

Damage to Port Facilities and Response to the 2024 Noto Peninsula Earthquake

Port, Coastal and Marine Department

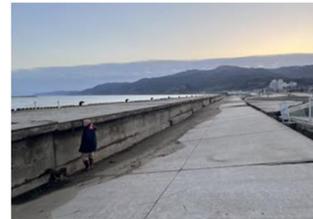
This paper introduces the decision on whether or not to use port facilities made immediately after the 2024 Noto Peninsula Earthquake, as well as the subsequent moves toward temporary use and emergency restoration of the facilities.

Research Introduction

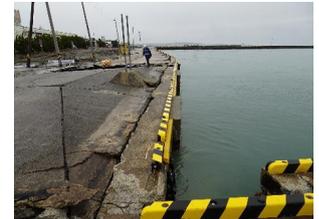
1. Typical examples of damage to port facilities

In the Noto Peninsula Earthquake in 2024, the damage to port facilities, especially the enormous damage to mooring facilities, was confirmed. In Wajima Port, there was a place where a step of about 2 m at the maximum was generated behind the gravity type quay. In Iida Port, there was a place where a sheet pile type quay protruded greatly. In Nanao Port, there was a case where there was a deformation in the bridge connecting the superstructure and the back ground of the pier, and it was estimated that the bearing capacity of the pier body for berthing and mooring was affected.

In addition, many damages to port facilities were confirmed in Ushitsu Port, Anamizu Port, Kanazawa Port, etc. In addition to mooring facilities, damages such as water depth decrease due to ground uplift, and sliding and sinking of breakwaters due to earthquakes and tsunamis were also confirmed.



Damage situation of Wajima Port Marine Town Quay



Damage situation of the loading dock (-4.0 m) in Iida Port



Damage situation of Yada New Pier (Daiichi West) in Nanao Port



TEC-FORCE investigation of damage situation of Gokuden 1 and 2 wharves in Kanazawa Port

2. Decision on whether or not to use facilities through field survey and technical support

In order to grasp the state of damage to port facilities, a field survey was conducted by dispatching TEC-FORCE from the NILIM. In the field survey of the mooring facilities, the displacement of the quay wall was estimated from the inclination of the quay wall superstructure and the crack width of the back ground, etc., and the usability of the mooring facilities was judged after considering the structural type, etc. In the judgment of the usability, the correspondence was examined in accordance with the disaster situation, for example, the operation with restrictions on berthing and toloading was proposed.

As for Gokuden No.1 Quay in Kanazawa Port, the technical support on the installation of temporary mooring poles was carried out as an emergency restoration method based on the disaster situation.

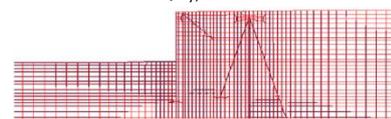


Technical support for the installation of temporary mooring poles (blocks) at Gokuden No.1 Quay, Kanazawa Port

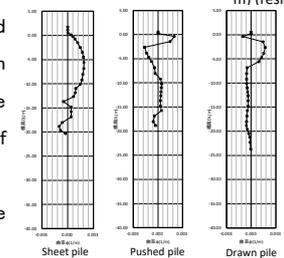
3. Efforts to contribute to quick and accurate decision on whether or not to use facilities

Among the mooring facilities, it was difficult to judge the degree of damage only by the field survey for the parts which cannot be visually confirmed such as underwater and underground parts. For these mooring facilities, the seismic response analysis which reproduced the structural cross-section and earthquake motion was carried out, and the residual capacity of each member was estimated, and it was judged that the restriction of use could be relaxed for some facilities.

In addition, a Berth Surveyor^{*1} was installed at the site in order to quickly measure the displacement of the mooring facilities during future aftershocks.



Results of FLIP reproduction analysis of section C at Ota No.2 Quay, Nanao Port (-10 m) (residual displacement)



Curvature distribution map of sheet pile and stay pile at section C at Ota No.2 Quay, Nanao Port (-10 m)

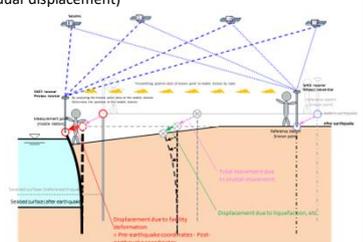


Image of displacement measurement by Berth Surveyor

4. Toward solving future issues

In order to systematize and expedite the judgment of whether or not to use mooring facilities in the future, we are preparing guidelines so that necessary information can be arranged in advance. We are also working on the development of a new earthquake-resistant design method for mooring facilities, with a view to standardizing a quantitative evaluation method for the performance of mooring facilities after an earthquake, and examining an evaluation method for the difficulty of immediate use and emergency restoration of facilities^{*2}. In addition to the technical examination, a disaster prevention drill is also being carried out by the local coordination and the National Institute for Land and Infrastructure Management (NILIM) to remotely judge whether or not to use TEC-FORCE using the on-site webcam, assuming that TEC-FORCE personnel cannot be dispatched due to a wide-area disaster.

^{*}1: Related page

^{*}1: Development of a support system for measuring displacement and evaluating stability of mooring facilities after an earthquake using RTK-GNSS <https://www.pari.go.jp/2020/03/TECHNICALNOTE1370.html>

^{*}2: Development of a new seismic design method to enable immediate use and easy emergency restoration of mooring facilities after an earthquake <https://www.nilim.go.jp/lab/bcg/hyouka/R6/r6index.html>