

## STRENGTH AND STRUCTURE

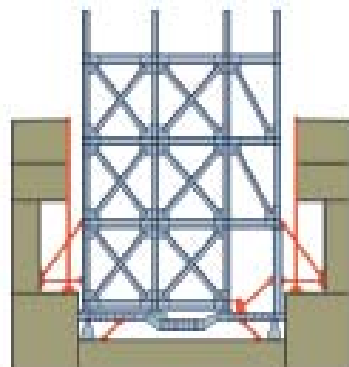
**DESIGN OF SECURING ARRANGEMENTS FOR NON-STANDARD BULKY CARGOES AT MARINE FREIGHT**

Nowadays it became a usual practice that at construction of new and upgrade of used offshore oil production platforms the technologies are being applied that incorporate huge modules being manufactured at one yard and assembled at sea or another yard. Those modules can be transported by sea only. Success of these transport operations is mostly dependent on the selection of transport vehicles, module securing arrangement, reliable fixing of heavy cargoes. To resolve these tasks it is necessary to develop a special methodology taking into account specifics of transportation, applied means and methods of cargo securing. The developed procedure and solutions were based on:

- ▶ Assessment of probable en-route wave and wind conditions;
- ▶ Assessment of pitch & roll parameters for transport vessel together with transported cargo;
- ▶ Optimization of cargo placement and arrangement;
- ▶ Optimal selection of material type and grade for securing components and joints;
- ▶ Validation of strength for fastening



Module transportation



Modules of offshore oil production platform topsides 400 to 1250 t in weight in the transport floating dry dock

components in accordance with requirements of regulation documents.

Practical implementation of this methodology allows:

- ✓ to minimize the total number of securing arrangements necessary for reduction of non-uniform load distribution between them;
- ✓ to split securing arrangements intended for prevention of module displacement and those that prevent the cargo capsizing;
- ✓ to reduce the level of loads applied to securing joints and components due to elastic flexibility in horizontal or vertical direction.

**THE TESTS OF HULLS FOR DEEP DIVING MANNED VEHICLES "MIR" FOR COMPLIANCE WITH THE REQUIREMENTS OF MARITIME REGISTER RULES**

The deep water manned vehicles "Mir-1" and "Mir-2" have been developed under supervision of Germanische Lloyds Shipping Register. In accordance with requirements of the Russian Maritime Register of Shipping, the pressure structures and equipment of deep water vehicles are subject to regular tests for test pressure aimed at identification of latent defects. The working diving depth of "Mir-1" and "Mir-2" DSUWMV is 6000 m, the test pressure is 750 bar (which is equivalent to the diving depth of 7500 m).

The Krylov Institute has performed the certification tests for these vehicles in the hydro-barometric stands (chambers). The pressure spheres of both vehicles and basic buoyancy units have been tested. The goal of testing was to confirm possibilities for further operation with the working diving depth up to 6000 meters. The work has been conducted under supervision of inspectors from International Register "German Lloyd". During preparation to the tests and their execution the following was accomplished:

- ✓ installation of strain gauges on the hulls of vehicles;
- ✓ manned, ballast and inverter spheres were subjected to non-destructive testing (ultrasonic and capillary inspection before and after the tests);
- ✓ material of manned spheres was checked by acoustic-emission method;
- ✓ the stress-strained state of spheres was measured and results were compared to measurements obtained before during acceptance trials.

The test results have confirmed the absence of latent defects initiation and propagation in the pressure structures and good correlation between their stress-strained state at the test pressure equal to 750 bar and the designed

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Loading of "Mir-2" manned sphere in the test chamber DK-600

values. The test results have allowed the Lloyds Register inspectors to make a conclusion on the possibility of further operation for spherical hulls and buoyancy units within "Mir-1" and "Mir-2" with operational diving depth of 6000 meters and to confirm compliance of strength parameters to the requirements of Rules in force.