



# **An Innovative Rail-Canal System**

**September 15, 2014**

**Korea Railroad Research Institute**



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- **Multi-Purpose Applications**

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# Why Rail-Canal System?





# Current Status of Conventional Canals

## Favorable routes to logistics industries

Canals greatly reduce the amount of time taken for ships to travel. For instance, the Panama canal and the Suez canal save 13,000km and 9,500 km, respectively. On the contrary to this attractive features, most of them have locks to adjust water level, which make the limitation of allowable ship size and passage time.

	Suez Canal	Panama Canal	Kiel Canal	Welland Canal	Volga-Don Canal
Length	160km	82km	98km	43.4km	160km
Size of lock gate (Minimum canal width)	No lock gate <sup>(2)</sup> (Minimum canal width of 300m)	320×33.53×25.9 m	310×42×14 m	225.5×2.3×8.2 m	140×16.6×3.5 m
Maximum ship size <sup>(1)</sup>	160,000 tons (Suezmax)	80,000 tons (Panamax)	74,000 tons	About 2,000 tons	5,000 tons (Volga-Don max)
Time required to pass through	15 hours	24 hours	10 hours	11 hours	16 hours
Annual cargo volume	930 million tons (~ 8%)	320 million tons (~ 3%)	150 million tons	40 million tons	8.5 million tons
Transit fee	Average \$250,000/ship	Average \$127,000 /ship	About \$5,000 /ship (based on 50,000-ton ship)	\$200 /ship (In case of passing through 8 lock gates)	Free of charge
Remarks	- No lock gate - Mediterranean Sea-Red Sea	- The Caribbean/the Pacific	- North Sea/Baltic Sea	- Lake Erie/Lake Ontario - Number of lock gates: 8 (total height difference : 99.5m)	- Black Sea/Caspian Sea



# Problems with Conventional Canals

## Congestion due to increased demand

The increase demand for the existing canals leads congestion in recent years. In this regards, two negative aspects are noted: 1) a hike in international logistics fees and 2) a rapid increase of passage time through a lock gate. For example, Panama Canal Authority announced plans for 15% increase (Oct. 2012) in transit fee and further 5% increase in 2013. It takes 24hrs to pass the Panama canal even though the net transit time is only 10hrs.





# Problems with Conventional Canals

## Enormous social and economic costs for canals

Many countries consider construction of new canals as alternatives to the existing canals. Furthermore, Panama undertook the expansion project allowing up to 15,000 TEU class vessels. However, that requires not only enormous construction cost(\$5.2 billion) but also substantial maintenance costs for periodic dredging and repair. In addition, environmental issues should be taken into consideration since canals need large basin area.





# We Propose Rail-Canal System

An innovative solution for the previously mentioned problems

The new system provides the following advantages, 1) lower construction cost than conventional canals, 2) no land separation due to canal construction, 3) easy to finance project costs using benefits from extra business such as vessel investigation and inland port, 4) minimizing environmental impacts.

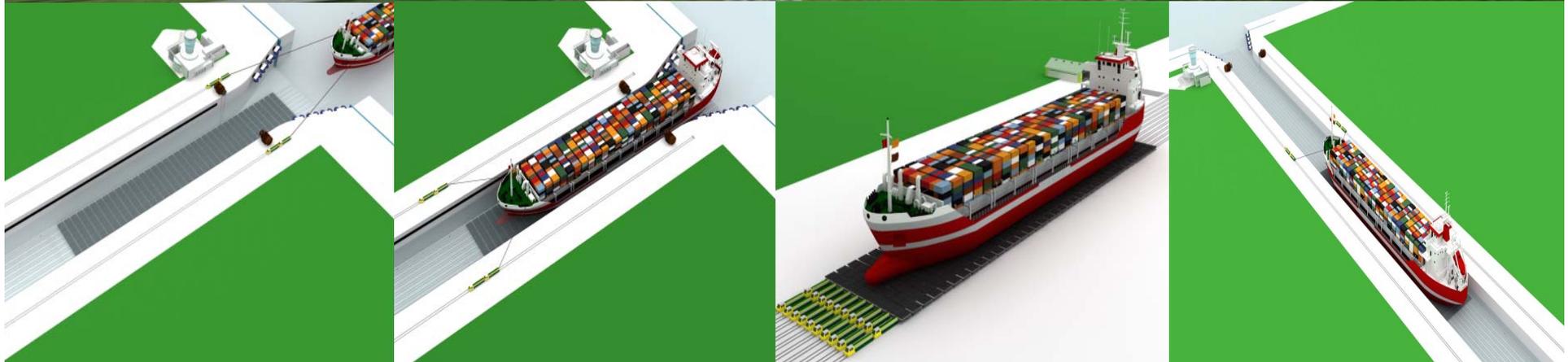




# How the Rail-Canal System Works?

## Reverse process of vessel launching

A vessel is shipped on a multi-axle freight car hauled by winch-driven ropeways and then connected with locomotives at both ends of the vessel. When launching back to the sea, the reverse process of entering the land is applied.



# Technical Issues

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## on Rail-Canal System





# Key technology is NOT new!

Motivated by a launching technology in ship building industry

A ship built on land is moved to the floating dock with self-driving bogies, followed by launching to the sea by submerging the floating dock.

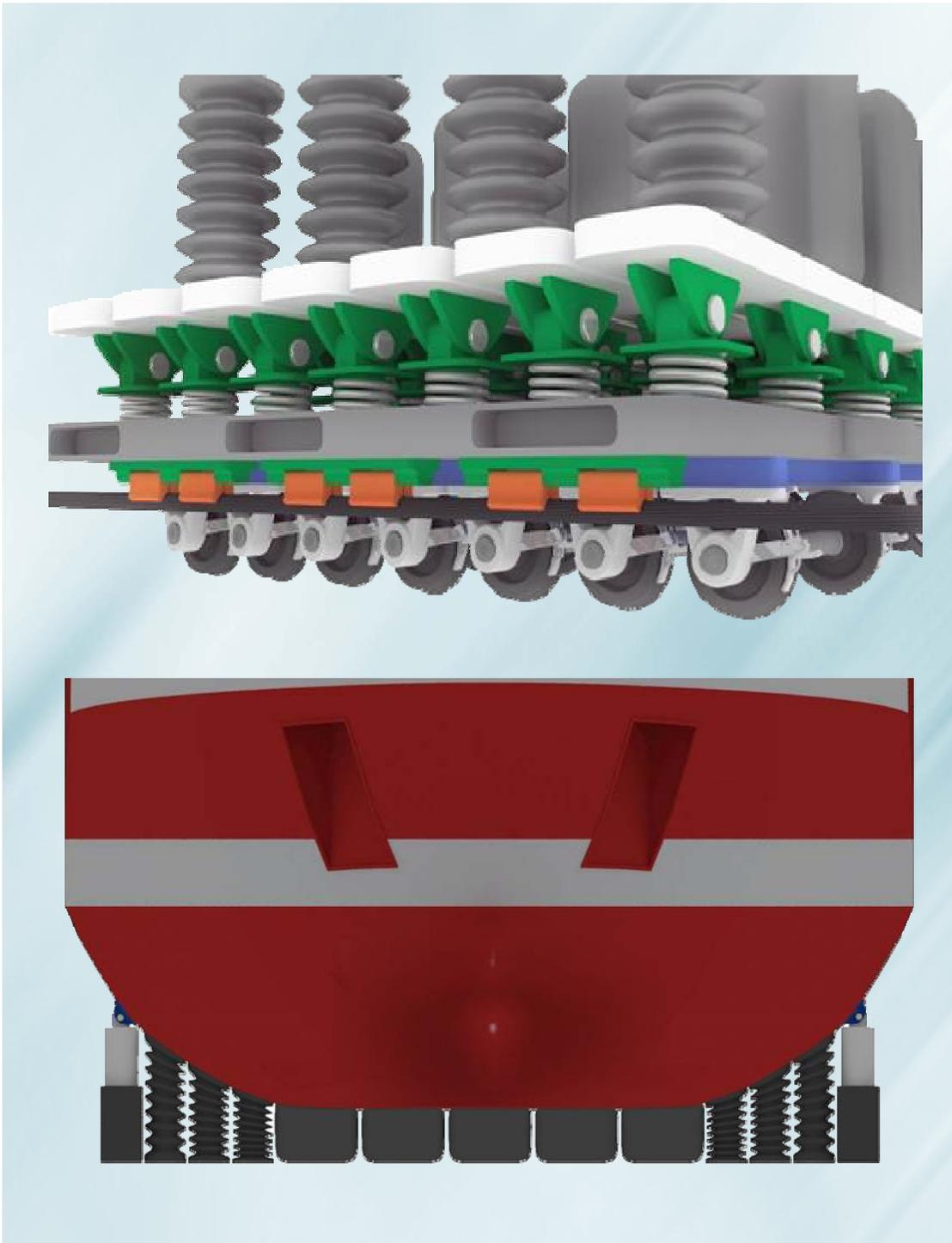


# Freight car is bearable to the load?

Multi-axle bogie reducing individual axle load

A freight car is composed of multi-axle wheels, vertical air springs, and mechanical braking system; The multi-axle wheels distribute a massive weight and the vertical air springs along with hydraulic actuators make a vessel stable during transport.

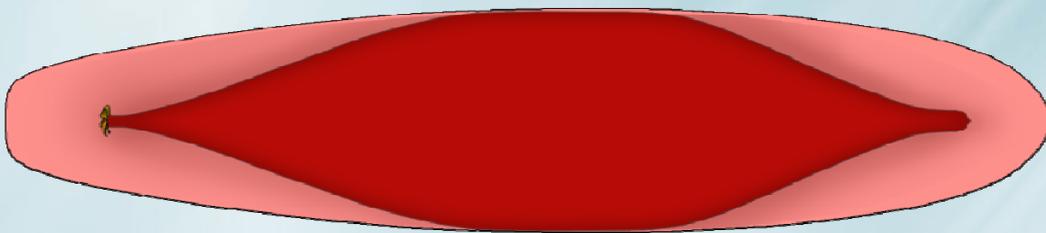
By designing an axle-distance of 0.5m, each axle support only 24.46tons within reasonable range.



# Ship Bottom is Safe?

Various types of ships can be loaded

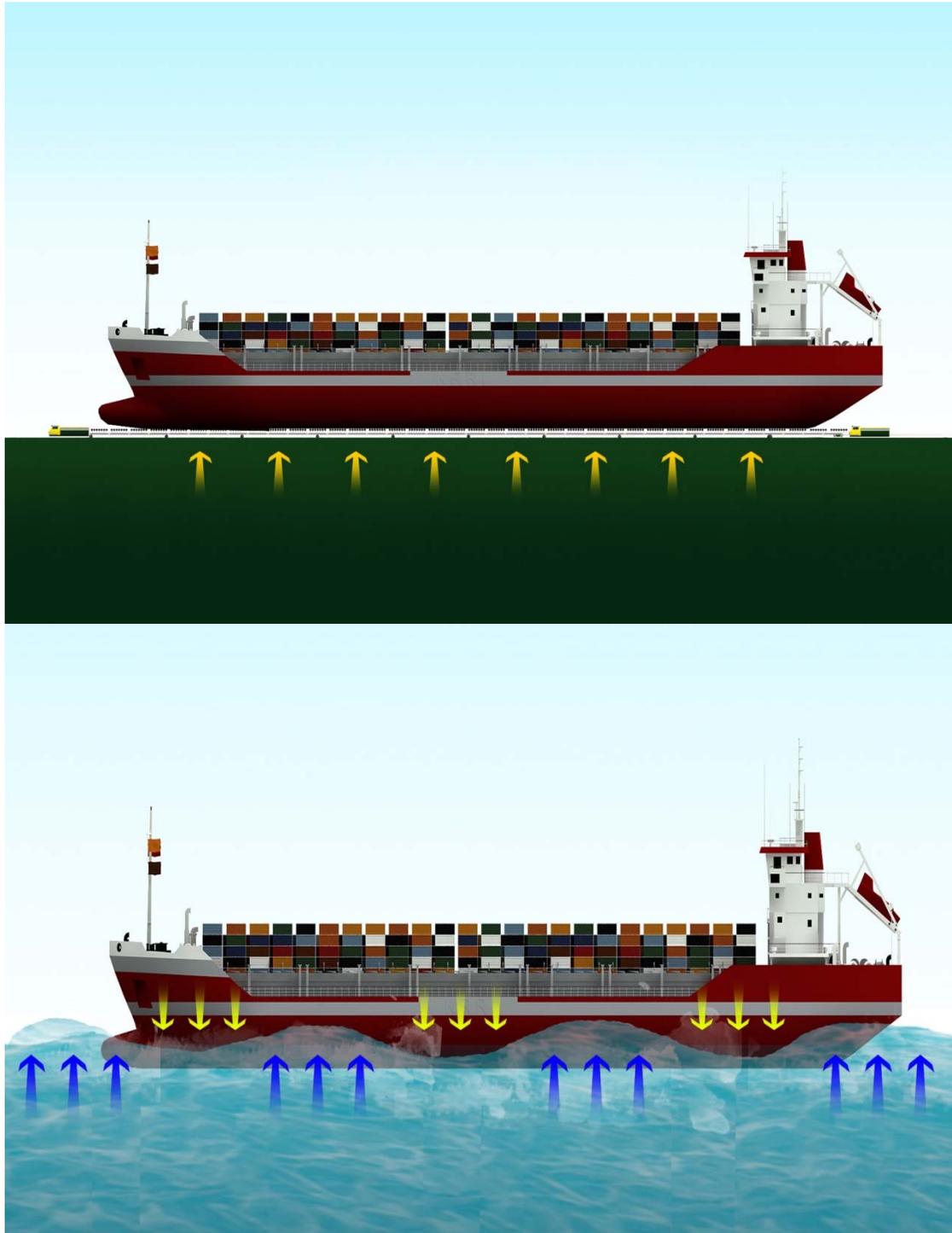
Since contact area of vessel bottom is over 50%, the sufficient load distribution is possible. According to ship design regulations, bottom strengths of typical vessels are large enough to resist full load of vessel.

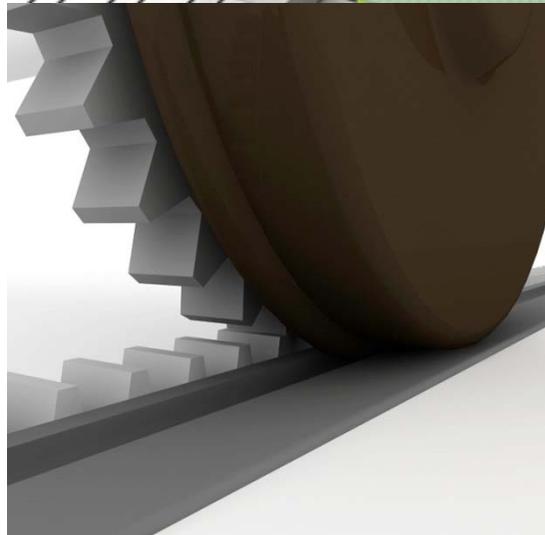
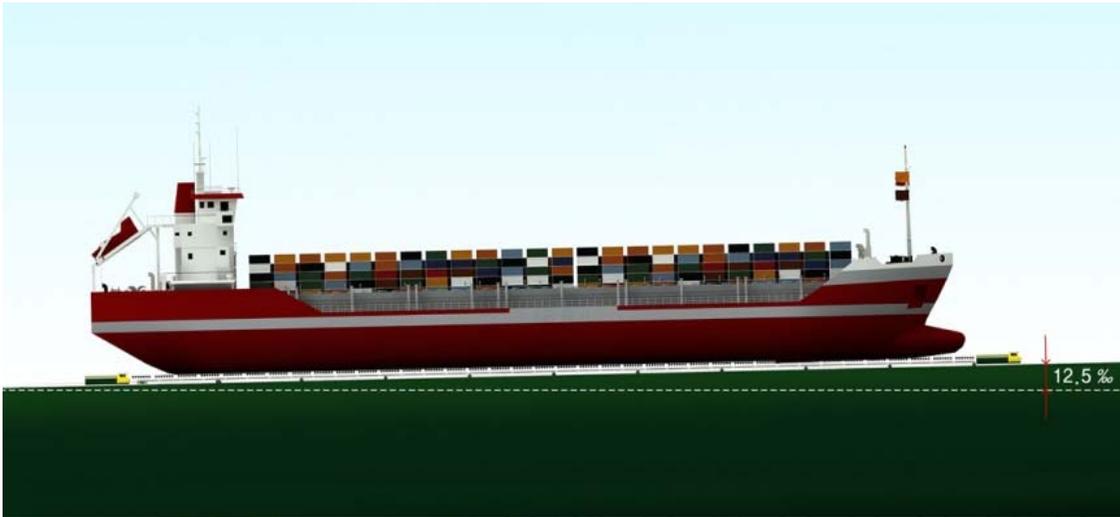


# Ship Strength is Large Enough?

Enough resistance to loading conditions

A Post-Panamax vessel is designed so as to resist at least a bottom pressure of  $2.0d$  and a wave bending moment of  $0.08WL$  according to the ship classification rules and regulations. However, the bottom pressure and bending moment applied to the ship structure are only  $1.1d$  and  $0.042WL$  while the ship is on the multi-freight cars. They are approximately 50% smaller than their strengths specified in the ship design regulations. Consequently, there is no problem on ship structures.



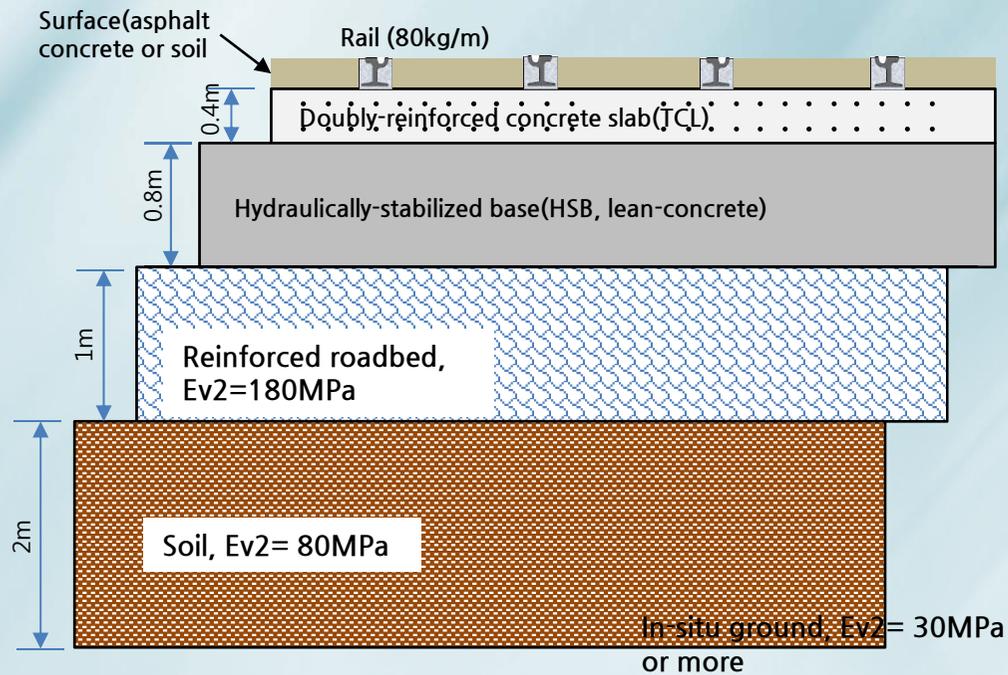
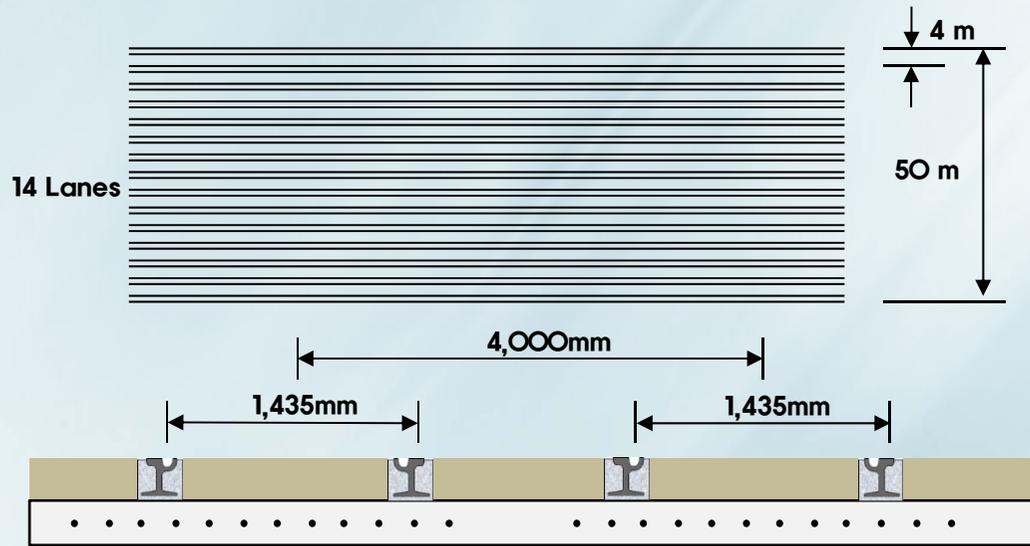


## The Operation Can be Flexible?

Special traction motor car to transport heavy vessel

It's able to travel 12.5‰ slope by 3,300 ton traction power. A catenary-free power supply is achievable to reduce maintenance cost and environmental impact. A special wheel using rack & pinion improves the adhesion and regenerative braking system on downward slope enhances the energy efficiency.





# Ground & rails are stable?

Reinforced trackbed and embedded rail

Post-Panamax standard-based design to bear 100,000ton load using; (1) High strength rail, (2) Concrete slab track, and (3) Elastic track technology to reduce the noise & vibration.



# Multi-Purpose Applications

## of Rail-Canal System





## To enhance the operation efficiency

A double track at the crossing with existing road and exit/entrance

Level crossing is possible by employing eco-friendly embedded tracks in the Rail-Canal system, preventing the country from separation.

Moreover, a double track at exit and entrance enables nonstop travel and travel time reduction.

The above cannot be achievable in the conventional canals.





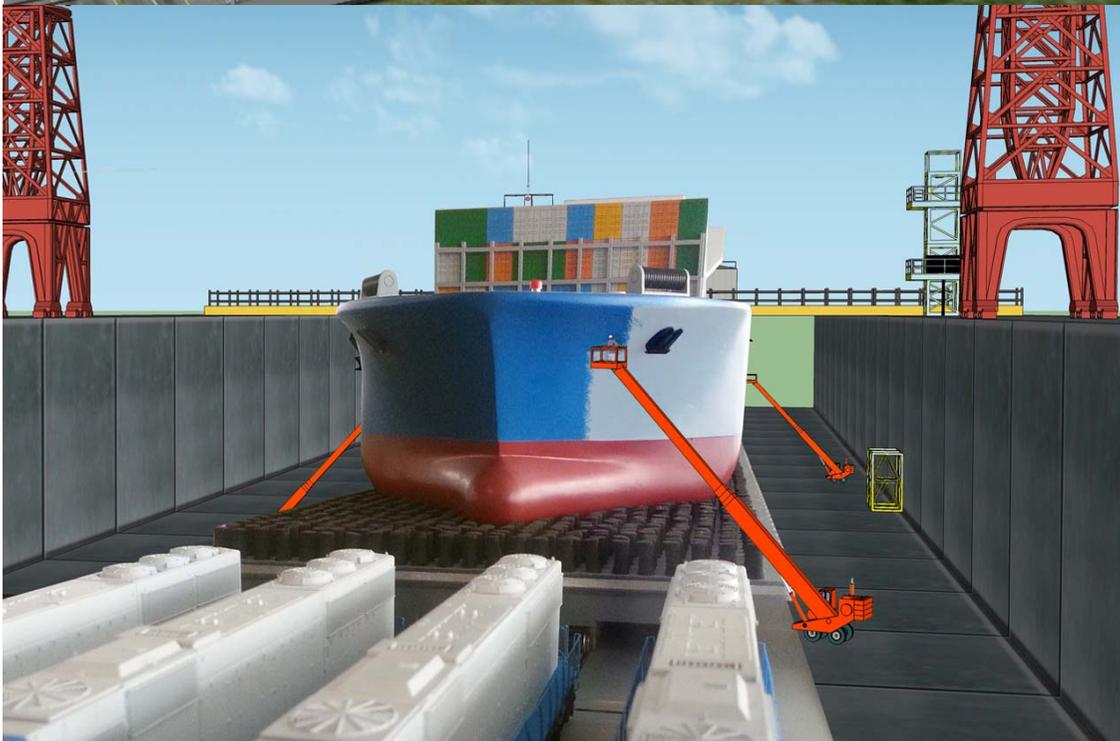
## If used for the other purposes?

Used as an inland port

A storage base can be exploited so as to load and unload containers in the Rail-Canal system.

By extending the innovative system to the distribution centers located in coastal cities, we expect the improved intermodal efficiency between ship and land transportations.





## Beneficial even to ship owners?

### Automated maintenance and repair service

In contrast to the usual maintenance practice performed underwater manually, a ship can be inspected more thoroughly using automated facilities in the Rail-Canal system. One thing to be noted in the Rail-Canal system is that ships are pulled out to dry land. By constructing a maintenance station in the middle of routes, a large body can be inspected, repainted, and cleaned.



# Future Plan of Rail-Canal System





## What will be for the Future?

Rail-canal system will be ready soon

Currently, fundamental research is going on by simulating small-scale test models.

For the next 3 years, verification test is planned with real vessel of 2,000-3,000tons.

Meantime, fund raising efforts will be made globally.



A young girl with long dark hair, wearing a white dress, is shown from the side, pointing her right index finger upwards towards the sky. The background is a bright blue sky filled with scattered white clouds. The overall mood is one of hope and aspiration.

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# **KRRI, Future Technology Partner for innovative logistics system**

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