REVIEW DRAFT

I-5 Columbia River Crossing Partnership:
Conceptual Engineering & Environmental Analysis

Evaluation of Design Guidelines & Criteria

Technical Memorandum #B.1.5

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EXECUTIVE SUMMARY

This technical memorandum provides an evaluation of the design guidelines and criteria associated with the I-5 Columbia River Crossing as well as the design units and platform to be used in the upcoming Draft Environmental Impact Study (DEIS) project. The evaluation found that the Oregon Department of Transportation (ODOT) and Washington State Department of Transportation (WSDOT) both have well-established design standards that generally meet or exceed the guidelines set forth by the American Association of State Highway Transportation Officials (AASHTO). However, while many of the standards are consistent between the agencies, there are a number of criteria in which the standards of each agency differ. The key design criteria with differences are listed below:

- Design speed
- Right side shoulder width
- The use of spirals
- Vertical clearance
- Stopping sight distance

For the majority of the Bridge Influence Area (BIA), the specific design standards of WSDOT and ODOT should be used for portions of the project north and south of the river, respectively. At the Columbia River crossing structure, where the two jurisdictions meet, a uniform set of design values must be adopted. A preliminary consultant team recommendation regarding a uniform set of design criteria for this portion of the project is summarized in Table 5. These design guideline and criteria recommendations as well as the design unit and platform recommendations will be summarized and presented to the agencies in Technical Memorandum #B.1.6 and PowerPoint Presentation #B.1.7 during a formal project meeting for comment and discussion.

INTRODUCTION

Interstate 5 (I-5) within the BIA falls under the jurisdiction of Oregon Department of Transportation (ODOT) south of the Columbia River and under Washington Department of Transportation (WSDOT) north of the Columbia River. Each jurisdiction has very specific design criteria, and at this stage it is the desire of each agency to meet their own standards within their respective jurisdictions. The bridge across Columbia River is the only piece of the overall design that ties the two sets of design criteria together.

This technical memorandum compares the ODOT and WSDOT design units, design platforms, and design criteria, and identifies various similarities and differences associated with these key design elements of the I-5 Columbia River Crossing project. In addition, the agency's design guidelines and criteria were also compared to the guidelines of the American Association of State Highway and Transportation Officials (AASHTO) (Federal Highway Administration requirements).

DESIGN TOOLS

Design Units

The study area along I-5 stretches across two states (i.e., Washington and Oregon). The previous work conducted within the I-5 Bridge Influence Area in Washington State was done in English Units, while the work in Oregon State was done in Metric Units, but conveyed in deliverables as English units. ODOT has recently converted back to the English Unit System.

Therefore, to bring the design concepts for the Full Corridor Concepts and within the Bridge Influence Area (BIA) to the same design units, the concepts developed in Oregon will be converted to English Units. Furthermore, it is the consultant team's preliminary recommendation that all future concepts and alternatives be developed using the English Unit System.

Design Platform

Both WSDOT and ODOT currently use MicroStation V8 as their Computer Aided Drafting (CAD) software package. WSDOT currently uses Casey as their design package, but will be switching to InRoads early in 2005. ODOT is already using InRoads as their design package. Therefore, by the anticipated start of the Draft Environmental Impact Statement (DEIS) of this project (March 2005), the exchange of design files between the two agencies should be consistent. As a result, it is the consultant team's preliminary recommendation that all future concepts and alternatives be developed using a design platform consisting of MicroStation V8 and InRoads.

DESIGN GUIDELINES AND CRITERIA EVALUATION

The following section provides an evaluation of the two agency's design guidelines and criteria in regards to the I-5 Columbia River Crossing Bridge Influence Area. This evaluation includes an annotated bibliography of the primary design reference documents, design requirements, and the potential conflicts between the current design guidelines and criteria utilized by each agency and the AASHTO guidelines.

Annotated Bibliography

As stated before, ODOT and WSDOT are the leading agencies within the BIA, and their respective design guidelines will govern the majority of design work. Table 1 references the documents that will be applicable to the interstate highway system.

Table 1. Summary of Design References

Document	Author	Publication Date	Summary
A Policy on Geometric Design of Highways and Streets	American Association of State Highway and Transportation Officials	2001	National Guidelines within United States of America
English 2003 Highway Design Manual	Oregon Department of Transportation (ODOT)	2003	Uniform standards and procedures for ODOT
Design Manual (M 22-01) English	Washington Department of Transportation (WSDOT)	2002	Policies, procedures and methods for developing and documenting design in Washington State.
Manual on Uniform Traffic Control Devices	Federal Highway Administration (FHWA)	2003	National standard for traffic control devices on all public roads open to public travel

At interchanges where the highway facilities connect to local streets, there may be transitions from the applicable state standards to the standards of the appropriate local agency (e.g., City of Portland, City of Vancouver, Tri-Met, C-Tran, etc.). In addition, a variety of external factors will also govern the design requirements within certain areas. These include the guidelines/requirements of the United State Coast Guard (at the river crossing), Federal Aviation Administration (in the vicinity of the airport), and Burlington Northern Santa Fe Railroad (at railroad crossings).

Primary Design Requirements

This section focuses on the three main components of geometric highway design: cross-section elements, horizontal alignment, and vertical alignment. Although there are numerous design elements under each design component, only the critical elements are summarized in this memorandum. The rest of the design elements can be found in the relevant design references listed in Table 1.

Cross-Section

Table 2 summarizes the design values for key elements of the typical cross section. In addition, elements such as tunnels, light-rail requirements, utility easements, and setbacks (right-of-way requirements) will also add to the complexity to determine the final impact area of an alternative.

Table 2. Summary of Cross-Section Criteria

Element	ODOT	WSDOT	AASHTO
Design Speed	~~60~~ m.p.h. – 60 only with concurrence from Roadway Manager – This section of freeway is currently designed for 70 mph.	70 m.p.h.	60-70 m.p.h.
Traveled Way Width*			
Mainline Lanes:	12 feet	12 feet	12 feet
Single-Lane Ramps$^{\Delta}$:	16 feet	15 feet	14 feet
Double-Lane Ramps$^{\Delta}$:	24 feet	25 feet	24 feet
Shoulder Width*	10 - 12 feet – depends if a barrier is present or not -		
Mainline:	12 feet †		
Left		10 feet	12 feet †
Right		10 feet	12 feet †
Single-Lane Ramps:	4 feet		
Left	6 feet – add 2' in barrier sections	2 feet	2-4 feet
Right		8 feet	8-10 feet
Double-Lane Ramps:	6 feet		
Left	10 feet – add 2' in barrier sections	4 feet	2-4 feet
Right		8 feet	8-10 feet
Median Width (Minimum)	26 feet	22 feet	22-26 feet
Normal Cross Slope*	2.0 % (inside two lanes) 2.5 % (outside lanes)	2.0 %	2.0 %
Horizontal Clearance*	*Follow 2002 AASHTO "Roadside Design Guide"*		
Vertical Clearance*	17 feet	16.5 feet	16 feet

* Design elements considered by AASHTO to be of sufficient importance to require a Design Exception Request if design criteria are not met.

$^{\Delta}$ Ramp traveled way width generally depends upon degree of horizontal curvature. Values shown are for tangent or large-radius segments.

† The shoulder width may be 10 feet where the directional design hourly volume of truck traffic is less than 250 vehicles per hour. (this section of freeway exceeds 250 – 12' would be the norm)

Horizontal Alignment

Table 3 highlights the design standards associated with key elements of the horizontal alignment.

Table 3. Summary of Horizontal Alignment Criteria

Element	ODOT	WSDOT	AASHTO
Design Speed	~~60~~ 70 m.p.h.	70 m.p.h.	60 – 70 m.p.h.
Minimum Radius (Maximum Degree of Curve) *	~~1,150~~ 1762' feet (~~5° 00'~~) 3 deg. 15 min.	1,640 feet (3° 30')	1,205 – 1820 feet (4° 45' – 3°10')
Superelevation*	8. ~~50~~ % - 12% on ramps	10.0 %	8.0 %
Spiral Curves	Use spirals for all curves with a degree of curve 1° or sharper	No longer in use on new highway construction	Not mandatory

* Design elements considered by AASHTO to be of sufficient importance to require a Design Exception Request if design criteria are not met.

Profile

Table 4 outlines the standards for key vertical alignment elements for each agency.

Table 4. Summary of Profile Criteria

Element	ODOT	WSDOT	AASHTO
Design Speed	~~60~~ 70 m.p.h.	70 m.p.h.	60 – 70 m.p.h.
Tangent Grade*	~~5~~ 3.0 %	5.0 %	3% (see Fed. Guidelines) 4.0 %
Vertical Curvature*			
Crest Curves	K = 401 ~~245~~	K = 550	K = 151 – 247
Sag Curves	K = 181 ~~136~~	K = 215	K = 136 – 181
Stopping Sight Distance (object height)*	730 ~~570~~ feet (0.5 feet)	855 feet (0.5 feet)	570 – 730 feet (2.0 feet)

* Design elements considered by AASHTO to be of sufficient importance to require a Design Exception Request if design criteria are not met.

Potential Conflict Areas and Proposed Resolution

As can be seen in the information summarized in Tables 2 through 4, both ODOT and WSDOT have well-established design standards that generally meet or exceed the guidelines set forth by AASHTO. There are a number of criteria, however, on which the standards of each agency differ. The key design criteria with differences are listed below:

- Design speed
- Right side shoulder width
- The use of spirals
- Vertical clearance
- Stopping sight distance

For the majority of the project area, the appropriate design standards of WSDOT and ODOT should be used for portions of the project north of the river and south of the river, respectively. At the Columbia River crossing structure, where the two jurisdictions meet, a uniform set of design values must be adopted. For this portion of the project, the consultant team preliminarily recommends the following design criteria:

Table 5. Preliminary Consultant Team Recommendation for Design Criteria at Columbia River Bridge Structure

Element	Recommended Design Value	Comment
Design Speed	70 m.p.h.	WSDOT standard.
Mainline Lane Width*	12 feet	ODOT, WSDOT, and AASHTO standards.
Mainline Shoulder Width*		ODOT standard and AASHTO recommended values. Meets or exceeds WSDOT minimums.
Left	12 feet †	
Right	12 feet †	
Median Width (Minimum)	26 feet	ODOT standard. Exceeds WSDOT minimum.
Normal Cross Slope*	2.0 % (2.5% for outer lanes)	WSDOT standard and recommended AASHTO value.
Vertical Clearance*	17 feet	ODOT standard. Exceeds WSDOT and AASHTO minimums.
Maximum Superelevation*	8.0 % -(12% for ramps)	ODOT standard and AASHTO recommended maximum rate for snow and ice conditions.
Minimum Horizontal Curve Radius*	1,820 feet	AASHTO standard for 70 m.p.h. design speed and 8% superelevation.
Maximum Grade*	~~3~~ ~~5~~.0 %	ODOT and WSDOT standards.
Object Height for Stopping Sight Distance	0.5 feet	ODOT and WSDOT standards.
Stopping Sight Distance	730 feet	AASHTO guideline for 70 m.p.h. design speed. Note: WSDOT standard is higher.
Vertical Curvature*		ODOT standards for 70 m.p.h. design speed and 730-foot SSD (based on 0.5-foot object height). Note: WSDOT design standards are higher.
Crest Curves	K = 401	
Sag Curves	K= 181	

* Design elements considered by AASHTO to be of sufficient importance to require a Design Exception Request if design criteria are not met.

† The shoulder width may be 10 feet where the directional design hourly volume of truck traffic is less than 250 vehicles per hour.

NEXT STEPS

The preliminary consultant team design guidelines and criteria recommendation presented herein will be summarized and presented in Technical Memorandum #B.1.6 and PowerPoint Presentation #B.1.7 to the agencies for comment and discussion. Based on the result of these discussions, the recommended design guidelines and criteria for the I-5 Columbia River Crossing Bridge Influence Area will be documented in the final draft of Technical Memorandum #B.1.6.