CRANE GENIE
DESIGN - ESTIMATION - DRAWINGS

EOT CRANE GIRDER

STRUCTURAL CALCULATION NOTE

IS:807-2006 | Bridge Girder & End Carriage Design

Project	30/8 ton
Design	30/8 ton DG EOT CRANE
Client	Crane Genie Sample Report
Location	Hyderabad
Document No.	CG-00001
Date	01 Aug 2026
Revision	R0

A. DESIGN INPUTS

Parameter	Value	Unit	Remark
CRANE PARAMETERS			
Main Hook Capacity (SL)	30	T	Gross rated capacity
Auxiliary Hook Capacity (AUX)	8	T	
Span of Crane (L)	18	m	C/C of LT rails
Appliance Group	M6	---	IS:807 Table 9
Steel Grade	Fe490	---	fy = 315 MPa, fu = 490 MPa
CT Rail Size	65x50	---	H = 142.88 mm, 45 kg/m
LT Rail Size	75x50	---	
CT Rail Placement	Centre	---	
TROLLEY DATA			
Trolley Self-Weight (STRLY)	12	T	Including hoist machinery
Wheel Base — Leading Side (X1)	180	cm	1800 mm
Wheel Base — Trailing Side (X2)	180	cm	1800 mm
CT Wheel Base a = X1 + X2	360	cm	3.6 m
CT Rail Gauge — Near Rail (Y1)	150	cm	1500 mm
CT Rail Gauge — Far Rail (Y2)	150	cm	1500 mm
Trolley Gauge l = Y1 + Y2	300	cm	3 m
Min. Hook Approach (ha)	140	cm	
END CARRIAGE & TRAVEL			

Parameter	Value	Unit	Remark
CT Travel Speed (Vc)	20	m/min	
LT Travel Speed (Vt)	50	m/min	
No. of LT Wheels	4	---	4-wheel (2 per EC)
Min. LT Wheel Dia	Auto	---	
Cabin Type	Closed Cabin (AC)	---	
DSL Cage	No	---	

1. CT WHEEL LOAD DISTRIBUTION — BARRE'S METHOD

Figure 1.1 — Trolley wheel arrangement (plan view):

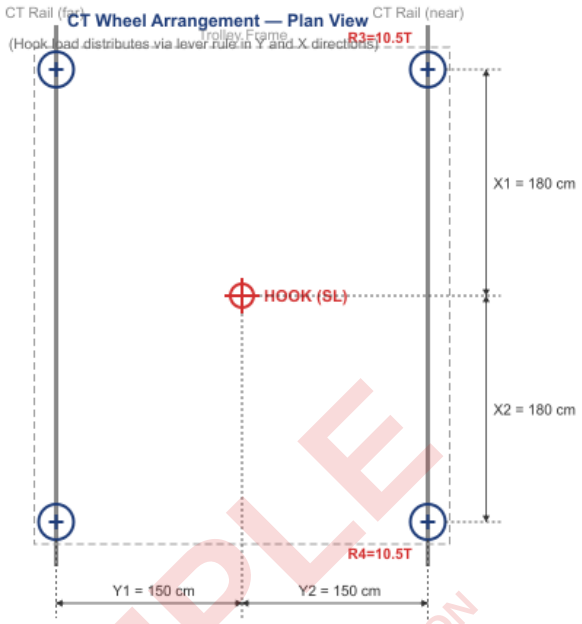
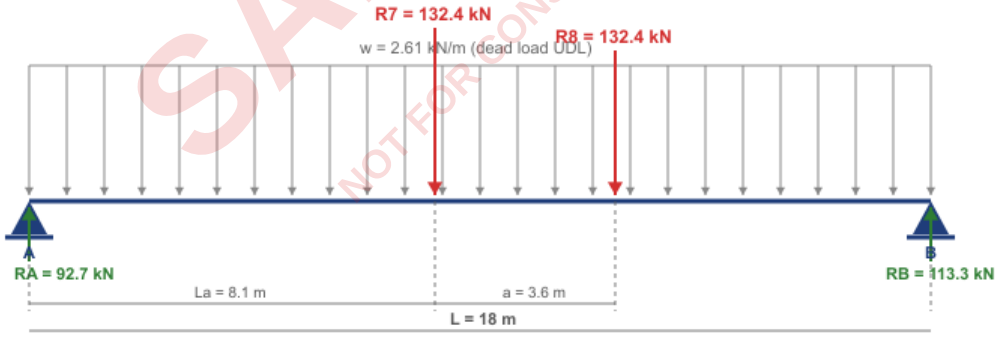


Figure 1.2 — Beam loading diagram:



1.1 Impact, Duty and Horizontal Factors

No.	Description	Formula / Calculation	Result	IS:807
1.1.1	Vertical Impact Factor psi	Appliance group M6, INDOOR — IS:807 Table 12	psi = 1.4	Table 12
	Applies to crane hook load only (NOT to trolley self-weight)			
1.1.2	Duty Factor gamma	M6 — IS:807 Table 13	gamma = 1.1	Table 13
	Case I (Indoor, no wind) — gamma not applied to wheel loads in this case			
1.1.3	Inertia Factor beta (along girder)	beta = 0.01 x sqrt(Vt) = 0.01 x sqrt(50)	beta = 0.07	Cl.6.1.3.1

No.	Description	Formula / Calculation	Result	IS:807
1.1.4	Side Force Constant lambda (perpendicular to girder)	l/a = 3 / 3.6 = 0.83 -> IS:807 Fig.5	lambda = 0.05	Fig.5

1.2 Hook Load Distribution to CT Rails — Y Direction (Gauge)

No.	Description	Formula / Calculation	Result	IS:807
	Lever-rule: hook is Y2 = 150 cm from near rail (drive side), Y1 = 150 cm from far rail (idle side)			
1.2.1	Hook load on near CT rail (drive side, Y1)	= SL x Y1/(Y1+Y2) = 30 x 150 / (150+150)	15 T	
1.2.2	Hook load on far CT rail (idle side, Y2)	= SL x Y2/(Y1+Y2) = 30 x 150 / (150+150)	15 T	
1.2.3	Trolley weight per CT wheel (uniform)	STRLY / (2 rails x 2 wheels) = 12 / 4	3 T = 29.43 kN	

1.3 Wheel Load Distribution — X Direction (Wheel Base) → R3, R4

Drive side (near rail) governs design. Idle-side loads (R1, R2) are lower and do not govern.

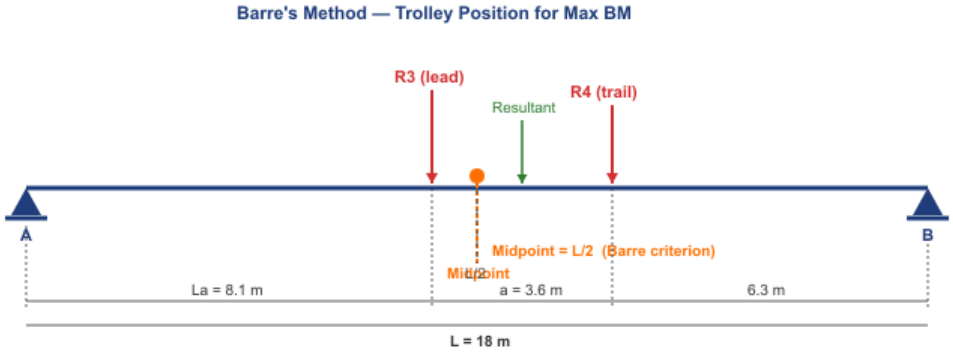
No.	Description	Formula / Calculation	Result	IS:807
1.3.1	Leading wheel load R3 (without impact)	R3 = SL x Y1/(Y1+Y2) x X2/(X1+X2) + STRLY/4		
	= 15 x 0.5 + 3	R3 = 10.5 T = 103.01 kN		
1.3.2	Trailing wheel load R4 (without impact)	R4 = SL x Y1/(Y1+Y2) x X1/(X1+X2) + STRLY/4	R4 = 10.5 T = 103.01 kN	
1.3.3	Check: R3 + R4 = total load on near CT rail	= 10.5 + 10.5 = 21 T	Expected: 21 T OK	

1.4 Design Wheel Loads with Impact → R7, R8

Impact psi = 1.4 applied to hook load only; trolley component unchanged.

No.	Description	Formula / Calculation	Result	IS:807
1.4.1	Leading design load R7 (hook x psi + trolley)	= 7.5 x 1.4 + 3	R7 = 13.5 T = 132.44 kN	Cl.6.1.1
1.4.2	Trailing design load R8 (hook x psi + trolley)	= 7.5 x 1.4 + 3	R8 = 13.5 T = 132.44 kN	Cl.6.1.1

Figure 1.3 — Barré positioning for max BM:



1.5 Barré's Method — Trolley Position for Maximum BM

No.	Description	Formula / Calculation	Result	IS:807
	Criterion: midpoint of {leading wheel position, resultant position} lies at midspan			
1.5.1	Resultant position from leading wheel (R4 acts at distance a)	= R4 x a / (R3+R4) = 10.5 x 360 / 21	180 cm	
1.5.2	Leading wheel position from End A (La)	La = L/2 - resultant_dist/2 = 900 - 90	La = 810 cm = 8.1 m	
1.5.3	Trailing wheel position from End A (Lb)	Lb = La + a = 810 + 360	Lb = 1170 cm = 11.7 m	
1.5.4	Verification: midpoint of {La, Resultant} = midspan?	Midpoint = La + resultant_dist/2 = 810 + 90	900 cm	
	Midspan = L/2 = 900 cm OK Barre criterion satisfied			

1.6 Support Reactions at Barré Position

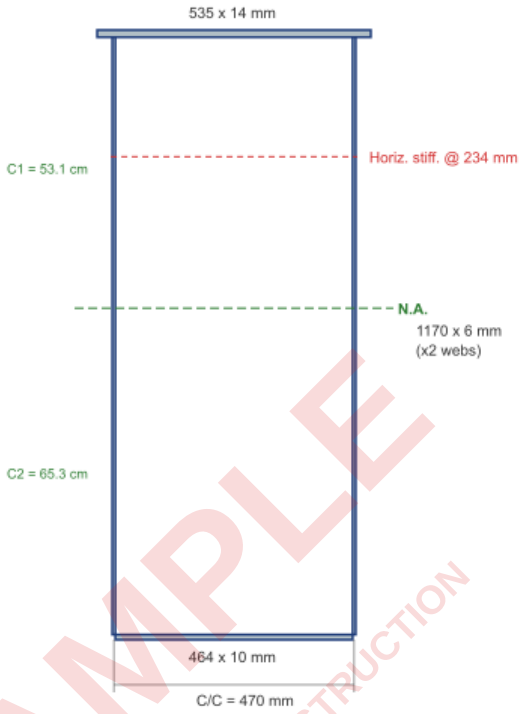
No.	Description	Formula / Calculation	Result	IS:807
1.6.1	Reaction at End A (RA)	RA = R3(L-La)/L + R4(L-Lb)/L = 103.01x9.9/18 + 103.01x6.3/18	RA = 92.7 kN	
1.6.2	Reaction at End B (RB)	RB = R3xLa/L + R4xLb/L = 46.35 + 66.95	RB = 113.31 kN	
1.6.3	Check: RA + RB = R3 + R4	92.7 + 113.31 = 206.01 kN	R3+R4 = 206.01 kN OK	

1.7 Dead Load UDL w_DL

No.	Description	Formula / Calculation	Result	IS:807
1.7.1	Girder self-weight	From section properties (see Section 2)	231.11 kg/m	
1.7.2	CT rail weight	1 rail per girder	45 kg/m	
1.7.3	LT platform + accessories	From crane layout specification	85 kg/m	
1.7.4	Total dead load UDL w_DL	= girder + rail + accessories	w_DL = 2.61 kN/m	
1.7.5	Allowable vertical deflection	L/750 = 18000 / 750	d_allow = 24 mm	Cl.20
1.7.6	Camber to be provided	Approx. dead load deflection or L/1000	Camber = 18 mm	

2. SECTION SELECTION & PROPORTION CHECKS

Figure 2.1 — Box girder cross-section:



2.1 Selected Bridge Girder Section

No.	Description	Formula / Calculation	Result	IS:807
	Dimension	Value		
2.1.1	Top flange plate	Width = 535 mm, Thickness c = 14 mm		
2.1.2	Web plates (x2)	Height h = 1170 mm, Thickness t = 6 mm		
2.1.3	Bottom flange plate	Width = 464 mm, Thickness = 10 mm		
2.1.4	C/C of web plates	470 mm		
2.1.5	Total section depth	1184 mm		

2.2 Section Properties

No.	Description	Formula / Calculation	Result	IS:807
2.2.1	Cross-section area A	Computed from plate dimensions	A = 261.7 cm2	
2.2.2	Self-weight of girder	= A x 0.785 + stiffener terms	231.11 kg/m	

No.	Description	Formula / Calculation	Result	IS:807
2.2.3	Moment of Inertia Ixx (about horizontal axis)	Parallel-axis theorem for all plates	Ixx = 567165.46 cm4	
2.2.4	Distance to compression fibre C1 (top)	= Ixx / Zxx(c) = 567165.46 / 10688.56	C1 = 53.06 cm	
2.2.5	Distance to tension fibre C2 (bottom)	= Ixx / Zxx(t) = 567165.46 / 8680.6	C2 = 65.34 cm	
2.2.6	Section Modulus Zxx (tension side — bottom fibre)	Zxx(t) = Ixx / C2	Zxx(t) = 8680.6 cm3	
2.2.7	Section Modulus Zxx (compression side — top fibre)	Zxx(c) = Ixx / C1	Zxx(c) = 10688.56 cm3	
2.2.8	Radius of Gyration Ryy (about vertical axis)	Computed from top flange Iyy and full section area	Ryy = 19.91 cm	

2.3 Proportions Check — Cl.25.1

No.	Description	Formula / Calculation	Result	IS:807
	h = 1170 mm (web height); b = 464 mm (min flange width); L = 18000 mm			
2.3.1	Span / Depth ratio (should be < 25)	L/h = 18000 / 1170 = 15.38	**PASS (61.5%)**	Cl.25.1
2.3.2	Span / Width ratio (should be < 60)	L/b = 18000 / 464 = 38.79	**PASS (64.7%)**	Cl.25.1
2.3.3	Compression flange b/c (clear width between webs, should be < 60)	b/c = (C/C - t_web) / c = (470 - 6) / 14 = 464 / 14	**PASS (55.2%)**	Cl.25.1

2.4 Compressive Stress Reduction — Cl.25.3

No.	Description	Formula / Calculation	Result	IS:807
	Full b/c = 33.14; with 1 horizontal stiffener → effective b/c = (b/2)/c			
2.4.1	Effective b/c (Cl.25.3, should be < 38)	= (b/2) / c = (464/2) / 14 = 232 / 14	**PASS (43.6%)**	Cl.25.3

2.5 Web h/t Ratio — Cl.25.2

No.	Description	Formula / Calculation	Result	IS:807
	C = 162, M = 376 (1 longitudinal stiffener)			
2.5.1	Actual h/t ratio	= h / t = 1170 / 6	h/t = 195	Cl.25.2
2.5.2	Stress ratio k = sigma_t / sigma_c	= 140.1 / 116.38	k = 1.2	
2.5.3	Allowable h/t ratio (IS:807 Cl.25.2)	= min[C x (k+1) x sqrt(1235 / 10.19 / sigma_c), M]		
	= min[162 x (1.2+1) x sqrt(1235 / 10.19 / 116.38), 376]			
	= min[357.02 x 1.02, 376]	(h/t)_allow = 364.34	Cl.25.2	

No.	Description	Formula / Calculation	Result	IS:807
2.5.4	Check: h/t actual <= (h/t)_allow	195 <= 364.34	**PASS (53.5%)**	Cl.25.2

2.6 Web Min Thickness — Cl.18.2

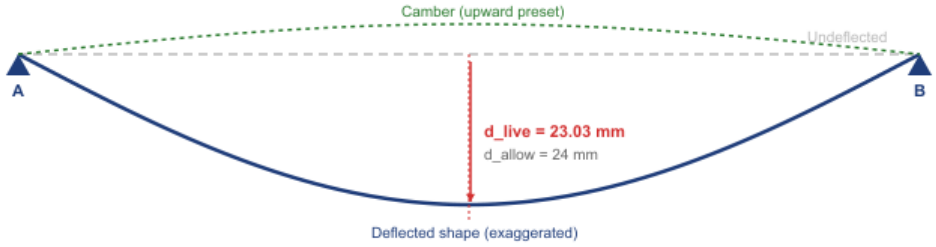
No.	Description	Formula / Calculation	Result	IS:807
	Checks web can resist local bending from wheel load			
2.6.1	Design wheel load R7	R7 = 13.5 T = 132.44 kN	R7 = 13500 kg	
2.6.2	Allowable bearing stress sigma_brg	= 0.75 x fy = 0.75 x 315	sigma_brg = 236.3 MPa	Cl.18.2
2.6.3	Load distribution length H_load	= 50 + (H_rail + c) x 2 = 50 + (142.88 + 14) x 2	H_load = 363.8 mm	Cl.18.2
2.6.4	Minimum web thickness t_min	= R7 / (sigma_brg x 10.19 x H_load/10) x 10		
	= 13500 / (236.3 x 10.19 x 36.38) x 10	t_min = 1.54 mm	Cl.18.2	
2.6.5	Check: t_provided >= t_min	6 mm >= 1.54 mm	**PASS (389.2%)**	Cl.18.2

2.7 Slenderness Ratio — Cl.12

No.	Description	Formula / Calculation	Result	IS:807
2.7.1	Slenderness ratio L/Ryy (should be < 180)	= L / Ryy = 1800 cm / 19.91 cm	**PASS (50.2%)**	Cl.12

3. DEFLECTION CHECK — Cl.20

Figure 3.1 — Deflected shape (exaggerated):



3.1 Dead Load Deflection (UDL)

No.	Description	Formula / Calculation	Result	IS:807
3.1.1	Modulus of elasticity E	Structural steel (IS:2062)	E = 200 GPa = 200000 MPa	
3.1.2	Moment of Inertia Ixx	From Section 2	Ixx = 567165.46 cm4 = 5671.65 x 10^6 mm4	
3.1.3	Dead load UDL w_DL	From Section 1.7	w_DL = 2.61 kN/m	
3.1.4	Dead load deflection d_dead	= 5 x w x L^4 / (384 x E x I)		
	= 5 x 2.61 x 18^4 / (384 x 200 x 567165.46 x 10^-4)			
	All units converted to kN, m: d = 5 x 2.61 x 324 / (384 x 200000 x 0.005672)	d_dead = 3.15 mm		

3.2 Live Load Deflection (Concentrated Loads)

No.	Description	Formula / Calculation	Result	IS:807
3.2.1	Leading wheel load R3 (design, with impact)	R3 = 103.01 kN at x = La = 8.1 m from End A		
3.2.2	Trailing wheel load R4 (design, with impact)	R4 = 103.01 kN at x = Lb = 11.7 m from End A		
3.2.3	Live load deflection d_live (engine result)	Computed by superposition of individual load deflections	d_live = 23.03 mm	Cl.20

3.3 Total Deflection & Adequacy Check

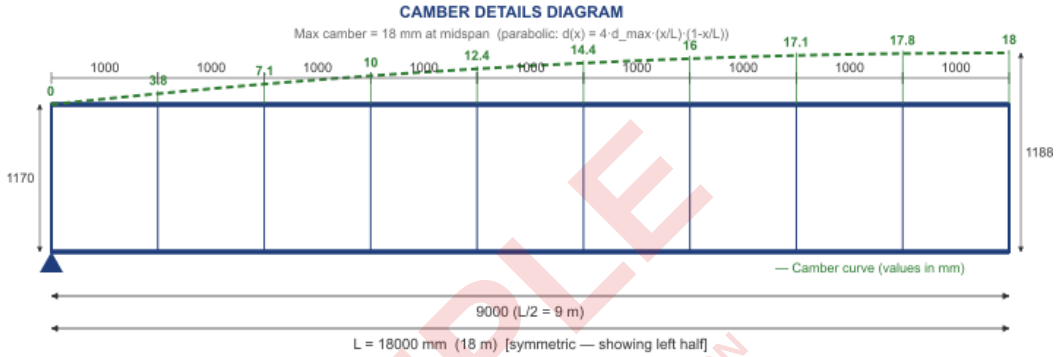
No.	Description	Formula / Calculation	Result	IS:807
3.3.1	Total deflection (dead + live)	= 3.05 + 23.03	d_total = 26.08 mm	

No.	Description	Formula / Calculation	Result	IS:807
3.3.2	Allowable live deflection d_allow	= L / 750 = 18000 / 750	d_allow = 24 mm	Cl.20
3.3.3	CHECK: d_live <= d_allow	23.03 mm <= 24 mm	**PASS (96 % util.)**	Cl.20
3.3.4	Camber to be provided	Compensates dead load sag; typically = dead deflection or L/1000	Camber = 18 mm (upward)	

3.4 Camber Details

Parabolic camber profile — values shown at equal intervals for left half (symmetric about midspan). Vertical stiffener spacing = 1090 mm.

Figure 3.2 — Camber details diagram:



No.	Description	Formula / Calculation	Result	IS:807
	Position from support	Panel width	Camber (mm)	
3.4.1	x = 0 mm	—	0 mm	
3.4.2	x = 1000 mm	1000 mm	3.8 mm	
3.4.3	x = 2000 mm	1000 mm	7.1 mm	
3.4.4	x = 3000 mm	1000 mm	10 mm	
3.4.5	x = 4000 mm	1000 mm	12.4 mm	
3.4.6	x = 5000 mm	1000 mm	14.4 mm	
3.4.7	x = 6000 mm	1000 mm	16 mm	
3.4.8	x = 7000 mm	1000 mm	17.1 mm	
3.4.9	x = 8000 mm	1000 mm	17.8 mm	
3.4.10	x = 9000 mm	1000 mm	18 mm	

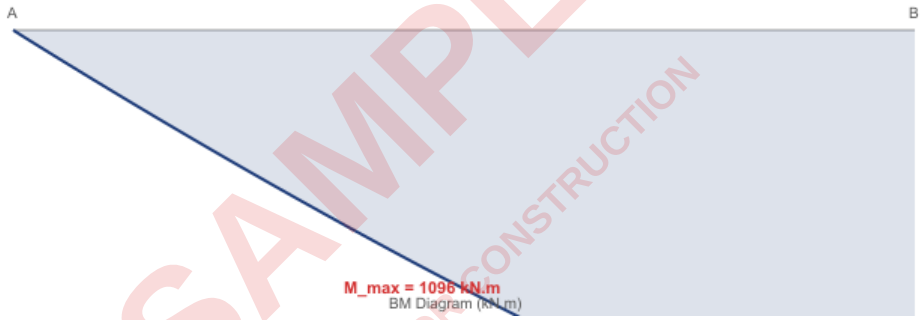
4. BENDING STRESS CHECK

4.1 Allowable Stresses — IS:807 Table 15/16

Fe490: fy = 315 MPa, fu = 490 MPa. sigma_t = min(fu/1.8, fy/1.5). Compression reduced for LTB per IS:800 Table 6.2.

No.	Description	Formula / Calculation	Result	IS:807
	Stress Type	Derivation	Allowable	Reference
4.1.1	Bending tension sigma_t,allow	min(fu/1.8, fy/1.5) = min(490/1.8, 315/1.5)	233.33 MPa	Table 15
4.1.2	Bending compression sigma_c,allow	LTB-reduced: l/Ryy = 90.4, D/T = 84.6	121.2 MPa	Cl.25.3
4.1.3	Shear tau_allow	sigma_t,allow / sqrt(3) = 233.33 / 1.732	134.72 MPa	Table 15
4.1.4	Bearing sigma_brg	0.75 x fy = 0.75 x 315	236.3 MPa	Cl.18.2

Figure 4.1 — Bending Moment diagram:



4.2 Maximum Vertical Bending Moment

No.	Description	Formula / Calculation	Result	IS:807
4.2.1	Maximum vertical BM M_v (from engine)	At Barré position (x = La = 8.1 m from End A)	M_v = 1096 kN.m	
4.2.2	Vertical bending stress at tension fibre sigma_v(t)	= M_v / Zxx(t) = 1096 x 100 / 8680.6 x 10	sigma_v(t) = 126.26 MPa	
4.2.3	Vertical bending stress at compression fibre sigma_v(c)	= M_v / Zxx(c) = 1096 x 100 / 10688.56 x 10	sigma_v(c) = 102.54 MPa	

4.3 Horizontal Bending Moment & Stress

Side forces per IS:807 Fig.5: lambda x (wheel load). Horizontal BM computed at Barré position.

No.	Description	Formula / Calculation	Result	IS:807
4.3.1	Horizontal force at leading wheel H_lead	= lambda x R7 = 0.05 x 132.44	H_lead = 6.62 kN	Fig.5
4.3.2	Horizontal force at trailing wheel H_trail	= lambda x R8 = 0.05 x 132.44	H_trail = 6.62 kN	Fig.5
4.3.3	Maximum horizontal BM M_h (from engine)	Computed at Barré position from horizontal load arrangement	M_h = 53.51 kN.m	

No.	Description	Formula / Calculation	Result	IS:807
4.3.4	Section modulus Zyy (whole section, parallel-axis)	Iyy = 103730.1 cm4; Zyy = Iyy / (B_top/2)	Zyy = 3877.8 cm3	
4.3.5	Horizontal bending stress sigma_h	= M_h / Zyy = 53.51 x 100 / 3877.8 x 10	sigma_h = 13.8 MPa	

4.4 Combined Bending Stress — Adequacy Check

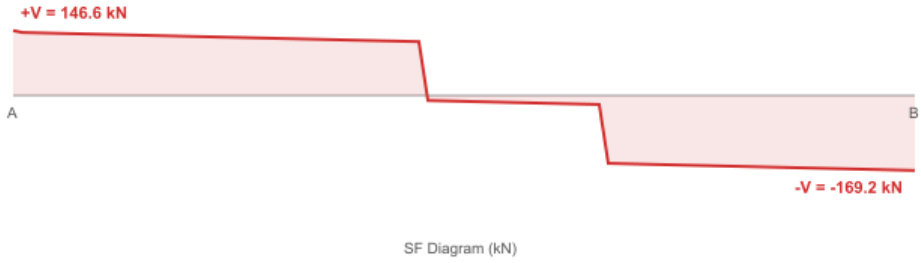
No.	Description	Formula / Calculation	Result	IS:807
	Combined stress = vertical bending + horizontal bending			
4.4.1	Total tension stress sigma_t (bottom fibre)	= sigma_v(t) + sigma_h = 126.26 + 13.8	sigma_t = 140.06 MPa	
4.4.2	CHECK: sigma_t <= sigma_t,allow	140.06 MPa <= 233.33 MPa	**PASS (60 % util.)**	
4.4.3	Total compression stress sigma_c (top fibre)	= sigma_v(c) + sigma_h = 102.54 + 13.8	sigma_c = 116.34 MPa	
4.4.4	CHECK: sigma_c <= sigma_c,allow	116.34 MPa <= 121.2 MPa	**PASS (96 % util.)**	Cl.25.3

4.5 Combined Stress Check — IS:807 Cl.16.2

No.	Description	Formula / Calculation	Result	IS:807
	Combined stress check: sigma_e = sqrt(sigma^2 + 3*tau_torsion^2) — IS:807 Cl.16.2			
4.5.1	Max bending stress sigma_max	= max(sigma_t, sigma_c) = max(140.1, 116.38)	sigma_max = 140.1 MPa	
4.5.2	Torsion shear stress tau	No torsion (rail at centre)	tau = 0 MPa	
4.5.3	Equivalent stress sigma_e	= sqrt(140.1^2 + 3 x 0^2)	sigma_e = 140.1 MPa	
4.5.4	CHECK: sigma_e <= sigma_allow	140.1 MPa <= 233.33 MPa	**PASS (60 % util.)**	Cl.16.2

5. SHEAR STRESS & STIFFENER DESIGN

Figure 5.1 — Shear Force diagram:



5.1 Shear Force & Stress

No.	Description	Formula / Calculation	Result	IS:807
5.1.1	Maximum shear force V_max (from engine)	Trolley positioned for maximum support reaction	V_max = 271.68 kN	
5.1.2	Total web shear area A_web	= 2 x h x t = 2 x 1170 x 6	A_web = 14040 mm2	
5.1.3	Actual shear stress tau (VQ/Ib at neck)	At flange-web junction, end of girder	tau = 131.55 MPa	
5.1.4	CHECK: tau <= tau_allow	131.55 MPa <= 134.72 MPa	**PASS (97.6 % util.)**	Table 15

Figure 5.2 — Neck (end) section for shear check:

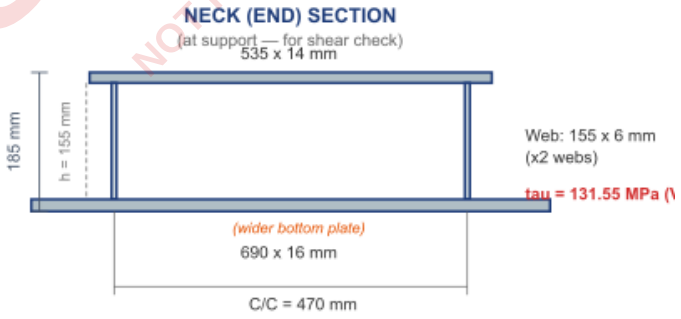
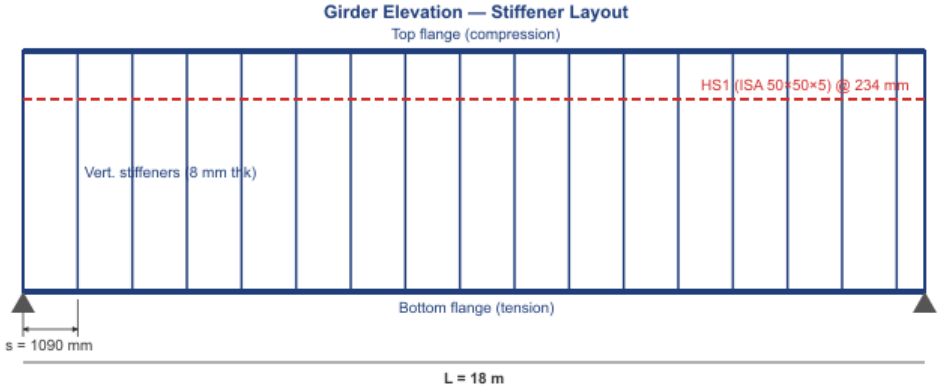


Figure 5.3 — Girder stiffener layout:



5.2 Vertical Web Stiffeners — Cl.21

Spacing = min(shear-based, absolute max, CT rail-based).

No.	Description	Formula / Calculation	Result	IS:807
5.2.1	Shear-based max spacing	= 800 x t / sqrt(tau_avg) = 800 x 6 / sqrt(19.35)	s_shear = 1091.17 mm	Cl.21
5.2.2	Absolute max spacing	= max(1750, h) = max(1750, 1170)	s_abs = 1750 mm	Cl.21
5.2.3	CT rail-based spacing	Based on rail section modulus and wheel load	s_ct = 1090 mm	Cl.22
5.2.4	Chosen spacing = min(s_shear, s_abs, s_ct)	= min(1091.2, 1750, 1090)	Spacing = 1090 mm	Cl.21
5.2.5	Stiffener thickness	Provided: 8 mm ≥ Min: 4.64 mm	**PASS**	Cl.22

5.3 Horizontal Stiffener — Cl.25.2.4

Positioned at ~0.2h from compression flange to increase allowable h/t ratio.

No.	Description	Formula / Calculation	Result	IS:807
5.3.1	Horizontal stiffener section	ISA 50×50×5 at 234 mm from top (20% of h)		Cl.25.2.4
5.3.2	CHECK: I_actual >= I_min	208333 mm4 >= 144389 mm4	**PASS (144% of required)**	Cl.25.2.4

6. END CARRIAGE DESIGN

Figure 6.1 — End carriage beam model:

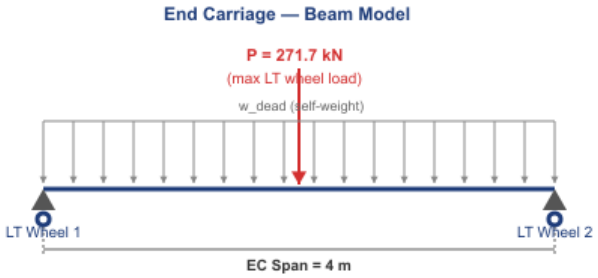
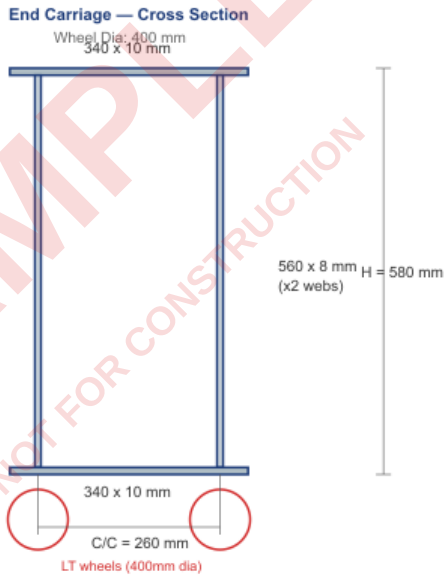


Figure 6.2 — EC box girder cross-section:



6.1 Crane Weight Breakdown

No.	Description	Formula / Calculation	Result	IS:807
	Section A — Structural Weight of Crane (without Trolley)	Weight (kg)		
6.1.1	Weight of Girders	Incl. CT rail × 2 girders + bearing plates	9450 kg	
6.1.2	Weight of End Carriages	× 2 end carriages + bearing plates	1550 kg	
6.1.3	LT Drive Platform	Lookup by crane capacity	500 kg	
6.1.4	Drive Side Platform	85 × (Span − 3.2) kg	1258 kg	
6.1.5	Idle Side Platform	85 × 4 m = 340 kg	340 kg	
6.1.6	CT Current Collection Beam	35 × Span	630 kg	

No.	Description	Formula / Calculation	Result	IS:807
6.1.7	Cabin	Closed cabin (AC)	1200 kg	
6.1.9	Pendant Beam	25 × Span	450 kg	
6.1.10	Subtotal		15378 kg	
6.1.11	Miscellaneous (2.5%)	2.5% of structural subtotal	384 kg	
6.1.12	STRUCTURAL TOTAL	CEIL to 50 kg	15800 kg	

No.	Description	Formula / Calculation	Result	IS:807
	Section B — Total Weight of Crane	Weight (kg)		
6.1.13	Structural Total (from above)		15800 kg	
6.1.14	LT Wheel Assembly	Lookup by wheel dia (400 mm)	840 kg	
6.1.15	LT Drive Assembly	Motors, gearboxes, brakes	840 kg	
6.1.16	Crab / Trolley	Trolley weight from input	12000 kg	
6.1.17	Electrical Panels + Fittings	Lookup by crane capacity	1250 kg	
6.1.18	Miscellaneous (2.5% of non-structural)	2.5% of non-structural items	373 kg	
6.1.19	TOTAL CRANE WEIGHT	CEIL to 50 kg	31150 kg	

6.2 LT Wheel Load per Wheel

MAX = trolley at drive end; MIN = trolley at idle end. Only trolley+load component differs.

No.	Description	Formula / Calculation	Result	IS:807
	Per-Wheel Load — Max (trolley at drive end)	kN	kg	
6.2.1	Due to Girders	Girder wt / 4 wheels	23.18 kN	2363 kg
6.2.2	Due to End Carriages + Wheel Assembly	(EC wt + wheel assy) / 4 wheels	5.86 kN	598 kg
6.2.3	Due to Trolley & Load	(Cap + Aux) × 500 × (Span − HookAppr) / Span	171.89 kN	17522 kg
6.2.4	Due to LT Drive Machinery	LT drive assembly / 2	4.12 kN	420 kg
6.2.5	Due to Cabin	Cabin (1200 kg) × (Span−1.4)/Span / 2	5.43 kN	553 kg
6.2.6	Due to Drive Side Platform	Drive platform / 2	6.17 kN	629 kg
6.2.8	Due to Pendant Beam	Pendant beam / 2	2.21 kN	225 kg
6.2.9	Due to Electrical Panels	Electrical panels / 2	6.13 kN	625 kg
6.2.10	Due to Miscellaneous	2.5% allowance / N wheels	1.86 kN	189 kg
6.2.11	MAX WHEEL LOAD (per wheel)	CEIL to 100 kg → kN	227.59 kN	23124 kg

No.	Description	Formula / Calculation	Result	IS:807
	Wheel Load Summary			
6.2.12	MIN WHEEL LOAD (trolley at idle end)	Dead loads same; trolley component reduced	69.65 kN (7080 kg)	

No.	Description	Formula / Calculation	Result	IS:807
6.2.13	MEAN WHEEL LOAD	(2 × Max + Min) / 3	175.11 kN (17833 kg)	
6.2.14	LT Wheel Diameter / Rail / Count	400 mm / 75x50 / 4 wheels		

6.3 Selected End Carriage Section

No.	Description	Formula / Calculation	Result	IS:807
	End Carriage Section Geometry			
6.3.1	EC span (bogie wheelbase)	Distance between LT wheel centres	4 m = 4000 mm	
6.3.2	Top flange plate	Width x Thickness	340 x 10 mm	
6.3.3	Web plates (x2)	Height x Thickness	560 x 8 mm	
6.3.4	Bottom flange plate	Width x Thickness	340 x 10 mm	
6.3.5	C/C of web plates		260 mm	
6.3.6	Total depth	= web + top plate + bottom plate	580 mm	
6.3.7	Cross-section area		A = 157.6 cm2	
6.3.8	Self-weight		137.01 kg/m	
6.3.9	Moment of Inertia Ixx	About horizontal (bending) axis	Ixx = 78654.1 cm4	
6.3.10	Section Modulus Zxx	For symmetric section, Zxx(t) = Zxx(c)	Zxx = 2712.2 cm3	

6.4 EC Loading

No.	Description	Formula / Calculation	Result	IS:807
6.4.1	Dead load on EC	EC self-weight + platform + CT rail (span portion)	W_dead = 2794.6 kg = 27.42 kN	
6.4.2	Live load on EC (with impact)	Trolley + rated load at max end (with psi)	W_live = 24900 kg = 244.27 kN	
6.4.3	Live load on EC (without impact)	For deflection check (impact excluded)	W_live_noImpact = 19366.7 kg	
6.4.4	Total point load at EC midspan P	Max girder reaction (dead + live with impact)	P = 271.68 kN	

6.5 EC Bending Stress Check

No.	Description	Formula / Calculation	Result	IS:807
6.5.1	Max BM on EC (midspan)	= P x L / 4 = 271.68 x 4 / 4	M_ec = 271.68 kN.m	
6.5.2	Actual bending stress (from engine)	= M / Zxx (includes dead load UDL component)	sigma_ec = 120.84 MPa	
6.5.3	Allowable tension stress	= min(fu/1.8, fy/1.5)	sigma_t,allow = 233.33 MPa	Table 15
6.5.4	CHECK: sigma_ec <= sigma_t,allow (tension)	120.84 <= 233.33	**PASS (51.8% util.)**	

No.	Description	Formula / Calculation	Result	IS:807
6.5.5	Allowable compression stress (LTB-reduced)	IS:800 Table 6.2 for EC dimensions	sigma_c,allow = 121.2 MPa	Cl.25.3
6.5.6	CHECK: sigma_ec <= sigma_c,allow (compression)	120.84 <= 121.2	**PASS (99.7% util.)**	

6.6 EC Deflection Check

No.	Description	Formula / Calculation	Result	IS:807
6.6.1	Actual EC deflection (live load, from engine)	Computed using beam deflection formula	d_ec = 1.59 mm	
6.6.2	Allowable EC deflection	= EC_span / 600 = 4000 / 600	d_allow = 6.7 mm	Cl.20
6.6.3	CHECK: d_ec <= d_allow	1.59 mm <= 6.7 mm	**PASS (23.7% util.)**	Cl.20

6.7 EC Shear Stress Check (VQ/Ib)

No.	Description	Formula / Calculation	Result	IS:807
6.7.1	Actual EC shear stress (VQ/Ib)	tau = V x Q / (I x b) at flange-web junction	tau = 10.67 MPa	
6.7.2	Allowable shear stress	= sigma_t / sqrt(3) = 233.33 / sqrt(3)	tau_allow = 134.72 MPa	Cl.8.4
6.7.3	CHECK: tau <= tau_allow	10.67 <= 134.72	**PASS (7.9% util.)**	Cl.8.4

6.8 EC Stiffener Spacing & Web Min Thickness

No.	Description	Formula / Calculation	Result	IS:807
6.8.1	Stiffener spacing	= 1.0 x web height	a = 560 mm	Cl.22
6.8.2	Web min thickness (panel proportion)	= min(a, h_w) / 180 = 560 / 180	t_min = 3.11 mm	Cl.25.2
6.8.3	CHECK: t_web >= t_min	8 >= 3.11	**PASS (actual / min = 257.2%)**	Cl.25.2

6.9 EC Design — All 10 IS:807 Checks

No.	Description	Formula / Calculation	Result	IS:807
	EC Check	Actual	Allowable	Status
6.9.1	EC Flange Proportion — Span/Depth	7.14	**25**	PASS (28.6%)
6.9.2	EC Flange Proportion — Span/Width	15.87	**60**	PASS (26.5%)
6.9.3	EC Flange b/c Ratio	25.2	**38**	PASS (66.3%)
6.9.4	EC Slenderness Ratio L/Ryy	34.09	**150**	PASS (22.7%)
6.9.5	EC Web h/t Ratio	70	**116.75**	PASS (60%)

No.	Description	Formula / Calculation	Result	IS:807
6.9.6	EC Bending Stress — Tension	120.84	**233.33**	PASS (51.8%)
6.9.7	EC Bending Stress — Compression	120.84	**121.2**	PASS (99.7%)
6.9.8	EC Deflection	1.59	**6.67**	PASS (23.9%)
6.9.9	EC Shear Stress (VQ/Ib)	10.67	**134.72**	PASS (7.9%)
6.9.10	EC Web Min Thickness	8	**3.11**	PASS (257.1%)

7. DESIGN SUMMARY

7.1 Main Girder — 14 IS:807 Checks

No.	Description	Formula / Calculation	Result	IS:807
	Check	Actual	Allowable	Status
7.1.1	Flange Proportion — Span/Depth	15.38	**25**	PASS (61.5%)
7.1.2	Flange Proportion — Span/Width	38.79	**60**	PASS (64.7%)
7.1.3	Flange b/c Ratio	33.14	**60**	PASS (55.2%)
7.1.4	Web Min Thickness	6 mm	**2.84 mm**	PASS (211.6%)
7.1.5	Slenderness Ratio L/Ryy	90.41	**180**	PASS (50.2%)
7.1.6	Deflection	23.03 mm	**24 mm**	PASS (96%)
7.1.7	Stiffener Bearing	8 mm	**4.64 mm**	PASS (172.3%)
7.1.8	Bending Stress — Tension	140.1 MPa	**233.33 MPa**	PASS (60%)
7.1.9	Bending Stress — Compression	116.38 MPa	**121.2 MPa**	PASS (96%)
7.1.10	Web h/t Ratio	195	**364.34**	PASS (53.5%)
7.1.11	Shear Stress	131.55 MPa	**134.72 MPa**	PASS (97.6%)
7.1.12	Stiffener Spacing	1090 mm	**1090.97 mm**	PASS (99.9%)
7.1.13	CT Rail Stiffener Spacing	1090.97 mm	**1090 mm**	PASS (100.1%)
7.1.14	Combined Stress (Von Mises)	140.1 MPa	**233.33 MPa**	PASS (60%)

7.2 End Carriage — 10 IS:807 Checks

No.	Description	Formula / Calculation	Result	IS:807
	Check	Actual	Allowable	Status
7.2.1	EC Flange Proportion — Span/Depth	7.14	**25**	PASS (28.6%)
7.2.2	EC Flange Proportion — Span/Width	15.87	**60**	PASS (26.5%)
7.2.3	EC Flange b/c Ratio	25.2	**38**	PASS (66.3%)
7.2.4	EC Slenderness Ratio L/Ryy	34.09	**150**	PASS (22.7%)

No.	Description	Formula / Calculation	Result	IS:807
7.2.5	EC Web h/t Ratio	70	**116.75**	PASS (60%)
7.2.6	EC Bending Stress — Tension	120.84	**233.33**	PASS (51.8%)
7.2.7	EC Bending Stress — Compression	120.84	**121.2**	PASS (99.7%)
7.2.8	EC Deflection	1.59	**6.67**	PASS (23.9%)
7.2.9	EC Shear Stress (VQ/Ib)	10.67	**134.72**	PASS (7.9%)
7.2.10	EC Web Min Thickness	8	**3.11**	PASS (257.1%)

--- End of Structural Calculation Note ---