Section 1
GENERAL PROVISIONS

1.1 DESIGN ANALYSIS AND GENERAL STRUCTURAL INTEGRITY FOR BRIDGES

The intent of these Specifications is to produce integrity of design in bridges.

1.1.1 Design Analysis

When these Specifications provide for empirical formulae, alternate rational analyses, based on theories or tests and accepted by the authority having jurisdiction, will be considered as compliance with these Specifications.

1.1.2 Structural Integrity

Designs and details for new bridges should address structural integrity by considering the following:

(a) The use of continuity and redundancy to provide one or more alternate load paths.
(b) Structural members and bearing seat widths that are resistant to damage or instability.
(c) External protection systems to minimize the effects of reasonably conceived severe loads.

1.2 BRIDGE LOCATIONS

The general location of a bridge is governed by the route of the highway it carries, which, in the case of a new highway, could be one of several routes under consideration. The bridge location should be selected to suit the particular obstacle being crossed. Stream crossings should be located with regard to initial capital cost of bridgeworks and the minimization of total cost including river channel training works and the maintenance measures necessary to reduce erosion. Highway and railroad crossings should provide for possible future works such as road widening.

1.3 WATERWAYS

1.3.1 General

1.3.1.1 Selecting favorable stream crossings should be considered in the preliminary route determination to minimize construction, maintenance, and replacement costs. Natural stream meanders should be studied and, if necessary, channel changes, river training works, and other construction that would reduce erosion problems and prevent possible loss of the structure should be considered. The foundations of bridges constructed across channels that have been realigned should be designed for possible deepening and widening of the relocated channel due to natural causes. On wide flood plains, the lowering of approach embankments to provide overflow sections that would pass unusual floods over the highway is a means of preventing loss of structures. Where relief bridges are needed to maintain the natural flow distribution and reduce backwater, caution must be exercised in proportioning the size and in locating such structures to avoid undue scour or changes in the course of the main river channel.

1.3.1.2 Usually, bridge waterways are sized to pass a design flood of a magnitude and frequency consistent with the type or class of highway. In the selection of the waterway opening, consideration should be given to the amount of upstream ponding, the passage of ice and debris and possible scour of the bridge foundations. Where floods exceeding the design flood have occurred, or where superfloods would cause extensive damage to adjoining property or the loss of a costly structure, a larger waterway opening may be warranted. Due consideration should be given to any federal, state, and local requirements.

1.3.1.3 Relief openings, spur-dikes, debris deflectors and channel training works should be used where needed to minimize the effect of adverse flood flow conditions. Where scour is likely to occur, protection against damage from scour should be provided in the design of bridge piers and abutments. Embankment slopes adjacent to structures subject to erosion should be adequately protected by rip-rap, flexible mattresses, retards, spur dikes or other appropriate construction. Clearing of brush and trees along embankments in the vicinity of bridge openings should be avoided to prevent high flow velocities and possible scour. Borrow pits should not be located in areas which would increase velocities and the possibility of scour at bridges.

1.3.2 Hydraulic Studies

Hydraulic studies of bridge sites are a necessary part of the preliminary design of a bridge and reports of such studies should include applicable parts of the following outline:

1.3.2.1 Site Data

(a) Maps, stream cross sections, aerial photographs.
(b) Complete data on existing bridges, including dates of construction and performance during past floods.
(c) Available high water marks with dates of occurrence.
(d) Information on ice, debris, and channel stability.
(e) Factors affecting water stages such as high water from other streams, reservoirs, flood control projects, and tides.
(f) Geomorphic changes in channel flow.

1.3.2.2 Hydrologic Analysis

(a) Flood data applicable to estimating floods at site, including both historical floods and maximum floods of record.
(b) Flood-frequency curve for site.
(c) Distribution of flow and velocities at site for flood discharges to be considered in design of structure.
(d) Stage-discharge curve for site.

1.3.2.3 Hydraulic Analysis

(a) Backwater and mean velocities at bridge opening for various trial bridge lengths and selected discharges.
(b) Estimated scour depth at piers and abutments of proposed structures.
(c) Effect of natural geomorphic stream pattern changes on the proposed structure.
(d) Consideration of geomorphic changes on nearby structures in the vicinity of the proposed structure.

1.4 CULVERT LOCATION, LENGTH, AND WATERWAY OPENINGS

Culvert location, length, and waterway openings should be in accordance with the AASHTO *Guide on the Hydraulic Design of Culverts* in *Highway Drainage Guidelines.*

1.5 ROADWAY DRAINAGE

The transverse drainage of the roadway should be provided by a suitable crown in the roadway surface and longitudinal drainage by camber or gradient. Water flowing downgrade in a gutter section should be intercepted and not permitted to run onto the bridge. Short, continuous span bridges, particularly overpasses, may be built without inlets and the water from the bridge roadway carried downslope by open or closed chutes near the end of the bridge structure. Longitudinal drainage on long bridges should be provided by scuppers or inlets which should be of sufficient size and number to drain the gutters adequately. Downspouts, where required, should be made of rigid corrosion-resistant material not less than 4 inches in least dimension and should be provided with cleanouts. The details of deck drains should be such as to prevent the discharge of drainage water against any portion of the structure or on moving traffic below, and to prevent erosion at the outlet of the downspout. Deck drains may be connected to conduits leading to storm water outfalls at ground level. Overhanging portions of concrete decks should be provided with a drip bead or notch.

1.6 RAILROAD OVERPASSES

1.6.1 Clearances

Structures designed to overpass a railroad shall be in accordance with standards established and used by the affected railroad in its normal practice. These overpass structures shall comply with applicable Federal, State, and local laws.

Regulations, codes, and standards should, as a minimum, meet the specifications and design standards of the American Railway Engineering Association, the Association of American Railroads, and AASHTO.

1.6.2 Blast Protection

On bridges over railroads with steam locomotives, metal likely to be damaged by locomotive gases, and all concrete surfaces less than 20 feet above the tracks, shall be protected by blast plates. The plates shall be placed to