Characterizing the Load Environment of Washington State Ferry and Alaska Marine Highway Ferry Landings

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Andrew Metzger

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16. ABSTRACT

Anybody riding a ferry wants it to dock safely — and for port managers, having passengers and goods in the water is never a good thing. This project aims to mitigate uncertainty and assumptions about load demands on ferry terminal structures, specifically, ferry landing structures. The project will provide information needed to safely and efficiently design ferry berthing and landing facilities, decrease the uncertainty in design criteria, and remove assumptions associated with procedures traditionally used to design these structures. For Alaska Marine Highway System facilities, loads imposed on dolphin structures and mooring line loads are of most concern. Due to a lack of information about the magnitude of these loads or how they may be determined, AMHS engineers are forced to make (sometimes gross) design assumptions.

The Washington State Ferry System also confronts these uncertainties, specifically in the design of wingwall structures that accept vessels during loading/unloading of passengers and vehicles. While the structures used by AMHS and WSFS have fundamental differences, the metrics needed to determine appropriate design criteria are the same. Thus, the instrumentation used to monitor these facilities in operation is also similar. These similarities present an opportunity for a cost-sharing project in which the ADOT&PF and Washington State DOT are able to leverage research funding and benefit from a much more comprehensive project than either might be able to support individually. To achieve this project's goals, the research team will acquire a robust statistical sample of the metrics (strains and displacements) needed to define the design criteria (loads from vessels and waves). The data will be gathered via in situ monitoring of in-service facilities, specifically, the AMHS terminal at Auke Bay near Juneau, Alaska, and the WSF Seattle terminal in Washington.

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Characterizing the Load Environment of Washington State

Ferry and Alaska Marine Highway Ferry Landings

AUTC Research Project Number: 309001

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Project Duration:	36 months (Commencing on September 1, 2009)

Summary

The ultimate goal of this project is to mitigate uncertainty and assumptions regarding load demands on ferry terminal structures. Specifically, ferry landing structures.

For Alaska Marine Highway (AMH) facilities, loads imposed on dolphin structures and mooring line loads are of most concern. Due to a lack of information regarding the magnitude of these loads or how they may be determined, AMH engineers are forced to make (sometimes gross) design assumptions due to inadequate information.

The Washington State Ferry (WSF) system must also confront these uncertainties. Specifically, in the design of wingwall structures that accept vessels during loading/ unloading of passengers and vehicles.

The benefits of this research initiative will be to provide information necessary for safe and efficient designs of ferry berthing and landing facilities. The results of this research should decrease the uncertainty in design criteria and remove assumptions associated with procedures traditionally used in the design of these structures. Ideally, the project should result in a design point, consistent with Load-Resistance Factor Design (LRFD) philosophy. This will allow confident use of existing design codes for materials typically used to construct such facilities.

While the structures used by AMH and WSF have fundamental differences, the metrics needed to determine appropriate design criteria are the same. Henceforth, the instrumentation used to monitoring these facilities in operation is also similar. These facts have presented the opportunity for a cost-sharing project in which AKDOT&PF and WSDOT are able to leverage research funding and benefit from a much more comprehensive project than either might be able to support individually.

The approach to achieving the goals of this project will be to acquire a robust statistical sample of the metrics (strains and displacements) needed to define the design criteria (loads from vessels ad waves). This will be achieved via in situ monitoring of in-service facilities. Specifically, the AMH terminal at Auke Bay and the WSF Seattle terminal.

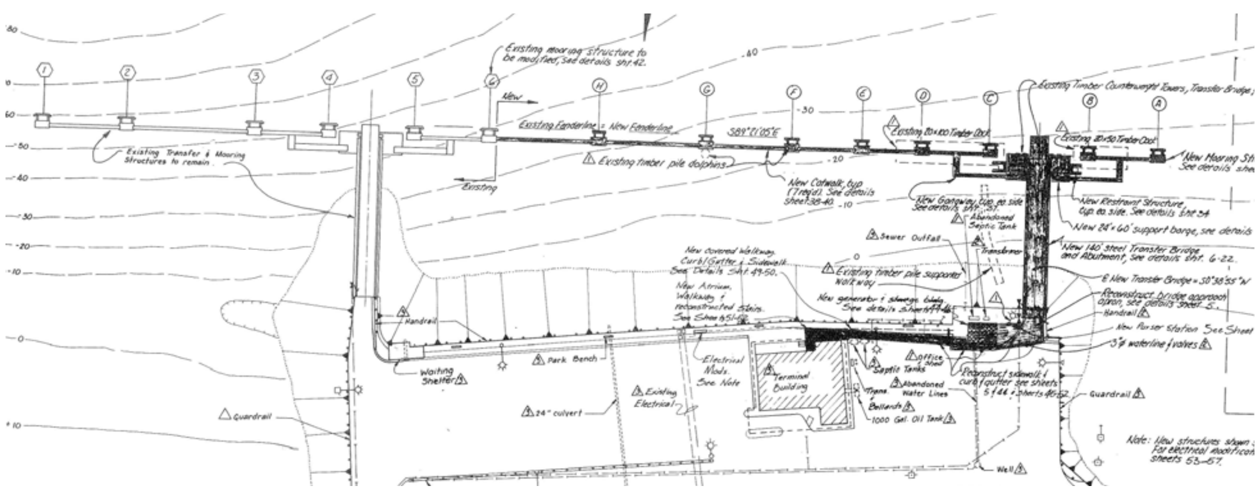

Figure 1: Auke Bay AMH Terminal Plan

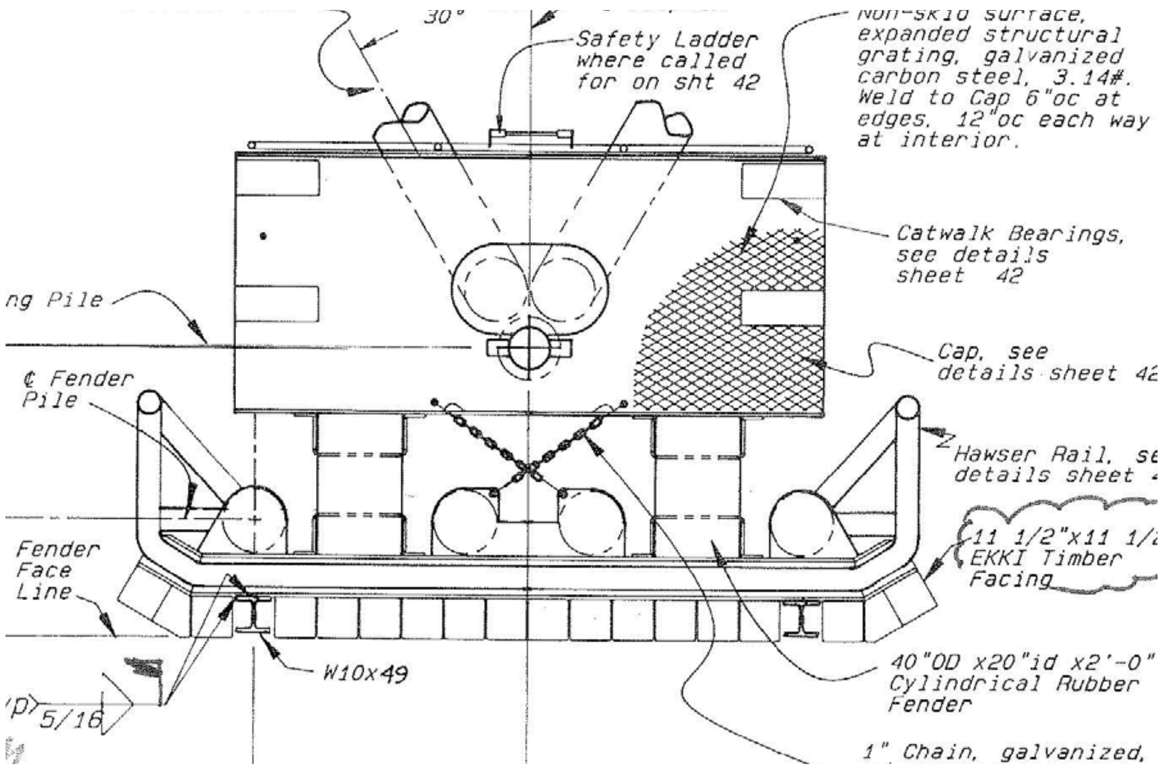

Figure 2: Typical dolphin at Auke Bay

Figure 3: Seattle Ferry Terminal, Seattle, WA. (Wingwall supported by dark piling)

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Problem Statement

A great deal of uncertainty exists when determining design loads for a vessel mooring/ berthing structure – like those in use by the Alaska Marine Highway (AMH) system and Washington State Ferries (WSF). Published berthing loads are based on empirical data derived from large vessels of the marine [shipping] and Naval fleets. Loading for the classes of vessels operated by WSF and AMH are at the lower extreme of published data. This fact, coupled with the differences in vessel configuration (vessel class) makes the application of published figures to civilian ferries questionable. There is a perceived need by both AMH and WSF engineers to verify existing design criteria for loads from ferry vessels.

Analytically, the load demands on a marine fender are not trivial and represent a challenge to the design engineer. Improving our understanding of the load environment to which ferry berthing structures are subjected will reduce uncertainty when designing such elements; potentially resulting in cost savings. These savings can be significant when one considers the future of both AMH and WSF - further described herein.

Problem Background

A great deal of uncertainty exists when determining design loads for a vessel mooring/ berthing structure – like those in use by the Alaska Marine Highway (AMH) system and Washington State Ferries (WSF). Published berthing loads are based on empirical data derived from large vessels of the marine [shipping] and Naval fleets. Loading for the classes of vessels operated by WSF and AMH are at the lower extreme of published data. This fact, coupled with the differences in vessel configuration (vessel class) makes the application of published figures to civilian ferries questionable. There is a perceived need by both AMH and WSF engineers to verify existing design criteria for loads from ferry vessels.

Wave action can also play a significant role in the design of marine fenders and their support structures. Wave loads are usually based on an idealized wave model. The instrumentation for this proposed project will have the ability to measure response from wave forces as well as vessels. This additional information will be collected and provided in the results; further enhancing the value of this proposed project and augmenting the knowledge base for wave loads.

Analytically, the load demands on a marine fender are not trivial and represent a challenge to the design engineer. Improving our understanding of the load environment to which ferry berthing structures are subjected will reduce uncertainty when designing such elements; potentially resulting in cost savings. These savings can be significant when one considers the future of both AMH and WSF as described below:

Pertaining to the AKDOT&PF-

By accurately quantifying berthing and mooring loads, marine structures are efficiently designed, thus improving reliability, safety and resulting in overall project cost savings. If research confirms current design loads are appropriate, the improved confidence in the reliability and safety of existing structures prevents over-designing in the future. If research indicates current design loads are excessive, accurate loading will result in more efficient and less costly structures with a potential cost savings system-wide. Many of the 35 terminals served by AMHS have dolphins over 25 years old that will require replacement within the next 10 years. With recent steel material price increases, the effect on overall project cost is significant.

Pertaining to the Washington DOT-

The Washington State Ferry system, technically a highway system, is vital to public transportation within Puget Sound and the surrounding area. The Washington State Ferries (WSF) provides service to over 23 million passengers per annum and is the Nation's largest ferry system. The system is a vital component of the region's multi-model transportation infrastructure, operating 22 vessels and 20 ferry terminals; requiring some terminals to service multiple vessels simultaneously. (www.wsdot.wa.gov/ferries)

Passenger demand is expected to grow in the next 25 years. This has prompted renovation of a number of ferry terminals. It is anticipated that these planned renovations will occur over the next decade. WSF also has a long-range strategic plan for service needs by 2030 and beyond – likely requiring upgraded design and renovation of ferry terminals well into the future. (www.wsdot.wa.gov/ferries)

Given the scope of service provided by WSF, the need for sound engineering design criteria cannot be overstated. Refined and/or verified design load criteria, a deliverable of this proposed research initiative, will result in greater certainty of the performance of future designs and will likely result in cost savings due to more economical designs.

The vast majority of literature related to the design of berthing structures is intended for ocean-going cargo vessels. This would include vessels greater than 10,000 dead weight tons (dwt) which, in general, are side-berthing (Bruun 1976). In contrast, ferry vessels are generally less than 4,000dwt and are often not side-berthing. WSF vessels are all end-berthing as are a number of the AMH ferries. Little design information is available for ferry-class or end berthing vessels (Jahren and Jones 1996).

The standard philosophy used to design berthing fenders is to consider the vessel's kinetic energy at the time of contact (Merritt 1983). A number of berthing coefficients (correction factors) are applied to the calculated energy to account for eccentricity, vessel configuration, mass, etc. (Gaythwaite 2004). The applicability of published coefficients for ferry-class vessels is not certain. (Jahren and Jones 1996) appears to be the only study to specifically address berthing loads on ferry structures. This study was conducted at the Edmonds Ferry Terminal in Washington State (different than the Seattle terminal). In this study, displacement of fender structures was estimated from video of vessel landing events. The result was a design framework using site specific data for the Edmonds terminal. The (Jahren and Jones 1996) study acknowledges the need for validation and a broader database of vessel landing parameters. Such a database could be used to provide general design recommendations.

The Load-Resistance Factor Design (LRFD) Methodology

The LRFD methodology has become the dominant structural design philosophy in the United States. This approach to structural design uses statistical information for both material strength (Load Capacity) and applied loads (Load Demand). Referring to Figure 4: the left curve is a representation of the statistical distribution of load demands (the variability of applied loads); the right curve represents the variability associated with material strength (variability in load capacity). The Design Load is taken to be a certain distance above the mean value. Conversely, the Design Capacity is taken a distance less than the Mean Load Capacity. If the two curves are reasonably well defined, the distance above and below the respective mean values may be chosen to result in a design with a certain degree of mathematical *reliability*. The distance off the means is typically defined with *load factors* and *resistance factors*. These are described in Equation 1.

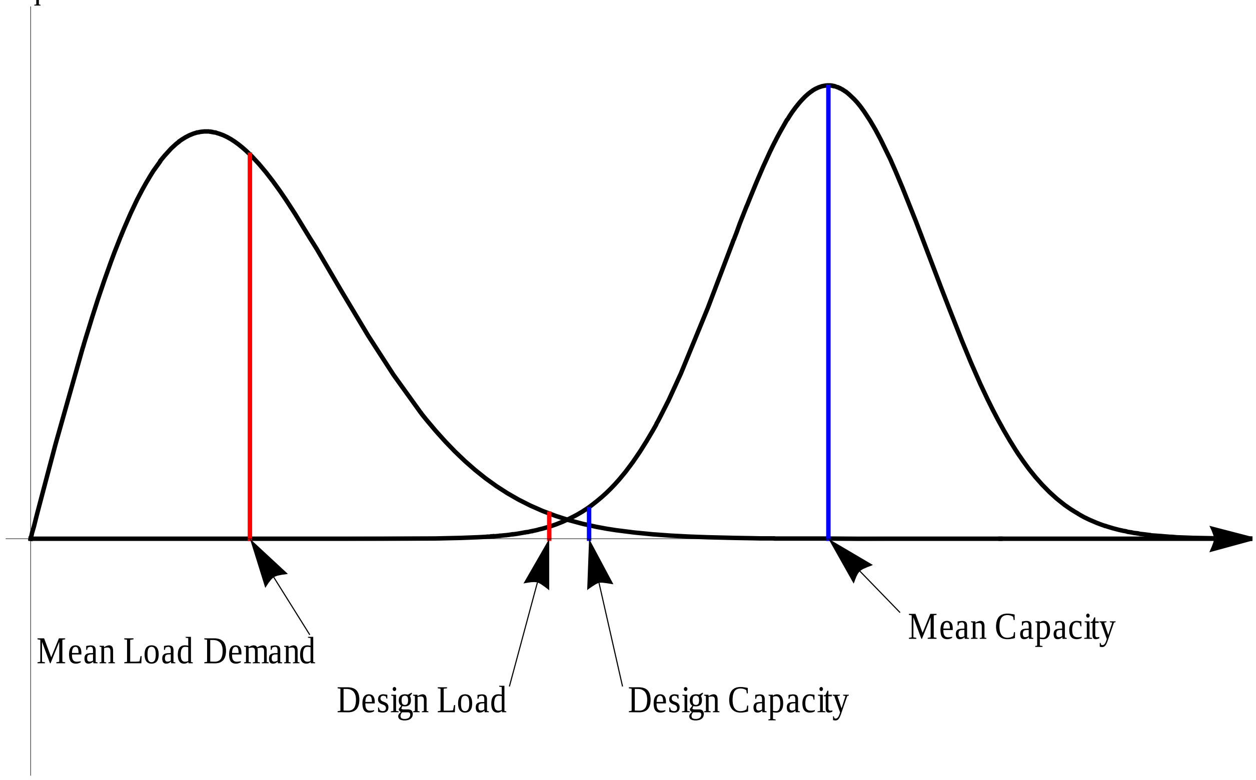

Figure 4: Graphical Representation of the LRFD Philosophy

$$\text{Design Load} = \gamma L \leq \phi R = \text{Design Capacity} \qquad (1)$$

Where: γ = the load factor, typically larger than 1.0, that accounts for the dispersion or *uncertainty* in load demands
L = the mean load demand
ϕ = the resistance factor, typically less than 1.0, that accounts for the uncertainty in material strength or element capacity
R = the mean resistance or element capacity

ϕ and R are readily available in material design codes; i.e., steel code, timber code, concrete code, etc. For most civil engineering structures, γ and L maybe found in codified documents; i.e., ASCE 7, AASHTO LRFD design specifications, etc. However, the load demands for ferry-class vessels, and uncertainty associated therewith, are not well understood and generally not available. AMH, WSF and industry in general would benefit greatly from statistical samples of ferry berthing events – a left-hand-side curve of Figure 4 represented of ferry-class marine vessels.

REFERENCES

Bruun, P. 1976. *port engineering*. Gulf Publishing Co., Houston, TX.

Gaythewaite, John. 2004. *Design of Marine facilities for berthing, mooring, and repair of vessels*. ASCE Publications. American Society of Civil Engineers, Reston, VA.

Jahren, Charles T. and Ralph Jones. 1996. *Design Criteria for Fenders at Ferry Landings*. Journal of Waterway, Port, Coastal, and Ocean Engineering, Vol. 122, No. 4, July/August. American Society of Civil Engineers, Reston, VA.

Merritt, Frederick S., ed. 1983. *Standard Handbook for Civil Engineers*. McGraw-Hill, Inc. New York, NY.

Study Objectives

The overarching objective of this study is to validate and further define certain load parameters used in the design of ferry landings; essentially, determining an estimate of the Load Demand distribution and statistical moments of Figure 4. With this information, WSF and AMH engineers should be able to directly apply LRFD design standards for materials commonly used in the construction of ferry terminals.

As was stated previously, both AMH and WSF have an interest in this. Because of this mutual interest, another objective of this study is to accomplish these particular research goals of both agencies, WSDOT and AKDOT&PF, while sharing costs. Cost of labor, travel and graduate student support will be split among agencies contributing funds to this project.

AKDOT & PF

An objective of the AMH component of this study is to acquire a sample of empirical data for mooring line loads on bollards. A bollard at the Auke Bay facility is shown in Figure 5. With a sample of mooring line loads during service of the facility it will be possible to draw conclusions with regard to what might be an appropriate design magnitude and sense for use in design.

Another objective is to acquire a sample of berthing loads form actual AMH vessels. Auke Bay services a number of different sized vessels and will give insight into loads demands imposed by ferry vessels of different dwt. Figure 2 illustrates a typical dolphin at Auke Bay.

WSDOT

The primary objective of the WSF component of this project is to collect a sample of in-service load demands on wingwalls at the Seattle terminal. One of the wingwalls is shown in Figure 6. The sample will be used to estimate a distribution and identify statistical moments for loads in this setting. It is intended to use this information to identify design points for use in future designs of similar facilities.

The instrumentation used to measure metrics related to vessel loads may also provide samples of loads from wave-action. Assuming wave loads are large enough to provide a measurable response; direct measurement of loads from wave action should be possible with instrumentation already in place. This should be the case for both WSF and AMH facilities. For this reason, an attempt will be made to acquire a statistical sample of wave forces as well as corresponding statistical moments and design points.

Figure 5: Typical Bollard at AMH Auke Bay Terminal; Note “doughnut” fender behind bollard

Figure 6: Posterior of WSF wingwall at Seattle terminal

<u>Research Plan</u>

Introduction

The general approach to this research will be to collect a statistically-robust sample of the metrics of interest over a year of operation of an AMH facility and a WSF facility. The metrics shall be collected by in situ monitoring of mechanical strain and displacement of existing structures. Strains shall be resolved to forces and both forces and displacements shall be applied to kinematic models of the facilities. The kinematic response shall be used to determine the vessel or wave loads applied to the facility.

The sample of loads events shall be resolved to statistical moments and an estimate of a probability distribution; analogous to the right-hand curve of Figure 4. This information should allow a design point to be identified. A research report-of-findings, and any design points (possible new design criteria), are the intended final deliverables for this project.

Research Approach

The approach to this project will be to acquire physical measurements from in-service AMH and WSF facilities and then resolve the data into a statistical representation of the load environment. The statistics should provide insight for establishing new, respective design criteria for both WSF and AMH.

The approach used for the AMH facility at Auke Bay will be to instrument the piling at a number of dolphins, shown in Figure 2, to measure mechanical strain. The dolphins will also be instrumented with linear displacement transducers to measure the deflection of the "doughnut" marine fender. The force-displacement for the rubber doughnut fender used at Auke Bay is well defined. Measuring the displacement will allow determination of the force applied to the fender. Coupling this information with axial loads in select dolphin piles will allow conclusions to be drawn about the load applied to the dolphin. At a minimum, the monitoring scheme should result in a statistical sample of loads in the rubber fenders and axial loads in the piling. However, it is anticipated that the data collected during monitoring will allow the load environment of the dolphins to be better defined – a significant enhancement over what is currently available.

The WSF wingwalls at the Seattle terminal shall be instrumented in a similar way. Select piling and marine fenders shall be instrumented as described above. Figure 7 is a cross-section of a wingwall at the Seattle Terminal.

The instrumentation scheme for both facilities should also be capable of measuring the response of the structures to wave action – provided the wave forces are significant enough to cause a measurable response. If measurable, response from wave forces shall also be included in the data collected and final report.

In addition to that described above, AMH desires better information regarding mooring line loads. The loads are applied to bollard; like that shown in Figure 5. The approach taken in the study shall be to instrument a number of bollards with strain gauges at a number of locations around its base. Strains shall be measured when a vessel is moored. The strains shall be resolved to stresses. The measured states of stress shall be used to extrapolate both axial forces and bending moments applied to the bollards studied.

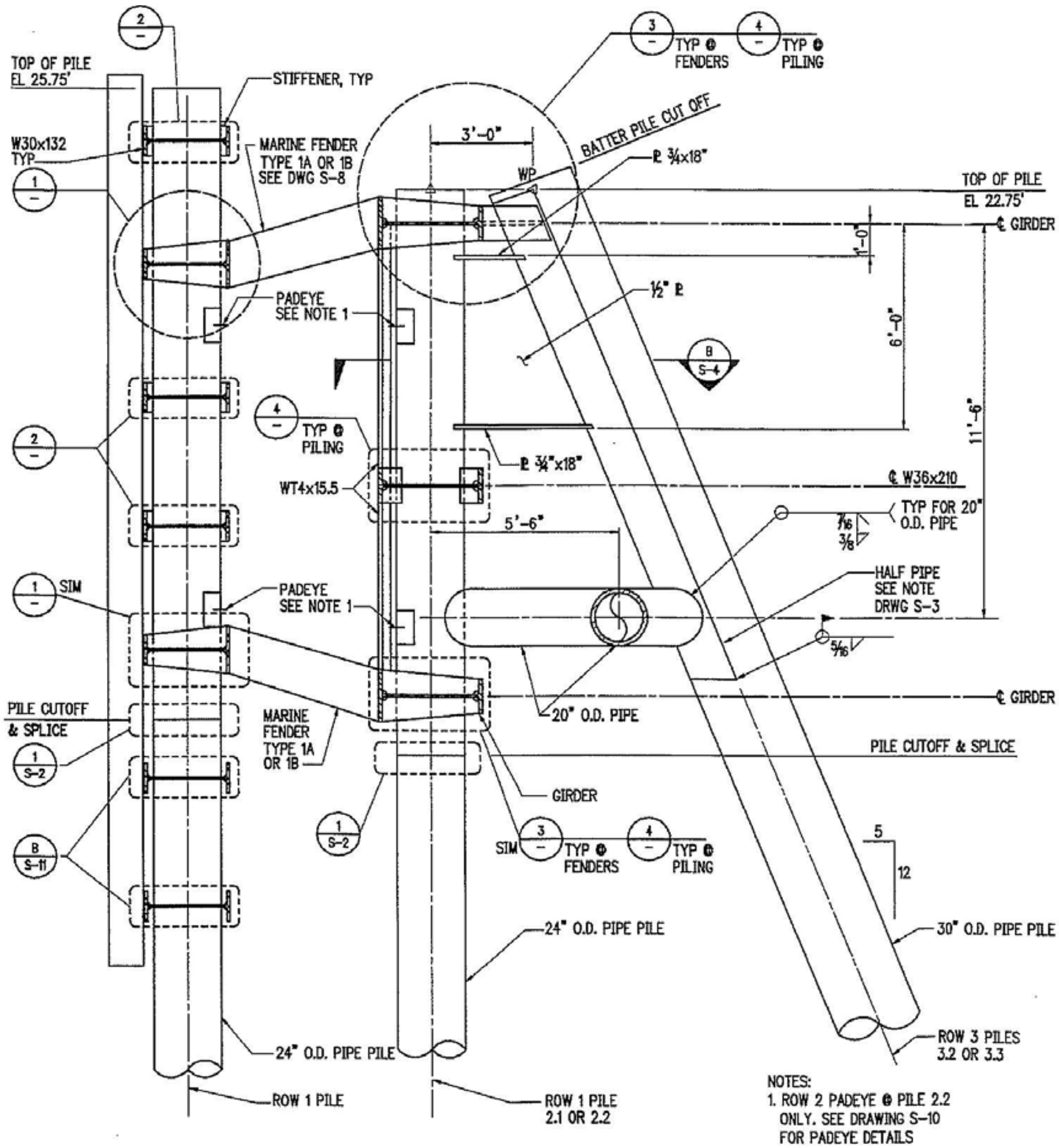

Figure 7: Cross-section of WSF wingwall

Implementation Plan

Statistical information and proposed design points derived from the data collected during this project shall be provided to the engineering component of both AMH and WSF upon completion of the project. The results of the study may be applied to design of related facilities immediately thereafter. Implementation would likely take the form of revised design criteria for future projects. Formal adoption of such design criteria would be at the pleasure of each DOT; separately.

Applicability of Results to Practice

The results of this proposed project shall be directly and readily applicable to practices as no similar information is currently in existence. And, both WASF and AMH have expressed a need for a study of this nature.

Qualifications of Research team

The research team will be composed of Drs. Andrew T. Metzger, Ph.D., P.E. and Leroy Hulsey, Ph.D., P.E., S.E.

Andrew Metzger is an Assistant Professor in the Civil and Environmental Engineering Department at University of Alaska Fairbanks. He holds registration as a Professional Engineer in both Alaska and Washington State. Dr. Metzger specializes in coastal and offshore marine structures. A trained commercial diver, Dr. Metzger has performed underwater inspection of a number of WSF terminals while working as a project engineer for RVE, Inc. out of Corpus Christi, Texas. This experience has given him the opportunity to become familiar with WSF facilities as well as Operations. This experience will prove invaluable during deployment of instrumentation for this project.

Dr. Hulsey is an expert in the field of environmental effects on bridge structures. He is a licensed professional engineer in Alaska and Alabama and is a licensed structural engineer in the state of Illinois. During the past 40 years, he has instrumented railroad rails, railroad ties, bridge structures, buildings, automobiles, special structures such as water slides and pilings for port and harbor facilities in Wilmington, North Carolina. He has extensive instrumentation and testing experience for both static and dynamic type loadings. Where possible, Dr. Hulsey utilizes off-of-the-shelf instruments that best suit the application. However, he also has developed reliable professional quality transducers for measuring stress, strain, load, moisture and displacement.
In any testing program of this magnitude, the conditions are extremely harsh (wind, wave, and vessel) produce special challenges for retrieving; storing and saving reliable long term (longer than a day) data. Special attention must be given to providing a robust and redundant monitoring system.

Both Drs. Metzger and Hulsey have extensive experience with instrumentation and monitoring structures under in-situ conditions. This research team has the expertise to provide a testing system that will give reliable, long term data for structures subjected to vessel operations and a coastal marine environment.

ANDREW T. METZGER, Ph.D., P.E.

University of Alaska Fairbanks

EDUCATION
Ohio University, Civil Engineering, B.S.C.E., 1994
Ohio University, Civil Engineering, M.S., 1995
Case Western, Civil Engineering, Ph.D., 2007

PROFESSIONAL EXPERIENCE
2007 - present Assistant Professor of Civil Engineering, University of Alaska Fairbanks, Fairbanks, Alaska
1999-2001; 2003 Project Manager, RVE, Inc., Corpus Christi, Texas
1996-1999; 2001-2002 Project Engineer, Thorson Baker & Associates, Inc., Richfield, Ohio
1994-1995 Research Associate, Ohio University Center for Geotechnical and Environmental Research, Athens, Ohio

PROFESSIONAL REGISTRATION
Alaska – PE # 12189
Ohio – PE # 64609
Washington State – PE # 37774

RESEARCH INTERESTS
Structures
Characterizing Long-term Damage Accumulation in Infrastructure
Cold-Regions Engineering

HONORS AND AWARDS
2006 First International Conference on Fatigue and Fracture in Infrastructure, Student Paper Award
2004 Saada Family Fellowship Recipient
1993 Stocker Scholarship
1993 Associated General Contractors of America Scholarship

RELEVENT PUBLICATIONS – Submitted for Review
Metzger, A.T., Huckelbridge, A., 2007, “Temporal Nature of Fatigue Damage in Highway Bridges”, ASCE Journal of Bridge Engineering.
Huckelbridge, A., Metzger, A.T., “Investigation of the Dayton IR 75 Sign Truss Failure of September 11, 2006”, 2007, ASCE Journal of Performance of Constructed Facilities.

RELEVENT CONFERENCE PROCEEDINGS
Metzger, A.T., Huchelbridge, A., 2006, “Predicting Residual Fatigue Life from Short Duration Field Observations”, International Conference on Fatigue and Fracture in Infrastructure – proceedings.

J. LEROY HULSEY, Ph.D., P.E.
University of Alaska Fairbanks

EDUCATION
Missouri School of Mines and Metallurgy, Civil Engineering, B.S., 1964
University of Missouri at Rolla , Civil Engineering, M.S., 1966
University of Illinois, Post Graduate, 1968-1971
,University of Missouri-Rolla, Structural Engineering, Ph.D., 1976

PROFESSIONAL EXPERIENCE
2006 - Present Associate Director of the Alaska University Transportation Center
2001 - Present President, CEO of Alignment Systems, Inc.
2006 – Present Professor of Civil & Environmental Engineering; University of Alaska Fairbanks
1993 - Present Assoc. Professor, Dept. of Civil Eng., University of Alaska Fairbanks; Vice President of Advanced Engineering Consolidated Technologies, Inc.
1987 - 1993 Assoc. Professor, Dept. of Civil Eng., Univ. of Alaska Fairbanks. Depart.
Chairman 1988 - 1990 Assoc. Professor, Univ. of Alaska Fairbanks & Civil Dept. Chairman.
1985 - 1987 Assistant Director of the Institute for Transportation Research & Education (ITRE),
General Services Administration, University of North Carolina
1965 – 1987 Design engineer, Military service during Vietnam conflict, Corporate executive, owner of two companies, & professor at North Carolina State University.

SPECIAL SKILLS
Practical Experience.- Buildings, bridges, special structure and special excavations and foundations. Experienced as an owner, office manager, project leader, designer, construction manager, construction foreman, draftsman, carpenter and master craftsman.

Academic Experience.- Teaching, research, and author. Experienced at developing user friendly computer programs for structures, geotechnical and soil-structure interaction problems. Programs include static and dynamic analysis of structures, bridge design, retaining wall design, slope stability analysis, the pile wave equation, design of prestressed and post tensioned systems and other types of analysis. Analytical capabilities include finite element, finite difference, and closed form for both continuum and discrete field mechanics. Experienced in experimental stress analysis; this includes design & manufacture of special transducers.

REGISTRATION
- Professional Engineer
North Carolina (inactive), Alaska, Illinois (inactive), Missouri (inactive)
- Structural Engineer
Illinois

PUBLICATIONS
The author has more than 70 publications. These include 18 journal articles, 19 referred conference papers, numerous short courses and published lectures, over 20 published reports, and 1 book.

AFFILIATIONS
Dr. Hulsey is past President, of the Fairbanks Chapter of ASCE. He is a paper reviewer and serves on several committees for ASCE, ACI, ACEC and TRB and serves as on a research panel for the National Academy of Sciences. Examples are ASCE Steel Bridge and TRB A2F04 Construction of Bridges & Structures and TRB committee A1A02 Management and Productivity.

Disclosure

To the best knowledge of the project team, there are no issues related to objectivity in this proposal.

Equipment and Facilities

1. One-way and two-way actuators: We have two actuators available for use.
2. Data acquisition systems:
    a. Lap top for controlling the data acquisition equipment.
    b. Optim Electronic Corporation MEGADAC 541AC/DC 24 channels
    c. (2) Campbell Scientific, Inc. CRX9000 64 channel Measurement & Control Systems
    d. (2) Campbell Scientific, Inc. CRX5000 16 channel Measurement & Control Systems
3. Load cells, LVDT's, LMT's
4. Accelerometers, cabling and thermal sensors, etc.
5. Digitally Controlled MTS Load Frames
    a. MTS 810 System (Model 810.13)- Load Unit Model 318.25, 55 kip/250 kN with a Flextest SE controller
6. MTS 810 High Force Load Frame System (Model 810.15) - Load Unit Model 311.31 (4 column), 220 kip/1000 kN; TestStar IIs Controller; Cincinnati Sub-Zero CS2 Environmental Chamber; MTS Hydraulic Power Supply; & Model 510.21 Hydraulic Power Supply, 21 gpm
7. Numerous desk top computers with structural engineering software that includes RISA 2, RISA 3D, SAP2000; & STAAD PRO.
8. Super Computer with ABACUS finite element software & other scientific software that is supported by the center.

Time Requirements

The project is scheduled to be completed in 36 months from September 1, 2009 through August 2012. The project will be composed of two major phase; each phase including twelve months of data collection at each facility studied.

The expected time schedule, with milestones, is shown in the following table:

2009		2010		2011		2012	
JANUARY		JANUARY	Fabricate and prove bollard instrumentation	JANUARY		JANUARY	
FEBRUARY		FEBRUARY		FEBRUARY		FEBRUARY	
MARCH	submit AUTC Phase II proposal; Finalize technical aspects of AK, WA research needs; AUTC Quarterly Report	MARCH	AUTC Quarterly Report	MARCH	AUTC Quarterly Report	MARCH	AUTC Quarterly Report
APRIL	Submit WSDOT Proposal; Submit AKDOT&PF Proposal	APRIL		APRIL	Graduate Student Search	APRIL	
MAY	Graduate Student Search	MAY	Deploy instrumentation at Auke Bay	MAY	Recover instrumentation at Auke Bay	MAY	
JUNE	Graduate Student Search	JUNE	Report of preliminary data: Auke Bay; AUTC Quarterly Report	JUNE	Test, Refurbish, Refit instrumentation; mobilize for Seattle	JUNE	AUTC Quarterly Report
JULY	Graduate Student Search	JULY	Graduate Student Search	JULY	Deploy instrumentation at Seattle Terminal	JULY	Recover instrumentation from Seattle Terminal
AUGUST	finalize equipment list	AUGUST	Graduate Student Search	AUGUST	Report of preliminary data: Seattle	AUGUST	Final Report
SEPTEMBER	Sept. 1st - Official Start-date; purchase equipment and instrumentation; AUTC Quarterly Report	SEPTEMBER	AUTC Quarterly Report	SEPTEMBER	AUTC Quarterly Report	SEPTEMBER	Project Closeout
OCTOBER	Fabricate and prove pile instrumentation in laboratory	OCTOBER		OCTOBER	Report of Findings at Auke Bay	OCTOBER	
NOVEMBER		NOVEMBER	Interim Report of Findings: Auke Bay	NOVEMBER	Interim Report of Findings: Seattle Terminal	NOVEMBER	
DECEMBER	AUTC Quarterly Report	DECEMBER	AUTC Quarterly Report	DECEMBER	AUTC Quarterly Report	DECEMBER	

Cooperative Features

This project will require support form both the Alaska Department of Transportation and Public Facilities and the Washington State Department of Transportation. Support from both agencies will be in the form of direct funding and in-kind services. Funding is outlined in the 'Budget" section of this proposal. In-kind support will be in the form of information and documentation surrounding the facilities to be monitored as well as on-site support if/ when needed.

Budget

Budget Justification:

Salaries

Senior Personnel. Funding to support a total of 900 hours is requested for the Principal Investigator Andrew T. Metzger. Funding to support 520 hours of salary is requested for Co-I Leroy Hulsey. Leroy Hulsey will assist in the fabricating and proving the instrumentation prior to deployment. Per UAF policy, faculty receive leave benefits at a rate of 1.5%, calculated on salary. Total cost to Project: $82,782. Requested AUTC commitment: $54,520.

Other Personnel. It is planned to hire a graduate student and undergraduate student for this project. Additionally a technician will be utilized for various tasks. Total cost to Project: $71,712. Requested AUTC commitment: $29,425.

Fringe Benefits

Staff benefits are applied according to UAF's benefit rates for FY08, which are negotiated with the Office of Naval Research (ONR) annually. Rates are 32.1% for senior salaries, 48.7% for exempt and 8.5% for other personnel. Total cost to Project: $45,263. Requested AUTC commitment: $25,274.

Travel

This Project will require a number of site visits to both Juneau and Seattle. This will include extended stays for deployment of the instrumentation. Deployment will require the PI and a graduate student to spend approximately two weeks at each site. Per Diem is estimated based on US Government figures. Justification is attached. Total cost for this project: $30,069. Requested AUTC commitment: $2,878.

Other Direct Costs

Services. A total of $2,500 is requested for fieldwork and publications. Requested AUTC commitment: $2,500.

Equipment, Materials & Supplies. A total of $28,250 is requested for equipment. This cover the measurement instrumentation required for the project. Requested AUTC commitment: $28,250.

Tuition. Tuition is supplied for the graduate student for each year. Also an additional student health care fee is added for the grad student. Total cost for this project: $29,445. Requested AUTC commitment: $0.

Indirect Costs. Total cost to project: $96,759. Requested AUTC commitment: $54,434.

Facilities and Administrative (F&A) Costs are negotiated with the Office of Naval Research and for research are calculated at 47.5% of the Modified Total Direct Costs (MTDC) for federal projects, including the AUTC, 25% for Alaska state projects and 45.1% for the Washington DOT commitment to the project. MTDC includes Total Direct Costs minus tuition, stipends, scholarships, subaward amounts over $25,000, participant support costs**, and equipment. A copy of the agreement is available at:
http://www.alaska.edu/controller/cost-analysis/negotiated_agreements.html

Cost Sharing. The State of Alaska DOT P&F has agreed to provide $100,000 of this project. The Washington DOT has also agreed to commit $100,000 to the project. Each commitment represents approximately 25.2% of the project cost, for a total of 50.4% of the project total. Please see the attached letter of commitment for this project.

LOADS ON FERRY LANDINGS - MASTER BUDGET

Budget Worksheet for INE proposal # _______

		starting wage	leave rate	time period (hrs)	AY 09-10	AY 10-11	AY 11-12	Summary
SALARIES & BENEFITS								
	Andrew T. Metzger	$ 47.53	1.015	varies	$14,473	$15,124	$15,805	$45,402
	Leroy Hulsey	$ 67.73	1.015	varies	$11,916	$12,452	$13,013	$37,381
	Grad. Student	$ 22.16	1	varies	$14,655	$15,315	$16,004	$45,974
	U. Grad. Researcher	$ 15.00	1	varies	$7,520	$7,746	$8,212	$23,478
	lab tech (APT)	$ 25.00	1.219	varies	$731	$753	$776	$2,261
	Staff benefits							
	PIs		0.321		$ 13,175	$ 13,768	$ 14,388	$ 41,331
	grad student (summer only)		0.085	varies	$ 843	$ 940	$ 1,048	$ 2,832
	lab tech		0.487		$ 356	$ 367	$ 378	$ 1,101
	TOTAL SALARIES & BENEFITS				**$63,670**	**$66,465**	**$69,623**	**$199,758**
TRAVEL	**TOTAL TRAVEL**				**$ 30,069**	**$ -**	**$ -**	**$ 30,069**
SERVICES								
	publication & dissemination				$339			$339
	field shipping & communication				$500	0	0	$500
	other							$0
	TOTAL SERVICES				**$839**	**0**	**0**	**$839**
SUPPLIES	**TOTAL SUPPLIES**				**$1,250**	**$1,250**	**$0**	**$2,500**
EQUIPMENT	**TOTAL EQUIPMENT**				**$28,250**			**$28,250**
OTHER								
	(Student Health Insurance)			**$1,500**	**$1,500**	**$1,500**	**$0**	**$3,000**
TUITION	**$12,593/yr/student**			**$ 12,593**	**$12,593**	**$13,852**	**$0**	**$26,445**
	TOTAL DIRECT COSTS				**$138,171**	**$ 83,067**	**$ 69,623**	**$290,861**
	MTDC (TDC minus tuition, equipment)				**$ 97,328**	**$ 69,215**	**$ 69,623**	**$236,166**
	F&A				$ 38,527	$ 29,092	$ 29,141	$ 96,759
	AKDOT&PF ADMIN. FEES				$ 9,660			
	Total Requested Funds				**$186,358**	**$112,159**	**$ 98,763**	**$397,280**

LOADS ON FERRY LANDINGS - AUTC Budget

Budget Worksheet for INE proposal # _______

		starting wage	leave rate	time period	AY 09-10	AY 10-11	AY 11-12	Summary
SALARIES & BENEFITS				(hrs)				
	Andrew T. Metzger	$ 47.53	1.015	175	$8,443	$8,822	$9,219	$26,484
	Leroy Hulsey	$ 67.73	1.015	130	$8,937	$9,339	$9,759	$28,036
	Grad. Student	$ 22.16	1	275	$6,094	$6,368	$6,655	$19,117
	U. Grad. Researcher	$ 15.00	1	200	$3,000	$3,090	$3,276	$9,366
	lab tech (APT)	$ 25.00	1.219	10	$305	$314	$323	$942
Staff benefits								
	PIs		0.321		7,535	7,874	8,228	$23,637
	grad student (summer only)		0.085	275	351	391	436	$1,177
	lab tech		0.487		148	153	157	$459
	TOTAL SALARIES & BENEFITS				**$34,812**	**$36,352**	**$38,055**	**$109,219**
TRAVEL								
	Domestic	(REMAINDER IN BUDGETS OF			$2,878			$2,878
	TOTAL TRAVEL	AKDOT&PF AND WSDOT)			**$2,878**	**$ -**	**$ -**	**$2,878**
SUPPLIES								
	Wire, connectors, adhesives, etc.				$1,250	$1,250		$2,500
	TOTAL SUPPLIES				**$1,250**	**$1,250**	**$0**	**$2,500**
EQUIPMENT								
					$ 28,250	$ -	$ -	$ 28,250
	TOTAL EQUIPMENT				**$ 28,250**	**$ -**	**$ -**	**$ 28,250**
	TOTAL DIRECT COSTS				**$ 67,191**	**$ 37,602**	**$ 38,055**	**$142,847**
	MTDC (TDC minus tuition, equipment & subward amounts over 25,000)				**$ 38,941**	**$ 37,602**	**$ 38,055**	**$114,597**
	F&A	0.475			$ 18,497	$ 17,861	$ 18,076	$ 54,434
	Total Requested Funds				**$ 85,687**	**$ 55,462**	**$ 56,131**	**$197,280**

<u>Match Commitment Letters</u>

(attached below)

STATE OF ALASKA

DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

Sarah Palin, Governor

2301 PEGER ROAD
FAIRBANKS, ALASKA 99709-5399
PHONE: (907) 451
TDD: (907) 451-2363
FAX: (907) 451-

February 9, 2009

Billy Connor, P.E.
Director, Alaska University Transportation Center
University of Alaska Fairbanks
P.O. Box 755960
Room 245 Duckering Building
Fairbanks, AK 99775-5960

RE: Intent to Commit Matching Funds to Alaska University Transportation Center (AUTC) for 2009 Transportation Research Projects

Dr. Mr. Connor,

The Alaska Department of Transportation & Public Facilities (AKDOT&PF) requests that AUTC's principal investigators collaborate with our project advisors to develop phase 2 proposals as follows:

AUTC Proposal No.	Proposal Title	AKDOT&PF Project Advisors
309043	OMG, The Gas Line	Clint Adler (451-5321)
309010	Seismic Performance of Bridge Foundations in Liquefied Soils	Elmer Marx (465-6941)
309029	Alaska Rural Airport Inspection Program	Clark Milne (451-5285)
309001	Load Environment of Washington State Ferry & Alaska Marine Highway Landings	Tim Doggett (465-2719)
309015	Alaska Specification for Palliative Applications on Unpaved Roads and Runways	Clark Milne (451-5285)
309038	Succession Planning for a State DOT	Clint Adler (451-5321)
309022	Evaluation of In-place MEMS Inclinometer Strings in Cold Regions	David Stanley (269-6236)
309009	Compare Two Designs to Prevent River Bend Erosion in Arctic Environments	Don Carlson (451-2233)
309024	Verification of Job Mix Formula for Alaskan Hot Mix Asphalt	Steve Saboundjian (269-6234)
309023	Inclusion of Life Cycle Cost Analysis in AK Flexible Pavement Design Program	Steve Saboundjian (269-6234)
309003	Evaluating Stormwater Best Management Practices for Cold Regions Construction Sites	Kristine Benson (465-6326)

The Department intends to provide to the AUTC up to $600,000 in State Planning & Research Funds and additional in-kind match as AUTC researchers and AKDOT&PF advisors may negotiate to support the research projects mutually agreed to and described in complete phase 2 proposals.

Please contact me at 451-5321 or clint.adler@alaska.gov with any questions.

Sincerely,

Clint Adler, P.E.
Chief of Research, Development, & Technology Transfer

cc:
Roger Healy, Chief Engineer
James Sweeney, Research Engineer
Richard Pratt, State Bridge Engineer
Elmer Marx, Lead Bridge Design Engineer
Michael Coffey, Chief of Maintenance & Operations
Clark Milne, Northern Region Maintenance Engineer
John Falvey, General Manager, Alaska Marine Highway System
Tim Doggett, AMHS Design Engineer
Kirk Miller, AMHS Design Engineering Manager
Michael SanAngelo, State Materials Engineer
David Stanley, Chief Engineering Geologist
Michael Knapp, State Hydraulic Engineer
Don Carlson, Northern Region Hydraulic Engineer
Steve Saboundjian, State Pavement Engineer
Bill Ballard, Statewide Environmental Coordinator
Kristine Benson, Environmental Impact Analyst

Washington State
Department of Transportation
Paula J. Hammond, P.E.
Secretary of Transportation

Transportation Building
310 Maple Park Avenue S.E.
P.O. Box 47300
Olympia, WA 98504-7300

360-705-7000
TTY: 1-800-833-6388
www.wsdot.wa.gov

February 11, 2009

Billy Connor, P.E.
Director, Alaska University Transportation Center
University of Alaska Fairbanks
P.O. Box 755960
Fairbanks, AK 99775-5960

Dear Mr. Connor:

The Washington State Department of Transportation (WSDOT) is pleased to support the Alaska University Transportation Center Proposal Number 309001 entitled "Characterizing the Load Environment of Washington State Ferry and Alaska Marine Highway Ferry Landings – A Collaborative Research Effort", by Dr. Andrew T. Metzger, University of Alaska Fairbanks. By this letter, I approve use of WSDOT's SPR funds up to $100,000 as match requirement for this collaborative project. Further in-kind match may be negotiated as needed and feasible with the WSDOT project advisors.

The SPR funding used for match has been provided through the WSDOT Research Executive Committee for this collaborative research project. This collaboration with the AUTC and the Alaska Department of Transportation and Public Facilities will expedite this project to improve the understanding of ferry berthing loads and terminal designs.

Rhonda Brooks and Tom Bertucci will serve as the project advisors for WSDOT. If you need further information please call Rhonda at (360) 705-7945.

Sincerely,

Leni Oman
Director, Office of Research & Library Services

cc: Andrew Metzger, UAF
Tom Bertucci
Rhonda Brooks
Clint Adler, AKDOT&PF
Project File