kpff Consulting Engineers

May 18, 2005

Mr. Patrick Clarke, PE
Washington State Department of Transportation
Bridge and Structures Office
PO Box 47340
Olympia, WA

Subject: I-90 Floating Bridge Test Program for Light Rail Transit (LRT)
Fee Proposal for Structural Services

Dear Pat:

KPFF is pleased to present this proposal for engineering services. We propose to accomplish a full scale load test, simulating light rail transit loading on the I-90, Homer Hadley, Floating Bridge.

Our specific scope of work is as follows:

SCOPE OF WORK

Perform full scale load tests on the floating bridge pontoons in order to simulate the analytical studies included in the KPFF report titled, "Homer Hadley (Interstate 90) Floating Bridge - Draft Structural Feasibility Study Light Rail Conversion," dated September 13, 2001. The specific purpose of the proposed test program is to determine the static and dynamic global response of the floating bridge to simulated Sound Transit light rail train (LRT) loading.

In the report referenced above, analytical studies were performed on the floating pontoons and elevated superstructure to determine if the existing bridge structure could support Sound Transit's current light rail train (LRT) loads. The analysis of the bridge incorporated a two dimensional continuous stiffness model of the floating structure supported on an elastic foundation and subject to LRT live loading located in the existing HOV lanes. Bridge pontoon freeboard loss, list, moment, and torsion were obtained, and used to analyze the response of the bridge to the applied loads. The results of the study indicated that for LRT live load alone, freeboard loss on the bridge is significant; structure bending moments appear to be within acceptable levels, and torsion stresses are high.

The proposed study will involve performing full-scale load tests on the floating bridge and comparing these results to those obtained in the analytical study. Bridge response under both static and dynamic load conditions will be measured. Response parameters to be measured include freeboard loss, bridge roll, longitudinal moments, cantilever tip deflections along the south edge, horizontal and vertical deflections at the expansion joint, and vertical and horizontal accelerations under dynamic loading. It is assumed that the

acceleration data would be used by Sound Transit to verify the compatibility between the bridge response and acceptable substructure motions for a LRT vehicle. Sound Transit will need to review the layout and output plan for the acceleration gages prior to installation on the bridge to assure that the results could be used in an effective manner. Static load conditions will be simulated by placing a test vehicle at specific locations within the existing HOV lanes of the bridge. Dynamic load conditions will be simulated by driving a fully loaded test vehicle at speeds between 10 and 40 miles per hour within the existing HOV lanes of the bridge. The actual upperbound speed will be controlled by the comfort level and safety of vehicle drivers. Response data will be collected in real-time as the test vehicle is moving along the bridge.

A test vehicle staging site will need to be set up on one or both ends of the bridge. Possibilities include the elevated approach structures or city streets or parking lots, which are in close proximity to the Homer Hadley bridge entrances or exits. The final location will be prepared and coordinated with WSDOT as part of preparation of the test procedure. The staging area will need to provide one lane for a supply truck and a small crane for loading the test trucks with weights, one lane for the test trucks and one lane for bypass.

The trucking company, Shaughnessy, will provide test vehicles. The proposed vehicle will be Shaughnessy's 4-axle tractor with 3-axle trailer (*see attached diagram*). Four vehicles will be used in each direction to simulate to 4-car trains bypassing each other. The trailer of each vehicle will be loaded with weights to approximate an LRT vehicle load.
While an LRT vehicle uniform load will be simulated, the test program is not scoped to simulate the actual LRT axle load pattern since the truck axle spacing and loads do not match the LRT vehicle. Since a uniform LRT load simulation is adequate to verify the global response of the floating bridge, this approach is consistent with the objective of this test program.

The final uniform load used in the test will be limited by the capacity of both the existing structures, which the truck must cross to come onto the bridge, and the capacity of the floating bridge itself. For example, if one 70-foot truck is loaded to simulate a fully loaded LRT vehicle, the total truck weight would be 148 kips, which is an overload condition somewhere between an AASHTO OL1 and OL2 truck load. This condition needs to be checked for any staging area and truck route chosen. It was also determined in previous studies by KPFF that the LRT bypass loadings create high torsion stresses in the floating bridge, and need to be checked by a more refined analysis. The LRT bypass loadings also overstress both the approach structures and transition spans. Ultimately, a testing procedure needs to be developed which is consistent with this information and approved by WSDOT.

Specific elements of our scope of work include:

1.0 Establish a preliminary test procedure and instrumentation plan for initial WSDOT and Sound Transit approval. KPFF will seek input from WSDOT and Sound Transit during this preliminary phase of the project to set project criteria and to verify acceptability of proposed methods of testing.

2.0 Analyze the existing floating bridge and approach structure for its capacity to support test vehicle wheel loads. Modifications to the test vehicle and/or test procedure may be necessary to assure that the proposed testing will not overstress the existing structure.

3.0 Prepare a formal test plan document in the form of 11" x 17" drawings. As a minimum, the test plan document will include the following: test plan notes and criteria, test plan outline and order of events, load and instrumentation tolerances, instrumentation device schedule and notes, test matrix, bridge instrumentation plan, bridge loading plan, and miscellaneous bridge sections as required to clearly indicated test vehicle loading and instrumentation. The preparation of this document will rely on close coordination between WSDOT and KPFF.

4.0 Organize and lead a pre-test meeting with all parties involved. All test program logistics and coordination items will be discussed and verified prior to execution.

5.0 Attend and oversee bridge instrumentation and testing. A representative of KPFF will be on-site during the entire test period to manage the testing process.

6.0 Process test data and write test report. At a minimum, the test report will include the interpretation of all test results, correlation of test results to the analytical study and, if necessary, specific recommendations for reconciliation of test data that does not match to the analytical results. The report may also include modification of the current analytical model of the bridge to more closely match its response to applied loads.

7.0 The bridge vertical motion instrumentation and data collection will be accomplished by WSDOT (Kurt Iverson, (360) 709-5599). Vertical motion data will be obtained using a WSDOT GPS system, which is capable of delivering the vertical motions to an accuracy of plus or minus 1 to 2 centimeters. Back-up vertical motion data will be provided by Construction Technology Laboratories, Inc. (CTL).

8.0 The remainder of the bridge instrumentation and data collection will be handled by Construction Technology Laboratories, Inc. under the direction of KPFF. CTL will be under contract with KPFF to provide installation and operation of all data collection instrumentation for the testing program. Installed instrumentation will be left on-site as property of WSDOT after the test program is complete. The data acquisition system provided by CTL for the duration of the testing will remain the property of CTL. CTL's proposal to KPFF is enclosed for your information.

9.0 The test vehicles will consist of heavily loaded flatbed trucks. These trucks can be obtained with additional axles as required to achieve the large train load equivalents necessary for the simulation.

10.0 The cost of the test vehicles is approximately $9,000 per truck-night, (cost includes state sales tax). Since approximately four trucks will be required to simulate each 4-car train, dual 4-car train simulations will cost $72,000 per night. We have estimated the simulations will require two full nights, and therefore we have budgeted $144,000 for the test vehicles. A copy of the proposal from a local trucking company, Shaughnessy, is attached.

ASSUMPTIONS

Test Program Assumptions: The following assumptions were made in the preparation of this proposal:

- The testing program will require a total of two night bridge closures. Hours of closure are assumed to be limited to the hours of 9:00 p.m. to 5:00 a.m.
- Fair weather conditions are required during testing. Excessive pontoon movement due to wind and wave action may adversely affect the test results.
- Clear skies and good satellite positions during testing, as required for the GPS system to operate.
- Bridge closures and traffic control will be provided by WSDOT.
- All special permitting for delivery of test vehicles and use of fully loaded test vehicles on the bridge will be handled by WSDOT.
- The scope of the proposed test program applies only to the floating pontoon portion of the bridge. Bridge response will not be monitored on the transition spans or approach structures.
- WSDOT will provide the test vehicle staging site within 1 mile of the each end of the bridge.

PROPOSED FEE

KPFF's proposed fee is summarized below. An itemized breakdown of the fees is enclosed.

Homer Hadley Floating Bridge Test Program

KPFF Engineering Fee	$138,847
CTL Instrumentation Fee	150,401
Test Vehicle Truck Fee and Tax	144,000
Reimbursables	1,000
Total Fee	***$434,248***

If you have any questions, please call me at (206) 622-5822.

Sincerely,

Richard K. Johnson, PE
Principal

RKJ:jas

Enclosure

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