

Corsi di aggiornamento

Progettazione in zona sismica

**Procedure semplificate e calcoli manuali  
per il controllo dell'ordine di grandezza  
dei risultati ottenuti dal programma di calcolo**

06 - Ridimensionamento della struttura

Vasto

30 settembre - 1 ottobre 2016

Aurelio Ghersi

# Il dimensionamento iniziale è accettabile?

Il dimensionamento è tutto sommato accettabile, anche se in alcuni elementi le sollecitazioni sono un po' più grandi del previsto

La risposta sismica mostra però rotazioni rilevanti, non accettabili. È quindi opportuno ritornare al dimensionamento, per correggere le carenze evidenziate

In particolare, è opportuno irrigidire la parte destra dell'edificio, aumentando le dimensioni di alcuni elementi o girando alcuni pilastri, e/o indebolire la parte sinistra

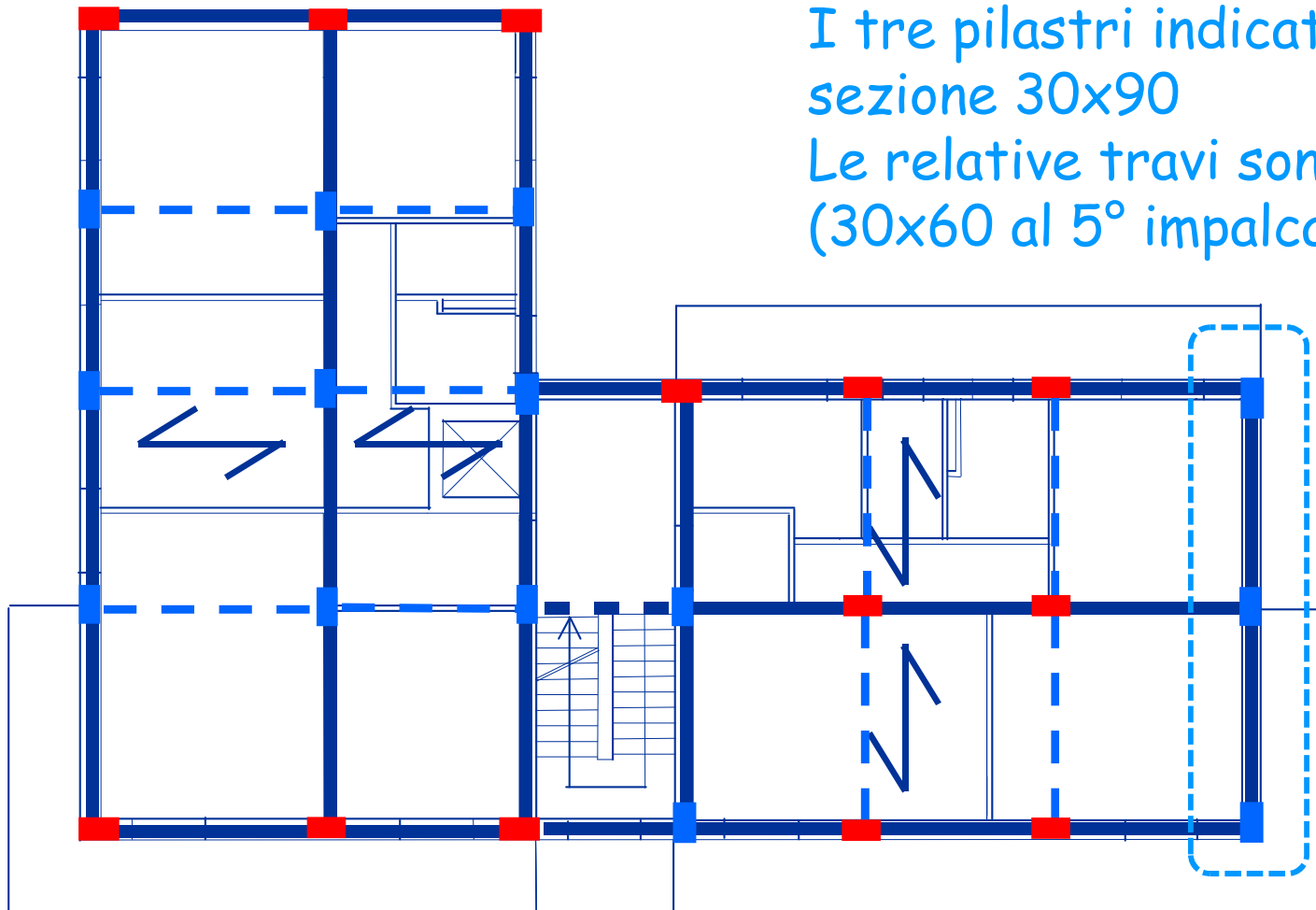
# Ridimensionamento della struttura

# Esame della carpenteria per quanto riguarda le azioni orizzontali

Variazione effettuata:

I tre pilastri indicati hanno  
sezione 30x90

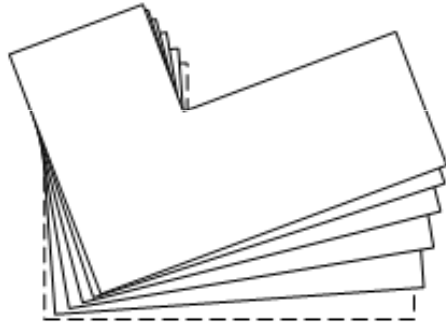
Le relative travi sono 30x70  
(30x60 al 5° impalcato)



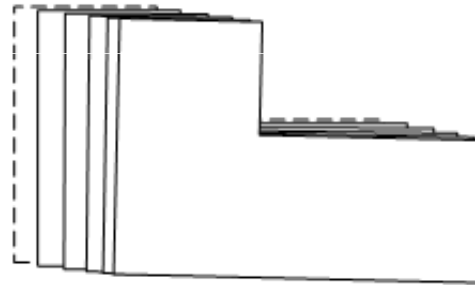
Questi  
pilastri  
hanno  
dimensioni  
maggiori  
per evitare  
che il lato  
destro sia  
meno rigido

# Deformate modali confronto tra le soluzioni

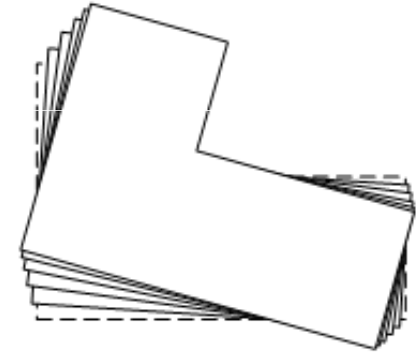
Dimensionamento precedente



Modo 1  $T = 0.582 \text{ s}$



Modo 2  $T = 0.553 \text{ s}$

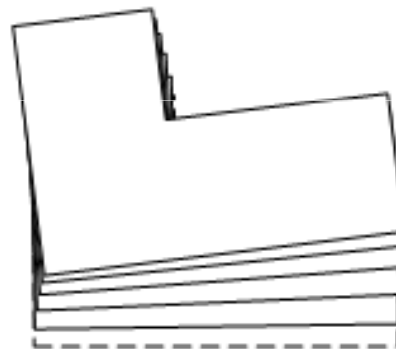


Modo 3  $T = 0.463 \text{ s}$

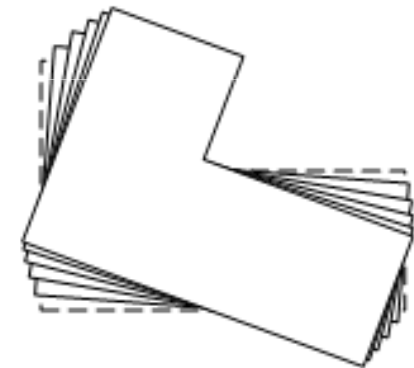
Nuovo dimensionamento



Modo 1  $T = 0.550 \text{ s}$

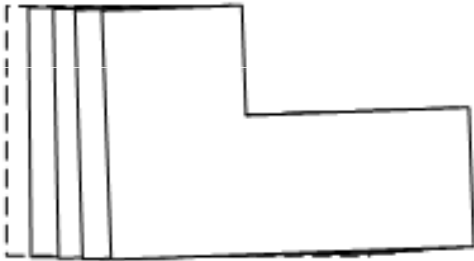


Modo 2  $T = 0.517 \text{ s}$

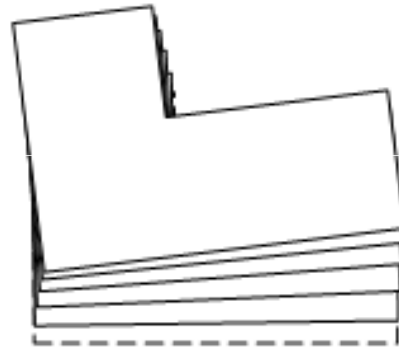


Modo 3  $T = 0.440 \text{ s}$

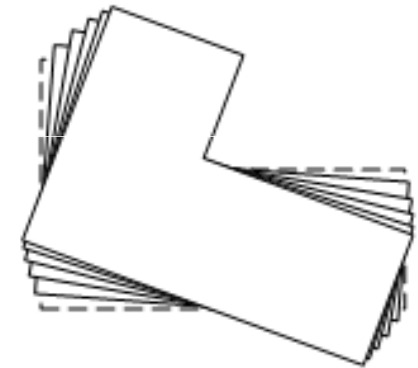
# Deformate modali nuova soluzione



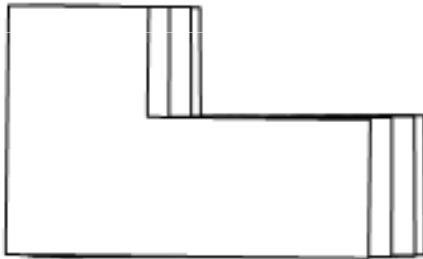
Modo 1  $T = 0.550 \text{ s}$



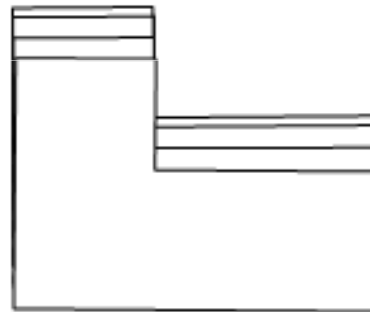
Modo 2  $T = 0.517 \text{ s}$



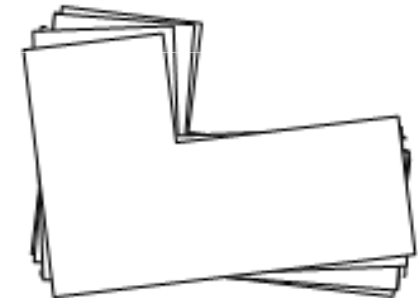
Modo 3  $T = 0.440 \text{ s}$



Modo 4  $T = 0.176 \text{ s}$



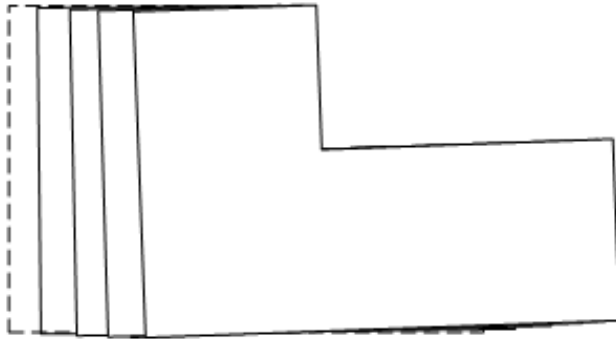
Modo 5  $T = 0.164 \text{ s}$



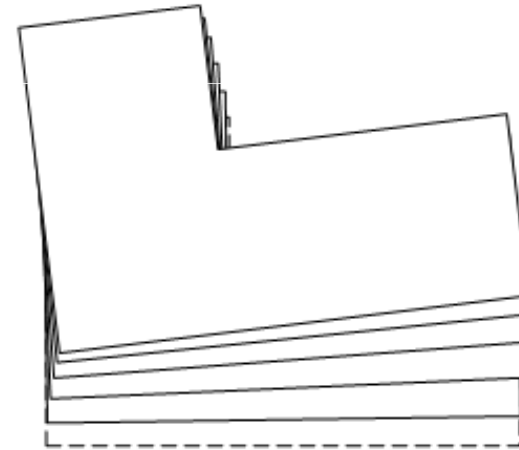
Modo 6  $T = 0.140 \text{ s}$

# Deformate modali

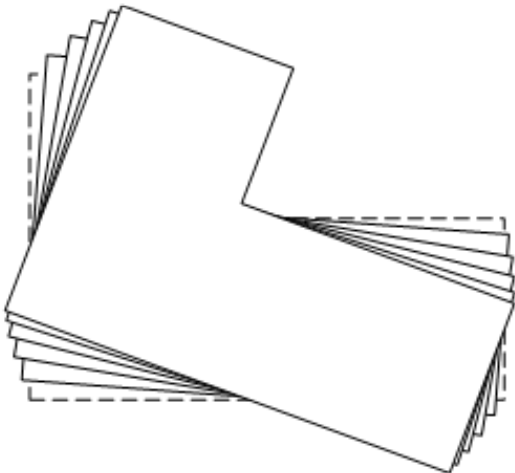
Modo 1  $T = 0.550 \text{ s}$



Modo 2  $T = 0.517 \text{ s}$



Modo 3  $T = 0.440 \text{ s}$

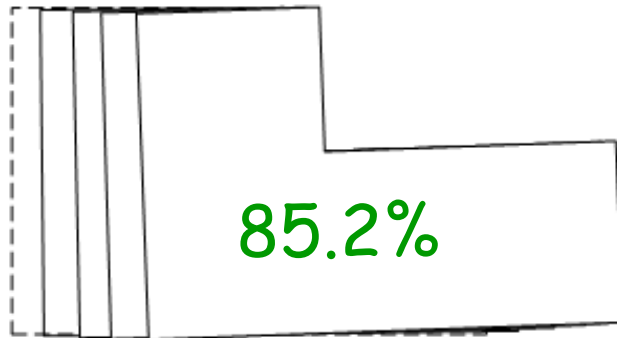


Il modo 1 è sostanzialmente di traslazione secondo x

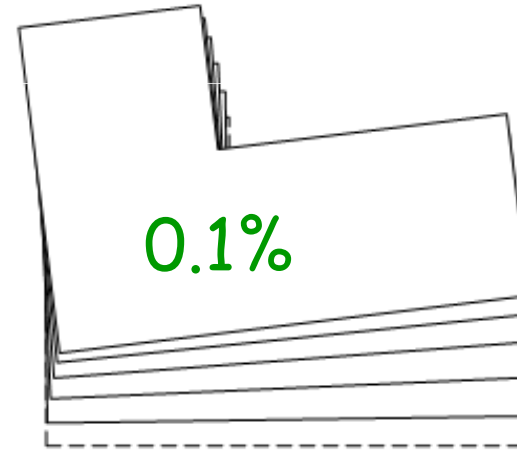
Il modo 2 è di traslazione secondo y accoppiata ad un po' di rotazione

# Masse partecipanti, sisma x

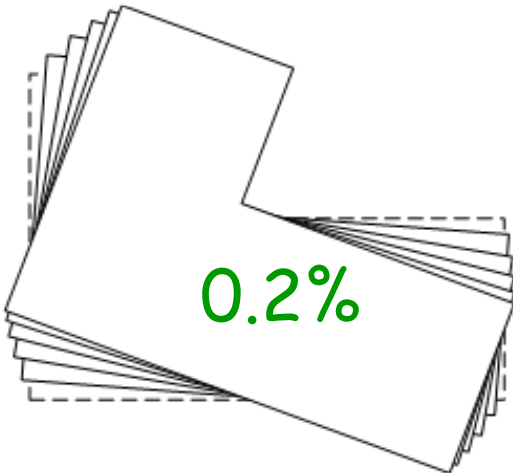
Modo 1  $T = 0.550 \text{ s}$



Modo 2  $T = 0.5173 \text{ s}$



Modo 3  $T = 0.440 \text{ s}$



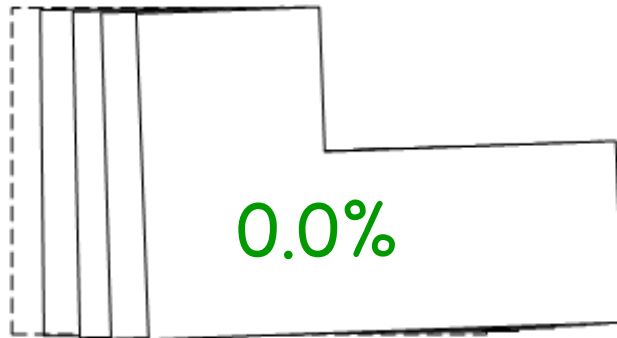
Il modo 1 dà il contributo massimo

Il modo 4, di traslazione x con spostamenti nei due versi, dà un ulteriore contributo (9.3%)



# Masse partecipanti, sisma y

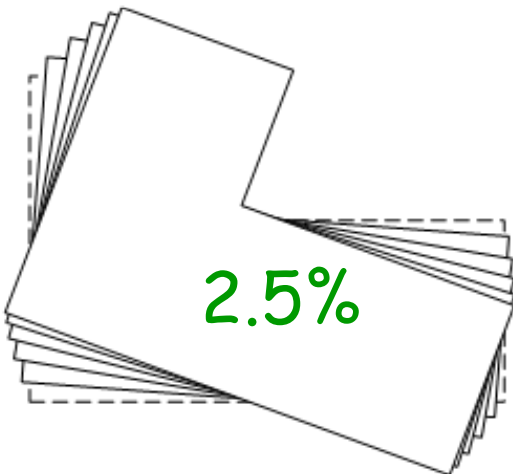
Modo 1  $T = 0.550 \text{ s}$



Modo 2  $T = 0.5173 \text{ s}$



Modo 3  $T = 0.440 \text{ s}$



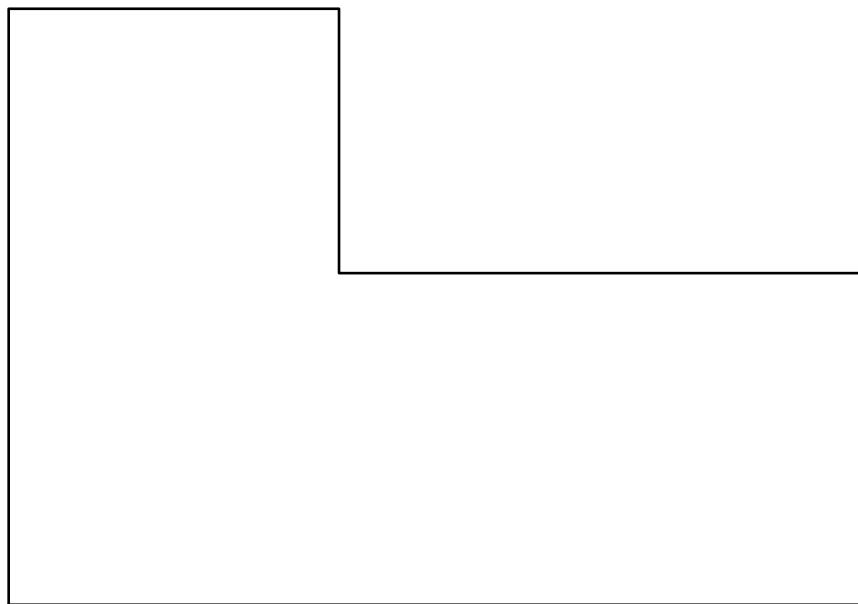
Il modo 2 dà il contributo massimo

Il modo 5, di traslazione x con spostamenti nei due versi, dà un ulteriore contributo (9.6%)

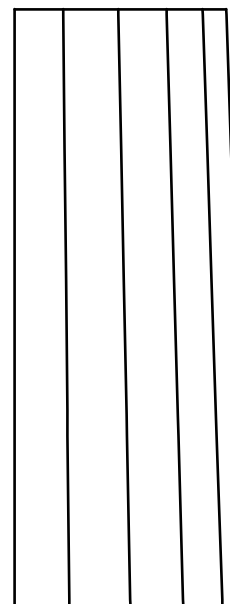
# Inviluppo modale sisma x

0.82

1.34

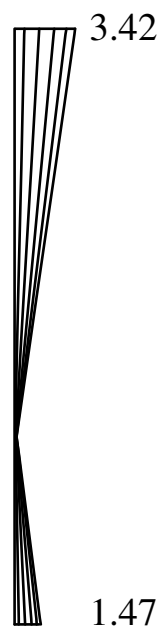
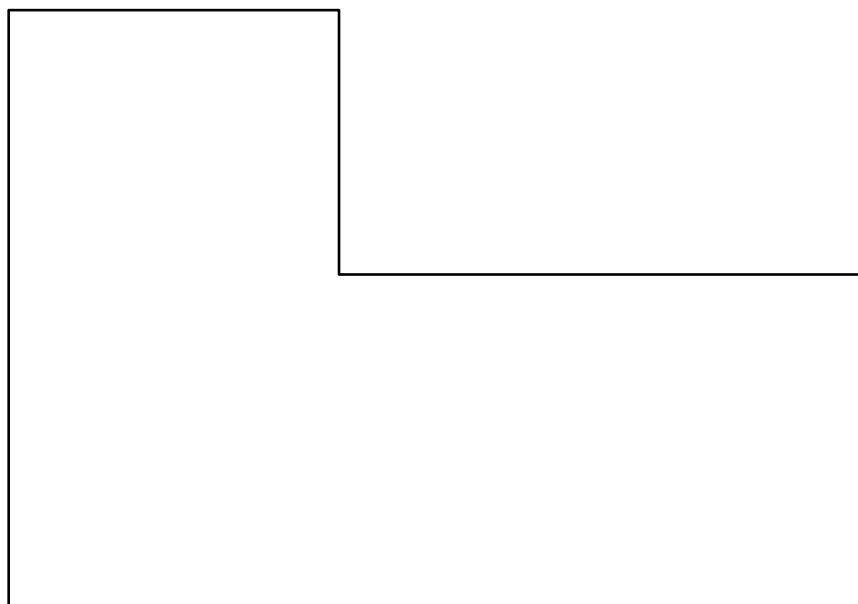
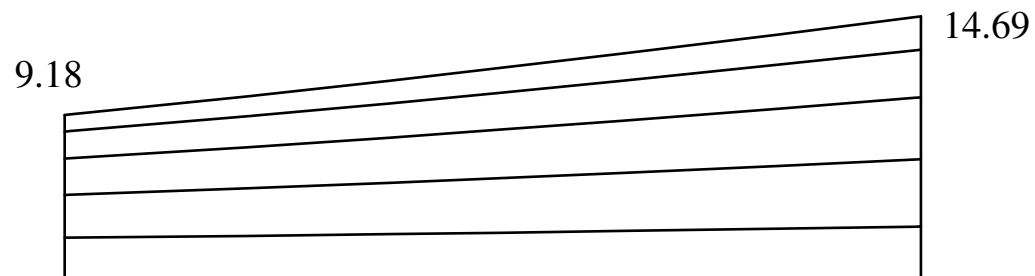


11.94

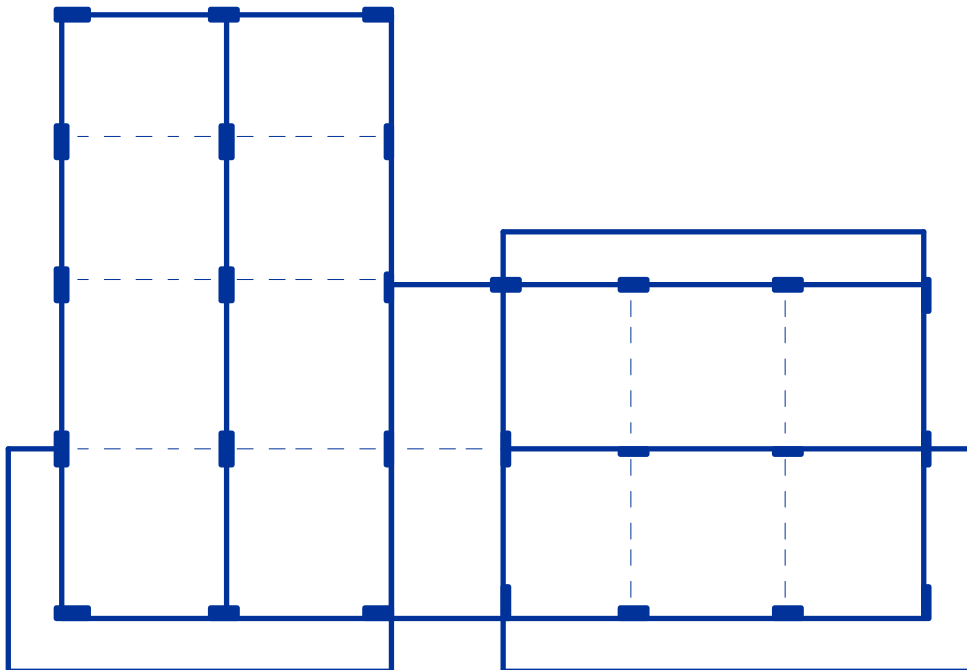
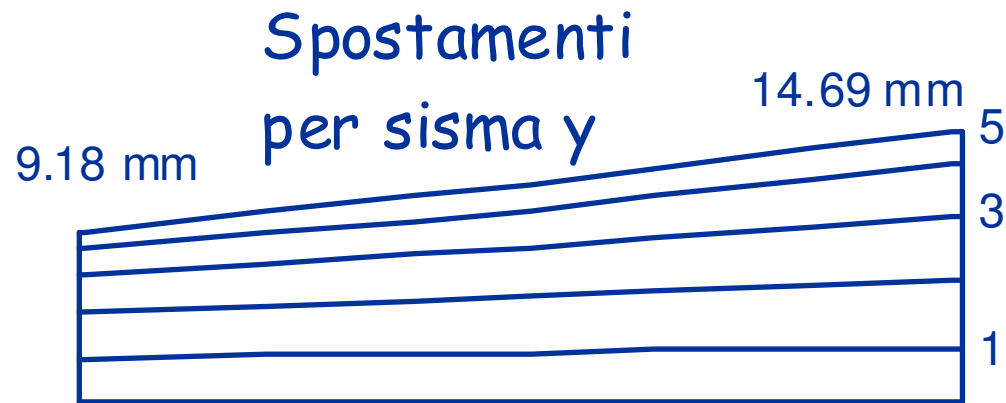


13.13

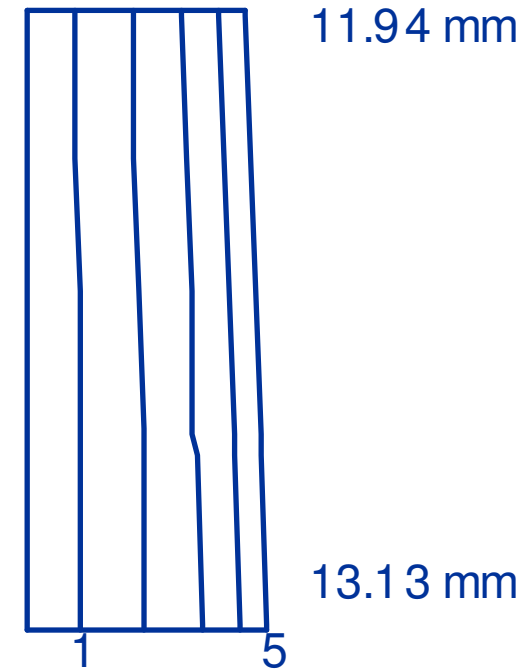
# Inviluppo modale sisma y



# Spostamenti, inviluppo modale



Spostamenti  
per sisma x

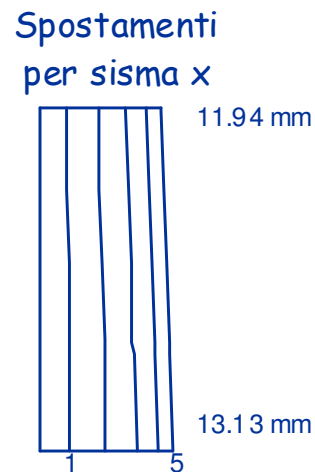
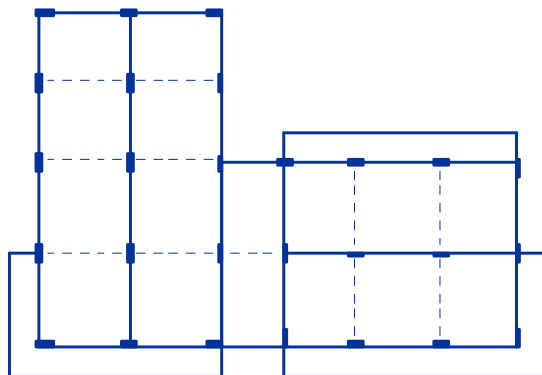


# Spostamenti, inviluppo modale

Rotazione per sisma y  
non trascurabile, ma in  
definitiva accettabile



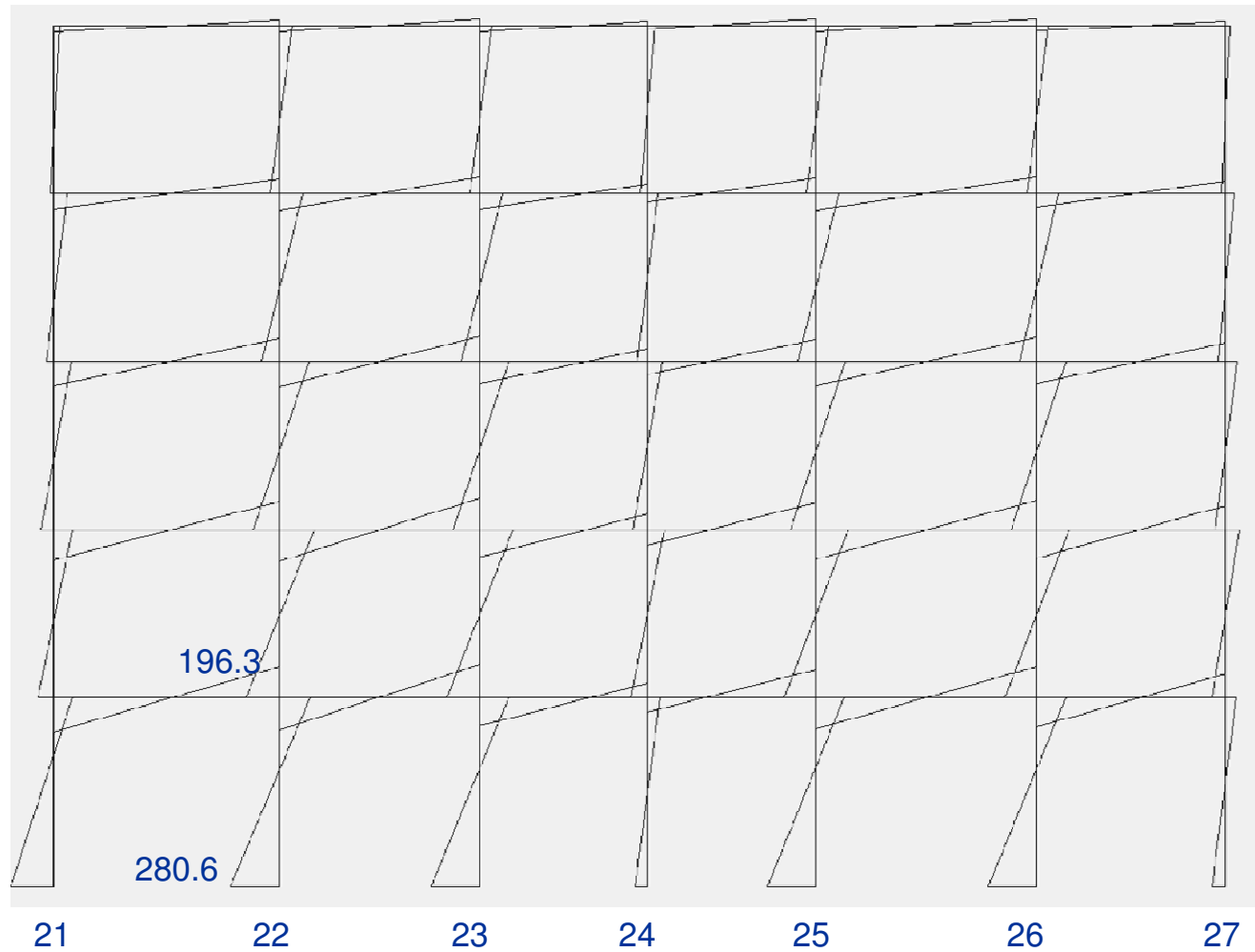
Si potrebbe provare  
a indebolire la parte  
sinistra



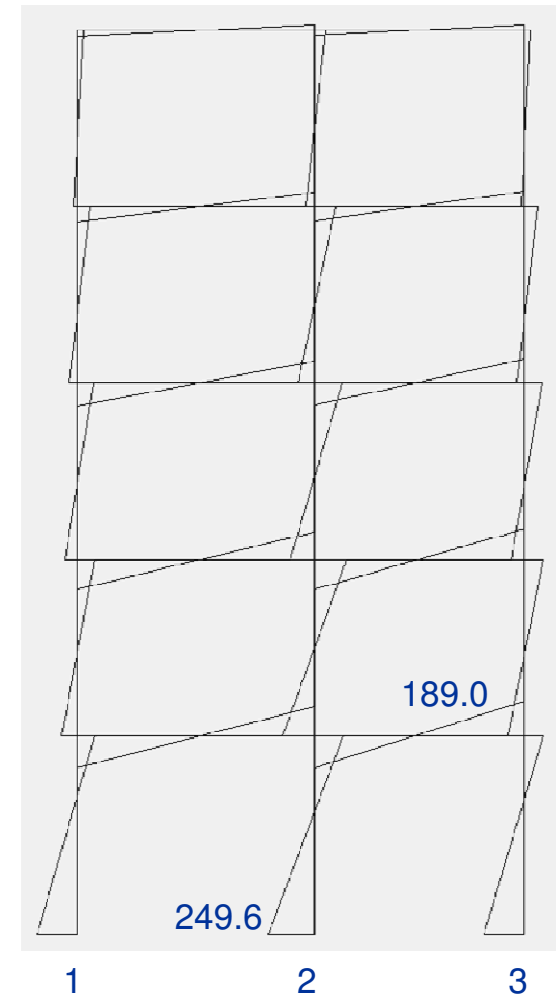
gli spostamenti massimi per  
sisma y sono maggiori di  
quasi il 20% rispetto a  
quelli medi per sisma x

Spostamenti per sisma x  
abbastanza uniformi  
(vicini a quelli del modo 1)

# Sollecitazioni per sisma in direzione x



Telaio 1x

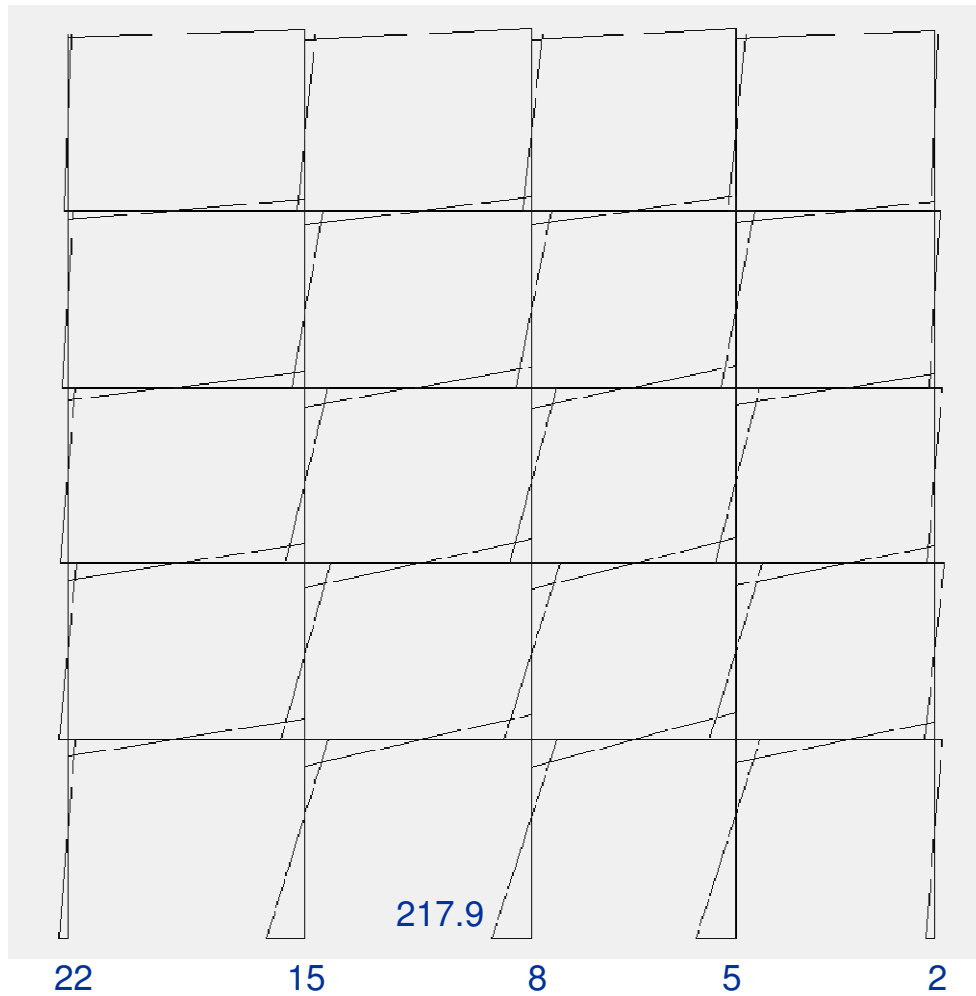


Telaio 5x

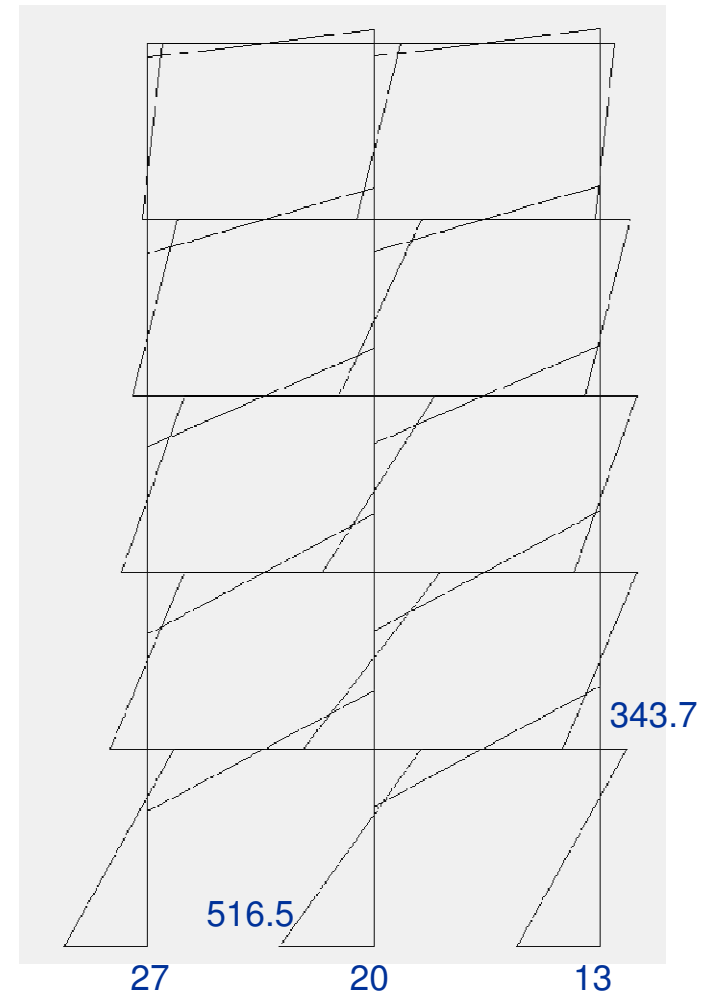
# Sollecitazioni per sisma in direzione x

piano	pilastri			travi		
	previsto	telaio 1x	telaio 5x	previsto	telaio 1x	telaio 5x
5	67.6	74.1	61.1	33.8	38.1	33.9
4	119.2	131.8	115.3	93.4	95.2	85.2
3	158.2	170.6	152.6	138.7	141.6	132.9
2	184.7	195.6	176.7	171.5	178.5	170.7
1 testa	176.5	174.9	155.6	180.6	196.3	189.0
1 piede	264.8	280.6	249.6			

# Sollecitazioni per sisma in direzione y



Telaio 2y



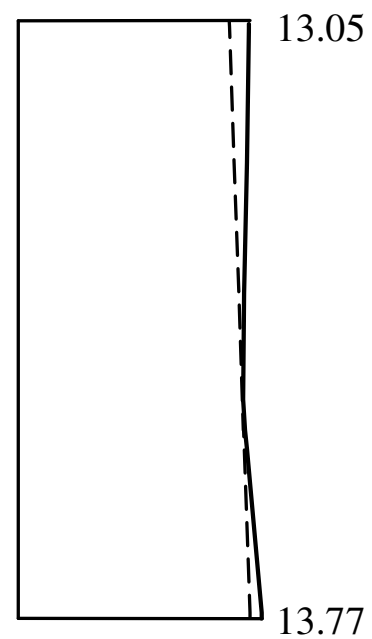
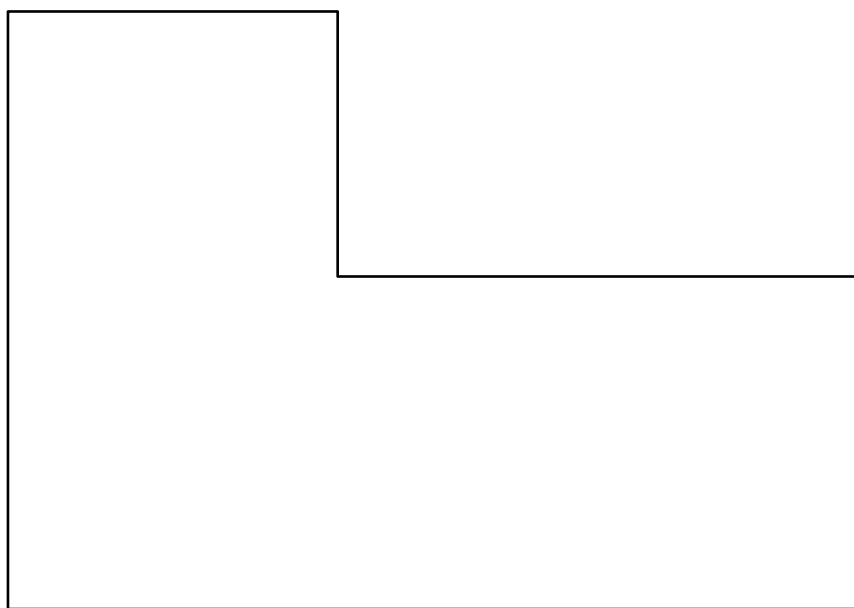
Telaio 7y



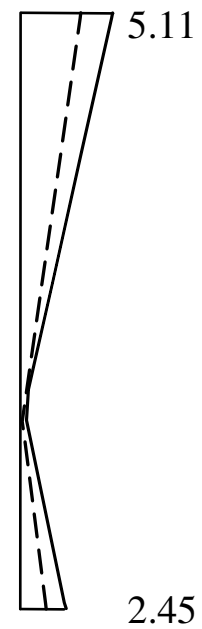
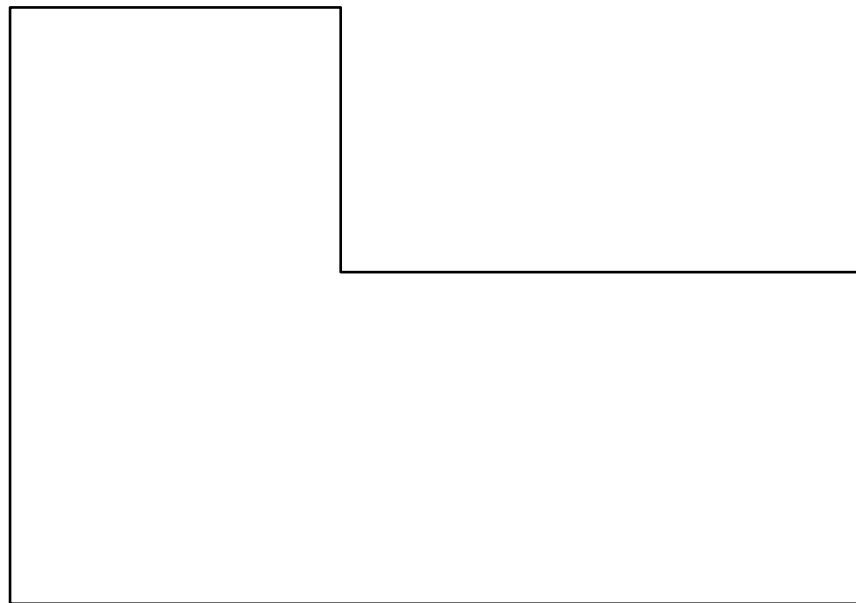
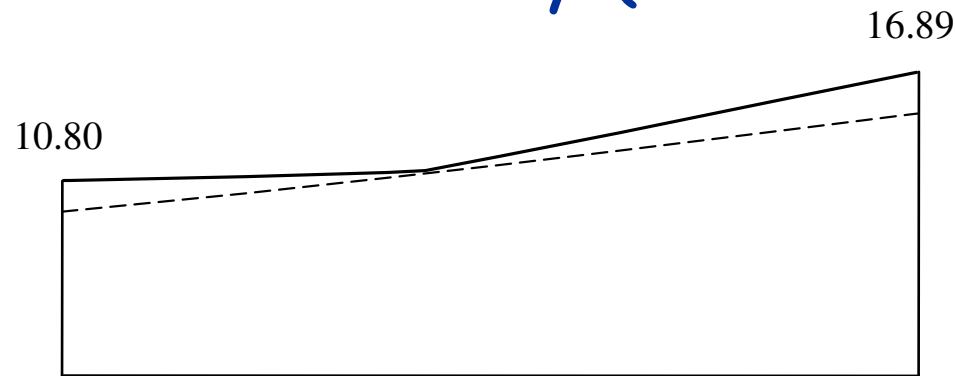
# Sollecitazioni per sisma in direzione y

piano	pilastri telaio 2y		pilastri telaio 7y		travi telaio 2y		travi telaio 7y	
	previsto	calcolato	previsto	calcolato	previsto	calcolato	previsto	calcolato
5	57.5	61.1	115.0	146.1	28.7	31.1	57.5	78.0
4	101.3	105.6	202.6	255.2	79.4	76.9	158.8	183.7
3	134.5	135.7	268.9	329.5	117.9	112.7	235.8	273.3
2	157.0	153.0	314.0	361.7	145.7	140.4	291.5	338.9
1 testa	150.1	136.6	300.1	259.6	153.5	149.1	307.1	343.7
1 piede	225.1	217.9	450.2	516.5				

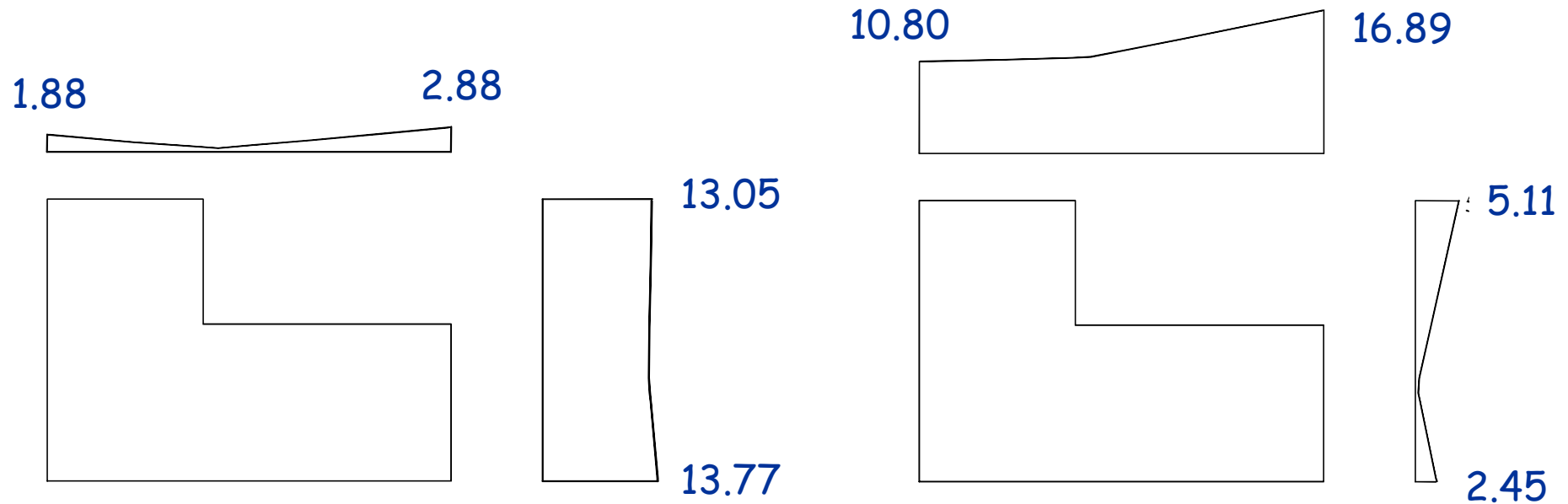
# Spostamenti per forze e coppie direzione x (analisi modale)



# Spostamenti per forze e coppie direzione y (analisi modale)



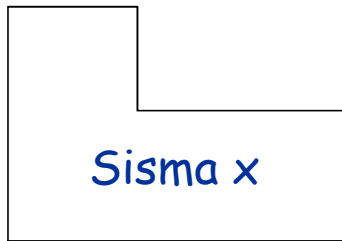
# Effetto complessivo del sisma separatamente nelle due direzioni



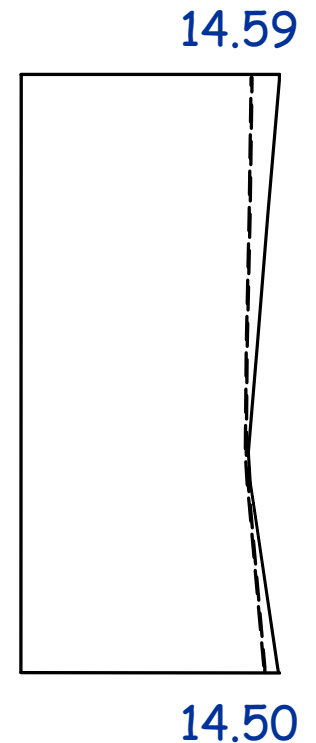
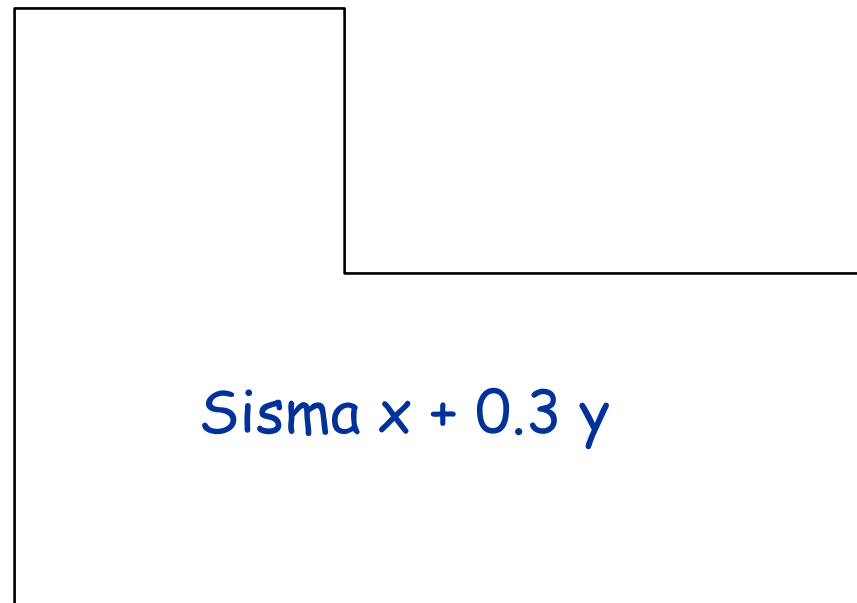
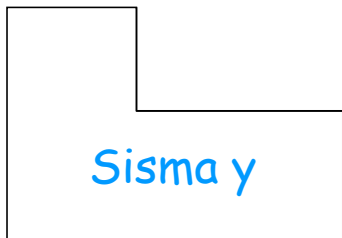
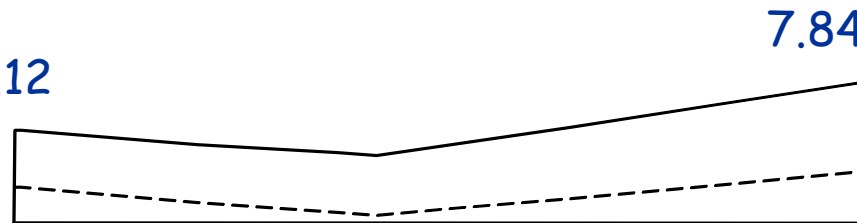
Sisma in  
direzione x

Sisma in  
direzione y

# Inviluppo: $s_{isma\ x} + 0.3\ s_{isma\ y}$ analisi modale



5.12



# Inviluppo: sisma y + 0.3 sisma x analisi modale

