

CITY OF CARO

ENGINEERING DESIGN STANDARDS

ADOPTED October 19, 2015

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CITY OF CARO
ENGINEERING DESIGN STANDARDS

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DEFINITIONS
CITY OF CARO
ENGINEERING DESIGN STANDARDS

For the purpose of this Ordinance, the following rules of construction apply:

- A. Words used in the present tense include the future tense; and in the singular include the plural, unless the context clearly indicates the contrary.
- B. The term “shall” is mandatory; the term “may” is permissive.
- C. The word or term not interpreted or defined by this Article shall be used with a meaning of common or standard utilization.

TERMS DEFINED

The following is a list of words and phrases defined for the purpose of their use in interpretation of the Design Standards Manual. These definitions shall apply in the interpretation, administration and enforcement of the Design Standards Manual. Words and phrases not specifically defined shall rely on their definition in the City of Caro’s Zoning Ordinance and Master Plan.

“AASHTO” shall mean the **“American Association of State Highway and Transportation Officials”** policy manual.

“Alley” shall mean any dedicated public way affording a secondary means of access to abutting property and not intended for general traffic circulation, and not more than twenty (20) feet wide.

“American Water Works Association” or **“AWWA”** shall mean that national standards setting organization.

“Approach” shall mean an area improved for vehicular traffic on a public street right-of-way which connects the traveled portion of the street with a driveway.

“Building Service Sewer (Drainage water)” shall mean any drainage water pipe extension from a building foundation drain outlet located five (5) feet outside of a building or dwelling unit to a public storm water drain.

“Building Service Sewer (Wastewater)” shall mean the sewer extension from a building drain outlet point located five (5) feet outside of a building or a dwelling unit to a point of connection with a public sanitary sewer.

“Building Service Water Supply Pipe” shall mean any water supply mains, pipes, services and/or appurtenances, except meters, that extend from a point of connection with the building water pipe located five (5) feet outside of a building or a dwelling unit to a point of connection with the public water supply system.

“Curb Cut” shall mean that section of curb removed to permit ingress from the pavement to the adjacent property and shall be measured between the points of tangency of the opening radii with the normal street curbing.

“Customer Wastewater Disposal Outlet” shall mean the point of connection to the public sewer.

“Customer Water Supply Outlet” shall mean either the outlet on the customer side of a “stop valve” near the public easement or public right of way (in the case of a supply for a single building) or on the customer side of a master water meter where the City has allowed the use of a master water meter to serve special types of customers.

“Design Standards” are the applicable standards relevant to the planning, design and construction of infrastructure improvements within the City, as adopted and contained in the City’s Design Standards Manual.

“Development” or **“Developer’s Project”** or **“Project”** shall mean a specifically designated site being developed (or proposed for development) by a Developer.

“Ditch” or **“Drainage Swale”** shall mean an open channel used to transport water, groundwater, surface water run-off, or drainage water from any source.

“Drainage Facilities” or **“Drainage Water Facilities”** shall mean any storm sewers, lakes, ponds, streams, rivers or storm drains, including facilities designated as County Drains that receive water from lands owned by more than one Owner.

“ Dwelling Unit” A dwelling unit is any house or building or portion thereof having cooking facilities which is occupied wholly as the home, residence or sleeping place of one (1) family, either permanently or transiently, and placed on a permanent foundation, but in no case shall a travel trailer, automobile chassis, tent or portable building be considered a dwelling. In case of mixed occupancy where a building is occupied in part as a dwelling unit, the part so occupied shall be deemed a dwelling unit for the purpose of this Ordinance and shall comply with the provisions thereof relative to dwellings.

“Easement” shall mean an acquired legal right of a person, governmental agency or public utility for the specific use of land owned by others.

“Engineer” is the City’s Engineer or other City Officer, Employee or Agent acting on behalf of the City in the administration of the City’s Design Standards Manual.

“Foundation Drain Service Pipe” shall mean a conveyance pipe that receives only foundation drain groundwater seepage, exclusive of directly and intentionally introduced surface water runoff.

“Land Developer” or **“Developer”** shall mean a person, firm, association, partnership, corporation or any other legal entity who intends to develop land by making various improvements to the land as described under “Site Improvements”.

“Land Development” or **“The Development of Land”** shall mean the reshaping of the land environment to provide for the elements or amenities associated with community living. Items considered as these elements or amenities include any of the items listed under the definition for “Site Improvements”.

“Lot” shall mean a parcel of land occupied or intended to be occupied by a main building or a group of such buildings and accessory buildings, or utilized for the principal use and uses accessory thereto, together with such yards and open spaces as are required under the provisions of the Zoning Ordinance. A lot may or may not be specifically designated as such on public records. Each such parcel shall also have its front line abutting a public street or a recorded easement.

“Mains” or **“Water Mains”** as applied to the water supply facilities and connections thereto, shall mean any water supply conveyance pipe larger than two (2) inches in diameter.

“Michigan Department of Environmental Quality” or **“MDEQ”** shall mean the State Agency which regulates water supply facilities in the State and certain wastewater disposal facilities in the State.

“Michigan Department of Transportation” or **“MDOT”** shall mean the State Agency which operates State roadways and Federal expressways.

“National Pollution Discharge Elimination System” or **“NPDES”** shall mean that system required by the State of Michigan to regulate treatment and discharge of storm water and/or wastewater to the waters of the State.

“Natural Outlet” shall mean any drainage water outlet, including storm drains and sewers into a watercourse, pond, ditch, lake or other body or surface or groundwater.

“Open Drain” shall mean a large open channel used to transport water, groundwater, surface water runoff or drainage water from any source.

“Opening” shall mean the point of connection of the driveway and the approach at the street right-of-way line. Its width and location shall be determined by extending the driveway line to the street right-of-way line.

“Parking Lot Bay” shall mean a portion of the width of a parking lot which includes a set of parking stalls on either side of a driveway provided for access to such parking stalls.

“Parking Lot” shall mean a designated area used primarily for the off-street parking of motor vehicles.

“Person” shall mean any individual, firm, company, association, society, corporation, governmental agency (including school district), or other legal entity.

“Plat” shall mean a map or chart of a subdivision of land as defined in Act No. 288 of Michigan Public Acts of 1967, as amended.

“Plot Plan” shall mean a scaled topographic drawing of existing and proposed modifications to land utilized for or zoned for single and duplex residential dwelling.

“Preliminary Subdivision Plan” shall mean a preliminary plat showing the salient features of a proposed subdivision of land submitted to an approving authority for purposes of preliminary consideration, as defined in Act No. 288 of Michigan Public Acts of 1967 as amended.

“Public Sanitary Sewer” shall mean a sanitary sewer owned and operated by a governmental agency intended to be located in public easements or public right of way that collect, or is intended to collect wastewater from more than one user or premises and that is required to receive the approval and issuance of a construction permit from the Municipal Wastewater Control Section of the MDEQ.

“Public Sewer” or **“Public Drain”** shall mean a common sewer or drain that serves more than one user or premises and is controlled by the City or another governmental agency.

“Public Utility Company” or **“Utility Company”** shall mean a legally constituted firm, corporation or agency (other than the City or a County Agency acting under a contract with the City) that operates under a franchise or agreement approved by the City for the purpose of installing and operating public utilities, including, but not limited to, gas piping, electric or

telephone wiring (underground or overhead), oil piping, television cable, water supply, transmission mains, sanitary sewer interceptors, and/or drainage facilities. The Detroit Water and Sewer Department (DWSD) is a “Public Utility Company” under this definition.

“**Public Water Main**” shall mean a main, existing or proposed, in public easements or public rights of way that is intended to serve more than one user or premises and that is required to receive the approval and issuance of a construction permit from the Municipal Water Supply Section of the Michigan Department of Environmental Quality. The service pipe extending from a public water main to a “Customer Water Supply Outlet” shall also be considered “Public”.

“**Right of Way**” or “**ROW**” shall mean land dedicated, reserved, used or to be used for a street, alley, walkway or other public purposes.

“**Sanitary Sewer**” or “**Wastewater Sewer**” shall mean a sewer, together with appurtenances, that carries liquid and water carried wastes from residences, commercial buildings, industrial plants and institutions, together with minor quantities of ground, storm and surface waters that are not admitted intentionally.

“**Services**” as applied to the water supply facilities and connections thereto, shall mean any water supply conveyance pipe outside of a building.

“**Sewage Force Main**” or “**Force Main**” shall mean a wastewater conveyance pipe which carries wastewater under pressure.

“**Sewer**” shall mean a pipe or conduit that carries wastewater or drainage water.

“**Sight Distance**” shall mean the unobstructed straight line length of view from a driver’s eye height to an object height.

“**Site Improvements**” or “**Improvements**” shall mean such operations, acts of construction or changes affecting land that increases the value, utility or habitability of the site and including, but not limited to, site grading; drainage water sewers, culverts or drains; sanitary sewers; wastewater disposal facilities; water supply piping; water supply facilities; gas piping; oil piping; television cable; electric power supply wiring; telephone wiring; roadway surfacing or paving; parking lot paving; driveways; bridges; lakes, ponds, or lagoons; sidewalks; landscape walls and fences, and/or other appropriate appurtenant items.

“**Site Plan**” shall mean the plan required under the City’s Zoning Ordinance for “Site Plan Review” for all projects other than a land subdivision plat.

“**South Central Michigan Construction Code Inspection, Inc.**” or “**SCMCCI**” shall mean that agency responsible for Soil Erosion and Sedimentation Control Permits.

“**Stop Valve**” or “**Curb Stop**” shall mean the valve placed on a building service water supply pipe that is located at a “Customer Water Supply Outlet”.

“**Storm water Drain**” or “**Storm Drain**” or “**Storm Sewer**” shall mean a watercourse or a sewer intended for the conveyance of water, groundwater, surface water runoff, drainage water or other water from any source, exclusive of intentionally admitted wastewater.

“**Storm water Inlet Structure**” shall mean a structure designed and constructed to intentionally admit surface water runoff, drainage water or other water from any source, exclusive of intentionally admitted wastewater.

“Street” shall mean any street, avenue, place, way, drive, lane, boulevard, highway, road or other right of way that provides for vehicular or pedestrian access to abutting properties by the general public; and includes the land between the street right of way lines whether improved or unimproved. An alley is not a street.

1. **“Street, public”** shall mean a right of way that provides for vehicular and pedestrian access to abutting properties that is deeded or dedicated to the City or other governmental agency authorized to own road right of way and/or operate vehicular transportation facilities.
2. **“Street, private”** shall mean a right of way or easement that provides for vehicular and pedestrian access to abutting properties for the general public, but is not deeded or dedicated to a governmental agency for ownership, operation or maintenance. The landowners of the property served by the private street are responsible for its maintenance.
3. **“Street, major”** shall mean streets meeting one or more of the following:
 - a. Streets that provide extensions to State Trunk Lines or County Primary Roads in facilitating through traffic.
 - b. Streets that provide an integral network to service the traffic demands created by industrial, commercial, educational or other traffic generating centers.
 - c. Streets that provide for the circulation of traffic and around the central business district.
 - d. Streets that are designated truck routes.
 - e. Streets that collect traffic from an area served by an extensive network of local streets.
4. **“Street, local”** shall mean streets not meeting any of the criteria from major streets.

“Surface Water Runoff” or **“Storm water”** shall mean that part of rainfall or melting snowfall that reaches the storm water drain as runoff from natural land surfaces, building roofs or pavements.

“Trunk Storm Sewer” shall mean a public storm sewer having a diameter of twenty-four (24) inches or larger.

“Tuscola County Drain Commissioner” or **“TCDC”** shall mean that person or agency responsible for drainage improvements under the jurisdiction of the State Drain Act, PA 40 of 1956, as amended.

“Tuscola County Road Commission” or **“TCRC”** shall mean that agency responsible for the construction, operation and maintenance of county highways, roads and streets.

“Underdrain Pipe” shall mean a geotextile wrapped perforated pipe installed underground for the specific purpose of lowering a high groundwater condition or draining a granular subbase by receiving groundwater seepage and conveying it to a storm water drain. Farm Drain Tile is not Underdrain Pipe.

“Unpolluted Water” or **“Drainage Water”** is water of a quality equal to or better than the effluent criteria currently in effect, as specified by the MDEQ, or water that would not cause

violation of receiving water quality standards and would not be benefited by discharge to the City sanitary sewers and wastewater disposal system.

“User” shall mean the owner or occupant of any premises connected with and/or using any of the facilities operated by the Department.

“Utility Company’s Contractor” shall mean a construction contractor engaged by the utility company to install public utilities for the utility company; or, in the case where the utility company has a construction division that installs its own utilities, shall mean the utility company.

“City” shall mean the City of Caro (Michigan) and its Officers, Employees and Agents, including, but not limited to, the City Council, City Planning Commission, City Staff, City Attorney, City Engineer, etc.

“Wastewater Treatment Works” or **“Sewage Treatment Plant”** shall mean facilities for treating wastewater, industrial wastes and sludge.

“Wastewater” or **“Sewage”** shall mean the spent water of a community, including liquid and water-carried wastes from residences, commercial buildings, industrial plants and institutions, together with any groundwater, surface water and storm water that may be present.

“Watercourse” shall mean a natural or artificial open channel for the passage of water either continuously or intermittently.

SECTION 1 – GENERAL REQUIREMENTS & SUBMITTALS
CITY OF CARO
ENGINEERING DESIGN STANDARDS

The items found in this section contain the general requirements for the submittal of plans to the City for review, comment and approval. In addition, specific requirements pertaining to Water Mains, Sanitary Sewers, Storm Drains, Detention, Paving and Grading, Street Names, Street and Easement Widths, all other Street and Easement Survey information, Subdivision Names, Lot Numbers and Permanent Parcel Numbers, follow this Section and apply as stated within their respective context.

Submittal

1. Complete sets of Site Plans including Engineering Plans, bearing the seal of a Professional, licensed to practice in the State of Michigan, shall be submitted to the City for review. The number of sets shall be according to the City of Caro's Procedure Manual or as determined by the Zoning Administrator. The City may elect to send the plans to a consulting firm of their choice for review. Each plan sheet shall contain the project name and the project owner's name and address.
2. A Certified Boundary Survey of the site or a copy of the complete plat shall be submitted along with the Engineering Construction Plans.
3. Plans shall be submitted on 24 inch x 36 inch plans having blue or black lines and shall be neatly and accurately prepared.
4. All plans shall contain the latest version of the applicable City's Standard Detail Sheets.
5. The cover sheet shall include a location map at a scale of 1 inch = 2000 feet (1"=2000'), showing the location of the proposed project, a symbol legend and a sheet index.
6. Existing information, topography, utilities, etc., shall be shown in gray or lighter line weight, while proposed improvements shall be shown in dark and heavy black lines. The legend shall clearly refer to all line symbols used.
7. For projects having more than one (1) sheet of plans, a general plan having a scale of 1 inch equal to 100 feet (1"=100') shall be provided showing the overall project, and indicating the size and general location of all improvements shown in the detailed plans. Street names, street and easement widths, lot lines, lot dimensions, lot numbers, zoning and ownership shall be shown on all plans.
8. Utilities shall be located in accordance with the City's Standards. Utilities shall be parallel to lot lines. Generally, utilities shall be constructed in the road right of way or in easements adjacent to the road right of way and shall not be located under existing or proposed pavement, including paths and sidewalks. Side yard easements are acceptable.

9. Grading plans are required for all developments.
10. Engineering plans having a scale of no greater than 1 inch equals 50 feet (1"=50') horizontal and 1 inch equals 5 feet (1"=5') vertical (for profiles) shall be provided. Sanitary sewer and water main shall be shown on the same sheet. Plan and profile views are required on all gravity sewers. The profile, where possible, shall be shown below the plan view on the same sheet.
11. Storm sewer and pavement shall be shown on the same sheets. Plan and profile views are required for all storm sewers. A plan view with centerline stationing shown is required on all paving plans. Show the top of curb line on profile.
12. In the profile view, all crossings of utilities must be shown. When a water main crosses a sewer, an invert elevation for the water main shall be shown. The minimum vertical clearance between utilities shall be eighteen (18) inches.
13. Profiles of sewers shall indicate the size, rim elevations of all structures, the length of pipe between structures, the slope of the pipe, numbering of structures, and casting. The profile shall indicate the existing and proposed ground elevations above the route of the sewer. The inverts of all sewers, both existing and proposed, shall be given at manholes. The location of areas requiring compacted sand backfill shall be indicated on the profile.
14. Elevations shall be on U.S.G.S. Datum. A minimum of two (2) permanent benchmarks for the work shall be indicated on the plans.
15. Any areas that are considered to be "wetlands" as defined by the Michigan Department of Environmental Quality (MDEQ) shall be indicated on the plans. No improvements will be allowed in wetlands unless the MDEQ issues a permit for such improvements.
16. Finished grade shall be indicated at the corners of all buildings and for all utility structures.
17. Plans for landscaping or tree planting required by either the City Ordinance or the City Standard relating to such items as greenbelts, street islands, detention basins, or landscape and open space areas, shall conform to the City Standards and shall be submitted for review and approval prior to final site approval.
18. All new grass areas that are required in the public right of way and all existing grass areas that are disturbed by construction shall be established or restored in conformance with the City's Standard Specifications.
19. Street names shall be approved by the City.
20. The Developer's consulting engineer shall forward plans for approval to any public utility (gas, electric, etc.) and any Federal, State or County Agency, whose facilities or right of way may be affected by the proposed construction. Permits for such construction, if required, shall be the responsibility of the Developer. One (1) copy of any such permit shall be provided to the City prior to construction.

21. For all developments, one (1) mylar copy and two (2) sets of prints sealed by a Registered Professional Surveyor or Engineer, licensed to practice in the State of Michigan, of all as-built drawings for sanitary sewers, storm sewers, water mains, detention basins, streets and roads, shall be provided by the Developer prior to final approval and acceptance by the City.
22. All materials and workmanship shall conform to the latest edition of the Michigan Department of Transportation's (MDOT) "Standard Specifications for Construction", the Tuscola County Road Commission (TCRC) published criteria and the requirements of this ordinance. In the event of a conflict between standards, the most stringent shall govern, except when the City agrees that a less stringent interpretation is appropriate for the intended use.

SECTION 2 – WATER DISTRIBUTION SYSTEM
CITY OF CARO
ENGINEERING DESIGN STANDARDS

A. Plans and Specifications — Submittal Procedure

1. The plans and specifications shall be submitted in accordance with “Section 1-General Requirements & Submittals.”
2. The Applicant may proceed with water main permitting once the City has conducted an initial review of the entire construction plan submittal and all revisions pertaining to the water main have been completed.

B. Plans and Specifications — Design Considerations General

1. All water systems shall be designed conforming to the current edition of the “Recommended Standards for Water Works”, published by Health Education Services, also known as the “Ten State Standards”.
2. Plans shall consist of a cover sheet showing plan and profile views of the complete job.
3. Reference “Section 1 - General Requirements & Submittals” for specific requirements pertaining to the presentation of plans.
4. The cover sheet shall contain a total quantity listing of the proposed water main improvements, indicating the lengths of pipe, type of pipe and their respective sizes.
5. Provide continuous stationing. Identify all existing and proposed tees, valves, bends, hydrants, etc.

C. Benchmarks and Elevations

1. Elevations shall be on U.S.G.S. Datum. There shall be a minimum of two (2) benchmarks with one (1) benchmark at least every 1,200 feet.
2. Proposed finish grade elevations at hydrants and gate wells shall be shown on the plans.

D. Soil Conditions

1. Water main design, relative to pipe bedding and location, shall reflect the proper selection of materials and construction method compatible with the field conditions. Areas which show unsatisfactory ground material for pipe bearing or possible chemical deterioration due to soils, shall be avoided or the pipe shall be suitably installed on adequately designed bedding and/or enclosed in protective wrap or coating.

E. Location and Layout

1. The distribution system in all developments requiring more than six hundred (600) feet of water main, shall have a minimum of two (2) connections to a source of supply and shall be a “looped” system, whenever possible.

2. Generally, water mains shall be installed in a public street right of way or in easements exclusively reserved for such use on the opposite side of the street from sanitary sewers. Whenever possible, water main shall be located on the north side of an east-west street and on the east side of a north-south street.
3. Water main shall be installed parallel to the property lines or building lines, with clearance distances to allow for a twenty (20) foot width dedication of easement centered on the water main. Water mains shall be kept on one side of the street for the entire length of the street.
4. Water main shall be constructed outside of paved parking areas, streets and drives, unless approved by the City. The City shall not be liable to repair improved areas within an easement.
5. In new developments water mains shall be installed from boundary to boundary in abutting roads and interior streets and at other locations, as may be deemed necessary by the City for future extensions.
6. When connecting to an existing water main, a cut in tee with gate valve or a tapping sleeve and valve will be required. A full body sleeve is required for all taps made to ductile iron, cast iron or PVC water main, or as directed by the City. Same size tapping sleeves will be allowed.
7. The plans shall indicate the finish grades of all hydrants, valve boxes and gate wells.
8. All water mains shall be located so as to provide a minimum of ten (10) feet horizontal clearance between the nearest edge of the water main and the nearest edge of any sanitary or storm sewer.
9. Where conditions require tunneling or boring, consult the City for specific requirements. These conditions may include road crossings or conflicts with trees, shrubs, structures or other utilities. Where water mains cross improved roads of any type, the pipe shall be installed by tunneling or boring and be placed in a steel casing pipe, or as approved by the City. All boring work shall be in accordance with the current MDOT standards and as approved by the City.

F. Easements

1. Easements for possible extensions or looped connections shall be extended to the property line at locations designated by the City. All easements shall be a minimum of twenty (20) feet wide and shall be dedicated to the City.
2. The easement descriptions shall include the hydrant leads and shall extend a minimum of ten (10) feet beyond the hydrant on any lead. The easement documents shall contain a provision prohibiting the construction of or locating of any above ground structures within the limits of such easements.

G. Pipe Sizes

1. Eight (8) inch diameter water mains are the minimum size to be installed in single family residential areas.

2. Twelve (12) inch water mains are considered to be the minimum size in commercial, office, industrial and multiple family residential areas, except in a looped system of 1,500 feet or less where eight (8) inch mains may be permitted, if approved by the City.
3. Water main shall be sized to provide the volumes required by the proposed developments. Design shall include ample research to verify that the required volumes and pressures are available.
4. Water mains shall be designed to provide adequate volumes for the fire fighting purposes. Insurance Services Office (ISO) Standards shall be used, as a minimum guideline, to provide 1000 gallons per minute (GPM) for emergency use.
5. All single hydrant leads longer than seventy-five (75) feet must be a minimum of eight (8) inches in diameter.

H. Pipe Materials

1. Ductile iron Class 54, cement-lined pipe, with connectivity wedges installed in each joint or PVC C909 DR18 with tracer wire. Tracer wire shall be 10 AWG copper wire or 12 AWG copper clad, steel core wire, both of which shall have a 30 mil polyethylene jacket.
2. Ninety (90) degree bends are not permitted, except as detailed for hydrant assemblies.

I. Valves - Location

1. A valve shall be provided at every connection to existing mains, unless otherwise approved by the City.
2. In general, valves on cross connecting mains shall be arranged so that no single line failure will require more than eight hundred (800) feet of main to be out of service. Also, sufficient valves shall be placed such that not more than twenty-four (24) homes, thirty (30) multiple family units, or two (2) hydrants shall be out of service within such section of water main, which can be isolated. On transmission mains, valves shall be spaced not more than one-quarter (1/4) mile apart. Valves shall be so arranged that any section can be isolated by closing not more than four (4) valves.
3. A valve shall be provided on every dead-end line where required for future extension, at a location approved by the City. All dead-end mains must be valved at the tee.
4. Valves shall be as specified within the detail sheets.
5. Valves should not be located under roadway pavement, bike paths, sidewalks or driveway approaches, unless approved by the City.

J. Gate Wells

1. All valves and tapping sleeves should be placed outside of hard surfaces whenever possible. Valves located outside of hard surface areas shall utilize a valve box, as specified on the Standard Detail Sheet. Approval from the City is required for all valves to be located within a hard surface area.

K. Fire Hydrants

1. In general, no residential dwelling shall be more than three hundred (300) feet from a fire hydrant, as measured along the street right of way line. Hydrants should be positioned as close to lot lines as possible. Locations shall be approved by the City.
2. Commercial building sites shall be serviced by a minimum of two (2) hydrants located no closer than forty (40) feet from the structure.
3. Spacing of hydrants around commercial and/or manufacturing establishments shall be considered on an individual case and shall be determined by consultation with the City and the Fire Department.
4. A hydrant shall be installed at the end of every dead-end main. Temporary blow-offs may be allowed at the end of dead-end mains when future extension is imminent, as approved by the City.
5. In general, hydrants shall be located in the road right of way nine (9) feet from the right of way line, but not closer than six (6) feet to the back of curb. The location of hydrants with respect to the right of way line shall be indicated on the plans. Hydrant valves shall face the road and hydrants shall be plumb and set to grade prior to final acceptance.
6. In all other areas, no part of the exterior of commercial buildings shall be further than two hundred and fifty (250) feet from a hydrant, measured along the shortest feasible exterior route for laying hose.
7. Hydrants and valves shall be as specified within the Standard Detail Sheets.

L. Pipe Restraints

1. Thrust blocks shall be installed at all bends, dead-ends, tees, reducers and hydrants (See Standard Detail Sheet).
2. Restrained joints of a type acceptable to the City may be used in lieu of thrust blocks with the number of restrained joints determined by the manufacturer and approved by the City.

M. Services

1. Service lines are to be shown to all buildings other than single family detached dwellings.
2. Service lines shall be installed using Type "K" soft copper for services two (2) inches or less. Services over two (2) inches, shall be same material as main.
3. A curb stop for each service line shall be provided and located at the right of way. Curb stops in drives and sidewalk will not be allowed.
4. The internal diameter shall be shown for each service and the minimum size shall be one (1) inch in diameter. Meter brackets shall be "Angled Meters Stop" and can be purchased from the City.

N. Fire Protection Lines

1. Fire protection lines, where applicable, are to be shown to all buildings.
2. A valve and a back flow device for each fire protection line shall be provided.
3. The domestic supply lead shall be a separate lead from the fire protection line.

O. Acceptance of Utilities

1. Preliminary Acceptance

- a. The installed mains must pass all required pressure tests and bacteriological tests, as required by the current City Standards, prior to the final connections.
- b. Prior to acceptance, water mains shall be flushed in accordance with the City Standards.
- c. All structures and valve boxes must be clean and free of construction debris.
- d. The Developer shall submit record drawings, which must include rim elevations, pipe size and tie downs to all water main appurtenances.

2. Final Acceptance

- a. Approved “mylar” record drawings shall be submitted to the City prior to final acceptance of the water mains.

CITY OF CARO
ENGINEERING DESIGN STANDARDS
WATER MAIN DETAIL SHEET

STANDARD DETAILS PREPARED BY
ROWE PROFESSIONAL SERVICES COMPANY
LAFAYETTE OFFICE
120 N. Superior St., Lafayette, MS 39440
Phone: (601) 664-8111

NO.	DATE	DESCRIPTION
1	10-11-02	APPROVED BY CITY
2	10-11-02	REVISIONS FOR MECHANICAL STREET
3	10-11-02	REVISIONS FOR MECHANICAL STREET
4	10-11-02	REVISIONS FOR MECHANICAL STREET
5	10-11-02	REVISIONS FOR MECHANICAL STREET

GENERAL WATER MAIN NOTES

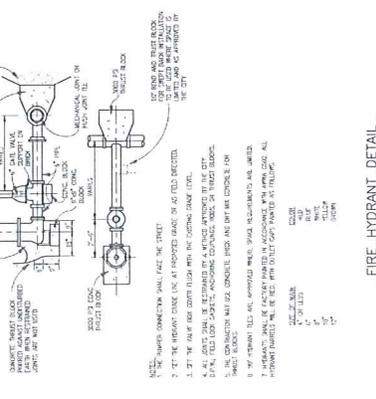
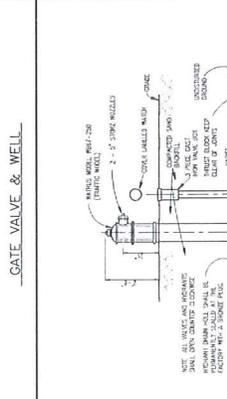
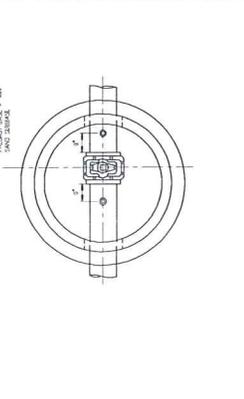
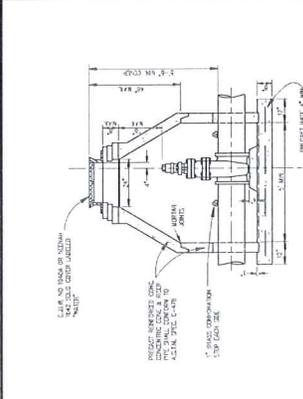
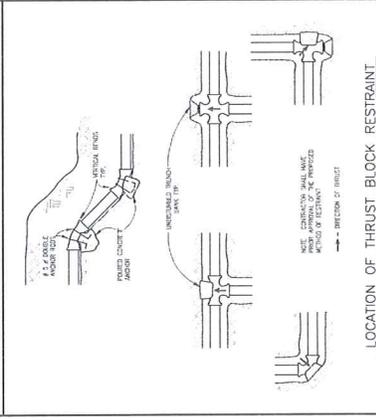
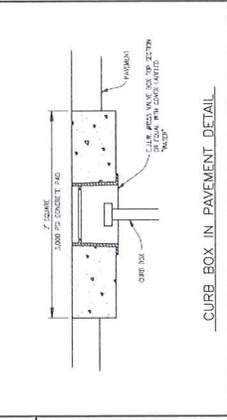
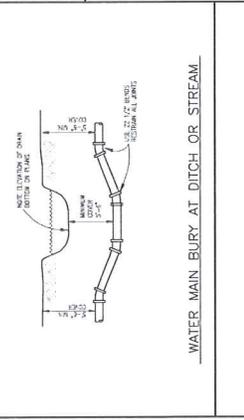
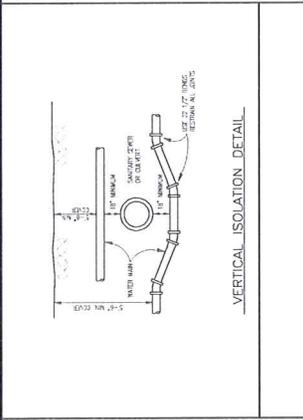
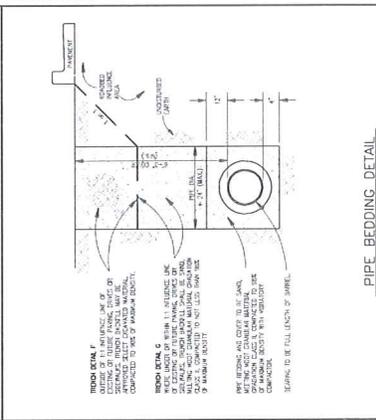
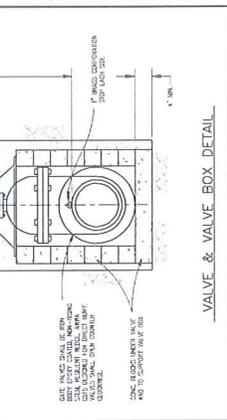
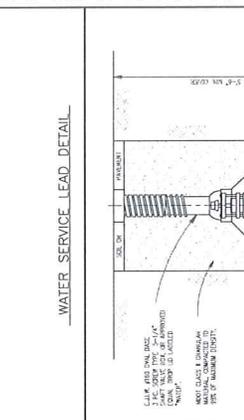
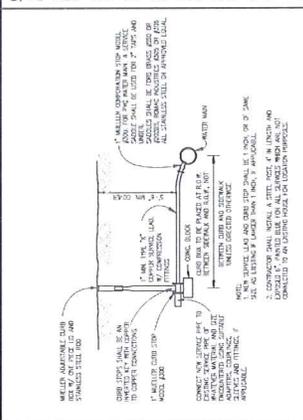
1. THE CONTRACTOR SHALL NOTIFY THE CITY OF CARO DEPARTMENT OF PUBLIC WORKS FORTY EIGHT (48) HOURS PRIOR TO CONSTRUCTION.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND FOR THE LOCATION OF ALL UNDERGROUND UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION OF ALL UTILITIES IN THE VICINITY OF THE MAIN, WHICH MAY NOT BE INDICATED BY MOST D.C.
3. CONCRETE THROAT BLOCKS SHALL BE CONSTRUCTED FOR ALL BENDS, TEES, FLANGES, TAPS, AND HYDRANTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION OF ALL UTILITIES IN THE VICINITY OF THE MAIN, WHICH MAY NOT BE INDICATED BY MOST D.C.
4. ALL END OF LINE GATE VALVES SHALL BE SET WITH THE CENTERLINE OF THE MAIN. THE LOCATION OF THE MAIN SHALL BE INDICATED BY A PERMANENT MARK AND A PERMANENT MARK SHALL BE SET TO THE LOCATION OF THE MAIN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION OF ALL UTILITIES IN THE VICINITY OF THE MAIN, WHICH MAY NOT BE INDICATED BY MOST D.C.
5. ALL VALVES SHALL BE INSTALLED IN ACCORDANCE WITH THE CITY OF CARO DEPARTMENT OF PUBLIC WORKS ADVANCE NOTICE TO THE DEPARTMENT OF PUBLIC WORKS.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION OF ALL UTILITIES IN THE VICINITY OF THE MAIN, WHICH MAY NOT BE INDICATED BY MOST D.C.
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HYDROSTATIC PRESSURE TESTING

1. WATER MAIN SHALL BE HYDROSTATICALLY TESTED IMMEDIATELY AFTER THE SECTION IS BEING INSTALLED.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION OF ALL UTILITIES IN THE VICINITY OF THE MAIN, WHICH MAY NOT BE INDICATED BY MOST D.C.
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DISINFECTION

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION OF ALL UTILITIES IN THE VICINITY OF THE MAIN, WHICH MAY NOT BE INDICATED BY MOST D.C.



LEGEND

1. ALL DIMENSIONS SHALL BE IN FEET AND INCHES.

2. ALL DIMENSIONS SHALL BE IN FEET AND INCHES.

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20. ALL DIMENSIONS SHALL BE IN FEET AND INCHES.

SECTION 3 – SANITARY SEWERS
CITY OF CARO
ENGINEERING DESIGN STANDARDS

A. Plans and Specifications - Submittal Procedure

1. The plans and specifications shall be submitted in accordance with Section 1 - General Requirements & Submittals.

B. Plans and Specifications - Design Considerations: General

1. All sanitary sewer designs shall be developed conforming to the current edition of “Recommended Standards for Waste Water Facilities”, published by Health Education Services, also known as the “Ten State Standards”.
2. Prior to starting any sanitary sewer design, the applicant is encouraged to make use of maps and information available at the City offices. It shall be the responsibility of the applicant to field check and verify utility locations provided by the City.
3. The Developer shall research to determine if the sewer has adequate capacity to handle the anticipated volumes. Such research shall be provided to the City for their review and may be required for the MDEQ permit.
4. A cover sheet shall show, in addition to those items required in the General Requirements & Submittals, the following:
 - a. Overall layout of the sewer system with manhole numbers and direction-of-flow arrows. Existing and proposed sewers shall be shown with different symbols and line types.
 - b. A flow calculation for the service area and any future service area that may be ultimately served by the proposed sewer.
5. In general, construction of all sanitary sewers eight (8) inch in diameter and larger shall be considered a public sanitary sewer and will require a permit from the MDEQ.
6. If the Developer determines that it is not possible to service their development with a gravity flow sewer, then the Developer shall discuss the alternatives with the City.
7. Lift stations, grinder pumps and low pressure sewers will require specific approval from the City.

C. Plan and Profile Sheets

1. The plan portion of the sheet shall include, at a minimum, the following:
 - a. Existing topography and all existing or planned surface or underground improvements in streets or easements in which sewer construction is proposed or in contiguous areas, if pertinent to design and construction.
 - b. Location, length, size and direction of flow of each section of the proposed sewer between manholes.
 - c. Locations of all manholes and other sewer appurtenances and special structures.

- d. Building sewers or wye branches are to be constructed or installed concurrently with sewer construction with locations at easement and/or property lines.
2. The profile portion of the sheet shall appear below the companion plan portion, generally projected vertically and shall show, at a minimum, the following:
 - a. Size, slope, type, class of pipe and class of bedding material and controlling invert elevations for each section of proposed sewer between manholes.
 - b. Limits of special backfill requirements.
 - c. Location of existing or proposed utilities crossing the line of the sewer or otherwise affecting sewer construction.
 - d. Location by station, of every proposed manhole with manhole number, invert elevation of all inlet or outlet pipes, top of casting elevation and manhole size.
 - e. Length of run between manholes.
 - f. Location by station, from downstream manhole of all building sewers or wye branches to be constructed or installed concurrently with the proposed sewer construction.
 - g. Existing and proposed ground elevation above the route of the sewer.
 - h. Invert elevation at property line for building sewers to be included with sewer construction.
 - i. Manholes shall be identified by numbers assigned consecutively and increasing in direction opposite to direction of flow in each sewer.
 - j. All elevations shall be on U.S.G.S. datum.
 - k. There shall be a minimum of two (2) benchmarks with one (1) benchmark at least every 1,200 feet.

D. Location of Sanitary Sewers

1. Sanitary sewers shall generally be located on opposite sides of streets from water mains and shall, whenever possible, be installed on the south side of an east-west street and on the west side of a north-south street.
2. Generally, sanitary sewers shall be installed in a public street right of way or in easements exclusively reserved for such use.
3. Sewers shall be constructed outside of paved parking areas, streets and drives, whenever possible. The City shall not be liable to repair improved areas within an easement.
4. Sewers shall be installed parallel to the property lines or building lines.
5. Sanitary sewers shall maintain ten (10) feet of horizontal separation from all parallel utilities.
6. Sanitary sewer crossings of other utilities shall have a minimum vertical clearance of eighteen (18) inches, with the sanitary sewer placed below the other utility.

E. Drop Connection

1. Internal drop connections are required at manholes where the invert of the outlet pipe is eighteen (18) inches or more below the invert of the inlet pipe.
2. External drop connections are not allowed, unless specifically approved by the City.

F. Tunneling and Boring

1. Where conditions require tunneling or boring, consult the City for specific requirements. Where sanitary sewers or sanitary sewer leads cross improved roads of any type, the pipe shall be installed by tunneling or boring, located within a steel casing pipe, unless approved otherwise by the City. All boring work shall be in accordance with the current MDOT standards and as approved by the City.

G. Extensions and Future Connections

1. Where the sanitary sewer must be extended from off-site, sanitary sewer leads extending two (2) feet beyond the property line of all adjacent property on both sides of the right of way, the entire length of the off-site sanitary sewer installation shall be provided.

H. Allowable Minimum Pipe Slopes

Pipe Diameter <u>(inches)</u>	Minimum Slope <u>(feet per 100 feet)</u>
6 (services only)	1.00
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12

I. Manhole Locations

1. Manholes shall be constructed at every change in sewer grade, alignment and pipe size and at the end of each sewer line. Maximum distance between manholes shall not exceed four hundred (400) feet.
2. Where future connections to a manhole are anticipated, stubs with watertight bulkheads shall be provided.

J. Hydraulic Calculations

1. Calculations

- a. Gravity sanitary sewers: Manning's Formula shall be used.
- b. Low-pressure sewer systems and force mains: Hazen-Williams Formula shall be used.

2. Minimum and Maximum Velocities

Minimum design velocities for gravity and low pressure sanitary sewers shall be two (2) feet per second, and a maximum design velocity shall be ten (10) feet per second with pipe flowing full.

K. Allowances for Changes in Pipe Size

1. Maximum flow velocity for full pipe flow shall be maintained by continuity of the 0.80 diameter depth above invert for pipe size increases and also with intersecting sewer grade raised to compensate for head loss due to direction change.
2. Provide a drop of 0.10 feet in the downstream sewer invert for all manholes to compensate for velocity head loss of the incoming flow.

L. Building Sewers

1. Unless otherwise approved by the City, construction of building sewers from the public sewer beyond the easement and/or property line for each fronting parcel which the sewer is designed to serve, shall be included with the construction of each sanitary sewer.
2. Where construction of building sewers to the property line is not required concurrently with sanitary sewer construction, a wye branch with riser, if required, and a watertight stopper or plug with type of joint used for the sewer pipe shall be installed for every lot or building site which the sewer is designed to serve.
3. Minimum size for building sewers shall be six (6) inch nominal internal diameter. Each structure shall have a separate individual sanitary service lead connected to a public sanitary sewer.
4. For service leads beyond the right of way, cleanouts shall be provided every ninety (90) feet and at any bend forty-five (45) degree or greater.

M. Sewer Capacity Design

1. Tributary Area

- a. Sanitary sewers shall be designed to serve all tributary areas, with due consideration given to topography, the master sanitary sewer plan, established zoning and the adopted Master Land Use Plan.

2. Population

- a. For design purposes, population shall be based on a minimum of 3.5 persons per detached single-family home site (or equivalent single family unit), and 2.5 persons for each multiple-family dwelling unit.
- b. Submissions for review shall include a tabulation of occupancy (usage) types and the conversion of these into terms of equivalent single-family units. The areas of

the site, in acres, may be used to calculate dwelling units based on density allowed in the Zoning Ordinance.

3. Sewage Quantities for Pipe Design

- a. For all service areas, sewer design flows shall be in accordance with the “Ten State Standards”.

N. Acceptance of Utilities

1. Preliminary Acceptance

- a. Prior to acceptance, all sanitary sewers shall be flushed and cleaned in accordance with City Standards.
- b. Air Test or Infiltration Test shall be completed in accordance with the “Ten State Standards”.
- c. Televising shall be completed in accordance with the City Standards (see Sewer Detail Sheet).
- d. The Developer shall submit record drawings, which must include rim elevations, inverts, pipe size, and slopes.

2. Final Acceptance

- a. Approved “mylar” record drawings shall be submitted to the City prior to final acceptance of the sanitary sewer. The City will review the record drawings and video tapes to determine if the sewer is acceptable. If the City determines the sewer has deficiencies, they shall be corrected to the City’s satisfaction prior to the City accepting the sewer.

NO.	DATE	DESCRIPTION	BY
1	10-11-14	ADOPTED BY CITY	
2	07-15-14	2013 AMENDMENTS	
3	07-15-14	2013 AMENDMENTS	
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7	07-15-14	2013 AMENDMENTS	
8	07-15-14	2013 AMENDMENTS	
9	07-15-14	2013 AMENDMENTS	
10	07-15-14	2013 AMENDMENTS	
11	07-15-14	2013 AMENDMENTS	
12	07-15-14	2013 AMENDMENTS	
13	07-15-14	2013 AMENDMENTS	
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20	07-15-14	2013 AMENDMENTS	

STANDARDS PREPARED BY
ROWE PROFESSIONAL SERVICES COMPANY
 120 N. Soghoos St., Logansport, IN 46844
 Phone: (317) 664-9411

CITY OF CARO
 ENGINEERING DESIGN STANDARDS
 SEWER DETAIL SHEET

SHEET # 1 of 1

STORM SEWER MATERIALS

1. ALL STORM LEADS SHALL BE CONCRETE PIPE UNLESS APPROVED BY THE CITY. SIZES FOR 4" OR 6" SHALL BE A MINIMUM OF 2' OF GAGE.
2. ALL STORM LEADS SHALL BE CONCRETE PIPE UNLESS APPROVED BY THE CITY. SIZES FOR 8" OR 10" SHALL BE A MINIMUM OF 2' OF GAGE.
3. ALL STORM LEADS SHALL BE CONCRETE PIPE UNLESS APPROVED BY THE CITY. SIZES FOR 12" OR 15" SHALL BE A MINIMUM OF 2' OF GAGE.
4. CONCRETE MANHOLE STRUCTURES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF ADOPTED M-36. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS.

SANITARY SEWER MATERIALS

1. PVC SCHEDULE 40 OR 20 SHALL BE USED FOR SEWERS.
2. 8" LEADS SHALL BE ON SCHEDULE 40. THE SEWER LEAD MATERIAL SHALL BE COMPATIBLE WITH THE SEWER MAIN MATERIAL.
3. PIPE JOINTING SHALL BE CAST INTO THE PRECAST SECTION OR CASTED INTO FINISHED WALL MANHOLE PRECAST CONNECTIONS SHALL BE FINISHED WITH AN INHERENTLY CAST SEAL SYSTEM, NON-W-SEA OR EQUAL.

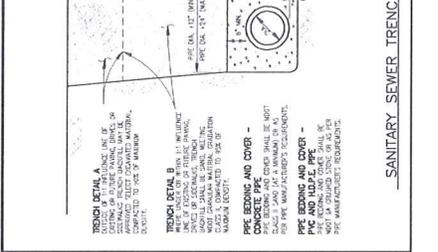
SANITARY SEWER PIPE JOINTING

1. THE PROCEDURE FOR AIR TESTING OF SEWERS SHALL BE AS FOLLOWS:
2. THE SEWER SHALL BE TESTED IN SECTIONS BETWEEN MANHOLES. THE LEAD SHALL BE CLEANED AND FLUSHED AT EACH MANHOLE. SEWER PIPES SHALL BE TESTED TO A PRESSURE OF 2.0 PSI ABOVE THE TEST PRESSURE AND A PRESSURE GAUGE FOR CONTINUOUSLY MEASURING THE AIR PRESSURE IN THE SEWER. THE PRESSURE GAUGE SHALL HAVE A MINIMUM DIAPHRAGM OF 3-1/2" INCHES AND A RANGE OF 0-10 PSI. THE GAUGE SHALL HAVE MINIMUM THICKNESS OF 1/16" INCH AND AN OPENING OF 1/8" INCH.
3. AFTER THE SEWER HAS BEEN TESTED TO THE TEST PRESSURE, THE PRESSURE SHALL BE MAINTAINED FOR A PERIOD OF 15 MINUTES. THE PRESSURE SHALL BE MAINTAINED FOR A PERIOD OF 15 MINUTES.
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5. THE TIME REQUIRED FOR THE AIR PRESSURE TO DECREASE TO 1.0 PSI DURING THE TEST SHALL NOT BE LESS THAN THE TIME SHOWN IN THE FOLLOWING TABLE.

PIPE DIAMETER (INCHES)	MINUTES
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
14	7.5
18	10.0

GENERAL SEWER NOTES

1. THE CONSTRUCTION SHALL BE TO THE CITY (VERTICAL) (45) HOURS PRIOR TO CONSTRUCTION.
2. ALL STRUCTURE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF ADOPTED M-36. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS.
3. A MANHOLE POINT SHALL BE REQUIRED FOR ALL SANITARY SEWER CONSTRUCTION.
4. UNLESS OTHERWISE NOTED ON THE PLANS, ALL MANHOLE POINTS SHALL BE SET TO THE ELEVATION OF THE EXISTING GROUND.
5. ALL EXISTING MANHOLE POINTS SHALL BE 4" OF TYPICAL SEED & WEED.
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7. ALL SEWER CONSTRUCTION SHALL MEET CITY CONSTRUCTION SPECIFICATIONS.



STANDARD SANITARY MANHOLE DETAIL



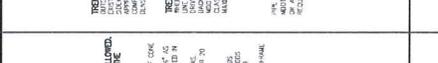
INTERNAL DROP MANHOLE CONNECTION



DRAINAGE STRUCTURE DETAIL



CATCH BASIN EDGEDRAIN DETAIL



STORM SEWER PIPE BEDDING



SANITARY SEWER TRENCH DETAIL



SANITARY SERVICE CONNECTION



CLEANOUT RISER IN PAVED AREA



DETAILS OF HOUSE LEAD CONNECTIONS TO SEWER MAIN - THESE PIPE OPENINGS ARE NOT PROVIDED TAP INTO SEWER PIPE

NO.	DATE	DESCRIPTION	BY
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CITY OF CARO
 ENGINEERING DESIGN STANDARDS
 SEWER DETAIL SHEET

SHEET # 1 of 1

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3. ALL STORM LEADS SHALL BE CONCRETE PIPE UNLESS APPROVED BY THE CITY. SIZES FOR 12" OR 15" SHALL BE A MINIMUM OF 2' OF GAGE.
4. CONCRETE MANHOLE STRUCTURES SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF ADOPTED M-36. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS.

SANITARY SEWER MATERIALS

1. PVC SCHEDULE 40 OR 20 SHALL BE USED FOR SEWERS.
2. 8" LEADS SHALL BE ON SCHEDULE 40. THE SEWER LEAD MATERIAL SHALL BE COMPATIBLE WITH THE SEWER MAIN MATERIAL.
3. PIPE JOINTING SHALL BE CAST INTO THE PRECAST SECTION OR CASTED INTO FINISHED WALL MANHOLE PRECAST CONNECTIONS SHALL BE FINISHED WITH AN INHERENTLY CAST SEAL SYSTEM, NON-W-SEA OR EQUAL.

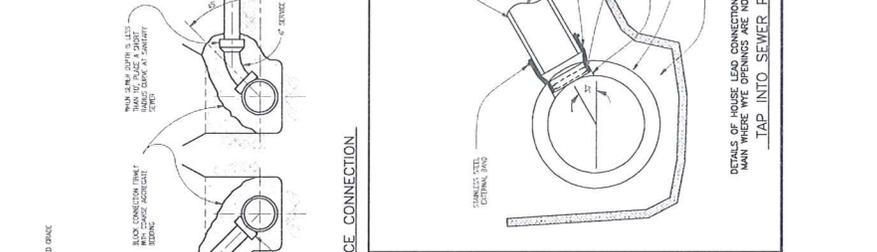
SANITARY SEWER PIPE JOINTING

1. THE PROCEDURE FOR AIR TESTING OF SEWERS SHALL BE AS FOLLOWS:
2. THE SEWER SHALL BE TESTED IN SECTIONS BETWEEN MANHOLES. THE LEAD SHALL BE CLEANED AND FLUSHED AT EACH MANHOLE. SEWER PIPES SHALL BE TESTED TO A PRESSURE OF 2.0 PSI ABOVE THE TEST PRESSURE AND A PRESSURE GAUGE FOR CONTINUOUSLY MEASURING THE AIR PRESSURE IN THE SEWER. THE PRESSURE GAUGE SHALL HAVE A MINIMUM DIAPHRAGM OF 3-1/2" INCHES AND A RANGE OF 0-10 PSI. THE GAUGE SHALL HAVE MINIMUM THICKNESS OF 1/16" INCH AND AN OPENING OF 1/8" INCH.
3. AFTER THE SEWER HAS BEEN TESTED TO THE TEST PRESSURE, THE PRESSURE SHALL BE MAINTAINED FOR A PERIOD OF 15 MINUTES. THE PRESSURE SHALL BE MAINTAINED FOR A PERIOD OF 15 MINUTES.
4. AFTER THE SEWER HAS BEEN TESTED TO THE TEST PRESSURE, THE PRESSURE SHALL BE MAINTAINED FOR A PERIOD OF 15 MINUTES. THE PRESSURE SHALL BE MAINTAINED FOR A PERIOD OF 15 MINUTES.
5. THE TIME REQUIRED FOR THE AIR PRESSURE TO DECREASE TO 1.0 PSI DURING THE TEST SHALL NOT BE LESS THAN THE TIME SHOWN IN THE FOLLOWING TABLE.

PIPE DIAMETER (INCHES)	MINUTES
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
14	7.5
18	10.0

GENERAL SEWER NOTES

1. THE CONSTRUCTION SHALL BE TO THE CITY (VERTICAL) (45) HOURS PRIOR TO CONSTRUCTION.
2. ALL STRUCTURE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF ADOPTED M-36. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS.
3. A MANHOLE POINT SHALL BE REQUIRED FOR ALL SANITARY SEWER CONSTRUCTION.
4. UNLESS OTHERWISE NOTED ON THE PLANS, ALL MANHOLE POINTS SHALL BE SET TO THE ELEVATION OF THE EXISTING GROUND.
5. ALL EXISTING MANHOLE POINTS SHALL BE 4" OF TYPICAL SEED & WEED.
6. ALL STRUCTURE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF ADOPTED M-36. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS. THE DEVELOPER SHALL FURNISH THE CITY WITH REINFORCED CONCRETE PIPE AND FITTINGS.
7. ALL SEWER CONSTRUCTION SHALL MEET CITY CONSTRUCTION SPECIFICATIONS.



STANDARD SANITARY MANHOLE DETAIL



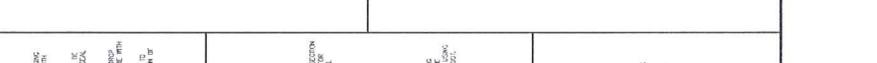
INTERNAL DROP MANHOLE CONNECTION



DRAINAGE STRUCTURE DETAIL



CATCH BASIN EDGEDRAIN DETAIL



STORM SEWER PIPE BEDDING



SANITARY SEWER TRENCH DETAIL



SANITARY SERVICE CONNECTION



CLEANOUT RISER IN PAVED AREA



DETAILS OF HOUSE LEAD CONNECTIONS TO SEWER MAIN - THESE PIPE OPENINGS ARE NOT PROVIDED TAP INTO SEWER PIPE

SECTION 4 – STORM DRAINAGE SYSTEMS

CITY OF CARO

ENGINEERING DESIGN STANDARDS

A. Plans and Specifications - Submittal Procedure

1. The plans and specifications shall be submitted in accordance with Section 1- General Requirements & Submittals.

B. Plans and Specifications - Design Considerations: General

1. Storm sewer systems for roadways and individual parcels less than thirty (30) acres (not including off site drainage areas) shall be designed for a ten (10) year storm by means of the rational method formula: $Q=CIA$; where Q is the peak rate of runoff in cubic feet per second, A is the area in acres, C is the co-efficient of runoff for the drainage area and I is the average rainfall intensity in inches per hour for a certain time of concentration. The rainfall intensity shall be determined by the formula: $I=175/(T+25)$; where T is the time of concentration equal to the time required for a drop of water to run from the remote point of the watershed to the point for which runoff is being estimated. In most instances, an initial T equal to twenty (20) minutes for residential areas can be used. Use T equal to fifteen (15) minutes in other land use areas.

Larger drainage areas shall be designed by a method approved by the City.

The calculations submitted shall indicate the following information for each pipe: Drainage District Number, Structure Number of Receiving and Collecting Structures, Area, "C" Factor, Intensity, "Q", Length, Size and Slope of Pipe Run, Velocity, Pipe Capacity, Rim Elevation and Elevation of the Hydraulic Gradient.

2. The Developer's Engineer shall use judgment in arriving at proper imperviousness factors, but in general, the following "C" factors are acceptable minimums. The applicant shall submit calculations to justify the "C" factors used.
 - A. Lawn areas – 0.2
 - B. Pavement and roof areas – 0.9
 - C. Overall area of single-family subdivision – 0.35
 - D Overall area of multiple housing development – 0.55
 - E. Overall area of commercial development – 0.80
 - F. Overall area of industrial development – 0.80

3. The plans shall include a hydraulic design calculation for each run of pipe and open channel. Flow velocities shall be calculated using Manning's equation:

$$Q=VA=\frac{1.49(A)(rH)^{2/3}\sqrt{S}}{N}$$

The following "N" factors shall be used as follows:

Concrete Pipe	=	0.013
PVC Pipe	=	0.010
Corrugated Pipe	=	0.021

4. The 10-year storm hydraulic gradient for non-submerged drain systems shall be maintained below the top of the sewer pipe.
5. A drainage area map showing all sub-watershed areas, runoff coefficients, acreage of each area and proposed drainage system in plan view, shall be included with the plans.
6. All off-site drainage flowing onto the site shall be included in the drainage area map and such flows provided for in the design calculations.
7. Storm water detention or retention is required for all developments in the City. (See Section 5 – Storm Water Basins for applicable information)

C. Plan and Profile - General

1. All storm sewers shall be shown in Plan and Profile, with the profile generally shown below the plan view. All structures and end sections shall be sequentially labeled in both plan and profile views.
2. Scale of plan portion of sheet shall be no smaller than 1 inch = 50 feet, with scale of profile portion of sheet, 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical.
3. All elevations shall be on U.S.G.S. datum.

D. Plan View

1. Plan portion of sheet shall include, at a minimum:
 - a. Existing topography and all existing and planned surface and underground improvements in streets and easements in which sewer construction is proposed, and in contiguous areas if pertinent to design and construction.
 - b. Location and direction of flow of each section of proposed sewer between manholes.
 - c. Locations of all manholes and other sewer appurtenances and special structures, with proposed rim elevations for all inlets and catch basins.
 - d. Elevations shall be on U.S.G.S. Datum. There shall be a minimum of two (2) benchmarks and one (1) benchmark at least every 1,200 feet.

E. Profile View

1. Profile portion of sheet shall appear below companion plan portion, generally projected vertically and, as a minimum, show the following:
 - a. Size, slope, length, type and class of pipe, and controlling invert elevations for each section of proposed sewer between manholes.
 - b. Limits of special backfill requirements.
 - c. Profile (over centerline of proposed sewer) of existing and proposed finished ground and pavement surfaces.
 - d. If the hydraulic grade is provided in the previously mentioned calculations, then it does not have to be shown on the profile.
 - e. Location of existing and proposed utilities crossing the line of the sewer or otherwise affecting sewer construction.
 - f. Location, by station, of every proposed manhole with manhole number, invert elevation of all inlet and outlet pipes, and top of casting elevation.
2. Manholes shall be identified by numbers assigned consecutively and increasing in magnitude in the direction opposite to the direction of flow.
3. All catch basin and inlet leads shall have a minimum slope of one percent (1%).

F. Location of Sewers

1. Storm sewers shall generally be located on the same sides of streets as water mains, and generally within the street right of way.
2. For subdivisions, storm sewers shall be located in the public road right of way or in easements adjacent to the public road right of way. Storm sewers shall not be located in rear yards, except to pick up rear yard drainage or in unusual circumstances, or for sump pump discharge lines.
3. The horizontal alignment of sewers, which are not proposed to generally follow street, drive or parking area pavements, shall parallel property lines or building lines with clearance distances sufficient to accommodate the full width of any proposed easement.
4. Where possible, provide a minimum of three and one-half (3 ½) feet of cover from the top of finish road or earth grade to the horizontal centerline of any storm sewer.
5. In parking areas, catch basins should be located in the gutter or parking stall areas. Catch basins in the driving areas should be avoided when possible.

G. Catch Basin and Inlet Locations

Catch basins and inlets shall be located, in general:

1. So that the flows to be accommodated do not exceed the intake capacity of the structure casting.
2. At all low points in gutters and in swales and ditches, where applicable.
3. At the upstream curb return, if more than two hundred (200) feet downstream of a high point in the gutter, or as required to prevent water from crossing an intersection.

4. Catch basins shall be spaced no more than three hundred and fifty (350) feet from the crest of the road. Subsequent catch basins shall be spaced a maximum of four hundred (400) feet apart.
5. Yard type catch basins shall be provided at all low points in drainage swales. Provide intercepting yard type catch basins such that not more than four hundred (400) feet of swale drainage runs into any one (1) catch basin, other than a low point catch basin where six hundred (600) feet of drainage is allowed.

H. Manholes

1. Manholes shall be located at:
 - a. All changes in alignment.
 - b. Points where the size of the sewer changes.
 - c. Points where the grade of the sewer changes.
 - d. The junction of sewer lines.
 - e. Street intersections or other points where catch basins or inlets are to be connected.
2. Manhole spacing for storm sewers shall be as follows:

Diameter of Sewer	Maximum Manhole Spacing
12" to 42"	400 feet
48" to 60"	500 feet
66" and larger	600 feet

3. Where future connections to a manhole are anticipated, stubs with watertight bulkheads shall be provided.

I. Covers for Manholes, Catch Basins and Inlets:

Cover		Minimum	E.J.I.W.* No.
<u>Designation</u>	<u>Description</u>	<u>Weight (lb)</u>	<u>or Equal</u>
B	Solid Cover	375	1120
B-M1	Flat Grate (Round)	375	1120M1
C	Low Curb Inlet	500	7066
D	Flat Grate (Square)	455	5105
G	Low Beehive Inlet	300	6517
E	High Beehive Inlet	200	6508
K	High Curb Inlet	500	7045

*East Jordan Iron Works

J. Hydraulics

1. Minimum pipe size for sewers, catch basin leads and inlet leads shall be twelve (12) inch nominal internal diameter.
2. Minimum design velocity shall be two (2) feet per second and maximum design velocity shall be ten (10) feet per second, with pipe flowing full.
3. Design life of enclosed storm sewers and bridges shall be fifty (50) years or more, except for driveway culverts in open ditch areas, which shall have a design life of twenty (20) years or more.

K. Open Drains

1. Where proposed, open drains shall be designed to convey the upstream design flow. A one (1) foot freeboard shall be provided.
2. Side slopes of open drains shall have a maximum slope of one (1) foot vertical to six (6) feet horizontal, except that a low flow channel (roadside ditches, rear yard swales, etc.) may have side slopes of one (1) foot vertical to three (3) feet horizontal. Open drain side slopes shall have an established sod surfacing or be seeded, fertilized and mulched as soon as possible after construction.
3. Open drains must have slope protection (i.e. riprap, gabion baskets, etc.) at bends, under bridges and at other critical points required by the City.
4. The City will not accept the work until all turf is established.
5. Hydraulic calculations for open channel flow shall be provided to assure the channel has adequate conveyance. Velocities shall be kept to a minimum, less than four (4) cfs, to prevent scour.

L. End Section and Bar Screens

1. An end section with prefabricated bar screen shall be installed on the end of all storm sewers fifteen (15) inches in diameter and larger. Openings of the bar screen shall be no more than six (6) inches on centers and shall be designed to be sturdy, permanent, easily maintained, and non-clogging.

SECTION 5 – STORM WATER BASINS
CITY OF CARO
ENGINEERING DESIGN STANDARDS

A. Plans and Specifications - Submittal Procedure

1. All plans, specifications and calculations for detention basins and storm water storage shall be submitted, in accordance with Section 1 - General Requirements & Submittals.
2. Detention or Retention Basin plans are required to be submitted along with all new storm drainage system plans.

B. Design Criteria:

1. Detention basins shall be designed to detain the volume of runoff from the entire site, resulting from a twenty-five (25) year frequency storm. Detention is not required for flows originating offsite that flow through the site, unless the receiving storm facilities cannot handle the offsite flow
2. Detention basins shall drain by gravity. Pumped basins shall be considered, in extreme cases, and approved by the City.
3. Detention basins shall discharge to a natural watercourse, established drainage system, or drainage area where a dedicated easement exists for the purpose of drainage. In no case shall a basin or system discharge onto adjacent property without an easement or the property owner's permission.
4. In general, the Oakland County "A Simple Method of Detention Basin Design" method shall be used for detention. Basin sizing discharge of detention basins shall be limited to 0.4 cfs per acre of the site, but in no case shall exceed the capacity of the receiving stream or body of water. In the event that the receiving stream cannot properly convey the 0.4 cfs per acre design discharge, the discharge shall be limited to the existing capacity of the receiving system and must have the outlet pipe invert above the normal water level. Hydraulic calculations may be required by the City showing the existing capacity of the receiving stream for their review.
5. All basins must have a minimum of twelve (12) inches of freeboard above the design high water elevation.
6. All basins must be designed with an overflow to control flooding. The overflow shall discharge to an existing drainage system or storm drain. If a weir overflow is used, sufficient erosion protection must be incorporated into the design. Calculations for the overflow design must accompany the plans.
7. Where orifice restrictors are used, the diameter of the restrictor shall be a minimum of four (4) inches to prevent clogging. Outlet shall be a pipe rounded to nearest full pipe size.

8. Erosion control protection such as riprap, placed on filter fabric, shall be used at all entrances and exists to the basin. Riprap may be natural stone or clean broken concrete, a minimum of four (4) inches in diameter.
9. Exterior side slopes of basins shall not be steeper than four (4) horizontal to one (1) vertical or 4:1. Interior side slopes shall not exceed six (6) horizontal to one (1) vertical or 6:1, unless approved by the City. All basins must be fenced, if the maximum side slopes specified herein are exceeded. The City may waive fencing when the design is an integral part of the landscaping and the variance from these Design Standards does not present a potential hazard. Fences shall be a minimum of six (6) feet high, vinyl clad chain link, with a locking access gate, eight (8) feet wide. Alternate types of fencing may be permitted for aesthetic purposes, subject to approval by the City.
10. The bottom of the basin shall have a minimum grade of one percent (1.0%) from the perimeter toward the flow line. The slope of the flow line to the outlet shall have a minimum grade of one-half percent (0.5%). All inlet and outlet pipes twelve (12) inches in diameter and larger shall have a bar screen, a flared end section and riprap.
11. The entire detention basin area must be seeded (MDOT Class A seed) or sodded (MDOT Class B sod) and the turf shall be fully established before the City approves the detention basin for operation and maintenance. Straw mats or mulch blankets may be required for steeper banks or when storm water enters basin via sheet flow.
12. Retention basins (basins with no outlet) must be sized to accommodate two (2) consecutive one hundred (100) year storms (as calculated by the Oakland County method for retention). Documentation by a licensed Professional Engineer must be submitted to support that the basin will percolate into the soils naturally, with an estimate of the time to accomplish this, based on hydraulic calculations. The City will determine the acceptance of the design.
13. Parking lot storage is not allowed, unless there is no other feasible alternative. Maximum depth of storage is six (6) inches. No storage is allowed near the entry and exit ways of the building or designated handicapped parking spaces.
14. In commercial areas, such as gas stations, where the entire site is paved and the site area is extremely limited, detention may be accomplished via underground storage tanks or oversized storm pipes. Large diameter HDPE piping with a minimum of six (6) inches of stone above pipe are acceptable to the City. The maximum void space within backfill stone allowed to be included in the storage volume and below the top of the storage pipe shall be forty percent (40%). The system shall have provisions for cleaning.
15. Minimum isolation (setback from property lines) of all basins shall be no less than twenty (20) feet.

C. Maintenance Agreement

1. An agreement for operation and/or maintenance of the detention basin system must be executed by the developer and submitted to and accepted by the City. The agreement, both as to form and content, shall be subject to the approval of the City's legal counsel.

D. Easements and Access

1. For all new residential development, the property in which the detention basin is located upon must be contained in an easement deeded for detention purposes only.
2. A minimum twenty (20) foot wide access easement shall be provided.
3. At a minimum, a twelve (12) foot wide gravel access drive shall be located within the above easement for maintenance purposes.

SECTION 6 - GRADING
CITY OF CARO
ENGINEERING DESIGN STANDARDS

A. Requirements for Master Grading Plans

A Master Grading Plan is required for all developments. Master Grading Plans shall accompany the set of engineering construction plans and shall include the following:

1. Benchmark locations, descriptions and elevations (USGS) to be used for the development.
2. The minimum scale for grading plans is one inch equals fifty feet (1" = 50').
3. The grades of existing adjacent houses, buildings, drainage structures and streets shall be shown. One (1) foot existing contours shall be shown for the site and one hundred (100) feet past the property line(s). The drainage pattern of all adjacent land shall be indicated. All off site drainage flowing onto the site shall be clearly labeled and identified.
4. Match existing grade at the property boundaries.
5. Grading plans shall correspond with proposed landscape and soil erosion requirements. Any revisions in the grading plan may require Planning Department approval if it directly or indirectly effects the approved landscape.
6. The grading plan shall be designed to ensure that if a failure occurs in the storm system, water will drain without flooding structures.
7. Show proposed building finish floor grade to hundredths of a foot. For residential developments, place house grades within the plan view of the typical house to be built in this development.
8. The finish grade shall be compatible with the grades of surrounding buildings and yards.
9. For non-residential developments show the proposed sidewalk grades at lot lines, center of driveway crossings and at fifty (50) foot intervals to hundredths of a foot.
10. Rear yard storm drainage is required in all residential developments where necessary to prevent storm drainage from running onto adjacent properties.
11. All existing and proposed earth grades are to be in tenths of a foot.
12. Rear yard swales shall be, in general, no longer than four hundred (400) feet before being intercepted by a catch basin and shall have a minimum grade of 0.5%.
13. Rear yard storm drain piping shall be twelve (12) inches minimum diameter.
14. Show existing and proposed ground grades at lot corners around the perimeter boundaries.
15. Show the proposed side yard swale elevation between all buildings. This elevation must be a minimum of 0.5 feet below the lower adjacent building grade. The side yard swale must have a minimum slope of 0.5% to the front and rear.

16. Where topography prevents rear yard drainage from being practical, rear to front or rear to side drainage may be allowed.
17. The general direction of flow of all yard drainage and all swales must be indicated with arrows.
18. Additional grades shall be shown under special conditions as required.
19. The lot number or address shall be shown for each lot.
20. Any required storm sewer easements shall be a minimum of twenty (20) feet wide. All drainage easements for swales shall be a minimum of ten (10) feet wide. Easements for drainage ditches shall include the ditch plus a minimum of ten (10) feet beyond the top of banks. The City shall require additional easement width when sewer size or depth and soils or other conditions warrant a wider easement. Easements are required for all public storm drains and private drains serving more than one (1) parcel.
21. Drainage shall be adequately discharged off site to either the street or a dedicated storm drain. Drainage from adjacent properties or "offsite drainage" that flows onto project on site, shall be maintained.
22. Sodded swale or ditch slopes shall be a maximum slope of one (1) foot vertically and three (3) feet horizontally.
23. No berms shall be placed over any underground public water main, sanitary sewer, storm drain, or within the designated easements for such facilities.
24. Drainage water runoff from building roofs shall be piped to a point five (5) feet away from the outside walls of any building. No drainage water runoff shall be allowed on adjacent property. Drainage water, sump pump water and/or ground water shall not be discharged to the sanitary sewer system.
25. It shall be unlawful for any person to interfere with, modify or obstruct the flow of drainage water across any property in any manner different from the approved plan.
26. During periods of the year when weather conditions make site grading work impractical, a temporary Certificate of Occupancy may be issued, subject to the furnishing of a satisfactory Bond, Letter of Credit, or Cash Deposit in an amount determined by the City guaranteeing the completion of the work when weather conditions permit.

B. Retaining Walls

1. Retaining walls should be used when adequate grading cannot be accomplished.
2. Retaining walls exceeding forty-two (42) inches in height should include protective fencing on top or as required by State and County codes.
3. Retaining walls exceeding thirty-six (36) inches in height shall be designed by a licensed Professional Engineer. Design calculations shall be submitted with the construction plans.

SECTION 7 - PAVING
CITY OF CARO
ENGINEERING DESIGN STANDARDS

A. Plans & Specifications - Submittal Procedure

1. The plans and specifications shall be prepared in accordance with “Section 1 - General Requirements & Submittals.”

B. Plans & Specifications – General Content

1. All plans are to clearly identify public/private dedication.
2. Provide continuous stationing.
3. Centerline curve data (radius, deflection angle, degree of curvature and total arc length) for all roads shall be indicated on the plans. All horizontal curves shall be consecutively numbered and indicated in the plan view.
4. Finish grade of all structures shall be indicated in the plan view.
5. Show a detail of all intersections and cul-de-sacs. The detail shall show layout and detailed grades. Maximum scale of the detail shall be one inch equals thirty feet (1”=30’).
6. A profile view shall be provided for all roads (pubic and private) and shall include the following:
 - a. Elevations at top of curb or at centerline, if not curbed.
 - b. Existing ground elevations at the center of the right of way and at other locations, as required for review. Elevations shall be based on USGS Datum.
 - c. Station and elevations of all high points, low points, grade breaks, curb returns and necessary information at vertical curves.
 - d. Top of curb (or centerline) elevations at each station. Grade in vertical curves must be indicated at twenty-five (25) foot intervals.

C. Requirements for Paving

1. Private roads are to be designed to Public Road Standards.

2. Street paving width shall conform to the following requirements:

Type	Minimum B/C to B/C Width (feet)	Minimum Lane Width (feet) **See Note 2	Minimum ROW Widths (feet) *See Note 1
Major Streets	28	12	70
Local Streets	26	11	66
Boulevards (per lane)	17	13	N/A
Access Drives	24 (no curb)	12	N/A
Cul-de-sacs (residential)	52 (radius)	30	75
Cul-de-sacs (industrial)	62 (radius)	40	80

* Note 1 – Right of way (ROW) width shall be adjusted as required to maintain a minimum of eighteen (18) feet from back of curb (B/C) to right of way line.

**Note 2 – For streets with parallel parking an additional six (6) foot per side shall be added.

3. The intersection of roads shall be as close to ninety degrees (90°) as possible with a variation of no more than ten degrees (10°).
4. When boulevard sections are used at the entrance, the minimum pavement widths shall be twenty-eight (28) feet (B/C to B/C), and the minimum island width shall be ten (10) feet. The edge of metal of the median shall be offset at least twelve (12) feet from the edge of lane of the intersecting street.
5. All islands and medians shall be curbed in the same manner and in accordance with the same detail for curb and gutter used elsewhere. Hour glass and other odd shaped medians are not acceptable. Material placed between the curbs shall be seeded earth, crushed limestone or other materials approved by the City.
6. Cul-de-sacs shall be avoided, unless space restraints require such usage and street shall not exceed seven hundred and fifty (750) feet in length. A reduced pavement section may be submitted for review for a temporary cul-de-sac. “T” and “L” type turnarounds shall not be permitted.
7. Soil borings, five (5) feet below existing grade (minimum), shall be taken by an independent testing laboratory or qualified professional at intervals not to exceed five hundred (500) feet. Additional borings may be required where the USDA Soil Survey or onsite inspection indicates unstable soil may be present.
8. The applicant shall remove all unsuitable soil including muck, peat and marl, as well as brush, trees, tree stumps and similar materials from the full width of the roadway. These areas shall then be backfilled with MDOT Class II Granular Material to provide a stable subgrade for the roadway construction.

9. Street cross-sections shall include curb and gutter and shall meet or exceed the minimum pavement thicknesses shown in the figures. Subsurface soil conditions shall govern exact thickness. Pavement cross-sections may have either an aggregate base or full depth asphalt. No concrete cross-sections will be allowed. All cross-sections shall be subject to the approval by the City. Phased development shall use the same cross-section throughout the entire project.
10. Minimum curb and gutter radii at intersections shall be as follows, unless otherwise approved by the City:

	Minimum Radius (Back of Curb)
Major Streets	40 feet
Local Streets	30 feet
Industrial Streets	50 feet

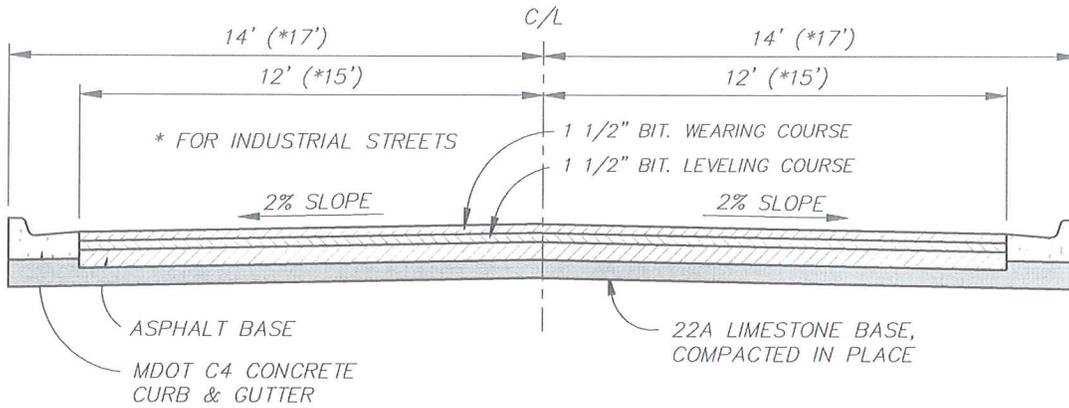
Entrances (residential, commercial or industrial) shall be designed to accommodate the larger vehicles anticipated to use the site and stay within their lane.

11. Maximum allowable pavement grade shall be six percent (6%) and the minimum allowable(s) shall be as follows:

Concrete gutter grades	= 0.40%
Concrete gutter return at intersections	= 1.00%
Pavement surface grade to gutter line	= 1.00%
Typical cross-slope	= 2.00%

12. At the intersection of two (2) roadways, the maximum grade shall be three percent (3%) for a distance of one hundred (100) feet from the point of intersection.
13. All streets shall be designed for a minimum design speed of thirty (30) mph (posted speed 25 mph). Design criteria (AASHTO and Design Speed) shall be noted on the plans.
14. The minimum sight distance for all roads shall be three hundred (300) feet for streets with design speeds of thirty (30) mph. Higher design speeds shall be designed according to AASHTO (latest edition).
15. Whenever a change in the vertical centerline grade of one percent (1%) or more occurs, provide a vertical curve. The minimum length of vertical curve shall be one hundred (100) feet and shall be rounded to the nearest fifty (50) feet thereafter. For a thirty (30) mph design speed, the minimum crest "K" value shall be thirty (30) and the minimum sag "K" value shall be forty (40). Higher design speeds shall be designed according to AASHTO (latest edition).
16. Left turn lanes and bypass lanes should be considered on streets where traffic volumes are high enough or safety considerations are sufficient to warrant them. Such usage shall be determined on a case by case basis at the City's discretion.

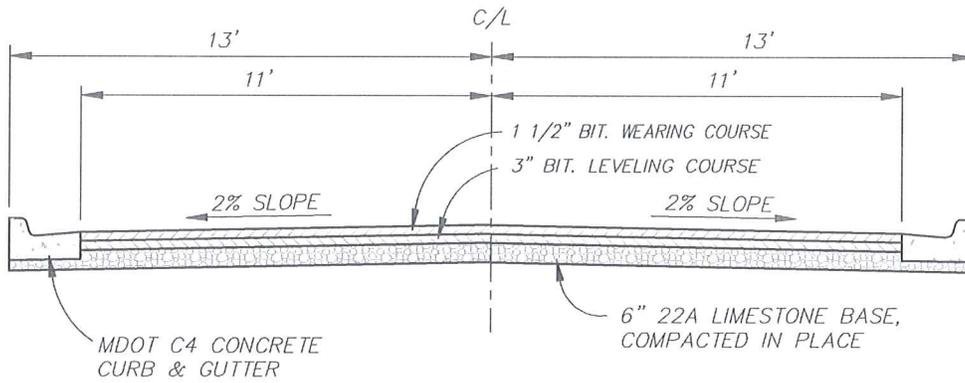
17. All curbing shall be concrete meeting the details provided in the figures unless otherwise approved by the City. The curb detail shall be approved by the City prior to placing.
18. All curbing shall drain to catch basins in the curb. Catch basins shall be spaced as specified in the Storm Drainage System Section.
19. Edgedrain shall be used at the low points in the road. Edgedrain shall be placed for a minimum distance of twenty-five (25) feet in both directions from the catch basin. Additional or continuous edgedrain may be required, as directed. Edgedrain shall be a minimum of four (4) inch diameter pipe wrapped with a geotextile fabric and backfilled with a granular material or clean crushed stone. Edgedrain shall be connected to catch basin.
20. Streetlights: The City may require street lighting at street intersections or other locations to serve purposes of safety and/or security. When required, the intensity and type of illumination, location and types of poles, bases, etc., shall be coordinated with the existing and future street lighting within the area.
21. The Owner/Developer shall provide and properly maintain, until accepted by the City, all traffic and pavement markings which the City may determine necessary for the proper operation of the roadway/driveway/curb cut. Only those traffic signs and pavement markings specified by the City (or jurisdictional authority) may be used within the road right of way. All signs and pavement markings shall conform to the current Michigan Manual of Uniform Traffic Control Devices (MMUTCD). The Developer will be responsible for constructing all required signs and pavement markings.



NOTE: MAJOR STREETS DESIGN SHALL BE AS APPROVED BY THE VILLAGE

MAJOR STREETS

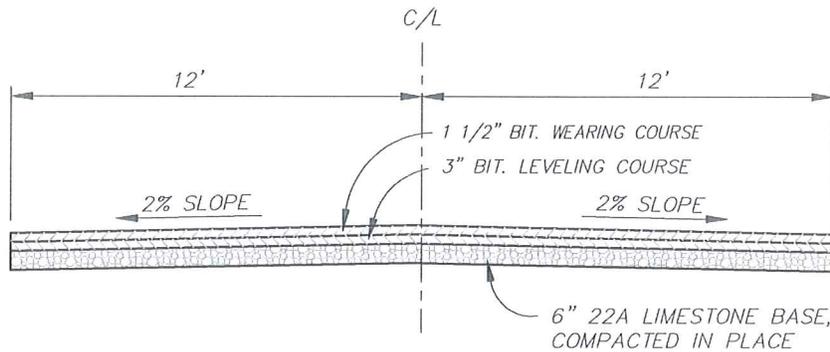
NOT TO SCALE



NOTE:
FULL DEPTH ASPHALT PAVEMENT MAY
BE SUBSTITUTED FOR THE LOCAL
STREET CROSS SECTION

LOCAL STREETS

NOT TO SCALE



ACCESS DRIVES

NOT TO SCALE

DATE: FEB 2015

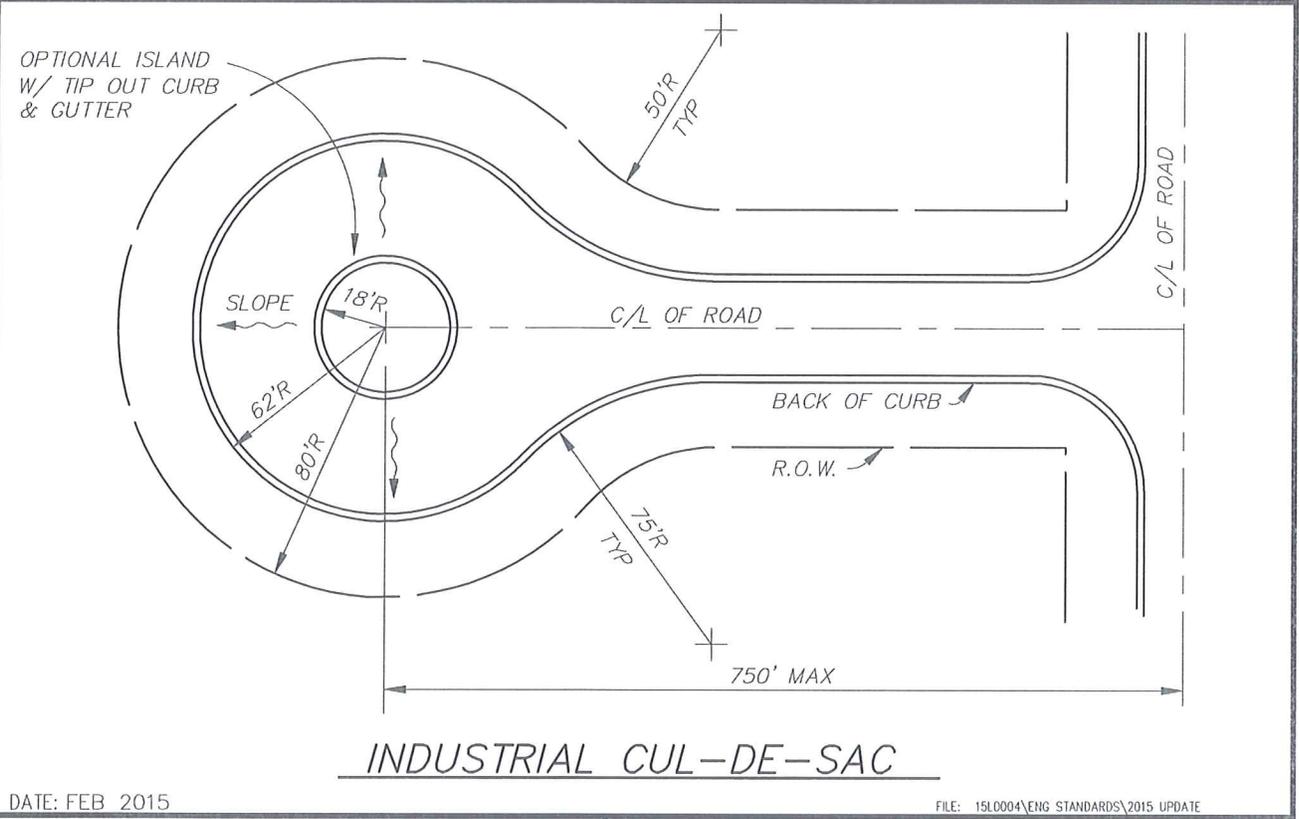
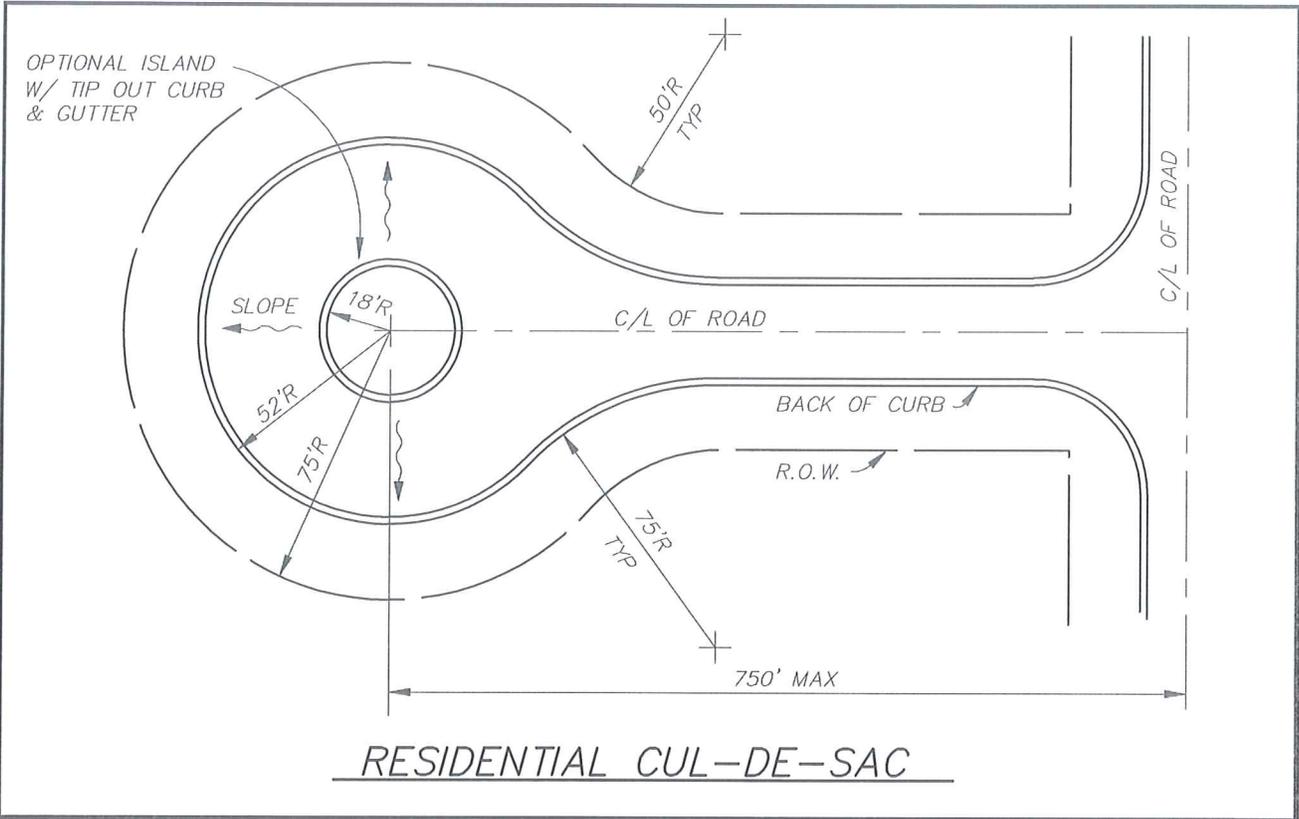
FILE: 15L0004\ENG STANDARDS\2015 UPDATE



**ROWE PROFESSIONAL
SERVICES COMPANY**

128 N. Saginaw St. Lapeer, MI (810)-664-9411

CITY OF CARO
SECTION 7 - FIGURE 1



DATE: FEB 2015

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CITY OF CARO
SECTION 7 - FIGURE 2

SECTION 8 – PARKING LOTS
CITY OF CARO
ENGINEERING DESIGN STANDARDS

A. Plans and Specifications – Submittal Procedure

1. Plans and specifications for Parking Lots shall be submitted as part of a site development package in accordance with “Section 1 - General Requirements & Submittals”.

B. Plans and Specifications – Design Criteria

1. Parking lots shall be grouped as follows:
 - a. Class “A” – Light duty driveways, school yards, playgrounds and small parking lots with less than forty (40) stalls. This cross-section is not suitable for heavy refuse truck pick-ups or delivery services. In areas where these services are used, the commercial/industrial cross-section should be used for routing to and from the service area.
 - b. Class “B” – Parking lots containing more than forty (40) stalls, medium to heavy truck traffic, some commercial lots.
 - c. Class “C” – Industrial lots, heavy truck uses, some commercial lots, bus routes.

Note: Cross-section for the above can be found in the provided figures at the end of this section.

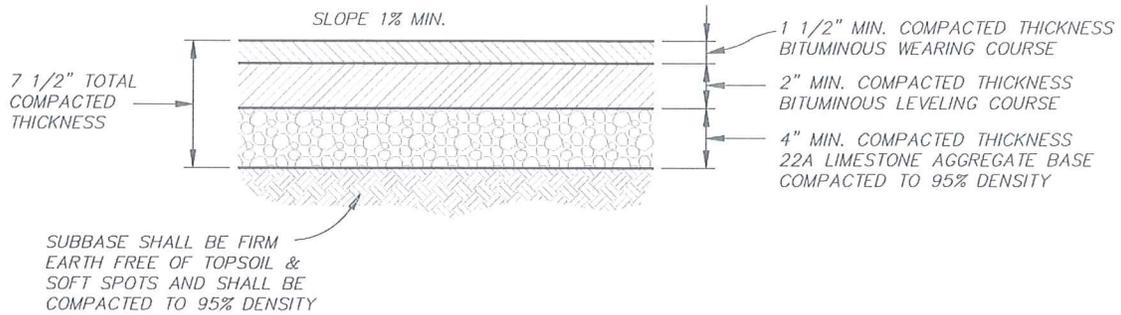
2. Alternate cross-sections designed by a qualified, licensed Professional Engineer and accompanied by supporting data will be considered.
3. Service drives shall utilize the Class “B” cross-section. Class “C” or design alternatives should be considered where extremely high volumes of truck traffic will be encountered.
4. Concrete curb shall be placed on drive entrances for the paved parking area. Concrete curbing shall be required in all locations where pavement meets landscaping areas or sidewalk. Concrete curb shall be MDOT C-4, unless approved otherwise. Bituminous curbing will not be permitted. Thickened edge sidewalks are acceptable when the pavement is sloped away from the sidewalk.
5. When sidewalks are provided adjacent to the parking area curbs where car overhangs occur, such walks shall be a minimum width of seven (7) feet, as measured from the face of the curb.
6. Parking bays shall be sixty-four (64) foot wide (20 foot stall plus 24 foot aisle plus 20 foot stall). However, for a single bay, a car overhang of two (2) feet can be assumed and the width between face of curbs may be reduced to sixty (60) feet. Moreover, on the curb side of a multiple bay parking area, the two (2) foot overhang may be assumed for the purposes of reducing the pavement width of the outside bay to sixty-two (62) feet. Where the parking area is adjacent to the project boundary line, the face of curb shall be located at least two (2) feet from such boundary line.

7. Individual parking spaces shall be marked by painted on yellow stripes a minimum of four (4) inches wide. The stripe shall extend from the front of the parking stall space to the end of the space. The distance center to center of stripes, as measured perpendicular to the stripes, shall be per zoning ordinance.
8. Barrier free parking spaces shall be striped in blue and signed meeting the latest ADA (Americans with Disabilities Act) requirements.

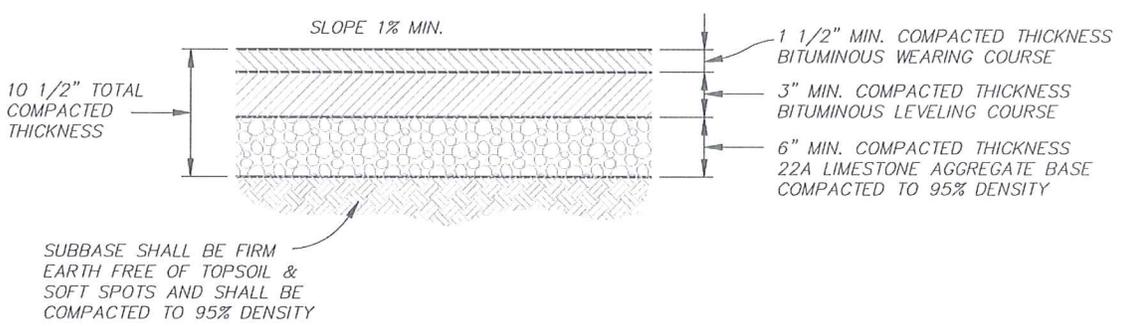
C. Parking Lot Lighting

1. All parking lots shall be illuminated. Lighting intensities shall average one (1) foot candle measured at the surface for parking areas. Service drives shall have a lower intensity averaging 0.5 foot candles. All outdoor lighting shall be shielded to reduce glare and be arranged to reflect light away from all residential districts, adjacent residences and public right of ways. At the property line, 0.1 foot candles shall be the maximum amount of light.
2. A photometric plan (lighting grid) is required to determine the appropriateness of the proposed lighting layout and intensity.
3. Light poles shall have a maximum height of twenty (25) feet, unless approved by the City.
4. All fixtures shall be LED unless otherwise approved by the City. Photocells or other approved equipment are required on all fixtures.
5. All wiring shall be UL listed for wet locations. No wiring shall be exposed.

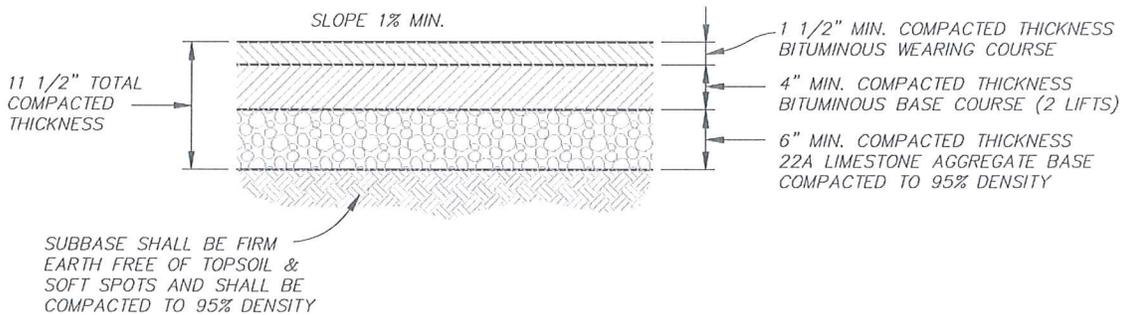
CLASS 'A'



CLASS 'B'



CLASS 'C'



DATE: FEB 2015

FILE: 15L0004\ENG STANDARDS\2015 UPDATE



**ROWE PROFESSIONAL
SERVICES COMPANY**

128 N. Saginaw St. Lapeer, MI (810)-664-9411

CITY OF CARO
SECTION 8 – FIGURE 1

SECTION 9 – DRIVEWAYS & SIDEWALKS

CITY OF CARO

ENGINEERING DESIGN STANDARDS

A. Plans and Specifications - Submittal Procedure

1. Plans and specifications shall be submitted as part of a site development package in accordance with “Section 1 - General Requirements & Submittals.”

B. Plans and Specifications - Design Criteria for Driveways

1. Residential – All residential driveways within the road right of way shall be concrete with a minimum thickness of six (6) inches. Residential driveways shall have a minimum width of ten (10) feet or match the existing drive. No residential driveway shall be wider than thirty (30) feet (measured at the edge of the street), unless approved in writing by the City.
2. Commercial – All commercial driveways within the road right of way shall be concrete with a minimum thickness of eight (8) inches and reinforced with w/ 6x12, w14/w6 paving mesh. Commercial drives shall be of a width approved by the City.
3. Industrial – Heavily traveled industrial drives shall be designed by a qualified Professional Engineer and approved by the City. Industrial drive widths shall be approved by the City.
4. Residential approaches shall have adequate flares to provide a safe turning radius. Minimum flaring shall be five (5) feet. Flaring length shall be a minimum of ten (10) feet. If a residential driveway is wider than twenty (20) feet, the flaring widths shall be adjusted to provide a maximum drive opening of thirty (30) feet.
5. Commercial and industrial approaches shall be MDOT Type “M” openings.
6. Driveways shall be sloped to direct drainage to the street.
7. No curb cut or driveway approach shall be made to a public street or right-of-way without first obtaining a permit from the City.
8. Curb cuts or approaches installed unlawfully or unused shall be removed by the property owner including replacing the street curb and gutter. If such is not replaced by the property owner in accordance with City specifications, the City will have the work done and the cost thereof shall be charged to the property owner.
9. For approaches constructed on an existing curbed street, the curb and gutter shall be entirely removed and replaced to construct a MDOT type “N” curb opening for residential drives or a MDOT Type “M” curb opening for commercial drive approaches. The extent of the removal shall extend to the nearest joint past the spring line of the new curb opening. No horizontal curb cutting will be allowed.
10. Driveway construction shall also conform to the Michigan Department of Transportation Standard Plan sheets series R-29, latest revision. The most recent version of which (at the time of this document) is attached and the end of this section.

C. Plans and Specifications – Design Criteria for Sidewalks

1. Sidewalks shall generally be located one (1) foot inside of the right of way line and parallel to such line and shall be required on both sides of a new street. For commercial site plans, continuous sidewalk shall be provided across the parcels frontage.
2. Sidewalks shall be five (5) feet wide with control joints one (1) inch deep at five (5) foot intervals.
3. Sidewalks shall generally conform to the grade of the existing topography. Sidewalk transverse slopes shall not exceed one-half (1/2) inch per foot. Transverse slopes less than one-quarter (1/4) inch per foot shall not be used unless longitudinal drainage is provided. Longitudinal grades shall not exceed one (1) inch per foot.
4. Sidewalks shall also meet latest ADA (Americans with Disabilities Act) requirements.
5. Sidewalks shall have smooth transitions and gentle curves. No sharp edges or abrupt changes in alignment are allowed. Sidewalks shall “jog” around natural features (i.e. trees, etc.)
6. Plans for sidewalks shall include existing contours at a minimum of two (2) foot intervals. Proposed grades along the centerline of the sidewalk shall be at fifty (50) foot intervals.
7. In general, sidewalks shall be at a higher elevation than the street and slope transversely toward the street at two percent (2%) minimum.
8. Where sidewalks meet driveways, they shall run continuously through the drives. The slope of the drives shall be designed to meet the sidewalk.
9. At street intersections, sidewalk ramps shall be used to meet the existing street grade. If existing curb is involved, the curb shall be removed and the sidewalk ramped to meet the pavement. No horizontal curb cutting will be allowed.
10. Integrated curb and sidewalk shall not be used, except for commercial site plans.
11. Sidewalks shall have the following thicknesses:

Thru commercial drives*	8” w/6x12, w14/w6 paving mesh
Thru residential drives*	6”
Sidewalk ramps	6”
All others	4”

*Plus one (1) flag each side of driveway

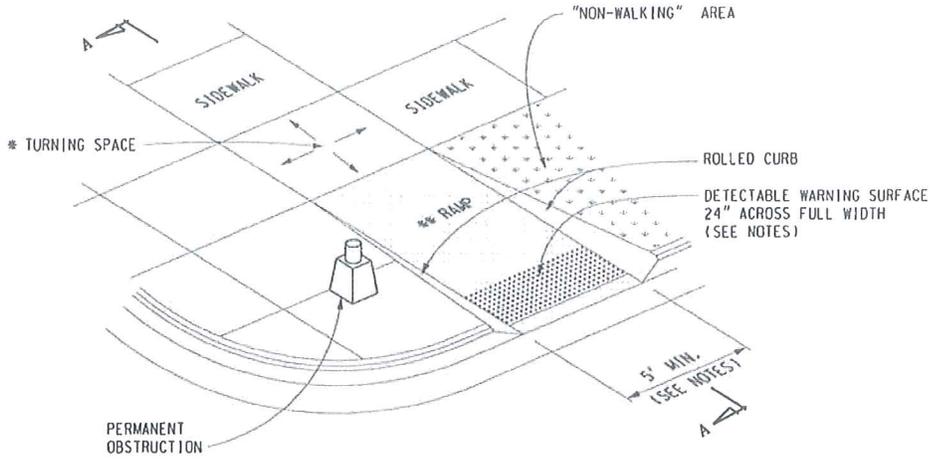
12. Sidewalk construction shall also conform to the Michigan Department of Transportation Standard Plan sheets series R-28 and R-29, latest revisions. The most recent versions of which (at the time of this document) are attached and the end of this section.

D. Materials

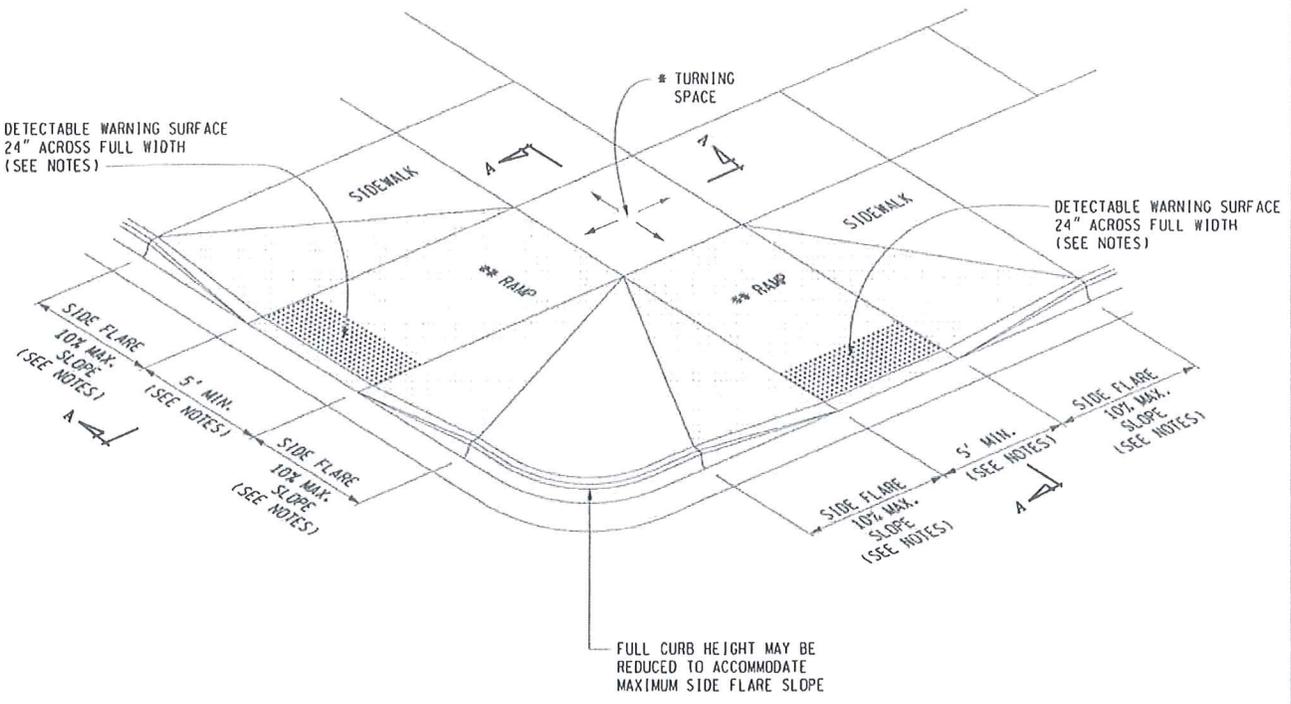
1. Sidewalks and driveways shall be air-entrained concrete with a minimum compressive strength of 3500 psi. Sidewalk shall be treated with one (1) coat of a curing compound membrane.
2. Sidewalk and driveway base shall be four (4) inches of Class II Sand, compacted to ninety-five percent (95%) maximum density.
3. Shoulders shall be graded gently away from the sidewalk and be either seeded and mulched, or sod.

* MAXIMUM TURNING SPACE SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



SIDEWALK RAMP TYPE R
(ROLLED SIDES)



SIDEWALK RAMP TYPE F
(FLARED SIDES, TWO RAMPS SHOWN)

MDOT
Michigan Department of Transportation

PREPARED BY
DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

APPROVED BY: *Randy Van Pelt*
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: *Paul A. Van Pelt*
DIRECTOR, BUREAU OF HIGHWAY DEVELOPMENT

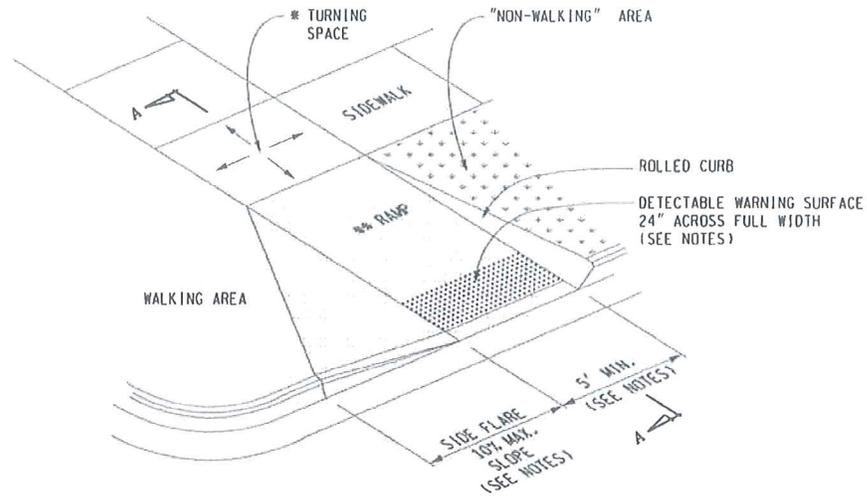
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

**SIDEWALK RAMP AND
DETECTABLE WARNING DETAILS**

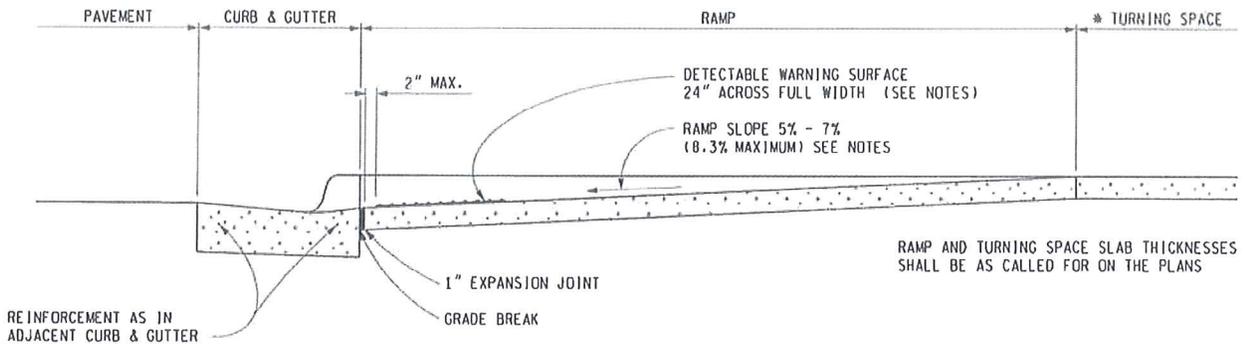
9-30-2014 F.H.W.A. APPROVAL	7-1-2014 PLAN DATE	R-28-I	SHEET 1 OF 7
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* MAXIMUM TURNING SPACE SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.

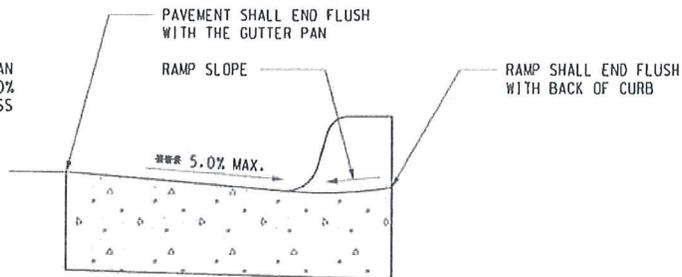


SIDEWALK RAMP TYPE RF
(ROLLED / FLARED SIDES)



SECTION A-A

*** TRANSITION ADJACENT GUTTER PAN CROSS SECTION TO PROVIDE 5.0% MAXIMUM COUNTER SLOPE ACROSS THE RAMP OPENING.



SECTION THROUGH CURB CUT
(TYPICAL ALL RAMP TYPES)

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

**SIDEWALK RAMP AND
DETECTABLE WARNING DETAILS**

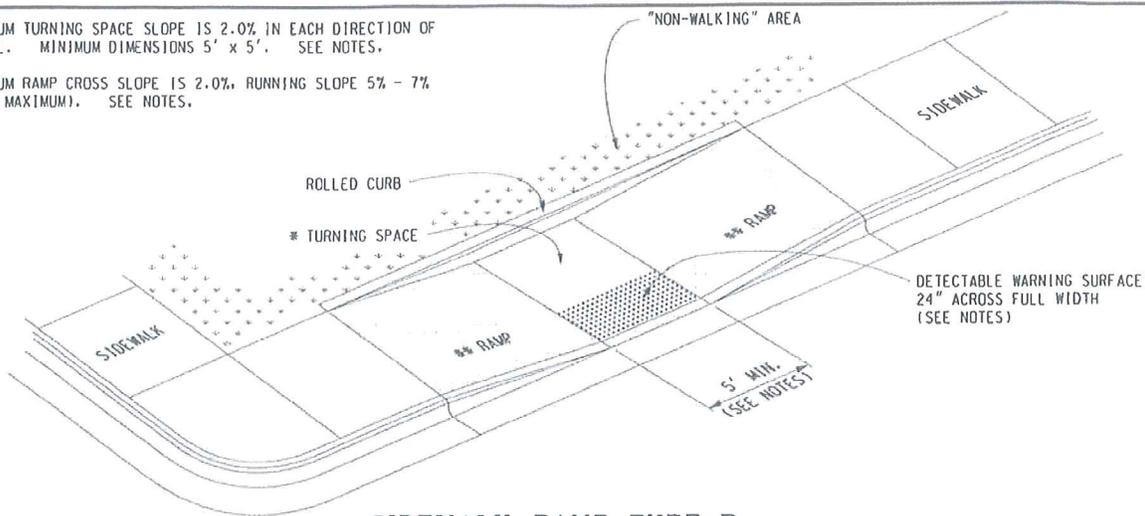
9-30-2014
F.H.W.A. APPROVAL

7-1-2014
PLAN DATE

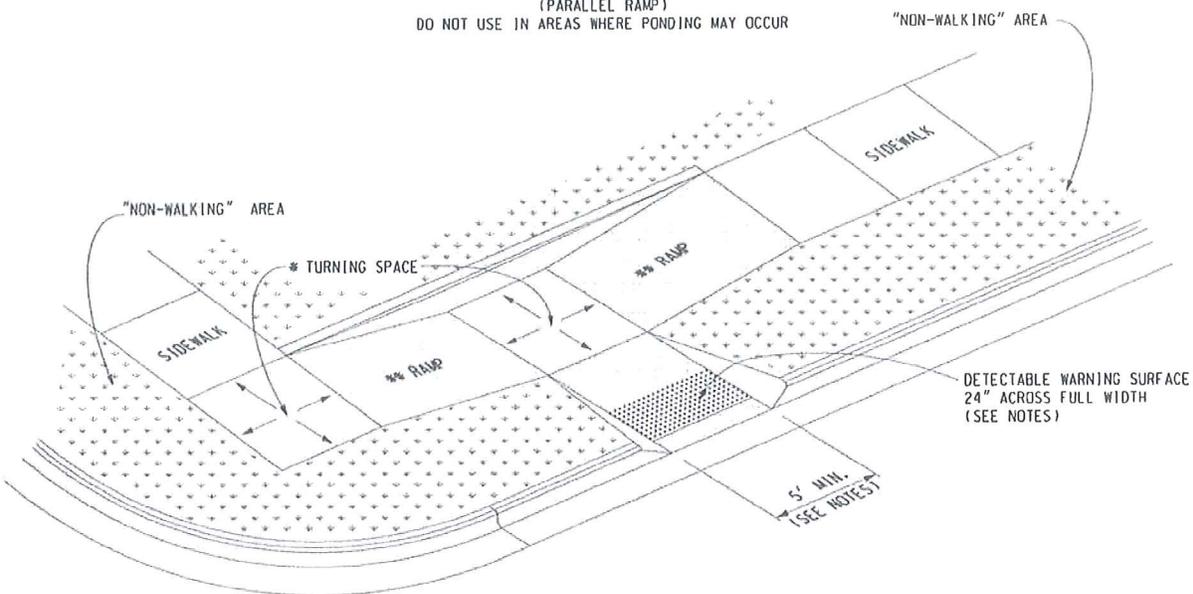
R-28-I

SHEET
2 OF 7

* MAXIMUM TURNING SPACE SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.
 ** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.

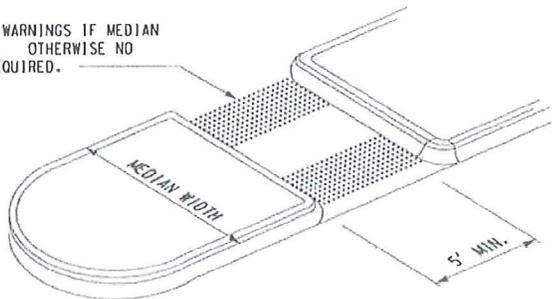


SIDEWALK RAMP TYPE P
 (PARALLEL RAMP)
 DO NOT USE IN AREAS WHERE PONDING MAY OCCUR



SIDEWALK RAMP TYPE C
 (COMBINATION RAMP)

USE 24" DEEP DETECTABLE WARNINGS IF MEDIAN WIDTH IS AT LEAST 6'-0". OTHERWISE NO DETECTABLE WARNING IS REQUIRED.



SIDEWALK RAMP TYPE M
 (MEDIAN ISLAND)

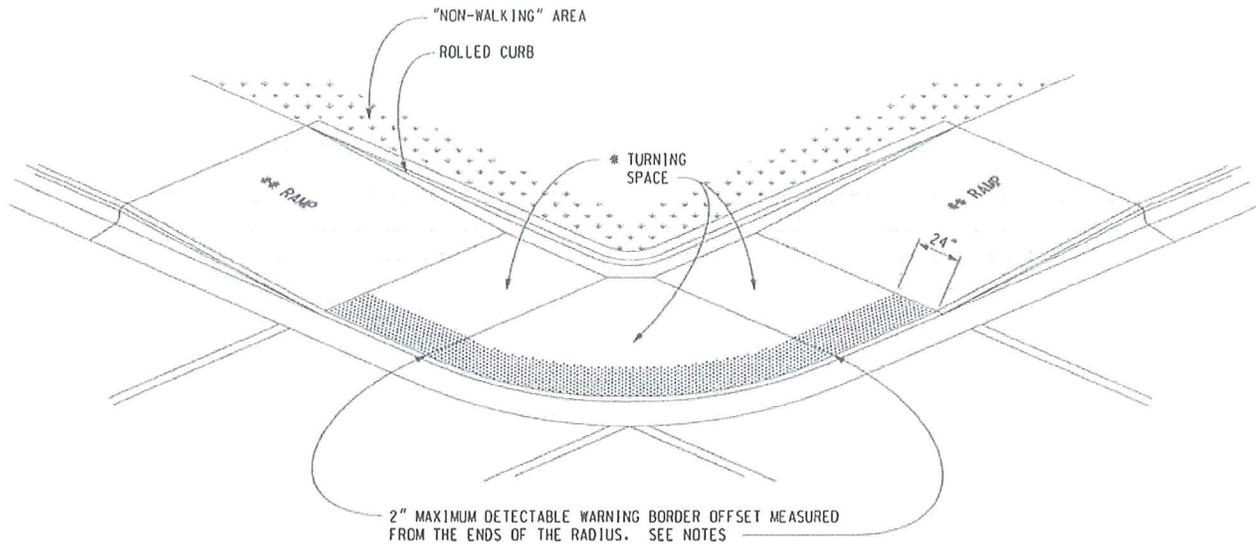
MICHIGAN DEPARTMENT OF TRANSPORTATION
 BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

**SIDEWALK RAMP AND
 DETECTABLE WARNING DETAILS**

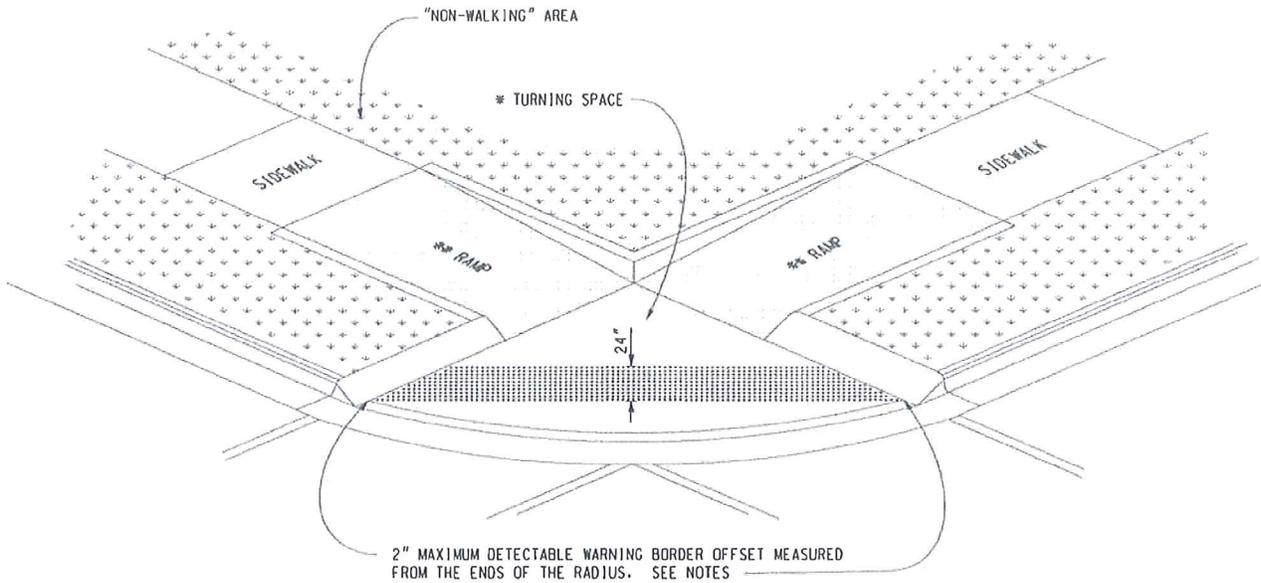
9-30-2014 F.H.W.A. APPROVAL	7-1-2014 PLAN DATE	R-28-I	SHEET 3 OF 7
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* MAXIMUM TURNING SPACE SLOPE IS 2.0% IN EACH DIRECTION OF TRAVEL. MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.0%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



(RADIAL DETECTABLE WARNING SHOWN)



(TANGENT DETECTABLE WARNING SHOWN)

SIDEWALK RAMP TYPE D
(DEPRESSED CORNER)

USE ONLY WHEN INDEPENDENT DIRECTIONAL RAMPS CAN NOT BE CONSTRUCTED FOR EACH CROSSING DIRECTION

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

**SIDEWALK RAMP AND
DETECTABLE WARNING DETAILS**

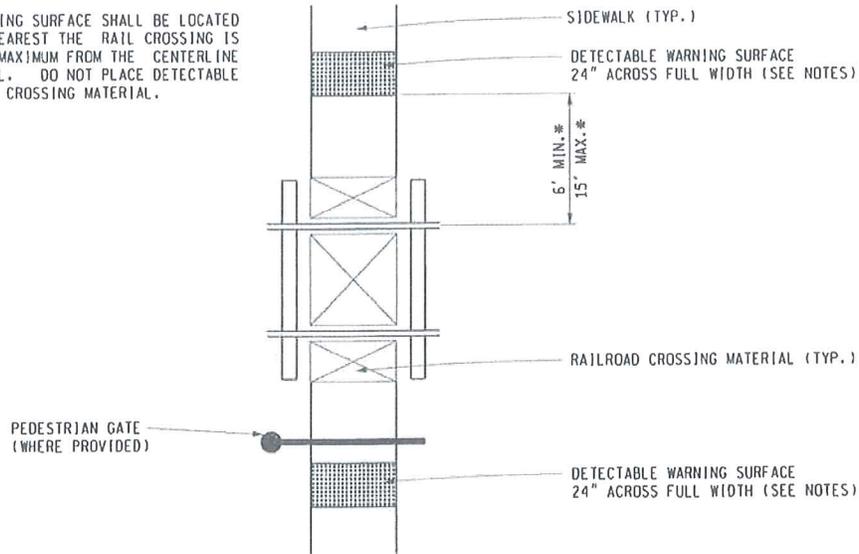
9-30-2014
F.H.W.A. APPROVAL

7-1-2014
PLAN DATE

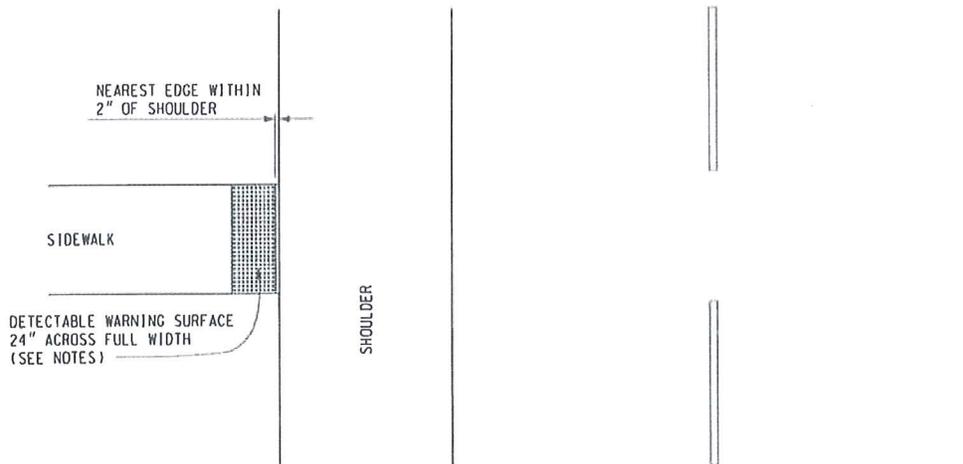
R-28-I

SHEET
4 OF 7

* THE DETECTABLE WARNING SURFACE SHALL BE LOCATED SO THAT THE EDGE NEAREST THE RAIL CROSSING IS 6' MINIMUM AND 15' MAXIMUM FROM THE CENTERLINE OF THE NEAREST RAIL. DO NOT PLACE DETECTABLE WARNING ON RAILROAD CROSSING MATERIAL.



DETECTABLE WARNING AT RAILROAD CROSSING



DETECTABLE WARNING AT FLUSH SHOULDER OR ROADWAY

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

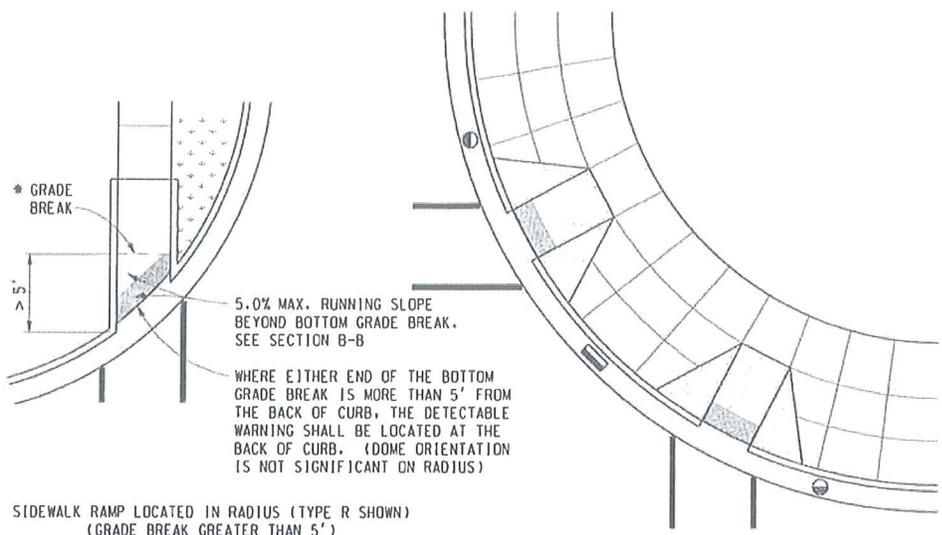
SIDEWALK RAMP AND
DETECTABLE WARNING DETAILS

9-30-2014
F.H.W.A. APPROVAL

7-1-2014
PLAN DATE

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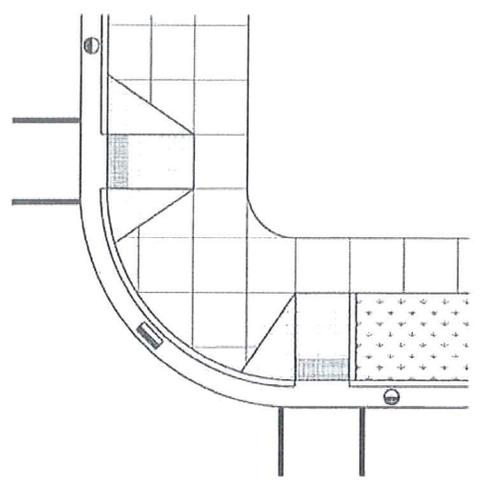
SHEET
5 OF 7



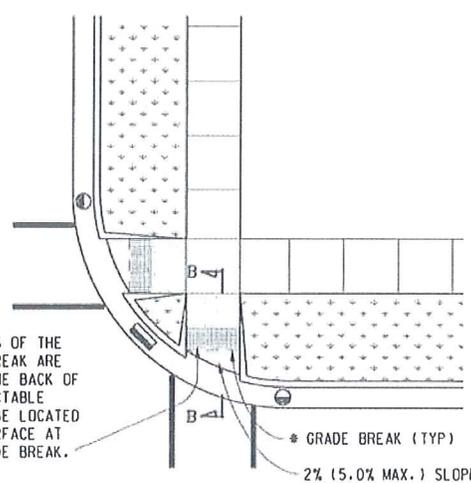
LEGEND	
	SLOPED SURFACE
	DETECTABLE WARNING
	"NON-WALKING" AREA
	CROSSWALK MARKING
	PREFERRED LOCATION OF DRAINAGE INLET (TYP.)
	ALTERNATE LOCATION OF DRAINAGE INLET (TYP.)

SIDEWALK RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK GREATER THAN 5')

SIDEWALK RAMP PERPENDICULAR TO RADIAL CURB (TYPE F SHOWN)
(USE WITH RADIAL CURB WHEN THE CROSSWALK AND SIDEWALK RAMP ARE NOT ALIGNED)



SIDEWALK RAMP PERPENDICULAR TO TANGENT CURB
(TYPE F AND TYPE RF SHOWN)

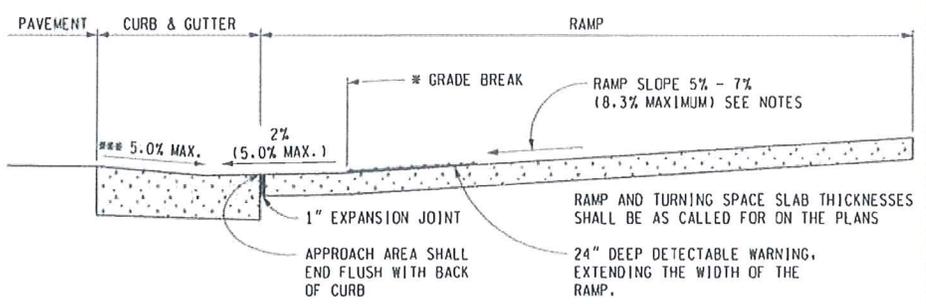


WHERE BOTH ENDS OF THE BOTTOM GRADE BREAK ARE WITHIN 5' OF THE BACK OF CURB, THE DETECTABLE WARNING SHALL BE LOCATED ON THE RAMP SURFACE AT THE BOTTOM GRADE BREAK.

SIDEWALK RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK LESS THAN 5')

* GRADE BREAKS AT THE TOP AND BOTTOM OF CURB RAMPS SHALL BE PERPENDICULAR TO THE DIRECTION OF TRAVEL.

*** TRANSITION ADJACENT GUTTER PAN CROSS SECTION TO PROVIDE 5.0% MAXIMUM COUNTER SLOPE ACROSS THE RAMP OPENING.



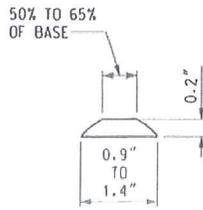
SECTION B-B

SIDEWALK RAMP ORIENTATION

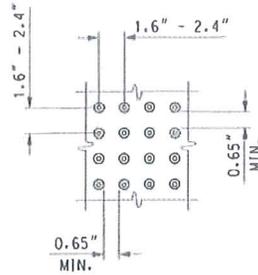
MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

SIDEWALK RAMP AND DETECTABLE WARNING DETAILS

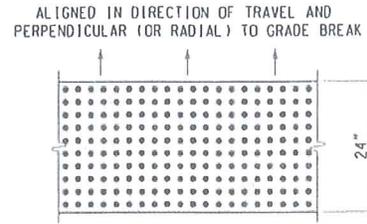
9-30-2014 F.H.W.A. APPROVAL	7-1-2014 PLAN DATE	R-28-I	SHEET 6 OF 7
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DOME SECTION



DOME SPACING



DOME ALIGNMENT

DETECTABLE WARNING DETAILS

NOTES:

DETAILS SPECIFIED ON THIS PLAN APPLY TO ALL CONSTRUCTION, RECONSTRUCTION, OR ALTERATION OF STREETS, CURBS, OR SIDEWALKS IN THE PUBLIC RIGHT OF WAY.

SIDEWALK RAMPS ARE TO BE LOCATED AS SPECIFIED ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

RAMPS SHALL BE PROVIDED AT ALL CORNERS OF AN INTERSECTION WHERE THERE IS EXISTING OR PROPOSED SIDEWALK AND CURB. RAMPS SHALL ALSO BE PROVIDED AT MARKED AND/OR SIGNALIZED MID-BLOCK CROSSINGS.

SURFACE TEXTURE OF THE RAMP SHALL BE THAT OBTAINED BY A COARSE BROOMING, TRANSVERSE TO THE RUNNING SLOPE.

SIDEWALK SHALL BE RAMPED WHERE THE DRIVEWAY CURB IS EXTENDED ACROSS THE WALK.

CARE SHALL BE TAKEN TO ASSURE A UNIFORM GRADE ON THE RAMP, WHERE CONDITIONS PERMIT, IT IS DESIRABLE THAT THE SLOPE OF THE RAMP BE IN ONLY ONE DIRECTION, PARALLEL TO THE DIRECTION OF TRAVEL.

RAMP WIDTH SHALL BE INCREASED, IF NECESSARY, TO ACCOMMODATE SIDEWALK SNOW REMOVAL EQUIPMENT NORMALLY USED BY THE MUNICIPALITY.

PROVIDE TURNING SPACES WHERE PEDESTRIAN TURNING MOVEMENTS ARE REQUIRED.

WHEN 5' MINIMUM WIDTHS ARE NOT FEASIBLE, RAMP WIDTH MAY BE REDUCED TO NOT LESS THAN 4' AND TURNING SPACES TO NOT LESS THAN 4' x 4'.

DETECTABLE WARNING SURFACE COVERAGE IS 24" MINIMUM IN THE DIRECTION OF RAMP/PATH TRAVEL AND THE FULL WIDTH OF THE RAMP/PATH OPENING EXCLUDING CURBED OR FLARED CURB TRANSITION AREAS. A BORDER OFFSET NOT GREATER THAN 2" MEASURED ALONG THE EDGES OF THE DETECTABLE WARNING IS ALLOWABLE. FOR RADIAL CURB THE OFFSET IS MEASURED FROM THE ENDS OF THE RADIUS.

FOR NEW ROADWAY CONSTRUCTION, THE RAMP CROSS SLOPE MAY NOT EXCEED 2.0%. FOR ALTERATIONS TO EXISTING ROADWAYS, THE CROSS SLOPE MAY BE TRANSITIONED TO MEET AN EXISTING ROADWAY GRADE. THE CROSS SLOPE TRANSITION SHALL BE APPLIED UNIFORMLY OVER THE FULL LENGTH OF THE RAMP.

THE MAXIMUM RUNNING SLOPE OF 8.3% IS RELATIVE TO A FLAT (0%) REFERENCE. HOWEVER, IT SHALL NOT REQUIRE ANY RAMP OR SERIES OF RAMPS TO EXCEED 15 FEET IN LENGTH.

DRAINAGE STRUCTURES SHOULD NOT BE PLACED IN LINE WITH RAMPS. THE LOCATION OF THE RAMP SHOULD TAKE PRECEDENCE OVER THE LOCATION OF THE DRAINAGE STRUCTURE. WHERE EXISTING DRAINAGE STRUCTURES ARE LOCATED IN THE RAMP PATH OF TRAVEL, USE A MANUFACTURER'S ADA COMPLIANT GRATE. OPENINGS SHALL NOT BE GREATER THAN 1/2". ELONGATED OPENINGS SHALL BE PLACED SO THAT THE LONG DIMENSION IS PERPENDICULAR TO THE DOMINANT DIRECTION OF TRAVEL.

TRANSITION THE GUTTER PAN CROSS SECTION SUCH THAT THE COUNTER SLOPE IN THE DIRECTION OF RAMP TRAVEL IS NOT GREATER THAN 5.0%. MAINTAIN THE NORMAL GUTTER PAN CROSS SECTION ACROSS DRAINAGE STRUCTURES.

THE TOP OF THE JOINT FILLER FOR ALL RAMP TYPES SHALL BE FLUSH WITH THE ADJACENT CONCRETE.

CROSSWALK AND STOP LINE MARKINGS, IF USED, SHALL BE SO LOCATED AS TO STOP TRAFFIC SHORT OF RAMP CROSSINGS. SPECIFIC DETAILS FOR MARKING APPLICATIONS ARE GIVEN IN THE "MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES".

FLARED SIDES WITH A SLOPE OF 10% MAXIMUM, MEASURED ALONG THE ROADSIDE CURB LINE, SHALL BE PROVIDED WHERE AN UNOBSTRUCTED CIRCULATION PATH LATERALLY CROSSES THE SIDEWALK RAMP. FLARED SIDES ARE NOT REQUIRED WHERE THE RAMP IS BORDERED BY LANDSCAPING, UNPAVED SURFACE OR PERMANENT FIXED OBJECTS. WHERE THEY ARE NOT REQUIRED, FLARED SIDES CAN BE CONSIDERED IN ORDER TO AVOID SHARP CURB RETURNS AT RAMP OPENINGS.

DETECTABLE WARNING PLATES MUST BE INSTALLED USING FABRICATED OR FIELD CUT UNITS CAST AND/OR ANCHORED IN THE PAVEMENT TO RESIST SHIFTING OR HEAVING.

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

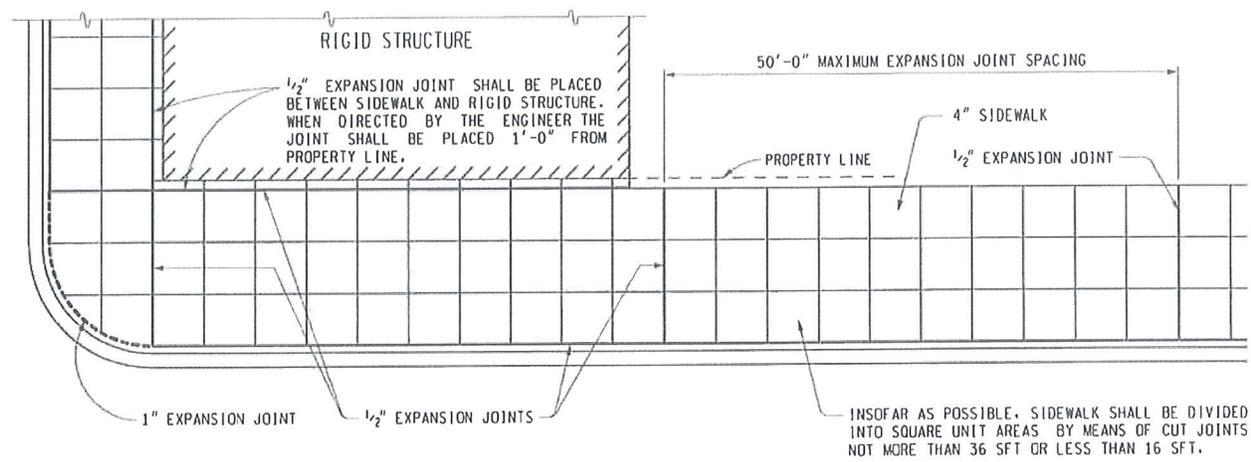
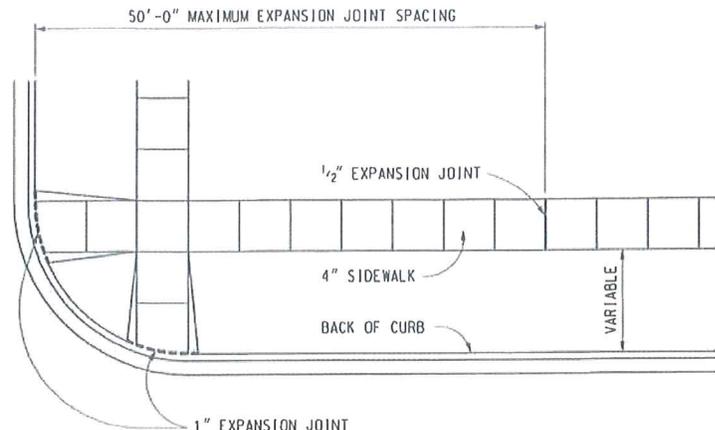
SIDEWALK RAMP AND
DETECTABLE WARNING DETAILS

9-30-2014
F.H.W.A. APPROVAL

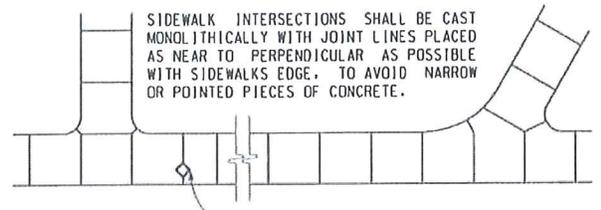
7-1-2014
PLAN DATE

R-28-I

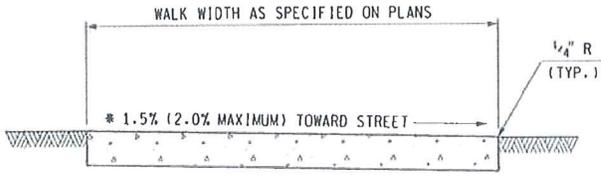
SHEET
7 OF 7



LOCATION OF JOINTS IN CONCRETE SIDEWALK



WHERE A PERMANENT STRUCTURE IS LOCATED IN SIDEWALK, PLACE EXPANSION MATERIAL AROUND STRUCTURE AND ADJUST JOINT PATTERN TO INTERSECT STRUCTURE AS ILLUSTRATED.



* SEE NOTES

TYPICAL SIDEWALK JOINT LAYOUTS

4" CONCRETE SIDEWALK

MDOT
Michigan Department of Transportation

PREPARED BY
DESIGN DIVISION

DRAWN BY: B.L.T.

CHECKED BY: W.K.P.

DEPARTMENT DIRECTOR
Kirk T. Steudle

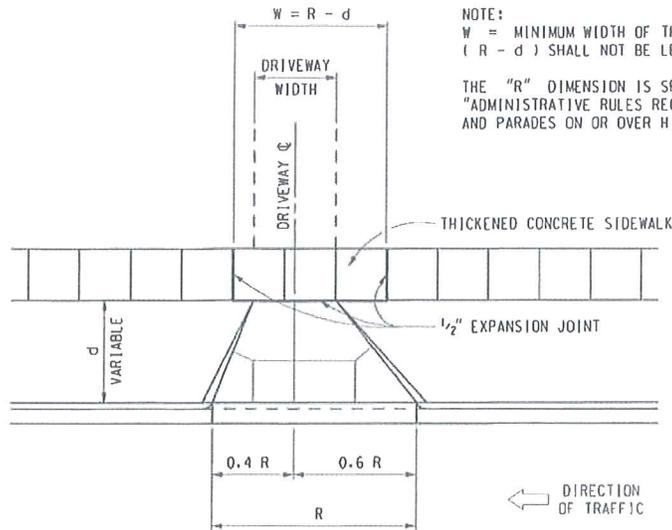
APPROVED BY: *Randy U. Purcell*
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: *Mark A. Van Pelt*
DIRECTOR, BUREAU OF HIGHWAY DEVELOPMENT

MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

**DRIVEWAY OPENINGS
& APPROACHES,
AND CONCRETE SIDEWALK**

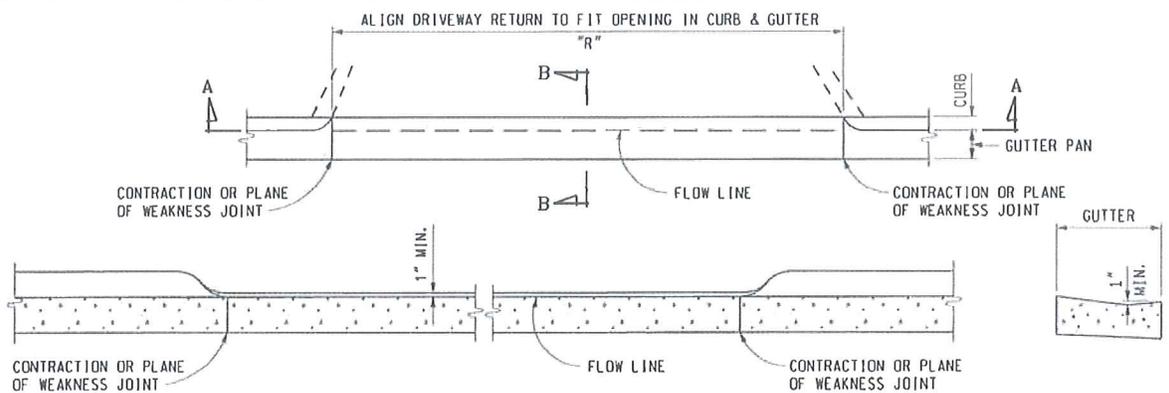
9-30-2014 F.H.W.A. APPROVAL	7-1-2014 PLAN DATE	R-29-I	SHEET 1 OF 4
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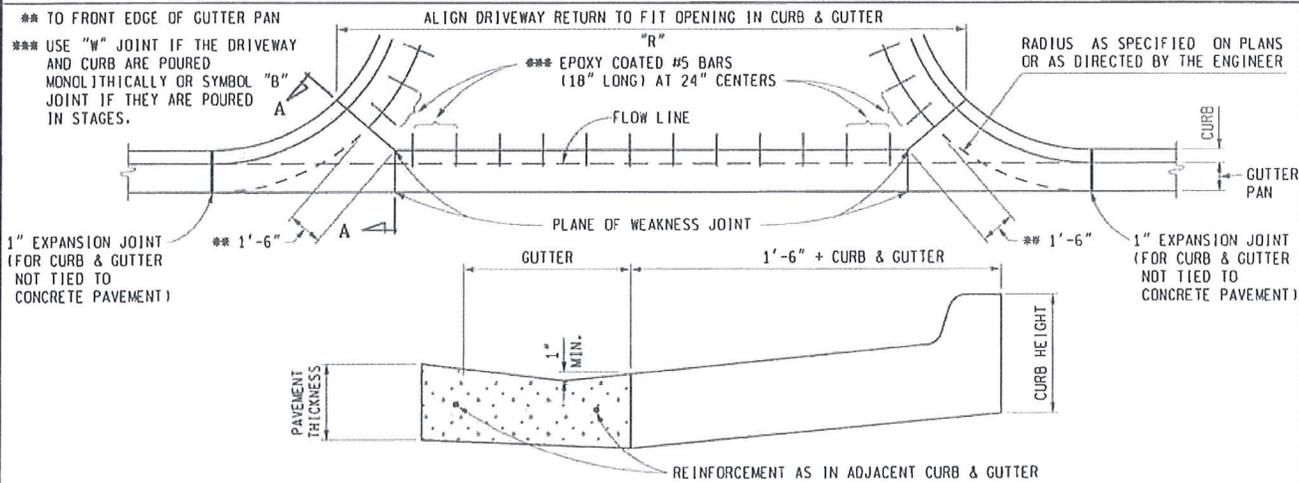
NOTE:
 W = MINIMUM WIDTH OF THICKENED CONCRETE SIDEWALK.
 (R - d) SHALL NOT BE LESS THAN DRIVEWAY WIDTH.

THE "R" DIMENSION IS SPECIFIED IN THE PUBLICATION
 "ADMINISTRATIVE RULES REGULATING DRIVEWAYS, BANNERS
 AND PARADES ON OR OVER HIGHWAYS".

CONCRETE DRIVEWAY OPENING LAYOUT



SECTION A - A
 CONCRETE DRIVEWAY OPENING, DETAIL L



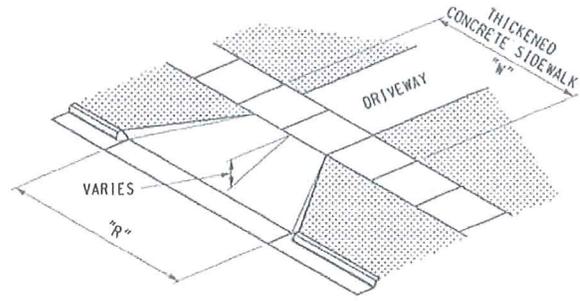
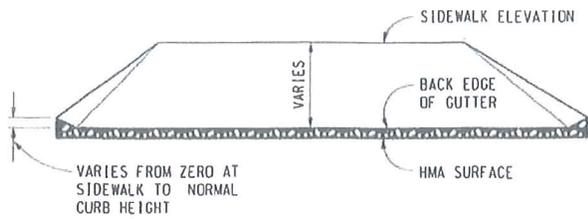
SECTION A - A
 CONCRETE DRIVEWAY OPENING, DETAIL M

NOTE:
 FOR ROADWAYS WITH CONCRETE PAVEMENTS, LONGITUDINAL LANE TIES WILL
 BE CONTINUOUS THROUGH THE DRIVEWAY OPENING AND THE SPACING OF THE
 #5 BARS IN CONCRETE DRIVEWAYS SHALL BE ADJUSTED TO AVOID CONFLICT
 WITH THE LONGITUDINAL LANE TIES.

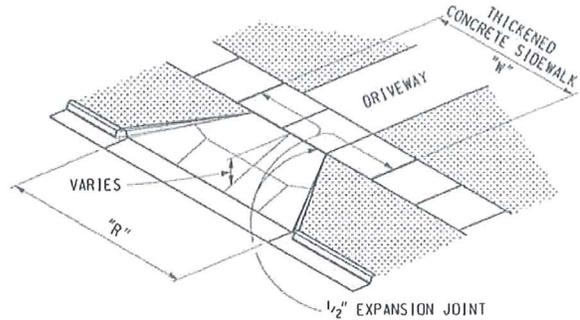
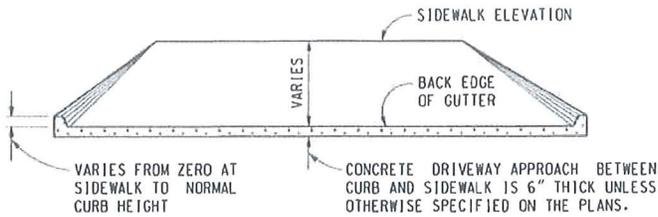
MICHIGAN DEPARTMENT OF TRANSPORTATION
 BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR

**DRIVEWAY OPENINGS
 & APPROACHES,
 AND CONCRETE SIDEWALK**

9-30-2014 F.H.W.A. APPROVAL	7-1-2014 PLAN DATE	R-29-I	SHEET 2 OF 4
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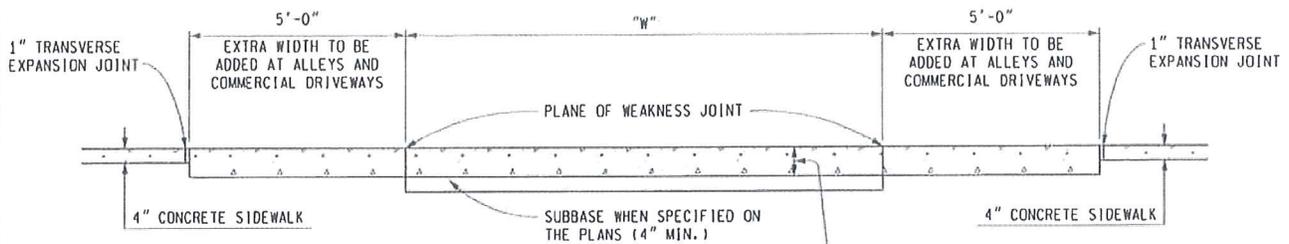


HMA DRIVEWAY APPROACH
(TO BE USED WITH DETAIL L)



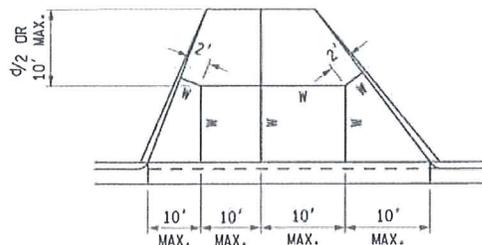
NOTES:
MONOLITHIC CURB IS INCLUDED IN THE CONCRETE DRIVEWAY APPROACH QUANTITY.
REINFORCEMENT IS NOT REQUIRED UNLESS SPECIFIED ON THE PLANS. WHEN REINFORCEMENT IS SPECIFIED, SEE CHART ON THIS SHEET.

CONCRETE DRIVEWAY APPROACH
(TO BE USED WITH DETAIL L OR M)



WHEN CONCRETE DRIVEWAY APPROACH IS SPECIFIED, THE THICKENED CONCRETE SIDEWALK THICKNESS IS EQUAL TO THE THICKNESS OF THE CONCRETE DRIVEWAY APPROACH. WHEN HMA DRIVEWAY APPROACH IS SPECIFIED, THE THICKENED CONCRETE SIDEWALK THICKNESS IS 6" MIN.

THICKENED CONCRETE SIDEWALK



ADJUST DRIVEWAY JOINTS AS NEEDED TO ALIGN WITH ANY COINCIDING TRANSVERSE PAVEMENT JOINTS.
JOINT LAYOUT IS AS INDICATED OR AS DIRECTED BY THE ENGINEER.

INTERMEDIATE DRIVEWAY JOINT DETAILS

REINFORCEMENT FOR CONCRETE DRIVEWAYS

CONCRETE DRIVEWAY THICKNESS	WIRE SIZE (6" x 6" MESH)	AVERAGE WEIGHT (LBS/100 SFT)
LESS THAN 8"	W1.4	21
	W2.9	42
8" OR GREATER	USE WIRE FABRIC REINFORCEMENT SPECIFIED ON STANDARD PLAN R-37-SERIES	

MICHIGAN DEPARTMENT OF TRANSPORTATION
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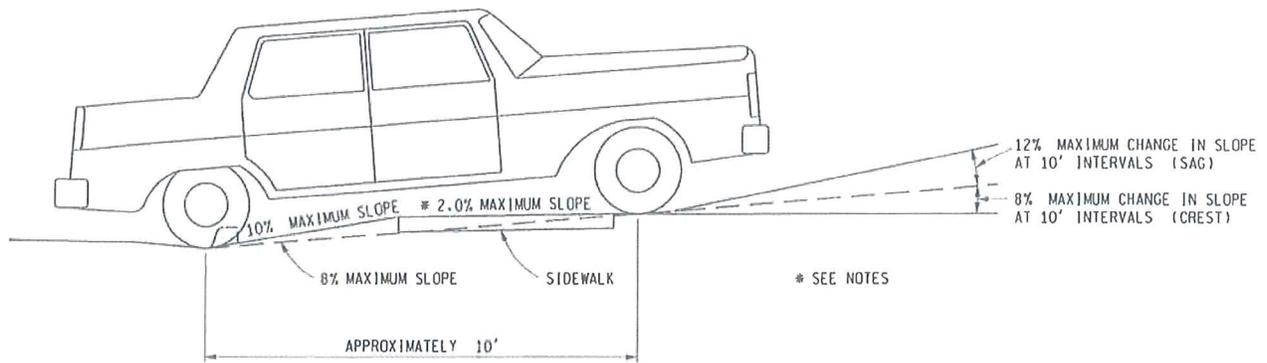
DRIVEWAY OPENINGS & APPROACHES, AND CONCRETE SIDEWALK

9-30-2014
F.I.H.W.A. APPROVAL

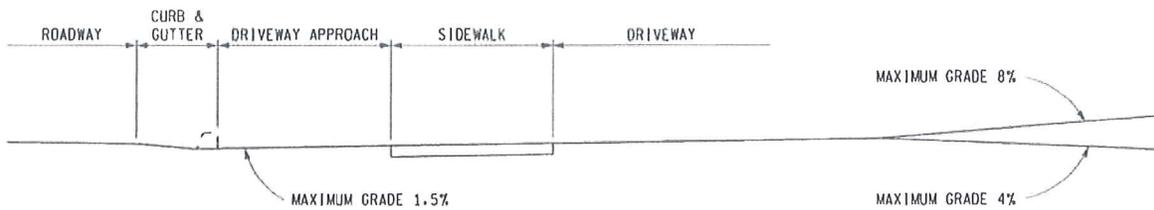
7-1-2014
PLAN DATE

R-29-I

SHEET
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LOW VOLUME COMMERCIAL OR RESIDENTIAL DRIVEWAY SLOPES



COMMERCIAL DRIVEWAY PROFILE FOR MAJOR TRAFFIC GENERATORS

NOTES:

FOR DRIVEWAY DESIGN REFER ALSO TO "ADMINISTRATIVE RULES REGULATING DRIVEWAYS, BANNERS, AND PARADES ON OR OVER HIGHWAYS" AND GEOMETRIC DESIGN G-680-SERIES, COMMERCIAL DRIVEWAYS.

FOR CURB AND GUTTER DETAILS, SEE STANDARD PLAN R-30-SERIES.

TRANSVERSE SIDEWALK SLOPES ARE TYPICALLY 1.5% (2.0% MAXIMUM). IN ORDER TO MEET SITE CONDITIONS, IF THE TRANSVERSE SLOPE IS REQUIRED TO BE LESS THAN 1.5%, LONGITUDINAL DRAINAGE MUST BE PROVIDED.

WHEN SETTING GRADES FOR COMMERCIAL DRIVES, THE TYPES OF VEHICLES USING THE DRIVE SHOULD BE CONSIDERED.

MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAY DEVELOPMENT STANDARD PLAN FOR DRIVEWAY OPENINGS & APPROACHES, AND CONCRETE SIDEWALK			
9-30-2014 F.H.W.A. APPROVAL	7-1-2014 PLAN DATE	R-29-I	SHEET 4 OF 4

SECTION 10 – SOIL EROSION AND SEDIMENTATION CONTROL
CITY OF CARO
ENGINEERING DESIGN STANDARDS

A. Submittal Procedure

1. Soil Erosion and Sedimentation Control Plans shall be incorporated into any plans submitted. A Tuscola County Soil Erosion Control Permit is required.

B. Plan Requirements

The Soil Erosion and Sedimentation Control Plans shall contain the following data and other information as required by the county or other agencies on sheets twenty-four inch by thirty-six inch (24" x 36"), using the USGS Vertical Datum.

1. Public and private roads in the area and all adjacent properties and the extent of site grading, all to at least one hundred (100) feet outside site boundaries.
2. Topographic plan scale, one inch equals fifty feet (1" = 50') to one hundred (100) feet beyond site boundaries showing:
 - a. Existing ground elevations, with either two (2) foot contour intervals or spot elevations on a fifty (50) foot grid.
 - b. Existing structures and significant features including trees six (6) inches in diameter or larger, existing ground cover, extent and condition.
 - c. Existing drainage and soil information.
3. Site Grading and Development Plans as required under other sections of the City of Caro's Design Standards for all proposed utilities on the site.
4. The Soil Erosion and Sedimentation Control Plan shall include the following:
 - a. Description and location of the limits for all proposed earth changes.
 - b. Description and location of all soil erosion measures.
 - c. The timing and sequence of all proposed earth changes.
 - d. Information as to how excavated material will be handled and stored to prevent erosion.
 - e. Information on trench backfill restoration including schedule of placement.
 - f. Information concerning the existing drainage system including a provision for maintenance.

C. Notes

The following notes shall appear on the plans:

1. Daily inspections shall be made by the Contractor for effectiveness of erosion and sedimentation control measures and any necessary repairs shall be performed without delay.

2. Any sedimentation from work on this site shall be contained on the site and not allowed to collect on any off site areas or in waterways.
3. Contractor shall apply temporary erosion and sedimentation control measures when required and as directed on these plans. The Contractor shall remove temporary measures as soon as permanent stabilization of slopes, ditches and other earth changes have been accomplished. This would include temporary sedimentation ponds.
4. Staging the work will be done by the Contractor as directed in these plans and as required to ensure progressive stabilization of disturbed earth.
5. Soil erosion control practices shall be established in the early stages of construction by the Contractor. Sediment control practices will be applied as a perimeter defense against any transporting of silt off the site.

D. Principles of Erosion and Sediment Control

1. Plan the development to fit the topography, soils, waterways and natural vegetation at a site with the least necessary earth disturbance or change.
2. Expose the smallest practical area of land for the shortest practical time through staging the work and early application of temporary or permanent erosion control measures.
3. Apply soil erosion control measures as a first line of defense against on site damage, to prevent sediment from being produced. These measures included special grading methods, run-off control structures, temporary and permanent vegetation.
4. Apply sedimentation control measures as a perimeter protection to prevent off site damage. These measures include diversion ditches, sediment traps, vegetative filters, and sediment basins.
5. Apply follow up and periodic maintenance for continued effectiveness of control measures.

E. Design Standards

1. Riprap is required at all locations where storm water velocities may be erosive to soils. Riprap shall be placed at all storm water inlets and outlets and basin outlets. Riprap shall be a nominal four (4) inch to six (6) inch minimum diameter and be clean of any foreign material.
2. Newly constructed storm water facilities shall be constructed to control flow velocities to limit erosion.
3. The plans shall, based on the nature of the proposed development, contain a time schedule for the installation of permanent soil erosion control measures.
4. If specific details are required for soil erosion control measures, they shall be shown on the plans.
5. Soil erosion controls shall be used to prevent silt from entering public roadways and storm sewers at all times.

6. All disturbed areas shall receive four (4) inches of topsoil, seed and mulch.
7. Crushed aggregate mud mats 100 feet long by 26 feet (100' x 26') wide, at a minimum, shall be used at the entrance of construction sites.
8. On larger projects or when phasing is involved, the developer may be required to provide alternate construction drives to the site to avoid damage to newly constructed streets. A crushed aggregate mud mat should be used any time the new approach is used for construction traffic. All construction drives shall be approved by the City.