

The State of Oil Tanker Construction for CSR in Shipbuilding Industry

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Abstract:

Common Structural Rules for Double Hull Oil Tankers has been applied to the new generation of oil tanker. As the structural reliability has been improved, more steel weight and other constructing works have been introduced. The production efficiency is becoming more important factor in shipbuilding industry. Herein, a brief presentation of the construction technology, i.e. Shipbuilding by Two Parts, applied in DSIC for improving production efficiency will be introduced.

1. Introduction

In order to reduce the risks of structural failure and provide adequate durability of the hull structure for the design life, the Common Structural Rules for Double Hull Oil Tankers established and became effect for new generation of oil tanker.

In the meantime, more conventions and/or regulation became or will become mandatory to CSR tanker concerning the marine safety and environment protection, such as PSPC, FOT protection, BWTS and so on, they also have important influence to the construction of oil tanker and introduced more construction work.

DSIC has finished the development and design of new generation of VLCC, Suezmax tanker, Aframax Tanker and Panamax tanker complied with CSR and relevant new conventions and/or regulations. The design and construction experience show that more steel weight introduced and upgraded structural details should be applied, that is well known.

Considering that more construction works are introduced, the production efficiency is becoming more and more important factor in shipbuilding for the present and future CSR tanker.

Improvement of production efficiency is comprehensive. It is relevant on all the shipbuilding process from the design to the construction technology and project management.

Herein, a specific efficient construction technology for VLCC, we name it “Shipbuilding by Two Parts”, applied in DSIC will be introduced.

2. Procedures of Shipbuilding by Two Parts

The construction of large tanker normally applies the “Island” type or “Tier” type method. With traditional method, at the beginning, a base block is placed on a slipway or in a dry dock, and then to assemble hundreds of other blocks in order until to complete a whole vessel. If building in dock with this kind of method, it will occupy long period in the dock and make the production efficiency lower to DSIC because of its special construction resources.

Shipbuilding by Two Parts means a whole vessel to be built in a dry dock by joining two large sections, i.e. aft body part and fore body part, however, the two parts can be built in different docks and/or slipways.

This technology will improve the production efficiency to the shipbuilding obviously, especially when it is applied for the construction of series vessel. It can fully utilize the relevant facilities and resources in the DSIC.

The construction procedures of one cycle for a series of vessels by this method will illustrated below.

The first round:

At first stage, aft body of ship B (B1) and a whole ship A are built in dock at the same time.

When ship A and after body B1 are completed, the ship A and after body B1 will float out of the dock. The ship A is coming to the mooring test stage and the after body B1 is prepared for next round.

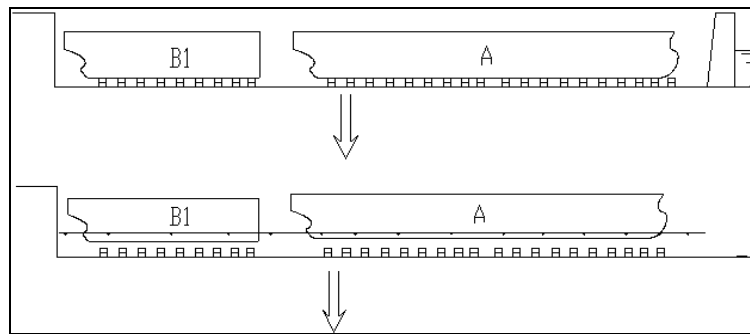


Figure (a): First round

The second round:

As per the projects procedures, when the first round is over, the fore body B2 of ship B should complete in other dock or slipway and is ready for joining with the aft body B1 of the vessel B.

Two parts of B1 and B2 will float into the dock and to be combined into a whole ship. After assembled, the Ship B will be floating out for mooring.

At the mean time, the aft body of ship D1 is building in the dock aft.

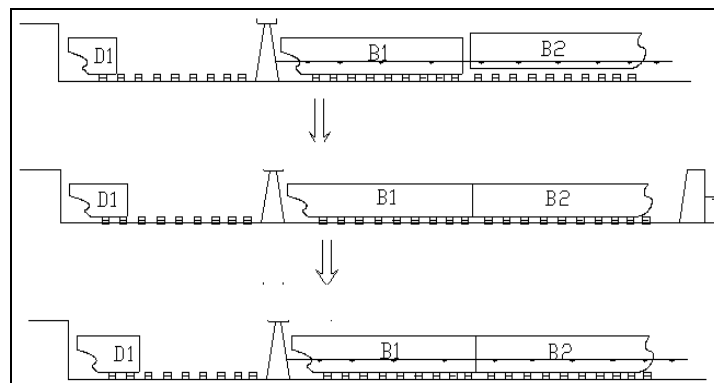


Figure (b): Second round

The third round:

During ship B is on the process of combination, the construct of aft body of ship D (D1) to be continued.

Aft the ship B floating out, the aft body of ship C (C1) is built in the dock and the fore body of ship C (C2) is built in other dock or slipway.

When C1 and C2 are completed, the fore body of ship C (C2) will float into the dock to combine with aft body (C1) and the ship C will finish for mooring and to leave the aft body of ship D (D1) for next round.

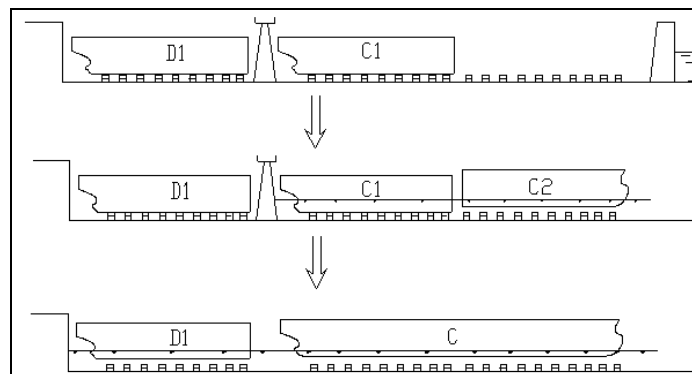


Figure (c): Third round

The forth round:

Combining the two parts of D1 and D2 to complete ship D, and construct aft body of ship E (E1) in dock, and to another cycle.

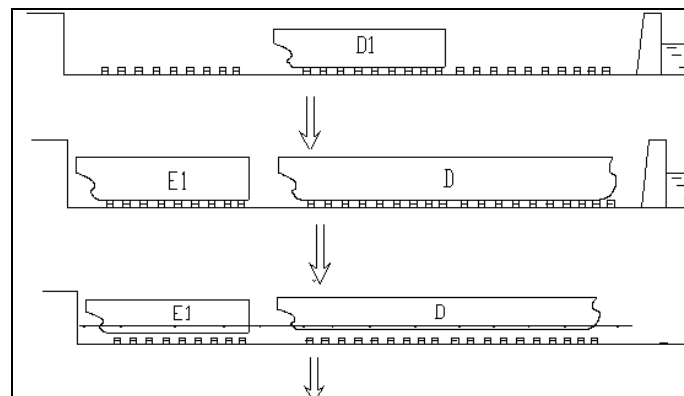


Figure (d): Forth round

From the illustrated procedures, we can find:

- (1) The first and third round occupied the dock for block erection, the other two rounds mainly for the joint of two parts.
- (2) The aft part of the dock is used to build the aft part of another ship, so the full dry dock has been utilized fully.
- (3) During the second and third round, the construction of vessel (aft part) in the aft dock has not been interrupted by the joint of another vessel in fore part of the dock, and the construction process in the whole dock is continuously without any pause.
- (4) The other resources such as other dock or slipway can be used for building of large vessel, and the resources mentioned above can be full utilized.

3. Key issues of Shipbuilding by Two Parts

The vessel is huge and comprehensive building, even half of the vessel. The movement, even a little adjustment, should rely on the building's gravity and the buoyancy, there is no other way. When combined two parts together, we have to be very carefully and every thing should be exact and to be in order. There are some key issues we have to pay most attention.

(1) Size of the parts

Since the movement and location adjustment should rely on the parts' gravity and the buoyancy, all the weight and centroid of the steel, equipment and outfitting of each part will be exactly estimated for choosing the proper size of the parts to adjust and control the draft and trim and make it possible of the proper alignment of the two parts for joint.



Figure (e): Fore body built on slipway

As for our solution of part subdivision, suitable ballast have to be introduced before docking: The draft of the aft body is a little bigger than that of fore body, so the aft body part can dock first; The aft body may have a little trim and the fore body is near even.

(2) Section accuracy of the two parts

The shipbuilding is comprehensive. The welding, erection, heavy pressure and self weight of the structure, all those may bring deformation more or less, and the construction tolerance is another important issue to be seriously considered.

Fortunately, by the amassed experience and practice and the tolerance control system throughout building process in DSIC, the section tolerance, especially at the section plane of the joint, is within the allowable range.

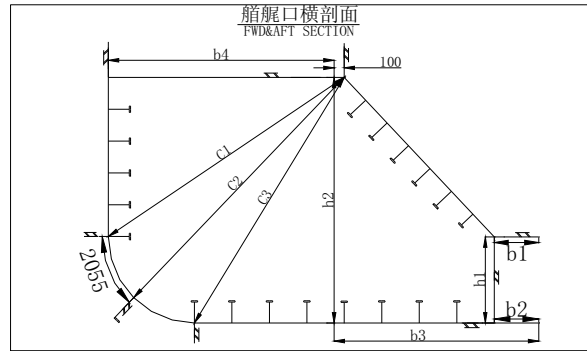


Figure (f): Example Table used for tolerance control

(3) Docking in the exact position

Docking in the exact location can ensure the accuracy of alignment for the two parts, and that is another key issue for proper joint.

So, we have to prepare a particular operation procedure as detail as possible after cautiously investigating the whole process and all kind of possibility that might come forth, such as the circumstance, weather, human element and so on. During docking, each people and every course shall strictly follow the procedure.

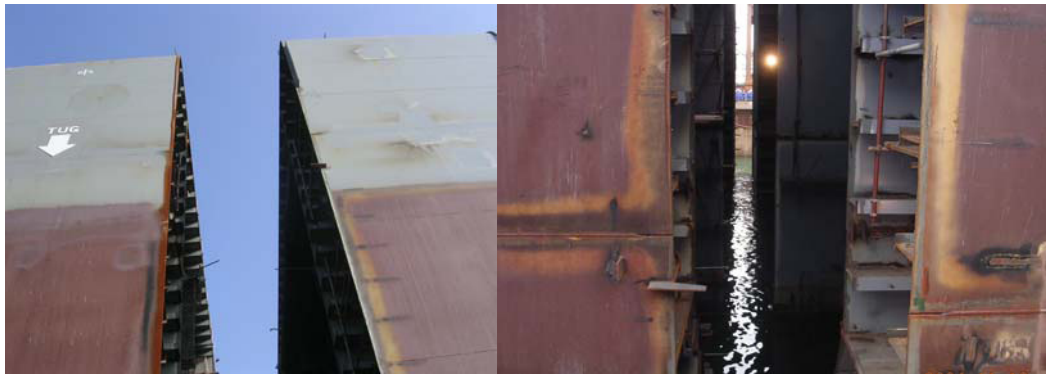


Figure (g): Afloat condition of two parts just before combination



**Figure (h):
Fore body docking by means of limiter**

**Figure (i):
Two parts after docking for joint**



Figure (j): Completed for sea trial

4. Benefits of Shipbuilding by Two Parts

Up to now, some VLCC have been constructed in DSIC with the technology of Shipbuilding by Two Parts. Considering the special resource configuration of DSIC, there are more benefits with the shipbuilding technology.

(1) The existing resource and facilities can be utilized comprehensive. DSIC has many dry dock and slipways, among those, there is a dry dock enough long to arrange one and a half of vessel, a big slip way and a smaller dry dock suitable for construction of half vessel. With the shipbuilding technology, all those resource can be utilized fully.

(2) The average period occupied by each vessel will reduced obviously, the construction efficiency is improved correspondingly.

(3) Since other resources can be used for building of large vessel, no great investment or great alteration to the existing facility is needed in order to increase amount of shipbuilding.

Shipbuilding by Two Parts will require more high level of the project management and construction, and will make the progress in the shipbuilding technology to satisfy the demand of the shipping.