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TECHNICAL SPECIFICATIONS

IFB 022-2024
Conversion of Existing Center Island into Additional Parking

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1.02 CONTRACT DOCUMENTS

A. The Work shall be performed and completed in accordance with the following documents:

1. The General Conditions and the Supplementary Conditions; the Contract Specifications which invoke, modify, and augment the Standard Specifications; and the various forms and exhibits; all contained in the Contract Documents.

2. The Contract Drawings.

1.03 DESCRIPTION

A. The project is located at GMHA's existing parking lot front of the main building and across from Guam Behavioral Health and Wellness Center.

1.04 MEASUREMENT AND PAYMENT

A. Separate measurement and payment will not be made for work required under this Contract

Specifications Section. All costs in connection therewith will be considered incidental to the item of work to which they pertain.

1.05 SCOPE OF WORK

A. The project intends in converting GMHA's existing center island into additional parking and to increase parking stalls and provide safe passage from the main parking area to the secondary parking lot by Guam Behavioral and Wellness Center.

1.06 CONTRACT LIMITS

A. Contract limits are described in the Contract Drawings.

1.07 SITE ACCESS

A. The Contractor's access to the Jobsite shall be coordinated with the Engineer.

B. Contractor shall comply with the following Specifications and requirements prior to performing any physical work on the Jobsite:

1. Section 01 32 16, Construction Progress Schedules

2. Section 01 33 00, Submittal Procedures

3. Section 01 35 24, Construction Safety

4. Section 01 43 00, Quality Assurance and Quality Control

5. Section 01 57 00, Temporary Controls

6. Permits (When applicable)

C. Access to the project site will only be permitted provided the Contractor has received approval. Access shall be primarily for purposes of mobilization. Additional Jobsite activities require approval of the Baseline Schedule or approval of the Baseline Schedule's initial activities.

D. Work shall be scheduled and performed only in accordance the Hours of Work specified herein.

1.08 HOURS OF WORK

A. Regular construction work shall be performed between the hours of 7:00 a.m. and 4:00 p.m., on weekdays.

B. Work shall not be performed on Saturdays, Sundays or Owner holidays without prior approval from the Engineer. Holidays are as follows:

1. New Year's Day – January 1

2. Dr. Martin Luther King, Jr. Day – First Monday after January 15

3. President's Day – Third Monday in February

4. Memorial Day – Last Monday in May

5. Independence Day – July 4

6. Labor Day – First Monday in September

7. Veterans Day – Second week in November

8. Thanksgiving Day, fourth Thursday in November

9. Christmas Day – December 25

C. Exceptions to the above hours of work will be permitted only upon written authorization from the Engineer.

1.09 CONTRACT DURATION [IF APPLICABLE ADD "AND MILESTONES"]

A. Contract Completion Time: Pursuant to the General Conditions, the Contractor shall commence Work on the date specified in the Notice to Proceed (NTP) and shall complete all Contract Work as required.

1.10 CONTRACT LIQUIDATED DAMAGES

A. Liquidated Damages: The amount of liquidated damages that will be assessed under the provisions of the General Conditions for each Day's delay in achieving Substantial Completion of the Work, within the time specified.

1.11 PERMIT

A. Refer to General Conditions, Permits and Licenses, which provides that the Contractor is responsible for all permits and their costs.

1.12 TEMPORARY STORAGE OF MATERIALS AND LAYDOWN AREA

A. Refer to Contract Specifications Section 01 52 00, Construction Facilities, for storage provisions.

B. The Contractor may request in writing for material storage on Owner property which shall be subject to Owner's approval.

C. Material storage and laydown areas shall be in compliance with Section 01 57 00, Temporary Controls for EPA, Storm Water Pollution Prevention Plan or Water Pollution Control Plan compliance pursuant to the General Condition.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 11 00

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 DESCRIPTION

A. This Section includes specifications for measurement and payment as they apply to the Work, and includes provisions applicable to lump sum prices, unit prices, and allowances, as indicated.

1.02 LUMP-SUM MEASUREMENT

A. Lump-sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as indicated in the Bid Schedule of the Bid Form.

1. If the Contractor requests progress payments for lump-sum items or amounts in the Bid Schedule, such progress payments will be made in accordance with a Schedule of Values, a well-balanced, detailed program of payment-apportioning. Such Schedule of Values shall be prepared by the Contractor and submitted to the Engineer for approval within seven (7) Days of the effective date of the Notice to Proceed. Such Schedule of Values may require modifications during the Contract, as determined by the Engineer.

2. Such Schedule of Values for each applicable lump-sum item shall show fixed definable and measurable quantities where possible and unit prices there for as developed and assigned by the Contractor to the different features of the work and major subdivisions thereof. The Schedule of Values shall include a fair and reasonable value for As-Built drawings, and as applicable, values for O&M manuals, training, and spare parts. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump-sum Contract Price or lump sum bid item indicated in the Bid Schedule.

3. Following the Engineer's approval, progress payments will be made in accordance with the Contractor's Schedule of Values and from the approved progress schedule, reflecting the progress which occurred during the payment period as approved by the Engineer.

1.03 MEASUREMENT OF QUANTITIES FOR UNIT PRICES

A. Measurement Standards: All work to be paid for at a Contract price per unit measurement, as indicated in the Bid Schedule.

1.04 VALUES OF UNIT PRICES

A. The number of units and quantities contained in the Bid Schedule as estimated quantities are approximate only, and final payment will be made for the actual number of units and quantities which are incorporated in the Work and required by the Contract.

B. In the event that work or materials or equipment are required to be furnished to a greater or lesser extent than is indicated in the Contract Documents, such work or materials or equipment shall be furnished in greater or lesser quantities in accordance with General Conditions.

1.05 CONTRACT PAYMENTS

A. Progress Payments:

1. Invoice for Work Completed: Not more than once each month the Contractor shall submit to the Engineer a proposed invoice for work performed or completed on forms supplied by the Engineer for evaluation and approval by the Engineer. The proposed invoice shall be certified and shall be supported by evidence as required by the Engineer, that the work invoiced has been completed in accordance with the requirements of the Contract. The proposed invoice shall be submitted with, among other things, current certified payroll records (submitted weekly and within seven (7) Days after the regular payment date of the payroll period), proof of payment to Subcontractors, satisfactory Construction Progress Schedule and Monthly Progress Reports. Failure to comply with these requirements may cause a suspension of progress payments during the period of noncompliance or may delay final payment. Except as noted, payment for work directed under any Change Notice shall not be invoiced and will not be paid until execution of the related Change Order. The Engineer will review the proposed invoice, and subject to making any modifications agreed to by the parties that are needed to make the invoice acceptable, the Engineer will approve the proposed invoice. The Engineer will retain a copy of such approved invoice for reference in preparing the payment application package and then provide the Contractor with a complete package in PDF form. Package will contain Payment Application Forms signed by the Management, the approved invoice, and any additional supporting evidence as required for processing of the payment.

2. Invoice for Stored Materials: Unless otherwise specified in the Contract Specifications, partial payments for Contractor-furnished materials not yet installed will be made only after such materials have been furnished, inspected and stored for use in the Work, provided they are stored in an area approved by the Engineer. All such material shall be covered by insurance. Said invoice may include the amount and value of such acceptable material as has been furnished, inspected and delivered to the site, and such acceptable material as has been furnished, inspected and stored for use in the Work, provided it is stored and is segregated and designated for exclusive use of the project within approved material storage.

3. Cost Determination: The cost of invoiced materials shall be determined in accordance with General Conditions Materials. Invoices from suppliers shall be furnished to substantiate the cost.

B. Full Compensation:

1. Payment will be full compensation for furnishing all labor, materials, tools, equipment, transportation, facilities, services, and incidentals for performing all work necessary for completing the construction or installation of the item or work classification.

2. Whenever it is specified or indicated in the Contract Documents that the Contractor is to perform work or furnish materials for which no price is fixed in the Contract, it is understood and agreed that there is included in each lump-sum price bid, or unit price bid, the entire cost of the Work, including all items of work which are incidental to the completion of those portions of the work covered by such lump-sum price bid, or unit price bid, or, if not directly incidental to any specific Bid Item in the Bid Schedule, the cost thereof has been distributed

among those Bid Items in the Bid Schedule considered most appropriate by the Contractor.

3. Work which is not clearly delineated in the Contract Documents to be under a particular Bid Item in the Bid Schedule shall be automatically assigned to one of the lump-sum Construction items in the Bid Schedule by the Contractor, so that all items of work, regardless of their characteristics or anonymity, are included in the Contract Price. Additional compensation will not be made for work items which do not clearly fall under listed Bid Items in the Bid Schedule.

1.06 REJECTED, EXCESS, OR WASTED MATERIALS

Quantities of material wasted or disposed of in a manner not called for under the Contract; rejected loads of material, including material rejected after it has been placed by reasons of the failure of the Contractor to conform to the provisions of the Contract; material not unloaded form the transporting vehicle; material placed outside the lines indicated on the Contract Drawings or established by the Engineer; or material remaining on hand after completion of the Work, will not be paid for, and such quantities shall not be included in the final total quantities. No additional compensation will be permitted for loading, hauling, and disposing of rejected material.

1.07 MEASUREMENT AND PAYMENT

Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

END OF SECTION 01 20 00

SECTION 01 31 19

PROJECT MEETINGS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Pre-construction meeting.

B. Construction Progress meetings.

1.02 RELATED SECTIONS

A. Section 01 57 00, Temporary Controls.

B. Section 01 35 24, Construction Safety.

1.03 PRE-CONSTRUCTION MEETING

A. A pre-construction meeting will be scheduled by the Engineer which may occur prior to but not more than seven (7) working Days after the effective date of the Notice to Proceed. The purpose of this meeting is to introduce the Engineer's representatives for construction management to their counterparts in the Contractor's organization and to establish lines of communication among these representatives. The Contractor's Project Manager, superintendent, quality representative, safety representative, and Subcontractor representatives, and community relations representatives shall attend. Not less than four working Days before the meeting, the Engineer will distribute a notice of this meeting, along with an agenda of the subjects to be addressed.

B. The Engineer will discuss the following requirements at this meeting:

1. Responsibilities and authorities of the Owner and the Engineer.

2. Quality assurance, quality control, inspection, and coordination of the Work.

3. Discuss and establish arrangements for safety, first-aid, emergency actions, security, and full-time safety representative as defined in Section 01 35 24, Construction Safety.

4. Traffic requirements and permit requirements as applicable to the Work.

5. Procedures for submitting and processing Change Notices, Change Orders, Shop Drawings, product data, and samples.

6. Monthly progress payment cut-off dates.

7. Partial and final payments.

8. Discuss permitting, insurance, and bonding requirements.

9. Discuss equipment and material use and storage by implementation of a Water Pollution Control Plan or Storm Water Pollution Prevention Plan as applicable in Section 01 57 00, Temporary Controls.

C. The Contractor shall perform the following at this meeting:

1. Introduce the Contractor's representatives, and briefly describe each person's responsibilities.

2. Distribute and discuss the list of major Subcontractors, their areas of responsibility, sequence of critical work, and tentative schedule of construction.

3. Discuss use of office, storage areas, staging areas, construction areas, and temporary easements.

4. Discuss construction safety.

5. Define housekeeping procedures.

6. Discuss construction methods.

7. Discuss quality control/quality assurance.

8. Describe construction sequencing of the entire Contract, general jobsite layout, erosion and sedimentation control plans, haul routes, noise abatement, dust abatement, air and water pollution control, temporary street closings, and street restoration, as applicable.

9. Discuss coordination and notifications required for utility work and services.

10. Discuss construction progress schedule.

1.04 CONSTRUCTION PROGRESS MEETINGS

A. The Engineer will schedule construction progress meetings each week and more often as necessary for the competent and timely execution of the Contract. The Contractor's personnel as indicated shall attend these meetings. Progress meetings shall include representatives of Subcontractors who are or will be performing work during the next week.

B. The Engineer will distribute notices of these meetings before such meeting to the Contractor.

C. The agenda for construction progress meetings will be prepared by the Engineer with input from the Contractor and will include the following:

1. Introduction of new attendees and areas of responsibility.

2. Review of minutes of previous meetings, amendment of minutes if necessary, and acceptance of minutes.

3. Analysis of work accomplished since the previous meeting, offsite fabrication problems, product delivery problems, submitted schedule slippages, problems arising from proposed

changes, and other circumstances which might affect progress of the Work. The Contractor shall have an updated Four-Week Work Plan schedule showing all activities started, completed, and ongoing during previous week and such activities scheduled for the next week.

4. Discussion of sequence of work on the critical path, and schedule of construction using the progress schedule. Each activity shall have a current status and forecast completion. The Contractor shall report on all activities which are forecast to be completed beyond the approved schedule date(s) and shall identify means of maintaining the approved schedule.

5. Discussion of work quality observations, problems, and employee work standards.

6. Discussion of coordination of utility work and other work by Owner and outside parties.

7. Discussion of changed conditions, time extensions, and other relevant subjects as they affect the progress of the Work.

8. Discussion of corrective measures to maintain construction progress schedule when necessary.

9. Discussion of potential claims and pending disputed issues.

10. Inquiries, requests for information, and Change Notices/Change Orders.

11. Discussion of upcoming month's work.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 31 19

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Contract Schedule.

B. Baseline Narrative Report.

C. Progress Status Report.

D. Gantt Charts.

E. Four-Week Work Plan.

F. Review, Updates and Revisions.

G. Recovery Schedule.

H. Time Impact Evaluation.

I. Requests for time extensions.

1.02 RELATED SECTIONS

A. Refer to the following sections for requirements:

1. Section 01 11 00, Summary of Work.

2. Section 01 33 00, Submittal Procedures.

3. Section 01 33 23, Shop Drawings, Product Data, and Samples.

1.03 DEFINITIONS

A. Definitions: The following definitions, in addition to definitions included in General Conditions, apply to the Contract.

1. Activity: A task, event or other Contract element on a schedule that contributes to completing the Contract. An activity has a description, start date, finish date, duration, and is linked to one or more other activities.

2. Actual Dates: The actual start or finish date of an activity.

3. Bar Chart (Gantt Chart): A graphic display of schedule-related information in which activities or other Contract elements are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.

4. Baseline Schedule: The first Critical Path schedule submitted by the Contractor and approved by the Engineer. The baseline schedule includes the scope of Work and show Contract milestones, and deliverables, including the Contractor's scheduled completion date, any float, and the Contract completion date.

5. Contract Completion Date: The contractual date for completion of the Contract, calculated from Notice-to-Proceed and the Contract day duration indicated, or revised Contract duration based on any approved Change Orders authorizing additional time.

6. Contract Schedule: The baseline schedule as modified by any subsequent, approved schedules including subsequent approved revisions, progress schedules or recovery Schedules. Approved shall mean approval by the Engineer.

7. Critical Path Operations: Refer to General Conditions, for definition.

8. Critical Path: Refer to General Conditions, for definition.

9. Critical Path Method (CPM): A network-based planning technique using activity durations and the relationships between activities to mathematically calculate a schedule for the entire Contract.

10. Data Date: The date in the Contract schedule that gives the current status of activities as of this date. Everything occurring on or after the data date is planned.

11. Early Completion Date: A scheduled completion date that is earlier than the Contract completion date.

12. Float: Also called slack. The amount of time that any activity or chain of activities can be delayed before extending the Contract completion date.

13. Lag: A scheduling tool that allows for insertion or removal of time between two linked activities in a manner that impacts the successor activity's forecasted start or completion dates. Negative lag occurs where the start time for an activity overlaps with and is earlier than the finish time of the preceding activity. Positive lag occurs where Day(s) for which no work is scheduled elapse between the start time of one activity and the finish time of the preceding activity.

14. Milestone: A marker in a network which is typically used to mark a point in time or denote the beginning or end of a sequence of activities in the Contract schedule. A milestone has zero duration but will otherwise function in the network as if it were an activity. Milestones shall include but are not limited to any activities described as milestones in Contract Specifications Section 01 11 00, Summary of Work.

15. Narrative Report: A document submitted with each schedule that discusses, in narrative form, topics related to Contract progress and scheduling. The narrative report shall identify any changes made in the attached schedule submittal and the reasons for the change.

16. Out-of-Sequence Activity: Any activity that actually starts in a sequence other than that shown in the Contract schedule.

17. Progress Schedule: An updated Contract Schedule submitted by the Contractor on a monthly basis subject to approval by the Engineer that incorporates monthly as-built progress and any planned changes.

18. Progress Status Report: The narrative report submitted with a progress schedule that also summarizes activities and work completed during the past month.

19. Recovery Schedule: A revision to the Contract schedule prepared by the Contractor for the Engineer's review and approval to show how delays can be recovered so that the Contract completion date or any specified milestone is met.

20. Revision: A change to the Contract schedule either initiated by the Contractor or requested by the Engineer that modifies logic; adds or deletes activities; or alters activities, sequences, or durations.

21. Scheduled Completion Date: The planned date of completion of the Work shown on the Contract schedule.

1.04 SUBMITTALS

A. Comply with submittal requirements herein and in Section 01 33 00, Submittal Procedures.

B. Qualifications of Contractor's Contract scheduler: submitted seven (7) Days after NTP.

C. Contract schedule shall be submitted as follows:

1. Baseline schedule and narrative report: submitted within thirty (30) Days after NTP.

2. Progress schedule and progress status report: submitted monthly in accordance with General Conditions or as often as deemed necessary by Engineer. Submit updated progress schedule and progress status report by at least five (5) Days before submitting a payment invoice. Progress schedule submittals shall show an accurate history of the submittals and resubmittals and the Owner review period for each submittal and resubmittal. Actual submittal numbers shall be included in the submittal activity name.

D. Contract schedule submittal shall include the following:

1. A USB drive containing the schedule file in the native file format (e.g. Primavera), if required by the Engineer.

2. One soft copy in pdf file format and three hard copies. Each copy shall include:

    a. The time-scaled bar chart with logic lines formatted and printed on an 11-inch x 17-inch paper or, as required by the Engineer.

    b. A time-scaled logic diagram.

    c. An activity report in tabular form showing activity ID, description, duration, float, early start, early finish, late start, late finish, predecessors, successors, constraints, percent complete, and remaining duration. Report shall be consistent with the scheduling file.

    d. The baseline narrative report or progress status report.

1.05 QUALITY ASSURANCE

A. The Contractor's Contract scheduler shall have a minimum of five (5) years of scheduling experience on construction projects of the size and scope similar to or larger than the Contract. Within seven (7) Days of the issuance of NTP, the Contractor shall submit for the Engineer's approval the resume of its proposed Contract scheduler. If the approved Contract scheduler stops working under the Contract or assumes responsibilities other than scheduling, the Contractor shall immediately notify the Engineer and submit, for the Engineer's approval, the resume of the intended replacement Contract scheduler.

1.06 CONTRACT SCHEDULE

A. General

1. The Contract Schedule and any subsequent modifications shall represent a logical and practical plan to complete the Work by the Contract completion date and shall convey the Contractor's intent in the manner of prosecution and progress of the Work.

2. The scheduling and execution of construction in accordance with the Contract Documents shall be the responsibility of the Contractor. The Contractor shall involve and coordinate with Subcontractors and Suppliers in the development and updating of any Contract Schedule that may affect a Subcontractor or Supplier.

3. Contract Schedule submitted by the Contractor shall be understood to be the Contractor's representation that the Contract schedule meets the requirements of the Contract Documents and that the Work shall be executed in the sequence and duration indicated in the Contract schedule.

4. Contract Schedule prepared by the Contractor shall meet the requirements for access, sequencing, construction staging, delivery of Owner-furnished materials, Contract constraints, Contract milestone and completion dates as specified in the Contract Documents.

5. The Contract Schedule shall be the basis for evaluating Contract progress and time extension requests. Responsibility for developing the Contract schedules and monitoring actual progress rests with the Contractor.

6. Inaccuracy in the Contract schedule or failure of the schedule to include any element of the Work shall not relieve the Contractor from responsibility for accomplishing the Work in accordance with the Contract requirements. It shall be the Contractor's responsibility to prepare and submit accurate and realistic Contract schedules for the duration of the Contract. The Engineer will rely on the Contract schedule for planning purposes. The Contractor shall be responsible for any inaccurate information or flaws in logic shown in the Contract schedule that may lead to inaccurate time extension analyses or conclusions. Engineer's review and approval of Contract schedule does not void Contractor's responsibility.

B. Format

1. Contract schedule shall be computer produced in the Critical Path Method (CPM) format, utilizing project scheduling software such as Primavera and Microsoft Project or other equivalent software as approved by the Engineer.

   Contract schedule shall show Contract tasks, duration of tasks, percent complete, progress bars, milestones, start and finish dates, and other breakdowns as required by the Engineer.

2. Activities shall be identified by the work area in which the activity occurs. The work area of each activity shall be identified by work area code.

3. Each activity shall be coded by one responsible party.

4. Contract schedules shall clearly show the sequence of activities and shall list specifically the following activities:

   a. Milestone completion dates. Phasing and staging shall be prominently identified.

   b. Submittals and the Engineer's review of submittals.

   c. Acquisition of permits.

   d. Major procurement activities and all long lead time items. Long lead items shall mean any item that takes over sixty (60) Days for delivery.

   e. Work to be performed by other contractors or agencies.

5. Activities in the Contract schedule shall include sufficient detail to identify the work that is to be accomplished. Such detail shall include the following:

   a. Clear, well defined, and unambiguous activity descriptions including what signifies the start and finish of the activity.

b. Sufficient activities to clearly show the sequence and interdependencies of the Work. An activity or group of activities shall correspond directly with Bid Item breakdowns or the breakdown of lump sum Bid Items. Add additional activities requested by the Engineer.

c. Activity durations shall be expressed in whole Days. Work that is to be performed by Subcontractors shall be clearly defined. The duration of field activities shall not exceed ten (10) working days.

d. Activities, with the exception of the first and last activities, shall have a minimum of one predecessor and a minimum of one successor.

e. Dependencies or relationships between activities shall be shown.

f. Punchlist tasks and time for testing shall be included prior to Substantial Completion.

g. The interface with the work of other contractors and agencies such as, but not limited to, utility companies, shall be indicated.

h. A list of anticipated non-work weather days and holidays. Exclude weekends from this list.

i. Include activities for the review of any submittals, and, access notice.

j. The activity calendars shall show the working hours for each calendar.

k. Clearly show the non-revenue hours work activities.

l. Incorporate and log the anticipated and actual non-work weather days per General Conditions.

6. Contractor shall keep multiple Critical Paths and near Critical Paths to a minimum. A total of not more than 50 percent of the baseline schedule activities shall be critical or near critical unless authorized by the Engineer.

7. Float suppression techniques, such as preferential sequencing (e.g. crew movement, equipment use, and form reuse), extended duration, imposed dates, scheduling of work not required for the Contract, shall not be used. The use of constraint dates shall be minimized and shall be approved by the Engineer if used. Mandatory constraints are not allowed.

C. Contract schedule submittal showing that Work is completed in less than the completion time specified in the Contract may be found to be impractical by the Engineer.

D. Contract schedule showing that Work is completed prior to the Contract completion date and that is found to be practical by the Engineer shall be considered to have float. Floats shall be a resource available to both parties as the need for the use of the float arises.

E. Any Contract Schedule submittal showing a completion date earlier than the Contract completion date shall show the time between the scheduled completion date and the contract completion date as float.

F. The term “delay” shall mean failure to meet the Contract completion date or any dates specified in Contract Specifications Section 01 11 00, Contract Liquidated Damages. Failure to meet the scheduled completion date shall not entitle the Contractor to compensable delay damages, if the Contract completion date is met. The Owner shall not be responsible for any damages related to the use of float to a failure to meet an early completion date, including extended overhead costs or early completion delay damages.

G. The use of negative lag is not allowed. Positive lag may be allowed subject to approval by the Engineer.

H. Contract schedule found to be impractical by the Engineer for insufficient detail or for any other reason shall be revised by the Contractor and resubmitted for review and approval.

1.07 BASELINE NARRATIVE REPORT

A. Baseline narrative report shall describe the basis, assumptions, planned sequences of work operations, production rates, equipment, resources, and constraints used to develop the baseline schedule. Upon request by the Engineer, provide a written statement signed by Subcontractors showing acceptance of the baseline schedule and any portion of said schedule affect the Subcontractor.

1.08 PROGRESS STATUS REPORT

A. Progress status report shall include the following:

1. Identification of unusual restrictions or conditions occurring or discovered during the update period regarding labor, equipment, or material. Unusual restrictions or conditions may include multiple shifts, six-day work weeks, and specified overtime or work at times other than regular Days or hours.

2. Description of the current Critical Path and the reasons for deviation from the last update.

3. Current and anticipated delays including cause of delay; impact of delay on other activities, milestones, and other completion dates; and corrective action and schedule adjustments to correct the delay.

4. Any proposed or approved corrective action and schedule adjustments to correct the delays, if any.

5. Work completed during the update period. List and detailed explanation of schedule logic changes from last schedule submittal.

6. Schedule logic changes include name changes; added or deleted activities; and added or deleted links, lags, duration changes and constraints.

1.9 GANTT CHARTS

A. The time-scaled Gantt charts shall conform to the following:

1. Show a continuous flow of information from left to right.

2. Be based on early start and early finish dates of activities.

3. Clearly show Critical Paths using graphical presentation.

1.10 FOUR-WEEK WORK PLAN

A. A schedule in calendar time-scaled bar chart format depicting the Contractor's intended work activities for the upcoming four-week period shall be submitted on a weekly basis and shall be due on the first working day of each week. Each activity of one (1) Day or more in duration shall be indicated. This Four-Week Work Plan shall also show the previous week's activities, leading into the upcoming four-week period.

B. The first Four-Week Work Plan shall be submitted one week ahead of any physical Work at the Jobsite.

C. The Four-Week Work Plan shall be a detailed break-down and update of activities of the Contract schedule. Every task in the Four-Week Work Plan shall show the corresponding activity ID number in the latest submitted Contract schedule as well as the Subcontractor's or Supplier's name performing the work.

D. The Four-Week Work Plan shall identify activities to be performed outside of the normal work shift for the Engineer to schedule inspection resources

E. Any deviations, such as sequences of work, timing, and durations of activities from the approved Contract schedule, shall be noted and explained in writing.

F. The Engineer's comments on the Four-Week Work Plan with which the Contractor disagrees shall be resolved in a meeting held for that purpose, if necessary.

G. The Four-Week Work Plan shall be submitted on sheets not less than 8-1/2 inches by 11 inches, or as approved by the Engineer.

1.11 REVIEW, UPDATES, AND REVISIONS

A. The Engineer will review and return the following Contractor's Contract Schedule submittals with written comments according to the schedule below.

Baseline Schedule: Twenty (20) Days

Progress Schedule, Revisions and Recovery Schedule:	Fourteen (14) Days

B. The Contractor shall make all corrections to a Contract Schedule submittal as requested by the Engineer and resubmit the schedule for approval within seven (7) Days of notification by the Engineer. If the Contractor does not agree with the Engineer's comments, the Contractor shall provide written notice of disagreement within five (5) Days from the receipt of the Engineer's comments. In case of disagreement on schedule logic changes, parties shall meet within five (5) Days to discuss proposed changes. The Engineer's direction with respect to logic change shall be noted in all the subsequent progress status reports if no agreement is reached.

C. Resubmittals shall conform to the same requirements as original submittals.

D. Allow seven (7) Days for Engineer's review of Contract schedule resubmittals.

E. The Engineer reserves the right to withhold progress payments or a portion thereof until a current Contract schedule has been approved by the Owner.

F. The numbering of the activities in the progress or recovery schedules shall be the same as in the accepted baseline schedule. Numbers of deleted activities shall not be used on any subsequent progress or recovery schedules. New numbers shall be used for new activities.

G. The first of each type of schedule and the first monthly progress schedule and report submitted by the Contractor will be reviewed for format, as well as content. The Engineer may request format changes. Once the format has been approved, all subsequent schedules, progress schedules, and progress status reports submitted by the Contractor shall be submitted in the approved format.

1.12 RECOVERY SCHEDULE

A. If, according to the progress schedule, the Contractor is thirty (30) or more Days behind the Contract completion date or for a milestone for which liquidated damages are specified, including all approved time extensions, the Contractor shall submit a recovery schedule.

B. Within seven (7) Days after request by the Engineer, the Contractor shall submit a proposed schedule, showing the Contractor's proposed revisions to recover the lost time. As part of this submittal, the Contractor shall provide a written narrative report that shall discuss each proposed revision made to recover the lost time.

C. The narrative report shall explain the Contractor's proposed methodology, basis, and assumptions made in the recovery of lost time. If the revisions include sequence changes, the Contractor shall provide a schedule diagram comparing the original sequence to the revised sequence of Work. The recovery schedule shall be prepared as a modification to the current progress schedule that incorporates proposed revisions to recover the lost time.

D. The proposed changes in a recovery schedule shall not be incorporated into any updated progress schedule until they have been approved by the Engineer. Once proposed revisions are approved by an Engineer, the Contractor shall include the approved revisions into the next monthly progress schedule submittal.

E. Upon request by the Engineer, the Contractor shall provide written statements signed by affected Subcontractors showing approval of the recovery schedule and portions of the schedule affecting the Subcontractor.

1.13 TIME IMPACT EVALUATION

A. When the Contractor becomes aware of circumstances including Change Notices, Force Account directives, or other Owner-caused delays, the Contractor shall prepare and submit a time impact evaluation ("TIE") within fifteen (15) Days of the event, which includes both a written narrative and a schedule diagram depicting how the changed work affects other schedule activities. The Contractor's failure to provide the TIE within the time specified shall be considered as Contract non-compliance pertaining to the Contractor's attempt to file any claims or time extension requests associated with the pertinent TIE issue.

B. TIE shall be based on an approved baseline or progress schedule that has a data date closest to and before the occurrence of the event. The TIE shall incorporate Owner's previous unaddressed or pending schedule review comments. The TIE shall show actual logic for the completed portion of the schedule as performed and verified in the field. If the approved baseline or progress schedule used for TIE does not show accurate as-built or remaining incomplete activity logic and duration, then the TIE schedule shall be revised to show the most accurate logic and sequence.

C. The schedule diagram shall show how the Contractor proposes to incorporate the changed work in the Contract schedule and how it impacts the Contract completion milestones or any interim milestone with liquidated damages.

D. The diagram shall be tied to the main sequence of schedule activities to enable the Engineer to evaluate the impact of the changed work to the Critical Path. Until approved by the Engineer, the TIE activities shall not be incorporated into monthly progress schedule submittals.

E. If the parties cannot agree on the time extension as depicted in the TIE, the Contractor shall submit a revised TIE at the conclusion of the delay period, incorporating as-built dates and logic in the revised TIE. The revised TIE shall incorporate the latest schedule logic revisions that were made after the submittal of the initial TIE and the impact of any and all concurrent delays, consistent with requirements of General Conditions and other relevant sections.

1.14 REQUESTS FOR TIME EXTENSIONS

A. If the Contractor requests an extension of time for the Contract completion date or for a milestone for which liquidated damages are specified, the Contractor shall furnish necessary justification for such extension so that the Engineer can determine whether or not the Contractor is entitled to an extension of time under the provisions of the Contract. Submission of proof based on revised

activities logic, and duration, is obligatory to any approvals. The cost of such justification or subsequent schedule revisions shall be borne solely by the Contractor.

1. The time extension evaluation shall fully comply with requirements of General Conditions and other relevant sections and clearly display that the Contractor has used, in full, the entire float available for the Work involved in its request.

2. The Engineer's determination as to the total number of Days for extension of the Contract completion date will be based upon the Contract schedule, General Conditions and other relevant information. Actual delays in activities that, according to the schedule, do not affect the Contract completion date as shown by the Critical Path, shall not be the basis for a change to the Contract completion date.

3. After receipt of such justification and supporting evidence, the Engineer will review the facts and advise the Contractor of the Engineer's decision. Any change to a milestone, for which liquidated damages are specified, or to the Contract completion date will be made by a Contract Change Order.

4. In addition to TIE, any Contractor's request for compensation for schedule delays shall include a but-for analysis that incorporates a complete concurrent delay analysis as required by General Conditions. Since the TIE is based on progress schedules that may not depict the correct dates or logics of incomplete activities, such but-for analysis requires analysis of as-built information at a later date so that the impact of the actual as-built dates and logic ties are used.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 32 16

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Stages of construction.

B. Quality and quantity of photographs.

C. Identification of photographs.

D. Video recordings.

E. Disputes, and potential claims.

F. Safety violations, accidents, unusual occurrences, near misses.

1.02 STAGES OF CONSTRUCTION

A. The Contractor shall take photographs at all construction milestones and at each of the following stages of construction:

1. Before commencement of clearing and demolition;

2. Upon completion of clearing and demolition;

3. Monthly during performance of the Work; and

4. Upon completion of the Work.

5. Anytime a problem arises that may result in a Notice of Potential Claim and the problem can be illustrated by photographs.

B. At least three different views or vantage points of each milestone and stage of construction shall be furnished. The quantity of photographs required for submission will be determined by the Engineer. Location of views shall be as approved by the Engineer.

1.03 QUALITY AND QUANTITY OF PHOTOGRAPHS

A. All photographs shall be digital photographs stored on CD-ROM, DVD or approved other media. Digital photographs shall be in pdf, jpg or png format with the following requirements:

1. Minimum resolution: 1024 x 768 pixels.

2. Colors: 24 Bits per Pixel.

3. Maximum File size of 3MB.

B. Digital photographs provided shall use the following file naming convention:

PYYMMDDLOCATIONSEQ.EXT

P = Photograph

YYMMDD = Date in Year, Month, Day format

LOCATION = (8 Characters maximum) Location taken, either by OWNER 3-character alpha numeric + 5, or Milepost by line designation. (e.g. M90, C40-west, A1MP32-1, etc.)

SEQ = Sequential number from 001 to 999.

EXT = File extension (e.g. pdf, jpg, or png).

C. CD-ROM or DVD disc shall be labeled to include the Contract number and the date the photographs were taken.

1.04 IDENTIFICATION OF PHOTOGRAPHS

A. The following information shall be furnished for each digital photograph in a manner approved by the Engineer.

1. Title of Contract and Contract Number;

2. Identification of subject shown;

3. Station point of camera and direction of view;

4. Camera or Portable Electronic Device (PED) shall be capable of printing time and date stamp on photos taken. No PEDs shall be used for taking photos when fouling the tackway.

1.05 VIDEO RECORDINGS

A. The Contractor shall provide video recordings to supplement contract photographs of certain construction milestones and events as indicated herein:

1. Start of construction including clearing and demolition operations, as applicable;

2. Highlights of all formal inspections; and

3. Highlights of the final inspection and acceptance by the Owner.

4. As requested by the Engineer

B. Video recordings shall be standard definition DVD - Video format and stored on a DVD optical disc.

C. Video recordings shall include a complete, clearly spoken narration of the events being photographed. Also, video recordings shall include an unobtrusive time and date indicator on the film, accurately depicting the time and date when the photography was performed.

D. The DVD disc shall be labeled with the same identifying information specified above for photographs. In addition, the narration of each recording shall lead off with this same identifying information.

E. Individual digital video files shall use the file naming convention indicated in 1.04B, however the filename shall be modified such that the first character shall be “V” for video instead of “P”.

1.06 DISPUTES AND POTENTIAL CLAIMS:

A. In the event a problem arises or dispute occurs which may result in a Notice of Potential Claim General Conditions and the problem or dispute can be illustrated by photographs and video recordings, the Contractor shall provide such photographs and video files.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 32 33

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. List of material sources.

B. Submittal requirements.

1.02 RELATED SECTIONS

A. Project progress schedules and status reports are specified in Section 01 32 16, Construction Progress Schedules.

B. General requirements and procedures for preparing and submitting Shop Drawings, product data, and samples are specified in Section 01 33 23, Shop Drawings, Product Data, and Samples.

C. Submittals related to the Contractor's quality program are specified in Section 01 45 00, Quality Control.

D. Submittals required to complete the Contract closeout are specified in Section 01 77 00, Closeout Procedures.

E. Preparation and submission of project record documents are specified in Section 01 78 39, Project Record Documents.

F. Preparation and submission of equipment and systems operation and maintenance manuals are specified in Section 01 78 23, Operation and Maintenance Data.

1.03 SUBMITTAL REQUIREMENTS

A. Submittals for Approval: Specific submittals shall be understood to be submitted to the Engineer for approval or specified to be submitted to others such as a designated approval authority for its approval.

B. Schedule of Submittals:

1. Within 10 Days after the effective date of Notice to Proceed, the Contractor shall submit a completed submittal schedule and list of products for all items requiring the Engineer's review and approval, as follows:

    a. Submittals, including description of the item and name of manufacturer, trade name and model number.

    b. Contract Specifications reference.

    c. Intended submission/resubmission date(s).

d. Order release date.

e. Lead time to delivery/anticipated delivery date(s).

f. Highlight any items that require expedited review to meet the Contract schedule.

g. Not more than 30 Days after the effective date of Notice to Proceed, the Contractor shall provide to the Engineer an updated schedule of submittals.

2. These schedules shall be presented in a form acceptable to the Engineer in both electronic and hard copy versions and shall be updated and sent to the Engineer on a monthly basis. Identify all submittals that are required by the Contract Documents and determine the date on which each submittal will be submitted in conformance with the schedules specified in Section 01 32 16, Construction Progress Schedules.

C. Professional Seal Required: Submittals involving engineering design services, when required by the Contract Documents or by governing codes and regulations, such as shoring and underpinning, excavation support structures, falsework for concrete, fire protection system design, and load and design calculations, shall be sealed and signed by a professional engineer, currently registered in Guam, for the discipline involved.

D. Review Period:

1. Prepare submittals sufficiently in advance so that approval may be given before commencement of related work.

2. Unless otherwise specified, allow 30 Days after receipt by the Engineer for review of each submittal, including 30 Days for each resubmittal.

3. The Contractor shall be responsible for determining whether or not certain governmental entities and utility owners require longer review periods. When longer review periods are required, the Contractor shall schedule the Work accordingly, so that the Work and project progress schedules are not adversely impacted.

E. Submittal Delivery: Ship submittals prepaid or deliver by hand directly to the Engineer.

F. Transmittal Form: Accompany submittals with an Owner-furnished transmittal form in duplicate containing the following information:

1. The Contractor’s name, address, and telephone number;

2. Submittal number and date;

3. Contract title and number;

4. Supplier’s, manufacturer’s, or Subcontractor’s name, address, and telephone number; and

5. Subject identification including Contract Drawing and Specifications reference.

G. Changes in Approved Submittals: Changes in approved submittals will not be allowed unless those approved submittals with changes have been resubmitted and approved, in the same manner as the original submittal.

H. Supplemental Submittals: Supplemental submittals initiated by the Contractor for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. Contractor's Review and Approval:

1. Each submittal shall be reviewed, stamped, and signed as reviewed and approved by the Contractor prior to submission. The Contractor's approval shall indicate review and approval with respect to the following responsibilities:

2. The Contractor shall be responsible for:

   a. The correctness of the drawings, for shop fits and field connections, and for the results obtained by the use of such drawings.

   b. Verification of catalog numbers, and similar data.

   c. Determination and verification of field measurements and field construction criteria.

   d. Checking and coordinating information in the submittal with requirements of the Work and of the Contract Documents.

   e. Determination of accuracy and completeness of dimensions and quantities.

   f. Confirmation and coordination of dimensions and field conditions at the site.

   g. Safety precautions.

   h. Errors or omissions on submittals.

   i. Coordination and performance of work of all trades.

   j. Identification of deviation(s) from Contract requirements.

   k. Sustainability attributes of products, including any required manufacturer's certifications, must be included in the product data submittal.

3. The Contractor shall coordinate each submittal with the requirements of the Work, placing particular emphasis upon assuring that each submittal of one trade is compatible with other submittals of related work. Ensure submittal is complete with all relevant data required for review.

4. The Contractor shall stamp, initial or sign the submittal, certifying:

a. Dimensional compatibility of the product with the space in which it is intended to be used.

b. Review of submittals for compliance with Contract requirements.

5. Do not start work for that requires approval by the Engineer until submittals have been returned to the Contractor with official indication that approval has been granted by the Engineer.

6. If a submittal is designated to be submitted to a designated approval authority for approval, the Contractor shall submit a copy of the Contractor's submittal to that authority to the Engineer for information. Upon approval by the designated approval authority, the approved submittal shall be submitted for the Engineer's information.

7. Approval of drawings and associated calculations by the Engineer shall not relieve the Contractor from the responsibility for errors or omissions in the drawings and associated calculations, or from deviations from the Contract Documents, unless submittals containing such deviations were submitted to the Engineer and the deviations were specifically called to the attention of the Engineer in the letter of transmittal and within the submittal, and approved specifically by the Engineer as a Contract change.

8. Approval of the Contractor's submittal by the Engineer shall not relieve the Contractor of any responsibility, including responsibility for accuracy and agreement of dimensions and details.

B. Submittal Quantities: Refer to Contract Specifications Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal quantities.

C. Review by the Engineer**:** One marked up reproducible set of drawings, one copy of product data, and one sample will be returned to the Contractor.

D. Distribution of Submittals after Review: Distribute prints or copies of approved submittals, bearing the Engineer's or designated approval authority's stamp and signature, to the Contractor's field office and the Engineer's field office; to affected and concerned Subcontractors, Suppliers, and fabricators; and to affected and concerned members of the Contractor's workforce.

1.05 ENGINEER'S REVIEW

A. Submittals will be reviewed for conformance with requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. Nether review nor approval shall relieve the Contractor from Contractor's responsibility for accuracy of submittals, for conformity of submittals to requirements of Contract Documents, for compatibility of described product with other provided products and the rest of the system, or for prosecution and completion of the Contract in accordance with the Contract Documents.

B. Submittals shall be understood as being made for approval, unless otherwise specified, for example, as being made for information, record, or review. The Engineer will indicate its reviews of submittals and the action taken (approvals and non-approvals) by means of its review stamp. The review stamp will be affixed by the Engineer, the action block will be marked, and the stamp will be signed in blue ink and dated.

1. Approval of the submittal by the Engineer does not relieve the responsibilities of the professional engineer who originally signed and sealed the submittal or the responsibilities of the Contractor to meet the Contract requirements.

C. The review-stamp action-block marks will have the following meanings:

1. The mark APPROVED is an acceptance, and means that the submittal appears to conform to the respective requirements of the Contract Documents; that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed; and that the submittal need not be resubmitted.

2. The mark APPROVED AS NOTED - RESUBMISSION NOT REQUIRED is an acceptance, and means that the submittal appears to conform to the respective requirements of the Contract Documents upon incorporation of the reviewer's corrections, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed. Submittals so marked need not be resubmitted unless the Contractor challenges the reviewer's exception within seven Days. All noted changes shall be reflected in the Record (as-built) Drawings and other Record Documents by the Contractor.

3. The mark LIMITED APPROVAL – RESUBMISSION REQUIRED is an approval except for the work impacted by the notes and comments and means that the submittals require corrections to conform to the respective requirements of the Contract Documents. Fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed at the Contract's risk only for the elements of work not impacted by and changes required to incorporate the reviewer's corrections. The noted work cannot proceed until verification by the Engineer that the review's corrections have been properly incorporated in the submittal.

4. The mark NOT APPROVED – RESUBMISSION REQUIRED is a disapproval, and means that the submittal requires corrections to conform to the respective requirements of the Contract Documents, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may not proceed until incorporation of the reviewer's corrections and verification by the Engineer that the reviewer's corrections have been properly incorporated in the submittal.

5. The mark REJECTED – RESUBMISSION REQUIRED is a disapproval, and means that the submittal is deficient to the degree that the reviewer cannot correct the submittal with a reasonable degree of effort, has not made a thorough review of the submittal, and that the submittal needs revision and is to be corrected and resubmitted.

6. The mark NOT REVIEWED is acknowledgement of receipt and means that the submittal is for information and record purposes only.

D. Review stamps or other approval methods of the various designated approval authorities may not be the same as those of the Owner. The Contractor shall work with the various designated approval authorities and shall obtain approvals in the clearest and most straightforward manner possible.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 33 00

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Shop drawings.

C. Other submittals.

D. Product data.

E. Samples.

1.02 RELATED SECTIONS

A. Section 01 33 00, Submittal Procedures.

B. Section 01 78 39, Project Record Documents.

1.03 DEFINITIONS

A. Drawings: The term “Shop Drawings,” as used herein, includes fabrication, erection and installation, application, layout, and setting drawings, lists or schedules of materials and equipment, manufacturer’s standard drawings, wiring and control diagrams, all other drawings as may be required to show that the materials, equipment, and systems, and the positions thereof, comply with Contract requirements.

B. Product Data: The term “product data,” as used herein, includes manufacturer-prepared descriptive literature, catalog sheets, brochures, performance data, test data, printed diagrams, schedules, illustrations, and other information furnished by the Contractor or the various product and materials suppliers to illustrate and describe a product, material, system, or assembly for some portion of the Work.

C. Samples: The term “samples,” as used herein, are physical examples which illustrate materials, equipment, colors, textures, finishes, functions, configuration, and work quality, and establish the standards of quality and utility by which the Work will be judged for acceptance.

1.04 SUBMITTALS

A. Refer to Section 01 33 00, Submittal Procedures, for submittal procedures.

B. Quantities:

1. Three full size bond prints of each drawing.

2. Three copies of manufacturers' standard schematic drawings.

3. Three copies of Contractor's or manufacturers' calculations, and three copies of manufacturers' standard data.

4. Three copies of manufacturers' printed installation, assembly, erection, application, and placement instructions.

5. Two of each sample item specified in the various Specification Sections, unless otherwise specified.

6. Three copies of inspection reports, test reports, and certificates of compliance.

7. Where submittals are submitted to the Engineer for information or record purposes, submit two copies.

8. Where permits and licenses and other such documents are obtained in the Owner's name, submit the original and one copy.

1.05 SHOP DRAWINGS

A. Drawings shall be legible and prepared in accordance with the following requirements:

1. Drawings shall be limited to the following standard sizes in inches: Maximum size shall be 22 inches by 34 inches.

Name	WIDTH (Vertical)	LENGTH (Horizontal)
ANSI A	8 1/2 inches (215.9mm)	11.0 inches (279.4mm)
ANSI B	11.0 inches (279.4mm)	17.0 inches (431.8mm)
ANSI C	17.0 inches (431.8mm)	22.0 inches (558.8mm)
ANSI D	22.0 inches (558.8mm)	34.0 inches (863.6mm) (Maximum)

2. Each drawing shall have the following information in the title block.

   a. Drawing number, date, title, revision number, and sheet number

   b. Contract number, Contract sheet number, Contract page number.

   c. Contractor's name.

d. Subcontractor/manufacturer name (if applicable)

e. Name of installation location.

3. Each drawing shall use symbols from one standard reference source. The Contractor shall furnish a complete symbol list that includes non-standard symbols used on the drawing.

B. Drawings shall be submitted in accordance with the following requirements:

1. The first drawings submitted by the Contractor will be reviewed for conformance to the requirements herein. Once approval is given, the Contractor shall use this approved drawing as the standard and prepare subsequent drawings to a quality equal to or better than the approved standard.

2. Each drawing prepared and submitted for review shall have in the lower right-hand corner, just above the title block, a five-inch square blank space in which the Engineer may indicate the action taken.

3. All final approved drawings and catalog cuts shall be submitted to the Engineer upon completion of the Work as specified in Section 01 78 39, Project Record Documents.

C. When specified, shop drawings shall be prepared and submitted electronically. Such drawings shall be created using AutoCAD in accordance with the Owner's Contract Drawing CADD Requirements.

1. The initial submittal of such shop drawings shall include electronic copies for review of their conformance with applicable drafting standards. The Engineer will make the Contract Drawing CADD Requirements available upon request.

1.06 OTHER SUBMITTALS

A. Other submittals shall be furnished upon request for the Engineer's approval to verify compliance of all equipment and materials with the Contract Documents. These submittals shall include in addition to drawings: catalog cuts, certifications of compliance, or any other substantiating information or samples of material items as necessary.

1.07 PRODUCT DATA

A. The Contractor shall modify manufacturers' standard diagrams, charts, illustrations, brochures, calculations, schematics, catalog cuts, and other descriptive data to delete information which is not applicable to the Contract. The Contractor shall supplement standard information with additional information applicable to this Contract, and indicate dimensions, clearances, performance characteristics, capacities, wiring and other diagrams, and controls.

B. If the Contractor utilizes drawings prepared by others, such drawings may include the standards and symbols of others if the drawings are a mix of existing product drawings and drawings prepared specifically for this Contract. In the event others provide drawings prepared specifically

for this Contract, such drawings shall conform in symbols, media and standards to the Contractor's drawings.

C. The Contractor shall modify the manufacturer's printed installation, erection, application, and placing instructions to delete information which is not applicable to the Contract.

D. Submittals shall include the following:

1. Date and revision dates.

2. Contract title and number.

3. Reference Contract Drawing numbers.

4. Applicable Contract Specification Section numbers.

5. Identification of product by either description, model number, style number, serial number, or lot number.

6. The names of the Contractor, Subcontractors, Suppliers, and manufacturers as applicable.

7. Applicable standards, such as ASTM or Federal specification numbers.

E. Certificates of Compliance:

1. The Engineer may permit the use of certain materials prior to sampling and testing if accompanied by a certificate of compliance stating that the materials involved comply in all respects with the requirements of the Contract Documents. The certificate shall be signed by the manufacturer of the material. A certificate of compliance shall be furnished with each lot of material delivered to the Work, and the lot so certified shall be clearly identified in the certificate.

2. Materials used on the basis of a certificate of compliance may be sampled and tested at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve the Contractor of responsibility for incorporating material in the Work which conforms to the requirements of the Contract Documents. Any such material not conforming to such requirements shall be subject to rejection whether in place or not.

3. The Engineer reserves the right to refuse the use of material submitted for approval solely on the basis of a certificate of compliance.

4. The form of the certificate of compliance and its disposition shall be as approved by the Engineer.

1.8 SAMPLES

A. The Contractor shall furnish to the Engineer samples required by the Contract Documents. Samples shall be submitted without charge, with shipping charges prepaid. Materials for which samples are required shall not be used in the Work until approved in writing by the Engineer.

B. Sample Label: Each sample shall be labeled with the following data:

1. Name, number, and location on project;

2. Name of Contractor;

3. Material or equipment represented, and location in the project;

4. Name of producer, brand, trade name if applicable, and place of origin; and

5. Date of submittal.

C. The Contractor shall forward a letter in triplicate to the Engineer submitting each shipment of samples and containing the information listed on the Sample Label specified herein. Approval of a sample shall be only for the characteristics and use named in the submittal and approval, and shall not be construed to change or modify any Contract requirement. Before submitting samples, the Contractor shall assure itself that the materials or equipment will be available in the quantities required in the Contract, as no change or substitution shall be permitted after a sample has been approved unless such change or substitution is approved by the Engineer in writing.

D. Samples of material from local sources shall be taken by or in the presence of the Engineer. Samples taken otherwise shall not be considered for testing.

E. Inspection and tests will be made, but it is understood that such inspections and tests, if made at any point other than the point of incorporation in the Work, in no way shall be considered as a guaranty of acceptance of any material which may be delivered later for incorporation in the Work.

F. Approved samples not damaged in testing may be incorporated in the finished work if marked for identification and approved by the Engineer. Materials incorporated in the Work shall match the approved samples.

G. Failure of any material to pass the specified tests shall be sufficient cause for refusal to consider, under the Contract, any further samples of the same brand, make, or source of that material. The Engineer reserves the right to disapprove any material which has previously proven unsatisfactory in service.

H. Samples of material delivered to the site or installed in place may be taken by the Engineer for testing. Failure of samples to meet Contract requirements shall annul previous approvals of the item tested.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 33 23

SECTION 01 35 24

CONSTRUCTION SAFETY

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Contractor's Safety Program.

B. First Aid.

C. Emergencies and emergency procedures.

D. Protecting the general public.

E. Specific requirements.

F. Inspections by outside agencies.

G. Inspections by the Owner.

H. Hazardous materials encountered during construction.

1.02 RELATED SECTIONS

A. Section 01 57 00, Temporary Controls

1.03 REFERENCES

A.	OSHA	Occupational Safety and Health Administration
B.	ANSI	American National Standards Institute
C.	ASSE	American Society of Safety Engineers

1.04 SUBMITTALS

A. Refer to Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

B. Submit within seven Days of Notice to Proceed the following items. Submittals must be approved prior to any physical work on the Jobsite and prior to submitting first monthly progress payment.

1. Contractor's Safety Program.

2. Two copies of the Contractor's Site Specific Emergency Action Plan.

C. When public areas are affected, submit for review and approval plans in accordance with Section 01 57 00, Temporary Controls.

1.05 CONTRACTOR'S SAFETY PROGRAM

A. The Contractor and Sub-Contractor's Safety Programs shall include an Injury and Illness Prevention Program, along with Trade Specific Safety Programs, Hazard Communication Program. The Contractor shall be responsible for ensuring Subcontractor safety compliance.

1. Injury and Illness Prevention Programs must meet the OSHA minimum requirements:

   a. Management commitment and assignment of responsibilities.

   b. Safety communication system with workers.

   c. System for assuring worker compliance with safe work practices.

   d. Scheduled inspections and evaluation system.

   e. Accident investigation.

   f. Procedures for correcting unsafe and unhealthy conditions.

   g. Safety and health training and instruction.

   h. Recordkeeping and documentation.

2. Trade Specific Safety Programs including, but not limited to:

   a. Lockout and Tagout.

   b. Respiratory Protection.

   c. Fall Protection.

   d. Welding, Cutting, Brazing, and Hot Work.

   e. Excavation and Trenching.

   f. Confined Space.

   g. Lead and Asbestos with current licenses, permits, and training records.

   h. Forklift operations.

   i. Crane and derrick signaling and operation.

3. Disciplinary Program, a policy that prohibits rough or boisterous play and activity, gambling, the use of alcohol or drugs, and the possession of weapons on the Jobsite.

4. Heat Illness Prevention Program.

B. All elements of the Safety Program must be indexed.

1.06 FIRST AID

A. Contractor shall provide a minimum of one person who has a valid certificate in First Aid/CPR training from the American Red Cross, or equivalent training, that can be verified by documentary evidence. This person shall be made available at the Jobsite, at all times, to render First Aid/CPR.

B. Contractor shall provide first aid kit(s) in a weatherproof container. The contents of the first aid kit shall be inspected regularly to ensure that the expended items are promptly replaced. The contents of the first aid kit shall be arranged to be quickly found and remain sanitary. First aid dressings shall be sterile in individually sealed packages for each item. The minimum first aid supplies shall be in accordance with OSHA Title 8, Section 1512 Emergency Medical Services.

C. Workers shall receive prompt first aid care when injured.

1.07 EMERGENCIES AND EMERGENCY PROCEDURES

A. Contractor shall develop a Site Specific Emergency Action Plan for any event that may occur for the following categories: fire; worker injury; property damage and damage to various utilities (such as, electrical, gas, sewage, water, telephone or public roadways); earthquake; public demonstrations; bomb threats; hazardous materials encountered; toxic spills; explosions; vehicular accidents; and other items, as applicable to the project.

B. The Site-Specific Emergency Action Plan shall be in writing and shall cover those designated actions employers and employees must take to ensure worker safety.

C. At a minimum, the following shall be included in the Site-Specific Emergency Action Plan:

1. Alarm system and worker notification of emergency.

2. Means of reporting fires and other emergencies.

3. Designated evacuation assembly area.

4. Evacuation procedures and emergency escape route assignments.

5. Procedures for workers who remain to operate critical plant operations before they evacuate.

6. Accounting method for workers after an emergency evacuation has been completed.

7. Rescue and medical duties for workers performing them.

8. Emergency Notification Flow Chart containing names, job titles, and contact information of persons who can be contacted. This must be posted at the Jobsite in a location clearly visible

to all Jobsite personnel or made readily available.

9. Identification of persons responsible for making emergency calls (preferably the ranking supervisor present).

10. Emergency Procedures shall be kept current.

11. Site Specific Emergency Action Plan training shall be included in employee orientation and re-training shall be provided to all workers as the Site-Specific Emergency Action Plan is updated.

D. Information and directions for Hospital and Occupational Clinic closest to the Jobsite, shall be posted at the Jobsite or made readily available.

E. Contractor shall inform the Engineer immediately, should an accident or incident occur.

F. Following an accident or incident, the Contractor shall:

1. Secure the area as expeditiously as possible.

2. Provide only those, authorized representatives of the Owner and specific governmental agencies, an account of the nature of the emergency. Questions from media personnel shall be referred to the Engineer.

3. Whenever the Contractor requires emergency services, such as ambulance, Fire Department or Police, the Contractor shall use the posted emergency numbers.

1.8 PROTECTING THE GENERAL PUBLIC

A. The Contractor shall take the necessary steps to prevent injury to the general public, Owner's employees, and patrons, or damage to public property. The public shall be considered as any persons not employed by the Contractor or its Subcontractors. The Contractor shall adhere to the following requirements:

1. ANSI/ASSE "Protection of the Public on or Adjacent to Construction Sites." This standard provides the recommended elements and activities on construction projects to provide protection for the public.

2. Work shall be performed outside of the designated work area only when specifically stated in writing from the Engineer.

3. Necessary steps shall be taken to protect and maintain work areas that interface with public areas (sidewalks, station entrances, lobbies, corridors and aisles, stairways, escalators, elevators, station platforms, etc.).

4. All travel ways, access and egress points shall be maintained and clear of obstructions at all times.

5. Warning signs stating, "Construction Area Authorized Personnel Only" shall be conspicuously posted around the perimeter of each secured construction site to warn the

public.

6. Warning signs shall be conspicuously positioned and a trained flag person shall be assigned when the Contractor's material or equipment may be encountered by pedestrians or vehicles.

1.09 SPECIFIC REQUIREMENTS

A. Work Areas: The Contractor shall provide a safe work area. When unsafe conditions do exist, immediate abatement is required.

B. Work Practices: The Contractor shall be responsible for assuring that all workers work safely.

C. Daily "Tool Box" Meetings:

1. The Contractor shall conduct daily "Tool Box" meetings for all workers. The purpose of these meetings is to:

   a. Discuss observed accident trends and causes.

   b. Plan safety into the work activities.

   c. Take action to correct workers' safety concerns.

   d. Review emergency procedures with workers.

   e. Review public protection for daily work activities.

   f. Review identified daily work hazards and hazard control methods.

2. Daily documented pre-shift inspection shall be completed by a trained Competent Person, as defined by OSHA. The identified hazards and hazard control methods shall be communicated to all workers involved prior to the start of work, requiring written acknowledgement from the workers.

3. These meetings shall be documented and include the date, subject line, notes, names, and signatures of attendees. Documentation shall be forwarded to the Engineer within one week of the meeting.

D. Accident and Incident Reports: Notify Engineer immediately of any injury, property damage, incident or near miss. Provide Engineer with copies of all accident and incident reports, including witness names and contact information, responding agencies and contact information, pictures, corrective action, and all other supporting documentation within 24 hours of occurrence. Written reports shall be required for all injuries, property damage, and near misses using Unusual Occurrence Report (UOR) form furnished by the Engineer. The Engineer, at her or his discretion, may hold a Safety Stand Down after an accident prior to commencement of work after the incident.

E. OSHA Permit and Registration Requirements:

1. Each Contractor shall obtain relevant permits, licenses, and certificates pertinent to the safety of workers and operations in compliance with the applicable legal requirements. Copies of the documents shall be submitted to the Engineer.

2. Permits shall be available for review at the Jobsite upon request of the Engineer.

3. Contractors must obtain and post OSHA Activity Permits for the following:

    a. Erection or demolition of any building, falsework, scaffolding, or structure the equivalent of three stories or higher, or the equivalent height of 36 feet.

    b. Erection or dismantling of vertical shoring systems more than 3 stories high, or the equivalent height of 36 feet.

    c. Excavation Permits shall be required for excavations 5 feet or deeper.

    d. Performing any work related to hazardous materials.

    e. Use of fixed or mobile tower cranes, if required.

F. Personal Protective Equipment (PPE): The Contractor's personnel, without exception, are required to wear certain PPE. All PPE must meet the requirements of OSHA, ANSI, and any other PPE regulating agency.

1. Hard hats and safety vests are mandatory and must be worn at all times within the Jobsite.

    a. All safety vests shall be made of high visibility fluorescent material.

    b. Safety vests and personal protective equipment must meet OSHA requirements when flagging or working on roadways.

2. Hearing protection mandatory in all operations where workers are exposed to 80 decibels or higher.

3. Eye protection mandatory at all times when on construction site. When performing tasks that produce flying debris or when handling any chemicals, appropriate eye protection shall be selected for the hazard or as specified.

4. Fall protection shall be worn and used when working above a potential hazard or a fall hazard greater than 6 feet.

5. Protective Footwear – work boots shall be required at all times on the Jobsite. Work boots shall comply with the American Society for Testing and Materials (ASTM) standard ASTM F-2413. Work boots with visible damage will not be permitted.

6. Clothing – only long pants and shirts with sleeves allowed. No tank tops, mesh or flammable clothing will be permitted.

7. Respiratory protection – when required by law to protect workers from breathing contaminated and oxygen-deficient air when effective engineering controls are not adequate, or while engineering controls are being instituted.

1.10 INSPECTIONS BY OUTSIDE AGENCIES

A. The Contractor shall be subject to inspections by outside agencies, including, but not limited to OSHA. The Contractor shall notify the Engineer immediately should citations, warnings or safety violations be issued. Copies of same shall be provided to the Engineer within 48 hours.

1.11 INSPECTIONS BY THE OWNER

A. The Contractor shall cooperate with designated Owner's representatives when conducting site inspections.

B. The Owner may periodically make quality assurance audits of the Contractor's Safety Program.

1.12 CONSTRUCTION HAZARDS

A. Temporary Fencing: Refer to Specification 01 52 00, Construction Facilities.

B. Hazard Warning Signs: Signs and symbols shall be visible at all times when work is being performed and shall be removed or covered promptly when the hazards no longer exist.

C. Secure Work Areas: Secure work areas at all times to prevent unauthorized access.

D. Gates: Secure gates with a chain and tamper proof lock in an open or closed position to prevent from accidental swinging.

E. Traffic Control: Approved traffic controls shall be inspected daily to ensure compliance.

F. Flaggers: All flaggers must have current, OSHA approved flagger training certification when directing traffic.

G. All mobile equipment shall have a functioning backup alarm or a spotter when the vehicle is backing up or when views are obstructed.

H. Pedestrian Control: Pedestrians must be able to see and understand the routes they are to follow.

I. Scaffolds: Scaffolds shall be erected, moved, dismantled, or altered only under the supervision and direction of a Competent Person qualified in scaffold erection, moving, dismantling or alteration. Such activities shall be performed only by experienced and trained person selected for such work by the Competent Person.

J. Lockout and Tagout:

1. The Contractor must properly lockout and tagout any equipment within the Contractors responsibility.

2. Control of the lock and tag is also the Contractor's workers' responsibility.

3. The Contractor shall coordinate instances that require multi-employer lockout and tagout activities.

K. Ground Fault Circuit Interrupters (GFCIs):

1. Shall be used for temporary electrical wiring cords and equipment.

2. GFCIs shall be tested in accordance with the manufacturers' requirements and tested daily prior to use.

3. STOP WORK for GFCI trips and immediately notify the Engineer for further direction. Inspect equipment for defects and confirm with manufacturer that there are no recalls.

L. Dust and Silica Control: Workers and the public shall be protected from respirable crystalline silica exposures by using dust controls and personal protective equipment.

M. Respiratory Protection: When air is contaminated above the Permissible Exposure Level (PEL) including harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, appropriate respirators shall be provided to each potentially exposed worker as required per OSHA.

N. Tools and Equipment: When using tools and equipment, follow manufacturer's instructions.

O. Transporting Materials in Public Areas: Travel ways, access, and egress points shall be maintained and clear of obstructions, in order to prevent slips, trips, and falls. When transporting material in public areas a spotter(s) shall be required. A temporary barricade system shall also be required when needed and requested by the Engineer. All ground and floor openings shall be covered, secured, and properly marked. No materials may be transported on public elevators or escalators.

P. Confined Space: Precautions shall be taken when workers enter a confined space. These precautions include current written confined space program, current documented training that meets OSHA requirements, confined space permit that includes rescue plan.

Q. Excavation: Elements of the OSHA Trenching and Excavation Standards shall apply. OSHA Excavation Permits shall be required for excavations 5□ or deeper. At least one Trenching and Excavation Competent Person, with current OSHA certification certificate must be present at all times during trenching and excavation activities.

R. Fall Protection: Elements of the OWNER and OSHA Standards shall apply. Fall protection shall also be required when requested by the Engineer. The most stringent requirements shall govern.

S. Fire Extinguishers: Fire extinguishers not less than 5 lbs. each shall be made available. A hazard assessment shall be required in order to determine potential hazards that exist and the types of firefighting equipment that shall be necessary for each construction area.

T. Fire extinguishers shall be kept in close proximity to locations where fuel is used.

U. “No Smoking” Signs: Signs shall be posted at fuel storage areas.

V. Smoking: Smoking shall be permitted only in designated areas approved by the Engineer.

W. Hot Work:

1. Hot work includes, but is not limited to, the following activities: grinding, cutting, welding, brazing or soldering, heating, hot air welding or other operations that generate heat, flames, arcs, sparks or other sources of ignition. Prior to performing hot work, the Contractor shall evaluate the following: type of hot work to be performed, site preparation, atmospheric conditions, and use of appropriate personal protective equipment, and firefighting equipment.

2. Site preparation shall include a survey for the following: combustible materials; hazards posed by heat transfer; flammable, corrosive, or toxic residues; and equipment linings. Items like ones listed above shall be removed or protected from hot work activities prior to the start of work. Hole openings that sparks may enter through shall be secured prior to hot work operations.

3. The Contractor shall also evaluate the work area for the potential consequences of thermal conduction. Thermal conduction is the transfer of heat that could cause ignition by or through an object heated by the hot work operation.

4. A Hot Work Permit system shall be established and implemented.

X. The use of a secondary containment sufficient to catch any contaminant or fuel releases that may occur shall be required around stationary equipment or fuel cans.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 35 24

SECTION 01 43 00

QUALITY ASSURANCE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Contractor's construction quality plan.

B. Contractor's quality control representative.

1.02 RELATED SECTIONS

A. Section 01 45 00 – Quality Control

1.03 SUBMITTALS

A. Construction Quality Plan: Submit the Contractor's proposed Construction Quality Plan not later than 14 Days after the effective date of the Notice to Proceed. The Contractor's Construction Quality Plan will be reviewed by the Engineer, who will provide comments to the Contractor within 20 Days after its submittal. The Contractor shall revise its plan in accordance with the review comments and resubmit as required. The Contractor shall perform the Work in accordance with the approved plan.

1. In the event that the Contractor chooses to schedule activities prior to the approval of the Construction Quality Plan, the Contractor shall submit interim Quality Plans for such activities to the Engineer for approval. The activities addressed in such Quality Plans may not be started until the appropriate Quality Plan has been approved by the Engineer. Such plans shall be incorporated later into the overall Construction Quality Plan.

B. Construction Quality Control Representative: Submit to the Engineer for approval, within ten Days after the effective date of the Notice to Proceed, the name, qualifications, experience, and resume of the Contractor's proposed Construction Quality Representative as specified.

C. Quality Control Testing Firm: The Contractor shall submit the name, address, and qualification, together with the scope of proposed services, of the proposed testing firm to the Engineer for approval as least 30 Days prior to the scheduled commencement of any work involving such testing. Should the Contractor desire to use more than one firm for quality control testing, the required information shall be submitted for each such proposed firm.

1.04 CONTRACTOR'S CONTRUCTION QUILITY PLAN

A. The Contractor shall prepare a Construction Quality Plan which shall identify the Contract quality requirements for each activity and describe how the Contractor intends to furnish that quality, including control testing, certification, and records which the Contractor intends to provide.

B. The Construction Quality Plan shall include, but not be limited to, the following elements:

1. Training of personnel;

2. Installation, inspection, examination, and test control;

3. Control of measuring and test equipment;

4. Material control;

5. Control of non-conforming items;

6. Subcontractor controls;

7. Supplier and vendor controls:

8. Documentation and records control;

9. Special process control, and

10. Facility turnover.

11. Test Program Plan.

C. Test Program Plan:

1. A Test Program Plan shall be prepared, identifying the approach for accomplishing each of the specified tests. A narrative shall be prepared for each test specified, describing the test set-up, equipment, and instrumentation that will be used; procedure to be implemented; and the anticipated, as well as acceptable, test results. Drawings showing the relationship of the test sample and all significant components of the test equipment shall be included, as necessary, to describe the test set-up and procedure. The Test Program Plan shall include the test sequencing.

2. Equipment specifications and calibration methods for all testing equipment shall be included in the Test Program Plan.

3. Identity and qualifications of personnel who will perform testing shall be included in the Test Program Plan.

4. The Test Program Plan shall include the proposed format for reporting test data.

5. The projected schedule for test procedure submittals, test executions, and test results report submittals shall be included in the Test Program Plan.

6. After approval of the Test Program Plan, any proposed changes will require approval of the Engineer prior to implementing the change.

1.05 CONTRACTOR'S QUALITY CONTROL REPESENTIVE

A. The Contractor shall assign a Quality Control Representative to monitor the quality of construction activities.

B. In addition to persons performing or directly supervising the Work, the Contractor shall use qualified persons for quality verification and audits. These employees shall not be part of the production staff nor subject to the authority of the production staff, and shall have the necessary authority to perform their roles effectively.

C. The Contractor shall define the responsibility and authority of personnel primarily responsible for performing quality verification and audits. Include responsibility and authority to perform the following:

1. Identify and record nonconforming items or conditions;

2. Initiate and recommend correction through appropriate channels;

3. Verify correction or implementation of solutions to correct nonconforming items or conditions; and

4. Prevent or control further nonconformance.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 43 00

SECTION 01 45 00

QUALITY CONTROL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Source of materials.

B. Work quality.

C. Manufacturer's specifications and instructions.

D. Specialist applications/installer.

E. Manufacturer's field services.

F. Finish tolerances.

G. Engineer's monitoring.

H. Engineer's inspections and tests.

I. Contractor's quality testing.

J. Test reports.

K. Quality control audits.

L. Certificates of compliance.

M. Special inspections.

1.02 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

B. Within five (5) Days after completion of testing performed by or for the Contractor, submit test results of such tests to the Engineer. Identify test reports with the information specified for submittals in Section 01 33 00, Submittal Procedures, and additionally, the name and address of the organization performing the test, and the date of the tests.

1.03 SOURCE OF MATERIALS

A. In accordance with Section 01 33 23 - Shop Drawings, Product Data, and Samples, the Contractor shall notify the Engineer in writing of the sources from which the Contractor proposes to obtain materials requiring Owner's approval, certification, or testing.

1.04 WORK QUALITY

A. Shop and field work shall be performed by mechanics, crafts-persons, artisans, and workers skilled and experienced in the fabrication and installations of the work involved. The work shall be performed in accordance with the Contract Documents and the reviewed and accepted Shop Drawings.

B. Work shall be erected and installed plumb, level, square, and true, or true to indicated angle, and in proper alignment and relationship to the work of other trades. Finished Work shall be free from defects and damage.

1.05 MANUFACTURER'S SPECIFICATIONS AND INSTRUCTIONS

A. Unless otherwise indicated or specified, manufactured materials, products, processes, equipment, systems, assemblies, and the like shall be erected, installed, or applied in accordance with the manufacturer's instructions, directions, or specifications. Said erection, installation, or application shall be in accordance with printed instructions furnished by the manufacturer of the material or equipment concerned for use under conditions similar to those at the jobsite.

B. Any deviation from the manufacturer's printed installation instructions and recommendations shall be explained and acknowledged as correct and appropriate for the circumstances, in writing, by the particular manufacturer. The Contractor will be held responsible for installations contrary to the respective manufacturer's installations and recommendations.

1.06 SPECIALIST APPLICATOR/INSTALLER

A. Materials, equipment, systems, and assemblies requiring special knowledge and skill for the application or installation of such materials, equipment, systems, or assemblies shall be applied or installed by the specified product manufacturer or its authorized representative or by a skilled and experienced Subcontractor qualified and specializing in the application or installation of the specified product.

B. The installation Subcontractor shall be approved by the product manufacturer, as applicable.

1.07 MANUFACTURER'S FIELD SERVICES

A. The Contractor shall have the manufacturer of a product, system, or assembly that requires special knowledge and skill for the proper application or installation of such product, system, or assembly provide appropriate field or job service at no additional cost to the Owner. The Contractor shall have the manufacturer inspect and approve the application or installation work.

B. The Contractor shall make all necessary arrangements with the manufacturer of the products to be installed to provide onsite consultation and inspection services to assure the correct application or installation of the product, system, or assembly.

C. The manufacturer's authorized representative shall be present at the time any phase of this work is started.

D. The Contractor shall have the manufacturer inspect and approve all surfaces over which, or upon which, the manufacturer's product will be applied or installed.

E. The Contractor shall have the manufacturer's representative make periodic visits to the site as the work progresses as necessary for consultation and for expediting the work in the most practical manner.

1.08 FINISHED TOLERANCE

A. Except as specified otherwise in the individual Specifications Sections, Sections, finished tolerances shall conform with the following requirements:

1. Walls: Finished wall surfaces shall be plumb and shall have a maximum variation of 1/8 inch in 8 feet when a straightedge is laid on the surface in any direction, and no measurable variation in any 2-foot direction.

2. Ceilings: Finished ceiling surfaces shall present true, level, and plane surfaces, with a maximum variation of 1/8 inch in eight feet when a straightedge and water level are laid on the surface in any direction, and no measurable variation in any two-foot direction.

3. Concrete Floors: Tolerances for concrete floors and pavement are specified in Section 03 35 00, Concrete Finishing.

4. Finished Floors: Finished floors shall be level to within plus or minus 1/8 in 10 feet. Where floor drains occur, slope finished floor to the drain at the rate of 1/8 inch per foot or as otherwise indicated on the Contract Drawings.

1.09 ENGINEER'S MONITORING

A. The Engineer will perform surveillance inspection of the Contractor's on-site construction activities. Surveillance inspection consists of a review, observation, or inspection of Contractor personnel, material, equipment, processes, and test results, performed at random or at selected stages of the construction operations. The purpose of surveillance inspection is to determine if an action has been accomplished or if documents have been prepared in accordance with selected requirements of the Contract Documents.

B. The Contractor shall provide access to the Work and shall furnish the Engineer reasonable facilities for obtaining such information as may be necessary to be fully informed of the quality and progress of the Work.

C. Surveillance inspection does not take the place of the Contractor's quality programs or assume any responsibility for such programs or the quality of the Work. The Contractor shall establish its own quality program, perform the required inspections, and provide the necessary documentation to assure that acceptable quality has been achieved. The Contractor is responsible for specifying and controlling the quality of work performed by its Subcontractors.

1.10 ENGINEER'S INSPECTIONS AND TESTS

A. The Engineer may perform inspections and tests as necessary to determine the Contractor's compliance with Contract requirements. The Engineer may perform such additional inspections and tests as it deems necessary to verify compliance with Contract requirements.

B. For inspections and tests by the Engineer, the Engineer will provide the services of a qualified testing laboratory, soils engineer, or inspector, selected and paid for by the Owner.

C. The Owner-employed testing laboratory will supervise the preparation and selection of samples required for testing.

D. The Contractor shall provide such facilities and assistance as the testing laboratory may require for obtaining the necessary samples.

1.11 CONTRACTOR'S QUALITY CONTROL TESTING

A. Scope: The Contractor shall perform quality control inspections and tests as necessary to ensure compliance with Contract requirements.

B. Testing Services:

1. Quality control testing is the testing of materials prior to their delivery from a manufacturer, or during construction, such as soils compaction tests, load tests, concrete tests during placement, concrete strength tests, pipe leakage tests, and such other tests as are specified in the various Sections of the Specifications to ensure compliance with the Contract Documents. The Contractor shall assume full responsibility for quality control testing and shall give sufficient notice to the Engineer to permit the Engineer to witness the tests. Quality control testing shall be at the expense of the Contractor and shall be performed by a Contractor-employed independent testing firm.

C. Laboratory Tests: All laboratory testing shall be performed by an independent, qualified testing laboratory approved by the Engineer. The selected laboratory shall employ the proper equipment and qualified testing personnel for the testing specified in these Specifications. The Contractor shall obtain the Engineer's approval of the testing equipment and personnel. The Engineer may monitor the operations to ensure that tests are being performing in accordance with approved procedures and in compliance with these Specifications.

D. Qualification of Laboratory Testing Personnel: Personnel performing laboratory tests shall be qualified for such work by virtue of prior experience and training.

E. Testing Equipment: Testing equipment shall be in satisfactory operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be calibrated in accordance with national standards which are certified by the National Institute of Standards and Technology. Testing equipment shall be calibrated at the frequency recommended by the equipment manufacturer.

1.12 TEST REPORTS

A. Test reports shall include the following information:

1. Actual test results compared with the Contract requirements and identification of all non-conforming items.

2. Calibration Certificates.

B. The Engineer will make available to the Contractor copies of all test reports of tests performed by the Engineer.

1.13 QUALITY CONTROL AUDITS

A. The Engineer may perform quality control audits of the Contractor's, Subcontractor's, and Supplier's quality records and performance. The Contractor shall ensure that all quality control records and places of work are open and available to the Engineer for inspection. The Engineer will give 30 Days' notice of intention to audit specific activities or installations.

B. The Contractor, Subcontractor, or Supplier being audited shall be available during the audit as required by the audit team.

1.14 CERTIFICATES OF COMPLIANCE

A. The Contractor may use certificates of compliance for certain materials and products in lieu of the specified sampling and testing procedures. Submit any certificates required for demonstrating proof of compliance of materials with specification requirements with each lot of material delivered to the Work. The lot so certified shall be clearly identified by the certificate. Certificates shall be signed by an authorized representative of the producer or manufacturer and shall state that the material complies in all respects with Contract requirements.

B. The Contract Schedule specified in Section 01 32 16, Construction Progress Schedule, shall indicate the date scheduled for the submittal of certificates. In the case of multiple shipments, each of which shall be accompanied by a certificate of compliance, the scheduled date on the Project CPM Schedule shall indicate the initial submittal only.

C. The certificate of compliance shall be accompanied by a certified copy of test results or shall state that such test results are on file with the producer or manufacturer and shall be furnished to the Owner on request. In addition to the identifying information specified for submittals of Section 01 33 00, Submittal Procedures, the name and address of the organization performing the tests, the date of the tests, and the quantity of material shipped.

D. Materials used on the basis of a certificate of compliance may be sampled and tested by the Engineer at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve the Contractor of its responsibility for incorporating material in the Work which conforms to the requirements of the Contract, and any such material not conforming to such requirements will be subject to rejection, whether in place or not.

E. The Owner reserves the right to reject a certificate of compliance and require submittal and execution of sampling and testing procedures described herein.

1.15 SPECIAL INSPECTONS

A. Any special inspections required shall be executed by an independent inspection organization, not affiliated with the Contractor or its regular quality control organization.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 45 00

SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Temporary electrical facilities.

B. Temporary water.

1.02 RELATED SECTIONS

A. Temporary toilet conveniences, washing facilities, and drinking water are specified in Section 01 52 00, Construction Facilities.

B. Section 01 33 00, Submittal Procedures

C. Section 01 57 00, Temporary Controls

D. Installation, placement, maintenance, and removal of temporary utilities shall be performed in accordance with Section 01 57 00, Temporary Controls.

1.03 TEMPORARY ELECTRICAL FACILITIES

A. Electrical Services: Provide and maintain during the course and progress of the Work all electrical power and wiring requirements to facilitate the work of all trades and services associated with the Work. Electrical power shall be provided at the Contractor's expense. The Contractor shall request the utility company to install temporary power poles in locations required. All temporary wiring, feeders, and connections shall be furnished by the Contractor, as required.

1.04 TEMPORARY WATER

A. Provide temporary water service as required for the Work, at the Contractor's expense. Closest availability of water shall be determined by the Contractor and shall be approved by authorities having jurisdiction before making the connection.

B. Provide temporary piping or hose to carry water to every point where needed. All water used shall be potable water, unless otherwise approved by the jurisdictional authority for a specific purpose.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 CLEANUP

A. Remove all materials and equipment as a part of final cleanup.

END OF SECTION 01 51 00

SECTION 01 52 00

CONSTRUCTION FACILITIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Temporary sanitary facilities.

B. Contractor's field office.

C. Storage and parking areas.

D. Enclosed storage and shops.

E. Protective barricades and safety precautions.

F. Temporary fencing.

G. Security.

1.02 RELATED SECTIONS

A. Refer to the following sections for requirements

1. Section 01 35 24, Construction Safety

2. Section 01 57 00, Temporary Controls

3. Section 32 31 13, Chain Link Fences and Gates

1.03 GOVERNING LAWS

A. Temporary facilities shall be in compliance with applicable federal, state, and local utility, rules, and regulations. Nothing in these Contract Documents shall be construed to permit work not conforming with such codes and regulations.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide adequate temporary toilet conveniences, washing facilities, and drinking water for the use of all employees and persons engaged on or about the Work, including Subcontractors and their employees. Drinking water shall be potable and drinking water facilities shall be clean and sanitary.

B. Locate sanitary facilities where approved by authorities having jurisdiction and maintain in a clean and sanitary condition during the course of the Work. Keep such facilities adequately supplied with toilet paper, paper toweling, paper cups, and related supplies as required.

C. At completion of the Work, sanitary facilities shall be properly disinfected and all evidence of

same removed from the site.

1.05 CONTRACTOR'S FIELD OFFICE

A. The Contractor shall provide and maintain, in good condition, on the site or near the site as approved by the Engineer, a temporary field office of suitable size for construction administrative operations and consultations with representatives of the Owner, as required or approved by the Owner.

B. The Contractor's field office shall contain a complete set of Contract Documents.

1.06 STORAGE AND PARKING AREAS

A. The Contract Drawings may indicate work areas available to the Contractor for storage of materials and for parking of construction equipment. If so indicated, these areas will be provided to the Contractor for the durations indicated in the Contract Specifications. Additional work and storage space, if required, shall be provided by the Contractor at Contractor's expense.

B. The Contractor shall provide parking facilities for the Contractor's personnel, Subcontractors, supplier's delivery vehicles, and authorized visitors. Off-site parking facilities (if any) shall not impair or interfere with existing community parking and traffic conditions, regulations, and restrictions.

1.07 ENCLOSED STORAGE AND SHOPS

A. The Contractor shall provide all temporary storage and shop rooms that may be required at the jobsite for safe and proper storage of tools, materials, and equipment. Construct such rooms only in locations indicated or as approved by the Engineer, and so as not to interfere with the proper installation and completion of other work.

B. Remove such rooms within three Days of receipt of notices from the Engineer that removal is necessary and incur all expenses for such removal.

1.08 PROTECTIVE BARRICADES AND SAFETY PRECAUTIONS

A. Construct and maintain barricades, lights, shoring, and warning signs as required by Federal and State safety ordinances and as required to protect the Owner's property from injury or loss and as necessary for the protection of the public and adjacent properties. Provide walks around obstructions made in a public place for executing the Work. Leave all protection in place and maintain until removal is authorized.

B. Maintain access to and clearly mark Fire Department Connection (FDC).

C. Guard and protect all workers, pedestrians, and the public from excavations, construction equipment, obstructions, and other dangers with adequate railings, guard rails, temporary walks, barricades, warning signs, directional signs, overhead protection, planking, decking, danger lights, and other suitable safeguards.

D. Flaggers shall be provided to direct or divert pedestrian or vehicular traffic when necessary as

specified in Section 01 57 00, Temporary Controls.

E. Additional safety requirements are specified in Section 01 35 24, Construction Safety.

1.09 TEMPORARY FENCING

A. The Contractor shall furnish, construct, maintain, and later remove temporary fencing around the jobsite perimeter as indicated. Contractor is responsible for all maintenance of temporary fence, including but not limited to removal of graffiti within 24 hours and preventing fence from falling over.

B. Except as otherwise specified herein, temporary fencing shall conform to Specifications Section 32 31 13, Chain Link Fences and Gates.

C. Used materials may be employed for temporary fencing, provided such used materials are good, sound, and are suitable for the purpose intended.

D. Fencing materials may be commercial quality, provided the dimensions and sizes of said materials are equal to, or greater than, the dimensions and sizes indicated in Specifications Section 32 31 13, Chain Link Fences and Gates. Additional fencing options include the following:

1. Posts may be either metal or wood.

2. Galvanizing and painting of steel items will not be required.

3. Treating wood with wood preservatives will not be required.

4. Concrete footings for metal posts will not be required, except where portable footings are required for temporary anchorage of posts.

E. Temporary fencing that is damaged from any cause during the progress of the Work shall be repaired or replaced by the Contractor at no additional cost to the Owner.

F. When no longer required for the Work, temporary fencing shall be removed. Removed fencing and related materials shall become the property of the Contractor and shall be removed from the jobsite, except as otherwise provided herein.

G. Holes caused by the removal of temporary fences shall be properly filled to match adjacent surfaces.

H. In public areas, temporary fencing stands, supports, and corners shall be made obvious with high visibility safety cones secured at each fence stand and support. Temporary fencing in public parking areas shall have reflective cones at each corner. Fencing may also require additional reflectors when requested by the Engineer. Ensure that fence supports shall support screened fencing during wind events. Temporary fencing and gates shall be inspected regularly during daily inspections.

1.10 SECURITY

A. The Contractor shall provide for security of the Work and the Jobsite until final inspection and Acceptance of the Work. Storage areas shall be suitably fenced and lighted and routinely patrolled by security guards.

B. The Owner assumes no responsibility for protection of structures and finished work or for loss of materials and equipment from the time that Contract operations have commenced until Acceptance of the Work.

C. If watchman service is deemed necessary by the Contractor, such protection shall be provided by the Contractor, and all costs therefore shall be paid for by the Contractor.

D. Damaged, lost, or stolen materials and equipment, whether or not stored or already installed, shall be replaced by the Contractor with new specified materials and equipment, including reinstallation where applicable, at no additional cost to the Owner.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 CLOSEOUT

A. Upon completion of the Work, or prior thereto when required by the Engineer, remove temporary facilities' structures and installations from the Owner's property.

B. Return exterior areas utilized for temporary facilities to their original, natural state or, when called for on the Contract Documents, complete such areas as indicated.

END OF SECTION 01 52 00

SECTION 01 57 00

TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Traffic plan and controls.

B. Pedestrian and patron controls.

C. Construction operations under traffic.

D. Pollution abatement.

E. Erosion and sediment control.

F. Dust control.

1.02 SUBMITTALS

A. Traffic plan and permits.

B. Water Pollution Control Plan (WPCP).

C. Storm Water Prevention Plan (SWPPP).

1.03 TRAFFIC PLAN AND CONTROLS

A. Traffic Plan and Permits:

1. The Contractor shall prepare a traffic plan required for the Work. The traffic plan shall include drawings showing proposed traffic control devices including temporary signage and temporary pavement markings and striping. The Contractor shall apply to the jurisdictional agency for approval of the plan and for a permit or permits to work in the public right-of-way.

2. Include traffic plans for each phase of the work requiring different traffic diversion patterns and methods of control. Include for each phase detailed schedules for performance of work and include proposed traffic control devices.

B. Control Devices and Facilities:

1. Furnish, install, operate, maintain, and remove when no longer required, all traffic control and protective devices required for the approved traffic plan.

2. Traffic control and protective devices shall include temporary directional electrical warning signs, detour signs, and danger signals; temporary barricades and guard rails; crash cushions; temporary lighting, overhead warning lights and flashing lights; temporary

pavement markings, and removal of permanent and temporary pavement markings; and the services of qualified flaggers.

3. Maintain communication with the jurisdictional agency(s) regarding the Contractor's operations in maintaining and controlling traffic.

C. Traffic Control Signs: Each change in location of traffic shall be adequately posted with signs mounted on barricades or standard posts. The Contractor shall make arrangements for providing temporary no parking signs.

D. Pavement Marking: Install necessary temporary and permanent pavement marking as required in connection with the temporary street work and remove or obliterate existing or temporary pavement markings whenever vehicle traffic is moved to a newly available pavement area or to different traffic patterns.

E. Prior to starting work on each phase requiring traffic control, demonstrate to the satisfaction of the Engineer that necessary materials, equipment, and personnel are on site and that, once started, work can be completed in an expeditious manner without interruptions.

F. Redirecting Traffic:

1. All channelizing, shifting of traffic lanes, and barricading of traffic in connection with the Work will be subject to approval of the appropriate jurisdictional agency. Existing local standards for signing and marking of construction areas will apply.

2. When required by the Contract Specifications, or indicated on the Contract Drawings, or required by responsible public agencies, the Contractor shall construct, maintain, and remove detours and for the use of public traffic.

3. Failure or refusal of the Contractor to construct and maintain detours at the proper time shall be sufficient cause for closing down the Work until such detours are in satisfactory condition for use by public traffic.

G. Temporary Closing to Traffic: Prior to temporary closing to traffic of any street, sidewalk, or other access, or to changing traffic patterns from those indicated on the Contract Drawings, obtain approval from appropriate jurisdictional authority, and comply with imposed conditions, at least two weeks before such closures or changes are made. Deviations will be for an emergency condition affecting life and property only, and the Contractor shall immediately notify the Engineer and the appropriate jurisdictional authority of any such emergency changes. Copies of all approvals shall be furnished to the Engineer.

H. Temporary Walkways: In areas where removal of existing sidewalks is necessary, access to adjacent businesses, entrances, and properties shall be maintained by temporary walkways having a width of not less than four feet.

I. Intersections and Street Crossings: Intersections and street crossings shall be excavated and decked in stages as indicated. Construction shall be phased so that the required number of traffic lanes on each street will be provided at all times during these operations. Upon completion of decking installation, traffic in all directions shall be fully maintained. Trenches or open excavations shall be properly bridged where traffic lanes are to be open to traffic.

J. Temporary Paving and Patching: Construct, maintain, and remove temporary pavement and patching required to safely and expeditiously handle vehicle and pedestrian traffic, within or adjacent to the jobsite. Temporary pavement and patching composition shall conform to the specifications of the local jurisdictional authority. Any construction, maintenance, or removal required by the Contractor's operations off site shall conform to the requirements specified herein.

K. New and Existing Traffic Control Devices:

1. The Contractor shall arrange with the respective local authorities to provide governmental services as required for salvaging reusable street-name and traffic signs, removal of parking meters, and for removal, relocation, and adjustment of traffic signals.

2. The Contractor shall provide such work and construction services as may be required by local authorities to assist in salvaging reusable street-name and traffic signs, removing of parking meter posts and bases, and removing, relocating, and adjusting of traffic signals, all in accordance with jurisdictional standards and regulations.

1.04 CONSTRUCTION OPERATIONS UNDER TRAFFIC

A. Definitions: "Construction equipment" is defined for the purposes of this Article as all types of equipment, vehicles, and tools used in connection with construction work. The term "workers" includes every person or firm performing work in or adjacent to public streets.

B. Construction Equipment: When in traffic lanes, all vehicles and equipment shall be operated at normal traffic speeds. Construction equipment shall not be parked in any lane intended for use by normal traffic. Equipment parked or stored at the work site shall be behind a guard rail, barrier, curb, or other protective device.

C. One-Way Traffic: No construction equipment shall be operated in traffic lanes, except in the designated direction of travel for respective lanes.

D. Construction Operations:

1. Schedule surface operations so that work is not carried on intermittently throughout the area. Excavation or construction activities shall be scheduled and pursued to completion as required to permit opening of street areas to traffic without unnecessary delays.

2. No construction work involving occupancy of traffic lanes shall be performed during adverse weather conditions or adverse road conditions, and traffic shall be properly safeguarded by the use of flashers and lights in addition to the signs and other markings specified herein. During these periods, no construction deliveries shall take place over a travel lane or immediately adjacent thereto.

3. When traffic conditions dictate, the Contractor shall modify its work operation for such length of time as required to alleviate the hazardous traffic conditions.

E. Equipment Travel:

1. No construction equipment other than that designated and used for general highway transportation shall be moved on streets during hours of darkness or periods of adverse weather conditions that reduce normal visibility.

2. Any construction equipment or material required for construction operations which exceeds the maximum vehicle dimensions, shall be moved only in accordance with established local regulations. No such oversize load shall be moved over public streets without first obtaining approval of the appropriate jurisdictional authority.

F. Crossing Traffic Lanes: Construction equipment entering the traveled way from the median shall be safeguarded by a portable changeable message sign and with flaggers as required. This operation shall be performed at off-peak hours, and requires coordination between the Contractor and the local police or Highway Patrol, with the cost being borne by the Contractor.

G. Flaggers: When flagging is required.

H. Removal of Traffic Control Devices: All temporary signs, barricades, barrier curbs, crash cushions, drums, and cones used to safeguard traffic in connection with construction work shall be removed at the close of the work day, unless the state of the work is such that warning devices are still needed and are adapted for night closing.

I. Storage: No material or traffic control devices shall be stored on any lane intended for traffic use.

1.05 POLLUTION ABATEMENT - GENERAL REQUIREMENTS

A. Conduct construction operations in a manner that will minimize pollution of the environment surrounding the area of the Work by all practicable means and methods. Apply specific controls as specified in the Contract Specifications and as follows:

1. Waste Materials: No waste or eroded materials shall be allowed to enter natural or man-made water or sewage removal systems. Eroded materials from excavations, borrow areas, or stockpiled fill shall be contained within the Work area. The Contractor shall develop methods for control of erosion as specified in Article 1.08, herein.

2. Burning: No burning of waste materials or debris will be permitted.

3. Burying: No burying of waste materials and debris will be permitted within the limits of the Owner's property.

B. Provide for and maintain the flow of all sewers, drains, building or inlet connections, and all water courses which may be encountered during progress of the Work. Do not allow the contents of any sewer, drain, or building or inlet connection to flow into trenches. Immediately remove from proximity of the Work all offensive matter, using such precautions as are required by local authorities having jurisdiction.

1.06 EROSION AND SEDIMENT CONTROL

A. Requirements:

1. The Contractor shall prevent erosion of excavated areas, embankments, stockpiled earth materials, and other erodible areas, and shall provide control of runoff sediment from siltation and pollution of the drainage systems.

2. Prevent erosion of excavated areas, embankments, stockpiled earth materials, and other erodible construction areas, and prevent pollution of drainage systems by diversion of storm runoff around construction activities or by trapping or retaining sediment delivered by storm runoff.

3. Provide control of construction operations and implementation of storm water best management practices to prevent sediment or siltation and from being introduced into other storm drainage systems from Construction site storm runoff.

4. Comply with all applicable Federal, State, and local laws, and regulations concerning the prevention, control, and abatement of water pollution. The Contractor shall be responsible for fines, penalties, and damages assessed or levied on the Contractor or the Owner by any regulatory agency as a result of the Contractor's failure to comply with the provisions of this Section. The Owner may retain any money due the Contractor under the Contract for any fines, penalties, or damages as a result of the Contractor's failure to comply with the requirements of this Section.

B. Erosion and Sediment Control Plan:

1. Within 30 Days after the effective date of the Notice to Proceed, the Contractor shall submit a Water Pollution Control Plan (WPCP) or Storm Water Pollution Prevention Plan (SWPPP) for erosion and sediment control for the Engineer's approval.

2. The proposed plan or program shall indicate complete design and construction details and locations of all proposed temporary control structures, barriers, berms, sediment retention basins, and any other salient features.

3. Approval of the Contractor's proposed plan or program shall not relieve the Contractor of responsibility for designing, constructing, operating, and maintaining erosion and sediment control facilities in a safe and systematic manner, and for repairing any damage to the control structures and equipment caused by floods or excessive storm runoff or other unforeseen circumstance.

C. Prevention of Erosion:

1. Protect open excavations, trenches, embankments, and the like with barriers, berms, dams, waterproof coverings, or other measures as required to prevent erosion of open earth areas and excavated piles from storm runoff.

2. Protect stockpiled earth materials to prevent erosion. Contract shall be responsible for installing and maintaining BMPs associated with stockpiling, trenching, and other earthwork operations.

3. Where natural drainageways are intercepted by construction activities, such drainageways shall be protected so that runoff from the site or water from construction activities is not allowed to enter the natural drainage way.

D. Sediment Control:

1. Sediment retention basins shall be constructed only when there are no other, more economical, measures that can be employed to prevent sediment from entering streams, drainage systems, and storm sewers during storm runoff.

2. Sediment control shall be achieved by well-planned and scheduled excavation and backfill operations and effective control measures.

E. Removal of Temporary Structures: Erosion and sediment control structures and facilities shall be removed from the site upon completion of the affected work.

F. SWPPP Implementation:

1. The Contractor shall implement the SWPPP as approved by the Owner. The Contractor shall also conduct and document inspections prior to anticipated storm events and during and after actual storm events to identify areas contributing to storm water discharge, and to evaluate whether measures to reduce pollutant loading identified in the SWPPP are adequate and properly implemented. The Contractor shall modify as necessary any measures found to be inadequate in controlling storm water discharges.

2. If the Engineer identifies a deficiency in the implementation of the approved SWPPP, the deficiency shall be corrected immediately, unless an agreed date for correction is approved in writing by the Engineer. The Contractor's failure to correct identified deficiencies by agreed upon dates shall be cause for the Engineer to suspend work until such corrections are made.

3. For each progress period during which the Contractor fails to conform to the approved SWPPP, the Engineer may withhold up to 25 percent of the progress payment or the value of the SWPPP work that the Contractor has failed to perform, whichever is higher.

1.07 DUST CONTROL

A. The Contractor shall provide dust control at all times, including holidays and weekends, as required to abate dust nuisance or fugitive wind born particulates from the site due to construction activities or stockpiles. Dust and stockpile wind borne erosion control shall be by means of sprayed water or by other approved methods (eg. temporary hydraulic mulch rolled erosion control products (RECPs)), polyacrylamide or straw mulch with tackifier. Chemicals, oil, or similar palliative shall not be used. Recycled water shall be used where available. Do not allow duct control activities to initiate non-storm water discharges of water, silt, or sediment into MS4s or other storm drains.

B. Quantities and equipment for dust control shall be sufficient to effectively prevent dust nuisance on and about the jobsite; and when weather conditions warrant, sprinklering equipment shall be on hand at all times for immediate availability.

C. The Engineer will have authority to order dust control work whenever conditions warrant, and there shall be no additional cost to the Owner therefor. Dust control shall be effectively maintained whether or not the Engineer orders such work.

D. Complaints from the public shall be reported to the Engineer and shall be acted on immediately.

E. Where earthwork operations are in progress, keep exposed earth surfaces dampened continuously. Also, keep dirt accessways and roads dampened continuously.

F. If portions of the site are temporarily inactive or abandoned for more than 14 Days, provide dust control and abatement continuously during such periods of inactivity.

G. Prohibit mud, dust, and particulates from construction activities from leaving the Jobsite by use of temporary construction entry-exits, tire washers, and/or stabilized construction roadways. Perform street sweeping activities as needed, with a commercial grade vacuum sweeper with rotating bristles and spray/fogger nozzles to remove off site tracking of mud, dirt or dust particulates.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 57 00

SECTION 01 58 00

PROJECT IDENTIFICATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Project identification signs.

B. General construction signs.

1.02 PROJECT IDENTIFICATION SIGNS

A. Requirements: Provide temporary project identification signs as indicated.

B. Location: Locate the signs as indicated or as designated by the Engineer. Additional identical signs, as desired and paid for by the Contractor, may be placed at intermediate points if first approved by the Engineer. Place no other signs on the right-of-way or within the limits of the jobsite.

1.03 GENERAL CONSTRUCTION SIGNS

A. Requirements: Provide temporary general construction signs and field office identification signs as indicated or required. Provide field office identification signs for Contractor's field office.

B. Design, Layout, and Size: Design, layout, style of lettering, and colors shall be approved by the Engineer.

1. General construction signs shall be constructed from a sheet of plywood four feet by eight feet or three feet by six feet in size, as appropriate for the location, mounted on two posts set in the ground.

2. Field office signs shall be of similar design, three feet by six feet in size, for wall or post mounting, as appropriate for the location.

C. Location: Locate the signs as indicated or as designated by the Engineer.

1.04 CONSTRUCTION AND INSTALLATION

A. Materials: Sign faces shall be constructed of 3/4-inch thick, five ply, exterior grade, A-B-faced, Douglas-fir plywood, APA-grade-stamped. The frame shall be nominal two by two or two-by four stock, either construction-grade Douglas fir or A-grade redwood. Posts shall be four by six construction-grade Douglas fir, pressure-preservative-treated, eight to 12 feet long as required for the location.

B. Construction: Plywood signs shall be let into the frame, and the frame corners shall be mitered and screwed together. The sign shall be screwed to two, two by six Douglas-fir cleats that shall be bolted to the posts with at least two 1/4-inch bolts per post.

C. Installation: Sign posts shall be installed in the ground three feet deep, with the top of the sign horizontal, level, and even with the top of the posts, seven feet minimum above the ground.

D. Painting: Signs shall receive one coat of primer sealer and two base coats of exterior semi-gloss enamel. Generally, letters and logos shall be painted black or blue on a white background. Style of letters shall be Helvetica, unless otherwise indicated.

E. Maintenance: Keep signs clean and in good repair until Substantial Completion of the Contract.

F. Sign Quantities: Quantities of signs required are shown on the Contract Drawings.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 CLOSEOUT

A. Upon completion of the Work, the signs shall be left in place or shall be removed and disposed of off the Owner's property, as determined by the Engineer.

END OF SECTION 01 58 00

SECTION 01 71 13

MOBILIZATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Organization and mobilization of the Contractor's forces.

B. Transporting construction plant and equipment to the Jobsite and setting up of same.

C. Transporting various tools, materials, and equipment to the Jobsite.

D. Erection of temporary buildings and facilities as required for field offices, staging, storage, and construction operations.

1.02 RELATED SECTIONS

A. Refer to Section 01 51 00, Temporary Utilities, Section 01 52 00, Construction Facilities, Section 01 57 00, Temporary Controls, and Section 01 58 00, Project Identification for specific requirements, as applicable.

1.03 DESCRIPTION

A. Mobilization shall include mobilization of all construction equipment, materials, supplies, appurtenances, facilities, and the like, staffed and ready for commencing and prosecuting the Work; and the subsequent demobilization and removal from the Jobsite of said equipment, appurtenances, facilities, and the like upon completion of the Work.

B. Mobilization shall also include assembly and delivery to the jobsite of plant, equipment, tools, materials, and supplies necessary for the prosecution of work which are not intended to be incorporated in the Work; the clearing of and preparation of the Contractor's work area; the complete assembly, in working order, of equipment necessary to perform the required work; personnel services preparatory to commencing actual work; and all other preparatory work required to permit commencement of the actual work on construction items for which payment is provided under the Contract.

1.04 SUBMITTALS

A. Refer to Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

B. Submit a plan of the proposed layout of the construction site, including fences, roads, parking, buildings, staging, and storage areas, within seven Days after the effective date of the Notice to Proceed.

1.05 DELIVERY

A. Delivery to the jobsite of construction tools, equipment, plant, temporary buildings, materials, and supplies shall be accomplished in conformance with local governing ordinances and

regulations.

1.06 TOOLS AND SUPPLIES

A. Provide construction tools, equipment, materials, and supplies of the types and quantities necessary to facilitate the timely execution of the Work.

B. Provide personnel, products, construction materials, equipment, tools, and supplies at the jobsite at the time they are scheduled to be installed or utilized.

1.07 PLANT LOCATION

A. Locate plant, or plants, appropriately close to the portion of the Work for which it will be used.

1.08 DEMOBILIZATION

A. Upon completion of the Work, remove construction tools, apparatus, equipment mobile units and buildings, unused materials and supplies, plant, and personnel from the Jobsite.

B. Restore all areas utilized for mobilization to their original, natural state or, when called for in the Contract Documents, complete such areas indicated.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 71 13

SECTION 01 74 14

CLEANING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Cleaning and cleanup during construction.

B. Dust control.

C. Disposal of debris.

D. Final site cleanup.

1.02 RELATED STECTIONS

A. Refer to Section 01 57 00, Temporary Controls, for basic mud control and dust abatement requirements.

B. When demolition is involved, refer to Section 02 41 19, Selection Structure Demolition, as applicable, for additional dust abatement requirements.

1.03 CLEANING AND CLEANUP DURING CONSTRUCTION

A. The entire site of the Work, including the Contractor's work and storage areas, shall be kept in a neat, clean, and orderly condition at all times during the course of this Contract. The Engineer may, at any time during construction, order a general cleanup of the site as a part of the Work, and there shall be no additional cost to the Owner therefore. The Contractor shall provide general daily clean-up and disposal service for removal of waste, rubbish, trash, and debris away from the jobsite.

B. Perform cleaning of all facilities and ancillary buildings as required during construction to prevent accumulations of dust, dirt, soil, trash, and debris, so that a clean and safe working environment will be present at all times.

C. Walkways or designated pathways for authorized visitors shall be kept broom clean at all times. Walkways over exposed earth surfaces shall also be kept neat and free of pebbles and other obstacles to walking comfortably, equivalent to broom clean of paved surfaces.

D. The Contractor shall remove all graffiti placed during the course of the Work within the Contractor’s enclosed secured areas at the work site. The Contractor shall remove the graffiti within 24 hours after its detection in these areas.

1.04 DUST CONTROL

A. Clean interior spaces prior to the start of finish painting and the application of other finishes and continue cleaning as required until such work is completed.

B. Schedule operations to prevent dust and other contaminants, resulting from cleaning

operations, from adhering to set or newly finished surfaces.

C. Also, schedule operations to prevent dust and other flying particles from contaminating sensitive train control equipment in Train Control Rooms. Enforce tight controls as required to provide absolute dust control and abatement in these areas.

1.05 DISPOSAL OF DEBRIS

A. Dispose of waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no waste material and debris on the site. Burning of trash and debris on the site will not be permitted.

B. Location of disposal site for trash and debris and length of haul are the Contractor's responsibility.

1.06 FINAL SITE CLEANUP

A. Prior to Final Inspection, thoroughly clean the entire site and put it into a clean and neat, acceptable condition. Remove from the site all construction waste and unused materials, dunnage, loose rock and stones, excess earth, and debris of any description resulting from the Work.

B. Hose down and scrub clean where necessary all pavement and paved walks.

C. Thoroughly remove mortar droppings from concrete slabs and pavement where they occur. Hose down and scrub clean all concrete flatwork and exposed vertical surfaces of concrete and masonry.

D. Free and clear all new and existing drainage systems.

E. Clean and protect all conduit openings.

F. Prior to Final Inspection, the Contractor shall remove all markings from streets, sidewalks, walls and other Owner infrastructure within the enclosed secured area at the work sites.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used

END OF SECTION 01 74 14

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements preparatory to final inspection.

B. Final inspection.

C. Acceptance of the Work and final payment.

1.02 MEASUREMENT AND PAYMENT

A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

1.03 REQUIREMENTS PREPARATORY TO FINAL INSPECTION

A. The Contractor shall request a preliminary final inspection to determine the state of completion of the Work.

B. The request shall be made in writing, addressed to the Engineer, at least seven (7) Days in advance of the requested date of the preliminary inspection.

C. The Engineer will perform the preliminary inspection within three Days of the requested date.

D. Prior to the requested date of the preliminary inspection, the Contractor shall perform or provide the following, as applicable:

1. Temporary facilities, except as may be required for punch list work, shall be removed from the site.

2. The site and all applicable appurtenances and improvements shall be cleaned as specified in Section 01 74 14, Cleaning.

3. Record drawings and specifications shall be completed, signed, and submitted to the Engineer as specified in Section 01 78 39, Project Record Documents.

4. Operating instructions for equipment shall be properly mounted and posted as specified in Section 01 78 23, Operation and Maintenance Data.

5. Guaranties and warranties shall be submitted to the Engineer, as specified in the General Conditions and various sections of the Specifications, along with required operations and maintenance manuals as specified in Section 01 78 23, Operation and Maintenance Data.

E. The Contractor shall be represented by its principal superintendent and such Subcontractors

and Suppliers as may be necessary to answer the questions of the Engineer's inspection team.

F. Certain elements of the Work, such as mechanical and electrical work, may be scheduled separately at appointed times in order to keep the preliminary inspection more focused and the number of persons in the Engineer’s inspection team to a minimum.

G. From the information gathered from this inspection, the Engineer will prepare a punch list of work to be performed, corrected, or completed.

H. All work on the punch list shall be completed by the Contractor prior to requesting the final inspection.

1.03 FINAL INSPECTION

A. When all requirements of the above prepared punch list have been completed, the Contractor shall request the final inspection to determine eligibility for issuance of the Certificate of Substantial Completion.

B. The request shall be made in writing, addressed to the Engineer, at least seven (7) Days in advance of the requested date of the final inspection.

C. The Contractor shall be represented by its principal superintendent and such Subcontractors and Suppliers as may be necessary to verify the completion of the Work including punch list items.

D. Depending on the extensiveness of the punch list items, certain elements of the Work may be scheduled separately for final inspection at appointed times.

E. If the Work has been substantially completed in accordance with the Contract Documents, and only minor corrective measures are required, the Engineer will recommend that the Owner issue a Certificate of Substantial Completion, based upon the Contractor's assurance that remaining corrective measures will be completed within the shortest practicable time period. The Engineer will attach a corresponding punch list to the Certificate of Substantial Completion. A fixed schedule for such corrective measures shall be submitted to the Engineer, for approval.

F. If the Work has not been substantially completed in accordance with the Contract Documents, and corrective measures are still required, a new punch list will be prepared by the Engineer, based on the information gathered from the final inspection, and the Contractor will be required to complete this work and then call for another final inspection, following the procedure outlined above.

G. The date of the Certificate of Substantial Completion will establish the completion date of the Work, or portions thereof as specifically referenced in the Certificate, for determining liquidated damages.

1.04 ACCEPTANCE OF THE WORK AND FINAL PAYMENT

A. Upon completion of the Substantial Completion punch list items, the Engineer will recommend that the Owner formally accept the Work.

B. Acceptance of the Work and Final payment will be made in accordance with the General Conditions.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 77 00

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Post operating instructions.

B. Manual description.

C. Submittal requirements.

D. Submittal of final Operation and Maintenance (O&M) Manuals.

E. Liquidated damages in regard to O&M Manual submittals.

E. Printed Manual requirements.

F. Electronic version of Manual (eManual) for System Manuals.

1.02 POSTED OPERATING INSTRUCTIONS

A. Provide, where directed, printed sheets under framed clear acrylic plastic, giving brief, concise operating and maintenance instructions for all items of mechanical and electrical equipment and similar equipment and specialty items, as applicable, at their respective locations.

1.03 OPERATION AND MAINTENANCE MANUAL DESCRIPTION

A. Manuals shall be provided for all equipment and systems furnished under the Contract that require maintenance, operation, or modification including testing and training equipment. Manuals shall also be provided for other items, such as finishes, when specified in the Contract Specifications. Provide manuals for each item of equipment and its component parts.

B. Manuals shall be written in English.

C. Manuals shall be subject to revisions, updates, and other alterations at the Owner's discretion.

D. Manuals shall be provided in one of the three following formats:

1. Off-the-Shelf Equipment Manuals shall be provided for off-the-shelf items. Such equipment includes sub-assemblies and components that will be replaced instead of repaired or has no need for modifications, drawings, or manual revisions.

2. System Manuals shall conform to the requirements specified herein. Submit manufacturer's operation and maintenance instructions, if required, separately.

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, for submittal requirements. Schedule submittal of manuals in coordination with other submittals for the subject system or equipment.

B. Submit six sets of hard copy originals for review of each draft manual and for Owner's use of each final approved manual. At the Owner's discretion, the number of hardcopy originals may be reduced, but shall not be less than three sets.

C. Concurrently submit electronic files in accordance with requirements in Article 1.08C.

D. All text, including notes, manufacturer-supplied information such as cut sheets, specifications and other related material shall be clearly legible. All data and text incorporated in illustrations and drawings shall be legible.

E. Handwritten edits to content is prohibited. Alterations to content shall be legible, noted and detailed explanations reflected in the manual's Appendix.

F. System Manuals shall be submitted in accordance with the following requirements:

1. Submit Outline, Complete Draft, and Pre-Final submittals for review before submitting final version.

    a. Outline – Submit manual layout, sections and headings after final design of system or equipment has been approved.

    b. Complete Draft – Submit all text and illustrations, sample of binder and electronic files prior to first delivery of system or equipment.

    c. Pre-Final – Submit complete manual in accordance with criteria specified herein.

2. Pre-Final O&M Manual Review: Submit for approval prior to final acceptance tests for the particular system or equipment and no later than 42 Days prior to initial training course for Owner's personnel.

    a. Information gathered during final acceptance testing and training courses shall be incorporated to develop final version of the manual.

G. Off-The-Shelf Equipment Manuals shall be submitted in accordance with the following requirements:

1. Submit Complete Table of Contents and Complete Draft for review before submitting final version.
    a. Complete Table of Contents – Submit and obtain approval of the proposed Table of Contents, including volumes, chapter numbers, section titles setup, list of figures, list of tables, list of drawings and warranty information.

    b. Complete Draft – Submit all text and illustrations, sample of binder and electronic files prior to first delivery of system or equipment.

H. One set of each manual will be returned to the Contractor, marked with review-stamp-action-block marks as described in Section 01 33 00, Submittal Procedures.

I. Any non-compliant section of the manual will be identified and communicated to the Contractor in writing by the Engineer.

J. A manual returned to the Contractor marked “Not Approved” shall be revised and six sets resubmitted to the Engineer for review within 42 Days.

K. If the Engineer returns a manual to the Contractor that does not require resubmittal, the Contractor will make any noted corrections and submit copies of manual to the Engineer per the requirements of Article 1.08.

L. Asset Register: Submit 90 Days before Substantial Completion.

1.05 SUBMITTAL OF FINAL OPERATION AND MAINTENANCE MANUALS

A. Schedule: Submit final manuals no later than 42 Days following the satisfactory completion of Acceptance tests for the subject system or equipment.

B. The requirements specified in this Article apply to both System and Off-the-Shelf Equipment Manuals.

C. Electronic submission of each manual in its final form shall include

1. System Manuals: In addition to submittal requirements above, one CD-ROM or USB drive of the electronic version (eManual) containing all native (MS Word) and Adobe (pdf) files required to create the submitted manual. Native and Adobe (pdf) files will be assembled in separate folders.

2. Off-the-Shelf Manuals: One CD-ROM or USB drive of the Adobe (pdf) files used to create the submitted manual.

3. Electronic files shall include a matrix or document showing how the files are set up and how to access them.

4. The content of all files, native or Adobe (pdf), shall be identical to hardcopy manual submitted to Owner. All manuals shall be submitted as one eManual pdf file, as well as separate pdf files representing each volume and chapter.

5. Extraneous files or information should not be submitted with or incorporated in manuals.

1.06 PRINTED MANUAL REQUIREMENTS

A. Final Assembly: All hard copies shall be printed out, assembled, and placed in binders in accordance to Operation and Maintenance Manual Requirements.

B. The first section for each volume or book shall contain the cover sheet for that volume/book, and the master Table of Contents listing all of the chapters for the entire volume/book. When a volume is contained in more than one binder, each binder shall include a cover sheet, and

master Table of Contents for the entire volume/book in accordance to Operation and Maintenance Manual Requirements.

1.07 ELECTRONIC VERSION OF MANUAL (eMANUAL) FOR SYSTEM MANUALS

A. The eManual shall be created from the native electronic files, as specified, herein, using Adobe Acrobat.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION 01 78 23

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Maintenance of Record Documents.

B. Drawings.

C. Specifications.

D. Submission of documents.

1.02 MAINTENANCE OF RECORD DOCUMENTS

A. Maintain at the Jobsite one copy of the following documents for record purposes:

1. Conformed Contract Documents. One set of full size 22 by 34 inch prints shall be maintained for recording "as-built" revisions and special features.

2. Change Orders.

3. Approved Submittals.

4. Clarifications.

5. Inspection Reports.

6. Laboratory Test Records.

7. Field Test Reports and Records.

8. Factory Test Reports and Records.

B. Maintain for record purposes at a location approved by the Engineer, electronic files for those shop drawings and other documents which are required to be submitted electronically. Ensure that backups of electronic files are made on a regular basis and stored at a remote location.

C. Store documents used for record purposes in the Contractor's field office or other approved location, apart from documents used for construction. Do not use record documents for construction or fabrication purposes.

D. Provide files and racks for storage of documents.

E. File documents in accordance with the filing format of the Contract Specifications, by Section number and title.

F. Maintain documents in clean, dry, legible condition.

G. Label each document "Project Record".

H. Make documents available at all times for inspection by the Engineer. Make copies of electronic documents available upon Engineer's request.

1.03 DRAWINGS

A. Record ("As-Built") Drawings:

1. Maintain record ("as-built") drawings of all work and subcontracts, continuously as the job progresses. A separate set of prints, for this purpose only, shall be kept at the Contractor's field office at all times.

2. These drawings shall be kept up-to-date and are required to be so certified by the Engineer at the time invoices are submitted for progress payments. The Engineer may withhold progress payments if record drawings are not kept current.

3. The Owner will furnish the Contractor a complete set of full-size copies of the Contract Drawings for the purpose of making prints for record ("as-built") drawings.

4. Deviations from the drawings, utilities and services, mechanical and electrical lines, details, and other work shall be incorporated on the record ("as-built") prints in red ink, or in red pencil if sharp, neat, and clearly legible.

5. During the course of construction, identify actual locations to scale in red ink on the Contract Drawings for runs of mechanical and electrical work, including utilities and services, installed in walls, or otherwise concealed. Deviations from the Drawings shall be shown in detail. Locate main runs, whether wiring, piping, conduit, ductwork, or drain lines by dimension and elevation. Shop Drawings may be used to reflect record ("as-built") conditions, in which case the appropriate Contract Document shall be marked to refer to such Shop Drawings as part of the record ("as-built") configuration.

6. No work shall be permanently concealed until the required information has been recorded.

7. Where the Contract Drawings are not of sufficient size, scale, or detail, the Contractor shall furnish its own drawings for incorporation of details and dimensions.

8. The final submittal of record ("as-built") drawings shall be stamped "Project Record ", signed and dated in blue ink by the Contractor, and shall be delivered to the Engineer prior to the final inspection as specified in Section 01 77 00, Closeout Procedures.

B. Change Orders:

1. Changes to the Contract Drawings as the result of Change Orders shall be incorporated on the prints, and these changes shall be identified by Change Order number and effective date.

2. When revised Contract Drawings are issued as the basis of, or along with, Change Orders, these revised drawings shall be incorporated into the record ("as-built") set with appropriate annotation. Drawings deleted by Change Order will not be part of the record ("as-built") set. The Owner will furnish the Contractor with reproductions of such revised Owner-furnished Contract Drawings.

C. Submittals:

1. One complete set of approved Submittals, including shop drawings, product data, manufacturers' printed catalog cuts and data, shall be collected and maintained for record purposes.

2. Pages of catalog cuts shall be clear, legible, and permanent. The drawings shall be on vellum or bond paper. Blueprints will not be acceptable. These drawings and catalog cuts shall become the property of the Owner.

3. Submittals shall be filed and maintained separate from Contract Drawings and Shop Drawings. Documents shall be filed in nine inch by 12 inch file folders to the greatest extent possible and shall be indexed as herein before specified.

4. Submittals shall be delivered in new paperboard boxes manufactured for the storage of file folders. Boxes shall have covers and cutout handles and shall be accurately identified as to the contents. Include a packing list of all boxes and their contents.

D. Electronic Documents: Record (“as-built”) information, as applicable, shall be recorded on an electronic copy of those documents which are required to be submitted electronically.

1. For those drawings which are required to be submitted electronically, submit one complete set of full size (22 by 34 inch, unless otherwise required) hard copy originals.

2. Record documents for each submittal which was required to be prepared and submitted electronically shall include two CD-ROMs of the electronic version. Electronic files shall include a matrix or document showing how the files are set up and how to access them. Include no extraneous files. Folder arrangement must be clear and understandable, and subfolders are to be used only when necessary.

3. When specified by the Contract, Record Drawing shall be prepared and submitted electronically. Such drawings shall be created using AutoCAD in accordance with the Owner’s Requirements.

1.04 SPECIFICATIONS

A. Contract Specifications:

1. The specifications for record purposes shall be filed in one or more large-ring, three-ring binder or binders.

2. Information, changes, and notes shall be recorded in the specifications in blank areas, such as page margins or the backs of opposite pages, or on separate sheets inserted in the binder. All such information, changes, and notes shall be legibly recorded with red pen or

red printing as appropriate.

3. In applicable specification sections, record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually furnished and installed, including manufacturer and supplier's address and telephone number.

4. The record specifications shall be complete and shall include all applicable Contract Documents other than drawings.

B. Change Orders:

1. Change Orders shall be incorporated into the front of the record specifications in reverse chronological order. Use appropriate page dividers to identify Change Orders and to separate Change Orders from the Specifications.

2. In addition, changes to the Specifications effected by Change Order shall be legibly annotated on the affected page or pages of the Specifications or adjacent thereto.

1.05 SUBMISSION OF DOCUMENTS

A. At completion of the Work, and before requesting final inspection, deliver Jobsite record documents to the Engineer.

B. For record ("as-built") drawings, submit the blackline print (full size) with revisions incorporated on the prints in red ink. For those documents which are required to be maintained electronically, submit full size plot of drawings, hard copies of 8 1/2 by 11-inch documents, and electronic files on CD-ROM.

C. Record documents, separate from Contract Drawings and Shop Drawings, shall be delivered neatly and efficiently filed and packaged in appropriate file storage cabinets or boxes, 12 inches by 16 inches in size.

D. Submission of record documents shall be accompanied with a transmittal letter, in triplicate, containing the following information:

1. Date of submission.

2. Project title and number.

3. Contractor's name and address.

4. Title and number of each record document. (Shop Drawings may be grouped in basic categories or divisions of work and by box identification.)

5. Certification that each document as submitted is complete and accurate.

6. Signature of Contractor, or its authorized representative.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 01 78 39

SECTION 02 41 00

DEMOLITION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Permits.

B. Site conditions.

C. Materials, equipment, and facilities.

D. Preservation of reference markers.

E. Demolition.

F. Removal.

G. Disposal of removed materials and debris.

1.02 RELATED SECTIONS

A. Temporary facilities, such as fences, barricades, warning lights, and other temporary safety measures, are specified in Section 01 52 00, Construction Facilities.

B. Dust control is specified in Section 01 57 00, Temporary Controls.

C. Selective demolition and removal for renovation of existing buildings, structures, and facilities are specified in Section 02 41 19, Selective Structure Demolition.

D. Removal of vegetation and trees is specified in Section 31 11 00, Clearing and Grubbing.

1.03 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A10.6 Safety and Health Program Requirements for Demolition Operations

1.04 DESCRIPTION

A. Demolition as follows:

1. If required, existing buildings and structure foundations, footings, and foundation systems shall be completely removed.

2. Utility services to the existing facilities to be removed or demolished shall be disconnected,

cut, and capped.

B. Removal of at-grade existing structures, such as existing pavements, curbs, gutters, sidewalks, and designated utility structures.

1.05 PERMITS

A. The Contractor shall obtain all special permits and give all notices required for performance and completion of the demolition and removal work, hauling, and disposal of debris.

1.06 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures.

B. Permits: Submit copies of demolition, hauling, and debris disposal permits and notices for record purposes.

C. Provide certificates, issued by the utility owners, of severance of utility services for record purposes.

1.07 SITE CONDITIONS

A. Protection of Persons and Property:

1. Install chain link fencing around the area of demolition work. Comply with applicable requirements of Section 01 52 00, Construction Facilities.

2. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other measures as necessary to protect the public, workers, and adjoining property from damage from demolition work, all in accordance with applicable codes and regulations.

3. Open depressions and excavations occurring as part of this work shall be barricaded and posted with warning lights when accessible through adjacent property or through public access. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

4. Protect utilities, pavements, and facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by demolition operations.

B. Protection of Utilities:

1. Protect active sewer, water, gas, electric, and other utilities; and drainage lines indicated or, when not indicated, found or otherwise made known to the Contractor before or during demolition work. If utility is damaged, immediately notify the utility owner for corrective action.

2. Arrange with and perform work required by utility companies and municipal departments

for discontinuance or interruption of utility services due to demolition work.

C. Noise and Dust Abatement: Comply with requirements specified in Section 01 57 00, Temporary Controls, and the following:

1. Provide continuous noise and dust abatement as required to prevent disturbance and nuisance to the public and workers and to the occupants of adjacent premises and surrounding areas. Dampen or cover areas affected by demolition operations as necessary to prevent dust nuisance.

2. When a certain level of noise is unavoidable because of the nature of the work or equipment involved, and such noise is objectionable to the occupants of adjacent premises, make arrangements with the jurisdictional authorities to perform such work or operate such equipment at the most appropriate time periods of the day. Provide abatement measures to the extent feasible and practicable.

D. Unknown Conditions:

1. The Contract Drawings and related documents may not represent all surface conditions at the site and adjoining areas. The known surface conditions are as indicated and shall be compared with actual conditions before commencement of work.

2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other such surface fixtures.

3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the work until written instructions are received from the Engineer.

4. Thickness of existing pavements are from previous construction documents, and do not imply the actual depth or thickness of the total pavement or base material, where it occurs. Remove pavement of whatever thickness as required.

PART 2 – PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

A. The Contractor shall furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the demolition and removal work.

B. Materials used for backfill shall conform to the requirements for backfill of Section 31 00 00, Earthwork.

PART 3 – EXECUTION

3.01 DEMOLITION

A. Perform demolition in accordance with the approved Demolition Plan.

B. Cap or plug sanitary sewer in accordance with the utility owner's standard details and instructions. Cap and plug pipe and other conduits abandoned due to demolition, with approved type caps and plugs as required by the utility owners.

C. Backfill and compact depressions caused by excavations, demolition, and removal in accordance with applicable requirements of Section 31 00 00, Earthwork.

3.02 REMOVAL

A. Remove existing pavements, structures, and site improvements that interfere with new construction, where demolition is not indicated. Coordinate as required with the work of Section 31 11 00, Clearing and Grubbing.

B. Remove walls and masonry construction to a minimum depth of two feet below existing ground level in areas where such items do not interfere with new construction.

C. Slabs may be broken for drainage and left in place where they are below grade and are not detrimental to the structural integrity of the fill or structure to be placed above, as determined by the Engineer.

3.03 DISPOSAL OF REMOVED MATERIALS AND DEBRIS

A. Dispose of removed materials, waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.

B. Burying of trash and debris on the site will not be permitted. Burning of trash and debris at the site will not be permitted.

C. Remove trash and debris from the site at frequent intervals so that their presence will not delay the progress of the work or cause hazardous conditions for workers and the public.

D. Removed materials, trash, and debris shall become the property of the Contractor and shall be removed from the Owner's property and disposed of in a legal manner. Location of disposal site and length of haul shall be the Contractor's responsibility.

3.04 CLEANUP

A. Provide a clean and orderly site at all times in accordance with Section 01 74 14, Cleaning.

END OF SECTION 02 41 00

SECTION 02 41 19

SELECTIVE STRUCTURE DEMOLITION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Inspection.

B. Demolition.

C. Cutting.

D. Salvaging.

E. Initial building cleaning.

F. Disposal of debris.

G. Restoration of existing structures and facilities.

H. Field Quality Control.

1.02 RELATED SECTIONS

A. Temporary facilities, such as fences, barricades, warning lights, and other temporary safety measures, are specified in Section 01 52 00, Construction Facilities. Provide such additional temporary facilities as may be required to facilitate continuous station or building operations during transitional construction work.

B. Dust control is specified in Section 01 57 00, Temporary Controls.

1.03 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A10.6 Safety and Health Program Requirements for Demolition Operations

1.04 DESCRIPTION

A. The adjacent/ or existing building involved in this work will be in continuous operation during the construction period. This will require that the Contractor plan the Work carefully to work around unavoidable obstacles in the prosecution of the Work. It will require further that the Contractor complete some new construction facilities required in the renovation work before removing existing like facilities during transitional work.

B. Utility services to facilities to be removed or demolished shall be disconnected, cut, and capped,

as required.

C. The work includes restoration of existing structures and facilities to remain in place that are damaged by demolition and removal operations.

1.05 PERMITS

A. The Contractor shall obtain special permits required for the work at no cost to the Owner, and give all notices required for performance and completion of the selective demolition and removal work, hauling, and disposal of debris.

1.06 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures.

B. Permits: Submit copies of demolition, hauling, and debris disposal permits and notices for record purposes. Include description of proposed haul routes.

C. Provide certificates, issued by the utility owners, of severance of utility services for record purposes.

1.07 SITE CONDITIONS

A. Protection of Persons and Property: Erect and maintain temporary bracing, shoring, lights, barricades, baffles, curtains, signs, and other measures as necessary to protect the public, workers, and adjoining property from damage from demolition work, all in accordance with applicable codes and regulations. Conform also with applicable requirements of Section 01 57 00, Temporary Controls.

B. Protection of Utilities:

1. Protect active sewer, water, gas, electric, and other utilities; and drainage and irrigation lines indicated or, when not indicated, found or otherwise made known to the Contractor before or during demolition work. If utility is damaged, immediately notify the utility owner for corrective action.

2. Arrange with and perform work required by utility companies and municipal departments for discontinuance or interruption of utility services due to demolition work.

C. Noise and Dust Abatement: Comply with requirements specified in Section 01 57 00, Temporary Controls, and the following:

1. Provide continuous noise and dust abatement as required to prevent disturbance and nuisance to the public and workers and to the occupants of adjacent premises and surrounding areas. Dampen or cover areas affected by demolition operations as necessary to prevent dust nuisance.

2. When a certain level of noise is unavoidable because of the nature of the work or equipment involved, and such noise is objectionable to the occupants of adjacent premises, make arrangements with the jurisdictional authorities to perform such work or operate such equipment at the most appropriate time periods of the day. Provide abatement measures to the extent feasible and practicable.

D. Unknown Conditions:

1. The Contract Drawings and related documents may not represent all surface conditions at the site and adjoining areas. The known surface conditions are as indicated and shall be compared with actual conditions before commencement of work.

2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other such surface fixtures.

3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the work until written instructions are received from the Engineer.

PART 2 – PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FACILITIES

A. The Contractor shall furnish all materials, tools, equipment, devices, appurtenances, facilities, and services as required for performing the selective demolition and removal work.

B. Materials forming portions of the structure indicated to be removed shall become the Contractor's property, and the Contractor shall be responsible for their removal from the site.

PART 3 – EXECUTION

3.01 INSPECTION

A. Prior to starting selective demolition operations, perform a thorough inspection of the building and premises, and report to the Engineer any defects and structural weaknesses of existing construction and of improvements to remain.

B. Examine areas affected by the Work of this Section and verify the following conditions:

1. Disconnection of utilities as required.

2. That utilities serving occupied portions of adjacent or surrounding facilities will not be disturbed, except as otherwise indicated.

C. If unsatisfactory conditions exist, notify the Engineer, and do not begin demotion operations until such conditions have been corrected.

3.02 PREPARATION

A. The limits of the site are shown on the Contract Drawings. The Contractor shall confine its operations within the site limits indicated.

B. Lay out cutting work at the site and coordinate with related Work for which cutting is required.

C. Review the proposed layout with the Engineer prior to performing cutting operations.

3.03 DEMOLITION

A. Operational Procedures and Methods:

1. Perform demolition and removal work in accordance with the approved Selective Demolition Plan.

2. Operational procedures shall be optional with the Contractor in so far as procedures do not infringe on the approved work schedule or salvage requirements. Conduct demolition and removal work in a manner that will minimize the spread of dust and flying particles.

3. Remove items indicated for demolition within the limits of the Work and as required to complete the Work of this Contract. Do not remove anything beyond the limits of Work indicated without prior written approval of the Engineer. If in doubt whether to remove an item, obtain written approval of the Engineer prior to proceeding.

4. Remove materials carefully, to the extent indicated and as required, providing for neat and orderly junctions between existing and new materials.

5. Protect existing structures, facilities, and landscaping from damage. Items damaged as a result of demolition operations shall be repaired or replaced, as required, at no increase in the Contract Price.

6. Perform work so as to provide the least interference and most protection to existing facilities and improvements to remain.

7. Demolish concrete and masonry in small sections. Perform demolition with small tools as much as possible. Blasting will not be permitted.

B. Jackhammering:

1. Jackhammering will be permitted only to a limited degree with prior approval of the Engineer.

2. Do not jackhammer within two inches of reinforcing or structural steel to remain. Remove final two inches of material with a chipping gun.

3.04 CUTTING

A. Cut new openings neat, as close as possible to profiles indicated.

B. Do not cut or alter structural members without the prior written approval of the Engineer.

C. Remove concrete and masonry whenever possible by saw cutting or similar approved method.

3.05 SALVAGING

A. Certain items, as indicated, shall be salvaged and reused in the Work or delivered to a Owner's storage facility as directed.

B. Where salvaging is required, procedures shall be such that the maximum amount of salvage will result.

C. Coordinate the Work of this section closely with the Work of other sections of these Specifications requiring salvage and reuse of materials.

3.06 INITIAL BUILDING CLEANING

A. After demolition operations are completed, or along with demolition operations, as appropriate, clean the entire buildings and site of all dirt and dust, cobwebs, oil and grease, stains of asphalt and paint, and the various encrustations.

B. Ceilings, walls, and floors shall be dusted and wiped clean with brooms and cloths or other suitable methods as required to clean all surfaces free of dirt and dust.

C. Use suitable cleaning fluids or solvents, steel wool, blowtorch burning, scraping, and power sanding as required to remove the various encrustations and stains, including asphalt.

D. Broom clean the entire building and site immediately after demolition is complete. Provide a clean and orderly site in accordance with applicable requirements of Section 01 74 14, Cleaning.

3.07 DISPOSAL OF DEBRIS

A. Dispose of removed materials, waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.

B. Burying of trash and debris on the site will not be permitted. Burning of trash and debris at the site will not be permitted.

C. Remove trash and debris from the site at frequent intervals so that their presence will not delay the progress of the work.

D. Removed materials, trash, and debris shall become the property of the Contractor and shall be removed from the Owner's property and disposed of in a legal manner. Location of disposal site

and length of haul shall be the Contractor's responsibility.

3.08 RESTORATION OF EXISTING STRUCTURES AND FACILITIES

A. All damage to existing structures and facilities, which are to remain in place, shall be repaired to a condition equal to that existing prior to the beginning of demolition and removal operations. The cost of repairing existing structures and facilities damaged by the Contractor's operations shall be at the Contractor's expense.

3.09 FIELD QUALITY CONTROL

A. Following performance of the Work, perform an inspection of the premises and report defects and structural weaknesses of structures partially demolished, cut, or removed; of adjacent structures; and of improvements remaining.

B. The Engineer will accompany the Contractor before and after performance of the Work to confirm the physical condition of the structures and improvements involved.

END OF SECTION 02 41 19

SECTION 03 05 15

PORTLAND CEMENT CONCRETE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Portland cement.

B. Aggregates.

C. Drying shrinkage of concrete.

D. Concrete admixtures and cementitious materials.

E. Tests and analysis of materials.

F. Mix designs.

G. Batching, mixing, and transporting.

H. Inspection and Testing.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1.	ACI CT	Concrete Terminology
2.	ACI 117	Specification for Tolerances for Concrete Construction and Materials
3.	ACI 207.1R	Guide to Mass Concrete
4.	ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
5.	ACI 211.2	Standard Practice for Selecting Proportions for Structural Lightweight Concrete
6.	ACI 301	Standard Specifications for Structural Concrete
7.	ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
8.	ACI 304.2R	Placing Concrete by Pumping Methods

9. ACI 305R	Guide to Hot Weather Concreting
10. ACI 306.1	Standard Specification for Cold Weather Concreting
11. ACI 318	Building Code Requirements for Structural Concrete and Commentary

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

1. ASTM C31/C31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
2. ASTM C33/C33M	Standard Specification for Concrete Aggregates
3. ASTM C39/C39M	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C40/C40M	Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
5. ASTM C42/C42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
6. ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
7. ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
8. ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
9. ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
10. ASTM C123/C123M	Standard Test Method for Lightweight Particles in Aggregate
11. ASTM C127	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
12. ASTM C128	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate
13. ASTM C131/C131M	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
14. ASTM C136/C136M	Standard Test Method for Sieve Analysis of Fine and

Coarse Aggregates

15. ASTM C142/C142M	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
16. ASTM C143/C143M	Standard Test Method for Slump of Hydraulic Cement Concrete
17. ASTM C150/C150M	Standard Specification for Portland Cement
18. ASTM C157/C157M	Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
19. ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
20. ASTM C260	Standard Specification for Air-Entraining Admixture for Concrete
21. ASTM C330/C330M	Standard Specification for Lightweight Aggregates for Structural Concrete
22. ASTM C470/C470M	Standard Specification for Molds for Forming Concrete Test Cylinders Vertically
23. ASTM C490/C490M	Standard Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete
24. ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
25. ASTM C 535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
26. ASTM 567/C567M	Standard Test Method for Determining Density of Structural Lightweight Concrete
27. ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
28. ASTM C979/C979M	Standard Specification for Pigments for Integrally Colored Concrete
29. ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
30. ASTM C1017/C1017M	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

31. ASTM C1116/C1116M	Standard Specification for Fiber-Reinforced Concrete
32. ASTM C1399/C1399M	Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete
33. ASTM C1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
34. ASTM C1697	Standard Specification for Blended Supplementary Cementitious Materials
35. ASTM E329	Standard Specification for Agencies Engaged in the Construction Inspection, Testing or Special Inspection

1.03 DESCRIPTION

A. Portland cement concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, and water, with or without admixtures as approved by the Engineer, proportioned and mixed as specified herein.

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Concrete Mix Designs: Submit mix designs as herein specified in Article 2.03. Include laboratory test reports of trial strength and shrinkage tests.

1. Submit concrete mix designs and laboratory test reports of trial strength and shrinkage tests, including data at 56 Days, at least 10 working Days before placing concrete.

C. Product Data: Submit manufacturer's product data for proposed concrete admixtures.

D. Samples: Furnish and deliver samples of cement and aggregates as selected by the Engineer for testing and analysis. This requirement may be waived if certificates of compliance are furnished as specified in following Article 1.07E. and Article 2.02.

E. Affidavits/Certificates: For each shipment of materials, submit evidence of compliance with Specification requirements for cement, aggregate, and admixtures. Mill tests and manufacturers' certification of compliance with ASTM Specifications will be accepted in lieu of testing of cement and analysis of aggregates. Certificates of Compliance shall be signed by the materials manufacturer and the Contractor.

F. Batch Tickets: Submit a delivery ticket with each batch of concrete delivered to the site in accordance with the requirements of ASTM C94/C94M.

G. Quality Control Program: Submit quality program meeting requirements of Article 1.08C. herein.

H. Submit for the Engineer's approval the name, address, and telephone number of the laboratory, agency, mill, or ready-mix plant which the Contractor intends to engage to design the concrete mixes.

1.05 QUALITY ASSURANCE AND CONTROL

A. The Contractor shall select a qualified concrete supplier capable of meeting project requirements and the requirements of these Specifications.

B. The concrete supplier shall be certified and shall hold a valid certificate of conformance for concrete production facilities.

C. In conformance with applicable requirements of Section 01 45 00, Quality Control, the Contractor shall provide a quality control plan to assure control and uniformity of materials, conformance with accepted mix designs, and prompt and proper delivery of concrete to the Jobsite in accordance with applicable requirements of ASTM C94/C94M. Include in the plan all tests the Contractor will perform to verify compliance with Specification requirements, and the independent laboratory the Contractor intends to engage to perform the tests.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Hot Weather Concreting:

1. Batching, mixing, and delivering of concrete in hot weather shall conform to the applicable requirements of ACI 305R.

2. Maximum ambient temperature for placing concrete shall be 90 degrees Fahrenheit. If the ambient temperature exceeds 90 degrees Fahrenheit, the mix shall be cooled by an appropriate method approved by the Engineer, such as icing the mixing water. Maintain uniform concrete temperature of succeeding batches placed.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II. For exposed concrete, use one manufacturer for each type of cement.

B. Aggregates:

1. Coarse Aggregate: ASTM C33/C33M, clean and well graded from three-eighths inch to maximum size indicated or specified. When not specified, provide one-inch maximum size (ASTM C33, Size No. 57). Deleterious materials in aggregates shall not exceed the limits specified in ASTM C33/C33M.

2. Fine Aggregate: ASTM C33/C33M, well graded from three-eighths inch to fines, washed clean. Deleterious materials in fine aggregates shall not exceed the limits specified in ASTM C33/C33M.

3. Lightweight Aggregates: ASTM C330/C330M, well graded to maximum size indicated or specified. When not specified, provide three-fourths inch to No. 4 coarse aggregate combined with ASTM C33/C33M graded fine aggregate.

4. Aggregate for Exposed Concrete: Aggregate for concrete which will be exposed to the public shall be obtained from one source for each type of aggregate required in order to produce a uniform color.

C. Concrete Admixtures and Cementitious Materials: The Contractor may include accepted concrete admixtures and cementitious materials in the mix to improve the water-cement ratio or water-cementitious ratio or workability of the concrete, providing the strengths specified and other desirable characteristics of the concrete can be achieved and maintained. Admixtures require the Engineer's acceptance before they may be used, and shall be included in the design mix, introduced in solution form. Admixtures shall be added at the batch plant, except as otherwise noted herein.

1. Chemical Admixtures, Water-Reducing: ASTM C494/C494M, Type A.

2. Air Entraining Admixtures: ASTM C260

3. Pozzolanic Admixtures: ASTM C618, Class N or F.

4. Fly Ash: ASTM C618, Class F, with a maximum of 25 percent retained on the No. 325 mesh sieve and a loss on ignition of 1.0 percent maximum.

5. Pigments for integrally colored concrete: ASTM C979/C979M, for synthetic or natural iron oxides (red).

6. Chemical Admixtures, Plasticizing: ASTM C1017/C1071M, or ASTM C494/C494M Type F or Type G, high-range water-reducing admixtures.

7. Prohibited Admixtures: Admixtures containing chlorides or sulfides are not acceptable.

8. Slag Cement (GGBFS): Cementitious material conforming to ASTM C989/C989M.

9. Silica Fume: Cementitious material conforming to ASTM C1240.

10. Blended supplementary cementitious material conforming to ASTM C1697 except Fly Ash shall be as specified hereinabove. The amount of each cementitious material in the blend will be used separately in calculating the mix design equation specified herein Article 2.03.

E. Water: Water for concrete mixes, curing, and cleaning shall be clean and potable, free of impurities detrimental to concrete.

2.02 TESTS AND ANALYSES OF MATERIALS

A. Tests and Sample Analyses: Testing of cement and analysis of aggregates shall be performed by the Contractor as specified herein. Mill tests and supplier's certification of compliance with ASTM Specifications will be accepted in lieu of testing of cement and analysis of aggregates. Tests and services shall consist of the following:

1. Testing of Portland cement in accordance with ASTM C150/C150M and ASTM C114.

2. Analysis of aggregates in accordance with ASTM C33/C33M, and sieve analysis of fine and coarse aggregates in accordance with ASTM C136/C136M.

3. Tests of special aggregates for reducing shrinkage and creep shall conform to the requirements herein specified under Article 2.01C.

B. Samples: Furnish and deliver identified samples of materials required for tests and analysis in the amounts required by the Contractor's employed independent testing laboratory without charge. Samples shall be selected at random by the testing laboratory. Deliver samples of cement and aggregates at least 30 Days prior to use on the project.

2.03 MIX DESIGNS

A. Design of concrete mixes, including recommended amounts of admixture and water to be used in the mixes, shall be obtained by the Contractor from a qualified independent testing laboratory or agency, or from a mill or ready-mix plant, properly equipped to design concrete mixes. The design shall be performed and certified by a professional engineer currently registered professional civil or structural engineer. The laboratory, agency, mill, or ready-mix plant shall meet applicable requirements of ASTM E329, and shall be approved by the Engineer. Costs of obtaining the mix designs shall be paid by the Contractor. .

B. Selection of mix proportions shall conform to the applicable requirements of ACI 211.1 and ACI 211.2. Concrete shall comply with ACI 301 and ACI 318, as applicable.

C. Mix design shall include replacement of 40 to 50 percent of Portland cement by weight with Fly Ash.

D. In addition to satisfy the mix design equation specified hereinabove, mix design for subway structures and below grade retaining walls for stations and other facilities shall include a minimum of 15 percent of Fly Ash by weight of the total cement in the concrete, along with a plasticizing admixture conforming to ASTM C1017/C1071M, to provide a dense and plastic concrete with low shrinkage and permeability characteristics.

E. In addition to satisfy the mix design equation specified hereinabove, mix design for architectural concrete and formed concrete which will be exposed to the public in finished work shall include a minimum of 10 percent of Fly Ash by weight of the total cement in the concrete, along with a plasticizing admixture, conforming to ASTM C1017/C1071M, to provide a dense and plastic concrete mix which completely fills out the forms and form detail without air holes and rock

pockets.

F. Mix designs shall indicate brands, types, and quantities of admixtures included. The mix designs shall identify the percentage of each of the cementitious admixtures by weight of the total cement in the concrete and the locations in the structures where such mixes are proposed for use.

G. Mix designs for integrally colored concrete shall indicate brand type of natural or synthetic metallic oxide or pigment, and quantity used, all prepared as specified in ASTM C979/C979M. Compensate for Fly Ash with additional pigment as applicable. Concrete encasements of below-grade electrical conduits and ductbanks containing circuits over 600 Volts shall be integrally colored red concrete.

H. Mix design for mass concrete shall have a percentage of Fly Ash replacement of cement by weight to reduce the amount of heat generated during heat of hydration. Amount of fly ash to be introduced into the mix shall be approved by the Engineer. ASTM C494/C494M Type F or Type G high-range water-reducing admixture may also be used to reduce heat of hydration.

I. If concrete is to be placed by pumping, concrete mixes shall be designed in accordance with the applicable requirements of ACI 304R and ACI 304.2R and shall include strengths and slumps.

J. Mix design shall be proportioned to meet the following slump limitations.

1. Concrete without high-range water-reducing admixture: 4 inches nominal slump

2. Concrete with high-range water-reducing admixture: Concrete nominal slump prior to addition of water-reducing admixture shall not be 3 inches for normal weight concrete. After addition of water-reducing admixture, the concrete shall be a maximum slump of 8 inches unless otherwise by Engineer.

K. Drying Shrinkage of Concrete: Cast-in-place concrete, precast concrete and prestressed concrete shall meet the following requirements:

1. A trail batch of the proposed (mix design) concrete shall be prepared using the aggregates, cement, and admixture prosed for this work. From the trial batch, three specimens (four inches by four inches by 11 inches) for determining “Drying Shrinkage” shall be prepared, cured, dried, and measured as specified in ASTM C157/C157M and ASTM C490/C490M, with the following modifications:

   a. Cast-in-place concrete shall be moist cured for 10 Days.

   b. Precast, prestressed concrete shall be steamed cured one Day.

   c. Measurements shall be made and reported for seven, 14, 21, and 28 Days of drying after nine Days of moist curing and one Day of steam curing. Measurements shall also be made and reported for 56 Days of drying.

2. Shrinkage of specimens for cast-in-place concrete shall not exceed 0.040 percent when

measured in accordance with ASTM C157/C157M and ASTM C490/C490M after 21 Days of drying.

3. Shrinkage of specimens for precast and prestressed concrete shall not exceed 0.035 percent when measured in accordance with ASTM C157/C157M and ASTM C490/C490M after 21 Days of drying.

4. Shrinkage specimens shall not exceed 0.055 percent when measured in accordance with ASTM C157/C157M after 28 Days drying including minimum seven Days moist cure.

L. Mix designs shall indicate location of each mix within the structure. Mix designs shall specify both coarse and fine aggregate sources.

M. Upon receipt of acceptable mix designs from the prequalified testing laboratory or agency or concrete supplier, conforming to specified requirements, the Contractor shall submit these accepted mix designs to the Engineer for review, 10 Days prior to batching or delivering any concrete.

2.04 BATCHING, MIXING, AND TRANSPORTING

A. Batching, mixing, and transporting Portland-cement concrete shall conform to the applicable requirements of ACI 301 and ACI 304R.

B. Concrete shall be central-mixed concrete from a central batch plant, to be transported to the Jobsite in a truck mixer, in accordance with the requirements of ASTM C94/C94M. Equipment used in the manufacture of concrete shall be kept clean at all times.

C. Mixers shall be equipped with automatic device for recording number of revolutions of drum prior to completion of mixing operation. Each transit mixer shall also be equipped with water measuring devices consisting of either accurately calibrated water tanks or water meters.

D. Concrete in truck mixer shall be mixed continuously until discharged. The discharge time for concrete after the introduction of mixing water shall not exceed 60 minutes. Discharge of concrete shall be completed within 90 minutes or before 250 revolutions of the drum or blades, whichever occurs first, after the introduction of the cement to the aggregates. Delivery tickets shall show departure time from plants.

E. Ready-mixed concrete shall be mixed for a period of not less than 10 minutes and at least three minutes of the mixing period shall be immediately prior to discharging at the job. The introduction of additional water into transit type mixers after leaving the plant will not be permitted.

1. If adjustment slump in field is necessary, it may be made by addition of high range water reducing admixture within the limitations prescribed by the concrete technologist.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

A. Inspection and Testing Services:

1. Visual inspections and acceptance of concrete mix designs will be by the Engineer. The Engineer will observe concrete batching, mixing, and placing operations, and the Contractor shall keep records of all concrete placed. Copies of such records shall be submitted to the Engineer for record purposes.

2. Testing services for the Contractor's quality control program, including concrete strength tests, shall be provided by an independent testing laboratory or agency, employed by the Contractor and approved by the Engineer, and shall be performed in accordance with the applicable requirements of ACI 301. If, as a result of these tests, it is determined that the specified concrete properties are not being obtained, the Engineer will order such changes in proportions or materials, or both, as may be necessary to secure the specified properties.

    a. Field tests shall be performed by personnel having ACI Level 1 Field Technician Certification.

3. Failure of the Engineer to detect defective work or material shall not prevent later rejection when such defect is discovered, nor shall it obligate the Engineer for final acceptance.

4. Additional inspection and testing services required by the Engineer because of changes in materials, sources, or proportions; or occasioned by failure of inspections and tests to meet specification requirements, shall be paid for by the Contractor.

5. Provide materials, labor, and services for sampling and testing of concrete, including the following facilities and services:

    a. Preparation, handling, storage, and delivery of concrete test specimens.

    b. Suitable containers for the storage, curing, and delivery of concrete test specimens in accordance with ASTM C31/C31M and ASTM C470/C470M.

    c. Suitable storage for a supply of test cylinder molds, test specimens to be cured at the Jobsite, and other items required for sampling and testing.

B. Methods of Sampling and Testing:

1. Sampling: Representative composite samples shall be taken by the Contractor in accordance with ASTM C172/C172M. Each sample shall be obtained from a different batch of concrete on a random basis.

2. Slump Tests: The above-specified Contractor-employed testing laboratory shall perform slump tests of concrete during placing of concrete, as required, in accordance with ASTM C143/C143M. At least one test shall be performed at the delivery trucks for each 50 cubic

yards of concrete delivered.

3. Tests for Concrete Uniformity: The same testing laboratory shall perform tests for concrete uniformity in accordance with ASTM C94/C94M, Annex A1. Each batch of concrete shall be tested as specified in ASTM C94/C94M, Annex A1.

4. Tests for Concrete Temperature: Freshly mixed concrete shall be tested hourly when the ambient temperature is below 40 degrees Fahrenheit and above 80 degrees Fahrenheit, and each time compression test cylinders are made. The concrete temperature shall be recorded on all compression test cylinders made. Refer to Article 1.07 herein for hot and cold weather remedial requirements.

5. Strength Tests:

   a. The Contractor shall prepare, cast, and deliver to the same independent testing laboratory, cylinders for laboratory-cured compression test samples. Cylinders shall be made and cured in accordance with ASTM C31/C31M. Cylinders shall be tested in accordance with ASTM C39/C39M.

   b. The minimum number of test cylinders to be made for each class of concrete and for each placement shall be six cylinders for each 100 cubic yards or fraction thereof. When additional sets of test cylinders are required beyond the normal seven- and 28-Day tests, each set shall consist of a minimum of two test cylinders.

   c. All cylinders in a set shall be marked with a unique number on one end. The Contractor shall record this number on the record of concrete placed. All cylinders shall be cured by the Contractor's independent testing laboratory.

   d. From each set of cylinders cast, two each shall be tested at seven, 28, and 56 days.

6. Tests for Contractor's Benefit: Tests required verifying early form removal, or other reasons for the Contractor's benefit, shall be performed at Contractor's expense as part of the Contractor's quality control program.

C. Evaluation and Acceptance of Tests:

1. Acceptance of Concrete: The strength of the concrete shall be considered satisfactory, provided the averages of all sets of three consecutive strength test results equal or exceed the specified 28 Day compressive strength, and no individual strength test result falls below the specified 28 Day compressive strength by more than 500 psi.

2. Adjustments: The Contractor's independent testing laboratory shall order adjustments to the mix proportions, increase in the minimum cement content, additional curing of the structure, or any combination of the above when strength tests acceptance criteria specified are not being met.

3. Test Cores:

    a. When laboratory test results indicate concrete to be more than 300 psi below the specified strength, or if there is a likelihood of low strength concrete, a significant reduction in load-carrying capacity, or absence of desired durability in the concrete, the Engineer will require tests of cores to be drilled from the areas in question.

    b. Test cores shall be obtained from each member or area of suspect strength, from locations designated by the Engineer, and test specimens shall be prepared by the Contractor in accordance with ASTM C42/C42M.

    c. Three cores shall be taken for each determination of in-place strength. Concrete in the area represented by the core tests will be considered structurally adequate if the average of the three cores is equal to at least 85 percent of the specified design strength and no single core is less than 75 percent of the design strength. Locations represented by erratic core strengths shall be retested at the direction of the Engineer.

    d. Fill core holes in accordance with the requirements of Section 03 35 00, Concrete Finishing, for repair of surface defects.

4. Rejection of Concrete; Repair and Replacement: The Engineer has authority to reject concrete work which does not meet specification requirements, and to require repair or replacement as necessary to complete the Work.

D. Acceptance of Structure: Acceptance of the completed concrete work requires conformance with the dimensional tolerances, appearance, and strengths specified in these Specifications, in ACI 301, and in ACI 117.

END OF SECTION 03 05 15

SECTION 03 11 00

CONCRETE FORMING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Layout of formwork.

B. Formwork construction.

C. Embedded items and openings in concrete.

D. Form release materials.

E. Removal of forms.

F. Field quality control.

G. Detection of movement.

H. Re-use of forms.

1.02 RELATED SECTIONS

A. Finishes for formed surfaces are specified in Section 03 35 00, Concrete Finishing.

B. Concrete mix design as specified in Section 03 05 15, Portland Cement Concrete.

1.03 REFERENCES

A. American Concrete Institute (ACI):

1.	ACI 117	Specification for Tolerances for Concrete Construction and Materials and Commentary
2.	ACI 301	Specifications for Structural Concrete
3.	ACI 318	Building Code Requirements for Structural Concrete and Commentary
4.	ACI 347R	Guide to Formwork for Concrete

B. American Plywood Association (APA):

1. U.S. Product Standard PS-1 Structural Plywood

1.04 QUALITY ASSURANCE

A. Formwork Standards: Unless otherwise indicated, design, construct, erect, maintain, and remove forms and related structures for concrete work in accordance with applicable requirements of ACI 301, ACI 318, and ACI 347R.

1. Architectural Concrete: Forms for architectural concrete shall be designed and constructed in accordance with ACI 301.

2. Deflection: Where dead and live loads on forms will be more than 20 percent greater than the weight of the concrete, provide framing lumber of required strength, and comply with ACI 301 and ACI 347R for design of framing members. Deflection shall be kept within the herein specified tolerances.

3. Concrete Mix Design: Design of formwork shall be coordinated with the concrete mix design, as specified in Section 03 05 15, Portland Cement Concrete, so that form materials, form surfaces, and formwork strength will produce the desired concrete tolerances and finishes.

B. Formwork Surface Materials: Provide material and work quality which will produce clean and uniform finished surfaces within the allowable tolerances specified and which will conform with the following requirements:

1. Concrete Exposed to View: Provide material and work quality that will produce clean, smooth, and uniform concrete surfaces. Refer to Section 03 35 00, Concrete Finishing, and ACI 301 for requirements.

2. Concrete Concealed from View: Provide material and work quality that will produce aligned concrete surfaces free of fins, honeycomb, and stains.

C. Special Formwork Sections: Provide openings, offsets, sinkages, keyways, recesses, moldings, rustication strips, chamfers, blocking, screeds, bulkheads, anchorages, embedded items, and other features. Select materials and provide workmanship that will ensure indicated finishes.

D. Chamfered Corners: All external corners shall be chamfered, unless otherwise indicated.

E. Removal Features: Design formwork to be readily removable without impact, shock, and damage to concrete surfaces and adjacent materials.

F. Tolerances for Formed Surfaces: For buildings and similar structures, comply with the requirements of ACI 301, as applicable. For those items of work or parts of the structure not covered by ACI 301, comply with the requirements of ACI 117, as applicable. Coordinate with the requirements specified in Section 03 30 00, Cast-In-Place Concrete.

1. The class of surface for offset between adjacent pieces of formwork facing material shall be Class A for surfaces permanently exposed to public view and Class C for surfaces that will be permanently concealed, unless otherwise specified.

G. Abrupt and Gradual Irregularities Tolerances for Formed Surfaces: In addition to the tolerance requirements of ACI 301, surfaces of buildings and similar structures permanently exposed to view shall conform to the abrupt and gradual irregularities tolerances specified herein. Abrupt irregularities shall be understood to mean offsets and fins resulting from displaced, mismatched, or misplaced forms, sheathing, or liners or from defects in forming materials are considered abrupt irregularities. Gradual irregularities shall be understood to mean those resulting from warping and similar uniform variations from planeness or true curvature. Gradual irregularities shall be checked with a straightedge for plane surfaces or a shaped template for curved or warped surfaces.

1. In measuring irregularities, the straightedge or template shall be placed in various places on the surface in various directions. Permitted abrupt or gradual irregularities in formed surfaces as measured within a five-foot length with a straightedge shall be as specified in ACI 117, Section 4.8.3, Formed Surface Irregularities (gradual or abrupt):

Class of Surface	Maximum Abrupt or Gradual Irregularity
A	One eighth inch
B	One fourth inch
C	One half inch
D	One inch

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage: Store form panels to prevent warpage. Protect panels from damage and contamination which could adversely affect concrete.

B. Handling: Lift form panels by methods that will protect panels from damage and distortion.

1.07 JOB CONDITIONS

A. Allow sufficient time between erection of forms and placing of concrete for the various trades to properly install concrete reinforcement, embedded items, sleeves, and blockouts.

B. Do not apply superimposed loads to the structure until concrete has developed its specified 28-day compressive strength.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Lumber: Boards and framing lumber shall be graded, and grade marked.

1. Boards: Use dressed side of lumber for surface in contact with the concrete and provide boards with dressed or tongue-and-groove edges to provide tight joints to prevent mortar leakage.

2. Framing Lumber:

a. Light Framing: Provide “Construction” or “Standard” Light Framing, dressed or rough. Where loads are not a factor, “Utility” Light Framing will be acceptable.

b. Joists and Planks: Provide “No. 2” Structural Joists and Planks, dressed or rough.

c. Beams and Stringers: Provide “Standard” Beams and Stringers or “No. 2 Structural” Beams and Stringers, dressed or rough.

B. Plywood (Plyform): Plywood shall be graded and grade-marked in accordance with U.S. Product Standard PS-1.

1. Thickness: As required to maintain surface smoothness without deflection, but not thinner than 5/8 inch.

C. Steel Forms: Proprietary, patented, or fabricated steel forms, using standard or commercial quality, uncoated steel sheet or plate, 3/16-inch minimum thickness, for panel facings. Provide surfaces that will not impart corrosion residue to concrete. Include panel framing, reinforcement, and erection accessories.

D. Waffle Slab Forms: Steel or reinforced plastic dome forms for two-way joist construction, smooth surface, of sizes indicated.

E. Round Column Forms: Pressed or molded fiber-reinforced plastic or steel, manufactured round column forms, seamless or one-piece (one vertical seam), smooth surface, of sizes indicated.

1. Provide forms with will not deflect under pressure of concrete placement, and which will not deflect or blow off under added pressure of placement of fly-ash-modified concrete.

F. Formliners for Exposed and Architectural Concrete: Thermally formed, pressed or molded fiber-reinforced plastic (FRP), ABS alloy plastic, PVC alloy plastic, or similar material, manufactured to produce finished concrete of design, configuration, and surface texture indicated. Formliners shall be continuous, one piece. No horizontal joints shall be acceptable unless the applicable height exceeds the available formliner height. Provide formliners with inherent form-release surface. Formliners may be manufactured for single-use or multi-use service as appropriate.

G. Leakage Control Materials: Provide materials capable of producing flush, watertight, and nonabsorbent surfaces and joints, and compatible with forming material and concrete ingredients. Seal form edges with gasketing material or sealant placed in the joint in such a way that neither a fin nor groove is made in the face of the cast concrete.

H. Form Release Agent: Commercial formulation, silicone-free form-release agent, designed for use on all types of forms, which will not bond with, stain, nor adversely affect concrete surfaces, and which will not impair subsequent treatment of concrete surfaces requiring bond or adhesion nor impede wetting of surfaces which will be cured with water, steam, or curing compounds.

I. Plugged Cone Form Ties: Rod type, with ends or end fasteners which can be removed without spalling the concrete and which leave a hole equal in depth to the required reinforcement clearance. Form ties shall be of a design in which the hole left by the removed end or end fastener is easily filled to match the surface of the hardened concrete. Provide removable cones one and a fourth inches in diameter by one and a half inches deep. Provide preformed mortar plugs to match the color of the concrete, recessed one fourth inch, adhered with an approved epoxy adhesive.

J. Inserts: Cast stainless steel or welded stainless steel, Type 316 or similar 300 Series, complete with anchors to concrete and fittings such as bolts, wedges, and straps. Provide hanger inserts spaced to match grid of suspended ceiling.

K. Dovetail Anchor Slots: 22 gage or heavier galvanized steel dovetail anchor slots, for anchoring of masonry veneer with galvanized steel dovetail anchors provided under Division 4, Masonry.

L. Chamfer Strips: Three fourths inch by three fourths inch triangular fillets milled from clear, straight-grain pine, surfaced each side, or extruded vinyl type with or without nailing flange.

M. Miscellaneous Joint Strips: Preformed strips for reveals, rustications, and similar joints fabricated of wood, metal, or plastic.

PART 3 – EXECUTION

3.01 LAYOUT OF FORMWORK

A. Locate and stake out all forms and establish all lines, levels, and elevations.

3.02 CONSTRUCTION

A. Formwork:

1. Construct formwork in a manner that will produce finished concrete surfaces conforming to indicated design and within specified tolerances. Formwork for concrete not exposed to view in the finished work may be constructed of any material that will adequately support the weight of the concrete.

2. Make joints and seams mortar tight. Install leakage control materials in accordance with the

manufacturer's installation instructions, and in a manner that will maintain a smooth continuity of plane between abutting form panels and which will resist displacement by concreting operations.

3. Kerf wood inserts for forming keyways, reglets, and recesses in a manner that will prevent swelling and ensure ease of removal.

4. Maintain forms clean and free from indentations and warpage. Do not use rust-stained steel surfaces for forms in contact with concrete. Do not sandblast steel form surfaces to remove rust or mill scale; remove these imperfections by grinding.

5. Brace temporary closures to prevent warpage or displacement and set tightly against forms in a manner that will prevent loss of concrete mortar.

6. Support joints with extra studs or girts, and in a manner that will ensure true, square intersections.

7. Assemble forms in a manner that will facilitate their removal without damage to the concrete.

8. Construct molding shapes, recesses, and projections with smooth finish materials and install in forms with sealed joints.

9. Provide camber in formwork as required to compensate for deflections caused by weight and pressures of fresh concrete and construction loads and as otherwise indicated. Provide camber strips to compensate for deflections due to permanent loads and long-term deflections due to shrinkage and creep as required.
10. Provide construction openings in forms where required for concrete pour pockets, vibrator access holes, and inspection openings to aid in proper placement and consolidation of concrete and close up openings during placement of concrete as applicable.

11. Provide inspection and cleanout openings in forms at bottom of walls and columns and elsewhere as required. Do not close cleanouts until inspected and accepted by the Engineer just before placing concrete.

12. Drill air escape holes in bottom members of blockouts.

13. Ensure that formed stair risers within a stair run are equal.

B. Edge Forms and Screeds for Slabs: Set edge forms or bulkheads and intermediate screeds for slabs to obtain required elevations and contours in the finished slab surface. Support screeds substantially without penetrating waterproof membranes and vapor barriers.

C. Corner Treatment: Form chamfers with three fourths inch on each leg, unless otherwise indicated, and accurately shape and surface in a manner which will produce uniformly straight lines and edge joints, and which will prevent mortar runs. Extend terminal edges to limits, and miter chamfer strips at changes in direction.

D. Construction Joints:

1. Locate joints as indicated. Support forms for joints in concrete so as to rigidly maintain their positions during placement, vibration, and curing of concrete. Install keys in all joints.

2. Locate and install construction joints, for which locations are not indicated, so as not to impair strength and appearance of the structure and indicate such joints on Shop Drawings. Locations of construction joints require approval of the Engineer.

3. Position joints perpendicular to longitudinal axis of pier, beam, or slab as the case may be.

4. Locate joints in walls, vertically as indicated; at top of footing; at top of slabs on grade; at bottom of door openings; and at underside of the deepest beam or girder framing into wall; or as required to conform to indicated details.

5. Provide keyways as indicated in construction joints in walls and slabs, and between walls and footings unless otherwise indicated. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.

E. Load Supports: Loads for construction of roof slab and suspended floor slabs shall be carried down to on-grade base slabs. These loads shall not be carried by intermediate slabs at any time. Formwork loads shall be carried only by structural elements that are supported directly by footings.

3.03 EMBEDDED ITEMS AND OPENINGS IN CONCRETE

A. Install conduit, pipe sleeves, water stops, appliance boxes, frames for items recessed in walls, door frames, drains, metal ties, inserts, nailing strips, blocking, grounds, and other fastening devices required for anchorage or attachment of other work. Firmly secure products in position, located accurately as indicated, before beginning concrete placement.

B. Provide openings in concrete for passage of ducts, and provide clearances therefore as indicated on approved Shop Drawings.

C. Where masonry walls will be tied to concrete construction in future construction, use dovetail anchor slots positioned for maximum flexibility for masonry installation.

3.04 FORM RELEASE MATERIAL

A. Coat form contact surfaces with approved form release material before reinforcement is placed. Do not allow excess form release material to accumulate in the forms or to come into contact with surfaces that are required to be bonded to fresh concrete such as concrete reinforcement and embedded items. Apply form release material in compliance with manufacturer’s application instructions.

B. Coat steel forms with non-staining, rust-preventive form release material or otherwise protect against rusting.

C. Apply form release material to bolts and rods that are to be removed or that are to be free to move.

3.05 REMOVAL OF FORMS

A. Remove forms by methods which will not injure, mar, gouge, or chip concrete surfaces, overstress concrete members, or distort formwork. Use air pressure or other approved methods. Do not pry against concrete. Cut off nails flush. Leave surfaces clean and unblemished.

1. Where early form removal is not necessary, leave forms in place at least 72 hours, unless otherwise approved by the Engineer.

B. When repair of surface defects or finishing is required at an early age, forms may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations and its own weight.

1. Concrete work that is damaged by removal operations shall be repaired as specified in Section 03 35 00, Concrete Finishing. Where exposed surfaces are damaged beyond acceptable repairing measures, the damaged concrete shall be removed and replaced with new concrete.

C. Top forms on sloping surfaces of concrete may be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once and shall be followed by the specified curing.

D. Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete.

E. Formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently so as not to be damaged by removal operations.

F. Forms and shoring in the formwork used to support the weight of concrete in beams, suspended slabs, girders, and other structural members shall remain in place until the concrete has reached adequate strength and stiffness to support itself. Forms shall not be removed before the concrete has reached a minimum of 70 percent of the indicated design compressive strength, unless otherwise approved in writing by the Engineer.

G. When shores and other vertical supports are so arranged that the non-load-carrying form-facing material may be removed without loosening or disturbing the shores and supports, the facing material may be removed at an earlier age provided the concrete surfaces are not damaged by such earlier removal.

H. Plan reshoring operations in a manner that will ensure that areas of new construction will not be required to support their own weight. Reshoring shall be in place before shoring is removed. During reshoring, do not permit live loads on new construction. Do not locate reshores in a manner and location that will overstress members or induce tensile stresses where reinforcing bars have not been provided.

I. When removal of formwork or reshoring is based on the concrete reaching a specified strength, the concrete shall be presumed to have reached this strength when test cylinders, field cured along with the concrete they represent, have reached the strength specified for removal of formwork or reshoring. Except for the field curing and age at test, the cylinders shall be molded and tested as specified in Section 03 05 15, Portland Cement Concrete.

3.06 FIELD QUALITY CONTROL

A. Before placing concrete, check lines and grades of erected formwork and positioning of embedded inserts, blackouts, and joints for correctness. Verify that embedded piping and conduit are free from obstructions. Make corrections or adjustments to ensure proper size and location of concrete members and stability of forming systems.

B. While placing concrete, provide quality control to assure that formwork and related supports have not been displaced, that loss of cement paste through joints is prevented, and that completed work will be within specified tolerances.

C. During form removal, verify that architectural features meet the form and texture requirements of the samples approved by the Engineer.

3.07 DETECTION OF MOVEMENT

A. Check movement using methods, such as plumb lines, tell tales, and survey equipment, to detect movement of formwork during concrete placement.

3.08 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable. Remove such material from the site. Apply form release coating as specified for new formwork.

B. Align and secure joints in a manner that will preclude offsets. Do not use patched forms for exposed concrete surfaces.

END OF SECTION 03 11 09

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Steel reinforcing bars.

B. Galvanized reinforcing bars.

C. Epoxy-coated reinforcing bars.

D. Wire and spiral reinforcement.

E. Welded steel wire fabric.

F. Steel bar mats.

G. Tie wire.

H. Accessories.

I. Welding Electrodes.

J. Exothermic Metal-filled Sleeve.

K. Mechanical Splice Coupler.

1.02 RELATED SECTIONS

A. Reinforcement for masonry is specified in Section 04 22 00, Concrete Unit Masonry.

B. Reinforcing steel for Portland cement concrete paving, concrete curbs, gutters, and walks, and utility structures is specified in their respective Sections.

1.03 REFERENCES

A. American Concrete Institute (ACI):

1.	ACI 117	Specification for Tolerances for Concrete Construction and Materials
2.	ACI SP-066	ACI Detailing Manual
3.	ACI 301	Specifications for Structural Concrete

4. ACI 318 — Building Code Requirements for Structural Concrete and Commentary

5. ACI 439.3R — Types of Mechanical Splices for Reinforcing Bars

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

1. ASTM A184/A184M — Standard Specification for Wielded Deformed Steel Bar Mats for Concrete Reinforcement

2. ASTM A370 — Standard Test Methods and Definitions for Mechanical Testing of Steel Products

3. ASTM A615/ A615M — Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

4. ASTM E8/E8M — Standard Test Methods of Tension Testing of Metallic Materials

5. ASTM E165/ E165M — Standard Practice for Liquid Penetrant Examination for General Industry

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures.

B. Shop Drawings:

1. Submit bar lists, bending diagrams and schedules, and placement plans and details for all reinforcing steel. Bar lists shall include weights.

2. Indicate descriptions, details, dimensions, arrangements and assemblies, and locations of reinforcing steel. Include number of pieces, sizes, and markings of reinforcing steel, laps and splices, supporting devices and accessories, and any other information required for fabrication and placement. Indicate any adjustments required as specified in Article 1.06.B.

3. Check Contract Drawings for anchor bolt schedules and locations, anchors, hangers, inserts, conduits, sleeves, blockouts, and any other items to be cast in concrete for possible interference with reinforcing steel. Indicate required clearances on Shop Drawings.

4. Detail reinforcing steel in accordance with requirements of the ACI SP-066. Indicate individual weight of each bar, total weight of each bar size, and total weight of all bars on the list. Base calculated weights upon nominal weights specified in ACI 318, Appendix on Steel Reinforcement Information.

5. For mechanical splice couplers furnish the following:

a. Certified test reports showing that the couplers meet all of the specified requirements.

b. Written assembly and installation instructions for each type, model and bar size for which the coupler is designed. Installation instructions shall include typical installation sequence, recommended installation tools, guidelines for laboratory testing of couplers and coupler size designations with corresponding range of bar sizes.

c. Reports showing the results of all tests.

C. Product Data:

1. Submit manufacturers' product data and installation instructions for proprietary manufactured materials and reinforcement accessories.

2. Submit manufacturers' product data and installation instructions for proprietary exothermic metal splicing systems and proprietary mechanical coupler splicing systems when such splicing methods are permitted.

D. Certificates:

1. For each lot or load of reinforcing steel delivered to the jobsite, furnish mill affidavits or test reports of compliance or similar certification, certifying the grades and physical and chemical properties of the reinforcing steel and conformance with applicable ASTM Specifications, including ASTM A370.

2. For exothermic sleeve coupler splicing, furnish certificates or affidavits attesting to the crew's special qualifications to perform the splicing.

1.05 QUALITY CONTROL

A. Tolerances:

1. Fabrication: Fabricate bars to meet the following tolerances:

a. Sheared length: plus, or minus 1 inch.

b. Depth of truss bars: plus 0, minus 1/2 inch.

c. Overall dimensions of stirrups, ties and spirals: plus, or minus 1/2 inch.

d. All other bends: plus, or minus 1 inch.

e. Fabrication tolerances not indicated on the Contract Drawings or specified above shall comply with the applicable requirements of ACI 301 and CRSI Manual of Standard Practice, Chapter 7.

2. Placement: Place bars to the following tolerances:

a. Clear distance to formed surfaces: plus, or minus 1/4 inch.

b. Minimum spacing between bars: minus 1/4 inch.

c. Top bars in slabs and beams:

1) Member 8 inches deep or less: plus, or minus 1/4 inch.

2) Member greater than 8 inches, but less than 2 feet deep: plus, or minus 1/2 inch.

3) Members 2 feet or more deep: plus, or minus 1 inch.

d. Crosswise of members: spaced evenly within 2 inches.

e. Lengthwise of members: plus, or minus 2 inches.

f. Placement tolerances not indicated on the Contract Drawings or specified above shall comply with the requirements of ACI 301, ACI 318, ACI 117, and CRSI Manual of Standard Practice, as applicable.

B. Adjustments: Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or in excess of the above tolerances, the resulting arrangement of bars shall require the Engineer's approval. Minimum spacings shall not be decreased, and the required number of bars shall be placed. Bars moved to permit access for cleanup operations shall be properly replaced and secured before the start of concrete placement.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcing bars to the fabricator in bundles, limited to one size and length of bar, securely tied and identified with plastic tags in an exposed position indicating the mill, the melt or heat number, and the grade and size of bars.

B. Deliver steel reinforcement to the jobsite, store, and cover in a manner which will ensure that no damage shall occur to it from moisture, dirt, grease, oil, or other cause which might impair bond with concrete.

C. Deliver steel reinforcement to the jobsite properly tagged and identified, as specified herein in Article 2.03, in accordance with approved Shop Drawings.

D. Handle and store galvanized and epoxy-coated reinforcement in a manner which will prevent damage to the coatings.

E. Maintain identification of steel reinforcement after bundles are broken.

F. Provide special facilities for the storage and handling of exothermic materials as recommended by the splicing system manufacturer.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Steel Reinforcing Bars:

1. Deformed Carbon Steel Bars: ASTM A615/A615M.

2. Weights of Bars: Refer to ACI 318, Appendix on Steel Reinforcement Information.

3. See OWNER Facility Standards, Facility Design, Criteria, structure, Reinforced Concrete for the application of types and grades of reinforcing steel to the OWNER facilities.

B. Wire and Spiral Reinforcement: ASTM A1064/A1064M for plain wire and deformed wire.

C. Accessories: Provide reinforcement accessories, consisting of bar supports, spacers, hangers, chairs, ties, and similar items as required for spacing, assembling, and supporting reinforcement in place.

D. Tie Wire: No. 16 gage or heavier, black or galvanized, soft or commercial grade steel tie wire. For galvanized reinforcement, provide zinc-coated wire. For epoxy-coated reinforcement, provide nylon-, epoxy-, or plastic-coated wire. Where tie wire is in close proximity to finish surfaces of exposed-to-view concrete, provide soft stainless-steel wire.

E. Exothermic Metal-Filled Sleeve Coupler:

1. System Description: Provide bar splicing connection, produced by a standard exothermic process whereby molten filler metal, contained by a high-strength steel sleeve of larger inside diameter than adjoining bars, is introduced into the annular space between the bars and the sleeve as well as between the ends of the bars. Splicing system shall produce complete fusion with 100 percent penetration of the joint.

2. Spliced Strength in Tension: 125 percent of the yield strength of connected reinforcing bars.

F. Mechanical Splice Coupler:

1. System Description: Provide bar-splicing connections, produced by threaded reinforcing bar ends and threaded coupler, or by sleeves hydraulically pressed or forged onto butt-ended reinforcing bars, or by other proprietary mechanical splicing method as proposed by the Contractor and approved by the Engineer. Mechanical splice couplers shall be capable of being installed in the clear space indicated and to provide the required clearances.

2. Spliced Strength in Tension: Minimum 125 percent of the yield strength of connected reinforcing bars, unless otherwise indicated.

2.02 FABRICATION

A. Fabrication Standards: Fabrication of steel reinforcement shall be in accordance with the

Contract Drawings and approved Shop Drawings. Where specific details are not indicated, comply with applicable requirements of ACI 301, ACI 318, and CRSI Manual of Standard Practice.

B. Cutting and Bending: Cutting and bending shall be performed at a central location, equipped and suitable for the purpose. Bars shall be accurately cut and bent as indicated. Bars shall be bent cold prior to placement. Field bending of reinforcement partially embedded in concrete shall not be permitted. Heating of bars for bending or straightening is not permitted. Bars shall not be bent or straightened in any manner that damages the material. Label bars in accordance with bending diagrams and schedules, and secure like pieces in bundles when appropriate.

2.03 IDENTIFICATION

A. Reinforcing steel shall be bundled and tagged with grades and sizes, heat numbers, and suitable identification marks for checking, sorting, and placing. Sizes and mark numbers shall correspond to placing Shop Drawings and schedules. Tags and markings shall be water-resistant and shall not be removed until steel reinforcement is placed in position.

PART 3 – EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that surfaces, over or against which concrete is to be placed, are clean and in proper condition for placing reinforcement.

B. Verify that items to be embedded in concrete inserts, sleeves, and block-outs are secured in place as required.

3.02 PLACING

A. Placing Standards: Reinforcing steel shall be placed in accordance with the Contract Drawings, approved Shop Drawings, and the applicable requirements of ACI 301, ACI 318, ACI 117, CRSI Manual of Standard Practice, and CRSI Placing Reinforcing Bars. Install reinforcement accurately and secure against movement, particularly under the weight of workers and the placement of concrete.

B. Reinforcing Supports: Bars shall be supported on metal or plastic chairs, spacers, and hangers, accurately placed and securely fastened to steel reinforcement in place. Support legs of accessories in forms without embedding in the form surface. Hoops and stirrups shall be accurately spaced and wired to the reinforcement.

C. Placing and Tying: Reinforcing steel shall be installed in place, spaced, and securely tied or wired with tie wire at all splices and at crossing points and intersections in the positions indicated. Comply with requirements of CRSI Placing Reinforcing Bars, Chapter 10. Welding to secure or support rebar replacement is prohibited. Snap ties are acceptable for intermediate intersections. Rebending of bars on the job to fit different conditions will not be permitted. Point ends of wire ties away from adjacent form surfaces.

D. Spacing: Center-to-center distance between parallel bars shall be in accordance with the Contract Drawings or, where not indicated, the minimum clear spacing shall be in accordance with ACI 318.

E. Longitudinal Location of Bends and Ends of Bar: A maximum of plus or minus 2 inches from the indicated location shall be permitted, provided that specified protective concrete cover at ends of members is not reduced by more than 1/2 inch. At a discontinuous end of a structural member, the tolerance shall be plus or minus 1 inch. At the discontinuous ends of corbels and brackets, the tolerance shall be plus or minus 1/2 inch.

F. Splices:

1. Lapped Splices:

a. Laps of splices shall be securely tied together to maintain the alignment of the bars, to provide the required minimum clearances, and to transfer stress by bond. Lapped splices and development lengths not shown shall be detailed to develop Class B lapping lengths and development lengths in tension, respectively, in accordance with ACI 318.

b. Splices of alternate bars shall be staggered a minimum clear offset of 2 feet between splices. Splices shall be tied with tie wire, or splices may be lap welded in accordance with AWS D1.4/D1.4M. Lapped splices are not permitted for No. 14 and No. 18 bars, or when specifically excluded by Contract provisions regardless of size.

2. Exothermic Metal-Filled Coupler Splices: Conform with the product manufacturer's installation instructions and recommendations and with applicable requirements of AWS D1.4/D1.4M for exothermic welding.

3. Mechanical Coupler Splices:

a. Perform installation of coupler and tightening of joint assembly in accordance with the coupler manufacturer's installation instructions and recommendations.

b. Reinforcing bars to be joined shall be shop threaded using special machinery to produce the required tapered threads. Where previously threaded bars must be cut or where threads are damaged, bars shall be replaced, or an alternate splicing system approved by the Engineer shall be substituted. Bars shall not be rethreaded, and damaged threads shall not be repaired in the field.

c. Prior to joining, inspect all threads and assure that they have been properly made and are clean.

d. Rotate coupler and bar initially by hand or wrench until snug (approximately 3-1/4 to 4 turns). Apply 24-inch minimum pipe wrench and turn coupler (or bar) until further turning is resisted with the application of a minimum torque of 200 foot-pounds. Suitably mark joint to indicate that tightening has been completed.

e. For proprietary mechanical splicing systems not specified herein, installation shall

conform with the manufacturer's installation instructions.

4. Spiral Reinforcement Splices: Splices shall conform with applicable requirements of ACI 318.

5. Splices in Tension Tie Members: Splices in tension tie members shall be made with a mechanical or welded splice. Splices in adjacent bars shall be staggered at least 30 inches.

6. Splice lengths of shell reinforcement shall be at least the greater of 1.3 *ld.* and 18 inches. Splices shall be staggered at least *ld.* with not more than one-third of the reinforcement spliced at any section, in which *ld.* is development length in tension of bar.

G. Dowels: Provide dowels where indicated or required for connecting construction and for maintaining structural and reinforcement continuity. Dowels shall be tied securely in place before concrete is deposited. Provide additional bars for proper support – and anchorage where required. Do not bend dowels after embedment.

H. Welded Wire Fabric:

1. Wire fabric shall be installed in lengths as long as practicable and shall be wire-tied at all laps and splices. End laps shall be offset in adjacent widths. Lap welded wire fabric in accordance with applicable requirements of ACI 318.

2. Where required welded wire fabric shall be secured in position with suitable supports, accessories, and tie wire as indicated and required to ensure against movement from workers and placement of concrete lift fabric as concrete is placed to assure proper embedment at position indicated.

3.03 PROTECTIVE CONCRETE COVER

A. Minimum concrete coverage for steel reinforcement shall be as specified in ACI 301, ACI 318, or CRSI Manual of Standard Practice. If there is a conflict between the standards specified, the thicker concrete coverage shall govern.

3.04 CLEANING:

A. Reinforcement at time of depositing concrete shall be free of corrosion and coatings that may impair bond with concrete, such as form oil, mill scale, or loose deposits of rust and other corrosion.

3.05 FIELD QUALITY CONTROL

A. In accordance with Section 01 45 00, Quality Control, quality control inspections and tests to be performed by the Contractor include the following:

1. Placement of Reinforcing Steel: Visual inspection of reinforcing steel in place, including bar supports, tied laps and intersections, welded wire fabric, and bar mats.

2. Welds:

    a. Visual inspection of reinforcing bar welds.

    b. Tension tests of welded butt joints. Tests shall be performed on sample welds produced by the Contractor in accordance with ASTM E8/E8M.

    c. Nondestructive tests of installed welded butt joints shall be performed in accordance with
    ASTM E165/E165M.

    d. Inspections and tests shall be performed in accordance with the applicable requirements of AWS D1.4/D1.4M, Chapters 8 and 9.

3. Exothermic/Coupler Splices:

    a. Continuous visual inspection for the first eight hours, minimum, of the work as performed by any crew, and again by any replacement crew. All splices require visual inspection before concrete may be placed.

    b. Visual inspection shall be performed in accordance with the product manufacturer's instructions and recommendations for such inspection.

    c. Inspections shall measure and record all voids. Exothermic rebar splices shall be accepted, provided measured "void limits," per end, do not exceed manufacturer's specified "void limits."

    d. Splices indicating improper fill, slag at tap hole, or blowouts shall be rejected.

4. Mechanical Coupler Splices: Test 100 percent of the couplers, using a 24-inch click-type torque wrench calibrated to 200 foot-pounds. Minimum turning torque of 200 foot-pounds shall be applied to the extent that further turning is resisted. Where tests reveal failure of couplers to be properly tightened, couplers shall be removed and replaced.

B. For exothermic/coupler splices, the Contractor shall provide qualification splices for each position as follows:

    1. One sister splice for the first 25 splices; thereafter, one sister splice for every 50 splices.

    2. Sister splices shall be laboratory tested by the Engineer for strength in tension (125 percent of the yield strength of connecting bars).

END OF SECTION 03 20 00

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Conveying and placing concrete.

B. Placement under water.

C. Consolidation.

D. Construction joints.

E. Expansion and contraction joints.

F. Curing and protection.

1.02 RELATED SECTIONS

A. Portland cement concrete specified in Section 03 05 15 - Portland Cement Concrete.

B. Finishing and curing of formed and unformed concrete surfaces, including repair and patching of surface defects, are specified in Section 03 35 00 - Concrete Finishing.

1.03 DEFINITIONS

A. The words and terms used in these Specifications conform with the definitions given in ACI 116R.

1.04 REFERENCES

A. American Concrete Institute (ACI):

1.	ACI 116R	Cement and Concrete Terminology
2.	ACI 117	Standard Specification for Tolerances for Concrete Construction and Materials
3.	ACI 301	Standard Specifications for Structural Concrete
4.	ACI 302.1R	Guide for Concrete Floor and Slab Construction
5.	ACI 303.1	Standard Specification for Cast-In-Place Architectural Concrete

6.	ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
7.	ACI 304.2R	Placing Concrete by Pumping Methods
8.	ACI 305R	Hot Weather Concreting
9.	ACI 306.1	Standard Specification for Cold Weather Concreting
10.	ACI 308	Standard Practice for Curing Concrete
11.	ACI 309R	Guide for Consolidation of Concrete
12.	ACI 318	Building Code Requirements for Structural Concrete
13.	ACI 503.2	Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

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

1.	ASTM C31	Standard Practice of Making and Curing Concrete Test Specimens in the Field
2.	ASTM C94	Specification for Ready-Mixed Concrete
3.	ASTM C881	Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00 - Submittal Procedures for submittal requirements and procedures.

B. Shop Drawings:

1. Submit drawings that indicate the locations of all joints in concrete, including construction joints, expansion joints, isolation joints, and contraction joints. Coordinate with the requirements specified in Section 03 11 00 - Concrete Forming.

2. Submit drawings that indicate concrete placement schedule, method, sequence, location, and boundaries. Include each type and class of concrete, and quantity in cubic yards.

C. Product Data: Submit manufacturer's product data for epoxy adhesive.

D. Records and Reports: Report the location in the finished work of each mix design, and the start and completion times of placement of each batch of concrete placed for each date concrete is placed.

1.06 QUALITY CONTROL

A. Tolerances:

1. Concrete Tolerances: Comply with the requirements of ACI 117 as applicable. Coordinate with the requirements specified in Section 03 11 00 - Concrete Forming.

2. Tolerances for Slabs and Flatwork: Comply with the requirements specified in Section 03 35 00 - Concrete Finishing.

B. Architectural Concrete: Where concrete is indicated as architectural concrete exposed to public view, such concrete shall be produced in accordance with applicable requirements of ACI 301 and ACI 303.1.

C. Site Mock-Ups:

1. Construct site mock-ups for all architectural concrete work and formed concrete that will be exposed to the public in the finished work, not less than 4 feet by 6 feet in surface area, for review and acceptance by the Engineer, before starting the placement of concrete.

2. Approved site mock-ups shall set the standard for the various architectural concrete features, formed finishes, and colors of the concrete. Provide as many mock-ups as required to show all the different features and formed surfaces of the concrete.

D. Cold Joints: Cold joints in concrete will not be permitted unless planned and treated properly as construction joints.

E. Monitoring of Formwork: Provide monitoring of forms and embedded items to detect movement, or forms and embedded items out-of-alignment, from pressure of concrete placement.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Delivering and placing of concrete in hot weather shall conform with applicable requirements of ACI 305R and ACI 306.1 and Section 03 05 15 - Portland Cement Concrete.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Formwork: Refer to Section 03 11 00 - Concrete Forming, for requirements.

B. Reinforcing Steel: Refer to Section 03 20 00 - Concrete Reinforcing, for requirements.

C. Portland Cement Concrete: Refer to Section 03 05 15 - Portland Cement Concrete, for mix designs and other requirements.

D. Concrete Curing Materials: Refer to Section 03 35 00 - Concrete Finishing, for requirements.

E. Epoxy Adhesive: ASTM C881, Type II for non-load-bearing concrete and Type V for load- bearing concrete, Grade and Class as determined by project conditions and requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Inspect forms, earth bearing surfaces, reinforcement, and embedded items, and obtain the Engineer's written approval before placing concrete. Complete and sign a pour card on the form supplied by the Engineer. The Engineer shall countersign the card prior to commencing the pour.

3.02 PREPARATION

A. Place concrete under the observation of the Engineer and with the Contractor’s Quality Control Representative present to document requirements and results of the placement.

B. Whenever possible, place concrete during normal working hours. When concrete- placement schedules require concrete placement at times other than normal working hours, ensure that the Engineer is notified and is present at the time of placement.

C. Do not place concrete until conditions and facilities for the storage, handling, and transportation of concrete test specimens are in compliance with the requirements of ASTM C31 and Section 03 05 15 - Portland Cement Concrete and are approved by the Engineer.

D. Prior to placement of concrete, the subgrade shall be in a firm, well-drained condition, and of adequate and uniform load-bearing nature to support construction personnel, construction materials, construction equipment, and steel reinforcing mats without tracking, rutting, heaving, or settlement. All weak, soft, saturated, or otherwise unsuitable material shall be removed and replaced with structural backfill or lean concrete.

E. All structure foundations, including those for Stations and for subway box, shall be inspected and approved, in writing, by a qualified, independent geotechnical engineer prior to placement of footings and base slabs, to confirm the adequacy of the supporting soil for concrete placement.

F. Earth bottoms or bearing surfaces for footings and slabs shall be dampened but not saturated or muddied just before placing concrete.

3.03 TRANSPORTING

A. Concrete shall be central-mixed concrete from a central batch plant, transported to the jobsite in a truck mixer, in accordance with the requirements specified in Section 03 05 15 - Portland Cement Concrete, and ASTM C94.

B. Transport concrete to the jobsite in a manner that will assure efficient delivery of concrete to

the point of placement without adversely altering specified properties with regard to water-cement ratio, slump, air entrainment, and homogeneity.

3.04 CONVEYING AND PLACING

A. Placement Standards: Conveying and placing of concrete shall conform with applicable requirements of ACI 301, ACI 302.1R, ACI 304R, and ACI 318.

B. Handling and Depositing:

1. Concrete placing equipment shall have sufficient capacity to provide a placement rate that will preclude cold joints and that shall deposit the concrete without segregation or loss of ingredients.

2. Concrete placement, once started, shall be carried on as a continuous operation until the section of approved size and shape is completed.

3. Concrete shall be handled as rapidly as practicable from the mixer to the place of final deposit by methods that prevent the separation or loss of ingredients. Concrete shall be deposited, as nearly as practicable, in its final horizontal position to avoid redistribution or flowing.

4. Concrete shall not be dropped freely where reinforcing will cause segregation, nor shall it be dropped freely more than 5 feet. Concrete shall be deposited to maintain a plastic surface approximately horizontal.

5. In placing walls, columns, or thin sections (6 inches or less in thickness) of heights greater than 10 feet, concrete placement rate, lift thickness, and time intervals between lifts shall be as indicated on approved Shop Drawings. Openings in the form, elephant trunk tremies, or other approved devices, shall be used that will permit the concrete to be placed without segregation or accumulation of hardened concrete on the forms or metal reinforcement above the level of the fresh concrete.

6. Concrete that has partially hardened shall not be deposited in the work. The discharge of concrete shall be started not later than 60 minutes after the introduction of mixing water. Placing of concrete shall be completed within 90 minutes after the first introduction of water into the mix.

C. Pumping:

1. Concrete may be placed by pumping if the maximum slump can be maintained and if accepted in writing by the Engineer for the location proposed.

2. Placing concrete by pumping methods shall conform with applicable requirements of ACI 304R and ACI 304.2R.

3. Equipment for pumping shall be of such size and design as to ensure a continuous flow of concrete at the delivery end without separation of materials. Concrete from end of hose

shall have a free fall of less than 5 feet. Pump hoses shall be supported on horses or similar devices so that reinforcement or post-tensioning ducts or tendons are not moved from their original position.

4. The concrete mix shall be designed to the same requirements as specified in Section 03 05 15 - Portland Cement Concrete and may be altered for placement purposes with the prior approval of the Engineer.

3.05 PLACEMENT UNDER WATER

A. Placement Standards: Placing of concrete in or under water shall conform with requirements of ACI 304R. All concrete to be placed under water shall be placed by the tremie method or by direct pumping.

B. Placement Requirements: Deposit concrete in water only when indicated or approved in writing by the Engineer, and only under the observation of the Engineer. Use only tremie method and direct pumping with equipment that has been accepted by the Engineer.

3.06 CONSOLIDATION

A. Concrete shall be thoroughly consolidated and compacted by mechanical vibration during placement in accordance with the requirements of ACI 309R.

B. The Engineer will inspect concrete placement to confirm that proper placing methods are being employed, and that special techniques are being used in congested areas and around obstructions such as pipes and other embedded items. Check installation of embedded items for correct location and orientation during concrete placement.

C. Conduct vibration in a systematic manner by competent, skilled, and experienced workers, with regularly maintained vibrators, and with sufficient back-up units at the jobsite. Use the largest and most powerful vibrator that can be effectively operated in the given work, with a minimum frequency of 8,000 vibrations or impulses per minute, and of sufficient amplitude to effectively consolidate the concrete.

D. Insert and withdraw the vibrator vertically at uniform spacing over the entire area of the placement. Space the distance between insertions such that "spheres of influence" of each insertion overlap.

E. Conduct vibration so as to produce concrete that is of uniform texture and appearance, free of honeycombing, air and rock pockets, streaking, cold joints, and visible lift lines.

F. On vertical surfaces and on all architectural concrete where an as-cast finish is required, use additional vibration and spading as required to bring a full surface of mortar against the forms, so as to eliminate objectionable air voids, bug holes, and other surface defects. Additional procedures for vibrating concrete shall consist of the following:

1. Reduce the distance between internal vibration insertions and increase the time for each insertion.

2. Insert the vibrator as close to the face of the form as possible, without contacting the form.

3. Use spading as a supplement to vibration at forms to provide fully filled out form surfaces without air holes and rock pockets.

4. Provide vibration of forms only if approved by the Engineer for the location.

3.07 CONSTRUCTION JOINTS

A. Construction joints will be permitted only where indicated or approved by the Engineer.

B. Provide and prepare construction joints and install waterstops in accordance with the applicable requirements of ACI 301 and ACI 304R, and as specified in Section 03 11 00 – Concrete Forming.

C. Make construction joints straight and as inconspicuous as possible, and in exact vertical and horizontal alignment with the structure, as the case may be.

D. Use approved key, at least 1-1/2 inches in depth, at joints unless otherwise indicated or approved by the Engineer.

E. Thoroughly clean the surface of the concrete at construction joints and remove laitance, loose or defective concrete, coatings, sand, sealing compound and other foreign material. Prepare surfaces of joints by sandblasting or other approved methods to remove laitance and expose aggregate uniformly.

F. Immediately before new concrete is placed, wet the joint surfaces and remove standing water. To allow for shrinkage, do not place new concrete against the hardened concrete side of a construction joint for a minimum of 72 hours.

G. Locate joints that are not indicated so that the strength of the structure is not impaired. Joint types and their locations are subject to prior approval of the Engineer.

H. Ensure that reinforcement is continuous across construction joints.

I. Where bonding of the joint is required, provide epoxy adhesive hereinbefore specified and apply in accordance with ACI 503.2.

J. Retighten forms and dampen concrete surfaces before concrete placing is continued.

K. Allow at least 72 hours to elapse before continuing concrete placement at a construction joint. Approval for accelerating the minimum time elapsing between adjacent placements will be based on tests and methods that confirm that a minimum moisture loss at a relatively constant temperature will be maintained for the period as necessary to control the heat of hydration and hardening of concrete, and to prevent shrinkage and thermal cracking.

3.08 EXPANSION AND CONTRACTION JOINTS

A. Refer to Section 03 11 00 - Concrete Forming, for slab screeds and for formwork where

expansion and contraction joints are indicated as architectural features, such as reveals or rustications.

B. Refer to Section 03 35 00 - Concrete Finishing, for finishing of edges of expansion joints in slabs with curved edging tool.

3.09 CURING AND PROTECTION

A. Curing of concrete shall conform with applicable requirements of ACI 301 and ACI 308, except that the curing duration shall be a minimum period of ten days.

B. Keep concrete in a moist condition from the time it is placed until it has cured for at least ten days. Keep forms damp and cool until removal of forms.

C. Immediately upon removal of forms, exposed concrete surfaces shall be kept moist by applying an approved curing compound or by covering with damp curing materials as specified in Section 03 35 00 - Concrete Finishing.

D. Concrete shall not be permitted to dry during the curing period because of finishing operations.

E. Protect fresh concrete from hot sun, drying winds, rain, damage, or soiling. Fog spray freshly placed slabs after bleed water dissipates and after finishing operations commence. Allow no slabs to become dry at any time until finishing operations are complete.

F. Finishing and curing of slabs are specified in Section 03 35 00 - Concrete Finishing.

G. Protect concrete from injurious action of the elements and defacement of any kind. Protect exposed concrete corners from traffic or use that will damage them in any way.

H. Protect concrete during the curing period from mechanical and physical stresses that may be caused by heavy equipment movement, subjecting the concrete to load stress, load shock, or excessive vibration.

3.10 REPAIR OF SURFACE DEFECTS

A. Refer to Section 03 35 00 - Concrete Finishing, for requirements.

END OF SECTION 03 30 00

SECTION 03 35 00

CONCRETE FINISHING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Repair of surface defects.

B. Finishing of formed surfaces.

C. Slabs and flatwork.

D. Curing.

1.02 RELATED SECTIONS

A. Concrete formwork is specified in Section 03 11 00, Concrete Forming.

B. Cast-in-place concrete is specified in Section 03 30 00, Cast-In-Place Concrete.

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1.	AASHTO M182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

B. American Concrete Institute (ACI):

1.	ACI 117	Specification for Tolerances for Concrete Construction and Materials and Commentary
2.	ACI 301	Specifications for Structural Concrete
3.	ACI 308R	Guide to External Curing of Concrete
4.	ACI 503.4	Standard Specification for Repairing Concrete with Epoxy Mortars

C. American Society for Testing and Materials (ASTM):

1.	ASTM C33/ C33M	Standard Specification for Concrete Aggregates
2.	ASTM C150/ C150M	Standard Specification for Portland Cement

3.	ASTM C171	Standard Specifications for Sheet Materials for Curing Concrete
4.	ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
5.	ASTM C881/ C881M	Standard Specification for Epoxy-Resin-Base Bonding System for Concrete
6.	ASTM E1155	Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures. Submittals involving exposed concrete finishes require approval of the Engineer before they may be incorporated in the Work.

B. Shop Drawings: Submit drawings, or diagrams to scale, that indicate the location in plan and elevation of all concrete finishes.

C. Product Data: Submit manufacturers' product data for manufactured products.

1.05 QUALITY ASSURANCE

A. Finishes:

1. Finishing of formed concrete surfaces shall conform to applicable requirements of ACI 301.

2. Finishes for slabs and flatwork shall conform to applicable requirements of ACI 301.

3. Special architectural finishes for formed concrete surfaces shall conform with applicable requirements of ACI 301.

B. Curing: Conform to requirements of ACI 301 and ACI 308R, as applicable, and requirements specified herein.

C. Site Mock-Ups: Provide site mock-ups, at least 3 feet by 4 feet in size, of finishes of formed surfaces in exposed locations and of exposed slab finishes for the Architectr's review and approval.

D. Site Mock-ups of Architectural Concrete: Provide site mock-ups of architectural concrete showing finish texture and pattern of exposed formed concrete surfaces.

1. Size of mock-up shall be a minimum of 8 feet by 10 feet, unless otherwise approved by the Architect to be smaller.

2. The number of mock-up panels required shall be the number necessary to obtain the Architect's approval of pattern and texture of panel.

3. Approved mock-up shall be used as the standard for the aesthetic quality of the surface finish of architectural concrete.

E. Requirements of Regulatory Agencies: Comply with air pollution regulations of governing authorities for sand-blasting activities and operations.

PART 2 – PRODUCTS

2.01 TOOLS AND EQUIPMENT:

A. The Contractor shall furnish all materials, tools, equipment, facilities, and services as required for performing the required concrete-finishing work.

2.02 REPAIR AND FINISHING MATERIALS

A. Portland Cement: ASTM C150/C150M, Type II, of same brand as used in the work. Furnish white portland cement where required to produce color matching color of surrounding concrete.

B. Aggregate:

1. For Bonding Grout: ASTM C33/C33M, washed clean sand passing a No. 30 sieve.

2. For Patching Mortar: ASTM C33/C33M, washed clean, graded fine aggregate of suitable size for areas to be repaired. Clean coarse aggregate up to Size No. 8 may be added for repair of larger pockets and voids.

C. Commercial Patching Mortar: A structural repair mortar may be furnished if appropriate for the use and approved by the Engineer.

D. Epoxy Patching Mortar: As specified in ACI 503.4 for Epoxy Mortar.

E. Epoxy Adhesive: ASTM C881/C881M, Type II or Type V, epoxy-based bonding agent.

F. Anti-Slip Abrasive Grit: Virgin grain Aluminum Oxide or Silicon Carbide particles, or a mixture of the two.

2.03 CURING MATERIALS

A. Damp Curing Materials:

1. Waterproof Sheet Materials: ASTM C171, waterproof paper with white paper face, polyethylene film pigmented white, or white burlap-polyethylene sheeting.

2. Burlap: AASHTO M182, of class or weight suitable for the use and location. Do not use burlap where concrete is exposed to direct sunlight.

B. Curing Compound: ASTM C309, liquid membrane-forming curing compound, Type 1, Class A or B as appropriate for the use or location.

1. Where concrete surfaces will receive architectural finishes, such as resilient floor coverings or paint, or membrane waterproofing, membrane-forming curing compound shall not leave a coating or residue that will impair bond of adhesives, paints, and coatings with concrete.

PART 3 – EXECUTION

3.01 REPAIR OF SURFACE DEFECTS

A. Repair Standards: Repair of surface defects shall conform with applicable requirements of ACI 301. When using epoxy mortar, conform with applicable requirements of ACI 503.4.

B. Surface Defects:

1. Repair of surface defects shall begin immediately after form removal. For repair with epoxy mortar, concrete shall be dry.

2. Surface defects are defined to include: form-tie holes, air voids or pockets, bug holes with a nominal diameter or depth greater than 1/4-inch, honeycombed areas, rock pockets, visible construction joints, fins and burrs.

3. Repair of surface defects shall be tightly bonded and shall result in concrete surfaces of uniform color and texture, matching adjacent surfaces, and free of shrinkage cracks.

C. Repair Work:

1. Remove honeycombed and other defective concrete down to sound concrete. Saw-cut the edges perpendicular to the surface or slightly undercut. Featheredges will not be permitted. Dampen the area to be patched and an area at least 6 inches wide surrounding it to prevent absorption of water from the patching mortar.

2. Where rock pockets or similar defects or voids expose steel reinforcement, cutout to solid surface behind the reinforcing steel to provide suitable key-lock for patching mortar. Patching mortar shall envelope the exposed reinforcing bar.

3. Bond patching mortar to concrete with bonding grout or epoxy adhesive. Bonding grout shall consist of 1-part Portland cement to 1-part No. 30 mesh sand, mixed to the consistency of a thick cream, and then well brushed onto the concrete. Bond commercial patching mortar to concrete in accordance with the manufacturer's instructions.

4. Make the patching mortar of the same materials and of approximately the same proportions as used for the concrete, except omit the coarse aggregate. Use not more

than 1-part Portland cement to 2-1/2 parts sand by damp loose volume and substitute white Portland cement for a portion of the regular gray Portland cement to produce patching mix matching the surrounding concrete in color when dry. Determine the proportion of white Portland cement by trial mixes and test areas, prior to repair of actual defective areas.

5. After surface water has evaporated from the area to be patched, brush the bond coat well into the surface. When the bond coat begins to lose the water sheen, apply the patching mortar. Compact the mortar into place and strike off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave the patch undisturbed for at least one hour before being finally finished. Keep the patched area damp for 7 Days.

6. Neatly finish patched surfaces to match adjacent surrounding surface texture of concrete. Grind or fill surfaces to produce level and plumb, true planes.

7. For walls exposed in the finish work, form tie holes shall be patched and finished flush with adjacent surface. For holes passing entirely through walls, a plunger type injection gun or other suitable device shall be used to completely fill the holes.

8. Patching of honeycombed areas or rock pockets that are too large and unsatisfactory for mortar patching shall be cut out to solid surface, keyed, and packed solid with matching concrete to produce firm bond and flush surface. Patching shall match texture of adjacent surfaces where exposed in the finished work.

9. Repair work in exposed locations that does not match the texture and color of surrounding adjacent surfaces or that was not well performed shall be removed and performed again until the repair work conforms with Specification requirements.

10. Surfaces to receive membrane waterproofing shall have fins and loose material removed, and voids and cracks patched flush with adjacent surfaces.

11. Completed repairs shall be cured as herein specified under Article 3.04, Curing.

3.02 FINISHING OF FORMED SURFACES

A. Unexposed Surfaces:

1. Concrete that will not be exposed in the completed structure shall be any form finish as specified in Section 03 11 00, Concrete Forming, and ACI 301 for “rough form finish.”

2. Concrete to receive membrane waterproofing shall receive a “smooth form finish” in accordance with ACI 301.

B. Exposed Surfaces: Unless indicated otherwise, concrete that will be exposed in the completed structure shall receive the following finishes as indicated:

1. Smooth Form Finish: Conform to ACI 301.

2. Smooth Rubbed Finish: Conform to ACI 301.

3. Grout Cleaned Finish: Conform to ACI 301.

4. Unspecified Finish: When finish is not indicated, provide “smooth form finish” as specified above.

C. Sand Blast Finish:

1. Blasting Operations and Requirements:

   a. Apply sandblasted finish to exposed concrete surfaces where indicated.

   b. Perform sand blasting at least 72 hours after placement of concrete. Coordinate with formwork construction, concrete placement schedule, and formwork removal to ensure that surfaces to be blast finished are blasted at the same age for uniform results.

   c. Determine type of nozzle, nozzle pressure, and blasting techniques required to match the Engineer’s control samples.

   d. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line.

2. Depths of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surface to match the Engineer’s control samples as follows:

   a. Brush Sand Blast Finish: Remove cement matrix to expose face of fine aggregate; no reveal.

   b. Light Sand Blast Finish: Expose fine aggregate with occasional exposure of coarse aggregate; maximum 1/16-inch reveal.

   c. Medium Sand Blast Finish: Generally, expose coarse aggregate; 3/16-inch to 1/4-inch reveal.

3. Surface Continuity: Perform sand blast finishing in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns of variances in depths of cuts as indicated.

4. Construction Joints: Use technique acceptable to the Engineer to achieve uniform treatment of construction joints.

5. Protection and Repair:

   a. Protect adjacent materials and finishes from dust, dirt, and other surface or physical damage during abrasive blast finishing operations. Provide protection as required and remove from site at completion of the work.

b. Repair or replace other work damaged by finishing operations.

6. Clean-up: Maintain control of concrete chips, dust, and debris in each area of the work. Clean up and remove such material at the completion of each day of operation. Prevent migration of airborne materials by use of tarpaulins, wind breaks, and similar containing devices.

3.03 SLABS AND FLATWORK

A. Placement and Finishing Standards: Slabs and flatwork shall be placed, consolidated, and finished in accordance with applicable requirements of ACI 301. Coordinate with Section 03 30 00, Cast-In-Place Concrete, as applicable.

1. High volume fly ash concrete (HVFAC) exhibits little or no bleed water. Commence finishing as soon as power screeding is complete and commence initial curing as soon as finishing has been completed.

B. Placement:

1. Slabs and flatwork shall be placed and finished monolithically. Strike off and screed slabs to true, plane surfaces at required elevations, and thoroughly compact concrete with vibrators, floats, and tampers to force coarse aggregate below the surface. Finish slab within four hours of concrete placement.

2. Whether indicated or not, in areas where drains occur, slope finished slab to drains. Slope shall be a minimum of 1/8-inch per foot unless otherwise indicated.

C. Slab Finishes: Unless indicated otherwise, slabs and flatwork shall receive the following finishes as indicated:

1. Scratched Finish: Conform to ACI 301. Provide “scratched finish” for slab substrates to receive cementitious toppings or finishes, such as terrazzo or mortar setting bed for ceramic tile.
2. Floated Finish: Conform to ACI 301. Provide “floated finish” for track slabs and mud slabs and for slabs and flatwork to receive roofing and membrane waterproofing.

3. Troweled Finish: Conform to ACI 301. Provide “troweled finish” for interior slabs and flatwork to be exposed in the completed structure, for slabs to receive resilient floor coverings, and for flatwork to receive elastomeric bearing pads.

4. Broom Finish: Conform to ACI 301. Exact texture and coarseness of the broom finish shall match the approved site mock-up. Provide fine or medium-coarse “broom finish” as indicated for exterior sidewalks and paving, exterior ramps, equipment and transformer pads, and subway invert slab.

5. Nonslip Finish: Conform to ACI 301. Nonslip materials shall be aluminum oxide and silicone carbide grit particles. Provide “nonslip finish” for interior pedestrian ramps, walkways, subway cross-passage floors, and other floor areas where indicated.

6. Swirl Pattern Finish: Provide for garage floors. After basic floating operations have been completed, hand float slabs using wood float to produce a continuous swirl patterned surface, free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near surface. Use natural arm circular motion to produce rows of approximately one-foot radius swirl pattern covering approximately half of the preceding row with each successive row.

7. Unspecified Finish: When finish is not indicated or specified, provide finishes as specified in ACI 301.

D. Surface Tolerances: As specified herein:

1. Flat Tolerance: Slabs and flatwork with “troweled finish” and with “nonslip finish.”

2. Straightedge Tolerance: Slabs and flatwork with fine “broom finish” or medium-coarse “broom finish.”

3. Bullfloated Tolerance: Slabs and flatwork with “scratched finish,” with “floated finish,” and with coarse “broom finish.”

E. Joints:

1. Construction, expansion, isolation, and contraction joints shall be located as indicated. Construction joints shall act as contraction joints. Where additional contraction joints are required to prevent shrinkage cracks, saw-cut such joints. All joints shall be straight and true to line. Saw-cut joints not less than twelve hours nor more than twenty-four hours after placing concrete, unless otherwise approved by the Engineer.

2. Mark-off lines or edges at formed construction and expansion joints shall be finished with 1/4-inch radius curved edging tool, neat and true to line, uniform throughout.

3.04 CURING

A. Curing Standards: Curing of concrete shall conform with applicable requirements of ACI 301 and ACI 308R, except that the duration of the curing period shall be 10 Days. Curing with earth, sand, sawdust, straw, and hay will not be permitted.

B. Curing Requirements:

1. Concrete shall be cured with waterproof sheet materials, damp burlap, or curing compounds.

2. Curing compounds shall not be used on top of ballasted aerial structures and on surfaces when their use may be detrimental to bonding of concrete, mortar, membrane waterproofing, calking and sealants, adhesives, plaster, paint, or the specified surface finish or coating.

C. Damp Curing:

1. Vertical surfaces shall be cured by keeping the forms wet at all times and by leaving the forms in place as long as possible as specified in Section 03 11 00, Concrete Forming. After removal of forms, concrete shall be kept continuously damp by fog spraying or otherwise washing down the concrete in an accepted manner until 10 Days after placing. Protect exposed surfaces by covering with sheet materials or burlap kept continuously moist.

2. Horizontal surfaces shall be cured and protected by covering the finished surfaces with waterproof sheet materials or damp burlap, left in place for a minimum of 10 Days and kept continuously moist.

3. Fog spray freshly placed slabs until finishing operations commence. Allow no slabs to become dry until finishing operations are complete.

D. Curing HVFAC: Initiate damp curing as soon as finishing has been completed. Damp cure for a minimum of 10 Days. Continue curing for a total of 28 Days. Curing after initial 10 Days may be by damp curing or using membrane-forming curing compound. Use evaporation reducer between finish operations, as necessary, to protect concrete from rapid drying

E. Curing Compound: Application of curing compound shall conform to applicable requirements of ACI 308R.

3.05 PROTECTION

A. Protect exposed concrete surfaces, including flatwork, as required to prevent damage from impact or strains.

B. Protect fresh concrete from drying winds, rain, damage, or soiling.

C. Refer to Section 03 30 00, Cast-In-Place Concrete, Article 3.09, for additional requirements.

3.06 TOLERANCES

A. Formed Surfaces: Conform with applicable requirements of ACI 117.

1. Where elastomeric bearing pads are indicated, the level plane upon which bearing pads are placed shall not vary more than 1/16-inch from a 10-foot straightedge placed in any direction across the area and the area shall extend a minimum of 1 inch beyond the limits of the pads.

2. Bearing surfaces of girders on a slope or girders with a camber shall be finished on a horizontal/level plane so that loads are uniformly distributed over the entire surface of the elastomeric bearing pads.

3. The finished plane shall not vary more than 1/8-inch from the elevation indicated.

B. Slabs and Flatwork: Conform to applicable classification requirements of ASTM E1155, as follows:

1. Very Flat Tolerance: FF 50, FL30. True plane with maximum variation of 1/8-inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.

2. Flat Tolerance: FF 30, FL20. True plane with maximum variation of 3/16-inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.

3. Straightedge Tolerance: FF 20, FL 15. True plane with maximum variation of 5/16-inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.

4. Bullfloated Tolerance: FF 15, FL 13. True plane with maximum variation of 1/2 inch in 10 feet when measured with a 10-foot straightedge placed anywhere on the slab in any direction.

END OF SECTION 03 35 00

SECTION 04 22 00

CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Concrete Masonry Units.

B. Epoxy Bonding Adhesive.

C. Control Joint Materials.

D. Joint Reinforcement.

E. Reinforcing Steel.

F. Precast Beams, Lintels and Copings.

G. Mortar.

H. Grout.

I. Surface Sealer.

1.02 RELATED SECTIONS

A. Reinforcing steel for concrete and connecting dowels for grouted unit masonry are specified in Section 03 20 00, Concrete Reinforcing.

1.03 REFERENCES

A. The Masonry Society (TMS):

1.	TMS 402/602	Building Code Requirements and Specification for Masonry Structures

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

1.	ASTM C33/ C33M	Standard Specification for Concrete Aggregates
2.	ASTM C90	Standard Specification for Load-Bearing Concrete Masonry Units
3.	ASTM C91/ C91M	Standard Specification for Masonry Cement

4. ASTM C94/ C94M — Standard Specification for Ready-Mixed Concrete
5. ASTM 9/ C109M — Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
6. ASTM C140/ C140M — Standard Methods of Sampling and Testing Concrete Masonry Units and Related Units
7. ASTM C143/ C143M — Standard Test Method for Slump of Hydraulic Cement Concrete
8. ASTM C144 — Standard Specification for Aggregate for Masonry Mortar
9. ASTM C150/ C150M — Standard Specification for Portland Cement
10. ASTM C207 — Standard Specification for Hydrated Lime for Masonry Purposes
11. ASTM C270 — Standard Specification for Mortar for Unit Masonry
12. ASTM C404 — Standard Specification for Aggregates for Masonry Grout
13. ASTM C426 — Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units
14. ASTM C476 — Standard Specification for Grout for Masonry
15. ASTM C881/ C881M — Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
16. ASTM C979/ C979M — Standard Specification for Pigments for Integrally Colored Concrete
17. ASTM C1006 — Standard Test Method for Splitting Tensile Strength of Masonry Units
18. ASTM C1019 — Standard Test Method for Sampling and Testing Grout

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures for submittal requirements and procedures.

B. Shop Drawings: When not indicated in sufficient detail or definition, submit detailed drawings of unit masonry, showing type of mortar joints, bond pattern, reinforcing steel, connecting dowels, joint reinforcement, grouted cells, and control joints.

C. Product Data: Submit manufacturer's product data for block, including available color range, epoxy adhesive, joint reinforcement, and control-joint materials, along with installation instructions where applicable.

D. Samples: Submit full-size sample of block and samples of colored mortar for approval. Block and colored joint mortar require approval of the Engineer before they may be used in the concrete masonry work.

E. Certificates: Submit certification stating that concrete masonry units meet specification requirements and that masonry units conform with the special strength requirements of these Specifications. Each certificate shall be signed by the masonry unit manufacturer and shall contain the name of the manufacturer, the project location, and the quantity and dates of shipment or delivery to which the certificate applies.

1.05 QUALITY ASSURANCE

A. Concrete unit masonry work shall conform with applicable requirements of TMS 402/602, except as modified in these Specifications.

B. Construction tolerances for concrete unit masonry shall conform with TMS 402/602.

C. Refer to Section 01 45 00, Quality Control, for additional requirements and procedures.

1.06 DELIVERY, HANDLING, AND STORAGE

A. Delivery masonry materials in undamaged condition. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, or other causes.

B. Limit moisture absorption of concrete masonry units during delivery and until time of installation. Conform to handling and storage requirements in accordance with ASTM C90.

C. Store cementitious materials off the ground, under cover, and in a dry location.

D. Store and protect aggregates where grading and other required characteristics can be maintained.

E. Store and protect masonry accessories, including metal items, to prevent deterioration by corrosion and accumulation of dirt.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Concrete Masonry Units (Concrete Block):

1. Concrete masonry units shall be of modular face dimensions and thicknesses indicated.

Furnish necessary shapes and sizes, bond-beam units, and corner units as required to satisfy conditions indicated. Include half-size units where indicated or required.

2. Concrete masonry units shall be hollow load-bearing units conforming to ASTM C90, and shall be No. 1 Normal Weight, No. 2 Medium Weight, or No. 3 Light Weight, as applicable, Type I - Moisture Controlled Units. Units shall have a maximum linear shrinkage of 0.06 percent when tested in accordance with ASTM C426, and shall meet water absorption requirements of ASTM C90.

3. Concrete masonry units shall be normal cement-colored units with standard face surfaces. Cinders or ingredients that might stain paint finishes will not be permitted in the manufacture of concrete masonry units.

B. Split-Face Concrete Masonry Units:

1. Split-face concrete masonry units shall conform with ASTM C90, as specified above for concrete masonry units, of modular face dimensions and thicknesses indicated. Face of units shall have special surface texture split-face, scored to dimensional module indicated. Minimum strength requirements shall conform with foregoing specified concrete masonry units.

2. Block shall have integral color as selected by the Engineer from manufacturer's standards.

C. Cement: ASTM C150/C150M, Type I or Type II Portland cement, low alkali. Provide white cement when required to achieve the mortar color selected by the Engineer. ASTM C91/91M, Type S, masonry cement may be used together with ASTM C150/150M portland cement as herein specified under "Mortar."

D. Lime: ASTM C207, hydrated, Type S.

E. Mortar Sand: ASTM C144, natural sand, clean and graded.

F. Mortar Coloring Pigment: ASTM C979/C979M, manufactured, inert mineral oxides in color or colors as selected and approved by the Engineer.

G. Grout Aggregate: ASTM C33/C33M or ASTM C404, clean and graded concrete aggregates, proportioned by volume as follows: three parts fine and graded concrete aggregate to two parts of graded 3/8-inch maximum size coarse aggregate.

H. Water: Fresh, clean, potable, free from deleterious amounts of acids, salts, alkali, mineral, and organic substances that would adversely affect the cement mortar, grout, and reinforcing.

I. Epoxy Bonding Adhesive: Adhesive for bonding of mortar bed to concrete slabs shall be an epoxy-based bonding agent conforming to ASTM C881/C881M, Type V, tinted to show by visual inspection where it has been applied.

J. Control Joint Materials: Conform with requirements of TMS 402/602.

K. Joint Reinforcement: No. 9 gage ladder or truss type steel wire conforming to TMS 402/602.

L. Reinforcing Steel: Provide reinforcing steel for grouted block masonry under this Section in accordance with the requirements of Section 03 20 00, Concrete Reinforcing, and TMS 402/602.

M. Precast Beams, Lintels, and Copings: Precast concrete of configuration indicated, conforming to requirements of Section 03 40 00, Precast Concrete, and TMS 402/602. Provide exposed surfaces with light sand-blasted finish matching finish of masonry units as closely as possible.

N. Single Source Responsibility:

1. Masonry Units: Obtain masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each exposed continuous surface or visually related surfaces.

2. Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

2.02 MORTAR

A. Mortar Type and Mixing Requirements:

1. Mortar for grouted unit masonry shall be Type S mortar in accordance with the California Building Code, Chapter 21 and 21A, TMS 402/602, and ASTM C270, with a minimum compressive strength at 28 Days of 1,500 psi. A minimum of two 94-pound sacks of portland cement (ASTM C150/C150M) shall be provided per cubic yard of mortar when using ASTM C91/C91M masonry cement.

2. The use of an admixture for the purpose of reducing water content in mortar will be permitted, provided the strength of the mortar is not reduced.

3. Mortar shall be job mixed and, in lieu of specific requirements specified herein, shall conform with ASTM C270, including measurement, mixing, proportioning, and water retention.

4. Accurately measure mortar ingredients and mix a minimum of three minutes after water has been added, in a mechanical batch mixer, using sufficient water to produce a workable and plastic consistency. Hand mixing will be permitted for small quantities only.

5. Use mortar within 2-1/2 hours after mixing when air temperature is 80 degrees or higher, and within 3-1/2 hours when air temperature is below 80 degrees. Discard any mortar that has been mixed longer or that has begun to set. If necessary, mortar may be retempered within this time limit, by replacing only water lost due to evaporation and by thorough remixing.

B. Colored Joint Mortar: Provide colored mortar for exposed masonry joints where indicated. Color shall be as approved by the Engineer or Architect from samples prepared and submitted by the

Contractor. Pigment amount for selected color and mixing of colored mortar shall conform with the pigment manufacturer's instructions.

2.03 GROUT

A. Grout shall be Coarse Grout, as defined in ASTM C476, with a minimum compressive strength at 28 Days of 2,000 psi and shall be proportioned by volume in accordance with TMS 402/602.

B. Grout mix shall be designed in accordance with ASTM C94/C94M for manufacturer designed mixes, and for handling by an approved grout pump. Slump shall be 8-10 inches.

C. The use of an admixture for the purpose of reducing water content in grout and adding flowability will be permitted, provided the strength of the grout is not reduced. Admixture shall be added to the mix as recommended by the manufacturer for the purpose intended.

2.04 SURFACE SEALER

A. Provide a water-based, VOC-compliant, clear, penetrating water-repellent sealer, designed to provide long-term protection against water absorption, for exterior concrete unit masonry surfaces. Submit sealer performance data and VOC compliance verification for approval.

PART 3 – EXECUTION

3.01 LAYING CONCRETE MASONRY UNITS

A. Installation Standards: Comply with applicable requirements of TMS 402/602.

B. Requirements: Construct concrete unit masonry to dimensions indicated. Concrete masonry units shall be dry when laid. Avoid using less than half-size units in exposed locations. Do not expose cells on any surface. Where concealed, spaces not large enough for full or half-size units may be filled with concrete building brick or mortar.

1. Basic layouts, positions, and elevations shall be as shown on the Construction Drawings. Unit layouts within each panel or wall area shall be made to achieve symmetrical, uniform appearance and to avoid cut units where possible.

2. Perform no work during rain or when outside temperature is 40 degrees Fahrenheit or lower, or when it appears probable that temperatures below 40 degrees Fahrenheit will be encountered before the mortar or grout has set.

3. Masonry walls shall be adequately braced against lateral loads during construction.

4. Do not apply loads for at least three Days after construction of masonry walls.

C. Work Quality:

1. Masonry work shall be performed by skilled and experienced masons. Erect walls plumb and

true to line, with courses level and joints uniform in width, using specified mortar. Vertical joints shall line up plumb in exposed walls.

2. Concrete masonry units shall be sound and free of cracks and surface defects. Handle units carefully to avoid chipping and breaking. Do not substitute cut units where special shapes are available.

3. Where steel beams or joists frame into masonry, fill spaces with mortar and finish off flush with masonry surface, neatly pointed around steel. Where pipes and ducts penetrate masonry, point neatly and accurately around pipes and ducts.

D. Cutting of Units: Cutting of units shall be kept to a minimum. Perform cutting accurately to accommodate items passing through or embedded in masonry, to meet surfaces that masonry abuts, and to fit various conditions. Cutting of masonry units shall be performed with a power-driven masonry saw. Rub cuts smooth and even with carborundum or emery stone. Do not use chipped or cracked masonry units.

E. Bedding and Jointing:

1. Use full mortar bed and coverage on horizontal and vertical face shells of hollow units. Webs also shall be bedded in mortar. Shove vertical joints tight.

2. Top surfaces of concrete foundations or other bed joints shall be clean concrete with aggregate exposed before start of laying. Tops of foundations shall be roughened and cleaned to remove laitance for exposing aggregates in the concrete. Where block is to be laid on slabs, bed joints shall be roughened and cleaned, and an epoxy bonding adhesive shall be applied before laying first course of block.

F. Joint Reinforcement: Provide ladder or truss type joint reinforcement, spaced a maximum of 16 inches on center vertically. Place in accordance with TMS 402/602, fully embedded in mortar.

G. Bond Pattern: Lay masonry units in stretcher bond or running bond, unless otherwise indicated.

H. Alignment of Vertical Cells: Masonry shall be built to preserve the unobstructed vertical continuity of the cells. The vertical alignment shall be sufficient to maintain a clear, unobstructed vertical flue, measuring not less than 3 inches in all directions for grouted masonry.

I. Cleanouts: Cleanout openings shall be provided at the bottoms of cells to be filled with grout. Mortar droppings shall be removed from cells, and cleanouts shall be sealed after inspection and before grout placement.

J. Pipe Chases: Chases and recesses for conduits, pipes, and ducts shall be formed as masonry work is constructed. Do not enclose conduit runs until complete and approved, or piping until it has been tested and approved. Make such chases and recesses plumb, with inside joints struck flush, and the interiors kept free of obstructions and cleaned-out upon completion.

K. Anchorage and Embedded Items:

1. Set accurately in place and bond into masonry, as the masonry work progresses, bolts, straps, hangers, sleeves, anchors, inserts, frames for doors and windows, and any other anchorage items or attachments as indicated. Provide suitable recesses for cabinets, junction boxes, panels, and other items to be built into masonry. Consult with other trades in advance so their work can be accommodated at correct locations, as masonry work progresses, to avoid cutting and patching.

2. Cells containing anchorage or built-in items shall be grouted solid.

3. Where masonry is laid against concrete or metal, the joints between shall be filled with mortar as each course is laid.

L. Joint Finishing:

1. Pack mortar tightly in joints and wipe wall faces clean as work progresses. Unless otherwise indicated, exposed joints shall be densely tooled concave and smooth with joint tool when mortar is thumbprint hard.

2. Joints in work concealed by other finishes shall be cut or struck off flush. Rake out joints around metal frames in openings 3/4-inch deep for sealant to be applied under Section 07 90 00, Joint Protection.

3. Nominal joint size, both vertical and horizontal, shall be 3/8 inch.

M. Joining Work: Step back unfinished work for joining with new work. Before starting or resuming work, remove loose mortar and foreign matter from work in place, and clean all surfaces of work to be joined.

N. Control Joints: Provide control joints where indicated. Comply with TMS 402/602.

3.02 REINFORCING STEEL

A. Provide reinforcing steel for grouted masonry as indicated. Comply with applicable requirements of TMS 402/602.

B. Vertical reinforcing bars shall be placed prior to laying the wall and shall be held in place by standard reinforcing supports. Vertical bars shall be held in position at top and bottom and at intervals not exceeding 190 diameters of the reinforcement or nine feet, whichever is less. Vertical reinforcing steel shall have a minimum clearance of one inch from the masonry.

C. When a foundation dowel does not line up with a vertical core, it shall not be sloped more than one horizontal in six verticals. Dowels shall be grouted into a core in vertical alignment, even though it is an adjacent cell to the vertical wall reinforcing.

D. Horizontal reinforcing bars for bond-beam or channel units shall be laid on the webs of the units

in continuous masonry courses and shall be solidly embedded in mortar and grout. Horizontal bars shall be tied to vertical bars as the block work progresses. Placing of horizontal reinforcing bars in mortar joints will not be permitted.

E. Reinforcing bars shall be straight except for bends around corners and where bends or hooks are indicated.

F. Reinforcing steel shall be lapped in accordance with TMS 402/602, Chapter 2 or Chapter 3. Length of lapped splices shall be not less than 30 bar diameters for bars in compression and 40 bar diameters for bars in tension. Lapped splice bars shall be wire-tied together for the entire length of the splice.

3.03 GROUTING

A. Grouting Requirements:

1. Cells of concrete unit masonry shall be filled solid with grout where indicated. Cells containing reinforcement and anchorage, or built-in items shall be filled solid with grout. Comply with applicable requirements of TMS 402/602.

2. Spaces around metal frames and other built-in items shall be filled solid with grout or mortar.

3. Reinforcing steel shall be secured in place, inspected, and approved before grouting starts.

4. Mortar droppings and projections shall be kept out of the grout space. Webs, wythes, and reinforcement shall be cleaned of mortar droppings before grout is placed.

5. Grout shall be rodded, puddled, or vibrated in place.

6. Cells shall be filled solid with grout, and pours shall be stopped 1-1/2 inches below the top of a course to form a key at pour joints.

7. Grouting of beams over openings shall be performed in one continuous operation. Tops of unfilled cell columns under a horizontal masonry beam shall be covered with metal lath, or special units shall be used to confine the grout fill to the beam section.

8. Do not place pipes or conduits in any structural masonry, except that rigid electric conduit may be embedded in structural masonry when its location has been detailed on the structural Construction Drawings.

9. Do not form chases or recesses not shown on structural Constructional Drawings.

B. Grout Construction:

1. Grout construction, including grout placement and consolidation, shall conform with applicable requirements of TMS 402/602, except as otherwise specified herein.

2. Grout shall be placed in lifts not to exceed 4 feet, with a waiting period of one hour between lifts. The full height of the wall or masonry section shall be placed in one Day.

3. Rod or vibrate grout thoroughly the entire height of the pour when first placed to push grout into all spaces and interstices. A mechanical vibrator with a 3/4 inch to 1-inch head and low velocity shall be used. The vibrator shall be withdrawn slowly enough while on to allow the grout to close up the space that was occupied by the vibrator. After the waiting period of an hour, place second lift and rod or vibrate the pour again to penetrate not more than halfway into the first lift. Repeat this placing operation, waiting period, and consolidating technique until the top is reached. The top pour or lift shall likewise be reconsolidated after waiting period to allow excess water to be absorbed and escape.

3.04 REPAIRING AND POINTING

A. Upon completion of the work, carefully examine masonry surfaces and cut out and replace broken or defective units. Rake out defective mortar joints and repoint.

3.05 CLEANING

A. After erection and pointing, masonry shall be cleaned down with stiff brushes and water, followed by a thorough rinsing with clean water. All mortar deposits, stains, or other foreign matter shall be removed from masonry surfaces.

B. After masonry has been fully grouted, laitance and stains that have percolated through the blocks and mortar joints shall be hosed off with water under pressure.

C. The Engineer may direct that certain masonry surfaces or areas be cleaned with a commercial masonry cleaner manufactured for the purpose, in which case follow the instructions or recommendations of the masonry-cleaner manufacturer for cleaning method.

3.06 CURING

A. Masonry work and top of the grout pour shall be damp cured for at least seven Days to prevent too rapid drying during hot or drying weather, and drying winds.

B. Walls shall be kept moist or damp with water from a fogging nozzle but shall not be wet to the point that free water drops from the surface.

3.07 SEALER APPLICATION

A. Preparation: Surfaces receiving sealer shall be thoroughly dry and free of all construction stains, surface dirt, and efflorescence.

B. Application: Apply sealer, where concrete unit masonry is exposed to the weather, in accordance with the manufacturer’s application instructions and recommendations.

3.08 FIELD QUALITY CONTROL

A. Slump Tests: Perform slump tests of grout during grout placement in accordance with ASTM C1019 and ASTM C143/C143M.

B. Strength Tests: Provide laboratory tests conforming to the following requirements:

1. Concrete Masonry Units: Tensile strength tests shall be performed in accordance with ASTM C1006 and compressive strength test shall be performed in accordance with ASTM C140/C140M. Three units shall be tested for each 2,000 square feet of wall area.

2. Mortar: Compressive strength tests shall be performed in accordance with ASTM C109/C109M. Three cubes shall be tested for each 2,000 square feet of wall area, one at seven Days and two at 28 Days.

3. Grout: Compressive strength tests shall be performed in accordance with ASTM C1019. Three square prisms shall be tested for each 2,000 square feet, or fraction thereof, of wall area.

C. Test Reports: Submit certified copies of all test results to the Engineer for record purposes.

D. Rejection of Masonry; Repair and Replacement: The Engineer shall have authority to reject concrete masonry work that does not meet specification requirements, and to require repair or replacement as necessary to complete the concrete masonry work.

3.09 ACCEPTANCE OF STRUCTURE

A. Acceptance of the completed concrete masonry work requires conformance with the dimensional tolerances, appearance, and strengths specified in these Specifications and in TMS 402/602.

END OF SECTION 04 22 00

SECTION 26 56 01

SOLAR STREET LIGHTING SYSTEM

PART 1 – GENERAL

1.01 REFERENCES

A. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

B. ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C1089	(2013) Standard Specification for Spun Cast Prestressed Concrete Poles
ASTM G154	(2016) Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

C. CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24	(2016) Building Energy Efficiency Standards For Residential and Nonresidential Buildings

D. EUROPEAN UNION (EU)

Directive 2011/65/EU	(2011) Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

E. ILLUMINATING ENGINEERING SOCIETY (IES)

ANSI/IES LM-79	(2019) Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
ANSI/IES LM-80	(2020) Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
ANSI/IES LP-11	(2020) Lighting Practice: Environmental Considerations for Outdoor Lighting
ANSI/IES LS-1	(2020) Lighting Science: Nomenclature and Definitions for Illuminating Engineering
ANSI/IES RP-8	(2018; Addenda 1 2020; Errata 1-2 2021) Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting
ANSI/IES TM-15	(2020) Technical Memorandum: Luminaire Classification System for Outdoor Luminaires
ANSI/IES TM-21	(2019) Technical Memorandum: Projecting Long-Term Lumen, Photon, and Radiant Flux Maintenance of LED Light Sources
IES Lighting Library	IES Lighting Library

F. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

G. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C136.3 (2020)	Roadway and Area Lighting Equipment - Luminaire Attachments
ANSI C136.13	(2020) Roadway and Area Lighting Equipment - Metal Brackets for Wood Poles
ANSI C136.21	(2014) American National Standard for Roadway and Area Lighting Equipment - Vertical Tenons Used with Post-Top-

	Mounted Luminaires
ANSI C136.41	(2013) Roadway and Area Lighting Equipment-Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver
NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2017) Electric Lamps— Specifications for the Chromaticity of Solid State Lighting Products
NEMA C82.77-10	(2020) Harmonic Emission Limits – Related Power Quality Requirements
NEMA C136.10	(2017) American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing
NEMA C136.20	(2012; R 2021) Roadway and Area Lighting Equipment - Fiber Reinforced Composite (FRC) Lighting Poles
NEMA C136.31	(2018) Roadway and Area Lighting Equipment - Luminaire Vibration
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA IEC 60529	(2004) Degrees of Protection Provided by Enclosures (IP Code)
NEMA SSL 1	(2016) Electronic Drivers for LED Devices, Arrays, or Systems
NEMA SSL 3	(2011) High-Power White LED Binning for General Illumination
NEMA WD 7	(2011; R 2016; R 2021) Occupancy Motion Sensors Standard

H. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

I. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

J. UNDERWRITERS LABORATORIES (UL)

UL 773	(2016; Reprint Jul 2020) UL Standard for Safety Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2016; Reprint Jun 2020) UL Standard for Safety Nonindustrial Photoelectric Switches for Lighting Control
UL 916	(2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment
UL 924	(2016; Reprint May 2020) UL Standard for Safety Emergency Lighting and Power Equipment
UL 1310	(2018) UL Standard for Safety Class 2 Power Units
UL 1598	(2021; Reprint Jun 2021) Luminaires
UL 8750	(2015; Reprint Sep 2021) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.02 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications and on the drawings must be as defined in IEEE 100 and ANSI/IES LS-1.

B. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in ANSI/IES LM-80.

C. For LED luminaires, "Luminaire Efficacy" (LE) is the appropriate measure of energy efficiency, measured in lumens/watt. This is gathered from LM-79 data for the luminaire, in which absolute photometry is used to measure the lumen output of the luminaire as one entity, not the source separately and then the source and housing together.

D. Total Harmonic Distortion (THD) is the Root Mean Square (RMS) of all the harmonic components divided by the total fundamental current.

1.03 SUBMITTALS

Refer to Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

A. Submit shop drawings including the following:

1. Luminaire Drawings;
2. Pole Drawings;
3. Control System One-Line Diagram;

B. Submit the product data including the following:

1. Luminaires;
2. Light Sources;
3. LED Drivers;
4. Luminaire Warranty;
5. Lighting Controls Warranty;
6. Pole Warranty;
7. Poles;
8. Brackets;

C. Submit Design data including the following:

1. Luminaire Design Data;
2. Photometric Plan;

D. Submit Test Reports including the following:

1. ANSI/IES LM-79 Test Report;
2. ANSI/IES LM-80 Test Report;
3. ANSI/IES TM-21 Test Report;

E. Submit Manufacturer's Instructions for poles.

F. Submit operation and maintenance manual for the following:

1. Lighting System

1.04 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the IES Lighting Library as applicable, for the lighting system specified.

A. Drawing Requirements

1. Luminaire Drawings

Include dimensions, effective projected area (EPA), weight, accessories, and installation and construction details. Photometric data, including CRI, CCT, TM-15-11 BUG rating, LED driver type, aiming diagram, zonal lumen data, and candlepower distribution data per LM-79 must accompany shop drawings.

2. Pole Drawings

Include dimensions, wind load determined in accordance with ASCE 7-05, pole deflection, pole class, and other applicable information.

B. Luminaire Design Data

1. Provide distribution data according to IES classification type as defined in IES Lighting Library and ANSI/IES RP-8.

2. B.U.G. rating for the installed position as defined by ANSI/IES TM-15 and shielding as defined by ANSI/IES RP-8.

3. Provide safety certification and file number for the luminaire family. Include listing, labeling and identification in accordance with NFPA 70 (NEC). Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratories).

4. Provide long term lumen maintenance projections for each LED luminaire in accordance with ANSI/IES TM-21. Data used for projections must be obtained from testing in accordance with ANSI/IES LM-80.

5. Provide wind loading calculations for luminaires mounted on poles. Weight and effective projected area (EPA) of luminaires and mounting brackets must not exceed maximum rating of pole as installed in particular wind zone area.

C. ANSI/IES LM-79 Test Report

Submit test report on manufacturer's standard production model of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "14.0 Test Report" in ANSI/IES LM-79.

D. ANSI/IES LM-80 Test Report

Submit report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "8.0 Test Report" in ANSI/IES LM-80.

E. ANSI/IES TM-21 Test Report

Submit test report on manufacturer's standard production LED light source (package, array or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data, as well as required interpolation information as outlined under "7.0 Report" in ANSI/IES TM-21.

F. Photometric Plan

For parking lots include computer-generated photometric analysis of the "designed to" values in accordance with ANSI/IES RP-8 or ANSI/IES LP-11 for the "end of useful life" of the luminaire installation using a light loss factor of 0.81. Provide photometric plans that meet criteria in the Basis of Design in the project plans. Include the following in the submittal:

1. Horizontal illuminance measurements at finished grade, taken at a maximum grid size of 10 feet by 10 feet.

2. Vertical illuminance measurements at 5 feet above finished grade at all sidewalks and crosswalks, taken at a maximum of 10 feet.

3. Minimum and maximum lux footcandle levels.

4. Average maintained lux footcandle level.

5. Maximum to minimum ratio for horizontal illuminance only.

6. Average maintained luminance in candela per square meter.

G. Test Laboratories

Test laboratories for the ANSI/IES LM-79 and ANSI/IES LM-80 test reports must be one of the following:

1. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program.

2. One of the qualified labs listed on the Department of Energy – Energy Efficiency & Renewable Energy, Solid-State Lighting web site.

3. One of the EPA-Recognized Laboratories listed at for LM-80 testing.

H. Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory provisions of NFPA 70 unless more stringent requirements are specified or indicated. Provide luminaires and assembled components that are approved by and bear the label of UL for the applicable location and conditions unless otherwise specified.

I. Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for six months prior to bid opening. The six-month period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six-month period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1. Alternative Qualifications

Products having less than a six-month field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

2. Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

1.05 DELIVERY, STORAGE, AND HANDLING OF POLES

A. Aluminum Poles

Do not store poles on ground. Support poles so they are at least one-foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

B. Steel Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

C. Concrete Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation.

1.06 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

A. Luminaire Warranty

Provide and transfer to the government the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

1. Provide a written five-year minimum replacement warranty for material, luminaire finish, and workmanship. Provide written warranty document that contains all warranty processing information needed, including customer service point of contact, whether or not a return authorization number is required, return shipping information, and closest return location to the luminaire location.

    a. Finish warranty must include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

    b. Material warranty must include:

        i. All LED drivers and integral control equipment.

        ii. Replacement when more than 15 percent of LED sources in any lightbar or subassembly(s) are defective, non-starting, or operating below 70 percent of specified lumen output.

2. Warranty period must begin in accordance with the manufacturer's standard warranty starting date.

3. Provide replacements that are promptly shipped, without charge, to the using Government facility point of contact and that are identical to or an improvement upon the original equipment. All replacements must include testing of new components and installation.

B. Lighting Controls Warranty

Provide and transfer to the government the original lighting controls manufacturers standard commercial warranty for each different lighting controls manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the earliest. Warranty service must be performed by a factory-trained engineer or technician.

1. Unless otherwise noted, provide a written five-year minimum warranty on the complete system for all systems with factory commissioning. Provide warranty that covers 100 percent of the cost of any replacement parts and services required over the five years which are directly attributable to the product failure. Failures include, but are not limited to, the following:

    a. Software: Failure of input/output to execute switching or dimming commands.

    b. Damage of electronic components due to transient voltage surges.

    c. Failure of control devices, including but not limited to photosensors and motion sensors.

2. Provide a written five-year minimum warranty on all input devices against defect in workmanship or materials provided by device manufacturer.

c. Provide a written five-year minimum warranty on all control components attached to luminaires against defect in workmanship or materials.

C. Pole Warranty

Provide and transfer to the government the original pole manufacturers standard commercial warranty for each different pole manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the earliest. Provide a written minimum one-year replacement warranty for material, luminaire finish, and workmanship. Warranty service must be performed by a factory-trained engineer or technician.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 Operation and Maintenance Data that provide basic data relating to the design, operation, and maintenance of the lighting system.

1. Manufacturers' operating and maintenance manuals.

2. Luminaire shop drawings for modified and custom luminaires.

3. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

PART 2 – PRODUCTS

2.01 PRODUCT COORDINATION

A. A stand-alone solar photovoltaic (SPV) street lighting system (SLS) is an outdoor lighting unit used for illuminating a street or an open area. It consists of photovoltaic (PV) module(s), LED, lead acid battery, control electronics, inter-connecting wires/cables, module mounting Pole including hardware and battery box. The LED is fixed inside a luminaire which is mounted on the pole. The PV module is placed at the top of the pole at an angle to maximize incident solar radiation, and a battery is placed in a box attached to the pole. The module is mounted facing south, so that it receives solar radiation throughout the day, without any shadow falling on it. Electricity generated by the PV module will charge the battery during the daytime. This system operates from dusk to dawn.

B. Technical Specifications & General Specifications

1. Duty Cycle:

   The system should automatically switch is ON at dusk, operate throughout the night and automatically switch is OFF at the dawn.

2. PV Module (S):

   a. Both crystalline and thin film technology modules are allowed in the system. The PV module should have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 or IEC 61646 for crystalline and thin film PV modules respectively. The manufacturer should produce the certificate for a higher wattage module, in case the certificate is not available for the offered PV module. Further, the manufacturer should certify that the supplied module is also manufactured using similar material, design and process as that of the certified PV module. The certificate should be from an NABL or IECQ accredited Laboratory.

   b. The power output of the module(s) under STC should be a minimum of 74 Wp. Either two modules of minimum 37 Wp output each or one module of 74 Wp output should be used. In case of thin film technology PV modules, the specified values refer to the stabilized power output after the initial degradation. The module efficiency should not be less than 12%.

   c. The operating voltage corresponding to the power output mentioned above should be 16.4 ± 0.2 V.

   d. The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.

   e. The terminal box on the module should have a provision for opening for replacing the

cable, if required.

f. Each PV module must use a RF identification tag (RFID), which must contain the following information:

   i. Name of the manufacturer of PV Module.
   ii. Model or Type Number
   iii. Serial Number
   iv. Month and year of the manufacture
   v. I-V curve for the module
   vi. Peak Wattage of the module at 16.4 volts
   vii. Im, Vm and FF for the module
   viii. Unique Serial No and Model No of the module

   Until March 2013, the RFID can be inside or outside the module laminate but must be able to withstand harsh environmental conditions.

g. A distinctive serial number starting with NSM will be engraved on the frame of the module. The distinctive number starting NSM will also be screen printed on the tedlar sheet of the module.

3. Battery

   a. Lead Acid, tubular positive plate flooded electrolyte or Gel or VRLA Type.

   b. The battery will have a minimum rating of 12V, 75 Ah (at C/10 discharge rate).

   c. 75 % of the rated capacity of the battery should be between fully charged and load cut off conditions.

4. Lamp

   a. The lamp shall be LED.

5. Electronic Protections

   a. Adequate protection is to be incorporated under no load conditions e.g. when the lamp is removed, and the system is switched ON.

   b. The system should have protection against battery overcharge and deep discharge conditions.

   c. Fuses should be provided to protect against short circuit conditions.

   d. Protection for reverse flow of current through the PV module(s) should be provided.

   e. Electronics should have temperature compensation for proper charging of the battery

throughout the year.

6. Mechanical Hardware

   a. A metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s). The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that the module(s) can be oriented at the specified tilt angle.

   b. A vented, acid proof and corrosion resistant painted metallic box for outdoor use should be provided for housing the battery with a provision of lock and Key.

7. Other Features

   a. The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery.

   b. There will be a Name Plate on the system, which will give:

      i. Name of the Manufacturer or Distinctive Logo.

      ii. Serial Number.

   c. Components and parts used in the solar street lighting systems should conform to the latest BIS specifications, wherever such specifications are available and applicable.

   d. The PV module(s) will be warranted for a minimum period of 25 years from the date of supply and the street lighting system (including the battery) will be warranted for a period of two years from the date of supply. PV modules used in Solar Street Lighting System must be warranted for their output peak watt capacity, which should not be less than 90% at the end of Twelve (12) years and 80% at the end of Twenty-five (25) years.
   The Warranty Card to be supplied with the system must contain the details of the system**.** The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

   e. Necessary lengths of wires/cables and fuses should be provided.

   f. An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar Street Lighting System. The following minimum details must be provided in the Manual:

      i. Basic principles of Photovoltaics.

      ii. A small write-up (with a block diagram) on Solar Street Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.

iii. About Charging and Significance of indicators.

iv. Clear instructions about erection of pole and mounting of PV module (s) and lamp housing assembly on the pole.

2.02 LUMINAIRES

A. Luminaires

UL 8750, ANSI/IES LM-79, ANSI/IES LM-80. For all luminaires, provide:

1. Complete system with LED drivers and light sources.

2. Housing constructed of non-corrosive materials. All new aluminum housings must be anodized, or powder coated. All new steel housings must be treated to be corrosion resistant.

3. ANSI/IES TM-21, ANSI/IES LM-80. Minimum L70 lumen maintenance value of 50,000 hours unless otherwise indicated in the luminaire schedule. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

4. Minimum efficacy shall be 119 LPW.

5. Product rated for operation within an ambient temperature range of minus 30 degrees C minus 22 degrees F to 40 degrees C 104 degrees F or 50 degrees C 122 degrees F.

6. UL listed for wet locations. Optical compartment for LED luminaires must be sealed and rated a minimum of IP65 per NEMA IEC 60529.

7. IES Lighting Library. Light distribution and NEMA field angle classifications as indicated in luminaire schedule on project plans.

8. Housing finish that is baked-on enamel, anodized, or baked-on powder coat paint. Finish must be capable of surviving ASTM B117 salt fog environment testing for 2500 hours minimum without blistering or peeling.

9. LED driver and light source package, array, or module are accessible for service or replacement without removal or destruction of luminaire.

10. ANSI/IES TM-15. Does not exceed the BUG ratings as listed in the luminaire schedule. If BUG ratings are not listed in the luminaire schedule, provide luminaires that meet the following minimum values for each application and mounting conditions.

11. Fully assembled and electrically tested prior to shipment from factory.

12. Finish color is as indicated in the luminaire schedule or detail on the project plans.

13. Lenses constructed of clear or frosted tempered glass or UV-resistant acrylic. Provide polycarbonate vandal-resistant lenses.

14. All factory electrical connections are made using crimp, locking, or latching style connectors. Twist-style wire nuts are not acceptable.

15. NEMA C136.31. Comply with 3G vibration testing.

16. Luminaire arm bolts constructed from 304 stainless steel or zinc-plated steel.

17. Wiring compartment on pole-mounted, street and area luminaires is accessible without the use of hand tools to manipulate small screws, bolts, or hardware.

18. Incorporate modular electrical connections, and construct luminaires to allow replacement of all or any part of the optics, heat sinks, LED drivers, surge suppressors and other electrical components using only a simple tool, such as a manual or cordless electric screwdriver.

19. ANSI C136.3. For all roadway and area luminaires, provide products with an integral tilt adjustment of plus or minus 5 degrees to allow the unit to be leveled.

2.03 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type, lumen rating, and wattage as indicated in luminaire schedule on project plans.

A. LED Light Sources

Provide LED light sources that meet the following requirements:

1. NEMA ANSLG C78.377. Emit white light and have a nominal Correlated Color Temperature (CCT) of 4000 Kelvin.

2. Minimum Color Rendering Index (CRI) of 80.

3. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

4. Light source color consistency by utilizing a binning tolerance within a 4-step McAdam ellipse.

2.04 LED DRIVERS

NEMA SSL 1, UL 1310. Provide LED Drivers that are electronic, UL Class 1 or Class 2, constant-current type and meet the following requirements:

A. The combined LED driver and LED light source system is greater than or equal to the minimum luminaire efficacy values as listed in the luminaire schedule provided.

B. Operate at a voltage of 120-277 volts at 50/60 hertz, with input voltage fluctuations of plus or minus 10 percent.

C. Power Factor (PF) greater than or equal to 0.90 at full input power and across specified dimming range.

D. Maximum Total Harmonic Distortion (THD) less than or equal to 20 percent at full input power and across specified dimming range.

E. Operates for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.

F. Meets the "Elevated" (10kV/10kA) requirements per IEEE C62.41.2 -2002. Manufacturer must indicate whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire. Provide surge protection that is integral to the LED driver.

G. Contains integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.

H. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 15, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

I. Class A sound rating for all drivers mounted under a covered structure, such as a canopy, or where otherwise appropriate.

J. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

K. UL listed for wet locations typical of exterior installations.

L. Rated to operate between ambient temperatures of minus 30 degrees C minus 22 degrees F and 40 degrees C 104 degrees F 50 degrees C 122 degrees F.

2.05 LIGHTING CONTROLS

Provide integral photo-electric control system.

A. Photosensors

UL 773, UL 773A. Provide Photosensors that meet the following requirements:

1. Hermetically sealed, cadmium sulfide or silicon diode light sensor type, rated at 1000 watts, 50/60 Hz with single-pole, single or double-throw contacts.

2. Turns ON at 10 to 30 lux 1 to 3 footcandles and turns OFF at 30 to 150 lux 3 to 15 footcandles.

3. Designed to fail to the ON position.

4. Housing is constructed of polycarbonate or die cast aluminum or UV stabilized polypropylene, rated to operate within a temperature range of minus 40 to 70 degrees C minus 40 to 158 degrees F.
5. Time delay that prevents accidental switching from transient light sources.

6. Directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

7. Designed for 20-year service to match life expectancy of long-life LED fixtures and exceed 15,000 operations at full load. Provide photosensors with zero-cross technology to withstand severe in-rush current and extend relay life.

8. Fixed or Swivel base type housing with 12.7 mm 1/2 in threaded base for mounting to a junction box or conduit.

9. NEMA C136.10. Twist-lock receptacle type. Provide with solid brass prongs and voltage markings and color coding on exterior of housing.

10. Provide photosensors with metal oxide varistor (MOV) type surge protection.

2.06 POLES

AASHTO LTS ASCE 7-16. Provide round straight or tapered poles designed for wind loading of 190 miles per hour while supporting luminaires and all other appurtenances indicated. The effective projected areas (EPA) of luminaires and appurtenances used in calculations must be specific for the actual products provided on each pole. Provide poles that are embedded anchor-base type designed for use with underground or overhead supply conductors. Poles, other than wood poles, must have oval-shaped hand hole having a minimum clear opening of 3 by 5 inches. Secure hand hole covers by stainless steel captive screws. Provide metal poles with an internal grounding connection accessible from the hand hole near the bottom of each pole. Install a means of wire disconnection accessible from the hand hole. Do not install square poles. Provide poles from a Manufacturer with a standard provision for protecting the finish during shipment and installation. Do not install scratched, stained, chipped, or dented poles.

A. Aluminum Poles

Provide aluminum poles with uniform satin or anodized finish unless otherwise noted in luminaire schedule on project plans. Do not paint aluminum poles. Provide poles that meet the following requirements:

1. AASHTO LTS. Manufactured of corrosion resistant aluminum alloys for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys.

2. Seamless extruded or spun seamless type with minimum 0.188-inch wall thickness.

3. Top of shaft is fitted with a round or tapered cover.

4. ASTM B108/B108M. Pole base is mounted by anchor bolts, made of cast 356-T6 aluminum alloy. Base must be machined to receive the lower end of shaft.

5. Joint between shaft and base is welded.

6. ASTM B108/B108M. Base cover is cast 356-T6 aluminum alloy.

7. All hardware other than anchor bolts are either 2024-T4 anodized aluminum alloy or stainless steel.

8. Grounding connection is designed to prevent electrolysis when used with copper ground wire.

B. Steel Poles

Provide steel poles with hot-dipped galvanized in accordance with ASTM A123/A123M or iron-oxide primed factory finish. Provide poles that meet the following requirements:

1. Minimum 11-gage steel with minimum yield/strength of 48,000 psi

2. Pole is mounted by anchor bolts or direct set.

3. Consists of tapered tubular members, either round in cross section or polygonal.

4. Pole shaft is one piece and is of welded construction with no bolts, rivets, or other means of fastening except as specifically approved.

5. Base covers are of structural quality hot-rolled carbon steel plate, with a minimum yield of 36,000 psi.

6. Markings are approximately 3 to 4 feet above grade and includes manufacturer, year of manufacture, top and bottom diameters, and length.

7. Grounding connection is designed to prevent electrolysis when used with copper ground wire.

C. Concrete Poles

ASTM C1089. Cross-sectional shape must be round.

1. Steel Reinforcing

Provide prestressed concrete pole shafts that are reinforced with steel prestressing members. Provide internal longitudinal loading by either pre-tensioning or post-tensioning longitudinal reinforcing members.

2. Tensioned Reinforcing

Primary reinforcement steel used for a prestressed concrete pole shaft must be tensioned between 60 to 70 percent of its ultimate strength. The amount of reinforcement must be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

3. Coating and Sleeves for Reinforcing Members

   Where minimum internal coverage cannot be maintained next to required core opening, such as hand holes and wiring inlet, protect reinforcing with a vapor proof noncorrosive sleeve over the length without the 1/2-inch concrete coverage. Apply a nonmigrating slipper coating to each steel reinforcing member which is to be post-tensioned prior to the application of concrete to ensure uniformity of stress throughout the length of each member.

4. Strength Requirement

   As an exception to the requirements of ASTM C1089, provide poles that are naturally cured to achieve a 28-day compressive strength of 7000 psi. Poles must not be subjected to severe temperature changes during the curing period.

5. Shaft Preparation

   Provide completed prestressed concrete pole shaft with a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost, and must be clean, smooth, and free of surface voids and internal honeycombing. Do not install poles within 15 days of manufacture.

D. Brackets and Supports

ANSI C136.3, ANSI C136.13, and ANSI C136.21. Provide pole brackets that are not less than 1 1/4 inch galvanized steel pipe or aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets must be coordinated to luminaires provided, and brackets for use with one type of luminaire must be identical. Brackets for pole-mounted streetlights must correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Provide special mountings or brackets as indicated and of metal which will not promote galvanic reaction with luminaire head.

E. Pole Foundations

Provide anchor bolts consisting of a steel rod with a minimum yield strength of 50,000 psi; the top 12 inches of the rod must be galvanized in accordance with ASTM A153/A153M. Concrete must be as specified in Section 03 30 00 Cast-In-Place Concrete.

2.07 EQUIPMENT IDENTIFICATION

A. Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

B. Labels

UL 1598. Luminaires must be clearly marked for operation of specific light sources and drivers according to proper light source type. Note the following luminaire characteristics in the format "Use Only _____":

1. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

2. Driver and dimming protocol.

Markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. LED drivers must have clear markings indicating dimming type and indicate proper terminals for the various outputs.

2.08 FACTORY APPLIED FINISH

NEMA 250. Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum meets requirement of corrosion-resistance testing.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Luminaires

Install all luminaires in accordance with the luminaire manufacturer's written instructions. Install all luminaires at locations and heights as indicated on the project plans. Level all luminaires in accordance to manufacturer's written instructions. Aim all luminaires in accordance with aiming diagram.

B. LED Drivers

Provide LED drivers integral to luminaire as constructed by the manufacturer.

C. Field-Applied Painting

Provide field applied painting for luminaire type. Paint lighting equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

D. Concrete Poles

Install according to pole manufacturer's instructions.

E. Aluminum and Steel Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit bells, and ground rods must be as specified in Section 03 30 00 Cast-In-Place Concrete. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. After installation, paint exposed surfaces of steel poles with two finish coats of exterior oil paint of a color as indicated or aluminum paint. Install according to pole manufacturer's instructions. Alterations to poles after fabrication will void manufacturer's warranty and is not allowed.

F. Pole Setting

Set pole to depth as indicated.

G. Lighting Controls

1. Photosensors

Aim photosensor according to manufacturer's recommendations.

H. Grounding

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as required.

3.02 FIELD QUALITY CONTROL

A. Tests

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Perform initial operational test, consisting of the entire system energized for 72 consecutive hours without any failures of any kind occurring in the system.

1. Lighting Control Verification Test

Verify lighting control system and devices operate according to approved sequence of operations. Verification tests are to be completed after commissioning.

3.03 CLOSEOUT ACTIVITIES

A. Training

Provide on-site training to the Owner's personnel in the operation and maintenance of lighting and lighting control system. Provide training that includes calibration, adjustment, troubleshooting, maintenance, repair, and replacement.

1. Maintenance Staff Training

   Submit a Maintenance Staff Training Plan at least 30 calendar days prior to training session that describes training procedures for Owner's personnel in the operation and maintenance of lighting and lighting control system. Provide on-site training which demonstrate full system functionality, assigning schedules, calibration adjustments for light levels and sensor sensitivity, integration procedures for connecting to third-party devices, and manual override including information on appropriate use. Provide protocols for troubleshooting, maintenance, repair, and replacement, and literature on available system updates and process for implementing updates.

2. End-User Training

   Submit a End-User Training Plan at least 30 calendar days prior to training session that describes training procedures for end-users on the lighting control system. Provide demonstration for each type of user interface. Provide users with the curfew schedule as currently commissioned, including conditional programming based on astronomic time clock functionality. Provide users with the correct contact information for maintenance personnel who will be available to address any lighting control issues.

END OF SECTION 26 56 01

SECTION 31 00 00

EARTHWORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Staking and grades.

B. Existing utilities.

C. Earthwork general requirements.

D. Subsurface extraction.

E. Rough grading and filling.

F. Excavation.

G. Embankment construction.

H. Subgrade preparation.

I. Foundation preparation.

J. Subgrade filling/raising grade.

K. Compaction.

L. Backfilling.

M. Finish grading.

1.02 RELATED SECTIONS

A. Aggregate subbase is specified in Section 32 11 17, Aggregate Subbase Courses.

B. Aggregate base course is specified in Section 32 11 23, Aggregate Base Courses.

C. Aggregate drainage fill is specified in Section 32 11 24, Aggregate Drainage Layer.

D. Drainage and filter aggregates and permeable material for subsurface drainage are specified in Section 33 46 00, Sub drainage.

1.03 REFERENCES

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

1. ASTM C131/C131M Standard Test Method for Resistance to Degradation of

		Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
2.	ASTM C136/C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3.	ASTM C535	Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact the Los Angeles Machine
4.	ASTM D653	Standard Terminology Related to Soil, Rocks, Rods, and Contained Fluids
5.	ASTM D1140	Standard Test Methods for Determining the Amount of Material Finer Than 75-um (No. 200) Sieve in Soils by Washing
6.	ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft3 (2,700kN-m/m3))
7.	ASTM D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8.	ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
9.	ASTM D2974	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Materials
10.	ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
11.	ASTM D4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
12.	ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13.	ASTM D6913/ D6913M	Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
14.	ASTM D6938	Standard Test Methods for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.04 DEFINITIONS

A. Earthwork Terminology: Terms used in this Section and not defined herein shall be interpreted in accordance with the definitions given in ASTM D653.

B. Soil Classification: Soil classification is based on the Unified Soil Classification system given in ASTM D2487. Group symbols, when used, conform with the symbols of ASTM D2487.

C. Fill: Soil or soil-rock material placed to raise the subgrade or natural grade of the site.

D. Backfill: Soil or soil-rock material used to backfill excavations and to backfill excavated spaces around foundation walls, building walls, retaining walls, head walls, and abutments.

E. Embankment: Soil or soil-rock material for embankment construction. Embankment construction includes constructing embankments and dikes, including the preparation of the areas upon which they are to be placed; and the construction of temporary surcharge embankment above the grading plane.

F. Borrow: Soil or soil-rock material used for fill, backfill, embankment, or other construction that is excavated from an off-site location and hauled in.

G. Unsuitable Material: Excavated material or material below the natural ground surface in embankment areas or below sub grade elevation in excavated areas, which is unsuitable for its planned use. Unsuitable material is further defined as material determined to be:

1. Incapable of being compacted to specified density using ordinary methods at optimum moisture content; or

2. Too wet to be properly compacted and circumstances prevent suitable drying prior to incorporation into the work; or

3. Otherwise unsuitable for the planned use.

   The presence of excessive moisture in a material is not, by itself, sufficient cause for determining that the material is unsuitable. The existence of unsuitable material may be indicated in the Contract Documents or may be determined by the Engineer during the progress of the work.

H. Relative Compaction: The ratio, expressed as a percentage, of the in-place dry density of material as compacted in the field to the maximum dry density of the same material as determined by laboratory test ASTM D1557.

I. Optimum Moisture Content: The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.

J. Relative Density: Mass per unit volume as specified in ASTM D4253 and ASTM D4254, as applicable to the soil and test method employed.

1.05 CLASSIFICATION OF EARTHWORK

A. For specification purposes, earthwork shall be classified as follows:

1. Excavation - Common: All excavation involved in grading and construction of the trackway, parking areas, landscaped areas, walkways, roads, driveways, and connections thereto; and any other excavation classified or indicated as common excavation.

2. Excavation - Rock: Includes removal of material in place which cannot be loosened or broken down with one pass of a crawler tractor weighing not less than 55,000 pounds, with a maximum draw-bar pull of not less than 57,000 pounds-force, pulling a single 24-inch hydraulic ripper tooth approved by the tooth manufacturer for use with the tractor under full hydraulic down pressure, or equipment of equivalent ripping capacity.

3. Structure Excavation: The removal of material for the construction of foundations for aerial structures, bridges, buildings, retaining walls, headwalls, cut-and-cover subways, and other structures, and such other excavation indicated as structure excavation.

4. Structure Backfill: Structure backfill includes furnishing structural fill material and placing and compacting structural fill material around structures to the lines and grades indicated. Structure backfill includes borrow excavation and material when required.

5. Fill for Raising Grade: Includes raising of sub grade or grade to indicated elevation with structural fill, including moisture-conditioning and compaction of placed fill material. Structural fill material includes borrow excavation and material when required.

6. Pervious Backfill: Includes furnishing, placing, and compacting pervious backfill material behind abutments, wingwalls, and retaining walls, as indicated.

7. Common Embankment: Used only for embankment construction, above surrounding grade, below 2.5 feet of the finished embankment grade or sub grade, and where there are no foundation-bearing concrete structures above. Common embankment includes borrow excavation material when required.

8. Select Embankment: Used only for embankment construction, above surrounding grade, within 2.5 feet of the finished embankment grade or sub grade. Select embankment includes borrow excavation material when required.

9. Subsurface Extraction: Includes removal of abandoned utilities, tanks, walls, foundations, and other miscellaneous subsurface man-made structures that interfere with new construction and are designated to be removed, and the cleaning of such items if they are indicated to be salvaged. Removal of such obstructions at or above grade is specified in Section 02 41 00, Demolition.

10. Salvaging Topsoil: Salvaging topsoil is the removal of topsoil to the depth indicated, stockpiling the material on-site, and maintaining the stockpile until the material is reused in the work. Salvaging of topsoil shall be classified the same as the excavation with which it is associated, but if no such classification can be made, it shall be classified as Excavation - Common.

1.06 DESCRIPTION

A. Provide excavation for trackway and pavement; excavation and placement of compacted fill and backfill for structures, and subsurface and surface drainage; placement of pervious backfill; construction of embankments; sub grade and foundation preparation; subsurface extraction of miscellaneous structures and facilities indicated or required to be removed; and finish grading.

1.07 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Quality Plan: Refer to Section 01 43 00, Quality Assurance, and Section 01 45 00, Quality Control, for general requirements. The Quality Plan shall include a schedule of all tests specified to be performed by the Contractor.

C. Test Reports: Submit certified test reports of all tests specified to be performed by the Contractor.

D. Samples: Furnish and deliver samples of fill and backfill materials as selected by the Engineer for testing and analysis.

E. Field Verification for In-Situ Treatment: Submit the proposed program for field verification of Standard Penetration Test "N" Values after in-situ treatment for mitigation of liquefaction potential.

1.08 QUALITY CONTROL

A. Quality Plan: The Contractor shall submit a Quality Plan, conforming to the requirements of Section 01 43 00, Quality Assurance, and Section 01 45 00, Quality Control, covering all earthwork operations and the field quality control to be performed by the Contractor.

B. Quality Control: The Contractor shall provide proper quality control measures to assure compliance with specified requirements. Foundation and sub grade preparation and the placement and compaction of fills shall be performed under the surveillance of Guam registered professional geotechnical engineer employed by the Contractor.

C. Tests: The Contractor shall engage the services of an approved independent soils testing laboratory to perform tests.

D. Tolerances:

1. Construct finished surfaces to plus or minus 1/2-inch of the elevations indicated.

2. Complete embankment slopes to plus or minus six inches of the slope line indicated. Do not encroach on the trackway bed or roadbed.

3. Maintain the moisture content of fill material as it is being placed within plus or minus two percent of the recommended moisture content of the material.

1.09 SITE CONDITIONS

A. Unfavorable Weather Conditions:

1. Excavating, filling, backfilling, and grading work shall not be performed during weather conditions which might damage or be detrimental to the condition of existing ground, in-progress work, or completed work. When the work is interrupted by rain, excavating, filling, backfilling, and grading work shall not resume until the site and soil condition

(moisture content) are suitable for compaction.

2. Sub grade shall be free from mud, and deleterious material when work is resumed.

3. Soil material that is too wet for compaction shall be left to drain, to be aerated and dried by disking and harrowing or other approved methods until the moisture content of the area is uniform and within the specified limits.

B. Prevention of Erosion: Comply with requirements specified in Section 01 57 00, Temporary Controls, and the following:

1. Prevent erosion of stockpiles, ditches, embankments, filled, backfilled, and graded areas until such time as permanent drainage and erosion control measures have been installed.

2. Perform "protective grading" to provide positive drainage and to minimize ponding of surface water.

PART 2 – PRODUCTS

2.01 FILL AND BACKFILL MATERIALS - GENERAL REQUIREMENTS

A. Material used for fill, backfill, and embankment construction shall be an inert, inorganic soil, free from deleterious substances, and of such quality that it will compact thoroughly without the presence of voids when watered and rolled. (Inorganic soil is defined as soil containing less than two percent by weight of organic material when tested in accordance with ASTM D2974). Excavated on-site material will be considered suitable for fill, backfill, and embankment construction if it is free from organic matter and other deleterious substances and conforms to the requirements specified herein.

B. Excavated material that is suitable for fill, backfill, and embankment construction shall be conditioned for reuse and properly stockpiled for later filling and backfilling operations. Conditioning shall consist of spreading material in layers not to exceed eight inches and raking free of debris and rubble.

C. Where conditions require the importing of fill or backfill material, the material shall be an inert soil or soil-rock material free of organic matter and meeting or exceeding the minimum requirements specified herein for the location.

D. All material to be used for filling, backfilling, and embankment construction requires written approval of the Engineer.

2.02 FILL AND BACKFILL MATERIALS - SPECIFIC REQUIREMENTS

A. Common Fill: Well-to moderately well-graded soils consisting of sands, silts, and clays, with or without gravel, as excavated, screened or blended, having the following mechanical properties and gradation:

1. Gradation (ASTM D6913/D6913M):

Sieve Opening	Percent Passing, by Weight
6-inch square	100
3/4-inch square	70 minimum
Liquid Limit (ASTM D4318):	50 maximum

2. Plasticity Index (ASTM D4318): 25 maximum

B. Common Embankment: Common fill, with the following additional requirements:

1. Liquid Limit (ASTM D4318): 40 maximum
2. Plasticity Index (ASTM D4318): 15 maximum

C. Select Embankment: Well-to moderately graded soils consisting of sands, silts, and clays, with or without gravel, as excavated, screened or blended, having the following mechanical properties and gradation:

1. Gradation (ASTM D6913/D6913M):

Sieve Opening	Percent Passing, by Weight
1-inch square	100
3/8-inch square	75 minimum
U.S. No. 4	20 minimum
U.S. No. 200	35 maximum

2. Sand Equivalent : 10 minimum
3. Plasticity Index (ASTM D4318): 10 maximum

D. Structural Fill: Well to moderately-graded granular soils, as excavated, screened or blended, having the following mechanical properties and gradation:

1. Liquid Limit (ASTM D4318): 25 maximum
2. Plasticity Index (ASTM D4318): 6 maximum
3. Gradation (ASTM D6913/D6913M):

Sieve Opening	Percent Passing, by Weight
3-inch square	100
U.S. No. 4	35 minimum
U.S. No. 30	20 minimum

U.S. No. 200	25 maximum

4. Sand Equivalent: 20 minimum

E. Pervious Backfill: Clean washed gravel or crushed stone, natural sands, manufactured sand, or combination thereof, conforming to the following requirements:

1. Gradation (ASTM C136/C136M):

Sieve Opening	**Percent Passing, by Weight**
2 inches square	100
U.S. No. 50	0-100
U.S. No. 100	0-8
U.S. No. 200	0-4

2. Percentage wear

(ASTM C131/C131M or C535): 50 percent maximum

3. Soft fragments as a function of percent wear: 15 percent maximum

4. Coal and lignite: 0.25 percent maximum

5. Clay Lumps: 0.25 percent maximum

6. Other deleterious material: 2.0 percent maximum

2.03 MATERIALS FOR EARTHWORK

A. Fill and Backfill Materials: Where specific fill, backfill, and embankment materials are not indicated on Contract Drawings, conform to the following requirements:

1. Embankment: Common embankment below 2.5 feet for finished sub grade; select embankment for top 2.5 feet of finished sub grade.

2. Fill for Raising Grade: Structural fill beneath foundations and for sub grade below structures. Fill for raising grade under pavements and trackways shall be sub base material as specified in Section 32 11 17, Aggregate Sub base Courses.

3. Backfill Against Concrete Walls and Waterproofing: Structural fill or pervious backfill as indicated.

4. Backfill for Wing Walls, Retaining Walls, and Abutments: Structural fill or pervious backfill as indicated.

5. Fill or Backfill Under Supporting Walls and Columns and Similar Locations: Class 4000 concrete.

6. Backfill Where Not Otherwise Indicated: Common fill.

2.04 SOURCE QUALITY CONTROL

A. Fill, backfill, and embankment materials proposed to be used in the work shall be tested in the laboratory for compliance with specified requirements as follows:

1. Moisture-Density Relationship: ASTM D1557.

2. Moisture Content: ASTM D2216.

3. Liquid Limit: ASTM D4318.

4. Plastic Limit and Plasticity Index: ASTM D4318.

5. Percentage of Wear: ASTM C131/C131M or C535 as applicable.

6. Sieve Analysis: ASTM D6913/D6913M, and ASTM C136/C136M, as applicable.

7. Percent Passing No. 200 sieve: ASTM D1140.

8. Sand Equivalent: California Test 217.

9. Organic Content of Soils: ASTM D2974.

B. Where classification of soils is necessary to meet specified requirements, perform laboratory tests in accordance with ASTM D2487.

C. Submit certified test reports of all tests as herein specified under Submittals.

D. Provide samples as requested by the Engineer for preparing checklists. Provide three samples of each type of material proposed for use from locations selected by the Engineer.

PART 3 – EXECUTION

3.01 STAKING AND GRADES

A. Lay out the work, establish all necessary markers, benchmarks, grading stakes, and other stakes as required.

3.02 EXISTING UTILITIES

A. Verify on site the location and depth (elevation) of all existing utilities and services before performing any excavation work. Refer to Section 33 05 25, Support and Protection of Utilities, for additional requirements. Excavation within three feet of an active utility line shall be performed by hand.

B. Abandoned sewers, piping, and other utilities encountered in the progress of the excavating shall be removed and the ends plugged.

C. Active utility lines encountered, which are not indicated in the Contract Documents, shall be

reported immediately to the Engineer and utility owners involved. The Engineer and utility owners shall be permitted free access to determine the measures deemed necessary to repair, relocate, or remove the utility.

3.03 EARTHWORK GENERAL REQUIREMENTS

A. Dust Control: Refer to Section 01 57 00, Temporary Controls, for dust control requirements.

B. Erosion Protection: Prevent erosion of the site at all times. Construct temporary berms and dikes and cut temporary swales to promote natural drainage of site. Refer to Section 01 57 00, Temporary Controls, for additional requirements.

C. Construction Traffic: Disperse travel paths of traffic and construction equipment over entire width of compacted surfaces so as to aid in obtaining uniform compaction. Protect exposed soil layers with high moisture content from excessive wheel loads.

D. On-Site Excavation or Borrow Pits: Do not excavate or remove any material from the project site or right-of-way which is not within the designated excavation, as indicated by the slope and grade lines, without written authorization from the Engineer.

E. Salvaging Topsoil:

1. Salvage topsoil from stripped and excavated areas, and stockpile on the site at appropriate locations. Prevent topsoil from contamination by other materials and provide adequate drainage and erosion protection.

2. Place stockpiled topsoil in areas to be landscaped as indicated on the Contract Drawings.

F. Stockpiling of Fill and Backfill Material:

1. Excavate and separately stockpile suitable fill and backfill material, as indicated, during the progress of the excavation work. Save sufficient suitable excavated material, if available, for later filling, backfilling, and embankment construction.

2. Store materials from required excavations that are suitable for fill, backfill, and embankment as excavated, in stockpiles segregated by type.

3. Establish excavated material stockpiles on site only in locations where they will not interfere with the progress of the work. Offsite stockpiling, if necessary, shall be the responsibility of the Contractor.

G. Disposal of Surplus Material:

1. Excess earth materials, unsuitable materials, and debris shall become the property of the Contractor and shall be removed from the site and disposed of in a legal manner.

2. Location of disposal site and length of haul shall be the Contractor's responsibility.

H. Maintenance of Excavations, Slopes, and Embankments:

1. Excavate and remove material outside the limits of the excavation which is unstable and

constitutes potential slides, and material which comes into excavations for any reason including from the driving of piles.

2. Maintain slopes and embankments until substantial completion and acceptance of the work. Promptly repair slides, slipouts, washouts, settlements, and subsidences that occur for any reason, and refinish the slope or embankment to the indicated lines and grades.

3. Refer also to Section 31 35 00, Slope Protection, for requirements.

I. Safeguarding of Structure Walls: Heavy equipment and rollers greater than one ton shall not be operated within four feet of structure walls.

3.04 SUBSURFACE EXTRACTION

A. Remove subsurface facilities and obstructions to the extent indicated.

B. When subsurface facilities are encountered during excavation which interfere with new construction, and such facilities are not indicated, notify the Engineer promptly for corrective determination.

3.05 ROUGH GRADING AND FILLING

A. Prior to commencement of earthwork, perform such soil and rock removal and filling as may be required to facilitate the progress of the work and bring all elevations to the rough grading lines indicated on the Contract Drawings. Grading shall be performed by blading or as herein specified under Article 3.08.

B. Fill or backfill, test pits, or holes which will not be completely removed by excavation, with lean concrete, pervious backfill, or clean structural fill, and compact as herein specified in layers not exceeding eight inches of uncompacted thickness.

C. Fill or backfill holes, swales, and low points that will not otherwise be removed in the course of the work to the indicated grades.

3.06 EXCAVATION

A. General Excavation Requirements:

1. Perform excavating as indicated in the Contract Documents and required for trackway and roadway beds, for concrete footings, foundations, retaining walls, exterior paving, floor slabs, concrete walks, and for site levels and grading, and provide shoring, bracing, underpinning, cribbing, pumping, and planking as required.

2. The bottoms of excavations shall be level, firm, undisturbed earth, clean and free from loose material, debris, and foreign matter.

3. Excavate to the lines and grades indicated on the Contract Drawings.

4. Excavations shall be supported and maintained by providing structural support of earth walls as specified in Section 31 50 00, Excavation Support and Protection, so that sides are stable and will not move. Excavations may be maintained by sloping cut faces where space

permits, if calculations, sealed and signed by a civil or structural engineer currently registered in Guam, show that the slopes are safe. Calculations shall consider all existing conditions, including adjacent traffic, construction loading, and other local effects.

5. Limits of excavations shall allow for adequate working space for installing forms, wall waterproofing, and as required for safety of personnel. Cut excavations in solid rock accurately to the lines indicated on the Contract Drawings, or to the width of the ductbank or concrete encasement.

6. Dewater excavation as specified in Section 31 23 19, Dewatering. Construct berms around excavations as required to prevent surface water and runoff from entering the excavation.

7. Remove unstable bottom material. Remove large stones, debris, and compressible soils from excavation bottoms to a minimum depth of 12 inches. Where required to excavate to rock, it shall be understood to mean sound bedrock. Remove loose and unsound material.

8. Except as otherwise indicated in the Contract Documents, preserve the material below and beyond the lines of excavations. Where an excavation is carried below the indicated grade, backfill to the indicated grade as herein specified.

9. Excavations for convenience of the Contractor shall be approved by the Engineer.

10. Place excavated material at a sufficient distance from edge of excavation so as not to cause cave-ins or bank slides, but in no case closer than three feet from the edge of excavations.

11. Unauthorized over excavations for footings and foundations shall be filled with lean concrete to indicated elevations.

12. Excavated earth material that is suitable for fill, backfill, or embankment shall be conditioned for re-use and properly stockpiled for later filling and backfilling operations as herein specified. Test, screen, and mix as necessary to meet specified requirements.

B. Rock Excavation:

1. Rock which cannot be broken up and removed by ripper equipment shall be excavated and removed by drilling and blasting. The use of explosives requires written approval of the Engineer as specified.

2. Use pre-splitting to establish a shear plane in the rock along the cut periphery or proposed break lines to reduce over breakage. Pre-split a periphery plane to the depth to be excavated prior to other blasting within the limits of that particular plane; except that the Contractor will not be required to pre-split to slopes flatter than one-to-one. Pre-split by drilling appropriately sized holes at intervals of not more than three feet, to the depth of the cut, along the plane of the proposed cut; load and stem such holes with an appropriate light charge explosive, and detonate all holes in the particular plane simultaneously.

3. If the depth of the cut is more than can be drilled from the top, an 18-inch offset will be allowed in the slope to begin succeeding drilling operations. The end result shall be a relatively smooth shear plane with localized irregularities which do not exceed two feet behind or one foot in front of the shear plane surface and which do not extend within the indicated lines of the excavation.

4. Where footings or foundations are to be placed on rock which is not horizontal, key the center of the foundation approximately 12 inches in depth throughout an area approximately equal to the dimensions of the column or footing to be placed on the rock, or the entire width of the slab, at not more than ten-foot intervals. Remove loose fragments, and clean and fill all seams with lean concrete.

5. Material excavated beyond or below the indicated cross section shall be at the Contractor's expense. Fill over breakage to required invert with lean concrete at no additional expense to the owner.

6. Leave the side slopes of rock cuts with reasonably uniform faces whether the excavation is carried beyond the specified side slopes or not. Remove all loose rock on cut slopes immediately after blasting. Sloped surfaces shall conform to the typical section indicated or to natural cleavage planes, where these are compatible with the typical section.

7. Exposed rock faces shall be mapped by a Contractor-employed, registered professional geotechnical engineer. If structural mapping indicates that unstable planes or other features are exposed which jeopardize the stability of the slope, the Contractor shall modify the slope as required.

3.07 EMBANKMENT CONSTRUCTION

A. Construct embankments to lines, grades, and contours indicated, in layers as nearly uniform and horizontal as is consistent with the indicated finished contour and profile. Maximum thickness of the layers shall be eight inches before compaction.

B. Compact each layer to specified density for entire width of the embankment. Achieve required compaction by rolling with compaction equipment suitable for type and condition of the particular material. Roll in a longitudinal direction parallel to longest dimension, starting at outer edges and progressing toward the center.

C. Moisture-condition embankment fill material as required to achieve its compaction to the specified density, within the tolerances specified herein.

D. Do not compact material that contains excessive moisture. In such cases, scarify to the full depth of the layer having excessive moisture content and dry by reworking, mixing with dry materials, or other approved methods.

E. Remove material that cannot be compacted to required density within specified tolerances and replace with suitable material.

F. Where pipes, culverts, or structures extend into embankments, construct embankment to at least two feet over and ten feet on either side of the pipe, culvert, or structure location prior to excavation.

G. Where fill is to be placed against hillsides or slopes steeper than five to one (horizontal to vertical), the existing slope shall be benched at least six feet horizontally into the hillside as the new embankment is placed in horizontal lifts.

H. Do not commence final shaping until above specified requirements have been completed. Shape entire surface of the slopes of cuts and embankments to true grade, alignment, and cross

section indicated. Leave cut slopes in rock with uniform surface and remove all loose overhanging rock.

3.08 SUBGRADE PREPARATION

A. Perform all cutting, blading, and shaping as required to cut and shape the sub grade to the grades and elevations indicated.

B. Sub grade preparation includes fine grading, reworking as necessary, and preparation of cut, fill, or embankment upon which the structure and equipment foundations, pipe, sub ballast, subbase, base, and pavement will be placed. Remove unsuitable sub grade material, such as weak or compressible soils.

C. Scarify and mix entire surface of sub grade to a depth of at least six inches. Moisture-condition scarified sub grade to three percent above optimum moisture content. If sub grade stabilization material is required, incorporate it into the sub grade at this time.

D. After the material has been thoroughly mixed and moisture-conditioned, accurately construct and fine grade the sub grade to indicated line, grade, and contour with high and low spots eliminated. Compact for full width to the specified density. Remove soft spots developed during working, fill with approved material, and re-compact.

E. Finish sub grade to straightedge or template within specified tolerances with the finished surface bladed to a uniform, dense, smooth texture.

3.09 FOUNDATION PREPARATION

A. Complete construction of the excavation support and dewatering systems prior to construction of structure and equipment foundations.

B. Avoid disturbing bottom of excavation. If bottom is disturbed, restore and stabilize the bearing foundation with compacted pervious backfill material as specified herein.

C. If material at bottom of the excavation is rock, remove loose material and roughly level the bearing foundation to indicated elevation. If the bottom contains occasional rock outcroppings or rock in only a portion of the area, remove such rock to a depth of six inches below indicated sub grade and backfill with lean concrete.

D. Where unsuitable material is encountered at the elevations indicated for foundations, all soft, loose, or unsuitable material shall be removed. The area shall be scarified to a minimum depth of 12 inches, and the planned elevation shall be re-established by backfilling with structural backfill, moisture-conditioning, and compacting to a minimum dry density of 95 percent of the maximum laboratory dry density as determined in accordance with ASTM D1557. Where the exposed foundation consists of competent, undisturbed in-place soils, scarifying may be omitted.

3.10 SUBGRADE FILLING/RAISING GRADE

A. Compacted fill for raising of sub grade to indicated elevation shall be constructed by approved methods. Fill material shall be spread in uniform lifts not exceeding eight inches in uncompacted thickness. Fill material that does not contain sufficient moisture to compact properly shall be

sprinkled with water; if it contains excess moisture it shall be aerated or permitted to dry to the proper water content. Fill material and water shall then be thoroughly mixed before being compacted. Each layer of spread fill material shall be compacted to the specified density.

B. Control of fill shall consist of field inspection and testing to determine that each layer has been compacted to the required density and to ensure that optimum moisture is being obtained. Any layer or portion of a layer that does not attain the compaction required shall be scarified and re-compacted until the required compaction is obtained.

C. Spreading and compacting shall be performed as required to produce the required density and a uniform surface smooth and true to grade.

3.11 COMPACTION

A. Compaction Density: Compact each layer of embankment, fill, and backfill material to not less than the indicated or specified compaction. Required compactions are defined as Class I and Class II, as follows:

1. Class I Compaction: 90 percent relative compaction as determined by ASTM D1557.

2. Class II Compaction: 95 percent relative compaction as determined by ASTM D1557.

B. Required Compactions:

1. Embankment or Fill where the Surface will be Bearing Foundation: Class II for full depth. Where embankment construction exceeds five feet in depth, provide minimum Class I compaction below the top 2.5 feet.

2. Fill Below Trackways and Pavements: Class II for full depth. Where fill exceeds three feet in depth, provide minimum Class I compaction below the top three feet.

3. Backfill around Structures: Class I under top 12 inches; Class II for top 12 inches.

4. Cut-and-Cover Backfill: Class I to 36 inches above structure or utility; Class II for balance, with a minimum of Class II for top 12 inches.

5. Original Ground or Cut Sub grade: Except as specified in Articles 3.08 and 3.09 where original ground or cut sub grade, or fill less than one foot thick, will be sub grade or bearing foundation, scarify the surfaces and provide Class II compaction for at least eight inches in depth. Include the following additional requirements:

a. Provide Class II compaction for original ground when such original ground is within 3.5 feet of top of rail profile or within 2.5 feet of finished pavement grade, for full width of trackway and pavement plus three feet on each side thereof.

b. Provide Class II compaction for top six inches of undisturbed original ground upon which embankments are to be constructed.

6. Where not otherwise indicated or specified and where structures are not involved, provide Class I compaction to minimize settlement.

3.12 BACKFILLING

A. Use materials removed from site excavations if such material meets specified requirements.

B. Backfilling is required around all substructures. Fill all abandoned vaults, shafts, airways, adits, holes, pits, and other voids.

C. Place backfill in layers not to exceed eight inches of loose material, and compact each layer to specified density before the next layer is placed.

D. Place backfill material in such manner that unbalanced horizontal loads will not be applied to a newly placed structure or portion of structure, utility, or pipeline. Do not backfill around portions of structures requiring backfill on only one side or on less than all sides, until the concrete has reached the specified 28-day strength to withstand the earth pressures on structures.

E. When placing material for backfill around waterproofed structures, protect such structures and the waterproofing thereof with a shield when necessary to prevent displacement or injury by stones or other hard substances in the backfill.

F. Do not backfill on or against structural concrete until the specified 28-day concrete strength has been attained.

G. Complete backfill for end bents and abutments, including backfill for wingwalls, in accordance with the above specified time/strength limit. Step slopes behind abutments, unless otherwise indicated, to prevent backfill from acting as a wedge against the abutment. Provide drainage behind abutments and wingwalls as indicated.

H. Do not use compaction equipment and methods that produce excessive horizontal or vertical earth pressures on structures. Excessive horizontal earth pressures are those in excess of at-rest earth pressures. Excessive vertical earth pressures are those in excess of overburden pressures.

3.13 FINISH GRADING

A. Finish grade all areas to elevations and grades indicated. In areas to receive topsoil and landscape planting, finish grading shall be performed to a uniform seven to eight inches below the grades and elevations indicated.

B. Place and spread stockpiled topsoil to a uniform thickness of six inches (approximately) in areas to receive topsoil and landscape planting. Place and spread to a uniform thickness approximately one inch below finish grades indicated.

END OF SECTION 31 00 00

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Clearing and grubbing

B. Tree branches

C. Demolition and removal

D. Disposal of removed materials and debris

E. Salvage

F. Backfill

1.02 RELATED SECTIONS

A. Temporary facilities, such as fences, barricades, warning lights, and other temporary safety measures, are specified in Section 01 52 00, Construction Facilities.

B. Dust control is specified in Section 01 57 00, Temporary Controls.

C. Demolition of structures and removal, salvage, or other disposition of slabs, footings and foundations; existing pavement, curbs and gutters, sidewalks, headwalls, walls, and steps; utility service facilities; guardrail and posts, highway and street signs and fences; and other miscellaneous structures and site improvements that interfere with new construction are specified in Section 02 41 00, Demolition.

D. Removal of items that are buried below grade is specified in Section 31 00 00, Earthwork.

1.03 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

1.04 JOBSITE CONDITIONS

A. Dispose of cleared, grubbed, and removed material away from the site. Burying and burning of materials at the site will not be permitted. Stockpile salvaged material in a secured location.

B. Clear and restore areas used for the Contractor's convenience. Restore such areas to their original condition, and provide mulching, seeding, and planting as required.

C. Protect survey markers and monuments, existing improvements, and adjacent properties from removal and damage.

D. Give written notices to utility companies and municipal departments requesting discontinuance of services to areas that will be affected by the site clearing and grubbing work.

E. Provide noise and dust abatement as specified in Section 01 57 00, Temporary Controls.

1.05 CARE OF EXISTING TREES

A. Trees and plants indicated in the Contract Documents to remain and to be preserved shall be protected from damage by constructing suitable barriers or fences at, or near, the driplines of the trees and plants. Vehicles, equipment, materials, and debris shall not be placed or parked in these areas or under trees to remain.

B. Feed, water, and maintain protected trees and plants in a healthy, growing condition during the construction period.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. The Contractor shall furnish all materials, tools, equipment, facilities, and services as required for performing site clearing, grubbing and other site preparation work.

PART 3 – EXECUTION

3.01 CLEARING AND GRUBBING

A. Perform clearing and grubbing as necessary to remove vegetation and objectionable material from the site. Clear the site within the limits indicated and remove cleared materials and debris from the site. Unless otherwise indicated, clearing and grubbing shall include removing the top four inches of the existing ground. Coordinate with salvaging of topsoil specified in Section 31 00 00, Earthwork.

B. Remove stumps and roots completely in excavation areas and under embankments where the original ground level is within 3.5 feet of sub grade or slope of embankments. In embankment areas, where the original ground level is more than 3.5 feet below the sub grade or slope of embankment, cut off trees, stumps, and brush to within six inches of the ground.

C. Do not start earthwork operations in areas where clearing and grubbing are not complete, except that stumps and large roots may be removed concurrently with excavation.

D. Where the work includes requirements for wood chip mulch, acceptable material from clearing and grubbing activities may be used to produce such mulch.

3.02 TREE BRANCHES

A. Remove tree branches overhanging trackways, roadways, and other designated areas of the site to within 20 feet of finish grade. Cut off branches neatly and close to the tree boles. Remove other branches as necessary to present a balanced appearance. Treat scars resulting from tree branch removal with a heavy coat of an approved asphaltic tree paint.

3.03 DEMOLITION AND REMOVAL

A. Coordinate the work of this Section with the work of Section 02 41 00, Demolition, as required to remove existing pavements, curbs, structures and site improvements that interfere with new construction and where demolition is not indicated.

B. Remove walls and masonry construction to a minimum depth of two feet below existing ground level in areas where such items do not interfere with new construction.

C. Take possession of, remove, and dispose of abandoned rail and track materials.

D. Slabs may be broken for drainage and left in place where they are below grade and the Engineer determines it is not detrimental to the structural integrity of the fill or structure to be placed above.

3.04 DISPOSAL OF REMOVED MATERIALS AND DEBRIS

A. Dispose of removed materials, waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.

B. Burying of trash and debris on the site will not be permitted. Burning of trash and debris at the site will not be permitted.

C. Remove trash and debris from the site at frequent intervals so that its presence will not delay the progress of the Work or cause hazardous conditions for workers and the public.

D. Removed materials, waste, trash, and debris shall become the property of the Contractor and shall be removed from the Owner's property and disposed of in a legal manner. Location of disposal site and length of haul shall be the Contractor's responsibility.

3.05 SALVAGE

A. Refer to Section 02 41 00, Demolition, for salvage requirements.

3.06 BACKFILL

A. Backfill trenches and excavations resulting from work under this Section in accordance with applicable requirements of Section 31 00 00, Earthwork.

END OF SECTION 31 11 00

SECTION 32 11 17

AGGREGATE SUBBASE COURSES

1.01 SECTION INCLUDES

A. Subbase materials.

B. Installation standards.

C. Spreading of material.

D. Compacting.

E. Field quality control.

1.02 RELATED SECTIONS

A. Aggregate base course for pavements is specified in Contract Specifications Section 32 11 23, Aggregate Base Courses.

B. Preparation of sub grade is specified in Contract Specifications Section 31 00 00, Earthwork.

1.03 CLASSIFICATION

A. Aggregate subbases are designated as Class 1, Class 2, or Class 3. The class of aggregate subbase shall be indicated.

1.04 REFERENCES

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

1.	ASTM C136/ C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
2.	ASTM D1241	Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses
3.	ASTM D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
4.	ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
5.	ASTM D2844/ D2844M	Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils
6.	ASTM D6913/ D6913M	Standard Test Methods for Particle Size Distribution (Gradation of Soils Using Sieve Analysis)

7. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.05 SUBMITTALS

A. General: Refer to Contract Specifications Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

B. Product Data: Submit source, gradation, R-value, and sand equivalent for the proposed subbase material.

C. Test Reports: Submit plant and field test reports as specified in Articles 2.02 and 3.05 herein.

PART 2 – PRODUCTS

2.01 SUBBASE MATERIAL

A. Aggregates for the three classes of aggregate subbase shall conform to the requirements approved by the Engineer on record.

2.02 SOURCE QUALITY CONTROL

A. The Contractor shall take, prepare, and perform sampling and tests of the aggregate subbase material as delivered to the site in accordance with the ASTM D6913/6913M Test Methods herein specified, to determine compliance with specified requirements.

B. Aggregate grading or sand equivalent test shall represent no more than 500 cubic yards of subbase material or one day's production, whichever is the lesser amount.

PART 3 – EXECUTION

3.01 EXAMINATION

A. The Contractor shall request an inspection by the Engineer and obtain acceptance of the prepared sub grade before proceeding with placement of the aggregate subbase.

B. Immediately prior to spreading, the sub grade to receive aggregate subbase, shall conform to the compaction and elevation tolerances indicated for the material involved and shall be free of standing water and loose or extraneous material.

3.02 INSTALLATION STANDARDS

A. Aggregate subbase shall be applied over the prepared sub grade and compacted in accordance with the contract requirements.

B. Aggregate subbase shall be minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be six inches.

C. Compaction expressed in percentage in this Section refers to the maximum dry density as determined by ASTM D1557.

3.03 SPREADING OF MATERIAL

A. Spreading of aggregate subbase material shall be by approved methods and conform to the contract requirements.

3.04 COMPACTING

A. Compaction of aggregate subbase material shall be by approved methods and conform to the contract requirements.

3.05 FIELD QUALITY CONTROL

A. The Contractor shall perform field tests in accordance with ASTM D6938 to determine compliance with specified requirements for density and compaction of subbase material, and with ASTM D6938 to determine moisture-content compliance of the installed subbase material.

B. Testing frequency shall be not less than one test for every 2,000 square feet of subbase material, per layer or lift.

END OF SECTION 32 11 17

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Aggregate base material.

B. Installation standards.

C. Spreading of material.

D. Compacting.

E. Field quality control.

1.02 RELATED SECTIONS

A. Aggregate subbase for pavements and foundations is specified in Contract Specifications Section 32 11 17, Aggregate Subbase Courses.

B. Preparation of sub grade is specified in Contract Specifications Section 31 00 00, Earthwork.

1.03 CLASSIFICATION

A. Aggregate bases are designated as Class 2 or Class 3. The class of aggregate base shall be as indicated.

1.04 REFERENCES

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

1.	ASTM C136/ C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
2.	ASTM D1241	Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses
3.	ASTM D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
4.	ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
5.	ASTM D2844/ D2844M	Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils

6.	ASTM D3744/ D3744M	Standard Test Method for Aggregate Durability Index
7.	ASTM D6913/ D6913M	Standard Test Methods for Particle Size Distribution (Gradation) of Soils Using Sieve Analysis
8.	ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.05 SUBMITTALS

A. General: Refer to Contract Specifications Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

B. Product Data: Submit source, gradation, R-value, sand equivalent, and durability for the proposed base course material.

C. Test Reports: Submit plant and field test reports as specified in Articles 2.02 and 3.05 herein.

PART 2 – PRODUCTS

2.01 AGGREGATE BASE MATERIAL

A. Aggregates for the two classes of aggregate bases shall conform to the requirements approved by the Engineer on record.

B. Aggregate for the two classes of aggregate bases at the time the base material is deposited on the prepared sub grade or subbase shall be free from vegetable matter and other deleterious substances and conform with ASTM D1241.

2.02 SOURCE QUALITY CONTROL

A. The Contractor shall perform sampling and tests of the aggregate base material in accordance with the ASTM D6913/D6913M and tests required in Caltrans Standard Specification Section 26 to determine compliance with specified requirements.

B. Aggregate grading or sand equivalent test shall represent no more than 500 cubic yards of base course material or one day's production, whichever is the lesser amount.

PART 3 – EXECUTION

3.01 EXAMINATION

A. The Contractor shall call for an inspection by the Engineer and obtain written acceptance of the prepared sub grade or subbase before proceeding with the placement of aggregate base course.

B. The sub grade or subbase to receive aggregate base course, immediately prior to spreading, shall conform to the compaction and elevation tolerances indicated for the material involved and shall be free of standing water and loose or extraneous material.

3.02 INSTALLATION STANDARDS

A. Aggregate base course shall be applied over the prepared sub grade or subbase and compacted in accordance with the contract requirements.

B. Aggregate base course shall have minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be six inches for parking stalls and eight inches for roads, driveways, and aisles of parking areas.

C. All compaction expressed in percentages in this section refers to the maximum dry density as determined by ASTM D1557.

3.03 SPREADING OF MATERIAL

A. Spreading of aggregate base material shall be approved methods and conform to the contract requirements.

3.04 COMPACTING

A. Compaction of aggregate base material shall be approved methods and conform to the contract requirements.

3.05 FIELD QUALITY CONTROL

A. The Contractor shall perform field tests in accordance with ASTM D6938 to determine compliance with specified requirements for density and compaction of aggregate base material, and with ASTM D6938 to determine moisture-content compliance of the installed base course.

B. Testing frequency shall be not less than one test for every 2,000 square feet of base course material, per layer or lift.

END OF SECTION 32 11 23

SECTION 32 11 24

AGGREGATE DRAINAGE LAYER

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Aggregate drainage fill.

B. Vapor barrier.

C. Sand cushion.

D. Field quality control.

1.02 RELATED SECTIONS

A. Preparation of sub grade is specified in Contract Specifications Section 31 00 00, Earthwork.

B. Drainage and filter aggregates for subsurface drainage systems are specified in Contract Specifications Section 33 46 00, Sub drainage.

1.03 REFERENCES

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

1.	ASTM C33/ C33M	Standard Specification for Concrete Aggregates
2.	ASTM C131/ C131M	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
3.	ASTM C136/ C136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
4.	ASTM C144	Standard Specification for Aggregate for Masonry Mortar
5.	ASTM C535	Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
6.	ASTM D4253	Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
7.	ASTM D4254	Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
8.	ASTM D6938	Standard Test Methods for In-Phase Density and Water

Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.04 SUBMITTALS

A. General: Refer to Contract Specifications Section 01 33 00, Submittal Procedures, and Contract Specifications Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Samples: Submit a 10-pound cloth bag of clean and graded aggregates proposed for the aggregate drainage fill for approval.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aggregate Drainage Fill:

1. Aggregate drainage fill for capillary break under concrete slabs shall consist of broken stone, crushed or uncrushed gravel, clean quarry waste, or a combination thereof, free from adobe, vegetable matter, loam, volcanic tuff, and other deleterious substances. It shall be of such quality that the absorption of water in a saturated surface dry condition does not exceed three percent of the oven dry weight of the samples.
2. Aggregate drainage fill shall be of such size that the percentage composition by dry weight as determined by laboratory sieves (U.S. Series) will conform to the following grading when measured in accordance with ASTM C136/C136M:

Sieve Size	**Percentage Passing Sieves**
1-1/2 inches	100
1 inch	90-100
No. 4	0-5

3. Percentage wear when tested in accordance with ASTM C131/C131M and ASTM C535 shall be 50 percent maximum.

B. Vapor Barrier Materials: Refer to Contract Specifications Section 07 26 00, Vapor Retarders, for requirements.

C. Sand Cushion: Sand for sand cushion or blanket under slabs and over vapor barrier shall be a clean and graded, washed sand, all passing a No. 4 U.S. Standard Sieve, and conforming generally to ASTM C33/C33M for fine aggregate. Clean masonry aggregate conforming to ASTM C144 is also acceptable.

PART 3 – EXECUTION

3.01 EXAMINATION

A. The Contractor shall call for an inspection by the Engineer and obtain written approval of the prepared sub grade or subbase before proceeding with placing of the aggregate drainage fill.

B. The sub grade or subbase to receive aggregate drainage fill shall conform to the compaction and elevation tolerances indicated for the material involved and shall be free of standing water and loose or extraneous material.

3.02 INSTALLATION

A. Aggregate Drainage Fill:

1. Pipes, drains, conduits, and any other mechanical or electrical installations shall be in place before any aggregate drainage fill is placed. Backfill at walls to elevation of drainage fill shall be in place and compacted.

2. Aggregate drainage fill under concrete slabs shall be the minimum uniform thickness after compaction of dimensions indicated. Where not indicated, minimum thickness after compaction shall be four inches.

3. Aggregate drainage fill shall be compacted with appropriate compaction equipment to form a well-compacted bed. Provide for relative density of 75 percent as determined by ASTM D4253, Dry Method, and ASTM D4254, Method A.

4. Heavy equipment shall not be used within four feet of concrete walls. Instead, aggregate drainage fill shall be compacted with suitable light equipment, such as hand-held mechanical tampers.

5. The Contractor shall have the Engineer inspect and approve the finished aggregate drainage fill before proceeding with any subsequent construction over the compacted fill.

B. Vapor Barrier Installation: Lay vapor-barrier membrane over the compacted aggregate drainage fill.

C. Sand Cushion: A sand cushion shall be placed over the vapor barrier membrane under concrete building slabs on grade. Sand cushion shall be placed in uniform thickness indicated. Where not indicated, thickness shall be two inches.

3.03 FIELD QUALITY CONTROL

A. The Contractor shall perform field tests in accordance with ASTM D6938 to determine compliance with specified requirements for density and compaction of the installed aggregate drainage fill.

END OF SECTION 32 11 24

SECTION 32 12 16

ASPHALT PAVING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Placing of base course.

B. Placing of asphalt concrete.

C. Sealant.

D. Field quality control.

E. Maintenance of pavement.

F. Repair of asphalt pavement.

1.02 RELATED SECTIONS

A. Preparation of sub grade to proper grade for base course, including compaction, is specified in Contract Specifications Section 31 00 00, Earthwork.

B. Preparation of subbase and base, where required, is specified in Contract Specifications Section 32 11 17, Aggregate Subbase Courses, and Contract Specifications Section 32 11 23, Aggregate Base Courses, respectively.

C. Portland cement concrete paving is specified in Contract Specifications Section 32 13 13, Concrete Paving.

D. Painting of stripes and other markings on pavement is specified in Contract Specifications Section 32 17 23, Pavement Marking.

E. Portland cement concrete curbs and gutters are specified in Contract Specifications Section 32 16 21, Concrete Curbs, Gutters, and Walks.

1.03 REGULATORY REQUIREMENTS

A. Asphaltic products and solvents shall be compliant with the latest local codes and regulations governing permissible content of volatile organic compounds (VOC).

1.04 SUBMITTALS

A. General: Refer to Contract Specifications Section 01 33 00, Submittal Procedures, for submittal requirements and procedures.

B. Mix Design: Submit proposed mix design for each asphaltic concrete mixture and seal coat to be used in the work, covering the specific materials to be used in the mixes. Include test data in support of each proposed mix design.

C. Test Reports: Submit test results of sampling and testing, and inspection records within 24 hours of asphaltic concrete placement.

1.05 PROTECTION

A. Protect concrete pavements and walks, curbs and bases, and other improvements adjacent to the operations with suitable materials. The Contractor shall be responsible for any damage caused by the Contractor's employees or equipment and shall make necessary repairs. Buildings and other surfaces shall be covered with paper or other protection, where required. All damage caused by the Contractor's operations shall be repaired or replaced as required.

1.06 PROJECT ENVIRONMENT REQUIREMENTS

A. Work shall comply with construction requirements and not be performed under the following conditions:

1. Over-saturated base and subbase material. Base and subbase to be wheel-rolled by loaded water truck to determine any yielding. If deflection is observed, do not perform paving until grade is stable and unyielding and conforming to compaction requirements.

PART 2 – PRODUCTS

2.01 BASE COURSE MATERIAL

A. Class 3 Aggregate Base mineral aggregate as specified in Contract Specifications Section 32 11 23, Aggregate Base Courses.

2.02 TACK COAT

A. Tack Coat: Diluted SS-1 or SS-1h emulsion.

2.03 ASPHALT PAVING MATERIALS

A. Hot Mix Asphalt: Type A, with the gradation of the combined aggregate conforming to one-half inch maximum size, or three-fourth inch maximum size, as indicated. Unless shown otherwise, top two-inch lift shall be one-half inch maximum size.

B. Asphalt Binder: Performance Grade asphalt binder.

C. Mixing Facilities: Asphalt concrete surfacing material shall be furnished from an approved commercial asphalt central mixing plant.

2.04 BITUMINOUS SEAL

A. Bituminous seal, as indicated, or required.

2.05 MIX DESIGN

A. Design of asphaltic concrete mixes shall be provided by the Contractor and shall be obtained from a qualified independent testing laboratory or agency, properly equipped to design asphaltic concrete mixes. Costs of obtaining mix designs shall be at the Contractor's expense.

B. Design of asphaltic concrete mixes, including aggregate quality and gradation, shall be approved by the Engineer on record.

2.06 SOURCE QUALITY CONTROL

A. The Contractor shall perform sampling and tests of materials in accordance with the following requirements:

1. Aggregate Grading: The combined aggregate, prior to addition of asphalt binder (paving asphalt), shall conform with the contract requirements.

2. Frequency of Tests: Minimum testing frequency shall be one test for every 500 tons, or fraction thereof, for each graded aggregate placed each day.

3. Asphalt Content: Asphalt content shall be within plus or minus 0.50 percent of the mix design content. Minimum testing frequency shall be one test for every 500 tons, or fraction thereof, for each asphaltic paving mix placed each day.

PART 3 – EXECUTION

3.01 PLACING OF BASE COURSE

A. The Contractor shall call for an inspection by the Engineer and obtain written approval of the sub grade before proceeding with the base course.

B. Base course shall be placed over finished sub grade with compacted thickness in accordance with Contract Specifications Section 32 11 23, Aggregate Base Courses.

C. After base course has been completed, the Contractor shall call for an inspection by the Engineer and obtain written approval before proceeding with application of the asphalt-wearing surface.

3.02 PLACING ASPHALT CONCRETE

A. Areas to be paved shall be covered with a layer of hot asphalt concrete surfacing not less than the thickness indicated after compaction. Where not indicated, compacted thickness shall be a minimum of four inches.

B. Paving asphaltic concrete shall be delivered, laid, rolled, and finished.

C. Before placing asphalt concrete on untreated base, a liquid asphalt prime coat shall be applied to the base course in the areas to be surfaced. Prime coat shall be applied at the rate of 0.25

gallons per square yard.

D. Before placing asphalt concrete, a tack coat (paint binder) shall be applied to all vertical surfaces against which asphalt concrete surfacing will be placed. Tack coat (paint binder) shall be applied at the rate of from 0.02 to 0.10 gallons per square yard.

E. Where cold joints are indicated or necessary, cut back the placed and compacted cold asphalt a minimum of three inches with a concrete or masonry power saw, so that a vertical face of compacted full thickness material is exposed. Treat this surface with a tack coat before proceeding with the placement of new asphaltic concrete surfacing.

F. Finish paving shall conform to finish elevations within plus or minus 0.01 of a foot and shall be level to within plus or minus one-fourth inch in ten feet when measured with a 10-foot straightedge in any direction.

G. Joints shall be heated if laid more than 3 hours previously.

H. Initial compaction rolling shall occur when mix cools below 250 degrees Fahrenheit.

I. Provide and roll 1/4-inch lip above adjoining Portland cement concrete surfaces.

3.03 BITUMINOUS SEAL

A. Apply bituminous seal over finished paving surface as indicated or required.

3.04 FIELD QUALITY CONTROL

A. The Contractor shall control the quality of the Work and shall provide adequate testing to assure compliance with these Specifications herein.

B. After completion of paving work, all paving shall be flooded with water, and any resulting “ponds” shall be ringed with chalk. Such hollows shall be corrected with addition of asphalt paving materials and re-rolling until all paving is completely level and free from hollows and high spots.

C. The Contractor shall perform in-place density and compaction tests of the completed pavement in accordance with CTM No. 375 to determine compliance with specified requirements. Relative compaction shall be between 92-96 percent. Test density core for each 250 tons of HMA. Maximum area size shall be 500 tons with a minimum of 3 tests per location, and 1 test for each 50 tons after. Each pavement area shall be an independent lot. Compaction shall be taken as the average for a pavement area. If compaction does not comply, Engineer may accept HMA and take payment deduction as shown in table for reduced payment factors for Caltrans Standard Specifications Section 39-2.01A.

3.05 MAINTENANCE OF PAVEMENT

A. Upon completion of final rolling, traffic shall not be permitted on the finished pavement for at least six hours, and until the asphalt concrete has cooled sufficiently to withstand traffic without being deformed.

B. Finished pavement shall be maintained in finished clean condition until the Work is accepted by the Engineer.

3.06 REPAIR OF ASPHALT PAVEMENT

A. Repair shall be as follows:

1. Sawcut vertical edges of pavement in rectangular shape 1 foot minimum beyond damaged material.

2. Provide base material per Contract Drawings and Contract Specifications Section 32 12 16, Asphalt Paving, herein.
3. Apply tack coat to vertical faces of adjoining asphalt and concrete.

4. Paving lifts shall be a single lift if less than 3.5 inches depth. If four or more inches, place in lifts of 3 inches maximum and minimum of 2 inches for top lift. Paving and compaction shall comply with requirements as described previously. Heat cold joints of adjacent existing pavement if placed over 3 hours prior to place on new asphalt.

END OF SECTION 32 12 16

SECTION 32 16 21

CONCRETE CURBS, GUTTERS, AND WALKS

PART 1 – GENERAL

1.01SECTION INCLUDES

A. Materials and accessories.

B. Preparation of sub grade.

C. Types of construction.

D. Joints.

E. Form removal.

F. Finishing.

G. Curing and protection.

H. Detectable warning surface.

I. Existing curbs and sidewalks.

1.02 RELATED SECTIONS

A. Preparation of sub grade to proper grade for concrete, including compaction, is specified in Contract Specifications Section 31 00 00, Earthwork.

B. Portland cement concrete, concrete reinforcement, and various materials, services, and incidentals pertaining thereto shall conform with Contract Specifications Section 03 20 00, Concrete Reinforcing, and Section 03 30 00, Cast-In-Place Concrete.

1.03 REFERENCES

A. American Concrete Institute (ACI):

1.	ACI 117	Specification for Tolerances for Concrete Construction Materials and Commentary
2.	ACI 301	Specifications for Structural Concrete
3.	ACI 318	Building Code Requirements for Reinforced Concrete and Commentary

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

1.	ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped,

		Zinc-Coated, Welded and Seamless
2.	ASTM A615/ A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
3.	ASTM A663/ A663M	Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
4.	ASTM C260/ C260M	Standard Specification for Air-Entraining Admixtures for Concrete
5.	ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
6.	ASTM C881/ C881M	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
7.	ASTM C979/ C979M	Standard Specification for Pigments for Integrally Colored Concrete

1.04 SUBMITTALS

A. General: Refer to Contract Specifications Section 01 33 00, Submittal Procedures, and Contract Specifications Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Product Data:

1. Submit the respective manufacturer's product data for manufactured products.

2. Submit product data and manufacturer's instructions for concrete color additives.

C. Shop Drawings:

1. Submit drawings that indicate the section profile of curb and gutter, and the locations of joints in concrete, including construction joints, expansion joints, isolation joints, and contraction joints.

2. Submit drawings of extruded curbs and gutters, if proposed, and any modification of the indicated section profile required by the extrusion process.

3. Submit drawings of reinforcing steel, tie bars, and connecting dowels. Comply with requirements specified in Contract Specifications Section 03 20 00, Concrete Reinforcing.

D. Samples:

1. Submit samples of colored concrete for differing locations for approval. Samples shall be 4 inches by 6 inches by 3/4 inch.

2. Approved samples shall be identified for each location.

3. Final colors shall match approved samples identified for each location.

1.05 QUALITY ASSURANCE

A. Tolerances:

1. Construct concrete surfaces within 1/4 inch of the indicated elevation and deviating not more than 1/8 inch from a 10-foot straightedge placed anywhere on the surface.

2. Slab tolerances shall be “straightedge tolerance” as specified in ACI 117.

B. Finishes: Slab finishes shall be as specified herein in accordance with the requirements of ACI 301.

C. Site Mock-Ups: Provide site mock-up, in accordance with Contract Specifications Section 01 43 38, Field Samples and Mockups, at least 3 feet by 4 feet in size, of slab finishes for walks, for the Engineer’s review and approval. Site mock-ups require approval of the Engineer in writing before this work may proceed.

PART 2 – PRODUCTS

2.01 MATERIALS AND ACCESSORIES

A. Concrete Reinforcement: Refer to Contract Specifications Section 03 20 00, Concrete Reinforcing, for requirements.

B. Portland Cement Concrete: Refer to Contract Specifications Section 03 05 15, Portland Cement Concrete, for requirements. Provide Class of Concrete indicated on the Contract Drawings.

C. Benches and Chairs: ACI 318.

D. Tie Bars: ASTM A615/A615M, Grade 60, of type and size indicated.

E. Dowels: Plain round bars meeting requirements of ASTM A615/A615M, Grade 60, or ASTM A663/A663M, Grade 80, epoxy-coated bars, furnished with a cardboard sleeve.

F. Weep Holes: ASTM A53/A53M galvanized pipe of size indicated.

G. Expansion-Joint Filler and Joint Sealing Compound: Refer to Contract Specifications Section 03 15 00, Concrete Accessories, for requirements.

H. Surfacing Material for Nonslip Finish: Refer to Contract Specifications Section 03 35 00, Concrete Finishing, for requirements.

I. Concrete Curing Compound: ASTM C309, Type 1-D, Class A.

J. Detectable warning surfaces: Refer to Contract Specifications Section 32 17 26, Tactile Surfacing, for requirements.

K. Integral Color Concrete Pigment: ASTM C979/C979M.

PART 3 – EXECUTION

3.01 PREPARATION OF SUBGRADE

A. Excavate for and prepare the sub grade as specified in Contract Specifications Section 31 00 00, Earthwork, true to the indicated grade and cross section.

B. Test completed sub grade for correct grade and cross section by means of template supported on side forms.

C. Dampen sub grade and forms just before placing concrete.

3.02 TYPES OF CONSTRUCTION

A. Provide cast-in-place concrete construction, plain or reinforced as indicated. Curbs and gutters shall be formed accurately to indicated section profile with template screed.

B. Extruded curbs and gutter, placed by an extrusion machine, may be provided where site conditions are suitable, and the extrusion process is appropriate for the purpose.

3.03 JOINTS

A. Expansion Joints:

1. Construct 3/8-inch to 1/2-inch thick expansion joints in the following locations:

    a. In curb and combination curb and gutter at the locations of expansion joints in the concrete roadway.

    b. In curb or combination curb and gutter, at points where curved and tangent sections join.

    c. Between curb or combination curb and gutter, and any drain inlet, or similar structure occurring within the limits of the curb or combination curb and gutter.

    d. At corners in sidewalks, following the projections of the building lines from the corner of the building to the curb.

    e. Between sidewalks and any permanent structure.

    f. Between sidewalk and curb.

    g. Through sidewalks at intervals not greater than 60 feet.

    h. In sidewalks, encircling fixtures more than 12 inches in diameter.

2. Construct expansion joints as specified in Contract Specifications Section 32 13 13, Concrete

Paving, except that load transfer devices will not be required unless indicated. Shape preformed filler to cross section of curbs and combination curb and gutter.

B. Contraction Joints: In sidewalks, provide contraction joints as indicated in uniform intervals between 12-20 square feet, with the edges rounded to a 1/4-inch to 3/8-inch radius.

C. Tooling: Finish joints with an edging tool having 1/4-inch to 3/8-inch radius, leaving joints free of mortar and concrete. In preformed type joints, leave joint filler material exposed for full length of joint with clean and true edges.

D. Joint Sealing:

1. Seal to within 1/8 inch of pavement surface joints in curbs and gutters, including gutter surfaces of combination curb and gutter sections; all joints between curbs and vehicular pavement; all joints between gutters and vehicular pavement; and all other expansion joints. Do not seal other joints unless so indicated.

2. Do not seal joints until concrete curing is complete. Prior to installation of the joint sealing compound, clean the joints of dirt and other foreign material. Joints may be cleaned with compressed air jets provided that the air in such jets is free of oil or water. Do not fill joints when there is any free water in or adjacent to the joints. Joint walls and all surfaces to which the sealing material is to adhere shall be surface dry for at least three hours prior to sealing.

3. Apply with approved pressurized equipment. Perform sealing of joints to make them impervious to water and to prevent the sealing compound from spreading over the surface of the pavement.

3.04 FORM REMOVAL

A. Remove front curb forms not less than two nor more than six hours after placing concrete, but in no case while the concrete is still plastic enough to slump.

B. Remove other forms not less than twelve hours after finishing is completed.

3.05 FINISHING

A. Curb and Combination Curb and Gutter:

1. Trowel the face of curb smooth to a depth of not less than 2 inches below the flow line, or to the flow line of integral curb and gutter, and finish with a steel trowel, all immediately after removal of front curb forms.

2. Finish all curb edges with a radius of 1/2-inch.

3. Provide a final fine brush finish to both top and face of curb with brush strokes parallel to the line of the curb, so that both top and front face present the same uniform appearance.

4. Keep the curb face wet during above finishing operations.

5. Allow no coarse aggregate to show on the finished curb surface.

B. Sidewalk, Island Paving, and Ramps:

1. After the concrete has been placed, consolidated, struck off, leveled, grooved and edged as specified herein and in Contract Specifications Section 03 30 00, Cast-In-Place Concrete, and in Contract Specifications Section 03 35 00, Concrete Finishing, do not work the concrete further until ready for floating.

2. Provide “floated finish” or light “broom finish” as indicated in accordance with the requirements of ACI 301.

3. For pedestrian and wheelchair ramps, and all other surfaces where the Contract Drawings require a non-slip finish, provide a “nonslip finish” in combination with a “floated finish” or “broom finish” in accordance with the requirements of ACI 301.

4. Broom finish shall be applied perpendicular to the direction of traffic flow.

C. Joints and Edges: As soon as the condition of the work permits, perform joint work, edging, and marking. Finish all edges with a radius of 1/4 inch to 3/8 inch.

3.06 CURING AND PROTECTION

A. Comply with the applicable requirements of Contract Specifications Section 03 35 00, Concrete Finishing, for curing concrete with liquid membrane-forming curing compound. Do not permit traffic on new concrete pavement until the concrete has cured a minimum period of ten days.

B. Provide damp curing only, in accordance with Contract Specifications Section 03 35 00, Concrete Finishing, for concrete slab surfaces indicated to be treated with concrete hardener and dust proofer.

C. Provide color additive to match surrounding existing pavement, or as indicated on Contract Drawings. Cure and finish according to manufacturer’s recommendations.

3.07 DETECTABLE WARNING SURFACE

A. Provide detectable warning surface as indicated or required.

3.08 EXISTING CURBS AND SIDEWALKS

A. Repair of existing curb, sidewalk, curb ramp, driveway, or gutter, as indicated or required.

END OF SECTION 32 16 21

SECTION 32 17 13

PARKING BUMPERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Parking bumpers.

B. Adhesive.

C. Steel bars for installation.

1.02 SUBMITTALS

A. General: Refer to Contract Specifications Section 01 33 00, Submittal Procedures, and Contract Specifications Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Shop Drawings: Submit Shop Drawings of bumpers, including plan layout and installation details, for approval.

C. Product Data: Submit manufacturers' product data of precast bumpers and epoxy adhesive for approval.

1.03 QUALITY ASSURANCE

A. Precast parking bumpers shall be manufactured for the intended purpose by a company or firm specializing in the manufacture of precast concrete parking appurtenances.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Parking Bumpers:

1. Provide precast concrete parking bumpers of half octagonal configuration and dimensions indicated on Contract Drawing. Unless indicated otherwise, provide bumpers 48 inches length.

2. Bumpers shall be manufactured of Class 4000 reinforced concrete, as specified in Contract Specifications Section 03 05 15, Portland Cement Concrete, to withstand constant use and rough service. Each bumper shall be reinforced with two No. 4 deformed steel reinforcing bars, minimum.

3. Bumper to be installed on at-grade asphalt pavement shall be manufactured with two holes to accommodate the installation rebar. Holes shall be positioned 6 inches in from each

end and shall not exceed the dowel diameter by more than 1/4 inch.

4. Bumpers to be installed on concrete slabs of parking structures, shall be manufactured without holes.

B. Steel Bars for Installation: Epoxy-coated rebar, No. 5 size, conforming with applicable requirements of Contract Specifications Section 03 20 00, Concrete Reinforcing.

PART 3 – EXECUTION

3.01 INSTALLATION

A. For installation on asphalt pavements, precast concrete bumpers shall be anchored and secured in position on at-grade, as indicated, with two No. 5 epoxy-coated rebar and an appropriate epoxy adhesive.

B. For installation on concrete pavements, precast concrete bumpers shall be secured in position on at-grade concrete pavements, as indicated, with an appropriate epoxy adhesive.

END OF SECTION 32 17 13

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Traffic line paint for parking stalls.

B. Application of traffic striping and control markings.

1.02 RELATED SECTIONS

A. Asphalt pavement is specified in Contract Specifications Section 32 12 16, Asphalt Paving.

B. Concrete curbs, gutters, and walks are specified in Contract Specifications Section 32 16 21, Concrete Curbs, Gutters, and Walks.

1.03 SUBMITTALS

A. General: Refer to Contract Specifications Section 01 33 00, Submittal Procedures, and Contract Specifications, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Shop Drawings: Submit drawings and diagrams, indicating stripe width of roadway divider stripes and parking stalls, configuration and dimensions of directional arrows, style and size of letters for “compact car” designation, configuration and dimensions of international handicapped symbol, and any other traffic control markings on pavement, such as “in” and “out” or “enter” and “exit” designations as indicated.

C. Certificate of Compliance: Submit evidence or affidavit that certifies that paint to be used complies with latest VOC regulations.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Traffic Paint Material: Provide traffic paint waterborne traffic paint material.

B. Stall Numbers: Numbers shall be yellow, 12 inches high, Helvetica Light font.

PART 3 – EXECUTION

3.01 APPLICATION

A. Surface receiving application of paint shall be prepared.

B. Apply no paint material until pavement has cured for at least three days or for the number of days as recommended by the manufacturer, whichever is longer. Ensure that pavement has cured sufficiently to carry application equipment without damage.

C. Provide traffic striping and control markings on pavement, parking stalls, and curbs in accordance with the layout, configurations, and dimensions indicated by Contract Drawings, and approved Shop Drawings.

D. Application equipment and procedures shall conform to the manufacturer's instruction and recommendation.

E. Parking stalls shall be applied with the use of substantial cutout patterns and templates, or with striping equipment that applies straight, uniform width, sharp lines without fuzziness at the edges. Coverage shall be thorough and complete in accordance with the manufacturer's instructions and recommendations.

1. Provide three coats for painted striping. Application rate per coat shall be based on Manufacturer's recommendation.

F. Accessible parking stalls shall include the International Symbol for Accessibility.

G. At completion, the Contractor shall check the work thoroughly and shall touchup traffic control markings and parking stalls that are not distinct or thorough in coverage or are not uniform in color.

3.02 TOLERANCES AND APPEARANCE

A. In addition to the tolerances and appearance, edges shall be uniform with local variations not exceeding an eighth of an inch per foot and surfaces shall be smooth and uniform.

B. Letter sizes and patterns shall be as indicated on the Contract Drawings with variations of not more than plus or minus 15 percent in dimension.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Fencing and gate materials.

B. Concrete.

C. Fence and gate installation.

1.02 FENCE CLASSIFICATIONS AND STANDARDS

A. Type of fence, dimensions, components, gates, and accessories are indicated in accordance with the Civil Standard Drawings and/or the Contract Drawings.

B. Fence Types: Chain link fencing shall be of the types indicated as follows unless otherwise specified in the Contract Documents:

1.	Type CL	Zinc-coated steel fence fabric with galvanized steel posts, rails, caps, hardware, and fittings.
2.	Type VCL	Polyvinyl chloride (PVC) coated steel fence fabric with vinyl-coated and factory-painted steel posts, rails, caps, hardware, and fittings in selected color.

1.03 REFERENCES

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

1.	ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2.	ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
3.	ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4.	ASTM A153/A153M	Standard Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
5.	ASTM A392	Standard Specification for Zinc-Coated Steel Chain Link Fence Fabric
6.	ASTM A491	Standard Specification for Aluminum-Coated Steel Chain Link Fence Fabric

7. ASTM A824	Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence
8. ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
9. ASTM F567	Standard Practice for Installation of Chain Link Fence
10. ASTM F626	Standard Specification for Fence Fittings
11. ASTM F668	Standard Specification for Polyvinyl Chloride (PVC), Polyoefin and other Polymer Coated Steel Chain Link Fence Fabric
12. ASTM F900	Standard Specification for Industrial and Commercial Swing Gates
13. ASTM F934	Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Material
14. ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
15. ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
16. ASTM A1011/A1011M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength
17. ASTM F1184	Standard Specification for Industrial and Commercial Horizontal Slide Gates
18. ASTM F3000/F3000M	Standard Specification for Polymer Privacy Insert Slats for Chain Link Fabric and Privacy Chain Link Fabric Manufactured Containing Pre-Installed Privacy Slats

B. Chain Link Fence Manufacturers Institute (CLFMI): CLFMI Publication, “Standards for Chain Link Fence Installation”

C. Federal Specifications:

1. RR-F-191/2E	Fencing, Wire and Post, Metal (Chain Link Fence Gates) (Detail Specification)
2. RR-F-191/4F	Fencing, Wire and Post, Metal (Chain Link Fence Accessories)

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Product Data: Submit manufacturer’s product data and specifications of the specified chain link fencing and gates.

C. Shop Drawings: Submit detailed Shop Drawings of the fences and gates layout, including installation details of the fencing, posts, gates, hardware, and accessories for review.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Requirements: Fencing shall include fabric covering, framework, barbed wire, when specified in the Contract Documents and supporting arms, concrete footings, gates, hardware, and all appurtenances and accessories as required for a complete installation. Heights of fences shall be as indicated in Contract Documents.

B. Fence Fabric:

1. Type CL Fence Fabric: Zinc-coated steel fabric conforming to ASTM A392 with Class 2 coating. Mesh size one-inch square fabricated No. 9 gauge wire unless otherwise specified in the Contract Documents.

    a. The Contractor may furnish aluminum-coated steel fence fabric conforming to ASTM A491, with one-inch square mesh size fabricated No. 9 gauge wire unless otherwise specified in the Contract Documents.

2. Type VCL Fence Fabric: Type CL fence fabric, PVC-coated in accordance with ASTM F668. Class 1, Class 2a, and Class 2b wire and fabric types are acceptable. Mesh size one-inch square fabricated No. 9 gauge wire unless otherwise specified in the Contract Documents. Color shall be as selected by the Engineer from manufacturer's standards, as specified in ASTM F934.

3. Selvages: Twisted and barbed at top and bottom selvages when barbed wire is used; knuckled at both selvages when barbed wire is not used; unless otherwise indicated.

C. Pipe Framework for Type CL Fencing and Gates: Posts, braces and rails shall be standard weight galvanized steel pipe conforming to ASTM F1083. Posts shall include galvanized bolted fittings to properly secure rails and braces to posts.

D. Pipe Framework for Type VCL Fencing: Post and rails shall be vinyl-clad steel with color-coated EMV (epoxy modified polyvinyl chloride) chemically bonded to heated standard weight ASTM F1083 galvanized steel pipe, as specified, by electrostatically applied powder coating process. Protective vinyl coating thickness shall be 10 to 14 mils, according to pipe diameter. Pipe vinyl coating shall have the following properties: specific gravity of 1.32 to 1.37; tensile strength of 2,000 pounds per square inch; minimum elongation of 180 percent; tear strength at 15 mils -0.36 pounds per mil; hardness of coating of 87 to 92 Shore A Durometer. Color shall match fence fabric color. Sizes and weights shall be as specified for Type CL fence or alternate high-strength pipe framework.

E. Tension Wire: Tension wire for top and bottom edge support of fence fabric shall be No. 7 gauge marcelled wire, conforming to ASTM A824, Type II Zinc-Coated Class 5-2.0 oz/sf with minimum tensile strength of 80,000 pounds per square inch. For type VCL fencing, provide tension wire coated with PVC, matching fence fabric in color.

F. Post Caps and Fittings: Manufacturer's standard, pressed steel or malleable iron post caps, fittings, and accessories, meeting requirements of ASTM F626 and Federal Specification RR-F-191/4F, galvanized for Type CL and RP fencing, and PVC coating by the thermal-fusion-bond process, in color matching posts, for Type VCL fencing. Post caps shall be designed to fit securely over the posts to exclude water and to carry the top pipe rail and extension arms, where indicated. All other required fittings and hardware shall be provided to fasten to the pipe posts or concrete in the manner indicated.

G. Truss Rod Assembly: In compliance with ASTM F626, 3/8-inch diameter steel truss rod with a pressed steel tightener or self-tightening turnbuckle, minimum zinc coating of 1.2 ounce per square foot, assembly capable of withstanding a tension of 2,000 pounds. Truss tightener must have a strap thickness of at least 1/4 inch.

H. Tension Bars: In compliance with ASTM F626. Galvanized steel one-piece length 2 inch less that the fabric height. Minimum zinc coating 1.2 ounce per square foot.

1. Bars for mesh size 2-inch square shall have a minimum cross section of 3/16 inch by 3/4 inch.

2. Bars for mesh size 1-inch square shall have a cross section of 3/16 inch by 3/8 inch.

I. Tension and Brace Bands: Galvanized pressed steel complying with ASTM F626 with a minimum steel thickness of 12 gauge (0.105 inch), minimum width of 3/4 inch, and minimum zinc coating of 1.20 ounce per square foot. Tension bands shall be spaced not greater than 12 inches on center.

J. Accessories: Provide miscellaneous materials and accessories, clips, tie wires (9 gauge), anchors, eye bolts, hog rings, and fasteners as required for a complete installation. All items shall be galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M as applicable. Accessories for Type VCL fencing shall be vinyl-coated or painted to match color of fence fabric.

K. Barbed Wire Extension Arms; if required: Pressed steel conforming to ASTM A653/A653M, hot-dip galvanized after fabrication, minimum zinc coating of 1.2 ounce per square foot, capable of supporting a vertical 250 lb. load, complete with provision for anchorage to end, corner, and pull posts and for attaching three rows of barbed wire to each arm. Arms shall be 45-degree angle or vertical as indicated, for three strands of barbed wire. Arms shall be integral with post top weather cap. Intermediate arms shall have hole for passage of top tension wire. Arms shall be capable of withstanding 250 pounds downward pull at outermost end of arm without failure. Arms for Type VCL fencing shall be vinyl-coated or painted to match color of fence fabric.

L. Barbed Wire; if required: Three-strand, zinc-coated, 12-1/2-gauge steel wire with 14 gauge, four-point steel barbs spaced 5 inches apart, conforming to ASTM A121. Zinc coating shall be Class 3, 0.80 ounce per square foot for 12-1/2-gauge wire and 0.65 ounce per square foot for 14-gauge wire.

M. Gates: Gates shall be swinging type or sliding type as indicated, furnished complete with all hardware and accessories as required for a complete installation.

1. Gate Frames: Frames shall be fabricated from zinc-coated steel pipe members (to match posts in Type CL and RP fencing). Sizes shall be as indicated.

2. Fabrication: Conform to applicable requirements of ASTM F900, Federal Specification RR-F-191/2E, and the following:

    a. Assemble gate frames by welding or with fittings and rivets for rigid connections. Use same fabric as for fence. Install fabric with stretcher bars at vertical edges, and tie wires at top and bottom edges. Attach stretcher bars to gate frame at not more than 15 inches on center. Attach hardware with rivets or by other means that will provide security against removal or breakage.
    b. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware, and accessories.

    c. Provide diagonal cross bracing consisting of minimum 3/8-inch diameter adjustable length truss rods on gates where necessary to provide frame rigidity without sag or twist.

    d. For Type VCL fencing, gate components shall be PVC-coated or painted in color matching fence fabric.

    e. For pre-engineered gates, stamped and signed calculations shall be provided by the manufacturer to verify gate design is adequate.

3. Gate Hardware:

    a. Swinging Gates:

        1) Provide gate hinges, latch, stop, and keeper for each gate leaf, conforming to applicable requirements of ASTM F900 and Federal Specification RR-F-191/2E. Provide latch with provision for locking gate with padlock. If locking provisions required, include chain, chain shall be hardened steel chain, bolt cutter resistant, tested to at least 9 tonnes of cutting force unless otherwise specified in Contract Drawings.

        2) Gate hinges shall be of adequate strength for the gate and shall have large bearing surfaces for clamping or bolting in position. Hinge action shall be such that gates may be easily opened and closed by one person. Hinges shall provide for full 180-degree swing of gate leaf. Hinges shall be tack welded to post and gate after adjustment.

    b. Sliding Gates:

        1) Provide manufacturer's standard rubber-tired rollers and roller track for floor-supported sliding gates, conforming to applicable requirements of ASTM F1184. Include intermediate rollers or casters where required to prevent gate sag or deflection.

        2) Provide locking device and padlock eyes as part of latch for locking gate with padlock.

        3) Bottom of gate shall be guarded by a skirt around wheels and cantilever supports to maintain maximum allowable clearance under gate and around gate sides.

c. Padlocks to be furnished by the District.

O. Pipe Sleeves: Pipe sleeves for fence post embedment in concrete curbs, barriers, and walls shall be fabricated from steel pipe conforming to ASTM A53/A53M and galvanized in accordance with ASTM A123/A123M, sized to receive and support fence posts.

2.02 CONCRETE

A. Provide concrete footings for fence posts under this Section. Concrete for posts shall have a minimum compressive strength at 28 days of 3,000 pounds per square inch, using one-inch maximum size aggregate and five sacks of cement minimum per cubic yard, with a maximum slump of four inches. Concrete and grout materials, placing, and curing shall conform to the applicable requirements of Section 03 30 00, Cast-In-Place Concrete, respectively.

PART 3 – EXECUTION

3.01 PREPARATION

A. Installation of fencing shall not be started until final grading has been completed.

B. Locate fencing correctly as indicated.

C. Where posts are indicated or required to be embedded or set in concrete curbs, traffic barriers, or retaining walls, coordinate the installation of fencing closely with the installation of concrete as specified under Division 3 Concrete.

D. Furnish galvanized steel pipe sleeves for fence posts, as applicable, for installation in formwork at time required. Supervise installation of sleeves during formwork and placing of concrete to maintain exact dimensions according to template.

3.02 INSTALLATION

A. Install fencing and gates as indicated, in accordance with approved Shop Drawings, and applicable requirements of ASTM F567 and CLFMI Standards for Chain Link Fence Installation. Site fabricate as required to complete the fence installation.

B. Posts shall be plumb and rigid after installation. Gap between post and adjacent infrastructure shall be less than 2 inches. Rails shall be straight and tight. Chain link fabric shall be smooth and uniformly stretched tight and straight. Tension wires and barbed wires shall be pulled taut. Fabric shall be secured to the line post with tie wires spaced no greater than 12 inches on center and to rail spaced no greater than 18 inches on center. Turn ends of tie wire two-360-degree wraps around fabric. Tip to tie wire shall face away from public. Secure fabric to the tension wire with hog rings spaced no greater than 18 inches apart. Slats in Type RP fence shall be straight and plumb.

C. Drill holes for post footings in firm, undisturbed or compacted soil. Footing holes shall be not less than required dimensions of post footings per approved design. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.

D. Where posts are indicated or required to be embedded or set in concrete curbs, traffic barriers, or retaining walls, grout or seal posts in sleeves as indicated.

E. Gates shall be installed plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricate. Sliding gates shall operate smoothly and easily under minimum pressure.

F. Welds shall be protected by applying zinc rich paint in accordance with ASTM practice A780.

3.03 CONCRETE

A. Handling and placing of concrete shall conform to the applicable requirements of Section 03 30 00, Cast-In-Place Concrete.

B. Place concrete around posts in a continuous pour. Check each post for plumb and vertical and top alignment and hold in position during placement and finishing operations.

C. Trowel finish tops of footings, and slope or dome to direct water away from posts. Set keepers, stops, sleeves, tracks, eye bolts, and other accessories into concrete as required. Wheel rolling area for sliding gates shall be steel-trowel smooth finish concrete.

END OF SECTION 32 31 13

SECTION 33 46 00

SUBDRAINAGE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Drainage Material

1.02 RELATED SECTIONS

A. Structure excavation and backfill are specified in Section 31 00 00, Earthwork.

1.03 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Shop Drawings: Submit detailed drawings that indicate subsurface drainage in plan and section, including relationship to other systems, interfaces, connections, alignment, grade, bedding, drainage and filter aggregates, and other pertinent data.

C. Product Data: Submit manufacturers' product data for filter fabric (geotextiles).

PART 2 – PRODUCTS

2.01 DRAINAGE MATERIALS

A. Drainage and Filter Aggregates: Aggregate drainage and filter material (permeable material) for filling trenches under, around, and over underdrains, and for pervious blankets shall consist of clean, coarse sand and gravel or crushed stone 2"Ømin. Washed drain rocks, conforming to the contract requirements.

B. Filter Fabric: Geotextile engineering fabric conforming to the Caltrans Standard Specifications, Section 96 Geosynthetics, for Filter Fabric for Underdrains.

PART 3 – EXECUTION

3.01 INFILTRATION TRENCH

A. Excavate trenches as indicated. Coordinate with Section 31 00 00, Earthwork, as applicable.

B. Compacted sub grade where indicated.

C. Fill excavations for underdrains with drainage or filter aggregates as indicated. Place drainage aggregate and compact as required to fill voids and prevent settlement. Envelope the composite underdrain with filter fabric as indicated.

D. The Contractor shall have the Engineer inspect and approved the finished aggregates

END OF SECTION 33 46 00