Journal of Marine
Technology and Environment
DOI: 10.53464/JMTE.01.2022.02

ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

THE STUDY OF A JIB CRANE FROM A CARGO SHIP

Milis Nilgun Caibula[1]

[1]Politehnica University of Bucharest, Splaiul Independentei 313 street, 060042, Bucuresti, Romania,
e-mail address: caibulamilis@yahoo.com

Abstract: This paper presents the study of a jib crane from a general cargo ship. There are numerous different types of vessels operating today in the various markets worldwide. Besides, thousands of cargo vessel ply the world's oceans and seas each year, handling the bulk of international trade. The cranes from cargo ship is required to be adequate stability and strength for each load. All cranes from vessel are mounted on deck of the ship. Having regard in particular to the stress induced at its mounting or fixing points, adequately ballasted, securely anchored and supported by outriggers as necessary to ensure its stability when lifting. A jib from a crane from cargo ship is a type of overhead lifting device that is often used in a smaller work cell area for repetitive and unique lifting tasks. The extreme values of the stresses and reaction forces are determined by the finite element method. In this manuscript, the design of the cargo ship and the study of a jib crane are made using NX software from Siemens.

Key words: jib, crane, ship, cargo, stress.

1. INTRODUCTION

A general cargo ships is a freighter is a merchant vessel that carries goods from one harbor to another. The most used cargo vessels are, [1]:

- Bulk-cargo ship.
- Container cargo (boxship)
- Livestock vessels
- Reefer ship.

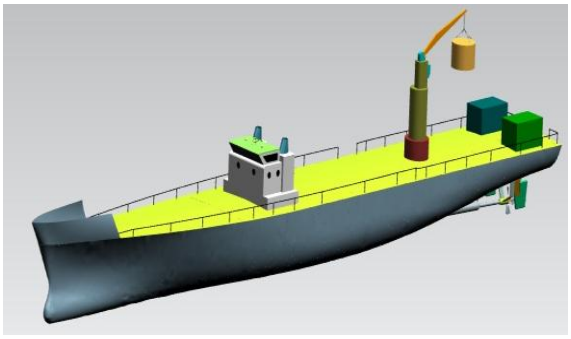

Figure 1 General cargo ship

Some cargo ships are equipped with cranes and other mechanisms to load and unload, Fig. 1.
Cargo ships are generally classified according to: deadweight tonnage (DWT), cargo capacity and vessel dimensions. In fact, the vessel presented in the paper is small in size (carrier of 22,000 TDW), [2].
General cargo ships generally have a life expectancy of 25 to 30 years before being scrapped.

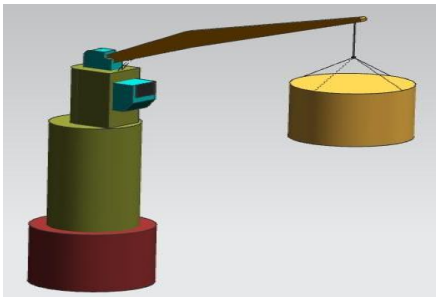

Figure 2 Crane cargo vessel

Often, the main parts of the crane on the ship are: pedestal, column (main support), cabin, jib, etc. [3]
Usually, the cabin is attached to the column of the crane. Because, the operator working in the cabin must have a higher visibility. But, the jib crane is above the body and the cabin. The jib crane is raised with two hydraulic cylinders, Fig. 3.

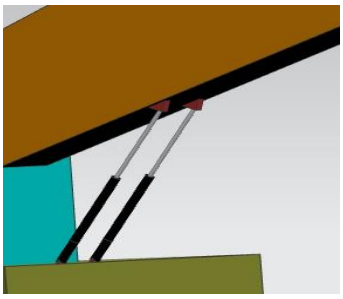

Figure 3 Crane hydraulic cylinders

Journal of Marine
Technology and Environment
DOI: 10.53464/JMTE.01.2022.02
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

Moreover furthermore, there are many types of ship crane. Usually, the ship crane are more complex to lift or lower a heavier load , Fig. 4.

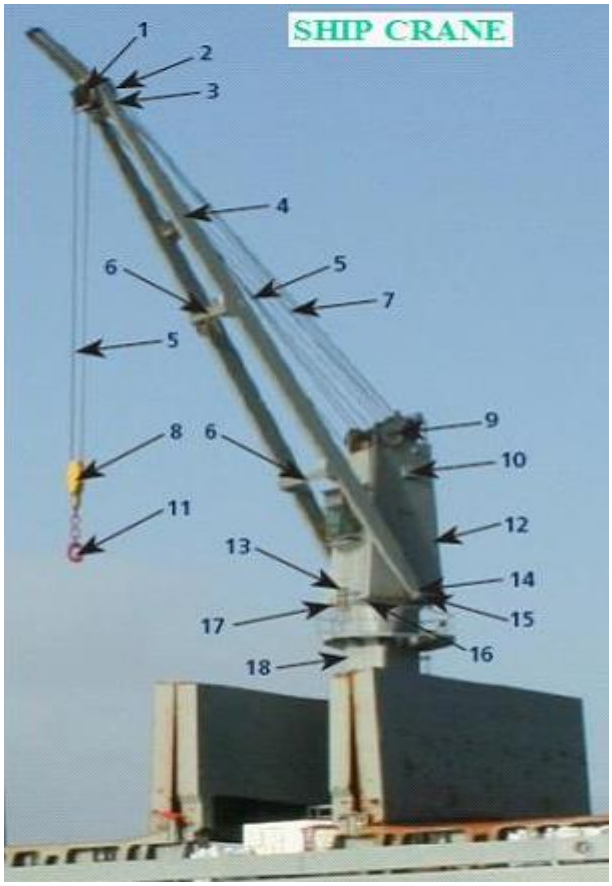

Figure 4 Ship crane

Table 1. The components of a ship crane

No.	Description
1	Jib head
2	Jib head sheaves
3	Luffing sheaves
4	Main chords of jib
5	Cargo hoist ropes
6	Transverses
7	Luffing ropes
8	Hook block
9	Slew column head
10	Jib stop
11	Hook
12	Slewing column
13	Machinery deck
14	Jib heel
15	Jib heel pin
16	Slew ring bearing
17	Slew ring bolts
18	Pedestal

Jib crane from cargo vessel has the following motions:

- Derricking/luffing motion.
- Hoisting motion.

Slewing column with jib has slewing motion.

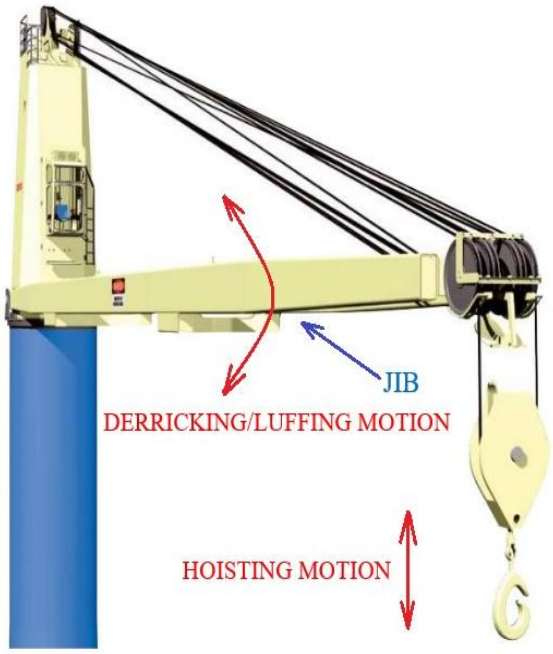

Figure 5 Jib crane motions

2. THE STUDY OF A JIB CRANE

A jib is a horizontal or nearly horizontal beam used on cargo ship cranes.
In fact, these frames are used in many types of cranes to support the load away from the main support.
The beam of the cranes are primary used to transport, lower loads and lift, Figure 4.
On the jib are mounted: trolley, hook block, hoist wire rope, etc, [4].

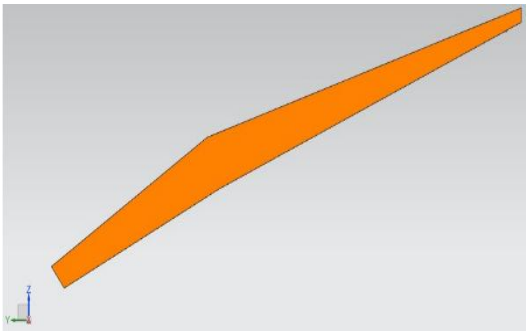

Figure 6 Crane hydraulic cylinders

The study of crane frame is performed using the finite element method. Thus, creating a mesh model with 1069 type CTETRA(10) finite elements, [5].

Journal of Marine
Technology and Environment
DOI: 10.53464/JMTE.01.2022.02
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

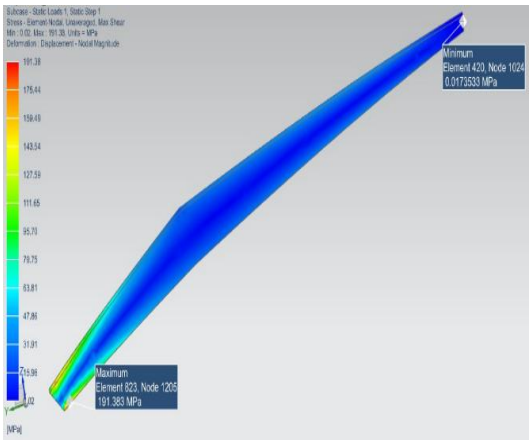

Figure 7 Shear stress – Jib crane

The maximum shear stress τ_{max} =191.383 MPa is at node 1205 in the finite element 823. But the minimum shear stress τ_{min} = 0.017 MPa is at node 1024 in the finite element 420, Fig. 7.

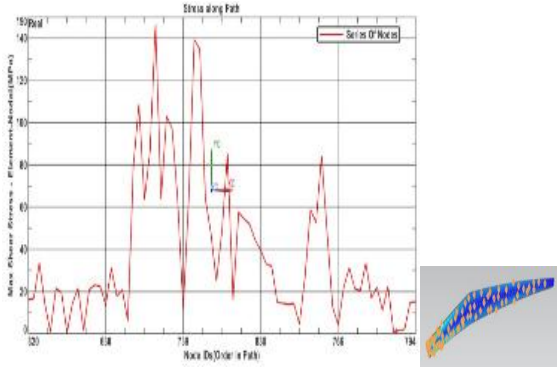

Figure 8 Diagram of shear stress – Jib crane

In order to achieve the diagram of shear stresses, we must choose the most important nodes. From the diagram, it can be seen that all the values of the shear stresses are positive.

Thus, in the diagram the minimum shear stress is and the maximum shear stress is τ'_{max} =191.383 MPa, Fig. 8.

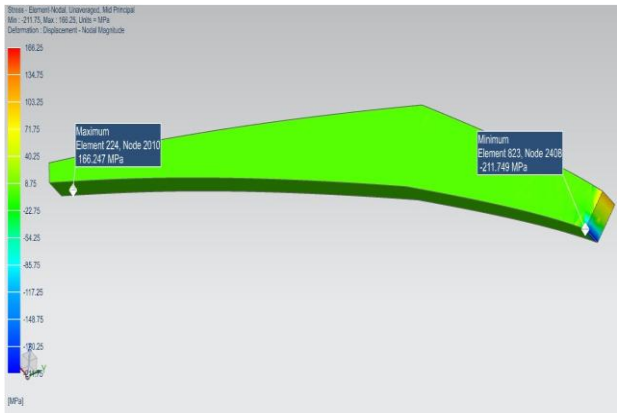

Figure 9 Normal stress – Jib crane

At node 2408 of element 823 is the minimum normal stress σ_{min} = -211.749 MPa, [6].

But, at the 2010 node in element 224 is the maximum normal stress σ_{max} = 166.247 MPa, Fig. 9.

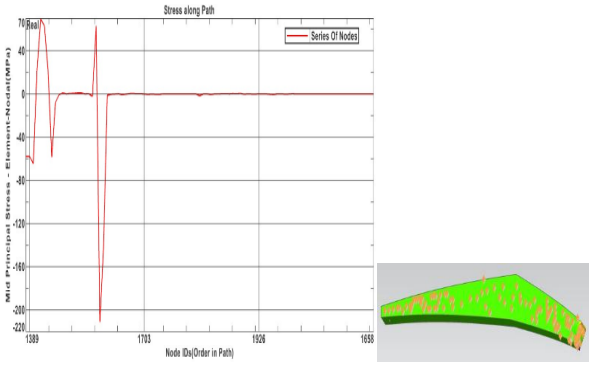

Figure 10 Diagram of normal stress – Jib crane

In the normal stresses diagram, the extreme values are: minimum normal stress is σ'_{min} = -211.749 MPa and the maximum normal stress is σ'_{max} = 220 MPa , Fig. 10.

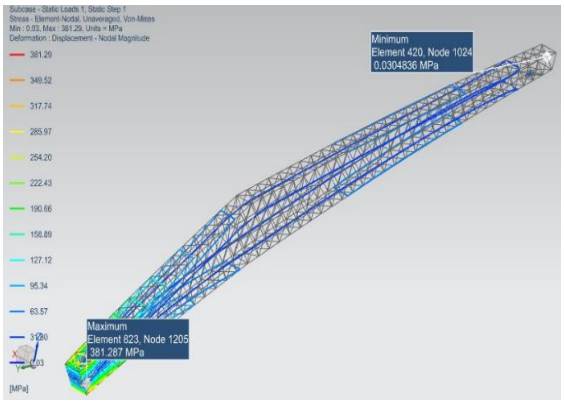

Figure 11 Von Mises stress – Jib crane

The maximum von Mises stress $\sigma_{v\,max}$ = 381.287 MPa is at node 1205 from element 823, [7].

But, the minimum von Mises stress in this case is $\sigma_{v\,min}$ = 0.030 MPa which is located at the node 1024 from element 420, Fig. 11.

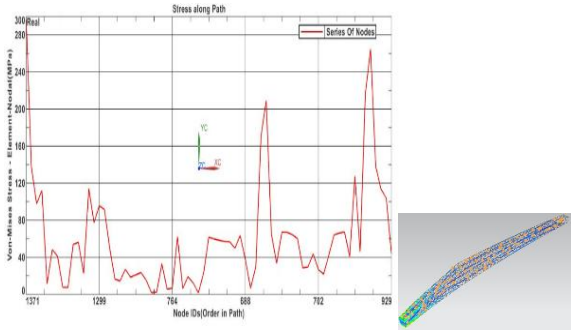

Figure 12 Diagram of von Mises stress – Jib crane

Journal of Marine
Technology and Environment
DOI: 10.53464/JMTE.01.2022.02
ISSN (Print): 1844-6116
ISSN (Online): 2501-8795
https://www. jmte.eu

All values in the von Mises stresses diagram are positive. In the diagram the extreme values of the Mises stresses are: the minimum stress is $\sigma'_{v\,min} = 0$ MPa and the maximum stress is $\sigma'_{v\,max} = 300$ MPa , Fig. 12.

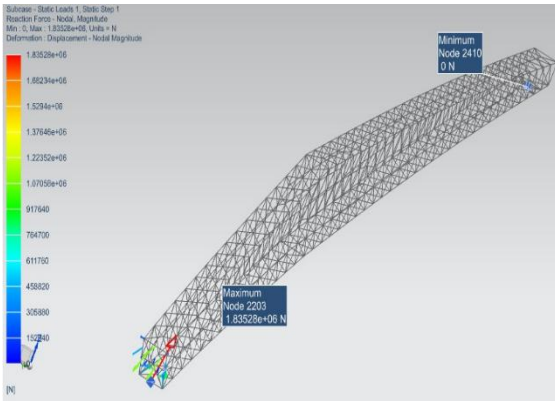

Figure 13 Von Mises stress – Jib crane

The maximum reaction force $F_{max} = 1.835 \cdot 10^6$ N is in the node 2203.

However, the minimum reaction force $F_{min} = 0$ N is in the node 2410, Fig. 13 .

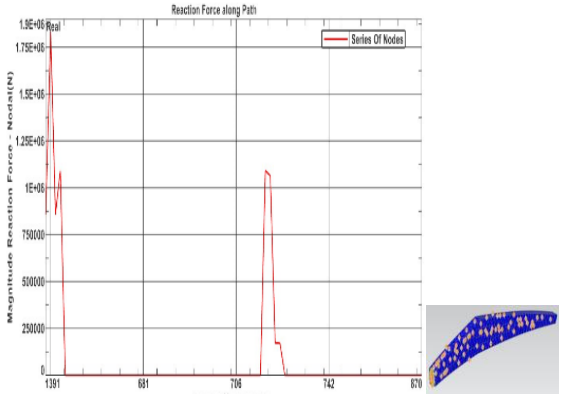

Figure 14 Diagram of reaction force

In the diagram of reaction forces, most values are null, [7]. Only at the beginning of the chart is there a maximum value $F'_{max} = 1.9 \cdot 10^6$ N, Fig. 14.

3. CONCLUSIONS

The jib cranes of cargo vessels have a relatively simple design and structure. They are easier to control and don't require a lot of servicing.

On the cargo ship, the jib can be deformed in the following cases: great winds, storm, during loading/unloading of goods, etc.

Authorized repairs should only be carried out on shipyards by specialized crane personnel. They must repairs to crane jibs by cropping and welding inserts over damaged or wasted sections.

Because, the jib crane are made of high-tensile for which special procedure have to be observed during repairs.

On general cargo ships, it was reported that the ship's staff had carrier out unauthorized repairs to crane frame by cropping and welding sections.

In fact, any damage noticed to crane jibs must be reported to the general cargo vessel and also advice sought before carrying out any kind of repair. It is recommended that during the maintenance of the cargo vessel, the strength structure of jib crane be checked.

In paper, extreme values were determined from a jib crane with finite element methods. These extreme values are of the shear stressess, normal stresses, von Mises stresses and reaction forces.

On the future, we want to develop the study for the jib from a crane on other ships.

4. REFERENCES

[1] Kaluza P., Kolzch A., Gastner M., Blasius B., 2010, *The complex network of global cargo ship movements*, Journal of the Royal Society, Vol. 7, Issue 8, ISSN: 1742-5662.

[2] Panaitescu, M., Panaitescu FV., 2019, *Simulation of the Cargo Tank Cleaning Plant for an Oil Tanker*, Hidraulica Magazine, Issue 1.

[3] www.liebherr.com.

[4] Gasic V., Zrnic N., Rakin M., 2012, *Consideration of a moving mass effect on dynamic behaviour of a jib crane structure*, Tehnicki vjesnik, Vol. 19, No. 1.

[5] Kodani N., Ouchi S., Takahashi K., 2016, *Transport control a jib crane with a rotating cargo*, IEEJ Transactions on Electronics, Informationand Systems, pp. 821-831, Vol. 136, Issue 6.

[6] Năstăsescu V., 2004, *Finite element method*, Military Technical Academy Publishing, Bucharest.

[7] Cojocaru R.C., 2021. *Evaluation of the quality standards of the water discharged into the sea after washing the exhaust gass*, Journal of Marine Technology and Environment,
Vol.I,DOI:10.53464/JMTE.01.2021.03.