DETAILS EXPLANATIONS

CE : Paper-2 (Paper-7) [Full Syllabus]

[PART : A]

1. The fluid, at the scale of interest, is a continuum-a continue substance rather than discrete particles.

2. In fluid dynamics, drag is a force acting opposite to the relative motion of any object moving w.r.t a surounding fluid.

3. Pacing, pedometer, odometer, perambulator, speedometer, chain, tape etc.

4. It is a bar of known length, made of stable material such as invar when used with theodolite, serves as quick and conviniet method of indirect distance measurement.

5. Silty sand and sand silt mixture sands with proportion of fine more than 12%.

6. Field of clearest and acute vision is within a cone whose angle is only 3°, and fairly satisfactory upto 10° in general and 20° in horizontal plane.

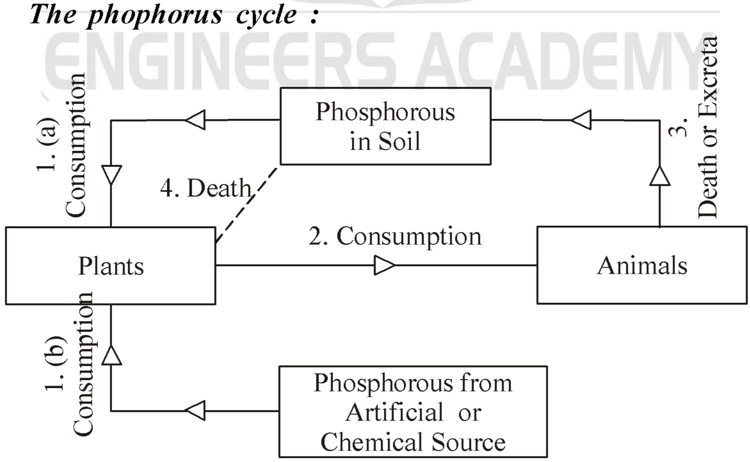
7. Oxygen transfer capcity (kgO_2/h)

$$N = N_s \times \frac{C_s - C_L}{9.17} \times 1.024^{T-20} \times \propto$$

8. It was developed to take advantage of the absorptive properties of activate sludge.

9.
- Chemical coagulation
- Chemical precipitation
- Ion-exchange
- Super-chlorination

10. ***The phophorus cycle :***



11.
- Lime soda process
- Base-Exchange process/Zeolite process
- Demineralisation process.

12. It consists of a R.C.C. caisson of 4.3 m (13') in diameter and 0.45 m (18") thick, sunk into the ground upto the required level.

13. Municipal water required for drinking must be colourfess, odourless and tasteless.

14. When the froude's number is less than 1.

$$\frac{V}{\sqrt{gR}} < 1$$

15. ***The name of chemicals :***

DDT	5%
BHC	0.5%
Aldrin	0.25%
Heptachlor	0.25%
Chlordane	0.5%

16. It is defined as the rate at which the temperature changes (reduces) with elevation.

17. Baluster is the vertical member of wood or methal, supporting the hand rail of staircase.

18. The centrally sponsored command Area Development has the main objective of improving utilization of irrigation-potential.

19. Process by which water is transferred from land to atmosphere by evaporation and from plants by transpiration.

20. Simpson's formula :

$$A = \frac{d}{3}\left[\left(h_0 + h_n\right) + 4\left(h_1 + h_3 + ...\right) + 2\left(h_2 + h_4 + ...\right)\right]$$

[PART : B]

21. Volume of tape/chain per mt. run

$$= 0.08 \times 100 = 8 \text{ cm}^3$$

$\because$ Weight of chain per mt run

$$= 8 \times 0.078 = 0.624 \text{ N}$$

$\therefore$ Total wt of the tape/chain suspended between two support.

$$w = 8 \times 0.078 \times 10 = 6.24 \text{ N}$$

Now correction of sag

$$\Rightarrow \quad C_s = \frac{nl_1(wl_1)^2}{24p^2} = \frac{nl_1 w^2}{24p^2}$$

$$= \frac{3 \times 10 \times (6.24)^2}{24(100)^2} = 0.00487 \text{ m}$$

22. The maximum errors in the individual measurements will be 0.005 and 0.005, while the most probable errors will be ±0.0025 and ±0.0025 respectively.

Now maximum error $\delta S = y\delta x + x\delta y$

$= (8.34 \times 0.005) + (2.86 \times 0.005)$

$= 0.0417 + 0.0143 \simeq 0.06$

The most probable error :

$$e_1 = \pm xy\sqrt{\left(\frac{e_x}{x}\right)^2 + \left(\frac{e_y}{y}\right)^2}$$

$$e_1 = \pm(2.86 \times 8.34)\sqrt{\left(\frac{0.0025}{2.86}\right)^2 + \left(\frac{0.0025}{8.34}\right)^2}$$

$e_1 = \pm 0.02$

Now, $S = x \times y = 2.86 \times 8.34 = 23.85$

Hence, Most probable limits are 23.87 and 23.83 and by rounding off process value may be given as 23.85.

23. The cross sectional area, in terms of m and n, is given by equation:

$$A = \frac{n(b/2)^2 + m^2(bh + nh^2)}{m^2 - n^2}$$

$m = 10,\ n = 1,\ h = 5,\ b = 10$

$\therefore$ $A = 76\ m^2$

$V = A.L = 76 \times 120$

$V = 9120$ Cubic meter

24. The baffle wall type mixing basins are rectangular tanks which are divided by baffle walls. The baffles may either be provided in such a way as the water flows horizontal around their ends, or they may be provided as to make the water move vertically over and under the baffles.

25. ***Well-Log :*** During drilling a well hole, the description of the materials encountered in sequence through the drilling, has to be recorded, and this period is called as well-log.

A well log will, therefore, record the different types of formations with their correct depths of occurances. Samples of drill cuttings at different depths, at regular intervals of 1.5 to 2 m, are also collected, to determine the exact nature of the rock being drilled.

26. Mass-Curve flow is a plot of accumulated inflow (i.e., supply) or outflow (i.e., demand) varsus time. The mass curve of supply (i.e., supply line) is, therefore, first of all, drawn, and is superimposed by the demand curve. The amount of storage can then be easily determined by adding the maximum ordinates between the demand and supply lines.

27. Initial speed $u = \frac{40}{3.6} = 11.11$ m/sec

Breaking time $t = 1.8$ sec

Using fundamental relation of motion for uniform acceleration/ retardation.

$$V = u + at$$

$\because$ $V = 0$

$$a = \frac{u}{t} = \frac{11.11}{1.8} = 6.17 \text{ m/s}^2$$

From relation; force $F = ma$

$$wf = \frac{wa}{g}$$

Average skid resistance

$$f = \frac{a}{g} = \frac{6.17}{9.81} = 0.6$$

28. The ratio $\frac{\text{Pavement width}}{\text{Mounting height}} = \frac{15}{7.5} = 2$

Cofficient of utilization = 0.44

Assume a maintanance factor = 0.8

$$\text{Spacing} = \frac{\text{Lamp Lumen} \times \text{Coff. Of Utilization} \times \text{Maintanance factor}}{\text{Average Luc} \times \text{Width of Road}}$$

$$\text{Spacing} = \frac{6000 \times 0.44 \times 0.8}{6 \times 15} = 23.2$$

29. Let 80% of water goes into the sewage and detention period is 2 hours.

Capacity of tank required = $\frac{72000}{24} \times 2 = 600 \text{ m}^3$

Again, let us assume an overflow rate of 30 $m^3/d/m^2$ for average flow.

Surface area required = $\frac{7200}{30} = 240 \text{ m}^2$

Effective depth = $\frac{600}{240} = 2.5$ m

$$B \times L = 240 \text{ m}^2$$

Let $L = 4B$

$\Rightarrow$ $B = 7.46$ m

$L = 30$ m

Say $\simeq 7.5$ m

30.

$$(BOD)_5 = L_0 - L_5$$

$$\Rightarrow \quad (BOD)_5 = L_0(1 - 10^{-5K})$$

$$\Rightarrow \quad 160 = L_0(1 - 10^{-5 \times 0.12})$$

$$160 = L_0(0.7488)$$

$$\Rightarrow \quad L_0 = 213.7 \text{ mg/lit}$$

$$\text{or} \quad L_0 = 213.7 \text{ PPM}$$

31. ***Damp proff course (DPC) :***

A damp proof cource, as it's name speaks, is a treatment applied to domestic and commercial properties to prevent damp problems occuring. Damp proof courses can be crucial for the health and protection of property specially in a wet country.

Types :

- Electro-osmotic Damp proof course
- Chemical damp proof course
- Pressure Grouting
- Membrane damp proof course
- Integral damp proof course

32. Ashler is finely dressed stone, either an individual stone that has been worked untill squared or the structure built of it. Ashler is the finest stone masonary unit, generally rectangular cuboid.

Rubble masonary also called rubble work, the use of undressed, rough stone, generally in the wall construction. An intermediate method is course rubble walling for which stones are roughly dressed and laid in courses.

[PART : C]

33. ***Terrazzo-Flooring :***

It is a type of floor finish that is laid in thin layer over concrete typping. It is very decorative and has good wearing properties. Due to this, it is widely used in resisential buildings, hospitals, offices, schools and other public buildings.

It is a specially prepared concrete surface containing cement (white or grey) and marble chips (of different colours) in proportion to 1 : $1\frac{1}{4}$ to 1 : 2 when the surface has set, the clips are exposed by grinding operation. Marble chips may vary from 3 mm to 6 mm size. Colour can be mixed to white cement to set desired tint. The flooring, is however, more expensive.

The sub base preparation and concrete base laying is done in a similar manner, as explained for cement concrete flooring. The top layer may have about 40 mm thickness, consisting of (i) 34 mm thick cement concrete layer (1 : 2 : 4) laid over the base concrete and (ii) About 6 mm thick terrazzo topping.

Mosaic Flooring :

It is made of small places of broken tiles of china glazed or of cement or of marble and different patterns. These places are cut to desired shapes and sizes. A concrete base is prepared as in the case of concrete flooring and over it 5 to 8 cm thick lime-surkhi mortar is spread and levelled, over an area which can be completed conventionally within working period so that the mortar may not get dried before the floor is finished. On this, a 3 mm thick cementing material, in the form of paste of 2 parts of slaked lime, 1 part of powdered marble and 1 part of puzzolana material is spread and is left to dry for about 4 hours. Thereafter small pieces of broken tiles of different colours are arranged in definite patterns and hammered into the cementing layer. the surface is gently rolled by a stone roller of 30 cm diameter and 40 to 60 cm long.

34. • ***At Junction Point 'A' :***

$$(y_A)_5 = \frac{(5\times1)+(2\times20)}{5+2} \approx 6.43 \text{ mg/lit}$$

But $(y_A)_5 = L_0(1 - 10^{-K.t})$

$\Rightarrow$ $6.43 = L_0(1 - 10^{-0.12\times5})$

From which $L_0 = 8.59$ mg/lit

$$(DO)_A = \frac{(5\times9.17)+(2\times2)}{5+2} = 7.12 \text{ mg/lit}$$

$\therefore$ $(DO)_A = 9.17 - 7.12 = 2.05$ mg/lit

• ***At a point just upstream of 'B' :***

$V = 0.3$ m/s

$x_B = 20$ km $= 20000$ m

$$t_B = \frac{20\times10^3}{0.3(24\times3600)} = 0.772 \text{ days}$$

DO deficit prior to point B is given by streater-phelps equation.

$$(D)_{0.772} = \frac{KL_0}{R-K}\left[10^{-Kt} - 10^{-Rt}\right] + D_0 10^{-Rt}$$

$$= \frac{0.12\times8.59}{0.36-0.12}\left[(10)^{-0.12\times0.772} - (10)^{-0.36\times0.772}\right] + 2.05(10)^{-0.36\times0.772}$$

$\Rightarrow$ $= 2.29$ mg/lit

$\therefore$ DO of river $= 9.17 - 2.29 = 6.88$ mg/lit

- ***Just after junction Point 'B' :***

$$(DO)_B = \frac{6.88(5+2)+(9\times 2)}{(5+2)+2} = 7.35 \text{ mg/lit}$$

$$(DO)_B = 9.17 - 7.35 = 1.82 \text{ mg/lit}$$

Also, $$(y_5)_B = \frac{6.43(5+2)+(2\times 2)}{(5+2)+2} = 5.45 \text{ mg/lit}$$

But, $$(y_5)_B = L_0(1 - 10^{-Kt})$$

$$5.45 = L_0(1 - 10^{-0.12\times 5})$$

$$(L_0)_B = 7.28 \text{ mg/lit}$$

- ***At a point just before junction 'C' :***

Distance $x_{BC} = 25$ km

$V = 0.3$ m/s

$$t_{BC} = \frac{25\times 10^3}{0.3(24\times 3600)} = 0.965 \text{ days}$$

$$\therefore (D)_{0.965} = \frac{0.12\times 7.28}{0.36-0.12}\left[10^{-0.12\times 0.965} - 10^{-0.36\times 0.965}\right] + 1.82(10)^{-0.36\times 0.965}$$

$$(D)_{0.965} = 1.97 \text{ mg/lit}$$

$\therefore$ (DO) of river = 9.17 – 1.97 = 7.2 mg/lit

- ***Just after junction point 'C' :***

$$(DO)_c = \frac{7.2\times(5+2+2)+(3\times 2)}{(5+2+2)+2} = 6.44 \text{ mg/lit}$$

$$(D_0)_c = 9.17 - 6.44 = 2.73 \text{ mg/lit}$$

Also, $$(y_5)_c = \frac{5.45(5+2+2)+(16\times 2)}{(5+2+2)+2} = 7.37 \text{ mg/lit}$$

$$(y)_5 = L_0(1 - 10^{-Kt})$$

$$\Rightarrow 7.37 = L_0(1 - 10^{-0.12\times 5})$$

$$\Rightarrow (L_0)_c = 9.84 \text{ mg/lit}$$

Thus D_0 and L_0, just after the junction point 'C' are known.

- ***At point P, 20 km from 'C' :***

Distance $x_{cp} = 20$ km

$V = 0.3$ m/s

$$t_{cp} = \frac{20000}{0.3(24\times 3600)} = 0.772 \text{ days}$$

D.O. deficit at point p in given by the streeter phelps equation :

$$(D)_{0.772} = \frac{0.12\times 9.84}{0.36-0.12}\left[10^{-0.12\times 0.772} - 10^{-0.36\times 0.772}\right] + 2.73(10)^{-0.36\times 0.772}$$

$$\therefore (D)_{0.772} = 2.82 \text{ mg/lit}$$

35. ***Experiment :*** To find the colour of a water sample :

Theory : Dissolved organic matter from decaying vegetation, or some inorganic matter such as coloured soils etc, may impart colour to the water. The excessive growth of algae and aquatic micro-ogranisms may also sometimes impart colour to the water. The presence of colour in water is not objectionable from health point of view but may spoil the colour of the clothage if washed in such waters colours in water are also objectionable from aesthetic point of view.

The colour of a given sample of water can be measured by comparing it's colour with the colour of standard glass tuses known as nessler tubes.

One standard unit of colour is that which is produced by dissolving one mg of platinum cobalt in one litre of distilled water.

Different standard colour intensities of 1, 2, 3, ..., mg/lit, can be easily prepared by dissolving 1 mg, 2 mg, 3 mg, ... respectively of platinum cobalt in 1 lit of distilled water.

The maximum permissible colour for domestic supply is 20 mg/lit (on cobalt scale)

Procedure :

- Fill a 100 cc (ml) nesler tube to the mark with the water to be testd.
- compare the colour of the sample with that of the standard coloured nessler tube.
- If the colour of the sample is greater than that of the standard chosen, the standard water should be diluted with distilled water, untill the required matching is obtained.
- The colour intensily of the standard colour, matching with the sample, may be noted down to represent the colour of the water sample.

Result : The colour number of the given water is.....(on cobalt scale).

36. ***Design Procedure :***

It is similar to the under sluice section and the weir bay section. However the crest levels of the two portions are different. Generally khosla's theory is used for design. The procedure may be summerised as follows :

- Fix the discharge over the weir bay and the unsluice-bay sections, as discussed.
- Fix the crest levels of the under sluice section and the wiere-bay section.
  The crest of the under sluice section, the slope is kept between 3 : 1 and 5 : 1 at downstream.
- Fix the waterways for weir bay and under sluice-sections.
- Determine characterstics of hydraulic-jump.
- Calculate the normal scour depth and determine the bottom levels of the upstream and downstream piles.
- Find the total length of the impervious floor from the exit gradient consideration. Also fix the upstream and down stream floor lengths and levels.
- Calculate the percentage uplife pressure at the key points of all piles by khosla's theory for the following conditions.
- No flow conditions.
- High flood condition and pond level condition with flow concentration and with retrogression.
- High flood condition and pond level condition, without flow concentration and without retrogression.
- Determine the uplife pressure at various points from the subsoil H.G.L. for no flow condition.
- Calculate the thickness of the flow at various points for the maximum of the uplift obtained for the three conditions metioned in step above.
- Provide concrete block protection on the up stream and down stream sides.
- Provide launching aprons on the up stream and down stream sides.

37. ***Water Absorption Test :***

The clay bricks are tested in accordance with the procedure laid down in IS : 3495-1992. The code recommends that this test should be performed in both cold water and boilling water. This is because water absorption in bricks occur in the pores and many times pores are completely seaies and hence inaccessible to water under ordinary conditions. As per the code the average water absorption of common building bricks should not be more than 20% by weight upto class 12.5 MPA and 15% by weight for heigher classes.

Crushing Strength Test :

Bricks often have to withstand great compressive stresses. The durability of the masonary depends upon the strength of the bricks. The crushing or compressive strength of a bricks is found out by blacing it in a compression testing machine.

It is pressed till it breaks. As per IS : 1077-1992, the minimum crushing strength of bricks is 3.5 MPa.

Hardness Test :

In this test a scartch is made on bricks surface with the help of a finger nail. If no impression is left on the surface, the bricks is treated to be sufficiently hard.

Soundness Test :

In this test the two bricks are taken and they are struck with each other. The bricks should not break and a clear ringing sounding be produced.

Resence of Soluble Salts Test :

The soluble solt is present in bricks will cause efflorescence on the surface of bricks. For finding out the presence of soluble salts in a bricks it is immersed in water for 24 hours. It is then taken out and allowed to dry in shade. The absence of grey or white deposits on its surface windicates absence of soluble solts.

- ***Nil*** : When there is no perceptible deposit of efflorescence.
- ***Slight :*** When no more then 10% of the area of the bricks is covered with a thin deposit of salts.
- Moderate
- Heavy
- Serious

38. Edge Region

- ***Edge load stress from chart :***

  For $h = 20$ cm

  and $K = 15$ kg/cm^3

  $S_e = 24.0$ kg/cm^2

- ***Warping stress at edge :***

  Redius of relative stiffness

$$1 = \left[\frac{3\times10^5\times20^3}{12\times15(1-0.15)^2}\right]^{1/4} = 60.8 \text{ cm}$$

Length of slab $L_x = 4.5$ m $= 450$ cm

Wraping stress coefficient, C_x from

$$\frac{L_x}{l} = \frac{450}{60.8} = 7.4$$

$$C_x = 1.02$$

Similary at $$\frac{L_y}{l} = \frac{350}{60.8} = 5.75$$

$$C_y = 0.87$$

$$t = 18^oC$$

Maximum warping stress at edge,

$$S_{te} = \frac{E.e.t.}{2}.C_x$$

$$= \frac{1}{2} \times 3 \times 10^5 \times 10^{-6} \times 18 \times 1.02$$

$$= 27.54 \text{ kg/cm}^2$$

- ***Frictional stress :***

$$S_f = \frac{w.L_x.f}{2\times10^4}$$

$$= \frac{2400\times4.5\times1.5}{2\times10^4}$$

$$= 0.81 \text{ kg/cm}^2$$

- ***Conbined Stress at Edge region :***

Corner Region :

- ***Load stress :***

For $h = 20$ and $k = 15$

$$S_c = 28.0 \text{ kg/cm}^2$$

- ***Maximum wraping stress :***

$$S_{te} = \frac{E.e.t}{3(1-u)}\sqrt{\frac{a}{l}}$$

$$= \frac{3\times10^5\times10\times10^{-6}\times18}{3(1-0.15)}\sqrt{\frac{15}{60.8}}$$

$$S_{te} = 9.15 \text{ kg/cm}^2$$

- ***Frictional stress :*** This is zero at corner region.
- ***Combined stress at corner region :*** The critical combination of stress in summer mid-night

$$= \text{Load stress} + \text{Wraping stress}$$

$$= 28.0 + 9.15 = 37.15 \text{ kg/cm}^2$$

(It may be nated that the critical combination of stresses at the edge region is higher than that at the corner under the indential conditionof pavement, load and temperature.)

39. Linear scale ratio, $L_r = 20$

Sub-merged area of model,

$A_m = 5.0 \text{ m}^2$

Length of model, $L_m = 8.0$ m

Total drag of model, $R_m = 20$ m

Velocity of model, $V_m = 1.5$ m/s

Let, A_p, L_p, R_p, V_p = Corresponding values for prototype.

Fluid in model is the same as in prototype and is sea-water.

Kinematic viscosity of sea-water

$V_m = V_p = 0.01$

Stokes $= 0.1 \text{ cm}^2/\text{s} = 0.01 \times 10^{-4} \text{ m}^2/\text{s}$

Density of water, $P_m = 100 \text{ kg/cm}^3$

The skin (frictional) resistance of model is given by

$$(F_f)_m = \frac{1}{2}(f_m P_m A_m V_m^2)$$

Where $$C_{f_m} = \frac{0.0735}{[(R_f)_m]^{1/5}}$$

Where $(R_e)_m$ = Reynold's number for model

$$= \frac{P_m V_m L_m}{\mu_m} \text{ or } \frac{V_m L_m}{V_m}$$

$$= \frac{1.5 \times 8.0}{0.01 \times 10^{-4}} \times 1.2 \times 10^7$$

Substituting this value in equation (2), we get

$$C_{f_m} = \frac{0.0735}{(1.2 \times 10^7)^{1/5}} = \frac{0.0735}{26.0517}$$

$$= 2.82 \times 10^{-3}$$

Substituting the value of C_{f_m} in equation (1), we get

$$(F_f)_m = \frac{1}{2} \times 2.82 \times 10^{-3} \times 1000 \times 5.0 \times (1.5)^2$$

$$= 15.8617 = 15.862 \text{ N}$$

Using equation, we get

$$R_m = (R_w)_m + (R_f)_m$$

where $(R_{fm}) = (F_f)_m = 15862$ or $20 = (R_w)_m + 15.862$

$\therefore$ Wave resistance for model, $(R_w)_m = 20 - 15.862$

The wave resistance expresienced by the ship is given by equation as:

$$(R_w)_P = \frac{P_p}{P_m} \times \left(\frac{L_P}{L_m}\right)^3 \times (R_w)_m$$

$$= 1 \times L_R^3 \times 4.138 \text{N}$$

$$= 1 \times 20^3 \times 4.138 = 33104 \text{ N}$$

and skin (frictional) resistance of prototype is given by

$$(R_f)_P = (F_f)_P = \frac{1}{2} C_{tP} \times P_P \times A_P \times V_P^2$$

Where V_P is the velocity of prototype and is given by froude model law,

$$(F_e)_m = (F_e)_P \text{ or } \frac{V_m}{\sqrt{L_m g}} = \frac{V}{\sqrt{L_P g}}$$

or $$\frac{V_m}{\sqrt{L_m}} = \frac{V_p}{\sqrt{L_P}}$$

$\therefore$ $$V_P = \sqrt{\frac{L_P}{L_m}} \times V_m = \sqrt{L_r} \times V_m$$

$$= \sqrt{20} \times 1.5 = 6.708 \text{ m/s}$$

Now $$\frac{A_p}{A_m} = L_r^2 = 20^2$$

$\therefore$ $A_P = A_m \times 20^2 = 5 \times 400 = 2000 \text{ m}^2$

and $L_P = L_m \times L_r = 8 \times 20 = 160$ m

In equation, the value of C_{tP} is given by

$$C_{tP} = \frac{0.0735}{[(R_e)_P]^{1/5}}$$

Where $(R_e)_P$ = Reynold number for prototype

$$= \frac{V_P \times L_P}{V_P} = \frac{6.708 \times 160}{0.01 \times 10^{-4}}$$

$$= 1.073 \times 10^9$$

$$C_{fP} = \frac{0.0735}{(1.073 \times 10)^{91/15}} = \frac{0.0735}{63.99}$$

$$C_{fP} = 1.1486 \times 10^{-3}$$

Substituting the value of C_{fP} in equation, we get.

$$(R_f)_P = (C_f)_P$$

$$= \frac{1}{2} \times 1.1486 \times 10^{-3} \times 1000 \times 2000 \times (6.708)^2$$

= 51.683.8 N

$\therefore$ Total dran on prototype is obtained by using equation.

$$R_P = (R_w)_P + (R_f)_P$$
$$= 33104 + 51683.8 = 84787.8 \text{ N}$$

OOO