Attachment 3

Example calculation Excel base

Support reactions from Staad calculations (steel frame)

Example calculation made with DL+INS+WIND(+X)
(See attachment Staad picture Sheet No. 13)
User inserts chosen load case from support reactions report here:

Load case: DL+INS+WIND(+X)

Node	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
1	-100,503	-137,168	-16,268	-3,346	-0,102	4,428
2	-100,875	-145,233	16,593	-1,994	-0,001	5,121
3	-3,189	589,687	-0,182	-0,104	-0,001	7,289
4	-3,434	590,562	-0,144	-0,051	-0,001	7,946

Forces effecting the stack foundation

	FX (kN)	FY (kN)	FZ (kN)	MX (kNm)	MY (kNm)	MZ (kNm)
1	100,503	137,168	16,268	3,346	0,102	-4,428
2	100,875	145,233	-16,593	1,994	0,001	-5,121
3	3,189	-589,687	0,182	0,104	0,001	-7,289
4	3,434	-590,562	0,144	0,051	0,001	-7,946

Ground filling calculation is optional. Only calculated when needed.
Insert height of the foundation

h= 800 mm foundation height

1729,8 kN weight of the foundation

Ground filling weight: (calculate if needed)

Height of the ground filling: 1000 mm

surface area of foundation under the ground = 1643,31 m2
density of the ground = 19 kN/m3
ground filling weight = 31222,89 kN
insert 0, if ground filling not calculated!!!

Bearing pressure calculations

User inserts the perliminary dimensions here.

Measures of the structure

Insert measures A and B

A=	9300	mm	length of the foundation
B=	9300	mm	length of the foundation
P=	33850,5	kN	
Mxx=	-5092	kNm	moment in direction x
Myy=	418,776	kNm	moment in direction y
ex=	Myy/P	=	0,012 m
ey=	Mxx/P	=	-0,150 m

Note!! Axes not equal with STAAD!!!

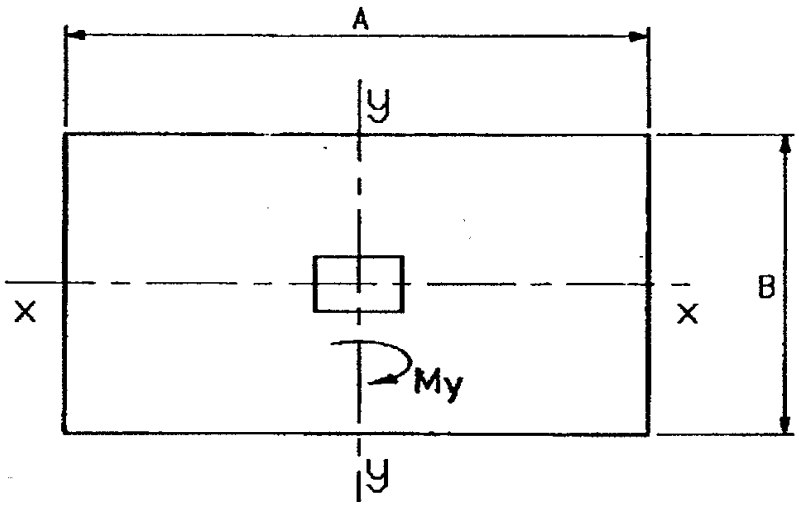

Figure 4. (Reinforced concrete, Analysis and design, S.S. Roy)

After inserting the tables and measures, the base gives a zone as a result.
If the foundation is too small, calculation base commands to redesign the measures.

Variables for x and y

res x =	0,012	place of resultant in direction x
res y =	0,150	place of resultant in direction y

LINE 1	resultant is inside Line 1	Overturning > 1.5
LINE 2	resultant is inside Line 2	
		Resultant is in Zone2
LINE 3	resultant is inside Line 3	Resultant is in Zone?
		Resultant is in Zone?
LINE 4	resultant is inside Line 4	Resultant is in Zone?
		Resultant is in Zone?
LINE 5	resultant is inside Line 5	

Resultant is in Zone2

Based on the result of the zone, designer uses one of the following formula groups.

Resultant in Zone 1 of base

If factor of safety for overturning is less than 1,5. Redesign size of base.

Rectangular pad - uniaxial bending - no loss of contact			
p 1=(P/A*B)+(6*Myy/A^2*B)	=	394,5	kN/m²
p 2=(P/A*B)-(6*Myy/A^2*B)	=	388,3	kN/m²
Rectangular pad - uniaxial bending - loss of contact			
p 1=2*P/((1,5*A)-(3*ex))*B	=	523,233	kN/m²
x=1,5*A-3*ex	=	13,91	m

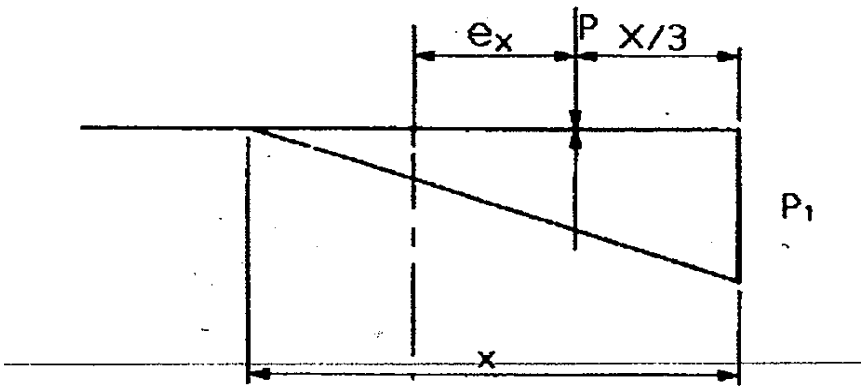

Figure 5. (Reinforced concrete, Analysis and design, S.S. Roy)

Resultant in Zone 2 of base

p_1=(P/A*B)+(6*Myy)/(A^2*B)+(6*Mxx/(A*B^2))	=	356,522 kN/m²
p_2=(P/A*B)+(6*Myy)/(A^2*B)-(6*Mxx)/(A*B^2))	=	432,488 kN/m²
p_3=(P/A*B)-(6*Myy)/(A^2*B)-(6*Mxx)/(A*B^2))	=	426,240 kN/m²
p_4=(P/A*B)-(6*Myy)/(A^2*B)+(6*Mxx)/(A*B^2))	=	350,274 kN/m²

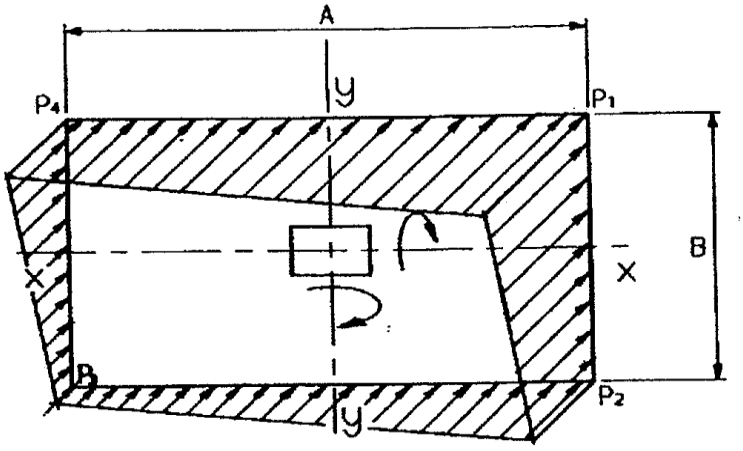

Figure 6. (Reinforced concrete, Analysis and design, S.S. Roy)

Resultant in Zone 3 of base

S=B/12*(B/ey+(B^2/ey^2-12)^(1/2))	=	47,45	m
tanα=(3*(A-2*ex))/(2(S+ey))	=	0,294	
p 1=(12*P/B*tanα)*(B+2*S/B^2+12*S^2)	=	570,86	kN/m²
p 2=(S-(B/2))/(S+(B/2))**p* 1	=	468,96	kN/m²
x 1=(S+(B/2))*tanα	=	15,3	m
x 2=(S-(B/2)*tanα	=	12,6	m

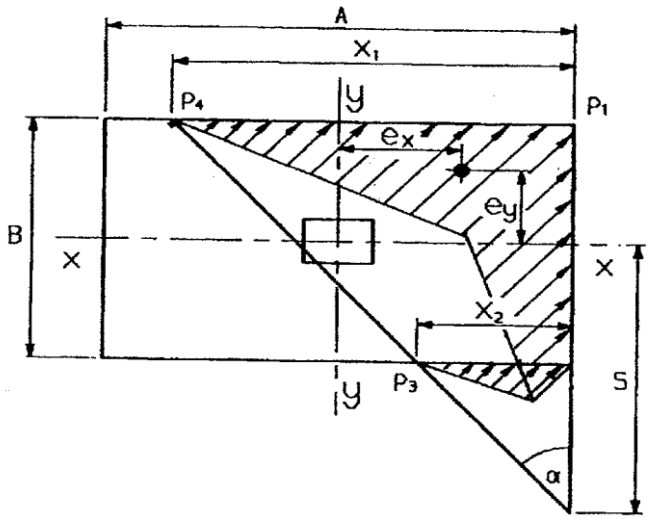

Figure 7. (Reinforced concrete, Analysis and design, S.S. Roy)

Resultant in Zone 4 of base

$t=A/12*(A/e_x+(A^2/e_x^2-12)^{(1/2)})$	=	1165,19	m
$\tan\beta=3(B-2*e_y)/(2*(t+e_x))$	=	0,012	
$p1=(12*P/A*\tan\beta)*(A+2*t/A^2+12*t^2)$	=	507,51	kN/m²
$p4=(t-(A/2)/(t+(A/2))*p1$	=	503,48	kN/m²
$y1=(t+(A/2))*\tan\beta$	=	14,46	m
$y2=(t-(A/2))*\tan\beta$	=	14,34	m

p2 = 0

p3 = 0

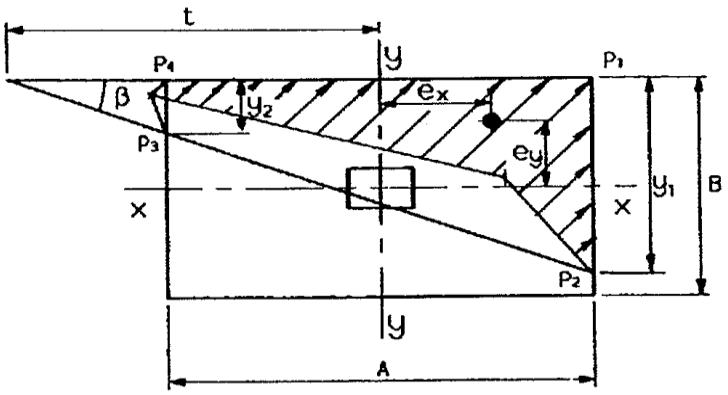

Figure 8. (Reinforced concrete, Analysis and design, S.S. Roy)

Resultant in Zone 5 of base

$k=(e_x/A)+(e_Y/B)$	=	-0,015	m
$p1=(P/A*B)*k*(12-3,9(6*k-1)*(1-2*k)*(2,3-2*k))$	=	-128,91	kN/m²
$p2=((S-(B/2))/(S+(B/2)))*p1$	=	-105,90	kN/m²
$p4=(t-(A/2))/(t+(A/2))*p1$	=	-127,89	kN/m²
$x1=(S-(B/2)*((t+(A/2)/(S+(B/2)))$	=	961,01	m
$y1=(t-(A/2))*((S+(B/2))/(t+(A/2))$	=	51,68	m

p3 = 0

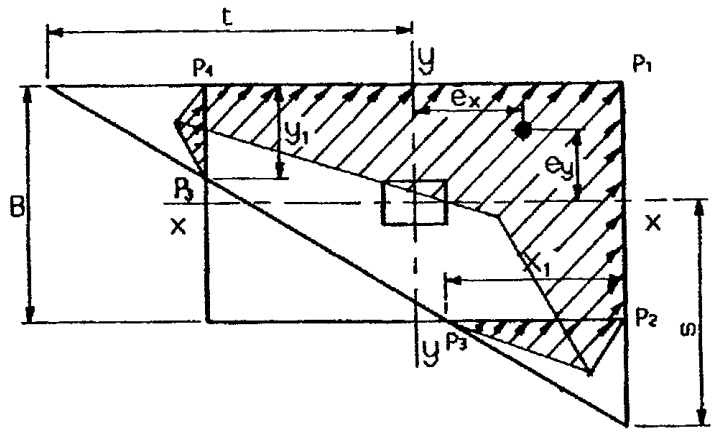

Figure 9. (Reinforced concrete, Analysis and design, S.S. Roy)

Zone areas in example foundation

Zone areas divided by straight lines, which has been given own equations

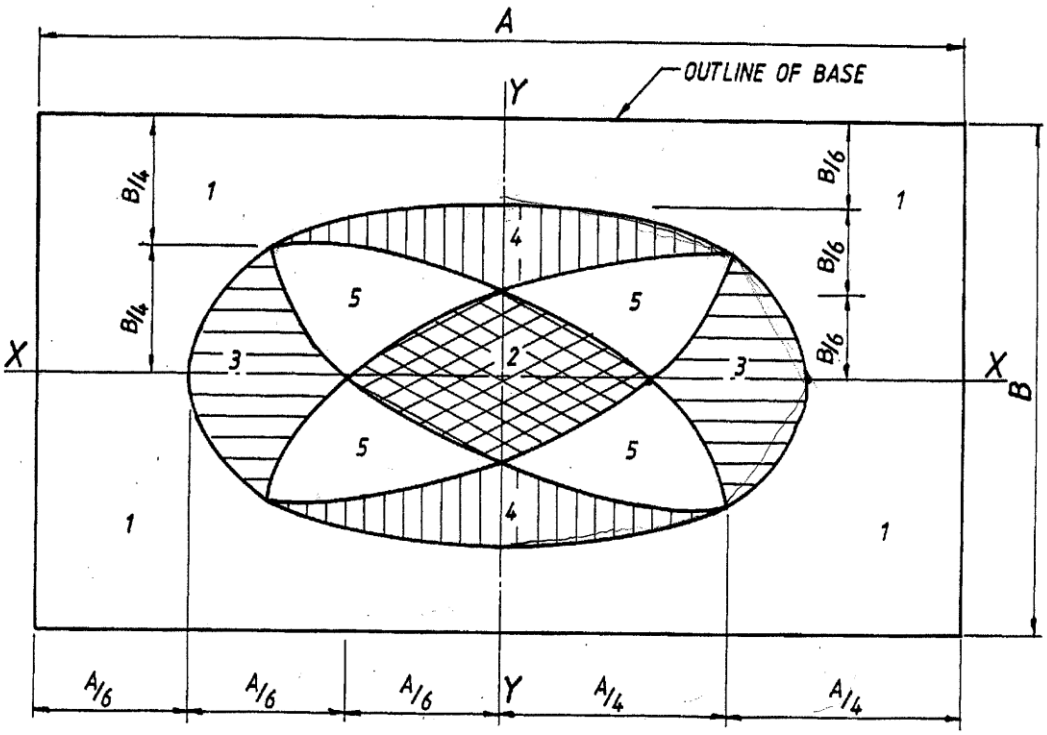

Figure 10. (Reinforced concrete, Analysis and design, S.S. Roy)