

Static Analysis of Steel Structure of Reboiler Equipment Using Staad.Pro Software

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ABSTRACT

The study employs STAAD.Pro software to perform a static analysis of a steel structure supporting reboiler equipment. The primary aim is to evaluate the structural performance and stability of the framework under various loading conditions, including dead loads, live loads, and equipment-specific loads. A comprehensive 3D model of the reboiler support structure was developed, incorporating material properties and connection details in accordance with industry standards. The analysis focuses on assessing key structural parameters such as deflections, shear forces, and bending moments to ensure compliance with safety and design codes. The results demonstrate that the structure maintains adequate load-carrying capacity and stiffness, with maximum deflections well within permissible limits. The analysis also identified critical points in the structure that require reinforcement to enhance overall stability and resilience. This study underscores the effectiveness of STAAD.Pro in conducting comprehensive static analyses for complex industrial applications and emphasizes the importance of thorough design practices in ensuring the reliability and safety of steel structures in the chemical processing sector. Future work may include dynamic analysis and fatigue assessment to further enhance the structural design under varying operational conditions.

INTRODUCTION

Steel structures are crucial in modern infrastructure, used in commercial and residential buildings, bridges, towers, and industrial facilities. Their design and analysis require consideration of strength, stability, and durability. Advanced software tools allow engineers and architects to efficiently design, analyse, and simulate steel structures' behaviour under various loads and conditions.

Staad Pro is a popular software package used in civil engineering for steel structure design and analysis. It offers comprehensive tools for modelling, analysing, and designing steel structures, including beams, columns, trusses, and frames. With its user-friendly interface and advanced calculation engine, Staad Pro enables engineers to quickly and accurately analyse steel structures, ensuring compliance with relevant building codes and standards.

LITERATURE REVIEW

Steel structures are essential for supporting reboiler equipment in industries such as chemical and petrochemical, where they must endure various loads, including dead loads, live loads, thermal stresses, wind, and seismic forces. Steel is widely used because of its high strength, flexibility, and ease of fabrication, making it suitable for complex industrial setups. The American Institute of Steel Construction (AISC) code offers comprehensive guidelines for designing steel structures to ensure stability and safety under combined loading conditions. STAAD.Pro software, which follows AISC standards, enables accurate structural analysis by calculating bending moments, shear forces, and axial stresses. It helps simulate load interactions effectively, enhancing design precision and material efficiency. However, challenges persist in modeling thermal expansion and joint flexibility in steel structures. Thermal load guidelines can sometimes be conservative, and better connection modeling is needed to reflect real-world conditions accurately. Advancements in thermal load simulation and joint behavior analysis could further improve the safety and performance of steel support structures for reboilers.

AIM

TO ANALYSE STEEL STRUCTURE OF REBOILER EQUIPMENT USING STAAD.Pro SOFTWARE.



OBJECTIVE

• Analysis of support structure of reboiler equipment by AISC.

METHODOLOGY

Isometric view



3D Rendering view



I



Primary Loading:-

Dead Load

In structural engineering, **dead loads** refer to the permanent static forces acting on a structure, including the self-weight of structural members and other permanently attached elements such as flooring, roofing, cladding, and fixed equipment. In **STAAD.Pro**, dead loads are essential for accurate analysis and design, especially for **steel structures**, which are lighter and more flexible compared to concrete structures.



respectively.

- Grating Load (32 Thk.) = 0.5 kN/ m2.
- Handrail Load =0.3 kN/m.
- Stair Dead Load = 2.25 kN/m Height.
- Cage Ladder Load = 0.35 kN/m.
- Fireproofing Load = Material considered with density of 25 kN/m3 for heavy concrete fireproofing and 8.5 kN/m3 for Light fireproofing & generated in STAAD Specifications.

Live Load

Live load is a critical factor in the analysis and design of steel structures. It represents temporary or moving forces that act on the structure during its lifetime. Unlike dead loads, which remain constant, live loads vary in magnitude and location. In STAAD.Pro, live loads must be applied correctly to ensure compliance with design codes such as:

• structures.

AISC 360 (American Institute of Steel Construction) – Governs the design of steel

• ASCE 7 (Minimum Design Loads for Buildings and Other Structures) – Provides live load values and combinations.



These standards ensure that steel structures are designed to withstand service loads, strength requirements, and deflection limits.



- Staircase Live Load = 4.8 kN/ m2
- Live Load on Operating/Access Platform & Walkways = 3.6 kN/ m2
 - Live load is applied on Beam as one way Floor load.

Wind Load :-

Wind load on Process Structure in accordance with 'General Design rules for Foundation & Structures' 4398-AX-SG-2G00200000001 (SA-AMI-G00-TECI-003195), ASCE 7-05 and Wind load for petrochemical and other industrial facilities document.

Wind load applied to the main frames along Moment and Braced direction using STAAD wind load generator command. Pressure coefficient Cf for Structural members are considered as 1.80. Wind Load on Equipment are validated and adopted from Mechanical data sheet.

Wind load on pipes are calculated based on maximum spanning of pipe as 9m and respective diameter. As per the Wind load for petrochemical and other industrial facilities document, frame load + Equipment load + Piping load (FT) in one axis, simultaneously acting 50% wind on frame on other orthogonal direction (FS) applied in STAAD. Refer Below Figure. Wind load on Process Structure in accordance with 'General Design rules for Foundation & Structures' 4398-AX-SG-2G0020000001 (SA-AMI-G00-TECI-003195), ASCE 7-05 and Wind load for petrochemical and other industrial facilities document.



Wind load applied to the main frames along Moment and Braced direction using STAAD wind load generator command. Pressure coefficient Cf for Structural members are considered as 1.80. Wind Load on Equipment are validated and adopted from Mechanical data sheet. Wind load on pipes are calculated based on maximum spanning of pipe as 9m and respective diameter.

As per the Wind load for petrochemical and other industrial facilities document, frame load + Equipment load + Piping load (FT) in one axis, simultaneously acting 50% wind on frame on other orthogonal direction (FS) applied in STAAD. Refer Below Figure.

Variation of wind pressure over the height of the structure is simulated by defining different pressure values over different heights as per ASCE 7-05 & pressure intensity is updated in STAAD wind load generator command. Variation of wind pressure over the height of the structure is simulated by defining different pressure values over different heights as per ASCE 7-05 & pressure intensity is updated in STAAD wind load generator command.







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Seismic Load

Seismic load is as per clause 4.5 of 4398-AX-SG-2F0020000001(SA-AMI-G00-TCMT-003195)

TYPE OF STRUCTURE					R
Moment-resisting frame system:					
Steel	Ordinary moment	-resist	ting fr	ame	3
	Ordinary braced f	rames	;		3
Seismic parameters					
MCE spectral response acceleration par	ameter at short periods:	Ss= 0	,09 g	(AMIES-A-112 Table 1)	
MCE spectral response acceleration para	meter at a period of 1 s:	S1= 0	,03 g	(AMIES-A-112 Table 1)	
	Site Class:	0)	(AMIES-A-112 Table 1)	
Short-period site co	efficient (at 0.2 s-period)	F.= 1	.6	(ASCE 7-05 Table 11.4-1)	
Long-period site co	efficient (at 1.0 s-period)	F.= 2	2,4	(ASCE 7-05 Table 11.4-2)	
MCE Spectral Response Acceleration Parameter adjusted for s	te class effect = F _a x S _c	S _{M5} = 0),14 g	(ASCE 7-05 Eq. 11.4-1)	
MCE Spectral Response Acceleration at a period of 1s adjusted for site	e class effects = F _y x S _t	SM1= 0	,07 g	(ASCE 7-05 Eq. 11.4-2)	
Design spectral acceleration parameters at s	hort period Sos=2/3 S _{MS}	S _{DS} = 0	9,09 g	(ASCE 7-05 Eq. 11.4-3)	
Design spectral acceleration parameters at a p	eriod of 1s So1=2/3 SM1	S ₀₁ = 0),05 g	(ASCE 7-05 Eq. 11.4-4)	
Start of	plateu T _a = 0.2 S _{D1} /S _{D5}	T ₀ = 0	0,11	(ASCE 7-05 Para. 11.4.5)	
E	nd of plateu $T_{\rm S}{=}~S_{\rm D1}/S_{\rm DS}$	T ₈ = 0	55	(ASCE 7-05 Para. 11.4.5)	
	Occupancy Category:	n	v	(AMIES-M-001 Para. 6.5.4)	
	Importance Factor:	l= 1	.5	(ASCE 7-05 Table 11.5-1 & A	MIES-M-001 Para. 6.5.4
Seismic Design Category based on short period response	acceleration parameter:	A	1	(ASCE 7-05 Table 11.6-1)	
Seismic Design Category based on 1 second period response	acceleration parameter:	A	N	(ASCE 7-05 Table 11.6-2)	



Load Application (As per AISC 360-16 LRFD)

Loads are applied in compliance with AISC 360-16 LRFD and ASCE 7-16.

Dead Load (DL)

- Self-weight of structural members (automatically included in STAAD.Pro).
- Additional dead load from:

Ι



Live Load (LL)

- Applied uniformly distributed loads as per ASCE 7-16.
 - Considered floor and roof live loads based on occupancy type.
- Used live load reduction for large tributary areas.

Wind Load (WL) – ASCE 7-16

•

Wind pressure calculated using:

q=0.00256×Kz×Kd×Ke×V2

Where:

0	Kz = Exposure coefficient
0	Kd = Directionality factor
0	Ke = Elevation factor
0	V2 = Basic wind speed (mph)

Applied as lateral forces at each floor level due to the absence of bracing.

Seismic Load (SL) – ASCE 7-16

•		Base shear calculated as: $V=Cs \times WV = C_s \setminus WV=Cs \times W$ Where:
	0	CsC_ = Seismic response coefficient
	0	WWW = Total building weight
•		Applied seismic forces laterally at multiple levels since the structure has no bracing.
•		Ensured frame stability using rigid connections and moment-resisting frames.

Load Combinations (As per AISC 360-16 LRFD)

The following LRFD load combinations were applied:

1.	1.4D1.4D1.4D
2.	1.2D+1.6L1.2D + 1.6L1.2D+1.6L
3.	1.2D+1.0L+0.5W1.2D+1.0L+0.5W1.2D+1.0L+0.5W
4.	$1.2D + 1.0W + 0.5L \\ 1.2D + 1.0W + 0.5U \\ 1.2D + 1.0W + 0.5W \\ 1.2D + 1.0W \\ 1.2W \\ $
5.	1.2D+1.0E+0.5L1.2D+1.0E+0.5L1.2D+1.0E+0.5L
6.	0.9D+1.0W0.9D+1.0W0.9D+1.0W
7.	0.9D+1.0E0.9D + 1.0E0.9D+1.0E

RESULT

WORK	RESULT
Project Setup	The project was successfully set up in STAAD.Pro, with all relevant project details, unit preferences, and design standards initialized
Structural Geometry Definition	The geometry accurately represents the design requirements and is ready for further analysis.



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Load Combination	Loads including dead load, live load, wind load, and seismic loads were defined and applied based AISC 360. The loads were correctly applied, and load combinations are prepared for analysis.				
Check for utilization Ratio	 The Utilization Ratio (UR) in STAAD.Pro shows how much of a member's strength is being used compared to its maximum allowable limit.: UR ≤ 1.0 → The member is safe. UR > 1.0 → The member fails and needs resizing or strengthening. 				

- Utilization Ratio For Strength
- Utilization Ratio For Serviceability
- Utilization Ratio For Beam Local Check
- Utilization Ratio For Strength

Beam Parameter Design Property Status Actuato Ratio Allowabe Ratio Code Clause L/C 10 Parameter 1 HE340A Pass 0.133 1 360-16.1 Eq.H1-3e[H1 8024 11 Parameter 1 HE340A Pass 0.201 1 360-16.1 Eq.H1-3th 8024 12 Parameter 1 HE340A Pass 0.213 1 360-16.1 Eq.H1-3th 8025 13 Parameter 1 HE340A Pass 0.213 1 360-16.1 Eq.H1-3th 8025 14 Parameter 1 HE340A Pass 0.203 1 360-16.1 Eq.H1-3th 8025 21 Parameter 1 HE340A Pass 0.211 1 360-16.1 Eq.H1-3th 8025 22 Parameter 1 HE340A Pass 0.232 1 360-16.1 Eq.H1-3th 8025 23 Parameter 1 HE340A Pass 0.329 1 360-16.1 <th colspan="10">UTILIZATION RATIO-STRENGTH CASE</th>	UTILIZATION RATIO-STRENGTH CASE									
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27 Parameter 1 HE340A Pass 0.232 1 360-16 L Eq.H1-18 B028 29 Parameter 1 HE300A Pass 0.538 1 360-16 L Eq.H1-1b 8029 31 Parameter 1 HE300A Pass 0.538 1 360-16 L Eq.H1-1b 8027 34 Parameter 1 HE180A Pass 0.111 1 360-16 L Eq.H1-1b 8027 35 Parameter 1 HE120A Pass 0.044 1 360-16 L Eq.H1-1b 10028 37 Parameter 1 HE200A Pass 0.018 1 360-16 L Eq.H1-1b 11030 38 Parameter 1 HE300A Pass 0.189 1 360-16 L CG.H1-1b 1001 41 Parameter 1 HE300A Pass 0.427 1 360-16 L CG.H1-1b 8028 44 Parameter 1 HE300A Pass 0.183 1 360-16 L CG.H1-1b 8028	26	Parameter 1	HE340A	Pass	0.497	1	360-16 L	Eq.H1-3a(H1	7029	
29 Parameter 1 HE300A Pass 0.369 1 360-16 L Eq.H1-1b 8028 31 Parameter 1 HE300A Pass 0.339 1 360-16 L Eq.H1-1b 8027 34 Parameter 1 HE180A Pass 0.011 1 360-16 L Eq.H1-1b 8027 35 Parameter 1 HE120A Pass 0.083 1 360-16 L Eq.H1-1b 8027 36 Parameter 1 HE20A Pass 0.014 1 360-16 L Eq.H1-1b 11028 37 Parameter 1 HE270 Pass 0.018 1 360-16 L Eq.H1-1b 8013 39 Parameter 1 HE300A Pass 0.123 1 360-16 L Eq.H1-1b 7015 41 Parameter 1 HE270 Pass 0.622 1 360-16 L Eq.H1-1b 8028 42 Parameter 1 HE300A Pass 0.123 1 360-16 L Eq.H1-1a	27	Parameter 1	HE340A	Pass	0.232	1	360-16 L	Eq.H1-3a(H1	8028	
31 Parameter 1 HE300A Pass 0.538 1 360-16 L Eq.H1-1b 8027 33 Parameter 1 HE180A Pass 0.319 1 360-16 L Eq.H1-1b 8027 34 Parameter 1 HE180A Pass 0.083 1 360-16 L Eq.H1-1b 8027 36 Parameter 1 HE270 Pass 0.044 1 360-16 L Eq.H1-1b 11028 37 Parameter 1 HE270 Pass 0.018 1 360-16 L Eq.H1-1b 10130 38 Parameter 1 HE270 Pass 0.497 1 360-16 L Eq.H1-1b 1030 40 Parameter 1 HE270 Pass 0.49 1 360-16 L Eq.H1-1b 10001 41 Parameter 1 HE270 Pass 0.622 1 360-16 L Eq.H1-1b 10021 42 Parameter 1 HE30A Pass 0.133 1 360-16 L Eq.H1-1a <	29	Parameter 1	HE300A	Pass	0.369	1	360-16 L	Eq.H1-1b	8028	
33 Parameter 1 HE300A Pass 0.339 1 360-16 L Eq.H1-1b 8027 34 Parameter 1 HE180A Pass 0.083 1 360-16 L Eq.H1-1b 8027 35 Parameter 1 IPE270 Pass 0.044 1 360-16 L Eq.H1-1b 11028 37 Parameter 1 HE200A Pass 0.012 1 360-16 L Eq.H1-1b 11030 38 Parameter 1 HE300A Pass 0.108 1 360-16 L Eq.H1-1b 11030 40 Parameter 1 HE270 Pass 0.477 1 360-16 L Eq.H1-1b 1001 41 Parameter 1 HE270 Pass 0.427 1 360-16 L Eq.H1-1b 1001 42 Parameter 1 HE270 Pass 0.427 1 360-16 L Eq.H1-1b 8029 44 Parameter 1 HE300A Pass 0.183 1 360-16 L Eq.H1-1a	31	Parameter 1	HE300A	Pass	0.538	1	360-16 L	Eq.H1-1b	8029	
34 Parameter 1 HE180A Pass 0.111 1 360-16 L Eq.H1-1b 8027 35 Parameter 1 HF270 Pass 0.083 1 360-16 L Eq.H1-1b 11028 36 Parameter 1 HF200A Pass 0.044 1 360-16 L Eq.H1-1b 11030 38 Parameter 1 HF270 Pass 0.018 1 360-16 L Eq.H1-1b 1030 39 Parameter 1 HF270 Pass 0.123 1 360-16 L Eq.H1-1b 1030 40 Parameter 1 HF270 Pass 0.427 1 360-16 L Eq.H1-1b 7015 42 Parameter 1 HF270 Pass 0.622 1 360-16 L Eq.H1-1b 1030 43 Parameter 1 HF270 Pass 0.622 1 360-16 L Eq.H1-1b 8028 44 Parameter 1 HF270 Pass 0.114 1 360-16 L Eq.H1-1b <td< td=""><td>33</td><td>Parameter 1</td><td>HE300A</td><td>Pass</td><td>0.339</td><td>1</td><td>360-16 L</td><td>Eq.H1-1b</td><td>8027</td></td<>	33	Parameter 1	HE300A	Pass	0.339	1	360-16 L	Eq.H1-1b	8027	
35 Parameter 1 HE180A Pass 0.083 1 360-16 L Eq.H1-1b 1028 37 Parameter 1 HE200A Pass 0.014 1 360-16 L Eq.H1-1b 11028 37 Parameter 1 HE200A Pass 0.018 1 360-16 L Eq.H1-1b 11028 38 Parameter 1 HE300A Pass 0.018 1 360-16 L Eq.H1-1b 11030 40 Parameter 1 HE300A Pass 0.477 1 360-16 L Eq.H1-1b 10001 41 Parameter 1 HE270 Pass 0.622 1 360-16 L Eq.H1-1b 10001 42 Parameter 1 HE300A Pass 0.622 1 360-16 L Eq.H1-1b 8028 44 Parameter 1 HE300A Pass 0.1181 1 360-16 L Eq.H1-1b 8023 45 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a	34	Parameter 1	HE180A	Pass	0.111	1	360-16 L	Eq.H1-1b	8029	
36 Parameter 1 IPE270 Pass 0.044 1 360-16 L Eq.H1-1b 11028 37 Parameter 1 IPE270 Pass 0.089 1 360-16 L Eq.H1-1b 1003 38 Parameter 1 IPE270 Pass 0.089 1 360-16 L Eq.H1-1b 1001 40 Parameter 1 IPE270 Pass 0.477 1 360-16 L Eq.H1-1b 7015 41 Parameter 1 IPE270 Pass 0.497 1 360-16 L Eq.H1-1b 7015 42 Parameter 1 IPE270 Pass 0.622 1 360-16 L Eq.H1-1b 8028 44 Parameter 1 HE400A Pass 0.183 1 360-16 L Eq.H1-1b 8029 45 Parameter 1 STAR70X7 Pass 0.183 1 360-16 L Eq.H1-1a 8035 46 Parameter 1 STAR70X7 Pass 0.213 1 360-16 L Eq.H1-1a	35	Parameter 1	HE180A	Pass	0.083	1	360-16 L	Eq.H1-1b	8027	
37 Parameter 1 HE200A Pass 0.312 1 360-16 L Eq.H1-1b 11030 38 Parameter 1 HE300A Pass 0.008 1 360-16 L Eq.H1-1b 8015 39 Parameter 1 HE300A Pass 0.108 1 360-16 L Eq.H1-1b 1030 40 Parameter 1 HE270 Pass 0.477 1 360-16 L Eq.H1-1b 7015 41 Parameter 1 HE270 Pass 0.49 1 360-16 L Eq.H1-1b 70015 42 Parameter 1 HE270 Pass 0.622 1 360-16 L Cl.F2.2 7014 43 Parameter 1 HE300A Pass 0.183 1 360-16 L Eq.H1-1b 8028 445 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a 8035 459 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a	36	Parameter 1	IPE270	Pass	0.044	1	360-16 L	Eq.H1-1b	11028	
38 Parameter 1 IPE270 Pass 0.089 1 360-16 L Eq.H1-1b 8015 39 Parameter 1 IPE270 Pass 0.108 1 360-16 L Eq.H1-1b 11030 40 Parameter 1 IPE270 Pass 0.123 1 360-16 L Eq.H1-1b 7001 41 Parameter 1 IPE270 Pass 0.49 1 360-16 L Eq.H1-1b 10001 43 Parameter 1 IPE270 Pass 0.622 1 360-16 L Eq.H1-1b 8028 44 Parameter 1 HE300A Pass 0.183 1 360-16 L Eq.H1-1b 8028 45 Parameter 1 HE400A Pass 0.183 1 360-16 L Eq.H1-1a 8035 46 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a 8035 47 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a	37	Parameter 1	HE200A	Pass	0.312	1	360-16 L	Eq.H1-1b	11030	
39 Parameter 1 HE300A Pass 0.108 1 360-16 L Eq.H-1b 11030 40 Parameter 1 HE270 Pass 0.477 1 360-16 L Eq.H-1b 7015 41 Parameter 1 HE270 Pass 0.123 1 360-16 L Eq.H-1b 7015 42 Parameter 1 IPE270 Pass 0.622 1 360-16 L Eq.H-1b 8028 43 Parameter 1 HE300A Pass 0.427 1 360-16 L Eq.H-1b 8028 44 Parameter 1 HE400A Pass 0.114 1 360-16 L Eq.H-1b 8029 47 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H-1-1a 8035 48 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H-1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H-1-1a	38	Parameter 1	IPE270	Pass	0.089	1	360-16 L	Eq.H1-1b	8015	
40 Parameter 1 IPEZ70 Pass 0.477 1 360-16 L Cl.2.2 10004 41 Parameter 1 IPEZ70 Pass 0.123 1 360-16 L Eq.H1-1b 7015 42 Parameter 1 IPEZ70 Pass 0.622 1 360-16 L Eq.H1-1b 8028 43 Parameter 1 HE300A Pass 0.622 1 360-16 L Cl.61 11028 44 Parameter 1 HE400A Pass 0.183 1 360-16 L Cl.61 11028 45 Parameter 1 STAR70X7 Pass 0.183 1 360-16 L Eq.H1-1b 8035 46 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.623 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 STAR70X7 Pass 0.623 1 360-16 L Eq.H1-1a	39	Parameter 1	HE300A	Pass	0.108	1	360-16 L	Eq.H1-1b	11030	
41 Parameter 1 HE300A Pass 0.123 1 360-16 L Eq.H1-1b 7015 42 Parameter 1 IPE270 Pass 0.699 1 360-16 L Eq.H1-1b 10001 43 Parameter 1 IPE270 Pass 0.622 1 360-16 L Eq.H1-1b 8028 44 Parameter 1 HE400A Pass 0.183 1 360-16 L Eq.H1-1b 8028 45 Parameter 1 HE400A Pass 0.183 1 360-16 L C.E3 8035 46 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.223 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8031 52 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a	40	Parameter 1	IPE270	Pass	0.477	1	360-16 L	CI.F2.2	10004	
42 Parameter1 IPE270 Pass 0.49 1 360-16 L Eq.H1-1b 10001 43 Parameter1 IPE270 Pass 0.622 1 360-16 L Cl.F2.2 7014 44 Parameter1 HE300A Pass 0.183 1 360-16 L Cl.G1 11028 45 Parameter1 HE180A Pass 0.114 1 360-16 L Eq.H1-1b 8028 46 Parameter1 STAR70X7 Pass 0.183 1 360-16 L Eq.H1-1a 8035 47 Parameter1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 50 Parameter1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8035 52 Parameter1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8031 53 Parameter1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a	41	Parameter 1	HE300A	Pass	0.123	1	360-16 L	Eq.H1-1b	7015	
43 Parameter 1 IPE270 Pass 0.622 1 360-16 L CJ-2.2 7014 44 Parameter 1 HE300A Pass 0.427 1 360-16 L Eq.H1-1b 8028 45 Parameter 1 HE400A Pass 0.183 1 360-16 L Eq.H1-1b 8029 46 Parameter 1 STAR70X7 Pass 0.183 1 360-16 L Eq.H1-1a 8035 47 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8031 53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8030 54 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a </td <td>42</td> <td>Parameter 1</td> <td>IPE270</td> <td>Pass</td> <td>0.49</td> <td>1</td> <td>360-16 L</td> <td>Eq.H1-1b</td> <td>10001</td>	42	Parameter 1	IPE270	Pass	0.49	1	360-16 L	Eq.H1-1b	10001	
44 Parameter 1 HE300A Pass 0.427 1 360-16 L Eq.H1-1b 8028 45 Parameter 1 HE400A Pass 0.183 1 360-16 L CLG1 11028 46 Parameter 1 STAR70X7 Pass 0.183 1 360-16 L Eq.H1-1a 8029 47 Parameter 1 STAR70X7 Pass 0.183 1 360-16 L Eq.H1-1a 8035 48 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.0424 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8035 52 Parameter 1 STAR70X7 Pass 0.244 1 360-16 L Eq.H1-1a 8031 53 Parameter 1 STAR70X7 Pass 0.244 1 360-16 L Eq.H1-1a	43	Parameter 1	IPE270	Pass	0.622	1	360-16 L	CI.F2.2	7014	
45 Parameter 1 HE400A Pass 0.183 1 360-16 L Cl.G1 11028 46 Parameter 1 HE180A Pass 0.114 1 360-16 L Eq.H1-1b 8029 47 Parameter 1 STAR70X7 Pass 0.301 1 360-16 L Eq.H1-1a 8035 48 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.424 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 STAR70X7 Pass 0.072 1 360-16 L Eq.H1-1a 8033 52 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8035 53 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8030 57 Parameter 1 STAR70X7 Pass 0.729<	44	Parameter 1	HE300A	Pass	0.427	1	360-16 L	Eq.H1-1b	8028	
46 Parameter 1 HE180A Pass 0.114 1 360-16 L Eq.H1-1b 8029 47 Parameter 1 STAR70X7 Pass 0.183 1 360-16 L Eq.H1-1a 8035 48 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a 8035 49 Parameter 1 STAR70X7 Pass 0.424 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.424 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 STAR70X7 Pass 0.072 1 360-16 L Eq.H1-1a 8061 53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8031 56 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H	45	Parameter 1	HE400A	Pass	0.183	1	360-16 L	Cl.G1	11028	
47 Parameter 1 STAR70X7 Pass 0.183 1 360-16 L CLE3 8035 48 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a 8035 49 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.424 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 STAR70X7 Pass 0.072 1 360-16 L Eq.H1-1a 8035 52 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8035 53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8031 54 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8036 60 Parameter 1 IPE200 Pass 0.033<	46	Parameter 1	HE180A	Pass	0.114	1	360-16 L	Eq.H1-1b	8029	
48 Parameter 1 STAR70X7 Pass 0.391 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 IPE270 Pass 0.072 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 IPE270 Pass 0.072 1 360-16 L Eq.H1-1a 8033 52 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8035 53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8031 54 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8031 56 Parameter 1 STAR70X7 Pass 0.836 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.294<	47	Parameter 1	STAR70X7	Pass	0.183	1	360-16 L	CI.E3	8035	
49 Parameter 1 STAR70X7 Pass 0.304 1 360-16 L Eq.H1-1a 8033 50 Parameter 1 IPE270 Pass 0.424 1 360-16 L Eq.H1-1a 8033 51 Parameter 1 IPE270 Pass 0.072 1 360-16 L Eq.H1-1a 8025 52 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8031 53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8031 54 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8031 56 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.294 1 360-16 L Eq.H1-1b 8036 61 Parameter 1 IPE200 Pass 0.204 <td>48</td> <td>Parameter 1</td> <td>STAR70X7</td> <td>Pass</td> <td>0.391</td> <td>1</td> <td>360-16 L</td> <td>Eq.H1-1a</td> <td>8035</td>	48	Parameter 1	STAR70X7	Pass	0.391	1	360-16 L	Eq.H1-1a	8035	
S0 Parameter 1 S1AR/0X7 Pass 0.424 1 380-16 L Eq.H1-1a 8033 51 Parameter 1 IPE270 Pass 0.072 1 360-16 L Eq.H1-1a 8035 52 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8061 53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8031 54 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8030 55 Parameter 1 STAR70X7 Pass 0.836 1 360-16 L Eq.H1-1a 8031 56 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.035 1 360-16 L Eq.H1-1a 8031 61 Parameter 1 IPE200 Pass 0.033 1 360-16 L CLD2 <td>49</td> <td>Parameter 1</td> <td>STAR/UX/</td> <td>Pass</td> <td>0.304</td> <td>1</td> <td>360-16 L</td> <td>Eq.H1-1a</td> <td>8033</td>	49	Parameter 1	STAR/UX/	Pass	0.304	1	360-16 L	Eq.H1-1a	8033	
51 Parameter 1 IPEZ/0 Pass 0.072 1 360-16 L Eq.H1-16 8025 52 Parameter 1 STAR70X7 Pass 0.253 1 360-16 L Eq.H1-1a 8035 53 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8035 54 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8030 57 Parameter 1 STAR70X7 Pass 0.836 1 360-16 L Eq.H1-1a 8030 58 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.035 1 360-16 L Eq.H1-1a 8036 61 Parameter 1 IPE200 Pass 0.033 1 360-16 L CLD2 8032 62 Parameter 1 IPE200 Pass 0.26	50	Parameter 1	STAR/UX/	Pass	0.424	1	360-16 L	Eq.H1-1a	8033	
52 Parameter 1 STAR70X7 Pass 0.253 1 380-16 L Eq.H1-1a 8061 53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8035 54 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8030 57 Parameter 1 STAR70X7 Pass 0.836 1 360-16 L Eq.H1-1a 8031 58 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.294 1 360-16 L Eq.H1-1b 8036 61 Parameter 1 IPE200 Pass 0.035 1 360-16 L CLO2 8032 63 Parameter 1 IPE200 Pass 0.26 1 360-16 L Eq.H1-3a(H1 11030 67 Parameter 1 HE400A Pass 0.268 <td>51</td> <td>Parameter 1</td> <td>IPE270</td> <td>Pass</td> <td>0.072</td> <td>1</td> <td>360-16 L</td> <td>Eq.H1-1D</td> <td>8025</td>	51	Parameter 1	IPE270	Pass	0.072	1	360-16 L	Eq.H1-1D	8025	
53 Parameter 1 STAR70X7 Pass 0.691 1 360-16 L Eq.H1-1a 8035 54 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8030 57 Parameter 1 STAR70X7 Pass 0.836 1 360-16 L Eq.H1-1a 8031 58 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.294 1 360-16 L Eq.H1-1b 8036 61 Parameter 1 IPE200 Pass 0.033 1 360-16 L CLD2 8032 63 Parameter 1 IPE200 Pass 0.264 1 360-16 L Eq.H1-3a(H1 11030 64 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H	52	Parameter 1	STAR/0X/	Pass	0.253	1	360-16 L	Eq.H1-1a	8061	
54 Parameter 1 STAR70X7 Pass 0.344 1 360-16 L Eq.H1-1a 8031 55 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8030 57 Parameter 1 STAR70X7 Pass 0.836 1 360-16 L Eq.H1-1a 8030 58 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.294 1 360-16 L Eq.H1-1b 8036 61 Parameter 1 IPE200 Pass 0.035 1 360-16 L CLD2 8033 62 Parameter 1 IPE200 Pass 0.026 1 360-16 L CLD2 8032 63 Parameter 1 HE400A Pass 0.264 1 360-16 L Eq.H1-3a(H1 11030 67 Parameter 1 HE400A Pass 0.268 1 360-16 L Eq.H1-3a(H1	53	Parameter 1	STAR70X7	Pass	0.691	1	360-16 L	Eq.H1-1a	8035	
35 Parameter 1 STAR70X7 Pass 0.729 1 360-16 L Eq.H1-1a 8030 57 Parameter 1 STAR70X7 Pass 0.836 1 360-16 L Eq.H1-1a 8030 58 Parameter 1 STAR70X7 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.294 1 360-16 L Eq.H1-1b 8036 61 Parameter 1 IPE200 Pass 0.035 1 360-16 L CLD2 8033 62 Parameter 1 IPE200 Pass 0.026 1 360-16 L CLD2 8032 63 Parameter 1 HE400A Pass 0.26 1 360-16 L Eq.H1-3a(H1 11030 64 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1 11030 73 Parameter 1 HE400A Pass 0.251 1 360-16 L Eq.H1-3a(H1 <td>54</td> <td>Parameter 1</td> <td>STAR/UX7</td> <td>Pass</td> <td>0.344</td> <td>1</td> <td>360-16 L</td> <td>Eq.H1-1a</td> <td>8031</td>	54	Parameter 1	STAR/UX7	Pass	0.344	1	360-16 L	Eq.H1-1a	8031	
57 Parameter 1 STAR70X7 Pass 0.830 1 300-10 L Eq.H1-1a 11006 58 Parameter 1 IPE200 Pass 0.394 1 360-16 L Eq.H1-1a 8031 60 Parameter 1 IPE200 Pass 0.294 1 360-16 L Eq.H1-1b 8036 61 Parameter 1 IPE200 Pass 0.035 1 360-16 L CLD2 8032 62 Parameter 1 IPE200 Pass 0.266 1 360-16 L CLD2 8032 63 Parameter 1 IPE200 Pass 0.266 1 360-16 L Eq.H1-3a(H1 11030 64 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1 11030 67 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1 11030 73 Parameter 1 HE30A Pass 0.268 1 360-16 L Eq.H2-1	55	Parameter 1	STAR/UX/	Pass	0.729	1	360-16 L	Eq.H1-1a	8030	
So Parameter 1 STRT/GAT Pass 0.294 1 360-16 L Eq.H1-18 8031 60 Parameter 1 IPE200 Pass 0.294 1 360-16 L Eq.H1-18 8036 61 Parameter 1 IPE200 Pass 0.035 1 360-16 L CLD2 8033 62 Parameter 1 IPE200 Pass 0.033 1 360-16 L CLD2 8032 63 Parameter 1 IPE200 Pass 0.264 1 360-16 L CLD2 8032 64 Parameter 1 HE400A Pass 0.204 1 360-16 L Eq.H1-3a(H1 11030 67 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1 11028 73 Parameter 1 HE340A Pass 0.268 1 360-16 L Eq.H1-3d(H1 8027 75 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1	57	Parameter 1	STAR/UX/	Pass	0.830	1	360-16 L	Eq.H1-1a	8031	
61 Parameter 1 IPE200 Pass 0.035 1 360-16 L Ed, H1-10 8036 62 Parameter 1 IPE200 Pass 0.035 1 360-16 L CLD2 8033 62 Parameter 1 IPE200 Pass 0.033 1 360-16 L CLD2 8032 63 Parameter 1 IPE200 Pass 0.26 1 360-16 L CLD2 8032 64 Parameter 1 HE400A Pass 0.264 1 360-16 L Eq.H1-3a(H1 11030 67 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1 11028 73 Parameter 1 HE30A Pass 0.268 1 360-16 L Eq.H1-3a(H1 8027 75 Parameter 1 HE30A Pass 0.268 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1	58	Parameter 1	JPE200	Pass	0.394	1	360-16 L	Eq.H1-18	8035	
621 Parameter 1 IPE200 Pass 0.035 1 360-16 L CLD2 8033 63 Parameter 1 IPE200 Pass 0.033 1 360-16 L CLD2 8032 63 Parameter 1 IPE200 Pass 0.26 1 360-16 L CLD2 8032 64 Parameter 1 HE400A Pass 0.264 1 360-16 L Eq.H1-3a(H1 11030 67 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1 11028 73 Parameter 1 HE340A Pass 0.251 1 360-16 L Eq.H1-1b 11030 74 Parameter 1 HE340A Pass 0.268 1 360-16 L Eq.H1-1b 11030 75 Parameter 1 L70X70X7 Pass 0.38 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1	61	Parameter 1	IPE200	Pass	0.035	1	360-10 L	CLD2	8030	
G2 Parameter 1 IPE200 Pass 0.033 1 360-16 L CLD2 8032 63 Parameter 1 IPE200 Pass 0.26 1 360-16 L CLD2 8032 64 Parameter 1 HE400A Pass 0.26 1 360-16 L Eq.H1-3a(H1 11030 67 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1 11030 73 Parameter 1 HE340A Pass 0.251 1 360-16 L Eq.H1-3a(H1 11030 74 Parameter 1 HE340A Pass 0.268 1 360-16 L Eq.H1-3a(H1 8027 75 Parameter 1 L70X70X7 Pass 0.38 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 <td>62</td> <td>Parameter 1</td> <td>IPE200</td> <td>Dace</td> <td>0.033</td> <td>1</td> <td>360-16 L</td> <td>CLD2</td> <td>8033</td>	62	Parameter 1	IPE200	Dace	0.033	1	360-16 L	CLD2	8033	
63 Parameter 1 HE400A Pass 0.204 1 360-16 L Eq.H1-3a[H1 11030 67 Parameter 1 HE400A Pass 0.204 1 360-16 L Eq.H1-3a[H1 11030 67 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a[H1 11030 73 Parameter 1 HE340A Pass 0.251 1 360-16 L Eq.H1-3a[H1 11030 74 Parameter 1 HE340A Pass 0.268 1 360-16 L Eq.H1-3a[H1 8027 75 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.38 1 360-16 L Eq.H2-1 10004 77 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 81 Parameter 1 HE400A Pass 0.374 1 360-16 L <	63	Parameter 1	IPE200	Pass	0.055	1	360-161	(1.62.2	10004	
67 Parameter 1 HE400A Pass 0.294 1 360-16 L Eq.H1-3a(H1) 11030 73 Parameter 1 HE340A Pass 0.294 1 360-16 L Eq.H1-3a(H1) 11030 74 Parameter 1 HE340A Pass 0.268 1 360-16 L Eq.H1-3a(H1) 8027 75 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 77 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8033 81 Parameter 1 HE400A Pass 0.374 1 360-16 L <t< td=""><td>64</td><td>Parameter 1</td><td>HEADDA</td><td>Pass</td><td>0.204</td><td>1</td><td>360-161</td><td>En H1-3a/H1</td><td>11030</td></t<>	64	Parameter 1	HEADDA	Pass	0.204	1	360-161	En H1-3a/H1	11030	
Or Parameter 1 HE340A Pass 0.254 1 360-16 L Eq.H1-1b 11028 73 Parameter 1 HE340A Pass 0.251 1 360-16 L Eq.H1-1b 11030 74 Parameter 1 HE340A Pass 0.268 1 360-16 L Eq.H1-1a 8027 75 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.38 1 360-16 L Eq.H2-1 10004 77 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8033 81 Parameter 1 HE400A Pass 0.374 1 360-16 L Cl.G1 7015 82 Parameter 1 HE400A Pass 0.499 1 360-16 L Eq.H1-3a(H1	67	Parameter 1	HEADDA	Pace	0.204	1	360-16-1	Eq.H1-3a/H1	11028	
74 Parameter 1 HE340A Pass 0.268 1 360-16 L Eq.H1-38[H1 8027 75 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H1-38[H1 8027 76 Parameter 1 L70X70X7 Pass 0.38 1 360-16 L Eq.H2-1 10004 77 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8033 81 Parameter 1 HE400A Pass 0.374 1 360-16 L Cl.G1 7015 82 Parameter 1 HE400A Pass 0.409 1 360-16 L Eq.H1-38[H1 8024 83 Parameter 1 HE400A Pass 0.409 1 360-16 L Eq.H1-38	73	Parameter 1	HERMON	Pass	0.254	1	360-161	Eq.H1-1b	11028	
75 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 76 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 77 Parameter 1 L70X70X7 Pass 0.382 1 360-16 L Eq.H2-1 10004 77 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8033 81 Parameter 1 HE400A Pass 0.374 1 360-16 L Cl.G1 7015 82 Parameter 1 HE400A Pass 0.409 1 360-16 L Eq.H1-3a[H1 8024 83 Parameter 1 HE400A Pass 0.409 1 360-16 L Eq.H1-3a[H1 8024	74	Parameter 1	HE340A	Pass	0.251	1	360-161	Eq.H1-3a/H1	8027	
76 Parameter 1 L70X70X7 Pass 0.38 1 360-16 L Eq.H2-1 10004 77 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8032 81 Parameter 1 HE400A Pass 0.374 1 360-16 L Eq.H2-1 8033 82 Parameter 1 HE400A Pass 0.195 1 360-16 L Eq.H1-3a(H1 8024 83 Parameter 1 HE400A Pass 0.409 1 360-16 L Eq.H2-3a(H1 8024	75	Parameter 1	17087087	Pass	0.200	1	360-161	Eq.H2-1	10004	
77 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 10004 78 Parameter 1 L70X70X7 Pass 0.269 1 360-16 L Eq.H2-1 8032 78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8033 81 Parameter 1 HE400A Pass 0.374 1 360-16 L Cl.G1 7015 82 Parameter 1 HE400A Pass 0.495 1 360-16 L Eq.H1-3a(H1 8024 83 Parameter 1 HE400A Pass 0.409 1 360-16 L Cl.F2 7055	75	Parameter 1	17087087	Pass	0.362	1	360-161	Eq.H2-1	10004	
78 Parameter 1 L70X70X7 Pass 0.296 1 360-16 L Eq.H2-1 8032 81 Parameter 1 HE400A Pass 0.374 1 360-16 L Cl.G1 7015 82 Parameter 1 HE400A Pass 0.195 1 360-16 L Eq.H2-1 8033 83 Parameter 1 HE400A Pass 0.374 1 360-16 L Eq.H1-3a(H1 8024 83 Parameter 1 HE400A Pass 0.409 1 360-16 L Eq.H1-3a(H1 8024	77	Parameter 1	170X70X7	Pass	0.269	1	360-161	Eq.H2-1	8032	
R1 Parameter 1 HE400A Pass 0.150 1 360-16 L Eq.H2-1 8033 81 Parameter 1 HE400A Pass 0.374 1 360-16 L Cl.G1 7015 82 Parameter 1 HE400A Pass 0.195 1 360-16 L Eq.H1-3a(H1 8024 83 Parameter 1 HE400A Pass 0.409 1 360-16 L Cl.F2 2 7025	78	Parameter 1	170X70X7	Pass	0.296	1	360-161	Eq.H2-1	8033	
82 Parameter 1 HE400A Pass 0.195 1 360-16 L Eq.H1-3a(H1 8024 83 Parameter 1 HE400A Pass 0.409 1 360-16 L Eq.H1-3a(H1 8024	81	Parameter 1	HE400A	Pass	0.374	1	360-161	CLG1	7015	
83 Parameter 1 HE400A Pass 0.409 1 360-161 CI-F2-2 7025	82	Parameter 1	HE400A	Pass	0.195	1	360-161	Eq.H1-3a(H1	8024	
	83	Parameter 1	HE400A	Pass	0.409	1	360-16 L	CI.F2.2	7025	

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SERVICEABILITY CHECK

Allowable Lateral Displacement of structure is considered as H/200 as per 4398-AX-SG-2F00200000001 (SA-AMI-G00-TCMT-003195) - General design rules for foundations and structures – Clause 13.2.

Allowable Inter-story drift is considered as h/200 as per 4398-AX-SG-2F00200000001 (SA-AMI-G00- TCMT-003195) - General design rules for foundations and structures – Clause 13.2.

Where, H = Total Height of Structure

h = Inter-story Height.

	Description	Design	Charles .	Actual	Allowable	Code	Clause	
Beam	Parameter	Property	Status	Ratio	Ratio	Code	Clause	L/C
597	Parameter 2	HE200A	Pass	0.153	1	360-161	Deflection	13004
506	Decemeter 2	LIELOOA	Dave	0.005	-	360 16 1	Deflection	12004
390	Parameter 2	HEIBUA	Pass	0.096	1	300-10 L	Deflection	23004
595	Parameter 2	HE200A	Pass	0.108	1	360-16 L	Deflection	13001
594	Parameter 2	HE200A	Pass	0.109	1	360-16 L	Deflection	13003
593	Parameter 2	HE200A	Pass	0.108	1	360-16 L	Deflection	13002
592	Parameter 2	HE200A	Pass	0.109	1	360-16 L	Deflection	13003
591	Parameter 2	HE200A	Pass	0.131	1	360-16 L	Deflection	13002
590	Parameter 2	HE200A	Pass	0.131	1	360-161	Deflection	13001
590	Parameter 2	HEDOOA	Pass	0.167	1	360 16 1	Deflection	12004
389	Parameter 2	HEZUUA	Pass	0.107	1	300-10 L	Deflection	13004
588	Parameter 2	HEZUUA	Pass	0.131	1	300-10 L	Deflection	13002
587	Parameter 2	HE200A	Pass	0.719	1	360-16 L	Deflection	13001
586	Parameter 2	HE200A	Pass	0.131	1	360-16 L	Deflection	13002
585	Parameter 2	HE300A	Pass	0.074	1	360-16 L	Deflection	13002
582	Parameter 2	HE300A	Pass	0.177	1	360-16 L	Deflection	13001
581	Parameter 2	HE300A	Pass	0.558	1	360-161	Deflection	13004
590	Parameter 2	HEADDA	Pase	0.241	1	360-161	Deflection	12002
530	Parameter 2	HE400A	Pass	0.241	-	300-10 L	Deflection	13002
579	Parameter 2	HE400A	Pass	0.241	1	300-10 L	Deflection	13002
569	Parameter 2	HE300A	Pass	0.485	1	360-16 L	Deflection	13002
568	Parameter 2	HE300A	Pass	0.319	1	360-16 L	Deflection	13004
567	Parameter 2	HE300A	Pass	0.107	1	360-16 L	Deflection	13002
563	Parameter 2	IPE160	Pass	0.021	1	360-16 L	Deflection	13002
562	Parameter 2	IPE200	Pass	0.925	1	360-161	Deflection	13004
561	Parameter 2	IPE160	Pass	0.018	1	360-161	Deflection	13004
560	Parameter 2	105200	Pass	0.025	-	360 16 1	Deflection	13004
500	Parameter 2	IPE200	Pass	0.925	1	300-10 L	Deflection	13004
559	Parameter 2	IPE160	Pass	0.018	1	360-16 L	Deflection	13002
558	Parameter 2	IPE200	Pass	0.925	1	360-16 L	Deflection	13004
557	Parameter 2	IPE160	Pass	0.018	1	360-16 L	Deflection	13003
556	Parameter 2	IPE200	Pass	0.925	1	360-16 L	Deflection	13004
554	Parameter 2	HE300A	Pass	0.029	1	360-161	Deflection	13001
551	Parameter 2	HE200A	Pace	0.678	1	260-161	Deflection	12004
550	Parameter 2	HEDOOA	Pass	0.678	1	360-161	Deflection	13004
530	Parameter 2	HESOUA	Pass	0.037	-	300-10 L	Deflection	13004
539	Parameter 2	HE300A	Pass	0.472	1	360-16 L	Deflection	13002
537	Parameter 2	HE300A	Pass	0.585	1	360-16 L	Deflection	13004
534	Parameter 2	IPE270	Pass	0.002	1	360-16 L	Deflection	13001
530	Parameter 2	HE200A	Pass	0.004	1	360-16 L	Deflection	13003
529	Parameter 2	HE200A	Pass	0.003	1	360-16 L	Deflection	13003
528	Parameter 2	HE200A	Pass	0.027	1	360-161	Deflection	13001
520	Darameter 2	HEDOOA	Pass	0.027	1	360-161	Deflection	13001
527	Parameter 2	HE200A	Pass	0.327	-	300-10 L	Deflection	13001
526	Parameter 2	HEZOUA	Pass	0./19	1	360-16 L	Deflection	13001
523	Parameter 2	IPE270	Pass	0.027	1	360-16 L	Deflection	13002
521	Parameter 2	HE300A	Pass	0.472	1	360-16 L	Deflection	13002
516	Parameter 2	HE180A	Pass	0.221	1	360-16 L	Deflection	13002
511	Parameter 2	IPE160	Pass	0.002	1	360-16 L	Deflection	13004
510	Parameter 2	IPE270	Pass	0.384	1	360-16 L	Deflection	13001
509	Parameter 2	HE300A	Pass	0,107	1	360-161	Deflection	13002
509	Parameter 2	IRE270	Pase	0.284	1	360-161	Deflection	13001
507	Parameter 2	105270	Deser	0.504	4	260 161	Deflection	12002
507	Parameter 2	IPE270	PdSS	0.031	1	300-10 L	Deflection	13002
506	Parameter 2	IPE2/U	PdSS	0.384	1	300-10 L	Denection	13001
505	Parameter 2	IPE270	Pass	0.631	1	360-16 L	Deflection	13002
504	Parameter 2	HE200A	Pass	0.269	1	360-16 L	Deflection	13001
503	Parameter 2	IPE270	Pass	0.014	1	360-16 L	Deflection	13001
501	Parameter 2	HE300A	Pass	0.013	1	360-16 L	Deflection	13001
500	Parameter 2	HE300A	Pass	0.025	1	360-16 L	Deflection	13002
499	Parameter 2	IPE160	Pass	0.003	1	360-161	Deflection	13002
409	Darameter 2	HERODA	Desc	0.019	1	260-161	Deflection	12002
498	Parameter 2	HERODA	Pass	0.018	1	260 16 L	Deflection	13002
407	Parameter 2	HESUUA	PdSS	0.143	1	300-10 L	Denection	13004
466	Parameter 2	IPE270	Pass	0.049	1	360-16 L	Deflection	13003
465	Parameter 2	IPE270	Pass	0.094	1	360-16 L	Deflection	13001
463	Parameter 2	IPE270	Pass	0.094	1	360-16 L	Deflection	13001
462	Parameter 2	IPE270	Pass	0.004	1	360-16 L	Deflection	13003
459	Parameter 2	IPE270	Pass	0.049	1	360-16 L	Deflection	13003
456	Parameter 2	IPE270	Pass	0.002	1	360-161	Deflection	13003
452	Parameter 2	HE200A	Pase	0.711	1	360-161	Deflection	13/001
449	Parameter 2	IPE270	Pass	0.002	1	360-161	Deflection	13002
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	UTILIZATION RATIO - BEAM LOCAL CHECK STRENGTH CASE									
Beam	Parameter	Design Property	Status	Actual Ratio	Allowable Ratio	Code	Clause	L/C		
596	Parameter 1	HE180A	Pass	0.428	1	360-16 L	Eq.H1-1b	12061		
504	Parameter 1	HE200A	Pass	0.535	1	360-16 L	Eq.H1-1b	12003		
425	Parameter 1	IPE270	Pass	0.273	1	360-16 L	CI.F2.2	12001		
299	Parameter 1	HE180A	Pass	0.513	1	360-16 L	Eq.H1-1b	12003		

CONCLUSION

The static analysis of the steel structure of reboiler equipment using STAAD.Pro software has provided valuable insights into its structural performance under various loading conditions. The analysis, conducted as per AISC code using the LRFD method, ensured accurate load combinations and strength evaluation. The results indicate that the structure meets safety and design standards, with acceptable utilization ratios and minimal deflection. This study highlights the effectiveness of STAAD.Pro in optimizing steel structure design, ensuring reliability and cost efficiency.

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