

Appendix B - Mooring and Loading Study

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Methodology

A mooring and loading study was conducted to examine the total time it would take to moor and unload and load a day boat ferry using different terminal configurations. These times, called mooring and loading operations (MLOPS), are instrumental in creating day boat operating schedules.

The development of mooring and loading times is based on measured vessel mooring times for both Alaska Marine Highway System (AMHS) vessels and Washington State Ferry (WSF) vessels. The known mooring and loading times were extrapolated to various vessel configurations and combined in order to develop round trip MLOPS.

Using both the assumed mooring times and the loading times, specific round trip times for mooring and loading operations (MLOPS) can be developed. Each MLOPS is one full round trip between two terminals. To determine an average loading and unloading time for use in the development of schedules, the total MLOPS times are divided by 4.

Mooring

MEASURED MOORING TIMES

Coastwise has previously measured vessel mooring times for some of the AMHS and the WSF vessel/terminal combinations during the development of the Juneau Access Improvements marine segments.

At the time of the previous study, not all of the existing AMHS mooring times were measured. The un-measured mooring times have been estimated to assist in the development of assumed mooring times for the Day Boat ACF. Below is a summary of vessel mooring times based on the results of the previous study.

Current AMHS displacement vessel side mooring
Arrival: 2.9 transition, 10.5 mooring = 13.4 minutes

Departure: 7.0 unmooring, 2.0 transition = 9.0 minutes

Current AMHS Fast Vehicle Ferry stern end mooring

Arrival: 2.1 transition, 6.8 mooring = 9.9 minutes

Departure: Not measured¹, assume 50% faster = 5.0 minutes

Current AMHS Displacement Vessel stern end mooring

Arrival: Not measured¹, assume not more than side load = 13.4 minutes

Departure: Not measured¹, assume = 5.0 minutes

Current WSF double-end displacement vessel (straight in - end moor – hold with propulsion)

Arrival: 2.1 transition, 1.9 mooring = 4.0 minutes

Departure: Not measured, assume 10% faster = 3.0 minutes

¹ The actual vessel mooring times in Whittier (Aurora end mooring) and Juneau (Fairweather) should be measured in order to verify the estimated times.

ASSUMED MOORING TIMES FOR DAY BOATS:

Based on the measured mooring times, the following mooring configurations were developed. The configurations listed below assume a single ended vessel propulsion system. Each configuration is intended to be used as the mooring time at one end terminal of a MLOPS scenario. The assumed arrival and departure times for each mooring configuration are estimated values only.

- 1) Bow End Moor – This is similar to traditional double-ended ferry mooring configurations. The vessel sails straight in to the berth such that the bow is captured as shown in Figure 1. Vessel position is maintained by the propulsion system, with additional safety lines in place for emergency purposes. The arrival and departure times are increased from WSFS times to account for single ended operation.

Arrival: = 5.0 minutes

Departure: = 4.0 minutes

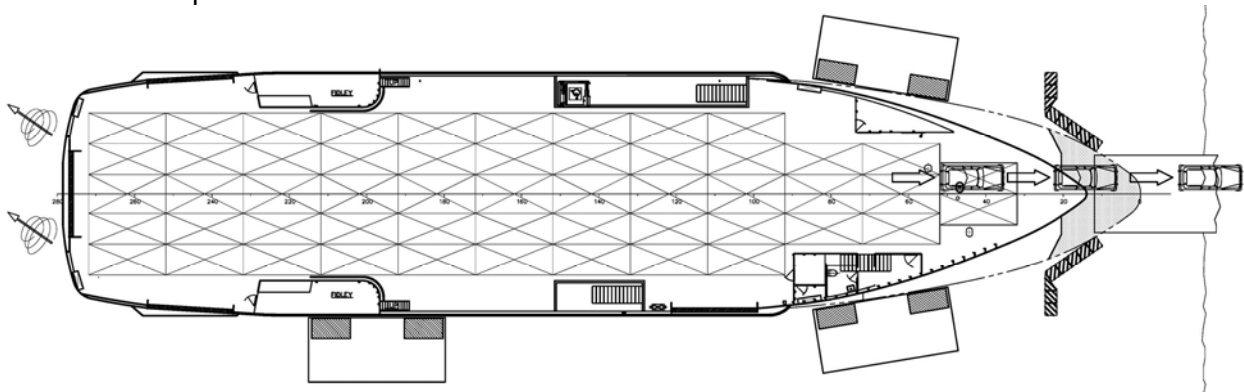


Figure 1: Bow End Moor, Bow Loading

- 2) Side Moor – This mooring configuration requires the vessel to tie off to a side berth as shown in Figure 2. In order to ensure that the side door is aligned with the terminal ramp, this mooring configuration normally requires multiple tie-off attempts. Arrival and departure times for the Day Boat ACF are assumed to be quicker than the measured AMHS times to account for improved vessel operations for tight schedules.

Arrival: = 12.0 minutes

Departure: = 8.0 minutes

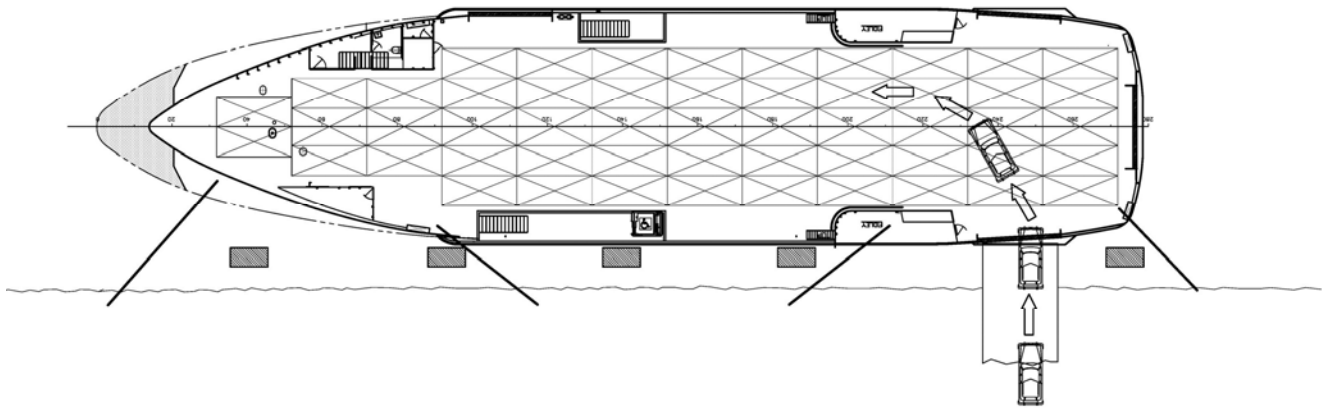


Figure 2: Traditional Side Moor, Side Loading

- 3) Stern End Moor – This is similar to the current AMHS end mooring configuration as shown in Figure 3. This mooring configuration requires the vessel to turn around just prior to arriving at the berth. The vessel then backs into the berth and ties off using stern lines. Pending actual vessel operation measurements, it is assumed that this style of mooring can be accomplished by the Day Boat ACF in the same time as a side mooring arrangement.

Arrival: = 12.0 minutes

Departure: = 4.0 minutes

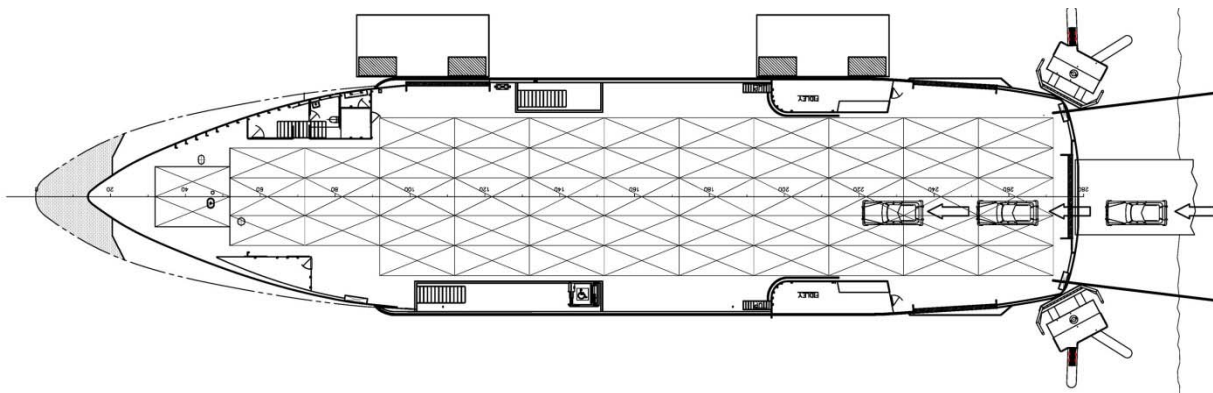


Figure 3: Stern End Moor, Stern Loading

Vehicle Loading

ACTUAL LOADING TIMES:

Coastwise has previously measured vessel loading and unloading times for some of the AMHS and the WSF vessel/terminal combinations during the development of the Juneau Access Improvements marine segments.

At the time of the previous study, not all of the existing AMHS loading times were measured. The un-measured loading times were estimated to assist the development of loading times for the Day Boat ACF. Below is a summary of vessel loading times based on the results of the previous study, with loading rates given in cars per minute (CPM).

Current AMHS (displacement vessel) side loading

Arrival/Unloading: 2.9 minute delay, 2.0 CPM

Departure/Loading: Not measured

Current AMHS Fast Vehicle Ferry (turn around end moor stern) stern loading

Arrival/Unloading: 2.2 minute delay, 4.6 CPM

Departure/Loading: Not measured

Current WSFS DE displacement vessel (straight in - end moor – hold with propulsion)

Arrival/Unloading: 0.0 minute delay, 10 CPM per lane

Departure: Not measured, assume 9 CPM per lane

ASSUMED LOADING TIMES FOR DAY BOATS:

The loading times listed below assume that vehicles drive straight on and off the vessel, requiring no turn around either during loading or unloading operations. In addition, the load times assume vehicles are not required to stop at the top of the ramp for ticket collection; rather, the terminal uplands are adequately sized and configured to stage all of the vehicles to be loaded on to the ferry after the ticketing. The offloading lanes are also assumed to be sized appropriately to prevent any backlog or stopping of vehicles. In order to meet the estimated loading times, no unattended trailers are permitted to be loaded onto the vessel.

The estimated loading times shown below vary from the previously measured AMHS loading times due to improved vehicle traffic patterns. For end load times, due to the vehicle types and sizes typically operated in Alaska, the loading and unloading times are estimated to be slightly greater than similar arrangements for WSF.

- 1) Side Loading – Loading the vessel from the side can only be accomplished using a side mooring configuration similar to Figure 2. Although this figure shows loading at the stern end of the vessel, side loading can also occur at the forward end of the vessel. In this loading configuration the majority of the vehicles can drive straight into their parking place; however when fully loaded some vehicles will need to back into place at either the bow or the stern.

Side load	= 4.0 CPM	if cars are 10 feet apart = 1.36 MPH average
Side discharge	= 6.0 CPM	if cars are 10 feet apart = 2.05 MPH average
- 2) End Loading – With an appropriate vessel arrangement, end loading can occur either at the stern of the vessel, as shown in Figure 3, or at the bow, as shown in Figure 1. This style of loading is the most efficient as the vehicles do not need to make any turns on the vehicle deck.

End load	= 6.0 CPM	if cars are 10 feet apart = 2.05 MPH average
End discharge	= 9.0 CPM	if cars are 10 feet apart = 3.07 MPH average

Day Boat Mooring and Loading Operational Scenarios

In order to compare the different MLOPS, each scenario assumes that a full complement of 53 vehicles is loaded and unloaded at each terminal. Since the scenarios are based on the estimated loading times discussed above, the vehicles are assumed to be able to load and unload from the vessel without turning around. This means that vehicles must load from the front end of the vessel at one terminal and at the rear of the vessel at the second terminal.

MLOPS 1 Round Trip: Straight In Bow : Straight In Stern

This MLOPS is for a double ended ferry and was developed for comparison purposes only. A double ended ferry operates without the necessity of turning the vessel around to load at the bow and the stern. This means that a double ended ferry can moor using the bow end mooring configuration described above for both terminals and still be able to load and unload vehicles without requiring them to turn around.

Mooring Terminal A: Bow End Moor

Mooring Terminal B: Bow End Moor

Loading Terminal A: End Load (bow ramp)

Loading Terminal B: End Load (bow ramp)

Activity	Mooring (minute)	Delay (minute)	Traffic Rate (cars / Min. avg.)	Traffic Time (minute)	Total Time (minute)
Load 53 cars			6.0	8.8	8.8
Mooring Departure A	4.0				12.8
Mooring Arrival B	5.0				17.8
Unload 53 cars			9.0	5.9	23.7
Security Sweep		3.0			26.7
Load 53 Cars			6.0	8.8	35.6
Mooring Departure B	4.0				39.6
Mooring Arrival A	5.0				44.6
Unload 53 cars			9.0	5.9	50.4
Security Sweep		3.0			53.4
Sum of Time:	18.0	6.0		29.4	53.4

MLOPS = 13.4

MLOPS 2 Round Trip: Back In Stern : Straight In Bow

Mooring Terminal A: Stern End Moor

Mooring Terminal B: Bow End Moor

Loading Terminal A: End Load (stern ramp)

Loading Terminal B: End Load (bow ramp)

Activity	Mooring (minute)	Delay (minute)	Traffic Rate (cars / Min. avg.)	Traffic Time (minute)	Total Time (minute)
Load 53 cars			6.0	8.8	8.8
Mooring Departure A	4.0				12.8
Mooring Arrival B	5.0				17.8
Unload 53 cars			9.0	5.9	23.7
Security Sweep		3.0			26.7
Load 53 Cars			6.0	8.8	35.6
Mooring Departure B	4.0				39.6
Mooring Arrival A	12.0				51.6
Unload 53 cars			9.0	5.9	57.4
Security Sweep		3.0			60.4
Sum of Time:	25.0	6.0		29.4	60.4

MLOPS = 15.4

MLOPS 3 Round Trip: Side Load Aft : Straight In Bow

Mooring Terminal A: Side Moor

Mooring Terminal B: Bow End Moor

Loading Terminal A: Side Load (aft side ramp)

Loading Terminal B: End Load (bow ramp)

Activity	Mooring (minute)	Delay (minute)	Traffic Rate (cars / Min. avg.)	Traffic Time (minute)	Total Time (minute)
Load 53 cars			4.0	13.3	13.3
Mooring Departure A	8.0				21.3
Mooring Arrival B	5.0				26.3
Unload 53 cars			9.0	5.9	32.1
Security Sweep		3.0			35.1
Load 53 Cars			6.0	8.8	44.0
Mooring Departure B	4.0				48.0
Mooring Arrival A	12.0				60.0
Unload 53 cars			6.0	8.8	68.8
Security Sweep		3.0			71.8
Sum of Time:	29.0	6.0		36.8	71.8

MLOPS = 18.0

MLOPS 4 Round Trip: Side Load Fwd : Back in Stern

Although the assumed side loading times are referenced to Figure 2, which shows the ramp on the aft end of the vessel, side loading can also occur at the forward end of the vessel with no impact on the mooring. Forward side loading permits vehicles to drive straight on the stern and straight off the side.

Mooring Terminal A: Side Moor

Mooring Terminal B: Stern End Moor

Loading Terminal A: Side Load (forward side ramp)

Loading Terminal B: End Load (stern ramp)

Activity	Mooring (minute)	Delay (minute)	Traffic Rate (cars / Min. avg.)	Traffic Time (minute)	Total Time (minute)
Load 53 cars			3.0	17.7	17.7
Mooring Departure A	8.0				25.7
Mooring Arrival B	12.0				37.7
Unload 53 cars			9.0	5.9	43.6
Security Sweep		3.0			46.6
Load 53 Cars			6.0	8.8	55.4
Mooring Departure B	4.0				59.4
Mooring Arrival A	12.0				71.4
Unload 53 cars			4.0	13.3	84.6
Security Sweep		3.0			87.6
Sum of Time:	36.0	6.0		45.6	87.6

MLOPS = 21.9

MLOPS 5 Round Trip: Assumed Standard MLOPS

For the purpose of comparing schedules a slightly more generous MLOPS time of 30 minutes (per each loading and unloading cycle) was developed and implemented. This MLOPS 5 time has the benefit of requiring an even hour of port time and more closely aligns with some current AMHS operations. However, if the vessel is carrying a full load of 53 vehicles, this MLOPS 5 time still requires much faster loading and unloading times, compared to current AMHS operation.