



## Innovations in Shiplift Navigation Concepts

### Terms of Reference

Version 6, 19<sup>th</sup>. Feb 2018

#### Background

Shiplifts are one of the main types of navigation structures. In the 21<sup>st</sup> PIANC International Navigation Congress, the development of shiplifts was emphasized, and it is recognized that shiplifts have several advantages over navigation ship locks when the lift height is over 40m. In 1984, PIANC established a "Study Commission of ship lift" and published a technical report in 1989 named "Ship lifts", which introduced and summarized the experiences in design and management of shiplifts from 1950 to 1986.

Since the 1990's, shiplift technology has been developing rapidly in the world and particularly in China, UK, Germany and Belgium. Many different types of shiplifts have been built or are being designed, e.g., Strépy-Thieu Shiplift in Belgium, Three Gorges Shiplift and Jinghong Shiplift in China, new Niederfinow Shiplift in Germany, Falkirk Wheel in UK. Many advanced and innovational construction techniques and design concepts have been used in these projects.

There are many pre-1990 shiplifts and inclined planes, the oldest dating from 1875. Most are still in regular use and all require ongoing maintenance and, in some cases, conservation as important heritage structures.

Today it is required to establish a new PIANC report to update the new development on shiplifts and summarize the technical innovations, operation and maintenance experiences in shiplifts during the past 30 years (1986-2018). It is also necessary to discuss the future development direction of shiplifts and give guidance on construction, management and maintenance of new and old shiplifts for the coming 20-30 years.

#### Objectives

The main goal of Innovations of Shiplift is to provide guidance and insight into the research, design, construction, management and maintenance of shiplifts.

The objectives of this working group are:

- To review the shiplift construction achievements all over the world in past 30 years and update the knowledge of shiplifts;
- To classify the innovations in new shiplift design, with focus on new methodologies and technologies/concepts;

- To summarize experiences of shiplift operation and maintenance, including new and old shiplifts;
- To define the future development directions for shiplift design, and the optimized selection and overall layout of shiplifts as navigation structures. This includes detailed and quantified economical comparison but also technological advantages and shortcoming (multi criteria assessment) with navigation locks with or without water saving basins and with incline planes.
- and to make recommendations for common practices, where these would be helpful.

This working group seeks to gather inputs and compare current practices from a wide variety of shiplifts managers, field practitioners, academics, consultants and organizations supporting historical shiplifts, from UK, France, Germany, Belgium, China but also from other countries having old incline planes as US, Japan, Russia, Canada

## 1. Earlier reports to be reviewed

Supplement to bulletin N° 65 (1989) "Ship lifts" is the first technical report on shiplift. The report summarized the application circumstances of shiplifts, classification of shiplifts, specific principles and characteristics of shiplifts, examining 8 typical shiplifts. This information should be reviewed by the more specialized members of the new working group and then be enhanced and integrated. Report No. 106 "Innovation in navigation lock design" presented the detailed innovations of Falkirk Wheel Shiplift (UK).

## 2. Scope

### Matters to be investigated:

- An overview of shiplift construction achievements, including typical case studies of shiplifts built or designed during the past 30 years, e.g., Three Gorges Shiplift in China, Jinghong Shiplift in China, Silin Shiplift in China, reconstruction of Danjiangkou Shiplift in China, Strépy-Thieu Shiplift in Belgium, new Niederfinow Shiplift in Germany and Falkirk Wheel in UK;
- Innovations in shiplift design, including new methodologies and technologies/concepts;
- Standards and regulations of shiplift design, construction, management and maintenance;
- Overall layout of shiplifts in navigation structure and their selections (including the specific hydraulic aspects of the shiplifts as ship accessibility and manoeuvrability, protection of doors against the shocks, generation of long waves during the translation, the evacuation of the volume of water between the doors before the beginning of the translation, the management of the water levels o for a ship lift implanted in a river, sedimentation aspects,...);
- Experiences of shiplift operation and maintenance;
- Old shiplifts and incline planes, from navigation structures to historical heritage conservation;
- Characteristics and application scopes of different types of shiplifts, through comparison with other technologies such as locks with water saving basins.

### Method of Approach

Evaluation of research, design, construction, management and maintenance of shiplifts and approaches used for operational, engineering, financial and policy decision-making. This will include conceptual design, design research, analytical models, numerical models, desktop and physical models, prototype survey and test, which are used to address the new developments of shiplifts in the world.

Water resources, CAPEX and OPEX cost, environment, reliability, maintenance, longevity, etc., need to be considered for recommendations and comparison

The global cost and socio-environmental impacts of a IWT development depends, firstly, of the types of hydraulic works as locks (1,2,3,...), ship lifts, inclined plans or a combination of them. It is thus necessary to develop a methodology to make an objective analysis of all the possible

situations through, for instance, a multi-criteria analysis!

### **3. Intended product**

1) Working Group Technical Report. All results will be described in a published PIANC report. The final report will be a good technical guidance for persons involved in shiplift research, design, construction, management and maintenance, with a specific focus on the historical shiplifts.

2) Database of shiplifts, including brief lists of the types, dimensions and technical parameters of representative shiplifts in the world.

3) Short presentation of representative shiplifts (case studies), which can be added on PIANC large infrastructure database.

4) If practical and appropriate, the WG will prepare a technical press release brief and organizing workshops to disseminate the main outcomes.

### **4. Working Group membership**

Organizations representing inland navigation systems, especially waterways/canals with shiplifts (e.g. waterway management organizations, governmental administrations, consultants from China, UK, Germany, Belgium, France, Canada and etc.), as well as academic and private researchers. Waterways authorities and specialized maintenance companies are expected. General experts in navigation structures, from other domains, and from countries that may build shiplifts in the future (e.g. Brazil), are welcome.

Because of the difficulties/costs of traveling in China, it may be interesting to set up local sub WGs as, i.e., a sub-European group (D, BE, F, UK,...) for the historical heritage issue.

### **5. Relevance for Countries in Transition**

The subject of the working group can be considered as universal and will also be applicable, and can be helpful, for inland waterway projects in countries in transition. The report could be of value for countries in transition in supporting their application for a grant to a development bank or other fund holder.

### **6. Climate Change**

During the preparation of the report, the possible impacts of Climate Change should be considered and any findings and/or recommendations should be made accordingly.