HALFEN Adjustable Cantilever
REVOLUTION IN TUNNEL PIPE SUPPORT

HALFEN Adjustable Cantilever

The advantages at a glance

The HALFEN Adjustable Cantilever combines the established high load bearing of the medium duty system with much faster installation. Specifically designed for tunnels or other areas with a curved or inclined substrate. It is not necessary to know the cantilever angle at the time of design.

ONE PART FOR ALL LOCATIONS, DRAMATICALLY REDUCED COMPLEXITY

- **suitable for pipe clamps, shoes and cable trays**
- **can be used for laid or suspended pipes**
- **takes up site tolerance. Cope with changes due to site conditions**

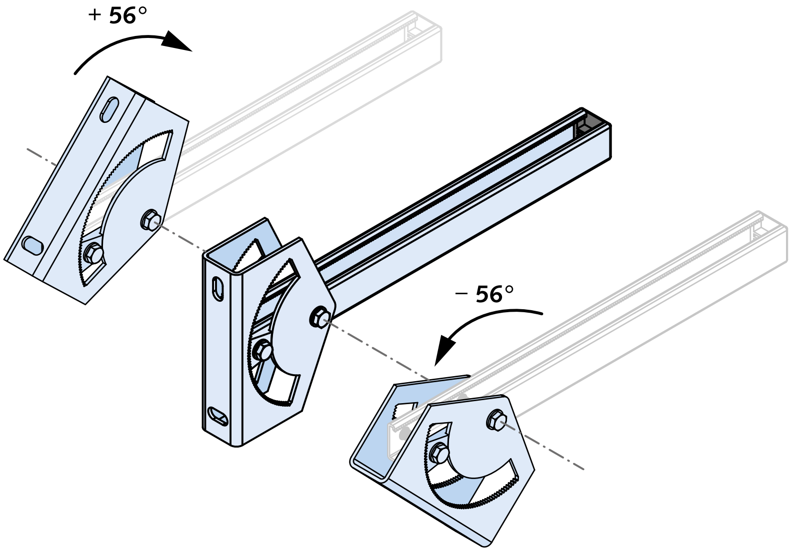
NO CUSTOM CANTILEVERS REQUIRED, NO ANGLES TO MEASURE

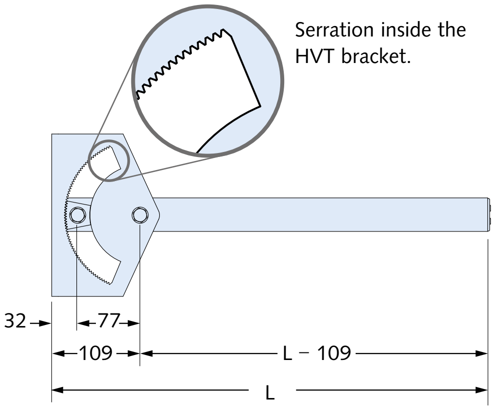
- **simplified design**
- **no risk of custom cantilevers not fitting**
- **rapid delivery of stock item = no custom fabrication lead time**

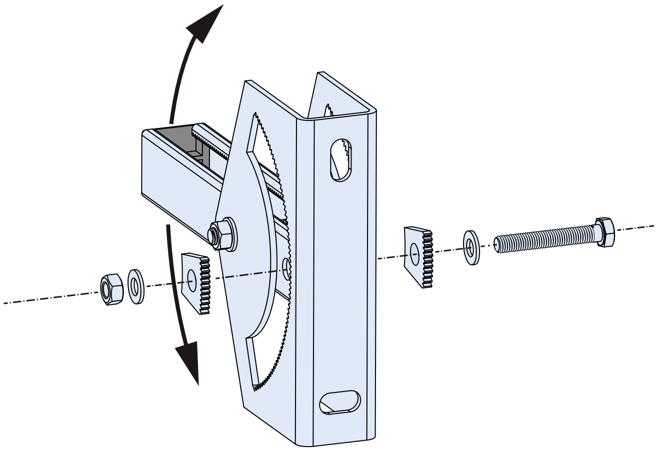
Introduction

The KON 41/V cantilever is freely adjustable from an angle of -56° to +56°, and can be fixed to curved cast-in channel or surface-mounted framing channel or directly to the tunnel wall – including curved or inclined surfaces.

KON 41/V is made without welding, and is composed of a HALFEN Framing channel 41/41 cantilever arm and an adjustable HVT rear bracket.
The HVT rear bracket may also be used separately as a fixed support connection element in the HALFEN 41 Framing Channel System to restrain the rotation of a beam, unlike hinge connection elements.







The cantilever is available in three standard lengths. Custom lengths are also available.

The KON 41/V cantilever is easily set to the correct angle by loosening the serration plates. The bracket is set to the required angle, then the assembly is simply re-tightened.

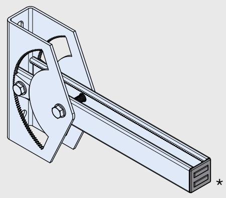
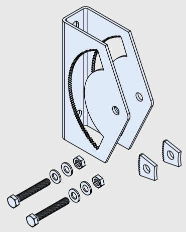
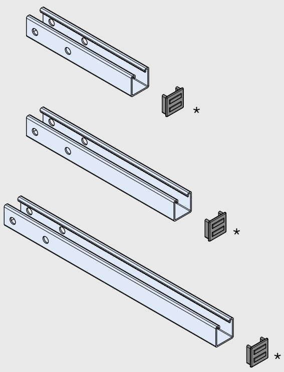
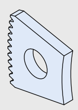
Tried and tested – HALFEN Cast-in or Framing channel with HALFEN Bolts.
The ideal team for fastening in any environment.

For cast-in channels please refer to our catalogue "Technical Product Information HALFEN Cast-in channel".

HALFEN Adjustable Cantilever

KON 41/V

KON 41/V Product overview

	Order no.	Item name	Item description
Sets - Assembled			
	0310.300-00001	KON 41/ V FV L=245 mm Adjustable Cantilever. complete, assembled.	Complete set. Fully assembled.
	0310.300-00002	KON 41/ V FV L=345 mm Adjustable Cantilever. complete, assembled.	Complete set. Fully assembled.
	0310.300-00003	KON 41/ V FV L=495 mm Adjustable Cantilever. complete, assembled.	Complete set. Fully assembled.
Components - for assembly			
	0310.310-00001	KON 41/ V- FV Rear bracket set of Adjustable Cantilever - with toothed plates and assembly bolts.	Requires arm for assembly.
	0310.320-00001	KON 41/ V-FV 245 mm arm only of Adjustable Cantilever	Arm only. Requires rear bracket set for assembly.
	0310.320-00002	KON 41/ V-FV 345 mm arm only of Adjustable Cantilever	Arm only. Requires rear bracket set for assembly.
	0310.320-00003	KON 41/ V-FV 495 mm arm only of Adjustable Cantilever	Arm only. Requires rear bracket set for assembly.
Spares			
	0310.330-00001	KON 41/V- FV spare toothed plate for adjustable cantilever	FV Toothed plate. Single spare, if required
Components and sets in stainless steel (A4) are available on request			

FV = hot-dip galvanized
A4 = stainless steel

* Note – order end caps separately, if required

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KON 41/V

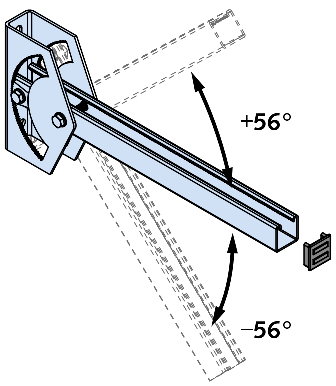
KON 41/V

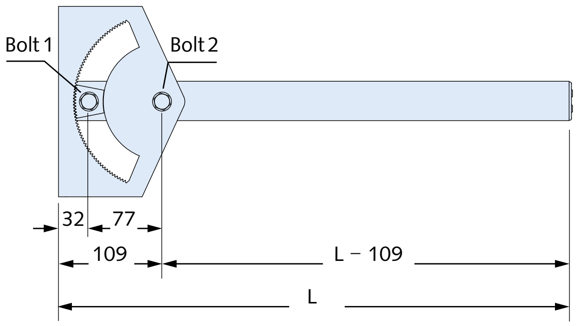
The KON 41/V is the latest addition to the family of adjustable fixing products, providing the designer with elegant, load-tested solutions, while also giving the contractor a rapid and reliable install, which allows for site tolerances.

Design example → see page 8.

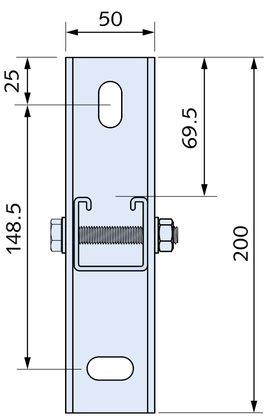
Maximum allowable and design forces

Length L	Load	F_1 ($\Delta/2$, $\Delta/2$)	F_2 (Δ)	F_3, F_3 ($3 \times \Delta/3$)	F_4, F_4, F_4 ($4 \times \Delta/4$)
[mm]	F [kN]	F_1	F_2	F_3	F_4
257	allow. load	5.55	2.89	2.77	1.85
	F_{Rd}	7.76	4.04	3.88	2.59
357	allow. load	3.44	1.72	1.72	1.15
	F_{Rd}	4.82	2.41	2.41	1.61
507	allow. load	2.15	1.07	1.07	0.72
	F_{Rd}	3.00	1.50	1.50	1.00





Cantilever disposition [mm]



Connector reaction forces for the maximum allowable and design forces

Length L	Load	F_Z, F_Q, F_1 ($\Delta/2$, $\Delta/2$)	F_Z, F_Q, F_2 (Δ)	F_Z, F_Q, F_3, F_3 ($3 \times \Delta/3$)	F_Z, F_Q, F_4, F_4, F_4 ($4 \times \Delta/4$)
[mm]	F [kN]	F_1	F_2	F_3	F_4
257	allow. load F_Z	6.83	4.99	6.83	6.83
	$F_{Z,Rd}$	9.57	6.99	9.57	9.57
	allow. load F_Q	5.55	2.89	5.55	5.55
	$F_{Q,Rd}$	7.76	4.04	7.76	7.76
357	allow. load F_Z	5.40	4.14	5.40	5.40
	$F_{Z,Rd}$	7.56	5.79	7.56	7.56
	allow. load F_Q	3.44	1.72	3.44	3.44
	$F_{Q,Rd}$	4.82	2.41	4.82	4.82
507	allow. load F_Z	4.45	3.66	4.45	4.45
	$F_{Z,Rd}$	6.23	5.13	6.23	6.23
	allow. load F_Q	2.15	1.07	2.15	2.15
	$F_{Q,Rd}$	3.00	1.50	3.00	3.00

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KON 41/V Calculation Example

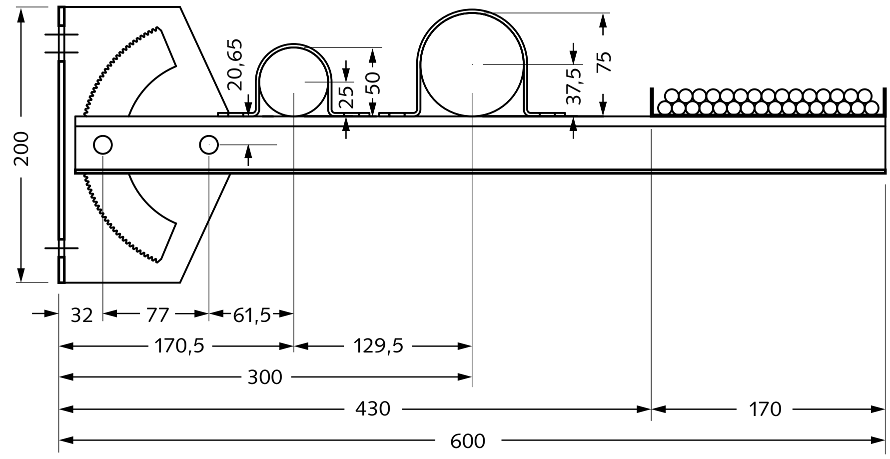
Calculation of the adjustable cantilever KON 41/V is based on the static calculation models as shown in the figures. The example is based on a cantilever with two mounted pipes of different diameter and a cable tray. The example is calculated with design values.

Loads:

$F_{Z,1}$ = 0.95 kN
$F_{X,1}$ = 0.10 kN
$F_{Z,2}$ = 1.90 kN
$F_{X,2}$ = 0.20 kN
q_Z = 1.10 kN/m

Design loads:

$F_{Z,1,d} = 1.4 \cdot F_{Z,1} = 1.33$ kN
$F_{X,1,d} = 1.4 \cdot F_{X,1} = 0.14$ kN
$M_{Y,1,d} = 2.065 \cdot F_{X,1,d} = 0.14$ kNcm
$F_{Z,2,d} = 1.4 \cdot F_{Z,2} = 2.66$ kN
$F_{X,2,d} = 1.4 \cdot F_{X,2} = 0.8$ kN
$M_{Y,2,d} = 2.065 \cdot F_{X,2,d} = 0.58$ kNcm
$q_{Z,d} = 1.4 \cdot q_Z = 1.54$ kN/m



Calculation model 1 for design of:

HZM 41/41 or HM 41/41 profile:

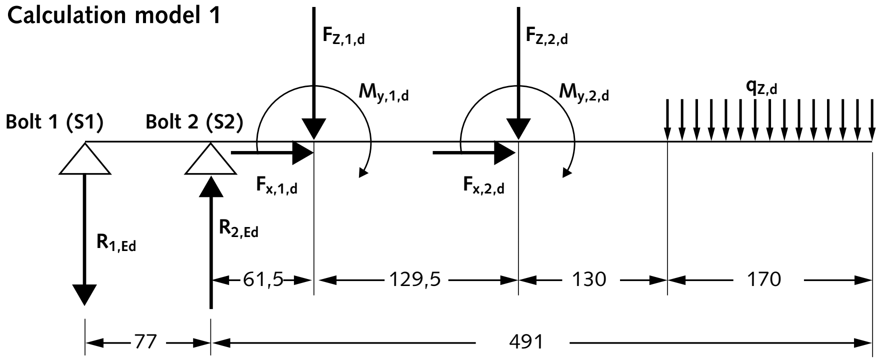
shear forces at infinite distance to bolt 2 from both sides

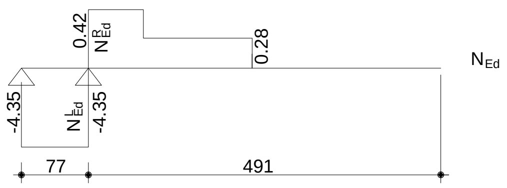
$V^L_{Z,Ed} \leq V_{Z,Rd}$
$V^R_{Z,Ed} \leq V_{Z,Rd}$

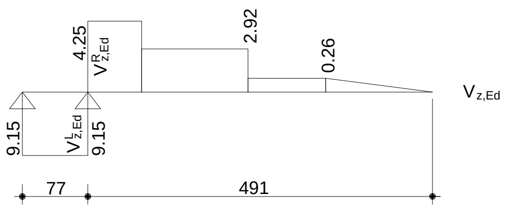
bending moment above bolt 2, considering shear force on both sides
$M_{Y,Ed} \leq M_{Y,Rd}$ (with $V^L_{Z,Ed}$) ρ if required
$M_{Y,Ed} \leq M_{Y,Rd}$ (with $V^R_{Z,Ed}$) ρ if required

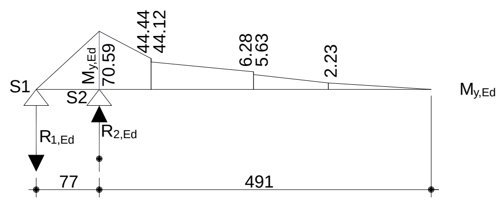
normal force on both sides of bolt 2
$N^L_{Ed} \leq N_{Rd}$ (ρ if required)
$N^L_{Ed} \leq N_{Rd}$ (ρ if required)

Calculation model 1









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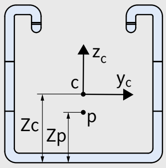
KON 41/V

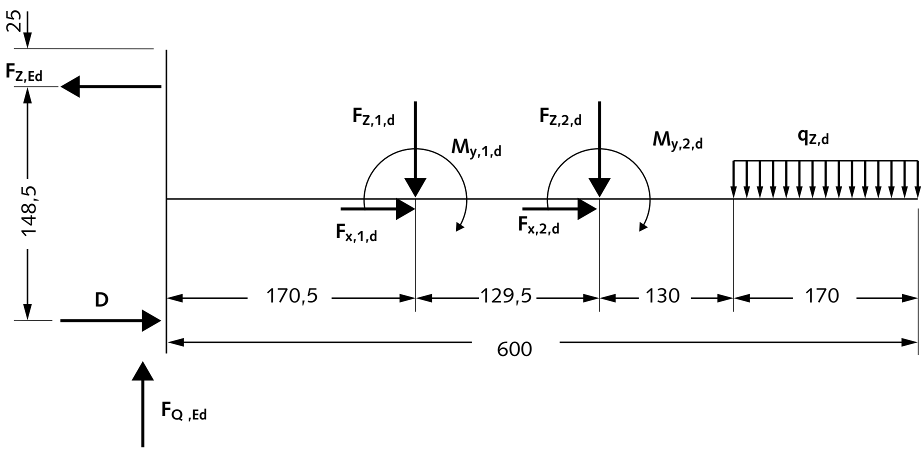
HZM or HM 41/41

Section properties	f_Y [N/mm²]	τ [N/mm²]	A [cm²]	Zc [cm]	I_Y [cm⁴]	I_Z [cm⁴]	Zp [cm]	W_{pl}[cm³]	N [kN]	V_Z [kN]	M_Y [kNcm]	Deformation
	235.00	135.68	2.688	1.725	7.130	6.887	0.969	3.946	63.16	11.98	69.67	elastic
									63.16	17.08	92.73	plastic

f_Y: material yield strength
τ: material shear strength
A: section area
Z_c: ordinate of elastic centroid
I_y, I_z: bending moment of inertia
Z_p: ordinate of plastic centroid
W_{pl}: plastic moment resistance
el: elastic section forces N_{el}; $V_{y,el}$; $M_{y,el}$
pl: plastic section forces N_{pl}; $V_{y,pl}$; $M_{y,pl}$

We provide technical support for planning and calculating of all assembly products. Please refer to your local sales company. Contact information can be found at www.halfen.com

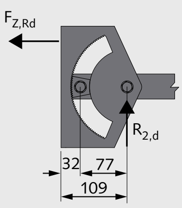
Calculation model 2



Calculation model 2
for calculation of connector forces:

$F_{Z,Ed} \leq F_{Z,Rd}$
$F_{Q,Ed} \leq F_{Q,Rd}$

Connector forces

	Allowable forces		Design forces	
	Allowable R_2 [kN]	Allowable F_Z [kN]	$R_{2,d}$ [kN]	$F_{Z,d}$ [kN]
	12.0	10.7	16.8	15.0

The values are adopted from the tables "maximum forces" and "connector reaction forces" normalization according f_y.

HVT Connector:
According to the first design criteria the following conditions must be verified:

$R_{2,Ed} \leq R_{2,d}$ (for design loads)
$R_{2,Ed} \leq R_{2,allow.}$ (for allowable loads)

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KON 41/V Calculation Example

Example:
From calculation model 2 the connector force $F_{Z,Ed}$ can be calculated

Connector force

$$\sum M^{+} = q_{z,d} \cdot 0.17 \cdot 51.5 + F_{z,2,d} \cdot 30 + M_{y,2,d} + F_{z,1,d} \cdot 17{,}05 + M_{y,1,d}$$

$$F_{Z,Ed} = \frac{1}{14.85} \cdot \sum M^{+} - F_{x,1,d} - F_{x,2,d}$$

$$F_{z,Ed} = 7.45 \text{ kN}$$

Design values for KON 41/V-FV

see table „Section properties“

$$M_{y,Rd} = \frac{M_{y,pl}}{\gamma_m} = \frac{92.73}{1.1} = 84.30 \text{ kN}$$

$$V_{z,Rd} = \frac{V_{z,pl}}{\gamma_m} = \frac{17.08}{1.1} = 15.52 \text{ kN}$$

$$N_{Rd} = \frac{N_{pl}}{\gamma_m} = \frac{63.16}{1.1} = 57.42 \text{ kN}$$

$$R_{2,d} = 16.8 \text{ kN}$$

$$F_{z,d} = 15.0 \text{ kN}$$

Proof of cantilever profile HZM 41/41 left from support S2

$$\frac{V^{L}_{z,Ed}}{V_{z,Rd}} = \frac{9.15}{15.52} = 0.59 \text{ kN} \quad < 1.0 \quad ✓$$

$$V^{L}_{z,Ed} > 0.5 \cdot V_{z,Rd} \Rightarrow \rho = \left(2 \cdot \frac{V^{L}_{z,Ed}}{V_{z,Rd}} - 1\right)^2 = 0.0321 \quad ✓$$

$$\frac{M_{y,Ed}}{(1-\rho) \cdot M_{y,Rd}} = \frac{70.59}{(1-0.321) \cdot 84.3} = 0.865 \text{ kN} < 1.0 \quad ✓$$

$$\frac{N^{L}_{Ed}}{(1-\rho) \cdot N_{Rd}} = \frac{4.35}{(1-0.321) \cdot 57.42} = 0.078 \text{ kN} < 1.0 \quad ✓$$

$$\frac{M_{y,Ed}}{(1-\rho) \cdot M_{y,Rd}} + \frac{N^{L}_{,Ed}}{(1-\rho) \cdot N_{Rd}} = 0.943 \text{ kN} < 1.0 \quad ✓$$

Proof of cantilever profile HZM 41/41 right from support S2

$$\frac{V^{R}_{z,Ed}}{V_{z,Rd}} = \frac{4.25}{15.52} = 0.27 \text{ kN} \quad < 1.0 \quad ✓$$

$$V^{R}_{z,Ed} < 0.5 \cdot V_{Z,Rd} \Rightarrow \rho = 0$$

$$\frac{M_{y,Ed}}{M_{y,Rd}} = \frac{70.59}{84.3} = 0.837 \text{ kN} < 1.0 \quad ✓$$

$$\frac{N^{R}_{Ed}}{N_{Rd}} = \frac{0.42}{57.42} = 0.007 \text{ kN} \quad < 1.0 \quad ✓$$

$$\frac{M_{y,Ed}}{(1-\rho) \cdot M_{y,Rd}} + \frac{N^{R}_{Ed}}{(1-\rho) \cdot N_{Rd}} = 0.844 \text{ kN} < 1.0 \quad ✓$$

All design criteria are fullfilled by the cantilever profile HZM 41/41

Proof of the HVT 41/V-VK-FV connector

see table „Connector forces“

$$\frac{R_{2,Ed}}{R_{2,d}} = \frac{13.4}{16.8} = 0.79 \text{ kN} \quad < 1.0 \quad ✓$$

$$\frac{F_{x,Ed}}{F_{x,d}} = \frac{7.45}{15.0} = 0.50 \text{ kN} \quad < 1.0 \quad ✓$$

All design criteria are fullfilled by the connector

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Full contact details are available online at Leviat.com.

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