AGH

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Assessment of soil – micropile interface parameters using three – dimensional numerical modeling.

Back analysis conducted for large number of axially loaded test piles.

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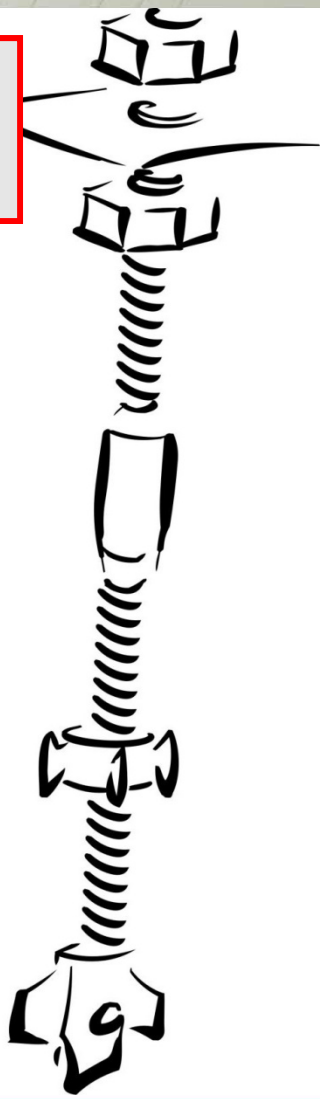
Aim of research

Assess the soil – micropile interface parameters

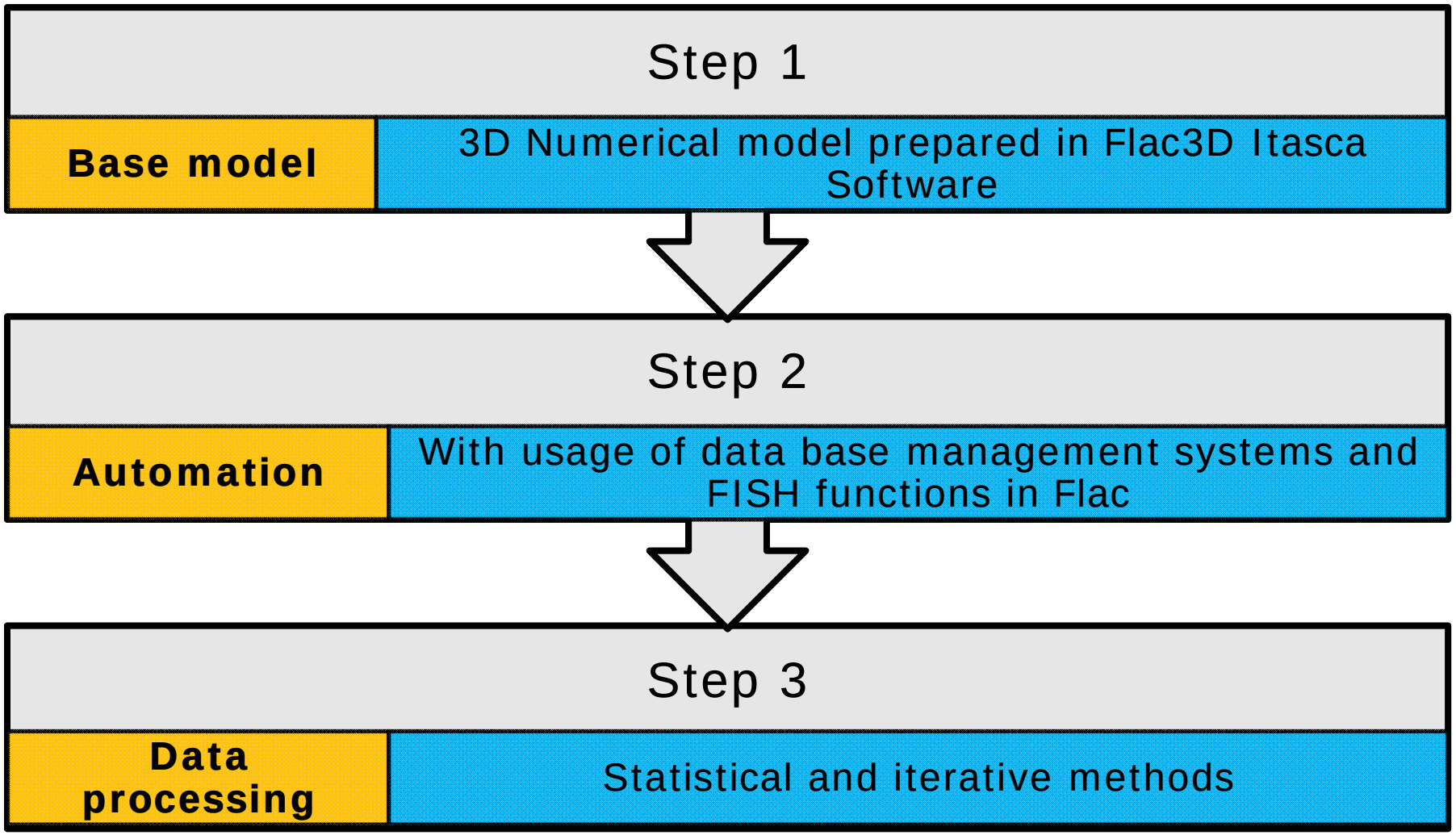
What for:

To precisely represent micropile scheme of work in layered soils with numerical modeling.

It enables possibility to accurate assess micropiles displacements.

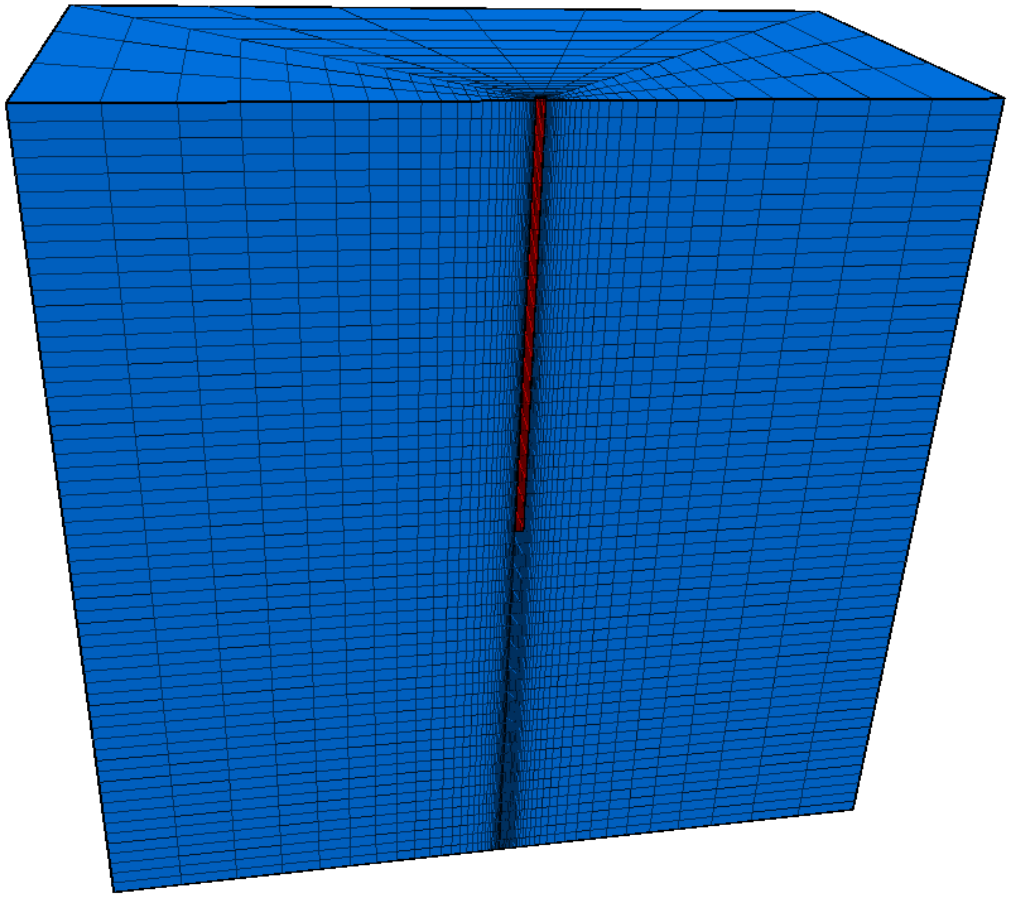


Method outline



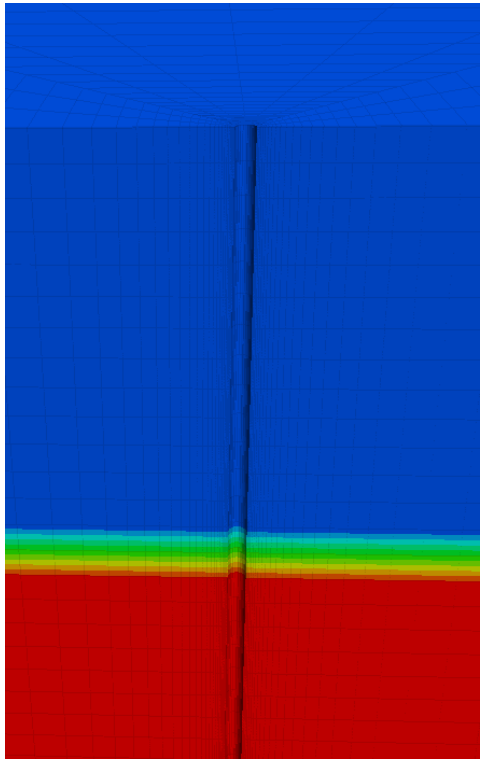
Base model construction

- Constructed in Flac3D by Itasca
- 23 796 zones
- „Brick” and „Wedge” type, 8 nodal zones
- Dimension of the model: 30x15x30 meters

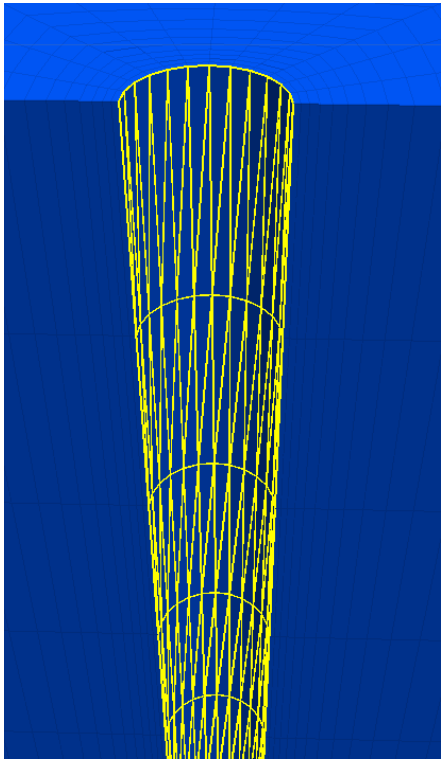


Base model construction

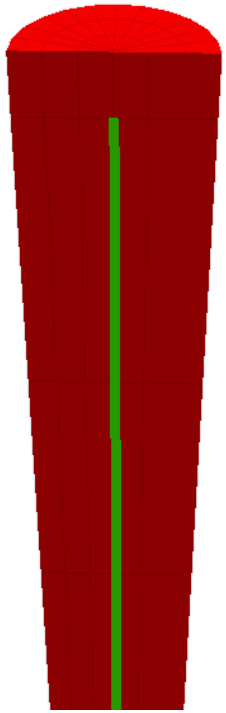
3 Elements of the base model



Layered soil

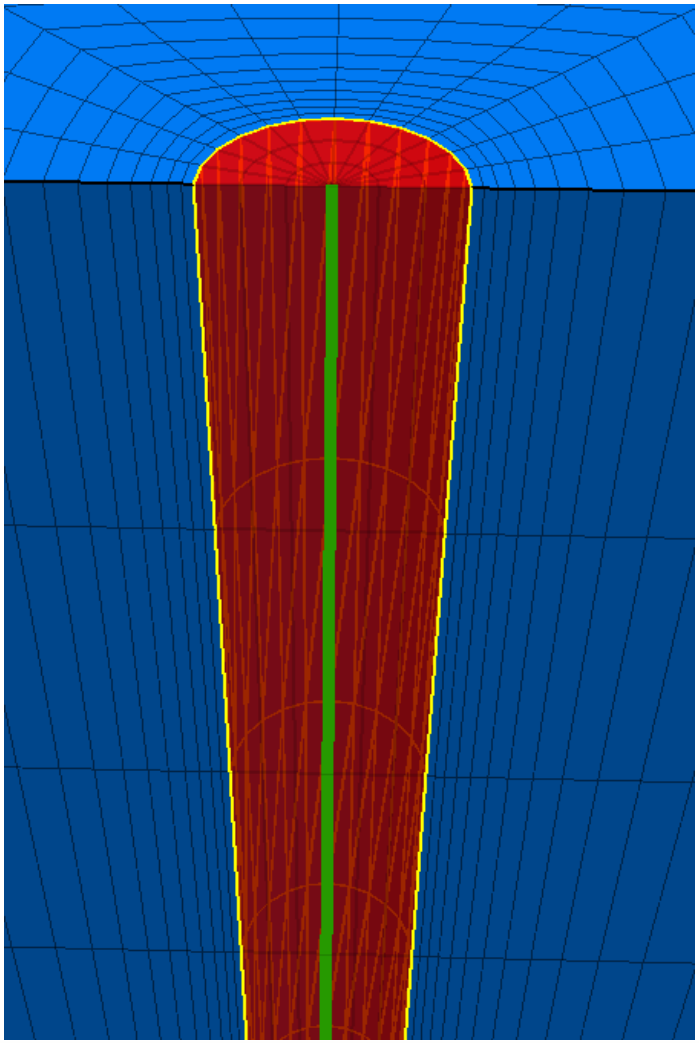


Interface



Micropile

Base model construction



Model parameters

- **Soil parameters**
  - ✓ From test load documentation
- **Micropile parameters**
  - ✓ Steal rod parameters
  - ✓ Grout parameters
- **Interface parameters**
  - ✖ Will be obtained from back analysis

Base model construction

Interface characterized by Coulomb slide and tensile and shear bonding.

Interface parameters	
▪ Friction	▪ normal stiffness
▪ Cohesion	▪ shear stiffness
▪ Dilation	▪ tensile bond strength
	▪ shear bond strength

Base model construction

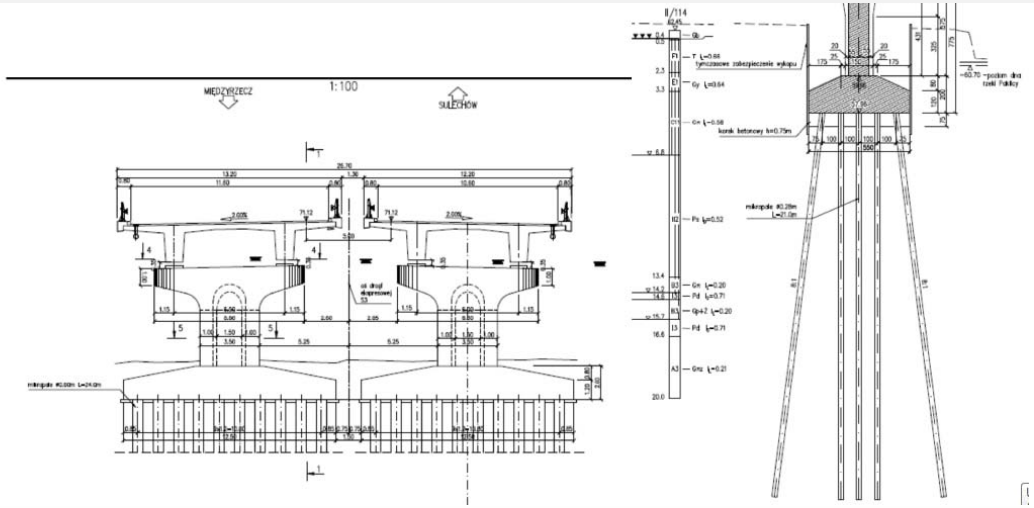
Interface parameters assumptions

▪ Friction ▪ Cohesion ▪ Dilation	▪ Failure criterion parametres
▪ normal stiffness ▪ shear stiffness	▪ Elastic behavior
▪ tensile bond strength ▪ shear bond strength	▪ Initial bonding

Model verification

Entry data for numerical model

- Documentation from estacade project for express road S3 in Poland
- Micropile foundation of the props
- Each prop rested on 50 micropiles
- Test loads of one micropile in each prop



Model verification

Assumptions correction

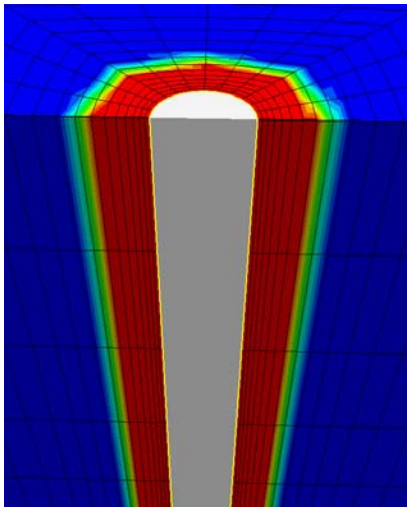
Designed capacity of the pile:	**1120 kN**
Displacements from test load:	**16 mm**
Displacements from numerical modeling:	**???**

Model not stable, because of the yielding in soil zones around the micropile.

Model verification

Assumptions correction

- Region of higher mechanical soil parameters is assumed
- Higher parameters are assigned to annular volume of soil mass around micropile
- Diameter of the volume is obtained from back analysis



	Force		
	560 [kN]	840 [kN]	1120 [kN]
Settlements from test load	3 [mm]	6,7 [mm]	15,66 [mm]
Settlements from numerical model	1,31 [mm]	4,87 [mm]	18,12 [mm]

Automation features in numerical model constructing

Clear structure of micropile numerical entry data for model creation in Flac3D in the text file data type

```
;Parametry materialu
set grav 10
sel beam prop emod 210e9 nu 0.29 xcarea 0.006289 xciz 5.19274e-6 xciy 5.19274e-6 xcj 1.03855e-5
sel beam prop dens 1900 range z -7 0
sel beam prop dens 2000 range z -30 -7

model mech mohr range group piasek
;Warstwa I Piasek drobny
property bulk 48.96e6 shear 22.6e6 cohesion 5e3 friction 32 dens 1900 range group piasek z -7 0
;Warstwa II Piasek pylasy
property bulk 67.71e6 shear 31.25e6 cohesion 5e3 friction 32 dens 2000 range group piasek z -30 -7
```

Gives an ability to prepare special form which can automatically generate the entry txt file, for various data input

Conclusions

Essential for the research is to prepare clearly constructed numerical model which precisely simulates micropile behavior in soils.

Two groups of interface parameters need to be obtain:

- Diameter of strengthened soil around the pile
- Failure criterion parameters

Further analysis must be conducted to validate presented numerical model, firstly to check the accuracy of simulating behavior when no yielding occurs, than to assess the parameters connected with failure criterion.

Thank you for your attention

Any questions ???

Have a nice time in Krakow !