

TITAN POLSKA



Engineering
Office
TITAN POLSKA

Automation in micropile design

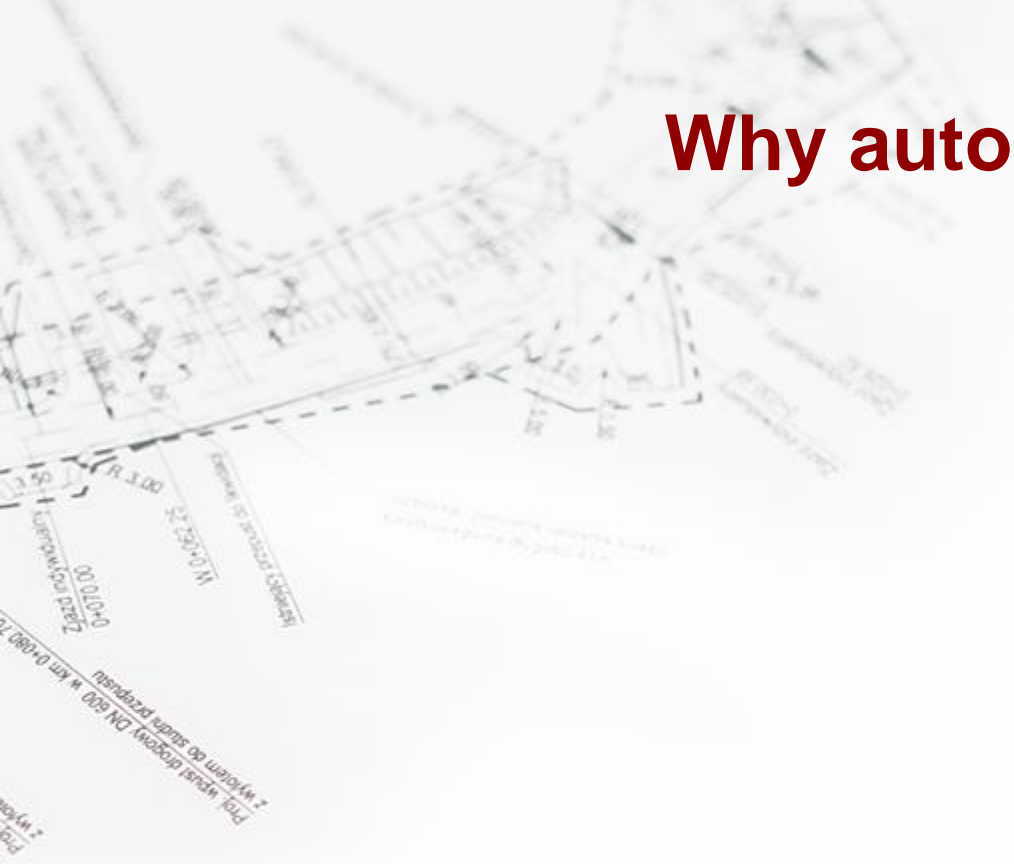
Maciej Szczygielski
Natalia Maca



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Why automate micropile design ?

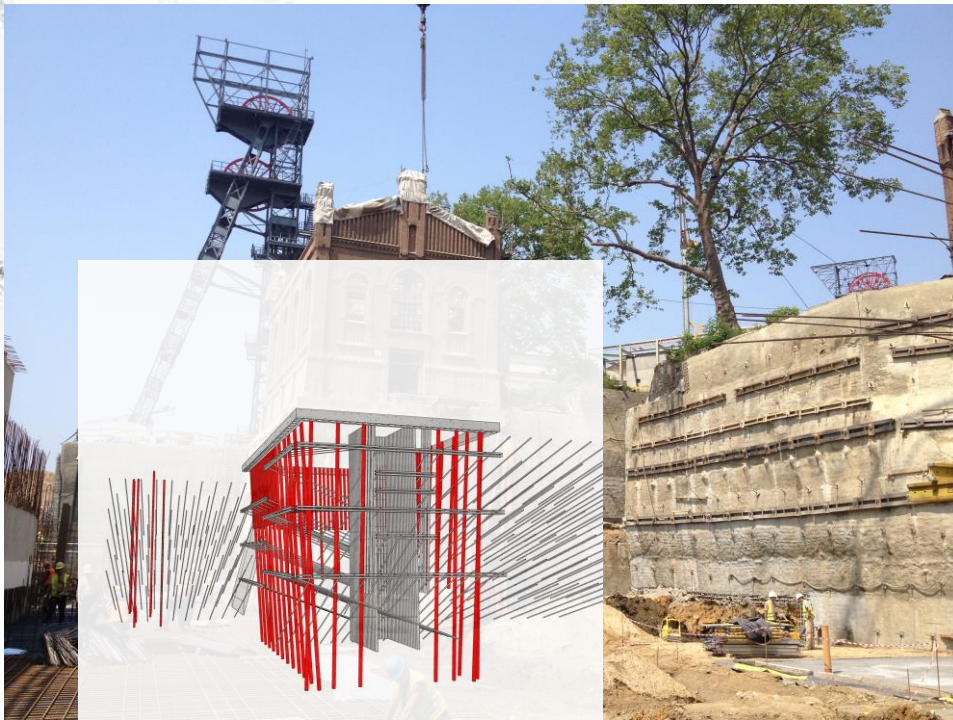


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Why automate micropile design ?

Wide range of possible geometrical configurations of micropiles group



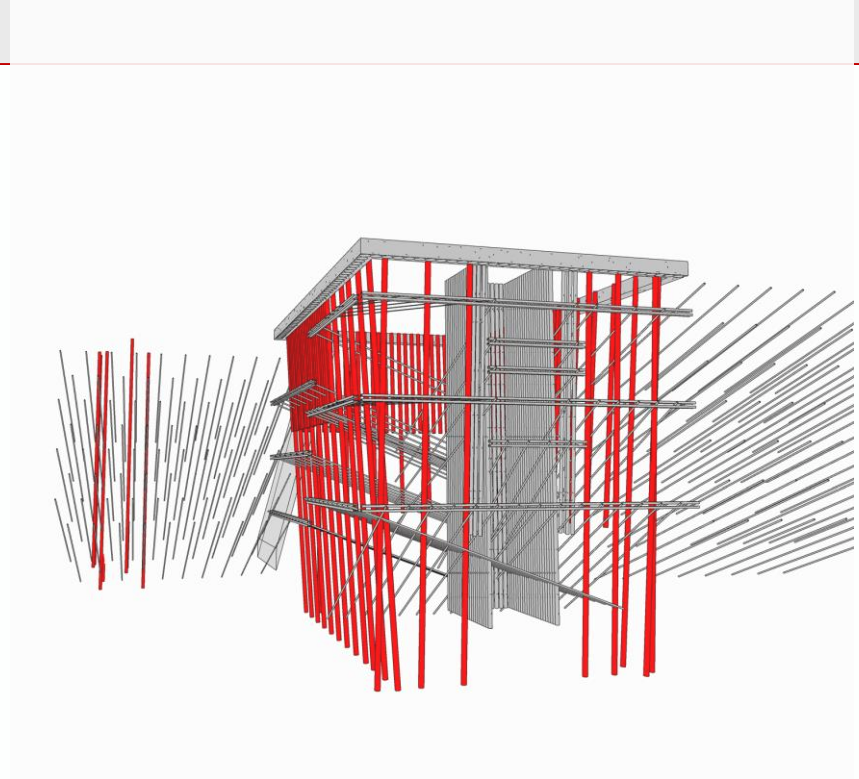
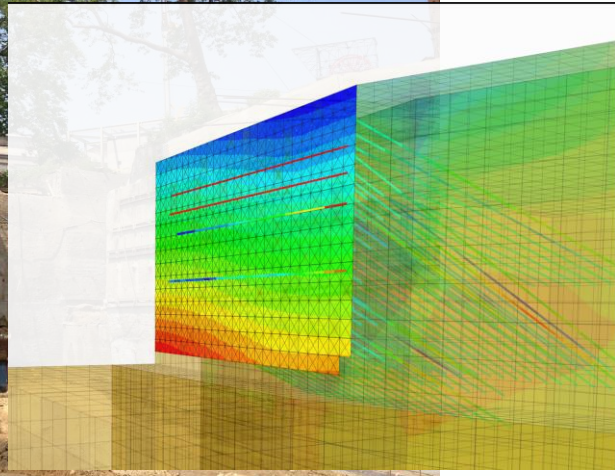
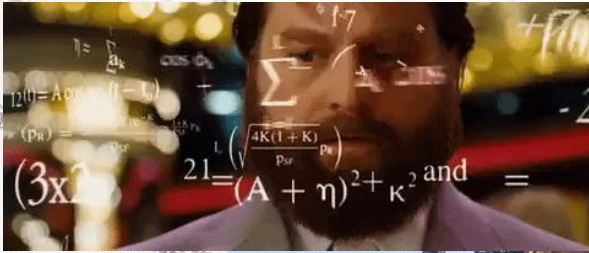
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Why automate micropile design ?

Wide range of possible geometrical configurations of micropiles group

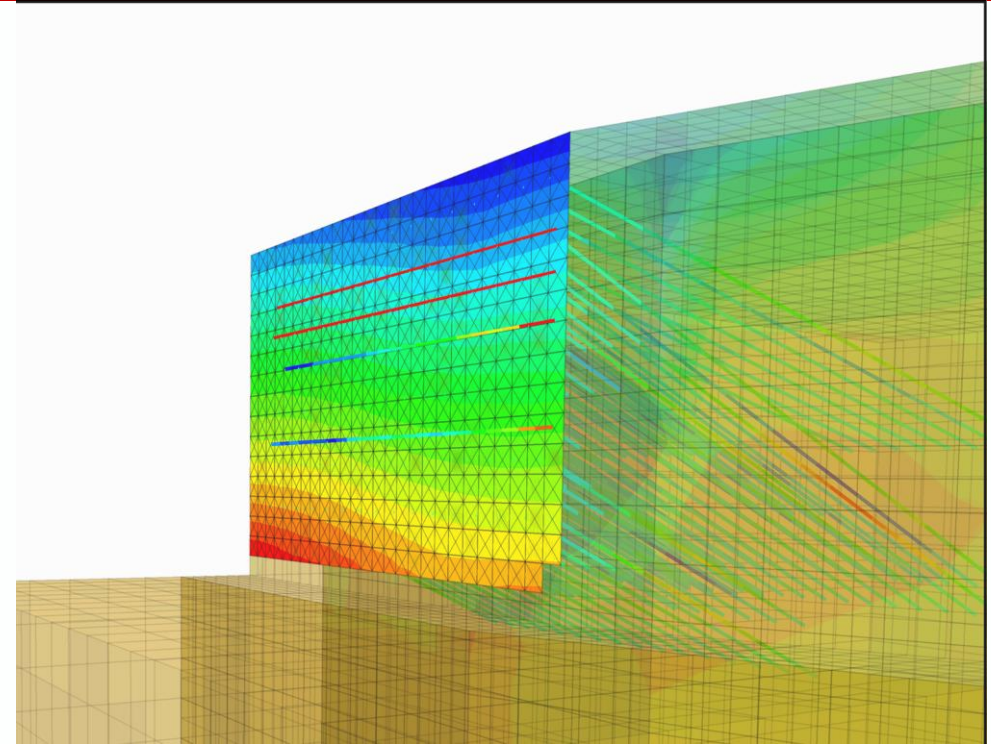
= numerical modeling



Why automate micropile design ?

Wide range of possible geometrical configurations of micropiles group

= numerical modeling + scripting



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Why automate micropile design ?

Simple repeatable calculation of single pile length from given forces and ground conditions.

The screenshot displays a web-based software interface for micropile design, divided into several sections:

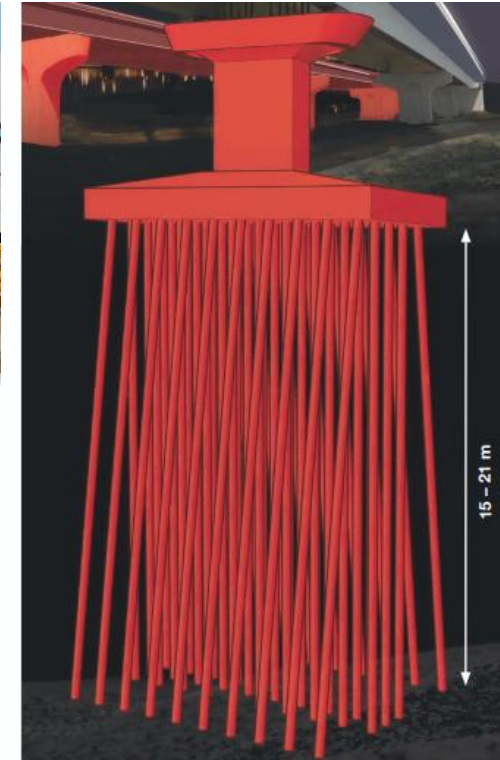
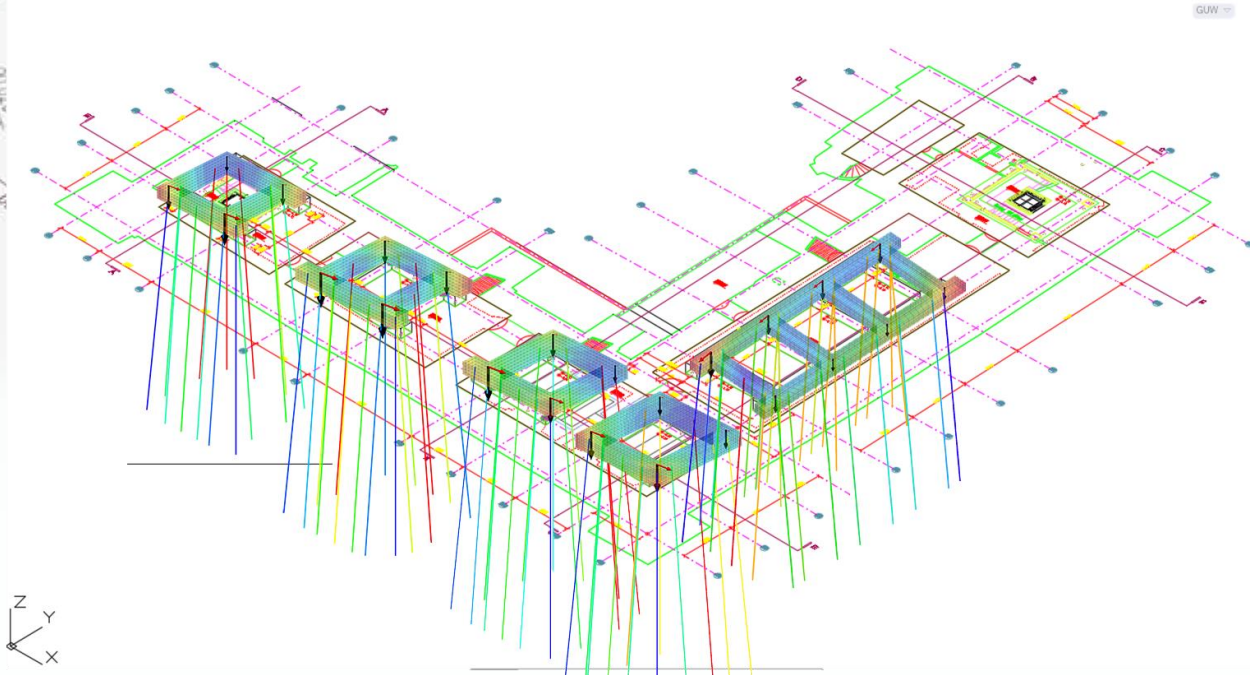
- 1. Podaj obciążenia obciążeniowe [kN]:*** (Provide design loads [kN]): A list of load levels with corresponding design load values and sliders for adjustment.
- 2. Współczynnik korekcyjny** (Correction coefficient): A section for selecting a correction coefficient based on design load ranges.
- 3. Współczynnik modelu** (Model coefficient): A section for selecting a model coefficient based on micropile diameter ranges.
- 4. Różnica stopni warstw ściśniętych** (Difference in degrees of compressed layers): A section for inputting the difference in degrees of compressed layers.
- 5. Długość mikropila w warstwach słabych** (Length of micropile in weak layers): A section for inputting the length of the micropile in weak layers.
- 6. Długość mikropila do wyrostania głowicy** (Length of micropile for head protrusion): A section for inputting the length of the micropile for head protrusion.
- 7. Rodzaje gruntu rodzaje** (Soil types): A section for selecting soil types from a grid of options, including soil strength diagrams.
- 8. Wykresy** (Charts): A table showing soil strength values for different soil types and load levels.

Wykres	Wzrost	Grupa	Grupa	Grupa	Grupa	Grupa	Grupa
Lewy grunt	Tyć 30	75	75	91	95	91	75
	Tyć 40	100	100	115	115	115	115
	Tyć 50	125	125	140	140	140	140
Prawy grunt	Tyć 30	100	100	115	115	115	115
	Tyć 40	125	125	140	140	140	140
	Tyć 50	150	150	165	165	165	165



Why automate micropile design ?

Optimization – analysis of various design options



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Why automate micropile design ?

Numerical modeling

Simple repeatable calculation of single pile length from given forces and ground conditions.

Optimization – analysis of various design options



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How to automate micropile design ?

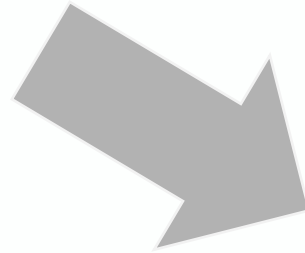


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How to automate micropile design ?

With algorithms !



Library of scripts and
commands for micropiles



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Library structure

Base objects

- Micropile
- Micropile group

Methods

- In /Out
- Generating objects
- Modifying objects
- Simple calculations



Library structure

OBJECTS

Micropile

**Micropile
group**

Single micropile

LIST

*[param1, param2,
param3.... param12]*

- Geometrical,
- Structural,
- Derived from calculation



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Library structure

OBJECTS

Micropile

Micropile
group

Micropile group

LIST

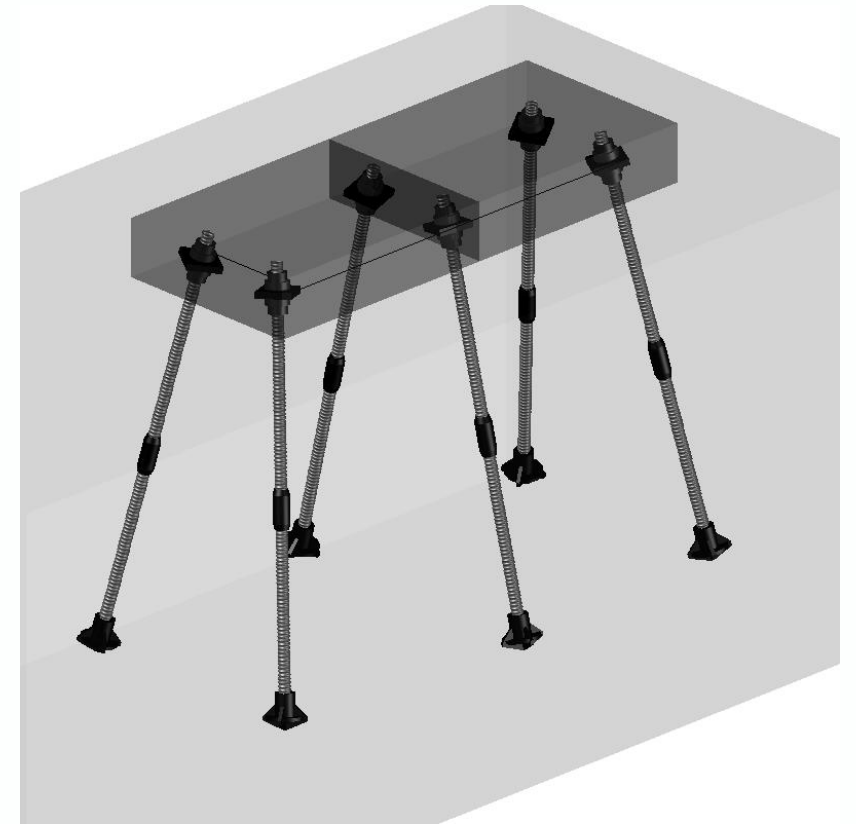
[micropile1,

micropile2,

micropile3,

...

micropileN]



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Library structure

METHODS

Generating

Modifying

Simple
calculation

In / Out

Commands used to
generate objects i.e. :

gen_one_micropile()

add_to_group(pile)

gen_group_circular()

gen_group_rectangular()

All only with geometrical
parameters



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Library structure

METHODS

Generating

Modifying

Simple
calculation

In / Out

Commands used to modify
objects parameters i.e. :

mod_[param](value, pile)

add_to_[param](value, pile)



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Library structure

METHODS

Generating

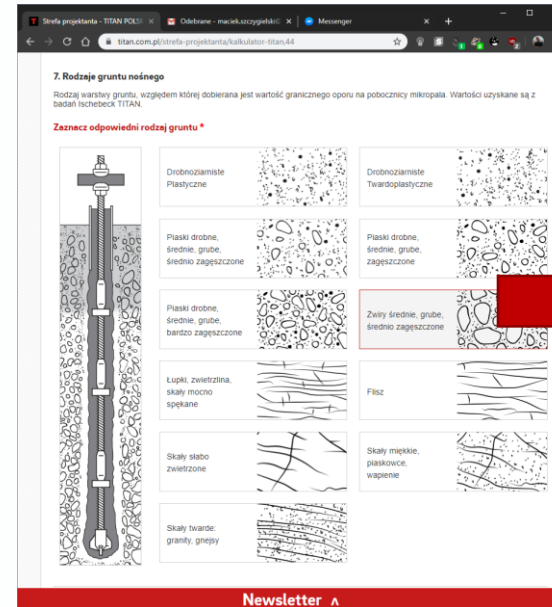
Modifying

Simple calculation

In / Out

Calculating a pile length from:

- Pile forces
- Skin friction table



```
def getlenfrontble(pile, soil_params, soil_layers, elem_len=3.0, ksi=1.4e):  
    """Return length of pile for given soil conditions and axial forces"""  
    exforce = pile[9]  
    freelen = pile[12]  
    anchorlen = pile[11]  
    drilld = pile[8]  
    params = ListtoDict(soil_params)  
    alphas = radians(pile[5])  
  
    if exforce >= 0:  
        gammas = 1.1  
    else:  
        gammas = 1.15  
  
    pilelen_range = [elem_len * x for x in range(1, int(36 / elem_len) + 1)]  
  
    for l in pilelen_range:  
        n = len_soil_layers - anchorlen  
        g = 0  
        a = 0  
        s = 0  
  
        soil_layers[len_soil_layers - 1][1] = 50.0  
  
        flag = 0  
        fl = True  
  
        for elem in soil_layers:  
            pileinlay = float(elem[1]) / cos(alphas)  
  
            # print elem[1], pileinlay  
            acclen += pileinlay  
  
            if acclen >= freelen:  
                flag += 1  
                if flag == 1:  
                    pileinlay = pileinlay - (acclen - freelen)
```



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Library structure

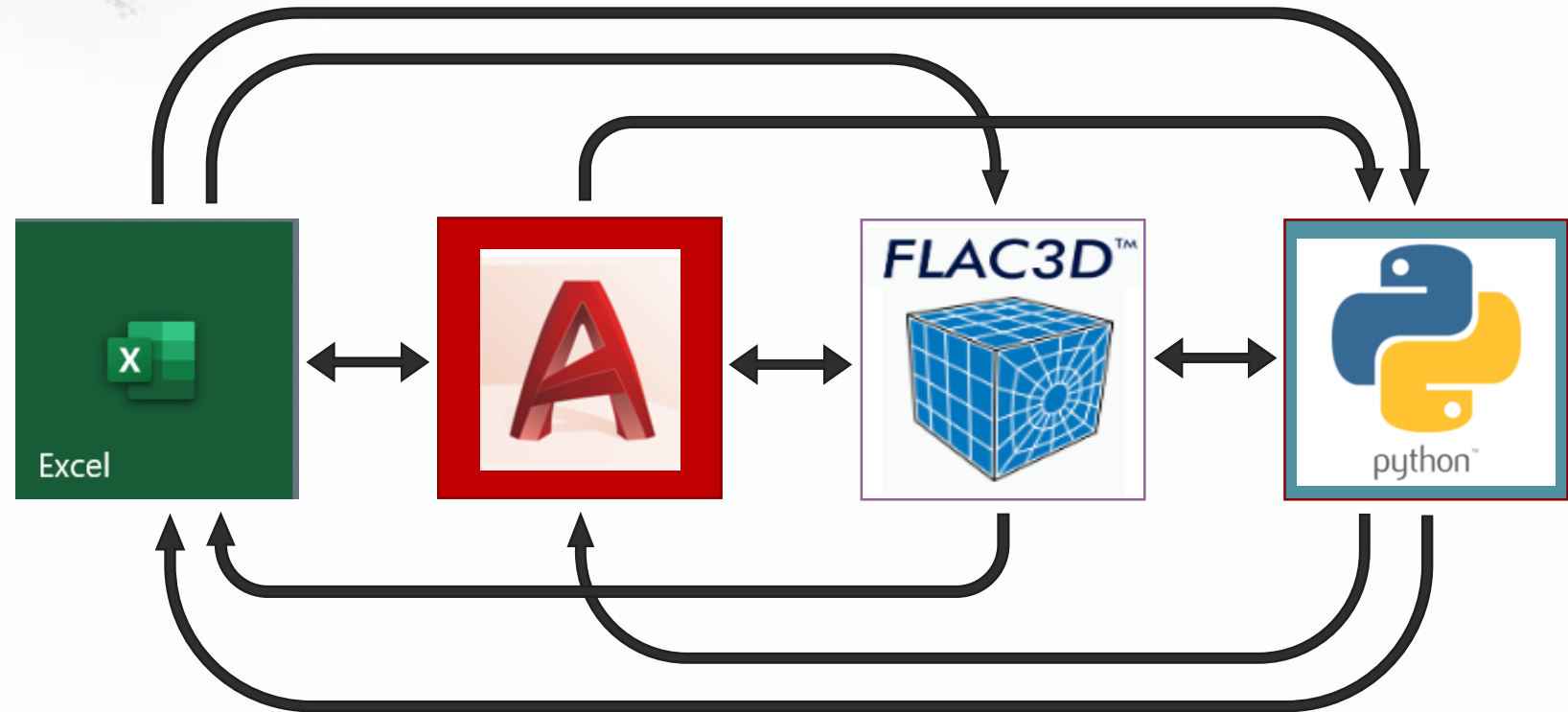
METHODS

Generating

Modifying

Simple calculation

In / Out



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titan.com.pl/python-micropiles

Working on github profile....

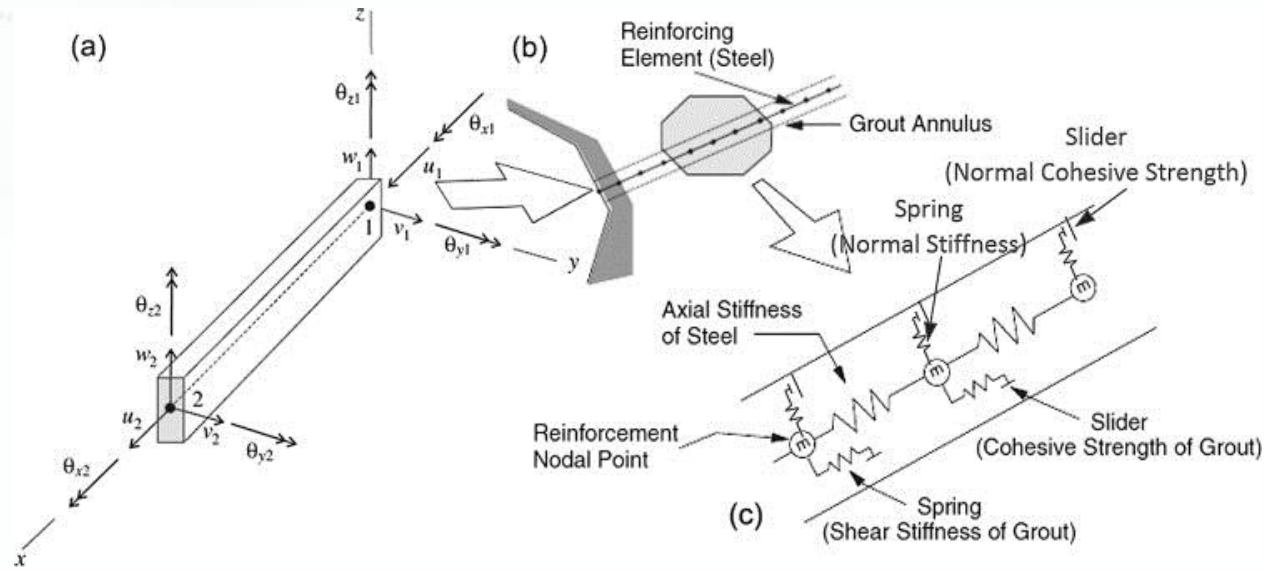


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Where to use automation ?

Numerical modeling



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Where to use automation ?

Numerical modeling

FLAC3D 6.00
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Zone Group
Cut Plane: on

- Typ=grunt, Layer=A1
- Typ=grunt, Layer=B3
- Typ=grunt, Layer=C2
- Typ=grunt, Layer=D4
- Typ=grunt, Layer=I1b
- Typ=grunt, Layer=NB
- Typ=grunt, Layer=Va

Pile Group of Element

- Default=circumferential piles1
- Default=circumferential piles2
- Default=core_piles

Geometry Type

- Edge
- Polygon

Zone Group

- Default=group1, Typ=podpora

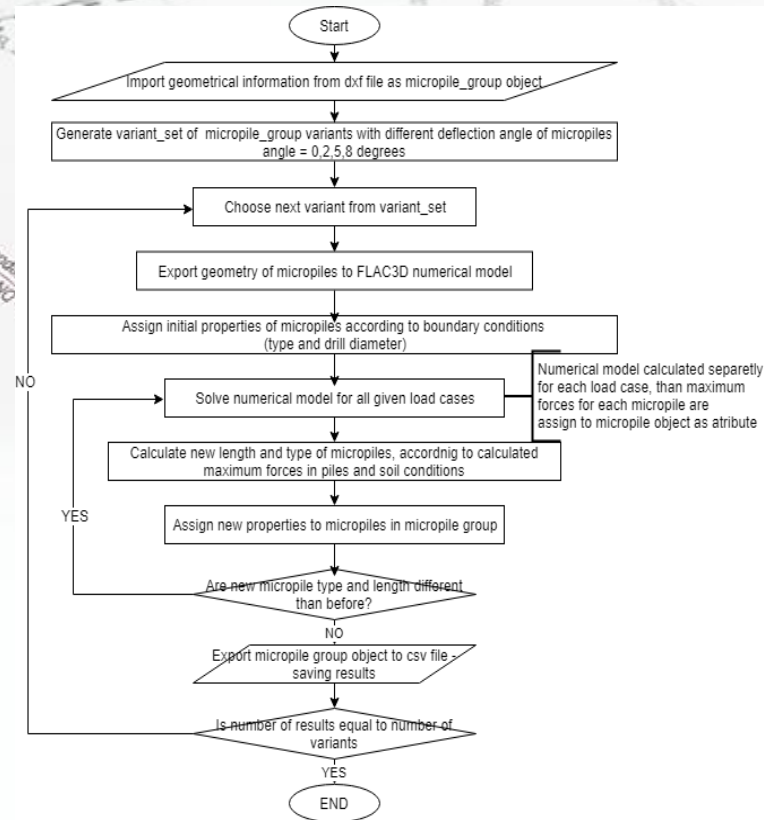
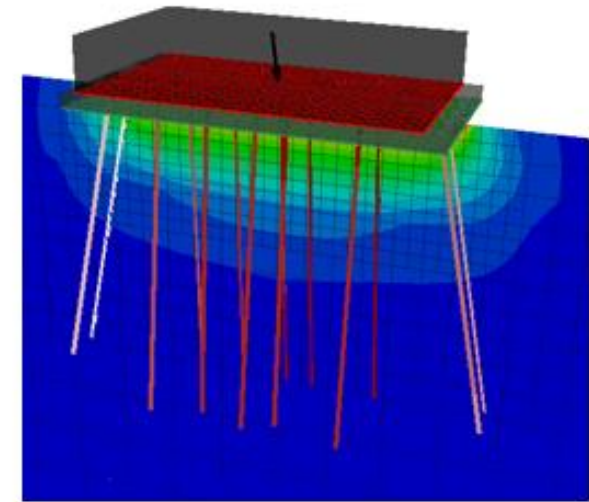
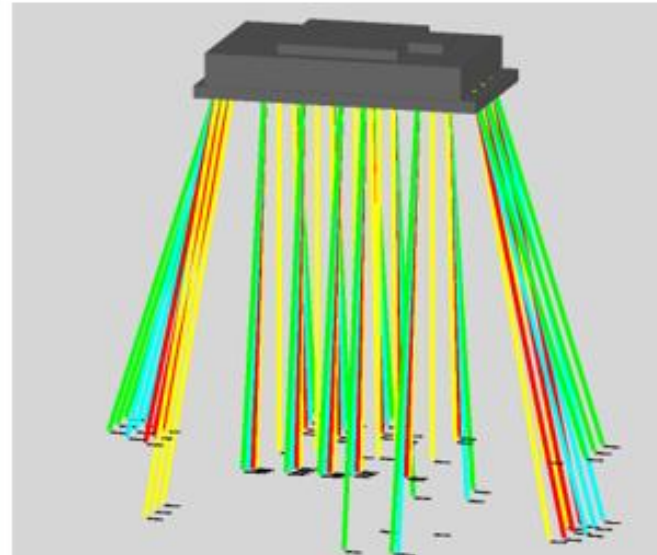


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Where to use automation ?

Complex algorithms



Variant	Micropile type	Length	Micropile type	Length	Total length
Deflection angle 10	TITAN 40/20	330 m	-	-	330 m
Deflection angle 12	TITAN 40/20	324 m	-	-	324 m
Deflection angle 15	TITAN 40/20	330 m	-	-	330 m
Deflection angle 18	TITAN 40/20	240 m	TITAN 40/16	87 m	327

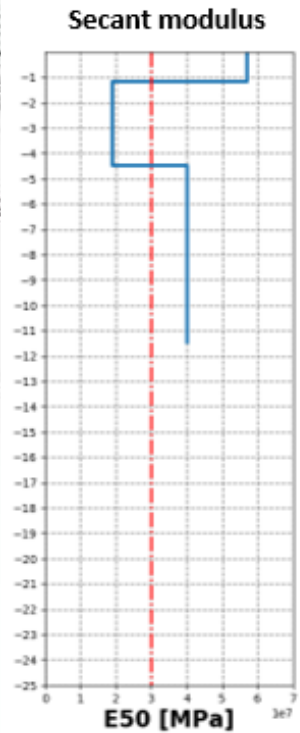


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Where to use automation ?

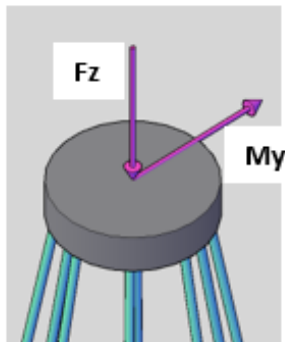
Complex algorithms



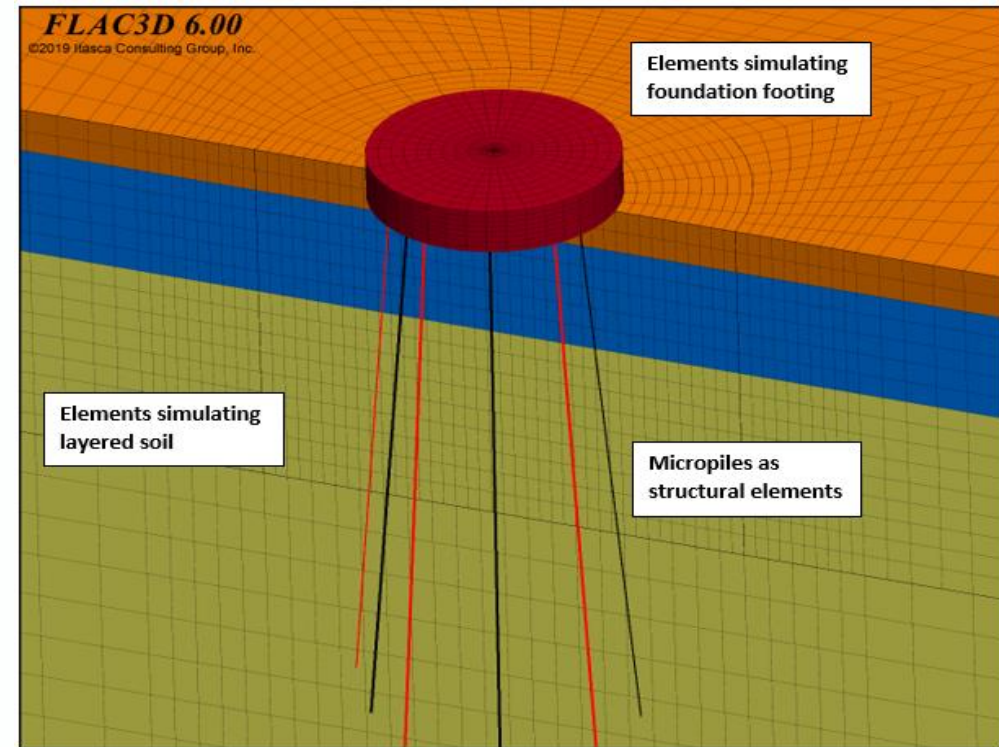
Soil parameters

Layer name	Depth	Density	Cohesion	Friction	Secant modulus E50	qsk
	m	kg/m ³	kPa	deg	MPa	kPa
Rp2	1.17	1850	0	39	57	150
Gz2	3.3	2050	10	25	13	50
Gz3	7	2175	12	30	40	100

Loading case

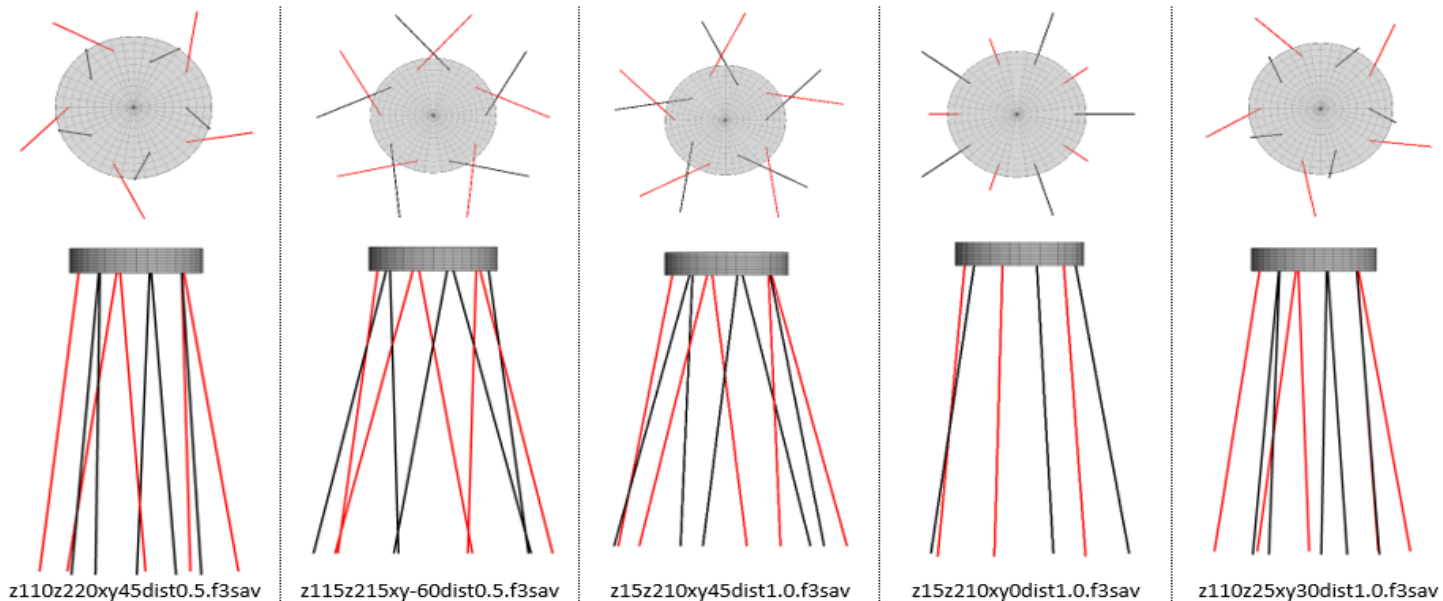


$F_z = 0.4 \text{ MN}$
 $M_y = 3.68 \text{ MN}$



Where to use automation ?

Complex algorithms



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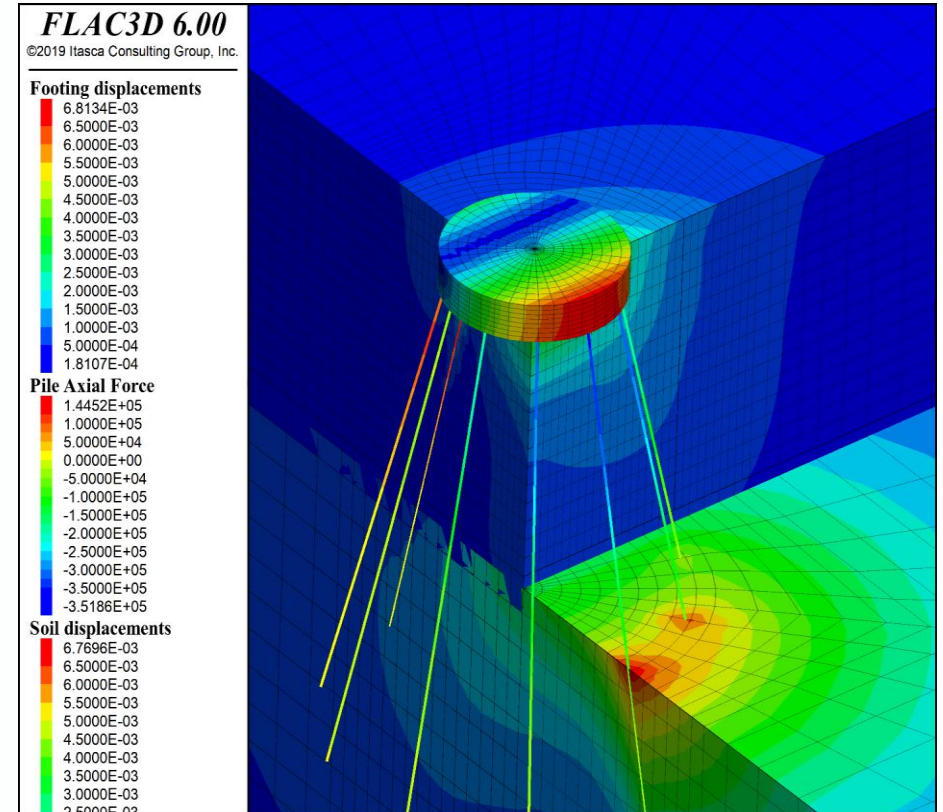
Where to use automation ?

Complex algorithms

Variant name	Max disp. [mm]	Max Axial Force [kN]
z115z215xy0dist0.5.f3sav	6.54	-351.9
z110z220xy0dist0.5.f3sav	5.96	-374.2
z18z28xy0dist1.0.f3sav	6.62	-374.3
z15z215xy0dist0.5.f3sav	5.79	-374.7
z15z210xy30dist0.5.f3sav	5.56	-375.3
z110z25xy0dist0.5.f3sav	5.72	-377.3
z110z210xy-45dist0.5.f3sav	6.62	-377.8
z110z210xy0dist0.5.f3sav	6.63	-378
z110z220xy30dist0.5.f3sav	5.84	-380.2
z115z25xy0dist0.5.f3sav	5.78	-380.5
z110z210xy-60dist0.5.f3sav	6.71	-380.5
z15z210xy0dist1.0.f3sav	6.66	-381.4
z15z210xy45dist0.5.f3sav	5.63	-381.7
z15z25xy0dist1.0.f3sav	6.64	-382.1
z110z220xy45dist0.5.f3sav	5.88	-382.9
z15z215xy30dist0.5.f3sav	5.6	-384.3
z115z215xy-45dist0.5.f3sav	6.89	-385.3

Variant name	Max disp. [mm]	Max Axial Force [kN]
z110z25xy0dist1.0.f3sav	6.6	-389.1
z115z215xy-60dist0.5.f3sav	6.77	-389.8
z110z25xy45dist0.5.f3sav	5.62	-390
z110z210xy0dist1.0.f3sav	7.94	-391.5
z115z25xy30dist0.5.f3sav	5.6	-392.2
z110z25xy30dist1.0.f3sav	6.54	-393
z110z25xy30dist0.5.f3sav	5.64	-394.8
z18z28xy30dist1.0.f3sav	6.55	-394.9
z115z25xy45dist0.5.f3sav	5.67	-395.5
z115z215xy0dist1.0.f3sav	8.28	-397.8
z110z210xy30dist1.0.f3sav	6.72	-397.9
z15z210xy0dist0.5.f3sav	5.84	-399.6
z18z28xy45dist1.0.f3sav	6.68	-400.2
z15z25xy30dist1.0.f3sav	6.48	-400.3
z15z215xy45dist0.5.f3sav	5.67	-403.6
z110z25xy45dist1.0.f3sav	6.57	-404.2
z15z25xy45dist1.0.f3sav	6.56	-404.4

Variant name	Max disp. [mm]	Max Axial Force [kN]
z110z210xy-45dist1.0.f3sav	7.8	-405.4
z115z25xy0dist1.0.f3sav	7.07	-407
z15z210xy30dist1.0.f3sav	6.59	-407.8
z110z210xy-60dist1.0.f3sav	7.82	-410.6
z15z215xy0dist1.0.f3sav	7.13	-411.6
z15z210xy45dist1.0.f3sav	6.67	-412.7
z110z210xy45dist1.0.f3sav	6.72	-413.8
z115z215xy-60dist1.0.f3sav	8	-414.6
z110z220xy0dist1.0.f3sav	8.65	-417.2
z115z25xy30dist1.0.f3sav	6.77	-419.2
z115z215xy30dist1.0.f3sav	7.52	-419.7
z115z215xy-45dist1.0.f3sav	8.08	-420.2
z15z215xy30dist1.0.f3sav	6.81	-425
z110z220xy30dist1.0.f3sav	7.26	-425.1
z15z215xy45dist1.0.f3sav	6.95	-433.3
z115z25xy45dist1.0.f3sav	6.8	-441
z115z215xy45dist1.0.f3sav	7.01	-446.3
z110z220xy45dist1.0.f3sav	7.19	-450.9



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Summary

Very efficient tool in engineer toolbox

Simple way to exchange data about micropiles between different file types

Extremaly usefull in case of numerical modeling

titan.com.pl/python-micropiles



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Kliknij, aby edytować styl wzorca tytułu

Thank You! 😊

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