Weld, Standard

This calculation module offers the calculation of welded joints loaded with static and dynamic loads. The base of the calculation of safety (utilization) are four different calculation standards and is chosen by the user. Base for this selection is generally the field of application or directly recommended by customer or certifier. It is possible to select between DVS 1612 and DVS 0705. The calculation of welds according the FKM guideline is only part of the extended version MDESIGN weld. The same applies for calculation of welds used in steel constructions according Eurocode 3. All these calculation standards based on stress concept for static and dynamic stress. The determination of working stress is not part of the calculation standards but it's part of the calculation module. Stress will be calculated in by using the nominal stress concept for known cross sections. The cross section of weld is determined by input of weld position and weld thickness. So of course, the calculation is limited to known cases. But with combination of the type of welded joint and geometry, lots of cases can be calculate. Only the weld seem will be taken into consideration.

Determination of working stress:
The determination of working stress doesn't differ by different calculation standards because it is not part of them. Stress will be calculated by general methods of applied mechanics. The input of working forces and moments must be in the plane of weld of course and are used directly for the calculation of stress utilization factor. Specially for beamed components often bending moments must be calculated before. So first calculate all the working loads in plane of weld, therefore also the calculation module “Beam” is useful. Model the beam situation with the welded joint as fix bearing and read all loadings and bearing conditions at weld.

Material database:
There are different material databases for the material of weld for the different calculation standards. The standard DVS 1612 offers only the standard materials S235 and S355. The largest number of materials exist in database of the FKM guideline. This database is used for standard DVS 0705.

Base of calculation

All used calculation standards for calculation module:

- DVS 1612	Edition August 2014	Design and fatigue strength assessment of welded connections with steels in rail vehicle construction
- DVS 0705	Edition February 2012	Recommendation for assigning evaluation groups according to DIN EN ISO 5817
- DIN EN ISO 5817	Edition October 2006	Welding - Fusion connections on steel - Assessment groups
- Hobbacher, IIW	Edition July 1996	Recommendations for the fatigue strength of welded connections and components

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Input data:

Weld, Standard

Calculation procedure	static strength proof
Calculation method	DVS 0705
Internal stresses	no/low internal stress

Weld, Standard

Geometry

Geometry of the weld

Connection form of the weld	Connection of a girder	
Girder geometry	Standard profiles	
Weld type	Fillet weld	
Circumferential weld	yes	
Profile	Square, cold hollow sections DIN EN 10219-2	
Letter symbol	50x5	
Maximum part thickness at the weld	t_{max} = 4	mm

Girder cross sections and thickness of the welds

Width				b = 50	mm
Height				h = 50	mm
	above	below	right	left	
Part thickness	t = 5	5	5	5	mm
Weld thickness	a = 3	3	3	3	mm

Loading Data

Load specifications

Axial force	F_x = -700	N
Shear load	F_y = 1500	N
Shear load	F_z = 300	N
Bending moment	M_y = -25500	N·mm
Bending moment	M_z = 183500	N·mm
Torsional moment	T_x = 24000	N·mm

Factors for maximum load

Axial force Fx	1,5
Shear load Fy	1,5
Shear load Fz	1,5
Bending moment My	1,5
Bending moment Mz	1,5
Torsional moment Tx	1,5

Material Data

Material according to	MDESIGN database
Type of material	steel

Weld, Standard

Material designation	S235	
Ultimate strength	R_m = 360	N/mm²
Yielding point	R_e = 240	N/mm²
Material factor	1,1	
Own input of review group	No	

Results:

Calculation procedure: static strength proof

Geometry

Cross section

Position of the centre of gravity of the part	y_S	=	25	mm
Position of the centre of gravity of the part	z_S	=	25	mm
Position of the centre of gravity of the welds	y_{wS}	=	25	mm
Position of the centre of gravity of the welds	z_{wS}	=	25	mm

Cross section values of the weld

Weld	Area A_w mm²	Moment of gyration y-axis, 2 order I_w cm⁴	Moment of gyration z-axis, 2 order I_w cm⁴
above	150	3,125	0,011
below	150	3,125	0,011
right	150	0,011	3,125
left	150	0,011	3,125

Total area of the welds	A_{wges}	=	600	mm²
Total moment of gyration, y-axis	I_{wges}	=	25,023	cm⁴
Total moment of gyration, z-axis	I_{wges}	=	25,023	cm⁴

Cut sizes

			Amplitude	Mmean value	Upper load	Maximum load	Breaking equivalent load	
Axial load	F_x	=	-	-	-	-1,05	-	kN
Shear load	F_y	=	-	-	-	2,25	-	kN
Shear load	F_z	=	-	-	-	0,45	-	kN

Bending moment	M_y	=	-	-	-	-38,25	-	N·m
Bending moment	M_z	=	-	-	-	275,25	-	N·m
Torsional moment	T_x	=	-	-	-	36	-	N·m

Loading Data

Stresses in the welds

	Des.	Maximum load N/mm²
Stresses caused by axial force F_x	$\sigma_\perp$	-1,75
Stresses caused by shear force F_y	$\tau\|\|$	8,43
Stresses caused by shear force F_z	$\tau\|\|$	1,686
Stresses caused by bending moment M_y	$\sigma_\perp$	3,822
Stresses caused by bending moment M_z	$\sigma_\perp$	27,5
Stresses caused by torsional moment T_x	$\tau\|\|$	2,4

Normal stresses caused by axial force F_x (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
-1,167	-1,167	-1,167	-1,167	-1,167	-1,167	-1,167	-1,167	-1,167	-1,167	-1,167	-1,167
-1,75	-1,75	-1,75	-1,75	-1,75	-1,75	-1,75	-1,75	-1,75	-1,75	-1,75	-1,75

Shear stresses caused by shear load F_y (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
3,747	5,62	3,747	3,747	0	-3,747	3,747	5,62	3,747	3,747	0	-3,747
5,62	8,43	5,62	5,62	0	-5,62	5,62	8,43	5,62	5,62	0	-5,62

Program : MDESIGN 2020 -	User :	Customer :
Module version : 18.0.6	Date : 26.03.2024	Project :

Weld, Standard

Shear stresses caused by shear force F_z (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
-0,749	0	0,749	0,749	1,124	0,749	-0,749	0	0,749	0,749	1,124	0,749
-1,124	0	1,124	1,124	1,686	1,124	-1,124	0	1,124	1,124	1,686	1,124

Normal stresses caused by bending moment M_y (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
-2,548	-2,548	-2,548	-2,548	0	2,548	2,548	2,548	2,548	2,548	0	-2,548
-3,822	-3,822	-3,822	-3,822	0	3,822	3,822	3,822	3,822	3,822	0	-3,822

Normal stresses caused by bending moment Mz (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
18,333	0	-18,333	-18,333	-18,333	-18,333	-18,333	0	18,333	18,333	18,333	18,333
27,5	0	-27,5	-27,5	-27,5	-27,5	-27,5	0	27,5	27,5	27,5	27,5

Shear stresses caused by torsional moment T_x (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
-1,6	-1,6	-1,6	-1,6	-1,6	-1,6	1,6	1,6	1,6	1,6	1,6	1,6
-2,4	-2,4	-2,4	-2,4	-2,4	-2,4	2,4	2,4	2,4	2,4	2,4	2,4

Weld, Standard

Resultant normal stresses (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
14,619	-3,714	-22,048	-22,048	-19,5	-16,952	-16,952	1,381	19,715	19,715	17,167	14,619
21,929	-5,572	-33,072	-33,072	-29,25	-25,429	-25,429	2,072	29,572	29,572	25,75	21,929

Resultant shear stresses (row 1 under nominal load, row 2 under maximum load)

Point 1 N/mm²	Point 2 N/mm²	Point 3 N/mm²	Point 3* N/mm²	Point 4 N/mm²	Point 5* N/mm²	Point 5 N/mm²	Point 6 N/mm²	Point 7 N/mm²	Point 7* N/mm²	Point 8 N/mm²	Point 1* N/mm²
1,397	4,02	2,896	2,896	-0,476	-4,597	4,597	7,22	6,096	6,096	2,724	-1,397
2,096	6,03	4,344	4,344	-0,714	-6,896	6,896	10,83	9,144	9,144	4,086	-2,096

Static proof			weld above	weld below	weld right	weld left	
Max resultant normal stress	σ_{res}	=	-33,072	29,572	29,572	-33,072	N/mm²
Max resultant shear stress	τ_{res}	=	-6,896	9,144	10,83	6,03	N/mm²
Allowable normal stress	σ_{zul}	=	106,364	106,364	106,364	106,364	N/mm²
Allowable shear stress	τ_{zul}	=	106,364	106,364	106,364	106,364	N/mm²

Material Data

Material designation	S235			
Ultimate strength	R_m	=	360	N/mm²
Yielding point	R_e	=	240	N/mm²

Note:

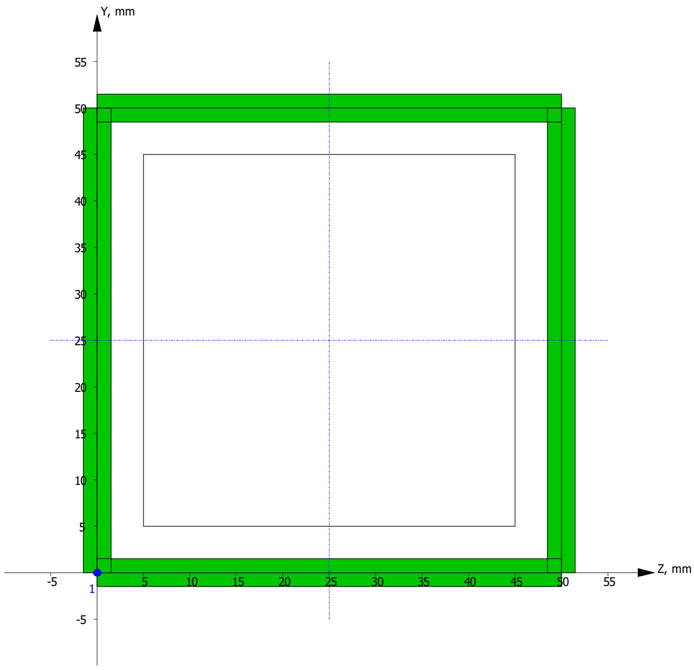
Static proof: 3,176e-1 < 1

Educational version

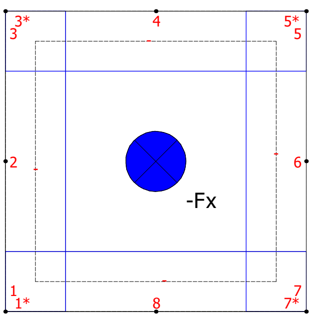
Program : MDESIGN 2020 -	User :	Customer :
Module version : 18.0.6	Date : 26.03.2024	Project :

Weld, Standard

Rectangular profile

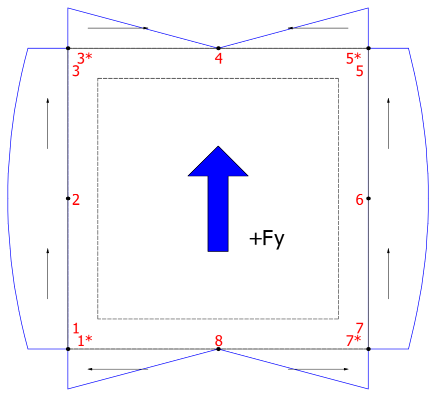


Normal stresses caused by axial force Fx

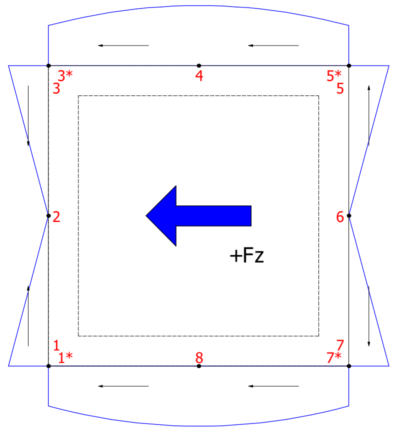


Weld, Standard

Shear stresses caused by shear force Fy

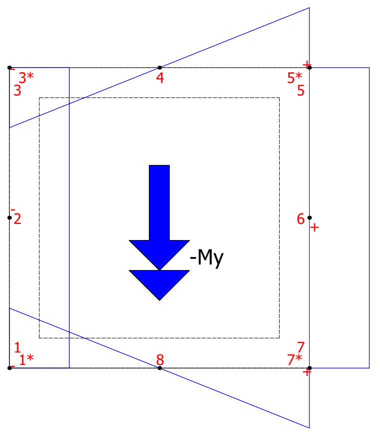


Shear stresses caused by shear force Fz

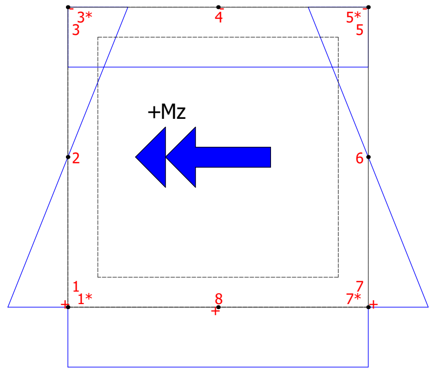


Weld, Standard

Normal stresses caused by bending moment My



Normal stresses caused by bending moment Mz



Weld, Standard

Shear stresses caused by torsional moment Tx