Reinforcement Development and Lap Length from Bond Stress

Development (anchorage) length of a reinforcing bar from bar diameter, the stress to develop and the design bond stress, with the lap length for a lap factor.

Method: Bond force balance for anchorage

Input parameters

Unit system: SI

Parameter	Value	Unit
Bar diameter	16.000	mm
Stress to develop in the bar	435.00	MPa
Design bond stress	2.8000	MPa
Lap factor (lap / development length)	1.3000	

Calculated results

Parameter	Value	Unit
Development length	621.43	mm
Development length in bar diameters	38.839	
Lap length	807.86	mm
Bar force developed	87.462	kN

Notes for this case

• Force balance σ_s·πφ²/4 = τ_bd·πφ·L_d gives L_d = φσ_s/(4τ_bd). Codes raise bond stress for deformed bars and compression and lower it for top bars, coated bars or poor cover; enter the design bond stress your code gives.

Formula and method

$$L_d = \frac{\phi \sigma_s}{4 \tau_{bd}}, \quad L_{lap} = k_l L_d$$

Variables

ϕ	Bar diameter	m
σ_s	Stress to develop in the bar	Pa
τ_{bd}	Design bond stress	Pa
k_l	Lap factor (lap / development length)	-
L_d	Development length	m
L_d/ϕ	Development length in bar diameters	-
L_{lap}	Lap length	m
F	Bar force developed	N

Method and standards

Bond anchorage.

Assumptions and limits

- Uniform bond stress along the bar.

References

Bond force balance for anchorage

Report details

Report reference	FCC-BCZX-JZM0 (the same inputs always give the same reference)
Generated	23 November 2026, 18:08 UTC
Calculator	Reinforcement Development and Lap Length from Bond Stress
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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/rebar-development-length

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.