# Lab No( 2 )

# Zero- Displacement Length (Zd) Calculation

**Aims**: **Calculate the zero- displacement length Zd using engineering methods .**

## Tools:

**1-** Miniature model of buildings and plants at a known scale, which represent the obstacles in the reality.

2-Sewing tape measure.

## Theoretical Part:

Some of the obstacles elements like the cities and forests, line up closely to form a homogeneous obstacle roof (imagen level ). this led to making wind speed equal to zero at this level. The height of this level is called the displacement length Zd. The displacement length Zd can be calculated through the relationship derived by Bottema in 1995, which is as follows:

$$Z_d = \left[\frac{\sum A_{pb} + \sum (1-P) A_{pt}}{A_T}\right]^{0.6} * Z_H \dots\dots\dots (1)$$

Whereas:

Zd: Zero- Displacement Length

$A_{pb:}$ Surface level area of buildings

P: Air permeability coefficient of trees and its value 0.4

$A_T$: Total section area

$A_{pt:}$ : Surface level area of trees

ZH: The average of obstacle element height and can be calculated as follows:.

$$ZH = \frac{(ZH1 + ZH2 + ZH3 + \cdots .. + ZHn)}{n} \dots\dots\dots\dots [2]$$

Whereas**:**

N= 1,2,3,4,----------,n and It represents the number of roughness elements

## Methodology:

1- Calculate the obesticals height averag ZH from equation No. [2] and using measuring tape.

2- Using a sewing tape measure, calculate the surface area of the buildings $A_{bp}$ and the surface area of plants $A_{pt}$ .

2- Calculate the total area $A_T$.

3- From equation [1] calculate the Zero-Displacement Length Zd by using the table

| $A_{Pt}$ | $A_{Pb}$ |
|---|---|
| | |
| | |
| | |
| $\sum A_{Pt}$ = | $\sum A_{Pb}$ = |