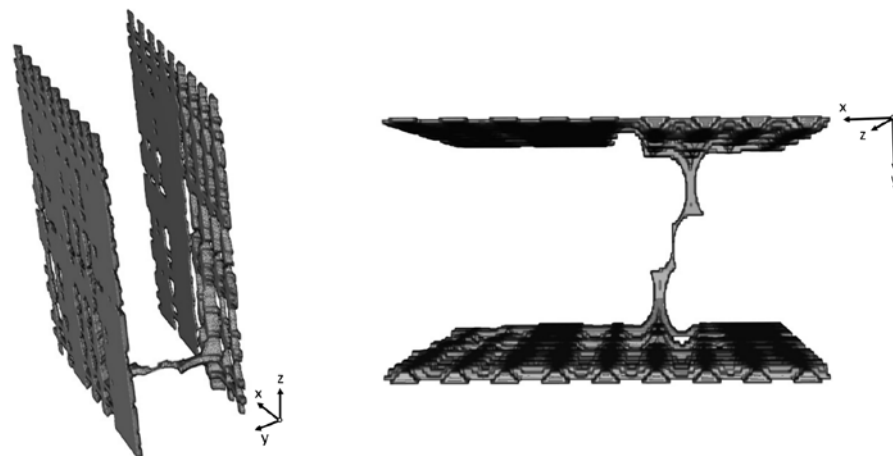


Vurdering av risiko for lekkasje gjennom jetpelevegger

NGF årsmøte 2023 og «Når telen går» - 21. mars 2023

Emil Hansen

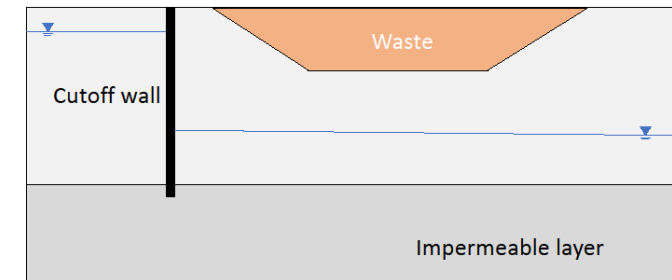
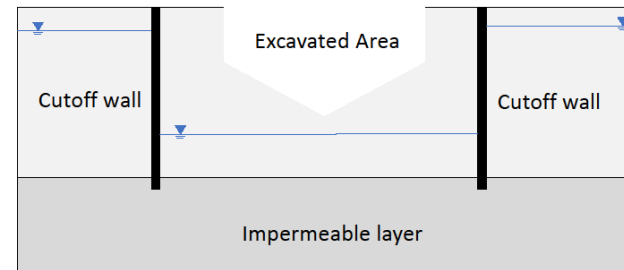
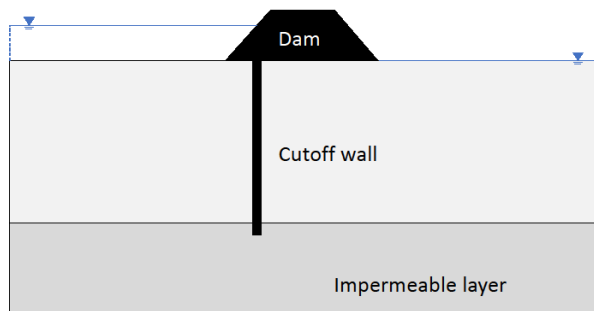


Innhold

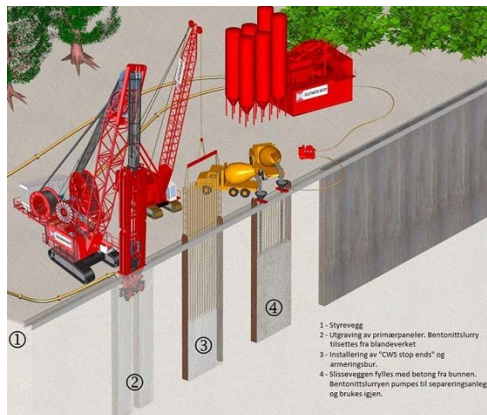
- Bakgrunn
- Problemdefinisjon
- Løsning: FPDA metoden
- Resultat
- Vinkling mot bærekraft

Bakgrunn

- Behov for å hindre grunnvannsstrømning i permeable lag

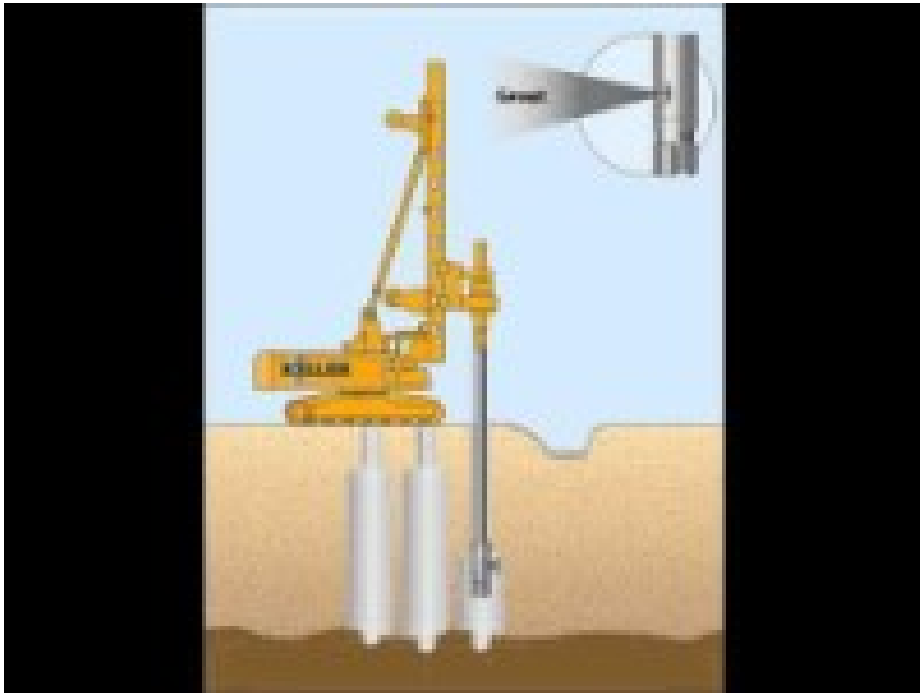


- Strømningsbarrierer kan etableres med ulike metoder



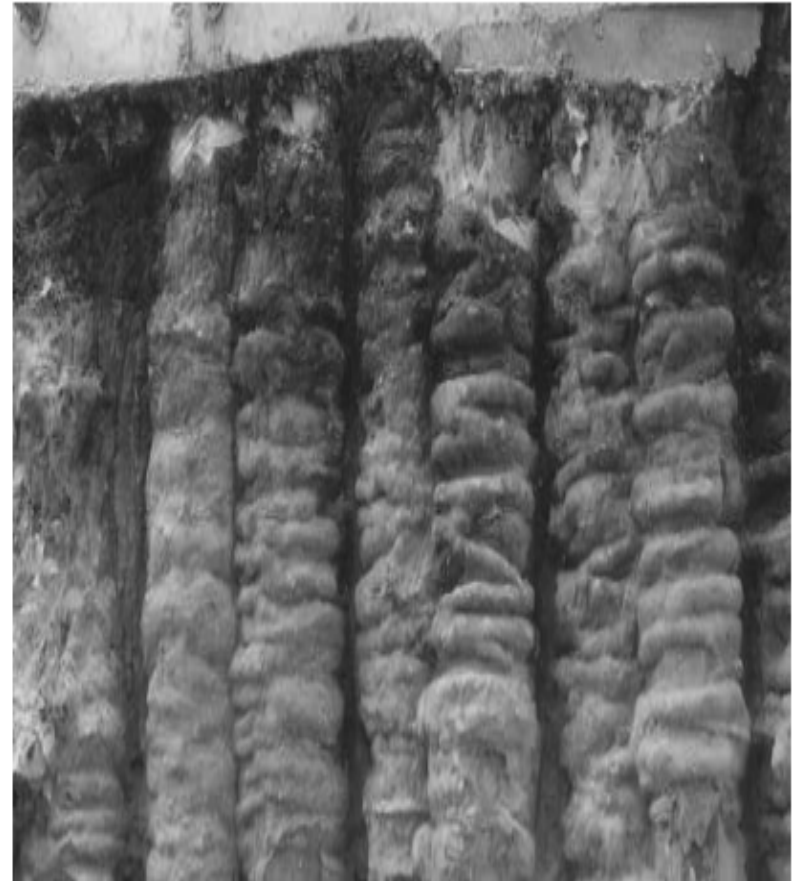
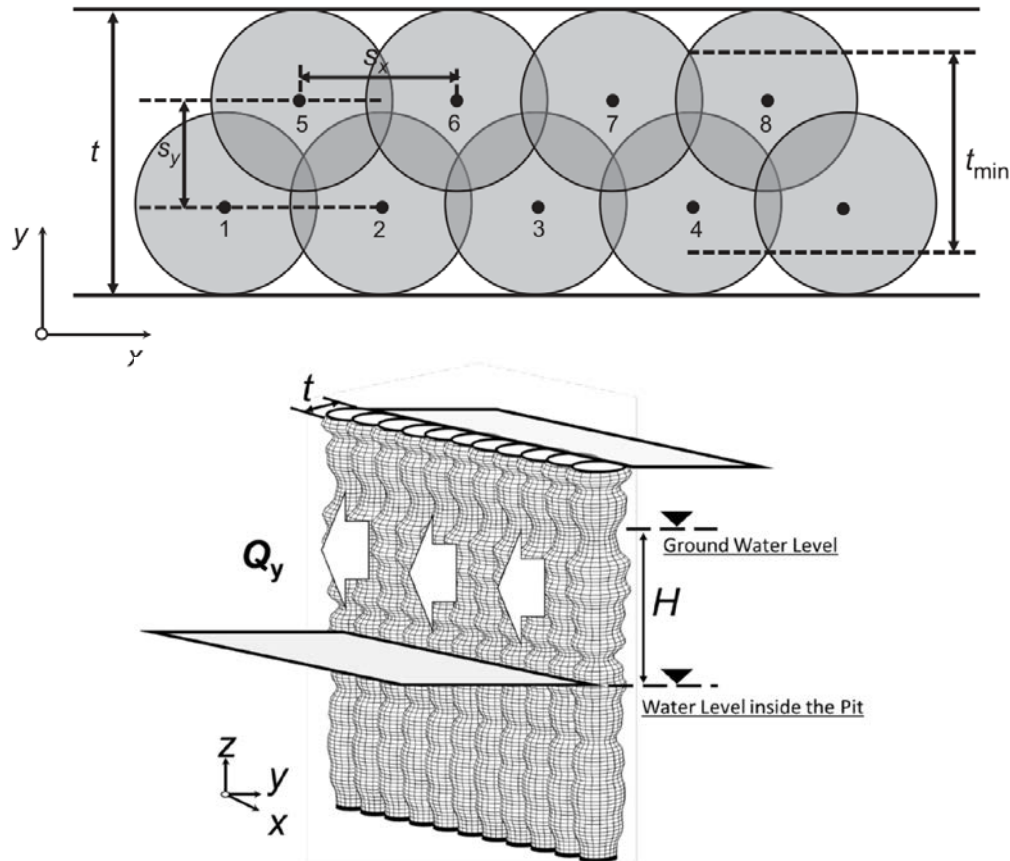
Bakgrunn

- Jetpeler



Bakgrunn

- Jetpelevegger

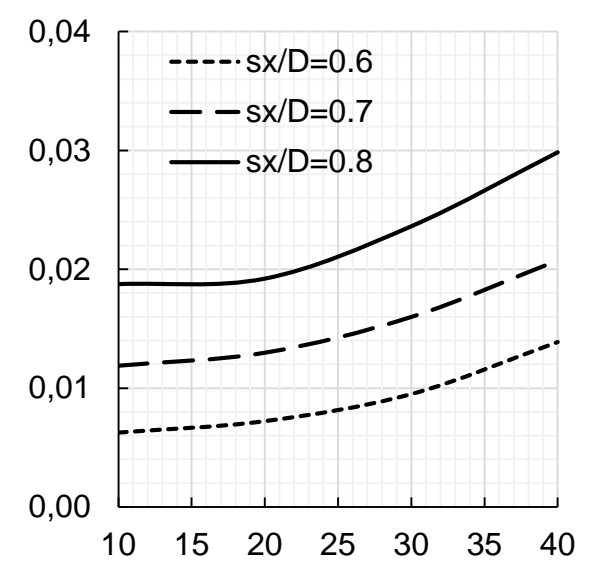
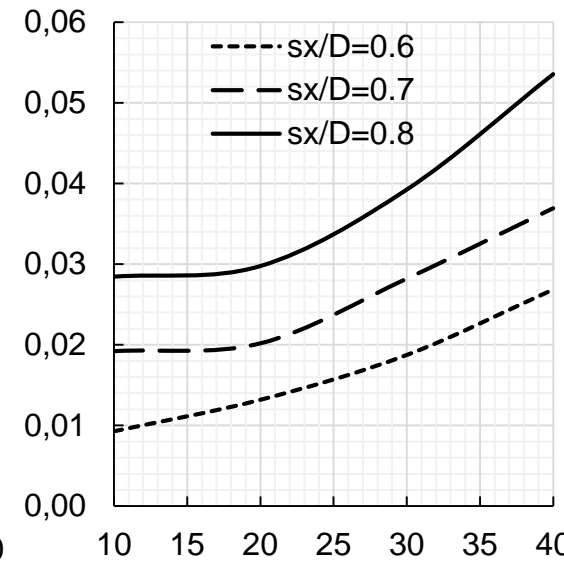
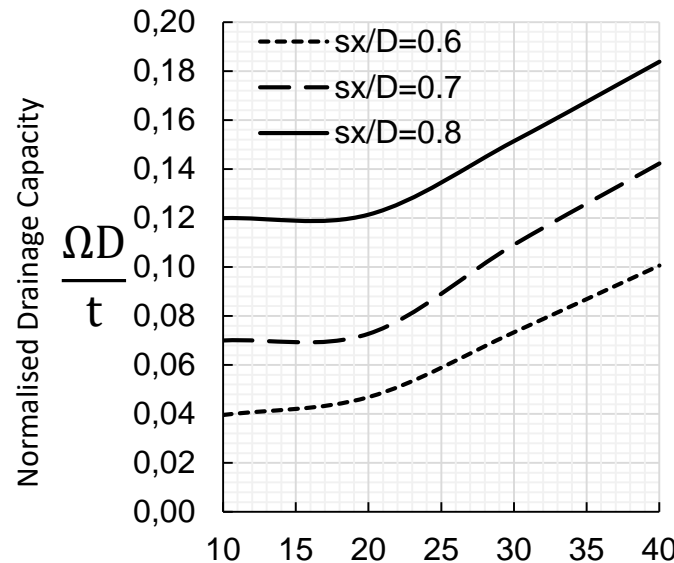
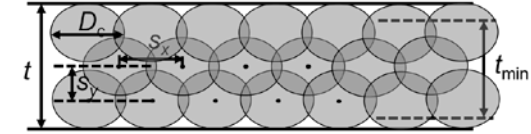
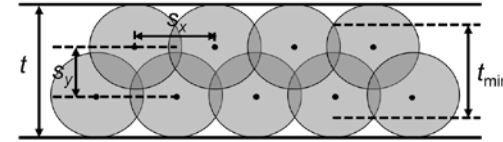
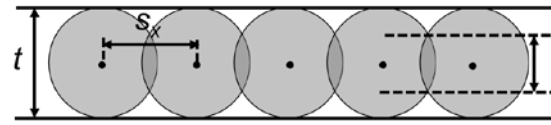
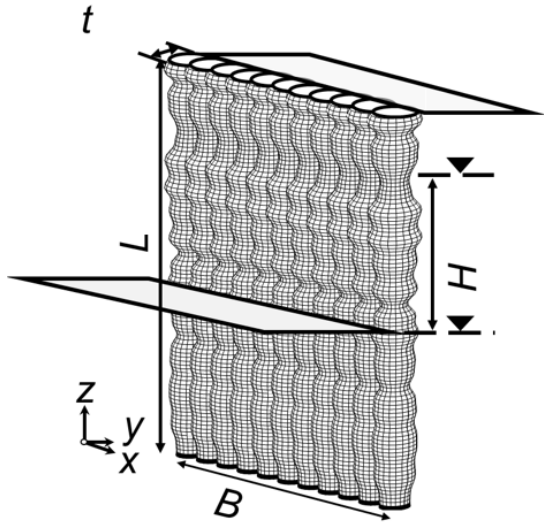


Bakgrunn

Ref. 1-4

Iht. EC7 2.4.5 (11)

- TDA metoden



- Benchmark

- 2 feltobservasjoner

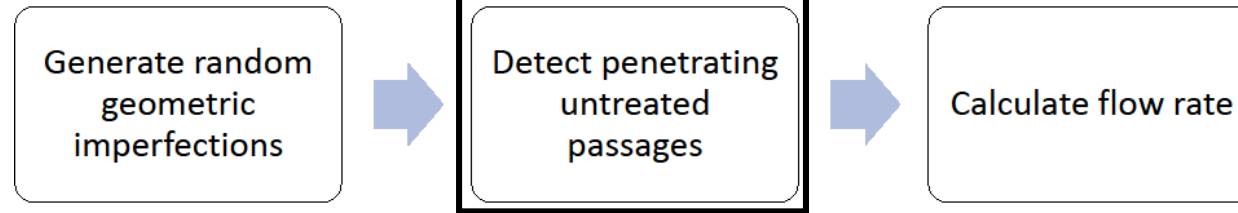
- Richardson et al. (2015): *seepage was «successfully reduced after cut-off wall installation»*
- Sembenelli & Sembenelli (1999): *«negligible seepage»*

- Sammenligning med FEM

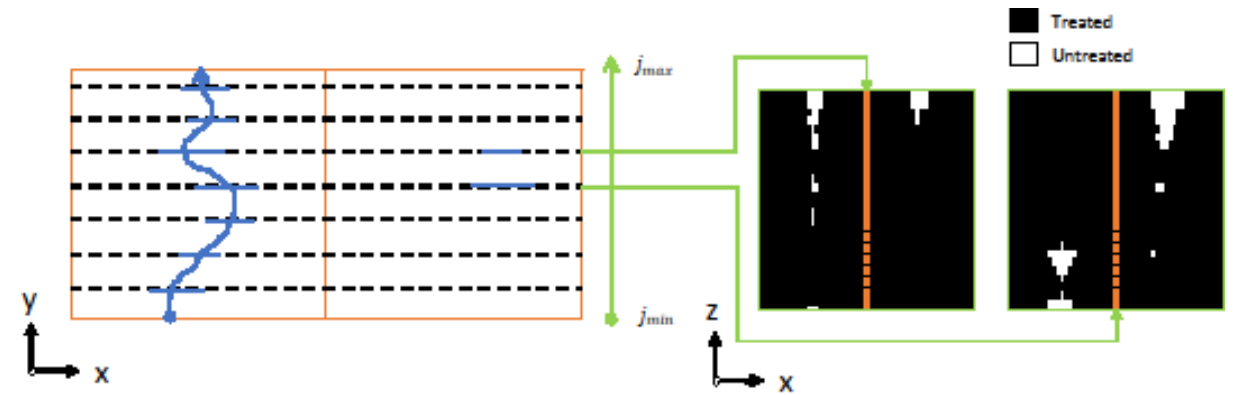
- Omtrent samme resultat med $1/1000 \sim 1/10\,000$ av beregningstiden

Problemdefinisjon

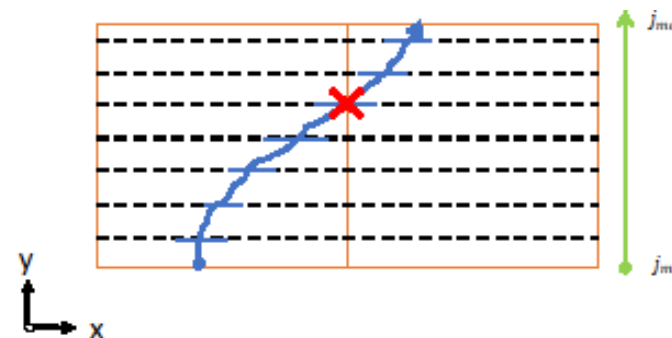
- TDA metoden



1. Overser vertikale barrierer

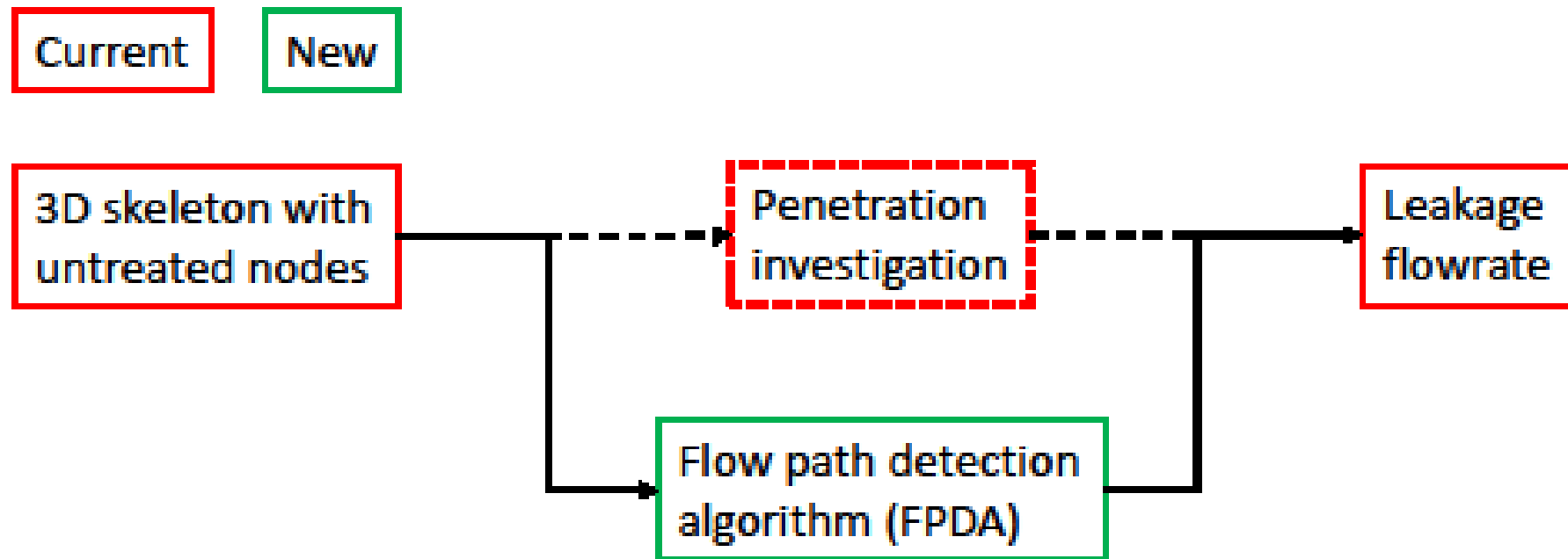


2. Strømning på tvers forkastes



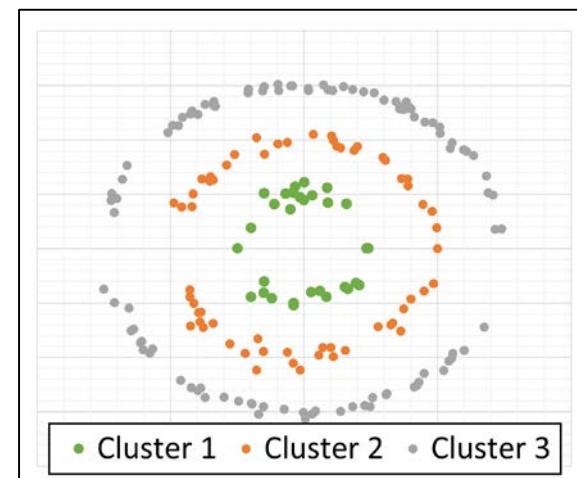
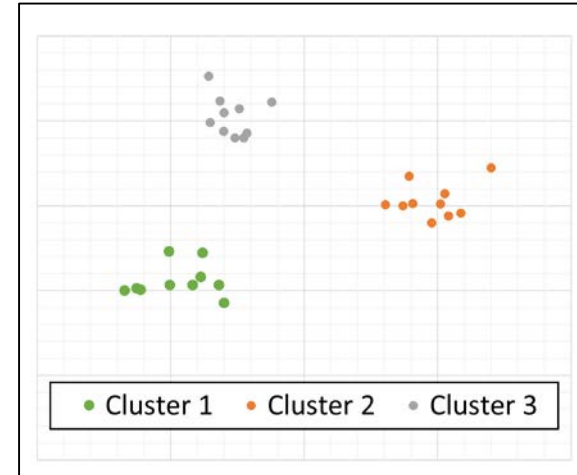
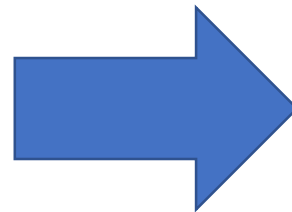
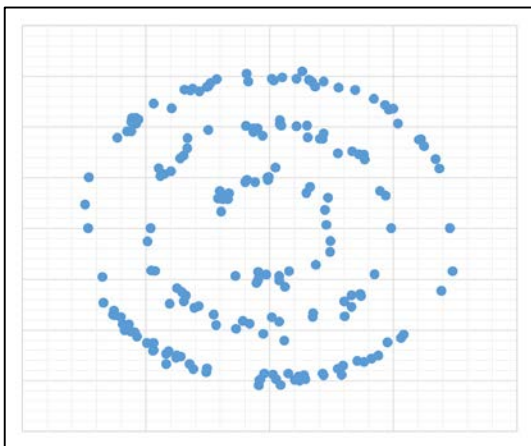
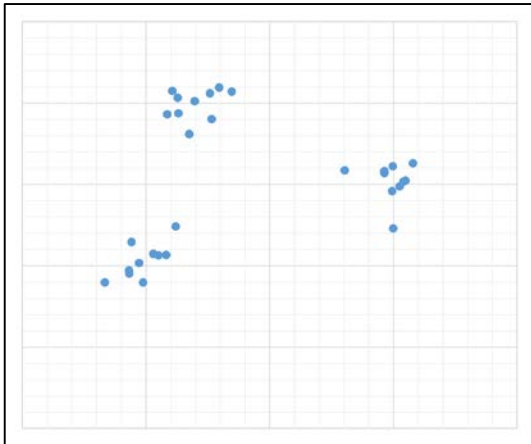
FPDA metoden

- Oversikt



FPDA metoden

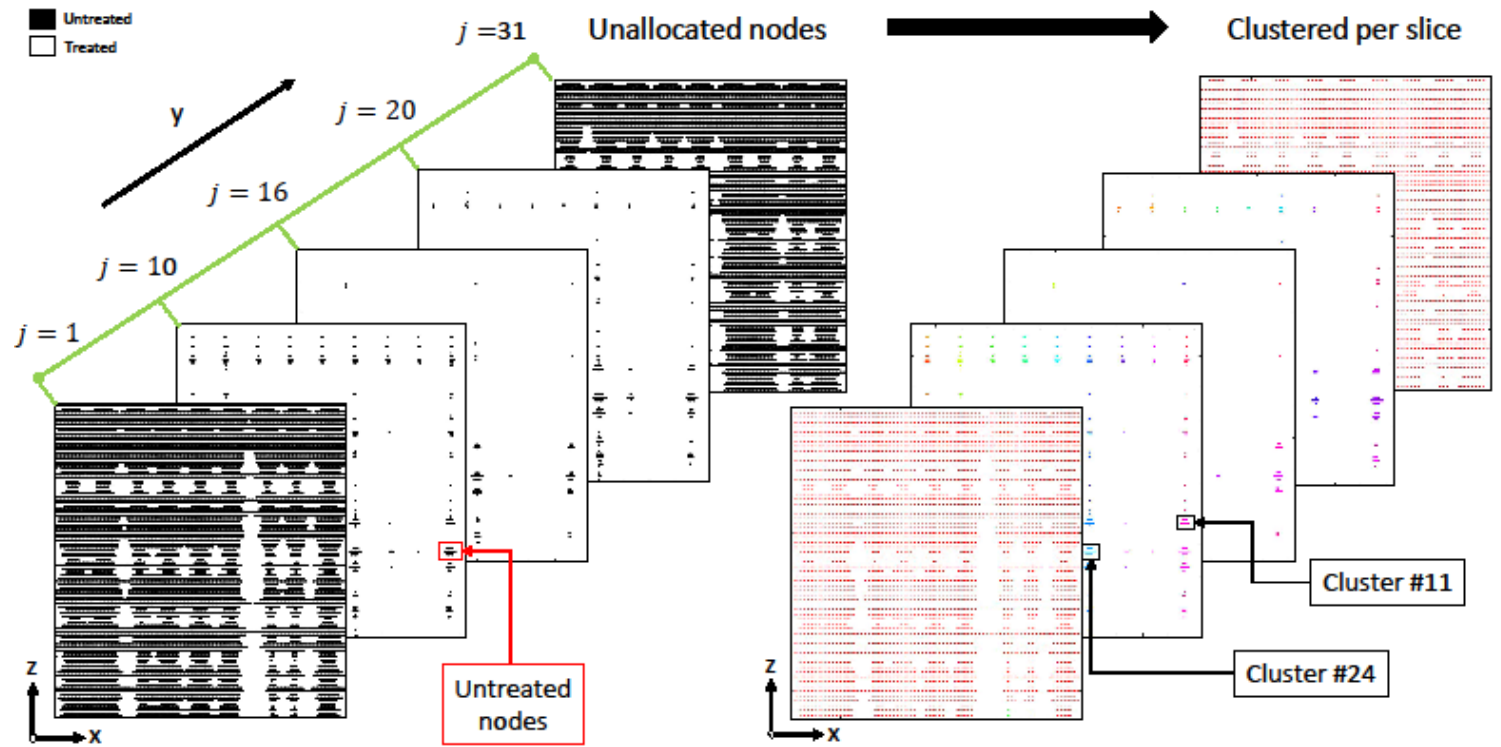
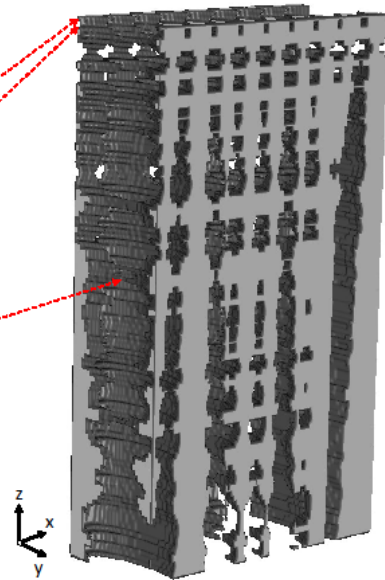
- DBSCAN



FPDA metoden

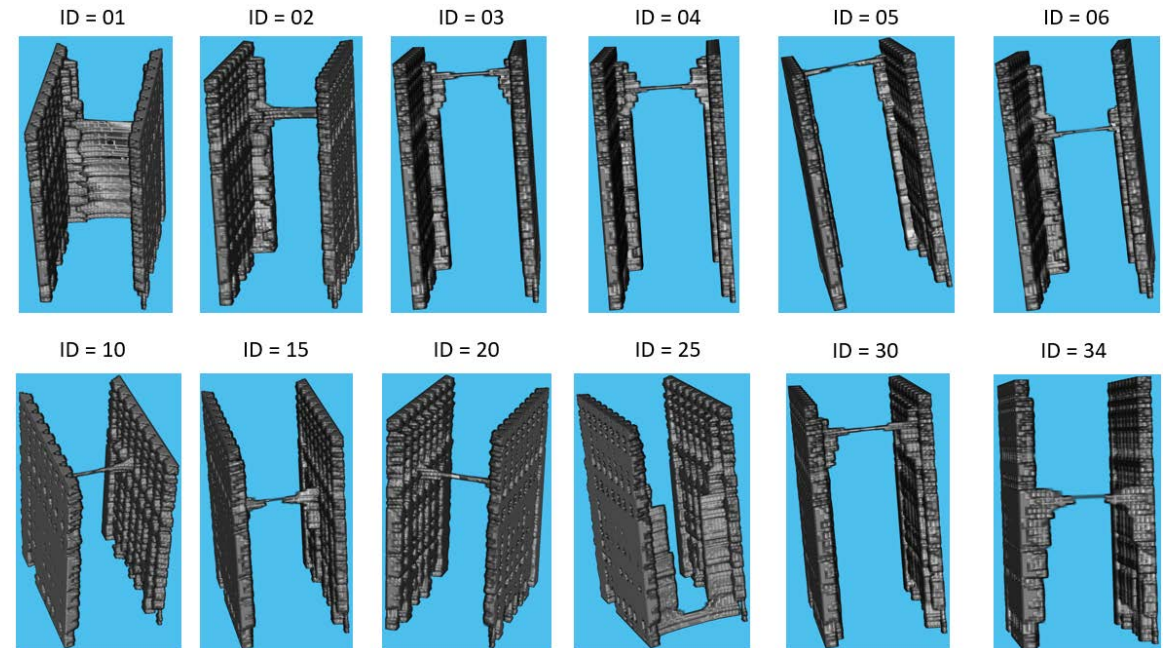
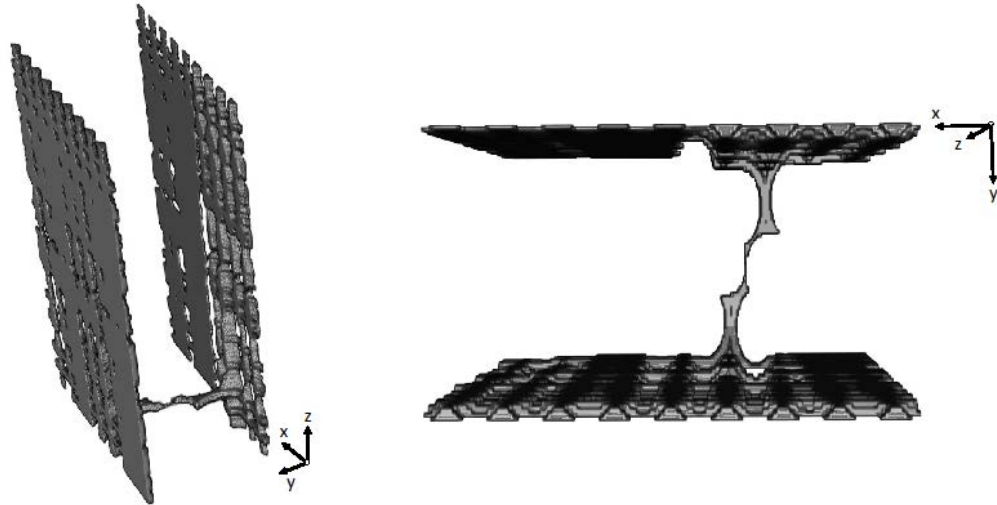
- Metode

i	j	k
1	1	100
1	1	99
...
44	28	62
...



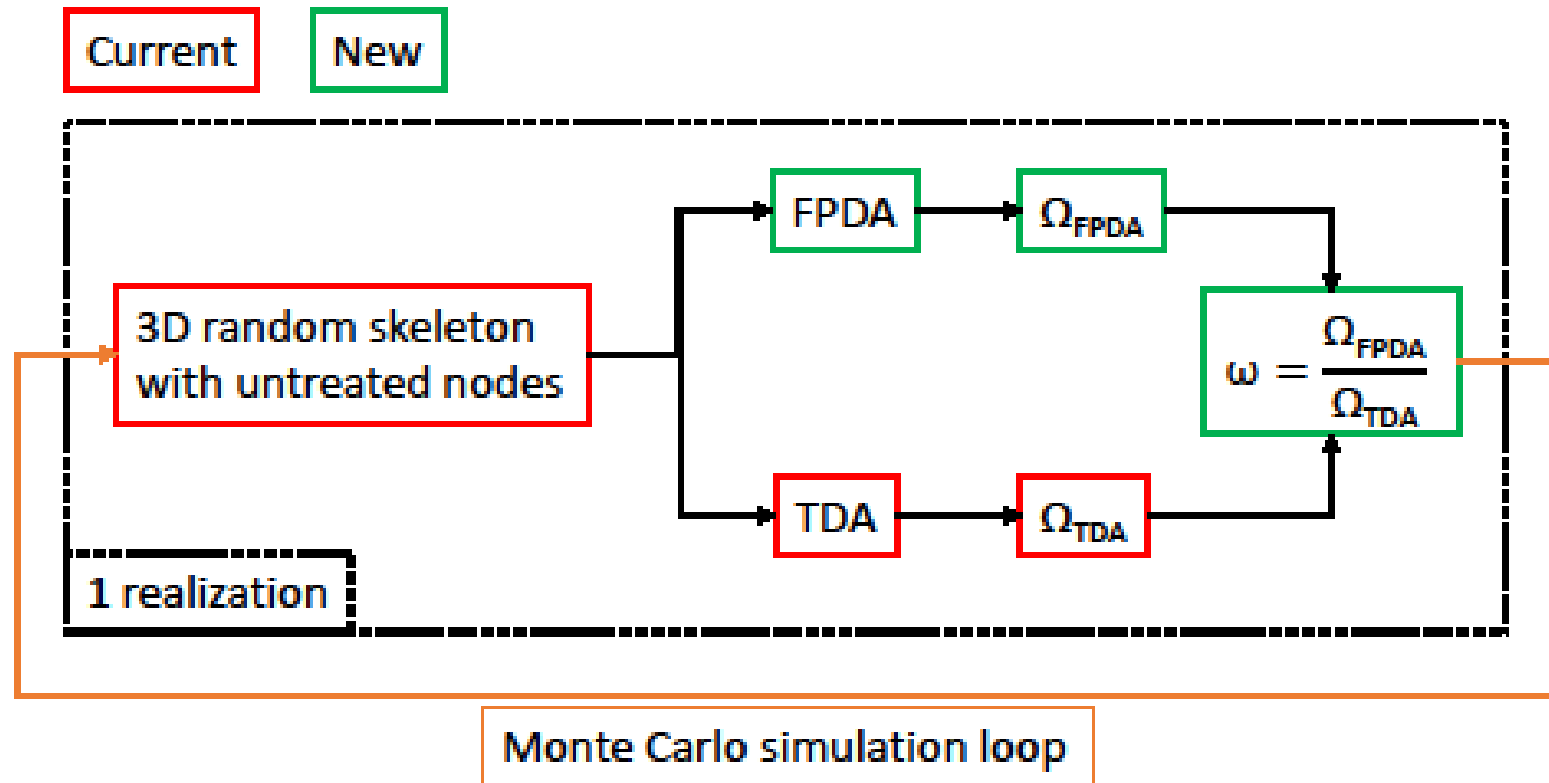
FPDA metoden

- Metode

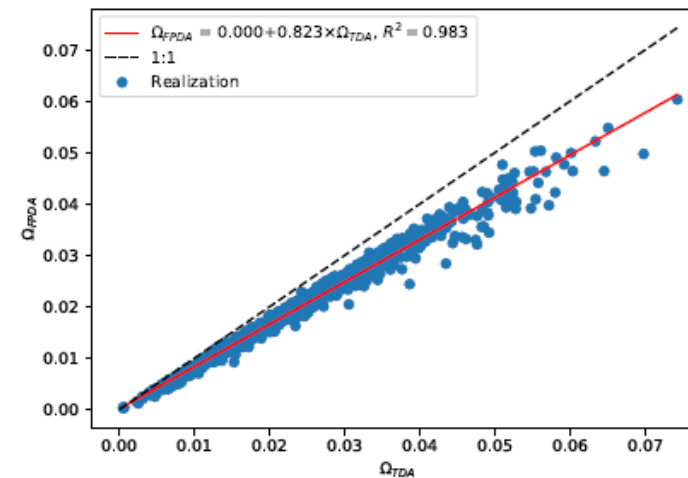
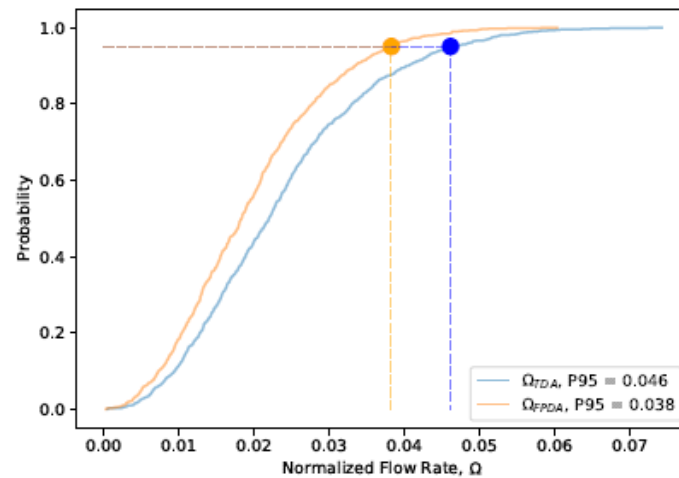
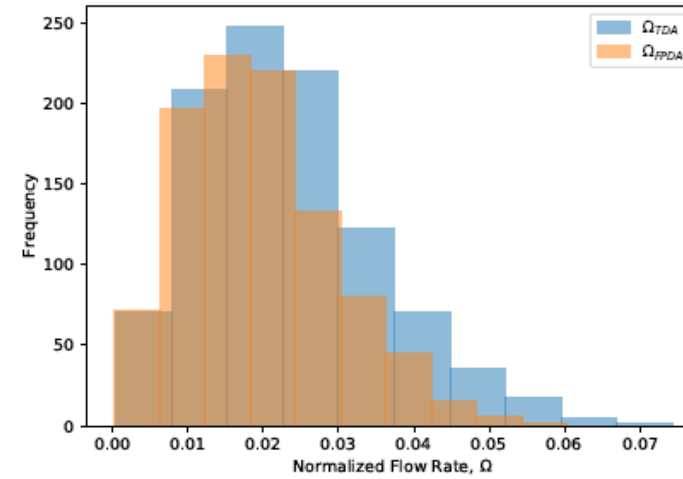
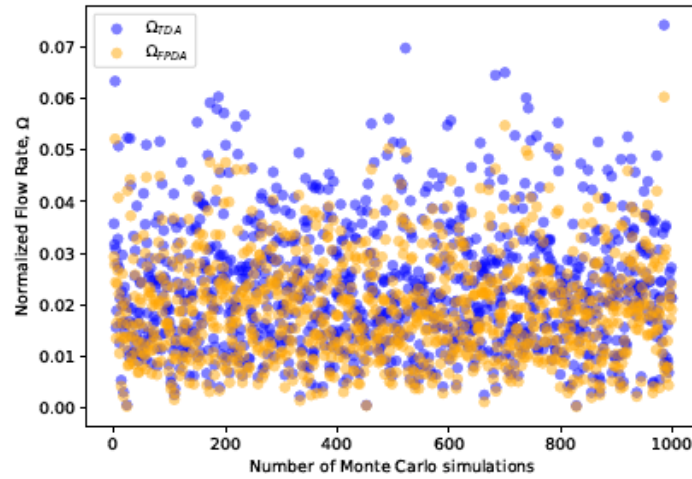


Resultat

- Oppsett



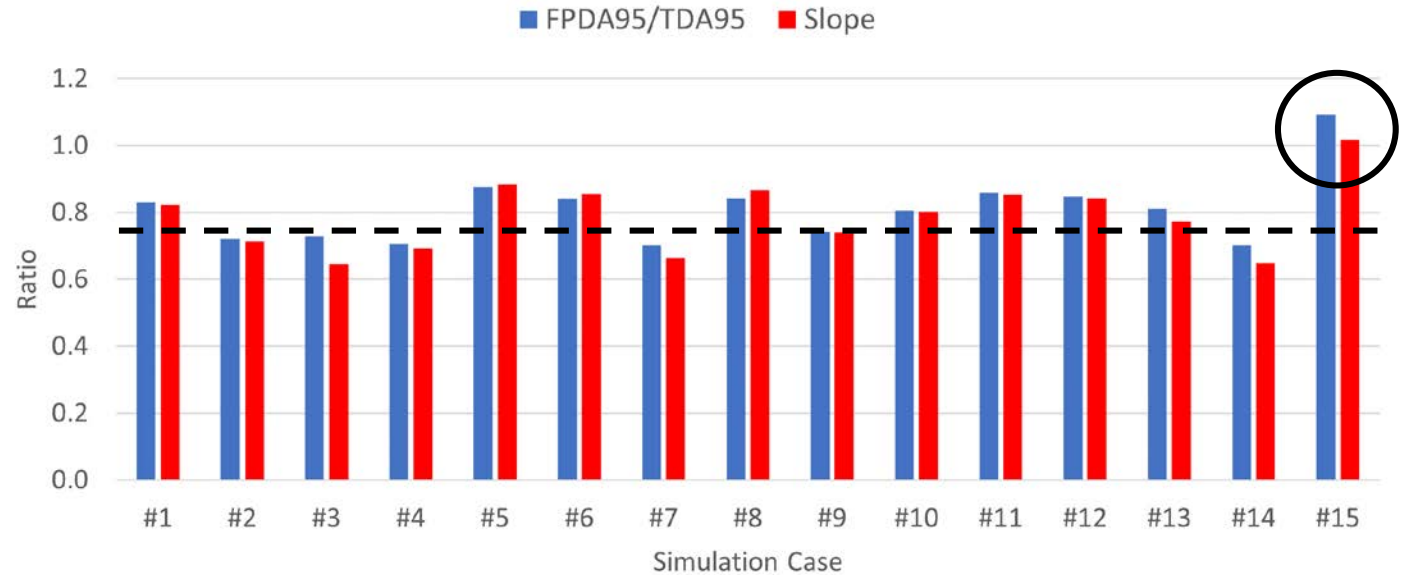
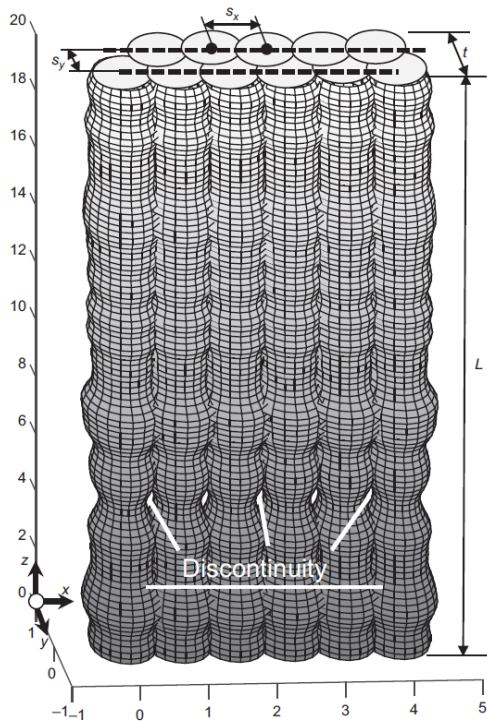
Resultat



Resultat

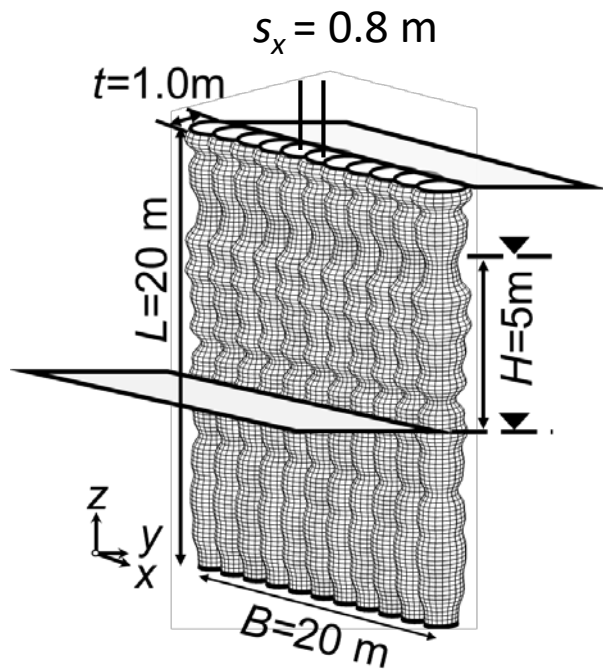
Case	#1 (Reference case)
d_i [m]	1.2
Columns per row	10
Set-up	Triangular
n_{row}	1
$COV(d_i)$	0.1
$\sigma(\beta)$ [°]	0.3
Depth, L [m]	20
SOF [m]	0.5
s_x [m]	1
s_y [m]	0.7

Case	Vary	To
# 1		
# 2	n_{row}	2
# 3		3
# 4	$COV(d_i)$	0.05
# 5		0.20
# 6	$\sigma(\beta)$	0.1
# 7		0.5
# 8	Depth***	15
# 9		25
# 10	SOF	0.25
# 11		1.00
# 12	s_x	0.9
# 13		1.1
# 14	s_y ****	0.5
# 15		0.9



1. 15 % reduksjon i strømningsrate for jetpelevegger med èn rad
2. Arresterer manglende håndtering av strømning på tvers

Bærekraft



$\approx 400\text{ m}^3$

Bilkjøring bensin km (0,16 kg CO ₂ / km)		Volum jetpelevegg [m ³]		
		40	400	4 000
Intensitet [kg CO ₂ / tonn betong]	150	13 500	135 000	1 350 000
	200	18 000	180 000	1 800 000
	250	22 500	225 000	2 250 000

15 %

Anerkjennelse

- NTNU
 - Tilrettelegging fra administrasjonen
 - Generøs veiledning fra geoteknisk faggruppe
 - Grundig og variert opplæring
 - Spesielt takk til **veileder professor Y. Pan og stipendiat Rui Tao**
- Indira
 - Tilgang til kontorlokaler sentralt i Bodø
 - Gratis lunsj
 - Sparringspartnere i geoteknikk og eksponering i et profesjonelt arbeidsmiljø
- Oppfordring LEAN
 - Ressurseffektivitet vs. flyteffektivitet



Referanser

1. Y. Pan, J. Yi, S.-H. Goh, J. Hu, W. Wang and Y. Liu, 'A three-dimensional algorithm for estimating watertightness of cement-treated ground with geometric imperfections,' *Computers and Geotechnics*, vol. 115, 2019.
2. Y. Pan, Y. Liu, J. Hu, M. Sun and W.Wang, 'Probabilistic investigations on the watertightness of jet-grouted ground considering geometric imperfections in diameter and position,' *Canadian Geotechnical Journal*, vol. 54, no. 10, pp. 1447–1459, 2017.
3. Y. Pan, Y. Liu and E. J. Chen, 'Probabilistic investigation on defective jet-grouted cut-off wall with random geometric imperfections,' *Géotechnique*, vol. 69, no. 5, pp. 420–433, 2019.
4. Y. Pan, M. A. Hicks and W. Broere, 'An efficient transient-state algorithm for evaluation of leakage through defective cutoff walls,' *International Journal for Numerical and Analytical Methods in Geomechanics*, vol. 45, pp. 108–131, 2021.



www.indira.no



post@indira.no



Indira AS



indira_bodo_narvik_tromso

«Besøk oss på vår hjemmeside,
følg oss på facebook og instagram,
og ta gjerne kontakt med oss!»

