

Real scale test design of a sand flowslide by MPM slope (in)stability analysis

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Understanding flowslides in flood defenses

(MPM-Flow Project)

Validation Anura3D – from 2016 to 2020

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Outline

Real scale test design of a sand flowslide by MPM slope (in)stability analysis

Introduction

Methodology

Real Scale Test

• Questions and answers







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Conclusions







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What is a flowslide?

(Hungr et al. 2014)





Range of possible behaviors



sea bed



State parameter Ψ Been and Jefferies 1985





sea bed

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Motivations







Motivations

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THE SINGULARITY IS NEAR, Ray Kurzweil, Viking Press. Publisher: Viking Adult (2005)



Numerical methods origins







Alternatives to numerical modeling

Experimental investigation:

- Full scale model
 - Expensive and often impossible
 - Measurements errors
- On a scale model
 - Simplified
 - Difficult to extrapolate
 - Measurements errors

Theoretical calculation:

- Analytical solution
 - Exist only for a few cases
 - Sometimes complex
- Numerical solution

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• For almost any problem







Anura3D MPM software





Possible applications

- Modeling landslides in unsaturated slopes subjected to rainfall infiltration (Bandara 2016)
- Cone penetration (Ceccato 2016)
- Partially drained penetration and pore pressure dissipation in
 piezocone test (Ceccato 2016)
- Unsaturated silica sand in triaxial compre
- Dyke failures involving soft materials (Fern
- Column collapses (Fern 2016)
- Landslide behavior (Parera 2016)
- Pile installation effects in sand (Phuong 2016)
- Solid foundations for dredging projects (Rot
- Flood defences (Rohe 2016)
- Wave attack on sea dikes (Tan 2016)
- Jacked piles (Tehrani 2016)

Publications in the Community 25 in 2016 19 in 2015 10 in 2014 10 in 2013 5 in 2012 6 in 2011 1 in 2010



Impression of possible MPM applications



AVALIABLE OUTPUTS:

	SCALAR: liquid pressure; virtual material point; solid volumetric strain; solid	VECTOR: solid velocity; liquid velocity; solid
	deviatoric strain; mean effective stress; deviatoric stress; solid incremental	displacement; liquid displacement; solid
	volumetric strain; solid incremental deviatoric strain; solid mass; liquid mass; solid	acceleration; global position; local position;
(F)	weight; liquid weight; porosity; integration weight; material point id; element id;	bodyforce; liquid bodyforce; externalforce; liquid
ÍU Delft	entity id; material id; damping; liquid free surface; liquid free surface cumul;	externalforce
	NorSand void ratio; NorSand image pressure; liquid volumetric strain; liquid density	TENSOR: strain; solid effective stress; liquid stress



Sand mining or real scale test?



Plan of actions



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2.791e-05 0.02 0.04 0.06 0.08 0.1 1.173e-01



Sondering

S01

S02

S03

S04

S05

CPT correlations



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Desk study (site investigation)



Header data legend



Slope Design (CUR113)



[m3/m]	[m3/m]	[m3/m]	[m3/m]	[m3/m]	[m]
max capa	now	3 berms	1 berm	no berm	depth
950	0	950	750	150	40
563	0	562,5	387,5	400	30
200	0	200	200	200	20
75	0	75	75	75	10

[m]	[m3/m]	[m3/m]	[m3/m]	[m3/m]	[m3/m]
depth	no berm	1 berm	3 berms	now	max capa
22	50	90	130	0	130
20	200	200	200	0	200
10	75	75	75	0	75





Action plan for real scale test







Action plan for real scale test



Stability of underwater slopes realized by means of a suction dredger

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Models in analysis





Models in analysis





My questions...

- Rapid flow or breaching?
- How to model the triggering?
- What sensor technology?
- How to model layers?

Do you have any?





Thank you!

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