3rd Iberian Congress – Advances on SPH

Wave-structure interaction mechanisms anticipating the collapse of the Pont del Petroli footbridge

Giorgia C. Goursand-Parente

Bonaventura Tagliafierro
Giacomo Viccione
Corrado Altomare

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UNIVERSITÀ DEGLI STUDI DI SALERNO

UNIVERSITAT POLITÈCNICA DE CATALUNYA

EPhysLab

G. C. Goursand-Parente | G. Viccione

B. Tagliafierro | C. Altomare

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CONTENTS

- Pont del Petroli structural failure

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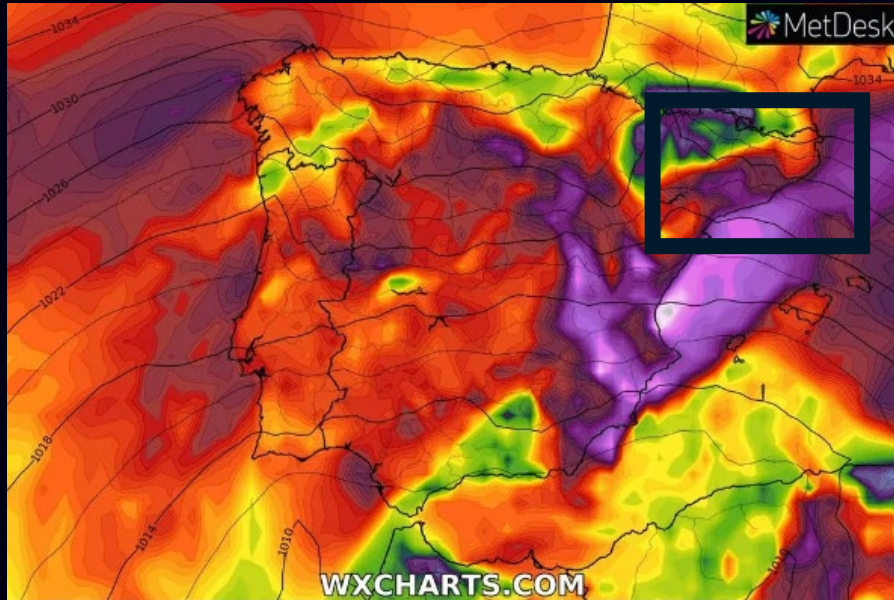- Meshless-to-Mesh Offline Coupling

- Conclusions

PONT DEL PETROLI STRUCTURAL FAILURE

2020 STORM GLORIA

Mapa de rachas máximas totales para el periodo 18-20 de enero de 2020, según GFS. En algunas áreas del Mediterráneo podrían tener rachas huracanadas. WXCHARTS
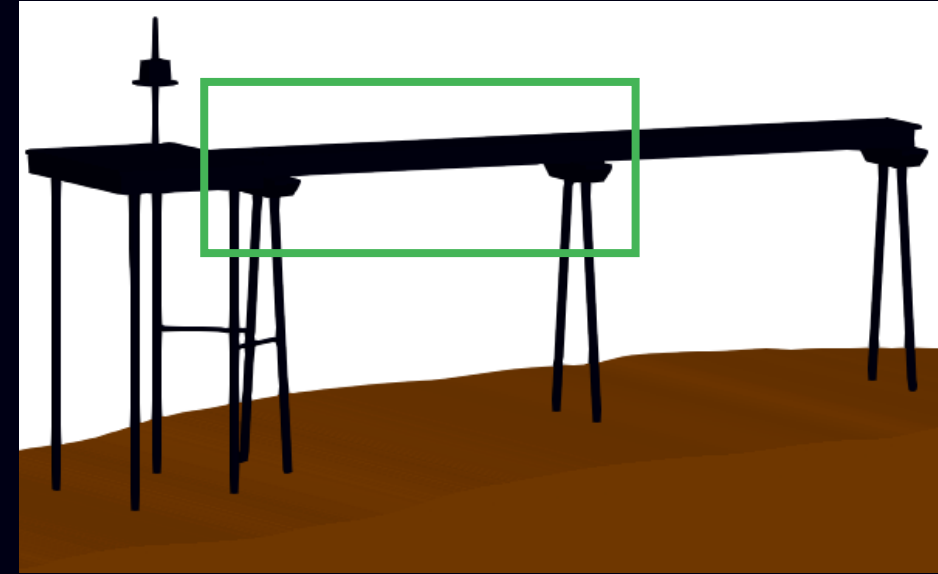
PONT DEL PETROLI STRUCTURAL FAILURE

PONT DEL PETROLI STRIKED BY STORM GLORIA

MOST ACREDITED CAUSE: OVERCOME OF SOIL LATERAL RESISTANCE
(Badalona City Council Report; Altomare et al. 2022)

DualSPHysics MODEL VALIDATION

CIEM WAVE FLUME (Experimental campaign)

2D SIMULATION

```
Particle summary:
  Fixed....: 150,704  id:(0-150703)   MKs:7 (10-12,14-17)
  Moving...: 7,703  id:(150704-158406)   MKs:1 (13)
  Floating.: 0
  Fluid....: 1,284,979  id:(158407-1443385)   MKs:1 (1)

Total particles: 1,443,386 (bound=158407 (fx=150704 mv=7703 ft=0) fluid=1284979)
Total MK blocks: 9 (bound=8 (fx=7 mv=1 ft=0) fluid=1)
```
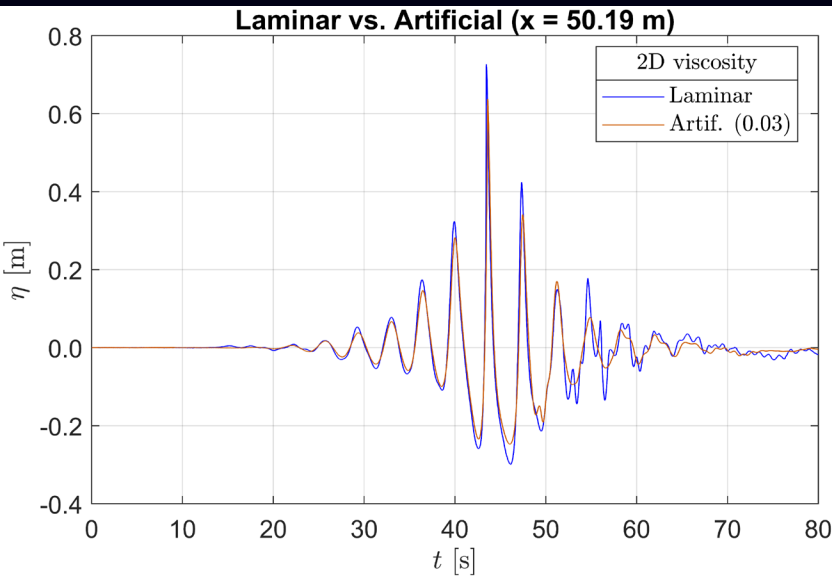
DualSPHysics MODEL VALIDATION

2D SIMULATION

Laminar vs. Artificial (x = 50.19 m)

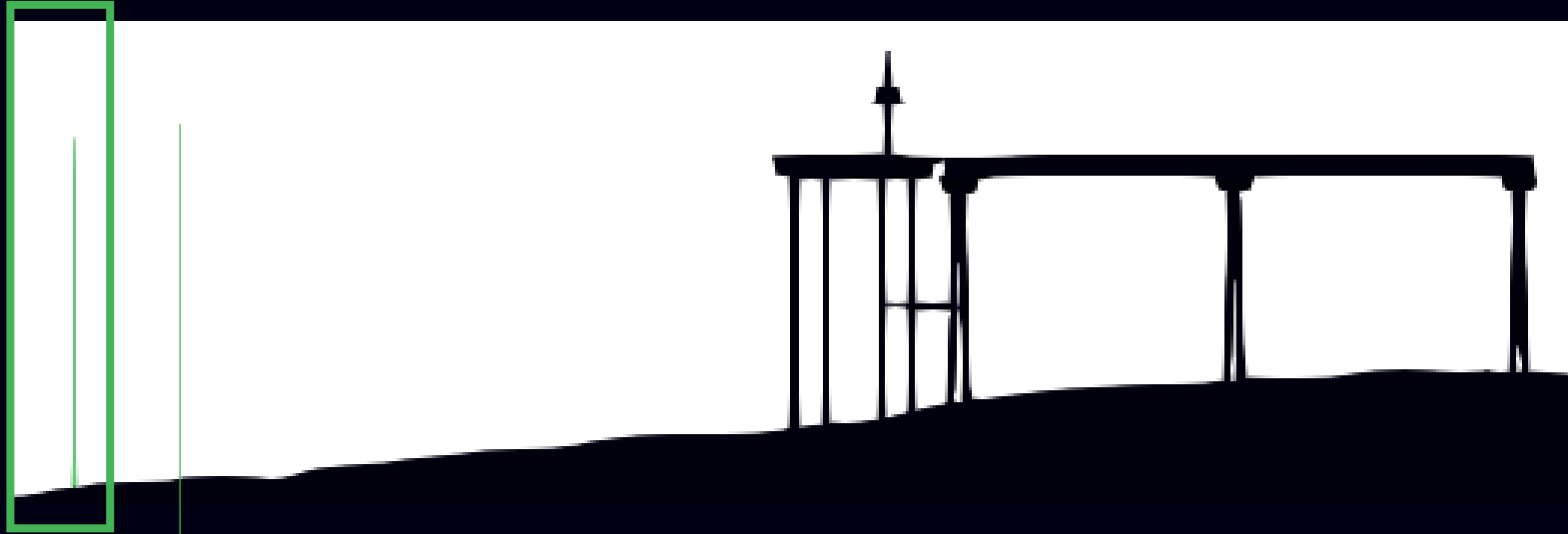## 3D SIMULATION

WG6

WG6
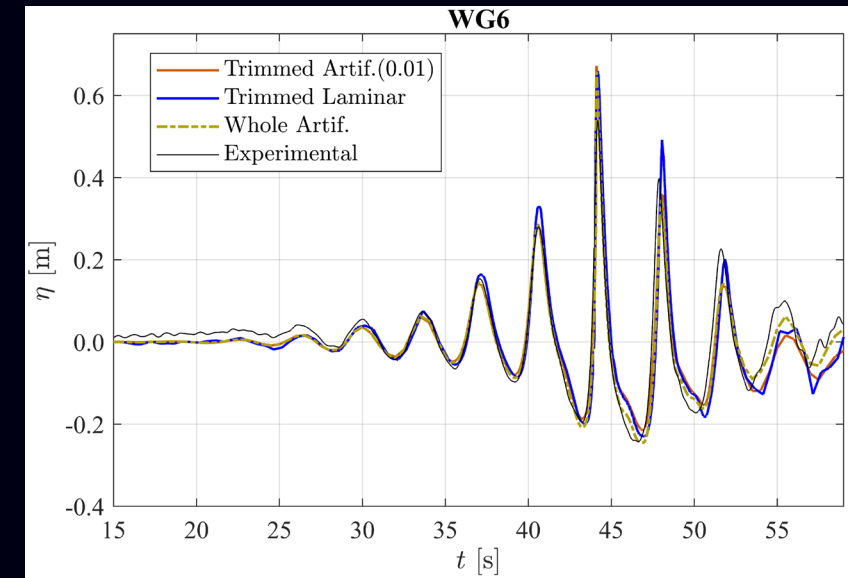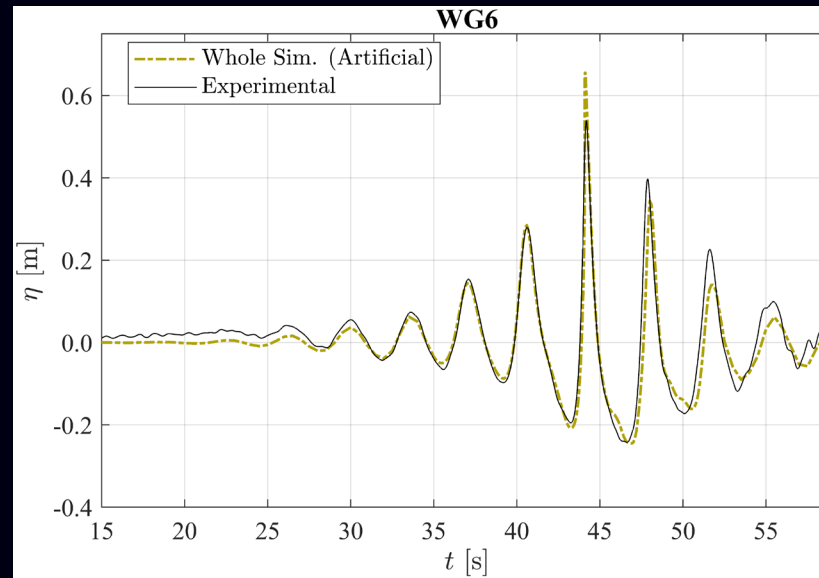
DualSPHysics MODEL VALIDATION

INOUT ZONE (x = 50.19 m)

2D SIMULATION

Total particles: 1,443,386

3D SIMULATION

Total particles: 4,436,560

WG6 (x = 52.12 m)

DualSPHysics TRIMMED MODEL

TRIMMED DOMAIN

WG6
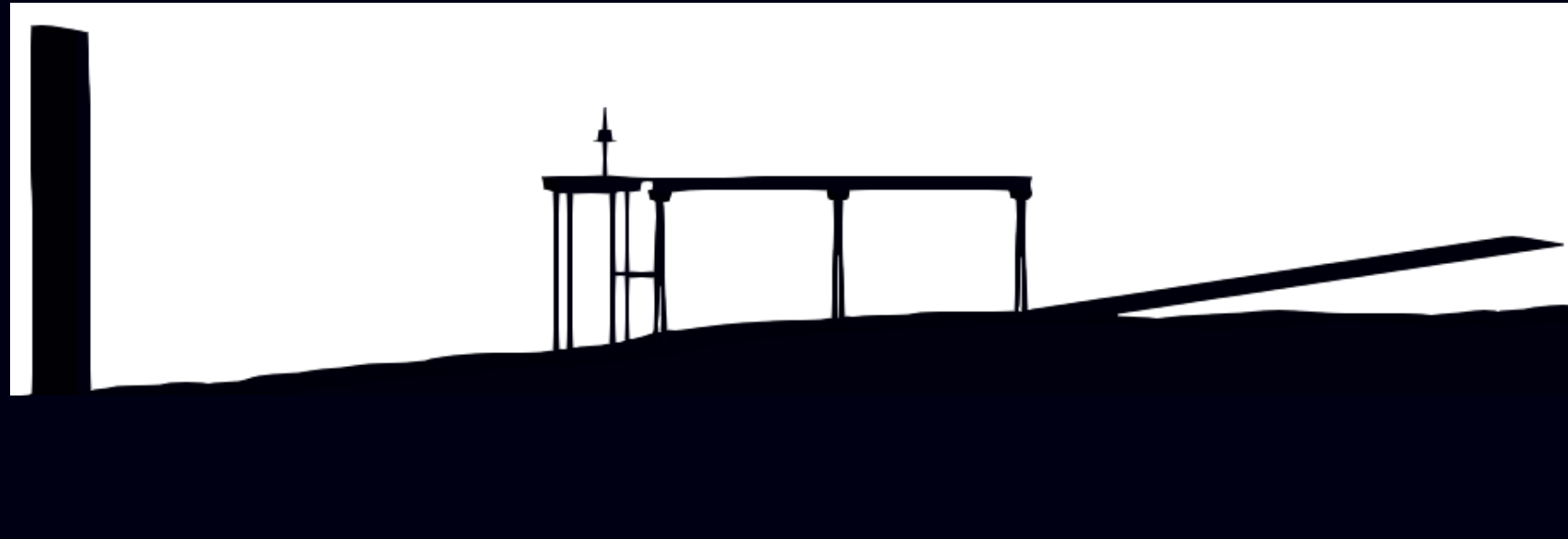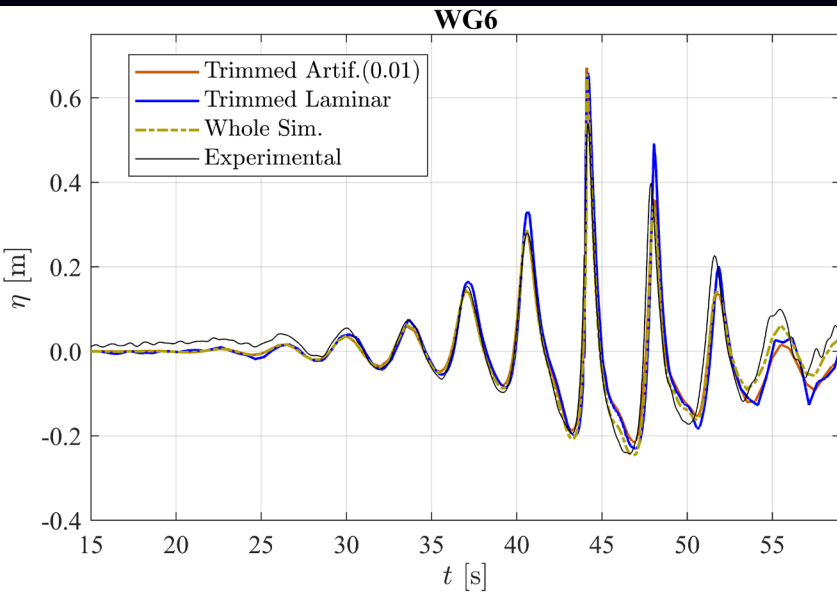

```
Particle summary:
  Fixed....: 1,105,088  id:(0-1105087)   MKs:9 (10-12,14-19)
  Moving...: 0
  Floating.: 0
  Fluid....: 3,331,472  id:(1105088-4436559)   MKs:2 (1-2)

Total particles: 4,436,560 (bound=1105088 (fx=1105088 mv=0 ft=0) fluid=3331472)
Total MK blocks: 11 (bound=9 (fx=9 mv=0 ft=0) fluid=2)
```
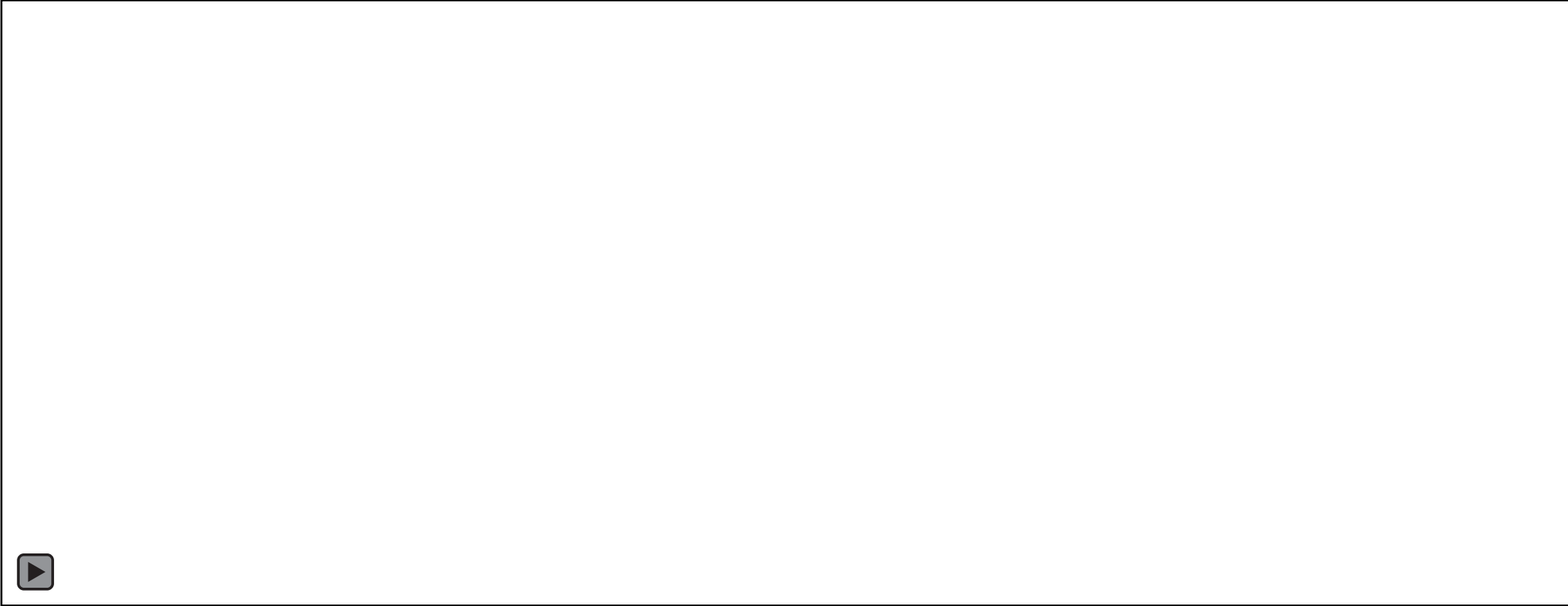
```
Particle summary:
  Fixed....: 400,230  id:(0-400229)   MKs:8 (11-12,14-19)
  Moving...: 0
  Floating.: 0
  Fluid....: 1,897,116  id:(400230-2297345)   MKs:2 (1-2)

Total particles: 2,297,346 (bound=400230 (fx=400230 mv=0 ft=0) fluid=1897116)
Total MK blocks: 10 (bound=8 (fx=8 mv=0 ft=0) fluid=2)
```

DualSPHysics TRIMMED MODEL

MESHLESS-TO-MESH OFFLINE COUPLING

DSPH SIMULATIONS

«*RECIPROCAL VALIDATION*»

PEAK THRUST

MESHLESS-TO-MESH OFFLINE COUPLING

SAP2000 STRUCTURAL ANALYSIS
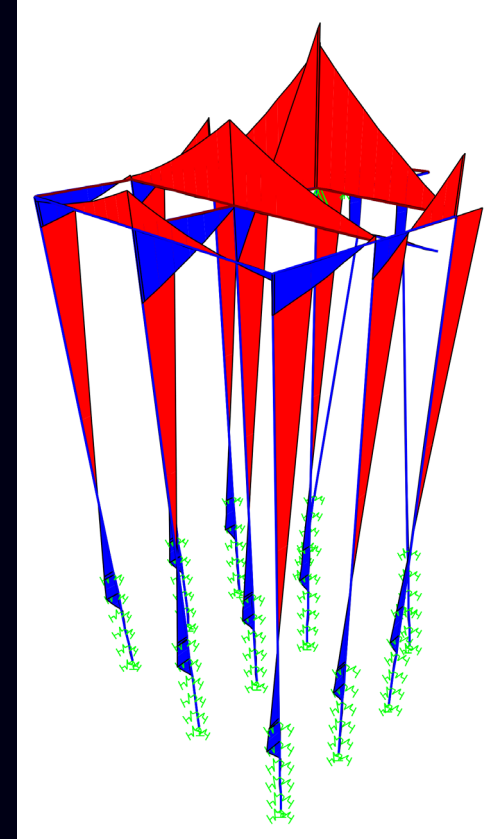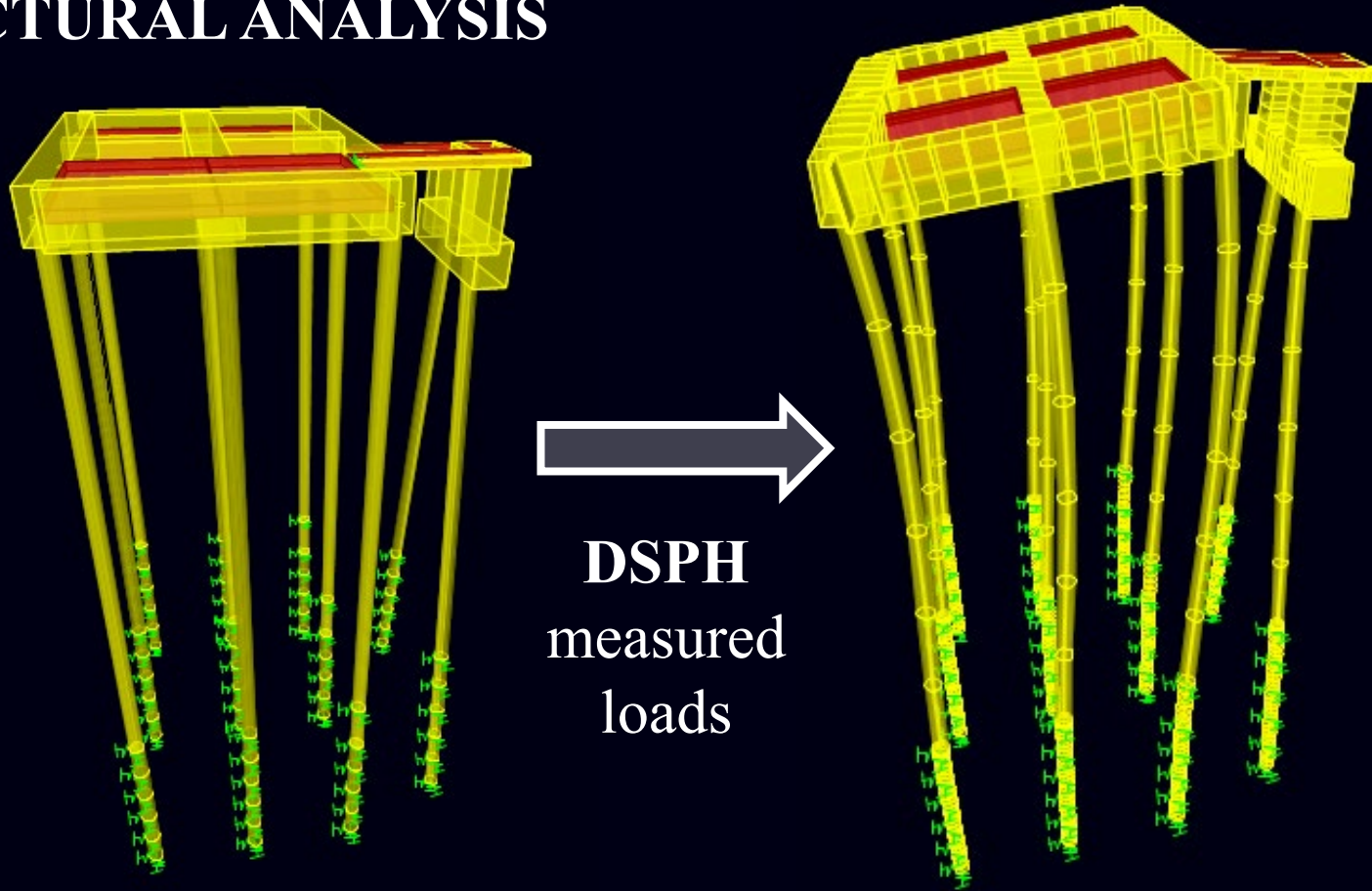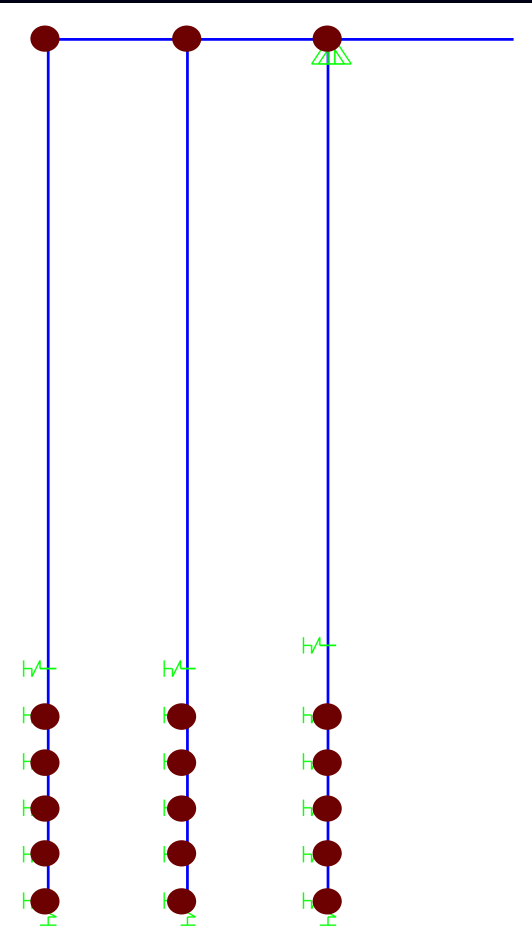
DSPH
measured
loads

CONCLUSIONS
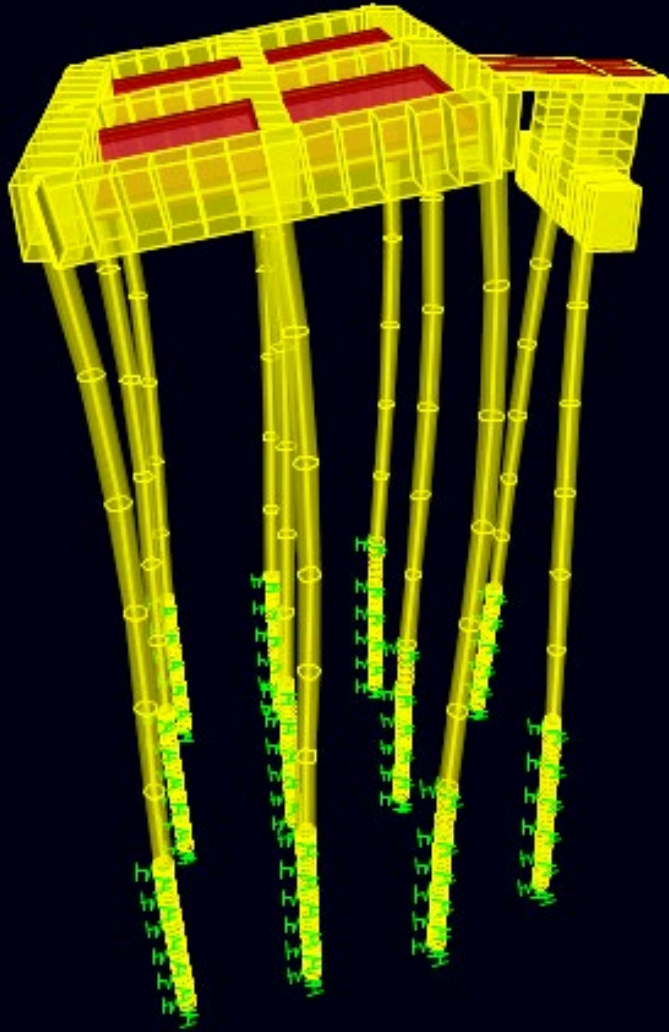
- The artificial viscosity model was overcome in this case: the sole Laminar regime could caption the wave heights and loads, in accordance with experimental measurements;

- An optimization of the computational effort was achieved by trimming the rear part of the domain without losing physical accuracy;

- An offline approach is proposed, with the introduction of the DSPH fluid loads as static loads in the Finite Element structural solver – structural mechanisms could be foreseen in the design phase of civil engineering projects or corroborate post-damage survey hypothesis.

THANK YOU!

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