STATIC DESIGN OF Z/C-PROFILES - EXAMPLE No. 1.

1) Load-bearing capacity determined from load tables

1.1 Initial data

Function		Roof purlin
Profile:		Z220
Yield point of steel (N/mm2):	fy=	350
Static system:		Continuous overlapped 6-span
Profile thickness in internal spans (mm)	t,nom=	2,0
Profile thickness in external spans (mm)	t,nom=	2,5
Span (mm):	L=	6000
Deflection limit:	e,lim=	L/300

1.2 Supporing conditions

Latel support of upper flange:	By cladding (screw c/c333mm)
Latel support of lower flange:	No
Anti-sag bars:	No
Global support in the direction of web:	Bolts in shear

1.3 Results:

ULS downward capacity (kN/m)	qH,ULS,ny=	3,344
ULS upward capacity (kN/m)	qH,ULS,sz=	4,975
SLS capacity (kN/m)	qH,SLS=	3,876

2) Acting loads

2.1 Characteristic values:

			γf	γa	$\psi,0$
Deadweight of purlin (kN/m)	g1=	0,07	1,35	1,00	
Deadweight of roof cladding (kN/m2)	g2=	0,23	1,35	1,00	
Other permanent load (kN/m2)	g3=	0,00	1,35	1,00	
Snow load (kN/m2)	p,s=	1,00	1,50		0,50
Extreme snow load (kN/m2)	p,esl=	2,00	1,00		0,00
Wind load pressure (kN/m2)	p,wp=	0,10	1,50		0,60
Wind load suction (kN/m2)	p,ws=	-1,00	1,50		0,60

Roof slope (degree)	α=	6,0
	cos(α)=	0,995
Purlin spacing (m)	b=	1,50

2.2 Governing ULS load combination (normal direction to the roof surface)

1) Snow load is main
q,ULS,1= $\gamma f*g1*\cos(\alpha)+b*(\gamma f*(g2+g3)*\cos(\alpha)+\gamma*p,s*\cos^2(\alpha)+\gamma*\psi,0*p,wp)$
q,ULS,1= 2,92 kN/m

2) Wind pressure is main
q,ULS,2= $\gamma f*g1*\cos(\alpha)+b*(\gamma f*(g2+g3)*\cos(\alpha)+\gamma*\psi,0*p,s*\cos^2(\alpha)+\gamma*p,wp)$
q,ULS,2= 1,90 kN/m

Governing downward load:
q,ULS,ny= max(q,ULS,1; q,ULS,2)
q,ULS,ny= 2,92 kN/m

Governing upward load:
q,ULS,sz= $\gamma a*g1*\cos(\alpha)+b*(\gamma a*g2*\cos(\alpha)+\gamma*p,ws)$
q,ULS,sz= -1,84 kN/m

2.3 ELS extreme snow load combination (normal direction to the roof surface)

q,ELS= $1,0*g1*\cos(\alpha)+b*(1,0*(g2+g3)*\cos(\alpha)+p,esl*\cos^2(\alpha))$
q,ELS= 3,38 kN/m

2.4 Governing SLS load combination (normal direction to the roof surface)

1) Snow load is main
q,SLS,1= $g1*\cos(\alpha)+b*((g2+g3)*\cos(\alpha)+p,s*\cos^2(\alpha)+\psi,0*p,wp)$
q,SLS,1= 1,99 kN/m

2) Wind pressure is main
q,SLS,2= $g1*\cos(\alpha)+b*((g2+g3)*\cos(\alpha)+\psi,0*p,s*\cos^2(\alpha)+p,wp)$
q,SLS,2= 1,07 kN/m

Governing downward load:
q,SLS,ny= max(q,SLS,1; q,SLS,2)
q,SLS,ny= 1,99 kN/m

Governing upward load:
q,SLS,sz= $g1*\cos(\alpha)+b*(g2*\cos(\alpha)+p,ws)$
q,SLS,sz= -1,09 kN/m

3) Checking (utilization factors)

3.1 ULS limit state

downward direction	n,ULS=	q,ULS,ny/qH,ULS,ny=	**87,3%**	SATISFIED!
upward direction	n,ULS=	q,ULS,sz/qH,ULS,sz=	**36,9%**	SATISFIED!

3.2 ELS limit state

Extreme snow load	n,ELS=	q,ELS/qH,ULS,ny=	**101,1%**	ACCEPTABLE!

3.3 SLS limit state

downward direction	n,SLS=	q,SLS,ny/qH,SLS=	**51,3%**	SATISFIED!
upward direction	n,SLS=	q,SLS,sz/qH,SLS=	**28,0%**	SATISFIED!

STATIC DESIGN OF Z/C-PROFILES - EXAMPLE No. 2.

1) Load-bearing capacity determined from load tables

1.1 Initial data

Function		Roof purlin
Profile:		Z180ECO
Yield point of steel (N/mm2):	fy=	350
Static system:		Continuous overlapped 6-span
Profile thickness in internal spans (mm)	t,nom=	2,0
Profile thickness in external spans (mm)	t,nom=	2,5
Span (mm):	L=	5000
Deflection limit:	e,H=	L/300

1.2 Supporing conditions

Latel support of upper flange:	By cladding (screw c/c333mm)
Latel support of lower flange:	No
Anti-sag bars:	No
Global support in the direction of web:	Bolts in shear

1.3 Results:

ULS downward capacity (kN/m)	qH,ULS,ny=	3,448
ULS upward capacity (kN/m)	qH,ULS,sz=	4,651
SLS capacity (kN/m)	qH,SLS=	3,472

2) Acting loads

2.1 Characteristic values:

			γf	γa	ψ,0
Deadweight of purlin (kN/m)	g1=	0,06	1,35	1,00	
Deadweight of roof cladding (kN/m2)	g2=	0,15	1,35	1,00	
Other permanent load (kN/m2)	g3=	0,10	1,35	1,00	
Snow load (kN/m2)	p,s=	1,00	1,50		0,50
Extreme snow load (kN/m2)	p,esl=	2,00	1,00		0,00
Wind load pressure (kN/m2)	p,wp=	0,12	1,50		0,60
Wind load suction (kN/m2)	p,ws=	-0,82	1,50		0,60

Roof slope (degree)	α=	12,0
	cos(α)=	0,978
Purlin spacing (m)	b=	1,50

2.2 Governing ULS load combination (normal direction to the roof surface)

1) Snow load is main
q,ULS,1= $\gamma f*g1*\cos(\alpha)+b*(\gamma f*(g2+g3)*\cos(\alpha)+\gamma*p,s*\cos^2(\alpha)+\gamma*\psi,0*p,wp)$
q,ULS,1= 2,89 kN/m

2) Wind pressure is main
q,ULS,2= $\gamma f*g1*\cos(\alpha)+b*(\gamma f*(g2+g3)*\cos(\alpha)+\gamma*\psi,0*p,s*\cos^2(\alpha)+\gamma*p,wp)$
q,ULS,2= 1,92 kN/m

Governing downward load:
q,ULS,ny= max(q,ULS,1; q,ULS,2)
q,ULS,ny= 2,89 kN/m

Governing upward load:
q,ULS,sz= $\gamma a*g1*\cos(\alpha)+b*(\gamma a*g2*\cos(\alpha)+\gamma*p,ws)$
q,ULS,sz= -1,57 kN/m

2.3 ELS extreme snow load combination (normal direction to the roof surface)

q,ELS= $1,0*g1*\cos(\alpha)+b*(1,0*(g2+g3)*\cos(\alpha)+p,esl*\cos^2(\alpha))$
q,ELS= 3,30 kN/m

2.4 Governing SLS load combination (normal direction to the roof surface)

1) Snow load is main
q,SLS,1= $g1*\cos(\alpha)+b*((g2+g3)*\cos(\alpha)+p,s*\cos^2(\alpha)+\psi,0*p,wp)$
q,SLS,1= 1,97 kN/m

2) Wind pressure is main
q,SLS,2= $g1*\cos(\alpha)+b*((g2+g3)*\cos(\alpha)+\psi,0*p,s*\cos^2(\alpha)+p,wp)$
q,SLS,2= 1,19 kN/m

Governing downward load:
q,SLS,ny= max(q,SLS,1; q,SLS,2)
q,SLS,ny= 1,97 kN/m

Governing upward load:
q,SLS,sz= $g1*\cos(\alpha)+b*(g2*\cos(\alpha)+p,ws)$
q,SLS,sz= -0,95 kN/m

3) Checking (utilization factors)

3.1 ULS limit state

downward direction	n,ULS=	q,ULS,ny/qH,ULS,ny=	**83,8%**	SATISFIED!
upward direction	n,ULS=	q,ULS,sz/qH,ULS,sz=	**33,7%**	SATISFIED!

3.2 ELS limit state

Extreme snow load	n,ELS=	q,ELS/qH,ULS,ny=	**95,6%**	SATISFIED!

3.3 SLS limit state

downward direction	n,SLS=	q,SLS,ny/qH,SLS=	**56,7%**	SATISFIED!
upward direction	n,SLS=	q,SLS,sz/qH,SLS=	**27,4%**	SATISFIED!

STATIC DESIGN OF Z/C-PROFILES - EXAMPLE No. 3.

1) Load-bearing capacity determined from load tables

1.1 Initial data

Function		Roof purlin
Profile:		C180ECO
Yield point of steel (N/mm2):	fy=	350
Static system:		Single span
Profile thickness in internal spans (mm)	t,nom=	2,0
Profile thickness in external spans (mm)	L=	5000
Span (mm):	e,H=	L/300
Deflection limit:		

1.2 Supporing conditions

	By cladding (screw c/c333mm)
Latel support of upper flange:	No
Latel support of lower flange:	No
Anti-sag bars:	Bolts in shear
Global support in the direction of web:	

1.3 Results:

	qH,ULS,ny=	2,725
ULS downward capacity (kN/m)	qH,ULS,sz=	1,563
ULS upward capacity (kN/m)	qH,SLS=	1,237
SLS capacity (kN/m)		

2) Acting loads

2.1 Characteristic values:

			γf	γa	ψ,0
Deadweight of purlin (kN/m)	g1=	0,05	1,35	1,00	
Deadweight of roof cladding (kN/m2)	g2=	0,15	1,35	1,00	
Other permanent load (kN/m2)	g3=	0,10	1,35	1,00	
Snow load (kN/m2)	p,s=	1,00	1,50		0,50
Extreme snow load (kN/m2)	p,esl=	2,00	1,00		0,00
Wind load pressure (kN/m2)	p,wp=	0,12	1,50		0,60
Wind load suction (kN/m2)	p,ws=	-0,82	1,50		0,60

Roof slope (degree)	α=	12,0
	cos(α)=	0,978
Purlin spacing (m)	b=	0,75

2.2 Governing ULS load combination (normal direction to the roof surface)

1) Snow load is main	q,ULS,1=	γf*g1*cos(α)+b*(γf*(g2+g3)*cos(α)+γ*p,s*cos^2(α)+γ*ψ,0*p,wp)	
	q,ULS,1=	1,47	kN/m
2) Wind pressure is main	q,ULS,2=	γf*g1*cos(α)+b*(γf*(g2+g3)*cos(α)+γ*ψ,0*p,s*cos^2(α)+γ*p,wp)	
	q,ULS,2=	0,99	kN/m
Governing downward load:	q,ULS,ny=	max(q,ULS,1; q,ULS,2)	
	q,ULS,ny=	**1,47**	kN/m
Governing upward load:	q,ULS,sz=	γa*g1*cos(α)+b*(γa*g2*cos(α)+γ*p,ws)	
	q,ULS,sz=	**-0,76**	kN/m

2.3 ELS extreme snow load combination (normal direction to the roof surface)

q,ELS=	1,0*g1*cos(α)+b*(1,0*(g2+g3)*cos(α)+p,esl*cos^2(α))	
q,ELS=	**1,67**	kN/m

2.4 Governing SLS load combination (normal direction to the roof surface)

1) Snow load is main	q,SLS,1=	g1*cos(α)+b*((g2+g3)*cos(α)+p,s*cos^2(α)+ψ,0*p,wp)	
	q,SLS,1=	1,00	kN/m
2) Wind pressure is main	q,SLS,2=	g1*cos(α)+b*((g2+g3)*cos(α)+ψ,0*p,s*cos^2(α)+p,wp)	
	q,SLS,2=	0,61	kN/m
Governing downward load:	q,SLS,ny=	max(q,SLS,1; q,SLS,2)	
	q,SLS,ny=	**1,00**	kN/m
Governing upward load:	q,SLS,sz=	g1*cos(α)+b*(g2*cos(α)+p,ws)	
	q,SLS,sz=	**-0,46**	kN/m

3) Checking (utilization factors)

3.1 ULS limit state

downward direction	n,ULS=	q,ULS,ny/qH,ULS,ny=	**54,0%**	SATISFIED!
upward direction	n,ULS=	q,ULS,sz/qH,ULS,sz=	**48,9%**	SATISFIED!

3.2 ELS limit state

Extreme snow load	n,ELS=	q,ELS/qH,ULS,ny=	**61,2%**	SATISFIED!

3.3 SLS limit state

downward direction	n,SLS=	q,SLS,ny/qH,SLS=	**81,2%**	SATISFIED!
upward direction	n,SLS=	q,SLS,sz/qH,SLS=	**36,9%**	SATISFIED!

STATIC DESIGN OF Z/C-PROFILES - EXAMPLE No. 4.

1) Load-bearing capacity determined from load tables

1.1 Initial data

Function		Roof purlin
Profile:		Z350
Yield point of steel (N/mm2):	fy=	350
Static system:		Continuous overlapped 6-span
Profile thickness in internal spans (mm)	t,nom=	3,0
Profile thickness in external spans (mm)	t,nom=	4,0
Span (mm):	L=	11750
Deflection limit:	e,H=	L/300

1.2 Supporing conditions

Latel support of upper flange:	By cladding (screw c/c333mm)
Latel support of lower flange:	No
Anti-sag bars:	1 line / span
Global support in the direction of web:	Bolts in shear

1.3 Results:

ULS downward capacity (kN/m)	qH,ULS,ny=	4,448
ULS upward capacity (kN/m)	qH,ULS,sz=	3,250
SLS capacity (kN/m)	qH,SLS=	3,077

2) Acting loads

2.1 Characteristic values:

			γf	γa	ψ,0
Deadweight of purlin (kN/m)	g1=	0,17	1,35	1,00	
Deadweight of roof cladding (kN/m2)	g2=	0,15	1,35	1,00	
Other permanent load (kN/m2)	g3=	0,00	1,35	1,00	
Snow load (kN/m2)	p,s=	1,00	1,50		0,50
Extreme snow load (kN/m2)	p,esl=	2,00	1,00		0,00
Wind load pressure (kN/m2)	p,wp=	0,20	1,50		0,60
Wind load suction (kN/m2)	p,ws=	-1,20	1,50		0,60

Roof slope (degree)	α=	6,0
	cos(α)=	0,995
Purlin spacing (m)	b=	2,00

2.2 Governing ULS load combination (normal direction to the roof surface)

1) Snow load is main
q,ULS,1= $\gamma f*g1*\cos(\alpha)+b*(\gamma f*(g2+g3)*\cos(\alpha)+\gamma*p,s*\cos^2(\alpha)+\gamma*\psi,0*p,wp)$
q,ULS,1= 3,96 kN/m

2) Wind pressure is main
q,ULS,2= $\gamma f*g1*\cos(\alpha)+b*(\gamma f*(g2+g3)*\cos(\alpha)+\gamma*\psi,0*p,s*\cos^2(\alpha)+\gamma*p,wp)$
q,ULS,2= 2,71 kN/m

Governing downward load:
q,ULS,ny= max(q,ULS,1; q,ULS,2)
q,ULS,ny= 3,96 kN/m

Governing upward load:
q,ULS,sz= $\gamma a*g1*\cos(\alpha)+b*(\gamma a*g2*\cos(\alpha)+\gamma*p,ws)$
q,ULS,sz= -3,13 kN/m

2.3 ELS extreme snow load combination (normal direction to the roof surface)

q,ELS= $1,0*g1*\cos(\alpha)+b*(1,0*(g2+g3)*\cos(\alpha)+p,esl*\cos^2(\alpha))$
q,ELS= 4,42 kN/m

2.4 Governing SLS load combination (normal direction to the roof surface)

1) Snow load is main
q,SLS,1= $g1*\cos(\alpha)+b*((g2+g3)*\cos(\alpha)+p,s*\cos^2(\alpha)+\psi,0*p,wp)$
q,SLS,1= 2,69 kN/m

2) Wind pressure is main
q,SLS,2= $g1*\cos(\alpha)+b*((g2+g3)*\cos(\alpha)+\psi,0*p,s*\cos^2(\alpha)+p,wp)$
q,SLS,2= 1,90 kN/m

Governing downward load:
q,SLS,ny= max(q,SLS,1; q,SLS,2)
q,SLS,ny= 2,69 kN/m

Governing upward load:
q,SLS,sz= $g1*\cos(\alpha)+b*(g2*\cos(\alpha)+p,ws)$
q,SLS,sz= -1,93 kN/m

3) Checking (utilization factors)

3.1 ULS limit state

downward direction	n,ULS=	q,ULS,ny/qH,ULS,ny=	**89,0%**	SATISFIED!
upward direction	n,ULS=	q,ULS,sz/qH,ULS,sz=	**96,4%**	SATISFIED!

3.2 ELS limit state

Extreme snow load	n,ELS=	q,ELS/qH,ULS,ny=	**99,5%**	SATISFIED!

3.3 SLS limit state

downward direction	n,SLS=	q,SLS,ny/qH,SLS=	**87,3%**	SATISFIED!
upward direction	n,SLS=	q,SLS,sz/qH,SLS=	**62,8%**	SATISFIED!

STATIC DESIGN OF Z/C-PROFILES - EXAMPLE No. 5.

1) Load-bearing capacity determined from load tables

1.1 Initial data

Function		Wall beam
Profile:		Z120
Yield point of steel (N/mm2):	fy=	350
Static system:		Continuous overlapped 6-span
Profile thickness in internal spans (mm)	t,nom=	2,0
Profile thickness in external spans (mm)	t,nom=	2,5
Span (mm):	L=	6000
Deflection limit:	e,H=	L/150

1.2 Supporing conditions

Latel support of upper flange:	By cladding (screw c/c333mm)
Latel support of lower flange:	No
Anti-sag bars:	No
Global support in the direction of web:	Bolts in shear

1.3 Results:

ULS downward capacity (kN/m)	qH,ULS,ny=	1,698
ULS upward capacity (kN/m)	qH,ULS,sz=	1,764
SLS capacity (kN/m)	qH,SLS=	1,348

2) Acting loads

2.1 Characteristic values:

			γf	γa	ψ,0
Wind load pressure (kN/m2)	p,wp=	0,80	1,50		0,60
Wind load suction (kN/m2)	p,ws=	-1,00	1,50		0,60

Spacing of wall beams (m)	b=	1,20

2.2 Governing ULS load combination (normal direction to the roof surface)

Governing downward load:	q,ULS,ny=	b*γ*p,wp	
	q,ULS,ny=	**1,44**	kN/m
Governing upward load:	q,ULS,sz=	b*γ*p,ws	
	q,ULS,sz=	**-1,80**	kN/m

2.3 Governing SLS load combination (normal direction to the roof surface)

Governing downward load:	q,SLS,ny=	b*p,wp	
	q,SLS,ny=	**0,96**	kN/m
Governing upward load:	q,SLS,sz=	b*p,ws	
	q,SLS,sz=	**-1,20**	kN/m

3) Checking (utilization factors)

3.1 ULS limit state

downward direction	n,ULS=	q,ULS,ny/qH,ULS,ny=	**84,8%**	SATISFIED!
upward direction	n,ULS=	q,ULS,sz/qH,ULS,sz=	**102,0%**	ACCEPTABLE!

3.2 SLS limit state

downward direction	n,SLS=	q,SLS,ny/qH,SLS=	**71,2%**	SATISFIED!
upward direction	n,SLS=	q,SLS,sz/qH,SLS=	**89,0%**	SATISFIED!

STATIC DESIGN OF Z/C-PROFILES - EXAMPLE No. 6.

1) Load-bearing capacity determined from load tables

1.1 Initial data

Function		Wall beam
Profile:		C150
Yield point of steel (N/mm2):	fy=	350
Static system:		Single span
Profile thickness (mm)	t,nom=	2,5
Span (mm):	L=	4500
Deflection limit:	e,H=	L/150

1.2 Supporing conditions

Latel support of upper flange:	By cladding (screw c/c333mm)
Latel support of lower flange:	No
Anti-sag bars:	No
Global support in the direction of web:	Bolts in shear

1.3 Results:

ULS downward capacity (kN/m)	qH,ULS,ny=	3,027
ULS upward capacity (kN/m)	qH,ULS,sz=	1,844
SLS capacity (kN/m)	qH,SLS=	2,619

2) Acting loads

2.1 Characteristic values:

			γf	γa	ψ,0
Wind load pressure (kN/m2)	p,wp=	0,75	1,50		0,60
Wind load suction (kN/m2)	p,ws=	-0,75	1,50		0,60
Spacing of wall beams (m)	b=	1,50			

2.2 Governing ULS load combination (normal direction to the roof surface)

Governing downward load:	q,ULS,ny=	b*γ*p,wp	
	q,ULS,ny=	**1,69**	kN/m
Governing upward load:	q,ULS,sz=	b*γ*p,ws	
	q,ULS,sz=	**-1,69**	kN/m

2.3 Governing SLS load combination (normal direction to the roof surface)

Governing downward load:	q,SLS,ny=	b*p,wp	
	q,SLS,ny=	**1,13**	kN/m
Governing upward load:	q,SLS,sz=	b*p,ws	
	q,SLS,sz=	**-1,13**	kN/m

3) Checking (utilization factors)

3.1 ULS limit state

downward direction	n,ULS=	q,ULS,ny/qH,ULS,ny=	**55,7%**	SATISFIED!
upward direction	n,ULS=	q,ULS,sz/qH,ULS,sz=	**91,5%**	SATISFIED!

3.2 SLS limit state

downward direction	n,SLS=	q,SLS,ny/qH,SLS=	**43,0%**	SATISFIED!
upward direction	n,SLS=	q,SLS,sz/qH,SLS=	**43,0%**	SATISFIED!

STATIC DESIGN OF Z/C-PROFILES - EXAMPLE No. 7.

1) Load-bearing capacity determined from load tables

1.1 Initial data

Function		Wall beam
Profile:		Z200
Yield point of steel (N/mm2):	fy=	350
Static system:		Double span
Profile thickness (mm)	t,nom=	2,0
Span (mm):	L=	5500
Deflection limit:	e,H=	L/150

1.2 Supporing conditions

Latel support of upper flange:	By cladding (screw c/c333mm)
Latel support of lower flange:	No
Anti-sag bars:	No
Global support in the direction of web:	Bolts in shear

1.3 Results:

ULS downward capacity (kN/m)	qH,ULS,ny=	2,011
ULS upward capacity (kN/m)	qH,ULS,sz=	2,952
SLS capacity (kN/m)	qH,SLS=	7,160

2) Acting loads

2.1 Characteristic values:

			γf	γa	ψ,0
Wind load pressure (kN/m2)	p,wp=	0,75	1,50		0,60
Wind load suction (kN/m2)	p,ws=	-0,75	1,50		0,60

Spacing of wall beams (m)	b=	1,50

2.2 Governing ULS load combination (normal direction to the roof surface)

Governing downward load:	q,ULS,ny=	b*γ*p,wp	
	q,ULS,ny=	**1,69**	kN/m
Governing upward load:	q,ULS,sz=	b*γ*p,ws	
	q,ULS,sz=	**-1,69**	kN/m

2.3 Governing SLS load combination (normal direction to the roof surface)

Governing downward load:	q,SLS,ny=	b*p,wp	
	q,SLS,ny=	**1,13**	kN/m
Governing upward load:	q,SLS,sz=	b*p,ws	
	q,SLS,sz=	**-1,13**	kN/m

3) Checking (utilization factors)

3.1 ULS limit state

downward direction	n,ULS=	q,ULS,ny/qH,ULS,ny=	**83,9%**	SATISFIED!
upward direction	n,ULS=	q,ULS,sz/qH,ULS,sz=	**57,2%**	SATISFIED!

3.2 SLS limit state

downward direction	n,SLS=	q,SLS,ny/qH,SLS=	**15,7%**	SATISFIED!
upward direction	n,SLS=	q,SLS,sz/qH,SLS=	**15,7%**	SATISFIED!