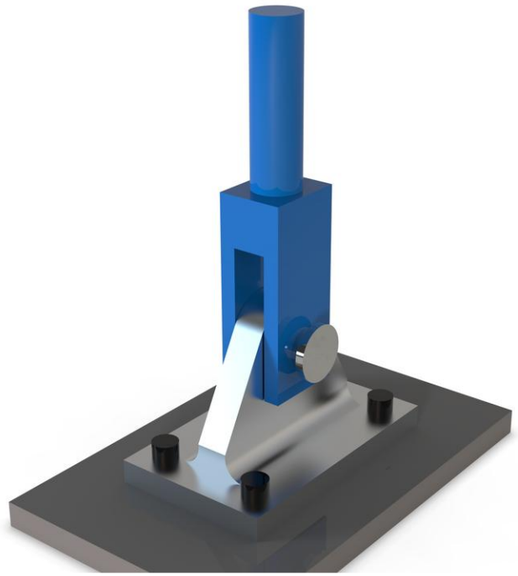
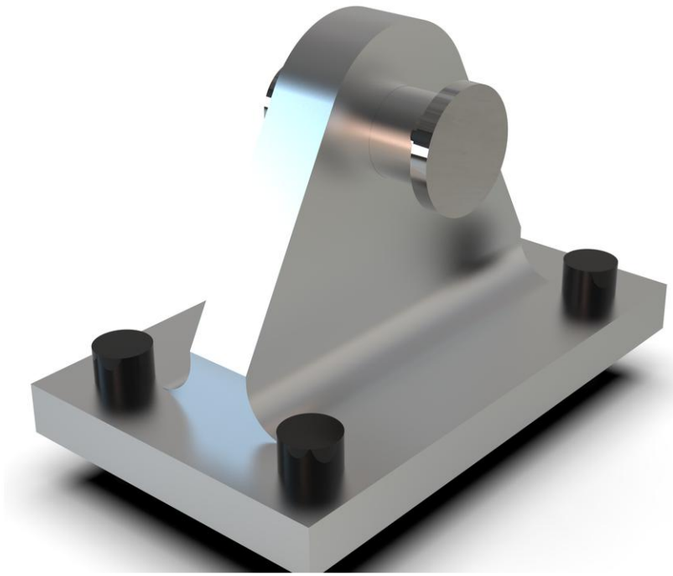
Machined lug fitting, 7075-T651, 45 kN limit load

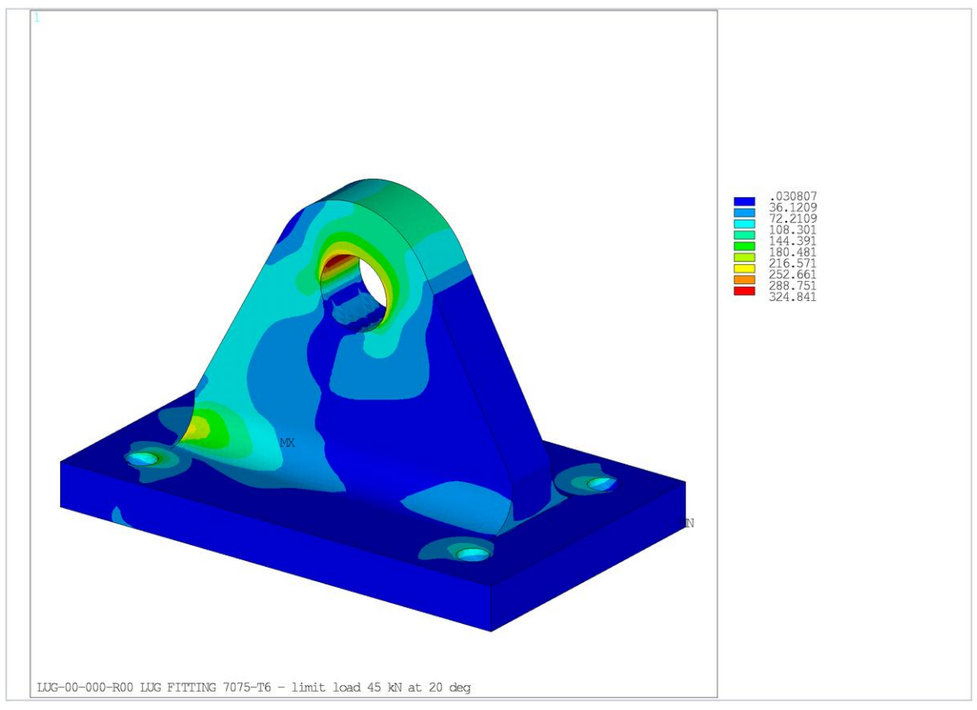
Concept design · parametric 3D CAD · lug hand analysis in MATLAB · solid FEA





Design data

Limit load	45 kN at 20 deg off axis
Ultimate load	67.5 kN (x 1.5)
Material	EN AW-7075 T651 plate
Strength	Rp0.2 470, Rm 540 MPa
Lug	16 mm thick, R24, pin D20
Base	130 x 80 x 12, fillets R10
Fasteners	4 x M8 class 12.9
Mass	0.56 kg, 0 interferences
Load / mass	80 kN/kg



Results at limit load

	FEA	Hand (MATLAB)
Peak stress at pin hole	325 MPa	301 MPa (Kt 3.0)
Fillets to base	240 MPa	
Margin on yield, limit load	+0.45	
Margin on ultimate, x 1.5	+0.11 (elastic peak, conservative)	
Screws M8, ultimate	+0.94	
Mesh check	307 -> 312 MPa nodal (101k -> 262k el.)	

Method

Classic lug checks by hand: net section with stress concentration, shear tear-out, bearing and screw loads from the offset force. Then a solid model with 262,000 tetrahedra: pin load as a cosine bearing pressure on the loaded half of the hole, screws as shear restraints with a clamped ring under each head. Peak stress changes by 1.4 % between two mesh sizes; the hand value is 7 % below the surface peak.