Gravina Access Project

Design Criteria Technical Memorandum

Draft

Agreement 36893013
DOT&PF Project 67698
Federal Project ACHP-0922(5)

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Section **Page**

1.0 Introduction

This memorandum describes the design criteria for evaluation of the alternatives being considered to improve access between Ketchikan (on Revillagigedo Island) and Gravina Island. This Design Criteria Technical Memorandum shall be used as the basis for developing and evaluating alternative crossing type designs for the Gravina Access Project. The design criteria should be considered preliminary, as they will be further developed with the collection of additional data. Revised project design criteria will be issued as additional information, such as design traffic data, has been collected and analyzed.

1.1 Project Description

The Gravina Access Project is intended to provide improved access from Ketchikan to Gravina Island across Tongass Narrows. Tongass Narrows is an active waterway, used by vessels that range in size from kayaks to ocean-going vessels such as large cruise ships. The waterway is an active floatplane base, particularly during the summer months. The presence of Ketchikan International Airport restricts the potential height of any crossing, with the degree of restriction depending on the crossing location. The project has been studied several times in the past, resulting in various proposed alignments and alternatives for bridge and tunnel crossings, as well as increased use of ferry service. The design criteria will be used in the engineering evaluation to support identification of a preferred crossing alternative in accordance with the National Environmental Policy Act (NEPA) and, if a build alternative is recommended, for subsequent design and implementation.

1.2 References

A list of applicable design standards and specifications is provided in Section 7.

2.0 Roadway Design Criteria

2.1 Project

1.	Project:	Gravina Access Project
2.	Project Funding:	Local, State, and Transportation Equity Act for the Twenty-First Century (TEA-21)
3.	Functional Classification:	Arterial Roadway
4.	Design Year:	2020

2.2 Traffic Data

5.	Current Average Daily Traffic (ADT):	6,250 outside downtown, 19,494 in downtown
6.	Design Year ADT:	9,068 outside downtown, 28,284 in downtown
7.	Mid-Design Period ADT:	7,528 outside downtown, 23,481 in downtown
8.	Design Hourly Volumes (DHV) (%):	10%
9.	Directional Split (%D):	55%/45% (PM peak from Gravina/to Gravina)
10.	Trucks (Percent Truck Traffic):	2%
11.	Equivalent Single-Axle Load (ESAL):	*Not available*

2.3 Operation and Geometry

12.	Pavement Design Year:	10 Years
13.	Design Vehicle:	AASHTO WB-15 (WB-50)
14.	Design Speed:	70 km/h (43.5 mph)
15.	Stopping Sight Distance:	94.1 meters (m) (308.7 feet [ft])
16.	Passing Sight Distance:	482 m (1,581.4 ft)
17.	Maximum Allowable Grade	
	Off bridge structure:	8.00% (6:00% desirable)
	On bridge structure:	6.00% (4.00% desirable)
18.	Minimum Radius (6% max. super):	195 m (639.8 ft) (225 m [738.2 ft] desirable)
19.	Minimum Length of Curve:	210 m (689.0 ft)
20.	Minimum K-value of Vertical Curves	
	Sag:	20-25
	Crest:	22-31

2.4 Roadway Standards

21.	Number of Lanes:	Two-Lane
22.	Width	
	Traveled Way (T/W):	7.2 m (23.6 ft)
	Outside Shoulders:	2.4 m (7.9 ft)
	Inside Shoulders:	Not applicable (Two-Lane, Two-Way)
23.	Surface Treatment	
	Traveled Way:	Asphalt Concrete Pavement
	Shoulders:	Asphalt Concrete Pavement

24.	Maximum Sideslope Ratios	
	Foreslopes:	2H:1V
	Backslopes:	2H:1V
25.	Degree of Access Control:	Controlled Access Facility
26.	Median Treatment:	None (Two-Lane, Two-Way)
27.	Illumination:	Rural Standard Illumination
28.	Curb Usage and Type:	*(To be determined)*
29.	Bicycle Provisions:	2.4-m (7.9-ft) combined shoulder/bicycle/ped path
30.	Pedestrian Provisions:	2.4-m (7.9-ft) combined shoulder/bicycle/ped path

2.5 Clearances

31.	Airspace Clearance:	Compliance with Federal Aviation Administration airspace for Ketchikan International Airport
32.	Shipping Clearance	
	Cruise Ships:	
	Horizontal Clear Span:	168 m (550 feet [ft]) one way traffic
	Vertical Height (above mean higher high water [MHHW]):	56.4 to 61.0 m (185 ft to 200 ft)
	Vertical Depth (below mean lower low water [MLLW]):	12.2 m (40 ft)
	Alaska Ferries:	
	Horizontal Clear Span:	152 m (500 feet) two way traffic
	Vertical Height (above mean higher high water [MHHW]):	36.6 m (120 ft)
	Vertical Depth (below mean lower low water [MLLW]):	12.2 m (40 ft)
33.	Roadway Clearance	
	Horizontal:	In accordance with Roadway Design Guide
	Vertical:	5 m (16.4 ft)

3.0 Bridge Design Criteria

3.1 Superstructure Loads

3.1.1 Dead Load (AASHTO 3.3)

Density

Pre-Stressed (P/S) and Reinforced Concrete:	Υ_c = 25.137 kN/m^3 (incl. reinf.) (160 pcf)
Steel:	Per AASHTO *Standard Specifications for Highway Bridges*
Slab:	Minimum 190 millimeters (mm) (7.5 inches [in]) without overlay (*thickness to be determined*); (65-mm [2 ½-in] Clear, top cover)
Wear Course:	200 mm (4 inches) of asphalt total
Barrier:	Alaska Multistate Bridge Rail (TL-4)

3.1.2 Live Load

Vertical Moving Loads – Truck Traffic and Lane:	Per AASHTO *Standard Specifications for Highway Bridges except:* MS23 (HS-25 [HS-20 x 1.25])
Longitudinal Forces (AASHTO 3.9):	Per AASHTO *Standard Specifications for Highway Bridges*

3.1.3 Impact (AASHTO 3.8)

Per AASHTO *Standard Specifications for Highway Bridges*

3.1.4 Vessel Collision

Per AASHTO *Guide Specification and Commentary for Vessel Collision Design of Highway Bridges*

3.1.5 Wind Load (AASHTO 3.15)

Design for wind and thermal bads will be according to AASHTO specifications. Due to the wind conditions that exist in Tongass Narrows high level structures with considerable cross sections, such as cable stayed or suspension bridges will be more susceptible to wind than

compact rigid structures, such as concrete box girders. Should a structure type be selected with a large cross section, additional wind studies may be warranted.

3.1.6 Earthquake Load (AASHTO 3.21 Division 1-A – Seismic Design)

A literature search of geotechnical data resulted in values of peak ground acceleration between 0.025g and 0.20g for the project area. Peak ground acceleration and other seismic criteria will be determined when a geotechnical investigation is completed.

Acceleration Coefficient:	A= To follow with geotechnical investigation
Importance Classification:	IC = To follow
Seismic Performance Category:	SPC = Per AASHTO *Standard Specifications for Highway Bridges or ADOT&PF*
Site Effects, Soil Profile Type I:	To follow

3.1.7 Thermal Forces (AASHTO 3.16)

Temperature Range

Concrete Structures:	Temperature rise, 20° C (35° F)
	Temperature fall, 25° C (45° F)
Steel Structures:	-34° to 49° C (-30° to 120° F)

Coefficients of Thermal Expansion (a)

Concrete:	0.0000108 m/m/° C (0.000006 ft/ft/° F)
Steel:	0.0000117 m/m/° C (0.0000065 ft/ft/° F)

3.1.8 Uplift (AASHTO 3.17)

3.2 Substructure Loads

Substructure loads will be the same as for the superstructure loads, except as follows.

3.2.1 Live Load

No impact from the footing level down

3.2.2 Soils Density

To follow with geotechnical investigation.

3.2.3 Lateral Soil Pressure (AASHTO 3.20)

To follow with geotechnical investigation.

3.2.4 Live Load Surcharge(AASHTO 3.20.3, -.4)

600 mm (2 feet) of live load surcharge.

4.0 Ferry Design Criteria

4.1 General

The vessel described is of a similar size to existing ferries operating between Ketchikan and the Ketchikan Airport on Gravina Island. The size described affords utility and flexibility, and is regarded as a suitable size for incremental addition to an existing and growing ferry fleet operating between Ketchikan and Gravina Island (possibly on multiple routes) to meet increasing passenger and vehicle traffic demand over the next 20 years and beyond.

4.2 Operation

One-Way Crossing Distance:	From 0.25 nautical miles (n.m.) to 2.0 n.m., depending on route
General Route:	Protected waters of Tongass Narrows
Nominal Operating Profile:	15 hours/day, 350 days/year
	Up to 30 one-way crossings/day (depending on route)
	Up to 60 landings/day (depending on route)
Endurance:	7 days (fuel, water, and sewage)

4.3 Environmental Conditions

Wind Speed:	50 knots (one-minute average)
Waves	
Significant Wave Height:	1.1 m (3.6 ft)
Peak (Modal) Wave Period:	3.8 – 5.2 seconds
Temperature	
Ambient:	0 to 90° F
Water:	32 to 65° F

4.4 Payload Capacity

Passengers:	150
Vehicles	
Capacity:	2 trucks (or 2 buses) and 17 cars
Design Truck:	80,000 lbs (5-axle semitrailer up to 16.5 m (54 ft) long, carrying 12.2-m (40-ft) container)

Design Car:	6000 lbs, 6.1 m (20 ft) long
Lane	
Width:	3.0 m (10 ft 0 in)
Height:	4.4 m (14 ft 6 in) clear

4.5 Performance

Speed

Trial:	10 knots (with engines at 85% MCR)
Service:	8 knots (under environmental conditions in 4.3 above)
Thrust	
Bollard Thrust of Pushing Propeller:	40 pounds per long ton of full displacement
Lateral Bollard Thrust of One Propeller/ Rudder Combination or Z-Drive:	12.5 pounds per long ton of full displacement

4.6 Hull Form and Dock Interface

Hull

Form:	Double-ended
Length Mmaximum):	45.7 m (150 ft)
Breadth (Maximum):	19.8 m (65 ft)
Vessel Compatibility:	Must be compatible with existing terminals
Trim (Maximum):	0.30 m (12 in) when loading/offloading design truck
Design Freeboard:	To suit existing dock interface
End Geometry:	Radial geometry to suit existing dock interface

4.7 Admeasurement

(Using the domestic admeasurement system)	<100 gross tons

4.8 Structure

Material:	Steel
General Scantlings:	Per American Bureau Shipping (ABS) rules
Main Deck Capacity:	15,422 kg (34,000 lbs) dual-axle (Alaska highway legal limit)
Tire Pressure:	8.4 kg/cm^2 (120 lbs per square inch [psi]) tire pressure

4.9 Propulsion Machinery

Engines:	Diesel
Propellers:	Fixed-pitch
Control:	Controllable from the pilothouse

4.10 Passenger Amenities

Seating

Capacity:	100 passengers
Climate Control of Seating Area:	21° C (70° F) inside in all environmental conditions
Public Rest Rooms:	Two (unisex)
Drinking Fountain:	One

4.11 Crew Amenities

Rest Rooms:	One (unisex)
Office/Workroom:	One
Other:	Lockers for personal effects of crew

4.12 Safety Equipment

Lifesaving:	Per 46 *Code of Federal Regulations* (CFR) Subchapter T and ABS
Fire Detection and Suppression:	Per 46 CFR Subchapter T and ABS
Communications/ Radar:	Per 46 CFR Subchapter T and ABS

5.0 Functional Ferry Terminal Design Criteria

5.1 Design Ferry

Design ferry(s) are double-ended, open-deck ferries designed to satisfy the Gravina Access Project ferry design criteria. The nominal ferry capacity is 150 passengers, two trucks or buses, and seventeen cars.

5.2 Vehicle Facilities

5.2.1 Holding Areas

Holding area for ticketed vehicles waiting to board the next ferry should be adequate for one entire ferry load of vehicles (approximate minimum of 143.3 m [470 ft] of lane length and 3.0-m [10-ft] minimum width, with no lane less than 16.8 m [55 ft] long; 436.6 square [sq] m [4,700 sq ft]).

5.2.2 Surge Area

The surge area for off-loading vehicles should be adequate for one entire ferry load of vehicles (approximate minimum of 143.3 m [470 ft] of lane length and 3.0-m [10-ft] minimum width, with no lane less than 16.8 m [55 ft] long; ≥ 436.6 sq m [4,700 sq ft]).

5.2.3 Travel Lanes

Travel lanes for loading or off-loading vehicles should be at least one lane (3.0-m or 10-ft minimum width) and at least 33.5 m (110 ft) long (two design trucks), with good access to arterial roads; ≥ 102.2 sq m (1,100 sq ft).

5.2.4 Vehicle Space on Arterial

Vehicle lane space off the arterial road accessing the ferry terminal should be provided for at least six cars waiting to purchase tickets or two design trucks; ≥ 102.2 sq m (1,100 sq ft).

5.2.5 Crew Parking

To allow for crew shift changes and supervisory or maintenance personnel, parking should be provided for a minimum of 12 ferry worker cars; ≥ 234.2 sq m (2,520 sq ft).

5.3 Passenger Facilities

5.3.1 Passenger Shelter

Shelter should be provided for 150 ticketed walk-on passengers; ≥ 139.4 sq m (1,500 sq ft). This shelter should be located as near to the ferry loading ramp as practicable.

5.3.2 Passenger Walkway

A covered walkway should be provided for walk-on passengers, beginning at the dropoff zone, proceeding from the dropoff zone to the ticket booth, thence to the shelter for waiting ticketed passengers, and finally to the head of the ferry loading ramp. The clear width for pedestrians in this covered walkway should, as a minimum, allow for the passage of two wheelchairs in

compliance with the Americans with Disabilities Act (ADA) standards (estimated ≥ 102.2 sq m [1,100 sq ft]).

5.3.3 Public Rest Rooms

ADA-accessible men's and women's rest rooms (toilet and lavatory) should be provided in the ticketed passenger shelter.

5.3.4 Dropoff Zone

A passenger dropoff zone with shelter should be provided with capacity for twenty-five passengers and loading and unloading space for at least six vehicles (estimated ≥ 140.3 sq m [1510 sq ft.]).

5.4 Other Facilities

5.4.1 Ticket Booth

Vehicular traffic should have access to the opposite side of the ticket booth. The ticket booth should meet local building codes, have suitable interior climate control, and adequate ventilation.

5.4.2 Fencing

The ferry terminal site provided for ticketed passengers and vehicles should be fenced with a chain link or other suitable fence and provided with gates at the entry and exit roadways and at the walkway.

5.4.3 Lighting

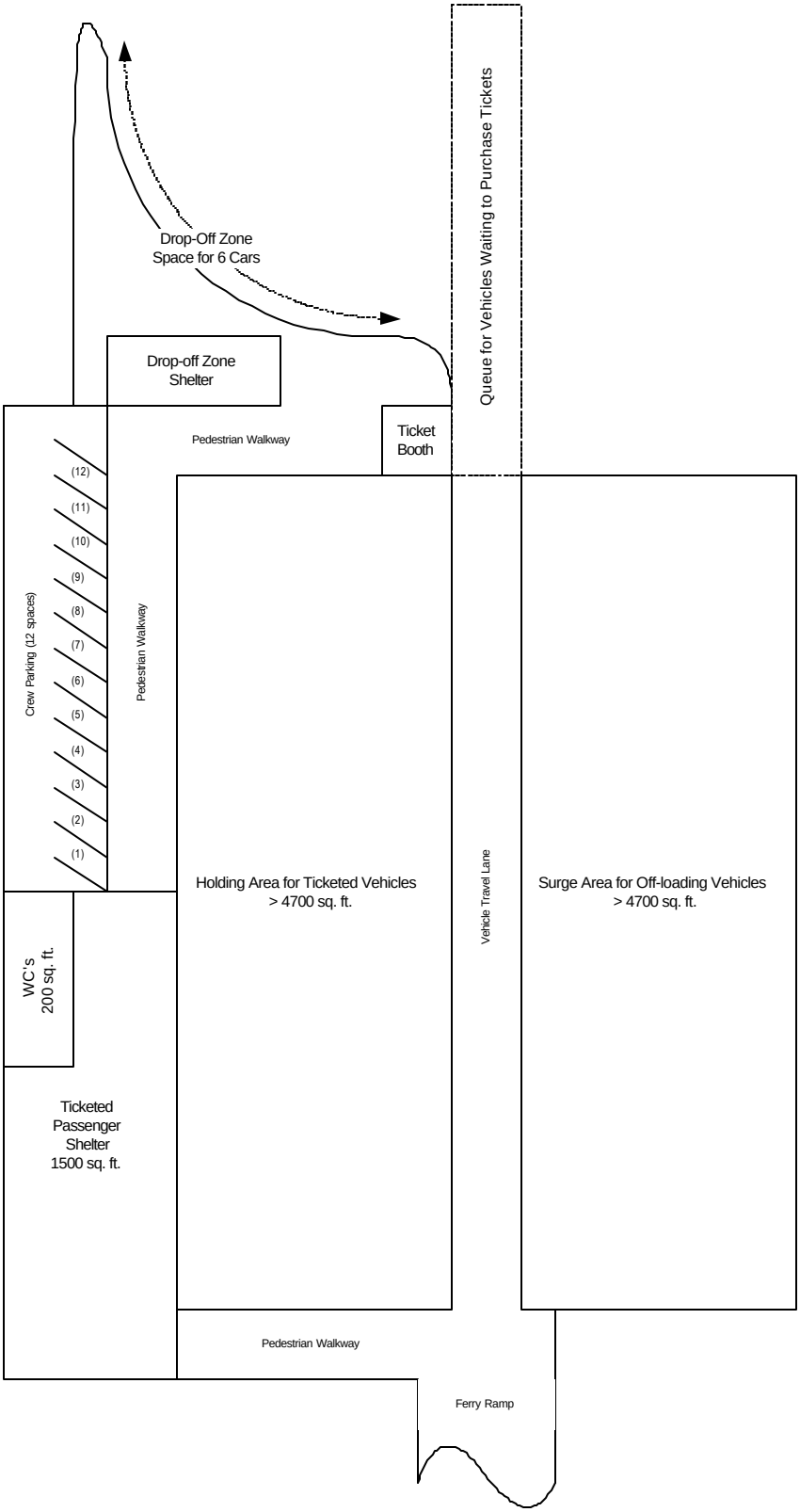
Adequate area floodlighting should be provided.

5.5 Total Required Area

The minimum total area to meet the functional ferry terminal requirements is 1,721.5 sq m (18,530 sq ft) or 0.172 hectares (0.425 acre), as detailed below:

Ferry Terminal Space Requirements

Facility	*Required Area (in square meter)*	*Required Area (in square feet)*
Ticketed Vehicle Holding Area	437	4,700
Off-loading Vehicle Surge Area	437	4,700
Dropoff Zone	140	1,510
Travel Lanes	102	1,100
Lane for Vehicles Waiting to Ticket	102	1,100
Ferry Crew Parking	234	2,520
Ticketed Passenger Shelter	139	1,500
Covered Walkway	102	1,100
ADA Restrooms	19	200
Ticket Booth	9	100
Minimum Total Area	1,721	18,530


Drop-Off Zone
Space for 6 Cars
Queue for Vehicles Waiting to Purchase Tickets
Drop-off Zone
Shelter
Pedestrian Walkway
Ticket
Booth
(12)
(11)
(10)
(9)
(8)
(7)
(6)
(5)
(4)
(3)
(2)
(1)
Crew Parking (12 spaces)
Pedestrian Walkway
Holding Area for Ticketed Vehicles
> 4700 sq. ft.
Vehicle Travel Lane
Surge Area for Off-loading Vehicles
> 4700 sq. ft.
WC's
200 sq. ft.
Ticketed
Passenger
Shelter
1500 sq. ft.
Pedestrian Walkway
Ferry Ramp

6.0 Functional Ferry Support Facility Design Criteria

The Gravina Access Project ferry design criteria require that the double-ended, open-deck ferries be capable of operating for seven days before refueling, taking on freshwater, or pumping sewage. As minimally manned dayboats, the ferries will receive routine maintenance during overnight layovers. Ferries will normally be moored in their slips during overnight layovers. However, at least once a week the vessels will be moved during the out-of-service period to a fuel dock for refueling, loading of freshwater, and pumping of sewage. This could occur at a commercial fuel dock or at a service slip provided as part of the ferry system infrastructure.

7.0 References

33 *Code of Federal Regulations* (CFR). Pollution Prevention.

46 CFR. Subchapters G (Admeasurement), F (Mechanical), E (Loadline), J (Electrical), S (Stability), and T (Small Passenger Vessels).

American Association of State Highway and Transportation Officials (AASHTO). *Guide Specification and Commentary for Vessel Collision Design of Highway Bridges.* 1991.

AASHTO. *Informational Guide for Highway Lighting.*

AASHTO. *Policy on Geometric Design of Highways and Streets.*

AASHTO. *Standard Specifications for Highway Bridges*, 16th ed. 1996, with Interims through 1998.

American Bureau of Shipping (ABS) Rules for Building and Classing Vessels for Service on Inland and Intracoastal Waterways.

Americans with Disabilities Act (ADA).

Institute of Electrical and Electronic Engineers (IEEE). 45.

State of Alaska Department of Transportation and Public Facilities (DOT&PF) *Highway Drainage Manual* 1995.

State of Alaska DOT&PF. *Preconstruction Manual.* 1999.

State of Alaska DOT&PF. *Standard Drawings.*

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