# Examples of the application of Permanent Means of Access to Tankers

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**Abstract**

The best way of ensuring that the condition of a ship's structure is maintained to conform to the applicable requirements is for all its components to be surveyed on a regular basis throughout their operational life. This will ensure that they are free from damage such as cracks, buckling or deformation due to corrosion, overloading, or contact damage and that thickness diminution is within established limits.
Ships should be designed and built with due consideration as to how they will be surveyed by flag state inspectors and classification society surveyors during their in-service life and how the crew will be able to monitor the condition of the ship.
Without adequate access, the structural condition of the ship can deteriorate undetected and major structural failure can arise. A comprehensive approach to design and maintenance is required to cover the whole projected life of the ship.
For this purpose, the 76th session of the IMO's Maritime Safety Committee (MSC) adopted a new regulation II-1/3-6 of the International Convention for the Safety of Life at Sea (SOLAS) and Technical provisions for means of access for inspections (TP) on 2002, in short, PMA regulations.
But, there were some different opinions between industries that the new regulation was too strict and severe to apply to the vessels. MSC 78 accepted the proposals of industries and shipowners and adopted the revised regulation II-1/3-6 on 2004.
This paper introduces the application of permanent means of access (PMA) to the new tankers in Korean shipyards.

## Introduction

For an oil tanker and a bulk carrier which are more susceptible to a casualty, Enhanced Survey Programme (ESP), consisting of periodic, overall close-up surveys and thickness measurements, helps to maintain its robust condition. To carry out ESP effectively, there is a need to install suitable means of access to the hull structure. In this regard, all oil tankers of 500 gross ton and over, constructed on or after 1 January 2005, are to comply with the regulation II-1/3-6 of SOLAS and technical provisions.

At the beginning of applying this regulation, there were differences of opinions between classifications and shipyards on some of the items. Some of these were solved by each classification society or by the unified interpretation of International Association of Classification Societies (IACS UI). IACS has continuously revised UI SC 191, Unified Interpretation relevant to Reg. II-1/3-6 of SOLAS. However, there are items that were temporarily cleared by an agreement between class and shipyard on a case by case basis and there is a need to resolve these items clearly.

# Application of PMA to tankers

Korean shipyards have been building several kinds of tankers complying with the PMA requirements since 2005. On the basis of vessels built by these shipyards, the examples of the application of PMA to tankers will be introduced in order of their size.

## *50K Oil and Chemical Tanker*

50K oil tanker is normally called Middle Range (MR) tanker. These tankers have recently been used as a combined chemical tanker to accommodate the increase in consumption of chemicals. The arrangement of tanks is generally composed of 2 rows with 6 compartments for cargo tanks in each row and water ballast tanks as shown in Fig.1.

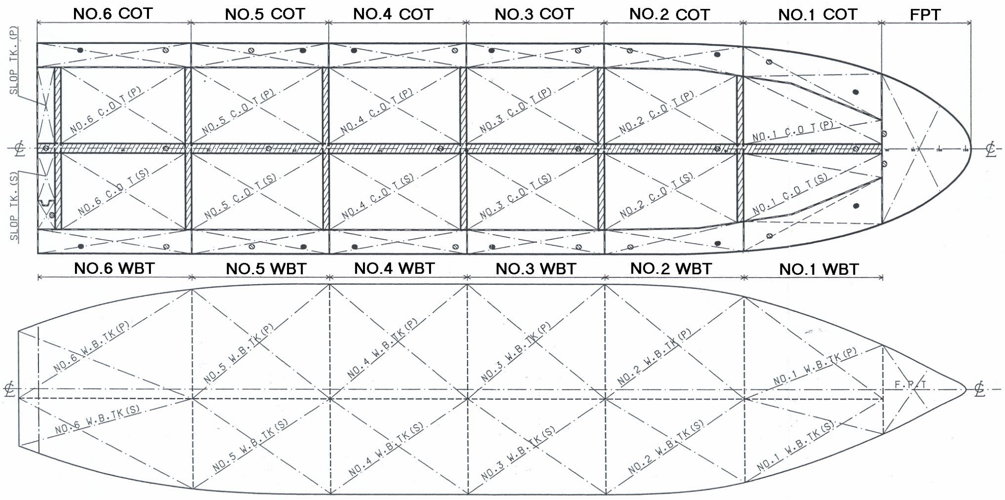


Fig. 1 Tank Arrangement of 50K Oil and Chemical Tanker

Considering the characteristics of the hull structure of tanker, in general, this tanker has longitudinal and transverse corrugated bulkheads with upper and lower stools, deck transverse webs and deck longitudinals on deck plate and web frames and side longitudinals in wing ballast tanks as shown in Fig. 2. Therefore, there is no internal structure in a cargo tank and there is no need to install PMA for inspection to overhead deck structures of cargo tanks in accordance with IACS UI SC191 (Fig. 3).

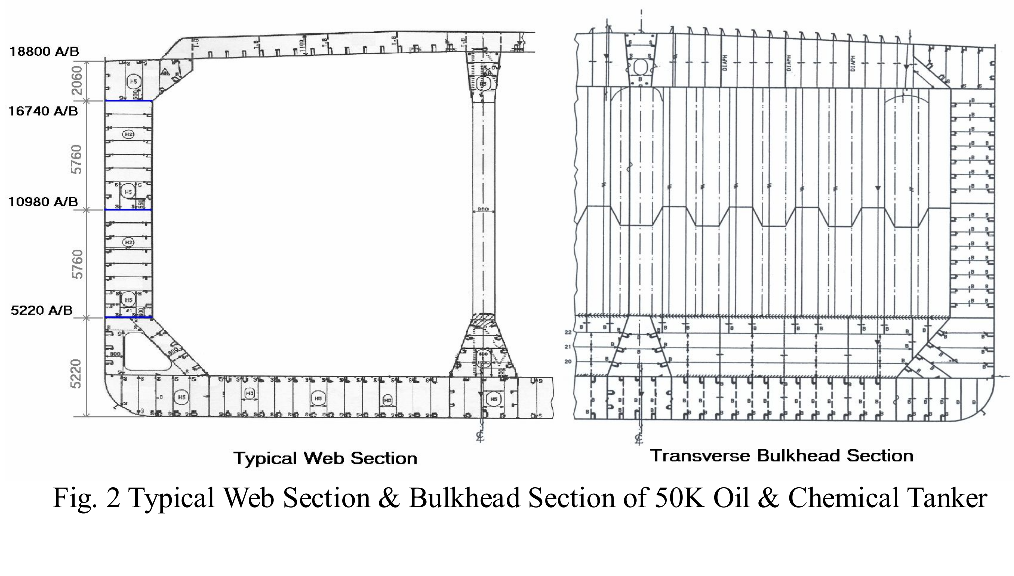


Fig. 2 Typical Web Section & Bulkhead Section of 50K Oil & Chemical Tanker

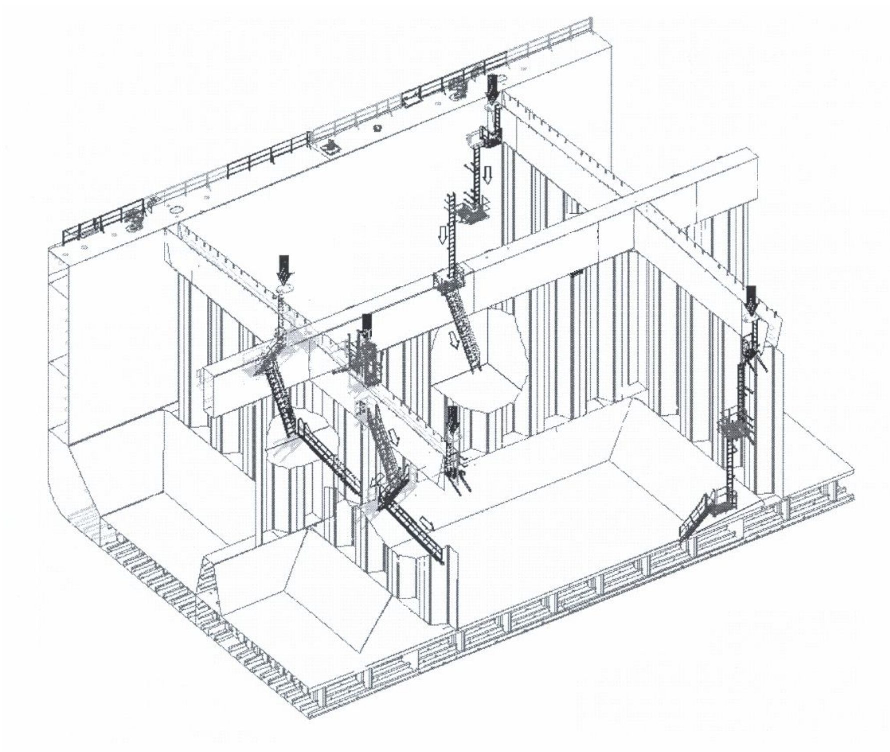

Fig. 3 Cargo Tank of 50K Oil & Chemical Tanker

Wing water ballast tanks shall be subject to the requirement of PMA because they have internal structural members to be surveyed. However, vertical distances between deck and stringers and between stringers in wing ballast tanks are less than 6 m as shown in Fig. 2. So, portable means of accesses in place of longitudinal PMAs are sufficient for the inspection of wing ballast tanks. For the hopper sections of No.6 water ballast tanks located in after part, the vertical distance from the tank bottom to the knuckle point is 6.0 m and over. Partial stringer is installed in this area as shown in Fig. 4.

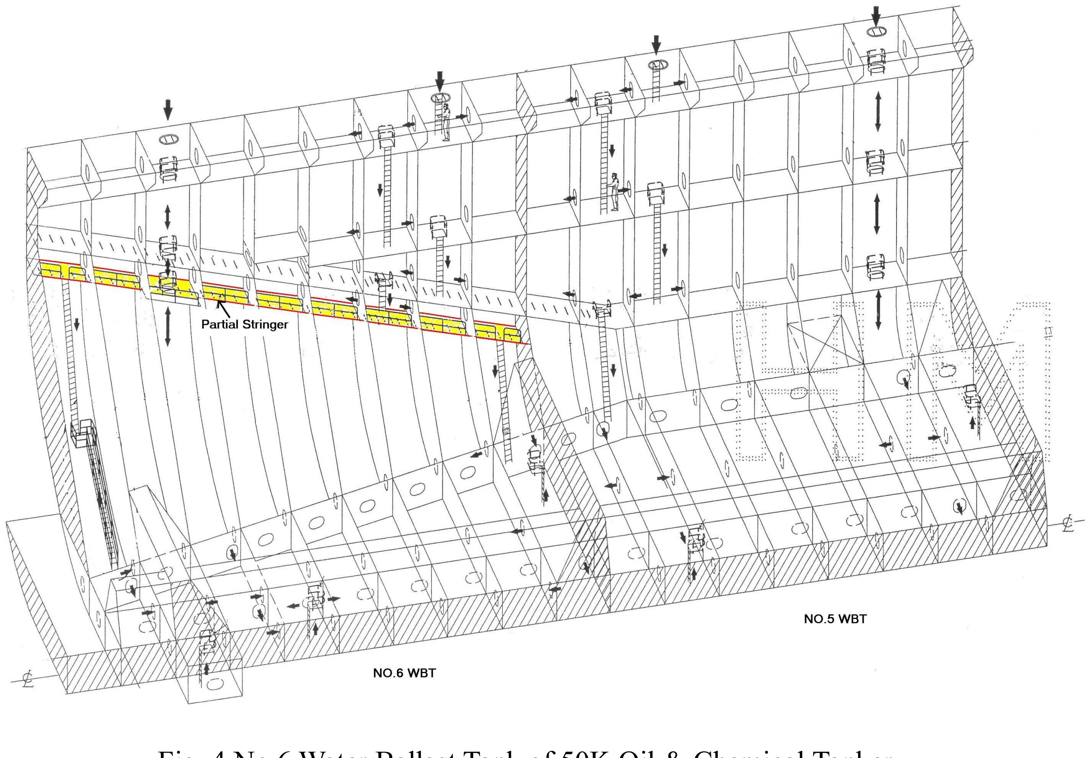


Fig. 4 No.6 Water Ballast Tank of 50K Oil & Chemical Tanker

## *70K Oil Tanker*

70K oil tanker is normally called Large Range 1 (LR1) tanker. The arrangement of tanks is similar to 50K tanker and is composed of 2 rows with 6 compartments for cargo tanks in each row and water ballast tanks as shown in Fig. 5.

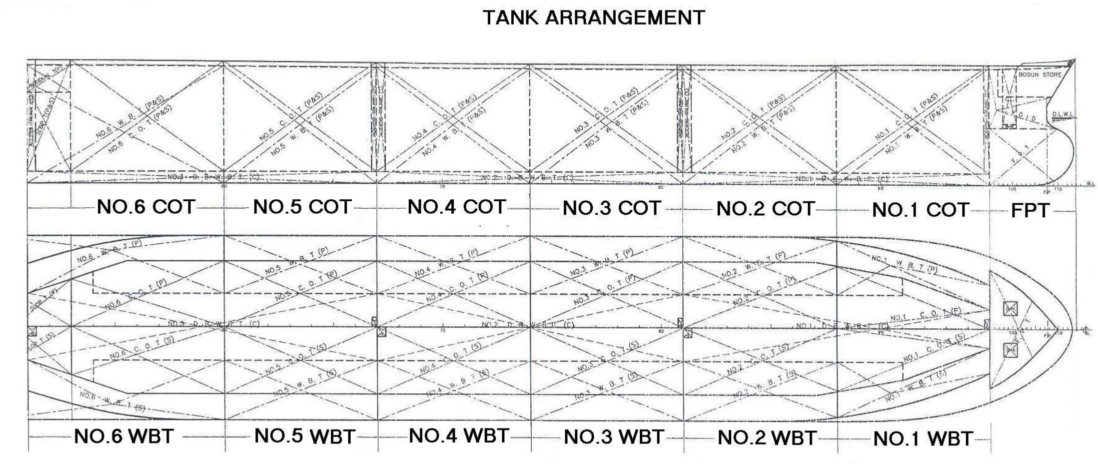


Fig. 5 Tank Arrangement of 70K Oil Tanker

Unlike 50K tankers, transverse bulkheads (BHD) and a longitudinal BHD in the cargo tank of 70K tankers are stiffened plates instead of corrugated BHD due to the scantling of these structural members. Consequently, the athwartship PMA shall be arranged, at a transverse BHD on stiffened side, at min. 1.6 m to max. 3.0 m below the deck plate and two longitudinal PMA shall be equipped below the deck plate. And the upper transverse PMA is normally made by a built-up platform as shown in Fig. 6.

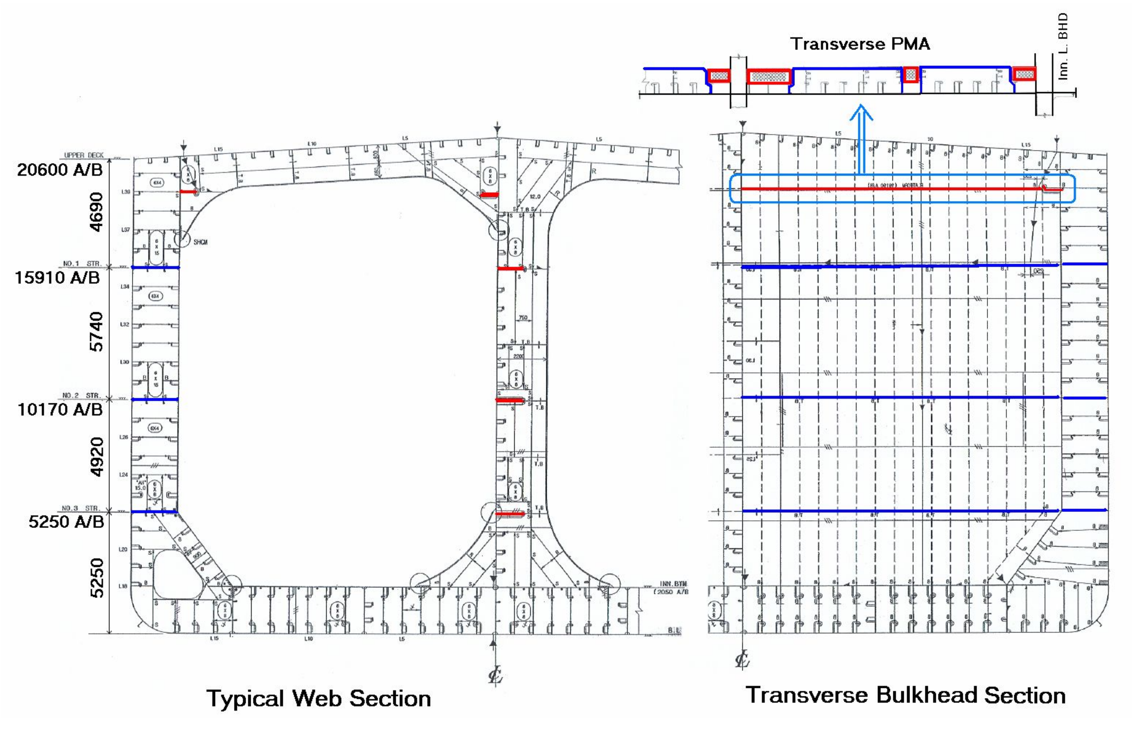


Fig. 6 Typical Web Section & Bulkhead Section of 70K Oil Tanker

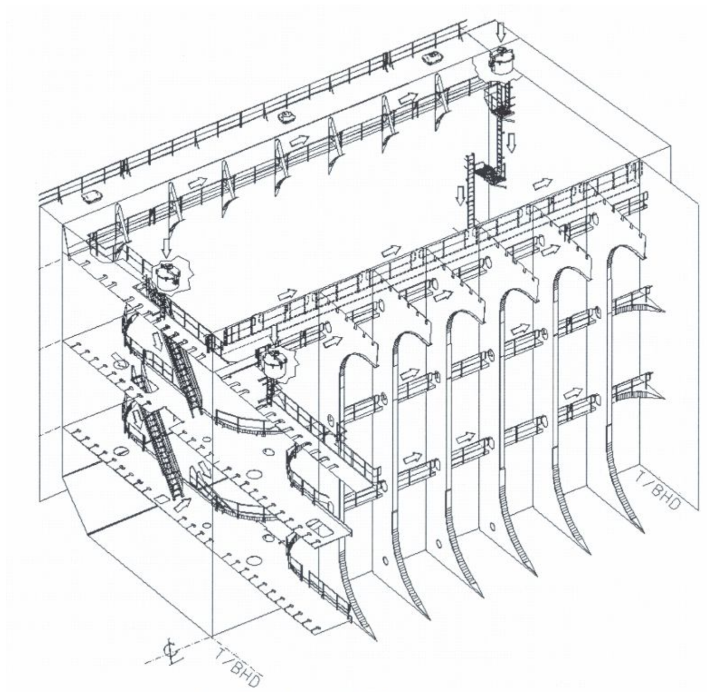


Fig. 7 Cargo Tank of 70K Oil Tanker

It can be seen from Fig.7 that two longitudinal PMAs for inspection of under deck structures are installed below the deck and another two longitudinal PMAs for survey of every vertical web section are equipped in alignment with horizontal girders of transverse bulkheads in cargo tanks. In wing water ballast tanks, vertical distances between deck and stringers and between stringers in wing ballast tanks are less than 6 m. There are only two access ladders at both end of the space as shown in Fig. 8.

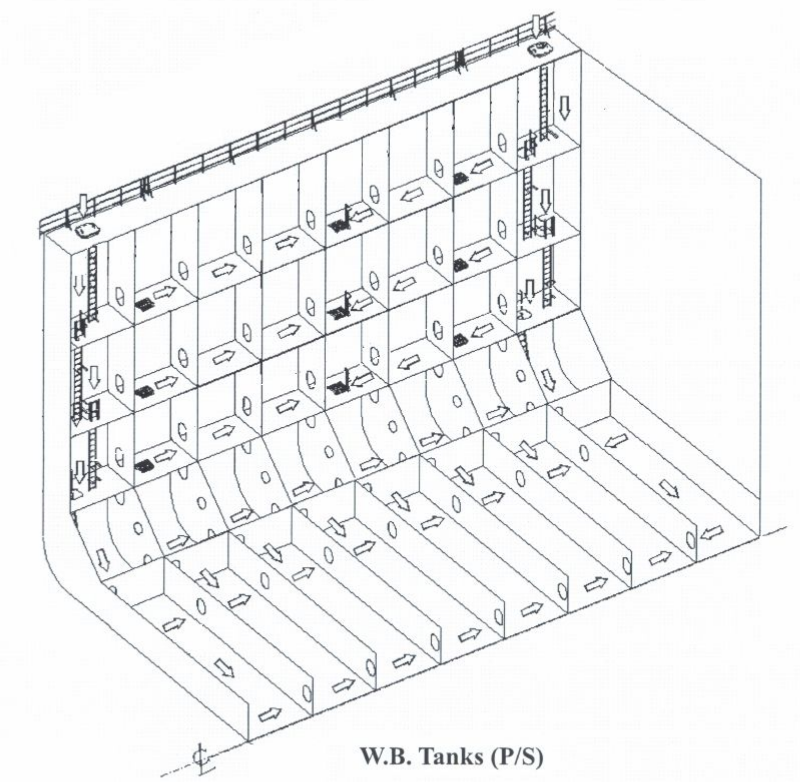


Fig. 8 Water Ballast Tank of 70K Oil Tanker

### *100K AFRAMAX Tanker*

100K Aframax tanker called Large Range 2 (LR2) tanker is also composed of 2 rows with 6 compartments for cargo tanks in each row and water ballast tanks as shown in Fig. 9.

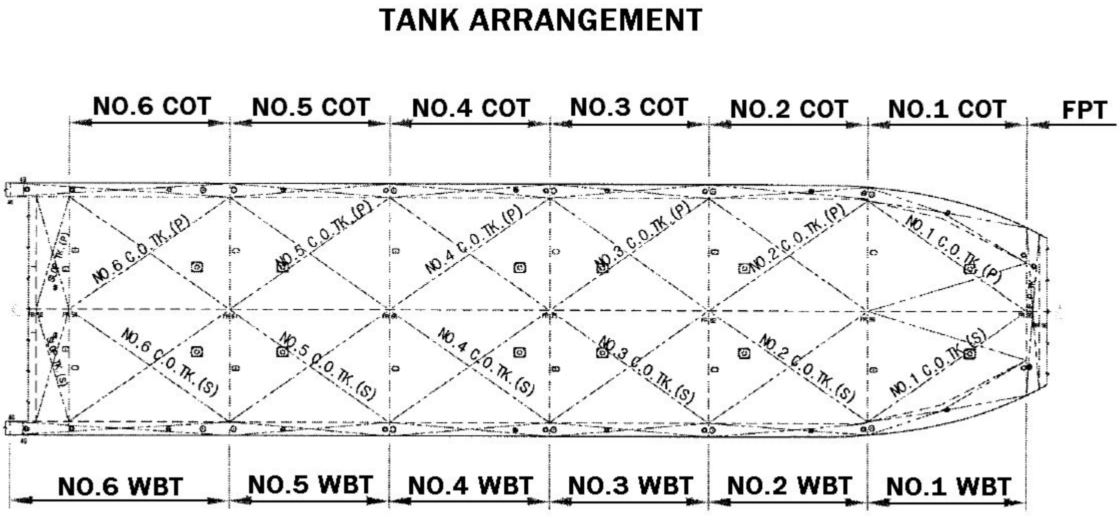


Fig. 9 Tank Arrangement of Afrmax Tanker

Fig. 10 shows the typical structure of an Aframax tanker in midship part. The distinctive feature in the example ship is that the vertical distance between deck plate and no.1 stringer plate is more than 6.0 m in the space of a water ballast tank. So, enlarged longitudinal considered as longitudinal PMA is installed at 2.5 – 3.0 m below the deck.
For the other parts including a bilge hopper section, vertical distances between stringers are less than 6 m and additional longitudinal PMA is omitted. One transverse PMA is also shown at the upper part of the transverse BHD.

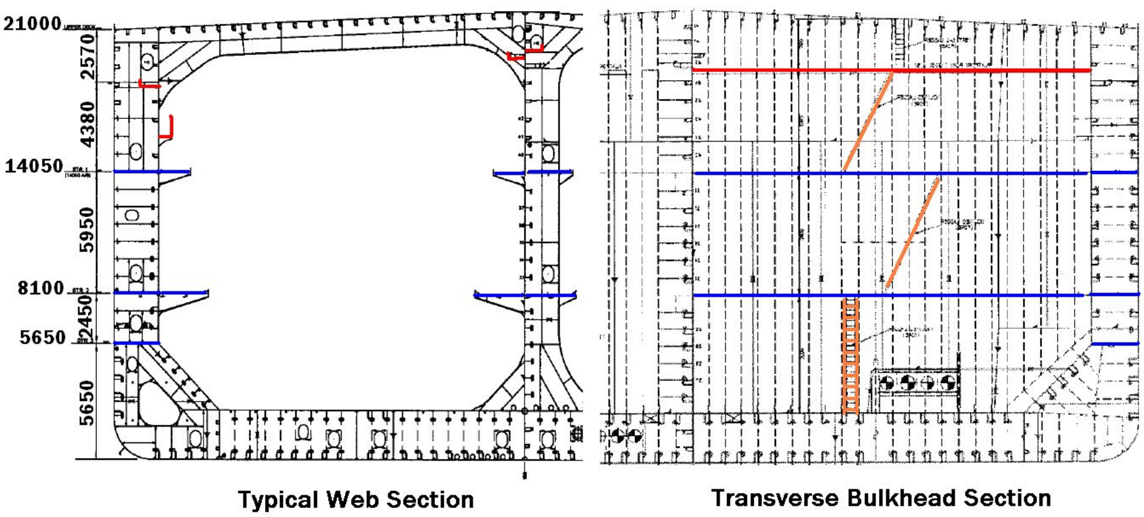


Fig. 10 Typical Web Section & Bulkhead Section of Afrmax Tanker

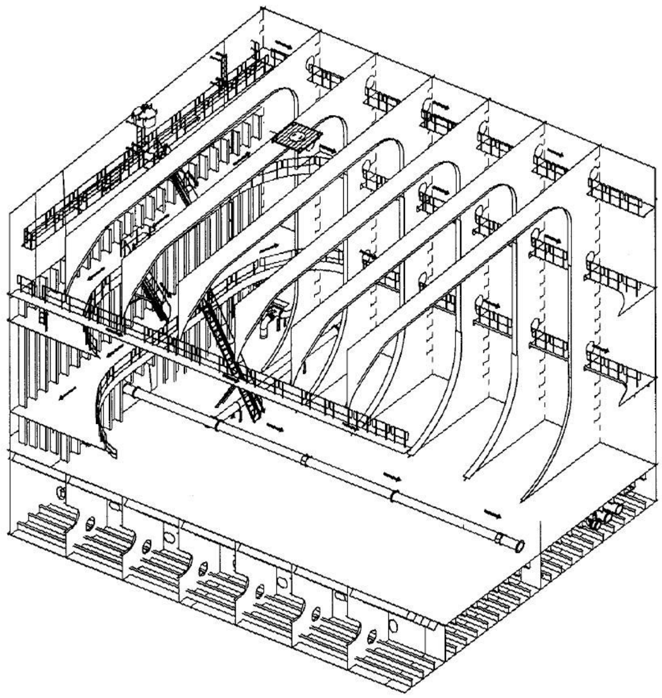

Fig. 11 Cargo Tank of Afrmax Tanker

Fig.11 shows that two longitudinal PMAs for inspection of under deck structures are installed below the deck and another two longitudinal PMAs for survey of every vertical web section are equipped in alignment with horizontal girders of transverse bulkheads in cargo tanks.
In wing water ballast tanks, vertical distances between stringers in wing ballast tanks are less than 6.0 m as shown in Fig. 12. For the hopper sections of No.6 water ballast tanks located in after part, the vertical distance from the tank bottom to the knuckle point is 6 m and over. Partial stringer is additionally installed in the area.

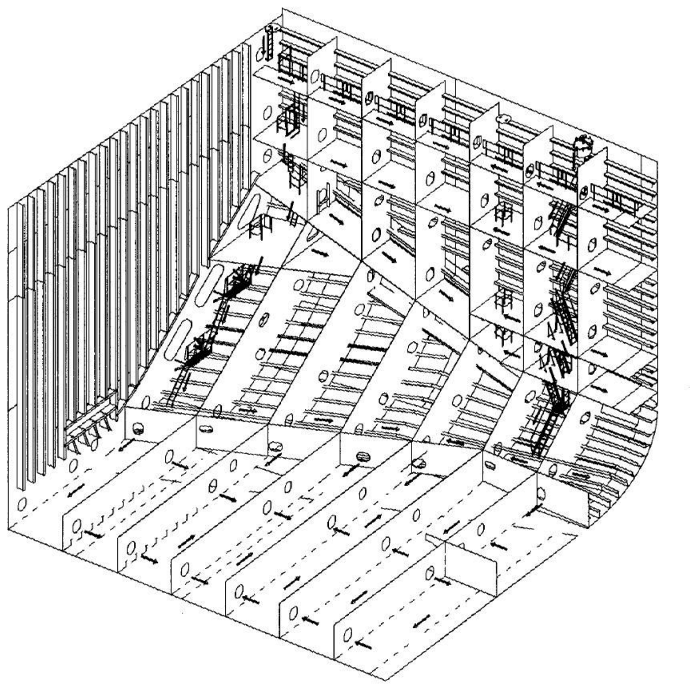

Fig. 12 Water Ballast Tank of Afrmax Tanker

### *150K SUEZMAX Tanker*

150K Suezmax tanker also has the tank arrangement composed of 2 rows with 6 compartments for cargo tanks in each row and water ballast tanks as shown in Fig. 13.

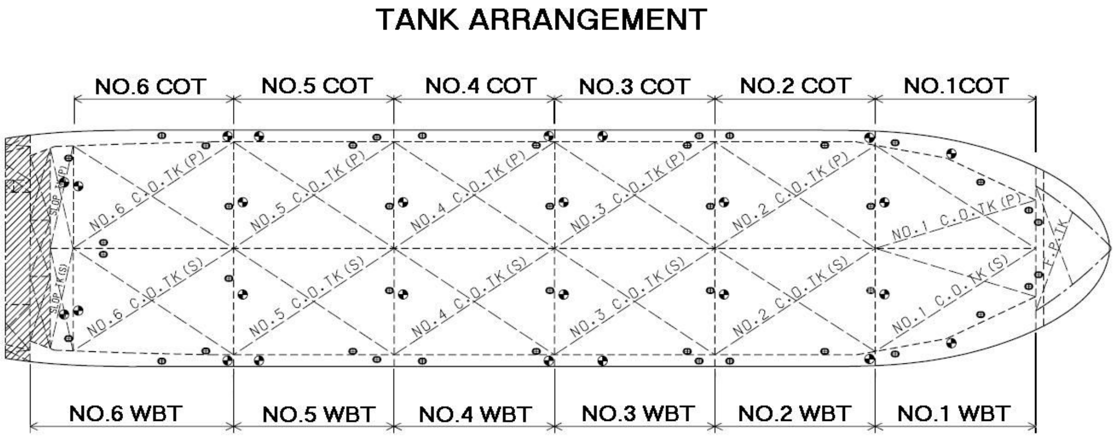


Fig. 13 Tank Arrangement of Suezmax Tanker

According to Fig. 14, Suezmax tankers have three horizontal stringers system in a cargo tank as well as in a wing ballast tank. The vertical distance between deck plate and stringers is less than 6.0 m except for the bilge hopper section and there is no additional PMA in a water ballast tank. For bilge hopper section, the vertical distance between a knuckle point and a tank bottom is more than 6.0 m and the enlarged longitudinal considered as longitudinal PMA is installed at 1.6 – 3.0 m below the lowest stringer plate.

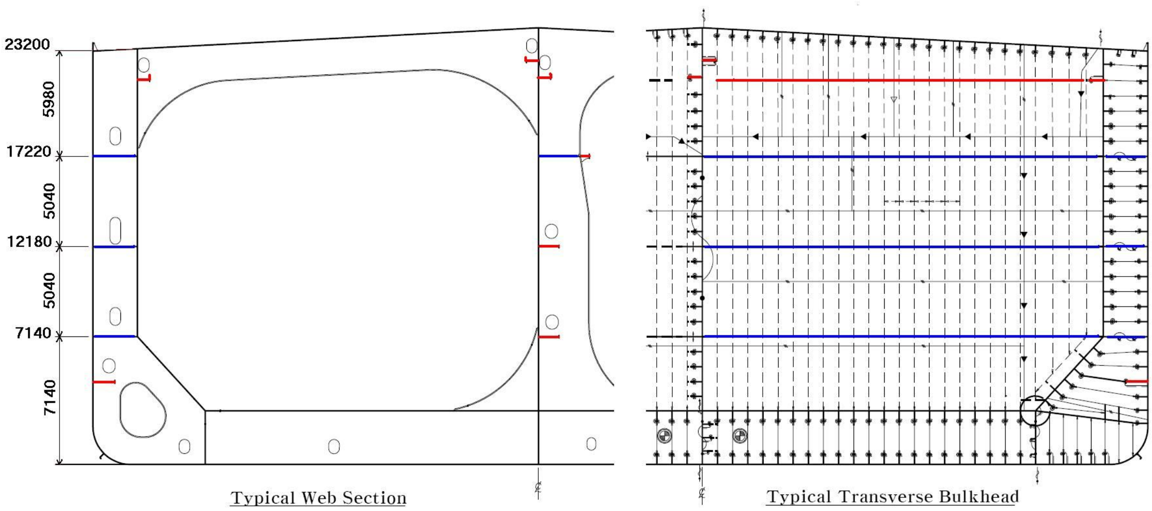


Fig. 14 Typical Web Section & Bulkhead Section of Suezmax Tanker

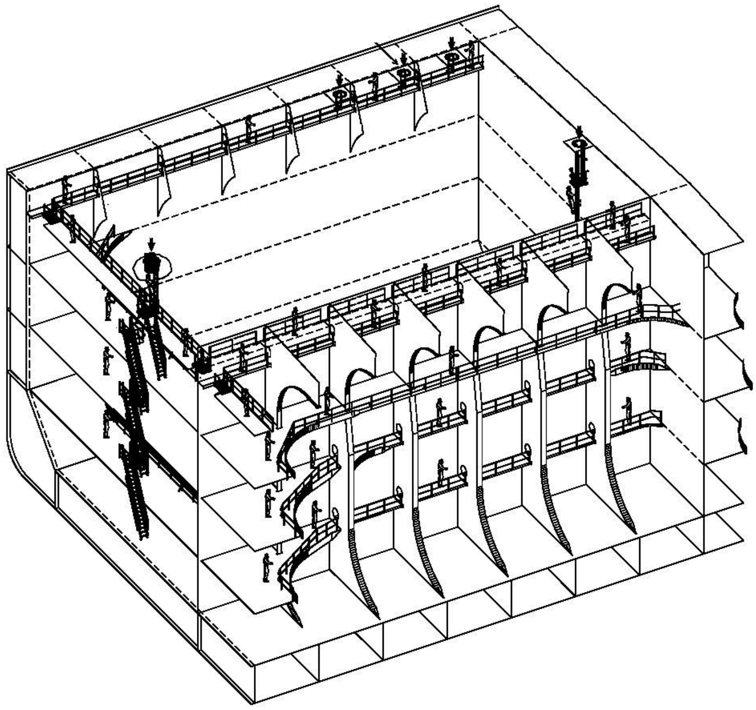

Fig. 15 Cargo Tank of Suezmax Tanker

It is seen from Fig.15 that two longitudinal PMAs for inspection of under deck structures are installed below the deck and three longitudinal PMAs for survey of every vertical web section are equipped in alignment with horizontal girders of transverse bulkheads in a cargo tank.

In water ballast tanks, vertical distances between deck and stringers and between stringers in wing ballast tanks are less than 6 m. However, for bilge hopper section, the vertical distance between a knuckle point and a tank bottom is more than 6.0 m and the enlarged longitudinal considered as longitudinal PMA is installed at 1.6 – 3.0 m below the lowest stringer as shown in Fig.16.

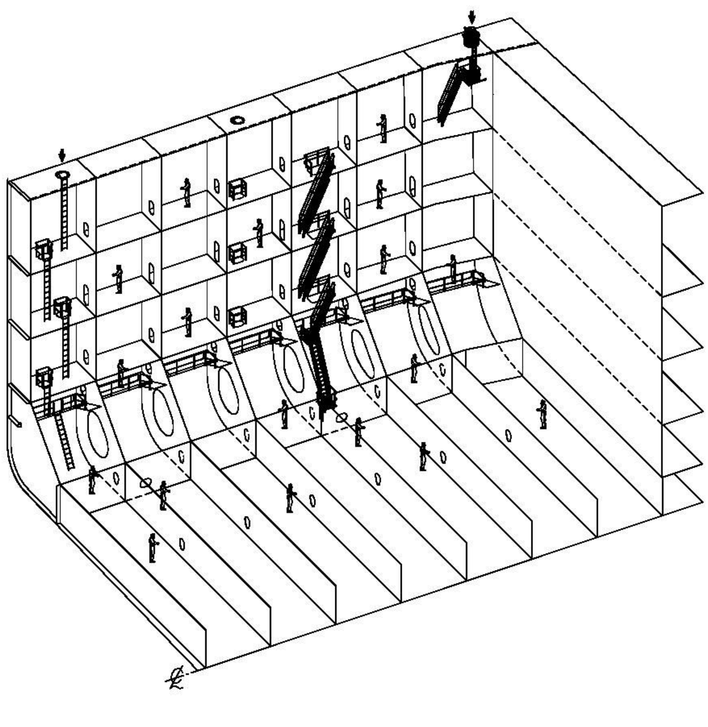

Fig. 16 Water Ballast Tank of Suezmax Tanker

## *320K Very Large Crude Oil Carrier (VLCC)*

Unlike the vessels of other sizes, the tank arrangement of 320K VLCC is 3 rows with 5 compartments for cargo tanks and 2 rows with 5 compartments for water ballast tanks as shown in Fig.17. VLCC is a very large vessel and the efficient arrangement of structuralized PMA is more important for cost-effectiveness.

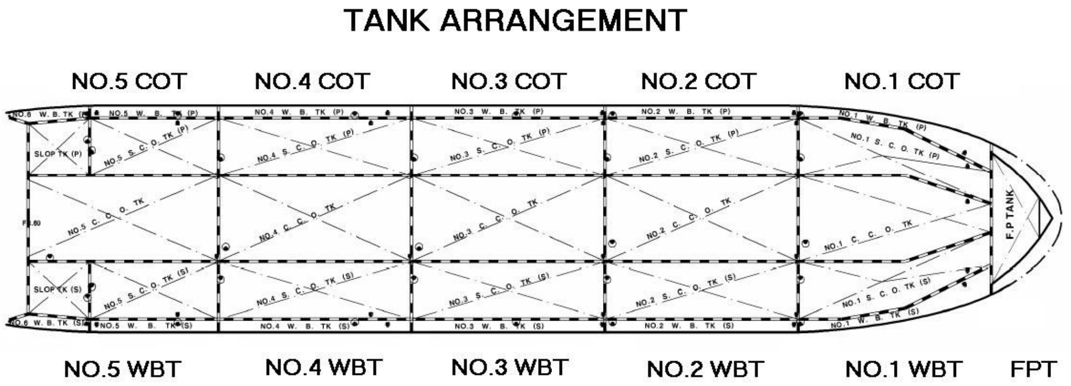


Fig. 17 Tank Arrangement of VLCC

Fig. 18 shows typical structural arrangement of VLCC built nowadays. Three stringers system, whose vertical distance between stringers is within 6.6 m except for uppermost part, is normally adopted by many shipbuilders. The figure 0.6 m of vertical distance criteria 6.6 m is considered as a reasonable deviation of 10 % by IACS where PMA is integral to the structure itself.
For the uppermost part where the distance is 6.6 m and more, an enlarged longitudinal or an additional stringer for access to the under deck structures are installed in water ballast tanks.
At the beginning of PMA application, one of the shipyards had adopted four horizontal stringers system with a view to adjusting the vertical distance between stringers within 6 m in cargo tanks and wing ballast tanks.

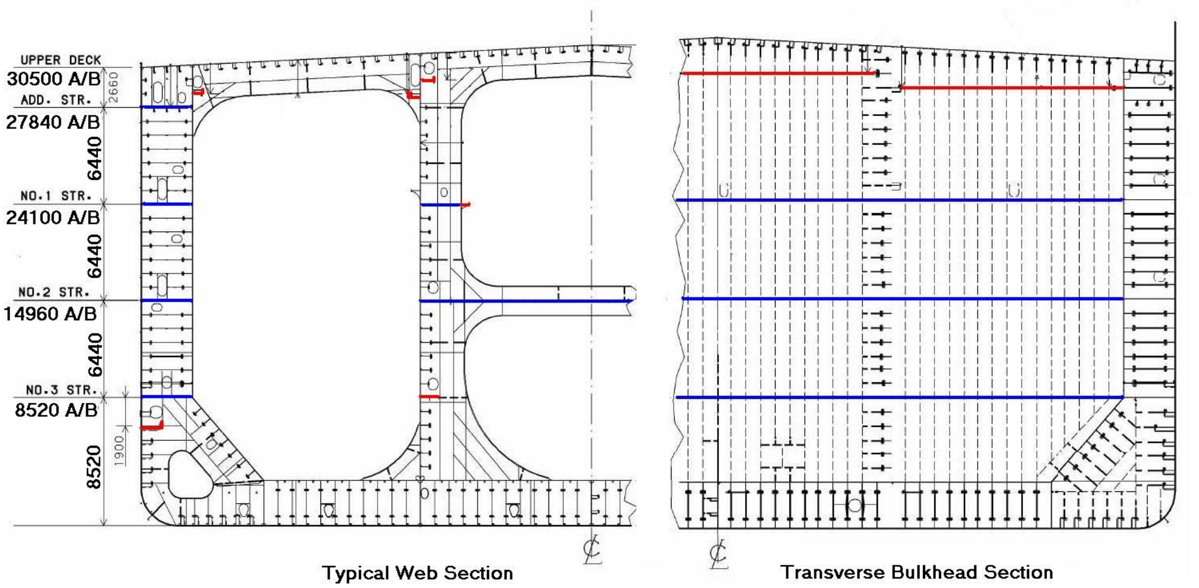


Fig. 18 Typical Web Section and Transverse Bulkhead Section of VLCC

For accessing the under deck structures, there are two longitudinal PMA on longitudinal bulkhead and one transverse PMA on stiffened side of transverse bulkhead in cargo tanks. And center tanks are provided with a transverse PMA on every crosstie and relevant longitudinal PMA in connection with horizontal stringer level as shown in Fig.19.

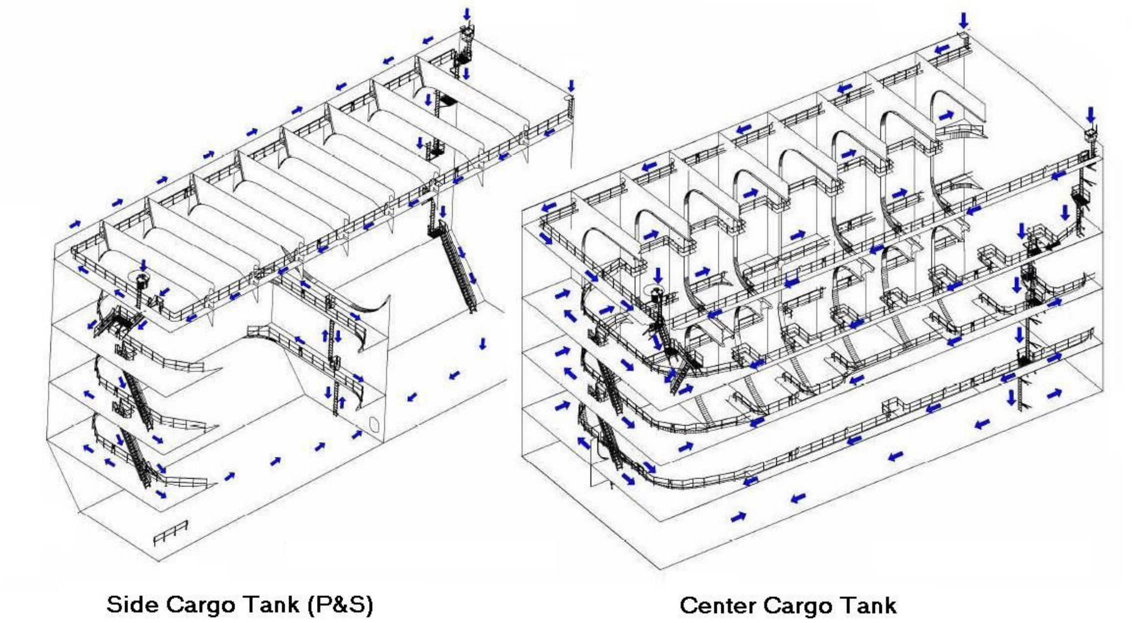


Fig. 19 Cargo Tank of VLCC

Fig.20 shows that the wing water ballast tanks are composed of four horizontal stringers and the vertical distance between stringers is less than 6.6 m, within the reasonable deviation of 10%. For bilge hopper sections, there is a longitudinal PMA because the height from bottom plate to upper knuckle point is 6.0 m and over.

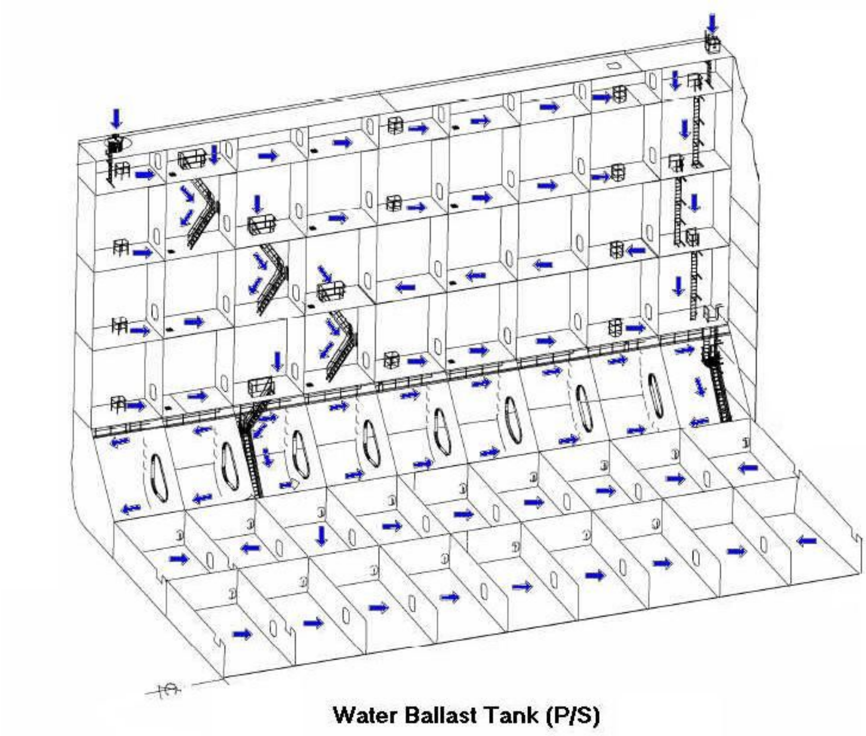


Fig. 20 Water Ballast Tank of VLCC

The additional steel weight and cost of installing PMA depends on the design of each shipyard. Table 1 shows a ballpark figure for the additional steel weight of PMA for each ship size on the basis of a shipbuilder's estimation.

Table 1 Additional steel weight for installment of PMA

| **Size of Ship** | **50K** | **70K** | **100K** | **150K** | **320K** |
|---|---|---|---|---|---|
| Additional Steel Weight (ton) | 10 | 100 | 200 | 300 | 500 |

The above figure is just one example of an extra steel weight due to the application of PMA calculated by one of the Korean shipyards. So, the figure may be changed depending on the shipyard and its design. The estimation of additional construction cost is also much more difficult because the cost is closely related to the production know-how of shipbuilders. Shipyards consider the rise in construction cost and man-hour at a contract stage.

### *Items additionally interpreted by IACS*

At the beginning, some problems were foreseen with the application of Reg.II-1/3-6 of SOLAS and relevant technical provisions for the means of access for inspections (TP). Consequently, IACS issued UI SC 191 to clarify the obscure clauses or the items to be defined in Reg.II-1/3-6 of SOLAS and the relevant technical provisions. Even so, additional problems broke out between the shipyards and classification societies during the construction of ships and, as a result, IACS revised the original UI three times through the discussion with its member societies. Representative examples of the interpretations are given in ensuing paragraphs.
One interpretation is regarding the installation of platform for rafting. Where rafting is carried out as the means to gain ready access to the under deck structures, to improve the safety during a survey, a vertical ladder from the deck and a small platform are to be fitted approximately 2 m below the deck in each bay or the platform shall be arranged in level with, or above, the maximum water level needed for rafting of under deck structure. In latter case, the maximum water level is to be assumed not more than 3 m from the deck plate measured at the midspan of deck transverses and in the middle length of the tank as shown in Fig. 21.

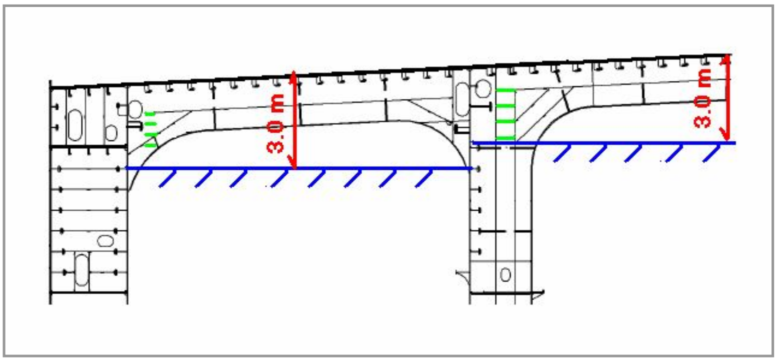


Fig. 21 Rafting Platform

Another item pertains to IACS UI SC 191 of Section 3.3 which is elevated passageway technical provisions that discontinuous handrails are allowed, provided the gap does not exceed 50 mm. Additionally, the maximum distance between the adjacent stanchions across the handrail gaps is to be 350 mm as illustrated in Fig. 22.

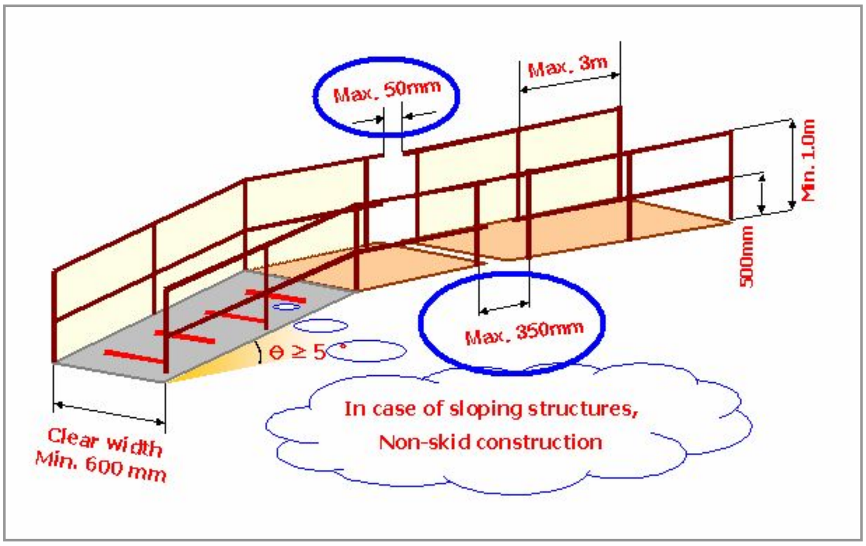


Fig. 22 Elevated Passageway

One of the Korean shipyards requested that these requirements should be revised appropriately considering the difficulty of actual design and construction processes. IACS replied to the questions and altered UI SC191 as follows:

*'Discontinuous top handrails are allowed, provided the gap does not exceed 50 mm. The same maximum gap is to be considered between the top handrail and other structural members (i.e. bulkhead, web frame, etc.). The maximum distance between the adjacent stanchions across the handrail gaps is to be 350 mm where the top and mid handrails are not connected together and 550 mm when they are connected together. The maximum distance between the stanchion and other structural members is not to exceed 200 mm where the top and mid handrails are not connected together and 300 mm when they are connected together. When the top and mid handrails are connected by a bent rail, the outside radius of the bent part is not to exceed 100 mm.'*

The interpretation is shown in the following Fig. 22.

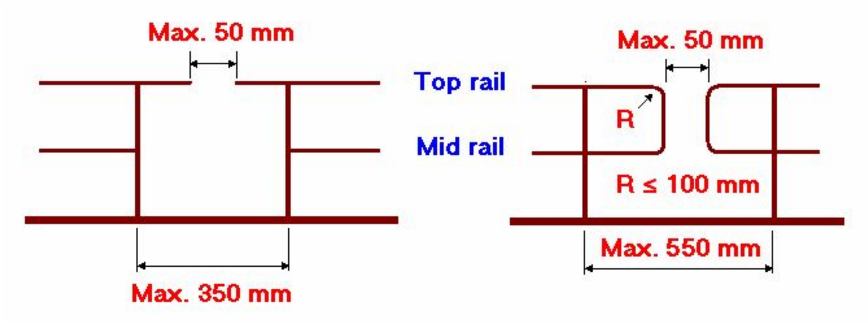


Fig. 23 Handrails of Elevated Passageway

Additionally, in the 49th Sub-committee on Ship Design and Equipment (DE) of IMO, there was an interpretation as to whether PMA regulations apply to the altered oil tankers or not. IMO decided that PMA regulations should not apply to tankers converted from single-hull to double-hull. However, if, in the course of conversion, substantial new structures are added, these new structures should comply with the regulations.

## Conclusion

In 2002, IMO adopted PMA regulations to carry out enhanced survey programme (ESP) effectively and since 1 January 2005, Korean shipbuilders have been constructing a number of ships which reflect PMA regulations. At the beginning, there were some mistakes and troubles in applying the regulations. After two and half years, however, each shipyard has developed its own typical vessel of different size as shown above. IACS and each classification society also have interpreted considerable number of PMA items. If new items to be interpreted come along in the future, to avoid different interpretations from different classes, it is desirable that the obscure ones are cleared by IACS, not by each classification society.

## References

SOLAS regulation II-1/3-6 adopted by resolution MSC.134(76), as amended by resolution MSC .151(78).
Technical Provisions adopted by resolution MSC.133(76), as amended by resolution MSC.158(78).
Guidelines on the Enhanced Program of Inspection During Surveys of Bulk Carriers and Oil Tankers adopted by resolution A.744(18), as amended.
IACS Unified Requirements Z10.1, Z10.2, Z10.4 and Z10.5, as appropriate.
IACS Unified Interpretation SC191, as amended.
IACS Recommendation No.39 “Safe use of rafts or boats for Survey”.
IACS Recommendation No.78 “Safe use of Portable Ladders for Close-Up Surveys.”
IACS Recommendation No.91, “Guidelines for Approval/Acceptance of Alternative Means of Access.”