

## SECTION 3000 – PROJECT DESIGN

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## 3000 PROJECT DESIGN

### 3001 GENERAL OVERVIEW

This section is to help with the development and preparation of roadway, bridge, storm drain, and other projects. Projects require compliance with guidelines that are effective for traffic operations and highway safety, based on past use. Design personnel are expected to have enough flexibility to develop cost effective, efficient and safe projects that are compatible with the terrain and adjacent development.

### 3002 DESIGN FUNCTION

The design section coordinates District wide planning and design activities, aids in resolving conflicts, designs exceptions and assures that District, local, State and AASHTO standards have been met.

### 3003 DESIGN STANDARDS AND SPECIFICATIONS

The design policies and standards serve as a basic District guide in design work. They are not considered to be mandatory. The standards represent minimum values and are not a substitute for engineering knowledge, experience or judgment. Final designs should be of the highest quality possible, consistent with existing conditions.

### 3004 ROADWAY DESIGN STANDARDS

#### 3004.1 Roadway Design

Roadway planning and design for the public road system shall conform to the following guidelines and referenced specifications. Use the most current edition, unless otherwise specified.

1. American Association of State Highway Transportation Officials (AASHTO) Policy on Geometric Design of Highways and Streets.
2. AASHTO Roadside Design Guide.
3. AASHTO Guide for Development of New Bicycle Facilities.
4. Erosion and Sediment Control on Highway Construction Projects (FHWA, FHPM 6-7-3-1).
5. Idaho Department of Transportation Standard Drawings, Specifications and Current Supplementals (where applicable).
6. Idaho Standards for Public Works Construction (ISPWC).
7. AASHTO Materials Testing and Sampling Methods.
8. American Society for Testing and Materials (ASTM) Specifications.

9. Traffic Engineering Hand Book from Institute of Transportation Engineers.

10. Manual on Uniform Traffic Control Devices (MUTCD).

## 3004.2 Bridge and Culvert Design Standards

### 3004.2.1 Definitions

- a. Bridge Structures with Spans 60 inches and greater shall be classified as a Bridge.
- b. Culvert Structures with Spans less than 60 inches shall be classified as a Culvert.
- c. Freeboard is the clearance between the lower limit of the Bridge superstructure or the ceiling of the Bridge/Culvert and the design water surface elevation.
- d. Idaho Standards for Public Works Construction (ISPWC) Shall mean the latest edition of the ISPWC Manual and ACHD supplemental specifications adopted for use by ACHD.
- e. Span shall mean the entire length along which a Bridge deck is separated from the ground, measured parallel to the roadway centerline; or the diameter of the pipe for pipe Culverts.

### 3004.2.2 Bridges

#### a. Design Standards

1. Design Engineer – Licensed Professional Engineer licensed to practice in the State of Idaho.
2. Design Life – Structures shall be designed with a 75-year life per the latest edition of the AASHTO Load and Resistance Factor Design (LRFD) specifications.
3. Load rating requirements – Provide structural calculations sealed by the Design Engineer, showing the proposed Bridge design meets AASHTO Load and Resistance Factor Design (LRFD) specifications.
4. With the expectation of Bridges over the Boise River, all Bridges shall be single clear Spans.
5. Hydraulic Requirements
  - i. Bridges over controlled waterways shall meet minimum flow capacity and Freeboard requirements of the regulating authorities, including irrigation/drainage companies/districts and ACHD. ACHD requires a

minimum Freeboard of 1-foot.

- ii. Bridges over natural waterways shall be designed to safely convey the 100-year flood with a minimum Freeboard of 1-foot.

6. Allowed Bridge Types

- i. Reinforced Concrete Pipe
- ii. Precast Reinforced Concrete Box
- iii. Precast Reinforced Concrete Stiff Leg – Non-Integral or non-existent floor.
- iv. Prestressed Precast Reinforced Concrete Single “T” Beam
- v. Prestressed Precast Reinforced Concrete Double “T” Beam
- vi. Prestressed Precast Reinforced Concrete “Bulb T” Beam
- vii. Prestressed Precast Reinforced Concrete Voided Slab
- viii. Prestressed Precast Reinforced Concrete Box Girder
- ix. Cast in Place Reinforced Concrete
- x. Cast in Place Reinforced Concrete Stiff Leg – Non-Integral or non-existent floor.
- xi. Cast in Place Reinforced Concrete Box
- xii. Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS)
- xiii. Steel Girder
- xiv. Post Tensioned Beams or Slabs

- 7. Extensions of existing Bridges shall meet current design standards.

- 8. Segmented Precast Bridges – The Design Engineer shall apply one of the methodologies listed below:

- i. A design of the precast sections using a reduced wheel load distribution factor in accordance with the following:

Span Distribution Width	Reduced Wheel Load Distribution Factor
8'	3.24'
10'	3.30'
12'	3.36'
14'	3.42'
16'	3.48'
18'	3.54'
20'	3.60'
22'	3.66'
24'	3.72'
26'	3.78'
28'	3.84'
30'	3.90'

- ii. A deck design that places a concrete topping slab over the precast deck to distribute the wheel load across the longitudinal joint. The topping slab may be either composite or non-composite as determined by the Design Engineer.
  - iii. A design that places weld plates to transfer the wheel load across the longitudinal joint. This option requires that the Design Engineer submit calculations to ACHD demonstrating that the weld plate size and spacing is adequate to transfer the concentrated load across the joints.
  - iv. A three-dimensional analysis prepared by the Design Engineer shall be submitted to ACHD for approval on behalf of a precast manufacturer demonstrating that the wheel loads are distributed across the longitudinal joint adequately to transfer the concentrated loads across the joints.
9. Bridge Traffic Type/Use  
New or improved structures shall accommodate vehicle, pedestrian and bicycle traffic for both directions in a manner consistent with ACHD policy.
10. Bridge Width  
New structures shall be designed to accommodate the width of the approaching road section. Bridges within alleys shall be designed to accommodate the full width of the alley right-of-way.
11. Multi-Use Pathways Ped / Bike Bridges  
Bridges designed to accommodate pedestrian and bicycle traffic only shall be designed to all applicable industry standards and ACHD standards, or if they conflict, whichever is more stringent.
12. Railing  
All structures shall include the installation of ACHD standard railing as detailed in the ACHD Supplemental to the ISPWC.
13. Decorative Elements  
Decorative elements proposed on structures will only be allowed under a Temporary License Agreement with ACHD and will be installed and maintained by the Licensee. Decorative elements shall not create or have the potential to create a hazard to the traveling public, shall not inhibit access for inspection and maintenance,

and shall not create any additional maintenance responsibilities for ACHD.

14. **Vegetative Materials**  
Vegetative materials, even those not requiring irrigation, shall not be permitted on, under or above any structure, without approval and under a Temporary License Agreement with ACHD. Trees, large shrubs, and/or any water intensive plantings shall not be allowed. Small, shallow rooted native plantings requiring minimal irrigation and maintenance may be allowed.

15. **Curb Gutter & Sidewalk**  
6-inch standard vertical curb and gutter shall be required across Bridge to extend 50-feet beyond the Bridge termini on either side. Slopes behind sidewalk shall not be steeper than 3:1 and shall not start until after a minimum 1-foot flat area behind the sidewalk.

16. **Access**  
Inspection and maintenance access for ACHD shall be provided at all structures. Manhole-type access shall be provided at all closed ends of structures, and at any angle point in structure alignment. Access panels of 2-feet by 3-feet, hinged on one side, and weighing less than 50 pounds or a standard manhole ring and cover shall be installed. Standard manhole steps will be installed in alignment with the access opening; step spacing shall meet ISPWC requirements.

A permanent right-of-way easement shall be provided to ACHD to allow for unrestricted use and access for a minimum distance of 20-feet beyond the limits of any point of the Bridge or greater as deemed necessary by ACHD for inspection and maintenance.

17. **Waterproofing**  
All concrete Bridges that have cover or non-integral decks over the superstructure shall have a waterproof membrane.

18. **Scour Control**  
i. Bridges over natural drains and creeks designed to have open channel bottoms shall:  
• Provide a minimum of two-feet of cover over footings measured from the bottom of the channel;  
• Be designed with wingwalls;

- Include angular riprap placed on non-woven geotextile fabric throughout the channel under the structure and extending beyond the entrance and exit of the structure for a minimum distance to match the width of the channel. Fabric to meet ISPWC requirements.

- ii. Bridges over controlled ditches and canals shall:
  - Be designed with headwalls, wingwalls, aprons and cutoff walls;
  - Be designed with reinforced concrete floors;
  - If the adjacent channel is lined, the concrete floor and wingwalls shall connect to the lining;
  - If the adjacent channel is not lined, then angular riprap shall be placed on non-woven geotextile fabric at the entrance and exit for a minimum distance to match the width of the channel. Fabric to meet ISPWC requirements.

19. Wingwalls, Cut-off Walls and Aprons

The wing walls shall extend past the top of bank of the channel a minimum of 2-feet and extend a minimum 0.5 - feet above back of sidewalk elevation. Pre-cast wingwalls shall connect to the main Bridge structure using a designed closure pour.

Cut off walls and aprons shall be cast in place and shall be connected to the other elements with stubbed steel reinforcement. Cutoff walls will extend down a minimum of 3-feet or to the deepest footing bottom elevation, whichever is deeper.

20. Reinforcement

- i. Specify high strength corrosion resistant steel meeting ASTM Specification A1035/A 1035M-06 low carbon, chromium, steel bars for the top and sides of concrete structures.
- ii. Grade 60 steel will be allowed for non-integral abutments and footings only.
- iii. Epoxy coated steel is not allowed.
- iv. Specify 3 lbs/cy polypropylene microsynthetic fibers for deck, sidewalks, and headwalls.

21. Utilities

All new Bridges shall include conduits for future utility installations if the design of the Bridge allows as determined by ACHD. Installation will include three 4-inch conduits and two 6-inch conduits installed per ISPWC standards. Conduit terminus locations will be terminated at a Junction Box marked at finish grade.

Utility companies proposing to install facilities across existing structures shall submit plans to ACHD for review and approval.

b. Construction

1. Permits and Easements

ACHD right-of-way permits are required for all work in the existing or proposed right-of-way. Applicable permits and easements for other regulating authorities may be required and shall be obtained prior to commencement of any construction activities.

2. Pre-Cast Fabrication and Installation

The Pre-Cast facility shall hold Plant Certification accreditation by the National Pre-Cast Association (NPCA).

Precast sections shall be designed to fit together with overlapping structural joints with no more than a 1-inch gap. A durable and waterproof compression joint seal material at all joints is required. Seal shall be designed and constructed to last the life of the structure.

3. Inspections

All Bridges shall be inspected by ACHD inspection personnel. 48-hour notice is required for all inspection requests. This inspection shall take place during construction of pre-cast units or cast in place units. All on-site work will be inspected by ACHD. Structures that have been cast or installed without ACHD approval and/or inspection will not be accepted.

4. Cure times and loading

Part 1: Removal of forms and falsework structural elements.	Minimum Days <sup>1,2</sup>	Percent of Design Strength <sup>5</sup>
Side forms for: footings, abutment caps, pier caps, traffic and pedestrian barriers, and any other sideforms not supporting the concrete mass.	1	----
Columns, abutment backwalls, and retaining walls	3	50
Cantilever bridge deck sidewalks	7	----
Bridge decks, top slabs of concrete box culverts or stifflegs	10	80
Crossbeams, caps, box girders, T-beam girders, and flat slab superstructures	7	80



Part 2: Subsequent Loading <sup>4</sup> of structural element	Min. Days <sup>1</sup>	Percent of Design Strength <sup>5</sup>
Footings and abutments	3	80
Approach slabs, and bottom slabs of box girders with falsework in place.	5	80
Columns and walls	5	100
Bridge decks, top slabs of concrete box culverts or stifflegs and all other members	10	100

<sup>1</sup> From the time of the last placement in the forms or falsework supports and excluding the days when the surrounding temperature is below 40 °F for a total of four hours or more. The Contractor shall monitor the temperature during curing time by continuous recording thermometers.

<sup>2</sup> Do not remove forms until the concrete has sufficient strength to prevent damage to the surface or cause over stressing of the concrete.

<sup>3</sup> Where continuous spans are involved, the time for spans will be determined by the last concrete placed affecting any span.

<sup>4</sup> Except loads from formwork and reinforcing steel of further concrete placements.

<sup>5</sup> Standard concrete mix designs will typically not achieve strength in the minimum days shown.

### 3004.2.3 Culverts

#### a. Design

1. Culverts constructed using pipes shall meet ISPWC section 600 and approved ACHD supplements. Metal Culverts shall not be allowed, regardless of size or type of metal. Pipe Culverts shall be designed as a single pipe, multiple barrel systems are not allowed. Culverts other than pipes shall be designed following Bridge requirements.
2. Trash racks will be required for Culvert crossings whenever the upstream channel is open.
3. Headwalls and wingwalls shall be required if the Culvert ends are exposed into the channel and do not have a manhole or box structure.
4. Aprons and cutoff walls shall be required if the adjacent waterway is not lined. Culverts utilizing plastic pipes that are adjacent to open ditches shall have concrete ends installed.

5. Provide minimum cover in accordance with manufacturer's specifications for cover and compaction requirements if plans specify less than 2.0' of cover.

b. Hydraulic Requirements

1. Culverts in controlled waterways shall meet minimum flow capacity required by all regulating authorities to include irrigation/drainage companies/districts and ACHD.
2. Culverts in natural waterways shall be designed for the 100-year storm or flood, whichever is greater.
3. Culverts shall not flow under pressure (they shall be sized for open channel flow).

c. Access

Inspection and Maintenance Access for ACHD shall be provided at all structures. Manhole type access shall be provided at all closed ends of structures, and at any angle point in structure alignment. Access panels of 2-feet by 3-feet, hinged on one side, and weighing less than 50 pounds or a standard manhole ring and cover shall be installed. Standard manhole steps will be installed in alignment with the access opening; step spacing shall meet ISPWC requirements.

A permanent right-of-way easement shall be provided to ACHD to allow for unrestricted use and access for a minimum distance of 10-feet beyond the limits of any point of the Culvert or greater as deemed necessary by ACHD for inspection and maintenance.

d. Scour Control

Culverts other than pipes shall meet the scour control requirements of bridges.

Pipe Culverts in unlined channels shall include angular riprap placed on non-woven geotextile fabric extending beyond the entrance and exit of the structure for a minimum distance to match the width of the channel. Fabric will meet ISPWC requirements.

e. Construction

Culvert construction shall meet all applicable ISPWC requirements.

f. Permits and Easements

ACHD right-of-way permits are required for all work in the existing or proposed right-of-way. Applicable permits and easements for other regulating authorities may be required and shall be obtained owner/developer prior to commencement of construction activities.

g. Inspections

All Culverts shall be inspected by ACHD inspection personnel. 48-hour notice is required for all inspection requests. All on-site work will be inspected by ACHD. Structures that have been cast or installed without ACHD approval and/or inspection will not be accepted.

3004.2.4 Bridge Design Guide

Standard Drawings and additional construction details are contained in the separate ACHD Bridge Design Guide and are hereto made part of this policy by reference and shall be adopted by Resolution of the ACHD Board of Commissioners.

3004.3 (Reserved)

3004.4 Storm Drain Design Standards

Design of storm drain related facilities shall be completed in accordance with section 8000, STORM WATER MANAGEMENT and appropriate subsections.

3005 PROJECT CHECKLIST

The purpose of the Project Development Checklist (Exhibit 1) is to provide a guideline in the development of various types of projects. This checklist should be a useful tool to the designer to prevent overlooking a project activity and also to evaluate the current status of a project. Some of the items shown on the checklist will not be necessary for some projects, while additional items may be necessary for other projects.

3006 BRIDGE DESIGN GUIDE

3006.1 Submittal Requirements

The following elements shall be included with all Bridge submittals:

1. Provide situation & layout sheet on civil plans referenced to survey control line.
2. Provide survey ties to known government and local monuments.

3. Provide stationing and offset for corners of barrel section and ends of wingwalls.
4. Provide a geotechnical report, stamped and signed by a geotechnical engineer licensed in the State of Idaho. The geotechnical report shall include a bore hole at the proposed Bridge site, provide soil bearing capacity, recommendations for site preparation, and the type, thickness of bedding and backfill. The civil plans shall show the locations of geotechnical bore logs with reference to geotechnical report.
5. Provide a cross section of roadway showing deck wear surface or fill over structure, the proposed sidewalk, and the proposed slope behind sidewalk.
6. Provide a cross section of Bridge barrel section.
7. The Hydraulic Grade Line (HGL) and high water mark shall be shown on the Bridge plans.
8. Show limits of excavation, type of backfill, and compaction requirements.

#### 3006.2 Concrete Mix Designs

All concrete mix designs shall be submitted to and approved by ACHD a minimum of 48 hours prior to construction or ordering of concrete products.

#### 3006.3 Waterproof Membrane

1. The membrane shall be Pre-coated Pre-formed Membrane consisting of prefabricated sheets which may be self-adhesive or may require a separate bonding agent.
2. Ensure application, surface preparation and primer (if required) is in accordance with manufacturer's recommendations. Lap joints between sheets of the membrane at least 2 in. Ensure the membrane sheet system does not have wrinkles.
3. Provide a detail to show the waterproof membrane wrapped over top and sides of the structure down to the footings.
4. Protect the membrane with concrete sand.

#### 3006.4 Pavement section over Bridges

1. Cast in place concrete wear surfaces shall have a minimum thickness of 6-inches.
2. A minimum 2-inches of concrete sand shall be used to protect the waterproof membrane when base aggregate is used over the structure.
3.  $\frac{3}{4}$ " minus base gravel shall be a minimum of 2-inches thick.

4. When pit-run is used over the structure, it shall be placed over a minimum 2-inches of sand and 4-inches of  $\frac{3}{4}$ " minus. The minimum thickness of pit-run shall be 1.5 times the largest nominal aggregate size. Pit-run shall be capped with a minimum of 4-inches of  $\frac{3}{4}$ " minus and 2.5 inches of asphalt pavement.
5. Asphalt pavement shall be a minimum thickness of 2.5 inches and shall not be placed directly on the membrane.

#### 3006.5 Riprap

Riprap will be sized to resist movement at the designed maximum flows. Minimum size (D50) will be 12-inches in diameter, layered to a minimum thickness of 2 times D50. Riprap shall be angular having at least 2 broken or jagged faces.

#### 3006.6 Design Drawings

Excavation and Backfill

Curb Attachment to Deck

Cutoff Wall Detail

Footing Base Preparation

Precast Grouting

Precast to Footing

Railing Connection

RCP to Headwall Connection

Typical Section

Waterproofing

Wingwall Backfill