



A technical update on the new Panama Canal locks upon opening

New Panama Canal inauguration

The Panama Canal opens the new expanded canal and the new massive locks allows transiting of gigantic ships like container ships of 366m or tankers as large as VLCC or Cape size bulkers, with maximum breadth of 49.0m.

The US\$5.4 billions effort to expand the 102-year old canal took nearly 10 years and the efforts from 40,000 engineers, personnel and workers to complete this quicker path between the Atlantic and Pacific Oceans.

Undoubtedly, the neighbouring countries will race in the next years to prepare port facilities for accommodating these giants of the seas who will visit very often now their areas!

The history of the Panama Canal, an *isthmus* or a shortcut between Atlantic and Pacific Oceans, travels back, at least in the 1500s, however only in 1913, while technological advantages and commercial environment allowed the construction of the first passage, known today as "Panama Canal"! This viable commercial venture for the shipping was in need of expansion, as the ships size growing and in 2007 the Panama Canal expansion project began!

The new Panama Canal locks have been inaugurated and opened to shipping on 26 June 2016, allowing large ships of up to 366m

Definitions

- Neopanamax ship

Neopanamax is a ship with dimensions greater than Panamax or Panamax Plus that comply with the size and draft limitations of the new locks, which are:

- max length 366.0m.
- max breadth 49.0m.
- max draft (fresh water) 15.2m.

- Panamax ship

Panamax ships are all ships that comply with the size and draft limitations of the existing (old) locks; namely, length 294.13m by 32.31m in breadth by 12.04 fresh water draft.

- Panamax Plus ship

Panamax Plus are all Panamax ships authorised for fresh water draft greater than 12.04m up to 15.2m and approved for transit in the new locks.



The enormous Chinese container ship MV COSCO SHIPPING PANAMA (IMO 9732606) of 300x48.25m was the first ship clearing the new Panama Canal, seen in the picture at new Aqua Clara lock, amid celebrations and fireworks. Note that at the new locks there are no locomotives, like the old passage and the ship is moved with her own power and the assisting tugs.

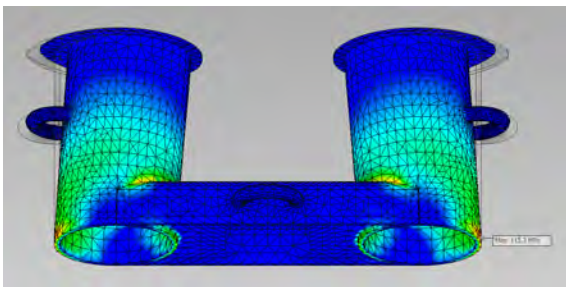
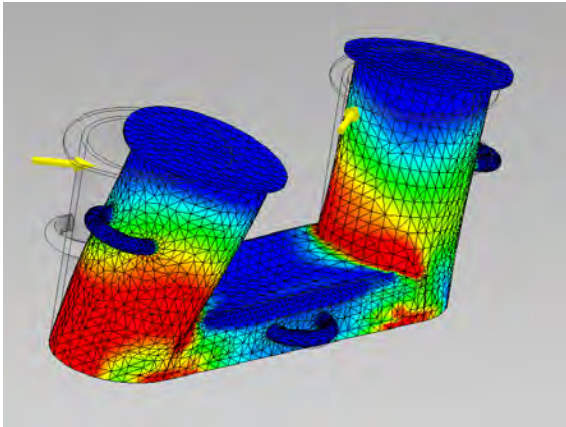
Photo Getty Images

length and up to 49m breadth to transit at a safe fresh water draft of 15.20m. Through the new canal large and very large container ships, Aframax or Suezmax tankers or ships with breadth greater of 32.31m can easily now be transiting, while older Panamax size ships having draft deeper than the maximum one of the older Panama Canal (TFW 12.04m) can now feel the waters of the new locks at Aqua Clara and Cocoli, close to Atlantic and Pacific sides respectively.



Issues with the mooring items

We would like to share with the shipping technical people and readers some issues, quite significant some times, as for the design, fabrication, certification and installation of various mooring items, including double bollards, chocks and stand rollers. Although the stand rollers are also mooring items that strongly affected by the new Panama Canal requirements, in this Technical News flyer we shall stand at bollards and chocks.



In the screenshots a typical double bollard of dia500mm is seen, as it has been loaded with various loads. The bollard is of the Norwegian Standards and the mesh produced in the finite elements strength evaluation is very tight, so any stress fluctuation can be easily discerned. The analysis is performed with the assistance of FEMAP and NX-Nastran, which that is a great tool for the engineers of STUDIO NAVALE, who are dealing with the strength calculation of the relevant items. STUDIO NAVALE is one of the very limited authorised users of this high-end software.

Bollards requirements: design, fabrication and installation

It is already broadly known that all ships wishing to transit the new locks of Panama Canal, will be required to have closed chocks and double bollards, additionally of the existing mooring parts, at distinctive locations, with strength 64TN for mooring and 90TN for towing. The requirement is for one mooring rope belayed in figure-of-eight or one towing rope, in eye-loop on one post, respectively for the mooring and towing bollards.

Existing chocks and bollards can also be utilised, should their strength capacity is the minimum required, however they must be located at specific, predetermined locations along the Neopanamax and Panamax Plus ships decks.

Unfortunately, the bollards and chocks design standards are different from country to country or shipyard to shipyard and several questions raised during the preparation of the Mooring Arrangement drawings for ACP. The thinks are getting worsen while the



In the picture a group of bollards during the fabrication at one of our affiliate workshops. The specific bollards were fitted on board the MT CAPE BONNY (IMO 9293131) of Columbia Shipmanagement (Deutschland) GmbH, during her dry docking time in Croatia.

certificates of the mooring items are not available or the mooring staff is significantly diminished in terms of nominated SWL or no relevant information are disclosed.

It has been noticed, in several cases, that some makers, for the same required SWL, follow one standard and others another standard, sometimes in great technical contradiction between them, which, nevertheless, addresses to a certification of quite similar products.



In the picture the foundation details of a bollard SWL=90TN, which was designed and fabricated against the Japanese standard. The design work was prepared by STUDIO NAVALE and both design and fabrication were approved by a major classification society.

Needless to point out that the majority of the standards have been issued some decades ago and there are no nowadays updates.

It is not the aim of this Technical News to deploy the available standards for the mooring bollards or the differences in details; however, STUDIO NAVALE technical team will always be available to respond to any relevant queries.

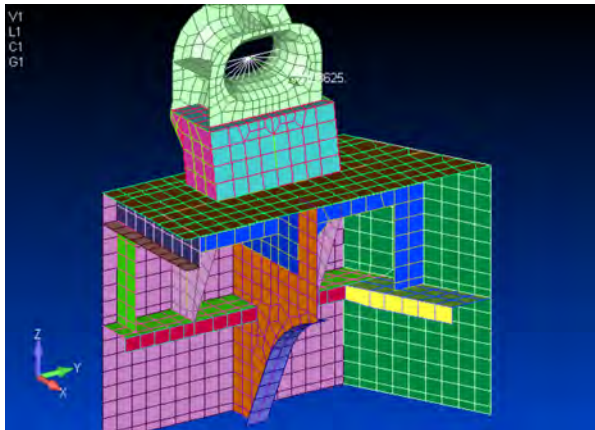
Apart from the theoretical approach of the structures, at STUDIO NAVALE we have developed, fabricated and installed on behalf of our Clients several bollards of both sizes of 64TN and 90TN. During the strength evaluation of the bollards, we discovered the weak points or positive points of each bollards standard and, based on a tailor-made proposal for each ship, we have the capacity to consult our Clients accordingly, so to achieve the best and more effective solution.

As an example, we mention double bollards, fabricated with posts of dia508x25mm (namely diameter and wall thickness of each post) weighted 723Kg, with the one standard to allow it to withstand, say, 51TN in mooring with two ropes or 130TN when towing and the other to allow for a fabrication with posts of dia508x20mm to be certified for 46TN, with no indication whether this is a safe load with one, two or how-many ropes! Another example may be a bollard fabricated with posts dia350mm, weighted 275Kg, certified to withstand 75TN in mooring or 146TN in towing! Note the weight difference ratio, being in the vicinity of 2.6!

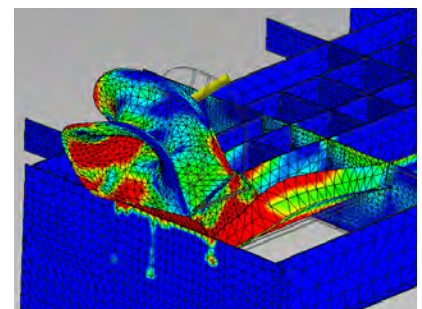
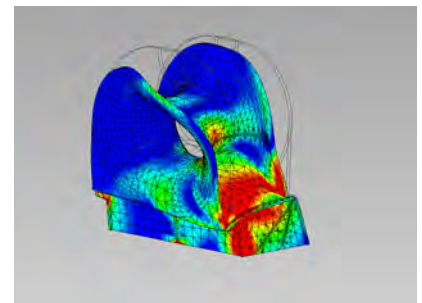
Apparently, there are differences of the design and materials and in the fields of SWL nomination, loading cases and relevant calculations; which differences in fact are not known or clear, offering many queries when the time of choosing mooring bollards closes.

At STUDIO NAVALE we have carried out many, in-depth, strength calculations, based on the various bollards available standards that leads us to acquisition of a very clear view of their capabilities and concrete opinion about each of

them. Based on this knowledge at STUDIO NAVALE we offer a tailor-made proposal for each ship and mooring items configuration.



A screenshot from the modelling of a new chock installation, of SWL=90TN, during the analysis in the FEMAP environment. The imperative modelling, simulation and review of the performance of the structure, under any loadings and conditions, makes this software the STUDIO NAVALE's cornerstone tool for resolving complicated problems, like the one seen.

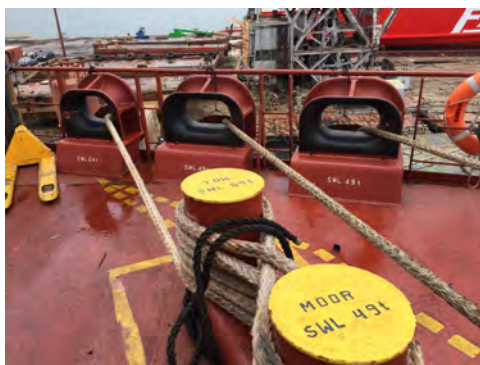


View of a chock located at the transom of a ship, under stress generated from a towing wire of 90TN. With the assistance of high-end finite element software the under deck structure can be optimised, resulting only to the absolute necessary additional strengthening.

Mooring chocks requirement, design, fabrication and installation

The primal requirement of new Panama Canal Authorities comes with the location of mooring and towing chocks, therefore appropriate locations should be determined on the main deck (and on the fo'c'sle and poop decks,

depending upon the ship's design), which will satisfy the requirements of mooring and towing necessities in the new Panama Canal locks. All chocks must be of closed type, with minimum throat opening 900cm² for all Panamax Plus and Neopanamax ships, appropriately certified.



Typical engraving of different SWL for mooring and towing on the same bollard and chocks. In the picture the SWL(MOOR)=49 TN and SWL(TOW)=64TN, apparently NOT accepted for this ship's transit in the new Panama Canal locks.

A very crucial difference between the old operation and new one in the Panama Canal, is the fact that the ship now moves in the locks with her own power and assistance by two tugs, one fore and one aft.

The locomotives of the old Panama Canal will not be required and are only used in the old, existing locks.

More, during mooring in the locks, each mooring rope is always connected to the drum of the winch and handled as such. Mooring bollards are utilised in a way of a sudden emergency (e.g. winches with no power). Also, the rollers and roller chocks are now not accepted (except for some distinctive cases) and therefore additional, closed, double chocks must be installed.

Apparently, the above reasons are enough for understanding that even a Panamax Plus ship that was in compliance with the old canal regulations, should now be treated as a Neopanamax!

The new Panama Canal with a capacity to triplicate not only the number of the ships transiting, but also the size of the ships (e.g. from a container ship of 5,000TEU to same of 14,000TEU or from a Panamax tanker to a Suezmax with breadth in vicinity of 49m), a new commercial word will soon emerge!



The engineers of STUDIO NAVALE work equally convenient at office or on board the ship. In the picture Alex Kouros, the General Manager of STUDIO NAVALE, during inspection of under deck strengthening structure of a bollard (this is onboard a Suezmax tanker, while she was undertaking repairs at Lisnave Shipyard of Portugal).

At STUDIO NAVALE we have the capability to prove the actual strength of each chock by using our technical expertise, knowledge and experience in the finite elements software FEMAP and the solver NX-Nastran. However, because of the low price of the items in the Far East market and the quite high plan approval fees, for finite element studies, we only rarely suggest to our Clients this method, unless the replacements hit a quite significant budget.

Technical support by STUDIO NAVALE

At STUDIO NAVALE we have an extensive experience in dealing with the requirements of Panama Canal new locks, working on them for some years now. A number of works have **already** been carried out, approved by all involved parties. The services provision of STUDIO NAVALE are governed by a certified by LRQA quality assurance against the standard ISO9000.

In the past we have dealt extensively with re-arrangements of mooring equipment, installations of strong points, reinforcement of diminished mooring areas and more, preparing solutions against various regulations and needs.

Just to underline that some of the Suezmax tankers are now fitted with SPM and chocks of SWL=350TN in replacement of existing smaller, which applies enormous stresses in way of the deck and bulwark of fo'c'sle area, especially when two chains are to be deployed to the single mooring buoy. With the use of high-end finite elements

software, like FEMAP and NX-Nastran, we could determine not only the required strengthening in a case like this, but also the critical points of the structure, making the steel distribution much more efficacious.

Our services include preparation of the preliminary arrangement of the mooring equipment, seeking approval from Panama Canal Authorities and thereafter preparation of all relevant drawings and documents for the modification or installation of new chocks and/or bitts and other required items.

The assessment against the Panama Canal Authorities requirements is not limited to the mooring items, it is extended in the navigation bridge, installation of bridge wing shelters, visibility calculations and more.

It is strongly proposed, as a first step, an assessment of the current condition of the ship and preparation of a proposal for the necessary modifications or new installations and associated hull strengthening.

Studio Navale...

... has been established in 1987 in Piraeus, by the Naval Architect and Marine Engineer Alex Kouros with the scope of providing the ultimate available level of services, to shipping and industrial Clients.

Studio Navale is now operating from the brand new, ergonomic and well designed premises in the Industrial Park of Schisto, the VIPAS or, in other words, the heart of the shipping and industrial technical businesses of Greece, in the characteristic building of **Turbomed**, just at the entrance of the Park.

Studio Navale negotiates with all kind of ship design, ship construction and ship repairs from the very basics to a turn-key project and assists with tender, production design, operational support scheduling, quality and profitability as well as day-to-day ship management operations.



STUDIO NAVALE is an authorized user of
FEMAP and NX-Nastran

FEMAP is an advanced engineering simulation software program that creates finite element analysis models of complex engineering products and systems, and displays solution results.

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