

I-90 Bridge Technical Review

ESHB 2358 Sec. 305(27), WSDOT Program D – Capital

...I-90/Two-Way Transit-Transit and HOV Improvements, Stages 2 and 3. Of these amounts, up to \$550,000 of the transportation partnership account - - state appropriation is to provide funding for an independent technical review, overseen by the joint transportation committee, of light rail impacts on the Interstate 90 – Homer Hadley Floating Bridge. The technical review shall complement sound transit's current and planned engineering design work to expand light rail in the central Puget Sound region. The department shall coordinate its work with sound transit and seek contributions from sound transit for the review.

DRAFT SCOPE OF WORK

April 8, 2008

I. Background

The central Puget Sound region is home to Fortune 500 corporations such as Microsoft, Boeing and Starbucks, while serving as a primary gateway for the movement of goods to and from East Asian markets through its world class ports and terminal facilities. The region has only two transportation facilities crossing Lake Washington: I-90 and SR 520 Floating Bridges. The Puget Sound area is faced with a growing population and increased congestion on these key regional links. The Central Puget Sound region has a steadily growing population with an estimated 3.5 million people in 2005 and is projected to grow to over 4.6 million by 2030 with notable growth assumed on the east side of Lake Washington.

For the I-90 Corridor, past studies and regional agreements have identified I-90 as the preferred corridor for high capacity transit, light rail. The I-90 roadway and floating bridges link the City of Seattle with the island community of Mercer Island and communities on the east side of Lake Washington. During an average weekday the I-90 roadway carries approximately 133,000 vehicles per day. It is for these reasons that Sound Transit is preparing the corridor to accommodate high capacity transit in the form of light rail across the I-90 floating bridge.

The Homer Hadley Floating Bridge was designed in the early 1980s. The design for the bridge was supported by the 1976 Memorandum Agreement signed communities and jurisdictions along the I-90 corridor to support the development of high capacity transit in the center roadway, the Homer Hadley Floating Bridge. As part of the bridge design process, the design included analysis of the bridge for light rail (LRT) loads which had different axle spacing for loads than current Sound Transit LRT loading standards. This previous analysis assumed that the center roadway HOV (South side) lanes would be converted to LRT. The effect of the large movement transition span joints at each end of the bridge on the LRT rails were recognized as an issue but were not addressed. It was assumed that rail/expansion joint issue would be addressed during design of LRT on I-90 across Lake Washington.

Beginning in 2001, studies and tests were initiated to evaluate the effects of LRT on the floating bridge utilizing current Sound Transit LRT loads. These structural feasibility studies performed by the consulting firm, KPFF assessed LRT in the center roadway and adding an HOV lane to the outer westbound roadway. The analysis showed LRT conversion modifications were structurally feasible with weight mitigation measures on the bridge and limitations on track system weight.

In 2005, fully loaded large trucks were run across the Homer Hadley Bridge to simulate an LRT system based on current Sound Transit train and track standards. The bridge was fully instrumented to record pontoon deflections and stresses during the test. The data from the load test demonstrated close correlation to the simpler computer model used in the 2001 Structural Feasibility Studies with minor modifications. LRT loads were combined with original design load combinations like wind, wave, temperature, dead load and pre-stress.

The analysis showed that LRT loading combined with the 1-year storm loads produced stresses that were 97% of the allowable stresses becoming the controlling case for operational limitations of LRT. The allowable stress protects for projected bridge fatigue and does not represent the ultimate factor of safety.

In 2006, Governor Christine Gregoire restated the state's previous commitment to dedicate the center roadway to light rail or light rail convertible bus rapid transit. During this year, the Sound Transit Board also identified light rail as the preferred mode for high capacity transit across the I-90 Bridge.

During summer and fall 2007, Sound Transit prepared preliminary concept studies for:

- Rail Expansion Joints Across The Transition Spans Joints
- LRT-Induced Vibrations
- Overhead Catenary System (OCS)
- Stray Current Issues (Structures and Utilities)
- Instrumentation of Transition Spans Joints For Current In-Service Motions

Sound Transit intends to expand structural analysis of light rail and mitigation to the Homer Hadley Bridge during the design phase of East Link, following the funding of light rail across Lake Washington from Seattle to Redmond.

II. Purpose of Independent Review

The purpose of the independent review is to evaluate the original bridge analysis, subsequent studies, tests, and preliminary concept studies to confirm the feasibility to install and operate LRT on the Homer Hadley Floating Bridge. In order to assess the feasibility of installing and operating LRT on the Homer Hadley Floating Bridge, Sound Transit is preparing some preliminary analysis to support this study. While there are similar developments of light rail across suspension bridges, there is no precedent in the world for implementing light rail across a floating bridge.

The following areas should be addressed as part of the independent structural review:

1. Review Sound Transit conceptual proposals for stray current mitigation and recommend areas of further investigation, and design milestones through PE and final design. Specifically, designs for isolating stray current that avoids corrosion of the steel reinforcing and other metal elements of the existing floating bridge and transition spans.
2. Review Sound Transit standard drawings for the light rail track and power system. Determine the extent of impact to LRT track system (including catenary poles, track ties, and safety rails) installation from embedded steel and moisture from lake effect on the bridge. Recommend design approaches for attaching the LRT track system to the pontoon, elevated roadway, and transition span decks that maintains the reinforcing steel, post-tensioning cables, other metallic imbeds; and limits existing concrete installation damage to an acceptable levels. Identify LRT operational factors, if any, from the avoidance of embedded steel bridge components during LRT track system installation should the material preclude full track system (bolts, plinths, ties) installation.
3. Review the previous load test data, perform preliminary analysis as required to evaluate structural feasibility and recommend additional analysis needed to determine the operational “storm” limitation on the floating bridge in combination with LRT dead and live loads. Review weight mitigation measures for sufficiency of loads.
4. Assess impact of weight mitigation measures on bridge life, effects of LRT track system on existing maintenance and operations policies, recommend new policies, maintenance criteria and potential work force and cost increases needed to accommodate LRT beyond existing bridge maintenance practices and budget, and recommend any additional analysis.
5. Review the effects (including eccentricity) of the LRT dead/live loads and rails on the transition span expansion joints, bridge decks, and other bridge elements and make recommendations for design criteria.
6. Review the proposed rail expansion joint design and provide any additional comment or suggestions to accommodate anticipated joint movements and any associated modifications to the bridge.

III. Agency Roles

The role of the WSDOT is to support the Joint Transportation Committee’s commission of the independent review panel by serving in the following functions: Contract administrator, technical expertise on bridge preservation, maintenance and operations, and project management for the review process.

The role of Sound Transit is to support the Joint Transportation Committee in providing technical expertise of light rail operations as the owner of the Link Light Rail program. The agency will provide information and insight to the independent review panel and the JTC in review of previous studies, areas for additional analysis and recommendations for design criteria specific to operating on the floating bridge.

IV. Independent Review Participants

The review and assessment will be performed by nationally and internationally recognized experts in the field of bridges and structures, corrosion control, naval architecture and light rail infrastructure. The professional field of floating bridge expertise and stray current corrosion control on structures is relatively narrow. To that end, each review participant has had limited or no previous involvement with Sound Transit or the East Link Project.

1. Tom Ballard, Principle Engineer-in-charge: SC Solutions, Sunnyvale, CA
 - i. Expert in the field of structural analysis, rail expansion/support/attachment analysis, structural design criteria evaluation
2. Ali Akbar Sohangpurwala, CONCORR, Inc., Sterling, VA
 - i. Expert in the field of corrosion of metals in concrete
3. Tom Bringloe, The Glosten Associates, Seattle, WA
 - i. Expert in the field of Naval and Marine Architecture
4. Chuck Ruth, SC Solutions, Sunnyvale, CA (Olympia Office)
 - i. Expert in the field of structural analysis, rail expansion/support/attachment analysis, structural design criteria evaluation – retired WSDOT I-90 bridge engineer
5. Steve Nikolakakos, Russell Corrosion Consultants, Inc., New York, NY
 - i. Expert in the field of light rail stray current control

IV. Project Schedule, Milestones and Deliverables

April 2008 - Begin Independent Review

- Inventory and review existing data, reports and studies
 - Initial Site Visit with review participants and JTC members*
 - Review participant interviews with WSDOT, Sound Transit and their respective consultant teams*
 - Identification of structural focus areas*
 - Prepare action plan/assignments for independent review participants*
 - Present action plan to JTC staff, WSDOT and Sound Transit*
- * Conducted on site in Seattle/Olympia

May 2008

- Perform assignments and prepare report for status of findings
- Report on initial findings/status of inventory and analysis*
- Identify additional issues to be addressed*
- Update assignments and review milestones*
- Meet with JTC members, WSDOT and Sound Transit to discuss status of study/findings, additional issues identified and revised action plan, where appropriate*

* Conducted on site in Seattle/Olympia

June 2008

- Continue progress on assignments and prepare draft recommendations
- Report/discuss findings and outline draft recommendations*
- Status report on any additional issues studied*
- Assign elements of draft report to review participants for completion*

* Conducted on site in Seattle/Olympia

July 2008

- Prepare assigned portions of study report recommendations and forward drafts to review team for comment
- Tour the I-90 bridge with JTC members, WSDOT and Sound Transit; meet with members to discuss draft findings and recommendations*
- Consolidation and team review of study draft report and recommendations

* Conducted on site in Seattle/Olympia

August 2008

- Draft report finalized and distributed to JTC, WSDOT and Sound Transit on or before August 1, 2008
- Stakeholders review and comment on DRAFT study report (first two weeks in August)
- Meet with JTC, WSDOT and Sound Transit to present final draft report and discuss comments*

September 2008

- JTC, WSDOT and Sound Transit comments addressed and incorporated into final report as appropriate
- Final Report to JTC at September meeting
- Conducted on site in Seattle/Olympia

V. Deliverables

- Analysis of calculations
- Record of all contacts made with outside agencies and resources
- Meeting Notes
- Analysis and recommendations to the six areas of review
- Final Report (including records of preliminary and final draft reports, and all comments and responses)
- Presentations to Stakeholders (electronic and hard copy)