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.

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

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

## KON 41/V

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Item name</th>
<th>Item description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sets - Assembled</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0310.300-00001</td>
<td>KON 41/ V FV L=245 mm Adjustable Cantilever.</td>
<td>Complete, assembled.</td>
</tr>
<tr>
<td></td>
<td>complete, assembled.</td>
<td></td>
</tr>
<tr>
<td>0310.300-00002</td>
<td>KON 41/ V FV L=345 mm Adjustable Cantilever.</td>
<td>Complete, assembled.</td>
</tr>
<tr>
<td></td>
<td>complete, assembled.</td>
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</tr>
<tr>
<td>0310.300-00003</td>
<td>KON 41/ V FV L=495 mm Adjustable Cantilever.</td>
<td>Complete, assembled.</td>
</tr>
<tr>
<td></td>
<td>complete, assembled.</td>
<td></td>
</tr>
<tr>
<td><strong>Components - for assembly</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0310.310-00001</td>
<td>KON 41/ V- FV Rear bracket set of Adjustable Cantilever</td>
<td>Requires arm for assembly.</td>
</tr>
<tr>
<td></td>
<td>with toothed plates and assembly bolts.</td>
<td></td>
</tr>
<tr>
<td>0310.320-00001</td>
<td>KON 41/ V-FV 245 mm arm only of Adjustable Cantilever</td>
<td>Arm only. Requires rear bracket set for assembly.</td>
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<tr>
<td>0310.320-00002</td>
<td>KON 41/ V-FV 345 mm arm only of Adjustable Cantilever</td>
<td>Arm only. Requires rear bracket set for assembly.</td>
</tr>
<tr>
<td>0310.320-00003</td>
<td>KON 41/ V-FV 495 mm arm only of Adjustable Cantilever</td>
<td>Arm only. Requires rear bracket set for assembly.</td>
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<tr>
<td><strong>Spares</strong></td>
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<td></td>
</tr>
<tr>
<td>0310.330-00001</td>
<td>KON 41/V-FV spare toothed plate for adjustable cantilever</td>
<td>FV Toothed plate. Single spare, if required</td>
</tr>
</tbody>
</table>

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
HALFEN Adjustable Cantilever
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

<table>
<thead>
<tr>
<th>Length L [mm]</th>
<th>Load</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[F [kN]]</td>
<td>Δ/2</td>
<td>Δ/2</td>
<td>Δ</td>
<td>Δ/4</td>
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<tr>
<td>257</td>
<td>allow. load</td>
<td>5.55</td>
<td>2.89</td>
<td>2.77</td>
<td>1.85</td>
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<tr>
<td></td>
<td>FRd</td>
<td>7.76</td>
<td>4.04</td>
<td>3.88</td>
<td>2.59</td>
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<tr>
<td>357</td>
<td>allow. load</td>
<td>3.44</td>
<td>1.72</td>
<td>1.72</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>FRd</td>
<td>4.82</td>
<td>2.41</td>
<td>2.41</td>
<td>1.61</td>
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<tr>
<td>507</td>
<td>allow. load</td>
<td>2.15</td>
<td>1.07</td>
<td>1.07</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>FRd</td>
<td>3.00</td>
<td>1.50</td>
<td>1.50</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Connector reaction forces for the maximum allowable and design forces

<table>
<thead>
<tr>
<th>Length L [mm]</th>
<th>Load</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[F [kN]]</td>
<td>Δ/2</td>
<td>Δ/2</td>
<td>Δ</td>
<td>Δ/4</td>
</tr>
<tr>
<td>257</td>
<td>allow. load</td>
<td>6.83</td>
<td>4.99</td>
<td>6.83</td>
<td>6.83</td>
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<tr>
<td>357</td>
<td>allow. load</td>
<td>5.55</td>
<td>2.89</td>
<td>5.55</td>
<td>5.55</td>
</tr>
<tr>
<td></td>
<td>FRd</td>
<td>7.76</td>
<td>4.04</td>
<td>7.76</td>
<td>7.76</td>
</tr>
<tr>
<td>507</td>
<td>allow. load</td>
<td>5.40</td>
<td>4.14</td>
<td>5.40</td>
<td>5.40</td>
</tr>
<tr>
<td></td>
<td>FRd</td>
<td>7.56</td>
<td>5.79</td>
<td>7.56</td>
<td>7.56</td>
</tr>
</tbody>
</table>

Cantilever disposition [mm]
HALFEN Adjustable Cantilever
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:
- \( F_{Z,1} = 0.95 \text{kN} \)
- \( F_{X,1} = 0.10 \text{kN} \)
- \( F_{Z,2} = 1.90 \text{kN} \)
- \( F_{X,2} = 0.20 \text{kN} \)
- \( q_z = 1.10 \text{kN/m} \)

Design loads:
- \( F_{Z,1,d} = 1.4 \cdot F_{Z,1} = 1.33 \text{kN} \)
- \( F_{X,1,d} = 1.4 \cdot F_{X,1} = 0.14 \text{kN} \)
- \( M_{Y,1,d} = 2.065 \cdot F_{X,1,d} = 0.14 \text{kNcm} \)
- \( F_{Z,2,d} = 1.4 \cdot F_{Z,2} = 2.66 \text{kN} \)
- \( F_{X,2,d} = 1.4 \cdot F_{X,2} = 0.8 \text{kN} \)
- \( M_{Y,2,d} = 2.065 \cdot F_{X,2,d} = 0.58 \text{kNcm} \)
- \( q_{z,d} = 1.4 \cdot q_z = 1.54 \text{kN/m} \)

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

\[
V_{Z,Ed}^L \leq V_{Z,Rd} \\
V_{Z,Ed}^R \leq V_{Z,Rd}
\]

bending moment above bolt 2, considering shear force on both sides

\[
M_{Y,Ed} \leq M_{Y,Rd} \text{ (with } V_{Z,Ed}^{L,R} \text{) if required}
\]

normal force on both sides of bolt 2

\[
N_{Ed}^L \leq N_{Rd} \text{ (p if required)} \\
N_{Ed}^R \leq N_{Rd} \text{ (p if required)}
\]
HALFEN Adjustable Cantilever
KON 41/V

<table>
<thead>
<tr>
<th></th>
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<tr>
<td></td>
<td>235.00</td>
<td>135.68</td>
<td>2.688</td>
<td>1.725</td>
<td>6.887</td>
<td>0.989</td>
<td>3.946</td>
<td>63.16</td>
<td>11.98</td>
<td>69.67</td>
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<tr>
<td></td>
<td>129.5</td>
<td>130</td>
<td>170</td>
<td>170</td>
<td>170</td>
<td>170</td>
<td>63.16</td>
<td>11.98</td>
<td>92.73</td>
<td>plastic</td>
</tr>
</tbody>
</table>

f_Y: material yield strength
τ: material shear strength
A: section area
Zc: ordinate of elastic centroid
l_Y, l_z: bending moment of inertia
W_pl: plastic moment resistance
N, V_Z, M_Y: elastic section forces
N_pl, V_pl, M_pl: plastic section forces

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 for calculation of connector forces:

F_Z,Ed ≤ F_Z,Rd
F_Q,Ed ≤ F_Q,Rd

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

R_2,Ed ≤ R_2,d (for design loads)
R_2,Ed ≤ R_2,allow. (for allowable loads)
HALFEN Adjustable Cantilever
KON 41/V Calculation Example

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

Connector force

$$\Sigma M^* = q_{z,d} \cdot 0.17 \cdot 51.5 + F_{z,2,d} \cdot 30 + M_{y,2,d} + F_{z,1,d} \cdot 17.05 + M_{y,1,d}$$

$$F_{z,\text{Ed}} = \frac{1}{14.85} \cdot \Sigma M^* - F_{x,1,d} - F_{x,2,d}$$

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

Design values for KON 41/V-FV
see table „Section properties“

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

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

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

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

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

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

$$\frac{V_{z,\text{Ed}}}{V_{z,\text{Rd}}} = \frac{4.25}{15.52} = 0.27 \text{ kN} < 1.0 \checkmark$$

$$\frac{V_{z,\text{Ed}}}{V_{z,\text{Rd}}} < 0.5 \cdot V_{z,\text{Rd}} \Rightarrow \rho = \frac{V_{z,\text{Ed}}}{V_{z,\text{Rd}}}$$

$$\frac{M_{y,\text{Ed}}}{M_{y,\text{Rd}}} = \frac{70.59}{84.3} = 0.835 \text{ kN} < 1.0 \checkmark$$

$$\frac{N_{\text{Ed}}}{N_{\text{Rd}}} = \frac{4.35}{57.42} = 0.076 \text{ kN} < 1.0 \checkmark$$

$$\frac{M_{y,\text{Ed}}}{(1-p) \cdot M_{y,\text{Rd}}} + \frac{N_{\text{Ed}}}{(1-p) \cdot N_{\text{Rd}}} = 0.943 \text{ kN} < 1.0 \checkmark$$

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

Proof of the HVT 41/V-VK-FV connector
see table „Connector forces”

$$\frac{R_{z,\text{Ed}}}{R_{z,d}} = \frac{13.4}{16.8} = 0.79 \text{ kN} < 1.0 \checkmark$$

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

All design criteria are fulfilled by the connector

Leviat
Please contact Leviat for more information on these products. Full contact details are available online at Leviat.com.

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