

# Chapter 8 — Deck Hydraulics

## 8.1—DECK HYDRAULICS

Deck hydraulic analysis shall be completed at every bridge site.

The presence of inlets near the approach slabs shall be determined by Roadway.

Hydraulic Section of the Bridge Division completes a hydraulic data sheet prior to the TS&L being finalized for state owned structures. Designers shall submit plan dimensions of the bridge deck to the Hydraulic Section to determine the type of rail and number of deck drains, if needed.

Roadway design is responsible for capturing the stormwater before it gets to the buttress of the approach section of the bridge. They are also responsible for capturing the stormwater as it conveys off the bridge's approach section.

## 8.2—RAIL POLICY

Closed rails shall be used on all bridges with the following exceptions

- Bridge lengths greater than 300 ft.
- Bridge longitudinal slope less than 0.5%

Designers shall consider open rail systems due to the large number of deck drains required in these cases. The necessity for deck drains on a bridge is not, by itself, a reason to switch to an open rail system.

Refer to §13.1.1 for more information on rails.

## 8.3—DRAINAGE THROUGH OPEN RAILS

No additional deck drainage details are required for bridge with open rails.

## 8.4—DRAINAGE THROUGH CLOSED RAIL

### 8.4.1—Without Deck Drains

No deck drains are required if analysis shows that the spread of water is within the allowable limit.

In these cases, the Hydraulic Section will coordinate with Roadway to capture the runoff from the bridge.

### 8.4.2—With Deck Drains

Bridge Division uses floor drain near the face of curb to provide deck drainage when necessary per analysis.

Standard deck drain size shall be 4 in. opening by 3 ft. long as shown on the "Floor Drain" base sheet. Other sizes may be used if required by analysis.

Bridge deck drains help reduce the spread of storm water on a bridge surface and the erosion around the wings of the approach section.

### 8.5—ANALYSIS AND DESIGN

Hydraulic analysis of decks is covered in the HEC-21 (Young et al., 1993) and HEC-22 (Kilgore et al., 2024) manuals.

Design frequency and allowable spread of storm water shall be as shown in Table 8.1.

Refer to HEC-22 (Kilgore et al., 2024) for typical value for Manning’s coefficients and for deck drain efficiency when other data is not available.

Table 8.1—Design Frequency and Allowable Spread of Storm Water

Roadway Classification	Design Speed	Design Frequency	Allowable Spread
Interstate	All	50-year	Lowest edge of the driving lane
Major	45 mph and greater	50-year	Lowest edge of the driving lane
	Up to 45 mph	10-year	Shoulder width plus one half of the outer driving lane
Minor	All	10-year	Shoulder width plus one half of the outer driving lane

### 8.6—LOCATION GUIDELINES

Deck drain location shall be as determined by analysis.

For crowned decks, deck drains shall be provided on either side of the deck. For superelevated decks, deck drains shall only be provided on the low side.

Deck drains where runoff is allowed to free fall to the ground shall not be located over roadways (including shoulders), railroad ROW, and MSE wall backfills.

There are no minimum quantity or absolute locations for deck drains. The following best practices for deck drain locations may be used as a general guidelines:

- Do not place a drain at the high point of crest curves.
- Locate a drain upslope from bridge abutments and deck expansion joints (5 ft. minimum)
- For bridges with sidewalks, make sure that the deck drains at the curb do not interfere with a girder line.
- For deck drains where runoff is allowed to free fall to the ground, locate drains at least 10 ft. from CL of piers or bents when the free fall is less than 20 ft. Otherwise, consider placing drains 25 ft from CL of piers or bents to reduce the risk of local erosion around the based of the pier or bent.

### 8.7—DECK DRAIN RUNOFF

#### 8.7.1—Free Fall

Where the runoff is allowed to free fall to the bare ground, designers should take appropriate steps to avoid erosion problems at these locations. The use of curbed edges on slope protection, splash pads, or splash blocks shall be evaluated. For free fall larger than 20 ft, larger splash pads shall be evaluated by the hydraulic designer.

The vertical structural tubing (drop tubes) shall extend at least 4 in. past the bottom flange of the girder for girder bridges or 4 in. past the bottom face of the slab for concrete slab bridges.

See Base Sheet for details.

### 8.7.2—Drainage Systems

In locations where runoff is not allowed to free fall, deck drainage systems shall be specified to carry the water to grade. Refer to HEC-22 (Kilgore et al., 2024) for design of conduit systems.

Plans for conduit systems shall include drain boxes, pipes, anchors, supports, and connections. Cleanouts shall be provided in the design of the drainage system for all straight sections of pipe.

The point of discharge from the drains shall be evaluated to determine erosion potential. Designers shall evaluate complex drain systems for interaction and interference with existing substructure and superstructure.

Examples of such locations are near parking lots, over roadways, or over railroads ROW.

### 8.8—REFERENCES

Kilgore, R., Atayee, A. T., & Herrmann, G. (2024). *Urban Drainage Design Fourth Edition Hydraulic Engineering Circular N<sup>o</sup> 22* (Technical Report FHWA-HIF-24-006). Kilgore Consulting and U.S. Department of Transportation Federal Highway Administration Office of Bridges and Structures. <https://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif24006.pdf>

Young, G. K., Walker, S. E., & Chang, F. (1993). *Design of Bridge Deck Drainage Hydraulic Engineering Circular N<sup>o</sup> 21* (Technical Report FHWA-SA-92-010). GKY and Associates and U.S. Department of Transportation Federal Highway Administration Office of Technology Applications. <https://www.fhwa.dot.gov/engineering/hydraulics/pubs/hec/hec21.pdf>

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