Hilti System MQ channel installation

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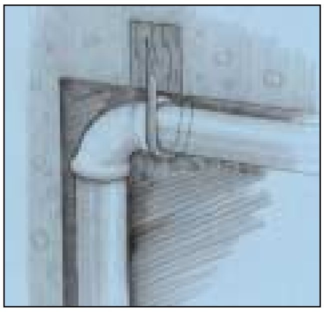
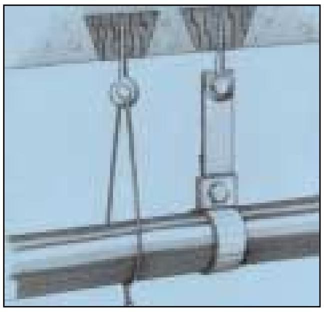
History of pipe fastening systems

Hooks, wire and strip metal

The materials used for the first methods of fastening pipes were hooks forged by local blacksmiths, temporary lengths of wire and simple strips of sheet metal. They were usually fastened to a ring bolt screwed into a cemented-in wooden plug.



Locally forged hook



Temporary wire and simple strip metal

Punched band and Rolli strap hanger

Since the middle of the 1970's, punched band and the Rolli strap hanger have been widely used for suspending pipes. The benefit of the Rolli strap hanger is that it can be installed efficiently and its height adjusted infinitely. This applies above all when an installation channel is used for multiple-pipe suspensions.

Punched band

Rolli strap hanger

Pipe rings

Industrially manufactured pipe rings made of malleable cast iron have been available since the beginning of the 19th. century. Nowadays though, pipe rings are mostly formed from steel. Fastening them to a building structure with internally threaded anchors and threaded rods causes a lot of effort and work if many pipes are being suspended. If installation channels are used as the basis, a large number of pipe rings can be used with little effort, while only two to three fastenings have to be made to the building structure.

Multiple-pipe suspension made with anchors and threaded rods

Multiple-pipe suspension made using an installation channel

M system structure for pipes in several layers

MN system structure on steel beams

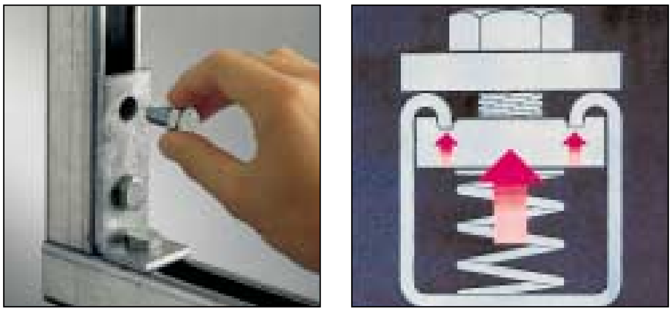
M, MN and MQ channel installation systems

As a result of mechanical and electrical installations in buildings becoming more and more complex, runs of cables, pipes, etc., on several planes have become commonplace. Installers began to weld or bolt steel sections together to form supporting structures. Hilti identified an opportunity here at an early date and developed easy-to-use solutions suitable for the applications. The modular-design of modern channel installation systems permits customised, economical solutions to be provided to suit the various requirements.

Individual phases in Hilti development work were:

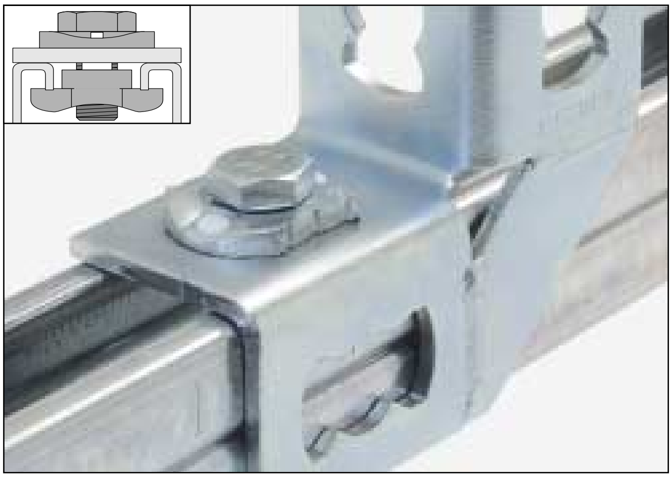
- 1990: M channel installation system
- 1996: MN channel installation system
- 2002: MQ channel installation system

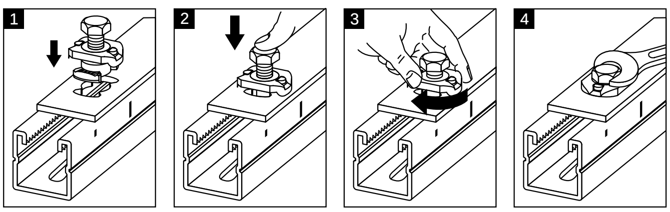
M system



M channel installation system: In the beginning, a serrated channel nut

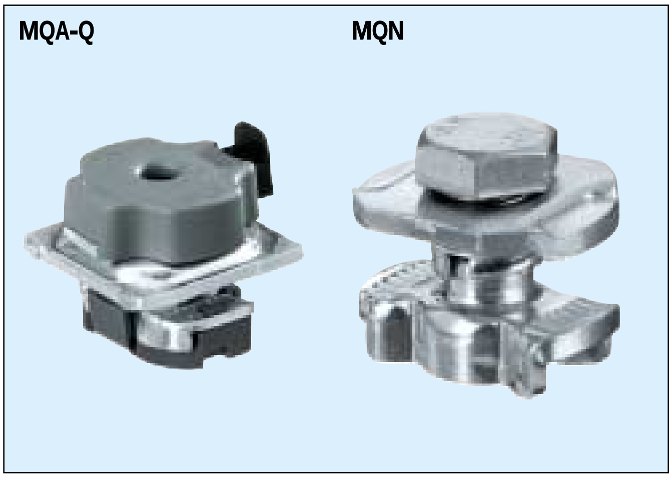
MN system

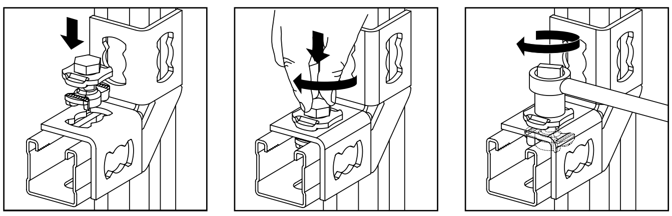




MN channel installation system:
A clear installation benefit from the single-part pushbutton

MQ system





MQ channel installation system:
Even greater installation efficiency with the new rapid pushbutton

Examples of applications

General benefits of Hilti MQ channel installation system:

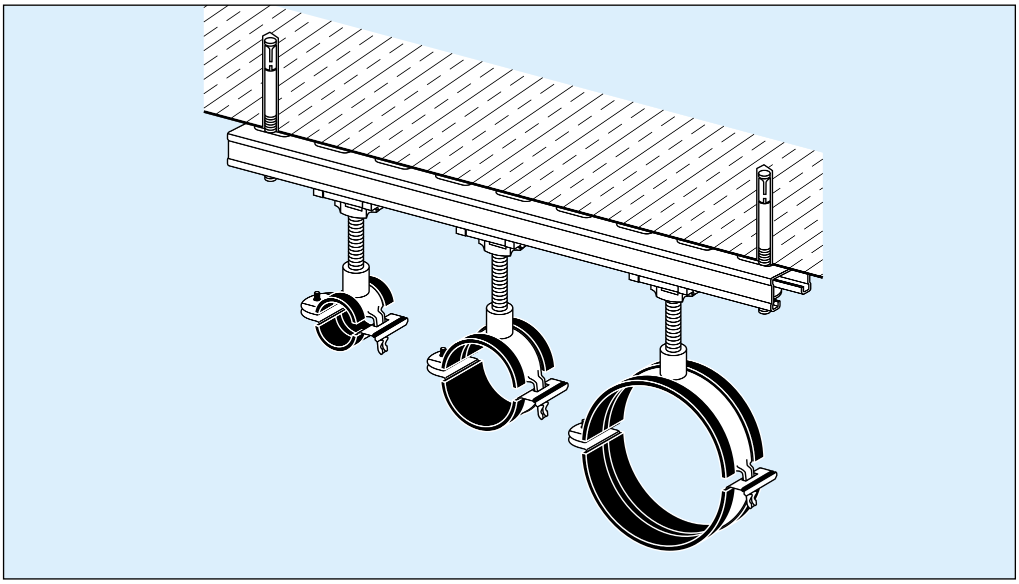
- Simple selection of channels ideal for applications
- Time-saving pipe ring installation (pipe ring and pipe ring saddle with push connection)
- Simple and accurate positioning of channels thanks to single-part rapid pushbutton
- Simple and quick connection of various channels thanks to a completely modular design
- Single-part rapid installation angle for 90° standard applications

Use:

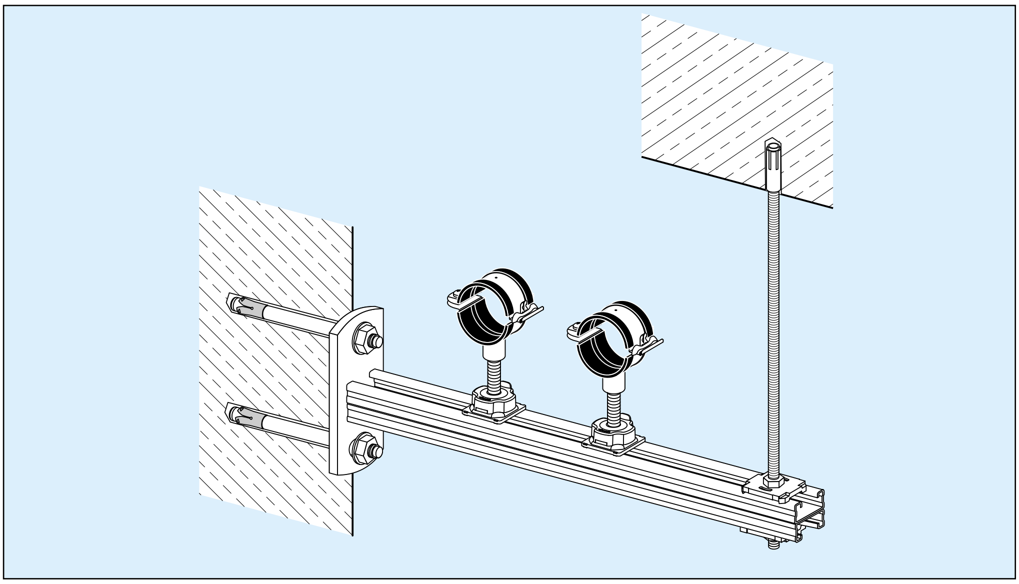
- Numerous possible uses by the mechanical and electrical installation trades
- Construction of supporting structures, bases, barriers, shelves and handrails

Trend in pipeline installation: Modular pipe run systems for various process lines

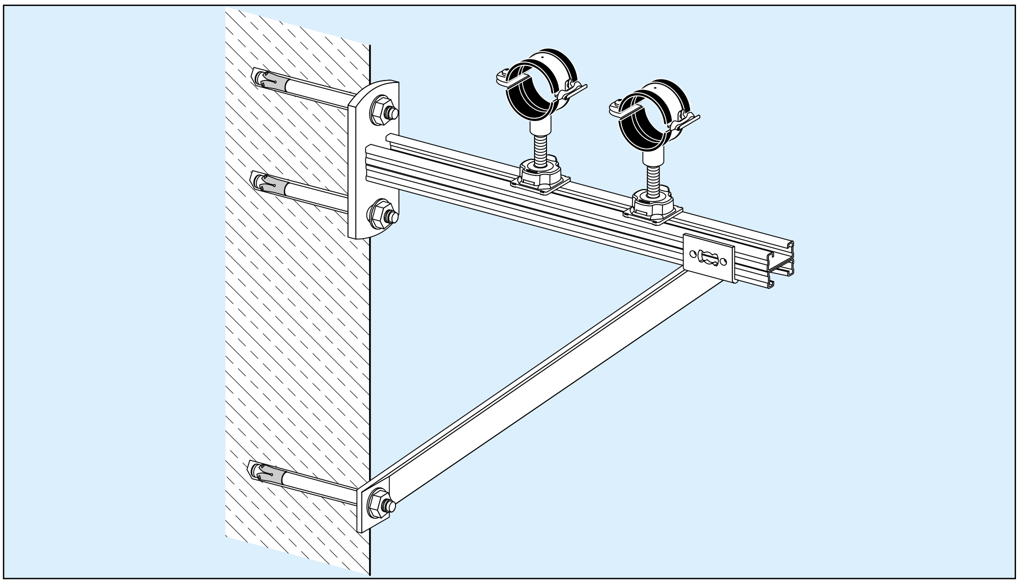
Channel on ceiling:
MQ-31 channel fastened with HST stud anchors
MPN-QRC pipe ring fastened to channel with MQA-Q pipe ring saddle



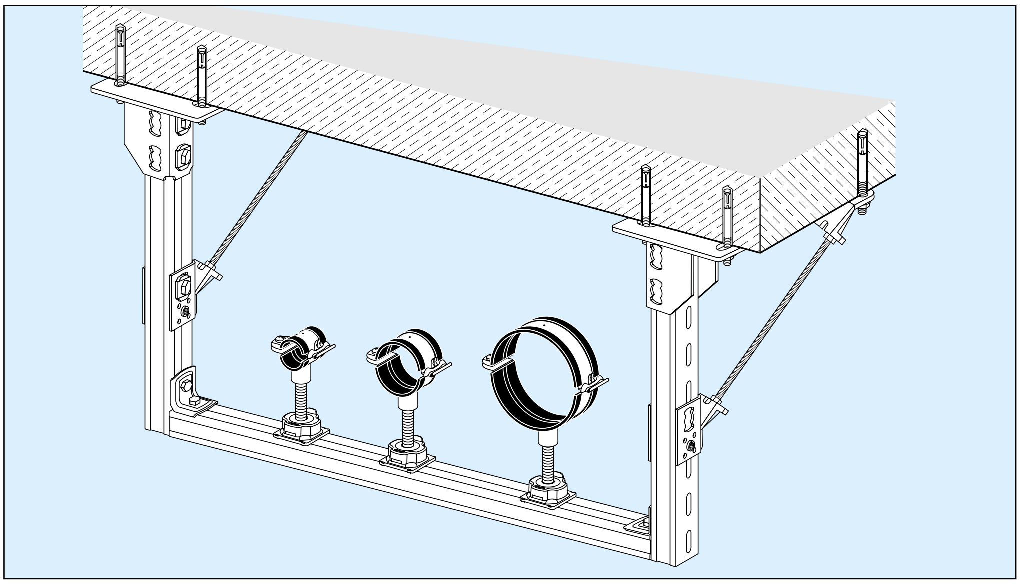
Cantilever-type bracket on wall:
MQK-21D bracket fastened with HST or HSA stud anchors and threaded rod support



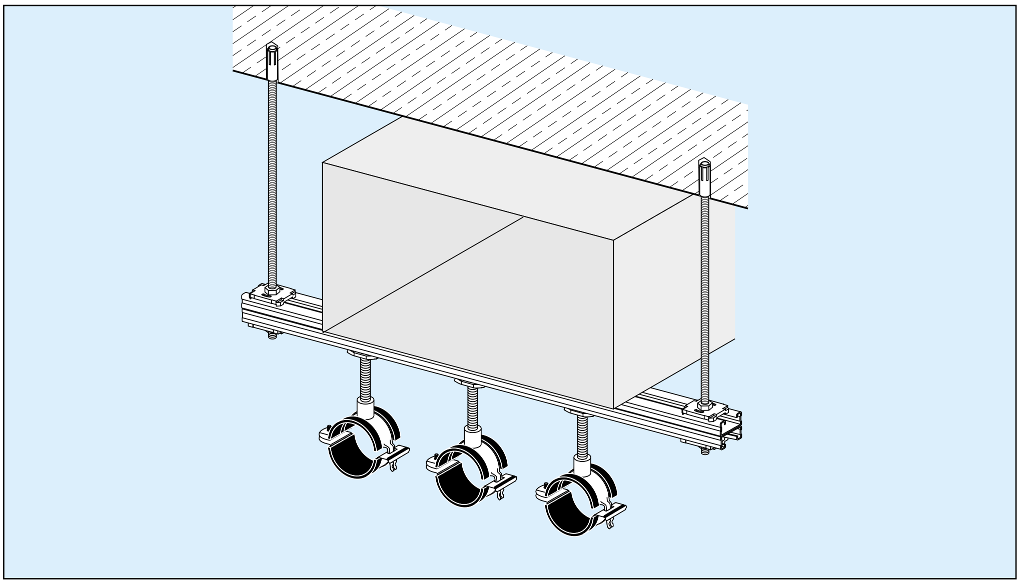
Cantilever-type bracket with brace:
MQK-21D bracket fastened with HST or HSA stud anchors and MQK-SK 45° brace



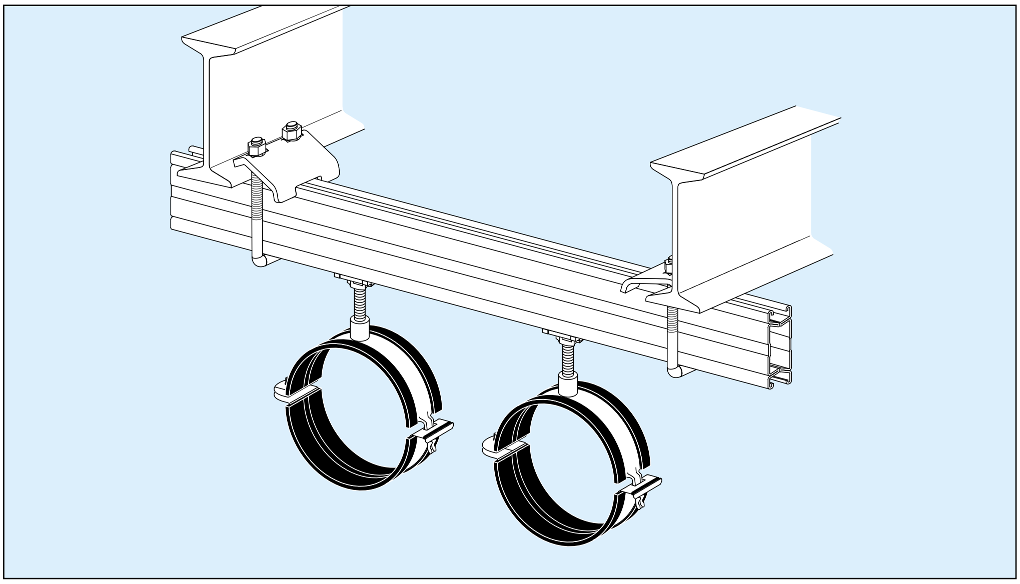
U-frame with bracing:
U-shaped structure with stiffening (bracing)

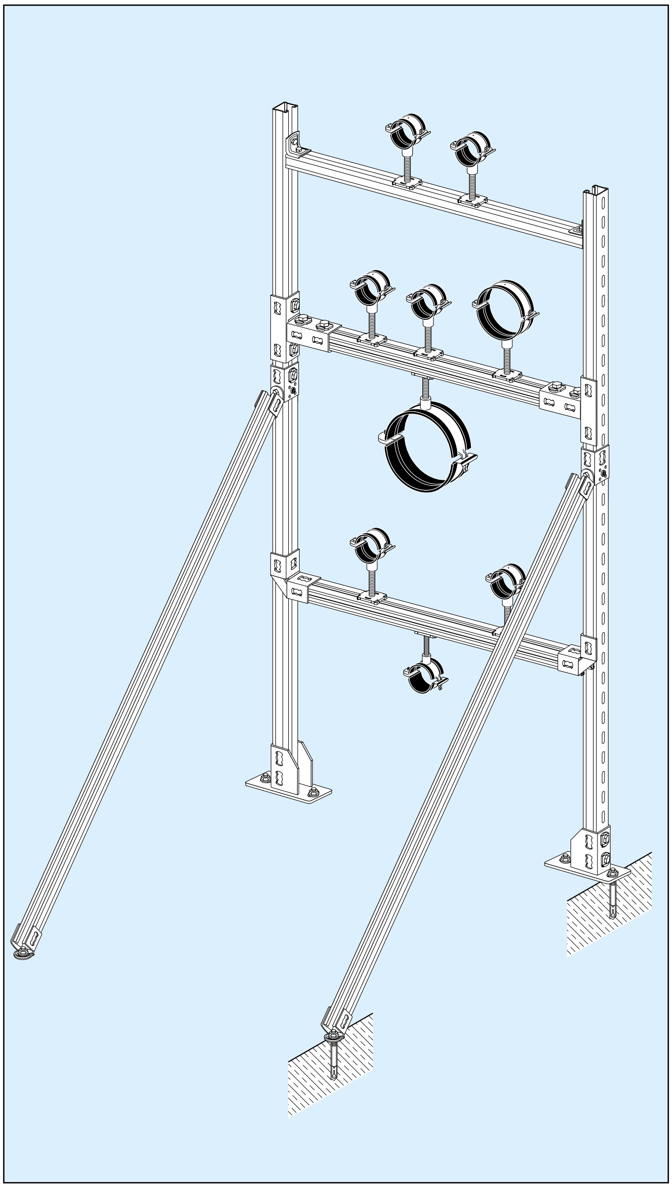


Air duct installation and pipe rings:
The perforated double channel permits infinite height adjustment when using MQZ or MQA-Q baseplates.

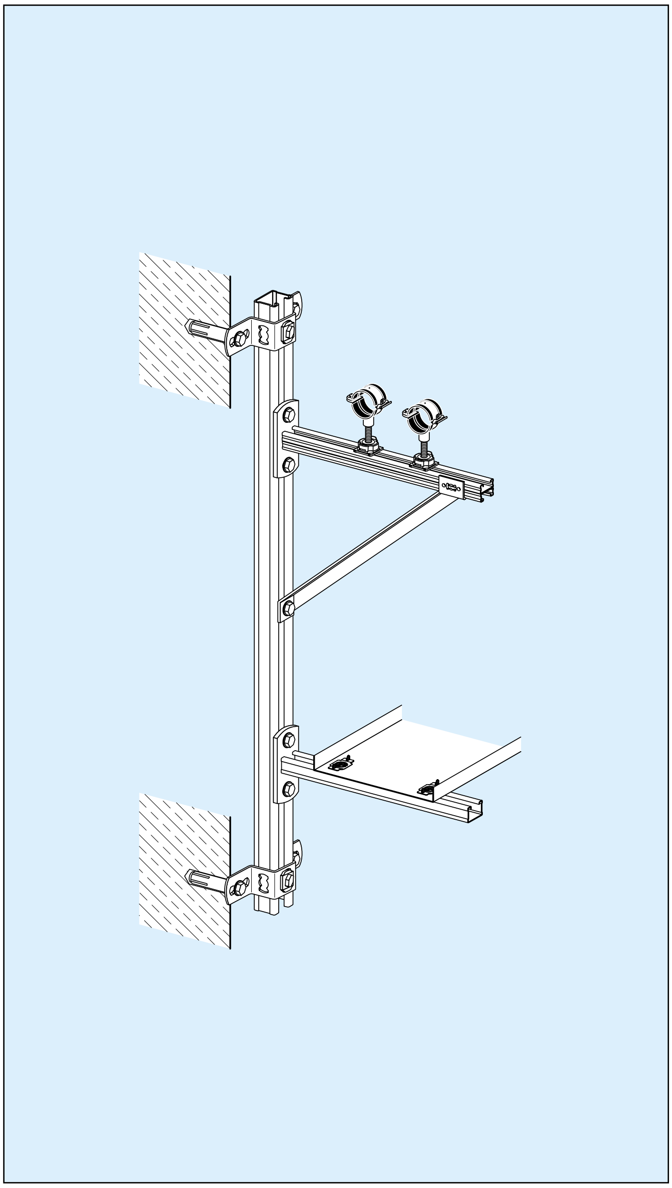


Fastening on steel beams:
Owing to its high section modulus (W_y = 30.33 cm^3), the MQ-124 XD double channel can be readily used for large spans and high loads.



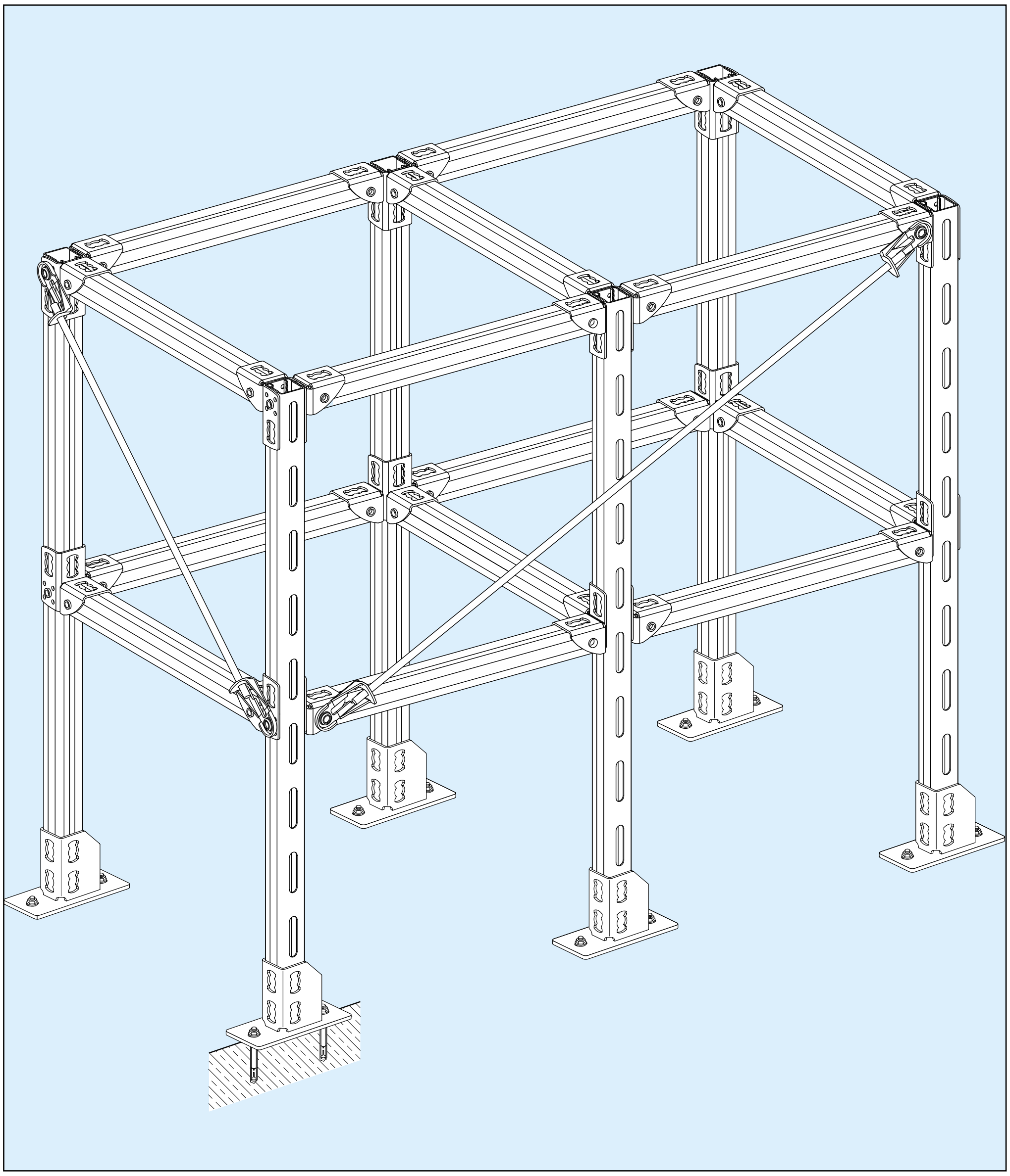


Installations on a vertical stand:
Stand with 45° bracing. Using the 3D system, this design can also take up loads along the pipe axis.

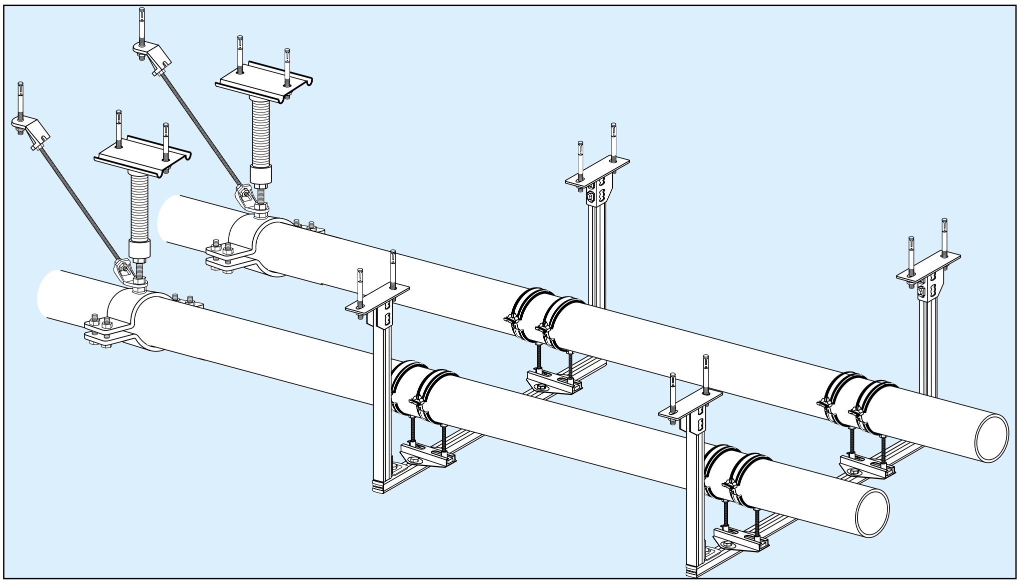


Wall bracket:
Bracket fastening, adjustable in height, supported with a 45° MQK-SK brace

3D structures with bracing:
The new 3D system permits structures to be braced in all directions, while taking up very little space. (See chapter 4 for more information about the 3D system.)

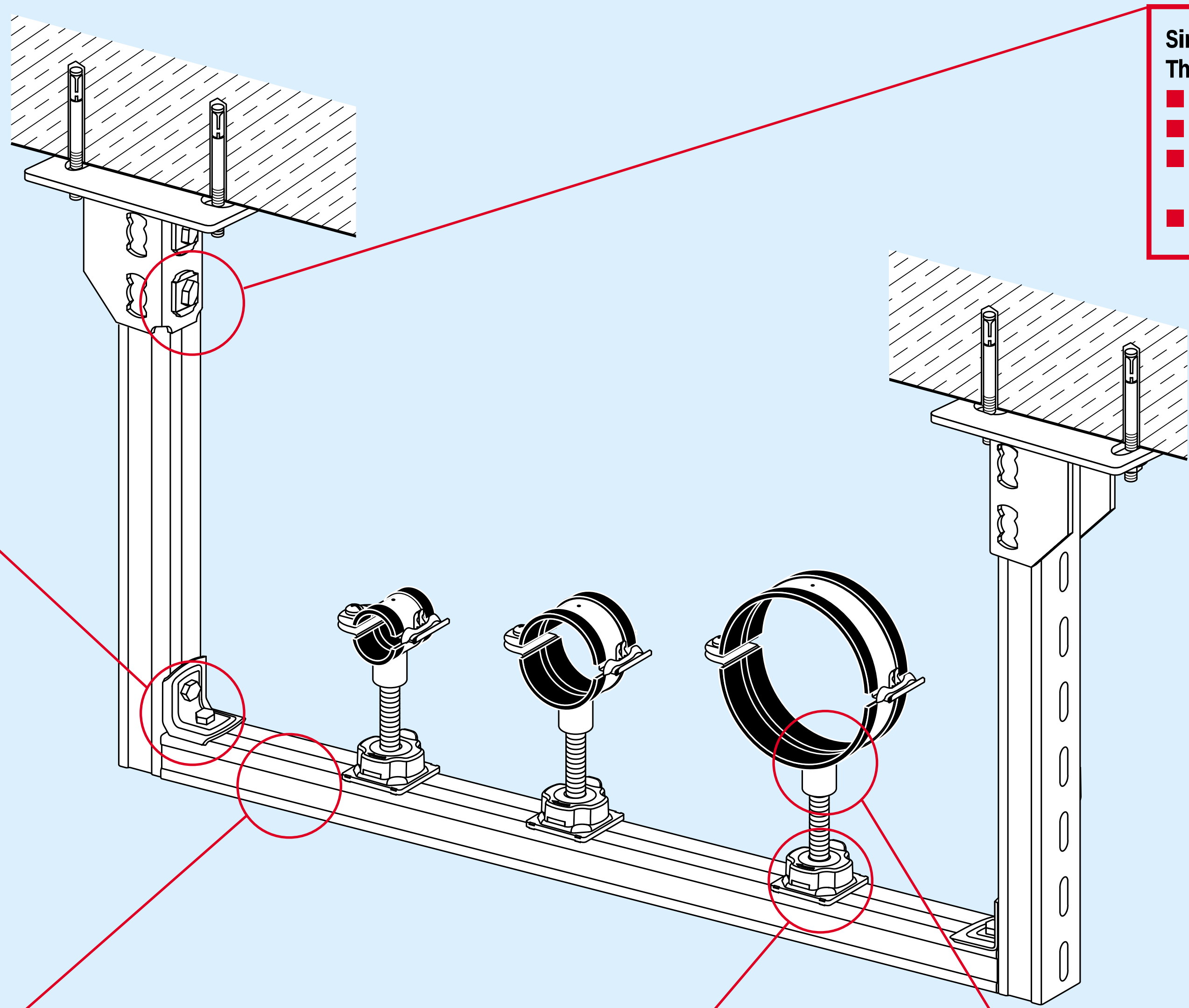


Use of fixed-points with double roll connectors:
Modular MFP fixed point used in conjunction with MQ system and MRG-D6 double roll connector

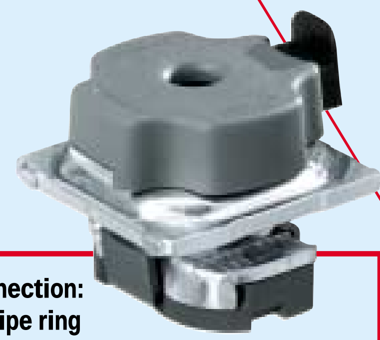


Economic aspects

Ingenious design: Pre-assembled 90° angle
- Only one part instead of three
- Quick installation
- Simple stocking
- Reliable keying hold in channel increases the strength
- Positioning and removal even easier than before
- No parts to be lost



Simplicity itself:
The new pushbutton
- Single-part, compact pushbutton very easy to use
- Quick installation thanks to simple positioning on channel
- One pushbutton for all channels for greater flexibility and functionality
- Easily removed and re-usable pushbutton



Strong design: New channels
- A wide programme for numerous applications
- A standard channel width guarantees system modularity.
- A pleasing design ensures a good appearance of visible structures.
- Serration guarantees better holding power.
- Graduation simplifies cutting to length and installation work.
- Slots ensure greater flexibility.
- Closed section for high loading and torsional stiffness

Time-saving with MN system:

	MN system Index	MQ system Index
MQN	100	90
MQA-Q	100	60
MPN-QRC	100	65
MQW-Q2	100	75
For entire structure (as shown)	**100**	**80**

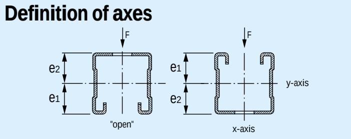
Revolutionary push connection:
New pipe ring saddle / pipe ring
- Pipe installation is quickest with Hilti: Push connections on MQA-Q pipe ring saddle and MPN-QRC pipe ring
- No deburring of threaded rods required
- Installation work without any additional tools
- Height adjustment when installed
- Coordinated loading capacities of pipe ring and pipe ring saddle

MPN-QRC push-connection pipe ring:
- Push- in connection: A much faster method than screwing in
- No deburring: no reworking of threaded rods
- Reliable loading capacity: Same loading capacity as pipe rings with screwed connection
- No twisting out of rubber inlay: Innovative slide strip for trouble-free pipe positioning
- Removal: Unscrew as in the past.

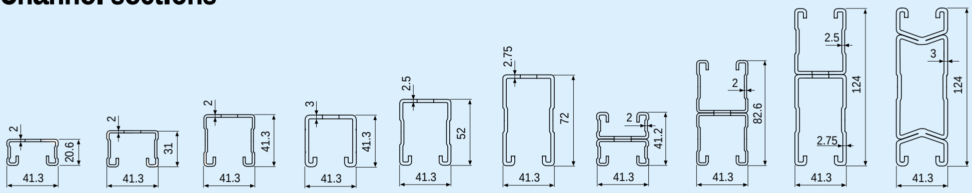
Section properties incl. torsional section properties

Technical data

Definition of axes



Channel sections



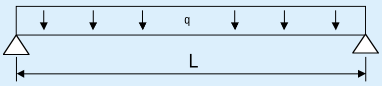
		MQ-21	MQ-31	MQ-41	MQ-41/3	MQ-52	MQ-72	MQ-21 D	MQ-41 D	MQ-52-72 D	MQ-124X D
Wall thickness,	t [mm]	2.0	2.0	2.0	3.0	2.5	2.75	2.0	2.0	2.5/2.75	3.0
Cross-sectional area,	A [mm²]	165.3	204.9	245.1	348,.4	352.1	492.8	330.6	490.3	844.9	1237.2
Channel weight,	[kg/m]	1.44	1.76	2.08	2.91	2.94	4.10	2.90	4.19	7.08	9.84
Supplied length,	[m]	3/6	3/6	3/6	3/6	6	6	3/6	3/6	6	6
Mechanical properties of material											
Yield strength,	$f_{y,k}$ [N/mm²]	290.0	280.0	270.0	290.0	280.0	270.0	290.0	270.0	270.0	250.0
Permissible tensile stress,	$\sigma_{zul.}$ [N/mm²]	188.3	181.8	175.3	188,.3	181.8	175.3	188.3	175.3	175.3	162.3
Permissible shear stress,	$\tau_{max.}$ [N/mm²]	108.7	105.0	101.2	108.7	105.0	101.2	108.7	101.2	101.2	93.7
Modulus of elasticity,	[N/mm²]	210000	210000	210000	210000	210000	210000	210000	210000	210000	210000
Modulus in shear	[N/mm²]	81000	81000	81000	81000	81000	81000	81000	81000	81000	81000
Surface finish											
Sendzimir galvanized, 250 g/m² ≙ 20 microns		●	●	●	●	●	●	●	●	●	●
Section values											
y-axis											
Axis of gravity "open" [1]	e_1 [mm]	10.84	16.01	21.13	21.52	26.67	36.79	20.60	41.30	62.02	62,00
Axis of gravity,	e_2 [mm]	–9.76	–14.99	–20.17	–19.78	–25.33	–35.22	–20.60	–41.30	–61.99	–62,00
Distance from axis of gravity to shear center,	$z_{M\,(A.\,of\,G.)}$ [mm]	–20.5	–31.4	–42.0	–40.0	–51.8	–71.1	0	0	–20.4	0
Moment of inertia,	I_y [cm⁴]	0,.2	2.60	5.37	7.02	11.41	28.70	4.98	30.69	115.41	188.04
Section modulus, "open",	W_{y1} [cm³]	0.85	1.62	2.54	3.26	4.28	7.80	2.42	7.43	18.61	30,33
Section modulus,	W_{y2} [cm³]	0.94	1.73	2.66	3.55	4.50	8.15	2.42	7.43	18.62	30,33
Radius of gyration,	i_y [cm]	0.74	1.13	1.48	1.42	1.80	2.41	1.23	2.50	3.70	3,90
Permissible moment [2]	M_y [Nm]	159	295	446	614	778	1368	455	1303	3263	4923
Static moment,	$S_{y\,max.}$ [cm³]	0.57	1.06	1.65	2.23	2.84	5.27	1.61	4.94	13,18	22.08
z-axis											
Moment of inertia,	I_z [cm⁴]	4.39	5.83	7.33	10.44	10.79	15.40	8.78	14.67	26.13	31.62
Section modulus	W_z [cm³]	2.13	2.82	3.55	5.06	5.23	7.46	4.25	7.10	12.65	15.31
Radius of gyration,	i_z [cm]	1.63	1.69	1.73	1.73	1.75	1.77	1.63	1.73	1.76	1.60
Static moment,	$S_{z\,max.}$ [cm³]	1.31	1.69	2.08	2.96	3.03	4.30	2.63	4.16	7.33	9.28
Torsional data											
Torsional moment of inertia,	ΣI_t [cm³]	0.022	0.026	0.031	0.102	0.071	0.122	0.043	0.063	0.193	36.44
Buckling moment of inertia,	$I_{\omega\omega} = C_M$ [cm³]	5.28	14.40	29.20	35.58	56.67	127.57	22.28	133.63	448.33	56.18
Unit buckling,	$\omega_{max.}$ [cm³]	2.80	4..8	6.23	5.49	7.46	10.02	4.45	9.45	14.00	2.83
Buckling plane moment,	$S\omega_{max}$ [cm³]	0.64	1.05	1.49	1.87	2.19	3.23	1.10	2.39	4.58	2.94

[1] The smaller value of (W_{y1}. W_{y2}) is decisive for the calculated (theoretical) bending dimension ($W_{y1} = I_y/e_1$ bzw. $W_{y2} = I_y/e_2$).

[2] Permissible $m_y = \sigma_{perm.} \cdot$ min. (W_{y1}. W_{y2})

Single-span channel: Formulae (simply-supported beam theory)

Loading condition 1:
Single-span channel with uniformly distributed load over span width L



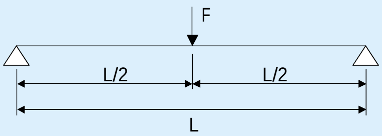
$$M_{max} = \frac{q * L^{2}\leq}{8} = \sigma_{perm.} * W$$

$$q = \frac{8 * \sigma_{perm.} * W}{L^{2}\leq}$$

$$f_{max} = \frac{5}{384} * \frac{q * L^4}{E * I}$$

$$q = \frac{384}{5} * \frac{E * I * f_{max}}{L^4}$$

Loading condition 2:
Single-span channel with single load at mid-span L/2



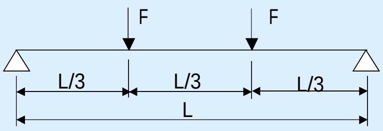
$$M_{max} = \frac{F * L}{4} = \sigma_{perm.} * W$$

$$F = \frac{4 * \sigma_{perm.} * W}{L}$$

$$f_{max} = \frac{1}{48} * \frac{F * L^3}{E * I}$$

$$F = 48 * \frac{E * I * f_{max}}{L^3}$$

Loading condition 3:
Single-span channel with two single loads each at L/3



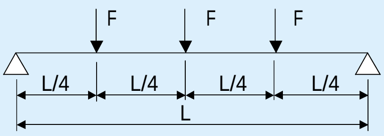
$$M_{max} = \frac{F * L}{3} = \sigma_{perm.} * W$$

$$F = \frac{3 * \sigma_{perm.} * W}{L}$$

$$f_{max} = \frac{23}{648} * \frac{F * L^3}{E * I}$$

$$F = \frac{648}{23} * \frac{E * I * f_{max}}{L^3}$$

Loading condition 4:
Single-span channel with three single loads each at L/4



$$M_{max} = \frac{F * L}{2} = \sigma_{perm.} * W$$

$$F = \frac{2 * \sigma_{perm.} * W}{L}$$

$$f_{max} = 0.04948 * \frac{F * L^3}{E * I}$$

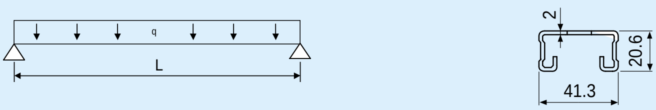
$$F = \frac{1}{0.04948} * \frac{E * I * f_{max}}{L^3}$$

M = bending moment	(kNcm)	E = modulus of elasticity	(kN/cm²)
F = single load	(kN)	I = moment of inertia	(cm⁴)
q = uniformly distributed load	(kN/cm)	W = section modulus	(cm³)
L = span width (channel length)	(cm)	f = deflection	(cm)
σ = stress	(kN/cm²)		

Single-span channels: Tables for MQ-21 channel

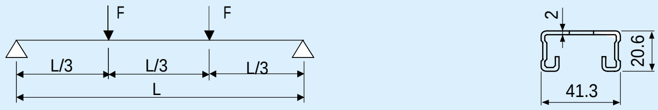
F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

Single-span channel with uniaxial deflection
Uniformly distributed load



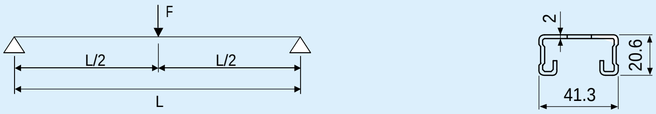
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	20.38	5.10	0.5	–	–	–	–
50	5.09	2.54	2.2	–	–	1.97	1.7
75	2.25	1.69	4.8	1.30	3.8	0.87	2.5
100	1.26	1.26	8.6	0.73	5.0	0.48	3.3
125	0.80	1.00	13.5	0.46	6.3	0.30	4.2
150	0.55	0.83	19.4	0.31	7.5	0.20	5.0
175	0.40	0.70	26.4	0.22	8.8	0.14	5.8
200	0.30	0.61	34.5	0.16	10.0	0.09	6.7
225	0.24	0.53	43.6	0.11	11.3	0.07	7.5
250	0.19	0.47	53.9	0.08	12.5	0.04	8.3
275	0.15	0.42	65.2	0.06	13.8	0.03	9.2
300	0.13	0.38	77.6	0.04	15.0	0.01	10.0
325	0.11	0.35	91.0	0.02	16.3	–	–
350	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–

Single-span channel with uniaxial deflection
Two concentrated loads



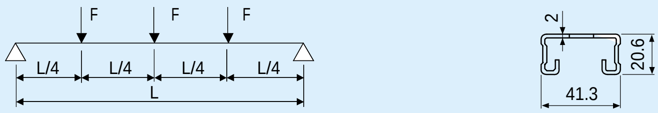
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		1.89	0.5	–	–	–	–
50		0.95	2.2	–	–	0.72	1.7
75		0.63	4.9	0.48	3.8	0.32	2.5
100		0.47	8.8	0.27	5.0	0.18	3.3
125		0.38	13.8	0.17	6.3	0.11	4.2
150		0.31	19.8	0.11	7.5	0.07	5.0
175		0.26	26.9	0.08	8.8	0.05	5.8
200		0.23	35.2	0.06	10.0	0.03	6.7
225		0.20	44.5	0.04	11.3	0.02	7.5
250		0.18	55.0	0.03	12.5	0.02	8.3
275		0.16	66.5	0.02	13.8	–	–
300		0.14	79.1	0.01	15.0	–	–
325		0.13	92.8	–	–	–	–
350		–	–	–	–	–	–
375		–	–	–	–	–	–
400		–	–	–	–	–	–
425		–	–	–	–	–	–
450		–	–	–	–	–	–
475		–	–	–	–	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channel with uniaxial deflection
Single concentrated load



Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		2.53	0.4	–	–	–	–
50		1.27	1.7	–	–	1.23	1.7
75		0.84	3.9	0.82	3.8	0.54	2.5
100		0.63	6.9	0.45	5.0	0.30	3.3
125		0.50	10.8	0.28	6.3	0.19	4.2
150		0.41	15.6	0.19	7.5	0.12	5.0
175		0.35	21.3	0.14	8.8	0.08	5.8
200		0.30	27.9	0.10	10.0	0.06	6.7
225		0.27	35.4	0.07	11.3	0.04	7.5
250		0.24	43.8	0.05	12.5	0.03	8.3
275		0.21	53.2	0.04	13.8	0.02	9.2
300		0.19	63.6	0.02	15.0	–	–
325		0.17	75.0	0.01	16.3	–	–
350		0.16	87.4	–	–	–	–
375		0.14	100.8	–	–	–	–
400		–	–	–	–	–	–
425		–	–	–	–	–	–
450		–	–	–	–	–	–
475		–	–	–	–	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channel with uniaxial deflection
Three concentrated loads

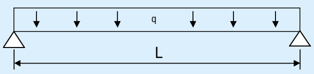


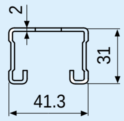
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		1.26	0.5	–	–	–	–
50		0.63	2.0	–	–	0.52	1.7
75		0.42	4.6	0.34	3.8	0.23	2.5
100		0.31	8.2	0.19	5.0	0.13	3.3
125		0.25	12.8	0.12	6.3	0.08	4.2
150		0.21	18.4	0.08	7.5	0.05	5.0
175		0.18	25.1	0.06	8.8	0.04	5.8
200		0.15	32.8	0.04	10.0	0.02	6.7
225		0.13	41.6	0.03	11.3	0.02	7.5
250		0.12	51.3	0.02	12.5	0.01	8.3
275		0.11	62.2	0.02	13.8	–	–
300		0.10	74.1	0.01	15.0	–	–
325		0.09	87.0	–	–	–	–
350		–	–	–	–	–	–
375		–	–	–	–	–	–
400		–	–	–	–	–	–
425		–	–	–	–	–	–
450		–	–	–	–	–	–
475		–	–	–	–	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channels: Tables for MQ-31 channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

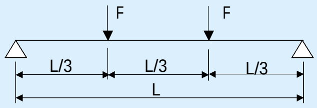
Single-span channel with uniaxial deflection
Uniformly distributed load

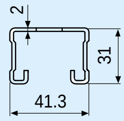




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	37.72	9.43	0.4	–	–	–	–
50	9.42	4.71	1.4	–	–	–	–
75	4.18	3.13	3.2	–	–	2.47	2.5
100	2.34	2.34	5.6	2.08	5.0	1.38	3.3
125	1.49	1.87	8.8	1.32	6.3	0.87	4.2
150	1.03	1.55	12.7	0.90	7.5	0.59	5.0
175	0.75	1.32	17.3	0.65	8.8	0.43	5.8
200	0.57	1.14	22.5	0.49	10.0	0.31	6.7
225	0.45	1.01	28.5	0.37	11.3	0.24	7.5
250	0.36	0.90	35.2	0.29	12.5	0.18	8.3
275	0.29	0.81	42.6	0.23	13.8	0.14	9.2
300	0.24	0.73	50.7	0.18	15.0	0.10	10.0
325	0.21	0.67	59.5	0.14	16.3	0.07	10.8
350	0.17	0.61	69.0	0.11	17.5	0.05	11.7
375	0.15	0.56	79.2	0.08	18.8	0.03	12.5
400	0.13	0.52	90.1	0.06	20.0	0.02	13.3
425	0.11	0.48	101.7	0.04	21.3	–	–
450	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–

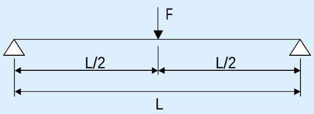
Single-span channel with uniaxial deflection
Two concentrated loads

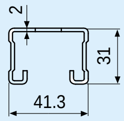




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		3.48	0.4	–	–	–	–
50		1.76	1.4	–	–	–	–
75		1.17	3.2	–	–	0.91	2.5
100		0.88	5.8	0.76	5.0	0.51	3.3
125		0.70	9.0	0.48	6.3	0.32	4.2
150		0.58	12.9	0.33	7.5	0.22	5.0
175		0.49	17.6	0.24	8.8	0.16	5.8
200		0.43	23.0	0.18	10.0	0.12	6.7
225		0.38	29.1	0.14	11.3	0.09	7.5
250		0.34	35.9	0.11	12.5	0.07	8.3
275		0.30	43.5	0.08	13.8	0.05	9.2
300		0.28	51.7	0.07	15.0	0.04	10.0
325		0.25	60.7	0.05	16.3	0.03	10.8
350		0.23	70.4	0.04	17.5	0.02	11.7
375		0.21	80.8	0.03	18.8	0.01	12.5
400		0.19	91.9	0.02	20.0	–	–
425		–	–	–	–	–	–
450		–	–	–	–	–	–
475		–	–	–	–	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

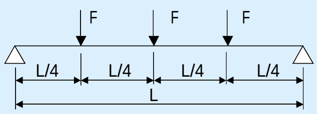
Single-span channel with uniaxial deflection
Single concentrated load

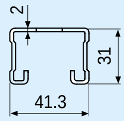




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		4.68	0.3	–	–	–	–
50		2.35	1.1	–	–	–	–
75		1.56	2.5	–	–	1.54	2.5
100		1.17	4.5	–	–	0.86	3.3
125		0.93	7.1	0.82	6.3	0.54	4.2
150		0.77	10.2	0.57	7.5	0.37	5.0
175		0.66	13.9	0.41	8.8	0.27	5.8
200		0.57	18.2	0.31	10.0	0.20	6.7
225		0.50	23.0	0.23	11.3	0.15	7.5
250		0.45	28.5	0.18	12.5	0.11	8.3
275		0.40	34.6	0.14	13.8	0.09	9.2
300		0.37	41.2	0.11	15.0	0.06	10.0
325		0.33	48.5	0.09	16.3	0.05	10.8
350		0.31	56.5	0.07	17.5	0.03	11.7
375		0.28	65.0	0.05	18.8	0.02	12.5
400		0.26	74.3	0.04	20.0	0.01	13.3
425		0.24	84.1	0.03	21.3	–	–
450		0.22	94.7	0.02	22.5	–	–
475		–	–	–	–	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channel with uniaxial deflection
Three concentrated loads



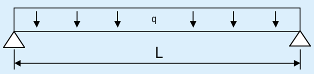


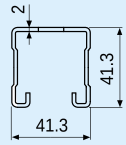
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		2.32	0.3	–	–	–	–
50		1.17	1.3	–	–	–	–
75		0.78	3.0	–	–	0.65	2.5
100		0.58	5.3	0.55	5.0	0.36	3.3
125		0.47	8.4	0.35	6.3	0.23	4.2
150		0.39	12.0	0.24	7.5	0.16	5.0
175		0.33	16.4	0.17	8.8	0.11	5.8
200		0.29	21.4	0.13	10.0	0.08	6.7
225		0.25	27.1	0.10	11.3	0.06	7.5
250		0.22	33.5	0.08	12.5	0.05	8.3
275		0.20	40.6	0.06	13.8	0.04	9.2
300		0.18	48.3	0.05	15.0	0.03	10.0
325		0.17	56.8	0.04	16.3	0.02	10.8
350		0.15	65.9	0.03	17.5	0.01	11.7
375		0.14	75.7	0.02	18.8	–	–
400		0.13	86.2	0.02	20.0	–	–
425		0.12	97.3	0.01	21.3	–	–
450		–	–	–	–	–	–
475		–	–	–	–	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channels: Tables for MQ-41 channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

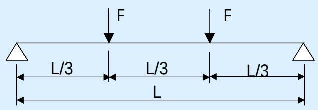
Single-span channel with uniaxial deflection
Uniformly distributed load

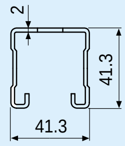




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	57.06	14.26	0.3	–	–	–	–
50	14.25	7.12	1.0	–	–	–	–
75	6.32	4.74	2.3	–	–	–	–
100	3.55	3.55	4.1	–	–	2.87	3.3
125	2.26	2.83	6.4	2.75	6.3	1.82	4.2
150	1.56	2.35	9.3	1.89	7.5	1.25	5.0
175	1.14	2.00	12.6	1.38	8.8	0.91	5.8
200	0.87	1.74	16.5	1.04	10.0	0.68	6.7
225	0.68	1.54	20.8	0.81	11.3	0.52	7.5
250	0.55	1.37	25.7	0.64	12.5	0.41	8.3
275	0.45	1.24	31.1	0.52	13.8	0.32	9.2
300	0.38	1.13	37.0	0.42	15.0	0.26	10.0
325	0.32	1.03	43.5	0.34	16.3	0.21	10.8
350	0.27	0.95	50.4	0.28	17.5	0.16	11.7
375	0.23	0.87	57.9	0.23	18.8	0.13	12.5
400	0.20	0.81	65.9	0.19	20.0	0.10	13.3
425	0.18	0.75	74.3	0.15	21.3	0.07	14.2
450	0.16	0.70	83.3	0.12	22.5	0.05	15.0
475	0.14	0.65	92.9	0.09	23.8	0.03	15.8
500	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–

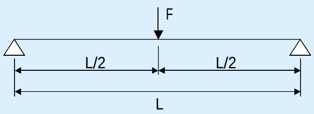
Single-span channel with uniaxial deflection
Two concentrated loads

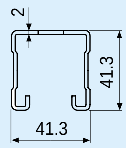




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		5.26	0.3	–	–	–	–
50		2.66	1.0	–	–	–	–
75		1.77	2.4	–	–	–	–
100		1.33	4.2	–	–	1.05	3.3
125		1.06	6.6	1.01	6.3	0.67	4.2
150		0.88	9.5	0.70	7.5	0.46	5.0
175		0.75	12.9	0.51	8.8	0.33	5.8
200		0.65	16.8	0.38	10.0	0.25	6.7
225		0.58	21.3	0.30	11.3	0.19	7.5
250		0.52	26.3	0.24	12.5	0.15	8.3
275		0.46	31.8	0.19	13.8	0.12	9.2
300		0.42	37.8	0.15	15.0	0.09	10.0
325		0.39	44.4	0.13	16.3	0.08	10.8
350		0.35	51.5	0.10	17.5	0.06	11.7
375		0.33	59.1	0.08	18.8	0.05	12.5
400		0.30	67.2	0.07	20.0	0.04	13.3
425		0.28	75.8	0.06	21.3	0.03	14.2
450		0.26	85.0	0.04	22.5	0.02	15.0
475		0.24	94.7	0.03	23.8	0.01	15.8
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

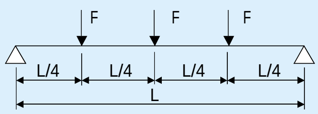
Single-span channel with uniaxial deflection
Single concentrated load

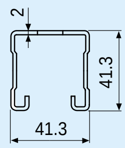




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		7.08	0.2	–	–	–	–
50		3.56	0.8	–	–	–	–
75		2.37	1.9	–	–	–	–
100		1.77	3.3	–	–	–	–
125		1.41	5.2	–	–	1.14	4.2
150		1.17	7.4	–	–	0.78	5.0
175		1.00	10.1	0.86	8.8	0.57	5.8
200		0.87	13.2	0.65	10.0	0.43	6.7
225		0.77	16.8	0.51	11.3	0.33	7.5
250		0.69	20.8	0.40	12.5	0.26	8.3
275		0.62	25.2	0.32	13.8	0.20	9.2
300		0.56	30.0	0.26	15.0	0.16	10.0
325		0.52	35.3	0.21	16.3	0.13	10.8
350		0.47	41.1	0.18	17.5	0.10	11.7
375		0.44	47.3	0.14	18.8	0.08	12.5
400		0.40	53.9	0.12	20.0	0.06	13.3
425		0.38	61.0	0.09	21.3	0.04	14.2
450		0.35	68.6	0.08	22.5	0.03	15.0
475		0.33	76.7	0.06	23.8	0.02	15.8
500		0.30	85.3	0.04	25.0	–	–
525		0.29	94.4	0.03	26.3	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channel with uniaxial deflection
Three concentrated loads



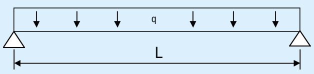


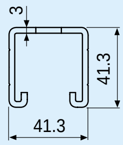
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		3.51	0.2	–	–	–	–
50		1.77	1.0	–	–	–	–
75		1.18	2.2	-–	–	–	–
100		0.89	3.9	–	–	0.75	3.3
125		0.71	6.1	–	–	0.48	4.2
150		0.59	8.8	0.50	7.5	0.33	5.0
175		0.50	12.0	0.36	8.8	0.24	5.8
200		0.44	15.7	0.27	10.0	0.18	6.7
225		0.38	19.8	0.21	11.3	0.14	7.5
250		0.34	24.5	0.17	12.5	0.11	8.3
275		0.31	29.6	0.14	13.8	0.09	9.2
300		0.28	35.3	0.11	15.0	0.07	10.0
325		0.26	41.4	0.09	16.3	0.05	10.8
350		0.24	48.1	0.07	17.5	0.04	11.7
375		0.22	55.2	0.06	18.8	0.03	12.5
400		0.20	62.9	0.05	20.0	0.03	13.3
425		0.19	71.0	0.04	21.3	0.02	14.2
450		0.17	79.7	0.03	22.5	0.01	15.0
475		0.16	88.8	0.02	23.8	–	–
500		0.15	98.5	0.02	25.0	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channels: Tables for MQ-41/3 channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

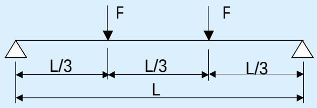
Single-span channel with uniaxial deflection
Uniformly distributed load

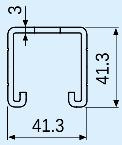




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	78.56	19.64	0.3	–	–	–	–
50	19.62	9.81	1.1	–	–	–	–
75	8.70	6.53	2.4	–	–	–	–
100	4.88	4.88	4.3	–	–	3.74	3.3
125	3.11	3.89	6.8	3.59	6.3	2.38	4.2
150	2.15	3.23	9.8	2.47	7.5	1.63	5.0
175	1.57	2.76	13.3	1.80	8.8	1.18	5.8
200	1.20	2.40	17.4	1.36	10.0	0.88	6.7
225	0.94	2.12	22.0	1.05	11.3	0.68	7.5
250	0.76	1.89	27.1	0.83	12.5	0.53	8.3
275	0.62	1.71	32.8	0.67	13.8	0.42	9.2
300	0.52	1.55	39.1	0.54	15.0	0.33	10.0
325	0.44	1.42	45.8	0.44	16.3	0.26	10.8
350	0.37	1.30	53.2	0.36	17.5	0.21	11.7
375	0.32	1.20	61.0	0.29	18.8	0.16	12.5
400	0.28	1.11	69.4	0.24	20.0	0.12	13.3
425	0.24	1.03	78.4	0.19	21.3	0.09	14.2
450	0.21	0.96	87.9	0.15	22.5	0.06	15.0
475	0.19	0.90	97.9	0.11	23.8	0.03	15.8
500	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–

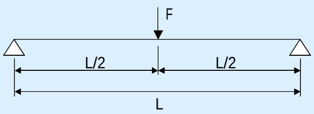
Single-span channel with uniaxial deflection
Two concentrated loads

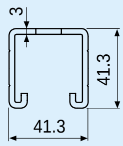




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		7.29	0.3	–	–	–	–
50		3.67	1.1	–	–	–	–
75		2.45	2.5	–	–	–	–
100		1.83	4.4	–	–	1.37	3.3
125		1.46	6.9	1.32	6.3	0.87	4.2
150		1.21	10.0	0.91	7.5	0.60	5.0
175		1.03	13.6	0.66	8.8	0.43	5.8
200		0.90	17.7	0.50	10.0	0.32	6.7
225		0.79	22.4	0.39	11.3	0.25	7.5
250		0.71	27.7	0.31	12.5	0.19	8.3
275		0.64	33.5	0.25	13.8	0.15	9.2
300		0.58	39.9	0.20	15.0	0.12	10.0
325		0.53	46.8	0.16	16.3	0.10	10.8
350		0.49	54.3	0.13	17.5	0.08	11.7
375		0.45	62.3	0.11	18.8	0.06	12.5
400		0.42	70.8	0.09	20.0	0.04	13.3
425		0.39	80.0	0.07	21.3	0.03	14.2
450		0.36	89.6	0.05	22.5	0.02	15.0
475		0.34	99.8	0.04	23.8	0.01	15.8
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

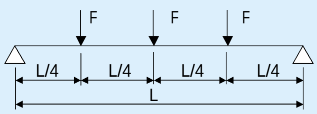
Single-span channel with uniaxial deflection
Single concentrated load

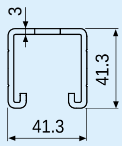




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		9.78	0.2	–	–	–	–
50		4.90	0.9	–	–	–	–
75		3.26	2.0	–	–	–	–
100		2.44	3.5	–	–	2.34	3.3
125		1.95	5.4	–	–	1.49	4.2
150		1.62	7.8	1.54	7.5	1.02	5.0
175		1.38	10.7	1.12	8.8	0.74	5.8
200		1.20	14.0	0.85	10.0	0.55	6.7
225		1.06	17.7	0.66	11.3	0.42	7.5
250		0.95	21.9	0.52	12.5	0.33	8.3
275		0.85	26.6	0.42	13.8	0.26	9.2
300		0.78	31.7	0.34	15.0	0.21	10.0
325		0.71	37.3	0.28	16.3	0.16	10.8
350		0.65	43.3	0.23	17.5	0.13	11.7
375		0.60	49.8	0.18	18.8	0.10	12.5
400		0.56	56.9	0.15	20.0	0.07	13.3
425		0.52	64.4	0.12	21.3	0.05	14.2
450		0.48	72.4	0.09	22.5	0.03	15.0
475		0.45	81.0	0.07	23.8	0.02	15.8
500		0.42	90.0	0.05	25.0	–	–
525		0.39	99.6	0.03	26.3	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channel with uniaxial deflection
Three concentrated loads



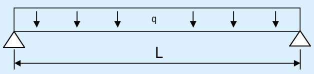


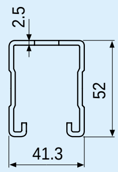
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		4.86	0.3	–	–	–	–
50		2.45	1.0	–	–	–	–
75		1.63	2.3	–	–	–	–
100		1.22	4.1	–	–	0.99	3.3
125		0.97	6.4	0.94	6.3	0.63	4.2
150		0.81	9.3	0.65	7.5	0.43	5.0
175		0.69	12.6	0.47	8.8	0.31	5.8
200		0.60	16.5	0.36	10.0	0.23	6.7
225		0.53	20.9	0.28	11.3	0.18	7.5
250		0.47	25.8	0.22	12.5	0.14	8.3
275		0.43	31.3	0.18	13.8	0.11	9.2
300		0.39	37.2	0.14	15.0	0.09	10.0
325		0.35	43.7	0.12	16.3	0.07	10.8
350		0.33	50.7	0.09	17.5	0.05	11.7
375		0.30	58.2	0.08	18.8	0.04	12.5
400		0.28	66.3	0.06	20.0	0.03	13.3
425		0.26	74.9	0.05	21.3	0.02	14.2
450		0.24	84.0	0.04	22.5	0.01	15.0
475		0.22	93.7	0.03	23.8	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channels: Tables for MQ-52 channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

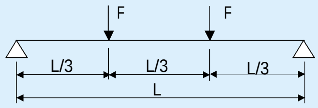
Single-span channel with uniaxial deflection Uniformly distributed load

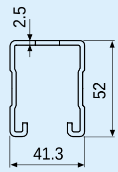




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	99.50	24.88	0.2	–	–	–	–
50	24.85	12.43	0.8	–	–	–	–
75	11.03	8.27	1.9	–	–	–	–
100	6.19	6.19	3.4	–	–	6.10	3.3
125	3.95	4.94	5.3	–	–	3.89	4.2
150	2.74	4.10	7.6	4.04	7.5	2.68	5.0
175	2.00	3.50	10.4	2.95	8.8	1.95	5.8
200	1.53	3.05	13.5	2.24	10.0	1.47	6.7
225	1.20	2.70	17.1	1.75	11.3	1.15	7.5
250	0.97	2.41	21.1	1.40	12.5	0.91	8.3
275	0.79	2.18	25.6	1.14	13.8	0.73	9.2
300	0.66	1.99	30.4	0.93	15.0	0.59	10.0
325	0.56	1.82	35.7	0.78	16.3	0.48	10.8
350	0.48	1.67	41.4	0.65	17.5	0.40	11.7
375	0.41	1.55	47.6	0.54	18.8	0.33	12.5
400	0.36	1.44	54.1	0.46	20.0	0.27	13.3
425	0.31	1.34	61.1	0.38	21.3	0.21	14.2
450	0.28	1.25	68.5	0.32	22.5	0.17	15.0
475	0.25	1.17	76.3	0.27	23.8	0.13	15.8
500	0.22	1.10	84.5	0.22	25.0	0.10	16.7
525	0.20	1.03	93.2	0.18	26.3	0.07	17.5
550	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–

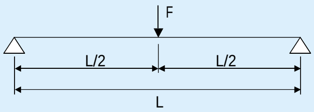
Single-span channel with uniaxial deflection Two concentrated loads

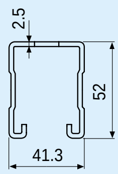




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		9.20	0.2	–	–	–	–
50		4.64	0.9	–	–	–	–
75		3.10	1.9	–	–	–	–
100		2.32	3.5	–	–	2.24	3.3
125		1.85	5.4	–	–	1.43	4.2
150		1.54	7.8	1.48	7.5	0.98	5.0
175		1.31	10.6	1.08	8.8	0.72	5.8
200		1.14	13.8	0.82	10.0	0.54	6.7
225		1.01	17.5	0.64	11.3	0.42	7.5
250		0.91	21.6	0.51	12.5	0.33	8.3
275		0.82	26.1	0.42	13.8	0.27	9.2
300		0.74	31.1	0.34	15.0	0.22	10.0
325		0.68	36.5	0.28	16.3	0.18	10.8
350		0.63	42.3	0.24	17.5	0.15	11.7
375		0.58	48.5	0.20	18.8	0.12	12.5
400		0.54	55.2	0.17	20.0	0.10	13.3
425		0.50	62.3	0.14	21.3	0.08	14.2
450		0.47	69.9	0.12	22.5	0.06	15.0
475		0.44	77.8	0.10	23.8	0.05	15.8
500		0.41	86.2	0.08	25.0	0.04	16.7
525		0.39	95.0	0.07	26.3	0.02	17.5
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

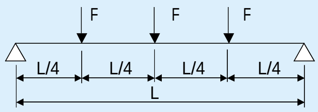
Single-span channel with uniaxial deflection Single concentrated load

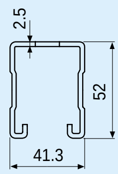




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		12.36	0.2	–	–	–	–
50		6.20	0.7	–	–	–	–
75		4.13	1.5	–	–	–	–
100		3.09	2.7	–	–	–	–
125		2.47	4.2	–	–	2.43	4.2
150		2.05	6.1	–	–	1.68	5.0
175		1.75	8.3	–	–	1.22	5.8
200		1.53	10.9	1.40	10.0	0.92	6.7
225		1.35	13.8	1.09	11.3	0.72	7.5
250		1.21	17.0	0.87	12.5	0.57	8.3
275		1.09	20.6	0.71	13.8	0.46	9.2
300		0.99	24.6	0.58	15.0	0.37	10.0
325		0.91	28.9	0.48	16.3	0.30	10.8
350		0.84	33.6	0.40	17.5	0.25	11.7
375		0.77	38.7	0.34	18.8	0.20	12.5
400		0.72	44.1	0.29	20.0	0.17	13.3
425		0.67	49.9	0.24	21.3	0.13	14.2
450		0.63	56.1	0.20	22.5	0.11	15.0
475		0.58	62.7	0.17	23.8	0.08	15.8
500		0.55	69.6	0.14	25.0	0.06	16.7
525		0.52	77.0	0.11	26.3	0.04	17.5
550		0.48	84.8	0.09	27.5	0.03	18.3
575		0.46	92.9	0.07	28.8	0.01	19.2
600		–	–	–	–	–	–

Single-span channel with uniaxial deflection Three concentrated loads



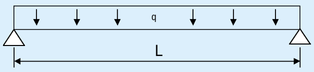


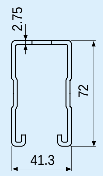
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		6.13	0.2	–	–	–	–
50		3.10	0.8	–	–	–	–
75		2.06	1.8	–	–	–	–
100		1.55	3.2	–	–	–	–
125		1.23	5.0	–	–	1.02	4.2
150		1.03	7.2	–	–	0.71	5.0
175		0.88	9.8	0.78	8.8	0.51	5.8
200		0.76	12.9	0.59	10.0	0.39	6.7
225		0.67	16.3	0.46	11.3	0.30	7.5
250		0.60	20.1	0.37	12.5	0.24	8.3
275		0.55	24.3	0.30	13.8	0.19	9.2
300		0.50	29.0	0.25	15.0	0.16	10.0
325		0.45	34.0	0.20	16.3	0.13	10.8
350		0.42	39.5	0.17	17.5	0.10	11.7
375		0.39	45.3	0.14	18.8	0.09	12.5
400		0.36	51.6	0.12	20.0	0.07	13.3
425		0.33	58.3	0.10	21.3	0.06	14.2
450		0.31	65.4	0.08	22.5	0.04	15.0
475		0.29	72.9	0.07	23.8	0.03	15.8
500		0.27	80.8	0.06	25.0	0.03	16.7
525		0.26	89.2	0.05	26.3	0.02	17.5
550		0.24	97.9	0.04	27.5	0.01	18.3
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channels: Tables for MQ-72 channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

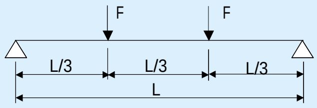
Single-span channel with uniaxial deflection
Uniformly distributed load

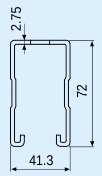




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	175.02	43.75	0.1	–	–	–	–
50	43.72	21.86	0.6	–	–	–	–
75	19.41	14.56	1.3	–	–	–	–
100	10.90	10.90	2.4	–	–	–	–
125	6.96	8.70	3.7	–	–	–	–
150	4.82	7.23	5.3	–	–	6.79	5.0
175	3.53	6.18	7.2	–	–	4.97	5.8
200	2.69	5.39	9.5	–	–	3.77	6.7
225	2.12	4.77	12.0	4.48	11.3	2.95	7.5
250	1.71	4.27	14.8	3.60	12.5	2.37	8.3
275	1.41	3.87	17.9	2.95	13.8	1.93	9.2
300	1.17	3.52	21.3	2.45	15.0	1.59	10.0
325	0.99	3.23	25.0	2.06	16.3	1.33	10.8
350	0.85	2.98	29.0	1.75	17.5	1.12	11.7
375	0.74	2.76	33.2	1.49	18.8	0.94	12.5
400	0.64	2.57	37.8	1.28	20.0	0.80	13.3
425	0.56	2.40	42.7	1.11	21.3	0.68	14.2
450	0.50	2.25	47.9	0.96	22.5	0.58	15.0
475	0.44	2.11	53.3	0.83	23.8	0.49	15.8
500	0.40	1.98	59.1	0.72	25.0	0.41	16.7
525	0.36	1.87	65.2	0.62	26.3	0.34	17.5
550	0.32	1.76	71.5	0.54	27.5	0.28	18.3
575	0.29	1.67	78.2	0.46	28.8	0.23	19.2
600	0.26	1.58	85.1	0.40	30.0	0.18	20.0

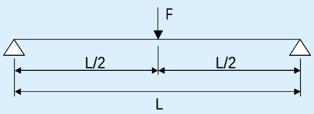
Single-span channel with uniaxial deflection
Two concentrated loads

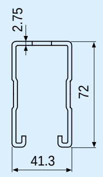




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		16.20	0.1	–	–	–	–
50		8.17	0.6	–	–	–	–
75		5.45	1.4	–	–	–	–
100		4.08	2.4	–	–	–	–
125		3.26	3.8	–	–	–	–
150		2.71	5.4	–	–	2.49	5.0
175		2.32	7.4	–	–	1.82	5.8
200		2.02	9.7	–	–	1.38	6.7
225		1.79	12.2	1.64	11.3	1.08	7.5
250		1.60	15.1	1.32	12.5	0.87	8.3
275		1.45	18.3	1.08	13.8	0.71	9.2
300		1.32	21.7	0.90	15.0	0.58	10.0
325		1.21	25.5	0.75	16.3	0.49	10.8
350		1.12	29.6	0.64	17.5	0.41	11.7
375		1.04	33.9	0.55	18.8	0.35	12.5
400		0.96	38.6	0.47	20.0	0.29	13.3
425		0.90	43.6	0.41	21.3	0.25	14.2
450		0.84	48.9	0.35	22.5	0.21	15.0
475		0.79	54.4	0.30	23.8	0.18	15.8
500		0.74	60.3	0.26	25.0	0.15	16.7
525		0.70	66.5	0.23	26.3	0.13	17.5
550		0.66	72.9	0.20	27.5	0.10	18.3
575		0.63	79.7	0.17	28.8	0.08	19.2
600		0.59	86.7	0.15	30.0	0.07	20.0

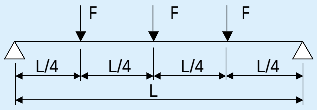
Single-span channel with uniaxial deflection
Single concentrated load

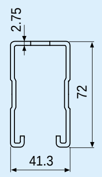




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		21.75	0.1	–	–	–	–
50		10.92	0.5	–	–	–	–
75		7.27	1.1	–	–	–	–
100		5.45	1.9	–	–	–	–
125		4.35	3.0	–	–	–	–
150		3.62	4.3	–	–	–	–
175		3.09	5.8	–	–	–	–
200		2.69	7.6	–	–	2.36	6.7
225		2.39	9.6	–	–	1.85	7.5
250		2.14	11.9	–	–	1.48	8.3
275		1.93	14.4	1.84	13.8	1.20	9.2
300		1.76	17.2	1.53	15.0	0.99	10.0
325		1.62	20.2	1.29	16.3	0.83	10.8
350		1.49	23.4	1.09	17.5	0.70	11.7
375		1.38	26.9	0.93	18.8	0.59	12.5
400		1.29	30.7	0.80	20.0	0.50	13.3
425		1.20	34.7	0.69	21.3	0.42	14.2
450		1.12	39.0	0.60	22.5	0.36	15.0
475		1.05	43.6	0.52	23.8	0.31	15.8
500		0.99	48.4	0.45	25.0	0.26	16.7
525		0.93	53.5	0.39	26.3	0.22	17.5
550		0.88	58.8	0.34	27.5	0.18	18.3
575		0.83	64.5	0.29	28.8	0.14	19.2
600		0.79	70.4	0.25	30.0	0.11	20.0

Single-span channel with uniaxial deflection
Three concentrated loads



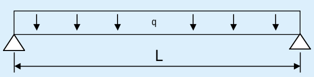


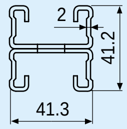
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		10.80	0.1	–	–	–	–
50		5.45	0.6	–	–	–	–
75		3.63	1.3	–	–	–	–
100		2.72	2.2	–	–	–	–
125		2.17	3.5	–	–	–	–
150		1.81	5.1	–	–	1.79	5.0
175		1.54	6.9	–	–	1.31	5.8
200		1.35	9.0	–	–	0.99	6.7
225		1.19	11.4	1.18	11.3	0.78	7.5
250		1.07	14.1	0.95	12.5	0.62	8.3
275		0.97	17.0	0.78	13.8	0.51	9.2
300		0.88	20.2	0.64	15.0	0.42	10.0
325		0.81	23.8	0.54	16.3	0.35	10.8
350		0.75	27.6	0.46	17.5	0.29	11.7
375		0.69	31.7	0.39	18.8	0.25	12.5
400		0.64	36.0	0.34	20.0	0.21	13.3
425		0.60	40.7	0.29	21.3	0.18	14.2
450		0.56	45.7	0.25	22.5	0.15	15.0
475		0.53	50.9	0.22	23.8	0.13	15.8
500		0.50	56.4	0.19	25.0	0.11	16.7
525		0.47	62.2	0.16	26.3	0.09	17.5
550		0.44	68.3	0.14	27.5	0.07	18.3
575		0.42	74.7	0.12	28.8	0.06	19.2
600		0.39	81.4	0.10	30.0	0.05	20.0

Single-span channels: Tables for MQ-21D channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

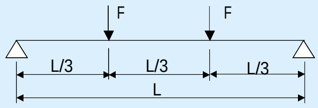
Single-span channel with uniaxial deflection
Uniformly distributed load

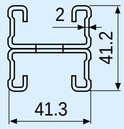




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	12.00	3.00	<0.1	–	–	–	–
50	6.00	3.00	0.5	–	–	–	–
75	4.00	3.00	1.6	–	–	–	–
100	3.00	3.00	3.8	–	–	2.65	3.3
125	2.30	2.88	7.1	2.53	6.3	1.68	4.2
150	1.59	2.39	10.2	1.74	7.5	1.15	5.0
175	1.16	2.03	13.9	1.26	8.8	0.82	5.8
200	0.88	1.76	18.1	0.95	10.0	0.61	6.7
225	0.69	1.55	23.0	0.73	11.3	0.46	7.5
250	0.55	1.38	28.3	0.57	12.5	0.36	8.3
275	0.45	1.24	34.3	0.45	13.8	0.27	9.2
300	0.38	1.13	40.8	0.36	15.0	0.21	10.0
325	0.32	1.03	47.9	0.29	16.3	0.16	10.8
350	0.27	0.94	55.5	0.23	17.5	0.12	11.7
375	0.23	0.86	63.8	0.18	18.8	0.08	12.5
400	0.20	0.79	72.6	0.13	20.0	0.05	13.3
425	0.17	0.73	81.9	0.10	21.3	0.02	14.2
450	0.15	0.68	91.8	0.07	22.5	–	–
475	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–

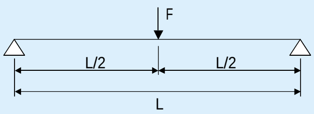
Single-span channel with uniaxial deflection
Two concentrated loads

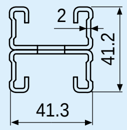




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		1.50	<0.1	–	–	–	–
50		1.50	0.6	–	–	–	–
75		1.50	2.2	–	–	–	–
100		1.35	4.6	–	–	0.97	3.3
125		1.08	7.2	0.93	6.3	0.62	4.2
150		0.89	10.4	0.64	7.5	0.42	5.0
175		0.76	14.2	0.46	8.8	0.30	5.8
200		0.66	18.5	0.35	10.0	0.22	6.7
225		0.58	23.4	0.27	11.3	0.17	7.5
250		0.52	28.9	0.21	12.5	0.13	8.3
275		0.47	35.0	0.17	13.8	0.10	9.2
300		0.42	41.6	0.13	15.0	0.08	10.0
325		0.38	48.9	0.10	16.3	0.06	10.8
350		0.35	56.7	0.08	17.5	0.04	11.7
375		0.32	65.0	0.06	18.8	0.03	12.5
400		0.30	74.0	0.05	20.0	0.02	13.3
425		0.28	83.5	0.04	21.3	–	–
450		0.25	93.5	0.02	22.5	–	–
475	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–

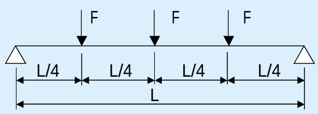
Single-span channel with uniaxial deflection
Single concentrated load

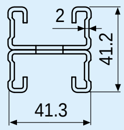




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		3.00	<0.1	–	–	–	–
50		3.00	0.7	–	–	–	–
75		2.42	2.0	–	–	–	–
100		1.81	3.6	–	–	1.66	3.3
125		1.44	5.7	–	–	1.05	4.2
150		1.19	8.2	1.09	7.5	0.72	5.0
175		1.02	11.2	0.79	8.8	0.51	5.8
200		0.88	14.6	0.59	10.0	0.38	6.7
225		0.78	18.5	0.46	11.3	0.29	7.5
250		0.69	23.0	0.36	12.5	0.22	8.3
275		0.62	27.8	0.28	13.8	0.17	9.2
300		0.56	33.2	0.22	15.0	0.13	10.0
325		0.51	39.1	0.18	16.3	0.10	10.8
350		0.47	45.5	0.14	17.5	0.07	11.7
375		0.43	52.4	0.11	18.8	0.05	12.5
400		0.40	59.9	0.08	20.0	0.03	13.3
425		0.37	67.9	0.06	21.3	0.02	14.2
450		0.34	76.4	0.04	22.5	–	–
475		0.31	85.5	0.03	23.8	–	–
500		0.29	95.2	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channel with uniaxial deflection
Three concentrated loads



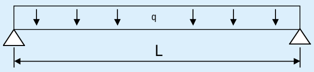


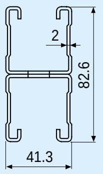
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		1.00	<0.1	–	–	–	–
50		1.00	0.6	–	–	–	–
75		1.00	2.0	–	–	–	–
100		0.90	4.3	–	–	0.70	3.3
125		0.72	6.7	0.67	6.3	0.44	4.2
150		0.60	9.7	0.46	7.5	0.30	5.0
175		0.51	13.2	0.33	8.8	0.22	5.8
200		0.44	17.3	0.25	10.0	0.16	6.7
225		0.39	21.8	0.19	11.3	0.12	7.5
250		0.35	27.0	0.15	12.5	0.09	8.3
275		0.31	32.7	0.12	13.8	0.07	9.2
300		0.28	38.9	0.09	15.0	0.06	10.0
325		0.26	45.7	0.08	16.3	0.04	10.8
350		0.23	53.0	0.06	17.5	0.03	11.7
375		0.22	60.9	0.05	18.8	0.02	12.5
400		0.20	69.4	0.04	20.0	0.01	13.3
425		0.18	78.4	0.03	21.3	–	–
450		0.17	88.0	0.02	22.5	–	–
475		0.16	98.1	0.01	23.8	–	–
500		–	–	–	–	–	–
525		–	–	–	–	–	–
550		–	–	–	–	–	–
575		–	–	–	–	–	–
600		–	–	–	–	–	–

Single-span channels: Tables for MQ-41D channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

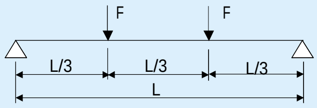
Single-span channel with uniaxial deflection
Uniformly distributed load

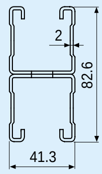




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	24.00	6.00	<0.1	–	–	–	–
50	12.00	6.00	0.2	–	–	–	–
75	8.00	6.00	0.5	–	–	–	–
100	6.00	6.00	1.2	–	–	–	–
125	4.80	6.00	2.4	–	–	–	–
150	4.00	6.00	4.1	–	–	–	–
175	3.36	5.88	6.4	–	–	5.31	5.8
200	2.56	5.13	8.4	–	–	4.04	6.7
225	2.02	4.54	10.7	–	–	3.16	7.5
250	1.63	4.06	13.2	3.85	12.5	2.53	8.3
275	1.34	3.67	15.9	3.16	13.8	2.07	9.2
300	1.12	3.35	19.0	2.62	15.0	1.71	10.0
325	0.94	3.07	22.2	2.21	16.3	1.43	10.8
350	0.81	2.83	25.8	1.87	17.5	1.20	11.7
375	0.70	2.62	29.6	1.60	18.8	1.02	12.5
400	0.61	2.44	33.7	1.38	20.0	0.86	13.3
425	0.54	2.27	38.0	1.19	21.3	0.74	14.2
450	0.47	2.13	42.6	1.03	22.5	0.63	15.0
475	0.42	2.00	47.5	0.90	23.8	0.53	15.8
500	0.37	1.87	52.6	0.78	25.0	0.45	16.7
525	0.34	1.77	58.0	0.68	26.3	0.38	17.5
550	0.30	1.66	63.7	0.59	27.5	0.32	18.3
575	0.27	1.57	69.6	0.51	28.8	0.26	19.2
600	0.25	1.49	75.8	0.44	30.0	0.21	20.0

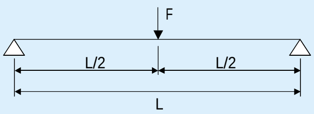
Single-span channel with uniaxial deflection
Two concentrated loads

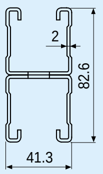




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		3.00	<0.1	–	–	–	–
50		3.00	0.2	–	–	–	–
75		3.00	0.7	–	–	–	–
100		3.00	1.7	–	–	–	–
125		3.00	3.2	–	–	–	–
150		2.58	4.8	–	–	–	–
175		2.20	6.6	–	–	1.95	5.8
200		1.92	8.6	–	–	1.48	6.7
225		1.70	10.9	–	–	1.16	7.5
250		1.52	13.4	1.41	12.5	0.93	8.3
275		1.38	16.3	1.16	13.8	0.76	9.2
300		1.26	19.4	0.96	15.0	0.63	10.0
325		1.15	22.7	0.81	16.3	0.52	10.8
350		1.06	26.3	0.69	17.5	0.44	11.7
375		0.98	30.2	0.59	18.8	0.37	12.5
400		0.91	34.4	0.51	20.0	0.32	13.3
425		0.85	38.8	0.44	21.3	0.27	14.2
450		0.80	43.5	0.38	22.5	0.23	15.0
475		0.75	48.5	0.33	23.8	0.20	15.8
500		0.70	53.7	0.29	25.0	0.17	16.7
525		0.66	59.2	0.25	26.3	0.14	17.5
550		0.62	64.9	0.22	27.5	0.12	18.3
575		0.59	71.0	0.19	28.8	0.09	19.2
600		0.56	77.2	0.16	30.0	0.08	20.0

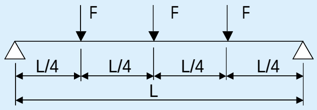
Single-span channel with uniaxial deflection
Single concentrated load

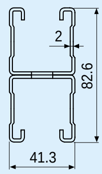




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		6.00	<0,1	-	-	-	-
50		6.00	0.2	-	-	-	-
75		6.00	0.8	-	-	-	-
100		5.19	1.7	-	-	-	-
125		4.14	2.6	-	-	-	-
150		3.44	3.8	-	-	-	-
175		2.94	5.2	-	-	-	-
200		2.56	6.8	-	-	2.53	6.7
225		2.27	8.6	-	-	1.98	7.5
250		2.03	10.6	-	-	1.58	8.3
275		1.84	12.8	-	-	1.29	9.2
300		1.67	15.3	1.64	15.0	1.07	10.0
325		1.54	18.0	1.38	16.3	0.89	10.8
350		1.42	20.9	1.17	17.5	0.75	11.7
375		1.31	24.0	1.00	18.8	0.64	12.5
400		1.22	27.4	0.86	20.0	0.54	13.3
425		1.14	31.0	0.75	21.3	0.46	14.2
450		1.06	34.8	0.65	22.5	0.39	15.0
475		1.00	38.9	0.56	23.8	0.33	15.8
500		0.94	43.2	0.49	25.0	0.28	16.7
525		0.88	47.7	0.42	26.3	0.24	17.5
550		0.83	52.5	0.37	27.5	0.20	18.3
575		0.79	57.5	0.32	28.8	0.16	19.2
600		0.74	62.8	0.27	30.0	0.13	20.0

Single-span channel with uniaxial deflection
Three concentrated loads



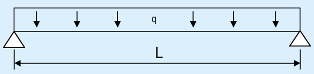


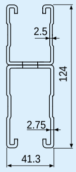
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		2.00	<0,1	–	–	–	–
50		2.00	0.2	–	–	–	–
75		2.00	0.7	–	–	–	–
100		2.00	1.5	–	–	–	–
125		2.00	3.0	–	–	–	–
150		1.72	4.5	–	–	–	–
175		1.47	6.1	–	–	1.40	5.8
200		1.28	8.0	–	–	1.06	6.7
225		1.13	10.1	–	–	0.83	7.5
250		1.02	12.5	1.01	12.5	0.67	8.3
275		0.92	15.2	0.83	13.8	0.54	9.2
300		0.84	18.0	0.69	15.0	0.45	10.0
325		0.77	21.2	0.58	16.3	0.38	10.8
350		0.71	24.6	0.49	17.5	0.32	11.7
375		0.66	28.2	0.42	18.8	0.27	12.5
400		0.61	32.1	0.36	20.0	0.23	13.3
425		0.57	36.3	0.31	21.3	0.19	14.2
450		0.53	40.7	0.27	22.5	0.16	15.0
475		0.50	45.3	0.24	23.8	0.14	15.8
500		0.47	50.3	0.21	25.0	0.12	16.7
525		0.44	55.5	0.18	26.3	0.10	17.5
550		0.42	60.9	0.15	27.5	0.08	18.3
575		0.39	66.6	0.13	28.8	0.07	19.2
600		0.37	72.6	0.11	30.0	0.05	20.0

Single-span channels: Tables for MQ-52-72D channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

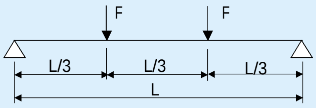
Single-span channel with uniaxial deflection
Uniformly distributed load

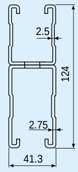




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F_1 (kN)	f (mm) </= $\sigma_{perm.}$	F_2 (kN)	f (mm) </= $\sigma_{perm.}$
25	44.80	11.20	<0.1	–	–	–	–
50	22.40	11.20	<0.1	–	–	–	–
75	14.93	11.20	0.3	–	–	–	–
100	11.20	11.20	0.6	–	–	–	–
125	8.96	11.20	1.2	–	–	–	–
150	7.47	11.20	2.1	–	–	–	–
175	6.40	11.20	3.3	–	–	–	–
200	5.60	11.20	4.9	–	–	–	–
225	4.98	11.20	7.0	–	–	–	–
250	4.11	10.26	8.8	–	–	9.75	8.3
275	3.38	9.30	10.6	–	–	8.01	9.2
300	2.83	8.49	12.6	–	–	6.68	10.0
325	2.40	7.80	14.8	–	–	5.64	10.8
350	2.06	7.21	17.2	–	–	4.82	11.7
375	1.79	6.70	19.7	6.35	18.8	4.15	12.5
400	1.56	6.24	22.4	5.53	20.0	3.59	13.3
425	1.37	5.84	25.3	4.85	21.3	3.13	14.2
450	1.22	5.48	28.4	4.28	22.5	2.75	15.0
475	1.09	5.16	31.6	3.79	23.8	2.41	15.8
500	0.97	4.87	35.1	3.37	25.0	2.13	16.7
525	0.88	4.60	38.7	3.00	26.3	1.88	17.5
550	0.79	4.36	42.4	2.69	27.5	1.66	18.3
575	0.72	4.13	46.4	2.41	28.8	1.47	19.2
600	0.65	3.93	50.5	2.16	30.0	1.30	20.0

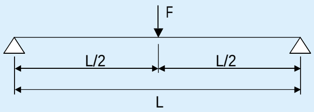
Single-span channel with uniaxial deflection
Two concentrated loads

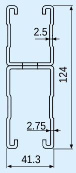




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F_1 (kN)	f (mm) </= $\sigma_{zperm.}$	F_2 (kN)	f (mm) </= $\sigma_{perm.}$
25		5.60	<0.1	–	–	–	–
50		5.60	0.1	–	–	–	–
75		5.60	0.3	–	–	–	–
100		5.60	0.8	–	–	–	–
125		5.60	1.6	–	–	–	–
150		5.60	2.8	–	–	–	–
175		5.55	4.4	–	–	–	–
200		4.84	5.7	–	–	–	–
225		4.29	7.3	–	–	–	–
250		3.85	9.0	–	–	3.58	8.3
275		3.49	10.8	–	–	2.94	9.2
300		3.18	12.9	–	–	2.45	10.0
325		2.93	15.1	–	–	2.07	10.8
350		2.70	17.5	2.70	17.5	1.77	11.7
375		2.51	20.1	2.33	18.8	1.52	12.5
400		2.34	22.9	2.03	20.0	1.32	13.3
425		2.19	25.9	1.78	21.3	1.15	14.2
450		2.06	29.0	1.57	22.5	1.01	15.0
475		1.93	32.3	1.39	23.8	0.89	15.8
500		1.82	35.8	1.24	25.0	0.78	16.7
525		1.73	39.4	1.10	26.3	0.69	17.5
550		1.63	43.3	0.99	27.5	0.61	18.3
575		1.55	47.3	0.88	28.8	0.54	19.2
600		1.47	51.5	0.79	30.0	0.48	20.0

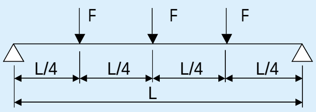
Single-span channel with uniaxial deflection
Single concentrated load

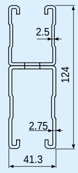




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F_1 (kN)	f (mm) </= $\sigma_{perm.}$	F_2 (kN)	f (mm) </= $\sigma_{perm.}$
25		11.20	<0.1	–	–	–	–
50		11.20	0.1	–	–	–	–
75		11.20	0.4	–	–	–	–
100		11.20	1.0	–	–	–	–
125		10.39	1.8	–	–	–	–
150		8.65	2.5	–	–	–	–
175		7.39	3.4	–	–	–	–
200		6.45	4.5	–	–	–	–
225		5.72	5.7	–	–	–	–
250		5.13	7.0	–	–	–	–
275		4.65	8.5	–	–	–	–
300		4.24	10.2	–	–	4.18	10.0
325		3.90	11.9	–	–	3.53	10.8
350		3.60	13.9	–	–	3.01	11.7
375		3.35	15.9	–	–	2.59	12.5
400		3.12	18.1	–	–	2.25	13.3
425		2.92	20.5	–	–	1.96	14.2
450		2.74	23.0	2.67	22.5	1.72	15.0
475		2.58	25.7	2.37	23.8	1.51	15.8
500		2.43	28.5	2.11	25.0	1.33	16.7
525		2.30	31.5	1.88	26.3	1.17	17.5
550		2.18	34.6	1.68	27.5	1.04	18.3
575		2.07	37.9	1.50	28.8	0.92	19.2
600		1.96	41.4	1.35	30.0	0.81	20.0

Single-span channel with uniaxial deflection
Three concentrated loads



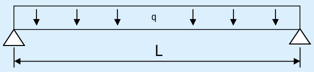


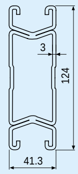
Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F_1 (kN)	f (mm) </= $\sigma_{perm.}$	F_2 (kN)	f (mm) </= $\sigma_{perm.}$
25		3.73	<0.1	–	–	–	–
50		3.73	<0.1	–	–	–	–
75		3.73	0.3	–	–	–	–
100		3.73	0.8	–	–	–	–
125		3.73	1.5	–	–	–	–
150		3.73	2.6	–	–	–	–
175		3.70	4.1	–	–	–	–
200		3.23	5.3	–	–	–	–
225		2.86	6.7	–	–	–	–
250		2.57	8.3	–	–	–	–
275		2.32	10.1	–	–	2.11	9.2
300		2.12	12.0	–	–	1.76	10.0
325		1.95	14.1	–	–	1.49	10.8
350		1.80	16.3	–	–	1.27	11.7
375		1.67	18.8	1.67	18.8	1.09	12.5
400		1.56	21.4	1.46	20.0	0.95	13.3
425		1.46	24.1	1.28	21.3	0.82	14.2
450		1.37	27.1	1.13	22.5	0.72	15.0
475		1.29	30.2	1.00	23.8	0.64	15.8
500		1.22	33.4	0.89	25.0	0.56	16.7
525		1.15	36.9	0.79	26.3	0.49	17.5
550		1.09	40.5	0.71	27.5	0.44	18.3
575		1.03	44.3	0.63	28.8	0.39	19.2
600		0.98	48.2	0.57	30.0	0.34	20.0

Single-span channels: Tables for MQ-124XD channel

F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$ incl. dead weight of channel

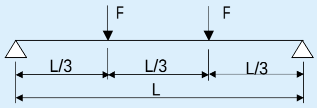
Single-span channel with uniaxial deflection Uniformly distributed load

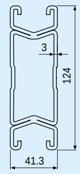




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25	571.43	142.86	<0.1	-	-	-	-
50	157.45	78.73	0.3	-	-	-	-
75	69.92	52.44	0.7	-	-	-	-
100	39.29	39.29	1.3	-	-	-	-
125	25.11	31.39	2.0	-	-	-	-
150	17.41	26.11	2.9	-	-	-	-
175	12.76	22.34	4.0	-	-	-	-
200	9.75	19.50	5.2	-	-	-	-
225	7.68	17.28	6.6	-	-	-	-
250	6.20	15.51	8.1	-	-	-	-
275	5.11	14.05	9.8	-	-	13.10	9.2
300	4.28	12.83	11.7	-	-	10.94	10.0
325	3.63	11.80	13.7	-	-	9.25	10.8
350	3.12	10.91	15.9	-	-	7.91	11.7
375	2.70	10.13	18.3	-	-	6.82	12.5
400	2.36	9.45	20.8	9.08	20.0	5.92	13.3
425	2.08	8.85	23.5	7.98	21.3	5.18	14.2
450	1.85	8.31	26.3	7.05	22.5	4.55	15.0
475	1.65	7.82	29.3	6.25	23.8	4.01	15.8
500	1.48	7.39	32.5	5.57	25.0	3.55	16.7
525	1.33	6.99	35.8	4.98	26.3	3.15	17.5
550	1.20	6.62	39.3	4.47	27.5	2.80	18.3
575	1.09	6.28	42.9	4.02	28.8	2.49	19.2
600	1.00	5.97	46.8	3.62	30.0	2.22	20.0

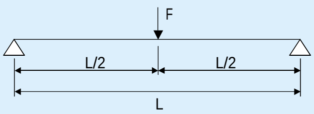
Single-span channel with uniaxial deflection Two concentrated loads

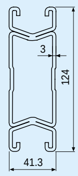




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		58.35	<0.1	–	–	–	–
50		29.43	0.3	–	–	–	–
75		19.64	0.7	–	–	–	–
100		14.72	1.3	–	–	–	–
125		11.76	2.1	–	–	–	–
150		9.79	3.0	–	–	–	–
175		8.37	4.1	–	–	–	–
200		7.31	5.3	–	–	–	–
225		6.48	6.7	–	–	–	–
250		5.82	8.3	–	–	–	–
275		5.27	10.0	–	–	4.80	9.2
300		4.81	11.9	–	–	4.01	10.0
325		4.42	14.0	–	–	3.39	10.8
350		4.09	16.3	–	–	2.90	11.7
375		3.80	18.7	–	–	2.50	12.5
400		3.54	21.2	3.33	20.0	2.17	13.3
425		3.32	24.0	2.93	21.3	1.90	14.2
450		3.12	26.9	2.58	22.5	1.67	15.0
475		2.93	29.9	2.29	23.8	1.47	15.8
500		2.77	33.1	2.04	25.0	1.30	16.7
525		2.62	36.5	1.83	26.3	1.16	17.5
550		2.48	40.1	1.64	27.5	1.03	18.3
575		2.36	43.8	1.47	28.8	0.91	19.2
600		2.24	47.7	1.33	30.0	0.81	20.0

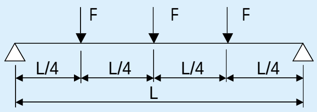
Single-span channel with uniaxial deflection Single concentrated load

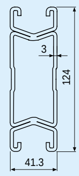




Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		78.33	<0.1	-	-	-	-
50		39.31	0.3	-	-	-	-
75		26.21	0.6	-	-	-	-
100		19.64	1.0	-	-	-	-
125		15.69	1.6	-	-	-	-
150		13.05	2.3	-	-	-	-
175		11.17	3.2	-	-	-	-
200		9.75	4.2	-	-	-	-
225		8.64	5.3	-	-	-	-
250		7.75	6.5	-	-	-	-
275		7.03	7.9	-	-	-	-
300		6.42	9.4	-	-	-	-
325		5.90	11.0	-	-	5.78	10.8
350		5.45	12.8	-	-	4.94	11.7
375		5.07	14.7	-	-	4.26	12.5
400		4.73	16.8	-	-	3.70	13.3
425		4.42	19.0	-	-	3.24	14.2
450		4.15	21.3	-	-	2.84	15.0
475		3.91	23.8	3.91	23.8	2.51	15.8
500		3.69	26.4	3.48	25.0	2.22	16.7
525		3.49	29.1	3.12	26.3	1.97	17.5
550		3.31	32.0	2.79	27.5	1.75	18.3
575		3.14	35.1	2.51	28.8	1.56	19.2
600		2.99	38.2	2.26	30.0	1.39	20.0

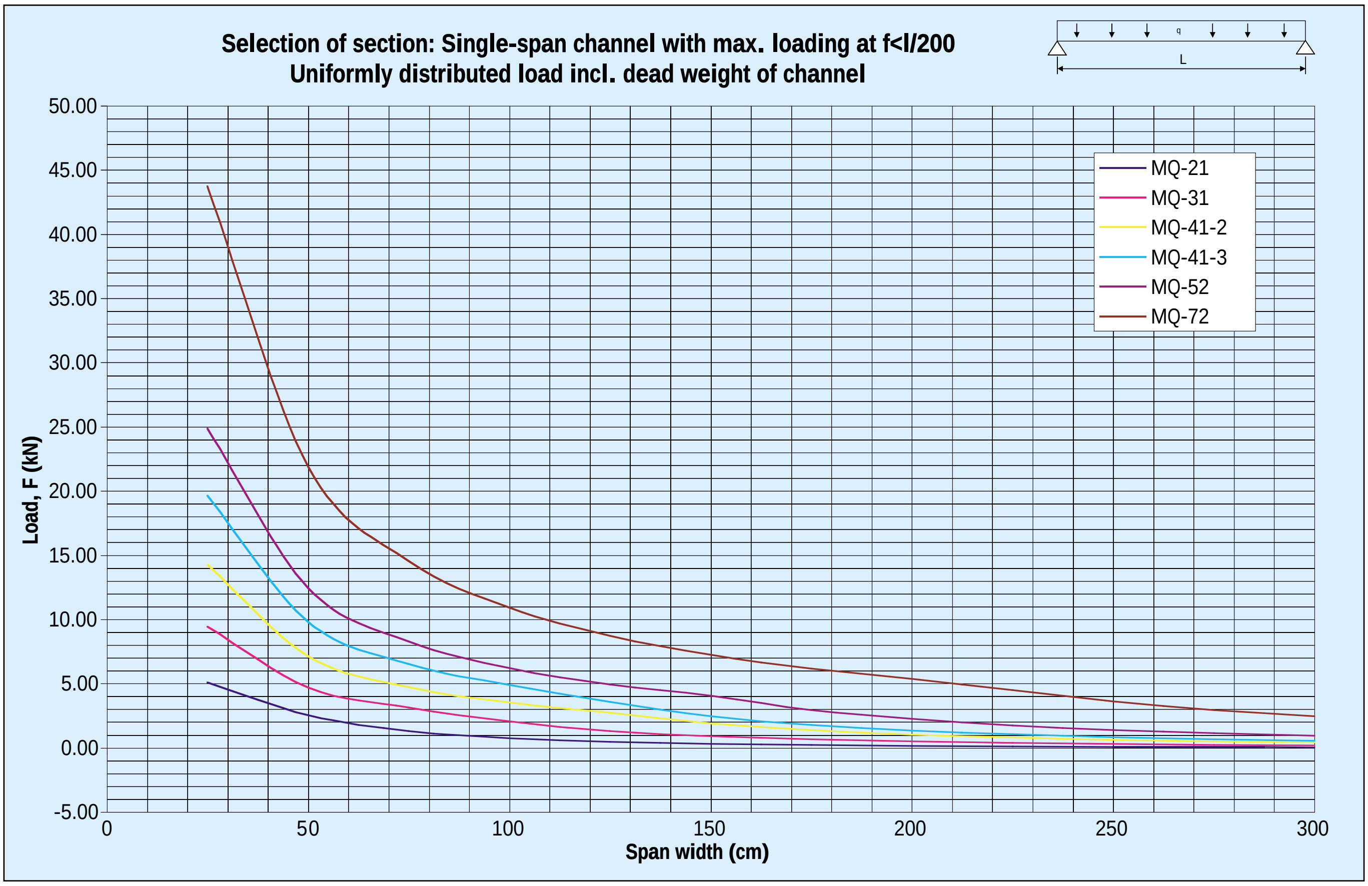
Single-span channel with uniaxial deflection Three concentrated loads

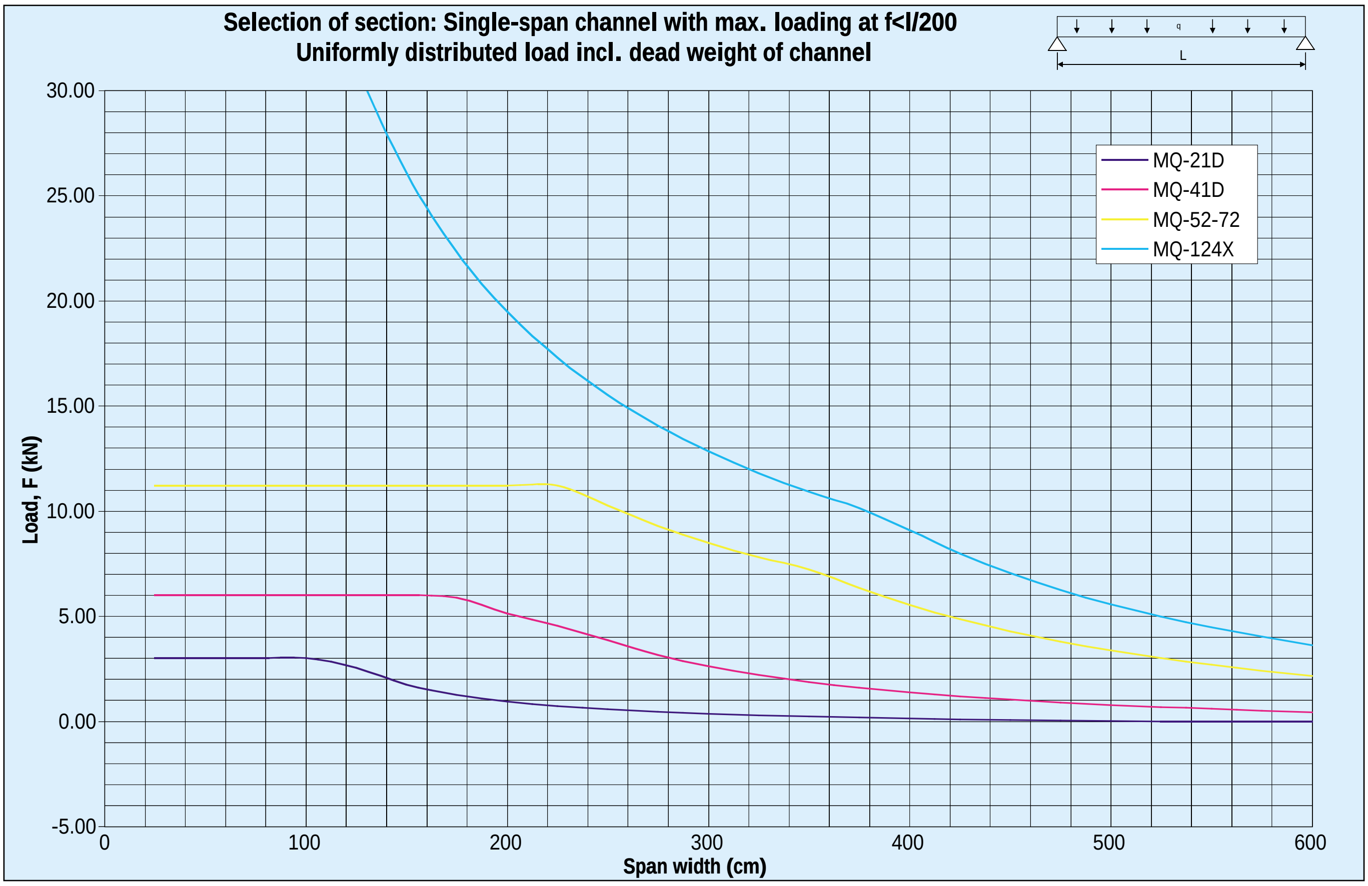


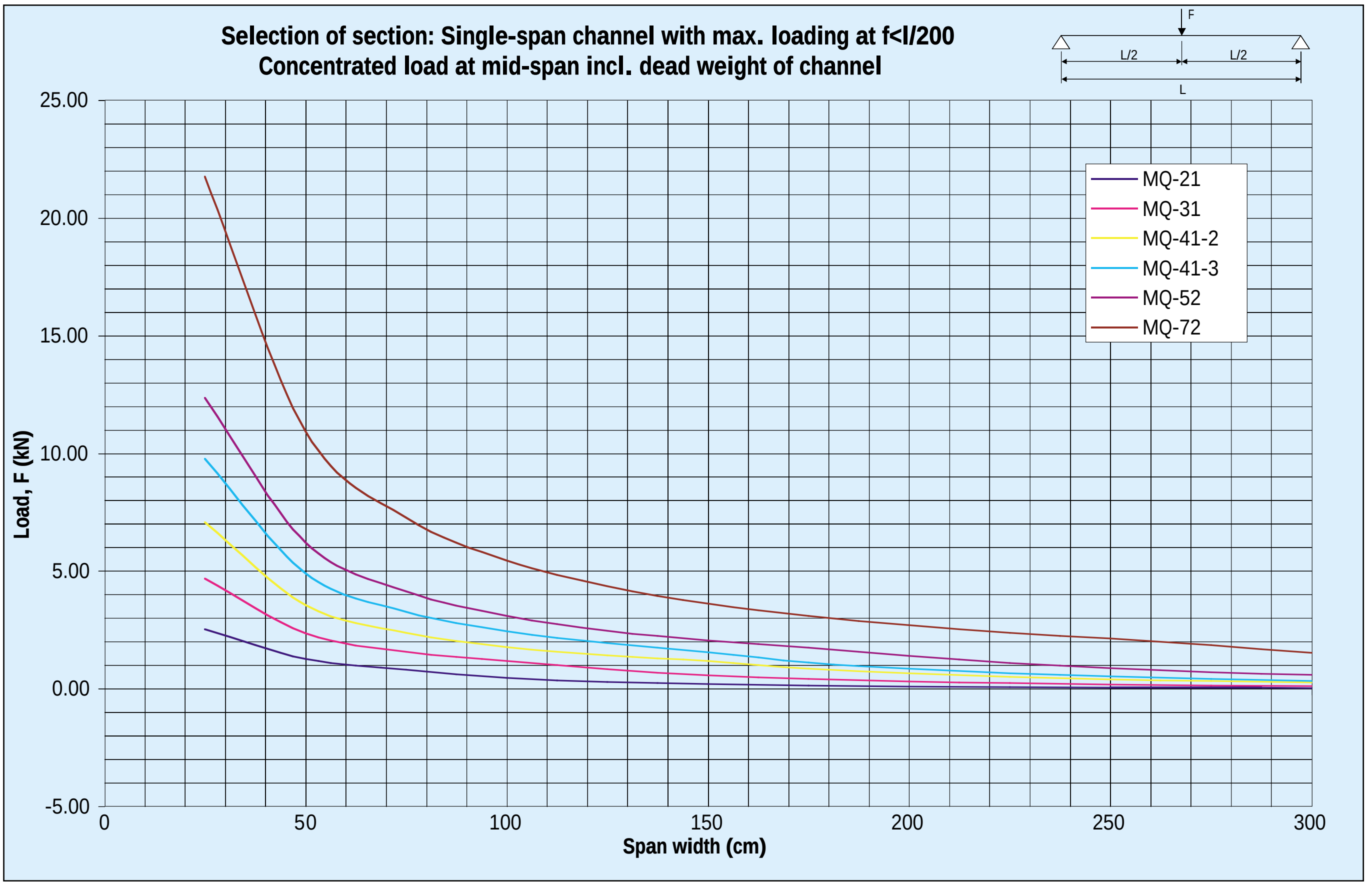


Span width (cm)	F (kN/m)	F (kN)	f (mm) </= $\sigma_{perm.}$	F1 (kN)	f (mm) </= $\sigma_{perm.}$	F2 (kN)	f (mm) </= $\sigma_{perm.}$
25		38.90	<0.1	–	–	–	–
50		19.62	0.3	–	–	–	–
75		13.09	0.7	–	–	–	–
100		9.81	1.2	–	–	–	–
125		7.84	1.9	–	–	–	–
150		6.53	2.8	–	–	–	–
175		5.58	3.8	–	–	–	–
200		4.87	4.9	–	–	–	–
225		4.32	6.2	–	–	–	–
250		3.88	7.7	–	–	–	–
275		3.51	9.3	–	–	3.45	9.2
300		3.21	11.1	–	–	2.88	10.0
325		2.95	13.0	–	–	2.43	10.8
350		2.73	15.1	–	–	2.08	11.7
375		2.53	17.4	–	–	1.79	12.5
400		2.36	19.8	–	–	1.56	13.3
425		2.21	22.3	2.10	21.3	1.36	14.2
450		2.08	25.1	1.85	22.5	1.20	15.0
475		1.96	27.9	1.65	23.8	1.06	15.8
500		1.85	30.9	1.47	25.0	0.93	16.7
525		1.75	34.1	1.31	26.3	0.83	17.5
550		1.65	37.5	1.18	27.5	0.74	18.3
575		1.57	41.0	1.06	28.8	0.66	19.2
600		1.49	44.6	0.95	30.0	0.58	20.0

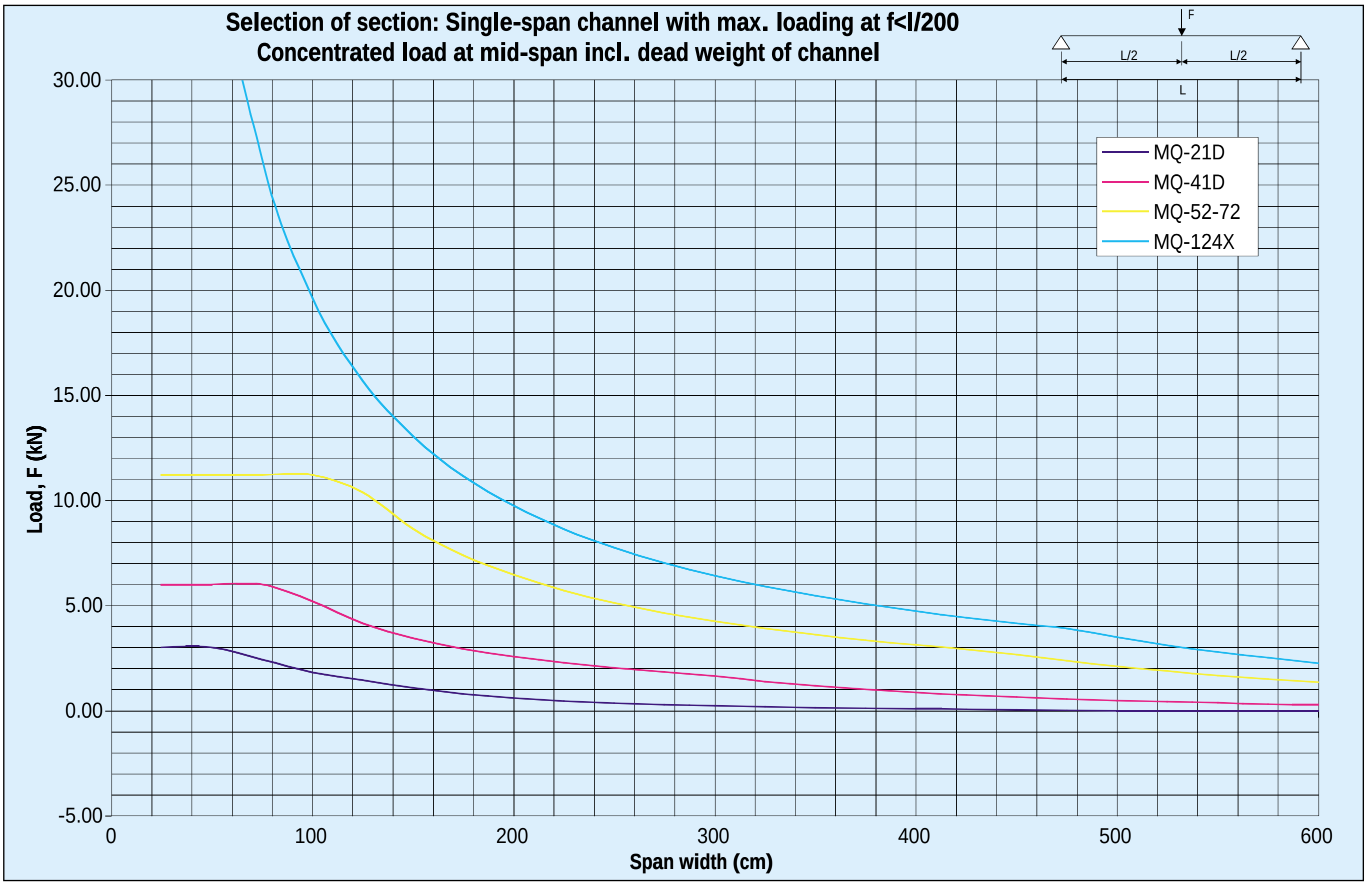
Single-span channels: Selection of channel section



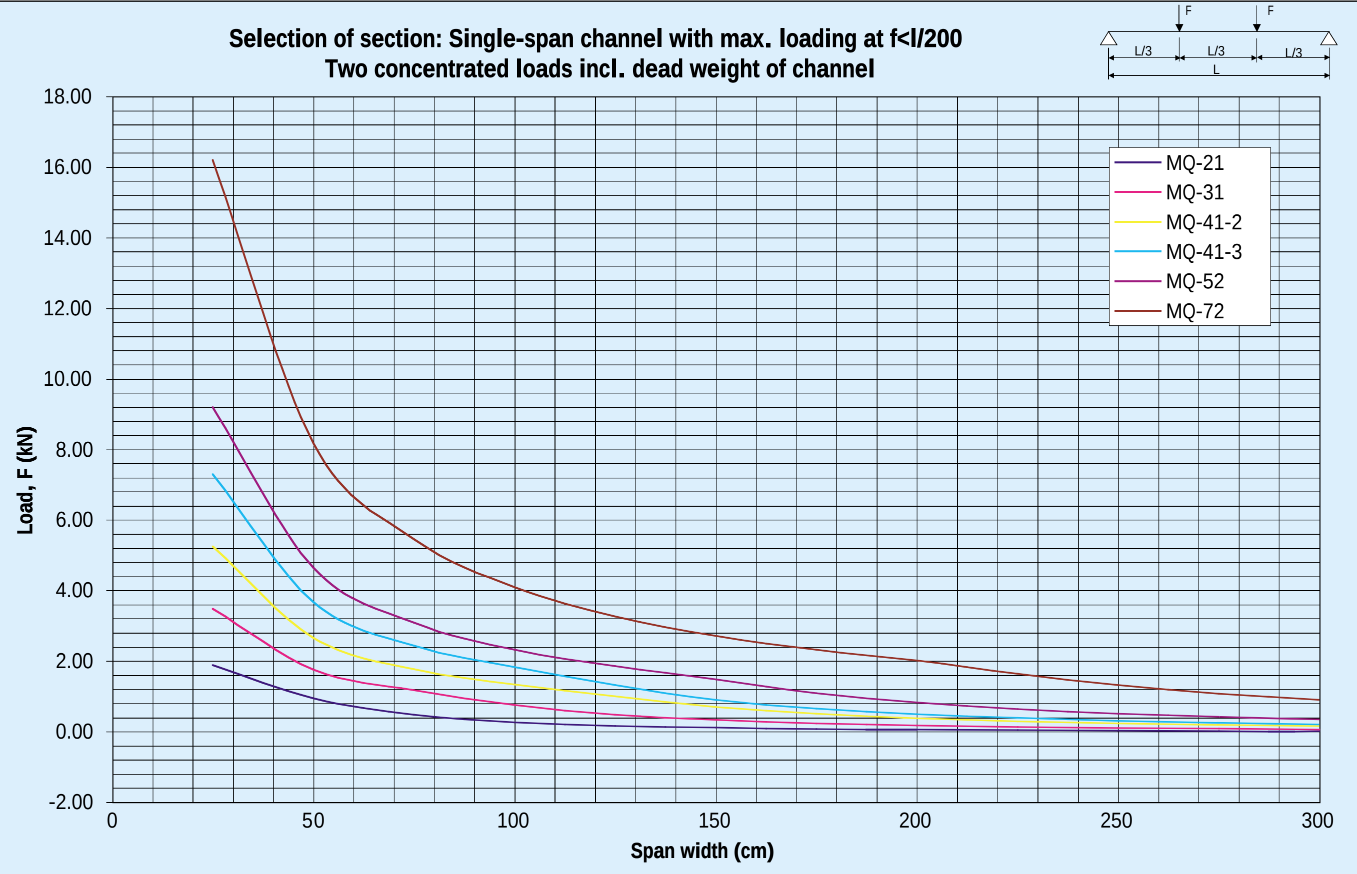


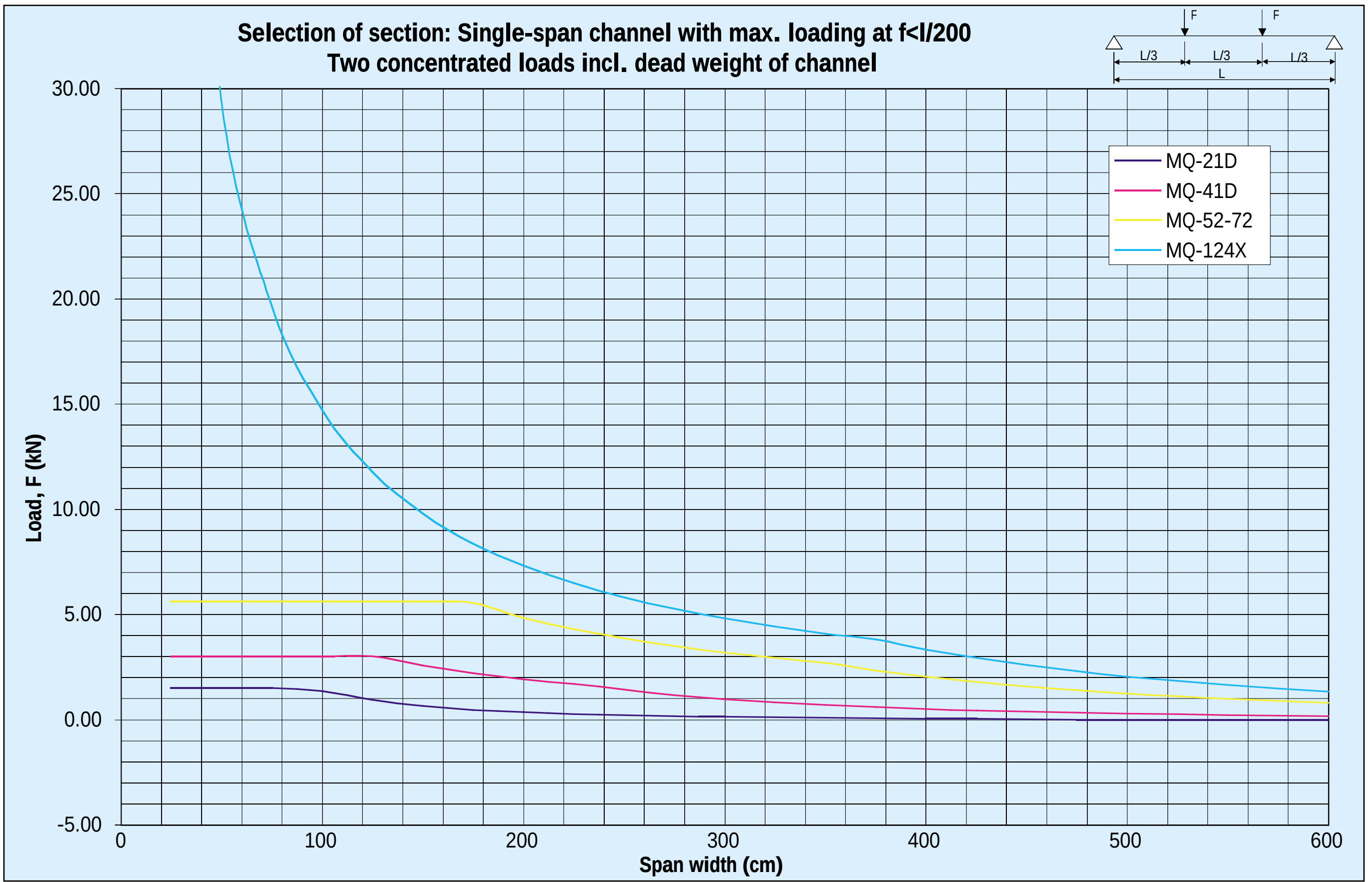


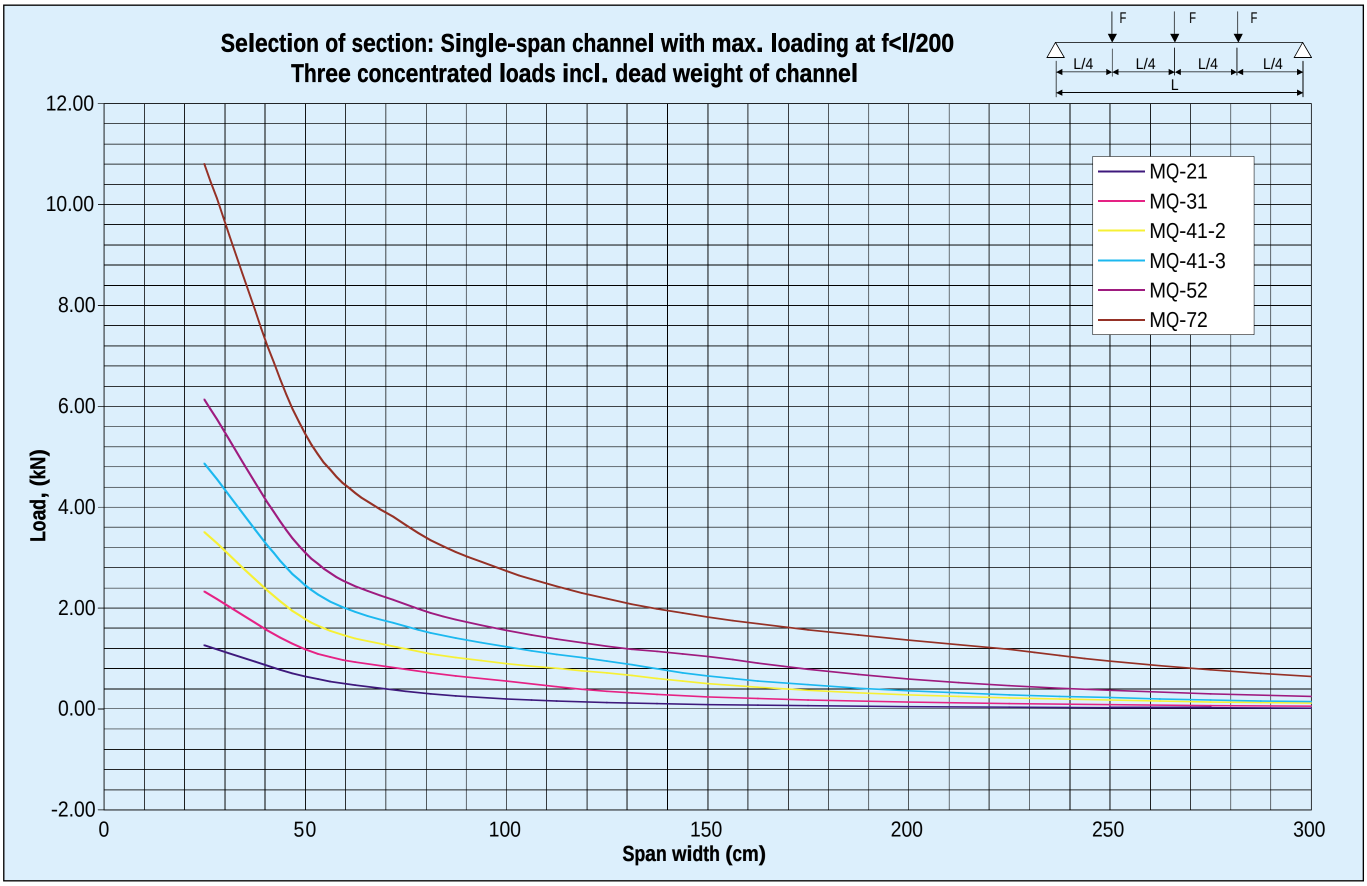
Selection of section: Single-span channel with max. loading at f<l/200
Concentrated load at mid-span incl. dead weight of channel
F
L/2
L/2
L
Load, F (kN)
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
0
50
100
150
200
250
300
Span width (cm)
MQ-21
MQ-31
MQ-41-2
MQ-41-3
MQ-52
MQ-72

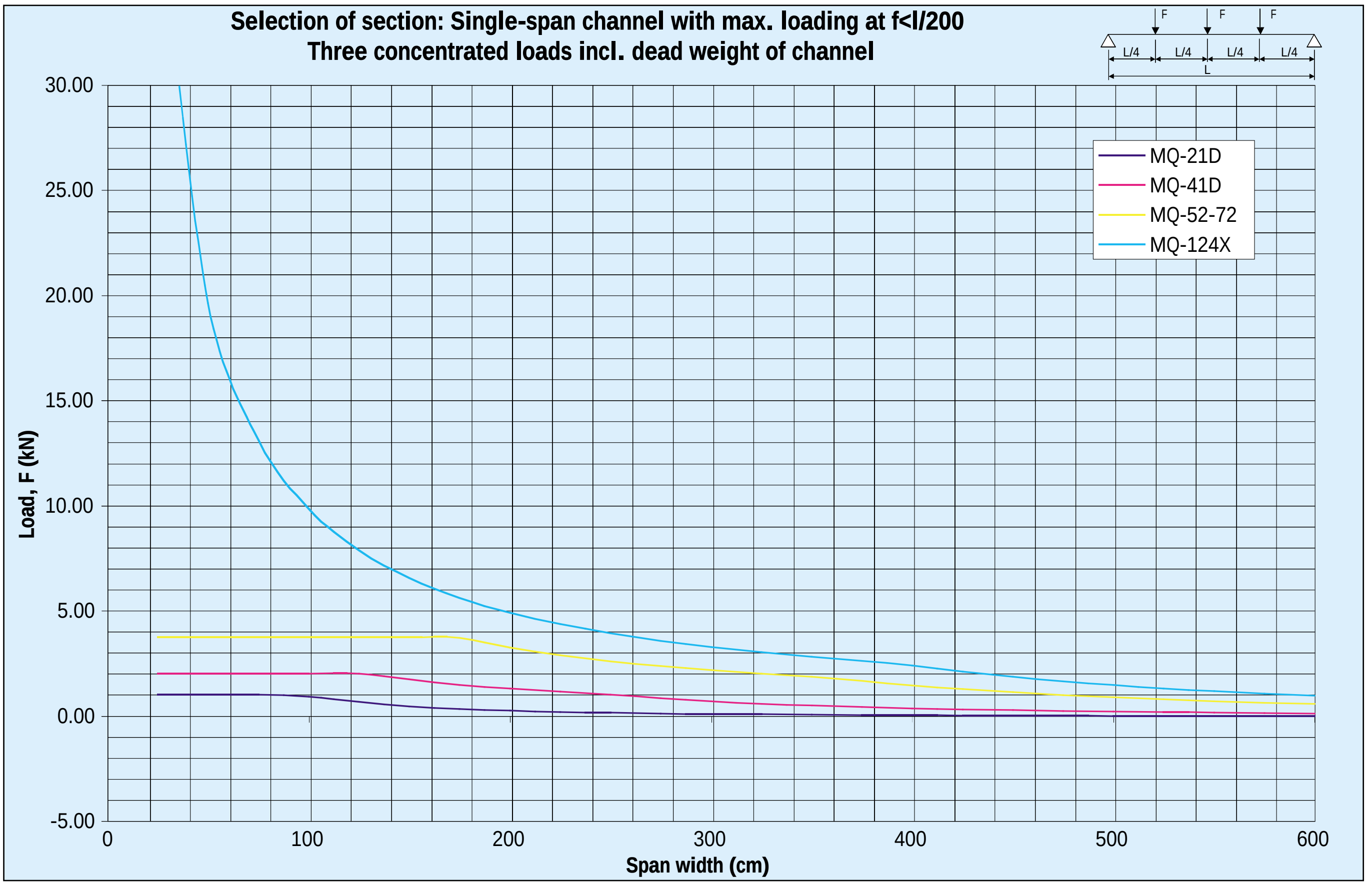


Selection of section: Single-span channel with max. loading at f<l/200
Concentrated load at mid-span incl. dead weight of channel
F
L/2
L/2
L
Load, F (kN)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
0
100
200
300
400
500
600
Span width (cm)
MQ-21D
MQ-41D
MQ-52-72
MQ-124X


Selection of section: Single-span channel with max. loading at f<l/200
Two concentrated loads incl. dead weight of channel
F
F
L/3
L/3
L/3
L
Load, F (kN)
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
0
50
100
150
200
250
300
Span width (cm)
MQ-21
MQ-31
MQ-41-2
MQ-41-3
MQ-52
MQ-72

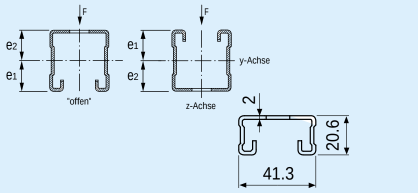

Selection of section: Single-span channel with max. loading at f<l/200
Two concentrated loads incl. dead weight of channel
F
F
L/3
L/3
L/3
L
Load, F (kN)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
0
100
200
300
400
500
600
Span width (cm)
MQ-21D
MQ-41D
MQ-52-72
MQ-124X

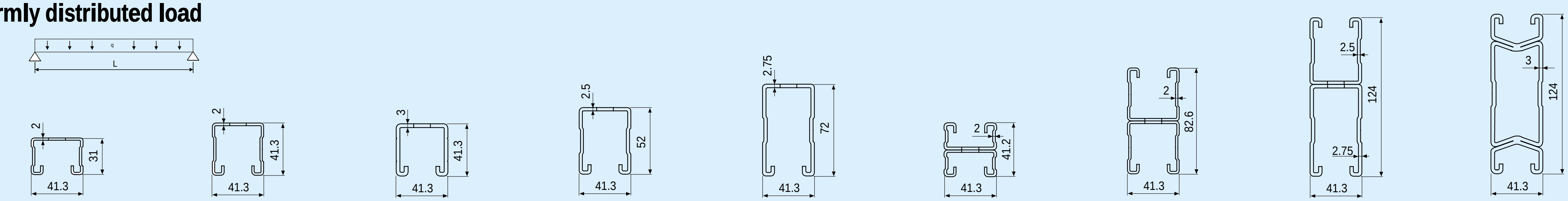

Selection of section: Single-span channel with max. loading at f<l/200
Three concentrated loads incl. dead weight of channel
F
F
F
L/4
L/4
L/4
L/4
L
Load, (kN)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
0
50
100
150
200
250
300
Span width (cm)
MQ-21
MQ-31
MQ-41-2
MQ-41-3
MQ-52
MQ-72


Selection of section: Single-span channel with max. loading at f<l/200
Three concentrated loads incl. dead weight of channel
F
F
F
L/4
L/4
L/4
L/4
L
Load, F (kN)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
0
100
200
300
400
500
600
Span width (cm)
MQ-21D
MQ-41D
MQ-52-72
MQ-124X

Single-span channel with uniformly distributed load

Max. span width under defined load incl. dead weight of channel

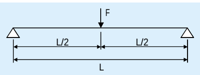




Load (kN/m)	MQ-21 Load (kN/m)	MQ-21 Span width (mm)	MQ-21 f ≤ L/200	MQ-31 Load (kN/m)	MQ-31 Span width (mm)	MQ-31 f ≤ L/200	MQ-41 Load (kN/m)	MQ-41 Span width (mm)	MQ-41 f ≤ L/200	MQ-41/3 Load (kN/m)	MQ-41/3 Span width (mm)	MQ-41/3 f ≤ L/200	MQ-52 Load (kN/m)	MQ-52 Span width (mm)	MQ-52 f ≤ L/200
0.25	0.15	165	8	0.09	266	13	0.07	365	18	0.06	394	20	0.05	484	24
0.50	0.42	120	6	0.25	198	10	0.18	279	14	0.16	310	15	0.13	387	19
0.75	0.76	98	5	0.46	164	8	0.32	233	12	0.29	262	13	0.23	329	16
1.00	1.17	86	4	0.70	143	7	0.49	204	10	0.43	230	12	0.34	291	15
1.25	1.63	77	4	0.98	128	6	0.68	183	9	0.60	208	10	0.48	263	13
1.50	2.14	70	4	1.28	117	6	0.89	168	8	0.79	191	10	0.62	242	12
1.75	2.70	65	3	1.61	109	5	1.12	156	8	0.99	177	9	0.78	225	11
2.00	3.29	61	3	1.96	102	5	1.37	146	7	1.20	166	8	0.95	211	11
2.25	4.00	56	3	2.34	96	5	1.63	138	7	1.43	157	8	1.13	200	10
2.50	4.94	51	2	2.74	91	5	1.91	131	7	1.68	149	7	1.32	190	9
2.75	5.99	46	2	3.23	85	4	2.20	125	6	1.93	142	7	1.52	181	9
3.00	7.13	42	2	3.84	78	3	2.55	118	6	2.20	136	7	1.73	174	9
3.25	8.38	39	1	4.51	72	3	2.99	109	5	2.48	131	7	1.95	167	8
3.50	9.73	36	1	5.23	67	3	3.46	101	4	2.77	126	6	2.17	161	8
3.75	11.19	34	1	6.01	62	2	3.97	94	4	3.07	122	6	2.41	156	8
4.00	12.75	31	1	6.83	59	2	4.52	89	3	3.38	118	6	2.65	151	8
4.25	14.42	29	1	7.72	55	2	5.10	83	3	3.71	115	6	2.93	145	7
4.50	16.19	28	1	8.66	52	2	5.71	79	3	4.16	108	5	3.29	137	6
4.75	18.08	26	1	9.65	49	1	6.37	75	2	4.63	103	5	3.66	130	6
5.00	20.08	25	1	10.70	47	1	7.06	71	2	5.12	98	4	4.05	123	5
5.25	22.19	24	0	11.81	44	1	7.78	67	2	5.65	93	4	4.46	118	5
5.50	24.41	23	0	12.97	42	1	8.54	64	2	6.20	89	3	4.90	112	4
5.75	26.75	21	0	14.18	41	1	9.34	62	2	6.77	85	3	5.35	107	4
6.00	29.21	21	0	15.46	39	1	10.17	59	1	7.37	81	3	5.82	103	4
6.25	31.78	20	0	16.79	37	1	11.04	57	1	8.00	78	3	6.32	99	3
6.50	34.48	19	0	18.17	36	1	11.94	54	1	8.65	75	2	6.83	95	3
6.75	37.30	18	0	19.62	34	1	12.88	52	1	9.32	72	2	7.37	92	3
7.00	40.25	17	0	21.12	33	1	13.86	51	1	10.03	70	2	7.92	88	3
7.25	43.33	17	0	22.68	32	1	14.87	49	1	10.76	67	2	8.50	85	2
7.50	46.54	16	0	24.30	31	1	15.92	47	1	11.51	65	2	9.09	82	2
7.75	49.88	16	0	25.98	30	0	17.01	46	1	12.29	63	2	9.71	80	2
8.00	53.36	15	0	27.72	29	0	18.14	44	1	13.10	61	2	10.34	77	2

Load (kN/m)	MQ-72 Load (kN/m)	MQ-72 Span width (mm)	MQ-72 f ≤ L/200	MQ-21D Load (kN/m)	MQ-21D Span width (mm)	MQ-21D f ≤ L/200	MQ-41D Load (kN/m)	MQ-41D Span width (mm)	MQ-41D f ≤ L/200	MQ-52-72 Load (kN/m)	MQ-52-72 Span width (mm)	MQ-52-72 f ≤ L/200	MQ-124X Load (kN/m)	MQ-124X Span width (mm)	MQ-124X f ≤ L/200
0.25	0.04	665	33	0.07	340	17	0.04	680	34	0.03	990	49	0.02	1076	54
0.50	0.09	563	28	0.19	264	13	0.09	578	29	0.06	904	45	0.05	1008	50
0.75	0.15	493	25	0.34	222	11	0.15	507	25	0.09	833	42	0.08	949	47
1.00	0.23	442	22	0.51	195	10	0.22	456	23	0.13	775	39	0.11	897	45
1.25	0.31	404	20	0.71	176	9	0.30	417	21	0.17	726	36	0.15	852	43
1.50	0.40	374	19	0.93	161	8	0.39	386	19	0.22	685	34	0.18	812	41
1.75	0.50	350	17	1.17	150	7	0.49	361	18	0.27	649	32	0.23	777	39
2.00	0.61	329	16	1.42	140	7	0.59	340	17	0.32	618	31	0.27	745	37
2.25	0.72	312	16	1.70	133	7	0.70	322	16	0.38	591	30	0.31	716	36
2.50	0.84	297	15	1.99	126	6	0.81	307	15	0.44	566	28	0.36	691	35
2.75	0.97	284	14	2.29	120	6	0.94	293	15	0.50	545	27	0.41	667	33
3.00	1.10	273	14	2.61	115	6	1.07	282	14	0.57	525	26	0.46	646	32
3.25	1.24	262	13	-	-	-	1.20	271	14	0.64	508	25	0.52	626	31
3.50	1.38	253	13	-	-	-	1.34	262	13	0.71	492	25	0.58	608	30
3.75	1.53	245	12	-	-	-	1.48	253	13	0.79	477	24	0.63	592	30
4.00	1.68	238	12	-	-	-	1.63	245	12	0.86	464	23	0.69	576	29
4.25	1.84	231	12	-	-	-	1.78	238	12	0.94	451	23	0.76	562	28
4.50	2.01	224	11	-	-	-	1.98	227	11	1.02	440	22	0.82	548	27
4.75	2.17	219	11	-	-	-	2.21	215	10	1.11	429	21	0.89	536	27
5.00	2.34	213	11	-	-	-	2.44	205	9	1.19	419	21	0.95	524	26
5.25	2.56	205	10	-	-	-	2.69	195	8	1.28	410	20	1.02	513	26
5.50	2.81	196	9	-	-	-	2.95	187	7	1.37	401	20	1.09	503	25
5.75	3.06	188	8	-	-	-	3.22	179	7	1.46	393	20	1.17	493	25
6.00	3.33	180	8	-	-	-	3.50	172	6	1.56	385	19	1.24	484	24
6.25	3.61	173	7	-	-	-	-	-	-	1.65	378	19	1.32	475	24
6.50	3.90	166	7	-	-	-	-	-	-	1.75	371	19	1.39	467	23
6.75	4.21	160	6	-	-	-	-	-	-	1.85	364	18	1.47	459	23
7.00	4.52	155	6	-	-	-	-	-	-	1.95	358	18	1.55	451	23
7.25	4.85	150	5	-	-	-	-	-	-	2.08	348	17	1.63	444	22
7.50	5.18	145	5	-	-	-	-	-	-	2.22	337	16	1.72	437	22
7.75	5.53	140	5	-	-	-	-	-	-	2.37	327	15	1.80	431	22
8.00	5.89	136	4	-	-	-	-	-	-	2.52	317	14	1.89	424	21

Max. span width, L (cm) / Deflection, f (mm)

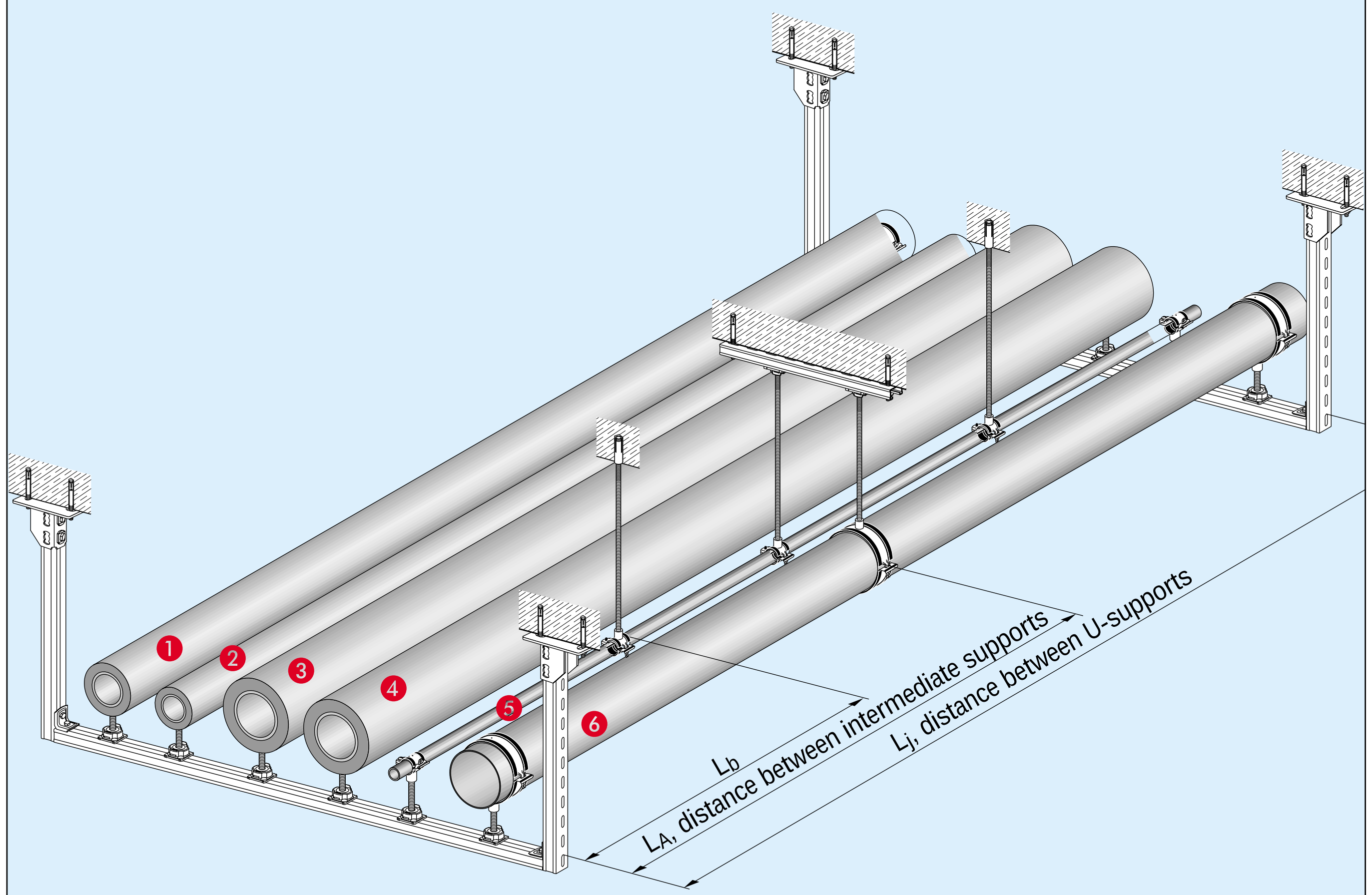


F (kN)	MQ-21 L (cm)	MQ-21 f (mm)	MQ-31 L (cm)	MQ-31 f (mm)	MQ-41 L (cm)	MQ-41 f (mm)	MQ-41/3 L (cm)	MQ-41/3 f (mm)	MQ-52 L (cm)	MQ-52 f (mm)	MQ-72 L (cm)	MQ-72 f (mm)	MQ-21D L (cm)	MQ-21D f (mm)	MQ-41D L (cm)	MQ-41D f (mm)	MQ-52-72 L (cm)	MQ-52-72 f (mm)	MQ-124X L (cm)	MQ-124X f (mm)
0.25	133	6.7	218	10.9	306	15.3	337	16.8	419	20.9	599	29.9	288	14.4	614	30.7	936	46.8	1034	51.7
0.50	95	4.8	159	7.9	226	11.3	254	12.7	321	16.0	482	24.1	216	10.8	496	24.8	821	41.0	938	46.9
0.75	78	3.9	131	6.5	187	9.3	212	10.6	268	13.4	411	20.5	179	9.0	424	21.2	735	36.8	861	43.0
1.00	63	2.8	114	5.7	163	8.1	185	9.2	235	11.7	364	18.2	156	7.8	375	18.8	670	33.5	797	39.9
1.25	51	1.8	94	4.0	141	6.6	166	8.3	211	10.5	329	16.5	140	7.0	340	17.0	618	30.9	745	37.2
1.50	42	1.2	78	2.8	118	4.6	152	7.6	193	9.7	303	15.1	120	5.3	313	15.6	576	28.8	701	35.0
1.75	36	<1	67	2.0	101	3.4	139	6.7	175	8.3	282	14.1	103	3.9	288	14.1	541	27.0	663	33.1
2.00	32	<1	59	1.6	89	2.6	122	5.2	154	6.5	264	13.2	90	3.0	254	11.0	511	25.6	630	31.5
2.25	28	<1	52	1.2	79	2.1	108	4.1	137	5.1	238	10.8	80	2.4	227	8.9	486	24.3	601	30.1
2.50	25	<1	47	1.0	71	1.7	98	3.3	123	4.2	215	8.9	72	1.9	205	7.3	464	23.2	576	28.8
2.75	23	<1	43	<1	65	1.4	89	2.8	112	3.5	196	7.4	66	1.6	187	6.1	444	22.2	554	27.7
3.00	21	<1	39	<1	59	1.2	82	2.3	103	2.9	180	6.3	60	1.3	172	5.1	415	19.7	534	26.7
3.50	18	<1	34	<1	51	<1	70	1.7	88	2.2	155	4.6	–	–	148	3.8	360	15.0	499	24.9
4.00	16	<1	29	<1	44	<1	61	1.3	77	1.7	136	3.6	–	–	129	2.9	317	11.7	466	22.9
4.50	14	<1	26	<1	39	<1	54	1.0	69	1.3	121	2.8	–	–	115	2.3	284	9.4	418	18.7
5.00	12	<1	23	<1	36	<1	49	<1	62	1.1	109	2.3	–	–	104	1.9	256	7.7	380	15.5
6.00	10	<1	19	<1	30	<1	41	<1	52	<1	91	1.6	–	–	87	1.3	215	5.5	320	11.1
7.00	9	<1	17	<1	25	<1	35	<1	44	<1	78	1.2	–	–	–	–	185	4.0	276	8.3
8.00	7	<1	14	<1	22	<1	31	<1	39	<1	68	<1	–	–	–	–	162	3.1	243	6.5

Design example for single-span channel
Complete structure design: Pipe run with U-support

Unknown:
- Support length, U-support width, L
- Type of support, required type of channel
- U-support spacing, L_j
- Position and number of intermediate supports, (L_A and L_b)

Known:
- Negligible change in pipe length in this section of run
- Support spacing as per DIN 1988 T2 (20°C)



1 Cold water, 2″, insulated (DIN 2440)
2 Hot water 1½″, insulated (DIN 2440)
3 Heating, V 60.3 × 2.9, insulated (DIN 2448)
4 Heating, R 60.3 × 2.9, insulated (DIN 2448)
5 Compressed air, HDPE 40 mm dia.
6 Waste water, PVC-U, 110 mm dia.

This design example illustrates how simple it is to select the type of channel when using Hilti design tables.

U-support widths

	Medium in pipe	Material	Pipe size	Outside dia.	Ins. thickness	Total dia.
1st pipe:	cold water	steel	2″	60.3 mm	50 mm	160 mm
2nd pipe:	hot water	steel	1½″	48.3 mm	40 mm	130 mm
3rd pipe:	heating, feed	steel	DN 50	60.3 mm	50 mm	160 mm
4th pipe:	heating, return	steel	DN 50	60.3 mm	50 mm	160 mm
5th pipe:	compressed air	HDPE	DW 34	40.0 mm	–	40 mm
6th pipe:	waste water	PVC-U	DW 100	110,0 mm	–	110 mm
Total pipes						**750 mm**

Space requirement

Gaps between pipes	5×100 mm	500 mm
Gaps between U-support and pipe	2×100 mm	200 mm
Total of all gaps		700 mm
Total space requirement *		**1450 mm**

* As there is a breach in the ceiling, the span width is increased to 2 m.

Max. possible pipe ring (U-support) spacing owing to raw materials used

	Medium in pipe	Material	Pipe size	Outside dia.	Ins. thickness	Total dia.
1st pipe:	cold water	steel	2″			max. 4.75 m
2nd pipe:	hot water	steel	1½″			max. 4.25 m
3rd pipe:	heating, feed	steel	DN 50			max. 4.75 m
4th pipe:	heating, return	steel	DN 50			max. 4.75 m
5th pipe:	compressed air	HDPE	DW 34			max. 1.50 m (with support cradle)
6th pipe:	waste water	PE	DW 100			max. 2.00 m (with support cradle)

The U-support spacing should, as far as possible, be a multiple of the smallest existing support widths for design and cost reasons. Consequently, the following has been selected here:

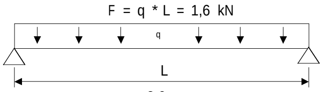
U-support spacing, L_j	4 × 1.00 m	or 2 × 2.00 m	**4.00 m**
Distance to intermediate support, L_b			**1.00 m**
Distance to intermediate support, L_A			**2.00 m**

Weight determination (incl. medium in pipe) per meter of pipe run

	Medium in pipe	Material	Pipe size	Outside dia.	Ins. thickness	Weight	Total
1st pipe:	cold water	steel	2″	60.3 mm	50 mm	9.90 kg/m (filled)	**39.60 kg**
2nd pipe:	hot water	steel	1½″	48.3 mm	40 mm	6.60 kg/m (filled)	**24.40 kg**
3rd pipe:	heating, feed	steel	DN 50	60.3 mm	50 mm	9.00 kg/m (filled)	**36.00 kg**
4th pipe:	heating, return	steel	DN 50	60.3 mm	50 mm	9.00 kg/m (filled)	**36.00 kg**
5th pipe:	compressed air	HDPE	DW 34	40.0 mm	–	0.34 kg/m (empty)	**0.34 kg**
6th pipe:	waste water	PE	DW 100	110.0 mm	–	10.00 kg/m (filled)	**20.00 kg**
Total pipes						**158.34 kg/m**	**≈ 1.6 kN**

Design example:
Determination of required channel

Single-span channel with uniformly distributed load



M	= Bending moment	(kNcm)
F	= Single concentrated load	(kN)
q	= Uniformly distributed load	(kN/cm)
L	= Span width	(cm)
σ	= Stress	(kN/cm^2)
E	= Modulus of elasticity	(kN/cm^2)
I	= Moment of inertia	(cm^4)
W	= Section modulus	(cm^3)
f	= Deflection	(cm)

a) Verification of stress

<u>1st step:</u>

Estimate the required channel section disregarding the dead weight of the channel:

q = F/L = 1.6 kN/2.0 m = 0.80 kN/m = 0.008 kN/cm

$$M_{max} = \frac{q * L^2}{8} = \frac{0.008 * 200^2}{8} = 40$$

First, $\sigma_{perm.}$ is assumed to be 16 kN/cm^2 for the estimate:

$$W_{min} = \frac{M}{zul} = \frac{40}{16} = 2.5 \text{ cm}$$

MQ-41 is selected with $W_{min.} = 2.54\ cm^2$ / EG = 2.08 kg/m = 2.08 • 10^{-4} kN/cm

<u>2nd step:</u>

Verify this while allowing for the dead weight of the channel:

$$\sigma = (40 + \frac{2.08 * 10^{-4} * 200^2}{8}) / 2.54 = 16.16 \text{ kN / cm}^2 < \sigma_{zul} = 17.5 \text{ kN/cm}^2 = 175 \text{ kN/mm}^2$$

Deflection (bending) is disregarded.

b) Deflection

Permissible deflection:

$$f_{max} = \frac{L}{200} = \frac{200}{200} = 10 \text{ cm}$$

<u>1st step:</u>

Estimate the required channel section disregarding the dead weight of the channel:

$$I_{erf} = \frac{5}{384} * \frac{q * L^4}{f_{max} * E} = \frac{5}{384} * \frac{0.008 * 200^4}{1.0 * 21000} = 7.94 \text{ cm}^4$$

MQ-52 is selected with $I_y = 11.41\ cm^4$ / EG = 2.94 kg/m = 2.94 • 10^{-4} kN/cm

The deflection (deformation) when allowing for the dead weight of the channel, is:

q = 0.008 kN/cm + 2.94 • 10^{-4} kN/cm = 0.00829 kN/cm

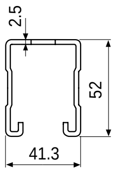
$$f_{max} = \frac{5}{384} * \frac{q * L^4}{I_y * E} = \frac{5}{384} * \frac{0.008294 * 200^4}{11.41 * 21000} = 0.72 \text{ cm} < f_{zul} = 1.0 \text{ cm}$$

Design example: Determination of required channel

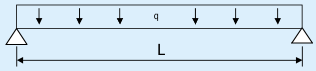
Simplified selection using Hilti design tables
On using the following Hilti design tables, you save the time otherwise taken for the laborious calculation needed to determine the required channel sections for many loading conditions of "single-span channels with a single, two or three concentrated loads or a uniformly distributed load".

Determination of channel type using individual design table:

Channel length:	2.0 m
Load:	Uniformly distributed
Loading:	F = q • L = 1.6 kN
Max. deflection:	f = L/200



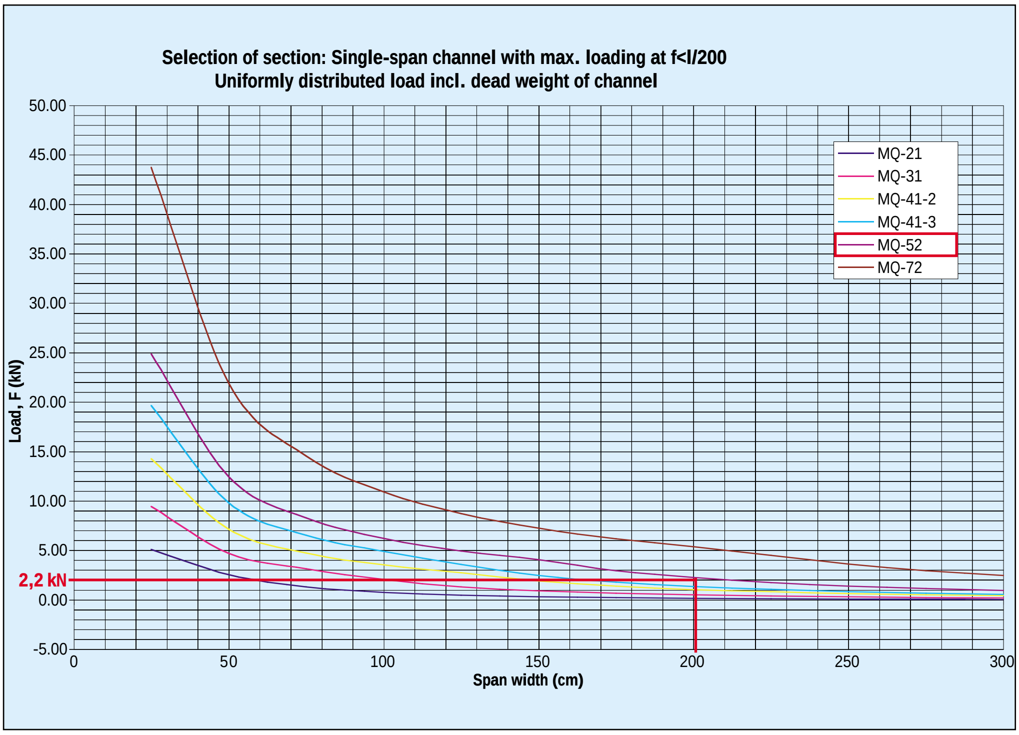
Single-span channel with uniaxial deflection
Uniformly distributed load



Span width (mm)	F (kN/m)	F (kN)	f (mm) </= σperm.	F1 (kN)	f (mm) </= σperm.	F2 (kN)	f (mm) </= σperm.
25	99.50	24.88	0.2	-	-	-	-
50	24.85	12.43	0.8	-	-	-	-
75	11.03	8.27	1.9	-	-	-	-
100	6.19	6.19	3.4	-	-	6.10	3.3
125	3.95	4.94	5.3	-	-	3.89	4.2
150	2.74	4.10	7.6	4.04	7.5	2.68	5.0
175	2.00	3.50	10.4	2.95	8.8	1.95	5.8
200	1.53	3.05	13.5	**2.24**	**10.0**	1.47	6.7
225	1.20	2.70	17.1	1.75	11.3	1.15	7.5
250	0.97	2.41	21.1	1.40	12.5	0.91	8.3
275	0.79	2.18	25.6	1.14	13.8	0.73	9.2
300	0.66	1.99	30.4	0.93	15.0	0.59	10.0
325	0.56	1.82	35.7	0.78	16.3	0.48	10.8
350	0.48	1.67	41.4	0.65	17.5	0.40	11.7
375	0.41	1.55	47.6	0.54	18.8	0.33	12.5
400	0.36	1.44	54.1	0.46	20.0	0.27	13.3
425	0.31	1.34	61.1	0.38	21.3	0.21	14.2
450	0.28	1.25	68.5	0.32	22.5	0.17	15.0
475	0.25	1.17	76.3	0.27	23.8	0.13	15.8
500	0.22	1.10	84.5	0.22	25.0	0.10	16.7
525	0.20	1.03	93.2	0.18	26.3	0.07	17.5
550	0.18	0.97	102.3	0.14	27.5	0.04	18.3
575	0.16	0.91	111.8	0.11	28.8	0.02	19.2
600	0.14	0.86	121.7	0.08	30.0	-	-

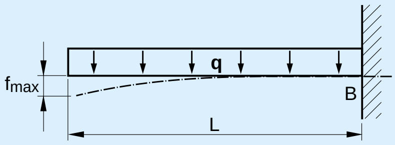
F_1 at f = L/200, F_2 at f = L/300, F at $\sigma_{perm.}$

Determination of channel type using diagram



Cantilever-type brackets: Design formulae

Loading condition 1:
Bracket with uniformly distributed load along bending arm, L



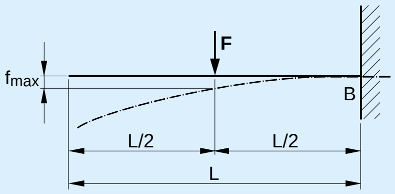
$$M_B = \frac{q * L^2}{2} = \sigma_{perm.} * W$$

$$q = \frac{2 * \sigma_{perm.} * W}{L^2}$$

$$f_{max} = \frac{1}{8} * \frac{q * L^4}{E * I}$$

$$q = 8 * \frac{E * I * f_{max}}{L^4}$$

Loading condition 2:
Bracket with single concentrated load at bending arm L/2



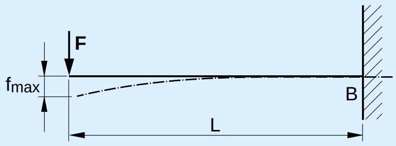
$$M_B = F * L/2 = \sigma_{perm.} * W$$

$$F = \frac{2 * \sigma_{perm.} * W}{L}$$

$$f_{max} = \frac{1}{24} * \frac{F * L^3}{E * I}$$

$$F = 24 * \frac{E * I * f_{max}}{L^3}$$

Loading condition 3:
Bracket with single concentrated load at bending arm L



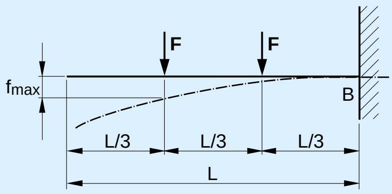
$$M_B = F * L = \sigma_{perm.} * W$$

$$F = \frac{\sigma_{perm.} * W}{L}$$

$$f_{max} = \frac{1}{3} * \frac{F * L^3}{E * I}$$

$$F = 3 * \frac{E * I * f_{max}}{L^3}$$

Loading condition 4:
Bracket with two concentrated loads at L/3



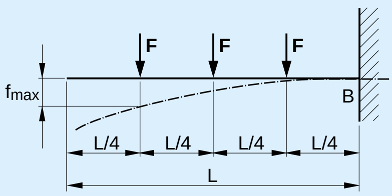
$$M_B = F * L$$

$$F = \frac{\sigma_{perm.} * W}{L}$$

$$f_{max} = 0.12963 * \frac{F * L^3}{E * I}$$

$$F = \frac{1}{0.12963} * \frac{E * I * f_{max}}{L^3}$$

Loading condition 5:
Bracket with three concentrated loads at L/4



$$M_B = \frac{3 * F * L}{2} = \sigma_{perm.} * W$$

$$F = \frac{2 * \sigma_{perm.} * W}{3 * L}$$

$$f_{max} = 0.24219 * \frac{F * L^3}{E * I}$$

$$F = \frac{1}{0.24219} * \frac{E * I * f_{max}}{L^3}$$

M	= Bending moment	(kN/cm)	L	= Channel length	(cm)	I	= Moment of inertia	(cm^4)
F	= Single concentrated load	(kN)	σ	= Stress	(kN/cm^2)	W	= Section modulus	(cm^3)
q	= Uniformly distributed load	(kN/cm)	E	= Modulus of elasticity	(kN/cm^2)	f	= Deflection	(cm)

Cantilever-type bracket tables

Bracket	Channel, L (mm)	Loading condition 1: F1 = q · i, uniformly distributed load, F1 [N]			Loading condition 2: F1, ½ ½, single concentrated load, F1 [N]			Loading condition 3, F1 [N]			Loading condition 4, F2 F2, ⅓ ⅓ ⅓, F2 [N]			Loading condition 5, F3 F3 F3, ¼ ¼ ¼ ¼, F3 [N]		
		HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS12,5[3]
The deflection of L/150 was maintained in all cases when measured at the point of load application.																
MQK-21/300	300	1050	1050	1050	1050	1050	1050	420	420	420	520	520	520	350	350	350
MQK-21/450	450	500	500	500	700	700	700	180	180	180	310	310	310	190	190	190
MQK-41/300	300	2950	2370	1460	2950	2370	1460	1480	1180	730	1470	1180	730	980	790	480
MQK-41/450	450	1960	1570	970	1960	1570	970	980	780	480	980	780	480	650	520	320
MQK-41/600	600	1470	1170	720	1470	1170	720	620	580	360	730	580	360	490	390	240
MQK-41/1000	1000	580	580	420	840	690	420	210	210	210	360	340	210	220	220	140
MQK-41/3/300	300	4070	2370	1460	4070	2370	1460	2040	1180	730	2030	1180	730	1350	790	480
MQK-41/3/450	450	2710	1570	970	2710	1570	970	1350	780	480	1350	780	480	900	520	320
MQK-41/3/600	600	2020	1170	720	2020	1170	720	810	580	360	1010	580	360	670	390	240
MQK-41/600/4	600	1470	1470	1470	1470	1470	1470	620	620	620	730	730	730	490	490	490
MQK-41/1000/4	1000	580	580	580	840	840	840	210	210	210	360	360	360	220	220	220
MQK-72/450	450	5690	2260	1370	5690	2260	1370	2840	1130	680	2840	1130	680	1890	750	450
MQK-72/600	600	4260	1680	1020	4260	1680	1020	2130	840	510	2130	840	510	1420	560	340
MQK-21 D/300	300	3010	2370	1460	3010	2370	1460	1510	1180	730	1500	1180	730	1000	790	480
MQK-21 D/450	450	2000	1570	970	2000	1570	970	1000	780	480	1000	780	480	660	520	320
MQK-21 D/600	600	1490	1170	720	1490	1170	720	570	570	360	740	580	360	490	390	240
MQK-41 D/1000	1000	2500	960	560	2500	960	560	1250	480	280	1250	480	280	830	320	180
The deflection of L/200 was maintained in all cases when measured at the point of load application.																
MQK-21/300	300	850	850	850	1050	1050	1050	310	310	310	520	520	520	320	320	320
MQK-21/450	450	370	370	370	550	550	550	140	140	140	230	230	230	140	140	140
MQK-41/300	300	2950	2370	1460	2950	2370	1460	1480	1180	730	1470	1180	730	980	790	480
MQK-41/450	450	1960	1570	970	1960	1570	970	830	780	480	980	780	480	650	520	320
MQK-41/600	600	1240	1170	720	1470	1170	720	460	460	360	730	580	360	470	390	240
MQK-41/1000	1000	430	430	420	610	610	420	160	160	160	270	270	210	160	160	140
MQK-41/3/300	300	4070	2370	1460	4070	2370	1460	2040	1180	730	2030	1180	730	1350	790	480
MQK-41/3/450	450	2710	1570	970	2710	1570	970	1080	780	480	1350	780	480	900	520	320
MQK-41/3/600	600	1610	1170	720	2020	1170	720	600	580	360	1010	580	360	620	390	240
MQK-41/600/4	600	1240	1240	1240	1470	1470	1470	460	460	460	730	730	730	470	470	470
MQK-41/1000/4	1000	430	430	430	610	610	610	160	160	160	270	270	270	160	160	160
MQK-72/450	450	5690	2260	1370	5690	2260	1370	2840	1130	680	2840	1130	680	1890	750	450
MQK-72/600	600	3320	1680	1020	4260	1680	1020	2130	840	510	2130	840	510	1420	560	340
MQK-21 D/300	300	3010	2370	1460	3010	2370	1460	1510	1180	730	1500	1180	730	1000	790	480
MQK-21 D/450	450	2000	1570	970	2000	1570	970	770	770	480	1000	780	480	660	529	320
MQK-21 D/600	600	1140	1140	720	1490	1170	720	420	420	360	730	580	360	440	390	240
MQK-41 D/1000	1000	2500	960	560	2500	960	560	950	480	280	1250	480	280	830	320	180

[1] Loading capacity of bracket (steel) or with HVZ M12 fastening / the loading capacity of the bracket is reached with the HVZ M12.
[2] Loading capacity of bracket fastened with HST anchor
[3] Loading capacity of bracket fastened with HUS screw anchor

The loads apply only if the bracket is installed in the right position, i.e. the open side pointing upwards.
The dead weight of the bracket has been taken into account.
The loads apply only if the bracket fastening is away from a building component edge (fastenings at building component edges must be verified separately).
The transfer of forces into the respective base material (steel, concrete) must be verified separately.
The guidelines for use / application of anchors in anchor approvals must be observed.

Technical data of brackets with inclined brace

Bracket	L (mm)	F1, F1(N), Short brace	F1, F1(N), Short brace	F1, Long brace	F1, Long brace	F1, Long brace
MQK-41/450	450	5000	5000	–	–	–
MQK-41/600	600	–	–	3500	3500	1500
MQK-41/1000	1000	–	–	3500	3500	–
MQK-41/3/450	450	6000	5000	–	–	–
MQK-41/3/600	600	–	–	4500	3500	2000
MQK-41/600/4	600	–	–	3500	3500	2000
MQK-41/1000/4	1000	–	–	3500	3500	–
MQK-72/450	450	6000	5000	–	–	–
MQK-72/600	600	–	–	6000	3500	2500
MQK-21 D/450	450	5000	5000	–	–	–
MQK-21 D/600	600	–	–	3500	3500	1500
MQK-41 D/1000	1000	–	–	3500	3500	1000

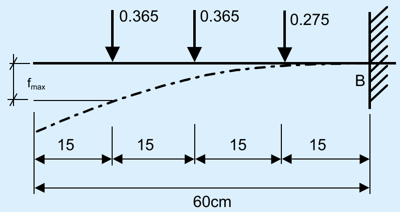
Cantilever-type bracket:
Design example with verification of stress and deflection

Example: Bracket

Known:
Three water-filled pipes without insulation or change in length due to temperature.
(The pipe sizes, spacing, etc., must be determined accurately in keeping with the example for single-span channels.)
Support spacing: 3.0 m
1. DN 65 9.16 kg/m*3.0 m = 27.48 kg = 0.275 kN on inside
2. DN 80 12.15 kg/m*3.0 m = 36.45 kg =0.365 kN
3. DN 80 12.15 kg/m*3.0 m = 36.45 kg = 0.365 kN
A bracket with a 600 mm cantilever arm is selected.
Three, equally spaced, single concentrated loads: pipe spacing, centerline to centerline, 150 mm

a) Verification of stress

Determination of bending moments (disregarding dead weight of bracket):



1st step:
Estimate the required channel section disregarding the dead weight of the channel.
$M_B = 0.275 \cdot 15 + 0.365 \cdot 30 + 0.365 \cdot 45 = 31.5$ kNcm
First, $\sigma_{perm.}$ is assumed to be 16 kN/cm² for the estimate.

$$W_{min} = \frac{M}{\sigma_{zul}} = \frac{31.5}{16} = 1.97\,cm^3$$

An MQ 41 channel is selected with $W_{min.} = 2.54\ cm^3$ / $I_y = 5.37\ cm^4$/ EG = 2.08 kg/m = $2.08*10^{-4}$ kN/cm
2nd step:
Verify this allowing for the dead weight of the channel:

$$M_{B/EG} = \frac{q * L^2}{2} = \sigma_{zul} * W$$

$$\sigma = \frac{M\,(EG + Rohr)}{W} = \frac{(2.08*10^{-4} * 60^2) + 31.5}{2 * 2.54} = 12.55\,kN/cm^2 < 17.5\,kN/cm^2 = 175\,N/mm^2$$

Disregarding the deflection

b) Deflection

Permissible deflection at the point of outermost load application 45 cm:

$$f_{max} = \frac{45}{200} = 0.23\ cm$$

To be on the safe side, the deflection is calculated for three times * DN. 80 (instead of DN. 65 and two times • DN. 80)

Deflection due to single concentrated load:

$$= 0.24219 * \frac{F * L^3}{E * I_y} = 0.24219 * \frac{0.315 * 60^3}{21000 * 5.37} = 0.15\ cm$$

Deflection due to dead weight of bracket:

$$f_{max} = \frac{1 * q * L^4}{8 * E * I_y} = \frac{1 * 2.08 * 10^{-4} * 60^4}{8 * 21000 * 5.37} = 0.003\,cm < L/200 = 0.225\,cm$$

This is negligibly small.

Cantilever-type brackets: Simplified selection using Hilti table

Determination of type of bracket:

Cantilever arm length:	0.6 m
Type of loading:	3 concentrated loads
Loading:	F = 0,315 kN
Max. deflection:	f = L/200

Technical data of cantilever-type brackets

Cantilever-type bracket	Channel, L (mm)	Loading condition 1: $F_1 = q \cdot i$ uniformly distributed load F1 [N]			Loading condition 2: ½ F1 ½ single concentrated load F1 [N]			Loading condition 3 F1 [N]			Loading condition 4 ⅓ F2 ⅓ F2 ⅓ F2 [N]			Loading condition 5 ¼ F3 ¼ F3 ¼ F3 ¼ F3 [N]		
		HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS 12,5[3]	HVZ M12[1]	HST M12[2]	HUS12,5[3]
MQK-21/300	300	850	850	850	1050	1050	1050	310	310	310	520	520	520	320	320	320
MQK-21/450	450	370	370	370	550	550	550	140	140	140	230	230	230	140	140	140
MQK-41/300	300	2950	2370	1460	2950	2370	1460	1480	1180	730	1470	1180	730	980	790	480
MQK-41/450	450	1960	1570	970	1960	1570	970	830	780	480	980	780	480	650	520	320
MQK-41/600	600	1240	1170	720	1470	1170	720	460	460	360	730	580	360	470	**390**	240
MQK-41/1000	1000	430	430	420	610	610	420	160	160	160	270	270	210	160	160	140
MQK-41/3/300	300	4070	2370	1460	4070	2370	1460	2040	1180	730	2030	1180	730	1350	790	480
MQK-41/3/450	450	2710	1570	970	2710	1570	970	1080	780	480	1350	780	480	900	520	320
MQK-41/3/600	600	1610	1170	720	2020	1170	720	600	580	360	1010	580	360	620	390	240
MQK-41/600/4	600	1240	1240	1240	1470	1470	1470	460	460	460	730	730	730	470	470	470
MQK-41/1000/4	1000	430	430	430	610	610	610	160	160	160	270	270	270	160	160	160
MQK-72/450	450	5690	2260	1370	5690	2260	1370	2840	1130	680	2840	1130	680	1890	750	450
MQK-72/600	600	3320	1680	1020	4260	1680	1020	2130	840	510	2130	840	510	1420	560	340
MQK-21 D/300	300	3010	2370	1460	3010	2370	1460	1510	1180	730	1500	1180	730	1000	790	480
MQK-21 D/450	450	2000	1570	970	2000	1570	970	770	770	480	1000	780	480	660	529	320
MQK-21 D/600	600	1140	1140	720	1490	1170	720	420	420	360	730	580	360	440	390	240
MQK-41 D/1000	1000	2500	960	560	2500	960	560	950	480	280	1250	480	280	830	320	180

[1] Loading capacity of bracket (loading capacity of steel) or with HVZ M12 fastening / The loading capacity of the bracket is reached with the HVZ M12.
[2] Loading capacity of the bracket with an HST anchor fastening
[3] Loading capacity of the bracket with an HUS screw anchor fastening

The loading values only apply if the bracket is installed in the right position, i.e. the channel opening pointing upwards.
The dead weight of the bracket has been taken into account.
The loads apply only to a bracket fastened away from a building component edge. (Separate verification of suitability must be provided for bracket fastenings made at a component edge.)
Separate verification must be provided of the further transfer of forces into the respective base material (steel, concrete).
The application guidelines in anchor approvals must be observed.

The deflection of L/200 was observed in all cases and measured at the point of load application.

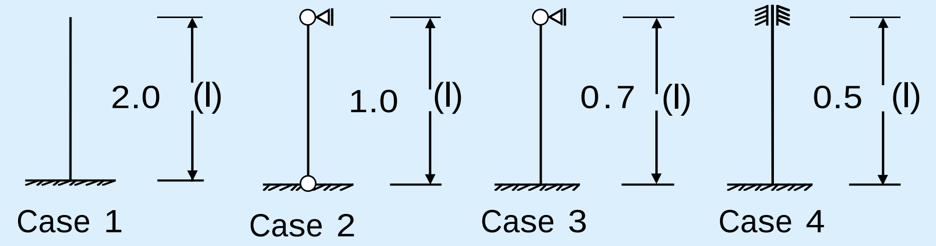
Selected: MQK 41/600 cantilever-type bracket where $F_{perm.}$ = 390 kN < F_{actual} = 0.315 kN incl. fastening with two HST M12 stud anchors for concrete. (The anchor fastening design was carried out using the HIDU anchor fastening design program.)

The dead weight of the bracket has been allowed for.

Flexural buckling: Formulae

Flexural buckling:

Channel length, l (cm)
Euler factor, β
Buckling length, s_k (cm) = l • β
Radius of gyration, i (cm)
Area, A (cm²)
Modulus of elasticity, = 21000 kN/cm²
Yield strength, β_s (kN/cm²) = $f_{y,k}$ (dependent on channel)
π = 3.14159



Determination of reference slenderness ratio and the auxiliary variables:

y-axis:	z-axis:
$\lambda_y = S_{k\,y} / i_y \le 250$	$\lambda_z = S_{k\,z} / i_z < 250$
$\sigma'_{Ki} = \pi^2 \cdot E / \lambda_y^2$	$\sigma'_{Ki} = \pi^2 \cdot E / \lambda_z^2$
$\lambda_a = \pi \cdot \sqrt{(E / \beta_s)}$	$\lambda_a = \pi \cdot \sqrt{(E / \beta_s)}$
$\bar{\lambda}'_{ky} = \lambda_y / \lambda_a$	$\bar{\lambda}'_{kz} = \lambda_z / \lambda_a$

Determination of loading capacity under normal force:

In this case, the channel has a C-section with edge stiffening → buckling stress curve, «b» → α = 0.34 (C-section flanged over).
The cross section can take the full load over its entire area (verified by buckling tests).

Coefficient of buckling

y-axis:	z-axis:
$k'_y = 0.5 \cdot (1+\alpha' \cdot (\bar{\lambda}'_{ky}-0.2) + \bar{\lambda}'^2_{ky})$	$k'_z = 0.5 \cdot (1+\alpha' \cdot (\bar{\lambda}'_{kz}-0.2) + \bar{\lambda}'^2_{kz})$
$\kappa'_y = \dfrac{1}{k'_y + \sqrt{k'^2_y - \bar{\lambda}'^2_{ky}}} \le 1$	$\kappa'_z = \dfrac{1}{k'_z + \sqrt{k'^2_z - \bar{\lambda}'^2_{kz}}} \le 1$

1) Compressive force

y-axis:	z-axis:
$N_u^D = A \cdot \beta_s$ (kN)	$N_u^D = A \cdot \beta_s$ (kN)

2) Buckling load

y-axis:	z-axis:
$N_{u;y}^B = \kappa'_y \cdot A \cdot \beta_s$ (kN)	$N_{u;z}^B = \kappa'_z \cdot A \cdot$ (kN)

3) Loading capacity

y-axis:
$N_u = \min.(N_u^D; N_{u;y,z}^B)$ (kN)

4) Safety and verification

	λ_F action	λ_M action
Constant action	$1.35 = \gamma_G$	$1.10 = \gamma_M$
Variable action	$1.50 = \gamma_Q$	$1.10 = \gamma_M$

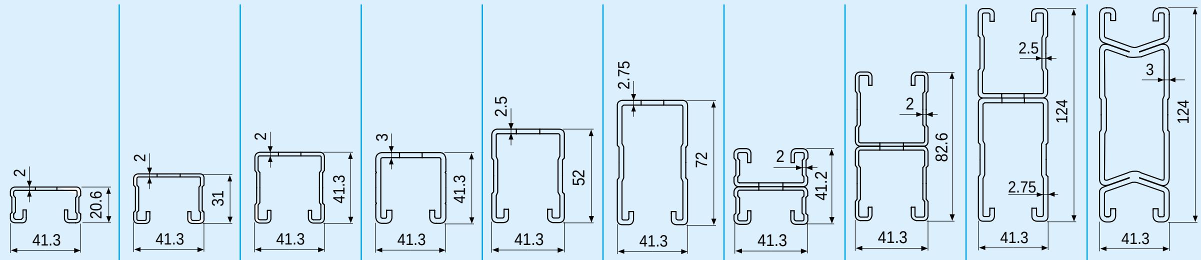
Action: $S_D = G_K \cdot \gamma_G + Q_K \cdot \lambda_Q$
Resistance: $R_D = N_u / \gamma_M$

Verification: $S_D / R_D \le 1$

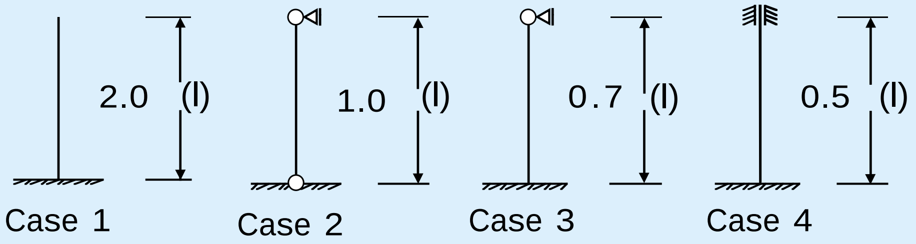
Flexural buckling: Tables

Permissible buckling load

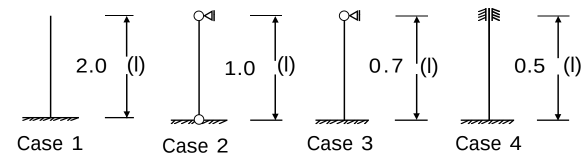
Verification of flexural buckling according to DIN 18800 and DASt-Rili 016 for C-section channels (fully loadbearing cross sections)



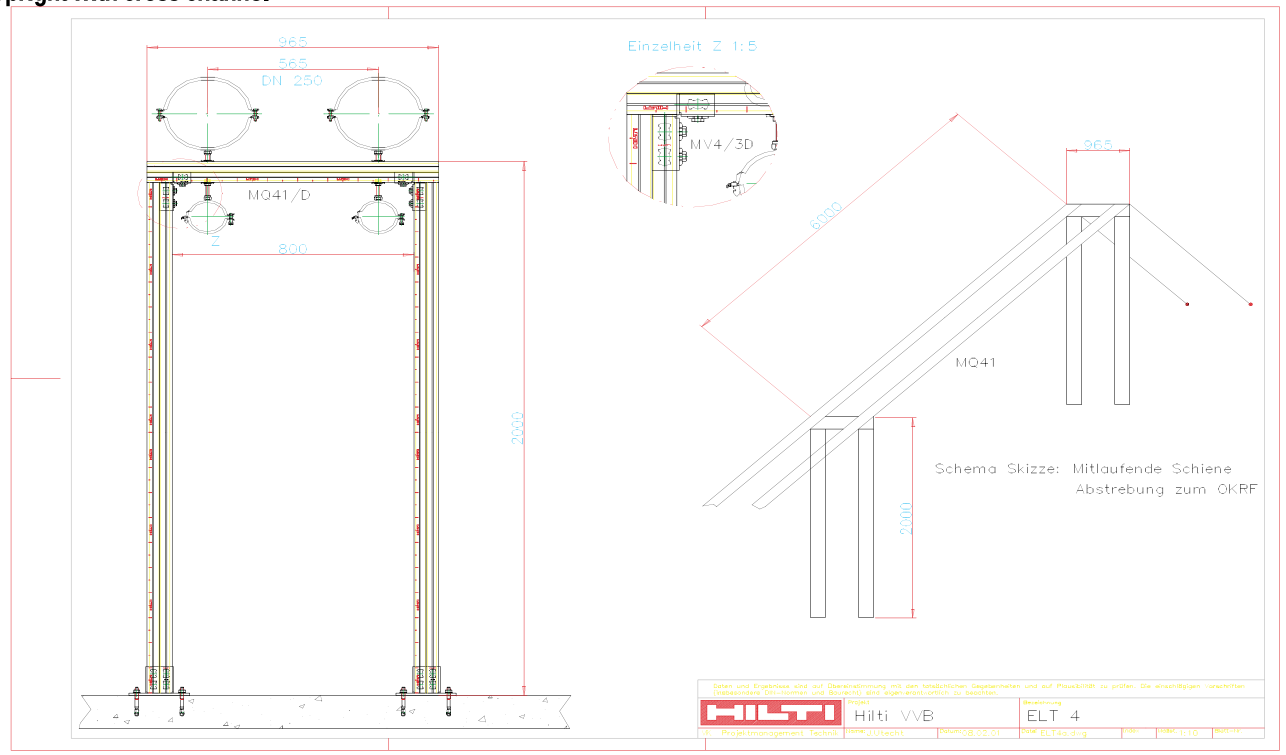
Buckling length, Sk (cm)	MQ-21 (kN)	MQ-31 (kN)	MQ-41 (kN)	MQ-41/3 (kN)	MQ-52 (kN)	MQ-72 (kN)	MQ-21 D (kN)	MQ-41 D (kN)	MQ-52-72 D (kN)	MQ-124X D (kN)
25	28.65	36.26	42.69	64.99	63.61	85.84	60.97	85.41	147.18	199.55
50	22.42	32.49	39.78	59.94	60,57	82.05	55.21	81.40	140.57	189.18
75	14.81	27.46	36.19	53.74	56.29	76.52	47.72	75.71	131.02	175.12
100	9.54	21.43	31.68	45.88	51.11	69.87	38.44	68.83	119.50	157.91
125	6.49	16.06	26.47	37.23	44.88	61.87	29.50	60.56	105.65	137.30
150	4.67	12.10	21.44	29.46	38.12	53.04	22.53	51.55	90.42	115.41
175	3.51	9.33	17.24	23.35	31.74	44.50	17.50	42.99	75.75	95.28
200		7.37	13.97	18.76	26.30	37.07	13.88	35.67	63.04	78.50
225		5.96	11.46	15.31	21.90	30.98	11.25	29.72	52.65	65.13
250		4.91	9.54	1270	18.41	26.10	9.28	24.99	44.33	54.60
275		4.11	8.05	10.69	15.63	22.20	7.79	21.23	37.70	46.29
300			6.88	9.11	13.41	19.07	6.62	18.22	32.38	39.67
325			5.94	7.85	11.62	16.54		15.79	28.07	34.34
350			5.17	6.84	10.16	14.46		13.80	24.54	29.99
375					8.95	12.75		12.16	21.63	26.41
400					7.94	11.32		10.79	19.20	23.42



Flexural buckling: Design example



Upright with cross channel



Loading of cross channel
Selected: MQ-41D channel in the context of example 1 or through the channel program

Symmetrical loading of upright channel:

Upright channel spacing, 6.0 m: constant action:	cold water pipe DN. 250, empty	41.60 kg/m • 6.0 m	2.50 kN	
	cold water pipe DN. 100, empty	9.33 kg/m • 6.0 m	0.56 kN	
EG channel + pipe ring + angle, estimated (6.0 m cross channel ½ support pipe + ½ cross channel length):				
7.7 m channel + small parts 7.7 m = • 5 kg/m + 5 kg			0.44 kN	
Total:			3.50 kN	
$S_{D/G}$ = 3.50 • 1.35				**4.72 kN**

Working load:	cold water pipe DN. 250, water	95.40–41.60 kg/m • 6.0 m	3.23 kN	
	cold water pipe DN. 100, water	17.31–9.33 kg/m • 6.0 m	0.48 kN	
Total:			3.71 kN	
$S_{D/Q}$ = 3.71 • 1.50				**5.56 kN**

Characteristic action, S_K:	7.20 kN	
Design action, S_D:		**10.28 kN**

Provisionally, the MQ-41D channel is selected for the upright.

Flexural buckling:	y-axis	z-axis
Channel length, l (cm)	200	200
Euler factor, β	2.0	0.7
Buckling length, s_k (cm) = l • b	400	140
Radius of gyration, i (cm)	2.50	1.73
Area, A (cm²)	4.90	4.90
Modulus of elasticity, E = 21000 kN/cm²	21000	21000
Yield strength, β_s (kN/cm²) = $f_{y,\kappa}$ (dependent on channel)	27.00	27.00
π =	3.1416	3.1416
Determination of reference slenderness ratio and auxiliary variables:	λ_y = 400/2.50 = 160.00 $\sigma'_{Ki} = \pi^2 \cdot \underline{21000/160^2} = 8.096$ $\lambda_a = \pi * \sqrt{(21000/27)} = 87.61$ λ'_{ky} = 160 / 87.61 = 1.83	$l_{y,z}$ = 140/1.73 = 80.92 $\sigma'_{Ki} = \pi^2 * \underline{21000/80.92^2} = 31.65$ $\lambda_a = \pi * \sqrt{(21000/27)}$ = 87,.61 λ'_{kz} = 80.92 / 87.61 = 0.92

Determination of loading capacity under normal force:

Coefficient of buckling:	$k'_y = 0.5 \cdot (1+0.34 \cdot (1.83-0.2)+1.83^2)$ = 2.45	$k'_z = 0.5*(1+0.34 \cdot (0.92-0.2)+0.92^2)$ = 1.05
	$\kappa_y = 1/(2.45 + \sqrt{2{,}45^2 - 1.83^2}) = 0{,}245 \le 1$	$\kappa_z = 1/(1.05 + \sqrt{1{,}05^2 - 0.92^2}) = 0.643 \le 1$
1) Compressive force:	N_u^D (kN) = 4.90 • 27 = 132.3	N_u^D (kN) = 132.3
2) Buckling load:	$N_{u;y}^B$ (kN) = 0.245 • 132.3 = 32.41	$N_{u;z}^B$ (kN) = 0.409 • 132.3=54.11
3) Loading capacity:	N_u (kN) = 32.41	
4) Verification:		
Action:	S_D (kN) = 10.28	
Resistance:	R_D (kN) = 32.41/1.1 = 29.46	
Verification:	10.28/29.46 = 0.35 < 1.0	

Alternative design using loading tables for verification of flexural buckling	
Characteristic action:	Total SK = 7.20 kN
Buckling length, s_{ky} = 400 cm	

An alternative design calculation is provided here using γ = 1.4 in view of the fact that our tables of results for flexural buckling are based on a combined partial safety factor for action of γ = 1.4:
S_D = (3.50 + 3.71) • 1.4 = 10.08 kN
The difference from the accurate design calculation:
10.28/10.08 = 1.9% is sufficiently accurate.

Important note: Forces acting on the cross channel must be transferred to an adjacent, supportable base material, e.g. floor, wall, etc., at reasonable distances (every 3 – 5 spans) by means of tensile bracing.

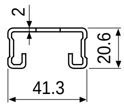
MQ-41D

Length (cm)	Perm. buckling load (kN)
25	85.41
50	81.40
75	75.71
100	68.83
125	60.56
150	51.55
175	42.99
200	35.67
225	29.72
250	24.99
275	21.23
300	18.22
325	15.79
350	13.80
375	12.16
400	**10.79**

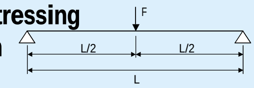
Solution: Fperm. = 10.79 kN >> Factual = 7.20 kN

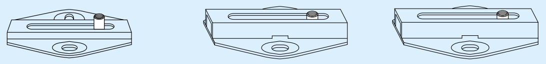
Torsion: Tables for MQ-21 channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and f ≤ L/300, δ ≤ 3.0°



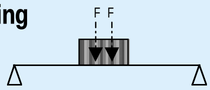
Single-span channel with torsional stressing
Single concentrated load at mid span

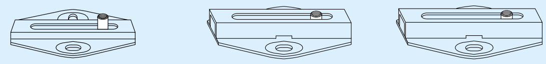




Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	0.85	0.1	0.6	0.89	0.2	0.6	0.69	0.1	0.7
50	0.48	0.7	2.2	0.50	0.7	2.1	0.40	0.5	2.4
75	0.26	1.2	3.0	0.28	1.3	3.0	0.19	0.9	3.0
100	0.15	1.7	3.0	0.16	1.8	3.0	0.11	1.3	3.0
125	0.10	2.4	3.0	0.11	2.6	3.0	0.08	1.8	3.0
150	0.08	3.3	3.0	0.08	3.5	3.0	0.06	2.6	3.0
175	0.06	4.5	3.0	0.07	4.8	3.0	0.05	3.6	3.0
200	0.05	6.1	3.0	0.06	6.4	3.0	0.04	4.9	3.0
225	0.04	7.5	2.7	0.04	7.5	2.6	0.03	6.5	3.0
250	0.03	8.3	2.1	0.03	8.3	1.9	0.03	8.3	2.8
275	0.02	9.2	1.4	0.02	9.2	1.3	0.02	9.2	1.9
300	0.01	10.0	0.7	0.01	10.0	0.7	0.01	10.0	1.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

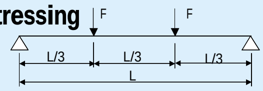
Single-span channel with torsional stressing
Two slide connectors next to each other

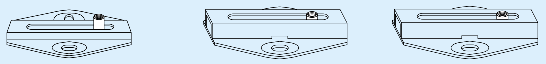




Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.33	0.8	2.6	0.34	0.8	2.6	0.28	0.7	3.0
75	0.14	1.2	3.0	0.15	1.3	3.0	0.10	0.9	3.0
100	0.08	1.7	3.0	0.08	1.9	3.0	0.06	1.3	3.0
125	0.05	2.4	3.0	0.06	2.6	3.0	0.04	1.8	3.0
150	0.04	3.4	3.0	0.04	3.5	3.0	0.03	2.6	3.0
175	0.03	4.6	3.0	0.03	4.8	3.0	0.02	3.6	3.0
200	0.03	6.1	3.0	0.03	6.4	3.0	0.02	4.9	3.0
225	0.02	7.5	2.7	0.02	7.5	2.5	0.02	6.5	3.0
250	0.01	8.3	2.1	0.01	8.3	1.9	0.01	8.3	2.8
275	0.01	9.2	1.4	0.01	9.2	1.3	0.01	9.2	1.9
300	–	–	–	–	–	–	–	–	–
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

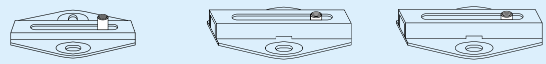
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.35	0.8	2.3	0.37	0.9	2.3	0.29	0.7	2.6
75	0.18	1.4	3.0	0.19	1.5	3.0	0.13	1.1	3.0
100	0.10	2.0	3.0	0.11	2.1	3.0	0.08	1.5	3.0
125	0.07	2.8	3.0	0.08	3.0	3.0	0.05	2.1	3.0
150	0.05	3.9	3.0	0.06	4.1	3.0	0.04	3.0	3.0
175	0.04	5.2	3.0	0.05	5.5	3.0	0.03	4.1	3.0
200	0.03	6.7	2.8	0.03	6.7	2.7	0.03	5.5	3.0
225	0.02	7.5	2.3	0.02	7.5	2.1	0.02	7.3	3.0
250	0.02	8.3	1.7	0.02	8.3	1.6	0.02	8.3	2.3
275	0.01	9.2	1.1	0.01	9.2	1.1	0.01	9.2	1.6
300	–	–	–	–	–	–	–	–	–
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

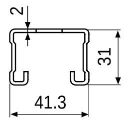
Single-span channel with torsional stressing
Four slide connectors next to each other



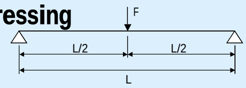
Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.08	1.3	3.0	0.09	1.3	3.0	0.06	0.9	3.0
100	0.04	1.8	3.0	0.05	1.9	3.0	0.03	1.3	3.0
125	0.03	2.5	3.0	0.03	2.6	3.0	0.02	1.9	3.0
150	0.02	3.4	3.0	0.02	3.6	3.0	0.02	2.6	3.0
175	0.02	4.6	3.0	0.02	4.8	3.0	0.01	3.6	3.0
200	0.01	6.1	3.0	0.01	6.4	3.0	0.01	4.9	3.0
225	0.01	7.5	2.7	0.01	7.5	2.5	0.01	6.6	3.0
250	0.01	8.3	2.0	0.01	8.3	1.9	0.01	8.3	2.8
275	–	–	–	–	–	–	–	–	–
300	–	–	–	–	–	–	–	–	–
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

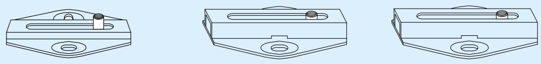
Torsion: Tables for MQ-31 channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and $f \leq L/300$, $\delta \leq 3.0°$



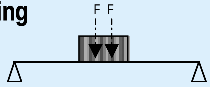
Single-span channel with torsional stressing
Single concentrated load at mid span

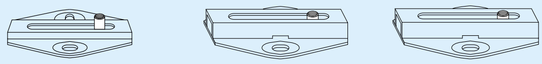




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = σperm.	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = σperm.	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = σperm.	MRG 4.0 Twist (°)
25	1.00	<0.1	0.3	1.45	<0.1	0.4	1.12	<0.1	0.4
50	0.72	0.3	1.5	0.78	0.4	1.5	0.60	0.3	1.6
75	0.51	0.8	3.0	0.56	0.9	3.0	0.39	0.6	3.0
100	0.26	1.0	3.0	0.29	1.1	3.0	0.20	0.8	3.0
125	0.16	1.3	3.0	0.18	1.4	3.0	0.12	1.0	3.0
150	0.12	1.7	3.0	0.13	1.9	3.0	0.09	1.4	3.0
175	0.09	2.2	3.0	0.10	2.4	3.0	0.07	1.8	3.0
200	0.07	2.9	3.0	0.08	3.1	3.0	0.05	2.3	3.0
225	0.06	3.7	3.0	0.07	3.9	3.0	0.05	3.1	3.0
250	0.05	4.7	3.0	0.06	5.0	3.0	0.04	4.0	3.0
275	0.04	6.0	3.0	0.05	6.3	3.0	0.03	5.1	3.0
300	0.04	7.5	3.0	0.04	7.9	3.0	0.03	6.5	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

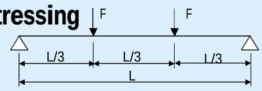
Single-span channel with torsional stressing
Two slide connectors next to each other

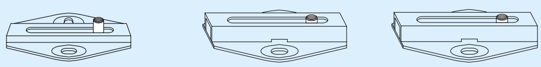




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = σperm.	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = σperm.	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = σperm.	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.48	0.4	1.8	0.52	0.4	1.8	0.41	0.3	2.0
75	0.27	0.8	3.0	0.29	0.9	3.0	0.21	0.6	3.0
100	0.13	1.0	3.0	0.15	1.1	3.0	0.10	0.8	3.0
125	0.08	1.3	3.0	0.09	1.4	3.0	0.06	1.0	3.0
150	0.06	1.7	3.0	0.06	1.9	3.0	0.05	1.4	3.0
175	0.04	2.2	3.0	0.05	2.4	3.0	0.03	1.8	3.0
200	0.04	2.9	3.0	0.04	3.1	3.0	0.03	2.3	3.0
225	0.03	3.7	3.0	0.03	4.0	3.0	0.02	3.1	3.0
250	0.03	4.7	3.0	0.03	5.0	3.0	0.02	4.0	3.0
275	0.02	6.0	3.0	0.02	6.3	3.0	0.02	5.1	3.0
300	0.02	7.5	3.0	0.02	8.0	3.0	0.02	6.6	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

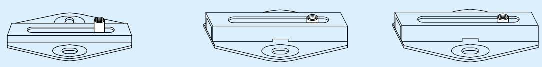
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = σperm.	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = σperm.	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = σperm.	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.53	0.4	1.6	0.57	0.5	1.6	0.44	0.4	1.8
75	0.34	1.0	3.0	0.38	1.0	3.0	0.26	0.7	3.0
100	0.18	1.2	3.0	0.19	1.3	3.0	0.13	0.9	3.0
125	0.11	1.5	3.0	0.12	1.7	3.0	0.09	1.2	3.0
150	0.08	2.0	3.0	0.09	2.1	3.0	0.06	1.5	3.0
175	0.06	2.5	3.0	0.07	2.7	3.0	0.05	2.0	3.0
200	0.05	3.2	3.0	0.05	3.5	3.0	0.04	2.6	3.0
225	0.04	4.2	3.0	0.05	4.5	3.0	0.03	3.4	3.0
250	0.04	5.3	3.0	0.04	5.6	3.0	0.03	4.4	3.0
275	0.03	6.7	3.0	0.03	7.1	3.0	0.02	5.7	3.0
300	0.03	8.3	3.0	0.03	8.8	3.0	0.02	7.2	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

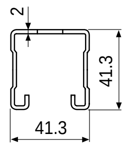
Single-span channel with torsional stressing
Four slide connectors next to each other



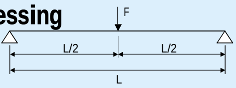
Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = σperm.	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = σperm.	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = σperm.	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.16	0.8	3.0	0.17	0.9	3.0	0.12	0.6	3.0
100	0.07	1.0	3.0	0.08	1.1	3.0	0.06	0.8	3.0
125	0.04	1.3	3.0	0.05	1.5	3.0	0.03	1.0	3.0
150	0.03	1.7	3.0	0.03	1.9	3.0	0.02	1.4	3.0
175	0.02	2.2	3.0	0.03	2.4	3.0	0.02	1.8	3.0
200	0.02	2.9	3.0	0.02	3.1	3.0	0.01	2.4	3.0
225	0.02	3.7	3.0	0.02	4.0	3.0	0.01	3.1	3.0
250	0.01	4.7	3.0	0.01	5.0	3.0	0.01	4.0	3.0
275	0.01	6.0	3.0	0.01	6.4	3.0	0.01	5.2	3.0
300	0.01	7.6	3.0	0.01	8.0	3.0	0.01	6.6	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

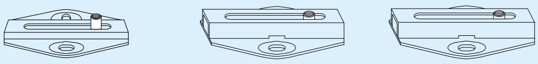
Torsion: Tables for MQ-41 channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and $f \leq L/300$, $\delta \leq 3.0°$



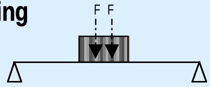
Single-span channel with torsional stressing
Single concentrated load at mid span

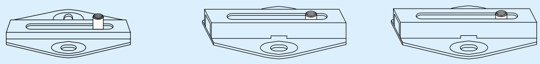




	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	1.00	<0.1	0.2	2.00	<0.1	0.3	1.55	<0.1	0.3
50	0.96	0.2	1.1	1.06	0.2	1.1	0.82	0.2	1.2
75	0.68	0.5	2.4	0.75	0.6	2.3	0.58	0.5	2.6
100	0.41	0.8	3.0	0.47	0.9	3.0	0.33	0.6	3.0
125	0.25	0.9	3.0	0.28	1.1	3.0	0.20	0.8	3.0
150	0.17	1.2	3.0	0.19	1.3	3.0	0.13	0.9	3.0
175	0.12	1.4	3.0	0.14	1.6	3.0	0.10	1.2	3.0
200	0.10	1.8	3.0	0.11	2.0	3.0	0.08	1.5	3.0
225	0.08	2.3	3.0	0.09	2.5	3.0	0.06	1.9	3.0
250	0.07	2.9	3.0	0.08	3.1	3.0	0.05	2.5	3.0
275	0.06	3.6	3.0	0.06	3.9	3.0	0.05	3.1	3.0
300	0.05	4.4	3.0	0.06	4.8	3.0	0.04	3.9	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

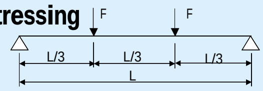
Single-span channel with torsional stressing
Two slide connectors next to each other

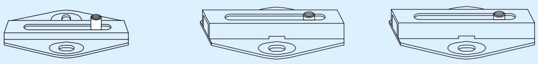




	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.63	0.3	1.3	0.70	0.3	1.3	0.55	0.2	1.4
75	0.41	0.6	2.7	0.45	0.7	2.7	0.36	0.5	3.0
100	0.21	0.8	3.0	0.24	0.9	3.0	0.17	0.6	3.0
125	0.13	1.0	3.0	0.14	1.1	3.0	0.10	0.8	3.0
150	0.08	1.2	3.0	0.10	1.3	3.0	0.07	0.9	3.0
175	0.06	1.4	3.0	0.07	1.6	3.0	0.05	1.2	3.0
200	0.05	1.8	3.0	0.06	2.0	3.0	0.04	1.5	3.0
225	0.04	2.3	3.0	0.04	2.5	3.0	0.03	1.9	3.0
250	0.03	2.9	3.0	0.04	3.1	3.0	0.03	2.5	3.0
275	0.03	3.6	3.0	0.03	3.9	3.0	0.02	3.1	3.0
300	0.03	4.5	3.0	0.03	4.8	3.0	0.02	3.9	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

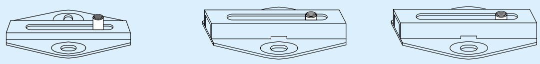
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.71	0.3	1.2	0.79	0.3	1.2	0.60	0.2	1.3
75	0.50	0.7	2.6	0.56	0.7	2.5	0.43	0.6	2.8
100	0.28	0.9	3.0	0.32	1.0	3.0	0.22	0.7	3.0
125	0.17	1.1	3.0	0.19	1.2	3.0	0.13	0.9	3.0
150	0.11	1.3	3.0	0.13	1.5	3.0	0.09	1.1	3.0
175	0.08	1.6	3.0	0.10	1.8	3.0	0.07	1.4	3.0
200	0.07	2.1	3.0	0.07	2.3	3.0	0.05	1.7	3.0
225	0.05	2.6	3.0	0.06	2.8	3.0	0.04	2.2	3.0
250	0.05	3.2	3.0	0.05	3.5	3.0	0.04	2.7	3.0
275	0.04	4.0	3.0	0.04	4.3	3.0	0.03	3.4	3.0
300	0.03	4.9	3.0	0.04	5.3	3.0	0.03	4.3	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

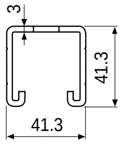
Single-span channel with torsional stressing
Four slide connectors next to each other



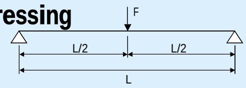
	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.26	0.7	3.0	0.29	0.7	2.9	0.21	0.5	3.0
100	0.12	0.8	3.0	0.13	0.9	3.0	0.09	0.6	3.0
125	0.07	1.0	3.0	0.08	1.1	3.0	0.05	0.8	3.0
150	0.04	1.2	3.0	0.05	1.3	3.0	0.04	1.0	3.0
175	0.03	1.5	3.0	0.04	1.6	3.0	0.03	1.2	3.0
200	0.03	1.8	3.0	0.03	2.0	3.0	0.02	1.5	3.0
225	0.02	2.3	3.0	0.02	2.5	3.0	0.02	1.9	3.0
250	0.02	2.9	3.0	0.02	3.1	3.0	0.01	2.5	3.0
275	0.01	3.6	3.0	0.02	3.9	3.0	0.01	3.1	3.0
300	0.01	4.5	3.0	0.01	4.8	3.0	0.01	3.9	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

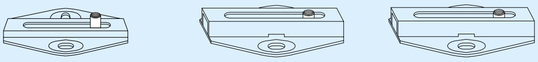
Torsion: Tables for MQ-41/3 channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and $f \leq L/300$, $\delta \leq 3.0°$



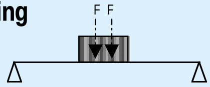
Single-span channel with torsional stressing
Single concentrated load at mid span

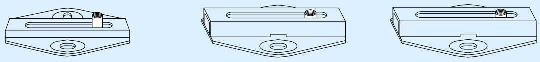




Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)
25	1.00	<0.1	0.1	2.00	<0.1	0.2	2.33	<0.1	0.4
50	1.00	0.2	0.8	1.66	0.3	1.2	1.30	0.2	1.3
75	1.00	0.6	2.2	1.24	0.7	2.4	0.99	0.6	2.7
100	0.75	1.1	3.0	0.85	1.2	3.0	0.59	0.9	3.0
125	0.50	1.4	3.0	0.56	1.6	3.0	0.39	1.1	3.0
150	0.36	1.9	3.0	0.41	2.1	3.0	0.29	1.5	3.0
175	0.29	2.4	3.0	0.32	2.7	3.0	0.23	2.0	3.0
200	0.24	3.1	3.0	0.27	3.4	3.0	0.19	2.5	3.0
225	0.20	3.9	3.0	0.23	4.3	3.0	0.16	3.2	3.0
250	0.17	4.8	3.0	0.20	5.3	3.0	0.14	4.0	3.0
275	0.15	6.0	3.0	0.17	6.6	3.0	0.12	5.0	3.0
300	0.14	7.3	3.0	0.16	8.0	3.0	0.11	6.2	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

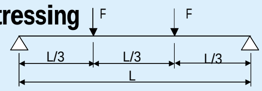
Single-span channel with torsional stressing
Two slide connectors next to each other

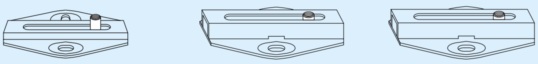




Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	0.3	1.5	1.12	0.4	1.4	0.90	0.3	1.6
75	0.70	0.8	2.9	0.77	0.9	2.8	0.58	0.7	3.0
100	0.39	1.1	3.0	0.44	1.2	3.0	0.31	0.9	3.0
125	0.25	1.4	3.0	0.29	1.6	3.0	0.20	1.1	3.0
150	0.19	1.9	3.0	0.21	2.1	3.0	0.15	1.5	3.0
175	0.15	2.4	3.0	0.16	2.7	3.0	0.11	2.0	3.0
200	0.12	3.1	3.0	0.13	3.4	3.0	0.09	2.5	3.0
225	0.10	3.9	3.0	0.11	4.3	3.0	0.08	3.2	3.0
250	0.09	4.9	3.0	0.10	5.4	3.0	0.07	4.0	3.0
275	0.08	6.0	3.0	0.09	6.6	3.0	0.06	5.0	3.0
300	0.07	7.4	3.0	0.08	8.0	3.0	0.05	6.2	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

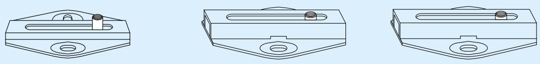
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	0.3	1.2	1.22	0.4	1.3	0.95	0.3	1.5
75	0.84	0.9	2.7	0.92	0.9	2.6	0.72	0.7	2.9
100	0.51	1.3	3.0	0.58	1.4	3.0	0.40	1.0	3.0
125	0.34	1.7	3.0	0.38	1.9	3.0	0.27	1.3	3.0
150	0.25	2.2	3.0	0.28	2.4	3.0	0.20	1.7	3.0
175	0.20	2.8	3.0	0.22	3.1	3.0	0.16	2.3	3.0
200	0.16	3.6	3.0	0.19	4.0	3.0	0.13	2.9	3.0
225	0.14	4.5	3.0	0.16	5.0	3.0	0.11	3.7	3.0
250	0.12	5.6	3.0	0.14	6.2	3.0	0.10	4.6	3.0
275	0.11	6.9	3.0	0.12	7.6	3.0	0.09	5.8	3.0
300	0.10	8.4	3.0	0.11	9.3	3.0	0.08	7.1	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

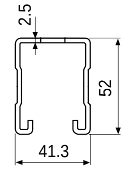
Single-span channel with torsional stressing
Four slide connectors next to each other



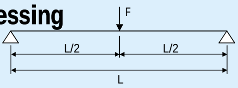
Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\leq = \sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.42	0.8	3.0	0.48	0.9	3.0	0.34	0.7	3.0
100	0.21	1.1	3.0	0.24	1.2	3.0	0.17	0.9	3.0
125	0.13	1.4	3.0	0.15	1.6	3.0	0.11	1.2	3.0
150	0.10	1.9	3.0	0.11	2.1	3.0	0.08	1.5	3.0
175	0.08	2.4	3.0	0.09	2.7	3.0	0.06	2.0	3.0
200	0.06	3.1	3.0	0.07	3.5	3.0	0.05	2.5	3.0
225	0.05	3.9	3.0	0.06	4.3	3.0	0.04	3.2	3.0
250	0.04	4.9	3.0	0.05	5.4	3.0	0.04	4.1	3.0
275	0.04	6.0	3.0	0.04	6.6	3.0	0.03	5.1	3.0
300	0.04	7.4	3.0	0.04	8.1	3.0	0.03	6.3	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

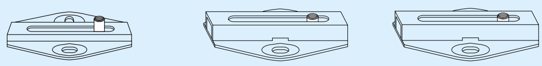
Torsion: Tables for MQ-52 channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and f ≤ L/300, δ ≤ 3.0°



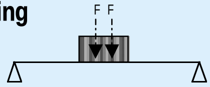
Single-span channel with torsional stressing
Single concentrated load at mid span

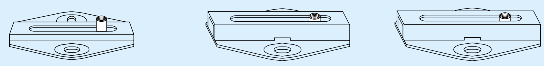




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	1.00	<0.1	<0.1	2.00	<0.1	0.1	2.60	<0.1	0.3
50	1.00	0.1	0.6	1.78	0.2	0.9	1.38	0.2	1.0
75	1.00	0.4	1.8	1.27	0.5	2.0	0.99	0.4	2.2
100	0.80	0.7	3.0	0.93	0.8	3.0	0.66	0.6	3.0
125	0.49	0.9	3.0	0.56	1.0	3.0	0.40	0.7	3.0
150	0.33	1.1	3.0	0.39	1.2	3.0	0.27	0.9	3.0
175	0.25	1.3	3.0	0.29	1.5	3.0	0.20	1.1	3.0
200	0.20	1.6	3.0	0.23	1.8	3.0	0.16	1.4	3.0
225	0.16	2.0	3.0	0.19	2.3	3.0	0.13	1.7	3.0
250	0.14	2.5	3.0	0.16	2.8	3.0	0.11	2.1	3.0
275	0.12	3.1	3.0	0.14	3.4	3.0	0.10	2.7	3.0
300	0.10	3.8	3.0	0.12	4.1	3.0	0.09	3.3	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

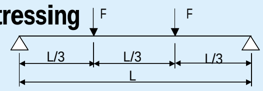
Single-span channel with torsional stressing
Two slide connectors next to each other

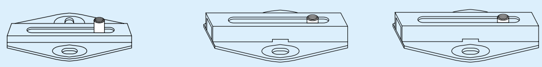




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	0.2	1.1	1.17	0.2	1.1	0.93	0.2	1.2
75	0.68	0.5	2.4	0.77	0.5	2.3	0.61	0.4	2.6
100	0.41	0.7	3.0	0.48	0.8	3.0	0.34	0.6	3.0
125	0.25	0.9	3.0	0.29	1.0	3.0	0.20	0.7	3.0
150	0.17	1.1	3.0	0.20	1.2	3.0	0.14	0.9	3.0
175	0.13	1.3	3.0	0.15	1.5	3.0	0.10	1.1	3.0
200	0.10	1.6	3.0	0.12	1.8	3.0	0.08	1.4	3.0
225	0.08	2.0	3.0	0.09	2.3	3.0	0.07	1.7	3.0
250	0.07	2.5	3.0	0.08	2.8	3.0	0.06	2.1	3.0
275	0.06	3.1	3.0	0.07	3.4	3.0	0.05	2.7	3.0
300	0.05	3.8	3.0	0.06	4.1	3.0	0.04	3.3	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

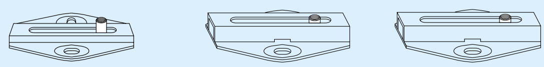
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	0.2	0.9	1.32	0.2	1.0	1.02	0.2	1.1
75	0.84	0.5	2.3	0.94	0.6	2.2	0.73	0.5	2.4
100	0.54	0.8	3.0	0.63	1.0	3.0	0.44	0.7	3.0
125	0.33	1.0	3.0	0.38	1.1	3.0	0.27	0.8	3.0
150	0.23	1.2	3.0	0.26	1.4	3.0	0.19	1.0	3.0
175	0.17	1.5	3.0	0.20	1.7	3.0	0.14	1.3	3.0
200	0.13	1.9	3.0	0.16	2.1	3.0	0.11	1.6	3.0
225	0.11	2.3	3.0	0.13	2.6	3.0	0.09	1.9	3.0
250	0.09	2.8	3.0	0.11	3.2	3.0	0.08	2.4	3.0
275	0.08	3.5	3.0	0.10	3.9	3.0	0.07	3.0	3.0
300	0.07	4.2	3.0	0.08	4.7	3.0	0.06	3.7	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

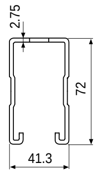
Single-span channel with torsional stressing
Four slide connectors next to each other



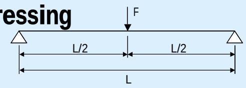
Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.43	0.5	2.6	0.49	0.6	2.5	0.40	0.5	2.8
100	0.23	0.7	3.0	0.26	0.8	3.0	0.19	0.6	3.0
125	0.13	0.9	3.0	0.15	1.0	3.0	0.11	0.7	3.0
150	0.09	1.1	3.0	0.10	1.2	3.0	0.07	0.9	3.0
175	0.06	1.3	3.0	0.08	1.5	3.0	0.05	1.1	3.0
200	0.05	1.6	3.0	0.06	1.9	3.0	0.04	1.4	3.0
225	0.04	2.0	3.0	0.05	2.3	3.0	0.03	1.7	3.0
250	0.04	2.5	3.0	0.04	2.8	3.0	0.03	2.2	3.0
275	0.03	3.1	3.0	0.04	3.4	3.0	0.02	2.7	3.0
300	0.03	3.8	3.0	0.03	4.2	3.0	0.02	3.3	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

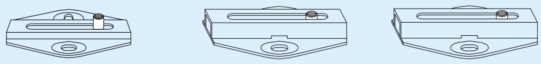
Torsion: Tables for MQ-72 channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and $f \le L/300$, $\delta \le 3.0°$



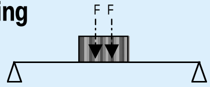
Single-span channel with torsional stressing
Single concentrated load at mid span

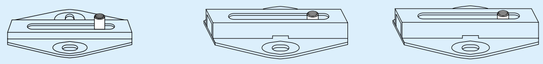




Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)
25	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	<0.1	0.2
50	1.00	<0,1	0.3	2.00	<0,1	0.5	2.16	<0,1	0.8
75	1.00	0.1	0.9	1.97	0.3	1.5	1.54	0.2	1.7
100	1.00	0.4	2.0	1.59	0.6	2.6	1.24	0.4	2.8
125	0.89	0.6	3.0	1.08	0.8	3.0	0.77	0.5	3.0
150	0.60	0.7	3.0	0.73	0.9	3.0	0.52	0.7	3.0
175	0.44	0.9	3.0	0.53	1.1	3.0	0.38	0.8	3.0
200	0.34	1.1	3.0	0.41	1.3	3.0	0.29	1.0	3.0
225	0.28	1.3	3.0	0.33	1.5	3.0	0.24	1.2	3.0
250	0.23	1.6	3.0	0.28	1.9	3.0	0.20	1.4	3.0
275	0.20	1.9	3.0	0.24	2.2	3.0	0.17	1.7	3.0
300	0.17	2.3	3.0	0.21	2.7	3.0	0.15	2.1	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

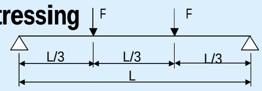
Single-span channel with torsional stressing
Two slide connectors next to each other

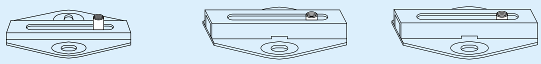




Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0.1	0.6	1.82	0.1	0.8	1.45	0.1	0.9
75	1.00	0.3	1.8	1.19	0.3	1.8	0.94	0.3	1.9
100	0.78	0.5	3.0	0.92	0.6	2.9	0.68	0.5	3.0
125	0.46	0.6	3.0	0.55	0.8	3.0	0.40	0.5	3.0
150	0.30	0.7	3.0	0.37	0.9	3.0	0.26	0.7	3.0
175	0.22	0.9	3.0	0.27	1.1	3.0	0.19	0.8	3.0
200	0.17	1.1	3.0	0.21	1.3	3.0	0.15	1.0	3.0
225	0.14	1.3	3.0	0.17	1.5	3.0	0.12	1.2	3.0
250	0.12	1.6	3.0	0.14	1.9	3.0	0.10	1.4	3.0
275	0.10	1.9	3.0	0.12	2.2	3.0	0.09	1.7	3.0
300	0.09	2.3	3.0	0.11	2.7	3.0	0.08	2.1	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

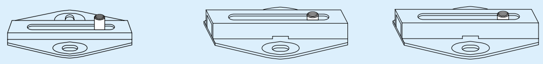
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0,1	0.5	2.00	0.1	0.8	1.60	0.1	0.8
75	1.00	0.3	1.4	1.47	0.4	1.7	1.14	0.3	1.8
100	1.00	0.6	2.9	1.18	0.7	2.8	0.89	0.5	3.0
125	0.61	0.7	3.0	0.74	0.9	3.0	0.53	0.6	3.0
150	0.41	0.9	3.0	0.49	1.0	3.0	0.35	0.7	3.0
175	0.30	1.0	3.0	0.36	1.2	3.0	0.26	0.9	3.0
200	0.23	1.2	3.0	0.28	1.5	3.0	0.20	1.1	3.0
225	0.19	1.5	3.0	0.23	1.8	3.0	0.16	1.3	3.0
250	0.16	1.8	3.0	0.19	2.1	3.0	0.14	1.6	3.0
275	0.14	2.2	3.0	0.17	2.5	3.0	0.12	2.0	3.0
300	0.12	2.6	3.0	0.15	3.0	3.0	0.10	2.4	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

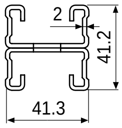
Single-span channel with torsional stressing
Four slide connectors next to each other



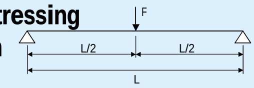
Span width (cm)	MSG 1.0			MRG 2.0			MRG 4.0		
	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)	F (kN)	f (mm) $\le = \sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.64	0.3	2.0	0.75	0.4	1.9	0.61	0.3	2.1
100	0.43	0.5	3.0	0.52	0.6	3.0	0.38	0.5	3.0
125	0.24	0.6	3.0	0.29	0.8	3.0	0.21	0.5	3.0
150	0.16	0.7	3.0	0.19	0.9	3.0	0.14	0.7	3.0
175	0.11	0.9	3.0	0.14	1.1	3.0	0.10	0.8	3.0
200	0.09	1.1	3.0	0.11	1.3	3.0	0.08	1.0	3.0
225	0.07	1.3	3.0	0.09	1.6	3.0	0.06	1.2	3.0
250	0.06	1.6	3.0	0.07	1.9	3.0	0.05	1.4	3.0
275	0.05	1.9	3.0	0.06	2.2	3.0	0.04	1.7	3.0
300	0.04	2.3	3.0	0.05	2.7	3.0	0.04	2.1	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

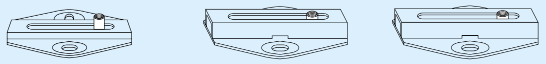
Torsion: Tables for MQ-21D channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and $f \le L/300$, $\delta \le 3.0°$



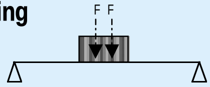
Single-span channel with torsional stressing
Single concentrated load at mid span

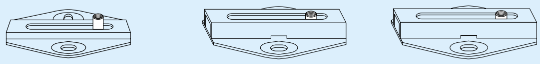




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	1.00	<0.1	0.2	2.00	<0.1	0.3	1.83	<0.1	0.4
50	1.00	0.3	1.2	1.28	0.3	1.5	0.99	0.2	1.7
75	0.88	0.8	3.0	0.92	0.8	3.0	0.63	0.5	3.0
100	0.46	0.9	3.0	0.48	1.0	3.0	0.32	0.7	3.0
125	0.29	1.2	3.0	0.30	1.3	3.0	0.21	0.9	3.0
150	0.21	1.6	3.0	0.21	1.6	3.0	0.15	1.2	3.0
175	0.16	2.0	3.0	0.16	2.1	3.0	0.11	1.5	3.0
200	0.13	2.6	3.0	0.13	2.7	3.0	0.09	2.0	3.0
225	0.11	3.4	3.0	0.11	3.5	3.0	0.08	2.7	3.0
250	0.09	4.3	3.0	0.10	4.4	3.0	0.07	3.4	3.0
275	0.08	5.4	3.0	0.08	5.5	3.0	0.06	4.4	3.0
300	0.07	6.8	3.0	0.07	7.0	3.0	0.05	5.7	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

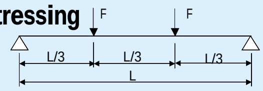
Single-span channel with torsional stressing
Two slide connectors next to each other

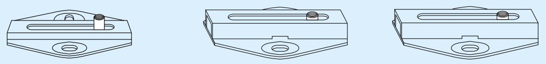




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.82	0.4	1.8	0.86	0.4	1.8	0.68	0.3	2.0
75	0.46	0.8	3.0	0.48	0.8	3.0	0.33	0.5	3.0
100	0.24	0.9	3.0	0.25	1.0	3.0	0.17	0.7	3.0
125	0.15	1.2	3.0	0.15	1.3	3.0	0.11	0.9	3.0
150	0.10	1.6	3.0	0.11	1.6	3.0	0.07	1.2	3.0
175	0.08	2.0	3.0	0.08	2.1	3.0	0.06	1.5	3.0
200	0.06	2.6	3.0	0.07	2.7	3.0	0.05	2.0	3.0
225	0.05	3.4	3.0	0.06	3.5	3.0	0.04	2.7	3.0
250	0.05	4.3	3.0	0.05	4.4	3.0	0.03	3.5	3.0
275	0.04	5.4	3.0	0.04	5.6	3.0	0.03	4.5	3.0
300	0.04	6.8	3.0	0.04	7.0	3.0	0.03	5.7	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

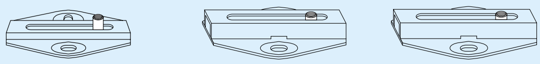
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	0.91	0.4	1.6	0.95	0.4	1.6	0.73	0.3	1.8
75	0.60	0.9	3.0	0.62	0.9	3.0	0.42	0.6	3.0
100	0.31	1.1	3.0	0.32	1.1	3.0	0.22	0.8	3.0
125	0.20	1.4	3.0	0.21	1.4	3.0	0.14	1.0	3.0
150	0.14	1.8	3.0	0.15	1.9	3.0	0.10	1.3	3.0
175	0.11	2.3	3.0	0.11	2.4	3.0	0.08	1.7	3.0
200	0.09	3.0	3.0	0.09	3.1	3.0	0.06	2.3	3.0
225	0.07	3.8	3.0	0.08	3.9	3.0	0.05	3.0	3.0
250	0.06	4.8	3.0	0.07	5.0	3.0	0.05	3.8	3.0
275	0.06	6.1	3.0	0.06	6.2	3.0	0.04	4.9	3.0
300	0.05	7.5	3.0	0.05	7.8	3.0	0.04	6.2	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

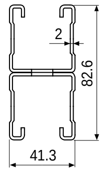
Single-span channel with torsional stressing
Four slide connectors next to each other



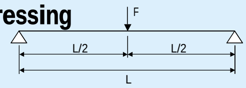
Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.27	0.8	3.0	0.28	0.8	3.0	0.20	0.5	3.0
100	0.13	0.9	3.0	0.13	1.0	3.0	0.09	0.7	3.0
125	0.08	1.2	3.0	0.08	1.3	3.0	0.06	0.9	3.0
150	0.05	1.6	3.0	0.06	1.6	3.0	0.04	1.2	3.0
175	0.04	2.0	3.0	0.04	2.1	3.0	0.03	1.6	3.0
200	0.03	2.6	3.0	0.03	2.7	3.0	0.02	2.0	3.0
225	0.03	3.4	3.0	0.03	3.5	3.0	0.02	2.7	3.0
250	0.02	4.3	3.0	0.02	4.4	3.0	0.02	3.5	3.0
275	0.02	5.4	3.0	0.02	5.6	3.0	0.01	4.5	3.0
300	0.02	6.8	3.0	0.02	7.0	3.0	0.01	5.7	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

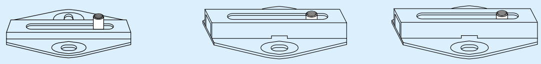
Torsion: Tables for MQ-41D channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and f ≤ L/300, δ ≤ 3.0°



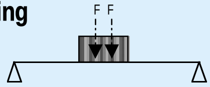
Single-span channel with torsional stressing
Single concentrated load at mid span

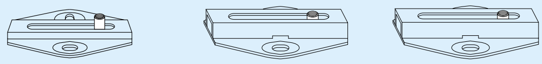




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	1.00	<0.1	<0,1	2.00	<0.1	<0.1	4.00	<0,1	0.2°
50	1.00	<0.1	0.2°	2.00	<0.1	0.5°	2.40	<0,1	0.8°
75	1.00	0.1	0.8°	2.00	0.3	1.5°	1.65	0.2	1.7°
100	1.00	0.3	1.8°	1.67	0.5	2.7°	1.29	0.4	3.0°
125	0.95	0.6	3.0°	1.04	0.7	3.0°	0.72	0.5	3.0°
150	0.60	0.7	3.0°	0.66	0.8	3.0°	0.45	0.5	3.0°
175	0.42	0.8	3.0°	0.46	0.9	3.0°	0.32	0.6	3.0°
200	0.31	0.9	3.0°	0.34	1.0	3.0°	0.23	0.7	3.0°
225	0.24	1.1	3.0°	0.26	1.2	3.0°	0.18	0.9	3.0°
250	0.20	1.3	3.0°	0.21	1.4	3.0°	0.15	1.1	3.0°
275	0.16	1.6	3.0°	0.18	1.7	3.0°	0.12	1.3	3.0°
300	0.14	1.9	3.0°	0.15	2.0	3.0°	0.11	1.6	3.0°
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

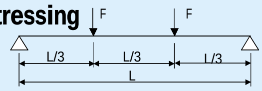
Single-span channel with torsional stressing
Two slide connectors next to each other

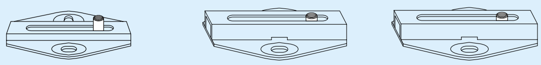




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0,1	0.4°	1.86	0.1	0.8°	1.58	0.1	0.9°
75	1.00	0.3	1.5°	1.18	0.3	1.8°	1.00	0.3	2.0°
100	0.88	0.6	3.0°	0.88	0.6	3.0°	0.67	0.4	3.0°
125	0.49	0.6	3.0°	0.49	0.6	3.0°	0.37	0.5	3.0°
150	0.31	0.7	3.0°	0.31	0.7	3.0°	0.23	0.5	3.0°
175	0.21	0.8	3.0°	0.21	0.8	3.0°	0.16	0.6	3.0°
200	0.16	0.9	3.0°	0.16	0.9	3.0°	0.12	0.7	3.0°
225	0.12	1.1	3.0°	0.12	1.1	3.0°	0.09	0.9	3.0°
250	0.10	1.3	3.0°	0.10	1.3	3.0°	0.07	1.1	3.0°
275	0.08	1.6	3.0°	0.08	1.6	3.0°	0.06	1.3	3.0°
300	0.07	1.9	3.0°	0.07	1.9	3.0°	0.05	1.6	3.0°
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

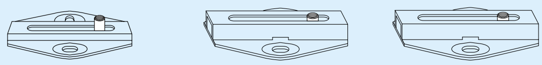
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0.1	0.4°	2.00	0.1	0.7°	1.79	0.1	0.9°
75	1.00	0.2	1.2°	1.60	0.4	1.7°	1.23	0.3	1.9°
100	1.00	0.6	2.6°	1.25	0.7	3.0°	0.87	0.5	3.0°
125	0.65	0.7	3.0°	0.70	0.8	3.0°	0.49	0.5	3.0°
150	0.41	0.8	3.0°	0.45	0.9	3.0°	0.31	0.6	3.0°
175	0.29	0.9	3.0°	0.31	1.0	3.0°	0.21	0.7	3.0°
200	0.21	1.1	3.0°	0.23	1.2	3.0°	0.16	0.8	3.0°
225	0.17	1.3	3.0°	0.18	1.3	3.0°	0.12	1.0	3.0°
250	0.13	1.5	3.0°	0.15	1.6	3.0°	0.10	1.2	3.0°
275	0.11	1.8	3.0°	0.12	1.9	3.0°	0.08	1.5	3.0°
300	0.10	2.1	3.0°	0.10	2.2	3.0°	0.07	1.8	3.0°
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

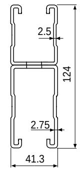
Single-span channel with torsional stressing
Four slide connectors next to each other



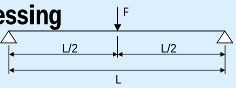
Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) ≤ = $\sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) ≤ = $\sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	0.81	0.4	1.9°	0.81	0.4	1.9°	0.64	0.3	2.2°
100	0.52	0.6	3.0°	0.52	0.6	3.0°	0.37	0.4	3.0°
125	0.28	0.7	3.0°	0.28	0.7	3.0°	0.20	0.5	3.0°
150	0.17	0.8	3.0°	0.17	0.8	3.0°	0.12	0.5	3.0°
175	0.12	0.9	3.0°	0.12	0.9	3.0°	0.08	0.6	3.0°
200	0.09	1.0	3.0°	0.09	1.0	3.0°	0.06	0.7	3.0°
225	0.07	1.2	3.0°	0.07	1.2	3.0°	0.05	0.9	3.0°
250	0.05	1.4	3.0°	0.05	1.4	3.0°	0.04	1.1	3.0°
275	0.05	1.7	3.0°	0.05	1.7	3.0°	0.03	1.3	3.0°
300	0.04	2.0	3.0°	0.04	2.0	3.0°	0.03	1.6	3.0°
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

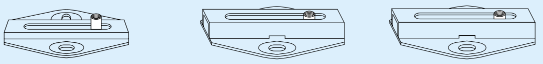
Torsion: Tables for MQ-52-72 D channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and $f \leq L/300$, $\delta \leq 3.0°$



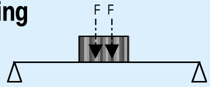
Single-span channel with torsional stressing
Single concentrated load at mid span

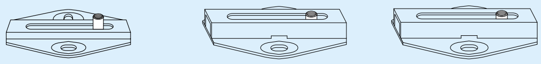




	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	<0.1	<0.1
50	1.00	<0.1	<0.1	2.00	<0.1	0.1	4.00	<0,1	0.4
75	1.00	<0.1	0.3	2.00	<0.1	0.5	3.65	0.1	1.2
100	1.00	<0.1	0.6	2.00	0.2	1.0	2.85	0.2	2.1
125	1.00	0.2	1.1	2.00	0.3	1.9	2.24	0.4	3.0
150	1.00	0.3	1.7	2.00	0.6	3.0	1.42	0.4	3.0
175	1.00	0.5	2.5	1.39	0.7	3.0	0.98	0.5	3.0
200	0.88	0.7	3.0	1.02	0.8	3.0	0.72	0.6	3.0
225	0.68	0.8	3.0	0.79	0.9	3.0	0.56	0.6	3.0
250	0.55	0.9	3.0	0.64	1.0	3.0	0.45	0.8	3.0
275	0.46	1.0	3.0	0.53	1.2	3.0	0.38	0.9	3.0
300	0.39	1.2	3.0	0.45	1.4	3.0	0.32	1.0	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

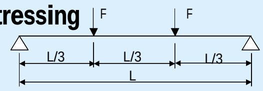
Single-span channel with torsional stressing
Two slide connectors next to each other

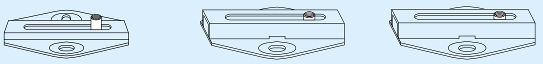




	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0,1	0.2	2.00	<0,1	0.3	3.46	<0,1	0.6
75	1.00	<0,1	0.5	2.00	0.1	0.9	2.20	0.2	1.4
100	1.00	0.2	1.2	2.00	0.3	2.0	1.65	0.3	2.3
125	1.00	0.3	2.2	1.62	0.5	3.0	1.15	0.4	3.0
150	0.87	0.5	3.0	1.02	0.6	3.0	0.72	0.4	3.0
175	0.60	0.6	3.0	0.70	0.7	3.0	0.50	0.5	3.0
200	0.44	0.7	3.0	0.52	0.8	3.0	0.36	0.6	3.0
225	0.34	0.8	3.0	0.40	0.9	3.0	0.28	0.6	3.0
250	0.28	0.9	3.0	0.32	1.0	3.0	0.23	0.8	3.0
275	0.23	1.0	3.0	0.27	1.2	3.0	0.19	0.9	3.0
300	0.19	1.2	3.0	0.23	1.4	3.0	0.16	1.0	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

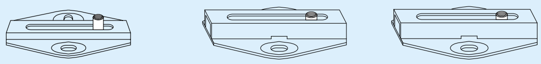
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0,1	0.1	2.00	<0,1	0.2	3.95	<0,1	0.6
75	1.00	<0,1	0.4	2.00	0.1	0.7	2.72	0.2	1.3
100	1.00	0.2	0.9	2.00	0.3	1.5	2.12	0.3	2.3
125	1.00	0.3	1.6	2.00	0.6	2.8	1.52	0.4	3.0
150	1.00	0.5	2.6	1.36	0.7	3.0	0.96	0.5	3.0
175	0.81	0.7	3.0	0.94	0.8	3.0	0.66	0.6	3.0
200	0.60	0.8	3.0	0.70	0.9	3.0	0.49	0.6	3.0
225	0.46	0.9	3.0	0.54	1.0	3.0	0.38	0.7	3.0
250	0.37	1.0	3.0	0.44	1.1	3.0	0.31	0.9	3.0
275	0.31	1.2	3.0	0.36	1.3	3.0	0.26	1.0	3.0
300	0.26	1.4	3.0	0.31	1.5	3.0	0.22	1.2	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

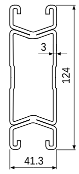
Single-span channel with torsional stressing
Four slide connectors next to each other



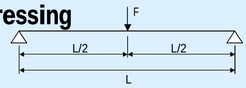
	MSG 1.0			MRG 2.0			MRG 4.0		
Span width (cm)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)	F (kN)	f (mm) ≤ = $\sigma_{perm.}$	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	1.00	0.1	0.9	1.77	0.2	1.4	1.42	0.2	1.5
100	1.00	0.3	2.2	1.24	0.4	2.3	0.99	0.3	2.6
125	0.73	0.5	3.0	0.86	0.5	3.0	0.61	0.4	3.0
150	0.45	0.5	3.0	0.53	0.6	3.0	0.38	0.4	3.0
175	0.31	0.6	3.0	0.36	0.7	3.0	0.26	0.5	3.0
200	0.23	0.7	3.0	0.26	0.8	3.0	0.19	0.6	3.0
225	0.17	0.8	3.0	0.20	0.9	3.0	0.14	0.6	3.0
250	0.14	0.9	3.0	0.16	1.0	3.0	0.12	0.8	3.0
275	0.12	1.0	3.0	0.14	1.2	3.0	0.10	0.9	3.0
300	0.10	1.2	3.0	0.11	1.4	3.0	0.08	1.1	3.0
325	–	–	–	–	–	–	–	–	–
350	–	–	–	–	–	–	–	–	–
375	–	–	–	–	–	–	–	–	–
400	–	–	–	–	–	–	–	–	–
425	–	–	–	–	–	–	–	–	–
450	–	–	–	–	–	–	–	–	–
475	–	–	–	–	–	–	–	–	–
500	–	–	–	–	–	–	–	–	–
525	–	–	–	–	–	–	–	–	–
550	–	–	–	–	–	–	–	–	–
575	–	–	–	–	–	–	–	–	–
600	–	–	–	–	–	–	–	–	–

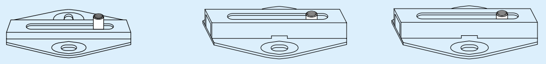
Torsion: Tables for MQ-124 XD channel section

F at $\sigma_{perm.}$ incl. dead weight of channel and $f \le L/300$, $\delta \le 3.0°$



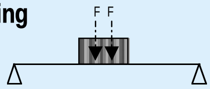
Single-span channel with torsional stressing
Single concentrated load at mid span

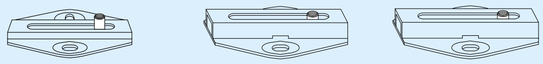




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	<0.1	<0.1
50	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	<0.1	<0.1
75	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	<0.1	<0.1
100	1.00	<0.1	<0.1	2.00	0.1	<0.1	4.00	0.2	0.1
125	1.00	0.1	<0.1	2.00	0.2	<0.1	4.00	0.4	0.2
150	1.00	0.2	<0.1	2.00	0.4	<0.1	4.00	0.7	0.2
175	1.00	0.3	<0.1	2.00	0.6	<0.1	4.00	1.2	0.2
200	1.00	0.5	<0.1	2.00	0.9	<0.1	4.00	1.7	0.3
225	1.00	0.7	<0.1	2.00	1.3	<0.1	4.00	2.5	0.3
250	1.00	1.0	<0.1	2.00	1.8	0.1	4.00	3.4	0.3
275	1.00	1.3	<0.1	2.00	2.4	0.1	4.00	4.6	0.3
300	1.00	1.7	<0.1	2.00	3.1	0.1	4.00	6.0	0.4
325	1.00	2.2	<0.1	2.00	4.0	0.1	4.00	7.6	0.4
350	1.00	2.7	<0.1	2.00	5.0	0.2	4.00	9.5	0.4
375	1.00	3.4	<0.1	2.00	6.2	0.2	4.00	11.8	0.5
400	1.00	4.2	0.1	2.00	7.6	0.2	3.70	13.3	0.5
425	1.00	5.1	0.1	2.00	9.2	0.2	3.22	14.2	0.4
450	1.00	6.1	0.1	2.00	10.9	0.2	2.79	15.0	0.4
475	1.00	7.3	0.1	2.00	13.0	0.2	2.49	15.8	0.4
500	1.00	8.6	0.1	2.00	15.2	0.2	2.22	16.7	0.4
525	1.00	10.1	0.1	1.97	17.5	0.2	1.97	17.5	0.3
550	1.00	11.7	0.1	1.75	18.3	0.2	1.75	18.3	0.3
575	1.00	13.6	0.1	1.56	19.2	0.2	1.56	19.2	0.3
600	1.00	15.6	0.2	1.39	20.0	0.2	1.39	20.0	0.3

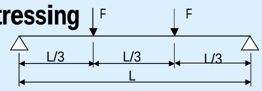
Single-span channel with torsional stressing
Two slide connectors next to each other

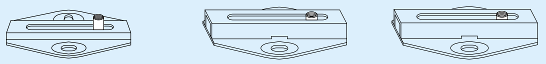




Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	<0.1	<0.1
75	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	0.1	0.2
100	1.00	0.1	<0.1	2.00	0.2	<0.1	4.00	0.3	0.2
125	1.00	0.2	<0.1	2.00	0.4	0.1	4.00	0.6	0.3
150	1.00	0.4	<0.1	2.00	0.7	0.1	4.00	1.1	0.4
175	1.00	0.6	<0.1	2.00	1.2	0.1	4.00	1.7	0.4
200	1.00	0.9	<0.1	2.00	1.7	0.2	4.00	2.6	0.5
225	1.00	1.3	0.1	2.00	2.5	0.2	4.00	3.7	0.5
250	1.00	1.8	0.1	2.00	3.4	0.2	3.67	6.1	0.6
275	1.00	2.4	0.1	2.00	4.6	0.2	3.31	7.4	0.6
300	1.00	3.1	0.1	2.00	5.9	0.3	3.01	8.8	0.6
325	1.00	4.0	0.2	2.00	7.6	0.3	2.75	10.3	0.6
350	1.00	5.0	0.2	2.00	9.5	0.3	2.48	11.7	0.5
375	1.00	6.2	0.2	2.00	11.7	0.3	2.14	12.5	0.5
400	1.00	7.6	0.2	1.86	13.3	0.3	1.86	13.3	0.5
425	1.00	9.1	0.2	1.62	14.2	0.3	1.62	14.2	0.4
450	1.00	10.9	0.2	1.42	15.0	0.3	1.42	15.0	0.4
475	1.00	12.9	0.2	1.26	15.8	0.3	1.26	15.8	0.4
500	1.00	15.2	0.2	1.11	16.7	0.2	1.11	16.7	0.3
525	0.99	17.5	0.3	0.99	17.5	0.2	0.99	17.5	0.3
550	0.88	18.3	0.2	0.88	18.3	0.2	0.88	18.3	0.3
575	0.78	19.2	0.2	0.78	19.2	0.2	0.78	19.2	0.3
600	0.69	20.0	0.2	0.69	20.0	0.2	0.69	20.0	0.3

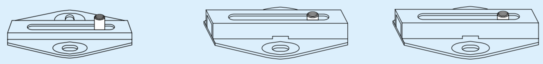
Single-span channel with torsional stressing
Concentrated loads each at 1/3 span





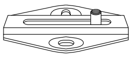
Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	<0.1	<0.1
75	1.00	<0.1	<0.1	2.00	<0.1	<0.1	4.00	0.1	0.1
100	1.00	<0.1	<0.1	2.00	0.2	<0.1	4.00	0.3	0.2
125	1.00	0.2	<0.1	2.00	0.4	<0.1	4.00	0.5	0.2
150	1.00	0.3	<0.1	2.00	0.6	<0.1	4.00	0.9	0.3
175	1.00	0.5	<0.1	2.00	1.0	0.1	4.00	1.5	0.3
200	1.00	0.8	<0.1	2.00	1.5	0.1	4.00	2.2	0.3
225	1.00	1.1	<0.1	2.00	2.1	0.1	4.00	3.2	0.4
250	1.00	1.5	<0.1	2.00	2.9	0.1	4.00	4.3	0.4
275	1.00	2.1	<0.1	2.00	3.9	0.2	4.00	5.8	0.5
300	1.00	2.7	0.1	2.00	5.1	0.2	4.00	7.5	0.5
325	1.00	3.4	0.1	2.00	6.5	0.2	3.39	10.8	0.5
350	1.00	4.3	0.1	2.00	8.2	0.2	2.90	11.7	0.4
375	1.00	5.4	0.1	2.00	10.1	0.2	2.50	12.5	0.4
400	1.00	6.6	0.1	2.00	12.3	0.2	2.17	13.3	0.4
425	1.00	8.0	0.1	1.90	14.2	0.2	1.90	14.2	0.3
450	1.00	9.5	0.2	1.67	15.0	0.2	1.67	15.0	0.3
475	1.00	11.3	0.2	1.47	15.8	0.2	1.47	15.8	0.3
500	1.00	13.3	0.2	1.30	16.7	0.2	1.30	16.7	0.3
525	1.00	15.5	0.2	1.16	17.5	0.2	1.16	17.5	0.3
550	1.00	17.9	0.2	1.03	18.3	0.2	1.03	18.3	0.2
575	0.91	19.2	0.2	0.91	19.2	0.2	0.91	19.2	0.2
600	0.81	20.0	0.2	0.81	20.0	0.1	0.81	20.0	0.2

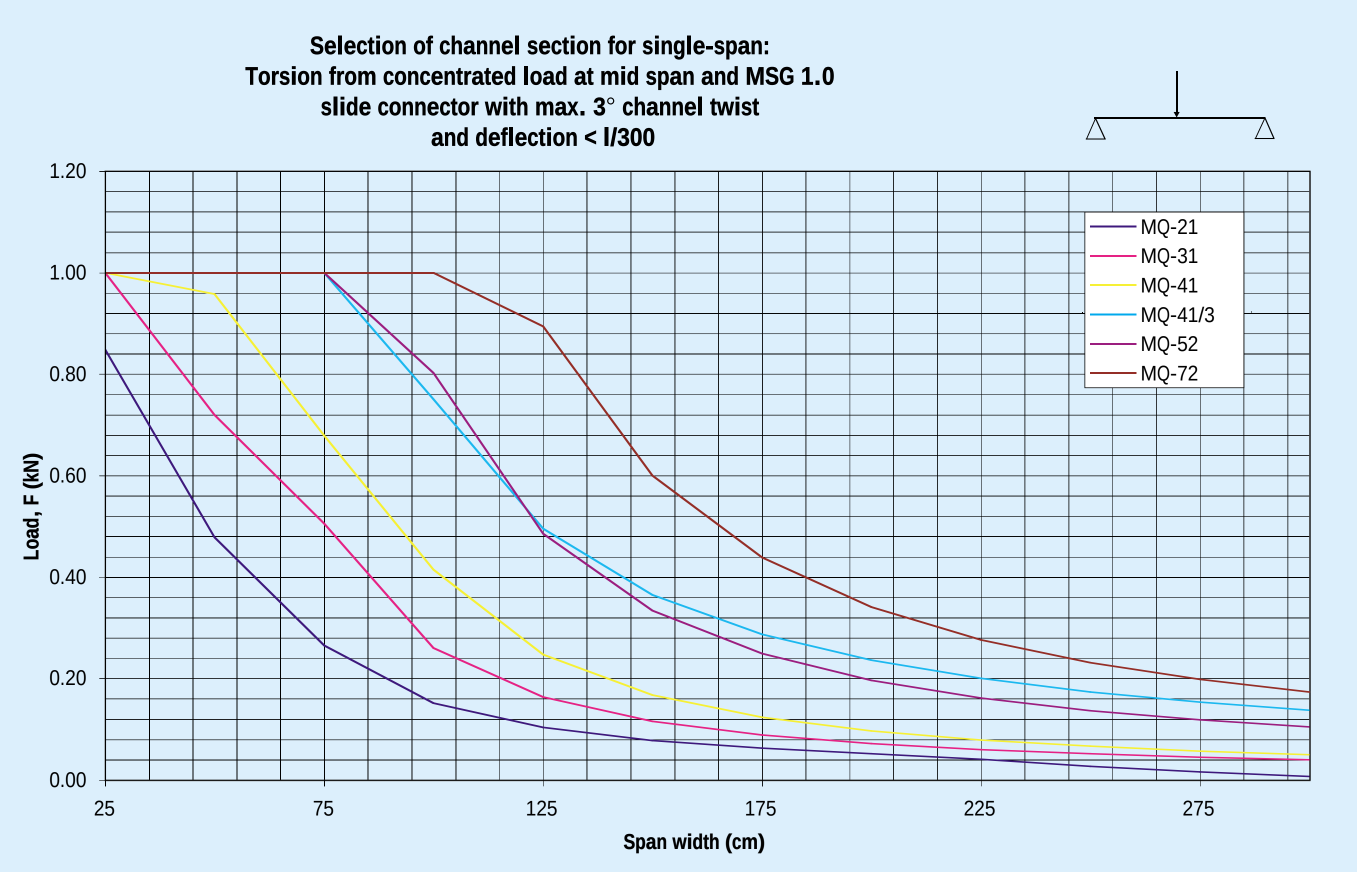
Single-span channel with torsional stressing
Four slide connectors next to each other

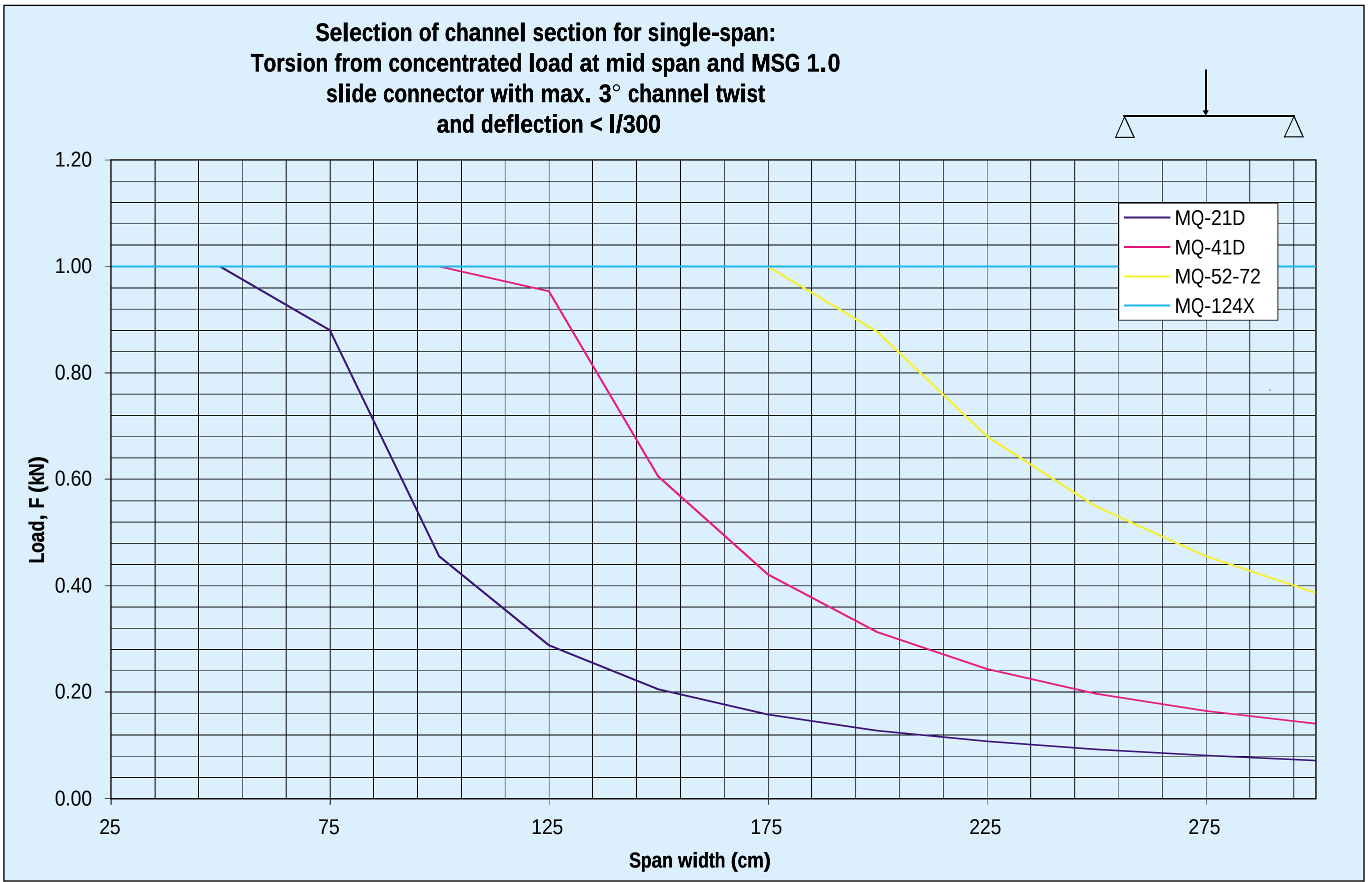


Span width (cm)	MSG 1.0 F (kN)	MSG 1.0 f (mm) $\le = \sigma_{perm.}$	MSG 1.0 Twist (°)	MRG 2.0 F (kN)	MRG 2.0 f (mm) $\le = \sigma_{perm.}$	MRG 2.0 Twist (°)	MRG 4.0 F (kN)	MRG 4.0 f (mm) $\le = \sigma_{perm.}$	MRG 4.0 Twist (°)
25	–	–	–	–	–	–	–	–	–
50	–	–	–	–	–	–	–	–	–
75	1.00	<0.1	<0.1	2.00	0.1	<0.1	4.00	0.2	0.2
100	1.00	0.2	<0,1	2.00	0.4	0.1	4.00	0.6	0.4
125	1.00	0.4	0.1	2.00	0.8	0.2	4.00	1.1	0.5
150	1.00	0.7	0.1	2.00	1.4	0.2	3.55	2.4	0.6
175	1.00	1.1	0.2	2.00	2.2	0.3	2.95	3.2	0.6
200	1.00	1.7	0.2	2.00	3.3	0.3	2.52	4.2	0.6
225	1.00	2.4	0.2	2.00	4.8	0.4	2.19	5.2	0.6
250	1.00	3.4	0.2	1.93	6.4	0.4	1.94	6.4	0.6
275	1.00	4.5	0.3	1.73	7.7	0.4	1.74	7.7	0.6
300	1.00	5.9	0.3	1.57	9.1	0.4	1.58	9.1	0.6
325	1.00	7.5	0.3	1.43	10.6	0.4	1.44	10.7	0.6
350	1.00	9.4	0.3	1.25	11.7	0.4	1.25	11.7	0.5
375	1.00	11.7	0.4	1.07	12.5	0.3	1.08	12.5	0.5
400	0.93	13.3	0.4	0.93	13.3	0.3	0.93	13.3	0.4
425	0.81	14.2	0.3	0.81	14.2	0.3	0.82	14.2	0.4
450	0.72	15.0	0.3	0.72	15.0	0.3	0.72	15.0	0.4
475	0.63	15.8	0.3	0.63	15.8	0.3	0.63	15.8	0.4
500	0.56	16.7	0.3	0.56	16.7	0.2	0.56	16.7	0.3
525	0.49	17.5	0.3	0.49	17.5	0.2	0.49	17.5	0.3
550	0.44	18.3	0.2	0.44	18.3	0.2	0.44	18.3	0.3
575	0.39	19.2	0.2	0.39	19.2	0.2	0.39	19.2	0.3
600	0.35	20.0	0.2	0.35	20.0	0.2	0.35	20.0	0.3

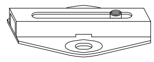
Selection of channel section for single span with MSG 1.0 slide connector

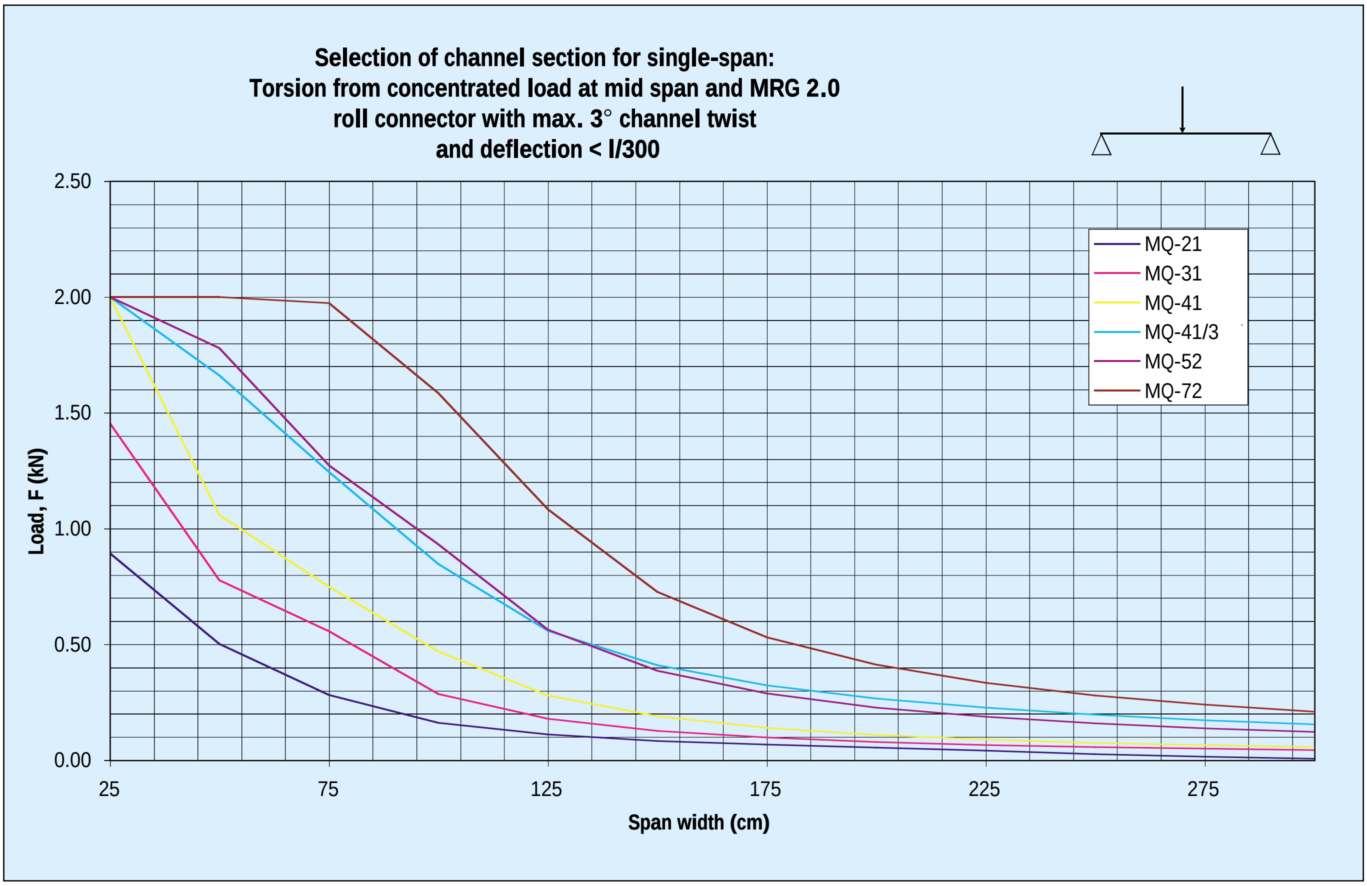


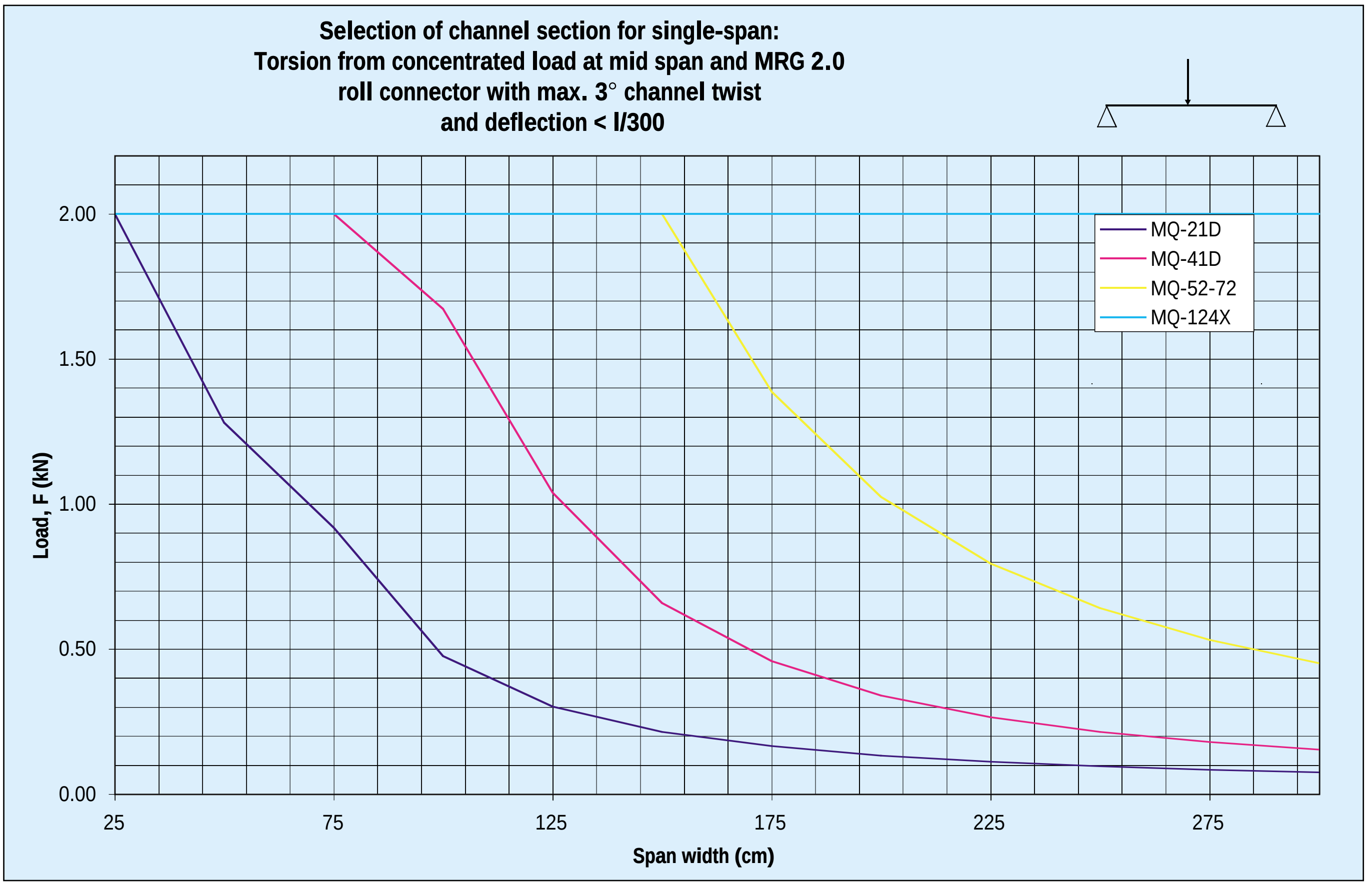




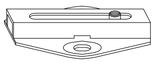
Selection of channel section for single span with MRG 2.0 roll connector

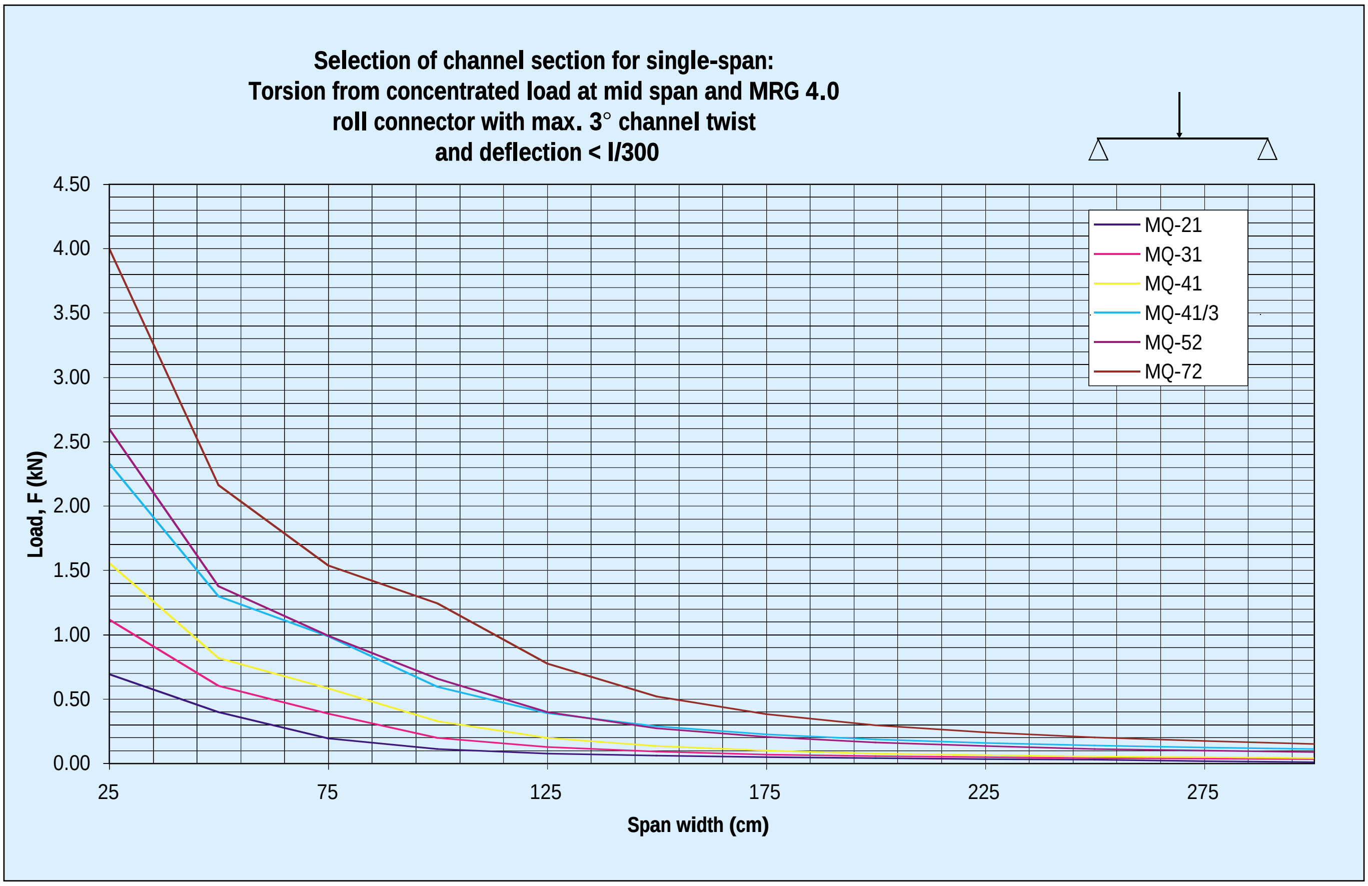


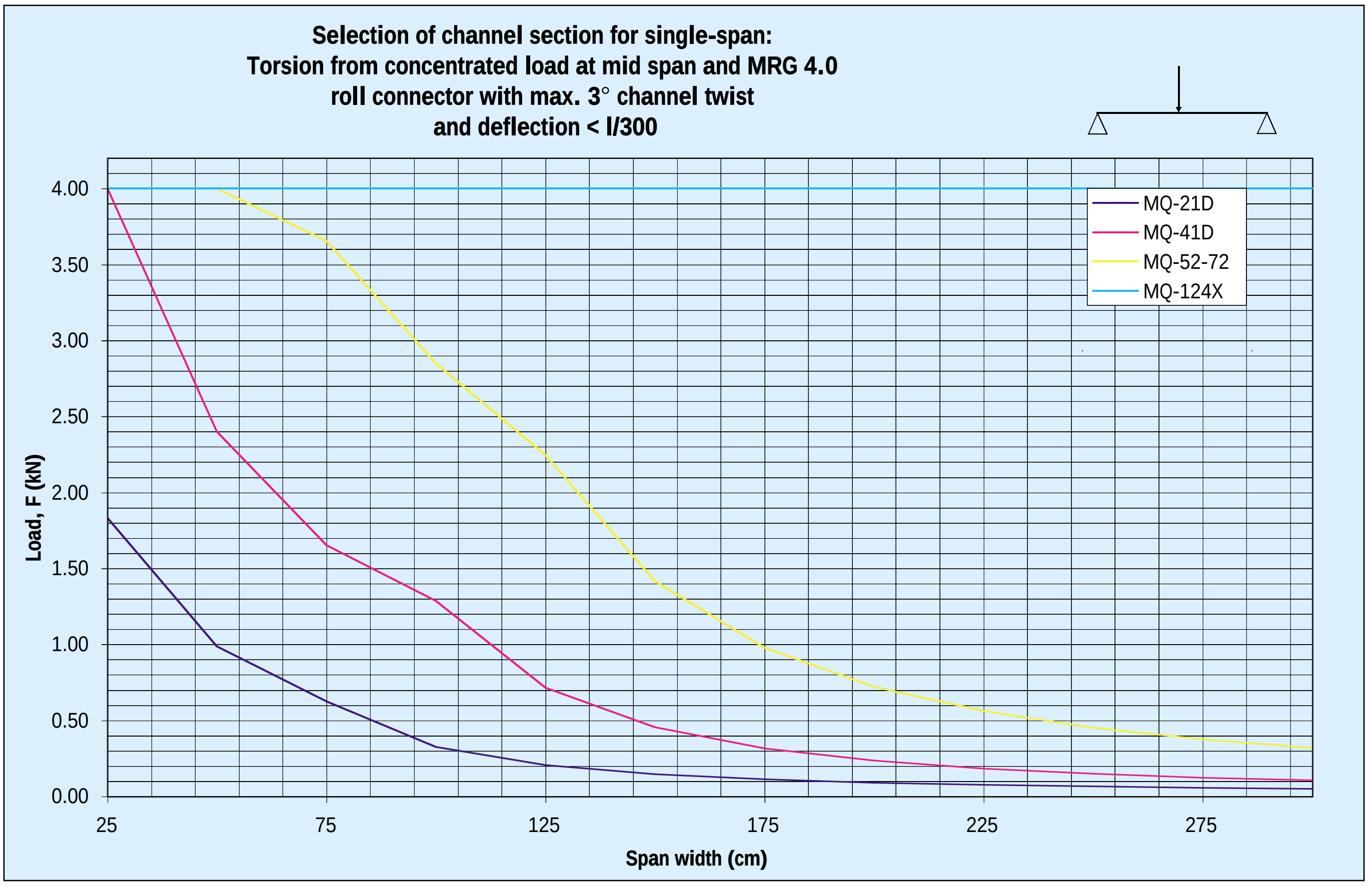




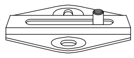
Selection of channel section for single span with MRG 4.0 roll connector

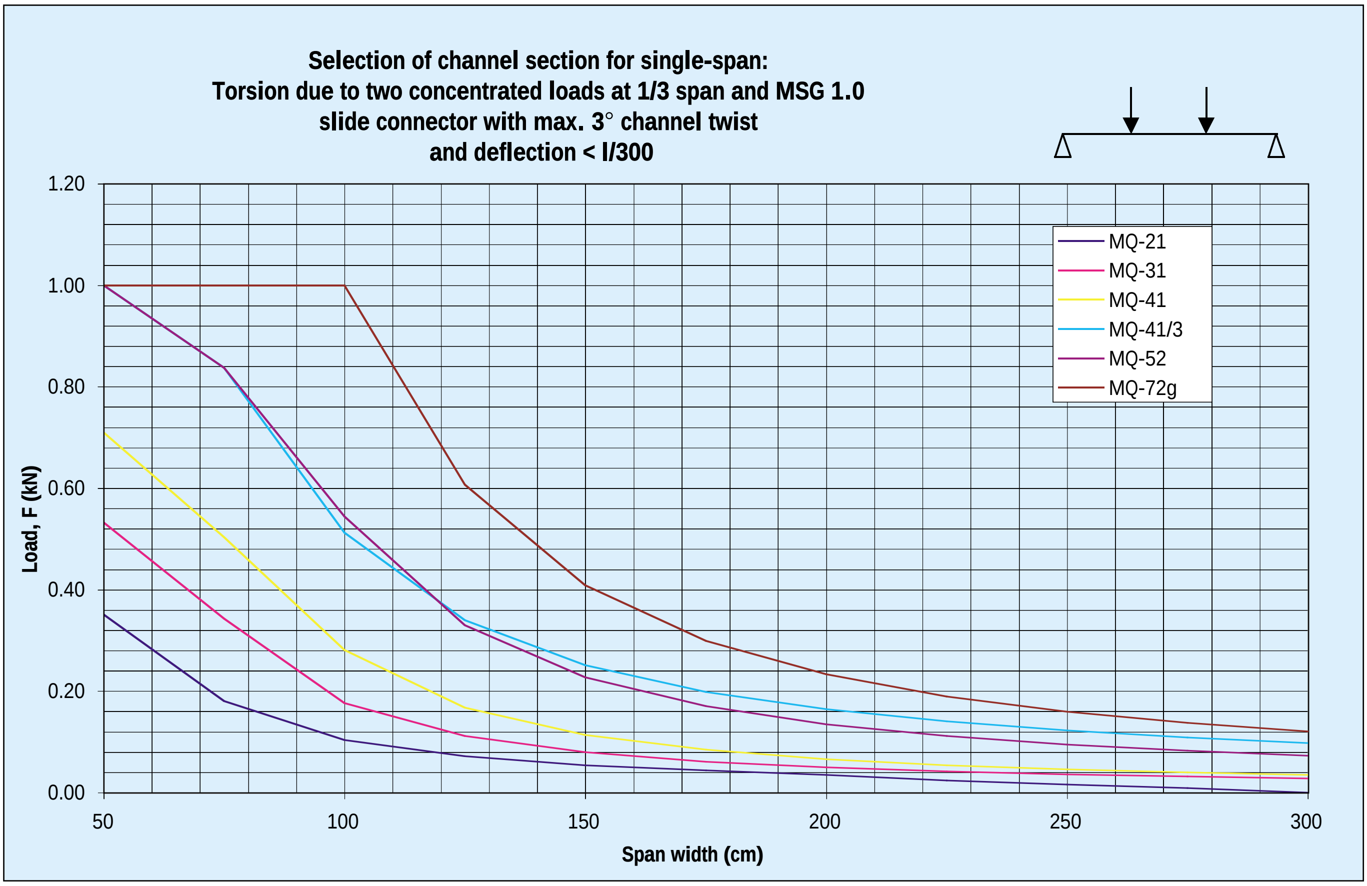


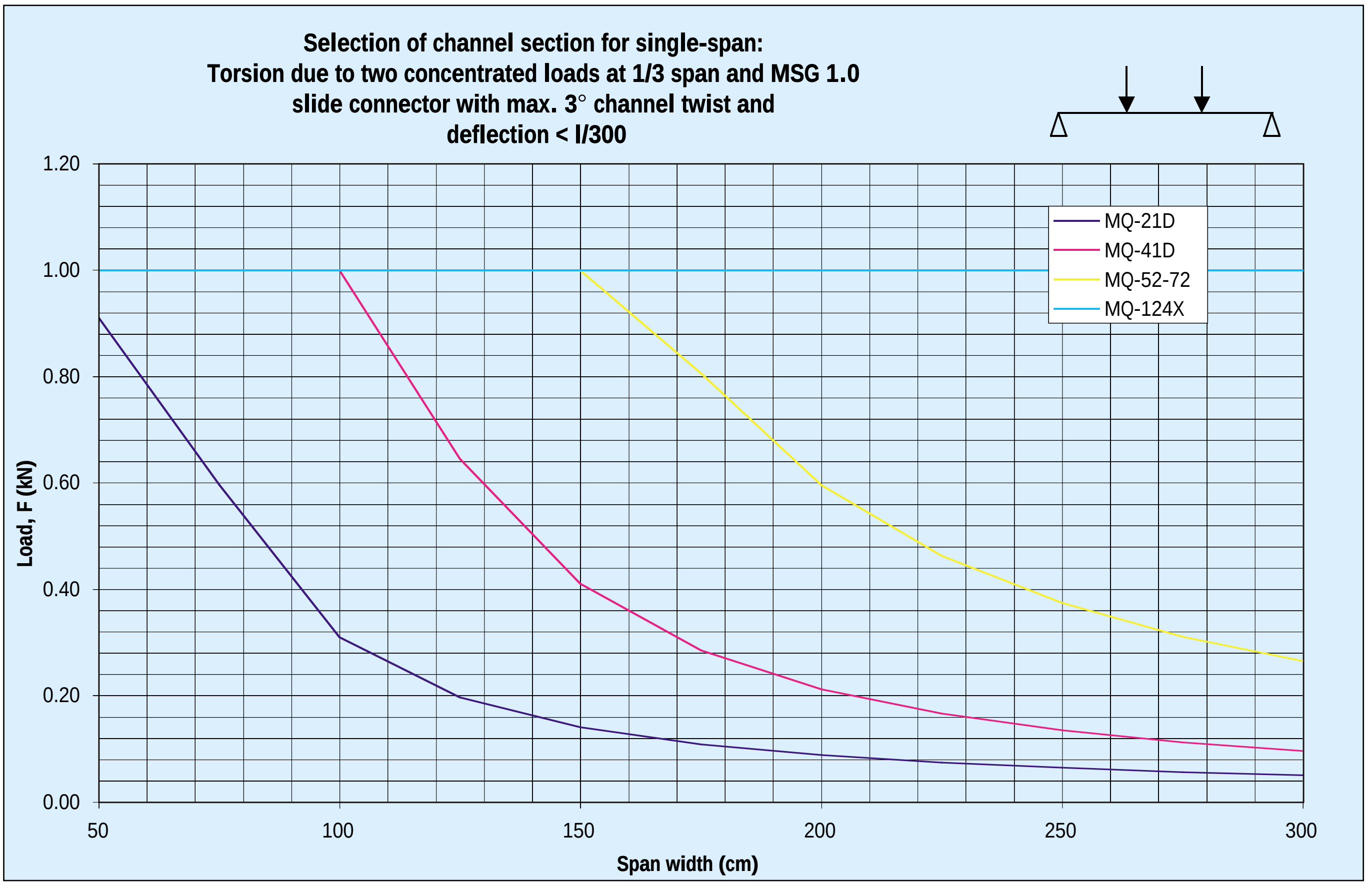




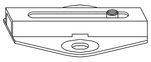
Selection of channel section for single span with MSG 1.0 slide connector

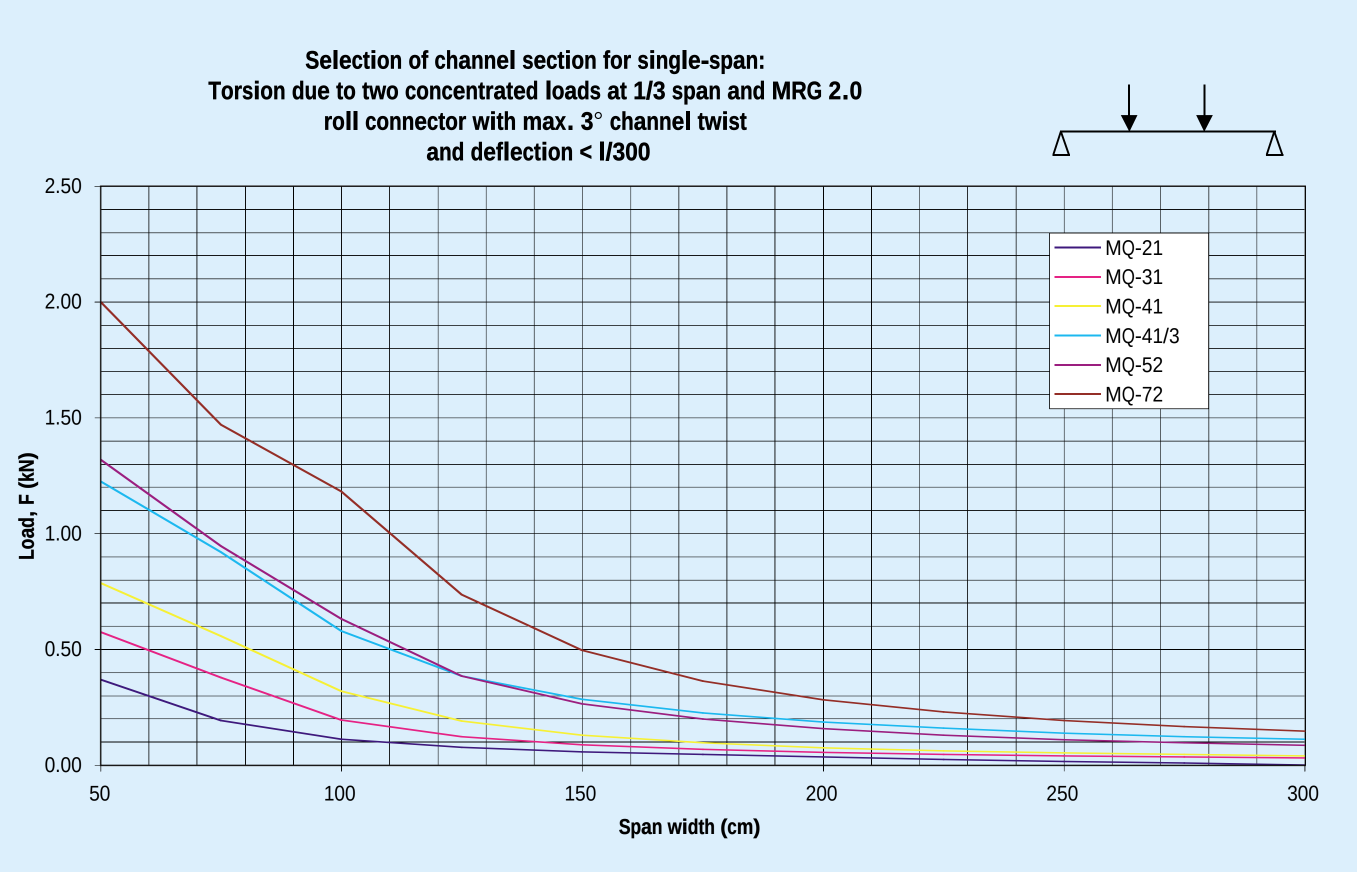


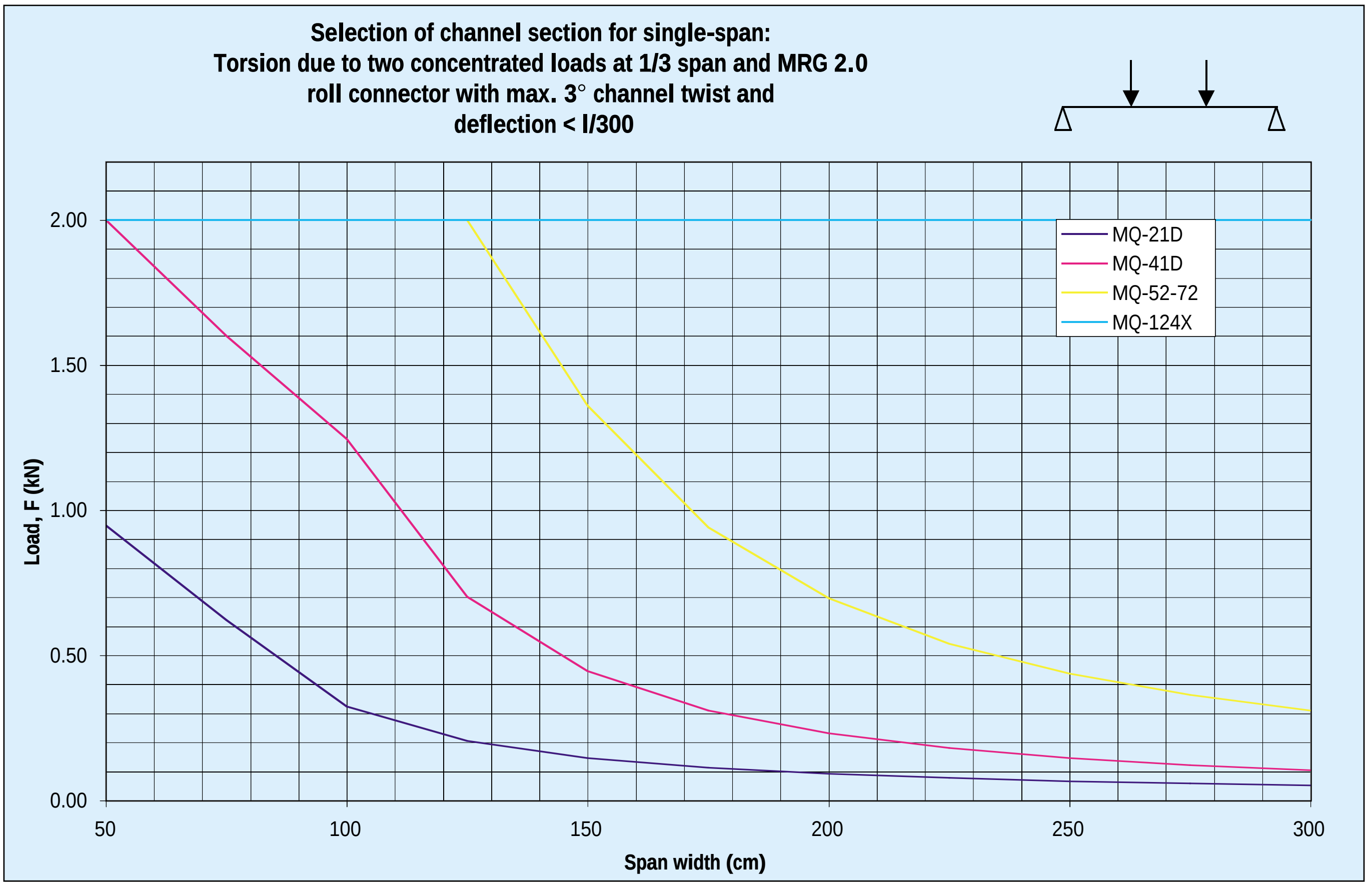




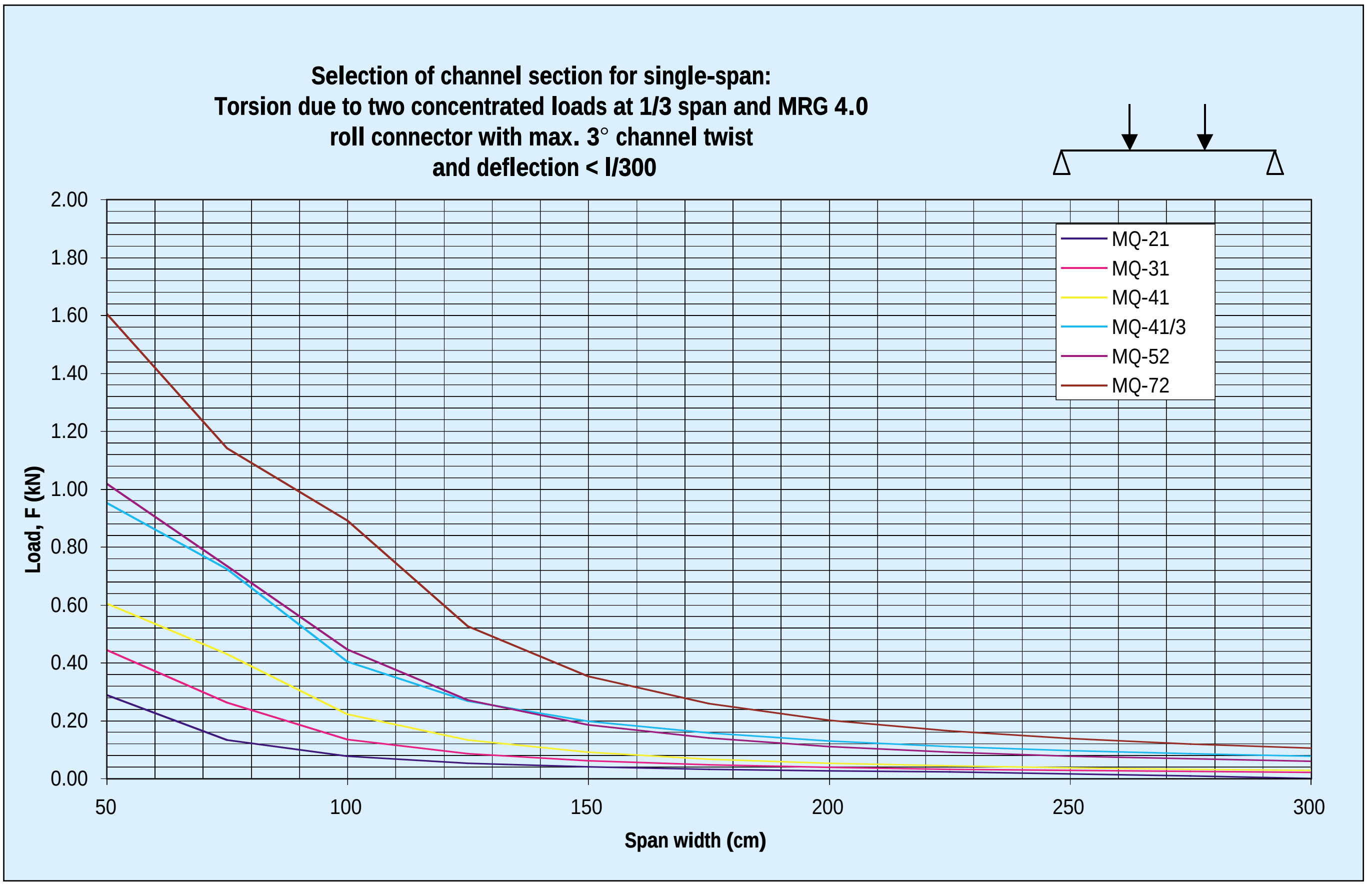
Selection of channel section for single span with MRG 2.0 roll connector

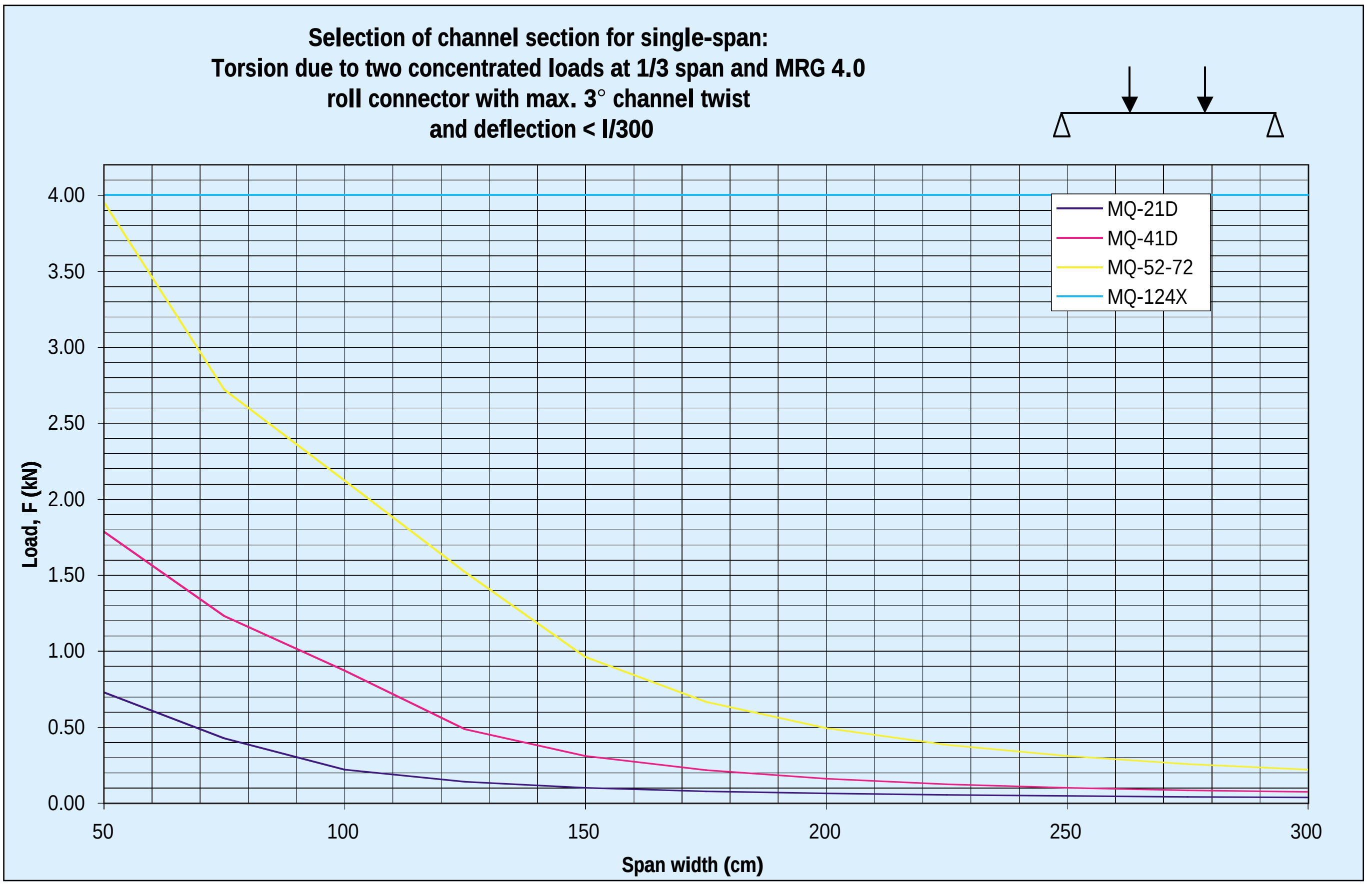




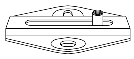


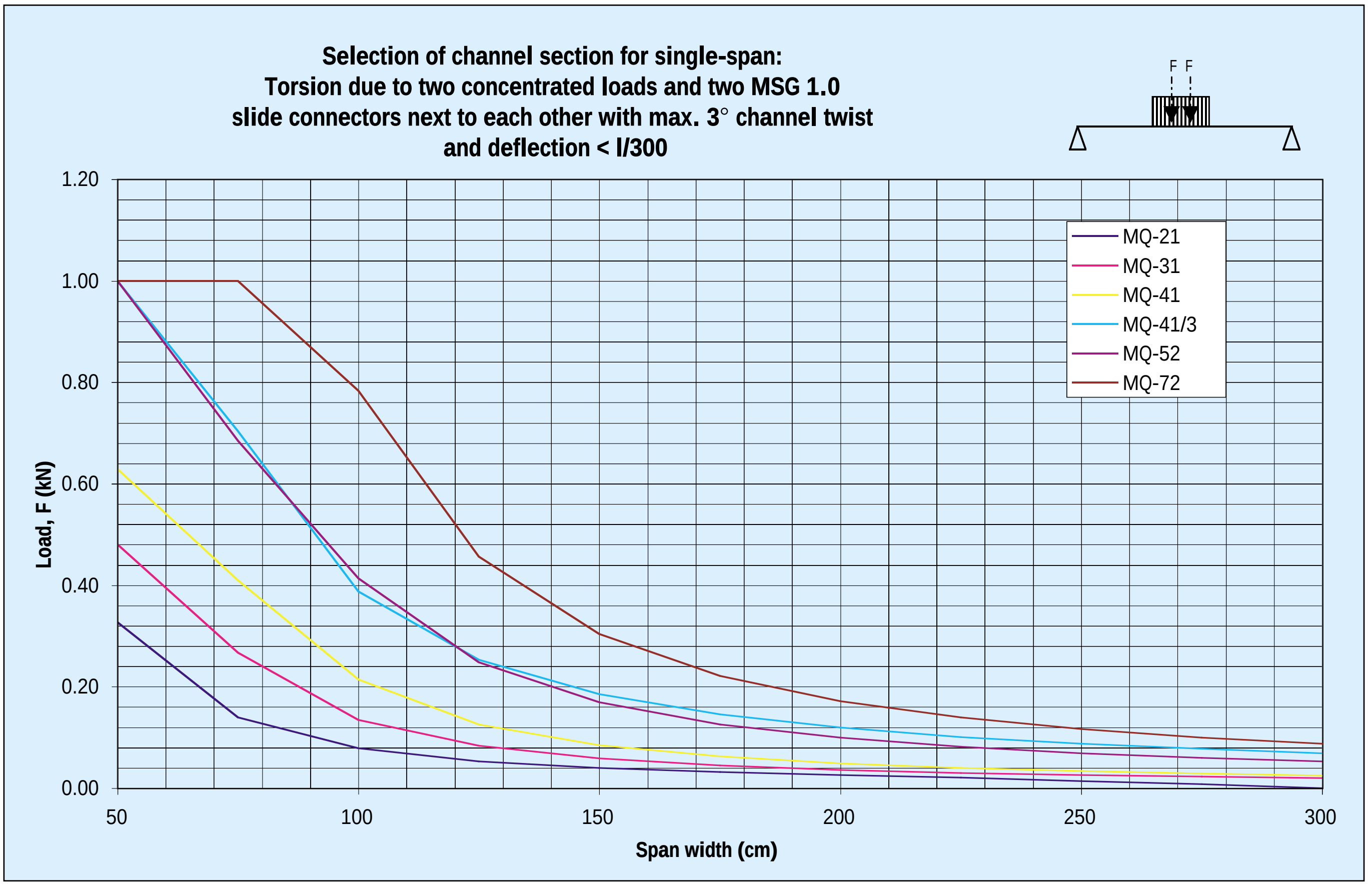
Selection of channel section for single span with MRG 4.0 roll connector

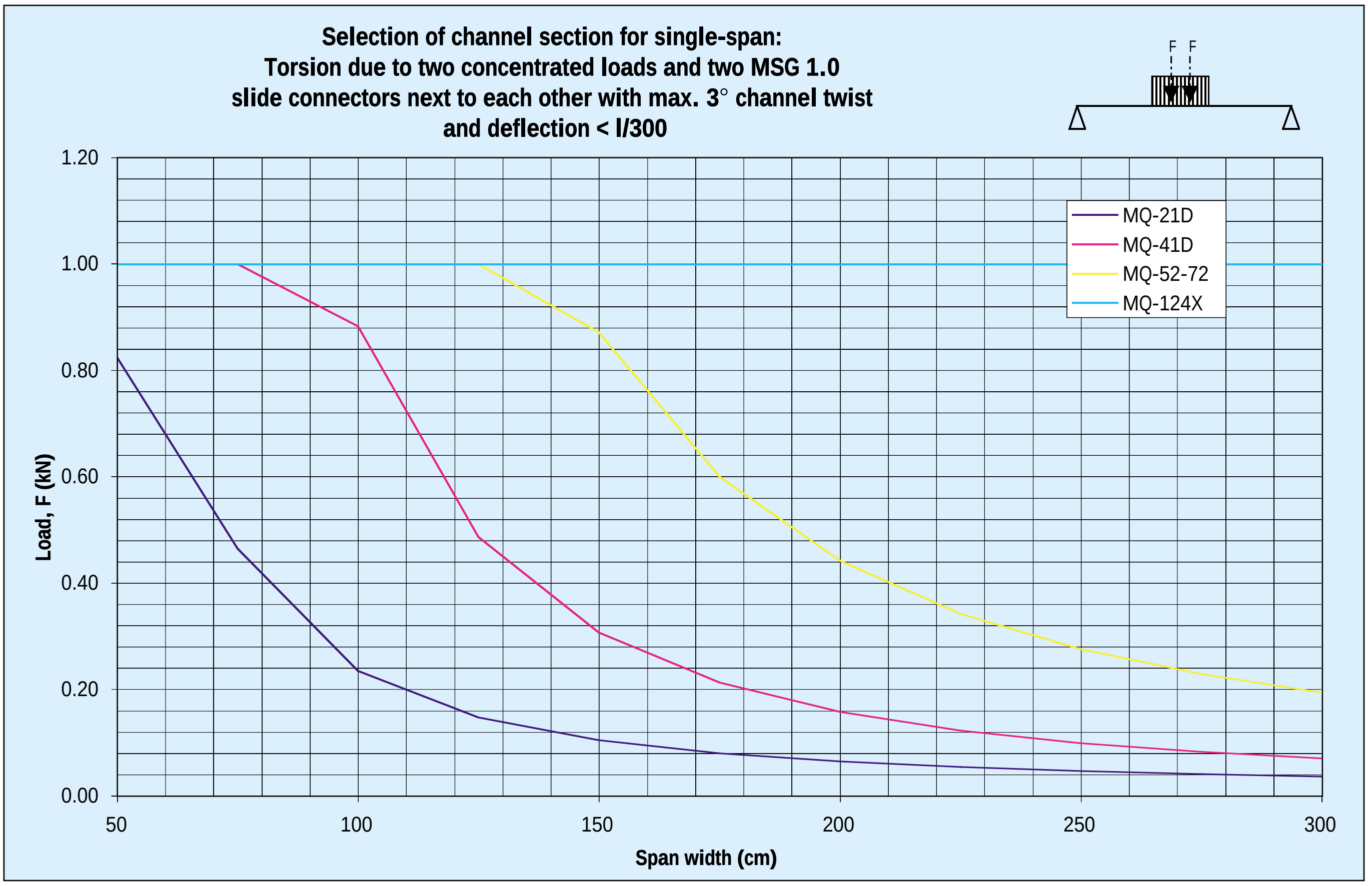




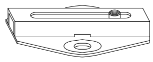
Selection of channel section for single span with MSG 1.0 slide connector

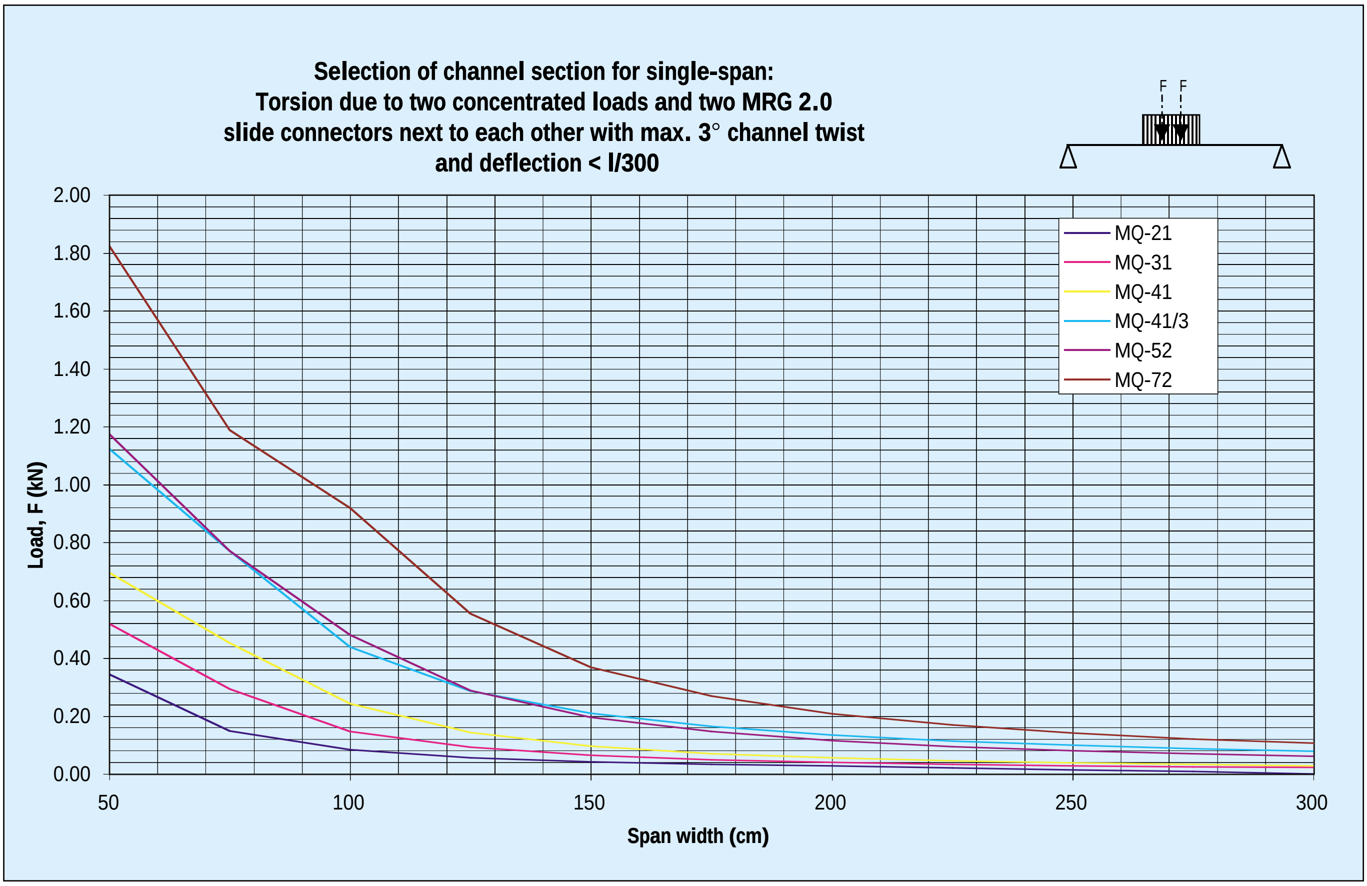


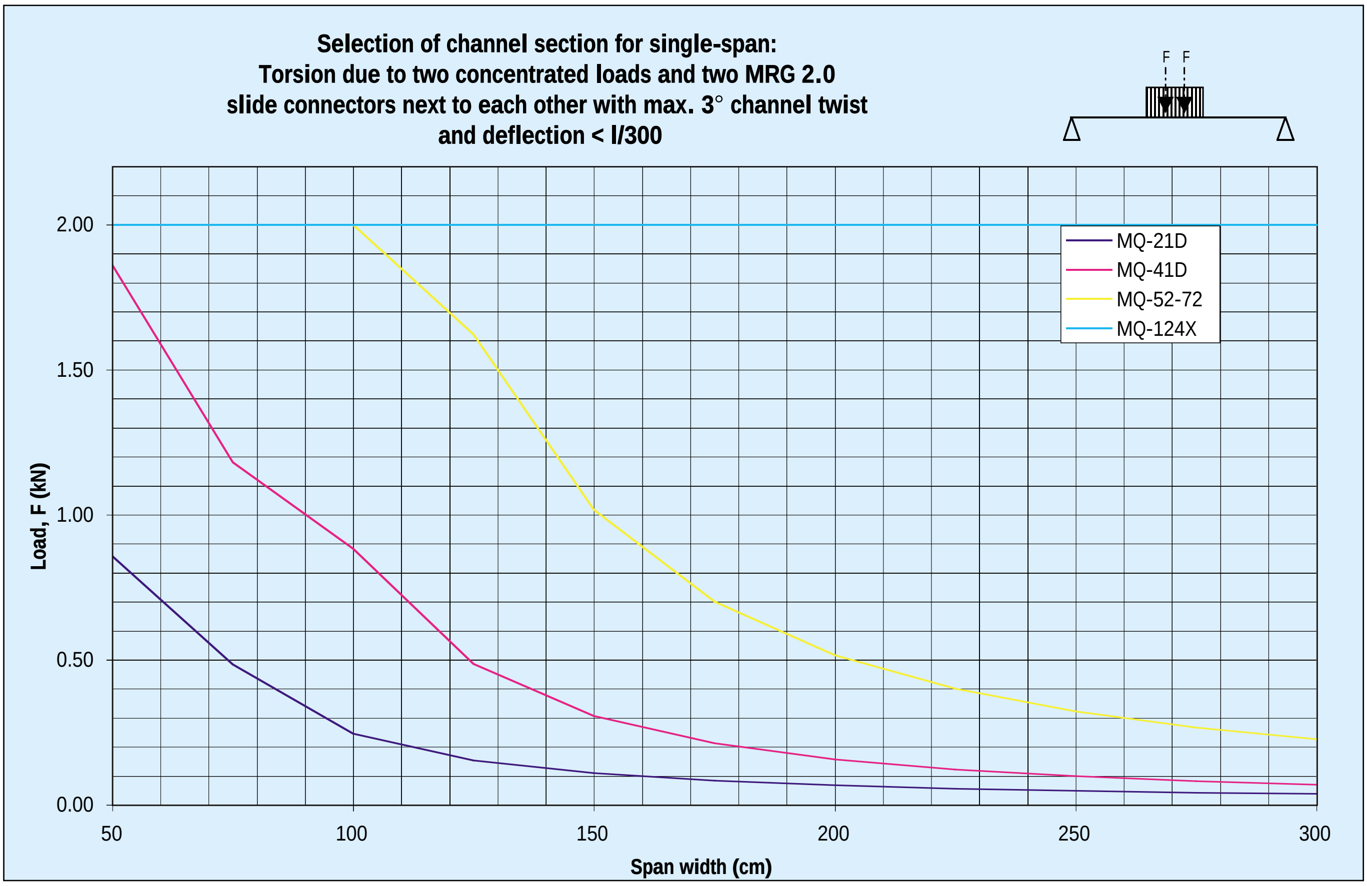




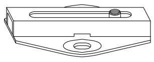
Selection of channel section for single span with MRG 2.0 roll connector

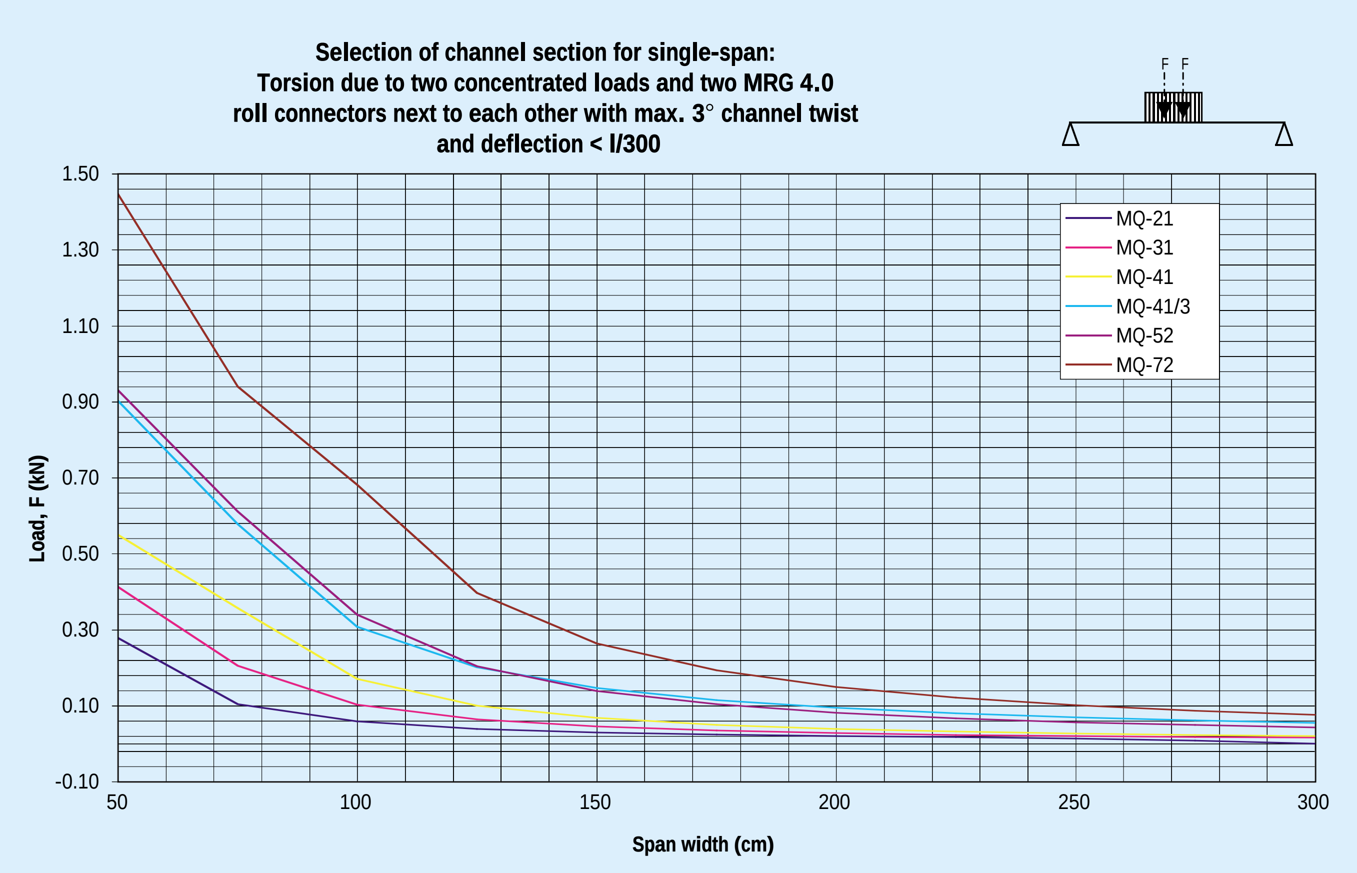


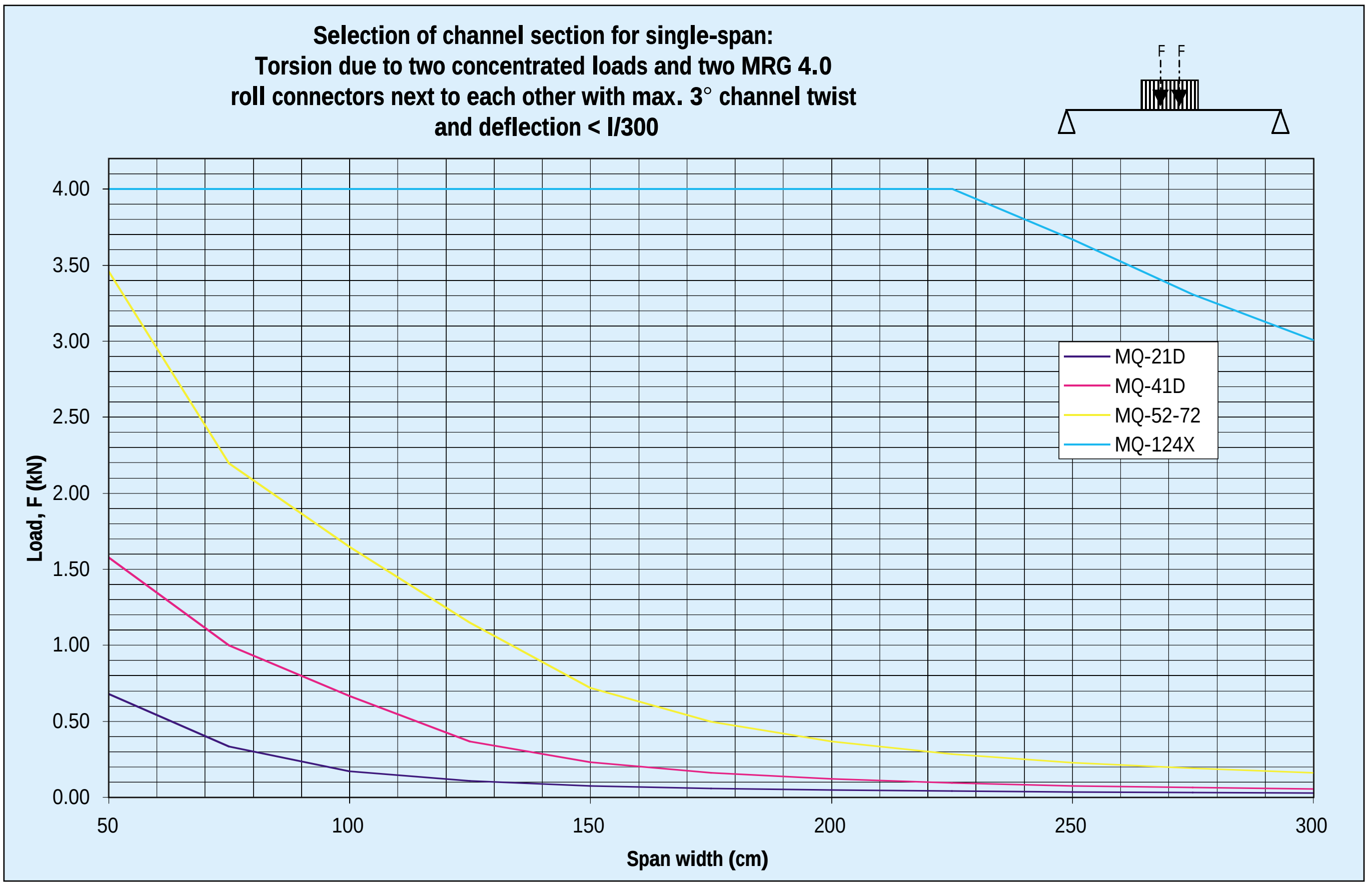




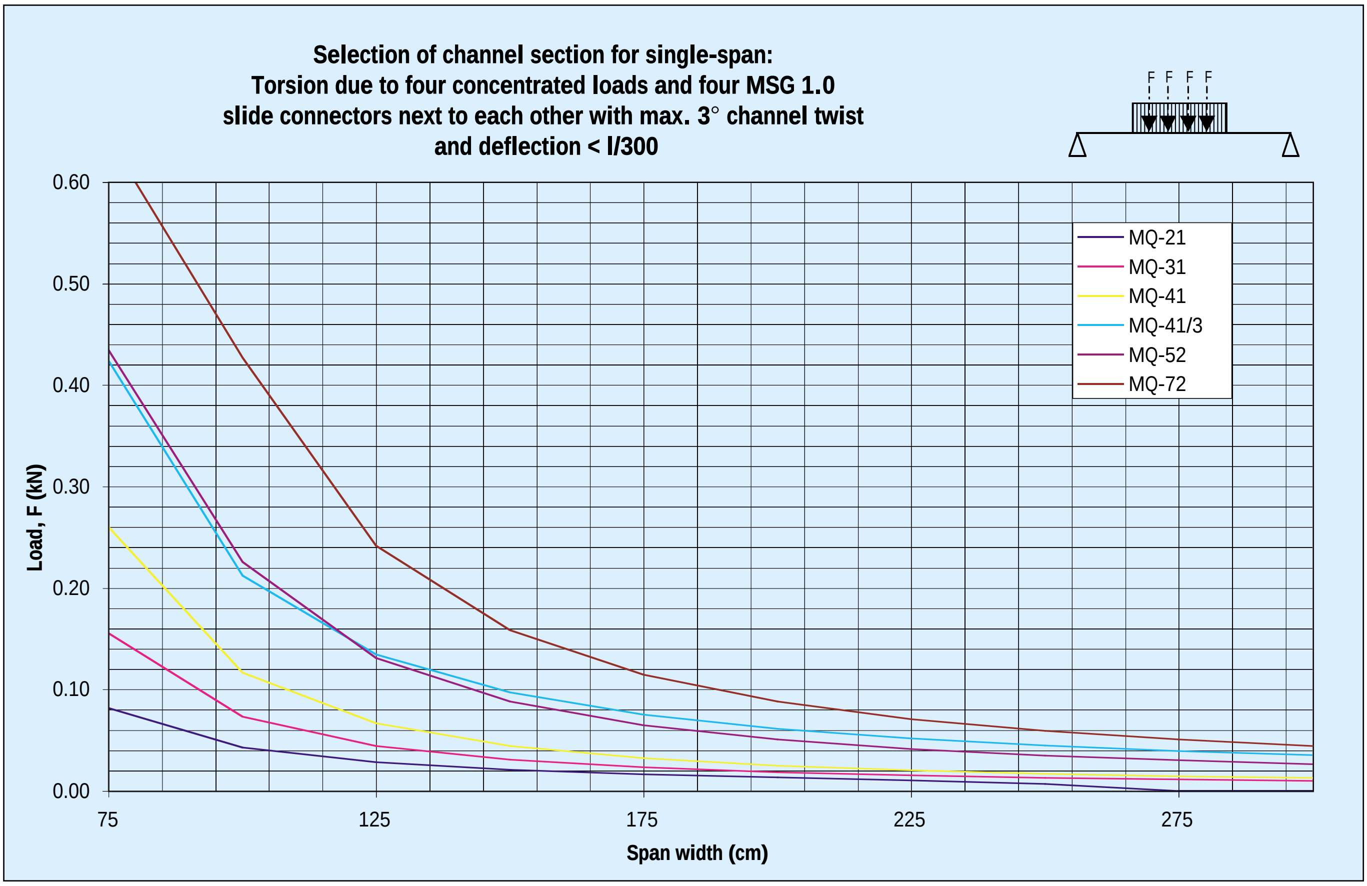
Selection of channel section for single span with MRG 4.0 roll connector

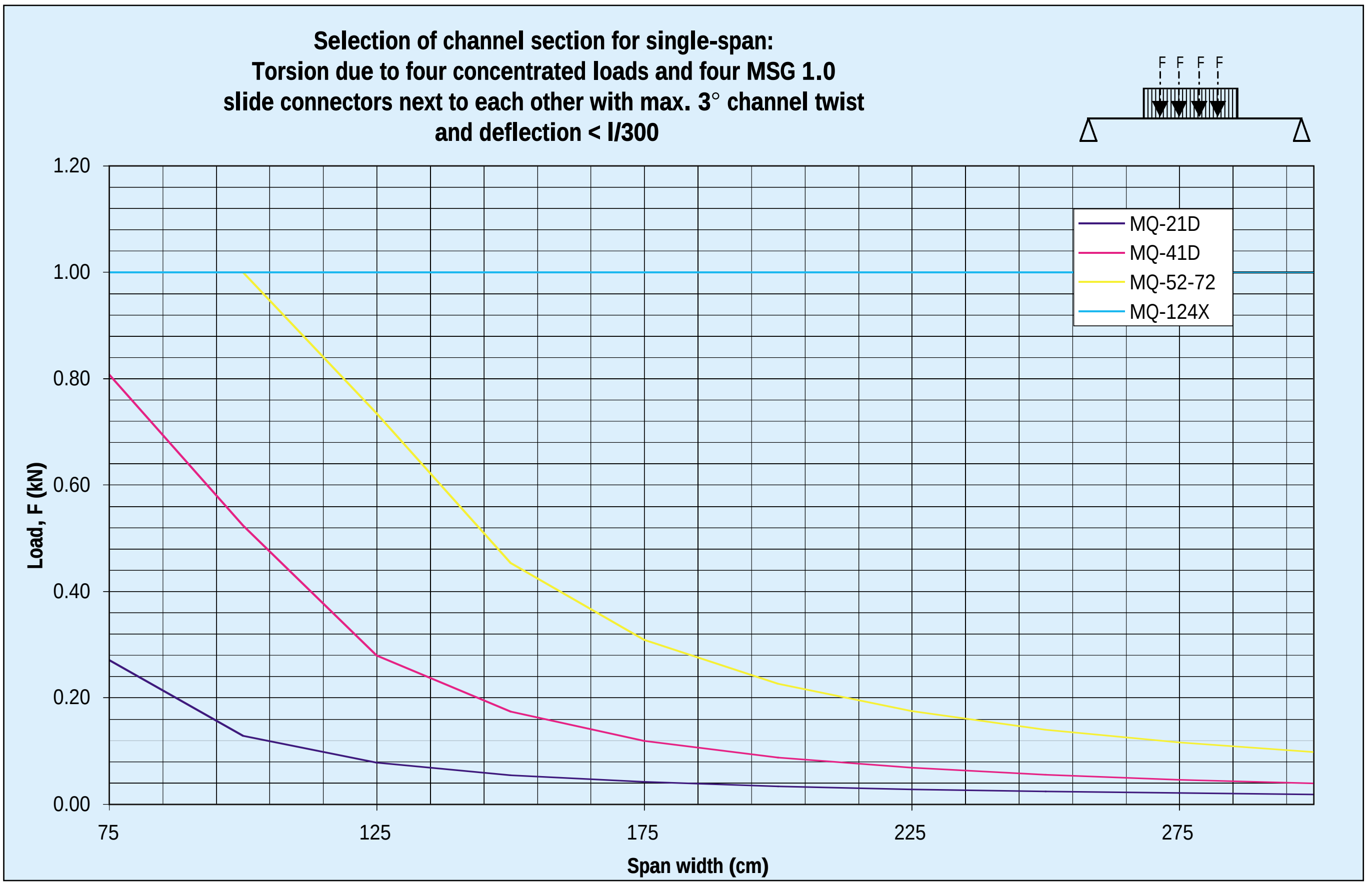




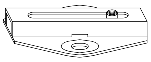


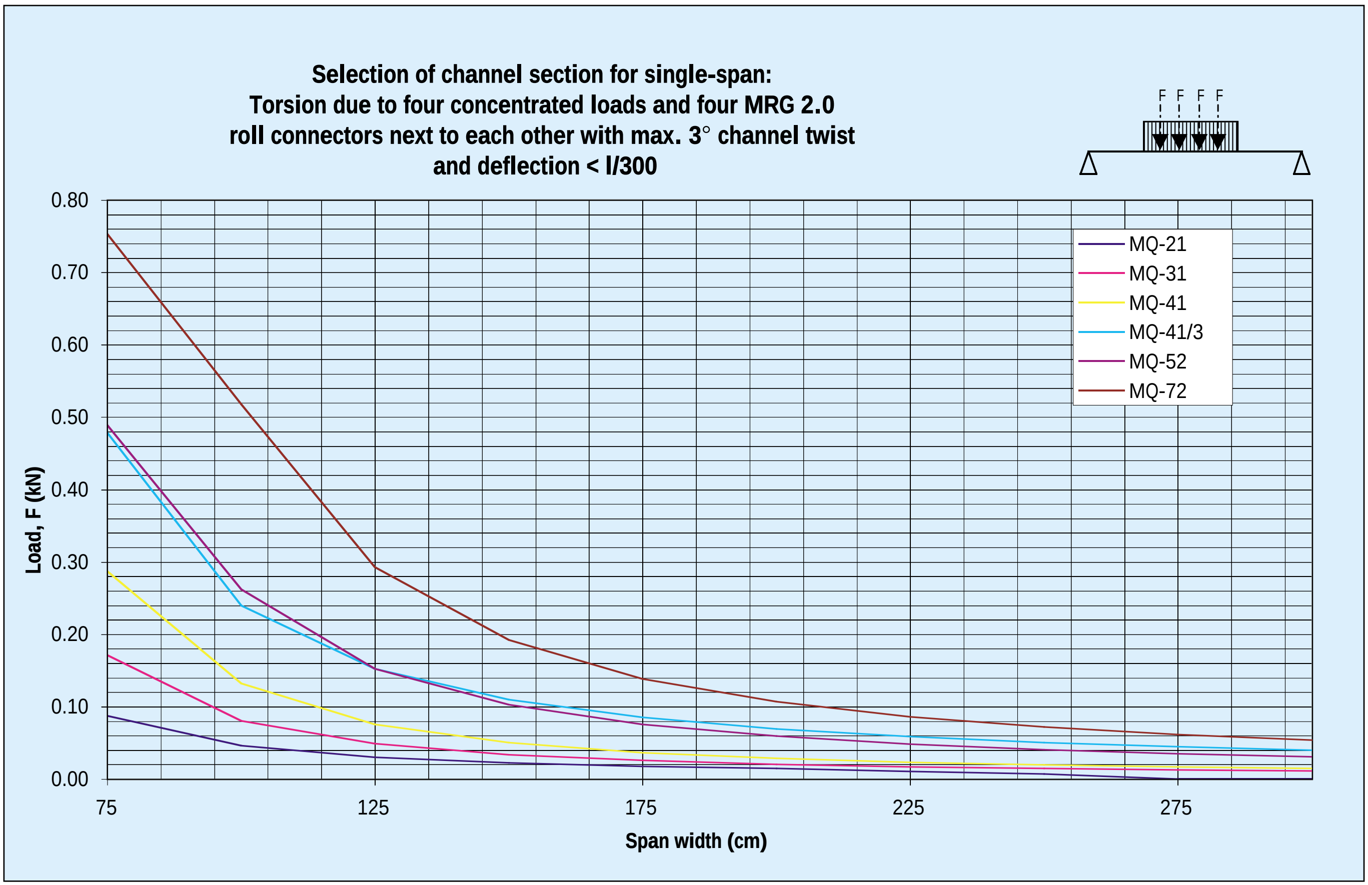
Selection of channel section for single span with MSG 1.0 slide connector

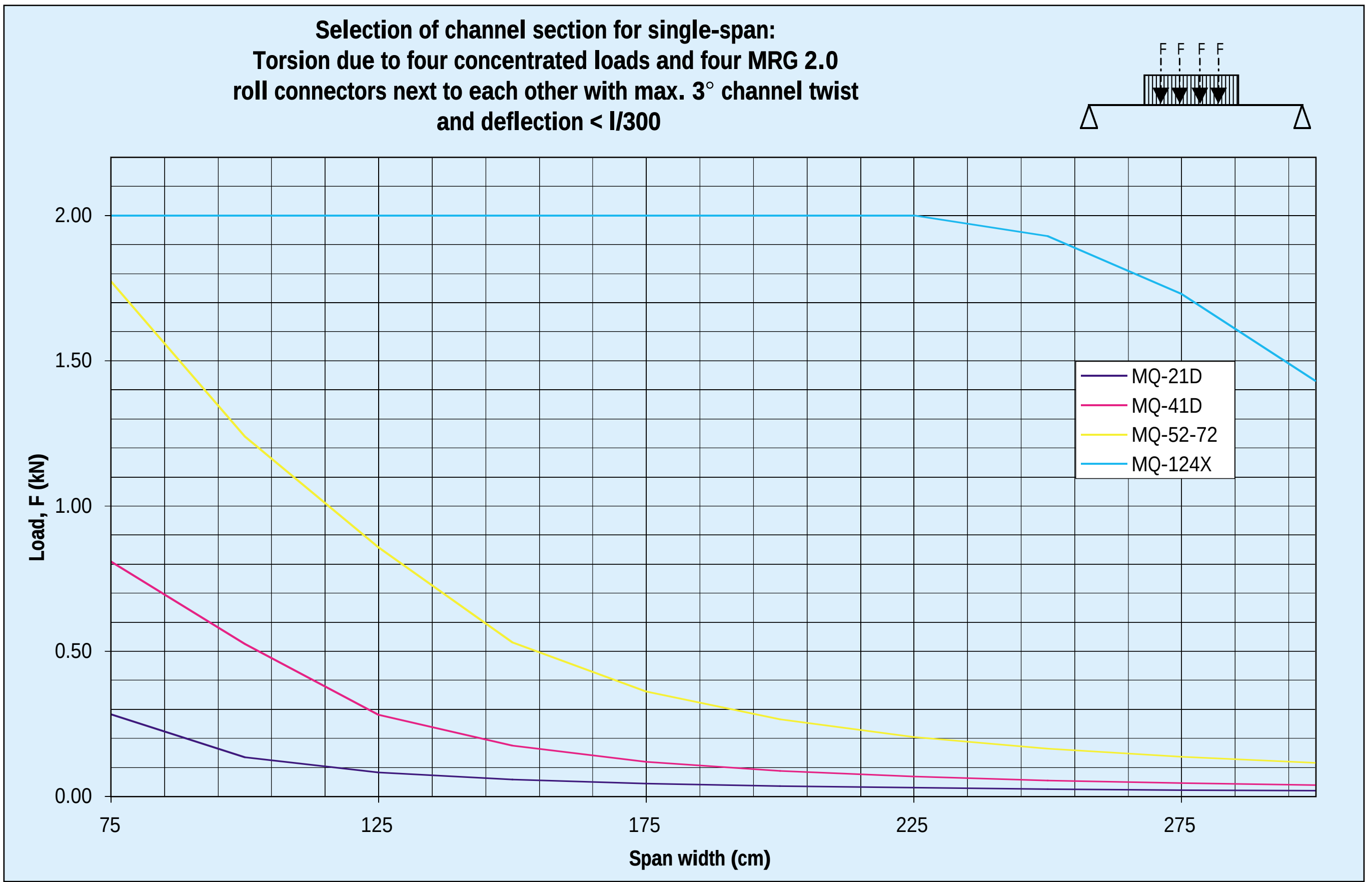




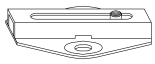
Selection of channel section for single span with MRG 2.0 roll connector

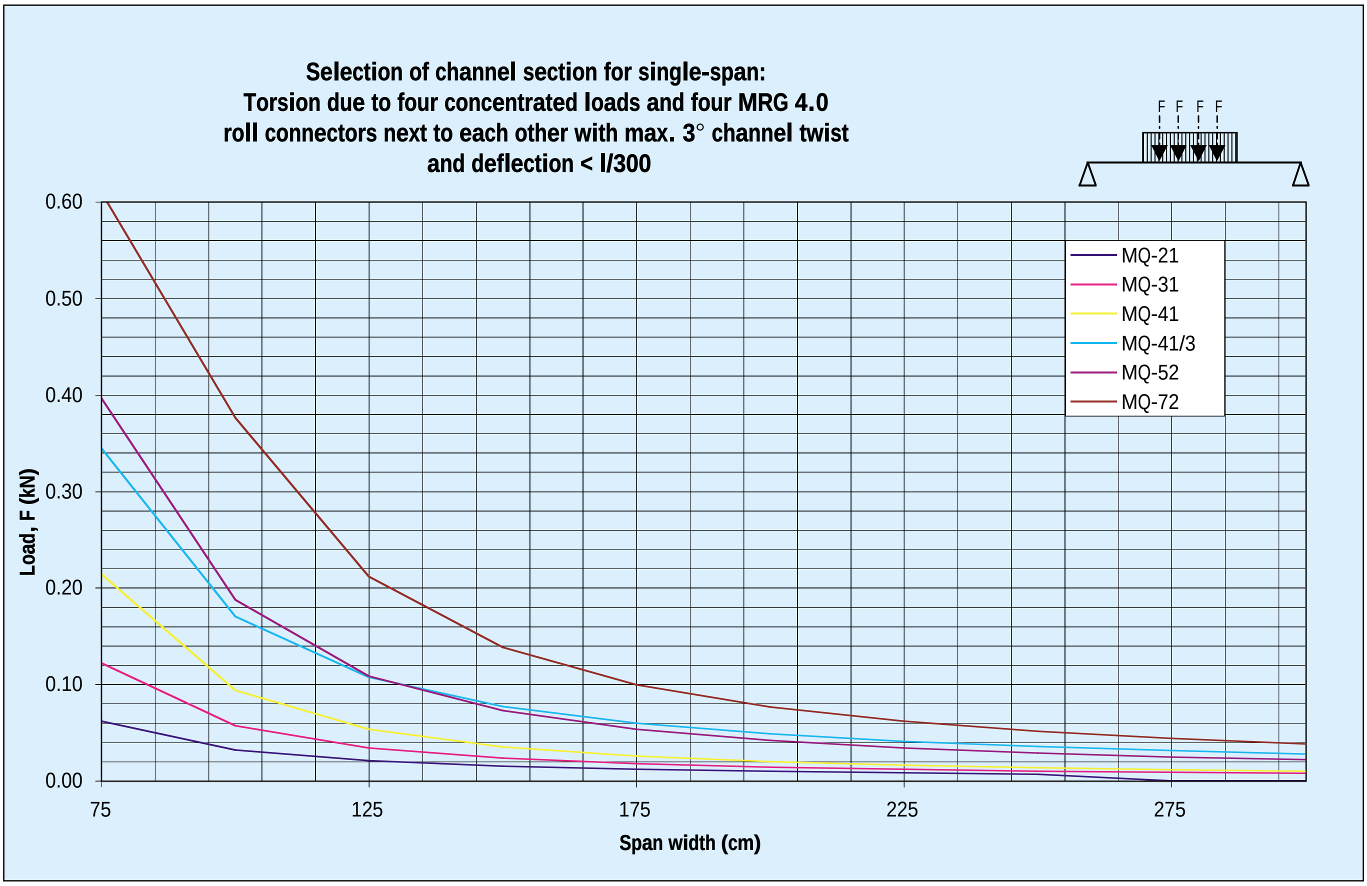


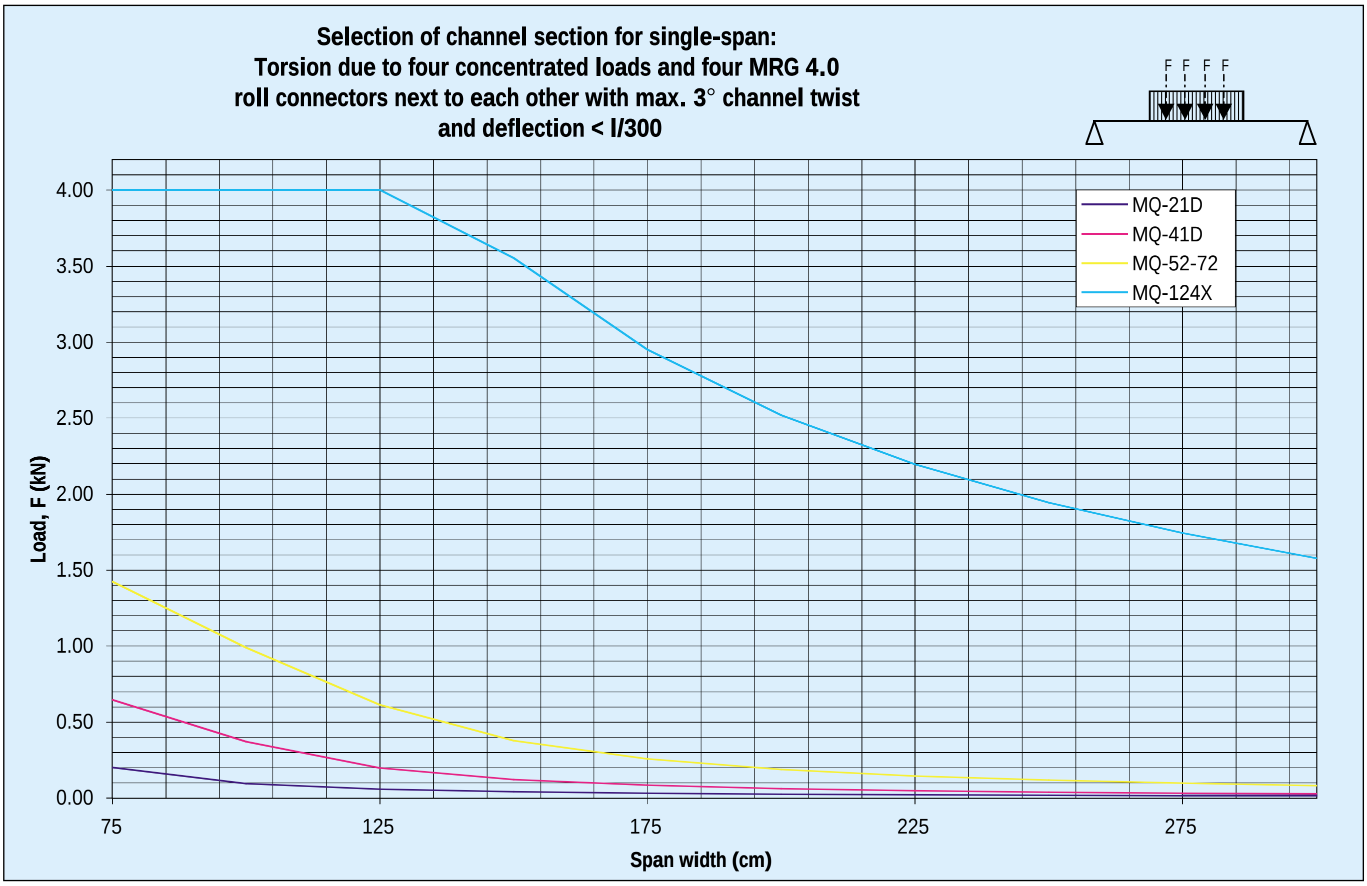




Selection of channel section for single span with MRG 4.0 roll connector





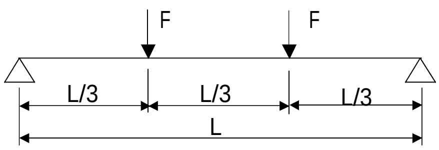


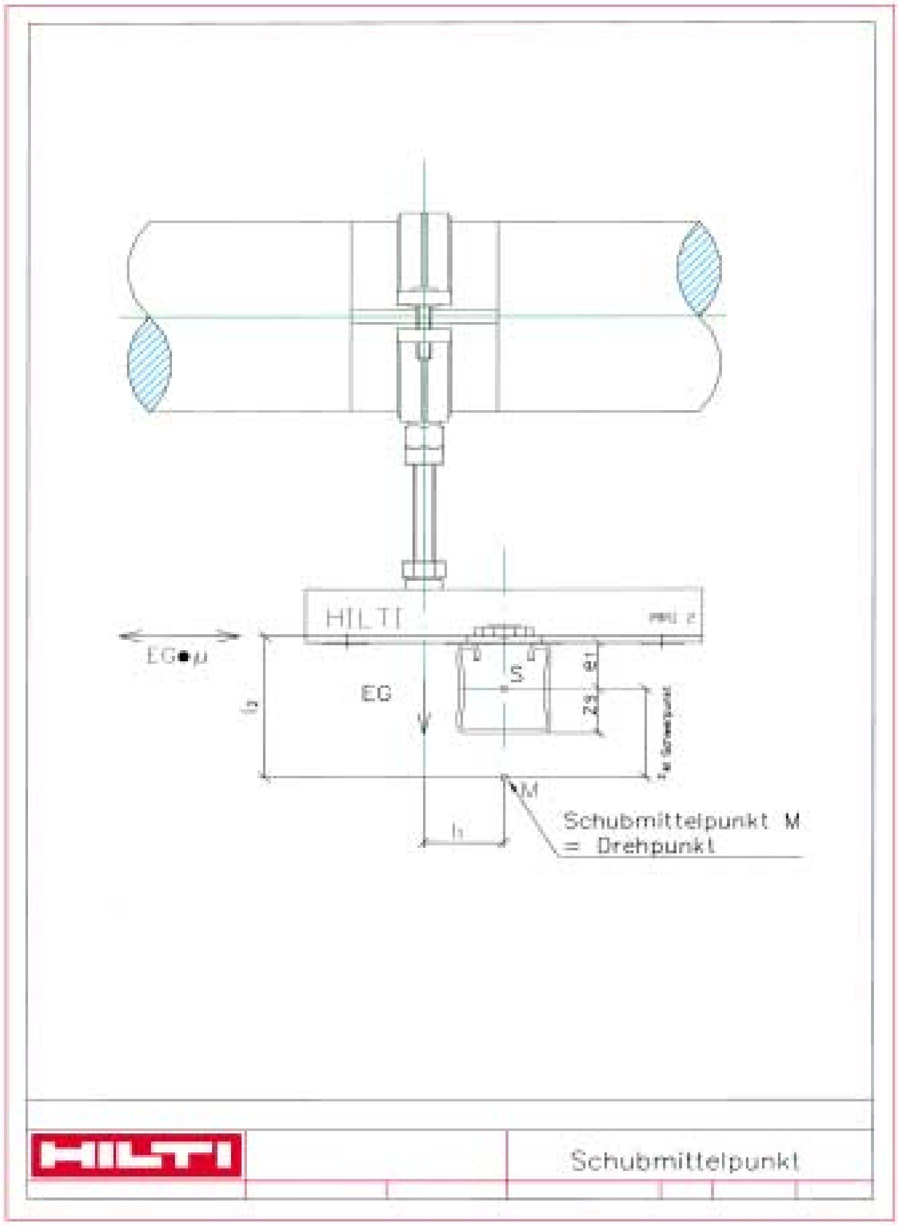
Example of torsion

In the following, a classical example representative of all cases of torsional stressing has been given so that the user can see which verification is provided. It would go beyond the bounds of this manual to provide a review of all interrelationships on a formula basis.

The following is an example from the chemical industry:
Two stainless steel pipes, Da = 76.1 mm, filled with a warm caustic medium (specific weight similar to water) are fastened to a channel every three meters. An MRG 2 roll connector (80 mm movement) is intended for use due to the large change in length owing to heat and the resulting displacement of 70 mm. As the pipe system and fastenings are in a dry hall, galvanized products are adequate.

The following static system is known:





M	= Bending moment	(kNcm)
F	= Single concentrated load	(kN)
q	= Uniformly distributed load	(kN/cm)
L	= Channel length	(cm)
σ	= Stress	(kN/cm²)
E	= Modulus of elasticity	(kN/cm²)
I	= Moment of inertia	(cm⁴)
W	= Section modulus	(cm³)
f	= Deflection	(cm)

Known:

Stainless steel pipe, 76.1 mm diameter, not insulated, filled with medium:	7.78 kg/m
Span width, 3.0 m / EG = 7.78 kg/m * 3.0 m / dead weight =	23.3 kg
Small parts, like roll connector, threaded rod and pipe ring:	3.0 kg
Total:	26.3 kg = 0.263 kN
Selected:	MQ 41/3 channel with dead weight = 2.9 kg/m and L = 1.5 m

In the following, the complete design calculation is carried out providing full verification, which, in principle, is identical to the tables and diagrams.

No pre-selection of the channel has been carried out because, basically, the design calculation is shown here.

1) Moments

M_{yEG}	$= 2.91 * 10^{-4}$ kN/cm * 150 cm² / 8 =	0.82 kNcm
M_{yF}	= 0.263 kN * 150 cm / 3 =	13.15 kNcm
$M_{y\,ges}$	=	13.97 kNcm
Roll connector, μ =		0.08
M_{zF}	= 0.08 * M_{yF} = 0.08*13.15 kNcm =	1.05 kNcm

2) Reaction (bearing) forces / shear forces

$A/B_{y/EG}$	$= 2.91 * 10^{-4}$ kN/cm * 150 cm / 2 =	0.022 kN
A/B_{yF}	=	0.263 kN
A/B_y	= Q_y =	0.285 kN
A/B_{zF}	= Q_z = 0.08 * 0.263 kN =	0.021 kN

3) Section forces from pure torsion:

l_1	= 80 mm / 2 = 40 mm =	4.0 cm
$z_{M\,C.\,of\,G.}$	=	40.0 mm
Distance e1	=	21.52 mm
Fitted height: Roll connector underside to roller center line:		17.0 mm
Total	= l_2 = 78.52 mm =	7.852 cm
M_t	= EG * l_1 + EG * μ * l_2 = F * l_1 + F * μ * l_2	
M_{ta}	= 0.263 kN * 4.0 cm + 0.263 kN * 0.08 * 9.83 cm =	1.22 kNcm
T_{li}	= T_{re} = $M_{t1/2}$ =	1.22 kNcm

4) Section forces from buckling: Buckling force torsion:
(See also formulas in Bornscheuer Stahlbau 1953 and 1961.)

The calculations have been given in circular measure (180° = π)
and the trigonometrical functions are hyperbolic.

a) Tensile and compressive forces

Modulus in shear, G =	8100 kN/cm²
Torsional moment of inertia (St.Vern.) =	0.10 cm⁴
Modulus of elasticity =	21000 kN/cm²
Buckling moment of inertia, C_M =	35.58 cm⁶

Decrease factor, (1/cm)
$$\lambda = \sqrt{\frac{G * I_t}{E * C_M}} = \sqrt{\frac{8100 * 0.10}{21000 * 35.58}} = 0.0332$$

L = 150 cm
Buckling moments at 1/3 span in each case:

$$M_{\lambda a} = \frac{M_{ta}}{\lambda} * \frac{\sinh(\lambda * 2/3 * L) * \sinh(\lambda * 1/3 * L) - \sinh(\lambda * 1/3 * L)^2}{\sinh(\lambda * L)}$$

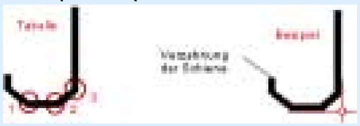
$M_{\omega a}$ = 1.22 kNcm / 0.0331 cm⁻¹ * 0.567 = 20.89 kNcm²
$T_1 = T_{li} – T_2$

$$T_2 = M_{ta} * \frac{\sinh(\lambda * 2/3 * L) - \sinh(\lambda * 1/3 * L)}{\sinh(\lambda * L)}$$

T_2 = 0.75 kNcm
T_1 = 1.22 kNcm–0.75 kNcm = 0.47 kNcm

5) Verification:

Verification is provided in the table for four points of the mono-symmetric channel sections, three points of the double-symmetric channel sections and a total of seven points of the MQ 72/52 channel section and these distributed over the entire cross-sectional area.
In this example, verification of the theoretical outer fiber has been provided as representative of all other points (this is sufficient for an approximate design calculation):



The cross-section values are given in the technical data sheet for the extremes and, thus, the verification is on the safe side.
The exact cross-section values are summarized in a data sheet which can be provided on request.

$I_y = 7.02\ cm^4$	$I_z = 10.44\ cm^4$	
$W_{ymin} = 3.26\ cm^3$	$S_{ymax/double\ shear}$: $2.23\ cm^3$	$S_{ymax/single\ shear}$: $2.23/2 = 1.12\ cm^3$
$W_z = 5.06\ cm^3$	S_{zmax}: $2.96\ cm^3$	
$C_M = 35.58\ cm^6$	S_{max}: $1.87\ cm^4$	
$\omega_{max} = 5.49\ cm^2$		

Verification of tensile stress:

$\sigma_y = M_y / W_y = 13.97\ kNcm / 3.26\ cm^3 =$ $4.29\ kN/cm^2$

$\sigma_z = M_z / W_z = 1.05\ kNcm / 5.06\ cm^3 =$ $0.21\ kN/cm^2$

$\sigma_\omega = M_{\omega a} / C_M * \omega = 20.89\ kNcm^2 / 35.58\ cm^6 * 5.49\ cm^2 =$ $3.23\ kN/cm^2$

$\sigma_{max} = |\sigma| =$ $7.73\ kN/cm^2 = 77.3\ N/mm^2 < 188.3\ N/mm^2 = \sigma_{perm.}$

By comparison, a • max. at the points results from the accurate calculation, as follows:
1) $7.52\ kN/cm^2$
2) $6.31\ kN/cm^2$
3) $4.63\ kN/cm^2$

Verification of shear stress:

$\tau_y = Q_y * S_y / (I_y * t) = 0.285\ kN * 1.12\ cm^3/(7.02\ cm^4 * 0.3\ cm) =$ $0.15\ kN/cm^2$

$\tau_z = Q_z * S_z / (I_z * t) = 0.021\ kN * 2.96\ cm^3/(10.44\ cm^4 * 0.3\ cm) =$ $0.02\ kN/cm^2$

$\tau_t = T_1 / I_t * t = 0.49\ kNcm/0.10\ cm^4 * 0.3\ cm =$ $1.47\ kN/cm^2$

$\tau_\omega = T_2 * S_\omega/(C_M * t) = 0.75\ kNcm * 1.87\ cm^4/(35.58\ cm^6 * 0.3\ cm) =$ $0.13\ kN/cm^2$

$\tau_{max} = |\tau|$ $1.77\ kN/cm^2 = 17.7\ N/mm^2 < 108.7\ N/mm^2 = \sigma_{perm.}$

By comparison, $\tau_{max.}$ at the points results from the accurate calculation, as follows:
1) $1.58\ kN/cm^2$
2) $1.44\ kN/cm^2$
3) $1.50\ kN/cm^2$

Comparison stress:

$$\sigma_V = \sqrt{(\sigma_{max.}^2 + 3\times\tau_{max.}^2)} = \sqrt{(7.73^2 + 3\times1.77^2} = 8.32\ kN/cm^2 = 83.2\ N/mm^2 < 188.3\ N/mm^2 = \sigma_{perm.}$$

By comparison, a σ_V at point 1 of $8.11\ kN/cm^2$ results from an accurate calculation.
Error: 8.32/8.11 = 1.025 or, in other words, 2.5 %

6) Deflection:

f_y = 23/648 * F_y * L^3/(E * I_y) + 5/384 * q * L^4/ (E * I_y) =
f_y = (23/648 * 0,263 kN * 150^3 cm^3 + 5/384 * 2,91 * 10^{-4} kN/cm) / (21000 kN/cm^2 * 7.02 cm^4) =
f_y = 0.01 cm + 0.21 cm = 0.22 cm < l/300 = 150 cm / 300 = 0.5 cm
f_z = 0.21 cm * 0.08 * 7.02 / 10.44 = 0.01 cm

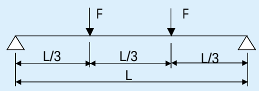
Torsion (twisting):
The twist is restricted to three degrees at the tolerance limit in view of appearance and a possible restriction to the serviceability state.

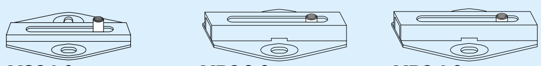
$$\delta_a = \frac{M_{ta}}{\lambda \cdot G \cdot I_t} \cdot \left(\frac{\lambda \cdot L}{3} - \frac{\sinh(\lambda \cdot {}^2/_3 \cdot L) \cdot \sinh(\lambda \cdot {}^1/_3 \cdot L) + \sinh(\lambda \cdot {}^1/_3 \cdot L)^2}{\sinh(\lambda \cdot L)} \right)$$

Twist, ϑrad 0.05 rad
in ° ϑ° 2.78° < 3.0°
If the twist is greater, a stronger channel section should be selected.
As will be seen, the twist is already decisive for the design calculation with open channel sections when the support distances are relatively short.

Selection using table: F_{actual} = 0.263 kN < $F_{perm.}$ = 2.8 kN

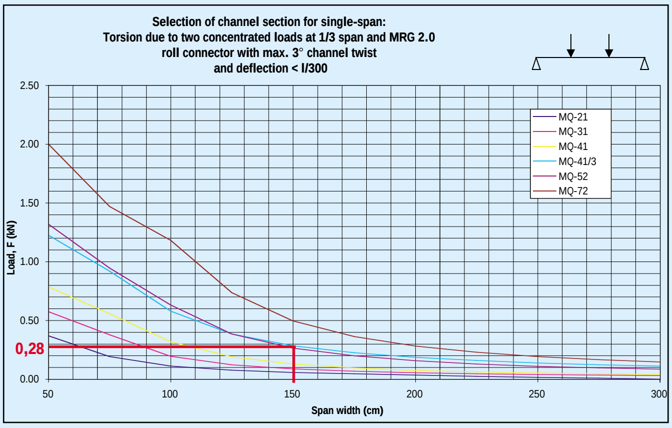
Torsion: Tables for MQ-41/3 channel
Single-span under torsional stress
Concentrated loads at 1/3 span





Span width, (cm)	MSG 1.0 F (kN)	f (mm) ≤ = σperm.	Twist (°)	MRG 2.0 F (kN)	f (mm) ≤ = σperm.	Twist (°)	MRG 4.0 F (kN)	f (mm) ≤ = σperm.	Twist (°)
25	–	–	–	–	–	–	–	–	–
50	1.00	0.3	1.2	1.22	0.4	1.3	0.95	0.3	1.5
75	0.84	0.9	2.7	0.92	0.9	2.6	0.72	0.7	2.9
100	0.51	1.3	3.0	0.58	1.4	3.0	0.40	1.0	3.0
125	0.34	1.7	3.0	0.38	1.9	3.0	0.27	1.3	3.0
150	0.25	2.2	3.0	0.28	2.4	3.0	0.20	1.7	3.0
175	0.20	2.8	3.0	0.22	3.1	3.0	0.16	2.3	3.0
200	0.16	3.6	3.0	0.19	4.0	3.0	0.13	2.9	3.0
225	0.14	4.5	3.0	0.16	5.0	3.0	0.11	3.7	3.0
250	0.12	5.6	3.0	0.14	6.2	3.0	0.10	4.6	3.0
275	0.11	6.9	3.0	0.12	7.6	3.0	0.09	5.8	3.0
300	0.10	8.4	3.0	0.11	9.3	3.0	0.08	7.1	3.0

Selection using diagram:



Fundamentals:

The following provide the basis for the following design tables and the diagrams for the MQ channel installation system:

- DIN 18800, dated 1990, parts 1-3 "Steel construction"
- DASt guideline 016, dated 1992, "Design and structural layout of support structures made of thin-walled, cold-formed members"
- "Bending-torsion problems of straight, thin-walled members," by Prof. Dr. Karlheinz Roik
- Stress analysis / static notes, FH Munich, by Prof. Dr. Schineis

Eurocode EC3 will be based on DIN 18800, but this is still the subject of great discussion and dispute by experts and has not, therefore, been taken into account. Verification in all cases was carried out allowing for the partial safety factors according to DIN 18800.

Safety factors:

Resistance: $\lambda_M = 1.1$ (See DIN 18800 part 1.)
Action: $\lambda_{G/Q} = 1.4$

These were selected for the following reasons:
The tables primarily apply to the fastening of pipe runs. The lion's share of the working load (water in this case) cannot, owing to the restricted volume in the pipe, be larger than the value given in the following tables.
Allowance must be made during planning work for forces of constraint set up by pipe expansion and, statically, they can be taken up by suitable support components, such as roll connectors. (See torsion tables.) The permissible loads given in the Hilti design aids for anchors have also been determined using the safety factor, $\lambda_{G/Q}$, of 1.4. As a result, rapid selection of anchors is possible. Verification in each case was carried out at the level of the design stress, σ_D, in order to make a comparison with channels of other manufacturers easier.

Design fundamentals:

- The section forces were calculated according to the elastic-elastic process.
- The dead weight of the channel has been integrated.

In accordance with the DASt guideline 016, dated 1992, "Design and structural layout of structures and thin-walled, cold-formed members", chapter 3.6, page 32, allowance has been made for the higher yield strength due to cold forming.

The shear loading of rivets and welding seams was determined. The welding seams of the brackets were such that the safety factor against failure is at least equivalent to that of the channel.

Static systems:

Supports:
Only the single-span channel systems were investigated (less favorable, statically, than multiple-span channels). Statically, the supports have been idealized as hinged (articulated, pivoted) and have the task of taking up shear forces. In the case of torsion, the supports additionally have to avoid twisting (knuckle / straddle / yoke support).

The selected products must be in keeping with the static system to the greatest possible extent. As a result, not all connectors and angles are suitable. When using heavy-duty angles like the MQW-D/3D, for example, additional means of restraint must, under circumstances, be allowed for which can have an unfavorable effect on the connecting struts (in the case of a U-structure). In the case of torsional stressing, angular components, such as the MQW-QZ 2 two-hole 90° angles, should be avoided as they cannot inhibit the twist. The permissible shear or tensile loading of the connectors can be taken from the technical data, e.g. catalogue sheet. The overall safety factor against the 5% fractile is generally higher than that of the channel at $\lambda_{tot<} = \lambda G/Q \cdot \lambda_M = 1.4 \cdot 1.1 = 1.54$

Multiple-span channel:
Needless to say, these tables, which are on the safe side, can also be used for multiple-span channels. Allowance must, however, be made then for the higher support forces, especially at the second and third supports.

Deflection:

The deflection owing to bending has been limited to L/200 and L/300. DIN 18800 basically stipulates no further restrictions. For aesthetic reasons, however, the existing restrictions should not be exceeded. Furthermore, attention must be paid to the restrictions in order not to impair the serviceability state and they should be discussed with the respective consulting engineer, planner or ordering party. There are certain specifications, e.g. industrial pipeline construction, which restrict the permissible deflection to 5 mm.

Here, for the first time, the twist is also restricted to 3°. Seeing as channels with open profiles twist very easily under torsion, the restriction is absolutely necessary. Apart from the appearance of the structure, the service life of the slide components and the pipe rings also play a major role. Larger tolerances have to be agreed with the consulting engineer, planner, etc. and Hilti. The twist of 3° results from the max. movement of the slide / roll connector (MRG, MSG).

Goal:

The tables and diagrams serve as a supplement to the design program "Channel" and they must be regarded as a rapid selection system, especially to support the design calculation.

If the actual static systems are similar to or more favorable than the system chosen here, no additional verification of static suitability is required for a channel as the verification necessary in all cases has been allowed for here. (See examples.) The user must, of course, provide a design evaluation of the loading capacity (ultimate state) of the connectors, such as pushbuttons, angles, etc. The permissible loads of anchors have been included in the tables for cantilever-type brackets.

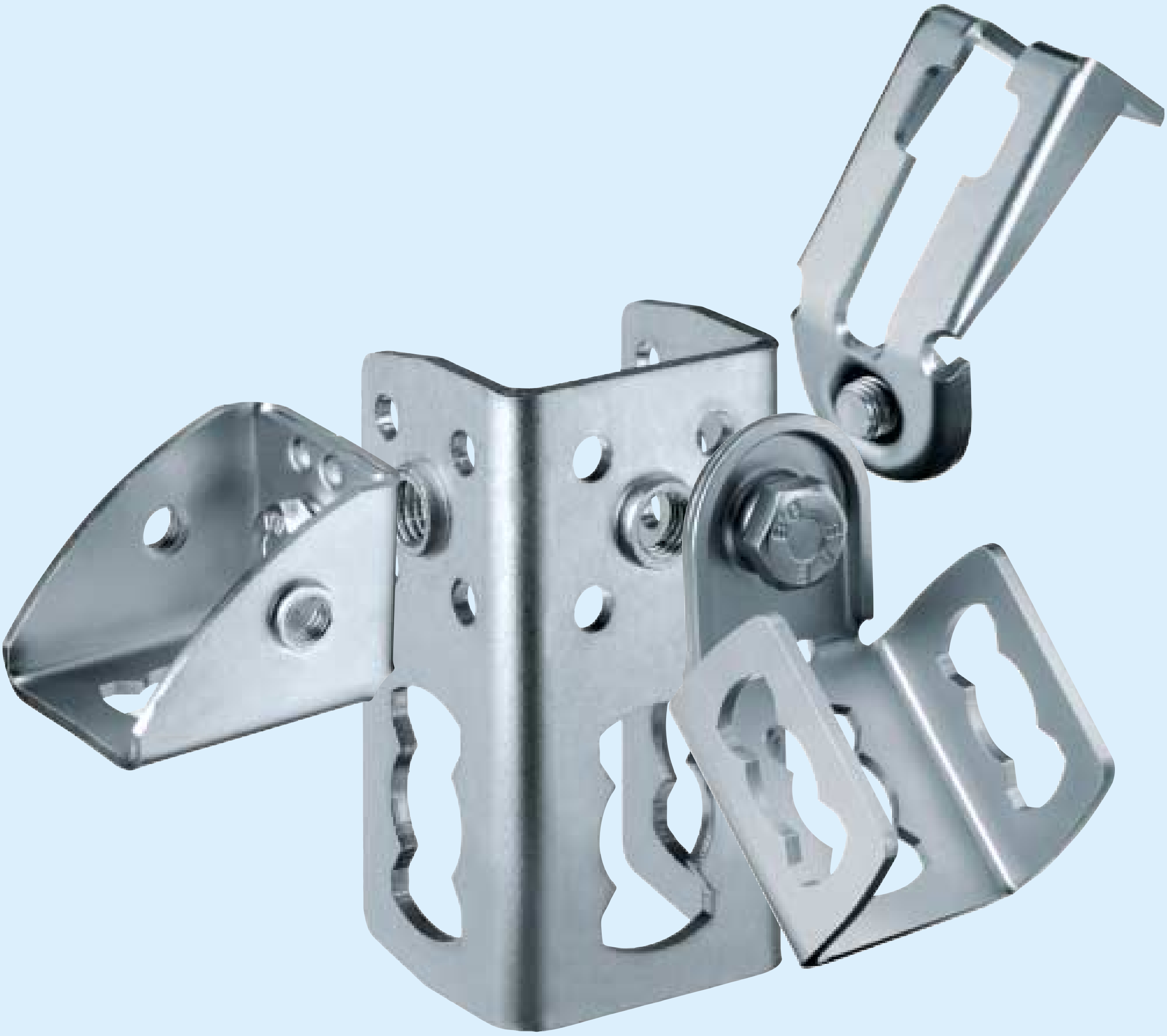
Verification of the further transfer of forces into the base material must be provided by those responsible for the building.

On request, individual chapters can be submitted for review. We recommend that the preamble and the pertaining design example also be included.

Important note: The tables and diagrams have been drawn up with the greatest care and checked several times in some cases. If an error has crept in unexpectedly, please inform the authors. The actual static system should always be checked for plausibility on principle.

Herbert Baumgaertel, team leader, project systems Hilti Germany
Peter Mender, marketing manager of installation systems BU

The new 3D system:
The way to infinite connections



A new dimension: Connectors in a 3D system

- Only four components for infinite possibilities for the right connection for each job
- Quick solutions from flexible assembly on the site
- A high rate of installation thanks to prefitted connection bolt

3D system: Program and technology

Benefits:
- Universal use, few parts for all applications
- Angles or connectors for fitting on site
- Quick and simple assembly
- 45° angle and bracing with predetermined bending point

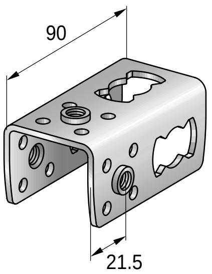
Technical data

Material:	
Basic part and 45° angle:	QStE 380 TM as per SEW 092
90° angle and brace:	DD11 as per DIN EN 10111
Material thickness:	3 mm
Connection thread:	M10
Galvanized:	Fe/Zn 13 B as per DIN 50961

Program:

Description	Weight, each (g)	Packaging contents (pcs)		Ordering designation	Item no.
Basic part	**206**	**20**	①	**MQ3D-B**	**369694/5**
90° angle	**212**	**20**	②	**MQ3D-W90°**	**369695/2**
45° angle	**153**	**16**	③	**MQ3D-W45°**	**369696/0**
Brace	**95**	**20**	④	**MQ3D-A**	**369697/8**

①



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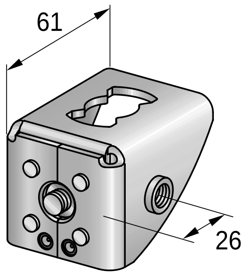

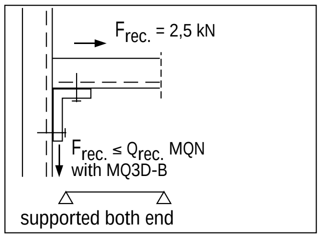

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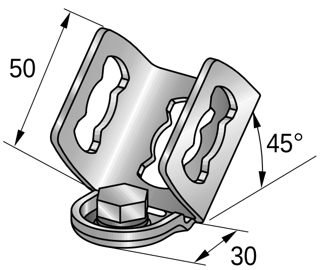

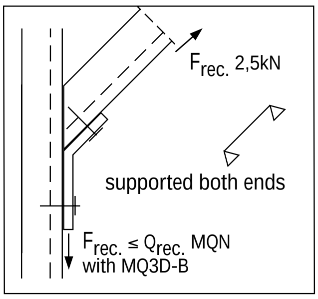

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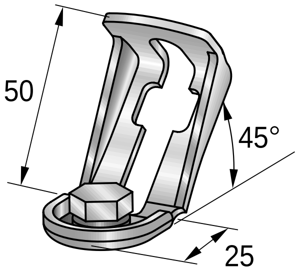
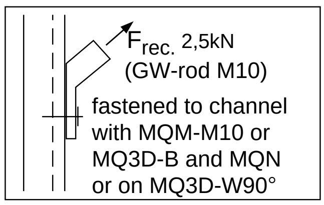
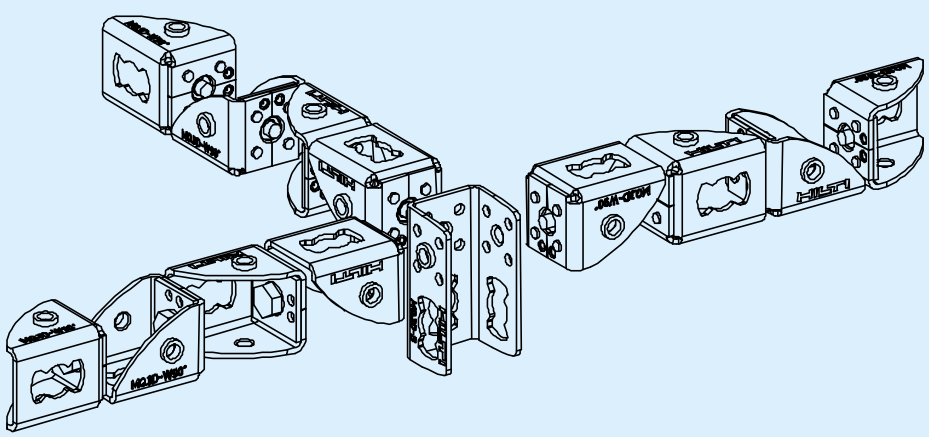
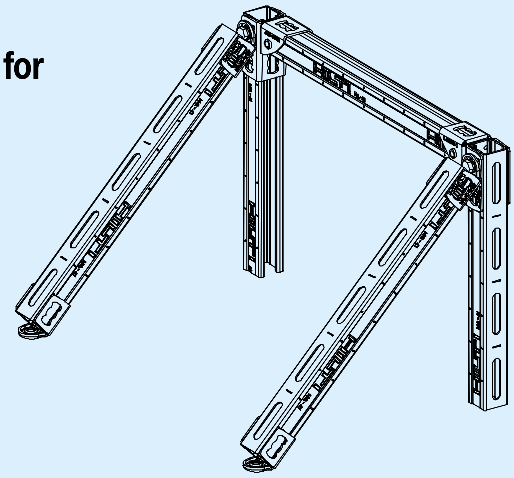


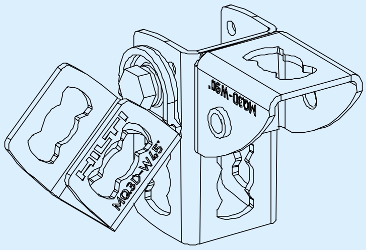




3D system: All structures are possible with three-dimensional fastenings. Only four parts for a wide variety of structures.

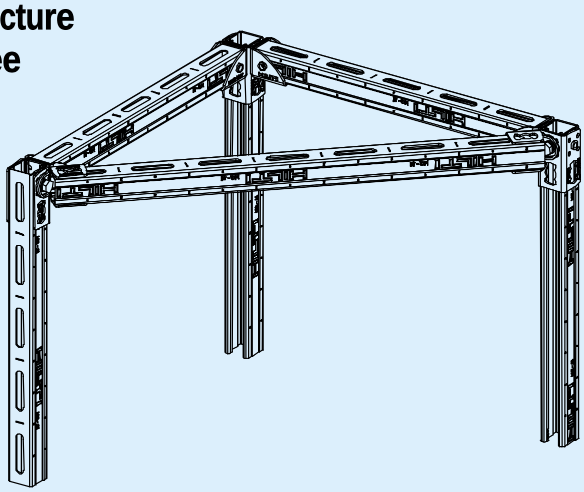
Bracing against compression also for U-structures

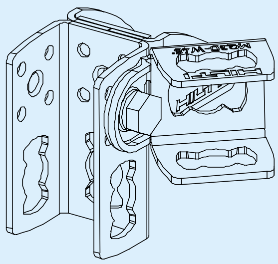




Basic part:	MQ 3D-B	369694/5
90° angle:	MQ 3D-W90°	369685/2
45° angle:	MQ 3D-W45°	369696/0

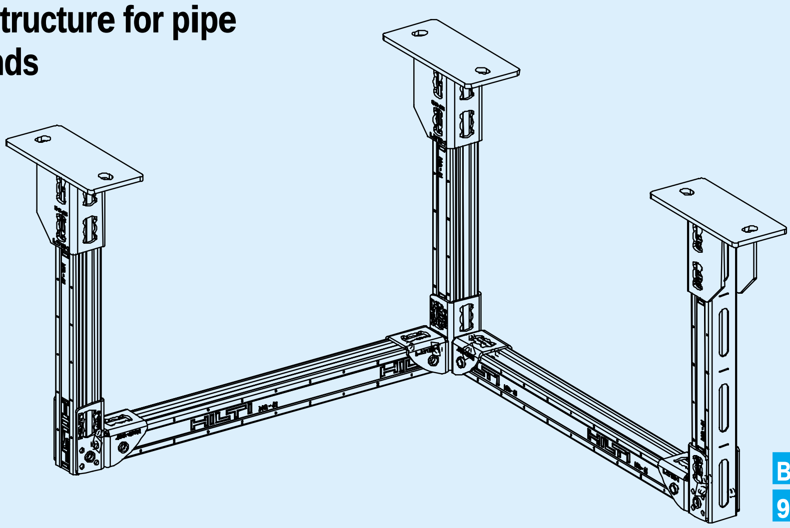
Triangular structure using only three parts

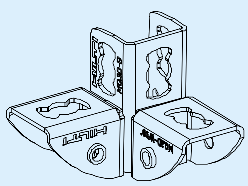




Basic part:	MQ 3D-B	369694/5
90° angle:	MQ 3D-W90°	369685/2
45° angle:	MQ 3D-W45°	369696/0

U-structure for pipe bends

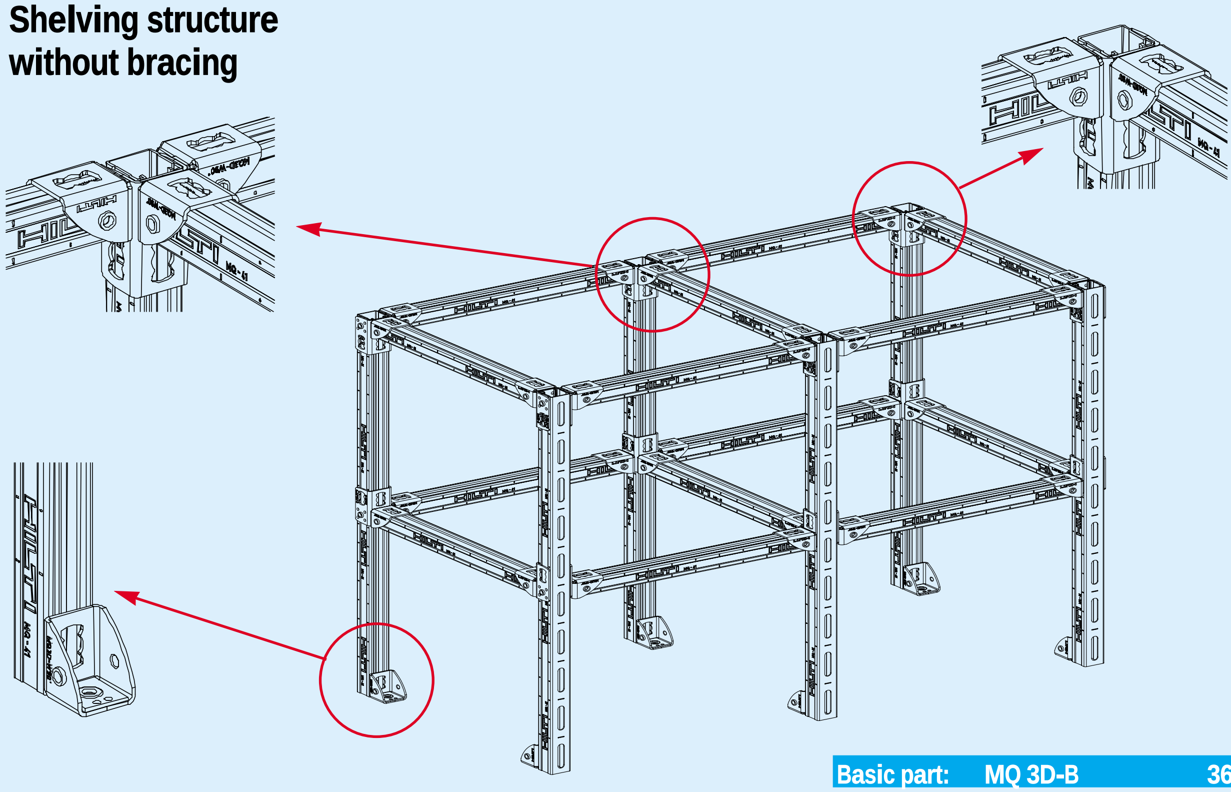




Basic part:	MQ 3D-B	369694/5
90° angle:	MQ 3D-W90°	369685/2

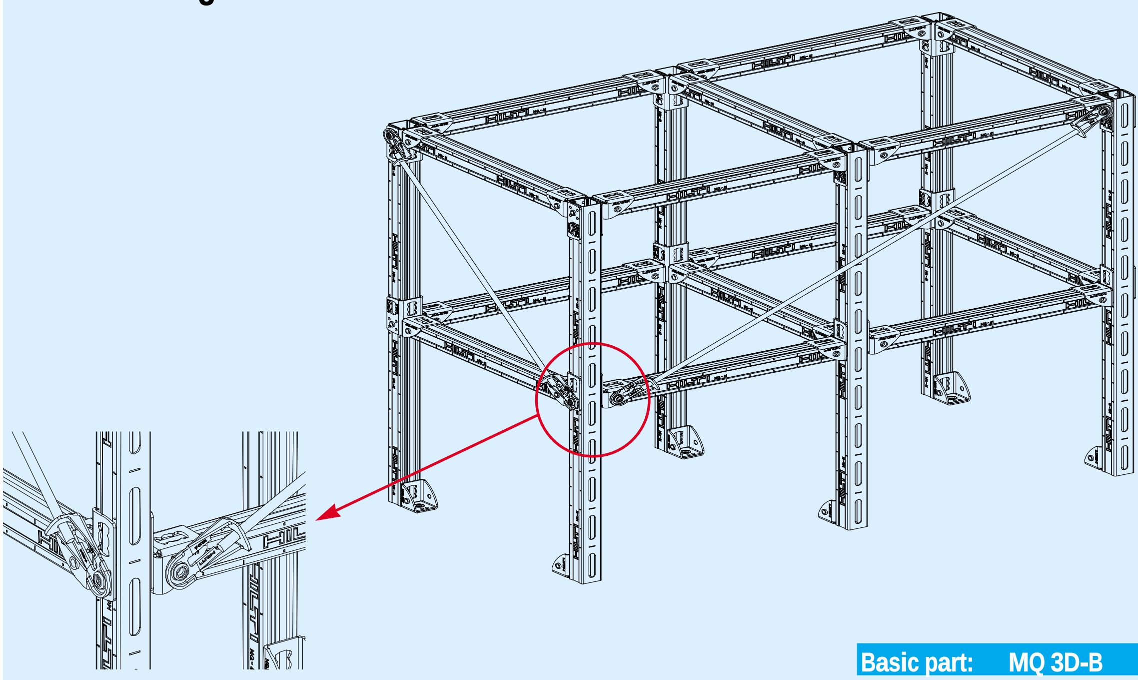
3D system:
Bracing where it's needed.

Shelving structure without bracing



Basic part:	MQ 3D-B	369694/5
90° angle:	MQ 3D-W90°	369685/2

Shelving structure with bracing

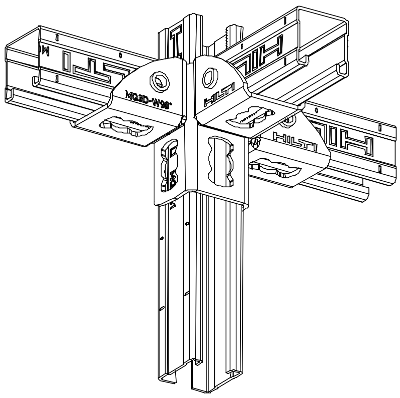


Basic part:	MQ 3D-B	369694/5
90° angle:	MQ 3D-W90°	369685/2
Brace:	MQ 3D-A	369697/8

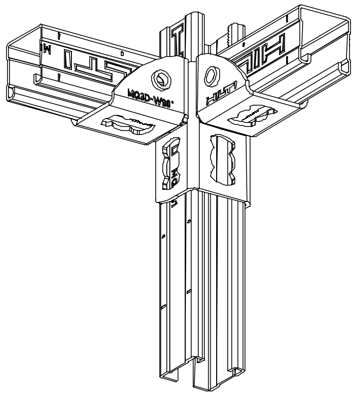
3D system: Flexibility on construction sites

Guide for applications with the new 3D system

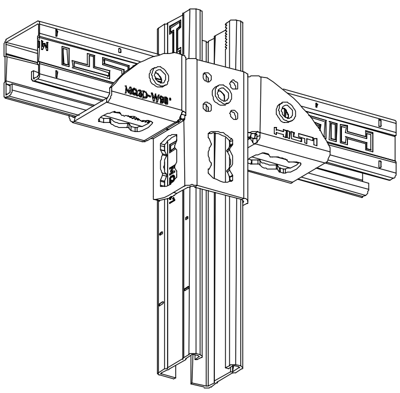
New 3D system



MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W90° angle	(3 pieces)	**369695/2**

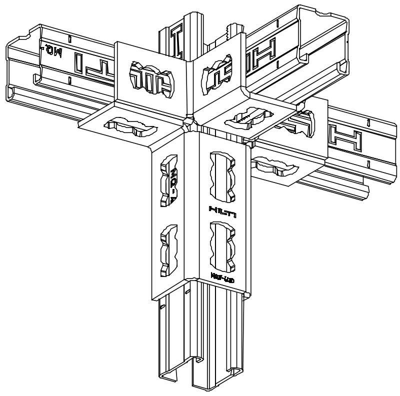


MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W90° angle	(2 pieces)	**369695/2**

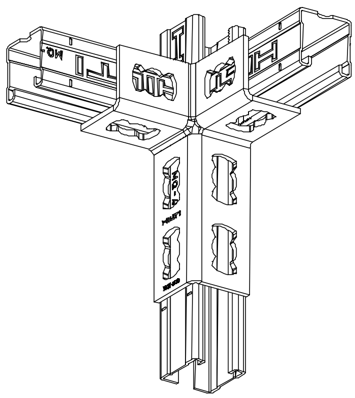


MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W90° angle	(2 pieces)	**369695/2**

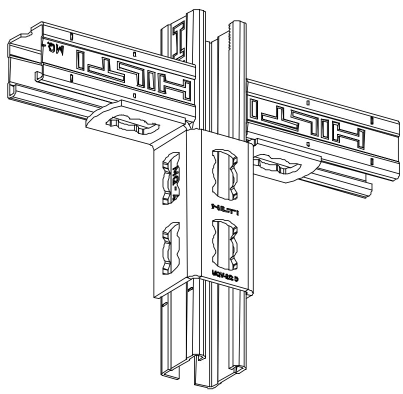
Existing system:



MQV-4/3D connector	(1 piece)	**369642/4**

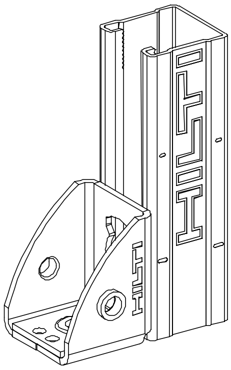
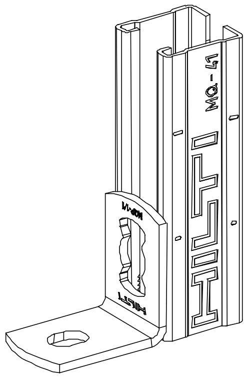
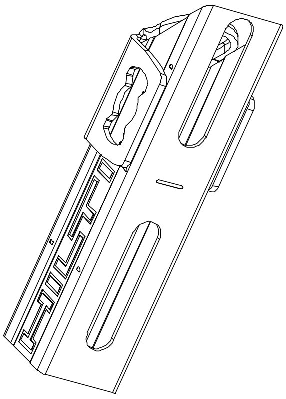
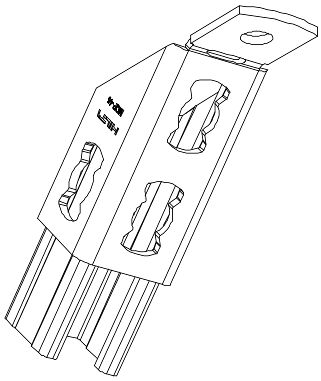
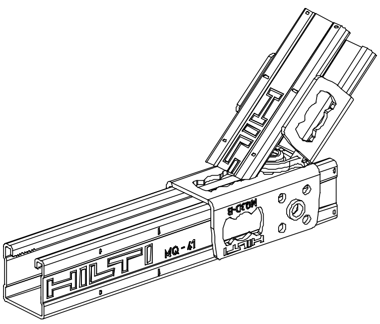
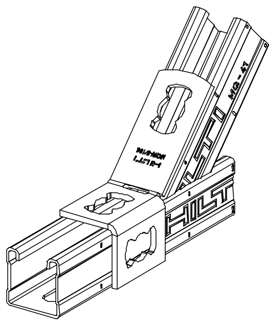


MQV-3/3D connector	(1 piece)	**369641/6**



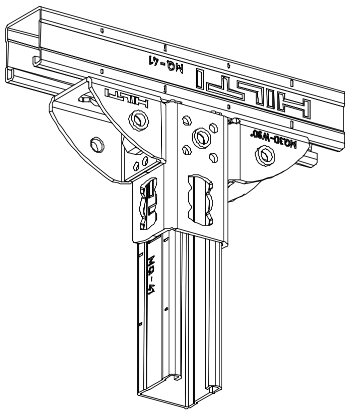
MQV-2/2D connector	(1 piece)	**369638/2**

Guide for applications with the new 3D system

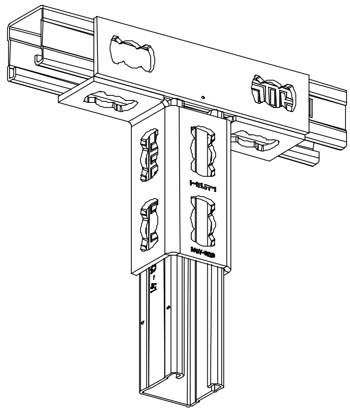
New 3D system	Existing system:
	
MQ3D-B basic part (1 piece) **369694/5**	**MQP-1/1 channel base** (1 piece) **369646/5**
	
MQ 3D-W45° angle (1 piece) **369695/2**	**MQP-45° channel base** (1 piece) **369649/9**
	
MQ3D-B basic part (1 piece) **369694/5** **MQ 3D-W45° angle** (1 piece) **369695/2**	**MQW 3/135° angle** (1 piece) **369663/0**

Guide for applications with the new 3D system

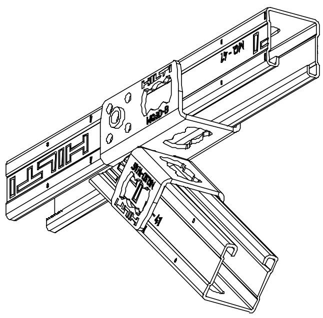
New 3D system			Existing system:		



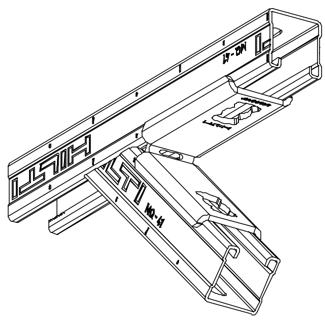
MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W90° angle	(2 pieces)	**369695/2**



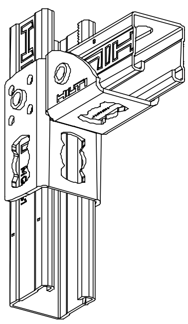
MQV-4/2D connector	(1 piece)	**369640/8**



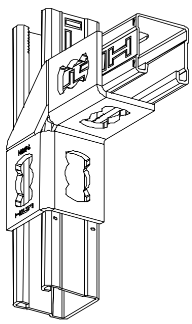
MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W45° angle	(1 piece)	**369695/2**



MQW-2/45°90° angle	(1 piece)	**369662/2**



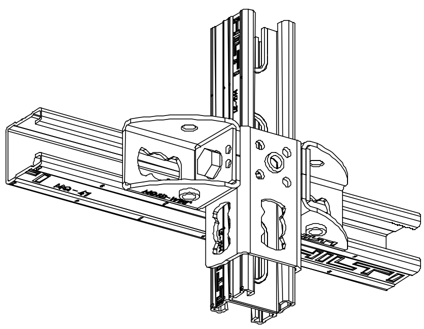
MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W90° angle	(2 pieces)	**369695/2**



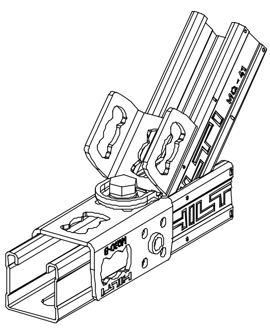
MQW-4 angle	(1 piece)	**369658/0**

Guide for applications with the new 3D system

New 3D system

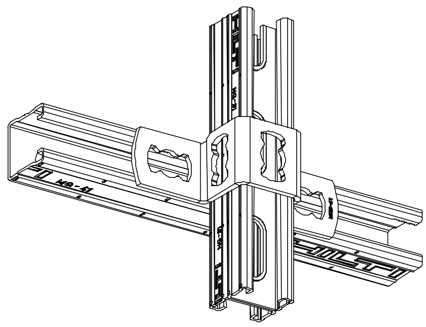


MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W90° angle	(2 pieces)	**369695/2**

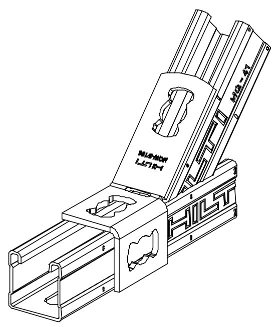


MQ3D-B basic part	(1 piece)	**369694/5**
MQ 3D-W45° angle	(1 piece)	**369695/2**

Existing system:



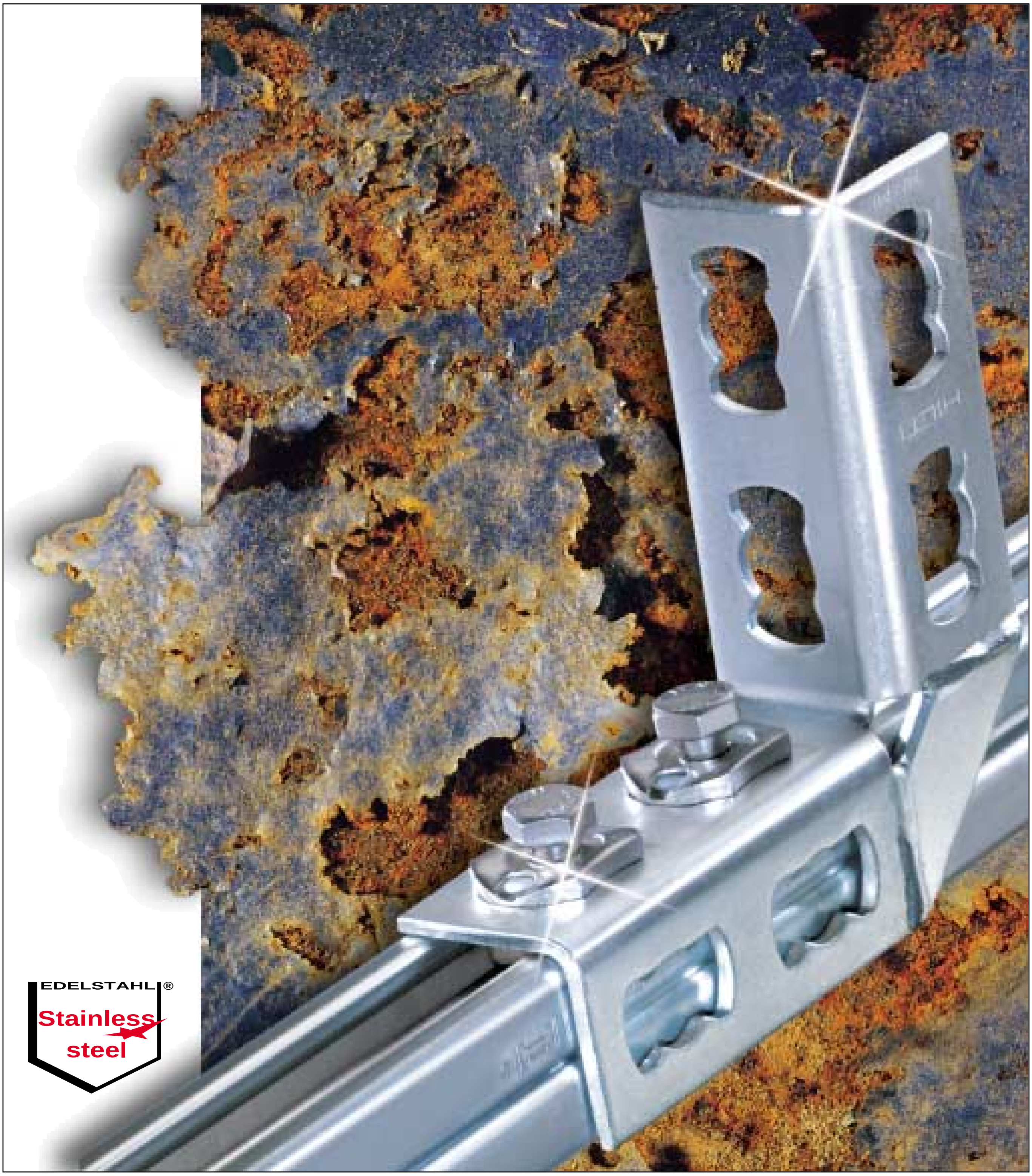
MQB-41 clamp	(1 piece)	**369668/9**



MQW-3/135° angle	(1 piece)	**369663/0**

User Information
about stainless-steel Hilti MN Channel Installation System

- General information about stainless steels
- Tips for ideal use
- Use and processing
- Welding and suitable follow-up treatment
- Professional maintenance



Miscellaneous / Introduction

Steel is one of the most versatile materials. Its mechanical, physical and technological properties are excellent. Its design and artistic possibilities are virtually unlimited. No difficulties arise when it is processed or worked, e.g. cold formed, machined, welded, riveted, screw fastened, etc., provided that this is done with expertise. These are all merits that stainless steel shares with steel, but the former material offers even more benefits.

Stainless steel owes its resistance to corrosion to a simple chemical reaction: the chromium in stainless steel combines with oxygen in the air, or also in water, and a film of oxide forms on the steel surface - a so-called passive layer. It can resist many corrosive substances. Even if damaged by an external influence, it reforms in a fraction of a second from the matrix of the steel, and can inhibit or stop further corrosive attack (repassivating behaviour). This, however, is only possible if the microstructure (grain structure) and surface of building components used are in perfect condition.

The resistance to corrosion comes primarily from the chromium content. It can be improved by adding nickel and molybdenum, or other alloying elements. In view of this, a large variety of stainless steels exist today which, being very specific alloys, are, so to speak, "tailor made" for certain applications..

Over wide ranges, the temperature resistance of stainless steels is excellent. Austenitic chromium-nickel steels remain tough (ductile but hard) even at temperatures close to absolute zero.

Not only do stainless steels have good resistance to corrosion, but these materials also possess excellent mechanical properties. Their stiffness is very high. In addition, their strength can be increased by cold working (strain hardening), e.g. bending up edges and shaping. Stainless-steel Hilti channels also benefit from this..

Hilti channels made of stainless steel

Stainless steel grades 1.4301 and 1.4571 are used for channels in the Hilti channel installation system for user cost-benefit reasons. These two materials in the A2 and A5 (formerly A4) class can cover a large number of applications in moderately to medium corrosive surroundings. Both materials used are austenitic stainless steels which have different chemical constituents and, thus, different resistance to corrosion.

Table 1: * Materials used by Hilti for stainless-steel channels

Material no.	DIN	AISI	Steel grade	
1. 4301 *	X5 CrNi 18 10	304	A2 (DIBT)	
1. 4401	X5CrNiMo 17 12 2	316	A4 (DIBT)	Approx. 2% Mo
1. 4404	X2CrNiMo 17 12 2	316L	A4L (DIBT)	Approx. 2% Mo
1. 4571 *	X6CrNiMoTi 17 12 2	316Ti	A5 (DIBT)	Approx. 2% Mo

The material 1.4301 is an austenitic chromium-nickel steel without any molybdenum content. In principle, the material 1.4571 is a stainless steel in the corrosion resistance class A4 with a content of approx. 2 to 2.5% molybdenum. It is also stabilised with titanium and can thus be readily welded without impairing its resistance to corrosion.

Uses for Hilti installation channels

Steel grades and categories were reclassified in the DIBt general construction supervisory authority approval no. Z-30.3-6 dated August 3, 1999, appendix 2. Accordingly, the materials of Hilti channels are basically suitable for the following uses:

Table 2: General uses for Hilti channels

Class II resistance to corrosion / moderate Accessible structures **with negligible** exposure to chlorides and sulphur dioxide	A2 channels
Class III resistance to corrosion / medium Inaccessible structures **with moderate** exposure to chlorides and sulphur dioxide	A4/A5 channels

In surroundings with a higher chloride content with or without an additional sulphur dioxide content, A2 and A4/A5 channels are not resistant to corrosion. In such conditions, these materials can suffer pitting and, as a later consequence, stress corrosion cracking. More resistant material must then be used. Further information in this respect can be found in the Hilti corrosion brochure. Please ask your local Hilti representative.

The kinds of surroundings (outside atmospheres) given in table 3 typify the macroclimate. In each case, it must be checked to what extent local factors have an influence, e.g. pollution, local heat-up or condensation, depending on wind force and direction (microclimate).

Table 3: Recommendations for outside use of Hilti stainless-steel channels

Type of channel	Atmosphere											
	Rural			Town			Industrial			Coastal		
	N	M	H	N	M	H	N	M	H	N	M	H
A2 (1.4301)	+	+	+	+	+	(+)	(+)	(+)	(–)	+	(+)	(–)
A5/ A4 (1.4571)	x	x	x	x	+	+	+	+	(+)	+	+	+

N = least exposure to corrosion (lowest temperature and humidity)
M = medium exposure to corrosion within the respective surroundings
H = high exposure to corrosion (high temperature and humidity, corrosive air pollutants)

x = basically meets the requirement, also a less-expensive steel can be considered.
+ = probably the best material to select (cost and / or resistance to corrosion)
(+) = sufficient on taking certain precautions, such as a smooth surface, e.g. electropolished, and regular cleaning
(-) = probably heavy corrosion

Table 4 shows recommendations for selecting the right material for Hilti stainless-steel channels which are based on typical inside uses. In general though, each case must be evaluated and the regulations in the DIBt general construction supervisory authority approval no. Z-30.3-6 dated August 3, 1999 observed.

Table 4: Recommendations for inside use of Hilti stainless-steel channels (examples)

Field of application	Hilti A2 (1.4301)	Hilti A5/ A4 (1.4571)
Indoor swimming pools	(–)	(+)(–) Take safety aspects into account
Hospitals	(+) Disinfectants: (–)	x/ + (Caution: disinfectants)
Waste water treatment	(+)(–)	+
Cold stores	+ Disinfectants: (–)	x x
Food industry	(+) Disinfectants: (–)	x

x = basically meets the requirement, A2 channel also possible under circumstances
\+ = probably, the best material to select (cost and resistance to corrosion)
(+) = sufficient on taking certain precautions, such as a smooth surface, e.g. electropolished, and regular cleaning
(-) = probably heavy corrosion
(+)(-) = suitable to unsuitable, depending on where used and safety aspects

Permissible combinations of materials

In use, Hilti installation channels can be in direct contact with many different components, such as connecting structures or fasteners. With this in mind, consideration must be given to the electrochemical potential of the connected materials to allow for contact corrosion. The main factors to be taken into account are:

- the practical electrochemical potential (medium) of the connected materials, and
- the ratio of surface areas of the connected components (total surface area of both components).

Table 5 shows which couples (channel / connector) are unproblematic and which material combinations result in corrosion problems because of their different electrochemical potentials. The basis for this consideration is that water is the medium and the channel used has a surface area at least 20 times larger than the connector used (conditions in field practice).

Caution: Pay attention to the general ratio of the surface areas of the connected components (noble : not noble). Either connect the same materials or keep the total surface area of the more noble material smaller. Often, the most reliable solution is galvanic separation, e.g. using a layer of plastic, etc.

Table 5: Corrosion behaviour of stainless-steel channel with various connecting parts

	Type of channel	
Connecting part	**Hilti A2**	**Hilti A4/ A5**
Galvanised	▲	▲
Aluminium	●	●
Structural (mild) steel	▲	▲
Cast steel	▲	▲
Chromium steel	◆	◆
Chromium-nickel steels, e.g. A2	◆	◆
Chromium-nickel steels, e.g. A4-1.4401, A4L-1.4404, A5-1.4571 or higher grade	◆	◆
Copper	■	■
Brass	●■	●■

◆ no contact corrosion to be expected
■ contact corrosion mainly in the contact area (channel or connecting parts)
▲ heavy corrosion on the connecting part (anchor or connector)
● moderate corrosion on connecting part (anchor or connector)

Recommendations for use

Storage and transport

The as-delivered condition of Hilti stainless-steel channels is excellent. In order to keep this ideal condition until channels are used, particular care must be exercised during transport and storage. Direct contact with steel parts or similar, for instance, must be avoided, e.g. rubbing, fretting, etc. The channel may not, for example, be pulled over loading ramps or carried on fork lifters without putting some form of protection like cardboard, timber or rubber on the forks. During storage the channels should be covered to prevent ferrite dust from settling on them. Also, when channels are on a jobsite, care must be taken to keep them free from unnecessary fouling, particularly, for example, from sparks from an angle grinder. Time and again, unacceptable impairment of the appearance of channels occurs in the form of red rust caused by foreign matter on the surface. In conducive surroundings (mediums), foreign particles of ferrous matter and mechanical damage can lead to pitting and crevice corrosion, then, as a consequence, to stress corrosion cracking (reduction in the resistance to corrosion).

Connection of Hilti stainless-steel channels

- **Nut-and-bolt / screw connection:** Commercially available nuts, bolts, screws, etc., in the same strength class, i.e. as per DIN 267 part 11, and with the same resistance to corrosion should be used on principle, e.g. material 1.4301 for A2 channels and 1.4401 for A4/A5 channels.
- **Welding:** With few restrictions, fusion and pressure welding processes can be used. Stainless steel must be welded by someone with the required skill and expertise. Care must be taken to ensure that the weld is continuous and completely closed without any design-related crevices.

Table 6 gives several physical properties important to know prior to welding Hilti stainless-steel channels.

Table 6: Physical properties of Hilti channel material

Type of channel	Thermal expansion between 20 and 100° C 10^{-6}*K^{-1}	Thermal conductivity at 20° C W/(m*K)	Electrical resistance at 20° C Ω*mm^2/m
A2 (1.4301)	16.0	15	0.73
A5/ A4 (1.4571)	16.5	15	0.75

If an austenitic stainless steel, as used for A24/A4 channels, is kept in a temperature range between approx. 500° to 800°C, as, for instance, when welding, chromium depletion can take place at grain boundaries in the microstructure. If, afterwards, the metal is in a suitable medium, this can result in intercrystalline corrosion, so-called weld decay. Remedies would be to reduce the carbon content in the steel to below 0.03%, or to use a stabilised steel like that of the Hilti A4/A5 channel, i.e. the material 1.4571 as per DIN. (See the Hilti corrosion brochure in this respect.) This is why the Hilti A4/A5 channel is very suitable for welding.

The result when welding all types of stainless steel depends to a great extent on the preparatory work prior to welding. The following should be observed without fail:

- cleanliness of the weld seam edges
- no oxide, no scale (separating process)
- no grease, no oil, no organic substances (risk of carbonising and inclusions)

When cleaning weld seams, only brushes with stainless-steel wires may be used. If cleaned chemically, only approved solvents may be used.

Welding additives:

In general, Hilti channels can be welded using the same types of additives without any problems. Further details can be found in DIN 8556.

Follow-up treatment of welds:

- **Brushing:** Only commercially available stainless-steel brushes that have not been used to clean other materials are acceptable. Brushing can be sufficient if it completely removes oxide layers and slag / scale remainders.

- **Grinding and polishing:** When grinding welding seams, care must be taken to ensure that what is used for grinding contains no ferrous material (risk of foreign matter causing rust). Excessive pressure should not be applied. There should be no discoloration caused by heat and no scoring by the grinding disc. The disc grit size should normally be between 180 and 240 or finer depending on the work being done. Surfaces that have to be especially smooth must be polished mechanically in addition. Pickling must be carried out additionally if there is a risk of stress corrosion cracking in surroundings containing chlorides.
- **Blasting:** For a blasting treatment of stainless steel, quartz sand, glass beads and other mineral or synthetic blasting substances containing no ferrous material should be used. Pickling and passivating must be carried out additionally if there is a risk of stress corrosion cracking in surroundings containing chlorides.
- **Pickling:** First, bad contaminants like grease and oil must be removed. Pickling can take the form of dipping and spraying or the use of paste and gel. In this respect, the pickling agent manufacturer's instructions must be observed. If more stringent requirements regarding corrosion resistance have to be met, subsequent passivation in nitric acid is necessary. Thorough rinsing in water is then always essential. No traces of the pickling agent may remain, most importantly not in crevices.

Processing

■ Suitable cutting method

Sawing and cutting: A circular saw, hack saw, band saw, jig saw or a hand saw can be used to cut stainless-steel Hilti channels. Only HSS saw blades with fine teeth should be used. If a hack saw is used, the blade should always be lifted when it is drawn back (risk of strain hardening). Commercially available nylon or diamond discs are suitable for cutting, especially thin-walled components.

■ Machining

Drilling and thread tapping: Tools made of high-speed steel (HSS) or TiN-coated tools are required for drilling or tapping.

■ Surface treatment and coating

Painting and coating: Although, basically, it is possible to paint stainless-steel Hilti channels, this should be avoided. This is because coatings that are only "more or less impervious" can, in a corrosive atmosphere, have a detrimental effect on the repassivating behaviour of the surface at pervious zones of the coating. The good resistance to corrosion of Hilti A2 and A4/A5 channels might thus be impaired. The usual treatment of, for example, cut edges and weld seams with zinc paint or zinc spray is not necessary or does not bring the desired effect. A suitable after-treatment of the worked surfaces is sufficient.
Electroplating: In special cases when particularly smooth surfaces, good maintenance and cleaning capability, improved resistance to corrosion or a bright appearance are specified, it might be necessary for the channels to be subsequently electropolished.
Pickling and passivating: Hilti channels of A2 and A4/A5 stainless steel meet the requirements for protection against corrosion in the general construction supervisory authority approval Z-30.3-6 dated August 3, 1999. Additional pickling and passivating is thus necessary only if the channels are reprocessed, the weld seams retreated or the channels maltreated.

■ Special conditions in use

Cleaning: The field of application of Hilti stainless-steel channels is extremely wide. Consequently they can come into contact with a great variety of materials and substances. In the food industry, for example, they can be in contact with traces of blood, grease, flour, starch, sugar, proteins, urine, faeces, etc. These contaminants must be cleaned off regularly. This work is often carried out with high-pressure water jet cleaners, brushes, cloths, etc., at high temperature and with appropriate cleaning and disinfecting agents. The Hilti stainless-steel channels will have a long service life if they are thoroughly washed down afterwards.
Disinfectants: In certain sectors of the food industry, in hospitals, catering, air-conditioned rooms, etc., disinfectants are used additionally. A disinfecting agent is understood to be a substance that is

suitable for combating pathogenic micro-organisms. If they are to be able to kill bacteria, viruses, spores and fungi a disinfectant must be bactericide, fungicide, virucidal and sporicidal, i.e. microbicidal. Owing to the many-facetted requirements that disinfectants have to meet, only few substances can be considered. Depending on the purpose, they are primarily aldehydes, phenol derivates, ammonium compounds, chlorine and iodine as well as substances with active oxygen (hydrogen peroxide or peracetic acid). Where disinfectants are employed, we recommend the use of Hilti channels made of A4/A5 steel. As substances are concerned here that can attack the channel material, subsequent thorough washing down becomes especially important. Remaining traces of disinfectants can be highly corrosive and considerably shorten the service life of channels. Hence, thorough washing down with water must be carried out, especially crevices and gaps.

In this brief guide, only subjects and questions have been dealt with which seemed interesting due to repeatedly received queries. Please contact your local Hilti field engineer if any further information is required.

The cleaning and care of Hilti installation systems Information for the user

- General information on cleaning methods and means
- Advice and tips for best cleaning results
- Recommendations for cleaning Hilti products
- Avoiding soiling and contamination

The information provided here represents our recommendations. The soiling or contamination on surfaces can be manifold. It is therefore recommended that each problem is treated individually and, if necessary, the most suitable solvent or cleaning method determined by conducting tests. This applies, in particular, when the type of soiling or contamination has not been precisely identified.

1. Introduction

The surfaces of metal components must, as far as possible, be kept free from soiling or contamination for reasons of appearance but also to ensure that corrosion protection characteristics remain effective under the conditions in which the component is to be used.
A difference must be drawn between the following types of soiling or contamination:
- Those resulting from the manufacturing process
- Those occurring after leaving the production facility

In accordance with present levels of technology, Hilti installation components leave the production facility in faultless condition. Accordingly, the information in this brochure applies only to the cleaning or removal of "soiling or contamination" on galvanised components and residues, etc., on stainless steels. Not all types of soiling or contamination which occur in practice can be covered by this brochure. Our recommendations are therefore restricted to the cleaning tasks which, according to practical experience, are faced most frequently. The recommendations listed apply exclusively to components of Hilti installation systems, such as channel, pipe rings, fittings and connecting parts, etc.

Note
The pickling, cleaning, coating, etc., of fastening components such as anchors and studs, etc., is not permissible.

2. General information

According to DIN 50 902, cleaning is a general term used to describe the removal of undesired substances from a surface. Such substances can be very complex and, as a result, their removal requires various processes. They can be split roughly into two groups:
- Substances that adhere only physically to metal surfaces, i.e. with no chemical bond (e.g. oil, grease, dust, metal rubbings, metal cuttings, grinding agents, etc.)
- Substances bonded chemically to the metal (e.g. oxides, scale or products of corrosion)

From this breakdown into groups, the following definitions for the cleaning of metal surfaces result:
a) Degreasing metal: Removing oil and grease residues
b) Cleaning metal: Degreasing and removal of adherent mechanically-bonded soiling or contaminants
c) Pickling: The removal of chemically-bonded soiling or contaminants, such as the products of corrosion or other covering layers through the effect of acids, mixtures containing acids, alkalis or molten salt.

In practice, however, clear separation in categories is not always possible. Further differentiation results from the type of soiling or contamination which, for the most part, depends on where and how it occurred. When the causes are known, they have a decisive influence on the choice of cleaning methods and means.

The type of material, its surface and the form of object to be cleaned (cracks or gaps etc., due to design) greatly influence the choice of cleaning method and means. The type and degree of soiling or contamination is also of decisive importance for selection of the means and method of cleaning. Should the surface be very heavily soiled or contaminated, the use of brushes or similar (with a machine or by hand) may be necessary in addition to the cleaning agent or solvent applied.

Suitable steps must be taken to ensure personal safety before each cleaning operation (ventilation, use of protective clothing, etc.). Environmental protection regulations (e.g. water pollution control) must be observed. Particularly when cleaning operations are carried out on the construction site, special attention must be paid to preventing possible negative effects on the neighbouring infrastructure (building, etc.) as a result of the use of chemical agents (observe safety data sheets!). Complex and problematic pickling and cleaning processes should not be carried out on construction sites. Such processes should be left up to companies with the required facilities (water disposal, etc.) and the necessary experience and specialist knowledge.

Today, ecologically acceptable cleaning agents which are harmless to humans and animals and environmentally compatible, are available for most cleaning tasks.

Generally speaking, the surface of the component after cleaning or degreasing, etc., should be in a condition suitable for its intended use, with no negative impact on the material's characteristics (e.g. material embrittlement, etc.). Before each application of a cleaning or degreasing agent, the user is therefore required to ensure that the component's characteristics, necessary for the conditions under which it is to be used, remain unaffected.

2.1 Chemical cleaning agents

Cleaning agents can be grouped according to their chemical properties: aqueous cleaners, solvent-based cleaners and mixed systems (usually cleaning emulsions).

2.1.1 Aqueous systems

Systems of this kind are usually supplied as a concentrate (powder or liquid to be diluted with water) but may also be supplied ready to use. They contain surface-active substances (surfactants) and organic or inorganic skeletal substances (builders). These cleaning agents can be grouped according to their pH values or, respectively, typical composition:

- Highly acidic cleaners (pickling agents, pH < 3)
- Acidic phosphate cleaners (pH 4.5–5.5)
- Neutral cleaners (pH 7.5)
- Alkaline cleaners (pH > 8)

2.1.2 Solvent-based cleaners

Solvents are chemicals and must thus be handled carefully. The solvent-based cleaners consist almost exclusively of solvents and, as a rule, contain only very small quantities of additives (e.g. stabilisers). Solvents generally remove organic soiling or contaminants quickly and completely. Examples of solvent-based cleaners are: halogenated hydrocarbons, hydrocarbons, alcohols, glycols, polyglycols, ether, glycolether, ketone, ester and glycolester.

In the past, organic solvents of almost all kinds were used without hesitation to remove adhesives as well as vegetable, animal and mineral greases and oils, etc. In the meantime, many of these substances such as the CFCs have been banned by legislation due to the damage they cause to the environment. Today, a wide range of ecologically acceptable solvent-based cleaners are available.

2.1.3 Mixed systems

Systems of this kind, for example, can be diluted water-based solutions containing short-chain alcohol compounds with a few additives. As a rule, emulsion cleaners are emulsions of mineral oil or solvents in water (alcohol cleaners, emulsions with a mineral oil / solvent base, micro-emulsions).
Please refer to section 4: "Recommendations for cleaning Hilti products" for examples.

2.1.4 Criteria relevant to the choice of system

The choice of cleaning system or cleaning method are influenced greatly by a number of criteria.

2.1.4.1 Material

As reaction of the metal with the cleaning agent is not permissible, or permissible only to the desired degree, the choice of a suitable cleaning system (chemical characteristics) is often very limited. Rust on steel, white rust on galvanised surfaces, discolouration of aluminium or copper, etc., are only a few of the points to be considered.

2.1.4.2 Soiling or contamination

Generally speaking, the soiling or contaminants on metal surfaces can be classified roughly according to their ease of removal by cleaning agents.

a) Organic
- Soluble in solvents
- Soluble in aqueous systems, pH 4–14
- Soluble in acids, <pH 4

b) Inorganic
- Insoluble in solvents
- Insoluble in aqueous systems, pH 4-14
- Soluble in complexing aqueous systems, pH 4-14
- Soluble in aqueous systems, pH 4-14
- Soluble in acids, <pH 4
- Insoluble in acids, <pH 4

c) Soiling or contamination in the form of particles
- Insoluble in water or solvents
- Lightly adherent, can be removed with solvents and water
- Firmly adherent, can be removed with special aqueous solutions
- Very firmly adherent, removable only by mechanical means or dissolution of the base material

It is therefore necessary, or at least always sensible, to conduct prior tests.

2.1.4.3 The form and quantity of components

The shape or form of the components to be cleaned can, in many cases, have a great influence on the choice of the most suitable cleaner. Narrow cracks or gaps and blind holes, etc., may make use of solvents necessary. When the quantities involved are large, it is often advisable to conduct the cleaning process in suitably equipped facilities.

2.1.4.4 Results and cost considerations

In the end, it is the costs for materials, energy and personnel required for the necessary cleaning balanced against the results of the cleaning operation that determines the cost efficiency of the cleaning process and whether or not it makes good sense.

2.2 Mechanical cleaning

Mechanical processes, for example, serve to clean, de-rust, de-scale and remove coatings from metal components. These processes include sand or shot blasting, sanding, grinding and use of high-pressure cleaning systems. Due to the complexity of the problems faced, mechanical cleaning of the surfaces of metal components, alone, is often not sufficient. Such processes are thus often applied simply as a preliminary step before treatment with chemicals or as a supporting measure in conjunction with "wet" treatment. In many cases, it must be ensured that the personnel carrying out the work exercises the necessary care due to the risk of the mechanical cleaning process having a negative affect on the surface of the components.

3. Recommendations for cleaning processes for Hilti installation components

3.1 Cleaning at the location

Only approved, commercially-available cleaners containing no dangerous substances, such as corrosive acids, etc., may be used for cleaning at the location (construction site, etc.).

3.1.1 Galvanised components

Generally speaking, in order to avoid damage, galvanised surfaces should be cleaned carefully with a pH-neutral or slightly alkaline cleaner (neutral cleaner has pH 7.5). The cleaning process can be accelerated by scrubbing the surface lightly with a soft nylon brush. Acidic (<pH 7) or strongly alkaline cleaners (>pH 9–10) cause dissolution of the zinc layer, thus destroying it and the corrosion protection it provides.

So-called white rust (product of zinc corrosion) on galvanised channel, for example, can also be removed with a slightly alkaline cleaner (up to max. pH 9). This, nevertheless, results only in a short-term "improvement" of appearance as protection from corrosion is, on the whole, negatively affected due to removal of some of the zinc layer. Coating the clean surface (e.g. plastic coating) subsequent to the cleaning process is often successful in achieving a long-term improvement.

In many cases, where the galvanised surface is badly corroded and parts of the underlying material are also corroded (red rust), only complete removal of the zinc layer and areas of corrosion followed by subsequent regalvanisation can be successful in achieving the desired result. Repairs to the surface, by applying zinc spray or thermal spray-galvanising with appropriate pre-treatment (cleaning, rust inhibitor, mechanical pre-treatment, e.g. sand or shot blasting of large components), are also possible.

Where cleaning tests on the spot do not achieve the desired results or are not possible, it is often necessary to subject the components to complete cleaning or removal of the zinc layer followed by regalvanisation at a facility equipped for this work. High-strength parts (screws, etc.), however, should not be subjected to wet chemical treatment such as pickling in acids, etc. Treatment of this kind may cause embrittlement of high-strength components or fastening system parts in general.

3.1.2 Stainless steels

Generally speaking, soiling or contaminants of all kinds can be removed easily from the austenitic stainless steels used by Hilti (see table of recommendations in section 4). In many cases where, for example, foreign material such as rust particles adheres or has even been pressed into the surface of the material, only complete cleaning (e.g. pickling) in a state-of-the-art process (pickling medium, pickling time, rinsing operations, etc.) can lead to success. Information on how to handle Hilti stainless steel installation systems can also be found in the Hilti brochure "Information for users of the Hilti stainless steel MN channel system".

3.2. Complete (commercial) cleaning

In the event of special complete cleaning and surface treatment processes being necessary, this may be carried out only after consultation with a Hilti technician at the location. Incorrect or unsuitable treatment may cause serious damage to the corresponding components, causing a change in their characteristics and suitability for the intended purpose.

3.2.1 Pickling

In general terms, pickling is understood to be the removal of bonded non-metallic products of corrosion, such as oxides and other covering layers, through the action of acids and alkaline solutions. Also the dissolution of particles of foreign material, e.g. iron, on the surfaces of stainless steels is known as pickling. This type of "surface cleaning", in most cases, cannot be applied on the construction site and is thus carried out in special pickling baths and facilities. The pickling of Hilti stainless steel components in baths, etc., should be seen as a last resort when all other cleaning processes have failed to achieve the desired results. This process generally requires trained specialist personnel.

3.3 Influence on the material to be cleaned

Special acids and strong alkalis attack the zinc layer and destroy its corrosion protection.

Organic solvents can attack and permanently damage plastic parts (rubber, etc.). The use of mechanical cleaning methods for Hilti products is subject to certain restrictions. Processes such as shot blasting, which can affect surface hardness, may be used only after prior consultation.

3.4 The influence of shape and form on the cleaning process

On parts designed to have blind holes and gaps, etc., there is a risk of cleaning agent residues remaining and consequently leading to corrosion. The suitability of the cleaning process to be applied should thus also be considered from this point of view.

3.5 Requirements concerning the degree of cleanliness of parts

Special requirements concerning the surface condition or finish of metal parts (roughness, freedom from silicones, etc.) exist for certain areas of application, such as in the chip industry and in clean rooms, etc.

The components often have to be supplied with electro-polished surfaces in order to meet these special requirements. The Hilti technician at your location can provide special solutions of this kind.

Generally speaking, for applications in the chip industry, etc., where silicone-free surfaces are demanded, substances of this kind should be avoided during the manufacturing process. Lubricants containing silicone are often very difficult to remove.

The wetability (degree of cleanliness) etc., of a surface can be tested or, respectively, categorised by way of suitable commercially-available means, such as brush-on solutions or special felt-tip pens.

4. Recommendations for cleaning Hilti products

S = acidic
A = alkaline up to approx. pH 9–10
M = mechanical
N = neutral
L = solvent

To be removed	General recommendations			General recommendations and commercially-available products
	Electro-chem. galvanised	Hot-dip galvanised	Stainless steel	
Dirt and dust	N	N - A	N, S, A, L	N = soap, neutral cleaner possibly with soft cloth or with aid of soft synthetic bristle brush S = e.g. Metaflux 75–35 A = e.g. Metaflux 75–32 A (zinc): Metaflux 75–37 L = e.g. Metaflux 75–58
Soot	N - A	N - A	N, S, A, M	N = soap, neutral cleaner possibly with soft cloth or with aid of soft synthetic bristle brush S = e.g. Metaflux 75–35 A = e.g. Metaflux 75–32 A (zinc): Metaflux 75–37 M = e.g. High pressure cleaning system
Greases, oils	N	N - A	A, N, L	N = soap, neutral cleaner possibly with soft cloth or with aid of soft synthetic bristle brush A = e.g. water, surfactants*, phosphate, ammonia solution, or A = e.g. Metaflux 75–32 A (zinc): Metaflux 75–37 L = e.g. Metaflux 75–58
Emulsions, coolants/lubricants	N - A	N - A	A, S	N = soap, neutral cleaner possibly with soft cloth or with aid of soft synthetic bristle brush A = e.g. water, surfactants*, phosphate, ammonia solution, or A = e.g. Metaflux 75–32 A (zinc): Metaflux 75–37 S = e.g. Metaflux 75–35
Cement, mortar, lime, plaster and concrete	A, M	A, M	S (no chlorides!)	S = commercially-available acidic cleaners containing e.g. phosphoric acid, amidosulphuric acid, citric acid and constituents: surfactants*, water and fragrances S = e.g. Metaflux 75–35 A = e.g. Metaflux 75–37 M = soft brush or similar
Areas of rust, oxidation, scale	White rust A	White rust A	S (no chlorides!)	S = e.g. Metaflux 75–50 (gel-type cleaner) A = Metaflux 75–37 or Metaflux 75–32 briefly
Rubber (from abrasion)	L	L	L	L = e.g. Metaflux 75–34
Grinding and polishing pastes	N	N	N	N = water and soap, possibly Metaflux 75–37
Paint splashes etc.	L, M	L, M	L, S, M	S = e.g. Metaflux 75–35 L = e.g. Metaflux 75–34 M = cloth, mop
Silicone (fresh), sealants, graffiti, bitumen, felt-tip pen, chewing gum etc., adhesive remains, adhesive tape	L	L	L	L = Metaflux 75–34
Industrial precipitation	N - A	N - A	A	N = soap, neutral cleaner possibly with soft cloth or with aid of soft synthetic bristle brush A = e.g. Metaflux 75–32 A (zinc): Metaflux 75–37
Earth	N	N	N	N = soap and water (neutral)
Clay	N	N	N	N = soap and water (neutral)
Algae, moss	–	–	L	S = e.g. Metaflux 75–30
PU foams (before curing)	L	L	L	L = Metaflux 75–34
Waxes	L		L	L = Metaflux 75–34

*Surfactants, also known as wetting agents, are chemical compounds that exist in oil-soluble and water-soluble forms. They are important constituents of aqueous cleaners as they improve surface wetting, displace and bind oil films by stabilising emulsions and disperse dirt in particle form.

With the exception of applications where water-insoluble solvents are used, careful rinsing with water is always necessary.

5. Avoiding soiling or contamination

All foreign materials that adhere firmly to metal surfaces and change their characteristics are considered to be soiling or contamination. A few basic technical or organisational measures, that may help to avoid unnecessary soiling or contamination of components, are listed below.

Cutting, drilling and machining, etc.
- A dry process should be used as far as possible (there are some newly-developed processes worth considering).
- Avoid lubricants and coolants that are difficult to remove (e.g. silicone).
- Where several steps in a process must be carried out consecutively, use only lubricants and coolants of a related type (removal in one cleaning operation?).

Material and design
- Avoid rough surfaces (adherence of dirt).
- Avoid narrow gaps, blind holes and undercuts.

Intermediate storage and transport
- Choose suitable means of packaging (e.g. take dampness during shipment by sea into account).
- Do not store outdoors unprotected.
- Do not store in manufacturing facilities, or only for a short period. Oily dust deposits are very difficult to remove.
- The same also applies to construction sites: Do not store unprotected parts in areas where work is carried out (concrete dust and dusts of all kinds, e.g. metal dust, etc.).
- Do not apply adhesive tape directly to the metal surfaces (e.g. use a cardboard underlay).
- Adequate cleanliness and tidiness should be ensured at all times.

Unnecessary subsequent cleaning operations can be avoided when such measures are applied, leading to significant cost savings.

5.1 Reasonable avoidance

Cleaning measures should, overall, contribute towards reducing costs. In the case of measures which form part of the manufacturing "philosophy", this is no problem. Other measures designed to avoid soiling or contamination, may well lead to additional costs. Special attention must thus always be paid to the degree in which the measures contribute towards reducing total costs.

An important complex question primarily concerns the desired or necessary state of the surface. The following points must be clarified in advance:
1. How clean does the surface have to be.
2. Which consequences do certain soiling or contamination of surfaces have on the component’s suitability for use?
3. How can any soiling or contamination be removed?
4. Costs / ecological aspects, etc.

In isolated cases, cleaning may well be less costly than the corresponding measures necessary to avoid soiling or contamination.

Test reports:
Firestop: Channel and pipe rings

MATERIALPRÜFANSTALT FÜR DAS BAUWESEN
INSTITUT FÜR BAUSTOFFE, MASSIVBAU UND BRANDSCHUTZ

iBMB
MPA Brunswick

Materialprüfanstalt für das Bauwesen
Hilti Corporation
Installation Systems BU / North Office
FL-9494 SCHAAN

Attention of Mr. R Loose / NETI / HEG

Your ref.	Your letter dated	Our ref.	Specialist	Tel. ext.	Date
NETI	30.8.2001	124/01 -Nau-	RR Dipl. Ing. Nause	5475	24.9.2001

Test report no. 3829/5270 -Nau- dated March 23, 2001 about behavior in a fire of Hilti MN channel installation system with MS-41, MS-41 D and MS-62 D channels in conjunction with MG baseplates and MSA pipe ring saddles

Here: Supplementary document about equivalence of MQ channel installation system from a fire prevention (firestop) aspect

Dear Mr. Loose,

In response to your enquiry about the equivalence of the MQ channel installation system from a fire prevention (firestop) point of view when compared with the MN channel installation system, we can inform you that in-house fire tests have been carried out in this respect. On the basis of the test results obtained, no second thoughts whatsoever exist from a technical fire prevention point of view about taking over the max. loads for duration of resistance to fire (fire ratings) of 30 to 120 minutes as well as the design / structural support distances / spans, ls, of 350 mm to 700 mm in accordance with tables 3 to 6 (see test report no. 3829/5270, pages 13 and 14) for the MQ-41/3, MQ-52, MQ-72, MQ-41 D, MQ-52/72 D, MQ-124X D and MQ-F-124X D channels when fastened with threaded rods, bolts or anchors of a size equal to or larger than M10 used in conjunction with MQZ-L baseplates and MQA pipe ring saddles with cast nuts of the M10 to M16 size.

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Furthermore, there are no second thoughts about taking over the max. loads for duration of resistance to fire (fire ratings) of 30 to 120 minutes in accordance with tables 3 to 6 when the application takes the form of brackets in accordance with fig. 3 (see test report no. 3829/5270, page 7) for channels equal to or smaller than MQ-41.

Special note:
This evaluation of the equivalence from a fire prevention aspect of the MQ channel installation system in comparison with the MN channel installation system as well as the MQA pipe ring saddles with cast nuts in comparison with the MSA pipe ring saddles applies only if the marginal conditions given in sections 2, 4 and 5 of test report no. 3829/5270 -Nau- dated March 23, 2001 and the marginal conditions given in the applicant's technical data sheets are allowed for.

This evaluation of the MQ channel installation system is valid only in connection with base materials which can be classified with at least the same fire rating corresponding to the duration of resistance to fire of the channel systems.

This supplementary document is valid only when read with test report no. 3829/5270 -Nau- dated March 23, 2001.

The validity of this supplementary document ends with end of validity of the test report.

We trust the information will be of assistance to you.

Yours faithfully,

Director on behalf

RR Dipl. Ing. Nause
Deputy Department Manager

MATERIALPRÜFANSTALT FÜR DAS BAUWESEN
INSTITUT FÜR BAUSTOFFE, MASSIVBAU UND BRANDSCHUTZ

iBMB
MPA Brunswick

Test Report

No. 3829/5270 -Nau- (March 23, 2001) 1st. issue

Applicant: Hilti Corporation
Installation systems BU / North Office
FL-9494 Schaan

Application dated: April 13, 2001 Ref.: verbal Received:-

Content of application:
Testing of behavior in a fire and evaluation of exposed...

Hilti MN channel installation system with MS-41, MS-41 D, MS-62 and MS-62 D channels used in conjunction with MG baseplates and MSA pipe ring saddles...

to determine duration of resistance to fire (fire rating) in keeping with DIN 4102-2:1977-09.

Receipt of test material: 51st. CW 1996 to 44th. CW 1998
Sampling: Information about official sampling of the supplied materials is not available to the testing station.
Marking: none

The test report consists of 16 pages and 16 appendices.

The validity of the test report ends on March 23, 2003.

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Evaluation of test results

On the basis of the test results obtained and given in the above-mentioned test report, corresponding fire ratings (duration of resistance to fire) in accordance with the following tables 1 to 4 and depending on the max. loading can be assigned to the Hilti MN channel installation system, made of either galvanized steel or A4 stainless steel, with the MS-41, MS-41 D, MS-62 and MS-62 D channels when fastened with threaded rods, bolts or anchors of a size equal to or larger than M10 in conjunction with MG baseplates and MSA pipe ring saddles.

Table 1: Max. loads for Hilti channel installation systems using MS-41, MS-41 D, MS-62 and MS- 62 D channels fastened with threaded rods, bolts or anchors of a size equal to or larger than M10 when used in conjunction with MG baseplates and MSA pipe ring saddles for a fire rating of 30 minutes

Fire rating		F30							
Installation channels		MS-41, MS-41 D, MS-62, MS-62 D							
Fastening means		M10 or M12 anchor / threaded rod with MG-11 or MG13 baseplates							
Type of fastening		suspended	direct	suspended	direct	suspended	direct	suspended	direct
Structural span	≤ (cm)	35		50		60		70	
Total uniform load	≤ (kN)	3.00	–	2.00	–	1.70	–	1.50	–
1 single load of	≤ (kN)	1.30	1.80	0.85	1.50	0.70	1.30	0.60	1.10
2 single loads of	≤ (kN)	0.75	1.20	0.50	0.95	0.40	0.80	0.35	0.70
3 single loads of	≤ (kN)	0.50	0.90	0.35	0.70	0.30	0.62	0.25	0.51
4 single loads of	≤ (kN)			0.30	0.58	0.24	0.50	0.20	0.42
5 single loads of	≤ (kN)	–		–		0.20	0.42	0.17	0.35
6 single loads of	≤ (kN)					–		0.15	0.30

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Table 2: Max. loads for Hilti channel installation systems using MS-41, MS-41 D, MS-62 and MS- 62 D channels fastened with threaded rods, bolts or anchors of a size equal to or larger than M10 when used in conjunction with MG baseplates and MSA pipe ring saddles for a fire rating of 60 minutes

Fire rating		F60							
Installation channels		MS-41, MS-41 D, MS-62, MS-62 D							
Fastening means		M10 or M12 anchor / threaded rod with MG-11 or MG13 baseplates							
Type of fastening		suspended	direct	suspended	direct	suspended	direct	suspended	direct
Structural span	≤ (cm)	35		50		60		70	
Total uniform load	≤ (kN)	1.60	–	1.10	–	1.00	–	1.00	–
1 single load of	≤ (kN)	0.70	0.95	0.50	0.80	0.42	0.70	0.42	0.60
2 single loads of	≤ (kN)	0.40	0.60	0.30	0.50	0.25	0.44	0.25	0.38
3 single loads of	≤ (kN)	0.25	0.45	0.20	0.38	0.18	0.33	0.18	0.28
4 single loads of	≤ (kN)			0.16	0.31	0.14	0.27	0.14	0.23
5 single loads of	≤ (kN)	–		–		0.11	0.22	0.11	0.19
6 single loads of	≤ (kN)					–		0.10	0.16

Table 3: Max. loads for Hilti channel installation systems using MS-41, MS-41 D, MS-62 and MS- 62 D channels fastened with threaded rods, bolts or anchors of a size equal to or larger than M10 when used in conjunction with MG baseplates and MSA pipe ring saddles for a fire rating of 90 minutes

Fire rating		F90							
Installation channels		MS-41, MS-41 D, MS-62, MS-62 D							
Fastening means		M10 or M12 anchor / threaded rod with MG-11 or MG13 baseplates							
Type of fastening		suspended	direct	suspended	direct	suspended	direct	suspended	direct
Structural span	≤ (cm)	35		50		60		70	
Total uniform load	≤ (kN)	1.00	–	0.90	–	0.80	–	0.80	–
1 single load of	≤ (kN)	0.40	0.65	0.35	0.50	0.35	0.45	0.35	0.40
2 single loads of	≤ (kN)	0.25	0.40	0.20	0.31	0.20	0.28	0.20	0.25
3 single loads of	≤ (kN)	0.18	0.30	0.14	0.23	0.14	0.21	0.14	0.19
4 single loads of	≤ (kN)			0.11	0.19	0.11	0.17	0.11	0.15
5 single loads of	≤ (kN)	–		–		0.09	0.14	0.09	0.12
6 single loads of	≤ (kN)					–		0.08	0.11

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Page 4 of letter no. 124/01 -Nau- dated September 24, 2001 to the Hilti Corporation, FL-9494 Schaan

Table 4: Max. loads for Hilti channel installation systems using MS-41, MS-41 D, MS-62 and MS- 62 D channels fastened with threaded rods, bolts or anchors of a size equal to or larger than M10 when used in conjunction with MG baseplates and MSA pipe ring saddles for a fire rating of 120 minutes

Fire rating	F120							
Installation channels	MS-41, MS-41 D, MS-62, MS-62 D							
Fastening means	M10 or M12 anchor / threaded rod with MG-11 or MG13 baseplates							
Type of fastening	suspended	direct	suspended	direct	suspended	direct	suspended	direct
Structural span ≤ (cm)	35		50		60		70	
Total uniform load ≤ (kN)	0.80	–	0.75	–	0.70	–	0.70	–
1 single load of ≤ (kN)	0.30	0.60	0.30	0.45	0.30	0.40	0.30	0.35
2 single loads of ≤ (kN)	0.18	0.38	0.18	0.28	0.18	0.25	0.18	0.23
3 single loads of ≤ (kN)	0.12	0.28	0.12	0.21	0.12	0.18	0.12	0.17
4 single loads of ≤ (kN)			0.10	0.17	0.10	0.15	0.10	0.13
5 single loads of ≤ (kN)	–		–		0.08	0.12	0.08	0.11
6 single loads of ≤ (kN)					–		0.07	0.10

Application conditions and restrictions

This evaluation of the Hilti channel installation systems excludes their use for service ducts according to DIN 4102-11:1985-12 as well as cable ducts with integrated maintenance of functioning and cable ducts according to DIN 4102-12: 1998-11. Further evaluation of and verification for the overall system are required for applications of this kind.

In the case of Hilti channel installations suspended in the intermediate area between floor deck undersides and suspended, firestop-relevant ceiling structures, a min. dimension, min. a, which is on the safe side, is defined for the distance from the top edge of the suspended ceiling to the underside of the channel installation (see fig. 1 on page 5) in accordance with the following table 5 (see page 6), in order to avoid any impairment of the ceiling structure resulting from deformation of the channels and changes in length of the threaded rods caused by temperature. To this end, the max. length of suspension by threaded rods, ha, of the channel installation is restricted to less than or equal to 1,500 mm for technical firestop reasons, assuming that no verification of suitability exists.

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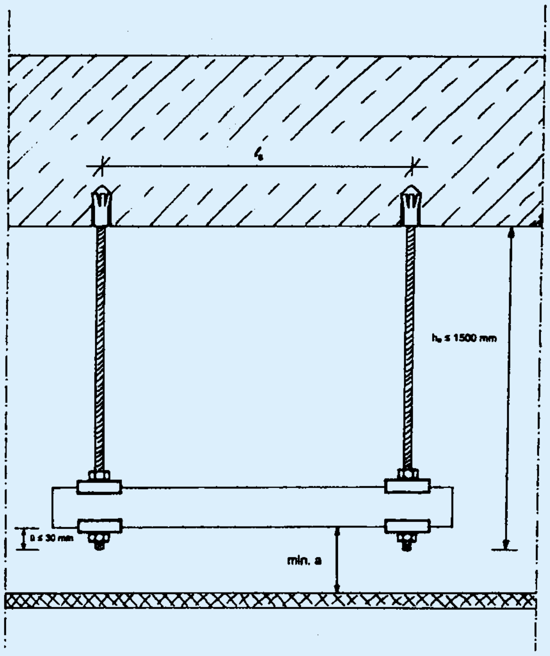
In the following table 5 (see page 6), the min. distances, a, for the individual fire ratings (duration of resistance to fire) are given additionally. The tabulated figures for the min. distances, a, take into account the protrusion of the threaded rods, ü, beneath the channel installation, the heat-induced change in length of the threaded rods used for the suspension and the max. amounts of deflection in the middle of the design (structural) spans

In this respect, it is presumed that the max. protrusion of threaded rods beneath the channels, ü, does not exceed 30 mm. If the protrusion of the threaded rods is greater, the figure, ü, of 30 mm must be added to the min. distances given in table 5.

To be on the safe side with directly fastened channel installations in the intermediate area between floor deck under-side and firestop-relevant, suspended ceiling structures , the figures in table 5 may be used for the min. distances, a.

Deformation caused by pipe rings or other means of fastening attached to the underside, have not been taken into account here and, in individual cases, separate verification must be to be provided in addition.

Fig. 1: Schematic drawing of use of Hilti MS-41, MS-41 D, MS-62 and MS-62 D channels in the intermediate area between floor deck underside and firestop-relevant, suspended ceiling structures



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Page 6 of letter no. 124/01 -Nau- dated September 24, 2001 to the Hilti Corporation, FL-9494 Schaan

Table 5: Min. distances, a, in millimeters, for use of Hilti MS-41, MS-41 D, MS-62 and MS-62 D channels in the intermediate area between floor deck underside and firestop-relevant suspended ceiling structures, depending on design (structural) span widths, ls, 30 mm threaded rod protrusion, ü, beneath channels and suspension heights, hs, for fire ratings of 30 to 120 minutes

Design (structural) span width, ls	[mm]	350			500			600			700		
Suspension height, hs	[mm]	500	1000	1500	500	1000	1500	500	1000	1500	500	1000	1500
Min. a for F30	[mm]	40	45	50	40	45	50	40	45	50	40	45	50
Min. a for F60	[mm]	40	45	50	40	45	50	40	55	60	55	60	65
Min. a for F90	[mm]	45	50	55	60	65	70	65	75	80	75	80	90
Min. a for F120	[mm]	55	65	70	75	80	90	85	95	100	100	110	115

Special notes

This evaluation applies only to the Hilti MN channel installation system, made of either galvanized steel or A4 stainless steel, when using the MS-41, MS-41 D, MS-62 and MS-62 D channels and fastened with threaded rods, bolts or anchors of a size equal to or larger than M10, made either of galvanized steel of a strength class equal to or greater than 5.8 or A4 stainless steel, in conjunction with MG baseplates as well as MSA pipe ring saddles, while allowing for the general conditions in the applicant's technical data sheets.

The evaluation of the MS-41, MS-41 D, MS-62 and MS-62 D channels applies only in connection with base materials which can be classified in at least a fire resistance class corresponding to the fire ratings (duration of resistance to fire) of the channel installation systems.

The validity of the supplement to the test report ends with termination of the validity of the above-mentioned test report no. on March 23, 2003.

Director
RD Dr.-Ing. Wesche

Deputy Department Manager
Dipl.-Ing. Nause

Brunswick, March 23, 2001

MATERIALPRÜFANSTALT FÜR DAS BAUWESEN
INSTITUT FÜR BAUSTOFFE, MASSIVBAU UND BRANDSCHUTZ

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Test Report

No. 3228/0041 -Nau- 1st. issue
(June 22, 2001)

Applicant: Hilti Corporation
Installation systems BU / North Office
FL-9494 Schaan

Application dated: March 9, 2001 Ref.: verbal Received:-

Content of application:
Testing of behavior in a fire and evaluation of...

Hilti MP-M, MP-MR and MP-MS heavy-duty, screw-type pipe rings

under pure tensile loading to determine the duration of resistance to fire (fire rating) in keeping with DIN 4102-2:1977-09

Receipt of test material:	50th. CW 1996 to 34th. CW 1998
Sampling:	Information about official sampling of the supplied materials is not available to the testing station.
Marking:	none

The test report consists of 11 pages and 14 appendices.

The validity of the test report ends on June 22, 2003.

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Page 2 of supplement to test report no. 3228/ 0041 -Nau-

Evaluation of test results

On the basis of the test results obtained and given in the above-mentioned test report, corresponding fire ratings (duration of resistance to fire) in accordance with the following table 1 and depending on the max. pure tensile loading can be assigned to the Hilti MP-M, MP-MI, MP-MIS, MP-MR, MP-MRI and MP-MS heavy-duty, screw-type pipe rings.

Table 1: Fire ratings (duration of resistance to fire) of Hilti MP-M heavy-duty, screw-type pipe rings, used with threaded rods of the min. strength class 5.6 a size equal to or larger than M10, depending on the max. pure tensile loading

	Fire rating (minutes)			
Hilti MP-M, MP-MR and MP-MS heavy-duty, screw-type pipe rings	**30 max. N [kN]**	**60 max. N [kN]**	**90 max. N [kN]**	**120 max. N [kN]**
3/8" to 3"	≤ 1.50	≤ 0.70	≤ 0.40	≤ 0.30
101.6 mm to 6"	≤ 2.25	≤ 1.20	≤ 0.80	≤ 0.70
177.8 to 267 mm	≤ 3.00	≤ 1.40	≤ 1.00	≤ 0.90

Application conditions and restrictions

This evaluation of the Hilti MP-M, MP-MR and MP-MS heavy-duty, screw-type pipe rings excludes their use for cable installations with integrated maintenance of functioning in accordance with DIN 4102-12: 1998-11. More extensive evaluations of and verifications for the entire system are required for applications of this kind.

The Hilti heavy-duty, screw-type pipe rings can be used to fasten non-flammable pipes and, without second thoughts, also flammable pipes with an outside diameter equal to or less than 160 mm with an additional, continuous layer of RS 800 or RS 835 rockwool insulation at least 30 mm thick.

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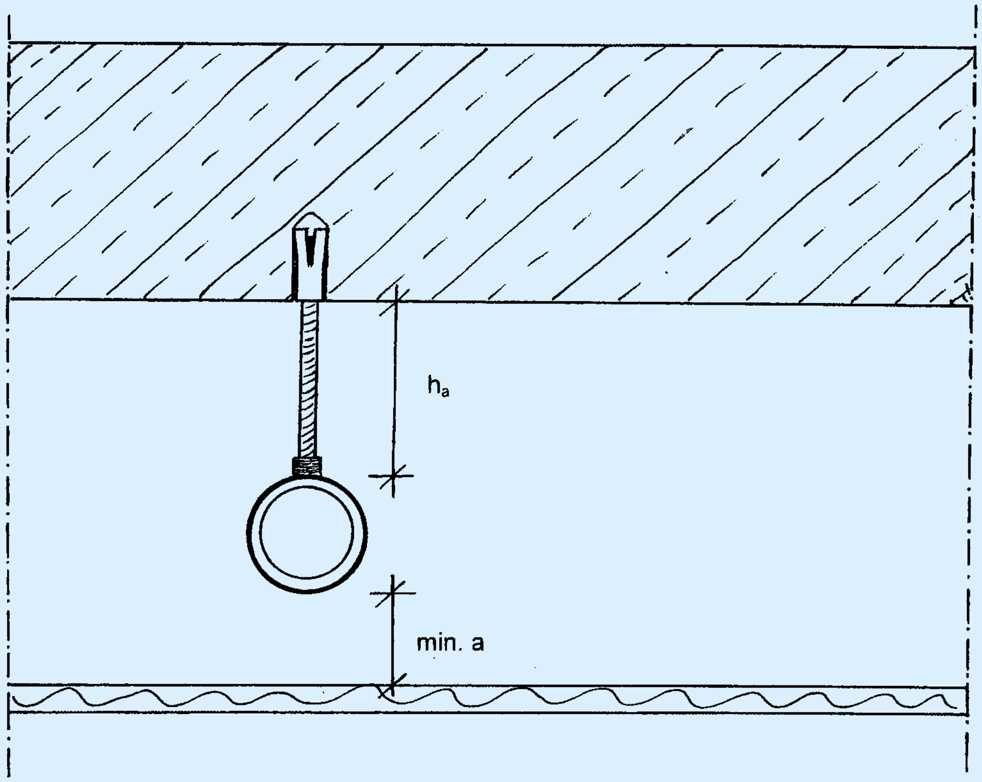
To remain on the safe side, a min. distance, a, from the top edge of the suspended ceilings and to the bottom edge of the pipe rings (see fig. 1) is defined in accordance with the following table 2 (see page 4) for applications with Hilti heavy-duty, screw-type pipe rings when used in the intermediate area between floor deck underside and fire-stop-relevant suspended ceilings in order to avoid any impairment of the ceiling structure by temperature-induced vertical deformation of the pipe rings and changes in length of the threaded rods. To this end, the max. suspended height of the pipe ring structure, ha, when using threaded rods is restricted to a dimension equal to or less than 1,000 mm for technical firestop reasons, provided that no other verification of suitability is provided.

In addition and on the safe side, the min. distances, min. a, for fire ratings of 30 to 120 minutes are given in the following table 2 (see page 4). The figures given there make allowance for temperature-induced changes in length of the threaded rods used for the suspension and the max. vertical deformation in dependence on the pipe ring clamping range.

Fig. 1: Schematic drawing of an application using the Hilti MP-M, MP-MR and MP-MS heavy-duty, screw-type pipe rings in the intermediate area between floor deck underside and firestop-relevant suspended ceilings



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Page 4 of supplement to test report no. 3228/ 0041 -Nau-

Table 2: Min. distances, min. a, in millimeters, for the use of Hilti MP-M, MP-MR and MP-MS heavy-duty, screw-type pipe rings in the intermediate area between floor deck underside and firestop-relevant suspended ceilings in dependence on the pipe ring clamping range and the suspended height, ha.

	Min. distances, min. a, in millimeters, for fire ratings of 30 to 120 minutes			
	Suspended height, h_a			
Pipe ring clamping range [mm]	≤ 250 [mm]	≤ 500 [mm]	≤ 750 [mm]	≤ 1000 [mm]
15–19	35	38	41	44
20–25	38	41	45	48
25–30	41	45	48	51
32–38	45	48	51	55
40–45	49	52	55	58
48–54	52	55	58	62
54–57	54	58	61	64
57–64	56	59	62	65
68–72	59	62	65	69
70–77	60	63	66	70
80–84	63	66	69	72
82–90	64	66	70	73
97–103	67	71	74	77
108–114	70	73	76	80
114–119	72	75	78	81
122–127	73	76	80	83
125–133	74	77	81	84
132–137	76	79	82	85
137–142	77	80	83	86
150–156	79	82	86	89
156–162	80	83	87	90
162–168	81	85	88	91
175–180	84	87	90	94
190–200	87	90	93	96
210–219	90	93	96	99
217–224	92	95	98	101
242–250	95	98	101	104
267–273	98	102	105	108

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Page 5 of supplement to test report no. 3228/ 0041 **-Nau-**

Special notes

This evaluation applies only to the Hilti MP-M, MP-MR and MP-MS heavy-duty, screw-type pipe rings, made of either galvanized steel or A4 stainless steel, taking into account the general conditions in the applicant's technical data sheets.

The evaluation of the Hilti heavy-duty, screw-type pipe rings applies only in connection with threaded rods of the min. strength class 5.6 and a size equal to or greater than M10 as well as building components which can be classified in at least a fire resistance class corresponding to the fire ratings (duration of resistance to fire) of the screw-type pipe rings.

The validity of the supplement to the test report ends with termination of the validity of the above-mentioned test report no. on June 22, 2003.

Director
RD Dr.-Ing. Wesche

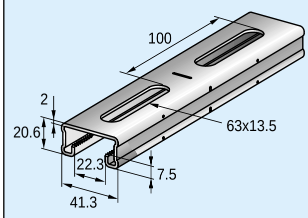
Deputy Department Manager
Dipl.-Ing. Nause

Brunswick, June 22, 2001

Texts for tendering

MQ-21, 3 m

Hilti installation channel, single, MQ system, MQ-21 3m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 21 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 1.44 kg/m, item number 369584/8.

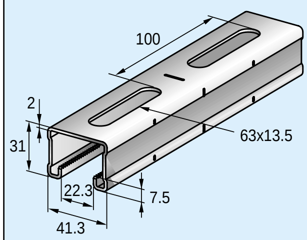


MQ-21, 6 m

Hilti installation channel, single, MQ system, MQ-21 6m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 21 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 1.44 kg/m, item number 369585/5.

MQ-31, 3 m

Hilti installation channel, single, MQ system, MQ-31 3m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 31 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 1.76 kg/m, item number 369589/7.

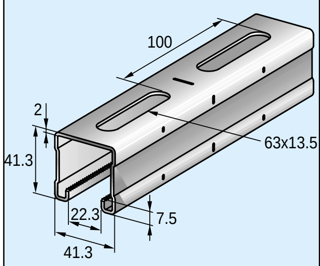


MQ-31, 6 m

Hilti installation channel, single, MQ system, MQ-31 6m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 31 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 1.76 kg/m, item number 369590/5.

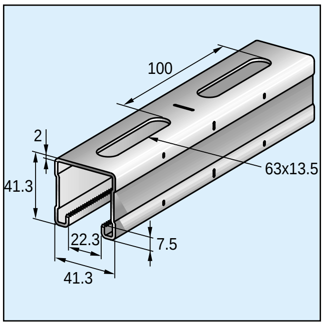
MQ-41, 3 m

Hilti installation channel, single, MQ system, MQ-41 3m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 41 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 2.08 kg/m, item number 369591/3



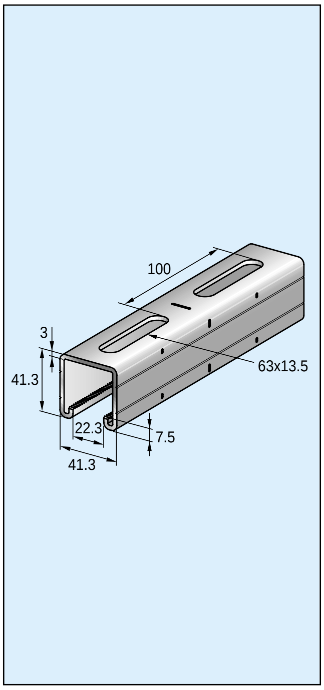
MQ-41, 6 m

Hilti installation channel, single, MQ system, MQ-41 6m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 41 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 2.08 kg/m, item number 369592/1



MQ-41/3, 3 m

Hilti installation channel, single, MQ system, MQ-41/3 3m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 41 mm, material thickness 3 mm, material S250GD, zinc plating thickness 20 microns, weight 2.91 kg/m, item number 369596/2.

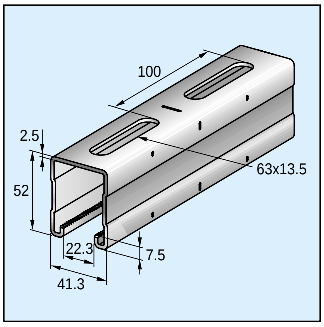


MQ-41/3, 6 m

Hilti installation channel, single, MQ system, MQ-41/3 6m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 41 mm, material thickness 3 mm, material S250GD, zinc plating thickness 20 microns, weight 2.91 kg/m, item number 369597/0.

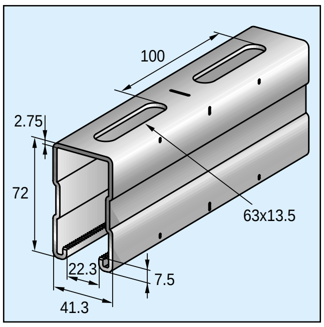
MQ-52, 6 m

Hilti installation channel, single, MQ system, MQ-52 6m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 52 mm, material thickness 2,5 mm, material S250GD, zinc plating thickness 20 microns, weight 2.94 kg/m, item number 369598/8.



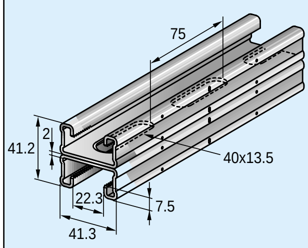
MQ-72, 6 m

Hilti installation channel, single, MQ system, MQ-72 6m, Sendzimir galvanised, with slots, made of a C-section, with serrated, inwardly rolled section edges, suitable for fastening structures or single-plane pipe installation, dimensions B×H 41 mm × 72 mm, material thickness 2.75 mm, material S250GD, zinc plating thickness 20 microns, weight 4.10 kg/m, item number 369599/6.



MQ-21D 3 m

Hilti installation channel, double, MQ system, MQ-21D 3m, Sendzimir galvanised, made of 2 C-section channels riveted together, with slots right through, with serrated, inwardly rolled section edges, suitable for fastening structures or two-plane pipe installation, dimensions B×H 41 mm × 41 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 2.90 kg/m, item number 369601/0

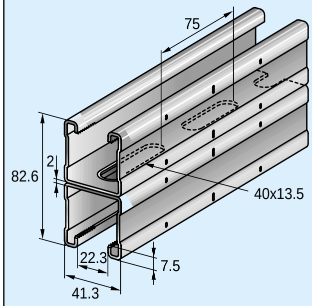


MQ-21D 6 m

Hilti installation channel, double, MQ system, MQ-21D 6m, Sendzimir galvanised, made of 2 C-section channels riveted together, with slots right through, with serrated, inwardly rolled section edges, suitable for fastening structures or two-plane pipe installation, dimensions B×H 41 mm × 41 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 2.90 kg/m, item number 369602/8

MQ-41D 3 m

Hilti installation channel, double, MQ system, MQ-41D 3m, Sendzimir galvanised, made of 2 C-section channels riveted together, with slots right through, with serrated, inwardly rolled section edges, suitable for fastening structures or two-plane pipe installation,dimensions B×H 41 mm × 82 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 4.19 kg/m, item number 369603/6.

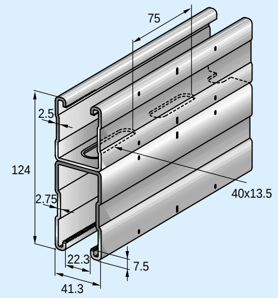


MQ-41D 6 m

Hilti installation channel, double, MQ system, MQ-41D 6m, Sendzimir galvanised, made of 2 C-section channels riveted together, with slots right through, with serrated, inwardly rolled section edges, suitable for fastening structures or two-plane pipe installation,dimensions B×H 41 mm × 82 mm, material thickness 2 mm, material S250GD, zinc plating thickness 20 microns, weight 4.19 kg/m, item number 369604/4.

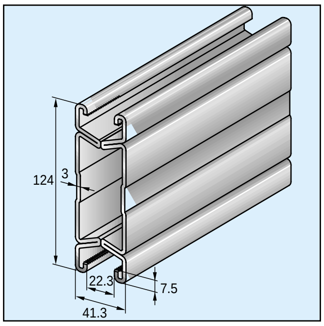
MQ-52-72D, 6 m

Hilti installation channel, double, MQ system, MQ-52-72D 6m, Sendzimir galvanised, made of 2 C-section channels riveted together, with slots right through, with serrated, inwardly rolled section edges, suitable for fastening structures or two-plane pipe installation,dimensions B×H 41 mm × 124 mm, material thickness 2.5/2.75 mm, material S250GD, zinc plating thickness 20 microns, weight 7.08 kg/m, item number 369605/1.



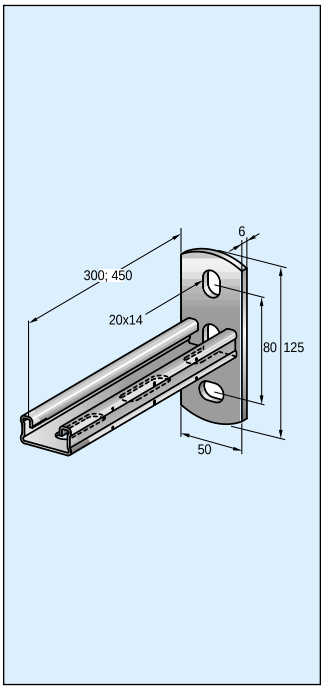
MQ-124X D, 6 m

Hilti installation channel, MQ system, MQ-124X D 6m, Sendzimir galvanised, made of 2 section parts welded together, without slots right through, with serrated, inwardly rolled section edges, suitable for fastening structures or two-plane pipe installation, dimensions B×H 41 mm × 124 mm, material thickness 3 mm, material S250GD, zinc plating thickness 20 microns, weight 9.84 kg/m, item number 369606/9.



Bracket MQK-21/300

Hilti bracket with channel section MQ-21, MQK-21/300, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 306 mm, material thickness 2/6 mm, material S235JR, weight 0.67 kg each, item number 369607/7.

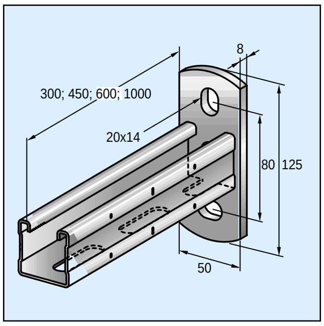


Bracket MQK-21/450

Hilti bracket with channel section MQ-21, MQK-21/450, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 456 mm, material thickness 2/6 mm, material S235JR, weight 0.89 kg each, item number 369608/5.

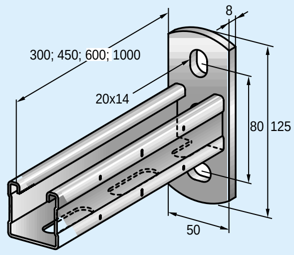
Bracket MQK-41/300

Hilti bracket with channel section MQ-41, MQK-41/300, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 308 mm, material thickness 2/8 mm, material S235JR, weight 0.95 kg each, item number 369609/3.



Bracket MQK-41/450

Hilti bracket with channel section MQ-41, MQK 41/450, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 458 mm, material thickness 2/8 mm, material S235JR, weight 1.26 kg each, item number 369610/1.



Bracket MQK-41/600

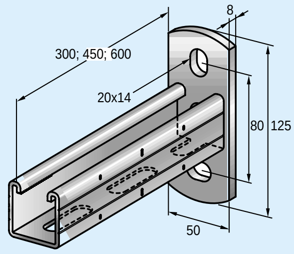
Hilti bracket with channel section MQ-41, MQK-41/600, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 608 mm, material thickness 2/8 mm, material S235JR, weight 1.57 kg each, item number 369611/9.

Bracket MQK-41/1000

Hilti bracket with channel section MQ-41, MQK 41/600, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 1008 mm, material thickness 2/8 mm, material S235JR, weight 2.40 kg each, item number 369612/7.

Bracket MQK-41/3/300

Hilti bracket with channel section MQ-41, MQK-41/3/300, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × ..... mm, material thickness 3/8 mm, material S235JR, weight 1.19 kg each, item number 370595/1.

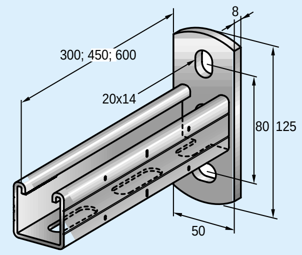


Bracket MQK-41/3/450

Hilti bracket with channel section MQ-41, MQK-41/3/450, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × .... mm, material thickness 3/8 mm, material S235JR, weight 1.63 kg each, item number 370596/9.

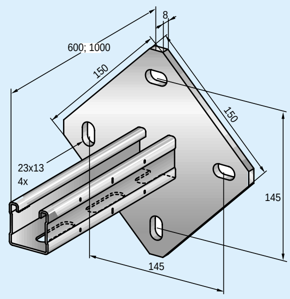
Bracket MQK-41/3/600

Hilti bracket with channel section MQ-41, MQK-41/3/600, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × .... mm, material thickness 3/8 mm, material S235JR, weight 2.06 kg each, item number 370596/9.



Bracket MQK-41/600/4

Hilti bracket with channel section MQ-41/large plate, MQK-41/600/4, galvanised, with welded-on 4-hole baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 23 mm × 13 mm, dimensions B×H×L 150 mm × 150 mm × 608 mm, material thickness 2/8 mm, material S235JR, weight 2.54 kg each, item number 369613/5.

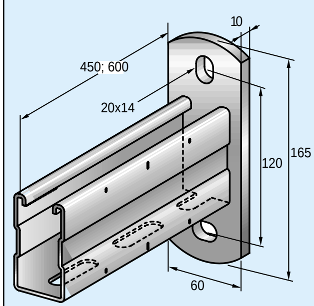


Bracket MQK-41/1000/4

Hilti bracket with channel section MQ-41/large plate, MQK 41/1000/4, galvanised, with welded-on 4-hole baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 23 mm × 13 mm, dimensions B×H×L 150 mm × 150 mm × 1008 mm, material thickness 2/8 mm, material S235JR, weight 3.37 kg each, item number 369614/3.

Bracket MQK-72/450

Hilti bracket with channel section MQ 72, MQK-72/450, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 60 mm × 165 mm × ..... mm, material thickness 2.75/10 mm, material S235JR, weight 2.51 kg each, item number 369615/0.



Bracket MQK-72/600

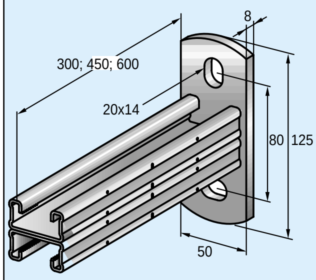
Hilti bracket with channel section MQ-72, MQK-72/600, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for single-plane pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 60 mm × 165 mm × .... mm, material thickness 2.75/10 mm, material S235JR, weight 3.13 kg each, item number 369616/8.

Bracket MQK-21 D/300

Hilti bracket with channel section MQ-21D, MQK-21D/300, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for multi-layer pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 308 mm, material thickness 2/8 mm, material S235JR, weight 1.25 kg each, item number 369617/6.

Bracket MQK-21 D/450

Hilti bracket with channel section MQ-21D, MQK-21D/450, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for multi-layer pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 458 mm, material thickness 2/8 mm, material S235JR, weight 1.72kg each, item number 369618/4.

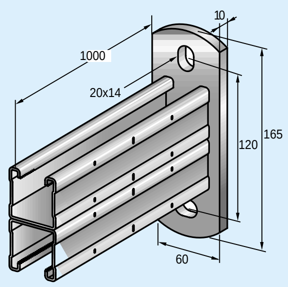


Bracket MQK-21 D/600

Hilti bracket with channel section MQ-21D, MQK-21D/600, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for multi-layer pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 50 mm × 125 mm × 608 mm, material thickness 2/8 mm, material S235JR, weight 2.19 kg each, item number 369619/2.

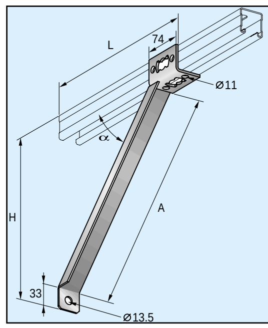
Bracket MQK-41 D/1000

Hilti bracket with channel section MQ-41D, MQK-41D/1000, galvanised, with welded-on baseplate for fabricating cantilever-type brackets and support stands, fastening straight to wall / floor material, for multi-layer pipe installation, hole / slot 20 mm × 14 mm, dimensions B×H×L 60 mm × 165 mm × 1010 mm, material thickness 2/10 mm, material S235JR, weight 5.08 kg each, item number 369620/0.



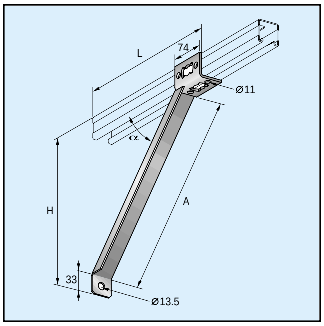
Angle support MQK-SL

Hilti angle support, long, MQ system, MQK-SL, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions A×H×L 625 mm × 397 mm × 625 mm, material thickness 4/3 mm, material S235JR, weight 1.06 kg each, item number 369621/8.



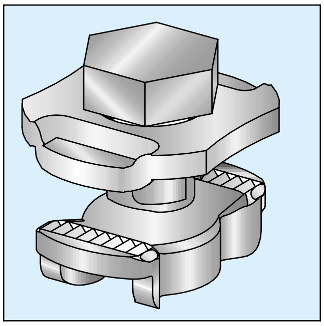
Angle support MQK-SK

Hilti angle support, short, MQ system, MQK-SK, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 347 mm × 328 mm × 325 mm, material thickness 4/3 mm, material S235JR, weight 0.65 kg each, item number 369622/6.



Pushbutton MQN

Hilti pushbutton, MQ system, MQN, galvanised, for fastening connecting parts, positive connection to the channel installation system, self-holding in unscrewed state, tightening torque 40 Nm, recommended tensile load, Z, in connection with channels MQ-21, MQ-31, MQ-41, MQ-21D, MQ-41D 5 kN, in connection with channels MQ41/3, MQ-52, MQ-72, MQ-52-72, MQ-124×D 8 kN, recommended shear load, Q, 5 kN, single-part version incl.Schraube, M10 hex. bolt, steel 8.8, material QStE 380 TM, weight 0.066 kg each, item number 369623/4.

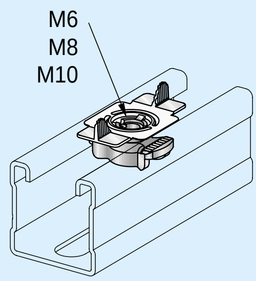


Nut MQM-M6

Hilti channel wing nut, MQ system, MQM-M6, galvanised, for connecting baseplates and similar parts, positive connection to the channel installation system, self-holding in unscrewed state, tightening torque 10 Nm, recommended tensile load, Z, 3 kN, recommended shear load, Q, 1.5 kN, M6 thread connection, material QStE 380 TM, weight 0.021 kg each, item number 369624/2

Nut MQM-M8

Hilti channel wing nut, MQ system, MQM-M8, galvanised, for connecting baseplates and similar parts, positive connection to the channel installation system, self-holding in unscrewed state, tightening torque 20 Nm, recommended tensile load, Z, 5 kN, recommended shear load, Q, 3.5 kN, M8 thread connection, material QStE 380 TM, weight 0.021 kg each, item number 369698/6

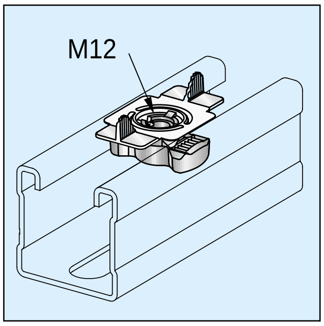


Nut MQM-M10

Hilti channel wing nut, MQ system, MQM-M10, galvanised, for connecting baseplates and similar parts, positive connection to the channel installation system, self-holding in unscrewed state, tightening torque 40 Nm, recommended tensile load, Z, in connection with channels MQ-21, MQ-31, MQ-41, MQ-21D, MQ-41D 5 kN, in connection with channels MQ41/3, MQ-52, MQ-72, MQ-52-72, MQ-124×D 8 kN, recommended shear load, Q, 5 kN, M10 thread connection, material QStE 380 TM, weight 0.021 kg each, item number 369626/7.

Nut MQM-M12

Hilti channel wing nut, MQ system, MQM-M12, galvanised, for connecting baseplates and similar parts, positive connection to the channel installation system, self-holding in unscrewed state, tightening torque 40 Nm, recommended tensile load, Z, in connection with channels MQ-21, MQ-31, MQ-41, MQ-21D, MQ-41D 5 kN, in connection with channels MQ41/3, MQ-52, MQ-72, MQ-52-72, MQ-124×D 8 kN, recommended shear load, Q, 5 kN, M12 thread connection, material QST 32-3 KGK, weight 0.023 kg each, item number 369627/5.

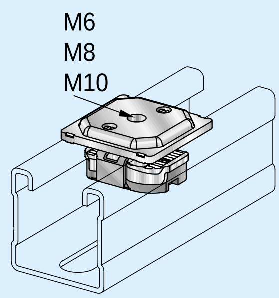


Saddle MQA-M6

Hilti pipe ring saddle for installation channel, MQ system, MQA-M6, galvanised, with metric thread for connecting adaptors or threaded rods, single-part, positive connection to the channel installation system, M6 thread connection, tightening torque 4 Nm, recommended tensile load, Z, 2 kN, material DD11, weight 0.057 kg each, item number 369628/3.

Saddle MQA-M8

Hilti pipe ring saddle for installation channel, MQ system, MQA-M8, galvanised, with metric thread for connecting threaded rods, single-part, positive connection to the channel installation system, M8 thread connection, tightening torque 9 Nm, recommended tensile load, Z, 3 kN, material DD11, weight 0.057 kg each, item number 369629/1.

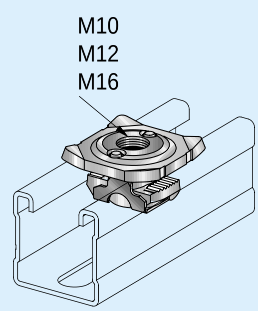


Saddle MQA-M10

Hilti pipe ring saddle for installation channel, MQ system, MQA-M10, galvanised, with metric thread for connecting adaptors or threaded rods, single-part, positive connection to the channel installation system, M10 thread connection, tightening torque 18 Nm, recommended tensile load, Z, 4 kN, material DD11, weight 0.057 kg each, item number 369630/9.

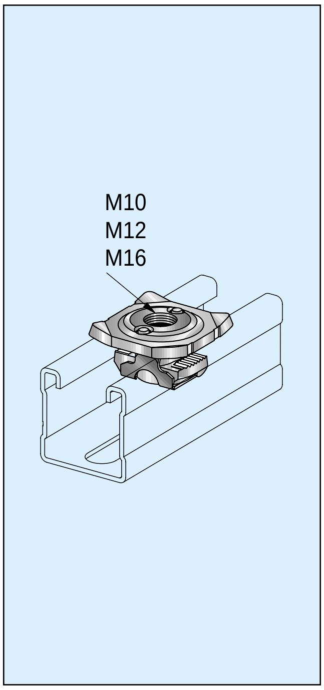
Saddle MQA-M10 B

Hilti pipe ring saddle for installation channel, MQ system, MQA-M10B, galvanised, with metric thread for connecting adaptors or threaded rods, single-part, positive connection to the channel installation system, M10 thread connection, tightening torque 18 Nm, tensile load, Z, in connection with channels MQ-21, MQ-31, MQ-41, MQ 21D, MQ-41D 5 kN, in connection with channels MQ-41/3, MQ-52, MQ-72, MQ-52-72D, MQ-124×D 8.0 kN, material S235JR, weight 0.057 kg each, item number 372471/3.



Saddle MQA-M12 B

Hilti pipe ring saddle for installation channel, MQ system, MQA-M12B, galvanised, with metric thread for connecting adaptors or threaded rods, single-part, positive connection to the channel installation system, M12 thread connection, tightening torque 31 Nm, tensile load, Z, in connection with channels MQ-21, MQ-31, MQ-41, MQ 21D, MQ-41D 5 kN, in connection with channels MQ-41/3, MQ-52, MQ-72, MQ-52-72D, MQ-124×D 8.0 kN, material S235JR, weight 0.057 kg each, item number 372431/7.

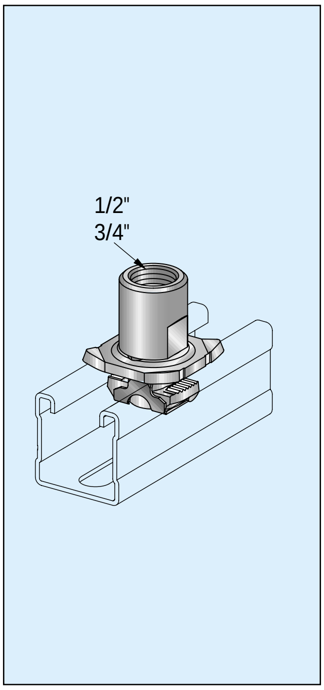


Saddle MQA-M16 B

Hilti pipe ring saddle for installation channel, MQ system, MQA-M16B, galvanised, with metric thread for connecting adaptors or threaded rods, single-part, positive connection to the channel installation system, thread connection M16, tightening torque 40 Nm, tensile load, Z, in connection with channels MQ-21, MQ-31, MQ-41, MQ 21D, MQ-41D 5 kN, in connection with channels MQ-41/3, MQ-52, MQ-72, MQ-52-72D, MQ-124×D 8.0 kN, material S235JR, weight 0.057 kg each, item number 372431/7.

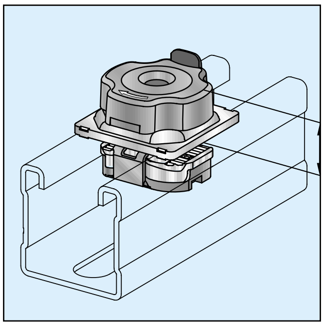
Saddle MQA-1/2″ and MQA-3/4″

Hilti pipe ring saddle for installation channel, MQ system, MQA-1/2″ and 3/4″, comprising saddle MQA-M12B (with metric thread for connecting adaptors or threaded rods, single-part, positive connection to the channel installation system) and adaptor MQZ-A 1/2″ and MQZ-A 3/42″ (for screwing into threaded plate as connector for threaded nipples, M12 thread connection, 1/2″ and 3/4″ nipple thread, height 47.5 mm) galvanised, tightening torque 31 Nm, tensile load, Z, in connection with channels MQ-21, MQ-31, MQ-41, MQ 21D, MQ-41D 5 kN, in connection with channels MQ-41/3, MQ-52, MQ-72, MQ-52-72D, MQ-124×D 8,0 kN, material S235JR, weight 0.184 kg each, item number 369633/3.



Saddle MQA-Q8

Hilti pipe ring saddle for installation channel, MQ system, MQA-Q8, galvanised, with push-type (plug-in) connection and integrated locknut for connecting adaptors or threaded rods, single-part, positive connection to the channel installation system, M8 thread connection, tightening torque 2,0 Nm, tensile load, Z, 1.5 kN, material DD11, weight 0.072 kg each, item number 369635/8.

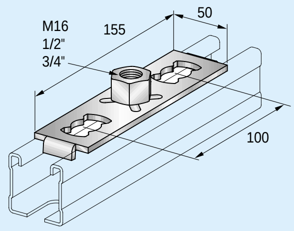


Baseplate MQG-2-M16

Hilti 2-hole baseplate, MQ system, MQG 2-M16, galvanised, thread connection M16, fastening slot of butterfly shape, tightening torque 40 Nm, recommended tensile load, Z, 6 kN, recommended shear load, Q, 10.0 kN, dimensions B×H×L 50 mm × 155 mm × 26 mm, material S235JR, weight 0.18 kg each, item number 369682/0.

Baseplate MQG-2-1/2″

Hilti 2-hole baseplate, MQ system, MQG 2-1/2″, galvanised, thread connection 1/2″, fastening slot of butterfly shape, tightening torque 40 Nm, recommended tensile load, Z, 6 kN, recommended shear load, Q, 10.0 kN, dimensions B×H×L 50 mm × 155 mm × 25 mm, material S235JR, weight 0.17 kg each, item number 369683/8.

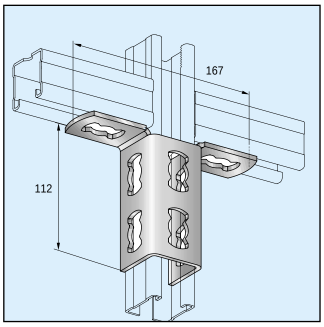


Baseplate MQG-2-3/4″

Hilti 2-hole baseplate, MQ system, MQG 2-3/4″, galvanised, thread connection 3/4″, fastening slot of butterfly shape, tightening torque 40 Nm, recommended tensile load, Z, 6 kN, recommended shear load, Q, 10.0 kN, dimensions B×H×L 50 mm × 155 mm × 27 mm, material S235JR, weight 0.19 kg each, item number 369684/6.

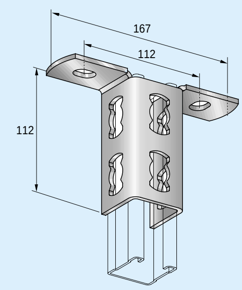
Connector MQV-2/2 D

Hilti connector, 2,3 fold, 2-dimensional, MQ system, MQV-2/2D, galvanised, installation connector of 2 or more channel parts, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 45 mm × 112 mm × 167 mm, material thickness 4 mm, material S235JR, weight 0.438 kg each, item number 369638/2.



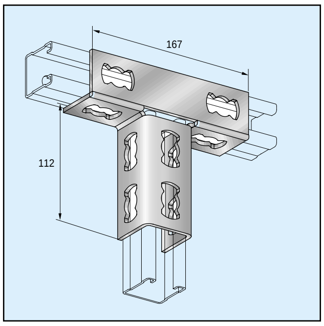
Connector MQV-2/2D-14

Hilti universal Schienen-Untergrundsaddle MQ system, MQV-2/2D-14, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 45 mm × 112 mm × 167 mm, material thickness 4 mm, material S235JR, weight 0.438 kg each, item number 369639/0.



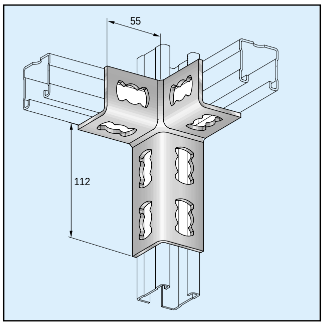
Connector MQV-3/2D

Hilti connector, 2,3 fold, 2-dimensional, MQ system, MQV 3/2D, galvanised, installation connector of 2 or more channel parts, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 45 mm × 153 mm × 167 mm, material thickness 4 mm, material S235JR, weight 0.615 kg each, item number 369640/8.



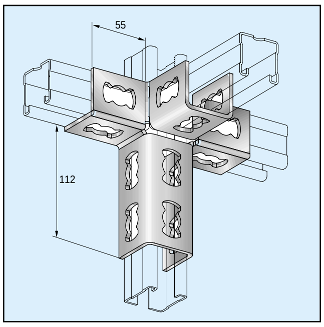
Connector MQV-3/3D

Hilti connector 3,4 fold 3 Dimensional MQ system, MQV 3/3D, galvanised, installation connector of 2 or more channel parts, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 103 mm × 103 mm × 153 mm, material thickness 4 mm, material S235JR, weight 0.451 kg each, item number 369641/6.



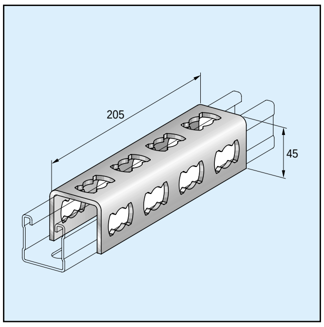
Connector MQV-4/3D

Hilti connector 3,4 fold 3 Dimensional MQ system, MQV 4/3D, galvanised, installation connector of 2 or more channel parts, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 167 mm × 103 mm × 153 mm, material thickness 4 mm, material S235JR, weight 0.77 kg each, item number 369642/4.



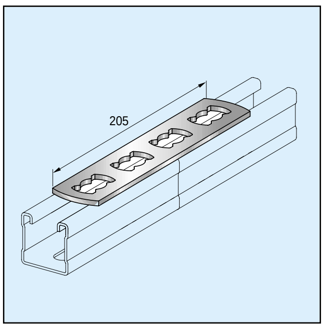
Connector MQV-12

Hilti channel connector, MQ system, MQV-12, galvanised, installation connector of 2 or more channel parts, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 50 mm × 45 mm × 205 mm, material thickness 4 mm, material S235JR, weight 0.555 kg each, item number 369643/2.



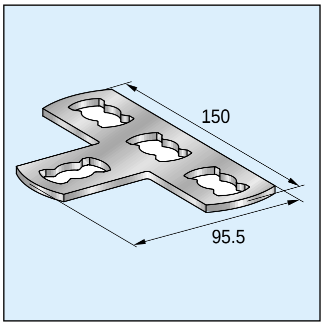
Connector MQV-P4

Hilti channel connector, flat, MQ system, MQV-P4, galvanised, installation connector of 2 or more channel parts, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H 41 mm × 205 mm, material thickness 4 mm, material S235JR, weight 0.188 kg each, item number 369644/0.



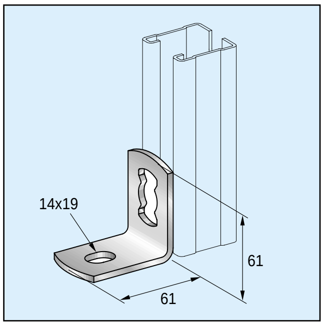
Connector MQV-T

Hilti 4-hole T-angle, MQ system, MV-T, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H 95,5 mm × 150 mm, material thickness 4 mm, material S235JR, weight 0.196 kg each, item number 369645/7.



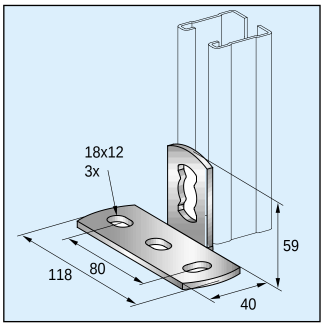
Channel base, MQP-1/1

Hilti universal channel base material L-connector, MQ system, MQP-1/1, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole / slot 14 mm dimensions B×H×L 45 mm × 61 mm × 61 mm, material thickness 4 mm, material S235JR, weight 0.11 kg each, item number 369646/5.



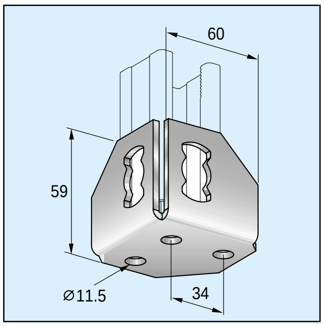
Channel base, MQP-1/3

Hilti universal channel base material L-connector, MQ system, MQP-1/3, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole 14 mm, dimensions B×H×L 40 mm × 59 mm × 118 mm, material thickness 4 mm, material S235JR, weight 0.19 kg each, item number 369647/3.



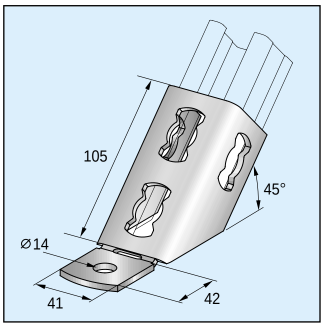
Channel base, MQP-2/3

Hilti channel base, MQ system, MQP-2/3, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 72 mm × 59 mm × 72 mm, material thickness 4 mm, material S235JR, weight 0.290 kg each, item number 369948/1.



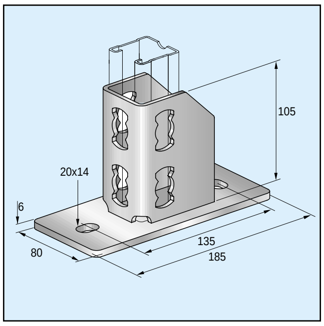
Channel base, MQP-45°

Hilti 4-hole support angle, 45°, MQ system, MQP-45, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole 14 mm, dimensions B×H×L 51 mm × 80 mm × 152 mm, material thickness 4 mm, material S235JR, weight 0.35 kg each, item number 369649/9.



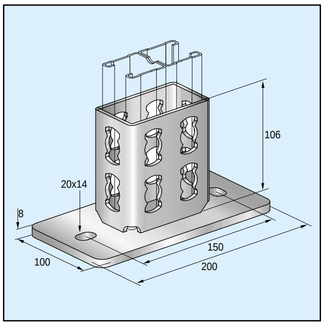
Channel base, MQP-21-72

Hilti channel base, MQ system, MQP-21-72, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole 14 mm, dimensions B×H×L 80 mm × 185 mm × 111 mm, material thickness 4/6 mm, material S235JR, weight 1.15 kg each, item number 369651/5.



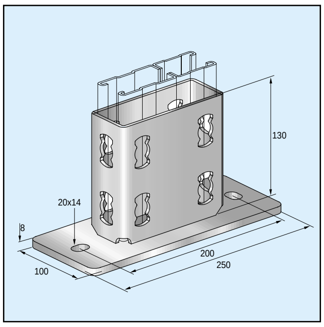
Channel base, MQP-82

Hilti channel base, MQ system, MQP-82, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole 14 mm, dimensions B×H×L 100 mm × 200 mm × 114 mm, material thickness 4/8 mm, material S235JR, weight 1.88 kg each, item number 369652/3.



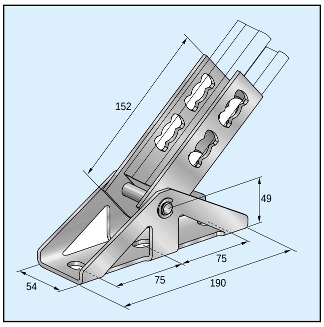
Channel base, MQP-124

Hilti channel base, MQ system, MQP-124, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole 14 mm, dimensions B×H×L 100 mm × 250 mm × 138 mm, material thickness 4/8 mm, material S235JR, weight 2.73 kg each, item number 369653/1.



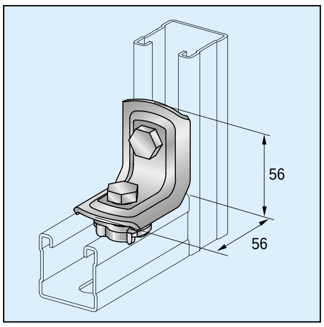
Channel base, MQP-G

Hilti pivot base, swivelling,180°, MQ system, MQP-G, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole 14 mm, dimensions B×H×L 70 mm × 190 mm × 185 mm, material thickness 4 mm, material S235JR, weight 1.055 kg each, item number 369654/9.



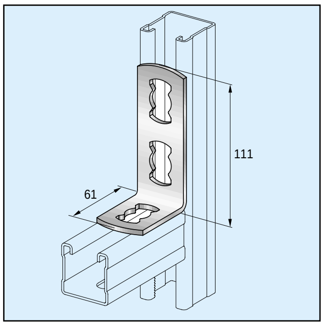
Angle MQW-Q2

Hilti 2-hole angle, 90°, MQ system, MQW-Q2, galvanised, with prefitted channel nut for fabricating frame structures in combination with the channel installation system, dimensions B×H×L 48 mm × 56 mm × 56 mm, material thickness 3 mm, material ..., weight 0.20 kg each, item number 369655/6.



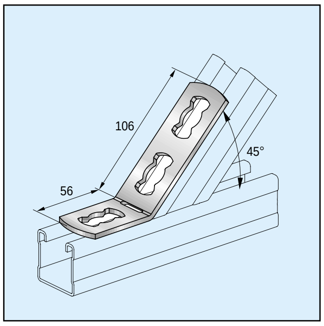
Angle MQW-3

Hilti 3-hole angle, 90°, MQ system, MQW-3, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 41 mm × 61 mm × 111 mm, material thickness 4 mm, material S235JR, weight 0.16 kg each, item number 369656/4.



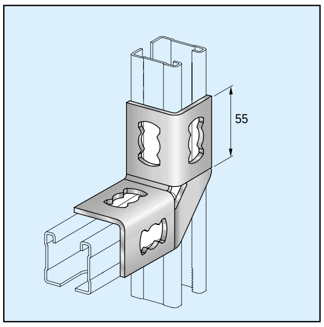
Angle MQW-3/45°

Hilti 3-hole angle, 45°, MQ system, MQW-3/45, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 41 mm × 45 mm × 150 mm, material thickness 4 mm, material S235JR, weight 0.16 kg each, item number 369657/2



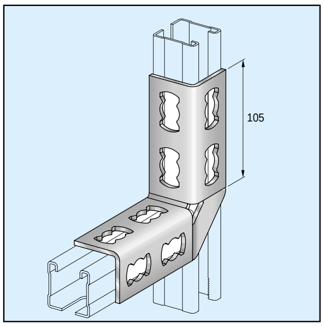
Angle MQW-4

Hilti 4-hole angle, MQ system, MQW-4, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 45 mm × 103 mm × 103 mm, material thickness 4 mm, material S235JR, weight 0.22 kg each, item number 369658/0.



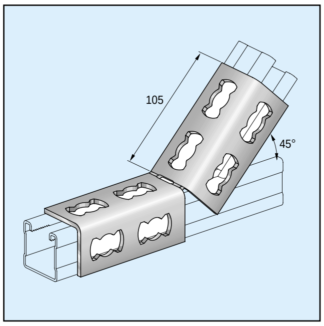
Angle MQW-8/90°

Hilti 8-hole angle, 90°, MQ system, MQW 8/90, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 45 mm × 153 mm × 153 mm, material thickness 4 mm, material S235JR, weight 0.42 kg each, item number 369659/8.



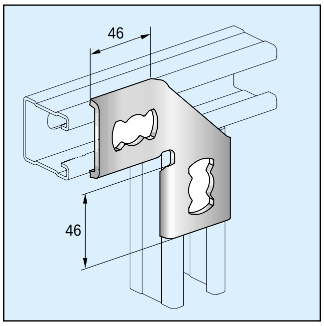
Angle MQW-8/45°

Hilti 8-hole angle, 45°, MQ system, MQW-8/45, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 45 mm × 122 mm × 216 mm, material thickness 4 mm, material S235JR, weight 0.41 kg each, item number 369660/6.



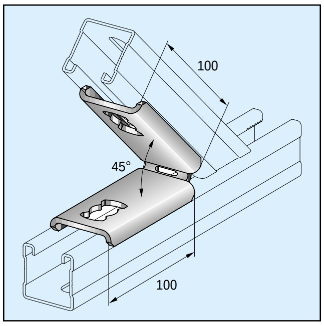
Angle MQW-P2

Hilti 2-hole angle, flat, MQ system, MQW-P2, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 99 mm × 99 mm × 9 mm, material thickness 4 mm, material S235JR, weight 0.162 kg each, item number 369661/4.



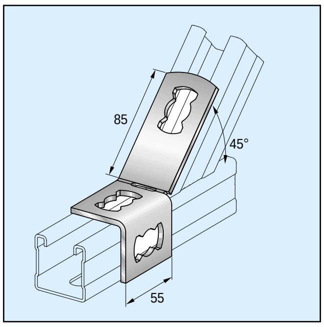
Angle MQW-2/45°

Hilti 2-hole angle, 45°, inside, MQ system, MQW-2/45, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 51 mm × 85 mm × 110 mm, material thickness 4 mm, material S235JR, weight 0.354 kg each, item number 369662/2.



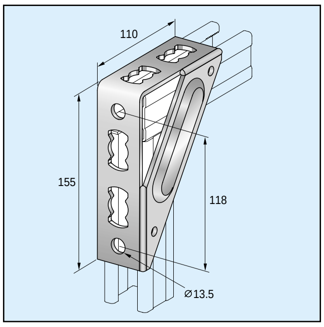
Angle MQW-3/135°

Hilti 3-hole angle,135°, MQ system, MQW-3/135, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 41 mm × 106 mm × 120 mm, material thickness 4 mm, material S235JR, weight 0.21 kg each, item number 369663/0.



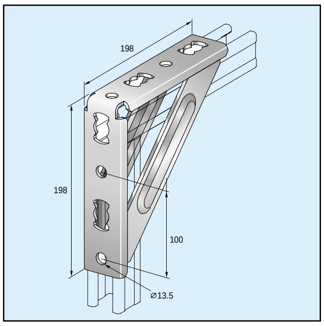
Angle MQW-S/1

Hilti angle bracket, 2-dimensional, MQW-S/1, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole slot 13,5 mm, dimensions B×H×L 49 mm × 110 mm × 155 mm, material thickness 4 mm, material S235JR, weight 0.46 kg each, item number 369664/8.



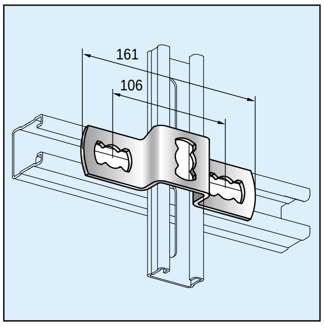
Angle MQW-S/2

Hilti angle bracket, 3-dimensional, MQW-S/2, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole slot 13.5 mm, dimensions B×H×L 58 mm × 198 mm × 198 mm, material thickness 4 mm, material S235JR, weight 1.18 kg each, item number 369665/5.



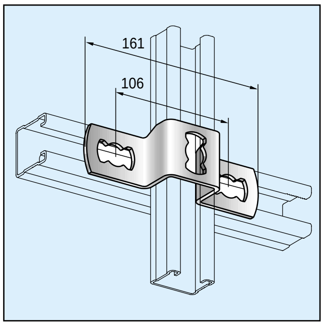
Clamp MQB-21

Hilti clamp, MQ system, MQB-21, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 26 mm × 161 mm, material thickness 4 mm, material S235JR, weight 0.211 kg each, item number 369666/3.



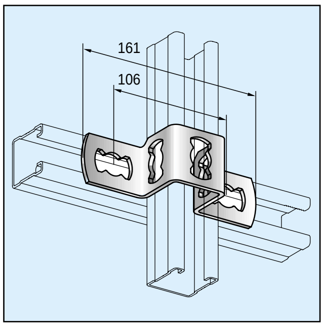
Clamp MQB-31

Hilti clamp, MQ system, MQB-31, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 36 mm × 161 mm, material thickness 4 mm, material S235JR, weight 0.22 kg each, item number 369667/1.



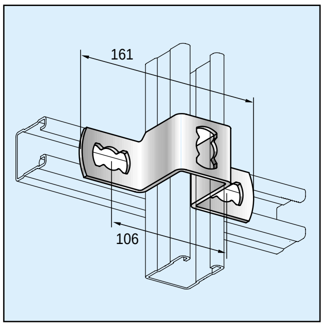
Clamp MQB-41

Hilti clamp, MQ system, MQB-41, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 46 mm × 161 mm, material thickness 4 mm, material S235JR, weight 0.24 kg each, item number 369668/9.



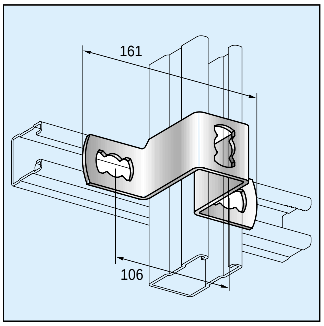
Clamp MQB-52

Hilti clamp, MQ system, MQB-52, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 57 mm × 161 mm, material thickness 4 mm, material S235JR, weight 0.34 kg each, item number 369669/7.



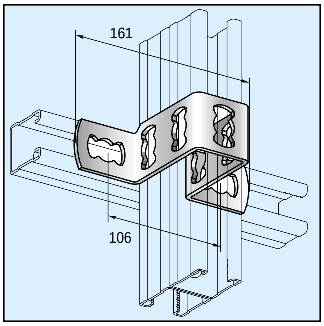
Clamp MQB-72

Hilti clamp, MQ system, MQB-72, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 77 mm × 161 mm, material thickness 4 mm, material S235JR, weight 0.38 kg each, item number 369670/5.



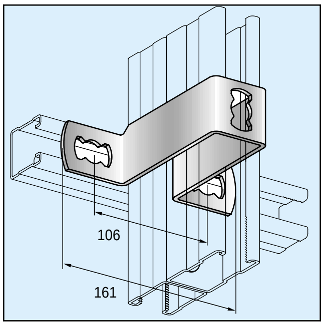
Clamp MQB-82

Hilti clamp, MQ system, MQB-82, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 87 mm × 161 mm, material thickness 4 mm, material S235JR, weight 0.34 kg each, item number 369671/3.



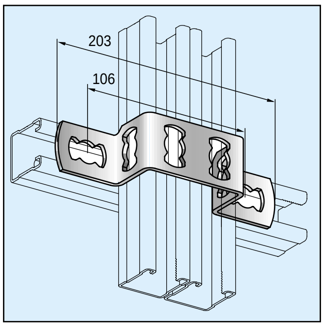
Clamp MQB-124

Hilti clamp, MQ system, MQB-124, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 129 mm × 161 mm, material thickness 4 mm, material S235JR, weight 0.553 kg each, item number 369672/1.



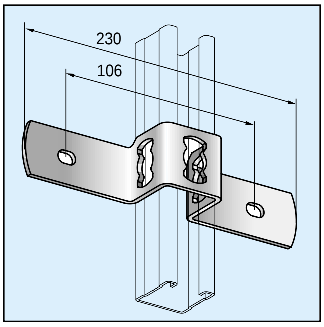
Clamp MQB-41×2

Hilti clamp, MQ system, MQB-41×2, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 47 mm × 46 mm × 203 mm, material thickness 4 mm, material S235JR, weight 0.295 kg each, item number 369673/9.



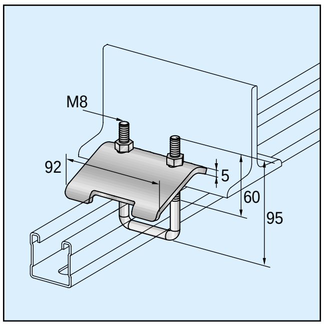
Clamp MQB-G41

Hilti clamp, MQ system, MQB-G41, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, hole slot 10 mm, dimensions B×H×L 47 mm × 46 mm × 230 mm, material thickness 4 mm, material S235JR, weight 0.366 kg each, item number 369674/7.



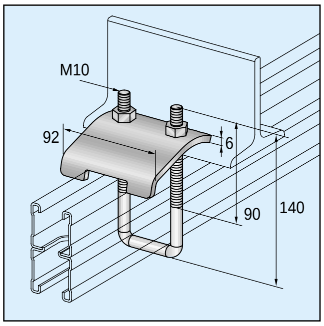
Beam clamp MQT-21-41

Hilti beam clamp, MQ system, MQT 21-41, galvanised, for securing installation channels on steel beams, plate thickness 5 mm, max. clamping thickness 26 mm, clamp hoop thickness 7.1 mm, channel height 21 to 41 mm, tightening torque 20 Nm, recommended tensile load, Z, 4.5 kN, material S235JR, weight 0.427 kg each, item number 369675/4.



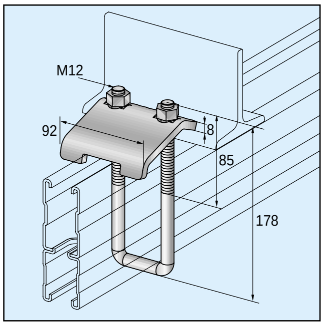
Beam clamp MQT-41-82

Hilti beam clamp, MQ system, MQT 41-82, galvanised, for securing installation channels on steel beams, plate thickness 6 mm, max. clamping thickness 26 mm, clamp hoop thickness 8.8 mm, channel height 41 to 82 mm, tightening torque 20 Nm, recommended tensile load, Z, 4.5 kN, material S235JR, weight 0.65 kg each, item number 369676/2.



Beam clamp MQT-82-124

Hilti beam clamp, MQ system,MQT 82-124, galvanised, for securing installation channels on steel beams, plate thickness 8 mm, max. clamping thickness 26 mm, clamp hoop thickness 10 mm, channel height 41 to 124 mm, tightening torque 20 Nm, recommended tensile load, Z, 5.0 kN, material S235JR, weight 0.85 kg each, item number 369676/2.

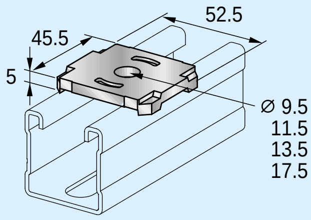


Bored plate MQZ-L9

Hilti baseplate, MQ system, MQZ-L9, galvanised, hole 9.5 mm, dimensions B×H×L 51 mm × 46 mm × 7 mm, material thickness 5 mm, to adapt the butterfly slot of connecting parts for metric fasteners such as anchors and bolts, material S235JR, weight 0.092 kg each, item number 369678/8

Bored plate MQZ-L11

Hilti baseplate, MQ system, MQZ-L11, galvanised, hole 11.5 mm, dimensions B×H×L 51 mm × 46 mm × 7 mm, material thickness 5 mm, to adapt the butterfly slot of connecting parts for metric fasteners such as anchors and bolts, material S235JR, weight 0.088 kg each, item number 369679/6.

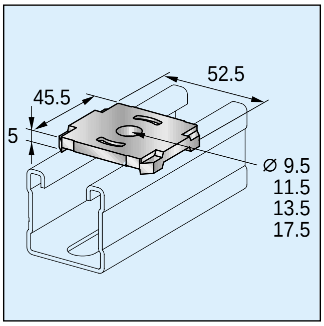


Bored plate MQZ-L13

Hilti baseplate, MQ system, MQZ-L13, galvanised, hole 13.5 mm, dimensions B×H×L 51 mm × 46 mm × 7 mm, material thickness 5 mm, to adapt the butterfly slot of connecting parts for metric fasteners such as anchors and bolts, material S235JR, weight 0.084 kg each, item number 369680/4.

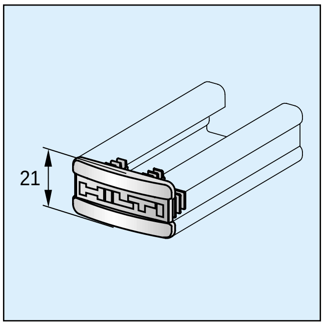
Bored plate MQZ-L17

Hilti baseplate, MQ system, MQZ-L17, galvanised, hole / slot 17.5 mm, dimensions B×H×L 51 mm × 46 mm × 7 mm, material thickness 5 mm, to adapt the butterfly slot of connecting parts for metric fasteners such as anchors and bolts, material S235JR, weight 0.080 kg each, item number 369681/2.



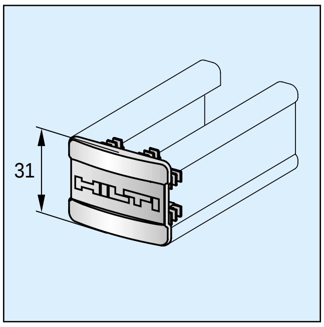
End cap MQZ-E21

Hilti channel end cap, MQ system, MQZ-E21, to close the ends of installation channels and to minimise the risk of injury on cut edges, red colour, dimensions B×H×L 41 mm × 21 mm × 12 mm, material thickness 2.5 mm, material plastic, weight 0.002 kg each, item number 370598/5.



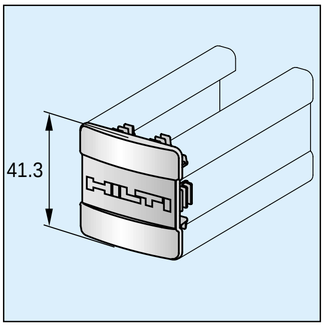
End cap MQZ-E31

Hilti channel end cap, MQ system, MQZ-E31, to close the ends of installation channels and to minimise the risk of injury on cut edges, red colour, dimensions B×H×L 41 mm × 31 mm × 12 mm, material thickness 2.5 mm, material plastic, weight 0.002 kg each, item number 369686/1.



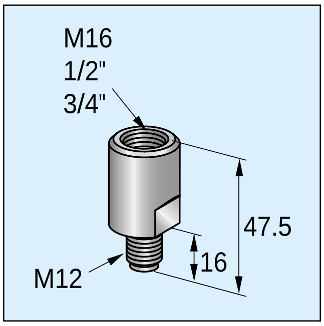
End cap MQZ-E41

Hilti channel end cap, MQ system, MQZ-E41, to close the ends of installation channels and to minimise the risk of injury on cut edges, red colour, dimensions B×H×L 41 mm × 41 mm × 12 mm, material thickness 2.5 mm, material plastic, weight 0.002 kg each, item number 369685/3.



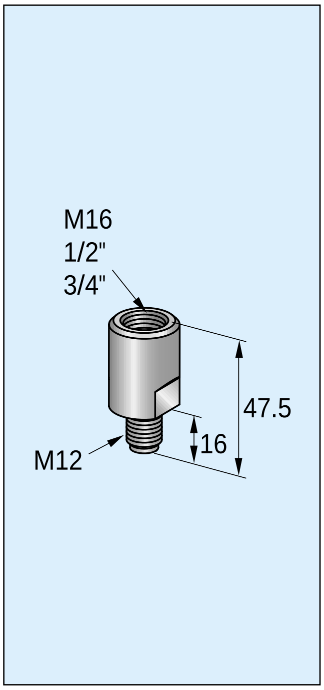
Adaptor MQZ-A-M16

Hilti MQZ-A adaptor, for pipe ring saddle MQ system, MQZ-A M16, galvanised, adaptor for screwing into threaded plate as connector for threaded nipples, M12 thread connection, nipple thread M16, height 47,5 mm, tightening torque 40Nm, recommended tensile load, Z, 9 kN, recommended shear load, Q, 6 kN material 11SMn30, weight 0.092 kg each, item number 369687/9.



Adaptor MQZ-A 1/2″

Hilti MQZ-A adaptor, for pipe ring saddle MQ system, MQZ-A 1/2″, galvanised, adaptor for screwing into threaded plate as connector for threaded nipples, M12 thread connection,1/2″ nipple thread, height 47.5 mm, tightening torque 40 Nm, recommended tensile load, Z, 9 kN, recommended shear load, Q, 6 kN, material 11SMn30, weight 0.109 kg each, item number 369688/7.

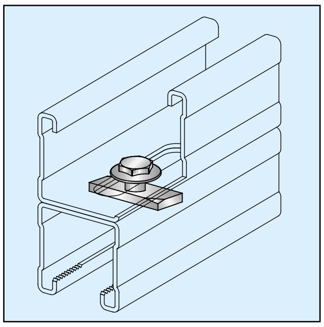


Adaptor MQZ-A3/4″

Hilti MQZ-A adaptor, for pipe ring saddle MQ system, MQZ-A 3/4″, galvanised, adaptor for screwing into threaded plate as connector for threaded nipples, M12 thread connection, 3/4″ nipple thread, height 47.5 mm, tightening torque 40 Nm, recommended tensile load, Z, 9 kN, recommended shear load, Q, 6 kN, material 11SMn30, weight 0.109 kg each, item number 369688/7.

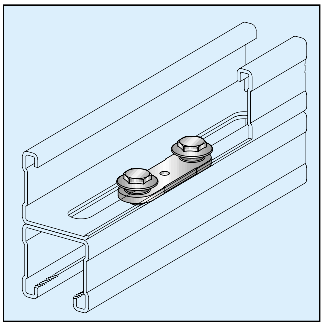
Accessory MQZ-SV

Hilti channel connector, for double channel, MQ system, MKN-SV, galvanised, channel connector, single-part, for highly accurate user-fabrication of double channels for the channel installation system, tightening torque 20 Nm, recommended shear load, Q, 3 kN, single-part version incl. bolt, M10 hex. bolt, steel 8.8, material S235JR, weight 0.023 kg each, item number 369690/3.



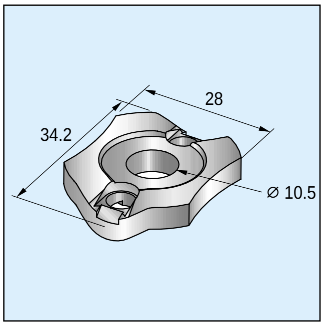
Shear brace MQZ-SS

Hilti shear brace for double channel, MQ system, MKN-SS, galvanised, channel connector, single-part, for highly accurate user-fabrication of double channels for the channel installation system, tightening torque 20 Nm, recommended tensile load, Z, 3 kN, recommended shear load, Q, 5 kN, single-part version incl. bolt , M8 hex. bolt, steel 8.8, material S235JR, weight 0.061 kg each, item number 369691/1.



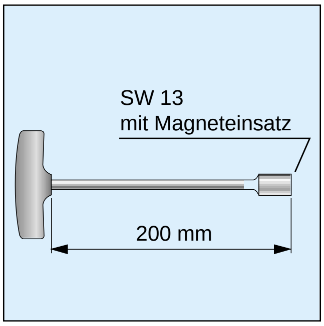
Washer MQZ-U

Hilti installation washer, MQ system, MQZ-U, galvanised, covering washer to adapt the butterfly slot of connecting parts for metric fasteners such as anchors and bolts, hole 10.5 mm, material thickness 5 mm, material S235JR, weight 0.,03 kg each, item number 369692/9



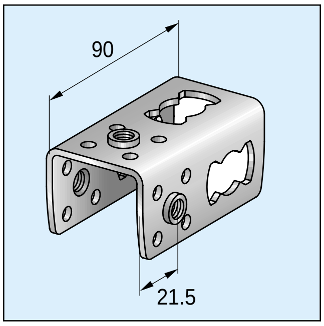
Wrench MQZ-SVS

Hilti installation wrench for channel connector, MKN-SVS, 13 mm AF, galvanised, wrench with magnetic insert and plastic grip, length 200 mm, width across flats 13 mm, channel connector, single-part, for highly accurate user-fabrication of double channels for the channel installation system, weight 0.16 kg each, item number 369683/7.



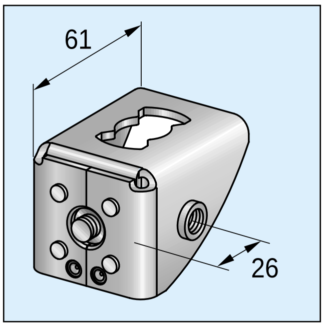
3D-basis MQ3D-B

Hilti 3D-basis, MQ3D-B MQ system, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 49 mm × 42 mm × 90 mm, material thickness 3 mm, material OStE 380 TM, weight 0.206 kg each, item number 369694/5.



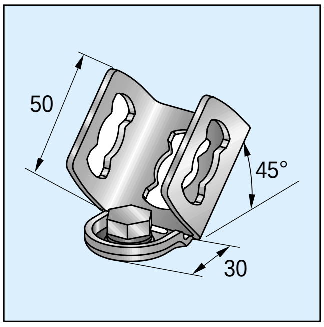
3D-angle MQ3D-W90°

Hilti 3D-angle, MQ3D-W90°, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 49 mm × 42 mm × 90 mm, material thickness 3 mm, material DD11, weight 0.212 kg each, item number 369695/2.



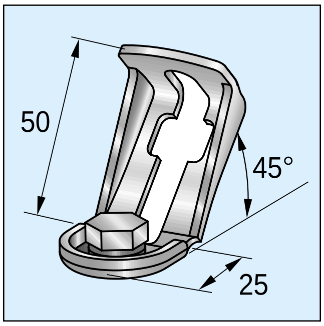
3D-angle MQ3D-W45°

Hilti 3D-angle, MQ3D-W90°, galvanised, for fabricating frame structures in combination with the channel installation system, fastening slot of butterfly shape, dimensions B×H×L 49 mm × 42 mm × 90 mm, material thickness 3 mm, material OStE 380 TM, weight 0.153 kg each, item number 369696/0.



Brace MQ3D-A

Hilti MQ3D-A brace, galvanised, for fabricating braces with threaded rods in combination with the channel installation system, material thickness 3 mm, material DD11, weight 0.095 kg each, item number 369697/8.



IDS: Installation Design Software

Pipe ring: Pipe run design

A programme for designing pipe runs and their fastening

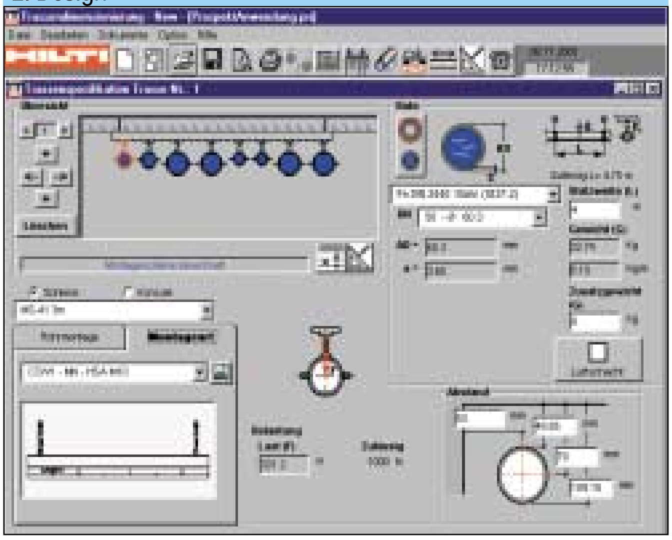
Main features at a glance:

- Quick layouts of pipe runs by adding in / copying pipe lines and support structures
- Automatic production of CAD drawings
- Photo database: Products and pre-defined applications
- Simple calculation of changes in length and condensation
- Preparation of bills of material with all necessary information
- Individual interactive print-outs: Bills of material, sketches, product photos and comments
- Print-outs can be used as installation instructions.
- Excellent documentation with print-outs specific to project

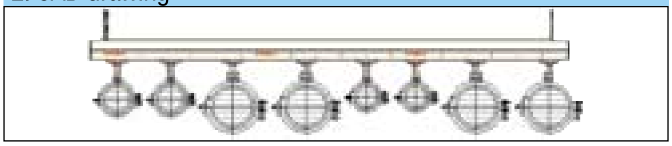
Application:

Solution:

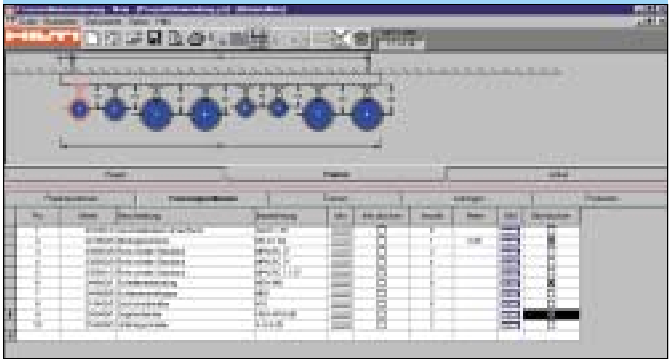
1. Design



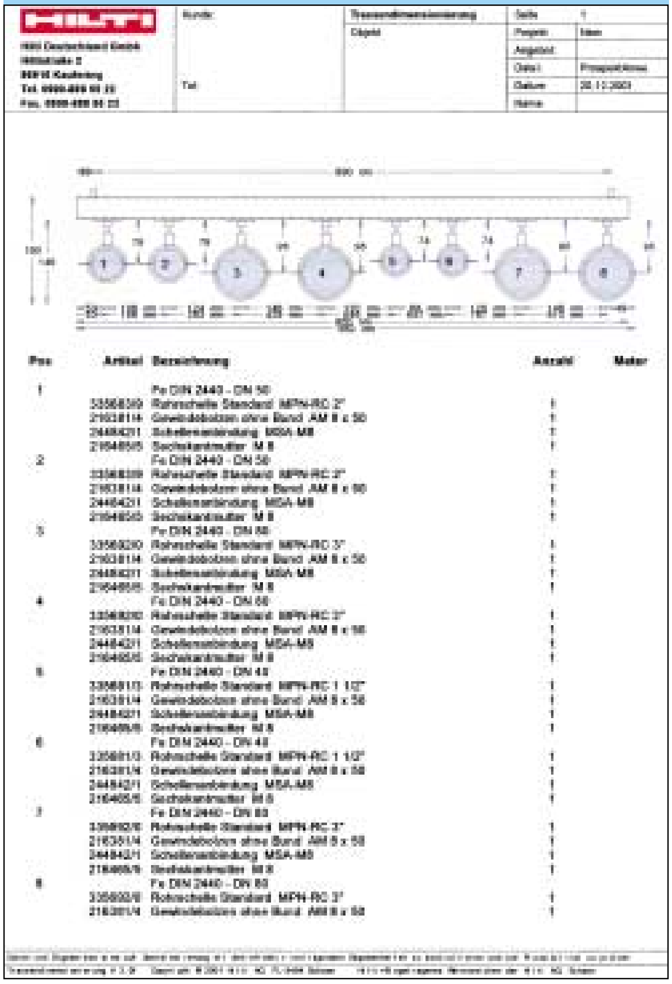
2. CAD drawing



3. Bill of material with sketch



4. Print-out: Sketch and bill of material



Channel: Channel design

A programme for calculating and selecting installation channels

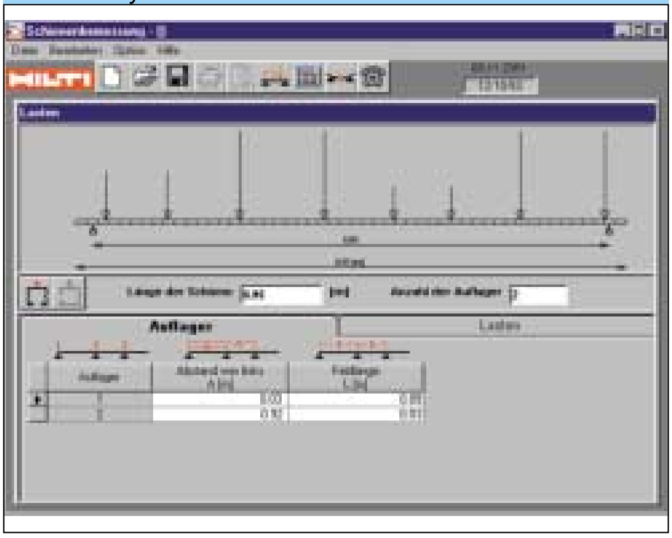
Main features at a glance:

- Quick channel sizing by simply entering data
- Automatic recommendation of suitable channel sections
- Design result also depicted as a diagram
- Compilation of bill of material with all necessary information
- Individual interactive print-outs: Bills of material, sketches, product photos and comments
- Excellent documentation with print-outs specific to project

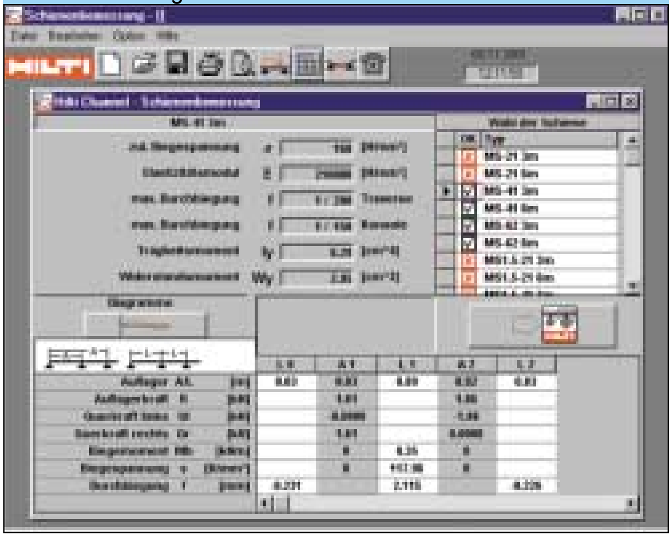
Application:

Solution:

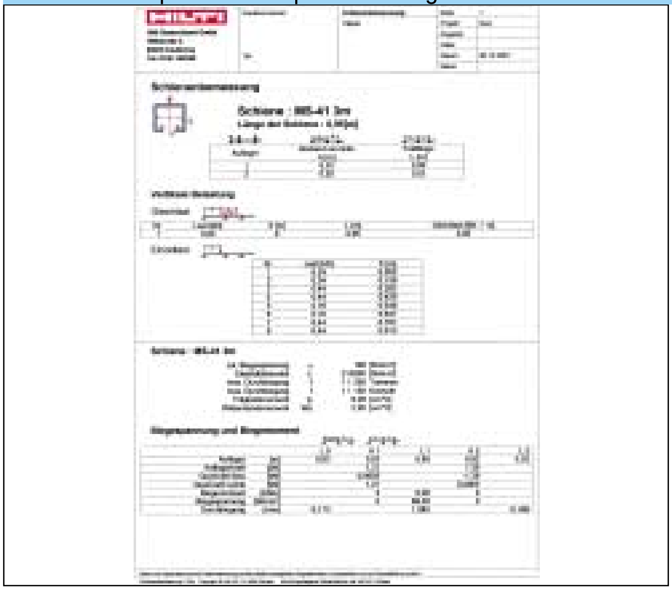
1. Data entry

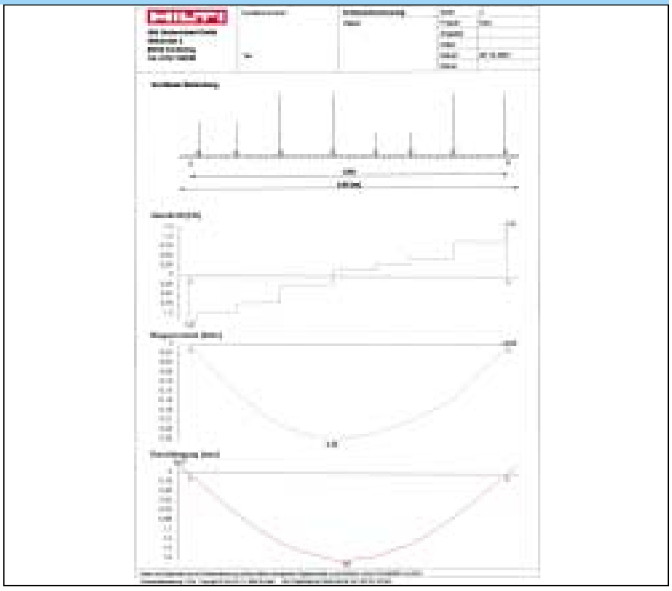


2. Channel sizing / selection



3. Print-out: Input data / output data / diagrams





Fixed point: Fixed point design

A programme for designing and selecting fixed points and slide / roll connectors

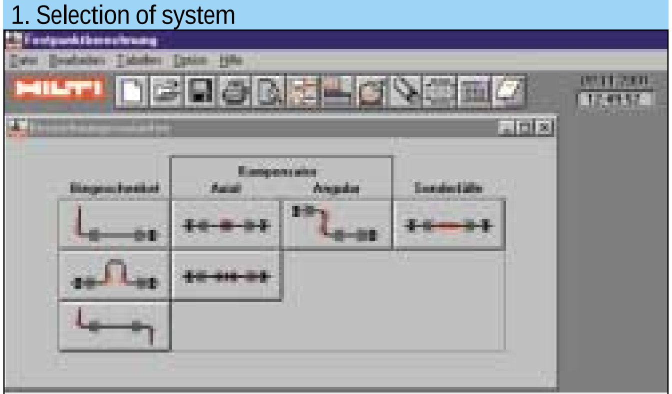
Main features at a glance:

- Selection of possible system: Pipe bend or expansion joint
- Calculation of force at fixed point and selection of fixed point and slide / roll connector
- Automatic compilation of bill of material
- Fixed point installation instructions
- Excellent documentation with print-out specific to project

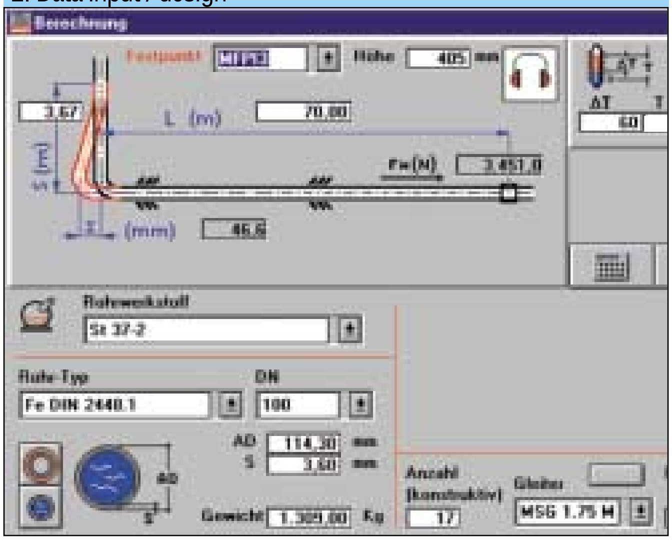
Application:

Solution:

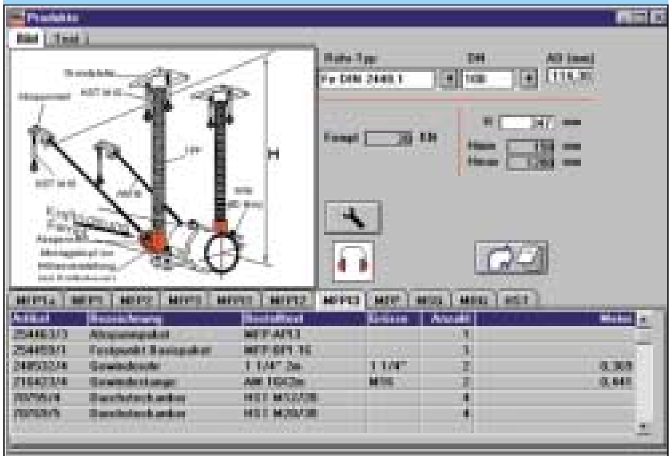
1. Selection of system



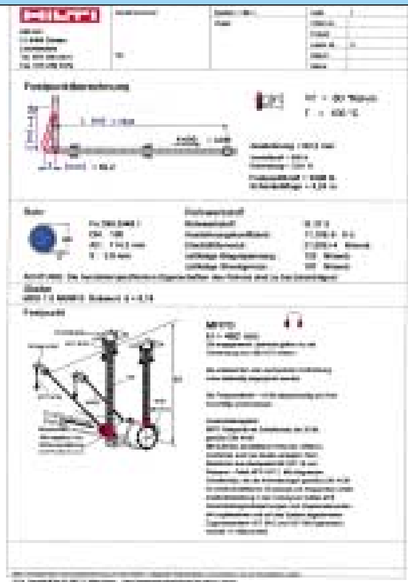
2. Data input / design



3. Product selection and bill of material



4. Print-out



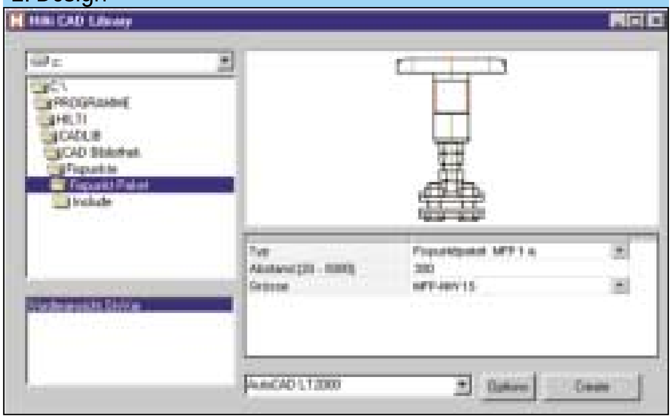
CAD library: CAD product library

Main features at a glance:

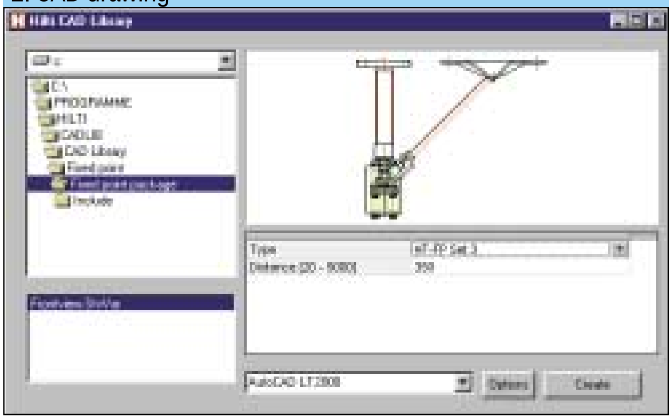
- Parametric CAD symbols: Entry of various parameters, e.g. length possible, automatic drawing modification
- CAD drawings with various views
- CAD symbols can be exported into various CAD systems

Solution:

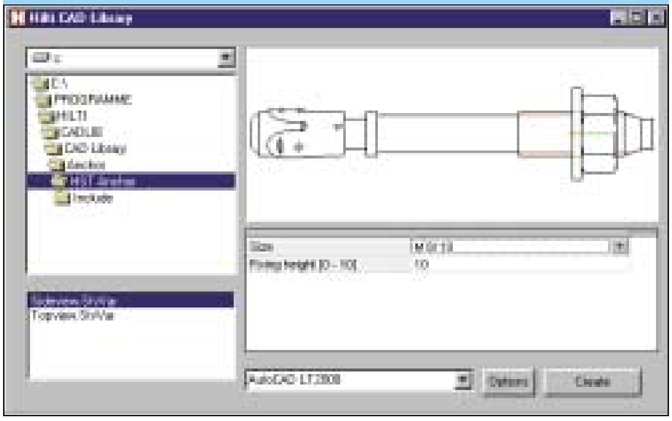
1. Design



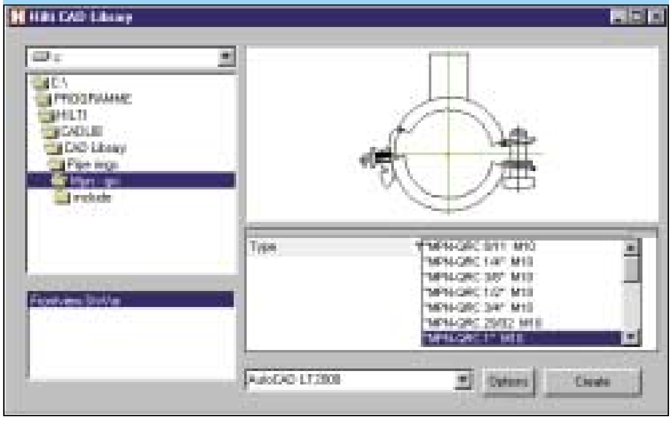
2. CAD drawing



3. Bill of material with sketch



4. Print-out: Sketch and bill of material



IPM: Integrated project management

A programme for managing large projects

Main features at a glance:

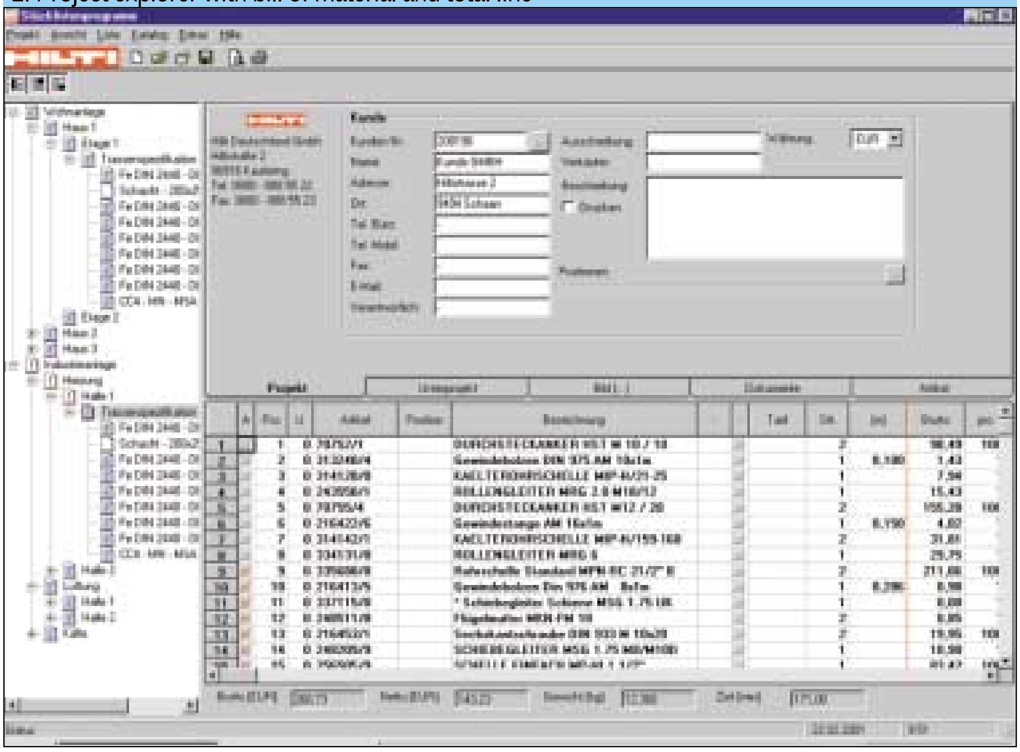
- Overall project costing from calculating product costs plus installation time (labour)
- No searching for project papers after, possible, filing / depositing project documents and drawings
- Integrated standard applications; quick selection of standard fastenings
- Simple bill-of-material management due to optional bill-of-material segregation according to construction phase, structure, floor, etc.
- Automatic allocation of item data, such as designation, price, weight, installation time, etc. Thus, errors can be avoided and costs saved.
- Quality assurance possible thanks to excellent documentation with print-outs specific to product

Prerequisites:

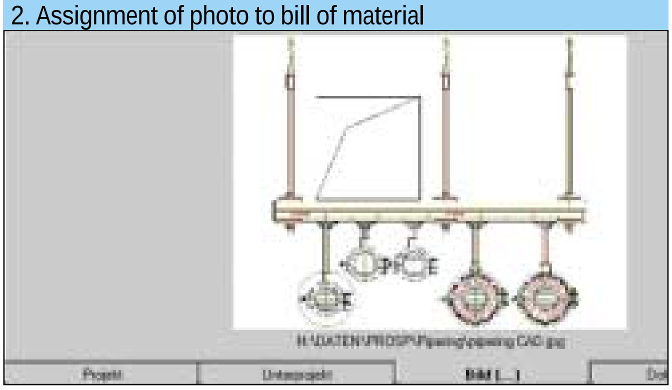
- Windows 95/98, NT4 or 2000
- Internet Explorer 4.0 SP1
- Working memory 32 MB, recommended 64 MB
- Screen resolution 800 x 600
- CD-ROM drive

Solution:

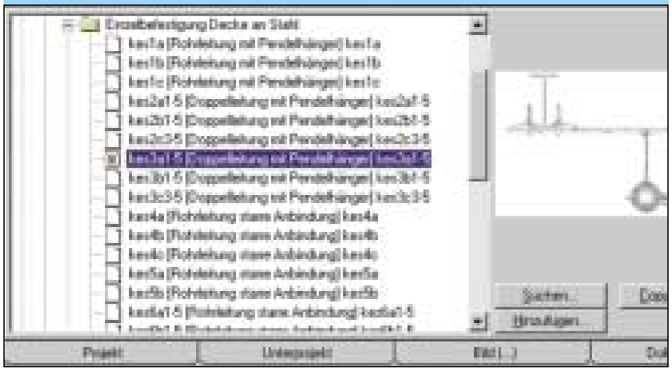
1. Project explorer with bill of material and total line



2. Assignment of photo to bill of material



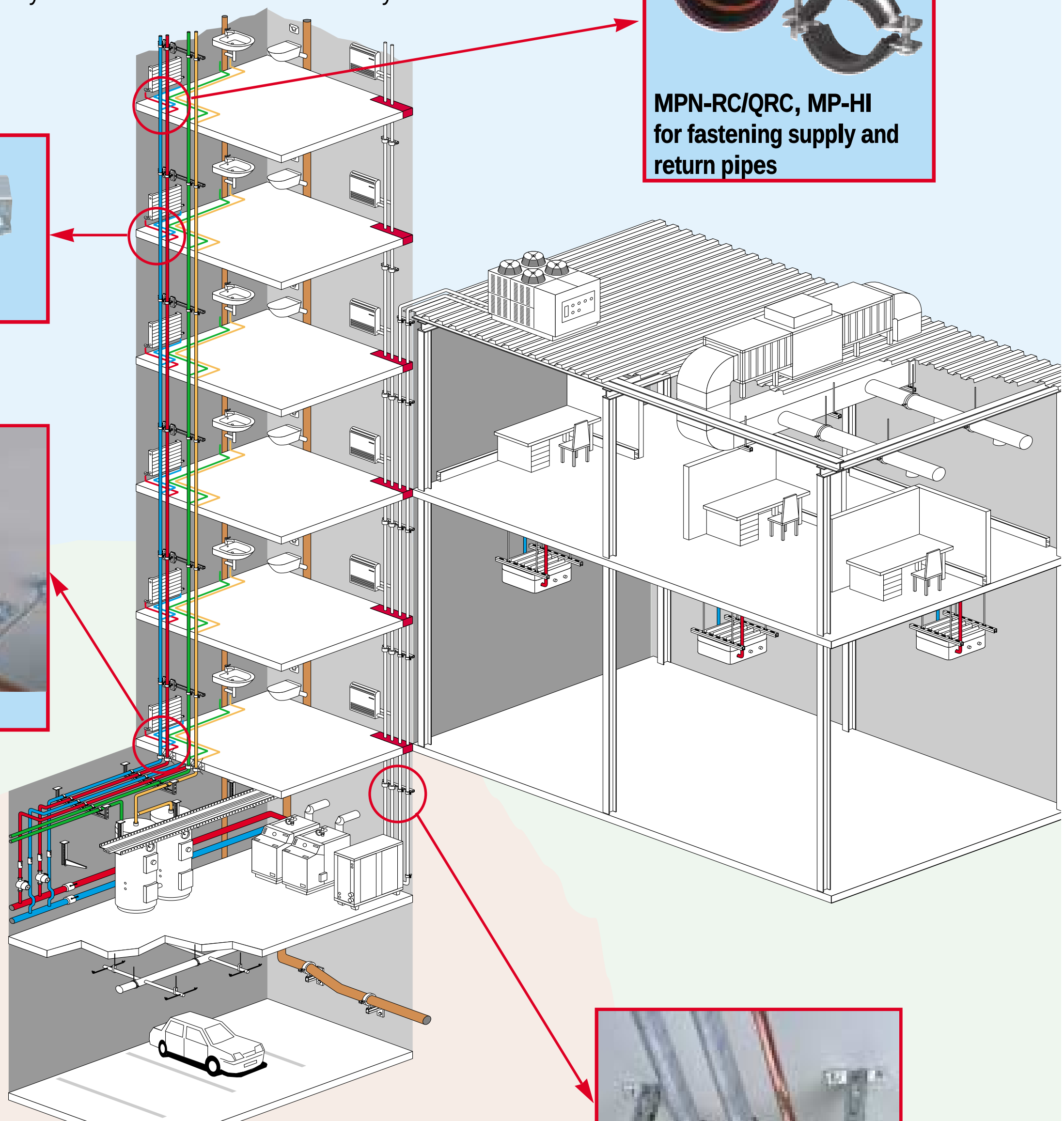
3. Selection of items or assemblies



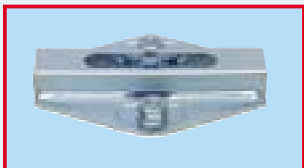
Chain of applications

Heating systems

- **Fastening heating supply and return pipes:**
  MPN-RC standard pipe ring, MPN-QRC deluxe pipe ring and MP-HI pipe ring for apartment construction
- **MFP fixed-point system for pipes exposed to temperature:**
  MFP fixed-point pipe ring with AP bracing (with and without acoustic insulation)
- **U-frame and multiple pipe fastenings:**
  MQ channel installation system and ML channel installation system
- **Fastening of pipes straight to walls and ceilings:**
  MQ channel installation system and ML channel installation system



MPN-RC/QRC, MP-HI for fastening supply and return pipes



MRG roll connector

MFP fixed point

ML system: Multiple pipe fastening

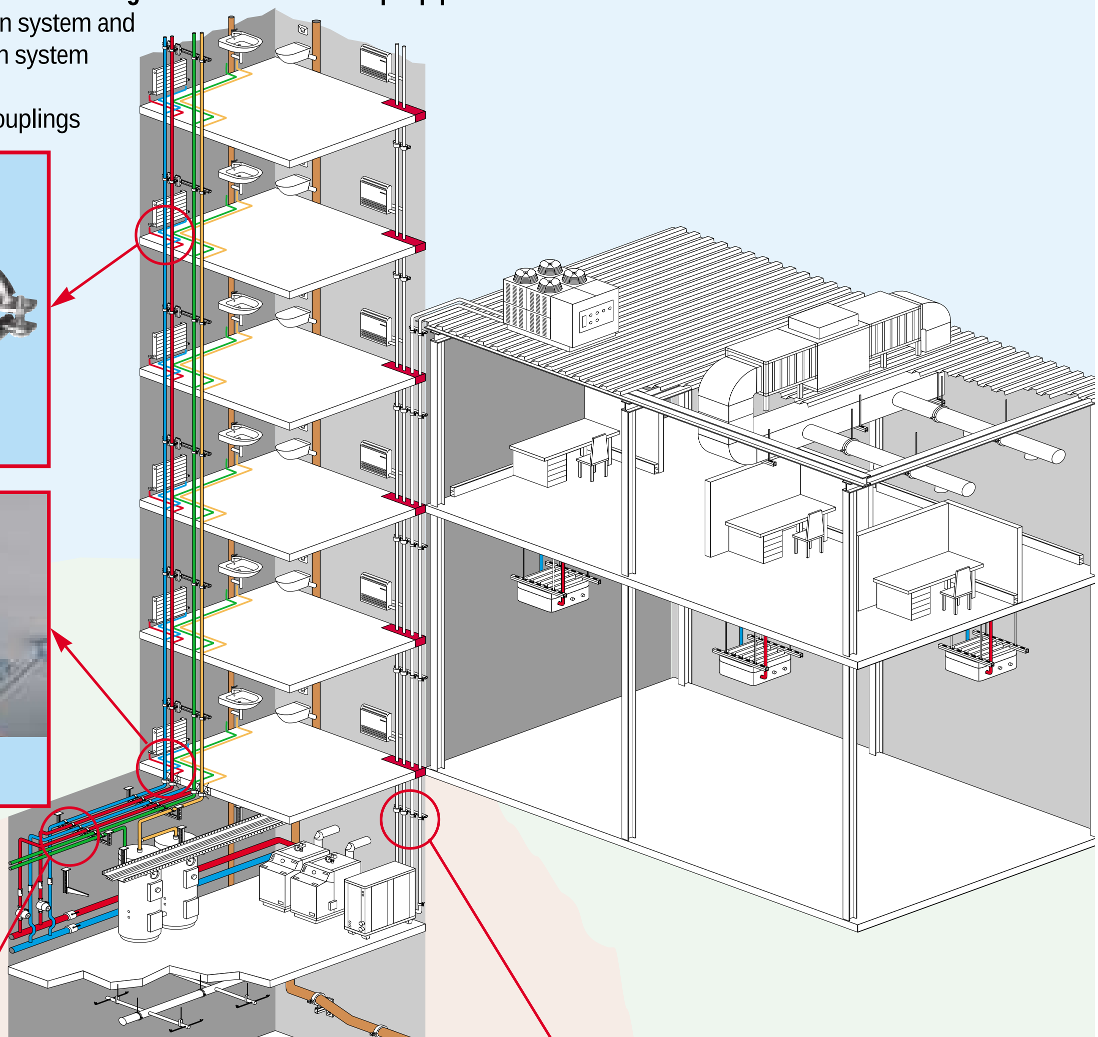
MQ system:
– U-frame
– Multiple pipe fastenings

Sanitary and waste water systems

- **Plumbing and waste water pipes:**
  MPN-RC standard pipe ring, MPN-QRC deluxe pipe ring and MP-HI pipe ring for apartment construction (with and without acoustic insulation)
- **Hot and cold water pipes:**
  MPN-RC standard pipe ring, MPN-QRC deluxe pipe ring and MP-HI pipe ring for apartment construction
- **Rising pipes:**
  MFP fixed-point system (with and without acoustic insulation)
- **U-frame and brackets for fastening wall-mounted or multiple pipes:**
  MQ channel installation system and
  ML channel installation system
- **Clamp couplings:**
  Single-screw clamp couplings

MPN-RC/QRC, MP-HI for sanitary and waste water pipes

MFP fixed point for rising pipes



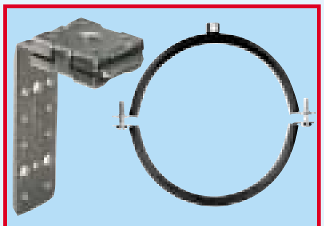
MQ system:
– U-frame
– Wall fastening
– Multiple pipe fastenings

ML system:
For wall fastening

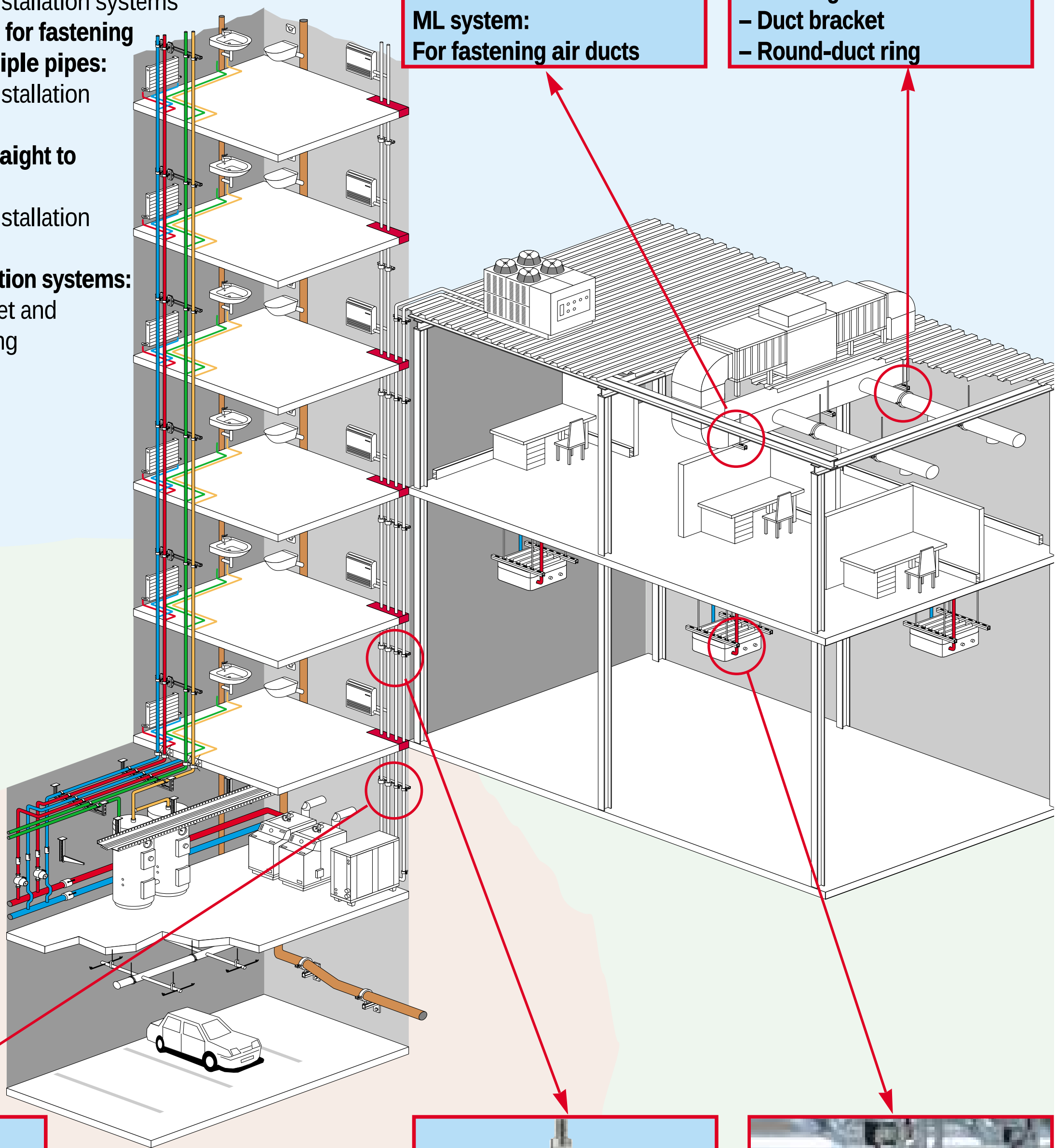
Refrigeration, air-conditioning and ventilation systems

- **Fastening of refrigeration pipes:**
  MIP, KF and MI-CF refrigeration pipe rings
- **Pipes at high temperature:**
  MP-MIS silicone pipe ring, acoustic insulation, up to 200°C
- **Air duct fastening and support frames for air-conditioning control rooms:**
  MQ and ML channel installation systems
- **U-frame and brackets for fastening wall-mounted or multiple pipes:**
  MQ and ML channel installation systems
- **Fastening of pipes straight to walls and ceilings:**
  MQ and ML channel installation systems
- **Fastenings for ventilation systems:**
  MAC-W air duct bracket and MAC-PI round-duct ring

ML system:
For fastening air ducts



Fastening air ducts:
– Duct bracket
– Round-duct ring



MIP pipe support:
For fastening refrigeration pipes

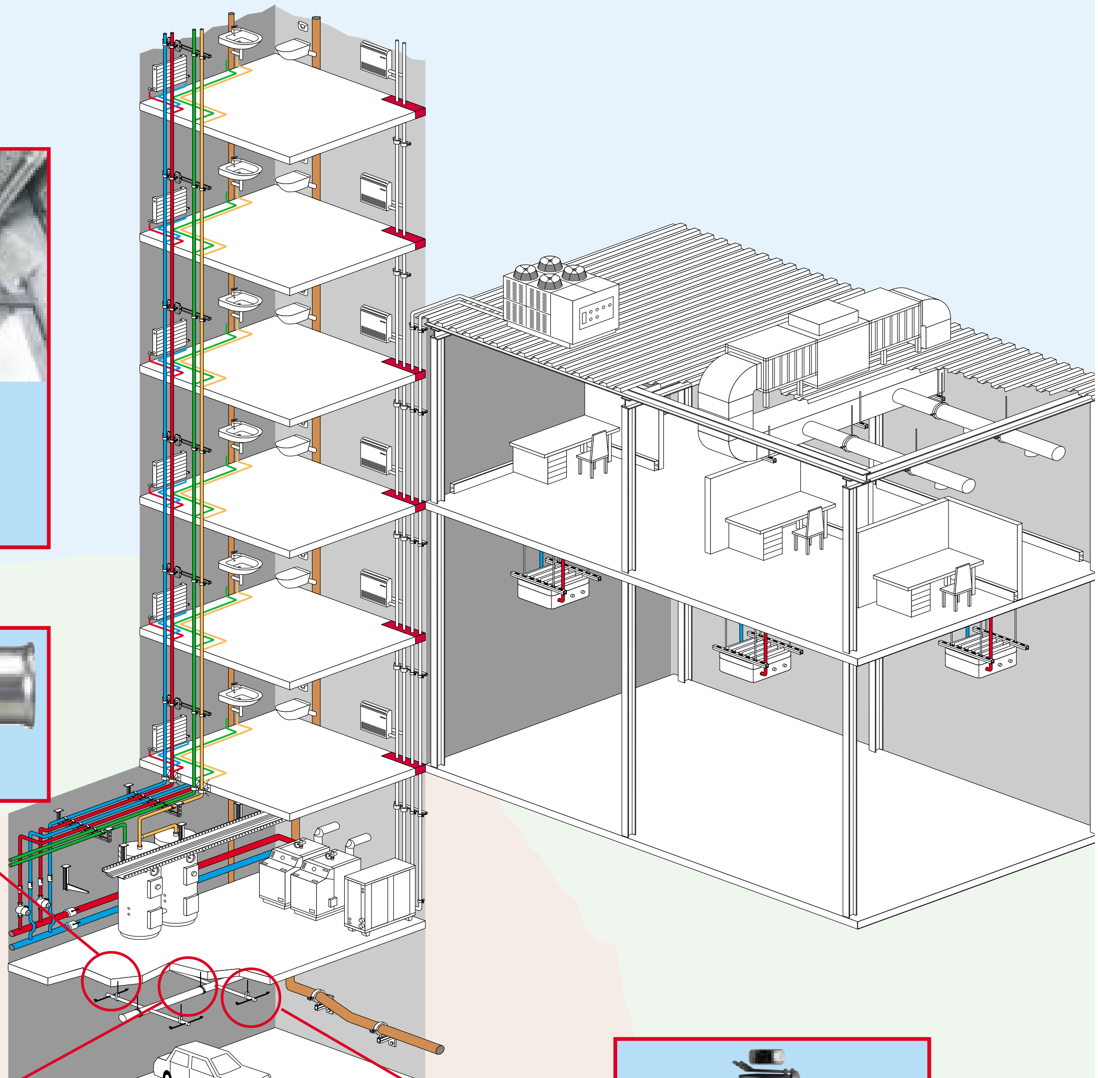
MP-MIS silicone pipe ring:
For high temperatures

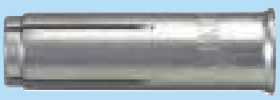
MQ system:
– Duct fastening
– Support frames in ventilation control rooms

Sprinkler systems

- **Single fastening of sprinkler pipes on ceilings:**
  MP-SP sprinkler band hanger (recognised by VdS)
- **Fastening of rising pipes for sprinkler systems:**
  MP-MS heavy-duty sprinkler pipe ring (recognised by VdS)
- **Brackets, channel structures and MQW-S2 (recognised by VdS):**
  MQ and ML channel installation systems
- **Anchor fastening (recognised by VdS):**
  HKD-S flush anchor

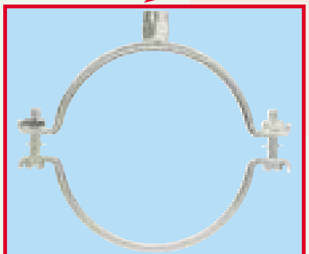
MQ system:
– Bracket *
– Channel structure *
– MQW-S2 angle *
*** (Recognised by VdS)**





HKD-S anchor:
Recognised by VdS

MP-SP sprinkler band hanger

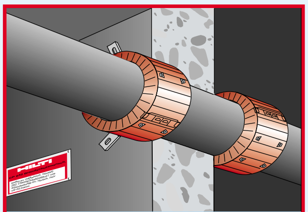


MP-MS heavy-duty sprinkler pipe ring

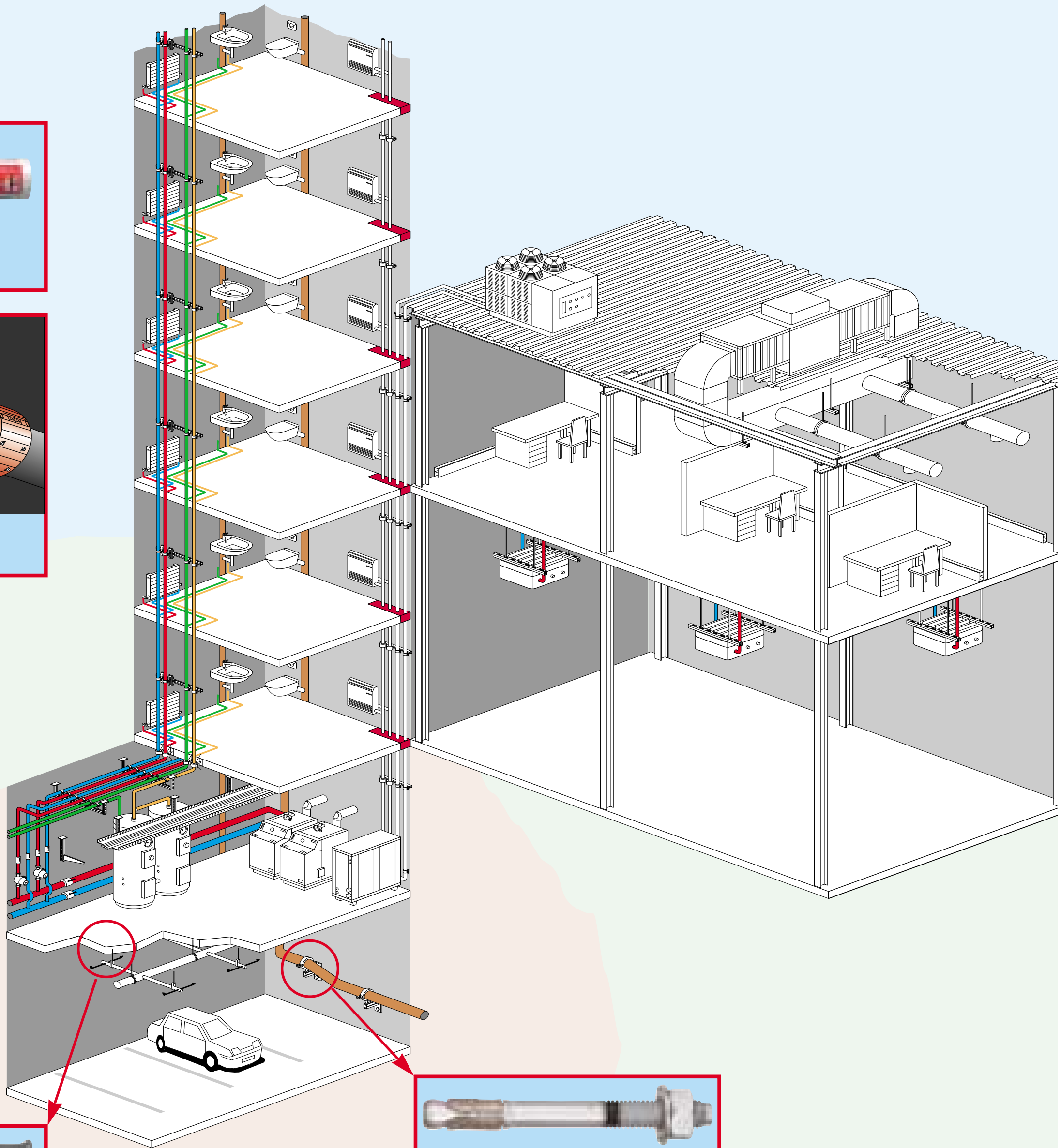
Passive fire prevention (firestop) / anchor systems

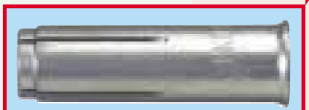
- **Elastic firestop sealant:**
  CP 601S firestop sealant
- **Sealing flammable pipes:**
  CP 642 firestop jackets
- Anchor fastening:
  – HKD-S flush anchor (recognised by VdS)
  – HST stud anchor
  – HUS Hilti universal screw

Firestop:
CP 601 S



Firestop:
CP 642





HDK-S anchor:
Recognised by VdS

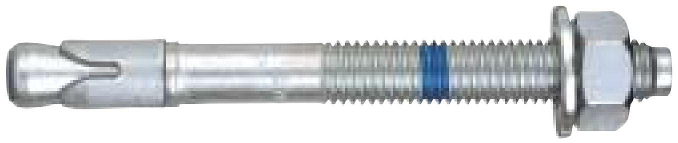
Anchors:
– HST stud anchor
– HUS universal screw

Anchors for fastening to base materials

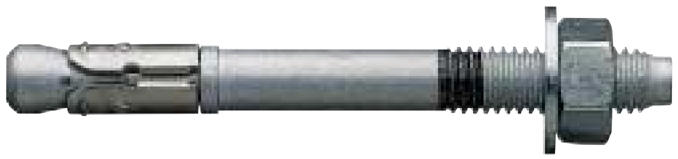
Various anchors exist for fastening parts of the MQ channel installation system to a building structure and they are available in the Hilti sales program. Their selection depends on the loading level and the base material.

Further information and details can be found in product-specific documentation, such as the anchor manual, powder-actuated fastening manual and product catalogues. Your local Hilti sales representative will be pleased to inform you at any time.

HSA



HST



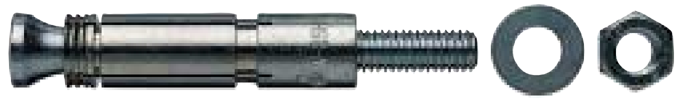
HUS

HKD-S

HIT-HY 20 / HIT-HY 50 / HIT-HY 150

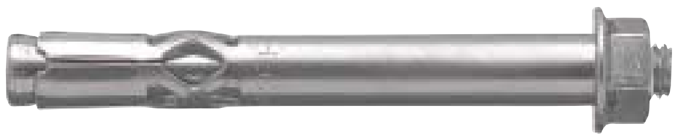
HVU

HSC

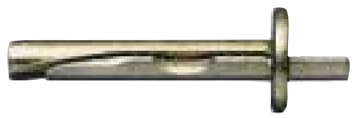


HSL

HLC



DBZ



DX Kwik