

Note de curs



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profesor

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<http://www.ct.upt.ro/users/TamasNagyGyorgy/index.htm>

Birou:

A219

3.1 TIPURI DE ARMĂTURI

3.2 EXEMPLE DE ARMĂRI

3.3 PROPRIETĂȚILE ARMĂTURILOR

3.4 ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE ARMATE CU FIBRE

Type of reinforcements / Tipuri de armături

Armătura se dispune în primul rând în zonele în care încărcările exterioare produc întinderi !

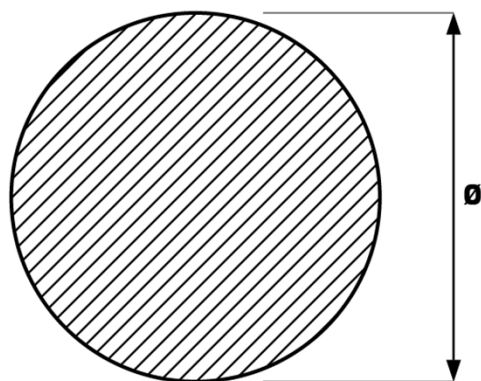
Tipuri de armături:

- 1) ARMĂTURI FLEXIBILE** → bare cu secțiune circulară
- 2) ARMĂTURI RIGIDE** → profile laminate sau sudate
- 3) ARMĂTURI DISPERSE** → diferite tipuri de fibre scurte sau textile
- 4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE ARMATE CU FIBRE**

Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

→ bare cu secțiune circulară

**OB 37**

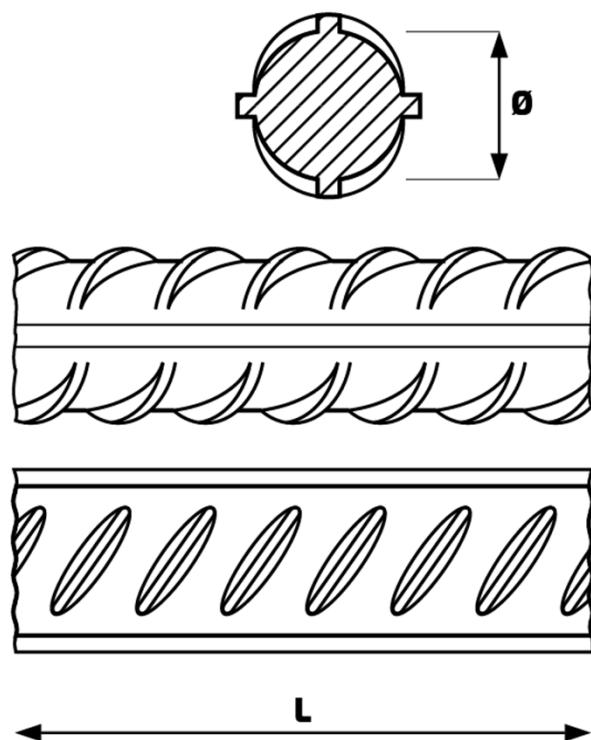
(Oțel Beton _ rezistența la rupere)



Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

→ bare cu secțiune circulară

**PC 52**

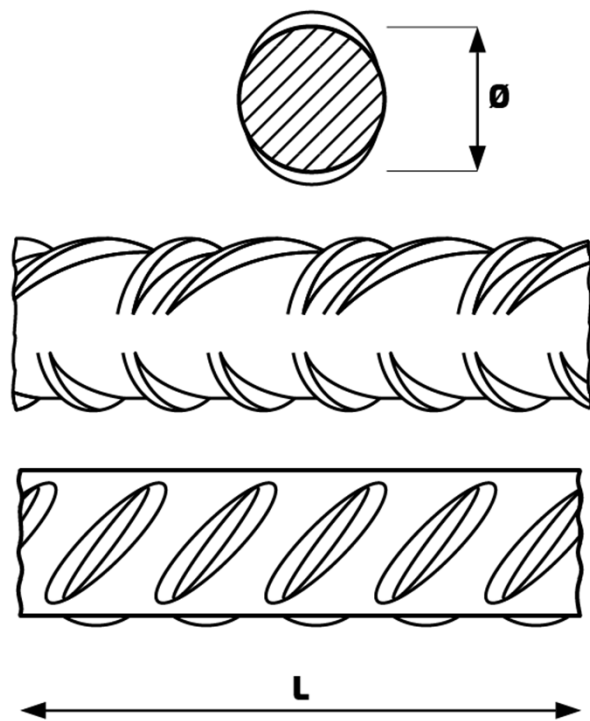
(Oțel cu profil periodic (P) laminat la cald (C)
_rezistența la rupere



Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

→ bare cu secțiune circulară



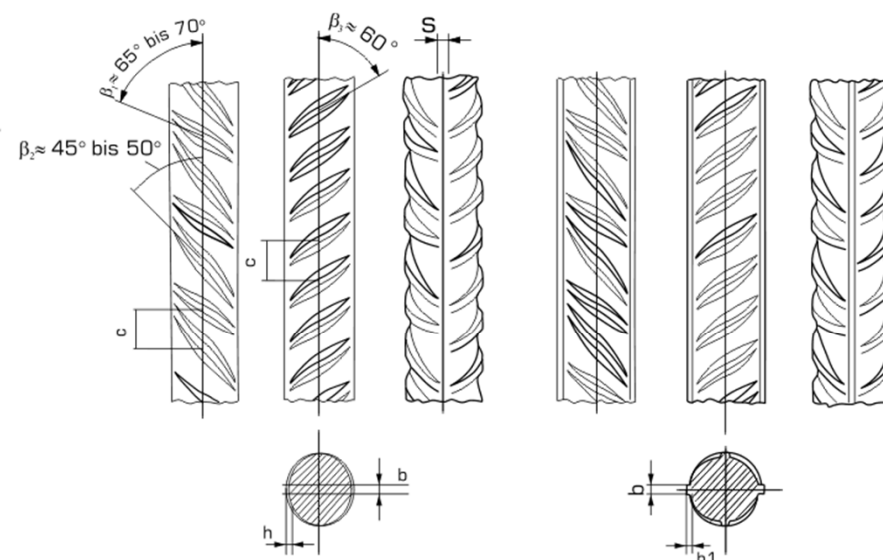
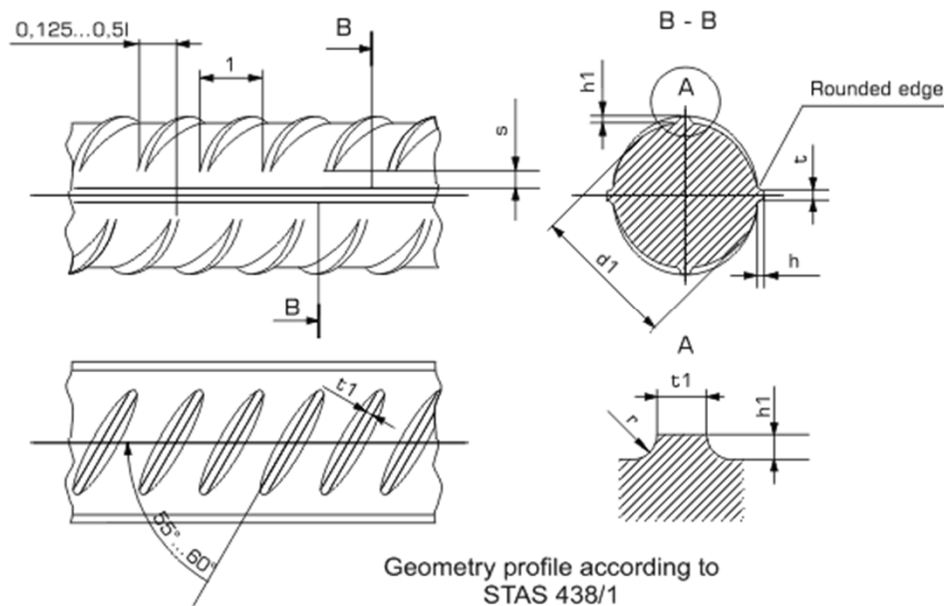
BST500
(Betonstabstahl)



Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

→ bare cu secțiune circulară

Geometry profile according to DIN 488
(Without longitudinal nerve)Geometry profile according to DIN 488
(With longitudinal nerve)

PC52

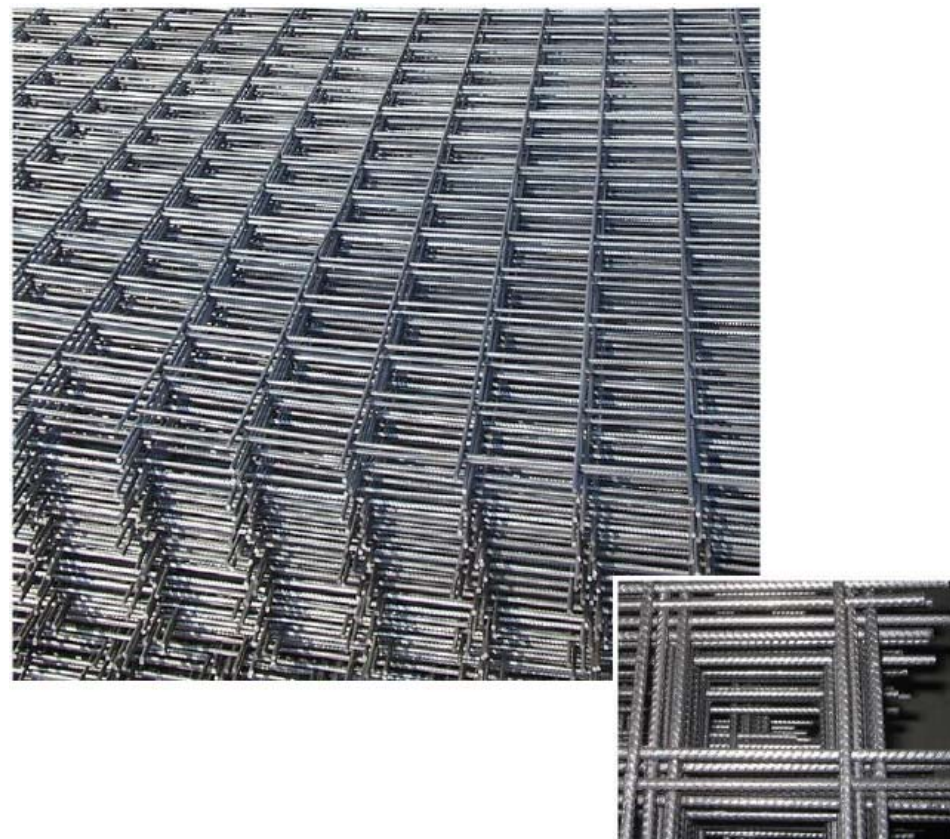
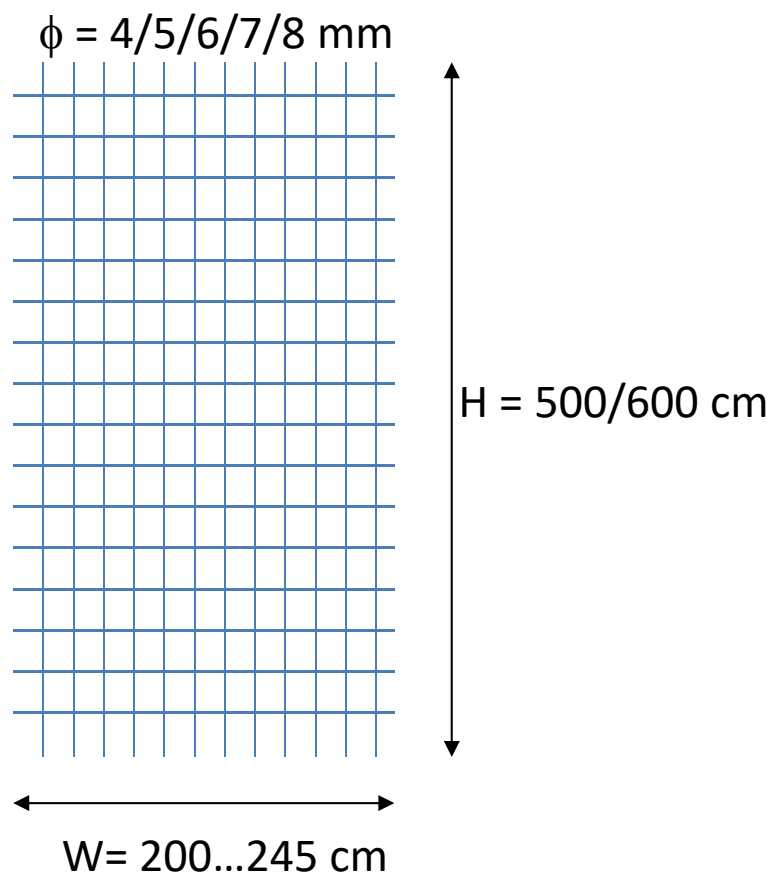


ALTE TIPURI

Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

→ bare cu secțiune circulară



Plase sudate SPPB (Sârmă cu Profil Periodic pentru Beton)

Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

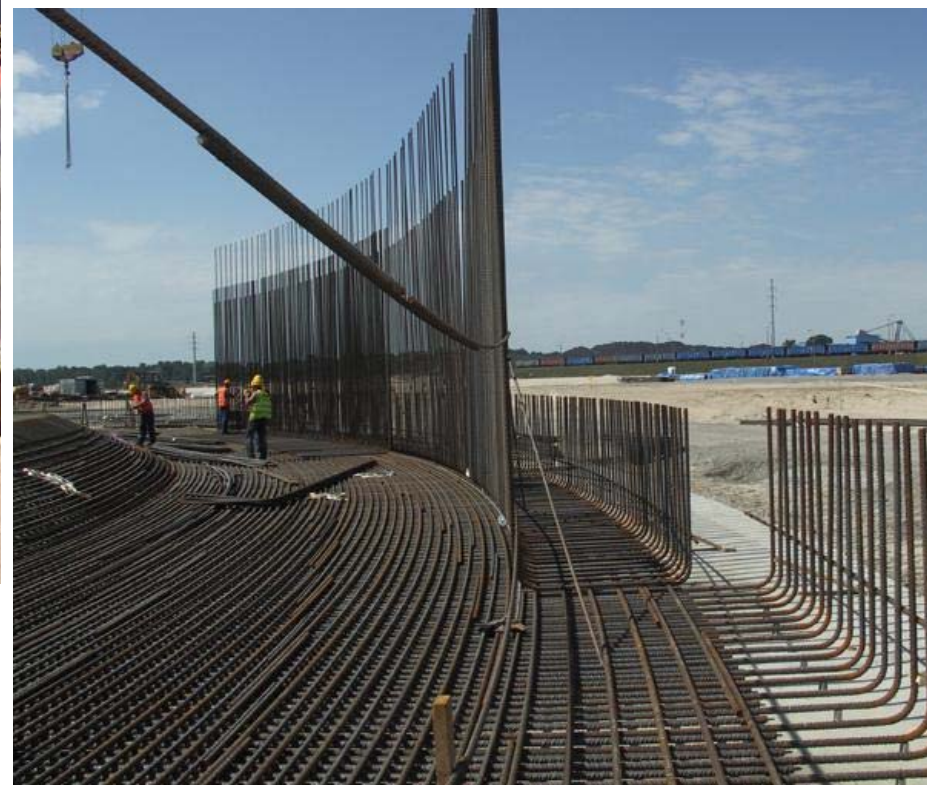
→ bare cu secțiune circulară



Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

→ bare cu secțiune circulară



Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

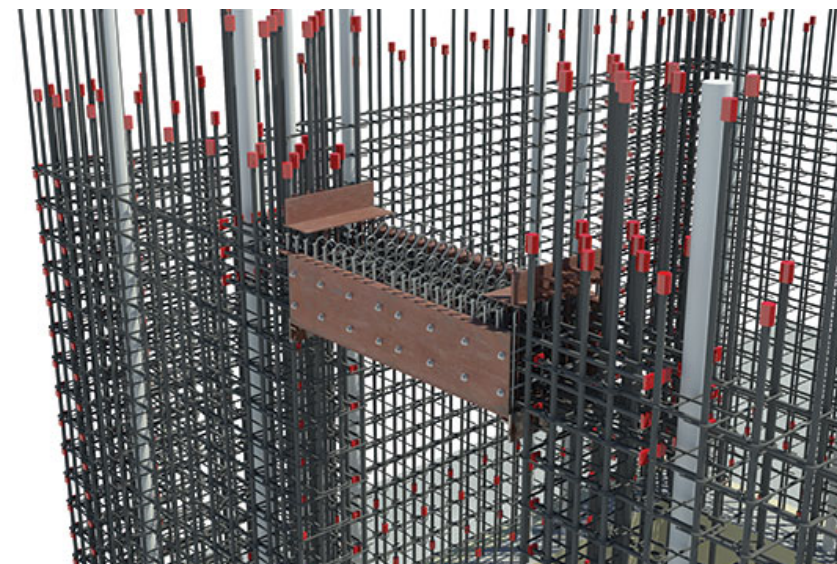
→ bare cu secțiune circulară



Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

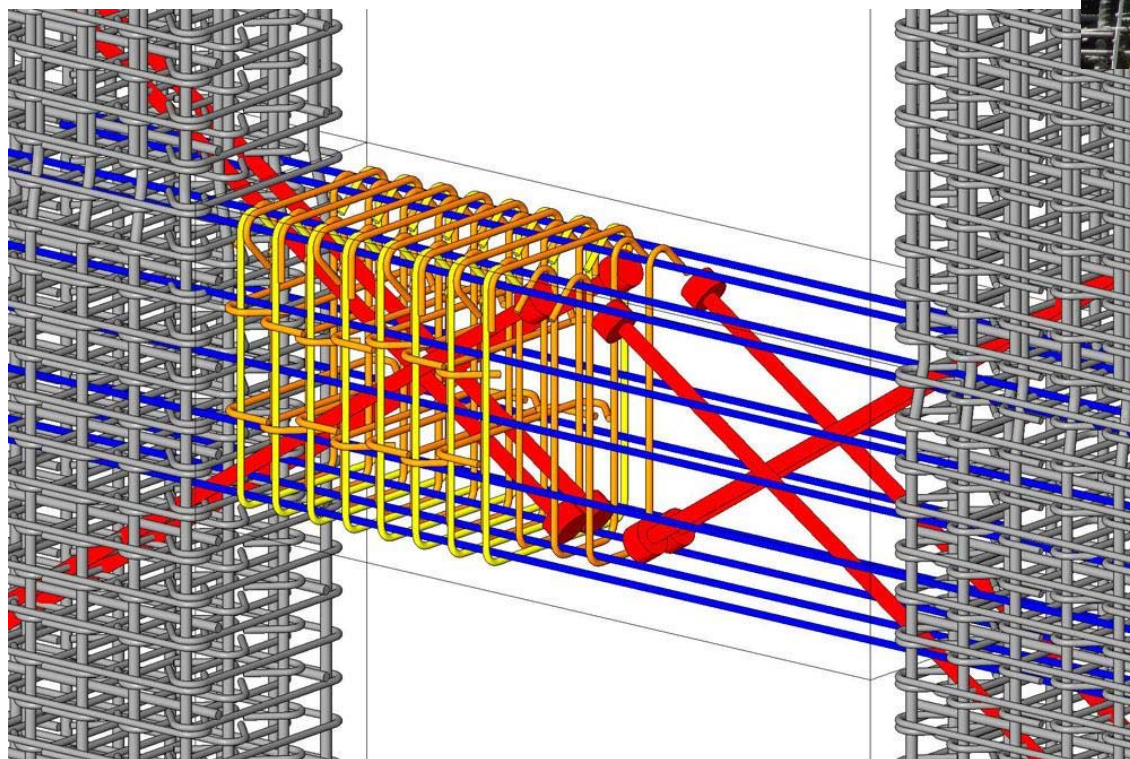
→ bare cu secțiune circulară



Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

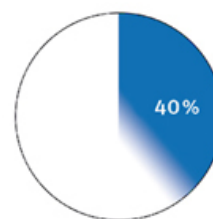
→ bare cu secțiune circulară



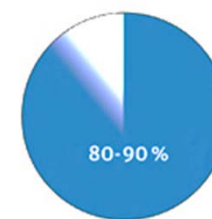
Type of reinforcements / Tipuri de armături

1) ARMĂTURI FLEXIBILE

→ bare cu secțiune circulară



up to 40 % material savings



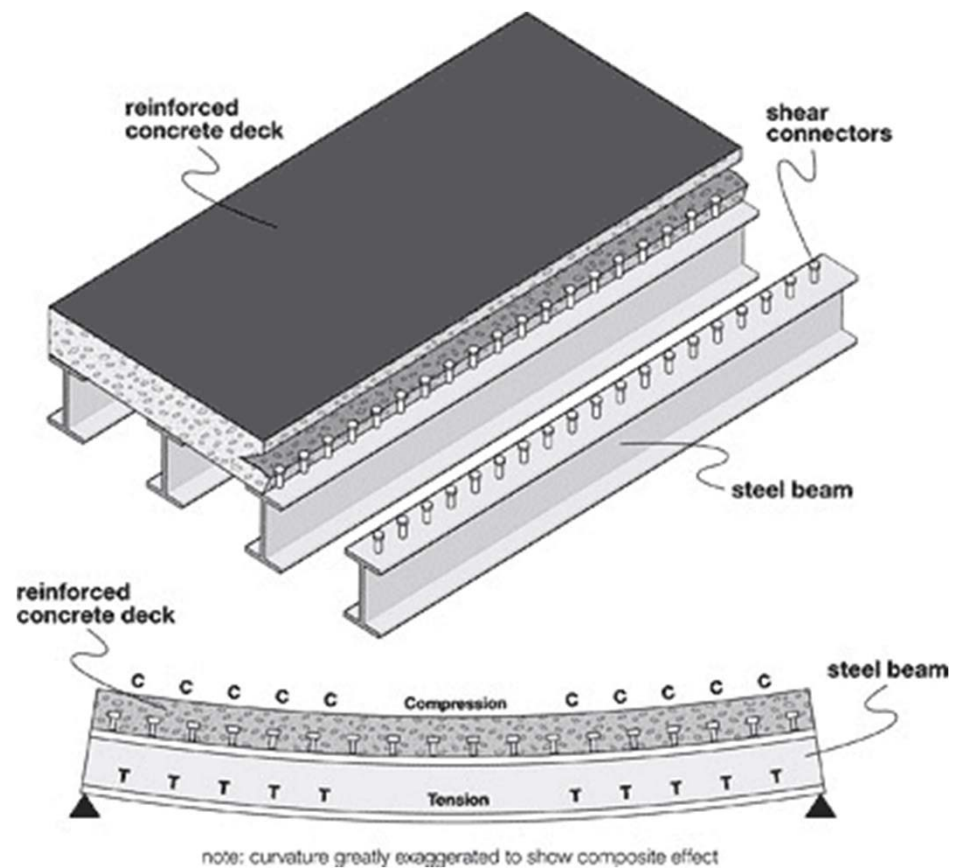
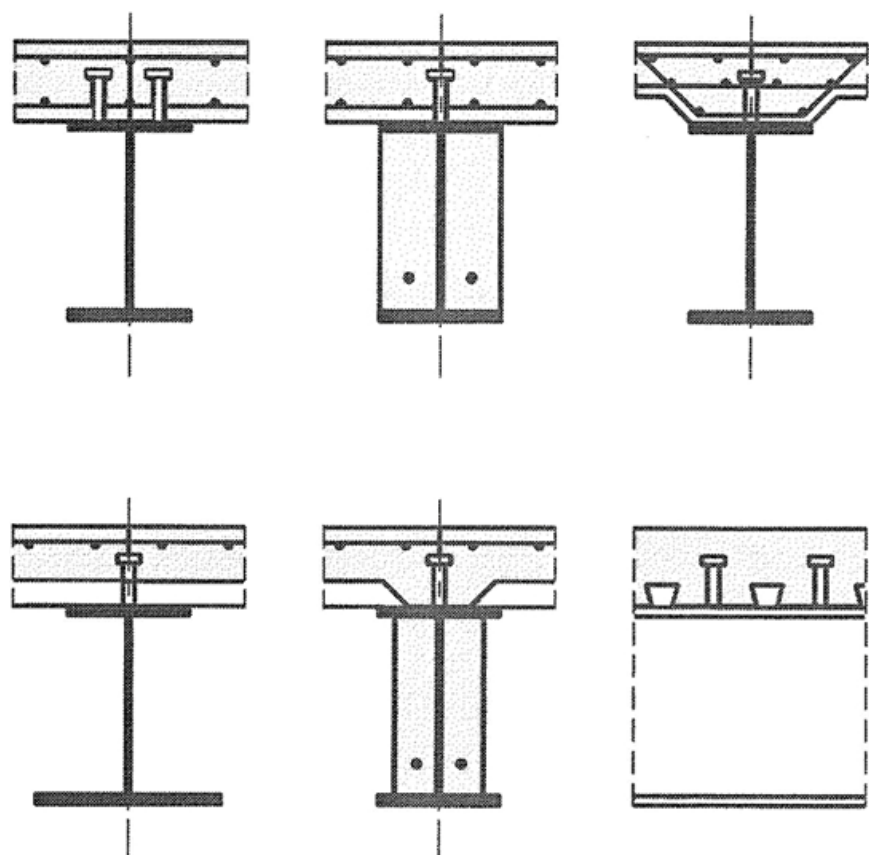
80-90 % savings in laying time

bamtec.com

Type of reinforcements / Tipuri de armături

2) ARMĂTURI RIGIDE → profile laminate sau sudate

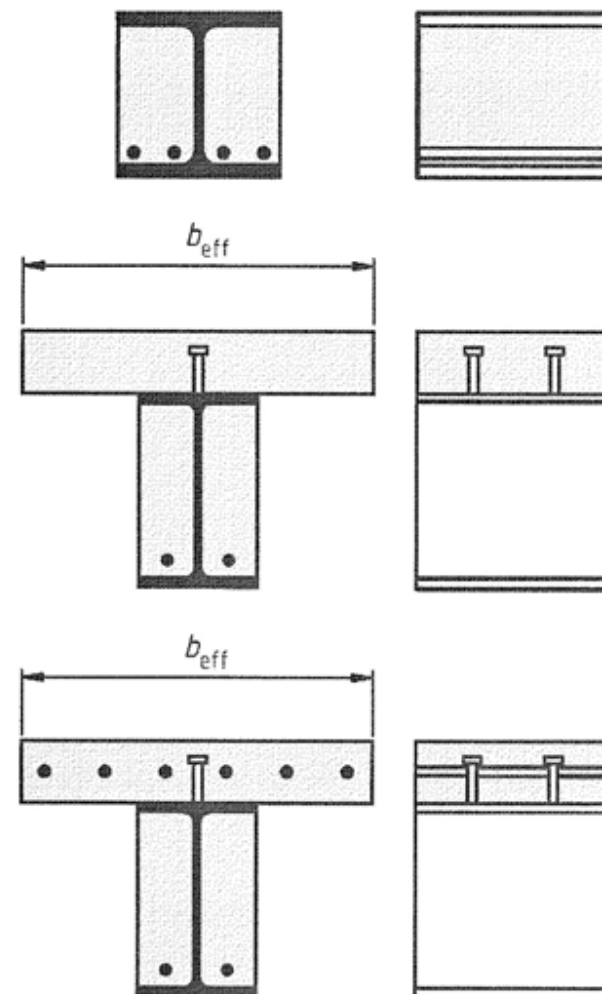
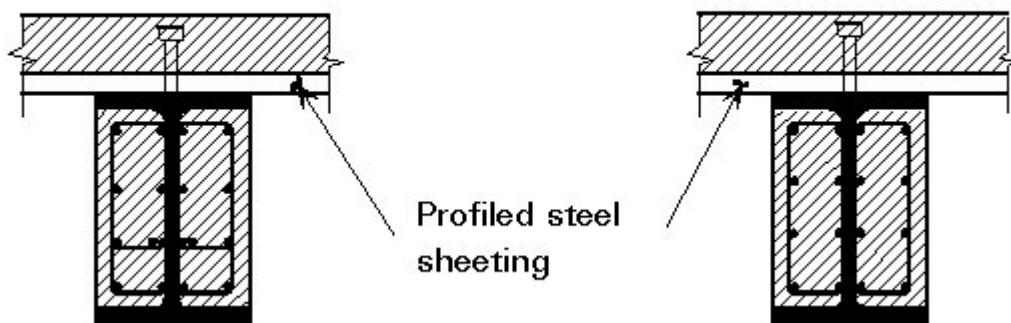
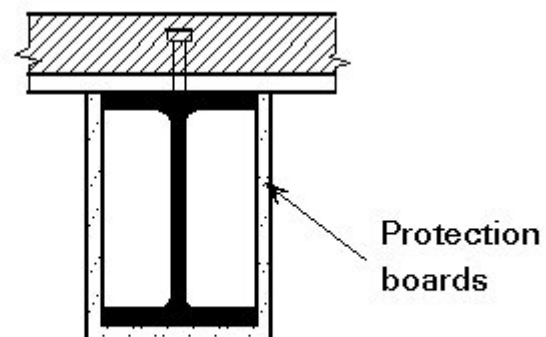
GRINZI



Type of reinforcements / Tipuri de armături

2) ARMĂTURI RIGIDE → profile laminate sau sudate

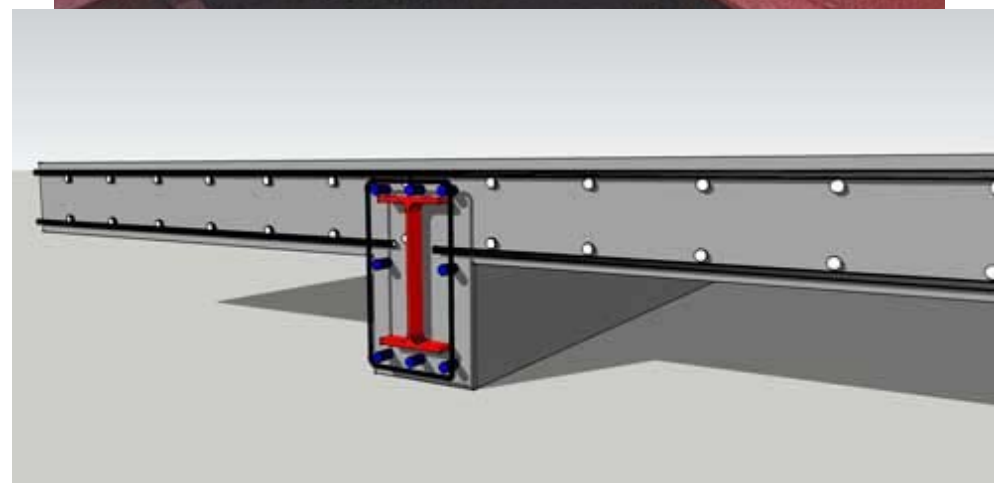
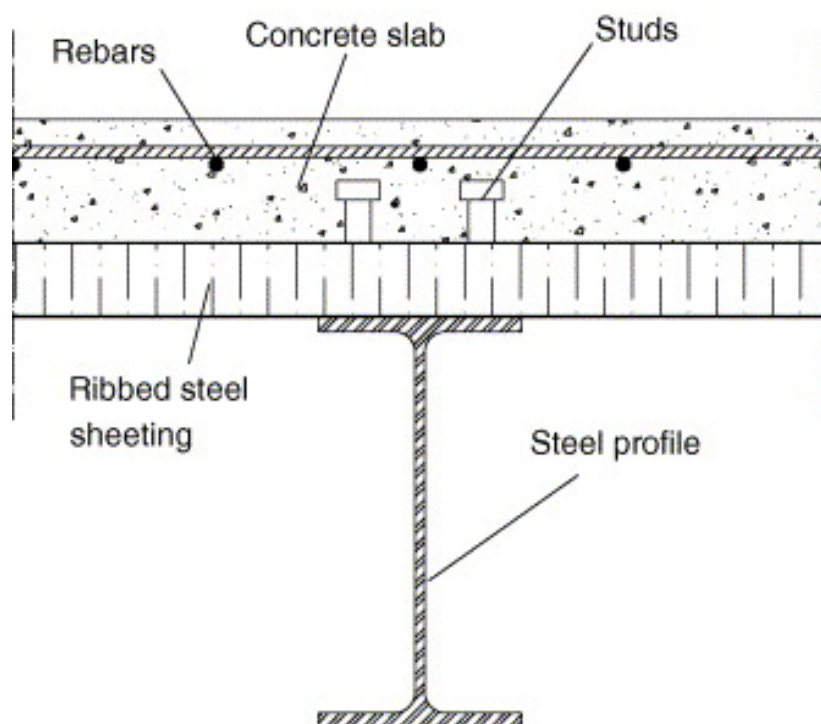
GRINZI



Type of reinforcements / Tipuri de armături

2) ARMĂTURI RIGIDE → profile laminate sau sudate

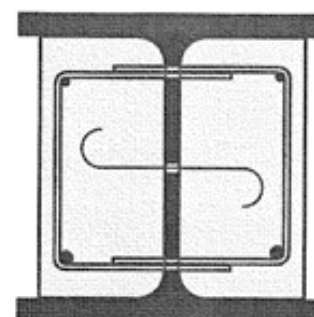
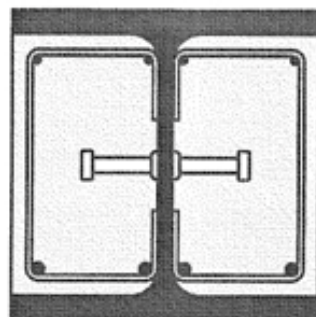
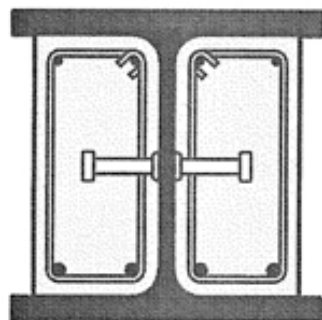
GRINZI



Type of reinforcements / Tipuri de armături

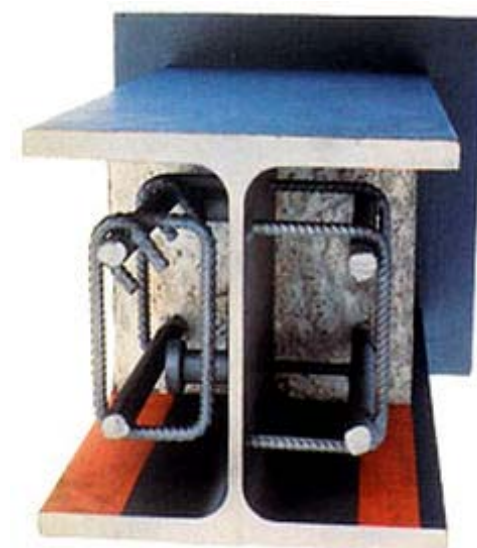
2) ARMĂTURI RIGIDE → profile laminate sau sudate

GRINZI



Key

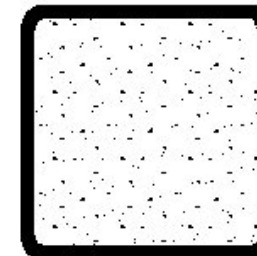
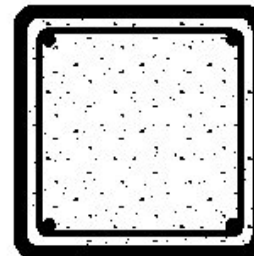
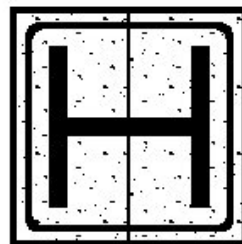
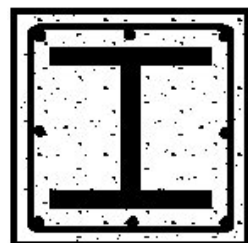
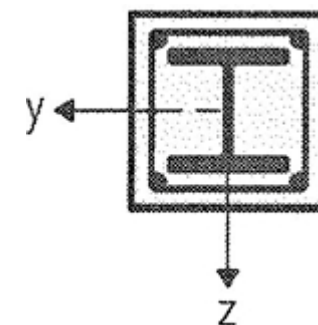
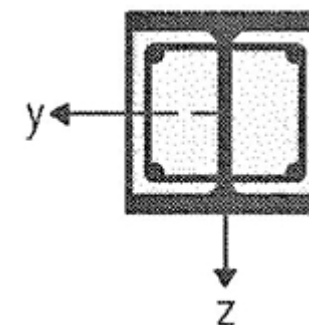
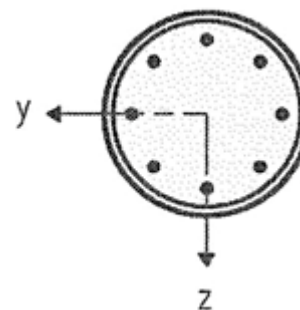
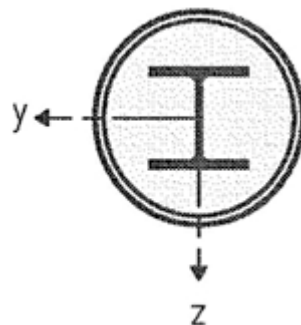
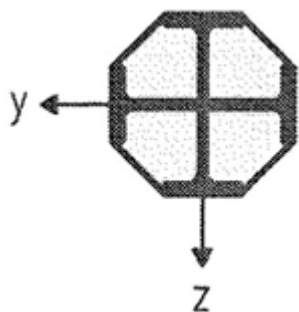
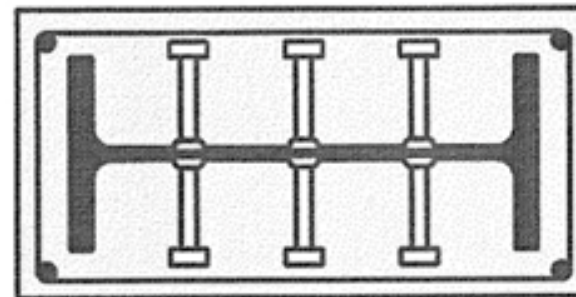
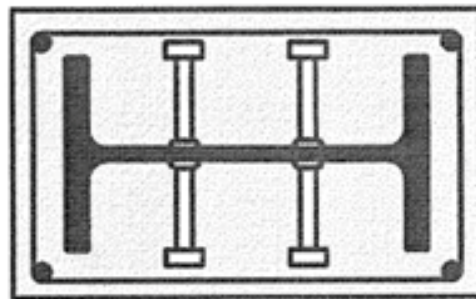
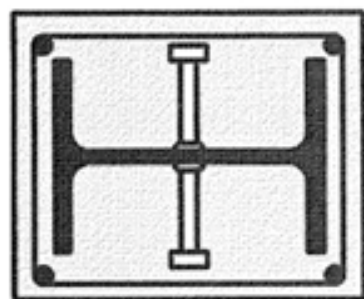
- 1 closed stirrups
- 2 open stirrups welded to the web
- 3 stirrups through the web



Type of reinforcements / Tipuri de armături

2) ARMĂTURI RIGIDE → profile laminate sau sudate

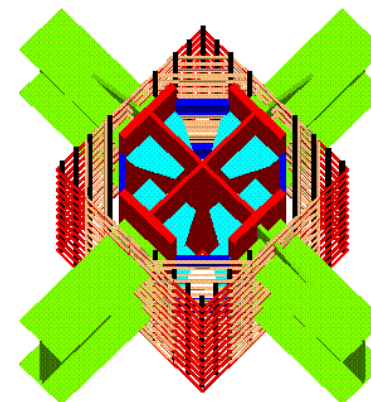
STÂLPI



Type of reinforcements / Tipuri de armături

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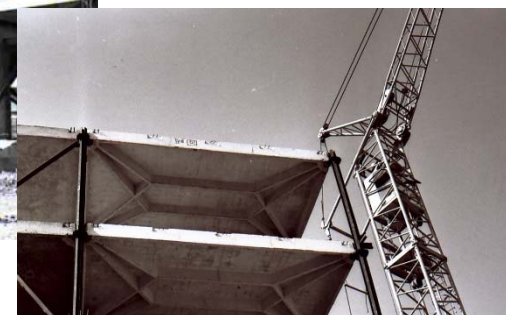
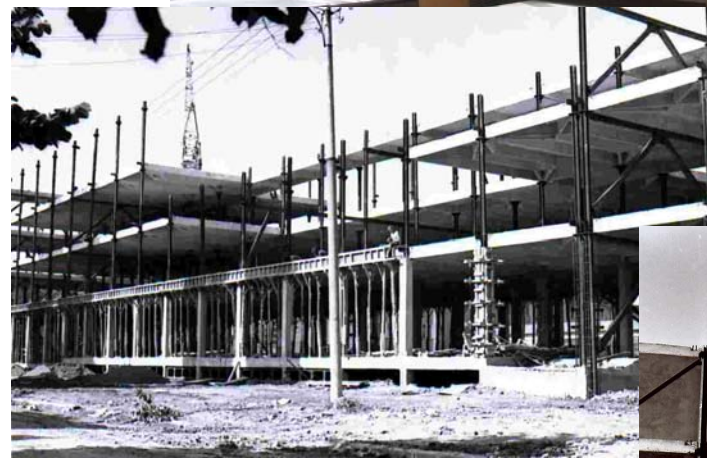
STÂLPI



Type of reinforcements / Tipuri de armături

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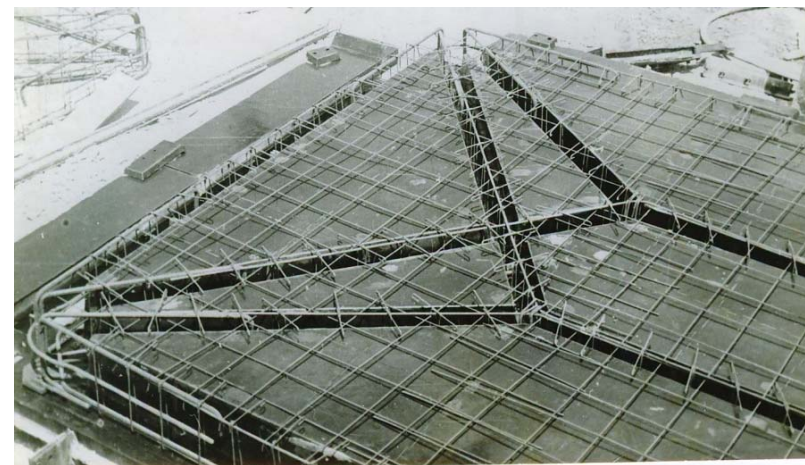
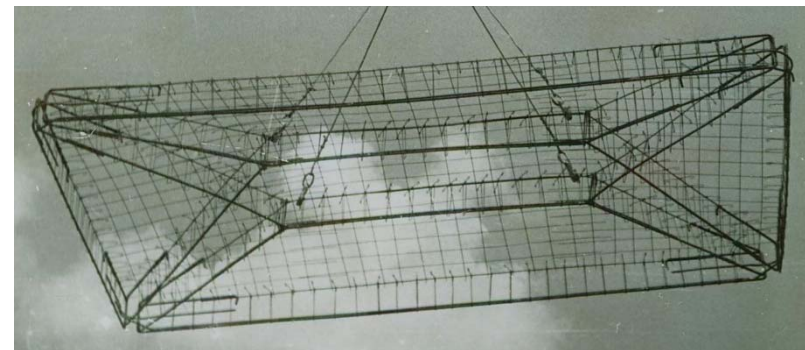
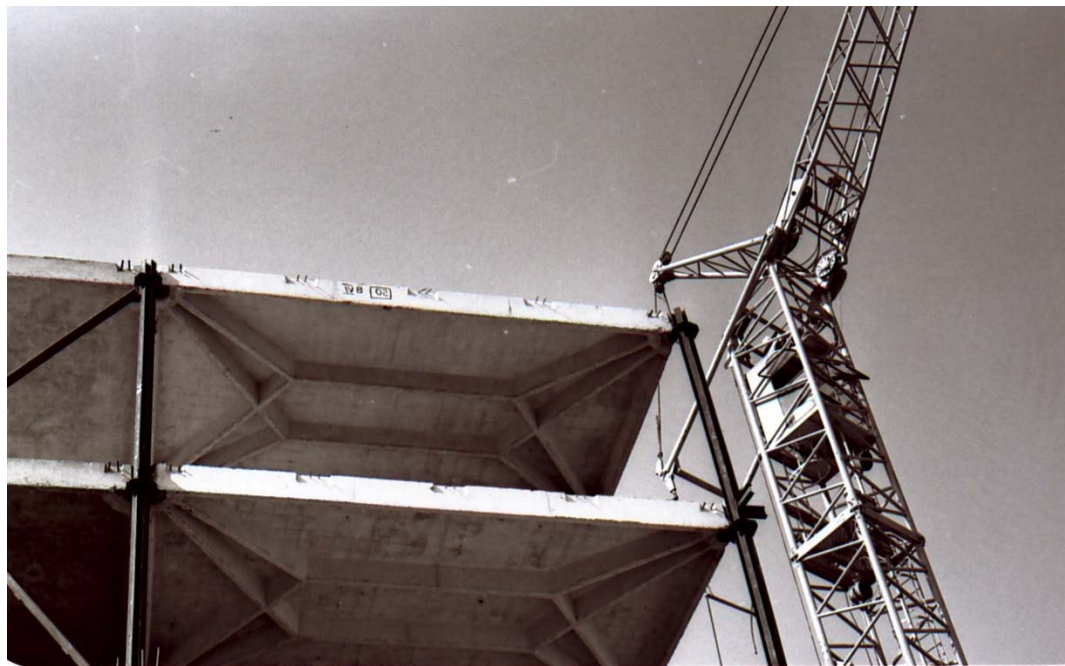
STÂLPI



Type of reinforcements / Tipuri de armături

2) ARMĂTURI RIGIDE → profile laminate sau sudate

STÂLPI



Type of reinforcements / Tipuri de armături

3) ARMĂTURI DISPERSE

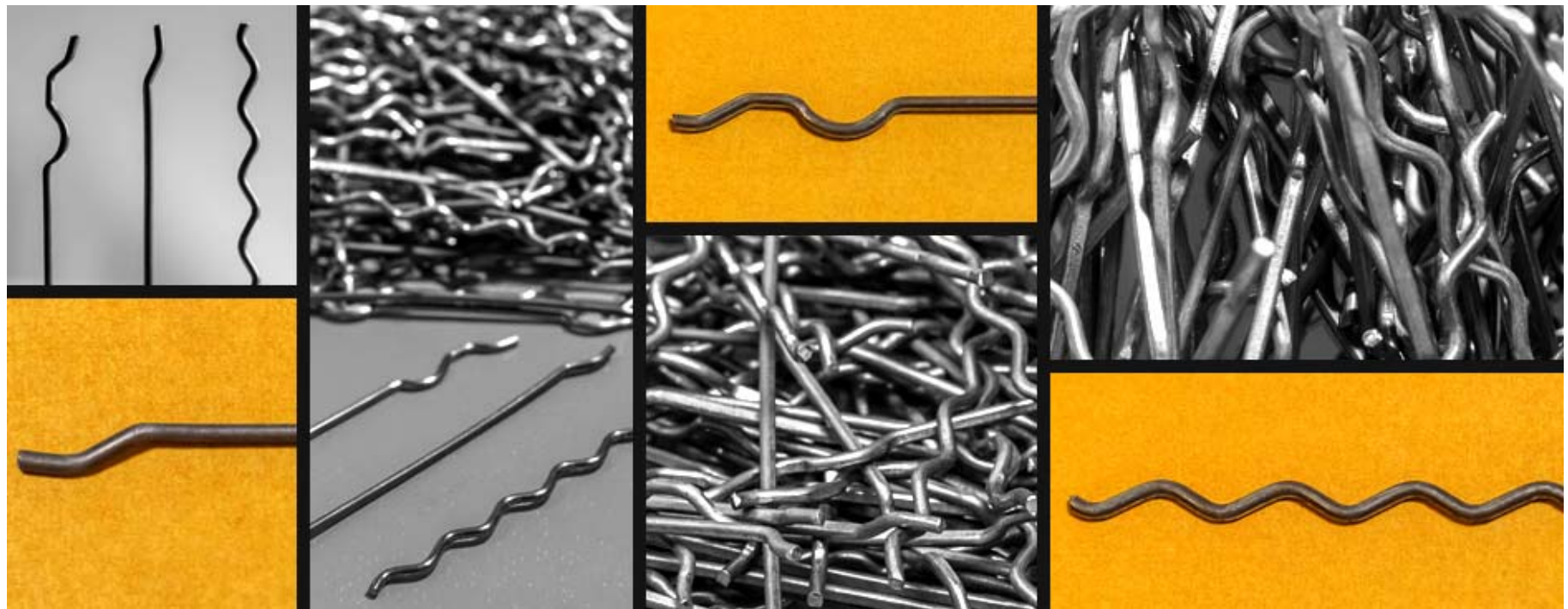
→ diferite tipuri de fibre SCURTE



Type of reinforcements / Tipuri de armături

3) ARMĂTURI DISPERSE

→ diferite tipuri de fibre SCURTE



Type of reinforcements / Tipuri de armături

3) ARMĂTURI DISPERSE

→ diferite tipuri de fibre SCURTE

- **Fibrele de polipropilenă** îmbunătățesc:

- coeziunea amestecului de beton
- pompabilitatea pe distanțe mari
- rezistența la îngheț-dezghet
- rezistența la foc
- rezistența la impact
- rezistența la contracție, etc

- **Fibrele de oțel** îmbunătățesc:

- rezistența structurală
- ductilitatea
- rezistența la impact și abraziune
- rezistența la îngheț-dezghet.

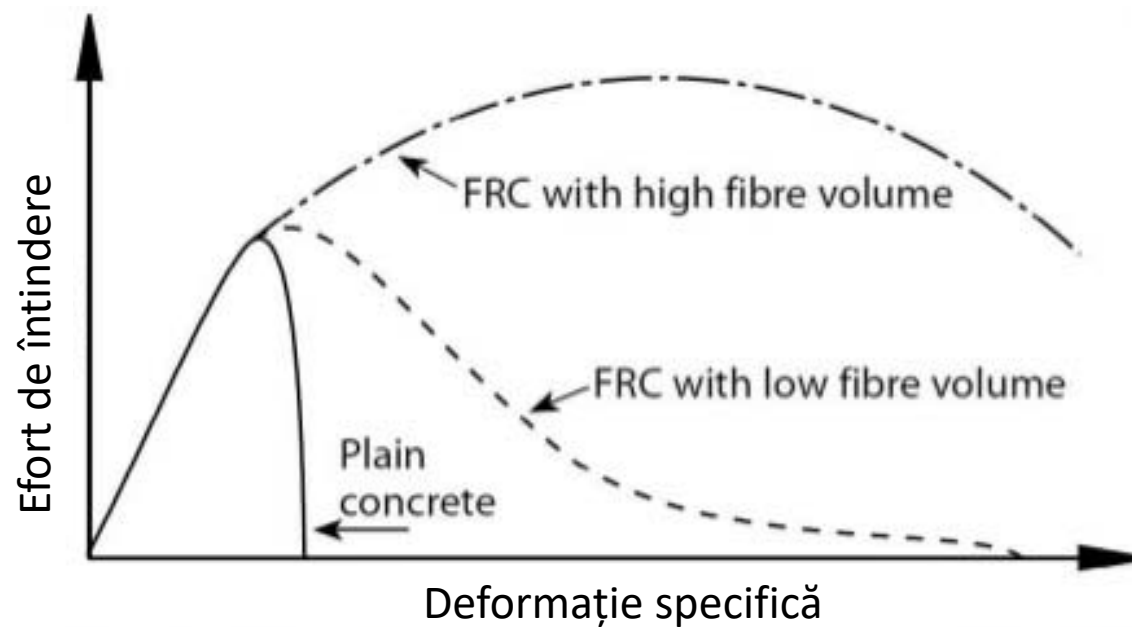
reduc:

- cantitatea de armătură necesară
- deschiderea de fisuri, controlează deschiderea (astfel măbind durabilitatea)

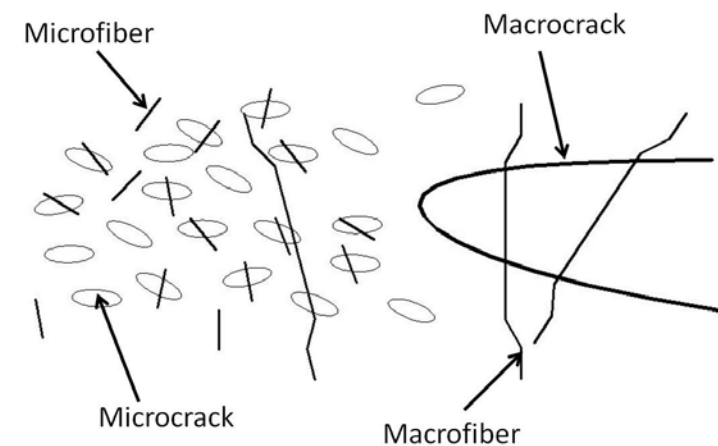
Tip of reinforcements / Tipuri de armături

3) ARMĂTURI DISPERSE

→ diferite tipuri de fibre SCURTE



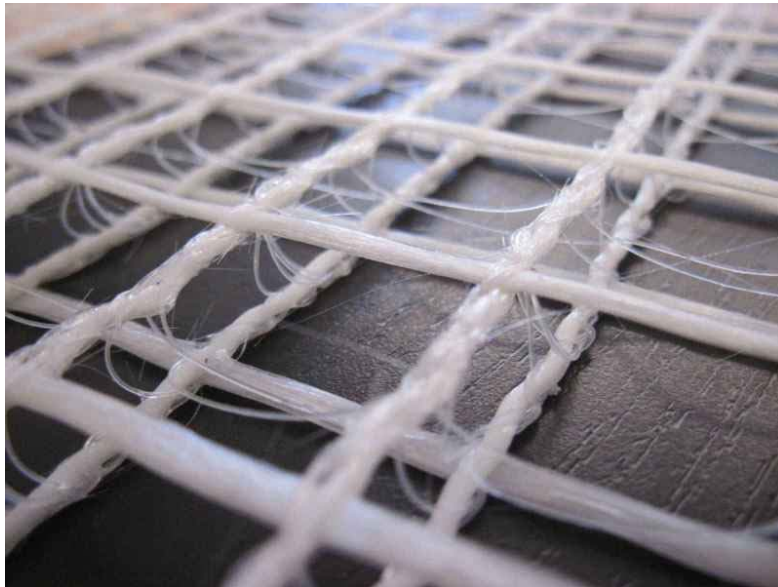
Reference: Cement & Concrete Institute
<http://www.cnci.org.za>



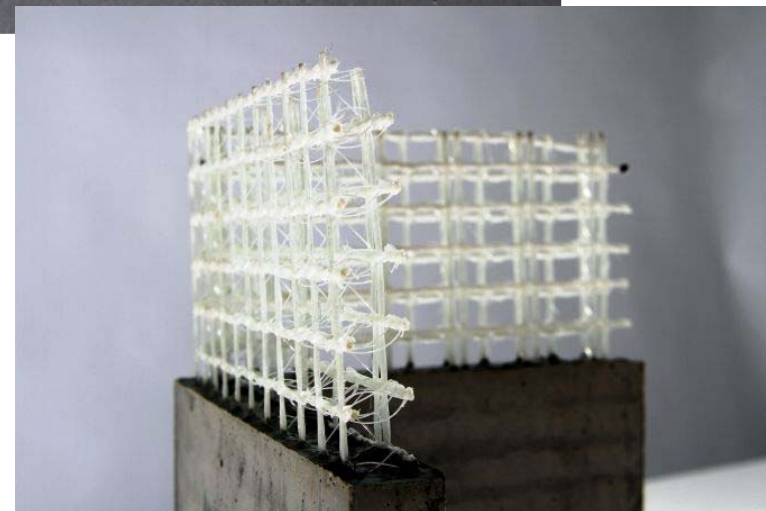
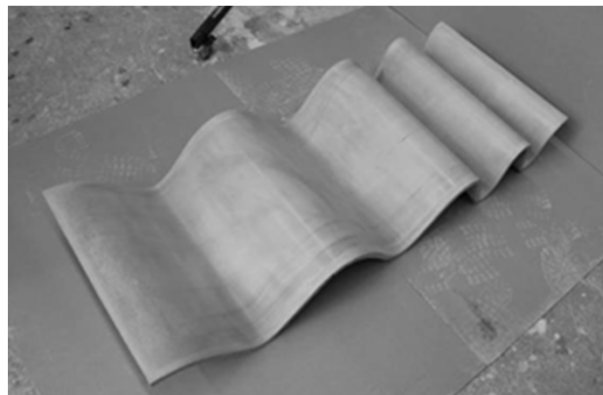
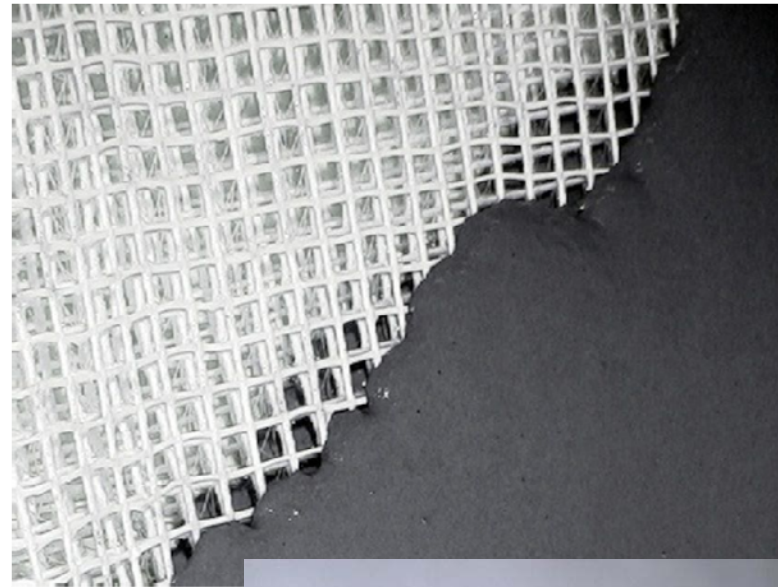
Type of reinforcements / Tipuri de armături

3) ARMĂTURI DISPERSE

→ diferite tipuri de TEXTILE



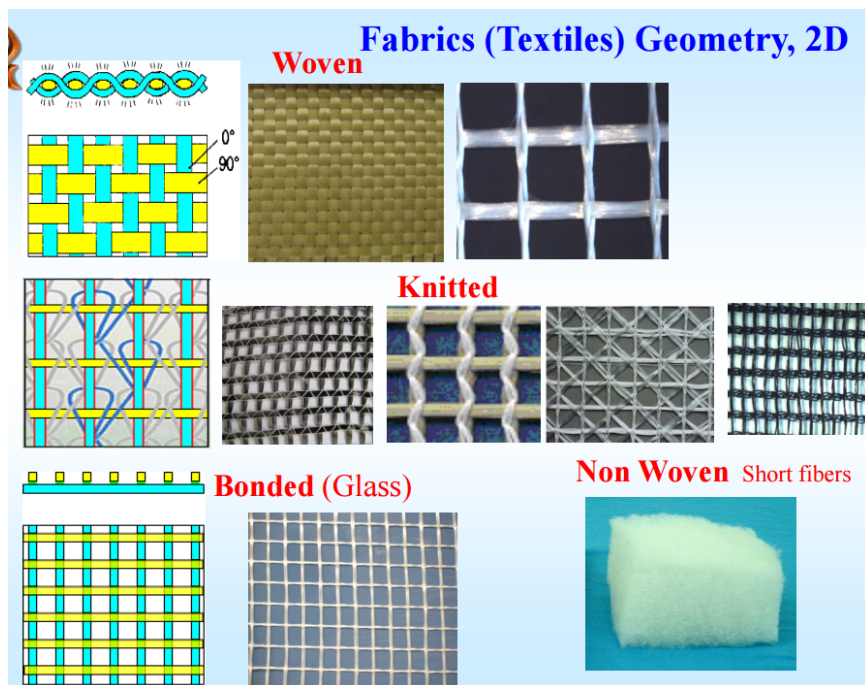
3D biaxial textile reinforcement



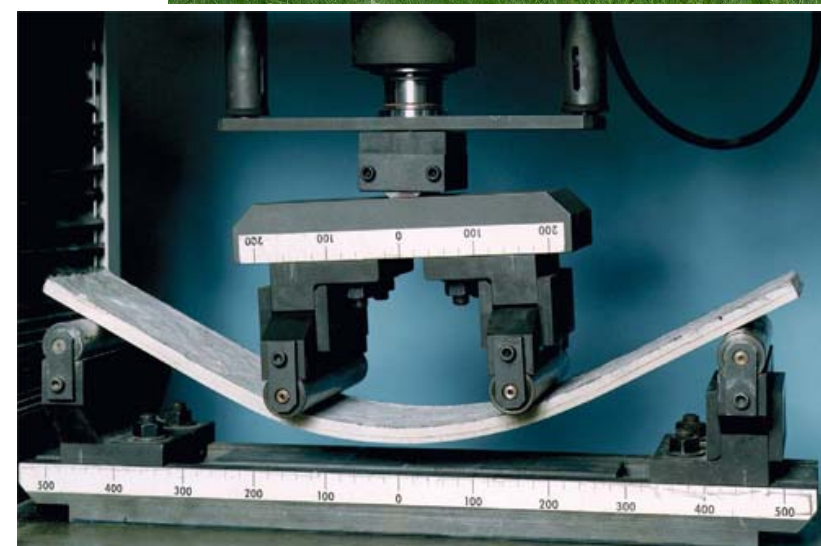
Type of reinforcements / Tipuri de armături

3) ARMĂTURI DISPERSE

→ diferite tipuri de TEXTILE



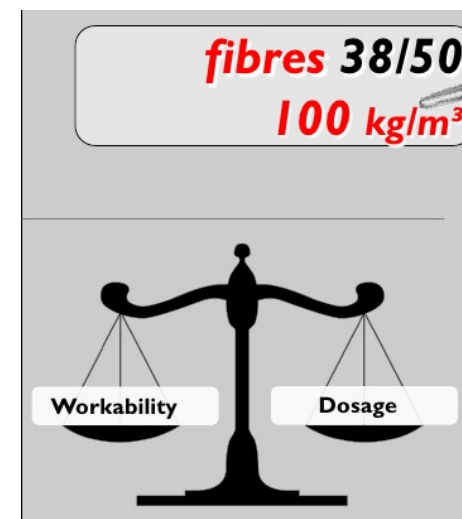
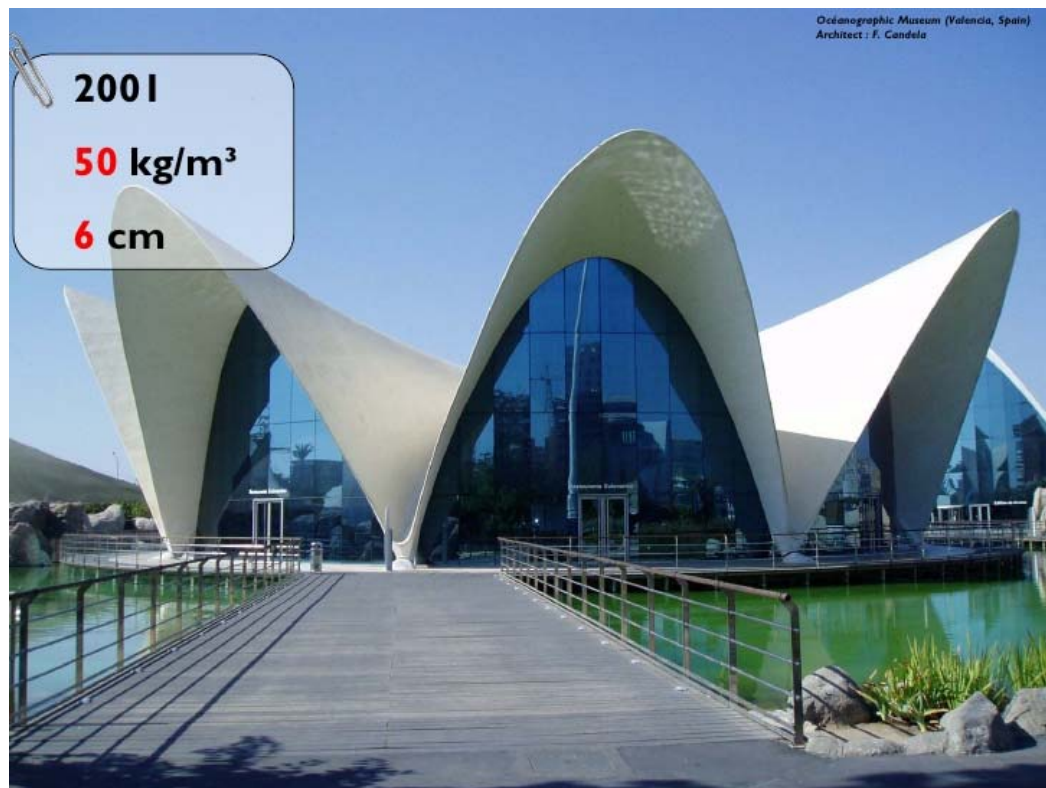
(Alva Peled)



Type of reinforcements / Tipuri de armături

3) ARMĂTURI DISPERSE

→ diferite tipuri de TEXTILE



4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE ARMATE CU FIBRE

Avantajele utilizării compozitelor în construcții

- rezistență ultimă ridicată ($>4000 \text{ N/mm}^2$)
- greutate mică ($\sim 1000 \div 2000 \text{ daN/m}^3$)
- durabilitate
- nu necesită întreținere
- varietate mare a sistemelor
- timp de execuție redus
- rezistență ridicată la impact

4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE ARMATE CU FIBRE

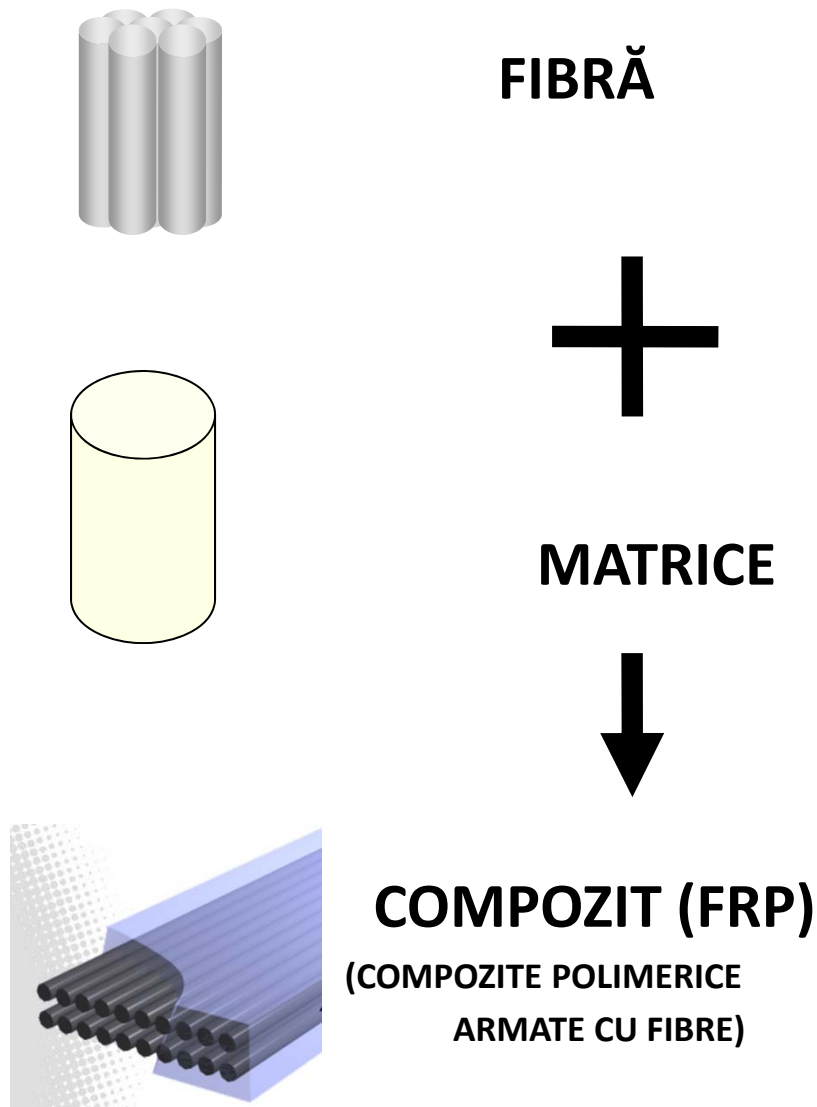
Domenii de utilizare

- Betonul armat supus acțiunii sărurilor
- Structuri maritime sau în zona mării
- Elemente de construcții supuse la alți agenți corozivi
- Aplicații care necesită conductivitate electrică redusă sau transparență electromagnetică
- Structuri sensibile la încărcări

Type of reinforcements / Tipuri de armături

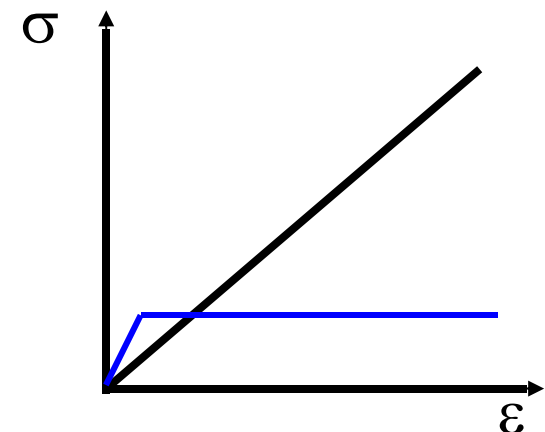
4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE ARMATE CU

FIBRE



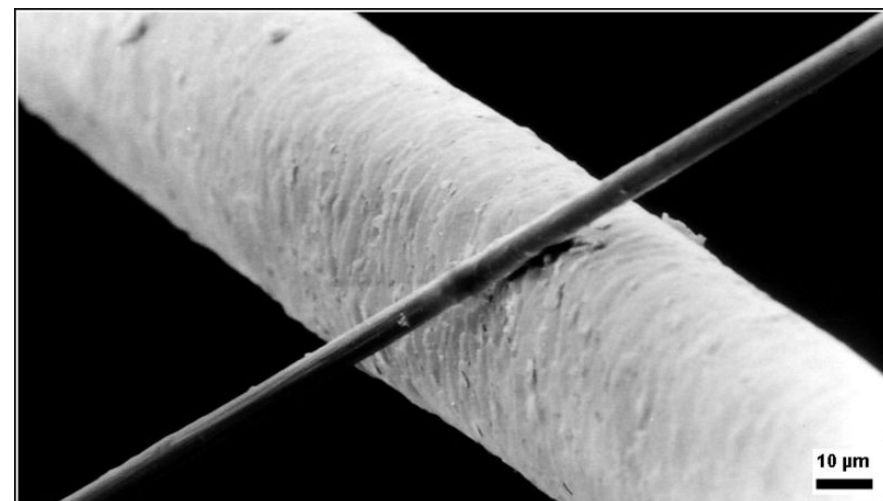
- grafit (carbon)
- sticlă
- aramidă
- bazaltică
- hibrid

- termoplaste
- termorigide



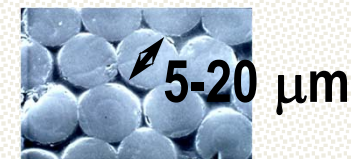
Type of reinforcements / Tipuri de armături

4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE



SECȚIUNE
TRANSVERSALĂ

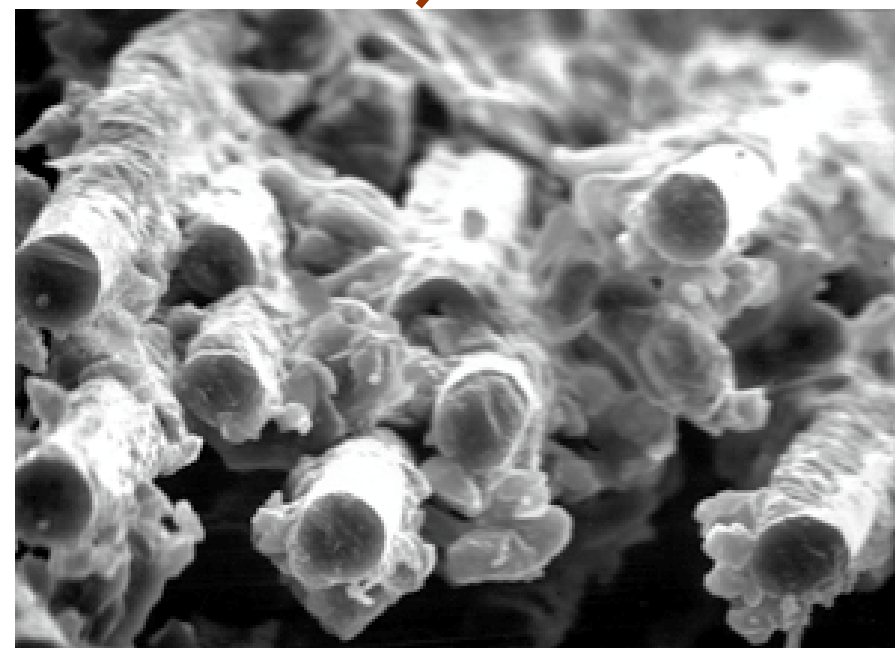
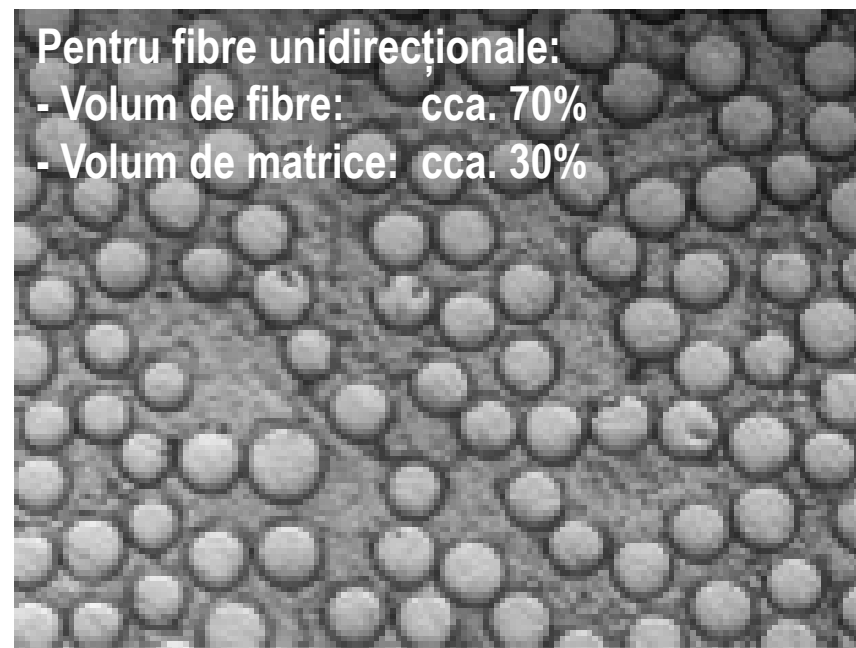
Raport >10:1



DIAMETRU FIR
DE PĂR ~ 200 μm

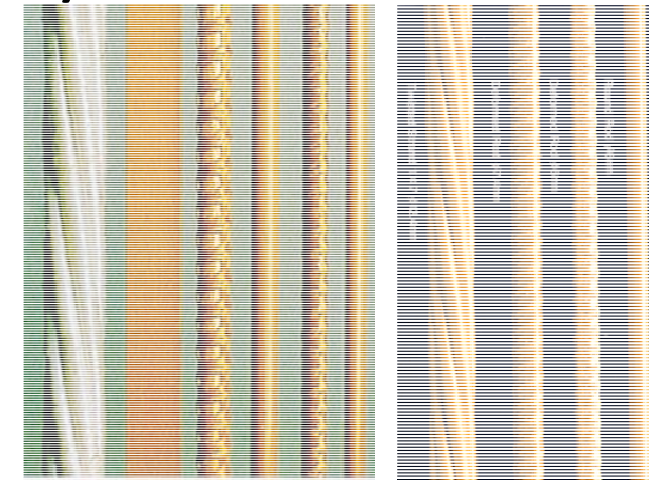
Pentru fibre unidirecționale:

- Volum de fibre: cca. 70%
- Volum de matrice: cca. 30%

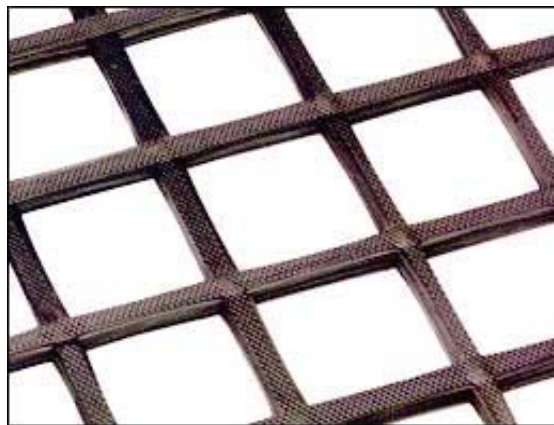


Type of reinforcements / Tipuri de armături

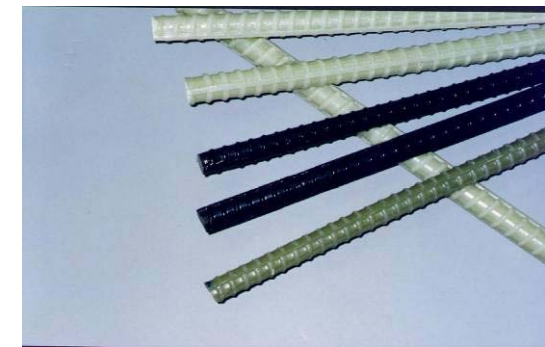
4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE



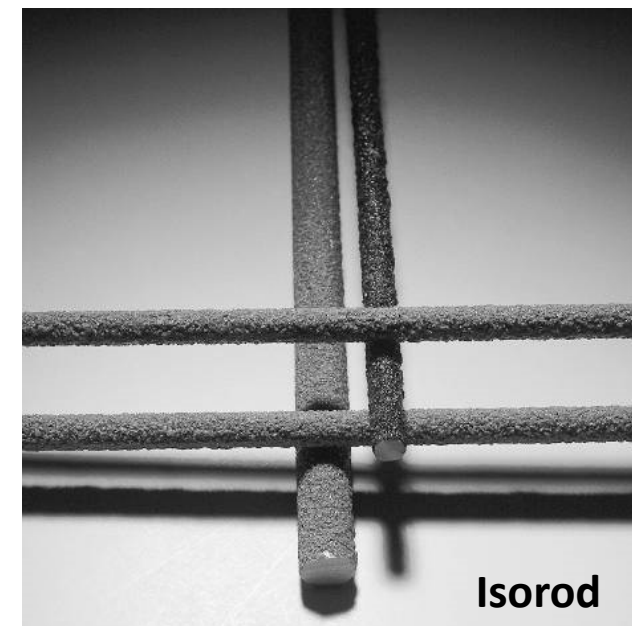
Technora rebars and strands



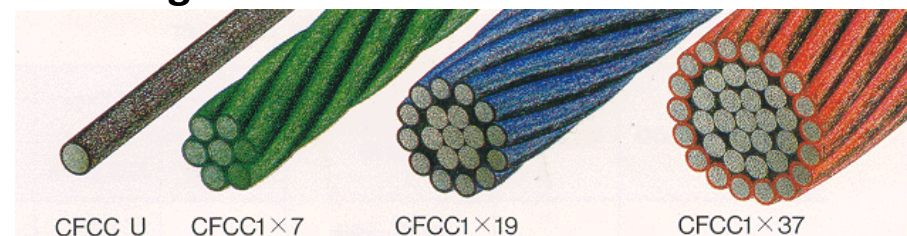
NEFMAC grid



C-Bar reinforcement



Isorod



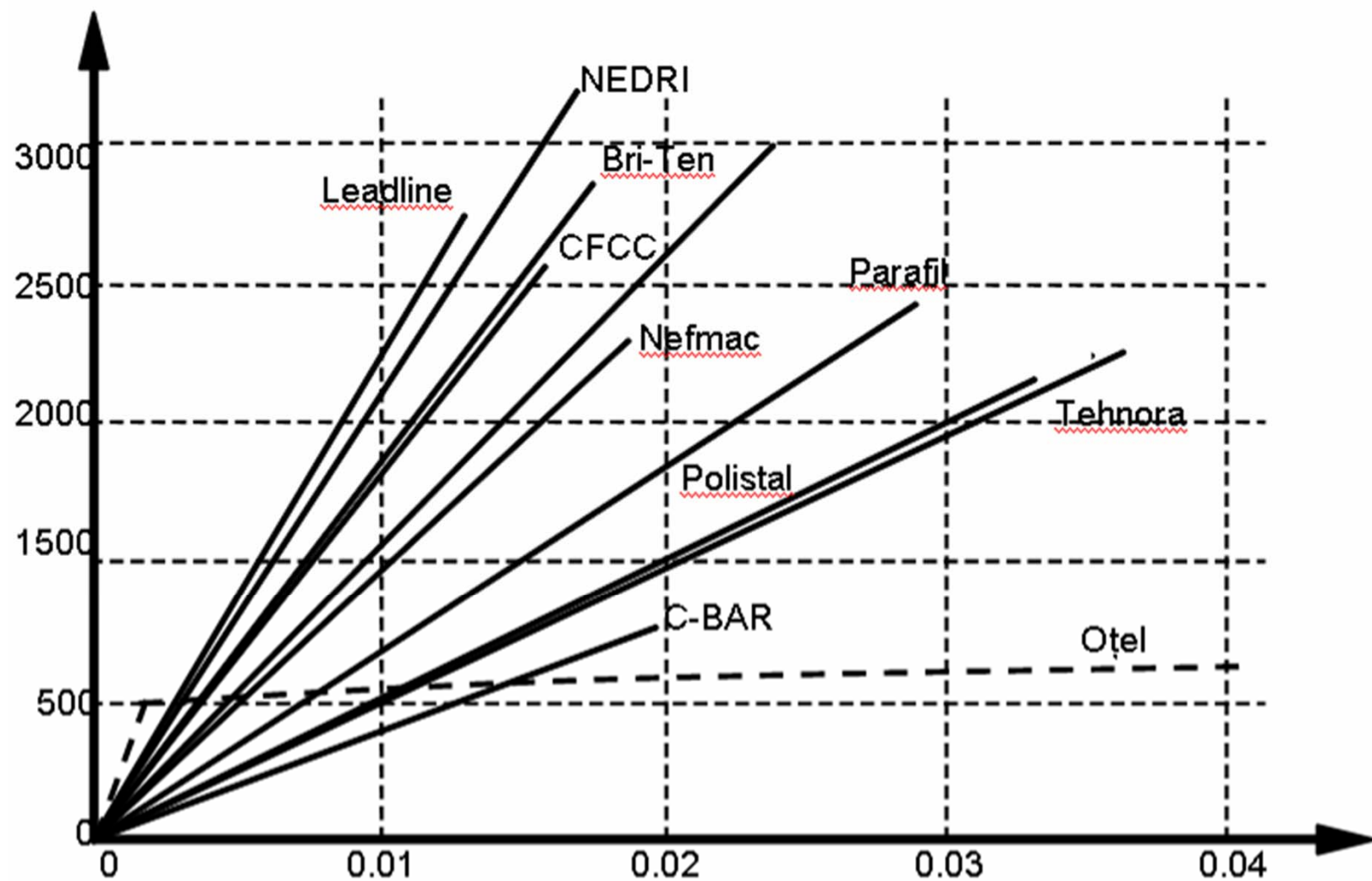
CFCC strands



CRT

Type of reinforcements / Tipuri de armături

4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE



Type of reinforcements / Tipuri de armături

Materiale	Rezistență la întindere [N/mm ²]	Modul de elasticitate [N/mm ²]	Densitate [kg/m ³]	Deformație specifică [%]
Fiberă de sticlă				
E	1900 ÷ 3000	70000	1200 ÷ 2600	3.0 ÷ 4.5
S	3500 ÷ 4800	85000 ÷ 90000		4.5 ÷ 5.5
Fibră de aramidă				
Modul mic	3500 ÷ 4100	70000 ÷ 80000	1200 ÷ 1700	
Modul mare	3500 ÷ 4000	115000 ÷ 130000		2.5 ÷ 3.5
Fibră de carbon				
Rezistență mare	3500 ÷ 4800	215000 ÷ 235000		1.4 ÷ 2.0
Rezist. ultra mare	3500 ÷ 6000	215000 ÷ 235000	1500 ÷ 1900	1.5 ÷ 2.3
Modul mare	2500 ÷ 3100	350000 ÷ 500000		0.5 ÷ 0.9
Modul ultra mare	2100 ÷ 2400	500000 ÷ 700000		0.2 ÷ 0.4
Fibră de bazaltică	4800	89000	2700	3.15
Rășină (Matrix)	80 ÷ 100	30000 ÷ 40000	900 ÷ 1700	0.5 ÷ 5
GFRP	770 ÷ 1670	38500 ÷ 155000	1800 ÷ 2100	0.45 ÷ 2.2
AFRP	1500 ÷ 3000	50000 ÷ 130000	13	2.4 ÷ 3.6
CFRP	1300 ÷ 2800	165000 ÷ 400000	1600	0.45 ÷ 1.7
Beton	1 ÷ 3	21000 ÷ 50000	2300 ÷ 2500	0.015
Armătură din oțel	350 ÷ 550	210000	7800	(0.2) 25
Armătură de pretensionare	1200 ÷ 1800	210000	7800	NA

Type of reinforcements / Tipuri de armături

4) ARMĂTURI DIN MATERIALE COMPOZITE POLIMERICE



3.1 TIPURI DE ARMĂTURI

3.2 EXEMPLE DE ARMĂRI

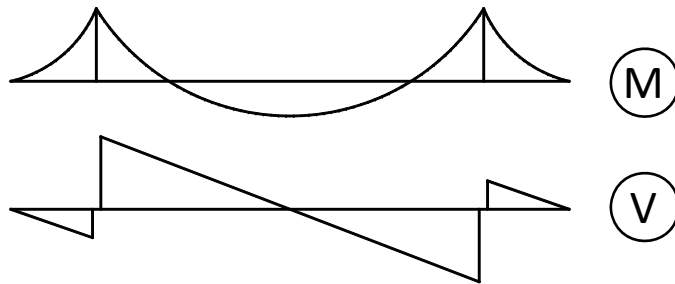
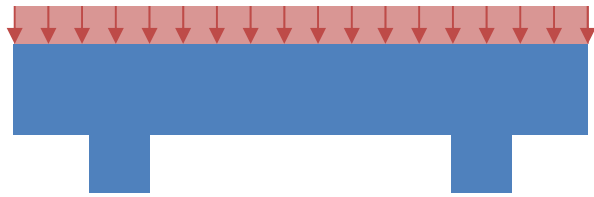
3.3 PROPRIETĂȚILE ARMĂTURILOR

Samples of element reinforcement / Exemple de armări

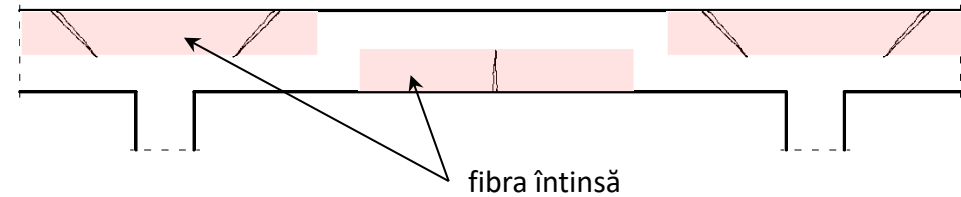
Din punctul de vedere al rolului:

A) Armături de rezistență → dintr-un calcul de dimensionare

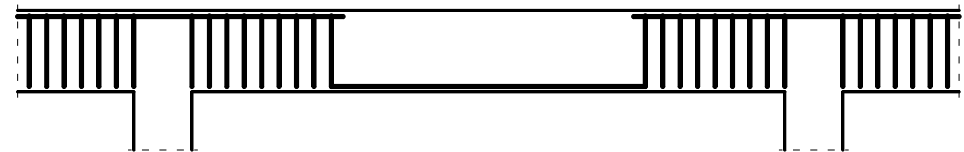
- Longitudinale de rezistență - constituie armătura principală a unei carcase ($M+N, T$)
- Transversale de rezistență - sub formă de etrieri sau frete (V, T)



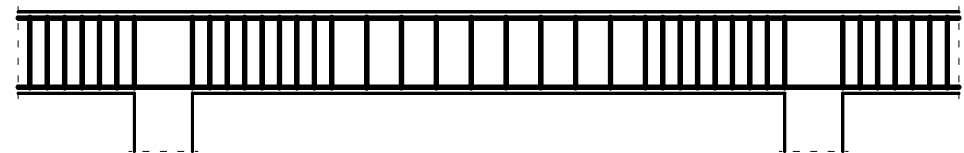
Modul de fisurare a unei grinzi pentru încărcările date



Armătura necesară teoretic



Dispunerea practică a armăturilor

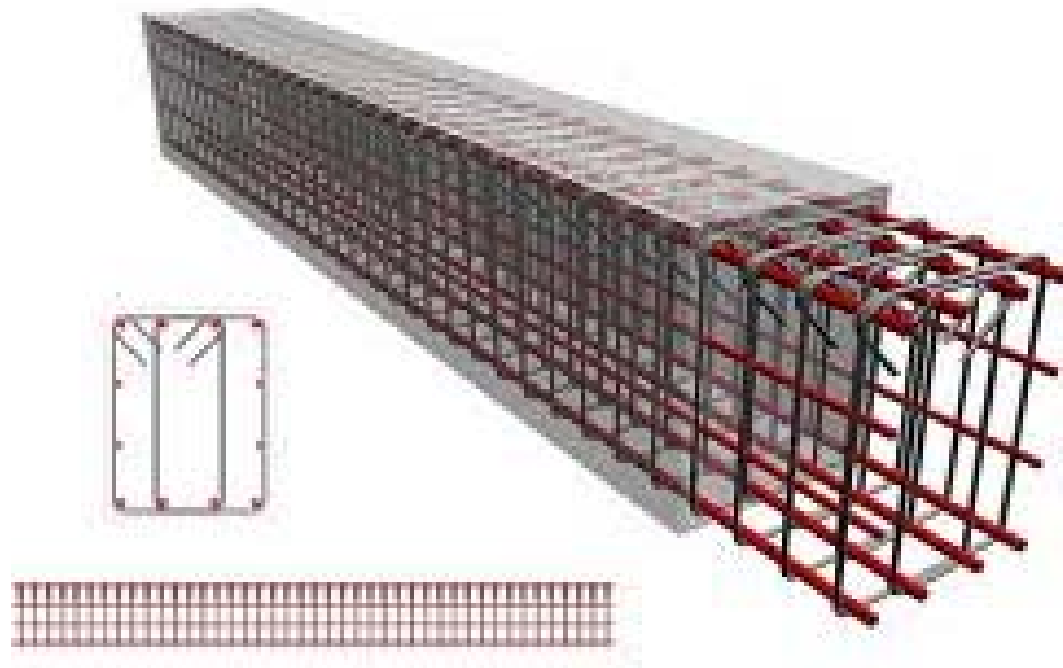


Samples of element reinforcement / Exemple de armări

Din punctul de vedere al rolului:

A) Armături de rezistență → dintr-un calcul de dimensionare

- Longitudinale de rezistență - constituie armătura principală a unei carcase (M+N, T)
- Transversale de rezistență - sub formă de etrieri sau frete (V, T)

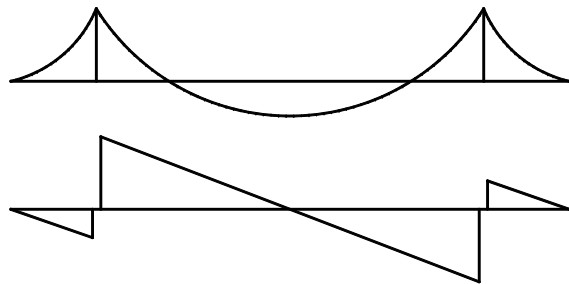
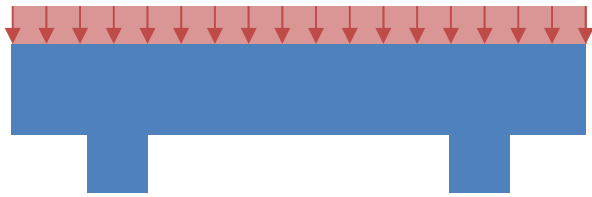


Samples of element reinforcement / Exemple de armări

Din punctul de vedere al rolului:

B) Armături constructive → pt asamblarea și stabilitatea carcasei

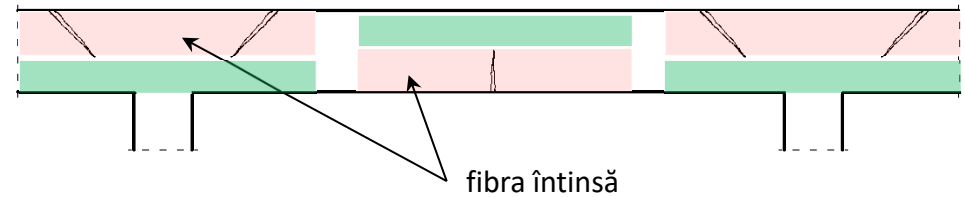
- de montaj, dispuse constructiv
- secundare (sau de repartiție)



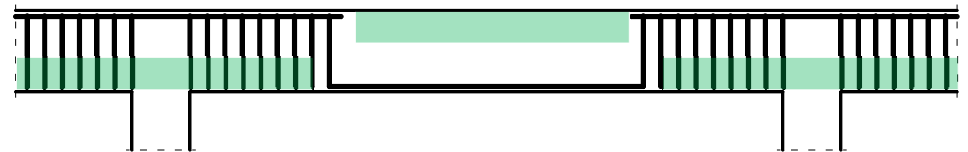
(M)

(V)

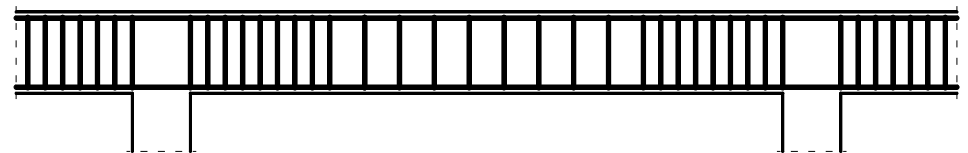
Modul de fisurare a unei grinzi pentru încărcările date



Armătura necesară teoretic



Dispunerea practică a armăturilor



Samples of element reinforcement / Exemple de armări

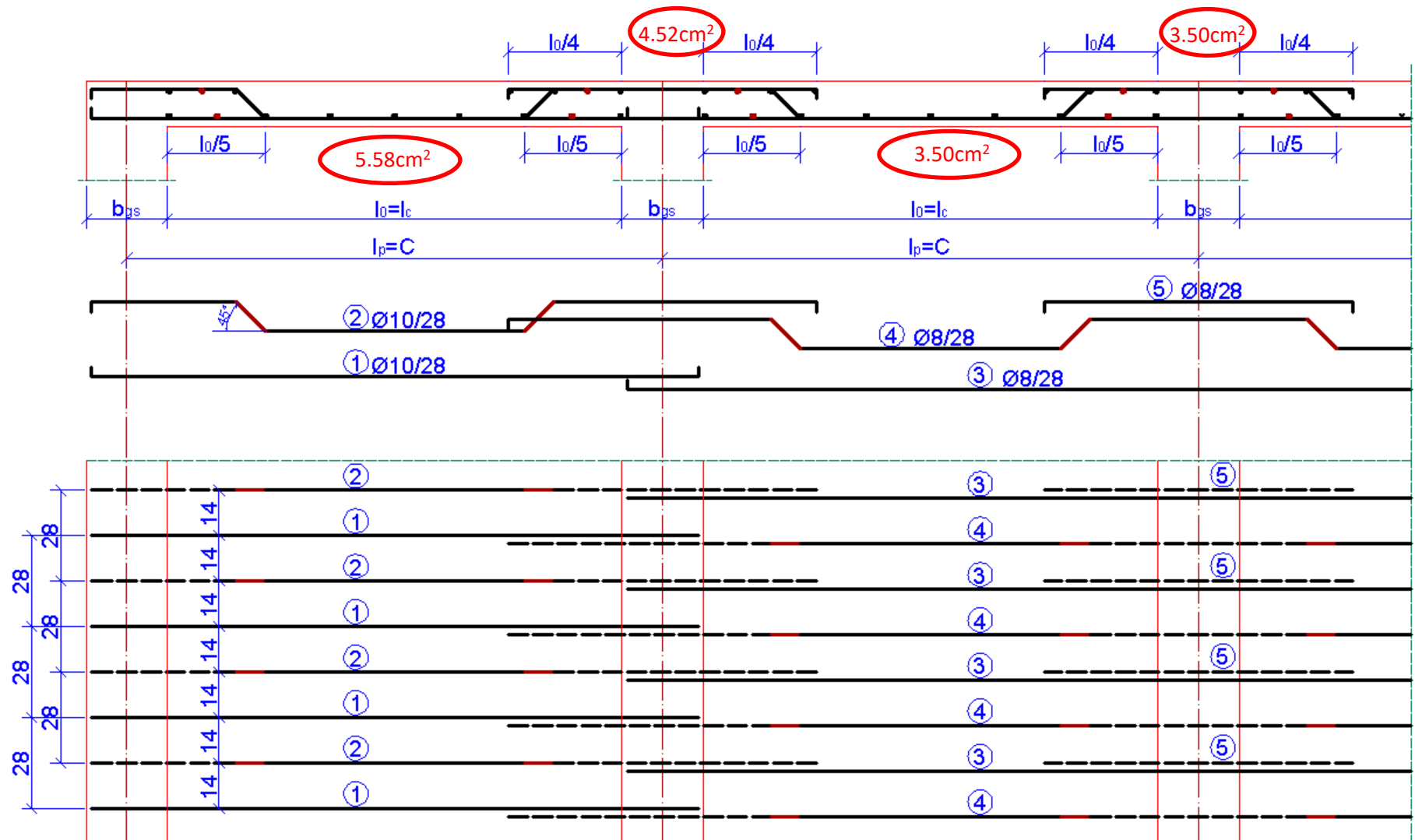
Din punctul de vedere al rolului:

B) Armături constructive → pt asamblarea și stabilitatea carcusei

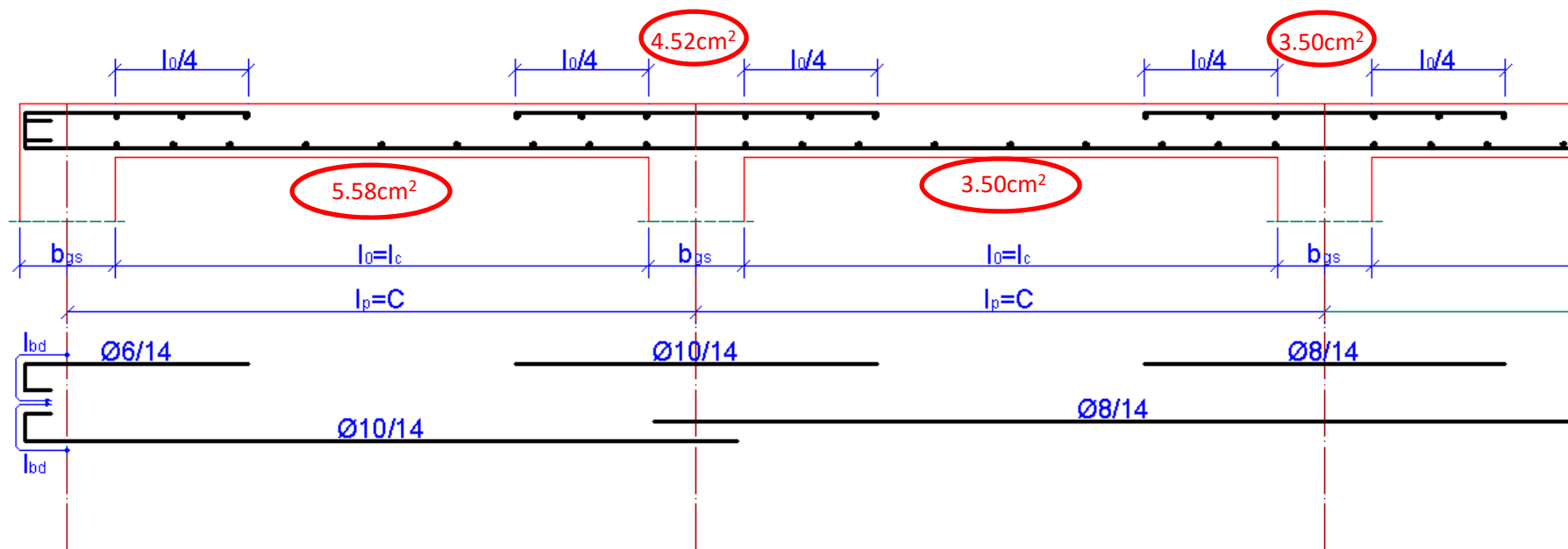
- de montaj, dispuse constructiv
- secundare (sau de repartiție)



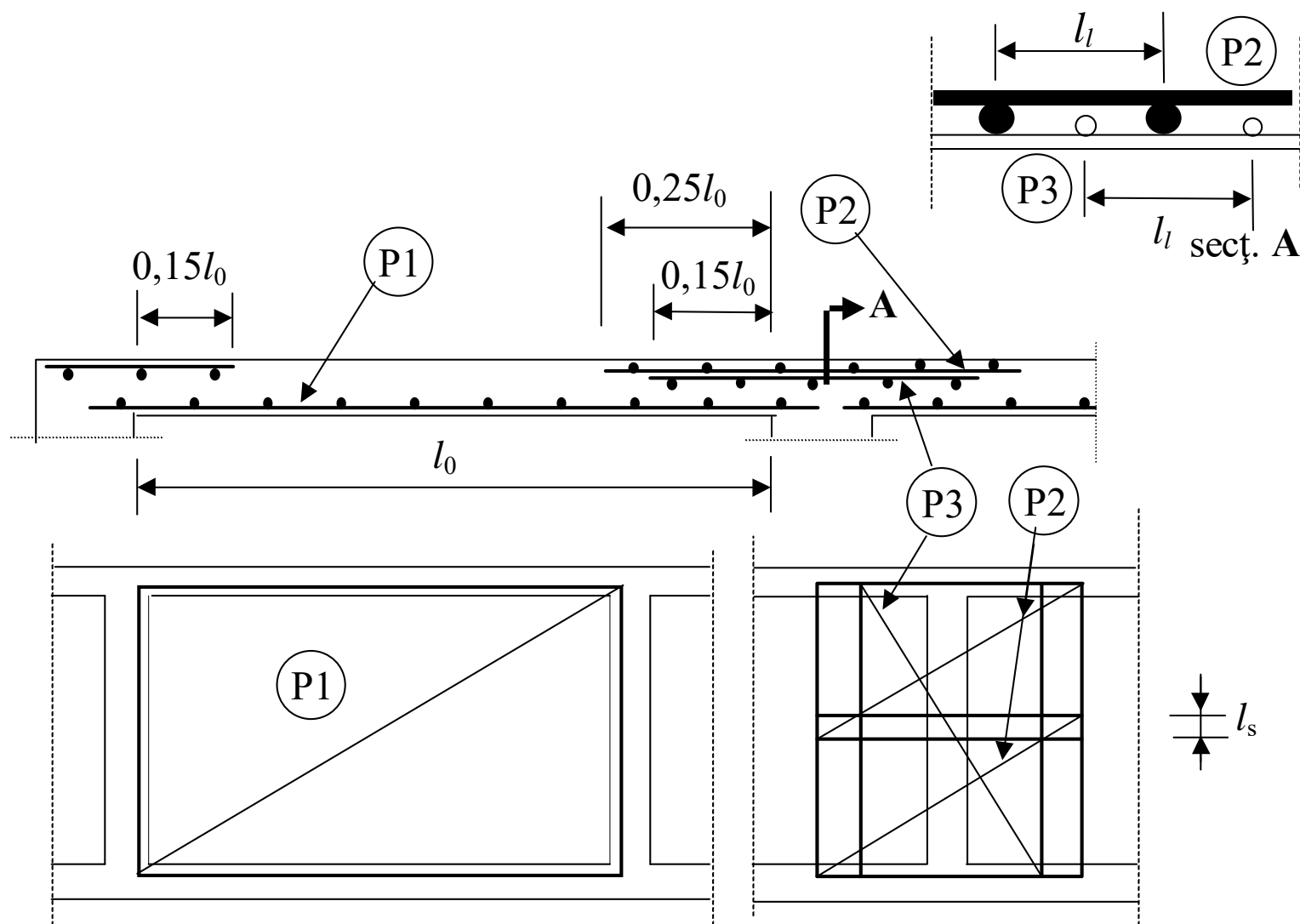
Samples of element reinforcement / Exemple de armări

Armarea planșelor → cu bare ridicate

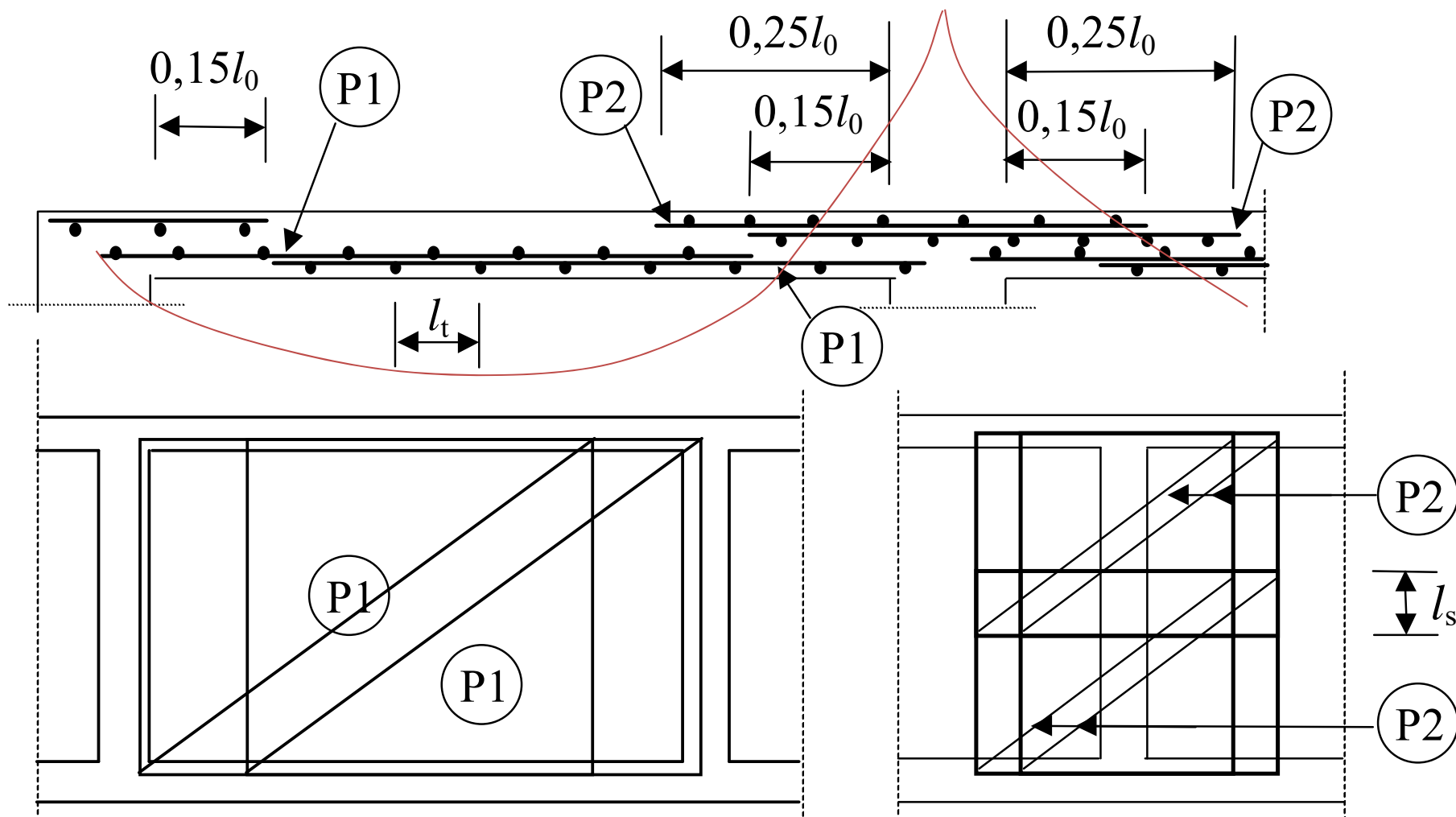
Samples of element reinforcement / Exemple de armări

Armarea planșelor → cu bare drepte

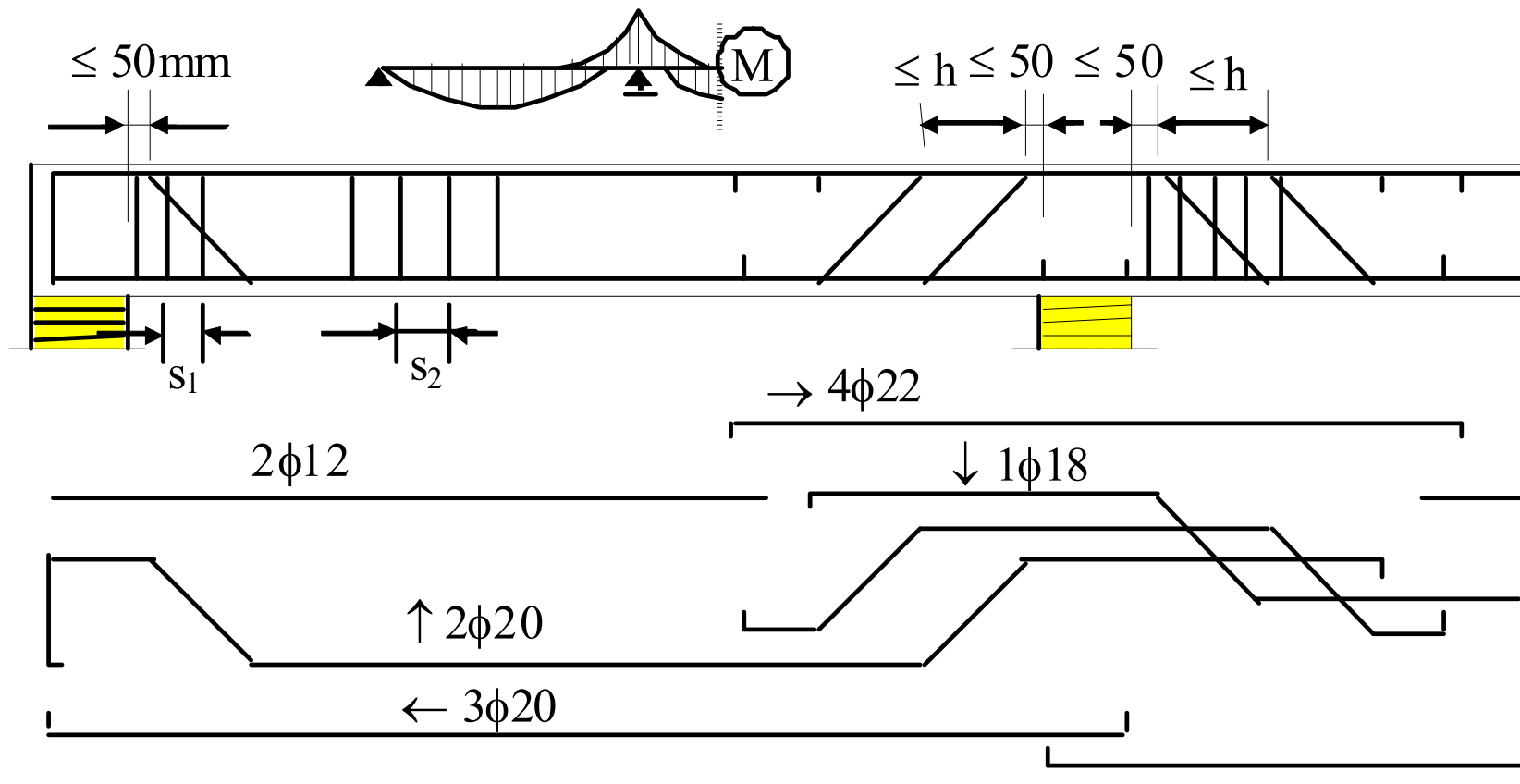
Samples of element reinforcement / Exemple de armări

Armarea planșelor → cu plase sudate

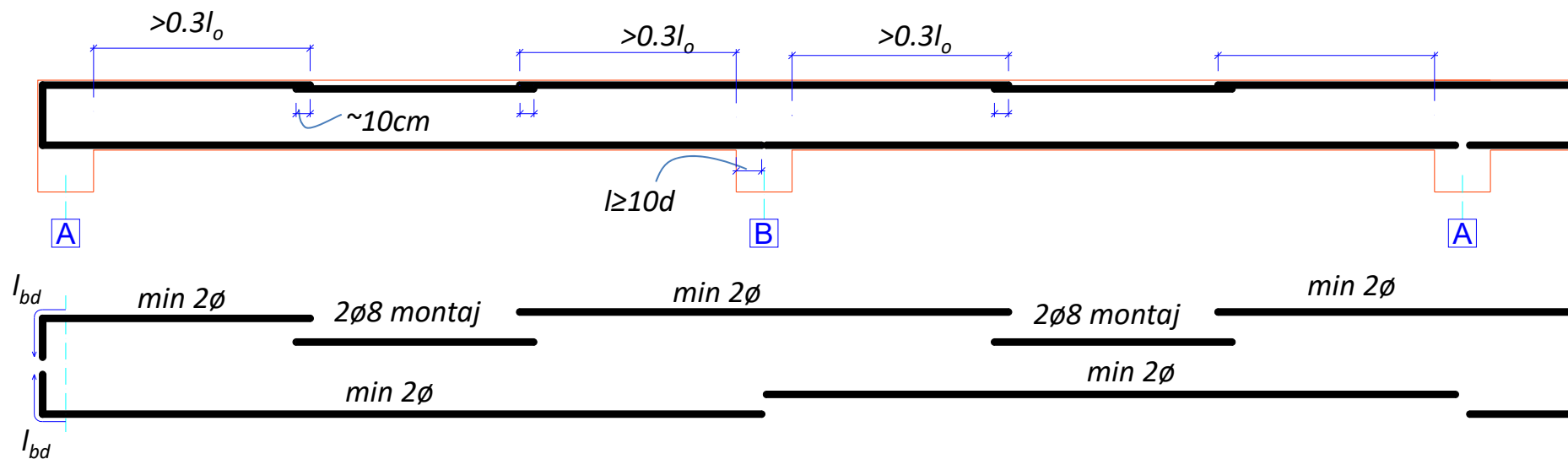
Samples of element reinforcement / Exemple de armări

Armarea planșelor → cu plase sudate

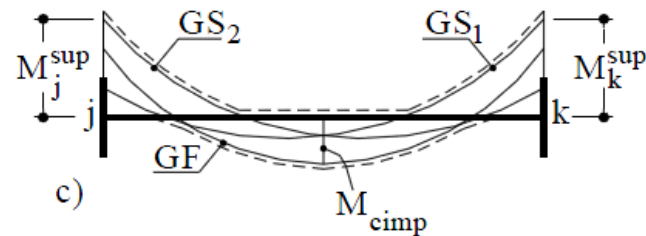
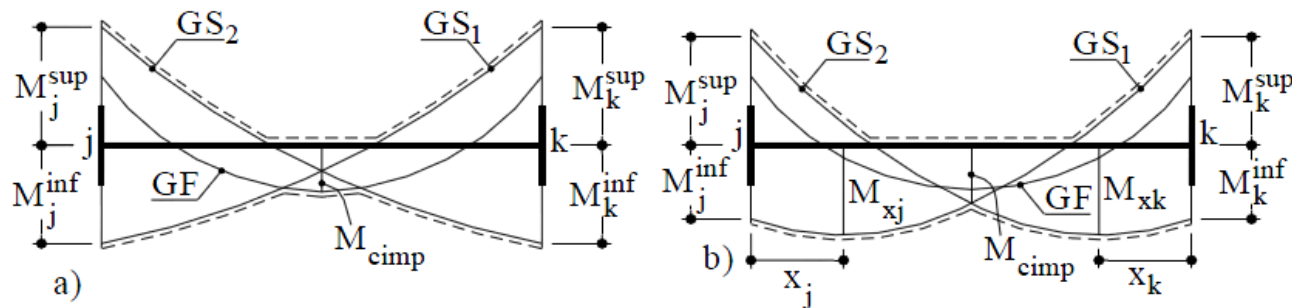
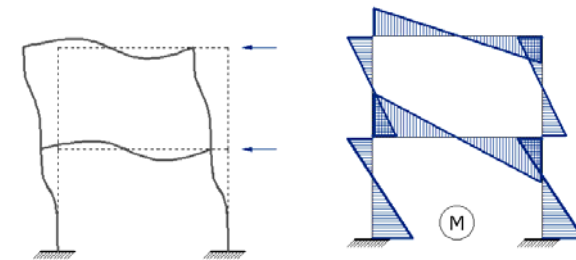
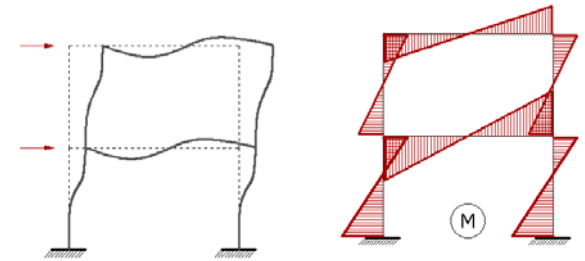
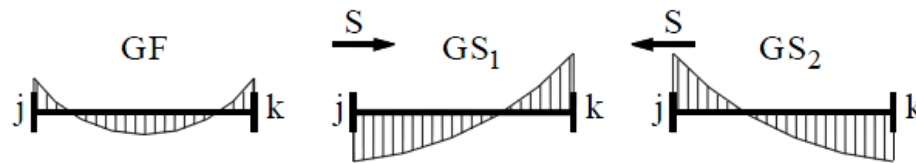
Samples of element reinforcement / Exemple de armări

Armarea grinzilor principale → cu bare înclinate

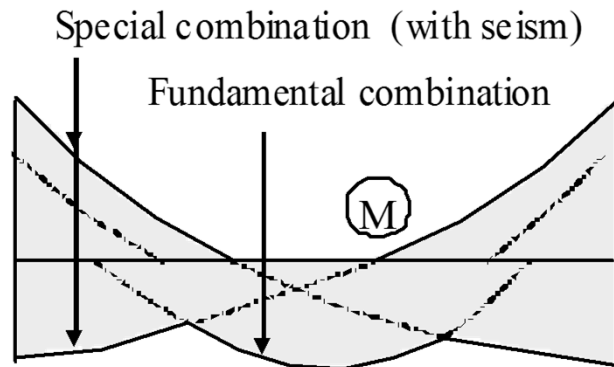
Samples of element reinforcement / Exemple de armări

Armarea grinzilor secundare → cu bare drepte

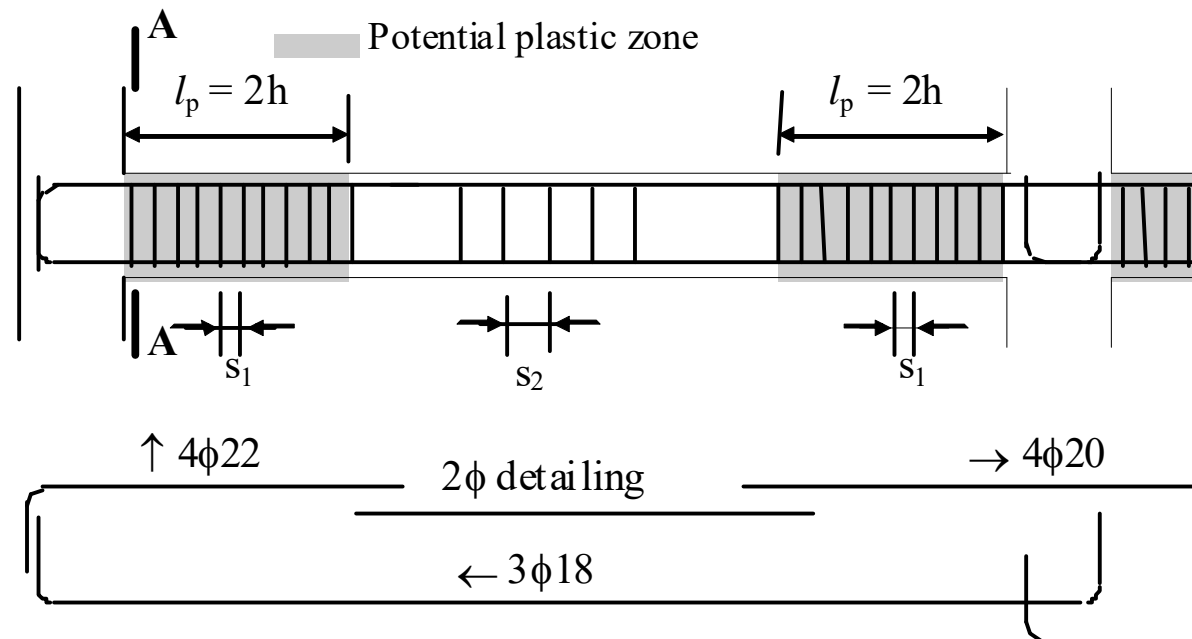
Samples of element reinforcement / Exemple de armări

Armarea grinzilor → în zone seismice

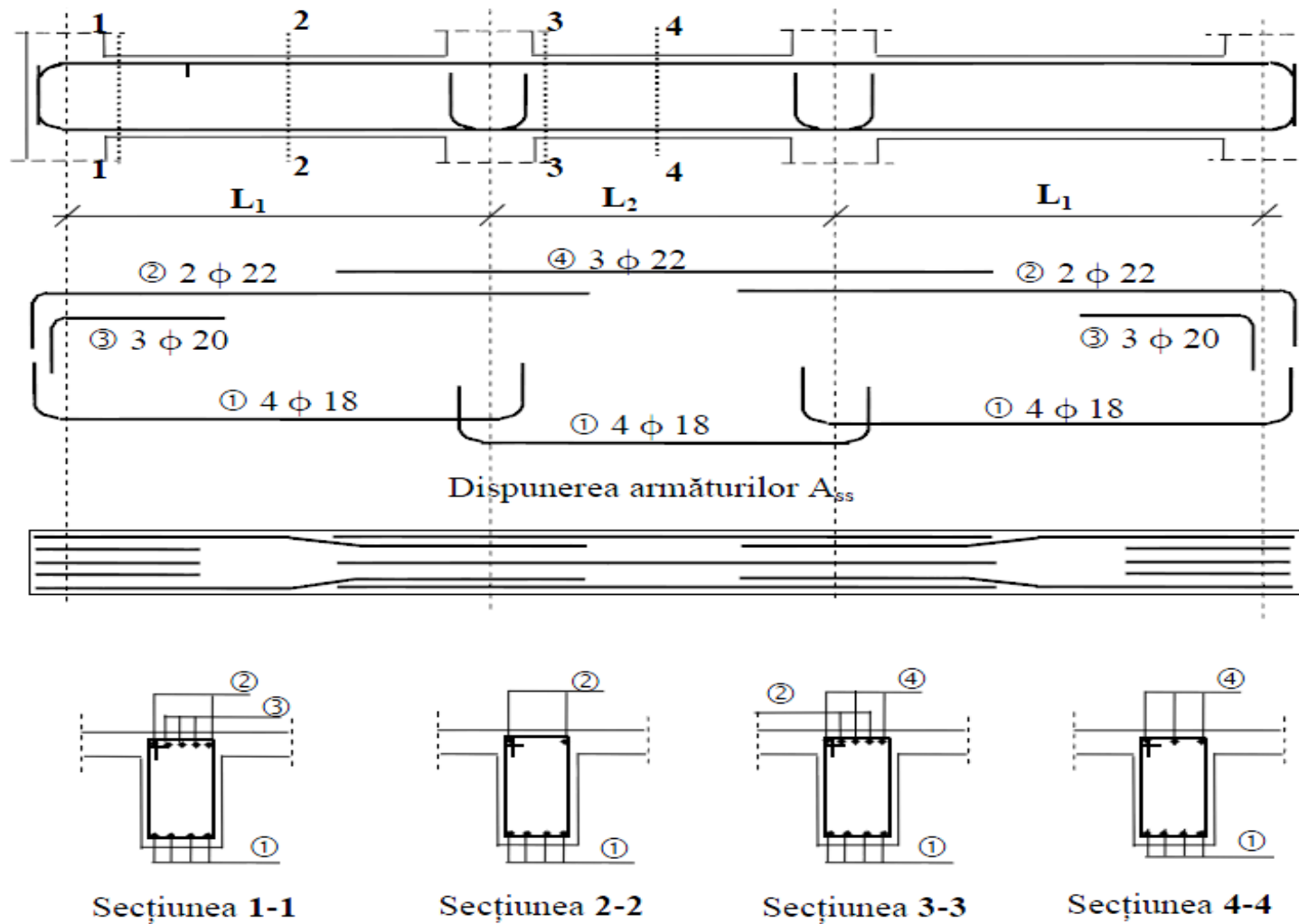
Samples of element reinforcement / Exemple de armări

Armarea grinzilor → în zone seismice

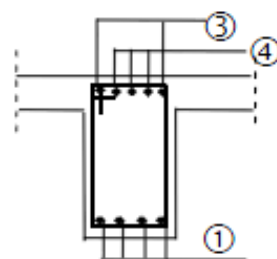
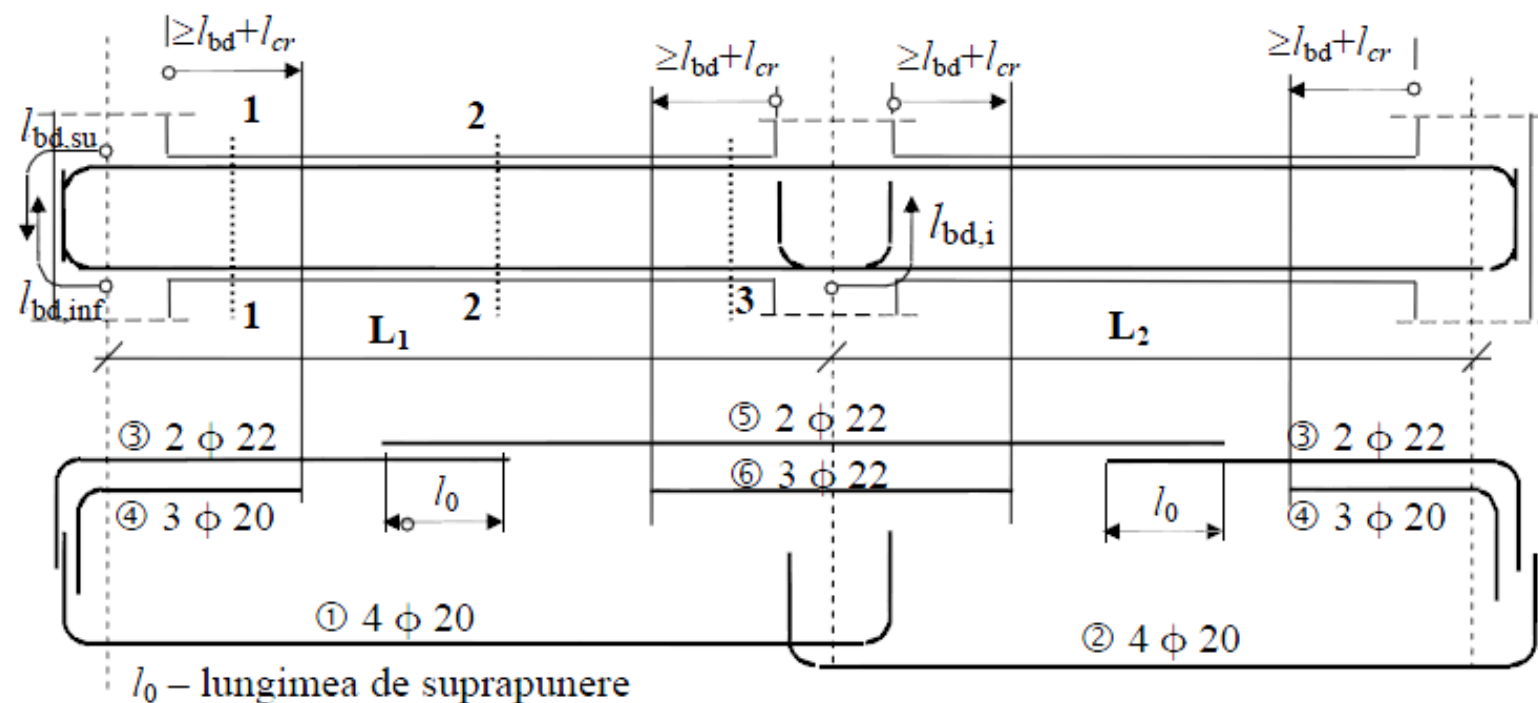
Envelope curve of the bending moments



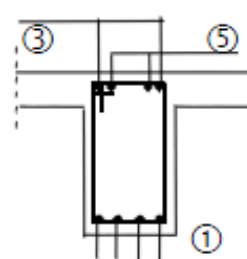
Samples of element reinforcement / Exemple de armări

Armarea grinzilor → în zone seismice

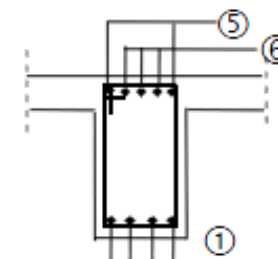
Samples of element reinforcement / Exemple de armări

Armarea grinzilor → în zone seismice

Secțiunea 1-1

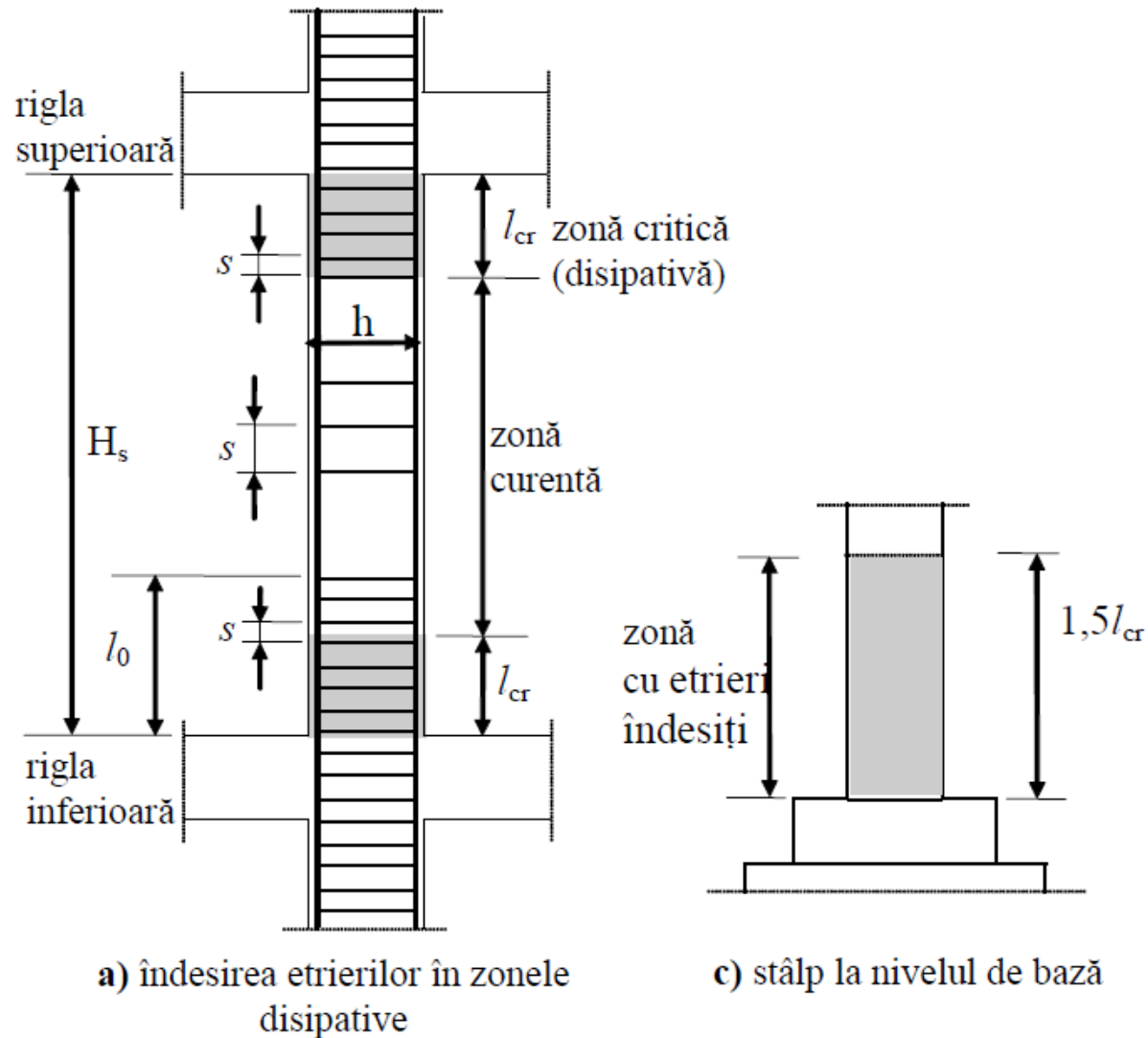


Secțiunea 2-2

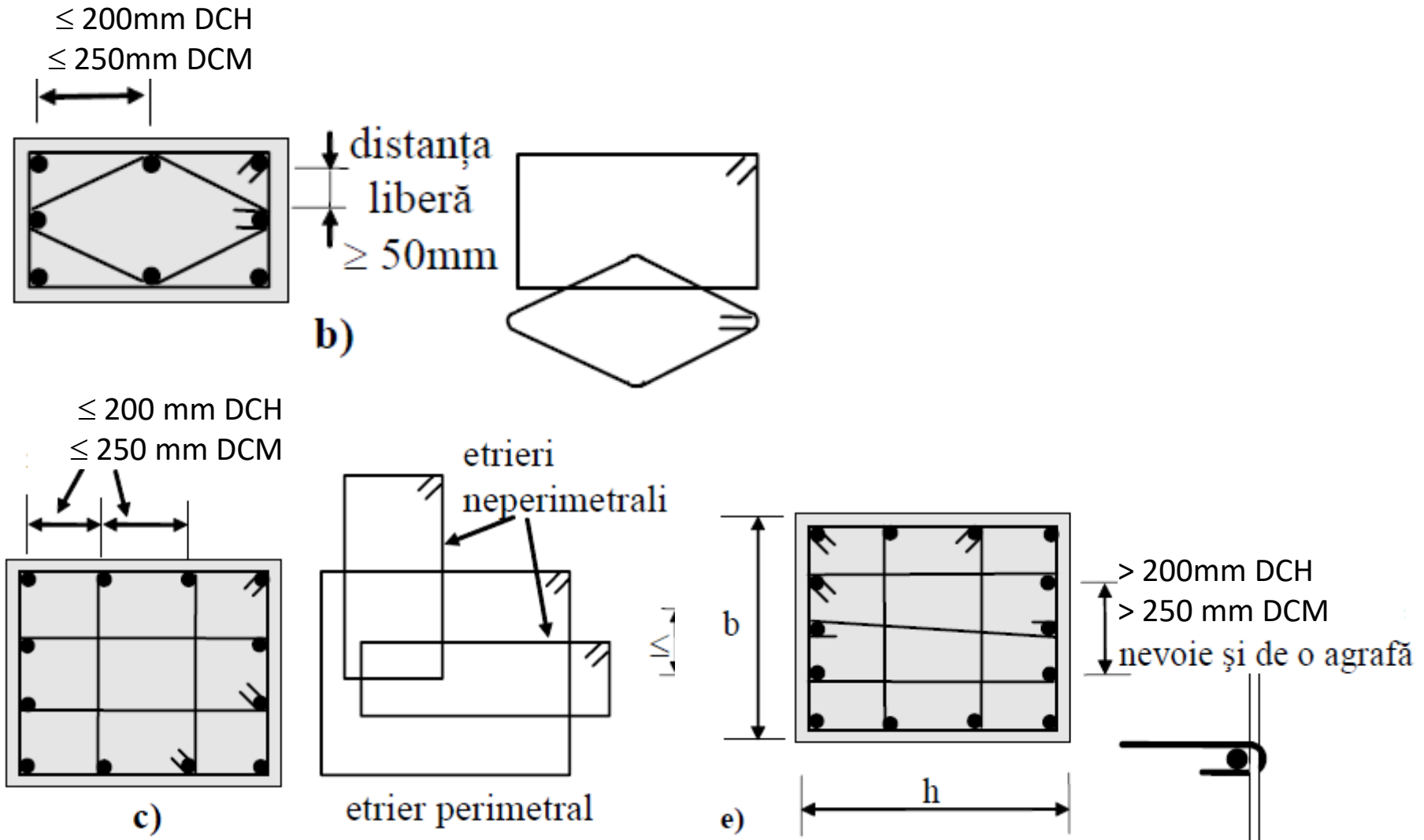


Secțiunea 3-3

Samples of element reinforcement / Exemple de armări

Armarea stâlpilor → în zone seismice

Samples of element reinforcement / Exemple de armări

Armarea stâlpilor → în zone seismice

3.1 TIPURI DE ARMĂTURI

3.2 EXEMPLE DE ARMĂRI

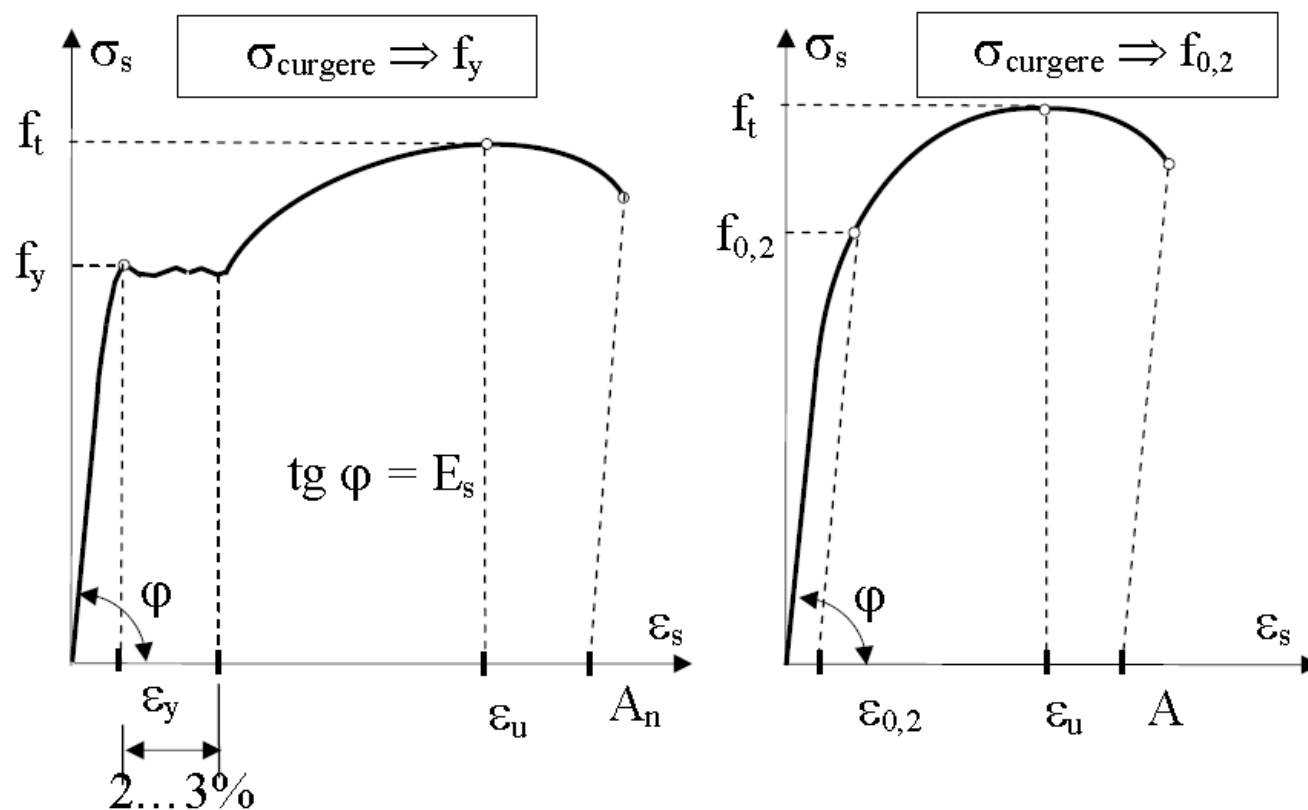
3.3 PROPRIETĂȚILE ARMĂTURILOR

Properties of the reinforcement / Proprietățile armăturilor

Comportarea sub încărcări statice de scurtă durată

– curba caracteristică a oțelului

→ încercarea la tracțiune



a) oțel cu palier de curgere

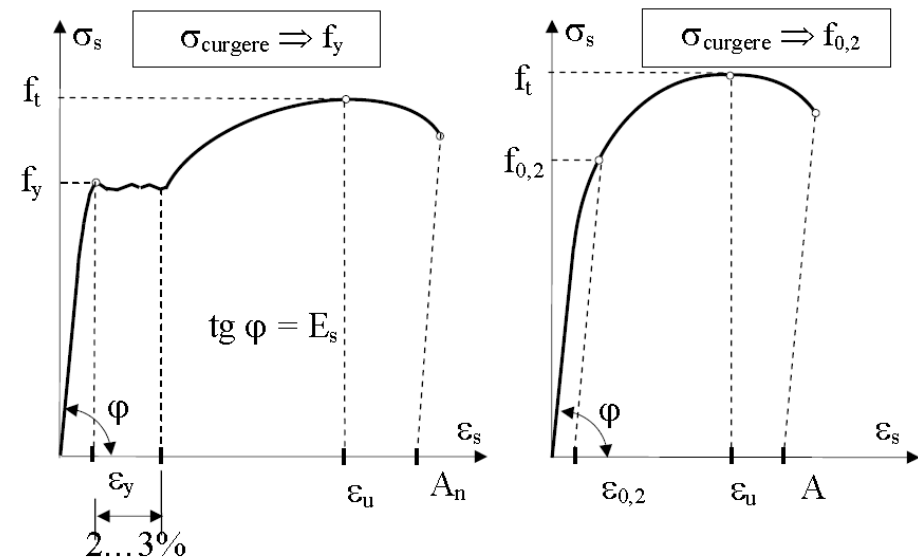
b) oțel fără palier de curgere

Properties of the reinforcement / Proprietățile armăturilor

Comportarea sub încărcări statice de scurtă durată

Elementele semnificative ale curbei :

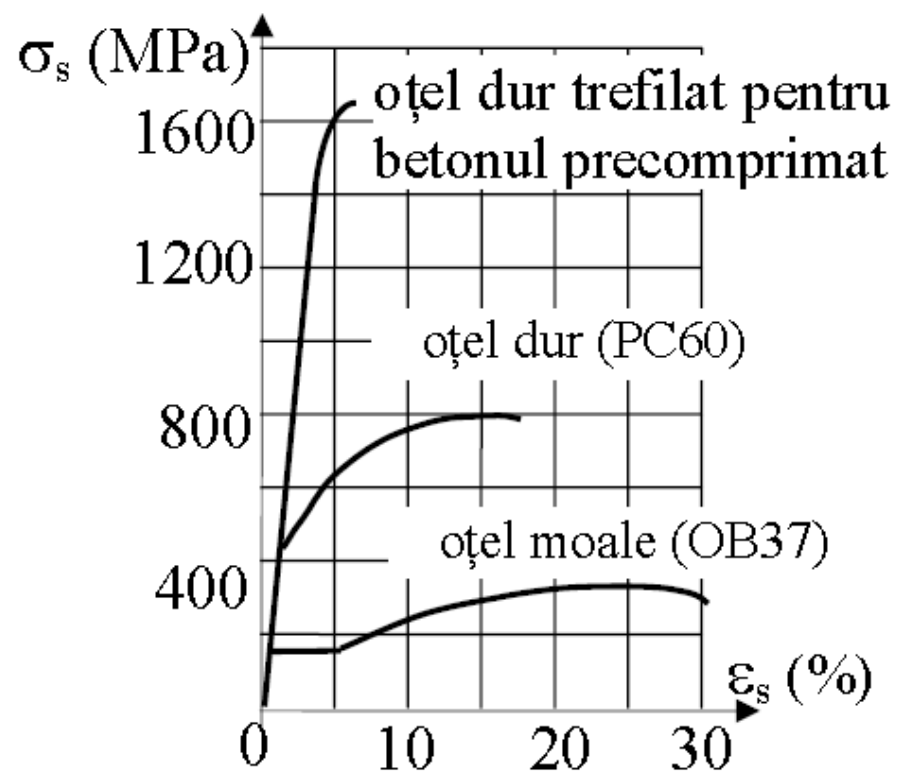
- Limita de elasticitate (sau de curgere)
 - limita de curgere aparentă f_y (R_e) în cazul oțelului cu palier
 - limita de curgere convențională $f_{0,2}$ ($R_{0,2}$)
- Rezistența de rupere la întindere f_t (R_m)
- Modulul de elasticitate E_s
- Alungirea la forța maximă ε_u (A_{gt})
- Alungirea la rupere, A_n .



Properties of the reinforcement / Proprietățile armăturilor

- **Oțelul moale** are un conținut de carbon redus, circa 0,2% :
 - comportare elastică până la atingerea limitei de curgere aparentă, f_y
 - comportare pronunțat plastică prin prezența palierului de curgere.
- **Oțelul dur** este un oțel slab aliat, are un conținut de carbon mai ridicat și alte elemente de aliere:
 - creșterea rezistenței la rupere, f_t
 - reducerea palierului de curgere, sau dispariția acestuia
 - reducerea alungirii la forța maximă, respectiv a celei măsurate după rupere.
 - comportarea plastică este indicată de atingerea limitei de curgere convențională, $f_{0,2}$
- **Armătură pentru betonul armat** → oțelul moale și dur cu un conținut de carbon mai mic de 0,3%
- **Armătură pentru betonul precomprimat** → oțelul dur cu un conținut de carbon de 0,6...0,9%, mangan 0,3...0,7% și maximum 0,035% fosfor și sulf.

Properties of the reinforcement / Proprietățile armăturilor



c) diagrame caracteristice pentru diferite tipuri de oțel autohton

Properties of the reinforcement / Proprietățile armăturilor

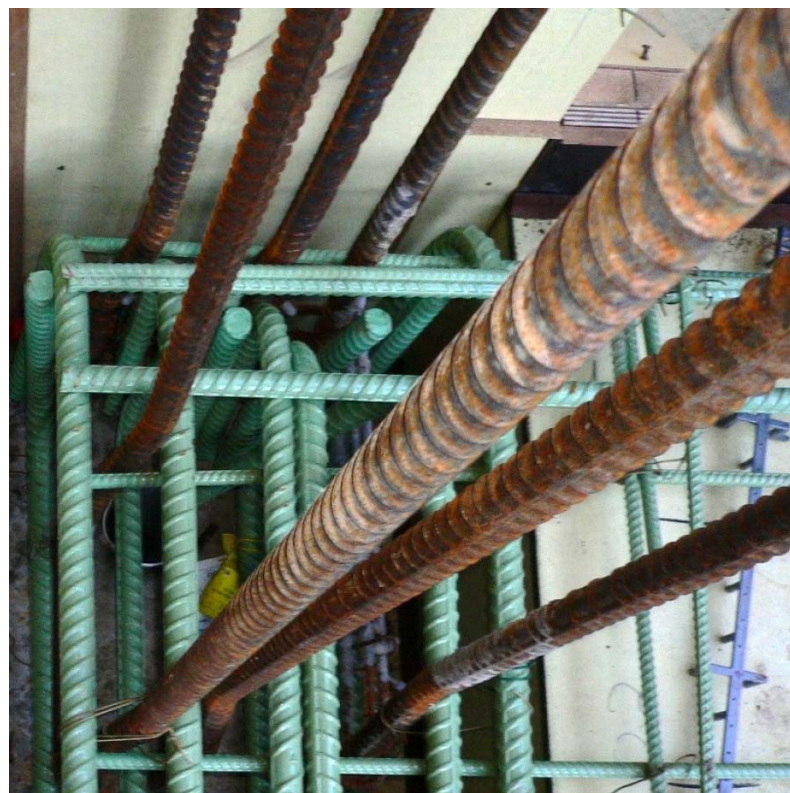
Caracteristici mecanice ale unor armături laminate la cald

Denumire comercială	Diametrul nominal (mm)	Valori caracteristice minime		
		Limita de curgere [Mpa]	Rezistența la rupere [MPa]	Alungirea la rupere A_5 [%]
OB37	6...12	255	360	25
	14...40	235		
PC52	6...14	355	510	20
	16...28	345		
	32...40	335		
B500A	5...50	500	xxx	xxx
STNB	3...10	400...510	510...610	6...8
SPPB	4...12	460	510	8...10

- Modulul de elasticitate $E_s = 200\ 000 - 210\ 000\ \text{N/mm}^2$

- Masa volumică = $7850\ \text{kg/m}^3$

MULȚUMESC FRUMOS PENTRU ATENȚIE!



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