DESIGN ATTEMPT

REINFORCED CONCRETE PEDESTAL

To start the project I shall list all the information that can be used to begin calculations on the structure. The structure is to be built in Brisbane, Australia and referring to Table 4.3 of Australian Standard 3600 the exposure classification for reinforced concrete members within 50km of the coastline is B1. So the concrete must have a strength rating of no less than 32 MPa.

The structure is a multiple span reinforced concrete pedestal carrying a conveyor structure. The following forces act on the structure:

DEAD LOADS:

Uniformly distributed load:

Finishes = 1.5kN/m

Self-weight of concrete = 24 kN/m^3 (design for 1m width, must assume slab depth to calculate)

Point loads at conveyor structure centerline:

Conveyor Structure = 1800 kg/m (18 kN/m)

LIVE LOADS:

Point loads at conveyor structure centerline:

Conveyor Structure = 200 kg/m (2 kN/m)

I have chosen to treat this structure like a portal frame as the span (15m) is quite large, the entire structure is rigid so all joints are fixed.

To begin solving the reactions for this structure we can draw a portal frame with all the loads and solve via the moment distribution method. Firstly however we must calculate the dead load due to the concrete in the beam. To begin we should work out what the maximum loadings on the frame are, the two point loads and the uniformly distributed load:

POINT LOADS AT CONVEYOR:

We have the following information from the brief:

Dead Load (G) = 18 kN/m

Live Load (Q) = 2 kN/m

Because the frames span over 15 meters we must calculate when the frame will be under the most adverse conditions.

Use the standard limit state formula to calculate the design loads.

Design Load = 1.2G + 1.5Q

= (1.2 x 18 x 15) + (1.5 x 2 x 15)

= 369 kN

So two point loads of 369 kN will act at the conveyor structures.

Now we must calculate the uniformly distributed load from the concrete and finishes. It is common in the preliminary stage of design to use a span/depth ratio from Australian Standard 3600, the standard span/depth ratio for a continuous beam is 15.

Beam span = 9000mm

Span/Depth ratio $= \frac{9000}{15}$

Depth of beam (D) = 600mm

Now the breadth of the beam is empirically taken to be 0.6 times that of the depth.

Breadth of beam (B) = 0.6 x 600

= 360mm

I will make the preliminary beam 600mm x 400mm. But before we calculate the self-weight we must find the effective depth. Minimum cover for exposure classification B1 is 40mm, I will assume ligatures of 10mm and reinforcement of N20.

Effective Depth (d) = D – 40 – 10 – 20/2

= 540mm

Self-weight of beam = 0.4 x 0.54 x 24.6 (assume an extra 0.6 kN/m^3 for 1% of steel reinforcement)

= 5.31 kN/m

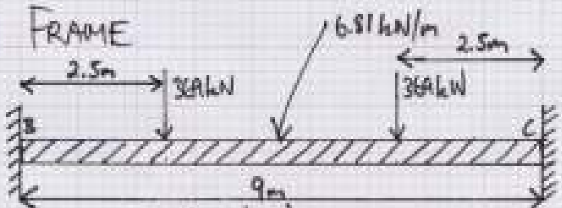
Add together the self-weight and finishes on the beam and we can begin calculating the reactions.

Total uniformly distributed load on beam

= 5.31 + 1.5

= 6.81 kN/m

Rigid Jointed Frame



Fixed end moments$_{BC}$ $= \dfrac{wl^2}{12} + \left(\left(\dfrac{wl}{8}\right) \times 2\right)$

$= \dfrac{6.81 \times 9^2}{12} + \left(2 \times \dfrac{369 \times 9}{8}\right)$

$= 45.97 + 830.25$

$= \pm 876.22$ kN/m

~~∴ Assume I is constant~~

∴ Solve the stiffness factors

$I_{AB} = \dfrac{300 \times 400^3}{12}$

$= 16 \times 10^8 \text{ mm}^4$

$I_{BC} = \dfrac{400 \times 600^3}{12}$

$= 72 \times 10^8 \text{ mm}^4$

$K_{AB} = \dfrac{I_{AB}}{L_{AB}}$

$= \dfrac{16 \times 10^8 \text{ mm}^4}{6000}$

$= 2.6 \times 10^5$

$K_{BC} = \dfrac{72 \times 10^8}{9000}$

$= 8 \times 10^5$

∴ Solve the distribution factors

$D_{AB} = \dfrac{K_{AB}}{\Sigma K_{AB}}$

$= \dfrac{2.6 \times 10^5}{2.6 \times 10^5 + 8 \times 10^5}$

$= 0.25$

$D_{BC} = 1 - D_{AB}$

$= 0.75$

JOINT	A	B		C		D
MEMBERS	AB	BA	BC	CB	CD	DC
DF	–	0.25	0.75	0.75	0.25	–
FIXED END MOMENT	0	0	-876.22	876.22	0	0
BALANCE	–	+219.05	+657.17	-657.17	-219.05	–
CARRY OVER	109.53	–	-328.59	+328.59	–	-109.53
BALANCE	–	+82.15	+246.44	-246.44	-82.15	–
CARRY OVER	+41.08	–	-123.22	+123.22	–	-41.08
BALANCE	–	+30.80	+92.42	-92.42	-30.80	–
CARRY OVER	+15.40	–	-46.21	+46.21	–	-15.40
BALANCE	–	+11.55	+34.66	-34.66	-11.55	–
CARRY OVER	+5.78	–	-17.33	+17.33	–	-5.78
BALANCE	–	+4.33	+13.00	-13.00	-4.33	–
TOTAL	+171.79	+347.88	+528.17	-528.17	-347.88	-171.79