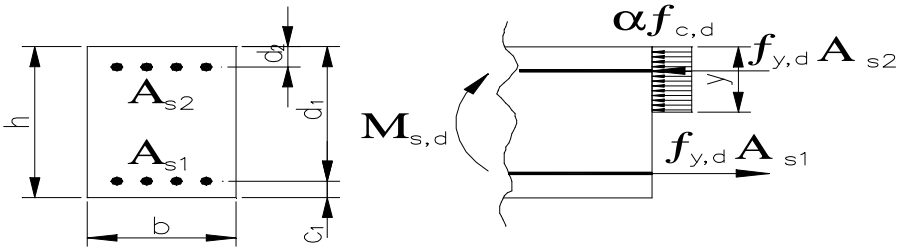


*Tõmbe- ja survearmatuuri dimensioneerimine paindel **

Lõige 1-1

*ristkülikuline ristlõige

Algandmed:

Ristlõige

b=	1000	*mm*
h=	500	*mm*
d_1=	444	*mm*
d_2=	56	*mm*

Armatuur

Terase klass A(B) 500

f_{yk}=	500	*MPa*
f_{yd}=	435	*MPa*
f_{ycd}=	400	*MPa*
μ_c=	0,372	
ω_c=	0,495	

Betoon

Klass C 30/37

f_{ck}=	30	*MPa*
f_{cd}=	20	*MPa*

Jõud

M_{Sd}= 46,50 *kNm*

Tulemused:

μ=	0,014
ω=	0,014

Vajalik armatuuri pindala

A_{s2}=	0	mm^2
A_{s1}=	243	mm^2

Valik

A_{s1}	5	Ø 8	A_s=	251	mm²	Samm	200mm
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s1}=**	**251**	**mm²**		
A_{s2}	0	Ø 12	A_s=	0	mm²		
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s2}=**	**0**	**mm²**		

Kontroll:

ω=	0,014	
μ=	0,014	
M_{Rd}=	**48,13**	***kNm*** **104%**

$$f_{cd} = \frac{f_{ck}}{\gamma_c}$$

$$f_{yd} = \frac{f_{yk}}{\gamma_{yc}}$$

$$f_{ycd} = f_{yd}$$

$$f_{ycd} \le 400MPa$$

$$\mu = \frac{M_{sd}}{\alpha f_{cd} b d_1^2}$$

$$\omega = 1 - \sqrt{1 - 2\mu}$$

$$\mu \le \mu_c \Rightarrow$$

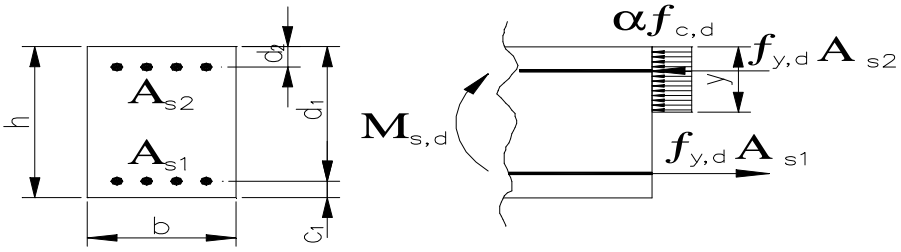
$$A_{s2} = 0$$

$$A_{s1} = \frac{\omega \alpha f_{cd} b d_1}{f_{yd}}$$

$$\mu > \mu_c \Rightarrow$$

$$A_{s2} = \frac{M_{sd} - \mu_c \alpha f_{cd} b d_1^2}{f_{ycd}(d_1 - d_2)}$$

$$A_{s1} = \frac{\omega_c \alpha f_{cd} b d_1}{f_{yd}} + \frac{f_{ycd}}{f_{yd}} A_{s2}$$



*Tõmbe- ja survearmatuuri dimensioneerimine paindel **

Lõige 2-2

*ristkülikuline ristlõige

Algandmed:

Ristlõige

b=	1000	*mm*
h=	500	*mm*
d_1=	444	*mm*
d_2=	56	*mm*

Armatuur

Terase klass A(B) 500

f_{yk}=	500	*MPa*
f_{yd}=	435	*MPa*
f_{ycd}=	400	*MPa*
μ_c=	0,372	
ω_c=	0,495	

Betoon

Klass C 30/37

f_{ck}=	30	*MPa*
f_{cd}=	20	*MPa*

Jõud

M_{Sd}= 71,19 *kNm*

Tulemused:

μ=	0,021
ω=	0,021

Vajalik armatuuri pindala

A_{s2}=	0	mm^2
A_{s1}=	373	mm^2

Valik

A_{s1}	5	Ø 10	A_s=	392	mm^2	Samm	200mm
☐	0	Ø 12	A_s=	0	mm^2		
		Kokku	**A_{s1}=**	**392**	**mm^2**		
A_{s2}	0	Ø 12	A_s=	0	mm^2		
☐	0	Ø 12	A_s=	0	mm^2		
		Kokku	**A_{s2}=**	**0**	**mm^2**		

Kontroll:

ω=	0,023	
μ=	0,022	
M_{Rd}=	**74,86**	***kNm*** **105%**

$$f_{cd} = \frac{f_{ck}}{\gamma_c}$$

$$f_{yd} = \frac{f_{yk}}{\gamma_{yc}}$$

$$f_{ycd} = f_{yd}$$

$$f_{ycd} \le 400MPa$$

$$\mu = \frac{M_{sd}}{\alpha f_{cd} b d_1^2}$$

$$\omega = 1 - \sqrt{1 - 2\mu}$$

$$\mu \le \mu_c \Rightarrow$$

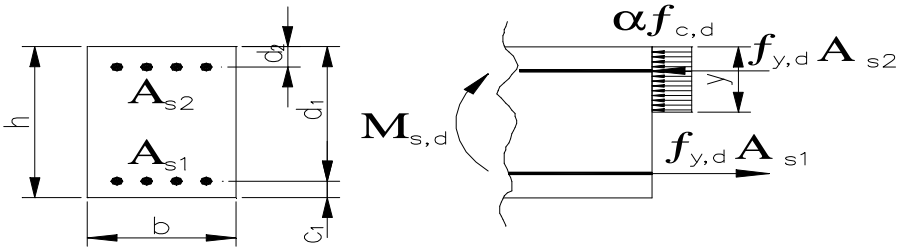
$$A_{s2} = 0$$

$$A_{s1} = \frac{\omega \alpha f_{cd} b d_1}{f_{yd}}$$

$$\mu > \mu_c \Rightarrow$$

$$A_{s2} = \frac{M_{sd} - \mu_c \alpha f_{cd} b d_1^2}{f_{ycd}(d_1 - d_2)}$$

$$A_{s1} = \frac{\omega_c \alpha f_{cd} b d_1}{f_{yd}} + \frac{f_{ycd}}{f_{yd}} A_{s2}$$



*Tõmbe- ja survearmatuuri dimensioneerimine paindel ** Lõige 3-3

*ristkülikuline ristlõige

Algandmed:

Ristlõige

b=	1000	*mm*
h=	500	*mm*
d_1=	444	*mm*
d_2=	56	*mm*

Armatuur

Terase klass A(B) 500

f_{yk}=	500	*MPa*
f_{yd}=	435	*MPa*
f_{ycd}=	400	*MPa*
μ_c=	0,372	
ω_c=	0,495	

Betoon

Klass C 30/37

f_{ck}=	30	*MPa*
f_{cd}=	20	*MPa*

Jõud

M_{Sd}= 206,48 *kNm*

Tulemused:

μ=	0,062
ω=	0,064

Vajalik armatuuri pindala

A_{s2}=	0	mm^2
A_{s1}=	1105	mm^2

Valik

A_{s1}	6	Ø 16	A_s=	1206	mm²	Samm	166mm
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s1}=**	**1206**	**mm²**		
A_{s2}	0	Ø 12	A_s=	0	mm²		
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s2}=**	**0**	**mm²**		

Kontroll:

ω=	0,070	
μ=	0,067	
M_{Rd}=	**224,83**	***kNm*** **109%**

$$f_{cd} = \frac{f_{ck}}{\gamma_c}$$

$$f_{yd} = \frac{f_{yk}}{\gamma_{yc}}$$

$$f_{ycd} = f_{yd}$$

$$f_{ycd} \le 400MPa$$

$$\mu = \frac{M_{sd}}{\alpha f_{cd} b d_1^2}$$

$$\omega = 1 - \sqrt{1 - 2\mu}$$

$$\mu \le \mu_c \Rightarrow$$

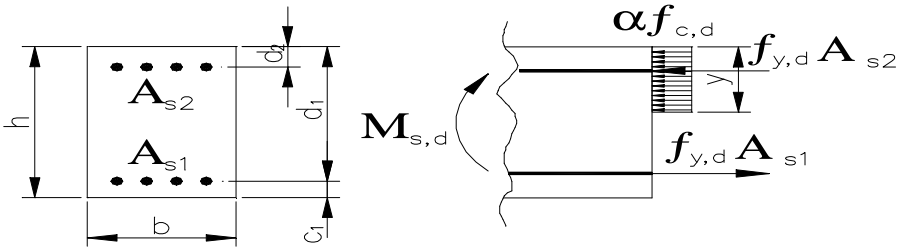
$$A_{s2} = 0$$

$$A_{s1} = \frac{\omega \alpha f_{cd} b d_1}{f_{yd}}$$

$$\mu > \mu_c \Rightarrow$$

$$A_{s2} = \frac{M_{sd} - \mu_c \alpha f_{cd} b d_1^2}{f_{ycd}(d_1 - d_2)}$$

$$A_{s1} = \frac{\omega_c \alpha f_{cd} b d_1}{f_{yd}} + \frac{f_{ycd}}{f_{yd}} A_{s2}$$



*Tõmbe- ja survearmatuuri dimensioneerimine paindel ** Lõige 4-4

*ristkülikuline ristlõige

Algandmed:

Ristlõige

b=	1000	*mm*
h=	500	*mm*
d_1=	444	*mm*
d_2=	56	*mm*

Armatuur

Terase klass	A(B) 500	
f_{yk}=	500	*MPa*
f_{yd}=	435	*MPa*
f_{ycd}=	400	*MPa*
μ_c=	0,372	
ω_c=	0,495	

Betoon

Klass	C 30/37	
f_{ck}=	30	*MPa*
f_{cd}=	20	*MPa*

Jõud

M_{Sd}=	115,22	*kNm*

$$f_{cd} = \frac{f_{ck}}{\gamma_c}$$

$$f_{yd} = \frac{f_{yk}}{\gamma_{yc}}$$

$$f_{ycd} = f_{yd}$$

$$f_{ycd} \le 400MPa$$

$$\mu = \frac{M_{sd}}{\alpha f_{cd} b d_1^2}$$

$$\omega = 1 - \sqrt{1 - 2\mu}$$

$$\mu \le \mu_c \Rightarrow$$

$$A_{s2} = 0$$

$$A_{s1} = \frac{\omega \alpha f_{cd} b d_1}{f_{yd}}$$

$$\mu > \mu_c \Rightarrow$$

$$A_{s2} = \frac{M_{sd} - \mu_c \alpha f_{cd} b d_1^2}{f_{ycd}(d_1 - d_2)}$$

$$A_{s1} = \frac{\omega_c \alpha f_{cd} b d_1}{f_{yd}} + \frac{f_{ycd}}{f_{yd}} A_{s2}$$

Tulemused:

μ=	0,034	
ω=	0,035	

Vajalik armatuuri pindala

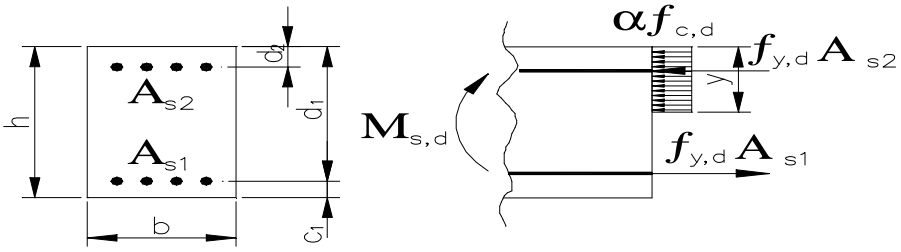
A_{s2}=	0	mm^2
A_{s1}=	608	mm^2

Valik

A_{s1}	6	Ø 12	A_s=	678	mm²	Samm	166mm
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s1}=**	**678**	**mm²**		
A_{s2}	0	Ø 12	A_s=	0	mm²		
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s2}=**	**0**	**mm²**		

Kontroll:

ω=	0,039	
μ=	0,038	
M_{Rd}=	**128,39**	***kNm*** **111%**



*Tõmbe- ja survearmatuuri dimensioneerimine paindel ** Lõige 5-5

*ristkülikuline ristlõige

Algandmed:

Ristlõige

b=	1000 *mm*
h=	500 *mm*
d_1=	444 *mm*
d_2=	56 *mm*

Armatuur

Terase klass A(B) 500

f_{yk}=	500 *MPa*
f_{yd}=	435 *MPa*
f_{ycd}=	400 *MPa*
μ_c=	0,372
ω_c=	0,495

Betoon

Klass C 30/37

f_{ck}=	30 *MPa*
f_{cd}=	20 *MPa*

Jõud

M_{Sd}= 45,01 *kNm*

Tulemused:

μ=	0,013
ω=	0,014

Vajalik armatuuri pindala

A_{s2}=	0 mm^2
A_{s1}=	235 mm^2

Valik

A_{s1}	5	Ø 8	A_s=	251	mm²	Samm	200mm
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s1}=**	**251**	**mm²**		
A_{s2}	0	Ø 12	A_s=	0	mm²		
☐	0	Ø 12	A_s=	0	mm²		
		Kokku	**A_{s2}=**	**0**	**mm²**		

Kontroll:

ω=	0,014	
μ=	0,014	
M_{Rd}=	**48,13 *kNm***	**107%**

$$f_{cd} = \frac{f_{ck}}{\gamma_c}$$

$$f_{yd} = \frac{f_{yk}}{\gamma_{yc}}$$

$$f_{ycd} = f_{yd}$$

$$f_{ycd} \le 400MPa$$

$$\mu = \frac{M_{sd}}{\alpha f_{cd} b d_1^2}$$

$$\omega = 1 - \sqrt{1 - 2\mu}$$

$$\mu \le \mu_c \Rightarrow$$

$$A_{s2} = 0$$

$$A_{s1} = \frac{\omega \alpha f_{cd} b d_1}{f_{yd}}$$

$$\mu > \mu_c \Rightarrow$$

$$A_{s2} = \frac{M_{sd} - \mu_c \alpha f_{cd} b d_1^2}{f_{ycd}(d_1 - d_2)}$$

$$A_{s1} = \frac{\omega_c \alpha f_{cd} b d_1}{f_{yd}} + \frac{f_{ycd}}{f_{yd}} A_{s2}$$