SECONDARY WIND MOMENTS IN A FIVE-BAY TEN STORY BUILDING BENT

Thesis by

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In Partial Fulfillment of the Requirements

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PROBLEM

The purpose of this thesis is to determine the effect of secondary wind moments due to column shortening under wind load upon a five bay ten-story structural steel building bent.

THE BENT

The bent used was obtained by adding two twenty-two foot bays to the upper ten stories of the classical Wilson-Maney bent, analyzed in Bulletin 80 of the University of Illinois. The dimensions and sections are the same as for the Wilson-Maney bent except that the first story height has been increased to 16'-0". Diagram 1 shows the dimensions and properties of the bent. This same structure was investigated for primary wind stresses only by Rolland A. Philleo as a thesis problem for the degree of Master of Science in Civil Engineering at the Graduate School of Cornell University.

ASSUMPTIONS

It was assumed that the joints in the bent were perfectly rigid and that no relative rotation of the members occurred at their intersections.

The foundations were assumed rigid against settlement but were allowed to rotate by connecting them with a beam.

These two assumptions are not consistent, of course, but it was thought that allowing the footings to rotate would be a better assump-

tion than the ordinary one of assuming them as completely fixed.

LOADS

The load used was the same one used in Bulletin 80 of the University of Illinois, i.e., a horizontal wind load of thirty pounds per square foot on a vertical surface one foot wide.

PROCEDURE

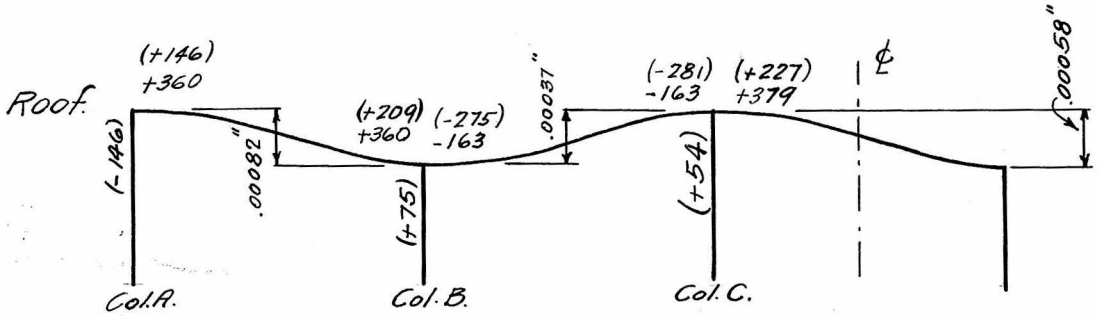
Calculation of Wind Moments

The wind moments were first obtained by the Hardy Cross method by the ordinary procedure. Seven complete cycles were carried through to obtain the moments. The wind moments are shown on diagram No. 2.

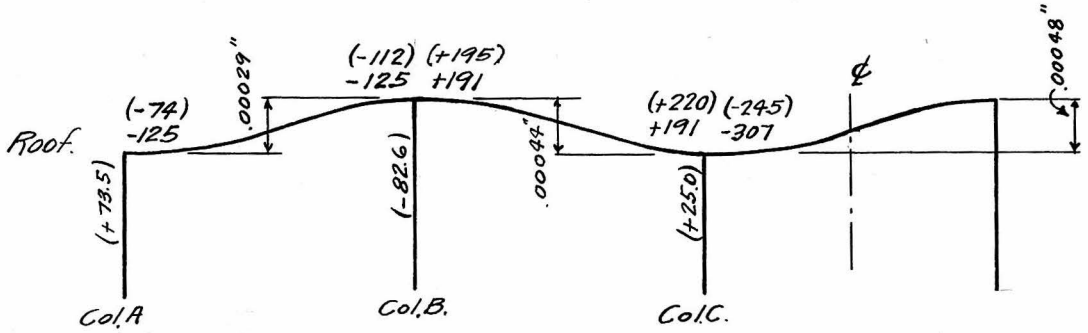
Calculation of Secondary Wind Moments

The change in length of the columns due to wind loads, the resulting differences in elevations of the ends of the beams and the fixed-end beam moments were then determined. These fixed end moments were then distributed by the Hardy Cross method and the secondary wind moments found. Six complete cycles were carried through with the Hardy Cross method to determine the moments.

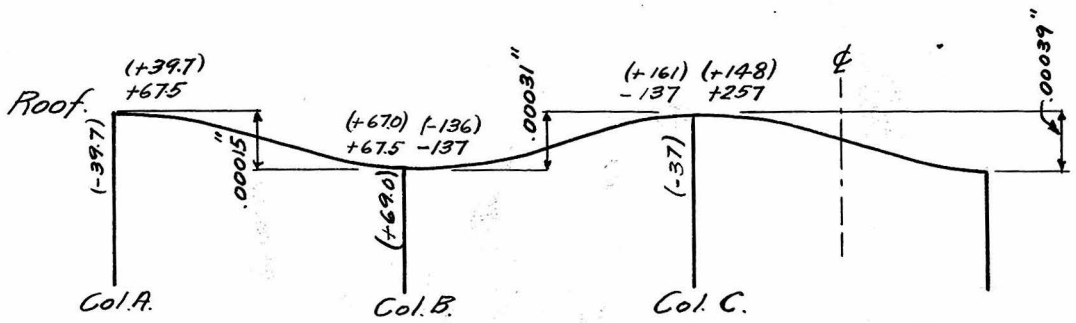
In the upper stories of the bent the secondary moments were quite large and would also produce column loads and deformations and more secondary moments or corrections to the secondary moments which, in general, would be opposite to the secondary moments. These corrections to the secondaries would produce a second correction which, in general, would add to the secondary moments. What actually happens when the wind load is applied to the bent is that the columns deform and the stresses arrange themselves in the structure producing equilibrium. In the solution for wind moments the columns are not allowed to deform and the column loads obtained from these moments are too large since it can be seen that allowing the columns to deform tends to reduce these loads.



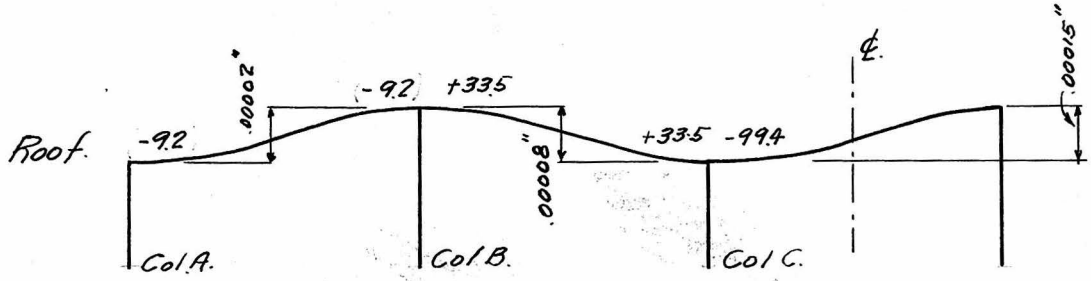
(a) Column Deformations and Moments Due to Wind Moments



(b) Column Deformations and Moments Due to Secondary Moments



(c) Column Deformations and Moments Due to First Correction to Secondary Moments.



(d) Column Deformations and Moments Due to Second Corrections to Secondary Moments.

Figure 1.

The diagrams in Figure 1 show the column deformations, fixed end moments, and final distributed moments at the roof due to wind moments, secondary moments, and first, and second corrections to the secondary moments.

The figures in brackets are the distributed moments and the other figures are the fixed end moments. The moments are in foot-pounds and positive moment tends to rotate the joint in a clockwise direction. The wind load is applied at the left.

The diagrams in Figure 1 are for the roof only but the floors below act in a similar way, the actual deflections of course being smaller. It can be seen from Figure 1 that one correction to the secondary moments will give secondary moments that are too small. When the second correction is applied the resulting corrected secondary moments (algebraic sum of secondary moments and two corrections) will be too large and the final wind moments (algebraic sum of wind moments and corrected secondary moments) will in general be too small. The magnitude of the error, however, will be small, as can be seen from the fixed end moments due to the second correction to the secondary moments. In the solution only two corrections to the secondary moments were solved for.

The steps gone through in obtaining the secondary moments are a series of approximations identically analogous to those gone through in

applying the Hardy Cross method. Assuming that the columns do not deform, corresponds to fixing the joints against rotation and the calculation of each set of moments corresponds to distribution. Allowing the columns to deform is analogous to balancing and the calculation of fixed-end moments gives the carry-over effect.

Diagram No. 3 shows the first secondary wind moments, the first and second corrections to the secondary moments, and the corrected secondary moments, (algebraic sum of first secondary moments and corrections.)

Diagram No. 4 gives the ratios of the first secondary moments to the wind moments and the ratios of the corrected secondary moment to the wind moments. The first ratio is given near the member and the latter is given over the first one. Positive ratios indicate that the secondary moments add to the wind moments and vice versa.

Diagram No. 5 shows the wind moments, corrected secondary moments, and the ratio of the former to the latter.

Floor	Span AB L = 22'-0" I/L = 7.7			Span BC L = 22'-0" I/L = 7.7			Span CC L = 18'-0" I/L = 9.4		
	$\frac{M_L + M_R}{L}$ lbs.	$\frac{d}{h} E$	Fixed-End Moment Ft. x lbs.	$\frac{M_L + M_R}{L}$ lbs.	$\frac{d}{h} E$	Fixed-End Moment Ft.x lbs.	$\frac{M_L + M_R}{L}$ lbs.	$\frac{d}{h} E$	Fixed-End Moment Ft. xlbs.
Roof	27.1	171.5	360	22.3	77.6	163	32.6	121.0	379
10	61.2	170.7	358	53.8	77.2	162	79.1	120.4	377
9	101.1	168.1	355	88.2	76.0	160	130.5	118.6	371
8	141.5	162.6	341	123.2	73.5	154	179.8	114.8	359
7	180.9	153.0	322	159.5	69.1	145	234.8	108.2	338
6	219.0	139.4	293	192.3	62.9	132	282.8	98.8	308
5	254.8	120.0	252	228.2	54.0	113	336.2	85.2	266
4	293.7	99.7	210	265.3	45.2	95	390.1	71.6	224
3	328.5	73.5	154	297.1	33.8	71	446.8	53.8	168
2	302.6	45.9	94	359.5	21.1	44	527.9	33.6	105

Table - 1.(a)

Calculation of Fixed End Moments Due to Wind Load Column Deformations

Story	Column A.			Column B.			Column C.		
	Load lbs.	Area Sq. in.	$\frac{P}{A}$ $\frac{\text{lbs.}}{\text{in.}^2}$	Load lbs.	Area Sq. in.	$\frac{P}{A}$ $\frac{\text{lbs.}}{\text{in.}^2}$	Load lbs.	$\frac{P}{A}$ $\frac{\text{lbs.}}{\text{in.}^2}$	Story Height
10-R	- 27.1	38.86	0.70	+ 4.8	41.00	0.1	- 10.3	0.3	12'-0
9-10	- 88.3	"	2.27	+12.2	"	0.3	- 35.6	0.9	"
8-9	-189.4	"	4.88	+25.1	"	0.6	- 77.9	1.9	"
7-8	-330.9	"	8.52	+43.4	"	1.1	-134.5	3.3	"
6-7	-511.8	42.26	12.10	+64.8	44.39	1.5	-209.8	4.7	"
5-6	-730.8	"	17.3	+91.5	"	2.1	-300.3	6.8	"
4-5	-985.6	53.79	18.3	+118.1	59.72	2.0	-408.3	6.8	"
3-4	-1279.0	"	23.7	+146.5	"	2.5	-533.1	8.9	"
2-3	-1607.8	64.24	25.0	+177.9	67.80	2.6	-682.8	10.1	"
1-2	-2004.1	"	31.2	+214.7	"	3.2	-851.2	12.6	16'-0

Table - 1.(b)

Calculation of Fixed End Moments Due to Wind Load Column Deformations.

Tables 1.(a) and 1.(b) show the calculations for the column deformations and fixed-end beam moments due to wind load. The quantity, $\frac{M_L + M_R}{L}$ which is the sum of the moments at each end of a beam, divided by span gives the beam shears, the sum of which is the column load. The quantity $\frac{d}{h} E$ is the difference in the elevations of the ends of the beams in inches, (d), divided by (h), the story height in inches times (E), the modulus of elasticity for steel, (30,000,000 lbs. per sq. in.).

All the story heights except the first one are equal, so by reducing the first story stress to one producing the same deformation in a column having the length of the upper columns, (multiply by $\frac{16}{12}$) it was possible to factor out the common story height as indicated.

If the difference in elevations of the ends of the beams are given the fixed-end moment is given by the following expression,

$$M = \frac{E\,I}{2L^2}\,d = \frac{E\,(I/L)}{2\,L}\;\frac{d\,E}{h}\;\frac{h}{E} = \frac{1}{2}\;\left(\frac{h}{L}\right)\left(\frac{I}{L}\right)\left(\frac{d\,E}{h}\right) \text{ Ft. x lbs.}$$

Where h is the story height (12'-0") and L is the span of the beam.

Checking Solution

Each solution for moments was checked by calculating the horizontal deflection of each column. Obviously the deflections of all the columns in a story should be equal since the ends are rigidly connected by the beams.

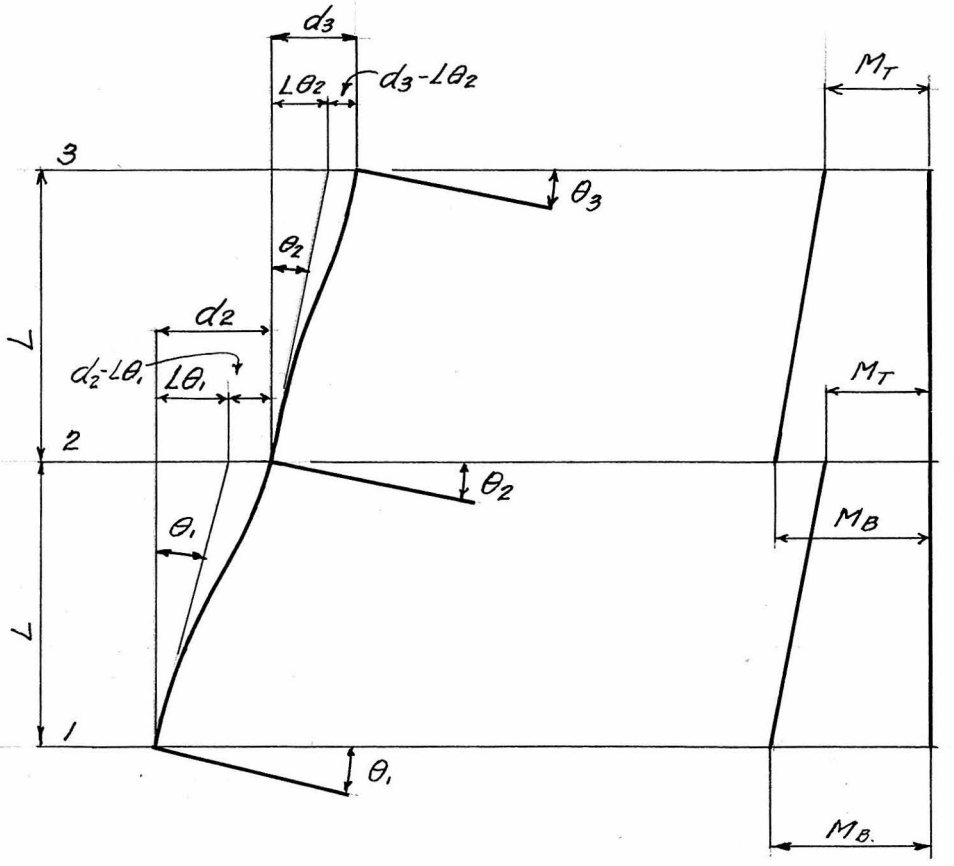


Figure 2.

Let Figure 2 represent a column under load causing bending moments shown in diagram. θ_1 can be calculated from the known conditions at the base, i.e., the foundations do not settle. Take statical moment of the moment diagram for Col. 1-2 about 2.

$$\frac{M_B}{EI}\ \frac{L}{2}\ \frac{2L}{3} - \frac{M_T}{EI}\ \frac{L}{2}\ \frac{L}{3} = \frac{2M_B - M_T}{6}\ \frac{L}{(\frac{I}{L})E} = d_2 - L\,\theta_1$$

Multiplying through by E/L,

$$\frac{2M_B - M_T}{6\,(\frac{I}{L})} = \frac{E\,d_2}{L} - \theta_1 E \qquad (1)$$

adding the known value of θ_1 we get the value of $\frac{E\, d_2}{L}$ which should be the same for each column in a story.

The value of θ_2 may be found by adding the change in rotation between the bottom and the top of the column 1-2 to θ_1. This is equal to the area of the $\frac{M}{EI}$ diagram of the column 1-2.

$$\Delta\, \theta_{1-2} = \left(\frac{M_B - M_T}{2\, EI}\right) L = \frac{M_B - M_T}{2\, E \frac{I}{L}}$$

Multiplying through by E we get:

$$E\, \Delta\, \theta_{1-2} = \frac{M_B - M_T}{2\, (\frac{I}{L})} \qquad (2)$$

Then $E\, \theta_2 = E\, \theta_1 + E \Delta\, \theta_{1-2}$.

The sign convention used in these expressions is the same as that used before, namely, that moments tending to rotate a joint in a clockwise direction are positive. Angular rotation in a clockwise direction is also considered positive.

Table II. gives the computations for the deflections of the columns in the first four stories of the bent due to secondary wind moments. No other calculations beside those appearing in the table are necessary and after a little practice the application of the check becomes very rapid.

Story	Column	E θ	$\frac{(d - L\theta)E}{L}$	$\frac{dE}{L}$	E Δ θ	$\frac{I}{L}$
1st.Story	A	+ .087	+ .364	+ .451	+ .957	18.8
	B	+ .162	+ .293	+ .455	+ .528	19.9
	C	+ .142	+ .343	+ .485	+ .628	19.9
2nd.Story	A	+1.044	+ .044	+1.088	+ .691	18.8
	B	+ .690	+ .360	+1.050	+ .502	19.9
	C	+ .770	+ .352	+1.122	+ .502	19.9
3rd.Story	A	+1.735	- .128	+1.607	+ .629	18.3
	B	+1.192	+ .439	+1.631	+ .511	18.6
	C	+1.272	+ .341	+1.613	+ .403	18.6
4th.Story	A	+2.364	- .283	+2.081	+ .601	18.3
	B	+1.703	+ .412	+2.115	+ .323	18.6
	C	+1.675	+ .385	+2.060	+ .350	18.6
5th.Story	A	+2.965	- .514	+2.451	+ .560	14.3
	B	+2.026	+ .423	+2.449	+ .171	14.6
	C	+2.025	+ .525	+2.550	+ .445	14.6

Table II.

Calculations of Horizontal Deflections of Columns

The values of E θ for the first story columns were calculated from the first story beams connecting the bottoms of the columns. Since the foundations were assumed to be fixed in elevation the value of d in equation (1) is zero and the expression gives the desired E θ. It will be noticed that the moments are given in foot-pounds so that if the deflections are wanted in inches, where E is in pounds per square inch, the result must be multiplied by 12". The values of $\frac{d\ E}{L}$ are merely proportional to the inclination of the column from the vertical and serve only as a check.

The above method of checking results was found to be very valuable. The expressions for the rotation and deflection are very simple and can be applied even with rough mental calculations and are often useful in

checking and predicting results at least in a qualitative way. The same concept may be applied to any indeterminate structure and should prove to be of appreciable assistance at least in interpreting results.

The calculations for wind moments and first secondary moments by the Cross method were made on large sized diagrams as used by the Engineering Department of the Institute. Subsequent calculations, however, were tabulated as suggested by E. A. MacLean, Esq. in his discussion of the Cross method on page 421, Proceedings of the American Society of Civil Engineers for March, 1932. The latter method was found much faster and easier than using the large diagrams and is recommended very highly. The flexibility of the Cross method in general was demonstrated on several occasions. In some cases the moments at a joint would not balance due to errors made in computations. The error was easily corrected applying it as an unbalanced moment and carrying over perhaps once or twice, depending on the relative size of the error. In calculating the fixed-end moments due to the secondary moments an error was made which affected all the fixed-end moments in the center span. The error was not discovered until the entire solution for the first correction to the secondary moments had been made. The error was corrected by running an independent solution using the error in the moments in the center span as the fixed-end moments. The correct moments were then the algebraic sum of the two solutions.

DISCUSSION

Foundations

As was stated above, the foundations were assumed fixed against vertical movement. This assumption of course does not seem reasonable since the foundations act as an elastic body and deform under load. The movement of the foundations would tend to increase the fixed-end moments and hence the secondary moments.

Assuming that the foundations deform 1/8" under a unit load of 6000 lbs. per square foot, and proportioning the footings to carry the allowable load of the first story columns at the above unit soil pressure, the deflections of the footings due to wind load were found to be from 25 to 50% of the column deformations at the roof. From this rough calculation it would seem that the settlement of the foundations would add appreciably to the secondary moments.

Secondary Wind Stresses in Wilson-Maney Bent

The secondary wind moments in the twenty-story Wilson-Maney bent were calculated by Mr. M. P. White as a thesis problem and were found to be negligible. This result can be justified if it is noticed that the unit wind stresses and hence the column deformations are very nearly proportional to the distance from the center line of the bent. All the fixed-end beam moments act in one direction and the resulting sway will tend to decrease them so that when equilibrium is reached

the beams will have very little moment in them and will be practically straight.

The column deformations in the bent analyzed in this problem were alternate lengthening and shortening (See Fig. 1.) and the fixed-end moments were in different directions. Side-sway in this case increases some moments and decreases others with the result that the secondary moments are quite appreciable.

CONCLUSION

The conclusions to be drawn from this investigation are not very definite or far reaching. Even the justification of the results obtained was at times quite difficult and certainly any very general prediction regarding the magnitude and effect of secondary moments would be hazardous.

It is believed that the following general statements may be safely made regarding secondary wind moments in building bents.

1. Secondary wind moments of appreciable magnitude occur in the upper stories only.

2. If the wind stresses in the columns vary approximately as their distance from the center of the bent, the secondary moments will be small and if the columns are alternately in tension and compression under wind load the secondary moments may be large.

DIAGRAM OF BENT.

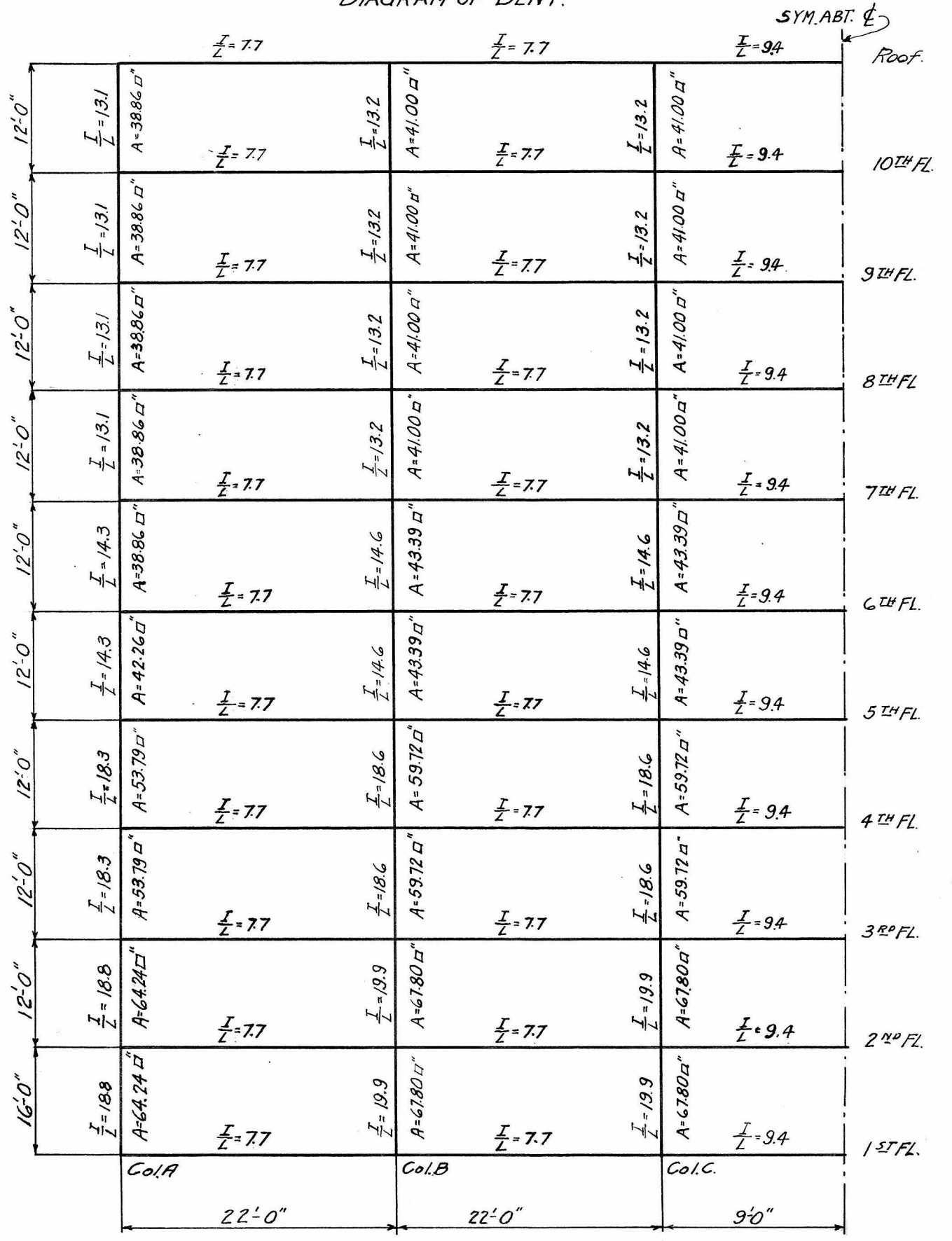
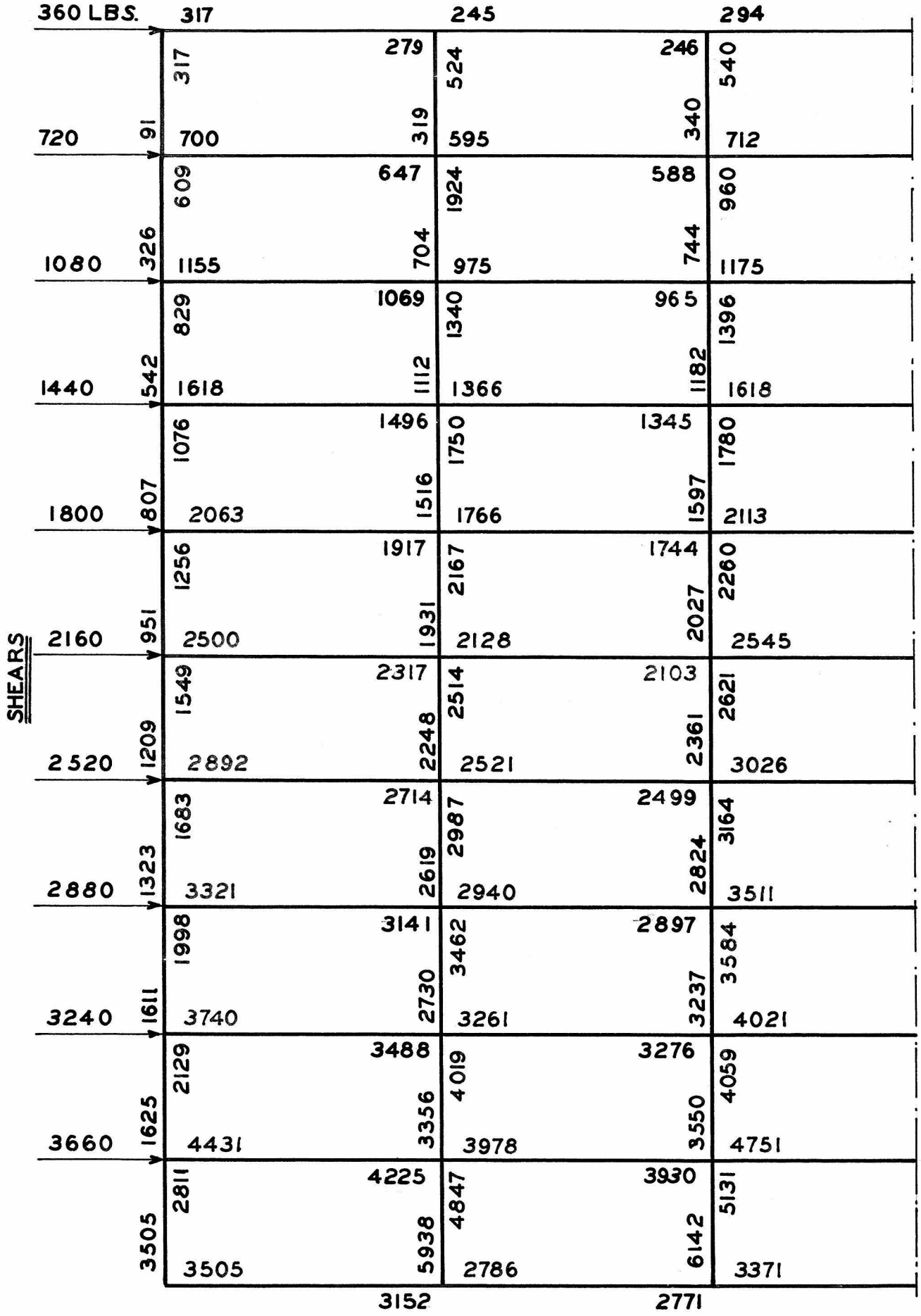


DIAGRAM NO. I



WIND-LOAD MOMENTS FT. LBS.

DIAGRAM NO. 2

FIRST SECONDARY MOMENTS, FIRST AND SECOND CORRECTIONS AND CORRECTED SECONDARY MOMENTS

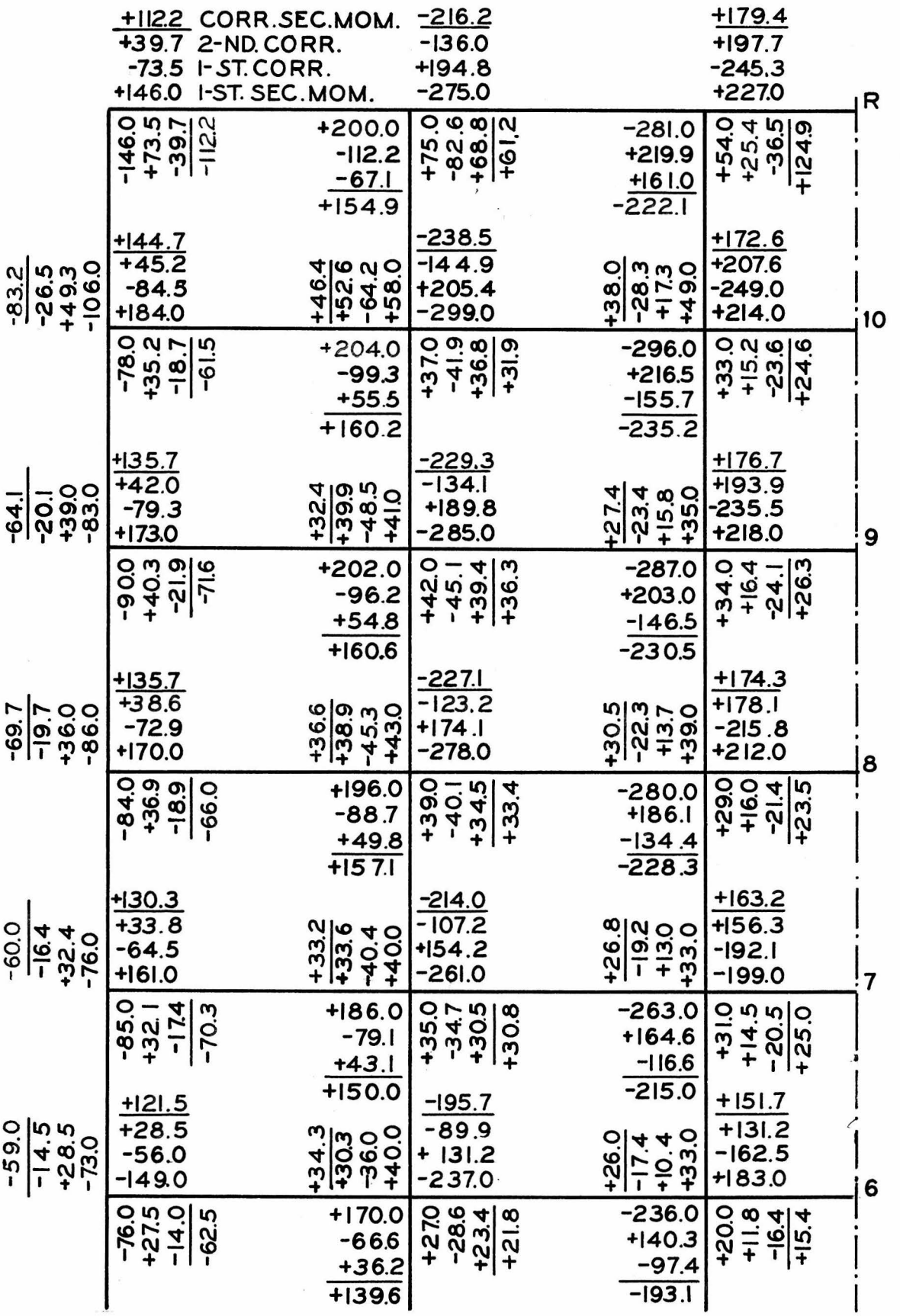
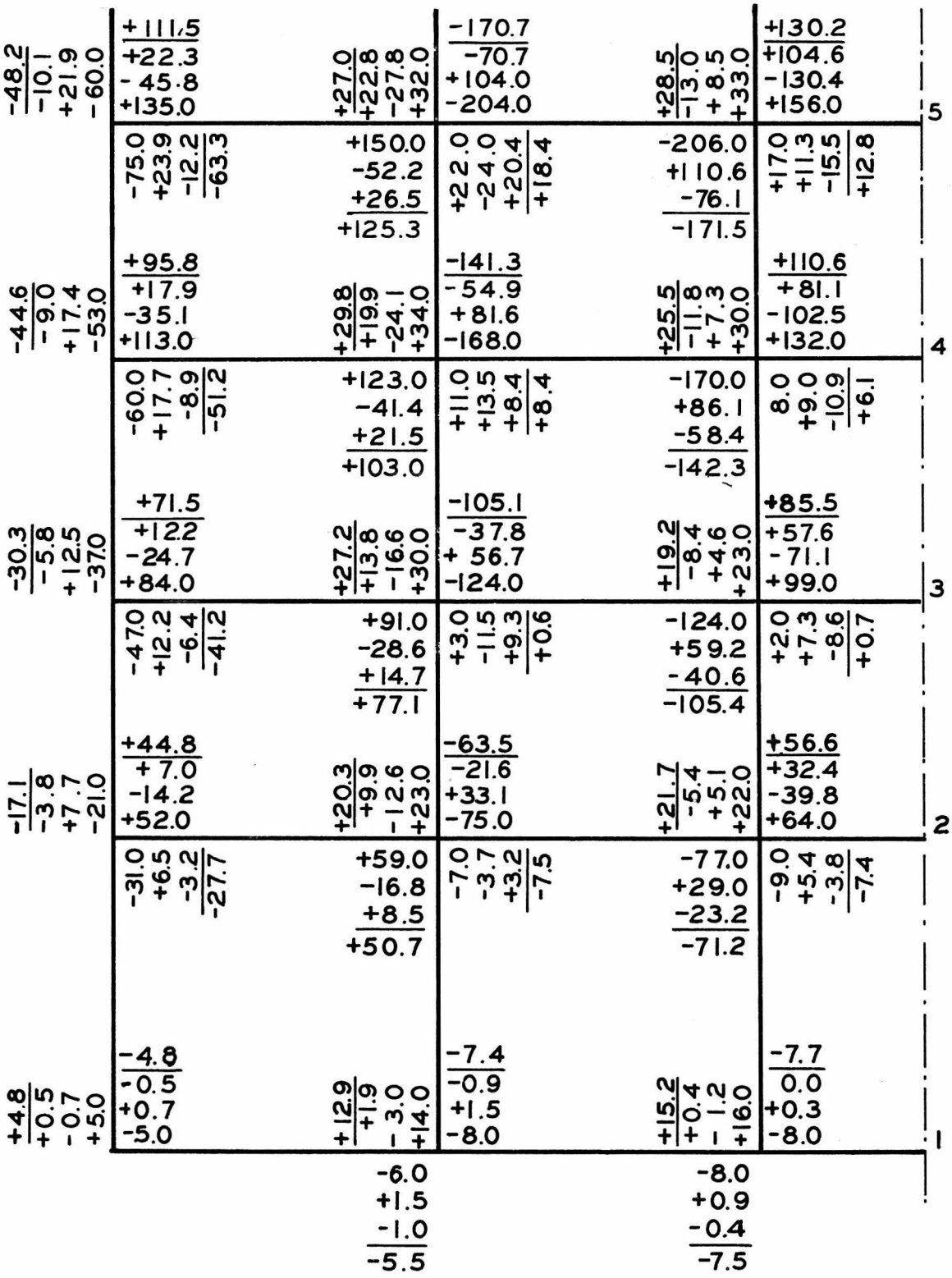


DIAGRAM NO. 3



NOTES:

ALL MOMENTS ARE IN FT. LBS.

+MOMENTS TEND TO ROTATE JOINT IN CLOCWISE DIRECT.

FIRST SECONDARY MOMENTS, FIRST AND SECOND CORRECTIONS AND CORRECTED SECONDARY MOMENTS

DIAGRAM NO. 3

RATIOS OF FIRST SECONDARY MOMENTS AND CORRECTED SECONDARY MOMENTS TO WIND MOMENTS

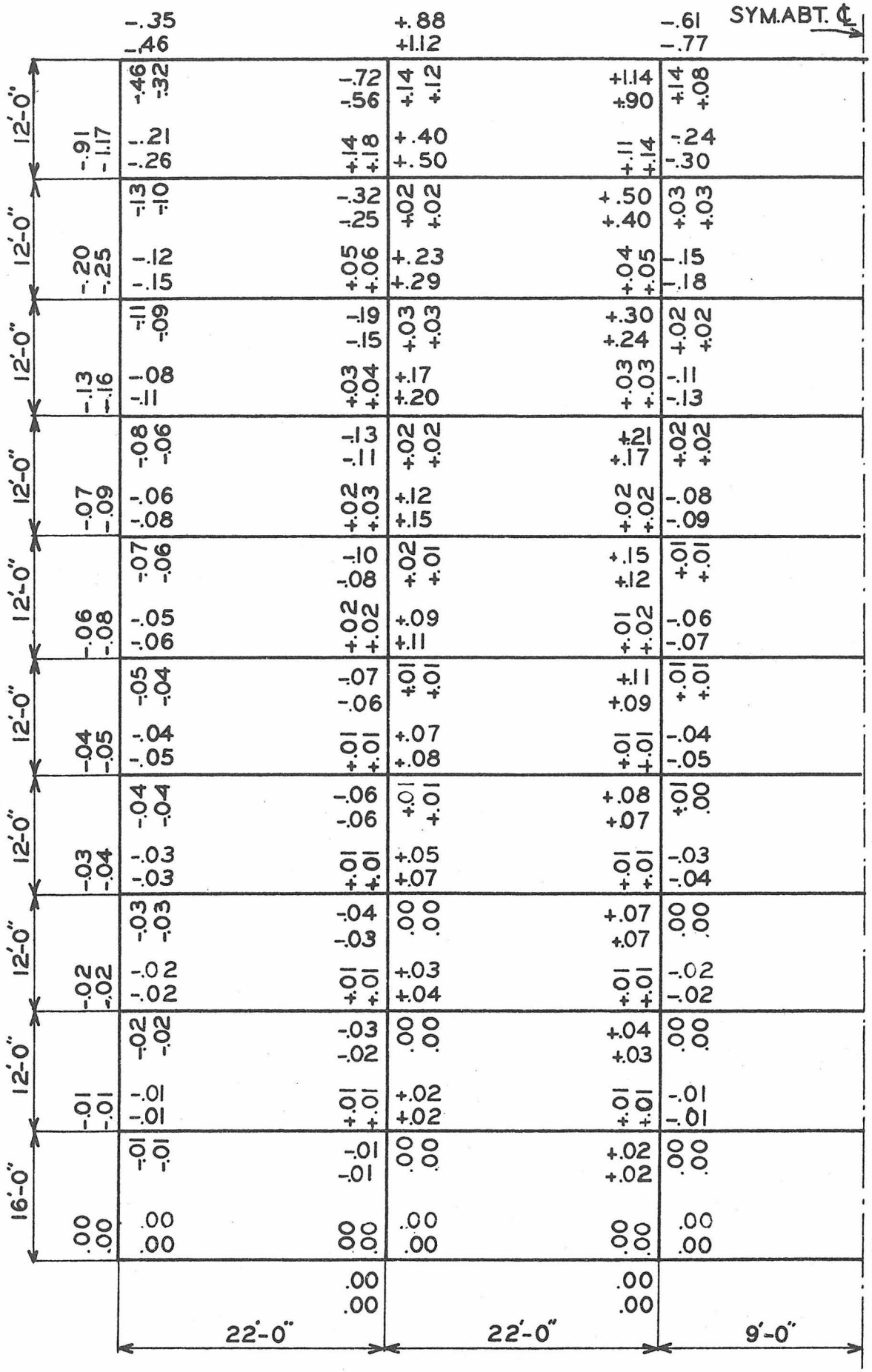


DIAGRAM NO.4

WIND MOMENTS, CORRECTED SECONARY MOMENTS AND RATIO OF CORRECTED SECONDARY MOMENTS TO WIND MOMENTS

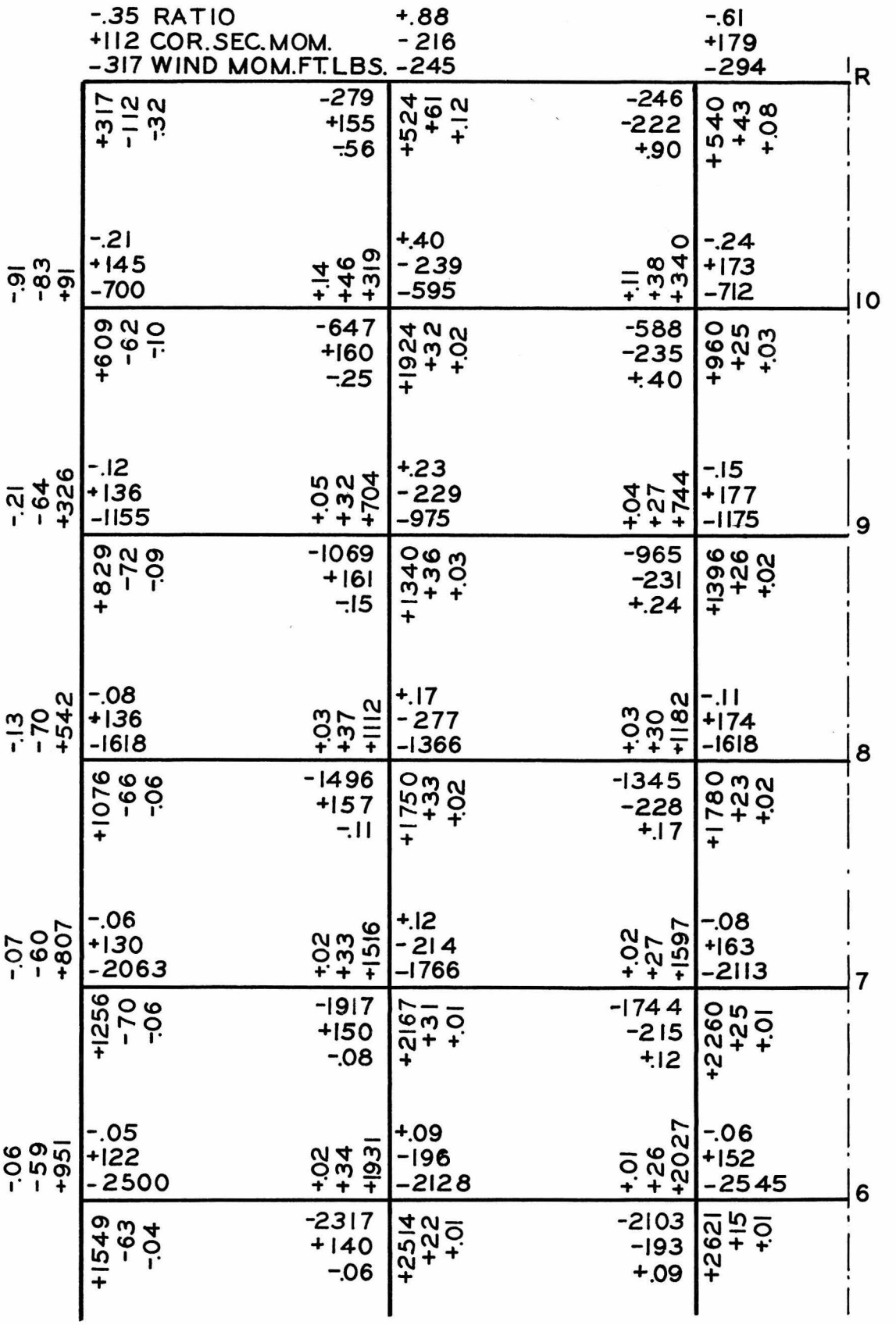
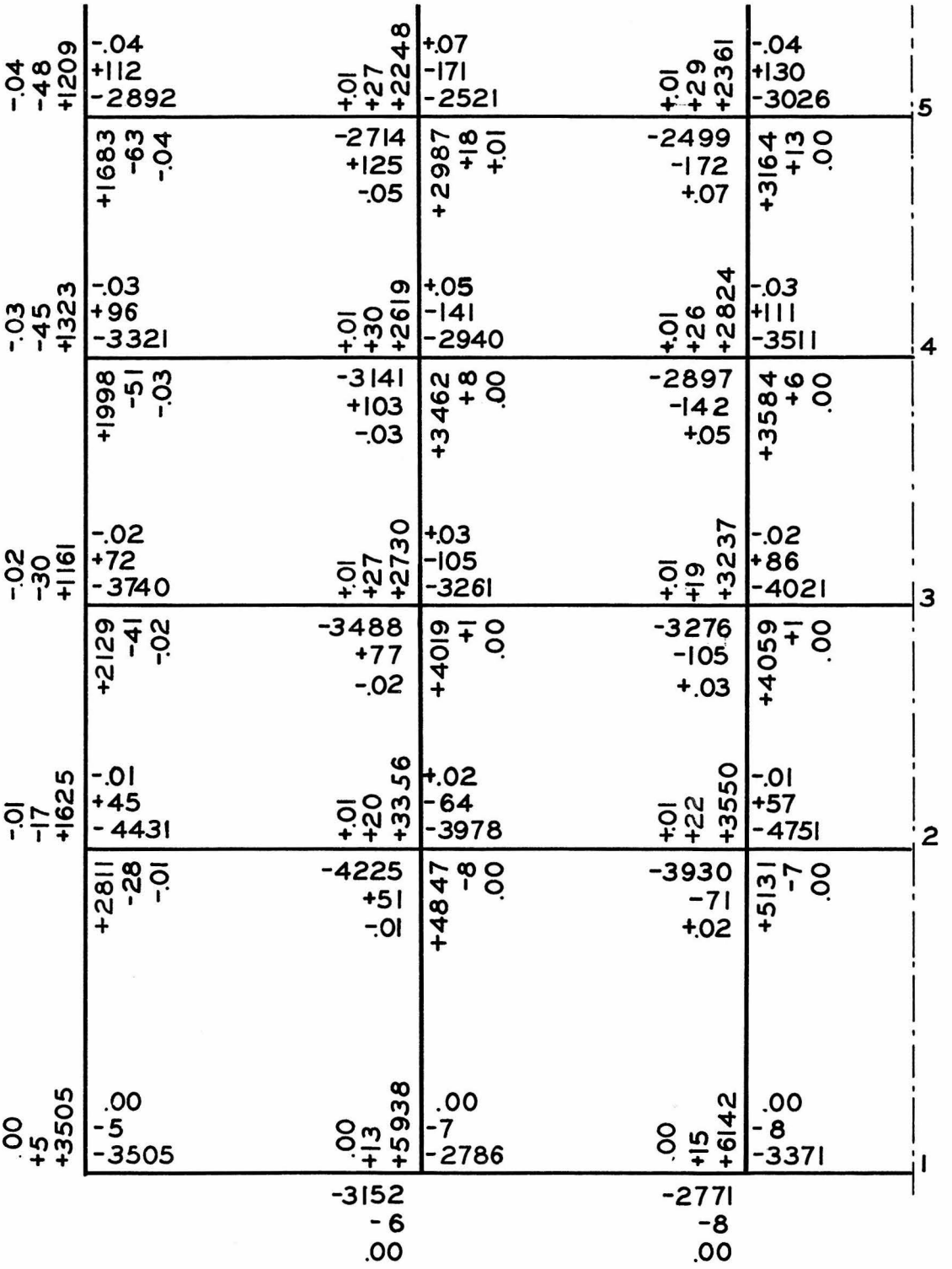


DIAGRAM NO. 5



NOTES:

MOMENTS ARE IN FT-LBS.

+MOMENTS TEND TO ROTATE JOINT IN CLOCKWISE DIRECTION.

WIND MOMENTS, CORRECTED SECONDARY MOMENTS AND RATIO OF CORRECTED SECONDARY MOMENTS TO WIND MOMENTS

DIAGRAM NO. 5

WIND BRACING IN STEEL BUILDINGS

Discussion

This article was submitted to the "Proceedings" of the American Society of Civil Engineers as a discussion to the report of the Committee on Wind Bracing.

A rather sketchy investigation disclosed only one reference to the subject of Secondary Stresses in building bents due to column shortening under wind-load. Bulletin 80 of the University of Illinois covers the subject in a paragraph. The shortening of the first story columns of the twenty-story bent is computed and the fixed-end moments in the first story girders determined. These moments are small compared with the original wind moments. However, it must be remembered that the effect of column shortening is cumulative from bottom to top, while the girder moments due to wind become smaller so that the effect of column shortening should be much greater at the top than near the ground.

In its discussion the Committee on Wind-Bracing states that in the case of a high, narrow building secondary moments require investigation. In the relatively high and narrow Wilson-Maney bent secondary moments are negligible. Apparently there is another criterion. The importance of secondary moments depends upon the relative size of bays and upon the relative stiffness of columns and girders. In the Wilson-Maney bent both columns on one side of the center line have the same kind of stress under wind load and this stress and, therefore, the shortening

is roughly proportional to the distance from the center line. Since all the fixed-end moments in the girders due to column shortening act in the same direction, they will all be reduced by the resulting sidesway and the girders in their final position (after equilibrium is reached) will be nearly straight. When we have alternate tension and compression in the columns, the girders are constrained and may therefore have large bending moments after equilibrium is reached. In such a case sidesway will increase certain girder moments and decrease others.

The Committee does not consider the possibility that the secondary moments as first obtained may require correction. For example, in general (not always) the secondary moments in the girders will be opposite to the primary moments. If the secondaries are large, say 50% of the primaries, the resultant moment will be one-half of the original. But the secondaries will also produce column shortening which will cause more secondary moments, ordinarily of the same sign as the primary moments. If the first secondaries are 50% of the primary moments then the second secondaries will be about 25% of the primary moments which will make the resulting moments 75% of the original moments instead of 50%.

In general the first secondary moments will give results which, for girders, are on the unsafe side.

Calculations were made on two bents; one, the twenty story Wilson-Maney bent, gave negligible secondary moments. The other bent which was obtained by adding twenty-two foot bays to the upper ten stories

of the Wilson-Maney bent gave very interesting results. Under wind loads the columns of this bent were alternately in tension and compression. The accompanying diagram* gives the ratio of the first secondary to the original wind moments (lower figure), and the ratio of the secondary moment after two corrections (algebraic sum of secondary plus first correction plus second correction) to the original moment.

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* Diagram No. 4.

- APPENDIX -

SECONDARY WIND MOMENTS IN A BUILDING BENT.

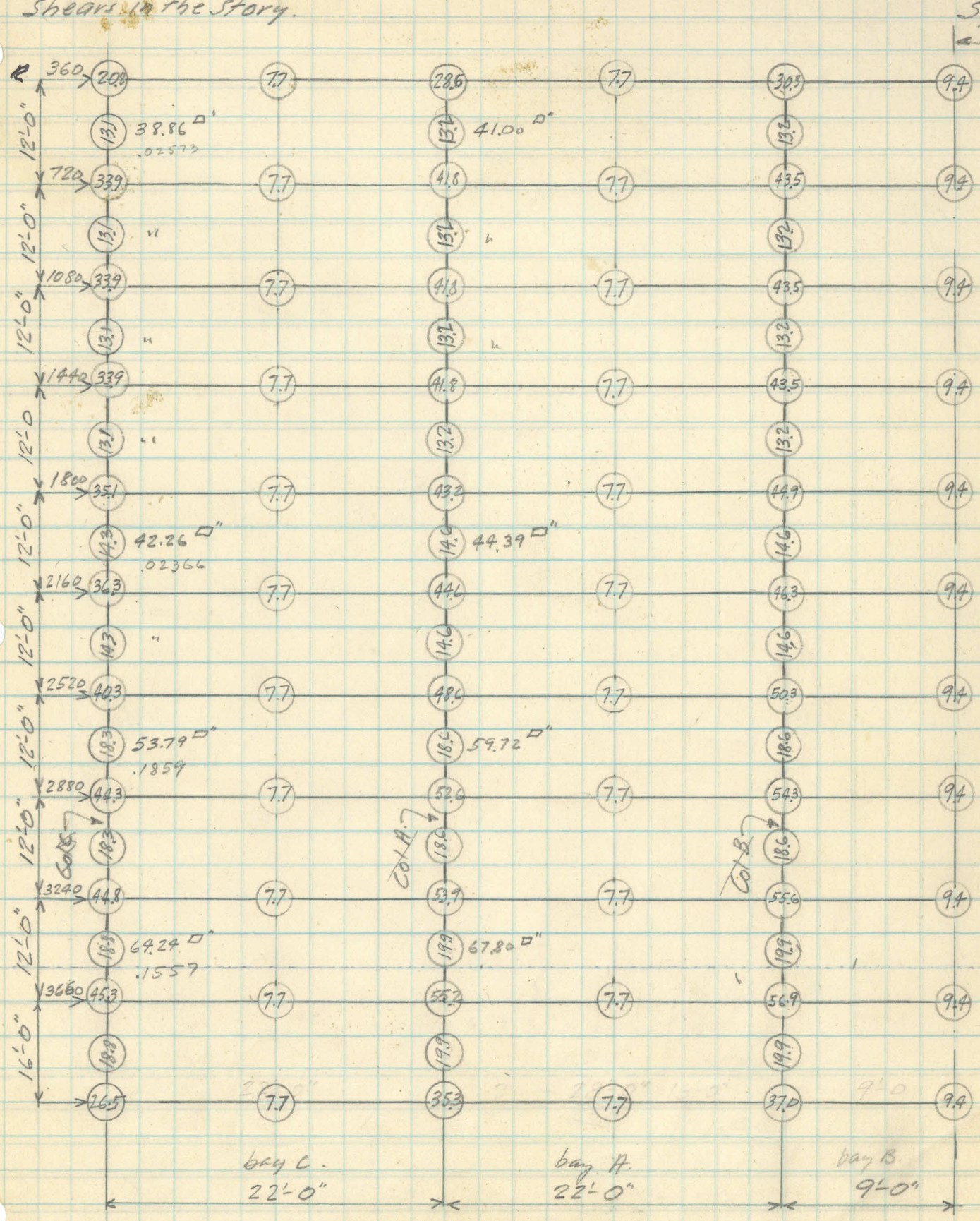
ORIGINAL CALCULATIONS.

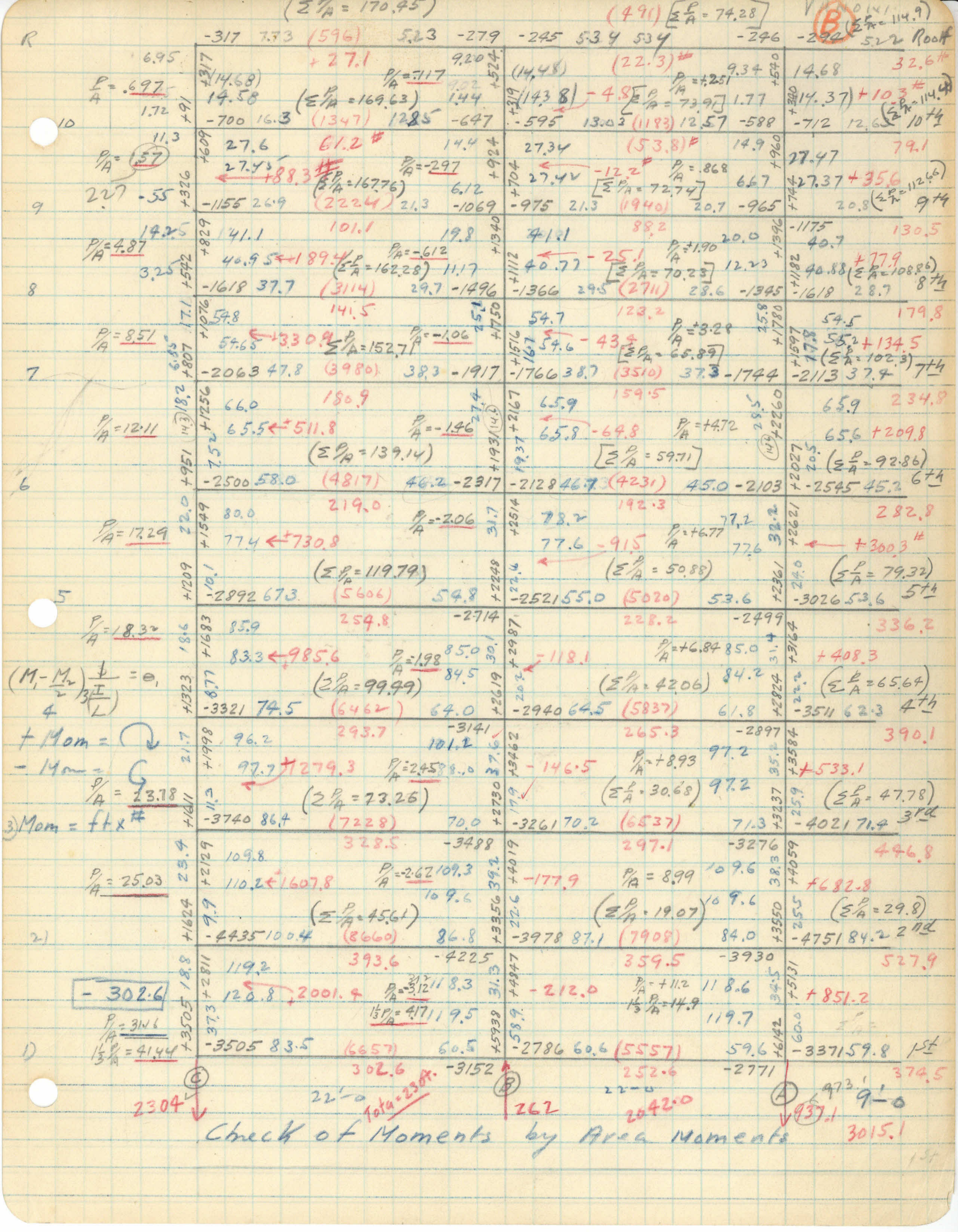
— CONTENTS —

Thesis.

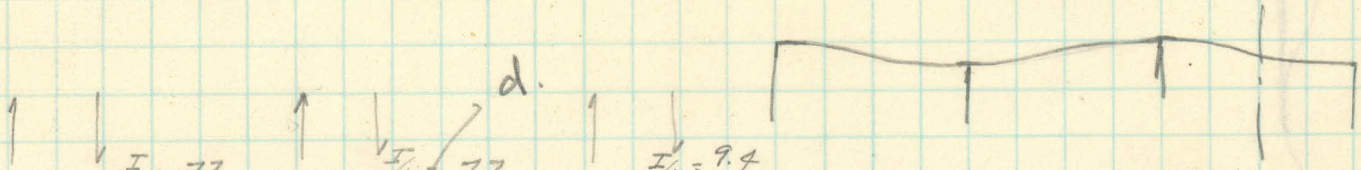
A

Wind load = 30#/□' on a vertical strip 1' wide. Loads given a total shears in the story.




Check of Moments by Area Moments

Calculation of Fix-end Moments Due to Wind-load
Col Shortening



	Span AB = 22'-0			Span BC 22'-0			Span CC 18'-0				Col A			Col B			Col C		
Floor	$\frac{M_L+M_R}{L}=\frac{1}{2}s$	$\frac{\Delta}{h}E$	Fix E M. Fact	$\frac{M_L+M_R}{L}$	$\frac{\Delta}{h}E$	Fix E Mom.	$\frac{M_L+M_R}{L}$	$\frac{\Delta}{h}E$	Fix E Mom.	Story	Load	Area	P/A	Load	Area	P/A	Load	P/A	Length
R	27.1	171.5	360	22.3	77.6	163	32.6	121.0	379	10-R	27.1	38.86	.70	4.8	41.00	.1	10.3	.3	12-0
10	61.2	170.7	358	53.8	77.2	162	79.1	120.4	377	9-10	88.3		2.27	12.2		.3	35.6	.9	
9	101.1	168.1	355	88.2	76.0	160	130.5	118.6	371	8-9	189.4		4.88	25.1		.6	77.9	1.9	
8	141.5	162.6	341	123.2	73.5	154	179.8	114.8	359	7-8	330.9		8.52	43.4		1.1	134.5	3.3	
7	180.9	153.0	322	159.5	69.1	145	234.8	108.2	338	6-7	511.8	42.26	12.10	64.8	44.39	1.5	209.8	4.7	
6	219.0	139.4	293	192.3	62.9	132	282.8	98.8	308	5-6	730.8	"	17.3	91.5	"	2.1	350.3	6.8	
5	254.8	120.0	252	228.2	54.0	113	336.2	85.2	266	4-5	985.6	53.79	18.3	118.1	59.72	2.0	408.3	6.8	
4	293.7	99.7	210	265.3	45.2	95	390.1	71.6	224	3-4	1279.3	"	23.7	146.5	"	2.5	533.1	8.9	
3	328.5	73.5	154	297.1	33.8	71	446.8	53.8	168	2-3	1607.8	64.24	25.0	177.9	67.80	2.6	682.8	10.1	12-0
2	396.3	45.9	94	359.5	21.1	44	527.9	33.6	105	1-2	2004.1	"	31.2	214.7	"	3.2	851.2	12.6	16-0
1	302.6	0	0	252.6	0	0	374.5	0	0			1/3 F/2	41.6			4.3		16.8	

Secondary Wind Moments. (With No Corrections)

		A		B		C	
R				+200		-281	
	-146	+146			+75	-275	+54	+227
10		-106		+204	+58		-296	+49
	-78	+184			+37	-299	+33	+214
9		-83		+202	+41		-287	+35
	-90	+173			+42	-285	+34	+218
8		-86		+196	+43		-280	+39
	-84	+170			+39	-278	+29	+212
7		-76		+186	+40		-263	+33
	-85	+161			+35	-261	+31	+199
6		-73		+170	+40		-236	+33
	-76	+149			+27	-237	+20	+183
5		-60		+150	+32		-206	+33
	-75	+135			+22	-204	+17	+156
4		-53		+123	+34		-170	+30
	-60	+113			+11	-168	+8	+132
3		-37		+91	+30		-124	+23
	-47	+84			+3	-124	+2	+99
2		-21		+59	+23		-77	+22
	-31	+52			-7	-75	-9	+64
1		+5		-6	+14		-8	+16
		-5			-8			-8

Figures in blue represent corrected secondaries

Final Secondary Moments in Ft x lbs.

These Moments Are uncorrected.

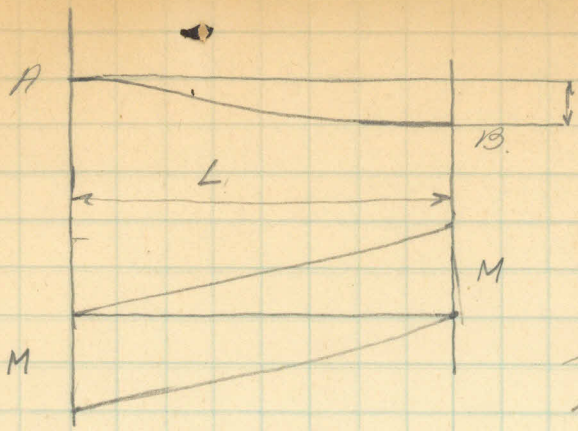
+85 { -115 / +200 } -75 { +206 / -281 } (R)

-68 / +78 / -146	+146 / -78 } +68	+3 / -72 / +75	-275 / +187 } +88	+63 / +9 / +54	+227 / -215 } +12	-252 / +235 / -17
	-106 / +53 / -53	+99 { -105 / +204 }	+57 / -56 / +1	-91 { +205 / -296 }	+49 / +4 / +53 (10)	
-91 / +38 / -79	+184 / -91 } +93	+1 / -36 / +37	-299 / +197 } +102	+37 / +4 / +33	+214 / -213 } +1	-162 / +146 / -16
	-83 / +42 / -41	+101 { -101 / +202 }	+41 / -42 / -1	-95 { +192 / -287 }	+35 / +5 / +40 (9)	
-47 / +43 / -90	+173 / -85 } +88	+3 / -39 / +42	-285 / +182 } +103	+39 / +5 / +34	+218 / -202 } +16	-176 / +159 / -17
	-86 / +39 / -47	+103 { -93 / +196 }	+44 / -39 / +5	-104 { +176 / -280 }	+39 / +3 / +42 (8)	
-95 / +39 / -84	+170 / -78 } +92	+5 / -35 / +40	-278 / +167 } -111	+35 / +6 / +29	+212 / -185 } +27	-164 / +142 / -22
	-76 / +35 / -41	+103 { -83 / +186 }	+40 / -35 / +5	-107 { +156 / -263 }	+33 / +4 / +37 (7)	
-51 / +34 / -85	+161 / -69 } +92	+5 / -30 / +35	-261 / +148 } -113	+35 / +5 / +30	+199 / -165 } +34	-159 / +140 / -19
	-74 / +31 / -43	+100 { -70 / +170 }	+41 / -31 / +10	-103 { +133 / -236 }	+34 / +2 / +36 (6)	
-47 / +29 / -76	+149 / -60 } +89	+2 / -25 / +27	-237 / +126 } -111	+25 / +4 / +21	+183 / -139 } +44	-136 / +115 / -21
	-60 / +24 / -36	+95 { -55 / +150 }	+33 / +24 / +9	-101 { +105 / -206 }	+34 / +2 / +36 (5)	
-51 / +25 / -76	+135 / -49 } +86	+2 / -21 / +23	-203 / +100 } -103	+21 / +4 / +17	+157 / -111 } +46	-129 / +104 / -25
	-53 / +19.1 / -33.9	+79.5 { +95.5 / +63 }	+34 / -20.7 / +13.3	-87.9 { +82 / -170 }	+30 / +1.6 / +31.6 (4)	
-41.7 / +18.3 / -60	+113 / -37.4 } +75.6	-3.4 / -14.4 / +11	-168 / +78.6 } 89.4	+11.8 / +3.8 / +8	+132 / -87.6 } 44.4	-97 / +72 / -25
	-37 / +13.9 / -23.1	+61 { +30 / +91 }	+30 / -14.2 / +15.8	-67.8 { +56.2 / -124 }	+23 / +0.9 / +23.9 (3)	
-34.4 / +12.6 / -47	+84 / -26.5 } +57.5	-7.3 / -103 / +3	-124 / +54.5 } 69.5	5.1 / +3.4 / +2	+99 / -60.5 } +38.5	-68 / +50 / -18
	-21 / +9. / -12.0	+41.3 { -17.7 / +59 }	+22 / -10.8 / +11.2	-49.7 { +27.3 / -77 }	+23 / +2.5 / +25.5 (2)	
-24.9 / +6.1 / -31	+52 / -15.1 } 36.9	-10.4 / -3.4 / -7	-75 / +21.9 } 43.1	-5.1 / +3.6 / -9	+64 / -33.7 } +30.3	-47 / +35 / -12
	+5 / -0.4 / +4.6	-4.9 { +1.1 / -6 }	+14 / -2.4 / +11.6	-7.2 { +0.8 / -8 }	+16 / -1.1 / +14.9	

(A) -5 / +0.4 } -4.6 (B) -8 / +1.3 } -6.7 (C) -8 / +0.3 } -7.7

Secondary moments after 4 cycles of Hardy Cross

Fixed End Beam moments



let Δh be the absolute difference in elevation of the ends of the beam A B
Assume ends fixed against rotation. Taking statical moment of $\frac{m}{L^2}$ diag about one end.

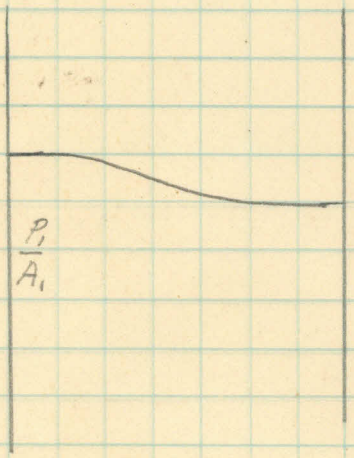
$$\Delta h = \frac{M}{EI}\left(\frac{L}{2}\frac{2}{3}L - \frac{L}{2}\frac{L}{3}\right) = \frac{ML^2}{6EI}$$

$$M = \frac{6EI\Delta h}{L^2} = \frac{6E\Delta h}{L}\left(\frac{I}{L}\right)$$

Δ = inches.
L = ft = 12L inches
M = ft x lbs = 12 M in x lbs

$$\left(\frac{I}{L}\right) = \left(\frac{in^4}{in}\right) = in^3.$$

$$12\,M = \frac{3E\Delta\Delta h\left(\frac{I}{L}\right)}{12L} \qquad M = \frac{3E\Delta h}{144L}\left(\frac{I}{L}\right)$$



$$\Delta h = \Sigma\frac{P_1 h}{A_1 E} - \Sigma\frac{P_2 h}{A_2 E}$$

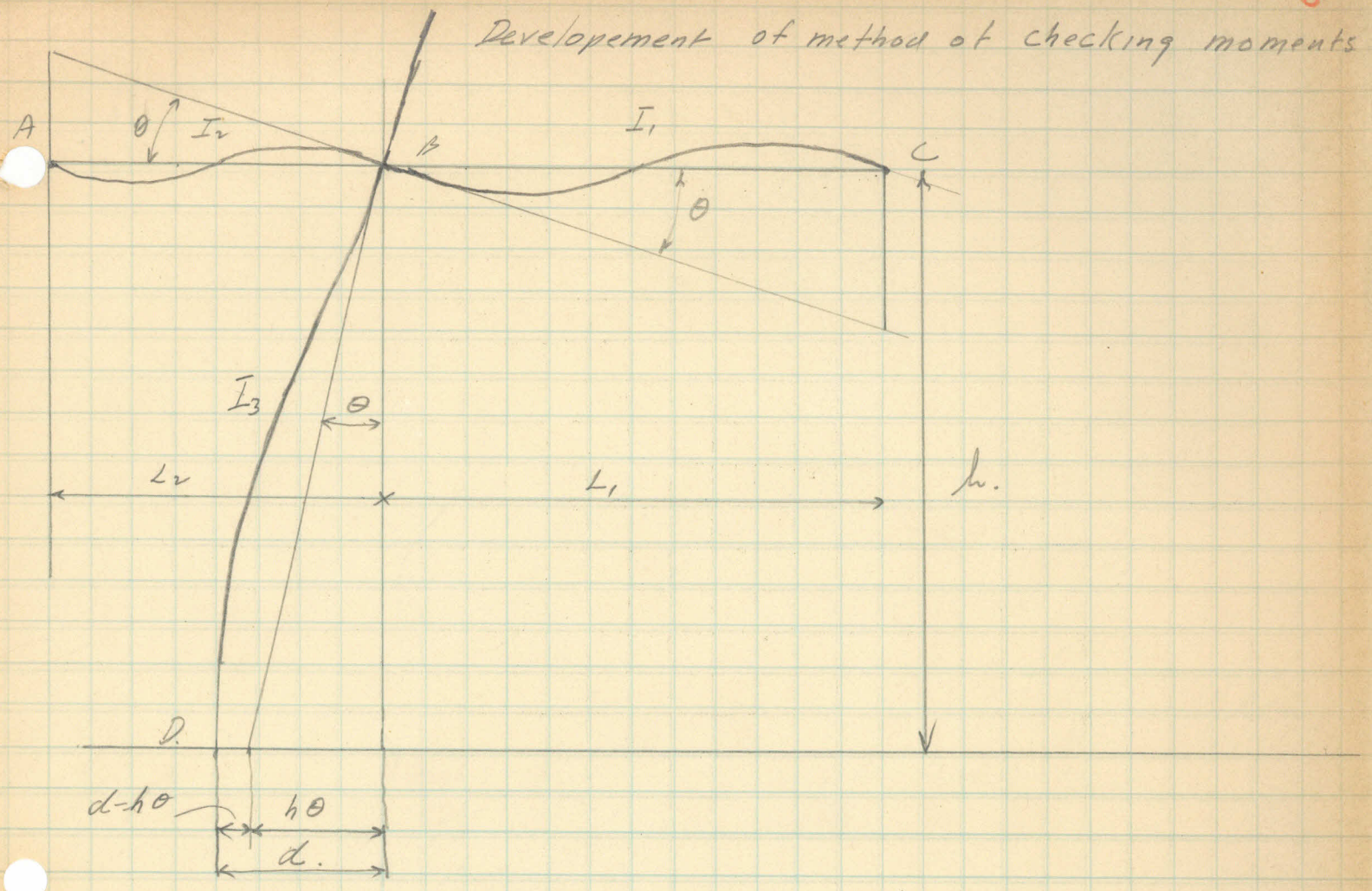
if h & E are Const

$$\Delta h = \frac{h}{E}\left[\Sigma\frac{P_1}{A_1} - \Sigma\frac{P_2}{A_2}\right]$$

$$M = \frac{6E}{L}\cdot\frac{h}{E}\left[\Sigma\frac{P_1}{A_1} - \Sigma\frac{P_2}{A_2}\right]\left(\frac{I}{L}\right) = in \times lbs$$

$$M = \frac{1}{2}\frac{h}{L}\left(\frac{I}{L}\right)\left[\Sigma\frac{P_1}{A_1} - \Sigma\frac{P_2}{A_2}\right] = Ft \times lbs$$

Developement of method of checking moments



Let Let above figure represent a portion of a beam under load applying the principle of area moment. The statical moment of moment diagram of Beam AB about A

$$L_2\theta_{BA} = L_2\theta = \frac{M_{BA}L_2}{2}\frac{2L_2}{3EI_2} + \frac{M_{AB}L_2}{2}\frac{L_2}{3EI_2}$$

$$\theta = \frac{1}{3E\left(\frac{I_2}{L_2}\right)}\left(2M_{BA} + \frac{M_{AB}}{2}\right)$$

Similarly $\theta_{BC} = \theta = \frac{1}{3E\left(\frac{I_1}{L_1}\right)}\left(M_{BC} + \frac{M_{CB}}{2}\right)$

Taking Statical moment of the $\frac{M}{EI}$ diag about D.

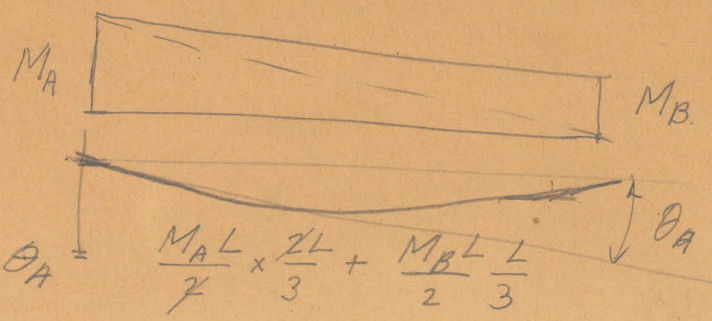
$$(d - L\theta) = \frac{1}{3E\left(\frac{I_3}{h}\right)}\left(M_{DB} + \frac{M_{BD}}{2}\right)$$

The check consists in finding the angle of rotation of each beam and comparing it with the angle of rotation for the other beam at the same joint. and also figuring the deflection d for the top and bottom of each column in each story. Obviously the deflections for all cols in one story should be the same

Moments after 4 cycles

		θ_0	$\frac{d-L\theta}{L}$	$\frac{d}{L}$	$\Delta\theta$	θ_0	$\frac{d-L\theta}{L}$	$\frac{d}{L}$	$\Delta\theta$	$\frac{I}{L}$
		Check for Secondary Stresses								8
1st Story	A	+.087	.372	.459	.985	+.087	.364	+.451	.957	
	B	+.173 ~~+.152~~	.294	.467 ~~.546~~	.528	+.162	.293	+.455	.578	
	C	+.130	.327	.957	.603	+.116	.343	+.459	.628	
2nd	A	1.072	.009	1.081	.638	1.044	.044	1.088	.692	
	B	.701	.318	1.019	.452	.740	.344	1.084	.488	
	C	.733	.335	1.268	.505	.744	.369	1.113	.577	
3RD	A	1.710	-.137	1.573	.628	1.736	-.128	1.608	.629	✓
	B	1.153	.413	1.566	.511	1.228	.440	1.668	.511	
	C	1.238	.332	1.570	~~.430~~	1.321	.341	1.662	.403	
4th	A	2.338	-.301	2.037	.601	2.365	-.273	2.092	.628	× 18.3
	B	1.664	+.377	2.041	.323	1.739	.403	2.142	.296	18.6
	C	1.668	+.350	2.018	.350	1.724	.385	2.109	.350	18.6
5th	A	2.939	-.513	2.426	.594	2.993	-.513	2.480	.560	14.3
	B	1.987	~~.434~~	2.421	.239	2.035	.445	2.480	.205	14.6
	C	2.018	.502	2.520	.445	2.074	.537	2.611	.445	14.6
6th	A	3.533	-.770	2.763	.350	3.553	-.735	2.818	.385	14.3
	B	2.226	.480	2.706	.171	2.240	.537	2.777	.205	14.6
	C	2.463	.411	2.874	.171	2.519	.434	2.953	.137	14.6
7th		3.883	-.891	2.992		.305	3.938	-.865	3.073	.305	13.1
		2.397	.480	2.877		.038	2.445	.505	2.950	0	13.2
		2.634	.430	3.064		.154	2.656	.468	3.124	.152	13.2
8th	A	4.188	-1.043	3.145	.191		4.243	-1.043	3.200	.153	
	B	2.435	.518	2.953	.038		2.495	.581	3.026	.077	
	C	2.788	.518	3.306	.189		2.808	.556	3.364	.189	
9th	A	4.379	-1.130	3.249	.153		4.396	-1.108	3.288	.153	
	B	2.473	.541	2.914	.152		2.522	.568	3.090	.152	
	C	2.977	.429	3.406	.076		2.997	.464	3.461	.076	
10th	A	4.532	-.840	3.692			4.549	-.840	3.709		
	B	2.625	.480	3.105			2.674	.493	3.167		
	C	3.053	.530	3.583			3.073	.551	3.624		

Check for Secondaries.



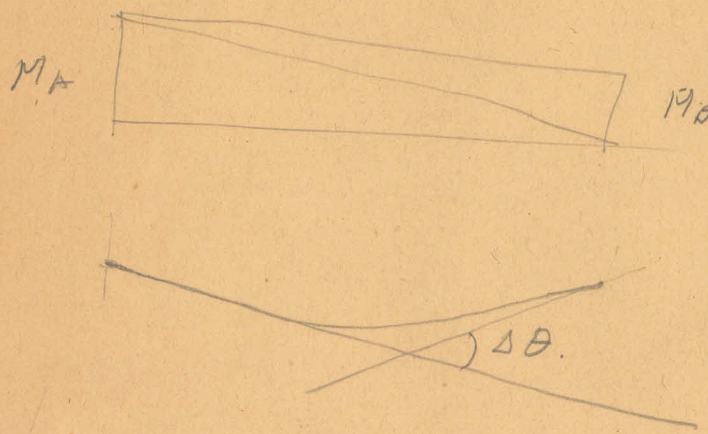
$$EI\,L\,\theta_A = \frac{M_A L}{2} \times \frac{2L}{3} + \frac{M_B L}{2}\,\frac{L}{3}$$

$$\theta_A = (2M_A + M_B)\frac{L}{6EI} = (2M_A + M_B)\frac{1}{6E\left(\frac{I}{L}\right)}$$

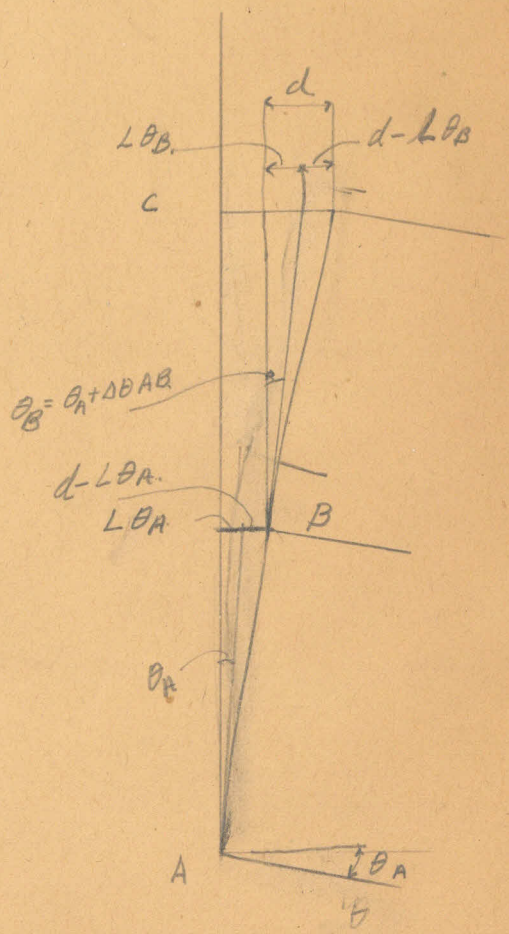
For Purposes of checking omit E

θ_A then becomes $(2M_A + M_B)\frac{1}{6\left(\frac{I}{L}\right)}$

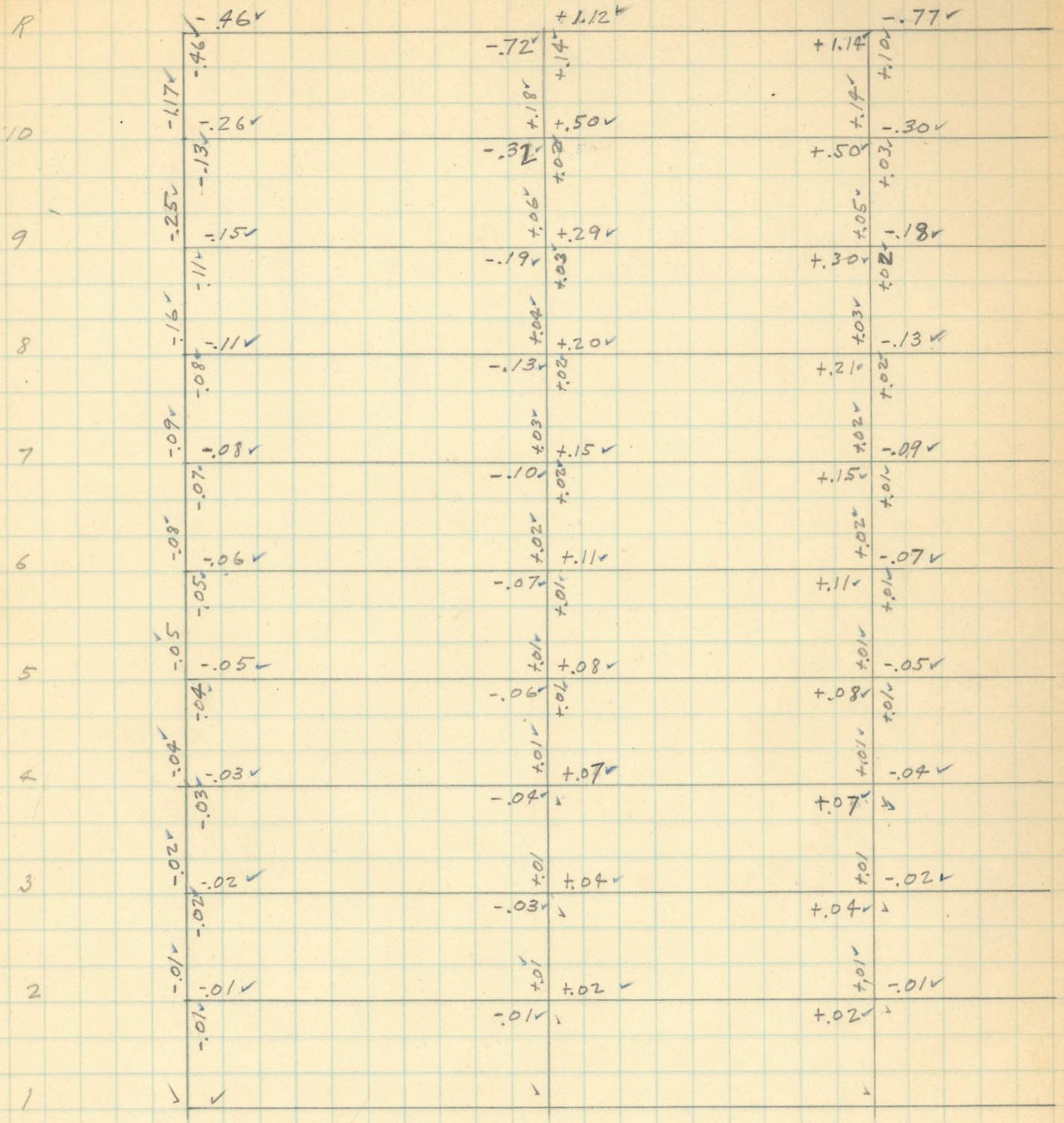
Change in θ



$$\Delta\theta = \frac{(M_A + M_B)L}{2EI} = \frac{M_A + M_B}{2E\left(\frac{I}{L}\right)}$$



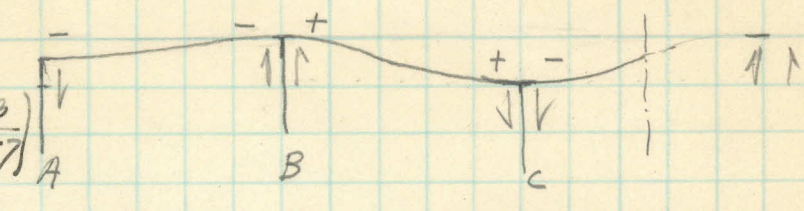
Ratio of First secondary Moment To Wind Moment.



Vito A. Vanoni

Calculation of Fix-End Moments Due to Uncorrected Secondaries Figured on Assumption that Foundations do not Settle.

Note:- Moments in span cc are too small (multiply by $\frac{3.13}{2.57}$)



Moment to be added to Span cc to give Correct Mom. $.56\,\Sigma P/A$

Bm	Beam Shear in lbs. $\frac{M_L+M_R}{L}$	$\Sigma P/A$	Fix End Mom	Span BC (22'-0) $\frac{M_L+M_R}{L}$	$\Sigma P/A$	Fix End Mom	Span CC (18'-0) $\frac{M_L+M_R}{L}$	$\Sigma P/A$	Fix End Mom
R-AB	15.7	59.50	-125.	25.3	90.93	+191	25.2	98.20	-256
10-	17.6	58.09	-122	27.1	88.70	+186	23.8	95.74	-246
9-	17.1	55.14	-116	26.0	84.14	+177	24.2	90.80	-233
8-	16.6	50.70	-107	25.4	77.30	+162	23.6	83.40	-214
7-	15.8	44.81	-94	23.8	68.11	+143	22.1	73.34	-188
6-	14.5	38.10	-80	21.5	57.80	+121	20.3	62.22	-160
5-	13.0	30.23	-64.	18.7	45.74	+96	17.4	49.22	-127
4-	10.7	23.52	-49	15.4	35.65	+75	14.7	38.36	-99
3-	7.95	16.17	-34	11.3	24.62	+52	11.0	26.50	-68
2-	5.05	9.39	-20.	6.9	14.29	+30	7.1	15.38	-40
1-		0	0		0	0		0	0

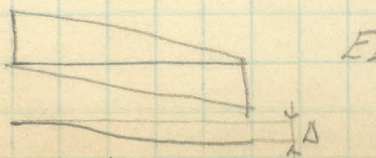
$\frac{2948}{22} = 134.$ $\quad \frac{4425}{22} = 201.1$ $\quad \frac{1705}{9} = 189.4$

Story	Col A Load	Col A Area	Col A P/A	Col B Load	Col B Area	Col B P/A	Col C Load	Col C P/A	L Length
10-R	+15.7	38.86	.41	-41.0	41.00	1.00	+50.5	1.23	12'-0
9-10	+33.3		.86	-85.7		2.09	+101.9	2.47	
8-9	+50.9		1.30	-128.8		3.14	+151.6	3.70	
7-8	+67.0		1.73	-170.8		4.16	+200.6	5.03	
6-7	+82.8	42.26	1.96	-210.9	44.39	4.75	+246.5	5.56	
5-6	+97.3	"	2.31	-246.9	"	5.56	+288.3	6.50	
4-5	+110.3	53.79	2.05	-278.1	59.72	4.66	+324.9	5.43	
3-4	+121.0		2.25	-304.2	"	5.10	+354.5	5.93	
2-3	+128.9	64.24	2.01	-323.5	67.80	4.77	+376.8	5.56	↓
1-2	+134.0	"	2.09	-335.9	"	4.95	+390.8	5.77	16'-0
			$\frac{1}{3}\frac{P}{A} = 2.79$			= 6.60		= 7.69	

Positive loads on cols are in downward direction.
Positive Deformation of Cols are a shortening of Col.

$$\frac{\Delta E}{h} = \Sigma \frac{P}{A}$$

$$\text{Defl.} = \frac{\text{Load}}{\text{Area}} \times \frac{h}{E} = \frac{Ph}{AE} \qquad h = 12'\text{-}0''$$



$$EI\Delta = \frac{ML}{2}\frac{L}{3} = \frac{ML^2}{6}$$

$$M = \frac{6EI\Delta}{L^2} = \frac{6E}{L}\left(\frac{I}{L}\right)\Delta = 6\frac{I}{L} \times \frac{E}{L}\left(\frac{\Delta E}{h}\right)\frac{h}{E} = 6 \times 7.7 \times \frac{12}{L}\left(\frac{\Delta E}{h}\right) \text{ in} \times \text{lbs}.$$

$M = 2.10\left(\frac{\Delta E}{h}\right)$ Ft x lbs for $L = 22'$

$M = 2.57\left(\frac{\Delta E}{h}\right)$ Ft x lbs for $L = 18'$

3.13

21

Correction To Secondary Wind Moments.

Joint	RA				RB					RC					
Mem.	A-(R-10)	R-B	R-AB	unbal Mom.	B(R-10)	R-BA	R-BC	unbal Mom.		C(R-10)	R-C	R-CB	R-CC	unb Mom	
	.166				.167					.167					
K/2K	.630		.370		.462	.269	.269			.436		.254	.310		
F.E.Mo.	0		-125		0	-125	+191	+76		0		+191	-256	-65	
Dist.	+79		+46		-35	-21	-20	66		+28		+17	+20		
C.O	+23		-10		-10	+23	+ 8			+ 9		-10	+10		
Bal	-29		0		-29	0	0			-29		0	0		
Dist	+10		+6	-16	+4	+2	+2	- 8		+9		+5	+6	-20	
CO	-1		-1		+9	+3	+3			+5		+1	+3		
Bal	-12				-13					-12					
Dist	+9		+5	-14	- 1	-1	0	+2		+1		+1	+1	-3	
C.O.	+2		0		+2	+2	0			+1		0	0		
Bal	-5				-5					-5					
Dist.	+2		+1	-3	+1	0	0	-1		+2		+1	+1	-4	
	+78		-78		-77	-117	+184	-10		+9		+206	-215		
					+ 5	+ 2	+ 3								
					-72	-115	+187								

Joint	10-A				10-B					10-C					
Mem	A(10-R)	A(10-9)	10-AB	unbal M	B(10-R)	B(10-9)	10-BA	10-BC	unbal Mom.	C-(10-R)	C-(10-9)	10-CB	10-CC	unb. M	
	.166	.166			.167	.167				.167	167				
K/2K	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		
F.E.M.	0	0	-122		0	0	-122	+186	+6	0	0	+186	-246		
Dist	+47	+47	+28		-20	-20	-12	-12	+64	+18	+18	+11	+13	- 60	
C.O.	+39	+22	-6		-17	- 9	+14	+5		+14	+8	- 6	+ 6		
Bal	- 29	- 22	0		- 29	- 22	0	0		- 29	- 22	0	0		
Dist	- 2	- 1	- 1	+4	+18	+18	+11	+11	-58	+ 9	+ 9	+ 5	+ 6	-29	
C.O.	+5	+1	+6		+ 2	+ 7	- 1	+ 3		+ 5	+ 4	+ 6	+ 3		
Bal	-12	-13			-12	-13				-12	-13				
Dist.	+5	+5	+3	-13	+4	+5	+2	+3	-14	+2	+2	+1	+2	-7	
Co	+4	+3	+1		0	0	+1	0		0	+1	+1	+1		
Bal	-5	-5			-5	-5				-5	-5				
Dist	+1	+1	0	-2	+3	+3	+2	+1	-9	+2	+2	+1	+2	-7	
	+53	+38	-91		-56	-36	-105	+197		+4	+4	+205	-213		

Correction To Seconday Wind Moments.

Joint	9-A				9-B					9C					Unbal Mom in Story
Mem	A 9-8	A 9-10	9-AB		B-9-8	B 9-10	9-BA	9-BC		C 9-8	C 9-10	9-CB	9-CC	UM.	
	.166	.166			.167	.167				.167	.167				
K/ΣK	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		
FEM	0	0	-116		0	0	-116	+177	+61	0	0	+177	-233		
Dist	+45	+45	+26		-19	-19	-11	-12		+17	+17	+10	+12	-56	9-8
C.O.	+20	+23	-5		-8	-10	+13	+5		+8	+9	-6	+6		
Bal	-21	-22	0		-21	-22	0	0		-21	-22	0	0		+124
Dist	+2	+2	+1	-5	+14	+14	+8	+7	-43	+8	+8	+5	+5	-26	
CO	+1	+1	+4		+6	+9	+1	+3		+4	+5	+4	+3		
Bal	-11	-13			-11	-13				-11	-13				+68
Dist	+7	+7	+4	-18	+2	+1	+1	+1	-5	+2	+3	+1	+2	-8	
CO	+3	+2	0		+1	+2	+2	0		+1	+1	0	+1		
Bal	-5	-5			-5	-5				-5	-5				+31
Dist	+2	+2	+1	-5	+2	+1	+1	+1	-5	+2	+2	+1	+2	-7	
	+43	+42	-85		-39	-42	-101	+182		+5	+5	+192	-202		

Joint	8A				8B					8C					Unbal Mom in Story
Mem	A 8-9	A 8-7	8-AB		B 8-9	B 8-7	8-BA	8-BC		C-8-9	C 8-7	8-CB	8-CC		
	.166	.166			.167	.167				.167	.167				
K/ΣK	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		
FEM	0	0	-107		0	0	-107	+162		0	0	+162	-214		
Dist	+41	+41	+25		-17	-17	-10	-11	+55	+16	+16	+9	+11	-52	7-8
C.O.	+22	+17	-5		+9	-7	+12	+4		+8	+6	-5	+5		
Bal	-21	-18	0		-21	-18	0	0		-21	-18	0	0		+109
Dist	+2	+2	+1	-5	+12	+12	+7	+8	-39	+7	+8	+4	+6	-25	
C.O.	+1	+1	+4		+7	+6	+1	+2		+4	+3	+4	+3		
Bal	-11	-10			-11	-10				-11	-10				+61
Dist.	+6	+6	+3	-15	+2	+1	+1	+1	-5	+2	+2	+1	+2	-7	
Bal	+3	+3	0		+1	0	+1	0		+1	+1	0	+1		
Co.	-5	-4			-5	-4				-5	-4				+26
Dist	+1	+1	+1	-3	+2	+2	+2	+1	-7	+2	+2	+1	+1	-6	
	+39	+39	-78		-39	-35	-93	+167		+3	+6	+176	-185		

Correction To secondary Wind Moments.

Joint	7-A				7-B					7-C					Unbal Mom in Story.
Mem	A 7-6	A-7-8	7-AB		B 7-6	B-7-8	7-BA	7-BC		C 7-6	C 7-8	7-CB	7-CC		
	.164	.166			.168	.167				.168	.167				
K/ΣK	.407	.373	.220		.338	.306	.178	.178		.325	.294	.171	.209		
F.E.M.	0	0	-94		0	0	-94	+143		0	0	+143	-188		6-7
Dist	+38	+35	+21		-16	-15	-9	-9	+49	+15	+13	+8	+95	-45	
C.O.	+16	+20	-4		-6	-8	+10	+4		+6	+8	-4	+4		
Bal	-17	-18	0		-17	-18	0	0		-17	-18				+102
Dist	+1	+1	+1	-3	+12	+11	+6	+6	-35	+7	+6	+4	+4	-21	
C.O.	+1	+1	+3		+6	+6	+1	+2		+3	+4	+3	+2		
Bal	-10	-10			-10	-10				-10	-10				+59
Dist	+6	+6	+3	-15	+2	+1	+1	+1	-5	+3	+2	+1	+2	-8	
C O	+2	+3	0		+1	0	+1	0		+1	+1	0	+1		
Bal	-5	-4			-5	-4				-5	-4				+29
Dist	+2	+1	+1	-4	+3	+2	+1	+1	-7	+2	+2	+1	+1	-6	
	+34	+35	-69		-30	-35	-83	+148		+5	+4	+156	-165		

Joint	6-A				6-B					6-C					Unbal Mom in Story.
Mem	A 6-7	A 6-5	6-AB		B 6-7	B 6-5	6-B-A	6-BC		C 6-7	C 6-5	6 C-B	6-CC		
	.164	.164			.168	.168				.168	.168				
K/ΣK	.394	.394	.212		.328	.328	.172	.172		.316	.316	.166	.202		
F.E.M.	0	0	-80		0	0	-80	+121		0	0	+121	-160		5-6
Dist	+32	+32	+16		-13	-14	-7	-7	+41	+12	+12	+7	+8	-39	
Co.	+19	+11	-3		-8	-5	+8	+3		+7	+4	-3	+4		
Bal	-17	-12			-17	-13				-17	-13				+77
Dist	+1	+1	0	-2	+11	+11	+5	+5	-32	+6	+6	+3	+3	-18	
C.O.	+1	0	+3		+6	+4	0	+2		+4	+2	+3	+2		
Bal	-10	-8			-10	-8				-10	-8				+46
Dist	+5	+6	+3	-14	+2	+2	+1	+1	-6	+2	+2	+1	+2	-7	
C O	+3	+2	0		+1	0	+1	0		+1	+1	0	+1		
Bal	-5	-4			-5	-4				-5	-4				+25
Dist	+2	+1	+1	-4	+2	+2	+2	+1	-7	+2	+2	+1	+1	-6	
	+31	+29	-60		-31	-25	-70	+126		+2	+4	+133	-139		

Correction To Secondary Wind Moments.

Joint	5-A				5-B					5-C					
Mem	A 5-4	A 5-6	5 A-B		B 5-4	B 5-6	5-BA	5-BC		C 45-4	C-56	5-CB	5-CC		unbal M in story
	.165	.164			.1675	.168				.1675	.168				
K/2K	.454	.355	.191		.383	.301	.158	.158		.370	.290	.153	.187		
F.E.M	0	0	-64		0	0	-64	+96		0	0	+96	-127		4-5
Dist	+29	+23	+12		-12	-10	-5	-5	+32	+11	+9	+5	+6	-31	
C.O.	+10	+16	-2		-4	-7	+6	+2		+4	+6	-2	+3		
Bal	-11	-12			-12	-13				-12	-13				+70
Dist	-1	0	0	+1	+11	+8	+5	+4	-28	+5	+4	+2	+3	-14	
C.O.	0	+1	+3		+4	+6	0	+1		+2	+3	+2	+2		
Bal	-7	-8			-7	-8				-7	-8				+41.5
Dist	+5	+4	+2	-11	+1	+1	+1	+1	-4	+2	+2	+1	+1	-6	
C.O	+2	+3	0		0	+1	+1	0		+1	+1	0	0		
Bal	-4	-4			-4	-4				-4	-4				+21.8
Dist	+2	+1	+0	-3	+2	+2	+1	+1	-6	+2	+2	+1	+1	-6	
	+25	+24	-49		-21	-24	-55	+100		+4	+2	+105	-111		

Joint	4 A				4-B					4-C					
Mem	A45	A43	4AB		B45	B43	4BA	4BC		C45	C43	4CB	4CC		unbal M in story
	.165	.165			.1675	.1675				.1675	.1675				
K/2K	.413	.413	.174		.354	.354	.146	.146		.343	.343	.141	.173		
F.E.M	0	0	-49		0	0	-49	+75		0	0	+75	-99		3-4
Dist	+20	+20	+9		-9	-9	-4	-4	+26	+8	+8	+4	+4	-24	
C.O.	+14	+7	-2		-6	-3	+4	+2		+5	+2.7	-2	+2		
Bal	-11	-8.1			-12	-8.2				-12	-8.2				+49.1
Dist	0	+.1	0	-.1	+8.2	+8.2	+3.4	+3.4	-23.2	+4.3	+4.3	+1.8	+2.1	-12.5	
CO	-1	0	+0.7		+6	+2.6	0	+.9		+3	+1.3	+1.7	+1.0		
Bal	-7.0	-5.1			-7.0	-5.1				-7.0	-5.1				+30.7
Dist.	+4.7	+4.7	+2.0	-11.4	+0.9	+0.9	+0.4	+0.4	-2.6	+1.7	+1.7	+0.7	+1.0	-5.1	
CO	+2	+1.2	+0.2		+0.5	+0.5	+1.0	+0.3		+1	+0.5	+0.2	+0.5		
Bal	-4	-2.9			-4	-3.0				-4	-3.0				+17.7
Dist	+1.4	+1.4	+0.7	-3.5	+1.7	+1.7	+0.7	+0.6	-4.7	+1.6	+1.6	+0.7	+0.8	-4.8	
	+19.1	+18.3	-37.4		-20.7	-14.4	-43.5	+78.6		+1.6	+3.8	+82.1	-87.6		

Correction To Secondary Wind Moments.

Joint	3-A				3-B					3-C					Unbal M. in Story
Mem.	A32	A34	3AB		B32	B34	3BA	3BC		C32	C34	3CB	3CC		
	.160	.165			.170	.1675				.170	.1675				
K/ΣK	.420	.408	.172		.369	.345	.143	.143		.358	.334	.139	.169		
F.E.M.	0	0	-34		0	0	-34	+52		0	0	+52	-68		2-3
Dist.	+14	+14	+6		-7	-6	-2.5	-2.5	+18	+5.7	+5.4	+2.2	+2.7	-16	
C.O.	+4.1	+10	-1.3		-1.8	-4	+3	+1.1		+1.7	+4	-1.3	+1.3		
Bal	-5.6	-8.1	↙		-5.3	-8.2	↙	↙		-5.3	-8.2	↙	↙		+31.2
Dist	+.1	+.1	+.1	-.3	+5.6	+5.2	+2.2	+2.2	-15.2	+2.8	+2.6	+1.1	+1.3	-7.8	
C.O.	+.2	0	+1.1		+1.6	+4.1	0	+.5		+1.9	+2.2	+1.1	+.7		
Bal	-3.8	-5.1	↙		-4.0	-5.1	↙	↙		-4.0	-5.1	↙	↙		+23.6
Dist	+2.5	+2.4	+0.9	-5.8 (1.5)	+1.1	+1.0	+0.4	+0.4	-2.9	+1.1	+1.1	+0.4	+0.6	-3.2	
C.O.	+1.3	+2.4	+0.2		+0.3	+0.5	+0.4	+0.2		+0.5	+0.8	+0.2	+0.3		
Bal	-2.1	-2.9	↙		-2.2	-3.0	↙	↙		-2.2	-3.0	↙	↙		+13.2
Dist	+.5	+.4	+.2	-1.1	+1.4	+1.3	+0.5	+0.6	-3.8	+1.2	+1.1	+0.5	+0.6		-3.4
	+11.8	+13.1	-26.8		-10.3	-14.2	-30.0	+54.5		+3.4	+0.9	+56.2	-60.5		
	+0.8	+0.8	+0.3	-1.9											
	+12.6	+13.9	-26.5												

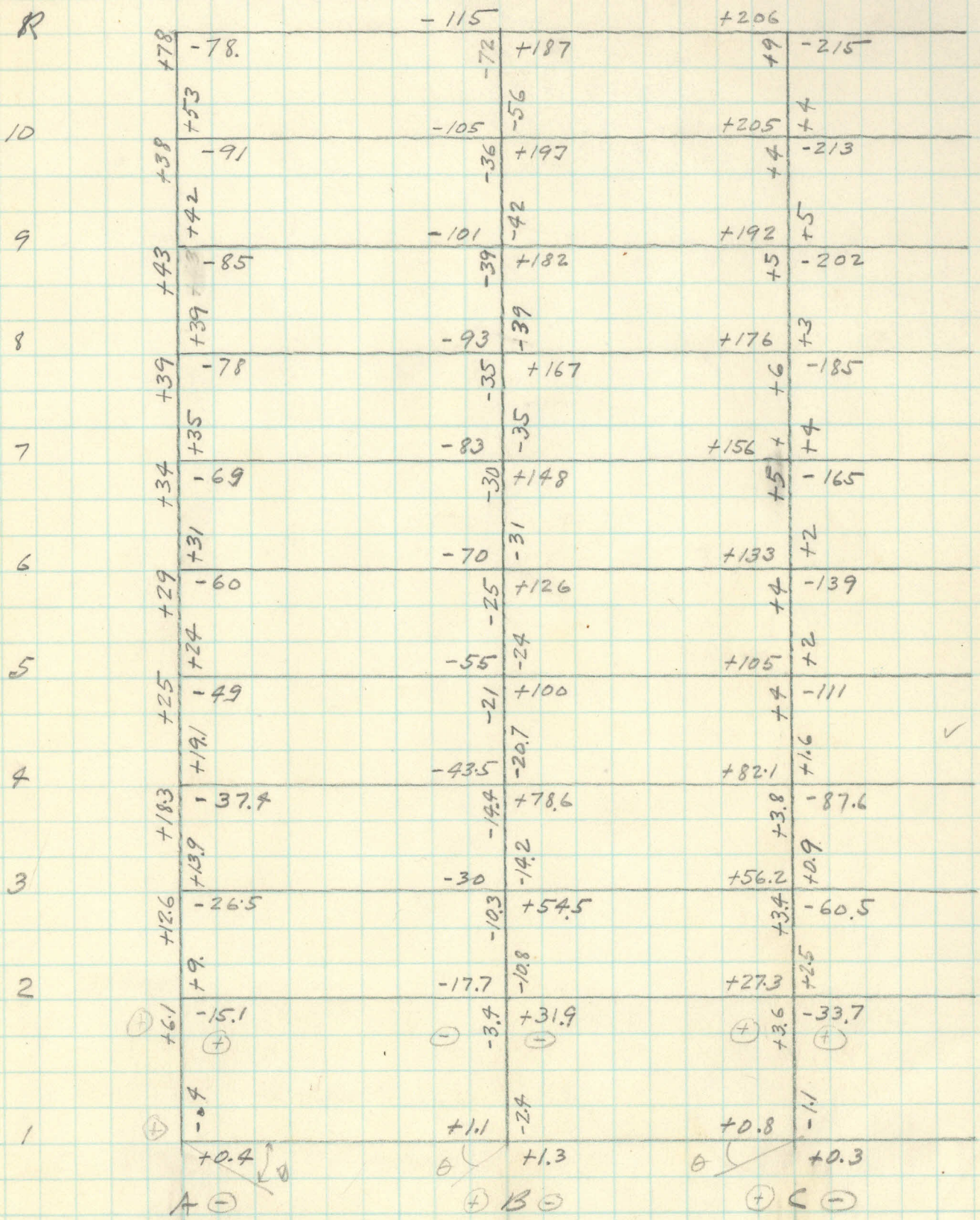
Joint	2-A				2-B					2-C					Unbal M in Story
Mem	A23	A21	2AB		B23	B21	2BA	2BC		C23	C21	2CB	2CC		
	.160	.160			.170	.170				.170	.170				
K/ΣK	.415	.415	.170		.360	.360	.140	.140		.350	.350	.135	.165		
F.E.M	0	0	-20		0	0	-20	+30		0	0	+30	-40		1-2
Dist	+8.3	+8.3	+3.4		-3.6	-3.6	-1.4	-1.4	+10	+3.5	+3.5	+1.4	+1.6	-10	
C.O.	+7.0	0	-.7		-3.5	0	+1.7	+.7		+2.8	0	-7.0	+.8		
Bal	-5.6	-2.0	↙		-5.3	-2.1	↙	↙		-5.3	-2.1	↙	↙		+12.2
Dist	+.3	+.3	+.1	-.7	+3.1	+3.1	+1.2	+1.1	-8.5	+3.8	+3.8	+1.4	+1.8	-10.8	
C.O.	0	-.7	+.6		+2.8	+1.1	0	+.7		+1.4	+.1	+.6	+.9		
B	-3.8	-2.0	↙		-4.0	-2.1	↙	↙		-4.0	-2.1	↙	↙	+2	+12.2
Dist	+2.5	+2.5	+0.9	-5.9	+0.5	+0.5	+0.3	+0.2	-1.5	+1.1	+1.1	+0.4	+0.5	-3.1	
C.O.	+1.3	+0.5	+0.4		+0.5	+0.2	+0.1	+0.2		+0.5	-0.1	+0.1	+0.2		
Bal	-2.1	-1.3	↙		-2.2	-1.4	↙	↙		-2.2	-1.4	↙	↙		+8.2
Dist	+0.5	+0.5	+0.2	-1.2	+0.9	+0.9	+0.4	+0.4	-2.6	+0.9	+0.9	+0.4	+0.5	-2.7	
	+9.0	+6.1	-15.1		+10.8	+3.4	-17.7	+31.9		+2.5	+3.6	+27.3	-33.7		

Correction To Secondary Wind Moments. 16

Joint	1-A				1-B				1-C				
Mem	A12	1AB	Unbal Mom		B12	1BA	1BC	Unbal Mom.	C12	1CB	1CC	Unbal Mom.	
	.160				.170				.170				
K/2K	.710	.290			.564	.218	.218		.538	.208	.254		
F.E.M	0	0			0	0	0		0	0	0		
Dist	0	0			0	0	0		0	0	0		
C.O.	+4.1	0			-1.8	0	0		+1.7	0	0		
Bal	-2.0	✓			-2.1	✓	✓		-2.1	✓	✓		
Dist	-1.5	-.6	+2.1	+2.1	+2.2	+.8	+.9	-3.9	+.2	+.1	+.1	-.4	
C.O.	+.1	+.4			+1.6	-.3	0		+1.9	+.5	+.1		
Bal	-2.0	✓			-2.1	✓	✓		-2.1	✓	✓		
Dist	+1.0	+0.5	-1.5		+.4	+0.2	+0.2	-.8	+0.2	-0.1	-0.1	+.4	
C o	+1.2	+0.1			+0.2	+0.2	+0		+0.5	+0.1	0		
Bal	-1.3	✓			-1.4	✓	✓		-1.4	✓	✓		
Dist	0	0		0	+0.6	+0.2	+0.2	-1.0	+0.4	+0.2	+0.2	-.8	
	-.4	+.4			-2.4	+1.1	+1.3		-1.1	+0.8	+0.3		

Correction to Secondary Moments

(Secondaries obtained by assuming no settlement of Found.)



Note:- This solution is in error. See other diagram for Corrected Solution.

Moments are in foot x lbs.

Check for Correction to Secondaries.

↷ + → +

Story	Col	θ_o	$\frac{d-L\theta}{L}$	d/L	$\Delta\theta$	I/L
1	A	+.0065	-.0612	-.0547	-.1730 ✓	18.8
	B	-.0390 ✓	.0117	.0507 ✓	+.0251 ✓	19.9
	C	-.0070 ✓	+.0486 ✓	.0556 ✓	-.1180 ✓	4
2	A	-.1665 ✓	+.0479 ✓	-.1186 ✓	-.0930 ✓	18.8
	B	-.0139 ✓	+.0946 ✓	-.1085 ✓	-.0125 ✓	19.9
	C	-.1250 ✓	+.0134 ✓	-.1116 ✓	-.0226 ✓	4
3	A	-.2595	+.0865	-.1730	-.1200	18.3
	B	-.0264 ✓	-.1255	-.1519	+.0054	18.6
	C	-.1476 ✓	-.0179	-.1655	-.0780	4
4	A	-.3795	+.1203	-.2592	-.1340	18.3
	B	-.0210	-.1830	-.2040	+.0081	18.6
	C	-.2256	+.007 ✓	-.2328	-.0645 ✓	4
5	A	-.5135	+.2220	-.2915	-.1400	14.3
	B	-.0129	-.2630	-.2759	+.034 ✓	14.6
	C	-.2901	-.0000	-.2901	-.0684	4
6	A	-.6535	+.3270	-.3265	-.1050	14.3
	B	+.0213	-.3650	+.3437	+.034 ✓	14.6
	C	-.3585	-.0114	-.3699	-.1027	4
7	A	-.7585	+.3950	-.3635	-.1530	13.1
	B	+.0555	-.4420	-.3865	.0000	13.2
	C	-.4612	+.0253	-.3359	-.0760	4
8	A	-.9115	+.4460	-.4655	-.1530	13.1
	B	+.0555	-.4930	-.4375	-.0000	13.2
	C	-.5372	+.0126	-.5246	-.0760	4
9	A	-1.0645	+.5850	-.4795	+.1530	13.1
	B	+.0555	-.6060	-.5505	-.2270	13.2
	C	-.6132	+.0757	-.5375	+.0379	4
10	A	-.9115	+.3570	-.5545		13.1
	B	-.1715	-.5060	-.6775		13.2
	C	-.5753	-.0126	-.5879		4

Correction of error in 1st Correction to Secondary Wind mom. 19X

Note:- error was in calculation of fix-end momin span CC.

Joint	RA				RB				RC					10-R
Mem	A R-10		R-AB	Unb. M.	B-R10		R-BA	R-BC	Unb. M	C-R10		R-CB	R-CC	Unb. M	
$\frac{K}{\Sigma K}$	.166				.167					.167					
$\frac{K}{\Sigma K}$ Jt.	.630		.370		.462		.269	.269		.436		.254	.310		
F.E.M.	0		0		0		0	0		0		0	-55		
dist	✓		✓		✓		✓	✓		+24.0		+14.0	+17.0		
C.O.	✓		✓		✓		✓	+7.0		+8.1		✓	+8.5		
Bal	-10.0		✓		-10.1		✓	✓		-10.1		✓	✓		+60.4
Dist	+6.3		+3.7	-10.0	+1.4		+0.8	+0.9	-3.1	-2.8		-1.7	-2.0	+6.5	
C.O.	+3.5		+0.4		+2.1		+1.9	-0.9		-1.2		+0.5	-1.0		
Bal	-3.4		✓		-3.4		✓	✓		-3.5		✓	✓		+20.6
Dist	-0.3		-0.2	+0.5	+0.1		+0.1	+0.1	+0.3	+2.3		+1.3	+1.6	-5.2	
C.O.	0		✓		+0.6		-0.1	+0.6		+1.4		✓	+0.8		
Bal	-1.5		✓		-1.5		✓	✓		-1.6		✓	✓		+9.2
Dist	+0.9		+0.6	-1.5	+0.2		+0.1	+0.1	-0.4	-0.2		-0.2	-0.2	+0.6	
	-4.5		+4.5		-10.6		+2.8	+7.8		+16.4		+13.9	-30.3		

Joint	10 A				10 B					10 C					9-10
Mem	A-10R	A 10-9	10-AB.	Unb. M.	B-10R	B 10-9	10-BA	10-BC	Unb M.	C 10-R	C 10-9	10-CB	10-CC	Unb. M.	
$\frac{K}{\Sigma K}$ St.	.166	.166			.167	.167				.167	.167				
$\frac{K}{\Sigma K}$ Jt.	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		
FEM	0	0	0		0	0	0	0		0	0	0	-54		
dist	✓	✓	✓		✓	✓	✓	✓		+16.3	+16.3	+9.5	+11.9		
C O	✓	✓	✓		✓	✓	✓	+4.7		+12.0	+7.8	✓	+5.8		
Bal	-10.0	-7.9	✓		-10.1	-8.0	✓	✓		-10.1	-8.0	✓	✓		+47.7
Dist	+6.9	+6.9	+4.1	-17.9	+4.2	+4.2	+2.5	+2.5	-13.4	-2.3	-2.3	-1.3	-1.6	+7.5	
C.O.	+3.2	+3.0	+1.3		+0.7	+1.7	+2.1	-0.7		-1.4	-0.8	+1.3	-0.8		
Bal	-3.4	-4.1	✓		-3.4	-4.1	✓	✓		-3.5	-4.1	✓	✓		+24.6
Dist	0	0	0	0	+1.2	+1.2	+0.7	+0.6	-3.7	+2.9	+2.9	+1.7	+1.8	-9.3	
CO	-0.1	+0.1	+0.3		0	+0.4	✓	+0.8		+1.1	+1.4	+0.3	+0.9		
Bal	-1.5	-2.0			-1.5	-2.0				-1.6	-2.0				+12.0
Dist	+1.2	+1.2	+0.8	-3.2	+0.7	+0.7	+0.4	+0.5	-2.3	-0.1	✓	✓	✓	+0.1	
	-3.7	-2.8	+6.5		-8.2	-5.9	+5.7	+8.4		+13.3	+11.2	+11.5	-36.0		

Correction of Error in 1st Corr. to Sec.

Joint	9 A				9 B					9 C					
Mem	A9-8	A9-10	9-AB	unbal M	B9-8	B9-10	9-BA	9-BC	unb. Mom.	C9-8	C9-10	9-CB	9-CC	unb M.	
K/ΣK St.	.166	.166			.167	.167				.167	.167				9-8
K/ΣK Jt.	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		8-9
F.E.M.	0	0	0		0	0	0	0		0	0	0	-51		
Dist	✓	✓	✓		✓	✓	✓	✓		+15.5	+15.5	+9.0	+11.0		
C.O.	✓	✓	✓		✓	✓	✓	+4.5		+7.1	+8.1	✓	+5.5		
Bal	-7.4	-7.9	✓		-7.4	-8.0	✓	✓		-7.5	-8.0	✓	✓		+44.6
Dist	+5.9	+5.9	+3.5	-15.3	+3.4	+3.4	+2.0	+2.1	-10.9	-1.6	-1.6	-0.9	-1.1	+5.2	
C.O	+2.7	+3.5	+1.0		+1.6	+2.1	+1.8	-0.5		-0.7	-1.4	+1.1	-0.6		
Bal	-3.7	-4.1	✓		-3.7	-4.1	✓	✓		-3.7	-4.1	✓	✓		+22.3
Dist	+0.2	+0.2	+0.2	-0.6	+0.9	+0.9	+0.5	+0.5	-2.8	+2.9	+2.9	+1.6	+2.0	-9.4	
C.O.	+0.1	0	+0.2		+0.4	+0.6	+0.1	+0.8		+1.2	+1.4	+0.2	+1.0		
Bal	-1.9	-2.0	✓		-1.9	-2.0	✓	✓		-1.9	-2.0	✓	✓		+11.2
Dist	+1.4	+1.4	+0.8	-3.6	+0.6	+0.6	+0.4	+0.4	-2.0	+0.1	✓	✓	✓	-0.1	
	-2.7	-3.0	+5.7		-6.1	-6.5	+4.8	+7.8		+11.4	+10.8	+11.0	+33.2		

Joint	8 A				8 B					8 C					
Mem.	A8-9	A8-7	8-AB	unb. M	B8-9	B8-7	8-BA	8-BC	unb. M	C8-9	C8-7	8CB	8-CC	unb M	
K/ΣK St.	.166	.166			.167	.167				.167	.167				8-7
K/ΣK Jt.	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		7-8
F.E.M.	0	0	0		0	0	0	0		0	0	0	-47		
Dist	✓	✓	✓		✓	✓	-	✓		+14.2	+14.2	+8.3	+10.3		
C.O.	✓	✓	✓		✓	✓	✓	+4.1		+7.8	+6.0	✓	+5.1		
Bal	-7.4	-6.5	✓		-7.4	-6.6	✓	✓		-7.5	-6.6	✓	✓		+39.4
Dist	+5.4	+5.4	+3.1	-13.9	+3.1	+3.1	+1.8	+1.9	-9.9	-1.4	-1.5	-0.8	-1.1	+4.8	
C.O	+3.0	+2.4	+0.9		+1.7	+1.4	+1.6	-0.4		-0.8	-0.7	+1.0	-0.6		
Bal	-3.7	-3.3	✓		-3.7	-3.3	✓	✓		-3.7	-3.3	✓	✓		+19.8
Dist	+0.3	+0.3	+0.1	-0.7	+0.8	+0.9	+0.5	+0.5	-2.7	+2.5	+2.5	+1.4	+1.7		-8.1
C.O	+0.1	+0.1	+0.2		+0.4	+0.4	✓	+0.7		+1.4	+1.1	+0.2	+0.8		
Bal	-1.9	-1.7	✓		-1.9	-1.7	✓	✓		-1.9	-1.7	✓	✓		+10.3
Dist	+1.2	+1.2	+0.8	-3.2	+0.7	+0.7	+0.4	+0.3	-2.1	+0.1	✓	✓	✓	-0.1	
	-3.0	-2.1	+5.1		-6.3	-5.1	+4.3	+7.1		+10.7	+10.0	+10.1	-30.8		

Correction of error to 1st Corr. to See.

Joint	7A				7B					7C					
Mem.	A7-6	A7-8	7-AB	Unb. M.	B-76	B7-8	7-BA	7-BC	Unb M	C7-6	C7-8	7-CB	7-CC	Unb M	6-7
K/ΣK St.	.164	.166			.168	.167				.168	.167				
K/ΣK Jt.	.407	.373	.220		.338	.306	.178	.178		.325	.294	.171	.269		
F.E.M.	0	0	0		0	0	0	0		0	0	0	-41		
Dist	✓	✓	✓		✓	✓	✓	✓		+13.3	+12.1	+7.0	+8.6		
C.O.	✓	✓	✓		✓	✓	✓	+3.5		+5.6	+7.1	✓	+4.3		
Bal	-6.0	-6.5	✓		-6.1	-6.6	✓	✓		-6.1	-6.6	✓	✓		+36.5
Dist	+5.1	+4.7	+2.7	-12.5	+3.1	+2.8	+1.6	+1.7	-9.2	-1.4	-1.3	-0.7	-0.9	+4.3	
C.O.	+2.1	+2.7	+0.8		+1.3	+1.5	+1.4	-0.4		-0.5	-0.8	+0.9	-0.5		
Bal	-3.1	-3.3	✓		-3.2	-3.3	✓	✓		-3.2	-3.3	✓	✓		+19.0
Dist	+0.3	+0.3	+0.2	-0.8	+0.9	+0.8	+0.4	+0.5	-2.6	+2.4	+2.2	+1.2	+1.6	-7.4	
CO	+0.1	+0.1	+0.2		+0.3	+0.4	+0.1	+0.6		+1.0	+1.2	+0.2	+0.8		
Bal	-1.6	-1.7	✓		-1.6	-1.7	✓	✓		-1.7	-1.7	✓	✓		+9.8
Dist	+1.2	+1.1	+0.6	-2.9	+0.6	+0.6	+0.4	+0.3	-1.9	+0.1	+0.1	✓	✓	-0.2	
	-1.9	-2.6	+4.5		-4.7	-5.4	+3.9	+6.2		+9.5	+9.0	+8.6	-27.1		

Joint.	6A				6B					6C					
Mem	A6-7	A6-5	6-AB	Unb. M.	B-67	B6-5	6-BA	6-BC	Unb M	C6-7	C6-5	6CB	6-CC	Unb M.	5-6
K/ΣK St.	.164	.164			.168	.168				.168	.168				
K/ΣK Jt.	.394	.394	.212		.328	.328	.172	.172		.316	.316	.166	.202		
F.E.M.	0	0	0		0	0	0	0		0	0	0	-35		
Dist	✓	✓	✓		✓	✓	✓	✓		+11.1	+11.1	+5.8	+7.0		
C.O	✓	✓	✓		✓	✓	✓	+2.9		+6.6	+4.0	✓	+3.5		
Bal	-6.0	-4.7	✓		-6.1	-4.8	✓	✓		-6.1	-4.9	✓	✓		+28.8
Dist	+4.2	+4.2	+2.3	-10.7	+2.6	+2.6	+1.4	+1.4	-8.0	+1.0	-1.0	-0.5	-0.6	+3.1	
C.O.	+2.6	+1.6	+0.7		+1.6	+1.1	+1.2	-0.3		-0.7	-0.4	+0.7	-0.3		
Bal	-3.1	-2.6	✓		-3.2	-2.6	✓	✓		-3.2	-2.6	✓	✓		+15.7
Dist	+0.3	+0.3	+0.2	-0.8	+0.7	+0.7	+0.4	+0.4	-2.2	+2.1	+2.1	+1.1	+1.2	-6.5	
CO	+0.1	+0.1	+0.2		+0.4	+0.3	+0.1	+0.5		+1.2	+0.8	+0.2	+0.6		
Bal	-1.6	-1.4	✓		-1.6	-1.4	✓	✓		-1.7	-1.4	✓	✓		+8.4
Dist	+1.0	+1.0	+0.6	-2.6	+0.6	+0.5	+0.3	+0.3	-1.7	+0.1	+0.1	✓	+0.1	-0.3	
	-2.5	-1.5	+4.0		-5.0	-3.6	+3.4	+5.2		+8.4	+7.8	+7.3	-23.5		

Correction to Error to 1st Corr to Sec.

Joint	5A				5B					5C					
Mem	A5-4	A5-6		Unb. M	B5-4	B5-6	5-BA	5-BC	unbal M	C-54	C 5-6	5-CB	5-CC	Unb M	
K/ΣK St.	.165	.164	5-AB		.1675	.168	~~.158~~			.1675	.168				
K/ΣK Jt.	.454	.355	.191		.383	.301	.158	.158		.370	.290	.153	.187		
F.E.M.	0	0	0		0	0	0	0		0	0	0	-2.8		
Dist	✓	✓	✓		✓	✓	✓	✓		+10.4	+8.1	+4.3	+5.2		
C.O.	✓	✓	✓		✓	✓	✓	+2.1		+3.7	+5.6	✓	+2.6		
Bal	-4.4	-4.7	✓		-4.5	-4.8	✓	✓		-4.5	-4.9	✓	✓		+26.7
Dist	+4.1	+3.2	+1.8	-9.1	+2.8	+2.2	+1.1	+1.1	-7.2	-0.9	-0.7	-0.4	-0.5	+2.5	
CO	+1.6	+2.1	+0.6		+1.1	+1.3	+0.9	-0.2		-0.3	-0.5	+0.6	-0.3		
Bal	-2.7	-2.6	✓		-2.7	-2.6	✓	✓		-2.7	-2.6	✓	✓		+16.2
Dist	+0.5	+0.3	+0.2	-1.0	+0.8	+0.7	+0.4	+0.3	-2.2	+2.2	+1.7	+0.9	+1.0	-5.8	
C.O.	+0.2	+0.1	+0.2		+0.3	+0.3	+0.1	+0.4		+0.8	+1.0	+0.1	+0.5		
Bal	-1.5	-1.4	✓		-1.5	-1.4	✓	✓		-1.6	-1.4	✓	✓		+9.3
Dist	+1.1	+0.9	+0.4	-2.4	+0.7	+0.5	+0.3	+0.3	-1.8	+0.2	+0.2	+0.1	+0.1	-0.6	
	-1.1	-2.1	+3.2		-3.0	-3.8	+2.8	+4.0		+7.3	+6.5	+5.6	-19.4		

Joint.	4A				4B					4C					
Mem	A4-5	A4-3	4-AB	Unb. M	B4-5	B4-3	4-BA	4-BC	Unb Mom	C-45	C43	4-CB	4-CC	Unb Mom.	
K/ΣK St.	.165	.165			.1675	.1675				.1675	.1675				
K/ΣK Jt.	.413	.413	.174		.354	.354	.146	.146		.343	.343	.141	.173		
F.E.M.	0	0	0		0	0	0	0		0	0	0	-21.5		
Dist	✓	✓	✓		✓	✓	✓	✓		+7.4	+7.4	+3.0	+3.7		
C.O.	✓	✓	✓		✓	✓	✓	+1.5		+5.2	+2.4	✓	+1.8		
Bal	-4.4	-3.0	✓		-4.5	-3.1	✓	✓		-4.5	-3.1	✓	✓		+18.4
Dist	+3.1	+3.1	+1.2	-7.4	+2.2	+2.1	+0.9	+0.9	-6.1	-0.6	-0.6	-0.3	-0.3	+1.8	
CO	+2.2	+1.0	+0.5		+1.4	+0.9	+0.6	-0.2		-0.5	-0.2	+0.5	-0.2		
Bal	-2.7	-2.0	✓		-2.7	-2.0	✓	✓		-2.7	-2.0	✓	✓		+12.1
Dist	+0.4	+0.4	+0.2	-1.0	+0.7	+0.7	+0.3	+0.3	-2.0	+1.7	+1.7	+0.7	+1.0	-5.1	
C.O.	+0.2	+0.1	+0.1		+0.4	+0.3	+0.1	+0.3		+1.1	+0.6	+0.1	+0.5		
Bal	-1.5	-1.2	✓		-1.5	-1.2	✓	✓		-1.6	-1.2	✓	✓		+7.2
Dist	+1.0	+1.0	+0.3	-2.3	+0.6	+0.6	+0.2	+0.2	-1.6	+0.2	+0.2	0	+0.1	-0.5	
	-1.7	-0.6	+2.3		-3.4	-1.7	+2.1	+3.0		+5.7	+5.2	+4.0	-14.9		

Correction to Error in 1st Corr. to Secs

Joint	3A				3B					3C					
Mem	A-32	A3-4	3-AB	Unb M	B-32	B-34	3-BA	3-BC	Unb M	C32	C34	3CB	3CC	Unb M	
K/ΣK St.	.160	.165			.170	.1675				.170	.1675				3 1 2
K/ΣK Jt.	.420	.408	.172		.369	.345	.143	.143		.358	.334	.139	.169		
FEM	0	0	0		0	0	0	0		0	0	0	-14.8		
Dist	✓	✓	✓		✓	✓	✓	✓		+5.3	+4.9	+2.1	+2.5		
CO	✓	✓	✓		✓	✓	✓	+1.0	4.✓	+1.5	+3.7	✓	+1.2		
Bal	-2.0	-3.0	✓		-2.1	-3.1	✓	✓		-2.1	-3.1	✓	✓		+12.4 ✓
Dist	+2.1	+2.0	+0.9	-5.0	+1.9	+1.8	+0.7	+0.8	-5.2	-0.4	-0.4	+0.2	-0.2	+1.2	
C.O.	+0.6	+1.6	+0.4		+0.4	+1.1	+0.5	-0.1		-0.1 ✓	-0.3	+0.4	-0.1		
Bal	-1.3	-2.0	✓		-1.4	-2.1	✓	✓		-1.4	-2.0	✓	✓		+8.2 ✓
Dist	+0.3	+0.3	+0.1	-0.7	+0.6	+0.6	+0.2	+0.2	-1.6	+1.3	+1.2	+0.5	+0.5	-3.5	
CO	✓	+0.2	+0.1		+0.1	+0.3	✓	+0.2		+0.4	+0.8	+0.1	+0.2		
Bal	-0.8	-1.2	✓		-0.8	-1.2	✓	✓		-0.8	-1.2	✓	✓		+4.9 ✓
Dist	+0.7	+0.7	+0.3	-1.7	+0.5	+0.5	+0.2	+0.2	-1.4	+0.2	+0.1	+0.1	+0.1	-0.5	
	-0.4	-1.4	+1.8		-0.8	-2.1	+1.6	+2.3		+3.9	+3.7	+3.0	-10.6		
					+0.4	-0.3	+0.2	+0.1	-1						
					-1.2	-2.4	+1.4	+2.2							

Joint	2A				2B					2C					
Mem	A2-3	A2-1	2AB	Unb M	B2-3	B2-1	2-BA	2-BC	Unb M	C-23	C2-1	2-CB	2-CC	Unb M	
K/ΣK St.	.160	.160			.170	.170				.170	.170				1 2
K/ΣK Jt.	.415	.415	.170		.360	.360	.140	.140		.350	.350	.135	.165		
FEM	0	0	0		0	0	0	0		0	0	0	-8.6 ✓		
Dist	✓	✓	✓		✓	✓	✓	✓		+3.0	+3.0	+1.2	+1.4		
CO	✓	✓	✓		✓	✓	✓	+0.6 ✓		+2.6 ✓	✓	✓	+0.7 ✓		
Bal	-2.0 ✓	-0.7 ✓	✓		-2.1 ✓	-0.8 ✓	✓	✓		-2.1 ✓	-0.8 ✓	✓	✓		+4.5 ✓
Dist	+1.1 ✓	+1.1 ✓	+0.5 ✓	-2.7 ✓	+0.8 ✓	+0.8 ✓	+0.3 ✓	+0.4 ✓	-2.3 ✓	-0.1 ✓	-0.2 ✓	0	-0.1 ✓	+0.4 ✓	
CO	+1.1 ✓	+0.3 ✓	+0.2 ✓		+1.0 ✓	+0.2 ✓	+0.3 ✓	0 ✓		-0.2 ✓	-0.2 ✓	+0.2 ✓	-0.1 ✓		
Bal	-1.3 ✓	-0.5 ✓	✓		-1.4 ✓	-0.6 ✓	✓	✓		-1.4 ✓	-0.6 ✓	✓	✓		+3.4 ✓
Dist	+0.1 ✓	+0.1 ✓	0	-0.2 ✓	+0.2 ✓	+0.2 ✓	+0.1 ✓	0.0 ✓	-0.5 ✓	+0.8 ✓	+0.8 ✓	+0.3 ✓	+0.4 ✓	-2.3 ✓	
CO	+0.1 ✓	-0.1 ✓	✓		+0.3 ✓	+0.1 ✓	✓	+0.1 ✓		+0.7 ✓	+0.2 ✓	✓	+0.2 ✓		
Bal	-0.8 ✓	-0.3 ✓	✓		-0.8 ✓	-0.4 ✓	✓	✓		-0.8 ✓	-0.4 ✓	✓	✓		+2.2 ✓
Dist	+0.4 ✓	+0.5 ✓	+0.2 ✓	-1.1 ✓	+0.2 ✓	+0.2 ✓	+0.2 ✓	+0.1 ✓	-0.7 ✓	+0.1 ✓	✓	✓	✓	-0.1 ✓	
	-1.3	+0.4	+0.9		-1.8	-0.3	+0.9	+1.2		+2.6	+1.8	+1.7	-6.1		

Correction of Error to 1st Cor to Sec.

Joint	1A			1B				1C			
Mem.	A1-2	1-AB	Unb M	B1-2	1-BA	1-BC	Unb M	C1-2	1-CB	1-CC	Unb M.
K/ΣK St.	.160			.170				.170			
K/ΣK Jt.	.710	.290		.564	.218	.218		.538	.208	.254	
F.E.M.	0	0		0	0	0		0	0	0	
Dist	↙	↙		↙	↙	↙		↙	↙	↙	
C.O.	↙	↙		↙	↙	↙		+1.5 ↙	↙	↙	
Bal	-0.7 ↙	↙		-0.8 ↙	↙	↙		-0.8 ↙	↙	↙	
Dist	+0.5 ↙	+0.2 ↙	-0.7 ↙	+0.4 ↙	+0.2 ↙	+0.2 ↙	-0.8 ↙	+0.4 ↙	-0.1 ↙	+0.2 ↙	+0.7 ↙
CO	+0.6 ↙	+0.1 ↙		+0.4 ↙	+0.1 ↙	-0.0 ↙		-0.1 ↙	+0.1 ↙	-0.1 ↙	
Bal	-0.5 ↙	↙		-0.6 ↙	↙	↙		-0.6 ↙	↙	↙	
Dist	-0.2 ↙	0 ↙	+0.2 ↙	+0.1 ↙	↙	↙	-0.1 ↙	+0.4 ↙	+0.1 ↙	+0.2 ↙	-0.7 ↙
C.O.	+ ↙	↙		+0.1 ↙	↙	↙		+0.4 ↙	↙	+0.1 ↙	
Bal	-0.3 ↙	↙		-0.4 ↙	↙	↙	- ↙	-0.4 ↙	↙	↙	
Dist	+0.3 ↙	+ 0 ↙	-0.3 ↙	+0.2 ↙	+0.1 ↙	↙	-0.3 ↙	+0.1 ↙	↙	↙	+0.1 ↙
	-0.3	+0.3		-0.6	+0.4	+0.2		+0.1	+0.1	0	

Moments (Correction of of Error in 1st Corr to Secondary Mom) 7

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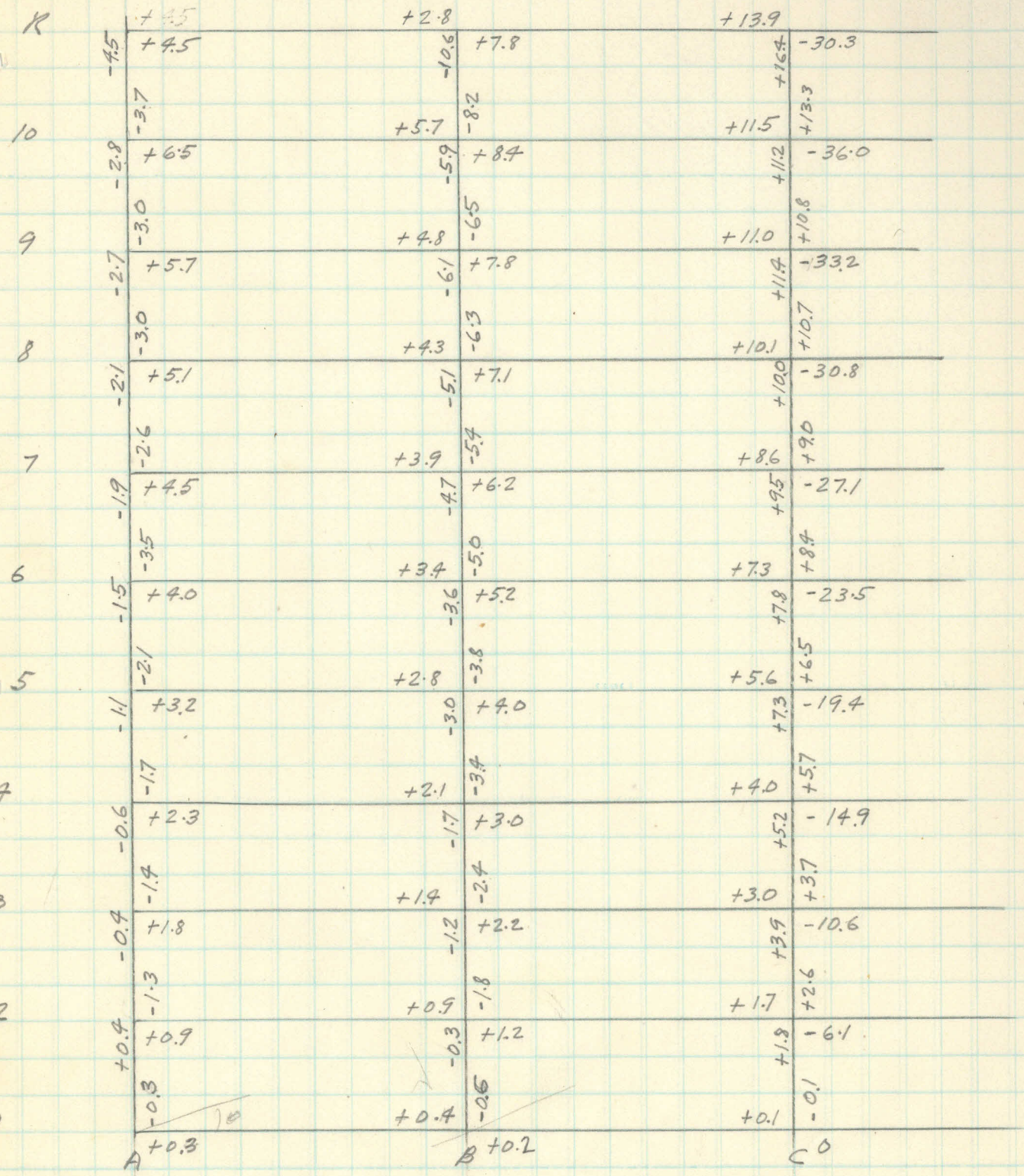
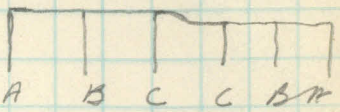


Moments are in ft x lbs

Correction of Error in 1st Corr to Secondary Wind Moments.
(Check of solution)

Value of θ_2 by Area M.	Story	Col	θ_0 (↻ +)	$\frac{d-L\theta}{L}$	d/L (↺ +)	$\Delta\theta$ (↻ +)	I/L
	1-2	A	-.00650	.00886	-.01536	+.0186	18.8
		B	-.00866	.00754	-.01620	+.00753	19.9
		C	.000	.0168	-.01680	+.04780	"
.0195	2-3	A	-.0251	-.0195	-.0446	-.0239	18.8
.0174		B	-.0162	-.0201	-.0363	+.01510	19.9
.0260		C	-.0478	+.0109	-.0369	+.0327	"
.0477	3-4	A	-.0490	-.0200	-.0690	-.0219	18.3
.0260		B	-.0313	-.0278	-.0591	-.0188	18.6
.0824		C	-.0805	+.0197	-.0608	-.0323	"
.0541	4-5	A	-.0709	-.0210	-.0919	-.0164	18.3
.0423		B	-.0501	-.0341	-.0842	-.0054	18.6
.1083		C	-.1128	+.0368	-.0760	-.0430	"
.0780	5-6	A	-.0873	-.0315	-.1188	-.0210	14.3
.0521		B	-.0555	-.0492	-.1047	-.0068	14.6
.1560		C	-.1558	+.0365	-.1193	-.0445	"
.0995	6-7	A	-.1083	-.0595	-.1678	-.0560	14.3
.0640		B	-.0623	-.0605	-.1228	-.0105	14.6
.2040		C	-.2003	+.0834	-.1169	-.0377	"
.110	7-8	A	-.1643	-.0395	-.2038	-.0191	13.1
.0770		B	-.0728	-.0720	-.1448	-.0114	13.2
.238		C	-.2380	+.1010	-.1370	-.0378	"
.1278	8-9	A	-.1834	-.0417	-.2251	-.0114	13.1
.0783		B	-.0842	-.0820	-.1662	-.0076	13.2
.284		C	-.2758	+.1263	-.1495	-.0265	"
.1580	9-10	A	-.1948	-.0407	-.2355	-.0076	13.1
.0897		B	-.0918	-.0644	-.1562	-.0227	13.2
.308		C	-.3023	+.1313	-.1710	-.0152	"
.1340	10-R	A	-.2024	-.0369	-.2393	-	13.1
.1078		B	-.1145	-.0732	-.1877	-	13.2
.316		C	-.3175	+.1290	-.1865	-	"

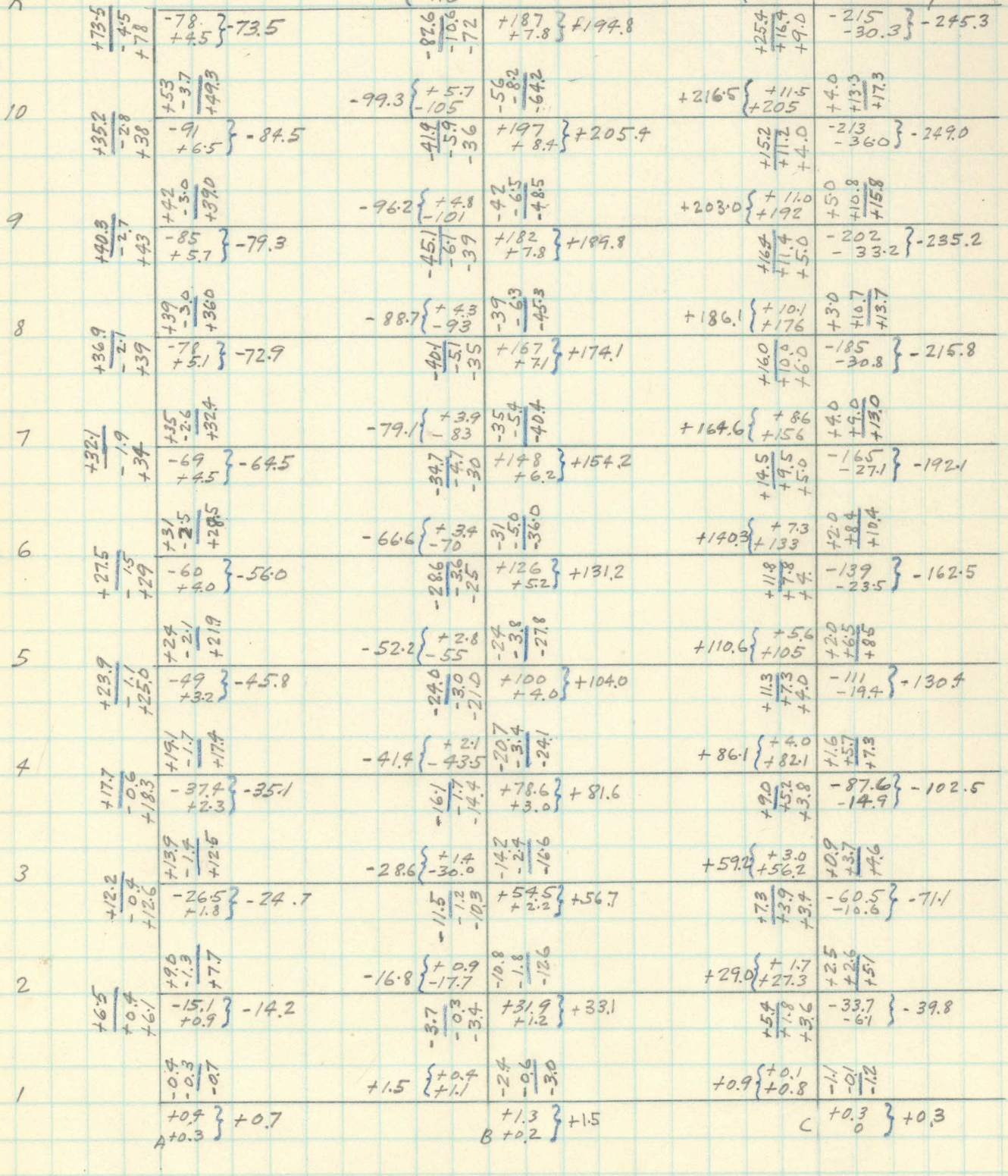


The Bent is deflected as shown in diag. and values of θ at Joints can be figured directly by area mom.

as can be seen from the check the deflection of Col A does not check with that of Col B & C. above sixth floor. It will also be noticed that the difference in deflection between Col A & Col B & C is Const above 6th Fl. This means that there is an error in the moments in Col A (6-7) Mom A 7-6 is probably too small.

First Correction to Secondary Moments.

Figure next to member is a moment which was found to be in error due to using incorrect values for fix-end moments.
The next figures represent the correction of the 1st moment and the third figure (Sum of 1st & 2nd) is the first Correction to Secondary moments.



Moments are in ft x lbs.

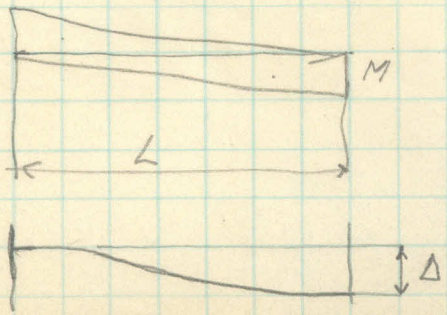
Fix-end moments due to 1st Correction to Secondaries

$I/L = 7.7$ $I/L = 7.7$ $I/L = 9.4$

	Span AB = 22'			Span BC = 22'			Span CC = 18-6				Col A			Col B			Col C		
Floor	$\frac{M_L+M_R}{L}$	$\frac{\Delta}{h}E$	FE.M ft x #	$\frac{M_L+M_R}{L}$	$\frac{\Delta}{h}E$	Fix E M	$\frac{M_L+M_R}{L}$	$\frac{\Delta}{h}E$	Fix E Mom.	Story	Load	Area	P/A #/in²	Load	Area	P/A	Load	P/A	Length
R	8.43	32.12	+67.5	18.80	65.22	-137.	27.2	82.08	+257	10-R	8.43#	38.86	.22	27.23	41.00	.66	46.60	1.12	12-0
10	8.35	31.24	+65.7	19.12	63.47	-133	27.7	79.84	+250.	9-10	16.78		.43	54.70		1.34	92.82	2.26	
9	7.97	29.47	+61.9	17.84	59.84	-126	26.1	75.32	+235	8-9	24.75		.64	80.51		1.97	136.16	3.32	
8	7.34	26.86	+56.4	16.37	54.55	-116	23.9	68.68	+215	7-8	32.09		.83	104.22		2.54	177.03	4.32	
7	6.52	23.49	+49.4	14.48	47.69	-100	21.3	60.04	+188	6-7	38.61	42.26	.91	125.22	44.39	2.83	212.81	4.80	
6	5.56	19.75	+41.5	12.32	40.06	-84.	18.0	50.44	+157	5-6	44.17	"	1.02	143.10	"	3.23	243.13	5.48	
5	4.45	15.56	+31.6	9.75	31.35	-65.8	14.5	39.48	+124	4-5	48.62	53.79	.91	157.30	59.72	2.64	267.38	4.48	
4	3.47	11.95	+25.1	7.61	24.23	-51.0	11.4	30.52	+95	3-4	52.09	"	.97	168.38	"	2.82	286.39	4.80	
3	2.42	8.16	+17.1	5.26	16.67	-34.9	7.9	20.92	+67.5	2-3	54.51	64.24	.85	176.06	67.80	2.60	299.55	4.42	12-0
2	1.41	4.71	+9.9	2.82	9.59	-20.2	4.4	12.08	+38.	1-2	55.92	"	.87	180.29	"	2.66	306.77	4.53	16-0
1												$\frac{16}{12}$ P/A	1.16			3.55		6.04	
													7.94			24.18		41.09	

Shear in #

$\frac{55.92}{2} \quad \frac{1236.1}{2v}$ $\quad \frac{124.37}{2} \quad \frac{2740.2}{2v}$ $\quad \frac{182.4}{9} \quad \frac{1643.7}{2v}$



$$EI\Delta = \frac{ML}{2}\left(\frac{2L}{3} - \frac{L}{3}\right) = \frac{ML^2}{6}$$

$$M = \frac{6EI\Delta}{L^2} = 6\left(\frac{I}{L}\right)\left(\frac{E\Delta}{h}\right)\frac{h}{L}$$

$$M = 6 \times 7.7 \times \frac{12}{22} \times \frac{E\Delta}{h} \times \frac{1}{12} = 2.10\ \frac{E\Delta}{h}\ \text{Ft x lbs for Span AB \& BC.}$$

$$M = 6 \times 9.4 \times \frac{12}{18} \times \frac{E\Delta}{h} \times \frac{1}{12} = 3.13\ \frac{E\Delta}{h}\ \text{Ft x lbs for Span CC.}$$

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Calculation of 2ND Correction to Secondary Wind Moments.

Joint	RA				RB				RC.					
Mem.	A(R-10)		R-AB	unbal. Mom.	B(R-10)		R(BA)	R-BC	unbal Mom.	C(R-10		R-CB	R-CC	unb Mom	unbal Mom in story.
K for Sk Cols.	.166				.167					.167					
K/2K	.630		.370		.462		.269	.269		.436		.254	.310		
FEM	0		+67.5		0		+67.5	-137	-69.5	0		-137	+257	+120	10-R
Dist	-42.5		-25.0		+32.1		+18.7	+18.7		-52.3		-30.5	-37.2		
C.O.	-12.7		+9.3		+10.6		-12.5	-15.2		-17.7		+9.3	-18.6		
B.	+25.5		✓		+25.6		✓	✓		+25.6		✓	✓		-153.3
D	-13.9		-8.2	+22.1	-3.9		-2.3	-2.3	+8.5	+0.6		+0.4	+0.4	-1.4	
C.O	-3.4		-1.2		-8.4		-4.1	+0.2		+0.7		-1.2	+0.2		
Bal	+9.4		✓		+9.4		✓	✓		+9.4		✓	✓		-56.3
Dist	-3.0		-1.8	+4.8	+1.3		+0.8	+0.8	-2.9	-4.0		-2.3	-2.8	+9.1	
CO	-0.8		+0.4		-1.5		-0.9	-1.1		-2.4		+0.4	-1.4		
Bal	+3.8		✓		+3.8		✓	✓		+3.8		✓	✓		-22.8
Dist	-2.1		-1.3	+3.4	-0.2		-0.1	-0.1	+0.3	-0.2		-0.1	-0.1	+0.4	
	-39.7		+39.7		+68.8		+67.1	-136.0		-36.5		-161.0	+197.7		

Joint	10-A				10-B					10C					
Mem	A(10-R)	A(10-9)	10-AB	unbal Mom	B(10-R)	B(10-9)	10-BA	10-BC	unbal Mom	C(10-R)	C(10-9)	10-CB	10-CC	unb Mom	unbal Mom in story
K for Sk Cols	.166	.166			.167	.167				.167	.167				
K/EK	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		
FEM	0	0	+65.7		0	0	+65.7	-133	-67.3	0	0	-133	+250	+117	9-10
Dist	-25.4	-25.4	-14.9		+21.3	+21.3	+12.4	+12.3		+35.4	-35.4	+20.7	-25.5		
CO	-21.2	-11.9	+6.2		+16.0	+10.1	-7.4	-10.3		-26.1	-16.5	+6.1	-12.7		
Bal	+25.5	+19.0	✓		+25.6	+19.1	✓	✓		+25.6	+19.1	✓	✓		-114.3
Dist	-6.8	-6.8	-4.0	+17.6	-16.8	-16.8	-9.7	-9.8	+53.1	+1.3	+1.4	+0.8	+1.0	-4.5	
C.O.	-7.0	-3.6	-4.9		-2.0	-6.3	-2.0	+0.4		+0.3	+0.4	-4.9	+0.5		
Bal	+9.4	+10.3	✓		+9.4	+10.3	✓	✓		+9.4	+10.3	✓	✓		-61.9
Dist.	-1.6	-1.6	-1.0	+4.2	-3.1	-3.1	-1.8	-1.8	+9.8	-4.8	-4.8	-2.8	-3.6	+16.0	
C.O.	-1.5	-1.7	-0.9		+0.6	-0.5	-0.5	-1.4		-2.0	-2.5	-0.9	-1.8		
Bal	+3.8	+4.7	✓		+3.8	+4.8	✓	✓		+3.8	+4.8	✓	✓		-28.6
Dist	-1.7	-1.7	-1.0	+4.4	-2.2	-2.1	-1.2	-1.3	+6.8	-0.4	-0.4	-0.3	-0.3	+1.4	
	-26.5	-18.7	+45.2		+52.6	+36.8	+55.5	-144.9		-28.3	-23.6	-155.7	+207.6		

2ND Corr to Secondary Wind Mom:

Joint	9-A				9B					9C					
Mem	A 9-8	A 9-10	9-AB		B 9-8	B 9-10	9-BA	9-BC		C 9-8	C 9-10	9CB	9CC		
K/ΣK for story	.166	.166			.167	.167				.167	.167	~~9CB~~	~~9CC~~		
K/ΣK	.386	.386	.228		.316	.316	.184	184		.303	.303	.177	.217		
FEM	0	0	+61.9		0	0	+61.9	-126	-64.1	0	0	-126	+235	+109	9-8
Dist	-23.9	-23.9	-14.1		+20.3	+20.2	+11.8	+11.8		-33.0	-33.0	-19.3	-23.7		
C.O.	-10.9	-12.7	+5.9		+9.4	+10.6	-7.0	-9.6		-15.0	-17.7	+5.9	-11.8		
Bal	+17.3	+19.0	✓		+17.4	+19.1	✓	✓		+17.4	+19.1	✓	✓		-104.4
Dist	-7.2	-7.2	-4.2	+18.6	-12.6	-12.6	-7.3	-7.4	+39.9	+0.6	+0.7	+0.4	+0.4	-2.1	
C.O.	-3.3	-3.4	-3.7		-5.6	-8.4	-2.1	+0.2		+0.3	+0.7	-3.7	+0.2		
Bal	+9.1	+10.3	✓		+9.1	+10.3	✓	✓		+9.1	+10.3	✓	✓		-54.7
Dist	-3.5	-3.5	-2.0	+9.0	-1.1	-1.1	-0.6	-0.7	+3.5	-5.1	-5.1	-3.0	-3.7	+16.9	
CO	-1.5	-0.8	-0.3		-0.6	-1.5	-1.0	-1.5		-2.2	-2.4	-0.3	-1.8		
Bal	+4.5	+4.7	✓		+4.6	+4.8	✓	✓		+4.6	+4.8	✓	✓		-27.5
Dist	-2.5	-2.6	-1.5	+6.6	-1.5	-1.5	-0.9	-0.9	+4.8	-0.8	-0.8	-0.5	-0.6	+2.7	
	-21.9	-20.1	+42.0		+39.4	+39.9	+54.8	-134.1		-24.1	-23.4	-146.5	+193.9		

Joint	8A				8B					8C					
Mem	A 8-9	A 8-7	8-AB		B 8-9	B 8-7	8-BA	8-BC		C 8-9	C 8-7	8-CB	8-CC		
K/ΣK for story	.166	.166			.167	.167				.167	.167				
K/ΣK Joint	.386	.386	.228		.316	.316	.184	.184		.303	.303	.177	.217		
FEM	0	0	+56.4		0	0	+56.4	-116	-59.6	0	0	-116	+215	+99	8-7
Dist	-21.8	-21.8	-12.8		+18.8	+18.8	+11.0	+11.0		-30.0	-30.0	-17.5	-21.5		
C.O.	-11.9	-9.2	+5.5		+10.1	+7.7	-6.4	-8.7		-16.5	-12.9	+5.5	-10.7		
Bal	+17.3	+15.4	✓		+17.4	+15.5	✓	✓		+17.4	+15.5	✓	✓		-92.7
Dist	-6.6	-6.6	-3.9	+17.1	-11.2	-11.2	-6.6	-6.6	+35.6	+0.5	+0.5	+0.3	+0.4	-1.7	
C.O.	-3.6	-2.8	-3.3		-6.3	-5.1	-2.0	+0.2		+0.3	+0.2	-3.3	+0.2		
Bal	+9.1	+8.3	✓		+9.1	+8.3	✓	✓		+9.1	+8.3	✓	✓		-49.9
Dist	-3.0	-3.0	-1.7	+7.7	-1.3	-1.3	-0.8	-0.8	+4.2	-4.5	-4.5	-2.6	-3.2	+14.8	
CO	-1.7	-1.3	-0.4		-0.5	-0.6	-0.8	-1.3		-2.5	-2.0	-0.4	-1.6		
Bal	+4.5	+4.1	✓		+4.6	+4.2	✓	✓		+4.6	+4.2				-25.1
Dist	-2.0	-2.0	-1.2	+5.2	-1.8	-1.8	-1.0	-1.0	+5.6	-0.7	-0.7	-0.4	-0.5	+2.3	
	-19.7	-18.9	+38.6		+38.9	+34.5	+49.8	-123.2		-22.3	-21.4	-134.4	+178.1		

2ND Corr to Secondary Wind Mom.

Joint	7A				7B					7C					
Mem	A7-6	A7-8	7A-B		B7-6	B7-8	7B-A	7B-C		C7-6	C7-8	7-CB	7-CC		
K/ΣK St.	.164	.166	~~.220~~		.168	.167				.168	.167				
K/ΣK Jt.	.407	.373	.220		.338	.306	.178	.178		.325	.294	.171	.209		
FEM	0	0	+49.4		0	0	+49.4	-100	-50.6	0	0	-100	+188	+88	7-6
Dist	-20.1	-18.4	-10.9		+17.1	+15.5	+9.0	+9.0		-28.6	-25.9	-15.1	-18.4		
CO	-8.1	-10.9	+4.5		+6.9	+9.4	-5.4	-7.5		-11.5	-15.0	+4.5	-9.2		
Bal	+14.0	+15.4	✓		+14.4	+15.5	✓	✓		+14.4	+15.5	✓	✓		-85.6
Dist	-6.1	-5.5	-3.3	+14.9	-11.3	-10.2	-5.9	-5.9	+33.3	+0.4	+0.4	+0.2	+0.3	-1.3	
CO	-2.5	-3.3	-3.0		-4.7	-5.6	-1.7	+0.1		+0.2	+0.3	-3.0	+0.2		
Bal	+7.6	+8.3	✓		+7.8	+8.3	✓	✓		+7.8	+8.3	✓	✓		-46.6
Dist	-2.9	-2.7	-1.5	+7.1	-1.4	-1.3	-0.7	-0.8	+4.2	-4.5	-4.1	-2.4	-2.8	+13.8	
CO	-1.2	-1.5	-0.3		-0.5	-0.6	-0.7	-1.2		-1.9	-2.2	-0.4	-1.4		
Bal	+4.0	+4.1	✓		+4.0	+4.2	✓	✓		+4.0	+4.2	✓	✓		-24.1
Dist	-2.1	-1.9	-1.1	+5.1	-1.8	-1.6	-0.9	-0.9	+5.2	-0.8	-0.7	-0.4	-0.4	+2.3	
	-17.4	-16.4	+33.8		+30.5	+33.6	+43.1	-107.2		-20.5	-19.2	-116.6	+156.3		

Joint	6A				6B					6C					
Mem.	A6-7	A6-5	6-AB		B6-7	B6-5	6-BA	6-BC		C6-7	C6-5	6-CB	6-CC		
K/ΣK St.	.164	.164			~~.168~~ .168	.168				.168	.168				
K/ΣK Jt.	.394	.394	.212		.328	.328	.172	.172		.316	.316	.166	.202		
FEM	0	0	+41.5		0	0	+41.5	-84	-42.5	0	0	-84	+157	+73	6-5
Dist	-16.3	-16.4	-8.8		+13.9	+13.9	+7.3	+7.4		-23.1	-23.1	-12.1	-14.7		
CO	-10.0	-5.6	+3.6		+8.5	+5.1	-4.4	-6.0		-14.3	-8.4	+3.7	-7.3		
Bal	+14.0	+10.7	✓		+14.4	+10.9	✓	✓		+14.4	+10.9	✓	✓		-65.1
Dist	-5.0	-5.0	-2.7	+12.7	-9.3	-9.4	-4.9	-4.9	+28.5	+0.3	+0.3	+0.2	+0.2	-1.0	
CO	-3.1	-1.8	-2.5		-5.7	-3.8	-1.4	+0.1		+0.2	+0.2	-2.5	+0.1		
Bal	+7.6	+6.1	✓		+7.8	+6.3	✓	✓		+7.8	+6.3	✓	✓		-37.2
Dist	-2.5	-2.5	-1.3	+6.3	-1.1	-1.1	-0.5	-0.6	+3.3	-3.8	-3.8	-2.0	-2.5	+12.1	
CO	-1.4	-1.0	-0.2		-0.7	-0.4	-0.6	-1.0		-2.2	-1.5	-0.3	-1.2		
Bal	+4.0	+3.3	✓		+4.0	+3.4	✓	✓		+4.0	+3.4	✓	✓		-20.0
Dist	-1.8	-1.8	-1.1	+4.7	-1.5	-1.5	-0.8	-0.9	+4.7	-0.7	-0.7	-0.4	-0.4	+2.2	
	-14.5	-14.0	+28.5		+30.3	+23.4	+36.2	-89.9		-17.4	-16.4	-97.4	+131.2		

2ND Corr to Secondary Wind Mom.

Joint	5A				5B					5C					
Mem	A-5-4	A-5-6	5-AB		B-5-4	B-5-6	5-BA	5-BC		C-5-4	C-5-6	5-CB	5-CC		
K/ΣK St	.165	.164			.1675	.168				.1675	.168				
K/ΣK Jt.	.454	.355	.191		.383	.301	.158	.158		.370	.290	.153	.187		
FEM	0	0	+31.6		0	0	+31.6	-65.8		0	0	-65.8	+12.4		
Dist	-14.3	-11.2	-6.1		+13.1	+10.3	+5.4	+5.4	-34.2	-21.6	-16.9	-8.9	-10.8	+58.2	4-5
C.O.	-5.2	-8.2	+2.7		+4.6	+6.9	-3.0	-4.4		-7.5	-11.5	+2.7	-5.4		
Bal	+9.7	+10.7	✓		+9.8	+10.9	✓	✓		+9.8	+10.9	✓	✓		-58.6
Dist	-4.4	-3.5	-1.8	+9.7	-9.5	-7.5	-3.9	-3.9	+24.8	+0.4	+0.3	+0.1	+0.2	-1.0	
C.O.	-1.6	-2.5	-2.0		-3.8	-4.7	-0.9	+0.1		+0.2	+0.2	-2.0	+0.1		
Bal	+5.9	+6.1	✓		+6.0	+6.3	✓	✓		+6.0	+6.3	✓	✓		-35.8
Dist	-2.7	-2.1	-1.1	+5.9	-1.1	-0.9	-0.5	-0.5	+3.0	-4.0	-3.1	-1.6	-2.1	+10.8	
CO	-1.1	-1.2	-0.2		-0.4	-0.5	-0.5	-0.8		-1.5	-1.9	-0.2	-1.0		
Bal	+3.4	+3.3	✓		+3.5	+3.4	✓	✓		+3.5	+3.4	✓	✓		-20.7
Dist	-1.9	-1.5	-0.8	+4.2	-1.8	-1.4	-0.7	-0.8	+4.7	-0.8	-0.7	-0.4	-0.4	+2.3	
	-12.2	-10.1	+22.3		+20.4	+22.8	+27.5	-70.7		-15.5	-13.0	-76.1	+104.6		

Joint	4A				4B					4C					
Mem	A4-5	A4-3	4-AB		B-4-5	B-4-3	4-BA	4-BC		C-4-5	C-4-3	4CB	4CC		
K/ΣK St.	.165	.165			.1675	.1675				.1675	.1675				
K/ΣK Jt.	.413	.413	.174		.354	.354	.146	.146		.343	.343	.141	.173		
FEM	0	0	+25.1		0	0	+25.1	-51.0	-25.9	0	0	-51.0	+9.5	+4.4	
Dist	-10.4	-10.4	-4.3		+9.2	+9.2	+3.7	+3.8		-15.1	-15.1	-6.2	-7.6		3-4
C.O.	-7.1	-3.5	+1.8		+6.5	+3.1	-2.1	-3.1		-10.8	-5.4	+1.9	-3.8		
Bal	+9.7	+6.9	✓		+9.8	+7.0	✓	✓		+9.8	+7.0	✓	✓		-41.9
Dist	-3.2	-3.2	-1.4	+7.8	-7.5	-7.5	-3.1	-3.1	+21.2	+0.4	+0.5	+0.2	+0.2	-1.3	
C.O.	-2.2	-1.1	-1.6		-4.8	-2.5	-0.7	+0.1		+0.2	+0.1	-1.6	+0.1		
Bal	+5.9	+4.3	✓		+6.0	+4.3	✓	✓		+6.0	+4.3	✓	✓		-25.9
Dist	-2.2	-2.2	-0.9	+5.3	-0.8	-0.9	-0.4	-0.3	+2.4	-3.1	-3.1	-1.3	-1.6	+9.1	
CO	-1.3	-0.7	-0.2		-0.5	-0.3	-0.4	-0.6		-2.0	-1.1	-0.1	-0.8		
Bal	+3.4	+2.6	✓		+3.5	+2.6	✓	✓		+3.5	+2.6	✓	✓		-15.6
Dist	-1.6	-1.6	-0.6	+3.8	-1.5	-1.5	-0.6	-0.7	+4.3	-0.7	-0.7	-0.3	-0.4	+2.1	
	-9.0	-8.9	+17.9		+19.9	+13.5	+21.5	-54.9		-11.8	-10.9	-58.4	+81.1		

2ND Corr to Secondary Wind Mom.

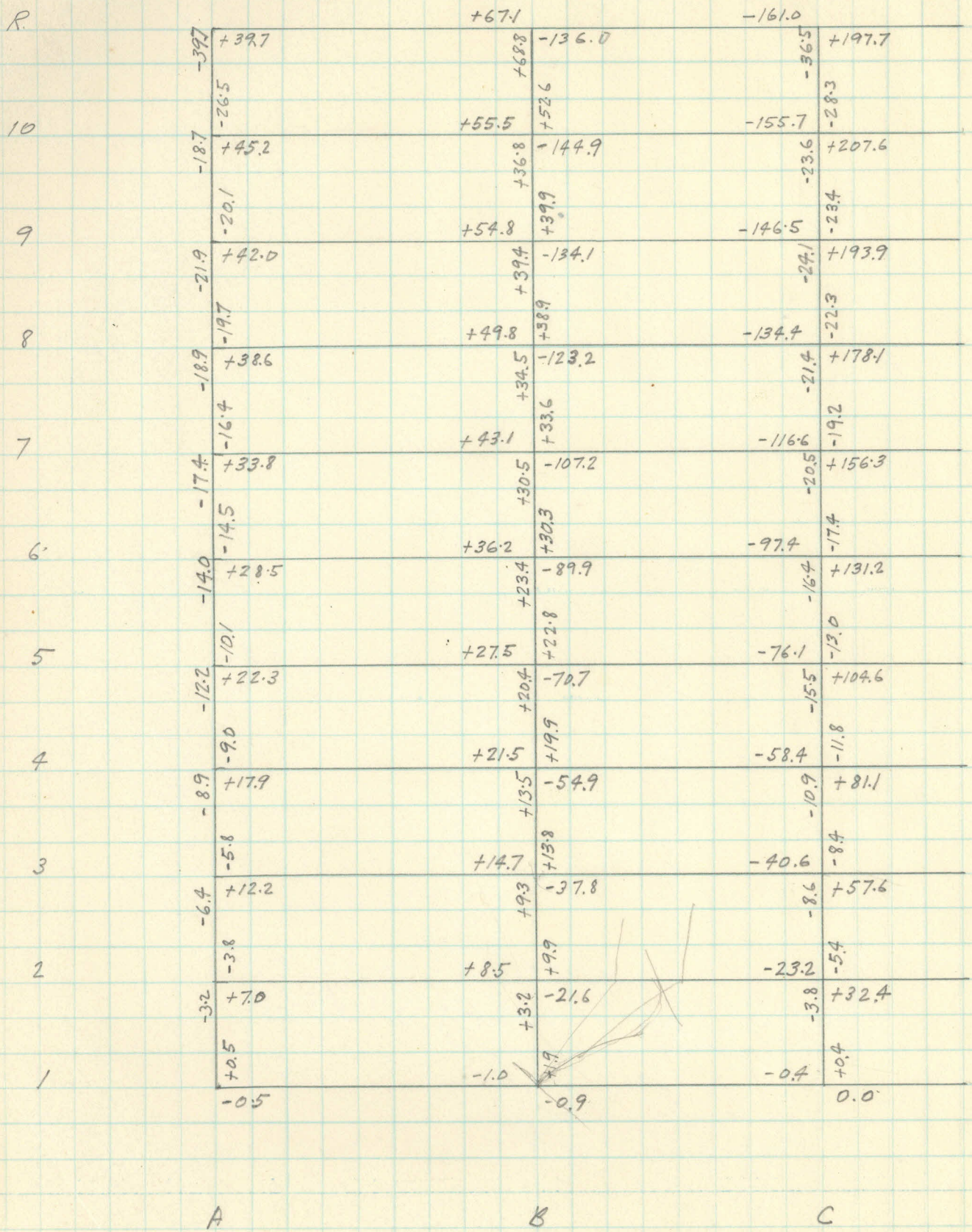
Joint	3A				3B					3C					
Mem.	A-32	A3-4	3-AB		B32	B3-4	3-BA	3-BC		C-32	C3-4	3-CB	3CC		
K/ΣK St.	.160	.165			.170	.1675				.170	.1675				
K/ΣK Jt.	.420	.408	.172		.369	.345	.143	.143		.358	.334	.139	.169		
FEM	0	0	+17.1		0	0	+17.1	-34.9	-17.8	0	0	-34.9	+67.5	+32.6	
Dist	-7.2	-7.0	-2.9		+6.6	+6.2	+2.5	+2.5		-11.7	+10.9	-4.5	-5.5		2-3
C.O.	-2.0	-5.2	+1.2		+1.8	+4.6	-1.4	-2.2		-3.1	-7.5	+1.2	-2.7		
Bal	+4.5	+6.9	✓		+4.8	+7.0	✓	✓		+4.8	+7.0	✓	✓		-28.3
Dist	-2.3	-2.2	-0.9	+5.4	-5.9	-5.0	-2.1	-2.1	+14.6	+0.1	+0.1	0	+0.1	-0.3	
C.O.	-0.7	-1.6	-1.2		-1.4	-3.8	-0.5	✓		+0.1	+0.3	-1.2	+0.1		
Bal	+2.8	+4.3	✓		+3.0	+4.3	✓	✓		+3.0	+4.3	✓	✓		-17.4
Dist	-1.5	-1.5	-0.6	+3.6	-0.6	-0.6	-0.2	-0.2	+1.6	-2.4	-2.2	-0.9	-1.1	+6.6	
C.O.	-0.6	-1.1	-0.1		-0.1	-0.4	-0.3	-0.4		-0.6	-1.5	-0.1	-0.5		
Bal	+1.7	+2.6			+1.8	+2.6	✓	✓		+1.8	+2.6	✓	✓		-10.7
Dist	-1.1	-1.0	-0.4	+2.5	-1.2	-1.1	-0.4	-0.5	+3.2	-0.6	-0.6	-0.2	-0.3	+1.7	
	-6.4	-5.8	+12.2		+9.3	+13.8	+14.7	-37.8		-8.6	-8.4	-40.6	+57.6		

Joint	2A				2B					2C					
Mem	A23	A21	2-AB		B2-3	B2-1	2-BA	2-BC		C-23	C21	2CB	2CC		
K/ΣK St.	.160	.160			.170	.170				.170	.170				
K/ΣK Jt.	.415	.415	.170		.360	.360	.140	.140		.350	.350	.135	.165		
FEM	0	0	+9.9		0	0	+9.9	-20.2	-10.3	0	0	-20.2	+38	+17.8	
Dist.	-4.1	-4.1	-1.7		+3.7	+3.7	+1.4	+1.5		-6.2	-6.2	-2.4	-3.0		1-2
Co.	-3.6	✓	+0.7		+3.3	✓	-0.8	-1.2		-5.8	✓	+0.7	-1.5		
Bal	+4.5	+1.6	✓		+4.8	+1.7	✓	✓		+4.8	+1.7	✓	✓		-10.0
Dist	-1.3	-1.3	-0.6	+3.2	-2.8	-2.8	-1.1	-1.1	+7.8	+0.1	✓	✓	✓	-0.1	
CO.	-1.2	+0.2	-0.6		-2.7	-1.0	-0.3	✓		+0.1	+0.4	-0.6	✓		
Bal	+2.8	+1.6	✓		+3.0	+1.6	✓	✓		+3.0	+1.6	✓	✓		-9.7
Dist	-1.2	-1.2	-0.4	+2.8	-0.2	-0.2	-0.1	-0.1	+0.6	-1.6	-1.6	-0.6	-0.7	+4.5	
C.O.	-0.7	-0.1	✓		-0.3	✓	-0.2	-0.2		-1.2	-0.2	✓	-0.3		
Bal	+1.7	+0.8	✓		+1.8	+0.9	✓	✓		+1.8	+0.9	✓	✓		-5.2
Dist	-0.7	-0.7	-0.3	+1.7	-0.7	-0.7	-0.3	-0.3	+2.0	-0.4	-0.4	-0.1	-0.1	+1.0	
	-3.8	-3.2	+7.0		+9.9	+3.2	+8.5	-21.6		-5.4	-3.8	-23.2	+32.4		

2ND Corr to Secondary Wind mom.

Joint	1A			1B				1C				
Mem.	A1-2	1-AB	unbal M.	B1-2	1-BA	1-BC	unbal N	C1-2	1-CB	1-CC	unbal M	unbal M in story
K/ΣK St.	.160			.170				.170				
K/ΣK Jt.	.710	.290		.564	.218	.218		.538	.208	.254		
FEM	0	0		0	0	0		0	0	0		
Dist	✓	✓		✓	✓	✓		✓	✓	✓		
CO	-2.1	✓		+1.8	✓	✓		-3.1	✓	✓		
Bal	+1.6	✓		+1.7	✓	✓		+1.7	✓	✓		
Dist	+0.4	+0.1	-0.5	-2.0	-0.7	-0.8	+3.5	+0.7	+0.3	+0.4	+1.4	
C.O.	-0.7	-0.4		-1.4	+0.1	+0.2 X		✓	-0.4	+0.2 X		
Bal	+1.6	✓		+1.6	✓	✓		+1.6	✓	✓		
Dist	-0.3	-0.2	+0.5	-0.3	-0.1	-0.1	+0.5	-0.7	-0.3	-0.4	+1.4	
C.O.	-0.6	✓		-0.1	-0.1	-0.1		-0.6	✓	-0.2		
Bal	+0.8	✓		+0.9	✓	✓		+0.9	✓	✓		
Dist	-0.2	✓	+0.2	-0.3	-0.2	-0.1	+0.6	-0.1	✓	-0.1	+0.1	
	+0.5	-0.5		+1.9	-1.0	-0.9		+0.4	-0.4	0		

2ND Correction to Secondary Wind Moment.



2ND Correction to Secondary Moms
(Check of Solution)

Story	Col.	θ (↻+)	$\frac{d-L\theta}{L}$	d/L (→+)	Δθ	I/L	$2M_L+M_R$	$\frac{M_L+M_R}{2}$
	A	0	.0372	+.0372	+.0985	18.8		
1-2	B	+.0325	.0050	+.0375	-.0327	19.9		
	C	0	.0386	+.0386	+.1057	"		
	A	+.0985	-.0106	+.0879	+.0692	18.8		
2-3	B	+.0002	.0880	+.0882	+.0151	19.9		
	C	.1057	.0186	+.0873	+.0805	"		
	A	+.1677	-.0246	+.1431	+.0847	18.3	2.7	1.55
3-4	B	+.0149	+.1267	+.1426	+.0081	18.6	14.1	.15
	C	+.1862	-.0529	+.1333	+.0672	"	5.9	1.25
	A	+.2524	-.0527	+.1997	+.0875	18.3	5.8	1.6
4-5	B	+.0230	+.1740	+.1970	-.0135	18.6	19.4	.25
	C	+.2534	-.0727	+.1807	+.0995	"	8.1	1.85
	A	+.3399	-.0722	+.2677	+.1360	14.3	6.2	1.95
5-6	B	+.0095	+.2540	+.2635	-.0206	14.6	22.2	.30
	C	+.3529	-.1097	+.2432	+.1164	"	9.6	1.70
	A	+.4759	-.1350	+.3409	+.1013	14.3	11.6	1.45
6-7	B	-.0111	.3440	+.3329	-.0069	14.6	30.1	0.10
	C	+.4693	.1633	+.3060	+.1060	"	14.3	1.55
	A	+.5772	.1770	+.4002	+.0955	13.1	13.9	1.25
7-8	B	-.0180	.4140	+.3960	-.0341	13.2	32.7	.45
	C	+.5753	.2150	+.3603	+.0834	"	17.0	1.1
	A	+.6727	.2230	+.4497	+.0840	13.1	17.5	1.1
8-9	B	-.0521	.4860	+.4339	-.0190	13.2	38.4	.25
	C	+.6587	.2590	+.3997	+.0682	"	20.5	.90
	A	+.7567	.2740	+.4827	+.0535	13.1	21.5	.70
9-10	B	-.0711	.5440	+.4729	+.1174	13.2	43.0	1.55
	C	+.7269	.2940	+.4329	+.0076	"	23.2	0.10
	A	+.8102	.1693	+.6409		13.1	13.3	
10-R	B	+.0463	.4610	+.5073		13.2	36.4	
	C	+.7345	.2540	+.4805		"	20.1	

Secondary Mom's With Two Corrections

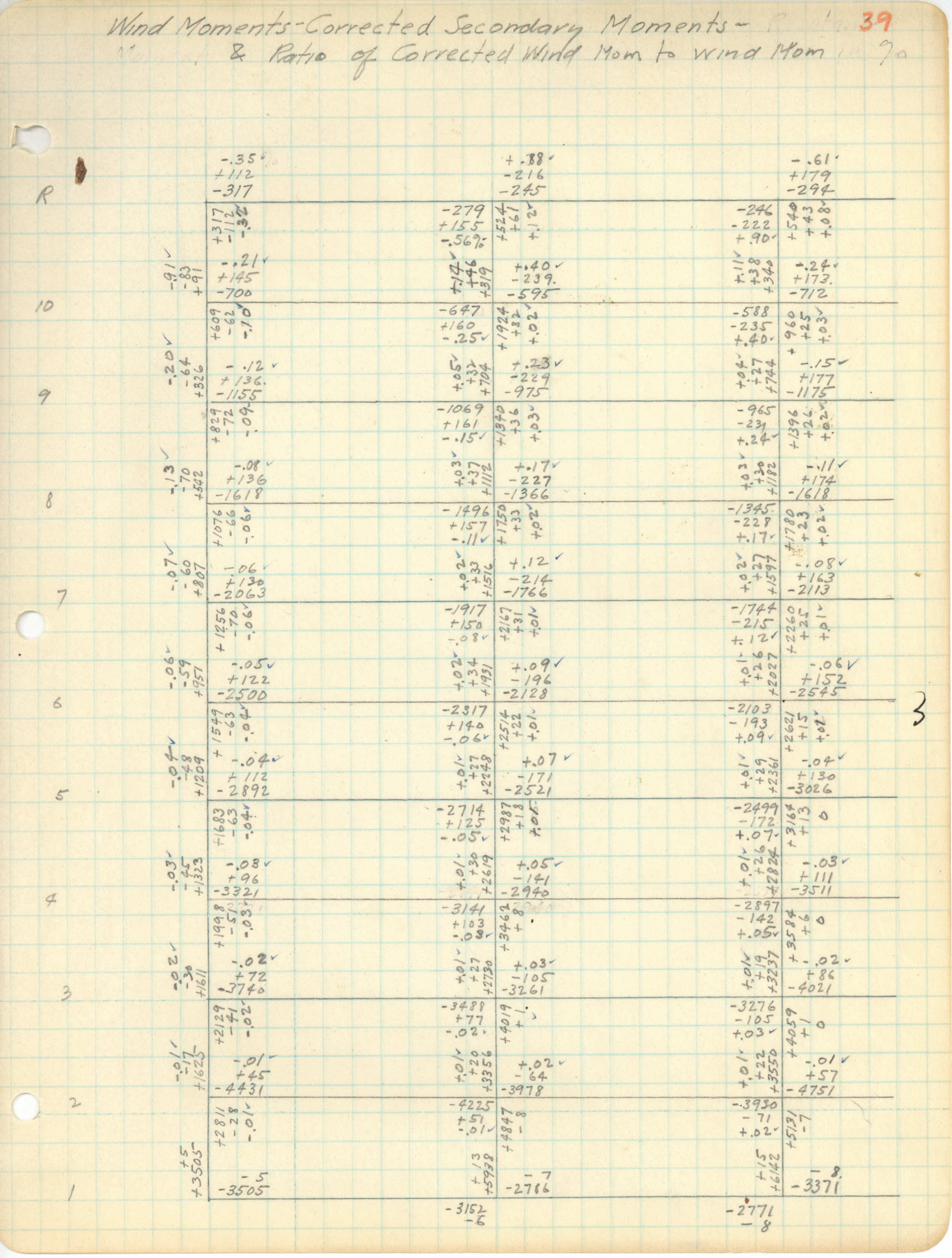
R						
				+154.9 +67.1 -112.2 +200.0		-222.1 -161.0 +219.9 -281.0
	-112.2 -39.7 +73.5 -146.0	+146.0 (Sec. 14) -73.5 (1st Corr) +39.7 (2nd Corr) +112.2	+61.2 +68.8 -82.6 +75.0	-275.0 +194.8 -136.0 -216.2	+42.9 -36.5 +25.4 +54.0	+227.0 -245.3 +197.7 +179.4
		-106.0 +49.3 -26.5 -83.2	+160.2 +55.5 -99.3 +204.0	+58.0 -64.2 +52.6 +46.4	-235.2 -155.7 +216.5 -296.0	+49.0 +17.3 -28.3 +38.0
10	-61.5 -18.7 +35.2 -78.0	+184.0 -84.5 +45.2 +144.7	+31.9 +36.8 -41.9 +37.0	-299.0 +205.4 -144.9 -238.5	+24.6 -23.6 +15.2 +33.0	+214.0 -249.0 +207.6 +172.6
		-83.0 +39.0 -20.1 -64.1	+160.6 +54.8 -96.2 +202.0	+41.0 -48.5 +39.9 +32.4	-230.5 -146.5 +203.0 -287.0	+35.0 +15.8 -23.4 +27.4
9	-71.6 -21.9 +40.3 -90.0	+173.0 -79.3 +42.0 +135.7	+36.3 +39.4 -45.1 +42.0	-285.0 +189.8 -134.1 -229.3	+26.3 -24.1 +16.4 +34.0	+218.0 -235.2 +193.9 +176.7
		-86.0 +36.0 -19.7 -69.7	+157.1 +49.8 -88.7 +196.0	+43.0 -45.3 +38.9 +36.6	-228.3 -134.4 +186.1 -280.0	+39.0 +13.7 -22.3 +30.5
8	-66.0 -18.9 +36.9 -84.0	+170.0 -72.9 +38.6 +135.7	+33.4 +34.5 -40.1 +39.0	-278.0 +174.1 -123.2 -227.1	+23.5 -21.4 +16.0 +29.0	+212.0 -215.8 +178.1 +174.3
		-76.0 +32.4 -16.4 -60.0	+150.0 +43.1 -79.1 +186.0	+40.0 -40.4 +33.6 +33.2	-215.0 -116.6 +164.6 -263.0	+33.0 +13.0 -19.2 +26.8
7	-70.3 -17.4 +32.1 -85.0	+161.0 -64.5 +33.8 +130.3	+30.8 +30.5 -34.7 +35.0	-261.0 +154.2 -107.2 -214.0	+25.0 -20.5 +14.5 +31.0	+199.0 -192.1 +156.3 +163.2
		-73.0 +28.5 -14.5 -59.0	+139.6 +36.2 -66.6 +170.0	+40.0 -36.0 +30.3 +34.3	-193.1 -97.4 +140.3 -236.0	+32.0 +10.4 -17.2 +26.0
6	-62.5 -14.0 +27.5 -76.0	+149.0 -56.0 +28.5 +121.5	+21.8 +23.4 -28.6 +27.0	-237.0 +131.2 -89.9 -195.7	+15.4 -16.4 +11.8 +20.0	+183.0 -162.5 +131.2 +151.7
		-60.0 +21.9 -10.1 -48.2	+125.3 +27.5 -52.2 +150.0	+32.0 -27.8 +22.8 +27.0	-171.5 -76.1 +110.6 -206.0	+33.0 +8.5 -13.0 +28.5
5	-63.3 -12.2 +23.9 -75.0	+135.0 -45.8 +22.3 +111.5	+18.4 +20.4 -27.0 +22.0	-204.0 +104.0 -70.7 -170.7	+12.8 -15.5 +11.3 +17.0	+156.0 -130.4 +104.6 +130.2
		-53.0 +17.4 -9.0 -44.6	+103.0 +21.5 -41.4 +123.0	+34.0 -24.1 +19.9 +29.8	-142.3 -58.4 +86.1 -170.0	+30.0 +7.3 -11.8 +25.5
4	-51.2 -8.9 +17.7 -60.0	+113.0 -35.1 +17.9 +95.8	+8.4 +13.5 -16.1 +11.0	-168.0 +81.6 -54.9 -141.3	+6.1 -10.9 +9.0 +8.0	+132.0 -102.5 +81.1 +110.6
		-37.0 +12.5 -5.8 -30.3	+77.1 +14.7 -28.6 +91.0	+30.0 -16.6 +13.8 +27.2	-105.4 -40.6 +59.2 -124.0	+23.0 +4.6 -8.4 +19.2
3	-41.2 -6.4 +12.2 -47.0	+84.0 -24.7 +12.2 +71.5	+0.6 +9.3 -11.5 +3.0	-124.0 +56.7 -37.8 -105.1	+0.7 -8.6 +7.3 +2.0	+99.0 -71.1 +57.6 +85.5
		-21.0 +7.7 -3.8 -17.1	+50.7 +8.5 -16.8 +59.0	+23.0 -12.6 +9.9 +20.3	-71.2 -23.2 +29.0 -77.0	+22.0 +5.1 -5.4 +21.7
2	-27.7 -3.2 +6.5 -31.0	+52.0 -14.2 +7.0 +44.8	-7.5 +3.2 -3.7 -7.0	-75.0 +33.1 -21.6 -63.5	-7.4 -3.8 +5.4 -9.0	+64.0 -39.8 +32.4 +56.6
		+5.0 -0.7 +0.5 +4.8	-5.5 -1.0 +1.5 -6.0	+14.0 -3.0 +1.9 +12.9	-7.5 -0.4 +0.9 -8.0	+16.0 -1.2 +0.4 +15.2
1		-5.0 +0.7 -0.5 -4.8		-8.0 +1.5 -0.9 -7.4		-8.0 +0.3 0.0 -7.7

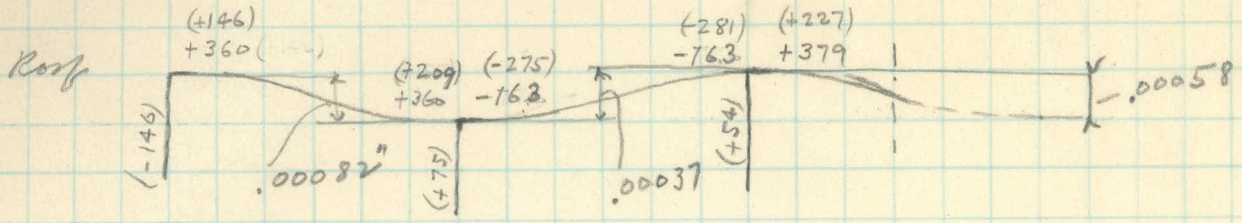
Fixed-end Moments Due to Second Correction to Secondary Moments.

↓ ↑ $I/L = 7.7$ ↑ ↓ $I/L = 7.7$ ↓ ↑ $I/L = 9.4$

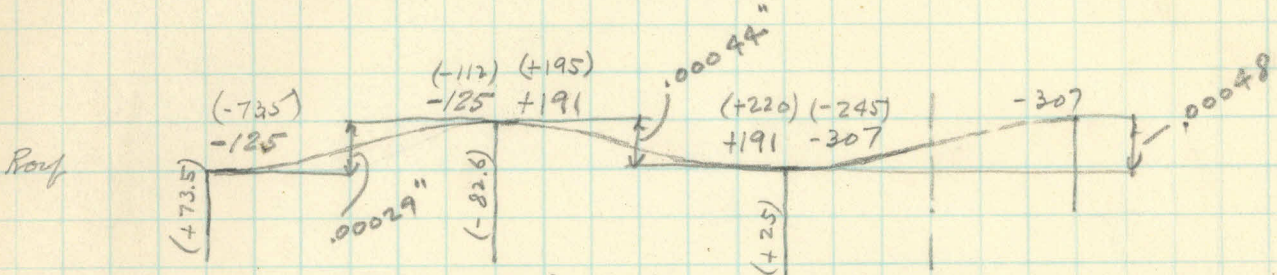
	Span AB = 22'			Span BC = 22'			Span CC				Col A			Col B			Col C		
Floor	$\frac{M_L+M_R}{L}$	$\frac{A}{h}E$	FEM. F'AB	$\frac{M_L+M_R}{L}$	$\frac{A}{h}E$	FEM.	$\frac{M_L+M_R}{L}$	$\frac{A}{h}E'$	FEM.	Story	Load	Area	P/A	Load	Area	P/A	Load	P/A	Length
R	4.85	4.37	-9.2	13.50	15.96	+33.5	21.90	31.75	-99.4	10-R	+4.85	38.86	+ .12	-18.35	41.00	- .45	+35.40	.86	12-0
10	4.57	4.25	-8.9	13.48	15.51	+32.6	23.00	30.89	-96.7	9-10	+9.45	"	.24	36.63	"	.89	72.08	1.76	
9	4.40	4.01	8.4	12.75	14.62	30.7	21.50	29.13	91.1	8-9	+13.85	"	.35	53.78	"	1.31	106.33	2.59	
8	4.01	3.66	7.7	11.70	13.31	28.0	19.80	26.54	83.0	7-8	17.86	"	.46	69.49	"	1.69	137.83	3.36	
7	3.50	3.20	6.7	10.17	11.62	24.4	17.40	23.18	72.5	6-7	21.36	4226	.51	83.16	4439	1.88	164.40	3.71	
6	2.94	2.69	5.6	8.52	9.74	20.5	14.60	19.47	61.0	5-6	24.36	"	.58	94.62	"	2.14	188.52	4.25	
5	2.26	2.11	4.4	6.67	7.60	16.0	11.60	15.22	47.7	4-5	26.56	5379	.49	103.55	5972	1.73	206.79	3.46	
4	1.79	1.62	3.4	5.15	5.87	12.3	9.01	11.76	36.8	3-4	28.35	"	.53	110.49	"	1.85	220.95	3.70	
3	1.22	1.09	2.3	3.56	4.02	8.4	6.40	8.06	-25.2	2-3	29.57	6424	.46	115.27	6780	1.70	230.91	3.41	↓
2	.71	.63	-1.3	2.04	2.32	+4.9	3.60	4.65	-14.6	1-2	30.28	"	.47	118.02	"	1.74	236.55	3.49	16-0
1										$\frac{16P}{12A}$			.63			2.32		4.65	
	30.25			87.74									4.37			15.96		31.75	

Wind Moments - Corrected Secondary Moments - & Ratio of Corrected Wind Mom to wind Mom

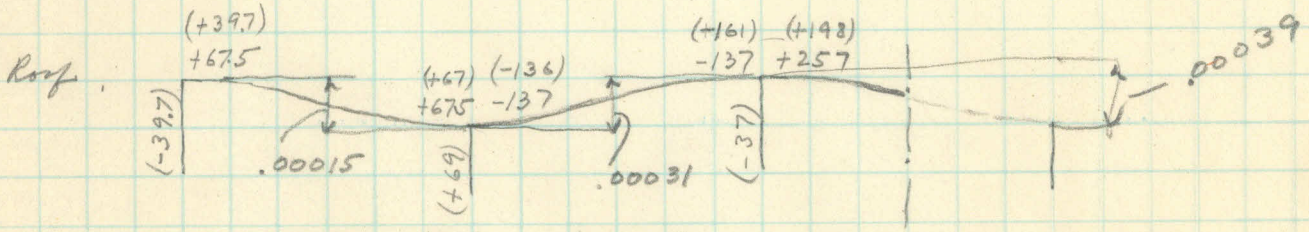




Col. Deformations due to Wind loads.

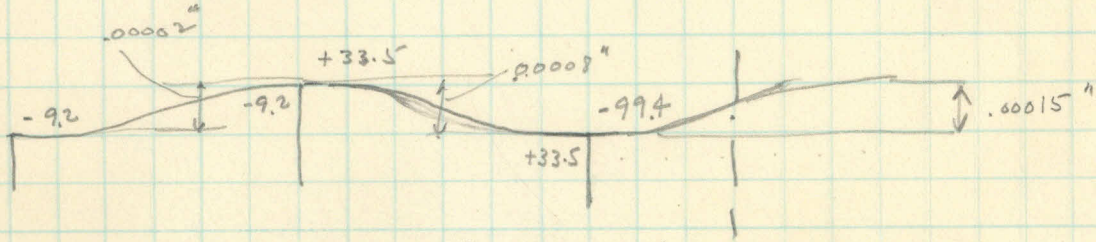


Col. Deformations due to Secondary Moments



Col Deformations Due to 1st Correction to Secondary moments.

Moments Without brackets are fixed end moments.
Moments in brackets are distributed fixend moms.



Col Def due to 2nd Cor to secondaries.