Annex for Switzerland

Steel Design 3

Connections

Stahlbau Zentrum Schweiz
Centre suisse de la construction en acier
Centro svizzero per la costruzione in acciaio
Swiss Center for Steel Construction

Colofon / Content

Annex for Switzerland to *Connections* (Steel Design 3)

This annex has been prepared by Dr. Hetty Bigelow and is based on the English translation of *Connections,* published in 2012 by Bouwen met Staal as *Verbinden* as well as the Dutch annex. References are made to each NA symbol in *Connections* and the corresponding clause in the Eurocode.
Annexes to *Structural basics* (Steel Design 1) and *Fire* (Steel Design 2) are also available and can be downloaded free of charge from the website of SZS Stahlbau Zentrum Schweiz.

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Eurocodes in Switzerland

Switzerland is an EFTA but not an EC member despite its central geographical location in Europe. Still, Switzerland is obliged just as well as every other European country to retract any codes and standards contradictive to European regulations.

Switzerland has a long tradition of national codes, starting with the first code named "*Verordnung betreffend Berechnung und Prüfung der eisernen Brücken- und Dachkonstruktionen auf den schweizerischen Eisenbahnen*" in 1892. Since then, a comprehensive set of national codes has been elaborated, whereas the 2013 revision is the latest state of the national structural codes. In 2011, a comprehensive set of national codes on existing structures named SIA 269 has been published as a world's first.

Still, Switzerland has been very close to the elaboration of European codes and is very active in the European code committees from their first days. As a result, the Swiss national codes published by SIA, the Swiss Society of Engineers and Architects, are non-contradictive to Eurocode since 2003 when the first codes of the 260 series were published. The Swiss national codes are compact, well-condensed versions of the European codes, well-adapted to Swiss legal and practice boundary conditions.

Eurocodes are also used in countries where the degree of regulation must be much higher. This leads to very large documents which makes the vast extent of the Eurocode regulations a constant matter of discussion among the European countries.

In Switzerland, on the other hand, codes are not mandatory rules to be strictly obeyed but – at least from a legal perspective – more of a recommendation assumed to possibly reflect the state of the art. Therefore, Swiss standards do not need to cover every detail, but leave a lot of freedom and responsibility to the engineer. This allows for much shorter codes limited to a few principles, whereas one of the most important paragraphs is the "Exception Article" which basically says: "If you know better, do better". As such, Swiss codes are a non-contradictory, slim version of the Eurocodes.

In addition to the Swiss codes, Switzerland maintains national annexes to most European codes.

The present book "Connections" explains the behaviour of connections in steel structures according to EN 1993 (Eurocodes 3). The Eurocodes allow for national regulations in some special cases and contain numerous "Nationally Determined Parameters" (NDPs), which must be defined in each country. The present annex thus is related to the Swiss national annexes and gives reference to the Swiss codes.

Annex CH1

Connections in steel structures

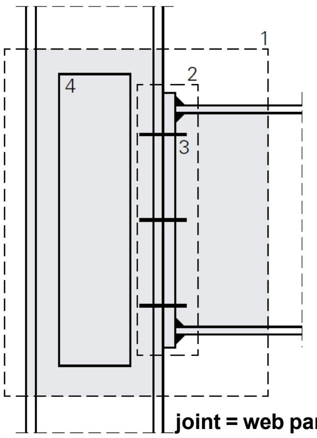

Figure CH1.1 Eurocode terminology

English	German	French	Dutch (EN 1993-1-8)	Dutch (common use)
connection	Verbindung	attache	verbindig	verbindig
joint	Anschluss	assemblage	verbindig	knoop

Table CH1.1: Use of connection and joint in Dutch, French and German

p. 1-2 — EN 1993-1-8, cl. 4.1

The terms “connection” and “joint” (according to Eurocode) are illustrated in *Figure CH1.1* and have also respective German, French and Dutch equivalents (*Table CH1.1*). However, “connection” is often used where “joint” is appropriate according to the given definitions. So in practice it is necessary to remain attentive to what is actually meant. Additionally, SIA 263 [8] uses the term “Rahmenknoten” for beam-to -column joints. Moreover, in the field of welding-technology, the term “joint” is used for exactly the welded area (as in in “butt-welds in T-joints”).
And even in this textbook (Connections) the term “connection” is sometimes used where strictly speaking it is a “joint” (occurring mostly in chapter 5).

p. 1-19 (a)

No additional remarks needed.

p. 1-19 (b)

No additional remarks needed.

p. 1-24

No additional remarks needed.

clause	parameter	Swiss National Annex
1.2.6 (group 6)	reference standards for rivets	no particular information is specified. information on rivets and their verification can be found in SIA 269/3:2011 [10]
2.2(2)	partial safety factors γ_{M2}, γ_{M3}, $\gamma_{M3,ser}$, γ_{M4}, γ_{M5}, $\gamma_{M6,ser}$ and γ_{M7}	recommended values γ_{M2} to γ_{M7} are adopted $\gamma_{M0} = \gamma_{M1} = 1.05$ SIA 263 [8] additionally defines $\gamma_{M3} = 1.4$ for bolts in long slotted holes
3.1.1(3)	bolt class	bolt classes 4.8, 5.8 and 6.8 are excluded
3.4.2(1)	requirements for the level of preloading, exclusively related to the characteristics during manufacturing and assembly or to the quality requirements	no specific requirements, reference to SIA 263/1 [9] regarding tensioning of bolts
5.2.1(2)	additional information related to the classification of joints	no additional information
6.2.7.2(9)	additional information with regard to the use of equation (6.26)	equation (6.26) is only applicable for connections with two bolts per row for connections with 4 bolts per row it is suggested to replace 1,9 $F_{t,Rd}$ by 0.95 $F_{t,,mode3,Rd}$ for the calculation of $F_{tx,Rd.}$

Table CH1.2: Overview of Swiss choices for NDP in EN 1993-1-8.

p. 1-26 (a) **EN 1993-1-8**

The Swiss National Annex to EN 1993-1-8 provides the choices of the nationally determined parameters (NDP) as shown in *Table CH1.2*.

cl. EN 1993-1-8	cl. SIA 263	topic
3.5	6.2.6.3	positioning of holes for bolts and rivets
3.6.1	6.2.2.1	bearing resistance
3.6.1	6.2.1.4 & 6.2.2.1	tension resistance
3.6.1	6.2.2.6	combined shear and tension
3.6.1 & 3.9	6.2.3	preloaded class 8.8 or 10.9 bolts
3.10.2	6.2.4.3 & 6.2.4.4	design for block tearing
3.10.3	6.2.4.5	unsymmetrically connected members in tension with 1 bolt
3.11 & 6.2.4	6.2.2.4	equivalent T-stub in tension
3.13	6.2.5 & 6.2.6	connections made with pins
4.3.4	6.3.3.3	intermittent butt weld must not be used
4.5.1	6.3.2.5	effective length of fillet welds
4.5.2	6.3.6	throat thickness of fillet welds
4.5.3	6.3.2.2	design resistance of fillet welds
4.10	4.6.2 & 6.3.4	connections to unstiffened flanges
7	Annex D	hollow section joints

Table CH1.3: Overview of NCCI given in SIA 263 [8]

p. 1-26 (b) EN 1993-1-8

The Swiss National Annex to EN 1993-1-8 does not provide non-contradictory complementary information (NCCI). However, SIA 263 [8] provides complementary information on the clauses given in *Table CH1.3*, which are discussed in detail throughout the text book and the corresponding NA comments.

p. 1-27 EN 1993-1-8

See remarks to p. 1-26 (a).

p. 1-28 (a)

No additional remarks needed.

p. 1-28 (b)

No additional remarks needed.

p. 1-32 **Literature**

Additional literature specific for Switzerland.

8. SN 505 263, Norm SIA 263: 2013, Stahlbau, SIA, Zürich, 2013.
9. SN 505 263/1, Norm SIA 263/1: 2020, Stahlbau – Ergänzende Festlegungen, SIA, Zürich, 2020
10. SN 505 269/3, Norm SIA 269/3: 2011, Erhaltung von Tragwerken – Stahlbau, SIA, Zürich, 2011

Annex CH 2

Bolts in clearance holes

Figure CH2.1 contact forces H due to a tension force F (left) on a T-stub and preload of a defined contact area due to favorable welding distortion (right), [19]

p. 2-5 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.4**

Figure CH2.1 displays how prying forces can also be reduced by favorable pre-deformation.

Bolts seize	hole d_0	practical distances in mm p_1, p_2	e_1	e_2	minimum distances in mm p_1, p_2	e_1	e_2
M10	12	30	20	15	30	15	12
M12	14	40	25	20	35	20	15
M16	18	50	35	25	40	25	20
M20	22	60	40	30	45	30	25
M24	26	70	50	40	55	35	30
M27	30	80	55	45	65	40	35
M30	33	90	60	50	70	45	40

Table CH2.1: hole diameters, practical and minimum bolt distances and spacings [19]

p. 2-11 (a) **bolt choice**

M22 bolts unusual in Switzerland [20]. SIA 263 [19] does not provide hole diameters, end distances or spacings between holes for M14 or M22 bolts, see *Table CH2.1*.

p. 2-11 (b) **EN 1993-1-8, cl. 3.1.1 (3)**

In Switzerland bolt classes 4.8, 5.8 and 6.8 are excluded.

p. 2-12 (no NA symbol in *Connections*) **SIA 263, cl.6.2.6.2 & cl.6.2.6.4**

Nominal clearances for normal round holes are 2 mm for M10, M12, M16, M20, M24 and 3 mm for M27 and M30 (see *Table CH2.1*). Maximum nominal clearances for short slotted holes are 4 mm for M12, 6 mm M16 to M24 and 10 mm for M27 and higher. Slotted holes exceeding the maximum nominal clearances for short slotted holes are long slotted holes.

p. 2-13 (no NA symbol in *Connections*) **SIA 263, cl.6.2.6.2**

See also *Table CH2.1*.

p. 2-14 (no NA symbol in *Connections*) **SIA 263, cl.6.2.6.2**

See also *Table CH2.1*.

p. 2-15 (no NA symbol in *Connections*) **SIA 263, cl.6.2.6.2**

See also *Table CH2.1*.

p. 2-18 (no NA symbol in Connections) **SIA 263, cl. 5.1.2.1**

Equation (2.4) yielding of gross cross section.

$$N_{Rd} = \frac{A\, f_y}{\gamma_{M1}}$$

p. 2-18 **SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$, $\gamma_{M2} = 1.25$ in Switzerland.

p. 2-19 (no NA symbol in *Connections*) **SIA 263, cl.6.2.4.5**

The design value $N_{u,Rd}$ of an unsymmetrically loaded connection with one bolt differs slightly from EN 1993-1-8:

$$N_{u,Rd} = \frac{0.9 f_u (2e_2 - d_0)t}{\gamma_{M2}}$$

p. 2-21 (no NA symbol in *Connections*) **SIA 263, cl.6.2.4.3**

SIA 263 [19] does not differ between symmetrical and non-symmetrical load patterns, but differs between:

a) Net cross section loaded in shear

$$V_{eff,Rd} = \frac{0.9 \cdot f_u}{\gamma_{M2}\sqrt{3}} A_{nv}$$

b) Gross cross section loaded in shear combined with net cross section loaded in tension:

$$V_{eff,Rd} = \frac{0.9 \cdot f_u \cdot A_{nt} + \frac{f_y \cdot A_v}{\sqrt{3}}}{\gamma_{M2}}$$

The first term of equation b) is the same as equation (2.5) (<u>with</u> the factor 0.9). The second term has a higher safety factor than the second term of equations (2.11) and (2.12) but uses the gross cross section A_v instead of the net cross section A_{nv}.

p. 2-22 (no NA symbol in *Connections*) **SIA 263, cl.6.2.4.3**

Results differ for SIA approach. For variant a:

$$A_{v,brut} = t_w(l_v + a_1) = 13 \cdot (280 + 45) = 4225\, mm^2$$

$$V_{eff,Rd} = \frac{0.9 \cdot f_u \cdot A_{nt} + \frac{f_y \cdot A_{v,brut}}{\sqrt{3}}}{\gamma_{M2}} = \frac{0.9 \cdot 360 \cdot 416 + \frac{235 \cdot 4225}{\sqrt{3}}}{1.25} = 566\, kN$$

For variant b:

$$A_v = t_w(l_v + a_1) = 13 \cdot (280 + 156) = 5668\, mm^2$$

$$V_{eff,Rd} = \frac{0.9 \cdot f_u \cdot A_{nt} + \frac{f_y \cdot A_v}{\sqrt{3}}}{\gamma_{M2}} = \frac{0.9 \cdot 360 \cdot 416 + \frac{235 \cdot 5668}{\sqrt{3}}}{1.25} = 723\, kN$$

p. 2-25 (a) (no NA symbol in *Connections*) **EN 1993-1-8, cl. 3.1.1 (3)**

$\alpha_v = 0.5$ is also to be considerd for bolt classes 4.8 and 5.8. However, in Switzerland bolt classes 4.8, 5.8 and 6.8 are excluded.

p. 2-25 (b) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.1, eq. (76)**

For $e_2 \geq 1.0 \cdot d_0$ and $p_2 \geq 2.0 \cdot d_0$ the bearing resistance is calculated as follows:

$$F_{b,Rd} = 0.85 \frac{e_1}{d_0} \frac{f_u}{\gamma_{M2}}\, d\, t \leq 2.4 \frac{f_u}{\gamma_{M2}}\, d\, t$$

If $p_1 < e_1 + d_0/2$, e_1 must be replaced by $(p_1 - d_0/2)$.

p. 2-27 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.1, eq. (76)**

Using the practical values for edge distances and spacings given in *Table CH2.1* for the calculation of the bearing resistance $F_{b,Rd}$ according to SIA 263 leads to similar values as those according to EN 1933-1-8 given in table 2.25:

	M12	M16	M20	M24	M27	M30
$F_{b,Rd}$ (kN)	5.2t	7.6t	8.9t	11.3t	12.1t	13.4t

Table CH2.2: Design values for the bearing resistance in S235 material

p. 2-28 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.1.4**

For countersunk bolts, thin nuts, bolts with internal treads and tension rods, the tension resistance must be reduced by 25%, unless more detailed investigations are carried out. This corresponds to a $k_2 = 0.9 \cdot 0.75 = 0.675$.

p. 2-29 (a) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.6**

For bolts loaded in shear and tension the following condition must be satisfied:

$$\left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^2 + \left(\frac{F_{t,Ed}}{F_{t,Rd}}\right)^2 \leq 1.0$$

p. 2-29 (b) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.1.4**

For countersunk bolts, the tension resistance must be reduced by 25%, unless more detailed investigations are carried out. This corresponds to a $k_2 = 0.9 \cdot 0.75 = 0.675$.

p. 2-30 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.6.3**

Minimum end and edge distances as well as minimum spacings according to SIA 263 are satisfied (c.f. *Table CH2.1*).

e_1 = 35 mm > 30 mm (OK)
e_2 = 85 mm > 25 mm (OK)
p_1 = 65 mm > 45 mm (OK)

p. 2-31 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.1**

The SIA 263 approach leads to very similar results as the EN 1993-1-18 approach:

$e_1 + d_0/2 = 35 + 22/2 = 46 < p_1 = 65$

end bolt:

$$F_{b,Rd} = 0.85 \frac{e_1}{d_0} \frac{f_u}{\gamma_{M2}} \, d \, t = 0.85 \frac{35}{22} \frac{360}{1.25} 20 \cdot 20 \cdot 10^{-3} = \mathbf{156\ kN} \leq 2.4 \frac{f_u}{\gamma_{M2}} \, d \, t = 276\ kN$$

p. 2-32 (no NA symbol in *Connections*) **SIA 263, cl. 5.1.2.1**

yielding of gross cross section (not critical)

$$N_{Rd} = \frac{A\,f_y}{\gamma_{M1}} = \frac{2400 \cdot 235 \cdot 10^{-3}}{1.05} = 537\ kN$$

alternative bolt placement:

$e_1 + d_0/2 = 40 + 22/2 = 51 < p_1 = 55$

$$F_{b,Rd} = 0.85 \frac{e_1}{d_0} \frac{f_u}{\gamma_{M2}}\ d\ t = 0.85 \frac{40}{22} \frac{360}{1.25} 20 \cdot 20 \cdot 10^{-3} = \mathbf{178\ kN} \leq 2.4 \frac{f_u}{\gamma_{M2}}\ d\ t = 276\ kN$$

p. 2-34 **Literature**

Additional literature specific for Switzerland.

19. SN 505 263, Norm SIA 263: 2013, Stahlbau, SIA, Zürich, 2013.
20. steel**work** C5/18, SZS, 2018

Slip-resistant connections, rivets and pins

p. 3-8 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.3**

SIA 263 [10] defines the design preload force as:

$F_{p,Cd} = 0.64\ f_{ub}\ A_s$

which is the same as the design preload force given in EN 1993-1-18 3.6.1 (2)

$F_{p,Cd} = 0.7\ f_{ub}\ A_s/\gamma_{M7} = 0.7\ f_{ub}\ A_s/1.1$

$F_{p,Cd}$ can be directly taken from the table on p. 104 of C5/18 [11].
According to SIA 263, the design slip resistance $F_{s,Rd}$ has to be calculated on basis of the design preload force $F_{p,Cd}$ (instead of using only the preload force $F_{p,C}$):

$F_{s,Rd} = \frac{k_s n \mu}{\gamma_{M3}} F_{p,Cd}$

where

k_s	reduction factor, the values depend on the type of hole and are the same as those given in table 3.6 of EN 1993-1-8.	
$\mu = 0.25$	this value can be considered without further analysis, higher values can be considered after surface treatment (c.f. table 3.8).	
$\gamma_{M3} = 1.10$	for the slip resistance in the SLS	(= category B in EN 1993-1-8)
$\gamma_{M3} = 1.25$	for the slip resistance in the ULS	(= category C in EN 1993-1-8)
$\gamma_{M3} = 1.40$	for the slip resistance of bolts in long slotted holes in the ULS	

p. 3-9 (a) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.1**

Bearing resistance: see comment to p. 2-25 (b).

p. 3-9 (b) (no NA symbol in *Connections*) **SIA 263, cl. 5.1.2.1**

Yielding of gross cross-section: see comment to p. 2-18.

p. 3-10 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.3**

$F_{p,Cd} = 0.7\ f_{ub}\ A_s/\gamma_{M7} = 0.7\ f_{ub}\ A_s/1.1 = 172/1.1 = 156\ kN$

$$F_{s,Rd,ser} = \frac{k_s n \mu}{\gamma_{M3,ser}} F_{p,Cd} = \frac{1.0 \cdot 2 \cdot 0.3}{1.1} \cdot 156 = 85.3\ kN$$

p. 3-11 (a) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.1**

Bearing resistance see comment to p. 2-31.

p. 3-11 (b) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.3**

$$F_{s,Rd} = \frac{k_s n \mu}{\gamma_{M3}} F_{p,Cd} = \frac{1.0 \cdot 2 \cdot 0.3}{1.25} \cdot 156 = 75.1\ kN$$

p. 3-11 (c) (no NA symbol in *Connections*)

SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$N_{net,Rd} = \frac{A_{net}\, f_y}{\gamma_{M0}} = \frac{440}{1.05} = 419\ kN$$

p. 3-15 (a) (no NA symbol in *Connections*) **SIA 263, cl.**

According to SIA 263, the design slip resistance $F_{s,Rd}$ and $F_{s,Rd,ser}$ have to be calculated on basis of the design preload force $F_{p,Cd}$ (instead of using only the preload force $F_{p,C}$):

category B $F_{s,Rd,ser} = \frac{k_s n \mu (F_{p,Cd} - 0.8 F_{p,t,Ed,ser})}{\gamma_{M3,ser}}$

category C $F_{s,Rd} = \frac{k_s n \mu (F_{p,Cd} - 0.8 F_{p,t,Ed})}{\gamma_{M3}}$

for k_s, μ, γ_{M3} and $\gamma_{M3,ser}$ see comment to p. 3.8.

p. 3-15 (b) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.6**

See comment to p. 2-29 (a).

p. 3-16 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.3**

$$F_{p,Cd} = 0.7\, f_{ub}\, A_s/\gamma_{M7} = 0.7\, f_{ub}\, A_s/1.1 = 212/1.1 = 193\ kN$$

$$F_{s,Rd} = \frac{k_s n \mu \left(F_{p,Cd} - 0.8 F_{p,t,Ed}\right)}{\gamma_{M3}} = \frac{1.0 \cdot 1 \cdot 0.5 \cdot (193 - 0.8 \cdot 55)}{1.25} = 59.5\ kN$$

$\frac{F_{s,Ed}}{F_{s,Rd}} = \frac{65.0}{59.5} = 1.09$ (not OK)

The required slip resistance is not met. However, M22 bolts are not recommended in Switzerland anyway, c.f. comment to p.2-11 (a). Using M24 bolts instead would suffice:

$$F_{p,Cd} = 0.7\, f_{ub}\, A_s/\gamma_{M7} = 0.7\, f_{ub}\, A_s/1.1 = 0.7 \cdot 1000 \cdot 353 \cdot 10^{-3}/1.1 = 225\ kN$$

$$F_{s,Rd} = \frac{k_s n \mu \left(F_{p,Cd} - 0.8 F_{p,t,Ed}\right)}{\gamma_{M3}} = \frac{1.0 \cdot 1 \cdot 0.5 \cdot (225 - 0.8 \cdot 55)}{1.25} = 72.3\ kN$$

$\frac{F_{s,Ed}}{F_{s,Rd}} = \frac{65.0}{72.3} = 0.90$ (OK)

p. 3-17 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.6**

Check for combined shear force:

$$\left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^2 + \left(\frac{F_{t,Ed}}{F_{t,Rd}}\right)^2 = \left(\frac{65}{121}\right)^2 + \left(\frac{142}{218}\right)^2 = 0.71 \leq 1.0 \quad \text{(OK)}$$

p. 3-19 (no NA symbol in *Connections*) **SN EN 1993-1-8/NA, cl 2.2 (2)**

$\gamma_{M4} = 1.10$ with reference to EN 1993-2. SIA 263 does not include regulations for injection bolts.

p. 3-22 (no NA symbol in *Connections*) **SN EN 1993-1-8/NA, cl 2.2 (2)**

$$F_{b,Rd,resin} = \frac{F_{b,Rk,resin}}{1.10} = \frac{117}{1.10} = 106\ kN$$

$F_{v,Ed} = 112\ kN > F_{b,Rd,resin} = 106$ (Not OK)

p. 3-23 (no NA symbol in *Connections*) **SN EN 1993-1-8/NA, cl 2.2 (2)**

$N_{b,Rd} = \frac{N_{b,Rk}}{1.05} = \frac{1645}{1.05} = 1567\ kN$ (OK)

p. 3-25 **SN EN 1993-1-8/NA, cl. 1.2.6**

Information regarding rivets and their inspection can be found in the following reference standard: SIA 269/3:2011. Erhaltung von Tragwerken – Stahlbau, SIA, Zürich.

p. 3-25 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.2.9**

Tensile stressed rivets are not permitted.

p. 3-26 (no NA symbol in *Connections*) **SIA 263, cl. 6.2.5**

The bearing resistance of the plate has to be restricted to:

$$\boldsymbol{F_{b,Rd} = \frac{1.5 f_y t d}{\gamma_{M2}}}$$

Additionally for a pin which has to prove motion:

Bearing resistance: $\boldsymbol{F_{b,ser} = 0.4\, f_{y,B} t d}$

Shear resistance: $\boldsymbol{F_{b,ser} = 0.3\, f_{y,B} \frac{\pi d^2}{2}}$

p. 3-28 **Literature**

Additional literature specific for Switzerland.

10. SN 505 263, Norm SIA 263: 2013, Stahlbau, SIA, Zürich, 2013.
11. steel**work** C5/18, SZS, 2018
12. SIA 269/ 3Erhaltung von Tragwerken – Stahlbau

Annex CH 4

Welds

p. 4-22 (no NA symbol in *Connections*) **SIA 263, cl. 6.3.2.5**

The effective length of a fillet weld shall be assumed to be equal to the total length of the fully executed weld. Lengths smaller than 40 mm may not be considered.

p. 4-23 (no NA symbol in *Connections*)

SIA 263 does not contain information on the directional method. As SN EN 1993-1-8 is also valid, the method can be used anyway.

p. 4-24 (no NA symbol in *Connections*) **SIA 263, cl. 6.3.2.2**

Additionally, to the verification given in equation (4.3) SIA 263 requires verification of the side cross section:

$\boldsymbol{F_{Ed} \leq s_{min} \Delta L \frac{f_s}{\gamma_{M2}}}$ with $\boldsymbol{f_s = 0.8 f_y}$

$\boldsymbol{s_{min}}$ smallest side cross section

p. 4-28 (no NA symbol in *Connections*) **SIA 263, cl. 6.3.2.2**

A verification according to SIA 263 requires verification of the side cross section.
Only side fillet welds

$\boldsymbol{s_{min} = \sqrt{2} \cdot a = \sqrt{2} \cdot 9 = 13\ mm}$

$\boldsymbol{F_{Ed} = 420 \leq s_{min} \Delta L \frac{f_s}{\gamma_{M2}} = 13 \cdot 2 \cdot 120 \cdot \frac{0.8 \cdot 235 \cdot 10^{-3}}{1.25} = 469\ kN}$ (OK)

Side fillet welds and end fillet weld

$\boldsymbol{s_{min} = \sqrt{2} \cdot a = \sqrt{2} \cdot 6 = 8.5\ mm}$

$\boldsymbol{F_{Ed} = 420 \leq s_{min} \Delta L \frac{f_s}{\gamma_{M2}} = 8.5 \cdot 360 \cdot \frac{0.8 \cdot 235 \cdot 10^{-3}}{1.25} = 460\ kN}$ (OK)

p. 4-29 (no NA symbol in *Connections*) **SIA 263, cl. 6.3.2.2**

A verification according to SIA 263 requires verification of the side cross section.

$\boldsymbol{s_{min} = \sqrt{2} \cdot a = \sqrt{2} \cdot 5 = 7\ mm}$

$\boldsymbol{F_{Ed} = 398 \leq s_{min} \Delta L \frac{f_s}{\gamma_{M2}} = 7 \cdot 2 \cdot 200 \cdot \frac{0.8 \cdot 235 \cdot 10^{-3}}{1.25} = 421\ kN}$ (OK)

p. 4-34

No additional remarks needed.

p. 4-35 **Literature**

Additional literature specific for Switzerland.

30. SN 505 263, Norm SIA 263: 2013, Stahlbau, SIA, Zürich, 2013.

Design and detailing of connections

p. 5-28 (no NA symbol) **SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$N_{pl,Rd} = \frac{b_p t_p f_y}{\gamma_{M0}} = \frac{1528}{1.05} = 1455\ kN$$

p. 5-29 (no NA symbol) **SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$t_p \geq \frac{F_{t,Ed}\gamma_{M0}}{2bf_y} = 12.3\ mm \cdot 1.05 = 12.9\ mm$$

p. 5-37 (no NA symbol) **SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$N_{pl,Rd} = \frac{A\,f_y}{\gamma_{M0}} = \frac{729}{1.05} = 694\ kN$$

p. 5-38 (no NA symbol) **SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$N_{t,Rd} = \frac{A\,f_y}{\gamma_{M0}} = \frac{395}{1.05} = 376\ kN$$

p. 5-40 (no NA symbol) **SIA 263, cl. 6.2.2.1, eq. (76)**

See comment to p. 2-25 (b) on the bearing resistance given in SIA 263.

$$F_{b,Rd} = 0.85\frac{e_1}{d_0}\frac{f_u}{\gamma_{M2}}\ d\ t = 0.85\frac{40}{26}\frac{360}{1.25}24 \cdot 20 \cdot 10^{-3} = 180\ kN \leq 2.4\frac{f_u}{\gamma_{M2}}\ d\ t = 332\ kN$$

p. 5-41 (a) (no NA symbol)**SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$N_{pl,Rd} = \frac{A\,f_y}{\gamma_{M0}} = \frac{1175}{1.05} = 119$$

p. 5-41 (b) (no NA symbol) **SIA 263, cl.6.2.4.3**

See comment to p. 2-21 on the block tearing approach given in SIA 263.

Results differ for SIA approach.

$$A_{v,brut} = 2(2p_1 + e_1)t_p = 2(2 \cdot 80 + 40) \cdot 20 = 8000mm^2$$

$$V_{eff,Rd} = \frac{0.9 \cdot f_u \cdot A_{nt} + \frac{f_y \cdot A_{v,brut}}{\sqrt{3}}}{\gamma_{M2}} = \frac{0.9 \cdot 360 \cdot 1280 \cdot 10^{-3} + \frac{235 \cdot 8000 \cdot 10^{-3}}{\sqrt{3}}}{1.25}$$
$$= 1200\ kN$$

p. 5-42 (a) (no NA symbol in *Connections*) **SIA 263, cl. 6.3.2.2**

See comment to p. 4-24 on the additional verification of the side cross section.

$$\boldsymbol{s_{min} = \sqrt{2} \cdot a = \sqrt{2} \cdot 5 = 7\ mm}$$

$$\boldsymbol{F_{Ed} = 850 \leq s_{min} \Delta L \frac{f_s}{\gamma_{M2}} = 7 \cdot 4 \cdot 240 \cdot \frac{0.8 \cdot 235 \cdot 10^{-3}}{1.25} = 1011\ kN}$$ (OK)

p. 5-42 (b) (no NA symbol) **SIA 263, cl.6.2.4.3**

See comment to p. 2-21 on the block tearing approach given in SIA 263.

Results differ for SIA approach.

$$\boldsymbol{V_{eff,Rd} = \frac{0.9 f_u}{\gamma_{M2}\sqrt{3}} A_V = \frac{855}{1.25} = 684\ kN}$$ (NOT OK)

p. 5-44 (a) (no NA symbol in *Connections*) **SIA 263, cl. 6.2.5**

See comment on p. 3-26 on the bearing resistance of the plate.

$$\boldsymbol{F_{b,Rd} = \frac{1.5 f_y t d}{\gamma_{M2}} = \frac{959}{1.25} = 767\ kN}$$ (NOT OK)

p. 5-44 (b) (no NA symbol)**SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$M_{Rd} = \frac{1.5 W_{el} f_{yp}}{\gamma_{M0}} = \frac{10.7}{1.05} = 10.2\ kNm$$

p. 5-50 (no NA symbol) **SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$\boldsymbol{\frac{\tau_{Ed}}{\frac{f_y}{\sqrt{3}\gamma_{M0}}} = 0.59 \cdot 1.05 = 0.62}$$ (OK)

p. 5-53 (no NA symbol in *Connections*) **SIA 263, cl.6.2.4.3**

See comment to p. 2-21.
Results differ for SIA approach.

$$A_{v,brut} = 350 \cdot 6 = 2100\ mm^2$$

$$V_{eff,Rd} = \frac{0.9 \cdot f_u \cdot A_{nt} + \frac{f_y \cdot A_{v,brut}}{\sqrt{3}}}{\gamma_{M2}} = \frac{0.9 \cdot 360 \cdot 234 \cdot 10^{-3} + \frac{235 \cdot 2100 \cdot 10^{-3}}{\sqrt{3}}}{1.25} = 289\ kN$$

p. 5-54 (no NA symbol) **SIA 263, cl. 6.2.2.1, eq. (76)**

See comment to p. 2-25 (b) on the bearing resistance given in SIA 263.

$$F_{b,Rd} = 0.85 \frac{e_1}{d_0} \frac{f_u}{\gamma_{M2}}\ d\ t = 0.85 \frac{50}{22} \frac{360}{1.25} 20 \cdot 10.2 \cdot 10^{-3} = 113\ kN \leq 2.4 \frac{f_u}{\gamma_{M2}}\ d\ t = 141\ kN$$

p. 5-55 (no NA symbol) **SIA 263, cl. 6.2.2.1, eq. (76)**

See comment to p. 5-54.

p. 5-63 (no NA symbol) **SN EN 1993-1-8/NA, cl. 2.2 (2) & SIA 263, cl. 5.1.2.1**

$\gamma_{M0} = \gamma_{M1} = 1.05$ in Switzerland.

$$\boldsymbol{M_{pl,Rd}} = \frac{\mathbf{1.35}}{\mathbf{1.05}} = \mathbf{1.29\ kNm}$$ (OK)

p. 5-64 (no NA symbol)

$$F_{T,1,Rd} = \frac{4\boldsymbol{M_{pl,Rd}}}{m} = \frac{4 \cdot 1.29}{34.3 \cdot 10^{-3}} = 150\ kN$$

$$F_{T,2,Rd} = \frac{2\boldsymbol{M_{pl,Rd}} + n \sum F_{t,Rd}}{m+n} = \frac{2 \cdot 1.29 + 35 \cdot 10^{-3} \cdot 6 \cdot 90.4}{(34.3 + 35) \cdot 10^{-3}} = 311\ kN$$

$$Q_1 = \frac{\boldsymbol{M_{pl,Rd}}}{n} = \frac{1.29}{35 \cdot 10^{-3}} = 36.7\ \mathrm{kN}$$

$$F_{b.Ed,1} = \frac{1}{6} \cdot 150 + \frac{1}{3} \cdot 36.7 = 37\ kN$$

p. 5-67 **Literature**

Additional literature specific for Switzerland.

5. SN 505 263, Norm SIA 263: 2013, Stahlbau, SIA, Zürich, 2013