



Specifications and  
Contract Documents for

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**2017  
ASPHALT REPLACEMENT**

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July 2017



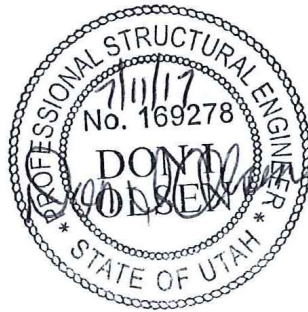
CONTRACT DOCUMENTS  
AND SPECIFICATIONS FOR

## 2017 Asphalt Replacement

July 2017

SOUTH VALLEY WATER RECLAMATION FACILITY

Principal



Signed  
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SOUTH VALLEY WATER RECLAMATION FACILITY

2017 Asphalt Replacement

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## DIVISION 2

### SITWORK

#### 020000 GENERAL

The provisions herein shall apply to all demolition, clearing, grading, excavation, filling, and backfilling, and the construction of all utility lines, fences, roadways, and other construction outside the lines of structures and existing facilities.

Existing improvements, adjacent property, utilities, and other facilities shall be protected from injury or damage resulting from the Contractor's operations.

#### 020001 PROTECTION OF EXISTING FLORA

All trees and shrubs found suitable for improvement and beautification, which will not interfere with excavation or embankment or cause disintegration of the improvements shall not be disturbed. The Contractor shall not damage, disturb, or cause injury to shrubbery, vines, plants, grasses, and other vegetation growing outside of the clearing limits. The dragging and the piling of materials of various kinds and the performing of other work which may be injurious to vegetation shall be confined to areas which have no vegetation or which will be covered by embankment or disturbed by excavation during grading operations.

#### 020002 COMPACTION CONTROL AND TESTING

Maximum density, as used in these Specifications, shall be defined as the maximum density obtained in the laboratory by ASTM D 1557. In-place density of compacted backfill will be determined in accordance with ASTM D 1556, or by nuclear density test procedures in accordance with ASTM D 2922 and ASTM D 3017.

It shall be the responsibility of the Contractor to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of the Contractor to coordinate control of his operations, through confirmation tests provided by the Owner, to verify and confirm that he has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

The frequency of confirmation tests shall be not less than as follows and each test location for trenches shall include tests for each layer, type, or class of backfill from bedding to finish grade.

#### A. Trenches:

- |   |                                  |
|---|----------------------------------|
| 1. Open fields  | 2 every 1,000 linear feet        |
| 2. Along dirt or gravel roads<br>or off traveled right-of-way | 2 every 500 linear feet          |
| 3. Crossing paved roads                                       | 2 locations along each crossing  |
| 4. Under pavement cuts or within<br>2 feet of pavement edges  | 1 location every 400 linear feet |

- B. Structural backfill 1 every 20 cubic yards

- C. Embankment or fill 1 every 200 cubic yards
- D. Base material 1 every 50 cubic yards

Confirmation tests shall be performed by the Owner.

Copies of the test reports shall be submitted promptly to the Engineer. The confirmation tests shall be performed by a soils testing laboratory acceptable to the Engineer.

The Contractor shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:

- A. 200 linear feet of trench backfill.
- B. 10 cubic yards of structural backfill.
- C. 100 cubic yards of embankment work.
- D. 50 cubic yards of base material.

Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.

After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified amounts.

Periodic compliance tests will be made by the Engineer to verify that compaction is meeting the requirements previously specified at no cost to the Contractor. For tests in backfill that has been water settled, the Contractor shall remove the overburden above the level at which the Engineer wishes to test and shall backfill and recompact the excavation after the test is complete.

If compaction fails to meet the specified requirements, the Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to the Engineer. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by the Contractor. The Contractor's confirmation tests shall be performed in a manner acceptable to the Engineer. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.

#### 020003 SOILS REPORT (Geotechnical Study)

No soils report has been generated for the project site. The Contractor is at the sole risk of such bidders or the Contractor who have the responsibility to satisfy themselves independently regarding the character and amount of rock, gravel, sand, silt, organic materials, groundwater, and all other material to be encountered in the work to be performed.

Bidders or Contractor shall make whatever investigations as are necessary in order to determine to their or his satisfaction the conditions that exist.

## 020200 CLEARING AND GRUBBING

Areas where construction is to be performed and other areas as indicated on the Plans or specified shall be cleared of all fences, lumber, walls, stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or form obstructions therein. Organic material from clearing and grubbing operations shall not be incorporated in fills and backfills.

Clearing and grubbing shall be performed in advance of grading operations.

Pits, fill, and other earthwork required for the erection of Contractor's construction facilities shall be filled or removed, as the case may be, upon the completion of the work and leveled to meet the existing contours of the adjacent ground.

## 020201 STRIPPING

Soil material containing sod, grass, or other vegetation shall be removed to a depth of 6 inches from all areas to receive fill or pavement and all areas to temporarily store excavated material. Topsoil shall be removed from all trenching areas and also the areas where the excavated material and backfill material will be stored or stockpiled. The stripped material shall be deposited in such locations as are acceptable to the Engineer or, if acceptable, the material may be used in the top 6 inches of areas to be used for future planting. Top soil shall be replaced as indicated on the Plans.

The Contractor must be aware that no mixing or contamination of the topsoil will be tolerated. Subsurface material must be kept separate from the topsoil. After replacement of the topsoil there must be no evidence of subsurface material or backfill material.

## 020300 EARTHWORK

The work covered by this Section of the Specifications consists in furnishing all labor, equipment, supplies, and materials and in performing all operations in connection with the following: loosening, excavating, filling, grading, borrow, hauling, subgrade preparation, compacting in final location, wet and dry, and all operations pertaining thereto for site grading for buildings, basins, reservoirs, boxes, pipelines, roads, and other structures of whatever nature and other purposes; furnishing, placing, and removing of all sheeting and bracing; pumping and draining of excavation; the supporting of structures above and below ground; the handling of all water encountered in the excavations; the backfilling, compacted and loose, around structures and backfilling of all trenches and pits; and all other incidental earthwork as indicated on the Plans, as specified and as required to complete the work ready for final use.

Where mud or other soft or unstable material is encountered, it shall be removed and the space refilled with good clean earth or gravel which can be compacted with no perceptible movement under the roller.

### 020300.10 EARTHWORK WITHIN ROADWAYS

Earthwork within the rights-of-way of the State Division of Highways, the County Road Department, and the respective cities shall be done in accordance with requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these Specifications.

#### 020301 WORK SEQUENCE

The Contractor shall schedule the earthwork operations to meet the requirements as provided in these Specifications for excavation and uses of excavated material. If necessary, the Contractor shall stockpile excavated material in order to use it in the specified locations.

#### 020302 CHARACTER AND AMOUNT OF MATERIAL

The Contractor shall satisfy himself regarding the character and amount of rock, gravel, sand, silt, water, and other inorganic or organic material as well as gradation and shrinkage of excavation and fill material, and the suitability of the material for the use intended, and all other material to be encountered in the work to be performed. The quantity of material, and the cost thereof, required for the construction of all excavation and fill, whether from site excavation, borrow or imported material; and/or the wasting of excess material, if required, shall be included in the Contractor's quoted price for construction of the work to be performed under this project.

#### 020303 PROTECTION OF EXISTING STRUCTURES

The Contractor, especially in blasting or in the use of heavy equipment, shall protect existing power lines, roofs, buildings, other structures, and utilities.

#### 020304 FINISH GRADE OF EXCAVATION, BACKFILL, AND FILL

Fine grading under the concrete structures shall be such that the finished surfaces are never above the established grade or approved cross section and are never more than 0.10 feet below. All areas which are not under concrete shall be graded uniformly. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade grader operations, except as otherwise specified. All gutters and ditches shall be finished so as to drain readily. The finished surface areas outside of structures shall be not more than 0.10 feet above or below the established grade or accepted cross section.

The finished graded surfaces of all areas which will not be under structures, concrete, asphalt, roads, pavements, walks, dikes, etc. shall either consist of undisturbed natural soil, or not less than the top 6 inches shall be cohesive materials. The intent of the preceding is to avoid sandy or gravelly areas.

Newly graded areas shall be protected from the action of the elements, and any settlement or washing that may occur from that or any other cause prior to acceptance of the Work shall be repaired and grades reestablished to the required elevations and slopes.

#### 020305 REMOVAL OF WATER

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work, whether the water be surface water or underground water. No concrete or masonry footings, foundations, or floors shall be laid in water, nor shall water be allowed to rise over them until the concrete or mortar has set at least 24 hours. Water shall not be allowed to rise unequally against walls for a period of 14 days following concrete placement.

The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. The Contractor shall be responsible for obtaining all water discharge permits that are required. No water shall be drained into work built or under construction.

Water shall be disposed of in such a manner as not to be a menace to the public health.

Written permission shall be secured from the Engineer before locating any wells, well points, or drain lines for purposes of dewatering within the limits of a structure foundation. The Engineer shall have the right to require that any dewatering well, line, or French drain left in place within the structure foundation limits be filled with Class C concrete or grout as herein specified.

#### 020320 EXCAVATION

Excavation shall comprise and include the satisfactory loosening, removing, loading, transporting, depositing, and compacting in the final location all materials, wet and dry, necessary to be removed for purposes of construction, or as required for ditches, grading, roads, and such other purposes as are indicated on the Plans; the furnishing, placing, and removing of all sheeting and bracing; all pumping, draining, and handling of water encountered in the excavations; the supporting of structures above and below ground. All excavated materials which are not required for fill and backfill, or which are unsuitable for fill or backfill, shall be disposed of by the Contractor, at his expense and responsibility, and in a manner acceptable to the Engineer.

No surplus material shall be dumped on private property unless written permission is furnished by the owner of the property.

During construction, excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Material required for fills in excess of that produced by excavation shall be obtained from borrow areas as specified herein.

Topsoil, and suitable excavated material required for fill under slabs, shall be separately stockpiled as directed by the Engineer.

Rocks, broken concrete, or other solid materials, which are larger than 4 inches in greatest dimension shall not be placed in fill areas and shall be removed from the site by the Contractor at no additional cost to the Owner.

#### 020322 EXCAVATION SUPPORT

- A. General: Contractor shall support the faces of excavations and shall protect structures and improvements in the vicinity of excavations from damage due to settlement of soils and alternations in the ground water level caused to such excavations and related operations.
  - 1. The provisions specified hereunder shall be understood:
    - a. To complement, and not to substitute or diminish, the obligations of Contractor for the furnishing of a safe place of work pursuant to the provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for the protection of the Work, structures, and other improvements.
    - b. To represent a minimum requirement:
      - 1) For the number and types of means needed to maintain soil stability.



- 2) For the strength of such required means, and
    - 3) For the methods and frequency of maintenance and observation of the means used for maintaining soil stability.
  2. Excavation support shall include sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain the stability of soils.
- B. Contractor shall provide excavation support in trenches for the protection of workers from the hazard of caving ground.
- C. Excavation supports shall be provided:
  1. Where, as a result of excavation work and an analysis performed pursuant to general engineering design practice, as defined hereinafter:
    - a. The excavated face or surrounding soil mass may be subject to slides, caving, or other type of failure, or
    - b. The stability and integrity of structures and other improvements may be compromised by settlement or shifting of soils.
  2. For trenches 5 feet and deeper.
  3. Where indicated on the Drawings.
- D. References:
  1. American Institute of Steel Construction, Inc., Manual of Steel Construction, herein referenced as the Steel Manual.
  2. International Conference of Building Officials, Uniform Building Code, herein referenced as the UBC.
- E. Definitions: As used under this title of Excavation Support, general engineering design practice shall be understood to mean the general engineering design practice in the area of the Project performed in accordance with recent literature on the subject of excavation support.
  1. Where general engineering design practice is specified it shall be understood that the design shall be performed, and the drawings and calculations shall be signed, by a civil or structural engineer registered in the State where the Project is located.
    - a. The design calculations shall disclose clearly the assumptions made, the criteria followed, and the stress values used for the various materials.
    - b. Where requested by Engineer, Contractor shall furnish acceptable references substantiating the appropriateness of the design assumptions, criteria, and stress values.
- F. Submittals:
  1. For trench excavation, Contractor shall submit, in advance of excavation of trenches 5 feet or more in depth, detailed plans showing the design of excavation support for worker protection.

- a. The design shall be performed pursuant to general engineering design practice, as defined hereinbefore.
2. For excavations other than trenches, Contractor shall submit:
  - a. An analysis performed pursuant to general engineering design practice, as specified hereinbefore, identifying the conditions under which excavation support will be required. This analysis shall be submitted in advance of and shall cover:
    - 1) Excavations 2 feet or more in depth adjacent to structures, and
    - 2) Excavations 5 feet or more in depth at other locations.
  - b. For excavations that will require excavation support, in accordance with the determination made under the preceding subparagraph a., Contractor shall submit excavation support design and details pursuant to general engineering design practice, as specified hereinbefore.
    - 1) The same procedure shall be followed for subsequent changes to the excavation support design.
3. Pursuant to provisions specified hereinafter, Contractor shall submit the location and details of control points and method and schedule of measurements.
4. Promptly upon performance of the measurements of control points specified hereinafter, Contractor shall submit a copy of the field notes with such measurements.

G. Design Criteria:

1. Excavation support shall be designed in accordance with general engineering design practice.
2. Steel members shall be designed in accordance with the Steel Manual.
3. Design involving materials other than steel shall be in accordance with the UBC.
4. Excavation support shall be designed in accordance with soil characteristics and design recommendations contained in a written report issued and signed by a civil or soil engineer registered in the state where the Project is located.
  - a. A copy of the written report shall be available at the site of the Project for Engineer's review.
  - b. The civil or soil engineer shall be retained by Contractor.
5. Where Contractor elects to design excavation support allowing materials to bear stresses higher than those prescribed in the referenced publications, the increase in such stresses shall not exceed 10 percent of the value of the prescribed stresses.
6. Where shoring is indicated on the Drawings, no other types of excavation support shall be used.

H. Performance Requirements: Appropriate design and procedures for construction and maintenance shall be used to minimize settlement of the supported ground to prevent damage to existing structures and other improvements. Such design and procedures shall include:

1. Using stiff support systems.

2. Following an appropriate construction sequence.
3. Preventing soil loss through or under the support system.
  - a. The support system shall be tight enough to prevent loss of soil and shall be extended deep enough to prevent heave or flow of soils from the supported soil mass into the excavation.
4. Providing surface runoff routing and discharge away from the excavations.
5. Recharging groundwater, where necessary.
  - a. Where dewatering is necessary, Contractor shall recharge the groundwater as necessary to prevent settlement in the area surrounding the excavation.
6. Not anchoring the support system to structures and other improvements.
7. Not applying support system loads to structures and other improvements.
8. Not changing existing soil loading on structures and other improvements.

I. Installation:

1. Excavation support shall be installed as indicated in the approved submittals.
2. Excavation, including trenching, shall not begin until the excavation support submittals have been approved by the Engineer and until the materials necessary for the installation are on site.

J. Maintenance:

1. Where loss of soil occurs, Contractor shall plug the gap in the support system and shall replace the lost soil with suitable fill material.
2. Where measurements and observations indicate the possibility of failure of the excavation support, determined in accordance with general engineering design practice, Contractor shall take appropriate action immediately.
3. Control Points:
  - a. Contractor shall establish control points on the support system and on structures and other improvements in the vicinity of the excavation for measurement of horizontal and vertical movement.
    - 1) Control points in the support system shall be set at distances not exceeding 25 feet at each support level. Support levels shall be the levels of tie-backs, walers, bottom of excavation, and other types of supports.
    - 2) Control points shall be set in corners of structures and on curbs, manholes, and other locations indicated on the Plans.

020327 DITCHES AND GUTTERS

Ditches and gutters shall be cut accurately to the cross sections and grades indicated on the Plans. Care shall be taken not to excavate ditches and gutters below the grades indicated. Any excessive ditch and gutter excavation shall be backfilled to grade either with suitable, thoroughly compacted material or with suitable stone or cobble to form an adequate gutter paving as directed. The Contractor shall maintain all ditches and gutters excavated under this Contract free from detrimental quantities of debris until final acceptance of the Work. No material shall be deposited within 3 feet of the edge of a ditch unless otherwise indicated on the Plans.

020330 COMPACTED FILLS

Fills, embankments, or backfills (except trench backfills specified elsewhere), herein designated as fills, shall be constructed at the locations and to the lines and grades indicated on the Plans. The completed fill shall correspond to the shape of the typical sections on the Plans or shall meet the requirements for the particular case. Material for fills shall be obtained from cut sections or borrow from a source as selected by the Contractor and accepted by the Engineer. Maximum particle size shall not exceed 3 inches. The fill material shall be free of leaves, grass, roots, stumps, and other vegetable matter. Unless otherwise indicated on the Plans, the areas to receive fill material shall be scarified to a minimum depth of 6 inches and recompact to the density of the fill material density specified in the following.

Unless otherwise indicated, fills and backfills and the upper 6 inches in cuts shall be compacted to the percentage of maximum density specified in the following tabulation:

<u>Location</u>	<u>Percent</u>
Backfill adjacent to structures	95
Under structures (present and future)	95
Under roadways, parking, storage areas, curbs, and sidewalks	90
Other areas	85

All compacted fills shall be placed in successive layers of loose material not exceeding 6 inches in depth after compaction. Each layer shall be brought to optimum moisture content for maximum density before compaction by rolling. If any material is placed that does not have the correct moisture content, it shall be removed and replaced. Soft, spongy, or springy material causing areas that "pump" when heavy loads pass over them shall be removed and replaced with suitable material. Dry material that will not "ball" shall be removed and replaced. These two conditions shall be considered as sufficient evidence without further testing that the moisture content is not correct and the material shall be removed.

Each layer shall be spread uniformly by the use of a road machine or other accepted device and rolled with an acceptable tamping roller, heavy pneumatic roller, or 3-wheeled power roller until thoroughly compacted to not less than the specified density.

Fill that is to be compacted and is inaccessible to rollers shall be compacted with pneumatic, vibrating, or other tamping equipment.

It shall be the responsibility of the Contractor to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of the Contractor to control his operations by confirmation tests to verify and confirm that he has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make use of the compaction afforded thereby as an addition to compaction by the use of rollers.

Where fill will not be under or adjacent to a wall or slab, under a paved area, under or in an area of compacted fill or embankment, or is not otherwise specified to have compaction to 95 percent of maximum density, the Contractor may backfill the first 2 feet above the bottom of the excavation by the method described above and proceed to the top of the fill in not less than three lifts placed as follows:

- A. Each lift shall be consolidated by first filling to the lift height with water and subsequently depositing sufficient granular material as defined herein under SELECT MATERIAL to absorb the water deposited to such extent that water is still evident on the entire surface before proceeding with the next lift.
- B. The filling of the soil to absorb the water shall be done gradually, to insure that the soil is uniformly wetted and to preclude the possibility of a large amount of soil displacing the water to the top.
- C. The Engineer reserves the right to require that the filling be done by hand, if use of mechanical equipment results in incomplete wetting of the material and improper compaction.
- D. Each lift shall be leveled by poling or tamping prior to the application of water for the following lift. Each lift shall be examined to determine if all the earth is saturated.

020331 BACKFILL AND BASE MATERIALS

Sand, untreated base course (UBC) material, gravel fill, drain rock, select material, and native material, where required for fill, backfill, bedding, and/or backfill around pipe and trench backfill shall conform to the following specifications.

020331.10 SAND

The sand used for bedding under and around the pipe shall be clean, coarse, natural sand which shall be nonplastic when tested in accordance with ASTM D 431B and 100 percent shall pass a 1/2-inch screen and no more than 20 percent shall pass a No. 200 screen.

020331.20 BASE MATERIAL

The material shall consist of hard, durable particles or fragments of stone or gravel, screened or crushed to the required size and grading. The material shall be free from vegetable matter, lumps or balls of clay, alkali, adobe, or other deleterious matter, and shall conform to the following gradations when tested in accordance with AASHTO T-27 or ASTM C 136 and AASHTO T-11 or ASTM C 117. Where indicated on the Plans for structures, compacted gravel fill shall be compacted untreated base (UBC) material compacted to not less than 95 percent of maximum density.

Sieve Sizes (Square Openings)	Percentage By Weight Passing Sieve		
	Gravel Fill	(UBC) Aggregate	
	Type A	Type B	Base
3-inch	100		

1-1/2-inch		100	
1-1/8-inch			100
No. 4	30- 75	30- 70	38- 65
No. 8	20- 60	20- 60	25- 60
No. 30	10- 40	10- 40	10- 40
No. 200	0- 12	0- 12	3- 12

In addition to the above requirements, all material, when sampled and tested in accordance with standard test methods, the aggregate shall meet the following requirements:

**PERCENTAGE OF WEAR:** When tested in accordance with ASTM C 131, the percentage of wear shall not exceed 40 percent after 500 revolutions.

**PLASTICITY INDEX:** When tested in accordance with AASHTO T-90 or ASTM D 431B, the plasticity index shall not be more than 5.

**LIQUID LIMIT:** When tested in accordance with AASHTO T-89 or ASTM D 431B, the liquid limit shall not be more than 25 percent.

Untreated base (UBC) for structures shall consist of crushed or fragmented particles. At the option of the Contractor, other base material shall be either crushed or natural material aggregate. The aggregate shall conform to the sieve analysis in this Specification except that the least dimension of the maximum particle size shall not exceed 2/3 of the compacted thickness of the specified lift being placed.

020331.30 SELECT MATERIAL (IMPORT ENGINEERED FILL)

Select material as specified herein shall mean sound earthen material conforms to classification A-1-a or A-1-b, 3-inch maximum, nonplastic of AASHTO M-145.

020331.40 NATIVE MATERIAL

Native material as specified herein shall mean sound, earthen material passing the 1-inch screen and the percent of material passing the No. 200 sieve shall not exceed 30 when tested in accordance with AASHTO T-27 or ASTM C 136.

020331.50 DRAIN ROCK

The materials shall consist of hard, durable particles of stone or gravel, screened or crushed to the required size and grading. The material shall be free from vegetable matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradings when tested in accordance with AASHTO T-27 or ASTM C 136.

Sieve Size (Square Opening)	2-inch Crushed Drain Rock Percent By Weight Passing Screen	3/4-inch Crushed Drain Rock Percent By Weight Passing Screen
2-inch	100	--
1-1/2 inch	95-100	--
3/4-inch	50-100	100

3/8-inch	15-55	15-55
No. 4	0-25	0-25
No. 8	0-5	0-5
No.200	0-3	0-3

Coarse material shall be crushed or wasted and fine material shall be wasted to meet the grading requirements set forth above.

Coarse aggregate, retained on the No. 4 sieve, shall have a percentage of wear not greater than 40 percent when tested by the Los Angeles Test, AASHTO T-96 or ASTM C 131.

#### 020331.60 BEDDING MATERIAL

Bedding material shall be sand and shall be clean, coarse, natural sand which shall be nonplastic when tested in accordance with ASTM D 431B and 100 percent shall pass a 1/2-inch screen and no more than 20 percent shall pass a No. 200 screen. Bedding shall be tamped and compacted to a minimum of 90 percent of the maximum density obtained in the laboratory by ASTM D 1557.

#### 020332 PREPARING GROUND SURFACES FOR FILL

After clearing is completed, the entire area which will underlie fill sections or structures shall be scarified to a depth of 6 inches and until the surface is free of ruts, hummocks, and other features which would prevent uniform compaction by the equipment used. The areas shall be recompacted to the density specified for COMPACTED FILLS before placing of fill material or concrete, as the case may be.

Where cemented rock, cobbles, or boulders compose a large portion of the foundation material underlying structures, slabs, or paved areas, it may not be advisable to scarify the top 6 inches prior to compaction. If the Engineer deems it advisable not to scarify the existing natural ground, the Contractor shall moisten the native soil and compact it as specified below in the following for coarsely graded material.

Foundations for fill having slopes in excess of one vertical to four horizontal shall be benched or terraced to adequately key the existing ground and the fill built thereon. The slopes of original hillsides and old fills shall be benched a minimum of 4 feet horizontally as the fill is placed. A new bench shall be started wherever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the Contractor at no additional cost to the Owner.

#### 020333 COMPACTION OF COARSE FILL

In the case of materials too coarsely graded to perform field density tests, the material shall be placed in lifts so as to obtain a compacted thickness of 6 inches and rolled with a minimum of five passes with pneumatic roller A or seven passes with pneumatic roller B as defined below. One pass shall be defined as one movement of a roller over the area being compacted. The width of a pass shall be measured between the centers of the outside tires. The moisture content of the fraction of the material passing a 3/4-inch sieve shall be within plus or minus 2.0 percent of optimum moisture as determined in accordance with ASTM D 1557, Method C.

The pneumatic tired roller shall be defined as a roller meeting with one of the following specifications:

<u>Roller</u>	<u>Roller Rating</u>	<u>Wheel Load</u>	<u>Tire Inflation Pressure</u>
A	45 ton min.	11.0 ton min.	140 psi min.
B	45 ton min.	5.5 ton min.	90 psi min.

There will be no variation in the number of passes required regardless of fill location.

#### 020334 BACKFILL AROUND STRUCTURES

After completion of foundation footings and walls and other construction below the elevation of the final grades and prior to backfilling, all forms shall be removed and excavation shall be cleaned of all trash and debris. Backfill in any area under concrete structures, under pavement, or where mechanized heavy compaction equipment, such as a pneumatic tired roller, cannot be used satisfactorily shall consist of UBC material as specified for untreated base course. Material for backfilling outside of, but adjacent to, structures, and not specified otherwise above, shall consist of select material passing a 1-1/2-inch screen or of imported sand, gravel, or other materials acceptable to the Engineer. All backfill material shall be free of trash, roots, lumber, organic matter, or other debris. The backfill material in confined areas shall be compacted with pneumatic, vibrating, or other acceptable tamping equipment to the density specified for COMPACTED FILLS in this Section. After inspection of foundations, walls, and pipes, backfill shall be placed symmetrically to prevent eccentric loading upon or against structures.

All backfill, whether adjacent to structures, in trenches, or in other areas, shall be compacted to the density specified under COMPACTED FILLS.

#### 020335 EMBANKMENTS AND ROADWAY FILLS

Compacted embankments or roadway fills, constructed in layers of the depths specified above, shall be compacted by rolling with power rollers weighing not less than 10 tons, with tamping rollers, with vibrating rollers or with pneumatic tire rollers. While and as each layer is deposited, water shall be applied in sufficient amount to insure optimum moisture to secure the compaction specified. If excess moisture is encountered in the fill, each layer shall be manipulated so as to dry out excess moisture. The water shall be uniformly incorporated with the fill material in an amount sufficient to assure the required density after rolling.

Unless otherwise specified or indicated on the Plans, material for construction of embankments and roadway fills may be surplus material from excavation for structures or other construction or, if approved by the Owner, borrow material excavated from a source within the Project site. Whatever the source, the fill material shall conform with specified requirements. The Contractor shall obtain acceptable material from other sources if surplus or borrow materials obtained within the Project site do not conform to the specified requirements or are not sufficient in quantity for construction of embankments and roadway fills.

Embankments or roadway fills shall be constructed in layers for the full width of the fill. Material first placed in the fill in piles or windrows shall be distributed by blading or similar methods to break up clods or lumps and spread out the material. Where the subgrade material is unsuitable, it shall be removed to a depth not less than 12 inches below the subgrade elevation and replaced with satisfactory materials.



No extra compensation will be made for hauling of fill materials nor for water required to compact the fill. Water from an acceptable source shall be used for compacting fill, and the Contractor shall, at his own expense provide such means or facilities as are required for transporting water.

No material shall be placed beyond the sloping lines of embankment. Material allowed to be placed beyond the lines of embankment indicated on the Plans will not require compaction and will be placed only for the purpose of wasting surplus material should the Engineer select the embankments as a location for wasting material.

#### 020340 TRENCH EXCAVATION

Pipe and electrical conduits shall be laid in an open trench. If the bottom of the excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to give a uniform bearing surface, said rock or other material shall be removed to a depth of not less than 3 inches below the bottom of the pipe and refilled to grade with UBC material or sand placed at a uniform density, with minimum possible compaction, all at the Contractor's expense.

If the bottom of the excavation is found to consist of soft or unstable material which is incapable of properly supporting the pipe, such material shall be removed to a depth required and for the lengths required and the trench refilled to grade with UBC material or sand, compacted to 90 percent of maximum density. Where indicated on the Plans, pipe shall be cradled in concrete.

The minimum clear width of the trench for pipe 4 inches in diameter and over, measured at the top of the pipe, shall be not less than the outside diameter of the pipe plus 18 inches. The maximum clear width of the trench for pipe, measured at the top of the pipe, shall not exceed the outside diameter of the pipe plus 24 inches for pipe sizes up to and including 24 inches and shall not exceed the outside diameter of the pipe plus 36 inches for pipe sizes over 24 inches.

Excavation for manholes, valves, or other accessories shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment or timber which may be used to hold the banks and protect them. Backfill with earth under manholes, vaults, tanks, or valves will not be permitted. Any unauthorized excess excavation below the elevation indicated for foundation of any structure shall be filled with sand, base material, or concrete, at the expense of the Contractor. Backfilling of manhole excavation shall conform to the backfilling required for trenches.

If, because of soil conditions, safety requirements or other reasons, the trench width at top of pipe is increased beyond the width specified in the preceding paragraphs, laying conditions shall be upgraded or stronger pipe installed, designed in conformance with the Specifications for the increased trench width, without additional cost to the Owner.

Before laying pipes or electrical conduits that are to be in fill, the fill shall first be placed and compacted to not less than 2 feet above the top of pipe or conduit. After the placing and compacting of the fill, the trench for the pipe or conduit shall be excavated through the fill and fine graded as required hereinafter.

Potable water pipe and appurtenances shall be laid in trenches separate from those used for sewers. Unless otherwise specified or indicated on the Plans, potable water pipe shall be laid in trenches having a cover of not less than 4 feet below the surface of the ground and located at a distance of not less than 10 feet from any parallel sewer trench.

At road crossings or where existing driveways occur on a road, the Contractor shall make provision for ditch crossings at these points, either by means of backfills, tunnels, or temporary bridges.

#### 020342 FINE GRADING

Unless otherwise specified in the Contract Documents, the bottom of the trench for pipes 16 inches in nominal diameter and under shall be accurately graded to provide uniform bearing and support for each section of the pipe, on undisturbed soil at every point along its entire length, except for portions of the pipe where it is necessary to excavate for bells and for the proper sealing of pipe joints.

Where the trench excavation is made below the grade required to accommodate the bedding material, the trench bottom shall be restored to the proper grade by backfilling and compacting the backfill to 95 percent of maximum density, at the expense of the Contractor. Backfill material shall be select material as specified herein.

Bell or coupling holes shall be dug after the trench bottom has been graded. Such holes shall be of sufficient width to provide ample room for caulking or banding.

Bell and coupling holes shall be excavated only as necessary to permit accurate work in the making of the joints and to insure that the pipe will rest upon the prepared bottom of the trench, and not be supported by any portion of the joint.

Depressions for joints, other than bell-and-spigot, shall be made in accordance with the recommendations of the joint manufacturer for the particular joint used.

#### 020344 PIPE BEDDING

Four inches of bedding material shall be placed and shaped for the pipe and bells and compacted. Bedding material shall not be placed in free standing water.

After the pipe is laid, bedding material shall be placed under and around the pipe to a level even with the spring line of the pipe, compacted to 90 percent of maximum density. The section of trench from the spring line to 12 inches above the top of the pipe shall then be filled with bedding material and water settled or compacted to 90 percent of maximum density. The Contractor shall take all necessary precautions in the placement and compaction of the bedding material to prevent displacement of the pipe. In the event there is movement or floating, the Contractor shall, at his own expense, re-excavate, re-lay, and backfill all pipe so affected. Consolidation, when acceptable to the Engineer, shall be performed by flooding and poling, or jetting so as to obtain a compaction of the fill material at least equal to that specified. When flooding, poling, or jetting methods are used, material for use as backfill shall be placed and consolidated in layers not exceeding 4 feet in thickness. Flooding and poling, or jetting methods shall be supplemented by the use of vibratory or other compaction equipment when necessary to obtain the required compaction. Water settling methods shall not be used when the backfill material is not sufficiently granular in nature to be self-draining during and after consolidation and when foundation materials may be softened or otherwise damaged by applied water.

After filling the trench to a level 12 inches above the top of the pipe, the Contractor has the option to water test the pipe or to backfill to the surface, at his own risk, before testing. If the pipe does not pass the hydrostatic test, he shall uncover the pipe, locate the leaks, repair and retest, repeating until the pipe section under test passes the hydrostatic test, all at the Contractor's expense.

### 020345 TRENCH BACKFILL

The trench backfill from 12 inches above the top of the pipe to the natural surface level or the finished grade indicated on the Plans shall be placed and compacted as follows:

Backfill for trench cuts across roadways and paved streets shall consist of backfilling the trench from 12 inches above the top of the pipe to the surface or to the underside of the specified pavement replacement with untreated base course (UBC) material compacted to 95 percent of maximum density.

Trench backfill for longitudinal trench cuts in roadways, paved areas, and storage areas shall consist of backfilling the trench from 12 inches above the top of the pipe up to within 2 feet of finished grade with native material compacted to 90 percent of maximum density. Backfill from 2 feet below finished grade to finished grade, to the underside of specified aggregate base course material as indicated on the Plans, or to the underside of specified pavement replacement shall consist of native material, untreated base course (UBC) material, or select material compacted to 95 percent of maximum density.

Trench backfill for trench cuts in areas outside the traveled right-of-way and in open country shall consist of backfilling the trench from 12 inches above the top of the pipe to finished grade with native material compacted to 85 percent of maximum density.

It shall be the responsibility of the Contractor to be assured that the native material, when used as previously specified, is capable of being compacted to the degree specified. If the native material cannot be compacted to the density as previously specified, it shall be the Contractor's responsibility to remove and dispose of this material whether it has been placed in the trench as backfill or not, and to utilize other backfill material from another source acceptable to the Engineer, at no extra cost to the Owner.

Where existing underground pipes or conduits larger than 3 inches in diameter cross the trench above the new work, the backfill from the bottom of the trench to the spring line of the intersecting pipe or conduit shall be aggregate base course material compacted to 90 percent of maximum density. The aggregate base course material shall extend 2 feet on either side of the intersecting pipe or conduit to insure that the material will remain in place while other backfill is placed.

Excess material shall be rounded up in a neat mound over the trench or removed as directed by the Engineer.

### 020382 SOIL STERILIZATION

The Contractor shall provide all labor, material, equipment, and services necessary to complete all work involved in soil sterilization for unwanted plant life under structures, sidewalks, and pavement. Soil sterilization shall be Karmex 80W, manufactured by DuPont; Duiron 4L, manufactured by Drexel Chemical Corporation; or equal. The weed killer shall be applied according to the manufacturer's published instructions. Weed killer shall be compatible with geotextile fabrics provided.

Areas to receive asphalt, crushed rock, UBC, or gravel ground covering (without plants) shall be sterilized.

#### 020400 ASPHALT REPLACEMENT

The Contractor shall not damage adjacent concrete surfaces that are not scheduled for removal. Adjacent asphalt or concrete surfaces that are damaged by removal operations will be restored by the Contractor at no additional cost to the Owner.

Existing asphalt pavements to be removed shall be saw cut to full depth, making a neat and reasonably straight and smooth cut, without damaging adjacent pavement that is not to be removed. The cutting device operation shall be subject to the approval of the Engineer.

#### 020410 REMOVAL OF ASPHALT PAVEMENT

Removal of asphalt pavement shall be by grinding machine according to APWA Standard Specifications, Section 02 41 14 Pavement Removal.

#### 020420 PROOF ROLL EXISTING BASE COURSE

After removal of existing asphalt, the Contractor shall proof roll existing base course to assist the Owner in confirming and/or identifying areas requiring over-excavation and replacement of subgrade materials.

#### 020430 PROTECTION OF UTILITY ACCESS

All valve boxes shall be adjusted to protect them during the repaving process and to bring them to 3/8" below the final finished grade of the wearing course. Valve boxes that are not centered on the valve shall be adjusted to be so.

#### 020431 CONCRETE GRADE RINGS

All existing manholes and valve boxes in areas affected by the work shall be finished with a circular concrete grade ring. All existing grade rings shall be removed and replaced as part of the project. Concrete grade rings shall be a minimum of 6" thick. Concrete shall be finished to 3/8" above top of valve box or manhole so they are even with the wearing course. Concrete grade rings around manholes shall extend 12" minimum around manholes and shall be circular in shape. Concrete grade rings around valve boxes shall extend 8" minimum around valve boxes and shall be circular in shape. Concrete shall have a minimum compressive strength of 4000 psi and shall be a 6.5 cement bag mix. Contractor shall submit on concrete mix design for approval.

#### 020600 A.C. PAVEMENT AND BASE

##### 020610 GENERAL

##### 020611 THE REQUIREMENT

The Contractor shall provide A.C. pavement and base, complete and in place, in accordance with Contract Documents.

##### 020612 REFERENCE SPECIFICATIONS, CODE, AND STANDARDS

Commercial Standards

AASHTO M 82	Cut-Back Asphalt (Medium Curing Type)
AASHTO M 140	Emulsified Asphalt
AASHTO M 208	Cationic Emulsified Asphalt
AASHTO M 226	Viscosity Graded Asphalt Cement
ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 692	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 977	Emulsified Asphalt
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures using Paraffin-Coated Specimens
ASTM D 1557	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10-lb (4.54-kg) Rammer and 18-in (45-mm) Drop7
ASTM D 2027	Cutback Asphalt (Medium Curing Type)
ASTM D 2397	Cationic Emulsified Asphalt
ASTM D 2726	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures using Saturated Surface-Dry Specimens
ASTM D 3381	Viscosity-Graded Asphalt Cement for use in Pavement Construction
ASTM D 3515	Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

#### 020613 CONTRACTOR SUBMITTALS

Submittals shall be in accordance with Section 01300- Contractors Submittals. Include materials testing reports, job-mix formulas and other pertinent information satisfactory to the ENGINEER.

Suitability Tests of Proposed Materials: Tests for conformance with the Specifications shall be performed prior to start of the WORK. The samples shall be identified to show the name of the material, aggregate source, name of the supplier, contract number, and the segment of the WORK where the material represented by the sample is to be used. Results of all tests shall be submitted to the ENGINEER for approval. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt cement.

Trial Batch: Before placing any paving material, a testing laboratory acceptable to the ENGINEER shall prepare a trial batch of asphalt concrete for each job-mix formula to be used by the CONTRACTOR for work. The trial batch shall be prepared using the aggregates and asphalt cement proposed by the CONTRACTOR, and approved by the ENGINEER. The compacted trial batch shall provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of not more than two laboratory trial batch tests will be paid by the OWNER but the CONTRACTOR shall be responsible for the materials. Performing and paying for additional trial batch testing shall be the CONTRACTOR's responsibility.

#### 020620 PRODUCTS

##### 020621 UNTREATED BASE COURSE

The untreated base course shall consist of select material, either natural or crushed and shall be graded as follows:

<u>Sieve Size</u>	<u>Ideal Gradation</u>	<u>Tolerances</u>
1-inch	100	0 %
½- inch	85	± 6 %
No. 4 Sieve	55	± 6 %
No. 16 Sieve	31	± 4 %
No. 200 Sieve	9	± 2 %

#### 020622 TACK COAT

Tack Coat shall be emulsified asphalt Grade SS-1 or SS-1h, CSS-1 or CSS-1h diluted with one part water to one part emulsified asphalt, undiluted asphalt Grade RS-1 or CRS-1, or paving asphalt Grade AR-1000. Emulsified asphalt shall comply with the requirements of AASHTO M 140 (ASTM D 977) or M 208 (ASTM D 2397); paving asphalt shall comply with the requirements of AASHTO M 226 (ASTM D 3381).

#### 020623 ASPHALT CEMENT

Asphalt coat shall be Grade AC-10 or AC-20 complying with the requirements of AASHTO M 226 (ASTM D 3381).

#### 020624 MINERAL AGGREGATE

Mineral aggregate shall be crushed stone, crushed slag, crushed gravel, stone or slag screening, sand, mineral filler, or a combination of two or more of these materials. Coarse and fine aggregate shall comply with all the quality requirements, except soundness, of ASTM D 692 and D 1073, respectively. Coarse aggregate failing to comply with abrasion requirements may be used if experience has demonstrated it to be satisfactory.

Mineral filler shall comply with ASTM D 242. Combinations of aggregates having a history of polishing shall not be used in surface courses.

#### 020625 ASPHALT-AGGREGATE MIXTURES

Bituminous Surface Course Mixtures: The CONTRACTOR shall submit for approval a job-mix formula for each mixture. The job-mix formula for the asphalt-aggregate base course mixture shall be within the following limits.

<u>Sieve Size</u>	<u>Total Percent Passing By Weight</u>
¾-inch	100
½-inch	74 - 99
⅜-inch	69 - 91
No. 4	49 - 65
No. 8	33 - 47
No. 16	21 - 35
No. 50	6 - 18
No. 200	2 - 6

Bituminous Surface Course Mixture Test Criteria: The asphalt-aggregate surface course mixture shall meet the following test criteria based on a blow count of 75.

Stability (Marshall):	1800 lbs
Flow (Marshall Method) (0.01 in):	8 - 14
Air Voids:	4 percent
Voids in Mineral Aggregate:	14 min. percent

#### 020626 SOIL STERILANT

Soil sterilant or chemical weed control agent shall be a commercial product manufactured specifically to sterilize the subgrade soil to prevent the growth of weeds, plants or any type of vegetation. Refer to Section – 020382 Soil Sterilization.

#### 020627 CRACK SEALANT FOR ASPHALT PAVEMENTS

Crack sealant mixtures shall conform to the Utah Department of Transportation 2017 Standard Specification 02745, Part 2.3 for hot-pour crack sealants.

#### 020628 SEAL COAT FOR ASPHALT PAVEMENTS

Seal coats shall be emulsion type. Contractor shall submit the proposed material to be used for approval. Material must meet ASTM D977, Grade SS-1h or ASTM D2397, Grade CSS-1h requirements. Seal coats shall be mixed and prepared according to the seal coat manufacturer's specifications.

#### 020630 EXECUTION

##### 020631 SUBGRADE PREPARATION

The subgrade shall be prepared in accordance with Section 020300- Earthwork as applicable to roadways and embankments. The surface of the subgrade after compaction shall be hard, uniform, smooth and true to grade and cross-section. Subgrade for pavement shall not vary more than 0.02 feet from the indicated grade and cross section. Subgrade for base material shall not vary more than 0.04 feet from the indicated grade and cross section.

Apply soil sterilant or chemical weed control agent in strict compliance with manufacturer's dosages and application instructions, and any applicable laws, ordinances or regulations governing the use of such chemicals.

##### 020632 UNTREATED BASE COURSE

Untreated base course shall be provided where indicated to the thickness indicated. Imported untreated bases shall be delivered to the Site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. Where the required thickness is 6-inches or less, the base materials may be spread and compacted in two or more layers of approximately equal thickness, and maximum compaction thickness of any one layer shall not exceed 6-inches. The relative compacted surface of the finished base shall be hard, uniform, smooth and at any point shall not vary more than 0.02-foot from the indicated grade or cross-section.

### 020633 TACK COAT

A tack coat shall be applied to existing paved surfaces where new asphalt concrete is to be placed on existing pavement. It shall also be applied to the contact surface of all cold pavement joints, curbs, gutters, waterways, manholes and the like immediately before the adjoining asphalt pavement is placed. Care shall be taken to prevent the application of tack coat materials to surfaces that will not be in contact with the new asphalt concrete pavement. Diluted emulsified asphalt shall be applied at the rate of 0.05 to 0.15 gal/sq-yd. Undiluted emulsified asphalt shall be applied at the rate of 0.025 to 0.075 gal/sq-yd. Paving asphalt shall be applied at the rate of approximately 0.05 gal/ sq-yd.

### 020634 ASPHALT CONCRETE

At the time of delivery to the Site, the temperature of mixture shall be lower than 260 degree Fahrenheit or higher than 320 degrees Fahrenheit, the lower limit to be approached in warm weather and the higher in cold weather.

Asphalt concrete shall not be placed when the atmospheric temperature is below 50 degrees Fahrenheit, during unsuitable weather, when the base is wet, or during other unfavorable weather conditions as determined by the ENGINEER. The air temperature shall be measured in the shade.

The asphalt concrete shall be evenly spread upon the subgrade or base to such a depth that, after rolling, it will be of the required cross section and grade of the course being constructed.

The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation by means of a self-propelled mechanical spreading and finishing machine designed specially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a pre-determined thickness. When paving is of a size or in a location such that use of a self-propelled machine is impractical, the ENGINEER may waive the self-propelled requirement.

Spreading, once commenced, shall be continued without interruption.

The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, vibratory roller, or a pneumatic-tired roller shall follow the paver as closely as possible. If needed, intermediate rolling shall eliminate marks from previous rolling. In areas too small for the roller, a vibrating plate compactor or hand tamper shall be used to achieve thorough compaction.

Upon completion, the pavement shall be true to grade and cross-section. When a 10-ft straightedge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straightedge more than 1/8-inch except at intersections or changes of grade. In the transverse direction, the surface shall not vary from the edge of the straightedge more than 1/4-inch.

The relative density after compaction shall be 95 percent of the density obtained by using ASTM D 1188 or D 2726. A properly calibrated nuclear density asphalt testing device shall be used in accordance with ASTM D 2922 for determining the field density of compacted asphalt concrete, or slabs or cores may be laboratory tested in accordance with ASTM D 1188.

### 020635 BITUMINOUS SURFACE PATCHING



Where utility trenches are excavated through bituminous surface roads, driveways, parking areas, etc., the surface shall be restored and maintained as follows:

1. A temporary gravel surface shall be placed and maintained after the required backfill and compaction of the trench has been accomplished.
2. The gravel shall be placed to such depth as to provide six inches below the pavement and shall be brought flush with the paved surface.
3. The area over trenches to be resurfaced shall be graded and rolled with a roller weighing not less than twelve tons, or with the rear wheels of a five-yard truck loaded to capacity, until the subgrade is firm and unyielding. Mud or other soft or spongy materials shall be removed and void filled with gravel and rolled and tamped thoroughly in layers not exceeding six inches in thickness. The edges of trenches which are broken down during the making of subgrade shall be removed and trimmed neatly before resurfacing.
4. Before any permanent resurfacing is placed, the CONTRACTOR shall trim the existing paving to clean, straight lines as nearly parallel to the centerline of the trench as practicable.
5. Existing bituminous paving shall be cut back a minimum of six inches beyond the limits of any excavation of cave-in along the trench so that the edges of the new paving will rest on at least six inches of undisturbed soil.

As soon as is practical, weather permitting, the bituminous surface shall be restored by standard paving practices to the thickness specified herein.

#### 020636 CRACK SEALING

The Contractor shall seal the existing cracks where indicated in the Plans. Application of crack sealants shall conform to the Utah Department of Transportation 2017 Standard Specification 02745, Part 2.3 for hot-pour crack sealants.

#### 020637 SEAL COATING

The Contractor shall seal coat the entire areas defined above for Crack Sealing using an asphalt emulsion seal coat and where indicated in the Plans. Contractor shall prepare the surface by removing debris, sand, dirt, dust, and other loose material using a power brush or power vacuum sweeper and blower. Areas to be seal coated that have oil or grease on them shall be prepped and sealed in accordance with manufacturer's recommendations.

Seal coating shall occur after Crack Sealing. Application of seal coat shall conform to the seal coat manufacturer's recommended procedures. Sealer must be applied at ambient temperatures between 50 and 80 degrees Fahrenheit. Sealer shall not be applied over wet pavement or when precipitation is imminent. A minimum of two (2) coats shall be applied. Each additional coat after the first shall not be applied until the previous coat has thoroughly dried. See attached Specification Section 32 01 19.

## 020680 CURBS, GUTTERS, AND SIDEWALKS

The various types of concrete curb, gutter, waterway, sidewalk, driveways, and alley intersections shall be constructed to the dimensions indicated on the Plans and detail drawings.

## 020681 MATERIALS

Concrete shall be Class A, conforming to the applicable requirements of DIVISION 3.

## 020682 CONSTRUCTION METHODS

The subgrade shall be constructed and compacted true to grades and lines indicated on the Plans and as specified hereinbefore. All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with satisfactory material.

Concrete curbs, gutters, and sidewalks shall be constructed by the conventional use of forms, or may be constructed by means of a curb and gutter machine if acceptable to the Engineer.

If machines designed specifically for such work and accepted by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory, the use of the machines shall be discontinued. All applicable requirements of construction by use of forms shall apply to the use of machines.

Forms conforming to the dimensions of the curb, gutter, sidewalk, driveways, and alley intersection shall be carefully set to line and grade, and securely staked in position. The forms and subgrade shall be watered immediately in advance of placing concrete. Forms shall be thoroughly cleaned each time they are used and shall be coated with a light oil or other releasing agent of a type which will not discolor the concrete.

The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators accepted by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface and the coarse aggregate is below the concrete surface.

The front face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight. Gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Special care shall be taken to prevent any damage. Any portion of concrete damaged while stripping forms shall be repaired or, if the damage is severe, replaced at no additional cost to the Owner. The face, top, back, and flow line of the curb and gutter shall be tested with a 10-foot straightedge or curve template longitudinally along the surface. Any deviation in excess of 1/4-inch shall be corrected at no additional cost to the Owner.

Any sections of the work deficient in depth or not conforming to the Plans or Specifications shall be removed and replaced by the Contractor at no additional cost to the Owner.

Finishing and curing of the concrete shall be done in the manner specified in DIVISION 3.

When required by the Engineer, where gutters have a slope of 0.8-foot per hundred feet or less, or where unusual or special conditions cast doubt on the capability of the gutters to drain, they shall be water

tested. Water testing shall consist of establishing flow in the length of gutter to be tested by supplying water from a hydrant, tank truck, or other source. One hour after the supply of water is shut off, the gutter shall be inspected for evidence of ponding or improper shape. In the event that water is found ponded in the gutter to a depth greater than 1/2-inch, or is found on the adjacent asphalt pavement, the defect or defects shall be corrected in a manner acceptable to the Engineer without additional cost to the Owner.

#### 020683 EXPANSION AND CONTRACTION JOINTS

Expansion joints shall be constructed vertical, and at right angles to the centerline of the street and shall match joints in adjacent pavement or sidewalks. Joints shall be constructed at all radius points, driveways, alley entrances, and at adjoining structures. Expansion joint filler shall comply with the requirements of the material as specified in DIVISION 3.

Contraction joints shall be constructed not more than 15 feet apart. Joints shall be made by the use of steel dividers scoring or saw cutting to a depth of not less than 1-1/2 inches and shall match joints in adjacent pavement or sidewalk.

#### 020684 BACKFILLING

Unless otherwise specified, the Contractor shall backfill behind the curbs or sidewalk with soil native to the area to the lines and grades indicated on the Plans. Such backfilling shall take place prior to any adjacent asphalt paving.

#### 020700 SITE IMPROVEMENTS

This section includes all surface improvements to the site other than pavement, curb, gutter, and sidewalk and those pertaining to the functional operation of the facility. This includes fences, masonry walls and screens, information and traffic control facilities, guards and guard rails, irrigation systems, and other similar improvements.

#### 021000 LANDSCAPE WORK

All tools, equipment, materials and labor shall be provided to as required to carry out planting operation. No error or discrepancy in the Plans or Specifications shall cause defective or inappropriate materials to be used or poor workmanship to be allowed. Work must be carried out only during weather conditions favorable to landscape construction and to health and welfare of plants.

All areas affected by construction shall be revegetated to the existing conditions prior to the construction project. All grass areas damaged shall be replaced with sod. Seeding will not be allowed. Any damage to sprinkler heads or piping during construction shall be repaired by contractor at his expense.

#### 021010 MATERIALS

##### 021010.30 SOD

Sod shall be species ASPA certified. Sod to be of uniform thickness, strongly rooted, and free of weeds, disease and pests, and shall match existing sod which has been damaged and is being replaced.

##### 021010.31 LAWN GUARANTEE

The Contractor shall guarantee a full stand of grass with no bare spots greater than 12 inches in diameter and shall provide maintenance of all turf until a full stand of grass is accepted by the Engineer. Areas that are not fully covered shall be cut out and replaced with new sod at the discretion of the Owner.

## 021012 PRODUCTS

### 021012.10 FERTILIZER

Fertilizer shall be 0 percent nitrogen, 20 percent phosphorus, and 20 percent potassium. Deliver fertilizer, mixed as specified, in original unopened standard size bags showing weight, analysis and name of manufacturer. Store fertilizer in a manner that it shall be kept dry.

### 021012.12 TOPSOIL

Top soil shall be natural, friable, fertile, fine loamy soil possessing characteristics of representative topsoil in the vicinity that produces heavy growth. It shall have a pH range of 5.5 to 7, 4% minimum organic material, and free from any materials which may be harmful to plant growth or hinder planting operations. It shall be supplied from naturally well-drained sites; do not obtain top soil from bogs or marshes.

### 021012.13 MANURE

Manure shall be well-rotted, unleached stable or cattle manure, reasonably free from shavings, sawdust, or refuse, and shall contain no more than 10 percent straw. Manure shall be odorless.

### 021012.14 PREPARED BACKFILL

Prepared backfill shall be composed of two parts of native soils to one part of a humus by volume and the fertilizer 0-20-20 to be added at a rate of 1-½ pounds per cubic yard.

### 021012.17 WATER

Water used in planting shall be kept free from oil, acids, alkali, salt, and other substances harmful to plant growth. Potable, on-site water shall be furnished by Owner. Contractor shall furnish hose and other watering equipment.

## 021020 EXECUTION

### 021022 SOIL PREPARATION

The planting of trees and seed mix shall be performed during favorable weather conditions, during the season or seasons which are normal for such work, as determined by acceptable local practice. The soil shall not be worked when the moisture content is so great that excess compaction will occur, nor when it is so dry that a dust will form in the air or that clods will not break readily. Water shall be applied if necessary to provide ideal moisture content for planting.

Any rock or other underground obstructions shall be removed, if possible, to the depth necessary to permit proper planting, according to the Plans and Specifications. If underground constructions,

obstructions, or rocks are encountered in the excavation of planting areas, other locations for the planting may be selected by the Contractor only upon acceptance of the Engineer. Prior to any work, the Contractor shall be knowledgeable of the locations of all existing underground installations, and their protection shall be his responsibility. All damage shall be corrected at the expense of the Contractor.

Where subsoils are unsuitable for planting due to excessive compaction, the soil shall be loosened with spikes, discing, or other means to a minimum of 12 inches with additional loosening as required to obtain adequate drainage. The Contractor may introduce peat moss, sand, or organic matter into the subsoil to obtain adequate drainage. Such remedial measure shall be considered as incidental, without additional cost to the Owner. Any construction materials, debris, or objectionable material shall be removed from the planting areas.

Uniformly till soil to a depth of 6 inches by dragging, disking, or other approved method prior to raking. Rake all seed areas, removing all clods or rocks 1 1/2 inch in diameter and larger. Two inches of top soil shall be placed over lawn and bed areas. Place topsoil so that after final settlement there will be positive drainage conforming to elevations shown on the Plans.

## 021023 PLANTING OF TREES, SHRUBS, AND GROUND COVER

### 021023.30 PLANTING OF SOD

Soil shall be prepared as specified herein. Cut and lay sod on the same day. Only healthy, growing sod is to be laid. Always lay sod across slope and tightly together so as to result in solid coverage free of gaps. Roll or firmly but lightly tamp new sod with suitable wooden or metal tamper sufficiently to set or press sod into underlying soil. After sodding has been completed, clean up and thoroughly moisten newly-sodded areas.

### 021023.40 FERTILIZATION

Grass or sodden areas shall have fertilizer applied in two applications with a thorough watering following each application. The first application shall be one week prior to seeding/sodding at the rate of 25 pounds per 1000 square feet and barrowed into the top two inches of topsoil. The second application shall be at the rate of 10 pounds per 1000 square feet immediately following the second mowing.

## 021030 PROTECTION

Use precautionary measure when performing work around trees, sidewalks, pavements, utilities and other feature either existing or previously installed. In order to avoid damage to roots, bark, or lower branches, no truck or other equipment shall be driven or parked within drip line of any tree. Plants shall be kept moist, fresh, and protected. Such protection shall encompass entire period during which plants are in transit, being handled, or are in temporary storage.

Plants too large for two people to lift shall be placed with a sling. Do not rock trees in holes to raise. Holes for trees shall be at least 2 feet greater in diameter than spread of root system and at least 6 inches deeper than root ball. Holes for shrubs and vines shall be at least 12 inches greater in diameter than spread of root system and at least 2 feet deep.

Protect seeded areas from pedestrian or vehicular trespassing while grass is germinating. Furnish and install fences, signs, barriers, or other necessary temporary protective devices. Contractor shall repair damage resulting from trespass, erosion, washout, settlement, or other causes at his expense.

#### 021040 GROUND MAINTENANCE DURING CONSTRUCTION

The Contractor shall begin maintenance immediately after planting. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated, and otherwise maintained and protected until acceptance. Settled plants shall be reset to proper grade and position, and dead material removed and replaced. Maintain all landscaped areas on a continuous basis as they are completed during the course of work and until final acceptance of the work. Maintenance shall include keeping the landscape areas free of debris and weeding and cultivating the planted areas at intervals acceptable to the Engineer. The Contractor shall provide adequate personnel to accomplish the required maintenance.

The Contractor shall ensure that all plant materials are in a sound, healthy, vigorous condition free from insects, bark abrasions, weak branches, or other objectionable disfigurements and shall immediately replace any plant which is unacceptable to the Engineer at any time up to and including final acceptance of the Work by the Owner.

#### 021050 PLANT MATERIAL AND GROUND MAINTENANCE PERIOD

##### 021051 DESCRIPTION

This work shall include watering, weeding, lawn mowing, clipping, pickup and disposal, lawn edging, and general care of all plant material to produce vigorous healthy growth. All granite and rock areas shall be cleaned of all debris and maintained in a clean condition throughout the maintenance period.

Maintenance period shall be performed for a period of 60 calendar days after acceptance of the entire project by the Owner.

##### 021052 GUARANTEE

During the maintenance period all plants shall be guaranteed to remain in a healthy vigorous state of growth. At any time, up to and including the end of the maintenance period, plants found not acceptable to the Engineer shall be replaced and guaranteed for an additional period of 60 calendar days. The 60-day guarantee period shall remain in effect on all plant replacements regardless of time and replacement and will apply to all replacements until they are successfully established for a 60-day period.

\* \* \* END OF DIVISION 2 \* \* \*

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## DIVISION 3

### CONCRETE

#### 030000 GENERAL

Except as otherwise specified, concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements of these Specifications and suitable to the specific conditions of placement. The proportions of materials shall be such as to secure the lowest water-cement ratio which is consistent with good workability, a plastic, cohesive mixture, and one which is within the specified slump range. The proportion of fine and coarse aggregate shall be such as not to produce harshness in placing nor honeycombing in the structures.

#### 030002 JOINTS AND BONDING

As far as practicable the concrete work shall be constructed as a monolith. The locations of contraction, construction, and other joints are indicated on the Plans or specified herein. Keyways in joints shall be provided as indicated on the Plans. Material for keyways shall be steel, plastic or lumber treated with form release coating, applied in accordance with the manufacturer's published instructions. Construction joints shall be washed free of sawdust, chips, and other debris after forms are built and immediately before the concrete placement. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, a vacuum cleaner shall be used for their removal, after which the cleaned surfaces shall be flushed with water.

In any case where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, the surface of the set concrete shall first be coated with epoxy bonding agent Concrete No. 1001 LPL as manufactured by Adhesive Engineering; Sikadur Hi-Mod as manufactured by Sika Chemical Corporation; or equal. This material shall be applied in accordance with the manufacturer's published instructions. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

The Contractor shall schedule the placing of concrete in such a manner as to complete any single placing operation to a construction, contraction, or expansion joint. Special care shall be taken to insure that concrete is well consolidated around and against waterstops and that waterstops are secured in the proper position.

#### 030100 WORKMANSHIP AND METHODS

Concrete work, including detailing of reinforcing, shall be in accordance with the best standard practices and as set forth in the ACI Building Code, Manuals, and Recommended Practices.

All concrete materials shall be so delivered, stored, and handled as to prevent damage to the materials and the inclusion of foreign substances. Packaged materials shall be delivered and stored in original containers until ready for use. Material containers or materials showing evidence of water or other damage shall be rejected.



### 030101 MEASUREMENTS OF MATERIALS

Materials shall be measured by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities of the individual item can be measured to within 1 percent of the desired amount of that item. Cement in unbroken standard packages (sack) need not be weighed, but bulk cement and fractional packages shall be weighed. The mixing water shall be measured by volume or by weight. The water measuring device shall be capable of control of water quantities to an accuracy of 1 percent of the desired amount. All measuring or weighing devices shall be subject to review and acceptance by the Engineer, and shall bear a valid seal of the Sealer of Weights and Measures having jurisdiction.

### 030103 CONCRETE MIXES

Prior to placement of concrete the Contractor shall submit to the Engineer for review and acceptance full details, including mix design calculations for the concrete mix he proposes to use for each class of concrete. After acceptance, the Contractor shall have trial batches of the accepted Class A concrete mix design prepared by a testing laboratory acceptable to the Engineer. The trial batches shall be prepared using the specified cement and aggregates proposed to be used for the project which conform to these Specifications. The trial batch shall be of sufficient quantity to determine slump, workability, consistency and finishing characteristics, and to provide sufficient 6-inch by 12-inch test cylinders prepared in accordance with ASTM C 31 for the following tests.

Eight test cylinders shall be compression tested in accordance with ASTM C 39, four at 7 days and four at 28 days. A ratio between 7-day and 28-day strength will be established for the mix and the 7-day strength may be taken as a satisfactory indication of the 28-day strength provided the effects on the concrete of temperature and humidity between the seventh and 28-day are taken into account.

Full information shall be submitted for each of the cylinders as to the mix and slump as determined in accordance with ASTM C 143.

If the trial batch tests do not meet the project specifications for slump, strength, workability, consistency, and finishing, the concrete mix design proportions and, if necessary, source of aggregate shall be changed and additional trial batches and tests shall be made until an acceptable trial batch is produced that meets the project specifications.

Test batches and tests required to establish trial batches and acceptability of materials shall be paid for by the Contractor.

After acceptance, the mixes shall not at any time be changed without reacceptance by the Engineer, except that at all times the batching of water shall be adjusted to compensate for the free moisture content of the fine aggregate. The total water content of each of the type concretes shall not exceed those listed in Table A of this Division. Satisfactory means shall be provided at the batching plant for checking the moisture content of the fine aggregate. The details of concrete mixes submitted for review shall include information on the correction of the batching for varying moisture contents of the fine aggregate.

If there is a change in the aggregate source, or if there is a change in aggregate quality from the same source, the Contractor shall submit to the Engineer for review and acceptance a new set of design mixes covering each class of concrete, and a new trial batch and test program shall be undertaken as hereinbefore specified. Each new trial batch and test program shall be at the expense of the Contractor.

#### 030104 TESTING OF CONCRETE

During the progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with the standards of quality specified herein. These tests shall be made in accordance with ASTM C 31, ASTM C 39, and ASTM C 172. Testing will be conducted by an agency retained by the Owner and the testing expense will be borne by the Owner.

Not less than three cylinder specimens, 6-inch by 12-inch, will be tested for each day that concrete is placed, every 50 cubic yards of structural concrete or every 150 cubic yards for each grade of non structural concrete with a minimum of three specimens for each grade placed and not less than three specimens for each half day's placement. One cylinder will be broken at 7 days and two at 28 days.

The Contractor shall test the slump of concrete using a slump cone in accordance with the requirements of ASTM C 143. The Contractor shall provide the test equipment. Concrete that does not meet the Specification requirements as to slump shall not be used but shall be removed from the job. The Contractor shall test the slump at the beginning of each placement, as often as necessary to keep the slump within the specified range, and when requested to do so by the Engineer.

The Contractor shall make provisions for and furnish all concrete for the test specimens, and provide manual assistance to the Engineer in preparing said specimens. The Contractor shall be responsible for the care of and providing curing conditions for the test specimens in accordance with ASTM C 31.

#### 030105 ENFORCEMENT OF STRENGTH REQUIREMENT

Concrete is expected to reach a higher compressive strength than that which is indicated in Table A as compressive strength. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the required strength and no individual strength test falls below the required strength by more than 500 psi. Where an individual strength test falls below the required strength by more than 500 psi, the Engineer shall have the right to ask for additional curing of the affected portion followed by cores taken in accordance with ASTM C 42 and ACI 318, all at the Contractor's expense. If the additional curing does not bring the average of three cores taken in the affected area to at least the strength specified, the Engineer may require strengthening of the affected portions of the structures by means of additional concrete or steel or he may require replacement of these affected portions, all at the Contractor's expense.

030110 CLASSES OF CONCRETE

TABLE A

CONCRETE WITH AIR ENTRAINMENT

<u>Class</u>	<u>Compressive Strength At 28-Day (psi)</u>	<u>Max. Net* Water to Cement Ratio by Weight</u>	<u>Min. Cement* Per Yard of Concrete (pounds)</u>	<u>Consistency Range In Slump (inches)</u>
A	4,000	0.45	594	3 to 5**

\* See 030180.

\*\* NOTE: Slump for slabs, decks, walks, and beams shall be not more than 3.5 inches.

TABLE B

CLASS "A" MIX DESIGN

CEMENT	594 LB/CY
AIR	6%
WATER	32 GAL/CY
CRUSHED ROCK	3/4"-#4 / 60 - 65%
SAND	35 - 40%
SLUMP**	3" Min. to 5" Max.
28 DAY STRENGTH	4000 PSI, MINIMUM
WATER/CEMENT RATIO	0.45
SUPERPLASTICIZER*	
WATER REDUCING AGENT*	

POZZOLAN OR FLY ASH MAY NOT BE USED  
CEMENT TO BE TYPE II (ASTM C 150)  
SUPERPLASTICIZER (ASTM C-494 TYPE A/F)

\* Dosages shall not exceed manufacturer's recommended amounts.

\*\* Slump for walls shall not be less than 5.0 inches.

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Concrete shall be Class A only as specified herein and which shall be used in the respective places called for in these Specifications. The concrete shall have a minimum weight of 140 pounds per cubic foot.

Any concrete that is pumped shall meet all the requirements of these Specifications. In no case shall concrete be placed which shows a slump outside the limits indicated in the table.

Classes A concrete shall be made with Type II low alkali. See Admixtures for allowable admixtures.

### 030120 AGGREGATE

All concrete aggregates shall be sound, uniformly graded, and free of deleterious material in excess of the allowable amounts specified.

The Contractor shall furnish the Engineer certified copies in triplicate of commercial laboratory tests of all samples of concrete aggregates submitted. Tests on concrete aggregates shall indicate as a minimum all specified tests. All concrete aggregate tests shall be at the Contractor's expense.

Aggregate shall be sampled and graded in accordance with ASTM D 75 and C 136. Sieves for testing grading of aggregates shall have square openings.

Sieve analyses of the fine and coarse aggregates being used shall be furnished the Engineer in triplicate at any time there is a significant change in the grading of the materials, and in any event, shall be furnished at least every three weeks. If such sieve analyses indicate a significant change in the materials, the Engineer may require that a new mix design be submitted for review and acceptance before further placing of concrete.

If either fine or coarse aggregate is to be batched from more than one bin, analyses shall be furnished for each bin, and a composite analysis made up from these, using the proportions of materials to be used in the mix.

The unit weight of fine and coarse aggregate shall be of a unit weight which will produce in place concrete with a weight of not less than 140 pounds per cubic foot.

### 030121 FINE AGGREGATE

Fine aggregate for concrete or mortar shall consist of clean, natural sand or of sand prepared from crushed stone or crushed gravel. Deleterious substances shall not be present in excess of the following percentages by weight of contaminating substances. In no case shall the total exceed 3 percent.

	<u>Test Method</u>	<u>Percent</u>
Removed by decantation (dirt, silt, etc.)	ASTM C 117	3
Shale or chert	ASTM C 295	1
Clay lumps	ASTM C 142	1

Fine aggregate shall not contain strong alkali nor organic matter which gives a color darker than the standard color when tested in accordance with ASTM C 40. Fine aggregate shall have a fineness modulus not less than 2.50 nor greater than 3.00 when tested in accordance with ASTM C 125. Except as otherwise specified, fine aggregate shall be graded from coarse to fine in accordance with the

requirements of ASTM C 33. Aggregate soundness shall comply with the requirements of ASTM C 33 when tested in accordance with ASTM C 88. Aggregate shall comply with the reactivity requirements contained in ASTM C-33 when tested in accordance with ASTM C-289.

030122 COARSE AGGREGATE

Coarse aggregate shall consist of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances. Thin or elongated pieces having a length greater than five times the average thickness shall not exceed 15 percent by weight. Deleterious substances shall not be present in excess of the following percentages by weight, and in no case shall the total of all deleterious substances exceed 2 percent.

	<u>Test Method</u>	<u>Percent</u>
Soft fragments or particles	ASTM C 851	2
Shale or chert	ASTM C 295	1
Coal and lignite	ASTM C 123	1/4
Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than No. 200 sieve	ASTM C 117	1/2 *

\* Except that when material finer than No. 200 sieve consists of crusher dust, the maximum amount shall be 1 percent.

Aggregate when tested in accordance with ASTM C 88 for soundness shall have a loss not greater than 10 percent when tested with sodium sulfate.

Abrasion loss of coarse aggregate shall not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131. Coarse aggregate reactivity shall not exceed the limits specified in the appendix of ASTM C 33 when tested in accordance with ASTM C 289.

Except as otherwise specified or authorized in writing by the Engineer, coarse aggregate shall be graded as specified in ASTM C 33, Size No. 57.

030150 WATER

Water for concrete, washing aggregate, and curing concrete shall be clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances. Water shall not contain more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion for conventional reinforced concrete. Water for prestressed or post-tensioned concrete shall not contain more than 650 milligrams per liter of chlorides calculated as chloride ion, nor more than 800 milligrams per liter of sulfates calculated as sulfate ion.

030160 PORTLAND CEMENT

Except as otherwise specified all Portland cement shall conform to the specifications and test for Portland cement ASTM C 150, Types II or III, Low Alkali. Low alkali Portland cement shall contain not more than 0.6 percent total alkali. The word "alkali" shall be taken to mean the sum of sodium oxide and

potassium oxide calculated as sodium oxide. The determination for total alkali shall be made by the method set forth in ASTM C 114. Only one brand of Portland cement shall be used for exposed concrete in any individual structure.

#### 030180 ADMIXTURES - GENERAL

Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer. Admixtures used shall be compatible with the concrete and other admixtures. Admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight shall not be used. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix.

#### 030181 AIR ENTRAINING ADMIXTURE

All concrete shall contain 6 percent, plus or minus 1 percent, entrained air of evenly dispersed air bubbles at the time of placement. The air entraining agent shall contain no chlorides and shall conform to ASTM C 260. The air entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.

The Contractor shall test the percent of air entrained in the concrete. The Contractor shall provide the test equipment. Concrete that does not meet the Specification requirements as to air entrainment shall not be used, and shall be removed from the job. The Contractor shall test the percent of entrained air in the concrete at the beginning of each placement, as often as necessary to keep the entrained air within the specified range, and when requested to do so by the Engineer. The Engineer may at any time test the percent of entrained air in the concrete received on the job. Air entrainment in the concrete shall be tested in accordance with ASTM C 173.

#### 030183 WATER REDUCING ADMIXTURE

A water reducing admixture may be used at the Contractor's option. Such admixtures shall conform to ASTM C 494, Type A or Type D. The admixture shall not contain air entraining agents. Admixture shall be in liquid form before adding to the concrete mix. No decrease in cement shall be permitted as a result of a water reducing admixture.

#### 030200 FORMS AND ACCESSORIES

Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades, and dimensions indicated on the Plans. It is intended that the surface of the concrete after stripping shall present a smooth, hard, and dense finish that will require a minimum amount of finishing. Sufficient number of forms shall be provided so that the work may be prosecuted rapidly and present a uniform appearance in form patterns and finish. Forms shall be clean and free from all dirt, debris, concrete, etc. and shall be coated with an acceptable form oil if required, prior to use or reuse.

The design of all concrete forms, falsework, and shoring shall be the responsibility of the Contractor and the design and installation of these items shall comply with all local, State, and Federal regulations.

Information on the Contractor's proposed forming system shall be submitted in such detail as the Engineer

may require to assure himself that the intent of the Specifications can be complied with by the use of the proposed system. Except as otherwise specified, or accepted in writing by the Engineer, only forming systems by manufacturers with a minimum of five years' experience shall be considered.

Vertical forms shall remain in place a minimum of 24 hours after the concrete is placed. If, after 24 hours, the concrete is sufficiently hardened to resist surface or other damage, the vertical forms may be removed. Other forms supporting concrete and shoring shall remain in place as follows:

Sides of footings	24 hours (minimum)
Vertical sides of beams, girders, and similar members	48 hours (minimum)
Slabs, beams, and girders	10 days (minimum) and until concrete strength reaches 85 percent of the specified strength
Shoring for slabs, beams, and girders	10 days (minimum) and until concrete strength reaches 85 percent of the specified strength
Wall bracing	Until concrete strength of the slab laterally supporting the wall reaches 85 percent of the specified strength

Forms shall not be removed from concrete which has been placed with outside ambient air temperature below 50 degrees F until the concrete has attained 85 percent of specified strength as determined by test cylinders stored in the field under equivalent conditions as the concrete structure. No heavy loading on green concrete (85 percent of specified strength) will be permitted. Immediately after forms are removed, the surface of the concrete shall be carefully examined, and any irregularities in the surface shall be repaired and finished as specified hereinafter.

#### 030204 INCIDENTALS

Where not shown otherwise on the Plans and Typical Details, all external angles of walkways, slabs, walls, beams, columns, and openings shall have a 3/4-inch bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip and external angles of walkways, walls, and slabs at expansion, contraction, and construction joints shall be a 1/2-inch bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip. Reentrant angles may be left square. Level strips shall be installed at the top of all wall concrete placements to maintain a true line at all horizontal construction joints.

Keyways shall be constructed as detailed on the Plans. Material for keyways shall be steel, plastic, or lumber treated with form coating, applied according to label directions.

Pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Plans or as required, shall be encased in the concrete. Dovetail anchors or ties shall be used in conjunction with the slots or inserts for the various materials as specified under their respective sections and as may be necessary for the required work.

### 030205 BRACING AND ALIGNMENT OF FORMS

It shall be the Contractor's responsibility to limit deviations in line and grade to tolerances which will permit proper installation of all structurally embedded items or mechanical and electrical equipment and piping.

All formwork shall be securely braced, supported, tied down, or otherwise held in place to prevent any movement of formwork. Adequate provisions shall be made for uplift pressure, lateral bulging of forms, and deflection of forms for slabs and beams.

When a second lift is placed on hardened concrete, special precautions shall be taken in the form work at the top of the old lift and bottom of the new lift to prevent spreading, vertical or horizontal displacement of forms; and to prevent grout "bleeding" on finished concrete surfaces. Pipe stubs, anchor bolts, and other embedded items shall be set in the forms where required.

Concrete beams or slabs shall not be placed directly on masonry walls so that any of the weight of the concrete either before or after the concrete has set is on the masonry wall, unless the masonry wall is identified on the Plans as "bearing wall."

No concrete shall be placed until all forms have been thoroughly checked by the Contractor for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items. All cracks, openings, or offsets at joints in the formwork which are 1/16-inch or larger shall be closed by tightening the forms or by filling with an acceptable crack filler.

### 030206 TOLERANCES

It is the intent that the finished concrete conforms to the shapes, lines, grades, and dimensions indicated on the Plans. It shall be the responsibility of the Contractor to comply with the intent of these Specifications, but it is also recognized that there will be occasions when some deviation will occur or be required. It shall therefore be agreed that the maximum deviation from true line and grade shall not exceed the tolerances listed below at the time of acceptance of the project.

- A. In general all tolerances shall comply with AC1 117-81, paragraphs 2.0 through 2.2 and paragraphs 4.0 through 4.5, except as modified in the following. All slabs shall be uniformly sloped to drain when a slope is indicated. Slabs which are indicated to be level shall have a maximum deviation of 1/8 inch in 10 feet without any apparent changes in grade.

### 030220 PREFORMED EXPANSION JOINT MATERIAL

Prefomed expansion joint material shall be sponge rubber or bituminous fiber types as specified herein. Specific type to be used in any application shall be as indicated on the Plans and on the Typical Details. The Contractor shall submit sufficient information on each type of material to the Engineer for review to determine conformance of the material to these Specifications.

Thicknesses and dimensions of the materials shall be as indicated on the Plans or as required according to the way it is used. Expansion joint strips shall be fastened to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.



Sponge rubber expansion joint material shall be Cementone Code 3329 as manufactured by W. R. Grace and Company, neoprene sponge rubber expansion joint as manufactured by Burke Concrete Accessories Inc.; or equal.

Bituminous fiber expansion joint material shall be Cone Fiber Expansion Joint Fillers Code 1390 as manufactured by W. R. Grace and company, Burke Fiber Expansion Joint, or equal.

### 030230 CAULKING, JOINTS, AND SEALING

Expansion, contraction, and construction joints shall be constructed as detailed on the Plans and Typical Details, and materials used shall be as specified herein. Pipe and conduit shall be installed in structures as detailed on the Plans and Typical Details, and shall be sealed with the materials specified herein. Doors, windows, louvers, and other items installed in or over concrete openings shall be caulked inside and out with the materials specified herein.

### 030231 CAULKING

All caulking where indicated on the Plans or as specified, except for masonry construction and where specified otherwise, shall be done with synthetic rubber sealing compound. Caulking shall be completed prior to painting.

Concrete must be thoroughly cured prior to caulking. All surfaces to be caulked shall be dry, clean, and free of dirt, grease, curing compounds, and other residue which might interfere with adhesion of the caulking compound. Concrete, masonry, wood, and steel surfaces shall be cleaned and primed in strict accordance with the manufacturer's recommendations prior to caulking. Sponge rubber filler materials may be used as backing for caulking, if acceptable to the Engineer. Filler material, when used, shall be compressible and untreated.

Caulking shall be applied with a pneumatic caulking gun. Nozzles of the proper shape and size shall be used for the application intended. A continuous bond shall be maintained between the caulking and the sides of the joint to eliminate gaps, bubbles, or voids and to fill the joint in a continuous operation without layering of the compound. All joints and seams shall be caulked by experienced applicators in a neat workmanlike manner.

No caulking shall be applied when the temperature exceeds 120 degrees F to avoid sponging or bubbling of compound. To hasten curing of the compound when used on wide joints subject to movement, the Contractor shall apply heat with infra-red lamps or other convenient means.

Excess caulking shall be removed by soaking and scrubbing before caulking has cured with Chem Seal CS9900; equivalent product of Products Research and Chemical Corporation; or equal. Excess cured material shall be removed by sanding with No. 80 grit sandpaper.

### 030260 SURFACE SEALANT SYSTEM

Concrete surfaces which are specified to be sealed watertight shall be sealed with ChemMasters, Spray-Cure & Seal 25 or equal. Material shall be applied as recommended by the manufacturer published instructions. Where concrete continues to sweat or leak, additional coats of the sealer shall be applied.

### 030261 SEALANT SCHEDULE

Sealant will be applied to the following surfaces: Sidewalk, curb, curb and gutter, waterway, collars & concrete patches.

### 030300 REINFORCEMENT

All reinforcing steel shall be new material, of the quality specified, free from excessive rust or scale or any defects affecting its usefulness.

### 030310 REINFORCING BARS

Reinforcing bars to be embedded in concrete or masonry shall be Grade 60 deformed bars conforming to ASTM A 615 and shall include the supplementary requirements. No field bending of bars will be allowed. All reinforcement bars lacking grade identification marks shall on delivery be accompanied by a manufacturer's guarantee of grade which will identify variations.

All bars shall be new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work. A thin coating of red rust resulting from short exposure will not be considered objectionable, but any bars having rust scale, loose mill scale, or a thick rust coat shall be thoroughly cleaned, or shall be rejected and removed from the premises upon order of the Engineer.

Bars shall be delivered bundled and tagged with identifying tags.

Bars shall be cut and bent in accordance with the provisions of ACI 315 and ACI 318. All bars shall be bent cold. Bars shall be free from defects and kinks and from bends not indicated on the Plans.

Reinforcing bars shall be welded where indicated on the Plans or acceptable to the Engineer. Welding shall be performed in accordance with AWS D1.4 "Structural Welding Code Reinforcing Steel."

Shop drawings on reinforcing steel detailed by the Contractor in accordance with the Contract Documents will not be reviewed and returned. The Contractor shall supply the Engineer with a copy of all reinforcing steel detail drawings. Changes to the Contract Documents made by the Contractor in reinforcing steel shop drawings shall be called out in the letter of submittal. Such changes will not be acceptable unless the Engineer has expressed consent to such changes in writing.

### 030311 PLACING BAR REINFORCEMENT

Reinforcing bars shall be accurately placed and adequately secured in position. Bars at splices shall overlap as specified or indicated on the Plans. If the lap splice length is not specified or indicated on the Plans, bars shall be lap spliced in accordance with ACI 318. Lap splices for masonry, if not specified or indicated on the Plans and not specified in DIVISION 4, shall be in accordance with the Uniform Building Code. Bar supports shall be galvanized steel, shall conform to ACI 315, and shall be furnished in sufficient number to prevent sagging and to support loads during construction, but in no case shall the quantities and locations of the supports be less than indicated in ACI 315. Bar supports, where used in slabs which will be exposed to view, shall be equipped with plastic tips. Reinforcing for concrete placed on the ground shall be supported by standard manufactured chairs, with steel plates for resting on the ground. No use shall be made of brick, broken concrete masonry units, spalls, rocks, or similar material

for supporting reinforcing steel.

Unless otherwise indicated on the Plans, reinforcement shall be placed so as to provide the thickness of protective concrete covering as indicated on the Typical Details. If not indicated on the Plans or Typical Details protective covering shall be in accordance with ACI 318.

The Contractor shall submit to the Engineer for review and acceptance samples of all chairs he proposes to use along with a letter stating where each type chair will be used. No concrete shall be placed until this prior acceptance has been obtained.

#### 030312 TYING BAR REINFORCEMENT

Bars shall be fastened securely in place with annealed steel wire ties. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (does not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity). Slab bars shall be tied at every intersection around the periphery of the slab and 50% at all other locations. Wall bars and slab bar intersections other than around the periphery shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

	<u>Slab Bars,</u> <u>inches</u>	<u>Wall Bars,</u> <u>inches</u>
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 and No. 11	120	96

The above tying requirements do not apply to reinforcement for masonry. For masonry, vertical bars shall be held in position at top and bottom and at intervals not exceeding 192-bar diameters.

Where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a length equal to the lap splice length indicated on the Plans. Where the lap splice length is not indicated on the Plans, then the lap splice length shall be as specified in ACI 318 and this Division. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

The Plans and Typical Details contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete.

#### 030400 MIXING CONCRETE

Mixing equipment shall be subject to review and acceptance by the Engineer. Mixers may be of the stationary plant, paver, or truck mixer type. Adequate equipment and facilities shall be provided for accurate measurement and control of all materials and for readily changing the proportions of the material.

The mixing equipment shall be capable of combining the aggregates, cement, and water within the

specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation.

Concrete mixing plant and equipment shall be maintained in good working order and shall be operated at the loads, speeds, and timing recommended by the manufacturer or as specified.

The cement and aggregate shall be proportioned by weight.

#### 030410 MACHINE MIXING

The batch plant shall be capable of controlling the delivery of all material to within 1 percent by weight of the individual material. If bulk cement is used, it shall be weighed on a separate visible scale which will accurately register the scale load at any stage of the weighing operation from zero to full capacity.

Cement shall not come in contact with aggregate or with water until the materials are in the mixer ready for complete mixing with all mixing water. The procedure of mixing cement with sand or with sand and coarse aggregate for delivery to the jobsite for final mixing and addition of mixing water will not be permitted. Retempering of concrete will not be permitted. The entire batch shall be discharged before recharging. The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer.

Mixing shall be done in batch mixers of acceptable type. Each mixer shall be equipped with a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanism shall be such that leakage will not occur when the valves are closed.

Transit-mixed concrete shall be mixed and delivered in accordance with ASTM C 94. The total elapsed time between the addition of water at the batch plant and discharging the completed mix shall not exceed 90 minutes or shall the elapsed time at the jobsite exceed 30 minutes. Under conditions contributing to quick setting, the total elapsed time permitted may be reduced by the Engineer. Each truck mixer shall be equipped with a device for counting the number of revolutions of the drum. Water shall not be admitted to the mix until the drum has started revolving. The right is reserved to increase the required minimum number of revolutions or to decrease the designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing, and the Contractor will not be entitled to additional compensation because of such increase or decrease.

In the case of other types of mixers, mixing shall be as follows. The concrete shall be mixed until there is uniform distribution of the materials, and the mixer shall be discharged completely before being recharged. Neither speed nor volume loading of the mixer shall exceed the manufacturer's recommendations. Mixing shall be continued for a minimum of 1-1/2 minutes after all materials are in the drum, and for batches larger than 1 cubic yard the minimum mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof.

#### 030420 HAND MIXED CONCRETE

Hand mixing of concrete shall be done only when requested by the Contractor in writing and accepted by the Engineer.

Hand mixed concrete shall be prepared on a watertight level platform in batches of not to exceed 1/3

cubic yard each. The required amount of coarse aggregate shall first be spread on the platform in an even and uniform layer, over which the proper proportion of fine aggregate shall then be likewise spread. The combined depth of both such layers shall not be greater than 1 foot. The required quantity of cement shall then be evenly distributed over the fine aggregate; following which the entire batch shall be turned with shovels at least twice before the water is added. The proper amount of water shall then be uniformly sprinkled or sprayed over the batch which shall thereafter be turned with shovels not less than three times before being removed from the platform.

#### 030500 CONVEYING AND PLACING CONCRETE

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials.

#### 030510 CONVEYING CONCRETE

Equipment for chuting, pumping, and conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials. Chutes and devices for conveying and depositing concrete shall be so designed and used that the concrete shall be directed vertically downward when discharged from the chute or conveying device.

Chutes for conveying concrete shall be kept thoroughly cleaned by washing and scraping upon the completion of any day's placement.

#### 030520 PLACING AND CONSOLIDATION

No concrete shall be placed without the prior authorization of the Engineer.

Concrete shall not be placed until all reinforcement is securely and properly fastened in its correct position and loose form ties at construction joints have been retightened, nor until all dowels, bucks, sleeves, hangers, pipes, conduits, bolts, and any other fixtures required to be embedded therein have been placed and adequately anchored, nor until the forms have been cleaned and oiled as specified.

Placement of concrete in which initial set has occurred or of retempered concrete will not be permitted.

No concrete shall be placed during rainstorms or high velocity winds. Concrete placed immediately before rain shall be protected to prevent the water from coming in contact with it or winds causing excessive drying. Sufficient protective covering shall be kept on hand at all times for protection purposes.

#### 030521 PLACING CONCRETE

The Contractor shall prepare and submit to the Engineer for review, a proposed sequence of placing concrete showing proposed beginning and ending of individual placements. After acceptance, this sequence shall be adhered to except when specific changes are requested by the Contractor and accepted by the Engineer. The Contractor shall notify the Engineer by written memorandum of his readiness (not just his intention) to place concrete in any portion of the work. This notification shall be such time in advance of the operation as the Engineer deems necessary for him to make final inspection of the preparations at the location of the proposed concrete placing. All forms, steel, screeds, anchors, ties, and inserts shall be in place before the Contractor's notification of readiness is given to the Engineer.

Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place and worked along the forms with the vibrator or otherwise. No concrete shall be dropped freely into place from a greater height than 5 feet. Tremies shall be used for placing concrete where the drop is over 5 feet. Placement of concrete on slopes shall commence at the bottom of the slope.

Concrete shall be placed in approximately horizontal layers not to exceed 24 inches in depth and shall be brought up evenly in all parts of the forms. Concrete placement shall continue without avoidable interruption, in a continuous operation, until the end of the placement is reached. The placement of concrete in wall forms shall not proceed at a faster rate of rise than 6 feet per hour when the temperature is 70 degrees F or over, and at a lesser rate for lower temperatures.

If it takes more than 20 minutes lapse prior to placement of new concrete over concrete previously placed, the depth of the layers being placed at one time shall be reduced, and/or placing equipment increased, until it is possible to return with the placing operation to previously placed concrete within 20 minutes. If concrete is to be placed over previously placed concrete and more than 20 minutes have elapsed, then a layer of grout not less than 1/2 inch thick nor more than 1 inch in thickness shall be spread over the surface before placing the additional concrete.

The placement of concrete for slabs, beams, or walkways cast monolithically with walls or columns shall not commence until the concrete in the walls or columns has been allowed to set and shrink. The time allowed for shrinkage shall be not less than one hour.

#### 030522 CONSOLIDATING CONCRETE

Concrete shall be placed with the aid of acceptable mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faces in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes, or other shapes built into the work. The vibration shall be sufficiently intense to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18 inches.

Sufficient vibrators shall be on hand at all times to vibrate the concrete as placed. In addition to the vibrators in actual use while concrete is being placed, the Contractor shall have on hand one spare vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

Special care shall be taken to place the concrete solidly against the forms so as to leave no voids. Every precaution shall be taken to make all concrete solid, compact, and smooth, and if for any reason the surfaces or interiors have voids or are in any way defective, such concrete shall be repaired in a manner acceptable to the Engineer.

#### 030523 REQUIREMENTS DUE TO EXTREME WEATHER CONDITIONS

For concrete placed when the ambient air temperature is above 90 degrees F, the forms and reinforcing steel shall be cooled to below 90 degrees F by water spraying. The temperature of the concrete mix at time of placement shall be kept below 90 degrees F by means possible which do not impair the quality of the concrete.

The Contractor shall secure the Engineer's acceptance for type of equipment to be used for heating materials and/or new concrete in the process of curing during excessively cold weather.

For concrete placed below an ambient air temperature of 40 degrees F, or 45 degrees F and falling, provision shall be made for heating the water. If materials have been exposed to freezing temperatures to the degree that any material is below 35 degrees F, the material shall be heated. Water, cement, or aggregate materials shall not be heated in excess of 160 degrees F. Concrete in the forms shall be protected by means of covering with tarpaulins, or other acceptable covering, and a means shall be provided for circulating warm moist air around the forms to maintain a temperature of 50 degrees F for at least five days.

For conditions which promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind, the Contractor shall take corrective measures to minimize the rapid water loss from the concrete. The Contractor shall submit the corrective measures he plans to use for review and acceptance by the Engineer prior to placing concrete.

The Contractor shall provide and use a sufficient number of maximum and minimum self-recording thermometers to adequately indicate the temperature around the concrete.

#### 030524 FOOTINGS AND SLABS ON GRADE

Concrete to be placed on ground or compacted fill shall not be placed until the subgrade is in a moist condition acceptable to the Engineer. If necessary, the subgrade shall be well sprinkled with water not less than 6 nor more than 20 hours in advance of placing concrete. If it becomes dry prior to the actual placing of concrete, it shall be sprinkled again, without forming pools of water. No concrete shall be placed if the subgrade is muddy or soft.

#### 030525 REPAIR OF DEFECTIVE CONCRETE

All defective work shall be removed and replaced or repaired. Any work which has not been constructed in accordance with the Plans and Specifications shall be considered defective.

Correction of defective work shall be as specified herein. No defective work shall be patched, repaired, or covered without inspection by the Engineer. Repair shall have a strength equal or greater than the specified concrete for the area. The Contractor shall provide a mix design for the grout which is proposed for use to the Engineer for review and acceptance. All imperfections in the work shall be chipped out and keyed ready for repair. The dry pack method shall be used for holes having a depth nearly equal to or greater than the least surface dimension of the hole, for cone-bolt, and narrow slots cut for repair. Smooth holes shall be roughened with a rotohammer before repair. The mortar method of replacement shall be used for holes too wide to dry pack and too shallow for concrete replacement and shall be used for comparatively shallow depressions, large or small, which extend no deeper than the reinforcement nearest the surface. Concrete replacement shall be used when holes extend entirely through the concrete section or when holes are more than 1 square foot in area and extend halfway through the section. All surfaces of the set concrete to be repaired shall first be coated with epoxy bonding agent, Adhesive Engineering Concrete No. 1001 LPL; Sika Chemical Corporation, Sikadur Hi-Mod; or equal. No repair shall be made until the Engineer has accepted the method of preparing the surface and proposed method of repair.

The color of the repair concrete dry pack and grout shall match that of the adjoining concrete. The use of

white cement may be required to match color. The Contractor shall prepare test panels for proposed repairs at the beginning of the project for review and approval by the Engineer. This panel will serve as a standard for repairs during the project.

Curing of all repaired concrete shall be the same as specified for concrete.

#### 030600 CURING CONCRETE - GENERAL

All concrete shall be cured by the methods specified herein. All concrete shall have cure method placed within 24 hours of placement or immediately following removal of forms. All concrete shall be cured a minimum of seven days. All concrete that is to be painted shall be water or plastic membrane cured. No curing compound shall be used on any concrete surface that is to receive paint or upon which any material is to be bonded. All other concrete shall be cured by water curing or sprayed curing membrane at the Contractor's option, except floors and slabs which are specified to be sealed with a concrete sealer. Floor slabs may be cured using a plastic film membrane curing.

#### 030601 WATER CURING

All surfaces of concrete being water cured shall be kept constantly and visibly moist day and night for a period of not less than seven days and nights. Each day the forms remain in place may count as one day of water curing. No further curing credit will be allowed for forms in place after contact has once been broken between the concrete surface and the forms. Ties shall not be loosened during the period when concrete is being cured by leaving the forms in place. The top of walls shall be flooded with water at least three times per day, and the concrete surface shall be kept moist at all times during the seven-day curing period.

#### 030602 SPRAYED MEMBRANE CURING

Membrane curing compound shall be a clear type with fugitive dye conforming to ASTM C 309, Type 1D.

The curing compound shall be applied to the concrete surface after repairing and patching, within 24 hours of placement or immediately following removal of forms. If more than one hour elapses after the removal of the forms, membrane compound shall not be used and water curing shall be applied for the full curing period. If the surface requires repairing or painting, the concrete shall be water cured.

Curing compound shall not be removed from the concrete in less than seven days. Curing compound may be removed by the Contractor only upon written request by the Contractor and acceptance by the Engineer, stating what measures the Contractor shall take to adequately cure the structure.

Care shall be taken to apply curing compound in the area of construction joints to see that curing compound is placed within the construction joint silhouette. The curing compound placed within the construction joint silhouette shall be removed by sandblasting prior to placing any new concrete.

The Contractor has the option of water curing the construction joint. Any curing compound shall be removed through heavy sandblasting of the joint.

Curing compound shall be applied by a mechanical, power operated spray and mechanical agitator that



will uniformly mix all pigment and compound. The compound shall be applied in at least two coats. Each coat shall be applied in a direction opposite to the preceding coat. The compound shall be applied in sufficient quantity so that the surface will have a uniform appearance and will effectively and completely conceal all natural color of the concrete at the time of the spraying. The Contractor shall continue to coat and recoat the surface until the specified coverage is achieved and until a coating film remains on the surface of the concrete. The thickness and coverage of the compound shall be such that the film can be scraped from the surface at any and all points after drying for at least 24 hours.

The Contractor is cautioned that the method of applying curing compound specified herein may require more compound than normally suggested by the manufacturer of the compound and also more than is customary in the trade. The amounts specified herein shall be applied, regardless of manufacturer's recommendations or customary practice, if the Contractor elects to use curing compound in place of water curing.

If the Contractor desires to use a curing compound other than the specified compound, the Contractor shall coat sample areas of concrete wall with the proposed compound and also a similar adjacent area with the specified compound in the specified manner for comparison. Complete data on the proposed compound shall also be submitted for review. If the proposed sample is not equal or better, in the opinion of the Engineer, in all features, the proposed substitution will not be allowed.

Prior to final acceptance of the work, the Contractor shall remove, by sandblasting or other acceptable method, any curing compound on surfaces that will be exposed to view, so that only the natural color of the finished concrete will be visible uniformly over the entire surface.

#### 030603 PLASTIC MEMBRANE CURING

Polyethelene film may be used to cure slabs, and shall be sealed at joints and edges with a small sand berm. The plastic membrane shall be installed as soon as the concrete is finished and can be walked on without damage. The concrete shall be kept moist under the plastic membrane.

#### 030610 CONCRETE FINISHING

Concrete finishes shall be in accordance with the Concrete Finish Schedule indicated on the Drawings. Finish designations shall be as defined below except that all concrete surfaces to be painted shall be "sacked" with cement mortar and whip sand blasted. All form ties shall be removed from all surfaces. Tie holes shall be roughened by heavy sandblasting before repair.

Edges of all joints shall be as indicated on the Drawings. Edges shall include any line where placement is stopped. All wall and slab surfaces at edges shall be protected against concrete spatter and shall be thoroughly cleaned upon completion of each placement.

Cement for finishes shall be from the same source and be of the same type as the concrete to be finished. The addition of white cement may be required to produce a finish which matches the color of the concrete to be finished. The Contractor shall prepare test panels for F-4 and F-5 finishes and tie-hole repairs for review and approval of the Engineer. The approved panels shall serve as the standard of quality and workmanship for the project.

A. The following finishes shall be used for vertical concrete surfaces:

1. FINISH F1: No special treatment other than repair of defective work and filling depressions 1-inch or deeper, and filling tie holes.
2. FINISH F2: No special treatment other than repair of defective work, removal of fins, filling depressions 1/2-inch or deeper, and filling tie holes.
3. FINISH F3: Finish F3 shall have defective work repaired, fins removed, and all offsets and projections ground smooth, and shall have all depressions 1/4-inch or larger in depth or width filled with mortar, and tie holes filled.
4. FINISH F4: The finish specified for Finish F3, and, in addition shall have all depressions and holes 1/16-inch or larger in width or depth filled with mortar. The mortar shall consist of 1 part cement and 1-1/2 parts of fine sand passing the No. 100 screen mixed with enough water and an emulsified bonding agent to have the consistency of a thick cream. The surfaces shall be "brush off" sandblasted prior to filling holes to expose all holes near the surface of the concrete. The surfaces shall be thoroughly wetted, and filling of all pits, holes, and depressions shall commence while the surface is damp. Filling shall be done by rubbing the mortar over the entire area with clean burlap, sponge rubber floats, or trowels. No material shall remain on the surface except that within the pits and depressions. The surfaces shall be wiped clean and moist cured.
5. FINISH F5: Exterior concrete surfaces exposed to view shall receive the same finish specified for Finish F3, and, in addition, shall receive a special stoned finish. The procedure shall be as follows:

Forms shall be removed as specified herein and all required repairs, patching, and pointing performed. The surfaces shall be wet thoroughly with a brush and rubbed with a hard wood float dipped in water containing two pounds of Portland cement per gallon. The surfaces shall be rubbed until all form marks and projections have been removed. The grindings from the rubbing operations shall be spread uniformly over the surface with a brush in such a manner as to fill all pits and small voids.

The brushed surface shall be moist cured and allowed to harden for three days, after which a final finish shall be obtained by rubbing with a carborundum stone of approximately No. 50 grit until the entire surface has a smooth texture and is uniform in color. Curing shall be continued for the remainder of the specified time. If any concrete surface should be allowed to become too hard to finish in the above specified manner, all related surfaces exposed to view, whether finished or not, shall be sandblasted and washed. While still damp, a plastic mortar, consisting of 1 part cement to 1-1/2 parts of sand which will pass a No. 16 screen, shall be rubbed over the surface and handstoned with a No. 60 grit carborundum stone, using additional mortar until the surface is evenly filled without an excess of mortar. Stoning shall be continued until the surface is hard. After moist curing for three days, the surface shall be made smooth in texture and uniform in color by use of a No. 50 or No. 60 grit carborundum stone. After stoning, curing shall continue until seven day curing period is completed.

- B. After proper and adequate vibration and tamping, the following finishes shall be used for

horizontal concrete surfaces:

1. FINISH S1: Screeded to grade and left without special finish.
2. FINISH S2: Smooth steel trowel finish.
3. FINISH S3: Steel trowel finish free from trowel marks. The finish shall be smooth and free of all irregularities.
4. FINISH S4: Steel trowel finish, without local depressions or high points, and in addition, shall be given a light hairbroom finish. Stiff bristle brooms or brushes shall not be used. Brooming shall be parallel to slab-drainage. Resulting finish shall be rough enough to provide a nonskid finish. Finish shall be subject to review and acceptance by the Engineer.

#### 030610.01 FINISHING

Concrete surfaces shall be finished as indicated on the Plans and Typical Details. Where not specified or indicated on the Plans, the surfaces shall be finished as follows:

Exposed walkways and driveway aprons	Finish - S4
Exposed curbing & slabs	Finish - S3 & F3
Buried concrete surfaces	Finish - S1 & F1

#### 030700 CEMENT MORTAR AND GROUT

Cement mortar or grout for the repair of imperfect concrete work, filling of holes left by form bolts or ties, and the filling of voids around items through the concrete, and grout for spreading over construction joints and cold joints etc., shall consist of Portland cement and sand mixed in the same proportions used for the concrete being repaired, with only sufficient water to give the required consistency. Essentially, this would consist of the concrete mix with the coarse aggregate removed and water quantity required. In no case shall the water-cement ratio be more than that specified for the concrete being repaired. In the case of mortar being used for patching or repairing exposed concrete surfaces which are not to be painted or which will not be submerged in water, sufficient white cement shall be used to make the color of the finished patch match that of the surrounding concrete. Bolt and tie holes shall be roughened with a rotohammer filled with dry-pack mortar, well tamped into the holes. For dry-pack mortar, only enough water shall be used so that the resulting mortar will crumble to the touch after being "balled."

Concrete surfaces shall be roughened with a rotohammer, cleaned, and thoroughly damp before grout or mortar is placed, or, where indicated on the Plans or specified, an epoxy bonding agent, such as Concessive No. 1001 LPL as manufactured by Adhesive Engineering Company, Sikadur Hi-Mod as manufactured by the Sika Chemical Corporation, or equal, shall be applied to the clean, roughened, dry surface before placing the mortar or grout.

Grout for spreading over the surfaces of construction joints or cold joints shall consist of sand and cement with no more water used than allowed by the water-cement ratio specified for the concrete.

Particular care shall be exercised in placing cement mortar or grout since it will be expected to furnish structural strength or an impermeable water seal or both. Cement mortar or grout that has not been placed within 30 minutes after mixing shall not be used.

Grout for which the mix is not otherwise specified shall be mixed in the proportions by volume of one part cement to four parts of concrete sand.

#### 030710 NONSHRINK GROUT

Nonshrink grout shall be made with a hydraulic cement, which when mixed with water will harden rapidly to produce a permanent high strength material suitable for exterior use. Nonshrink grout shall be nonmetallic and shall not contain calcium chloride or other chemicals which accelerate the corrosion of embedded steel. The grout shall show no shrinkage prior to initial setting in accordance with ASTM C 827 and shall show no shrinkage in the hardened state when tested in accordance with ASTM C 157 and Corps of Engineers CRD C-621. Nonshrink grout shall be Five Star Grout manufactured by U.S. Grout Corporation, Masterflow 713 Grout manufactured by Master Builders, or equal.

When mixed in accordance with manufacturer's published instructions, the nonshrink grout shall be semi-fluid and suitable for placing by pouring into place when mixed to a flowable consistency. The compressive strength tested in accordance with ASTM C 109 shall be not less than 3,000 psi at 1 day and not less than 6,000 psi at 28 days. Setting time tested in accordance with ASTM C 191 shall be not less than 30 minutes.

#### 030800 SPECIAL CONCRETES

##### 030811 CONDUIT ENCASEMENT

All concrete used for the encasement of electrical ducts, conduits, etc. shall be colored red by mixing into each cubic yard of concrete 10 pounds of red oxide No. 1117 as manufactured by the Frank D. Davis Company; equivalent product by I. Reiss Company, Inc.; or equal.

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