

Trends in Port and Harbour Technology and Future Outlook for Technology Development

Koizumi Tetsuya, Director of the Port and Harbour Department

(Key words) International Ferry, Inspection and Diagnosis Guidelines for Port and Harbour Facilities, Large-scale Temporary Works

1. Research on technologies contributing to regional revitalization and strengthening of international competitiveness

In recent years, a number of regional issues related to port and harbour technology have become apparent, including changes of socioeconomic conditions and logistics networks, development of more advanced technologies for disaster prevention/disaster mitigation based on the lessons of the Great East Japan Earthquake of 2011, and response to strengthening of operation and maintenance technologies for deterioration of social infrastructure with age, among others.

Globally, structural changes that will result in new patterns of international marine transportation are progressing rapidly, such as expansion of the Panama Canal and the Suez Canal, construction of larger scale container ships, etc. Moreover, the decreasing area of Arctic ocean ice is encouraging increasing use of the NSR, and it is assumed that this will also affect port improvement in the East Asian region over the long term.

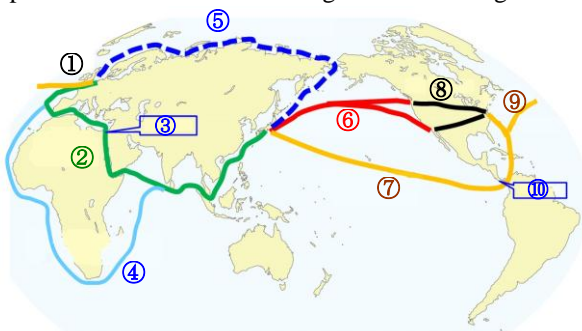


Fig. Main global navigation routes, Arctic passage, etc.

- ① European route (via Panama Canal)
- ② European route (via Suez Canal)
- ③ Suez Canal
- ④ Cape of Good Hope Route (Europe)
- ⑤ NSR (Northern Sea Route)
- ⑥ North America West Coast route
- ⑦ North America East Coast route (via Panama Canal)
- ⑧ DST (railway)
- ⑨ North America East Coast (to Europe)
- ⑩ Panama Canal

Calculation of the direct effects and ripple effects of these changes in freight transportation on related parties and promotion of effective port improvement and contribution to regional revitalization through individual cost-benefit analysis calculations, etc. are demanded.

In design and construction technologies, the Port and Harbour Department is studying responses to various issues and proposals for next-generation technical standards based on the needs of port authorities, companies located in ports, and other port users. To secure the safety of aging/deteriorating port and harbor facilities with limited fiscal resources, we are working to reduce and level maintenance/renovations costs and to realize labor saving responding to limited manpower.

Based on the present issues and future outlook for port and harbor technology, this article presents the aims of the research which is currently in progress in this department, as well as policies for future research, and introduces efforts to incorporate the results of research on strengthening of international competitiveness and

development of technology in Japan.

2. Research on international ferries

To address the need for more efficient transportation in the East Asian region, we analyzed trends focusing on international ferries between the Asian region and various parts of Japan, proposed draft standards for mooring facilities, developed a tool for forecasting the navigation route network and performed impact analyses for changes in the level of transport service and related policies (Research project for 2010-2013, “Study on transport facilitation measures corresponding to expansion of Asian international ferry transport).

Using a nationwide survey of import/export container cargo flows, we developed a model for estimating the condition of flows of international ferry and RORO ships (ferries, etc.) in a form that also includes container ship transportation, estimated the time value distribution of transportation between Japan and Korea and China (central area) by imports and exports and developed a model that makes it possible to estimate the condition of freightage by ferries, etc.

As a result, although the partial reproducibility of some parts of the freightage by individual transportation route cannot be called adequate, and in particular, in the model of the central area of China, there are remaining issues in the reproduction of the volume of freight transportation by international ferries, etc., which have a small freight volume/share in comparison with transportation by containers ships, we constructed a model that makes it possible to reproduce to a certain extent the freight volumes by international ferries, etc. for Osaka Bay and the northern Kyushu region by a minimum sacrifice model. This is a model which assumes selection of the route that minimizes the total sacrifice, defined as the sum of the cost of transportation and monetary conversion of the required transportation time.

Moreover, in addition to cost and time, transport routes are frequently selected so as to minimize vibration or impact. Therefore, for cargos for which transportation by

international ferry, etc. is selected, we also examined how this and similar factors will be considered in the minimum sacrifice model in the future.

3. Changes in marine transportation

Expansion of the Panama Canal is currently underway, aiming at completion in 2015, and will make it possible for large-scale ships and LNG ships to use the canal. A major expansion of the Suez Canal is also in progress, spanning approximately 72km on the southern side. The possibility of using other routes is also being studied, for example, determination of rules for navigation of the Arctic passage. On the other hand, from the viewpoint of ships, media reports have mentioned further upscaling of container ships, including construction of container ships of 20,000TEU class.

Thus, forecasting for planning of future port policies with a gaze fixed firmly on these large environmental changes has become critical. To strengthen international competitiveness, in the future, the Port and Harbour Dept. will promote research on port and harbor logistics responding to changes in the structure of marine transportation, as exemplified by the trends toward larger scale container ships and the use of NSR.

4. Revision of technical standards/study guidelines and efforts related to port construction and operation and maintenance

The Port and Harbour Dept. is currently grappling with research on Japan's Technical Standards for Port and Harbour Facilities with the aim of solving various problems, such as strengthening disaster prevention and disaster mitigation measures, establishing technical standards suitable for an era of operation and maintenance, strengthening international competitiveness, establishing technical standards for realizing stable imports of resources, energy, etc. and fostering a climate which supports overseas development by Japanese companies through internationalization of Japanese technical standards (revisions of Technical Standards for Port and Harbour Facilities and Guidelines for Study of

Ports and Harbours, study of large-scale temporary works, etc., support for establishment of technical standards in Vietnam, etc.).

With enforcement of the revised Ports and Harbours Law (December 2013), periodical inspections, etc. are required in maintenance of object facilities of the Technical Standards. Items concerning inspection and diagnosis are specified in the related ministerial ordinances/notifications. The “Guidelines for Inspection and Diagnosis of Port and Harbour Facilities” issued in July 2014 consisted of two parts, Part 1, “General Principles,” which describes common matters, and Part 2, “Implementation Procedures,” which provides concrete implementation methods, etc. for inspections and diagnoses of individual facilities which are objects of the Technical Standards. Inspection and diagnosis methods, etc. are described in easy-to-understand language so as to enable implementation of the minimum necessary inspections and diagnoses, even with limited human and financial resources (see Table).

Table Timing of periodical inspection/diagnosis

	Facilities subject to normal inspection/diagnosis	Facilities requiring priority inspection/diagnosis
General periodical inspection/diagnosis	Minimum of 1 time within each 5 years	Minimum of 1 time within each 3 years
Detailed periodical inspection/diagnosis	Minimum of 1 time at appropriate timing during service period In case design service period is extended	Minimum of 1 time within each 10-15 years For designated facilities, etc. subject to Technical Standards, which front on important navigation routes, minimum of 1 time within each 10 years

As in the case of welding defects remaining at the time of fabrication, which are said to be one cause of fatigue in steel bridges, issues related to operation and maintenance are not limited to deterioration after completion of the facility, but frequently include defects that occur after the passage of certain time due to poor workmanship, construction errors, etc.

The Port and Harbour Dept. intends to carry out research with the aims of improving the reliability and

safety of construction by more advanced design and construction, such as use of 3-dimensional design data, etc., conducting proper maintenance and inspection using construction data., and when improvement/repair is necessary, performing design work by utilizing that data.

Due to the larger scale of structures and the need for improved construction efficiency in port and harbor construction in recent years, construction accompanying by complicated, large-scale temporary works, etc. has increased. Construction under severe meteorological and hydrological conditions and complex ground conditions has also become more common. The following may be summarized and suggested as key items requiring attention in construction work in order to prevent accidents in large-scale offshore civil construction.

- In the process from shop fabrication to construction at the site, it is important to understand the effect on construction safety of the various types of temporary works provided depending on the circumstances of construction.
- Because various external forces act in combination in work at sea, it is important to understand the action of those forces and their effects on construction safety.
- More detailed safety countermeasures corresponding to the location and features of work, such as further mechanization, are important.

Based on these points, the Port and Harbour Dept. will promote research on large-scale temporary works, etc. with the aim of accumulating generally-applicable knowledge and technology in connection with large-scale temporary works, etc. in port and harbor construction so as to contribute to securing safety in port and harbour construction as a whole.

[References]

- 1) Project Research Report of the National Institute for Land and Infrastructure Management, No. 48
- 2) Chitoshi Miki, Special Lecture, “Confronting Operation and Maintenance of Social Capital Stock,” p. 10
<http://www.nilim.go.jp/lab/bbg/kouenkai/kouenkai2014/haifusiryou/13.pdf>