



PUNCHING SHEAR  
REINFORCEMENT ELEMENT

15

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## PUNCHING SHEAR REINFORCEMENT ELEMENT

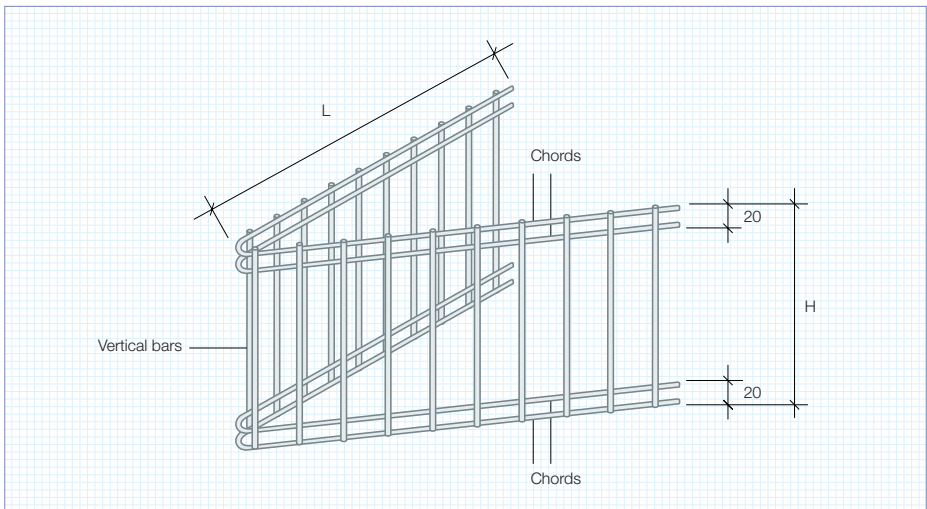


# A PUNCHING SHEAR REINFORCING ELEMENT FOR THE SUPPORT AREA OF POINT-BASED SUPPORTED SLABS

Punching shear elements are V-shaped ladder-like reinforcing strips which are manufactured industrially by means of electric resistance welding in a manner similar to reinforcing wire mesh. The wires of the chords and vertical bars comply with group B500A of ÖNORM B 4707.

Punching shear elements are manufactured in various sizes and can be used generally in all reinforced concrete plane load-bearing structures. They are arranged radially in a symmetrical fashion. The height of the punching shear elements is determined according to the thickness of the slabs minus the concrete covers and the height of the lower and upper reinforcement layers.

They are especially suited for use as punching shear reinforcement in the support area of point-based supported slabs (flat slabs).



Type	Height	Chords	Vertical Bars		Side length	$V_{Rds,El}$	Weight/Element
	H	$\emptyset$	$\emptyset$	Spacing	L		
	mm	mm	mm	mm	mm	kN	kg
DE 100	100	6,0	6,0	50	600	32	1,60
DE 120	120	6,0	6,0	50	600	39	1,71
DE 140	140	6,0	6,0	50	600	45	1,81
DE 160	160	6,0	6,0	50	700	52	2,24
DE 180	180	6,0	6,0	50	700	58	2,36
DE 200	200	6,0	6,0	50	700	64	2,49
DE 220	220	6,0	6,0	50	850	71	3,17
DE 240	240	6,0	6,0	50	850	77	3,32
DE 260	260	6,0	6,0	50	850	84	3,47
DE 280	280	6,0	6,0	50	1000	90	4,26
DE 300	300	6,0	6,0	50	1000	97	4,44
DE 320	320	6,0	6,0	50	1000	103	4,62

The range of heights is 100 mm to 320 mm.

$V_{Rds, El}$  ... Permissible punching shear load of an AVI DE punching shear element. Weight and dimensional tolerances as per ÖNORM B 4707

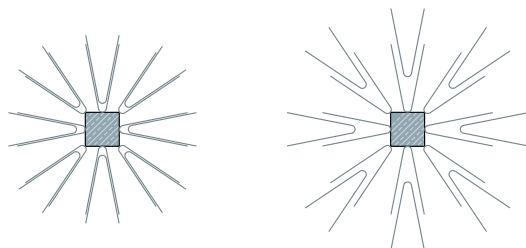
The area at punching-shear risk in point-based supported slabs is reinforced by the vertical bars of the punching shear element using a very close-meshed design. This enables the large shear forces in the induction zone to be absorbed by a great number of thin bars, thereby enlarging the punching shear area. The anchoring of the vertical bars in the tension or compression zone of the reinforced concrete slab is accomplished by using two welding joints each on the double chords. The application of the force to the bending tensile reinforcement above the support is also accomplished via the double chords.

The vertex of the V-shaped punching shear elements in the support area should be aligned along the supporting edge and it is therefore not necessary for it to extend into the column cross-section.

## PLACEMENT

AVI punching shear elements are placed between the upper and lower layers of flexural reinforcement and thus also serve as spacers at the same time. Generally, eight elements each with an opening angle of 22.5° are placed in the column head area in a radially symmetrical arrangement. The type of punching shear element depends on the slab thickness. This defines the outside diameter of the star-shaped shear load area, or the side length of the individual elements for a single row of elements.

Using a double-row, fish-bone style arrangement, it is possible to enlarge the punching shear reinforcement area by nesting the punching shear elements. Increasing the spacing between the first and second row of punching shear elements enlarges the outer control perimeter.



Fish-bone arrangement of the punching shear elements

The arrangement of the punching shear elements is accomplished using a calculation program based on Excel, and it can be downloaded from [www.avi.at/en/downloads/dimensioning-software](http://www.avi.at/en/downloads/dimensioning-software). A summary of the results is shown directly on the input page. A more detailed results page can also be printed.

### Required flexural reinforcement:

Upper reinforcement:  
Lower reinforcement:

### The flexural reinforcement must be increased

$A_{s,x} = 7,09 \text{ cm}^2/\text{m}$      $A_{s,y} = 7,09 \text{ cm}^2/\text{m}$   
 $A_{s,x} = 0,00 \text{ cm}^2/\text{m}$      $A_{s,y} = 0,00 \text{ cm}^2/\text{m}$

### Dimensioning for punching shear

Punching shear resistance of the slab:  $V_{Rdc} = 391,6 \text{ kN}$   
Punching shear resistance of the punching shear elements:  $V_{Rd,DE} = 352,5 \text{ kN}$   
Overall punching shear resistance:  $V_{Rd,cs} = 575,0 \text{ kN}$   
Maximum permissible column load:  $V_{Ed,max} = 500,0 \text{ kN}$

### Punching shear elements

8 pcs. DE 140

