	Customer	:	Bhogpur Sugar Mills Expansion Project
	Location	:	Bhogpur , Punjab
	Boiler type	:	
	Fuel	:	
	Reference considered	:	
	Furnace construction	:	
	BMCR Capacity	TPH	80
	MSSV outlet condition		
	Pressure	Kg/cm² (g)	
	Temperature	°C	

Input
Output

Sr. No.	Description	Units	Parameters	Remarks
A	**General**			
1	Air duct thickness	mm		
2	Flue duct thickness	mm		
3	Hopper thickness	mm		
4	Panel strip thickness	mm	6	
5	Insulation thickness (Furnace)	mm	125	
6	Aluminimum Cladding thickness	mm	0.8	
B	**Density**			
1	Carbon steel	Kg/m^3	7850	
2	Alloy steel	Kg/m^3	8050	
3	Refractory	Kg/m^3	2500	
4	Insulation	Kg/m^3	120	
5	Aluminimum Cladding	Kg/m^3	2700	
6	Ash Density	Kg/m^3	2500	
C	**Drum**			
	Steam drum OD	mm	1575	
	Steam drum ID	mm	1375	
	Shell Length	mm	8000	
	Steam Drum Dish end ID	mm	1375	
	Steam Drum Thickness	mm	100	
	Steam Drum Dish end Thickness	mm	75	
	Water drum OD	mm	1140	
	Water drum ID	mm	1000	
	Water Drum Shell Length	mm	7430	
	Water Drum Thickness	mm	70	
	Water Drum Dish end ID	mm	1000	
	Water Drum Dish end Thickness	mm	63	
	SD to WD centre distance	mm	5425	
D	**Furnace**			
	Furnace dimensions			
1	Panel tube OD	mm	63.5	
2	Panel tube thickness (8 SWG)	mm	4.065	
3	Tube pitch ovearll	mm	88	
4	Panel strip thickness	mm	6	
5	Panel strip width	mm	25	
6	Economiser Coil OD	mm	38.1	
7	Economiser Coil Thickness (8 SWG)	mm	4.06	
7	Superheater coil OD	mm	44.5	
8	Primary Superheater Coil (8 SWG)	mm	4.06	
9	Secondary Superheater coil thk (3 SWG)	mm	6.4	
10	Front Header Length	mm	7000	
11	Front Header OD	mm	273	
12	Front Header Thickness	mm	28.6	
13	Furnace top , bottom, front , rear header OD (250NB)	mm	273.1	
14	Furnace top , bottom, front , rear header thickness (Sch 160)	mm	28.6	
15	Economiser Header OD (200 NB)	mm	219.1	
16	Economiser Header Thickness (SCH 160)	mm	23	
17	Front & Rear Downcomer Header (200 NB)	mm	219.1	
18	Front & Rear Downcomer Header (Sch 100)	mm	15.1	
19	Main Down Comer Header (250 NB)	mm	273	
20	Main Down Comer Header (Sch 100)	mm	18.2	
21	Downcomer to Extension Panel (150NB)	mm	168.3	
22	Downcomer to Extension Panel (Sch 120)	mm	14.3	
23	Top to Bottom header height	mm	20882	
24	Riser Pipe Outer Diameter (100NB)	mm	114.3	
25	Riser Pipe Thickness (Sch 80)	mm	8.56	
26	Top header to Steam drum centre	mm		
27	Primay Superheater Inlet Header & Sec Superheater Outlet Header (250 NB)	mm	273	
28	Primay Superheater Inlet Header Thickness (Sch 120)	mm	21.4	
29	Primary Superheater Outlet Header & Sec Supeheater Inlet Header (250NB)	mm	273	
30	Primary Superheater Outlet & Sec Supeheater Inlet Header Thk (Sch 140)	mm	25.4	
31	Secondary Superheater Outlet Header Thickness (Sch 160)	mm	28.6	
32	Front & rear down comer branch OD (150 NB)	mm	168.3	
33	Front & rear down comer branch thickness (Sch 80)	mm	10.97	
34	Supply Pipes (Outer Diameter)	mm	114.3	
35	Supply Pipes (Thickness)	mm	8.56	
36	APH Stay & Expanded Tubes OD	mm	63.5	
37	APH Stay Tubes Thickness -9SWG	mm	3.658	
38	APH Expanded Tubes Thickness -13 SWG	mm	2.33	
39	Tube pitch above nose	mm	130	
40	Top Nose Angle	Deg	35	
41	Bottom Nose Angle	Deg	25	
42	Side Panel width after nose (Front to Rear)	mm	4050	
43	Side Panel width (with differed tube pitch) before nose (Front to Rear)	mm	4940	
44	Side Panel width (with common tube pitch) before nose (Front to Rear)	mm	630	
45	Length (LHS to RHS)	mm	2792	

	Nose height (H1 + H2+ H3)	**mm**	**3697**	
	H1	mm	933	
	H2	mm	2465	
	H3 (assumed)	mm	300	
	Bottom nose width	mm	2000	
5	**Boiler Bank Tubes**			
	Quantity		20	
	OD	mm	50.8	
	Thickness (8 SWG)	mm	4.065	
	Assumptions made if any			
1	Buckstay (size: MB 250 + MC 200 + 12 thk x 200 wide plate) weight per metre ISMB 250 - 37.3 w/m , ISMC 200 - 22.1 w/m , Plate =18.84 w/m (78.24 kg/m)	Kgs	100	
2	Buckstay levels	qty	5	
3	Access door assembly (including sealing arrangement) weight	kgs	1000	

Sr No	Description	Weight	Unit
	Total weight	739.91	T
1	Front Wall Panel	35.37	T
2	Roof Tube	35.13	T
3	Side Wall Panel	139.88	T
4	Rear Wall Panel	25.58	T
5	Steam Drum	53.59	T
6	Water Drum	24.88	T
7	Convection Bank	30.95	T
8	Eco	102.54	T
9	APH	129.38	T
10	Grate	50.00	T
11	Bagasse Feed System	29.27	T
12	Downcomers	17.80	T
13	Risers	7.15	T
14	Superheater Headers	57.01	T
15	Steam Collecting Pipes	1.38	T

Sr No	Description	Weight	Unit	
1	Tube Weight	181.35	T	
2	Water Weight	47.09	T	
	Tube Water Weight	31.37	T	
	Pipe Water Weight	9.36	T	
	Drum Water Weight	6.36	T	
3	Pipe Weight	33.19	T	
4	Drum Weight	48.47	T	
5	Insulation Weight	17.12	T	
6	Cladding Weight	2.86	T	
7	Panel Strips Weight	13.07	T	
8	Bukstay Weight	12.95	T	
9	Sealing Weight	4.90	T	
10	Refractory Weight	24.05	T	
11	Slings	5.24	T	
12	Pneumatic spreader assembly	6.00	T	
14	Miscellenous	23.75	T	Mountings + SootBlower + Manhole + AccessDoor +Sundry +Drum internals + Drum attachments + Stubs +Safety Valves

Sr. No.	Description	Parameters	Units		
	Front wall Panel	35373	kgs		
	Width	5.896	m		
i	**Front Bottom Header**				
	Size (NB)	250			
	Schedule	160			
	Front Header Length	7.2	m		
	Outer Diameter	0.2731	m		
	Thickness	0.02858	m		
	Inner Diameter	0.2159	m		
	Pipe Weight/m	172.27	kgs/m		
	Pipe Weight	**1240.34**	**kgs**		
	Water wt/m	36.62	kgs/m		
	Water Weight	**263.69**	**kgs**		
	Insulation				
	Thickness	0.125	m		
	Insulation density	120.00	kg/m^3		
	Insulation weight/m	18.76	kgs/m		
	Insulation Weight	**135.07**	**kgs**		
	Cladding				
	Thickness	0.0008	m		
	Cladding weight/m	3.56	kgs/m		
	Cladding Weight	**25.60**	**kgs**		
	Header mountings	100	kgs		
	Total weight	**1764.70**	kgs		
ii	**Tubes**				
	Outer Diameter	0.06350	m	0.06350	
	Wall thickness	0.004065	m	0.004065	
	Inner Diameter	0.05537	m	0.05537	
	Carbon Steel Density	7850	kg/m^3	7850	
	Tube weight /m	5.958	kg/m	5.958	
	Tube Weight	**1094**	**kgs**	**8022**	
	Water weight / m	2.4079	kg/m	2.4079	
	Total weight/m	**8.37**	**kg/m**	**8.37**	
	Water Weight	**442**	**kgs**	**3242**	
		Bottom Portion		**Front wall**	
	Length	2.7	m	19.8	
	Quantity	68		68	
iii	**Insulation**				
	Thickness	0.125	kgs		
	Insulation density	120.00	kg/m^3	120.00	
	Insulation weight	**239**	**kgs**	**1751**	
iv	**Cladding**				
	Thickness	0.0008	m	0.0008	
	Cladding density	2700.0000	kg/m^3	2700.0000	
	Cladding weight	**34**	**kgs**	**252**	
v	**Panel Strips**	**216**		**1585**	
	Width	0.025	m	0.025	
	Thickness	0.006	m	0.006	
	Weight/m	1.1775	kg/m	1.1775	
	Quantity	68		68	
	Total weight	**5771.87**	**kgs**	**29601**	
vi	**OFA Nozzle assembly weights including duct weights**		kgs	2000	assumed
vii	**Sealing weight**	300	kgs	1200	
viii	**Buckstay Weight**		kgs	3248	
	Weight / m			100	
	Buckstay length		m	6.496	
	Total number of buckstays		nos	5	
ix	**Pneumatic spreader assembly**		kgs	6000	assumed
	Total openings			4	
	Weight per opening (Inclusive of chute, refractory etc.)			1500	
x	**Slings**		kgs	800	assumed
	Sling dia considered		m	0.036	
	Sling length		m	5	
	Total slings		nos	12	
	Beam Weight				
xi	**Downcomer Weight**	**3364**			
xiii	**Front wall bottom header support loading**	**2886**			

Sr No	Description	Weight	Unit
1	Tube Weight	9116.20	kgs
2	Tube Water Weight	3684.09	kgs
3	Pipe Weight	1240.34	kgs
4	Pipe Water Weight	263.69	kgs
5	Insulation Weight	2124.97	kgs
6	Cladding Weight	312.14	kgs
7	Panel Strips Weight	1801.58	kgs
8	OFA Nozzle assembly weights including duct weights	2000.00	kgs
9	Sealing Weight	1500.00	kgs
10	Buckstay Weight	3248.00	kgs
11	Pneumatic spreader assembly	6000.00	kgs
12	Slings	800.00	kgs
13	Mountings	100.00	kgs
	Total	32191	kgs

Sr No	Description	Parameters		Units	Remarks
	Side Wall Panel	**69940**		**kgs**	
		Side Panel		**Extension Panel**	
		62001.7		**2822.94**	
	Length	20.9		7.2	m
	Width	5.7		1.5	m
i	**Headers**	**Top**	**Bottom**	**Extension Panel**	
	Size (NB)	250	250	200	
	Schedule	160	160	160	
	Header Length	7.6	8.6	2.2	m
	Outer Diameter	0.2731	0.2731	0.219	m
	Thickness	0.0286	0.0286	0.023	m
	Inner Diameter	0.2159	0.2159	0.173	m
	Pipe weight/m	172.30	172.3	111.27	kg/m
	Pipe Weight	**2791.3**		**244.8**	**kgs**
	Water weight/m	36.61	36.61	23.51	kg/m
	Water Weight	**593**		**52**	**kgs**
	Insulation				
	Thickness	0.125	0.125	0.125	m
	Insulation density	120.00	120.00	120.00	kg/m^3
	Insulation weight/m	18.76	18.76	16.21	kg/m
	Insulation Weight	**304**		**36**	**kgs**
	Cladding				
	Thickness	0.0008	0.0008	0.0008	m
	Cladding Density	2700.0000	2700.0000	2700.0000	kg/m^3
	Cladding weight	3.56	3.56	3.19	kg/m
	Cladding Weight	**57.59**		**7**	**kgs**
	Header mountings	100.00	100.00	100.00	kgs
	Total Weight	**3946**		**439**	**kgs**
ii	**Panel tubes**	**Side Panel**		**Extension Panel**	
	Tube Outer Diameter	0.0635			m
	Tube thickness	0.004065			m
	Inner Diameter	0.05537			m
	Carbon Steel Density	7850			kg/m^3
	Tube weight/m	5.96			kg/m
	Water weight/m	2.41			kg/m
	Total tube weight / m	8.4			kg/m
	Tube Weight	**7970**		**558**	**kgs**
	Water Weight	**3221**		**225**	**kgs**
	Tube length	20.9		7.2	m
	Tube quantity	64		13	
	Total Weight	**11191**		**783**	**kgs**
	Panel Strip Weight	Side Panel		Extension Panel	
	Width	0.025			m
	Thickness	0.006			m
	Weight/m	1.1775			kg/m
	Quantity	66		15	
	Length	20.9		7.2	m
	Total weight	1624.2435		127.17	kgs
	Insulation				
	Thickness	0.125			m
	Insulation density	120			kg/m^3
	Insulation weight	**1786.95**		**162**	**kgs**
	Cladding				
	Thickness	0.0008			m
	Cladding Density	2700			kg/m^3
	Cladding weight	**257**		**23**	**kgs**
iii	**Access Door Assembly**	**3000**			**kgs**
iv	**Buckstay Weight**				
	Weight/m	100			kg/m
	Quantity	5		1	
	Length	6.5		2	m
	Buckstay Weight	**3250**		**200**	**kgs**
v	**Sealing**	1500		200	**kgs**
vi	**Refractory**	5000		300	**kgs**
vii	**Riser**	**1009.69**			**kgs**
viii	**Superheater Headers**	**27031.70**			**kgs**
ix	**Downcomer Weight**	**1847.95**		**112.19**	**kgs**
x	**Supply Pipes**			**383.09**	**kgs**
xi	**Rear Wall Panel Weight**	**5115.12**			**kgs**
xii	Slings	557.34		92.89	kgs
	Weight of sling	92.89		92.89	kg

Sr No	Description	Weight	Unit
1	Tube Weight	17055	kgs
2	Tube Water Weight	6892	kgs
3	Pipe Weight	6072	kgs
4	Pipe Water Weight	1290	kgs
5	Insulation Weight	4577	kgs
6	Cladding Weight	691	kgs
7	Panel Strips Weight	3503	kgs
8	Access Door Assembly	6000	kgs
9	Sealing	3400	kgs
10	Buckstay Weight	6900	kgs
11	Refractory	10600	kgs
12	Mountings	600	kgs
13	Slings	1300	kgs

Sr. No.	Description	Units	Parameters			
	Roof Tubes	**kgs**	**35127**			
	Sections		**1**	**2**	**3**	**4**
	Total Weight		**11872**	**6319**	**7312**	**9624**
	Section Length		2.9	1.0225	0.91	1.6375
a	**Tubes**					
	Outer Diameter	m	0.0635	0.0635	0.0635	0.0635
	Wall thickness	m	0.0041	0.0041	0.0041	0.0041
	Inner Diameter	m	0.0554	0.0554	0.0554	0.0554
	Carbon Steel Density	kg/m^3	7850	7850	7850	7850
	Tube weight /m	kg/m	5.958	5.958	5.958	5.958
	Tube weight	kgs	1174.977	414.281	368.700	663.457
	Water weight / m	kg/m	2.41	2.41	2.41	2.41
	Water weight	kgs	474.84	167.42	149.00	268.12
	Total weight/m	kgs	8.37	8.37	8.37	8.37
	Quantity		68.00	68	68	68
	Total weight	**kgs**	**1650**	**582**	**518**	**932**
a	**Panel Strips Weight**					
	Width	m	0.230	0.230	0.230	0.230
	Thickness	m	0.006	0.006	0.006	0.006
	Weight/m	kg/m	10.83	10.83	10.83	10.83
	Quantity		68	68	68	68
	Total Weight	**kgs**	**2136**	**753**	**670**	**1206**
b	**Super Heater Coils**		**1720**	**2162**	**3524**	**3524**
c	**Insulation & Cladding**					
	Thickness	mm	0.125	0.125	0.125	0.125
	Insulation density	kg/m^3	120	120	120	120
	Insulation weight	**kgs**	**261.00**	**92.025**	**81.9**	**147.375**
	Cladding					
	Thickness	mm	0.0008	0.0008	0.0008	0.0008
	Cladding density	kg/m^3	2700	2700	2700	2700
	Cladding weight	**kgs**	**37.58**	**13.25**	**11.79**	**21.22**
	Refractory					
	Roof wall width	m	5.9	5.9	5.9	5.9
	Height	m	0.15	0.15	0.15	0.15
	Volume		2.0532	0.72393	0.64428	1.15935
	Refractory weight		**5133**	**1810**	**1611**	**2898**
d	**Slings Weight**	**kgs**				
	Rod dia	m	0.03	0.03	0.03	0.03
	Weight	kgs	5.55	5.55	5.55	5.55
	Hook length	m	4.5	4	3.8	3.8
	Total Hooks	Qty	10	10	10	10
	Rib Plate	kgs	54.45	54.45	54.45	54.45
	Total Weight	**kgs**	**794.1**	**766.4**	**755.3**	**755.3**

Sr No	Description	Weight	Unit
1	Tube Weight	2621.41	kgs
2	Tube Water Weight	1059.38	kgs
3	Insulation Weight	582.30	kgs
4	Cladding Weight	83.85	kgs
5	Panel Strips Weight	4766.09	kgs
6	Refractory Weight	11451.90	kgs
7	Slings Weight	3071.16	kgs

Sr. No.	Description	Parameters	Units	Remarks
	Rear Wall Panel	**25576**	**kgs**	
	No of Panel Tubes	66		
	Length	5.8	m	
	Width	5.896	m	
	Tube length considered	25	m	
i	**Tubes**			
	Outer Diameter	0.06350	m	
	Tube thickness	0.004065	m	
	Inner Diameter	0.05537	m	
	Carbon Steel Density	7850	kg/m^3	
	Tube weight /m	5.958	kg/m	
	Tube Weight	**9831.195**	**Kgs**	
	Water weight / m	2.4079	kg/m	
	Water Weight	**3973.0394**	**Kgs**	
ii	**Insulation**			
	Thickness	0.125	m	
	Insulation density	120.00	kg/m^3	
	Insulation weight	**512.95**	**kgs**	
iii	**Cladding**			
	Thickness	0.0008	m	
	Cladding weight	**73.87**	**kgs**	
iv	**Panel Strips**	**2001.750**	**kgs**	
	Width	0.025	m	
	Thickness	0.006	m	
	Weight/m	1.1775	kg/m	
v	**Rear Wall Header**			
	Size (NB)	250		
	Schedule	160		
	Rear Header Length	7.5	m	
	Outer Diameter	0.2731	m	
	Thickness	0.0286	m	
	Inner Diameter	0.2159	m	
	Pipe Weight/m	172.3	kg/m	
	Pipe Weight	**1292.25**	**kgs**	
	Water wt/m	36.61	kg/m	
	Water Weight	**274.57**	**kgs**	
vi	**Insulation**			
	Thickness	0.125	m	
	Insulation density	120.00	kg/m^3	
	Insulation weight/m	18.76	kg/m	
	Insulation Weight	**140.70**	**kgs**	
vii	**Cladding**			
	Thickness	0.0008	m	
	Cladding weight/m	3.56	kgs	
	Cladding weight	**26.66**	**kgs**	
viii	**Rear Wall Nose Stiffening weight**	600	kgs	
ix	**Buckstay Weight**	**2800**	kgs	
	Weight/m	100		
	Buckstay Length	7		
	No of Buckstays	4		
x	**Rear Downcomer**	1798.63		
xi	**Sealing and Refractory near water drum**	2000	kgs	
xii	**Mountings**	250	kgs	

	Weight % on steam drum	0.60	
	Weight & on each side panel	0.20	
	Weight on steam drum	15345	
	Weight on each side panel	5115	

Sr No	Description	Weight	Unit
1	Tube Weight	9831	kgs
2	Tube Water Weight	3973	kgs
3	Pipe Weight	1292	kgs
4	Pipe Water Weight	275	kgs
5	Insulation Weight	654	kgs
6	Cladding Weight	101	kgs
7	Panel Strips Weight	2002	kgs
8	Mountings	250	kgs
9	Buckstays	2800	kgs
10	Rear Wall Nose Stiffening weight	600	kgs
11	Sealing and Refractory near water drum	2000	kgs
12	Rear Downcomer Weight	1798.6	kgs

Sr No	Description	Parameters	Units	Remarks
	Steam Drum	**53588.70**	**kgs**	
	Outer Diameter	1.575	m	
	Inner Diameter	1.375	m	
	Thickness	0.1	m	
	Carbon Steel Density	7850	m	
	Length	8	m	
	Shell Weight	**29100.57**	**kgs**	
	Dish end Outer Diameter	1.53	m	
	Dish end Thickness	0.075	m	
	Dish end Inner Diameter	1.375	m	
	Dish Weight	**3892.28**	**kgs**	
	Drum Weight	**32992.9**	**kgs**	
	Miscellaneous			
	Manhole	1200	kgs	
	Stubs and piping	1500	kgs	
	Safety valves	1200	kgs	
	Drum internals	2000	kgs	
	Drum attachments	1000	kgs	
	Total Weight	**6900**	**kgs**	
	Water Weight			
	Shell Water	11879.15	kgs	
	Dished end water	1361.152	kgs	
	Total Water Weight	**13240.30**	**kgs**	
	Insulation			
	Insulation thickness	0.125	m	
	Insulation density	120	kg/m3	
	Dish end insulation	128.295	kgs	
	Shell Insulation	640.88	kgs	
	Total Insulation weight	**384.59**	**kgs**	**Considering shell insulation as half**
	Cladding			
	Sheet thickness	0.0008	m	
	Shell cladding weight	99.117	kgs	
	Dished end cladding weight	21.40	kgs	
	Cladding weight	**70.96**	**kgs**	**Considering shell cladding as half**

Sr No	**Description**	**Weight**	**Unit**
1	Drum Weight	32992.85	kgs
2	Drum Water Weight	13240.30	kgs
3	Insulation Weight	384.59	kgs
4	Cladding Weight	70.96	kgs
5	Miscellaneous	6900	kgs

Weight on drum slings	**150551**
Steam drum	53589
Water drum	24884
Convection bank	30953
Downcomer	10673
Supply pipes	1000
Risers	2019
Ducting	5000
Roof Panel	1588
Rear Panel	15345
Piping	2000
Sling assembly weight	3500
Weight per sling	37638
Margin considerd (%)	17
Weight to be considered	44036

Sr No	Description	Parameters	Units	Remarks
	Water Drum	**24884.20**	**kgs**	
	Outer Diameter	1.14	m	
	Inner Diameter	1	m	
	Thickness	0.070	m	
	Carbon Steel Density	7850	m	
	Length	7.43	m	
	Shell Weight	**13724.30**	**kgs**	
	Dish end Outer Diameter	1.126	m	
	Dish end Thickness	0.06	m	
	Dish end Inner Diameter	1.00	m	
	Dish Weight	**1757.66**	**kgs**	
	Drum Weight	**15482.0**	**kgs**	
	Miscellaneous			
	Manhole	1200.0	kgs	
	Stubs and piping	500	kgs	
	Drum attachments (T)	1000	kgs	
	Total Weight	**2700**	**kgs**	
	Water Weight			
	Shell Water	5835.51	kgs	
	Dished end water	523.60	kgs	
	Total Water Weight	**6359.11**	**kgs**	
	Insulation			
	Insulation thickness	0.125	m	
	Insulation density	120	kg/m^3	
	Dish end insulation	73.75	kgs	
	Shell Insulation	442.92	kgs	
	Total Insulation weight	**295.21**	**kgs**	
	Cladding			
	Sheet thickness	0.0008	m	
	Shell cladding weight	70.122	kgs	
	Dished end cladding weight	12.86	kgs	
	Cladding weight	**47.92**	**kgs**	

Sr No	Description	Weight	Unit
1	Drum Weight	15481.96	kgs
2	Drum Water Weight	6359.11	kgs
3	Insulation Weight	295.21	kgs
4	Cladding Weight	47.92	kgs
5	Miscellaneous	2700.00	kgs

Convection Bank	**30953**	**kgs**				
Tube OD	**0.0508**	**m**				
Tube thickness	**0.004065**	**m**				
Tube Inner Diameter	**0.042670**	**m**				
Tube Weight	**4.69**	**kg/m**				
Water Weight	**1.43**	**kg/m**				
Tube	Length (m)	Quantity	Tube Weight(kg)	Water Weight(kg)	Total Tube Weight (kg)	Total Water Weight (kg)
1	5.74	46	26.90	8.21	1237.56	377.73
2	5.419	46	25.40	7.75	1168.35	356.60
3	5.145	46	24.11	7.36	1109.28	338.57
4	4.91	46	23.01	7.02	1058.61	323.11
5	4.715	46	22.10	6.75	1016.57	310.28
6	4.545	46	21.30	6.50	979.92	299.09
7	4.409	46	20.67	6.31	950.59	290.14
8	4.3	46	20.15	6.15	927.09	282.97
9	4.235	46	19.85	6.06	913.08	278.69
10	4.2	46	19.69	6.01	905.53	276.39
11	4.2	46	19.69	6.01	905.53	276.39
12	4.235	46	19.85	6.06	913.08	278.69
13	4.284	46	20.08	6.13	923.64	281.91
14	4.395	46	20.60	6.29	947.58	289.22
15	4.525	46	21.21	6.47	975.60	297.77
16	4.685	46	21.96	6.70	1010.10	308.30
17	4.89	46	22.92	7.00	1054.30	321.79
18	5.105	46	23.93	7.30	1100.65	335.94
19	5.37	46	25.17	7.68	1157.79	353.38
20	5.685	46	26.65	8.13	1225.70	374.11
Manhole	1000	kgs				
Soot blower	2000	kgs				
Panel Strips Weight	1000	kgs				
Insulation						
Length	5.296	m				
Width	2.432	m				
Thickness	0.125	m				
Density	120	kg/m^3				
Insulation Weight	**193.20**	**kgs**				
Cladding	**27.83**	**kgs**				

1	Tube Weight	20481	kgs
2	Tube Water Weight	6251	kgs
3	Manhole	1000	kgs
4	Sootblower	2000	kgs
5	Panel strip	1000	kgs
6	Insulation	193	kgs
7	Cladding	28	kgs

Sr No	Description	Parameters		Units	Remarks
	Economiser	**103**		**tons**	
	Headers	**Top**	**Bottom**		
	Size (NB)	200	200		
	Schedule	160	160		
	Length	3.9	3.9	m	
	OD	0.2191	0.2191	m	
	Thickness	0.023	0.023	m	
	ID	0.1731	0.1731	m	
	Pipe Weight / m	111.23	111.2	kg/m	
	Pipe Weight	433.80	433.8	kgs	
	Water Weight / m	23.53	23.5	kg/m	
	Water Weight	91.78	91.8	kgs	
	Insulation				
	Thickness	0.125	0.125	m	
	Insulation density	120	120	kg/m^3	
	Insulation weight /m	22.11	22.1	kg/m	
	Insulation weight	86.21	86.2	kgs	
	Cladding thickness	0.0008	0.0008	m	
	Cladding weight /m	3.18	3.2	kg/m	
	Cladding weight	12.41	12.4	kgs	
	Weight / m	160.05	160.05	kg/m	
	Header mountings	200	100	kgs	
	Total Weight	**824.21**	**724.21**	kgs	
	Coil				
	Coil OD	0.0381		m	
	Coil thickness	0.00406		m	
	Coil ID	0.02998		m	
	Metal weight	3.81		kg/m	
	Water weight	0.71		kg/m	
	Coil support weight	0.3			
	Coil weight / m	4.82		kg/m	
	Coil length (m)				
	Section I	31.205	150.43	41	6167.63
	Section II	95.3375	459.59	41	18843.35
	Section III	95.3375	459.59	41	18843.35
	Section IV	88.9375	428.74	41	17578.40
	Future	36.036	173.72	41	7122.48
	Coil Weight (kgs)				68555.2192
	Casing weight (kgs)				21500
	Insulation thickness (m)				0.125
	Insulation weight (kgs)				2700
	Cladding thickness (m)				0.0008
	Cladding weight (kgs)				389
	Top Ducting Weight				4000
	Eco Hopper Weight				3850
	Total weight (kgs)				102542.434
	Perimeter				18
	UDL				6.096
	Margin considered				1.07

	Pipe Weight	867.60	kgs
	Pipe Water Weight	183.56	kgs
	Tube Weight		kgs
	Tube Water Weight		kgs
	Insulation Weight	2872.43	kgs
	Cladding Weight	413.63	kgs

Sr No	Description	Parameter	Unit	Remarks	
	APH Weight	**129.38**	Tons		
1	**APH Module Weight**	**100.177**	**Tons**		
	Tube Weight	**78.7**	**Tons**		
	Plate (6 Thk)	**10.881**	**Tons**		
	Sheeting	**2.4**	**Tons**		
	Frame	**6.5**	**Tons**		
	Access Door	**0.145**	**Tons**		
	Insulation	**1.545**	**Tons**		
	Tube Weight	78706.00211	kgs		
A	Top Portion				
	Total Tube Weight	28.86	tons		
	Tube (Stay)				
	Tube OD	0.0635	m		
	Tubes Thickness	0.003658	m		
	Length	2.2	m		
	Quantity	56			
	Weight/m	5.40	kg/m		
	Total Weight	665.09	kgs		
	Tube (Expanded)				ASTM A 423
	Tube OD	0.0635	m		
	Tubes Thickness	0.00233	m		
	Length	2.2	m		
	Quantity	345			
	Weight/m	3.51	kg/m		
	Total Weight	2667.8	kgs		
	Tube (Expanded)				BS 6323
	Tube OD	0.0635	m		
	Tubes Thickness	0.00233	m		
	Length	2.2	m		
	Quantity	3301			
	Weight/m	3.51	kg/m		
	Total Weight	25526.0	kgs		
b	Bottom Portion				
	Total Tube Weight	49.85	tons		
	Tube (Stay)				
	Tube OD	0.0635	m		
	Tubes Thickness	0.003658	m		
	Length	3.8	m		
	Quantity	56			
	Weight/m	5.40	kg/m		
	Total Weight	1148.79	kgs		
	Tube (Expanded)				ASTM A 423
	Tube OD	0.0635	m		
	Tubes Thickness	0.00233	m		
	Length	3.8	m		
	Quantity	345			
	Weight/m	3.51	kg/m		
	Total Weight	4608.0	kgs		
	Tube (Expanded)				BS 6323
	Tube OD	0.0635	m		
	Tubes Thickness	0.00233	m		
	Length	3.8	m		
	Quantity	3301			
	Weight/m	3.51	kg/m		
	Total Weight	44090.3	kgs		
2	**Top Ducting Weight**	**8.312**	**Tons**		
	Top Ducting Left Side	3.52	Tons	2*(H+W)*L*Thk*D	
	Height	2.9	m		
	Width	6	m		
	Length	4.2	m		
	Thickness	0.006	m		
	Density	7850	kg/m^3		
	Top Ducting Right Side	4.8	tons		
	Height	3.247	m		
	Width	6	m		
	Length	5.5	m		
	Thickness	0.006	m		
	Density	7850	kg/m^3		
3	**Bottom Ducting**	**2.84**	**Tons**	**0.53**	Volume to Be deducted
	Width	6		6	
	Height	1.151		1.3	
	Length	5		0.766	
	Thickness	0.006		0.006	
	Density	7850		7850	
4	**Ash + Hopper**	**18.05**	**Tons**		
	Volume	35	m^3		
	Height, H1	3.5	m	34.8	
	Height, H2	0.2	m	0.00375	
	Area of Bottom Base	0.0625	m^2	30.06	1.37
	Side A	0.25	m		
	Side B	0.25	m		
	Area Of Top Base	30	m^2		
	Side C	5.0	m		
	Side D	6.0	m		
	Density	7850	kg/m^3		
	Hopper Weight	5.0	**Tons**		
	Ash Density	2500	kg/m^3		
	Assuming hopper 15% filled	0.15			
	Ash Weight	**13.05**	**Tons**		

	Super Heater Headers	**57006.59**		kgs		
		PSH Inlet	**PSH Outlet**	**Attemperator**	**SSH Inlet**	**SSH Outlet**
	Pipe OD (m)	0.273	0.273	0.273	0.273	0.273
	Pipe Thickness (m)	0.02818	0.02818	0.02818	0.02818	0.02818
	Pipe ID(m)	0.22	0.22	0.22	0.22	0.22
	Length (m)	6.8	10	11	9	12
	Pipe Weight / m	172.1	172.1	172.1	172.1	172.1
	Pipe Weight	**1172**	**1723**	**1895**	**1551**	**2068**
	Water weight / m	36.59	36.59	36.59	36.59	36.59
	Water weight	**249**	**366**	**402**	**329**	**439**
	Insulation Thickness	0.125	0.125	0.125	0.125	0.125
	Insulation Density	120.00	120.000	120.000	120.000	120.000
	Insulation weight kg/m	18.76	18.76	18.76	18.76	18.76
	Insulation weight kgs	**128**	**188**	**206**	**169**	**225**
	Cladding Thickness	0.0008	0.0008	0.0008	0.0008	0.0008
	Cladding Density	2700.00	2700.00	2700.00	2700.00	2700.00
	Cladding weight kgs	**24**	**36**	**39**	**32**	**43**
	Mountings	250	250	250	250	250
	Saddle	150	150	150	150	150
	Coil weight	**16097**	**14097**	**0**	**8650**	**6881**
	Total Weight kgs	**16069**	**16809**	**2963**	**11131**	**10055**
	Weight per side panel	**8034.41**	**8404.33**		**5565.29**	**5027.67**
	SH Coils	**Primary**	**Secondary 1**	**Secondary 2**		
	OD	44.5	44.5	44.5		
	t'nk	4.06	4.87	6.4		
	ID	36.38	34.76	31.70		
	Tube wt kg / m	4.15	4.88	6.17		
	Water wt /m	1.04	0.95	0.79		
	Tube length	129.70	35.02	23.4		
	Tube quantity	51.00	51	51		
	Tube Metal Weight kgs	27465.85	8717.36	7359.30		
	Water weight kgs	6875.83	1694.97	941.88		
	Support weight	900	400	900		
	Total Weight kgs	35241.69	10812.23	8601.18		
	Load on roof tube	**7048**	**2162**	**1720**		

Sr No	Description	Description	Unit
1	Pipe Weight	8408.24	kgs
2	Pipe Water Weight	1785.56	kgs
3	Cladding Weight	173.46	kgs
4	Insulation Weight	915.26	kgs
5	Mountings	1250.00	kgs
6	Saddle	750.00	kgs
7	Tube Weight	43542.519	kgs
8	Tube Water Weight	9512.5796	kgs
9	Supports	1600	kgs

Sr. No.	Description	Parameters	Units	Remarks
13	**Risers**	**7150**	**kgs**	
	Pipe OD	**0.1143**	**m**	
	Pipe thickness	**0.008560**	**m**	
	Pipe Inner Diameter	**0.097180**	**m**	
	Insulation Thickness	**0.125**	**m**	
	Cladding Thickness	**0.001**	**m**	
	Pipe Weight	**22.32**	**kg/m**	
	Water Weight	**7.42**	**kg/m**	
	Total Weight	**29.74**	**kg/m**	
	Insulation Weight	**926.89**	**kgs**	
	Cladding Weight	**203.62**	**kgs**	

Sr No	Description	Weight	Unit
1	Pipe Weight	3669.51	kgs
2	Pipe Water Weight	1219.32	kgs
3	Insulation Weight	1853.78	kgs
4	Cladding Weight	407.23	kgs

Tube	Length (m)	Quantity	Weight /pipe (Kg)	Pipe Weight	Pipe Water Weight	Insulation Weight(kg)	Cladding Weight(kg)	Total weight	Weight on drum	Weight on side panel header	Weight on riser support
1	1.55	2	46.10	69.20	22.99	17.48	3.84	135	67	67	0
2	2	2	59.48	89.29	29.67	22.55	4.96	174	87	87	0
3	3.08	2	91.60	137.50	45.69	34.73	7.63	268	134	134	0
4	4.035	2	120.00	180.14	59.86	45.50	9.97	351	175	175	0
5	5.5	2	163.57	245.54	81.59	62.02	13.63	478	120	120	239
6	6.8	2	202.23	303.58	100.87	76.68	16.85	592	148	148	296
7	7.03	2	209.07	313.85	104.29	79.28	17.42	612	153	153	306
8	7.7	2	228.99	343.76	114.23	86.83	19.08	670	167	167	335
9	8	2	237.91	357.15	118.68	90.21	19.82	696	174	174	348
10	8.6	2	255.76	383.94	127.58	96.98	21.31	748	187	187	374
11	8.8	2	261.71	392.87	130.54	99.24	21.80	765	191	191	383
12	9.5	2	282.52	424.12	140.93	107.13	23.54	826	207	207	413
13	9.6	2	285.50	428.58	142.41	108.26	23.78	835	209	209	418
								7150	**2019**	**1010**	**1556**

Sr No	Description	Parameters	Units	Remarks
	Supply Pipe	**1383**	**kgs**	
	Outside Diameter	0.1143	m	
	Thickness	0.00856	m	
	Inner diameter	0.09718	m	
	Carbon Steel Density	7850	kg/m^3	
	Pipe Weight	22.32	kg/m	
	Quantity	12		
	Length	2.65	m	
	Total Pipe Weight	**709.84**	**kg**	
	Water Weight			
	Water Weight / m	7.42	kg/m	
	Water Weight	**235.87**	**kg**	
	Insulation			
	Insulation Thickness	0.125	m	
	Insulation Density	120	kg/m^3	
	Insulation Weight /m	11.28	kg/m	
	Length	2.65	m	
	Total Insulation Weight	**358.60**	**kg**	
	Cladding			
	Cladding Thickness	0.0008	m	
	Cladding Density	2700	kg/m^3	
	Cladding Weight / m	2.48	kg/m	
	Length	2.65	m	
	Total Cladding Weight	**78.78**	**kg**	

Sr No	Description	Weight	Unit
1	Pipe Weight	709.84	kgs
2	Pipe Water Weight	235.87	kgs
3	Insulation Weight	358.60	kgs
4	Cladding Weight	78.78	kgs

S	Downcomer			
Total Weight	**kgs**	**17795**		
Description	**Units**	**Sr. No.**		
		1	**2**	**3**	**4**
		To extension panel hdr	**To Front Panel Header**	**Main DC to Side bottom Panel Header**	**Rear DC to rear bottom panel hdr**
Size (NB)	-		200	250	200
Schedule	-		100	100	100
Length	m	1.3	24	15.5	15.2
Pipe Outer Diameter	m	0.1683	0.2191	0.273	0.2191
Pipe Thickness	m	0.0143	0.0151	0.0182	0.0151
Pipe Inner Diameter	m	0.1397	0.1889	0.2366	0.1889
Pipe Weight / metre	kg/m	54.31	75.97	114.36	75.97
Pipe Weight	kgs	70.60	1823.22	1772.65	1154.70
Water Weight / metre	kg/m	15.33	28.03	43.97	28.03
Water Weight	kgs	19.93	672.61	681.48	425.99
Insulation					
Thickness	m	0.125	0.125	0.125	0.125
Insulation density	kg/m^3	120.00	120.00	120.00	120.00
Insulation weight/metre	kg/m	13.82	16.22	18.76	16.22
Insulation Weight	kgs	17.97	389.17	290.71	246.47
Cladding					
Cladding Thickness	m	0.0008	0.0008	0.0008	0.0008
Cladding Density	kg/m^3	2700.0	2700.0	2700.0	2700.0
Cladding Weight/metre	kg/m	2.84	3.19	3.55	3.19
Cladding Weight	kgs	3.70	76.53	55.09	48.47
Weight / m	kg/m	86.30	123.40	180.64	123.40
Weight		**112.19**	**2961.52**	**2799.92**	**1875.63**
Quantity		1 each on LH &RH	1 each on LH &RH	1 each on LH &RH	1 each on LH &RH
Total Weight		**224**	**7475**	**5600**	**4497**
Weight considered on drum		**112**	**4111**	**3752**	**2698**
Total weight on drum		**10673**			
Weight on panels		**112**	**3364**	**1848**	**1799**

Sr No	Description	Weight	Unit
1	Pipe Weight	10927.75	kgs
2	Pipe Water Weight	4108.10	kgs
3	Insulation Weight	2306.04	kgs
4	Cladding Weight	453.46	kgs

	Branch Pipes				
Description	**Units**	**Sr. No.**			
		Front Downcomer Branch Pipes		Rear Down Comer Branch Pipes	
				Long	Short
Weight	**kgs**	**760.53**	**790.95**	**425.90**	**319.42**
Length considered		5.00	5.20	2.8	2.10
No of Pipes		2.00	2.00	2	2.00
Pipe Outer Diameter	m	0.1683	0.1683	0.1683	0.1683
Pipe thickness	m	0.0110	0.0110	0.0110	0.0110
Pipe Inner Diameter	m	0.1464	0.1464	0.1464	0.1464
Pipe Weight / metre	kg/m	42.56	42.56	42.56	42.56
Pipe Weight	kgs	212.82	221.33	119 18	89 38
Water Weight / metre	kg/m	16.82	16.82	16.82	16.82
Water Weight	kgs	84.12	87.49	47.11	35.33
Insulation Thickness	m	0.125	0.125	0.125	0.125
Insulation density	kg/m^3	120.00	120.00	120	120.00
Insulation weight/metre	kg/m	13.82	13.82	13.82	13.82
Insulation Weight	kgs	69.11	71.87	38.70	29.03
Cladding Thickness	m	0.0008	0.0008	0.0008	0.0008
Cladding Density	kg/m^3	2700.00	2700.00	2700	2700.00
Cladding Weight/metre	kg/m	2.84	2.84	2.84	2.84
Cladding Weight	kgs	14.22	14.79	7.96	5.97
Total Weight	kgs	380.27	395.48	212.95	159.71

Note	As Spring hangers are provided on front downcomer , weight need to be reduced (Approx 50% weight)

Sr No	Description	Parameter	Unit		Remarks
10	**Reciprocating Servo Grate**				
	Ash Weight	**24319.7907**	**kgs**		
	Hopper Weight				
	Grate Weight				
	Grate Length	6.662			
	Grate Width	3.048			
	Grate area	20.31			
	Load considered				
	Dead	**30.46**			Considered as per IS:800
	Live	**30.46**			
	Total	**60.92**			
		Dead	**Live**		
	Load arrived				
	Grate				
	Hopper				
	Ash in hopper		24.32		
	Ash on grate		10.15		
	Load / area MT / m^2				
A	**Ash hopper volume**	**3.22**	7.93	1.74	
	Height, H	3.02	m		
	A	0.965	m		
	B	2.583	m		
	Area of Base 1	2.49	m^2		
	C	0.365	m		
	D	0.365	m		
	Area of Base 2	0.133	m^2		
	Number of hoppers / grate	4			
	Total volume / grate	12.89	m^3		
	Ash density considered	2500	Kg /m3		
	Assuming hopper 50% filled	0.5			
	Total ash weight	**16117.14**	**kg**		
	Hopper weight		kg		To be Checked
B	**Ash hopper volume**	**4.71**	3.96	0.71	
	Height, H	3.02	m		
	A	1.481	m		
	B	2.586	m		
	Area of Base 1	3.83	m^2		
	C	0.365	m		
	D	0.365	m		
	Area of Base 2	0.133	m^2		
	Number of hoppers / grate	1			
	Total volume / grate	4.71	m^3		
	Ash density considered	2500	Kg /m3		
	Assuming hopper 50% filled	0.5			
	Total ash weight	**5885.73**	**kg**		
	Hopper weight		kg		
C	**Ash hopper volume**	**1.85**	1.43	0.42	
	Height, H	3.02			
	A	0.5			
	B	2.586			
	Area of Base 1	1.29			
	C	0.365			
	D	0.365			
	Area of Base 2	0.133			
	Number of hoppers / grate	1			
	Total volume / grate	1.85			
	Ash density considered	2500			
	Assuming hopper 50% filled	0.5			
	Total ash weight	**2316.93**	**kg**		
	Hopper weight				
	Ash on grate (MT)	10152.888	kgs		
	Thickness of ash layer	0.2			
	Area	20.305776	m2		
	Hopper on Front side of Grate				
	Cross Section				
	E =				
	F =				
	Height H =	3			
	Volume, V =				
	Quantity	2			
	Assuming hopper 100% filled				
	Total ash weight (MT)				
	Hopper weight (MT)				
	Total weight				
	Opening area				
	A =				
	B =				

Sr No	Description	Parameters	Units	Remark
11	Baggase Feed System	29.27	Tons	
	1. Elevation 24280:			
	Total	1.69	Tons	
	Baggasse controling grate	0.26	Tons	
	Chute	0.33	Tons	
	Silo	1.1	Tons	
	Baggasse			
	2. Elevation 20820:			
	Total	0.92	Tons	
	Silo	0.92	Tons	
	Baggasse			
	2. Elevation 16095:			
	Total	4.5		
	Silo	0.7	Tons	
	Baggasse		Tons	
	Baggasse extractor	1.8	Tons	
	Screw feeder	1.5	Tons	
	Chute below screw feeder	0.5	Tons	

U Bolt for Steam Drum

Sr No	Description	Weight	Units
	U Bolt Weight	**3138.69**	**kgs**
1	Plate (45 Thickness)	300	kgs
2	Rocker	200	kgs
3	Round Bar	2638.7	kgs

Sr No	**Description**	**Material Size**		**Grade**	**Ultimate Tensile Strength (F_u) Mpa**	**Yield Stress (F_y) Mpa**	**Remark**
		Parameter (Diameter / Thickness)	Unit				
1	Round Bar Ø140 x 10680 Lg	140	mm	IS 2062 ER 250BR	410	230	IS 2062 Table 2
2	PLATE	45	mm	IS 2062 ER 250BR	410	230	

Partial Safety Factor for Material Y_m				
Sr no	Description	PSF		Remarks
1	Resistance Governed by yielding (Y_{mo})	1.1		From IS 800 Table No 5
2	Resistance of member to buckling (Y_{mo})	1.1		
3	Resistance governed by ultimate stress (Y_{m1})	1.25		
4	Resistance of connections	Shop fabrication	Field Fabrication	
a	Bolts - Friction Type (Y_{mf})	1.25	1.25	
b	Bolts- Bearing Type (Y_{mb})	1.25	1.25	
c	Rivets (Y_{mv})	1.25	1.25	
d	Welds (Y_{mw})	1.25	1.5	

Tension Capacity in Bolts					
Sr No	Description	Formula	Parameter	Unit	Remark
i	**Permissible tensile stress of the bolt (f_{atb})**		**12.80**	**kg/mm²**	
ii	**Actual Tensile Stress in Bolt at Sides**		**0.00**	**kg/mm²**	
iii	**Actual Tensile Stress in Bolt at middle section**		**0.00**	**kg/mm²**	
1	**Design Strength Due to Yielding (T_d)**	**Fy x A /Y_{mo}**			
a	Yield Stress (F_{yj})		23.46	kg/mm²	
b	Gross Cross Section Area of Bolt (A)		15393.80	mm²	
c	Resistance governed by yielding (Y_{mo})		1.10		
	Design Strength Under Axial Tension In Bolt(T_d)		**328307.86**	**kg**	
2	**Design Strength due to Rupture at Threaded region (T_{dn})**	**0.9*F_u*An/Y_{m1}**			
a	Ultimate Tensile Stress (F_u)		41.82	kg/mm²	
b	Net Tensile Stress Area at Threads (An)		15312.29	mm²	
	For 5 - 1/2 Inch BSW				
	Thread Per Inch (n)		2.625	inch	
	Nominal Diameter (D)		5.5	Inch	
	Net Tensile Stress Area at Threads (An)	(pi()*(D-0.9743/n)^2)/4	15312.29	mm²	
	Root Area of Thread	(pi()*(D-1.3/n)^2)/4	12691.83	mm²	To be Checked
	Design Strength due to Rupture at Threaded region (T_{dn})		**461059.16**	**kg**	
3	**Nominal Tensile Capacity of Bolt (T_{nb})**		**328307.86**	**kg**	**As T_d < T_{dn}**
4	**Permissible tensile stress of the bolt (f_{atb})**	**0.6*T_{nb} / A**	**12.80**	**kg/mm²**	
5	**Actual Tensile Stress in the bolt (f_{tb})**	**Ts/A**			
	Tension in bolt under service load (T_{sj})		53.58869804	kgs	Steam Drum Weight
a	**Tension in bolt at sides**		**0.00**	**kg/mm²**	
b	**Tension in bolt at middle section**		**0.00**	**kg/mm²**	

Shear Stress Calculation in Bolts					
Sr No	Description	Formula	Parameter	Unit	Remark
i	**Permissible shear stress of the bolt (f_{atb})**		**11.94**	**kg/mm²**	
ii	**Actual Shear Stress in Bolt at Sides**		**0.87**	**kg/mm²**	
1	**Permisssible Shear Stress in Bolt (f_{atb})**	**0.6*V_{nb}/A_{sb}**			
	Nominal Shear Capacity of bolt (V_{nb})	f_u*(n_n*A_{nb}+n_s*A_{sb})/√3			
	Ultimate Tensile Stress (F_u)		41.82	kg/mm²	
	Nominal Plain Shank Area of Bolt (A_{sb})		15393.80	mm²	
	Net Shear area of bolt at threads (A_{nb})	(pi()*(D-1.3/n)^2)/4	12691.83	mm²	
	Nominal Shear Capacity of bolt (V_{nsb})		306441.49	kg	Considering n_n=1 & n_s=0
			371680.14	kg	Considering n_n=0 & n_s=1
	Permissible Shear Stress in Bolt		**11.94**	**kg/mm²**	
2	**Actual Shear Stress In Threaded Portion of Bolt (f_{tb})**	**V_{sb}/A_{sb}**			
	Actual Shear force under working load (V_{sb})		13397.17451	kgs	Steam Drum Weight/4
	Nominal Plain Shank Area of Bolt (A_{sb})		15393.804	mm²	
	Actual Shear Stress In Bolt (f_{sb})		**0.87**	**kg/mm²**	

Bearing Stress of Bolt on Plate					
Sr No	Description	Formula	Parameter	Unit	Remark
i	**Permissible Bearing Stress of Bolt/ Plate (f_{apb})**		**19.97**	**kg/mm²**	
ii	**Actual Stress of Bolt in Bearing on Plate (f_{pb})**		**0.68**	**kg/mm²**	
1	**Permisssible bearing Stress of Bolt/Plate (f_{apb})**	**0.6*V_{nsb}/A_{pb}**			
	Nominal bearing strength of bolt (V_{nsb})	2.5dtf_u			
	Nominal Diameter of bolt (d)		140.00	mm	
	Hole Diameter		145.00	mm	
	Nominal Bearing area of bolt on plate (A_{pb})	pi()*d*t	19792.03	mm²	**To Be Checked**
	Thickness of connected plate (t)		45.00	mm	
	Ultimate Tensile Stress (F_u)		41.82	kg/mm²	
	Nominal Bearing Strength of bolt (V_{npb})		658665.00	kgs	
	Permisssible bearing Stress of Bolt/Plate		**19.97**	**kg/mm²**	
2	**Actual Stress of Bolt in Bearing on plate (f_{pb})**	**V_{sb}/A_{pb}**		**kg/mm²**	
	Actual Shear force under working load (V_{sb})		13397.17	kgs	Steam Drum Weight/4
	Bearing area of bolt on plate (A_{pb})		19792.03	mm²	
	Actual Bearing Stress of bolt on plate		**0.68**	**kg/mm²**	

Plate Design					
Sr No	Description	Formula	Parameter	Unit	Remark
	Length of Plate (l)		500	mm	
	Width of Plate (w)		425	mm	
	Thickness of plate (t)		45	mm	
i	**Permissible Shear Stress (T_{ab})**		**9.38**	**kg/mm²**	
ii	**Actual Shear Stress (T_b)**		**0.22**	**kg/mm²**	
iii	**Permissible Bending stress (f_{abc})**		**17.60**	**kg/mm³**	
iv	**Actual Bending Stress (f_b)**		**9.92**	**kg/mm⁴**	
1	**Permsissible Shear Stress**				
a	**When subjected to Pure Shear**	**0.40*f_y**			
	Yield Stress (F_y)		23.46	kg/mm²	
	Permissibile Shear Stress		**9.38**	**kg/mm²**	
2	**Actual Shear Stress**				
	Working Load		13397.17	kgs	
	Shear Area	pi()*l*t			
	Shear Area		60082.96	mm²	
	Actual Shear Stress		**0.22**	**kg/mm²**	
3	**Permissible bending stress (f_{abc})**				
	Yield Stress (F_y)		23.46	kg/mm²	
	Permissibile Bending Stress	**0.75*f_y**	**17.60**	**kg/mm²**	
4	**Actual bending stress (f_b)**				
	Working Load Moment	w*l/4	1423449.792	kg -mm	
	Section Modulus (Z)	I/y			
	Moment of Inertia (I)		3227343.75	mm⁴	
	Distance from extreme fibre (y)		22.5	mm	
	Section Modulus (Z)		143437.5	mm³	
	Actual Bending Stress		**9.92**	**kg/mm²**	

Vb, Wind Velocity (m/sec) 47

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Vz = Vb * K1 * K2 * K3 * K4

Pz = 0.6 Vz^2

K1, Probability factor =	1
K2, Terrain roughness & height factor =	
Terrain height category =	2
K3, Topography factor =	1
K4, Importance factor for cyclonic region =	1

***To be discussed

Height	K2	Vz	Pz (kg/m^2)
10	1	47.00	135
15	1.05	49.35	149
20	1.07	50.29	155
30	1.12	52.64	169
50	1.17	54.99	185

Wind Application in Z

Column	Width	Height
1	3.25	20
2	6.4	33.5
3	5.5	33.5
4	4.21	34.49
5	4.86	18.60
6	5.4	16.6
7	3.4	16.6

		B1	A2	A3	B4	B5	B6	B7
Height	Pz	D1	E2	E3	D4	D5	D6	D7
10	135	0.439	0.865	0.743	0.568	0.656	0.730	0.459
15	149	0.484	0.953	0.819	0.627	0.724	0.804	0.506
20	155	0.503	0.990	0.851	0.651	0.751	0.835	0.526
30	169	-	1.085	0.932	0.713	-	-	-
50	185	-	1.184	1.017	0.778	-	-	-

Wind Application in X

Column	Width	Height
A	2	20
B	5.4	33.5
C	-	-
D	5.40	-
E	2.00	18.60

Height	Pz	A2	B1	B2	D1	D2	E2	A3	E3	B7	D7	B5	D5	B5	D5
10	135	0.270	0.730	-	0.730	-	0.270	0.270	0.270	0.730	0.730	-	-	-	-
15	149	0.298	0.804	-	0.804	-	0.298	0.298	0.298	0.804	0.804	-	-	-	-
20	155	0.309	0.835	-	0.835	-	0.309	0.309	0.309	0.835	0.835	0.835	0.835	0.835	0.835
30	169	0.339	-	0.915	-	0.915	0.339	0.339	0.339			-	-	0.915	0.915
50	185	0.370	-	0.999	-	0.999	0.370	0.370	0.370			-	-	0.999	0.999