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Introduction -> Dams are constructed in order to store large quantities of water for the purpose of irrigation and power generation. These are two types of dams based on shape.

i) Rectangular

ii) Trapezoidal.

Forces acting on the dam structure.

-> Self weight of the dam.
-> Water pressure.
-> Uplift pressure.
-> Silt pressure.
-> Wave pressure.
-> Ice pressure.
-> Pressure due to earthquake force.

Various modes of failure of dam.

1) Overturning -> If the resultant force acting on a dam passes through the toe of the dam, the dam will rotate and overturn about the toe.

2) Sliding -> If the net horizontal forces acting on the base exceeds frictional resistance of the dam, it causes sliding.

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3) Tension → Masonry & concrete are weak in tension so that they are usually designed in such a way that there is no tension anywhere.

Problems:-

1) A retaining wall 6 m high & 2.5 m wide retains water upto its top. Find the total pressure per meter length of the wall & the point at which the resultant cuts the base. Also find the resultant thrust on the base of the wall per meter length. Assume weight of masonry as 23 KN/m³.

Given:-

Height of retaining wall, $H = 6m$

weight of retaining wall, $b = 2.5m$

weight of masonry $(\rho) = 23\ KN/m^3$

Weight of water $(w) = 9.81\ KN/m^3$

→ Total pressure per meter length of the wall.

$$P = \frac{wH^2}{2} = \frac{9.81 \times 6^2}{2} = 176.6\ KN$$

→ Points at which the resultant cuts the base

$$W = 23 \times 6 \times 2.5 = \rho \times H \times b = 345\ KN.$$

→ Distance b/w the mid-point (M) of the wall & the point where resultant cuts the base (R).

$$\bar{x} = \frac{P}{W} \times \frac{H}{3} = \frac{176.6}{345} \times \frac{6}{3} = 1.02\ m.$$

→ Resultant thrust on the base of the wall per meter length

$$R = \sqrt{P^2 + W^2} = \sqrt{(176.6)^2 + 345^2} = 387.6\ m$$

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26 A concrete dam having water on vertical face is 16 m high. The base of the dam is 8m wide and top 3 m wide. Find the resultant thrust on the base per meter length of the dam & the point of where it intersects the base, where it contains water 16 m deep. Take weight of the concrete as 23 KN/m^3.

Given:-

H = Height of dam = 20 m

b = Base width = 8 m

a = Top width = 3 m

h = Depth of water = 16 m.

weight of concrete = 24 KN/m^3.

→ Resultant thrust on the base per meter length of the dam

$$P = \frac{wH^2}{2} = \frac{9.81 \times 16^2}{2} = 1257.7 \text{ KN}$$

→ Weight per meter length of the dam

$$W = 24 \times \frac{(8+3)}{2} \times 20 = 2640 \text{ KN}.$$

→ Resultant thrust on the base per meter length of the dam

$$R = \sqrt{P^2 + W^2} = \sqrt{(1255.7)^2 + (2640)^2}$$

$$= 2923.4 \text{ KN}$$

$$\rightarrow \bar{x} = \frac{a^2 + ab + b^2}{3(a+b)} = \frac{3^2 + (3 \times 8) + 8^2}{3(3+8)} = 2.94 \text{ m}$$

$$\rightarrow Z = \bar{x} + \frac{h}{3} \times \frac{P}{W} = 2.94 + \frac{16}{3} \times \frac{1257.7}{2640} = 5.48 \text{ m}$$

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3) A masonry retaining wall, trapezoidal in section, with on face vertical is 1m wide at top & 3m at the base & 8m high. The material retained on the vertical face exerts a lateral pressure varying from zero at top to 25 kN/m² at the base. If the unit weight of masonry is 21 kN/m, calculate the maximum & minimum stress intensities.

Given :-

$a = 1m$

$b = 3 m$

$H = 8 m$

$\gamma_{oh} = 21 \ kN/m^3$

$w = 10 \ kN/m^3$

lateral pressure $= 25 \ kN/m^2$

→ Weight of the dam per unit weight $\cdot W = \rho \times \left(\frac{a+b}{2}\right) H$

$= 21 \times \left(\frac{1+3}{2}\right) \times 8 = 336 \ kN$

→ Total pressure per unit length of the dam.

p = Total lateral thrust $p = \frac{1}{2} \times 25 \times 8 = 100 \ kN$

→ $\bar{x} = \frac{a^2 + ab + b^2}{2(a+b)} = \frac{1^2 + (3 \times 1) + 3^2}{2(1+3)} = 1.083 \ m.$

→ $Z = \bar{x} + \frac{h}{3} \times \frac{P}{W} = 1.083 + \frac{8}{3} \times \frac{100}{336} = 1.877 \ m$

→ Eccentricity $= Z - \frac{b}{2} = 1.877 - \frac{3}{2} = 0.377 \ m$

→ Max. intensity of pressure at base

$P_{max} = \frac{W}{b}\left(1 + \frac{6e}{b}\right) = \frac{336}{3}\left(1 + \frac{6 \times 0.377}{3}\right) =$

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$= 196.444\ KN/m^2$

Min. Intensity of pressure at base

$$P_{min} = \frac{W}{b}\left(1 - \frac{6e}{b}\right) = \frac{336}{3}\left(1 - \frac{6 \times 0.377}{3}\right)$$

$$= 27.556\ KN/m^2.$$

4) A masonry dam 1.2 m wide at top & 3.2 m wide at bottom & 5 m high. It has vertical water face exposed to water. If the water is likely to rise to the top of the dam calculate the max & min pressure at the base when the dam is full & when the dam is empty. Take density of masonry = 22.4 KN/m³. Density of water = 10 KN/m³. Draw the stress intensity diagram for both cases.

Given:-

$a = 1.2$ m

$b = 3.2$ m

$H = 5$ m

$\rho = 22.4\ KN/m^3$

$w = 10\ KN/m^3$

-> Weight of the dam per unit length

$$W = \rho\left(\frac{a+b}{2}\right)H = 246.4\ KN.$$

-> Total pressure per unit length of the dam

$$P = \frac{wh^2}{2} = \frac{10 \times 5^2}{2} = 125\ KN$$

$$\to \bar{x} = \frac{a^2 + ab + b^2}{3(a+b)} = \frac{1.2^2 + (1.2 \times 3.2) + 3.2^2}{3(1.2+3.2)}$$

$$= 1.18 m$$

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$\rightarrow \; x = \bar{x} + \frac{h}{3} \times \frac{P}{W} = 1.18 + \frac{5}{3} \times \frac{125}{246.4}$

$= 2.02 \text{ m}$

For full when reservoir full.

eccentricity $e = x - \frac{b}{2} = 2.02 - \frac{3.2}{2} = 0.421$

Max. pressure intensity

$P_{max} = \frac{W}{b}\left(1 + \frac{6e}{b}\right) = \frac{246.4}{3.2}\left(1 + \frac{6 \times 0.42}{3.2}\right)$

$= 137.82 \text{ KN/m}^2.$

Min pressure intensity

$P_{min} = \frac{W}{b}\left(1 - \frac{6e}{b}\right) = 16.18 \text{ KN/m}^2.$

$\rightarrow$ When reservoir empty.

eccentricity $= e = \frac{b}{2} - \bar{x} = 0.422\text{m}.$

$P_{max} = 138.25 \text{ KN/m}^2$

$P_{min} = 15.75 \text{ kN/m}^2$

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5) A masonry dam 2m wide at top & 7 m wide at bottom & 16m high. Water imposed up to a height of 15m, the water face being vertical. Determine the normal stress intensity at the base, both when the dam is empty & full. Take density of masonry = 22.4 kN/m³. Density of water = 10 kN/m³. Draw the stress intensity diagram for both case.

Given:-

$a = 2$ m

$b = 7$ m

$H = 16$ m

$h = 15$ m

roh $= 24$ kN/m³

$w = 10$ kN/m³

i) Weight of the dam per unit weight $W = \rho \times \left(\frac{a+b}{2}\right) \times H$

$$= 24 \times \left(\frac{2+7}{2}\right) \times 16 = 1728 \text{ kN}$$

-> Total pressure per unit length of the dam

$$P = \frac{wh^2}{2} = \frac{10 \times 15^2}{2} = 1125 \text{ kN}.$$

-> $$\bar{x} = \frac{a^2 + ab + b^2}{3(a+b)} = 2.48 \text{ m}$$

-> $$Z = \bar{x} + \frac{h}{3} \times \frac{P}{W} = 2.48 + \frac{15}{3} \times \frac{1125}{1728} = 5.74.$$

• When reservoir is full.

-> Eccentricity $(e) = Z - \frac{b}{2} = 5.74 - \frac{7}{2} = 2.24$ m.

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$$P_{max} = \frac{W}{b}\left(1 + \frac{6e}{b}\right) = 720.12 \ KN/m^2$$

$$P_{min} = \frac{W}{b}\left(1 - \frac{6e}{b}\right) = -226.41 \ KN/m^2$$

when reservoir is empty.

$$e = \frac{b}{2} - \bar{x} = \frac{7}{2} - 2.48 = 1.02 \ m$$

$$P_{max} = 462.68 \ KN/m^2$$
$$P_{min} = 31.03 \ KN/m^2$$

6) A masonry dam of trapezoidal section having water on vertical face is 16 m high. The base of the dam is 8 m wide & top 3 m wide.
Find.
1) Resultant thrust on the base per metre length of the dam.
2) Point, where resultant thrust cuts the base.
3) The intensity of max & min stress across the base.
Take weight of masonry 25 KN/m³ & that of water 10 KN/m³. Assume water may rise upto the top of the dam

Given

$a = 3 \ m$

$b = 8 \ m$

$H = 16 \ m$

$\rho = 25 \ KN/m^3$

$w = 10 \ KN/m^3$

→ Weight of the dam per unit weight $(W) = \rho \times \left(\frac{a+b}{2}\right) \times H$

$W = 2200 \ KN$.

P_{min} = ...

6) A masonry dam of trapezoidal section having water on vertical face is 16 m high. The base of the dam is 8 m wide & top 3 m wide.

Find.

1) Resultant thrust on the base per metre length of the dam.

2) Point, where resultant thrust cuts the base.

3) The intensity of max & min stress across the base.

Take weight of masonry 25 KN/m³ & that of water 10 KN/m³. Assume water may rise upto the top of the dam.

Given

$a = 3\ m$

$b = 8\ m$

$H = 16\ m$

$\gamma_{ob} = 25\ KN/m^3$

$w = 10\ KN/m^3$

→ Weight of the dam per unit weight $(W) = \rho \times \left(\frac{a+b}{2}\right) \times H$

$W = 2200\ KN.$

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→ Total pressure per unit unit length of the dam

$$P = \frac{wh^2}{2} = \frac{10 \times 16^2}{2} = 1280\ KN.$$

→ Resultant $(R) = \sqrt{P^2 + W^2} = \sqrt{1280^2 + 2200^2}$

$= 2545.27\ KN$

→ $\bar{x} = \dfrac{a^2 + ab + b^2}{3(a+b)} = 2.94\ m$

→ $x = \bar{x} + \dfrac{h}{3} \times \dfrac{P}{W} = 6.04\ m.$

→ Eccentricity $= e = x - \dfrac{b}{2} = 6.04 - \dfrac{8}{2} = 2.04\ m.$

$P_{max} = 646.25\ KN/m^2$

$P_{min} = -146.25\ KN/m^2.$

Experiment No. : 2 Date :

EXPERIMENT NO - 2

CHI SQUARE TEST FOR GOODNESS OF TEST

AIM:- to test the goodness of fit for the given set of data at a specified unit of significance.

PROCEDURE:- → From the given data or observed frequency expected frequency is calculated.

→ Find the difference between observed and expected frequency.

→ the square value of the difference obtained is calculated

→ Summation of $(O_i - E_i)^2$ is termed as chi-square value.

→ Considering the level of significance as 5%, we have to compare our result with the standard results

if $\chi^2 > \chi^2_\alpha$ → Null Hypothesis is rejected

if $\chi^2 < \chi^2_\alpha$ → Null Hypothesis is accepted.

Experiment No. :.................................... Date :....................................

PROBLEMS:-

1. An experiment was conducted to test the efficacy of chloromycetin in checking typhoid. In a certain hospital chloromycetin was given to 285 out of 392 patients suffering from typhoid the number of typhoid cases were as follows. With the help of chi square, test the effectiveness of chloromycetin in checking typhoid.

	Typhoid	No Typhoid	Total
Chloromycetin	35	250	285
No chloromycetin	50	57	107
Total	85	307	392

Answer:- Null Hypothesis:- chloromycetin has no effect on mortality (death and survival rates are independent)

Alternative Hypothesis:- chloromycetin affects mortality (dead and survival rates are not independent)

Calculation of Expected values

$$E = \frac{\text{Row total} \times \text{Column total}}{\text{Total}}$$

$$E = \frac{285 \times 85}{392} = 61.79$$

$$E = \cancel{107}\ \frac{285 \times 307}{392} = 223.30$$

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$$E = \frac{107 \times 85}{392} = 23.20$$

$$E = \frac{107 \times 307}{392} = 83.80$$

Observed	Expected	$\frac{(O-E)^2}{E}$
35	61.80	11.62
250	223.20	3.22
50	23.20	30.95
57	83.80	8.57
	TOTAL	54.36.

Chi calculated = 54.36

chi Square tabulated 3.841

Degree of freedom = 1

Significance = 5% ∴ 54.36 > 3.841.

CONCLUSION :- Since Chi-Square calculated is greater than the Chi Square tabulated we reject the null hypothesis. there is no Significant evidence to Conclude that chloromyce -tin affects typhoid mortality.

Experiment No. : .... Date : ....

2. On the basis of information given below about the treatment of 200 patients suffering from a disease, state whether the new treatment is comparitively superior to the conventional treatment.

No. of Patients			
Treatment	Favourable Response	No Response	
New	60	20	80
Conventional	70	50	120
Total	130	70	200

Answer: -

Null hypothesis :- Severity of accidents in independent of the city.

Alternative hypothesis :- Severity of accidents depends on the city.

Calculation of Expected Values

$$E = \frac{\text{Row total} \times \text{Row column total}}{\text{Total}}$$

$$E = \frac{80 \times 130}{200} = 52.00$$

$$E = \frac{80 \times 70}{200} = 28$$

$$E = \frac{120 \times 130}{200} = 78$$

$$E = \frac{120 \times 70}{200} = 42$$

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Observed	Expected	$\left[\frac{(O-E)^2}{E}\right]$
60	52	1.23
20	28	2.29
70	78	0.89
50	42	1.52
	TOTAL	5.86.

Chi Square Calculated = 5.86

Chi Square Tabulated = 3.841

Degree of freedom = 1

Significance = 5% ∴ 5.86 > 3.841

<u>CONCLUSION</u>:- We reject the null hypothesis since there is a significance difference between the two treatment the new treatment is comparitively superior to the conventional treatment.

Experiment No. : Date :

3. The following information is obtained Concerning an investigation of 50 ordinary Shops of Small size: -

	In towns	In villages	Total
Run by men	17	18	35
Run by women	3	12	15
Total	20	30	50

Can it be inferred that Shops run by women are relatively more in villages than in towns? Use chi square test.

Answer: -

Null hypothesis: - Employment Status among women is independent of location (village/town)

Alternative hypothesis - Employment Status among women is independent of location (village or town)

Calculation of Expected values: .

$$E = \frac{\text{Row total} \times \text{Column total}}{\text{Total}}$$

$$E = \frac{35 \times 20}{50} = 14.0 \longrightarrow 17$$

$$E = \frac{35 \times 30}{50} = 9.0 \longrightarrow 18$$

$$E = \frac{15 \times 20}{50} = 6 \longrightarrow 3$$

$$E = \frac{15 \times 30}{50} = 9 \longrightarrow 12$$

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OBSERVED	EXPECTED	$\frac{[(O-E)^2]}{E}$
17	14	0.64
18	9	4.00
3	6	1.50
12	9	1
TOTAL		12.14

Chi Square Calculated = 12.14
Chi Square tabulated = 3.841
Degree of Freedom = 1
Significance = 5%.

12.14 > 3.841

DECISION AND INTERPRETATION:-

(i) the chi calculated value is greater than the chi square tabulated

(ii) Hence we reject the null hypotheses

CONCLUSION:- There is no Statistically Significant evidence to conclude that Women are likely to be employed in villages than in towns.