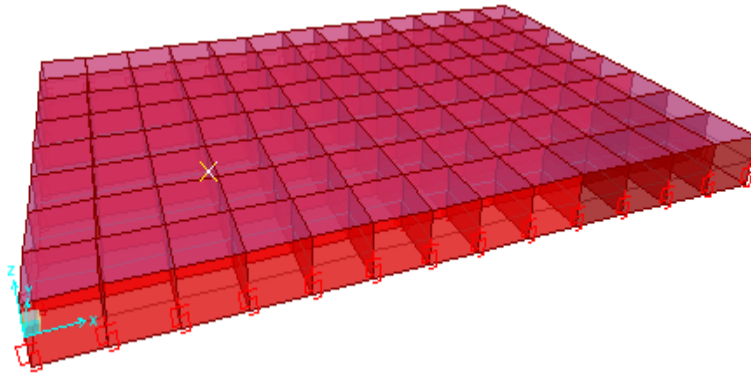


Design of Concrete lid of Manhole of Maryhill Truck Sewer



Prepared by

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SLAB DESIGN FOR H2O LOADING

A. DESIGN CRITERIA

- ① THE $3.045 \times 3.06 \text{ cm}$ SLAB IS DESIGNED TO RESIST H₂O LOADING
- ② SHARP KEYS TO BE DESIGNED TO RESIST HORIZONTAL LOADS.
- ③ LOAD CONSIDERATION TO ~~SLAB~~ H₂O LOADING
USE S 6 LOAD COMBINATION
- ④ USE FINITE ELEMENT MODELLING METHOD TO CHECK MOST SEVERE STRESS. ~~LOAD~~ LOCATION AT CENTER OF THE SLAB
- ⑤ EXTRA BAR TO BE USED TO COMPENSATE THE REINFORCING LOSS AT OPENNING.

B LOAD CASE AND COMBINATION

DEAD LOAD WITH CONCRETE UNIT WEIGHT
 $\approx 23.5 \text{ kN/m}^3$

H₂O LOADING, FREE WATER

71 kN/m^3

CONTACT AREA $20'' \times 10'' \approx 500 \times 250 \text{ mm}$

LOAD COMBINATION TO S6

$1.1 \times \text{DEAD} + 1.7 \text{ LIVE LOAD}$

C Assumption

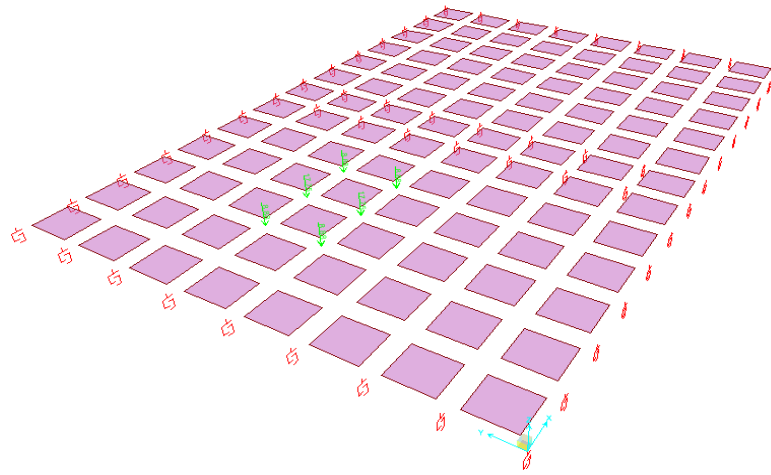
CONCRETE $f'_c = 4000 \text{ psi} \approx 28 \text{ MPa}$

$f_s = 400 \text{ MPa}$

$E_s = 200 \text{ GPa}$

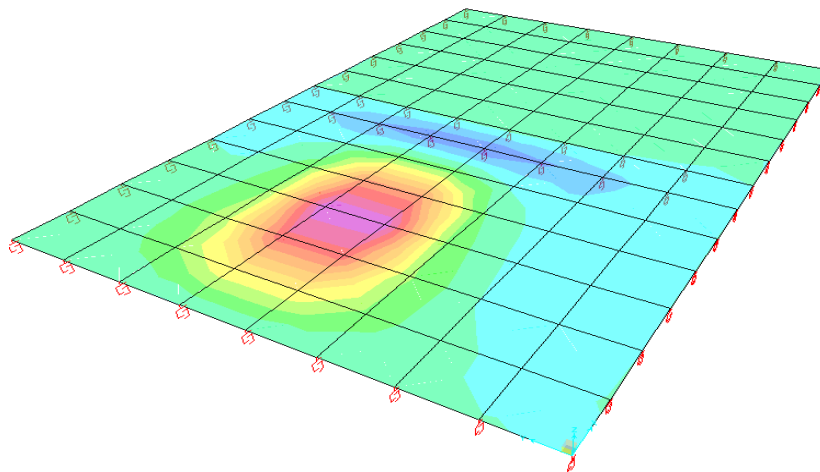
D: Model layout

1. use ~ 250x250x200 thin shell element
2. assign wheel load 71kn on 6 nodes to model the H20 loads
3. use Gap link element to model the slab supports all around the edge of slab
4. check the load resultant force to add the reinforcement steel
5. check the deflection due to the wheel load



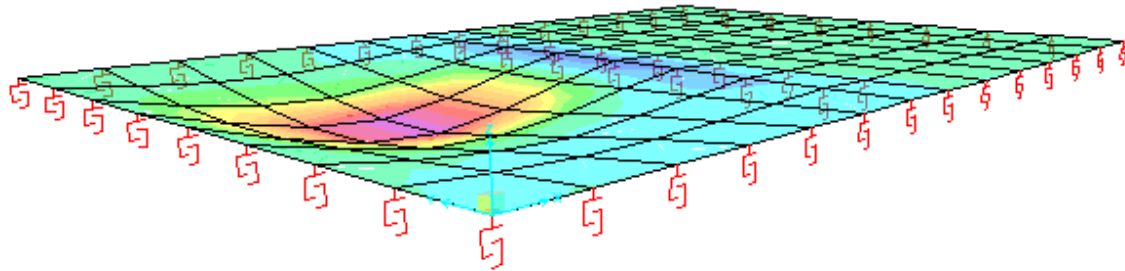
Shrink shell elements

E: Load resultant force, M11, M22, M12

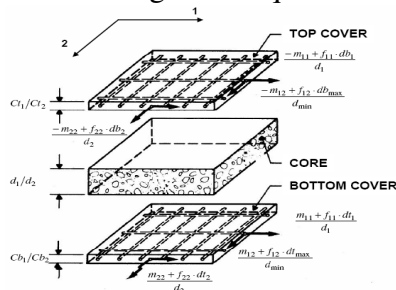


Contour view of resultant forces

F: Deflection due to wheel load. The deflection is small in this case for SLS load.



G: Reinforcing steel required:



Three layers of reinforced concrete model

INPUT Var.	mm
h=	200
Ct1=	0
Ct2=	0
Cb1=	50
Cb2=	50

	mm
dt1	100
dt2	100
db1	50
db2	50
d1	150
d2	150

	mm
dmin	150
dbmax	50
dtmax	100

Top Layer t	50
mid. layer t	100
Bot. Layer t	50

φrebar	0.85
Rebar Fy	400 Mpa

f11=	0	KN/m
f22=	0	KN/m
f12=	0	KN/m
m11=	19.1	KNm/m
m22=	14.15	KNm/m
m12=	5.8	KNm/m

N11(TOP)=	-127.33	KN/m
N22(TOP)=	-94.33	KN/m
N12(TOP)=	-38.67	KN/m
N11(BOT)=	127.33	KN/m
N22(BOT)=	94.33	KN/m
N12(BOT)=	38.67	KN/m

F11(TOP)=	-127.33	KN/m
F22(TOP)=	-94.33	KN/m
F12(TOP)=	-38.67	KN/m
F11(BOT)=	94.33	KN/m
F22(BOT)=	127.33	KN/m
F12(BOT)=	38.67	KN/m

NDes1'(TOP)=	0.00
NDes1'(BOT)=	166.00
NDes2'(TOP)=	-82.59
NDes2'(BOT)=	166.00

NDes1''(TOP)=	0.00
NDes1''(BOT)=	166.00
NDes2''(TOP)=	-82.59
NDes2''(BOT)=	166.00

NDes1(TOP)=	0.00
NDes1(BOT)=	166.00
NDes2(TOP)=	0.00
NDes2(BOT)=	166.00

Ast1(top)=	0.00
Ast1(bot)=	488.24
Ast2(top)=	0.00
Ast2(bot)=	488.24

Fc(top)=	139.08
Fc(bot)=	-77.33

Fc1(TOP)=	-77.33	KN/m
Fc1(BOT)=	-77.33	KN/m
Fc2(TOP)=	-110.18	KN/m
Fc2(BOT)=	-77.33	KN/m

Sc1(TOP)=	#DIV/0!	Mpa
Sc1(BOT)=	-0.77	Mpa
Sc2(TOP)=	#DIV/0!	Mpa
Sc2(BOT)=	-0.77	Mpa

Choose 10M @ 150mm to meet 488mm²/m reinforcement

