TRANSPORTATION STANDARDS AND DETAILS FOR THE ENGINEERING DIVISION

DENVER PUBLIC WORKS

CITY AND COUNTY OF DENVER PUBLIC WORKS DEPARTMENT

Approved By:

Lesley B. Thomas, P.E.
City Engineer

MAY 2015
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Centerline
Flowline or Grade Break
R.O.W. Line (Right-of-Way)
Expansion Joint Line (Reference CCD Standard Dwg. No. 11.2a for more information)
Transverse Contraction Joint Line (ESALS less than 1,000,000) or in permanent road shoulders or non-square sections less than 2 feet long at curb return radius. No tiebars or dowel bars
Doweled Transverse Contraction Joint Line (ESALS greater than 1,000,000). 12” o.c. smooth dowel bars
Longitudinal Contraction Joint Line. 30” o.c. tie bars
Longitudinal Construction Joint Line. 30” o.c. tie bars
Mid-Panel Transverse Construction Joint Line. 12” o.c. tie bars
Hand-Tooled Contraction Joint Line for sidewalks and curb cuts only. No tie bars or dowel bars

FLR Accessible Flare Slope = 9.5% design max. (10% (10H:1V) max., 2.0% min. allowed)
RMP Accessible Ramp Slope = 7.8% design max. (8.33% (12H:1V) max., 2.0% min. allowed)
CXS Accessible Cross Slope = 1.8% design max. (2.0% (50H:1V) max., 1.5% min. allowed)
RNG Accessible Running Slope = 4.5% design max. (5.0% (20H:1V) max. allowed)
Notes:
1. Parking generally allowed on both sides of the street.
2. R.O.W. may widen to accommodate intersection turn lanes and enhanced pedestrian, bicycle, and transit facilities. Cross-section depicts typical mid-block conditions.
3. At intersections, bulb-outs may be required to enhance pedestrian safety.
4. Cross-section applies for wet utilities less than 15’ deep, and maximum pipe inside diameters of: Storm 36”; Sanitary 12”; Water 16”.
5. Cross-section applies to streets adjacent to one or two story single or multi-family buildings, and streets where multi-family housing totals 15 units or less per building.
6. If all of the following conditions exist, the flowline to flowline width may be decreased to 30’:
   a) Access to the adjacent land use is from the alley only
   b) Need to accommodate only two wet utilities
   c) No horizontal curvature
   d) R.O.W. remains at 60’
   e) Adjacent land use is single-family or low-density multi-family residential
   f) The decrease in width will adequately serve transportation system needs, as determined by Public Works.
7. The flowline to flowline width may be increased to 36’ and the R.O.W. may be increased to 64’, as determined by Public Works.
8. If the adjacent land use is zoned industrial, the flowline to flowline width shall be increased to 36’. No on-street parking will be allowed.
9. For local streets adjacent to community facilities such as schools, recreation centers, and libraries, flowline to flowline width shall be increased to 40’. The R.O.W. shall be increased to 68’. Intersection bulb-outs will be required to enhance pedestrian safety.
**Utilities (Typical)**

Subsurface Wet Utilities

**Notes:**
1. Parking restrictions may be necessary on one or both sides of the street.
2. R.O.W. may widen to accommodate intersection turn lanes and enhanced pedestrian bicycle and transit facilities. Cross-section depicts typical mid-block conditions.
3. At intersections bulb-outs may be required to enhance pedestrian safety.
4. Cross-section applies for wet utilities less than 15' deep and maximum pipe inside diameters of:
   - Storm 36''; Sanitary 12''; Water 16''.
5. For residential land uses, if the following conditions exist the flowline to flowline width may be decreased to 36' (64' R.O.W.), as determined by Public Works and approved by DFD:
   - Land use adjacent to street is residential with alley access only and no mid-block street access.
   - Streets adjacent to one or two story multi-family buildings.
   - Streets where multi-family housing totals 15 units or less per building.
6. For main street or mix-use land uses, if the following conditions exist the flowline to flowline width may be decreased to 36' (64' R.O.W.), as determined by Public Works and approved by DFD:
   - Commercial collectors where loading is accommodated on-site or from an alley.
   - 2 lane main street collectors where loading is accommodated on-site or from an alley.
   - The amenity zone shall be widened to 15.5'; the R.O.W. remains 68'.
   - The decrease in width will adequately serve transportation system needs, as determined by Public Works.
7. If any of the adjacent land use is zoned industrial, the flowline to flowline width shall be increased to 44' (72' R.O.W.).
8. As determined by Public Works the 3 lane collector may be required due to frequent access driveways. The 3 lane collector shall accommodate two 11' travel lanes, a 10' painted center left-turn lane, and one 8' parking lane.

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City and County of Denver
Department of Public Works

Collector – 2 or 3 Lane Cross-Section

Date: 05/15

Std. Dwg. No. 5.1b
Utilities (Typical)

Subsurface Wet Utilities

Notes:
1. Additional street width and R.O.W. may be required for certain arterial corridors to accommodate special travel lanes and/or pedestrian, bicycle, or public transit facilities. Cross-section depicts typical mid-block conditions.
2. Cross-section applies for wet utilities less than 15' deep and maximum pipe inside diameters of: Storm 36"; Sanitary 12"; Water 16".
3. Median width may be wider for certain streets as requested by the developer, and approved by Public Works and Parks & Recreation. Medians will only be maintained by Denver Parks & Recreation with written approval and a maintenance agreement from the Manager of Parks & Recreation prior to median construction.
4. Tree lawn width may be reduced to 8' on infill arterials.
5. Utilities may be placed on either side of the median as long as they meet minimum wet utility spacing requirements.
Notes:
1. Parking is generally allowed except at intersections or major access points where additional travel lanes are needed.
2. Additional street width and R.O.W. may be required for certain arterial corridors to accommodate special travel lanes and/or pedestrian, bicycle, or public transit facilities. Cross-section depicts typical mid-block conditions.
3. At intersections bulb-out may be required to enhance pedestrian safety.
4. Cross-section applies for wet utilities less than 15’ deep and maximum pipe inside diameters of: Storm 36”; Sanitary 12”; Water 16”.
5. Median width may be wider for certain streets as requested by the developer and approved by Public Works and Parks & Recreation. Medians will only be maintained by Denver Parks & Recreation with written approval and a maintenance agreement from the Manager of Parks & Recreation prior to median construction.
6. Utilities may be placed on either side of the median as long as they meet minimum wet utility spacing requirements.
Notes:
1. Parking is generally not allowed on arterial roadways.
2. Additional street width and R.O.W. may be required for certain arterial corridors to accommodate special travel lanes, parking, and/or pedestrian, bicycle, or public transit facilities. Cross-section depicts typical mid-block conditions.
3. Cross-section applies for wet utilities less than 15' deep and maximum pipe inside diameters of: Storm 36", Sanitary 12", Water 16".
4. Median width may be wider for certain streets as requested by the developer and approved by Public Works and Parks & Recreation. Medians will only be maintained by Denver Parks & Recreation with written approval and a maintenance agreement from the Manager of Parks & Recreation prior to median construction.
5. Utilities may be placed on either side of the median as long as they meet minimum wet utility spacing requirements.

City and County of Denver
Department of Public Works
Arterial – 6 Lane
Cross-Section

Date: 05/15
Std. Dwg. No. 5.1e
TYPICAL SECTION—6” CURB & GUTTER WITH DETACHED SIDEWALK

Notes:
1. Side slope may exceed 3:1 only with the approval of Public Works. Some side slopes may require a hand railing to be installed.
2. Proposed variations from minimum dimensions may require a variance request submittal.
3. Standard minimum sidewalk widths for new construction: Local Street—5’ detached or 5’ attached; Collector Street—5’ detached or 5’ attached; Arterial Street—8’ detached. Tree grates cannot be used as part of the sidewalk.
4. Sidewalk Materials: The sidewalk material can be either concrete or sandstone for new sidewalk construction or full frontage sidewalk replacement. For limited sidewalk replacement work, like replacing several sidewalk panels for a utility trench, the sidewalk material should match the existing sidewalk material. Sandstone can only be used for the sidewalk material under the following conditions:
   a) No horizontal gaps or joints larger than 0.25” are allowed. Joints should be filled with sand.
   b) Sandstone must be at least 4” thick by 5’ long (minimum) by 2’ wide (minimum). Driving surfaces should be at least 6” thick. May use two layers to achieve this thickness.
   c) Sandstone must be set on a minimum 2” thick sand base under fitted with a rot resistant geotextile fabric. The Engineer may require a drainage system for some installations. Drainage systems, when required, must be able to support HS–20 loading.
   d) Sandstone should only be used on streets with a running slope less than or equal to 5%. Sandstone sidewalk on steeper slopes may not meet ADAAG slip resistance criteria.
5. Refer to Std. Dwg. 12.0 for patching and saw cut details.
6. Refer to Public Works Rules and Regulations for sidewalk and curb ramp construction.
7. 3” schedule 40 PVC shall be placed behind the back of curb along the entire property frontage when warranted by the traffic operations Conduit Engineer (720.865.4000) for future street lights, signals, etc.
8. All plantings within the tree lawn shall be per the Encroachment Rules & Regulations. No loose material shall be allowed. Decorative concrete or low growing plant material may be allowed only with the specific approval of Public Works. Trees shall be a minimum of 20’ from property corners at intersections, 25’ from street lights, 10’ from the edge of driveways, 20’ from curb ramps and 30’ from stop signs.

City and County of Denver
Department of Public Works
Curb & Gutter and Sidewalk

Date: 05/15
Std. Dwg. No. 5.2a
TYPICAL SECTION—6’’ CURB & GUTTER WITH ATTACHED SIDEWALK

Cross-slope
1.5% min.
4.0% max.
2% (typ.)

Select Base Material if required
Asphalt thickness per Std. Dwg. No. 12.6 or as approved by PW

6’’ Curb and Gutter, 2’ Pan
(See Std. Dwg. No. 5.3a)
Stabilization Material

Expansion joint required only when constructing curb & gutter and/or attached walk adjacent to concrete street. (See Std. Dwg. No. 11.3 for details)

TYPICAL SECTION—COMBINATION CURB, GUTTER, & SIDEWALK

This section is only for use to repair or replace existing sections of combination curb, gutter and sidewalk. 6’’ curb and gutter (See Std. Dwg. No. 5.3a) should be used for new construction.

City and County of Denver
Department of Public Works

Date: 05/15

Curb & Gutter and Sidewalk

Std. Dwg. No. 5.2b
6" CURB AND GUTTER—2’ CATCH PAN

6" CURB AND GUTTER—1’ SPILL PAN

4" MOUNTABLE CURB
For existing conditions only

Note:
1. Curb and gutter section lengths shall be 10’ long typical and adjusted in length so that concrete pavement panel joint lines will be continuous through the curb and gutter. Maximum length is 12’ for a 6” thick gutter section.
2. Refer to Std. Dwg. No. 11.6 for additional information on concrete panel replacement.
3. Gutters must transition at all Pedestrian Ramps. See ramp details.
6" CURB HEAD

Notes:
1. This section is only for use to repair or replace existing sections of 6" curb head. 6" curb & gutter (See Std. Dwg. No. 5.3a) should be used for new construction.
2. A 2' wide asphalt patch will also be required per Std. Dwg. No. 12.0.
3. Larger curb head sections may be required by Public Works. Public Works will review each project and make the final determination.

* Match existing width on repair projects only with 3' minimum width.

COMBINATION CURB, GUTTER AND SIDEWALK (5')

This section is only for use to repair or replace existing sections of combination curb, gutter and sidewalk. 6" curb and gutter (See Std. Dwg. No. 5.3a) should be used for new construction.
0.5" Depth Sealed Joint (approved silicone joint sealant)

Building

0.75" Preformed Expansion Joint Material

SIDEWALK EXPANSION JOINT AT BUILDINGS

Curb & Gutter

Concrete Median Island

CURB & GUTTER/CONCRETE MEDIAN ISLAND EXPANSION JOINT

0.5" Preformed Expansion Joint Material, sealant not required

Direction of Travel

SIDEWALK EXPANSION JOINT

All concrete panels with an adjacent (H) joint shall be generally square and shall not exceed 1.5L:1W shape. Triangular panels should not have any angles less than 30 degrees.

CURB & GUTTER/SIDEWALK TOOLED JOINT

Notes:
1. Concrete curb & gutter and sidewalk tooled joint spacing:
   - 10’ – Combination curb, gutter, and sidewalk
   - 10’ – Curb & gutter, curb head, or mountable curb
   - 5’ – Detached and attached sidewalks
2. For sidewalks, expansion joints shall be provided every 100’ to 120’ and shall extend the full depth of the concrete walk. May be lengthened for curve walks with approval of Public Works.
3. Expansion joint material shall be installed between new sidewalk and existing buildings (see detail above).
4. Expansion joint material shall be installed between new sidewalk and existing concrete slabs, inlets, fire hydrants, poles, and other fixed objects.
5. Expansion joint material between curb and sidewalk is required when sidewalk abuts back of curb on concrete streets.
6. These details and notes do not apply to bike paths – See Parks & Recreation Standards.
7. Minimum widening of sidewalks shall be 18” to accommodate L Joint (See Std. Dwg. No. 11.2b).
Notes:
1. For limited use with existing curb and gutter, and only with approval of Public Works. Not for new construction.
2. Transitions to existing concrete gutters (or to asphalt flowline when in gutter overlay) on either side of a concrete gutter overlay shall be carefully evaluated to identify future project impacts and ensure that drainage is preserved.
3. All transitions shall be approved by Public Works.
STANDARD RESIDENTIAL CURB CUT

Notes:
1. For construction in existing asphalt streets refer to asphalt patch requirements in Std. Dwg. No. 12.0.
2. For \( A \) and \( L \) joints refer to Std. Dwg. No. 11.2a and 11.2b. For \( Z \) and \( H \) joints refer to Std. Dwg. No. 5.4.
3. Tooled contraction joints are required to control the location of cracking, and to provide definition of sidewalk and driving surfaces. Tooled joints for driveway approaches shall be located as indicated above. Additional longitudinal tooled joints may be required when the driveway width exceeds 15'.
4. On-site parking stalls that back into the driveway aisle shall be set back a minimum of 10' from the R.O.W. line, measured to the nearest point of the parking space.
5. Any garage door or gate located within the driveway shall be located a minimum of 20' from the R.O.W. line and/or back of sidewalk, whichever is closer. A garage door or gate located at an exit only may be located at the R.O.W. line only by specific written permission of Public Works.
6. The sidewalk portions of the curb cut shall match the width and alignment of the approaching sidewalk, with a minimum width of 5' and a cross-slope of CXS toward the flowline.
7. If this distance is less than 6', additional detail grading must be developed to lower approaching sidewalks so that an 8.33% maximum driveway slope can be met.
STANDARD COMMERCIAL & MULTI—FAMILY CURB CUT

Notes:
1. For construction in existing asphalt streets refer to asphalt patch requirements in Std. Dwg. No. 12.0.
2. For \( \textcircled{A} \) and \( \textcircled{L} \) joints refer to Std. Dwg. No. 11.2a and 11.2b. For \( \textcircled{Z} \) and \( \textcircled{H} \) joints refer to Std. Dwg. No. 5.4.
3. Tooloed contraction joints are required to control the location of cracking, and to provide definition of sidewalk and driving surfaces. Tooloed joints for driveway approaches shall be located as indicated above. Additional longitudinal tooloed joints may be required when the driveway width exceeds 15'.
4. On-site parking stalls that back into the driveway aisle shall be set back a minimum of 10' from the R.O.W. line, measured to the nearest point of the parking space.
5. Any garage door or gate located within the driveway shall be located a minimum of 20' from the R.O.W. line and/or back of sidewalk, whichever is closer. A garage door or gate located at an exit only may be located at the R.O.W. line only by specific written permission of Public Works.
6. The sidewalk portions of the curb cut shall match the width and alignment of the approaching sidewalk, with a minimum width of 5' and a cross-slope of CXS toward the flowline.
7. A wider curb cut than shown may be approved by Public Works.
8. If this distance is less than 7', additional detail grading must be developed to lower approaching sidewalks so that a 8.33% maximum driveway slope can be met.
9. Narrower approach widening widths due to site constraints must be approved by Public Works.

City and County of Denver
Department of Public Works

Standard Commercial and Multi—Family Curb Cut

Date: 05/15

Std. Dwg. No. 6.1
SECTION A–A

SECTION B–B

Notes:
1. In special circumstances when maintaining maximum 8.33% driveway grade is difficult or to prevent ponding, a 1” lip (1.5” maximum allowed, with 0.125” R) at flowline may be installed.
2. When this width is less than 7’, a special detail must be developed to show how the sidewalk elevation transitions down to the approach to the curb cut.
3. Concrete curb cuts require fibermesh reinforcement at 1 to 1.5 pounds per cubic yard.
4. Driveways servicing heavy truck traffic shall provide 8” thick concrete at all places.
Notes:
1. If placing a new curb cut on the side of a street opposite an existing driveway, the new driveway shall directly align with an existing driveway or maintain a minimum 10' of separation between flares.
2. On local roads, corner clearance is 40' when the intersecting roadway is an arterial and 20' for all other classes of intersecting roadways.
3. Additional corner spacing may be required at signalized intersections to keep access point clear of required turn lanes.
4. All new accesses must be specifically approved in writing by Public Works.
1. The following Curb Ramp types are general representations and many require modifications to fit actual field conditions. Most applications within the City are retrofit situations where one or more constraints such as limited R.O.W., significant grade differences, and drainage concerns must be taken into account in locating the Curb Ramp. Design resources are available within the City to assist with the proper selection and application of ramp types to maintain applicable Standards.
   - Type 1 Ramps are for use in areas where the sidewalk is set back from the street, and pedestrian access from the side of the ramp is not likely to occur because the approach area is covered by lawn or gravel, or an obstacle is present.
   - Type 2 Ramps are for use where pedestrian access can occur from both sides of the ramp.
   - Type 3 Ramps are for use where sidewalk is attached on one side, detached on the other, and pedestrian access can occur from only one side.
   - Type 4 Ramps are for use when there are existing obstructions or there is not sufficient room in the R.O.W. to construct a Type 1, 2, or 3 Ramp, including the landing at the top of the ramp and an ADA route around the top of the ramp.
   - Downtown Signalized Corner Blended Transitions are for use in the Downtown area or other areas where the entire radius is depressed to eliminate use of teardrop islands between ramps.

Consult with the City Project Manager or Public Works for procedures and standards to follow for ramps located in Denver Landmark Districts, abutting Denver Landmark Districts, or for districts and structures listed in the National Register of Historic Places.

2. Refer to the most current version of the City and County of Denver "Sidewalk and Curb Ramp Construction Rules and Regulations" and "Curb Ramp Installation and Replacement Policy and Procedures" for additional design parameters.

3. Curb Ramps shall be positioned as directionally as possible to align with opposing curb ramps.

4. Placement of diagonal or mid-block Curb Ramps must be approved in writing by Public Works.

5. For each Curb Ramp installation, additional removal and replacement of existing sidewalks may be required to facilitate proper transitions to ramp. When "chasing grade," ramp and sidewalk transition length need not exceed 15', but slope must be uniform.

6. Curb Ramps shall match approaching clear sidewalk width, or 5’ minimum, whichever is greater. Curb Ramp throat width shall not exceed 8’ unless serving a shared use path, for which the throat width shall not exceed 10’.

7. The distance between the flowline (E) and the back of the Curb Ramp is variable depending on site conditions.

8. The maximum cross-slope of the Curb Ramp surface shall be 2%. Where ramps are being constructed on existing streets, the cross-slope of the ramp can increase beyond 2% to match the longitudinal street flowline grades at the bottom of the ramp. For construction of multiple Curb Ramps at corners, the longitudinal grade of the curb and gutter between the ramps shall not exceed an amount that causes either ramp to fall outside slopes as defined in Note 7.

9. The maximum "slope" of the gutter in front of a ramp shall be 5%. For a standard 2" gutter pan, this results in a maximum gutter depth of no more than 1.25". To transition from the standard 2" gutter depth to the 1.25" depth in front of the ramp, warp the gutter lip in a 2’-6” curb & gutter section adjacent to the ramp, as noted on each drawing.

10. A level (2% slope maximum in any direction) landing area, 5’ deep typical by the width of the ramp throat, shall be required at the top of each Curb Ramp. Slopes shall be designed to CXS in all directions. The depth of the level landing area is typically set at 5’ to match the width of approaching sidewalks, but in no cases shall be less than 4’.

Continued on 7.0b...
11. If possible, drainage structures shall not be placed in line with ramps. Location of the ramp shall take precedence over location of the drainage structure, except where existing structures are being preserved in proposed construction areas.

12. All Curb Ramps shall be constructed with tactile warnings (truncated dome panels). Truncated dome panels shall be installed across the full width of the ramp, and set so that the closest point or points are 6" from the face of curb/flowline. See Std. Dwg. No. 7.6a and 7.6b.

13. Truncated dome panels shall be brick red, tile red, black when noted, or other equivalent color as approved by Public Works to provide color contrast with the adjoining ramp or blended transition surface. When adjoining sidewalk is flagstone, or retrofitting truncated dome panels within red concrete, the truncated dome panels shall be light grey in color to provide required contrast. See Std. Dwg. No. 7.5 for dome panel colors in Blended Transition ramp application. Concrete for curb ramp construction shall never be stained or have color added.

14. A sample of the truncated domes shall be submitted to, and approved by Public Works prior to construction. Truncated dome size shall meet ANSI requirements and have non-slip tops. Panels are to be wet set into concrete. Integral anchors may be used if resetting is needed. Truncated dome sections set in a sand or other non-cementitious bed will not be allowed unless approved by Public Works. Truncated domes may not be stamped into wet concrete. Surface applied truncated domes are only allowed on pre-existing curb ramps that are otherwise in conformance with ADA standards, and are not allowed on newly constructed ramps unless specifically approved by Public Works. Brick shall not be used for truncated dome panels unless specifically approved in writing by Public Works.

15. Truncated domes fabricated from non-cementitious material (fiberglass composite, plastic, etc.) with hollow undersides may not be cut unless approved by Public Works and the manufacturer. Any proposed cuts must be at and along a rib-line, so whole sections to ribs are set into wet concrete ramp. Any section without ribs shall be cut off and discarded. If solid cementitious or other non-hollow truncated dome panels are cut, the location of the cuts should be positioned to minimize cutting through domes. If domes are cut, the remaining partial domes must be ground off completely. Placement of small cut triangles of truncated dome panels to fill gaps, corners, etc. is not allowed.

16. Curb ramps require fibermesh reinforcement at 1 to 1.5 pounds per cubic yard.

17. Any required transition between vertical and mountable curb adjacent to ramps should occur in a maximum of 10’.

18. Refer to Std. Dwg. No. 12.0 for patching and saw cut on asphalt streets. Refer to Std. Dwg. No. 11.1a and 11.1b for saw cut on concrete pavements and pavement joints.

19. Pay limits of all ramps are comprised of all area shown with concrete hatching on the applicable details, unless otherwise noted.

City and County of Denver
Department of Public Works

Curb Ramp Notes and Typical Section

Std. Dwg. No. 7.0b

Date: 05/15
TYPICAL CURB RAMP CROSS-SECTION

- **Section through sidewalk**
  (may turn up to 90\(^\circ\) at any point)

- **Level Landing per Curb Ramp General Note 10**
  (Not applicable to Curb Ramp Type 4)

- **Existing concrete sidewalk**
  15' min. (when continuous slope must meet or exceed 8.33\% to match existing)

- **Sidewalk transition**
  4' min. 5' preferred

- **Continuous Slope (RMP)**
- Slope may exceed RMP if the transition length has reached 15' and the grade has not yet matched existing

- **0.5" Preformed Expansion Joint Material**
  See Std. Dwg. No. 11.3

- **SE**
  Thickness of ramp concrete may be tapered in this area to match existing if desired

- **RNG**
  5' gap max. when applying Option 3 on Std. Dwg. No. 7.6b

- **6" Flowline to Face of Panel**

- **Curb Wing Transition**
  Truncated Dome Panel Transition

- **Curb and Sidewalk Wing Transition**

- **24" Gutter**

- **Varies**

- **2'**

- **6" Curb**

- **6"**
CURB RAMP — TYPE 1

Notes:
1. Type 1 Ramps shall be used where there is insufficient room for compliant flares (as shown on Std. Dwg. No. 7.2) on both sides of the ramp.
2. Typical Type 1 Curb Ramp installations shall consist of two ramps at each corner, each positioned to cross its leg of the intersection to a receiving ramp. A single ramp placed diagonally should not be used in new construction.
3. Adjacent landscaping/planted strips should transition to the back of Type 1 Curb Ramps. Alternatively, the ramp may be shortened such that its back matches the width of the landscaping, but not so much that a 12:1 maximum slope is exceeded.
4. Additional R.O.W. may be required to ensure that the Curb Ramp, including top landing and flares, are entirely within the public R.O.W.
5. See Std. Dwg. No. 7.0a — 7.0c Curb Ramp Notes and Typical Section.
6. 5’ bypass required for arterial streets.
Notes:
1. A Type 2 Curb Ramp shall be used where there is sufficient room for flares as depicted on this Std. Dwg., on both sides of the ramp.
2. Typical Type 2 Curb Ramp installations shall consist of two ramps at each corner, each positioned to cross its leg of the intersection to a receiving ramp. A single ramp placed diagonally should not be used in new construction.
3. Additional R.O.W. may be required to ensure that the Curb Ramp, including top landing and flares, are entirely within the public R.O.W.
4. See Std. Dwg. No. 7.0a – 7.0c Curb Ramp Notes and Typical Section.
5. 5' required bypass for arterial streets.
CURB RAMP — TYPE 3

Notes:
1. A Type 3 Curb Ramp shall be used where there is insufficient room for a compliant flare (as shown on Std Dwg. No. 7.2) on one side of the ramp.
2. Typical Type 3 Curb Ramp installations shall consist of two ramps at each corner, each positioned to cross its leg of the intersection to a receiving ramp. A single ramp placed diagonally should not be used in new construction.
3. Additional R.O.W. may be required to ensure that the Curb Ramp, including top landing and flares, are entirely within the public R.O.W.
4. See Std. Dwg. No. 7.0a — 7.0c Curb Ramp Notes and Typical Section.
5. 5' bypass required for arterial streets.
Notes:
1. A Type 4 Curb Ramp may be used in retrofit situations wherever there are existing obstructions or inadequate R.O.W. width at the intersection of existing residential streets to provide a Type 1, 2, or 3 Curb Ramp.
2. Typical Type 4 Curb Ramp installations shall consist of two ramps at each corner, each positioned to cross its leg of the intersection to a receiving ramp. Any proposed single ramp placed diagonally will only be considered if in retrofit situations at the intersection of existing residential streets, and must be specifically approved in writing by Public Works.
3. Additional R.O.W. may be required to ensure that the Curb Ramp, including top landings and flares, are entirely within the public R.O.W.
4. See Std. Dwg. No. 7.0a – 7.0c Curb Ramp Notes and Typical Section.
Existing Attached Walk (width varies)

Remove and replace sidewalk to the nearest joint, or as directed (curb & gutter also, if monolithic)

CXS as possible or match existing roadway slope

Obstacle or otherwise non-compliant pedestrian area

Match existing roadway slope

6' wide by variable height (0" to 6") monolithic curb. For heights from 6" to 2'
see Std. Dwg. No. 10.4.

R.O.W. Line

Match existing roadway slope

6' min. ramp and gutter transition. 15' max. to match existing sidewalk grade

6' min. ramp and gutter transition. 15' max. to match existing sidewalk grade

*Slope may exceed RMP if transition length has reached 15' and the ramp has not yet matched existing matching grade

4' min. level landing between adjacent ramps

Remove and replace sidewalk to the nearest joint, or as directed (curb & gutter also, if monolithic)

Notes:
1. A Type 4 Curb Ramp may be used in retrofit situations wherever there are existing obstructions or inadequate R.O.W. width at the intersection of existing residential streets, in order to provide a Type 1, 2, or 3 Curb Ramp.
2. Typical Type 4 Curb Ramp installations shall consist of two ramps at each corner, each positioned to cross its leg of the intersection to a receiving ramp. Any proposed single ramp placed diagonally will only be considered if in retrofit situations at the intersection of existing residential streets, and must be specifically approved in writing by Public Works.
3. Additional R.O.W. may be required to ensure that the Curb Ramp, including top landings and flares, are entirely within the public R.O.W.
4. See Std. Dwg. No. 7.0a – 7.0c Curb Ramp Notes and Typical Section.

City and County of Denver
Department of Public Works

Curb Ramp Type 4 (Existing Residential/Low Volume Corner Retrofit)

Date: 05/15

Std. Dwg. No. 7.4b
Notes:
1. A Type 4 Curb Ramp may be used wherever there are existing structures or inadequate existing or proposed R.O.W. width to fit in a Type 1, 2 or 3 ramp.
2. Typical Type 4 Curb Ramp installations shall consist of two ramps at each corner, each positioned to cross its leg of the intersection to a receiving ramp. A single ramp placed diagonally should not be used in new construction.
3. Additional R.O.W. may be required to ensure that the Curb Ramp, including top landing and flares, are entirely within the public R.O.W.
4. See Std. Dwg. No. 7.0a – 7.0c Curb Ramp Notes and Typical Section.

City and County of Denver
Department of Public Works

Curb Ramp Type 4
(Mid-Block)

Date: 05/15

Std. Dwg. No. 7.4c
Notes:
1. If existing sidewalk widths are different, match the smallest width, to 5' minimum.
2. For construction in existing asphalt streets, also refer to Std. Dwg. No. 12.0.
3. Slopes shown as typical on section A–A may be adjusted if necessary to fit existing conditions, but must meet RNG slope in all situations.
4. Black truncated dome panels shall be placed so that the triangular gap on the street side between panels is no wider than 2'. Radial panels are recommended where possible. Panels may be trimmed to reduce this gap (per Curb Ramp General Note 15) or the width of panels may be adjusted to meet the 2" maximum gap. Panels that are less than 2' wide must be approved by Public Works.
5. Black truncated dome panels proposed in cast iron material shall be asphalt-dipped for black color. Black truncated dome panels proposed for approval by Public Works in all other materials shall be ultraviolet and weather/wear resistant to maintain long-term color contrast.
6. All truncated dome panels proposed for placement at the same corner shall be made of uniform material. Therefore, when cast iron panels are used, red panels shall also be placed in cast iron.

City and County of Denver
Department of Public Works
Downtown Signalized Corner
Blended Transition

Date: 05/15
Std. Dwg. No. 7.5
**OPTION 1**
Apply when edge of ramp closest to intersection is located either at or outside of corner Point of Curb Return.

**OPTION 2**
Apply when inside edge of ramp closest to intersection is located either at or inside of corner Point of Curb Return.
OPTION 3
Ramp Dome Placement when ramp is not aligned perpendicular to curb/flowline

OPTION 4
Ramp Dome Placement when ramp is not aligned perpendicular to curb/flowline
Notes:
1. To allow required ramp length to meet maximum allowed slopes, sidewalks leading up to curb ramps may be offset as shown.
2. Sidewalk transition length need not exceed 15', but long slope must be uniform. See Std. Dwg. No. 7.0c for additional information.
3. See Std. Dwg. No. 7.0c Typical Curb Ramp Cross-Section.
Maintain a 20' "Clear Zone" at intersections for the installation of future Traffic Signal Equipment. Do not engineer or place permanent vertical or utility obstructions within this area.

PCR  Point of Curb Return

Notes:
1. When the flowline radius is greater than 22'-6", use Layout A.
2. When the flowline radius is 22'-6" or less, use Layout B.
3. The clear zone does not apply outside of R.O.W.
Notes:
1. This Standard Drawing shall only be used for the replacement of existing Intersection Valley Gutter, or where existing street grades necessitate their use. Intersection Valley Gutter should not be used in areas of new street construction. Intersection Valley Gutter may not cross arterial, collector, or streets with bike lanes without approval of Public Works.
2. See Std. Dwg. No. 7.0a – 7.0c Curb Ramp Notes and Typical Section.
3. Intersection valley gutters shall not be used where a storm sewer is available.
4. Valley gutter cross-pan requires fibermesh reinforcement at 1 to 1.5 pounds per cubic yard.
Transition to end of plate as necessary

Remove additional curb & gutter to maintain 2' min. stone length

Retaining Screw @1" o.c. or as approved by PW

PLAN VIEW

6" Vertical Curb, Gutter, and Sidewalk

Combination Curb, Gutter, and Sidewalk

SECTION A–A (2 VIEWS)

Variable, Max. allowable span: 1’ for 0.375” Plate and 2’ for 0.5” Plate

Tread Plate: 0.375” rolled–steel diamond pattern. Dimension variable

SECTION B–B

10.5” when 0.5” tread plate is used

0.375” or 0.5” Rolled Galvanized Steel Tread Plate

Concrete anchors welded to angle iron (typ.)

Anchor type may vary

Notes:
1. Length of steel plate varies.
2. Chase and cover plate run perpendicularly from Property Line to flowline unless approved by Public Works.
3. Chase and curb to be placed monolithically. Sidewalk to be placed separately.
CONCRETE BUS PULLOUT

Concrete Pad:
4" depth for bench
6" depth for shelter

Thickness to match greater of proposed concrete or adjacent pavement thickness, using grading S-100 mix.

Notes:
1. Length of bus pullout pad may vary to fit site conditions.
2. All bus pullout pads shall be 11" thick concrete in the street.
3. See Std. Dwg. No. 11.0 through 11.5b for pavement joint requirements.
4. R=15' Radius.
5. All projects that have a bus stop adjacent must provide a concrete bus pad or bus pullout, and a passenger boarding area or shelter pad. The passenger boarding area or passenger shelter pad shall be located in the R.O.W. or appropriate easement. The shelter pad, passenger boarding area, and bench shall be installed and maintained by the land owner directly adjacent.
6. Concrete bus pullout requires fibermesh reinforcement.
CONCRETE BUS PAD

Notes:
1. Length of bus pullout pad may vary to fit site conditions.
2. All bus pullout pads shall be 11” thick concrete in the street.
3. See Std. Dwg. No. 11.0 through 11.5b for pavement joint requirements.
4. Edge of concrete bus pad shall be designed outside of travel lane path.
5. All projects that have a bus stop adjacent must provide a concrete bus pad or bus pullout, and a passenger boarding area or shelter pad. The passenger boarding area or passenger shelter pad shall be located in the R.O.W. or appropriate easement. The shelter pad, passenger boarding area, and bench shall be installed and maintained by the land owner directly adjacent.
6. Concrete bus pads require fibermesh reinforcement.

City and County of Denver
Department of Public Works

Typical Concrete Bus Pad

Date: 05/15

Std. Dwg. No. 9.1b
Notes:
1. 0.75" Sealed Expansion Joint shall be placed at those locations where alley changes direction ("T" or "L" shaped alleys) and where adjacent to abutting buildings.
2. Tranverse Contraction Joints shall be spaced at a maximum of 15' intervals and placed at manholes, poles, and ends of curb head or as directed by Public Works (see Std. Dwg. No. 11.0).
3. Jointing plan for alley construction shall be approved by Public Works.
4. Dead-end alleys are not allowed.
5. Requests for any new alleys must be approved by Public Works.
ALLERY CUT (WITH ATTACHED SIDEWALK)

Notes:
1. Asphalt Patch may be required. See Std. Dwg. No. 12.0.
2. Alley cuts require fibermesh reinforcement at 1 to 1.5 pounds per cubic yard.
3. Alley, sidewalks that cross the alley, and alley approach paving thickness shall be 8" minimum.
4. Approach widening may be modified for areas with adjacent curb cuts only with approval of Public Works.
5. Site conditions may require replacement of the adjacent sidewalk outside alley limits in order to meet alley grades.

City and County of Denver
Department of Public Works

Allergy Cut

Date: 05/15

Std. Dwg. No. 10.1
Notes:
1. Asphalt Patch may be required. See Std. Dwg. No. 12.0.
2. Any sidewalk sections remaining or replaced must be larger than 4'x4'.
3. Alley sidewalks that cross the alley, and alley approach paving thickness shall be 8" minimum.
4. Approach widening may be modified for areas with adjacent curb cuts only with approval of Public Works.
5. Site conditions may require replacement of the adjacent sidewalk outside alley limits in order to meet alley grades.

City and County of Denver
Department of Public Works
Alley Cut
(Historic District)
Date: 05/15
Std. Dwg. No. 10.2
Alley Width Varies (Standard 16'')
(20' and clear of obstructions when used for commercial access)

Slope = X

8" Thick Concrete Slab with Designed Jointing approved by PW

Install a © or Z Joint at max. 14' from one longitudinal edge of alleys wider than 15'

Slope X = 3% desirable
1.5% minimum
8.33% maximum
RNG at sidewalk

TYPICAL ALLEY CROSS-SECTION
Notes:
1. Curb Head is to be poured separately from alley at locations as determined by Public Works.
2. Place No. 4 Deformed Bars at 12" on-center as directed by Public Works.
3. If the curb height is 6" or less no rebar is required.
4. For H greater than 2' a retaining wall design is required.
5. Jointing should be consistent with alley pavement joints.
Joint not required if curb & gutter poured monolithically with adjacent lane, and lane width to back of curb width does not exceed 14’

Circular Blockout at new Manhole

*Place 0.5” min. expansion joint filler in full section of pavement and curb & gutter, including the top 6” of curb joint at intersection return radius points. May require extra cut in curb head when not at expansion joint

8” thick or less
8’ min. 12’ max.

Thicker than 8”
8’ (min.) 15’ (max.)

6’ min.

Permissible alternate joints with small radii < 16’

Notes:
1. Transverse Contraction Joint spacing should not exceed 150% of the Longitudinal Joint spacing. Transverse Joints are across traffic direction, Longitudinal Joints are with traffic direction.
2. Construction Joint locations are dependent on manhole locations, traffic control constraints, and contractor’s placement sequence.
3. A final jointing plan must be approved by the Project Manager.
4. See Std. Dwg. No. 5.0 for joint line type legend and summary of usage. See Std Dwg. No. 11.1 to 11.5b for additional joint details.
5. New panels shall have no more than 2 sides with an E joint.
1. For new construction, all transverse joints (A, B, C, D, and E) shall be continuous across the pavement and curb and gutter. Construct transverse joints perpendicular to the centerline of pavement and extend the sawed joint through the curb and gutter. Gutter sections do not require dowels. Curb and gutter section should be designed to match the intended panel joint layout.

2. If the contractor proposes variations from this standard or the project has unusual or irregular conditions not discovered herein, a pavement joint layout shall be prepared for approval by Public Works.

3. Longitudinal joints shall coincide with edge of lane markings, if possible, and have a maximum spacing of 13' or 14' to back of curb if monolithic without extra joint. All longitudinal joints shall be tied. Lane widths over 13' require special design.

4. Immediately after sawing, joints shall be cleaned by pressurized water jet or other approved method. Joints shall also be cleaned and dried with sandblasting and compressed air just ahead (100' or less) of placing backer rod material and joint sealant. Joint cleaning methods shall be contained or vacuumed to prevent fugitive dust and runoff. Public Works may require other methods of joint cleaning if necessary.

5. The contractor shall use a circular blockout at new manholes and other roadway appurtenances of similar or larger sizes. Small appurtenances, such as valves, monument boxes, and existing manholes do not require a blockout, but do require a bond breaker and flexible expansion joint material. Unless otherwise directed, the blockout may be eliminated at new manholes if Removable CSLM is used for backfill of the manhole from manhole base to paving subgrade where soil compaction equipment cannot reach.

6. Tie bars shall conform to AASHTO M284 grade 40, epoxy coated, and deformed. Dowel bars shall conform to AASHTO M255 grade 60 for core material, and AASHTO M254 for epoxy coating the smooth bars. Dowel bars shall be wiped with form oil, but not dripping, just prior to concrete placement to prevent concrete bonding.

7. Tie and dowel bars shall be normally started half the required spacing from a panel edge. Tie bars shall be kept at least 6" clear of any dowel bar. Tie bars may be slightly bent to follow this rule. Dowel bars shall be spaced the full width across intersections and merged traffic lanes. Straight traffic lane sections shall have a minimum of 4 dowels in each wheel path, and 5 in the wheel path adjacent to any shoulder or gutter.

### REINFORCING SIZE TABLE

<table>
<thead>
<tr>
<th>Pavement Thickness T (in)</th>
<th>Tie Bar Size Grade 40 (deformed)</th>
<th>Dowel Bar Dia (in) Grade 60 (smooth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &lt; 8</td>
<td>No. 4</td>
<td>1.00</td>
</tr>
<tr>
<td>8 ≤ T ≤ 10</td>
<td>No. 5</td>
<td>1.25</td>
</tr>
<tr>
<td>10 &lt; T ≤ 15</td>
<td>No. 6</td>
<td>1.50</td>
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</tbody>
</table>

### TIE BAR AND DOWEL BAR SPACING

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Tie Bars deformed, 30” long</th>
<th>Dowel Bars smooth, 18” long</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>on center</td>
<td>from edge</td>
</tr>
<tr>
<td>DA</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>DC</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>E</td>
<td>30”</td>
<td>15”</td>
</tr>
<tr>
<td>L</td>
<td>30”</td>
<td>15”</td>
</tr>
<tr>
<td>X</td>
<td>12”</td>
<td>12”</td>
</tr>
</tbody>
</table>

Continued on 11.1b...

City and County of Denver
Department of Public Works

General Notes for Concrete Pavement and Pavement Joints

Date: 05/15
Std. Dwg. No. 11.1a
GENERAL NOTES FOR CONCRETE PAVEMENT AND PAVEMENT JOINTS

...continued from 11.1a

8. Any concrete road that carries heavy traffic loads (1,000,000 ESALS or greater) shall have Dowelled Transverse Contraction Joints per Std. Dwg. No. 11.2a.

9. Full panel replacement may be required at new curb cuts to concrete streets if the 2 joints of the driveway surfaces do not line up with the O or C joints of street pavement. Refer to Std. Dwg. No. 6.0 & 6.1. Selected O joint tie bars may be eliminated between drive pan and pavement. Use O joints on longitudinal tie-ins along street direction.

10. When within 100' of Railroad Track Centerline, concrete pavement for the entire roadway width shall be required for a minimum of 100' on either side of the Railroad Track centerline or 2' beyond Separator Medians, if any. Panels adjacent to tracks, bearing on ballast and/or aggregate base with separator geotextile, shall be reinforced with minimum 3 each full length rebar (use tie bar size and spacing in table above) longitudinally, with one transverse bar at each end and middle, 2" clear, placed at depth T/2. Also use dowels per C4 joints to adjacent panels.

11. Minimum width of concrete lane widening is 18" using O joint. Special jointing and reinforcing plans are required when transverse to longitudinal spacing is >1.5 or <0.70. Full panel length rebar is required when these panel size ratios are exceeded. Use minimum 2 each epoxy coated rebar, spaced and sized per above table for tie bars, 2" clear at ends, placed at depth T/2.

12. All sawn joints shall be to a minimum depth of T/4 when no reinforcing steel is used, and not less than T/3 when tie bars or dowel bars are used.

13. Dowel placement tolerances to be inspected and adjusted before concrete placement (refer to CDOT M-412-1 for graphical definition of terms and CDOT Specification 412.13(b)2) shall be:
   a) Vertical Translation <1.0", Horizontal Translation <2.0" when spacing bars from edge of panels.
   b) Longitudinal (End) Shift (equal bar length in each panel) <2.1"
   c) Horizontal and Vertical Rotational Alignment (ends not parallel with pavement surface) <0.5"

14. All concrete pavement and associated curb & gutter shall be placed on CDOT Class 6 aggregate base course, unless the existing subgrade materials are similar. Base shall be moisture conditioned, compacted, proof-rolled, final shaped, and re-compact to allow the required thicknesses to be placed.

15. If a sawed appearance joint is desired inside regular panels, it shall be no more than 0.5” deep. This appearance joint is designated O. See Std. Dwg. No. 11.2a.

16. Notes for Panel Replacements or rework for Trench Patches when ideal situations do not apply:
   a) Full panel replacement to normal joint lines is required.
   b) For establishing transverse joints, maintain the existing joint gap on existing adjoining panels at the time of panel replacement. Remove any gap filling material in the new joint before new joints are sealed. Use expansion caps the same as the gap width on the poured end of dowels to allow future movement of the entire length of joint across all lanes.
   c) Longitudinal joints should line up with existing adjacent joints. Transverse joints shall be made continuous across the street.
   d) Consult Construction Engineering for advice on special situations. Use of bond breakers, eliminating selected tie bars for offset joints or narrow panels, use of predicted crack mitigation techniques, added panel replacements, or special reinforcing for narrow or skinny panels may be advised or required.
   e) The Contractor’s warranty obligation shall not be waived if CCD conveys any advice or directive for non-standard situations.

17. Concrete street paving shall require fibermesh reinforcement at 1 to 1.5 pounds per cubic yard.

18. Take reasonable measures during saw cutting and joint cleaning to prevent particulate matter from becoming airborne and to prevent the discharge of particulate matter beyond the property from which the emissions originate. The measures must be effective in the control of fugitive particulate emissions at all times on the project site, including periods of inactivity.
A. EXPANSION JOINT (WITH THICKENED EDGE)
For pavements requiring smooth dowel bars in transverse joints
(Any A Joint may be replaced with a DA Joint)

B. EXPANSION JOINT (WITHOUT THICKENED EDGE)
For lower traffic situations or when new concrete is abutting existing concrete

Epoxy coated smooth dowel, 12" spacing, 12" from edge, using dowel basket per DC joint, or drilled into one side of existing.

Provide expansion cap 0.75", same as expansion joint material thickness, both ends

DA DOWELED EXPANSION JOINT

0.5" or less than T/16

SA SAWED APPEARANCE JOINT

Epoxy coated smooth dowel bar at 12" spacing (min. 12" from intersecting joint) within travel lanes on plans. Dowel bar dia. per table on Std. Dwg. No. 11.1a. Drill and epoxy individual dowels (basket not used) into existing transverse joint as needed when replacing panels (See Note 16 on Std. Dwg. No. 11.1b)

DC DOWELED TRANSVERSE CONTRACTION JOINT
For use in applications where ESALS equal to or greater than 1,000,000.
Apply per Std. Dwg. No. 11.1b.

City and County of Denver
Department of Public Works
Concrete Expansion and Sawed Transverse Contraction Pavement Joint

Date: 05/15
Std. Dwg. No. 11.2a
**LONGITUDINAL CONTRACTION JOINT**
(Any **E** Joint may be replaced with an **L** Joint)

*Tie bars placed mid-depth and the 15" insertion starts at keyway vertical face, when used.*

---

**MID PANEL TRANSVERSE CONSTRUCTION JOINT**
(More steel than CDOT’s T joint)

*Keyway Optional combined with tie bars*

---

**L**
LON**G**ITUDINAL CONSTRUCTION JOINT
(Equivalent to CDOT’s L joint)

---

**OPTIONAL ADDED KEYWAY DETAIL TO (X) OR (L)**
Only when T ≥ 9". Form only female keyway

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City and County of Denver
Department of Public Works

Sawed Longitudinal Contraction and Construction Joints

| Date: 05/15 | Std. Dwg. No. 11.2b | DENVER PUBLIC WORKS |
Notes:
1. Saw and seal width may be 0.1875" (3/16") maximum for new paving areas. Width may be 0.375" (3/8") maximum when matching existing appearance.
2. The final saw cut depth when no steel is present is T/4. The final saw cut depth when steel is present (tie or dowel bars) is T/3.
3. Backer rod diameter shall be twice the saw and seal width.
4. Joint sealant thickness should be equal to saw width. Joint sealant shall be approved silicone sealant, rated for streets or highways.
**MATCH EXISTING CURB AND GUTTER**
(No tie-bars required for short sections. Extra precautions are needed to obtain suitable compaction due to hand work)

- **Tie Bars drilled and epoxied (typ.) @ 30" O.C.**
- **Apply longitudinal construction joint if curb & gutter poured separately, or if dimension from nearest longitudinal pavement joint to back of curb is greater than 14"**

**CONCRETE PAVEMENT CURB AND GUTTER**

- **10' min. Transition**
- **Compact taper section of asphalt in separate lift**
- **Asphalt thickness to match existing asphalt thickness**

**CONCRETE PAVEMENT TO ASPHALT PAVEMENT TRANSITION**
CIRCULAR BLOCKOUT AT NEW MANHOLE*

* Unless otherwise directed, the boxout may be eliminated if Removable CLSM is used for the entire backfill of the manhole.

** Joints must line up with other Joints and not dead-end or tee at panel sides. Transverse joint spacing shall be adjusted to align at the diameter, or pass at least 4' from the blockout. Use skewed longitudinal joints when the joints are within 2' of the blockout.

Circular rebar rings may be required around large manholes with min. 2' wide boxout frame

SECTION A—A BLOCKOUT/BOXOUT

Note:
1. Reference Std. Dwg. No. 11.5b for additional details.
If existing manhole to \( \mathbb{E} \) or \( \mathbb{L} \) joint is at least 2' and \( \Delta \geq 2.0 \) or

If existing manhole to \( \mathbb{E} \) or \( \mathbb{L} \) joint is less than 2' and \( \Delta < 2.0 \).

Note: Adjust \( \mathbb{C} \) or \( \mathbb{D} \) to hit on diameter of manhole or pass at least 4' from the blockout.

**EXISTING MANHOLE**
When distance to nearest longitudinal joint is greater than or equal to 2'.

- Place 0.5” preformed expansion joint material on vertical surface of ring.
- Bond Breaker
- Concrete Pavement Thickness
- 4:1 Taper to meet structure

**EXISTING MANHOLE**
When distance to nearest longitudinal joint is less than 2'.

- Set ring or flange 0.25” to 0.5” below finish pavement grade
- Manhole or Inlet

**SECTION B-B**

Notes:
1. Bond Breaker shall be composed of plastic sheet, building paper, or other approved material to prevent bonding.
2. All expansion joint material shall be in preformed sheets, shall meet AASHTO M213 or ASTM 1751, asphalt saturated fiber. Material shall be full depth, width, and length in joints, and punched to snugly admit smooth dowel bars.
3. The sides of all valve boxes, pipes, and objects penetrating a placement shall be wrapped full depth with sealant backer material (Type 2 compressible foam sheets) meeting ASTM D 5249.
Notes:
1. See Std. Dwg. No. 11.0 to 11.5b for joint and sealant details.
2. All saw cuts shall be straight and follow existing panel joint lines. Contractor should use full slot cut to relieve pressure and minimize damage to surrounding panels during panel removals. Contractor shall replace any panels damaged during their activities. Consult City Inspector for alternate instruction when existing joints do not line up.
3. Subgrade preparation shall be completed to meet compaction and proofroll specifications. The surface shall be smooth and flat including areas under tie and dowel bars. Add 4" Class 6 Aggregate Base Course meeting moisture and compaction specifications if subgrade is not sand or gravel.
4. Re-establish any existing expansion joints (A or B) in transverse joints with full-depth expansion joint material. Match existing saw cut width of surrounding panels.
5. All steel is placed at mid-depth of thickness (T/2). See Std. Dwg. No. 11.1a and 11.1b for sizing, spacing, and alignment.
6. Use (O) joints even if dowels did not previously exist in transverse joints.
7. Minimum clearance between tie bars and dowel bars is 6". Tie bars may be bent horizontally to achieve clearance.
8. Tie bar spacing may be adjusted to keep 15" clear from any non-ideal panel lines and gutter pan lines. Do not drill in tie bars if panel is <30" long or near any existing cracks.
9. Drill larger than dowel or tie bar and epoxy bars into existing concrete per supplier instructions. Eliminate tie bars in the shortest section of adjoining panels when joint lines do not align.
10. Exposed end of dowel bars shall be lightly oiled or greased. Tie bars used and exposed shall be clean, rust free, and not oiled or greased.
11. Repeat layout on the left for multiple lane replacement.
Match existing surrounding pavement thickness (9" min.) or follow pavement design thickness when subgrade condition is improved (See Std. Dwg. No. 12.5a) (as required by Public Works). To achieve this depth, at least four (4) compacted lifts of asphalt are required. Refer to Std. Dwg. No. 12.5b

Notes:
1. Larger patch section may be required on new streets or streets that have undergone recent pavement work.
2. Curb to Curb replacement is required on a Moratorium Street, (those paved or resurfaced within the past 3 years).
3. Patches more than 10’ wide, or more than one lane wide, may trigger reconstruction of more of the existing street. When required, street reconstruction shall be per Std. Dwg. No. 12.5a.
4. Refer to Std. Dwg. No. 12.5a, 12.5b, and 12.6 for lift thickness and material usage.
5. Avoid saw cuts in the existing or future planned wheel paths.
6. Lane edges (joints between paving passes) shall follow the traffic striped lanes as much as practicable. Lane edge joints shall not be in a wheel path. They should stagger previous edge by a minimum of 6” to avoid stacked edges.
7. Where existing cross–slope is steeper than 4%, patch cross–slope may be allowed to match, with approval of Public Works.
TRENCH PATCH (GRAVEL OR LANDSCAPING)

Notes:
1. Wherever possible, conduit or cable shall be installed by boring, driving, or any other acceptable means under concrete units. Open cutting shall be used only under special circumstances and only with approval of Public Works.
2. Minimum width and type of restoration to be determined by PW Inspector, based on contractor's pre-activity photos, to match pre-existing conditions.
3. Sod replacement shall be a minimum of 18" in width.
4. Any hardscape (concrete or pavers) should be replaced in full panels or pavers of the same type, color, and size as before.
5. Restoration in Denver Parks shall be per the Parks Operations Supervisor. Contact Denver Parks at 720-865-0368 for details and any permits required.

City and County of Denver
Department of Public Works

Date: 05/15

Trench Patch
(Gravel or Landscape Materials)

Std. Dwg. No. 12.1
Notes:
1. Wherever possible, conduit or cable shall be installed by boring, driving, or any other acceptable means under concrete units. Open cutting shall be used only under special circumstances and only with approval of Public Works.
2. Removable CLSM layer thickness not to exceed 3' at a time, and bleed water shall be pushed off surface before another layer can be added.
3. Pipe or conduit shall be protected from floating when using CLSM. Use plastic wrapping to avoid Flash Fill from adhering.
5. This T-Patch detail is required for residential streets in Moratorium situations, and may be allowed for collector and arterial streets by PW in specific Moratorium situations involving one cut per street. A Moratorium street is one that has been resurfaced in the last 5 years.
TRENCH PATCH (CONCRETE)

Notes:
1. Wherever possible conduit or cable shall be installed by boring, driving, or any other acceptable means under concrete units. Open cutting shall be used only under special circumstances and only with approval of Public Works.
2. This Standard Drawing applies to all concrete streets, alleys, sidewalks, curb, gutters, and driveways.
3. Full panel replacement is required for concrete pavement including potholes for utilities and investigations.
4. A construction joint for longitudinal joints or for transverse joints. See Std. Dwg. No. 11.2a & 11.2b
5. The limits of concrete patching shall be perpendicular or parallel to the centerline of the street. Skewed panel replacement over trenches is not permitted.
6. Removable CLSM layer thickness not to exceed 3" at a time, and bleed water shall be pushed off surface before another layer can be added.
### Backfill Materials Required per Trench Class
(Apply to Standard Drawings 12.2, 12.3a, and 12.3b)


<table>
<thead>
<tr>
<th>Trench Class</th>
<th>Trench Size or Structure</th>
<th>Backfill Materials and Method Before Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Less than 150 square feet of surface cut</td>
<td>Method A=&gt; use Removeable CLSM</td>
</tr>
<tr>
<td>1</td>
<td>4 inch wide to 24 inch wide. No minimum length</td>
<td>Method A=&gt; use Removeable CLSM</td>
</tr>
<tr>
<td>1</td>
<td>Within 4 feet of structure, manhole or vault</td>
<td>Method A=&gt; use Removeable CLSM</td>
</tr>
<tr>
<td>2 &amp; 3</td>
<td>Greater than 150 square feet of surface cut, AND Greater than 24 inches wide</td>
<td>Method A=&gt; use Removeable CLSM OR Method B=&gt; approved excavated soil or import moisture adjusted and compacted**</td>
</tr>
</tbody>
</table>

**Before test refer to the specific Utility or Agency Specifications or Standards for pipe bedding and backfill material and construction requirements for lift thickness, moisture, and compaction.

### Requirements for Removable CLSM
(Apply to Standard Drawings 12.2, 12.3a, and 12.3b)

<table>
<thead>
<tr>
<th></th>
<th>Air Entrainment</th>
<th>28 day compressive strength</th>
<th>Flowability by Slump or Spread</th>
<th>Construction Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow-Fill (normal Removeable CLSM)</td>
<td>6.0% min. to 25.0% (test by pressure method or unit weight method)</td>
<td>50 psi minimum to 150 psi maximum</td>
<td>Slump (C143) 7” to 10”</td>
<td>Limit 3 feet thick. Between placements, push water OFF surface before adding more.</td>
</tr>
<tr>
<td>Flash-Fill (fast Removeable CLSM)</td>
<td>15.0% min. (test by unit weight method)</td>
<td>50 psi minimum to 300 psi maximum</td>
<td>Slump (C143, one lift, no redding) 7” to 10”, or Spread (D6103) 8” min.</td>
<td>Limit 3 feet thick. Between placements, protect from bonding to conduits, pipes.</td>
</tr>
</tbody>
</table>

Notes:
1. CLSM (Controlled Low Strength Material) that shall be easily removable and air entrained is required for Class 1 trenches, and optional for Class 2 trenches. CLSM shall consist of an approved mix design using either flow-fill (cement and aggregate based) or flash-fill (flyash based). Both types are required to meet Removability Modulus of less than 1.5, and require different ranges of air entrainment, per MGPEC Item 19 Specifications. Refer to www.mgpec.org.
2. Requirements for Reuse of Excavated Materials in Trench Backfill: materials shall be free of organics, trash, hazardous materials, rock or bedrock more than 3” diameter, high clay content (Plasticity Index (PI) shall be no more than 20), and soft or wet materials.
Typical Asphalt Layer Detail — Hot Mix Asphalt

New Roadway Design
1. A pavement design prepared by a qualified Geotechnical Engineer shall be submitted for new roadways to be constructed, or as requested by Public Works.
2. Table 12.5b–2 on Std. Dwg. No. 12.5b shall be applied for design of constructed lift thickness.

Existing Roadway Construction
1. A pavement design prepared by a qualified Geotechnical Engineer may be submitted for existing roadways to be reconstructed, in lieu of minimum requirements shown on Table 12.6–1 on Std. Dwg. No. 12.6.

Notes:
1. If patching, area to be patched shall be saw cut to the full depth or cut by a method approved by Public Works which leaves a vertical face on the existing pavement and no deformation of the surface at the cut. Apply tack coat to cut face.
2. For full depth reconstruction, asphalt thickness shown as full depth. Aggregate base course may be substituted for some of full depth asphalt per the pavement design only when the subgrade soils are non-swelling.
3. Subgrade to be moisture conditioned and compacted to meet project specifications.
4. Tack coat shall be applied between each asphalt layer unless the engineer determines the existing exposed layer is adequately sticky without a tack coat.
5. All asphalt to meet MGPEC Item 9 specifications. (www.mgpec.org)
6. When patching, a minimum depth of 5" for local and 9" for collectors and arterial streets is required, or match existing, whichever is greater.
7. All lifts of local street patching may be grading Sx, and all lifts of collectors and arterials may be grading S with the top lift maximum rock size matching existing asphalt.
8. See additional notes on Std Dwg. No. 12.0.
### LIFT THICKNESS BASED UPON MIX GRADING

<table>
<thead>
<tr>
<th>Mix Grading (nominal size)</th>
<th>Absolute Minimum Lift Thickness (3 x nominal size)</th>
<th>Recommended Lift Thickness (4 x nominal size)</th>
<th>Maximum Lift Thickness is limited by compaction equipment and crew’s ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX (1/2&quot;)</td>
<td>1.5&quot;</td>
<td>2.0&quot;</td>
<td>3.0&quot;</td>
</tr>
<tr>
<td>S (3/4&quot;)</td>
<td>2.3&quot; -&gt; use 2.5&quot;</td>
<td>3.0&quot;</td>
<td>4.0&quot;</td>
</tr>
<tr>
<td>SG (1&quot;)</td>
<td>3.0&quot; -&gt; use 3.5&quot;</td>
<td>4.0&quot;</td>
<td>5.0&quot;</td>
</tr>
</tbody>
</table>

### COMBINATIONS OF LIFT THICKNESSES TO ACHIEVE THE FULL DEPTH SECTION WITH HEAVY MAIN LINE PAVING EQUIPMENT

<table>
<thead>
<tr>
<th>Full Depth HMA</th>
<th>Top Lift (T)</th>
<th>Bottom Lift (B)</th>
<th>or</th>
<th>Top Lift (T)</th>
<th>Upper Mid-Lift (M₁)</th>
<th>Lower Mid-Lift (M₂)</th>
<th>Bottom Lift (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>2.0</td>
<td>4.0</td>
<td>or</td>
<td>3.0</td>
<td>N/A</td>
<td>N/A</td>
<td>3.0</td>
</tr>
<tr>
<td>6.5</td>
<td>2.5</td>
<td>4.0</td>
<td></td>
<td>3.0</td>
<td>N/A</td>
<td>N/A</td>
<td>3.5</td>
</tr>
<tr>
<td>7.0</td>
<td>3.0</td>
<td>4.0</td>
<td>or</td>
<td>2.5</td>
<td>N/A</td>
<td>N/A</td>
<td>4.5*</td>
</tr>
<tr>
<td>7.5</td>
<td>3.0</td>
<td>4.5*</td>
<td></td>
<td>3.0</td>
<td>N/A</td>
<td>N/A</td>
<td>4.5*</td>
</tr>
<tr>
<td>8.0</td>
<td>3.0</td>
<td>5.0*</td>
<td></td>
<td>2.0</td>
<td>3.0</td>
<td>N/A</td>
<td>3.0</td>
</tr>
<tr>
<td>9.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>2.0</td>
<td>3.0</td>
<td>N/A</td>
<td>4.0</td>
</tr>
<tr>
<td>10.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>2.0</td>
<td>4.0</td>
<td>N/A</td>
<td>4.0</td>
</tr>
<tr>
<td>11.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>3.0</td>
<td>4.0</td>
<td>N/A</td>
<td>4.0</td>
</tr>
<tr>
<td>12.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>13.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>14.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>15.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>3.0</td>
<td>4.0</td>
<td>4.0</td>
<td>5.0*</td>
</tr>
</tbody>
</table>

Note: For 0.5" increments add or subtract 0.5" to a lift

*Indicates SG grading mix shall be used at these thicknesses in lieu of S grading, based on contractor’s ability to achieve compaction.

Note:
1. Contractor must select proper compaction equipment and techniques to achieve required compaction in all cases. Compaction specification is 92% to 96% of Rice Value (maximum theoretical density).
Table 12.6–1

<table>
<thead>
<tr>
<th>Traffic Level</th>
<th>Residential</th>
<th>Local Collector</th>
<th>Heavy Collector (Truck or Bus Route)</th>
<th>Arterial</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Lane ESALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum, unless designer would perform vehicle classification per MGPEC Pavement Design Standards</td>
<td>70,000 + 80 x num. of new dwelling units to be constructed</td>
<td>500,000</td>
<td>3,000,000</td>
<td>5,000,000</td>
<td>Must perform MGPEC Pavement Design <a href="http://www.mgpec.org">www.mgpec.org</a></td>
</tr>
<tr>
<td>Minimum total full depth asphalt section (T+M+B) without MGPEC compliant geotechnical or pavement thickness design</td>
<td>7.0**</td>
<td>10.0**</td>
<td>13.5**</td>
<td>14.5**</td>
<td>14.5&quot; or per pavement design</td>
</tr>
</tbody>
</table>

* Or match existing, whichever is greater

Table 12.6–2

<table>
<thead>
<tr>
<th>Traffic Level</th>
<th>Residential &lt;100,000 ESALs</th>
<th>Local Collector</th>
<th>Heavy Collector (Truck or Bus Route)</th>
<th>Arterial</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Lift (T)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphalt Mix Grading (nominal size)</td>
<td>SX (1/2&quot;)</td>
<td>SX (1/2&quot;)</td>
<td>SX (1/2&quot;)</td>
<td>SX (1/2&quot;)</td>
<td>SX (1/2&quot;) or S (3/4&quot;) by permission of PW</td>
</tr>
<tr>
<td>Mix Design Gyration Compaction Effort Level</td>
<td>N=75</td>
<td>N=75</td>
<td>N=100</td>
<td>N=100</td>
<td>N=100 (from design)</td>
</tr>
<tr>
<td>Asphalt Binder Grade (PG hh-II)</td>
<td>PG 58–28</td>
<td>PG 58–28</td>
<td>PG 64–22</td>
<td>PG 64–22</td>
<td>PG 64–22 or by design</td>
</tr>
<tr>
<td></td>
<td>PG 64–22</td>
<td>PG 64–22 (polymer modified) No RAP in mix</td>
<td>PG 64–22 or by design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Lifts (M,B)</td>
<td>S (3/4&quot;) or SG (1.0&quot;) Note: 1</td>
<td>S (3/4&quot;) or SG (1.0&quot;) Note: 1</td>
<td>S (3/4&quot;) or SG (1.0&quot;) Note: 1</td>
<td>S (3/4&quot;) or SG (1.0&quot;) Note: 1</td>
<td></td>
</tr>
<tr>
<td>Asphalt Mix Grading (nominal size)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mix Design Gyroratory Compaction Effort Level</td>
<td>N=75</td>
<td>N=75</td>
<td>N=100</td>
<td>N=100</td>
<td>N=100 (from design)</td>
</tr>
<tr>
<td>Asphalt Binder Grade (PG hh-II)</td>
<td>Same as for top lift</td>
<td>Same as for top lift</td>
<td>PG 64–22 Note: 2</td>
<td>PG 64–22 Note: 2</td>
<td>PG 64–22 Note: 2</td>
</tr>
</tbody>
</table>

Notes:
1. Grading SG may be allowed based upon ability of paving operation to obtain required percent of Rice compaction, proper lift thickness, and sufficient length of paving. Not to be used when hand placement or moving is necessary that would result in segregation.
2. A one-grade softer binder may be allowed to meet “Perpetual Pavement” designs.
Optional 2" inset drain pipe with plastic mesh screen (installed at wall inlet). Install drains on uphill sidewalk side of planting area only.

Open planting area, 5'x14' outer dimensions.

Shredded mulch or other planting area treatment as approved by PW and Forestry.

Provide 2.5' min. concrete step-out whenever there is adjacent on-street parking/loading or as approved by PW.

Back of Curb

Flowline/ Face of Curb

Adjacent Street Curb & Gutter

SECTION A–A

Optional 2" Inset Drain Pipe with plastic mesh screen (installed at wall inlet). Install drains on sidewalk side of planting area only.

Adjacent Sidewalk

Standard 6" Curb

Head per Std. Dwg. No. 5.3b (typ.)

Undisturbed subgrade

Specified uncompacted backfill mixture. Include native soil where possible

Compacted soil for sidewalk support

Planting area treatment, 3" depth (typ.) starting from sidewalk grade. See plan for approved planting area treatments.

SECTION B–B

Notes:
1. Tree planting per Office of the City Forester standards and specifications.
2. Automatic irrigation system shall be provided for open planting area.
3. Concrete scoring outside open planting area shall be coordinated with Public Works field staff.
SECTION A–A

Maintain min. 2”–4” gap between bottom of grate and finish grade. Fill remaining gap with shredded wood mulch.

ADA compliant cast iron tree grating. 0.5” max. slot opening

Adjacent Existing Walk

TREE GRAVE FRAME shall be designed to grate manufacturer standards and specifications. Connection to surrounding concrete to be approved by Public Works

SECTION B–B

Set root collar at or 1’ above sidewalk grade. Remove excess soil from top of root ball

Shredded wood mulch, 3” deep and 4”–6” away from trunk

Undisturbed subgrade

Specified uncompacted backfill mixture. Include native soil where possible

Tree Planter (Grates)

City and County of Denver
Department of Public Works

Date: 05/15

Std. Dwg. No. 13.0b

Notes:
1. Tree planting per Office of the City Forester standards and specifications.
2. Automatic irrigation system shall be provided for open planting area.
3. Concrete scoring outside open planting area shall be coordinated with Public Works field staff.
Provide 2.5’ concrete step-out whenever there is adjacent on-street parking/loading or as approved by public works.

* Downtown Numbered Streets
** Downtown Named Streets

Tree Planter. Refer to Std. Dwg. No. 13.0a or 13.0b

Step-out (not required if no adjacent on-street parking/loading)

Optional Merchant Zone. (Requires a separate permit for tables, chairs, and railings)

City and County of Denver
Department of Public Works

Downtown Streets
Permitted Sidewalk Occupancy

Date: 05/15
Std. Dwg. No. 13.1
Flowline to R.O.W. Line width of approaching street shall be curved around entire cul-de-sac.

STANDARD CUL–DE–SAC
Only allowed on local streets

<table>
<thead>
<tr>
<th>Street Class</th>
<th>Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential*</td>
<td>45'</td>
</tr>
<tr>
<td>Industrial**</td>
<td>57'</td>
</tr>
<tr>
<td></td>
<td>25'</td>
</tr>
<tr>
<td></td>
<td>30'</td>
</tr>
</tbody>
</table>

*Based on SU–30 turning radius
**Use Industrial dimensions if any adjacent property is zoned industrial

Notes:
1. New cul–de–sacs must be approved by Public Works.
2. R.O.W. Line may vary based on specific site conditions.
3. Hammer–head turnarounds are not permitted on public roadways.
"L" TYPE ALLEY CONFIGURATIONS

Area required to create standard "L" alley configuration. Area will vary with different alley widths.