



Korea Combat Engineering Equipment Road-Map

**&
Korea Amphibious Bridge Vehicle**



Contents



KABV

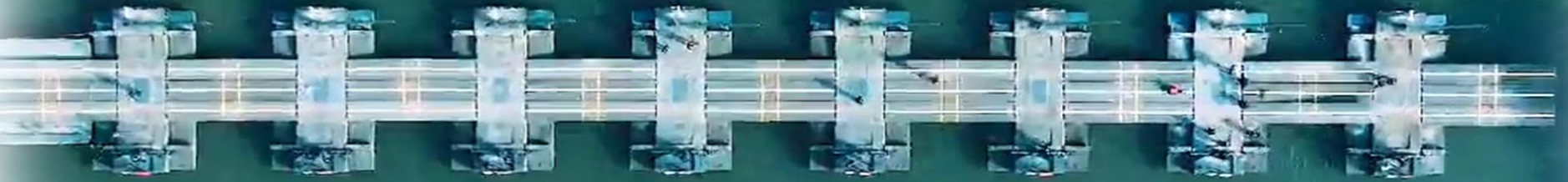
 Hanwha Aerospace

1 **Korea Combat Engineering Road-Map**

2 **What is New KABV?**

3 **M&S of KABV for Surface Operation**

4 **Q & A**



Korea Combat Engineering Equipment Road-Map

Future Combat Engineering Role and Vision

Current

**Mobility-support
leading
Strong & Fast
Engineering**

high mobility
self-propelled
armored

Future

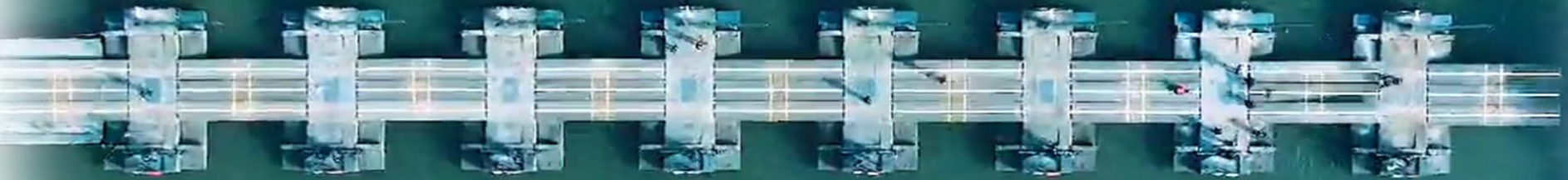
**MUM-T
Next generation
Engineering**

hyper connectivity

Conceptual

**Advanced Scientific
Multi-functional
Engineering**

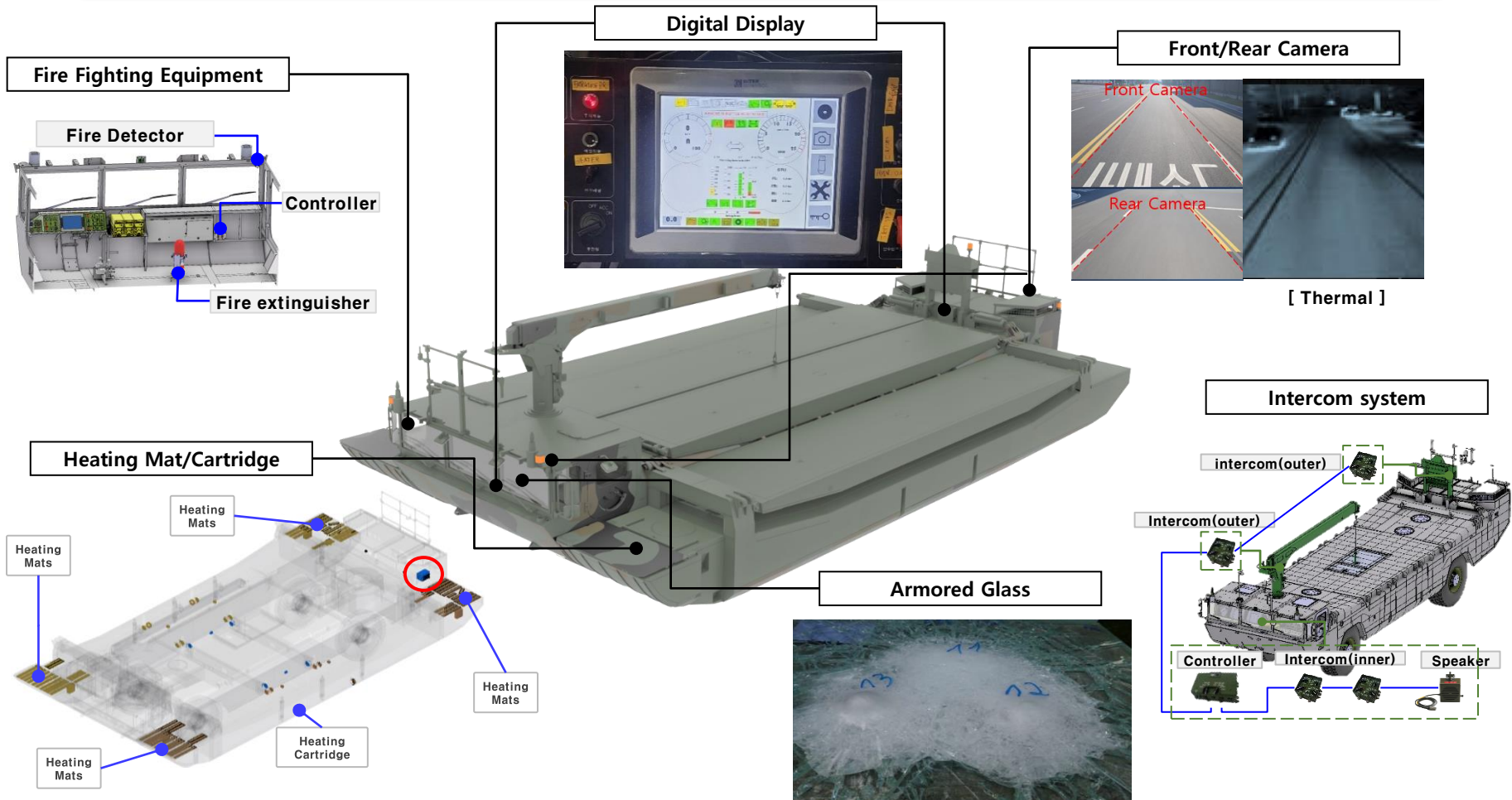
strong AI
unmanned
multi-dimensional



What is New KABV?

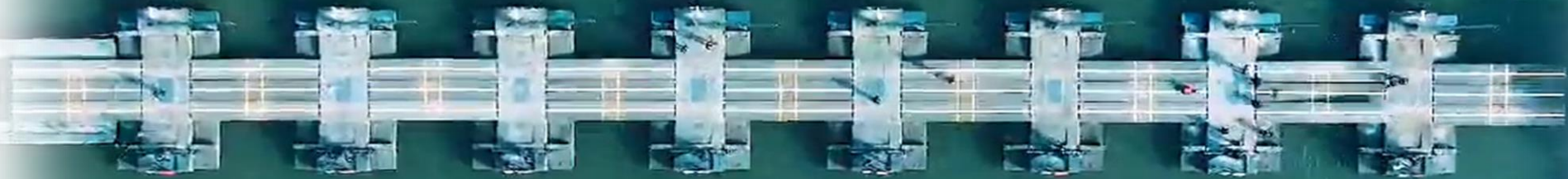
2 What is New KABV

Features specific to KABV



2 What is New KABV

Enjoy KABV Video



M&S of KABV under Extreme Surface Operation conditions

Contents

- Introduction
- Water operations
- Building Models
- CFD Model
- Ice breaking/impact Model
- Raft/Bridge M&S Model
(Modeling, Simulation results, Validation)
- Conclusions

Introduction

□ Background

- The topographical environment of the Korean Peninsula
 - Korea, with numerous rivers developed in the east-west direction, requires crossing many rivers depending on operational area.
 - Rivers presents substantial obstacles for mobile units carrying out missions, imposing numerous constraints in operational environment.
- M&S for KABV(Korea Amphibious Bridge Vehicle)
 - M&S has been used to assess the satisfaction of requirements regarding the river crossing capability of KABV, to verify the impact of extreme environmental conditions, and to confirm operational performance and safety under various operating conditions.
- Technology Cooperation Production
 - Foreign-developed weapons systems, tested and proven suitable for combat, are being domestically produced through technology cooperation, involving the transfer or leasing rights to foreign original equipment manufacturers or with foreign support.



< Rivers in Korean Peninsula near Seoul >

3

M&S of KABV for Surface Operation

Water operations

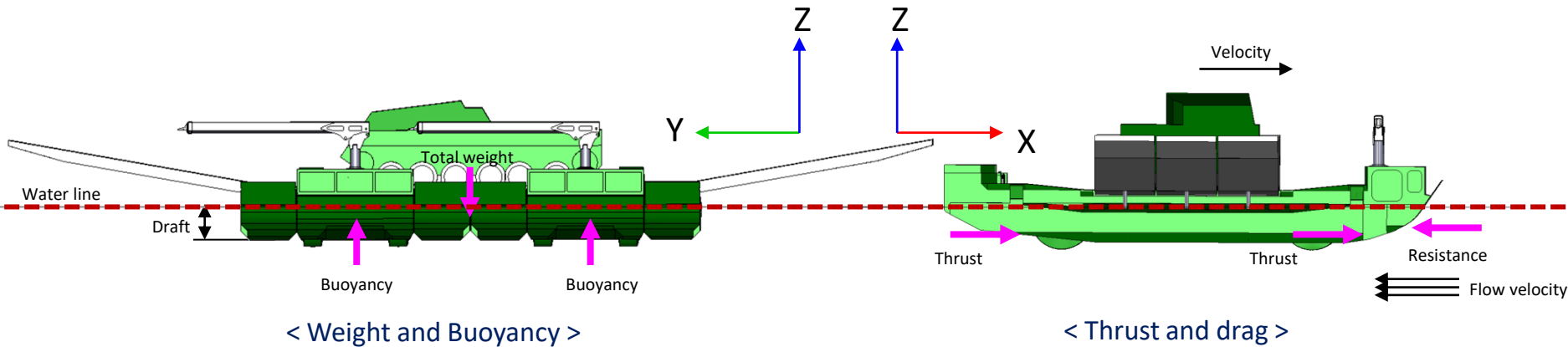
Basic theory

Weight & Buoyancy : Draft

- The total weight (raft model with vehicle model) is balanced by the buoyancy generated by the submerged volume in water.

Thrust & Drag : Velocity

- Propulsion of the raft is achieved by a thrust greater than the resistance caused by the flow velocity.



Building Models

□ KABV M&S Models

- CFD Model (Star-CCM+ model)

- Raft (Close coupled) resistance
- Bridge (Open coupled) resistance



Drag force results →

Drag force results

- Raft M&S Model (Ansys Motion model)

- Raft model
- Vehicle model
- Environment model (River, ground)
- Scenario

- Bridge M&S Model (Ansys Motion model)

- Bridge model
- Vehicle model
- Environment model (River, ground)
- Scenario

- Ice breaking & impact Model (LS-Dyna model)

- Ice breaking
- Ice impact

- Structural M&S Model (Ansys, structural model)

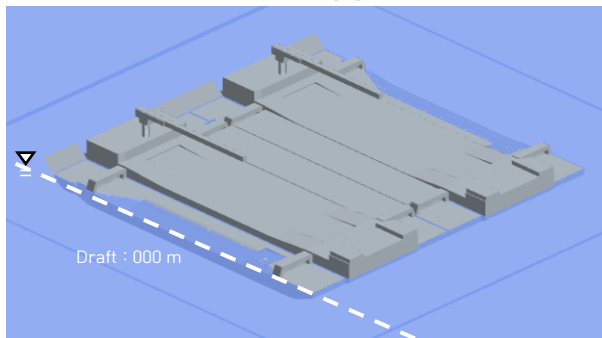
- Simple bridge model
(two KABV connected open coupled)
- Hinge model

CFD Model

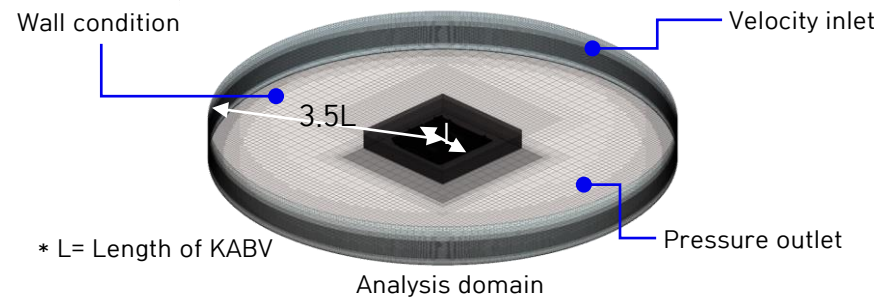
□ Modeling

● Star-CCM+

- Raft model for CFD : Two KABV are connected side by side.
- Velocity inlet condition : Constant velocity condition applied on the side of the domain according to inflow angle.
- Pressure outlet condition : Atmospheric pressure condition(≈ 101 kPa) applied on the top of the domain.
- Wall condition : None slip wall conditions applied on the hull of KABV and the bottom of the domain.
- Mesh is generated by Star-CCM+ as trimmer mesh. (Number of cells : 17.6 M)
- Overset mesh is applied on hull of KABV to simulate the motion of the vehicle well.



< Raft model for CFD >



< Boundary conditions and mesh >

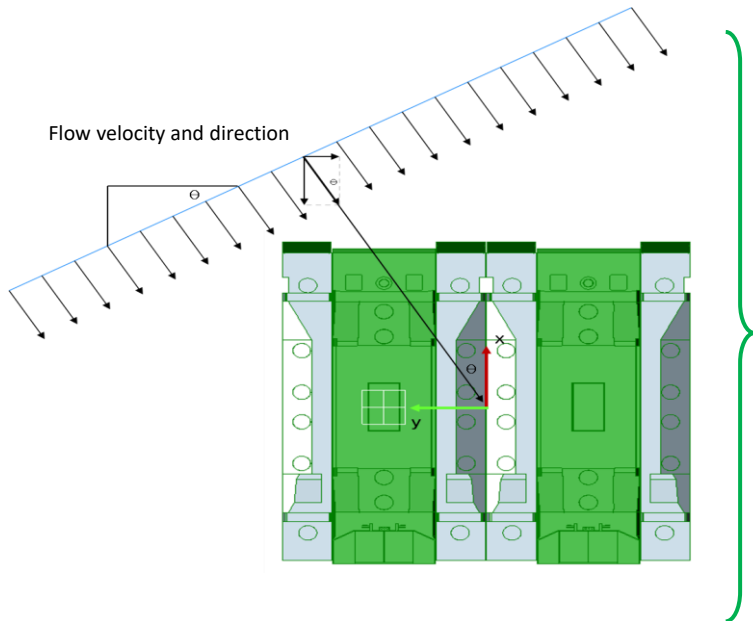
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M&S of KABV for Surface Operation

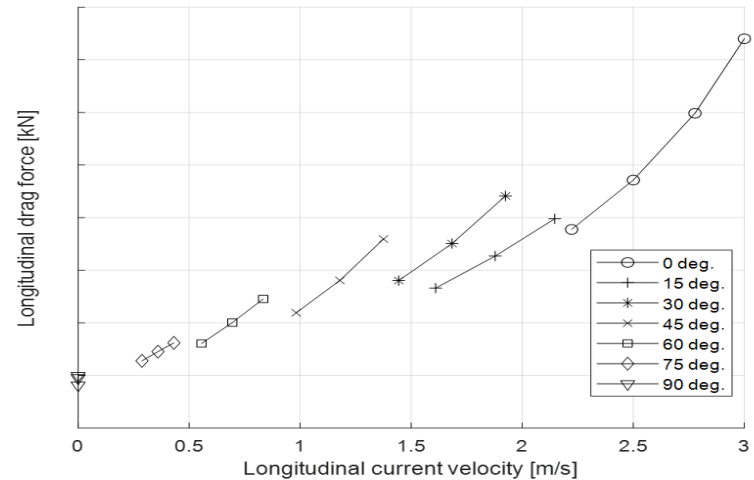
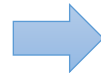
CFD Model

Simulation results

- This shows the result of calculated resistance based on flow velocity and direction.
- Longitudinal resistance tends to increase with higher flow velocity and decrease as the flow velocity angle becomes larger.



< flow condition for drag >



< Longitudinal drag force >

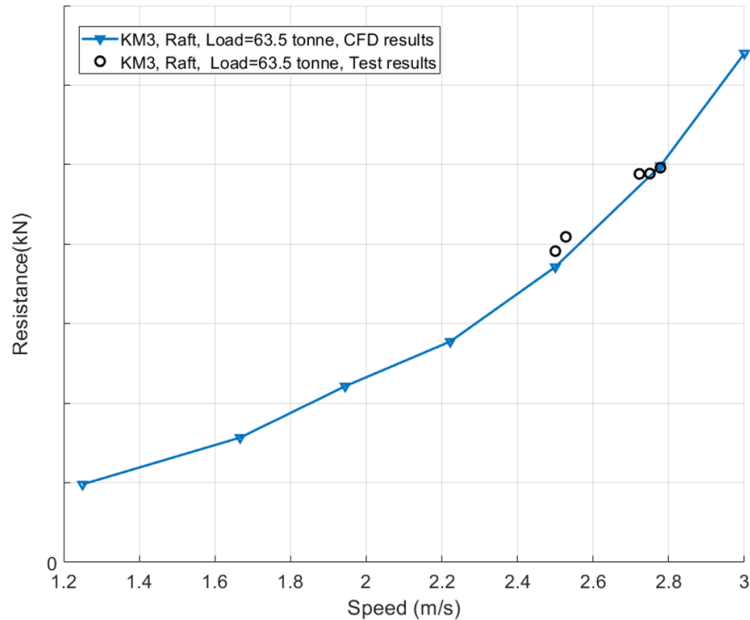
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M&S of KABV for Surface Operation

CFD Model

Validation

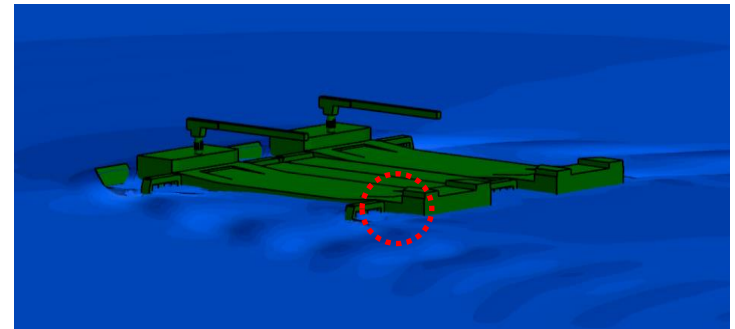
- Resistance results between CFD and experiment are good agreement.



< Comparison of resistance results >



< Photo of the experiment >

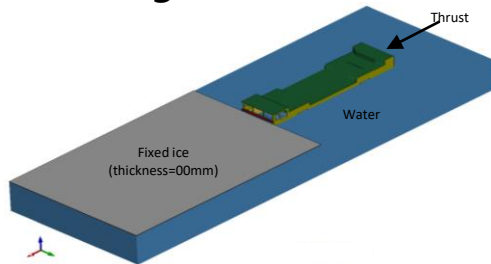


< CFD result >

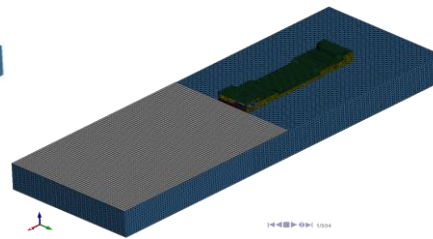
Ice breaking/impact Model

□ Modeling, Simulation results

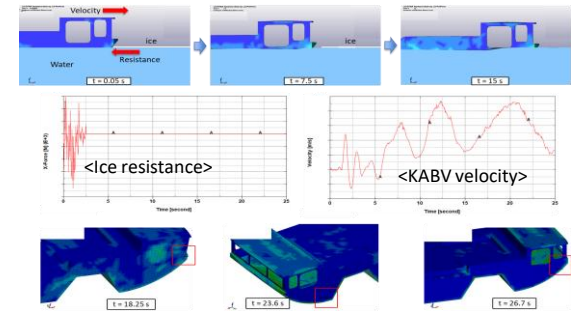
- Ice breaking analysis was conducted to determine if the thrust of KABV could break through a fixed ice with a thickness of 00 mm.



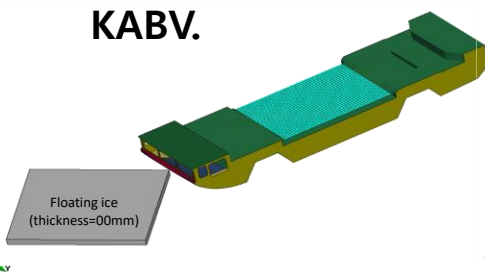
< Ice breaking concept >



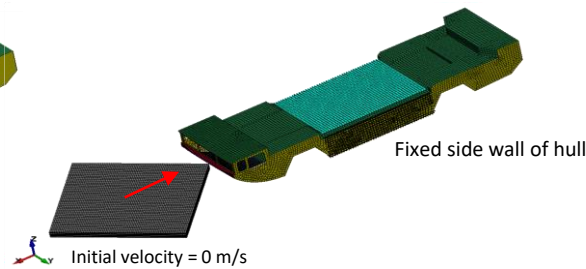
< Ice breaking model >

< Stress distribution >
< Simulation results >

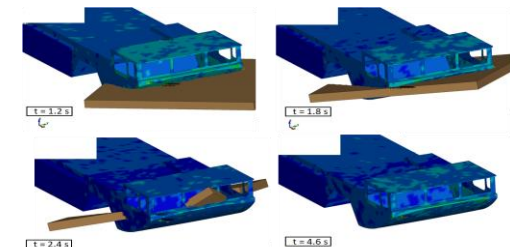
- Ice impact analysis was conducted to verify the structural integrity when ice collided with KABV.



< Ice impact concept >



< Ice impact model >



< Simulation results >

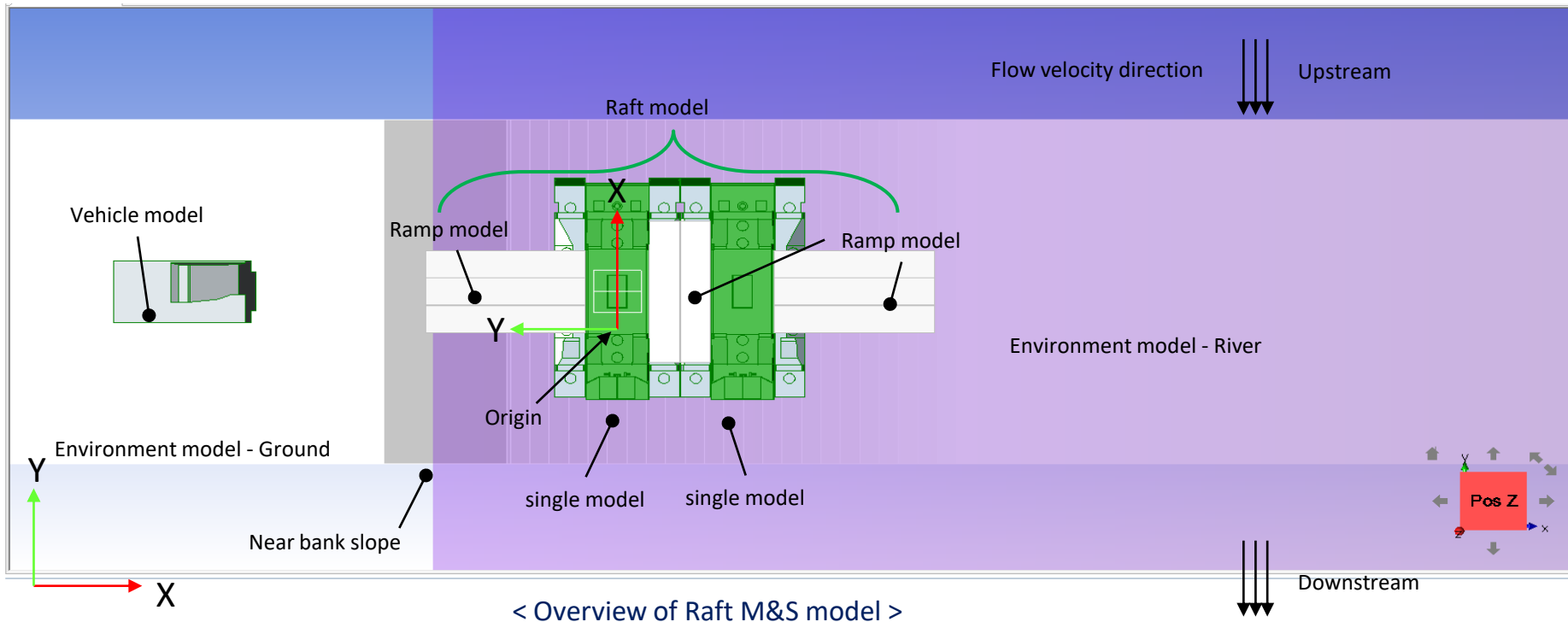
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M&S of KABV for Surface Operation

Raft M&S Model

□ Overview of Raft M&S Model

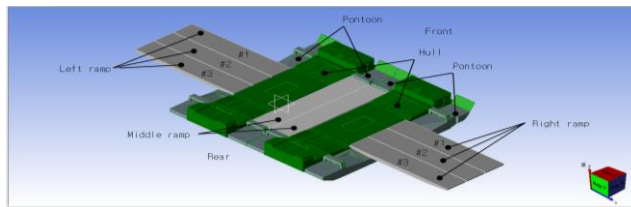
- Predicting its River crossing capabilities under various conditions. (Vehicle weight, flow velocity, etc.)



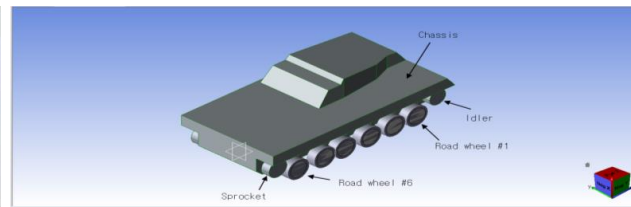
Raft M&S Model

□ Modeling – Components

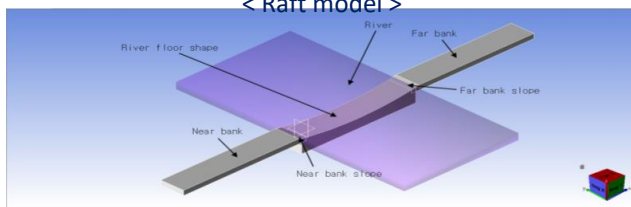
- Raft model : Two KABV are connected, close coupled type
- Vehicle model : A MLC OO Tracked vehicle modeled in a similar manner to a wheeled vehicle, excluding the track.
- Environment model : The density and flow velocity of a River modeled for both the near and far bank roads
- Simulation scenario : Simulation conditions set in the same order as the actual operation of the raft.



< Raft model >



< Vehicle model >



< Environment model >

- ① Initial condition
- ② Left ramp down
- ③ Vehicle move to raft model
- ④ Left ramp up
- ⑤ Driving in Water to reach far bank
- ⑥ Right ramp down
- ⑦ Vehicle move to far bank
- ⑧ Right ramp up

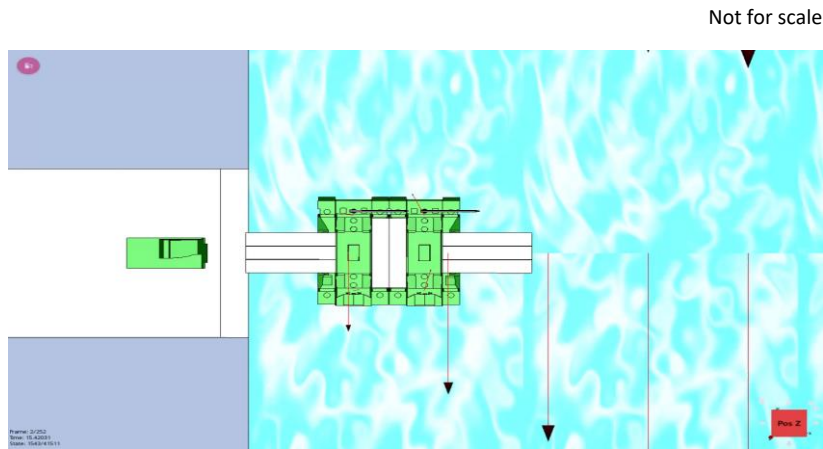
< Simulation scenario >

< Components of Raft M&S model >

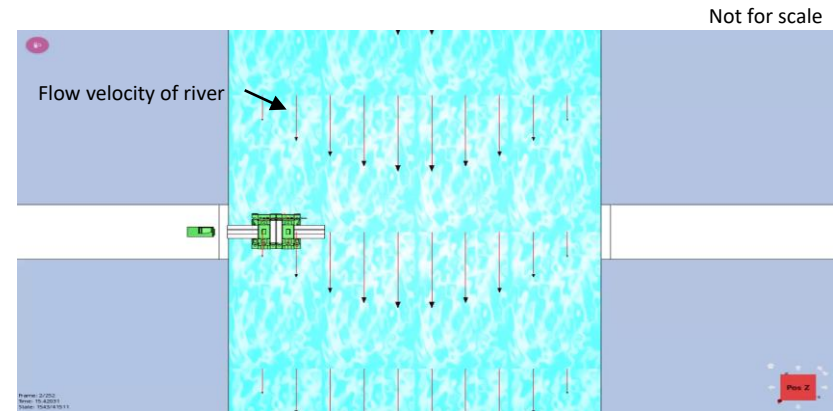
Raft M&S Model

❑ Simulation results

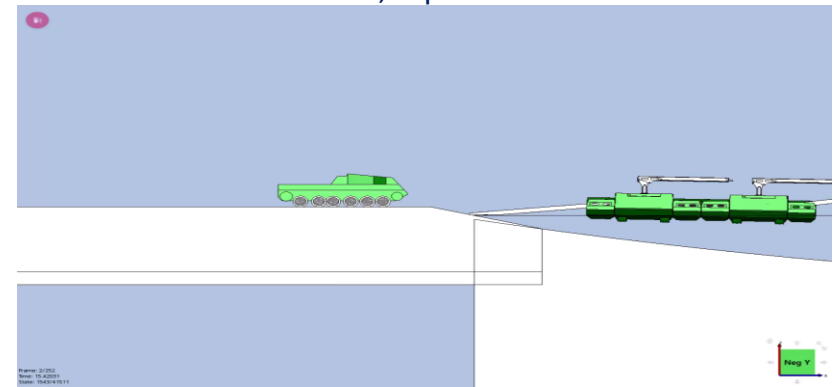
- Vehicle weight 00 tonne, flow velocity max. 0 m/s given.
- Attached arrow in raft model means the thrust forces determined by simple logic with commanded trajectory.



< Enlarge view - video >



< Simulation result, top view - video >



< Simulation result, side view - video >

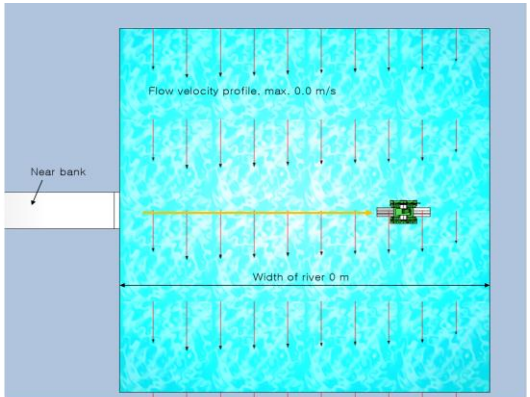
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M&S of KABV for Surface Operation

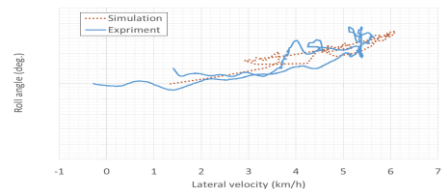
Raft M&S Model

Validation

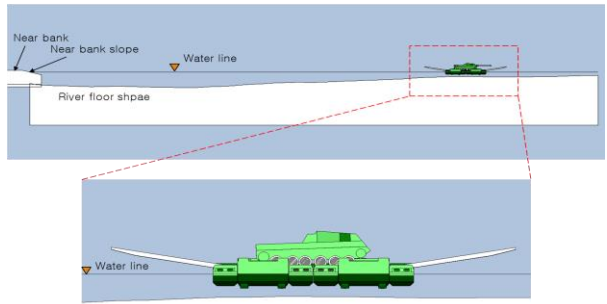
Comparison with experiment



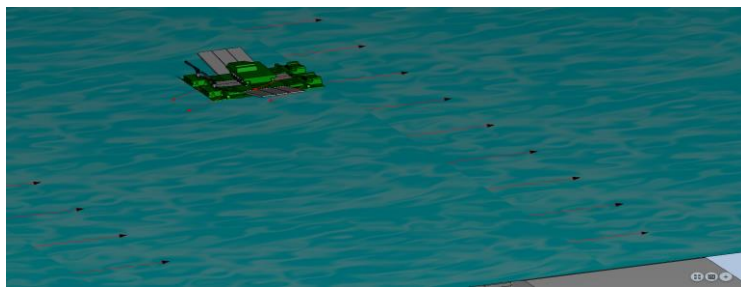
< Photo of raft operation >



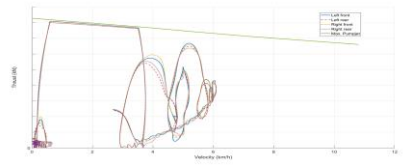
< Roll angle - Exp. vs. Sim >



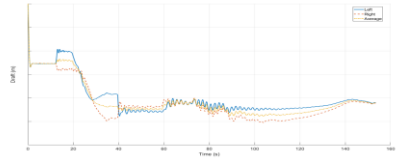
< Simulation of raft operation >



< Simulation of raft operation >



< Thrust - sim. >



< Draft - sim. >

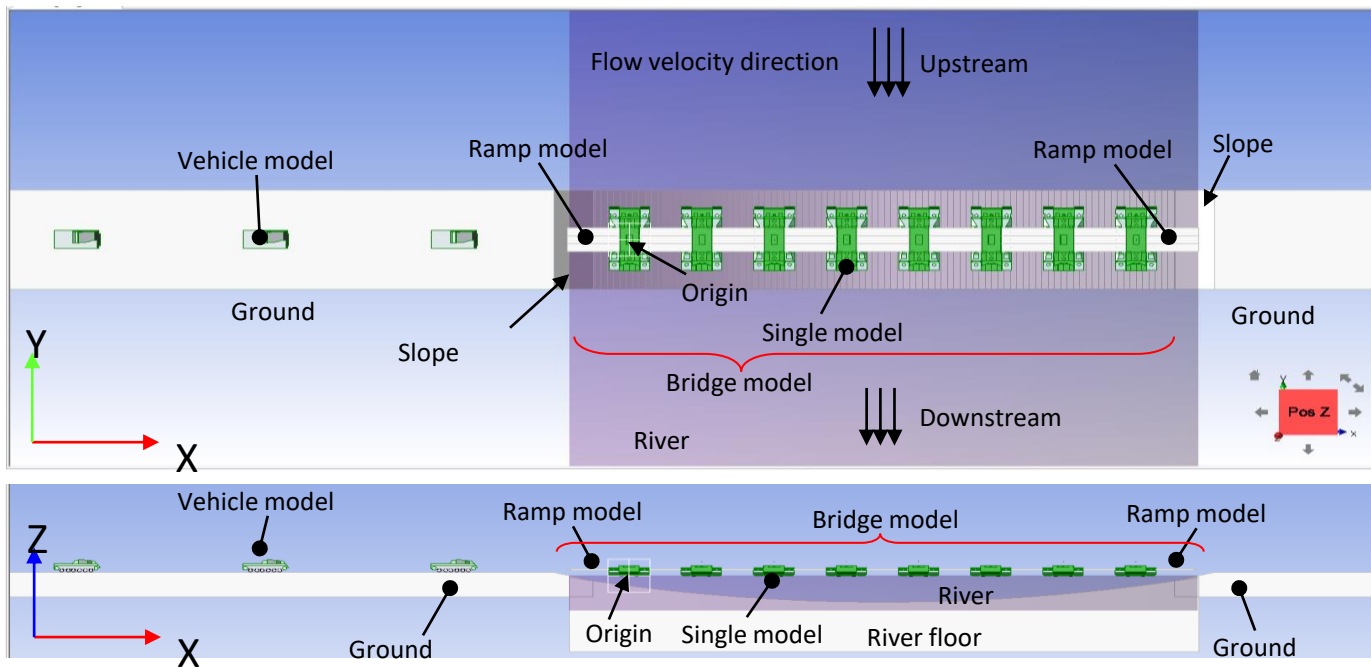
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M&S of KABV for Surface Operation

Bridge M&S Model

Overview of bridge M&S model

- Predicting its River crossing capabilities under various conditions. (Vehicle weight, flow velocity, etc.)

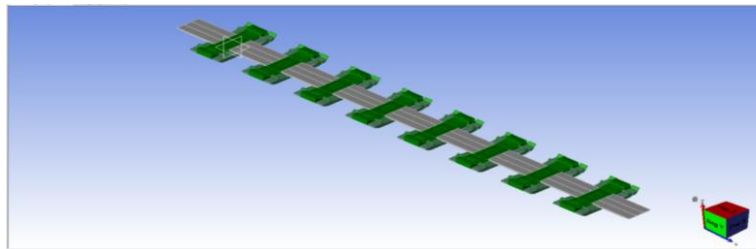


< Overview of Bridge M&S model >

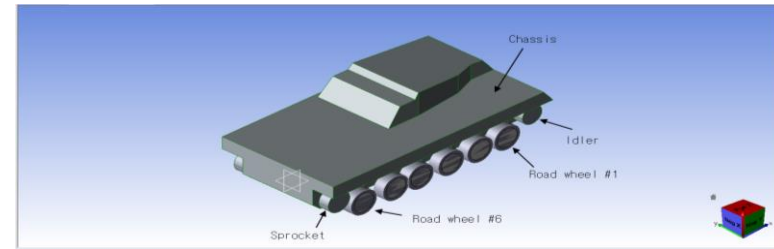
Bridge M&S Model

□ Modeling – Components

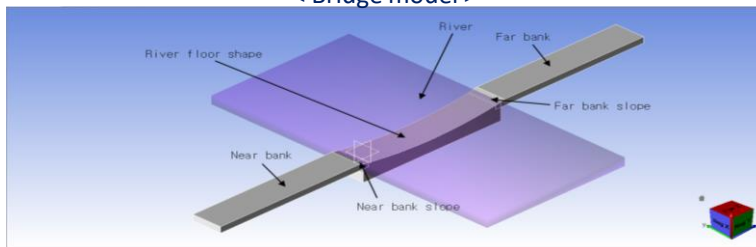
- Bridge model : Eight KABV are connected open coupled type
- Vehicle model : The vehicle model used in the Raft M&S model was reused.
- Environment model : The environment model used in the Raft M&S model was reused.
- Simulation scenario : the actual operation of the bridge is taken into consideration.



< Bridge model >



< Vehicle model >



< Environment model >

- ① Initial condition
- ② Left ramp(near bank), Right ramp(far bank) down
- ③ Vehicle move to bridge model
- ④ Driving on bridge model
- ⑤ Vehicle move to far bank

< Simulation scenario >

< Components of Bridge M&S model >

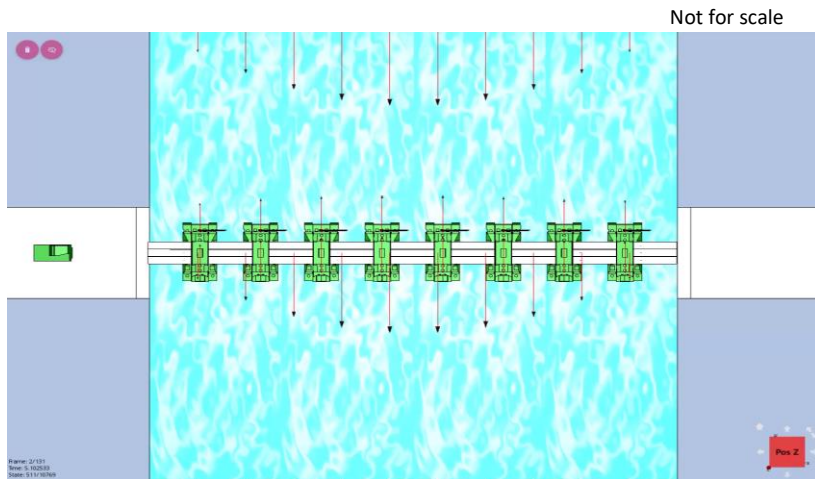
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M&S of KABV for Surface Operation

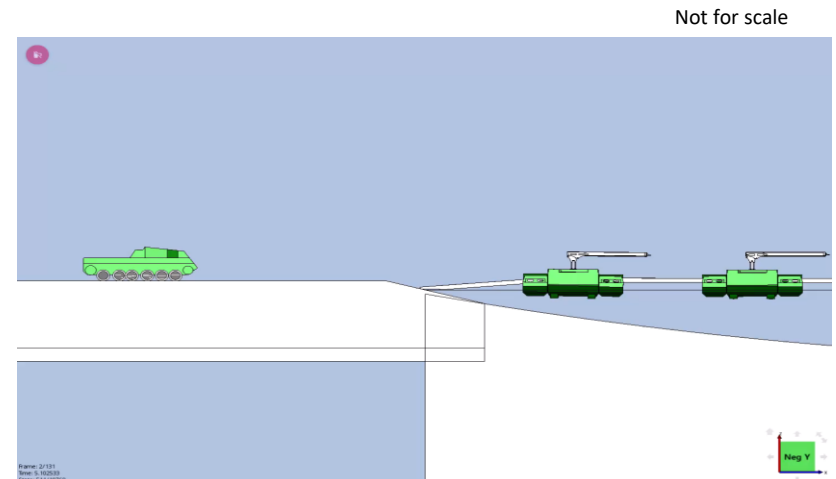
Bridge M&S Model

❑ Simulation results

- Vehicle weight 00 tonne, flow velocity max. 0 m/s given.
- Attached arrow in bridge model means thrust forces determined by simple logic with commanded trajectory.



< Simulation result - video >



< Enlarge view >

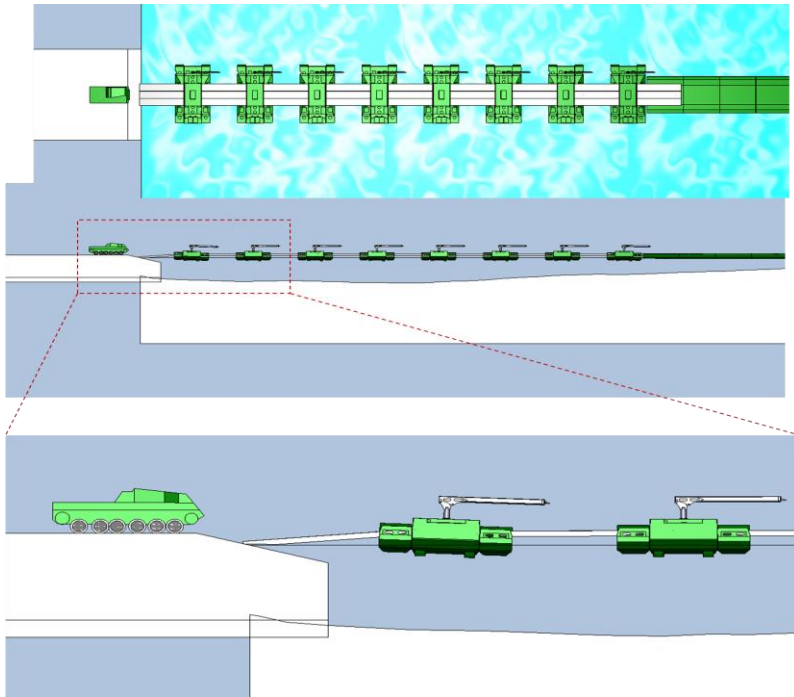
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M&S of KABV for Surface Operation

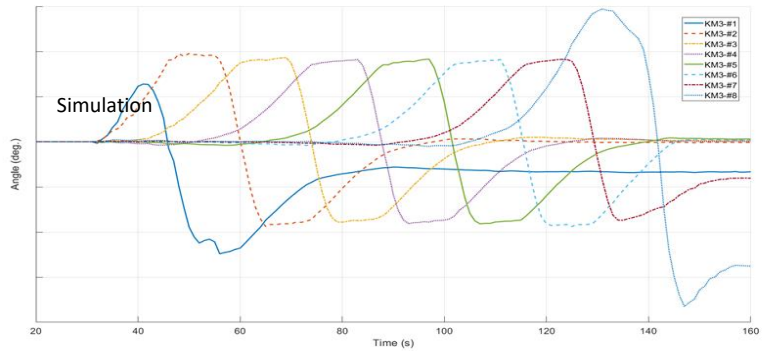
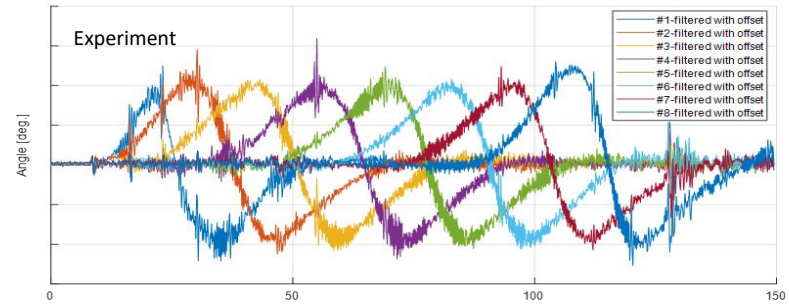
Bridge M&S Model

Validation

Comparison with experiment



< Simulation of bridge operation >



< Roll angle – Exp. vs. sim. >

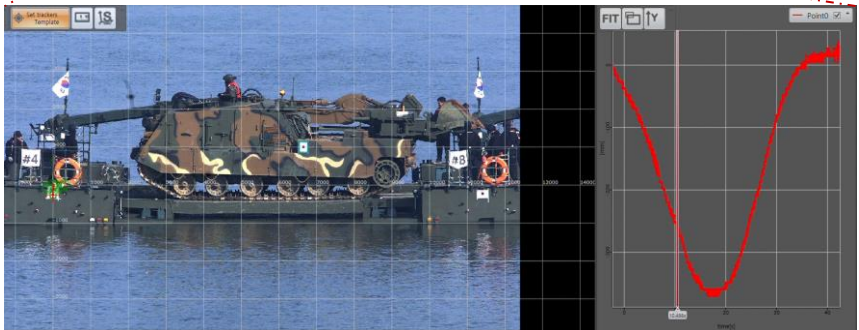
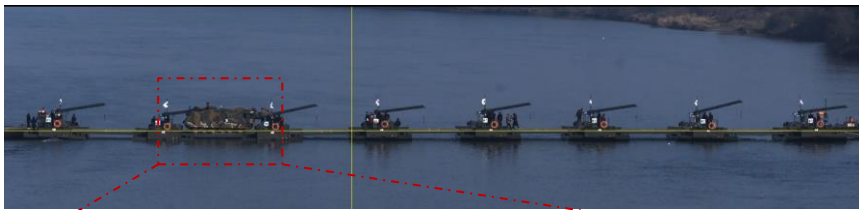
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M&S of KABV for Surface Operation

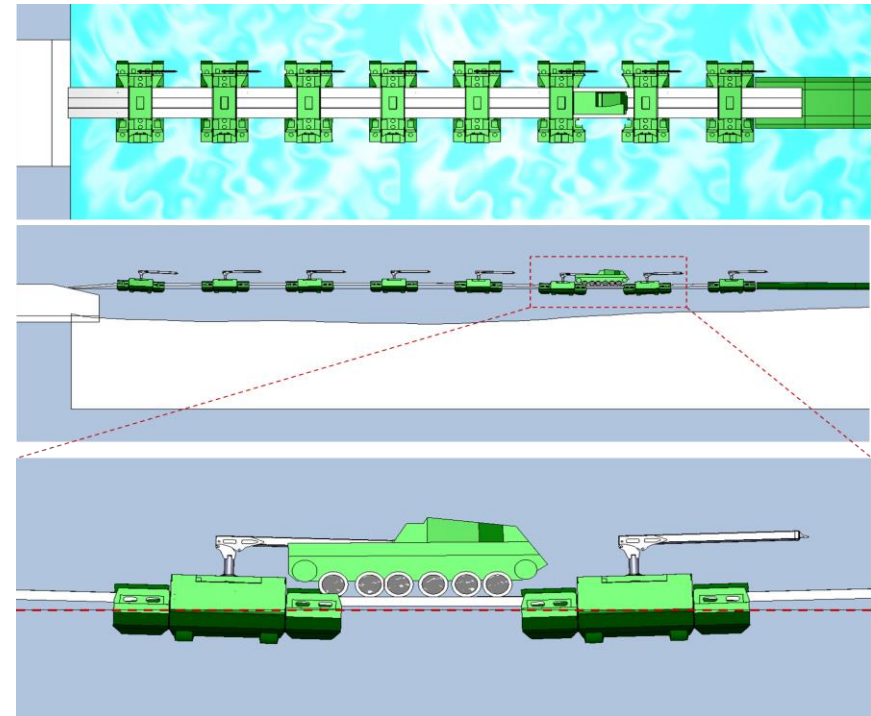
Bridge M&S Model

Validation

- Comparison with experiment



< Photo of the experiment of bridge operation >

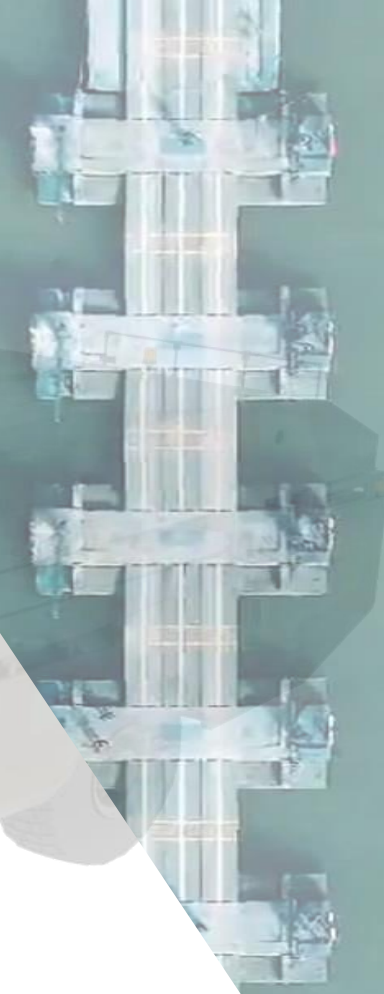


< Simulation of bridge operation >

Conclusion

- ❑ ROK Army uses various engineering M&S tools to evaluate the safety of KABV under extreme operational conditions.
- ❑ A M&S model was constructed based on the design and measurement data of KABV, and has been validated by the measured results under simulated test conditions.
- ❑ The resistance results from the CFD model were utilized in the construction of the Raft and Bridge M&S models, used to assess the river crossing capability under various conditions.
- ❑ Simulated results based on the specified conditions (requirement) were used to assess the river crossing capability.

Q&A



The image is a collage with three main visual elements. On the left, a semi-truck chassis is shown in a light grey, semi-transparent style against a white background. On the right, a large, multi-decked ship is shown from an aerial perspective, sailing on a teal-colored sea. At the bottom right, a barge is shown on a body of water, with a South Korean flag visible on its deck. The text 'Thank you' is centered in a dark blue font over the truck chassis.

Thank you