Panama Canal opens its gates to more and larger vessels

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Panama might not have received good comments lately, but the so-called "Panama Papers" affair should not put shadow on a recent great achievement of this country: the expansion of the Panama Canal. On June 26th 2016, the Panama Canal officially opened to more and larger vessels. This doubled its capacity in terms of cargo shipment and allow the passage of container carriers with nearly three times as many containers aboard.

It is difficult to underestimate the importance of this event or its impact on the economy of many countries. The immediate effect will be bolstering of Panama's economy, the country's position in Latin America and its role as a transit hub in global trade. There is indeed a chance that this will "transform Panama into a First World country", as predicted in 2006 by Martín Torrijos, the former president of the country. Whether this chance will be taken, depends in the first instance on the Panamanian people. History shows cases where increased prosperity stimulated the wellness of nations, but also where it brought stagnation or decay.

But the completion of the "Panama Canal Expansion Project", as the official name goes, will affect more countries, including the world's leading economies. Such a significant capacity increase will encourage the world's shipping lines to reschedule their global routes, send more cargo through the Canal and order the construction of large vessels that make maximal use of the extended dimensions of the new locks. What will certainly happen is the increased flow of goods manufactured in Asia, particularly in China, to the Eastern regions of North and South America and to the Gulf of Mexico. The shipment in opposite direction will probably include increased volumes of American grains, oil and gas products, particularly LNG, and coal. The Panama Canal route will also become more attractive for the European trade with China and the Far East. This will likely cause substantial decrease of cargo going through the Suez Canal, particularly in the shipments into and from the North European countries.

It goes without saying that the condition of global economy, possible political tensions and other factors will also play part in these developments. One must not forget, however, that the time span of such factors usually varies from a few years to two or three decades, while the impact of the Panama Canal expansion will last for ages. Therefore, there is every reason to thoroughly study and anticipate the effects of this great project.

The author of this article was a member of the Mechanical Engineering Advisory Board (MEAB) for the project on behalf the Canal administration. In this role, he was involved in providing guidance and review during critical phases of the preliminary and final design for the most complex part of the project – the construction of the Third Set of Locks. A general overview of the project objectives, applied solutions and technologies was presented by the author in this magazine two years ago in the Polish language [1]. The current article brings back parts of this publication in English, introduces new material and gives an update on the recent developments.

DOUBLED CAPACITY

As mentioned above, the Panama Canal expansion and the construction of the Third Set of Locks will double the Canal capacity. This will happen in quantitative and qualitative terms, which is a simple consequence of the following:

- Quantitative: The new, third lane of locks enables the locking of ships that carry about the same volume of cargo as the two old lanes put together. Other sections of the Canal have been widened to provide space for more intensive navigation.
- Qualitative: The new lane of locks allows for the locking of lager and deeper going ships than the old locks. The entire Canal route has also been deepened to receive ships of a deeper draught.

This means that the entire demand of vessels intending to pass the Canal will not only come from their large numbers that now wait for their turn at both entrances to the Canal. The ex-

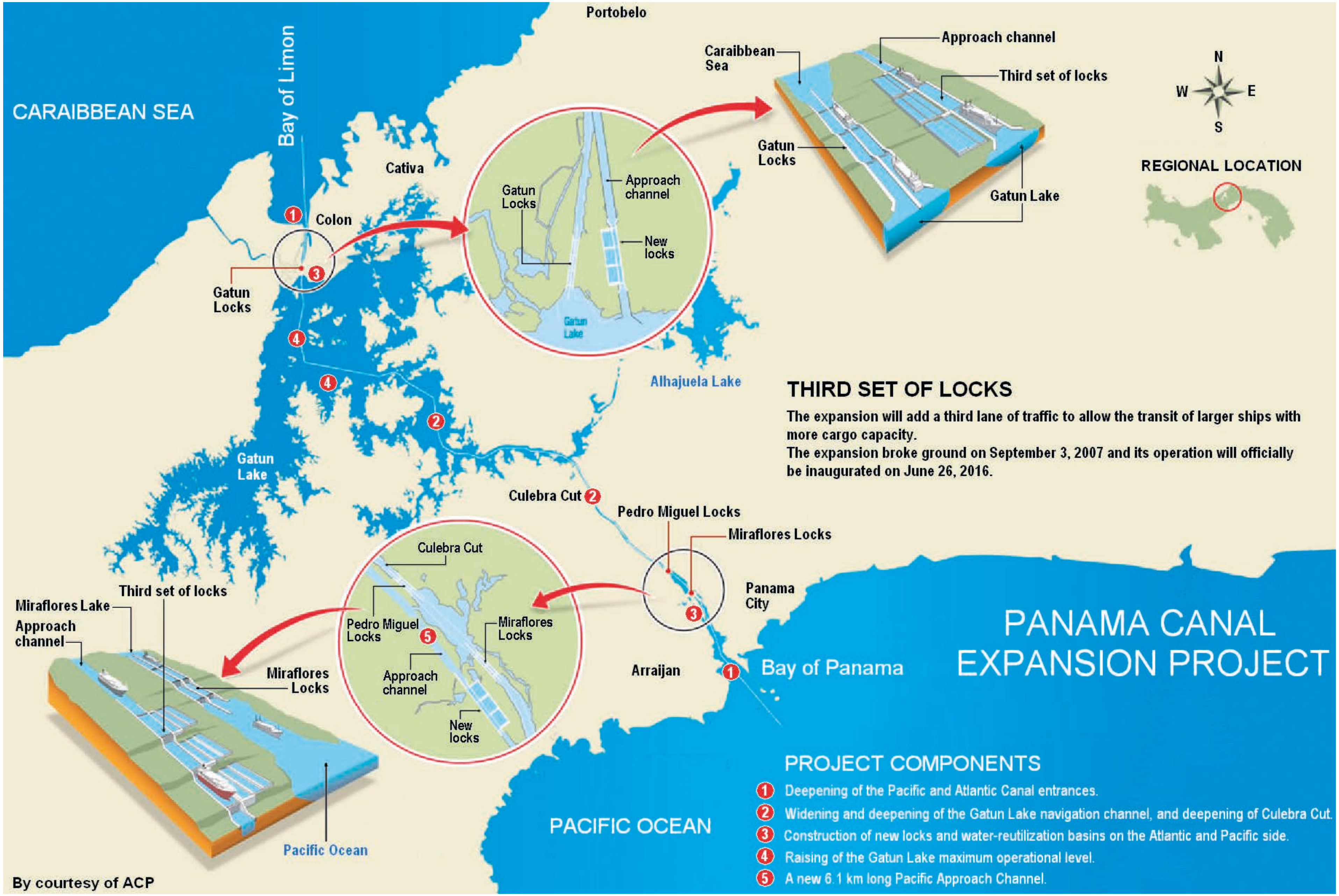

Fig. 1. Map of the Panama Canal Expansion Project

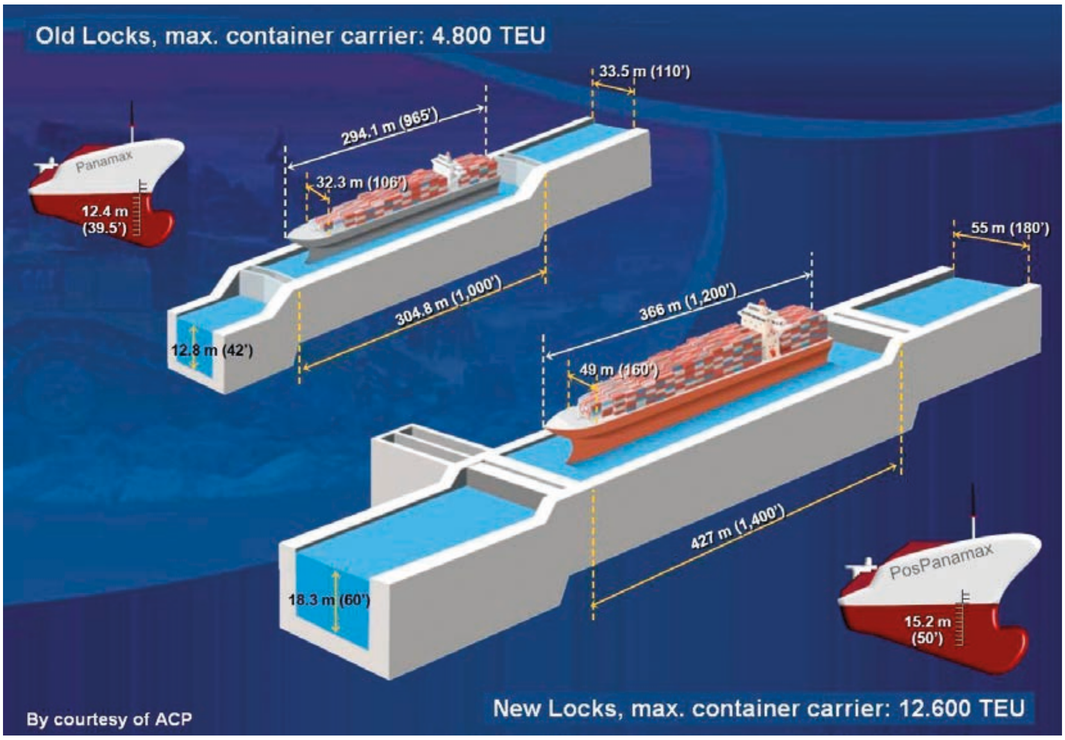

Fig. 2. Navigable dimensions of the old and new locks

panded passage will attract new, larger vessels. This is one of the reasons why the Canal administrator, public company Autoridad del Canal de Panamá (ACP), in English "Panama Canal Authority", does not worry much about the risk of lower navigation rates in the future. Having said that, one must admit that such a risk begins to emerge in recent years, but for a different reason. Most IMiG readers have certainly followed news about the Nicaragua Grand Canal project that is supposed to enter the construction stage later this year. At the time of writing this article, opinions about the feasibility of that project are still divided. Nonetheless, the financing seems secured, the contracts have been signed and there is little doubt that the work will begin as scheduled. The planned completion date in 2020 does not look realistic, but when completed the Nicaragua Canal can gradually become a serious competitor for the Panama Canal. The ACP is aware of this.

For the time being, the ACP prognoses of doubled ship demand date from 2006 and do not include the possible effect of the Nicaragua Canal construction. Since *SS Ancon*, the first ship that entered the Canal, actually passed it on August 15, 1914, nearly one and half million ships have done the same. The approximate number of vessels that go through the Canal ever since exceeds 14,000 a year; about 13,000 of which are the ocean-going commercial vessels. Based on historical studies, the ACP assumed a 3% annual growth of ship demand after 2006, which resulted in an annual rate of 19,600 ships in 2025 [2].

The main works that constitute the Panama Canal Expansion Project are indicated on the global Canal map in Fig. 1. Information in this figure is based on the data by ACP [3] and represents a slightly actualised situation shortly after the public announcement of the opening to navigation on June 26, 2016. The works mentioned in Fig. 1 are discussed in more detail further in this article.

As this figure shows, the most crucial part of the project is the construction of new navigation locks on both the Pacific and Atlantic side. After all, it was the existing locks that formed the bottleneck of the Canal and caused long queues of ships waiting at both entrances, the Bay of Panama and the Bay of Limon. The total cost of the project, as of today, is $ 5.25 billions, of which about $ 3.2 billions (61%) is the cost of the new lock sites. The navigational parameters of these locks are presented in Fig. 2, along with those of the old locks. Most convincing for the world's shipping lines will probably be the cargo volume increase of a single vessel. The ratio of this increase is for container carriers 2.6. The relations for bulk carriers and other vessels are similar. This is a tremendous improvement and extension of the current limits. The world's leading shipyards have been receiving increasing number of orders for vessels of the

Fig. 3: Container carriers with Asian goods in the Miraflores Locks (photo La Ruta/ACP)

so-called Post-Panamax (Pospanamax in Spanish) dimensions since a number of years already.

The term “Post-Panamax” has not, incidentally, been introduced, neither it is appreciated by the project organisation. Panamanians and other parties involved speak preferably of “New Panamax” or “Neopanamax”, the terms that sound better and evoke associations with the future rather than with the past. Whether these terms will win in a long term, remains to be seen. Anyhow, the demand for the new panamax standard is clear and the place where it is best visible is not the study reports or statistics but the operating old locks (Fig. 3).

WIDENING AND DEEPENING

The construction of the new locks marks the completion of the Panama Canal Expansion project, but it has not marked its beginning. Long before the works on the locks started, other activities had been carried on. These were, in the first instance, dredging and excavation works. Their beginning can be placed in September 2009 when the Belgian dredging company, Jan de Nul NV was awarded a contract to dredge about 15 million m^3 from the Atlantic entrance to the Canal. This and other contracts that followed resulted in a total volume of removed soil and rocks equalling about 135 million m^3. This figure includes all: dredged material, soil excavated on land and removed rock material.

Fig. 4. Backhoe dredger Rialto M. Christensen at work in Culebra Cut (photo P. Meesen)

Fig. 5. Excavations in the neighbourhood of operating Pedro Miguel Locks (photo author)

The latter comprised large volumes of basalt in various formations and some softer rocks of lower density locally known as the Pedro Miguel formation. Both of them required drilling and blasting prior to excavation. The applied explosives were so-called emulsion cartridges, specifically designed for seismic exploration. The cartridges, 92 mm in diameter and 400 mm long, were placed in boreholes of average depth 14.8 m. Technologies and parameters of the applied blasts are described in [4] and do not need to be discussed here. It should, however, be noted that this excavation method could not be used without restrictions. Its application was not permitted in the neighbourhood of Centennial Bridge, other structures, residential areas, at the distance of less that 450 m from passing ships, in weekends, evenings etc. This required narrow coordination on daily basis with many parties involved. The rock material crushed by detonations could, obviously, not be dredged out using the methods for sandy bottoms, like the “rainbowing”. Heavy, so-called “backhoe dredgers” needed to be used (Fig. 4).

To the most complex parts of the excavations belonged the sections of the so-called Culebra Cut, new Pacific Locks and their Approach Channel (all marked on Fig. 1). These were not only sections with a high presence of basalt formations, but they additionally ran at a close distance to the operating Canal, including the Miraflores Locks and Pedro Miguel Locks. To make things more challenging still, the new canal section from the Pacific locks to the vicinity of old Pedro Miguel Locks was laid on a 9 m higher water level then the neighbouring old canal. This resulted from the decision to accommodate the entire lift in single lock sites at both entrances, while the old canal has two lock sites at the Pacific entrance, see the project component no. 5 on the map in Fig. 1. This unconventional solution puts substantial water pressure on the narrow embankment between both canals. The geological conditions allow, apparently, for such a step despite the seismic activity of the area.

Fig. 5 gives an impression how complex the excavations were in the discussed canal sections. The pictured area is located near the Pedro Miguel Locks southern entrance. Visible are both basalt and softer excavated material, the first already crushed by preceding explosions. The neighbouring old canal bedding and the on-going navigation through the locks required very intensive coordination and monitoring of all works. Excavation conditions at other locations, particularly in the neighbourhood of other operating locks, were no less complex.

MASSIVE STRUCTURES

Once the necessary dredging and excavations were completed, the construction of new locks could begin. The massive structures that make parts of these locks can be divided in a number of system components, in accordance with the method of “systems engineering”. Such a global division has already been

Table 1. Principal partial functions and performing them system components in the massive structures of navigation locks

No.	Partial functions		System components
1	Safe and facile guidance to vessels into and out of the lock	➡	Lead-in and waiting berths and guide walls of the lock
2	Accommodation of vessels during locking, transfer of lateral loads	➡	Lock chambers (principally walls and bottom slabs)
3	Accommodation of gates and transfer of their hydrostatic loads	➡	Lock crowns (heads)*, including gate recesses
4	Providing desired water flows while filling and emptying the lock	➡	Culverts, their in- and outlets and water saving basins

*/ Both terms are in use. In this article, the term “lock crowns” will further be used.

Fig. 6: General layout of new locks on the Pacific side

presented by the author in an earlier article about this project [1] in the Polish language. For the sake of completeness, it is also repeated here (Table 1). Note that the method of systems engineering lays direct links between the major system components and their so-called partial functions. Such a design approach usually represents a standard in large infrastructure projects of today.

As discussed in [1], the performed studies resulted in the choice of a three-chamber system for the new locks at both the Pacific and the Atlantic side. This means that the ships heading for the new lane of locks will undergo a three-step lifting when entering the Canal, and a three-step lowering when leaving it. This arrangement is principally the same as on the old locks, apart from dropping the idea of two lock sites at the Pacific side. A three-step lifting and lowering gives the best-balanced solution in terms of construction costs, environmental aspects (saving of fresh water), locking time and other criteria. The readers interested in the methodology of such analyses will find proper guidance in [5] and [6]. In order to further minimize the loss of fresh water, both lock sites are provided with so-called water saving basins. The operation of these basins has also been discussed earlier in our magazine [1].

Another choice that to large extend determined the scope of massive structures was that for rolling gates. It had a tremendous impact on the layout of both lock sites and spatial planning in the area. For example, the location of water saving basins between the gate recesses was then a self-evident choice. A decision to construct double closures by rolling gates at each crown of all lock chambers completed the spatial boundary conditions for massive structures. The general site arrangement of the Pacific locks is shown in Fig. 6. The arrangement of locks on the Atlantic side is nearly identical.

The geological conditions allowed for the construction of lock chambers on floor slabs laid directly in natural soil and rock beddings. The foundation conditions have extensively been studied taking into account not only the load bearing capacity of these beddings, but also the seismic activity of rock masses. There was one active and a number of inactive tectonic faults in the area of locks on the Pacific side. On the Atlantic side, only a few inactive tectonic faults were present [7]. Detailed presentation of other geological conditions, conducted testing and investigations goes beyond the scope of this article. The fact is that the total number of boreholes exceeded 2,000 and their summed length was about 70,000 m, which gives an impression of the performed investigations.

The designed shapes of principal massive structures that make part of both new lock sites are presented In Fig. 7. Drawings (a) and (b) show global 3D views of, respectively, the bottom slab and complete chamber section. Drawing (c) presents a cross-section of the chamber wall. Note that the designers

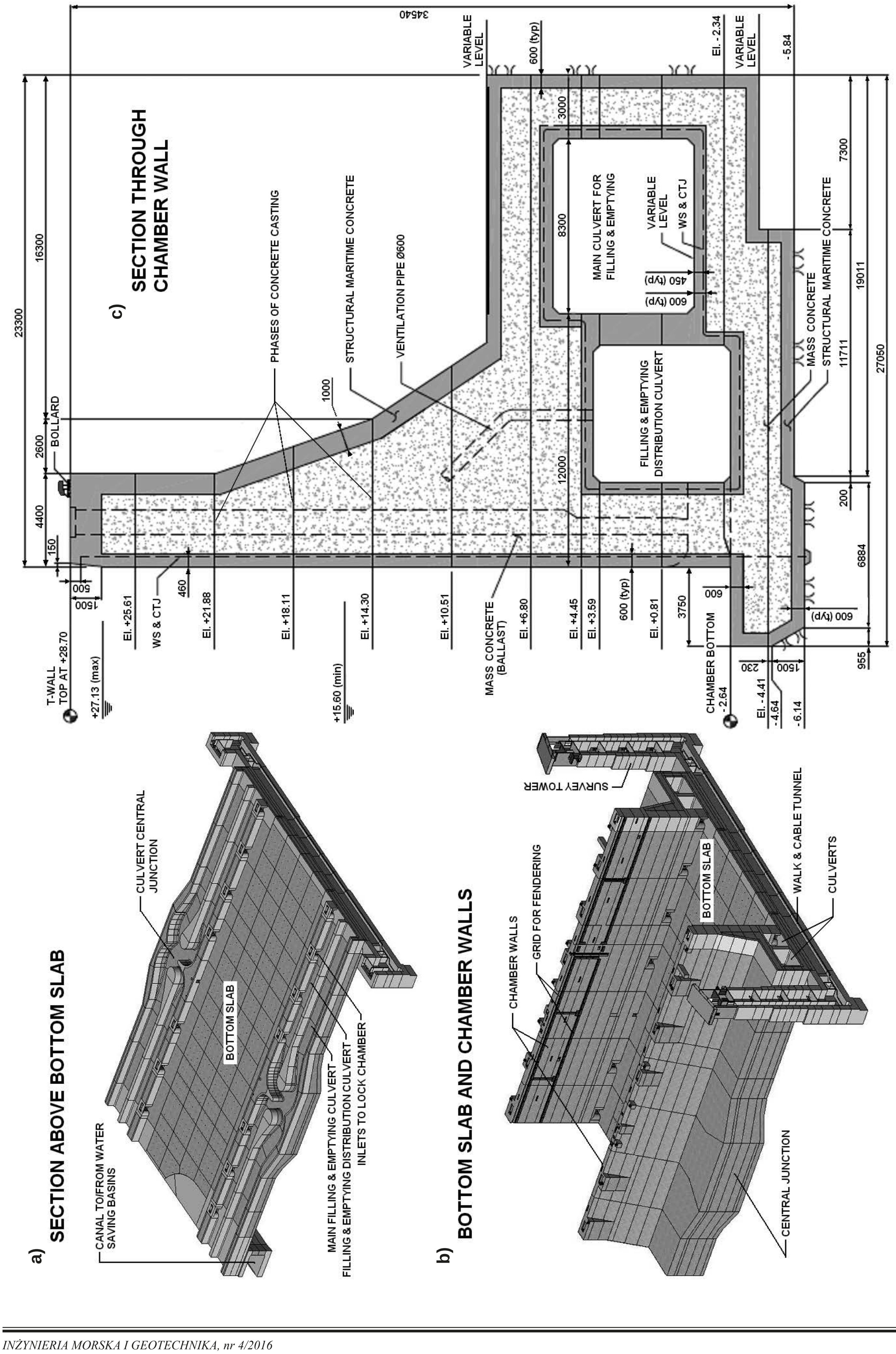

Fig. 7. Bottom slab and chamber walls of the new locks

applied large degree of integration between diverse partial functions in these structures. For example, the base structures of all lock chamber walls also accommodate filling and emptying culverts of the lock. Such a design strategy is undoubtedly clever and it certainly reduces construction costs, but it also has a shadow side. This side becomes apparent in view of the systems engineering method. After all, the integration of functions also means the integration of their failures. In this particular example, a structural failure of the main culvert might affect the stability of the entire chamber wall. Naturally, these remarks are purely theoretical. The author of this article has no intention to question the civil engineering solutions applied in this project.

As indicated in Fig. 7, concrete applied in the construction of the lock massive structures was basically of two following qualities:

- Structural Marine Concrete, according to ACI specifications [8] and [10].
- Interior Mass Concrete, according to ACI specifications [9].

The ACI specifications quoted above are sometimes (unfortunately not always) available on the Internet at the addresses given in the references to this article.

Additionally, the ACP made some restrictions and, on the other side, encouragements in the contract. The restrictions concerned, among other things, the design service life of 100 years for all concrete structures, the minimum 75 mm concrete coating of all reinforcement, and the maximum water-cementitious material ratio of 0.40. The encouragements concerned the use of fly ash and granulated blast-furnace slag in the mixture, as well as other measures that could dissipate the hydration heat and give concrete time for curing and strength gaining.

The dissipation of hydration heat while casting large concrete structures is a very important issue. This issue is related to a rather dramatic experience in my professional carrier, therefore I like to make a note of it: One of the first projects that I was involved in was a foundation casting for the Blast Furnace No. 1 of the "Huta Katowice" Steel Works in Poland in 1974. This is probably the largest compact concrete structure ever cast in Poland (Fig. 8a). I was a young engineer then and the management of the project was in hands of my older colleagues. Since there was little experience with handling the hydration heat of castings that large, inadequate measures were taken to control the phenomenon. As a result, that fresh concrete "cooked", to use the words of eyewitnesses. By pulling out all the stops, we managed to finish the casting of concrete and the blast furnace, probably the largest in Europe, successfully operates today still, but it was a hard-learned lesson.

An example of successful hydration heat control was the project of so-called "Naviduct" (lock on an aqueduct) in Enkhuizen, Netherlands [11, 12]. The challenge was how to dissipate the hydration heat not only for the sake of strong, well-cured concrete of wall pillars, but also in order to limit the thermal expansion and subsequent shrinkage that would have cracked the earlier constructed floor structure. The solution was an application of a piping system running in a serpentine fashion along the rebars in the casting form. The system was fed with cooling (later also with heating) water at the bottom of the wall pillar (Fig. 8b). This allowed the control of concrete temperature in all stages of casting and subsequent curing.

The designers of the Panama Canal new locks did not use such heat control methods. Instead, they maximized the control of hydration heat by proper mix design, use of additives and, to some extent, temperature control of both the ingredients and mixture. The application ways of fresh concrete largely depended of the accessibility of destinations. They included nearly all known means of concrete transport. The photographs in Fig. 9 give a global impression of the beginning and end of concrete casting in the sections of the new lock chambers.

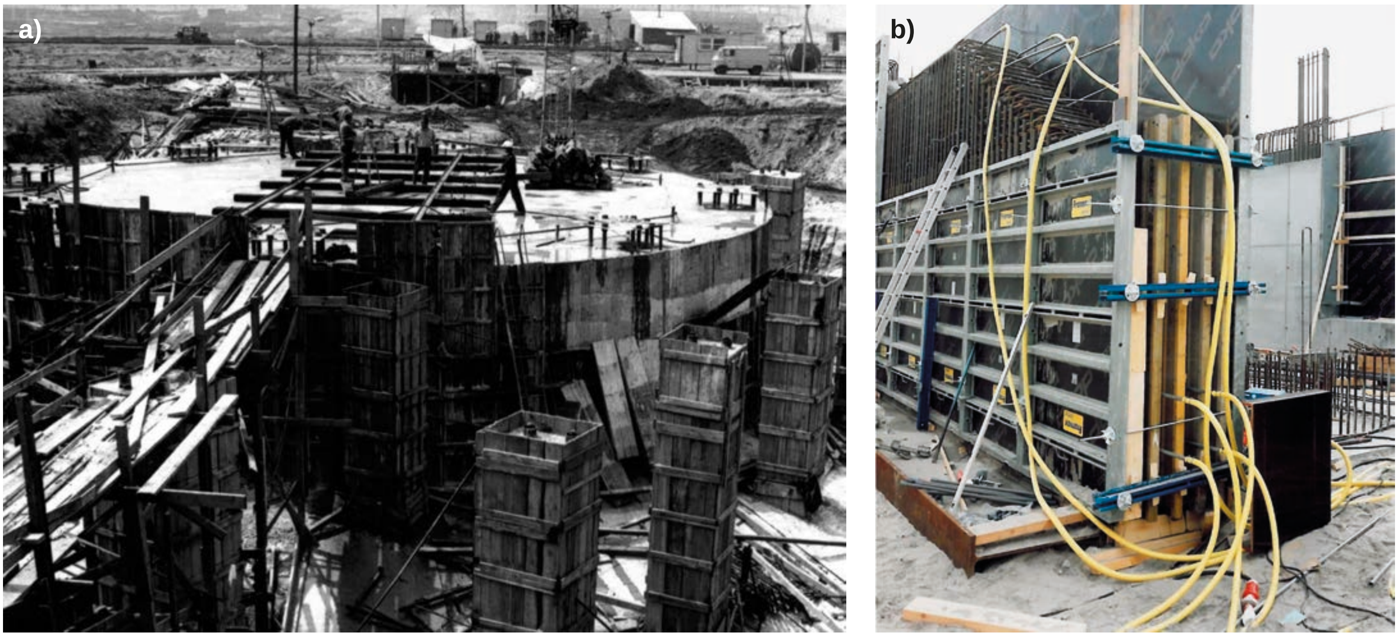

Fig. 8: Two structures that experienced hydration heat problem
a) foundation of Blast Furnace No. 1 in "Huta Katowice" Steel Works, Poland; b) wall pillars of Naviduct Enkhuizen, Netherlands (photos author)

Fig. 9. Beginning and end of concrete casting in sections of the new locks (photos author)

Note that the construction of the lock bottom slab did not present a significant problem. As already discussed, favourable soil conditions, rocky bedding in particular, allowed for a direct foundation. After completing the necessary excavations and bringing an equalizing layer of gravel, it was enough to lay a relatively light floor slab of reinforced concrete. More challenging was the construction of chamber walls, filling and emptying culverts and the gate recesses. The walls were cast in sliding forms, in stages as shown in Fig. 7c. Top levels of subsequent concrete casting that are indicated in that figure coincided with the shifting of casting forms, which can still be traced on the photo in Fig. 9. The inclined rear surface of the chamber walls and the split between structural and mass concrete made, however, the use of sliding forms relatively complex.

It can also be observed that the chamber walls were constructed in sections divided by vertical expansion joints. This is a "classical" arrangement that allows the structure to follow some displacements as result of small soil settlements, thermal expansion, long-term shrinkage etc. In case of the Panama Canal locks, the first two factors played a minor role. Expansion joints had, however, another good reason – the seismic activity of the area. Incidentally, it should be pointed out that expansion joints in navigation lock chambers are not any more as obvious as they once used to be. There already exist successful realisations of monolith lock chambers, without expansion joints. Examples can, for example, be found in Germany [13].

The followers of the Panama Canal Expansion project may have noticed that there also was worrying news about it in the media. Some sections of walls and thresholds in the new lock chambers appeared to leak water during testing. The photos that are published on the Internet indicate that the seepage concentrates along the division lines between some subsequent stages of concrete casting. This is a bad news that brings a blow to the hopes and well-earned pride of many people involved in this project. Nonetheless, the identified shortcomings are not irreparable and care has already been taken to correct them. According to Mr. Jorge Quijano, the Canal Authority Administrator, the contractors finished their last works on May 31, including the repair of the seepage; and the expanded Panama Canal opened for navigation as scheduled [14].

LOCK GATES

The choice for rolling gates may be rather obvious when seen from Europe, but it is nearly revolutionary for America. Panama broke in this way with a nearly Pan-American confidence in mitre gates. This was a quite remarkable and open-minded step, considering that the old Panama Canal locks were the country's only navigation locks of significance and they all utilized mitre gates. Also in the United States, the system of mitre gates has generally been considered superior since the replacement of the last rolling gates in the Ohio River locks in the first decades of the 20th century [15].

As shown in Fig. 6, the rolling gates of the new locks have been placed in double sets at each crown of all lock chambers. This configuration follows the European (particularly Belgian) design strategy, in which one gate is seen as operating and the other as redundant. That gate provides a backup in case the first gate fails or needs maintenance. In the Panama Canal locks, this approach is modified insofar that the site personnel will usually operate both gates during the locking procedure. Single gate closures are, in principle, foreseen to accommodate the locking of extreme long vessels, multiple vessels on busy days, and in periods of gate maintenance. This decision results from a risk analysis that takes different failure modes into account, including ship collision on a gate. It is, however, not undisputable and it can be revised in the future if new statistical data allow for other operating regimes.

A general view of the Panama Canal typical rolling gate is given in Fig. 10. The drawings in this figure are based on the original gate design drawings by Iv-Groep BV, a Dutch consulting company that was responsible for the design of lock gates within the organisation of CICP (Consultores Internacionales) of Grupo UPC (Unidos por el Canal), the leading contractor of the project. These design drawings [16, 17] were subject to the review by the author of this article on behalf of the ACP, the project owner.

The rolling gate structural system has already been discussed in this magazine in the Polish language [1]. To sum it up, it can be classified as a version of the so-called "wheelbarrow" system

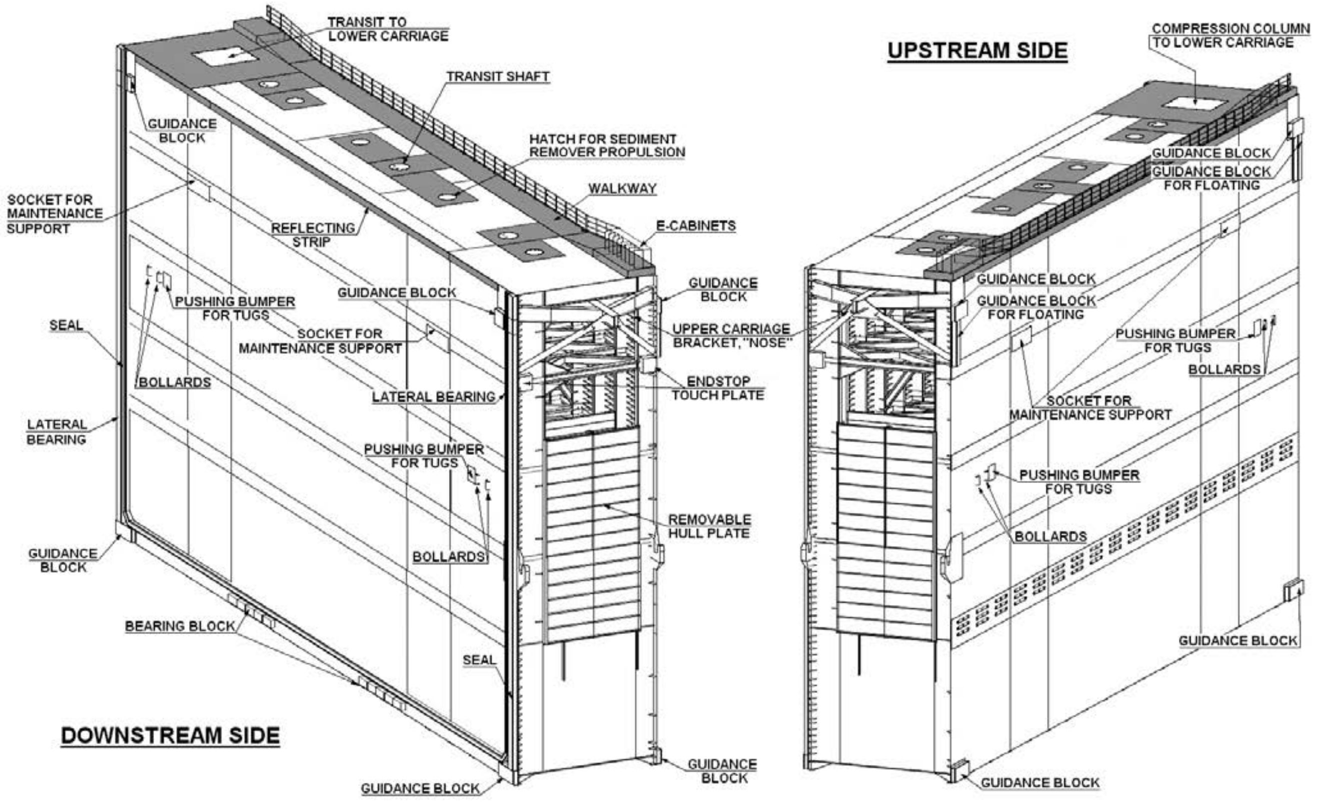

Fig. 10. Rolling gates of the Third Set of Locks in Panama Canal, drawn after [16, 17]

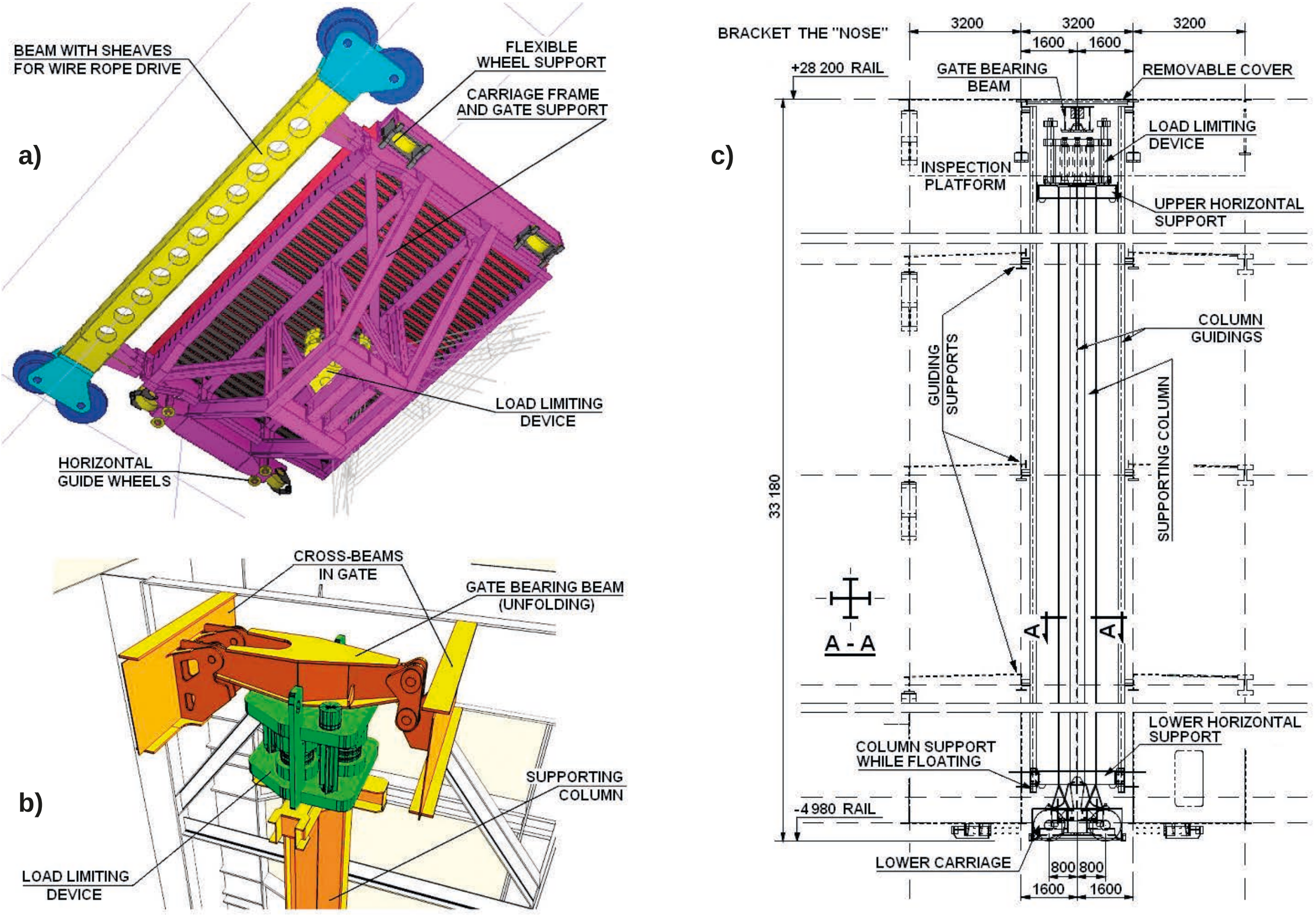

Fig. 11. Details of rolling gate vertical supports drawn after [16], [1]

[17], in which the gate supporting carriages are located diagonally: the front carriage at the bottom and the rear carriage at the top corner of the gate. As a result, the gate also has two rail tracks: a bottom track crossing the lock chamber and a top track with rails high in the gate recess. The "wheelbarrow" and other rolling gate support systems have earlier been presented by the author in this magazine [18] and in the PIANC E-magazine [19].

The designers of the Panama Canal rolling gates brought, however, an important modification to the "wheelbarrow" system. They did not support the front end of the gate directly to the low track carriage, but on a rocking column that runs up to the top girder, where it carries its portion of the gate own weight. To ensure the stability of the system, the column is placed in a shaft with narrow lateral clearances. This looks more complex than a conventional support of the gate bottom corner, but it solves three following problems:

- In combination with the elastic supports on the upper carriage, it allows unrestrained lateral movements of the gate within the size of column clearances.
- It provides space for a load-limiting device atop the column. This device and the large compression length of the column improve the earthquake resilience of the gate.
- It entirely eliminates horizontal lateral loads to the rails of the lower carriage. All such loads are now passed to the gate guides in concrete.

This concise explanation may be easier to follow when looking at the details presented in Fig. 11. Detail (a) shows the rear upper carriage of the gate, seen from underneath. The gate bracket or the "nose" (see also Fig. 10) reaches out into this upper carriage and supports on a load-limiting device. This device enables elastic response to both vertical and horizontal accelerations caused by earthquake, but it also allows the lateral free movements of the gate. It is better visible in detail (b), where it is installed on a supporting column running all the way down to the lower carriage at the other end of the gate. A subassembly of the latter has additionally been shown in drawing (c).

Since the lower carriage and its rail track do not receive any lateral loads in this arrangement, they can now be relatively narrow and light. Another advantage is that an early damage of gate rails and wheels is quite unlikely. Such damages have repeatedly caused serious problems on a number of European locks with rolling gates, recently in the Kaiserschleuse (Emperor's Lock) in Bremerhaven, Germany.

All rolling gates of both lock sites have the same length. Their thickness (depth) does not vary much either, with the exception of the most landward situated gates, that are 2 m narrower. Also the other details are quite similar. What varies is, however, the height of these gates. This results from some small differences between local hydraulic and topographic conditions on the Pacific and Atlantic side. Global dimensions of all gates are given in Table 2 after [20] and [1], along with the numbers and dead weights of gates in particular sizes. The weight data cover only the moving structures of the gates, i.e. excluding guides, rail tracks, maintenance and emergency closures of gate recesses, gate drives and their supports. Yet, the total steel mass of 66 thousands tons was clearly worth competing for.

Table 2: Gates and valves in chambers and culverts of the Panama Canal new locks

Gate type	Number of gates	Gate dimensions $L \times B \times H$ [m]	Single gate mass [tons]
Pacific gates, type PA1	2	57.6 × 8.0 × 22.30	2,410
Pacific gates, type PA2 & PA3	4	57.6 × 10.0 × 31.92	4,245
Pacific gates, type PA4	2	57.6 × 10.0 × 33.04	4,325
Atlantic gates, type AT1	2	57.6 × 8.0 × 22.30	1,920
Atlantic gates, type AT2 & AT3	4	57.6 × 10.0 × 30.19	3,380
Atlantic gates, type AT4	2	57.6 × 10.0 × 29.07	2,950
Total steel mass of lock gates			53,710
Main culvert valves	64 + 2	4.690 × 6.786	15.5
Equalization culvert valves	16 + 2	3.545 × 4.285	6.0
Conduit culvert valves	72 + 2	4.690 × 6.786	15.5
Total steel mass of culvert valves			2,280
Total steel mass of gates and valves			**55,990**

The contract for lock gates was awarded to the Italian company Cimolai S.p.A. in Pordenone near Venice, known in Poland from the construction of the National Stadium in Warsaw. The culvert valves were contracted by the Korean Hyundai concern. When 2 years ago this magazine worked on the first publication about the Panama Canal Expansion project, the last lock gates were still on a barge crossing the Atlantic Ocean on her way to Panama. The gate transport and actual installation have been described in more detail in [1]. These works are and now completed. Also the testing and commissioning have successfully been performed. Fig. 12 presents some illustrations from the last stages of these procedures. The photos were taken in April 2016 by the Belgian expert, dr. Ivar Hermans.

CONCLUDING NOTES

The opening of the Panama Canal Expansion will make news all over the world. Anticipating its course makes little sense because the reader will hardly miss is anyway. What does make sense is to reflect on people for whom this project was the work of their lives. Monumental projects of such a scale and time span make many such people.

To say that people make projects should be a cliché. In case of the Panama Canal Expansion, however, an opposite sentence is also true: Projects make people. This project managed not only to make hundreds if not thousands outstanding specialists all over the world, primarily in Panama itself. It also changed the individuals involved, gave them self-confidence, hardened where a person should be hard and softened where it is good to be soft. Equally precious is a different kind of confidence brought up by this project: the confidence in another man. Most of those who went through it all are now dedicated team workers, often team builders.

Fig. 12. Gates of new Panama Canal Locks during commissioning, photos I. Hermans
a) one gate in closed position, the other in recess, b) gate support on a load limiting device atop of compression column, c) gate in recess, view at front end, note the stiffeners and lateral bearings on the load bearing side, d) rail track of gate lower carriage, see explanation of its narrowness in the text, e) gate recess, rails visible in front, upper carriage in background, f) vertical load bearing wheels and horizontal guiding wheels of upper carriage, g) upper carriage wire rope sheaves for drive connection, h) engines, gear blocks and winch drums of the gate drive system

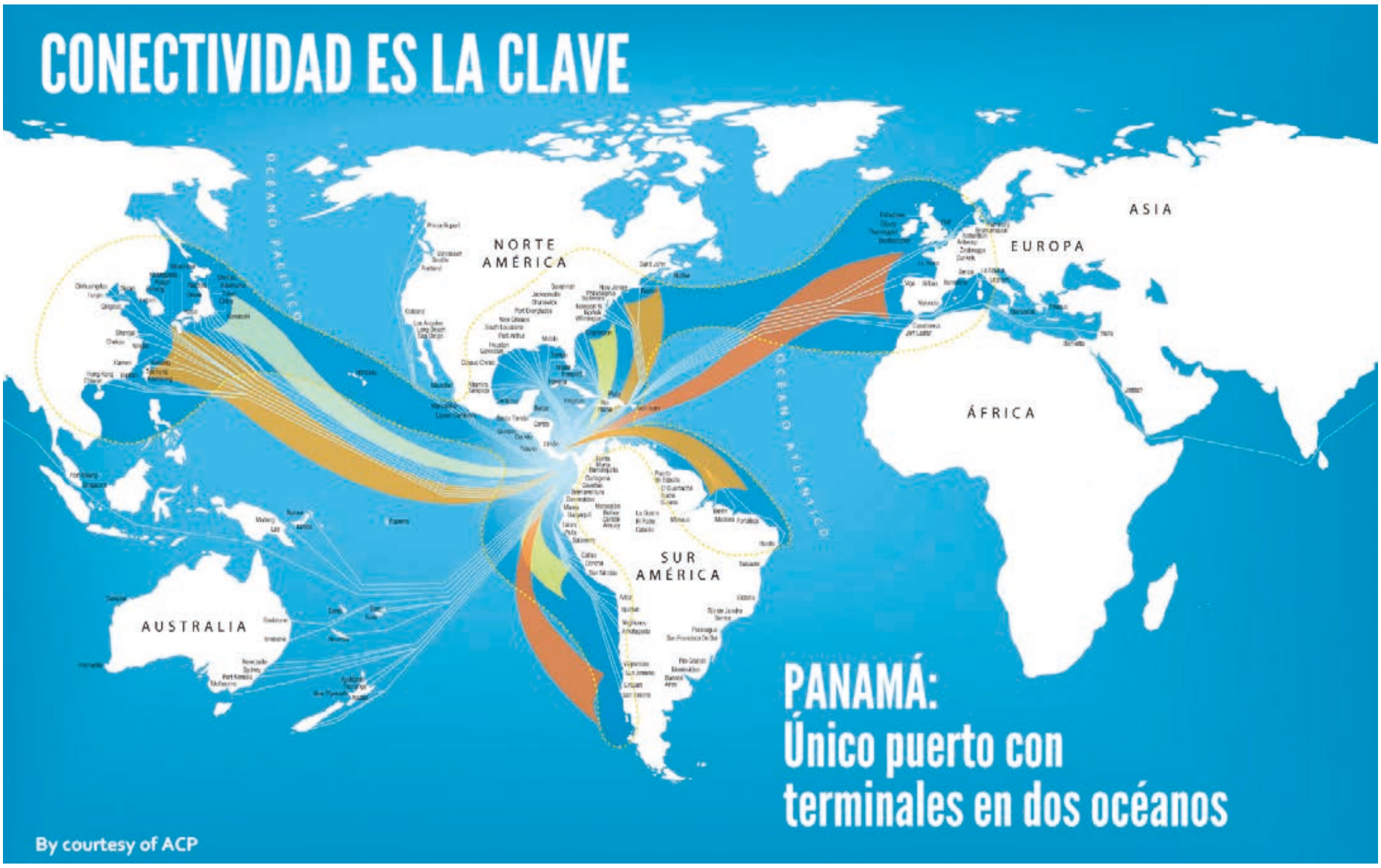

Fig. 13. The world according to the ACP [21]

This does not mean that every person involved will feel the same fulfilment when the Canal new gates open for navigation. At times, the stress of this project was a hard experience – too hard for some. Let us also mention these people and hope for them that time will be a healer. Inclusion is what powers this project; and the Panamanian colleagues and managers have shown plenty of this quality. It was no secret that Panama knew how to connect oceans; now we have seen that this country also knows how to connect people.

In my current country, The Netherlands, great words are not often used. But if there is a time for great words, then the completion of the Panama Canal Expansion project is such a time. The work on this project brought together many people from different parts of the world and connected them better than the politicians or their spin-doctors can do.

Therefore, it seems good to conclude this article with a single slide from a presentation by Alberto Alemán Zubieta, the CEO Administrator of the Panama Canal Authority (ACP) [20]. This picture may bring smiles to some faces, but it does express the views, ambitions and commitment of the Panamanian people. The Spanish text on this slide says “Connectivity is the key. Panama: the only port with terminals on two oceans”.

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