R6 Trail Bridge Standard Drawing/Design Aid Guidelines
March 2005

The Region 6 Trail Bridge Standard Drawing/Design Aids (developed in conjunction with Region 1) have been in use for over a year. We recently completed a major revision which updated the drawings to allow more flexibility and ease of use. The following instructions show when the design aids are applicable and how to use them effectively. These instructions should be used only as additional guidance to the FSH 7709.56b, Transportation Structure Handbook. These standard plans, design aids, and instructions were created to promote efficient and effective trail bridge design and construction by Forest personnel. Successful designs must mesh with customer needs. Trail bridge designs should be closely coordinated with Forest Recreation staff so they become familiar with the standards plan/design aids.

All previous Region 6 trail bridge standard drawings are obsolete and **SHOULD NOT BE USED.**

Design Specifications: The standard plan/design aids have been designed and developed in accordance with FSM and FSH direction.

Design Authorities: FSM 7722.04a, assigns trail bridge design authority to the Regional Director of Engineering or those delegated authority (in the Pacific Northwest Region bridge design authority is delegated to the Regional Bridge Engineer). FSH 2309.18, 3.16, b, 7 (Trail Management Handbook) delegates trail bridge design approval to the Forest Engineer if standard plans are available. The intention of these new standard plan/design aids are to replace all existing standard plans and delegate direct authority for the use of these new standard plan/design aids by the Forest Engineers. The Regional Bridge Engineer's signature and date have been placed on a hard copy of each of the detail sheets, identifying them as a standard plan prepared, and approved by the Regional Director of Engineering. The Forest Engineer must approve the bridge contract by signing all sheets in the Signature Block. Electronic AUTO CAD and PDF files are available on the R6 website for all the standards drawing sheets.

It is the responsibility of the Forest Engineer to:

1. Verify preliminary and final design requirements of FSH 7709.56b have been completed (site survey, location, hydraulic design, etc).
2. Determine if the standard plan/design aids are adequate for the proposed bridge site.
3. Ensure any forest revisions maintain the design integrity of the original standard plan/design aids.
4. Sign all sheets identifying the project and other specific project design information.

The Regional Bridge Group is available as needed at any time in the preliminary or final design process.

New Trail Bridge Standard Drawing / Design Aids: Each trail bridge standard plan / design aid includes a title sheet with a schematic of the bridge, and superstructure detail sheets. Each sheet is discussed further below.

- **Title Sheet and Project Design Criteria:** The Forest must revise this sheet to incorporate the proper project name, and identify the Project Design Criteria. The criteria to be established or identified include design loading, span, width, member size, railings, treatments, etc.
- **Design Aid Sheets:** The Design Aid sheets typically detail the superstructure and include design table with member sizes corresponding to various spans and loadings and all details needed to build the bridge superstructure and applicable connection/bearing details. The sheets are applicable for the spans and loadings shown in the design tables. For longer spans or heavier design loads, contact the Regional Bridge Group. The sheets were developed without specific bridge spans or widths dimensioned and alternative railing details. By identifying the bridge span, width, handrail, treatment and other options in the Project Design Criteria, persons building the bridge will be able to identify the proper details for the superstructure. The superstructure detail sheets are generic to span and width and the intent is they generally do not need to be revised or altered for each project.

In addition to the Title Sheet and Superstructure Detail Sheets, abutment details must be developed for a complete trail bridge package. The abutment detail sheets must be prepared by the Forest for each specific project. Example abutment details are included to provide guidance to the forest in preparing proper foundation details for trail bridges. The example abutment sheets can be modified by the Forest for each specific project, or new sheets can be prepared.

The following standard plan bridge types are included:

- **Glued-Laminated Stringer Trail Bridge, RA800**: This standard plan / design aid uses glued-laminated timber stringers and a plank deck. The plan details either a handrail or curbs only. Applicable spans are from 25 feet to 60 feet and any width. The plans includes superstructure and detail sheets for stringers spaced at 4-foot or 2-foot maximum spacing. Access, weight, etc., may influence the optimum spacing/number/size of stringers.
- **Glued-Laminated Longitudinal Slab Trail Bridge, R810:** This standard plan / design aid uses longitudinal glued-laminated slab panels with transverse tie rods. Applicable spans are from 10 feet to 35 feet and any width.
- **Single Log Stringer Trail Bridge, RA820:** This standard plan uses a single log stringer and handrail. Preservative treatment to the log stringer is recommended (see Preservative Treatments discussion below).
- **Log Stringer Trail Bridge, RA840:** This standard plan / design aid uses log stringers and a plank deck. Preservative treatment to the log stringers is recommended (see Preservative Treatments discussion below). The plans provide

details for both sawn and pole handrail and curbs. Applicable spans are from 10 feet to 40 feet and any width.

- **Solid Sawn Timber Stringer Trail Bridge, RA850:** This standard plan / design aid uses solid sawn timber stringers with a plank deck. The plans detail either a handrail or curbs only. Applicable spans are from 10 feet to 40 feet and any width.
- **Prefabricated Steel Truss Bridge Spans 100 feet of less, RA870:** This standard plan / design aid provides guidance for purchasing prefabricated steel truss bridges and sizes and details for a concrete sill abutment. The plans require the contractor to provide a design prepared by a qualified professional engineer for the bridge and abutments. All contracts using these plans must require design and shop drawing submittals. The span length has been limited to 100 feet. A concrete grade beam abutment foundation is a minimum requirement. Erection of a prefabricated steel truss bridge may require intermediate, in-stream bents or shoring and must be identified as an option in the Project Design Criteria.
- **Typical Abutment Details, RA890, RA891, and RA892:** Abutment plans and details must be developed by the Forest as part of the contract package for every trail bridge. Abutment plans are too site specific to develop standard plans, however, typical, recommended details are provided. These abutment sheets illustrate typical details. The sheets show:
    - An abutment detail sheet, RA890.
    - Foundation alternatives for Geocell and Rock Gabions, RA 891. (Use of geocell will require an SPS that is included with this package.)
    - Foundation alternatives for a concrete leveling pad and timber crib, RA892.

  The details are adequate for the standard superstructures.

GENERAL INSTRUCTIONS FOR USE: The standard plan / design aids show typical superstructure designs. However, proper bridge design includes many other aspects, some of which are discussed further below.

- Location and access.
- Site survey.
- Foundation capacity.
- Span length.
- Preservative Treatments.
- ADA Compliance.
- Design loading determination
- Hydraulic analysis.
- Abutment Details.
- Width requirements.
- Handrail or curbs only.
- Special project specifications.

Proper attention to these aspects will determine a successful design. FSH 7709.56b provides direction on these aspects and will not be reiterated here. The below discussions are instructions and guidance on how to use the standard plans with respect to these aspects and the possible variables and decisions to be made.

Location and Access: The location and access to a trail bridge project is the single most influential factor in selecting a bridge type and ultimately costs. Prior to selection of a bridge type, the location and access must be considered with respect to equipment, tools, force account crew or contractor skills. Easily accessible bridges can be constructed quickly and efficiently and most any bridge type can be used. Bridges located in

backcountry or wilderness areas that require helicopter use, mule packing, traditional tools, etc. will require special considerations when selecting the bridge type. The variables are too great to discuss briefly in these guidelines but must be considered at the earliest stages of project development.

Design Loading: Each trail bridge type (except Prefabricated Steel Truss) includes a design table identifying member sizes with respect to spans and design loadings. Each table lists two pedestrian live loads, 65 and 85 psf and three snow loads, 120, 150, and 200 psf. The Forest Engineer must determine and identify the design pedestrian and snow loading and the corresponding member size for the bridge span within the Project Design Information. Please note that design code requirements allow different factors of safety for pedestrian and snow loads, and thus some member sizes for 120 psf snow load are smaller than required member sizes for 85 psf pedestrian live load.

- **Pedestrian Live Load**: Manual direction establishes 85 psf as the pedestrian live load. Pedestrian live loads for backcountry or wilderness trail bridges (bridges on trails other than Rural or Urban ROS classifications), may justify a reduction from the 85 psf. The pedestrian live load for backcountry or wilderness trail bridges with a low probability of being fully loaded may be reduced, but not less than the 65 psf. However, designers are cautioned that the 85 psf live load provides significant overload capacity and long-term durability benefits that a reduction to 65 psf will not
- **Ground Snow Load**: The 50 year recurrence design ground snow load is to be determined for each site. If local values are unavailable, the following publications are recommended:
  - Washington: *Snow Load Analysis for Washington,* Second Edition, Structural Engineers Association of Washington.
  - Oregon: *Snow Load Analysis for Oregon,* Revised 2/78. Published by The Structural Engineers Association of Oregon, June 1971.

Foundation Capacity and Abutment Details: The Forest Engineer must develop abutment details specifically for the bridge. The example abutment details assume good well-drained subgrade material free of clays and silts with an allowable soil bearing pressure of 4000 psf. If little foundation information is available, it is recommended to install gabions or geocell below a timber or concrete abutment sill to distribute loads, and provide added stability and protection against settlement and scour. The intent of the abutment details is to provide positive attachment of the superstructure to the substructure, adequate bearing on the subgrade, proper drainage, treatment of materials to prevent decay, and protection against scour.

Span Length: The Forest Engineer must identify a span length for the bridge in the Project Design Information. A hydraulic analysis is needed to determine the required span length. Trail bridges should be designed to pass 100 year flood events with adequate freeboard clearance for debris and to span the bank full width for any fish bearing stream. The bridge should provide additional clearance or protection against stream scour.

Bridge Width: The Forest Engineer must identify a bridge clear width in the Project Design Information. The width determines the number of stringers needed. Trail bridge widths vary with the type of use but typical widths are 4, 6, or 8 feet. The width of the bridge should be determined in cooperation with the Forest Recreation staff.

Stringer, Log, Slab Panel Number and Size: The Forest Engineer must identify number and size of stringers, logs, or slab panels needed in the Project Design Criteria (if applicable). The number of stringers, logs, or slab panels must be determined from the bridge width, the required edge distances, and the maximum spacing requirements shown on the typical section. The stringer, log, or slab panel size is to be selected from the design table for the required span and loading.

Handrails or Curbs: Forest Engineer must identify whether handrail or curbs will be used in the Project Design Criteria. We recommend the Forest work with the recreation personnel to make this decision. In general, rails are required for all trail and pedestrian bridges with more than 8 feet of vertical drop. Railings may be eliminated and curbs substituted when an appropriate analysis, as described below, has been completed.

- An analysis has identified and evaluated the potential users and determined that the potential hazards of the trail is the same or greater than that of a bridge without a rail. The analysis should include the possibility of using a rail on only one side of the bridge. In general, rural and urban ROS settings with systems with difficulty levels described as “easiest” will have small children and more inexperienced users. Thus, a railing is warranted in most instances. In backcountry or wilderness settings with the trail system difficulty being “more” or “most difficult”, the users will be experienced and curbs may be adequate.

Bridge Rail Maximum Opening (Prefabricated Steel Truss only): Forest Engineer must identify if additional safety rails are required, or if a timber rub rail is adequate. The same criteria shown above for Handrails and Curbs should be applied.

ADA Compliance (Prefabricated Steel Truss only): Forest Engineer must determine with recreation if the trail and bridge are to meet ADA requirements. If ADA compliance is required, the handrail detail may be needed. Other details may be substituted.

Preservative Treatments: Forest Engineers must identify a timber preservative treatment in the Project Design Criteria. Preservative treatment is strongly recommended for all timber abutment and superstructure members. Proper preservative treatment will provide a 50 year or longer life for the members. If no treatment is used the expected life is 10 to 15 years. In most instances, a life cycle analysis will show a treated bridge is significantly more cost effective than an untreated bridge.

A number of preservative treatments options are listed in the Project Design Criteria. ACQ treatment is highly corrosive and should not be used with the Prefabricated Steel Truss bridges. All steel in contact with ACQ treated wood must be galvanized. In lieu of using treated handrail, redwood or cedar may be substituted for handrails.

If more information is needed to select a preservative treatment, contact the Regional Structures Group

Running Planks: Forest Engineers must identify whether running planks are to be included (and if they are to be treated) in the Project Design Criteria. We recommend running planks for bridges with stock use. If stock use is heavy, and damage from wear is significant, untreated planks may be practical. If ADA compliance is required, running planks should be full width of the bridge if used.

Construction and Special Project Specifications: The Standard Specifications for Construction and Maintenance of Trails is not an adequate specification for trail bridges, and should not be used. The following Special Project Specifications, based on the 1996 FS Specifications, are available on the R6, Engineering website:

- **SPS 106 – Measurement and Payment.** This SPS is to be added to all construction packages that have been prepared using the 1996 Standard Specifications and are using English units. The 1996 Standard Specification is metric and this SPS provides for the use of English units for the drawings and pay items.
- **SPS 557 – Timber Structures.** This SPS is a simplified, more applicable specification for timber structures than the current 557 section in the Standard Specifications. This SPS should be added in all trail bridge packages using timber.
- **SPS 260 – Geocell Abutment Stabilization and 726 – Geocell.** Any time geocell is included in the design package, these two SPS's need to be included in the package.

These SPS's will be updated to the FP-03 by July of 2005.

Construction Cost Estimates: Estimating trail bridge construction costs can be difficult due to the variability of location and access. Easily accessible bridges can be constructed quickly and efficiently. Bridges located in backcountry or wilderness areas that require helicopter use, mule packing, traditional tools, and etc. will be expensive.