VERIFICATION FOR LIGHT POST ON HANDRAIL. In Tanker Filling Station

CALCULATIONS THAT ARE REQUIRED FROM VENDOR STANDARDS

Mainly first the light pole will be installed on only one side.

Referring to document 03-150000-4100001496-SPM-STR-RPT-000083 from Gulf Riyadh

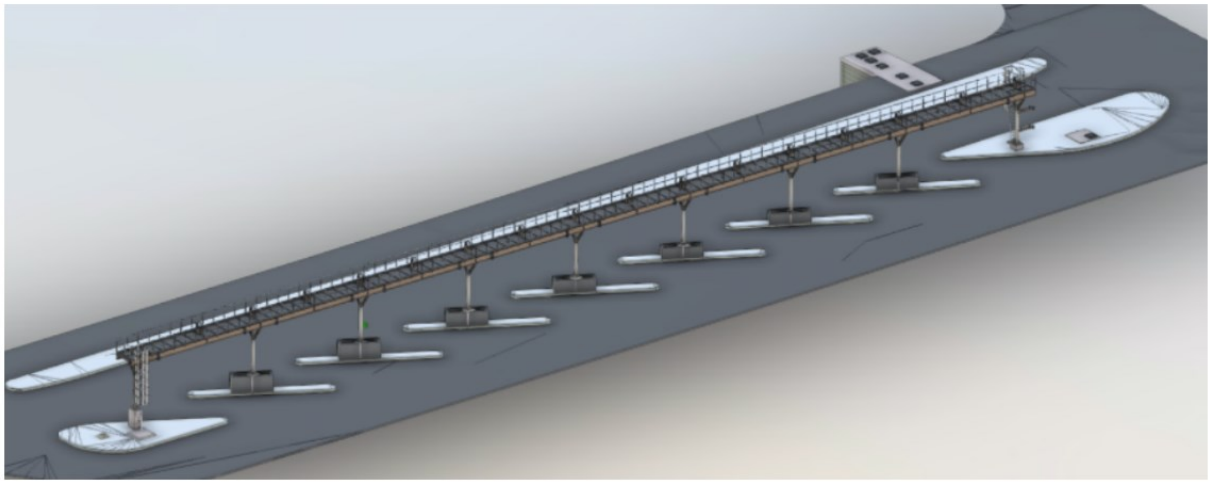


Figure 7-1: Tanker filling station 3D view

The light installed only on the side where the road is present. So mainly additional unit weight of the light post to be considered in SLS and ULS combinations.

The following are the dimensions from the drawings,

Height of the light post (length) = 2.00 m

Outer Diameter (width) = 73mm

Thickness of the post = 5mm

So for this pipe if we consider Round Pipe 73×5, Carbon steel 7850 kg/m³ then the weight of the pipe will come out to be 8.38kg i.e., 0.082KN (Additional weight to be considered as dead load)

See the image attached below,

8.1 Dead Loads (DL)

The dead load includes the weight of the steel structure, non-structural finishes and miscellaneous architectural items.

The following values for dead loads of structures is considered for the design:

- Structural steel self-weight (automatically calculated and applied by the finite element software).
- Platform plating 8mm thick is applied with 0.62 kN/m2 to account self-weight.
- Handrail rail load on the exterior periphery wall of 0.1 kN/m (estimated).

S No	Description	OD/Len.	WT/Width	Len./thk	Area	Vol	Quantity	Dry Weight
		mm	*mm*	*mm*	*sq.m*	*cu.m*	*Nos.*	*kN*
	Handrail							
1	Post - Tube 48.3 x 3.68	48.300	3.680	1000.000	0.001	0.00052	1	0.040
2	Handrail - Tube 48.3 x 3.68	48.300	3.680	1000.000	0.001	0.00052	2	0.079
						Total		0.119
						Unit weight (kN)		**0.099**

The additional unit weight to highlighted box 0.099 to be considered as calculated above.

Table 3: Preliminary Load Cases

Load Case	STAAD Load case name	Description
1	DL	Dead load – Self-weight
		Grating dead load
		Handrail dead load
		Cage ladder dead load
2	FL	Piping and water content dead load
3	LL	Live load
4		Piping friction load
5	WLX	Wind Load in +X
6	WLZ	Wind Load in +Z
7	ELX	Earthquake Load +X
8	ELZ	Earthquake Load +Z
9	ELY	Earthquake Load +Y
10	TL+	Temperature positive
11	TL-	Temperature negative

Table 4: Load Combinations – LRFD - ULS

Load Combinations	Description
12	1.4 DL + 1.4 FL
13	1.4 DL + 1.4 FL + 1.7 LL + 1.4 TL+
14	1.4 DL + 1.4 FL + 1.7 LL + 1.4 TL-
15	1.2 DL + 1.2 FL + 1.6 LL + 0.5 WLX
16	1.2 DL + 1.2 FL + 1.6 LL + 0.5 WLZ
17	1.2 DL + 1.2 FL + 1.0 LL + 1.0 WLX
18	1.2 DL + 1.2 FL + 1.0 LL + 1.0 WLZ
19	1.2 DL + 1.2 FL + 1.0 LL + 1.0 ELX + 1.0 ELY
20	1.2 DL + 1.2 FL + 1.0 LL + 1.0 ELZ + 1.0 ELY
21	0.9 DL + 0.9 FL + 1.0 WLX
22	0.9 DL + 0.9 FL + 1.0 WLZ
23	0.9 DL + 0.9 FL + 1.0 ELX + 1.0 ELY
24	0.9 DL + 0.9 FL + 1.0 ELZ + 1.0 ELY
25	1.264 DL + 1.25 ELX + 1.25 ELY + LL
26	1.264 DL + 1.25 ELZ + 1.25 ELY + LL
27	0.836 DL + 1.25 ELX + 1.25 ELY
28	0.836 DL + 1.25 ELZ + 1.25 ELY

Table 5: Load Combinations – LRFD - SLS

Load Combinations	Description
25	DL + FL
26	DL + FL + LL + TL+
27	DL + FL + LL + TL-
28	DL + FL + LL + 0.5 WLX
29	DL + FL + LL + 0.5 WLZ
30	DL + FL + 0.5 LL + 0.6 WLX
31	DL + FL + 0.5 LL + 0.6 WLZ
32	DL + FL + LL + ELX + ELY
33	DL + FL + LL + ELZ + ELY
34	0.9 DL + 0.9 FL + 0.6 WLX
35	0.9 DL + 0.9 FL + 0.6 WLZ
36	0.9 DL + 0.9 FL + 1.0 ELX + 1.0 ELY
37	0.9 DL + 0.9 FL + 1.0 ELZ + 1.0 ELY
38	DL + 0.6 LL
39	DL + FL + 0.6 LL
40	DL + FL + LL + 0.39 WLX
41	DL + FL + LL + 0.39 WLZ

All the Load combinations need reverification from the vendor who will be quoting as they will be designing the post on the handrail which is critical as the handrail is also on a welded connection.

Figure 10-2:Maximum UB section member utilization

Beam	Analysis Property	Design Property	Actual Ratio	Allowable Ratio	Normalized Ratio (Actual/Allowable)	Clause	L/C	Ax cm2	Iz cm4	Iy cm4	Ix cm4
344	UB152X89X1	UB152X89X1	0.811	1.000	0.811	Eq.H1-1b	13	20.300	834.000	89.800	3.561
345	UB152X89X1	UB152X89X1	0.811	1.000	0.811	Eq.H1-1b	13	20.300	834.000	89.800	3.561
330	UB152X89X1	UB152X89X1	0.670	1.000	0.670	Eq.H1-1b	14	20.300	834.000	89.800	3.561
331	UB152X89X1	UB152X89X1	0.668	1.000	0.668	Eq.H1-1b	14	20.300	834.000	89.800	3.561
340	UB152X89X1	UB152X89X1	0.599	1.000	0.599	Eq.H1-1b	19	20.300	834.000	89.800	3.561
341	UB152X89X1	UB152X89X1	0.599	1.000	0.599	Eq.H1-1b	19	20.300	834.000	89.800	3.561
334	UB152X89X1	UB152X89X1	0.591	1.000	0.591	Eq.H1-1b	19	20.300	834.000	89.800	3.561
335	UB152X89X1	UB152X89X1	0.591	1.000	0.591	Eq.H1-1b	19	20.300	834.000	89.800	3.561
336	UB152X89X1	UB152X89X1	0.585	1.000	0.585	Eq.H1-1b	19	20.300	834.000	89.800	3.561
337	UB152X89X1	UB152X89X1	0.585	1.000	0.585	Eq.H1-1b	19	20.300	834.000	89.800	3.561
338	UB152X89X1	UB152X89X1	0.583	1.000	0.583	Eq.H1-1b	19	20.300	834.000	89.800	3.561
339	UB152X89X1	UB152X89X1	0.583	1.000	0.583	Eq.H1-1b	19	20.300	834.000	89.800	3.561
332	UB152X89X1	UB152X89X1	0.567	1.000	0.567	Eq.H1-1b	19	20.300	834.000	89.800	3.561
333	UB152X89X1	UB152X89X1	0.567	1.000	0.567	Eq.H1-1b	19	20.300	834.000	89.800	3.561

Figure 10-3: Maximum member utilization ratio summary

In above image the arrowed beams to be monitored critically as the Utility Ratio is close to 1.0 as this is allowable limit beyond which the structure might fail.

The two beams which are having 0.811 utility ratio should be checked before going for installation of the light pole.

As the check needs to be made with finite element method this safe installation can be detected only by Finite Element software analysis and cannot be done manually.

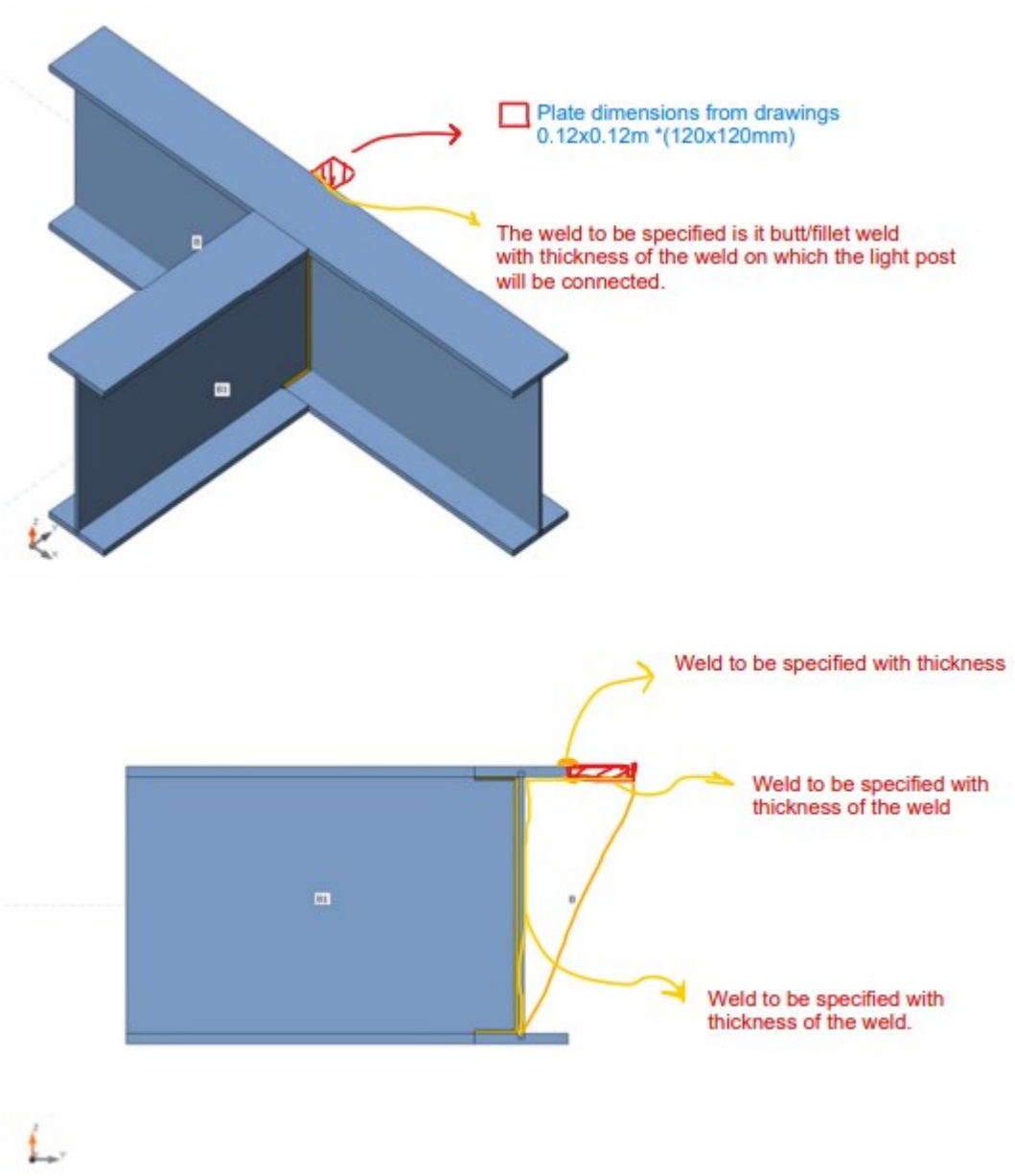
As there is a base plate of 120x120mm connecting the I beam of the structure the weld connection to be specified and checked for stresses on FEM and also the dead load of the plate should be considered.

Suppose say we take MS plate of 120x120mm then,

Area of the MS Plate = 0.12 x 0.12 = 0.0144 m2

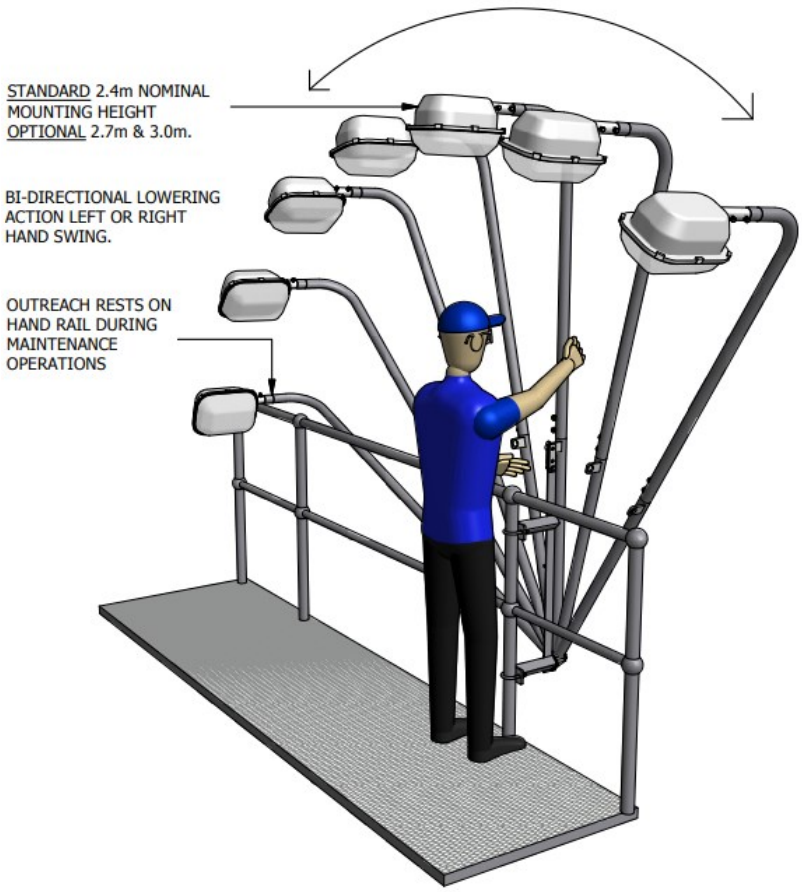
Volume of the MS Plate = 0.0144 x 0.010 (Thickness) = 0.000144m3

Weight = density x volume = 0.000144 x 7850 = 1.13 kg needs to be considered as part of DEAD LOAD.



After the load calculations, only we will know that the structure is SAFE or pose THREAT.

As of now, the practice of light pole installation on handrail is observed to be followed, for examples following are some images


STANDARD 2.4m NOMINAL
MOUNTING HEIGHT
OPTIONAL 2.7m & 3.0m.
BI-DIRECTIONAL LOWERING
ACTION LEFT OR RIGHT
HAND SWING.
OUTREACH RESTS ON
HAND RAIL DURING
MAINTENANCE
OPERATIONS