DESIGN CHECK

FOR

JIB CRANE OPERATION

PREPARED BY

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CHECKED BY .

Introduction:

This check is to exam the most critical load combination and check if we need to retrofit the column under the jib crane operation. Also, the roof truss is ~~under~~ to ~~the~~ checked against snow load and roof load defined in BCBC building code.

Following material properties apply to the analysis:

1. $f_y = 350$ MPa
2. $E_s = 200$ GPa
3. All column are pinned to the footing.
4. All steel are coated properly and no strength deduction appear except ϕ as defined.

Load consideration:

1. Roof truss self weight
2. Roof load   (6kpa from BCBC2006)
3. Bridge crane loading (provided by drawings)
4. Jib Crane load (3 tons, 30kn)
5. bridge rail self weight (5.5 kn)
6. Snow load (BCBC 2006)
7. Steel column self weight

Load case definition:

D: Steel self weight (truss, column weight, bridge crane rail weight, Jib crane weight)

BO: Bridge operation load

JO: Jib Crane operation Load

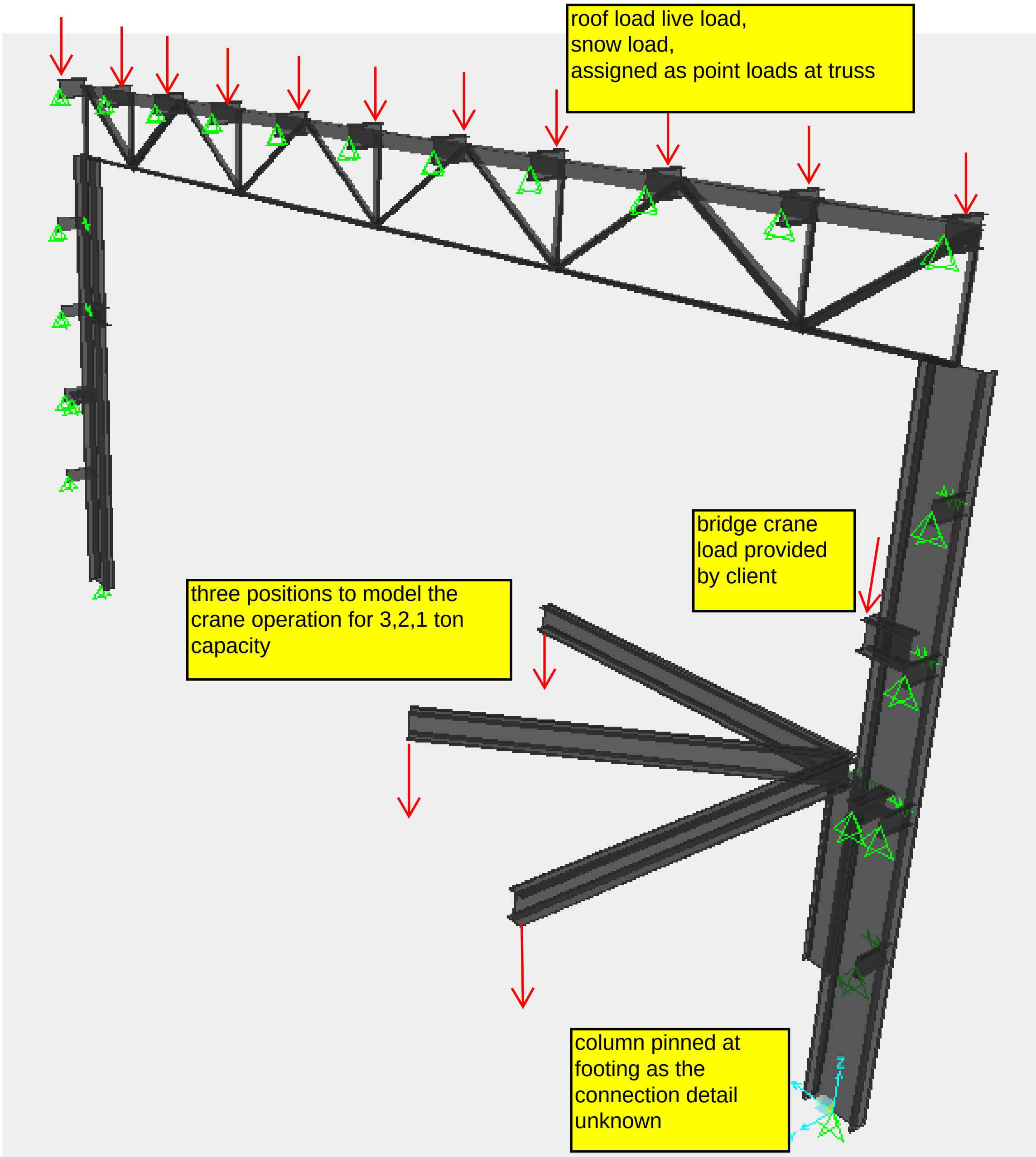
S: Snow load

LL: roof load

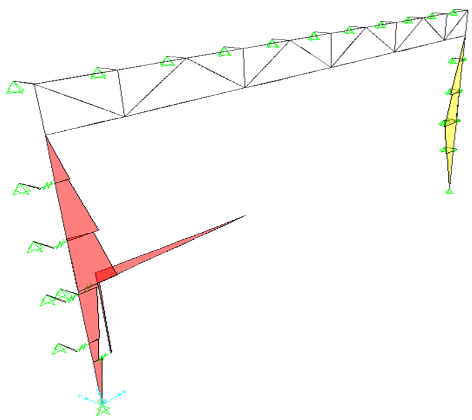
Load combination:

1. 1.25*D+1.5*(BO+JO+LL)+0.5*S
2. 1.25*D+1.5*S+0.5* (BO+JO+LL)
3. 1.25*D+1.5*(BO+JO)+0.5*S
4. 1.25*D+1.5*S+0.5* (BO+JO)
5. 1.25*D+1.5*(BO+JO+LL)
6. 1.0*D+1.0*LL+1.0*(BO+JO)
7. 1.0*D+1.0*S+1.0*(BO+JO)
8. 1.0*D+1.0*(BO+JO)

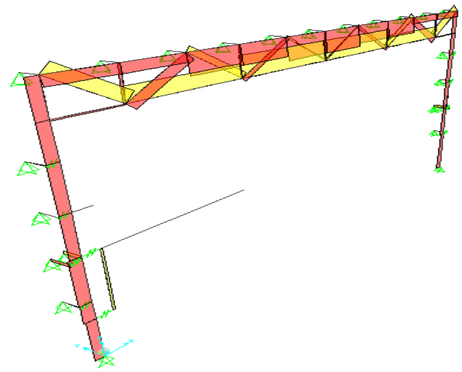
Model Features:



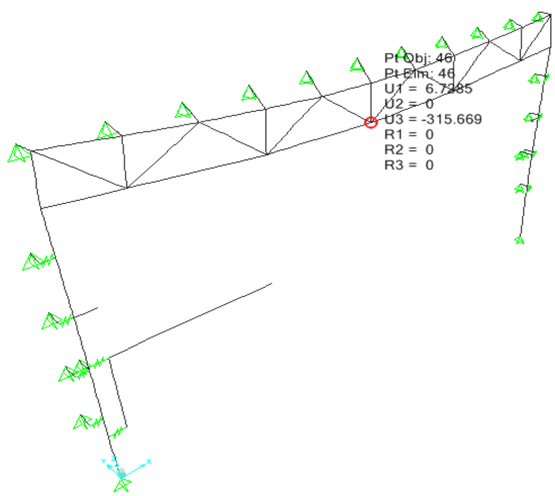
1. Steel self weight includes in the model
2. Roofing load (6kpa) and snow load are assigned as point loads (24' bay span and 17340mm wide)
3. Jib crane and bride crane load are assigned point loads at end of steel member.
4. Three crane operating locations are modeled to catch the worst case scenarios.
5. Rigid links are used to model the eccentricity
6. The columns are pinned at footings.
7. The columns are restrained as the horizontal and diagonal bracing presents.
8. The secondary bracing member are not modeled as it is a two dimensional model



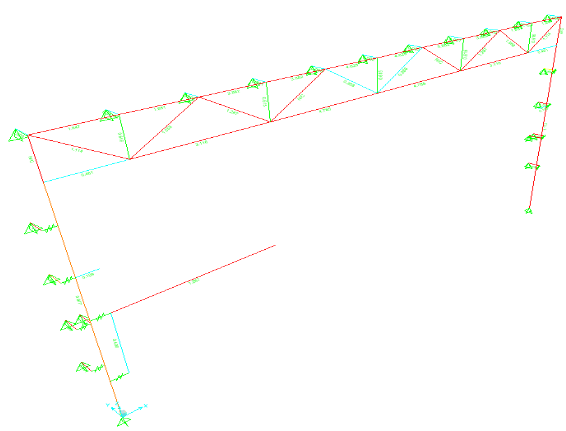
Moment Diagram



Aixal Force Diagram



Deflection Diagram



Demand/Capacity Ratio Diagram

Column Model Analysis, (3tons, kn-m,kn,mm)

LOAD.C	boom 90 DEGREE TO COLUMN LINE				boom 45 DEGREE TO COLUMN LINE				Boom 0 DEGREE TO COLUMN LINE			
	Axial	M Major	M Minor	Max. Defl.	Axial	M Major	M Minor	Max. Defl.	Axial	M Major	M Minor	Max. Defl.
1	784	413	25	n/a	843	396	100	n/a	936	365	148	n/a
2	590	294	20	n/a	611	288	30	n/a	646	277	50	n/a
3	220	92	4	n/a	221	90	109	n/a	271	43	160	n/a
4	369	188	12	n/a	389	181	33	n/a	424	170	54	n/a
5	665	356	21	n/a	724	338	102	n/a	817	307	151	n/a
6	445	238	14	n/a	485	226	67	n/a	548	205	102	n/a
7	249	139	7	3	281	127	72	4	343	106	105	5
8	66	80	4	1	89	59	76	2	105	32	109	2

Column Design Check d/c ratio

	boom 90 DEGREE TO COLUMN LINE	boom 45 DEGREE TO COLUMN LINE	Boom 0 DEGREE TO COLUMN LINE
1	0.97	1.45	1.93
2	0.7	0.81	1.01
3	0.26	0.95	1.31
4	0.45	0.6	0.79
5	0.84	1.34	1.82
6	0.56	0.9	1.22
7	0.32	0.7	1.03
8	0.13	0.04	0.88

Truss Model Analysis, (kn,mm)

Design Check

LOAD.C	Max. Tension Axial Force	Max. Compressive Axial Force	Max. Defl.	D/C
1	2192	2378	315	4.7
2	1634	1780	234	3.4
3	338	386	49	0.7
4	1016	1109	146	2.1
5	1859	2036	267	3.9
6	1242	1360	178	2.6
7	673	742	97	1.4
8	6	19	1.5	0.05

Column Model Analysis, (2tons, kn-m,kn,mm)

LOAD.C	boom 90 DEGREE TO COLUMN LINE				boom 45 DEGREE TO COLUMN LINE				Boom 0 DEGREE TO COLUMN LINE			
	Axial	M Major	M Minor	Max. Defl.	Axial	M Major	M Minor	Max. Defl.	Axial	M Major	M Minor	Max. Defl.
1	810	400	26	n/a	851	387	63	n/a	914	366	98	n/a
2	599	289	20	n/a	614	285	18	n/a	639	278	34	n/a
3	206	78	5	n/a	211	82	75	n/a	250	72	110	n/a
4	378	182	12	n/a	392	178	21	n/a	417	171	37	n/a
5	692	341	22	n/a	732	329	65	n/a	795	230	100	n/a
6	463	228	15	n/a	490	220	44	n/a	533	206	68	n/a
7	259	130	8	3	286	121	47	3	329	101	72	3
8	86	54	3	1	83	49	52	1	91	23	76	1

Column Design Check d/c ratio

	boom 90 DEGREE TO COLUMN LINE	boom 45 DEGREE TO COLUMN LINE	Boom 0 DEGREE TO COLUMN LINE
1	0.97	1.25	1.58
2	0.72	0.77	0.88
3	0.23	0.66	0.95
4	0.45	0.53	0.67
5	0.83	1.13	1.47
6	0.56	0.76	0.99
7	0.32	0.56	0.79
8	0.1	0.46	0.61

Column Model Analysis, (1tons, kn-m,kn,mm)

LOAD.C	boom 90 DEGREE TO COLUMN LINE				boom 45 DEGREE TO COLUMN LINE				Boom 0 DEGREE TO COLUMN LINE			
	Axial	M Major	M Minor	Max. Defl.	Axial	M Major	M Minor	Max. Defl.	Axial	M Major	M Minor	Max. Defl.
1	788	411	25	n/a	859	379	27	n/a	893	368	48	n/a
2	577	302	19	n/a	616	283	18	n/a	631	278	18	n/a
3	187	90	4	n/a	202	73	39	n/a	229	69	59	n/a
4	355	195	11	n/a	394	175	10	n/a	48	172	21	n/a
5	669	353	21	n/a	739	321	29	n/a	774	310	50	n/a
6	445	238	9	n/a	495	214	20	n/a	519	207	35	n/a
7	249	139	8	3	291	116	23	3	314	108	38	3
8	66	80	4	1	76	26	27	1	81	21	42	1

Column Design Check d/c ratio

	boom 90 DEGREE TO COLUMN LINE	boom 45 DEGREE TO COLUMN LINE	Boom 0 DEGREE TO COLUMN LINE
1	0.97	1.06	1.23
2	0.72	0.74	0.77
3	0.24	0.41	0.59
4	0.45	0.48	0.56
5	0.84	0.93	1.12
6	0.56	0.62	0.75
7	0.32	0.43	0.56
8	0.1	0.24	0.34

CONCLUSION AND RECOMMENDATION

(1) THE COLUMN MAY REACH 90% OF ITS CAPACITY WHEN JIB CRANE BOOM PARALLEL TO COLUMN LINE UNDER UNFACTORED LOAD COMBINATION.

(NOT CONSERVATIVE)

(2) THE COLUMN ARE NOT VERY UNDER STRESSED EVEN UNDER VERY CONSERVATIVE FACTORE LOAD COMBINATION WHEN THE BOOM IS PERPENDICULAR TO COLUMN LINE

(3) THE ROOF TRUSS IS OVER STRESSED AND DEFORMED SIGNIFICANTLY UNDER DEFINED SNOW LOAD AND ROOF LOAD EVEN WITH UNFACTORED LOAD COMBINATION.

(4) RECOMMEND THAT A BRACING IS INSTALLED TO OVERCOME THE JIB CRANE OPERATION. AND BEARING STIFFENER MAY NEED TO CONFRONT THE JIB CRANE OPERATION BEARING LOAD ON COLUMN.