CLAMPING AND SUSPEND SYSTEMS TO MANIPULATIONS DOCKING RAMPS

Vasile ALEXA^{1,*} - Sorin RATIU¹

¹ Politehnica University of Timișoara, Faculty of Engineering Hunedoara, Hunedoara, Romania

Received (13.05.2016); *Revised* (14.09.2016); *Accepted* (19.09.2016)

Abstract: This paper presents a comparative analysis of two proposed solutions to achieve the handling and transport platforms docking. The proposed solutions are analyzed by finite element method and validated by laboratory experiments. The solution adopted will be chosen according to the chosen transport equipment.

Key words: finite element, lifting eyes, safety factor.

1. INTRODUCTION

Any equipment, any construction element must be equipped with one or more devices suitable for transportation. Only in this way can during each stage of production, assembly, delivery (by train or truck), final assembly at the customer, speed ferry optimal conditions with maximum safety for staff and fixture construction. Attachment points - an absolute necessity that does not give importance to many builders.

In the next table (Table 1) shows the main mounting schemes depending on their weight and shape [1].

Table 1. The main mounting schemes

Scheme	Number of arms	β [°]	Scheme	Number of arms	β [°]
1	0		2	0-45
2	0		3-4	45-60
1	90		3-4	0-45
2	90		3-4	45-60

Means used to loading - unloading, transshipment goods transported adapters are selected according to the following criteria [2]:

- nature of the goods to be transported (solids or liquids, acids or bases, with or without risk of damage);
- shape and size of elements (in bulk chunks or small, heavy or bulky granular or powdery state, etc.);
- of packing (bags, packages, bottles, containers, etc.);
- how to place the deposit (in piles, stacks, palletized or not, etc.);
- type of means of transport to be achieved;
- the quantity of goods handled per unit time.

Frequently transported objects are equipped with threaded holes for all screws ring DIN. When you want to use very resistant screw attachment points, these holes are usually oversized and require the use of fixings too high [3]. Accessories and devices for catching and suspending pregnancy are built in a variety constructive handled by load characteristics and handling mechanism. Here are some examples (Figure 1) [4]:

Fig.1. Lifting eyes models

Fig.3. Transport case-using a crane

*Correspondence Author's Address: Politehnica University of Timișoara, Faculty of Engineering Hunedoara, 5 Revoluției Street, 331128 Hunedoara, Romania, vasile.alexu@fih.upt.ro

Most often using screws DIN 580 ring of C15 or predict construction sheet which do not allow the possibility of load angle respectively are usually oversized so that smaller hooks opening and flap safety cannot be caught. Docking ramp handling the manufacture, transport, installation and facilities according to of the economic agent can be done using overhead cranes (Figure 2) or a forklift (Figure 3).

Fig.4. Transport case-using a lifting

In this case, fixing and fastening systems have an important role due primarily to ensure the safety of workers and secondly is affected finished product quality by eliminating non-conformities.

In both cases should be considered gauge assembly to handle its geometrical shape and the binding mode of high load.

Loading gauge assembly docking ramp is different, depending on the type of ramp is designed and respectively its additional facilities [5, 6, 7].

Fixing and fastening system also has a very important role because it influences the production costs of both the manufacturing company and the beneficiary dock ramps.

2. THE PROPOSED CONSTRUCTIVE SOLUTIONS FOR FASTENING SYSTEMS AND HANDLING OF DOCKING RAMP

Given the above, we propose finding a technical solution to solve the problems faced by the manufacturer of the docking ramps manufacturer.

Like the initial starting date, we will consider two aspects:

- weights and dimensions to the docking ramps transported;
- the transport equipment used.

The main types of docking ramps carried out the following sizes shown in Table 2.

Special problems are caused by handling and transport using fork, given the typical geometric constructive and its forks, presented suggestive in Figure 5.

For the two types of equipment used to transport, we consider two constructive solutions for fixing and manipulating dock ramps, shown in Figure 6 and Figure 7.

Table 2. The main types of docking ramps

Type	Mass
SD 610 2500x2000x700	780
SD 610 3000x2000x700	870
TD 620 2500x2000x700	950
TD 620 3000x2000x800	1250
LHT 100 kN 3000x2000x800	1750

Fig.5. Fork lift truck – geometrical parameters

Fig.6. Fork lift truck-variant 1 – geometrical parameters

Fig.7. Fork lift truck-variant 2 – geometrical parameters

Axial force an a single lifting eye, according to the charts, when lifting a leveler with load G of charge for two types of transport used data handling relations:

- *using crane*: in this situation, for a single lifting eyes action load $\frac{G}{4}$ and is $\beta = 45^\circ$:

$$F_c = \frac{G}{4} \sin \beta = 0.176 G \quad (1)$$

- *using forklift*: in the worst scenario, when lifting only with two lifting eyes, axial force have value:

$$F_F = 0.75 G \quad (2)$$

3. ANALYSIS OF THE TWO PROPOSED SOLUTIONS

Based on the two proposed solutions, but also from the two means of handling and transport used make a pertinent analysis on their behavior in exploitation, analysis summarized in Table 3.

Table 3. Maximum leveler weight

Using a crane					
Safety factor	S_F	2	Safety factor	S_F	2
Yielding point load	G_Y [kg]	2000	Yielding point load	G_Y [kg]	1200
Maximum axial load	G_A [kg]	1000	Maximum axial load	G_A [kg]	600
Maximum leveler weight	G_{max} [kg]	5800	Maximum leveler weight	G_{max} [kg]	3500
Using a forklift					
Safety factor	S_F	2	Safety factor	S_F	2
Yielding point load	G_Y [kg]	2000	Yielding point load	G_Y [kg]	1200
Maximum axial load	G_A [kg]	1000	Maximum axial load	G_A [kg]	600
Maximum leveler weight	G_{max} [kg]	1333	Maximum leveler weight	G_{max} [kg]	800

Using machines tried to the traction have tried two fasteners and lifting proposed to square axial force-strain diagram, Figure 8 and Figure 9.

Fig.8. Fork lift truck – geometrical parameters

Fig.9. Fork lift truck – geometrical parameters

Fig.10. Virtual model 1 – FEA

In order to take into account the test conditions and fastening systems proposed lifting was carried out a simulation using ANSYS Mechanical software package Strength Analysis.

It has been observed that both the elastic and plastic behavior of real fasteners and lifting is approximately equal studied virtual behavior.

Fig.11. Virtual model 2 - FEA

Among the proposed option 1 (Figure 6) and version 2 (Figure 7) observed that the two provides greater resistance resulting in further dimensional rethinking of this embodiment, Figure 12.

1-BxT-35x8	4-BxT-40x8	7-BxT-50x8
2-BxT-35x10	5-BxT-40x10	8-BxT-50x10
3-BxT-35x12	6-BxT-40x12	9-BxT-50x12

Fig.12. Dimensional variations considered

Fig.13. Graph axial deformation-axial force

For the nine proposed dimensional variations were performed tensile testing, resulting graph in the figure below (Figure 13).

4. RESULTS AND CONCLUSIONS

While contribute through the implementation of attachment point, which provides safety to:

- minimize the risk of accidents!
- preventing damage and downtime!
- reducing transshipment times!

After analyzing virtual model proposed were identified following:

- increasing width from 35 to 40 mm to increase the resistance factor of 1.1, and an increase in the width of 40 to 50 mm, the same resistance factor from 1.4 increases.
- increasing the thickness of 8 to 10 mm to increase the resistance factor of 2, and an increase in the thickness of 10 to 12 mm, the same resistance factor increased to 3.4.

The optimal variant is the variant 5 (40 x 12), increasing the resistance coefficient of 3.9.

Compared to the version originally proposed, the new version has the following advantages: weight without screw is 1.8 kg and unit cost it is 2.8 euro (initial cost was 4 euro).

REFERENCES

- [1] Alcaz, T., ș.a, (2007). *Tehnologia organizării transportului de mărfuri*, Universitatea Tehnică a Moldovei, Chișinău.
- [2] Tezec, I. (2008). *Proiectarea sistemelor de transport în transportul de marfă*, Universitatea Tehnică a Moldovei, Chișinău.
- [3] Herman, M. (2007). *Sisteme și mijloace de transport și manipulare*, Editura MIRTON.
- [4] <http://www.thecrosbygroup.com/>
- [5] <http://web.rud.com/en-au/home.html>
- [6] <http://www.hoermann.de/>
- [7] <http://www.crawfordhafa.ro/>