CITY OF WOODLAND PARK, COLORADO

TITLE 6

CONCRETE CONSTRUCTION

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6.1 DESIGN

6.1.1 GENERAL PROVISIONS

All concrete work within any street, parking lot, trail, alley R.O.W. or in any part of the water system, sewage system, parks, and storm drainage system of the City shall meet the requirements of these Engineering Specifications. Engineering, plans, licenses, permits, inspection, warranties and acceptance shall be as detailed in these applicable Engineering Specifications for the type of construction involved.

Permits shall be obtained before work begins. Responsible Party shall give the City Engineer or appointed representative 48 hours notice, and inspection shall be made before placement of concrete can occur. Written notice of Inspector's approval to place materials shall be obtained by Responsible Party after inspection has been made and before concrete is placed. Written notice of rejection shall be given to Responsible Party in the event any aforementioned conditions given by the City Engineer or appointed representative are not met, and work shall be halted until corrective action is taken. Copies of the approved drawings and the permit shall be on the job site and available to the Inspector.

Concrete shall be composed of Portland cement, aggregate, and water, and shall be reinforced with steel bars, steel wire fabric or fibrous reinforcing where required. No admixture other than air-entraining agents shall be used without written permission of the City Engineer or appointed representative. All concrete shall have a minimum compressive strength of 4,000 psi in 28 days.

6.2 CONCRETE

6.2.1 CEMENT

All cement used in concrete work shall be Portland cement conforming to the requirements of ASTM C-150, Type I, IA, Type I/II modified, II, Type V. In general, Type II shall be used in concrete that shall be in contact with the soil, unless otherwise allowed or directed by the City Engineer or appointed representative. Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.

The Responsible Party shall be responsible for the proper storage of all cement until it is used. No damaged cement shall be used in the work, and all such cement shall be immediately removed from the site when so ordered by the City Engineer or appointed representative. When requested by the City Engineer or appointed representative the Responsible Party shall, at his own cost and expense, furnish the City Engineer or appointed representative with a certificate from an acceptable testing laboratory for each carload of cement from which cement is taken for use in the work, stating that the cement meets the requirements of these Engineering Specifications for Portland cement.

6.2.2 WATER

Water for concrete shall be clean and free from sand, oil, acid, alkali, organic matter, or other deleterious substances. Water from public supplies of water, which has been proven suitable for drinking, is satisfactory.

6.2.3 ADMIXTURES

The Responsible Party shall use air-entraining admixtures for all surfaces of exposed concrete. The Responsible Party may elect to use another admixture provided the admixture is specifically approved by the City Engineer or appointed representative. Admixtures to be used for plasticizing, densifying, or acceleration of hardening of concrete shall, when added to the mixture, produce a concrete of specified strength in seven (7) day and 28 day tests. Documented evidence of acceptability shall be required when new or unknown admixtures are proposed for use. Air-entraining admixtures shall conform to the requirements of ASTM C-260.

6.2.4 FINE AGGREGATE

Fine aggregate shall be composed of clean, hard, durable, uncoated particles of sand, free from of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate shall be well graded from coarse to fine and when tested by means of laboratory sieves shall meet the CDOT Concrete Aggregate Gradation Table and shall conform to AASHTO M6:

Sieve Size	Percent Passing
3/8”	100
#4	95 - 100
#8	80 - 100
#16	45 - 80
#30	25 - 60
#50	10 - 30
#100	2 - 10

6.2.5 COARSE AGGREGATE

The coarse aggregate shall consist of broken stone or gravel composed of clean, hard, tough and durable stone and shall be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, organic, or other deleterious matter.

Coarse aggregate shall conform to Number 357 or Number 467 course aggregate from the CDOT Concrete Aggregate Gradation Table 703-1, which shall also conform to AASHTO M43.

6.2.6 FIBROUS REINFORCING

A. When specified by the City Engineer or appointed representative fibrous reinforcing shall be used in all Portland cement concrete used for all curb, gutter, sidewalks, curb turn fillets, cross pans, and valley gutters.

B. The following shall be submitted to the City Engineer or appointed representative:

1. One (1) copy of manufacturer's printed product data clearly marked indicating proposed fibrous concrete reinforcement materials. Printed data should state 1.5 lbs of fiber to be added to each cubic yard of each type of concrete.

2. One (1) copy of manufacturer's printed batching and mixing instructions.

3. One (1) copy of a certificate prepared by the concrete supplier stating that the approved fibrous concrete reinforcement materials at the rate of 1.5 lbs per cubic yard were added to each batch of concrete delivered to the project site. Each certificate shall be accompanied by one (1) copy of each batch delivery ticket-indicating amount of fibrous concrete reinforcement material added to each batch of concrete.

C. Fibrous concrete reinforcement shall consist of:

1. 100 percent virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. Fibrous concrete reinforcement shall be as manufactured by Fibermesh Company, 4019 Industry Drive, Chattanooga, Tennessee 37416, or approved equivalent. Substitutions may he considered at the discretion of the City.

2. Physical characteristics:
   a. Specific gravity = 0.905 grams per cubic centimeter.
   b. Fiber lengths: ½ inch, ¾ inch, 1½ inch, two (2”) inches per manufacturer.
   c. Fibrous concrete reinforcement materials provided by this subsection shall produce concrete conforming to the requirements for each type and class of concrete required as indicated.
   d. Construction methods:
      (1) Add fibrous concrete reinforcement to concrete materials at the time concrete is batched in amounts in accordance with approved submittals for each type of concrete required.
      (2) Mix batched concrete in strict accordance with fibrous concrete reinforcement manufacturer's instructions and recommendations for uniform and complete dispersion.

D. CONCRETE PLACING AND FINISHING. Place and finish concrete materials as specified in Subsection 6.3.

All other right-of-way construction shall conform to the diagrams in Section 6.4. Where diagrams are not applicable or special conditions exist, all construction shall be approved in writing by the City Engineer or appointed representative.

6.3 CONSTRUCTION

All concrete shall be thoroughly mixed in a batch mixer of an approved type and capacity for a period of not less than two (2) minutes after all the materials, including the water, have been placed in the drum. During the period of mixing, the drum shall be operated at the speed specified by the manufacturer of the equipment. The entire contents of the mixer shall be discharged before recharge, and the mixer shall be cleaned frequently. The concrete shall be mixed only in such quantities that are required for immediate use. No re-tempering of concrete shall be permitted. Hand-mixed concrete shall not be permitted except by written approval of the City Engineer or appointed representative; and then in only very small quantities or in case of an emergency.

6.3.1 MIX DESIGN

A. PROPORTIONING

Proportioning the "dry" constituents of all concrete mixtures shall be accomplished by weighing. The Responsible Party shall provide adequate and accurate scales for this work. Scales shall be accurate within the allowable tolerances as prescribed by state law. The scales shall be sealed by the measurement standards section of the Colorado Department of Agriculture at least once each year, each time the scales are relocated, and as often as the City Engineer or appointed representative may deem necessary. Scales shall be operated by operators certified by the measurement standards section of the Colorado Department of Agriculture. The certified weigher shall perform the duties according to the Colorado Department of Agriculture's regulations. There shall be no variance permitted in the minimum cement factor (sacks per cubic yard) as specified for the calls of concrete. The total quantity of mixing-water per sack of cement, including free water in the aggregates, shall not exceed the maximum specified herein.

The Responsible Party shall be responsible for developing the proper proportions of aggregates, cement and water that shall conform to the various requirements of these Engineering Specifications. Mix design shall be submitted to the City Engineer or appointed representative, along with at least two (2) sets of certified 28 day test results, for review and approval. No concrete shall be incorporated into the work until the proportions are approved by the City Engineer or appointed representative.

B. CLASSIFICATION

Shall conform to CDOT Standard Specifications Table 601-1 for concrete classes and mix requirements for class Ax, except that Number 357 or Number 467 shall be used.

C. READY-MIXED CONCRETE

The use of ready-mixed concrete in no way relieves the Responsible Party of the responsibility for proportion, mix, delivery, or placement of concrete; all concrete must conform to all requirements of these Engineering Specifications and ASTM C-94.

Concrete shall be continuously mixed or agitated from the time the water is added until the time of use and shall be completely discharged from the truck mixer or truck agitator within 1½ hours after it comes in contact with the mixing water or with the aggregates. Retempered concrete shall not be allowed.

The City shall have free access to the mixing plant at all times of operation. The organization supplying the concrete shall have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate. The Responsible Party shall collect delivery, or batch, tickets from the driver for all concrete used on the project and deliver them to the City Engineer or appointed representative. Batch tickets shall provide the following information:

1. Weight and type of cement.
2. Weights of fine and coarse aggregates.
3. Volume (in gallons) of water including surface water on aggregates.
4. Quantity (cubic yards) per batch.
5. Times of batching and discharging of concrete.
6. Name of batch plant.
7. Name of Responsible Party.
8. Type of mix.
9. Type and amount of admixture.
10. Date and truck number.

6.3.2 SPACING OF JOINTS

A. EXPANSION JOINT

Expansion joint material shall be provided at the following locations and shall be in place prior to the placement of concrete:

1. At each end of curb return.
2. At both edges of driveway.
3. Between back of sidewalk and driveway slab or service walk.
4. Between new concrete and existing masonry buildings.

5. As shown on the drawings.
6. As directed by the City Engineer or appointed representative.
7. Between new and existing concrete.
8. Every 100 feet in sidewalk curb and gutter when handformed.
9. Every 200 feet in sidewalk, curb and gutter when place slip formed.
10. At or around inlets.

B. CONTRACTION JOINTS

Transverse joints shall be placed at maximum intervals of 10 feet to control random cracking; joints shall be formed, sawed, or tooled to a minimum depth of ¼ of the total thickness. If divider plates are used, the maximum depth of plates shall not be greater than ½ depth at the finished surface and shall be no less than one (1") inch.

C. TOOL JOINTS

Tool joints shall be spaced as follows:

1. Not more than ten 10 feet nor less than five (5') feet apart in curb and gutter and combination curb-sidewalk.
2. Not more than the width of the sidewalk (up to eight (8') feet), nor less than five (5') feet apart in sidewalk.
3. At least two (2) joints, equally spaced at not greater than 10 foot intervals applicable in driveways.
4. As directed by the City Engineer or appointed representative.

D. JOINT MATERIALS

Joint materials shall conform to AASHTO, ASTM Specifications according to the types as follows:

Joint Material	AASHTO	ASTM
Concrete joint sealer, hot poured elastic or Corning 888 or approved equivalent	M-173	D-1/90-74
Preformed expansion joint filler (Bituminous Type)	M-33	D-99-71
Preformed sponge rubber and cork expansion joint fillers	M-153	D-1752-67
Preformed expansion joint fillers-nonextruding and resilient bitumen	M-213	D-1751-73

6.3.3 REINFORCING STEEL AND FORMS

Before being positioned, all reinforcing steel shall be thoroughly cleaned of mill and rust scale and of coatings that destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, cleaned.

Reinforcement shall be carefully formed to the dimensions indicated on the plans by the cold bending method. Cold bends shall be made around a pin having a diameter of six (6) or more times the diameter of the reinforcing bars. Reinforcement shall not be bent and then straightened. Bars with kinks or bends not shown on the plans shall not be used. Precast mortar blocks, or other non-metal supports not approved by ACI shall not be allowed to remain in the concrete placement.

Reinforcing steel shall be accurately placed and secured against displacement by using annealed iron wire of not less than No.18 gauge, or by suitable clips at intersections. Where necessary, reinforcing steel shall be supported by ACI approved metal or plastic chairs, spacers, or metal hangers. Splicing of bars, except where shown on the plans, shall not be permitted without approval of the City Engineer or appointed representative.

Welded wire fabric for concrete reinforcement shall be of the gauge, spacing, dimensions, and form specified on the plans or detailed drawings and shall comply with "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A-741) or "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement" (ASTM A-497).

Responsible Party shall submit to the City Engineer or appointed representative shop drawings of the reinforcement for his approval. The City Engineer or appointed representative's approval of shop drawings and bar schedules shall not relieve the Responsible Party of fulfilling his responsibilities as outlined in the plans and specifications.

Unless otherwise shown on the plans, the minimum clear cover for reinforcing steel shall be the following, which is specified in ACI -301, Section 5.5:

- Bottom bars on soil bearing foundations and slabs, three (3") inches
- Bars adjacent to exposed surfaces or earth backfill:
  - > For bars more than ¾ inches in diameter, two (2") inches
  - > For bars ¾ inch or less in diameter, 1½ inches
- Interior Surfaces: slabs, walls, and joints with $1\frac{3}{8}$ inch diameter or smaller, ¾ inch

Whenever necessary, forms shall be used to confine the concrete and shape it to the required lines. Forms shall have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete. Forms shall be constructed so that the finished concrete shall conform to the shapes, lines, grades and dimensions indicated on the approved plans. Any form which is not clean and has not had the surface prepared with a commercial form oil that shall effectively prevent bonding and that shall not stain or soften concrete surfaces shall not be used.

Plywood forms, plastic coated plywood forms, or steel forms shall be used for all surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces of covered channels, or other places permanently obscured from view, may be formed with forms having sub-standard surfaces.

Forms shall not be disturbed until the concrete has hardened sufficiently to permit their removal without damaging the concrete or until the forms are not required to protect the concrete from mechanical damage. Minimum time before removal of forms and placing concrete shall be one (1) day for footings and Class “B” concrete and two (2) days for all other concrete except in curbs, gutters, sidewalks and pavements. The use of slip forms and concrete paving machines shall be allowed, with approval of the City Engineer or appointed representative.

6.3.4 PLACING CONCRETE

A. SUBGRADE PREPARATION

The subgrade shall be excavated or filled to the required grades and lines. All soft, yielding, or otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted and compaction shall extend a minimum of two (2’) feet outside the form lines.

The subgrade shall be compacted to the density shown on the plans or Title 7, Section 7.5.2, whichever is greater, and trimmed to provide a uniform surface at the correct elevation. A compaction test is required for every 100 lineal feet of sidewalk to be placed.

Before depositing concrete, debris shall be removed from the space to be occupied by the concrete and the forms, including any existing concrete surfaces and shall be thoroughly wetted. Concrete shall not be placed until all forms and reinforcing steel have been inspected and approved by the City Engineer or appointed representative. Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods, which prevent separation or loss of ingredients. The concrete shall be deposited in the forms as neatly as practicable in its final position to avoid rehandling. It shall be deposited in continuous layers, the thickness of which generally shall not exceed 12 inches. Concrete shall be placed in a manner that shall avoid segregation and shall not be dropped freely more than five (5’) feet. If segregation occurs, the City Engineer or appointed representative may require the concrete to be removed and replaced at the Responsible Party's expense. Concrete shall be placed in one (1) continuous operation, except where keyed construction joints are shown on the plans or as approved by the City Engineer or appointed representative. Delays in excess of 30 minutes may require removal and replacement of that pour, as determined by the City Engineer or appointed representative.

B. VIBRATING

Concrete shall be thoroughly compacted and/or vibrated. All concrete shall be compacted by internal vibration using mechanical vibrating equipment, except that concrete in floor slabs, sidewalks, or curb and gutter, not poured against form linings, shall be either tamped or vibrated. Care shall be taken in vibrating the concrete to vibrate only long enough to bring a continuous film of mortar to

the surface. Vibration shall stop before any segregation of the concrete occurs. Mechanical vibrators shall be an approved type as specified in ACI Publication 309, Chapter 5. Vibrators shall not be used to move or spread the concrete.

Any evidence of the lack of consolidation or over consolidation shall be regarded as sufficient reason to require the removal of the section involved and its replacement with new concrete at the Responsible Party's expense. The Responsible Party shall be responsible for any defects in the quality and appearance of the completed work.

C. WORKABILITY

The consistency of concrete shall be kept uniform for each class of work and shall be checked by means of slump tests or Kelly ball tests. The workability of the concrete shall be varied as directed by the City Engineer or appointed representative. At all times concrete shall have a consistency such that it can be worked into corners and angles of the forms and sound joints, dowels and tiebars by the construction methods which are being used without excessive spading, segregation or undue accumulation of water or latent material on the surface. If, through accident, intention, or error in mixing, any concrete fails to conform to the proportions of the approved mix design, such concrete shall not be incorporated in the work but shall be properly disposed of off the project site as waste material at the Responsible Party's expense. No water may be added at the job site without permission of the City Engineer or appointed representative. If approval is obtained and water is added at the job site, slump tests shall be run and test cylinders cast following the addition of the water. Any expense incurred in testing shall be borne by the Responsible Party.

6.3.5 FINISHING AND CURING

A. FINISHING CONCRETE

Where applicable, finishing shall be done with a metal screed designed to give proper shape to the section as detailed. Particular care shall be used to finish the gutter flowline to a true, uniform grade. When using face forms, they shall be left in place until the concrete has hardened sufficiently so that they can be removed without injury to the curb. The Responsible Party shall use at all times, a 10 foot straightedge for finishing curb and gutter sections. When irregularities are discovered, they shall be corrected by adding or removing concrete. All disturbed places shall be floated with a wooden or metal float which is not less than three (3’) feet long and not less than six (6”) inches wide, and again straightened. No water or cement shall be added to the surface of the concrete to aid in finishing, excessive working of the finished surface will not be permitted. Products such as “CONFILM” Evaporation Reducer, manufactured by BASF, or equal may be used. Before final finishing is complete and the concrete has taken its initial set, edges of the concrete and joints shall be carefully finished with an edger having a ⅛ inch radius. Concrete shall be finally finished with a wood float and lightly broomed to a slightly roughened surface. On

grades less than one (1) percent, the Responsible Party shall check for depressions before final finish so that no water holes exist. Any water puddles or "bird baths" larger than one (1) square foot and deeper than $^3/_8$ inch shall be cause for removal and replacement of the defective sections of concrete.

Exposed faces of curbs and sidewalks shall be finished to true-line and grade as shown on the plans. Sidewalk and curb shall be broomed or combed and edged, unless otherwise directed by the City Engineer or appointed representative. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms shall be tooled with an edger having a $^3/_8$ inch radius. No dusting or topping of the surface or sprinkling with water to facilitate finishing shall be permitted.

Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface shall be left sound, of acceptable finish, even, and uniform in color. Mortar used in pointing shall not be more than 30 minutes old. All construction and expansion joints in the completed work shall be left carefully tooled, free of all mortar, and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

B. CURING

Fresh concrete shall be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the City Engineer or appointed representative. The selected curing process shall be started as soon as it can be done without injury to the concrete surface. The use of a membrane curing compound is required.

The following curing procedures may be used subject to the approval of the City Engineer or appointed representative

1. Ponding (for slabs or footings).
2. Membrane curing compound.
3. Wet burlap, earth, or cotton mats.
4. Waterproof paper or polyethylene plastic cover.

Liquid membrane curing compound shall be Type 2, white pigmented Class B in accordance with AASHTO M148. Curing compound shall be applied immediately after the water sheen has left the finished concrete. At the time of application, pigmented curing compounds shall be thoroughly mixed, with the pigment uniformly dispersed throughout the mixture. The compound shall be applied at a rate to completely cover the surface uniformly and at a rate that will achieve the performance requirement specified in ASTM Specification C-309.

Liquid membrane curing compound shall not be used when the concrete surface is to be painted. The type of membrane curing compound chosen shall not permanently discolor the concrete surface. Where membrane curing compound is not used, the curing process shall be carefully adhered to as follows:

1. Surfaces being wetted by ponding, spraying, or wetted material shall be kept completely wetted, with an excess of free water on the surface, at all times for the first 72 hours. After this period, but for the remaining four (4) days, a wetting schedule shall be followed whereby the concrete is wetted on a schedule approved by the City Engineer or appointed representative.

2. Surfaces being protected by waterproof paper or polyethylene plastic cover shall receive special attention during the first 72 hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The engineer may require the removal of the cover and a wetting of the surface when, in his judgement, there is insufficient moisture for curing.

   After the first 72 hours the cover shall be kept tightly in place for the remainder of the curing period.

C. CURING TIME

Walks shall not be opened to pedestrian traffic for at least 24 hours after placement; driveways, crosspans, and curb and gutter shall not be opened to vehicular traffic for at least seven (7) days after placement. The contractor shall maintain suitable barricades to comply with these requirements.

D. PROTECTION

1. Cold Weather Concreting

   During extreme weather conditions, placing of concrete shall be permitted only when the temperature of the concrete placed in the forms is not less than 60 degrees Fahrenheit nor more than 90 degrees Fahrenheit. To maintain this temperature range, the Responsible Party shall provide acceptable heating apparatus for heating the aggregates and the water. Concrete may be placed when the air temperature in the shade is 40 degrees Fahrenheit, and rising. No concrete shall be placed, regardless of the present temperature, when the weather forecast promises freezing weather before final set of the concrete unless special means of heating and protection are used. Protection against freezing is the Responsible Party's responsibility regardless of the weather forecast or climatic conditions at the time of placing.

   Small structures and slabs may be protected by completely covering fresh concrete with plastic sheeting or insulating blankets to a thickness

that insures protection. Material shall be secured to prevent displacement by the elements. Large structures or vertical walls shall be protected against freezing by enclosing the structure and heating with salamanders, heaters, or other devices capable of providing uniform and even heat throughout the structure.

Concrete placed in cold weather shall be protected from extreme temperatures as follows:

a. A temperature of at least 50 degrees Fahrenheit for the first 72 hours shall be maintained.
b. After the first 72 hours and until the concrete is seven (7) days old, it shall be protected from freezing temperatures.
c. Concrete adjacent to heaters or salamanders shall be insulated from direct heat of the unit, which may dry it out prior to being properly cured.
d. Temperatures shall be measured by maximum and minimum thermometers furnished by the Responsible Party and installed adjacent to the concrete.

Concrete slabs shall not be placed regardless of temperature conditions if the supporting ground is frozen or contains pockets of frost. Use of salt or other additives to prevent concrete from freezing shall not be allowed. Concrete which has been frozen shall be completely removed and replaced as directed by, and to the satisfaction of, the City Engineer or appointed representative.

2. Hot Weather Concreting

Except by written authorization, concrete shall not be placed if the temperature of the plastic concrete cannot be maintained at 90 degrees Fahrenheit or lower. The placement of concrete in hot weather shall comply with ACI 305.

6.3.6 MISCELLANEOUS

A. REPAIRS

After stripping of the forms, if any concrete is found to be not formed as shown on the drawings or is out of alignment or level, or shows a defective surface, it shall be considered as not conforming with the intent of these Engineering Specifications and shall be removed and replaced by the Responsible Party at his expense unless the City Engineer or appointed representative gives written permission to patch the defective area. In this case, patching shall be done as described in the following paragraphs. Defects that require replacement or repair are those that contain honeycomb, damage due to stripping of forms, loose pieces of concrete, bolt-holes, tie-rod holes, uneven or excessive ridges at form joints, and bulges due to movement of the forms. Ridges and bulges

shall be removed by grinding. Honeycombed and other defective concrete that does not affect the integrity of the structure shall be chipped out, and the vacated areas shall be filled in a manner acceptable to the City Engineer or appointed representative. The repaired area shall be patched with a non-shrink, non-metallic grout with a minimum compressive strength of 5,000 psi in 28 days. All repair areas treated with an epoxy-bonding agent shall have the approval of the City Engineer or appointed representative before the repair filling is placed.

Bolt-holes, tie-rod holes, and minor imperfections as approved by the City Engineer or appointed representative shall be filled with dry-patching mortar composed of one (1) part Portland cement to two (2) parts of regular concrete sand (volume measurement) and only enough water so that after the ingredients are mixed thoroughly, the mortar shall stick together on being molded. Mortar repairs shall be placed in layers and thoroughly compacted by suitable tools. Care shall be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted mortar. The mortar mix proportions described above are approximate.

It shall be the contractor’s responsibility to protect fresh concrete from damage as a result of vandalism or other cause; damaged concrete shall be removed and replaced by and at the expense of the contractor.

Those areas with excessive deficiencies as determined by the City Engineer or appointed representative shall be removed and replaced at the Responsible Party's expense. Where repairs are made in existing sidewalks, all edges of the old sidewalk allowed to remain shall be sawcut to a minimum depth of two (2”) inches. No rough edges shall be permitted where new construction joins the old section. Unless directed by the City Engineer or appointed representative no section less than five (5’) feet in length shall be placed or left in place. Where new sidewalk construction abuts existing sidewalks, the work shall be accomplished so that there is no abrupt change in grade between the old section and the new work.

No addition to existing sidewalks or other flat work concrete shall be made less than four (4’) feet in width. The City Engineer or appointed representative may require doweling into the existing concrete.

B. CLEANUP

The exposed surfaces of the concrete shall be thoroughly cleaned upon completion of the work, and the site shall be left in a neat and orderly condition.

C. BACKFILLING

When side forms are removed and the concrete has gained sufficient strength, the space adjoining the concrete shall be promptly backfilled with suitable

material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill shall be level with the top of the concrete and then sloped as shown on the drawings or as directed by the City Engineer or appointed representative.

When the area behind the walk is to be paved, the pavement thickness shall be per Table 5-1 and or per Section 5.1.2. Existing pavement, which is damaged during construction, shall be repaired by the Responsible Party at his expense.

6.3.7 TESTING

A. GENERAL

The requirements of this section shall apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.

Concrete materials and operations shall be tested as directed by the City Engineer or appointed representative and as herein stipulated. The required testing services shall be performed by a testing agency approved by the City Engineer or appointed representative and all testing agencies shall meet the requirements of ASTM E-329.

A representative of the testing agency shall inspect, sample, and test material and production of concrete as required by the City Engineer or appointed representative at the Responsible Party's expense. When it appears that any material furnished or work performed by the Responsible Party fails to fulfill specification requirements, the testing agency shall report such deficiency to the City Engineer or appointed representative and the Responsible Party.

The testing agency shall report all test and inspection results to the City Engineer or appointed representative and Responsible Party immediately after they are performed. Test reports shall include the exact location of the work at which the batch represented by a test was deposited. The report of the strength test shall include detailed information on storage and curing of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.). All test reports shall bear the seal and signature of a Professional Engineer registered in the State of Colorado and competent in the field of concrete testing. Reports not properly certified shall not be accepted.

The testing agency or its representative is not authorized to revoke, alter, relax, enlarge or release any requirements of these Engineering Specifications nor approve or accept any portion of the work.

B. TESTS PROVIDED BY THE RESPONSIBLE PARTY

The following services shall be performed by the designated testing agency at the expense of the Responsible Party:

1. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T-141; mold and cure specimens from each sample in accordance with AASHTO T-23. The maximum time between sampling and casting the cylinders or beams shall be 45 minutes. One (1) test series shall be taken per 50 cubic yards (or fraction thereof) of the concrete placed per day, or as directed by the City Engineer or appointed representative.
   a. Field cured test series: four (4) cylinders, two (2) to be broken at seven (7) days and two (2) to be broken at 28 days or as directed by the City Engineer or appointed representative.
   b. Lab cured test series: four (4) cylinders, two (2) to be broken at seven (7) days, two (2) to be broken at 28 days.

2. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the City Engineer or appointed representative, in accordance with AASHTO T-119.

3. Determine air content of the concrete sample for each strength test in accordance with either AASHTO T-152 (pressure method), T-196 (volumetric method), or T-121 (gravimetric method).

4. Sample additional concrete at point of placement, and perform other testing or inspection service as required.

5. When required by the City Engineer or appointed representative, the Responsible Party shall provide concrete mix designs, the results of which shall be immediately reported to the City Engineer or appointed representative. When pumped concrete is to be used, a separate mix design shall be required. Mix designs shall be in accordance with ACI 211 and ACI 304, as applicable.

6. Additional testing and inspection required because of changes in materials or proportions.

7 When the work fails to pass inspection or previous tests fail to meet specifications, additional tests shall be taken as directed by the City Engineer or appointed representative.

8. Core samples shall be obtained and tested when samples of fresh concrete were not obtained and tested in accordance with the provisions of these Engineering Specifications. Obtaining and testing cores shall be

in accordance with ASTM C-42. Concrete in the area represented by a core test shall be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength, and if no single core is less than 75 percent of the specified strength. Core holes shall be filled with low slump concrete or mortar.

9. Failure of the Responsible Party to furnish testing as herein described shall be sufficient cause for rejection of the work in question.

C. RESPONSIBILITY AND DUTIES OF THE RESPONSIBLE PARTY

The Responsible Party shall provide the testing agency with the following:

1. Any labor necessary to assist the designated testing agency in obtaining and handling samples at the project or from other sources of material.

2. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T-23.

The use of testing services in no way relieves the Responsible Party of the responsibility to furnish material and construct in full compliance with these Engineering Specifications.

6.3.8 FLOWCRETE/FLOWFILL CONCRETE

A. SPECIFICATIONS

The following is the specification of the flowcrete/flowfill concrete as directed by the City Engineer or appointed representative:

Mix proportions: (per cubic yard of concrete)

Material	ASTM Specification	Weight
Cement	ASTM C-150	42 to 50 lbs.
Sand	ASTM C-33	1845 to 1850 lbs.
Aggregate	ASTM C-33	1700 to 1750 lbs.
Air Entrainment	ASTM C-260	5.0 ounces
Water	ASTM C-94	39 gallons

Design Physical Properties: Slump shall be six (6”) to eight (8”) inches.