HALFEN Adjustable Cantilever

A 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 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.

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

For cast-in channels please refer to our catalogue "Technical Product Information HALFEN Cast-in channel".
## HALFEN Adjustable Cantilever
### KON 41/V

<table>
<thead>
<tr>
<th>Sets - Assembled</th>
<th>Order no.</th>
<th>Item name</th>
<th>Item description</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Components - for assembly</th>
<th>Order no.</th>
<th>Item name</th>
<th>Item description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0310.310-00001</td>
<td>KON 41/ V- FV Rear bracket set of Adjustable Cantilever - with toothed plates and assembly bolts.</td>
<td>Requires arm for assembly.</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>
<td></td>
</tr>
<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>
<td></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>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spares</th>
<th>Order no.</th>
<th>Item name</th>
<th>Item description</th>
</tr>
</thead>
<tbody>
<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>
<td></td>
</tr>
</tbody>
</table>

Components and sets in stainless steel (A4) are available on request

<table>
<thead>
<tr>
<th>FV = hot-dip galvanized</th>
<th>* Note – order end caps separately, if required</th>
</tr>
</thead>
<tbody>
<tr>
<td>A4 = stainless steel</td>
<td></td>
</tr>
</tbody>
</table>

*4*
KON 41/V
The KON 41/V is the latest addition to the HALFEN 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.
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:
- $F_{Z,1,d} = 1.4 \cdot F_{Z,1} = 1.33 \text{ kN}$
- $F_{X,1,d} = 1.4 \cdot F_{X,1} = 0.14 \text{ kN}$
- $M_{Y,1,d} = 2.065 \cdot F_{X,1,d} = 0.14 \text{ kNm}$
- $F_{Z,2,d} = 1.4 \cdot F_{Z,2} = 2.66 \text{ kN}$
- $F_{X,2,d} = 1.4 \cdot F_{X,2} = 0.28 \text{ kN}$
- $M_{Y,2,d} = 2.065 \cdot F_{X,2,d} = 0.58 \text{ kNm}$
- $q_{z,d} = 1.4 \cdot q_z = 1.54 \text{ kN/m}$

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
  \[ V_{Z,Ed} \leq V_{Z,Rd} \]
  \[ V_{Z,Ed} \leq V_{Z,Rd} \]

- bending moment above bolt 2, considering shear force on both sides
  \[ M_{Y,Ed} \leq M_{Y,Rd} \] (with $V_{Z,Ed}^\alpha$ if required)
  \[ M_{Y,Ed} \leq M_{Y,Rd} \] (with $V_{Z,Ed}^\alpha$ if required)

- normal force on both sides of bolt 2
  \[ N_{Ed} \leq N_{Rd} \] (if required)
  \[ N_{Ed} \leq N_{Rd} \] (if required)
HALFEN Adjustable Cantilever

KON 41/V

### HZM or HM 41/41

<table>
<thead>
<tr>
<th>Section properties</th>
<th>f_Y [N/mm²]</th>
<th>τ [N/mm²]</th>
<th>A [cm²]</th>
<th>Z_{c} [cm]</th>
<th>l_{y} [cm]</th>
<th>Z_{p} [cm]</th>
<th>W_{pl} [cm³]</th>
<th>N [kN]</th>
<th>V_{Z} [kN]</th>
<th>M_{Y} [kNcm]</th>
<th>Deformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z_{c}</td>
<td>235.00</td>
<td>135.68</td>
<td>2.688</td>
<td>1.725</td>
<td>6.897</td>
<td>0.969</td>
<td>3.946</td>
<td>63.16</td>
<td>11.98</td>
<td>69.67</td>
<td>elastic</td>
</tr>
<tr>
<td>yc</td>
<td>63.16</td>
<td>17.08</td>
<td>92.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>plastic</td>
</tr>
</tbody>
</table>

- f_Y: material yield strength
- τ: material shear strength
- A: section area
- Z_{c}: ordinate of elastic centroid
- l_{y}, l_{z}: bending moment of inertia
- Z_{p}: ordinate of plastic centroid
- W_{pl}: plastic moment resistance
- el: elastic section forces N_{el}, V_{el}, M_{el}
- pl: plastic section forces N_{pl}, V_{pl}, M_{pl}

### Connector forces

<table>
<thead>
<tr>
<th>Allowable forces</th>
<th>Design forces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable R_{2}</td>
<td>Allowable F_{2}</td>
</tr>
<tr>
<td>[kN]</td>
<td>[kN]</td>
</tr>
<tr>
<td>12.0</td>
<td>10.7</td>
</tr>
</tbody>
</table>

The values are adopted from the tables "maximum forces" and "connector reaction forces" normalization according f_{y}.

HALFEN provides 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} ≤ 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 $F_{Z,Ed}$ can be calculated.

**Connector force**

\[
\sum M^+ = qz,d \cdot 0.17 \cdot 51.5 + M_{Y,2,d} + F_{Z,2,d} \cdot 30 + M_{Y,1,d} + F_{Z,1,d} \cdot 17.05 + M_{Y,1,d}
\]

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

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

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

\[
M_{Y,Rd} = \frac{M_{Y,pl}}{\gamma_m} = \frac{92.73}{1.1} = 84.30 \text{ kN}
\]

\[
V_{Z,Rd} = \frac{V_{Z,pl}}{\gamma_m} = \frac{17.08}{1.1} = 15.52 \text{ kN}
\]

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

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

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

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

\[
\frac{V_{Z,Ed}^2}{V_{Z,Rd}} = \frac{9.15}{15.52} = 0.59 < 1.0
\]

$V_{Z,Ed} < 0.5 \cdot V_{Z,Rd} \Rightarrow \rho = 0$

\[
\frac{M_{Y,Ed}}{(1-\rho) \cdot M_{Y,Rd}} = \frac{70.59}{(1-0.321) \cdot 84.3} = 0.865 < 1.0
\]

\[
\frac{N_{Rd}}{(1-\rho) \cdot N_{Rd}} = \frac{0.42}{(1-0.321) \cdot 57.42} = 0.007 < 1.0
\]

\[
\frac{M_{Y,Ed}}{(1-\rho) \cdot M_{Y,Rd}} + \frac{N_{Rd}}{(1-\rho) \cdot N_{Rd}} = 0.844 < 1.0
\]

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“

\[
\frac{R_{Z,Ed}}{R_{Z,d}} = \frac{13.4}{16.8} = 0.79 < 1.0
\]

\[
\frac{F_{x,Ed}}{F_{x,d}} = \frac{7.45}{15.0} = 0.50 < 1.0
\]

All design criteria are fulfilled by the connector