Shear Reinforcement: Stirrup Spacing for a Design Shear

Stirrup spacing a concrete beam needs for a design shear by the 45° truss model, from the concrete's share, stirrup legs and steel, with the steel shear capacity.

Method: Truss model of shear with 45° cracks (V_s = A_v f_yt d/s)

Input parameters

Unit system: SI

Parameter	Value	Unit
Design shear force	350.00	kN
Shear carried by the concrete (from your code)	150.00	kN
Strength reduction factor for shear	75.000	%
Stirrup bar diameter	10.000	mm
Number of stirrup legs	2.0000	
Stirrup yield strength	415.00	MPa
Effective depth	550.00	mm
Spacing provided (0 = skip check)	150.00	mm

Calculated results

Parameter	Value	Unit
Stirrup area (all legs)	157.08	mm²
Shear the stirrups must carry	316.67	kN
Largest spacing for the design shear	113.22	mm
Steel shear capacity at the spacing provided	239.02	kN
Design shear capacity at the spacing provided	291.77	kN

Notes for this case

• With 45° cracks each stirrup crossing a crack carries A_v f_yt, and d/s stirrups cross it, so V_s = A_v f_yt d / s. The stirrups must carry what the concrete cannot: V_s = V_u/φ − V_c. Codes also set a maximum spacing (often d/2), a minimum stirrup area and an upper limit on V_s: apply them from your code.

Formula and method

$$V_s = \frac{V_u}{\phi} - V_c, \quad s = \frac{A_v f_{yt} d}{V_s}$$

Variables

V_u	Design shear force	N
V_c	Shear carried by the concrete (from your code)	N
ϕ	Strength reduction factor for shear	-
$\emptyset$	Stirrup bar diameter	m
n	Number of stirrup legs	-
f_{yt}	Stirrup yield strength	Pa
d	Effective depth	m
s	Spacing provided (0 = skip check)	m
A_v	Stirrup area (all legs)	m²
V_s	Shear the stirrups must carry	N

s_{req}	Largest spacing for the design shear	m
$V_s(s)$	Steel shear capacity at the spacing provided	N
$\phi(V_c + V_s)$	Design shear capacity at the spacing provided	N

Method and standards

Stirrup spacing.

Assumptions and limits

- Vertical stirrups; 45° truss model.

References

Truss model of shear with 45° cracks (V_s = A_v f_yt d/s)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/civil/concrete/shear-stirrup-spacing

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Reopens the calculator with the inputs of this report.