Dataset of Simulated Undrained Cofferdam Models for Parameteric Study

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This dataset includes the numerical results of a undrained cofferdam box considering a parameter variation. The simulations have all been conducted using the Finite Element Method with the commercial software PLAXIS 2D. The investigated cofferdams represent a cofferdam box used as an excavation enclosure. The Hardening Soil Model with Small-Strain Stiffness is used as the material model. The results show the wall deformations, vertical stress distributions, and earth pressures on the cofferdam walls for different cofferdam dimensions and various parameter combinations.

Numerical Simulations

The numerical model of the cofferdam box is shown in Figure 1. The cofferdam box has an air side and a load side, with water pressure acting directly on the airside cofferdam wall. In some parameter variations, a point load acts on the loadside of the cofferdam. The parameter study varies the anchor position, bending stiffness, relative density, embedment depth, water level, and the point of application of the point load. Additionally, the ratio of the cofferdam width to the cofferdam height is varied.

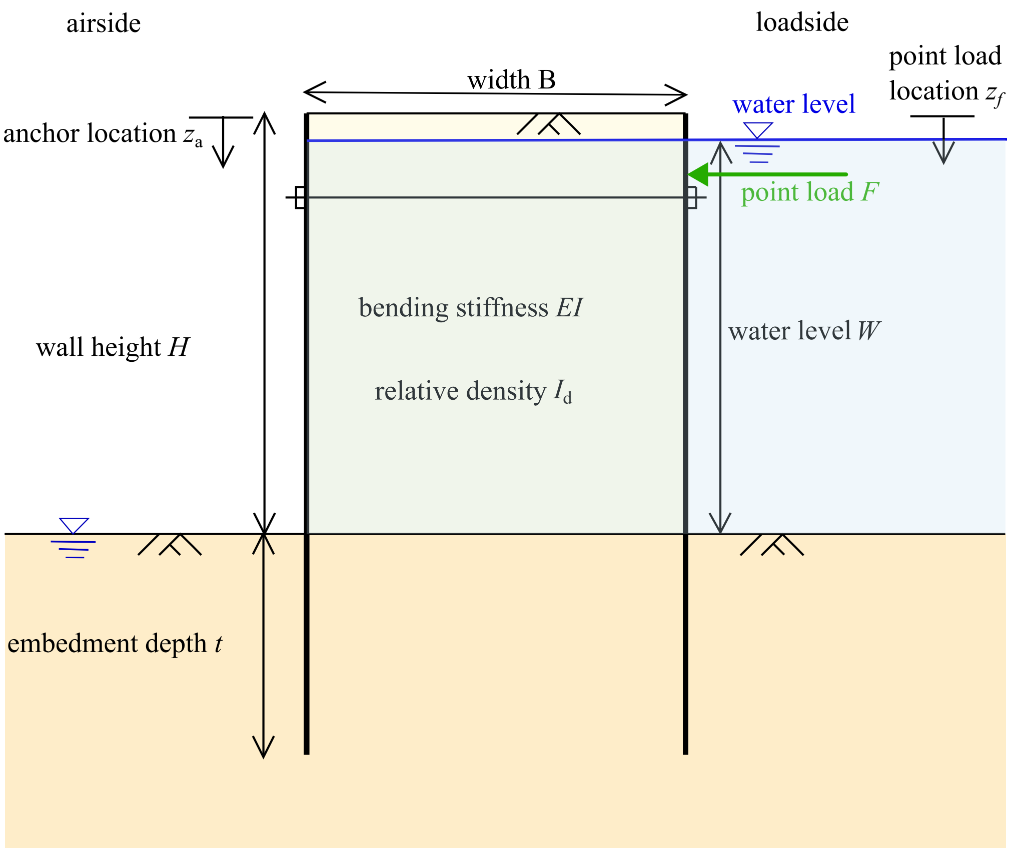

Figure 1: System sketch of the investigated cofferdam box

The material parameters used for the filling and underground are found in Table 1.The calculation phases in PLAXIS 2D are shown in Table 2. The ranges of the investigated parameters within the parametric

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Data available at: https://doi.org/10.15480/882.17440

study are shown in Table 3.

Table 1: Soil Parameters for Filling and Underground

Parameter	Unit	Filling Soil	Underground Soil
Soil model	-	HSsmall	HSsmall
I_D	%	50	75
γ_{unsat}	kN/m^3	17.0	18.0
γ_{sat}	kN/m^3	19.8	20.2
e_0	-	0.7145	0.5717
e_{min}	-	0.429	0.429
e_{max}	-	1.0	1.0
E_{50}^{ref}	kN/m^2	30,000	45,000
E_{oed}^{ref}	kN/m^2	30,000	45,000
E_{ur}^{ref}	kN/m^2	90,000	135,000
M	-	0.5437	0.4656
c'^{ref}	kN/m^2	0.1	0.1
φ'	°	34.25	37.38
Ψ	°	4.250	7.375
ν_{ur}	-	0.2	0.2
$\gamma_{0.7}$	-	1.5×10^4	1.25×10^4
G_0^{ref}	kN/m^2	94,000	111,000
p_{ref}	kN/m^2	100	100
K_0^{nc}	-	0.4372	0.3930
R_f	-	0.9375	0.9063
R_{inter}	-	0.6183	0.6183

* Starting at the top of the wall, see Figure 1.

Content Structure of Result Files

Each result file contains a set of columns representing different outcomes of the simulations, as showed in Table 4.

The description of columns is as follows:

- Phase: Calculation phase conducted in Plaxis 2D.
- Y-coordinate (m): Y-coordinate of results along the wall.
- σ_{xx} (kN/m^2): Horizontal soil stress component in cross-section along the wall.
- e_{ah} (kN/m^2): Horizontal earth pressure on the wall.
- e_{av} (kN/m^2): Vertical earth pressure on the wall.
- u_x (m): Horizontal displacement of the wall.
- M (kNm/m): Bending moment in the wall.
- Q (kN/m): Shear force in the wall.
- N (kN/m): Axial force in the wall.

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Table 2: Phases and descriptions of the model

Phase number	Phase name	Description
0	Initialization	Stress initialization based on the earth pressure (Existing, internal, and external water level)
1	Constructional element	Static deformation analysis: Anchors and sheet piles as well as interface elements are activated (Existing, internal, and external water level)
2	Filling phase 1	Static deformation analysis: The first filling area up to 1/3 H is activated (Existing, internal, and external water level)
3	Filling phase 2	Static deformation analysis: The second filling area up to 2/3 H is activated (Existing, internal, and external water level)
4	Filling phase 3	Static deformation analysis: The third filling area up to H is activated (Existing, internal, and external water level)
5	Loading phase	Static deformation analysis: The load is applied. Depending on the considered case, it is the applied water pressure or a combination of water pressure and pressure load (The airside water level is lowered, and the inner cofferdam is undrained with a water level corresponding to the water level on the loadside)

Table 3: Parameters and their ranges

Parameter	Range
B/H ratio [-]	0.1-8.0
Height H [m]	5 / 6 / 7 / 8 / 9 / 10
Bending stiffness EI [MN/m²]	124.5 (26) / 199.2 (38) / 273.3 (52) / 384.7 (1420) / 540.0 (2620)
Anchor position z_a [m] *	0.1 H / 0.2 H / 0.3 H / 0.4 H
Embedment depth t [m]	0.2 H / 0.4 H / 0.5 H / 0.6 H / 0.8 H / 1.0 H / 1.2 H / 1.4 H
Water level [m] *	0.1 H / 0.2 H / 0.3 H / 0.4 H / 0.5 H
Point load [kN]	50 / 100 / 200 / 300
Point load location z_f [m] *	0.1 H / 0.2 H / 0.3 H / 0.4 H
Relative density I_d [-]	0.15 / 0.35 / 0.50 / 0.65 / 0.85

Table 4: Exemplary structure of columns in a result file.

Phase	Y-coordinate [m]	σ_{xx} [kN/m²]	e_{ah} [kN/m²]	e_{av} [kN/m²]	u_x [m]	M [kNm/m]	Q [kN/m]	N [kN/m]
...	...	...	...	...	...	...	...	...

List of Files

The naming of result files follows the specified key, which is explained below:

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$$\underbrace{\text{HX}}_{\text{wall height}} \_ \underbrace{\text{WX.X}}_{\text{water level}} \_ \underbrace{\text{Erddruck\_xxxxseitig}}_{\text{earth pressure on loadside/airside}} - \underbrace{\text{BX.X}}_{\text{cofferdam width}} - \underbrace{\text{EI}}_{\text{bending stiffness}} - \underbrace{\text{zaX.X}}_{\text{anchor location}}$$
$$- \underbrace{\text{zfX.X}}_{\text{point load location}} - \underbrace{\text{FX}}_{\text{point load value}} - \underbrace{\text{tX.X}}_{\text{embedment depth}} - \underbrace{\text{IdX.X.txt}}_{\text{relative density}}$$

,where *X* is replaced by a number and *xxxx* might be replaced by either *luft* (airside) or *last* (loadside). The bending stiffness, as per the naming convention outlined, derives from the values presented in Table 3. Instead of the actual stiffness values, the naming convention employs the values enclosed in brackets for designation purposes.

The data set includes the following items:

- Variations for cases without a point load:
  - Variations of wall bending moment `01_B+EI_noload`: 252 txt-files,
  - Variations of anchor location `07_B+za_noload`: 206 txt-files,
  - Variations of wall height `08_B+H_noload`: 316 txt-files,
  - Variations of embedment depth `09_B+t_noload`: 262 txt-files,
  - Variations of water level `11_B+Hw_noload`: 252 txt-files,
  - Variations of bulk density `13_B+Id_noload`: 244 txt-files.
- Variations for cases with a point load:
  - Variations of wall bending moment `02_B+EI`: 252 txt-files,
  - Variations of point load location `03_B+zf`: 186 txt-files,
  - Variations of anchor location `04_B+za`: 182 txt-files,
  - Variations of point load value `05_B+F`: 162 txt-files,
  - Variations of wall height `06_B+H`: 294 txt-files,
  - Variations of embedment depth `10_B+t`: 222 txt-files,
  - Variations of water level `12_B+Hw`: 236 txt-files,
  - Variations of bulk density `14_B+Id`: 230 txt-files.

License

Cerek, K., Hadjiloo, E. and Grabe, J. (2026). Dataset of Simulated Undrained Cofferdam Models for Parameteric Study. Hamburg University of Technology (TUHH). https://doi.org/10.15480/882.17440

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