FZK

DFG-Round Table
"Near- and Onshore Tsunami Effects"
April 23 - 24. 2007 Hannover, Germany

LWI

Motivation, Primary Objectives and Prospective Outcomes of DFG – Round Table Discussion

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How to Avoid Future Disasters Similar to that of the 2004 Tsunami?

Mitigation Efforts after the 2004 Tsunami

- More towards rapid recovery & Set-up of Warning Systems
- Much less towards structural mitigation measures

Structural measures against tsunami

Need for multiple defence line strategy in which type, number and size of man-made/natural barriers should be adapted to the vulnerability of specific flood prone area and further local conditions

Need to close the knowledge gaps & improve modelling particularly for:

- Nearshore and onshore tsunami propagation
- Tsunami effects nearshore and onshore,including interaction with structures and further obstacles,sediments, debris...

Primary Objectives

1. **Briefly report on ongoing and planned research activities**

2. **Identify knowledge gaps / modelling weaknesses and research needs at:**

   - Source Level
   - Pathway Level
   - Receptor Level

   to

   - Implement Multiple Defence Line Strategy
   - Implement "Integrated Risk-Analysis & Management Framework"

3. **Derive from results in items (1) and (2) the priority research topics for which**

   - Closer Cooperation between German researcher (DFG-funding), US-researchers (NSF-funding) and other foreign researchers will substantially contribute to avoid duplications and to save time and financial resources
   - Cross-fertilization between Geoscience and Coastal Engineering Researchers is urgently required

Prospective Major Outcomes

1. **Define mechanisms /procedures for exchanging results of completed and ongoing related research projects**

2. **Specify "Individual Research Projects" (IRP) to be incorporated in "Joint Project Clusters" (JPC). Possible JPC-candidates are for instance:**

- JPC1: Nearshore effects on tsunami propagation and modelling, including interactions with natural barriers (coral reefs, sand banks, etc.) and man-made structures (artificial reefs, breakwater, groins, etc.)
- JPC2: Onshore effects on tsunami propagation and modelling, including interactions with natural barrier (beaches, dunes, forest vegetation, etc.) and man-made structures (sea walls, reinforces dunes, buildings and infrastructure)
- JPC3: Effects of debris on tsunami propagation and modelling, including the impact of debris flow on buildings, infrastructures, etc.

Nearshore and Onshore

Further Possible Outcomes

- **Although Tsunami in the open Sea is outside the scope of the proposed theme of the DFG-Round Table :**
  - JPC4: Tsunami Generation and Modelling in the Open Sea might also be considered because:
    1. Knowledge on tsunami parameters is still too poor and uncertainty bands of both seismic data and water wave characteristics are still too large
    2. reliable near- and onshore tsunami parameters strategy depend on the water wave characteristic at the tsunami source
    3. Occurrence probability of tsunami with certain heights and periods also strongly depend on generation mechanisms and their reliable modelling

- **Exploration of possibilities:**
  1. to elaborate a “Joint data Base for Model Validation”, incl. specification of standard procedures
  2. to jointly use unique experimental facilities for tsunami research.

MONDAY 23 April 2007

10:00 Registration and Coffee

10:30 Welcome Address and Introduction: S. Dürr, DFG; R. Ollig, BMBF und H. Oumeraci, FZK

PART I: Near- and Onshore Tsunami Effects: Ongoing and Planned Research		
Session 1: US Experience and Related Projects Chairman: Hocine Oumeraci, Forschungszentrum Küste (FZK)		
10:45	Philip Liu Cornell University Ithaca, New York	Present state and future of numerical modelling of tsunami in nearshore environment.
11:30	Patrick Lynett Texas A&M University Station College	Parallel and hybrid approaches to tsunami modelling (ongoing research) and hydrodynamic information in tsunami deposits (planned research)
12:15	**COFFEE BREAK**	
12:45	Harry Yeh Oregon State University Corvallis	Tsunami loading on structures: ongoing and planned research
13:30	Costas Synolakis Tsunami Research Center University of Southern California, Los Angeles	Lessons learned from tsunami field surveys and related projects
14:15	**LUNCH**	

At least 10 min. should be left for discussion after each presentation

MONDAY 23 April 2007

PART I: Near- and Onshore Tsunami Effects: Ongoing and Planned Research		
Session 2: Ongoing and Planned Tsunami Research in Germany Chairman: Werner Zielke, Forschungszentrum Küste (FZK)		
15:15	Klaus Schwarzer Universität Kiel	Joint Thai-German TRIAS-Research Project - Tracing tsunami on– and offshore in the Andaman Sea Region (DFG-NRCT Coop.)
15:45	Jörn Lauterjung Geoforschungszentrum (GFZ) Potsdam	German-Indonesian Tsunami Early Warning System (GITEWS): Present state and next steps
16:15	Jörn Behrens AWI Bremerhaven	Development of an operational tsunami model for inclusion into the Indian Ocean Tsunami Early Warning System (GITEWS)
16:45	Torsten Schlurmann Leibniz Universität Hannover Franzius Institut	Ongoing tsunami projects in UNU-EHS (Capacity Building, Numerical Last Miles)
17:15	Dieter Kelletat and Anja Scheffers Universität Duisburg, Essen	Tsunami deposits: Tasks for hydrodynamists towards more reliable tsunami hindcast
17:45	Joachim Grüne Forschungszentrum Küste (FZK), Hannover	Tsunami shoaling and run-up in the Large Wave Flume of Hannover: Introduction to the demonstration tests

At least 5 min. should be left for discussion after each presentation

Demonstration Tests in the Large Wave Flume (GWK) of Forschungszentrum Küste (FZK)	
18:00	**Demonstration tests in GWK (incl. transportation)**
20:00	**DINNER**

TUESDAY 24 April 2007

PART I: Near- and Onshore Tsunami Effects: Ongoing and Planned Research (continued)		
Session 3: Experience and Related Research in Southeast Asia and Japan Chairman: Torsten Schlurmann, Leibniz University Hannover, Franzius Institute		
08:30	Fumihiko Imamura Tsunami Engineering Disaster Control Center Tohoku Universtity, Japan	Ongoing and planned research in Japan
09:00	Hamzah Latief Institute of Technology Bandung (ITB), Indonesia	Ongoing and planned research in Indonesia
09:30	Janaka Wijetunge Disaster Management Post Graduate Programme, University of Peradeniya, Sri Lanka	Ongoing and planned research in Sri Lanka
10:00	V. Sundar Dept. of Ocean Engineering Indian Institute of Technology Madras, India	Ongoing and planned research in India
10:30	**COFFEE BREAK**	

At least 5 min. should be left for discussion after each lecture

TUESDAY 24 April 2007

PART II: Knowledge Gaps and (Joint) Priority Research		
Session 4: Knowledge Gaps and Modelling Weaknesses Chairman: Philip Liu, Provocateur: Patrick Lynett		
11:00	Identification of basic knowledge gaps and priority research needs	
12:00	Identification of modelling weaknesses and priority development needs	
12:30	Summary of discussion results by the chairman	
Session 5: Potential Joint Research and Cooperation Chairman: Hocine Oumeraci, Provocateur: Harry Yeh		
12:40	Sören Dürr Deutsche Forschungsgemeinschaft (DFG), Bonn	DFG - framework and opportunities for joint research and international cooperation
12:50	Reinhold Ollig, "System Earth" Federal Ministry of Education and Research (BMBF), Bonn	BMBF - framework and opportunities for joint research and international cooperation
13:00	Harry Yeh on behalf of Richard Fragaszy National Science Foundation Directorate for Engineering (NSF), USA	NSF - framework and opportunities for joint research and international cooperation
13:10	Discussion	
13:30	**LUNCH**	
14:30	Identification of joint research projects, including tentative agreements	
15:30	Identification of joint or other forms and procedures for cooperation (e.g. exchanges of research results, joint data base for model validation, benchmark tests, joint use of unique experimental faculties, etc.)	
16:10	**COFFEE BREAK**	
16:45	Summary of discussion results by the chairman	
17:00	Final Discussion	
17:15	Closure	

ANNEXES

Multiple Defence Line Strategy

A major Tsunami is
- too difficult to predict
- too strong to control

→ Apparent uncontrollability and invincibility of major tsunami

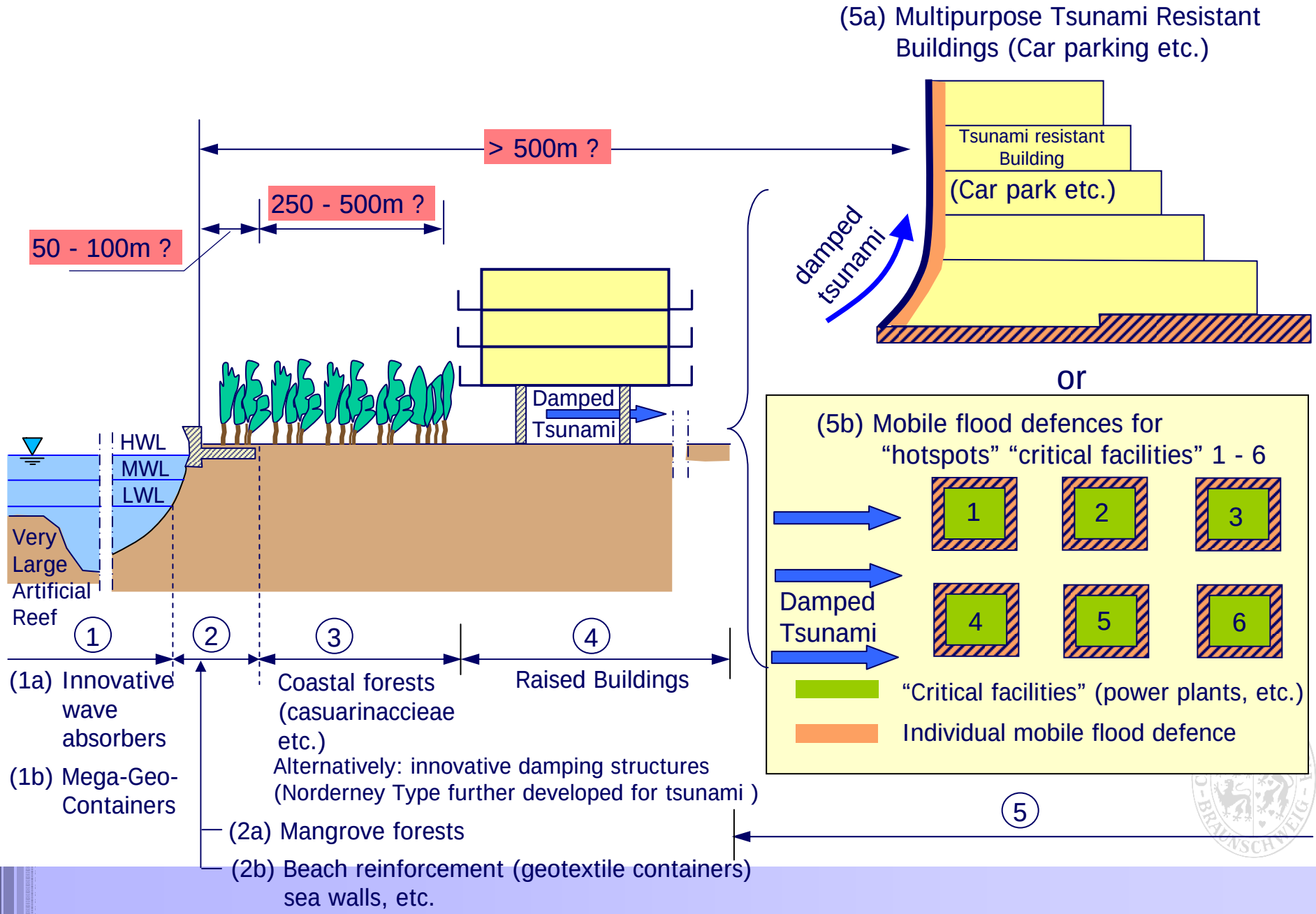
↓ Divide and Rule Defence strategy (DRDS)

↓ Multiple Defence Lines, with the types, number and size of barriers to be adapted to local conditions and vulnerability of flood prone area

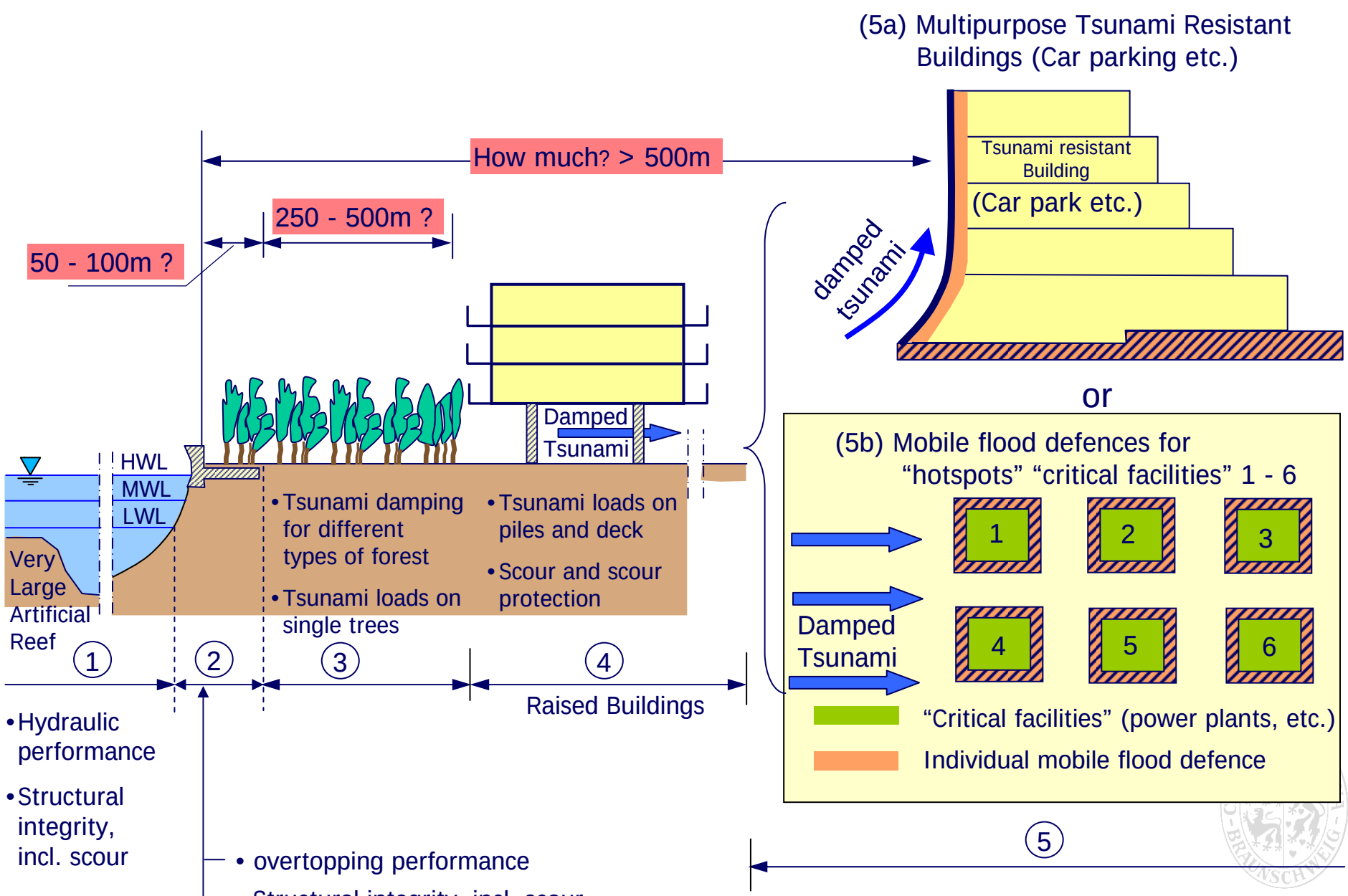
Tsunami → Guidelines for functional and structural Design

Man-Made Barriers		Natural Barriers		Man-Made Structures	
ARTIFICIAL REEFS	SEA WALLS	FORESTS	DUNES	RAISED BUILDUNGS	MOBILE DEFENCE SYSTEMS
➢ Technical feasibility: • Hydraulic performance • Structural integrity (incl. scour)	• Overtopping performance, etc. • Structural integrity (incl. scour and scour protection)	• Damping performance • Structural integrity	• Stability and breaching of natural and reinforced dunes	• Tsunami loading and structural integrity • Scour and scour protection	• Development of further innovative systems • loading, structural integrity and overtopping performance

Multiple Defence Lines Strategy for Densely Urbanized Areas (schematic)



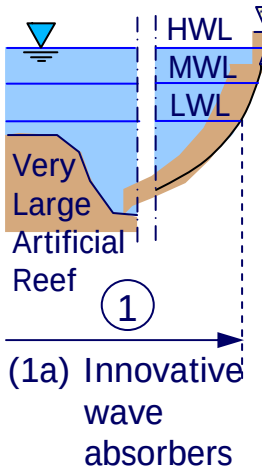
Research Needs to implement the multiple defence line system for the full range of Tsunami periods (T=5-60min).



Innovative Artificial Reef

- Developed and tested for wind waves in large wave flume
- Linearized theoretical model for the design developed and verified

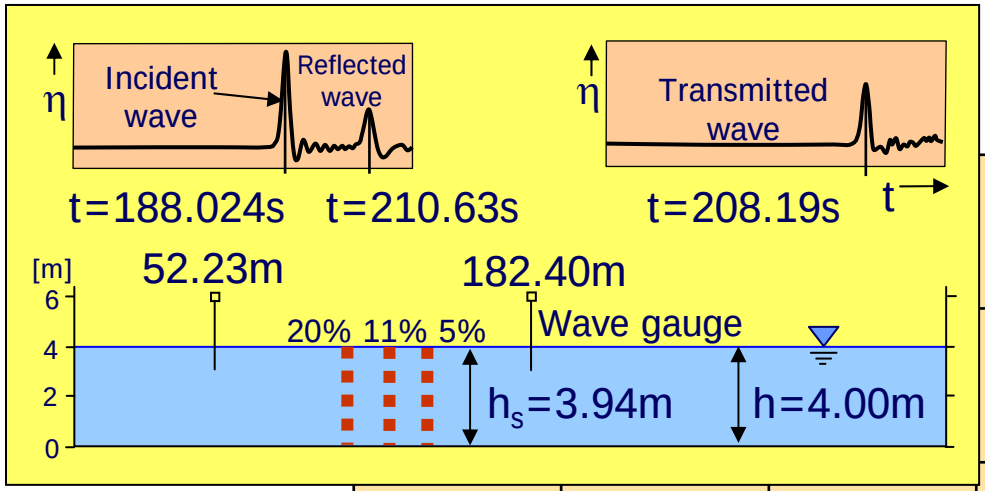
} Oumeraci and Köther (2004)



Does it work for tsunami?

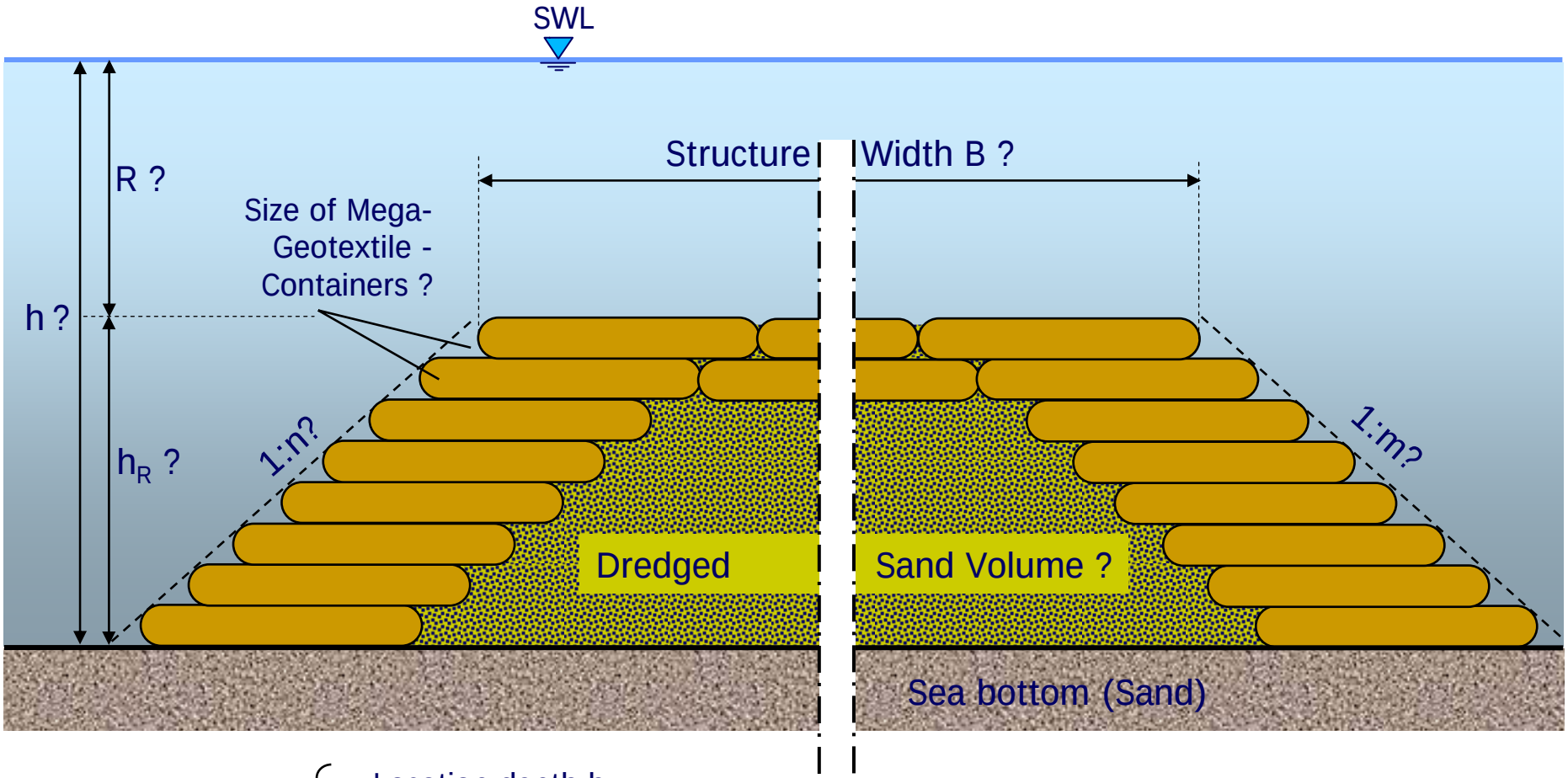
Feasibility for the full range of wave periods of tsunami (5-60 mn) has to be first checked by numerical modelling before embarking into detailed studies (BOUSSINESQ-like Model in progress).

Does it work for Tsunami ? (2)



Submerged three-Filter System subject to a solitary wave

Required Sand Reef parameters to be determined by numerical modelling (Technical and economic feasibility)

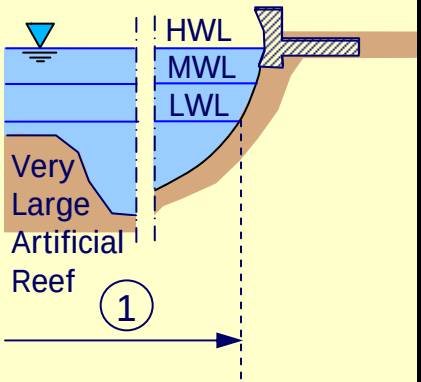


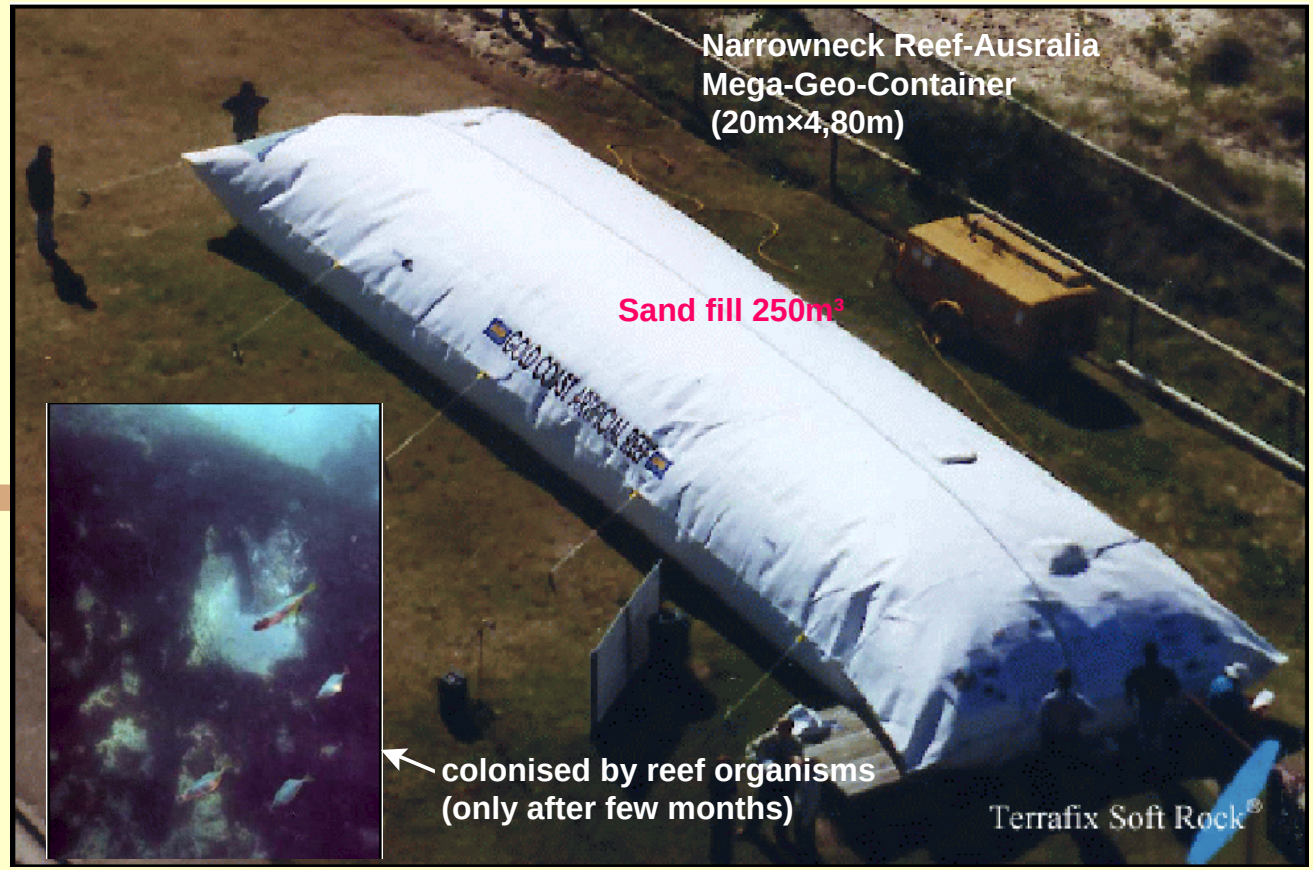
Reef Parameters

- Location depth h
- Structure width B and slope steepness 1:n and 1:m
- Reef height h_R and submergence depth R
- Size (volume, weight) of geotextile containers

must be determined as a function of target incident Tsunami wave parameters and target level of tsunami attenuation (transmitted wave parameters). The latter will depend on the nature of the next defence line(s) and the vulnerability of the flood prone area.

Example of Mega Geocontainers used for a surfing Reef in Australia

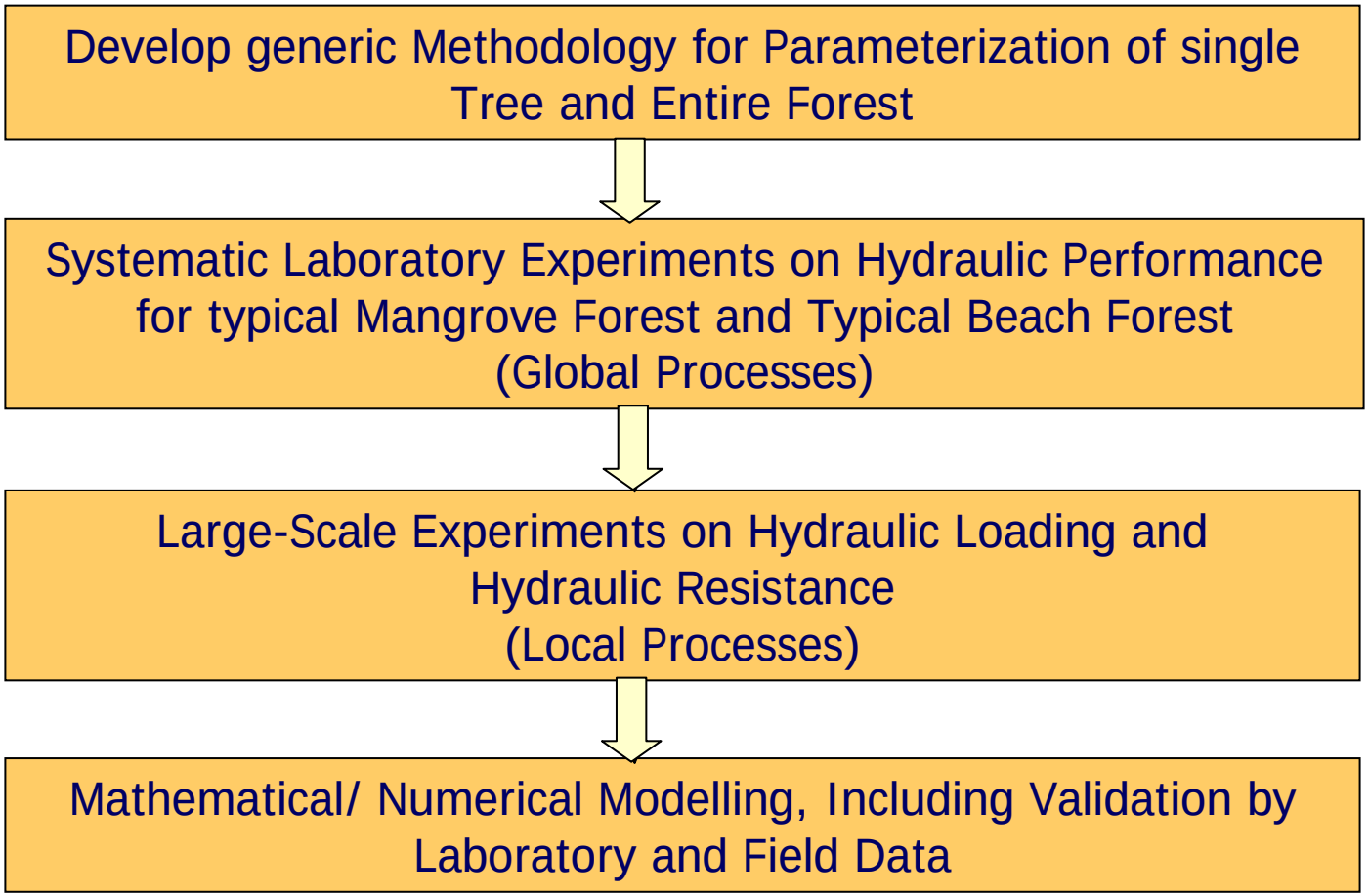




(1b) Mega-Geo-containers

Feasibility for the full range of wave periods (5 - 60 minutes) of tsunamis has first to be first checked.

Tsunami Attenuation Performance of Mangrove and Beach Forests



Soft Tsunami Man–Made Barriers

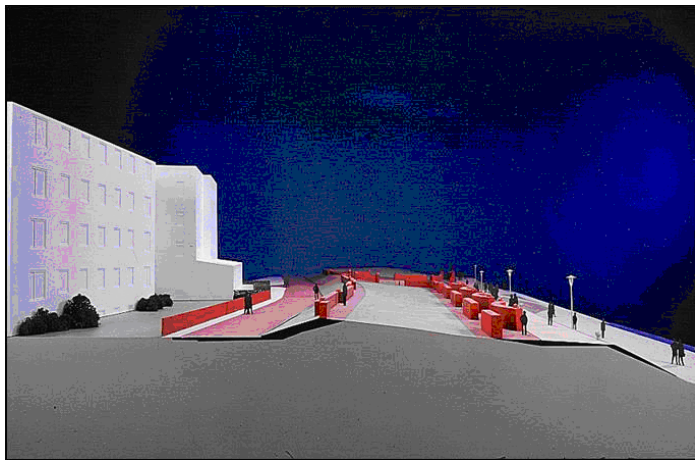
Objective:

⇒ To progressively weaken tsunami power without completely blocking inundation, but with additional benefit of broadly blocking floating debris.

Application:

⇒ As multi-purpose structures everywhere where planting of coastal forests is not feasible

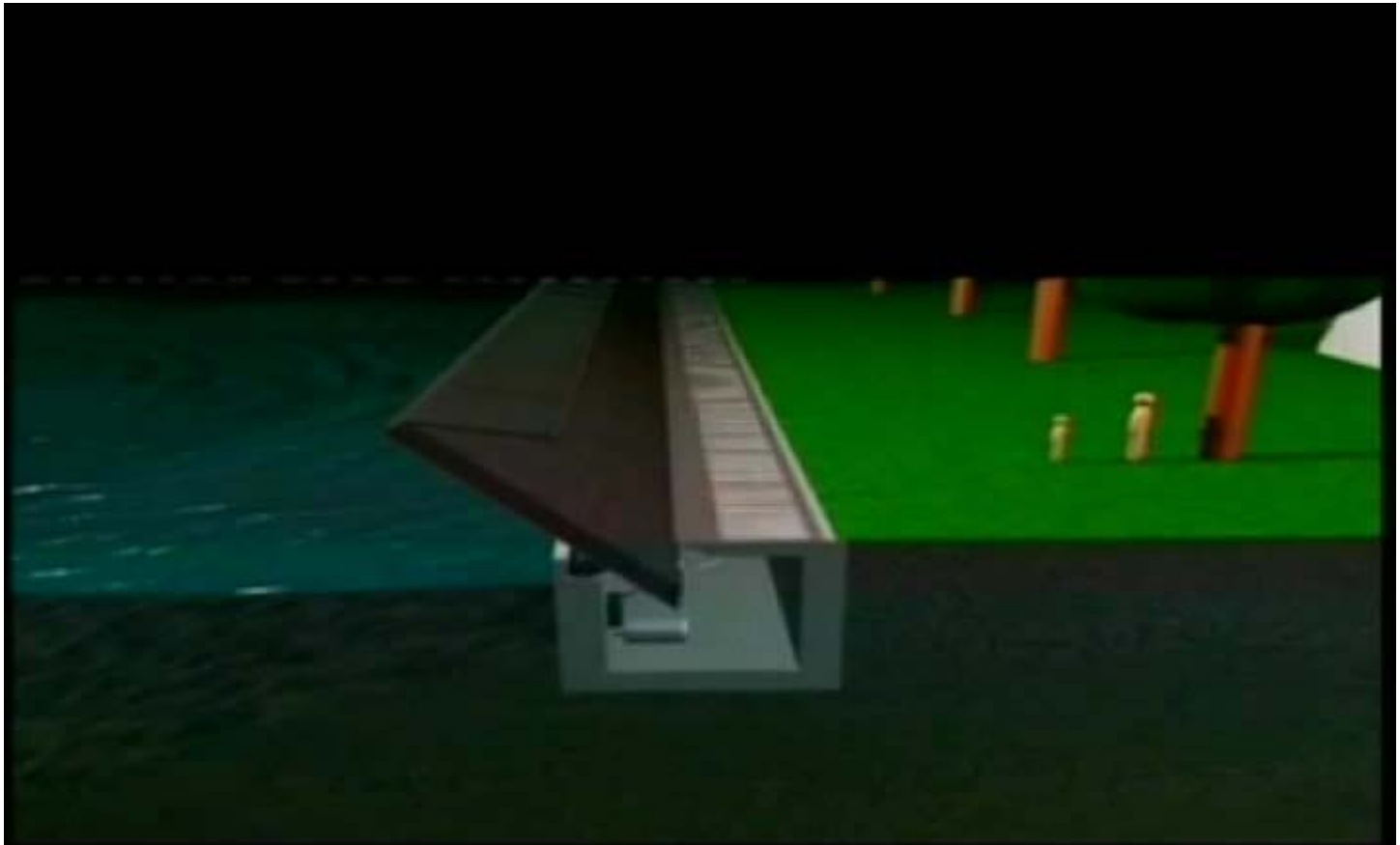
⇒ Especially appropriate for touristic and urbanized coastal areas where man-made protective structures should be fitted aesthetically into the local marine landscape.



a) Design (Computer Animation)

b) Built in Norderney (North Sea)

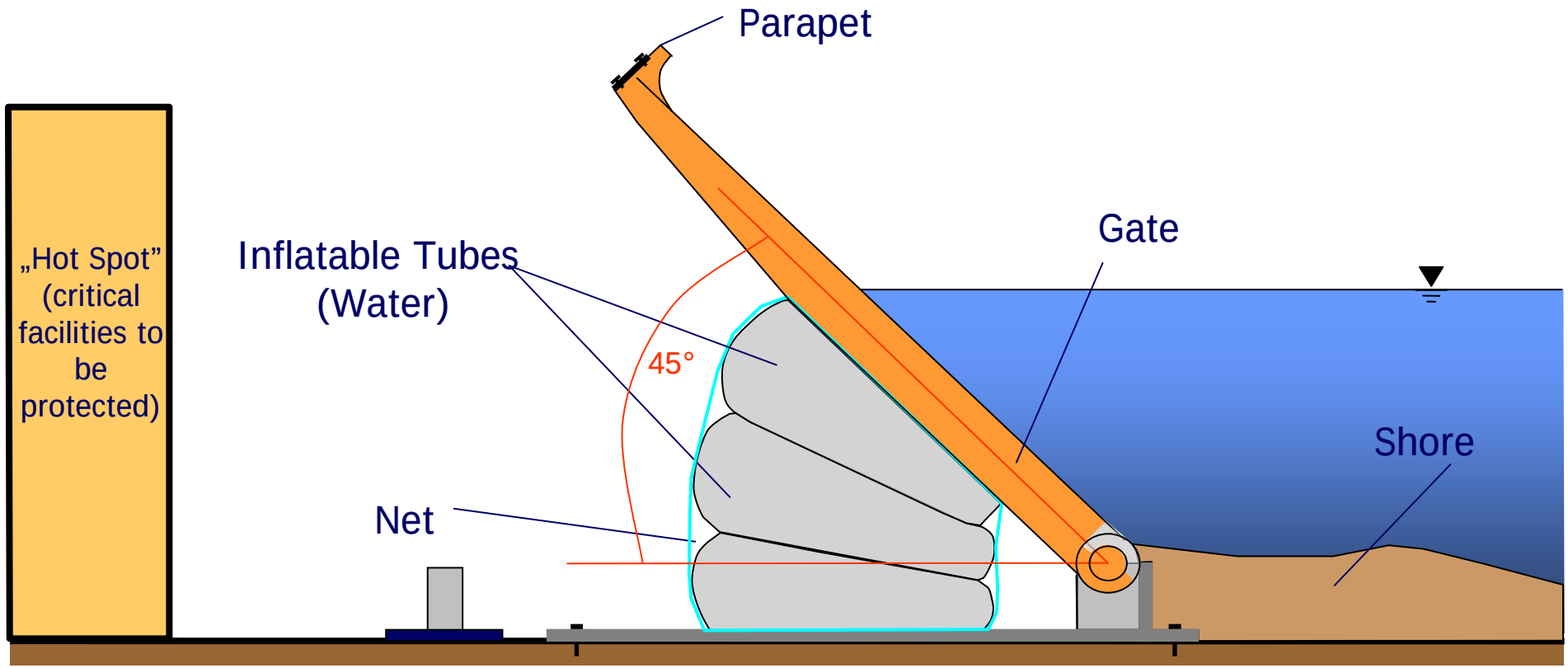
Mobile Defence for River Flood (Animation)



This light version has proved to be efficient against river floods. A more robust construction for tsunami is needed.

Credit: KWS (Switzerland)

New KWS – Mobile defence system for Coastal Zones



Concluding Remarks

➢Elaboration of a CEDM-TP(*) towards practical implementation of suggested „Divide and Rule Defence Strategy“ (multiple defence lines) requires additional research on the hydraulic performance, loading and structural integrity of each types of man-made and natural barriers which compose the entire defence system, incl.:

- Different types of artificial reefs (first defence line)
- Different types of sea walls
- Different types of forests
- Natural and reinforced dunes
- Raised buildings (e.g. for vertical evacuation)

} Intermediate defence lines

- Mobile defence systems (last defence line)

➢ However, the efficiency of the whole defence system strongly depends on the technical feasibility and performance of the first defence line (Artificial Reef)

↳ Therefore the first research proposals should focus on this issue

(*) CEDM-TP = Coastal Engineering Design Manual for Tsunami Protection

Future Research Topics

- Generation of Tsunami Wave trains instead of single solitay wave: This is important because generally the tsunami reach the nearshore-zone as a train of waves having the same propagation behaviour as solitary waves
- Effect of Tsunami wave train on wave run-up and overwash as well as on down rush
- Shoaling properties, incipient wave breaking and process of tsunami-wave train
- Tsunami damping performance of different types of forest (mangroves, casuarinaccieae) and man-made structures
- Tsunami-induced Scour in front and around structures


Thank you for your attention!