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# MAZATLAN EVALUATION 2012

## OVERVIEW

This report describes the results and conclusions of a brief simulation study of the design and future installation of two finger piers at the port of Mazatlan, Mexico. The addition of these piers will support visiting car and passenger ferry vessels currently calling at the port, and also provide additional general commercial berthing. Access to these piers will be via an extended inner channel and turning basin whose dredged depth is expected to be 10.0 meters. The one-day study was conducted at STAR Center, located in Dania Beach, Florida on 10 March 2012.

Although the installation of two finger piers is contemplated, the focus of our project is on the Southern most pier, which provides two berths, north side and south side, expected for use by the ferries. The Northern most pier, not specifically examined in this study, may provide commercial berthing for other class of vessels. For the purpose of pier identification, in our study, the Southern pier (ferry pier) is referred to as Pier 2, and berthing at Pier 1 is not addressed in this report. **Figure 1 – Project Plan** is provided below:

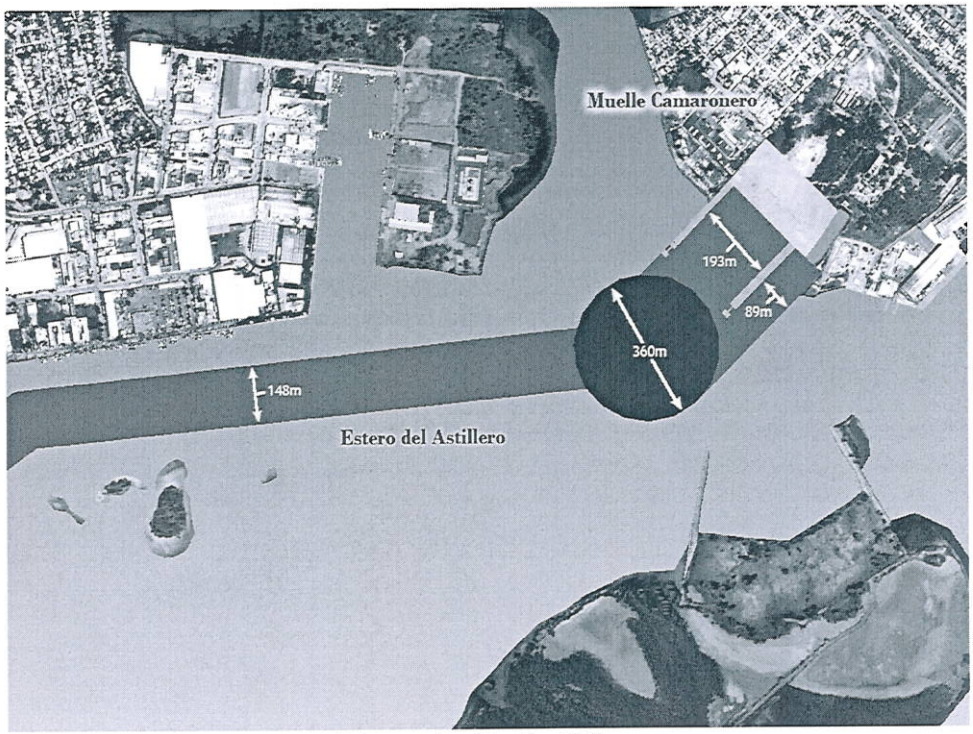


**Figure 1 – Project Plan**

## PARTICIPANTS

An experienced Mazatlan Pilot attended the study, and actively participated by operating the "Blue Horizon" ferry vessel during all simulation exercises. A port official attended all simulations as an observer, and assisted project personnel by providing valuable information relating to specific objectives of the harbor modification. STAR Center provided a senior researcher, mate/helmsman, simulator technician, simulator operator to operate and record data necessary to evaluate results, and a project facilitator to observe simulations, and conduct debriefings at the conclusion of each exercise.

## SIMULATOR MODELS

The ship response model of the "Blue Horizon" was the vessel utilized in simulations. This vessel model was available from STAR's library of vessel models, and it had been used in prior simulation studies at the port of Mazatlan. "Blue Horizon" is a passenger and car ferry closely resembling the ferries currently servicing the port, and its maneuverability, length, and draft provide reliable insight relating to pier orientation, turning basin diameter, channel width and depth required to support future ferry operations. Ship particulars for "Blue Horizon" are provided below:

### VESSEL PARTICULARS

| Vessel Name | Blue Horizon |
|---|---|
| Condition | Design |
| Displacement | 15,700 |
| Wind Profile | N/A |
| LOA (m) | 187 |
| Beam (m) | 27 |
| Draft (m) | 6.4 |
| Propulsion | Diesel Elec. |
| Shaft HP | 14,684 |
| Propeller | 2 (V) (OT) |
| Max Rudder | 35 |

V= variable pitch OT= outboard turning

## GEOGRAPHIC DATABASE

The geographic database of the port of Mazatlan was available at STAR Center having been developed for previous studies. This database and harbor bathymetry were modified to represent a "model of the future" representation of the port as identified by plans and drawings provided by officials of the port. These modifications included extension of the current navigation channel, delineation of an additional turning basin, and specifications of the two piers contemplated for installation. Additionally, dredge plans indicate a 10.0 meter minimum depth in the new channel, turning basin, and pier area is also contemplated as part of the project.

## ENVIRONMENTAL CONDITIONS

Winds, as identified by the participating pilot were predominantly Northwest in winter months, and Southwest in summer months. Due to its location in the inner part of the harbor, winds are expected to be moderate. Therefore, wind direction and velocities used in simulations were NW and SW 15 to 20 knots, the middle to upper range of moderate winds.

Tidal currents, anticipated to be 0.5 knots or less in the harbor interior, in the vicinity of the turning basin and berth area, were not considered a significant factor for vessel maneuvers. No tidal currents were incorporated in the simulation exercises for this reason. Environmental conditions, run direction, and berth destinations are listed in **Table 1 – Run Matrix** provided below:

**Table 1 – Run Matrix**

| Run Number | Direction | Wind Dir/Speed | Berth Side Pier #2 | Comments |
|---|---|---|---|---|
| 1 | Inbound | None | North | Familiarization |
| 2 | Inbound | SW 15/20 | South | uneventful |
| 3 | Inbound | NW 15/20 | South | Close to south side of berth limit |
| 4 | Outbound | NW 15/20 | South | Close to south side of berth limit |
| 5 | Inbound | NW 15/20 | South | Repeat run 3 better result |
| 6 | Outbound | NW 15/20 | North | Touched the dock with vessel stern |
| 7 | Outbound | NW 15/20 | North | Repeat run 6 better result |

## TUGBOAT USAGE

The port of Mazatlan has at its disposal, modern tractor type tugboats of approximately 4,000 HP. Use of a tugboat by transiting ferries is mandatory at the port. They may stand-by for use, or actively assist as directed by the pilot as conditions warrant.

## TESTING PROCEDURES AND RESULTS

To minimize time requirements, inbound simulation runs commenced in the channel, near Estero del Astillero just west of the turning basin, and ended when the vessel was parallel to the pier, under control, and at minimum speed. Outbound simulations commenced with the vessel off the dock, all lines released, and ended when the vessel was clear of the pier. All exercises required turning the vessel to dock stern in. An assist tractor tugboat was available for use in all simulations should the shiphandler desire its use. No tug assistance was requested during any wind conditions tested.

*Navigation Channel*
Pre-simulation discussions with the participant and observer affirmed that issues and vessel maneuvering difficulties were generally not anticipated. Relocating the ferry pier from its present position just inside the harbor breakwater to the new location, nearer city infrastructure, would increase transit time from entrance to dock. However, the intended 150 meter wide navigation channel, extended from the present channel to the new turning basin, facilitates this transit. Transit speeds of approximately 7 knots, as stated by the participating pilot, would minimize any adverse effects on moored vessels along the channel, while facilitating steering control of the transiting vessel in most expected wind conditions.

*Turning Basin*
The ferry vessel is equipped with a loading and unloading ramp on the stern. The stern location of this ramp necessitates that the vessel be turned, and backed into the berths on either side of the pier for access to the shore ramp. To provide adequate maneuver room to turn the vessel, a 360 meter diameter turning basin is located immediately adjacent to both Pier 1 and Pier 2. The 360 meter diameter did provide ample room to turn the vessel in all conditions tested in simulations. Its central location provides a good approach angle, after turning, to either the North or South berth of Pier 2.

*Pier 2*
Ferry vessels like the vessel used in our simulations, normally are high sided, making them especially vulnerable to the effects of wind against this extensive profile. This vulnerability is especially noticeable during slow speed transits when the wind is on the beam of the vessel, and during turning and docking/undocking maneuvers. Pier orientation (Southwest – Northeast) may ease effects of winds on vessels when from the Southwest, paralleling the berths, but challenge the shiphandler when blowing from the Northwest, setting a vessel on or off the pier. For this reason, we emphasized maneuvers during Northwest wind conditions in simulations. The North side berth at Pier 2 provides generous maneuver room for docking/undocking vessels, even during simulations when Pier 1 was occupied with a moored vessel, however, the South side berth provides very limited maneuver room. Simulation observations and pilot verbal comments highlight this situation.

If the environmental conditions warrant tugboat assistance for docking or undocking, the Southern berth offers little or no maneuver room for a tugboat to assist at the berth, or to provide maximum thrust in this limited berth.

## CONCLUSIONS

Extending the current 150 meter wide navigation channel to the new turning basin has proven in simulations to provide a safe and adequate transit lane for arriving or departing ferry vessels.

The 360 meter diameter turning basin does provide ample room to safely turn the ferry in all conditions tested.

Pier 1 Southern berth, even when occupied by a moored vessel does not adversely effect maneuver room and berthing at Pier 2 Northern berth for ferries.

Pier 2 does provide simultaneous berthing of two ferry vessels, however, the limited berth width at the Southern berth may limit its use by ferries to light wind (10 knots or less) conditions only. Widening the Southern berth is highly recommended, whether through additional dredging or repositioning the pier Northward (slightly lessening the generous maneuver room at the Northern berth). A wider Southern berth would facilitate ferry entry and exit in a wider range of wind conditions and directions, and make tug assist, should it be necessary, more practical.

A 10.0 meter controlling depth in the extended channel, turning basin and pier area is adequate to support ferry arrival and departure maneuvers.

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