



European Master in
Building Information Modelling

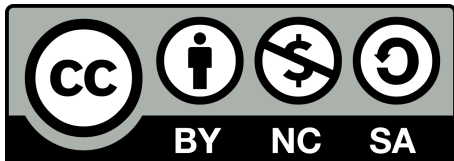
Programming assignments - 03

Topic 2: Fundamentals of programming

BIM A+3: Parametric Modelling in BIM

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- Develop a simple application for calculating different geometrical characteristics of a polygon shape using Python programming language.
- Basic requirements:
 - The end-user must be able to calculate polygon shapes of different sizes - the number of polygon points must not be limited.
 - The program should display end-user entered data (x and y coordinates of polygon points) in a “table” format.
 - The calculated results must be displayed with two decimal numbers.
- Work submission:
 - Deadline: 2. 12. 2019, 9:30am
 - Upload your solution to your GitHub repository and share the repository link (https://docs.google.com/spreadsheets/d/1hH-0Dsa9buz2bGSMVgMQcfZF_sWg3dcOWialk5apCkQ/edit?usp=sharing)
- *Instructions:*
 - *Start with VERY basic solution and work from there :-)*
 - *The formulas are on the next slide.*
 - *The points must be ordered counter clockwise.*

Površina prečnega prereza:

$$A_x = \frac{1}{2} \sum_{i=1}^n (x_{i+1} + x_i)(y_{i+1} - y_i)$$

Statična momenta prečnega prereza:

$$S_x = -\frac{1}{6} \sum_{i=1}^n (x_{i+1} - x_i)(y_{i+1}^2 + y_i y_{i+1} + y_i^2)$$

$$S_y = \frac{1}{6} \sum_{i=1}^n (y_{i+1} - y_i)(x_{i+1}^2 + x_i x_{i+1} + x_i^2)$$

Osní vztrajnostni momenti prečnega prereza:

$$I_x = -\frac{1}{12} \sum_{i=1}^n (x_{i+1} - x_i)(y_{i+1}^3 + y_{i+1}^2 y_i + y_{i+1} y_i^2 + y_i^3)$$

$$I_y = \frac{1}{12} \sum_{i=1}^n (y_{i+1} - y_i)(x_{i+1}^3 + x_{i+1}^2 x_i + x_{i+1} x_i^2 + x_i^3)$$

$$I_{xy} = -\frac{1}{24} \sum_{i=1}^n (y_{i+1} - y_i) \left[y_{i+1} (3x_{i+1}^2 + 2x_{i+1} x_i + x_i^2) + y_i (3x_i^2 + 2x_{i+1} x_i + x_{i+1}^2) \right]$$

Koordinati težišča prečnega prereza:

$$x_T = \frac{S_y}{A_x}$$

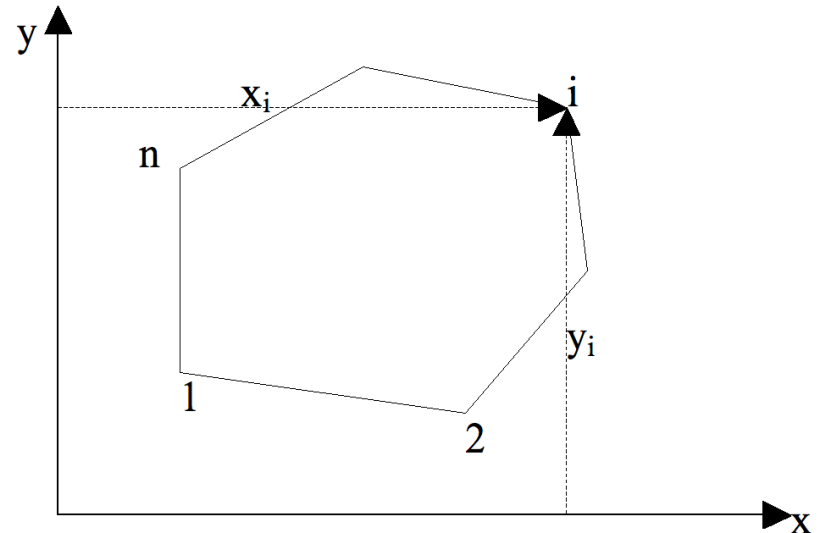
$$y_T = \frac{S_x}{A_x}$$

Vztrajnostni momenti glede na vzporedno premaknjeni osi skozi težišče prečnega prereza:

$$I_x^T = I_x - y_T^2 A_x$$

$$I_y^T = I_y - x_T^2 A_x$$

$$I_{xy}^T = I_{xy} + x_T y_T A_x$$



```
bimaplus — -bash — 80x29
[mbp15-2016:bimaplus mdolenc$ python3 geocaracteristics.py
Enter the number of polygon points: 4

Enter x and y coordinates for polygon points ...
Point 1: 0 0
Point 2: 1 0
Point 3: 1 1
Point 4: 0 1

Point      x      y
-----
1          0.00    0.00
2          1.00    0.00
3          1.00    1.00
4          0.00    1.00

Geometric characteristics:
Ax:      1.00
Sx:      0.50
Sy:      0.50
Ix:      0.33
Iy:      0.33
Ixy:     -0.25
xt:      0.50
yt:      0.50
Ixt:     0.08
Iyt:     0.08
Ixyt:    0.00
mbp15-2016:bimaplus mdolenc$
```