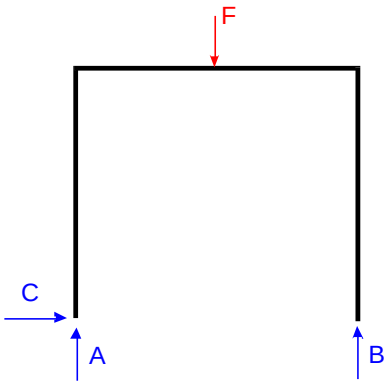
STATIČKI ODREĐENI SUSTAVI

STATIČKI ODREĐENI SUSTAVI

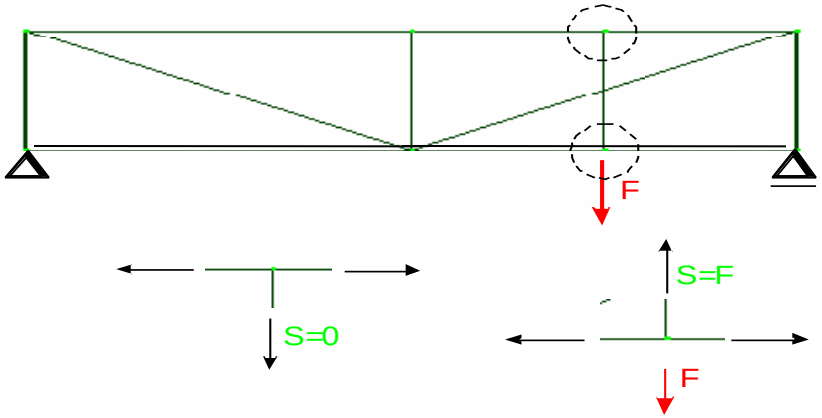
SVOJSTVA SUSTAVA

- Kod statički određenih nosača rješenja za reakcije i unutrašnje sile su jednoznačna.



1. $\Sigma F_x=0 \Rightarrow C$
2. $\Sigma M_B=0 \Rightarrow A$
3. $\Sigma F_y=0 \Rightarrow B$

Jednoznačno rješenje $\Rightarrow$ iz uvjeta ravnoteže.

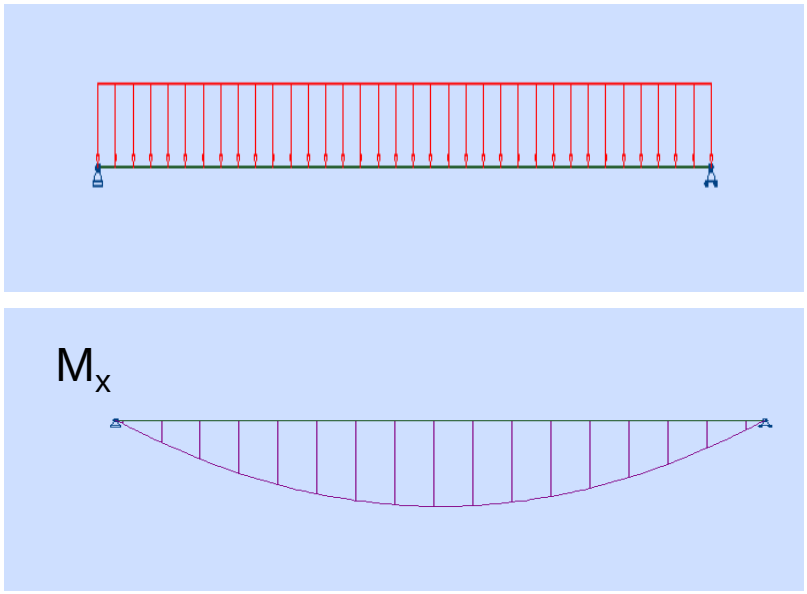


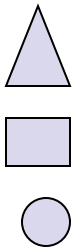
Rješenje nije jednoznačno

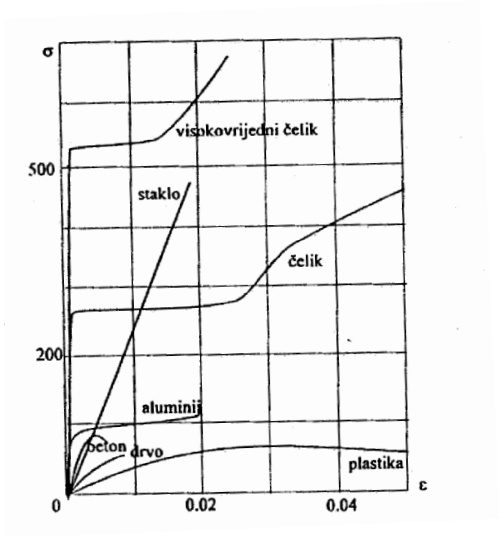
$\Rightarrow$mehanizam.

STATIČKI ODREĐENI SUSTAVI

- Kod statički određenih nosača reakcije i unutrašnje sile ne ovise o obliku i veličini poprečnog presjeka elemenata niti o materijalu iz kojeg su napravljeni pojedini elementi nosača. Pomaci ovise o istom.

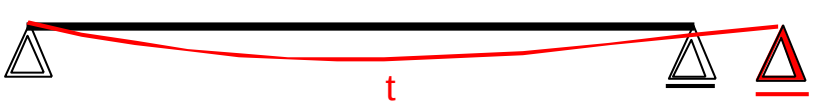


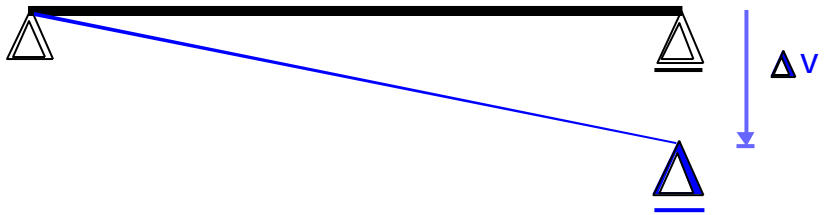




STATIČKI ODREĐENI SUSTAVI

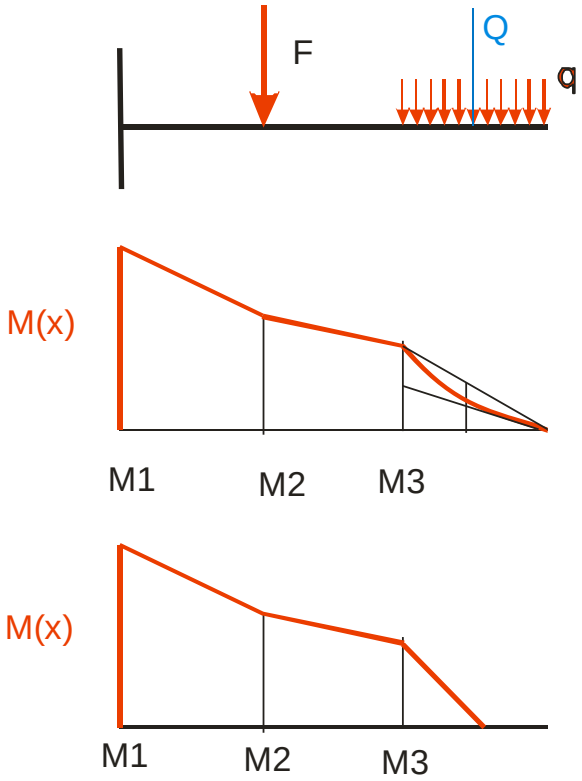
- Kod statički određenih sustava ne pojavljuju se reakcije i unutrašnje sile zbog djelovanja promjene temperature, popuštanja oslonaca ili uslijed netočno izvedenog pojedinog elementa u sustavu. Desi se samo pomak konstrukcije kao krutog diska.





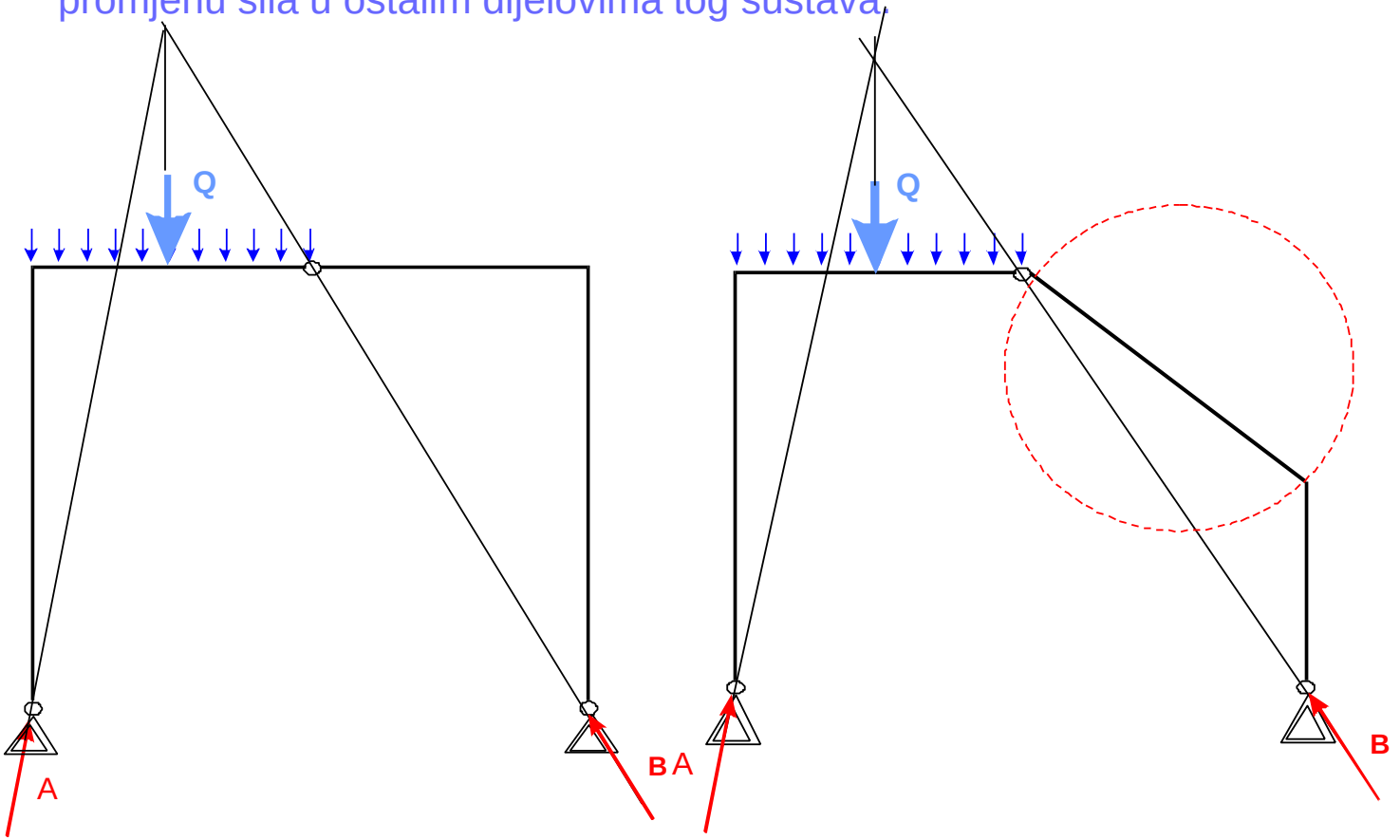
STATIČKI ODREĐENI SUSTAVI

- Ako se kod statički određenog sustava opterećenje na dijelu jednog diska zamijeni statički ekvivalentnim opterećenjem, neće doći do promjene reakcija kao ni unutarnjih sila na ostalom dijelu sustava izvan tog područja.



STATIČKI ODREĐENI SUSTAVI

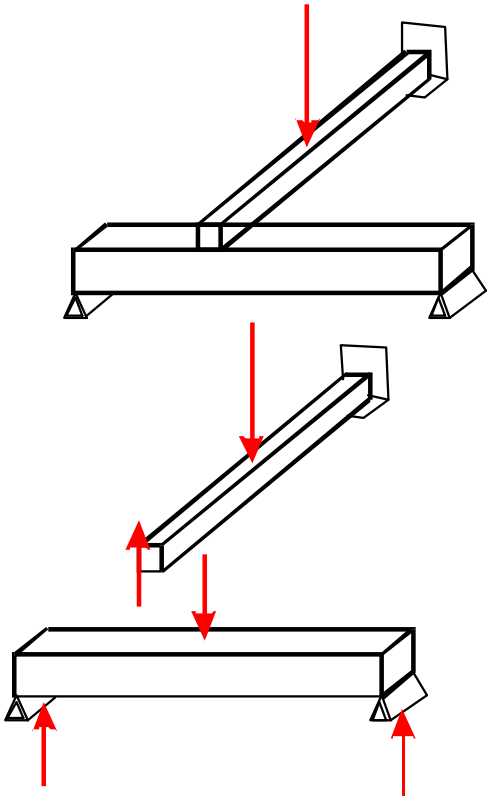
- Ako se promjeni oblik nekog elementa statički određenog sustava, bez promjene opterećenja i bez promjene veza u sustavu, ta promjena ne izaziva promjenu sila u ostalim dijelovima tog sustava.

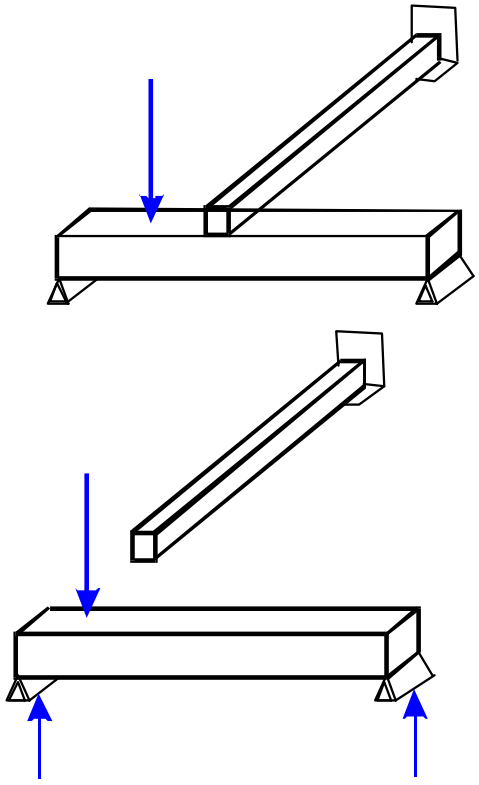


STATIČKI ODREĐENI SUSTAVI

- Ako je statički određen sustav složen i ima osnovni i sekundarni dio.

  Opterećenje osnovnog dijela ne izaziva sile u sekundarnom dijelu nosača, dok opterećenje sekundarnog dijela izaziva sile u osnovnom dijelu.

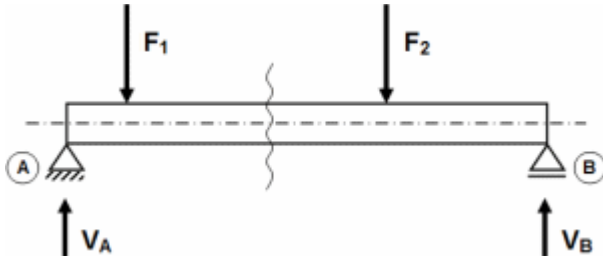


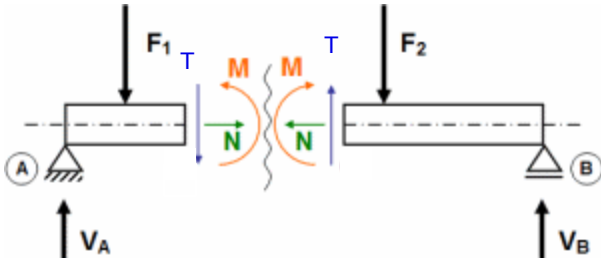


STATIČKI ODREĐENI SUSTAVI

- Statički određeni nosači nemaju rezervu u pogledu stabilnosti ako dođe do raskida neke vanjske ili unutrašnje veze. Ako dođe do popuštanja na mjestu jedne veze, dolazi do gubitka stabilnosti sustava ili dijela sustava.

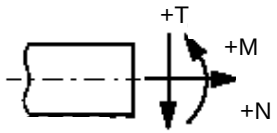
UNUTARNJE SILE

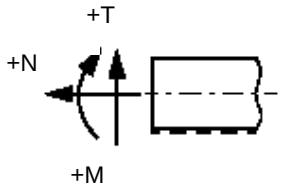


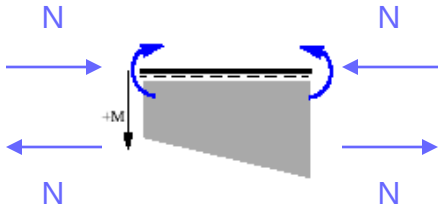


Uravnotežujuće sile u nekom presjeku sustava.

Predznaci unutarnjih sila : po konvenciji

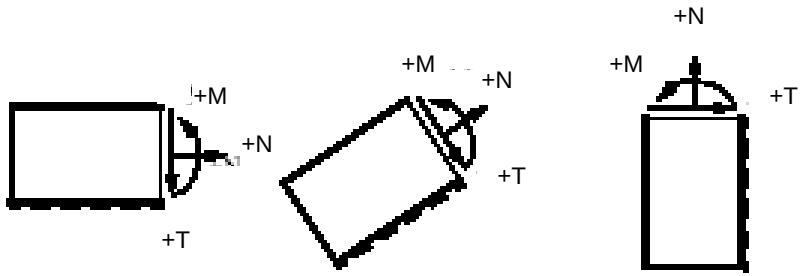




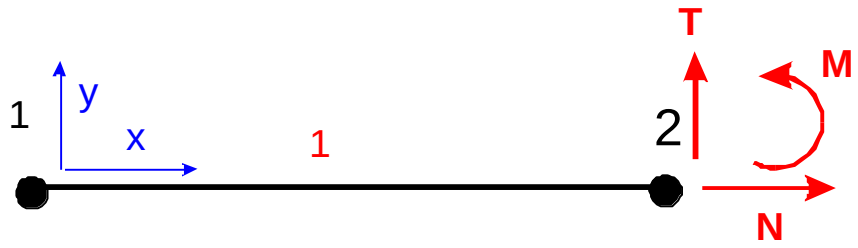


UNUTARNJE SILE

Unutarnje sile – očitavaju se u lokalnom kordinatnom sustavu

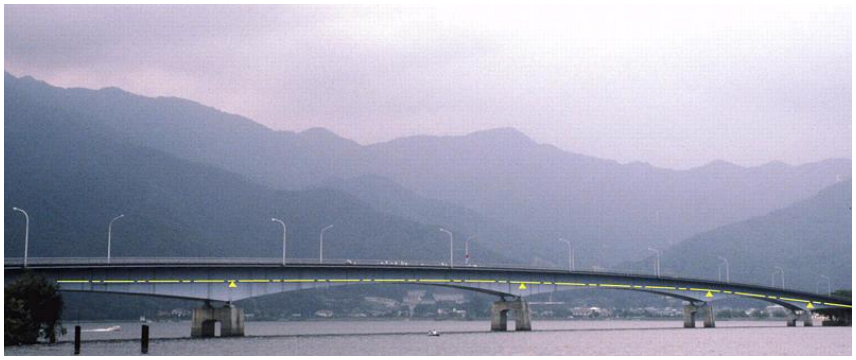


Kompjuterski rezultati unutarnjih sila su smjeru definiranog lokalnog kordinatnog sustava. Očitavaju se na početku i kraju elementa.



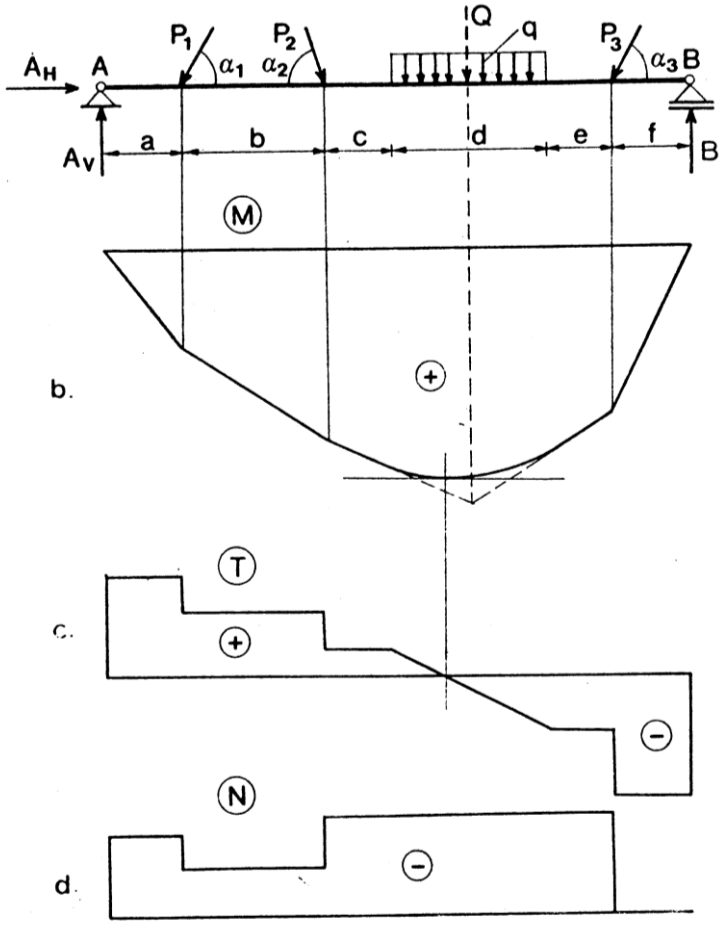
UNUTARNJE SILE

Unutarnje sile- za što služe ?



One su baza za dimenzioniranje elemenata i spojeva konstrukcije.

UNUTARNJE SILE



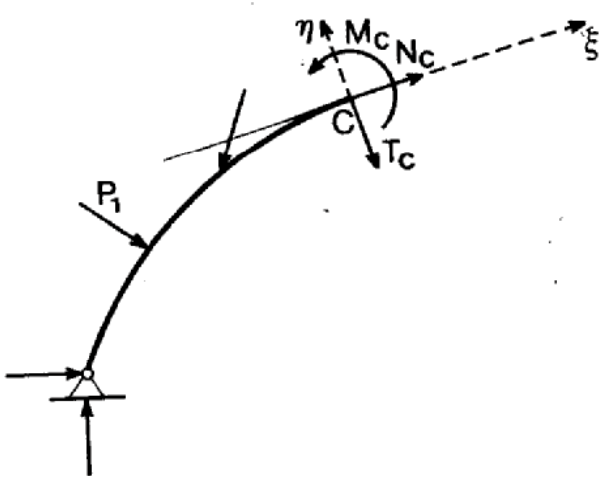
Dijagrami unutarnjih sila:

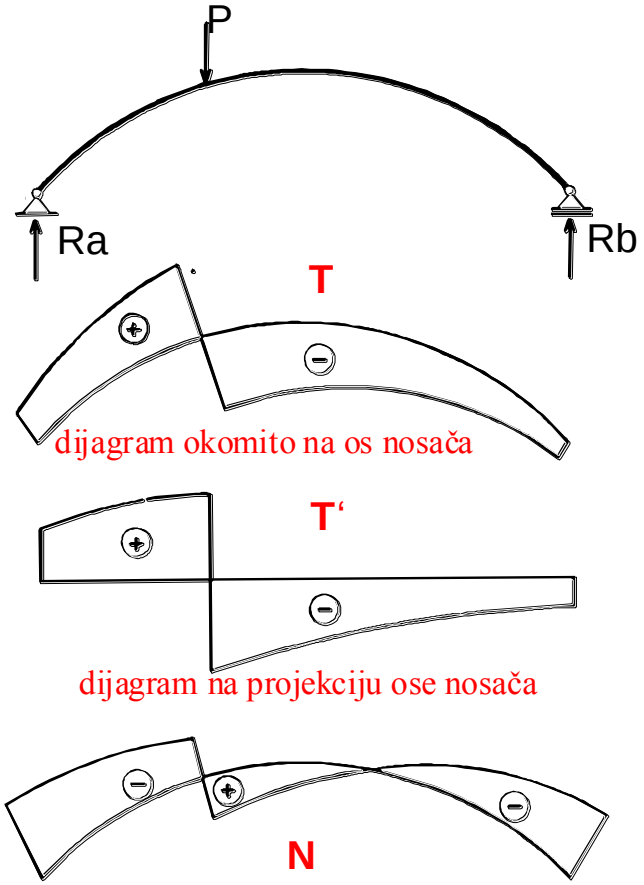
U karakterističnim točkama se računaju veličine un. sila.

T(x),N(x),M(x)= funkcija (x,opterećenja, stat. sustava, I)

UNUTARNJE SILE

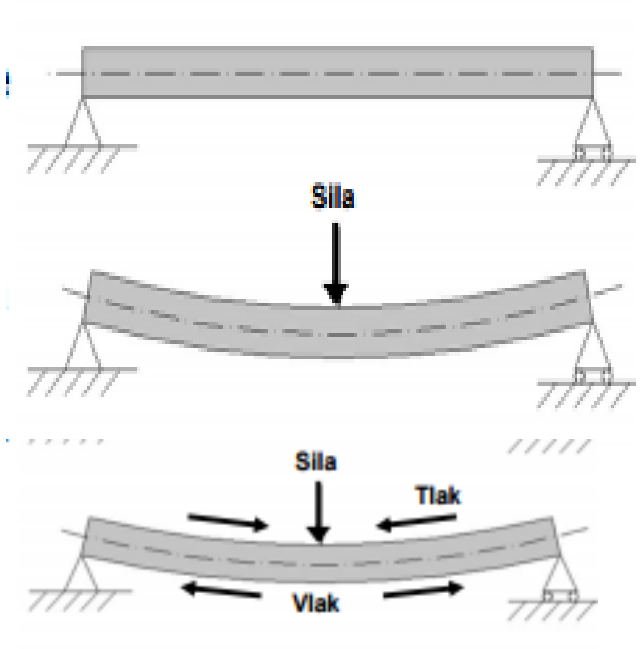
Na zakrivljenom nosaču:

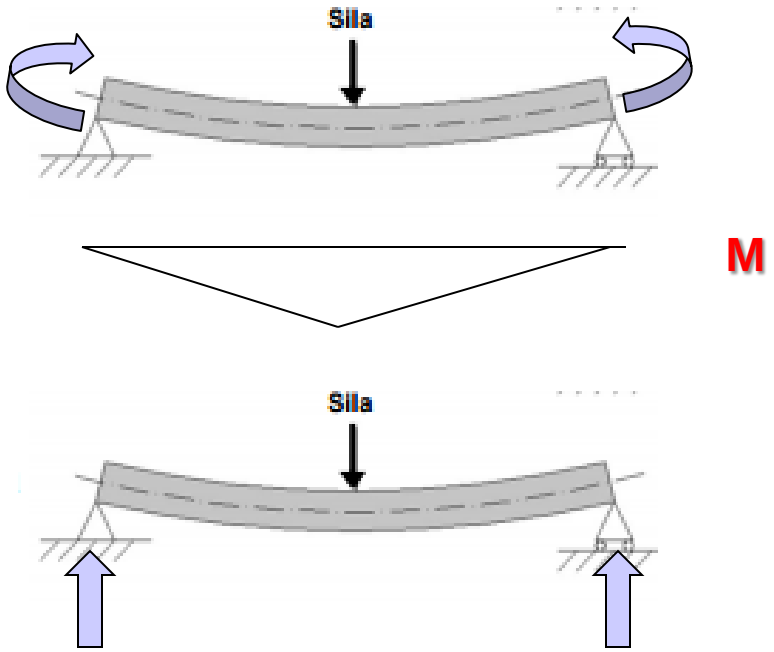




T(x),N(x),M(x)= funkcija (x, α, opterećenja, stat.sustava, l)

UNUTARNJE SILE





M

T

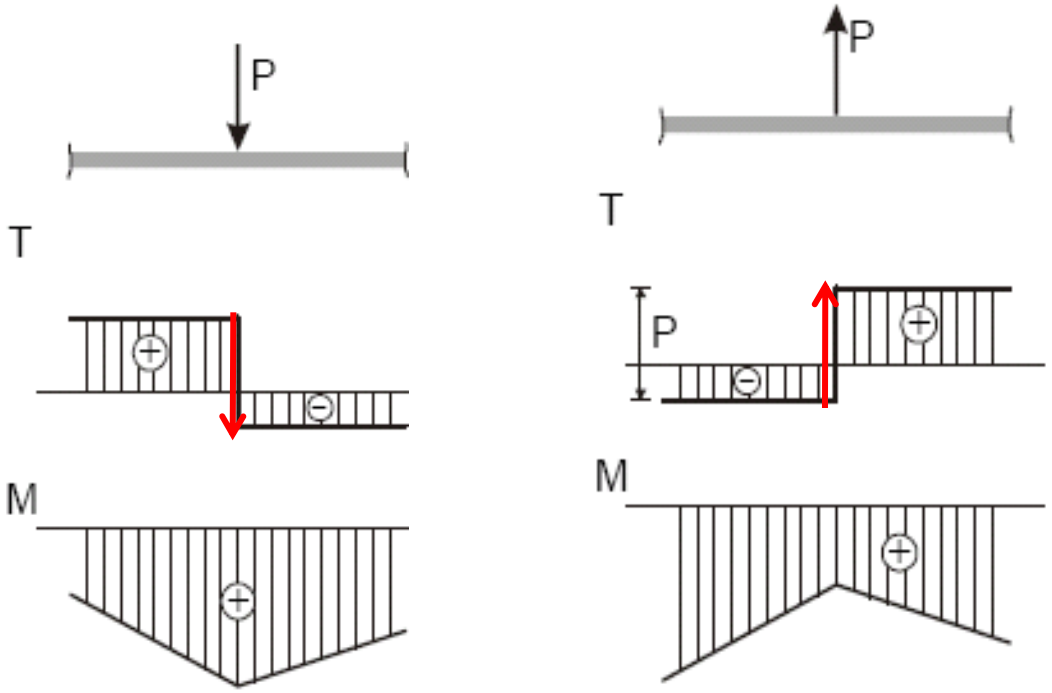
Unutarnja sila je funkcija koja svakoj točki duž nosača x pridružuje vrijednost unutarnje sile y po nekoj f-ji. Ovisi o položaju x, opterećenju, st.sistemu. Postoje pravila za dijagrame-ovisna o opterećenju.

Deformacija je vezana sa un.silom. Dijagrami f-je max 3 reda(x^3).

DIJAGRAMI UNUTARNJIH SILA

PRAVILA :

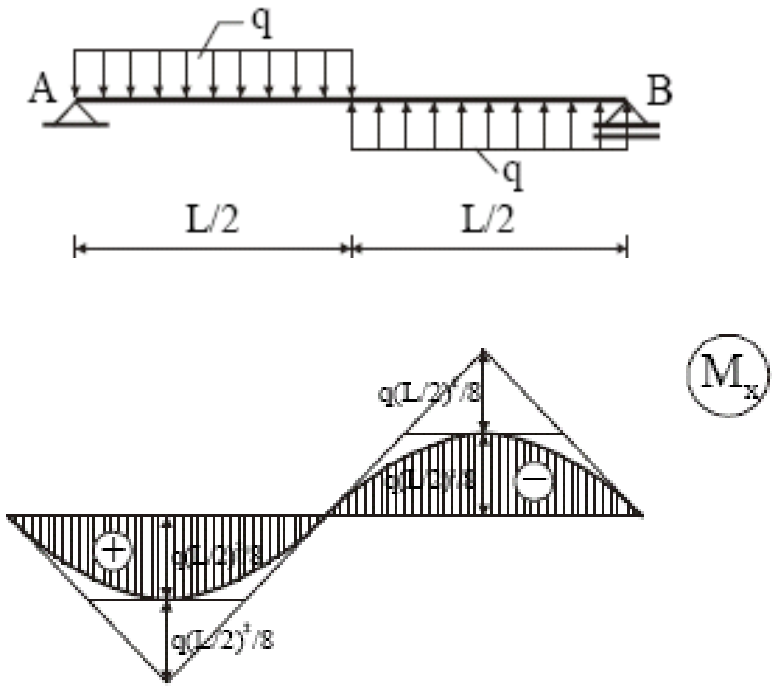
Skok u dijagramu poprečnih sila pojavljuje se na mjestu djelovanja koncentrirane sile u iznosu same sile. Na tom mjestu u dijagramu momenata savijanja pojavljuje se lom tangenti-u smjeru djelovanja opterećenja.



DIJAGRAMI UNUTARNJIH SILA

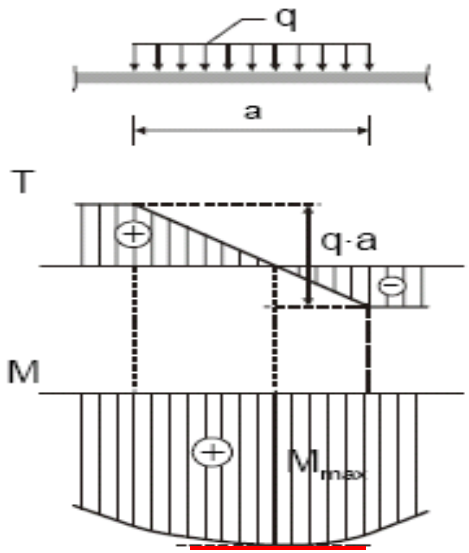
Moment savijanja je parabolična f-ja gdje je q(x) jednoliko opterećenje.

Oblik parabole u dijagramu je smjera kontinuiranog opterećenja. Što je veće opterećenje veća je i zakrivljenost.



DIJAGRAMI UNUTARNJIH SILA

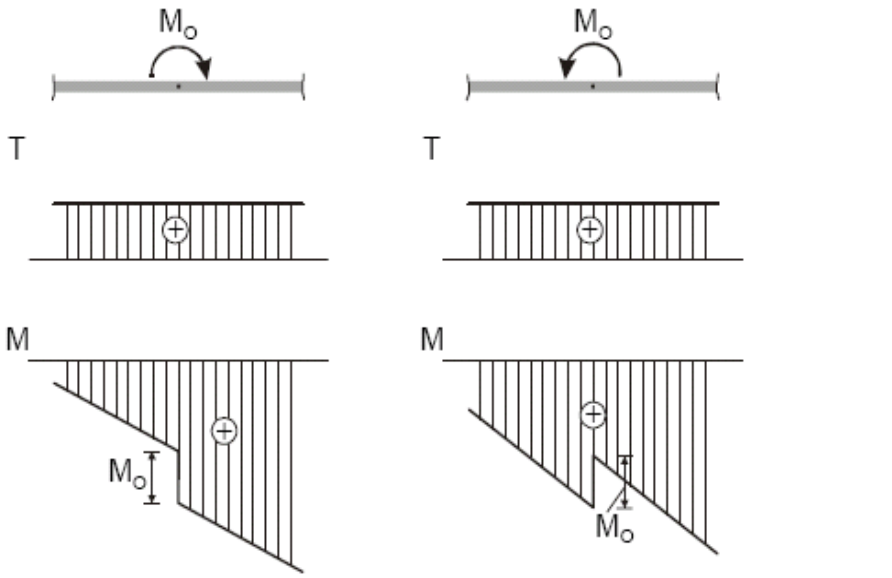
Ako je T=0 tada dijagram T mijenja predznak. Moment savijanja poprima ekstremnu vrijednost gdje je poprečna sila =0, odnosno nagib tangente je tg α = α = dM/dx=T=0.



tg α = 0

DIJAGRAMI UNUTARNJIH SILA

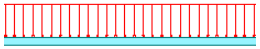
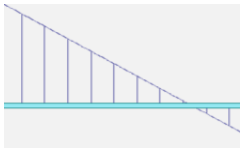
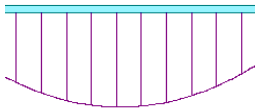
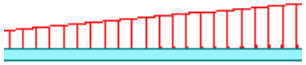
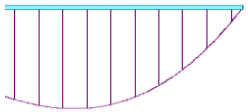
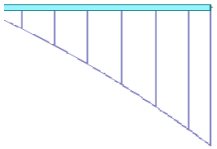
Skok u dijagramu momenata savijanja pojavljuje se samo na mjestu gdje djeluje koncentrirani moment. Skok u dijagramu je u smjeru koncentriranog M- iz punog u prazno.



DIJAGRAMI UNUTARNJIH SILA

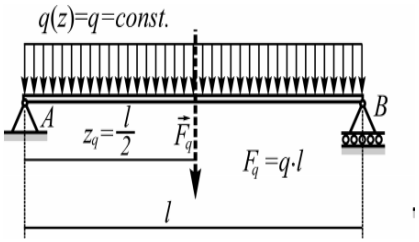
Poprečna sila je konstantna gdje je q(x)=0, odnosno linearna f-ja gdje je q(x) jednoliko opt.

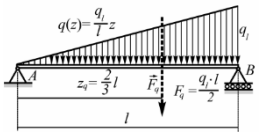
Moment savijanja je linearna f-ja gdje je q(x)=0

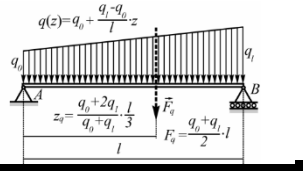
q	T	**M**
0 	konstantan 	linearan 
Konstan-tan 	linearan 	kvadratna parabola 
Linearan 	kvadratna parabola 	kubna parabola 

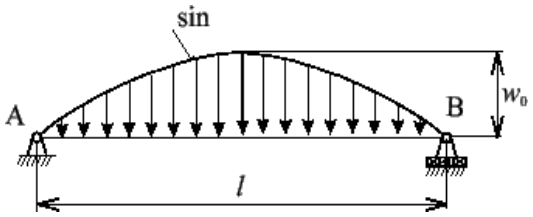
UNUTARNJE SILE–krivulje

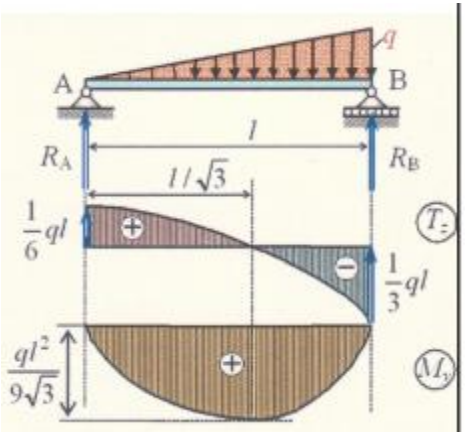
……kod kontinuiranog opterećenja

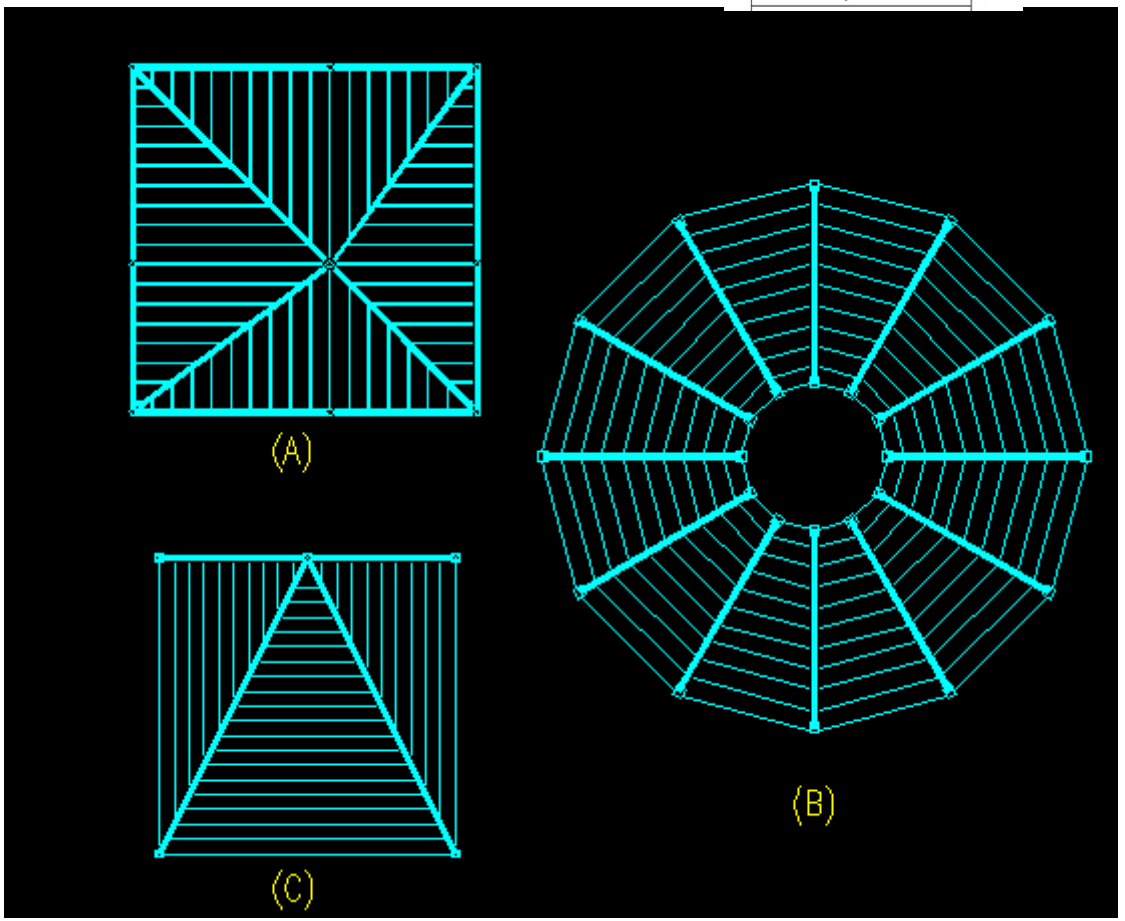






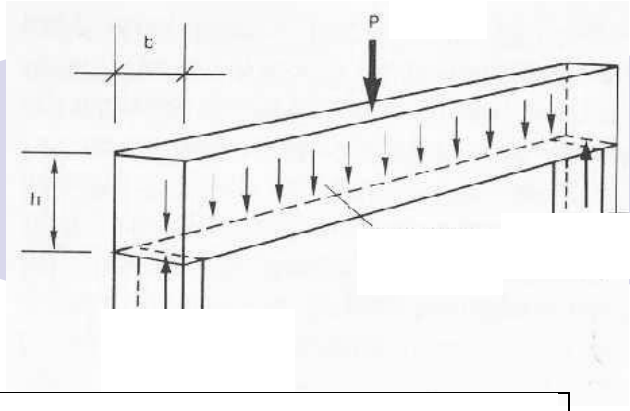




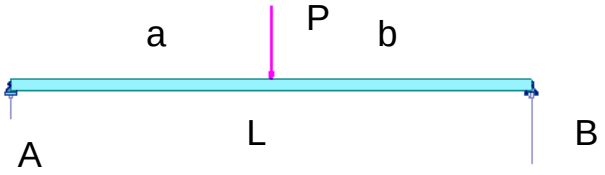


UNUTARNJE SILE

Osnovni statički sustavi

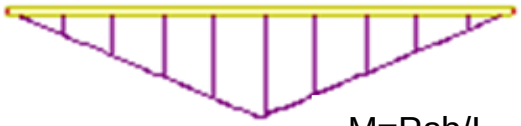


PROSTA GREDA



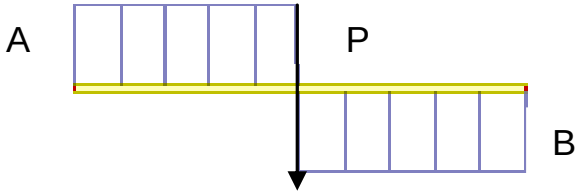
A=Pb/L B= Pa/L

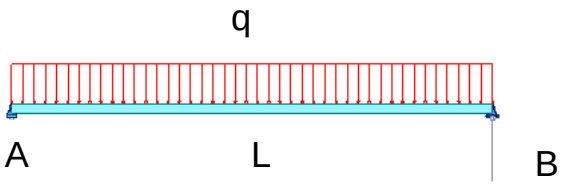
M(X)



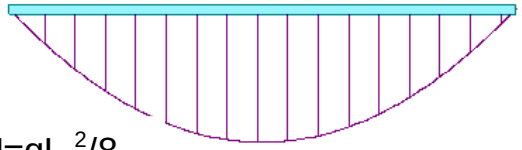
M=Pab/L

T(x)

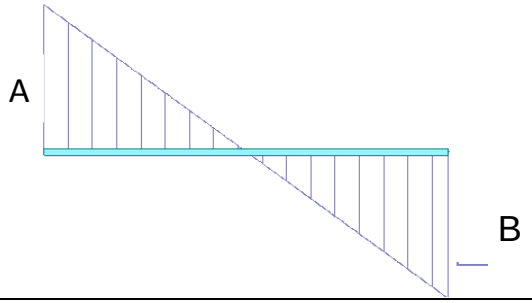




A=B=qL/2



M=qL ^{2}/8



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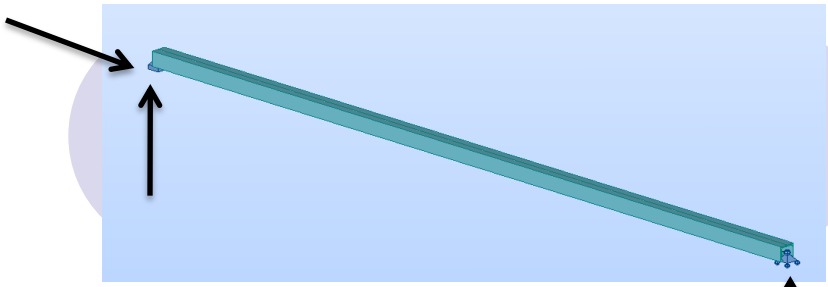
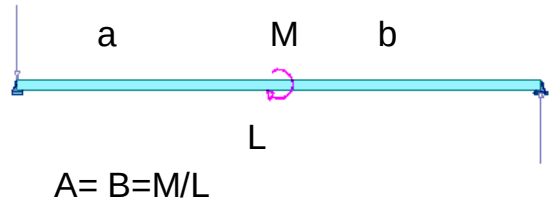
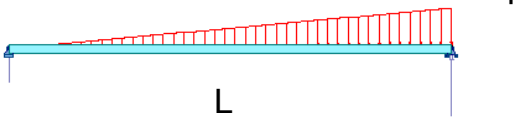


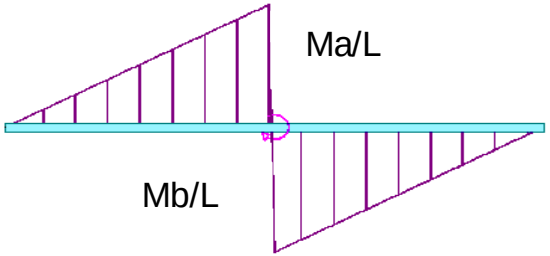


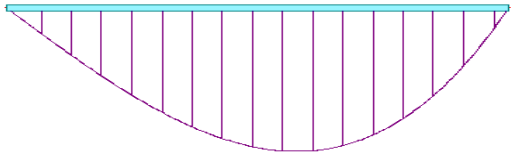
A= B=M/L

A=qL/6 B= qL/3



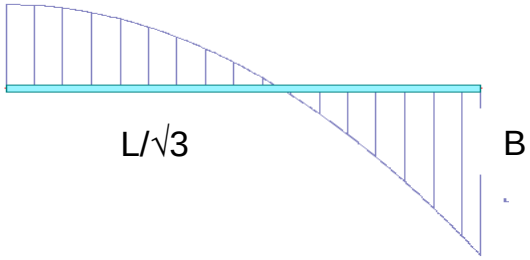
M(X)



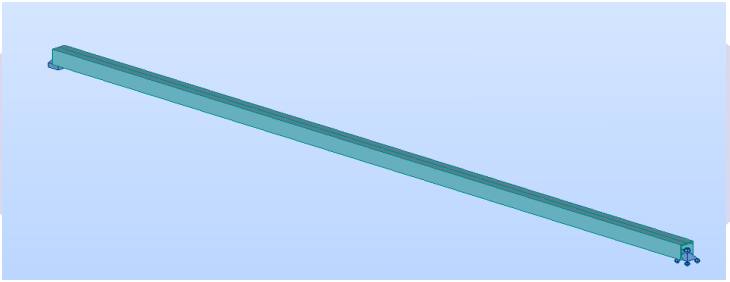


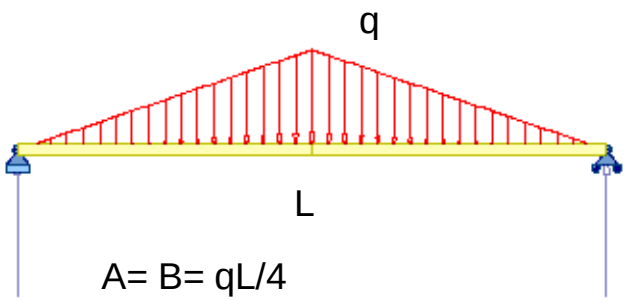
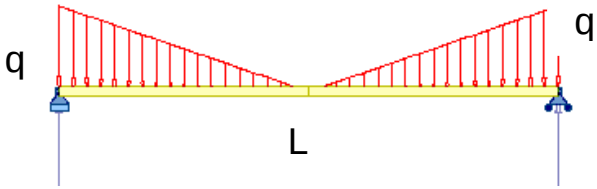
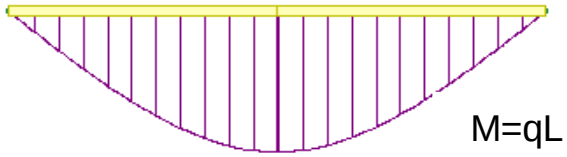
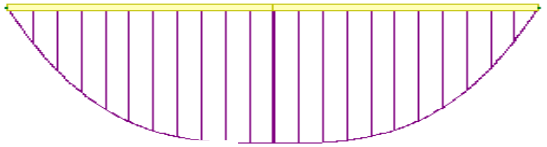
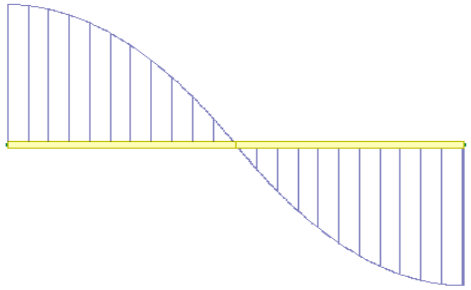
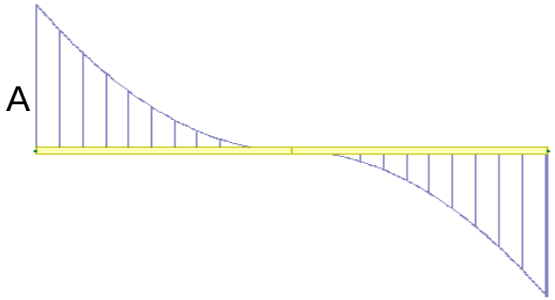
$M=qL^2/9\sqrt{3}$

T(x)



UNUTARNJE SILE



	 A= B= qL/4	 A= B= qL/4
M(X)	 M=qL ^{2}/12	 M=qL ^{2}/24
T(x)		

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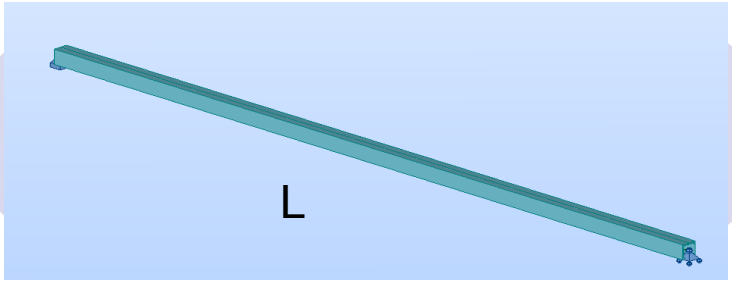
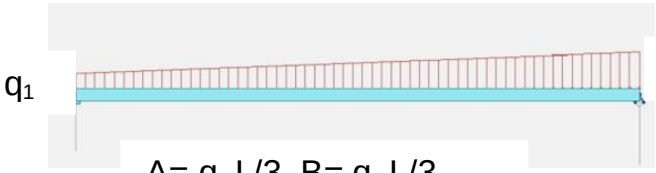
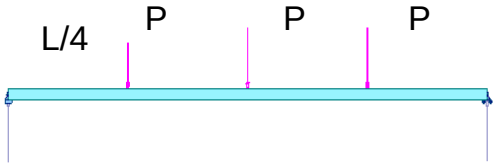
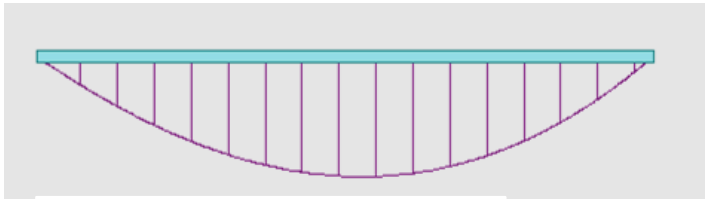
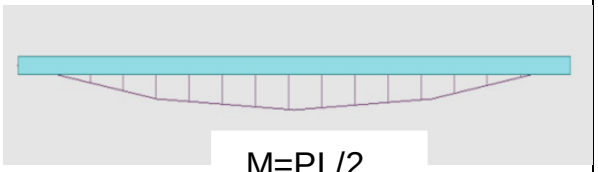
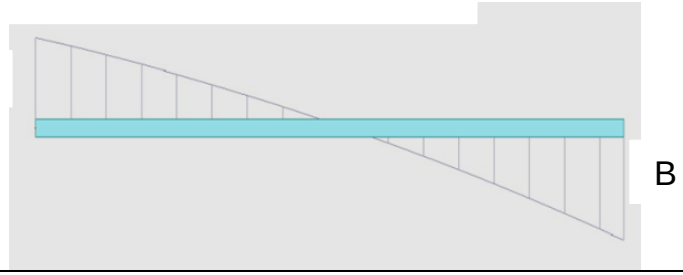
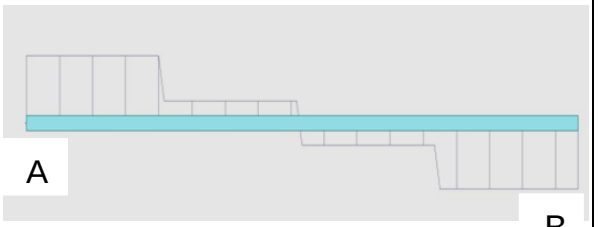
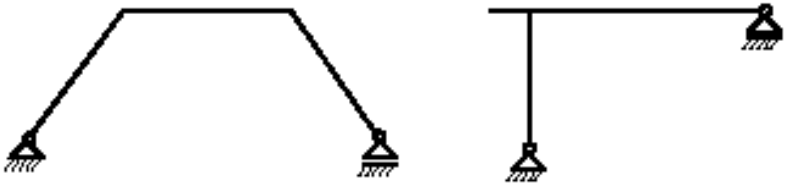


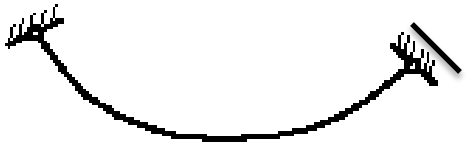
	 A= q_1 L/3 B= q_2 L/3	 A= B= 1.5 P
M(x)	 M=0.06325(q_1+ q_2) L ^{2}	 M=PL/2
T(x)		

UNUTARNJE SILE

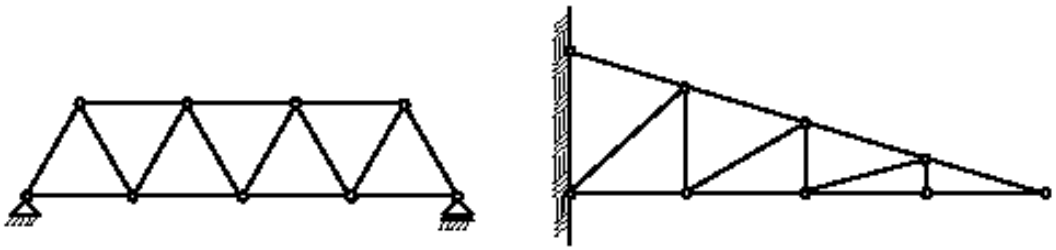
I ovo statički sustavi proste grede:



Poligonalna prosta greda



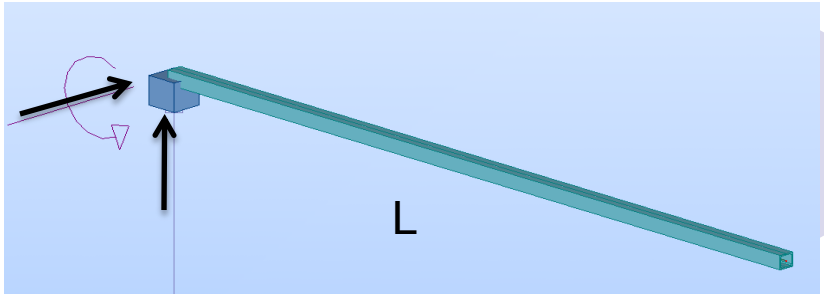
Zakrivljena prosta greda



Rešetka- prosta greda

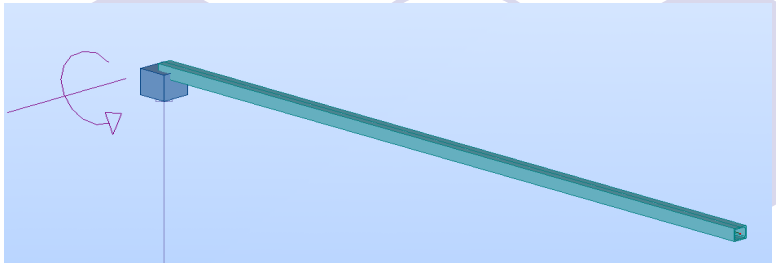
UNUTARNJE SILE

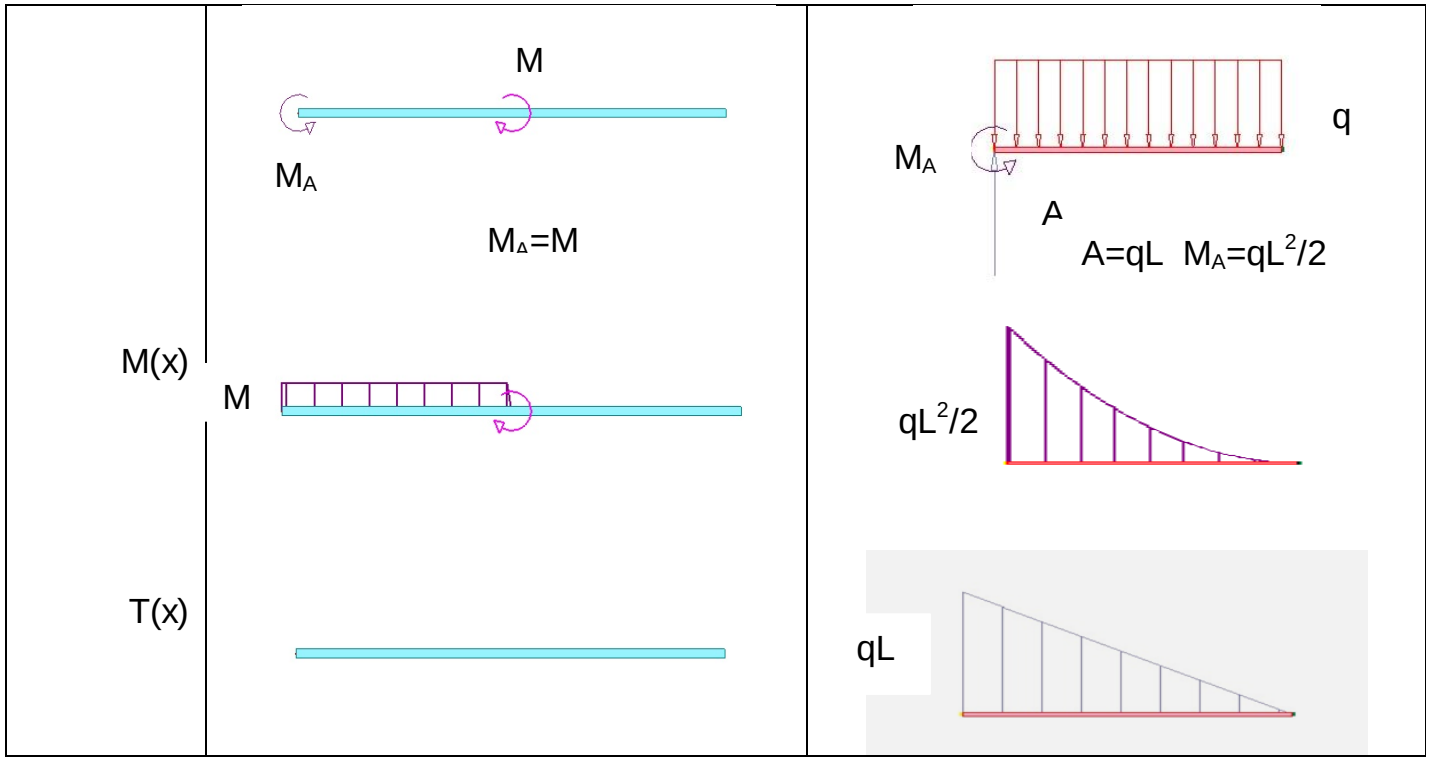
KONZOLA



	LIJEVA	DESNA
	M_A P A $A=P$ $M_A=PL$	P M_A $A=P$ $M_A=PL$ A
M(x)	PL	PL
T(x)	P +	P -

UNUTARNJE SILE





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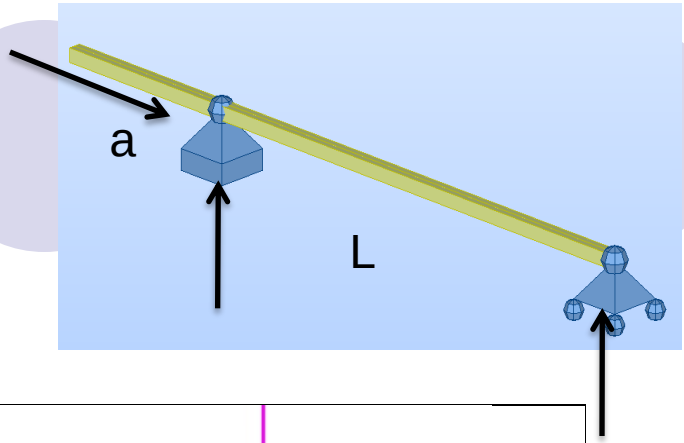
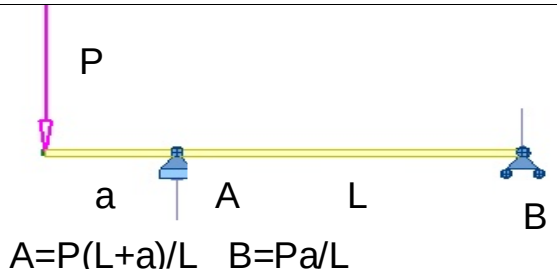
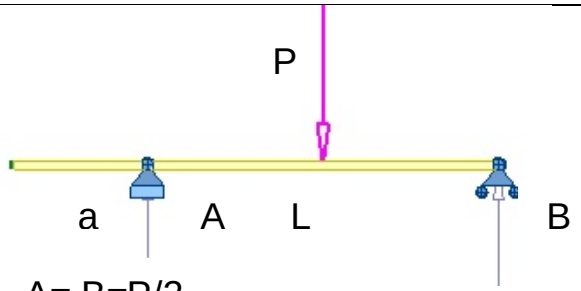
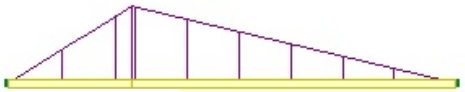
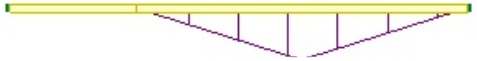
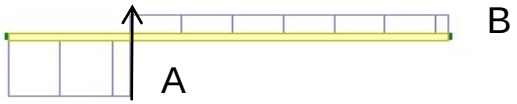
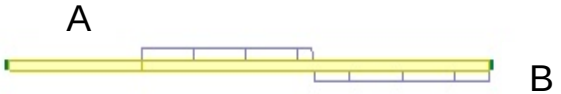
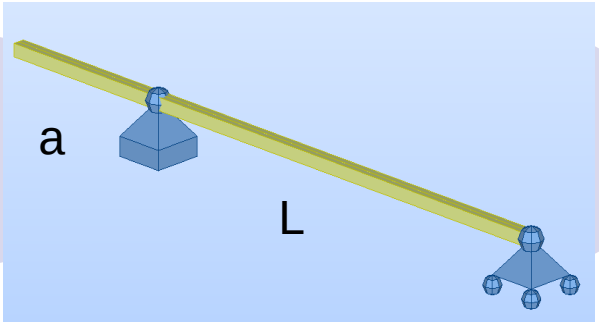
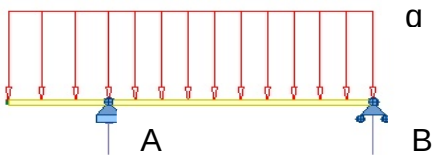
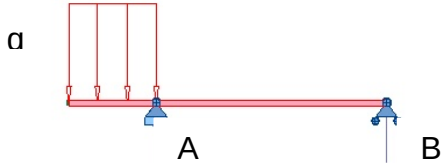
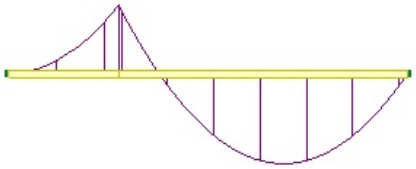
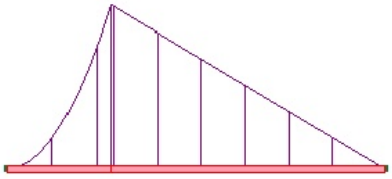
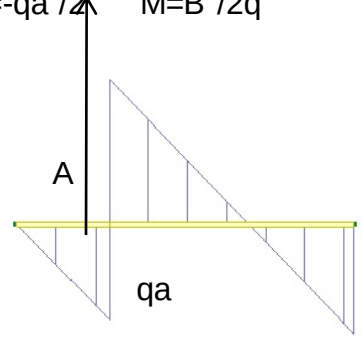
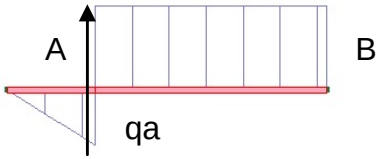
GREDA S PREPUSTOM



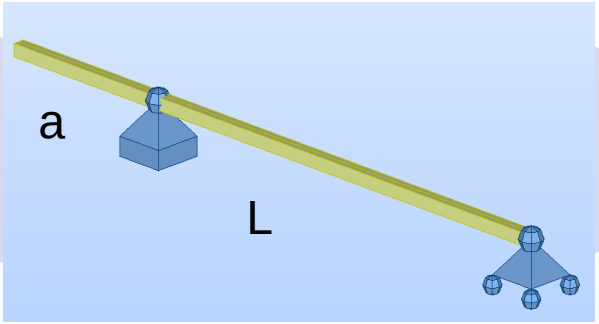
	 A=P(L+a)/L B=Pa/L	 A= B=P/2
M(X)	 M=Pa	 M=PL/4
T(x)		

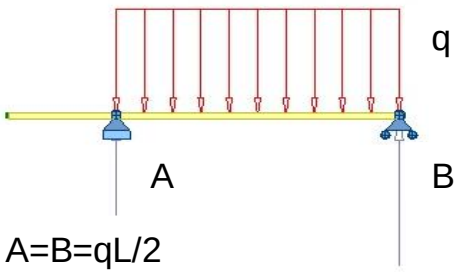
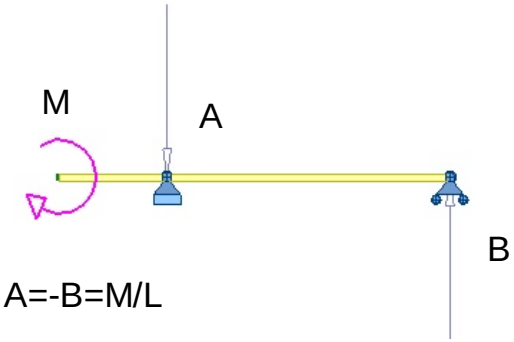
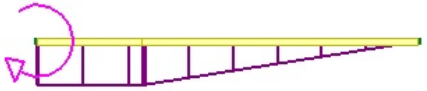
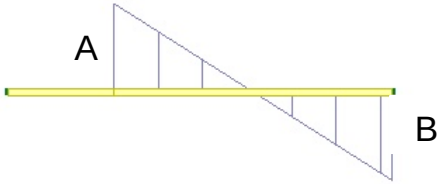
UNUTARNJE SILE



		
	$A=q(L+a)^2/2L$ $B=q(L+a)((L-a)/2L)$	$A=qa\ (1+a/2L)$ $B=-q(a^2/2L)$
M(X)		
	$M_A=-qa^2/2$ $M=B^2/2q$	$M_A=-qa^2/2$
T(X)		

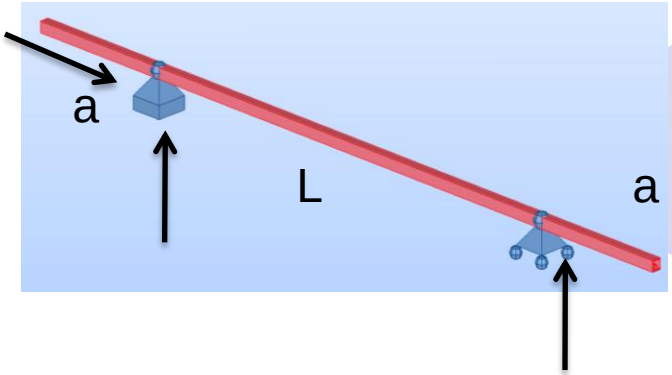
UNUTARNJE SILE

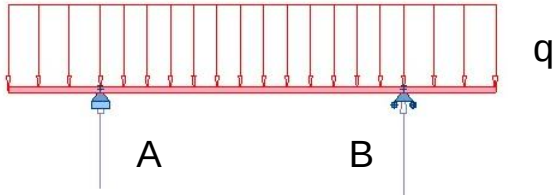
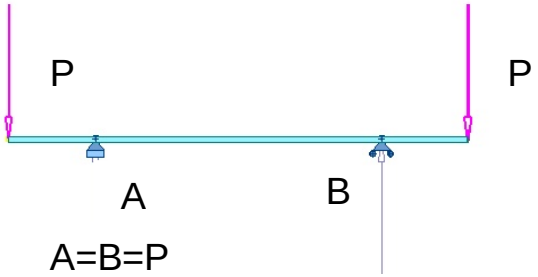
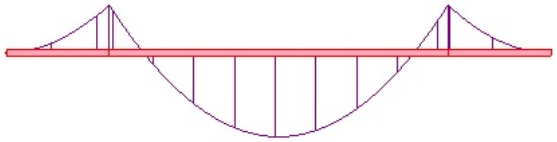
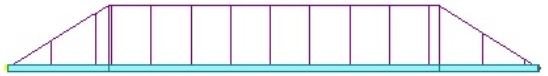


	 A=B=qL/2	 A=-B=M/L
M(X)	 $M=qL^2/8$	 M=M
T(X)		

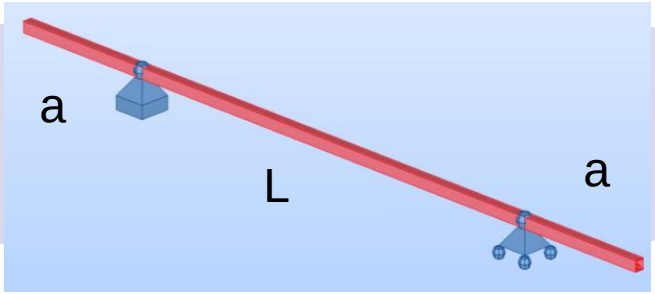
UNUTARNJE SILE

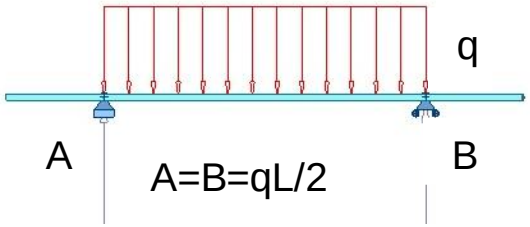
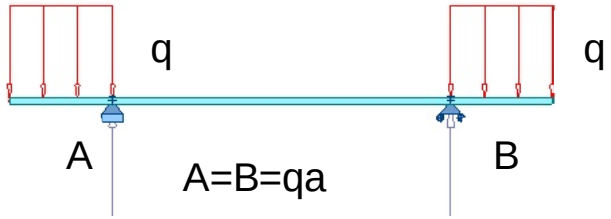
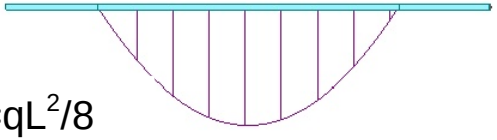
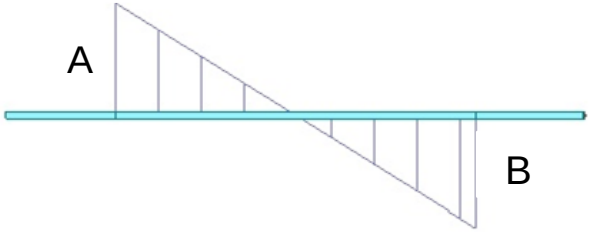
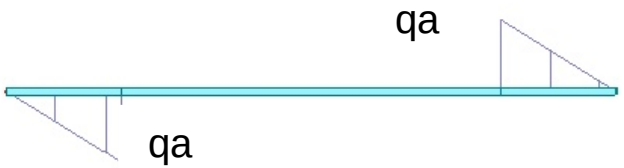
GREDA S DVA PREPUSTA



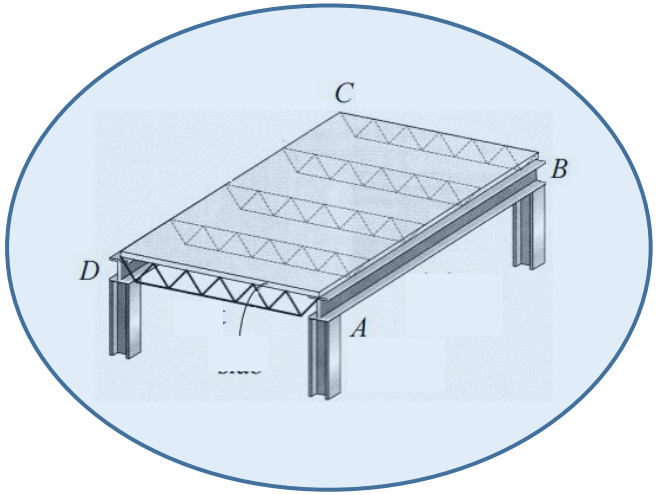
	 $A=B=q(L+2a)/2$	 $A=B=P$
M(x)	 $M_A=M_B=-qa^2/2$ $M=q(L^2/8-a^2/2)$	 $M_A=M_B=M=-Pa$
T(x)		

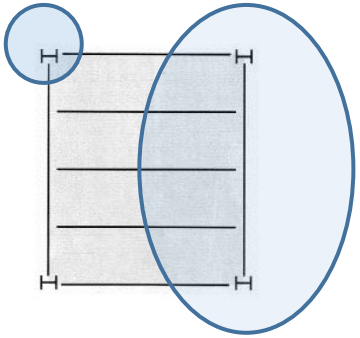
UNUTARNJE SILE

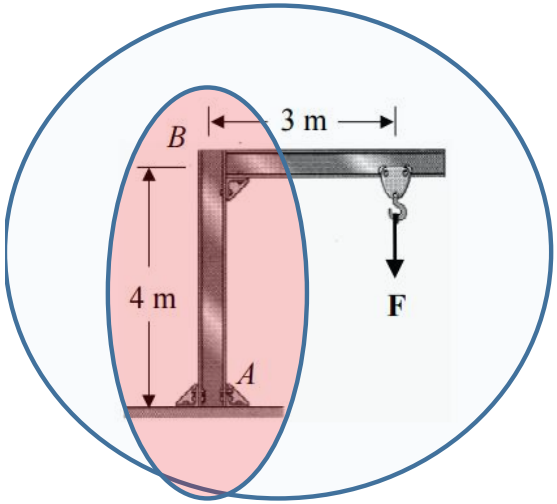


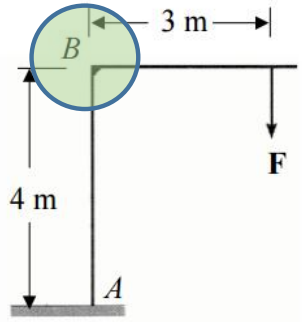
		
M(x)	 $M=qL^2/8$	 $M_A=M_B=M=-Pa^2/2$
T(x)		

RAVNOTEŽA, RAVNOTEŽA.....



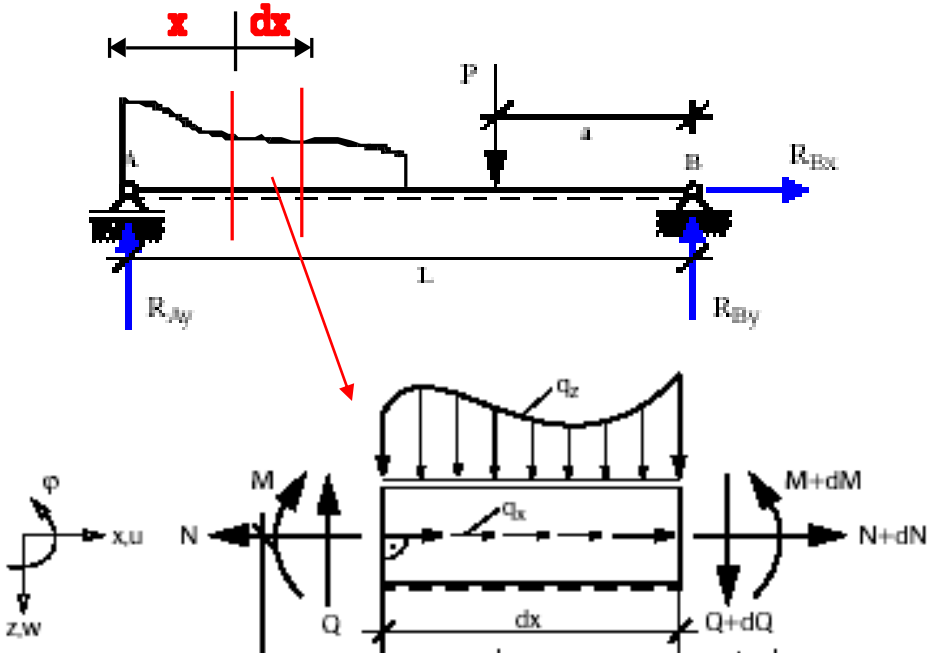






DIFERENCIJALNE VEZE

UN. SILA I OPTEREĆENJA

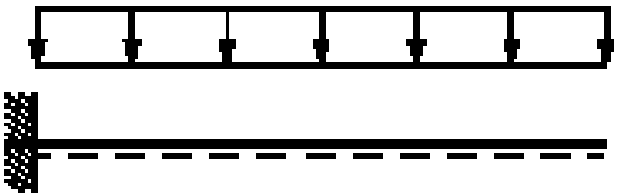


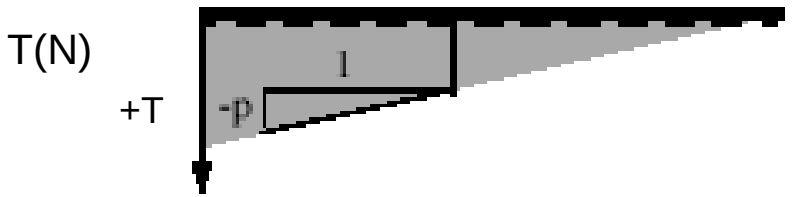
$dT/dx=-p$ $dN/dx=-n$ $dM/dx= T$

$d^2M/dx^2 =-p$

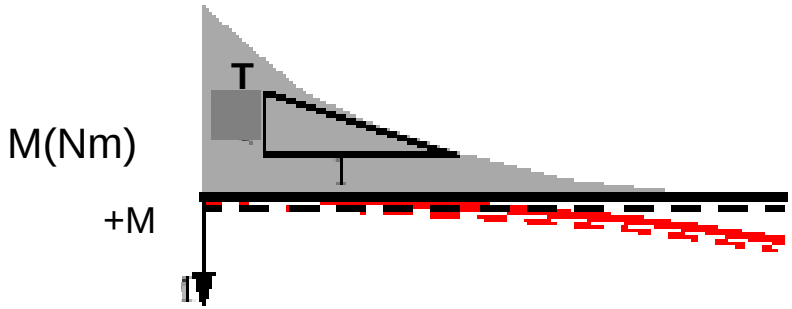
DIFERENCIJALNE VEZE

TUMAČENJE DIF. VEZA





dT/dx=-p

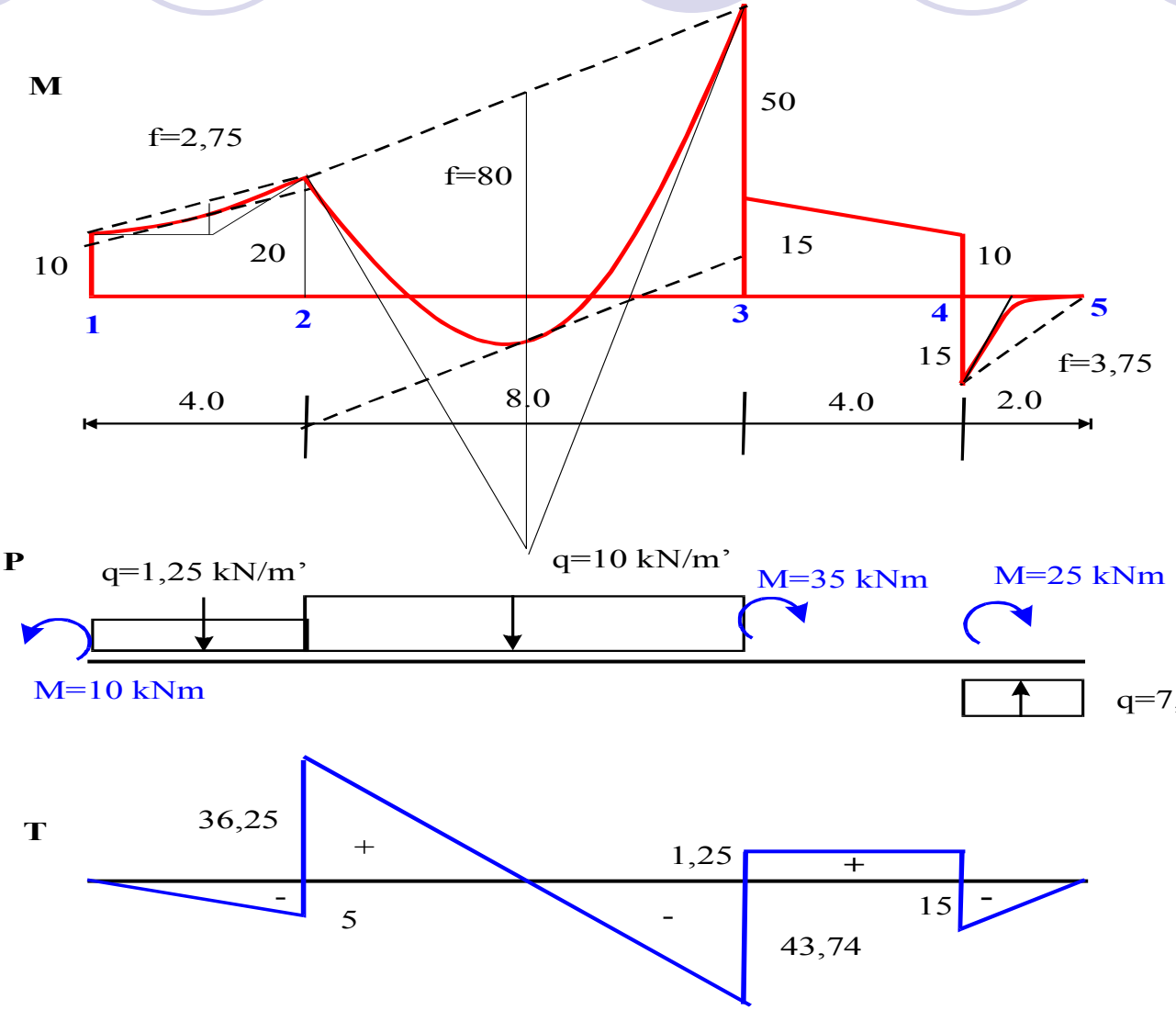


dM/dx=T= tg α

- *Nagib poprečne sile u nekom presjeku x jednak je vrijednosti opterećenja na tom mjestu, dT/dx=-p.*
- *Nagib tangente na krivulju momenta savijanja u nekoj točci jednak je poprečnoj sili na tom mjestu, dM/dx=T= tg α.*

DIFERENCIJALNE VEZE

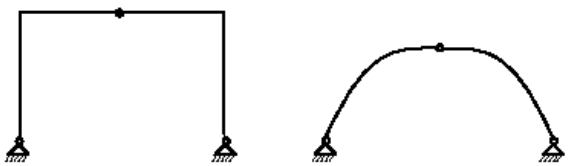
Primjer:

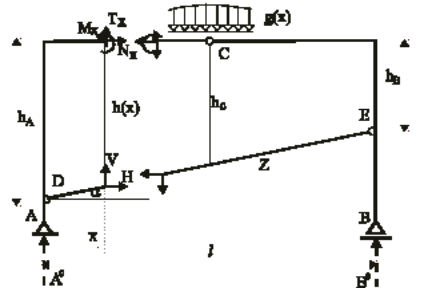


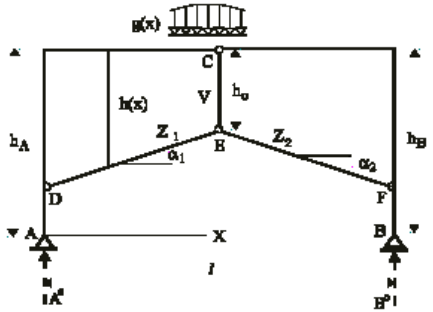
STATIČKI ODREĐENI SUSTAVI

Složeni statički sustavi

Trozglobni sustavi

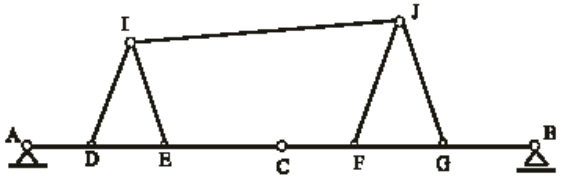


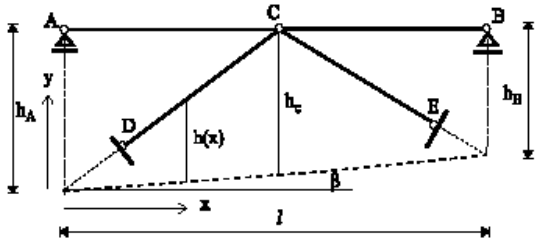




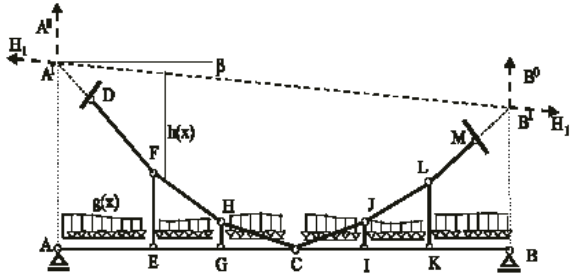
Sustavi sa zategama

Ojačani sustavi





Poduprti sustavi



Ovješeni sustavi