Paper Nº150 - Port of Buenos Aires future role and its link with inland waterway transport

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ABSTRACT

Port of Buenos Aires is one of the main ports of every shipping line operating at the Atlantic coast of South America. It is positioned in a strategic location (hub port), either for maritime transport, but also where more than 5000 Km of inland waterways converge. The importance of river navigation is based on being able to transport larger amounts of cargo at low cost and favouring the environment.

The 2040 master plan includes the extension of existing quay walls; the filling of old dock basins to increment storage areas for containers; land reclamation in the river for port expansion and the optimization of port equipment. The aim of this work is to respond, in a sustainable and planned way to the rapid growing international demands for accommodating larger vessels and throughputs.

1. INTRODUCTION

Port of Buenos Aires is located in South America, in the Rio de la Plata estuary, which reaches the Atlantic Ocean (34 ° 35'57"S 58 ° 22'17"O). It is divided into Puerto Nuevo and Puerto Sur. Puerto Nuevo is the concessioned area for port operations and attention for overseas and cabotage ships. It includes six docks, five of them for overseas called (from south to north) A, B, C, D, and E, and a cabotage one called dock F. The area occupied by the five general cargo port terminals is approximately 92 Hectares, with 7,250 dock´s meters of length and mooring sites for 23 ships.

Puerto Sur comprises an area of 115 Hectares and 5,000 dock meters in the Madero Sur and Boca Barracas zones. The companies located there develop activities compatible with Fiscal warehouses, storage of goods for import, export and naval ships repair.

Due to its geographical location, Argentina is a destination country for cargo. Vessels arrive with cargo which corresponds to 25% of its storage capacity, having discharged at other ports in Brazil or Uruguay. Almost all of its cargo is divided between import and export, so it has a high degree of dependence of its economy.

The movement of containers in ports grew substantially in the last decade, resulting in the need for large investments in infrastructure and adopt policies to generate the development conditions, not only to compete on equal terms and ensure the transport of the products at a lower price, but to maintain sovereignty in business decisions.

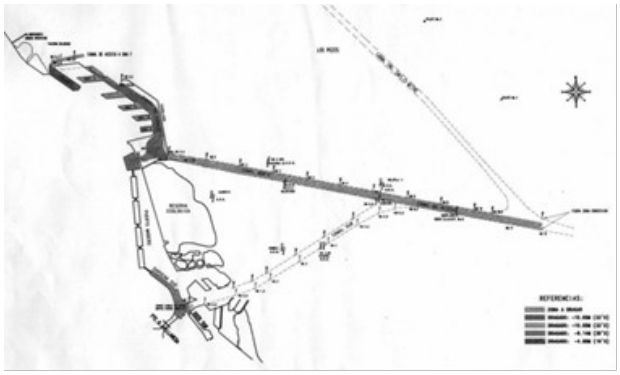

Figure 1. Port Access Channels

The port traffic is performed by larger vessels and the increase in cargo is explained by the growth in the size of vessels and not by the increase in the amount. Therefore, the projected cargo will be carried by fewer larger vessels.

Año	Buque	Loa	B	DWT	TEUs
2004	Laust Maersk	266	37,3	63.000	4.500
2005	Monte Rosa	272	40,0	65.000	5.560
2008	Río de la Plata	286	40,0	80.000	5.900
2010	Santa Clara	300	43,2	90.000	7.100
2011	Maersk La Paz	300	45,2	94.000	7.450
2012	Cosco Vietnam	334	42,8	102.000	8.200
2013	Cap San Nicolás	333	48,2	124.000	9.600

Figure 2. Maximum vessel: year, DWT, Loa, B, DWT and TEUs.

Since 2004 to present (comparing the Laust Maersk vessel with Cap San Nicolas vessel) it has observed an increase of 113.33% in this capacity and a growth of 96.82% in tons of deadweight.

Maersk Line suggests the arrival of New Panamax vessel in the year 2018-2019 and other vessels like "Triple E" in 2021- 2025. However, in this letter he clarifies: *"The growth of the ships will be subject to the evolution of markets and to the facilities of the Port of Buenos Aires and waterways of the Rio de la Plata that enable a safe entry and exit, and in a reasonable transit time".*

The facilities of the Port and Waterways for these vessels is the primary objective of the forthcoming reforms carried out in the port.

2. DEVELOPMENT

2.1. Waterways

In order to calculate waterways and port infraestructure, three study vessels have been selected (average, design and maximun). The average vessel is the one that enters Port of Buenos Aires more often, the design vessel will be used as a project parameter of the areas and waterways for the purpose of its sizing, and the maximun vessel is the one of larger size in the distribution considered to determine the magnitude of the existing limitations and/or restrictions in the port operative conditions (navigable areas and mooring posts), measured according to the design vessel.

Average Vessel: 4th Generation – "RIO DE LA PLATA" - 5,900 TEUs.
Lenght = 287 m
Breadth = 40 m (16 rows)
80.000 tons of deadwight

Design Vessel: 6th Generation – "MSC ALEXANDRA" - 14,000 TEUs
Lenght = 365,5 m
Breadth= 51,20 m (20 rows)
165.300 tons of deadwight

Maximum Vessel: 7th Generation – "EMMA MAERSK" - 15,500 TEUs
Lenght= 397 m
Breadth= 56 m (22 rows)

2.2. Waterways operative dimensions and maneuvering circle

2.2.1. Access waterways

The minimun bottom width is calculated using the suggested "APPROACH CHANNELS, A GUIDE FOR DESIGN" (PIANC, 1997). This width must extend from the sea entry in the Alfa zone (Km 239,100) to the Port Entrance (Km 0,800).

Unidirectional waterway (outer)

1. Wbm = 1,3 * M = 66,56 m
2. Vessel Speed = 10 nudos (moderada)
3. Transversal currents additional = 0,2*M = 10,24 m
4. Longitudinal currents additional = 0,1*M = 5,12 m
5. Depth additional < 1,25 = 0,3*M = 15,36 m
6. Bank clearance green side of channel= 0,5*M = 25,6 m
7. Bank clearance red side of channel= 0,5*M = 25,6 m

MINIMUN BOTTOM WIDTH = 150 M

2.2.2. Maneuvering circle at the North Outer Port

The maximum diameter of the turning circle that the North Outer Port can bear is of approximatedly 540 meters, with slope 1:4.

This takes into account, on the one hand, the rectification of the first Breakwater and, on the other hand, the operation of the design vessel suggested in the mooring post.

The turning relations reached for the suggested vessels are:
a.1 For an average vessel: 540 m / 287 m = 1,88
a.2 For a design vessel: 540 m / 366 m = 1,48
a.3 For a maximum vessel: 540 m / 397 m = 1,36

The turning relations reached seem to be lighlty insufficient, specially for the longest vessel. It must be considered that the Turning Circle at the North Outer Port a semi-protected navigable area (although there are shelter constructions, the entrance to the Port allows waves to get in).

Even though waves are decreased in height regarding the outer side of the shelter constructions, due to the diffraction phenomenon, they slighlty condition the operation of the maximum vessel. How much the port operations are affected will depend on the frequency of arrivals.

Figure 3 shows the maneuvering circle suggested in the first place (Ø540) at the North Outer Port, together with a container ship operating in the first Breakwater.

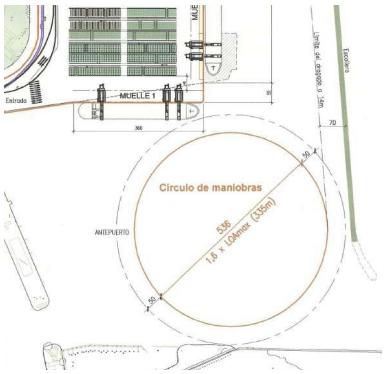

Figure 3. Maneuvering circle

2.2.3. Passage Waterway

As it is an interior channel, the passage waterway is protected from waves and partially from currents. However, enough revenge must be adopted in order to keep the navigating vessel away from the riffcliff (to the East) and from possible moored vessels at the new docking front of the first waterbreak (to the West), which takes into consideration the First, Second and Third Waterbreaks together with Docks A and B. The minimun bottom width is calculated using the suggested "APPROACH CHANNELS, A GUIDE FOR DESIGN" (PIANC, 1997).

Unidirectional waterway (outer)

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MINIMUN BOTTOM WIDTH= 160 M

Considering that the current Passage Channel has a bottom width of 180 meters and that (after filling Docks A and B) the waterbreaks and docks front are planned to be used as a mooring post, it is therefore essential to extend the channel at least 50 meters. Such wider part is possible through two construction factors:

a. Movement to the East of the Breakwater;

b. Shortening (to the West) of first and second Breakwaters.

2.2.4. Considerations in relation to the depth of inland waterways

It is essential to deepen the manouvering inland waterways and areas, so as to safely receive the suggested vessels and secure that they are able to transport the amount of cargo requested to arrive in Buenos Aires.

2.2.5. Access waterway

The suggested 14,000 TEUs design vessel of nominal capacity (365.5 meters long and 51.2 meters wide) has a maximum draft ("full load") of 15.50 meters. This draft is reached with a net load (properly distributed) of 140,000 tn (deadweight of 165,000 tn).

To simplify the analisis, it is considered that vessels arriving in Buenos Aires have 30 % of nominal capacity in TEUs (i.e. 4,200 TEUs). When also considering the unitary load of 9 tn/TEU agreed, the net load is of 37,800 tn, over the 140,000 tn maximum (27 %).

Then, by adopting a minimum draft of 9.0 meters (with no paid load but with enough amount of fuel) and considering a lineal variation load vs draft, a draft of approximately 10.77 m is adopted.

To that value we should add:

1) Movement vessel by waves: 0,15 m (Hs = 1,2 m)
2) Static Trim: 0,305 m
3) Squat1 = Trim Dinámico + Sinkage = (Barrass 3 a 10 kns) = 0,67 m

4) Revenge under keel: 0,305 (soft background y low dangerous cargo)

In this way, the final value of the calculated depth is of 12.20 meters (40 feet). This depth shall be kept, together with the calculated navigable width, from the sea entrance (Km 239,100) to the Port Entrance (Km 0,800), and the reference level considered is the Riachuelo's zero.

2.2.6. Turning circle and passage waterway

The design recommendation indicates that for Froude values lower than 0.3 (low speeds) the sinkage effect is insignificant, and one should only consider the static trim and the revenge under keel. Likewise, when the vessel is sailing in protected waters the tide effect is null. Thus, a minimum depth of 11.59 meters (38 feet) is suggested.

2.2.7. Docks and docksides

Due to the fact that vessels remain moored and in loading and unloading operations for an average of 36 hours (going through at least 6 cycles of astronomic tide), their buoyancy must be secured during that time, as the contrats between Terminals and Sea Lines specify. For that reason, a two feet deepening of mooring posts is suggested in relation to the minimum available depth in the Maneuvering circle and the Passage Waterway, resulting in an available deepening in dockside of 12.20 metros (40 feet).

2.2.8. Sedimentation

The anual sedimentation rate will turn from 3,297,100 to 5,631,500 m3, generating a total increasement of more than 70 %. These are divided into: Docks from 261,800 m3 to 433,800 m3, Passage Waterway from 512,600 m3 to 1,180,000 m3, Outer port from 352,700 m3 to 609,500 m3 and North Waterways and Access from 2,170,000 m3 to 3,670,000 m3.

2.3. Port infrastructure

2.3.1. Calculation of dock occupation factor

To simplify the analisys, the Port operation was considered globally for 2040 (project horizon), without evaluating the Terminal facilities individually.

a = (Q/q)* (t/T)*(1/N)

Q = anual load mobilized at the Port: 40,773,190 TN/Year

q = load transported by the average vessel at the Port = 15.930 TN/Vessel

T = Functioning days per year of the Port as regardsen loading and unloading operations = 330 days/Year

N = Mooring posts specialized in the loading and unloading of containers = 8

t = Time the vessel spends in the Port = Tservice + Tinoperative

Ts = q/u

u = A*n*d*b

A =Hour load mobilized by equipment = 25 mov/hour*18 TN/mov = 450

TN/Hour

n = Average amount of cranes per site = 3,5 (average value)

d = Hours per day the Port operates in loading/unloading = 24 Horas/día

b = Efficiency = 0,9Tr = 0,25 días

The suggested methodology indicates a Dock Occupation Factor of 0.7 in 2040. This value is acceptable, according to the chart provided by Port Management, United Nations Conference on Trade and Development (UNCTAD) in collaboration with International Association of Ports and Harbors.

Q [TN]	40.773.190,0	TN
q [TN/Buque]	15.930,0	TN/Buque
N	8	
T	330	Días
T´	Ts + Tr	Días
Tr	0,25	Días
A	450	TN/Hora
N	3,5	Gruas
d	24	Horas/Día
b	0,9	Rendimiento
u	34020	TN/Día
Ts	0,47	Dias
T´	0,72	Días
a	**0,70**	

During summer time (Octuber – April) more traffic will be registered, due to the arrival of cruciers, which will partially occupy the sites destined to the container opperations (although there will be 4 posts exclusively destined for such traffic).

2.3.2. Construction Plans

Modernization works must be planned to keep the Port in operational conditions most of the time and to allow simultaneous works, affecting as least as possible the port terminals.

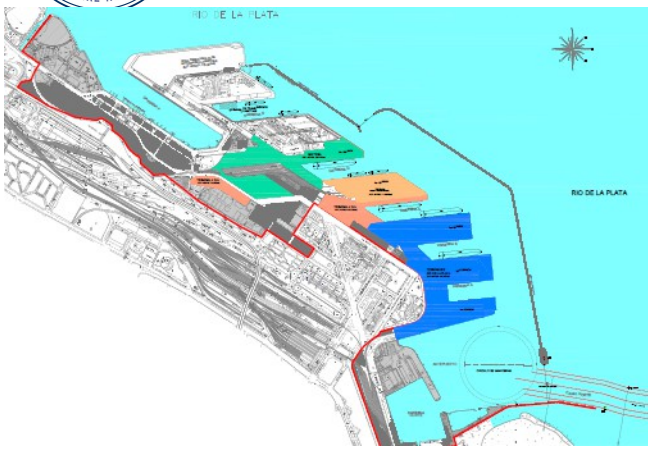

Figure 4. Actual Situation

Four work stages have been planned. In the first stages, it is the intention to build continuous docks of, at least, 400 meters. Later, the mooring posts will be uniform so as to have extensive lineal docks, filling docks to obtain container storage areas, gaining land by filling works, placing more larger cranes, reducing the shelter constructions so as to extend maneuvering limits, and dredging at a higher depth.

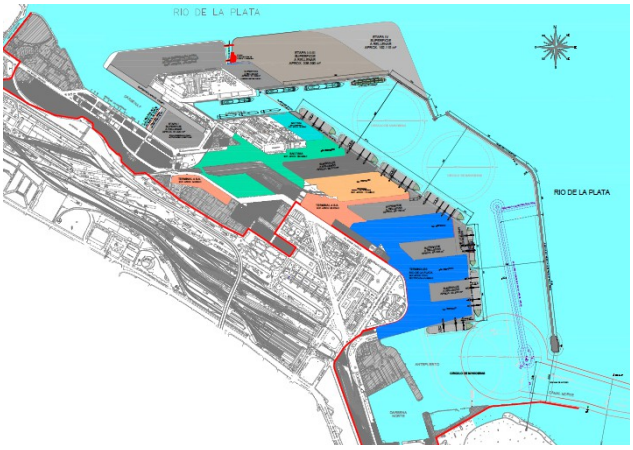

Figure 6. Stage 3

Likewise, it is planned that the Port Terminals improve and update their information and management systems, increasing the logistics efficiency.

Figure 5. Final Situation

2.3.3. Triggers or milestones in works planning

1. Trigger between Stages 1 and 2: Arrival design vessels (365.5 m length and 51.20 m beam). Estimated from 2017 to 2019.
2. Trigger between Stages 2 and 3: Movement of 1,700,000 TEUs in Buenos Aires Port.
3. Trigger between Stages 3 y 4: Movement of 2,100,000 TEUs in Buenos Aires Port.

3. CONCLUSION

There is a clear tendency towards receiving a lower amount of vessels per year, but larger ones. Each of them transport more load, and it is required that Terminals address them in a shorter period of time (24/36 hours), which implies larger container depots areas and a strong investment on port equipments, being the first restriction to satisfy, i.e., on the one hand togenerate the widths and depths necessary to sail safely. On the other hand, to build new mooring posts for the presented large vessels. Finally, the creation of more extensive areas for stowage (port container depots), logistics and consolidation and deconsolidation of the load. Otherwise, the country will turn from a being a "hub" destination to a "feeder" one, of Brazil or Uruguay, losing control over business decision-taking as regards sea transport.

This is a project to make navigable waterways fit the new vessel requirements and increase the surface for the operations and logistics necessary to address the new load.

Buenos Aires Port is the only one whose port authority is the National State, being a crucial tool for the country's logistics.

River traffic makes it possible to bring the vessel closer to the load and the load to the consumer areas, reducing transportation costs, allowing competition at international export and import prices, and lowering the environmental impacts produced by other types of goods transportation.

4. REFERENCES

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