X-HVB
DATA SHEET

Shear connector

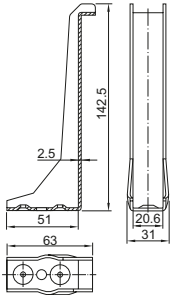
May 2021

X-HVB Shear connector

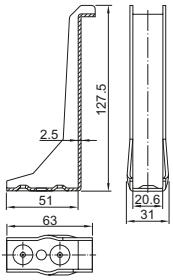
Product data

Dimensions

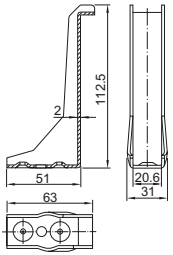
X-HVB 140



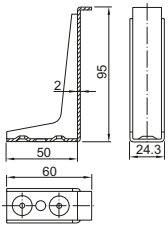
X-HVB 125



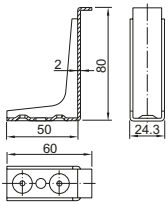
X-HVB 110



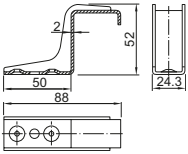
X-HVB 95



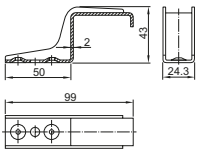
X-HVB 80



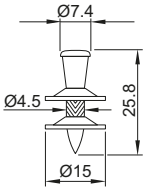
X-HVB 50



X-HVB 40



X-ENP-21 HVB



Material specifications

X-HVB

Carbon steel:	R_m = 295–350 N/mm²
Zinc coating:	≥ 3 µm

X-ENP-21 HVB

Carbon steel shank:	HRC58
Zinc coating:	8–16 µm

Recommended fastening tools

Tool	DX 76	DX 76 PTR
Fastener guide	X-76-F-HVB	X-76-F-HVB-PTR
Piston	X-76-P-HVB	X-76-P-HVB-PTR
Cartridges	6.8/18 M black, red (for details see application limit X-ENP-21 HVB)	

- For more details, please refer to the chapter **Accessories and consumables compatibility** in the Direct Fastening Technology Manual (DFTM).

Approvals and design guidelines

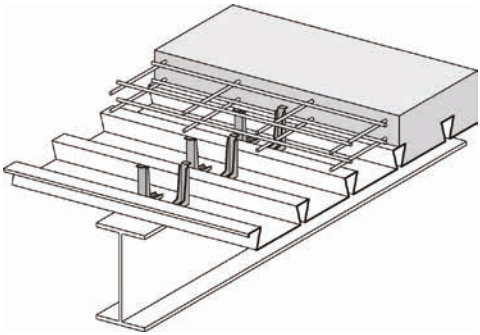
ETA-15/0876, design according to Eurocode 4 (EN 1994-1-1, EN 1994-1-2) and Eurocode 8 (EN 1998-1)

MLIT / BCJ (Japan)

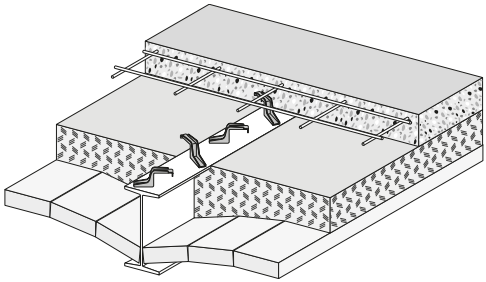
- With regard to composite design according to AISC (American Institute of Steel Construction), please refer to the technical literature of Hilti North America (Product Technical Guide).

Applications

Examples



Typical application of X-HVB shear connector with steel deck, e.g. new construction.



Typical application of X-HVB shear connector with jack arch system (without steel deck), e.g. rehabilitation project. “Duckwalk”

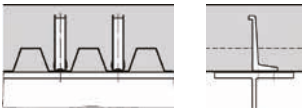
Characteristic and design resistance (ETA-15/0876) in composite beams with solid slabs

Shear Connector	Characteristic Resistance P_{Rk} [kN]	Design Resistance P_{Rd} [kN]	Minimum base material thickness [mm]	X-HVB positioning	Ductility assessment
X-HVB 40	29	23	6	“duckwalk”	Ductile according to EN 1994-1-1
X-HVB 50	29	23	6		
X-HVB 80	32.5	26	8*)	parallel with beam	
X-HVB 95	35	28			
X-HVB 110	35	28			
X-HVB 125	37.5	30			
X-HVB 140	37.5	30			

*) Reduction to 6 mm possible, with regards to required reduction of design resistance see annex C3 of ETA-15/0876.

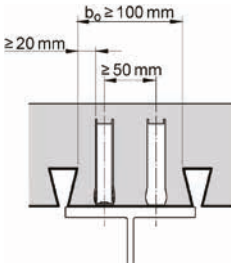
Conditions:
- Normal weight concrete C20/25 to C50/60
- Light weight concrete LC20/22 to LC50/55 with a minimum density ρ = 1750 kg/m³

Design resistance in composite beams with decking ribs transverse to beam axis

X-HVB positioning	Design Resistance $P_{Rd,t}$ [kN]	Ductility assessment
 X-HVB positioning longitudinal with the beam	$P_{Rd,t,l} = k_{t,l} \cdot P_{Rd}$ $k_{t,l} = \frac{0.66}{\sqrt{n_r}} \cdot \frac{b_0}{h_p} \cdot \left(\frac{h_{SC}}{h_p} - 1\right) \leq 1.0$	Ductile according to EN 1994-1-1
 X-HVB positioning transverse with the beam	$P_{Rd,t,t} = 0.89 \cdot k_{t,t} \cdot P_{Rd}$ $k_{t,t} = \frac{1.18}{\sqrt{n_r}} \cdot \frac{b_0}{h_p} \cdot \left(\frac{h_{SC}}{h_p} - 1\right) \leq 1.0$	

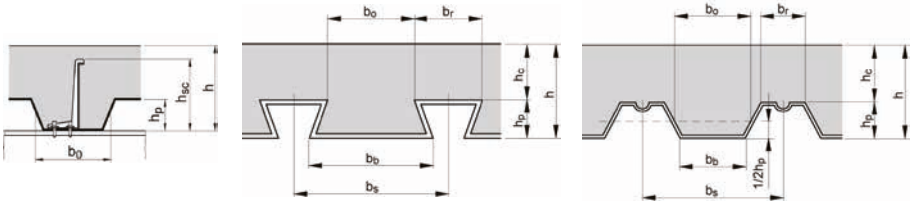
Conditions:
- Applicable for X-HVB 80, X-HVB 95, X-HVB 110, X-HVB 125, X-HVB 140
- n_r corresponds to the number of X-HVBs per rib ($n_r \leq 3$)

Design resistance in composite beams with decking ribs parallel to beam axis

X-HVB positioning	Design Resistance $P_{Rd,t}$ [kN]	Ductility assessment
 X-HVB positioning longitudinal with the beam	$P_{Rd,l} = k_l \cdot P_{Rd}$ $k_l = 0.6 \cdot \frac{b_0}{h_p} \cdot \left(\frac{h_{SC}}{h_p} - 1\right) \leq 1.0$	Ductile according to EN 1994-1-1

Conditions:
- Applicable for X-HVB 80, X-HVB 95, X-HVB 110, X-HVB 125, X-HVB 140
- X-HVB are to be positioned parallel with beam

Decking geometric parameters



Design information

Connector placement along the beam

The X-HVB is a ductile shear connector according to EN 1994-1-1, section 6.6, and may be uniformly distributed between critical sections. These critical sections, where large changes in shear flow occur, may be at supporting points, points of application of point loads or areas with extreme bending moments.

Partial shear connection

Strength:

The minimum connection depends on the design code used:

In EN 1994-1-1 design, N/N_f must be at least 0.4. This increases depending on span length and decking geometry.

Deflection control only

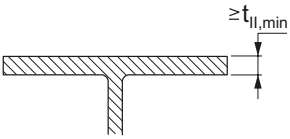
If the shear connection is needed for deflection control only, there is no minimum degree of connection. However, minimum allowable connector spacing applies and the steel beam must have enough strength to carry the self-weight and all imposed loads.

Further specific design topics covered in the ETA-15/0876

- Coverage of seismic loading according to Eurocode 8 (EN 1998-1-1)
- Design resistance in case of use of old steel with an ultimate strength greater than 300 N/mm² and less than 360 N/mm²
- Effect of reduced base material thickness less than 8 mm for X-HVB 80 to X-HVB 140
- Design of end anchorage of composite slabs
- Design in case of a fire

Application recommendation

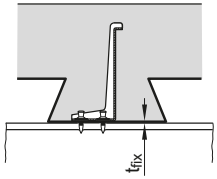
Thickness of base material



For beams with composite decking:
minimum thickness t_{II} = 8 mm.

For beams with solid concrete slabs:
minimum thickness t_{II} = 6 mm, especially relevant in renovation projects in order to take the thin flange thickness of small I-sections (e.g. IAO 100, I 100, IPE 100) into account.

Thickness of fastened material



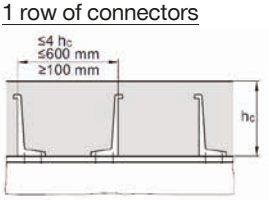
Maximum total thickness of fixed sheeting t_{fix}:

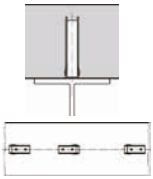
- 2.0 mm for X-HVB 80, X-HVB 95 and X-HVB 110
- 1.5 mm for X-HVB 125 and X-HVB 140

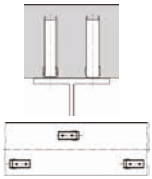
Positioning of X-HVB connectors in solid concrete slabs

X-HVB are to be positioned parallel with beam

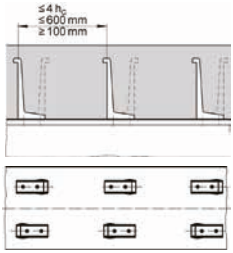
1 row of connectors



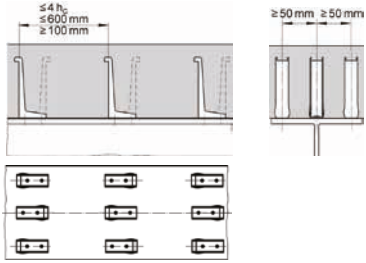




2 row of connectors

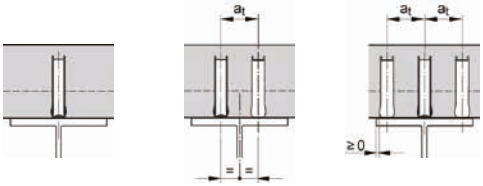


Maximum 3 row of connectors



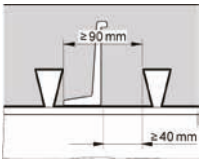
Positioning of X-HVB connectors with composite deck (deck positioned transverse to; and X-HVB positioned parallel with beam axis)

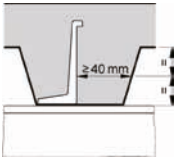
Spacing and positioning



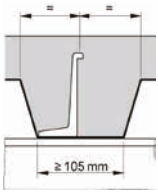
- $a_t \geq 50$ mm for compact profiled decking with $b_0/h_p \geq 1.8$
- $a_t \geq 100$ mm for other decking

1 row of connector - Minimum rib width and spacing to decking



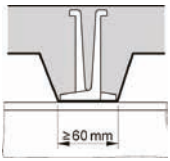


Rib width < 105mm



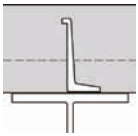
Rib width ≥ 105mm

Multiple rows of connector - Minimum rib width

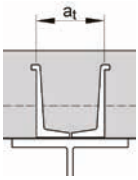


Positioning of X-HVB connectors with composite deck (deck and X-HVB positioned transverse to beam axis)

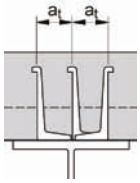
Spacing



1 row



2 rows



3 rows

2 rows:
- $a_t \geq 100$ mm for all types decking

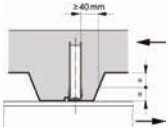
3 rows:
- $a_t \geq 50$ mm for compact profiled decking with $b_0/h_p \geq 1.8$
- $a_t \geq 100$ mm for other decking

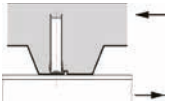
Positioning - 1 row of connectors

Without rib stiffener

Center in rib

With rib stiffener (X-HVB in contact with rib stiffener)

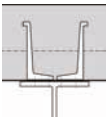


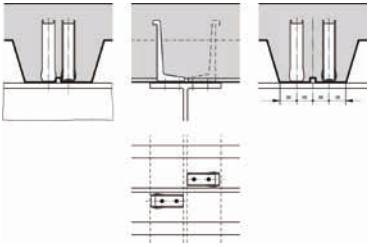


Preferred position in compression zone of concrete rib

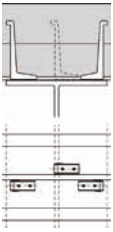
Positioning - 2 and 3 rows of connectors

Minimum width of deck rib





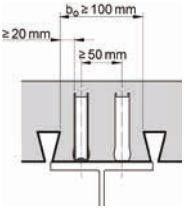
Contact with rib stiffener
OR equi-spacing

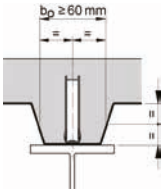


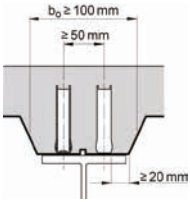
Positioning of X-HVB connectors with composite deck (deck parallel with beam axis)

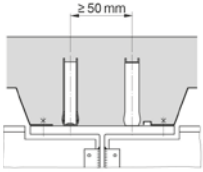
X-HVB are to be positioned parallel with beam

Spacing and positioning



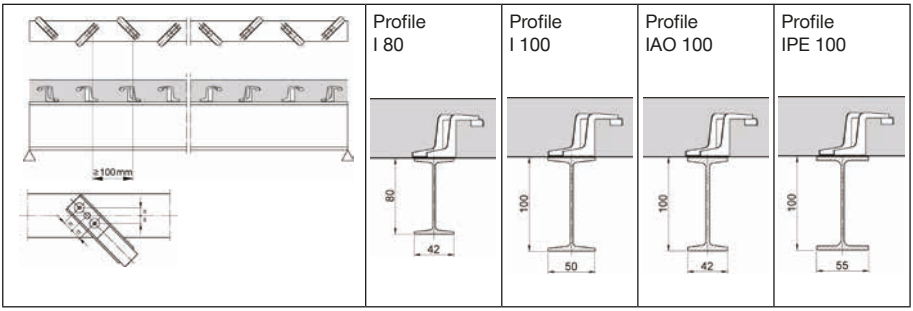






- If a centric positioning within the concrete rib is not possible due to the shape of the composite decking, the decking needs to be split.

“Duckwalk” positioning of X-HVB 40 and 50 in combination with thin solid slabs for renovation construction

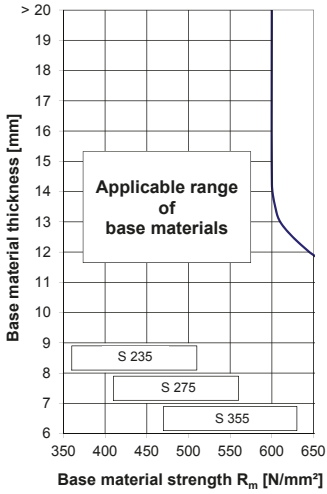


- Minimum section width = 40 mm (e.g. old section IAO 100)
- Minimum center distance of steel sections = 400 mm

Application limits

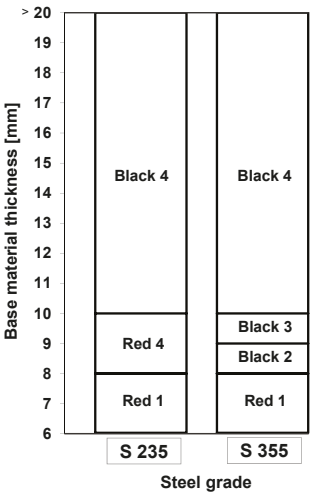
Application limits are valid only if correct cartridge and power setting are used!

Application limits X-ENP-21 HVB



In thermo-mechanically rolled construction steel, e.g. S 355M per EN 10025-4 the application limit is reduced by 50 N/mm²

Cartridge preselection and power setting



Fine adjustment by carrying out installation tests on site

- Minimum section covered: IPE 100
- Minimum base material thickness for beams with composite decking: 8 mm

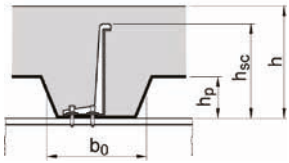
Fastener program

Minimum slab thickness

X-HVB	Minimum slab thickness h [mm]	
	Without effect of corrosion	With effect of corrosion
40	50	60
50	60	70
80	80	100
95	95	115
110	110	130
125	125	145
140	140	160

Maximum decking height h_p, dependent on decking geometry

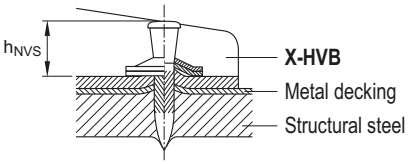
X-HVB	Maximum height of composite decking h_p [mm]		
	$\frac{b_o}{h_p} \geq 1.8$	$1.0 < \frac{b_o}{h_p} < 1.8$	$\frac{b_o}{h_p} \leq 1.0$ x)
80	45	45	30
95	60	57	45
110	75	66	60
125	80	75	73
140	80	80	80



x) $b_0 / h_p \geq 1.0$ for composite decking perpendicular to beam combined with X-HVB orientation parallel with beam

Quality assurance

Fastening inspection



8.2 mm ≤ h_{NVS} ≤ 9.8 mm

Clearly visible piston mark on top washer