

# **The Adjustment of Design Moment at Beam-Column Junction and His Effect on Required Steel**

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**ABSTRACT:** The aim of structural design to achieve economy in the consumption of structural materials like concrete and steel, in keeping with requirement of safety and serviceability. it is vital for economy to reduce steel consumption in reinforcement concrete building. it is seen that beam and column are heavily reinforced member. This paper presents a study to analyse the effect of variation of steel, considering face correction at beam-column junction. It is hoped that this study will be helpful to reduce the steel in beam as well as in column.

**KEYWORDS:** Beam-column junction design moment, Steel consumption, Economy.

## **I. INTRODUCTION**

The most commonly adopted structural system for medium rise buildings in developing countries has been the cast-in-situ reinforced concrete moment resisting frames coupled by solid floor slabs. These bare frames are infilled with non-structural brick or concrete block masonry panel walls for creating the external enclosure and internal partition walls. Our paper involves analysis and design of medium rise multi-storeyed [G + 5] building using (a) Centre line dimension of beam and column, for calculating steel consumption, (b) Considering face correction for calculation the steel consumption. The face correction introduced in many of the text book like, S Unni Krishna & Devdas Menon "Reinforced Concrete Design" & U H Viryani "Structural Design of Multi-Storeyed Building. The over-said concept has been used in STAAD-Pro software by using MMG command for column and MFACE command for beam.

- (a) A three dimensional model has been created in the software (STAAD-Pro) and matrix method analysis approached has been followed for the purpose of analysis. In general practice of frame analysis, centreline dimension of beam and column used to define the geometry of the frame. The moment diagram considering centre line geometry for beam and column are shown in Figure-1

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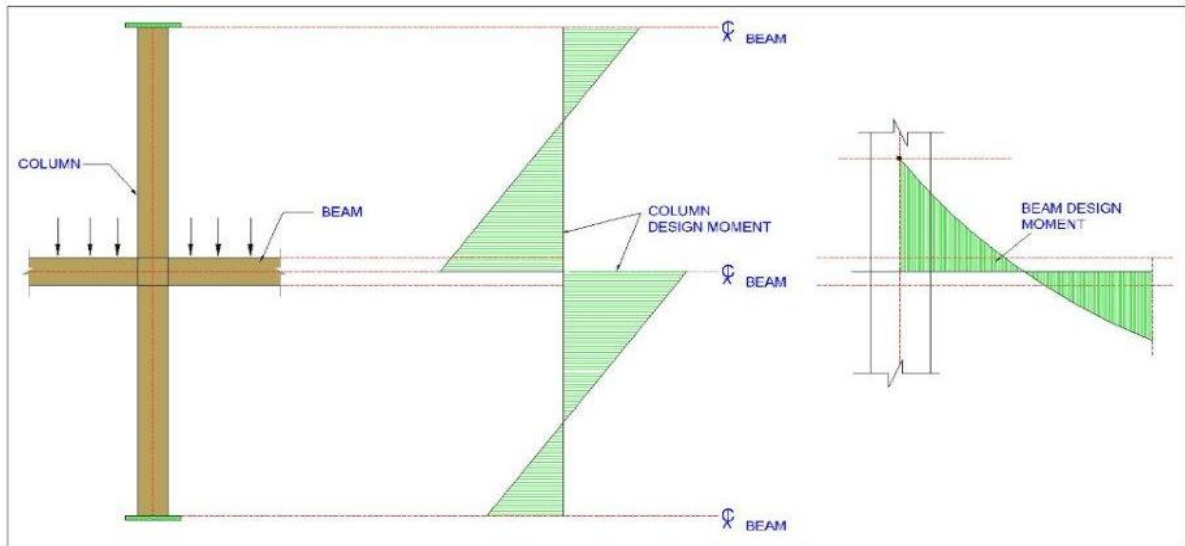


Figure 1: Centre line Moment Diagram for Beam and Column

- (b) The code permits, flexural member to be designed for the moment computed at the face of the support. Same as above a three dimensional model has been created in the software (STAAD-Pro) and matrix method analysis approached has been followed for the purpose of analysis. Considering face correction in beam and column the moment diagram for beam and column are shown in Figure 2.

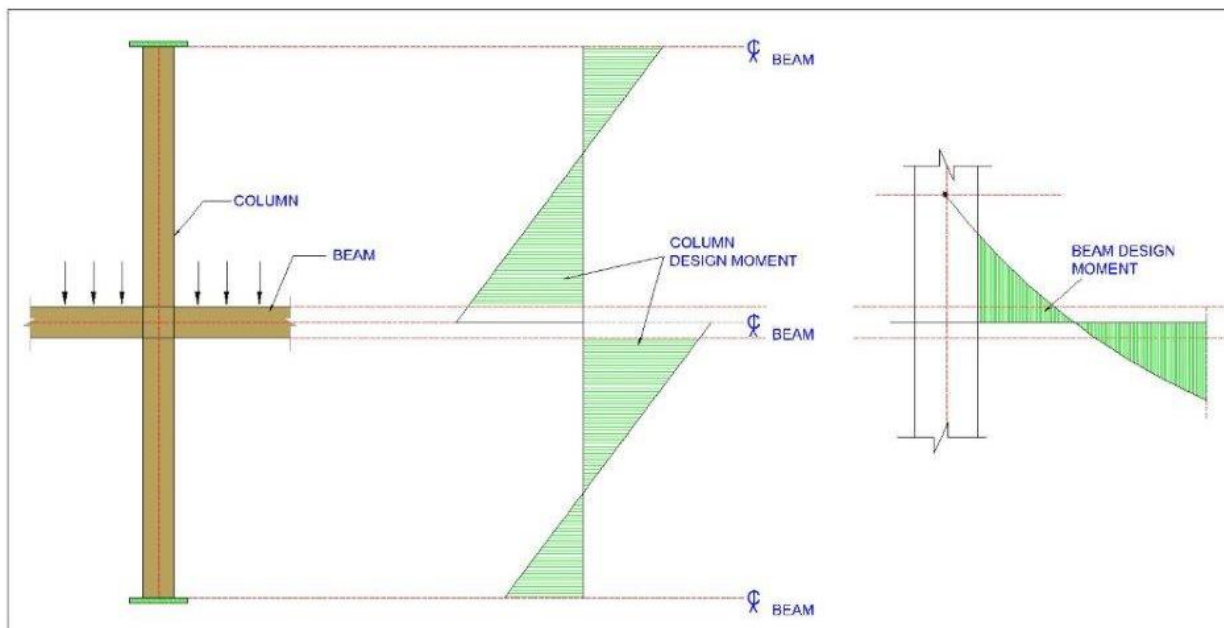


Figure 2: Face Moment Diagram for Beam and Column

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## II. RELATED WORK

A (G+5) storeyed medium rise RCC building has been consider for the above- said work .A computer based 3-D model has been created for analysis and design. The isomeric view of the prototype model (STAAD Model) is shown in Figure 3.

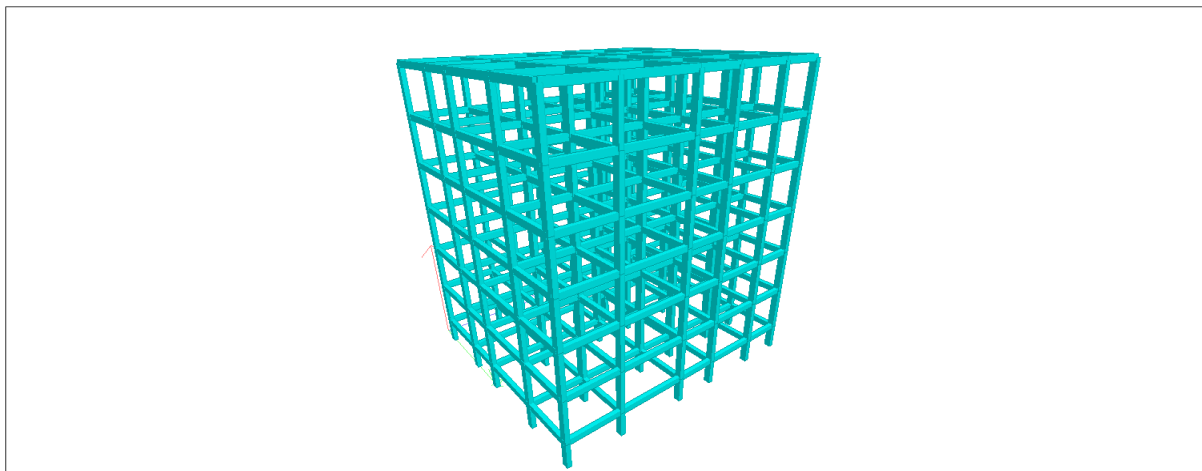


Figure 3: Isomeric view of STAAD Model

### Input data

<b>Construction Material properties:-</b>		
<b>Concrete</b>		
Young's Modulus of concrete, E	=	2.6 GPa
Characteristic strength of concrete, $f_{cu}$	=	25 N/mm <sup>2</sup> (M25)
Poisson's ratio of concrete	=	0.2
<b>Steel</b>		
HYSD reinforcement of grade, Fe	=	500 confirming to IS: 1786
<b>Design data:-</b>		
<b>Dead Loads</b>		
Density of concrete	=	25.00kN/m <sup>3</sup>
Density of Plaster/ finishing load	=	1 kN /m <sup>2</sup>
Railing load	=	1 kN /m
Wall load (230 mm wall at all beam)	=	20 kN/m <sup>3</sup>
<b>Live Load</b>		
Live load on pathway slab	=	2.0 KN /m <sup>2</sup> at typical floor.
	=	1.5 KN /m <sup>2</sup> at terrace.
<b>Seismic Load</b>		
The seismic forces are calculated on the basis of following parameters as per IS1893-2002.		
Seismic Zone		V1 (Delhi)
Seismic zone factor ,Z	=	0.24
Seismic importance factor, I	=	1.0
Time Period in X dirn	=	0.780

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Time Period in Z dirn	=	0.780
Sa/g in dirn of X	=	1.727
Sa/g in dirn of Z	=	1.727

**Load combination:**

The structure has been designed as per latest revision of Indian code with limit state method. The loads combinations used in computer based program are follow:

1. 1.5DL+1.5LL
2. 1.5(DL+EQ +X)
3. 1.5(DL+EQ -X)
4. 1.5(DL+EQ +Z)
5. 1.5(DL+EQ -Z)
6. 0.9DL+1.5EQ +X
7. 0.9DL+1.5EQ -X
8. 0.9DL+1.5EQ +Z
9. 0.9DL+1.5EQ -Z
10. 1.2DL+1.2LL+1.2EQ +X
11. 1.2DL+1.2LL+1.2EQ -X
12. 1.2DL+1.2LL+1.2EQ +Z
13. 1.2DL+1.2LL+1.2EQ -Z

### III. RESULT

After performing over said analysis and design considering both, centreline moment and face moment, the steel required in both condition and differences in steel are shown in Table-1 and Table-2. The column and beam number that reflected in table-1 and 2 are shown in Figure 4.

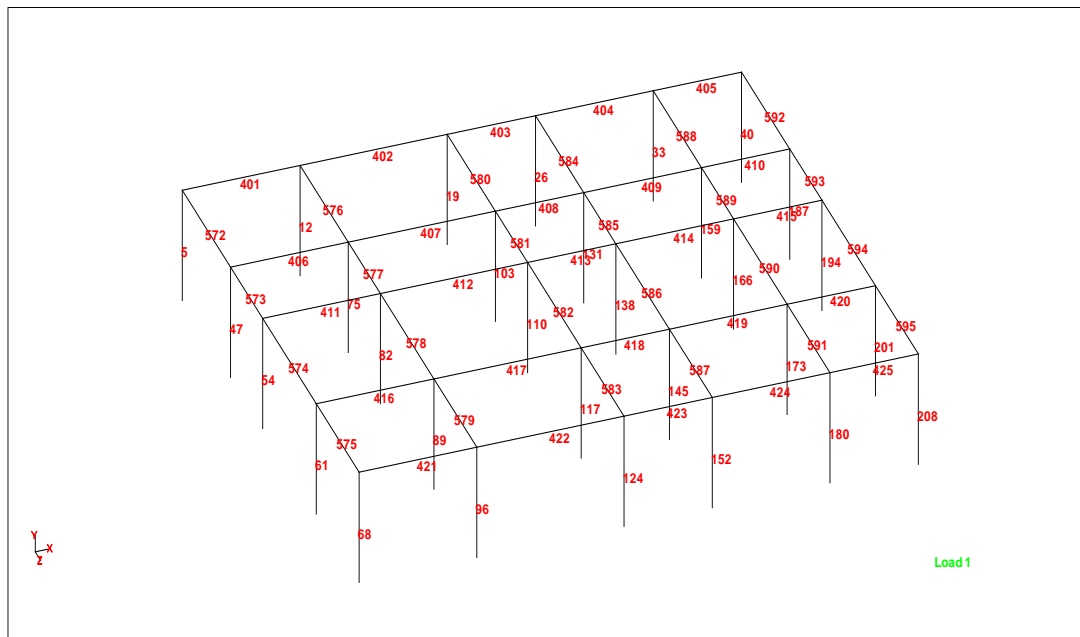


Figure 4: Column and Beam Numbering

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In table -1 shown the column Number that reflect in Figure 2,length of column, sizes, steel required in both condition as well as differences, if we are considers face correction.

Table-1

MEMBER NO.(Column No)	HEIGHT	Cross-section(mm)		Steel required considering centreline geometry	Steel required considering Face correction	Differences	Steel saving in column (%)
		Depth	Width				
5	3.5	450	300	1734.79	1192.67	542.12	31.2
12	3.5	450	300	2495	1755.74	739.26	29.6
19	3.5	450	300	2689.24	1890.87	798.37	29.7
26	3.5	450	300	2407.42	1685.19	722.23	30.0
33	3.5	450	300	2646.26	1890.19	756.07	28.6
40	3.5	450	300	1570.18	1058.16	512.02	32.6
47	3.5	450	300	1391.36	897.72	493.64	35.5
54	3.5	450	300	1563.03	994.65	568.38	36.4
61	3.5	450	300	1536.46	991.26	545.2	35.5
68	3.5	450	300	1705.39	1148.53	556.86	32.7
75	3.5	600	300	2314.19	1566.52	747.67	32.3
82	3.5	600	300	2383.92	1589.28	794.64	33.3
89	3.5	600	300	2485.23	1704.16	781.07	31.4
96	3.5	450	300	2433.55	1725.61	707.94	29.1
103	3.5	600	300	2726.04	1930.95	795.09	29.2
110	3.5	600	300	2915.77	2041.04	874.73	30.0
117	3.5	600	300	2901.73	2018.59	883.14	30.4
124	3.5	450	300	2646.03	1884.29	761.74	28.8
131	3.5	600	300	2426.93	1779.75	647.18	26.7
138	3.5	600	300	2560.37	1858.41	701.96	27.4
145	3.5	600	300	2464.96	1793.8	671.16	27.2
152	3.5	450	300	2377.03	1686.93	690.1	29.0
159	3.5	600	300	2338.11	1721.11	617	26.4
166	3.5	600	300	2461.03	1779.62	681.41	27.7
173	3.5	600	300	2395.58	1723.22	672.36	28.1
180	3.5	450	300	2603.88	1844.41	759.47	29.2
187	3.5	450	300	1133.7	764.42	369.28	32.6
194	3.5	450	300	1237	817.19	419.81	33.9
201	3.5	450	300	1202.2	733.58	468.62	39.0
208	3.5	450	300	1546.66	1020.14	526.52	34.0

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In table -2 shown the beam number that reflect in Figure 2, sizes, steel required in both condition as well as differences, if we are considers face correction.

Beam Size		Beam No. in STAAD Model	Required Steel Considering centre line Geometry, as per STAAD Output (mm <sup>2</sup> )		Required Steel Considering face correction, as per STAAD Output (mm <sup>2</sup> )		Steel saving in Beam(%)
			TOP		TOP		
			Start	End	Start	End	
300	450	401	976.46	741.85	866.44	636.83	12.5
300	450	402	958.49	973.87	832.76	846.16	13.1
300	450	403	758.42	722.38	638.5	606.05	16.0
300	450	404	871.66	812.19	745.09	689.66	14.8
300	450	405	535.56	882.86	439.78	766.32	15.0
300	450	406	1019.35	1015.2	867.36	856.65	15.3
300	450	407	1232.15	1216.83	1096.7	1075.4	11.3
300	450	408	958.57	915.08	821.95	778.41	14.6
300	450	409	1101.42	1060.39	915.27	882.58	16.8
300	450	410	746.63	873.83	630.32	750.29	14.8
300	450	411	1039.81	1060.13	870.5	877.09	16.8
300	450	412	1240.84	1224.41	1108.56	1085.52	11.0
300	450	413	967.5	925.94	829.6	787.66	14.6
300	450	414	1111.4	1071.66	923.54	891.95	16.8
300	450	415	769.72	877.59	651	754.14	14.7
300	450	416	1064.2	1060.95	887.34	877.32	17.0

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300	450	417	1254.48	1240.52	1125.54	1105.35	10.6
300	450	418	971.26	929.41	833.1	792.83	14.5
300	450	419	1118.38	1076.62	628.66	895.51	30.6
300	450	420	763.4	891.51	645.55	766.38	14.7
300	450	421	977.57	749.9	867.42	643.95	12.5
300	450	422	960.86	972.7	835.33	845.54	13.1
300	450	423	763.61	725.95	642.85	609.5	15.9
300	450	424	863.13	806.26	749.71	695.5	13.4
300	450	425	542.75	882.25	445.86	765.7	15.0
300	450	572	1086.35	858.31	777.85	607.47	28.8
300	450	573	775.7	744.32	546.41	523.7	29.6
300	450	574	1081.7	1031	788.9	754.15	27.0
300	450	575	711.57	993.43	504.4	749.07	26.5
300	450	576	1172.18	1234.4	833.79	902.3	27.9
300	450	577	1119.77	1053.5	776.09	730.51	30.7
300	450	578	1392.4	1349.41	1122.09	1068.81	20.1
300	450	579	1057.03	1100.21	747.45	777.59	29.3
300	450	580	1090.5	1191.74	794.16	875.79	26.8
300	450	581	1077	1017.5	746.67	703.63	30.8
300	450	582	1370.56	1325.59	1096.05	1036.66	20.9

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300	450	583	1031.64	1045.52	732.42	741.29	29.1
300	450	584	1065.84	1166.51	783.41	866.01	26.1
300	450	585	1021.38	971.8	722.97	683.28	29.4
300	450	586	1342.86	1303.38	1062.03	1010.67	21.7
300	450	587	977.31	984.92	714.72	719.21	26.9
300	450	588	1078.19	1144.76	775.11	829.54	27.8
300	450	589	975.54	920.73	696.52	656.23	28.7
300	450	590	1314.76	1275.39	992.57	947.73	25.1
300	450	591	933.52	977.16	677.34	714.07	27.2
300	450	592	941.37	776.77	701.58	559.71	26.6
300	450	593	687.63	661.41	484.07	464.61	29.7
300	450	594	959.53	916.05	708.04	674.2	26.3
300	450	595	651.82	889.08	464.5	651.74	27.6

Table-2

### IV. CONCLUSION

On the basis of above study, steel saving in column is approximate 30% and in beam is 20%, so we can say , After apply face correction, we can save 20 to 30 % steel in beam and in column.

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### BIOGRAPHY



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