

LA DURABILITE DES BETONS

Etude de cas – pathologie de shadowing dans les parois moulées

S. Rémond

Travaux issus de la thèse de Maria KMEID

LMDC – Toulouse

Dir. G Casaux-Ginestet

Codir. G. Escadeillas

Financée par NGE avec le soutien de la FNTP

Parois moulées - rappel

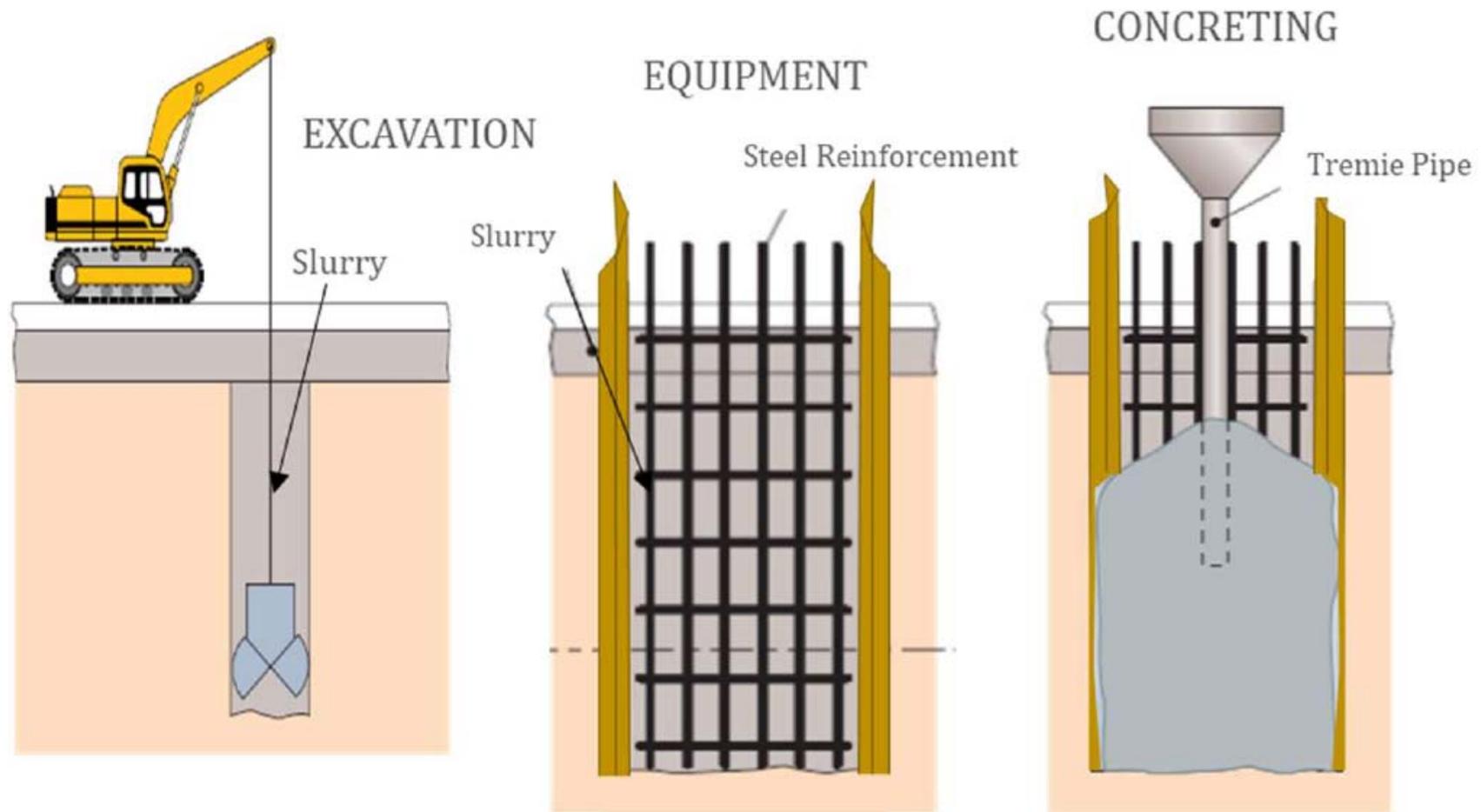
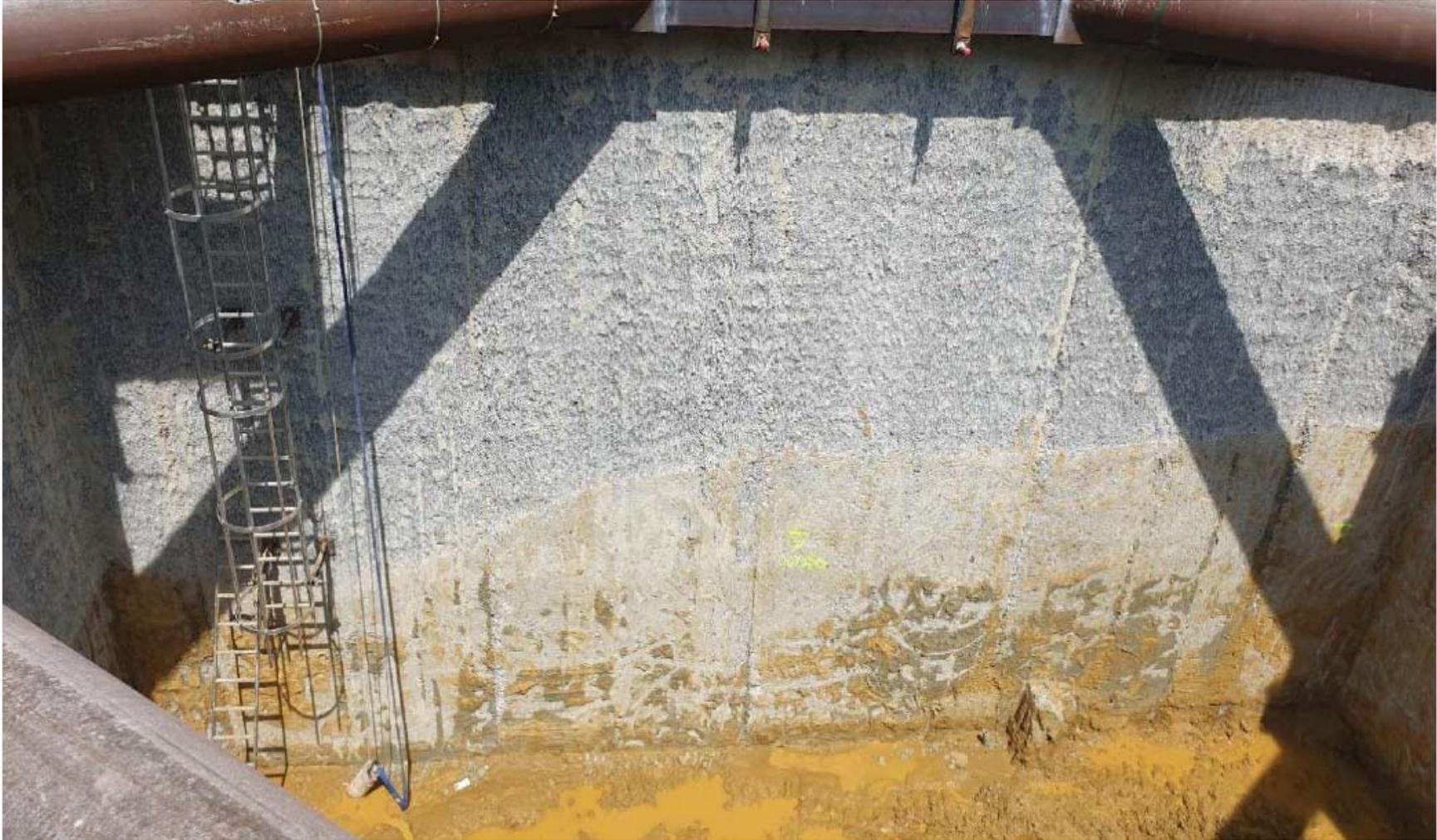


Figure 1: Diaphragm Walls Technique

Shadowing - définition



Paroi moulée de bonne qualité

Shadowing - définition



Exemples de shadowing

Shadowing - définition



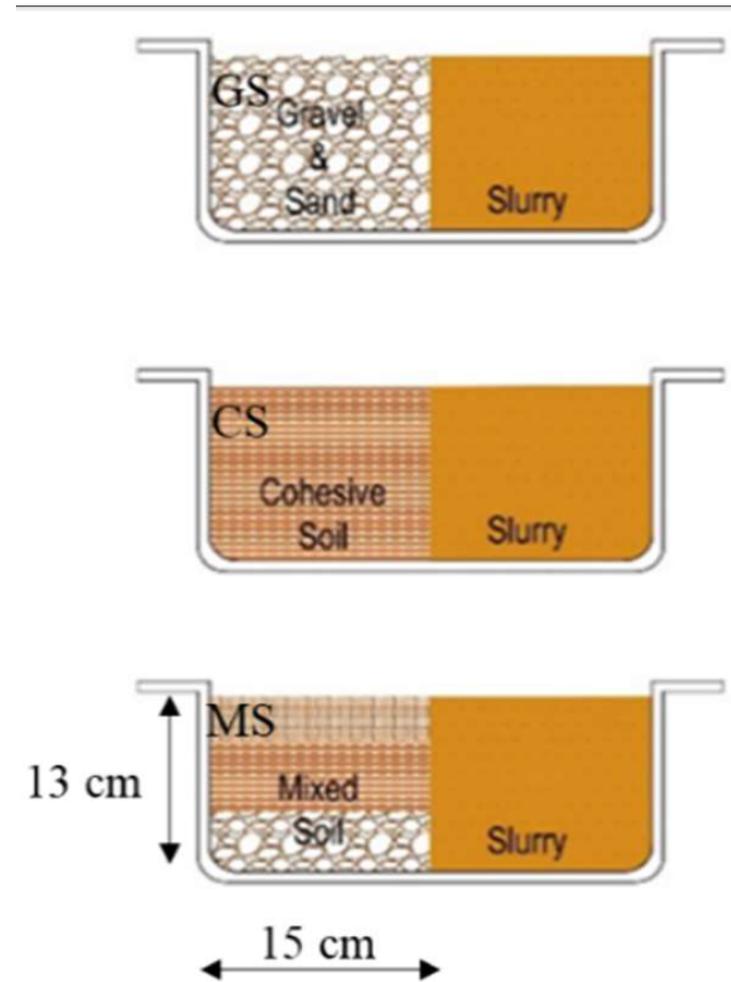
Exemples de shadowing

Méthodologie d'étude

Questions:

1. Quelle est l'origine de la pathologie (sol, bentonite, béton ...)?
2. Comment la reproduire au laboratoire?
3. Comment modéliser la pathologie
4. Quelles solutions pour l'éviter?

Shadowing – étude au laboratoire

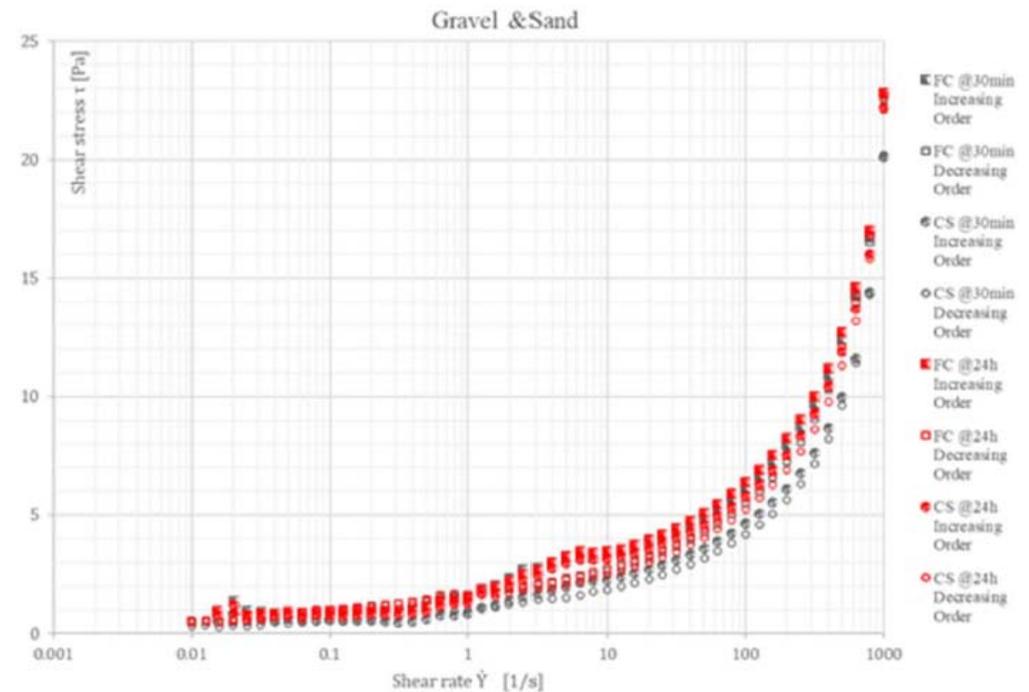


Modèle simplifié, petite échelle, pour reproduire la pathologie

Shadowing – étude au laboratoire



Figure 9: Resulting filter cake at interface of mixed soil



⇒ Peu d'influence de la nature du sol sur le comportement rhéologique de la boue

Caractérisation de la bentonite à l'interface boue - sols

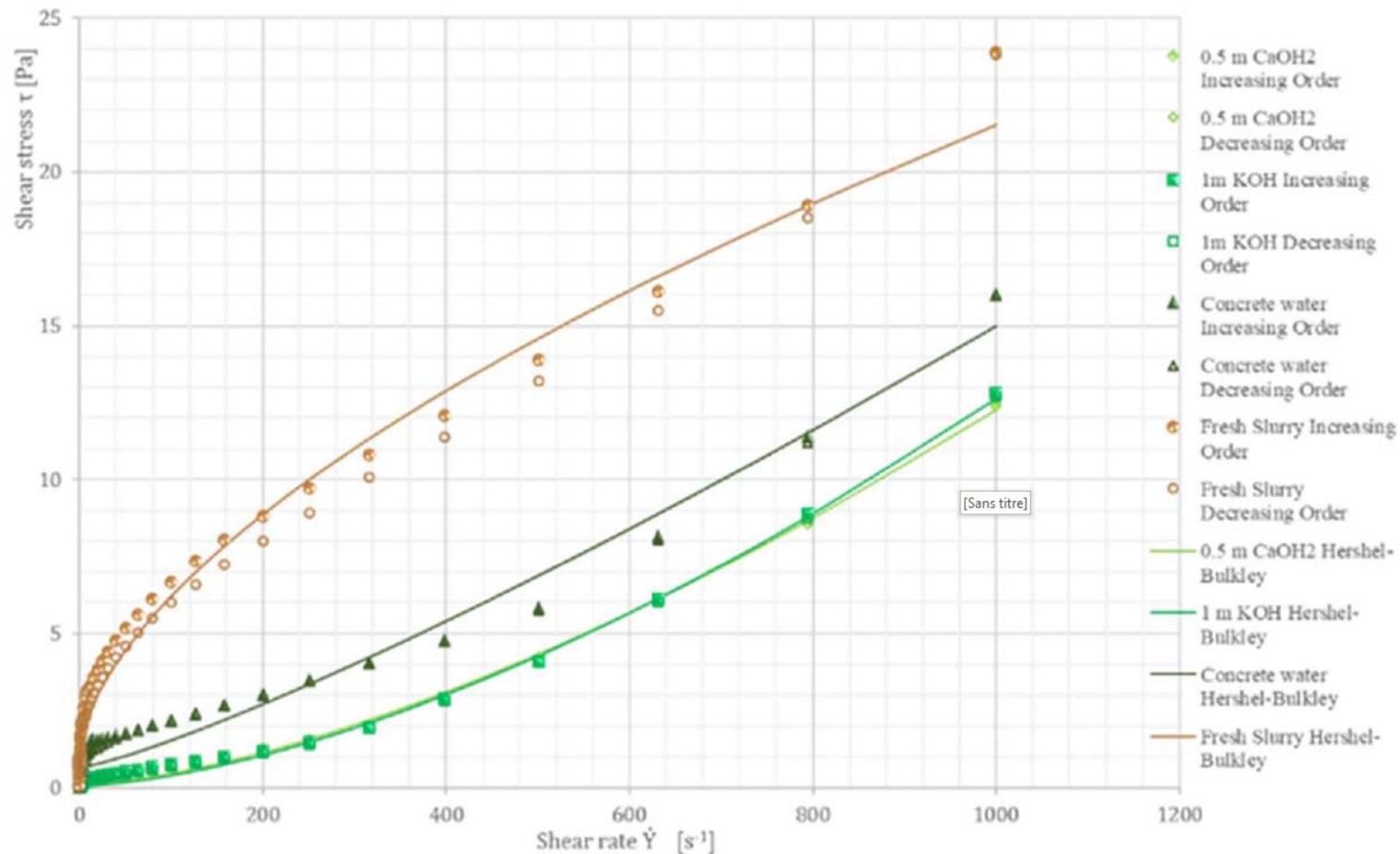
Shadowing – étude au laboratoire



Figure 11: Bentonite build up on the horizontal rebars

Dépôts bentonite - armatures

Shadowing – étude au laboratoire



Graph 9: Flow curves of slurries contaminated by alkali salts or concrete water

Influence du béton sur le comportement rhéologique de la bentonite - Changement d'un comportement rhéofluidifiant à un comportement rhéoépaississant

Shadowing – étude au laboratoire

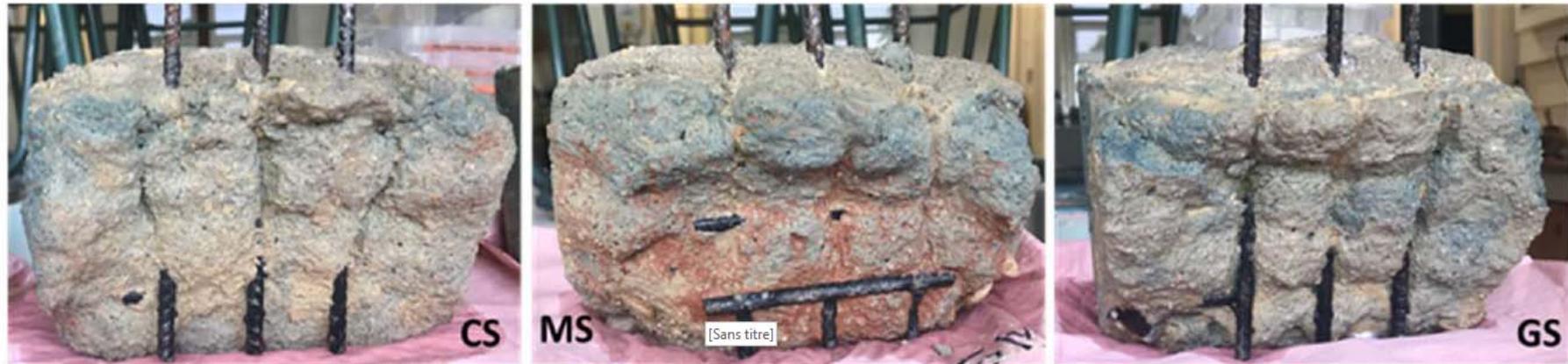


Figure 7: Resulting mini trench walls in a cohesive soil (CS), a mixed soil (MS), and gravels and sands (GS)

Influence du type de sol sur la pathologie

Shadowing – changement d'échelle

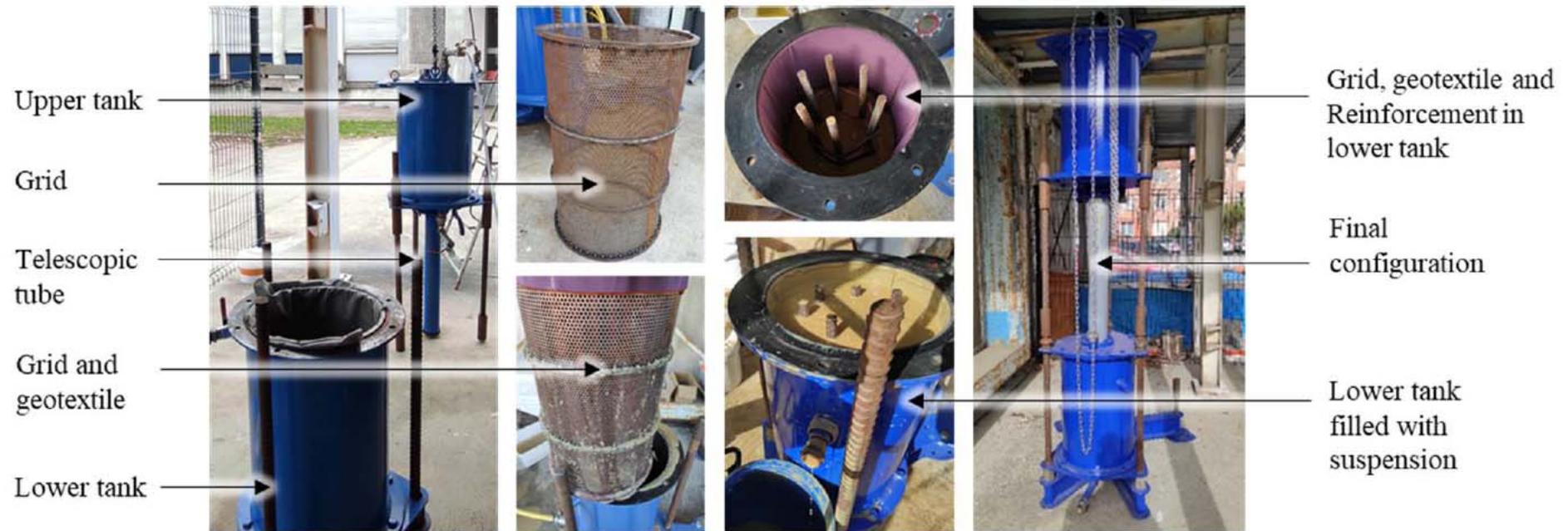
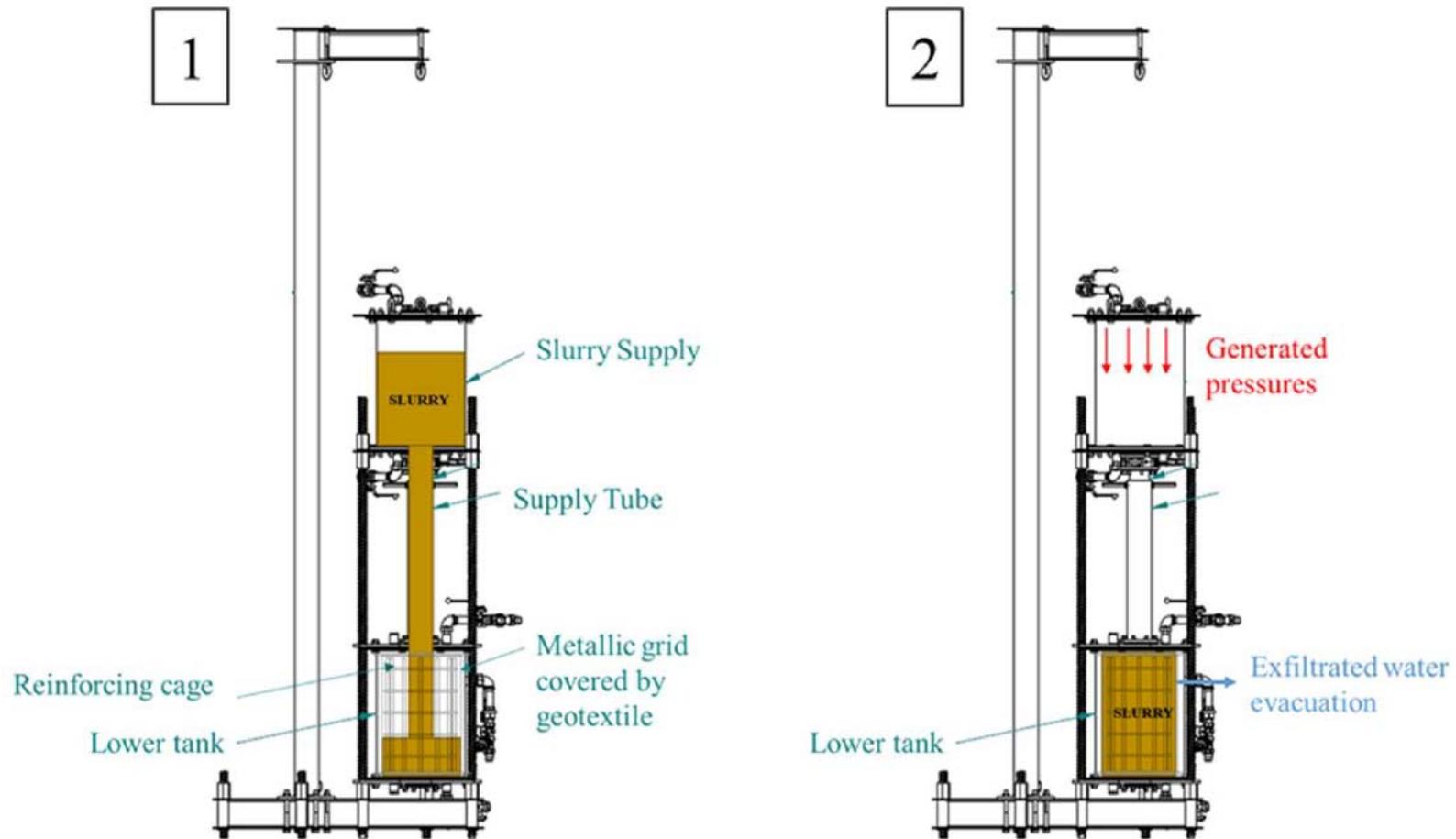


Figure 8: Beta tank for the construction of laboratory diaphragm walls

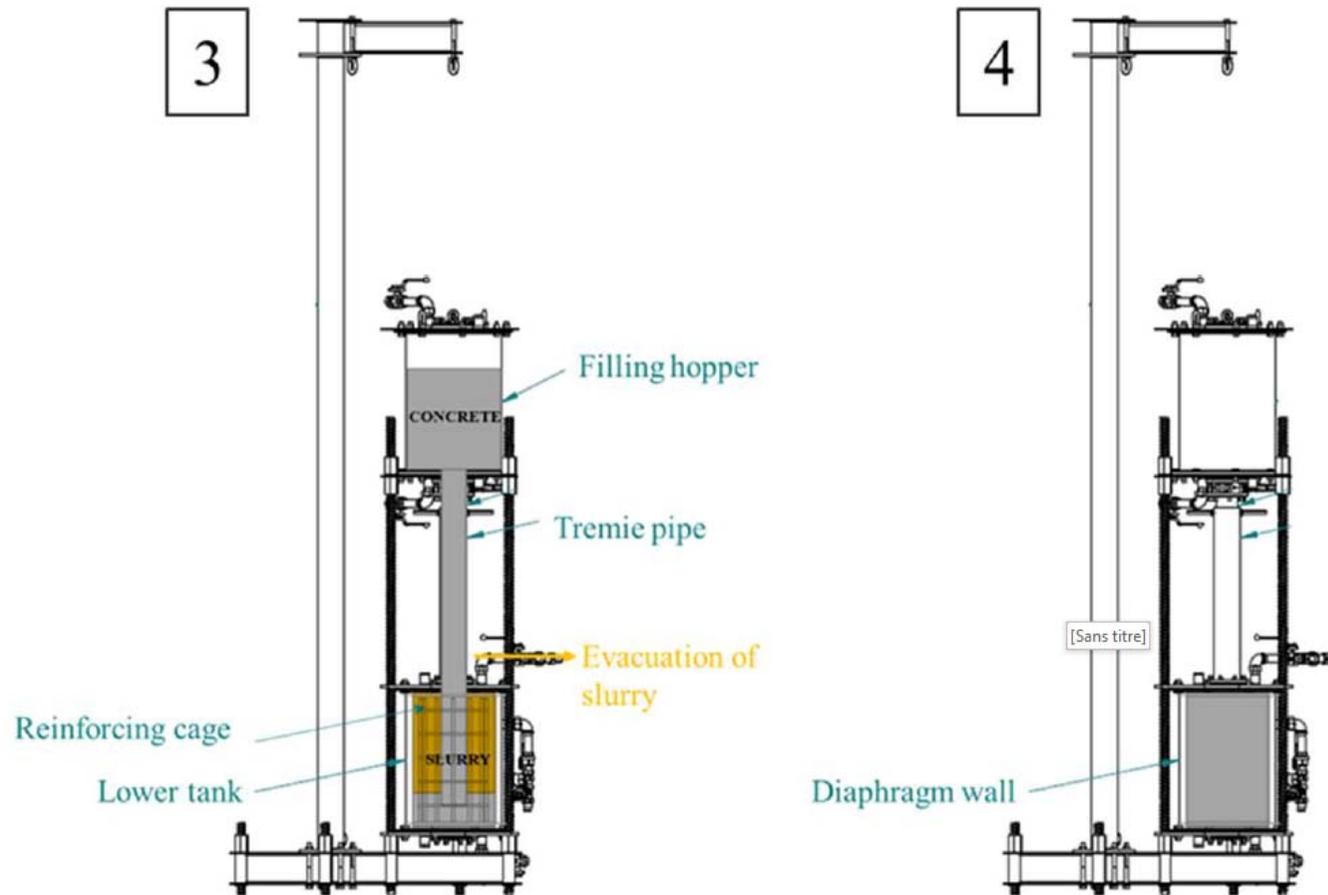
Mise au point d'un dispositif spécifique – le béta tank

Shadowing – changement d'échelle



Mise au point d'un dispositif spécifique – le béta tank

Shadowing – changement d'échelle



Mise au point d'un dispositif spécifique – le bêta tank

Shadowing – changement d'échelle



Figure 11: Filter Cake formation at the interface of the geotextile

Shadowing – changement d'échelle



Figure 10: Resulting panel before (left) and after (right) planing

Shadowing – changement d'échelle



Figure 17: Slurry deposits on rebars without exfiltration (left), with exfiltration (right)

Interactions bentonite - armatures

Shadowing – changement d'échelle



Figure 23: Concrete spread diameters equal to 365 mm (left), 465 mm (center), and 560 mm (right)



Etude de l'influence de la maniabilité du béton

Shadowing – changement d'échelle



A5h-CM10-35-2b-
7,5-NR-MTB-NA



A5h-CM10-35-0,5b-
4,5-NR-MTB-A



A2j-CM10-35-0,5b-
7,5-NR-RN19-NA



A5h-CM10-35-2b-
7,5-NR-RN19-NA



A2j-CM10-35-2b-
4,5-NR-RN19-NA



A2j-CM10-35-2b-
4,5-NR-MTB-A



A2j-CM10-35-0,5b-
7,5-NR-MTB-A



A5h-CM10-35-2b-
7,5-NR-RN19-A



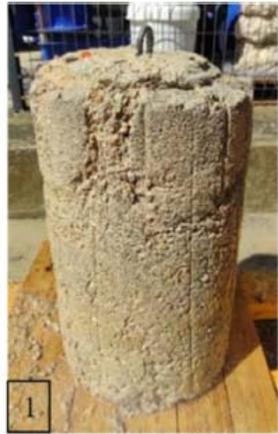
A2j-C2-40-0,5b-4,5-
NR-RN19-NA



A5h-C2-40-2b-7,5-
NR-MTB-NA

Corps d'épreuve avant nettoyage

Shadowing – changement d'échelle



1
A5h-CM10-35-2b-
7,5-NR-MTB-NA



2
A5h-CM10-35-0,5b-
4,5-NR-MTB-A



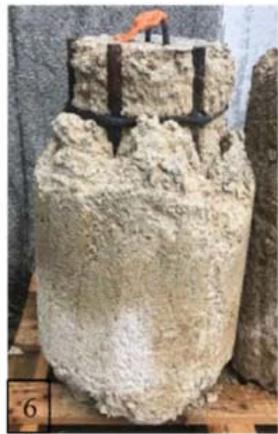
3
A2j-CM10-35-0,5b-
7,5-NR-RN19-NA



4
A5h-CM10-35-2b-
7,5-NR-RN19-NA



5
A2j-CM10-35-2b-
4,5-NR-RN19-NA



6
A2j-CM10-35-2b-
4,5-NR-MTB-A



7
A2j-CM10-35-0,5b-
7,5-NR-MTB-A



[Sans titre]

8
A5h-CM10-35-2b-
7,5-NR-RN19-A



9
A2j-C2-40-0,5b-4,5-
NR-RN19-NA



10
A5h-C2-40-2b-7,5-
NR-MTB-NA

Corps d'épreuve après nettoyage

Shadowing – modélisation

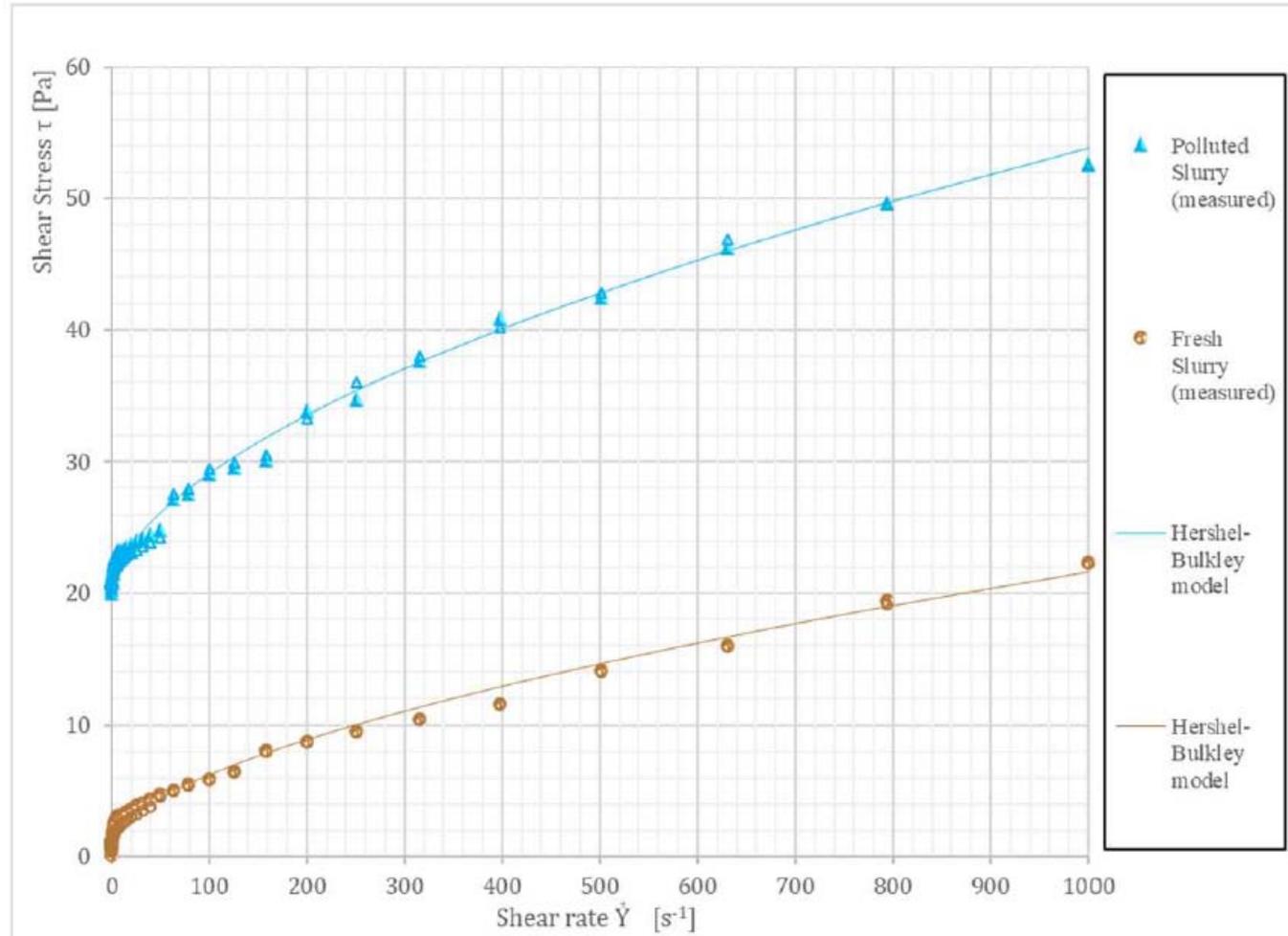


Figure 2: Flow curves measured for fresh slurry and polluted slurry

Modélisation des deux fluides en présence : bentonite et bentonite polluée après plusieurs jours de contact avec un sol

Shadowing – modélisation

Table 2: Bingham model parameters calculated for two concrete mix consistencies

Concrete mix	τ_0 (Pa)	μ_{pl} (Pa.s)
"Good"	650	300
"Bad"	1000	60

Modélisation des deux fluides en présence : béton

Shadowing – modélisation

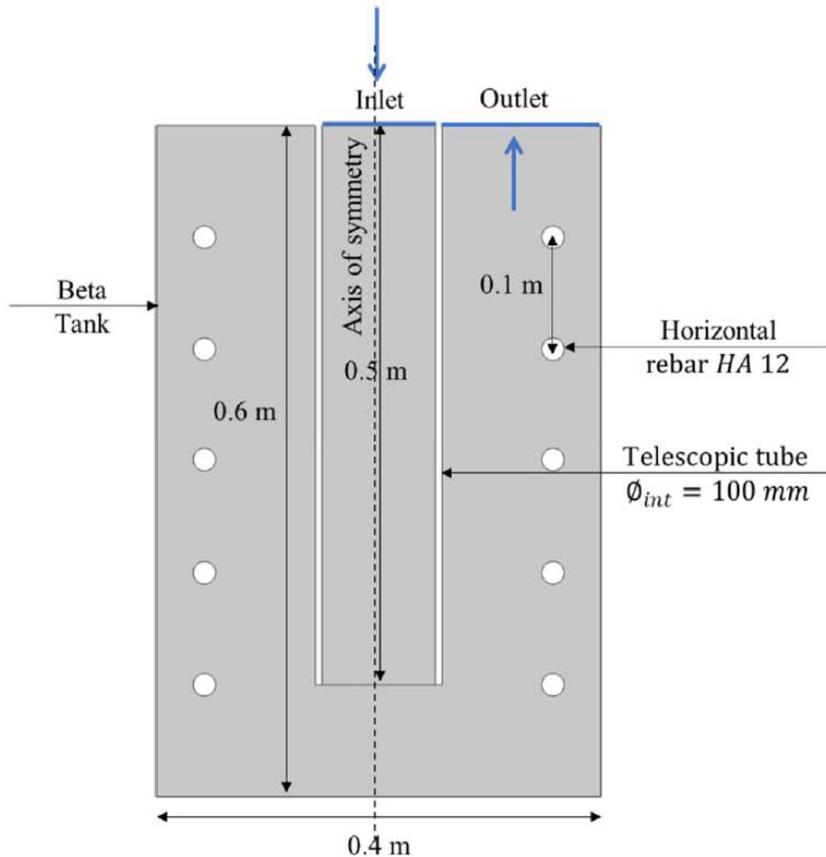


Figure 4: 2D Geometry in COMSOL for beta tank

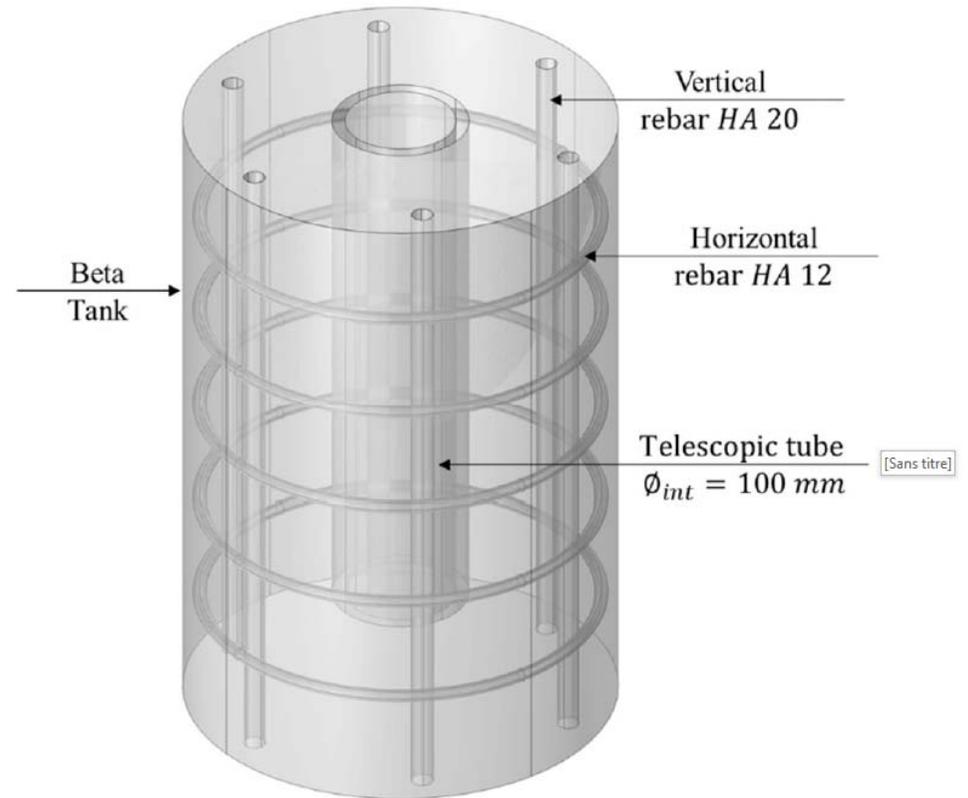


Figure 5: 3D Geometry in COMSOL for beta tank

Modélisations 2D et 3D du coulage

Shadowing – modélisation

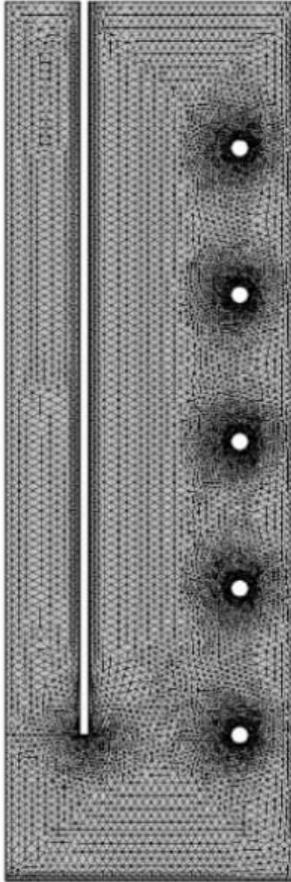


Figure 6: 2D Model's mesh

[Sans titre]

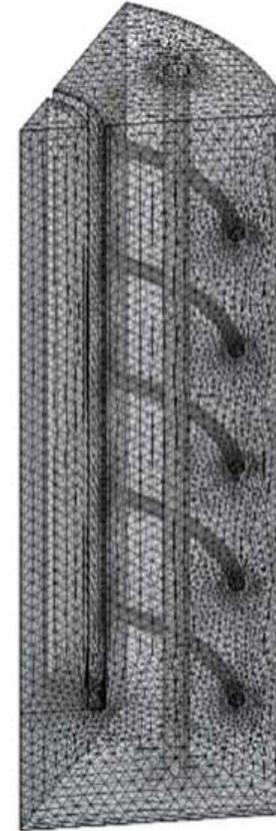


Figure 7: 3D Model's mesh

Modélisations 2D et 3D du coulage

Shadowing – modélisation

Case 1: Good Concrete & Fresh Slurry

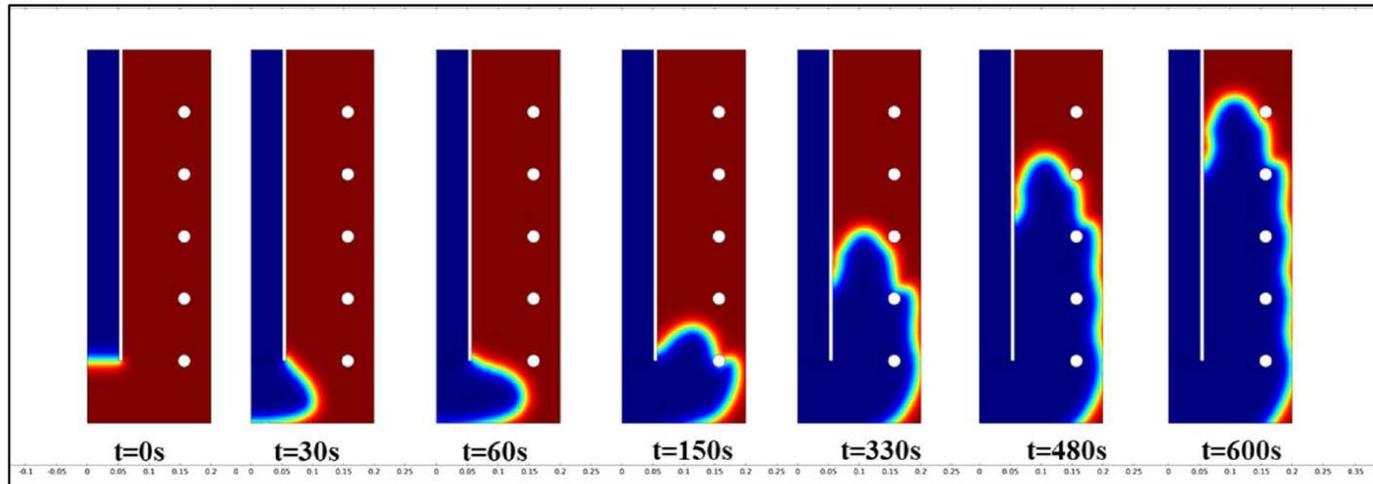


Figure 8: Flow pattern of a “good” concrete in a fresh slurry for a cover zone of 3.3 cm

Case 2: Good Concrete & Polluted Slurry

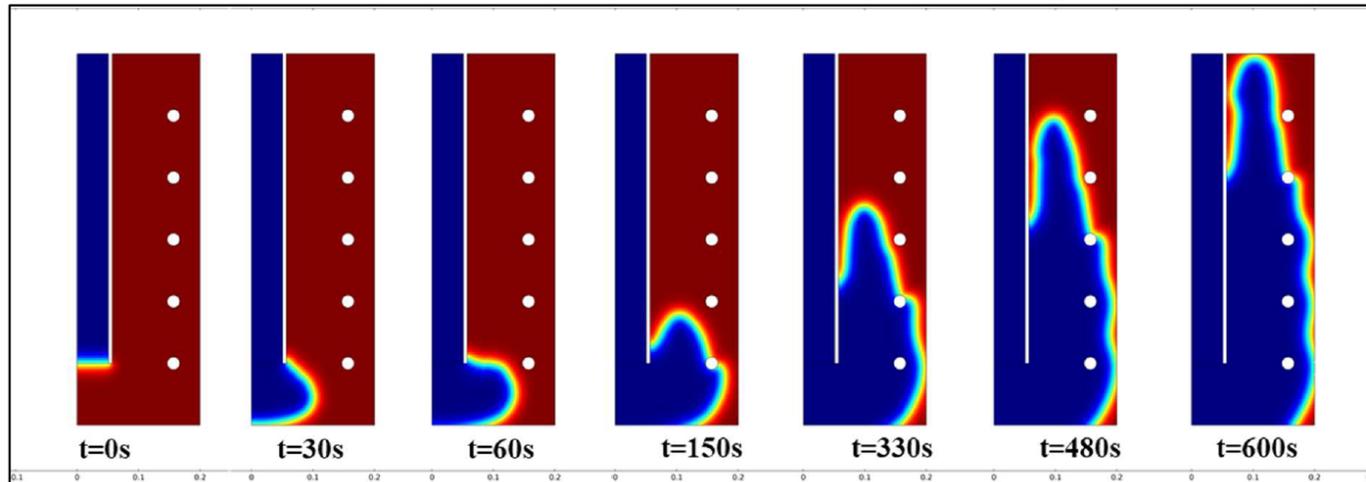
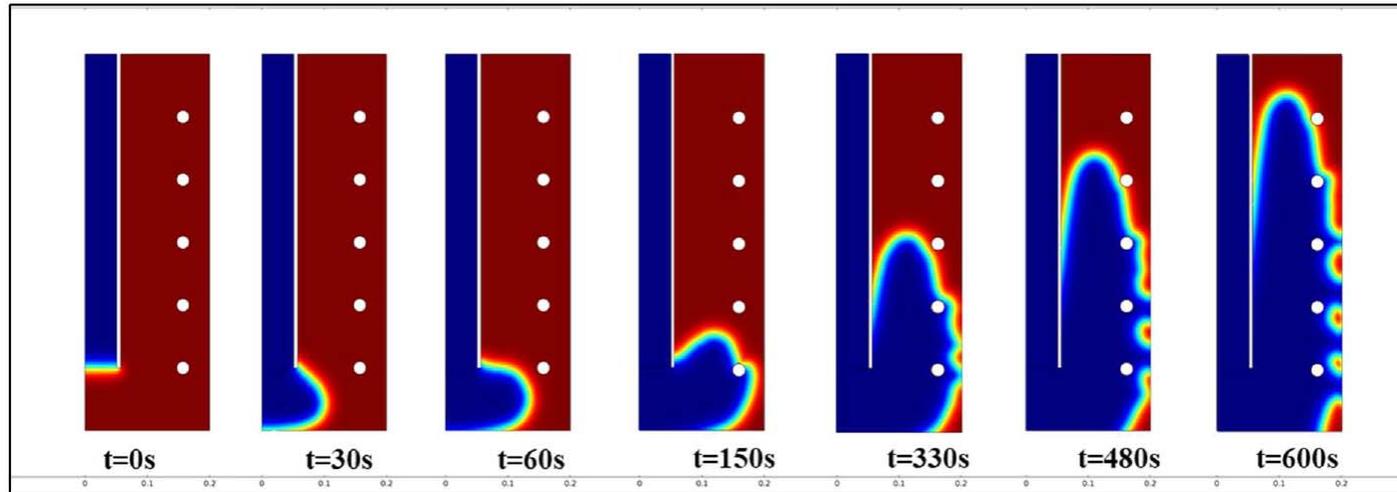


Figure 9: Flow pattern of a “good” concrete in a polluted slurry for a cover zone of 3.3 cm

Shadowing – modélisation

Case 3: Bad Concrete & Fresh Slurry



Case 4: Bad concrete & Polluted Slurry

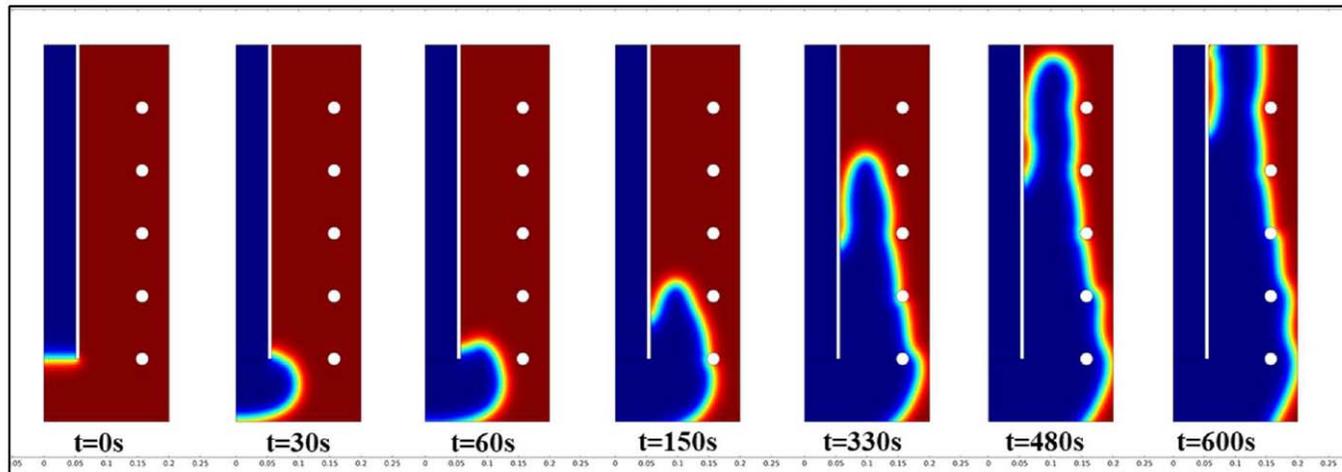
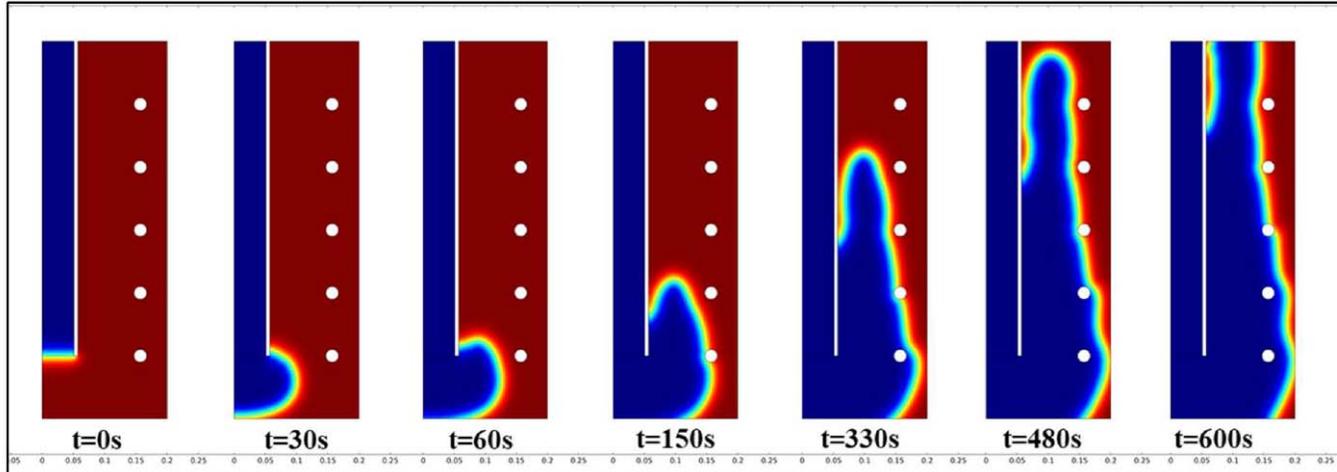


Figure 11: Flow pattern of a “bad” concrete in a polluted slurry for a cover zone of 3.3 cm

Shadowing – modélisation

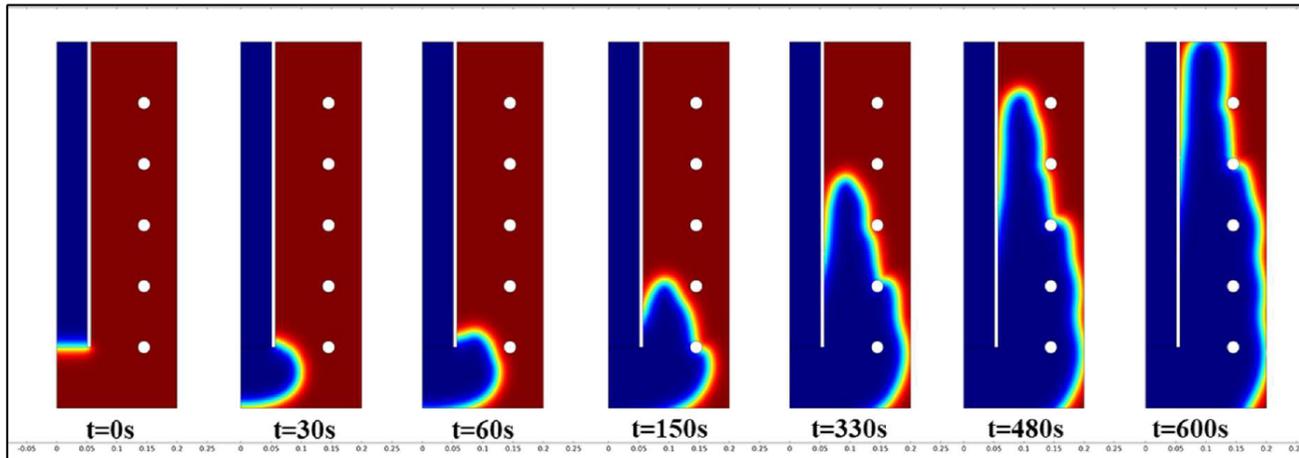
Case 4: Bad concrete & Polluted Slurry



E=3,3 cm

Figure 11: Flow pattern of a “bad” concrete in a polluted slurry for a cover zone of 3.3 cm

Case 4: Bad concrete & Polluted Slurry



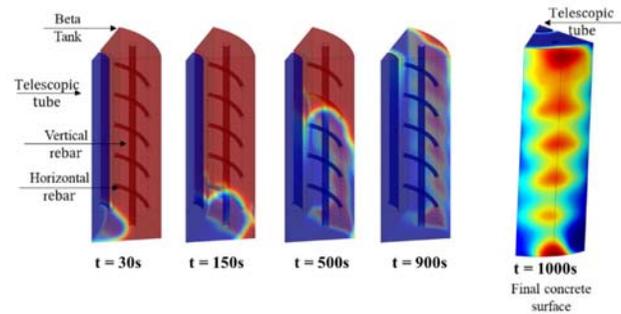
E=4,5 cm

Figure 16: Flow pattern of a “bad” concrete in a polluted slurry for a cover zone of 4.5 cm

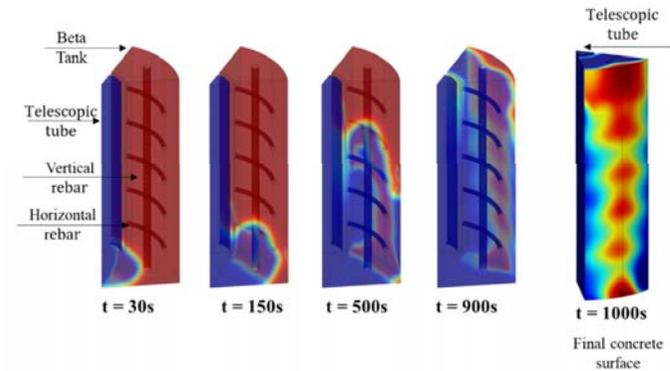
Modélisations 2D – Influence de l’enrobage

Shadowing – modélisation

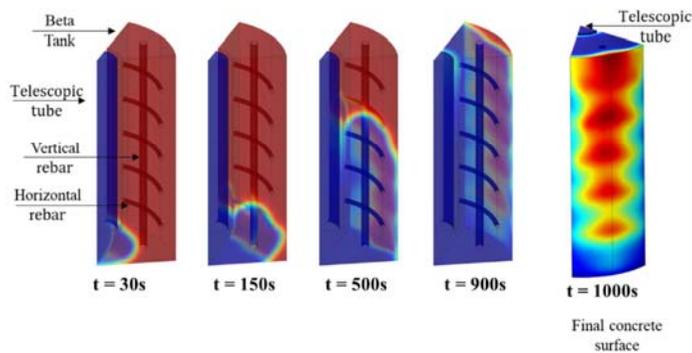
Case 1: Good Concrete & Fresh Slurry



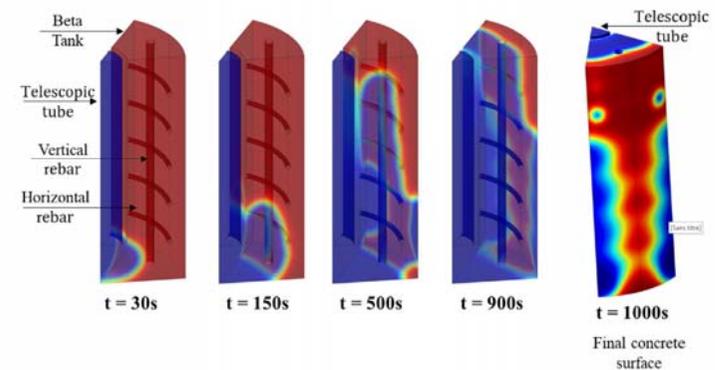
Case 2: Good Concrete & Polluted Slurry



Case 3: Bad Concrete & Fresh Slurry



Case 4: Bad concrete & Polluted Slurry



Shadowing – modélisation



Figure 27: Experimental result for good concrete & fresh slurry before (left) and after (right) cleaning



Figure 28: Experimental result for good concrete & polluted slurry before (left) and after (right) cleaning



Figure 29: Experimental result for bad concrete & fresh slurry before (left) and after (right) cleaning



Figure 30: Experimental result for bad concrete & polluted slurry before (left) and after (right) cleaning

Comparaison modélisation - expérimentation