. No reclaimed or scrap material may be used.
  - b. Tensile strength: 1400 psi minimum
  - c. Ultimate Elongation: 280 percent minimum
2. Construction Joints
  - a. Ribbed type without center bulb
  - b. 6 inch minimum width
  - c. 3/8 inch minimum thickness
3. Expansion Joints
  - a. Dumbbell type with a minimum 3/4-inch inside diameter center bulb.
  - b. 9 inch minimum with
  - c. 3/8 inch minimum thickness

### B. Hydrophilic Waterstops

1. Hydrophilic waterstop materials shall be bentonite-free and expand by a minimum of 80% of dry volume in the presence of water to form a water-tight joint without damaging the concrete in which it is cast.
2. The material shall absorb water and cause an increase in volume in a completely reversible and repeatable process. The material shall be dimensionally stable after repeated wet-dry cycles with no deterioration in swelling potential.
3. Minimum cross sectional dimensions are 3/16 inch by 3/4 inch.
4. Provide only where specifically indicated in the contract documents.

### C. Hydrophilic Sealants

1. Hydrophilic sealant shall be compatible with hydrophilic waterstop and shall firmly adhere to concrete, metal and PVC in a dry or damp condition. When cured, it shall be elastic indefinitely.

### D. Hydrophilic Injection Resin

1. Hydrophilic injection resin shall be acrylate-ester based with a viscosity of less than 50 cps. The resin shall be water soluble in its uncured state, solvent free and non-water reactive. In its cured state it shall form a solid hydrophilic flexible material resistant to permanent water pressure and compatible with bitumen, joint sealants and concrete.

## 2.09 ANCHORING MATERIALS

### A. Epoxy Anchors

1. Anchor embedded reinforcing, bolts and other items into existing concrete with an Epoxy Resin Base Bonding System for concrete meeting the requirements of ASTM C881, Type IV, Grade 3, Class B & C.

## 2.10 MISCELLANEOUS EMBEDDED METAL ITEMS

- A. Miscellaneous embedded metal items shall conform to the requirements of the section of the specifications to which they apply. Use “Form Saver” or “Threaded Coupler” to avoid drilling holes in the forms.
- B. Steel items, except reinforcing, shall be galvanized unless specified or shown otherwise.

## PART 3 EXECUTION

### 3.01 CONSTRUCTION JOINTS

#### A. General

1. Make construction joints only at locations shown and required on the Contract Drawings, the reviewed shop drawings or as directed or accepted by the ENGINEER. Any additional construction joints or relocation of construction joints shown on the drawings, proposed by the CONTRACTOR, must be submitted to the ENGINEER for review.
2. In addition to construction joints explicitly shown in the drawings, provide and locate additional construction joints as follows:
  - a. In walls locate vertical construction joints at a spacing of 40 feet maximum and approximately 12 feet from corners.
  - b. In foundation slabs and slabs-on-grade locate construction joints at a spacing of 40 feet maximum. Place concrete in a strip pattern, unless otherwise indicated in the Contract Drawings, to a maximum of 5000 square feet in any one placement.
  - c. In structural slabs and beams locate construction joints at a maximum spacing of 40 feet. Locate construction joints in compliance with ACI 301, unless otherwise indicated in the drawings, to a maximum of 5000 square feet in any one placement.
3. Allow a minimum of five (5) days to elapse before placing concrete adjacent to a slab or wall previously placed.
4. All joints shall be perpendicular to main reinforcement; continue all reinforcing across the joint.
5. Provide waterstops in all wall and slab construction joints as specified or in all water bearing structures, all below grade joints and, at locations shown on the Drawings.

#### B. Construction Joint Preparation

1. The joint surface of the previously cast member or existing concrete in all cases shall be cleaned free of all oil, grease, curing compound, dirt, or laitance, and shall be wetted. Cleaning shall be accomplished by high pressure water jet, wet sand blasting, dry sand blasting, or scrubbing, singly or in combination, as required and shall remove loosened particles of aggregate, damaged concrete at surface, and other substances which may prevent complete adhesion. Remove accumulated concrete on projecting reinforcing steel.
2. Horizontal construction joints shall be coated with a 6 inch layer of Construction Joint Grout (Section 03600) immediately prior to casting the adjacent member.
3. Vertical construction joints shall have a joint roughener applied in a thin even film in accordance with MANUFACTURER’s instructions. After roughener is dry, concrete may be placed. Where concrete has been in place for 60 days or more shall be coated with a bonding agent per the requirements of this Specification and the MANUFACTURER.

### 3.02 EXPANSION JOINTS

- A. Do not extend reinforcement or other embedded metal items that are continuously bonded to concrete through any expansion joints.
- B. Position dowels accurately if called for in the drawings. Support dowels against displacement during concrete placement and vibration. Install dowel sleeve grout-tight to prevent bonding of the dowel during concrete placement.
- C. Position expansion joint filler material accurately. Support against displacement during concrete placement and vibration. Place filler the full depth of the member less an allowance to form a groove for sealant as detailed.

### 3.03 CONTROL JOINTS

- A. Control joints shall be provided in non-water bearing slabs-on-grade only as shown in the drawings and specified herein.
- B. Make top grooves for control joints in slabs on grade as detailed and seal as specified. Grooves may be made with joint forming strip, via tooling or may be sawed.
- C. If control joints are sawed, properly time cutting with concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking and within twelve (12) hours of concrete placement. The CONTRACTOR shall have at least one spare saw available during the sawing operation.
- D. Control joints shall be cleaned and filled with expansion joint sealant. Inject sealant through a nozzle into the bottom of the joint, filling the entire joint space without air voids.

### 3.04 WATERSTOPS

#### A. General

- 1. Provide PVC waterstops in all horizontal and vertical joints in foundation slabs and peripheral walls of all structures up to a minimum of 12 inches above final ground level and all walls and slabs of liquid-containing structures or compartments to a minimum of 12 inches above maximum liquid level unless specifically shown otherwise on the drawings.

#### B. PVC Waterstops

- 1. Each piece of premolded PVC waterstop must be of maximum practicable length for a minimal number of end joints.
- 2. All PVC waterstops shall be continuous, and so jointed as to form a complete barrier to the passage of water through any construction, contraction or expansion joint.
- 3. Joints in PVC waterstops shall be made by heat sealing in accordance with the requirements of the MANUFACTURER. The joints in strips of waterstop shall be such that the entire cross section of the joint shall be dense, homogeneous and free of all porosity. All finished joints shall have a tensile strength of not less than 75% of the material of the strip as extruded.

4. All PVC waterstops shall be installed so that half its width will be embedded on each side of the joint. Tie the waterstop to the reinforcement at a maximum spacing of 18 inches to ensure that the waterstop will be held securely in true position and in straight alignment in the joint during placement and vibration of concrete.
5. Care shall be exercised to ensure that the PVC waterstop is completely embedded in concrete and without voids.

C. Hydrophillic Waterstops

1. Install all hydrophilic waterstops as called for in the Contract Drawings in accordance with the MANUFACTURER's requirements. Install hydrophilic sealant in accordance with all MANUFACTURER's requirements.
2. The hydrophilic waterstop shall be installed in a bed of hydrophilic sealant compatible with the hydrophilic waterstop before skinning and curing begins so that any irregularities in the concrete surface are completely filled and the waterstop is bonded to the sealant. After the sealant has cured, secure the waterstop to the concrete in accordance with the MANUFACTURER's instructions.
3. Prior to installation of the hydrophilic sealant, clean the concrete surface to removed laitance and any other materials that will adversely affect bonding of the sealant to the concrete.

3.05 SEALING JOINTS

- A. Clean, prime and apply sealants in accordance with MANUFACTURER's recommendations.
- B. Sealant shall be applied when the ambient temperature is between 40° F and 90° F, unless recommended otherwise by the sealant MANUFACTURER.
- C. During application, exercise care to prevent sealant from spilling onto surfaces adjacent to joints.

3.06 DOWELS

- A. Where indicated on drawings, install dowels at right angles to construction joints and expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement.

3.07 SETTING ANCHORS

- A. Anchor embedded reinforcing, bolts and other items as shown on the Drawings into existing concrete with an epoxy in accordance with these Specifications and all MANUFACTURER's recommendations.

3.08 SETTING ANCHOR BOLTS

- A. Set anchor bolts for structural steel specified in Division 5 - Metals, according to this section.
- B. Install equipment anchor bolts as required by the equipment MANUFACTURER.
- C. Provide accurately made templates for positioning anchor bolts.

3.09 EMBEDDED ITEMS

- A. Placement



1. Place embedded items to least impair strength of the structure. Obtain approval of locations for embedded items not shown on the structural drawings before placement of concrete. Should locations of embedded items be detrimental to the strength of the structure, notify the OWNER's Representative and relocate items as directed by the OWNER.
2. Do not cut or reposition reinforcing steel to facilitate installation of inserts, conduit, sleeves, anchor bolts, mechanical openings and similar items without prior acceptance of the ENGINEER, except that reinforcing bars may be moved one bar diameter or within tolerances specified in the Concrete Reinforcement section without acceptance of the ENGINEER as long as minimum specified reinforcing cover requirements are maintained.
3. It is the CONTRACTOR's responsibility to coordinate the requirements for embedded items and to ensure that embedded items are properly placed.

B. Installation

1. Accurately position and support embedded items against displacement during concrete placement.
2. Voids in sleeves, inserts, anchors, etc., shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.
3. Conduits, pipes and inserts of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
4. Except when plans for conduits and pipes are acceptance by the ENGINEER, conduits and pipes embedded within a slab, wall or beam shall satisfy the following:
  - a. They shall not be larger in outside dimension than  $1/3$  the overall thickness of slab, wall or beam in which they are embedded.
  - b. They shall not be spaced closer than three diameters or widths on center.
  - c. They shall not significantly impair the strength of the member.

END OF SECTION

## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This section contains all requirements for cast-in-place structural concrete.

##### 1.02 RELATED WORK

- A. Coordinate the requirements of this section with all other sections of Division 3, Concrete.

##### 1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
  1. ASTM C31: Standard Practice for of Making and Curing Concrete Test Specimens in the Field
  2. ASTM C33: Standard Specification for Concrete Aggregates
  3. ASTM C39: Standard Specification Test Method for Compressive Strength of Cylindrical Concrete Specimens
  4. ASTM C42: Standard Specification Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
  5. ASTM C87: Standard Specification Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
  6. ASTM C94: Standard Specification of Ready-Mixed Concrete
  7. ASTM C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
  8. ASTM C125: Terminology Relating to Concrete and Concrete Aggregates
  9. ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete
  10. ASTM C150: Standard Specification for Portland Cement
  11. ASTM C156: Standard Test Method for Water Retention by Concrete Curing Materials
  12. ASTM C171: Standard Specification for Sheet Materials for Curing Concrete
  13. ASTM C172: Standard Practice for Sampling Freshly Mixed Concrete
  14. ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
  15. ASTM C191: Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
  16. ASTM C192: Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
  17. ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
  18. ASTM C260: Standard Specification for Air-Entraining Admixtures for Concrete

19. ASTM C289: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
20. ASTM C293: Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
21. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
22. ASTM C494: Standard Specification for Chemical Admixtures for Concrete
23. ASTM C579: Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
24. ASTM C580: Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
25. ASTM C595: Standard Specification for Blended Hydraulic Cements
26. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
27. ASTM C806: Standard Test Method for Restrained Expansion of Expansive Cement Mortar
28. ASTM C827: Standard Test Method for Change in Height at Early Stages of Cylindrical Specimens of Cementitious Mixtures
29. ASTM C845: Standard Specification for Expansive Hydraulic Cement
30. ASTM C856: Standard Practice for Petrographic Examination of Hardened Concrete
31. ASTM C878: Standard Test Method for Restrained Expansion of Shrinkage-Compensating Concrete
32. ASTM C1077: Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
33. ASTM C1240: Standard Specification for Silica Fume used in Cementitious Mixtures
34. ASTM E329: Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

B. American Concrete Institute (ACI).

1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, heavy-weight and Mass Concrete.
2. ACI 214: Recommended Practice for Evaluation of Strength Test Results
3. ACI 223: Standard Practice for Use of Shrinkage Compensating Concrete
4. ACI 301: Specification for Structural Concrete for Buildings
5. ACI 304: Guide for Measuring, Mixing, Transporting & Placing Concrete
6. ACI 304.2R: Placing Concrete by Pumping Methods
7. ACI 305R: Hot Weather Concreting
8. ACI 306R: Cold Weather Concreting
9. ACI 308: Standard Practice for Curing Concrete
10. ACI 309: Guide for Consolidation of Concrete

11. ACI 318: Building Code Requirements for Reinforced Concrete.
12. ACI 350: Code Requirements for Environmental Engineering Concrete Structures

C. Corps of Engineers, Department of the Army Specifications

1. CRD-C621-83: Corps of Engineers Specification for Non-Shrink Grout

1.04 SUBMITTALS

- A. Submittals shall be prepared and submitted in accordance with Section 01300 - Submittals.
- B. Submit for review a proposed design mix for each concrete strength and class required by these Specifications. Failure to include any items of information noted in this paragraph for a given concrete strength or type will be cause for requirement of a resubmittal. Information to be submitted for each strength and class shall include the following items:
  1. Concrete mix design
    - a. Constituent quantities per cubic yard.
    - b. Sources of all concrete mix components including coarse aggregate, fine aggregate, cement, water, admixtures, and pozzolans where included.
    - c. Cement type and MANUFACTURER, include chemical analysis (mill test report) for each cement type to be used.
    - d. Pozzolan type and source; include chemical analysis for each pozzolan type to be used.
    - e. Water/cement ratio, by weight.
    - f. Air content
    - g. Mix design slump.
    - h. Average compressive strengths conforming to the requirements of ACI 318 – Chapter 5, Section 5.3.2 at 28 days. Provide both average strengths and sample standard deviation. Provide results at 7 and 14 days if available.
    - i. Laboratory shrinkage test results for concrete mix designs, where specified.
  2. Aggregate:
    - a. Laboratory sieve analysis, conforming to ASTM C-33.
    - b. Mechanical properties.
    - c. Verification that aggregate is not "deleterious," or "potentially deleterious," per ASTM C289 and that aggregate does not contain deleterious substances.
  3. Admixtures. Submit MANUFACTURER's data brochures on all admixtures proposed for use and provide certification of compliance with specified ASTM standards for each admixture.
- C. Submit concrete placement drawings showing pour sequence, lift numbers, locations of all joints, concrete mix being placed, concrete finishes, and all pertinent embedments including embedded plates, sleeves, pipes, conduits, anchors, etc., where applicable. Contract drawings shall not be reproduced and used as shop drawings. Where the Drawings permit the Contractor to select joint locations, show the selected dimensions on the placement drawings. Approval of the placement drawings shall not relieve the Contractor of the responsibility of placing all concrete and embedments as specified.
- D. Submit a work plan for cold weather concreting and for hot weather concreting, describing proposed methods and procedures for mixing, delivering, placing, finishing, and curing concrete. Include also procedures to be implemented upon abrupt changes in weather conditions or due to equipment failures.

- E. Furnish a delivery ticket for ready mixed concrete to the OWNER's Representative as each truck arrives. Each ticket shall provide a printed record of the weight of cement batched and each separate aggregate individually batched. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement, and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of mix trucks.
- F. Other product submittals of MANUFACTURER's data sheet and product Specifications required include curing compounds and items specified in other Sections including form release agents, bonding agents, etc. Identify the locations where each will be used in the Work as a part of the submittal.
- G. Submitted data shall demonstrate compliance with all requirements of this Specification or deviations shall be clearly noted.

#### 1.05 STORAGE OF MATERIALS

- A. Cement: Store cement in watertight buildings, bins or silos to provide protection from dampness and contamination. Improperly stored cement shall not be used. No cement shall be used that has been stored on the site for more than 90 days or that is lumped or caked.
- B. Aggregate: Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three feet in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregates.
- C. Sand: Before using, allow sand to drain until a uniform moisture content is reached.
- D. Admixtures: Store admixtures to avoid contamination, evaporation or damage. For those used in the form of suspensions or nonstable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.

#### 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work of similar scope and complexity with similar materials as found on this Project.
- B. MANUFACTURER's Qualifications: An experienced MANUFACTURER of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment. MANUFACTURER must be certified by the National Ready Mix Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An experienced independent testing agency, acceptable to authorities having jurisdiction and the ENGINEER that is qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same MANUFACTURER's plant, each aggregate from a single source and each admixture from the same MANUFACTURER.
- E. Concrete Consistency

1. Test for slump shall be performed at the job site immediately prior to placing in accordance with ASTM C143. Slump tests shall be performed for each batch of concrete to indicate workability and consistency from batch to batch.
2. If the slump is greater than the specified maximum, the concrete shall be rejected. Concrete showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed.
3. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, the concrete shall be rejected and changes in the concrete mix shall be made only by an adjustment of one or more of the following:
  - a. The gradation of aggregate.
  - b. The proportion of fine and coarse aggregate.
  - c. The percentage of entrained air, within the allowable limits.

F. Concrete Temperature

1. Concrete temperature shall be taken immediately before placement with the point of measurement being in the chute or bucket.
2. Perform temperature test for each batch and record result on batch ticket.

G. Concrete Air Content

1. Test for air content shall be made on a fresh concrete sample for each batch prior to placing in forms.
2. Air content for concrete made of ordinary aggregates having low absorption shall be made in accordance with either ASTM C231, or ASTM C173. If light weight aggregates or aggregates with high absorptions are used, use ASTM C173.

H. Compressive Strength

1. Compression test specimens shall be made, cured and tested in accordance with ASTM C31 and ASTM C39.
2. Compressive strength tests shall be made on cylinders at 7 and 28 days. The value of each test result shall be the average compressive strength of 2 cylinders taken at the same time from the same batch of concrete. For the 28 day cylinders, the strength level shall be satisfactory if the test result exceeds the required design compressive strength and no individual strength test falls below the required design strength by more than 500 psi.
3. Compressive test specimens shall be 6" x 12" cylinders; 4' x 8" cylinders are not permitted.
4. The number of sets of concrete test cylinders to be cast for each concrete pour shall be as follows. A "set" of test cylinders consists of six cylinders, two to be broken and strengths averaged at seven days; and two broken and strengths averaged at 28 days. Two cylinders will remain unbroken so that they will be available to be broken upon unforeseen circumstances or upon the option of the ENGINEER to break cylinders at different times.

Volume of Concrete Poured (CY)	Minimum No. of Sets of Cylinders
0-25	1
26-75	2
76-150	3
151-250	4

251-400	5
401-550	6

I. Failure to Meet Requirements

1. The OWNER may withhold payment for any section of concrete which does not meet the requirements of the Plans and Specifications. Withheld payment shall be based upon unit prices established for concrete if available. Payment shall be withheld until the unacceptable concrete has been repaired or removed and replaced or otherwise brought into conformance with the Plans and Specifications.
2. Concrete Strength
  - a. If the 28 day strength test results fall below required values, additional curing may be performed and test cores may be obtained in accordance with ASTM C42 with acceptance of the ENGINEER. Additional curing, core removal and testing shall be at the Contractor's expense.
  - b. If the strength results from test cores do not exhibit the required strength, the OWNER reserves the right to require strengthening, replacement of substandard materials and/or additional testing at the Contractor's expense.
3. Other Concrete Properties
  - a. If concrete properties besides strength do not meet required values, the ENGINEER may require concrete samples to be obtained in accordance with ASTM C42 and evaluated in accordance with ASTM C856 at the Contractor's expense.
  - b. If concrete properties besides strength do not meet required values, and the results of additional examination per ASTM C856 are deemed unsatisfactory at the sole discretion of the OWNER, the OWNER reserves the right to require strengthening, replacement of substandard materials and/or additional testing at the Contractor's expense.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Portland Cement:

1. Type II or Type I/II conforming to ASTM C 150. Use the same brand of cement upon which the selection of concrete was based. Only one brand of each type will be permitted in any one structure, unless otherwise specified.
2. Cement shall be low alkali; The total alkali content calculated as the percentage of sodium oxide (Na<sub>2</sub>O) plus 0.658 times the percentage of potassium oxide (K<sub>2</sub>O) shall not exceed 0.60.
3. Cement used in concrete placed in openings in existing water bearing structures shall be shrinkage compensating cement, ASTM C845.

B. Coarse Aggregate

1. Crushed stone or gravel conforming to ASTM C33, in the specified gradation size. Use aggregate from only one source in a single structure. Aggregate shall not be "deleterious," or "potentially deleterious," per ASTM C289 and shall not contain deleterious substances.

<b>Gradation No. 467 (max aggregate size 1 1/2")</b>		
Sieve Size	Percent Retained	Percent Passing
2"	0	100
1 1/2"	0-5	95-100
3/4"	30-65	35-70
3/8"	70-90	10-30
No. 4	95-100	0-5

<b>Gradation No. 57 (max aggregate size 1")</b>		
Sieve Size	Percent Retained	Percent Passing
1 1/2"	0	100
1"	0-5	95-100
1/2"	40-75	25-60
No. 4	90-100	0-10
No. 8	95-100	0-5

<b>Gradation No. 67 (max aggregate size 3/4")</b>		
Sieve Size	Percent Retained	Percent Passing
1"	0	100
3/4"	0-10	90-100
3/8"	45-80	20-55
No. 4	90-100	0-10
No. 8	95-100	0-5

<b>Gradation No. 8 (max aggregate size 3/8")</b>		
Sieve Size	Percent Retained	Percent Passing
1"	0	100
3/8"	0-15	85-100
No. 4	70-90	10-30



No. 8	90-100	0-10
No. 16	95-100	0-5

C. Fine Aggregate

1. Washed and screen natural sand or sand manufactured by crushing stone conforming to ASTM C33 and meeting the following gradation. Use aggregate from only one source in a single structure. Aggregate shall not be "deleterious," or "potentially deleterious," per ASTM C289 and shall not contain deleterious substances

Sieve Size	Percent Retained	Percent Passing
3/8"	0	100
No. 4	0-5	95-100
No. 8	0-20	80-100
No. 16	15-50	50-85
No. 30	40-75	25-60
No. 50	70-90	10-30
No. 100	90-98	2-10

D. Mixing Water: Potable and complying with ASTM C94

E. Admixtures: Using the following admixtures as required or permitted. The use of calcium chloride will not be permitted. The products must conform to the referenced standards.

1. Air-Entraining Admixture. Conform to ASTM C260.
2. Chemical Admixtures. Conform to ASTM C494.
3. Set retarding Admixtures. Conform to ASTM C494, types B or D only. Follow all MANUFACTURER's recommendations.
4. Water Reducing Admixture. Conform to ASTM C494, types A or D only. Follow all MANUFACTURER's recommendations.
5. High-Range Water Reducing Admixtures (HRWR). Conform to ASTM C 494 Type F or G. . Follow all MANUFACTURER's recommendations.

2.02 CURING MATERIALS:

A. Membrane Curing Compound.

1. Conform to ASTM C 309, commercial curing compound which will not permanently discolor concrete.

2. All curing compound shall contain a dye of color strength to render the film distinctly visible on the concrete for at least 4 hours after application.

B. Sheet Curing Material.

1. Conform to ASTM C 171.
  - a. waterproof paper
  - b. polyethylene film
  - c. white burlap-polyethylene sheeting

2.03 CONCRETE PROPORTIONING

A. Design Criteria

1. Use ACI 211.1 as the basis for selecting the proportions of ingredients to produce concrete having proper durability, strength, workability appearance and other required properties. Proportion ingredients to produce a homogenous mixture, which will work readily into corners and angles of forms and around reinforcement by methods of placing and consolidation employed on the work, but without permitting materials to segregate or allowing excessive free water to collect on the surface.
2. Strength: All concrete is required to have an average 28 day compressive strength at or greater than specified strength. Establish the required average compressive strength in accordance with ACI 301.
3. Entrained Air: Air-entrain all concrete, unless otherwise specified. Drilled shafts do not require air entrainment unless placed underwater. Provide for not less than three percent (3.0%) nor more than six percent (6.0%) by volume of total entrapped and entrained air for normal weight concrete.
4. Slump: Provide adequate slump to produce acceptable workability, do not exceed maximum specified slump.
5. Admixtures: Proportion admixtures according to the MANUFACTURER's recommendations. All admixtures shall be batched at the batch plant only.

B. Concrete Classification

Class	Min. 28-Day Compressive Strength (psi)	Max. Coarse Aggregate Size (in.)	Max. Water Cement Ratio	Max. Slump (in.)	Min. Cement Content (per CY)

A	4000	1.5 (No. 467)	0.45	5	517 lb (5.5 sacks)
B	3000	1.5 (No. 467)	0.50	4	517 lb (5.5 sacks)
C	4000	1.0 (No. 57)	0.45	4	564 lb (6.0 sacks)
D	5000	0.75 (No. 67)	0.45	5	611 lb (6.5 sacks)
E	1500	1.5 (No. 467)	0.70	4	376 lb (4.0 sacks)
F	4000	0.375 (No. 8)	0.50	8	611 lb (6.5 sacks)

NOTE: Maximum slump shown may be increased to 9 in. if HRWR admixture is used.

C. Concrete Usage

Class	Usage
A	All reinforced concrete unless otherwise specified
B	Concrete Encasement; Sidewalks, Curbs, Driveways
C	Drilled Shafts; Pumped Concrete; Thin Wall Sections
D	Precast Concrete and Panels
E	Lean Concrete Backfill; Foundation Seal; Blocking/Cradling
F	Underground Duct Banks

2.04 OFF SITE BATCH PLANT

- A. Batch plants shall be an established concrete batching facility meeting the requirements of the Concrete Plant Standards of the Concrete Plant MANUFACTURER's Bureau

2.05 CONCRETE MIXING

A. Ready-Mixed Concrete:

1. Mix and transport ready-mixed concrete according to ASTM C94.
2. Provide a suitable measuring device capable of measuring mixing water for each batch. Note the number of gallons of water as batched on printed batching tickets.
3. Compensate for varying moisture contents of both coarse and fine aggregates and change batch weights of materials if necessary before batching.
4. Provide adequate facilities for accurate measurement and control of each material entering each batch of concrete. Accuracy of weighing equipment must conform to applicable requirements of ASTM and NRMCA for such equipment.
5. Provide recorders/printers to produce tickets. Each ticket will provide a printed record of volume of water and weights for cement as batched and for separate aggregates as batched individually. Use the type of indicator that returns for zero punch or to zero after a batch is discharged. Clearly indicate by stamped letters or numerals the difference between

aggregates and cement as batched. Show the time of day stamped or printed at intervals of not more than six minutes. The delivery ticket shall also show the volume of water, in gallons, added at the batch plant. Deliver recorded ticket copies with concrete. The testing agency will keep one copy.

B. Transit Mix Truck Requirements:

1. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant.
2. Keep the water tank valve on each transit truck locked at all times that the truck is in use. Any addition of water must be directed by the ENGINEER. Added water must be incorporated by additional mixing of at least 35 revolutions.
3. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds. Counter shall be reset to zero at the batch plant. Concrete may be rejected if counters have fewer than 70 or more than 150 turns when they arrive at the site.
4. Transmit mix trucks are to be in good working condition. Trucks which are not mechanically sound, have worn or obstructed mixing fins, have non-functioning drum counters, or leaking water valves shall not be used.

C. Admixtures:

1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device. Do not use admixtures in powdered form.
2. Two or more admixtures may be used in the same concrete, provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other. Inject the admixtures separately during the batching sequence.
3. Add retarding admixtures as soon as practicable after the addition of cement.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Notify the OWNER's representative upon completion of various portions of the work required for placing concrete so inspection may be made as early as possible. Keep the OWNER's representative informed of the anticipated concrete placing schedules.
- B. All items, including lines and grades, forms, waterstops, reinforcing, inserts, piping, electrical, plumbing and the Contractor's concreting materials and equipment shall be complete and in compliance with the plans and specifications before proceeding with concrete placement.
- C. Concrete finishing shall be completed in daylight hours. When this is not possible, brilliantly light the work site so that all operations are plainly visible.
- D. Prior to and during concrete placement, forms shall be clean of any and all foreign matter.
- E. Mix concrete only in quantities for immediate use. Discard concrete which has set; re-tempering is not permitted. Completely discharge concrete at the site within one hour and 30 minutes after adding cement to aggregate. In hot weather, reduce this time to one hour or less to prevent stiffening of concrete before it is placed.

- F. Protection from Adverse Weather: If adverse weather is imminent, no concrete placement is permitted. Do not permit rainwater to increase mixing water or to damage the surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect the work.
- G. Cold Weather Concreting
1. If the air temperature is at or below 40 degrees F, cold weather concreting shall be performed in accordance with ACI 306. This includes cases where the temperature drops below 40 degrees F after concrete operations have been started. The temperature shall be taken in shade away from artificial heat.
  2. When air temperatures are at or below 40 degrees F, heated mixing water or a combination of heated mixing water and heated aggregates shall be used, if required, to raise the concrete temperature to 70 degrees F. The temperature of the heated water or aggregates shall not exceed 150 degrees F when entering the mixer.
  3. Concrete placement is not permitted when the air temperature is at or below 35 degrees F. The temperature shall be taken in shade away from artificial heat.
  4. Salts, chlorides, chemicals or other foreign materials shall not be mixed with the concrete to prevent freezing or act as an accelerator.
  5. When freezing temperatures may be expected during the curing period, the concrete shall be maintained at a temperature of at least 50 degrees F for five days or 70 degrees F for three days after placement. Concrete and adjacent form surfaces shall be kept continuously moist. Sudden cooling of concrete shall not be permitted.
- H. Hot Weather Concreting.
1. Hot weather concreting shall comply with ACI 305. At air temperature of 90 degrees F or above, concrete shall be kept as cool as possible during placement and curing.
  2. The temperature of the concrete when placed in the work shall not exceed 90 degrees F. Use chilled water or ice to reduce the temperature of the concrete as required.
  3. Concrete shall be placed in the forms without the addition of any more water than is required by design. No excess water may be added to the concrete surface to aid in finishing. Control of the initial set and extending the time for finishing may be accomplished through the use of admixtures in accordance with these Specifications.
- I. Plastic shrinkage cracking, due to rapid evaporation of moisture, shall be prevented. Concrete shall not be placed when the evaporation rate (actual or anticipated) equals or exceeds 0.2 pound per square foot per hour, as determined by Figure 2.1.5 in ACI 305.
- J. If concrete arrives at the project with slump below that specified, water may be added only if the addition of water does not exceed either the maximum permissible water-cement ratio or maximum slump. Mix adjustments to obtain specified slump must be acceptance by the ENGINEER.

### 3.02 EMBEDDED ITEMS

- A. Paint aluminum contact surfaces with a zinc rich primer where aluminum items are embedded in concrete.

### 3.03 JOINTS



- A. Construction, control, isolation and expansion joints shall be installed and sealed as called for by the Plans and in accordance with Section 03250.

### 3.04 WATERSTOPS

- A. PVC and hydrophilic waterstops shall be installed as called for by the Plans and in accordance with Section 03250.

### 3.05 GROUTING

- A. Perform all grouting as called for by the Plans and in accordance with Section 03600.

### 3.06 CONCRETE TRANSPORTATION AND CONVEYING

- A. Delivery tickets shall be required for each batch and shall be in accordance with ASTM C94, Section 16. Each ticket must clearly show the amount of water, in gallons, that can be added to the mixer truck at the site without exceeding the maximum water-cement ratio for that mix design.
- B. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Use methods which prevent loss of ingredients and segregation.
  - 1. Troughs, chutes and pipes shall be steel or steel lined.
  - 2. When steep slopes are necessary, provide baffles.
  - 3. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete.
  - 4. Concrete pumping is permitted and shall comply with ACI 304.2R.

### 3.07 CONCRETE PLACEMENT

#### A. Preparation

- 1. Sprinkle semi-porous subgrades to eliminate suction.
- 2. Seal extremely porous subgrades in an accepted manner.
- 3. Clean and prepare existing concrete surface in accordance with these Specifications prior to placing new concrete.

#### B. General

- 1. Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of cold joints, seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as accepted.
- 2. Proceed with placement at a rate such that concrete which is being integrated with fresh concrete is still plastic. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.

3. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only if made of galvanized metal or concrete, and if prior acceptance has been obtained.
4. Do not start placing of concrete in supported elements until concrete previously placed in columns and walls is no longer plastic.
5. Deposit concrete as nearly as practicable in its final position to avoid segregation. Do not subject concrete to a procedure which will cause segregation.
6. Deposit concrete through vertical drop chutes of rubber or metal of satisfactory size when operations involve placing concrete from above.
7. Concrete shall not be dropped more than 10 feet when HRWR admixture is used and 5 feet without HRWR.
8. Where surface mortar is to be the basis of a finish, especially those designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of mortar against the form. Prevent formation of excessive surface voids.

C. Slabs

1. After suitable bulkheads, screeds and if specified, jointing materials, have been positioned the concrete shall be placed continuously between construction joints, beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
2. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints.
3. Concrete shall then be brought to correct level with a straightedge and struck off. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.

D. Formed Concrete

1. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall be in contact with the concrete already placed.
2. In walls, place concrete in 12" to 24" lifts, keeping the surface horizontal. Compaction shall be by vibrator and shall be supplemented by hand puddling; puddling shall be continuous while pouring concrete and shall be done primarily between forms and reinforcing steel, around openings, or wherever needed to prevent honeycomb, fill voids or drive out large air bubbles.

E. Concrete Poured Against Rock

1. Where concrete is poured against undisturbed rock, especially in drilled shafts, place concrete as soon as practicable after excavation to prevent weathering of exposed rock.
  - a. For footings and slabs, place mud slabs within 4 hours after the excavation is at final grade.
2. Remove all water from excavation or shaft before placing concrete.

3.08 CONSOLIDATION OF CONCRETE

- A. All concrete shall be placed and consolidated with mechanical vibrators.

1. A minimum frequency of 7000 revolutions per minute is required for mechanical vibrators.
  2. Do not use vibrators to transport concrete within forms.
  3. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion, vibrate sufficiently to consolidate concrete, generally until a liquefied appearance is produced on the surface. Do not over-vibrate causing segregation.
  4. Keep a spare vibrator on the site during concrete placing operations.. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
- B. Concrete for slabs shall be compacted with vibrating screeds and internal vibrators.
- C. Internal vibrators shall be used; form attached vibrators are not permitted.
- 3.09 FINISHING OF FORMED SURFACES

- A. Forms shall be removed as specified in Section 03100. Patch, repair, finish and clean concrete within 7 days of form removal in accordance with the Specifications. Cure concrete as finishing progress in accordance with the Specifications.
- B. No Finish: A finish is not required on surfaces which are not visible from the inside or outside of the structure or more than 12 inches below finished grade
- C. Smooth Form Finish:
1. Unless otherwise specified, all surfaces not meeting the requirements for “no finish” shall receive a smooth form finish. Use a smooth form finish on all surfaces exposed to view and liquid.
  2. Provide a smooth, hard uniform texture on the concrete surface. Use plywood or fiberboard linings or forms in as large sheets as practicable and with smooth, even edges and close joints.
  3. Patch tie holes and defects. Rub fins and joint marks with carborundum stone to leave a smooth, unmarred finish surface.
- D. Related Unformed Surfaces: Tops of piers, walls, bent caps and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed. Float unformed surfaces to a texture reasonably consistent with that of the formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

3.10 FINISHING SLABS AND SIMILAR FLAT SURFACES

- A. Comply with the recommendations in ACI 302.1R for screeding, restraightening and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Finish slabs and similar flat surfaces monolithically and apply as indicated in the Plans and as follows:
1. Rough Finish.
    - a. Tank floors and slabs that receive grout or additional concrete toppings.
    - b. Provide a rough surface by screeding only without further finish.
  2. Trowel Finish

- a. Slab surfaces exposed to view, liquids or to be covered with a coating system, flooring coverings or membranes.
  - b. After apply float finish, apply trowel finish and consolidate by hand or power driven trowel. Continue troweling passes and restraigten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
3. Broom Finish
- a. Sidewalks, walkways and platforms.
  - b. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

### 3.11 CONCRETE CURING

- A. All concrete shall be cured in accordance with the Specifications. The curing methods shall be wet curing, sheet materials or membrane curing compound. Unless the curing method is specified otherwise, select the appropriate curing method.
- B. Length of Curing Period
1. A "curing day" shall be any day on which the atmospheric temperature taken in the shade, or the air temperature adjacent to the concrete, remains above 50 degrees F for at least 18 hours.
  2. Continuously cure concrete for a period until 7 curing days have been reached. In cold weather, curing may be terminated after a period of 14 consecutive days.
- C. Wet Curing
1. Immediately after the finishing operations are completed or forms are stripped, the concrete shall be covered with wet cotton mats or with a temporary covering of canvas or burlap, thoroughly saturated with water before placement. A temporary covering shall be used when factors dictate that cotton mats cannot be placed immediately after finishing operations without marring the finishing of the concrete surface.
  2. When temporary coverings are used keep them in place only until the surface has sufficiently hardened so that a cotton mat can be substituted without marring or disturbing the concrete finish.
  3. The coverings shall remain in contact with the concrete for the duration of the curing period.
  4. The coverings shall be kept saturated with water for a period of 4 days after the concrete has been placed.
  5. Water used for curing shall be potable and free from any injurious materials or deleterious substances.
- D. Sheet Curing
1. Immediately after the finishing operations are completed or forms are stripped, install sheet curing materials in accordance with all MANUFACTURER's recommendations.
  2. Sheet curing shall be in contact with the entire concrete surface so as to prevent drying for the duration of the curing period.
  3. When pedestrian traffic is unavoidable, provide suitable walkways to protect the sheet material.

E. Membrane Curing

1. Membrane curing compound is not permitted on surfaces to be rubbed or on surfaces to receive additional concrete, grout, plaster or coatings.
2. Immediately after the finishing operations are completed or forms are stripped, apply membrane curing compound solution under pressure with a spray nozzle so the entire exposed surface is completely covered with a uniform film. The rate of application shall insure complete coverage but shall not exceed 150 square feet per gallon of curing compound.
3. After application and under normal conditions, the curing compound shall be dry to the touch within 1 hour and shall be dry thoroughly and completely within 4 hours. When thoroughly dry it shall provide a continuous flexible membrane free from cracks and pinholes and shall remain intact during the required curing period.
4. If the membrane seal is broken during the curing period, immediately repair it with additional curing compound.

- F. After the curing period, the temperature of the exposed surface shall not be permitted to drop faster than 30 degrees F in 24 hours.

3.12 CONCRETE SURFACE REPAIRS

- A. Repair defective areas immediately after the removal of forms in accordance with Section 03740.
- B. If the concrete surface is bulged, uneven or exhibits defects which in the ENGINEER's opinion cannot be satisfactorily repaired, remove and replace the entire concrete section as directed.
- C. Patch tie holes immediately after removal of forms. After cleaning and thoroughly dampening the tie hole, fill solid with non-shrink, non-metallic grout.

3.13 FIELD QUALITY CONTROL

A. Concrete Testing

1. General
  - a. Tests shall be required throughout the work to monitor the quality of concrete. Take all samples in accordance with ASTM C172.
  - b. Testing of concrete shall be conducted by an independent, qualified testing agency.

END OF SECTION

## SECTION 03600

### GROUT

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

###### A. Scope of Work:

1. Provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install grout.

##### 1.02 RELATED WORK

- ###### A. Coordinate the requirements of this section with all other sections of Division 3, Concrete.

##### 1.03 REFERENCE STANDARDS

###### A. American Concrete Institute (ACI)

1. ACI 211.1, Practice for Selecting Proportions for Normal, Heavy-Weight and Mass Concrete.
2. ACI 301, Specification for Structural Concrete (Includes ASTM Standards referred to herein).

###### B. American Society for Testing and Materials (ASTM).

1. ASTM C33, Specification for Concrete Aggregates.
2. ASTM C109, Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-in. or 50 mm. Cube Specimens).
3. ASTM C150, Specification for Portland Cement.
4. ASTM C230, Specification for Flow Table for use in Tests of Hydraulic Cement.
5. ASTM C531, Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing.
6. ASTM C579, Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes.
7. ASTM C827, Test Method for Early Volume Change of Cementitious Mixtures.
8. ASTM C882, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete.
9. ASTM C937, Specification for Grout Fluidifier for Preplaced-Aggregate Concrete.
10. ASTM C939, Text Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
11. ASTM C1107, Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
12. ASTM C1181, Test Method for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.



#### 1.04 SUBMITTALS

- A. Submittals shall be prepared and submitted in accordance with Section 01300 - Submittals.
- B. Grout Mix Design:
  - 1. For Grout Fill and Construction Joint Grout, submit the following:
    - a. grout design mix design
    - b. laboratory test reports for grout strength tests.
- C. Reports and Certificates, submit the following:
  - 1. For proprietary materials, submit copies of MANUFACTURER's certification of compliance with the specified properties for Class I, II, and III grouts.
  - 2. Certified testing lab reports for ASTM C1107, Grade B and Grade C (as revised herein) requirements for Class I and II grouts tested at a fluid consistency for temperatures of 45, 73.4, 90 degrees F with a pot life of 30 minutes at fluid consistency.
  - 3. Certification that materials meet specification requirements for nonproprietary materials.
  - 4. Certifications that all grouts used on the project are free of chlorides or other chemicals causing corrosion.
  - 5. MANUFACTURER's specifications and installation instructions for all proprietary materials.

#### 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Grout materials from MANUFACTURERS shall be delivered in unopened containers and shall bear intact MANUFACTURER's labels.
- B. Storage of Materials: Grout materials shall be stored in a dry shelter and shall be protected from moisture.

#### 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed grout work of similar scope and complexity with similar materials as found on this Project.
- B. Testing Agency Qualifications: An experienced independent testing agency, acceptable to authorities having jurisdiction and the ENGINEER that is qualified according to applicable ASTM standards to conduct the testing indicated.
- C. Field Tests:
  - 1. Compression test specimens shall be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the ENGINEER to ensure continued compliance with these specifications. The specimens will be made by the ENGINEER or its representative.
  - 2. Compression tests and fabrication of specimens for non-shrink grout shall be performed as specified in ASTM C109. A set of three specimens will be made for testing at seven days, 28 days, and each additional time period as appropriate.
  - 3. Compression tests and fabrication of specimens for epoxy grout shall be performed as specified in ASTM C579, Method B. A set of three specimens will be made for testing at seven days, and each earlier time period as appropriate.

4. The cost of all laboratory tests on grout shall be borne by the OWNER, but CONTRACTOR shall assist in obtaining specimens for testing. However, CONTRACTOR shall be charged for the cost of any additional tests and investigation on work performed which does not conform to the requirements of the specifications. CONTRACTOR shall supply all materials necessary for fabricating the test specimens.

## PART 2 PRODUCTS

### 2.01 GROUTS

- A. General: Non-shrink grout shall be a prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. MANUFACTURER's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified herein shall be that recommended by the MANUFACTURER for the particular application.
- B. Class 1 Non-Shrink Grout:
  1. Class 1 non-shrink grouts are for general purpose grouting applications as specified herein.
  2. Required minimum 28 day compressive strength is 7000 psi.
  3. Shall meet the requirements of ASTM C 1107 and the following requirements when tested using the amount of water required to achieve the following properties:
    - a. flowable consistency (140 percent flow on ASTM C 230, five drops in 30 seconds).
    - b. fluid working time of at least 15 minutes.
    - c. flowable for at least 30 minutes.
  4. The grout shall not bleed when tested at maximum allowed water.
  5. The non-shrink property is not based on a chemically generated gas or gypsum expansion.
  6. Product and MANUFACTURER: Provide one of the following:
    - a. Set Grout, as manufactured by BASF Building Systems.
    - b. Five Star Grout, as manufactured by Five Star Products.
- C. Class 2 Non-Shrink Grout:
  1. Class 2 non-shrink grouts are for precision grouting and where water tightness and non-shrink reliability in both plastic and hardened states are as specified herein.
  2. Required minimum 28 day compressive strength is 7000 psi.
  3. Shall meet the requirements of ASTM C 1107 Grades B and C when tested using the amount of water required to achieve the following properties:
    - a. Fluid consistency (20 to 30 seconds) in accordance with ASTM C 939 at temperatures of 45, 73.4, and 95°F.
    - b. The length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured at 3 or 14 days. The expansion at 3 or 14 days shall not exceed the 28-day expansion.
  4. The non-shrink property is not based on a chemically generated gas or gypsum expansion.
  5. Fluid grout shall pass through the flow cone, with a continuous flow, one hour after mixing.
  6. Product and MANUFACTURER: Provide one of the following:
    - a. Masterflow 928, as manufactured by BASF Building Systems.
    - b. Five Star Grout, as manufactured by Five Star Products, Inc.

D. Class 3 Non-Shrink Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted, unless specifically recommended by the MANUFACTURER. MANUFACTURER's instructions shall be printed on each container in which the materials are packaged.
2. Required minimum 7 day compressive strength is 13,000 psi when tested in accordance with ASTM C579.
3. The following properties shall be attained with the minimum quantity of aggregate allowed by the MANUFACTURER.
  - a. The vertical volume change at all times before hardening shall be between 0.0 percent shrinkage and four percent expansion when measured according to ASTM C 827 (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1). Alternately, epoxy grouts which maintain an effective bearing area of not less than 95 percent are acceptable.
  - b. The length change after hardening shall be negligible (less than 0.0006 in/in) and the coefficient of thermal expansion shall be less than 0.00003 in/in/F when tested in accordance to the requirements of ASTM C 531.
  - c. The compressive creep at one year shall be negligible (less than .001 in/in) when tested under a 400 psi constant load at 140°F in accordance to the requirements of ASTM C 1181.
  - d. The grout shall be capable of maintaining at least a flowable consistency for a minimum of 30 minutes at 70°F.
  - e. The shear bond strength to Portland cement concrete shall be greater than the shear strength of the concrete when tested in accordance to the requirements of ASTM C 882.
  - f. The effective bearing area shall be a minimum of 95 percent.
4. Product and MANUFACTURER: Provide one of the following:
  - a. Sikadur 42 Grout Pak, as manufactured by Sika Corporation.
  - b. Five Star Epoxy Grout, as manufactured by Five Star Products.

E. Grout Fill & Topping Grout:

1. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 3300 shall apply except as noted otherwise herein.
2. Topping grout and concrete fill shall contain a minimum of 517 pounds of cement per cubic yard (5.5 sacks) with a maximum water cement ratio of 0.45.
3. Minimum 28 day compressive strength shall be 4000 psi.
4. Coarse aggregate shall be No. 8 (3/8" max) per Section 3300.
5. Fine aggregate shall be as required in Section 3300.
6. Slump shall be adjusted to match placement and finishing conditions, but shall not exceed 4 inches.

7. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.
8. Where grout placement is thicker than 4 inches, use Class A concrete as specified in Section 3300.

F. Construction Joint Grout:

1. Construction Joint Grout approximates Class A concrete, as specified in Section 03300 with aggregate coarser than 1/2 inch removed. The mix is to be designed as flowable with a high mortar content. It is intended to be placed over horizontal construction joints and mixed with Class A concrete as specified in Section 03300.
2. The mix requirements are as follows:
  - a. Compressive Strength: 5,000 psi minimum at 28 days.
  - b. Maximum Water-Cement Ratio of 0.45 by weight.
  - c. Coarse Aggregate: ASTM C33, No. 8 size.
  - d. Fine Aggregate: ASTM C33, approximately 60 percent by weight of total aggregate.
  - e. Air Content: 6±1 percent.
  - f. Minimum Cement Content: 752 pounds per cubic yard (8 sacks).

G. Requirements for Grout Fill and Construction Joint Grout

1. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for grout required. Comply with ACI 211.1 and report to ENGINEER the following data:
  - a. Complete identification of aggregate source of supply.
  - b. Tests of aggregates for compliance with specified requirements.
  - c. Scale weight of each aggregate.
  - d. Absorbed water in each aggregate.
  - e. Brand, type and composition of cement.
  - f. Brand, type and amount of each admixture.
  - g. Amounts of water used in trial mixes.
  - h. Proportions of each material per cubic yard.
  - i. Gross weight and yield per cubic yard of trial mixtures.
  - j. Measured slump.
  - k. Measured air content.
  - l. Compressive strength developed at seven days and 28 days, from not less than three test specimens cast for each seven day and 28 day test, and for each design mix.
2. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301, Section 4. However, mixes need not be designed for greater than 125 percent of the specified strength, regardless of the standard deviation of the production facility.
3. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301, Section 4.
4. Admixtures: Use air-entraining admixture in all grout. Use amounts of admixtures as recommended by the MANUFACTURER for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control. Do not use admixtures which have not been incorporated and tested in the accepted design mix, unless otherwise authorized in writing by ENGINEER.

- H. Grout Applications: The following is a listing of typical applications and the corresponding type of grout which is to be used. Unless indicated otherwise in the Drawings, grouts shall be provided as listed below.

Application	Grout Type
Beam base plates	Class 1
Column base plates	Class 2
Equipment & Tank Base Plates	Class 2
Machinery base plates	Class 3
Filling blockout spaces for embedded items (railing posts, gate guide frames, etc.)	Class 2
Toppings & fill 4 inches or less	Grout Fill & Topping Grout
Toppings & fill greater than 4 inches	Class A Concrete (Section 3300)
All other applications	Class 1

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 3300 and as recommended by the MANUFACTURER of prepackaged grouts.

2.03 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application.

PART 3 EXECUTION

3.01 INSPECTION

- A. CONTRACTOR shall examine the substrate and conditions under which grout is to be placed and notify ENGINEER, in writing, of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.02 INSTALLATION

- A. General:

1. Place grout as shown on the Drawings and in accordance with MANUFACTURER's instructions. If MANUFACTURER's instructions conflict with the Specifications do not proceed until ENGINEER provides clarification.
2. MANUFACTURERS of proprietary products shall make available upon 72 hours notification the services of a qualified, full time employee to aid in assuring proper use of the product under job conditions.

3. Placing grout shall conform to temperature and weather limitations in Section 03300.
  4. Grout shall be cured following MANUFACTURER's instructions for prepackaged grout and the requirements in Section 03300.
- B. Columns, Beams and Equipment Bases:
1. Epoxy grout: After shimming machinery to proper grade, securely tighten anchor bolts. Properly form around the base plates, allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the grout.
  2. Non-shrink grout: After shimming columns, beams and equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates allowing sufficient room around the edges for placing the grout. Adequate depth between the bottom of the base plate and the top of concrete base must be provided to assure that the void is completely filled with the grout.
- C. Handrails and Railings:
1. After posts have been properly inserted into the holes or sleeves, fill the annular space between posts and sleeve with the grout. Bevel grout at juncture with post so that moisture flows away from post.
- D. Construction Joints:
1. Place a 6 inch thick layer of Construction Joint Grout over the contact surface of the old concrete at the interface of horizontal construction joints as specified in Section 03250.
- E. Topping Grout:
1. All mechanical, electrical, and finish work shall be completed prior to placement of topping grout. The base slab shall be given a roughened textured surface by sandblasting or hydro-blasting exposing the aggregates to ensure bonding to the base slab.
  2. The minimum thickness of grout topping shall be 1-inch.
  3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is complete free from standing water. A thin coat of neat Type II cement slurry shall be broomed into the surface of the slab and topping or fill concrete shall be placed while the slurry is still wet. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment MANUFACTURER after the grout is brought to the established grade.
  4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
  5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used to assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.
  6. Cure and protect the grout topping as specified in Section 3300.



F. Grout Fill

1. All mechanical, electrical, and finish work shall be completed prior to placement of grout fill. Grout fill shall be mixed, placed, and finished as required in Section 3300.
2. The minimum thickness of grout fill shall be 1 inch. Where the finished surface of grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3 1/2 inches wide by 1 1/2 inches deep.
3. The surface shall be tested with a straight edge to verify that the surface slopes uniformly to drain and to detect high and low spots which shall be immediately eliminated. When the grout fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

END OF SECTION

## SECTION 03740

### CONCRETE MODIFICATIONS AND REPAIR

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to cut, remove, repair or otherwise modify parts of in-place concrete.
- B. Work under this Section may also be performed as a remedy for improperly or poorly placed concrete, or concrete damaged during construction operations. Such work shall be performed only after receiving written directions from the ENGINEER.

##### 1.02 RELATED WORK

- A. Division 3 – Concrete
- B. Division 5 – Metals

##### 1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
  1. ASTM C78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
  2. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 in. or 50 mm. Cube Specimens).
  3. ASTM C321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
  4. ASTM C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
  5. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
  6. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
  7. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
  8. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
  9. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

##### 1.04 SUBMITTALS

- A. Submittals shall be prepared and submitted in accordance with Section 01300 - Submittals.
- B. Submit a Schedule of Demolition which includes the detailed methods of demolition to be used at each location.
- C. Submit MANUFACTURER's technical literature on all product brands proposed for use. The submittal shall include the MANUFACTURER's installation and/or application instructions.

- D. When substitutions for acceptable brands of materials specified herein are proposed by the CONTRACTOR, submit MANUFACTURER's substitutions for acceptance prior to delivery to the Site. Submitted data shall demonstrate compliance with all requirements of this Specification or deviations shall be clearly noted.
- E. Submit documentation of MANUFACTURER qualifications and names of projects where products have been used, in accordance with Paragraph 1.05.C herein.

#### 1.05 QUALITY ASSURANCE

- A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the ENGINEER.
- B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing, and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work to protect personnel, to control dust, and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown, or specified, line drilling will be required in cutting existing concrete.
- C. MANUFACTURER qualifications. The MANUFACTURER of the specified products shall have a minimum of 5 years experience in the manufacture of such products, and shall have an ongoing program to provide training and technical support for the CONTRACTOR's personnel.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver the specified products in original, unopened containers with the MANUFACTURER's name, labels, product identification, and batch numbers.
- B. Store products as recommended by the MANUFACTURER.

### PART 2 PRODUCTS

#### 2.01 GENERAL

- A. Materials shall comply with these Specifications and any applicable federal, state or local regulations.
- B. All materials used shall be accepted for use in potable water facilities.

#### 2.02 CONCRETE REPAIR CONCRETE

- A. Use Class A concrete in accordance with Section 03300 for large volume repairs unless otherwise directed.

#### 2.03 CONCRETE REPAIR MORTAR

- A. The repair mortar shall be a polymer modified prepackaged cementitious repair mortar.
- B. Use an appropriate product for the specific application in accordance with all MANUFACTURER's requirements and recommendations.
- C. Material Properties.

1. Compressive strength (ASTM C109 Modified): 3800 psi min. at 7 days; 4800 psi min. at 28 days.
2. Splitting Tensile strength (ASTM C496): 500 psi min. at 28 days.
3. Flexural strength (ASTM C78): 1300 psi min. at 28 days.
4. Bond strength (ASTM C882 Modified): 2000 psi min. at 28 days.
5. Color to match surrounding material color which is exposed to view.

D. Products and MANUFACTURERS:

1. SikaTop 121 Plus as manufactured by Sika Corporation.
2. SikaTop 122 Plus as manufactured by Sika Corporation.
3. SikaTop 123 Plus as manufactured by Sika Corporation.
4. EMACO R310 CI, as manufactured by BASF.

## 2.04 STRUCTURAL CRACK INJECTION

A. Concrete Sealing Epoxy

1. High strength moisture insensitive epoxy system in compliance with ASTM C881, Type IV, grade 3, Class B & C and with the following properties:
  - a. Tensile strength: 10,000 psi (ASTM D638)
  - b. Flexural strength: 12,000 psi (ASTM D790)
  - c. Compressive strength: 14,000 psi (ASTM D695)
  - d. Bond strength: 600 psi after 24 hours (ASTM C321)
  - e. Minimum elongation of 2 percent (ASTM D638)
  - f. Maximum water absorption of 0.1 percent after 24 hours
2. The color of the sealing epoxy shall match the existing color of surrounding concrete surfaces if exposed to view.

B. Epoxy Injection Resin

1. High modulus, low viscosity epoxy crack injection system in compliance with ASTM C881, Type IV, grade 1, Class B&C and with the following properties:
  - a. Tensile strength: 10,000 psi (ASTM D638)
  - b. Flexural strength: 12,000 psi (ASTM D790)
  - c. Compressive strength: 14,000 psi (ASTM D695)
  - d. Bond strength: 600 psi after 24 hours (ASTM C321)
  - e. Minimum elongation of 2 percent (ASTM D638)
  - f. Maximum water absorption of 0.15 percent after 24 hours

## 2.05 WATERPROOFING INJECTION

A. Concrete Expansion Joint and Active Crack Sealing

1. SikaFix HH Hydrophilic as manufactured by Sika Corporation.

B. Water Infiltration Under Pressure

1. SikaFix HH+ as manufactured by Sika Corporation.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Apply methods specified in this Section as indicated on the Drawings, as specified, or as directed and/or accepted by the ENGINEER. Finishes, joints, reinforcements, sealants, etc., shall be as specified in their respective Sections of the Specifications.
- B. All commercial products specified in this Section shall be mixed and applied in strict compliance with the MANUFACTURER's recommendations.
- C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint, the repairs shall be made to preserve the isolation between components on either side of the joint.
- D. When drilling holes in concrete for dowels or bolts, drilling shall stop if reinforcing steel is encountered. The hole shall be relocated to avoid rebar. Rebar shall not be cut. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

### 3.02 CONCRETE REMOVAL

- A. General
  - 1. Concrete specified to be left in place which is damaged by the CONTRACTOR shall be repaired by accepted means to the satisfaction of the ENGINEER at no cost.
- B. Concrete Removal Equipment
  - 1. Use sawing equipment capable of sawing concrete to the specified depth.
  - 2. Use power driven chipping tools no heavier than a 30 lb. class for bulk concrete removal and no heavier than a 15 lb. class for removal of concrete beneath reinforcing steel or along the edges of the repair area.
  - 3. Hydrodemolition equipment may be used with prior written acceptance of the ENGINEER or via an accepted Schedule of Demolition.
- C. Concrete Removal Procedures and Requirements
  - 1. Concrete removal shall be initiated by first saw cutting (or by line drilling if saw cutting is not feasible) at the given removal limits. Removed concrete to the required depth by chipping or jack-hammering, as appropriate, in areas where concrete is to be taken out. Use the smallest equipment possible to avoid brusing or damaging concrete outside the removal zone and in accordance with this Section. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment are not damaged.
  - 2. All existing reinforcing exposed during concrete removal that will be covered with new material shall be undercut, exposing the entire perimeter of the bar, a minimum of 1 inch or 2 times the maximum aggregate size of the repair material, whichever is greater. Reinforcing to be left in place shall not be damaged during demolition.
  - 3. Where existing reinforcing is exposed due to saw cutting or core drilling and no new material is to be placed on the cut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/4 inch. Reinforcing shall be drilled and ground to establish minimum cover requirements prior to application of the surface treatment as detailed in the drawings.

4. In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the edge of concrete removal shall be a 1 inch deep saw cut on the exposed surface of the existing concrete.

### 3.03 REPAIR PREPARATION

#### A. Surface Preparation

1. Where bonding to existing surfaces, remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by abrasive blasting, grinding, etc. as accepted by the ENGINEER. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete..
2. Where bonding new concrete to existing concrete, the existing surface shall be roughened to a minimum 1/4 inch amplitude.

#### B. Existing Reinforcing Steel

1. Existing reinforcing which is exposed shall be cleaned by mechanical means to remove all loose material and corrosion products before proceeding with the repair.

### 3.04 REPAIR EXECUTION

#### A. Install any required formwork in accordance with Section 03100.

#### B. Prior to installing the repair concrete, or mortar, clean the concrete surface and apply mortar or epoxy bonding agents as required for Construction Joints in accordance with Section 03250.

#### C. Install repair concrete, mortar or other repair material in accordance with all MANUFACTURER's instructions and Section 03300. In the event of a conflict between the MANUFACTURER's instructions and Section 03300, the more restrictive requirement shall apply.

#### D. Cure the repair in accordance with all MANUFACTURER's instructions and Section 03300. In the event of a conflict between the MANUFACTURER's instructions and Section 03300, the more restrictive requirement shall apply.

### 3.05 EPOXY CRACK INJECTION

#### A. Flush out cracks and voids with chemical agent or chemical solvent to remove dirt and laitance prior to epoxy injection.

#### B. Provide temporary entry ports spaced to accomplish movement of fluids between ports, complying with MANUFACTURER's recommendations. Provide seal at concrete surface to prevent epoxy leakage.

#### C. Inject epoxy into prepared ports under pressure, using equipment appropriate for the particular application. Begin injection at lower entry port and continue until adhesive appears at adjacent entry port; continue from port to port until each crack is filled.

#### D. After epoxy adhesive has set, remove temporary seal and excess adhesive. Grind surfaces smooth.



END OF SECTION