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ABOUT TRANSPORT VESSEL HELICOPTER DECK AND PLATDFORM CONSTRUCTION

ПРО КОНСТРУКЦІЇ ВЕРТОЛІТНИХ ПАЛУБ ТА ПЛАТФОРМ ТРАНСПОРТНИХ СУДЕН

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Abstract. The development of mankind follows the path of humanization and respect for every human life, including, of course, in water transport, where the risks of life are especially great. The use of helicopter technology in water transport leads to a significant increase in the safety of its participants and to the expansion of the capabilities of transport vessels for cargo and other operations.
A great practical interest there is not only for the optimization of the parameters of helicopter decks and platforms for ships under construction, but also for refurbishment of already built ones.
The evolution in water transport is obvious – it is enough to trace the dynamics of the development of helicopter technology in water transport, especially over the past 20 years, both quantitatively and qualitatively.
The humanization of society and the struggle to improve the safety of people on water transport will inevitably lead to the further spread and development of helicopter technology on ships and other floating structures, including drilling platforms.
First of all it is required to make an analysis of the existing information about helicopter platforms of transport vessels and floating constructions and classify them in accordance with the ability to use a certain kind of helicopters. After that it is required toselect a drilling rig or transport vessel helicopter platform among the active ones as a prototype and make a construction computer simulation based on speciallized programs. That is a way of solutionthe problem of helicopter platforms parameters optimization on the base of elaborated target function.
It is very important to create the recommendations for helicopter platform construction parameters (including architecture, spacing, element thicknesses, spans) on the base of regular computer calculations and standards.
Purpose–is to improve the helicopter platform construction.
Method– analytical, numerical.
Results. There were presented the helicopter platformstrength computer calculation results and formula to evaluate the weight economy for perforated platform plates.
Scientific novelty. There were offered the directions of helicopter platform construction development.
Practical importance. Application of the results in practice could improve a vessel helicopter technology.
Key words: ship; helicopter platform, construction.

Анотація. Розвиток світової спільноти продовжує шлях гуманізації та поваги до кожного людського життя, включаючи і на водному транспорті, де ризики для життя особливо великі. Використання вертолітної технології на водному транспорті веде до значного підвищення безпеки його учасників та розширення можливостей транспортних суден для вантажних та інших операцій.
Великий практичний інтерес представляє не лише оптимізація параметрів вертолітних палуб та платформ суден які будуються, але також для обладнання вже збудованих.
Еволюція на водному транспорті очевидна – достатньо простежити динаміку розвитку вертолітної технології на водному транспорті, особливо за останні 20 років, кількісно і якісно.

Гуманізація спільноти та боротьба за покращення безпеки людей на водному транспорті безперечно приведе до подальшого поширення та розвитку вертолітної технології на судах та інших плавучих спорудах, включаючи бурові платформи.
Насамперед, необхідно провести аналіз інформації про вертолітні платформи транспортних суден та плавучих споруд, та класифікувати їх відповідно з можливістю використовувати відокремлені типи гелікоптерів. Після цього необхідно вибрати вертолітний майданчик бурової платформи або транспортного судна серед діючих як прототип і зробити комп'ютерне моделювання конструкції з використанням спеціалізованих програм. Це шлях оптимізації параметрів конструкції вертолітних платформ на основі обраної функції цілі.
Дуже важливо створити рекомендації для параметрів конструкції вертолітних платформ (включаючи архітектуру, шпації, товщини елементів, прольоти) на основі комп'ютерних розрахунків та стандартів.
Мета – покращення конструкції вертолітних платформ транспортних суден та підвищення їх ефективності.
Методика – аналітична, чисельна.
Результати –запропоновані аналітична формула оцінки економії ваги прі використанні перфорованих пластин платформи, а також наведено результати комп'ютерних розрахунків міцності вертолітної платформи.
Наукова новизна. Запропоновані нові напрямки розвитку конструкції вертолітних платформ.
Практична значимість. Використання результатів роботи на практиці може покращити суднові вертолітні технології.
Висновки. В результаті проведеної роботи була підтверджена можливість використання концепції формування суднового набору для вертолітних платформ.

Ключові слова: судно; вертолітна платформа; конструкція.

THE MAIN MATERIAL

The intensive development of helicopter technology on transport ships is primarily associated with economic, strategic and humanitarian needs. Helicopter technology on transport ships allows significantly expanding their capabilities for the delivery of goods both to equipped and unequipped coast, to other ships and drilling platforms, as well as for exploration (navigation, ice conditionsand so on), for the protection of state borders and the adjacent economic zones, delivery of crews, medical personnel, pilots, search and rescue operations and others.

The indisputable advantages of using helicopter technology have led to the fact that almost all large drilling platforms have helipads, and for mega yachts their design has become a practical standard. So, on the famous mega yacht <Eclipse>, 2 helipads are equipped at once. In practice, their installation is possible for yachts of more than 50 meters in length [1]. Nearly every year the new requirements of different Classification societies connected with helicopter technology in water transport have appeared[2-6]. That is a fact that due to additions of convention «SOLAS -74» now all the Ro-Ro vessels need to have a helicopter platform. The main parameters of helicopters that are used in China are presented in table 1 [7].

According to the possible helicopter loads the platforms should have a classification certificate with a cer-

Table 1. The main helicopter parameters

Helicopter Type	Maximum Weight (kg)	Minimum Weight (kg)	Height (m)	Maximum Length(D) (m)	Number of wheels	Platform Area (m^2)	Rotor disc Area (m^2)	Rotor Diameter (m)
Z-5	7600	5121kg	4.4m	20m	3 wheels	314m^2	295	21
Z-19	4500	2,350	4.01	12m	3 wheels	114	111.79	11.93
Z-11WB	2200	1120	3.14	13m	Landing gear	133	89.7	10.69
AC310	930	505	2.65	9.40m	Landing gear	69.5	52.5	8.18
EC-120	1680	895	3.4	11.52	Landing gear	104	78.54	10
AC301	2200	1250	3.14	13	Landing gear	133	147.12	13.69
MD520N	1157	493	2.7	9.8	Landing gear	75.4	54	8.3
EC135	2632	1180	3.51	12.16	Landing gear	116	81.7	10.2
MD500	1610	896	2.71	8.6	Landing gear	58	50.6	8.03

tain classification symbol. For example for helicopters with maximum weight not more then 2 tons, from 2 to 6 tons, from 6 to 10 tons and more than 10 tons.

The platform location is defined by FATO (final approach and take-off area) and TLOF (touchdown and lift-off area) requirements and can be installed in aft, bow, middle part or on the top of superstructure[8]. The last one is nearly free and it is possible to use it as a helicopter platform for nearly all kind of vessels without stability limitation if all structures here (for radar, aerials, lights and others) will be constructed with a height not more than a helicopter rotor height with a certain gap or an additional transverse or longitudinal consoles for them can be used. It is required also to reinforce such a platforms by additional pillars, girders and sometimes to increase a platform thickness or to limit a possible helicopter weight.

For calculation example there was taken a superstructure with a breadth14 metres, length 12 and hight 10 metres (4 tires 2.5 metres each) with outside plate thickness 6 mm, internal bulkheads 3mm and helicopter platform (wheelhouse top) 7 mm. The spacing of deck beams 100x10 mm was 500 mm. Three carlings 100x10/250x5 were located in Center plane and 3000 mm from it both sides. Betwin them the longitudinal girders 100x10 mm were installed and 6 pillars 120x5 mm in the web girders crossing were installed too but only for wheelhouse.

A load 98.1 kn was located 5000 mm from Center plane (one wheel load) in a cross point area (300x200 mm tyre print) of deck beam and deck longitudinal. A superstructure model with helicopter platform (without platform plating) is shown in fig. 1. and scheme of framework is in fig. 2.

The superstructure finit element model is shown in fig. 3 and in fig. 4 there is shown a deformation distribution in landing area.

In fig. 5 there is shown the stress distribution in platform plates and in fig. 6-8 are in deck longitudinal, pillar and deck beam in a load area.

The calculation results (if the maximum stress in platform plates is 100%) will be for deck longitudinal 355%, for pillar 13.9% and for deck beam 79.1%. So the architecture [9] in this example should be improved significantly. The best way is to take more powerful deck longitudinals or to add the flanges to existing ones.

For constructions like this one with a large local loads it is better to avoid a flat girders and recommended bulb ones, T and angle bars, frame girders with flanges and even channel bars in order to improve a neutral axis position for every support girder to increase section modulus with a minimum addition construction material.

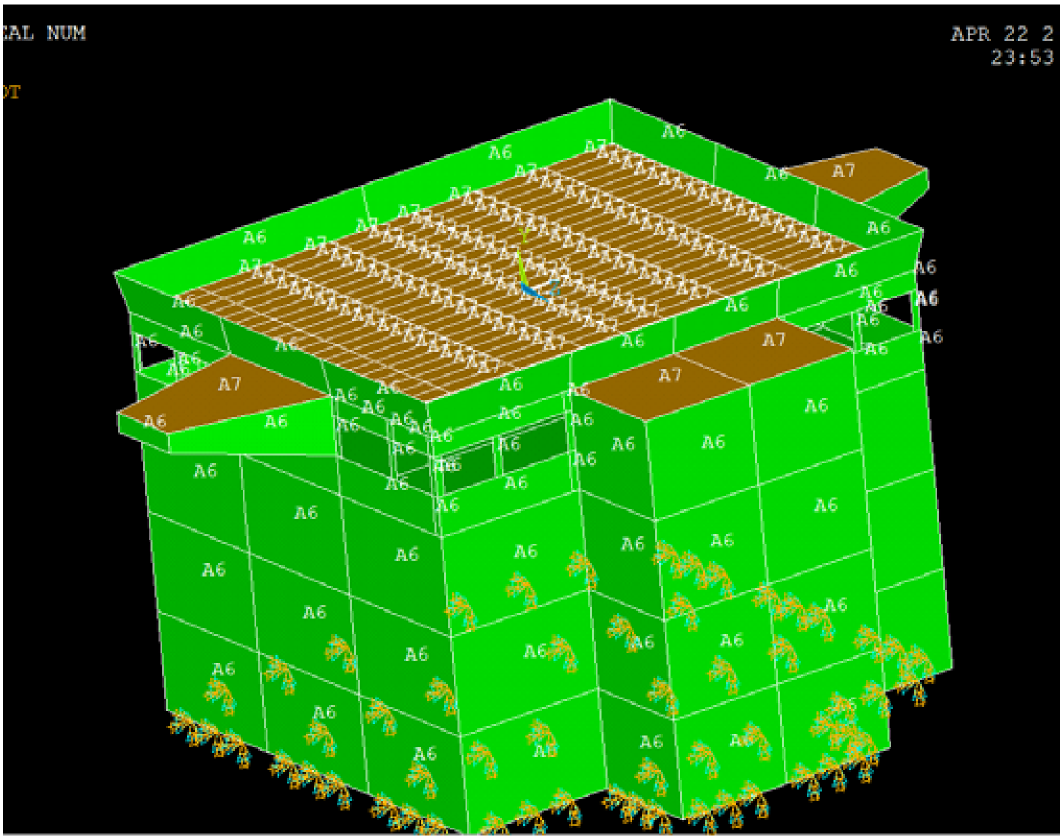

Fig. 1. A superstructure model with helicopter platform (without platform plating)

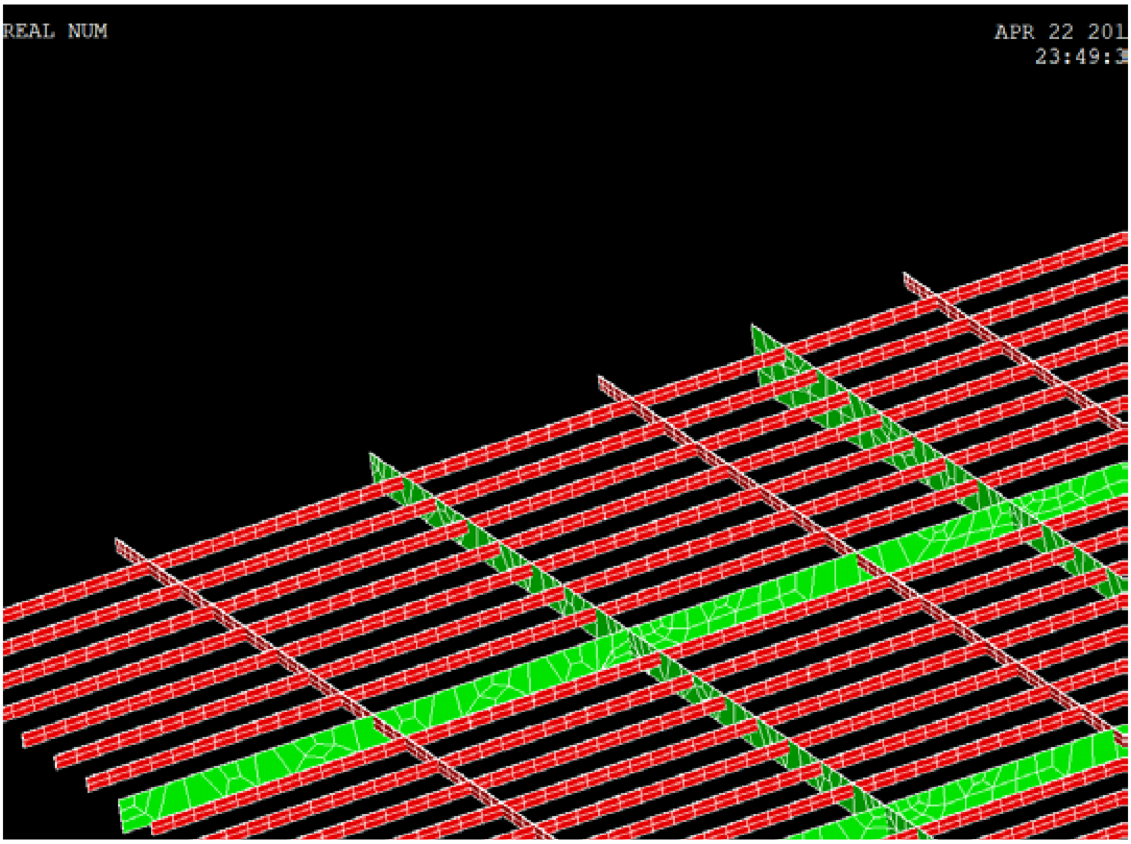

Fig. 2. The helicopter platform framework scheme

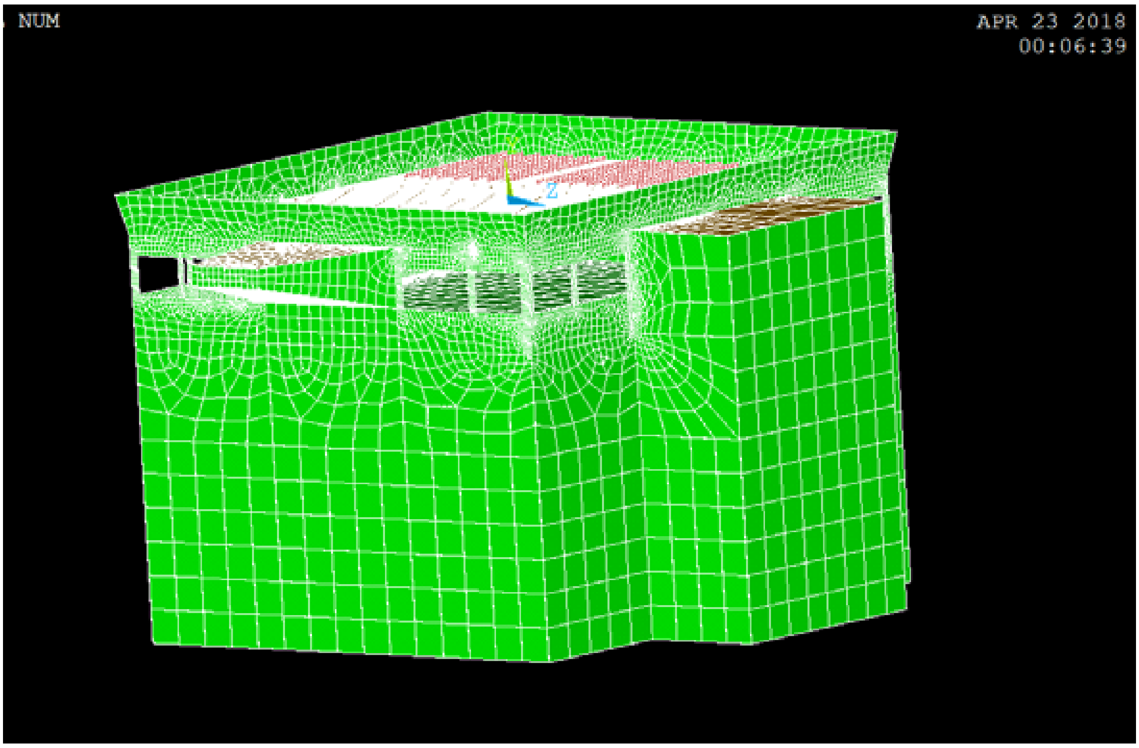

Fig. 3. The superstructure finite element model

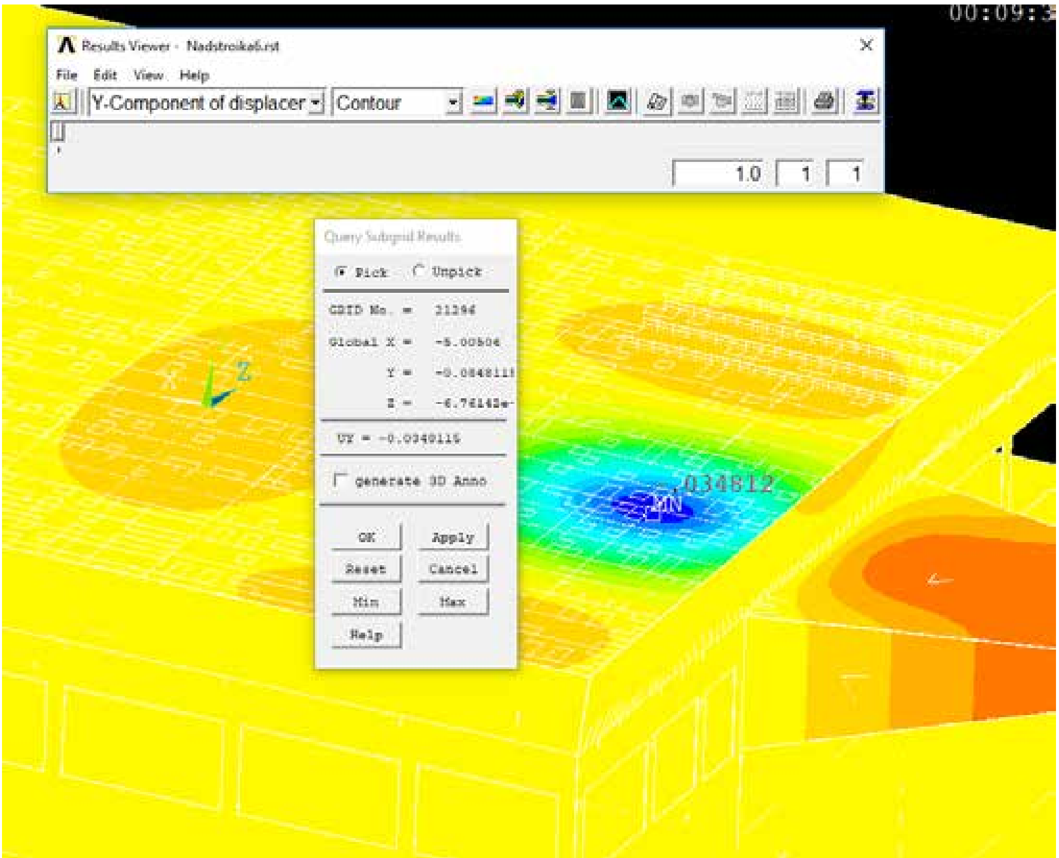

Fig. 4. The deformations distribution in landing area

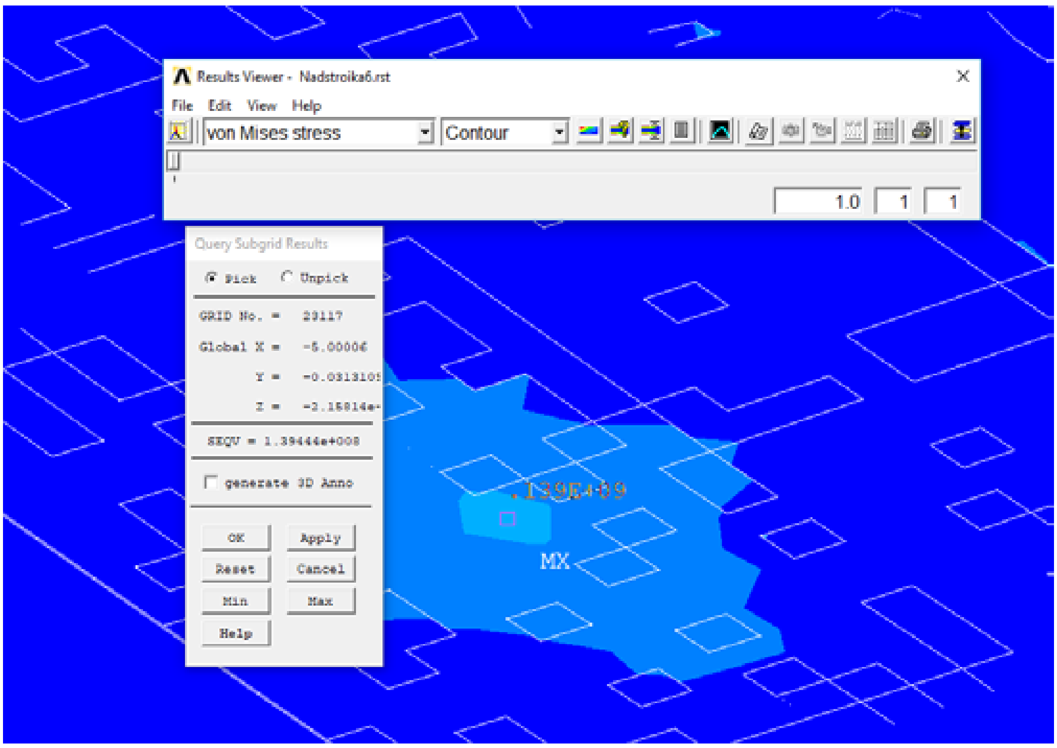

Fig. 5. The stress distribution in platform plates

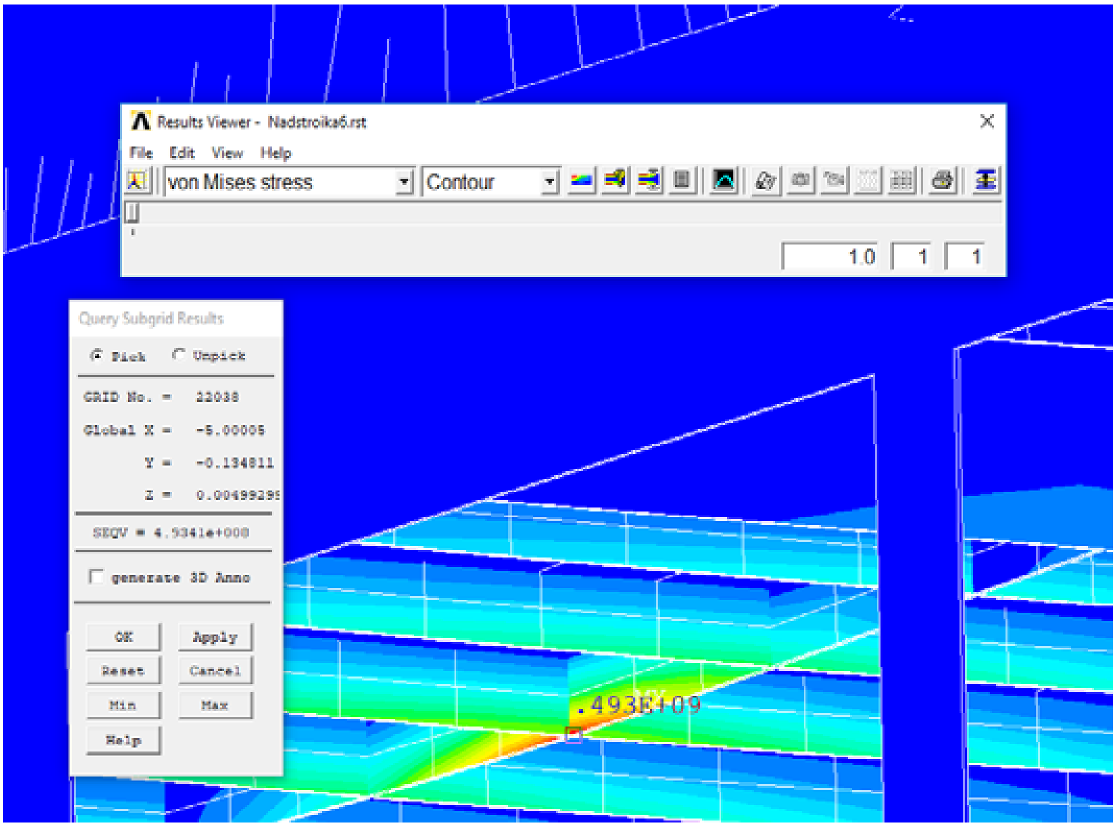

Fig. 6. The stress distribution in deck longitudinal

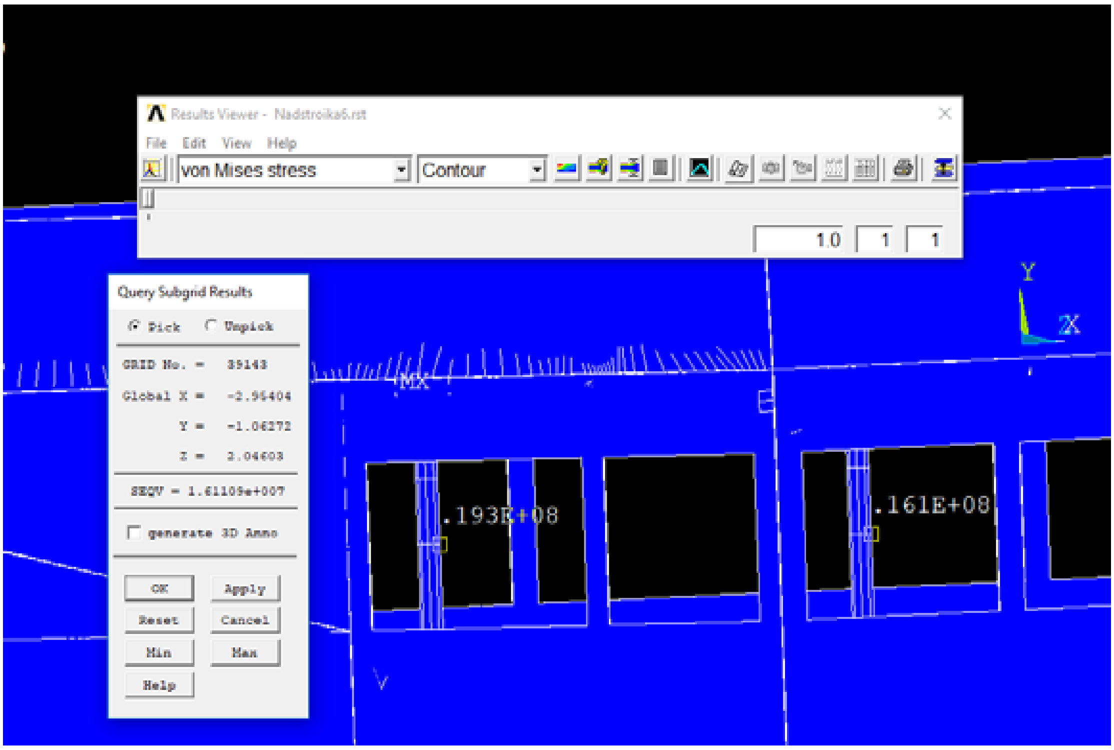

Fig. 7. Maximum stressies in pillars

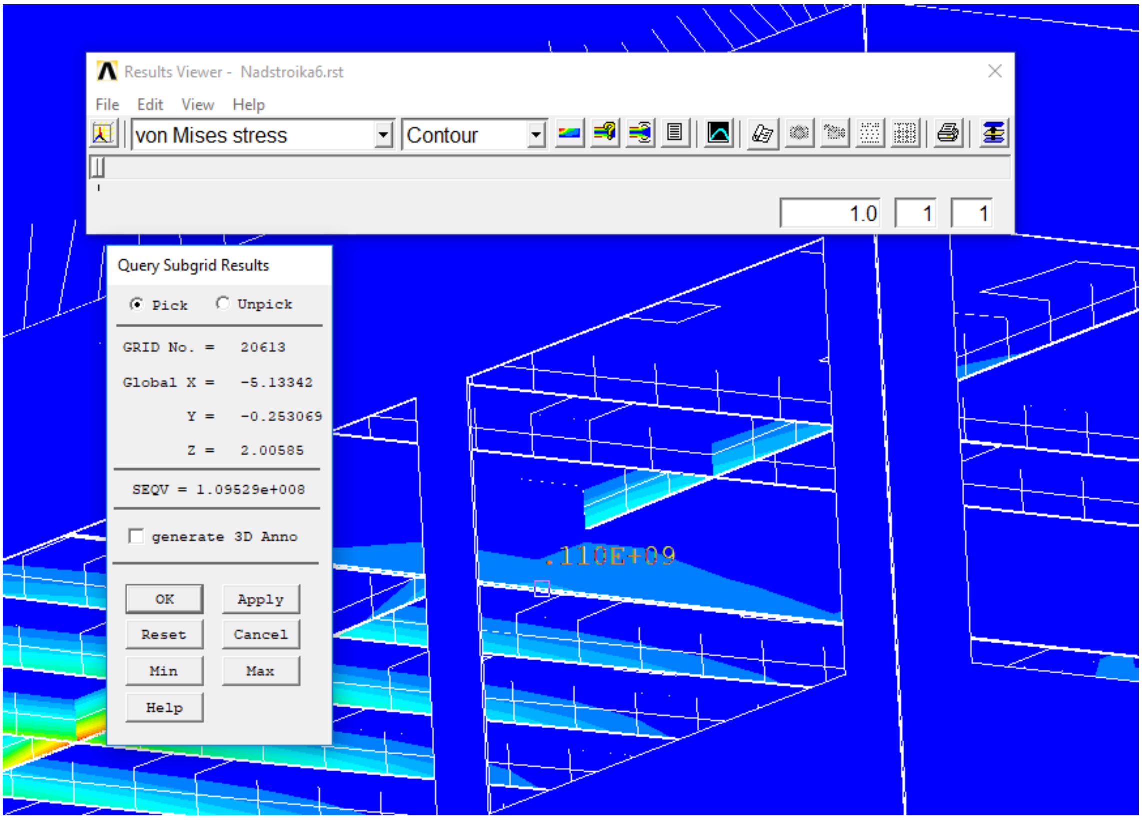

Fig. 8. The stress distribution in a deck beam under helicopter wheel

Another method to improve the neutral axis position for platform construction elements is to use a perforated plates when the platform watertightness is not required. Except it the friction coefficient for platform when helicopter take off and landing will be increased and weight economy M for plates will be:

$$M = 0.785\ S\ n\ d^2\ s\ p\ (\text{ton})$$

Where S – is a platform area, m^2

n – is a number of perforated holes per square metre

d – perforated hole diameter, m

s – plates thickness, m

p – specific gravity of construction material, t/m^3

Today there is possible to investigate the existing vessels hatch covers and upper deck location (for bulk carriers, oil tankers and others) to use them for helicopter technologies for sure taking in to account FATO and TLOF requirements.

Conclusion. Due to results analysis it was confirmed the ability of platforms with a typical vessel construction principles to use a helicopter technology and ways to minimize the weight of construction.

There was underlined a necessity to certify all helicopter decks, platforms and even transport vessels hatch covers in accordance with there maximum possible load (helicopter weight) when FATO and TLOF requirements are satisfied.

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