

Development of an Automatic Load Moment Control System for a Floating Dock

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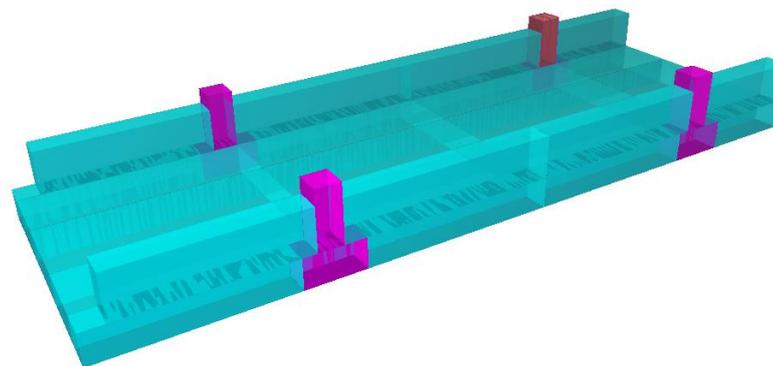
► Transfer - Shore → Floating Dock

– Static analysis

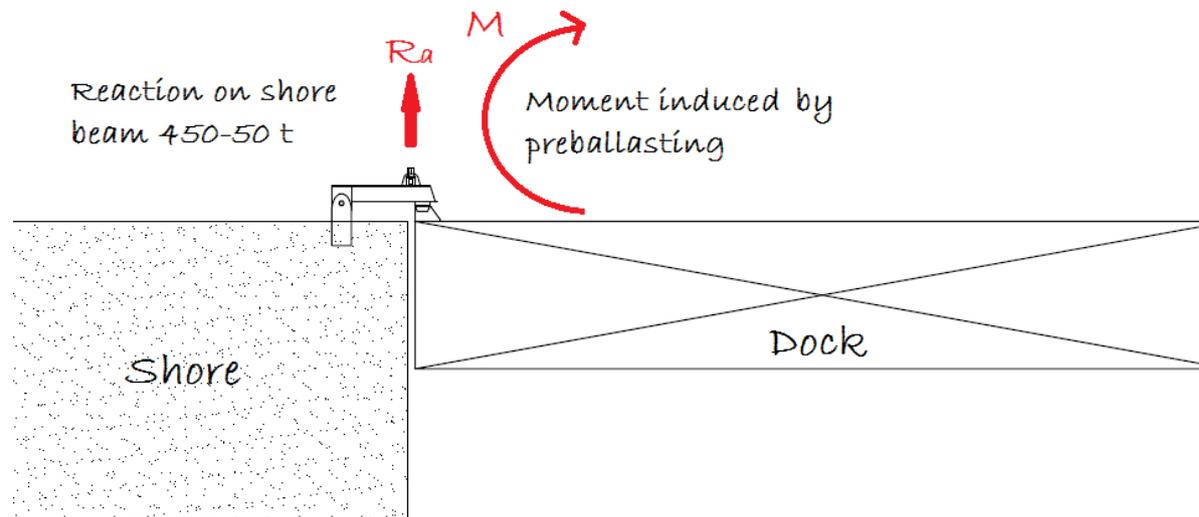
- Trolley Transfer System
- 9 or 4.5 m span
- Trolley max. Load - 650 tons

– Algorithm Development

- Trolley placement
- Concept for ballast tank planning

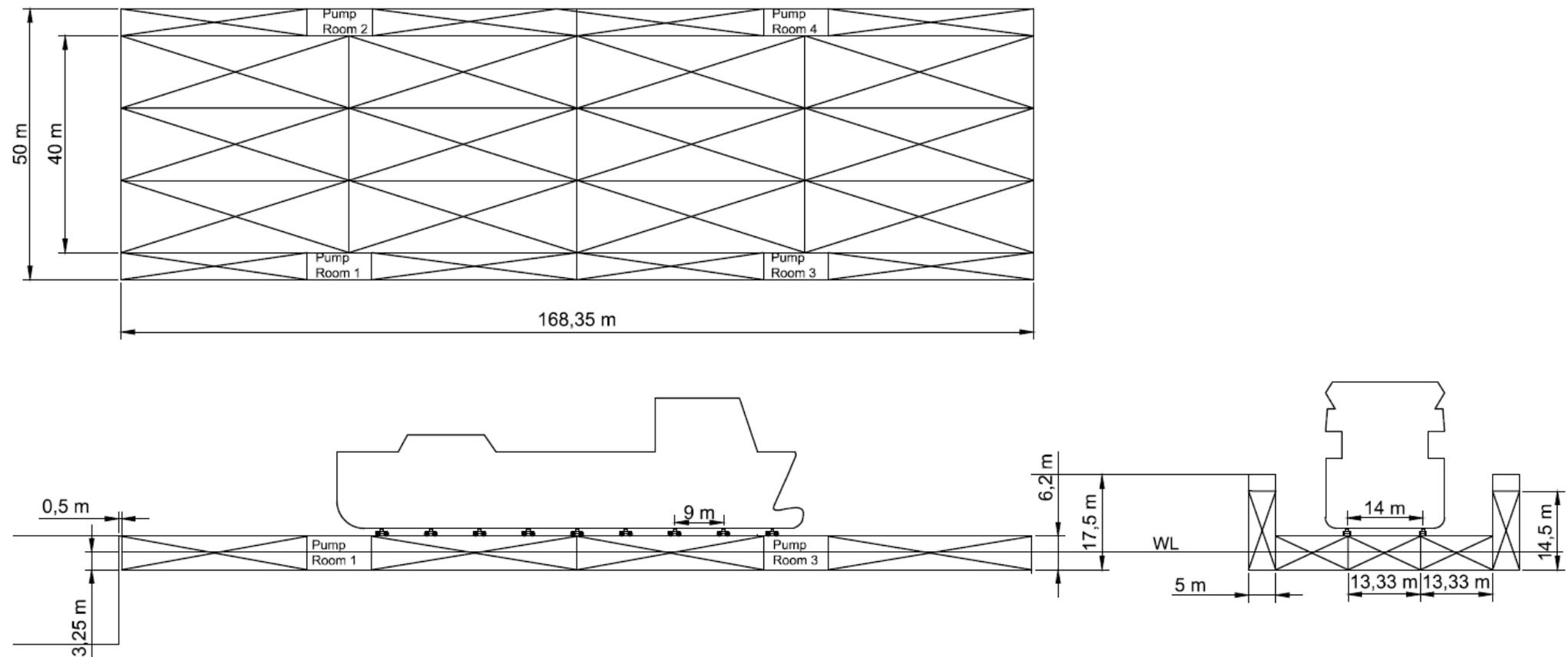


- ▶ Important considerations
 - 2 shore beams – 500 tons X shore beam
 - Pre-ballasting with 800-900 tons
 - Load cell reading < 500 !
 - Load cell reading > 0 !
 - Heeling not permitted → Simplify model



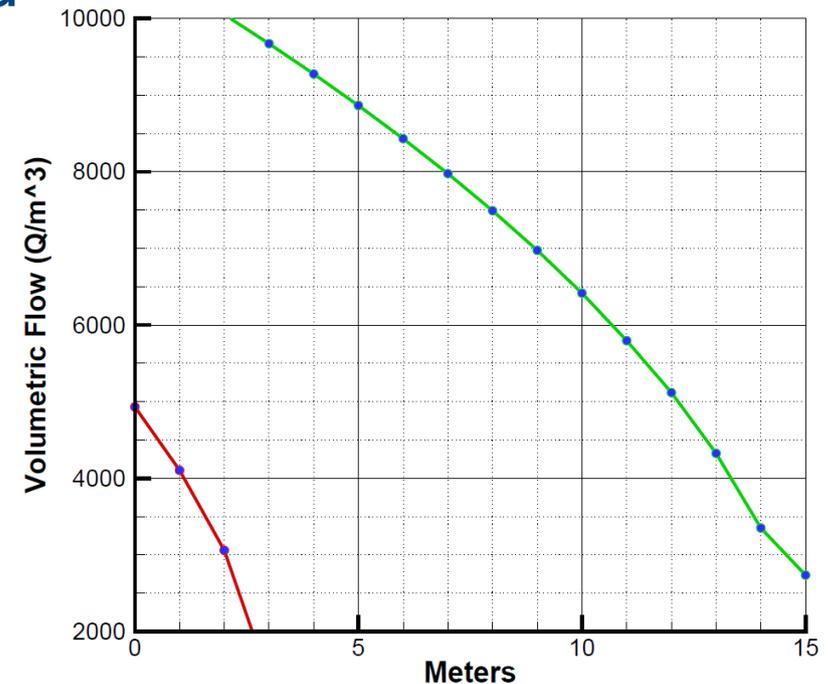
Project Description (Creo que nie wazne)

► Dock dimensions



Technical Changes & Specifications

- ▶ Reversible pump against gravity based filling
 - Torricelli for stream speed
 - No fixed flow
- ▶ Pump-Tank configuration
 - Facilitate ballast planning
 - 2 pumps on a section



2	Pump	4	6	Pump	8
10		12	14		16
17		18	19		20
9		11	13		15
1	Pump	3	5	Pump	7

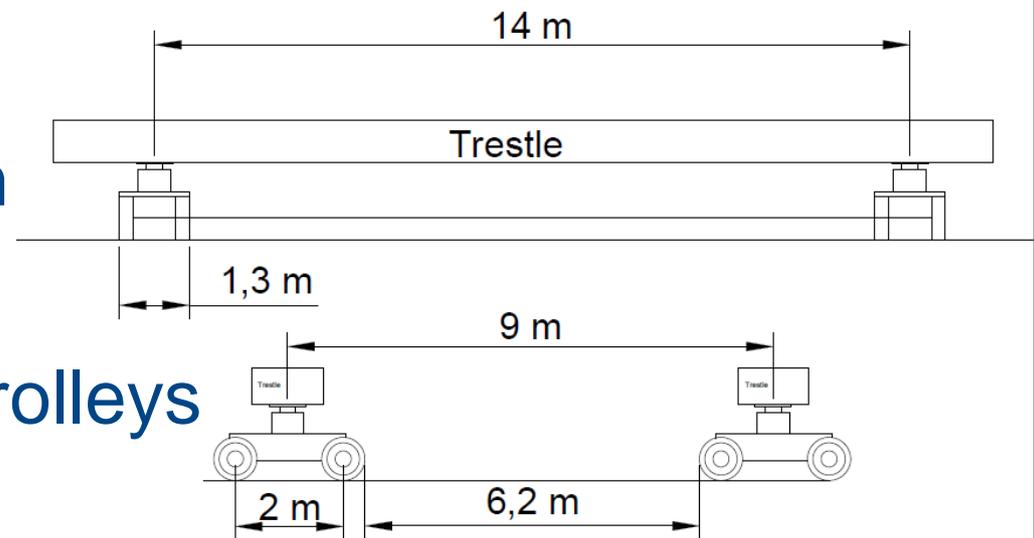


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Information for analysis

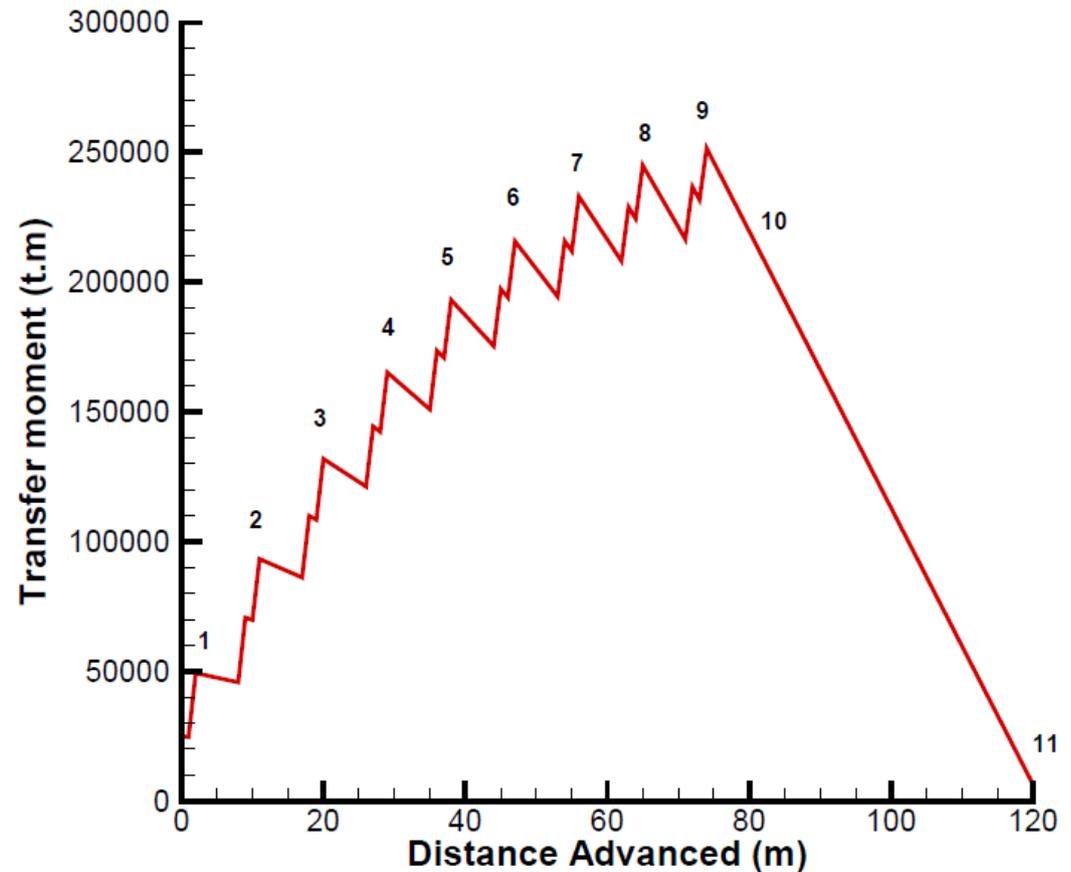
- ▶ Ship information (Block vessel)
 - 5000 tons → Maximum transfer capacity
 - Lightweight distribution constant
 - Vessel LOA – 85 m

- ▶ Trolley transfer system
 - 9 trolleys
 - 9 meters between trolleys

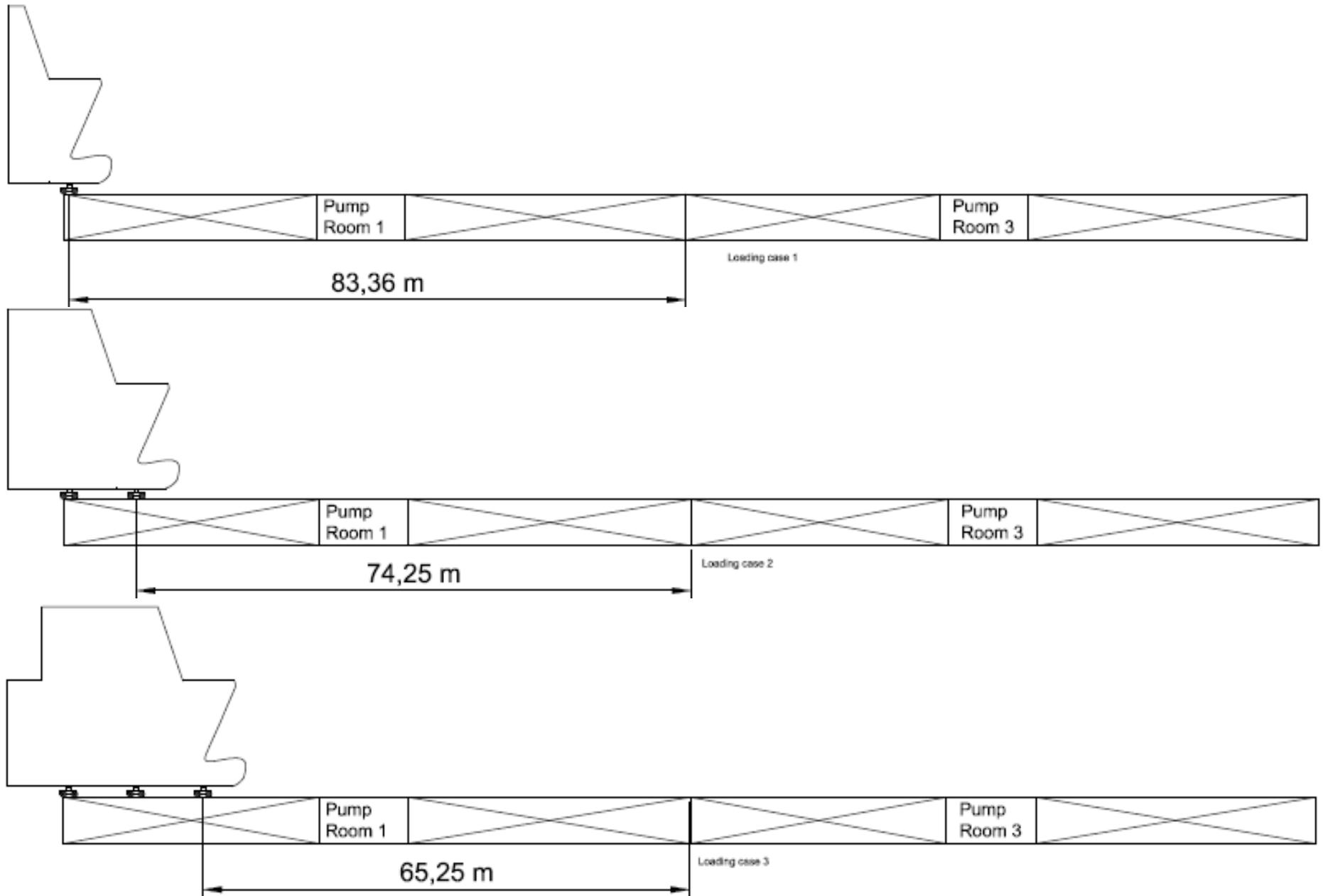


Meter per Meter moment calculation

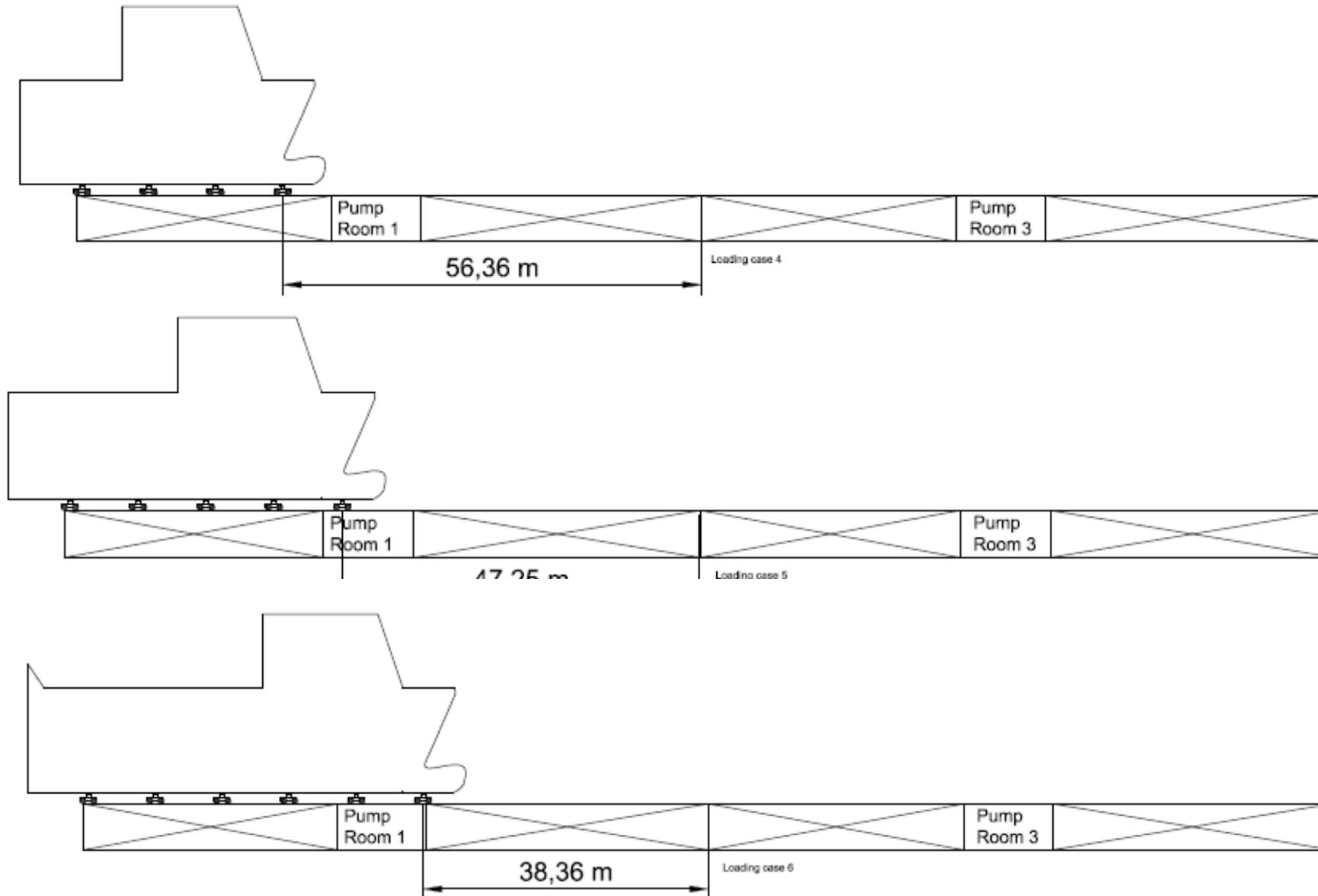
- ▶ Observations
 - 18 peaks
 - Small peaks
 - First trolley wheel
 - Big peaks
 - Trolley on dock
 - Interpolation between big peaks



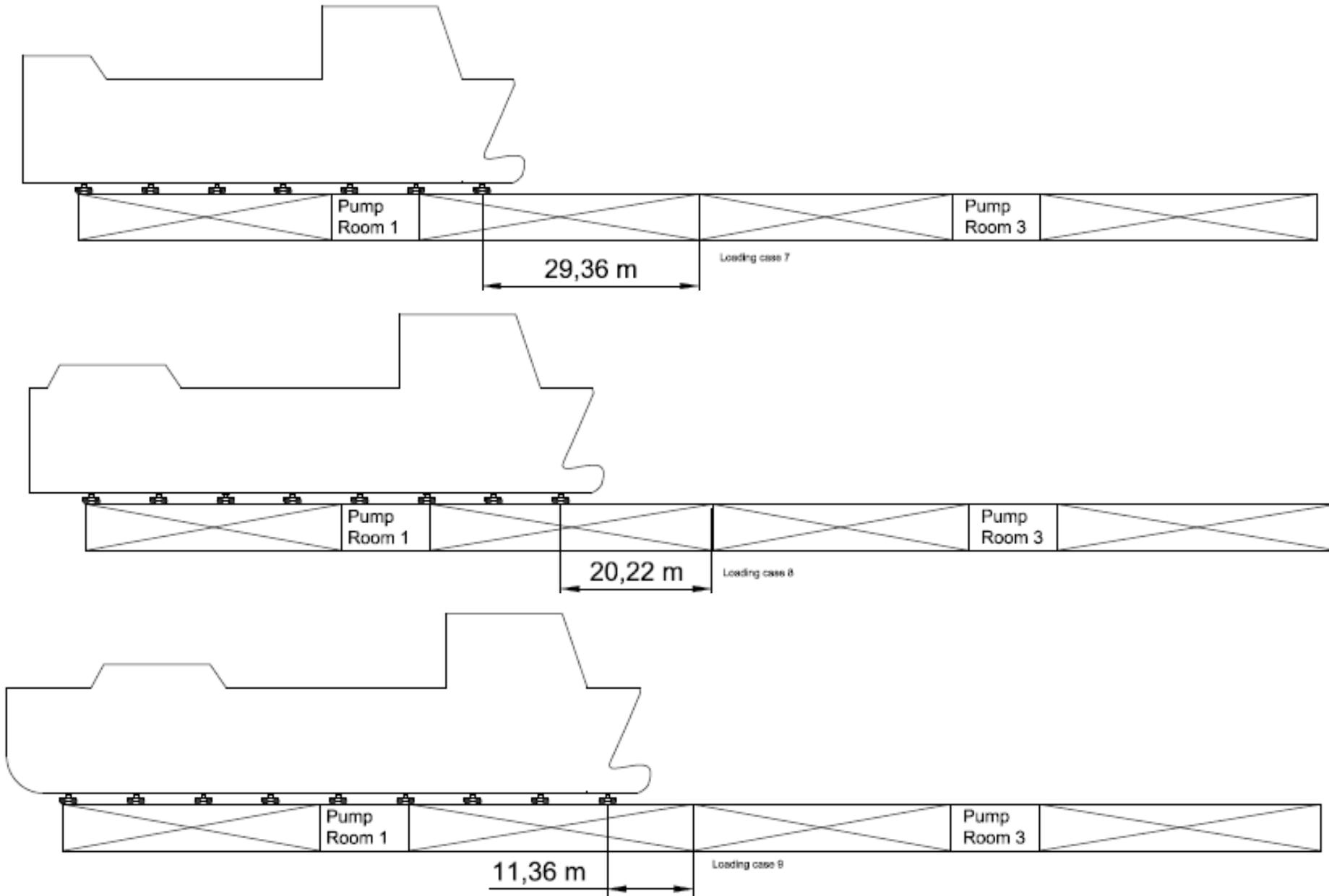
Loading Cases



Loading Cases

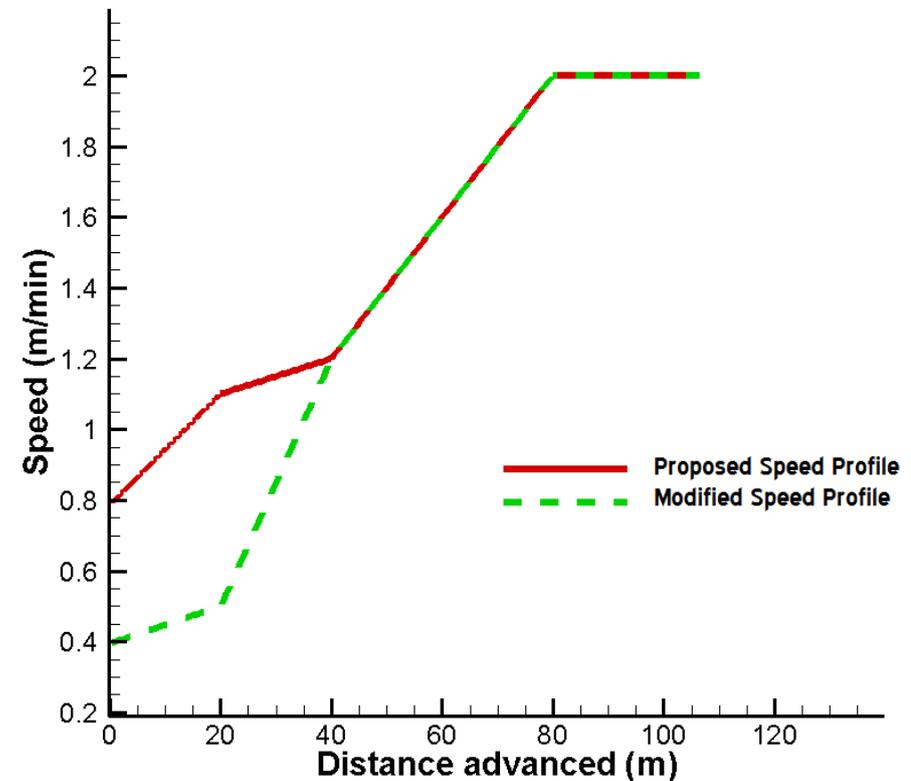


Loading Cases



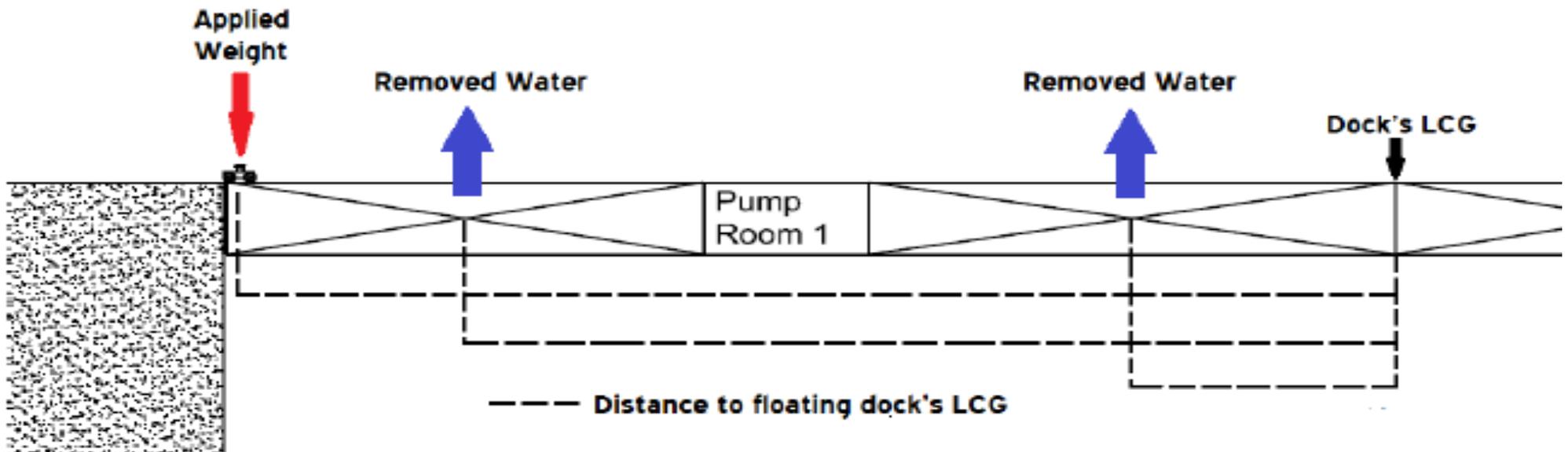
Righting Moment vs. Transfer Moment

- ▶ Observations
 - Ballast system
 - Difficulty to follow transfer system
 - Transfer system
 - Low speed at first meters.
 - Key variables to control
 - Trolley speed
 - Pump Capacity

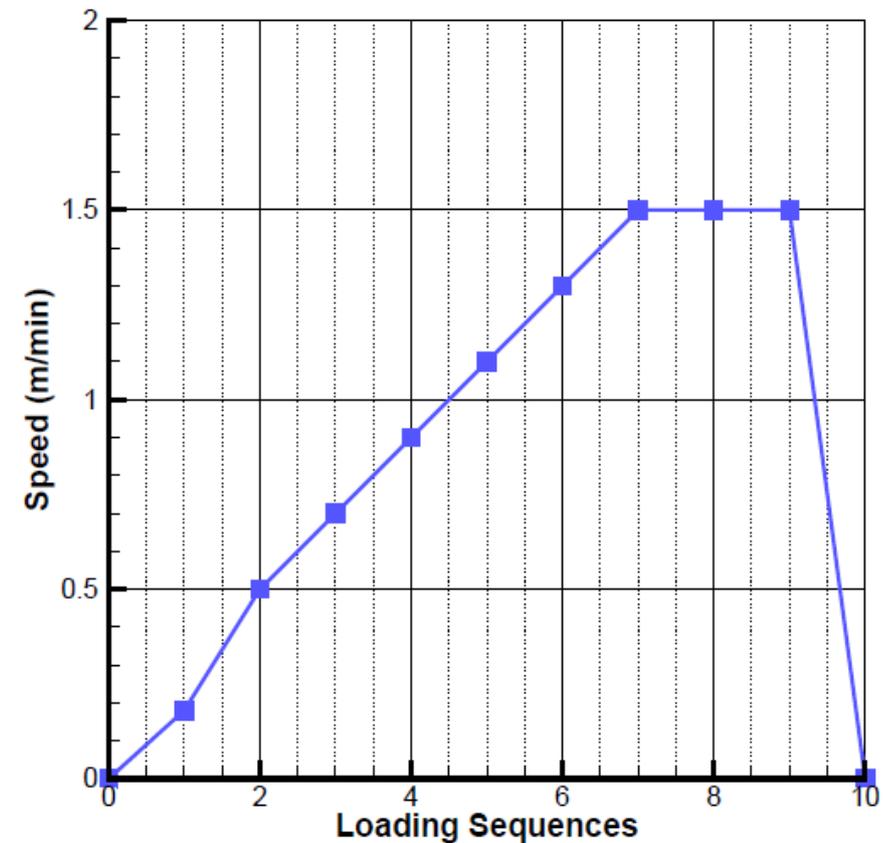


► Procedure

- Determine water volume in/out
- Calculate righting moment
- Difference between transfer and righting moments
- Difference between weight applied and removed.



- ▶ Observations
 - Preloading can be standardized.
 - Average water level in tanks similar to the designer
 - Limit of 5000 tons confirmed.
 - Transfer speed profile input/output variable



MEXICO - Guanajuato



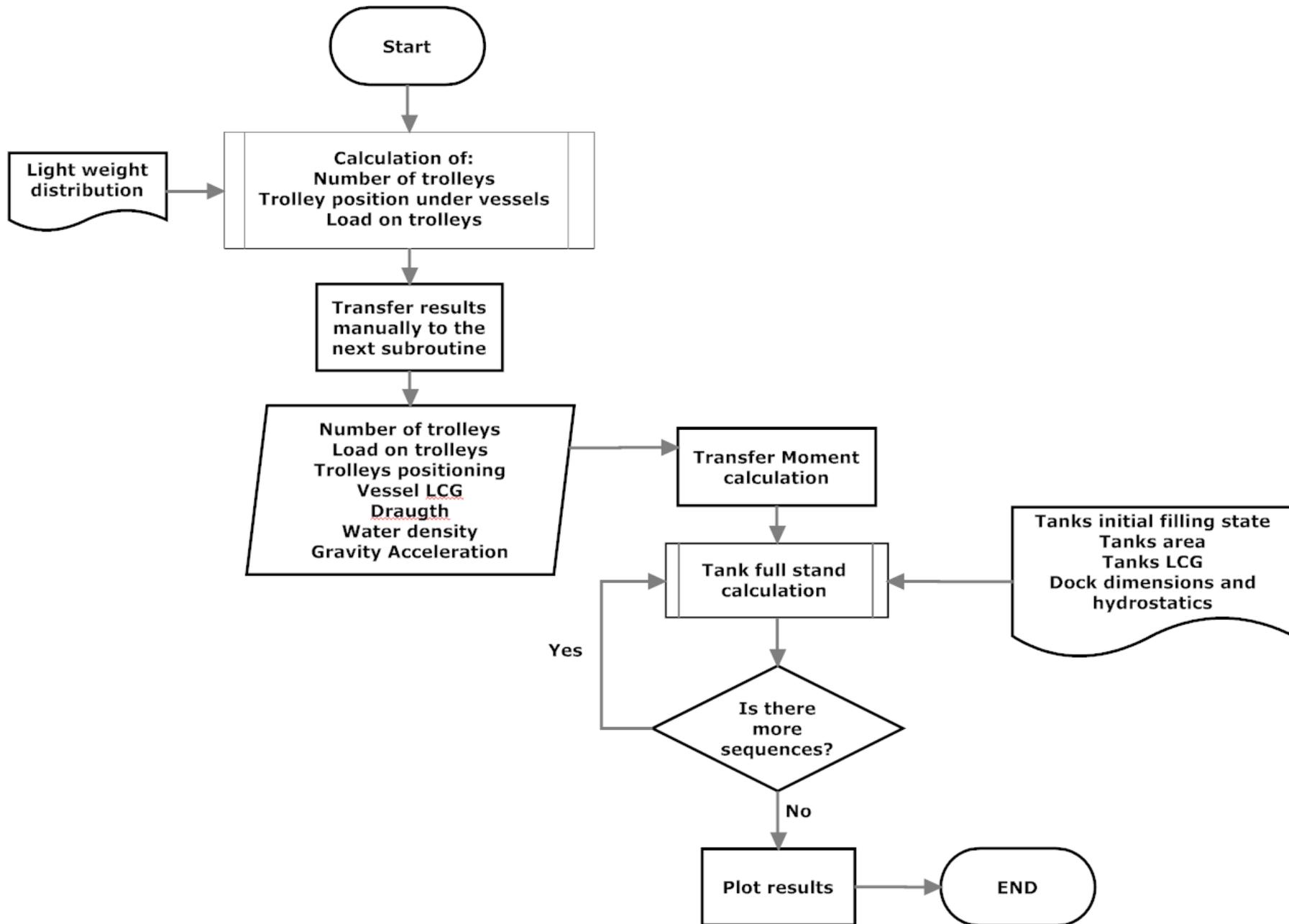
MEXICO - Teotihuacan



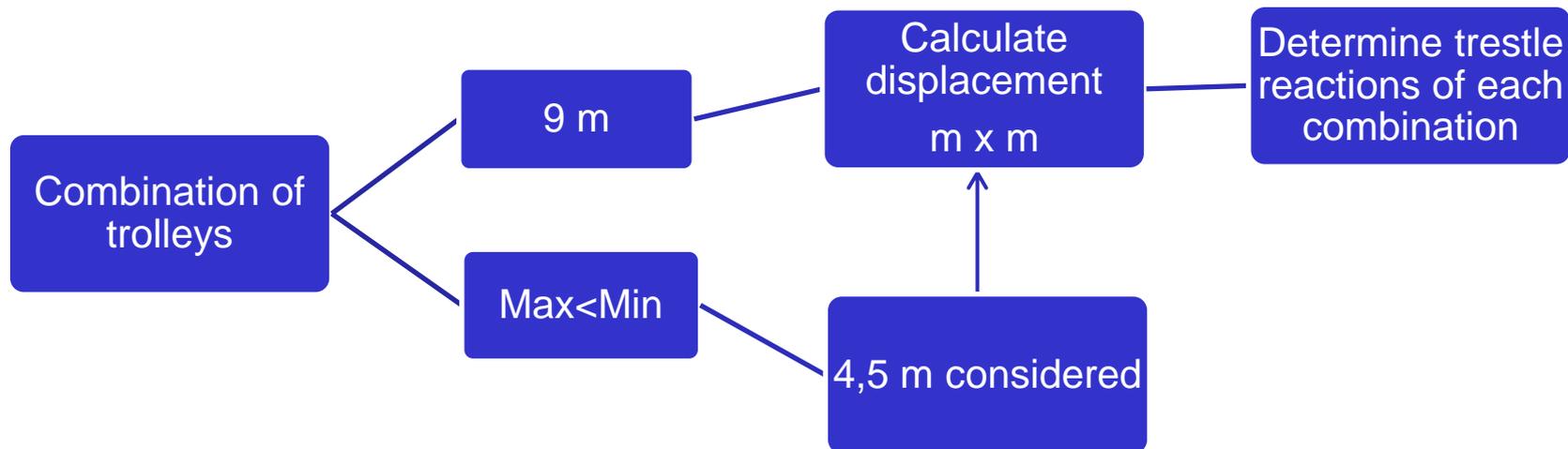
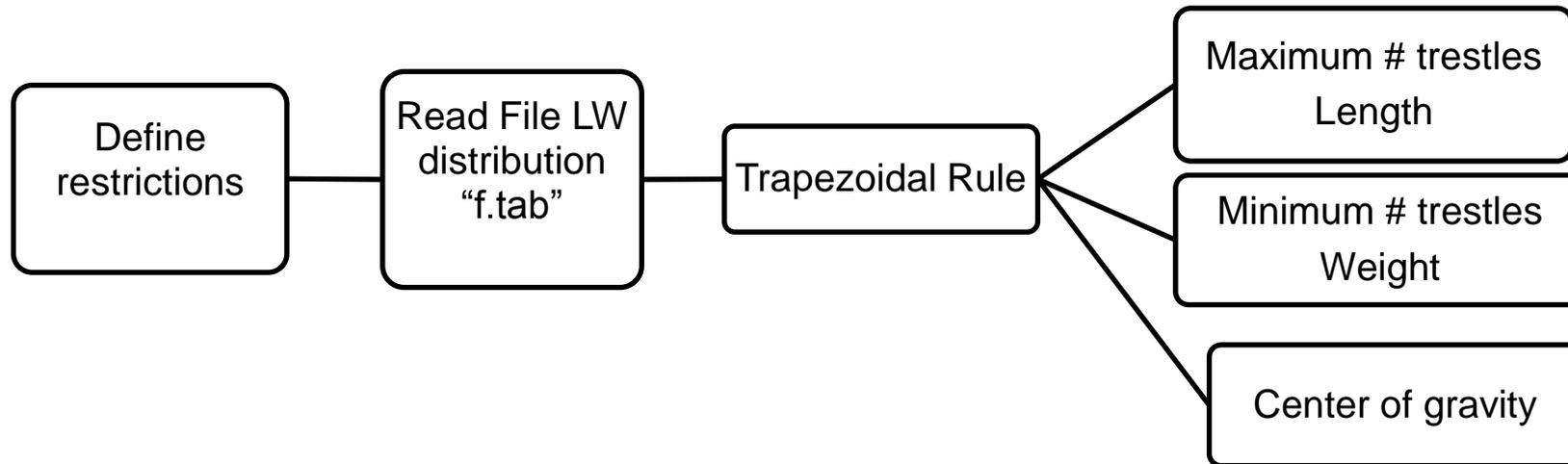
MEXICO – Jardín Surrealista



Algorithm Flow Chart



Trolley Placement Algorithm



- ▶ Procedure description
 - User is asked for parameters
 - Read from “initial_tank.tab” tank information
 - Tanks Initial volume and water level, LCG, water plane area.
 - Read from “initial_tank.tab” tank information
 - Dock length, breadth, displacement, GM, MTC.

Dock Parameters

Enter number of trestles:
3

Enter load per trestle (t):
500,500,500

Trestle position along vessel: (bow to stern, m)
9,9,9

Enter vessel LCG (m):
0

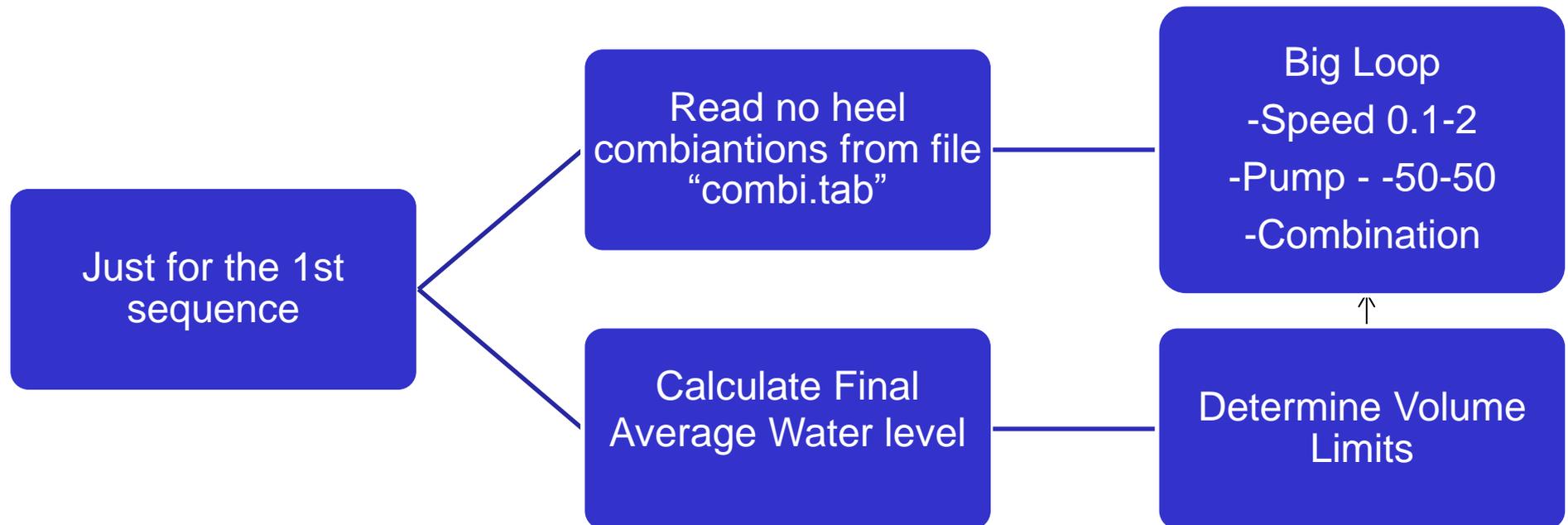
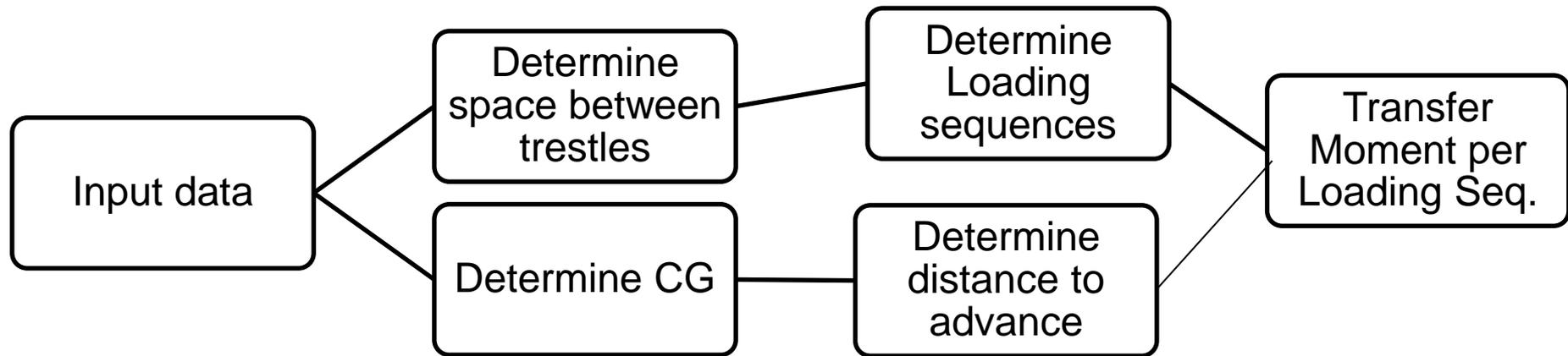
Enter dock draught (m)
3.325

Enter water density: (t/m³)
1.01

Enter Gravity Acceleration m/s²
9.81

OK Cancel

Concept for Ballast Tank Planning Algorithm



- ▶ Reversible pump implementation
 - ▶ The ballast system cannot keep up with the TTS speed for approx. the first 40 meters - Preloading
 - ▶ Coordination of Transfer and Ballast System
 - ▶ TTS system speed, pump capacity and trestle location as key variable for the whole process.
-
- ▶ Future Work
 - ▶ Combine both programs into one.
 - ▶ Complete code for ballast planning.



Thank You! - Vielen Dank! – Gracias! – Dziękuję!

¿Questions?

