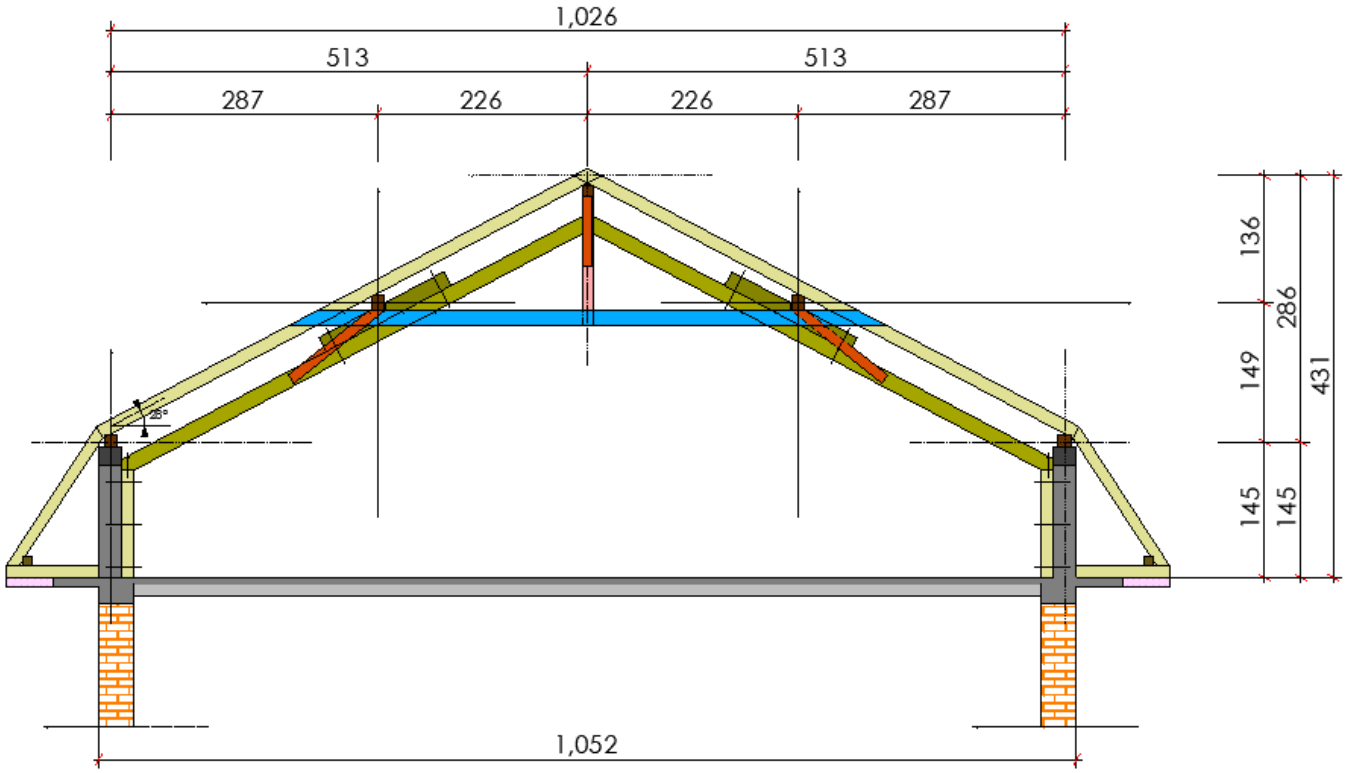
STATIČKI PRORAČUN
I
DIMENZIONISANJE KROVA

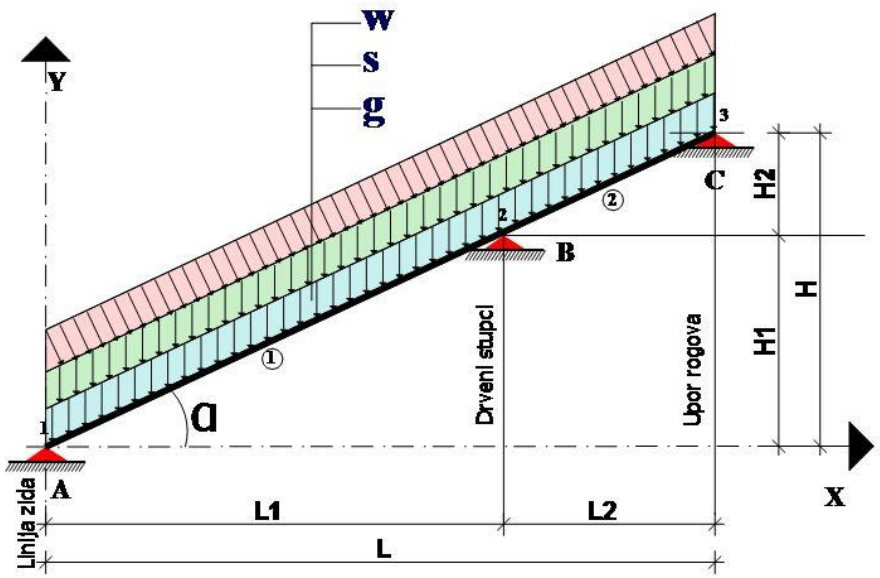


Aleksandar Ilić, dipl.građ.inž.

OPŠTE

Projektant je verovatno imao projektnim zadatkom zahtevanu što veću prohodnost tavana kako bi se u nekoj fazi izvršila prenamena tavanskog u poslovni prostor. Stim u vezi projektant nije išao na varijantu krovnih vezača sa drvenim krovnim stolicama, već na rešenje koje bi omogućilo prenamenu bez nove rekonstrukcije krovne konstrukcije.
U daljem, kao odgovorni Izvođač , predlažem sledeće rešenje drvene krovne konstrukcije

1.1. DRVENI KROVNI ROGOVI



$\alpha=28^{\circ} \Rightarrow \sin\alpha = 0{,}469;\ \cos\alpha = 0{,}883;\ \operatorname{tg}\alpha = 0{,}532$
max razmak rogova $\Lambda_{max} = 0{,}80$ m

$L_1 = 2{,}87$ m, $L_2 = 2{,}26$ m, $\Rightarrow L = 5{,}13$ m
$H_1 = 1{,}53$ m, $H_2 = 1{,}20$ m, $\Rightarrow H = 2{,}73$ m

- **Opterećenja koja deluju u krovnoj ravni**

- Sopstvena težina krovne konstrukcije
(pokrivač – falcovani crep) ..... g = 0,65 kN/m^2
- Opterećenje snegom
S = 95 - α = 95-28 = 67 $\Rightarrow$ .....usvajam.... s = 0,75 kN/m^2
- Opterećenje vetrom
(II zona vetra, objekat visine do 10 m , izložen) ..... w = 0,70 kN/m^2

- **<u>Analiza opterećenja za drvene krovne rogove</u>**

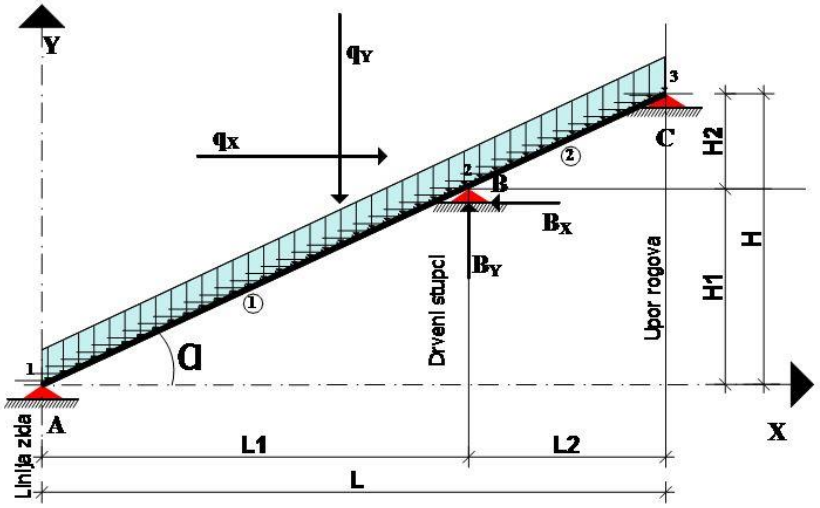
- Od sopstvene težine krovne konstrukcije..... $g_y = 0,65 \times 0,80 = 0,52$ kN/m^1
  $g_x = 0$ kN/m^1
- Od snega na krovnoj ravni..... $s_y = 0,75 \times 0,80 = 0,60$ kN/m^1
  $s_x = 0$ kN/m^1
- Od uticaja vetra ..... $w_0 = (1,2 \times \sin \alpha) \times w$

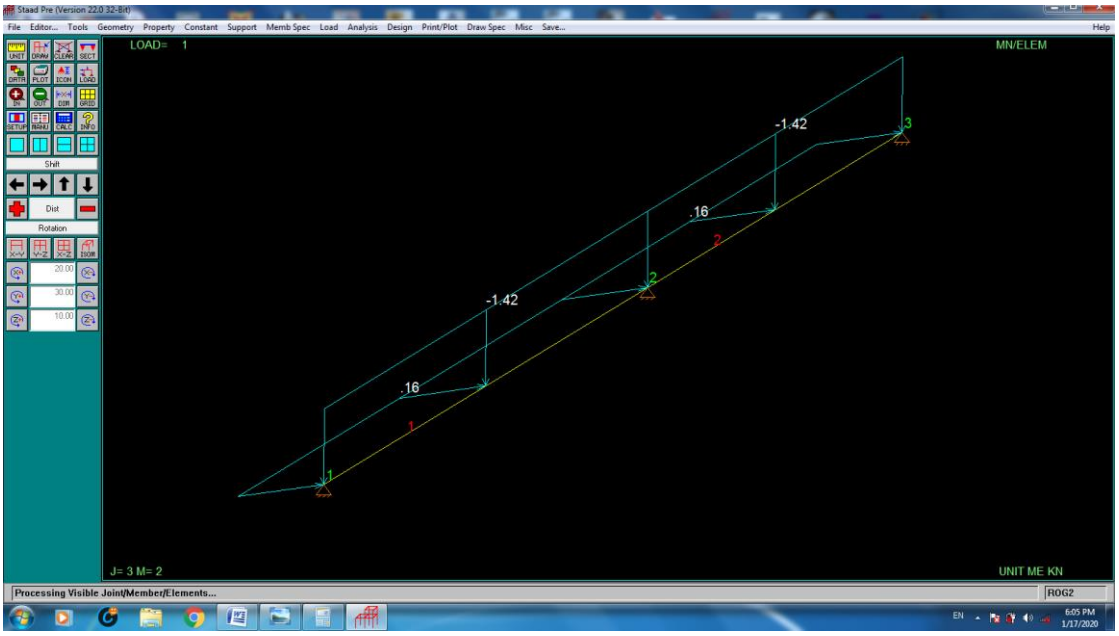
$w_0 = (1,2 \times 0,469) \times 0,70 = 0,42$ kN/m^2
$w_y = 0,42 \times 0,883 \times 0,80 = 0,30$ kN/m^1
$w_x = 0,42 \times 0,469 \times 0,80 = 0,16$ kN/m^1

- **<u>Zbirna opterećenja na drvene krovne rogove</u>**

$q_y = g_y + s_y + w_y = 0,52 + 0,60 + 0,30 = 1,42$ kN/m^1
$q_x = w_x = 0,16 =$ **0,16 kN/m^1**

- **<u>Statička šema rogova</u>**





► Statička analiza u programu STAAD III

STATIČKI UTICAJI ZA DRVENE KROVNE ROGOVE OD UTICAJA ZBIRNOG OPTEREĆENJA

```
*************************************************
*                                               *
*           S T A A D - III                     *
*           Revision 22.0W                      *
*           Proprietary Program of              *
*           Research Engineers, Inc.            *
*           Date=    JAN 17, 2020               *
*           Time=    18: 7: 30                  *
*                                               *
*      USER ID: tHeRaiN/UCF2000                 *
*************************************************
```

```
 ********************************************************
 *                                                      *
 * NATURAL FREQUENCY FOR LOADING    1 =  61.77268 CPS   *
 * MAX DEFLECTION =   .03 CM      GLO Z, AT JOINT    3  *
 *                                                      *
 ********************************************************
```

27. PRINT MEMBER FORCES ALL

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KNS METE

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	.86	1.71	.00	.00	.00	.00
		2	**.86**	2.61	.00	.00	.00	-1.46
2	1	2	.67	2.27	.00	.00	.00	1.46
		3	.67	1.13	.00	.00	.00	.00

********** END OF LATEST ANALYSIS RESULT **********

28. PRINT SUPPORT REACTIONS

" KROVNI ROGOVI "

SUPPORT REACTIONS -UNIT KNS METE STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-.05	1.91	.00	.00	.00	.00
2	1	-.94	5.03	.00	.00	.00	.00
3	1	.06	1.31	.00	.00	.00	.00

********** END OF LATEST ANALYSIS RESULT **********

29. PRINT FORCE ENVELOPE NSECTION 5 ALL

MEMBER FORCE ENVELOPE

ALL UNITS ARE KNS METE

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
1	.00	MAX.	1.71	1	.00	1	.00	1	.00	1
		MIN.	1.71	1	.00	1	.00	1	.00	1
	.65	MAX.	.85	1	-.83	1	.00	1	.00	1
		MIN.	.85	1	-.83	1	.00	1	.00	1
	1.30	MAX.	-.02	1	-1.10	1	.00	1	.00	1
		MIN.	-.02	1	-1.10	1	.00	1	.00	1
	1.95	MAX.	-.88	1	-.81	1	.00	1	.00	1
		MIN.	-.88	1	-.81	1	.00	1	.00	1
	2.60	MAX.	-1.75	1	.04	1	.00	1	.00	1
		MIN.	-1.75	1	.04	1	.00	1	.00	1
	3.25	MAX.	-2.61	1	1.46	1	.00	1	.00	1
		MIN.	-2.61	1	1.46	1	.00	1	.00	1

MAX/MIN FORCES FOR MEMBER 1,AMONGST ALL SECT LOCATIONS

	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	1.71	.00	1	1.46	3.25	1			
	.00	.00	1	.00	.00	1	.86 C	.00	1
MIN.	-2.61	3.25	1	-1.10	1.30	1			
	.00	3.25	1	.00	3.25	1	.86 T	3.25	1

2	.00	MAX.	2.27	1	1.46	1	.00	1	.00	1
		MIN.	2.27	1	1.46	1	.00	1	.00	1
	.51	MAX.	1.59	1	.47	1	.00	1	.00	1
		MIN.	1.59	1	.47	1	.00	1	.00	1
	1.02	MAX.	.91	1	-.17	1	.00	1	.00	1
		MIN.	.91	1	-.17	1	.00	1	.00	1
	1.54	MAX.	.23	1	-.46	1	.00	1	.00	1
		MIN.	.23	1	-.46	1	.00	1	.00	1
	2.05	MAX.	-.45	1	-.40	1	.00	1	.00	1
		MIN.	-.45	1	-.40	1	.00	1	.00	1
	2.56	MAX.	-1.13	1	.00	1	.00	1	.00	1
		MIN.	-1.13	1	.00	1	.00	1	.00	1

MAX/MIN FORCES FOR MEMBER				2,AMONGST ALL SECT LOCATIONS					
	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	2.27	.00	1	1.46	.00	1			
	.00	.00	1	.00	.00	1	.67 C	.00	1
MIN.	-1.13	2.56	1	-.46	1.54	1			
	.00	2.56	1	.00	2.56	1	.67 T	2.56	1

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

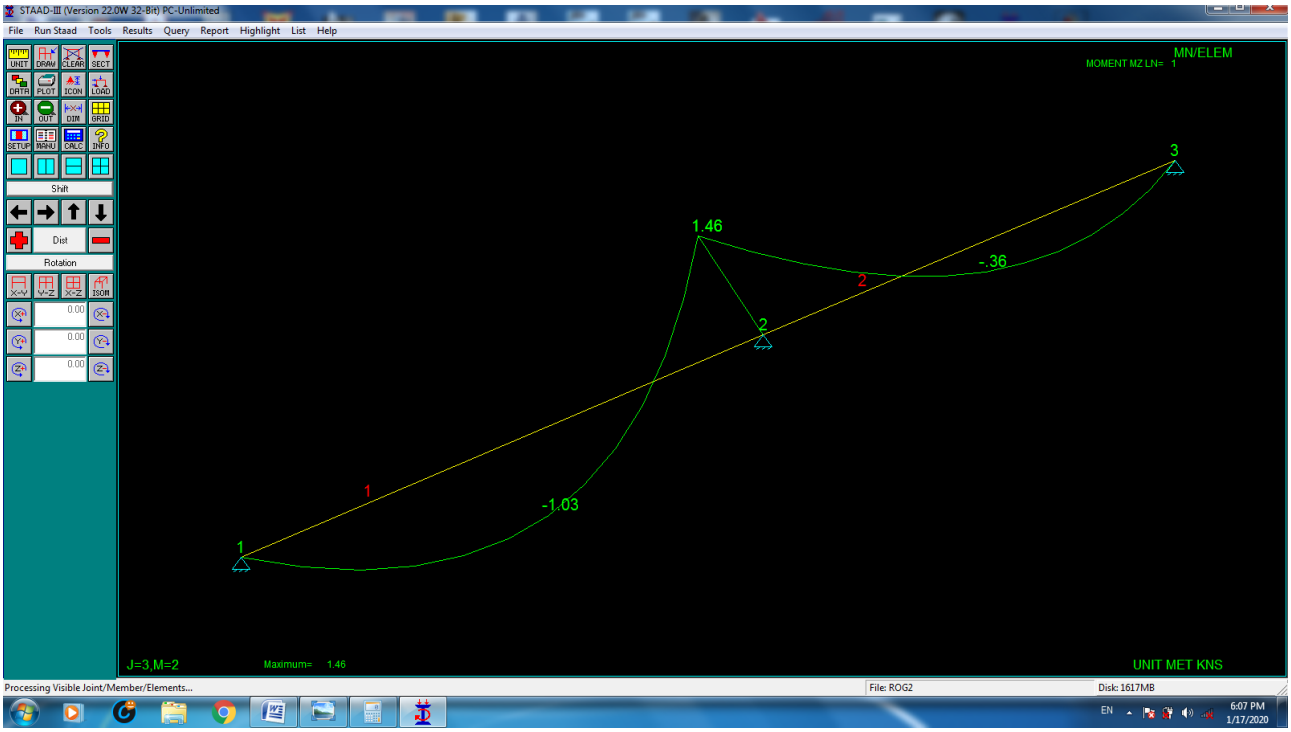
30. FINISH

********** END OF STAAD-III **********

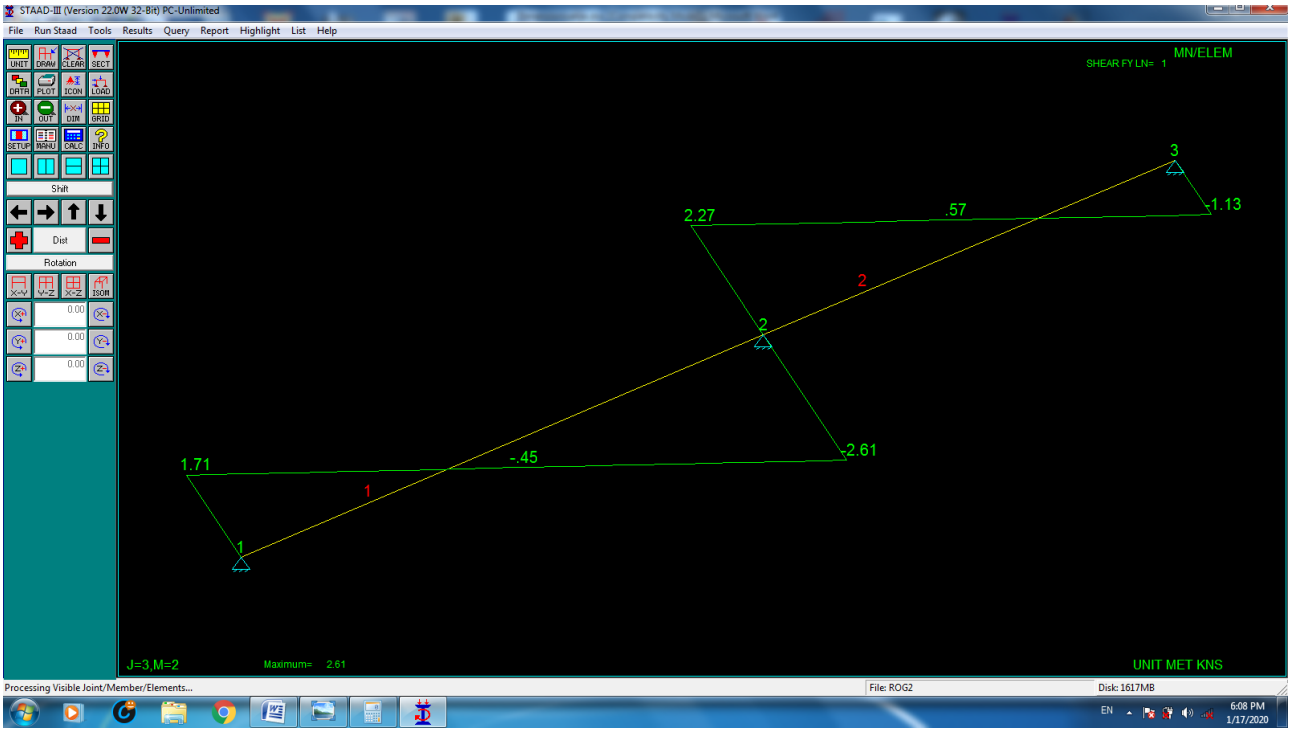
**** DATE= JAN 17,2020 TIME= 18: 7:30 ****

****

M - DIJAGRAM OD ZBIRNOG OPTEREĆENJA



T - DIJAGRAM OD ZBIRNOG OPTEREĆENJA



- **<u>Dimenzionisanje rogova</u>**

- <u>Polazne predpostavke</u>

  Za drvene krovne rogove b/h = 10/12 $\Rightarrow$ A=120 cm^2 , Wx=240 cm^3
  Za četinar II klase $\Rightarrow$ σ doz = 0,85 kN/cm^2

  $\lambda = \frac{287/0{,}883}{0{,}289\times 10} = 113{,}25 > 75 \Rightarrow \Omega = \lambda^2 / 3100 = 113{,}25^2/3100 =$ **4,14**

- <u>Kontrola napona u rogovima</u>

  $\sigma = \Omega \times \frac{N}{A} + \frac{M}{W} \leq \sigma$ doz

  $\sigma = 4{,}14 \times \frac{0{,}86}{120} + \frac{1{,}46\times 100}{240} \leq 0{,}85$ kN/cm^2

  $\sigma = 0{,}03 + 0{,}61 \leq 0{,}85$ kN/cm^2

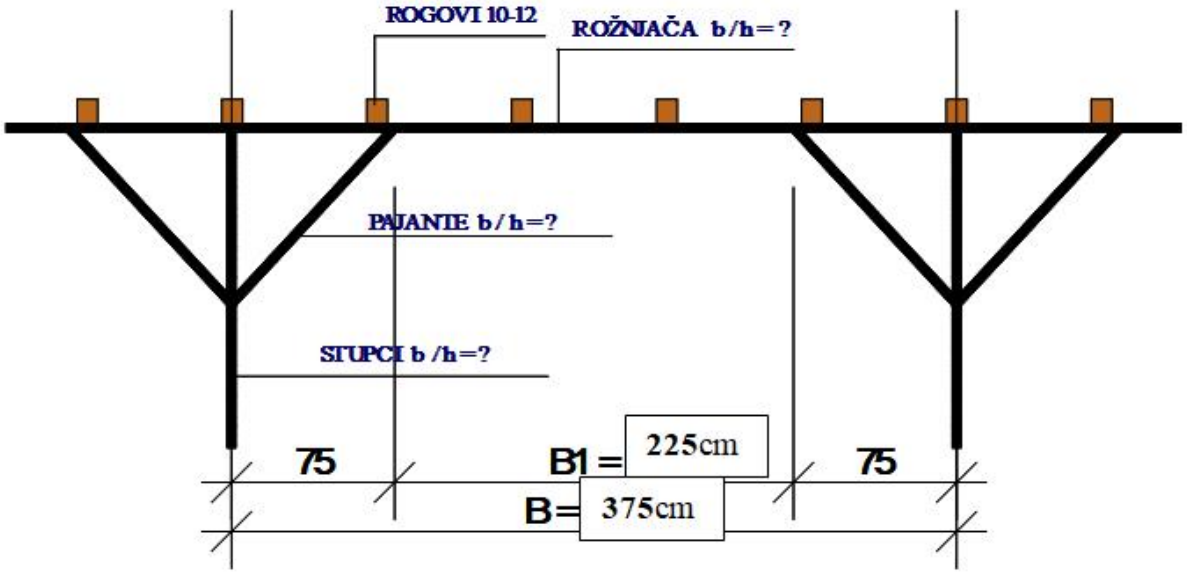
  σ= 0,64 kN/cm^2 $\leq$ 0,85 kN/cm^2

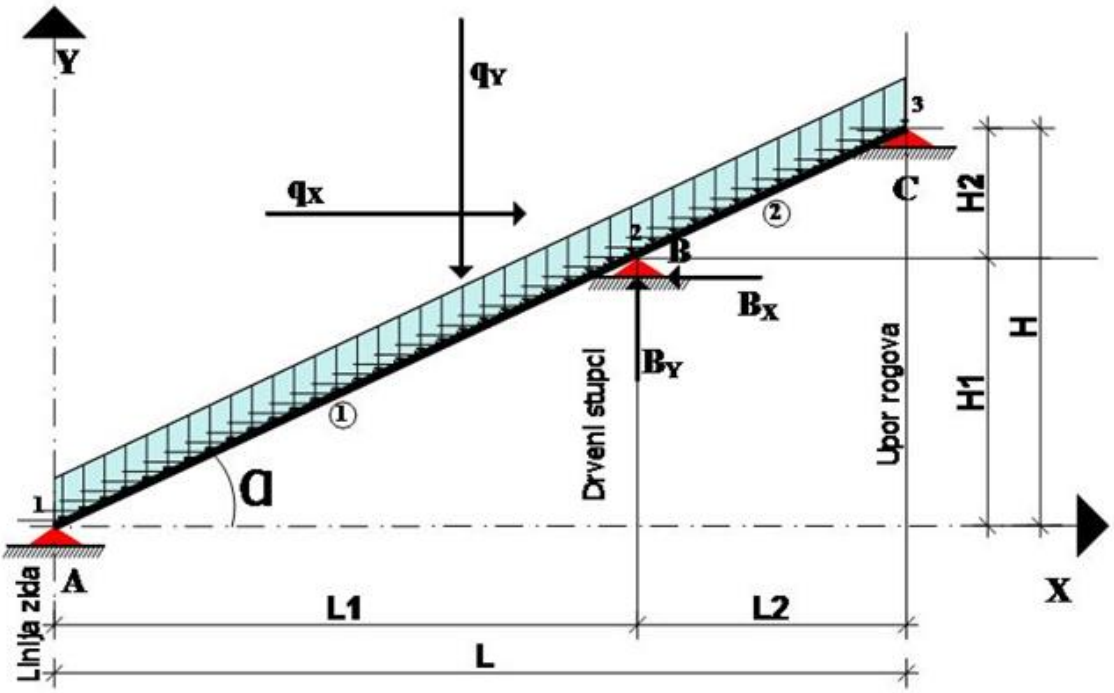
- **<u>Zaključak</u>**

Obzirom da su računski naponi blizu granice dozvoljenih za četinare II klase, zbog lošeg kvaliteta građe na tržištu, birati rogove bez čvorova i lijavosti $\Rightarrow$

<u>Usvajam drvene krovne rogove : b/h = 10/12 cm od četinara II klase.</u>

1.2. DRVENE KROVNE ROŽNJAČE





- **<u>Oterećenje vetrom</u>** **W_0 = 0,42 kN/m²**

  W_y = 0,30 kN/m²
  W_x = 0,16 kN/m²

  ► Statička analiza u programu STAAD III

STATIČKI UTICAJI ZA DRVENE KROVNE ROŽNJAČE OD UTICAJA VETRA

```
            ************************************************
            *                                              *
            *           S T A A D - III                    *
            *           Revision 22.0W                     *
            *           Proprietary Program of             *
            *           Research Engineers, Inc.           *
            *           Date=    JAN 17, 2020              *
            *           Time=    18:30: 36                 *
            *                                              *
            *      USER ID: tHeRaiN/UCF2000                *
            ************************************************


  ********************************************************
  *                                                      *
  * NATURAL FREQUENCY FOR LOADING    1 = 122.07360 CPS   *
  * MAX DEFLECTION =   .0010 CM    GLO Z, AT JOINT    3  *
  *                                                      *
  ********************************************************


   27. PRINT MEMBER FORCES ALL


  MEMBER END FORCES    STRUCTURE TYPE = PLANE
  -----------------
  ALL UNITS ARE -- KNS  METE

 MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z


     1    1     1       .00       .44      .00       .00       .00        .00
                2       .00       .67      .00       .00       .00       -.37

     2    1     2       .00       .58      .00       .00       .00        .37
                3       .00       .29      .00       .00       .00        .00


  ************** END OF LATEST ANALYSIS RESULT **************


   28. PRINT SUPPORT REACTIONS


  SUPPORT REACTIONS -UNIT KNS  METE    STRUCTURE TYPE = PLANE
  -----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z

    1     1       -.21       .39       .00       .00       .00       .00
    2     1      -.59      1.10       .00       .00       .00       .00
    3     1       -.14       .25       .00       .00       .00       .00


  ************** END OF LATEST ANALYSIS RESULT **************

   29. PRINT FORCE ENVELOPE NSECTION 5 ALL
```

" CENTRALNE DRVENE KROVNE ROZNJACE "

MEMBER FORCE ENVELOPE

ALL UNITS ARE KNS METE

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
1	.00	MAX.	.44	1	.00	1	.00	1	.00	1
		MIN.	.44	1	.00	1	.00	1	.00	1
	.65	MAX.	.22	1	-.21	1	.00	1	.00	1
		MIN.	.22	1	-.21	1	.00	1	.00	1
	1.30	MAX.	.00	1	-.28	1	.00	1	.00	1
		MIN.	.00	1	-.28	1	.00	1	.00	1
	1.95	MAX.	-.23	1	-.21	1	.00	1	.00	1
		MIN.	-.23	1	-.21	1	.00	1	.00	1
	2.60	MAX.	-.45	1	.01	1	.00	1	.00	1
		MIN.	-.45	1	.01	1	.00	1	.00	1
	3.25	MAX.	-.67	1	.37	1	.00	1	.00	1
		MIN.	-.67	1	.37	1	.00	1	.00	1

MAX/MIN FORCES FOR MEMBER 1,AMONGST ALL SECT LOCATIONS									
	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	.44	.00	1	.37	3.25	1			
	.00	.00	1	.00	.00	1	.00 C	3.25	1
MIN.	-.67	3.25	1	-.28	1.30	1			
	.00	3.25	1	.00	3.25	1	.00 T	2.60	1

2	.00	MAX.	.58	1	.37	1	.00	1	.00	1
		MIN.	.58	1	.37	1	.00	1	.00	1
	.51	MAX.	.41	1	.12	1	.00	1	.00	1
		MIN.	.41	1	.12	1	.00	1	.00	1
	1.02	MAX.	.23	1	-.04	1	.00	1	.00	1
		MIN.	.23	1	-.04	1	.00	1	.00	1
	1.54	MAX.	.06	1	-.12	1	.00	1	.00	1
		MIN.	.06	1	-.12	1	.00	1	.00	1
	2.05	MAX.	-.11	1	-.10	1	.00	1	.00	1
		MIN.	-.11	1	-.10	1	.00	1	.00	1
	2.56	MAX.	-.29	1	.00	1	.00	1	.00	1
		MIN.	-.29	1	.00	1	.00	1	.00	1

MAX/MIN FORCES FOR MEMBER 2,AMONGST ALL SECT LOCATIONS									
	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	.58	.00	1	.37	.00	1			
	.00	.00	1	.00	.00	1	.00 C	2.56	1
MIN.	-.29	2.56	1	-.12	1.54	1			
	.00	2.56	1	.00	2.56	1	.00 T	2.05	1

********** END OF FORCE ENVELOPE FROM INTERNAL STORAGE **********

30. FINISH

********** END OF STAAD-III **********

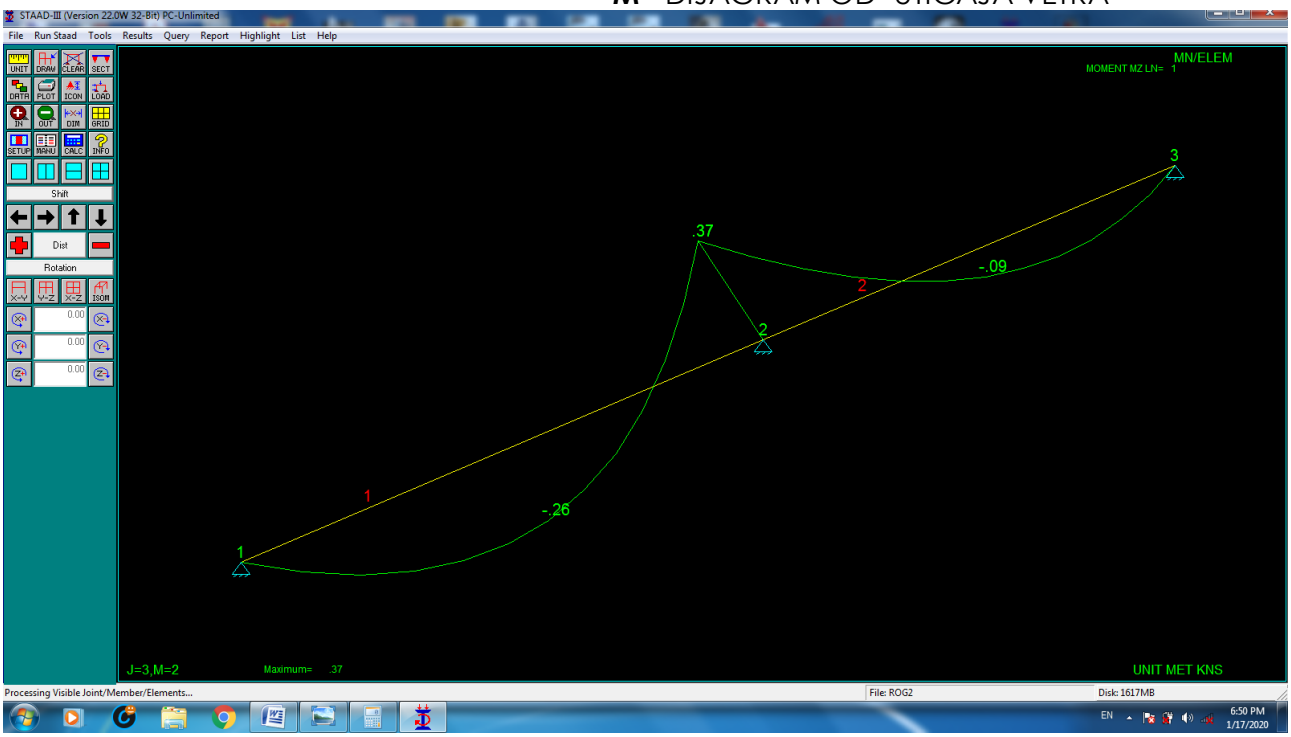
**** DATE= JAN 17,2020 TIME= 18:30:36 ****

****

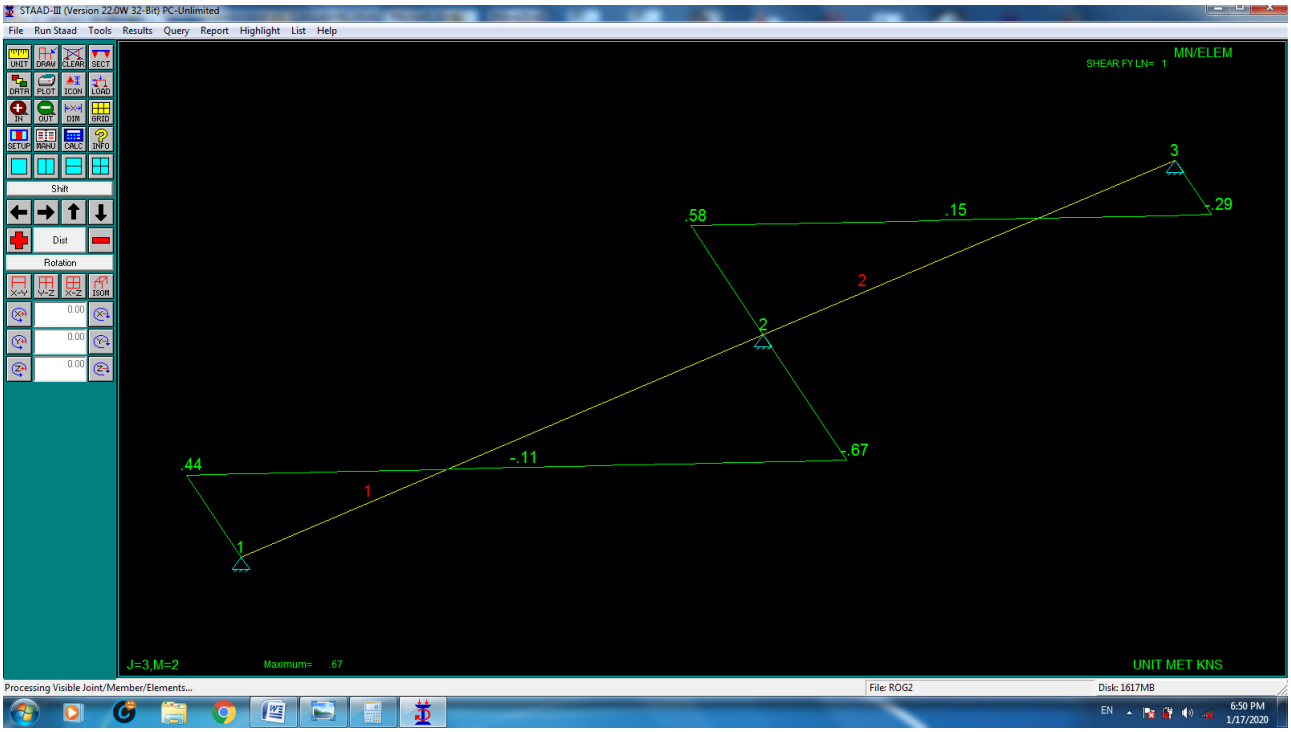
Iz statičke analize ⇒

B_y^w = 1,10 kN/m¹
B_x^w = 0,59 kN/m¹

M - DIJAGRAM OD UTICAJA VETRA



T - DIJAGRAM OD UTICAJA VETRA



STATIČKI UTICAJI ZA DRVENE KROVNE ROŽNJAČE OD SOPSTVENE TEŽINE KROVA

- **<u>Oterećenje od sopstvene težine krovne konstrukcije</u>** **G = 0,65 kN/m²**

G_y = 0,65 kN/m²
G_x = 0. kN/m²

STATIČKI UTICAJI ZA DRVENE KROVNE ROŽNJAČE OD UTICAJA SOPSTVENE TEŽINE KROVNE KONSTRUKCIJE

```
            ************************************************
            *                                              *
            *           S T A A D - III                    *
            *           Revision 22.0W                     *
            *           Proprietary Program of             *
            *           Research Engineers, Inc.           *
            *           Date=    JAN 17, 2020              *
            *           Time=    18:43:  6                 *
            *                                              *
            *      USER ID: tHeRaiN/UCF2000                *
            ************************************************


  26. PRINT MEMBER FORCES ALL


 MEMBER END FORCES    STRUCTURE TYPE = PLANE
 -----------------
 ALL UNITS ARE -- KNS  METE

MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

    1    1     1       .50       .74      .00       .00       .00        .00
               2       .50      1.13      .00       .00       .00       -.63

    2    1     2       .39       .98      .00       .00       .00        .63
               3       .39       .49      .00       .00       .00        .00


 ************** END OF LATEST ANALYSIS RESULT **************


  27. PRINT SUPPORT REACTIONS

 SUPPORT REACTIONS -UNIT KNS  METE    STRUCTURE TYPE = PLANE
 -----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z

    1     1        .09       .89       .00       .00       .00        .00
    2     1       -.21      2.28       .00       .00       .00        .00
    3     1        .12       .61       .00       .00       .00        .00


 ************** END OF LATEST ANALYSIS RESULT **************


  28. PRINT FORCE ENVELOPE NSECTION 5 ALL
```

" CENTRALNE DRVENE KROVNE ROZNJACE "

MEMBER FORCE ENVELOPE

ALL UNITS ARE KNS METE

MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
1	.00	MAX.	.74	1	.00	1	.00	1	.00	1
		MIN.	.74	1	.00	1	.00	1	.00	1
	.65	MAX.	.37	1	-.36	1	.00	1	.00	1
		MIN.	.37	1	-.36	1	.00	1	.00	1
	1.30	MAX.	-.01	1	-.48	1	.00	1	.00	1
		MIN.	-.01	1	-.48	1	.00	1	.00	1
	1.95	MAX.	-.38	1	-.35	1	.00	1	.00	1
		MIN.	-.38	1	-.35	1	.00	1	.00	1
	2.60	MAX.	-.75	1	.02	1	.00	1	.00	1
		MIN.	-.75	1	.02	1	.00	1	.00	1
	3.25	MAX.	-1.13	1	.63	1	.00	1	.00	1
		MIN.	-1.13	1	.63	1	.00	1	.00	1

MAX/MIN FORCES FOR MEMBER 1,AMONGST ALL SECT LOCATIONS									
	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	.74	.00	1	.63	3.25	1			
	.00	.00	1	.00	.00	1	.50 C	.00	1
MIN.	-1.13	3.25	1	-.48	1.30	1			
	.00	3.25	1	.00	3.25	1	.50 T	3.25	1

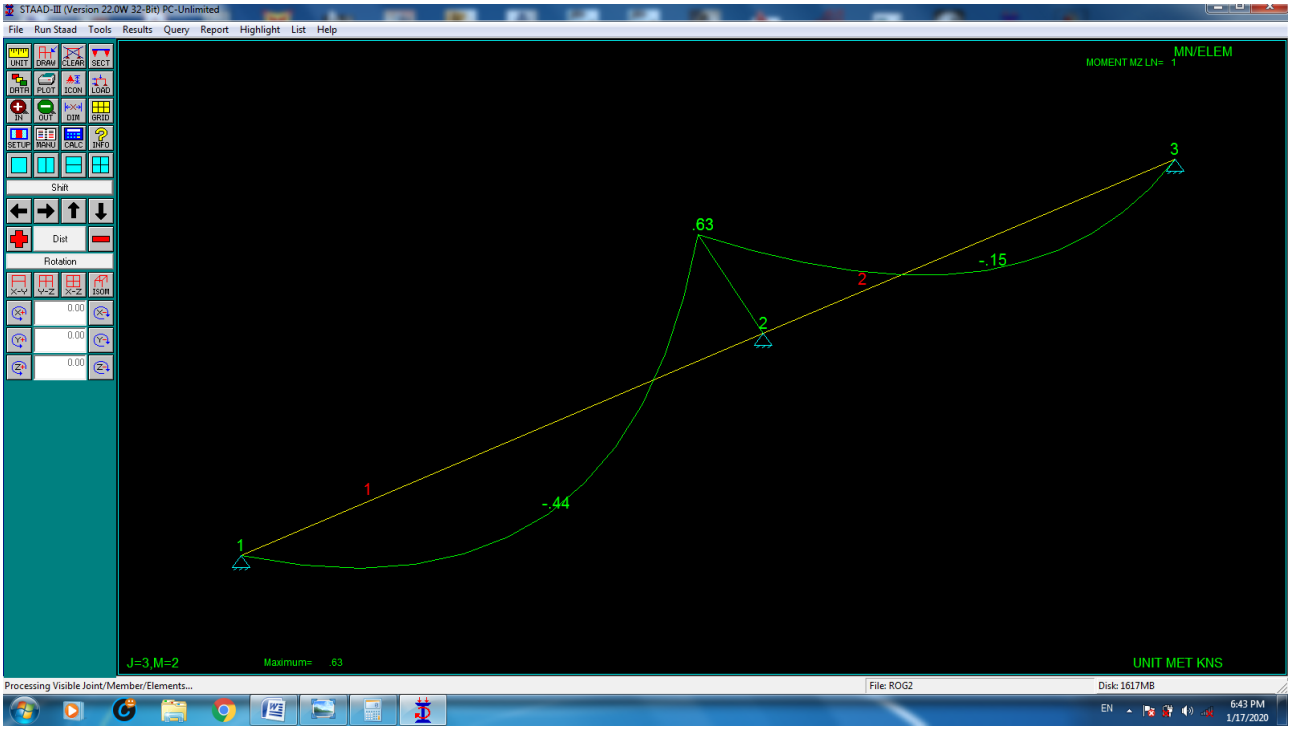
MEMB	DISTANCE		FY	LD	MZ	LD	FZ	LD	MY	LD
2	.00	MAX.	.98	1	.63	1	.00	1	.00	1
		MIN.	.98	1	.63	1	.00	1	.00	1
	.51	MAX.	.69	1	.20	1	.00	1	.00	1
		MIN.	.69	1	.20	1	.00	1	.00	1
	1.02	MAX.	.39	1	-.07	1	.00	1	.00	1
		MIN.	.39	1	-.07	1	.00	1	.00	1
	1.54	MAX.	.10	1	-.20	1	.00	1	.00	1
		MIN.	.10	1	-.20	1	.00	1	.00	1
	2.05	MAX.	-.19	1	-.17	1	.00	1	.00	1
		MIN.	-.19	1	-.17	1	.00	1	.00	1
	2.56	MAX.	-.49	1	.00	1	.00	1	.00	1
		MIN.	-.49	1	.00	1	.00	1	.00	1

MAX/MIN FORCES FOR MEMBER 2,AMONGST ALL SECT LOCATIONS									
	FY/ FZ	DIST	LD	MZ/ MY	DIST	LD	FX	DIST	LD
MAX.	.98	.00	1	.63	.00	1			
	.00	.00	1	.00	.00	1	.39 C	.00	1
MIN.	-.49	2.56	1						

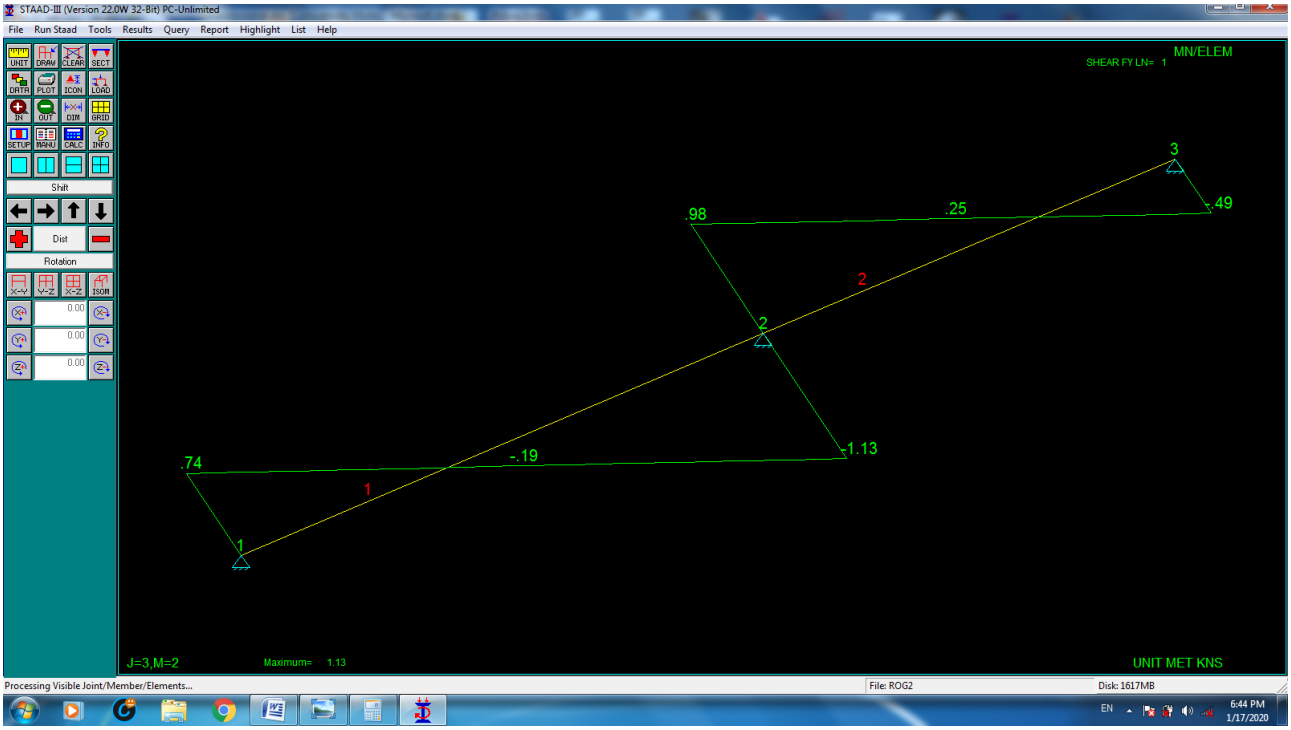
Iz statičke analize ⇒

B_y^g = 2,28kN/m¹
B_x^g = 0,21 kN/m¹

M - DIJAGRAM OD SOPSTVENE TEŽINE KROVA



T - DIJAGRAM OD SOPSTVENE TEŽINE KROVA



STATIČKI UTICAJI ZA DRVENE KROVNE ROŽNJAČE OD TEŽINE SNEGA

- **<u>Opterećenje od snega na krovnoj konstrukciji</u>** **S = 0,75 kN/m²**

$$B_y^s = \psi \times B_y^g = \frac{0,75}{0,65}\ 0,883 \times 2,28\ kN/m^1 = \underline{\mathbf{2,32\ kN/m^1}}$$

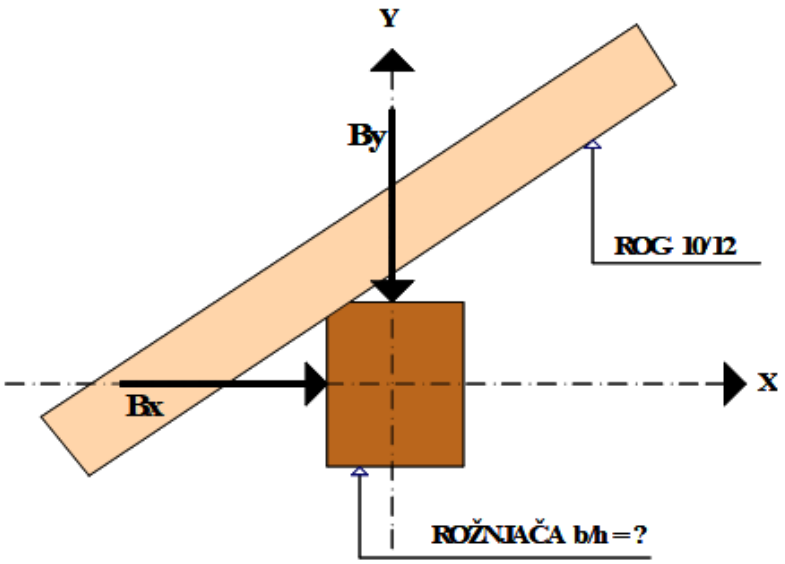
- **<u>I slučaj opterećenja</u>**

$B_y = B_y^g + B_y^s = 2,28 + 2,32 = 4,60\ kN/m^1$

- **<u>II slučaj opterećenja</u>**

$B_y = B_y^g + B_y^s + B_y^w = 2,28 + 2,32 + 1,10 = 5,60\ kN/m^1$
$B_x = B_x^g + B_x^w = 0,21 + 0,59 = 0,80$ kN/m^1

Usvajam za merodavni, II slučaj opterećenja za oslonac B ⇒



Lx = 1/2 (B+B_1) = ½ (3,75+2,25) = 3,00 m
Ly ≈ 3,00 m

$M_X = B_Y \times L_X^2 / 8 = 5,60 \times 3,00^2/8 =$ 6,30 kNm/m¹
$M_Y = B_X \times L_Y^2 / 8 = 0,80 \times 3,00^2/8 =$ 0,90 kNm/m¹

$R_Y = B_Y \times L_X / 2 = 5,60 \times 3,00 /2 =$ 8,40 kN
$R_x = B_x \times L_y / 2 = 0,80 \times 3,00 /2 =$ 1,20 kN

- **<u>Dimenzionisanje rožnjača</u>**

Za četinar II klase $\Rightarrow$ σ_m doz = 1,00 kN/cm^2 ,

Za usvojeno C = $\frac{Wx}{Wy} = \frac{h}{b}$ = 1,40 $\Rightarrow$

potr W_x = 100 × (6,30 + 1,4 × 0,90) / 1,00 = 756 cm^3 $\Rightarrow$

potr h = $\sqrt[3]{756 \times 1{,}4 \times 6}$ = 14,4cm $\Rightarrow$ potr b = 18,52/1,4=13,22cm

Za rožnjače b/h= 14/18cm $\Rightarrow$ A=252cm^2 ; W_x = 756 cm; I_x= 6804cm^3
W_y = 588 cm; I_y= 4116cm^3

- **<u>Kontrola napona</u>**

$$\sigma = \frac{Mx}{Wx} + \frac{My}{Wy} \leq \sigma_m \text{ doz}$$

$$\sigma = \frac{6{,}30 \times 100}{756} + \frac{0{,}9 \times 100}{588} \leq 1{,}00 \text{ kN/cm}^2$$

$$\sigma = 0{,}83 + 0{,}15 \leq 1{,}00 \text{ kN/cm}^2$$

$$\sigma = 0{,}98 \text{ kN/cm}^2 \leq 1{,}00 \text{ kN/cm}^2$$

- **<u>Kontrola ugiba rožnjača</u>**

$$f_x = \frac{5}{48} \times \frac{100 \times 6{,}30 \times 300^2}{1000 \times 6804} = 0{,}87\text{cm}$$

$$f_y = \frac{5}{48} \times \frac{100 \times 0{,}90 \times 300^2}{1000 \times 4116} = 0{,}21\text{cm}$$

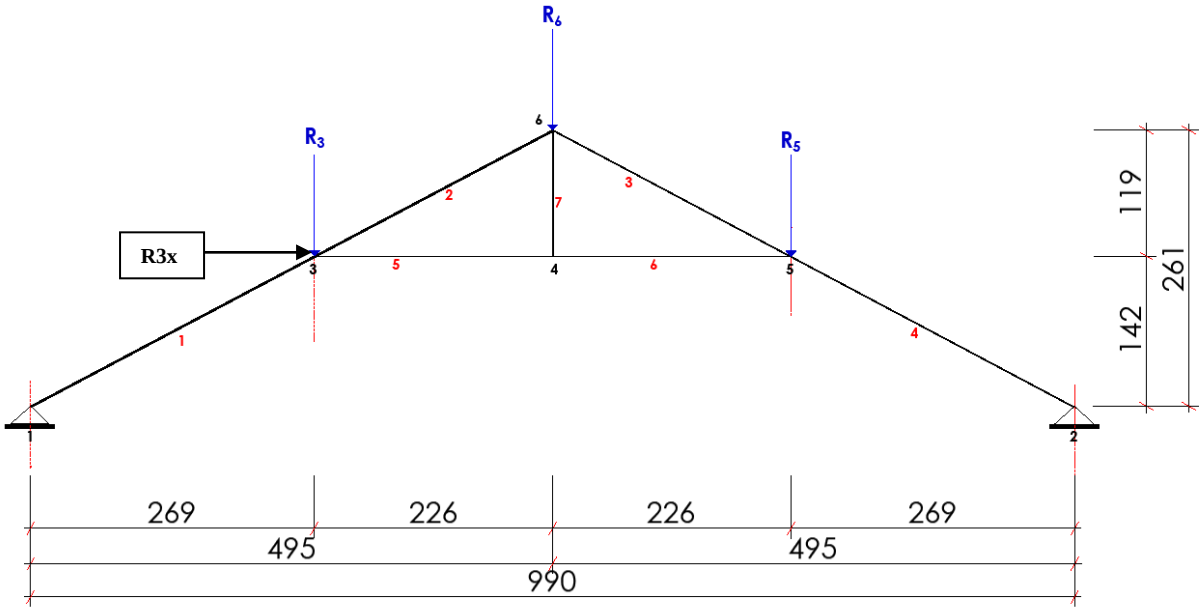
$$f = \sqrt{fx^2 + fy^2} = 0{,}89\text{cm} < f_{dozv} = L/200 = 300/200 = 1{,}50\text{cm}$$

- <u>Zaključak</u>

<u>Usvajam drvene krovne rožnjače : b/h = 14/18 cm od četinara II klase.</u>

1.3. DRVENI NOSEĆI ELEMENTI KROVNIH VEZAČA

STATIČKA DISPOZICIJA:

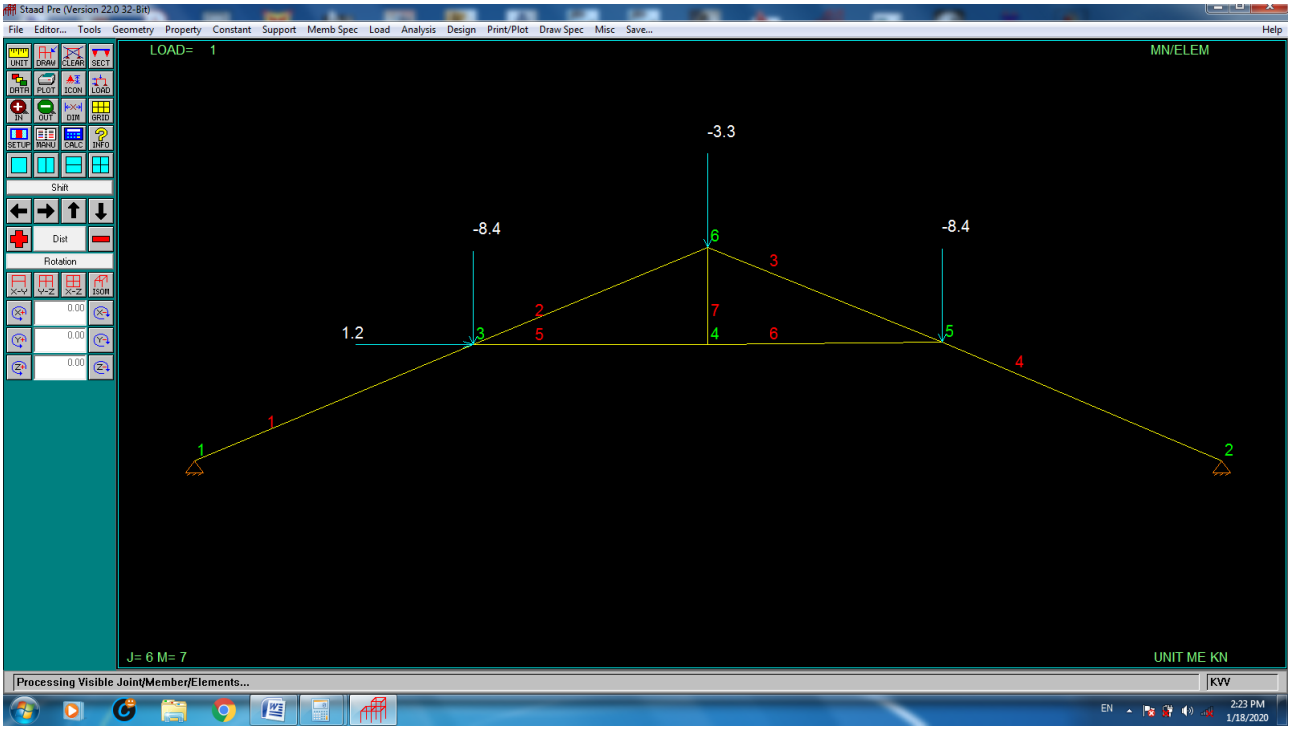



```
MEMBER RELEASE
    20. 4 END MZ
    21. 5 END MZ
    22. CONSTANT
```

- **Analiza opterećenja za krovni vezač**

- Od reakcije oslonaca centralnih rožnjača .... **R_{3y}= R_{5y}=8,40kN**
  R_{3x}= 1,20kN

- Od reakcije oslonaca slemene rožnjače .... **R_{4y} =2×1,65=3,30 kN**



► Statička analiza u programu STAAD III

```
" KROVNI DRVENI VEZACI "

            **************************************************
            *                                                *
            *           S T A A D - III                      *
            *           Revision 22.0W                       *
            *           Proprietary Program of               *
            *           Research Engineers, Inc.             *
            *           Date=    JAN 18, 2020                *
            *           Time=    14:32: 42                   *
            *                                                *
            *      USER ID: tHeRaiN/UCF2000                  *
            **************************************************


  ********************************************************
  *                                                      *
  * NATURAL FREQUENCY FOR LOADING     1 =    8.99542 CPS   *
  * MAX DEFLECTION =    .18468 CM    GLO Y, AT JOINT    3  *
  *                                                      *
  ********************************************************
```

" KROVNI DRVENI VEZACI "

40. PRINT MEMBER FORCES ALL

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KNS METE

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	20.64	.27	.00	.00	.00	.00
		3	-20.64	-.27	.00	.00	.00	.83
2	1	3	3.99	-.14	.00	.00	.00	-.37
		6	-3.99	.14	.00	.00	.00	.00
3	1	6	4.09	-.11	.00	.00	.00	.00
		5	-4.09	.11	.00	.00	.00	-.27
4	1	5	21.86	.17	.00	.00	.00	.53
		2	-21.86	-.17	.00	.00	.00	.00
5	1	3	15.73	-.25	.00	.00	.00	-.46
		4	-15.73	.25	.00	.00	.00	-.11
6	1	4	15.73	-.07	.00	.00	.00	.11
		5	-15.73	.07	.00	.00	.00	-.26
7	1	4	-.39	.00	.00	.00	.00	.00
		6	.39	.00	.00	.00	.00	.00

********** END OF LATEST ANALYSIS RESULT **********

41. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT KNS METE STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	18.13	9.88	.00	.00	.00	.00
2	1	-19.33	10.22	.00	.00	.00	.00

********** END OF LATEST ANALYSIS RESULT **********

42. PRINT JOINT DISPLACEMENTS ALL

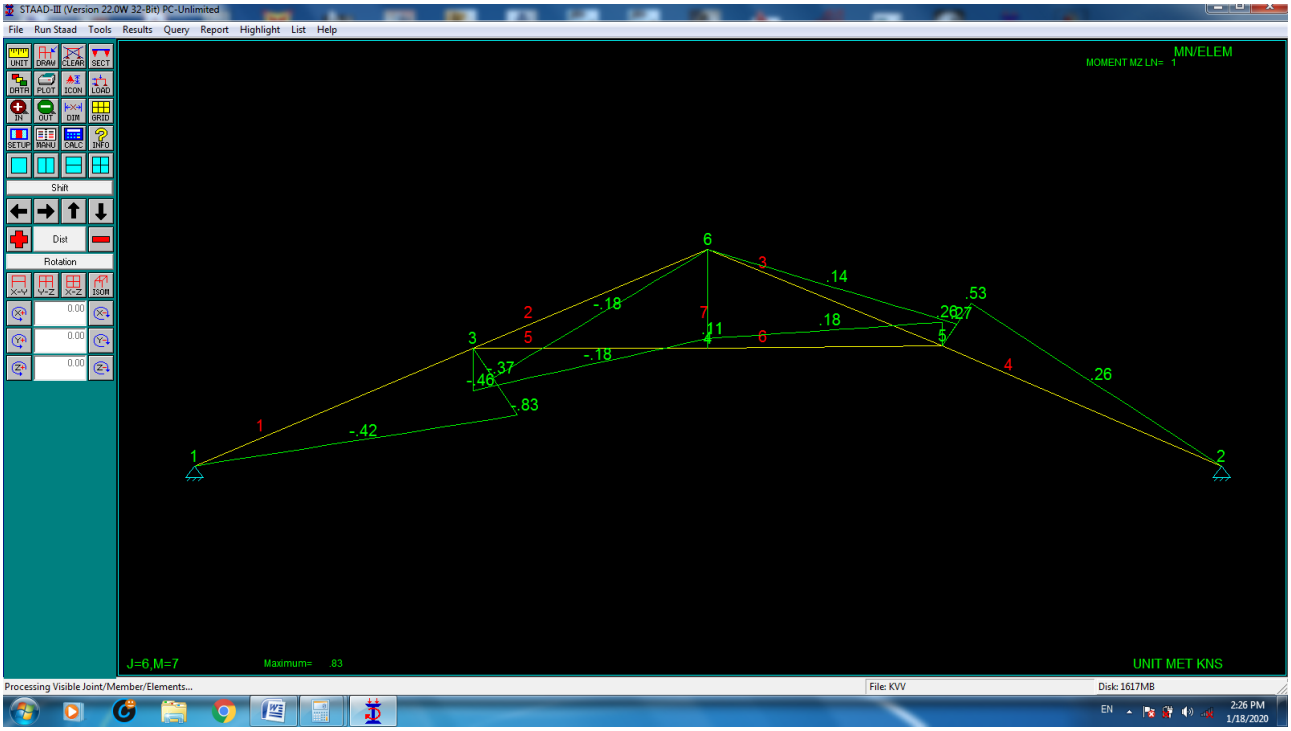
JOINT DISPLACEMENT (CM RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	.0000	.0000	.0000	.0000	.0000	-.0011
2	1	.0000	.0000	.0000	.0000	.0000	-.0006
3	1	.0805	-.1847	.0000	.0000	.0000	.0003
4	1	.0719	-.0411	.0000	.0000	.0000	.0007
5	1	.0618	.0809	.0000	.0000	.0000	.0003
6	1	.0020	-.0410	.0000	.0000	.0000	.0006

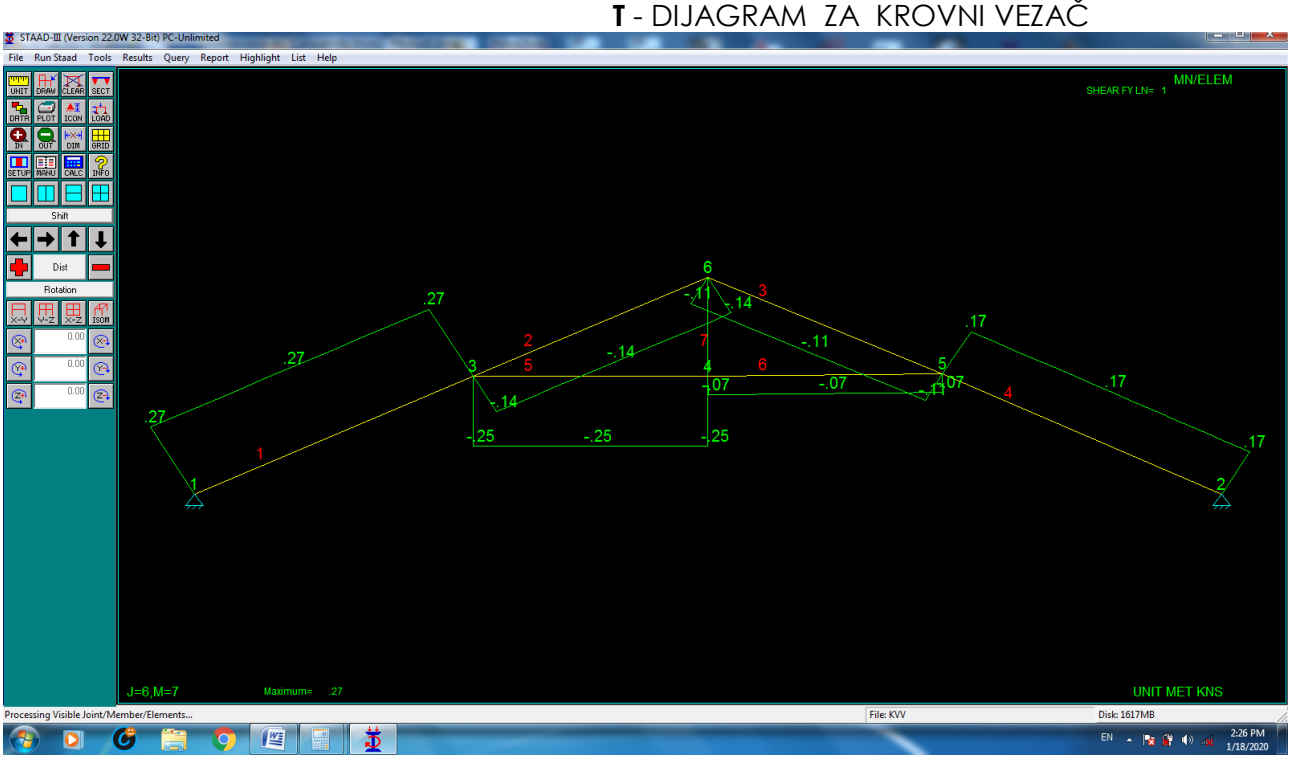
********** END OF LATEST ANALYSIS RESULT **********

```
43. FINISH
```

M - DIJAGRAM ZA KROVNI VEZAČ



T - DIJAGRAM ZA KROVNI VEZAČ



- **Slemeni stubac i slemena rožnjača**

Usvajam drvene krovne rožnjače u slemenu : b/h = 12/12 cm od četinara II klase.
Usvajam drvene krovne stupce u slemenu : b/h = 12/12 cm od četinara II klase.
Usvajam pajante rožnjače u slemenu : b/h = 10/12 cm od četinara II klase.

- **Klešta krovnih vezača**

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
5	1	3	15.73	-.25	.00	.00	.00	-.46
		4	-15.73	.25	.00	.00	.00	-.11
6	1	4	15.73	-.07	.00	.00	.00	.11
		5	-15.73	.07	.00	.00	.00	-.26

Dimenzionisanje

Za klešta b/h= 2×5/20cm $\Rightarrow$ A=200 cm^2 ; W_x = 660 cm^3
Za četinar II klase $\Rightarrow$ σ_m doz = 1,00 kN/cm^2 ,

- **Kontrola napona**

$$\sigma = \frac{N}{A} + \frac{M}{W} \leq \sigma_m \text{ doz}$$

$$\sigma = \frac{15,73}{200} + \frac{0,46 \times 100}{660} \leq 1,00 \text{ kN/cm}^2$$

$$\sigma = 0,08 + 0,09 \leq 0,17 \text{kN/cm}^2$$

$$\sigma = 0,17 \text{ kN/cm}^2 \leq 1,00 \text{ kN/cm}^2$$

Usvajam drvena krovna klešta kod krovnih vezača : b/h = 2× 5/20 cm od četinara II klase.

- **Kosi drveni nosači krovnih vezača**

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	20.64	.27	.00	.00	.00	.00
		3	**-20.64**	-.27	.00	.00	.00	**.83**
2	1	3	3.99	-.14	.00	.00	.00	-.37
		6	-3.99	.14	.00	.00	.00	.00
3	1	6	4.09	-.11	.00	.00	.00	.00
		5	-4.09	.11	.00	.00	.00	-.27
4	1	5	**21.86**	.17	.00	.00	.00	.53
		2	-21.86	-.17	.00	.00	.00	.00

Dimenzionisanje

Za nosač b/h= 12/16 cm $\Rightarrow$ A=192 cm^2 ; W_x = 512 cm^3
Za četinar II klase $\Rightarrow$ σ_m doz = 0,80 kN/cm^2 ,

- **Kontrola napona**

$$\sigma = \frac{N}{A} + \frac{M}{W} \leq \sigma_m \text{ doz}$$

$$\sigma = \frac{21{,}86}{192} + \frac{0{,}83 \times 100}{512} \leq 1{,}00 \text{ kN/cm}^2$$

$$\sigma = 0{,}11 + 0{,}16 \leq 0{,}27 \text{kN/cm}^2$$

$$\sigma = 0{,}27 \text{ kN/cm}^2 \leq 0{,}80 \text{ kN/cm}^2$$

Za četinar II klase $\Rightarrow$ σ_{II} doz = 0,85 kN/cm^2 ,
$\sigma \perp$ doz = 0,20 kN/cm^2 ,

Za drvene krovne rožnjače b/h = 12/16 $\Rightarrow$ A=252 cm^2

$$\lambda = \frac{H}{0{,}289 \times b} = \frac{261}{0{,}289 \times 14} = 64{,}50 < 75 \Rightarrow \Omega_1 = 1{,}35$$

- **Kontrola napona pritiska**

$\sigma_{II} = \Omega \times$ P / A = 1,35 $\times$21,86/252= 0,11 kN/cm^2 < σ_{II} doz = 0,85 kN/cm^2
$\sigma \perp$ = P /0,5$\times$A = 21,86/0,5$\times$252 = 0,17 kN/cm^2 < $\sigma \perp$ doz = 0,20 kN/cm^2

Usvajam drvene krovne nosače krovnih vezača : b/h = 12/16 cm od četinara II klase.

- **Napomene**

Jednovodni deo krovne konstrukcije ostaje onako kako je dato rešenjem u preseku C-C tehničke dokumenracije

Izvođač radova neće rušiti delove arm.betonske kaplame već će na jednovodnom delu krova produžetak postojeće kaplame ostvariti drvenom krovnom konstrukcijom kao na crtežu presek C-C a razliku u visini će anulirati stirodurom, mrežicom i lepkom.

Na ostalom delu dvovodne krovne konstrukcije nastavak postojećih a.b.kaplama se vrši kroz izradu mansardnog dela krovne konstrukcije gde takođe razliku u visini anulirati stirodurom, mrežicom i lepkom.

Dvovodni deo krovne konstrukcije predlažem da projektant uradi u skladu sa ovim ili vrlo sličnim rešenjem a u zavisnosti od zahtevanog gabarita tavanskog dela koji se može iskoristiti u nekoj kasnijoj fazi.

Stim u vezi potrebno je sagledati sledeće sugestije:

1. Visina krovnih nadzidaka je u direktnoj funkciji slobodnog gabarita tavanskog prostora i ona ne bi trebala preći visinu od 1,60m zajedno sa završnim serklažem na nadzidku
2. Prilikom izrade krovne dvovodne konstrukcije strogo voditi računa da se predvidi obavezna izrada a.b.stubova u okviru nadzidka i to tamo gde su predviđene pozicije krovnih vezača,
3. Pokušati svesti osovinski raster krovnih vezača a time i stubova nadzidaka na maksimalni razmak od 3,50m
4. Dati tačnu specifikaciju potrebne količine drvene krovne građe, letava, daske, folije i eventualne termoizolacije,
5. Vezu starog i novog betona (postojeći serklaž i novi stubovi nadzidaka) ostvariti ankerisanjem čeličnih ankera u šire bišene rupe sa obaveznom upotrebom SIKA anker fiksa, pri čemu voditi računa da se sa unutrašnje tavanske strane u stubovima nadzidka predvide profili 4R14 a na spoljnoj strani 2R14 sa uz. Ø8/15,
6. Krovne vezače centrirati osno na rasteru osa ab stubova nadzidaka
7. Razmisliti i olakšati Izvođaču ugradnju krovnih prozora koji neće imati dimenzije 120/120 već ići na prozore koji se mogu ugraditi unutar rogova, stim da druga dimenzija bude veća ili da ukupan broj tih manjih prozora bude veći, kako bi se dobilo isto osvetljenje prostora.

Statički proračun i dimenzionisanje

O V E R A V A

_____

ALEKSANDAR ILIĆ, dipl.građ.inž.