Frame technology of pusher tug construction for a two-element inland passenger ship

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ABSTRACT

The article presents a frame technology for a pusher tug, the construction of which was developed within the framework of the INCOWATRANS project. The technological division was made using a so-called mass criterion. The weight of the biggest sections does not exceed 12 tonnes, which allows the steel hull to be built using even as small a crane as the truck crane of approximate carrying capacity of 20 tonnes. Subsequent building stages are illustratively shown in the figures.

Keywords : frame technology, tug construction, inland passenger ship

INTRODUCTION

The subject of the article is the proposed technology for building the pusher tug hull of mixed panel and conventional structure. In particular it refers to Phase 10, [1], presented in Table 1.

Table 1. *Part of Table 4-1 from Ref. [1].*

Panel part – „raw”				
Phase number	**Phase name**	**Unitary division**	**General scope of work**	**Events**
10	Preparing documentation	Concept of constructional and technological division of the ship into panel and conventional parts	Catalogue of construction centres (panel joints with conventional construction)	Preparing documentation and selecting centres
			CAD Project	

The basic data for the article was a set of design drawings for a pusher tug and hotel barge, prepared by DESART on October 18, 2005. They show one of design variants and that is why the present proposal should be treated as one of possible technological divisions – a preliminary stage.

The CAD project, executed with the aid of UNX3 code package, includes the visualisation of the technological process of building of the ship's hull panel part.

CONCEPT OF TECHNOLOGICAL DIVISION OF THE PUSHER TUG

According to the assumptions concerning the frame hull building technology, [1], the following sequence of actions was adopted within the framework of phase division of ship building technology, and the ship construction was divided into two parts :

- conventional – referring to the bow and stern of the ship
- panel part – consisting of a grate, made of tube profiles and filled with panels, and a single-sheet (conventional) construction in the board and bilge regions.

Principles and qualification of the design and technology documentation were prepared based on the already existing, well-known division defined in the standard, adapting it to the purposes of prototype watercraft building. What is innovative here is proposed changes in principles of numbering *Classes, Groups* and *Subgroups,* [1, item 4.1]

The design of the pusher tug was modelled in UNX3.

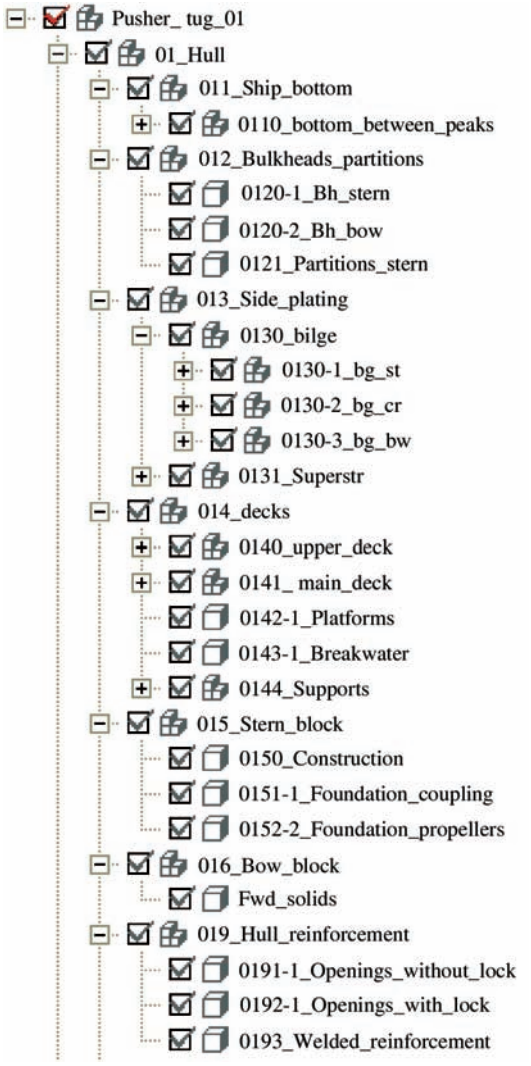


Fig. 1. *Structure of pusher tug construction, extended to three levels.*

Section and block division of pusher tug construction

The pusher tug construction was divided into block-sections, which then were divided into flat sections, consisting of a truss (grate) made of rectangular cross-section beams. The space inside the grate was filled with panels, Fig. 3. The main criterion of the division was the weight (mass) criterion. The total weight of each block-section element does not exceed 12 tonnes. All sections can be transported and manoeuvred by a crane of maximum carrying capacity of about 20 tonnes.

A collection of approximate masses of particular sections is given in Table 2.

Due to a variety of drawings illustrating subsequent building stages, a limited number of figures were selected for a simplified presentation illustrating the course of building.

Table 2. *Specification of pusher tug block-sections.*

Item	Name of block-section	Symbol	Mass from design [t]	M(sk) [t]	Identifier from NX **Tech_01**
1	**Stern – classical construction**	RU_01		7	RU_01
2	**Stern superstructure**	RU_02		5	RU_02
		Total :	**21.278**	**12**	
3	**Bottom**	DN_01	5.878	7	DN_01
			2.265	3	DN_01_P_01
4		DN_02	4.515	6	DN_02
			2.013	3	DN_01_P_03
5		DN_03	6.607	7	DN_03
		Total :	**21.278**	**26**	**BOTTOM**
6	**Main deck**	PG_01	10.753	12	PG_01
			1.381	2	PG_02_Pi_Sc
			2.796	4	PG_01_P_01
7		PG_02	5.084	6	PG_02
			1.258	2	PG_02_Pi_Sc
8		PG_03	8.555	10	PG_03_RAMA
			1.888	3	PG_03_Pi_Sc
			2.484	3	PG_03_P_03
		Total :	**34.199**	**42**	**Main deck**
9	**Upper deck**	PY_01	2.796	4	PY_01_P_01
			0.959	2	PY_01_Pi_Sc
			10.709	12	PY_01_RAMA
10		PY_02	5.084	6	PY_02_RAMA
			0.750	1	PY_02_Pi_Sc
11		PY_03	0.678	1	PY_03_Pi_Sc
			7.634	9	PY_03_RAMA
			2.484	3	PY_03_P_03
		Total :	**31.094**	**38**	**Upper deck**
12	**Bilge + board over bilge+ board between main and upper deck**	OB_01_LB	2.788	4	OB_01
		OB_01_PB	2.788	4	
		Total :	**5.576**	**8.0**	**Bilge st**
13	**Bilge + board over bilge+ board between main and upper deck**	OB_02_LB	2.074	3	OB_02
		OB_02_PB	2.074	3	
		Total :	**4.148**	**6.0**	**Bilge Ct**
14	**Bilge + board over bilge+ board between main and upper deck**	OB_03_LB	2.582	4	OB_03
		OB_03_PB	2.582	4	
		Total :	**5.164**	**8.0**	**Bilge bw**
15	**Bow**	DZ_01		6	DZ_01
16	**Bow superstructure**	DZ_02		5	DZ_02
		Total :		**11**	
TOTAL				**151**	

J – single-sheet structure, **R** – grate, **P** – sandwich panels; **M**(sk) – (corrected mass).

Figure does not take into account total mass including all small details.

Correction was assessed as equalling from 10% to 40% of the mass of the construction object of concern.

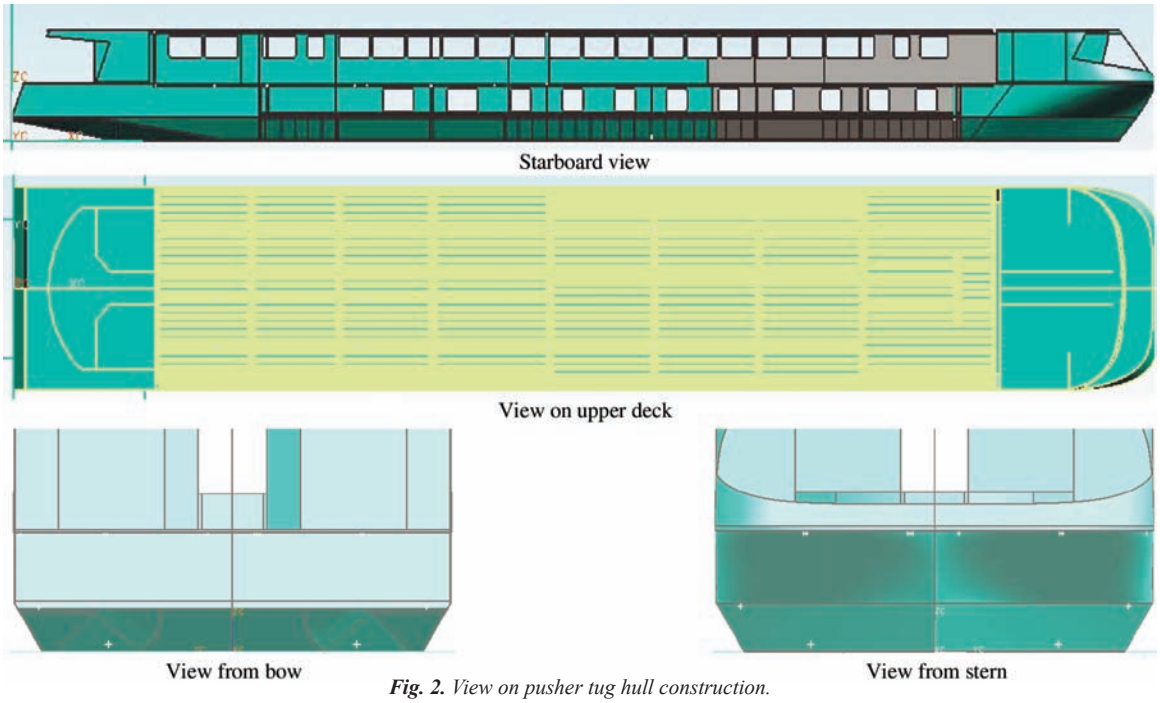


Fig. 2. *View on pusher tug hull construction.*

Certain simplifications were adopted which the reference to the description of building conditions. In particular they refer to :

- the place of building which is convenient for launching, such as a dry dock or a crane with carrying capacity above 200 t (MAJA, for instance)
- blocking made of poppets, for instance, to give an access from the bottom side for welding and checking tightness of joints
- knowledge on welding processes concerning thickness of steel sheets and construction elements, and types of welds and positions in which they are made
- the prepared catalogue of standards of manufacturing for panel and mixed panel-conventional constructions
- issues referring to power plant and cabin equipment were omitted
- the installations (pipelines) were assumed to be led mainly in the region of bilge tanks.

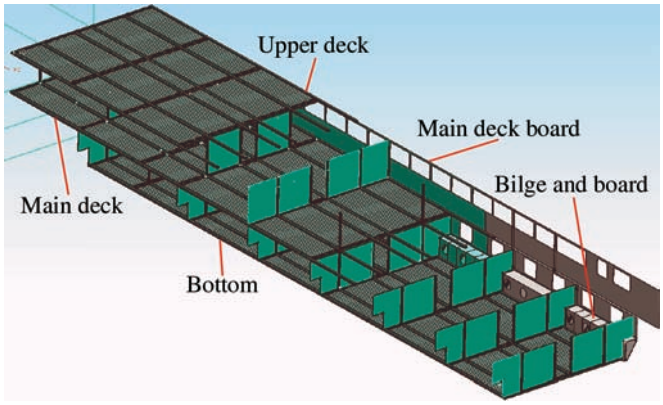


Fig. 3. *View on pusher tug panel part.*

Grate prefabrication and filling with panels for the bottom region

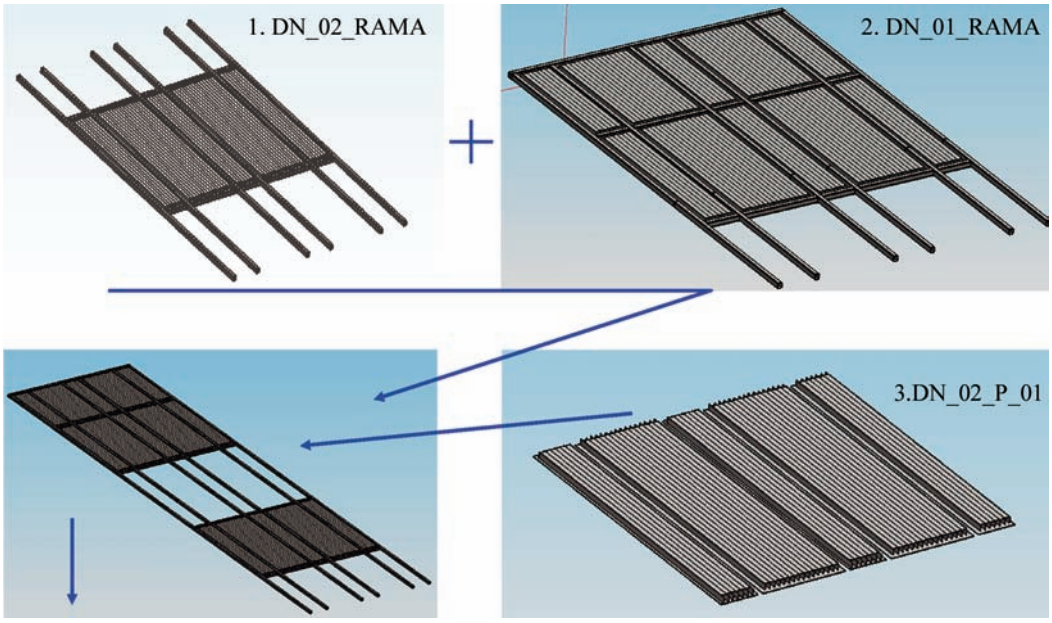


Fig. 4. *Bottom region prefabrication.*

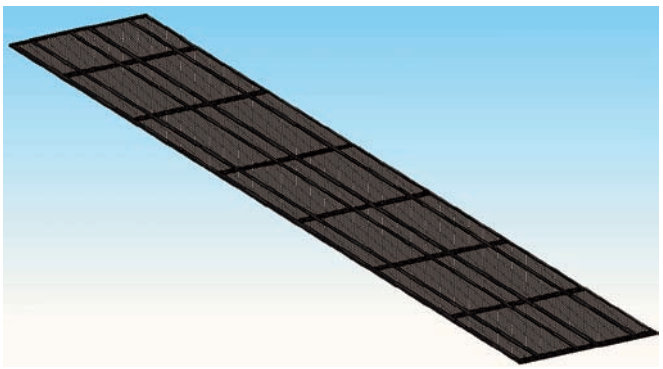
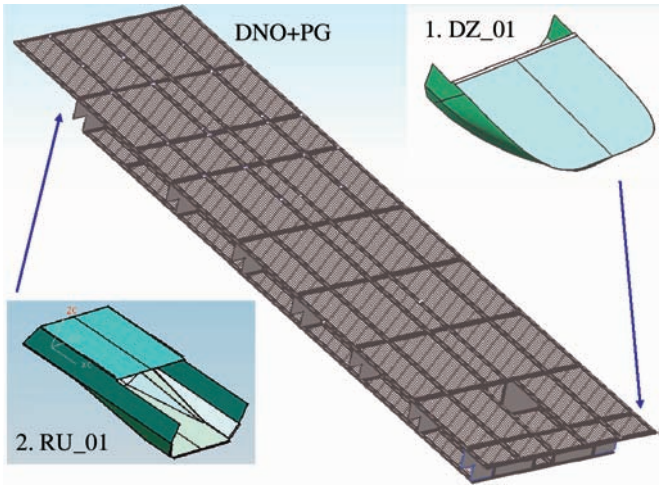


Fig. 5. *Bottom after prefabrication.*

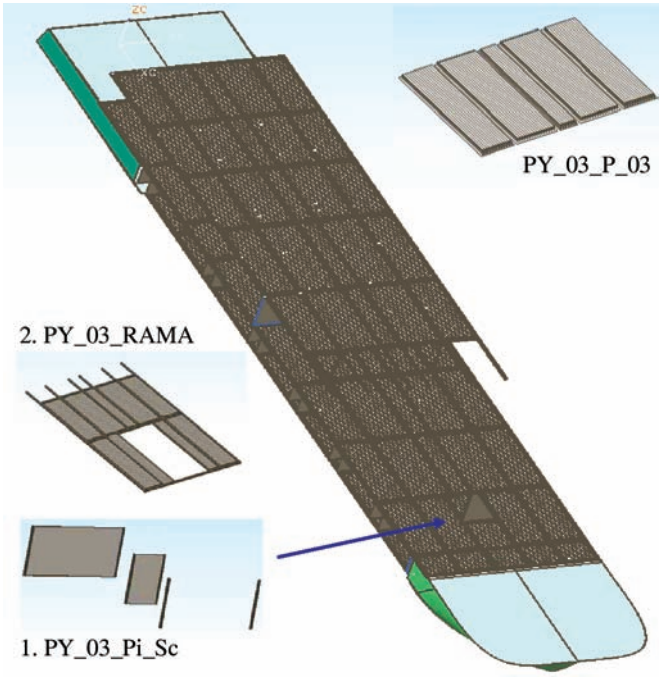
The bottom comprises items 3, 4 and 5 from Table 2.

Building the main deck together



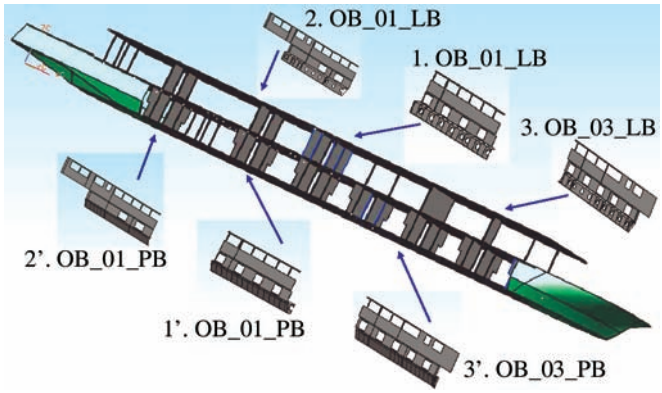
with bow and stern parts

Fig. 6. *Sequence of assembling bow and stern parts with the bottom and main deck construction.*



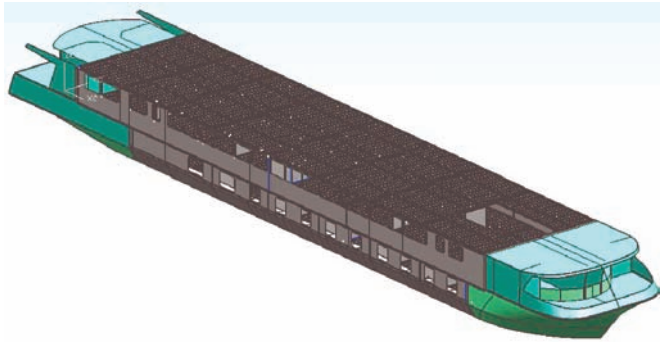
Building the upper deck

Fig. 7. *Sequence of assembling pillars and walls on the main and upper decks.*



Assembling board and bilge sections

Fig. 8. *Assembling conventional sections with the frame construction.*



Steel construction of the pusher tug hull

Fig. 9. *View on pusher tug hull after assembly and welding.*

BIBLIOGRAPHY

1. Pyszko R., Górski Z.: *Assumptions for developing frame technology for hotel barge and pusher tug building* (in Polish). Prace badawcze 208/e/05 *INCOWATRANS E!3065z*
2. Pyszko R., Górski Z.: *Frame technology for pusher tug hull building in a virtual shipyard* (in Polish). Prace badawcze 258/e/06 *INCOWATRANS E!3065*
3. Szalejko J.: *Shipfitter's manual* (in Polish). Wydawnictwo Morskie, Gdańsk 1977.