Application for '2017 Bali Open Award' Contest

< Application Information>

- · Applying to: Bali Open Award 2017, Technology Adoption field
- · Introduced technology: Cruise ship-only boarding facility mounted on a vehicle (Step-car)
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• Word Count: 1,669

<STEP-CAR, Easier and Faster walking down from the Cruise ship>

1. Summary of introduced technology

The Step-car is a cruise passenger boarding facility mounted on a vehicle that is fast and safe to move between cruise and port, and easily installed.

As the cruise industry develops lately, increase in demand for cruise ships visiting Incheon Port is expected. For this reason, IPA has developed a step-car, a boarding facility dedicated to cruise ships to provide safe and convenient boarding and landing facilities to passengers.

Once the cruise ship is docked at the port, the movement of the ship is transferred to the boarding facility due to continuous changes of tide, waves, wind and etc. Therefore, structural and operational safety of the boarding facility is essential.

The Step-car developed by IPA is the only vehicle-mounted boarding facility that is developed exclusively for the port, which is economical and provides convenience and safety to cruise passengers.



* A cruise-only step-car introduced through development of technology at Incheon Port Authority.

2. Main technical contents

• Necessity of introduction of new cruise-only boarding facility at Incheon Port

Prior to the development of the step-car at Incheon Port Authority, a 'Temporary passenger boarding path' was used. This path combines a first and second stage container boxes that can be used according to tide changes.



Water level below 3m

Water Level 3 ~ 7m

Water level above 7m

* Pictures above show a cruise ship that has arrived at Incheon port. The temporary passenger boarding path were installed and operated in accordance with the change of water level. Incheon Port is a representative area with remarkable range of tide worldwide. The maximum range of tide is 10m.

As shown in the pictures above, the temporary passenger boarding path is operated by a crane without its own power source. Thus following problems arise.

- It is necessary to move and install the boarding path by the crane from the storage place to the ship's berthing place.
- It is necessary to repeat the removal and installation of the boarding path at any time according to the change in water level
- Operating personnel has to monitor every single event happening when using the path.
- The crane has to be leased as there is no port only facility available. Also, the crane operator changes every time the equipment is leased, which increase the risk of accidents occuring due to human errors as operators may have different level of operating abilities.
- Excessive costs for leasing crane, etc.

Therefore, we developed the step-car according to the necessity of introducing a new type of cruiseonly boarding facility for efficient management and customer satisfaction.

· Conception and development of prototype considering port characteristics

In order to develop a cruise-only boarding facility suitable for the port, it was conceived as a vehiclemounted facility by modeling the one at the airport.

At the initial design stage, the size and operation method of the step-car were determined through research on issues such as the change of tide at the port, the scale of cruises and the operation status of the passenger boarding line at the airport. It is designed to be able to operate up to 10m of tide and to have maximum inclination angle of 25 degrees considering the stairway.

During the production of the prototype, we were able to discover differences between boarding on the airplane and the cruise through continuous data collection and monitoring. First, there were a number of customers using the walking assist device such as the elderly, the disabled, and infants on a cruise ship. Second, customers directly carried large luggage with them on a cruise ship. On the other hand, stair-like structure is suitable for aircraft's boarding facility due to the fact that large cargoes and passengers are boarded separately and that they cannot bring onboard secondary walking devices.

As there is a limit to improve the original plan fundamentally, the prototype development was completed without major changes in the basic standard. Some part of the stairway-type path was change to a flat floor, but stairway at the connection part remained unchanged.

- Developed contents: Boarding facility that automatically adjusting elevation according to change of water level and application of all cruise ships
- Development Company: Kanglim Co., Ltd.
- Development Period: 2013.12.1 ~ 2015.5.31 (18 months)



* Prototype operation

• Establishment of production standard for step-car optimized for Incheon Port

After the actual operation of the developed prototype, we found problems with structural safety and ease of use.

First, there were some structural problems. Prototypes were designed only to respond to tidal changes. However, complex external forces such as side-to-side rolling of the ship caused by waves and winds, and front to back movement of the ship caused by tidal changes have occurred. Another problem was that when the step-car and the ship try to be connected, weight of the step-car itself was added so the load transmitted from the ship cannot be distributed properly. As a result, cracks often occur in few parts of connection in the step-car

Lastly, very narrow width of the boarding path and stairway-type path have caused inconveniences to the passengers who use the walking assist devices like wheelchair.

Therefore, we have changed the step car production standard as following in order to reflect the results of prototype operation.

Division	Prototype specification	Step-car production standard
Path length	33.3m	46.7m
Minimum path width	0.64m	1.07m
Installation time	In five minutes	In five minutes
Passage maximum inclination angle	25 degree	15 degree
Structural change (for external force)	Main path directly connected to cruise	The main path is made in structural form & extra path to ship can be added
Operating power source	Engine output (PTO)	Engine output + external power (380V × $3\Phi \times 37$ kw)
Form of path floor	Some stairway	Entirely flat
Step-car connecting direction (Cruise basis)	Vertical direction	Horizontal direction

* New step-car production standard established through operating prototype

Manufacturing safe and convenient port-only step car that reflects the result of prototype operation

The step-car has set up the production standard suitable for the port through the trial and error and secured the operational safety and convenience.

- Improved contents: Expansion of path width, securing structural safety and application of flat floor
- Production Company: Kanglim Co., Ltd.

• Production period: May 30th 2015 ~ Feb 24th 2016 (9 months)

The new step-car is easier and faster to move to the dock and it is convenient and simple to install. It is evaluated to have excellent operational capability compare to any other cruise boarding facility.



* Image of step-car reflecting prototype improvements

For example, there is no difference in terms of structural and operational safety compared to a private port boarding facility. The step-car is optimally evaluated in terms of safety, convenience, economy, efficiency and etc. It is expected that both domestic and overseas ports will be interested in this product.

The step-car has also been certified by the nationally designated agency of verification for safety and structural adequacy through objective evaluation of design and structure.

CERTIFICATE		2. Test / Inspection	
Certificate No. HFCP-133-1512	Office : Koron Science Valley II (12th FL) 811, Guro-dong, Guro-Gu, Seoul Korea DATE : 09. December. 2015	KRE has performed this installation inspection according to related drawings & codes, visual check and function tests.	the order's specification, The results are as follows ;
This is to certify that SANG-HEE LEE, the proved that this installation inspection w. scope by the request of IPA from 18th Nov	e inspector of KR Engineering Co., Ltd. as performed faithfully according to the work rember 2015 to 20th November 2015.	A) Quality The commodities were inspection on the construction, dime equipments, and the results found to be satisfactory.	nsion, performance, safety
END USER : Incheon Port Autho	rity	B) Test / Inspection a) Drawing Review	: Satisfactory
MANUFACTURER : KANGLIM CO., Ltd.		b) Material Review	: Satisfactory
COMMODITY : Step Car for Cruise Ship		c) Welding Inspection	: Satisfactory
QUANTITY : 1 Unit		d) Construction & Visual Inspection	: Satisfactory
SCOPE OF WORKS : Installation Inspection		e) Main Dimension Inspection	: Satisfactory
		f) Performance Test	
		- No Load Test	: Satisfactory
1. Main Particulars		- Rated Load Test(End Step Part)	: Satisfactory
- Maximum Loading Capacity of Truck	: 8,500 kg	 g) Safety(Including interlock) & Warning Device Function Test 	: Satisfactory
		h) Function Test of Auxiliary Device	: Satisfactory
- Principal Dimensions(Maximum)	: Length17.3m x Breadth 2.5m x Height 6.3m	i) Emergency Function Test	: Satisfactory
- Minimum Install Height	: 0 Meter		
- Maximum Install Height	: 11 Meter	 Recommendation and Instruction 3.1 End user shall observe the Safety Regulation specified on Maintenance and Operation Manual for 	
- Maximum Install Angle of Step	: 25 Degree	him to be adopted to the commodity, and Manufacturer shall sufficiently furnish Training Service for End User's operator 3.2 Special Caution shall be taken for the safety reason during initial stage of this commodity.	
- Control Range of Automatic Adjusting height	: Under ± 100 mm	 Conclusion The underlight surveyor having inspected the above commodities in accordance with the specification of the KANGLIM CC., Ltd. and requirements of the rule Manufacturer, conformed that the results 	
- Install Time of Step Car	: Onder 5 minutes	4.2 Insection and Test user excited and exception in which we have a second state of the second state o	ation and with our boat becaused
		4.2 Inspection and Test were carried out conscientiously without prejudice and with our best knowledge.4.3 This installation inspection was performed faithfully to the work scope.	
	= To be continued =	KR ENGINEERING CO., KEP	

* Certificate of safety for structure of step cars issued by verification agency

3. Comparing the current status and characteristics of cruise boarding facilities operated at Incheon Port

Currently, Incheon Port Authority has secured three types of boarding facilities: two units of step cars (new products and prototype products), a boarding path (under construction for cruise-only docks), and a temporary passenger path (backup facilities). The introduction and operation costs for facilities are shown in the table below.

Step-car	Boarding path	A temporary passenger path
Introduction cost: 8.2 billion KRW (7million USD)	7.5 billion KRW (6.4 million USD)	100 million won (86,000 USD)
Operating cost (excluding labor costs): 3 million KRW (annual)	4 million KRW (annual) (3,450 USD)	3.5 million won (one time) (3,023 USD)

In terms of operation characteristics of boarding facilities of cruise lines, Boarding paths are installed in a structure in a structural form on a cruise-only dock, and although they are considered to be the most excellent in terms of safety and convenience, they can't be used outside except for private docks and have a disadvantage of high introduction cost .

Even though the cost of introducing a temporary passenger path is comparatively low, leasing crane equipment is required for operation and a rental cost is about 3.5 million won(3,000USD) each time, which takes about 500 million won(432,000 USD) or more annually. Also, there is a difference in safety depending on the operating capability of each operator.

The step-car is as safe and convenient as boarding path. It also offers low cost of introduction and operation compared to other boarding facilities, free movement within the berth, and the ability to use on passenger ships other than cruise ships.

5. Prospect of technology introduced

The step-car is a facility designed for practical harbor technology that prioritizes the efficiency and safety of harbor operation by applying the latest technology to the boarding facilities. It is a new type of boarding facility that has never been applied to domestic and overseas ports. Its technical implementation and operation method such as production form and facility structure is creative, and it is excellent in operational safety and economical efficiency.

The Step-car is a facility developed and manufactured specifically by Kanglim Co., Ltd., specializes in the production of special purpose vehicles in Korea, according to the request of corporation from IPA. IPA believes that this company has more competitiveness than other companies based on technical superiority in the ship boarding facilities.