

10. STRUCTURES

10.1 Review of Engineering Plans and Specifications for Structures

The review of engineering plans and specifications for structures will often be reviewed by a third party, hired by the City of Des Moines. All costs associated for the third-party review of engineering plans and specifications will be the responsibility of the applicant/developer and shall be supplemental to other city engineering review fees.

10.2 Bridges

10.2.1 Bridge Principal References

Except as specified below, all bridges within the City of Des Moines, whether on public roads or on private roads, shall be designed and constructed to meet the minimum requirements set forth in the latest edition, including all interim addenda of “AASHTO Standard Specifications for Highway Bridges,” or “AASHTO LRFD Bridge Design Specifications” and in accordance with the most current requirements of WSDOT/APWA Standard Specifications. Bridge traffic barrier and approach railings shall be provided in accordance with those references and the WSDOT Bridge Design Manual and WSDOT/APWA Standard Plans. All new bridges shall be designed to carry an AASHTO HS 25 or HL93 (LRFD) unless otherwise approved by the Public Works Director.

Bridges that will carry pedestrian and bicycle traffic bridges shall be designed in accordance with the most current AASHTO “Guide Specifications for Design of Pedestrian Bridges”.

10.2.2 Special Requirements

Construction or reconstruction of bridges may require permits from other agencies such as the Coast Guard, Army Corps of Engineers, Department of Ecology, or the Department of Fish and Wildlife, among others. It is the project applicant’s responsibility to obtain all necessary permits.

10.2.3 Bridge Geometrics and Design Criteria

In general, the bridge shall comprise the full width and configuration of the road being served, (e.g., traveled way plus curb, gutter, sidewalks, bike lane, and/or shoulder on one or both sides). Requirements of utilities shall be duly considered. Bridge roadway width shall be measured between curbs or between faces of bridge traffic barrier; whichever is less.

On designated bike routes, combination bridge traffic barrier and bicycle railings shall be used. Where typical speed is 35 mph or higher and significant pedestrian and bike traffic can be expected, the Public Works Director may require that the lanes for these other modes of traffic be separated from motor vehicle traffic by use of a bridge traffic barrier and further protected by a rail at the outer edge.

Approach railings and transitions shall be made structurally continuous with bridge railings and shall meet AASHTO specifications, and as Specified in Section 8.5 of these Standards.

Overhead vertical clearances for motor traffic on the traveled way or under overpasses shall be 16.5 feet minimum. Vertical clearance for bridges over railroad tracks shall comply with the minimum vertical

clearance required by the WSDOT Design Manual and also may require negotiations with the railroad company concerning necessary clearances. Vertical clearance of structures above a walkway or sidewalk shall be 10 feet minimum.

Bridges located at the low point of a sag vertical curve shall have adequate provisions to accommodate stormwater runoff on the bridge. Stormwater shall not be allowed to free drain off of the bridge deck. Drainage must be tight lined from the bridge deck to an enclosed drainage system or open channel located adjacent to or below the bridge, and consistent with Chapter 11 of these Standards.

Best available flood data, as defined in the Department of Development and Environmental Services Public Rule, Sensitive Areas: Flood Hazard Areas, shall be used to establish the 100-year water surface elevation in consultation with the Department of Natural Resources and Parks, Flood Hazard Reduction Services Section.

For stream crossing locations where the 100-year peak flow exceeds 100 cubic feet per second (cfs), the height of bridge clearance above rivers and streams shall be a minimum 3 feet above the 100-year water surface elevation unless otherwise required by the Public Works Director based on an evaluation of conveyance factors as specified below. For stream crossing locations where the 100-year peak flow is 100 cfs or less, there is no specific clearance requirement, but bridges must meet the standards in the King County Surface Water Design Manual.

Evaluation of conveyance factors shall consider hydraulic capacity, bed aggradations, debris passage, safety margins, and bridges and levees, as specified in Section 4.3.3.1 of the King County Surface Water Design Manual.

For future bridge inspection and maintenance, access beneath the actual structure of the bridge shall be provided. A minimum 3 feet of clearance between the low chord of the bridge and final grade shall be maintained along the entire bridge.

Bridge span lengths shall be designed of sufficient length so that no in-stream piers are required. Bridge abutments shall be located well behind the ordinary high water elevation (OHWE) to minimize construction impacts.

All new bridges shall be designed for actual dead load and superimposed dead loads, such as utilities, pavement, and bridge railings. The loading for design shall be based upon the AASHTO "Standard Specifications for Highway Bridges" and the most current WSDOT Bridge Design Manual.

Unless otherwise approved by the Public Works Director, concrete approach slabs will be required for all new bridges and shall be constructed in accordance with WSDOT/APWA Standard Plans.

New bridge plans shall be designed in accordance with WSDOT/APWA Standard Specifications to prevent corrosion of reinforcing steel.

Criteria under other recognized road and bridge project classifications, such as those of 3-R projects, set forth in WSDOT Local Agency Guidelines, may be applied under conditions deemed appropriate by the Public Works Director.

10.2.4 Guardrails and Railings

Bridge approach guardrails are generally required at all four corners of each bridge. Refer to WSDOT Standard Plans for typical approach guardrails.

Approach guardrails and bridge railings shall be designed in accordance with AASHTO's Standard Specifications for Highway Bridges, Guide for Selecting, Locating, and Designing Traffic Barriers, and/or the WSDOT Design Manual.

Approach guardrails shall be made structurally continuous with bridge railings.

10.2.5 Utility Installation on Bridges

Attachment of utility lines to a roadway structure, including bridges, may be allowed where such attachment conforms to sound engineering practice for preserving the roadway structure and ensuring its safe operation, maintenance and appearance. Attachment of any utility to any bridge within the city road right-of-way requires the approval of the Public Works Director.

Attachment of a utility shall not be considered unless the structure is designed to support the additional load and can accommodate the utility facility without limiting features such as ease of maintenance.

Utility features, such as manholes or access panels, shall not be placed within the roadway portion of the structure.

A pipeline carrying a hazardous substance shall not be attached to a roadway structure unless specifically approved by the Public Works Director.

The utility attachment shall not reduce any clearance requirement of the structure. Attachment to the outside of a structure shall be avoided unless there are no reasonable alternatives.

Utility mountings shall be of a type that do not create noise from vibration.

Any hole created in a structure abutment shall be sleeved, be of a minimum size necessary to accommodate the utility line and be sealed to prevent any leakage of water or backfill material.

A utility line behind an abutment shall curve or angle out to align outside the roadbed area in as short a distance as is operationally practicable.

Communication and electrical power line attachments shall be suitably insulated, grounded, and carried in protective conduit or pipe from point of exit from the ground to re-entry. Carrier pipe and casing pipe shall be properly isolated from electric power line attachments.

If at any time the installation or attachment of a utility to a bridge limits the structural capacity of the bridge for carrying traffic, the utility will be required to remove the installed facilities and make any repairs to the bridge structure as a result of the initial installation.

10.2.6 Submittals for Bridge Designs

The construction or reconstruction of bridges will necessitate submittal of the following items, at a minimum, to the Public Works Director.

1. Design calculations
2. Load rating analysis
3. Hydraulic report
4. Scour analysis
5. Material certification of the major load bearing members

6. Pile driving records, for all pile supported foundations
7. Record Drawings

The construction or reconstruction of bridges will necessitate the Public Works Director's approval of the following:

1. Bridge type
2. Foundation type
3. Size and shape of the hydraulic opening
4. Vertical clearance between the superstructure and the design water surface, including sensitive areas
5. Location of piers and abutments
6. Roadway cross section
7. Bridge traffic barrier and approach guardrail type
8. Aesthetic treatments
9. Expansion joints (the design of bridge expansion joints shall consider the presence of bicycle traffic).

10.3 Special Culverts

All corrugated metal structures and reinforced concrete 3-sided and 4-sided box culverts shall be designed in accordance with the most current AASHTO Standard Specifications for Highway Bridges.

10.4 Structural Walls

Structural retaining walls shall be designed in accordance with the most current AASHTO "Standard Specifications for Highway Bridges" and the most current WSDOT Bridge Design Manual.

10.5 Rock Facings

- A. Rock facings may be used for the erosion protection of cut or fill embankments up to a maximum height of 8 feet above the keyway in stable soil conditions, which will result in no significant foundation settlement or outward thrust upon the walls. For heights over 8 feet above the keyway or when soil is unstable, a structural wall of acceptable design stamped by a licensed structural engineer is required. See Section 10.4 for further details. As an exception, rock-facing heights may exceed 8 feet to a limited extent based on favorable soils analyses and a design by a geotechnical engineer or other professional engineer qualified in rock wall design, subject to approval by the Public Works Director. Terracing of rock facings is subject to approval by the Public Works Director. Terracing shall not surcharge lower rock facings.
- B. Materials:

The rock material shall be as nearly rectangular as possible. No stone shall be used which does not extend through the wall. The quarried trap rock shall be hard, sound, durable and free from weathered portions, seams, cracks and other defects. Rock quality shall meet all the test requirements of Section 9-13, "Riprap, Quarry Spalls, Slope Protection, and Rock Walls" of the

current WSDOT Standard Specifications.” Size requirements for wall rock shall conform to the requirements shown in Table 10-1.

Table 10-1. Material Size Requirements

| SIZE | WEIGHT/POUNDS (LBS) | DIAMETER (INCHES) |
|-------|---------------------|-------------------|
| 2-MAN | 200-700 | 18-28 |
| 3-MAN | 700-2,000 | 28-38 |
| 4-MAN | 2,000-4,000 | 36-48 |
| 5-MAN | 4,000-6,000 | 48-54 |
| 6-MAN | 6,000-8,000 | 54-60 |

C. Keyway:

A keyway consisting of a shallow trench of minimum 12-inch depth shall be constructed the full rockery length, and slightly inclined towards the face being protected. It shall be excavated the full rockery width including the rock filter layer. The keyway subgrade shall be firm and acceptable to the Public Works Director.

D. Underdrains:

1. A minimum 6-inch diameter perforated or slotted drainpipe shall be placed in a shallow excavated trench located along the inside edge of the keyway. The pipe shall be bedded on “Gravel Backfill for Drains”, consistent with Section 9-03.12(4) of the WSDOT/APWA Standard Specifications. The pipe shall be completely surrounded and covered with the gravel backfill to a minimum height of 18 inches from the bottom of the trench. Geotextile for underground use shall surround the gravel backfill and shall have a minimum one-foot overlap along the top surface of the gravel. This requirement for geotextile may be waived by the Public Works Director, if shown that soils and water conditions make it unnecessary.
2. The perforated pipe shall be connected to the storm drain system or to an acceptable outfall. Cleanouts must be provided at main angle points.

E. Rock Selection and Placement:

Rock selection and placement shall be such that there will be minimum voids and, in the exposed face, no open voids over 6 inches across in any direction. The final course shall have a continuous appearance and be placed to minimize erosion of the backfill material. The larger rocks shall be placed at the base of the facing so that it will be stable and have a stable appearance. The rocks shall be placed in a manner such that the longitudinal axis of the rock shall be at right angles to the face. The rocks shall have all inclined faces sloping to the back of the rockery. Each course of rocks shall be seated as tightly and evenly as possible on the course beneath. The rocks shall be placed so that there are no continuous joint planes either horizontally or vertically. After setting each course of rock, all voids between the rocks shall be chinked on the back with quarry rock to eliminate any void sufficient to pass a 2-inch square probe.

F. Rock Filter Layers:

The rock filter layer shall consist of quarry spalls with a maximum size of 4 inches and a minimum size of 2 inches. This material shall be placed to a 12-inch minimum thickness between

the entire facing and the cut or fill material. The backfill material shall be placed in lifts to an elevation approximately 6 inches below the top of each course of rocks as they are placed, until the uppermost course is placed. Any backfill material on the bearing surface of one rock course shall be removed before setting the next course.

G. Fill Rockery Facing Supporting Roadway Embankment:

Embankment behind rockeries exceeding 4 feet in height above the keyway shall be reinforced with a geosynthetic fabric or geogrid specifically manufactured for soil reinforcement, designed on a project-specific basis by a qualified engineer.

H. Sidewalks Above Rockery Facings:

When a sidewalk is to be built over a rock facing, the top of the facing shall be sealed and leveled with a cap constructed of cement concrete Class 4000 in accordance with the applicable provisions of Section 6-02 of the WSDOT/APWA Standard Specifications, but with reduced water content resulting in slump of not over 2 inches.

I. Fences and Handrails:

A chain link fence or metal handrail shall be installed when rockery is 18 inches or greater in height or as required by the Public Works Director.