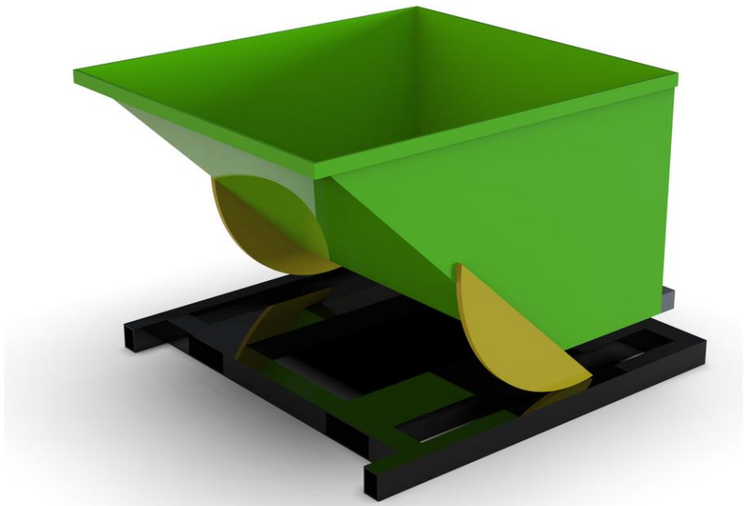
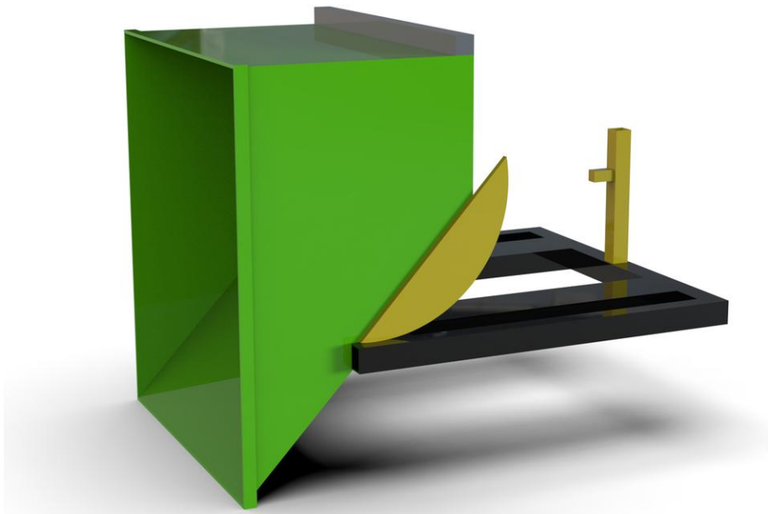
Self-dumping skip for forklift, 750 L / 1,000 kg

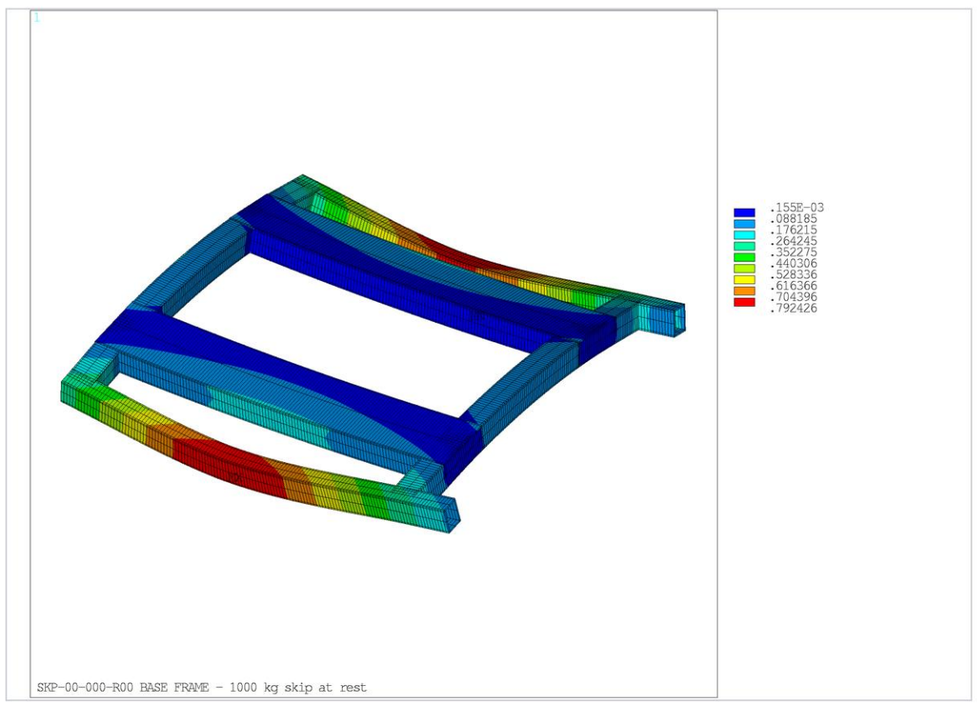
Concept design · parametric 3D CAD · balance and statics by hand in MATLAB · beam FEA of the base frame





Design data

Capacity	750 L, 1,000 kg
Body	1300 x 1136 x 750 mm, front at 43 deg
Plates	sides, front 3; rear 5; bottom 8 mm
Rockers	R450 segments, plate 20 mm
Counterweight	bar 60 x 60, 32 kg, at the rear
Rails	RHS 60 x 80 x 5
Fork pockets	RHS 200 x 80 x 5, 700 mm apart
Dumping	90 deg, rolls 707 mm forward
Mass	body 199.5 kg, total 299 kg



Results

	FEA	Hand (MATLAB)
Tipping moment at release, full		+852 N m
Minimum fill to dump by itself		55 % (93 % without bar)
Return moment, empty, 0 to 90 deg		46 to 199 N m
Fork loads at rest, front / rear	2.88 / 3.52 kN	2.86 / 3.51 kN
Rail stress at rest	43 MPa	57 MPa (simply supported)
Rail stress, end of travel	21 MPa	21 MPa
Rear fork load, end of travel, full	-0.28 kN	-0.29 kN (hold-down)

Method

On flat rails a circular rocker balances like a pendulum about its centre: the body tips when its centre of gravity is ahead of that centre and returns when it is behind and below. The rocker centre was placed so that the empty body returns by itself from any angle; a 32 kg bar at the rear then lowers the fill needed for self-dumping from 93 % to 55 %. A beam model of the base frame (744 elements) on the forks gives stresses, deflections and fork loads, at rest and at the end of travel.