Tutorial 3.1. Structural response under windload

Description: For the given geometry, compute the shear force and the bending moment of the structure along the height for the given wind load. Compare the base shear and the bending moment at the base with other buildings of similar height

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Created on: 16.11.2018

Last update: 27.09.2019

Exercise: Structural response for building with given geometry located at Jeddah Airport

For the given location of Jeddah airport compute the shear force and bending moment for the given geometry and compare the base shear and bending moment at the base for different geometry.

In [1]:

```
# import
import matplotlib.pyplot as plt
import numpy as np
```

Gust wind speed computed from the previous example for the location of the Jeddah Airport considering a return period of 50 years is 40.12 m/s. The mean wind speed is computed as

$$ u_{mean} = u_{gust}/1,4$$

In [2]:

```
gust_windspeed =
# 1.4 is the approximate factor to convert from gust to mean wind speed
mean_windspeed =
```

The building is located at an urban area with height of adjacent building upto 15m: **Terrain category IV**

Let us calculate the shear force and bending moment values for 600 m tall building having a uniform cross section of given geometry and building width = 60.0 m

the building is divided into slices of height 10m

In [3]:

```
height_slice = 10.0
height_start = height_slice
height_end = 600.0
height = np.arange(height_start, height_end + height_slice, height_slice)
# lever arm at the center of each slice
# so shift for lever arm
height = height - height_slice / 2.0
```

According to EN 1991-1-4 the wind profile for terrain category IV is
$$ u_{gust}(z) = 1,05 . v_b . (z/10)^{0,2}$$

In [4]:

```
a_gust_4 = 0.0
```

```
alpha_gust_4 = 0.0
ugust_4 = 0.0
air_density = 1.2 # airdensity in kg/m3
```

Drag coefficient for the given geometry

In [5]:

```
drag_coefficient = 0.0
# to be extended
```

Shear force over the height

In [6]:

```
shear_force = 0.0
# to be extended
```

Let us plot

In [7]:

```
plt.figure(num=1, figsize=(8, 6))
# to be extended
plt.show()
```

```
<Figure size 576x432 with 0 Axes>
```

Bending moment over the height

In [8]:

```
bending_moment = 0.0
# to be extended
```

Let us plot

In [9]:

```
plt.figure(num=2, figsize=(8, 6))
# to be extended
plt.show()
```

```
<Figure size 576x432 with 0 Axes>
```

Base shear and bending moment at the bottom

In [10]:

```
base_shear = 0.0
# to be extended
bending_moment_at_bottom = 0.0
# to be extended
```

Discuss amoung groups the base shear and bending moment at the base of the building.