



Technische
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CONCERT JAPAN
Connecting and Coordinating
European Research and Technology Development with Japan



Leichtweiß-Institute for Hydraulic Engineering and Water Resources
Department for Hydromechanics and Coastal Engineering



Contribution of LWI to the RAPSODI Project

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RAPSODI: Kick off meeting | 25. October 2013 | NGI, Oslo

Contents

1. Laboratory facilities at the LWI
2. Available measuring devices
3. Experience in tsunami physical modelling
 - 3.1. TAPFOR Project
 - 3.2. HYBTEW Project
4. LWI contribution to RAPSODI Project

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Twin-wave flume (1)



Length: ca. 90 m
Width: 1.0 und 2.0 m
Depth: ca. 1.20 m

Twin-wave flume (2)

Wave maker (operated synchronically or separately):

- Wave types generated:
 - Regular waves (max. wave height 0.3 m, max. wave period 5 s)
 - Wave spectra (max. wave height 0.3 m, max. wave period 5 s)
 - Solitary waves (max. wave height 0.24 m)



Twin-wave flume (3)

Bore gates (operated separately):

- Generation of a tsunami bore
- Swinging type of a gate
- Operated by a pneumatic system
- Constructed at a distance of 20.0 m from the wave maker
- Water depth in front of the bore gate 0.0 - 0.3 m, behind 0.3 - 0.9 m



Berliner-Rinne

Length: ca. 19 m
Width: 0.3 m
Depth: ca. 0.36 m



Wave types generated:

- Regular waves (max. wave height 0.06 m, wave period 0.9 - 2.6 s)
- Tsunami bore (water depth behind bore gate 0.05 - 0.5 m)

3D Wave Basin

Length: ca. 25 m
Width: 20 m
Depth: ca. 0.6 m



- Wave types generated:
 - Regular waves (max. wave height 0.10 m, max. wave period 2 s)
 - Wave spectra (max. wave height 0.10 m, max. wave period 2 s)
 - Solitary waves (max. wave height 0.17 m)
- Max. stroke: 1.1 m
- Current max. water depth: 0.3 m

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Current velocity measurements



Electromagnetic current meter (1)

- 3D
- 3 m/s (optionally 5 m/s)



Acoustic Doppler Velocimeter (3)

- Nortek1D (2)
- Sontek 3D (1)
- 2.9 m/s



Propeller-type current meters (5)

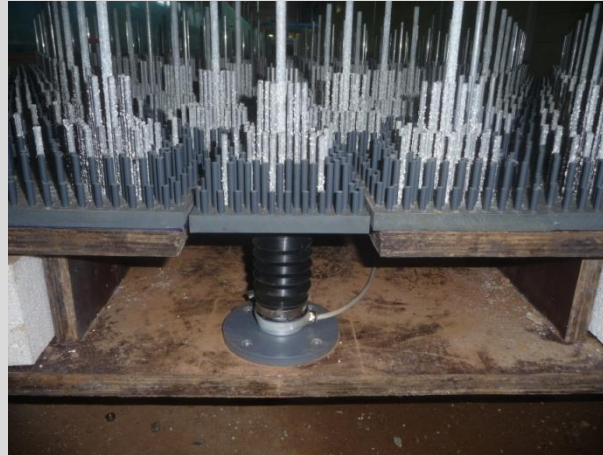
- No distinction between positive and negative velocity

Force measurements



Dynamometer (1)

- 3D forces: 5 kN
- Torsion moment: 2 kNm



Force transducers (11)

- 1D forces: 60 N



Pressure transducers

- 1, 5 bar
- 70, 175, 350, 700 mbar

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TAPFOR Project (Tsunami Attenuation Performance of Coastal Forests) (1)

TSUNAMI, 2004



TSUNAMI, 2011



Project objectives:

- development of tree parameterization method (for mangroves and coastal pines; stiff and flexible structure assumption)
- determination of damping performance of coastal forest, based on experiments (for varying flow regime, forest configuration, water depth)
- numerical prediction of tsunami/storm wave propagation through forest (including reproduction of past events)

TAPFOR Project (Tsunami Attenuation Performance of Coastal Forests) (2)



HYBTEW Project (Hydrodynamics of Boulder Transport Induced by Extreme Wave Events) (1)

TSUNAMI, 2004



CYCLONE THOMAS, 2010



TSUNAMI ? STORM WAVES?



Project objectives:

- improvement of knowledge on the processes associated with the incipient motion and transport of boulders induced by tsunami/storm waves
- determination of formulae for incipient boulder motion, based on the results of laboratory experiments
- development of a numerical model for the prediction of tsunami/storm wave-induced transport of boulders

HYBTEW Project (Hydrodynamics of Boulder Transport Induced by Extreme Wave Events) (2)

Project stages:

WP1: Literature review on wave-induced boulder transport

WP2: Determination of typical boulder parameters based on available field surveys

WP3: Scale-model experiments on incipient boulder motion and transport

- variation of boulder properties (shape, density, dimensions, etc.)
- tsunami bore, solitary wave, wave spectra, freak waves
- varying initial water depth conditions
- development of inertia sensor for measuring boulder dynamics

WP4: Numerical modelling, including model development and validation

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LWI contribution (1)

STAGE 1: Evaluation of existing knowledge and comparison of mitigation strategies

WP1: Evaluation of existing tools, data, and mitigation strategies (METU)

STAGE 2: Numerical and experimental studies

WP2: Numerical modelling of tsunamis (METU)

WP3: Laboratory experiments on tsunami impact on structures (LWI)

STAGE 3: Methodology for tsunami vulnerability assessment and risk management

WP4: Development of a risk assessment model (NGI)

WP5: Development of mitigation strategies (PARI)

WP6: Networking and dissemination (NGI)

LWI contribution (2)

WP3: Laboratory experiments on tsunami impact on structures:

- failure analysis of existing structures in Japan, based on field data
- experimental investigation on tsunami-induced damage to structures
- experimental investigation on performance of innovative structures



LWI + guests researchers

Improvement of knowledge on structure failure under tsunami impact
Development of innovative protective structures against tsunami

LWI contribution (3)

WP5: Development of mitigation strategies:

- design of mitigation strategies
- development of GIS methodology for tsunami risk assessment



PARI + LWI

Establishment of tsunami mitigation strategies

LWI funding (overview)

- **Duration: 1. July 2013 to 30. June 2015**
- **Overall Funding: ca. 54,000 € (BMBF, Germany)**
- **Staff:**
 - ca. 2 person months, mainly used for model tests
 - not allowed more than 20% of totals)
- **Travel costs:**
 - ca. 32,000 €
 - 2013: travels to Oslo, Yokosuka, Ankara
 - 2014: longer stays in Oslo, Yokosuka, Ankara & travels to 2 conferences
 - 2015: 2 conferences
- **Organisation events:**
 - ca. 9,000 €
 - only planned in 2013/2014, not allowed more than 20% of totals
 - mini-workshop 2014, before the model tests (for details of planning)
 - workshop “Tsunami Loads on Structures”, after model tests, with external experts

Preparatory work

1. Literature review on tsunami-resistant buildings in a framework of a bachelor thesis (in German)

Ina Zimmermann (2013): Entwicklung von Strategien für die Konstruktion von tsunamisicheren Bauweisen

- classification of typical buildings (houses, public/evacuation buildings) in tsunami-prone area (building materials, construction, etc.)
 - tsunami load on structures
 - failure modes
 - reconstruction plans in tsunami-prone areas
2. Determination of bore flow velocity over a horizontal flume bottom (for a scaling reference)



Thank you for your attention

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