Jinghong Hydro-floating Ship lift—An special ship lift that does not use electricity

Leyu Ding

Nanjing Hydraulic Research Institute

2021.11

Contents

NHRI Since 1935
南京水利科学研究院

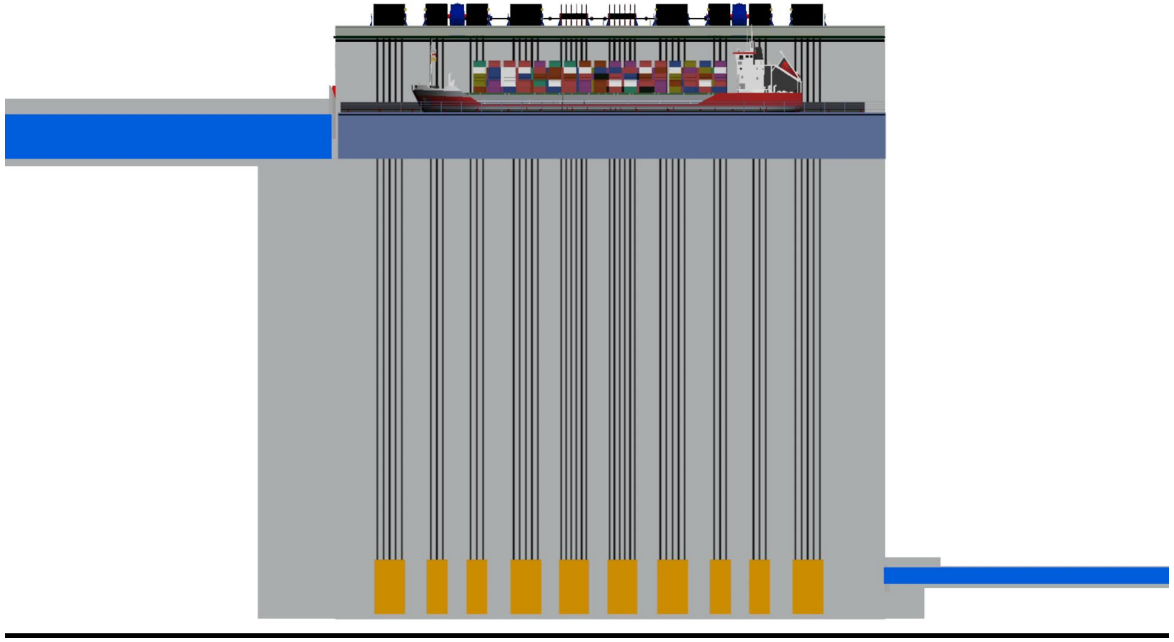
Part.1 Ship lifts on the dam

Introduction to ship lift

Navigable buildings - locks, ship lifts

Ship lifts

- Use less water、Run faster
- It has irreplaceable advantages in the navigation of high dams above 70m



The ship lift in Strebe, Belgium

Introduction to ship lift

The classification of ship lifts

- **By the track of the cabin**
  - Vertical ship lift —— Like Vertical elevator
  - Slanted ship lift —— Like escalator
  - Rotating ship lift —— Like Ferris wheel
- **Whether the cabin is in the water or not**
  - Not water-type（Mechanically balance）
  - Water-type（ Self-adaptive balance ）

Introduction to ship lift

Vertical ship lift

- ✓ **Driven by steel wire rope**

  Strebe, Belgium、Goupi beach China、Slynn、Sand, etc

- ✓ **Driven by rack and pinion**

  Niederfino Germany，Sanxia China、Xiangjia Dam China

The process of raising

Introduction to ship lift

- Slanted ship lift
  - ✓ Horizontal slope ship lift

  Vertical slope ship lift
  - ✓ Water slope

Horizontal slope lifter in Saint Louis-Arzviller

Vertical slope lifter in Longcur, Belgium

Montech Water slope

Introduction to ship lift

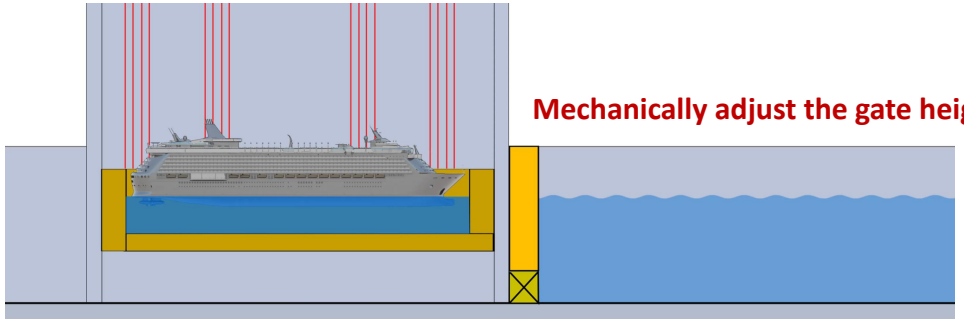
NHRI Since 1935 南京水利科学研究院

- Rotating lifter

Falkirk, Scotland

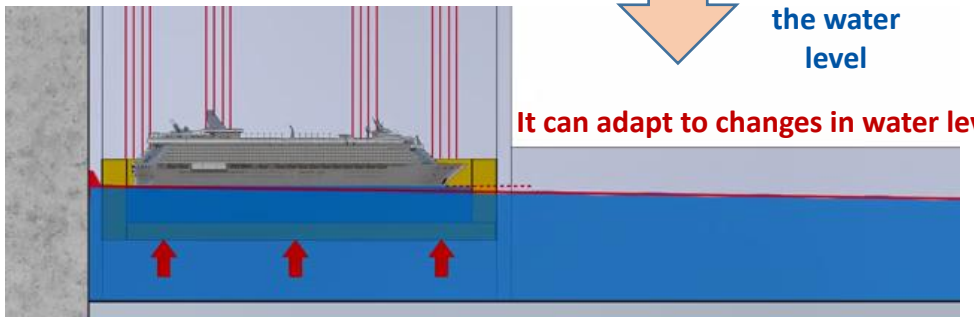
Introduction to ship lift

China's unique cabin underwater ship lift



The cabin does not go into the water

Change fast to adapt to the water level



The cabin goes into the water

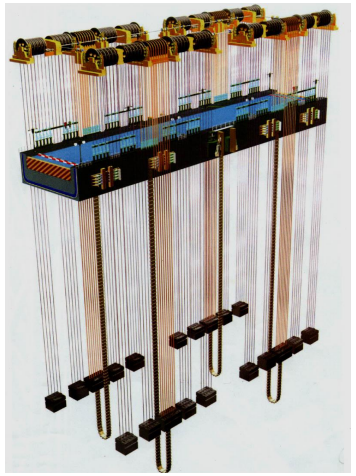
- Partial balance、Heavy load、High energy consumption
- Operating loads vary by thousands of tons

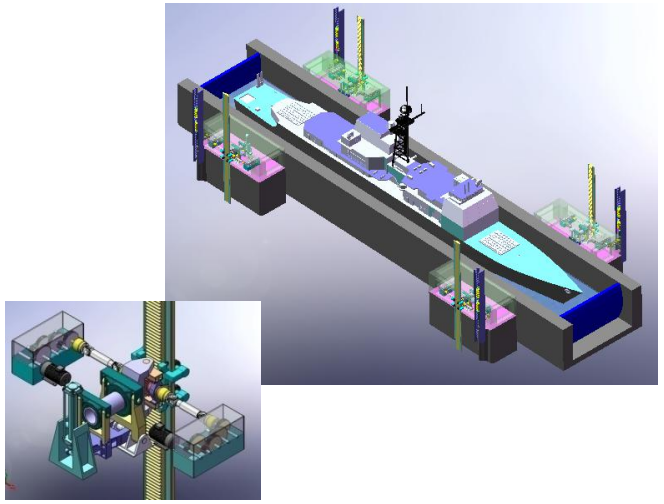
Introduction to ship lift

NHRI Since 1935 南京水利科学研究院

The common problem of traditional ship lift

- Powered by electricity, high energy consumption and high cost of use and maintenance.
- Neither can adapt well to the rapid change of water level in the lower reaches of rivers in China.





Part.2 Hydro-floating Ship lift

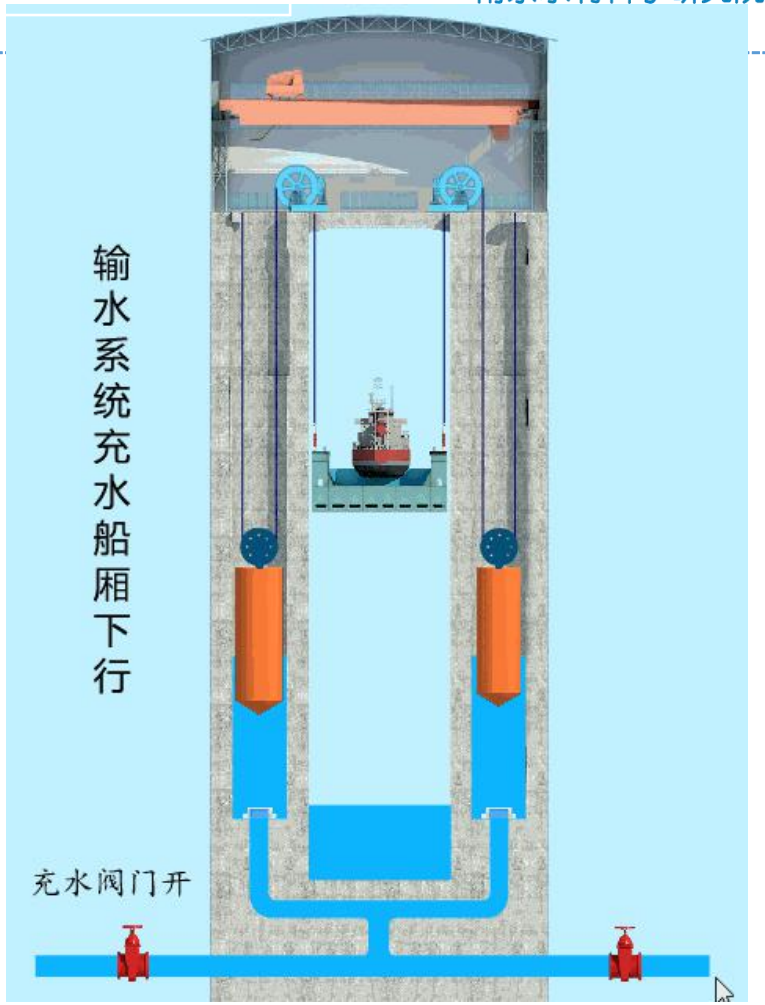
Hydro-floating Ship lift

NHRI Since 1935 南京水利科学研究院

Pioneered by China

Chinese scientists have proposed a new type of ship-lifting model that can use water energy to enhance power and safety——Hydro-floating Ship lift.

- The water transfer system fills/drains the shaft，drive the cabin up/down. When the load changes，the submerged water depth adaptive changes，a new equilibrium state will reached between the cabin and the balance weight.

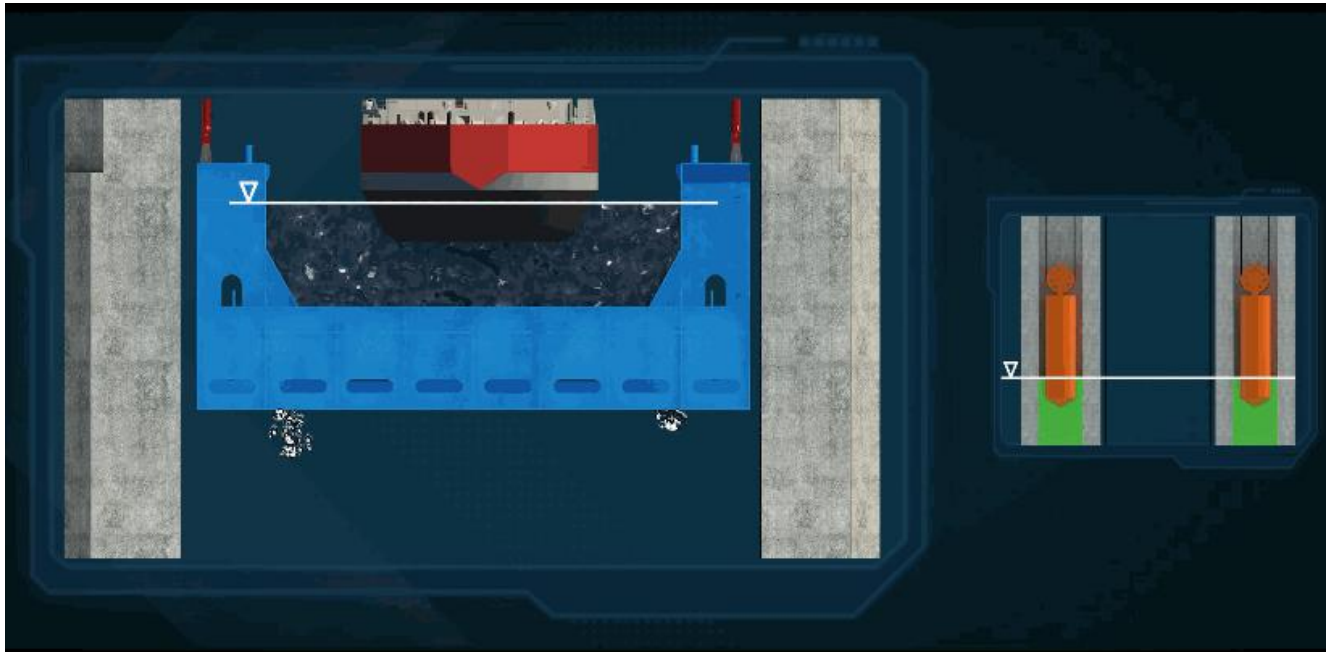


Hydro-floating Ship lift

NHRI Since 1935 南京水利科学研究院

Advantages

- Realized the real meaning of "adaptive balance" in the history of ship lift.**Eliminates the safety risk of the lift's operation in principle.**
- Adapted to the characteristics of rapid and large changes in river water levels in the central and western regions of China.
- Reduced installation costs, operation and maintenance costs.

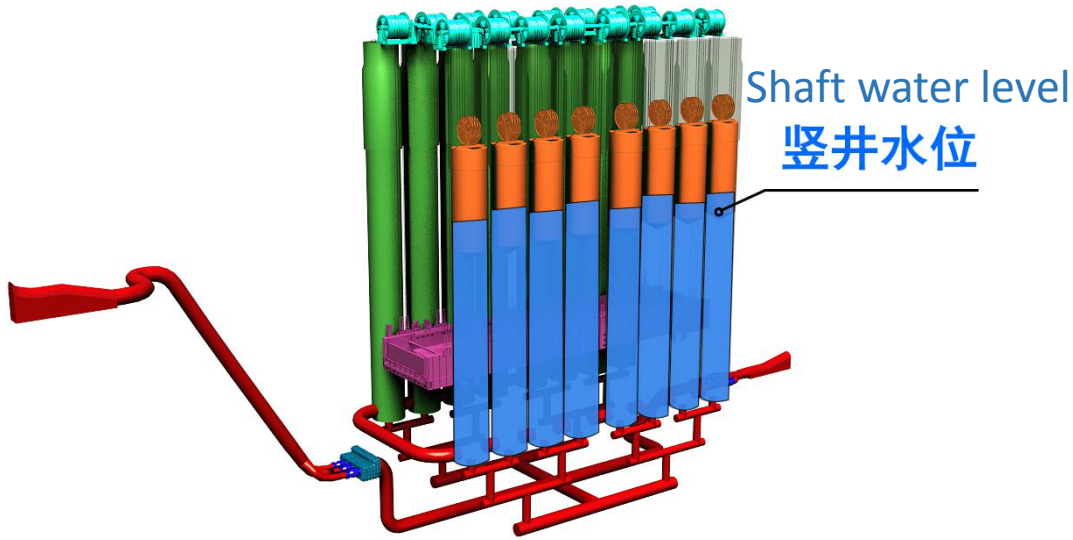


Hydro-floating Ship lift

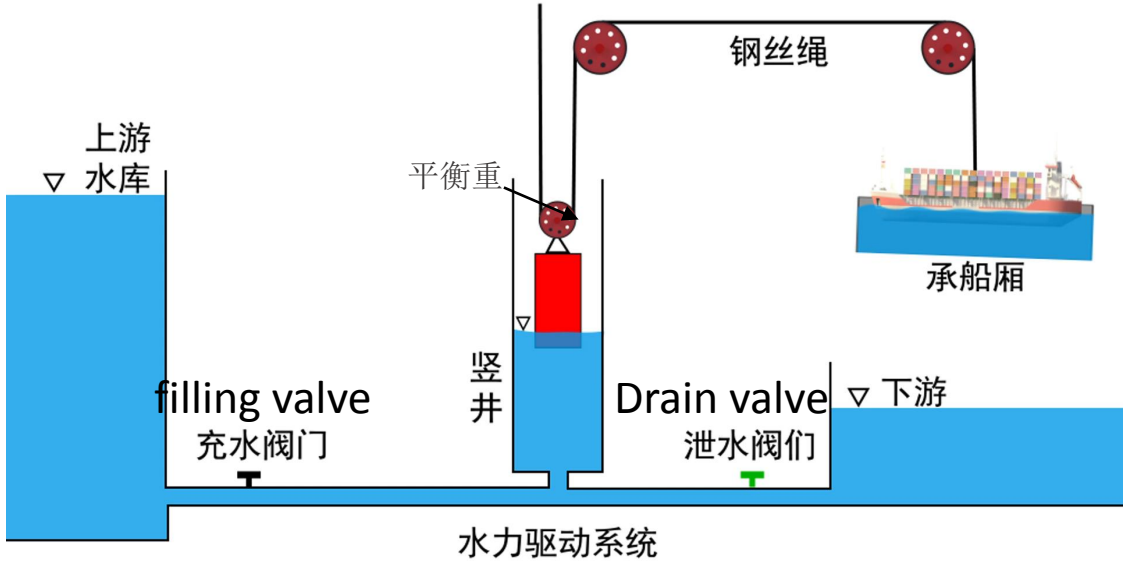
NHRI Since 1935 南京水利科学研究院

Problem.1 Hydraulic synchronization in different shaft ——the core and foundation of Hydro-floating Ship lift

- How to synchronize the water level of the 16 vertical shafts to ensure the smooth lifting of the cabin?



水力驱动系统示意图



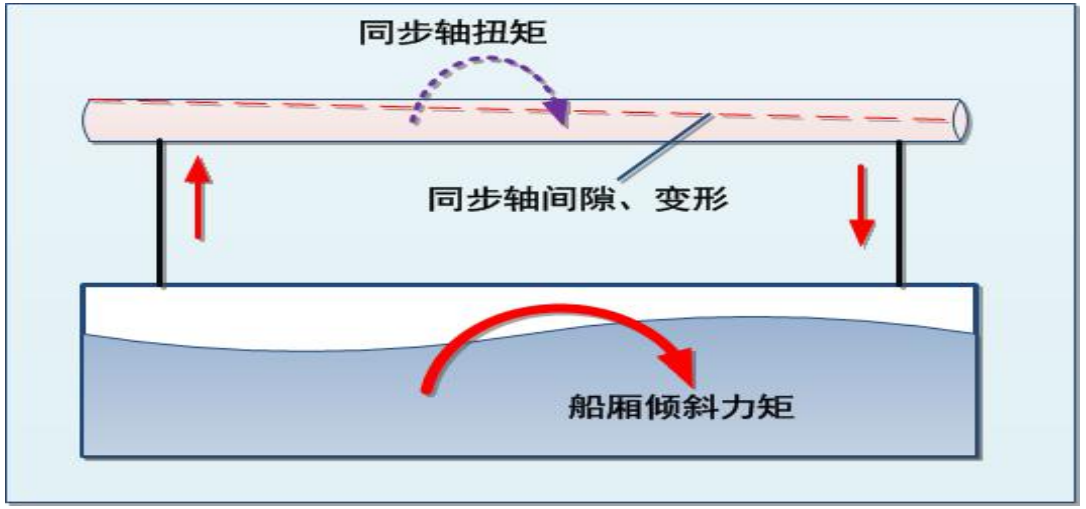
“水～机～厢”耦合作用概化图

Hydro-floating Ship lift

NHRI Since 1935 南京水利科学研究院

Problem.2 Anti-tilting of the cabin without motor correction

- The traditional ship lift controls the motor speed and output to actively eliminates various errors such as gaps and uneven loads
- The hydro-floating ship lift has no motor and reducer, and the tilting load will directly act on the synchronization system

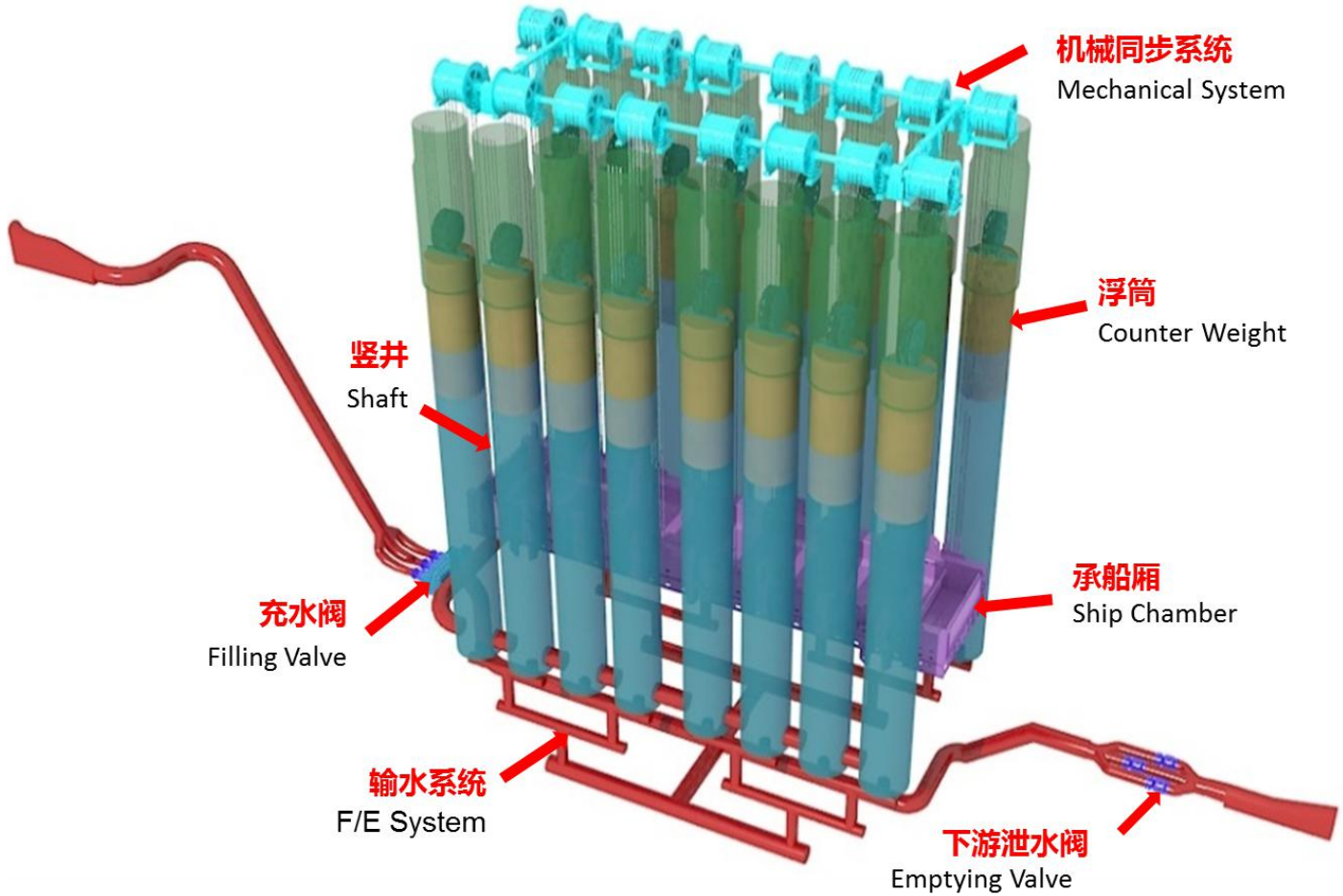


Part.3 Technical Innovation

Innovation.1

NHRI Since 1935 南京水利科学研究院

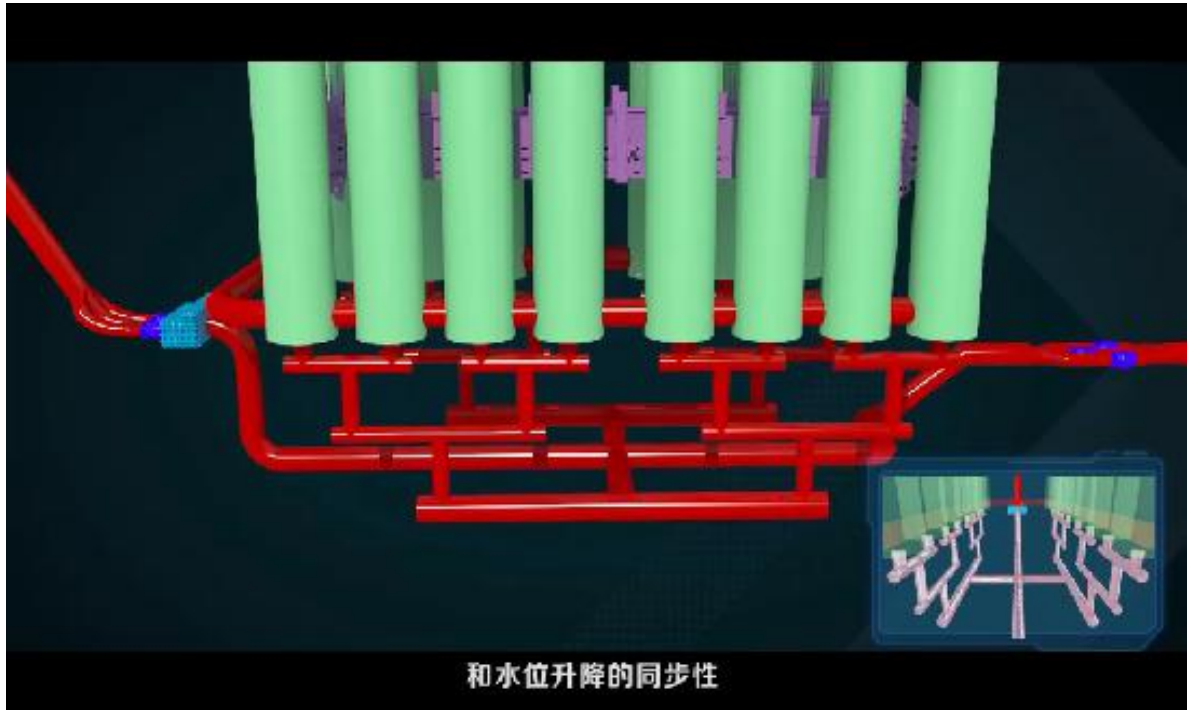
Creat the type of “independent shaft + equal inertial F/E system” (filling and emptying system).

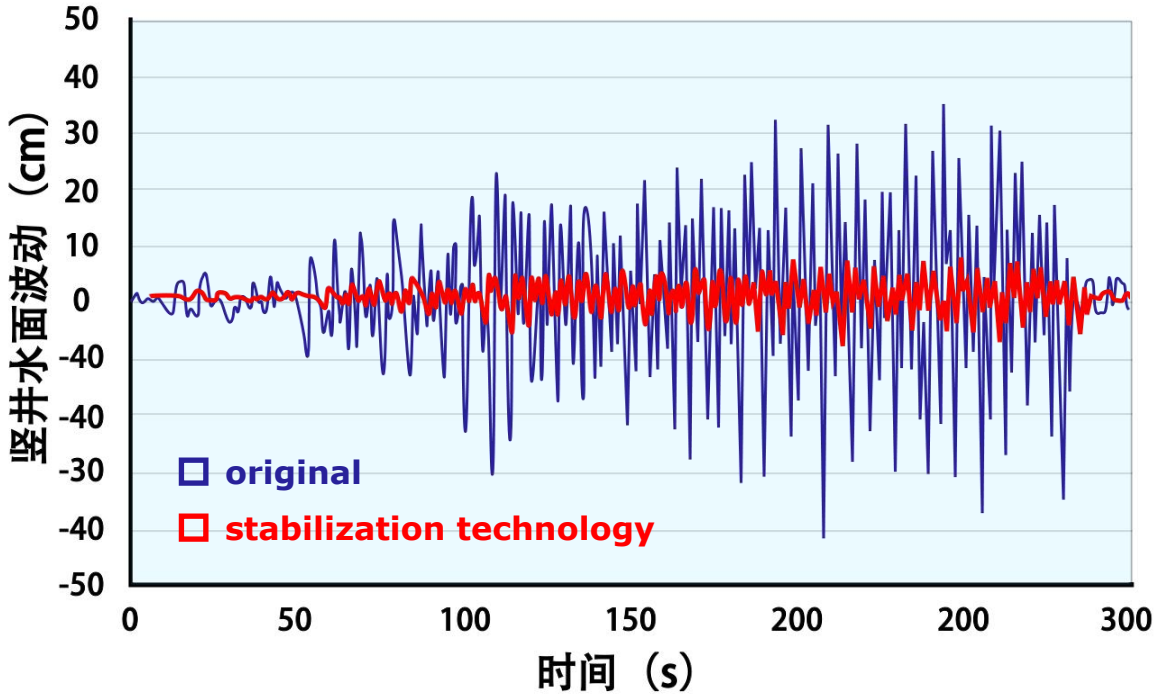


□ Main components of HFSL

Innovation.1

- After passing through the culvert diversion ports, the flow is diverted to the next stage by right-angle elbow.The water flow from the upstream main pipe is distributed to individual shafts by four diversions.From the point of view of geometric structure, the branch pipeline is completely symmetrical.

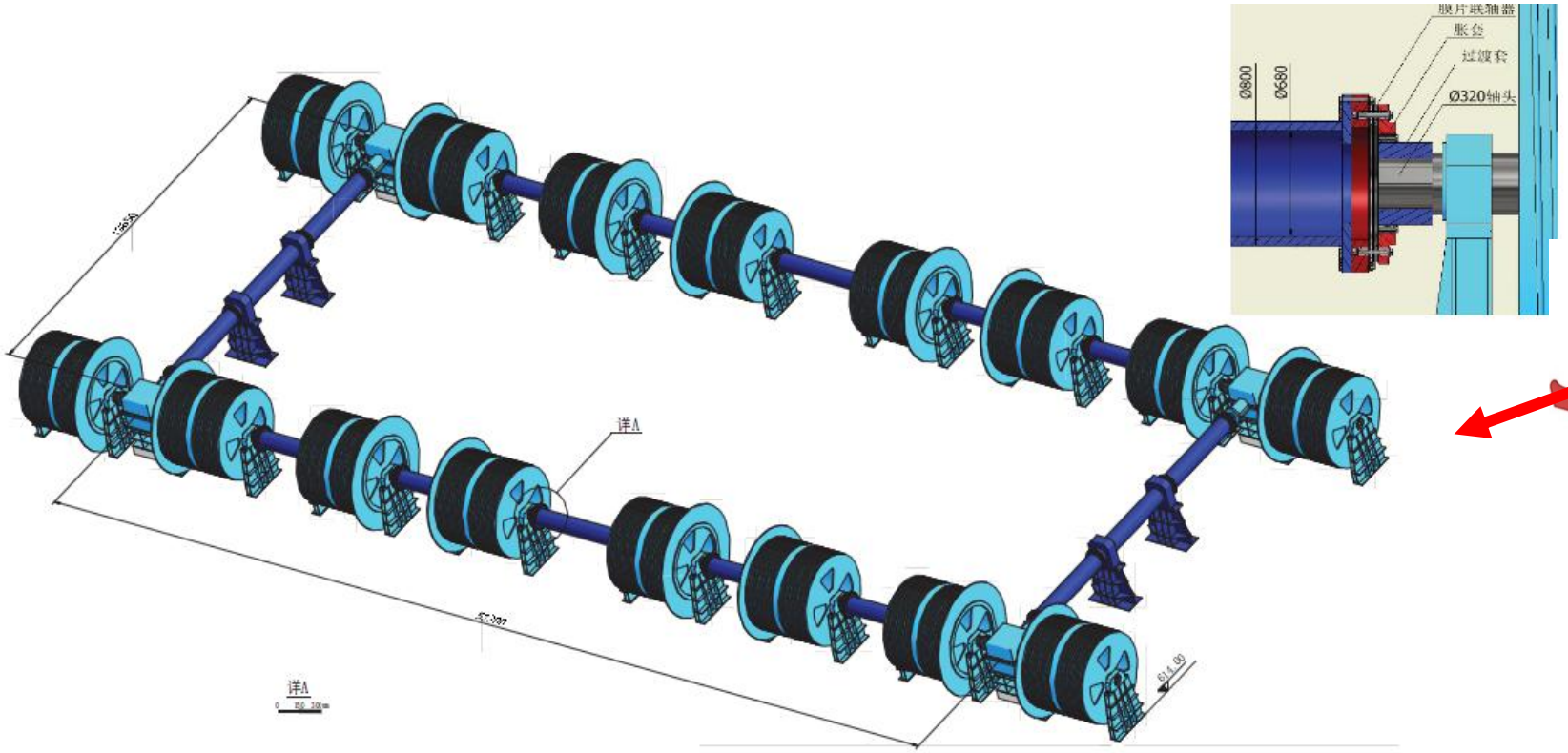


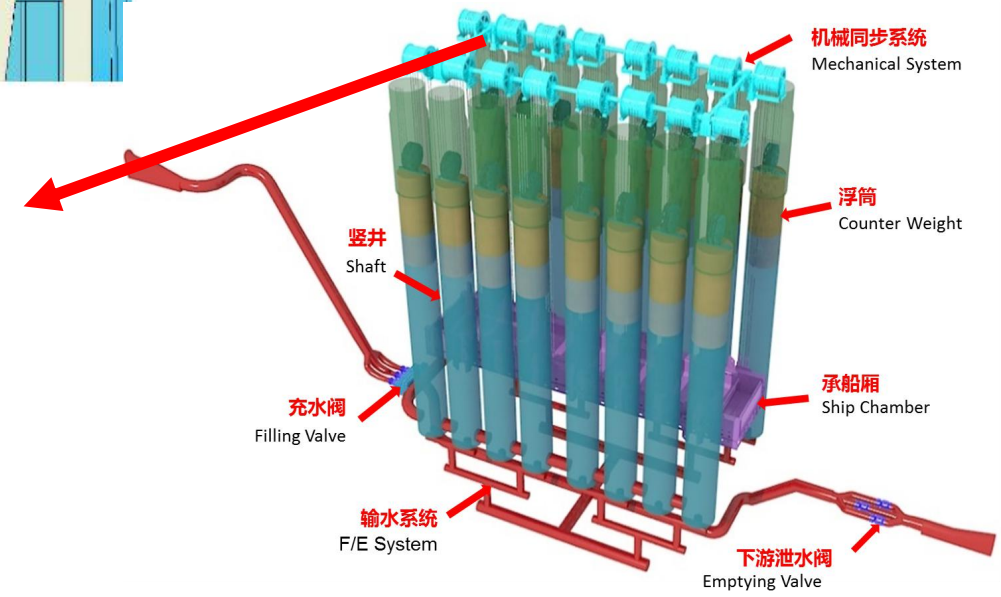


Innovation.2

NHRI Since 1935
南京水利科学研究院

Propose the anti-tilt technology of the ship cabin without motor correction



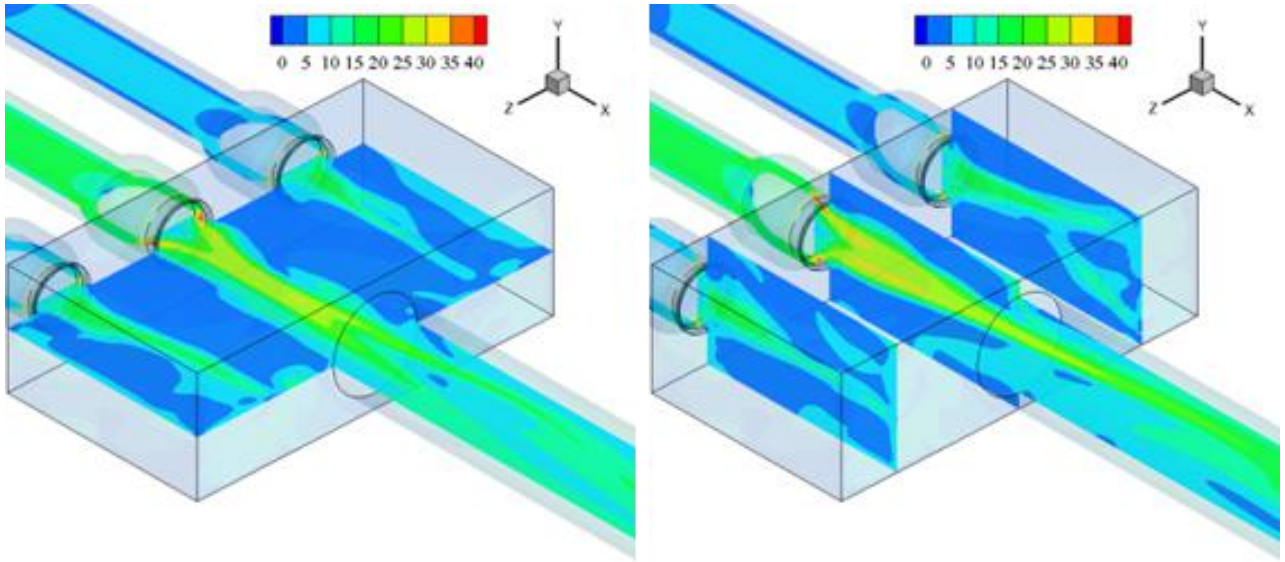


Innovation.3

NHRI Since 1935 南京水利科学研究院

Propose valve control technology to solve the problem of cabin operation and docking

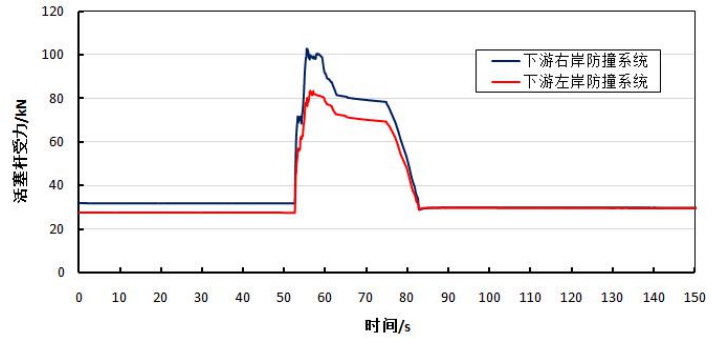
- A main valve and two auxiliary valves with a small flow rate are set to precisely adjust the water delivery flow, so as to realize the rapid operation of the hydraulic shiplift and the precise docking of the cabin.

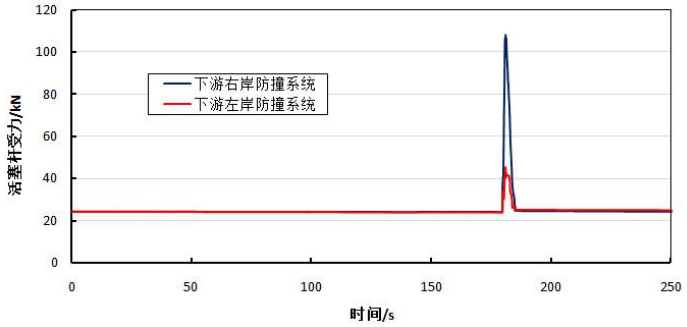


Innovation.4

NHRI Since 1935 南京水利科学研究院

- The reliability and effectiveness test of the anti-collision device of the ship lift was carried out on site for the first time to reveal its working principle and test the anti-collision effect of the device

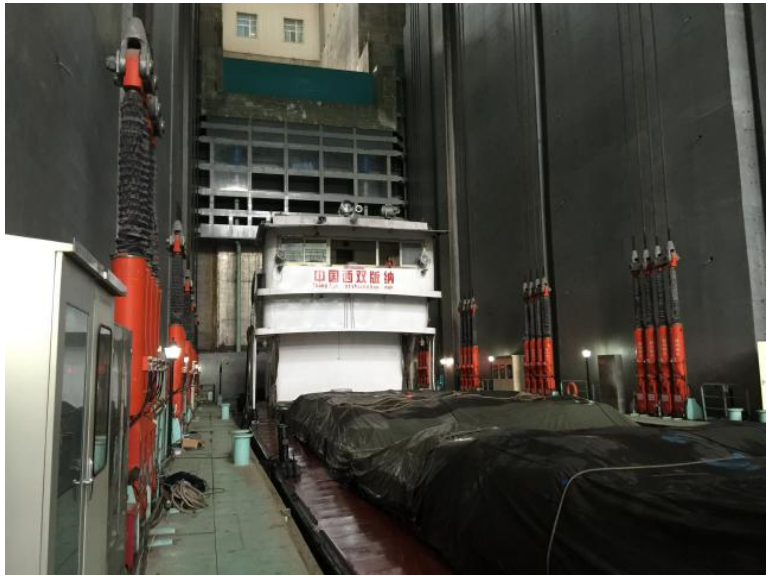




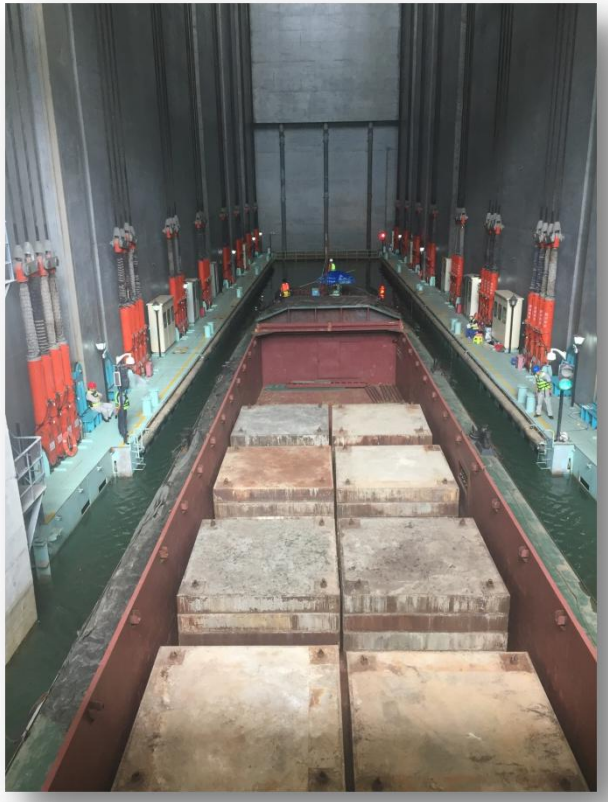
Part.4 Application and Economic Benefits

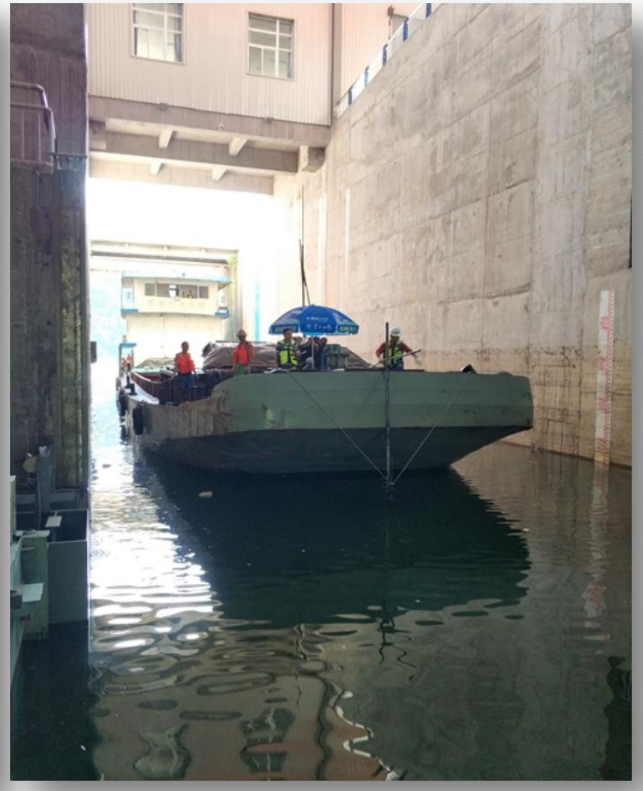
NHRI Since 1935
南京水利科学研究院

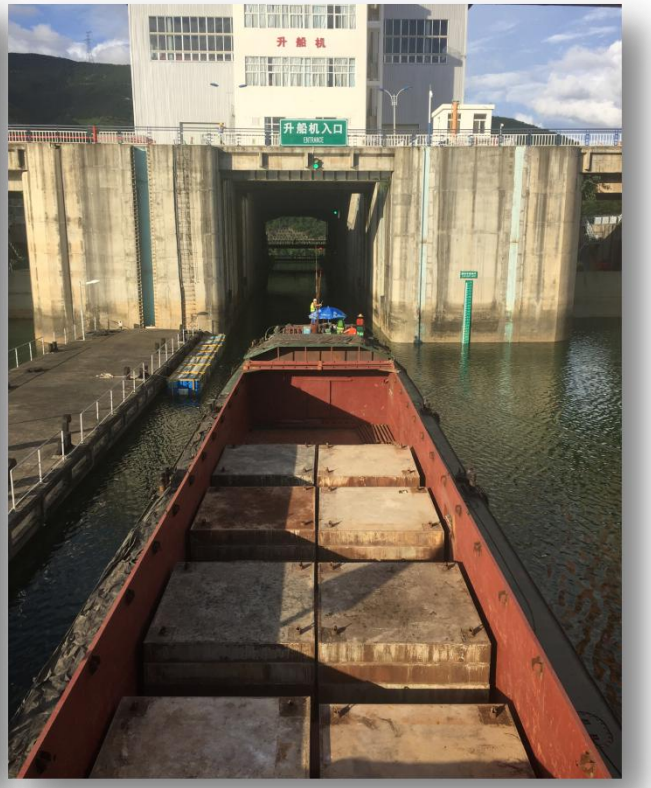
Jinghong HFSL has gone into operation in Nov, 2016



Application and Economic Benefits







For the scale of the 500t ship lift, the Hydro-floating Ship lift can save more than 14% of the investment compared with the traditional vertical ship lift and can save about 2 million to 3 million yuan in operation and maintenance costs each year.

Thanks for your listening!

Leyu Ding

Nanjing Hydraulic Research Institute

2021.11