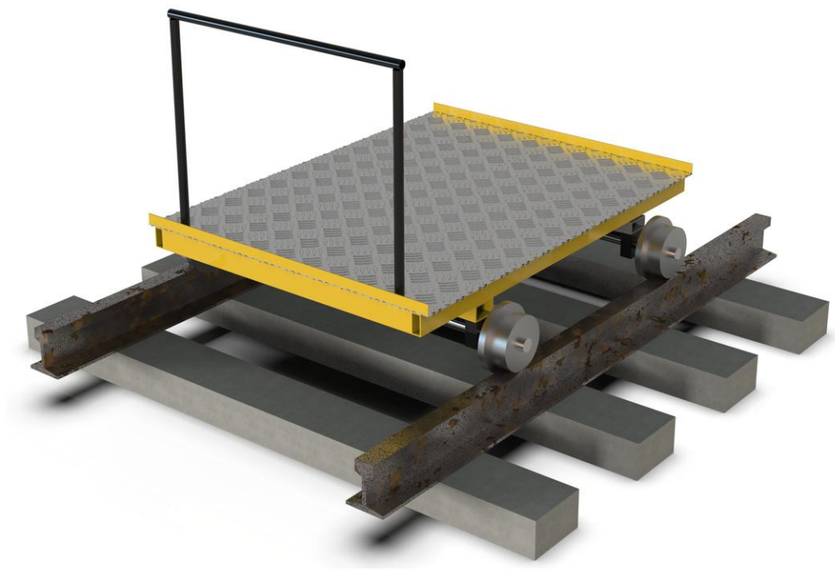
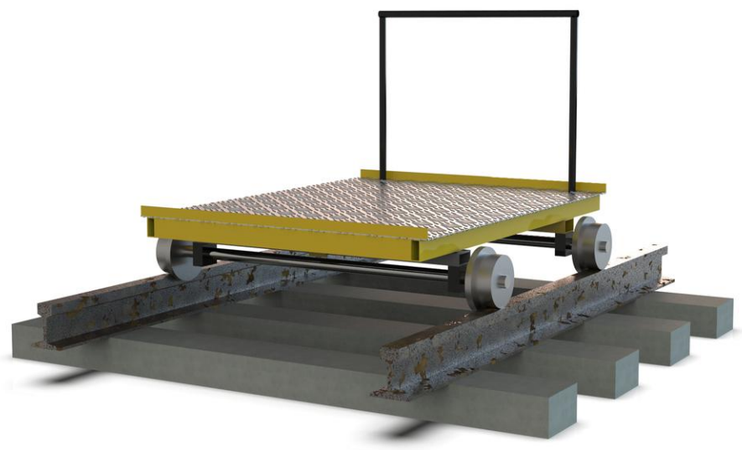
Rail trolley, 1000 kg, with pendulum axle

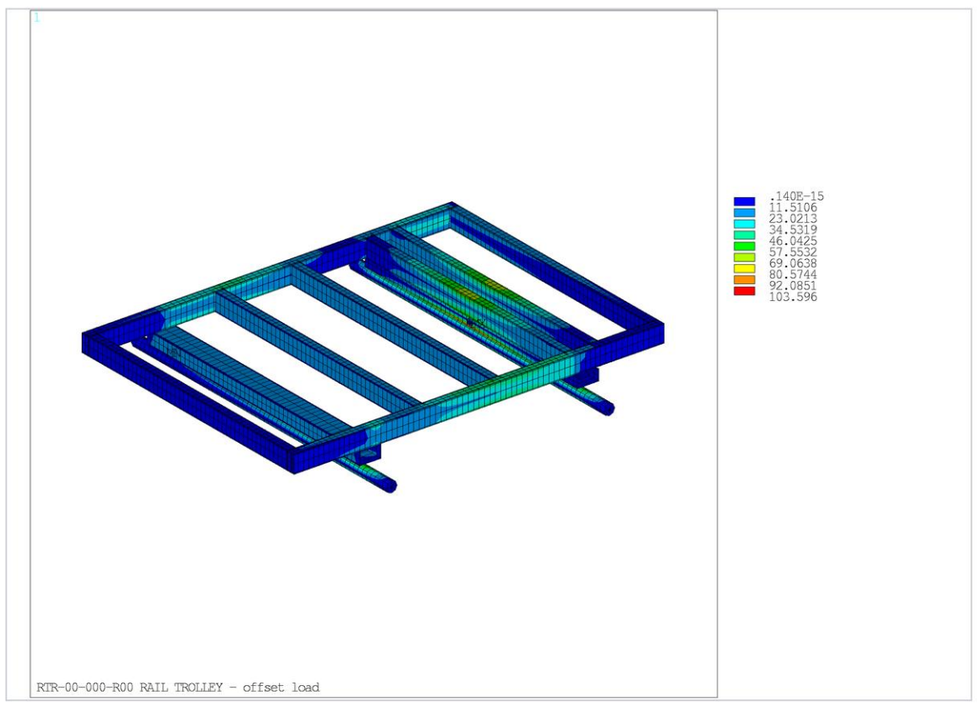
Concept design · parametric 3D CAD · wheel loads and hand checks in MATLAB · beam FEA





Design data

Rated load	1000 kg (x 1.25 in checks)
Track gauge	1435 mm
Deck	1700 x 1300 mm, 4 mm chequer
Deck height	294 mm above rail
Wheelbase	1000 mm
Wheels	D200, flange D250, C45
Axles	D50, C45
Rear axle	pendulum, +/- 12 mm at wheel
Frame	RHS 80 x 40 x 4, S355
Mass	339 kg, 0 interferences



Results, offset load (150 mm aft, 240 mm sideways)

	FEA	Hand (MATLAB)
Front wheel loads	4674 / 724 N	4702 / 752 N
Rear wheel loads	4554 N each	4567 N each
Axle bending stress	56 MPa	56 MPa, allow. 115
Rocker beam	104 MPa	109 MPa, allow. 231
Pivot cross members	67 MPa	74 MPa
Track twist absorbed		24 mm over wheelbase

Method

The rear axle swings on a central pivot, so the trolley rests on three points and all four wheels stay loaded on twisted track. Wheel loads, axle fatigue, rocker beam, pivot pin and push force are checked by hand in MATLAB, with the load centred and offset. The frame, rocker and axles are then verified with a 3D beam model (680 elements): bearings as couplings, one locating and one floating, pivot free to roll. Wheel loads match the hand model within 1 %.