

# Engineering Surveying

## 3<sup>rd</sup> Stage

Areas

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# Units of Area

- 1 hectare = 10,000 m<sup>2</sup>
- 1 donum=2500 m<sup>2</sup>
- 1 olk= 100 m<sup>2</sup>
- 1 hectare = 4 donum=100 olk
- 1 donum=25 olk

# Units of Area

- Example :
- $25360.22\text{m}^2$
- $25360.22/10,000=2.536022$  hectare    2hac
- $5360.22/2500=2.144088$  donum    2 donum
- $360.22/100=3.6022$  olk    3 olk
- 60.22  $\text{m}^2$
- 2hac, 2 donum, 3 olk , 60.22  $\text{m}^2$

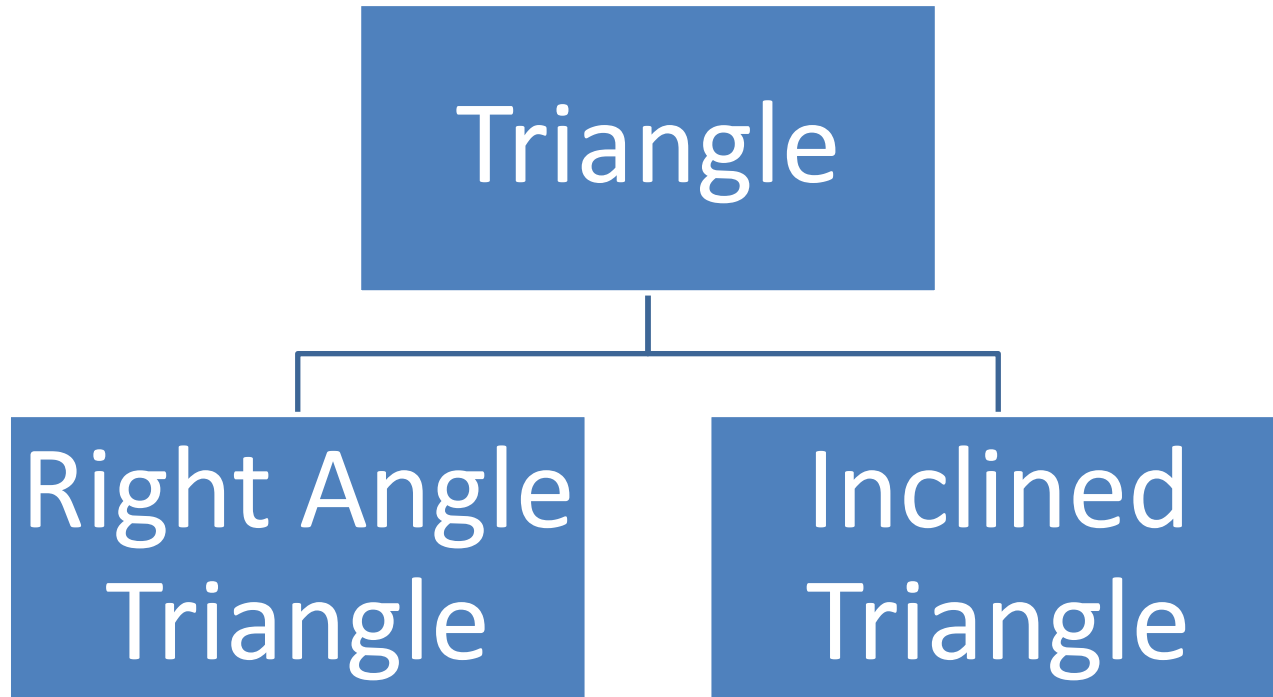
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graph TD; A[Area] --> B[Uniform Area]; A --> C[Non-Uniform Area]
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Area

Uniform  
Area

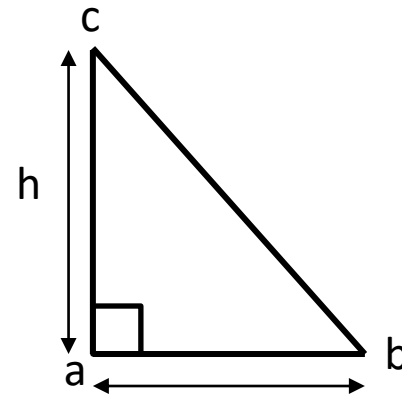
Non-Uniform  
Area

# Uniform Area \ Triangle



# Uniform Area \ Triangle

- Area of Right Angle Triangle
- $A = \frac{1}{2}( ab * ac )$
- $Ac = h$



$h$ : يمثل الارتفاع العمودي على القاعدة او امتدادها

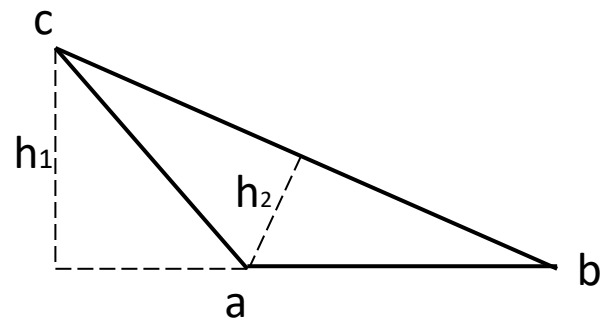
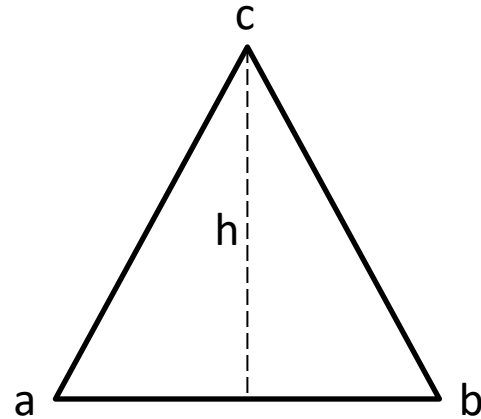
# Uniform Area \ Triangle

- Area of Inclined Triangle

- $A = \frac{1}{2}(ab * h)$

- $A = \frac{1}{2}( ab * h_1)$

- $A = \frac{1}{2}( cb * h_2)$



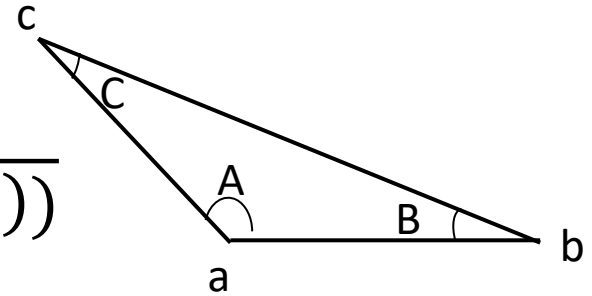
$h$ : يمثل الارتفاع العمودي على القاعدة او امتدادها

# Area of Inclined Triangle

- قانون نصف المحيط

- $$S = \frac{(ab) + (bc) + (ca)}{2}$$

- $$A = \sqrt{s(s - (ab))(s - (bc))(s - (ca))}$$



$$\frac{(bc)}{\sin A} = \frac{(ca)}{\sin B} = \frac{(ab)}{\sin C}$$

$$(ab)^2 = (bc)^2 + (ca)^2 - 2(bc)(ca)\cos(C)$$

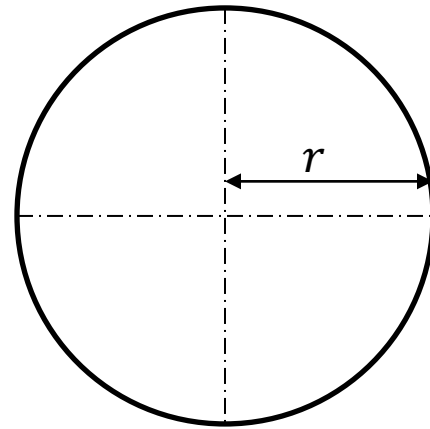
$$(bc)^2 = (ab)^2 + (ca)^2 - 2(ab)(ca)\cos(A)$$

$$(ca)^2 = (ab)^2 + (bc)^2 - 2(ab)(bc)\cos(B)$$



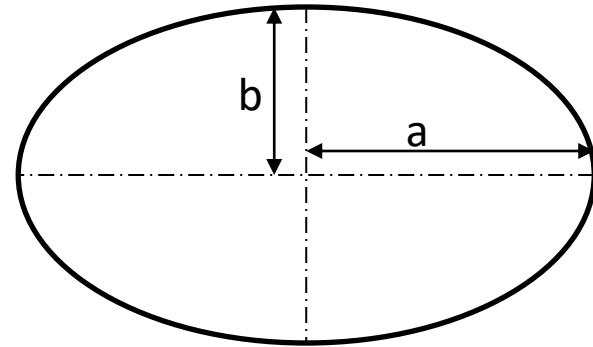
# Uniform Area \ Circle

$$A = \pi r^2$$



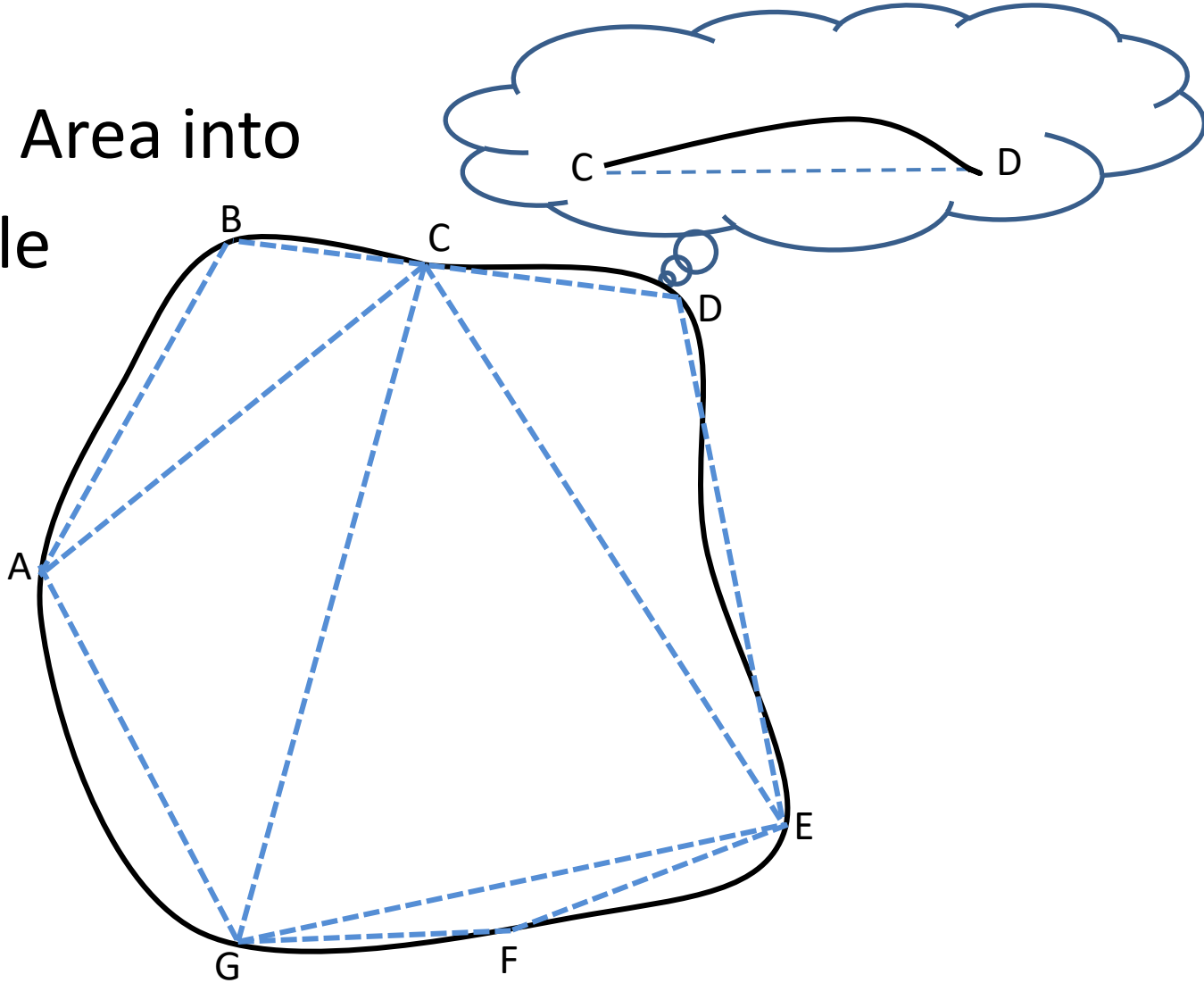
# Uniform Area \ Ellipse

- $A = \pi(a)(b)$



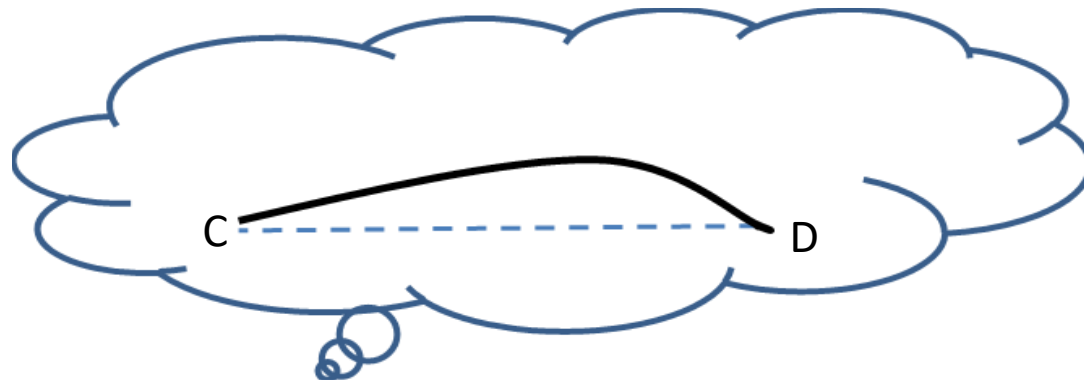
# Non-Uniform Area

Divide Area into  
Triangle



# Non-Uniform Area

Setting out offsets on a line

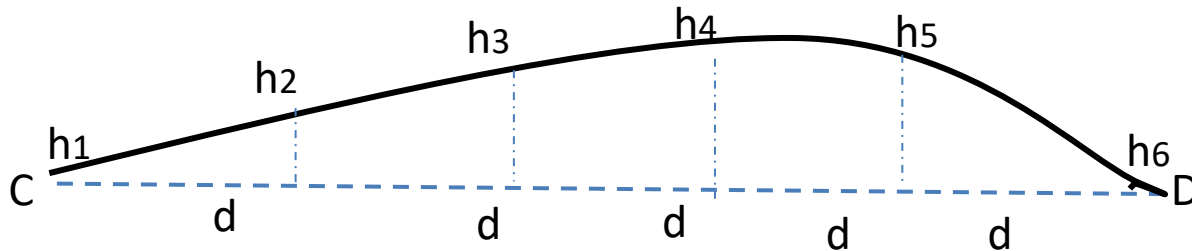


Setting out offsets on a line at regular interval

Setting out offsets on a line at irregular interval

# Non-Uniform Area

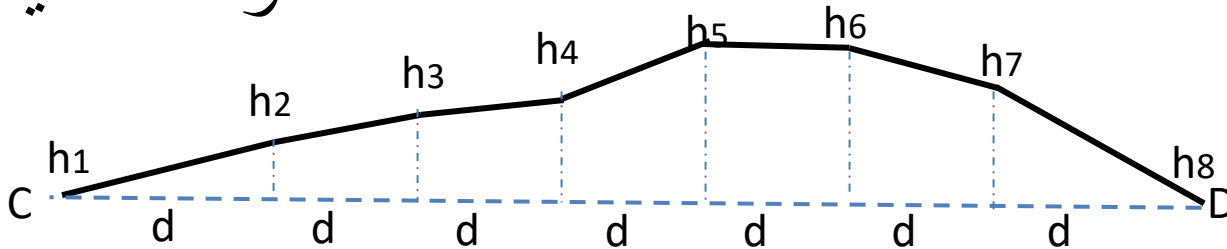
- Setting out offsets on a line at regular interval
  1. Average offsets formula باستخدام هذه الصيغة يتم حساب المساحة بصورة تقريبية



- $$A = \frac{[h_1 + h_2 + h_3 + \dots + h_n]}{n} * (n - 1)d$$

# Non-Uniform Area

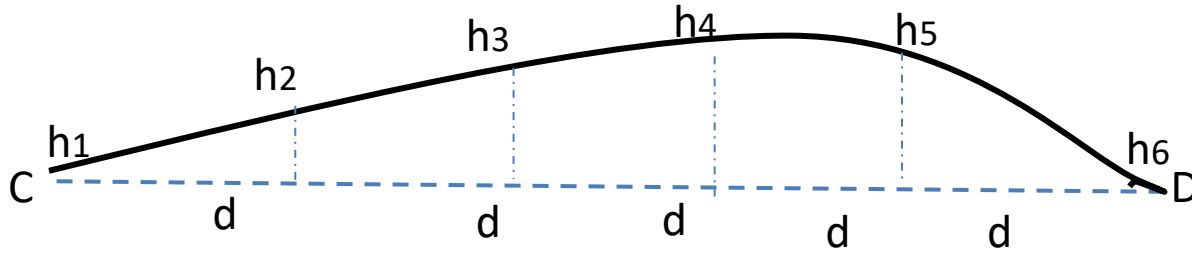
2. Trapezoidal Rule باستخدام هذه القاعدة يتم حساب المساحة بصورة دقيقة لكن من شروطها ان تكون حدود القطعة خطوط مستقيمة



- $$A = d \left[ \frac{h_1 + h_n}{2} + h_2 + h_3 + \dots + h_{(n-1)} \right]$$

# Non-Uniform Area

3. Simpson's Rule باستخدام هذه القاعدة يتم حساب المساحة بصورة اذق من سابقاتها لكن من شروطها ان تكون حدود القطعة غير منتظمة وعلى شكل اقواس او منحنيات وتطبق لعدد فردي من الاعمدة

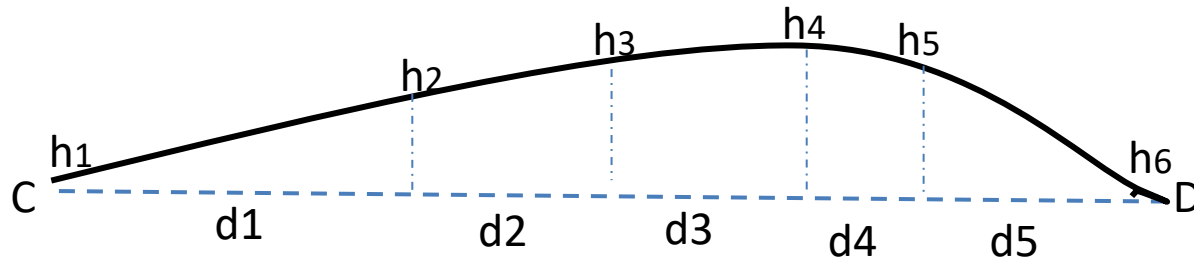


$$A = \frac{d}{3} [h_1 + h_n + 4(\sum h(\text{even})) + 2(\sum h(\text{odd}))]$$

ملاحظة مهمة : عند جمع الاعمدة الفردية لا يتم جمع العمود الاول والاخير وفي الشكل السابق المثلث الاخير يحسب على حده لان القانون يطبق على عدد فردي من الاعمدة

# Non-Uniform Area

- Setting out offsets on a line at irregular interval
1. Using Special law

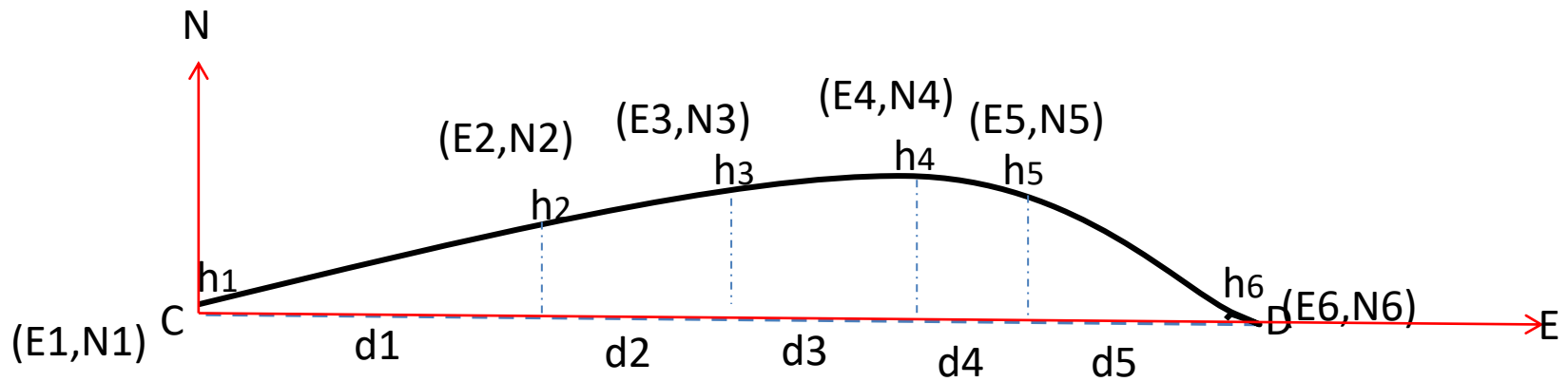


- $2A = [d_1(h_1 - h_3)] + [(d_1 + d_2)(h_2 - h_4)]$   
+  $[(d_1 + d_2 + d_3)(h_3 - h_5)] + [(d_1 + d_2 + d_3 + d_4)(h_4 - h_6)]$   
+  $[(d_1 + d_2 + d_3 + d_4 + d_5)(h_5 + h_6)]$
- $A = |2A/2|$

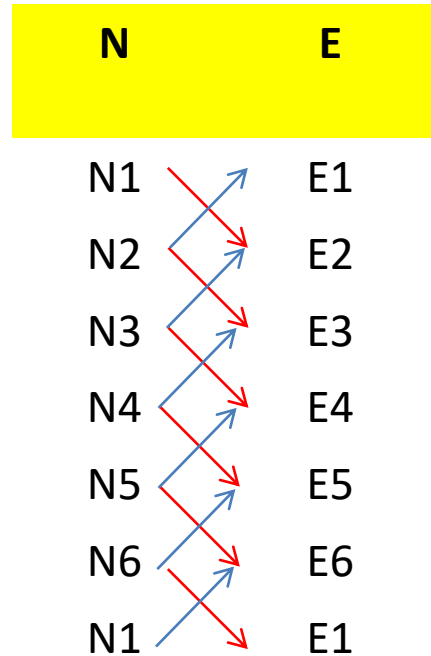


# Non-Uniform Area

## 2. Using Coordinate



# Non-Uniform Area



$$2A = (N1E2 + N2E3 + N3E4 + N4E5 + N5E6 + N6E1) - (N2E1 + N3E2 + N4E3 + N5E4 + N6E5 + N1E6)$$

$$A = |2A/2|$$

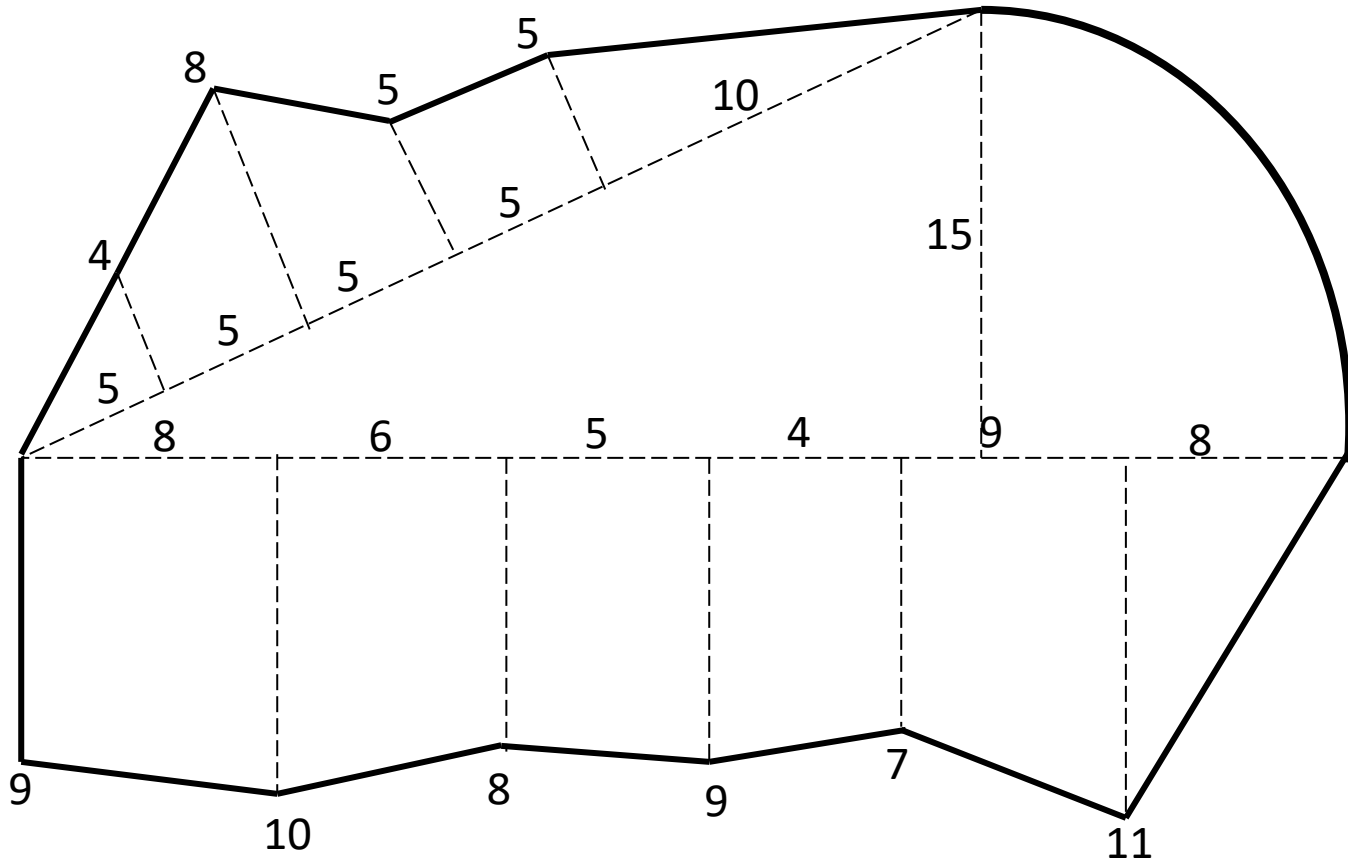
# Non-Uniform Area

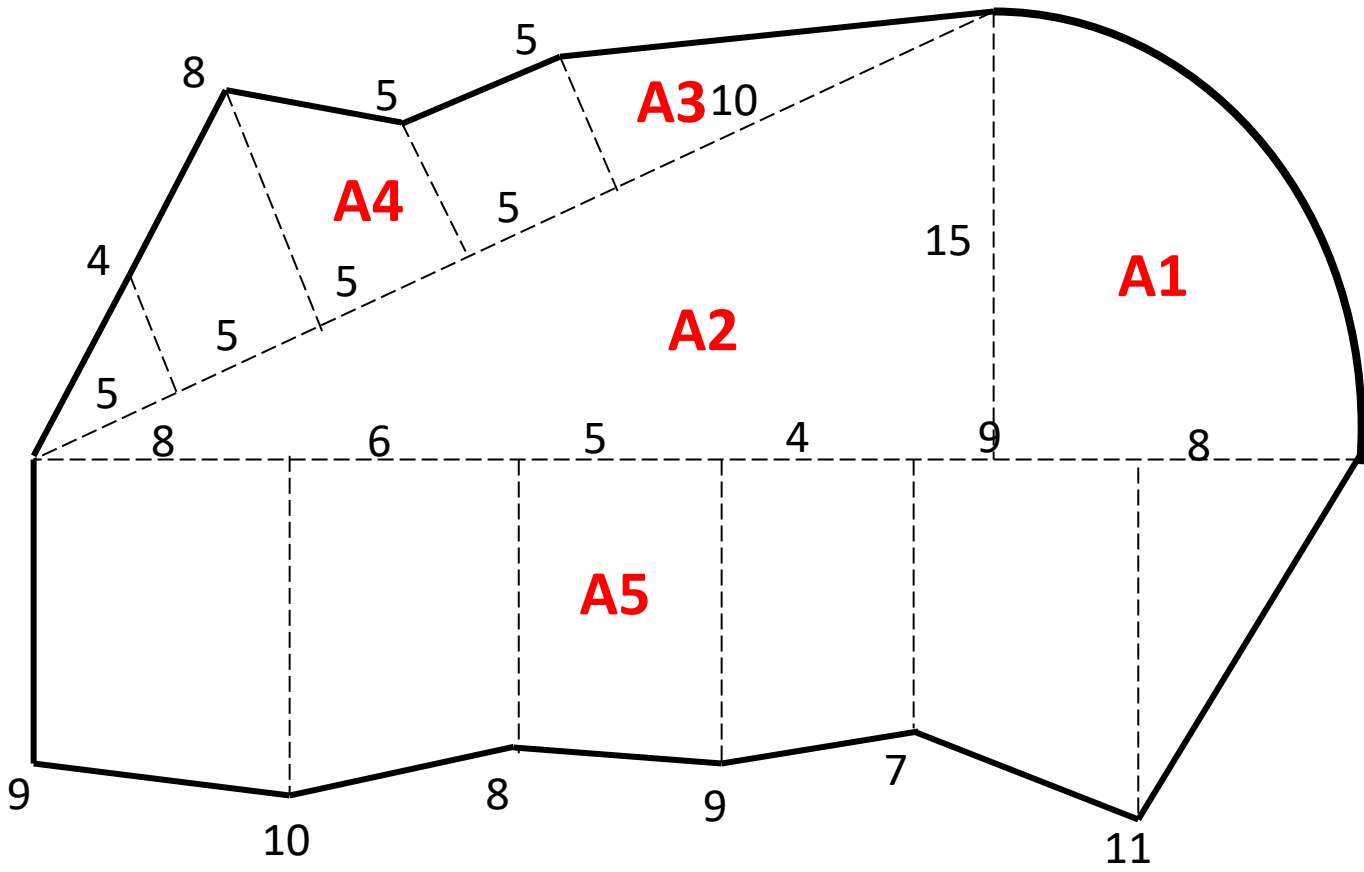
## 3. Using Double – Meridian – Distance Method (D.M.D Method)

توضح الطريقة مباشرةً بأستخدام جدول على المثال التالي

# Example

Compute the area of the following figure (all dimensions are in meters)





# Solution

- $A = \pi r^2$

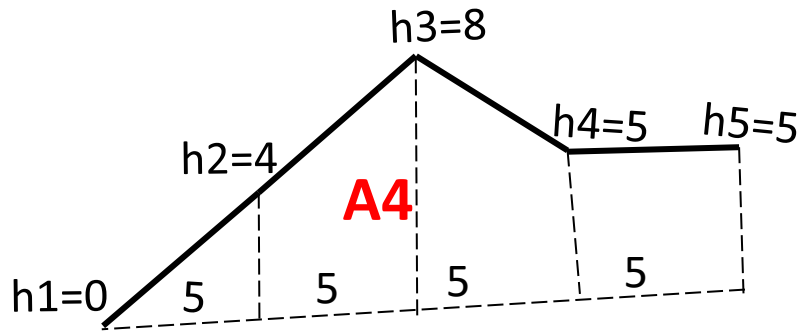
$$A1 = \frac{\pi(15)^2}{4} = 176.71 \text{ m}^2$$

$$s = \frac{(15)+(25)+(30)}{2} = 35 \text{ m}$$

$$A2 = \sqrt{35(35 - (15))(35 - (25))(35 - (30))} = 187.08 \text{ m}^2$$

$$A = \frac{1}{2}(ab*ac)$$

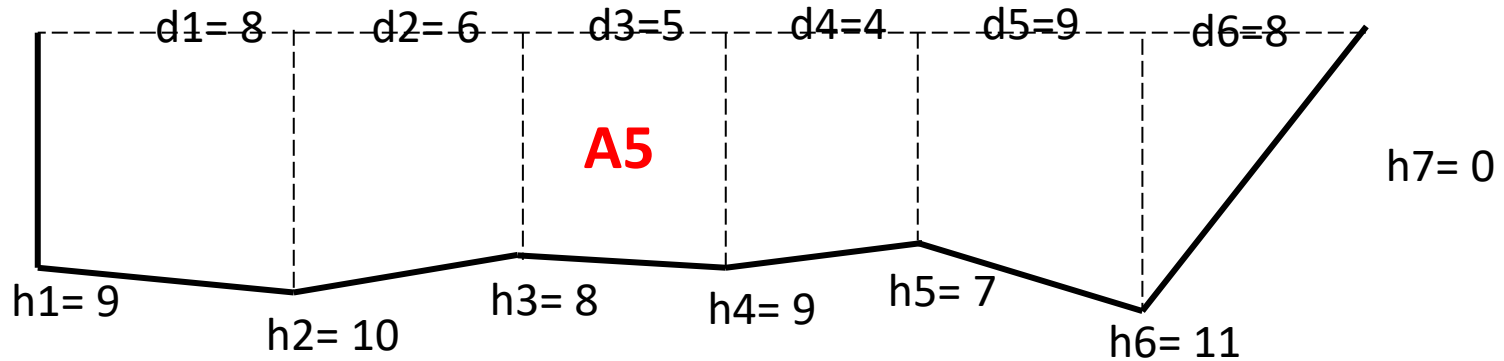
$$A3 = \frac{1}{2}(10*5) = 25 \text{ m}^2$$



$$d = 5$$

$$A = d \left[ \frac{h_1 + h_5}{2} + h_2 + h_3 + h_4 \right]$$

$$A_4 = 5 \left[ \frac{0+5}{2} + 4 + 8 + 5 \right] = 97.5 \text{m}^2$$



$$2A = [d_1(h_1 - h_3)] + [(d_1+d_2)(h_2 - h_4)] + [(d_1+d_2+d_3)(h_3 - h_5)] \\ + [(d_1+d_2+d_3+d_4)(h_4 - h_6)] + [(d_1+d_2+d_3+d_4+d_5)(h_5 - h_7)] \\ + [(d_1+d_2+d_3+d_4+d_5+d_6)(h_6 + h_7)]$$

$$2A_5 = [8(9 - 8)] + [(14)(10 - 9)] + [(19)(8 - 7)] + [(23)(9 - 11)] \\ + [(32)(7 - 0)] + [(40)(11 + 0)] = 659 \text{ m}^2$$

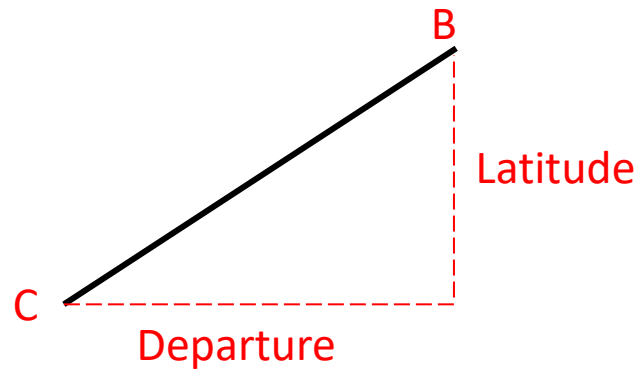
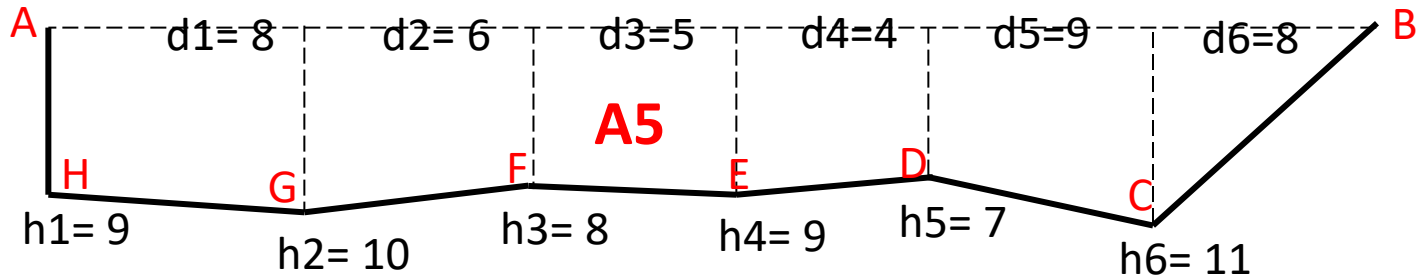
$$A_5 = 329.5 \text{ m}^2$$

$$A \text{ Total} = A_1 + A_2 + A_3 + A_4 + A_5$$

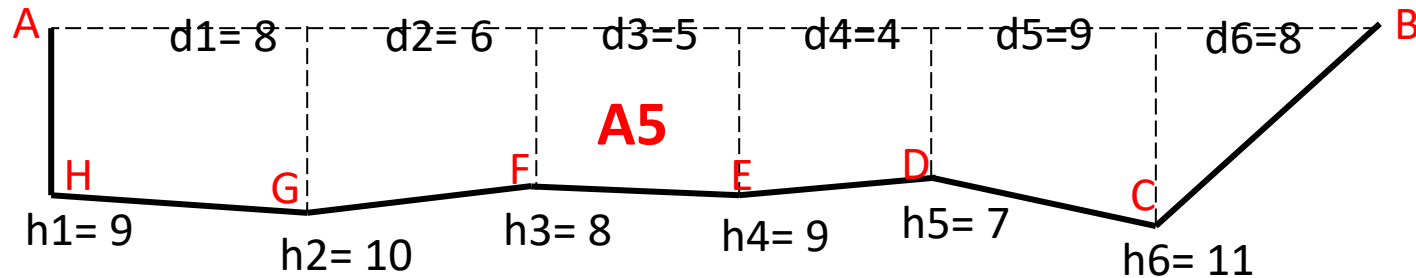
$$A \text{ Total} = 815.79 \text{ m}^2 \quad \text{8 olk } 15.79 \text{ m}^2$$



# (D.M.D Method)



# (D.M.D Method)



side	Dep.	D.M.D	Lat.	2A
AB	+40		0	
BC	-8		-11	
CD	-9		+4	
DE	-4		-2	
EF	-5		+1	
FG	-6		-2	
GH	-8		+1	
HA	0		+9	
$\Sigma$	0.00		0.00	

# (D.M.D Method)

side	Dep	D.M.D	Lat.	2A
AB	+40	+40	0	0
BC	-8	+72	-11	-792
CD	-9	+55	+4	+220
DE	-4	+42	-2	-84
EF	-5	+33	+1	+33
FG	-6	+22	-2	-44
GH	-8	+8	+1	+8
HA	0	0	+9	0
$\Sigma$	0.00		0.00	-659

$$A = |2A/2|$$

$$A = 329.5 \text{ m}^2$$

$A_{\text{Total}} = A_1 + A_2 - A_3 - A_4 + A_5$

$A_{\text{Total}} = 570.79 \text{ m}^2$

5 olk 70.79 m<sup>2</sup>

