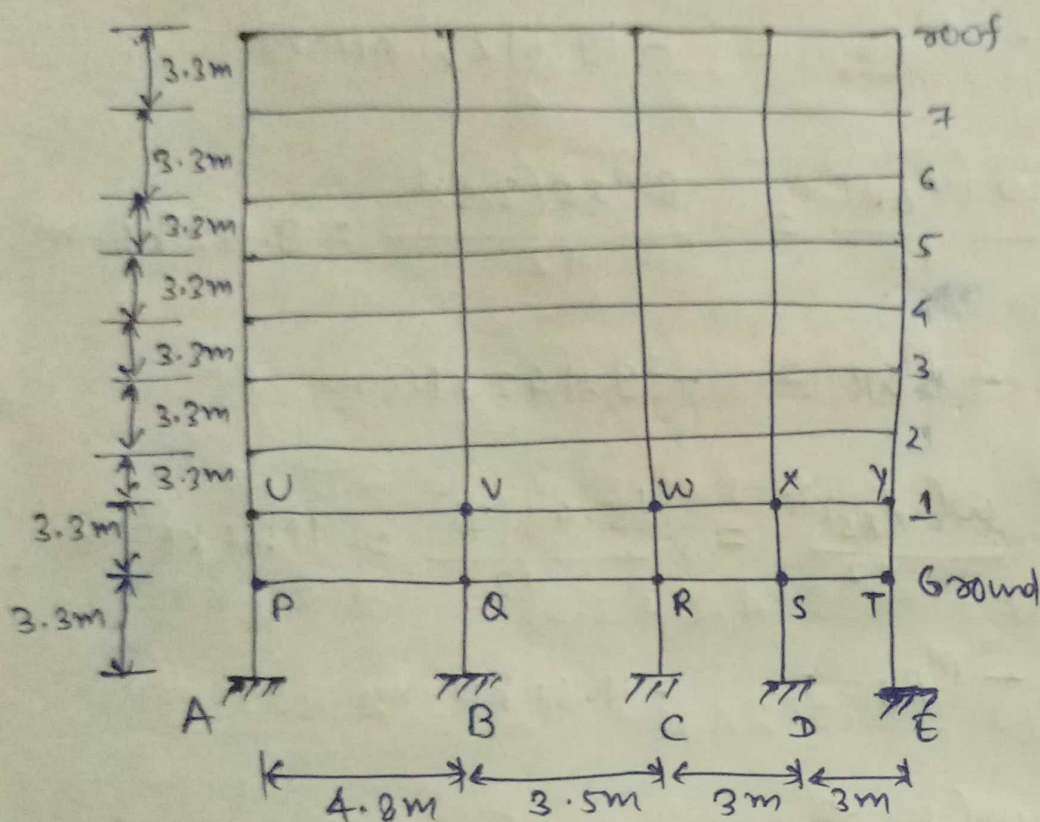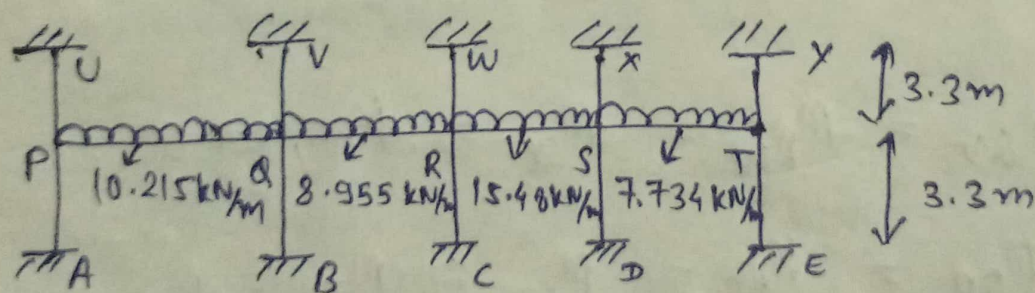(d) Calculation of Member end moments for load combination
1.5 (DL + LL) along gridline 4.

for Ground Floor :

$$U DL \quad on \quad PQ = 1.5 (\overset{DL}{3.06} + \overset{LL}{3.75}) = 10.215 \ kN/m$$

$$UDL \quad on \quad QR = 1.5 (2.5 + 3.47) = 8.955 \ kN/m$$

$$UDL \quad on \quad RS = 1.5 (\overset{4.32}{} + 6 \ ) = 15.48 \ kN/m$$

$$UDL \quad on \quad ST = 1.5 (2.156 + 3 \ ) = 7.734 \ kN/m$$

fixed end moments:

$$M_{PQ} = \frac{w \cdot (\ell_{PQ})^2}{12} = \frac{10.215 \times (4.8)^2}{12} = 19.6128 \text{ kN-m}$$

$$M_{QP} = -M_{PQ} = -19.6128 \text{ kN-m}$$

$$M_{QR} = \frac{w(\ell_{QR})^2}{12} = \frac{8.955(3.5)^2}{12} = 9.142 \text{ kN-m}$$

$$M_{RQ} = -M_{QR} = -9.142 \text{ kN-m}$$

$$M_{RS} = \frac{w(\ell_{RS})^2}{12} = \frac{15.48(3)^2}{12} = 11.61 \text{ kN-m}$$

$$M_{SR} = -M_{RS} = -11.61 \text{ kN-m}$$

$$M_{ST} = \frac{w(\ell_{ST})^2}{12} = \frac{7.734(3)^2}{12} = 5.8 \text{ kN-m}$$
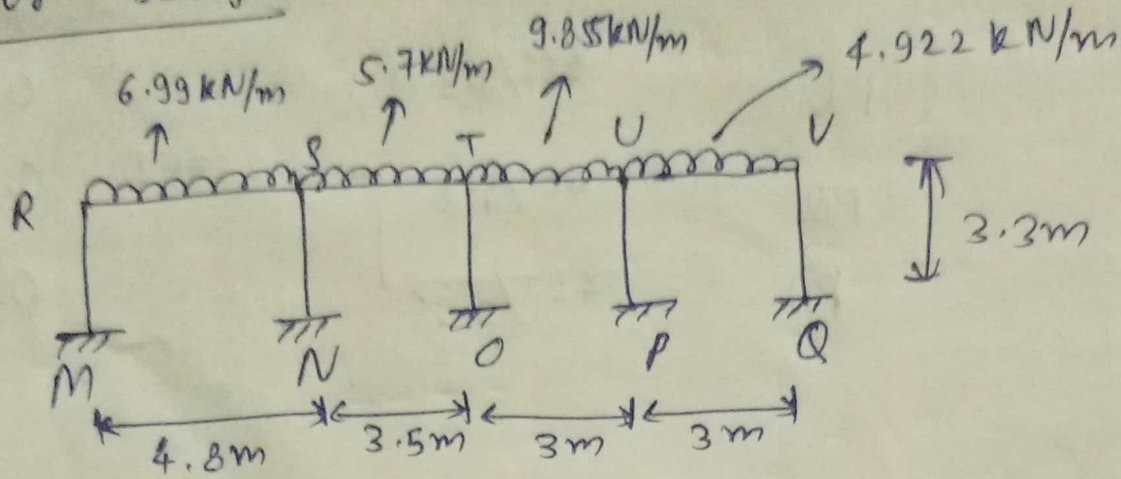
$$M_{TS} = -M_{ST} = -5.8 \text{ kN-m}$$

$$M_{PU} = M_{QV} = M_{RW} = M_{SX} = M_{TY} = 0$$

$$M_{PA} = M_{QB} = M_{RC} = M_{SD} = M_{TE} = 0$$

Joint	member	K	Σk	D.F.
P	PU	$4EI/3.3$		0.37
	PQ	$4EI/4.8$	$3.257EI$	0.26
	PA	$4EI/3.3$		0.37
Q	QV	$4EI/3.3$		0.28
	QR	$4EI/3.5$	$4.4EI$	0.26
	QB	$4EI/3.3$		0.28
	QP	$4EI/4.8$		0.19
R	RW	$4EI/3.3$		0.25
	RS	$4EI/3$		0.27
	RC	$4EI/3.3$	$4.9EI$	0.25
	RQ	$4EI/3.5$		0.23
S	SX	$4EI/3.3$		0.24
	ST	$4EI/3$	$5.09EI$	0.26
	SD	$4EI/3.3$		0.24
	SR	$4EI/3$		0.26
T	TY	$4EI/3.3$		0.32
	TE	$4EI/3.3$	$3.757EI$	0.32
	TS	$4EI/3$		0.35

Moment distribution table (rotated landscape).

Joint	P			Q				R				S				T		
Member	PQ	PU	PA	QP	QV	QB	QR	RQ	RW	Rc	RS	SR	SX	SD	ST	TS	TY	TE
D.F.	0.26	0.37	0.37	0.19	0.28	0.28	0.26	0.23	0.25	0.27	0.26	0.24	0.24	0.26	0.35	0.32	0.32	
F.E.M.	10.215	—	—	-10.215	—	—	9.142	-9.142	—	—	11.61	-11.61	—	—	5.8	-5.8	—	—
Balance	-2.66	-3.78	-3.78	.203	.30	.30	.29	-0.567	-0.617	-0.67	-0.64	1.39	1.39	1.51	2.03	1.86	1.86	1.86
C.O.	-1.89	-1.33	.1015	-1.33	.15	.15	-0.28	.145	-0.31	-0.31	0.755	-0.34	0.695	1.015	0.755	0.93	0.93	0.93
Balance	0.81	1.15	1.15	0.25	0.37	0.37	0.34	-0.06	-0.07	-0.07	0.34	-0.49	-0.49	-0.54	-0.92	-0.84	-0.84	-0.84
C.O.	0.58	0.4	0.125	0.4	0.18	0.18	-0.03	0.17	-0.04	-0.04	0.17	-0.08	-0.27	-0.24	-0.46	-0.42	-0.42	-0.42
Balance	-0.28	-0.41	-0.41	-0.14	-0.2	-0.2	-0.19	0.04	0.04	0.05	0.25	0.24	0.24	0.25	0.39	0.36	0.36	0.36
C.O.	-0.2	-0.14	-0.07	-0.14	-0.1	-0.1	0.02	-0.02	-0.02	-0.02	-0.12	-0.11	-0.11	-0.12	-0.2	-0.18	-0.18	-0.18
Balance	0.11	0.15	0.15	0.07	0.1	0.1	-0.02	-0.02	-0.02	-0.02	0.12	0.19	0.12	-0.15	-0.17	-0.15	0.18	0.18
Total moment (kN·m)	6.695	-3.96	-2.73	-10.9	0.8	0.8	9.38	-9.52	-0.99	-0.99	11.49	-10.87	1.61	1.61	7.64	-3.86	1.92	1.92

for roof :

$$DL + LL$$

$$UDL \ on \ RS = 1.5(3.06 + 1.6) = 6.99 \, kN/m$$

$$UDL \ on \ ST = 1.5(2.5 + 1.3) = 5.7 \, kN/m$$

$$UDL \ on \ TU = 1.5(4.32 + 2.25) = 9.855 \, kN/m$$

$$UDL \ on \ UV = 1.5(2.156 + 1.125) = 4.922 \, kN/m$$

fixed end moments :

$$M_{RS} = \frac{w \cdot (\ell_{RS})^2}{12} = \frac{6.99(4.8)^2}{12} = 13.421 \, kN\text{-}m$$

$$M_{SR} = - M_{RS} = -13.421 \, kN\text{-}m$$

$$M_{ST} = \frac{w \cdot (\ell_{ST})^2}{12} = \frac{5.7(3.5)^2}{12} = 5.819 \, kN\text{-}m$$

$$M_{TS} = - M_{ST} = -5.819 \, kN\text{-}m$$

$$M_{TU} = \frac{w(\ell_{TU})^2}{12} = \frac{9.855(3)^2}{12} = 7.391 \, kN\text{-}m$$

$$M_{UT} = - M_{TU} = -7.391 \, kN\text{-}m$$

$$M_{UV} = \frac{w(l_{UV})^2}{12} = \frac{4.922(3)^2}{12} = 3.692 \text{ kN-m}$$

$$M_{VU} = -M_{UV} = -3.692 \text{ kN-m}$$

$$M_{RM} = M_{SN} = M_{TO} = M_{UP} = M_{VQ} = 0$$

Joints	Members	k	Σk	D.F.
R	R S	$4EI/4.8$		0.41
			2.045 EI	
	R M	$4EI/3.3$		0.59
S	S T	$4EI/3.5$		0.36
	S N	$4EI/3.3$	3.188 EI	0.38
	S R	$4EI/4.8$		0.26
T	T U	$4EI/3$		0.36
	T O	$4EI/3.3$	3.688 EI	0.33
	T S	$4EI/3.5$		0.31
U	U V	$4EI/3$		0.34
	U P	$4EI/3.3$	3.878 EI	0.31
	U T	$4EI/3$		0.34
V	V Q	$4EI/3.3$	2.545 EI	0.48
	V U	$4EI/3$		0.52

Joints	M	R		S			T			U			V		Q	P	O	N
Members	MR	RS	RM	SR	ST	SN	TO	TS	TU	UT	UP	UV	VU	VQ	QV	PU	OT	NS
D.F.	—	0.41	0.59	0.26	0.36	0.38	0.35	0.31	0.36	0.34	0.31	0.34	0.52	0.48	—	—	—	—
F.E.M.	—	—	13.421	—	-13.421	5.819	—	-5.819	7.391	-7.391	—	3.692	-3.692	—	—	—	—	—
Balance	—	-5.5	-7.92	1.98	2.74	2.89	-0.52	-0.53	-0.56	1.25	1.15	1.25	1.92	1.77	—	—	—	—
C.O.	-2.75	—	0.99	-3.96	1.44	1.37	-0.26	-0.26	0.26	0.57	0.62	0.96	0.62	—	0.88	—	—	—
Balance	—	-0.41	-0.58	0.29	0.41	0.44	0.08	0.08	0.09	-0.73	-0.67	-0.73	-0.32	-0.29	—	—	—	—
C.O.	-0.2	—	0.14	-0.29	0.22	0.21	0.04	0.04	-0.36	0.04	-0.36	-0.33	-0.14	—	—	-0.19	—	—
Balance	—	-0.06	-0.08	-0.04	-0.05	-0.05	0.09	0.08	0.1	0.22	0.20	0.22	0.07	0.06	—	—	—	—
Total Moment (kN-m)	-2.95	7.451	-7.45	-15.44	4.86	4.86	-0.57	-6.409	6.921	-6.04	0.945	5.06	-1.54	1.54	0.74	—	—	—

Comparison for Ground Floor:

Member Element no.	Beam	Excel sheet	Moment distribution method
101	PQ	8.4285	8.685
100	QR	10.6194	9.38
78	RS	13.8671	11.49
75	ST	13.2239	7.64

Comparison for Roof:

Member Element no.	Beam	Excel sheet	Moment distribution method
373	RS	8.547	7.457
372	ST	6.0092	4.86
350	TU	-7.3731	6.921
347	UV	8.9133	5.06

The difference in values can be due to :- software precision of SAP 2000. Also there can be errors in manual calculation.