Onshore Tsunami Amplification Factor

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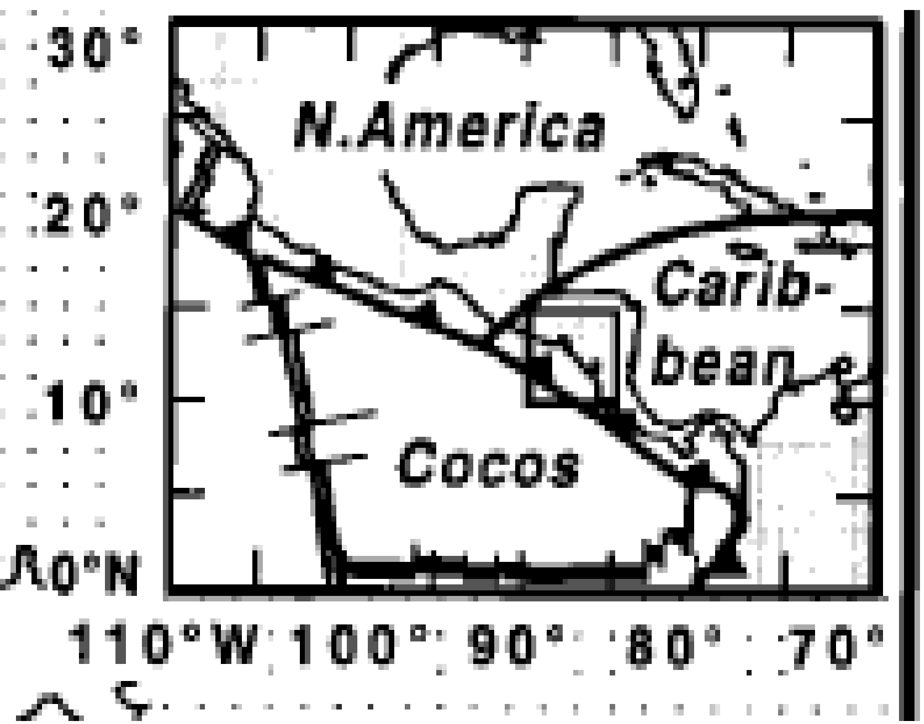
Contents

1. Background and Motivation
2. Experimental Setup
3. Reference Location
4. Amplification factor variation with cliff angles
5. Conclusion

Background



Satake, 1993

1992 Nicaragua Earthquake
- Mw 7.0, source around 100km from coast

Damage done
- 15000 either dead, homeless or injured, 1500 homes destroyed

Classified as a ‘tsunami earthquake’
- An earthquake that generates an unusually large tsunami relative to earthquake magnitude (Kanamori, 1972)

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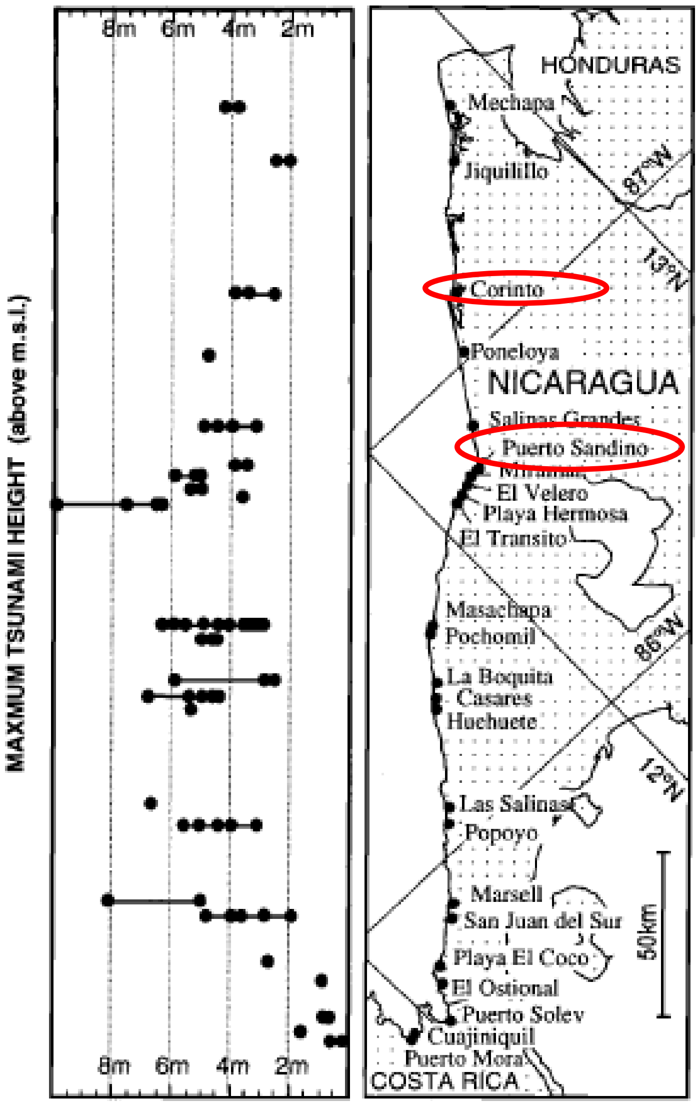
Background



Satake, 1993

Post tsunami surveys are conducted along the coast line.

Tidal gauges are found only at 2 locations; Corinto and Puerto Sandino

To better quantify the tsunami source parameters, Satake (1994) tried to adjust the numerically simulated wave height at shallow water to measured run-up.

He defined this adjustment as an amplification factor where;

$A = R_{obs}/H_{num}$

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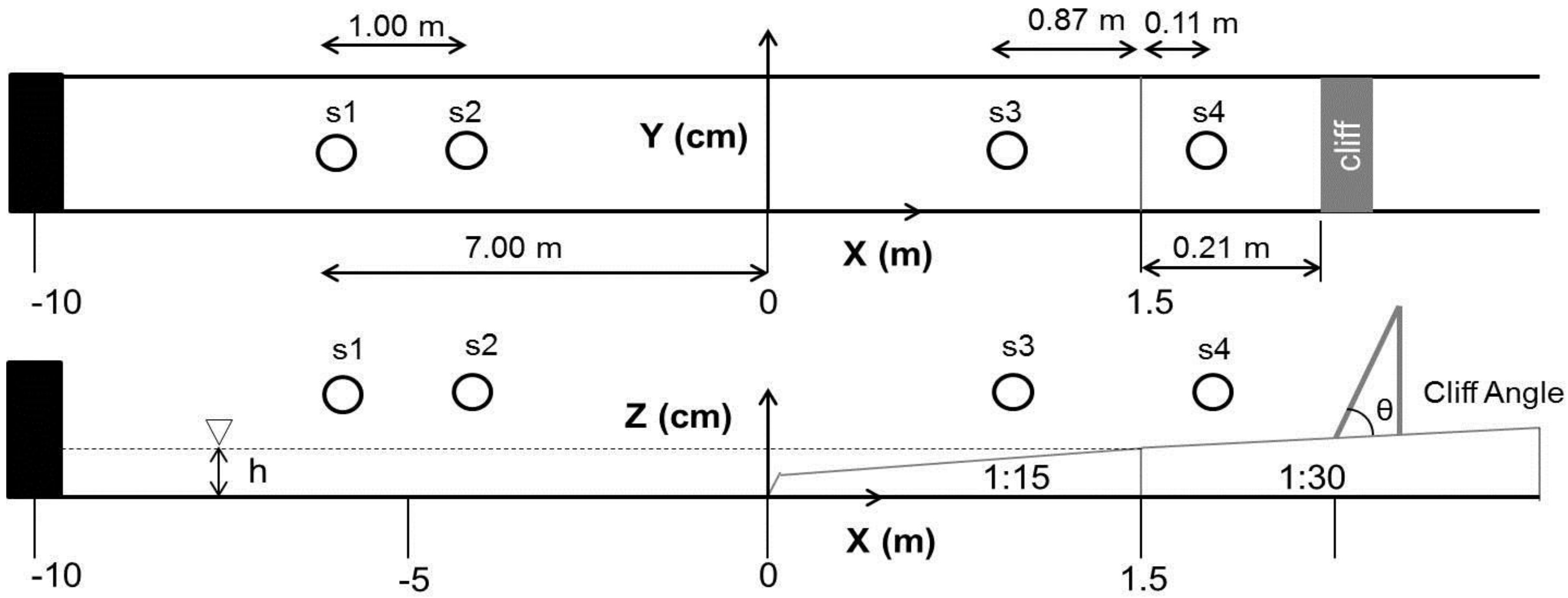
Motivation

Factors that affect the amplification factor

1. Coastal topography
2. Choice of near shore wave location

Try to understand how changes in topographical settings might affect the onshore flow depths at different onshore locations.

Experimental Setup



Variable parameters

1. H_o = 2.5, 3.5, 4.5 and 5.5 cm
2. θ = 14, 21.67, 39.33, 49 and 79°.
3. x = 0, 6, 11, 13, 16 and 21 cm

Fixed parameters

1. d = 35 cm
2. Reference location = *s3*.

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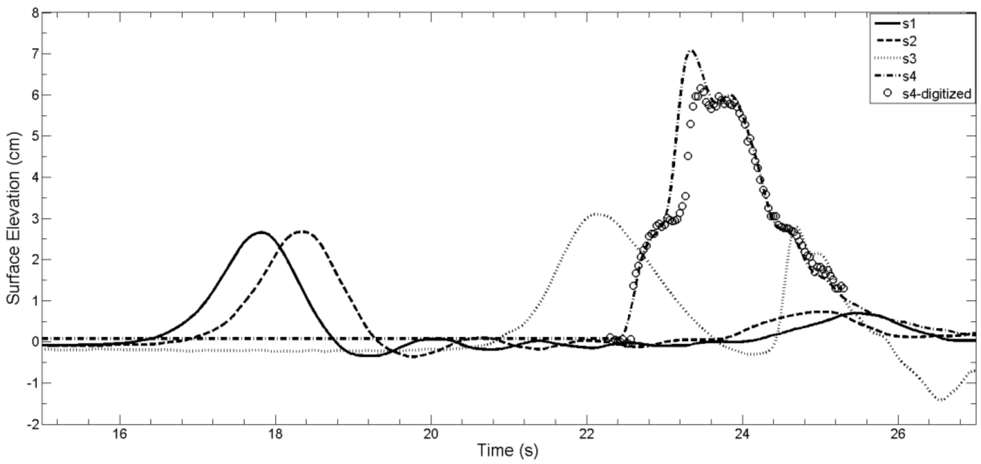
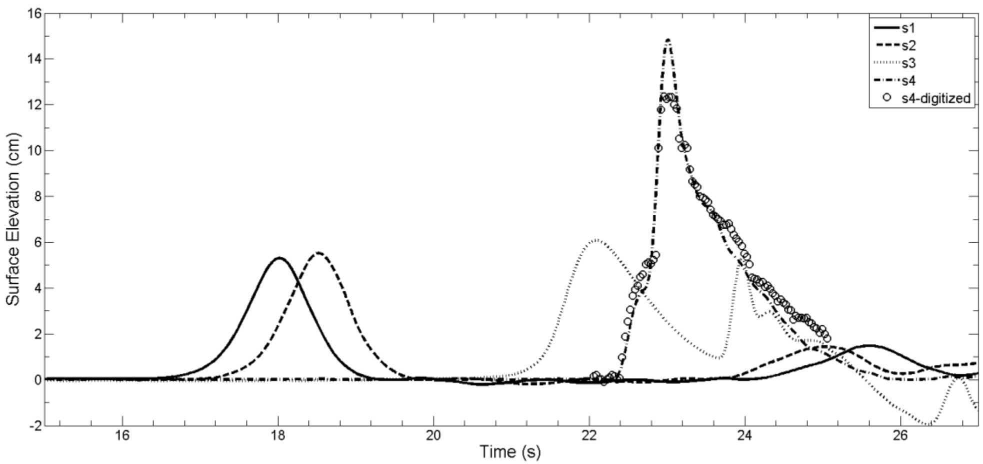
Reference Location





Main consideration for selection is that there should be no wave superposition between incident and reflected wave.

The 2 cases on the right show that the wave profile at s3 has 2 distinct peaks; signifying that the wave elevation we used at s3 is a true indicator of the near shore wave height

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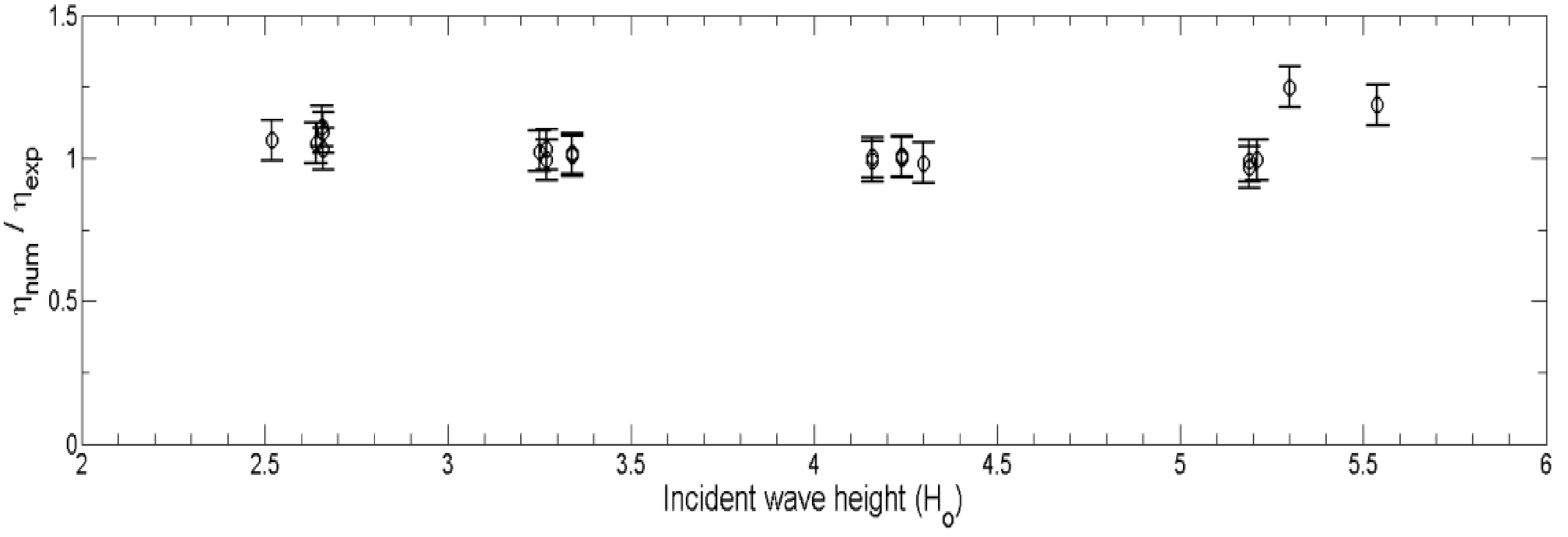
Reference Location

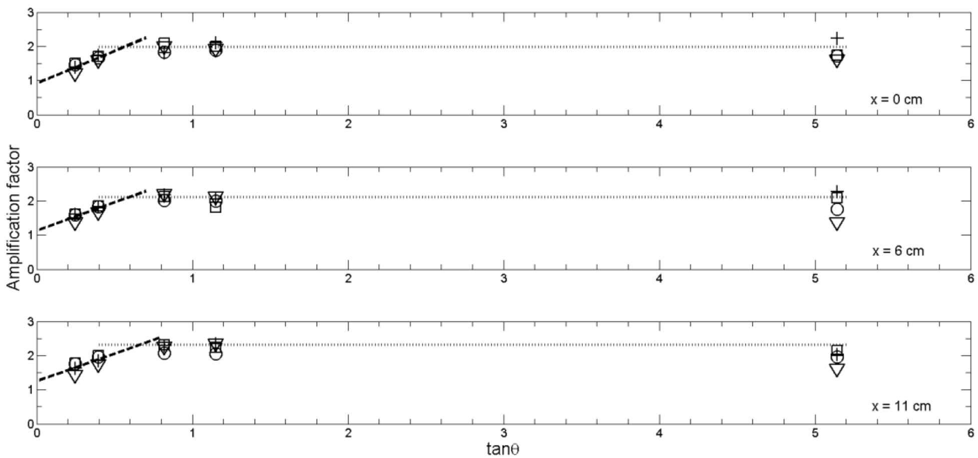


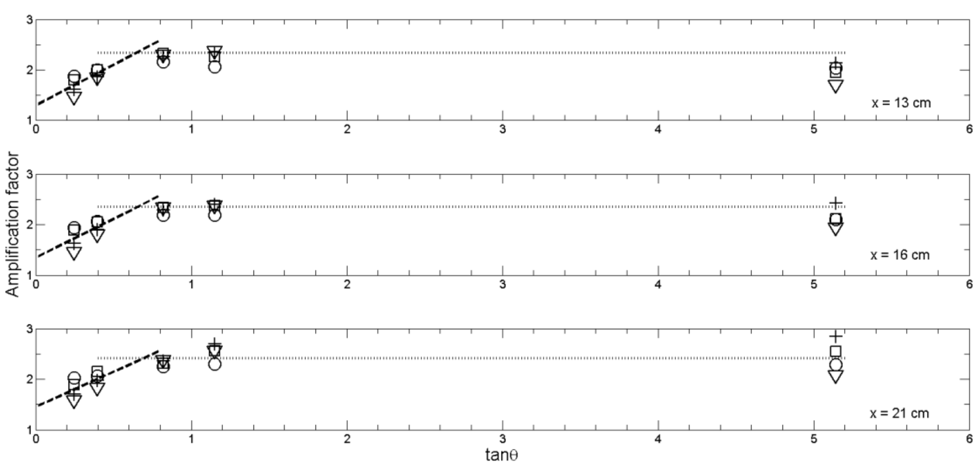
Matching between numerical and experimental results is rather good

Amplification factor variation with cliff angles

Definition of our amplification factor:

Amplification factor = $H_{measured}$ / $H_{numerical@s3}$





Circles are for H_o = 2.5cm; squares indicate H_o = 3.5cm, crosses for H_o = 4.5cm and downright triangles represent H_o = 5.5cm

Piecewise linear regression was used to the amplification at 6 onshore locations.

Small angles→ linear

Large angles→ constant

Past a critical angle, relationship is constant

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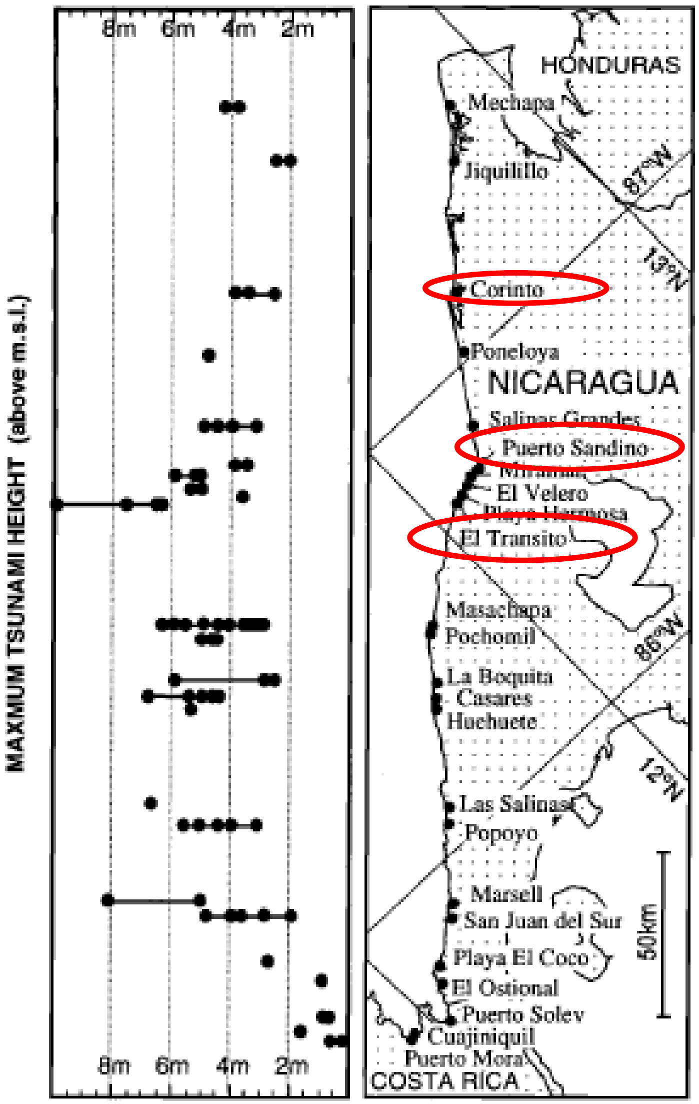
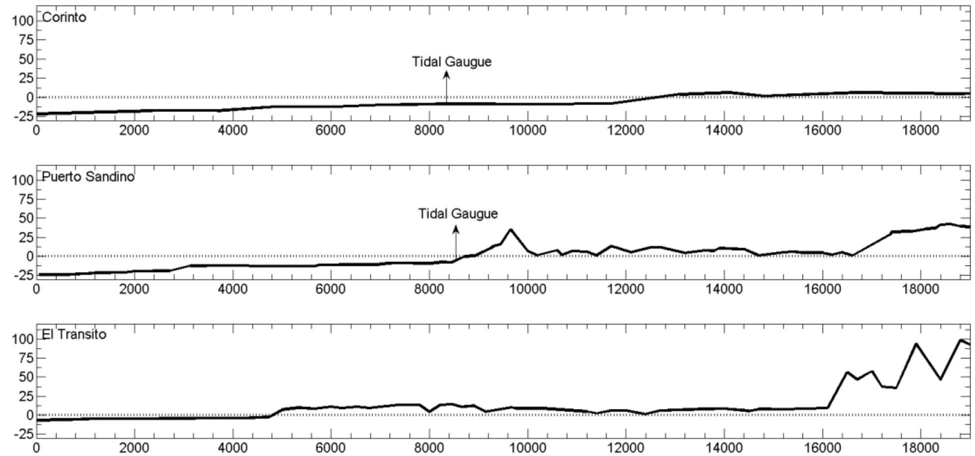
Amplification factor variation with topography





$A = R_{obs}/H_{num}$

Satake (1994) reported an average factor of 3 for both Corinto and Puerto Sandino.

However reported flow depth of El Transito is much higher

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Conclusion

Tsunami amplification factor is a parameter that can be used to adjust the numerically simulated wave run-up/onshore flow depth

However, it is highly dependent on:

1. Local topography
2. Selection of the reference location

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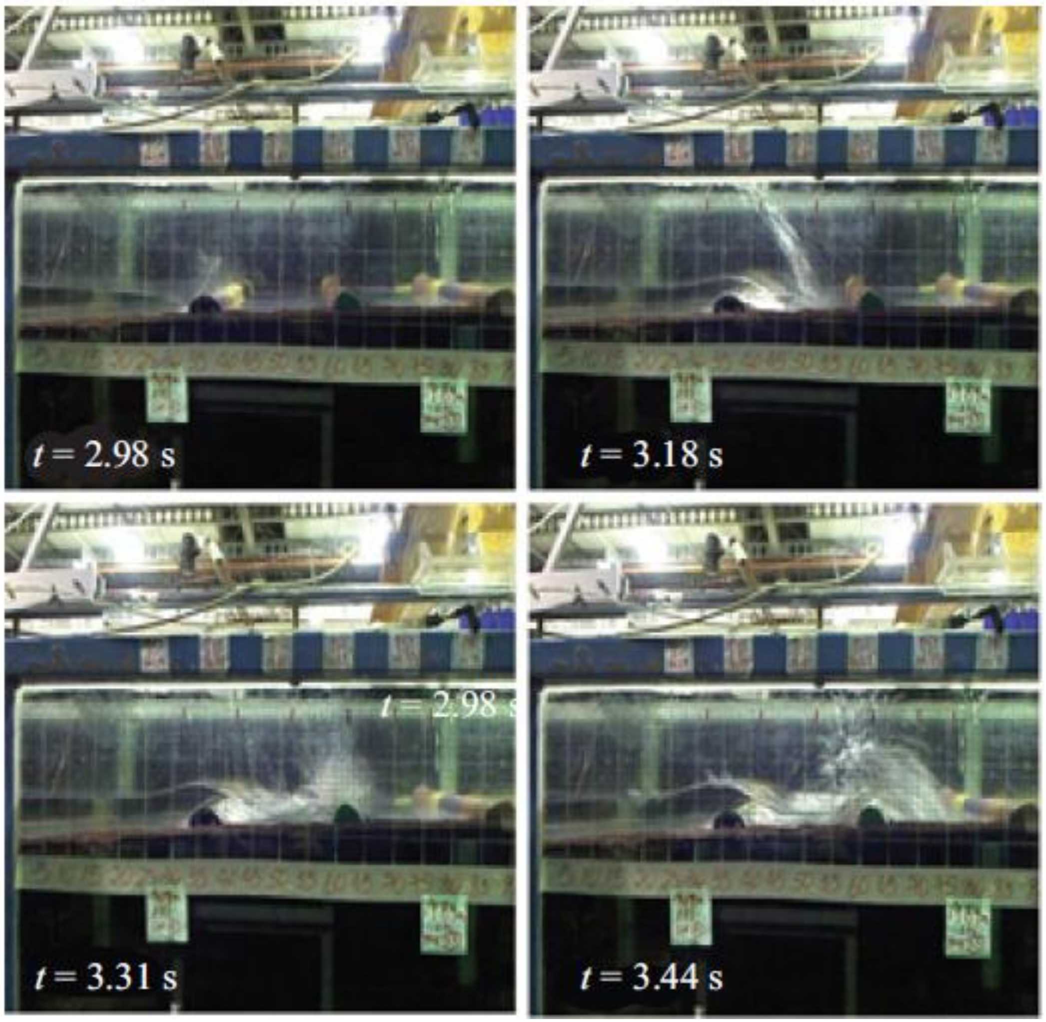

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