

January 19, 2021

MEMORANDUM

To: Daniel Gho  
Public Works Director  
City of Pacific Grove

From: Mark Foxx, CEG 1493 and John E. Kasunich, GE 455  
Haro Kasunich and Associates Inc.

Subject: Lovers Point Pier Damage

During the recent winter storms, the seaward tip of the Lovers Point Pier was severely damaged by ocean wave runup and wave impact forces. Waves were reportedly observed breaking on the pier structure and wave runup was flowing across the concrete deck that forms the surface of the pier.

A photograph of the pier from September 2015, before the January 2020 damage occurred is shown below:



From our observations of the damaged pier, it appears that the pier was originally constructed as a wooden wharf that was subsequently covered with concrete, with rip rap boulders being placed along the side of the pier that is more exposed to the ocean. At the tip of the pier, several large pieces of concrete fascia were stripped off the structure by wave impact. It appears that the concrete fascia has been historically patched based on different fascia thicknesses and concrete types that are now visible. Approximately seven large (up to about 4 ft by 8 ft) concrete fascia fragments fell into the sub-tidal zone water where they now rest on the seafloor immediately adjacent to the pier. The ends of two decayed wooden beams are visible where voids were created when the concrete fascia was stripped off the pier. The reinforcing ties that anchored the fascia to the concrete deeper within the pier structure are rusted away. This created a situation where the fascia was unattached or barely attached to the main bulk of the pier structure.

We cannot tell if the pier structure is hollow. It may be infilled with sand, dirt, boulders or concrete. Subsurface exploration (exploratory borings) would be necessary to assess the internal structure of the pier. The composition of the internal structure will be important in how the pier might be structurally stabilized. It also is an important factor in assessing whether the pier is subject to sudden collapse or accelerated deterioration.

Although we don't know the internal structure of the pier, we have developed a range of alternatives that can be considered to react to the recent damage. These are described below with a discussion of some of the pros and cons of each.

#### Alternative Actions to Consider:

1) Do nothing: If nothing is done then: a) Damage will continue; b) Concrete debris will remain in the ocean water; and c) The public will be at risk if they use the pier. This alternative is unacceptable.

2) Remove Concrete Debris: This includes the pieces of concrete fascia resting on the seafloor in shallow water, as well as loose pieces of fascia that are partly detached from the pier structure. This can be done with a crane or perhaps an excavator operated from the intact part of the concrete pier deck. A diver would likely need to assist in order to place slings or anchor bolts in the concrete debris pieces so they can be lifted, placed in a truck and transported to an appropriate disposal site. This alternative is environmentally appropriate.

3) Relocate Fencing at Tip of Pier: This involves removal of part of the existing fencing and installing new fencing in a location far enough landward of the damaged part of the pier so that users of the pier are only able to access the stable part of the pier. This involves relocating the fence to prevent access to approximately the seaward 20 feet of the pier. This alternative is a relatively low-cost alternative that maintains most of the public access; however, it does not prevent further deterioration of the pier structure over time. If the pier is determined to be hollow, this alternative is not feasible, since the hollow portion of the pier may be subject to sudden failure.

4) Monitor Future Deterioration; This involves periodically inspecting the condition of the pier to assess if future damage is occurring. This is prudent no matter which other alternative actions are taken. As part of the monitoring, supplemental recommendations should be made to the City, so those can be implemented as appropriate.

#### 5) Stabilize Past and Present Damaged Portions of Pier:

This first involves additional mapping of the condition of the pier and then conducting subsurface exploration to define the nature and condition of the pier structure. Several options for stabilization can be considered:

- a) Design and installation of a new structural fascia that wraps around the tip of the pier and allows restoration of public use of the tip of the pier. This would include replacement of the damaged fencing.
- b) Inclusion of soil nail restraints within the fascia to enable it to act as a retaining structure
- c) Consideration of both the need for the fascia to act as a structural element as well as a cosmetic surfacing.
- d) If the existing pier structure is found to be hollow or to be filled with sand, a condition where catastrophic failure could occur the fascia will need to be a surfacing on a thick new concrete or shotcrete retaining structure that wraps around the tip of the pier and allows restoration of public use of the tip of the pier. This would be very costly.
- e) If the existing pier structure is found to be constructed of monolithic concrete, there are several options for stabilization, which would be much less costly than stabilizing the hollow or cohesionless sand filled pier condition discussed above. Our surface observations cannot distinguish which condition presently exists.

6) Monitor Surf Forecasts: This can be done relative to ocean swell size, direction and period; and close the entire pier to public use for temporary periods of time if adverse (dangerous) conditions are forecast. If wave overtopping of the pier deck or large waves are forecast during king tide periods, close the pier to public use. This alternative is prudent no matter what other alternatives are selected and implemented.

In our opinion:

- A. Removing concrete debris, relocating fencing at the tip of the pier, monitoring future deterioration and monitoring of surf forecasts are the best short-term solution.
- B. Subsurface exploration of the internal composition of the pier should be scheduled next.
- C. Stabilization of the past and present damaged portions of pier is the appropriate long term solution.

Haro Kasunich and Associates can present a scope of work and cost estimate to perform a geotechnical investigation of the damaged pier after alternative actions are evaluated by the City of Pacific Grove and appropriate directives are issued. If you have any questions or would like to discuss this memorandum with us, please do not hesitate to call our office.

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