Concrete Works

اعمال الخرسانة

Concrete is a combination of three main materials; cement, sand and gravel, if the mixing of these three components mixed with water to prepare the concrete, the mixture loses about a **third** of its total volume. The mix usually based on volumetric proportions, and as following:

الخرسانة عبارة عن مزيج من ثلاث مواد رئيسية هي الأسمنت والرمل والحصى، فإذا تم خلط هذه المكونات الثلاثة مع الماء لتحضير الخرسانة فإن الخليط يفقد حوالي ثلث حجمه الإجمالي، وعادة ما يعتمد الخليط على النسب الحجمية، وكما يلي:

Cement **C**	**Sand** **S**	**Gravel** **G**
1	**1**	**2**
1	**1.5**	**3**
1	**2**	**4**
1	**3**	**6**
1	**4**	**8**

Volume of concrete = 0.67(C + S + G)

The number 0.67 indicates a contraction in the volume of concrete components after the water addition, this contraction is about third of the volume or 0.33. Accordingly, the net volume after volume reduction is two-thirds total volume before the mixing process or approximately 0.67 of the total volume.

يشير الرقم ٠.٦٧ إلى انكماش في حجم مكونات الخرسانة بعد إضافة الماء، وهذا الانكماش يبلغ حوالي ثلث الحجم أو ٠.٣٣. وعليه فإن الحجم الصافي بعد تقليص الحجم يبلغ ثلثي الحجم الإجمالي قبل عملية الخلط أو ما يقرب من ٠.٦٧ من الحجم الإجمالي.

Example: Compute the quantity of materials required for 1 m3 of concrete (cement, sand, gravel). Assume mix proportion (1:2:4).

Solution :-

Volume of concrete = 0.67 (C + S + G)

1.0 = 0.67 (C + 2C + 4C)

1 = 0.67 (7C) → C = 0.213 m^3

Weight of cement = Volume *x* Density = 0.213 *x* 1400 = 298.2 kg ≈ 300 kg

C = 6.0 sacks

S = 2 *x* 0.213 = 0.426 m^3

G =4 *x* 0.213 = 0.852 m^3

Example: Compute the quantity of materials required for 1 m3 of concrete (cement, sand, gravel). Assume mix proportion (1:1.5:3).

Solution :-

Volume of concrete = 0.67 (C + S + G)

1.0 = 0.67 (1C + 1.5C + 3C)

1 = 0.67 (5.5C) → C = 0.271 m3

Weight of cement = Volume *x* Density = 0.271*x* 1400 = 298.2 kg ≈ 379 kg

C = 379 kg

S = 1.5 *x* 0.271 = 0.41 m^3

G =3 *x* 0.271 = 0.81 m^3

Example: Estimate the amount of cement in tons, gravel and sand in cubic meters needed to cast 30 columns of height 4.5 m, note that the section of the column is square and each side 30 cm, the mixing ratio of 1:1.5:3.

Solution

Volume = (0.3 x 0.3 x 4.5) x 30 = 12.15 m^3

Volume of concrete = 0.67 (C + S + G)

12.15= 0.67 (C + 1.5C + 3C) C = 3.3 m^3

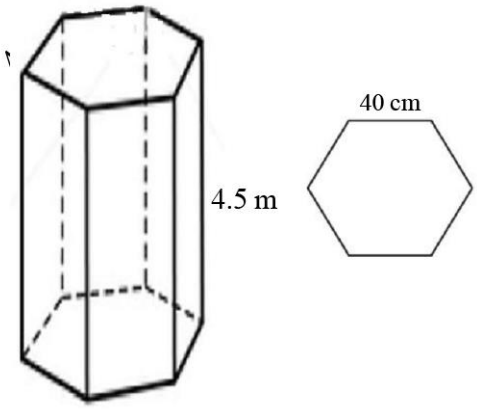
Weight of cement = Volume x Density = 3.3 x 1400 = 4620

C = 4.62 tons

S =1.5 C= 4.95 m^3

G= 3C = 9.9 m^3

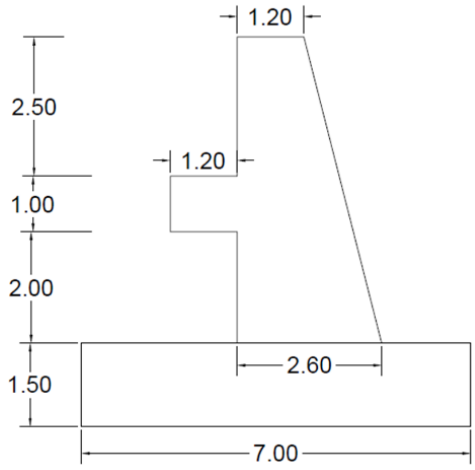
H.W.: Estimate the amount of cement in tons, gravel and sand in cubic meters needed to cast 30 columns of height 4.5 m, note that the section of the column is hexagonal and each side 40 cm, the mixing ratio of 1:1.5:3.



The area of hexagon is:-

$(3\sqrt{3}\ s^2)/2$, where 's' is the length of the side of the hexagon.

Example: Estimate the amount of construction materials needed to construct the retaining wall shown in the figure, knowing that the length of the wall 22 m and the mixing ratio is 1:1.5:3.



Solution:

Area = (7x 1.5) + (1.2 x 1) + ((1.2+2.62)/2 x 5.5) = 22.15 m2

Volume = 22.15 x 22 = 487.3 m3

Volume of concrete = 0.67 (C + S + G)

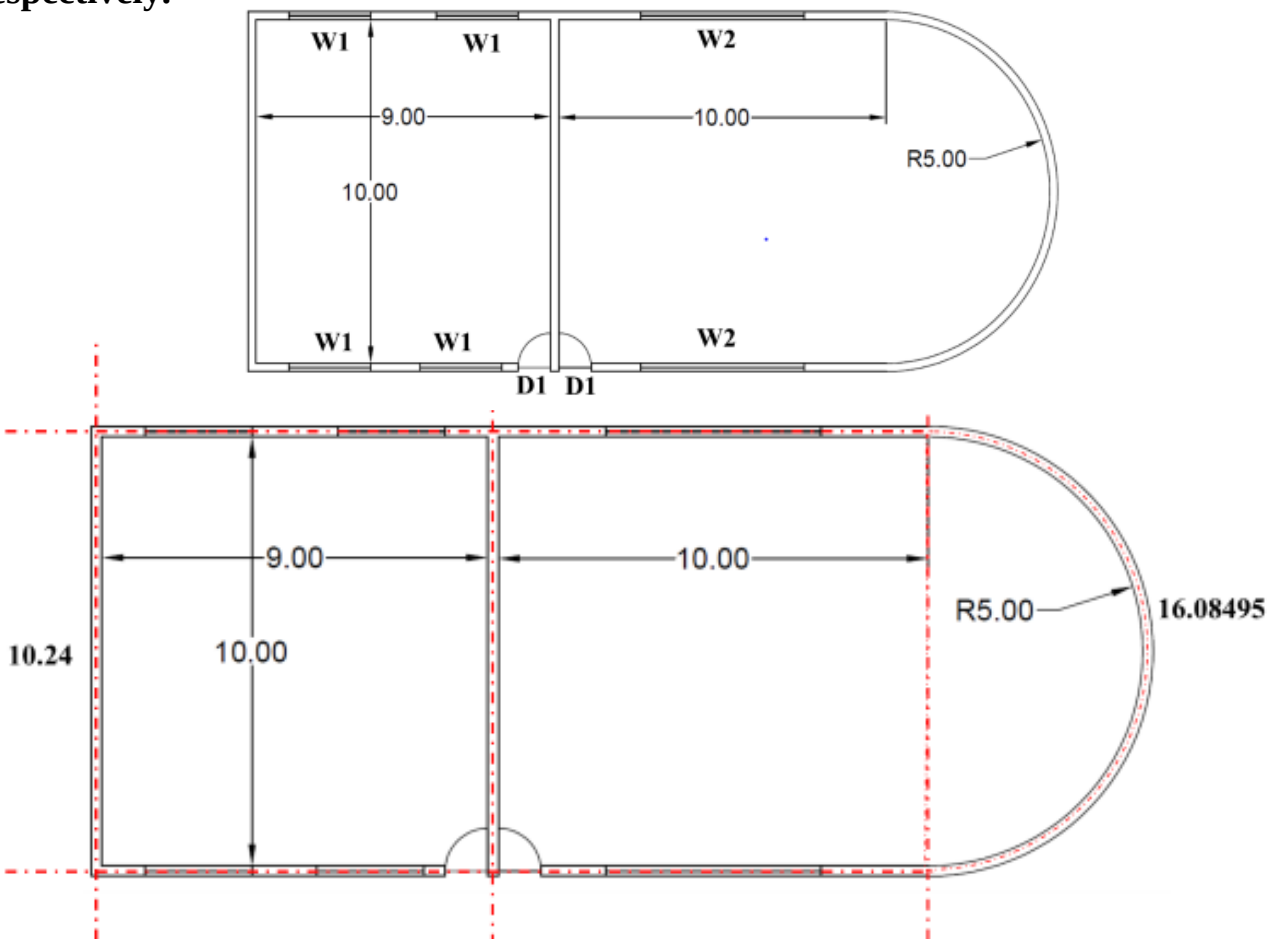
487.3 = 0.67 (C + 1.5C + 3C) C = 132.239 m3

C = 185.135 tons

S = 1.5C = 198.36 m3

G= 3C= 396.72 m3

Example: Calculate the concrete quantities of the foundation for the plan shown in figure: mixing ratio (1:1.5:3). Width and depth of foundation 0.7 m and 0.45 m respectively.



Length c/c = 10.24(2) +9.24(2) +10.12(2) +16.0768=75.276 m
Total length = Length c/c – 2 (T) x width of foundation/2
Total length = 75.276 – 2(0.70/2) = 74.576 m
Volume = 74.576 x 0. 7 x 0. 45 = 23.491 m3

Volume of concrete = 0.67 (C + S + G)

23.491=0.67(1C+1.5C+ 3C)

23.491 =0.67 x5.5C

C=23.491/0.67 x5.5

C (cement) = 6.374m^3

C= 1400 x 6.374 =8923.6 kg---------- 8.924 tons

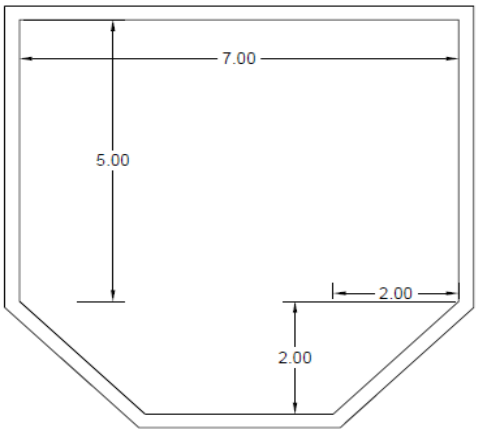
S (Sand) = 1.5 C

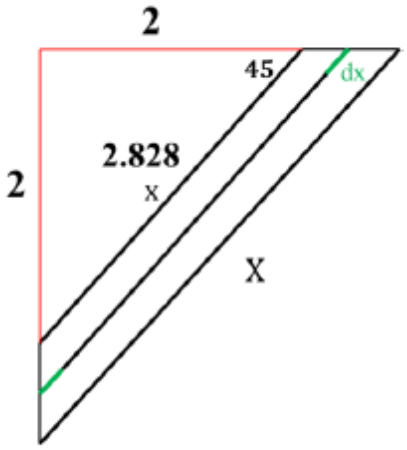
S= 1.5 x 6.374= 9.561 m^3

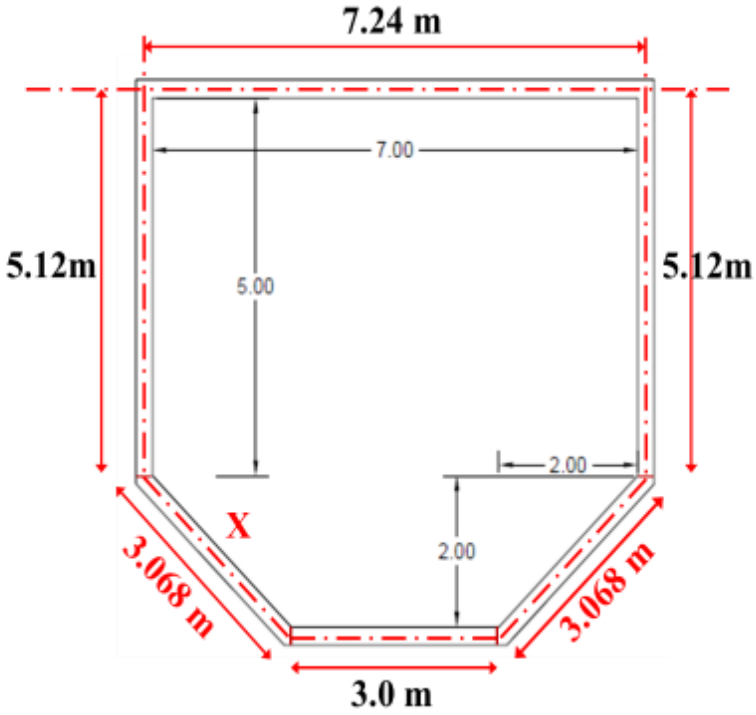
G (gravel) = 3C

G = 3 x 6.374 =19.122 m^3

H.W: Calculate the concrete quantities of the foundation for the plan shown in figure: mixing ratio (1:3:6). Width and depth of foundation 0.9 m and 0.25 m respectively. Width of walls = 24 cm.







Solution:

x=$\sqrt{2^2+2^2}$= 2.828 m

tan (45) = $dx/0.12$ tan (45) =1

dx = 0.12 m

X = 2.828 + 0.12 × 0.12 = 3.068 m

Length c/c =7.24 + 5.12(2) + 3.068(2) + 3 = 26.616 m

Another solution: -

$$X = \sqrt{(2+0.12)^2} + \sqrt{(2+0.12)^2} = 2.998\text{m}$$

Length c/c = 7.24 + 5.12(2) + 2.998(2) +3 = 26.476 m

The quantity of concrete: -

26.476 x 0.90 x 0.25 = 5.957 m^3

Volume of concrete = 0.67 (C + S + G)

5.957= 0.67 (1C+1.5C+ 3C)

5.957 =0.67 x5.5C

C=5.957/0.67 x5.5

C (cement) = 1.62 m^3

C= 1400 x 1.62 =2268 kg---------- 2.268 tons

S (Sand) = 1.5 C

S= 1.5 x 1.62= 2.43 m^3

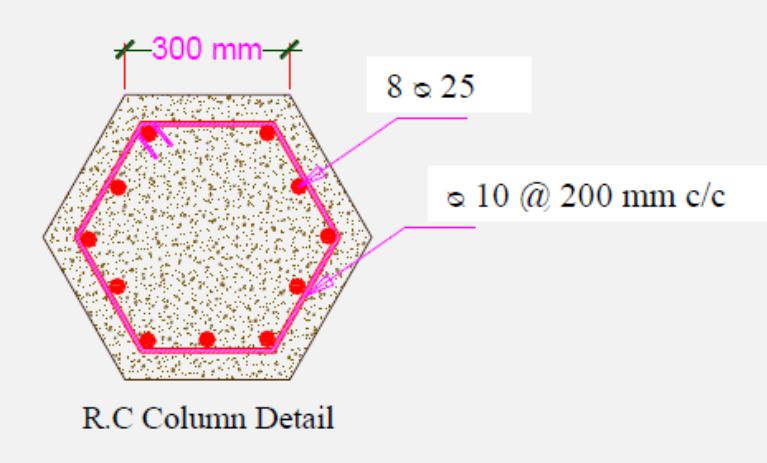
G (gravel) = 3C

G = 3 x 1.62 =4.86 m^3

Example: -

(Estimate the amount of cement in tons and gravel and sand in cubic meters needed to cast 30 columns. Hight is 4.5 m

(خمن كمية السمنت بالطن والحصى والرمل بالمتر المكعب اللازمة لصب 30 عموداً)



R.C Column Detail

$$Vol. = 30 * 6 * \frac{\sqrt{3}}{4} * 0.3^2 * 4.5 = 31.567 \text{ m}^3$$

$$31.567 = 0.67(C+1.5C+3C)$$

$$C=8.567 \text{ m}^3$$

$$\text{سمنت} = \frac{8.567 * 1400}{1000} = 11.99 \text{ ton}$$

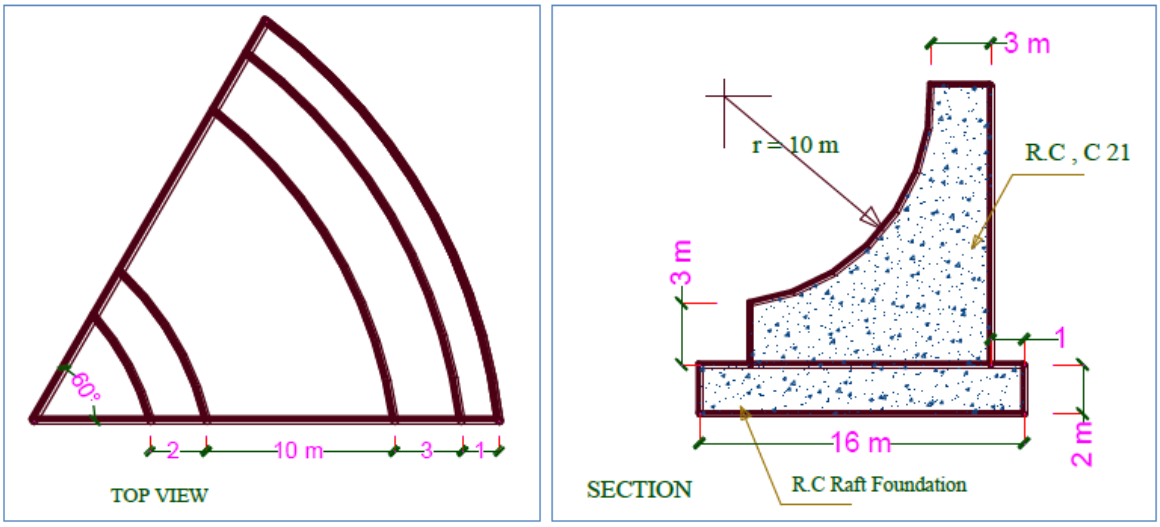
$$\text{رمل} = 1.5C = 1.5*8.567 = 12.85 \text{ m}^3$$

$$\text{حصى} = 3C = 3*8.567 = 25.69 \text{ m}^3$$

Example :- figure below represents a section of a small concrete dam and Figure (B) represents the projection of the dam at the construction site.

Estimate the amount of construction materials needed to build the dam with a mixing ratio of 1:2:4.

يمثل الشكل الأول مقطعا في سد خرساني مسلح ،الشكل الثاني يمثل منظور راسي لمقطع السد



Solution:-

$$A = 16*2 + 13^2 - \frac{\pi*10^2}{4} = 122.46\ m^2$$

$$A*\bar{x} = \sum ax$$

$$122.46*\bar{x} = 16*2*8 + 13^2*8.5 - \frac{\pi*10^2}{4}*(0.424*10+2)$$

$$\therefore \bar{x} = 9.819\,m$$

$$Vol. = S*\theta*A = (20+9.819)*\frac{60*\pi}{180}*12246 = 3823.983\,m^3$$

$$cement = \frac{3823.983*300}{1000} = 1147.194\,ton$$

$$sand = 3823.983*0.5 \cong 1912\,m^3$$

$$gravel = 3823.983*1 \cong 3824\,m^3$$