

**CITY OF LONGMONT
SECTION 200 – STREET IMPROVEMENTS
TABLE OF CONTENTS**

200.00 MINIMUM DESIGN CRITERIA.....	1
200.01 GENERAL	1
201.00 RIGHT OF WAYS AND STREET CROSS-SECTIONS	2
201.01 GENERAL	2
201.02 DESIGN CRITERIA	2
202.00 HORIZONTAL ALIGNMENT.....	3
202.01 GENERAL	3
202.02 DESIGN CRITERIA	3
203.00 VERTICAL ALIGNMENT	4
203.01 GENERAL	4
203.02 DESIGN CRITERIA	4
204.00 RESERVED.....	6
205.00 INTERSECTIONS	6
205.01 GENERAL	6
205.02 DESIGN CRITERIA	7
205.03 SPACING CRITERIA.....	9
205.04 AUXILLARY LANES	9
206.00 CUL-DE-SACS.....	11
206.01 GENERAL	11
206.02 DESIGN CRITERIA	11
207.00 STRUCTURAL CROSS-SECTION	12
207.01 GENERAL	12
207.02 DESIGN CRITERIA.....	12
207.03 MATERIALS	13
208.00 GENERAL - CONSTRUCTION.....	17
208.01 SEQUENCE OF CONSTRUCTION.....	17
208.02 FIXTURE ADJUSTMENT	18
208.03 PROTECTION AND CLEANING.....	18
209.00 CLEARING AND GRUBBING	18
210.00 REMOVAL OF STRUCTURES AND OBSTRUCTIONS.....	19
211.00 EXCAVATION AND EMBANKMENT	19
211.01 GENERAL	19

211.02 MATERIALS	20
211.03 SUBGRADE	21
211.04 EXCAVATION	21
211.05 BACKFILL, FILL AND EMBANKMENT	22
211.06 FINISH GRADING	23
211.07 COMPACTION AND TESTING.....	23
212.00 AGGREGATE BASE COURSE	24
213.00 PLANT MIXED BITUMINOUS PAVEMENT.....	25
213.01 GENERAL	25
213.02 MATERIALS	26
213.03 CONSTRUCTION REQUIREMENTS	27
213.04 TEST REQUIREMENTS/TOLERANCES	28
214.00 PORTLAND CEMENT CONCRETE PAVEMENT	30
214.01 MATERIALS	30
214.02 CONSTRUCTION REQUIREMENTS	30
214.03 TEST REQUIREMENTS.....	32
215.00 STREET RESTORATION (PATCHING AND MATCHING EXISTING)	33
215.01 AGGREGATE BASE COURSE	33
215.02 PAVEMENT REPLACEMENT	33
215.03 SURFACE TOLERANCES	34
215.04 TEMPORARY PATCHES	34
215.05 TIME LIMITS FOR PATCHING STREET CUTS	34
216.00 SIDEWALKS, CURB RAMPS, CURB AND GUTTER.....	34
217.00 SIGNS CONSTRUTION AND INSTALLATION	36
217.01 GENERAL	36
217.02 STANDARDIZATION.....	37
217.03 STREET NAME SIGNS	37
217.04 POST AND SIGN PLACEMENT	37

**SECTION 200 – STREET IMPROVEMENTS
INDEX OF DETAILS**

200-01	Typical Street Section
200-01A	Typical Street Section
200-01B	Street Intersection Crossspan Approach Detail
200-01C	Street Intersection Approach Detail
200-02	Intersection Right-of-Way
200-03	Concrete Cross Pan
200-04	Detached Sidewalk Detail
200-05	Bikeway Detail
200-06	Vertical Curbwalk Detail
200-07	Vertical Curb and Gutter Type “B”
200-08A	Concrete Driveway (Type A) With Attached Walk
200-08B	Concrete Driveway (Type B) With Attached Walk
200-09	Concrete Driveway Offset Walk (Monolithic Pour)
200-10	Mountable Curbwalk
200-11	Curb Ramp Detail – Radial Curbwalk
200-12	Curb Ramp Detail – Mid-Block, Single
200-13	Curb Ramp Detail – Detached Sidewalk
200-14A	Curb Ramp Transition Detail for Detached Walk and/or Bikepath (Alt. A)
200-14B	Curb Ramp Transition Detail for Detached Walk and/or Bikepath (Alt. B)
200-15	Curb Ramp Detectable Warning and Construction Joint Detail
200-16	Traffic Circle Detail
200-16A	Mid-Block Neckdown with Detached Walk
200-16B	Speed Tables or Speed Humps with Crosswalk
200-17	Chase Drain Detail
200-18	Type R (Modified) (Chase)
200-19	Staking Detail, Mountable Curb Inlet
200-20	Survey Monument Box
200-21	Pedestrian Handrail Detail
200-22	Conduit Trench
200-23	Standard Pipe Underdrain (Raised Irrigated Medians)
200-24	Rotomill Detail (Final Overlay)
200-25	Core Drilled Pothole Patching Detail

STREET IMPROVEMENTS

200.00 MINIMUM DESIGN CRITERIA

200.01 GENERAL

1. All street, alley, sidewalk, and concrete path systems will comply with these specifications, the State Specifications where applicable, and with the approved plans. Sidewalks and curb ramps shall comply with ADA accessibility requirements.
2. Street layout, alignment, and classification shall conform with the City of Longmont Subdivision Regulations and the Longmont Area Comprehensive Plan.
3. Consideration shall be given, within the established framework of local streets, to provide for, proper alignment, and conformity to existing street patterns. The street design shall be directly related to the traffic needs and the adjacent land uses. Street design for Local and Collector streets in residential areas shall specifically focus on creating a pedestrian friendly design avoiding excessively wide or long straight streets that encourage excess speed. Street design within such residential areas is intended to focus on developing a street system that can provide access to the adjacent properties, provide a safe transportation system for pedestrians, bicyclists, vehicles and minimize the impacts of traffic on adjacent residential property. The streets, intersections, driveways, and pedestrian facilities shall be designed to provide for the greatest safety for both pedestrians and motorists.
4. All alleys shall be paved to a full width and shall provide paved access to a paved street at both ends.
5. In situations where redevelopment occurs along an existing unpaved alley, and utilizes the alley as a primary access, the Developer shall be responsible for paving the alley along the frontage of the property, and extending the paving to the closest intersection of the alley with a public street.
6. Transportation Impact Studies are required in order to adequately assess the impacts of a development proposal on the existing and/or planned street system. Unless waived by the City Engineer, a written Transportation Impact Study will be required for all development proposals when trip generation is expected to exceed 50 vehicles during the peak hour or 500 Average Daily Traffic (ADT), or in the case where a localized safety or capacity deficiency exists as determined by the City Engineer.

The Transportation Impact Study shall comply with the Criteria for Transportation Impact Studies included in Appendix A.

7. All developments shall have access in accordance with the requirements of the Longmont Municipal Code.
8. The City of Longmont will review variations to these criteria in accordance with Section 15.02.090.J of the Municipal Code.
9. Streets of less than the entire right-of-way and pavement width are not permitted.

201.00 RIGHT OF WAYS AND STREET CROSS-SECTIONS

201.01 GENERAL

1. Sufficient right-of-way will be provided as required for the traffic needs and cross-section and maintenance of the street including cut or fill slopes, auxiliary lanes, sidewalks, public landscaping, signing, utilities, and other aspects of the development. The right-of-way will extend to the back of the detached sidewalk. A sign easement will be required in situations where the right-of-way does not extend two (2) feet behind the curbwalk.
2. All new local and collector streets shall be constructed with a minimum eight (8) foot planting strip on each side of the street and detached sidewalks. All sidewalks shall be a minimum of five (5) foot wide. On-street parking shall be provided on both sides of all new residential streets, unless otherwise approved by the engineer. The standard for on-street parking shall be one (1) on-street parking space for each single-family residential unit. Multi-family units will be reviewed on a case-by-case basis.
3. All collector streets shall include an on-street bicycle lane.
4. The minimum right-of-way width for arterial streets shall be one hundred twenty (120) feet. Arterial streets shall include an eight (8) foot wide detached concrete path, a minimum 12' wide planting area between the curb and detached concrete path, and the right-of-way shall extend four (4) minimum behind the concrete path. The twelve (12) foot wide planting strip may be reduced at intersections where turn lanes are required. The concrete path shall be attached at intersections per Detail 200-14 Alternate (Alt.) A and Alternate (Alt.) B.
5. Additional right-of-way and roadway width may be required to accommodate traffic or other development needs such as turn lanes, accel/decel lanes, extra lanes, pedestrian or bicycle facilities, landscaping, all utilities, drainage requirements per the City Storm Drainage Criteria Manual, or construction requirements such as cut or fill slopes.
6. All streets shall maintain a minimum of twenty (20) foot pavement width free of parking and obstructions with all turns having no less than a fifty (50) foot outside or a thirty (30) foot inside radius.
7. All alleys shall have a minimum of a twenty (20) foot pavement width and a twenty two (22) foot right-of-way width.

201.02 DESIGN CRITERIA

1. The cross-section of streets shall be designed based on the specific needs of the street, taking into consideration the need for travel lanes (exclusive of gutter pans), turn lanes, bicycle lanes, parking and pedestrian facilities. For design purposes the following lane width standards shall be used:

<u>Lane Width</u>	<u>Arterial</u>	<u>Collector</u>	<u>Local</u>
Travel Lane – Residential	12'	10'	10'
Travel Lane – Commercial/ Industrial	12'	12'	12'

Turn Lane – Residential	12'	10'	10'
Turn Lane – Commercial/ Industrial	12'	12'	12'
Parking Lane – Residential	N/A	8'	7'
Parking Lane – Commercial/ Industrial	N/A	8'	8'
Bicycle Lane (Required on all Arterial and Collector Streets)	5'	5'	5'
Bicycle/Parking Combined	N/A	12'	12'

202.00 HORIZONTAL ALIGNMENT

202.01 GENERAL

1. Horizontal alignment shall provide for the safety of pedestrians, bicyclists, and motorists. On collector and local streets in residential areas, particular care shall be given to avoid design that encourages excessive speed

On collector and local streets in residential areas, the design shall include “slow points” at no more than five hundred (500) foot spacing. Examples of slow points can include curves, medians, neckdowns, traffic circles, stop condition intersections (based on approved traffic conditions and meeting the criteria of the MUTCD), and other approved traffic calming techniques.

2. The street pattern in a subdivision shall be the most advantageous configuration to serve adjoining areas and the entire neighborhood or district. Where appropriate to the design, proposed streets shall be continuous and in alignment with existing, planned or platted streets.
3. Proposed streets shall be extended to the boundary lines of the subdivision, except where prohibited by topography or other physical conditions, or where such extension is not necessary for connection to adjacent properties. Where streets will be extended beyond the property line, sufficient engineering data shall be provided to establish feasibility of extension meeting city standards. Construction of the proposed streets may include grading and drainage transitions at the edge of the development.
4. Streets shall be placed in accordance with the Longmont Area Comprehensive Plan where applicable.

202.02 DESIGN CRITERIA

1. All proposed streets shall conform with the horizontal curve standards outlined as follows:

STREET TYPE DESIGN SPEED	MINIMUM CENTERLINE RADIUS (FT.)	MINIMUM TANGENT BETWEEN REVERSE CURVES (FT.)
Arterial 45 mph	710	300
Collector 30 mph	330	100

Local Industrial 30 mph	275	100
Local Commercial 30 mph	275	100
Local Residential Standard 25mph	100	100
Alley 20 mph	90	---
Emergency Access	---	---
Truck Route	---	---

- a. These horizontal curve standards are for the design speeds shown assuming 4% superelevation for arterial streets and no superelevation on collector or local streets. The City may require curves designed for higher design speeds as conditions require.
 - b. Where curves are designed with superelevation, the superelevation shall be in accordance with the recommendations of A.A.S.H.T.O. and approved by the City. The rate of superelevation, the superelevation runout length, the crown runout length, and the point at which the full superelevation is reached shall be clearly shown on the construction plans. Superelevation shall not be permitted on local streets.
 - c. A.A.S.H.T.O. stopping sight distances must be maintained at all times. These horizontal curve standards are for situations where there will be adequate stopping sight distance on the curve. In areas where obstructions limit sight distance, curve lengths may need to be greater than listed.
2. There shall be a minimum tangent where a curvilinear street is approaching an intersection. This distance shall be a minimum of one hundred fifty (150) feet for a collector street approaching an arterial street. The minimum tangent distance for local street intersections and a local street approaching a collector street shall be one hundred (100) feet.

203.00 VERTICAL ALIGNMENT

203.01 GENERAL

1. Vertical alignment and grades shall take into consideration the existing topography, drainage needs, and shall provide for the safety of pedestrians and motorists. Unless modified in these Standards, vertical alignment shall be designed in accordance with A.A.S.H.T.O. criteria.
2. Continuous changing of grades that create a "roller coaster" effect shall not be permitted.

203.02 DESIGN CRITERIA

1. All proposed streets shall conform with the minimum and maximum allowable grade standards shown in the following table:

STREET	LAND	% GRADE
Arterial	All	0.5/4.0
Collector	All	0.5/5.0
Local	Industrial	0.5/4.0
Local	Commercial	0.5/5.0
Local	Residential High Volume	0.5/5.0
Local	Residential Standard	0.5/5.0
Cul-de-sacs	Residential	0.6/5.0
Alley	All	0.5/5.0
Emergency	All	0.5/6.0

- Connections with existing streets shall be made in a way that will create a smooth transition. The higher volume street at an intersection shall govern the through grade, and cross-sections. The maximum allowable approach grade at an intersection shall be 4% for a distance as designated by the following table:

APPROACHING STREET	LOCAL	COLLECTOR	ARTERIAL
Local	50 feet	50 feet	75 feet
Collector	----	75 feet	150 feet
Arterial	----	----	200 feet (1)

Distances shown are measured from the flowline intersections.

Notes:

- The maximum allowable approach grade at the intersection of two arterials shall be 2%.
- In intersections where there will be crosspans, the transition of the crown into the crosspan shall occur in fifty (50) feet for areas where the approach grade is between 2% - 4%. The transition of the crown in the crosspan shall occur in thirty-five (35) feet for streets where the approach grade is less than 2%. There shall be no crosspans on collector and arterial streets. Unless otherwise approved by the City, there shall be no crosspans on local streets with an average daily traffic volume greater than five hundred (500) other than at stop conditions.

Crest vertical curves shall comply with the following criteria:

MINIMUM LENGTH OF CREST VERTICAL CURVES (IN FEET)			
Change In % Grade	Arterial (45 mph)	Collector (35 mph)	Other (25mph or less)
0.00 – 1.00	None	None	None
1.00 – 2.00	135	90	75
2.00 – 3.00	180	90	75
3.00 – 4.00	240	90	75
4.00 – 5.00	300	95	75
5.00 – 6.00	360	115	75
6.00 – 7.00	420	130	80
7.00 – 8.00	480	150	90
8.00 – 9.00	----	170	100
9.00 – 10.00	----	185	115

- a. Lengths above do not allow passing on crest of vertical curves. Design may warrant a passing move on collectors or arterials, which would lengthen the vertical curves. The required lengths for passing will be provided on a case by case basis by the City.
- b. These vertical curve lengths are for the design speeds as shown. The City may require curves designed for different design speeds as conditions require.

1. Sag vertical curves shall comply with the following criteria:

MINIMUM LENGTH OF SAG VERTICAL CURVES (IN FEET)			
Change In % Grade	Arterial (45 mph)	Collector (30 mph)	Other (25 mph or less)
0.00 – 1.00	None	None	None
1.00 – 2.00	160	90	75
2.00 – 3.00	240	110	80
3.00 – 4.00	320	150	110
4.00 – 5.00	390	190	130
5.00 – 6.00	470	220	160
6.00 – 7.00	550	260	180
7.00 – 8.00	630	290	210
8.00 – 9.00	----	330	230
9.00 – 10.00	----	370	260

- a. These vertical curve lengths are for the design speeds as shown. The City may require curves designed for different design speeds as conditions require.

204.00 RESERVED

205.00 INTERSECTIONS

205.01 GENERAL

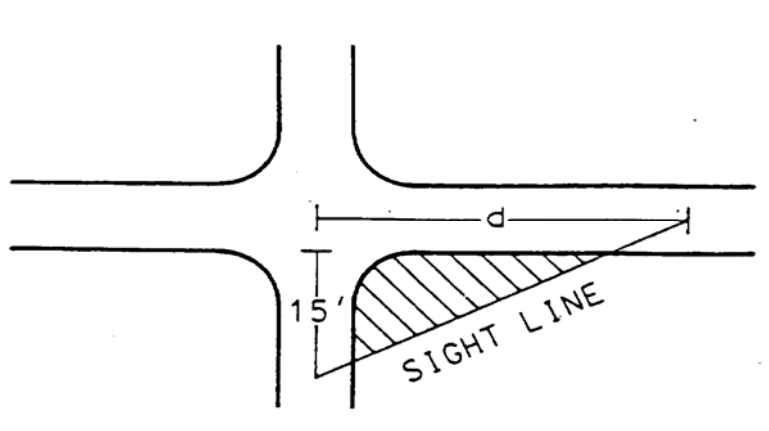
- 1. Intersections (which shall include all street access points - both public and private) shall be designed to provide for the safety of pedestrians and motorists.
- 2. At street intersections, property lines shall be truncated as shown in Detail 200-02 to provide adequate right-of-way for curb ramps and utilities.
- 3. Intersection design shall take into consideration auxiliary turn lanes as required by the approved Transportation Impact Study, or as required for site specific conditions.
- 4. Intersection spacing shall be in accordance with Section 205.03.
- 5. All proposed intersections shall be at right angles unless topography and other limiting factors of good design and safety otherwise require. No intersection shall be at an angle of less than 75 degrees.

205.02 DESIGN CRITERIA

1. The design criteria for all street intersections shall conform with the Horizontal Alignment Design Criteria outlined in this document.
2. All intersections shall be designed and constructed with pedestrian curb ramp access on all corners (Details 200-11, 200-14 Alt. A, 200-14 Alt. B, and 200-15).
3. Intersection Obstruction Free Areas - In order to preserve sight distance and the safety of pedestrians and vehicles, an unobstructed area shall be maintained with the following sight distance triangular areas. These areas shall be free from shrubs, ground covers, berms, fences, signs, structures, parking, or other material or items greater than three (3) feet in height, when measured from the grade of the roadway, which would block the intersection sight distance. Trees shall not be planted within the triangular area. Fences shall be excepted from the three (3) foot height limitation provided that the fence does not exceed three and one half ($3\frac{1}{2}$) feet in height, and is at least 50% open such that sight distance is not impaired.
 - a. At the intersection of any two streets, or where a street intersects with an alley: A triangle measuring thirty (30) feet along each curb or edge of roadway from their point of intersection, the third side being a diagonal line connecting the first two. The City may require a greater distance in certain high volume or high speed traffic intersections.
 - b. At the intersection of a private access point and street: A triangle measuring fifteen (15) feet in length along the edge of the driveway and along the curb or edge of roadway from their point of intersection, the third side being a diagonal line connecting the first two (2).
4. Additional Intersection Sight Distance Criteria - For new development, and in situations where specific safety concerns exist, or on higher speed or volume streets, the City will require additional sight distance review, and an increase in the obstruction free areas outlined above. The criteria used will be as follows.
 - a. Intersection sight distance shall be measured at a height of three and one half ($3\frac{1}{2}$) feet for the entering vehicle to a height of four and one quarter ($4\frac{1}{4}$) feet for the oncoming vehicle. The entering driver's eyes shall be assumed to be at a point fifteen (15) feet back from the edge of the traveled way.

The following table and figure shall be used to determine the area necessary for intersection sight distance. That area shall be free from shrubs, ground covers, berms, fences, signs, structures, parking, or other material or items greater than three (3.0) feet in height, when measured from the grade of the roadway, which would block the intersection sight distance. Fences shall be excepted from the three (3.0) foot height limitation provided that the fence does not exceed three and one half ($3\frac{1}{2}$) feet in height, and is at least 50% open such that sight distance is not impaired.

DESIGN SPEED STREET (FT.)	INTERSECTION SIGHT (D) 2-LNE THROUGH	INTERSECTION SIGHT (D) 4-LANE THROUGH
20	200	240
25	250	300
30	300	360
35	350	420
40	400	480
45	450	540
50	500	600
55	550	660



Note: Additional distance may be required where heavy truck traffic or other conditions warrant increased sight distance.

- Determination of need for traffic control devices, including stop signs and traffic signals shall be made by the City in accordance with the MUTCD and other applicable City regulations.
- Curb radii shall conform with the standards in the following table:

INTERSECTION TYPE RETURN RADIUS (FEET)	MINIMUM/MAXIMUM CURB
Arterial/Any Street	35-50
Collector/Collector	35-50
Collector/Local	25 minimum
Industrial/Any Street	35-50
Commercial/Any Street	35-50
Local/Local	15-25
Alley	20 minimum
Emergency Access	20 minimum
Truck Route/Any Street	35 minimum

205.03 SPACING CRITERIA

1. There shall be no direct access from any private property to an arterial unless no other alternative access is available or a variance to this section has been approved.
2. Intersections with no potential for signalization (as determined by the City) will be spaced in accordance with the following table:

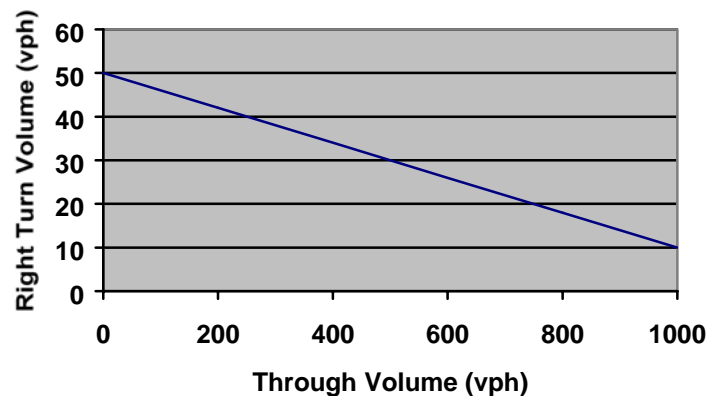
ROADWAY	OFFSET
Arterial	660 feet
Collector	330 feet
Local	135 feet

3. Intersections with the potential for signalization (as determined by the City) shall be spaced no less than one half ($\frac{1}{2}$) mile from the nearest existing or planned signalized intersection. If an intersection that will potentially need a signal cannot meet this spacing requirement it may be limited to right turns.

205.04 AUXILLARY LANES

1. Left turn lanes will be installed on intersection approaches (where left turns are not prohibited) when any of the following criteria are met:
 - a. The approach is at an intersection that is signalized or is planned to be signalized in the future.
 - b. On an uncontrolled approach on an arterial street.
 - c. On an uncontrolled approach on a collector street that is striped as a three lane street (with a continuous center turn lane.)
 - d. At a four-legged intersection when the opposing approach requires a left turn lane.
 - e. On a STOP sign controlled approach on a collector or arterial street with adequate width for more than one approach lane when an exclusive left turn lane minimizes the approach delay (as determined using the latest Highway Capacity Manual analysis techniques.)
 - f. At an existing intersection where the accident history identifies an accident pattern that is susceptible to improvement by installing a left turn lane as determined by the City.
2. Right turn lanes will be installed on intersection approaches when any of the following criteria are met:
 - a. The intersection is signalized or is planned to be signalized in the future.
 - b. At an existing intersection where the accident history identifies an accident pattern that is susceptible to improvement by installing a right turn lane.

- c. On a STOP sign controlled approach on a collector or arterial street with adequate width for more than one approach lane when an exclusive right turn lane minimizes the approach delay (as determined using the latest Highway Capacity Manual analysis techniques.)
- d. The approach is uncontrolled and the traffic volumes estimated in the approved traffic impact study (see appendix A), when applied to the following graph, require a right turn lane. In the graph, when the plotted point representing the through traffic (or the through traffic in the outside through lane when more than one through lane exists) on the approach and the corresponding right turn volume on the approach fall above the line a right turn lane is warranted.



- 3. On arterial streets, when conditions allow, the total length of left and right turn lanes will be the sum of the taper length plus the deceleration length plus the storage length as shown in part 205.04.4 below. Where intersection spacing or other space constraints do not allow this lane length the taper length may be considered as part of the deceleration length. If further reduction is necessary the desirable deceleration length may be reduced to fit the turn lane in the available space.

On uncontrolled approaches on collector streets the total length of left and right turn lanes will be the deceleration length plus storage length. The taper length will be considered as part of the deceleration length. If intersection spacing or other space constraints do not allow this lane length the desirable deceleration length may be reduced to fit the turn lane in the available space.

On controlled approaches on collector streets the total length of left and right turn lanes will be the taper length plus storage length. If there is not adequate space to allow this lane length, the storage length may be reduced to fit the turn lane in the available space.

- 4. Turn lanes should have the following lengths:
 - a. Taper length will be between one hundred twenty (120) feet and one hundred eighty (180) feet for all street classifications.
 - b. The desirable deceleration length is three hundred seventy five (375) feet on arterial streets (design speed 50 mph); two hundred sixty (260) feet on collector

streets (design speed 40 mph) and one hundred eighty (180) feet on local streets (design speed 30 mph).

- c. For left turn lanes, the desirable storage length (in feet) at signalized intersections is 1.1 times the left turn volume projected for the approach in the approved traffic impact study. For left turn lanes at unsignalized intersections, the desirable storage length is to be determined based on the results of the capacity analysis conducted as part of the approved traffic impact study. The 95th percentile queue calculated using the latest procedures in the Highway Capacity Manual will be used to determine the appropriate storage length assuming twenty five (25) foot per car in queue.
- d. For right turn lanes, the desirable storage length (in feet) at signalized intersections is 0.6 times the right turn volume projected for the approach in the approved traffic impact study. On controlled approaches at unsignalized intersections, the desirable storage length for right turn lanes shall be based on the results of the capacity analysis conducted as part of the approved traffic impact study. The 95th percentile queue, calculated using the latest procedures in the Highway Capacity Manual, will be used to determine the appropriate storage length assuming twenty five (25) feet per car in queue. On uncontrolled approaches at unsignalized intersections, no storage length is required for right turn lanes.

206.00 CUL-DE-SACS

206.01 GENERAL

1. Permanent dead-end streets shall be in the form of a cul-de-sac. Dead-end streets without a cul-de-sac shall not be allowed unless designed to connect with a future street. If the temporary dead-end street is longer than eight hundred (800) feet, or serves as primary access to any lot, a paved temporary turnaround or a paved temporary connection to another street shall be provided.

206.02 DESIGN CRITERIA

1. Permanent dead-end streets in the form of a cul-de-sac shall have a maximum length of 500 feet, measured along the centerline, from the edge of right-of-way of the intersecting street to the center point of the bulb. The right-of-way for a cul-de-sac shall conform to the right-of-way requirements for the specific street classification of the cul-de-sac.
2. All cul-de-sacs shall have a minimum flowline radius of fifty (50) feet.
3. Sufficient right-of-way will be provided as required for the traffic needs and cross-section and maintenance of the cul-de-sac including cut or fill slopes, auxiliary lanes, sidewalks, public landscaping, signing, utilities, and other aspects of the development. As a minimum, right-of-way will extend two (2) feet beyond the back of the sidewalk.
4. Cul-de-sacs which have internal islands shall be subject to review and approval by the Fire Department and Public Works. In general, the circulation aisle between the island and the exterior curb shall have a fifty (50) foot outside radius and a thirty (30) foot inside radius. There shall be no parking within these circulation aisles.

5. Where cul-de-sac have internal islands with irrigated landscaping, adequate design measures shall be made to drain the landscaped area to avoid damage to the adjacent pavement.
6. All other design criteria shall be based on the design criteria for the particular street classification.

207.00 STRUCTURAL CROSS-SECTION

207.01 GENERAL

1. The design of the pavement cross-section shall be performed by a Professional Engineer registered in the State of Colorado, whose expertise is soils engineering. The Engineer's report for the pavement thickness design and the soils report upon which it is based will be submitted for review and approval after the overlot grading has been completed and at least two weeks prior to the pre-paving conference.

207.02 DESIGN CRITERIA

1. The design of streets shall be based on the design period of twenty (20) years unless otherwise approved by the City Engineer.
2. The design of pavements shall be based upon the Roadway Design Manual of the Colorado Department of Transportation.
3. The Colorado Department of Transportation methodology is accepted for both rigid and flexible street pavement designs.
4. In no event shall pavement sections be less than the following minimum structural sections:

Pavement Section. The minimum structural section shall be four and one half (4½) inches of hot bituminous pavement on eight (8) inches of class six (6) aggregate base course placed on compacted subgrade.

Full Depth Asphalt. The Minimum full depth asphalt thickness shall be six (6) inches of hot bituminous pavement placed on compacted subgrade.

Concrete Pavement. The minimum concrete structural section shall be six (6) inches of non-reinforced Portland cement concrete pavement placed on compacted subgrade.

5. If the minimum pavement section is to be used, the report must demonstrate the adequacy of the structural section for the soil conditions encountered.
6. If a single pavement design is used for all streets within the development, that pavement design shall be based on the worst soil encountered from the standpoint of subgrade support.

7. For streets, the top one and one-half inch of asphalt pavement shall be constructed in accordance with Detail 200-26 at the end of the one year warranty period unless otherwise identified in the public improvements agreement, or agreed to by the City.
8. The following table includes the standard design volumes, speed, percent truck, and EDLA requirements to be used in the design of all streets unless site specific conditions or the approved traffic impact study warrant different criteria:

STREET TYPE	ADT	DESIGN SPEED	% TRUCK	EDLA (MINIMUM)
Local Standard Residential	2,500	25mph	1%	10
Local Commercial	2,500	30 mph	7%	50
Local Industrial	2,500	30 mph	20%	85 (2)
Residential Collector	9,000	30mph	(1)	50
Non-Residential Collector	9,000	30mph	(1)	100 (2)
Arterial	9,000+	45 mph	(1)	200 (2)

Notes:

1. For Collector and Arterial Streets, the percent truck usage shall be determined on a case by case basis.
2. EDLA for Local Industrial, Non-residential Collector and Arterial streets shall be based on values obtained from a traffic study. The listed EDLA values are minimum requirements.

207.03 MATERIALS

All plant produced hot bituminous asphalt pavement (HBP), shall conform to the City Standard and Specifications and the approved plans. Where these Standards do not address situations, materials, or construction requirements, the City may utilize any applicable requirements of Item 9 of the most recent version of the Metropolitan Governments Pavement Engineers Council (MGPEC) Pavement Design Standards MGPEC Form #9 shall be submitted with the pavement thickness design report.

AGGREGATE: Aggregates for HBP shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, or crushed slag. Excess of fine material shall be wasted before crushing.

The material shall not contain clay balls, vegetable matter, or other deleterious substances and shall meet the following requirements.

AGGREGATE TEST PROPERTY	COARSE: RETAINED ON #4	FINE: PASSING THE #4
Fine Aggregate Angularity, CP-L 5113 Method A		
Traffic Level 1 & 2	----	40% Min.
Traffic Level 3 to 5	----	45% Min.

Two Fractured Faces, CP 45 Top and Middle Lifts Bottom Lifts	80% Min. 70% Min.	---- ----
LA Abrasion, AASHTO T96	45% Max.	----
Flat and Elongated (Ratio 3:1) AASHTO M283	10% Max.	----
Adherent Coating (Dry Sieving) ASTM D5711	0.5% Max.	----
Sand Equivalent, AASHTO T176	----	45% Max.

Reclaimed Asphalt Pavement material (RAP) is allowed as follows:

- a. It shall be of uniform quality and gradation with a maximum size no greater than the nominal aggregate size of the mix.
- b. SG Mixes shall not contain more than 20% RAP.
- c. RAP is prohibited in other mixes, except as approved by the Engineer.

The HBP gradation for the proposed mix design shall be wholly within the requirements (control points) of the gradation range table below. The allowable job mix gradation for production shall be the design job mix gradation with the production tolerances applied. The proposed design job mix and the final allowable job mix gradation for production shall report all sieves listed in the table:

SIEVE SIZE	GRADATION RANGE					
	SX (1/2" NOMINAL)		S (3/4" NOMINAL)		SG (1" NOMINAL)	
	CONTROL POINTS	RESTRICTED ZONE	CONTROL POINTS	RESTRICTED ZONE	CONTROL POINTS	RESTRICTED ZONE*
1 1/2"	----	----	----	----	100	----
1"	----	----	100	----	90 – 100	----
3/4"	100	----	90 – 100	----	----	----
1/2"	90 – 100	----	----	----	----	----
3/8"	----	----	----	----	----	----
#4	----	----	----	----	----	39.5
#8	28 – 58	39.1	23 – 49	34.6	19 – 45	26.8 – 30.8
#16	----	25.6 – 31.6	----	23.3 – 28.3	----	18.1 – 24.1
#30	----	19.1 – 23.1	----	16.7 – 20.7	----	13.6 – 17.6
#50	----	15.5	----	13.7	----	11.4
#200	2.0 – 8.0	----	2.0 – 7.0	----	1.0 -7.0	----

* The restricted zone is a guideline only. It is recommended that the mix design gradation go above the restricted zone boundaries, on the "fine" side.

** These limits shall include the weight of lime at 1.0%

Voids in mineral aggregate (VMA) shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103) and Aggregate (AASHTO T84 & AASHTO T85), and calculated according to CP-48. All mixes shall meet the minimum VMA specified on Table below:

MIMINUM VMA, %			
Nominal Maximum Particle Size*	Air Voids**		
	3.5%	4.0%	4.5%
1"	12.5	13.0	13.5
3/4"	13.5	14.0	14.5
1/2"	14.5	15.0	15.5

* Nominal Maximum Particle Size is defined as one sieve size larger than the first sieve to retain more than 10%, but shall not exceed the 100% passing size. The nominal Maximum Particle Size can vary during mix production even when the 100% passing size is constant.

** Minimum VMA criteria applies to the mix design. The minimum VMA criteria shall be linearly interpolated based on actual air voids. See MIX DESIGN VERFIFICATION TOLERANCES section.

PERFORMANCE GRADED BINDERS - (ASPHALT CEMENT):

The Contractor shall provide acceptable 'Certifications of Compliance' of each applicable asphalt cement grade from the supplier. When production begins the Contractor shall provide a one quart can of each specified asphalt cement. Additionally, when requested, the Contractor shall provide the refinery test results that pertain to the asphalt binders used during production.

Asphalt Cement binder shall meet the requirements of the Superpave Performance-Graded Binders (PG) as presented below.

PROPERTIES OF PERFORMANCE GRADED BINDERS			
Property	PG 58-28	PG 64-22	PG 76-28
Traffic Level: Recommended Usage	1 & 2	2 to 5	3 to 5
Flash Point Temperature, °C, AASHTO T48	230 Min.	230 Min.	230 Min.
Viscosity at 135 ° C, Pas, ASTM D4402	3 Max.	3 Max.	3 Max.
Dynamic Shear, Temperature °C, Where C*/Sin? @ 10 Rad/Sec. ≥ 1.00 Kpa, AASTO TP5	58	64	76
Rolling Thin Film Oven Residue Properties, AASHTO T240			
Mass Loss, %, AASHTO T240	1.00 Max.	1.00 Max.	1.00 Max.
Dynamic Shear, Temperature °C, Where C*/Sin? @ 10 Rad/Sec. ≥ 2.20 Kpa, AASTO TP5	58	64	76
Elastic Recovery, 25° C, % Min.*	N/A	N/A	N/A
Pressure Aging Vessel Residue Properties, Aging Temperature 100 °C AASHTO PP1			
Dynamic Shear, Temperature °C, Where C*/Sin? @ 10 Rad/Sec. ≥ 5.00 Kpa, AASTO TP5	19	25	28
Creep Stiffness @ 60 Sec. Test Temperature in °C, AASHTO TP1	-18	-12	-18
S, Mpa, AASHTO TP1	300 Max.	300 Min.	300 Min.
M-Value, AASHTO TP1	0.300 Min.	0.300 Max.	0.300 Max.
Direct Tension Temperature in °C, @ 1.0 mm/min., Where Failure Strain > 1.0%, AASHTO TP3	-18	-12	-18

* Nominal Maximum Particle Size is defined as one sieve size larger than the first sieve to retain more than 10%, but shall not exceed the 100% passing size. The nominal Maximum Particle Size can vary during mix production even when the 100% passing size is constant.

** Minimum VMA criteria applies to the mix design. The minimum VMA criteria shall be linearly interpolated based on actual air voids. See MIX DESIGN VERIFICATION TOLERANCES section.

Performance Graded Binders (Asphalt Cement):

The Contractor shall provide acceptable 'Certifications of Compliance' of each applicable asphalt cement grade from the supplier. When production begins the Contractor shall provide a one quart can of each specified asphalt cement. Additionally, when requested, the Contractor shall provide the refinery test results that pertain to the asphalt binders used during production.

Asphalt Cement binder shall meet the requirements of the Superpave Performance-Graded Binders (PG) as presented below.

SUPERPAVE MIXTURE PROPERTIES			
Traffic Level	0	1, 2 & 3	4 & 5
Traffic Loading, Total 18,000 pound equivalent single axle loads (18K ESAL's). Over design life (usually 20 years)	Non-Vehicular or Paths	1) < 300,000 2) 300,000 to < 1.0 Million 3) 1.0 to < 3.0 Million	4) 3.0 to 10.0 Million 5) >10.0 Million
Initial gyrations, N _{initial} for information only	6	7	8
Air voids, N _{initial} , for information only	>8.5	>9.5	>11.0
Design gyrations, N _{design} (air void: 3.5% to 4.5%) (see note 1, 2)	50	75	100
Hveem stability (minimum) CP-L 5106 (grading S and SX only) (see note 1, 2)	N/A	28	30
Voids filled with asphalt, %, MS-2	70-80	65-78	65-75
Moisture susceptibility (Lottman), Tensile Strength Ratio, % retained, CP-L 5109, method B	80 Min.	80 Min.	80 Min.
Moisture susceptibility (Lottman), CP-L 5109 Dry Tensile Strength, psi	30 Min.	30 Min.	30 Min.
VMA % CP-48 (see note 1, 2)			

Note 1: Maximum Theoretical Specific Gravity of mix by CP-51.

Note 2: Also refer to production tolerances.

Aggregate Grading for the hot bituminous asphalt shall be as follows:

Bottom and intermediate lifts of full depth paving - Grading SG (Minimum lift shall be 3 times the maximum nominal particle size)

Bottom lifts of composite sections - Grading S

Final surface wearing course - Grading SX (one and one half (1½) inch minimum lift)

208.00 GENERAL - CONSTRUCTION

1. The purpose of this standard is to set forth the minimum criteria to be used in the construction of all streets within the City of Longmont.
2. "Streets" as used in this specification shall include the pavement section, right-of-way, sidewalks, driveways, concrete paths, alleys and alley approaches.
3. All materials and construction shall be done in conformance with the City of Longmont Standard Specifications and the approved plans. Where these Standards do not address situations, materials, or construction requirements the City of Longmont shall utilize the requirements of the Colorado Department of Transportation, "Standard Specifications for Road and Bridge Construction" and any applicable HBP mix design and material requirements of Item 9 of the most recent version of Metropolitan Governments Pavement Engineers Council (MGPEC) Pavement Design Standards. Requirements contained in the "Standard Specifications for Road and Bridge Construction" are intended to supplement these City standards.
 - a. The term "State Specifications" and "CDOT" in these standards refers to State Department of Transportation, Division of Highways, State of Colorado "Standard Specifications for Road and Bridge Construction". Sections 100 through 109 and measurement and payment provisions of the "State Specifications" shall not apply. Reference in these specifications to the "Division" shall be understood to refer to the City of Longmont and its authorized personnel.
 - b. The City of Longmont standards and specifications shall take precedence over conflicting provisions in the CDOT standard specifications and other referenced standards.
4. Where new construction ties into existing improvements, such as edges of pavement, sidewalks, curbs, etc., the Contractor shall line out and cut or saw the existing improvements to a true line and to an approved depth with a vertical face at the line of removal. Where the existing improvements are damaged, the Contractor shall remove the damaged improvements and shall tie-in to improvements which are in good condition as determined by the Inspector.

208.01 SEQUENCE OF CONSTRUCTION

1. All installation and proper compaction of buried utilities shall be completed prior to the construction of the subgrade, base course, pavement, curb, gutter, crosspans, sidewalks, concrete paths and driveways. However, with approval of the Engineer, in situations where a water service line has been added, modified, or inadvertently missed, water service lines may be installed after the curb, gutter and sidewalks have been placed at least seven (7) days, providing no damage is done to the street improvements. The Contractor shall adjust valve boxes and manholes to final grade after installation of the curb and gutter as described below. Electrical services Dry utility road crossing sleeves shall be installed after the water services but prior to the installation of curb radii. except where previous arrangements for use of conduit have been made and approved by the Engineer.

2. Prior to commencing paving operations, a pre-paving meeting shall be held.
3. After lower lift paving is installed, no cuts shall be made without the approval of the Engineer. If utility installation is required after installation of curb, gutter, sidewalk, concrete path or pavement, boring, jacking, or other alternative means of construction will be utilized.
4. If a pavement cut is permitted after installation of the top lift of pavement, the City may require heater scarifying of patch joints, overlaying of the street, or other techniques approved by the City to avoid any reduction in the useful life of the pavement.

208.02 FIXTURE ADJUSTMENT

1. The Contractor shall adjust all manholes, valve boxes and other fixtures encountered within the area to be paved to conform to the finished surface of the pavement to be built as per the street plans and details and in accordance with all requirements outlined in these specifications. Clean the outside of the fixtures of loose, foreign material for the depth of the pavement prior to the paving. The Contractor shall adjust manhole castings, valve boxes and other fixtures outside the paved areas, but within the street right-of-way, to conform with the finished cross section after construction. Inspect valve boxes by placing a valve key on the operating nut to assure a proper alignment. All adjustments shall be to proper alignment and grade to the satisfaction of the Engineer.
2. Manholes, valve boxes and other fixtures shall be adjusted to the interim street grade after the installation of the lower lift of pavement to produce a safe and rideable surface around the fixture. Prior to placing the final lift of asphalt, manholes, valve boxes, and other fixtures shall be adjusted to the final street grade.

208.03 PROTECTION AND CLEANING

1. The Contractor shall take proper precautions for the protection of all existing improvements which are to remain in place and all other identifiable installations that may be encountered during construction which are to remain and not be replaced.
2. The Engineer shall be the sole judge as to whether items may be reset and reused. If, in the opinion of the Engineer, items that were allowed to be reused and reset are damaged during construction the items shall be replaced by the Contractor.
3. The Contractor is responsible for site cleaning during the entire construction period. After paving operations have been completed, the Contractor shall clean and remove all leftover and waste materials. All curbs shall be properly backfilled and the adjacent ground left in a neat and uniform condition, acceptable to the Engineer.

209.00 CLEARING AND GRUBBING

1. This work shall consist of clearing, grubbing, removing and disposing of vegetation and debris within the limits of the right-of-way, easement areas, and such other areas as may be indicated on the drawings or required by the work, except such vegetation and objects designated to remain.

2. The Contractor shall remove and dispose of protruding obstructions, stumps, roots and matted roots over 4 inches in diameter to two feet below the finished grade. Backfill all holes resulting from the removal of obstructions, stumps, and roots and compact the backfill to 95% of Standard Proctor, ASTM D698. Undisturbed stumps, roots, and nonperishable solid objects located two feet or more below the subgrade may remain in place.
3. The Contractor shall clear and strip all surface vegetation, sod, and topsoil from subgrades for permanent construction, fills and embankments. Undisturbed stumps, roots, and nonperishable solid objects located two feet or more below the subgrade may remain in place.
4. The Contractor shall trim or remove and dispose of branches of trees extending over the roadway to a clear height of 15 feet above the roadway surface. All removal and trimming shall be done in accordance with good tree surgery practices.

210.00 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

1. This work shall consist of the removal, wholly or in part, and the satisfactory disposal of buildings, foundations, fences, signs, structures, old pavements, abandoned pipelines, and other obstructions which are not designated on the drawings to remain.
2. Where culverts or sewers are to be abandoned in place under local streets, the culvert and sewer ends are to be sufficiently filled or crushed to prevent the future settlement of embankments and backfills. Fill the ends of concrete, plastic or masonry culverts with concrete and crush the ends of metal culverts. The removal and plugging of culverts shall include the removal of head walls and other appurtenances that are necessary to accommodate the work.

All culverts or sewers to be abandoned under collector and arterial streets shall be flow-filled where they are located longitudinally within the public right-of-way. Unless otherwise approved by the Engineer, the culverts or sewers that cross the public right-of-way under collector and arterial streets shall be removed.

3. The Contractor shall not remove sidewalks, concrete paths, streets, driveways, culverts, or other drainage structures in use by traffic or pedestrians until satisfactory arrangements acceptable to the City have been made to accommodate traffic and drainage.
4. Culverts designated to remain shall be cleaned at the end of construction by removing all sediment and debris from within the culvert and appurtenant structures.
5. All structures designated to partially remain within the right-of-way shall be removed to a depth of two (2) feet below the proposed subgrade.

211.00 EXCAVATION AND EMBANKMENT

211.01 GENERAL

1. This section covers excavation, hauling, disposal, placement, subgrade preparation, shaping, backfill, compaction, and embankments.

2. For these specifications "Roadbed" is defined as the graded portion of a road within top and side slopes, prepared as a foundation for the pavement structure, gutters, sidewalks.
3. The Contractor shall complete all necessary clearing and grubbing and removal of obstructions prior to beginning grading operations.
4. The Contractor shall not begin site grading until the work has been properly staked. The Contractor shall not excavate beyond the dimensions and elevations established.
5. Completed or partially completed areas of work that are disturbed by subsequent construction operations or by adverse weather shall be scarified, reshaped, and recompacted to the required density.

211.02 MATERIALS

1. Generally, soil materials for roadway construction shall be as recommended in the approved soils report. The following soils materials are the minimum requirements for the materials to be used in the construction of roadways.
2. Embankment and fill material shall consist of soil, granular sand, gravel, cobble and boulder material, free from frozen material, organic material, trash, glass, broken concrete, other corrosive or deleterious material. The Contractor shall import approved material as necessary. Prior to placement of any imported material, the Contractor shall submit test results to the City for review and approval indicating compliance with the requirements of the soils report and design standards.

Approval of embankment and fill material is contingent on the material having a resistance value when tested by the Hveem Stabilometer, or equivalent resilient modulus value, of at least that specified in the approved plans and a maximum dry density of not less than 90 pounds per cubic foot. The material must be stable and have a liquid limit less than 40 and a plastic index less than fifteen (15) when tested in accordance with AASHTO T-89 and T-90, respectively. Size restrictions are as follow:

- a. No material shall have a dimension larger than six (6) inches. In the top eighteen inches of fill, no material shall have a dimension larger than four (4) inches.
 - b. These size restrictions are contingent upon the material being evenly distributed in finer material such that uniform soil consolidation is achieved. If uniform soil consolidation is not being achieved the Engineer may reduce the size of materials allowed or change the embankment and fill material requirements.
3. Where unstable subgrade is encountered, the Contractor shall take steps necessary to stabilize the material by techniques such as over excavation and backfill with imported material, use of geotextile fabrics, or other combinations. The contractor shall notify the Engineer of the proposed solution to stabilize the subgrade. If required by the City, the Developer's Design Engineer will make recommendations on stabilization techniques and materials.

211.03 SUBGRADE

1. The Contractor shall scarify the subgrade to the depth specified in the approved soils report and compact to the density specified within the approved soils report. In no case shall the depth be less than twelve (12) inches, or the compaction less that specified in these specifications.
2. The Contractor shall not place any embankment, fill, base course, pavement or other permanent improvements on frozen or muddy subgrade. Compact and consolidate subgrades such that they are free from mud and sufficiently stable to remain firm, dense and intact.
3. Wherever material is encountered that is wet or otherwise unstable and is incapable of supporting structures or the roadbed the material shall be over excavated to a depth suitable for construction of a stable subgrade. The Contractor shall backfill over excavated areas with a stabilization material approved by the Engineer. An approved filter fabric shall be used where required by the Engineer around the Stabilization Material and on the subgrade to stabilize the subgrade and prevent fines from migrating into the Stabilization Material.
4. Level and roll the subgrade so the materials will be uniformly compacted and bond well with the first layer of the base course, backfill, fill or embankment.
5. Shape the surface of the subgrade under areas of base course, and pavement surfaces so that they are not more than one quarter ($\frac{1}{4}$) inch above or one half ($\frac{1}{2}$) inch below the required subgrade elevation. Shape the surface of the subgrade under structures such that they are not more than zero inches above or one and one quarter ($1\frac{1}{4}$) inches below the required subgrade elevation. Fill areas of the subgrade that are low with the material to be placed upon the subgrade. Shape the subgrade to prevent the ponding of water from drainage and rain.
6. Where pipe will pass through backfill, embankment or fill the Contractor shall place and compact the backfill, embankment or fill to an elevation at least one foot above the top of the proposed pipe prior to beginning trenching.
7. Remove exposed cobbles, stones or boulders greater than four (4) inches in size that create an irregular surface at the subgrade under base course material. Backfill the resulting voids with base course material and compact to the specified density.

211.04 EXCAVATION

1. The Contractor shall remove and dispose of excess excavated materials and materials that are not suitable for use within the public right-of-way.
2. Foundations and the pavement structure shall be founded on original, undisturbed soil or on structural backfill extended to the undisturbed soil. Unless otherwise approved by the Engineer and stipulated in the approved soils report, Foundations and the pavement structure shall not be founded on existing fill if encountered at the project site. If existing fill is encountered at the subgrade, the Contractor shall excavate to original undisturbed soil and bring the grade to the required elevation with approved material. Existing fill material if encountered at the site shall be removed. Existing fill may be stockpiled for

reuse in backfills and embankments if it meets the requirements of the specifications. The Contractor shall remove unsuitable soil material as directed by the Engineer. The disposal of unsuitable soil material is the responsibility of the Contractor.

3. Excavate rock that is encountered at the site to a minimum depth of six (6) inches below subgrade within the limits of the roadbed.
4. The Contractor shall blend the intersection of cut slopes with the slopes of adjacent natural ground surfaces in a uniform manner. The tops of cut slopes shall be flattened and rounded in accordance with the approved plans. Slopes shall be graded as shown on the Approved Plans, shall not exceed a 4:1 slope unless otherwise approved by the Engineer, and shall be graded to drain.

211.05 BACKFILL, FILL AND EMBANKMENT

1. The Contractor shall import approved material if compaction cannot be obtained with job excavated material, or if job excavated material does not meet the criteria in Section 211.02, or the requirements of the geotechnical report. The Contractor shall provide the proper documentation showing that the existing and imported materials meets the appropriate criteria.
2. Place the backfill, fills and embankments on suitably prepared subgrades. Distribute material so as to preclude the formation of lenses of material differing from the surrounding materials. Lifts shall have uniform thickness prior to compaction and shall not exceed eight (8) inches in uncompacted thickness. Spread and level material that is deposited in piles or windrows prior to compaction. Continuously mix, level, and manipulate the material as compaction progresses to assure uniform moisture and density.
3. The Contractor shall insure that the methods of compaction shall not overturn or place excessive pressure against structures such as retaining walls, abutments, wing walls, or culvert head walls where backfill, fills or embankment is placed on only one side of structures. When backfill, fill or embankment is placed on all sides of a concrete structure, the embankment shall be brought up equally on all sides of the structure. The fill adjacent to the abutment of a bridge shall not be placed higher than the bottom of the backwall until the superstructure is in place.
4. Where embankments encroach on stream channels, ponds or lakes, the largest available rock from the excavation shall be placed along the toes of slopes to protect the embankments against erosion from water action. The Engineer may require the use of riprap along channels, ponds and lakes. All environmental and grading permits shall be obtained from the US Army Corps of Engineers, Colorado Department of Public Health and Environment and City of Longmont Public Works Division prior to construction adjacent to stream channels, ponds or lakes.
5. Rock embankment, if allowed, shall not be constructed above an elevation two feet below the finished subgrade. The balance of the embankment shall be placed in layers not to exceed eight inches loose thickness and compacted as specified for embankments. When rock fill is placed over any structure, the structure shall be covered with a minimum of two (2) feet of compacted earth or other approved material before the rock is placed.

6. Cross hauling or other action as appropriate will be required by the Engineer when necessary to insure that the best available material is placed in critical areas of embankments.
7. The Contractor shall use equipment suited to the soil being compacted. Compaction by use of water ponding or jetting or use of a hydro-hammer is strictly forbidden.

211.06 FINISH GRADING

1. After the pavement, permanent surface improvements, structures, backfills and fills have been completed the Contractor shall grade non-paved areas to slopes, contours or elevations indicated on the Drawings. Finish grading shall ensure proper positive flow and drainage. Conduct final rolling operations to produce a stable, uniform and smooth cross-section. Provide effective drainage with slopes of at least 1% unless otherwise indicated.
2. Where topsoil is to be placed in the non-paved areas the Contractor shall provide allowance for topsoil placement. Finish grade areas to receive topsoil to within not more than 0.1 feet above or below the required subgrade elevations. Compact areas to receive topsoil as specified and grade such that they are free from irregular surface changes.

211.07 COMPACTION AND TESTING

1. The requirements for Compaction and Testing, Construction Water, and Compaction Test Failure are the same as those required under their respective sections for trenching as specified in the General Requirements section of these Standard Specifications, except as modified herein.
2. The Contractor shall test the subgrades, fills, backfills and embankments for compliance with the requirements for thickness and compaction density. Provide, as a minimum, one (1) density test for each one hundred fifty (150) linear feet of subgrade, one (1) density test for each 100 lineal feet of curbwalk or concrete path and one (1) density test for each five hundred (500) cubic yards of embankment, fill or backfill. The Engineer may designate the locations for testing. The Engineer may require more tests when in their opinion they are required. Remove and replace unacceptable materials and repair unacceptable areas of thickness or compaction as required by the Engineer. Compaction tests do not relieve Contractor of the requirement for a firm, stable surface.
3. Field compaction densities shall be as indicated in the soil report but not less than the following minimum Standard Proctor densities, reference ASTM D698.
 - a. All compaction within the public right-of-way shall be equal to 95% compaction at plus or minus 2% optimum moisture content.
 - b. Do not compact topsoil.
4. Proof roll the subgrade and base course prior to the placement of the subsequent course after the specified compaction densities have been obtained. Proof rolling shall be done with an approved vehicle having an average minimum axle load of 18,000 pounds per axle. Use of graders or front-end loaders is not acceptable. Areas that show movement and unstable areas shall be corrected. Proof rolling shall be done within twenty four (24)

hours of the compaction density testing and within twenty four (24) hours of placement of any asphalt or concrete surface.

212.00 AGGREGATE BASE COURSE

1. The Contractor shall mix the aggregate by methods that insure a thorough and homogenous mixture.
2. The subgrade and base course shall be free from standing water during construction. Remove any water encountered during construction to the extent necessary to provide a firm and stable subgrade and base course. Divert surface runoff or use other means necessary to accomplish the above. Do not deposit, tamp, roll or otherwise mechanically compact the aggregate base course in water. Do not construct aggregate base course with frozen material or on frozen subgrade.
3. Aggregate base course shall be crushed stone or crushed gravel conforming to of Section 703.03 of "State Specifications" with an minimum "R" value of 70. The soils report shall identify areas that in the soils engineer's opinion need to be treated with mineral filler or hydrated lime. Commercial mineral filler if required shall conform to Section 703.01 of the "State Specifications". Hydrated lime shall conform to section 712.03 of the "State Specifications".
4. If the required compacted depth of the aggregate base course exceeds six (6) inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer of aggregate base course shall not exceed six (6) inches. The surface of each layer shall be maintained during the compaction operations so that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied during compaction in the quantity necessary for proper consolidation of the material, or the material shall be harrowed, disked, bladed, or otherwise worked to insure a uniform moisture content. Immediately prior to paving, proof roll the aggregate base course as described in the General Section of these Street Construction Specifications to verify the base course stability. Correct areas that are not stable.
5. Herbicides, conforming to the requirements of Section 217 of the "State Specifications", shall be applied to the aggregate base course and/or subgrade no more than one (1) day prior to paving. The rate of application shall be as recommended by the herbicide manufacturer. Herbicides shall not be used where they may contaminate water used for irrigation or drinking purposes.
6. As a minimum, the Contractor shall provide one field compaction test for each lift of aggregate base course for every one hundred fifty (150) linear feet of base course placed. The Engineer may designate the locations for testing. The aggregate base course shall be compacted to 95% minimum density, Modified Proctor, ASTM D1557 or AASHTO T180. All compacted aggregate base course shall be within 2% (+) of the optimum moisture content of the soil as determined by ASTM D1557. The Engineer may require more tests when in their opinion they are required due to visibly unstable areas. Remove and replace unacceptable materials and repair unacceptable areas of thickness or compaction as required by the Engineer. Compaction tests do not relieve Contractor of the requirement for a firm, stable surface.

7. The in-place compacted thickness of aggregate base course shall be no more than one quarter ($\frac{1}{4}$) inches less than the thickness shown on the approved drawings.
8. Test the finished surface of the compacted aggregate base course for smoothness using ten foot straightedge applied parallel with, and at right angles to centerline of the paved area. Any deviation in excess of one quarter ($\frac{1}{4}$) inches shall be corrected to the satisfaction of the Engineer.

213.00 PLANT MIXED BITUMINOUS PAVEMENT

213.01 GENERAL

1. Prior to beginning paving each calendar year, the Contractor shall submit to the Engineer for review and approval a mix design for each mix. The Engineer may also require mix designs from the Contractor during the year because of changes in the physical properties of the aggregate, source of the aggregate, or other changes in the mix.
2. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate and a single temperature for the mixture at the discharge point of the plant. The job mix formula shall also identify all additives, optimum asphalt content and the final gradation shown on 0.45 power graph. Mix designs shall also provide the results of a moisture susceptibility test (Lottman) performed at optimum oil content in accordance with CP-L 5109, method B. Where reclaimed asphalt is used in the job mix, the design report shall address the use of reclaimed asphalt and the percent of asphalt in the reclaimed asphalt. Submit the following with the job mix formula.
 - a. The proposed job mix gradation for each mixture which shall be wholly within the Gradation Range Table before the production (job mix) tolerances are applied.
 - b. The aggregate source, gradation, additive blending, aggregate physical properties, and percentage of each element used in the production of the final mix.
 - c. The name of the refinery supplying the asphalt cement, source and grade of performance graded binder, source of lime, and the source and type of anti-strip additive.
3. After the job mix formula is established, all mixtures furnished for the project shall conform to the approved job mix formula within the range of production tolerances.
4. Mix design (production) verification shall occur prior to the start of the project. Mix design (production) verification shall be performed by LABCAT Level C accredited technicians to verify the volumetric properties of the mix. If the mix has been produced for another project within the last ninety (90) days, data from that project can be submitted for verification. The mix verification test reports shall be submitted to the City prior to mix placement.

Volumetric properties shall be within the following tolerances. The tolerances in the following table are for mix design verification only (from plant produced material from the specified mix design). See Job Mix (Production) Formula Tolerances table for production tolerances.

MIX DESIGN (PRODUCTION) VERIFICATION TOLERANCES	
Air Voids	±-1.2%
VMA	± -1.2%
Asphalt Cement Content	± -0.3%
Stability	Applicable Minimum

Change in Source or Grade

Should a change in the source of Lime occur, or more than one temperature grade change on either the high or low end of Asphalt Binder (AC) occur, a one point verification test (at optimum asphalt content) of the mix must be performed to verify that the applicable criteria is still met. If this testing shows noncompliance, a new Design Job Mix shall be established before the new AC or Lime source is used. Any change in aggregate type or source will require a new mix design. The one point verification test may be performed on lab mixed samples or on Plant mixed samples.

Production test results shall comply with the following table:

JOB MIX (PRODUCTION) FORMULA TOLERANCES	
Passing No. ¾" and Larger	6%
Passing No. 4 and No. 8	5%
Passing No. 30	4%
Passing No. 200	2%
Air Voids	1.2%
VMA	1.2%
Hveem Stability	See Footnote #3
Asphalt Content	0.3%
Asphalt Content, Mixes with >10% RAP	0.4%

1. There is 1.0% tolerance for the maximum sieve size.
2. Mixes with -No.200 sieve material produced over 7.0% is allowed only when Air Voids are kept within 1.2% of the Air Voids at mix design optimum and VMA still meets requirements.
3. Hveem Stability must meet the minimum value specified in Superpave Mixture Properties table.
4. Hot bituminous pavement Gradation SG may contain up to 20% reclaimed asphalt pavement where approved by the Engineer. Hot bituminous pavement Gradation SX shall not contain any reclaimed asphalt pavement. Reclaimed asphalt pavement where allowed shall meet the requirements of Section 703.04 Gradation SG of the "State Specifications" and must meet all the requirements for hot bituminous pavement.

213.02 MATERIALS

1. Hot plant mixed bituminous pavement aggregate shall conform to the material requirements of Item 9 of the most recent version of Metropolitan Governments Pavement Engineers Council (MGPEC) Pavement Design Standards. Use Grade SG aggregate mix

for the bottom lift of full depth asphalt sections, aggregate mix S for the bottom lift of composite sections, and use Grade SX for the surface course and overlays.

2. Joint and crack sealant shall conform to Section 408.01 through 408.03 of the "State Specifications".

213.03 CONSTRUCTION REQUIREMENTS

1. Before starting the paving, the Contractor shall insure that utility lines, piping, general grading and heavy trucking are complete so such operations will not damage paving work. No less than one day prior to paving, the Engineer MUST receive all test results stating that the subgrade and/or aggregate base is approved.
2. Prior to placing the pavement, the Contractor shall adjust manhole frames, valve boxes and other fixtures.
3. Weather limitation requirements for construction of hot bituminous pavement shall be in accordance with the following table:

MINIMUM AIR AND SURFACE TEMPERATURE LIMITATIONS FOR MIX PLACEMENT				
Compacted Layer Thickness	Top Layer of Pavement*		Lower Layers	
	PG 58-28 PG 64-22	PG 76-28	PG 58-28 PG 64-22	PG 76-28
< 2 inches	60 degrees F	75 degrees F	N/A	N/A
2 inches to < 3 inches	50 degrees F	65 degrees F	40 degrees F	50 degrees F
> 3 inches	50 degrees F	50 degrees F	40 degrees F	40 degrees F

* Air temperature is taken in the shade. Surface temperature is taken on the subgrade or base.

* Do not place the mixture at a temperature lower than 245 degrees Fahrenheit or 290 degrees Fahrenheit for mixes containing polymer modified asphalt.

4. Requirements for construction of hot bituminous pavement shall be in accordance with Section 401.08 through 401.19 of the "State Specifications", except as modified herein.
5. Apply a tack coat, prior to bituminous paving, to the contact edges of previously constructed bituminous layers, Portland cement concrete surfaces, and metal surfaces abutting or projecting into the bituminous pavement. Tack coat the surface of the previously constructed bituminous layer when more than eight hours passes between paving of lifts. Distribute the tack coat at rate of 0.10 gallons per square yard or as otherwise directed. Allow the tack coat and prime coat to dry until tacky to touch prior to bituminous paving. Paving equipment shall be in accordance with Section 407.05 and surface preparation shall be in accordance with Section 407.06 of the "State Specifications".
6. Unless approved otherwise by the Engineer, bituminous pavement shall be placed in ribbons 12 foot wide. After the first ribbon is placed and rolled, place succeeding ribbons and extend screen to overlap previous strips by not less than six (6) inches. The

Contractor shall arrange paving operations so there will be no exposed longitudinal joints between adjacent travel lanes at the end of a day's run for all local roadways. Longitudinal joints for collector and arterial roadways shall be constructed in accordance with all applicable CDOT Specifications.

7. After final rolling, do not permit vehicular traffic on pavement until pavement has cooled sufficiently to avoid damage to the surface.
8. In areas where the Engineer allows patching the Contractor shall cut out the old bituminous pavement and clean, fill and compact the area with fresh, hot plant mix bituminous pavement. Remove the deficient areas the full depth of bituminous pavement to one foot outside the entire area of the failure or as marked in the field by the Engineer. Cut the sides of the patched area vertically, perpendicular and parallel to the direction of traffic flow. All subgrade material shall be compacted to 95% of standard proctor. All aggregate base course shall be compacted to 95% minimum density, Modified Proctor, ASTM D1557 or AASHTO T180. Remove and dispose of the spoiled material and clean the area thoroughly. Apply tack coat to exposed surfaces and base course before placing new pavement. Replace the bituminous pavement in the patched area with full depth hot plant mixed bituminous pavement in lifts not exceeding three (3) inches in compacted thickness. Compact the lifts to between 92% and 96% of Maximum Theoretical (Rice) density.

213.04 TEST REQUIREMENTS/TOLERANCES

1. Density, Gradation and Extraction - Test and monitor the bituminous pavement compaction density with a nuclear gauge on a continuous basis during the paving operation. The Engineer may require that core samples of the compacted bituminous pavement be taken by the Contractor at random locations on the project for testing of compaction and compliance with the design mix. Where the core samples have been taken, new material shall be placed and compacted into the holes by the Contractor to conform with the surrounding areas.

Compaction density shall be to between 92% and 96% of Maximum Theoretical (Rice) density. One test per 150 L.F. of pavement shall be required per day with a minimum of six tests per project. Tests shall also be taken by the Contractor to indicate the aggregate gradation, percent of air voids, and percent asphalt to verify compliance to approved pavement design. The Contractor shall perform, as a minimum, Rice test and gradation and extraction test per day of paving operation, unless the paving for the day is less than 100 tons. The test results shall be signed by a Professional Engineer employed by an independent testing company. The in-place pavement shall be tested for compliance with the requirements for surface smoothness. The Engineer may order additional testing at the Contractor's expense if the Engineer feels it is necessary to determine that the pavement is acceptable or to determine the extent of unacceptable pavement. Repair or remove and replace unacceptable pavement as required by the Engineer.

SCHEDULE FOR MINIMUM HBP MATERIALS SAMPLING AND TESTING		
Test	Standard	Minimum Frequency
Density	ASTM D2950, CP-44, CP-81, CP-82	One Test for Each 150 Lineal Feet/Lane
Thickness (Core)		One Test for Each 1,000 Lineal Feet/Lane

Air Voids and VMA	CP-44 & CP-48	One for Each Day
Gradation	AASHTO T27	One for Each Day
Hveem Stability	CP-L 5106, T 245	One for Each Day
PG Binder – AC Content	CP-L 5120 or AASHTO T164	One for Each Day
Moisture Susceptibility (Lottman)	CP-L 5109, Method B	One For Each 3 rd Day
Maximum Theoretical Specific Density (Rice)	CP-51	One for Each Day

The City may check pavement temperatures, segregation, rolling patterns and other construction means and methods, which affect the performance of the pavement system. The Contractor shall provide assistance in sampling and testing at all facilities and at the job site.

HBP Compaction

The temperature of the mixture immediately behind the screed shall be at least 245° Fahrenheit (290° Fahrenheit for polymer modified asphalt) and breakdown compaction shall be completed before the mixture temperature falls 20° Fahrenheit.

Rolling: Both steel wheel and pneumatic tire rollers are required. The number, weight, and type of rollers furnished shall be that which is sufficient to obtain the required density while the mixture is in a workable condition.

Compaction shall begin immediately after the mixture is placed and be continuous until the required density is obtained.

If the required density is not achieved and the surface temperature falls below 185° Fahrenheit, or there is obvious surface distress or breakage, no further compaction effort will be permitted unless approved by the Engineer. The criteria for mixtures containing polymer modified asphalt cements shall be 235° Fahrenheit.

Suspend pavement operations when density requirements are not met.

Remove all roller marks with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted during surface course final rolling and will not be permitted on any rolling on bridge decks covered with waterproofing membrane.

Compact all HBP paving to between 92-96% of Maximum Theoretical (Rice) Density (CP 51: Maximum Specific Gravity of Bituminous Paving Mixtures) with the average of five random and consecutive density tests equaling at least 93% of T209.

Compaction of less than 92% of maximum theoretical (Rice) density will be cause for removal and replacement.

Use the most recent maximum theoretical (Rice) density in calculating Relative Compaction according to CP-44.

Core the pavements for field density tests in accordance with Colorado Procedure 44, Method B (AASHTO T230), or for field calibration of nuclear density equipment in accordance with the Appendix of Colorado Procedure 81 (ASTM D2950).

At a minimum, take cores for nuclear density equipment calibration at the beginning of placement of each pavement layer or change of mixture materials or gradation.

Untested areas during placement will also require cores to be taken to verify compaction.

1. Thickness - The in-place compacted thickness for hot plant mix bituminous pavement shall not vary from the required design thickness by more than 1/4 inches less than the required design thickness and shall have no limitation on the greater thickness.
2. Tolerances - The surface tolerance for pavement shall not be greater than three sixteenths (3/16) inch, as measured with a ten (10) foot straight edge. If 10% or more of the final pavement surface fails to meet these tolerances, or requires repairs in the form of patching, the Developer shall be required to overlay the entire surface prior to final acceptance.

214.00 PORTLAND CEMENT CONCRETE PAVEMENT

214.01 MATERIALS

1. Concrete pavement shall conform to the requirements for Class "P" concrete as specified in Section 601.02 and 601.03 of the "State Specifications". All concrete shall be ready mixed concrete. No concrete shall be field mixed. The proposed mix shall be tested in accordance with ACI code requirements. Two copies of the certified test reports shall be submitted to the Engineer, for acceptance, prior to ordering of concrete.
2. Proportioning of the concrete shall conform to Section 601.05 of the "State Specifications". The Contractor shall include Class F fly ash in concrete for paving. The quantity of Class F fly ash shall be equal to 20% of the weight of cement shown in Table 601-1 and shall be included in addition to the full weight of cement shown in the Table. The voluntary substitution of fly ash as permitted in Section 601.05 is not permitted.
3. Additives for concrete, other than those specified in the mix design, shall not be used without prior approval of the Engineer. When approved for use, chemical admixtures or additives shall comply with applicable ASTM or AASHTO standards. Calcium chloride or admixtures containing chloride shall not be allowed in reinforced concrete.
4. The batching of concrete shall conform to Section 601.06 of the "State Specifications".
5. The mixing of concrete shall conform to Section 601.07 of the "State Specifications".
6. Equipment used for concrete mixing, conveyance and placement shall conform to Section 412.07 of the "State Specifications".

214.02 CONSTRUCTION REQUIREMENTS

1. Before starting the paving, the Contractor shall insure that utility lines, piping, general grading and heavy trucking are complete so such operations will not damage paving work.

2. Prior to placing the pavement, the Contractor shall adjust manhole frames, valve boxes and other fixtures.
3. Submit to the Engineer for approval a construction joint pattern showing types of each joint and joint spacing prior to paving operations. The pattern shall be based upon the Colorado Department of Transportation, M-Standard M-412-2, except that Expansion Joint Detail A shall be revised to a non-thickened section and shall include a smooth dowel sized one eighth (1/8) the concrete slab thickness at the mid-thickness of the slab, and fourteen (14) inches long placed at twelve (12) inch centers with an expansion cap on one side of the joint.
4. Construction requirements for concrete pavement shall be in accordance with Section 412.08 through 412.21 of the "State Specifications", except as modified herein.
5. The Contractor shall submit to the Engineer the ready mix delivery tickets for each load upon request by the Engineer indicating the following:
 - a. Supplier's name and date.
 - b. Truck number.
 - c. Project number and location.
 - d. Concrete class designation.
 - e. Cubic yards batched.
 - f. Mix design identification.
 - g. Type, brand, and amount of cement and fly ash.
 - h. Brand and amount of all admixtures.
 - i. Weights of fine and coarse aggregates.
 - j. Moisture content of fine and coarse aggregates.
 - k. Gallons of batch water.
 - l. Time at which water was added.
 - m. Elapsed time between when water was added and concrete load was in place.
 - n. Amounts of initial and supplemental water added.
 - o. Name of individual authorizing supplemental water.
 - p. Numerical sequence of delivery by indicating cumulative yardage delivered on each ticket.
 - q. Provide the following titles with blank space to record discharge time, water-cement ratio, air content, slump, revolutions.
6. Prior to concrete placement the Contractor shall remove all construction debris and extraneous matter from within the forms. Stays, bracing and blocks, serving temporarily to hold the forms in correct shape and alignment, shall be removed as the concrete placement progresses. All concrete shall be placed on a clean damp surface, free from standing water, and properly consolidated subgrade. Concrete shall not be placed with a free fall greater than four (4) feet to prevent segregation of the concrete.
7. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed the following time limits:
 - a. Air temperature 45 degrees F. to 80 degrees F. - 90 minutes maximum.

- b. Air temperature over 80 degrees F. with a retarder added to the mix - 90 minutes maximum.
 - c. Air temperature over 80 degrees F. without a retarder added to the mix - 60 minutes maximum.
8. The opening of concrete pavement to vehicular traffic, including the Contractor's vehicles, will not be permitted until the compressive strength of the concrete test cylinders, tested in conformity with the latest ASTM Standard Method of Test for "Compressive Strength of Molded Concrete Cylinders," Designation C-39 is at least 3,000 pounds per square inch. If permanent shoulders or curbs are not in place, a six (6) foot wide temporary earth shoulder shall be placed against the outside pavement edges before traffic is allowed on the pavement. Prior to opening to vehicular traffic all joints shall be properly sealed and the roadway shall be cleaned. The opening of concrete pavement to vehicular traffic shall not constitute a final acceptance of the pavement. No steel blades shall be used to clean concrete surface.

214.03 TEST REQUIREMENTS

- 1. The Contractor shall provide the necessary testing of concrete for acceptance by the City including the testing of concrete cylinders for compression testing and air and slump tests. Sample concrete test cylinders shall be made in sets of four. One cylinder shall be broken at seven (7) days, two cylinders shall be and broken at twenty eight (28) days, and one held on reserve for test if there is a failure on one of the twenty eight (28) day tests. If the twenty eight (28) day cylinders do not meet the specified minimum compressive strength then a representative number of concrete cores, as determined by the Engineer, shall be taken by the Contractor to determine if the in-place concrete meets the specified strength.
- 2. Concrete cylinders for strength tests shall be molded and cured in accordance with the "Practice for Making and Curing Concrete Test Specimens in the Field", ASTM C31 and tested in accordance with "Test Method for Compressive Strength of Cylindrical Concrete Specimens", ASTM C 39.
- 3. The following is the minimum number of sets of concrete test cylinders that are required for concrete used in the Work for each day's placement. Sets that are taken shall generally represent equal volumes of concrete that are placed within each day's placement.

<u>Quantity of Concrete</u>	<u>Number of Sets of Test Cylinders</u>
100 cubic yards or less	One
100 cubic yards or more	Four (4) sets plus one set for each additional 100 cubic yards of concrete

- 4. Conduct air and slump tests from one of the first three batches mixed each day and for each compressive strength test set, and whenever consistency of concrete appears to vary.
- 5. Mark or tag each sample of compression test cylinders with the date and time of day the cylinders were made. Identify the location in the Work where the concrete represented by

the cylinders was situated or stationed. Identify the delivery truck or batch number, air content, and slump. Submit to the Engineer two (2) copies of each test result.

6. Concrete shall meet the minimum acceptance standards of the State Specifications. Concrete that does not meet the acceptance criteria shall be removed and replaced.
7. The surface tolerance for Portland cement concrete pavement shall not be greater than three sixteenths (3/16) inch, as measured with a ten (10) foot straight edge. For collector and arterial streets, the City reserves the right to require a profilograph test with the specifications established by the CDOT standard specifications for the design criteria of the street.

215.00 STREET RESTORATION (PATCHING AND MATCHING EXISTING)

1. Proof rolling as described in Section 211 is required on subgrades and base courses prior to placement of subsequent courses. If the area is too small for a proof roll, field density tests shall be provided.

215.01 AGGREGATE BASE COURSE

1. Materials for aggregate base course shall conform to the requirements of Section 703.03 of the "State Specifications", Class 6 or Class 4.

215.02 PAVEMENT REPLACEMENT

1. All materials and construction techniques associated with pavement patches shall conform with the materials and construction requirements specified in these Standard

Specifications for hot bituminous plant mix pavement and Portland cement concrete pavement.

2. Patching materials and construction requirements for bituminous pavement shall meet the requirements for hot plant mix bituminous pavement of this specification except as modified herein. Patching shall be for the full depth of the existing bituminous pavement in place.
3. Apply a tack coat to the contact edges of previously constructed bituminous layers, aggregate base course, Portland Cement concrete surfaces, and metal surfaces abutting or projecting into the bituminous pavement.
4. Patches for Portland cement concrete pavement shall consist of Portland cement concrete Class "P". To increase the load transfer and protect the pavement against differential settlement the Contractor shall drill the existing concrete pavement and provide expansion dowels in accordance with Detail 100-03, minimum, distance on center at the mid-depth of the concrete. The dowels must be able to move from expansion and contraction of the concrete. To facilitate this movement, the dowels portion that protrude into the patch shall be painted and covered with a one sixteenth (1/16) inch coating of grease. The minimum size concrete patch allowed shall be as detailed under "Removal of Concrete Surfaces" in the general conditions.

215.03 SURFACE TOLERANCES

1. All patches shall be constructed true to grade with the existing pavement section. Variation from grade shall not exceed one-quarter (1/4) inch. If the variation exceeds one-quarter (1/4) inch, the pavement and backfill shall be repaired or replaced to the satisfaction and at the option of the Engineer.

215.04 TEMPORARY PATCHES

1. When weather limitations prevent the placement of pavement patches as defined herein, the Contractor shall obtain the approval of the Engineer to install a temporary patch of cold mix asphalt or other suitable material. As soon as conditions allow, the Contractor shall remove the temporary patch and install a permanent patch in accordance with these specifications. The Contractor shall be responsible for maintaining temporary patches in a manner satisfactory to the Engineer until they are replaced. In case of an emergency the Engineer may elect to repair the temporary patch and backcharge the Contractor for the repair of the patch.

215.05 TIME LIMITS FOR PATCHING STREET CUTS

1. All patches shall be made within the time frame stipulated in the appropriate permit.

216.00 SIDEWALKS, CURB RAMPS, CURB AND GUTTER, VALLEY GUTTER, CROSSPANS, CONCRETE PATHS, DRIVEWAY AND ALLEY APPROACHES

1. Sidewalks, curb ramps, curb and gutters, valley gutters, crosspans, concrete paths, driveway and alley approaches shall be Class B concrete unless approved otherwise by the Engineer. All concrete shall be ready mixed concrete. No concrete shall be field mixed. No admixtures or additives shall be field mixed unless approved by the Engineer.

Fly ash shall not be used in concrete for sidewalks, curb ramps, curb and gutters, valley gutters, crosspans, concrete paths, driveway, storm drainage structures, and alley approaches.

For concrete paths, the mix shall include one and one half (1½) pounds fiber mesh reinforcing fibers per cubic yard of concrete.

2. Additives for concrete, other than those specified in the mix design, shall not be used without prior approval of the Engineer. When approved for use chemical admixtures or additives shall comply with applicable ASTM or AASHTO standards. Calcium chloride or admixtures containing chloride shall not be allowed in concrete.
3. The Contractor shall submit to the Engineer the ready mix delivery tickets for each load upon request by the Engineer indicating the information specified under Section 215.02 (5) of these Specifications.
4. The weather limitations for the construction of sidewalks, curb ramps, curb and gutters, valley gutters, crosspans, concrete paths, driveway and alley approaches shall be the same as for Portland cement concrete pavement.

5. Subgrade requirements for the construction of sidewalks, curb ramps, curb and gutters, valley gutters, crossspans, concrete paths, driveway and alley approaches are the same as for Portland cement concrete pavement.
6. Where a section of a concrete sidewalk, curb ramp, curb and gutter, valley gutter, crossspan, concrete paths, driveway or alley approach has been disturbed, it shall be removed to a joint if the joint is situated within five (5) feet of the proposed or existing cut, otherwise a straight line shall be saw cut prior to replacement.
7. Construction requirements for concrete sidewalks and concrete paths shall conform to Section 608.03 of the "State Specifications" except as modified by these specifications. Construction requirements for concrete curb shall conform to Section 609.03 of the "State Specifications" except as modified by these specifications. Face forms for concrete curb, if used, may be removed for finishing curb face and fillets as soon as the concrete will retain its shape. Do not remove the back forms for concrete curbs until the concrete has been in place for at least six (6) hours.
8. Transverse joints shall be located at intervals of ten (10) feet in curbs, gutters, and crossspans. For curbwalks tooled joints shall be at ten (10) feet. Joints for concrete paths shall be zip strip or sawcut at eight (8) foot intervals, no tooled joints shall be allowed on any concrete path. Sawcutting of joints shall be performed as soon as the concrete surface is hard enough to allow the sawing operation without otherwise marring the concrete surface, prior to any development shrinkage cracks. Joints shall be continuous through gutter, curb and sidewalks. Joint depth shall be a minimum of one quarter ($\frac{1}{4}$) the thickness of the concrete. Set joints at right angles to face, top, and flow line of curb and gutter, valley gutter, or crossspan. Provide expansion joints at a maximum spacing of two hundred (200) feet.
9. Round the back edge of curbs, lip of gutters adjacent to pavement, and edges adjacent to joints with an edger of one quarter ($\frac{1}{4}$) inch radius.
10. Immediately after finishing all concrete surfaces such as curb ramps, curbs and gutters, sidewalks, concrete paths, valley gutters, driveways and alley approaches slightly roughen the concrete surface by brooming. Concrete paths shall be given a light broom finish. For sidewalks, concrete paths, and driveways broom the surface in the direction perpendicular to the main traffic flow. For all concrete surfaces that are designed to carry storm water such as curbs and gutters, valley gutters, and crossspans, broom the surface in the direction of flow.
11. Concrete for sidewalks, curb ramps, curb and gutters, valley gutters, crossspans, concrete paths, driveway and alley approaches shall be cured in the same manner as outlined in the Portland Cement Concrete Pavement Section.
12. The testing requirements shall be the same as outlined in the Portland Cement Concrete Pavement Section.
13. All sidewalks, curb ramps, curb and gutter, valley gutters, crossspans, concrete paths, driveways, and alley approaches shall be formed and placed true to line, grade, and cross section. All flowlines shall not vary by more than one eighth ($\frac{1}{8}$) inch in ten (10) feet.

14. Where sidewalk, curb ramp, or concrete path become adjacent to curb and gutter, the sidewalk, curb ramp, or concrete path must be poured monolithic with the curb and gutter, unless otherwise approved.
15. Curb ramps shall be designed and constructed in accordance with Details 200-11, 200-12, 200-13, 200-14 Alt. A, 200-14 Alt. B, and 200-15. Concrete used for the construction of curb ramps shall be CDOT Class B concrete unless otherwise approved by the Engineer. All curb ramps shall be constructed with truncated domes in accordance with the latest edition of the Americans With Disabilities Act Access Guidelines (ADAAG). The truncated domes shall be installed across the full width of the ramp as depicted in the details. Truncated dome sections shall be "wet set" in the concrete. Surface applied products or products that are installed on a sand bed will not be allowed in new construction. Truncated domes shall be brick red or tile red to provide color contrast with the adjoining walk surface as specified by Section 4.29.2 of the ADAAG. The type and color of truncated dome product shall be approved by the Engineer prior to construction.

217.00 SIGNS CONSTRUCTION AND INSTALLATION

217.01 GENERAL

These specifications for traffic sign installation are intended to provide a minimum standard that shall be followed when traffic sign installation work is done for the City of Longmont. These specifications shall apply to all materials supplied and methods and procedures of work to be followed. Work shall conform to these specifications and the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction (current edition). In situations where there is a conflict or question of interpretation, these specifications shall prevail.

1. Legal Requirements - All traffic control devices including signs and sign materials shall be in compliance with the Manual on Uniform Traffic Control Devices (MUTCD), the Colorado Supplement thereto, US Department of Transportation Federal Highway Administration (FHWA) Standard Highway Signs (current editions), and the Approved Materials List
2. Signing Plan - A complete signing plan shall be submitted as part of the design documents, which must be approved by the City prior to installation. The signing plan needs to specify the various types, combinations and locations of the signs and sign supports and any existing signs to be removed or replaced.
3. Conditions of Materials Furnished - All items furnished by the Contractor shall be new and in proper working order. For any items not recognized by the City, the Contractor shall submit a sample for approval.
4. Removal of Existing Traffic Signs and Posts - No signs and/or posts shall be removed by any Contractor or person unless authorized by the City. All signs and/or posts removed from the right-of-way will remain property of the City. Anyone removing signs and/or posts is responsible for the condition of the sign and post and will be responsible for the cost of replacing any damaged or missing items.

217.02 STANDARDIZATION

Each sign shall be displayed only for the specific purpose prescribed by the MUTCD. Each sign shall be displayed only in the proper location and at the proper height as prescribed by the MUTCD and the approved signing plan.

1. Symbols - Symbol designs shall in all cases be essentially like those shown in the Standard Highway Designs. All symbol signs, which are readily recognizable by the public may be erected without educational plaques. Whenever applicable, symbols shall be used in place of word messages.
2. Word messages - Where applicable, standard wording as shown in the Standard Highway Signs shall be used. Abbreviations should include only the following: AV, BLVD, ST, RD, DR, CIR, CT, LN, R.R. unless otherwise approved by the City.
3. Lettering - Sign lettering shall be in upper-case letters of the type approved by the FHWA with the exception of overhead street name signs on signal mast arms where the first letter shall be upper case and the remainder shall be lower-case lettering. All lettering shall follow the layout of signs shown in the Standard Highway Signs. For street name signs, the use of series C alphabet is the minimum size accepted. For any given legend, better legibility should be obtained by using a 20% increase in letter to letter space above spacing recommended by Standard Highway Signs.
4. Reflectorization - All signs shall be retro-reflectorized to show the same shape and color both day and night regardless of light conditions. Retro-reflectivity shall be achieved by using sheeting that conforms to the requirements of ASTM D 4956 and the Approved Materials List and shall be applied in accordance with the manufacturer's specifications.
5. Sign Border - Unless otherwise determined by the City, all signs shall have a border of the same color as the legend at or just inside the edge. A dark border shall be set in from the edge while a white border shall extend to the edge. The corners of the sign border shall be rounded. Borders shall be laid out on the sign as shown in the Standard Highway Signs manual for standard traffic signs.

217.03 STREET NAME SIGNS

For street name signs at non-signalized intersections, the sign panel shall be extruded aluminum, nine (9) inches in height by twenty four (24) inches to forty eight (48) inches in length, with approved sheeting on both sides of the sign panel. The legend shall be 6 inches in height, the exception being on numbered streets where the number shall be six (6) inches in height with "ND", "RD", "ST" and "TH" being three (3) inches in height and is to be held in line with the top of the number it follows. The legend shall be a minimum of series C alphabet approved by FHWA, all in upper-case letters. The legend shall be centered and placed on both sides of the sign panel.

217.04 POST AND SIGN PLACEMENT

1. Sign location, height and lateral clearance shall be in accordance with the MUTCD. Signs shall be placed no less than five (5) feet from any fire hydrant so that operation of the hydrant will not be impaired. For electrical equipment clearances, provide ten (10) feet from access doors and no less than three (3) feet from the sides and back and three (3)

feet from the underground electric lines. Where overhead utilities are found, maintain ten (10) feet separation from a wooden pole.

2. Signs should be mounted at right angles to the direction of and facing the traffic that they are intended to serve. Parking signs and Parking restriction signs shall be turned to a 45-degree angle toward the road in the direction of travel.
3. Signposts shall be two (2) inch, fourteen (14) gauge galvanized steel square tubing .with a three (3) foot long, two and one quarter (2¼) inch square base as per the approved materials list. The signpost shall be installed into the ground using the manufacturers specifications so that it is designed to break away, bend over or to fracture upon impact by an errant vehicle. The support system shall meet the criteria specified in the American Association of State Highway and Transportation Officials (AASHTO) publication, Standard Specifications for Structural Supports for Highway Signs, Luminars and Traffic Signals.

Using sign posts that meet these specifications and using lateral clearance listed in the MUTCD, install base (2 1/4" x 2 1/4" x 3") into the ground leaving approximately two (2) inches of the base above ground. If concrete, rock, gravel, etc. is going to be placed around the base, the Contractor shall place a three to three and one half (3 – 3½) inch round PVC sleeve around the outside of the base to the depth of the material to be placed around it. The base shall be two (2) inches above the sleeve. Place post into base so that the sign meets vertical clearance and is stable. Posts shall be connected to the base using two (2) three eights (3/8) inch drive rivets in accordance with the manufactures recommendations to insure proper breakaway.

Signs placed on sign posts shall be attached using three eights (3/8) inch drive rivets with E.G. finish (zinc coated) and nylon washers designed specifically for sign installation.

4. Signs shall not be placed on utility poles, street light poles or traffic signal poles without permission from the City of Longmont. When authorized, signs mounted on existing supports such as traffic signal poles, street light poles, or utility poles shall be mounted using bands and brackets specified in the approved materials list.
5. The Contractor is responsible and shall obtain underground utility locates before installation begins. Signs mounted to existing support such as signal poles or light poles require no utility locates.
6. When only a street name sign is on the post, the post shall be at a height as if a thirty (30) inch STOP sign were mounted on it.