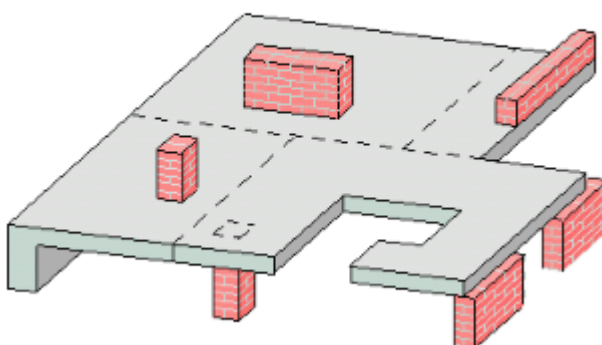


t201 - Система железобетонных плит



Программа предназначена для расчёта системы прямоугольных железобетонных плит по нормам Венгрии MSZ EN 1992-1-1.

Возможно задание прямоугольных колонн и вырезов.

Нагрузки могут быть как сосредоточенными, так и распределёнными по плоскости и/или по линии.

Статический расчёт проводится методом конечных элементов.

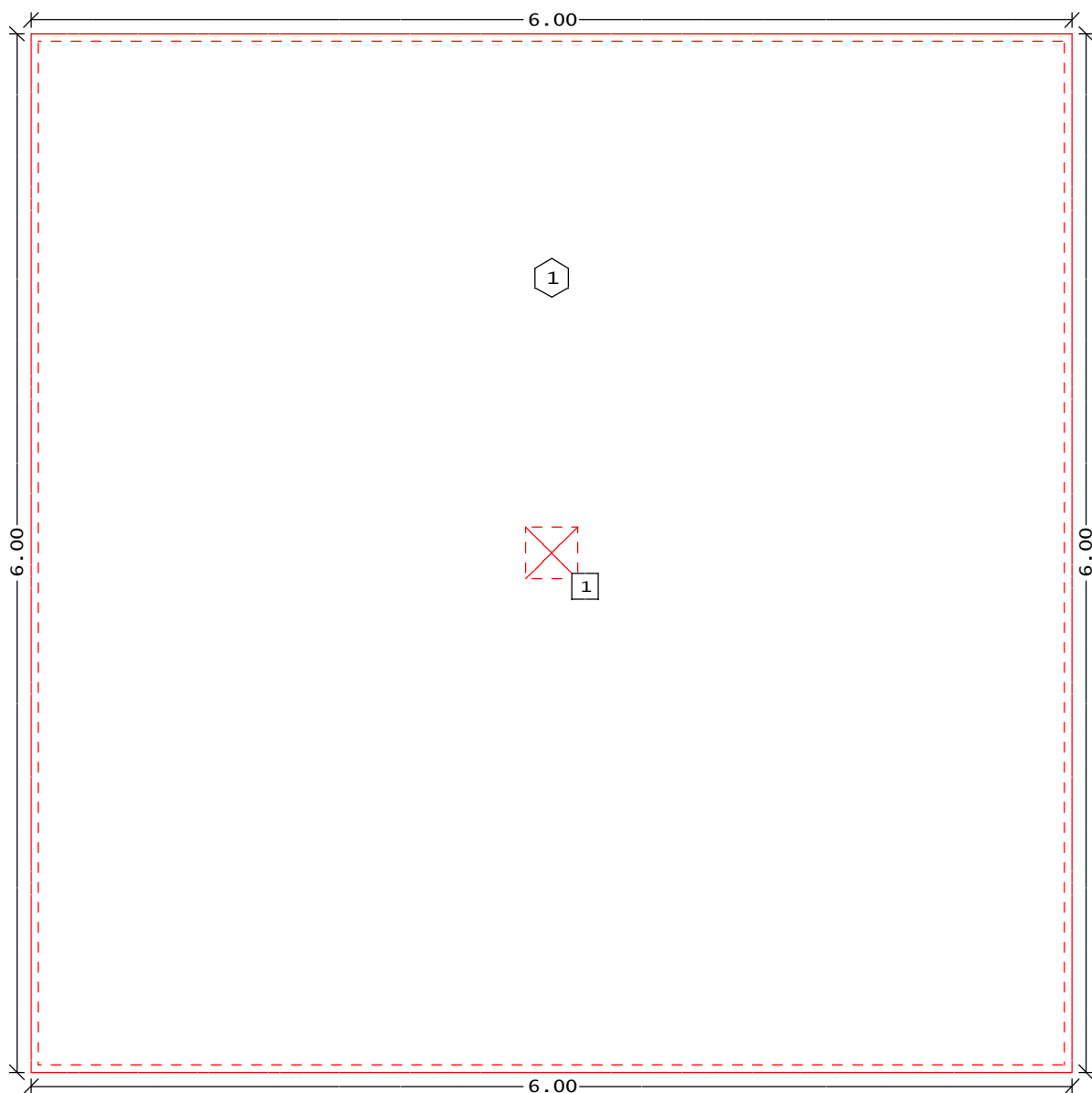
Расчётные сочетания усилий определяются согласно MSZ EN 1990:2011.

Расчёт требуемой арматуры и конструирование арматуры осуществляется по условиям прочности. Для подобранной арматуры проводится расчёт ширины раскрытия трещин и определение прогибов.

Design scheme

Design scheme

M = 1 : 40



Plates

N	Sizes		Thickness [cm]	Coordinates	
	lx [m]	ly [m]		x [m]	y [m]
1	6.00	6.00	20.0	0.00	0.00

Support conditions

N plate	Support width [cm]				bracing of sides[-,%]			
	B	R	T	L	B	R	T	L
1	30.0	30.0	30.0	30.0	0	0	0	0

Designations : B - bottom, R - right,
T - top, L - left

Bracing of plate: -1 - Free edge

0 - simple support

100 - clamping

Columns

N	lx [cm]	ly [cm]	x [m]	y [m]	P	V	M	Stiffness
1	30.0	30.0	3.00	3.00	1	1	1	5.000e+06

x, y - column center coordinates raised relative
to the vertex (V) of the plate (P)

Model of column (M):

1 - elastic base over the entire area of the
column (stiffness in kN/m3)

2 - rigid point support in the center column

3 - point spring in the center column
(stiffness in kN/m and kNm respectively)

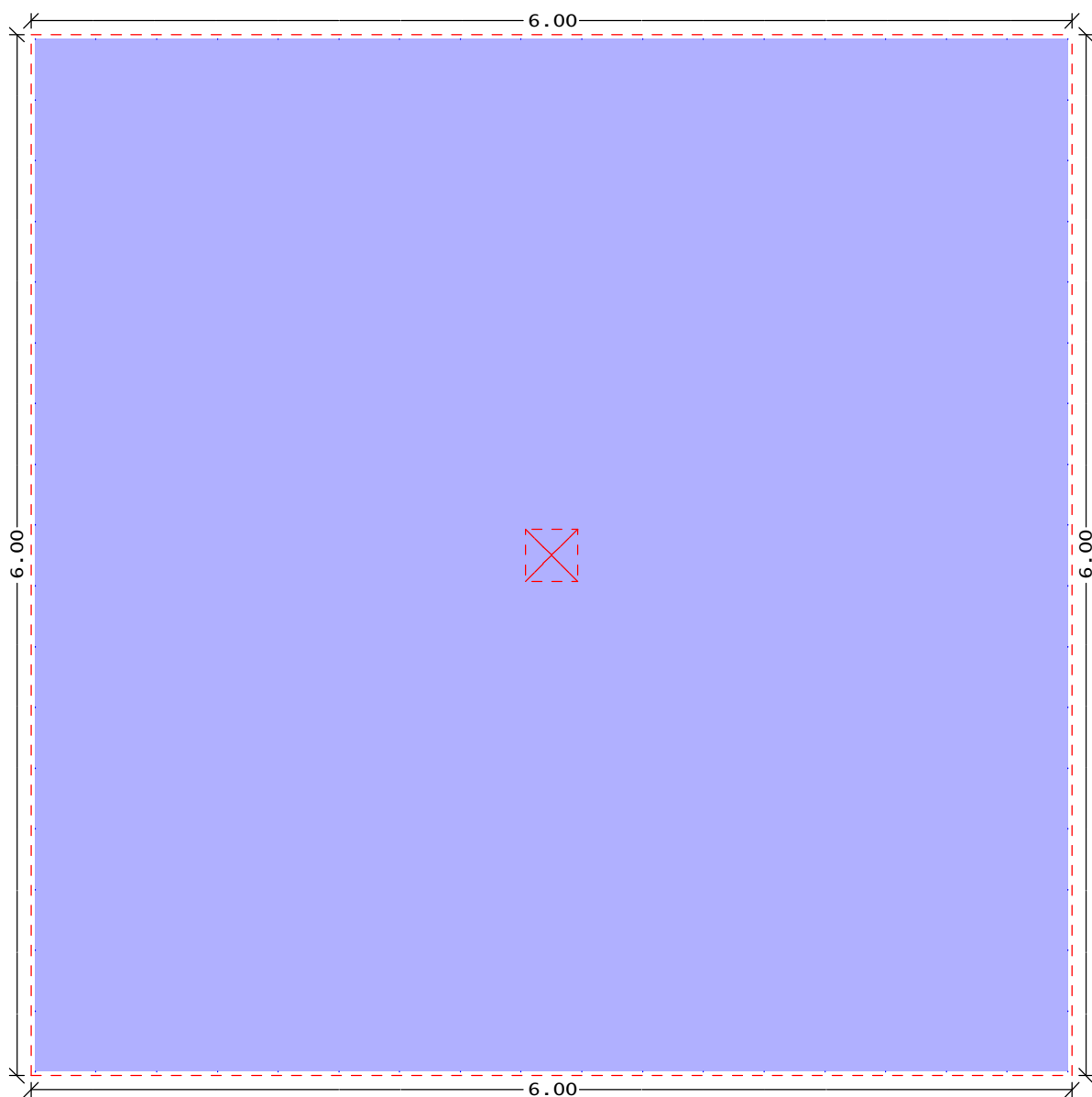
Caps of columns

N column	Kind	lx [cm]	ly [cm]	h [cm]
1	smooth	50.0	50.0	30.0

Loads

N	Kind	Comb. factor			γ_f	Distribution on fields	P[kN]
1	Постоянное воздей				1.35	Fixed	180.00
2	Категория Е: скла	1.00	0.90	0.80	1.50	Unfavorab.	720.00
P	- total load						

Load N 1
M = 1 : 40



Uniform load [kPa]

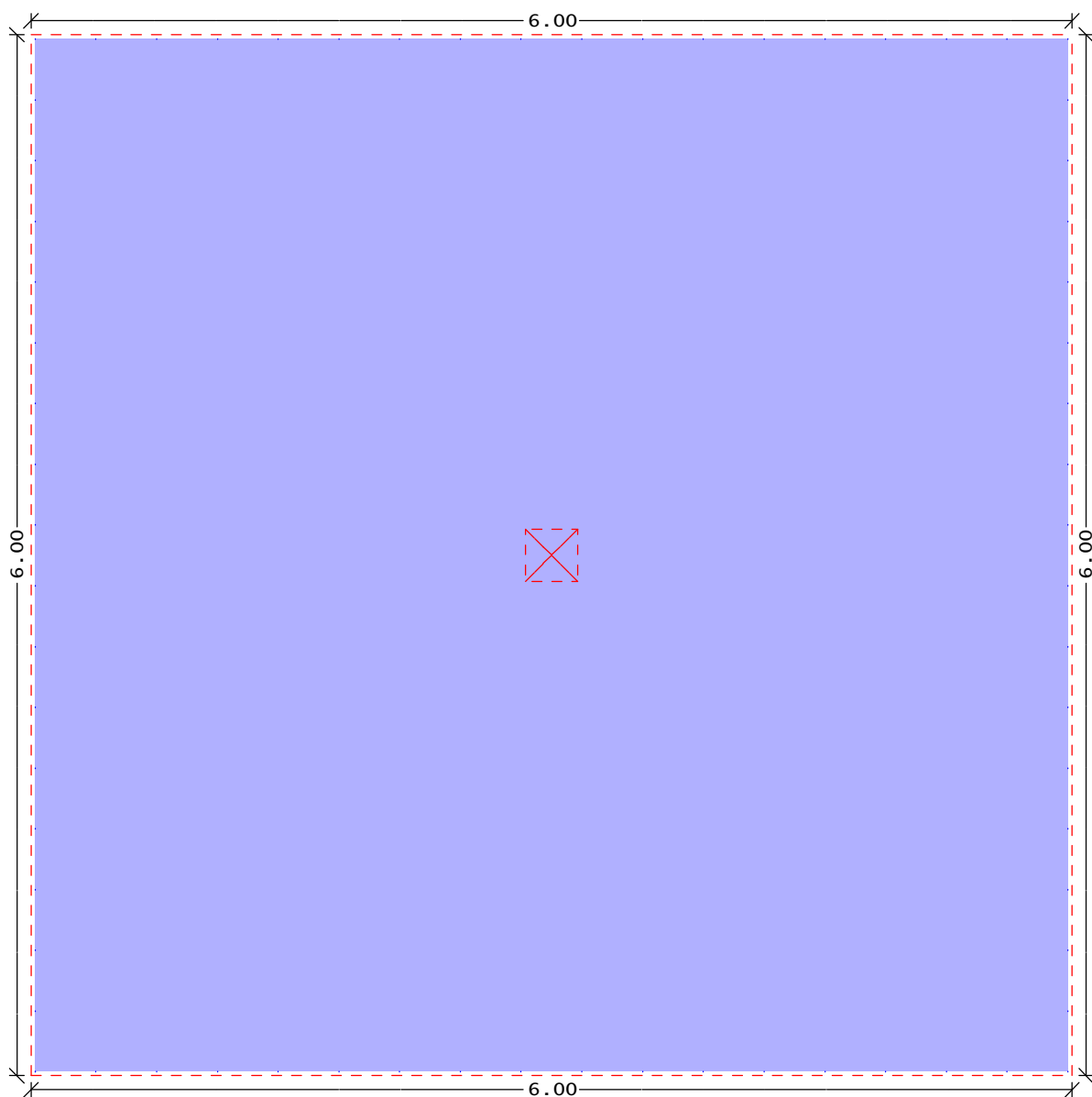
5.00



Uniform load

N plate	p [kPa]
1	5.00

Load N 2 1.00 0.90 0.80
M = 1 : 40



Uniform load [kPa]

20.00



Uniform load

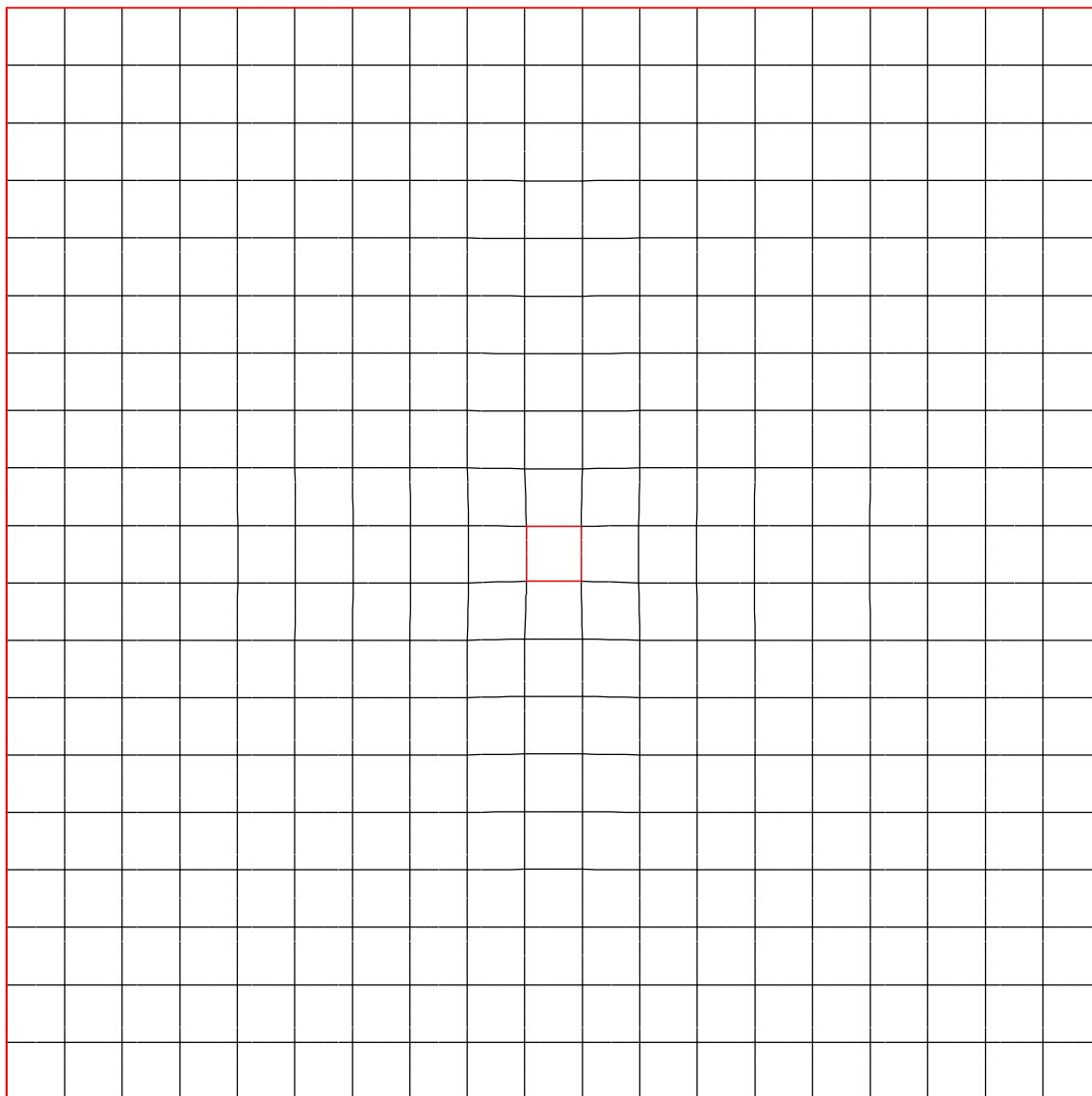
N plate	p [kPa]
1	20.00

Internal forces

from every load
(finite element method calculation)

Fe-grid

M = 1 : 40



The charact. size of the mesh $l = 0.30$ m

Elastic modulus $E_{cm} = 31000$ MPa

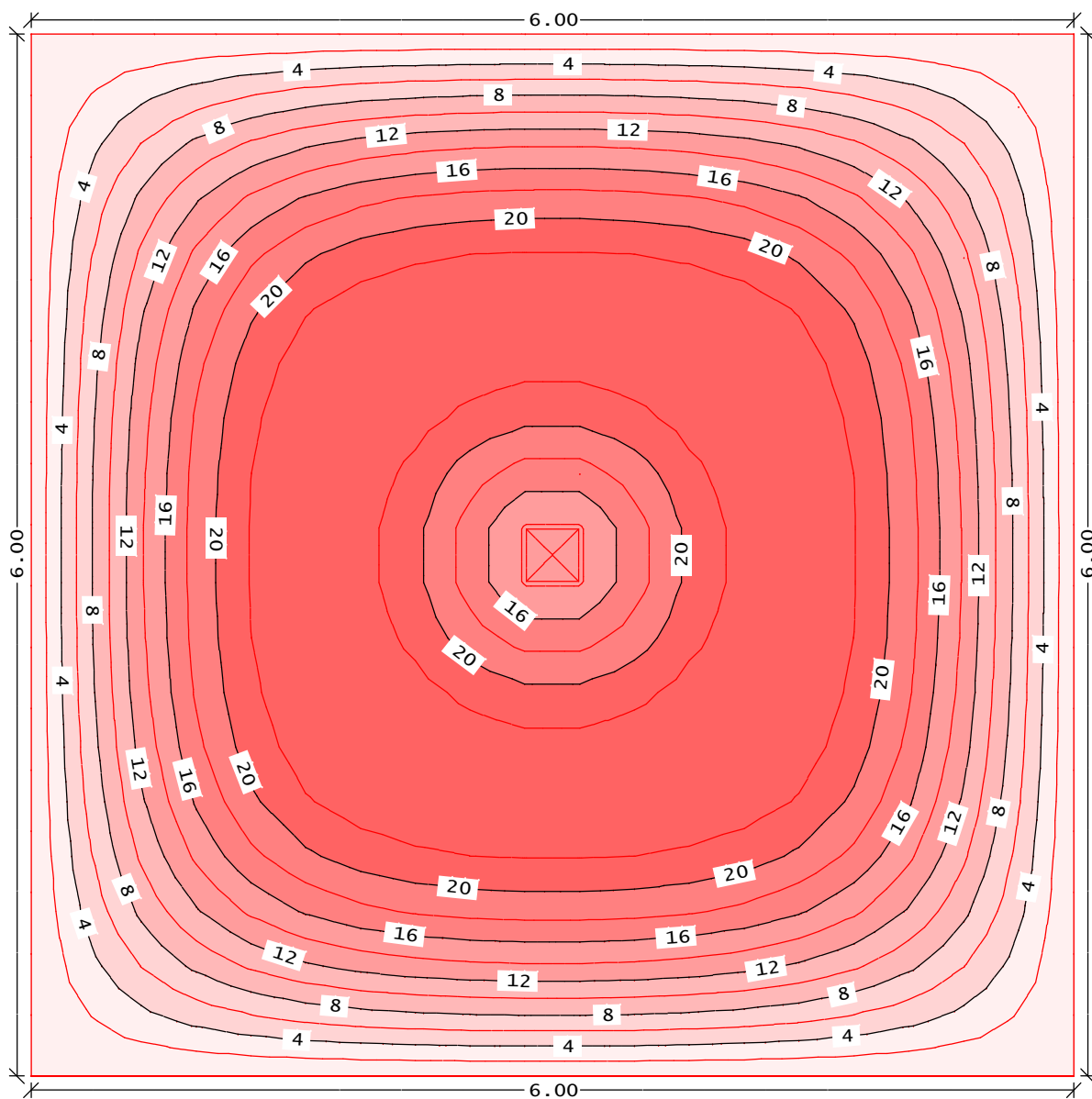
Poisson's ratio $\nu = 0.20$

Factor for torsion 0.5

Load _____ N 1
Deflections _____

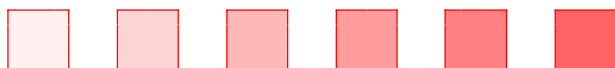
M = 1 : 40

[mm]



All values are multiplied by 100

0.0 4.0 8.0 12.0 16.0 20.0 23.8



Deflections

№ plate

w [mm]

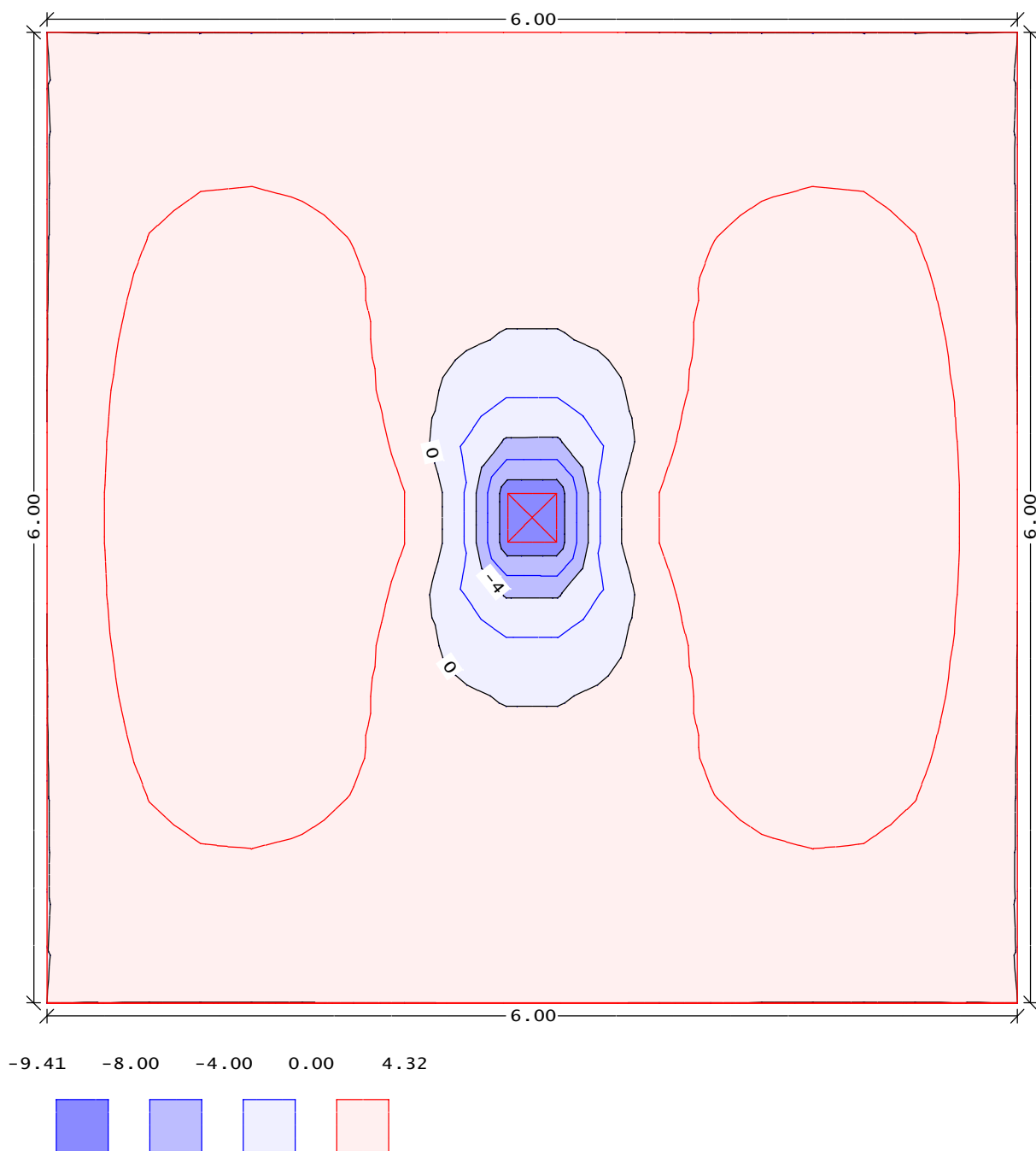
1

0.24

Moments Mx

[kNm / m]

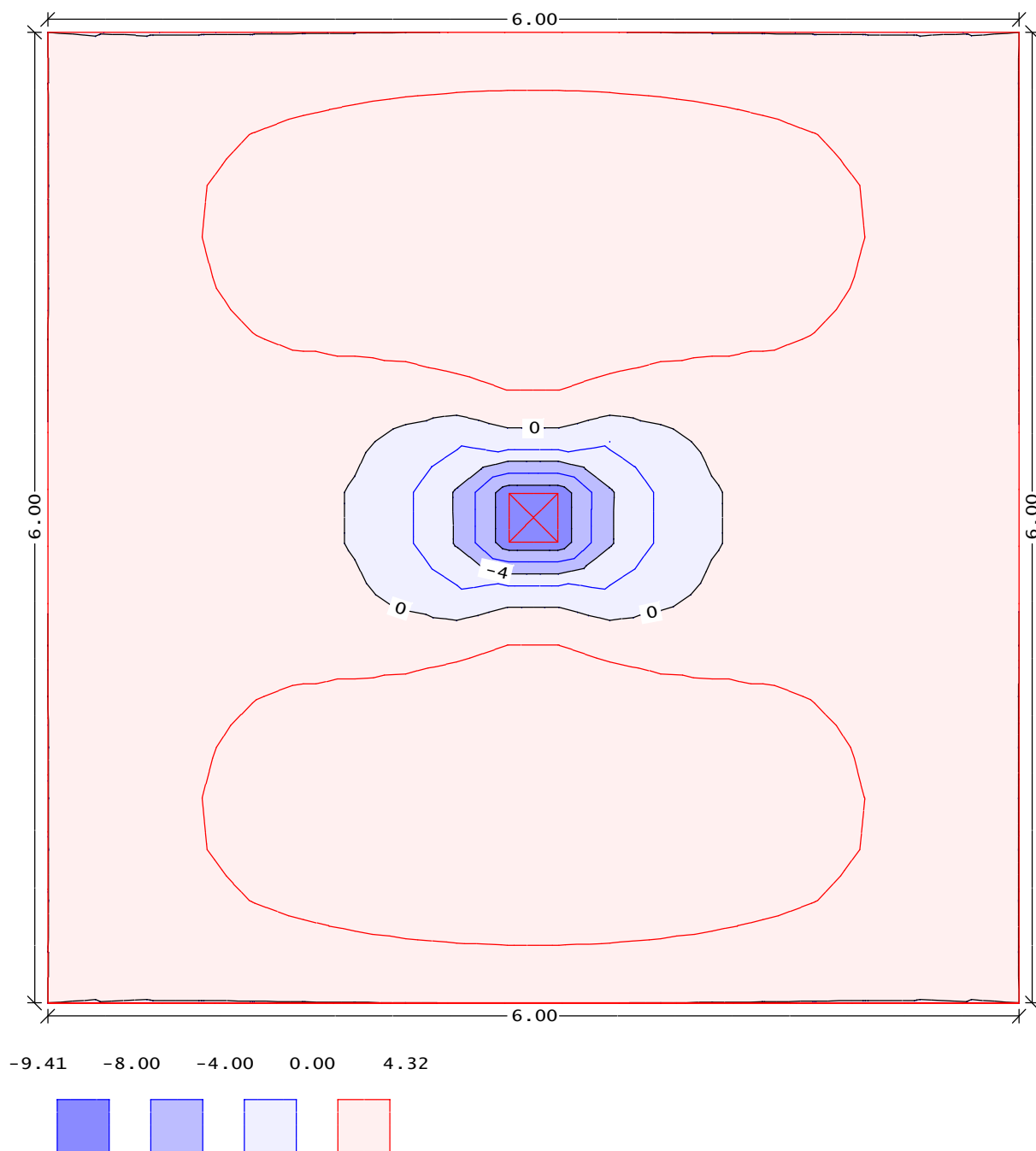
M = 1 : 40



Moments My

[kNm / m]

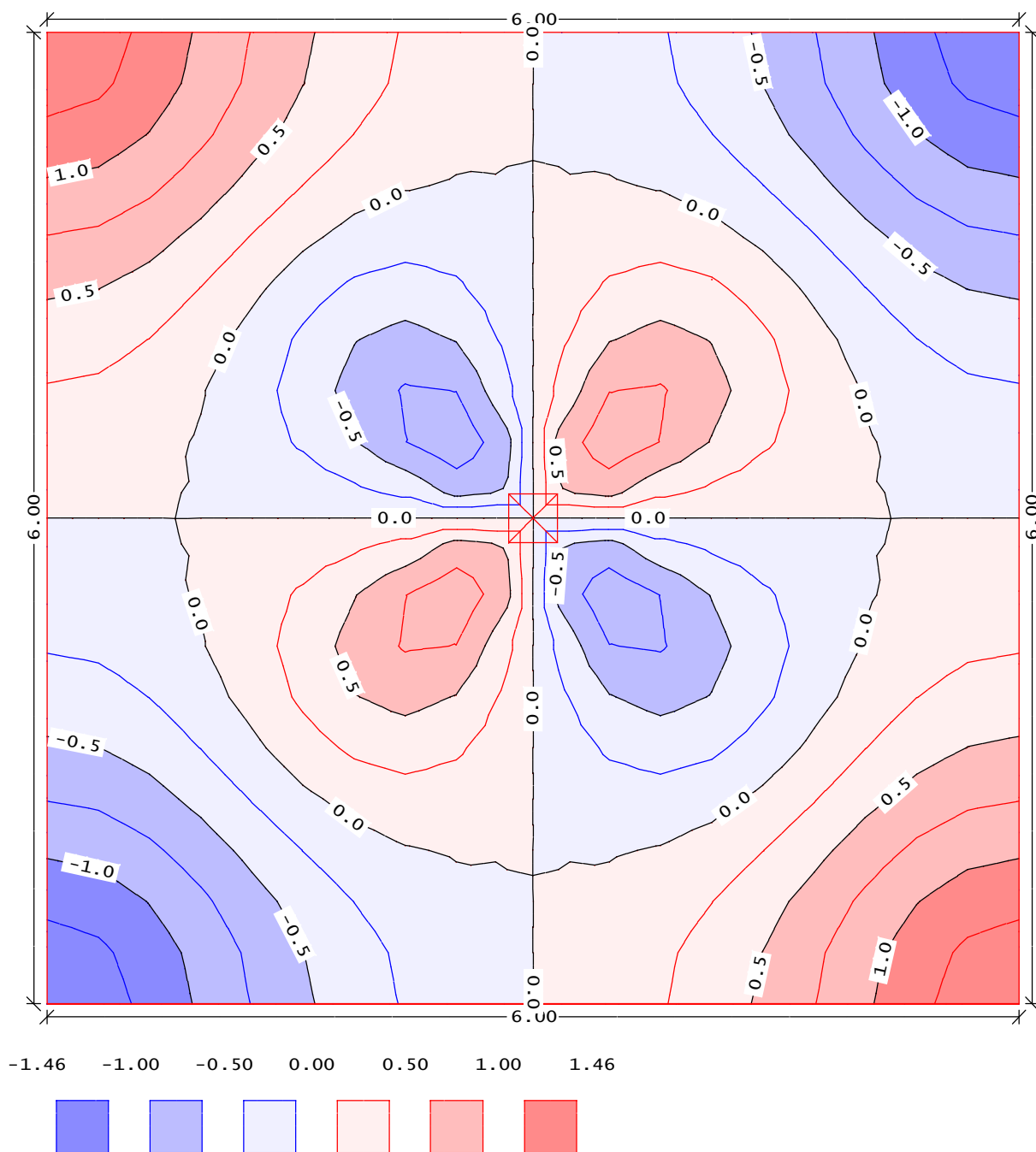
M = 1 : 40



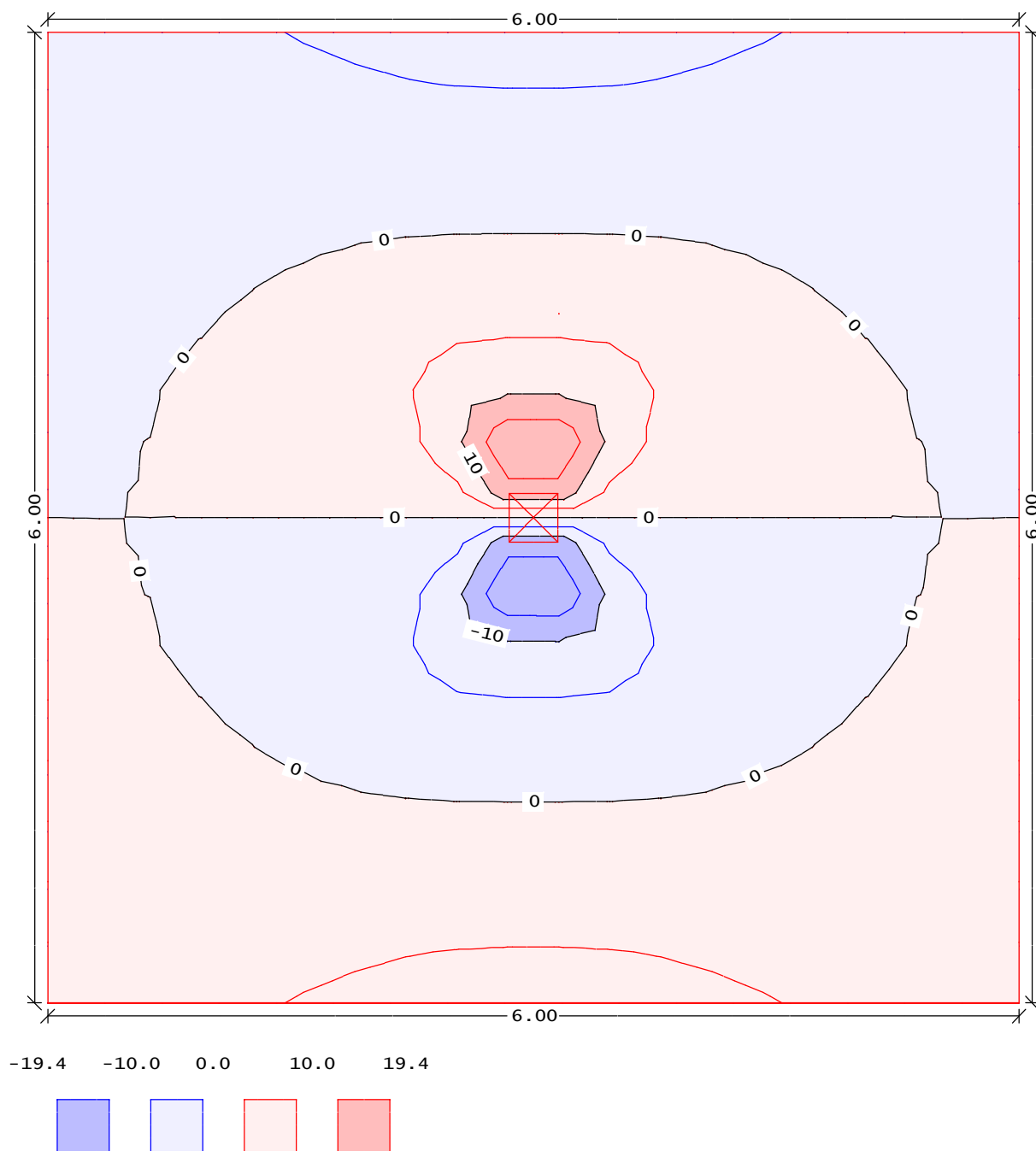
Moments Mxy

[kNm / m]

M = 1 : 40



Shear forces Q_y [kN/m]
M = 1 : 40



Support reactions

№ plate	Side	a [m]	l [m]	q [kN/m]
1	Bottom	0.00	6.00	5.05
	Right	0.00	6.00	5.05
	Top	0.00	6.00	5.05
	Left	0.00	6.00	5.05

Support reactions
at columns

№	Q [kN]	Mx [kNm]	My [kNm]
1	58.83	0.00	-0.00

The sum of all support reactions Q = 180.0 kN

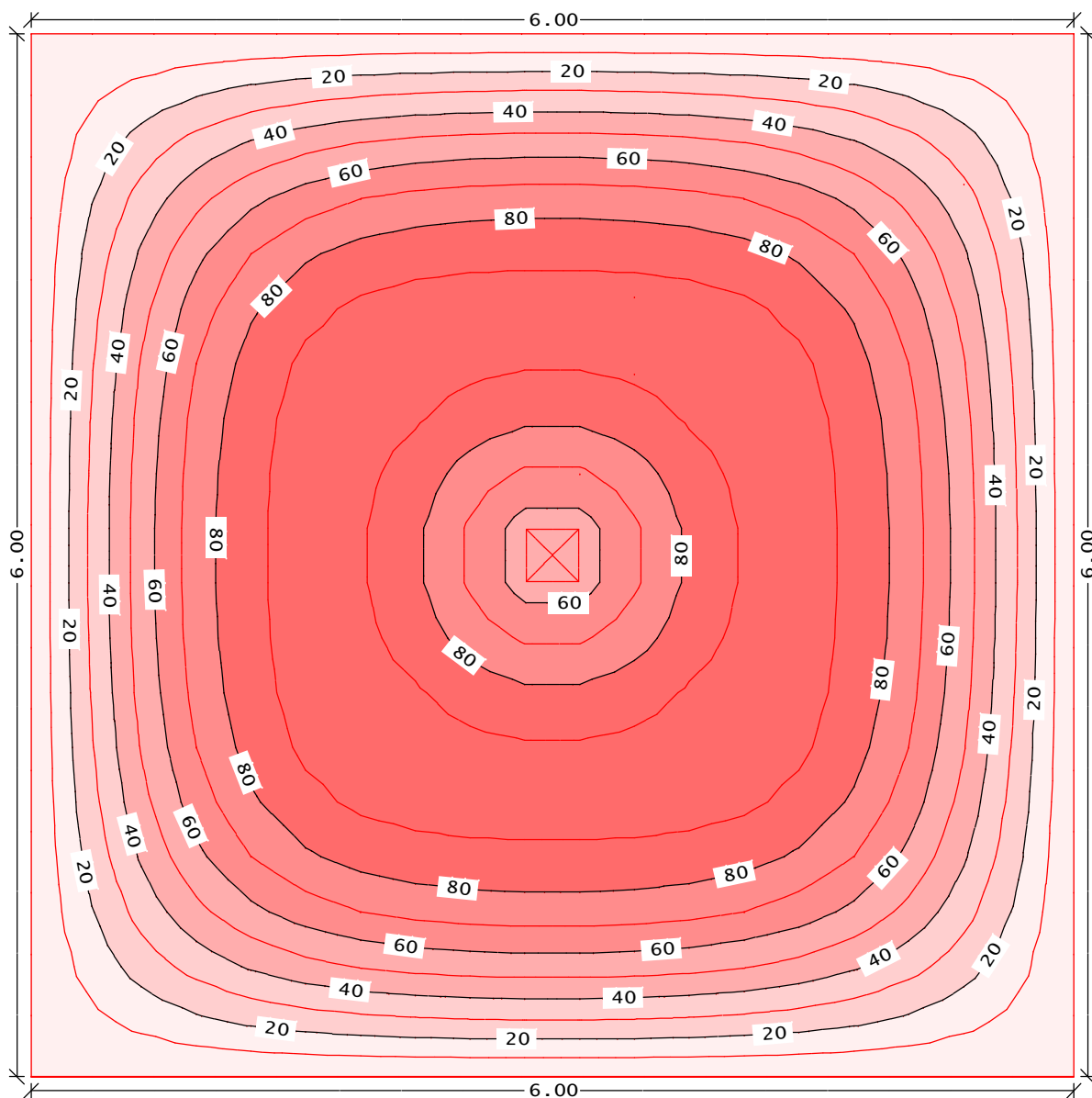
Load _____ N 2

Deflections

M = 1 : 40

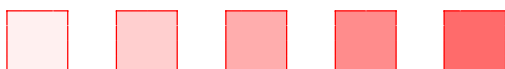
1.00 0.90 0.80

[mm]



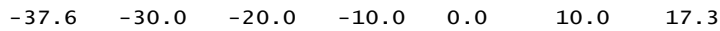
All values are multiplied by 100

0.0 20.0 40.0 60.0 80.0 95.1



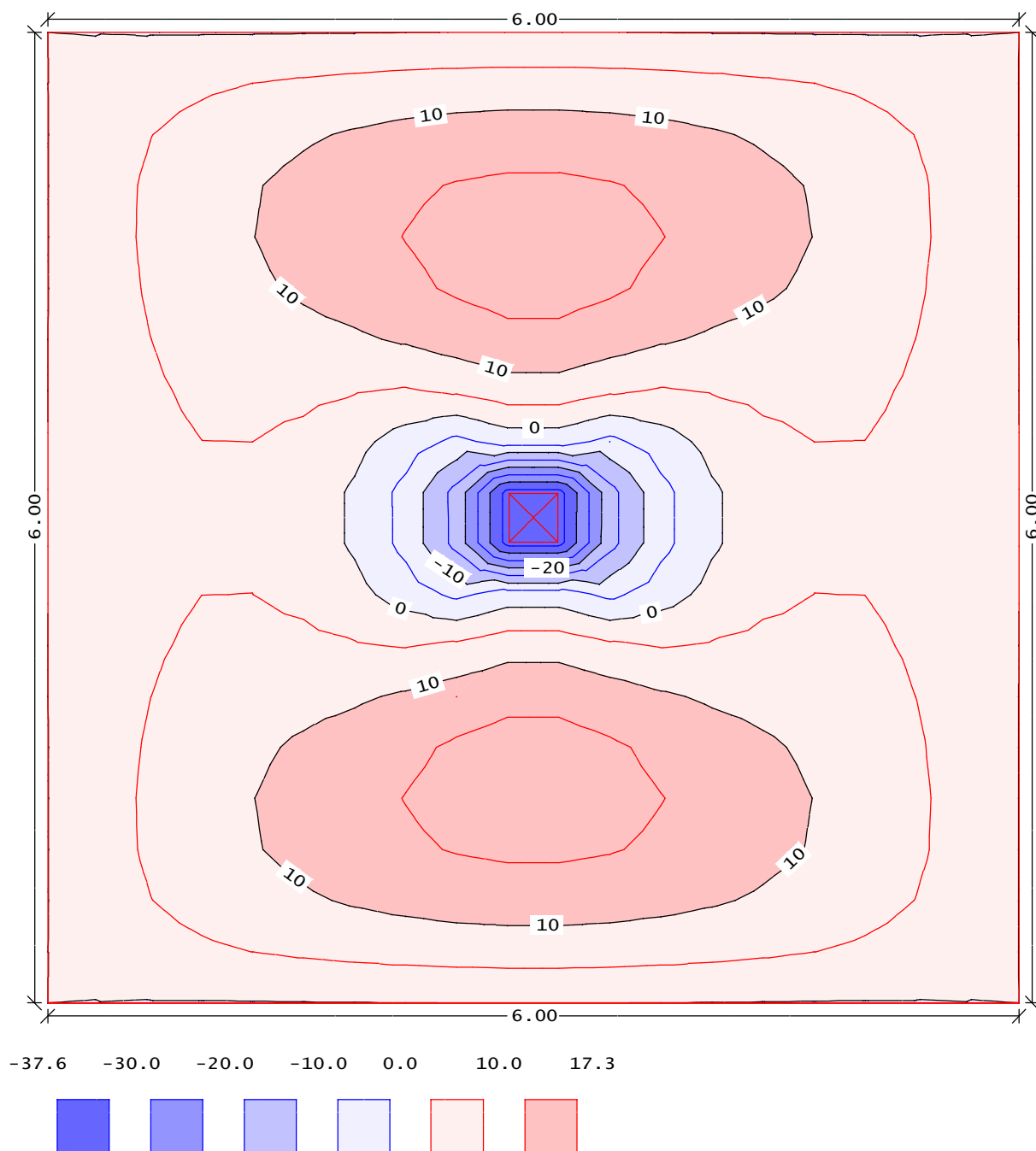
0.95

M = 1 : 40



Moments M_y
 $M = 1 : 40$

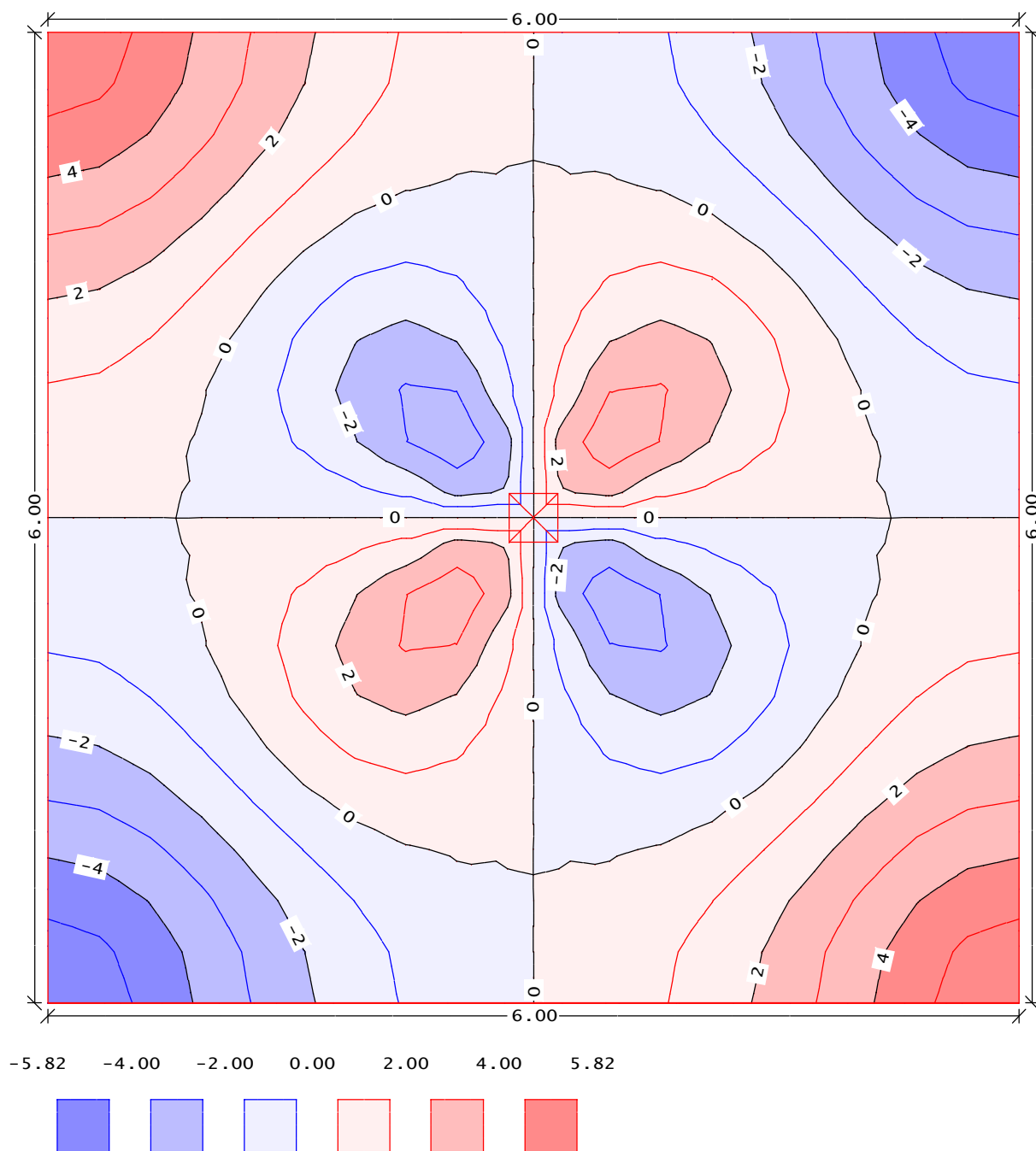
[kNm / m]



Moments Mxy

[kNm/m]

M = 1 : 40



Nº plate	Side	a [m]	l [m]	q [kN/m]
1	Bottom	0.00	6.00	20.19
	Right	0.00	6.00	20.19
	Top	0.00	6.00	20.19
	Left	0.00	6.00	20.19

Support reactions
at columns

№	Q [kN]	Mx [kNm]	My [kNm]
1	235.33	0.00	-0.00

The sum of all support reactions Q = 720.0 kN

Combinat. of loads

Factor
Combination

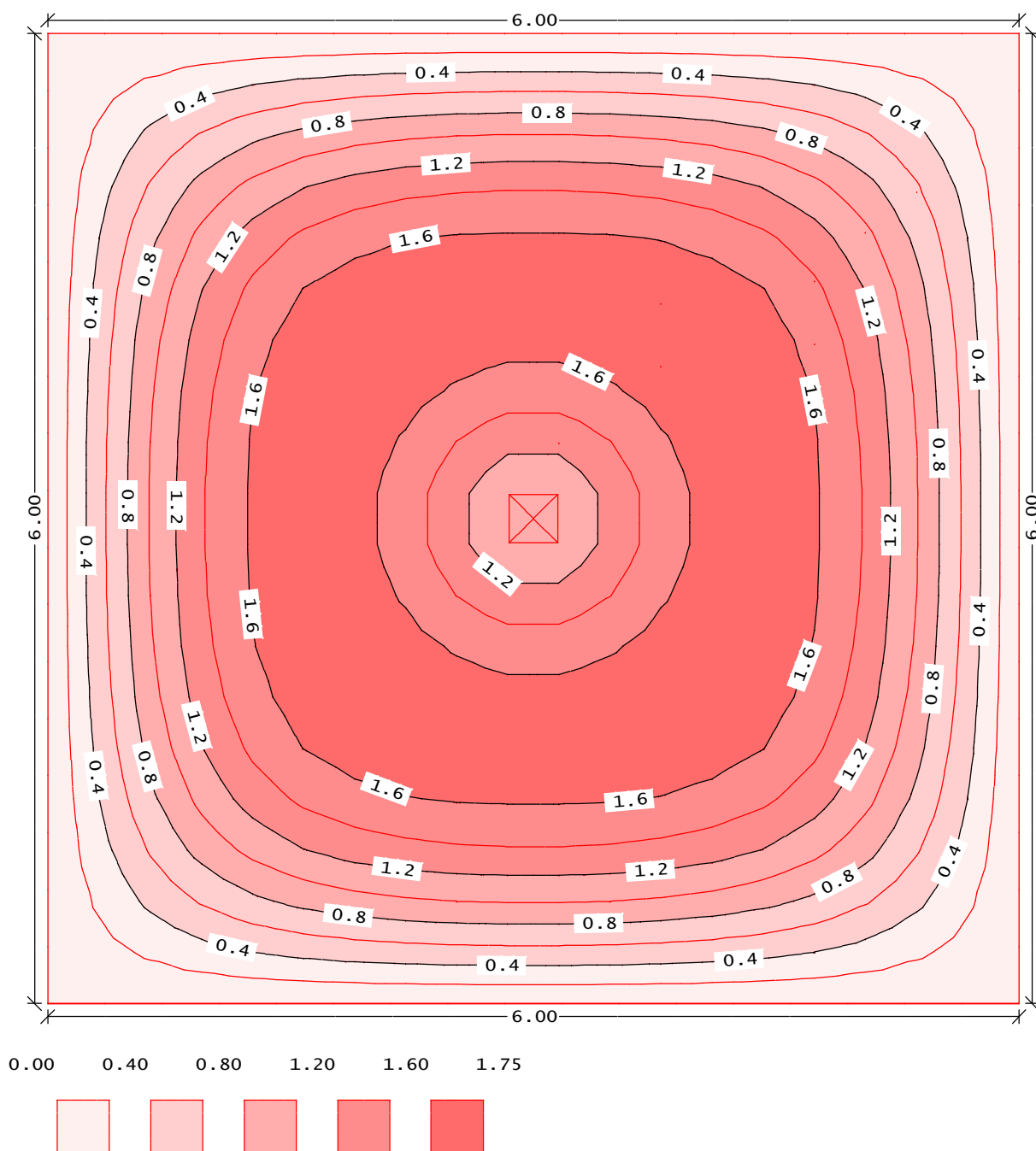
according to p. 6.4.3 MSZ EN 1990:2011.
for reliability differentiation
of actions by formula (6.10) EN 1990

 $K_{FI} = 1.00$

Deflections

M = 1 : 40

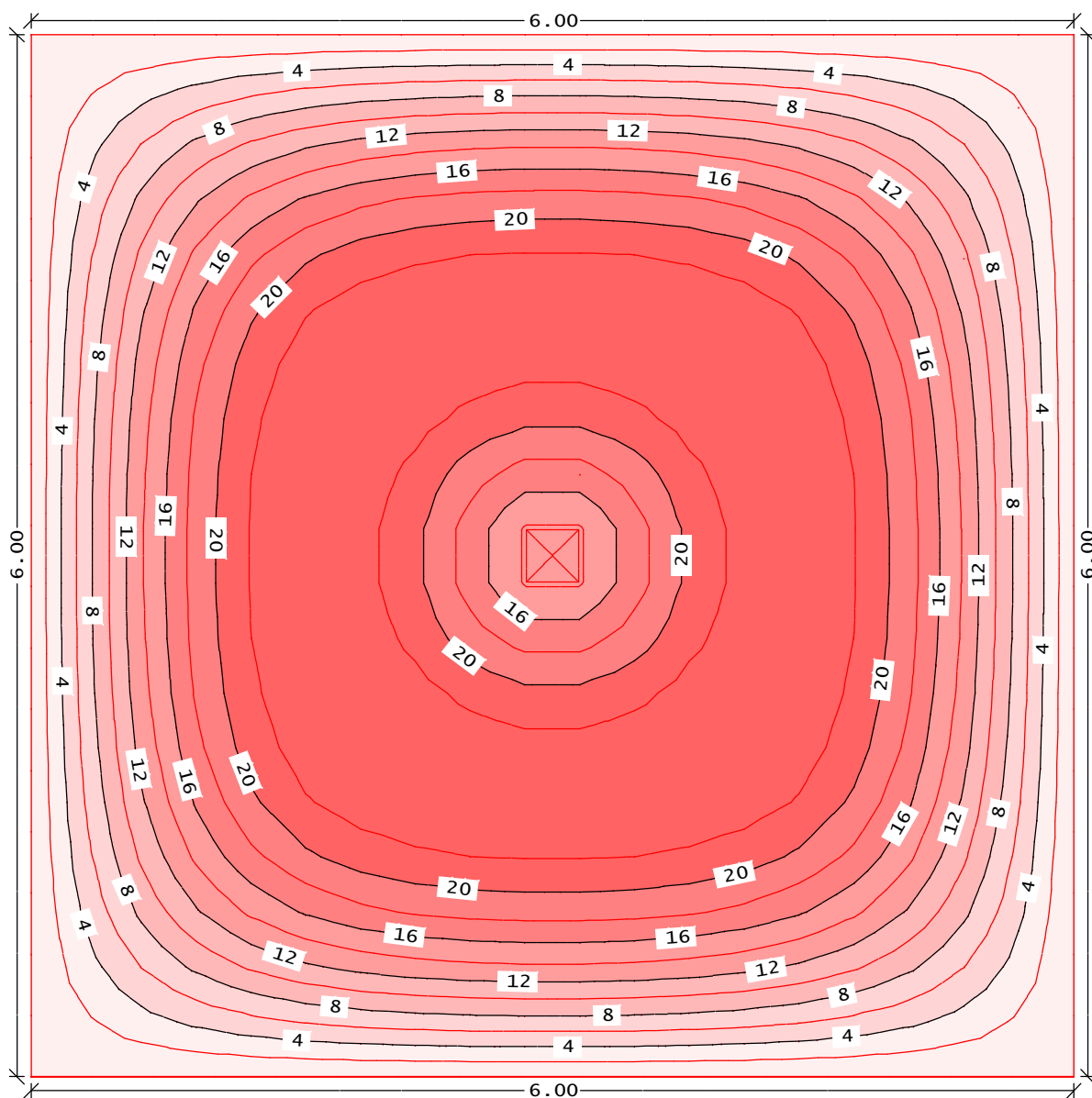
(maximal values) [mm]



Deflections

(minimal values) [mm]

M = 1 : 40



All values are multiplied by 100

0.0 4.0 8.0 12.0 16.0 20.0 23.8



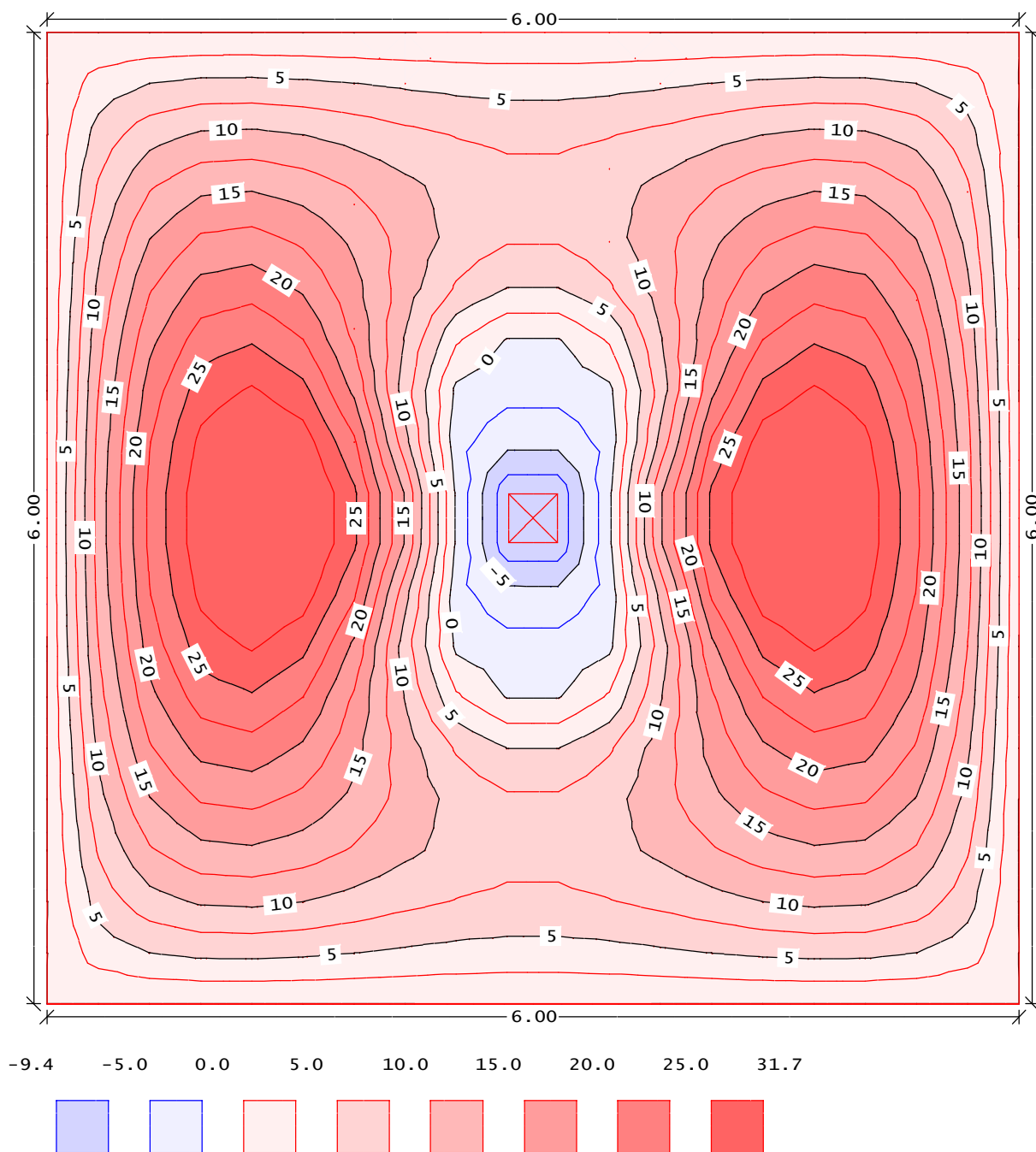
Deflections

№ plate	max w [mm]	min w [mm]
1	1.75	0.00

Moments Mx

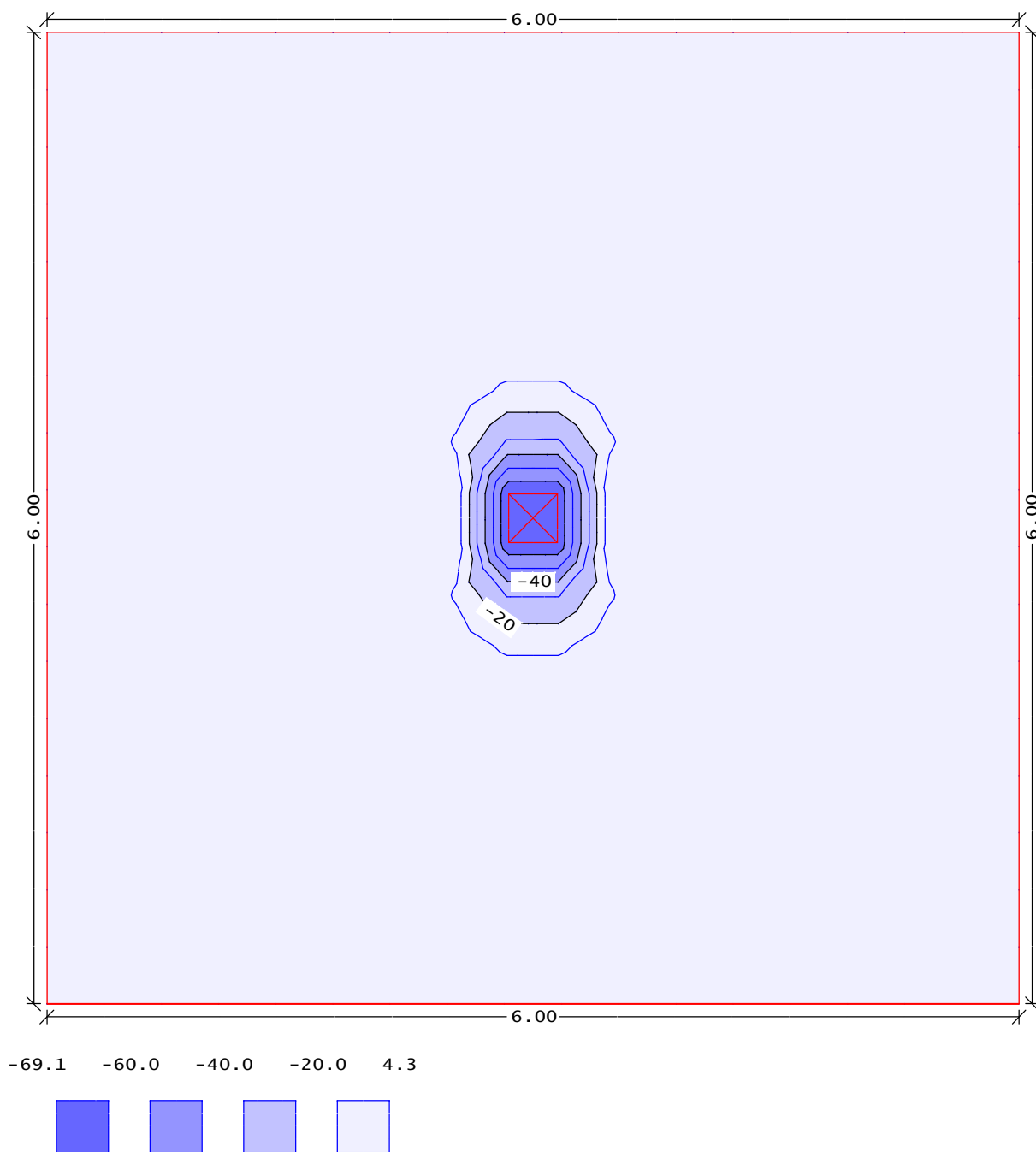
(maximal values) [kNm/m]

M = 1 : 40



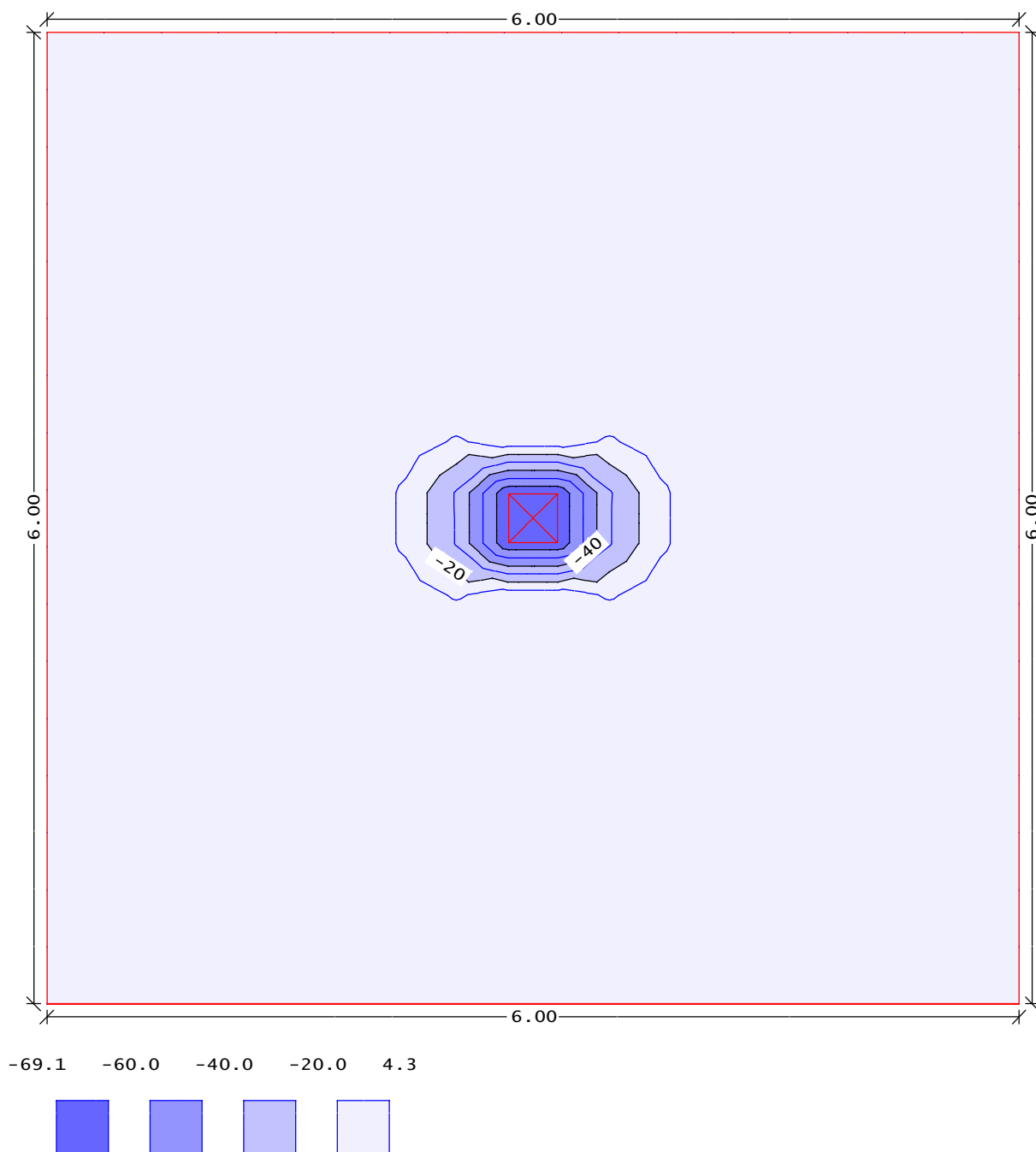
Moments Mx
M = 1 : 40

(minimal values) [kNm/m]



Moments My
M = 1 : 40

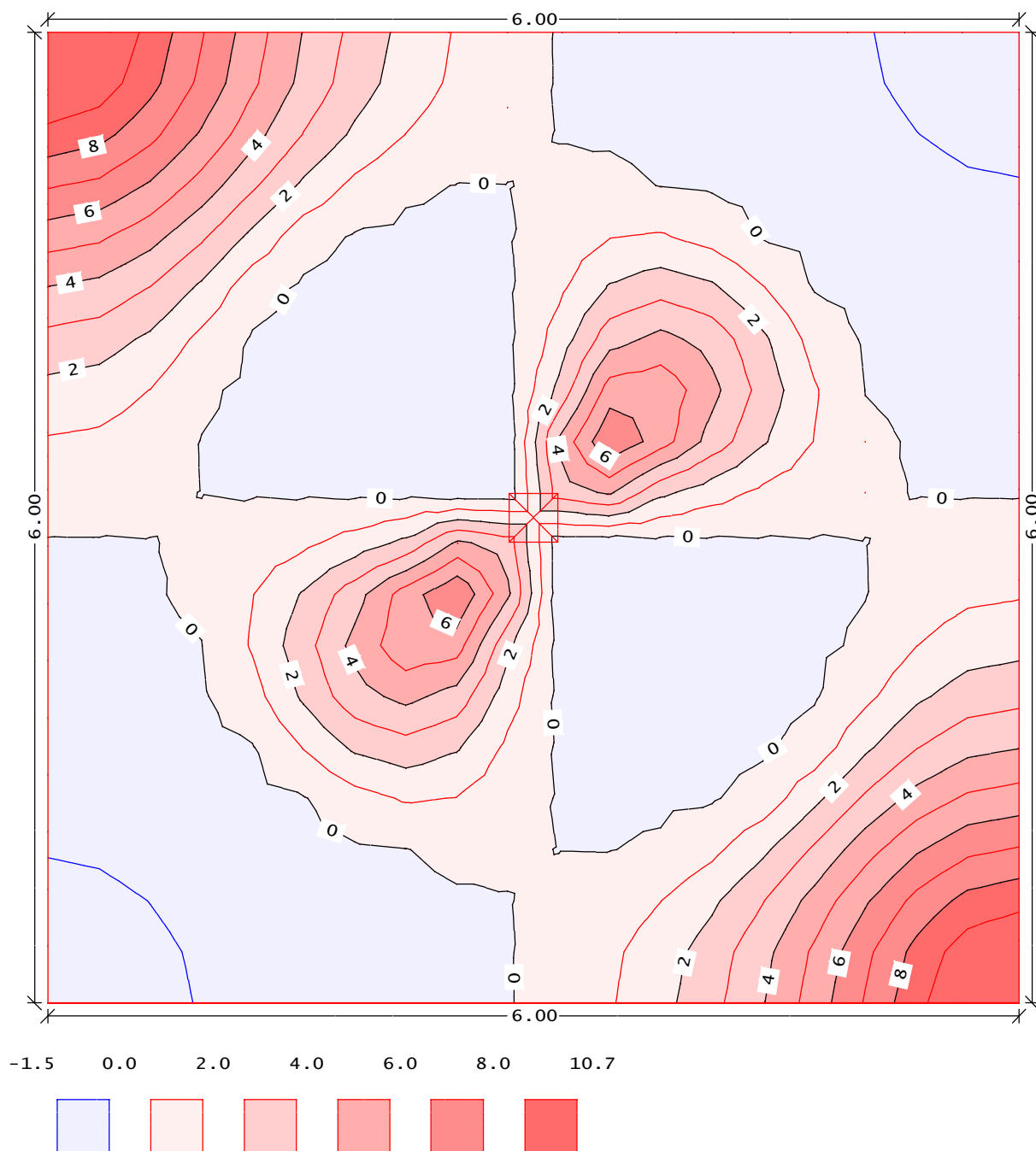
(minimal values) [kNm/m]



Moments Mxy

(maximal values) [kNm/m]

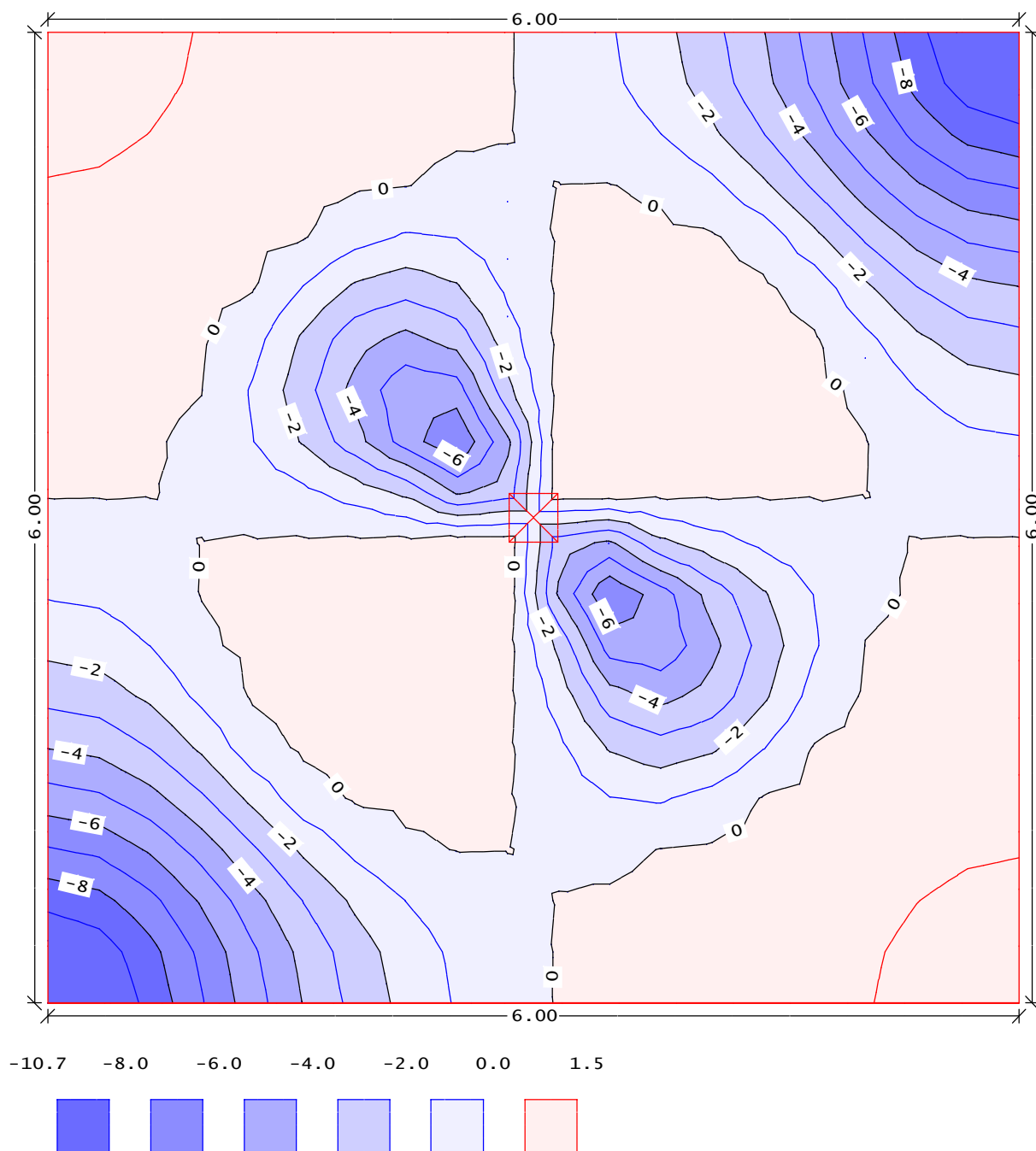
M = 1 : 40



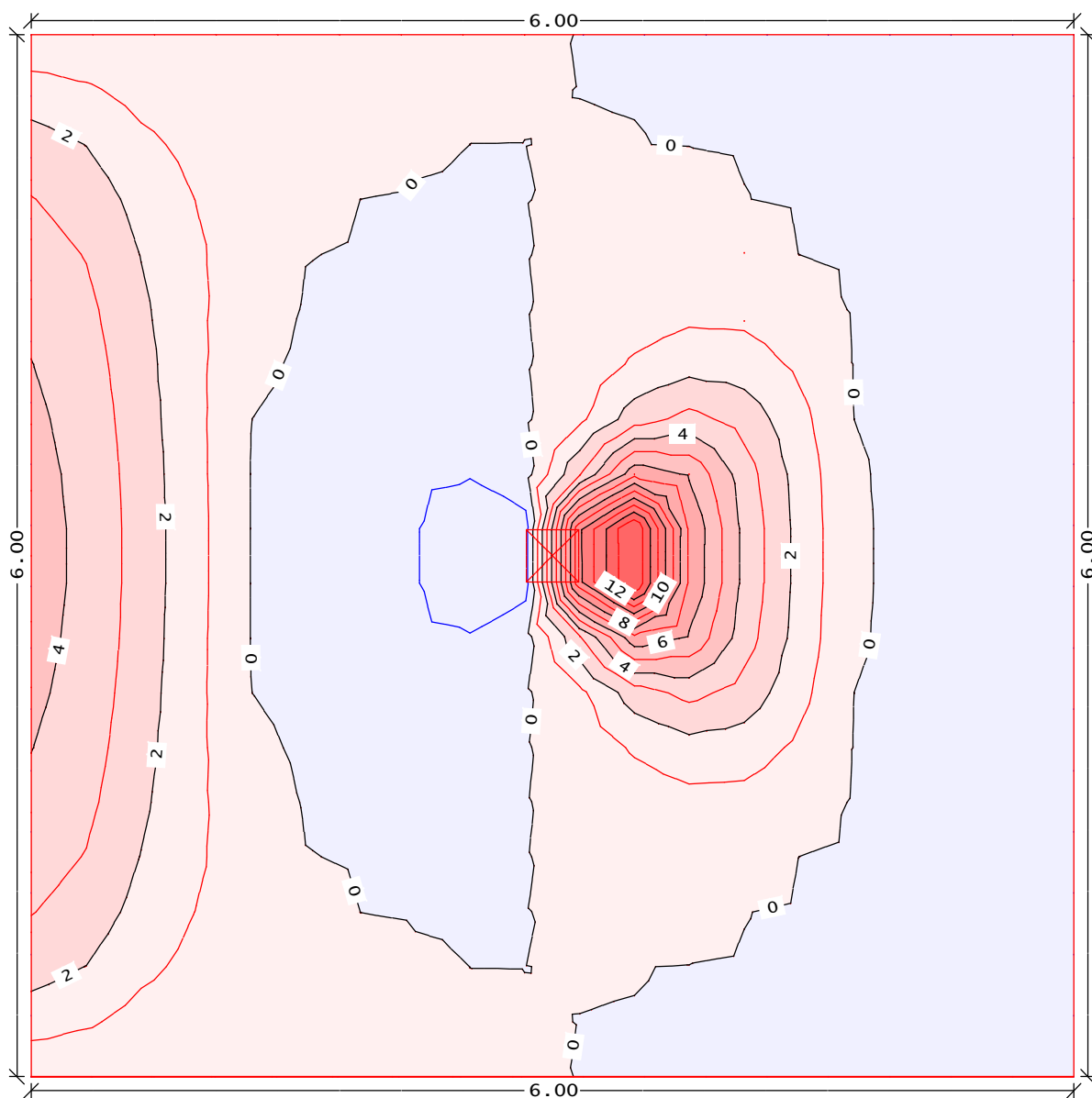
Moments Mxy

(minimal values) [kNm/m]

M = 1 : 40



Shear forces Q_x (maximal values) [kN/m]
M = 1 : 40

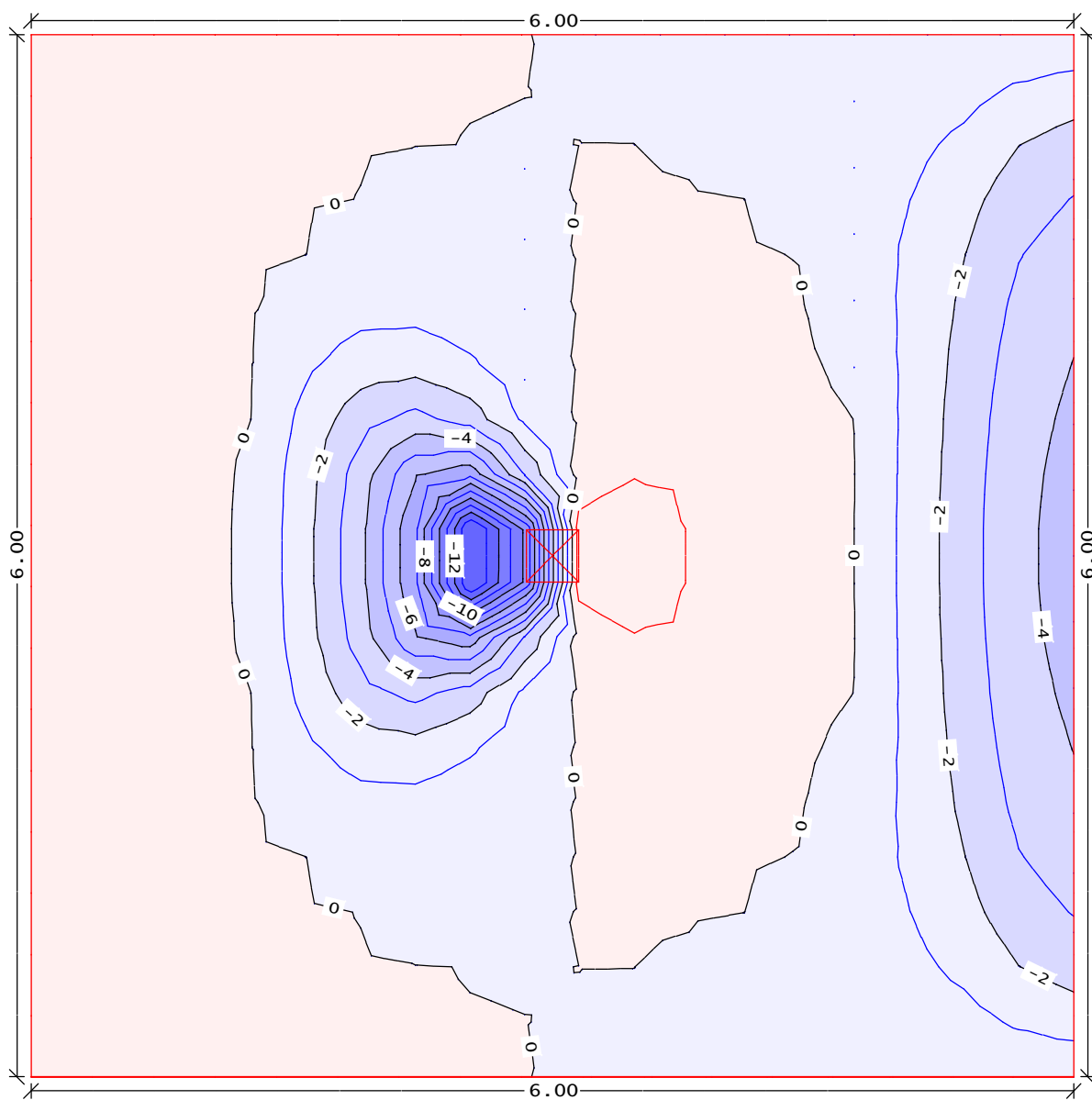


All values are multiplied by 0.1

-1.9 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.3



Shear forces Q_x (minimal values) [kN/m]
M = 1 : 40

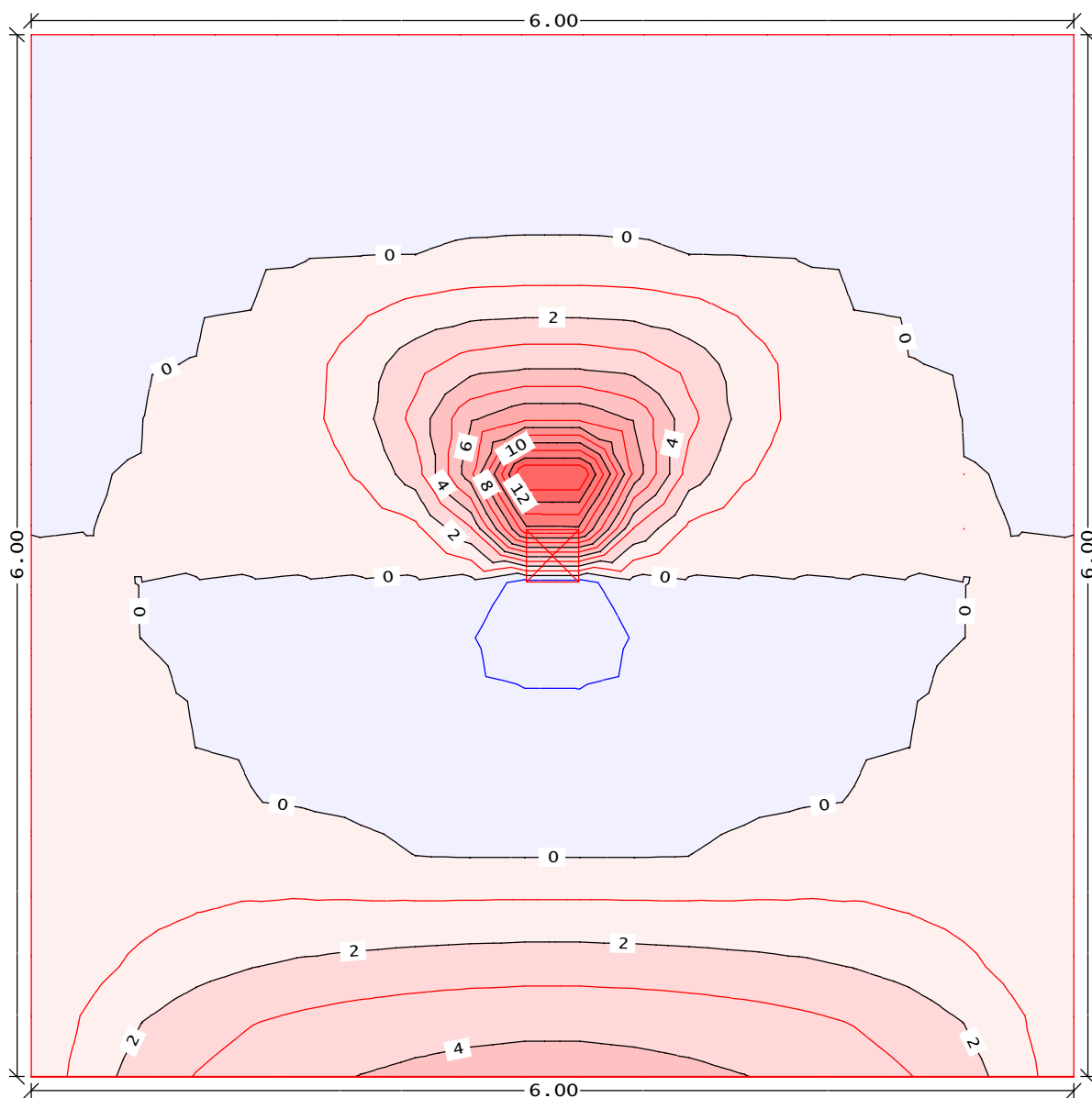


All values are multiplied by 0.1

-14.2 -12.0 -10.0 -8.0 -6.0 -4.0 -2.0 0.0 1.9



Shear forces Q_y (maximal values) [kN/m]
М = 1 : 40

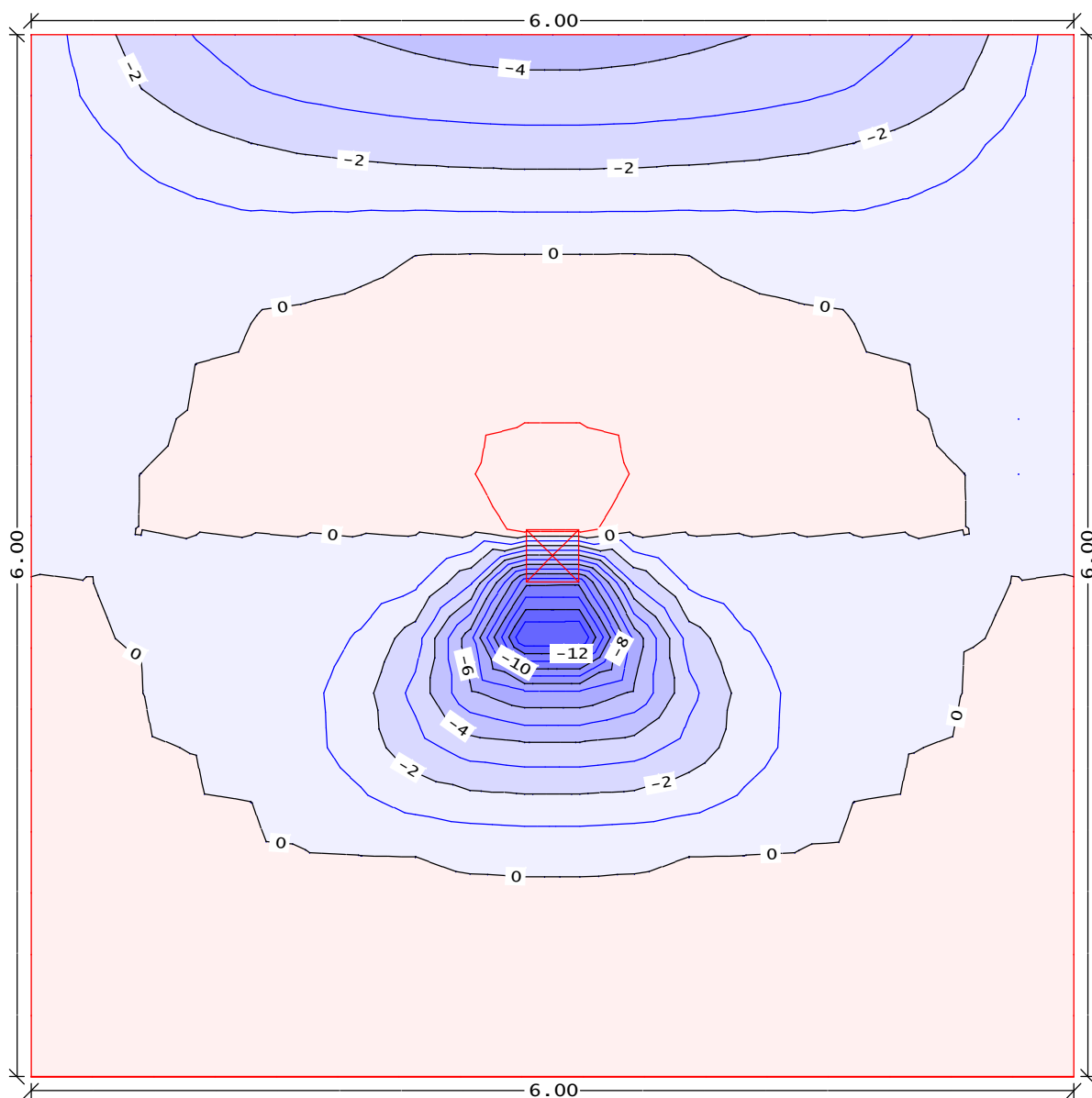


All values are multiplied by 0.1

-1.9 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.3



Shear forces Q_y (minimal values) [kN/m]
M = 1 : 40



All values are multiplied by 0.1

-14.2 -12.0 -10.0 -8.0 -6.0 -4.0 -2.0 0.0 1.9



Support reactions
(by segments)

№ plate	Side	a [m]	l [m]	max q [kN/m]	min q [kN/m]
1	Bottom	0.00	6.00	37.11	5.05
	Right	0.00	6.00	37.11	5.05
	Top	0.00	6.00	37.11	5.05
	Left	0.00	6.00	37.11	5.05

Support reactions
at columns

№	max Q [kN]	min Q [kN]	max Mx [kNm]	min Mx [kNm]	max My [kNm]	min My [kNm]
1	432.42	58.83	0.00	0.00	-0.00	-0.00

Calculated moments

Significant combin.

№ combinat.	№ load	Factor	Loaded fields
1	1	1.35	+
	2	1.50	+

Moments to determine
bottom reinforcement

№ plate	D	№ comb.	M [kNm/m]	Corresponding moments		
				Mx [kNm/m]	My [kNm/m]	Mxy [kNm/m]
1	X	1	32.13	31.75	7.89	0.38
	Y	1	32.13	7.89	31.75	0.38

Moments to determine
top reinforcement
on sides of plates

№ plate	Side	D	№ comb.	M [kNm/m]	Corresponding moments		
					Mx [kNm/m]	My [kNm/m]	Mxy [kNm/m]
1	Bottom	X	1	-10.70	0.00	0.00	10.70
		Y	1	-10.70	0.00	0.00	10.70
	Right	X	1	-10.70	0.00	0.00	-10.70
		Y	1	-10.70	0.00	0.00	-10.70
	Top	X	1	-10.70	0.00	0.00	-10.70
		Y	1	-10.70	0.00	0.00	-10.70
	Left	X	1	-10.70	0.00	0.00	10.70
		Y	1	-10.70	0.00	0.00	10.70

Moments to determine
top reinforcement
above the columns

№ column	D	№ comb.	M [kNm/m]	Corresponding moments		
				Mx [kNm/m]	My [kNm/m]	Mxy [kNm/m]
1	X	1	-72.54	-69.13	-69.13	3.40
	Y	1	-72.54	-69.13	-69.13	3.40

Strength design

by MSZ EN 1992-1-1: Design of concrete structures.

Hard concrete class

C 25/30

Definition of longitudinal reinforcement

Longitudinal reinforcement class

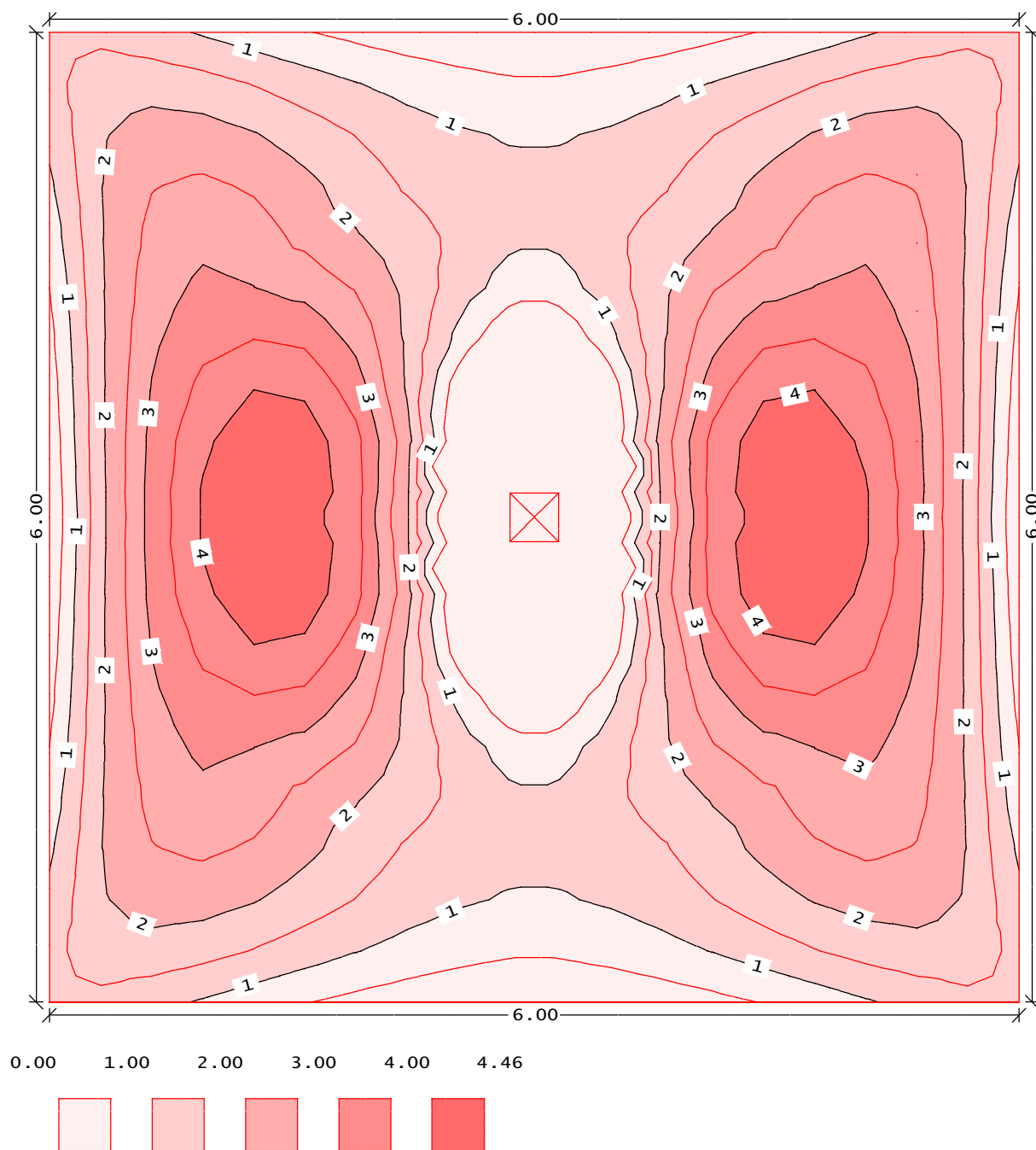
S 500

Distance to gr.c.
longitud. reinforc.

№ plate	Bottom reinforc. ax[cm]	ay[cm]	Top reinforcement ax[cm]	ay[cm]
1	3.5	3.5	3.5	3.5

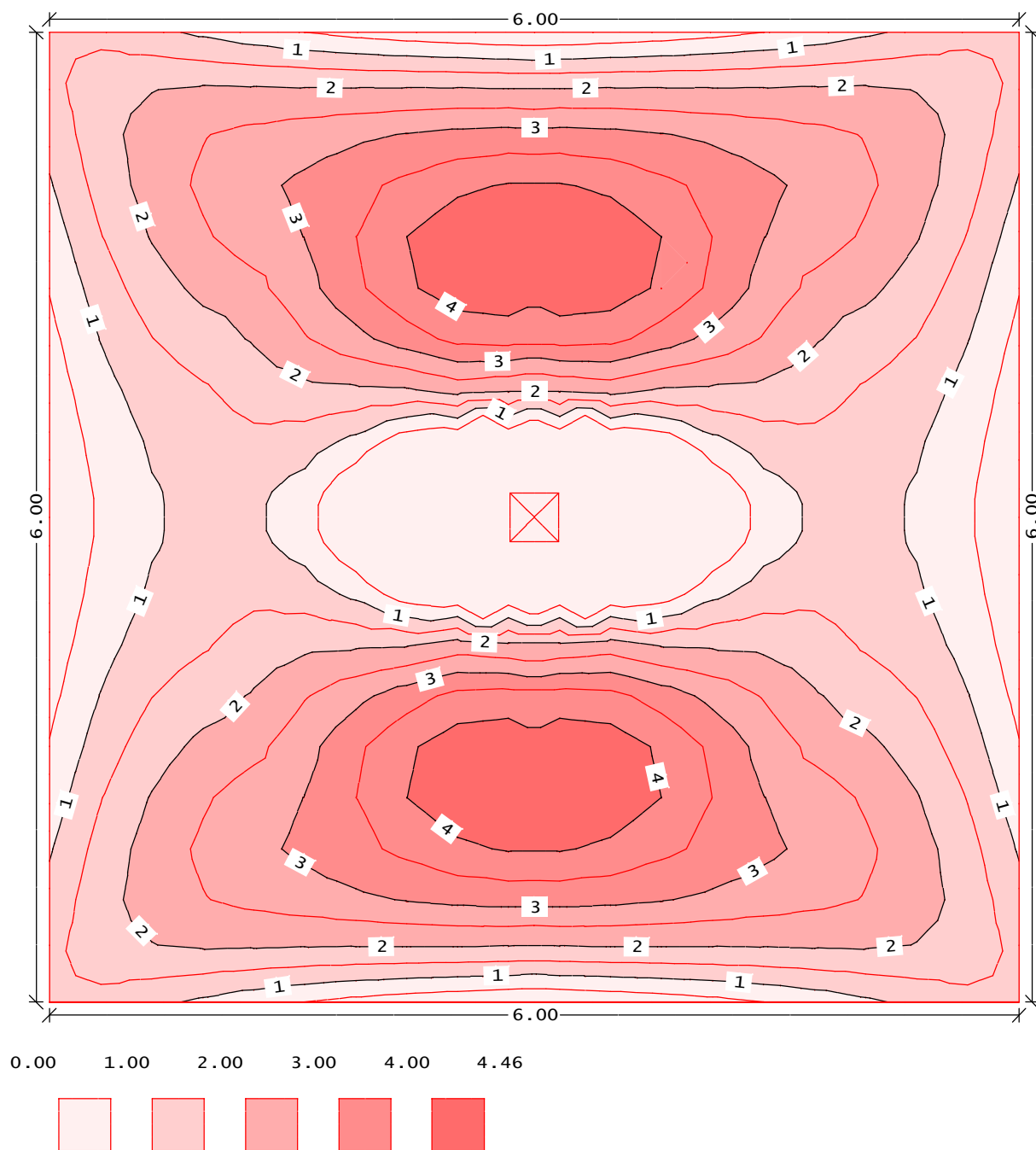
Bottom reforc. Asx[cm²/m]

M = 1 : 40



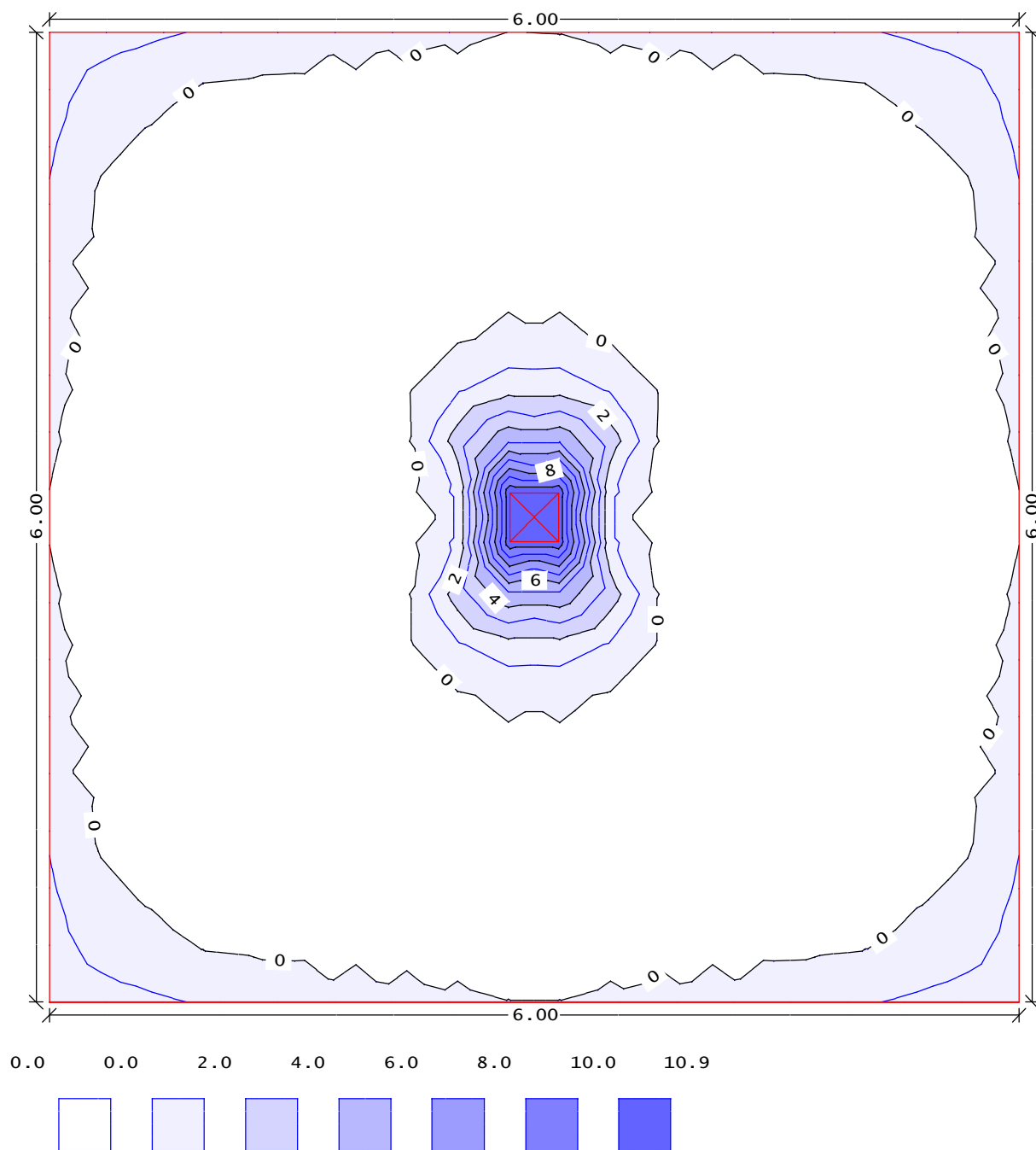
Bottom reforc. Asy[cm²/m]

М = 1 : 40



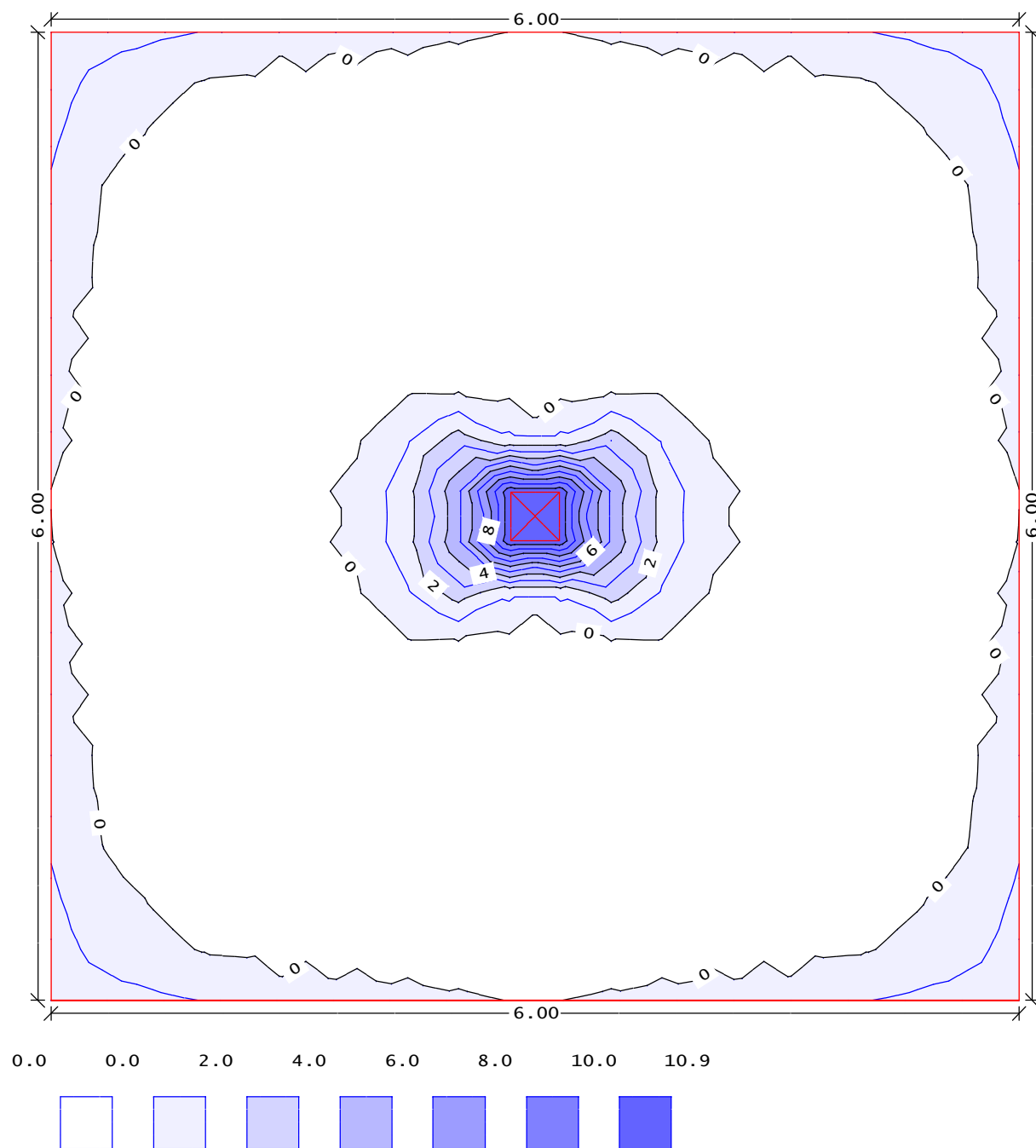
Top reinforc. Asx [cm²/m]

M = 1 : 40



Top reinforc. Asy [cm²/m]

M = 1 : 40



Bottom reinforcement

№	Mx	Asx	My	Asy
plate	[kNm/m]	[cm ² /m]	[kNm/m]	[cm ² /m]
1	32.13	4.46	32.13	4.46

Top reinforcement
on sides of plates

№ plate	Side	Mx [kNm/m]	Asx [cm ² /m]	My [kNm/m]	Asy [cm ² /m]
1	Bottom	-10.70	1.45	-10.70	1.45
	Right	-10.70	1.45	-10.70	1.45
	Top	-10.70	1.45	-10.70	1.45
	Left	-10.70	1.45	-10.70	1.45

Top reinforcement
above the columns

№ column	Mx [kNm/m]	Asx [cm ² /m]	My [kNm/m]	Asy [cm ² /m]
1	-72.54	10.87	-72.54	10.87

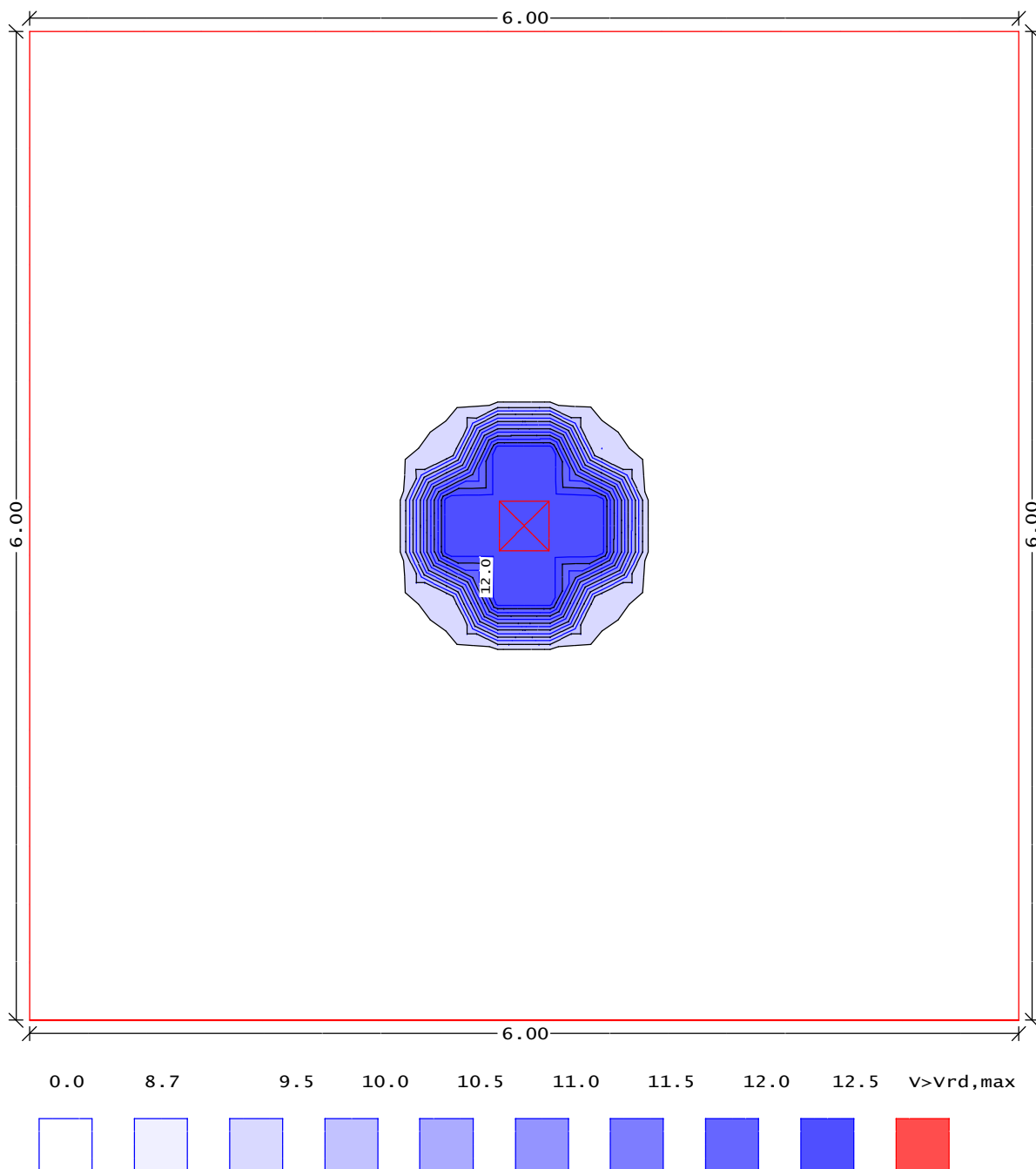
Definition of shear reinforcement

Shear reinforcement class

S 400

Shear reinforcement A_{sw} [cm^2/m^2]

$M = 1 : 40$



Shear reinforcement on the sides of plates

№ plate	Side	a [m]	l [m]	Vsd [kN/m]	Vrd,ct [kN/m]	Vrd,max [kN/m]	Asw [cm ² /m ²]
1	Bottom	0.00	6.00	14.1	81.7	742.5	0.00
	Right	0.00	6.00	14.1	81.7	742.5	0.00
	Top	0.00	6.00	15.9	81.7	742.5	0.00
	Left	0.00	6.00	14.1	81.7	742.5	0.00

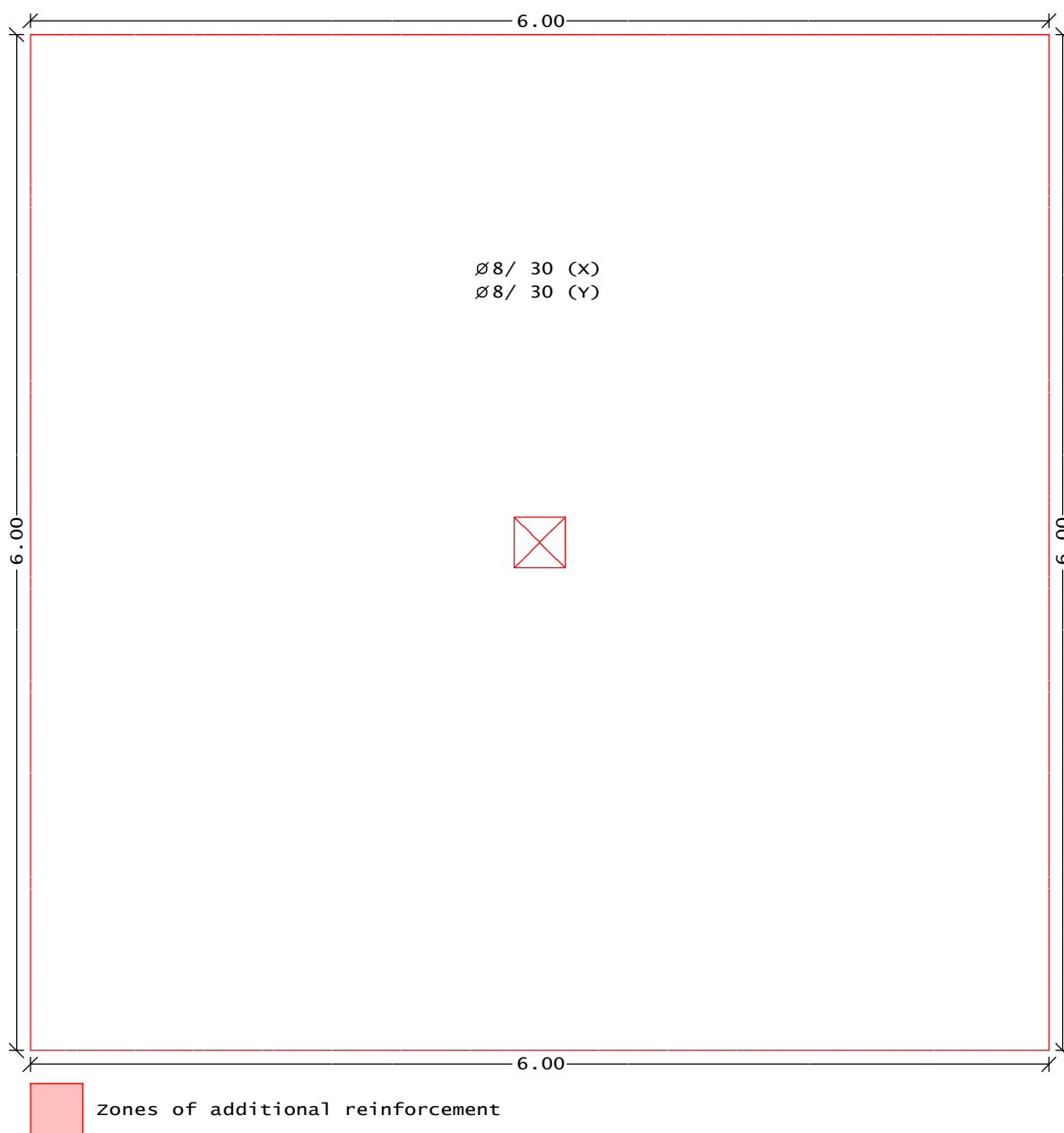
Shear reinforcement above the columns

№	Vsd [kN/m]	Vrd,ct [kN/m]	Vrd,max [kN/m]	Asw [cm ² /m ²]
1	137.8	100.7	451.9	12.52

Reinforc. designing

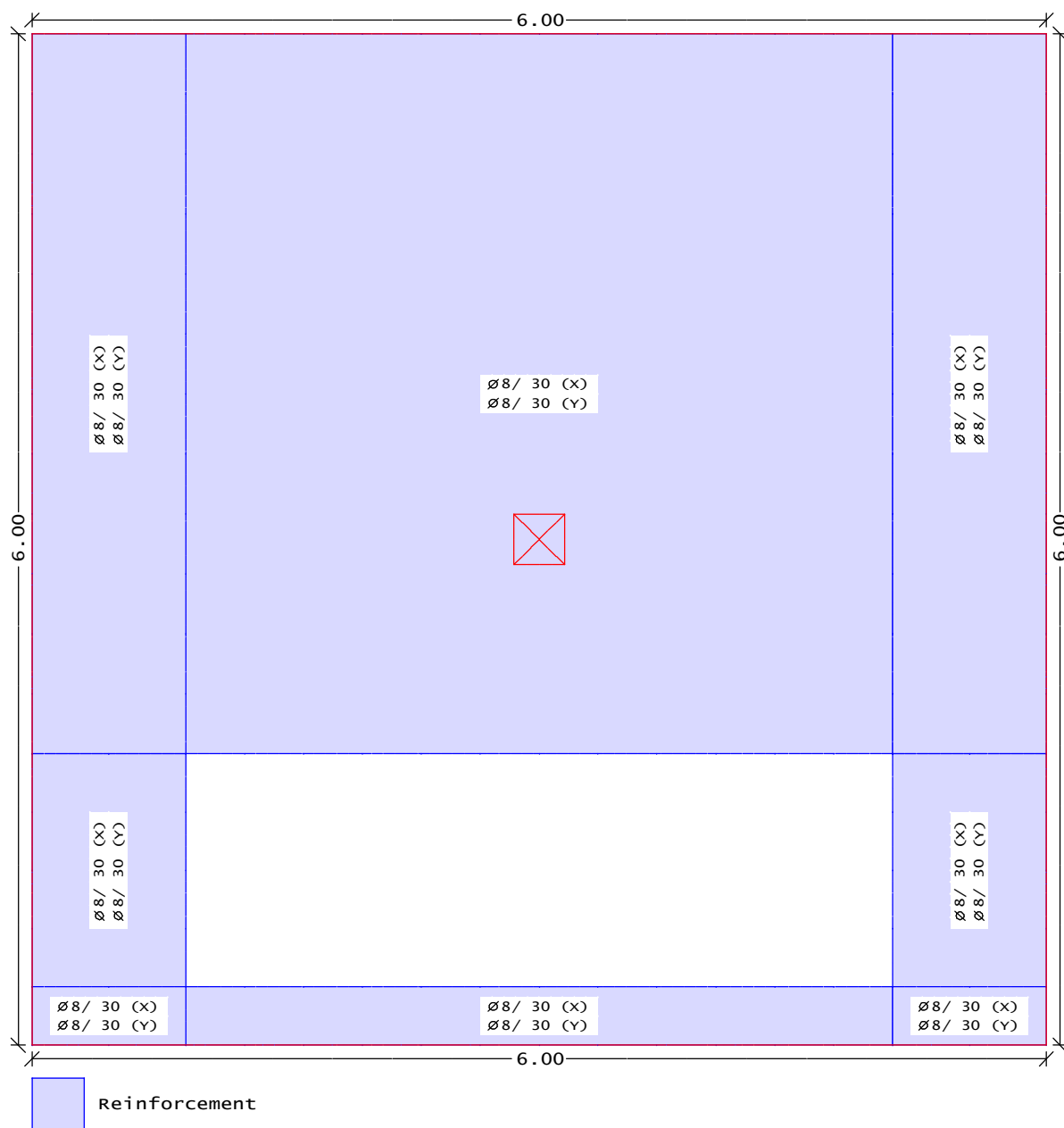
Selected bottom reinforcement

M = 1 : 40



Selected top reinforcement

M = 1 : 40



Main bottom reinforcement

№ plate	D	Required As [cm ² / m]	Selected Diameter [mm]	Selected Step [mm]	As [cm ² / m]
1	X	4.46	8	30	16.76
	Y	4.46	8	30	16.76

D - direction

Top reinforcement

№ plate	Location	l [m]	D	Required	Selected		
				As	Diameter	Step	As
				[cm ² / m]	[mm]	[mm]	[cm ² / m]
1	Bottom	0.3	X	1.00	8	30	16.76
			Y	1.04	8	30	16.76
	Right	0.9	X	1.37	8	30	16.76
			Y	1.35	8	30	16.76
	Top	4.3	X	10.87	8	30	16.76
			Y	10.87	8	30	16.76
	Left	0.9	X	1.37	8	30	16.76
			Y	1.35	8	30	16.76
	Corner B L		X	1.45	8	30	16.76
			Y	1.45	8	30	16.76
	Corner B R		X	1.45	8	30	16.76
			Y	1.45	8	30	16.76
	Corner T L		X	1.45	8	30	16.76
			Y	1.45	8	30	16.76
	Corner T R		X	1.45	8	30	16.76
			Y	1.45	8	30	16.76

D - direction

Designations:

B L - bottom left, B R - bottom right

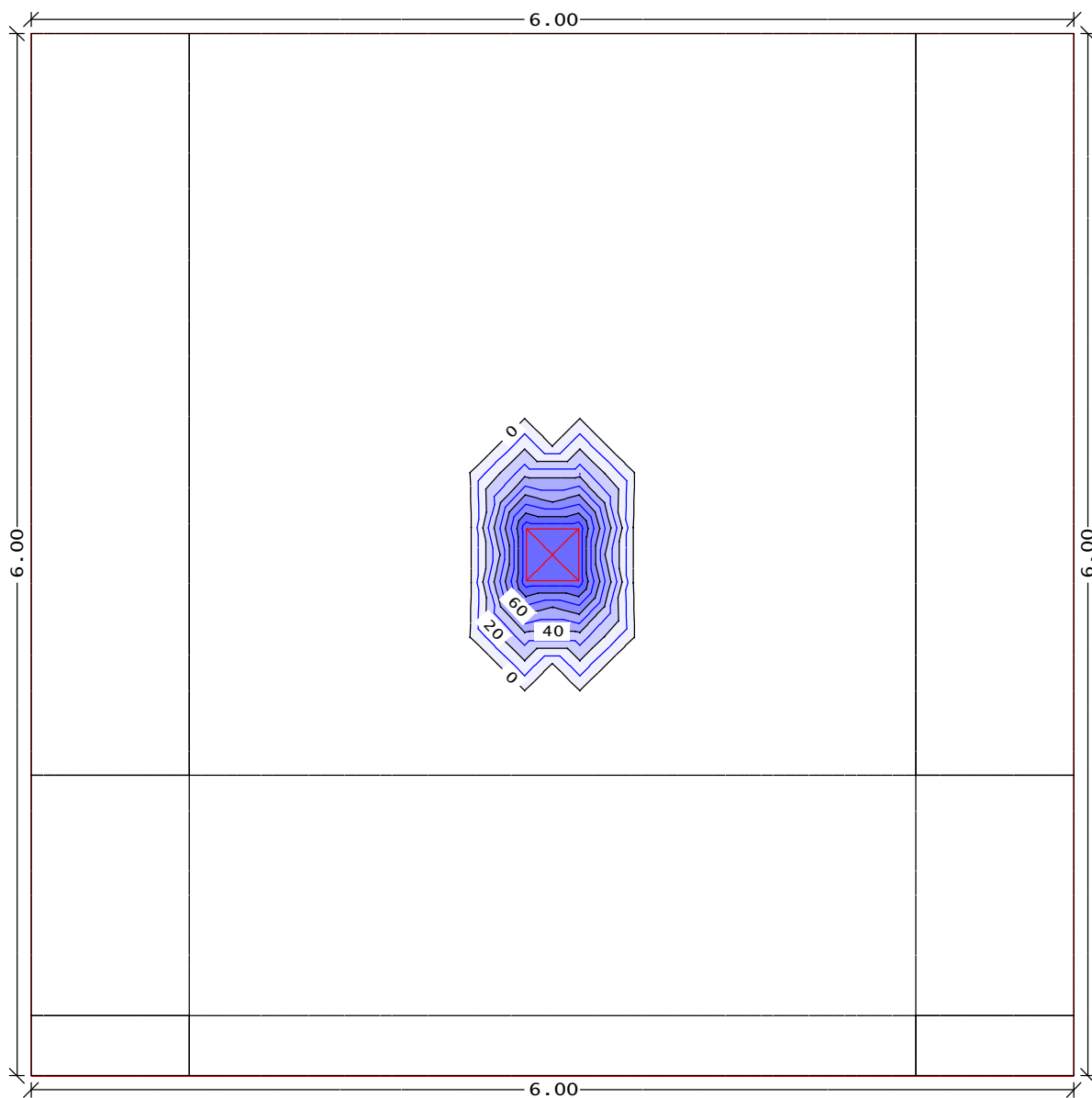
T L - top left, T R - top right

Cracks verification

Maximum permissible width of the cracks 0.40 mm

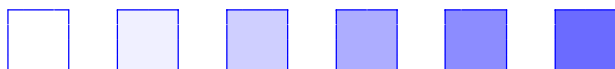
Width of the bottom cracks in X direction [mm]

M = 1 : 40



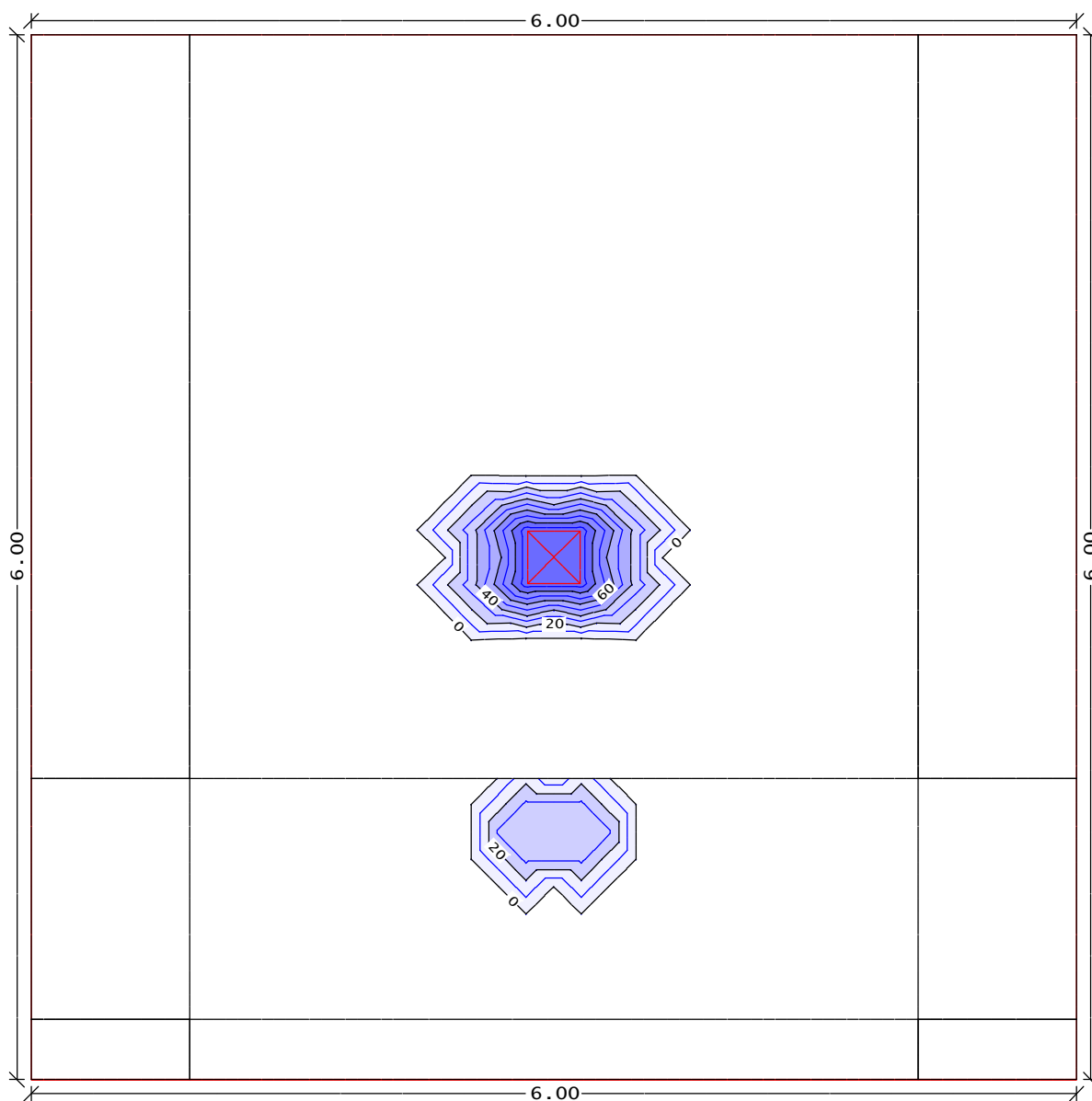
All values are multiplied by 1000

0.0 0.0 20.0 40.0 60.0 80.0 97.3



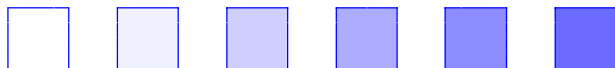
Width of the bottom cracks in Y direction [mm]

M = 1 : 40



All values are multiplied by 1000

0.0 0.0 20.0 40.0 60.0 80.0 97.3



Bottom cracks width

№ plate	Direction	M [kNm / m]	Mcrc [kNm / m]	acrc [mm]
1	X	-41.4	18.7	0.097
	Y	-41.4	18.7	0.097

Top cracks width

№ plate	Direction	M [kNm/m]	Mcrс [kNm/m]	acrc [mm]
1	X	9.3	0.0	0.000
	Y	10.3	0.0	0.000

The maximum width of the cracks

0.097

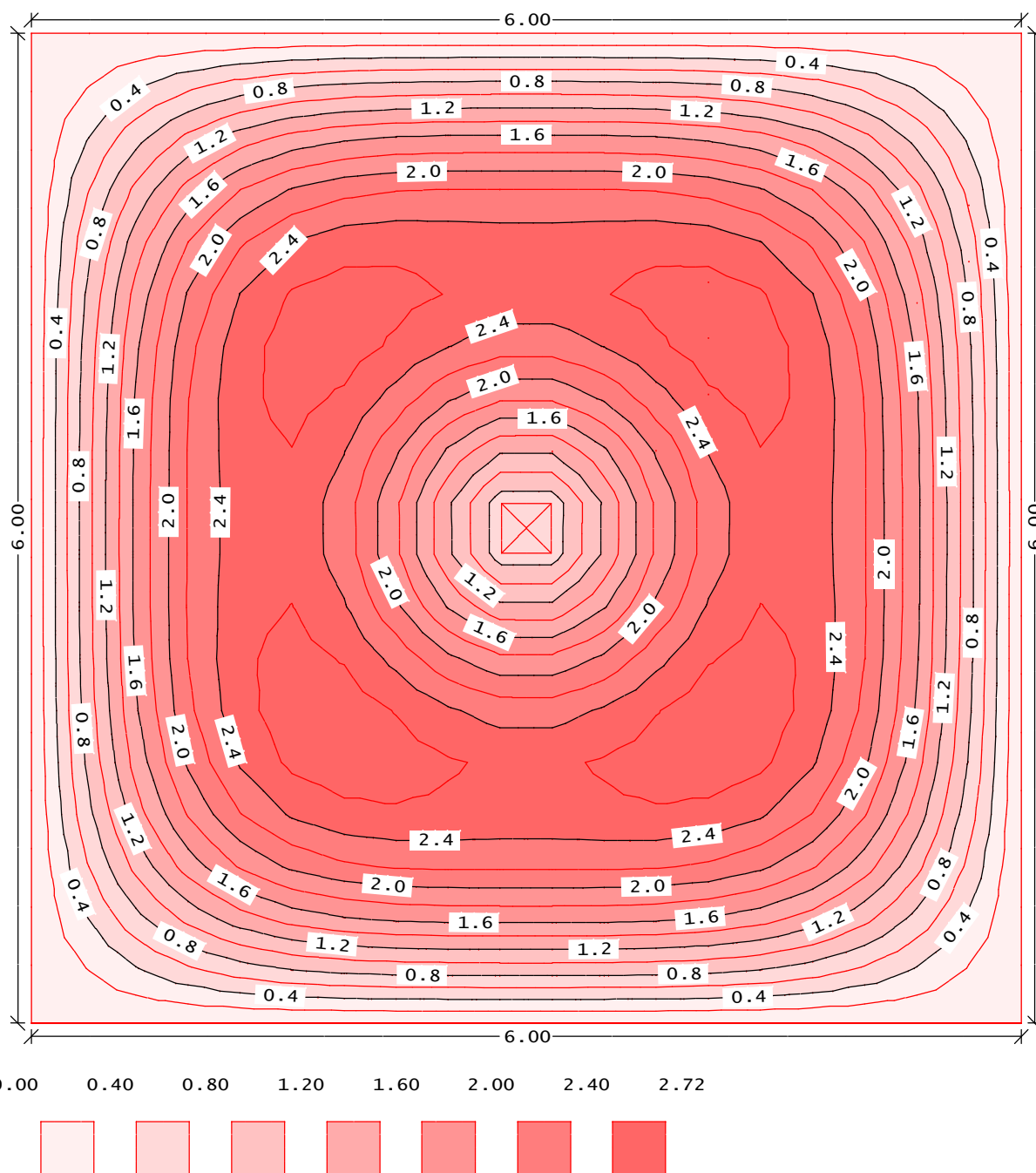
mm

Fracture toughness is secured

Deflections

Maximal deflections [mm]

M = 1 :40





Обозн.проект. **Тест всех модулей**

Стр.

РФ, Москва

Позиция

t201

Дата **10.03.2021**

Комплекс СТАТИКА 2021.010

Проект

СТАТИКА_2021

Deflections

№ plate	Allowable deflection [mm]	Maximal deflection [mm]
1	20.00	2.72

Check for deformation is satisfied

Расчет выполнен модулем t201 программы СТАТИКА 2021 © ООО Техсофт