

COMPOSIZIONE DEL CALCESTRUZZO

mercoledì 18 marzo 2020 13:51

ACQUA + CEMENTO + AGGREGATI + ADDITIVI

PASTA
CEMENTIZIA

SABBIA
($d < 5\text{mm}$)

GHIAIA
PIETRUSCO

1 m^3 CLS

0.8 m^3

INERTI A GRANA
GROSSA

0.4 m^3

INERTI A GRANA
FINE

200 L

ACQUA

3,5 KN

CEMENTO

CEMENTO

mercoledì 18 marzo 2020 14:06

CEMENTO PORTLAND



CLINKER

+

ACQUA

+

GESSO (7÷8% / CEMENTO)

1. ALLUMINATI DI CALCIO + H_2O → ALLUMINATI DI
(PRESA) CALCIO IDRATI

2. SILICATI DI CALCIO + H_2O
(INDURIMENTO)

INERTI

mercoledì 18 marzo 2020 14:17

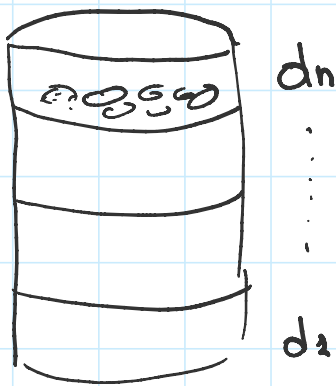
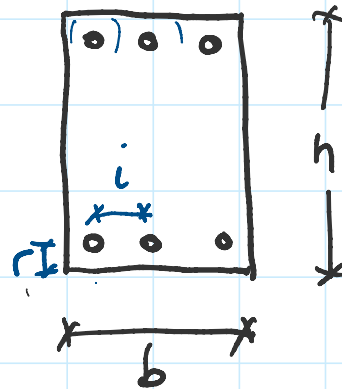
- NO CLORURI
 - NO SOLFATI
 - NO SILICE REATTIVA → POZZOLANA
 - NO SOSTANZE ORGANICHE
- } DEGRADO

GRANULOMETRIA

$$d_{\max} \leq 0.25 b$$

$$d_{\max} \leq i - 5 \text{ mm}$$

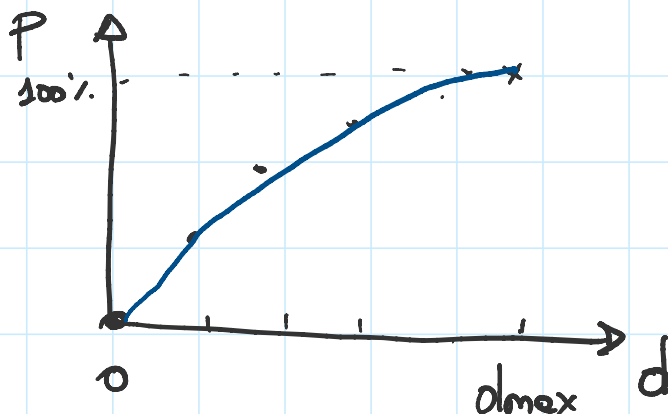
$$d_{\max} \leq 0.3 r$$



$$d_n > d_{n-1} \dots > d_1$$

$$\text{TRATTENUTO} = \frac{\sum_{d_i} \text{PESO TRAT}}{\text{PESO TOT}}$$

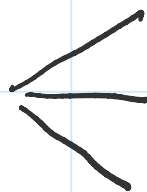
$$\text{PASSANTE} = 1 - \text{TRATTENUTO}$$



FULLER

$$P = 100 \sqrt{\frac{d}{d_{\max}}}$$

Q/C



RESISTENZA MECCANICA
DURABILITA'

CLASSE DI CONSISTENZA
DEL CLS (LAVORABILITA')

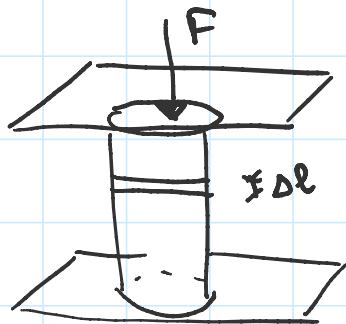
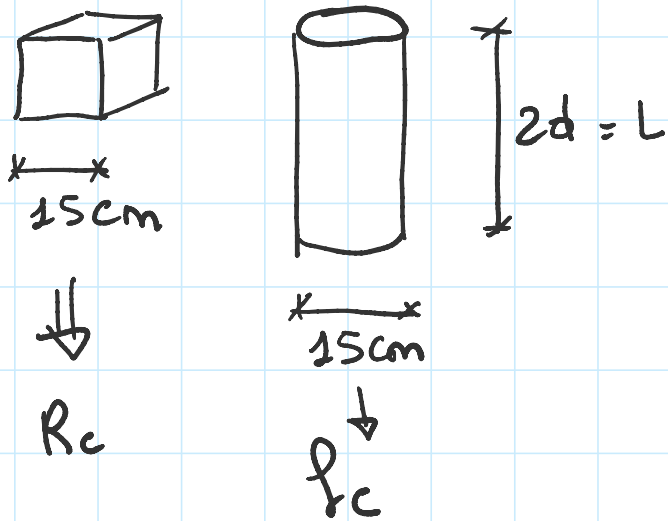
ADDITIVI

mercoledì 18 marzo 2020 14:37

1. FLUIDIFICANTI → AUMENTARE CLASSE DI CONSISTENZA
2. ACCELERANTI → TEMPERATURE BASSE
3. RITARDATI → ESTATE (T ALTE)
4. AERANTI → PROTEZIONE GHIACCIO
5. BATTERICIDI → SUPERFICI ESPOSTE AL NORD

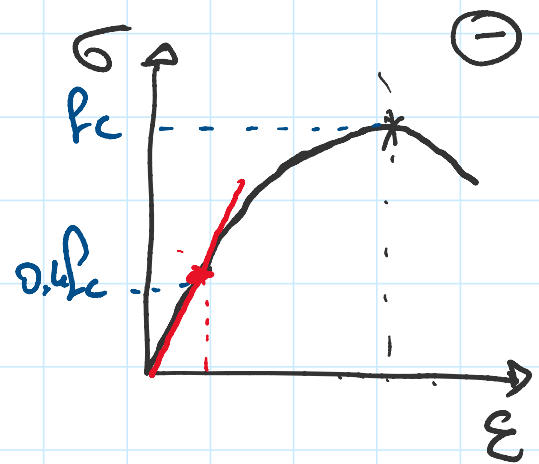
RESISTENZA A COMPRESSIONE E MODULO ELASTICO

mercoledì 18 marzo 2020 14:46



$$\epsilon = \frac{\Delta L}{L}$$

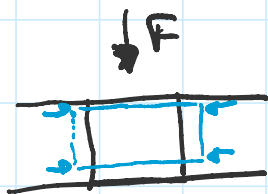
$$\sigma = \frac{F}{A}$$



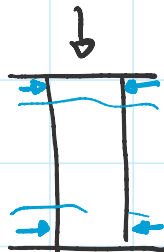
$\sigma \leq 0.4 P_c \Rightarrow \text{COMPORTAMENTO} \approx \text{LINEARE}$

$0.4 P_c \leq \sigma \leq 0.85 P_c \rightarrow \text{NON LINEARE}$

$\sigma \geq 0.85 P_c$



$R_c > P_c$



$$P_c \approx 0.83 R_c$$

C 25/30

↑ f_{ck} ↑ R_{ck}

$$\rightarrow f_{cd} = \frac{f_{ck}}{1.5} \cdot \alpha_{cc} \quad \begin{matrix} \nearrow 0,85 \\ \nwarrow 1.5 \end{matrix}$$

$$f_{cd} = \frac{25 \text{ MPa}}{1.5} \times 0,85 = 14,17 \text{ MPa}$$

MODULO ELASTICO (SECANTE $\sigma = 0,40 f_c$)

$$E_c = 22.000 \left(\frac{f_{cm}}{10} \right)^{0,3}$$

f_{cm} = RES. A COMPRESSIONE MEDIA [MPa]

$$f_{cm} = f_{ck} + 8 \text{ MPa}$$

$$C25/30 \rightarrow f_{cm} = 25 + 8 = 33 \text{ MPa}$$

$$E_c = 22.000 \left(\frac{33}{10} \right)^{0,3} = \frac{31475}{31500} \text{ MPa}$$

CONTROLLI DI ACCETTAZIONE

mercoledì 18 marzo 2020 15:11

CONTROLLI TIPO A

" TIPO B

GETTI $< 1500 \text{ m}^3$

$\geq 1500 \text{ m}^3$

1 PRELIEVO

OGNI GIORNO

100 m^3 GETTO

↳ 2 PROVINI

$$\text{RESISTENZA DI PRELIEVO} = R_i = \frac{R_{p1} + R_{p2}}{2}$$

CONTROLLI TIPO A

1 CONTROLLO 3 PRELIEVI

R_1, R_2, R_3

$R_1 < R_2 < R_3$

$$R_1 \geq R_{ck} - 3,5 \text{ MPa}$$

$$R_m \geq R_{ck} + 3,5 \text{ MPa}$$

CONTROLLI DI TIPO B

1 CONTROLLO OGNI 15 PRELIEVI

$R_1 \dots R_{15}$

$R_1 < R_2 \dots < R_{15}$

$$R_1 \geq R_{ck} - 3,5 \text{ MPa}$$

$$R_m \geq R_{ck} + 1,48 \text{ d}$$

σ = SCARTO QUADRATICO MEDIO

$$COV = \frac{\sigma}{R_m}$$

OK
ULTERIORI CONTROLLI
NON ACCETTABILE

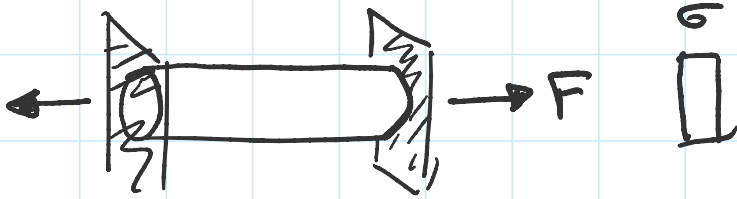
≤ 0.15

 ≥ 0.3

RESISTENZA A TRAZIONE

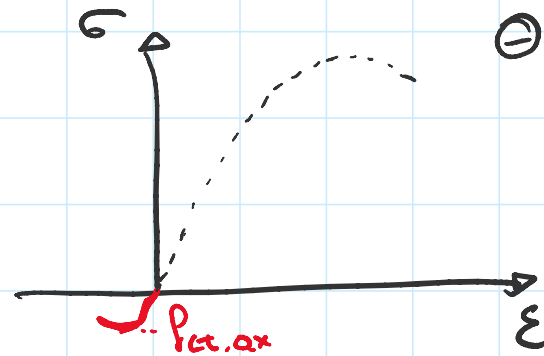
mercoledì 18 marzo 2020 15:25

TRAZIONE DIRETTA

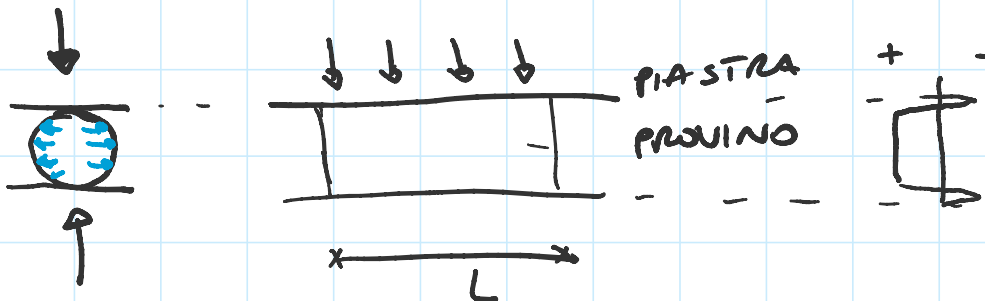


$$p_{ct, ax} = \frac{F}{A}$$

①



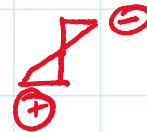
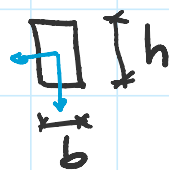
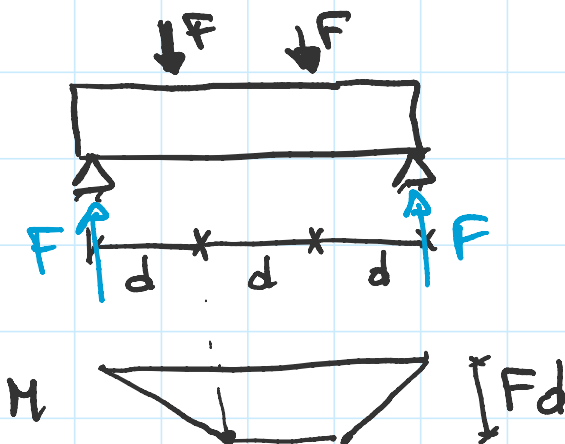
SPLITTING TEST (PROVA BRASILIANA)



$$p_{ct, sp} = \frac{F}{\pi r \cdot L}$$

$$p_{ct, ax} = 0.9 p_{ct, sp}$$

PROVA A FLESSIONE

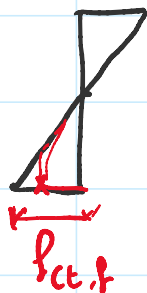
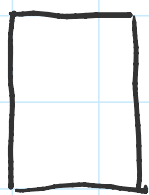


$$\sigma = \frac{M}{I} y$$

$$I = \frac{bh^3}{12}$$

$$y = h/2$$

$$p_{ct, f} = \frac{M}{bh^3/12} \cdot \frac{h}{2} = \frac{6M}{bh^2} = \frac{6 \cdot F \cdot d}{bh^2}$$



INDICAZIONI DI NORMATIVA

$$f_{ctm} = 0.3 \sqrt[3]{f_{ck}^2}$$

MPa

C50/60

$$f_{ctfm} = 1.2 f_{ctm}$$

→ ANCHE PER VALORI
CARATTERISTICI

$$f_{ctk_{5\%}} = 0.7 f_{ctm}$$

$$f_{ctk} = 0.7 f_{ctfm}$$

C25/30 →

$$f_{ctm} = 0.3 \sqrt[3]{25^2} = 2.56 \text{ MPa}$$

$$f_{ctk} = 0.7 f_{ctm} = 0.7 \times 2.56 = 1.79 \text{ MPa}$$

$$f_{ctfm} = 1.2 f_{ctk} = 1.2 \times 1.79 \text{ MPa} = 2.15 \text{ MPa}$$

MIX DESIGN

mercoledì 18 marzo 2020 16:10

OTTENERE PREFISSATO
 d_{INERTI} , q/c

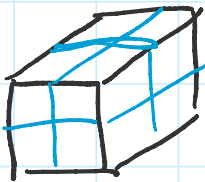
CLASSE DI CONSISTENZA
REGOLA DI LYSE

CLASSE DI RESISTENZA
REGOLA DI ABRAMS

REGOLA DI LYSE

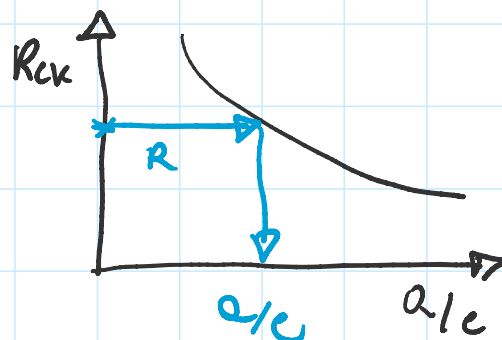
1. FISSO d_{max} INERTE \rightarrow PIU' ALTA E' LA CLASSE DI CONSISTENZA \Rightarrow MAGGIORE E' ACQUA NECESSARIA

2. FISSO S (CLASSE DI CONSISTENZA) \Rightarrow PIU' GRANDE E' d_{max} \Rightarrow MINORE ACQUA NECESSARIA



REGOLA DI ABRAMS

$$R_{ck} = \frac{k_2}{k_2^{q/c}}$$

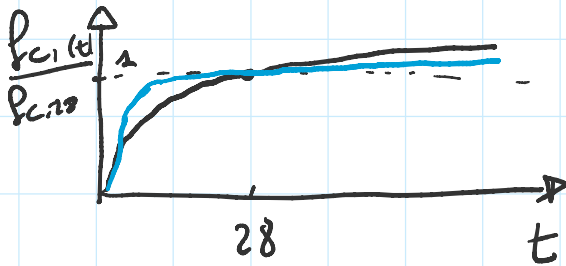


$$\frac{q}{c} = 0.63 \quad q = 240 \text{ kg/m}^3$$

$$\rightarrow c = \frac{240 \text{ kg}}{0.63 \text{ m}^3} = 3.8 \text{ KN}$$

COMPORTAMENTO NEL TEMPO

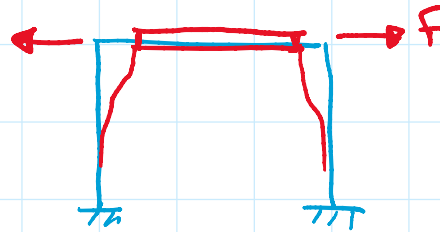
mercoledì 18 marzo 2020 16:21



$$P_{c \rightarrow \infty} = 1.28 P_{c28}$$

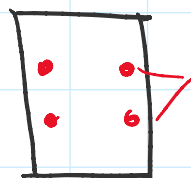
RITIRO

1. QUANTITATIVO DI ACQUA NELL'IMPASTO
2. UMIDITA' AMBIENTE
3. SUP. ESPOSTA ALL'ARIA



INDUGO EFFETTI

1. NON ECCEDERE σ/c
2. IN UNIDIRE IL CUS DURANTE LA STAGIONATURA
3. EVITARE ELEMENTI TROPPO GRANDI
4. DISPORRE ARMATURE PER ASSORBIRE TRAZIONE



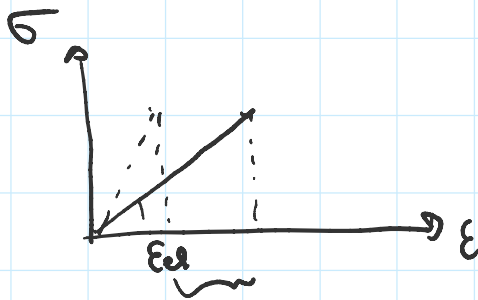
ARMATURE DI PARETE

DEFORMAZIONI VISCOSE (CREEP)

SI PRESENTANO PER CARICHI DI LUNGA DURATA

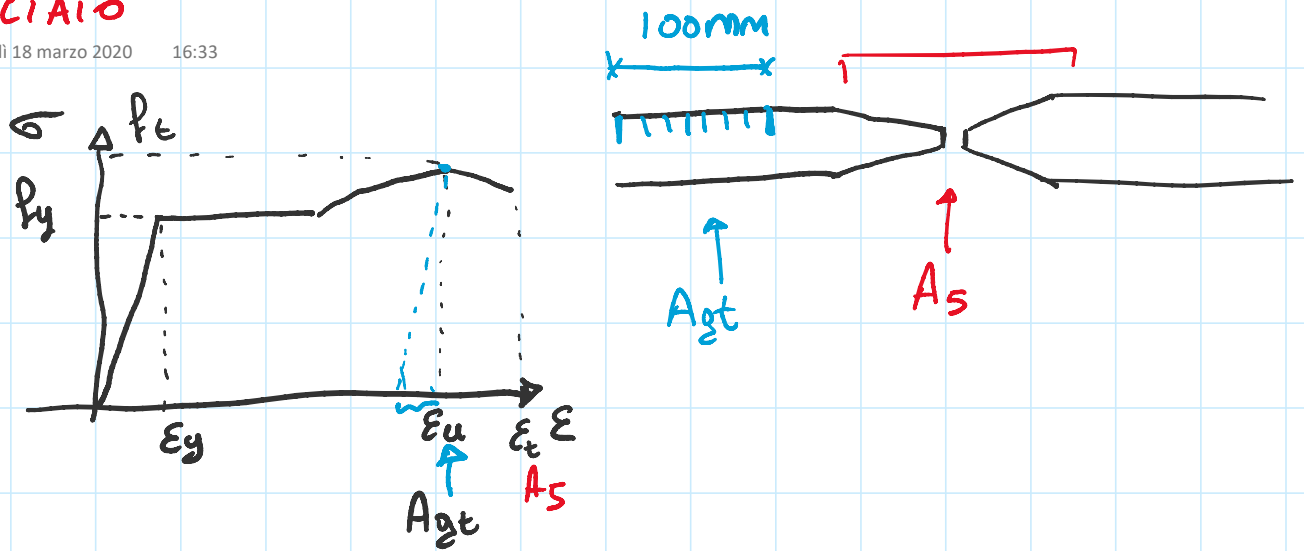
↓
2 ÷ 3 VOLTE ϵ_{el}

→ NE TENIAMO CONTO MODIFICANDO E_c
NEI CARICHI DI LUNGA DURATA



ACCIAIO

mercoledì 18 marzo 2020 16:33



TIPI DI ACCIAIO

B450 A → RETI ELETTRISALDATE $\phi = 5 \div 10 \text{ mm}$

B450 C → BARE D'ARMATURA $\phi = 6 \div 40 \text{ mm}$

L BARE = 12 m

$$f_{yk} = 450 \text{ MPa}$$

$$f_{yd} = \frac{f_{yk}}{\gamma_s = 1.15} = \frac{450 \text{ MPa}}{1.15} = 391.3 \text{ MPa}$$

$$E_s = 200'000 \text{ MPa}$$

EC2