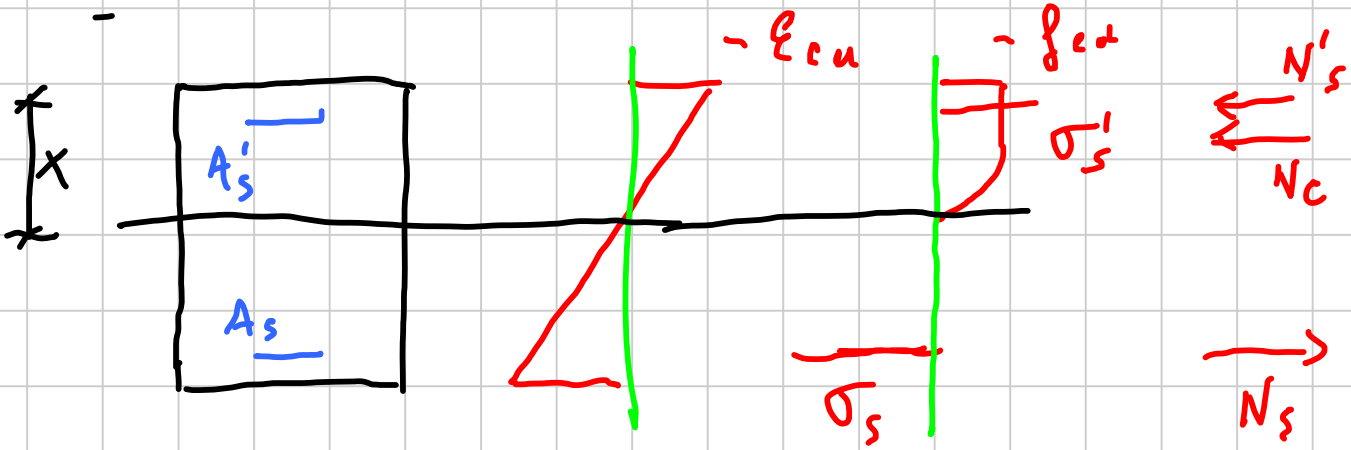
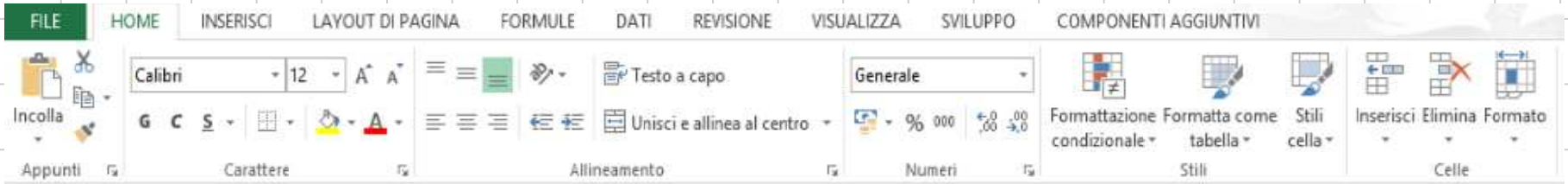
DOMINI M-N per SLU

Titolo nota 30/04/2015

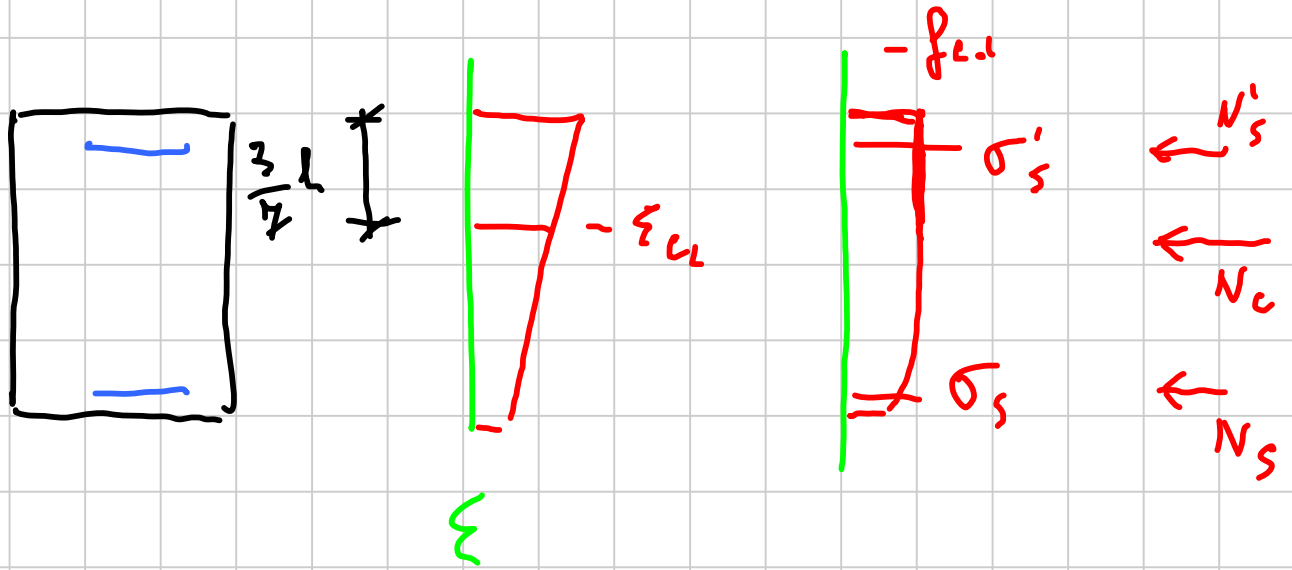


$$N = N_c + N'_s + N_s$$

$$M = -N_c\left(\frac{h}{2} - \kappa x\right) - N'_s\left(\frac{h}{2} - c\right) + N_s\left(\frac{h}{2} - c\right)$$



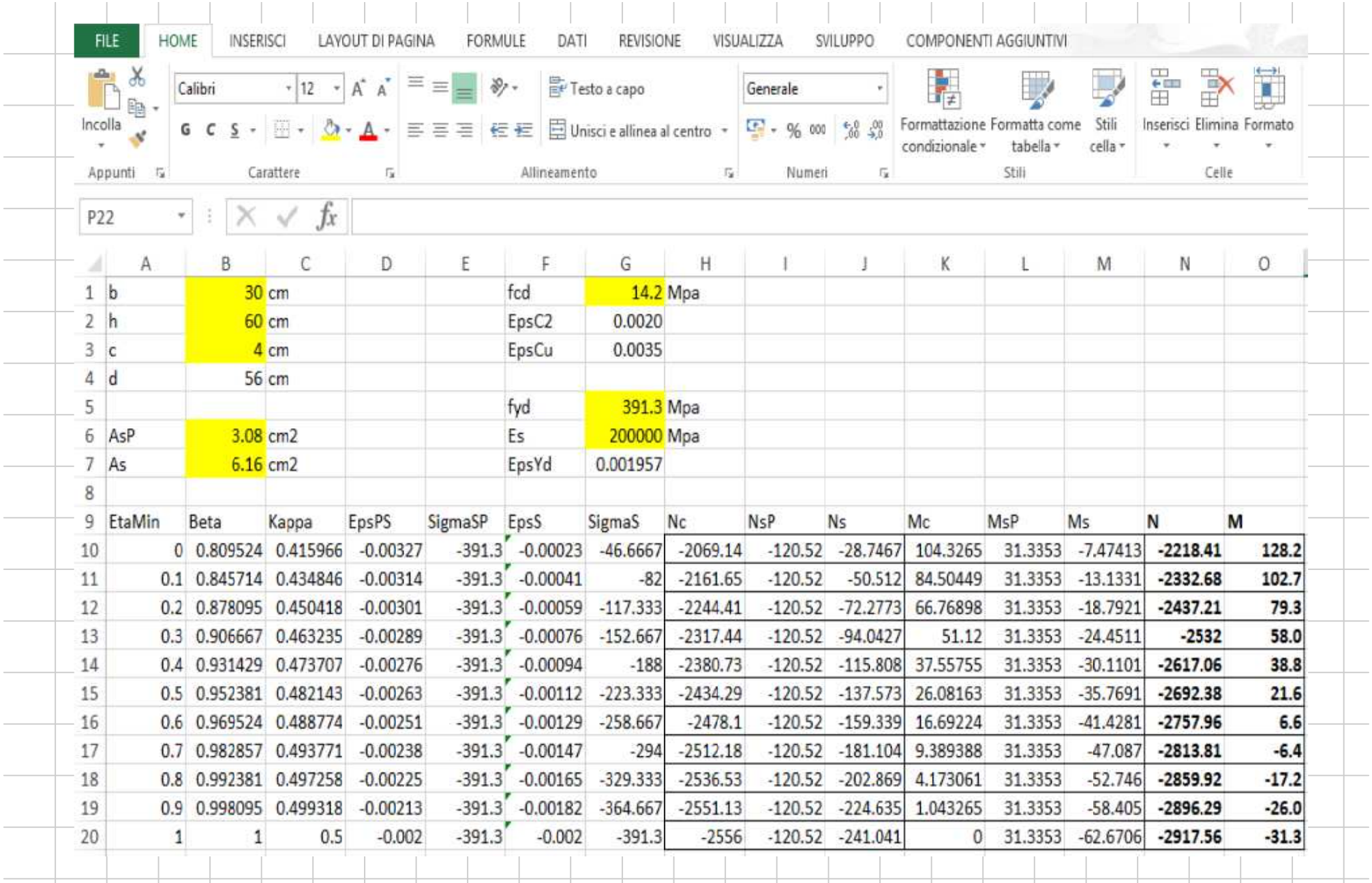
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	b	30	cm			fcd	14.2	Mpa							
2	h	60	cm			EpsC2	0.0020								
3	c	4	cm			EpsCu	0.0035								
4	d	56	cm												
5						fyd	391.3	Mpa		Beta	0.81				
6	AsP	3.08	cm2			Es	200000	Mpa		Kappa	0.416				
7	As	6.16	cm2			EpsYd	0.001957								
8															
9	X			EpsPS	SigmaSP	EpsS	SigmaS	Nc	NsP	Ns	Mc	MsP	Ms	**N**	**M**
10	0.000001			14000	391.3	196000	391.3	-3.5E-05	120.5204	241.0408	1.04E-05	-31.3353	62.67061	**361.6**	**31.3**
11	5			-0.0007	-140	0.0357	391.3	-172.53	-43.12	241.0408	48.17038	11.2112	62.67061	**25.4**	**122.1**
12	10			-0.0021	-391.3	0.0161	391.3	-345.06	-120.52	241.0408	89.1635	31.3353	62.67061	**-224.5**	**183.2**
13	15			-0.00257	-391.3	0.009567	391.3	-517.59	-120.52	241.0408	122.9794	31.3353	62.67061	**-397.1**	**217.0**
14	20			-0.0028	-391.3	0.0063	391.3	-690.12	-120.52	241.0408	149.618	31.3353	62.67061	**-569.6**	**243.6**
15	25			-0.00294	-391.3	0.00434	391.3	-862.65	-120.52	241.0408	169.0794	31.3353	62.67061	**-742.1**	**263.1**
16	30			-0.00303	-391.3	0.003033	391.3	-1035.18	-120.52	241.0408	181.3635	31.3353	62.67061	**-914.7**	**275.4**
17	35			-0.0031	-391.3	0.0021	391.3	-1207.71	-120.52	241.0408	186.4704	31.3353	62.67061	**-1087.2**	**280.5**
18	40			-0.00315	-391.3	0.0014	280	-1380.24	-120.52	172.48	184.4001	31.3353	44.8448	**-1328.3**	**260.6**
19	45			-0.00319	-391.3	0.000856	171.1111	-1552.77	-120.52	105.4044	175.1525	31.3353	27.40516	**-1567.9**	**233.9**
20	50			-0.00322	-391.3	0.00042	84	-1725.3	-120.52	51.744	158.7276	31.3353	13.45344	**-1794.1**	**203.5**
21	55			-0.00325	-391.3	6.36E-05	12.72727	-1897.83	-120.52	7.84	135.1255	31.3353	2.0384	**-2010.5**	**168.5**
22	60			-0.00327	-391.3	-0.00023	-46.6667	-2070.36	-120.52	-28.7467	104.3461	31.3353	-7.47413	**-2219.6**	**128.2**



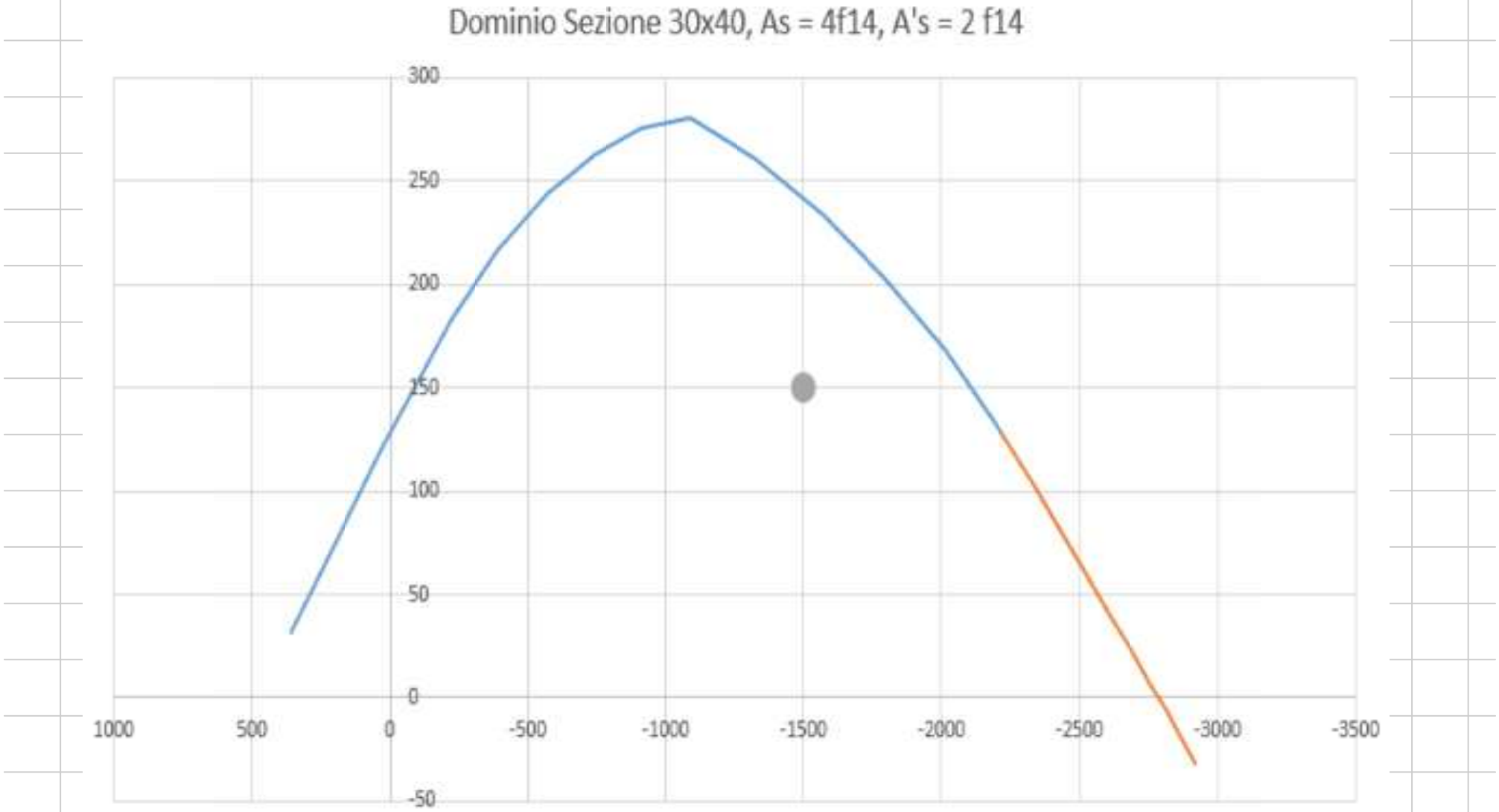
$$N = N_c + N'_s + N_s$$

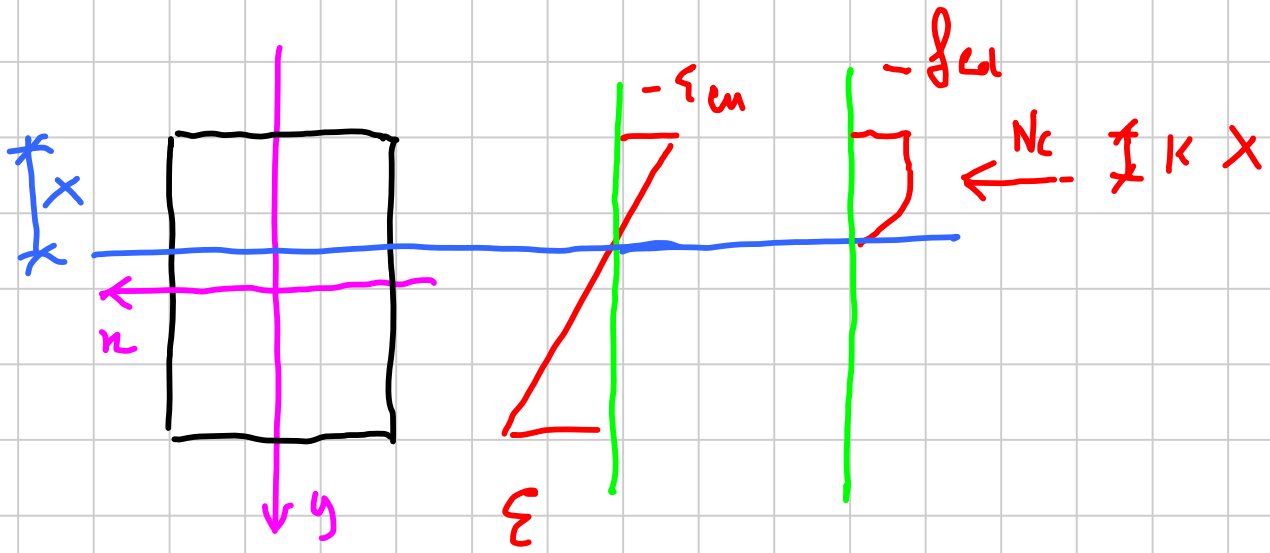
$$M = -N_c\left(\frac{h}{2} - \kappa h\right) - N'_s\left(\frac{h}{2} - c\right) + N_s\left(\frac{h}{2} - c\right)$$

$$\eta_{min} \rightarrow \beta, \kappa$$



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	b	30	cm			fcd	14.2	Mpa							
2	h	60	cm			EpsC2	0.0020								
3	c	4	cm			EpsCu	0.0035								
4	d	56	cm												
5						fyd	391.3	Mpa							
6	AsP	3.08	cm2			Es	200000	Mpa							
7	As	6.16	cm2			EpsYd	0.001957								
8															
9	EtaMin	Beta	Kappa	EpsPS	SigmaSP	EpsS	SigmaS	Nc	NsP	Ns	Mc	MsP	Ms	**N**	**M**
10	0	0.809524	0.415966	-0.00327	-391.3	-0.00023	-46.6667	-2069.14	-120.52	-28.7467	104.3265	31.3353	-7.47413	**-2218.41**	**128.2**
11	0.1	0.845714	0.434846	-0.00314	-391.3	-0.00041	-82	-2161.65	-120.52	-50.512	84.50449	31.3353	-13.1331	**-2332.68**	**102.7**
12	0.2	0.878095	0.450418	-0.00301	-391.3	-0.00059	-117.333	-2244.41	-120.52	-72.2773	66.76898	31.3353	-18.7921	**-2437.21**	**79.3**
13	0.3	0.906667	0.463235	-0.00289	-391.3	-0.00076	-152.667	-2317.44	-120.52	-94.0427	51.12	31.3353	-24.4511	**-2532**	**58.0**
14	0.4	0.931429	0.473707	-0.00276	-391.3	-0.00094	-188	-2380.73	-120.52	-115.808	37.55755	31.3353	-30.1101	**-2617.06**	**38.8**
15	0.5	0.952381	0.482143	-0.00263	-391.3	-0.00112	-223.333	-2434.29	-120.52	-137.573	26.08163	31.3353	-35.7691	**-2692.38**	**21.6**
16	0.6	0.969524	0.488774	-0.00251	-391.3	-0.00129	-258.667	-2478.1	-120.52	-159.339	16.69224	31.3353	-41.4281	**-2757.96**	**6.6**
17	0.7	0.982857	0.493771	-0.00238	-391.3	-0.00147	-294	-2512.18	-120.52	-181.104	9.389388	31.3353	-47.087	**-2813.81**	**-6.4**
18	0.8	0.992381	0.497258	-0.00225	-391.3	-0.00165	-329.333	-2536.53	-120.52	-202.869	4.173061	31.3353	-52.746	**-2859.92**	**-17.2**
19	0.9	0.998095	0.499318	-0.00213	-391.3	-0.00182	-364.667	-2551.13	-120.52	-224.635	1.043265	31.3353	-58.405	**-2896.29**	**-26.0**
20	1	1	0.5	-0.002	-391.3	-0.002	-391.3	-2556	-120.52	-241.041	0	31.3353	-62.6706	**-2917.56**	**-31.3**


Dominio Sezione 30x40, As = 4f14, A's = 2 f14
300
250
200
150
100
50
0
-50
1000
500
0
-500
-1000
-1500
-2000
-2500
-3000
-3500



$$N_c = -\beta b x f_{cd}$$

$$M_c = -N_c \left(\frac{h}{2} - \kappa x \right)$$

$$x = \frac{N_c}{-\beta b f_{cd}}$$

$\beta = 0{,}81$

$\kappa = 0{,}416$

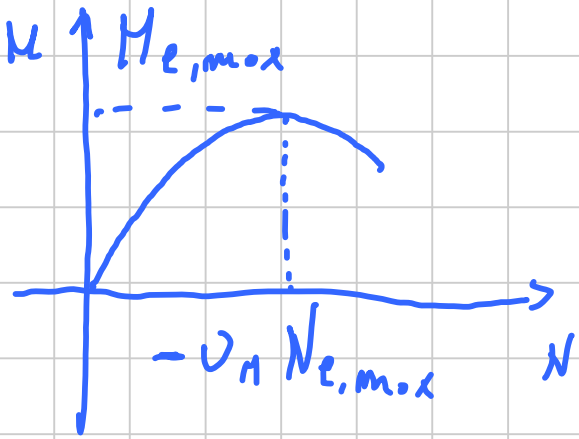
$$M_c = -N_c\left(\frac{h}{2} + \frac{\kappa N_c}{\beta b f_{cd}}\right)$$

$$\frac{dM_c}{dN_c} = -\frac{h}{2} - \frac{\kappa N_c}{\beta b f_{cd}} - \frac{N_c \kappa}{\beta b f_{cd}} = -\frac{h}{2} - \frac{2\kappa N_c}{\beta b f_{cd}} = 0$$

$$N_c = -\frac{\beta b h f_{cd}}{4\kappa} = -\frac{\beta}{4\kappa} A_c f_{cd}$$

$N_{c,max}$

$\nu_H \approx 0.48$

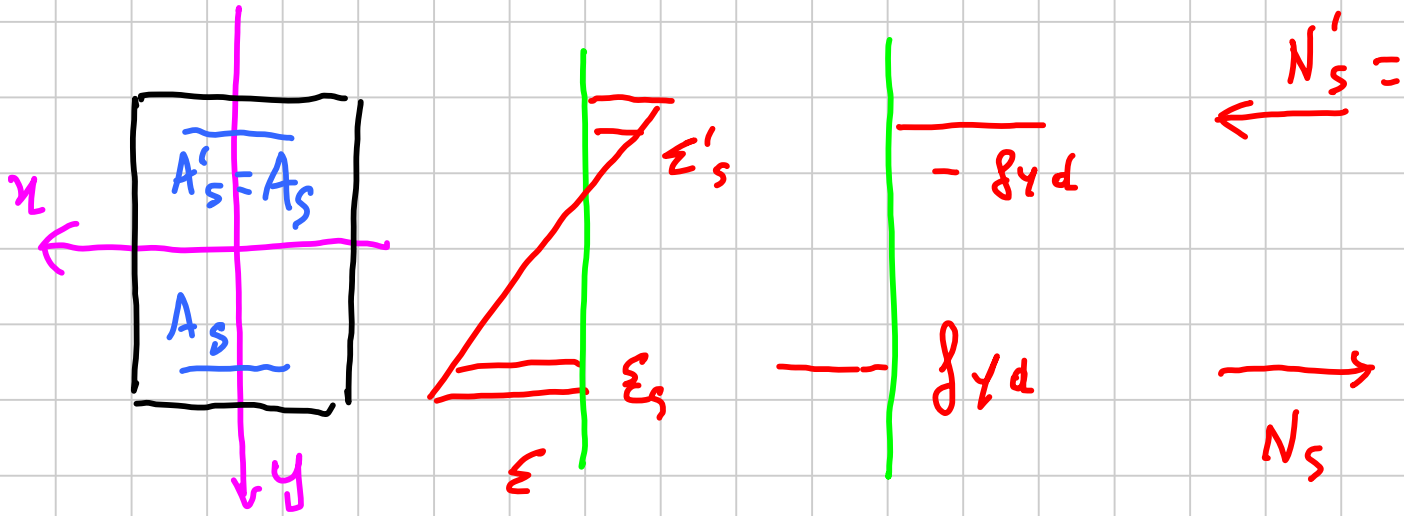


$$M_{c,max} = + \nu_H N_{c,max} \left(\frac{h}{2} - \frac{\kappa \nu_H N_{c,max}}{\beta b f_{cd}} \right)$$

$$= + \nu_H b h f_{cd} \left(\frac{h}{2} - \frac{\kappa \nu_H b h f_{cd}}{\beta b f_{cd}} \right)$$

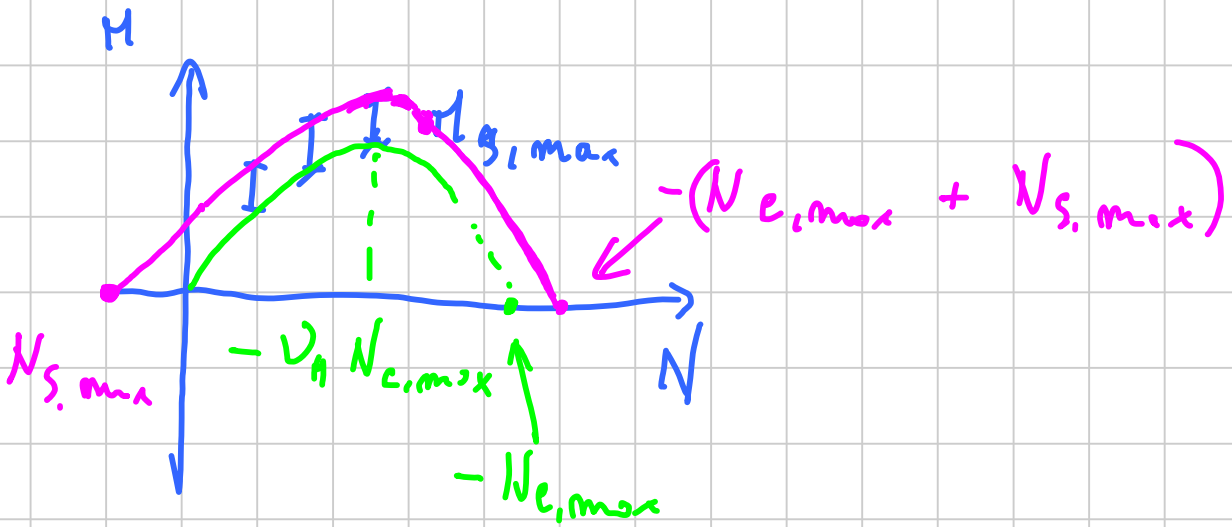
$$= \nu_H b h f_{cd} \left(\frac{h}{2} - \frac{h}{4} \right) = \nu_H b h f_{cd} \frac{h}{4}$$

$$= \frac{\nu_H}{4} b h^2 f_{cd} = 0{,}12\, b h^2 f_{cd}$$



$$M_{s,max} = N_s \left(\frac{h}{2} - c\right) - N'_s \left(\frac{h}{2} - c\right) = 2 N_s \left(\frac{h}{2} - c\right)$$

$$= 2 A_s \left(\frac{h}{2} - c\right) f_{yd} = A_s (h - 2c) f_{yd}$$



$$N_{s,max} = 2 A_s f_{yd} \longrightarrow M = 0$$

$$M_{Rd} = M_{s,max}\left(1 - \frac{N_{Ed}}{N_{s,max}}\right) \qquad N_{Ed} \geq 0$$

$$M_{Rd} = M_{c,max}\left[1 - \left(\frac{N_{Ed} + \upsilon_H N_{c,max}}{\upsilon_H N_{c,max}}\right)^2\right] + M_{s,max}$$

$$-\upsilon_H N_{c,max} \leq N_{Ed} < 0$$

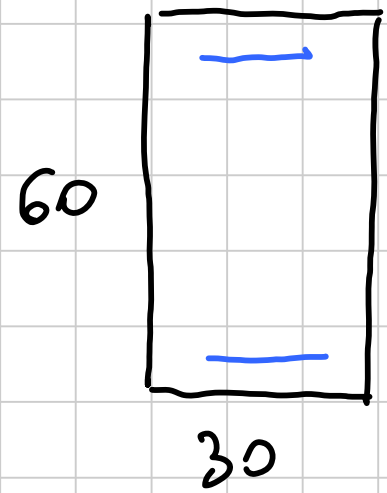
$$M_{Rd} = \left(M_{c,max} + M_{s,max}\right)\left[1 - \left(\frac{|N_{Ed} + \upsilon_H N_{c,max}|}{(1-\upsilon_H) N_{c,max} + N_{s,max}}\right)^n\right]$$

$$n = 1 + \left[\frac{\upsilon_H N_{c,max}}{(1-\upsilon_H) N_{c,max} + N_{s,max}}\right]^2$$

$$N_{Ed} < -\upsilon_H N_{c,max}$$

$$M_{Rd} = \left(M_{c,max} + M_{s,max}\right)\left[1 - \left(\frac{\left|N_{Ed} + \nu_H N_{c,max}\right|}{\nu_H N_{c,max} + N_{s,max}}\right)^m\right]$$

$$m = 1 + \frac{\nu_H N_{c,max}}{\nu_H N_{c,max} + N_{s,max}}$$



$M_{Ed} = 200\ kN\,m$

$N_{Ed} = -1500\ kN$

C25/30

B450C

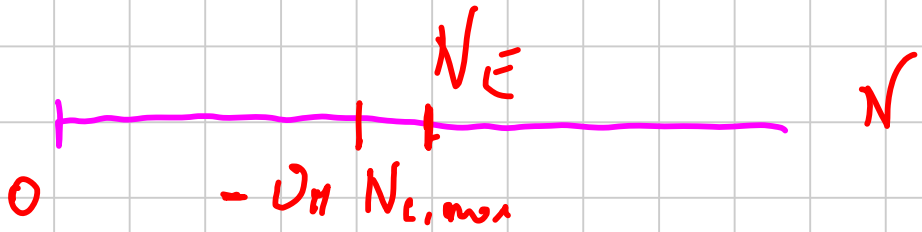
C = 4

$$N_{c,max} = 30 \times 60 \times \frac{14.1}{10} = 2538\ KN$$

$$M_{c,max} = 0,12\, b\, h^2\, f_{cd} : 0,12 \times 30 \times 60^2 \times 14.1\, \frac{1}{10^3} = 182,7\ kN\,m$$

$$N_{s,max} = 2 \times 6.16 \times \frac{391,3}{10} = 482,1\ KN$$

$$M_{s,max} = 6,16 \times (60 - 8) \times \frac{391.3}{10^3} = 125,3\ KN\,m$$



$-0{,}48 \times 2538\ KN$

$-1218\ KN$

$N_E = -1500K$

$$m = 1 + \left[\frac{-1218}{(1-0{,}48)\times 2538 + 482{,}1}\right]^2 = 1{,}45$$

$$M_{Rd} = (182.7 + 125.3)\left[1 - \left(\frac{|-1500 + 1218|}{(1-0{,}18)\times 2538 + 482.1}\right)^{1{,}45}\right]$$

$$= 287\ KN\,m > M_{Ed} = 200\ KN\,m \quad \text{Ok!}$$

$$M_{Rd} = (182.7 + 125.3)\left[1 - \left(\frac{|-1500 + 1218|}{1218 + 482.1}\right)^{1.72}\right] =$$

$$= 294 \text{ KNm} > M_{Ed} = 200 \text{ kNm}$$

$$m = 1 + \frac{1218}{1218 + 482.1} = 1.72$$

$$M_{R.d} = M_{c.max}\left[1 - \left(\frac{N_{Ed} + D_H N_{c.max}}{D_H N_{c.max}}\right)^2\right] + M_{s.max} = M_{Ed}$$

$$182.7 \times \left[1 - \left(\frac{-150 + 1218}{1218}\right)^2\right] \qquad 200\ kN\,m$$

$$\| \qquad \| \qquad \|$$

$$143\ KN\,m$$

$$M_{s.max} = 200 - 143 = 27\ KN\,m = A_s (h - 2c) f_{yd}$$

$$A_s = \frac{M_{s.max}}{(h-2c) f_{yd}} = \frac{27 \times 10^2}{(60-8) \times 391.3} \times \frac{10^3}{10^2} = 1,33\ cm^2$$