EXPERIMENTAL INVESTIGATION OF TRUSS TYPE RIGID FRAMES INCLUDING CONNECTION STUDIES -BOTTOM CHORD STRUT CONNECTIONS- VOLUME II

FR2 FRAME TESTS

by

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CHAPTER I

INTRODUCTION

A series of tests was conducted in the Fears Structural Engineering Laboratory, School of Civil Engineering and Environmental Science, University of Oklahoma, using standard rigid frames produced and erected by VULCRAFT, a division of Nucor Corporation, hereafter referred to as VULCRAFT. The purpose of these tests was to determine the structural strength and stiffness of the rigid frames, as well as the adequacy of the analysis/design procedures currently employed by VULCRAFT. The frames, designated FR-2, were fabricated to the dimensions below:

Overall Span	52ft.-10in.
Clear Span	50ft.-2in.
Eave Height	15ft.-11in.
Clear Height	13ft.-5in.
Roof Slope	1/2:12
Bottom Chord Strut Connections	

The FR-2 specimens consisted of clear span rigid frames with constant depth open web column sections and a tapered open web rafter section, all fabricated of shop welded steel angles. A roof slope of 1/2:12 was used for these frames.

The test specimens were fabricated as part of standard production runs. The test set-up consisted of two frames spaced 24 ft. 0 in. on center, with connecting simple span joists and girts, joist bridging, chord brace angles, and rod braces as shown in Figure 1.1 and 1.2. Roof deck and sidewall panel were not installed for the tests. The rafter to column connection consisted of two flat plates and high strength bolts as shown in Figure 1.3.

Simulated dead and live load was applied using gravity load simulators. Simulated wind loading (henceforth referred to as lateral load) was applied using hydraulic cylinders attached to reaction columns. These reaction columns, Figure 1.2(b), were located outside the frames at one end but are not shown in Figure 1.1.

Five test series were conducted: unbalanced live load, lateral load only, combined unbalanced live and lateral load (one with unbalanced live load on the leeward slope and one with unbalanced live load on the windward slope), and full live load. The final tests were continued until failure occurred.

This report provides a detailed description of testing procedures, instrumentation and test results.

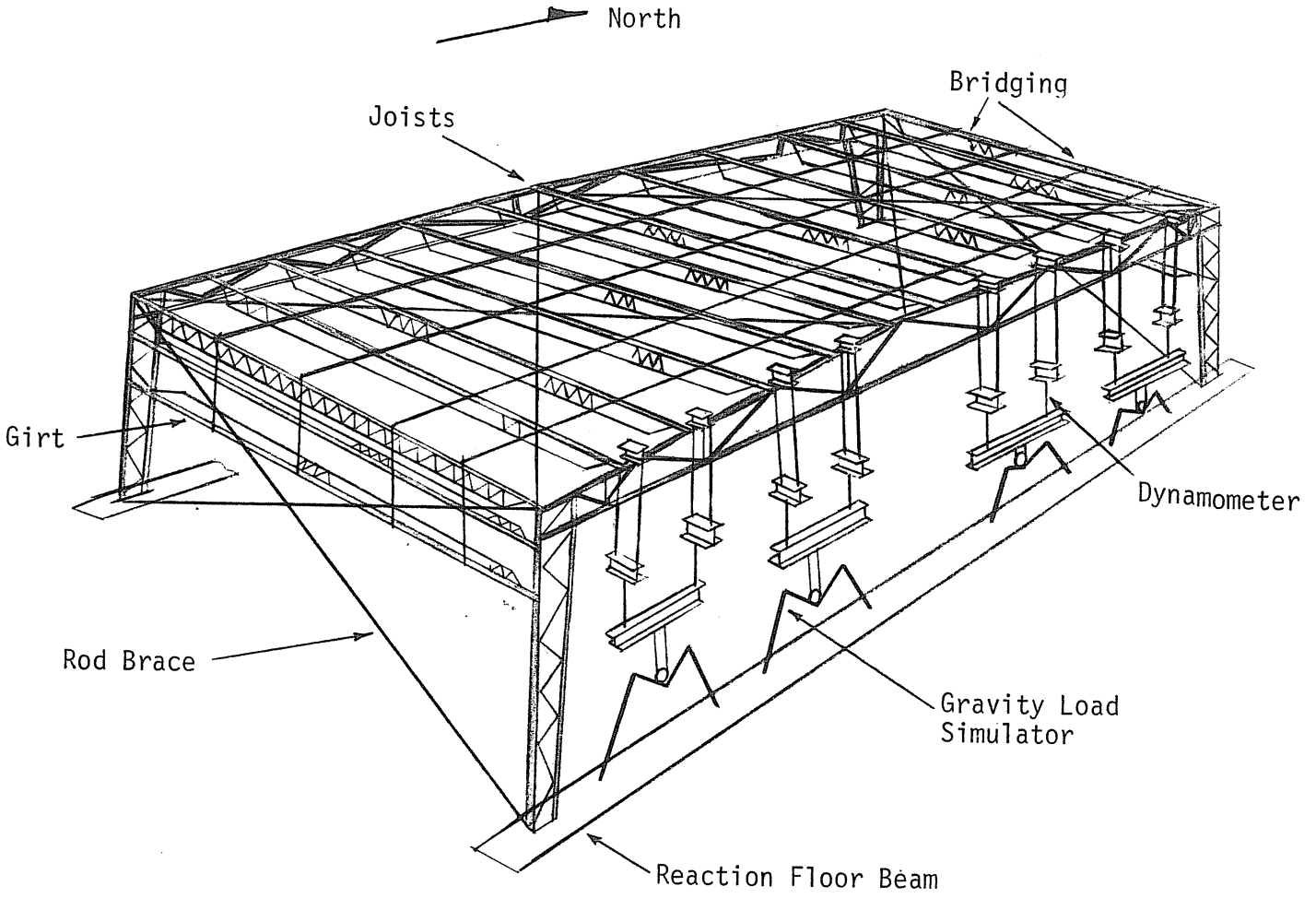
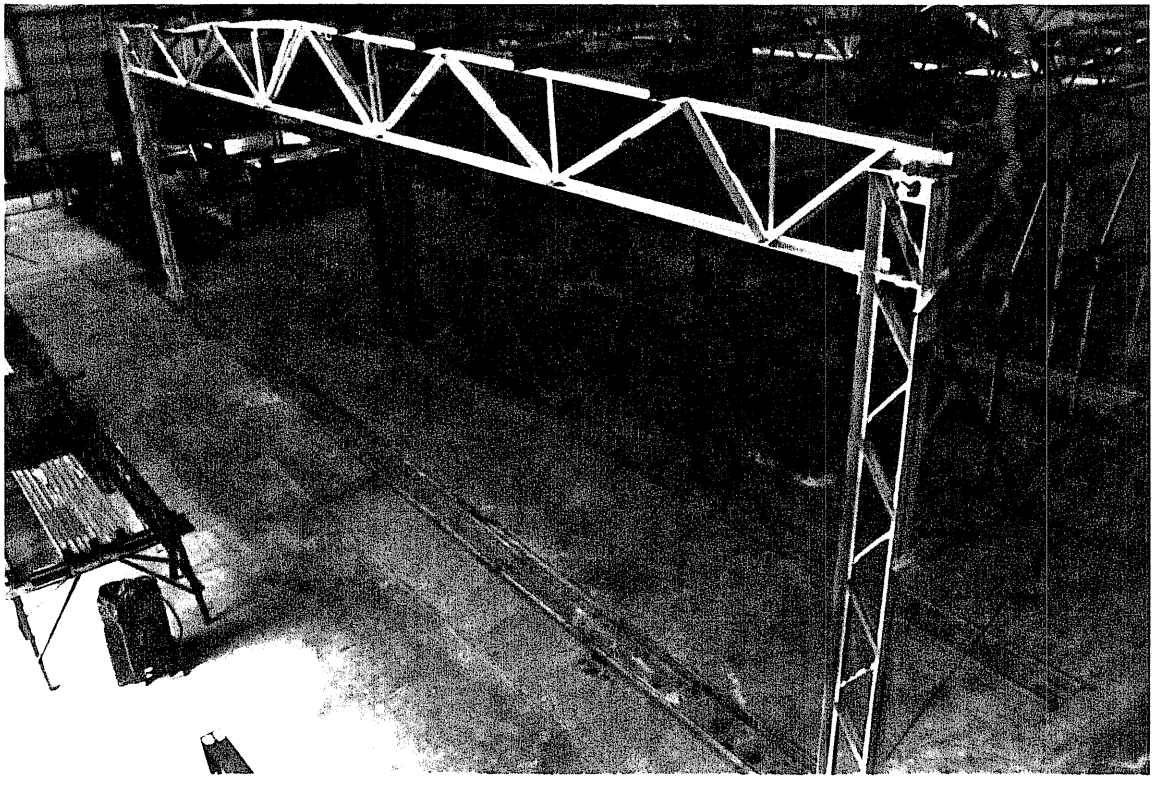
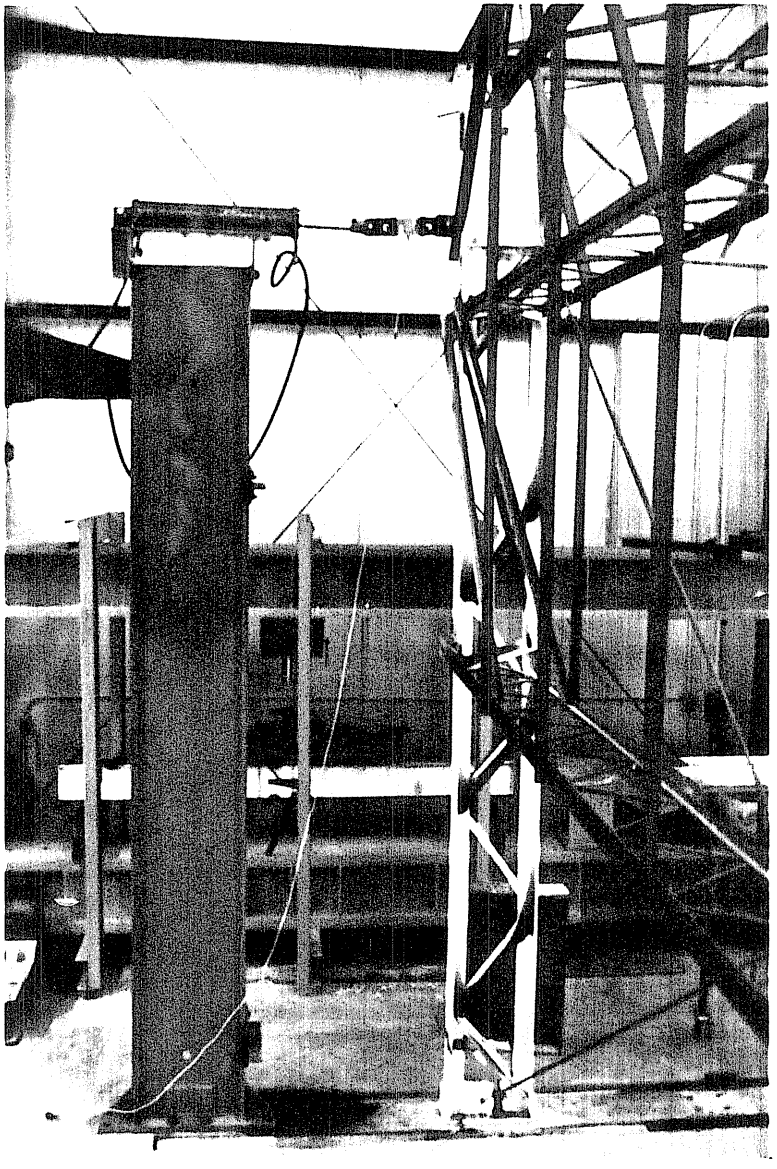


FIGURE 1.1 OVERALL VIEW OF TEST SET-UP



a) Overview



b) Lateral Loading Details

FIGURE 1.2 PHOTOGRAPHS OF TEST SETUP

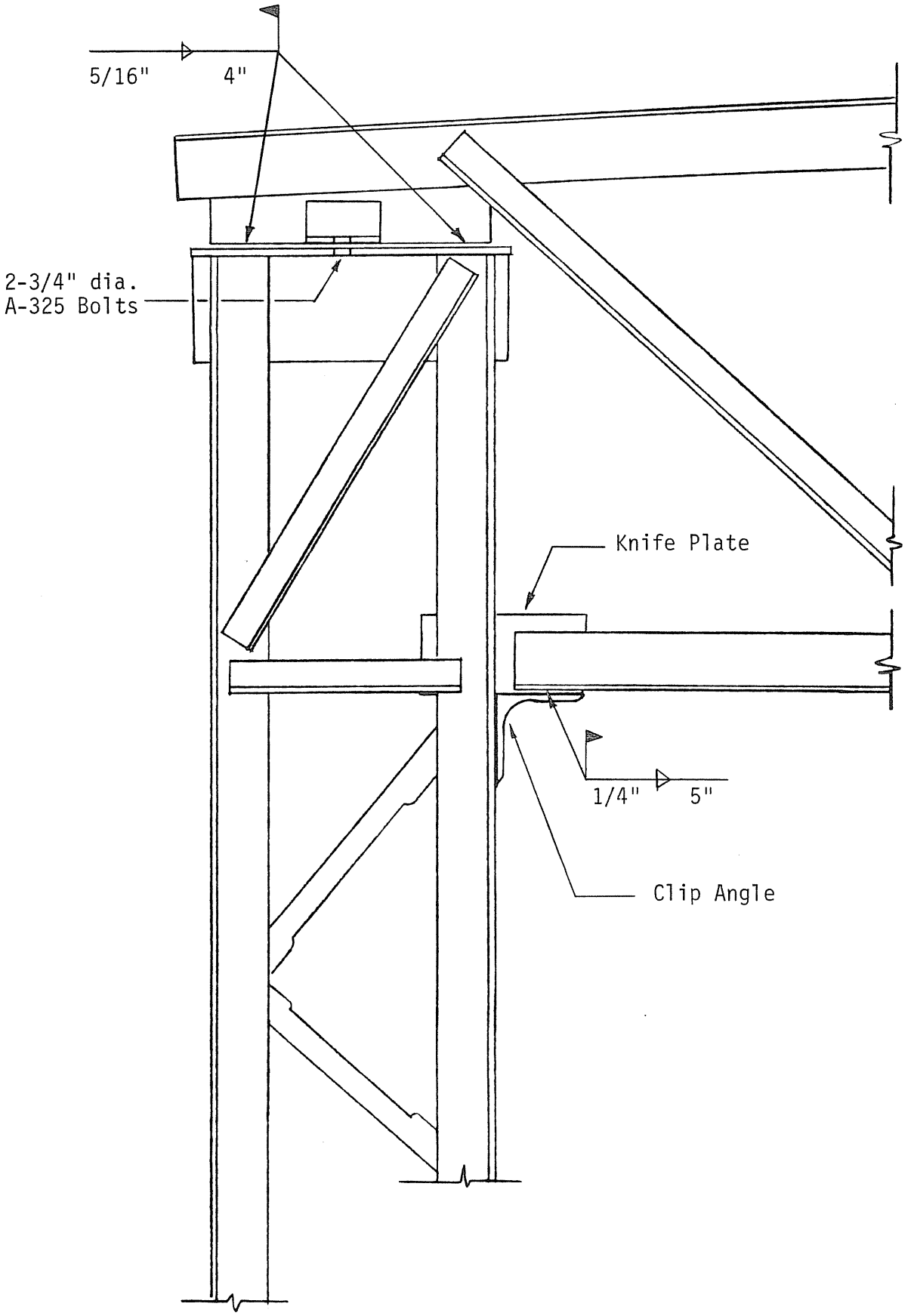


FIGURE 1.3 RAFTER-TO-COLUMN CONNECTION DETAIL

CHAPTER II

TEST DETAILS

2.1 Description of Specimens

Both the test frames and roof joists were fabricated from steel having a nominal yield stress of 50 ksi. The overall dimensions of the frames are shown in Figure 2.1. The member labeling used in the theoretical analyses and the dimensions and properties of the members are included with the stiffness analysis provided by VULCRAFT. Results of these analyses are found in Appendix A. Bottom chord brace locations and details are shown in Figure 2.2.

2.2 Test Set-up

The frames were erected inside the Fears Structural Engineering Laboratory on the laboratory reaction floor. The floor is a concrete slab 30 ft. by 60 ft. by 3 ft. 6 in. deep with four W36x150 steel beams embedded in concrete. The slab weighs one million pounds and is capable of reacting 320 kips in any one location. The frames were erected directly over two of the embedded W36 beams, spaced 24 ft. 0 in. apart. The two frames were connected by joists and wall girts at standard spacings. Standard rod bracing in both the roof and side walls was used. Compression chord braces at standard locations were connected between joists and the bottom chords of the

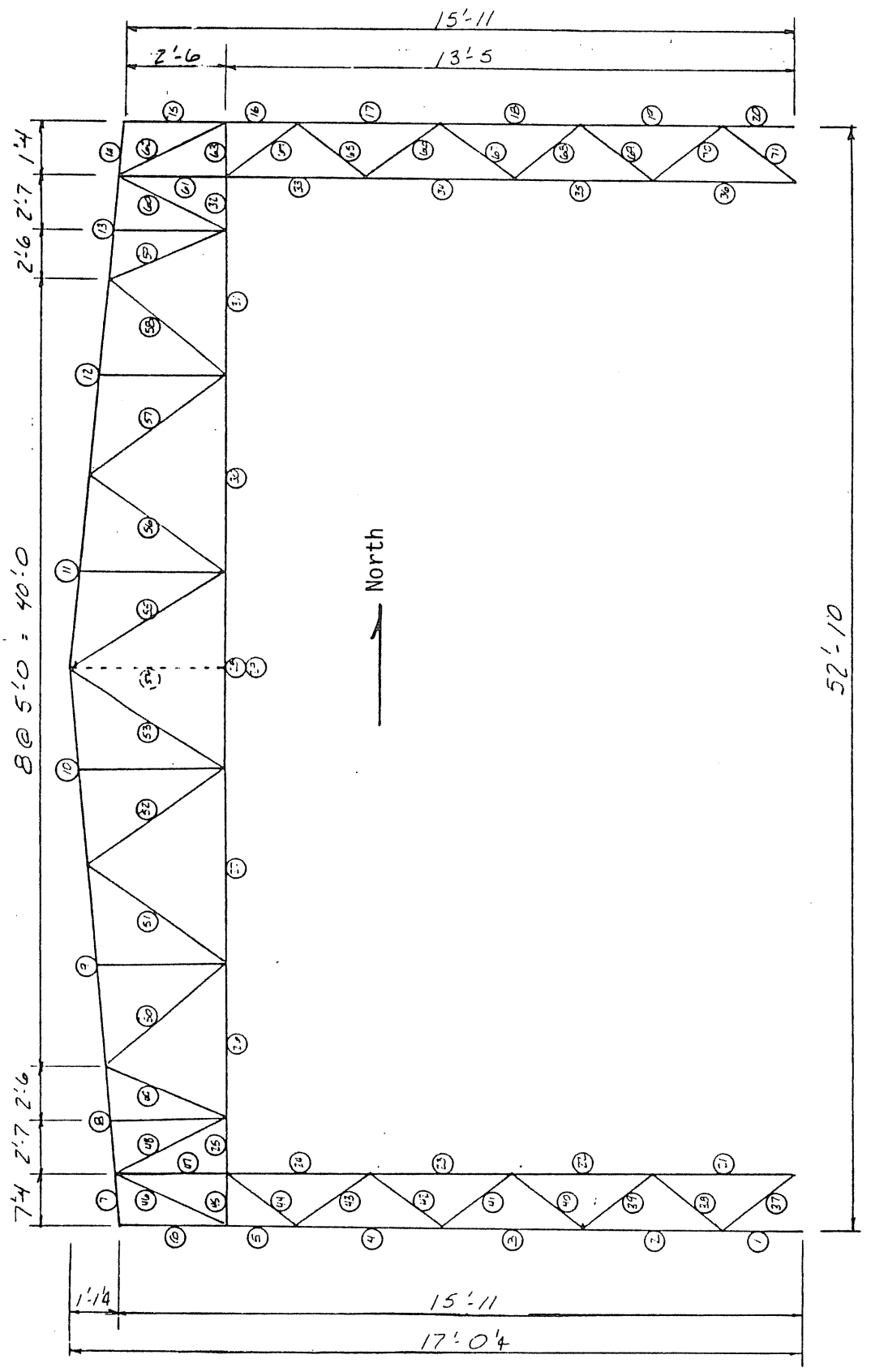
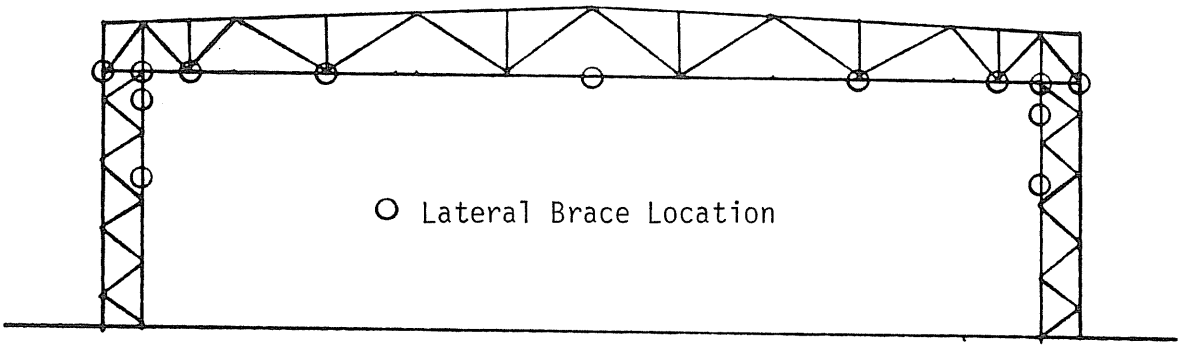
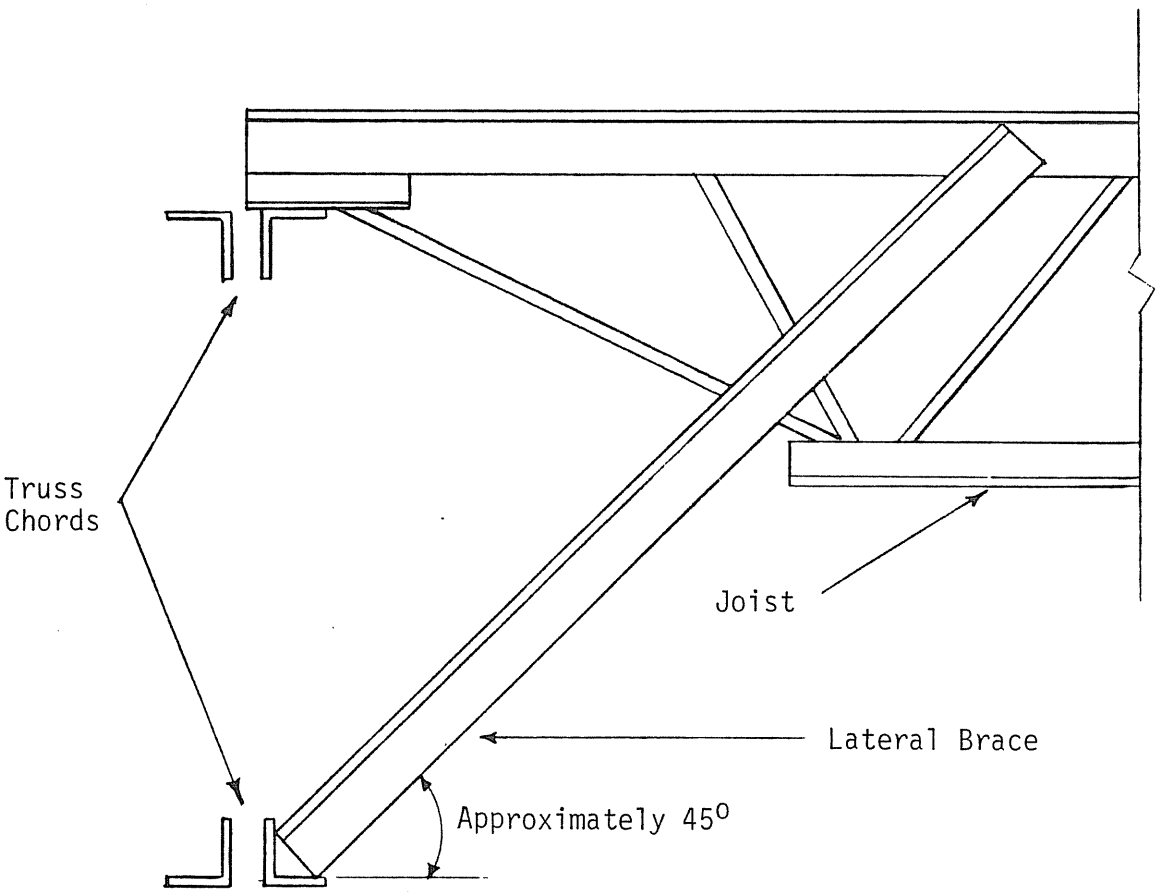


FIGURE 2.1 FRAME DIMENSIONS AND MEMBER LABELING



(a) Lateral Chord Brace Locations



(b) Lateral Brace Details

FIGURE 2.2 CHORD LATERAL BRACE LOCATIONS AND DETAILS

rafters. Eight runs of joist bridging, four on the top chords and four on the bottom chords, were installed the entire length of the structure as indicated in Figure 1.1.

A horizontal truss was constructed using light angles, in the plane of the top chord of the roof joists adjacent and parallel to the east frame rafter. This truss was used to simulate the diaphragm stiffness provided by standard, thru-fastener, metal roof deck.

The columns base plates were bolted to the reaction floor beams as shown in Figure 2.3. The erection procedure followed standard practice with no specific procedure used to tighten the column base plate bolts.

2.3 Load Applications

Simulated live load was applied using loading apparatus as shown in Figure 2.4. The loading apparatus consists of a gravity load simulator (Figure 2.5), a 35 kip tension-compression hydraulic cylinder, spreader beam, two calibrated dynamometers, and hanger beams and tension rods attached to the frame. The simulator is a device which permits horizontal movement of the point of load application while maintaining a vertical line of action of the applied load. For the simulator used in these tests, the point of application of the load can move left or right a maximum of 10 in. with the hydraulic ram remaining vertical.

Lateral load was applied using a reaction column erected adjacent to the frame, with hydraulic cylinders and calibrated load cells positioned as shown in Figure 2.6. For all lateral load applications, load was applied to both

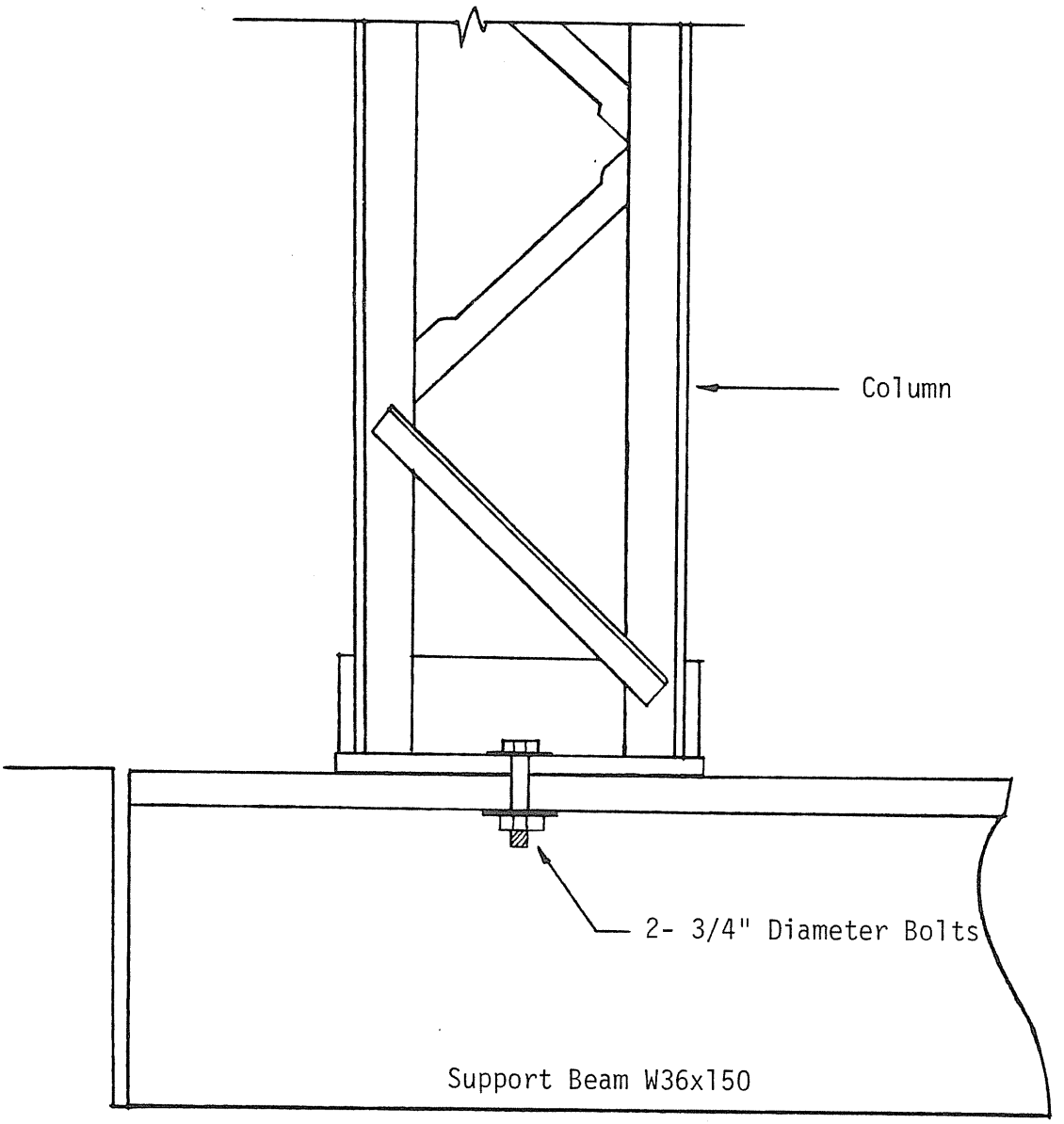


FIGURE 2.3 DETAILS OF COLUMN-TO-REACTION FLOOR CONNECTION

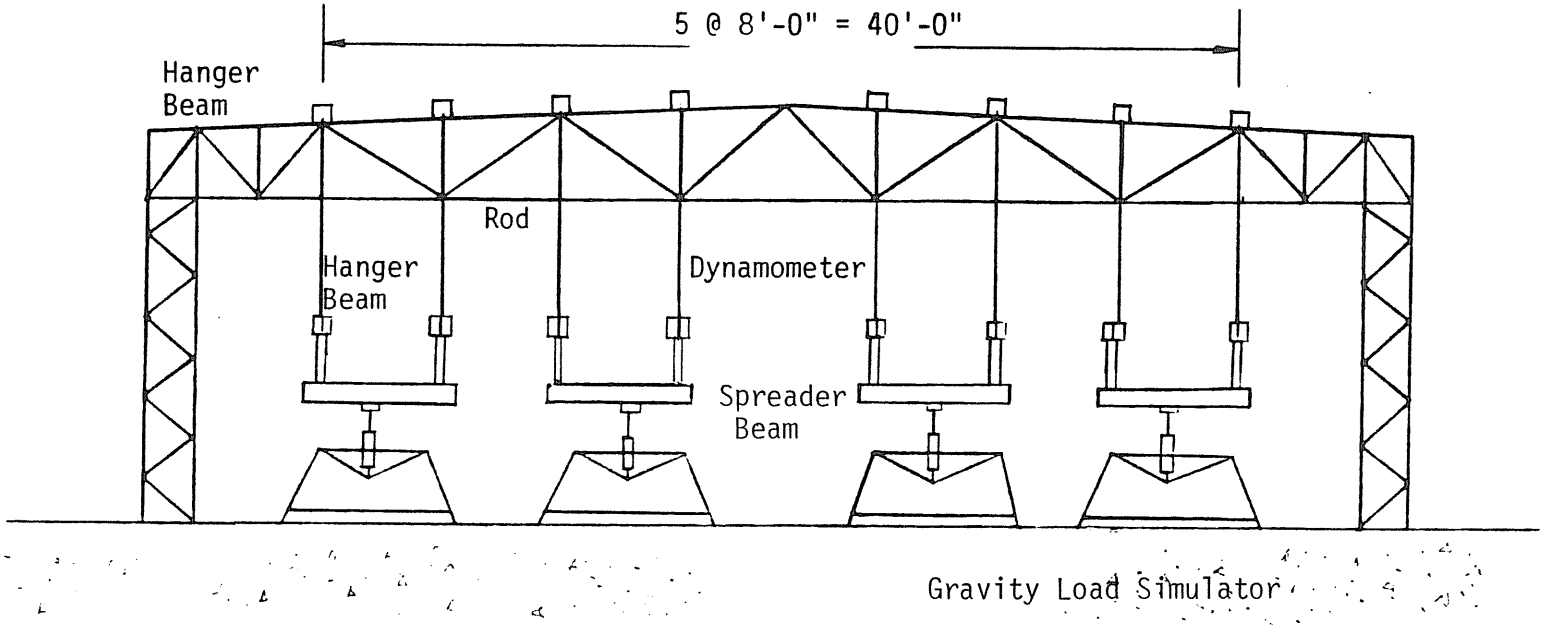


FIGURE 2.4 SIMULATED LIVE LOADING TEST SETUP

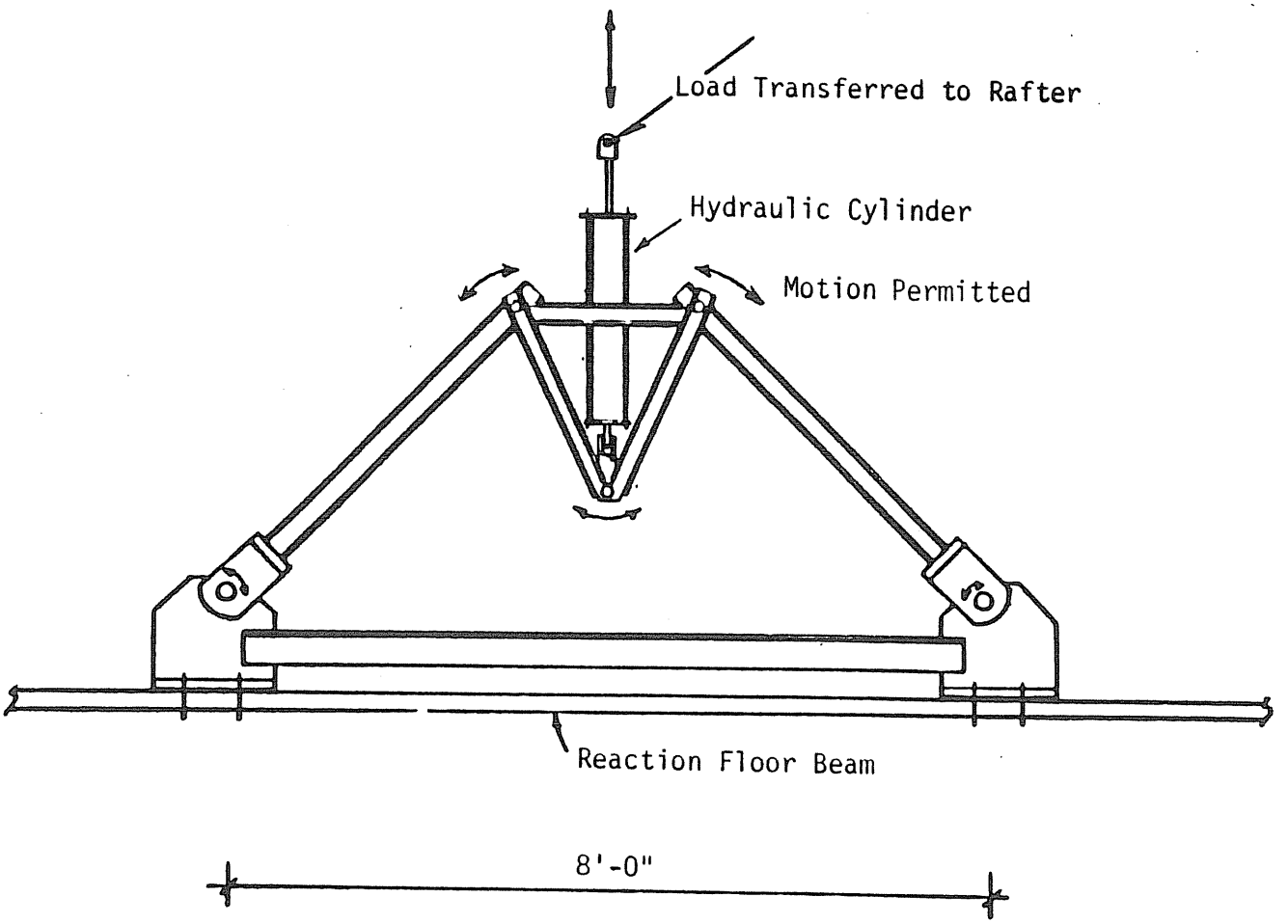


FIGURE 2.5 GRAVITY LOAD SIMULATOR

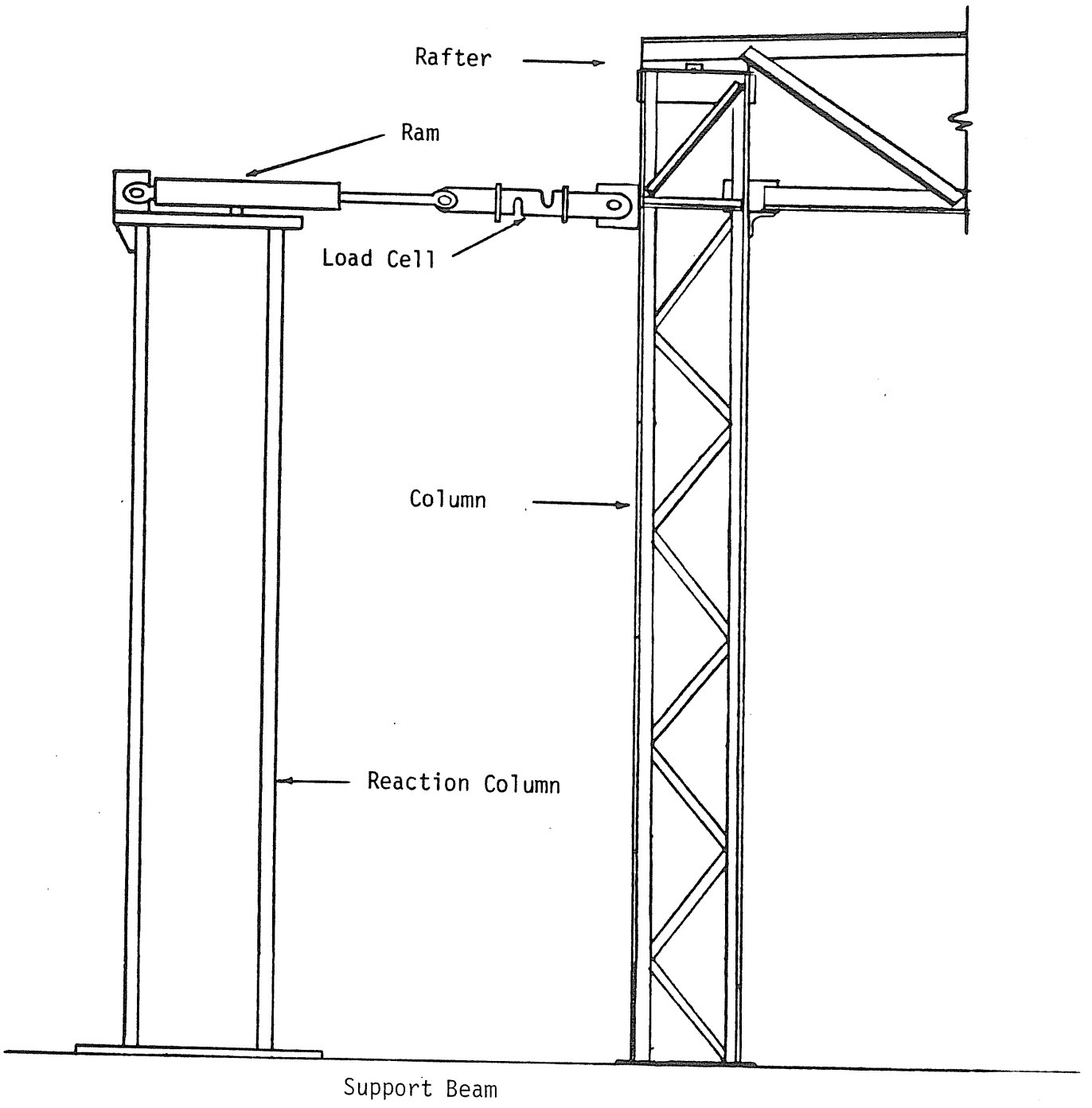


FIGURE 2.6 METHOD OF LATERAL LOAD APPLICATION

frames simultaneously using two identical hydraulic cylinders connected in series to an electric pump.

Five loading schemes were used as shown in Figure 2.7. Figure 2.7(a) shows full gravity loading applied to one frame. For this loading condition, four gravity load simulator hydraulic cylinders were connected in series to an electric pump. Figure 2.7(b) is lateral load only, applied as described above. Figure 2.7(c) shows gravity load applied to one-half of the span to simulate unbalanced live load. For this loading, both frames were loaded simultaneously with the four gravity load simulator hydraulic cylinders connected in series. Figures 2.7(d) and 2.7(e) show combined lateral load with unbalanced live load applied on the windward and leeward sides, respectively.

2.4 Instrumentation

Instrumentation consisted of calibrated dynamometers, calibrated load cells, calibrated calipers, and displacement transducers.

Gravity load was measured using the calibrated dynamometers located as shown in Figure 2.4. Lateral load was measured using the load cells positioned as shown in Figure 2.6.

Vertical deflections at the centerline and quarter points and sidesway movement of the frames were measured using wire-type displacement transducers attached to the bottom chords and to the reaction floor. Lateral movement of the rafter chords was measured utilizing weighted strings suspended from horizontal angles bolted to the

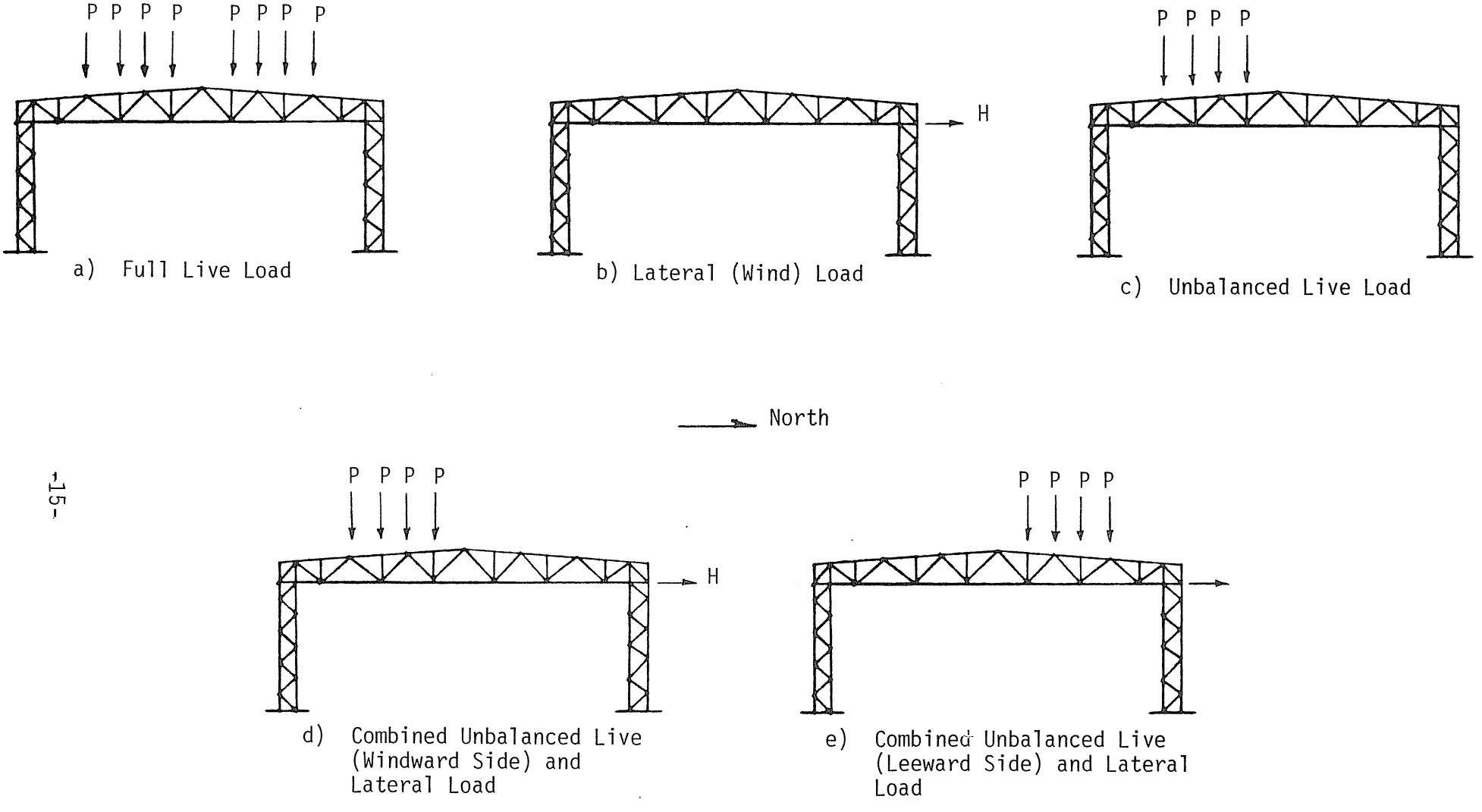


FIGURE 2.7 LOADING CONDITIONS

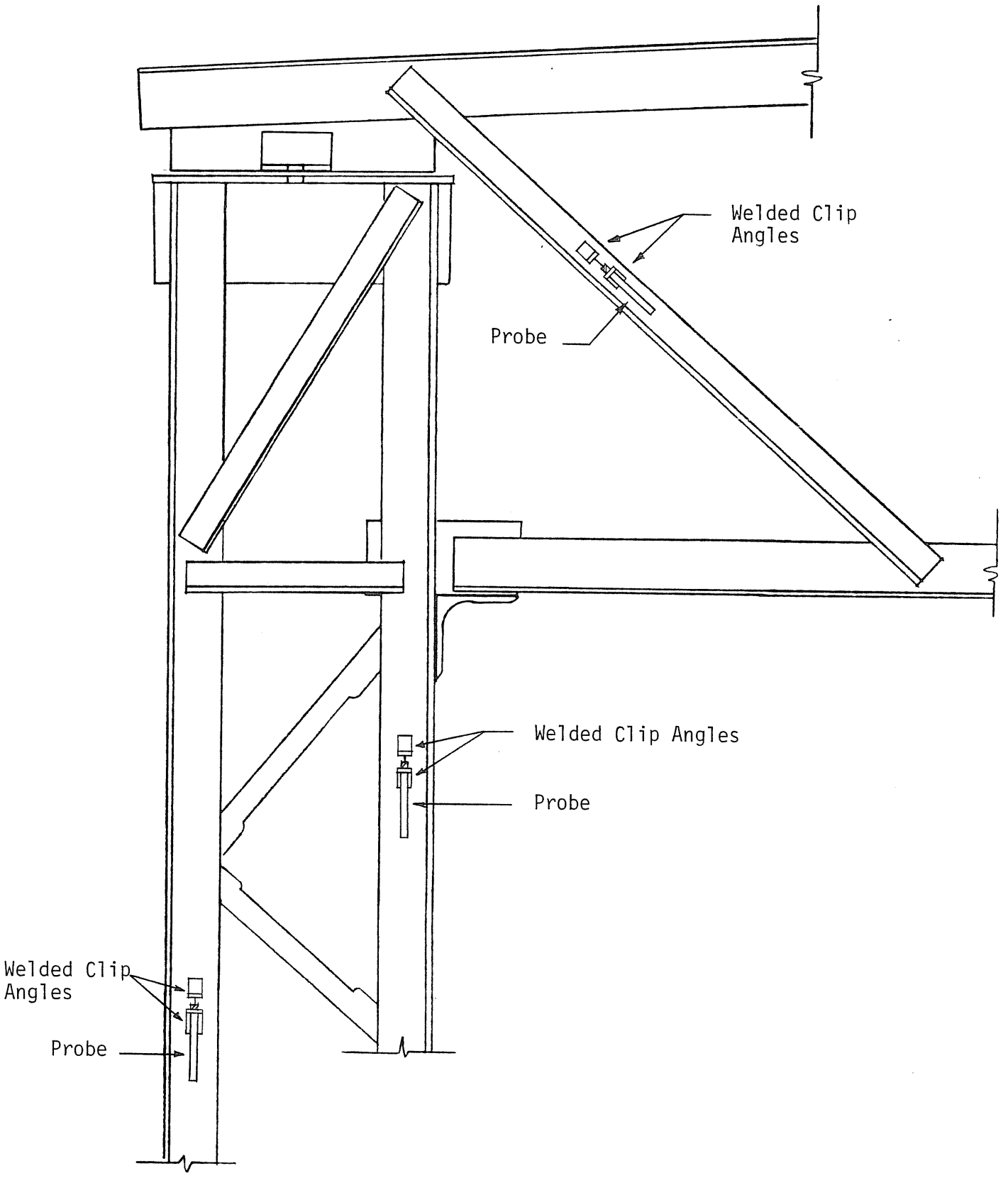


FIGURE 2.8 INSTRUMENTATION AT KNEE AREA

frame. A taunt wire running the length of the frame provided a fixed reference for the measurements. Scales were used to measure the relative movement between the strings and wire which indicated the lateral movement of the rafter chords.

To measure axial elongations of selected frame members, two displacement probes, capable of recording displacements as small as .001 in., were mounted on members of interest, Figure 2.8. The probes were mounted on one angle of the member and the deformation of the member measured. This deformation was converted to strain and then stress assuming elastic material properties and a modulus of elasticity of 29,000 ksi.

2.5 Testing Procedures

Prior to any actual testing, an overall check of the testing apparatus and instrumentation was made. In general, load was applied in 1 kip increments until near the target load at which time the increment was decreased. After each load increment, instrumentation readings were recorded and the specimens were checked for signs of yielding. Yielding was detected by flaking of the mill scale under the whitewash which had been applied to the frame members. When specimens were no longer able to resist additional loading, the maximum load was recorded and then removed.

Tests were conducted to verify the performance of the frames relative to analytical predictions for the following loading cases:

a) Full live load on the east frame, Figure 2.7(a). Loading was to the working level live load, 7.6 kips at each application point.

b) Lateral load applied to both frames simultaneously, Figure 2.7(b). Maximum load was working level wind load or 7.0 kips and was applied to the columns at the rafter bottom chord elevation.

c) Unbalanced live load on the south half of both frames simultaneously, Figure 2.7(c). Maximum loading was the working level live load at each application point or 7.6 kips.

d) Unbalanced live load on the south slope followed by lateral load to the north on both frames simultaneously, Figure 2.7(d). Maximum gravity load was 7.6 kips and maximum lateral load was 7.0 kips.

e) Unbalanced live load on the north slope followed by lateral load to the north on both frames simultaneously, Figure 2.7(d). Maximum gravity load was 7.6 kips per application point and maximum lateral load was 7.0 kips.

f) Full live load to failure on east frame, Figure 2.7(a). Maximum load was 1.86 times working level live load or 14.11 kips at each application point.

g) Full live load to failure on west frame, Figure 2.7(a). Maximum load was 1.64 times working level live load or 12.2 kips at each application point.

For the cases of unbalanced live load with lateral load, the simulated live load was applied first and then maintained while the lateral load was being applied in 1 kip increments.

2.6 Supplementary Tests

Upon completion of all testing, sections of undamaged rafter top chord members were cut out of the west frame. The sections were sent to the VULCRAFT, Norfolk, Nebraska facility where the sections were tested using a specially designed angle test device mounted in a universal testing machine. The reported yield stress and tensile strengths from these tests are found in Section 3.8.

CHAPTER III

TEST RESULTS

3.1 Overview of Test Results

Test results consist of a test summary sheet, various load versus displacement and stress plots (converted from displacement measurements), and a photographic record. Comparisons to predicted displacements and member forces are made using the results of stiffness analyses for each loading for each frame. Summaries of these analyses are found in Appendix A. The prediction curves are based on the assumption of a linear relationship between the applied load and the quantity plotted.

Predicted ultimate loads were obtained by multiplying the appropriate working load by 1.67. Working load levels were supplied by VULCRAFT and were based on the nominal yield stress of 50 ksi.

Detailed results are found for each loading in the appendices of this report (Appendices B thru H). Each of the appendices generally contains a test summary sheet, loading diagram, loading versus frame centerline and/or quarterpoint and sidesway deflections, and load versus member force.

3.2 Working Level Live Load, East Frame, Test LL

During this test, full live load was applied to the east frame as shown in Figure 2.7(a). The purpose of this test was to check instrumentation and to compare the frame behavior to the theoretically predicted behavior supplied by VULCRAFT. Results are found in Appendix B.

The load was incrementally applied up to the working live load of 7.6 kips. Some yielding was observed near the base of the knee clip angles at the reentrant corners; but in general, the frame showed no signs of overstrain. Figure B.2 shows the applied load vs. frame centerline deflection curve along with the theoretical predictions for centerline deflection. These theoretical predictions, and the predictions on all subsequent tests, were obtained from the VULCRAFT stiffness analyses which are included as Appendix A. The first prediction was obtained assuming fixed column bases and second assuming pinned column bases. As Figure B.2 shows,the frame behaved elastically but was slightly less stiff than predicted.

3.3 Working Level Lateral Load, Test WL

Wind load, henceforth referred to as lateral load, was applied equally to both frames at the north reentrant corner as shown in Figure 2.7(b). The load was applied incrementally to 7.05 kips. At this level, the columns at the north end of the frames were observed to be in double curvature. No major yielding was observed and the frame behaved elastically as shown in Figures C.2 and C.3, which are the applied load versus sidesway deflection curves for both frames. The experimental deflections fell between the

theoretical curves, which indicated that the frames were much stiffer than predicted assuming pinned column bases but not quite as stiff as predicted assuming fixed column bases. Midspan and quarterpoint deflections were neglible and were not plotted.

Figures C.4 thru C.9 show curves for member force versus lateral load for the instrumented members. For a given member, the measured axial member deformation was converted to strain, multiplied by an assumed modulus of elasticity (29,000 ksi) to obtain stress, and then multiplied by the member cross-sectional area, as supplied by VULCRAFT, to obtain member forces. With the exception of the force in member number 48, the member forces all fell between the predicted values for fixed and pinned column bases. The force in member 48 was found to be greater in compression than predicted using the pinned column base assumption.

3.4 Unbalanced Live Load, Test ULL

Both frames were subjected to the unbalanced live load shown in Figure 2.7(c). The loads were applied to the south rafters and were incrementally applied to the 7.6 kips level. No major yielding was detected during this test. Results are found in Appendix D.

Figures D.2 and D.3 show the load versus centerline deflection for the east and west frames, respectively. The deflections were in close agreement with the predicted values; the east frame was somewhat stiffer than predicted. The quarterpoint deflections were very close for both the east and west frames, thus only the curves for the east frame quarterpoints are shown (see Figures D.4 and D.5).

These curves also show that the deflections were close to those predicted. The plots of member force versus load are shown in Figures D.6 thru D.11. All member forces were reasonably linear. At maximum applied load, the force in member 4 was approximately 15% less than predicted and the force in member 17 was approximately 20% higher than predicted. The force in member 24 was approximately 25% less than predicted and the force in member 33 was approximately 40% less than predicted. The force in member 48 was approximately 30% greater than predicted. The force measured in member 60 was the same as predicted for both assumptions concerning column end conditions.

3.5 Lateral Load Plus Unbalanced Live Load on the Windward Side, Test ULL_W+WL

In this test, gravity load was incrementally applied up to the working level of 7.7 kips on the south rafter slopes. This load was held as constant as possible with the wind load incrementally applied to 7.2 kips (see Figure 2.7(d)). At this maximum combined load, an increase in yielding at the base of the north reentrant corner and at the column brace points was observed.

The results for this test are found in Appendix E. In all of the plots of experimental data, the change in slope of the theoretical and experimental curves at about 7.6 kips load marks the end of the gravity load application and the beginning of the application of lateral load.

In general, the vertical deflections of the frames corresponded to the predicted behavior. The plots of centerline deflection versus load for the frames are shown in Figures E.2 and E.3. It is evident that from these

figures that the fixed column base assumption more closely models true frame behavior. Conversely, the plots of quarterpoint deflection versus load shown in Figures E.4 thru E.7 show that the quarterpoint response was closer to the theoretical prediction when pinned column bases are assumed.

The sidesway deflections versus load for the frames are shown in Figures E.8 and E.9. It is interesting to note that the two theoretical curves for sidesway versus load are very close until the lateral load is applied. At this point, the curves deviate greatly, with the pinned base theoretical curve predicting almost 4 times the deflection predicted by the fixed base theoretical curve. The measured deflections for both frames fall between the theoretical deflections, but are closer to the fixed base predicted curve.

The plots of member force versus load are shown in Figures E.10 thru E.15. Member 4 had less force than predicted up to the application of lateral load. With the increase in lateral load, the member force stayed at about the average of the two predictions. Member 17 showed more force than predicted using either column base assumption but generally runs parallel to the pinned base case. Member 24 showed less force than predicted throughout most of the test but converges to the average of the predicted curves in the latter part of the test. Member 33 had less force than predicted throughout the test. The force in member 48 was close to the predicted values throughout the test and converged to the average of the predicted values in the latter part of the test. Finally, member 60 showed more force than predicted throughout the test but the force was not near the critical level.

3.6 Lateral Load Plus Unbalanced Live Load on the Leeward Side, Test ULL_L+WL

The results of this test may be found in Appendix F. In this test, gravity load was incrementally applied to working load level (7.7 kips) on the north rafter slopes. The gravity load was then held as constant as possible and wind load was incrementally applied to the 7.4 kips level (see Figure 2.7(e)).

At 7.6 kips gravity load and 1.0 kip wind load, some yielding near the knife plates of both north reentrant corners was observed. Also, increased yielding of column brace points was noted. At 7.6 kips gravity load and 3.0 kips lateral load, slight yielding of the column web member joints was observed. Double curvature of the north columns was apparent at this load level.

The plots of centerline deflection versus load are shown in Figures F.2 and F.3. Both frames showed behavior close to that predicted using the pinned base assumption. Figures F.4 thru F.7 show plots of quarterpoint deflection versus load. The quarterpoint deflections of both frames fell between the two predictions. The sidesway response of the frames is shown in Figures F.8 and F.9. The deflection of the frames due to lateral load fell between the two theoretical predictions, but tended to be closer to the fixed base theoretical curve.

Member force versus load plots for instrumented members are shown in Figures F.10 thru F.15. The force in member 4 was slightly higher than predicted under gravity load and is about parallel to the average of the two

theoretical curves with the application of wind load. The force in member 17 was less than predicted under gravity load, but the curve maintained about the same slope with the application of wind load. The force in member 24 was measured to be less than predicted under gravity load, did not decrease as predicted upon application of wind load, but was in the general range of the theoretical curves. The force in member 33 was less than predicted throughout the test. With the application of wind load, this member force curve is about parallel to the average of the theoretical curves. The force in member 48 closely agrees with the theoretical curves up to the application of lateral load after which the force is close to the average of the theoretical curves. The increase in force in member 60 was linear, but was 35% higher than predicted at the first application of wind load and about 45% higher than predicted at the maximum combined load.

3.7 Ultimate Full Live Load, East Frame, Test 1.86 LL_E

The results of this test may be found in Appendix G. In this test, full live load (see Figure 2.7(a)) was applied to the east frame until failure of the frame occurred at 14.1 kips. At 7.0 kips of applied load, yielding of the base plates near the column inside chords and yielding of column web members was observed. At 9.0 kips, yielding of all members in the knee area occurred at the member ends. At 12.5 kips, column web members 68 and 40 buckled at their respective column inside chords. No yielding had been observed prior to buckling of these members. Yielding along member 49 was also observed at 12.5 kips. At 13.4 kips, column web members 66 and 70 buckled and the test was stopped.

Figure G.2 shows the load versus centerline deflection curve for this test. The experimental curve follows the pinned base theoretical curve and remains fairly linear up to the 10.0 kips applied load level and then begins leaning at this point. This indicates a softening of the frame which continues until the test was stopped at 14.1 kips. Figures G.3 and G.4 are plots of load versus quarterpoint deflection for the frame. The two measured quarterpoint deflections were close to the theoretical curve based on pinned column bases to the 7.0 kips level but showed increased deviation from the theoretical curve for the remainder of the test. Figure G.5 is the plot of load versus sidesway deflection of the frame and shows that the sidesway deflection followed the pinned base prediction to about 12.5 kips at which load the deflection rapidly increased with only a small increase of applied load.

Load versus member force plots are shown in Figures G.6 thru G.8. The force in member 4 matched the predicted force to about 8.0 kips applied load at which point the member force (displacement) stayed nearly constant until the applied load reached 12.5 kips. The member force then increased with the same slope as it had when the applied load was under 8.0 kips. After unloading of the frame, the member had a permanent deflection as shown by the curve not returning to its origin. The force in member 24 was consistently about 35% less than predicted throughout the test. At about 13.5 kips applied load, the member force (displacement) curve changed slope and increased at a much higher rate, but did not approach the predicted member force.

For member 48, the member force curve is near the theoretical curve to about 5.0 kips applied load, but is

somewhat higher than predicted. From 5.0 to 9.0 kips, the member force continued to increase at a rate of about 25% greater than predicted. From this load point to that of maximum applied load (14.1 kips), the member force (displacement) changed erratically, probably indicating a redistribution of member forces in the knee area caused by member yielding.

For this test, the ratio of applied maximum load, 14.1 kips at each application point, to the corresponding working load, 7.6 kips, is 1.86.

3.8 Ultimate Full Live Load, West Frame, Test $1.64LL_W$

The results of this test may be found in Appendix H. In this test, full live load (see Figure 2.7(a)) was applied to the west frame until failure occurred at 12.5 kips. Prior to loading, the column web diagonals which corresponded to the buckled members of the east frame were reinforced.

At 5.0 kips applied load, marked yielding was observed under the clip angle at the north reentrant corner. Also, some yielding occurred at the base plate near the column inside chord. At 7.0 kips applied load, yielding was observed where the column web members in compression joined the column compression chord. At 8.0 kips applied load, yielding at most knee member joints was observed. At 9.0 kips applied load, yielding occurred at the lower column compression flange brace points. At 12.5 kips applied load, the vertical rafter web member at degree-of-freedom NP42 buckled and the test was stopped. Figure 3.1 shows the failed member.

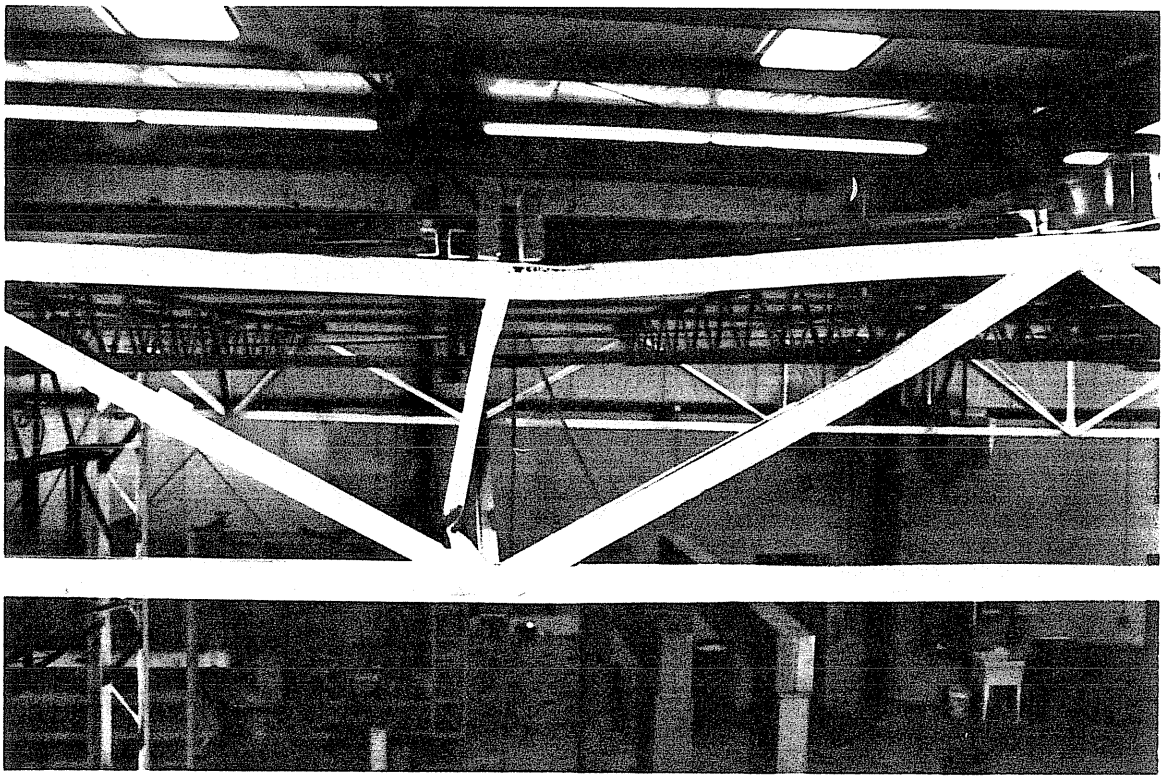


FIGURE 3.1 PHOTOGRAPH OF FAILED WEB VERTICAL MEMBER, WEST FRAME

Figure H.2 shows the load versus centerline deflection curve for this test. The curve followed the predicted curve based on the pinned base assumption and remained linear up to about 8.0 kips of applied load. With an increase in applied load, the curve begins to lean, indicating that the frame was softening. At 12.0 kips applied load (the last recorded load), the load drops sharply, with little decrease in deflection, thus marking the failure of the vertical member. Figures H.3 and H.4 show the plots of load versus quarterpoint deflections for the frame. The curves of both quarterpoints show that the frame was slightly less stiff than predicted. At the failure load, the curves show the sudden loss of applied load with the south quarterpoint returning toward its initial position while the north quarterpoint had increased deflection due to the occurence of failure near that quarterpoint. Figure H.5 shows the plot of load versus sidesway deflection for this test. The frame was somewhat stiffer than predicted in the sidesway direction and had a sudden movement upon failure of the vertical member which was near the point where sidesway instrumentation was located.

Figures H.6 thru H.11 show plots of load versus member force for the six instrumented members. Additional members instrumented for this test are members 2, 39, and 46. The plots of the force for member 2 show that the member was predicted to be in compression for a fixed column base condition and in tension for a pinned column base condition. The plot shows that the member was in compression and that the magnitude of the member force varied approximately as predicted for the fixed base case. At approximately 8.0 kips applied load, some member force

redistribution seems to have taken place in the surrounding members. The plot of load versus force for member 17 shows that the force was about 20% larger than predicted for the pinned base case to approximately 10.0 kips applied load. The force in member 33 was about 30% less than predicted for either column base condition but the relationship was approximately linear throughout the test. The force in member 39 was less than predicted to 7.5 kips applied load at which point the member went into compression and the force increased to the failure load. The force in member 46 followed the predicted curve for pinned column bases and was approximately linear to the failure load. The force in member 60 was about 30% greater than predicted and the relationship was linear throughout the test.

For this test, the ratio of applied maximum load, 12.5 kips at each application point, to the corresponding working load, 7.6 kips, is 1.64.

3.9 Supplementary Test Results

Results of the tensile coupon tests are given in Table 3.1. The average yield stress for the samples was 58.3 ksi.

Table 3.1

Tensile Coupon Test Results

Specimen	Description	Location On Test Specimen	Yield Stress (ksi)	Tensile Strength (ksi)	Elongation (%)
West Frame	3 1/2x3 1/2x0.355	Member 12	58.3	86.5	25.9
	3 1/2x3 1/2x0.357	Member 12	58.4	86.2	25.1

CHAPTER IV

SUMMARY AND CONCLUSIONS

A series of tests was conducted on standard pre-engineered metal building frames fabricated by VULCRAFT, a division of Nucor Corpoation. The test set-up consisted of two frames forming a single bay, 24 ft. 0 in. by 52 ft. 10 in. Joists, joist bridging, girts, chord braces and rod braces were used to construct the test set-up. The frames were subjected to a range of loadings, including unbalanced live load, lateral load, combined unbalanced live load and lateral load and full live load. All loading conditions other than full live load were applied to the complete assembly. Full live load was applied to each frame individually.

Experimentally determined results were compared to the theoretical results obtained from VULCRAFT'S stiffness analyses. For each load case, two stiffness analyses were performed; one with the assumption of fixed column bases and one with the assumption of pinned column bases. It should be noted that in these tests, the simulated column foundations were actually very rigid W36x150 beams, whereas in the actual construction of this type of frame, the foundation would probably provide much less resistant to rotation.

In general, the experimental deflections were close to the predicted deflections and were often bounded by the predicted curves resulting from the two assumptions. As compared to the predicted curves, the midspan vertical deflections were slightly less stiff than both assumptions in the working live load test LL, very close to both assumptions in the unbalanced live load test ULL, close to the fixed base predictions in the combined unbalanced live load plus lateral load tests ULL_W+W_L and ULL_L+W_L, and close to the pinned base prediction in the full live load tests to failure, 1.86 LL_E and 1.64 LL_W. As compared to the predictions, the quarterpoint vertical deflections were close to both predictions in test ULL, closer to the pinned base predictions in test ULL_W+WL close to the average of the predictions in test ULL_L+WL, close to the pinned base prediction in test 1.86 LL_E and slightly less stiff than the pinned base prediction in test 1.64 LL_W. The frame lateral deflection curves were bounded by the predicted curves but were closer to the fixed base prediction in test WL, test ULL_W+WL, and test ULL_L+WL. The lateral experimental deflections were close to the pinned base prediction in test 1.86 LL_E and were stiffer than predicted by both assumptions in test 1.64 LL_W.

The experimentally determined member forces had more variation with respect to the predicted values than did the deflections. The curve of the measured force in member 4, an outside column chord member, was bounded by the theoretical curves in test WL, was 15% less than the average of the predictions in test ULL, was slightly less than predicted up to the application of wind load, then parallel to the average of the predictions in test ULL_W+WL and test ULL_L+WL, and was close to the theoretical curves in test 1.86 LL_E. The curve of the measured force in

member 17, also an outside column chord member, was bounded by the theoretical curves in test WL, was 20% greater than the average of the curves in test ULL, was higher than predicted up to the application of wind load then parallel to the pinned base theoretical curve in test ULL_W+WL, was less than predicted with no change in slope in test ULL_L+WL, and was 20% greater than predicted in test 1.64 LL_W. The curve of the measured force in member 24, an inside column chord member, was bounded by the theoretical curves in test WL, was 25% less than predicted in test ULL, was less but in the same range as the theoretical curves in test ULL_W+WL and test ULL_L+WL, and was 35% less than predicted in test 1.86 LL_E. The curve of the measured force in member 33, an inside column chord member, was bounded by the theoretical curves in test WL, was 40% less than predicted in test ULL, was less than predicted until the application of wind load then parallel to the average of the theoretical curves in test ULL_W+WL and test ULL_L+WL, and was 30% less than predicted in test 1.64 LL_W. The measured force in member 48, an end rafter diagonal member, was slightly greater than predicted in test WL, was 30% greater in test ULL, was close to the average of the theoretical predictions in test ULL_W+WL and test ULL_L+WL, and was 25% greater than predicted in test 1.86 LL_E. The curve of the measured force in member 60, an end rafter diagonal member, was bounded by the theoretical curves in test WL, was close to the predicted curves in test ULL, was greater than predicted but not to a critical level in test ULL_W+WL and ULL_L+WL, and was 30% greater than predicted in test 1.66 LL_W. In test 1.64 LL_W, the force in member 2, an outside column chord member, was erractic but in the same range as the fixed base theoretical, the force in member 39, a lower column web diagonal member, was erratic and less than predicted, and the force in member 46, a knee

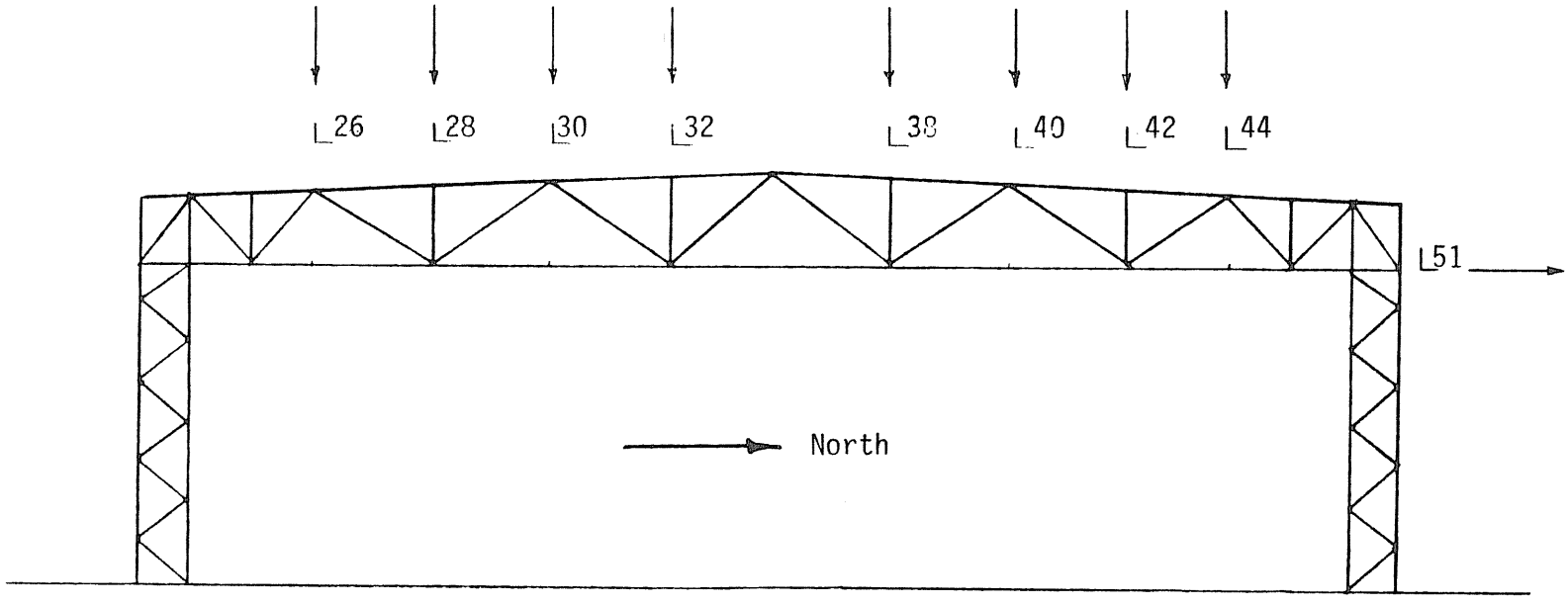
area diagonal member, was close to the pinned base prediction.

The failure of the east frame under full gravity loading (test 1.86 LL_E) occurred at an applied load of 14.1 kips at each load point. The failure mode was buckling of the column compression web members. The frame behaved elastically until the applied load was greater than the working load, then the deflection of the frame became nonlinear, which was accompanied by widespread local member yielding followed by the failure of the frame.

The failure of the west frame under full gravity loading (test 1.64 LL_W) occurred at a load of 12.5 kips at each load point. The failure mode was buckling of the vertical member under NP42. Frame behavior was similar to that of the east frame.

APPENDIX A

STIFFNESS ANALYSES



	LOAD CASE	LOCATION 26	28	30	32	38	40	42	44	51	LOAD CASE IN COMPUTER DESIGN PROGRAM
1.	DL+LL	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2		Normal I
2.	DL+W	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	-0.64	+7.0	Normal II
3.	DL+UBLL$_L$	-8.2	-8.2	-8.2	-8.2	-0.64	-0.64	-0.64	-0.64		Mult. II
	DL+UBLL$_R$	Symmetry makes this case same as previous case									
4.	DL+UBLL$_L$+W	-8.2	-8.2	-8.2	-8.2	-0.64	-0.64	-0.64	-0.64	+7.0	Mult. III
5.	DL+UBLL$_R$+W	-0.64	-0.64	-0.64	-0.64	-8.2	-8.2	-8.2	-8.2	+7.0	Mult. IV

(On computer printout member forces are reduced 25% at all load cases involving wind)

FIGURE A.1 LOADS USED FOR DESIGN

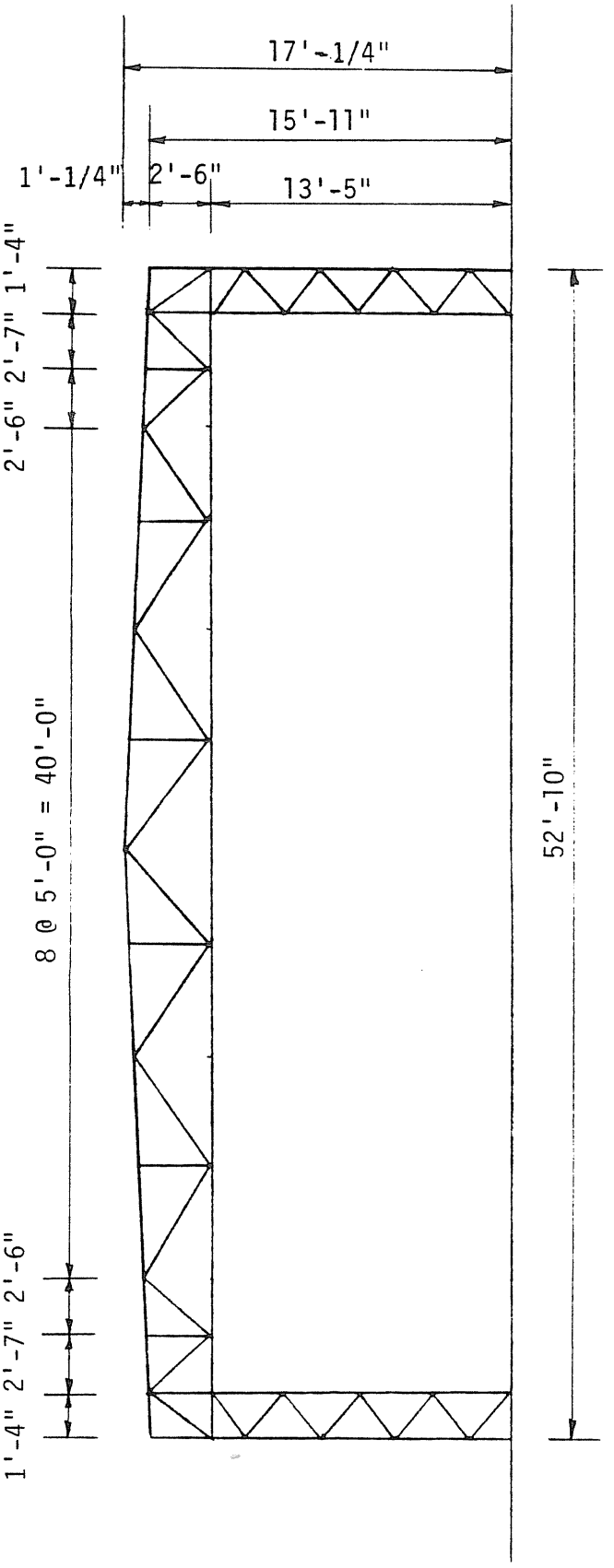


FIGURE A.2 FRAME DIMENSIONS

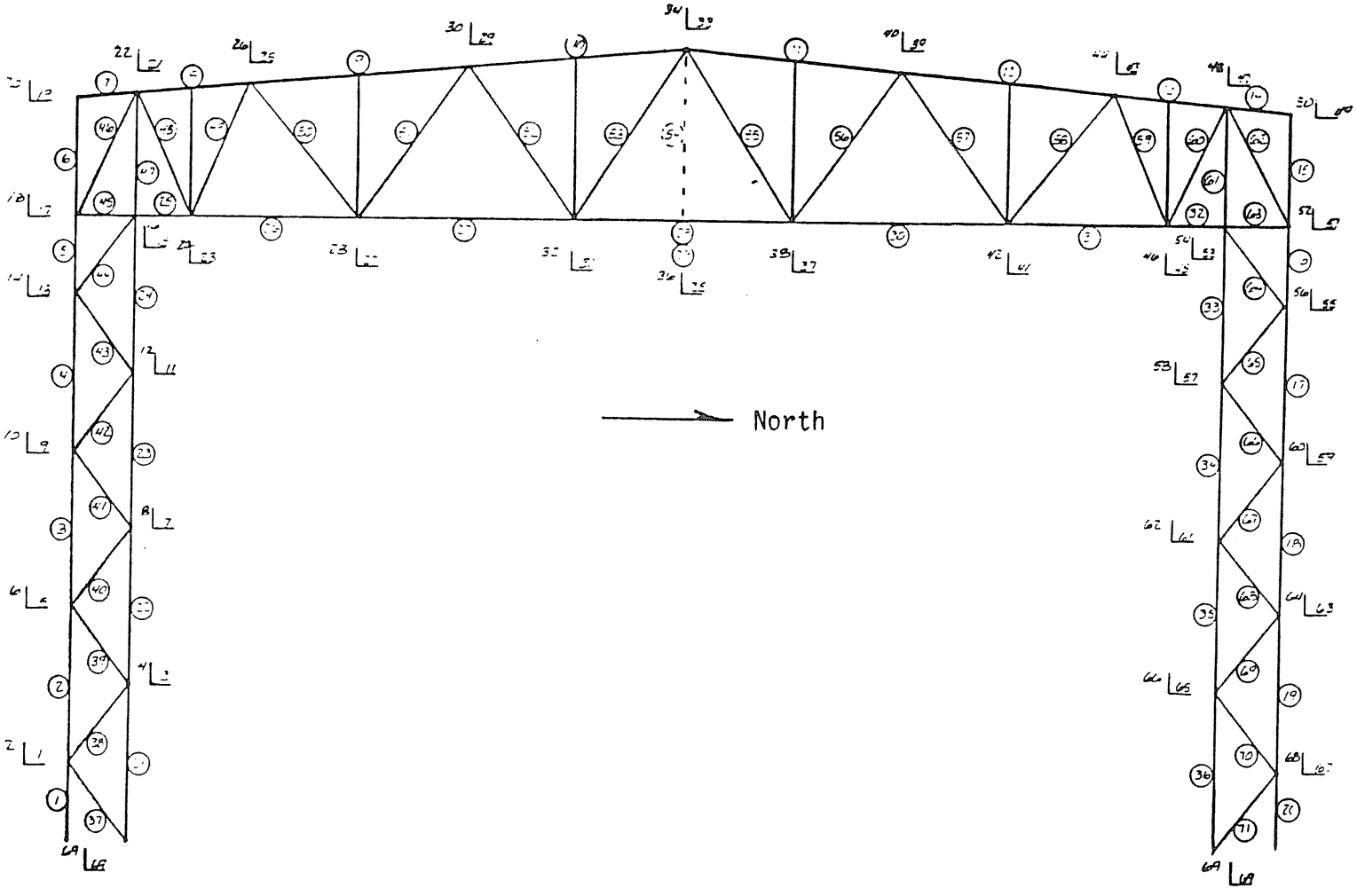
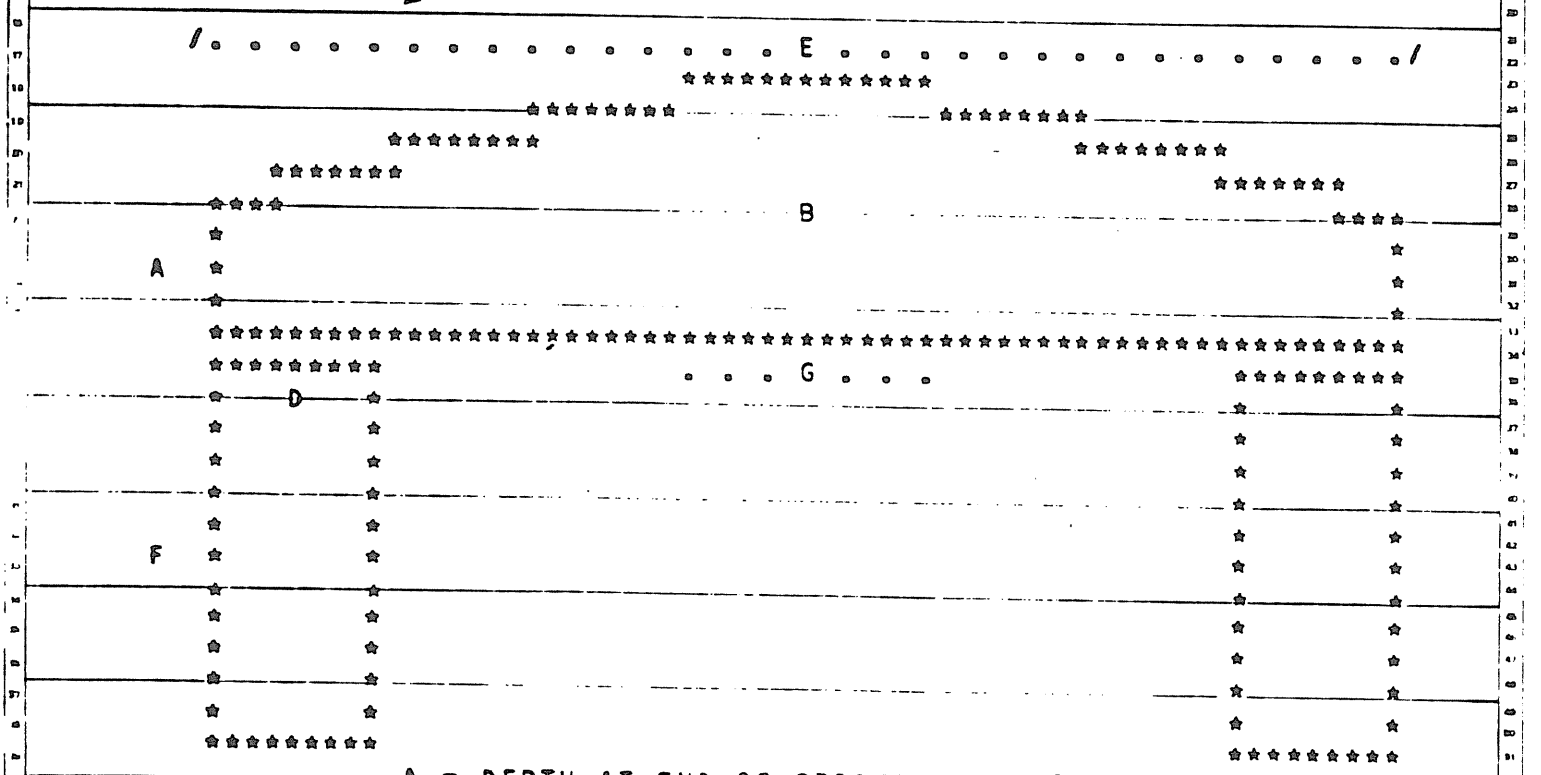


FIGURE A.3 MEMBER AND NODAL POINT IDENTIFICATION NUMBERS

RIGID FRAME ANALYSIS AND DESIGN
VULCRAFT - DIVISION OF NUCOR CORPORATION
SEPTEMBER 1984 RELEASE

TITLE - 53' X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 06/04/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR2



A - DEPTH AT END OF GIRDER. . . . 2- 6 0/0
B - DEPTH AT CENTER OF GIRDER . 3- 7 1/4
C - BASE OF COLUMN. 1- 4 0/0
D - TOP OF COLUMN 1- 4 0/0
E - FULL WIDTH OF FRAME 52-10 0/0
F - CLEAR HEIGHT. 13- 5 0/0
G - CLEAR WIDTH AT TOP. 50- 2 0/0

ROOF PITCH = 0.501 INCH TO 1 FOOT.
EAVE HEIGHT = F + A + JOIST SEAT DEPTH (STD 8 IN)
= 16- 0 0/0.
OVERALL BLDG WIDTH = E + WALL GIRTS
= 53- 0 0/0.
WALL GIRTS = 0- 1 0/0 AND 0- 1 0/0

LIVE LOAD = 7.56 PSF, DEAD LOAD = 0.64 PSF, UPLIFT LOAD = 0.00 PSF.
WIND LOADS: 0.00, 0.00, 0.00, 0.00 PSF, 1982 UBC.
BAY DEPTH = 0- 0 1/8.

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 06/04/85

FR#2

GIRDER SECTION FY = 50 KSI FOR ANGLES

TOP CHORD = 54 - L3-1/2X3-1/2X.344

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
7	16.01	-0.00	0.00	-131.98	137.40	16.0	14.9
8	61.05	-11.51	0.00	-121.00	137.40	38.5	35.7
9	120.10	-76.44	0.00	-107.34	137.40	60.1	55.7
10	120.10	-103.34	0.00	-107.34	137.40	60.1	55.7
11	120.10	-103.34	0.00	-107.34	137.40	60.1	55.7
12	120.10	-76.44	0.00	-107.34	137.40	60.1	55.7
13	61.05	-8.37	5.98	-121.00	137.40	38.5	35.7
14	16.01	-0.00	0.00	-131.98	137.40	16.0	14.9

MAX COMP. FORCE REQD = -103.34 KIPS.
LY DEVD AT 5- 0 0/0 = -122.94 KIPS. LY/RY = 32.5

LY	COMP	LY/RY
5- 0 0/0	-122.94	32.5
7- 6 0/0	-112.46	48.7
10- 0 0/0	-100.12	64.9
15- 0 0/0	-70.11	97.4

BOT CHORD = 48 - L 3 X 3 X.313

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
25	31.00	-33.08	4.25	-95.03	106.80	31.0	33.6
26	90.00	0.00	29.03	-54.30	106.80	90.0	97.6
27	120.00	0.00	88.48	-31.38	106.80	120.0	130.2
28	60.00	0.00	88.63	-77.72	106.80	60.0	65.1
29	60.00	0.00	88.63	-77.72	106.80	60.0	65.1
30	120.00	0.00	88.48	-31.38	106.80	120.0	130.2
31	90.00	0.00	29.03	-54.30	106.80	90.0	97.6
32	31.00	-33.09	0.00	-95.03	106.80	31.0	33.6

MAX COMP. FORCE REQD = -33.09 KIPS.
LY DEVD AT 10- 0 0/0 = -72.72 KIPS. LY/RY = 72.7

LY	COMP	LY/RY
5- 0 0/0	-93.74	36.4
7- 6 0/0	-84.11	54.5
10- 0 0/0	-72.72	72.7
15- 0 0/0	-44.67	109.1

NOTE: SIGN CONVENTION (-) COMPRESSION.

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 06/04/85

FR1
2

GIRDER WEBS FY = 50 KSI FOR ANGLES.

NO	LGTH	SEC	DESCRIPTION	Q	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		L/R	WELD REQD	WELD DEVD
48	40.2	39	L2-1/2X2-1/2X.250	2S	0.0	46.1	-55.9	71.2	55.0	16.6	19.0
49	41.3	39	L2-1/2X2-1/2X.250	2S	-43.7	0.0	-55.4	71.2	56.4	15.7	18.8
50	66.3	31	L 2.00X2.00X0.232	2S	0.0	44.2	-21.3	52.4	110.7	15.9	18.6
51	68.2	33	L 2.50X2.50X0.197	2	-24.6	0.0	-31.0	56.8	90.3	10.2	13.6
52	68.6	22	L 2.00X2.00X0.1370	2	-3.9	7.9	-12.5	31.7	112.3	7.8	14.2
53	71.3	22	L 2.00X2.00X0.1370	2	-6.5	17.6	-11.6	31.7	116.7	8.6	13.5
54V	42.2	16	L1-1/2X1-1/2X.130	1	0.0	0.0	-2.9	0.0	138.7	2.0	4.2
55	71.3	22	L 2.00X2.00X0.1370	2	-9.7	12.3	-11.6	31.7	116.7	8.6	13.5
56	68.6	22	L 2.00X2.00X0.1370	2	-2.0	11.7	-12.5	31.7	112.3	7.8	14.2
57	68.2	33	L 2.50X2.50X0.197	2	-24.6	0.0	-31.0	56.8	90.3	10.2	13.6
58	66.3	31	L 2.00X2.00X0.232	2S	0.0	44.2	-21.3	52.4	110.7	15.9	18.6
59	41.3	39	L2-1/2X2-1/2X.250	2S	-43.7	0.0	-55.4	71.2	56.4	15.7	18.8
60	40.2	39	L2-1/2X2-1/2X.250	2S	0.0	46.1	-55.9	71.2	55.0	16.6	19.0

VERTICALS

MEM	LGTH	SEC		Q	FORCE REQD IN KIPS	FORCE DEVD IN KIPS	L/R	WELD REQD	WELD DEVD
V1 LD	32.1	16	L1-1/2X1-1/2X.130	1	-2.1	-5.1	103.8	2.0	3.9
V2	34.7	16	L1-1/2X1-1/2X.130	1	-2.1	-4.3	113.6	2.0	4.2
V3	39.7	16	L1-1/2X1-1/2X.130	1	-2.1	-3.3	130.4	2.0	4.2
V5	39.7	16	L1-1/2X1-1/2X.130	1	-2.1	-3.3	130.4	2.0	4.2
V6	34.7	16	L1-1/2X1-1/2X.130	1	-2.1	-4.3	113.6	2.0	4.2
V7 RD	32.1	16	L1-1/2X1-1/2X.130	1	-2.1	-5.1	103.8	2.0	3.9

NOTE: VERTICALS BISECT TOP CHORD PANELS.
ENDPANEL VERTICALS MAY BE DIAGONAL (LD OR RD).

2DL DISTANCE FROM END OF RAFTER = 3- 2 1/2

2DR DISTANCE FROM END OF RAFTER = 3- 2 1/2

NOTE: SIGN CONVENTION (-) COMPRESSION.

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 06/04/85

FR2

LEFT COLUMN

FY = 50 KSI FOR ANGLES

COLUMNS ARE SYMMETRIC ABOUT CENTER LINE OF FRAME

INSIDE LEG = 48 - L 3 X 3 X.313

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
21	40.25	-22.12	0.00	-90.10	106.80	40.3	43.7
22	40.25	-25.25	0.00	-90.10	106.80	40.3	43.7
23	40.25	-47.01	0.00	-90.10	106.80	40.3	43.7
24	40.25	-68.76	0.55	-90.10	106.80	40.3	43.7
47	30.67	-79.64	2.97	-95.20	106.80	30.7	33.3

MAX COMP. FORCE REQD = -79.64 KIPS.
LY DEVD AT 7- 6 0/0 = -84.11 KIPS. LY/RY = 54.5

LY	COMP	LY/RY
5- 0 0/0	-93.74	36.4
7- 6 0/0	-84.11	54.5
10- 0 0/0	-72.72	72.7
15- 0 0/0	-44.67	109.1

OUTSIDE LEG = 48 - L 3 X 3 X.313

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
1	20.13	-40.18	14.97	-100.05	106.80	20.1	21.8
2	40.25	-18.42	10.12	-90.10	106.80	40.3	43.7
3	40.25	0.00	7.60	-90.10	106.80	40.3	43.7
4	40.25	0.00	25.06	-90.10	106.80	40.3	43.7
5	20.13	-4.45	46.84	-100.05	106.80	20.1	21.8
6	30.00	-0.00	0.00	-95.53	106.80	30.0	32.5

MAX COMP. FORCE REQD = -40.18 KIPS.
LY DEVD AT 7- 6 0/0 = -84.11 KIPS. LY/RY = 54.5

LY	COMP	LY/RY
5- 0 0/0	-93.74	36.4
7- 6 0/0	-84.11	54.5
10- 0 0/0	-72.72	72.7
15- 0 0/0	-44.67	109.1

COLUMN MOMENT OF INERTIA = 368.08

NOTE: SIGN CONVENTION (-) COMPRESSION.

LEFT COLUMN WEBS

FY = 50 KSI FOR ANGLES

NO	LGTH	SEC	DESCRIPTION	Q	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		L/R	WELD REQD	WELD DEVD
37	23.5	16	L1-1/2X1-1/2X.130	2	-3.1	13.9	-17.5	22.4	52.9	7.2	13.7
38	23.3	26	L 2.00X2.00X0.175	1	-13.9	3.1	-14.7	20.1	62.5	5.3	6.7
39	23.3	26	L 2.00X2.00X0.175	1	-3.1	13.9	-14.7	20.1	62.5	5.3	6.7
40	23.3	26	L 2.00X2.00X0.175	1	-13.9	3.1	-14.7	20.1	62.5	5.3	6.7
41	23.3	26	L 2.00X2.00X0.175	1	-3.1	13.9	-14.7	20.1	62.5	5.3	6.7
42	23.3	26	L 2.00X2.00X0.175	1	-13.9	3.1	-14.7	20.1	62.5	5.3	6.7
43	23.3	26	L 2.00X2.00X0.175	1	-3.1	13.9	-14.7	20.1	62.5	5.3	6.7
44	23.3	26	L 2.00X2.00X0.175	1	-13.9	3.1	-14.7	20.1	62.5	5.3	6.7
45	14.7	20	L 1.50X1.50X0.170	2	-24.4	2.3	-26.0	28.9	31.1	9.7	11.3
46	32.5	31	L 2.00X2.00X0.232	2S	-5.0	52.8	-41.1	52.4	55.3	19.0	19.6

NOTE: SIGN CONVENTION (-) COMPRESSION.

-- THE WELDING OF THE HAUNCH --

REQD FORCE = 39.78 KIPS

WELD (IN.)	DEV FORCE (KIPS)	
6.0	64.21	4.0-IN CONNECTER
5.0	58.62	
4.0	50.87	

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 06/04/85

FR 2

RIGHT COLUMN FY = 50 KSI FOR ANGLES.

COLUMNS ARE SYMMETRIC ABOUT CENTER LINE OF FRAME

INSIDE LEG = 48 - L 3 X 3 X.313

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
36	40.25	-3.50	20.11	-90.10	106.80	40.3	43.7
35	40.25	-25.25	6.08	-90.10	106.80	40.3	43.7
34	40.25	-47.01	0.00	-90.10	106.80	40.3	43.7
33	40.25	-68.76	0.00	-90.10	106.80	40.3	43.7
61	30.67	-79.64	0.00	-95.20	106.80	30.7	33.3

MAX COMP. FORCE REQD = -79.64 KIPS.
LY DEVD AT 7- 6 0/0 = -84.11 KIPS. LY/RY = 54.5

LY	COMP	LY/RY
5- 0 0/0	-93.74	36.4
7- 6 0/0	-84.11	54.5
10- 0 0/0	-72.72	72.7
15- 0 0/0	-44.67	109.1

OUTSIDE LEG = 48 - L 3 X 3 X.313

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
20	20.13	-40.18	0.00	-100.05	106.80	20.1	21.8
19	40.25	-20.17	0.00	-90.10	106.80	40.3	43.7
18	40.25	-4.31	3.33	-90.10	106.80	40.3	43.7
17	40.25	0.00	25.08	-90.10	106.80	40.3	43.7
16	20.13	0.00	46.84	-100.05	106.80	20.1	21.8
15	30.00	0.00	0.00	-95.53	106.80	30.0	32.5

MAX COMP. FORCE REQD = -40.18 KIPS.
LY DEVD AT 7- 6 0/0 = -84.11 KIPS. LY/RY = 54.5

LY	COMP	LY/RY
5- 0 0/0	-93.74	36.4
7- 6 0/0	-84.11	54.5
10- 0 0/0	-72.72	72.7
15- 0 0/0	-44.67	109.1

COLUMN MOMENT OF INERTIA = 368.08

NOTE: SIGN CONVENTION (-) COMPRESSION.

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 06/04/85

FR 2

RIGHT COLUMN WEBS

FY = 50 KSI FOR ANGLES.

NO	LGTH	SEC	DESCRIPTION	Q	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		L/R	WELD REQD	WELD DEVD
71	23.5	16	L1-1/2X1-1/2X.130	2	0.0	13.9	-17.5	22.4	52.9	7.2	13.7
70	23.3	26	L 2.00X2.00X0.175	1	-13.9	0.0	-14.7	20.1	62.5	5.3	6.7
69	23.3	26	L 2.00X2.00X0.175	1	0.0	13.9	-14.7	20.1	62.5	5.3	6.7
68	23.3	26	L 2.00X2.00X0.175	1	-13.9	0.0	-14.7	20.1	62.5	5.3	6.7
67	23.3	26	L 2.00X2.00X0.175	1	0.0	13.9	-14.7	20.1	62.5	5.3	6.7
66	23.3	26	L 2.00X2.00X0.175	1	-13.9	0.0	-14.7	20.1	62.5	5.3	6.7
65	23.3	26	L 2.00X2.00X0.175	1	0.0	13.9	-14.7	20.1	62.5	5.3	6.7
64	23.3	26	L 2.00X2.00X0.175	1	-13.9	0.0	-14.7	20.1	62.5	5.3	6.7
63	14.7	20	L 1.50X1.50X0.170	2	-24.4	0.0	-26.0	28.9	31.1	9.7	11.3
62	32.5	31	L 2.00X2.00X0.232	2S	0.0	52.8	-41.1	52.4	55.3	19.0	19.6

NOTE: SIGN CONVENTION (-) COMPRESSION.

-- THE WELDING OF THE HAUNCH --

REQD FORCE = 39.78 KIPS

WELD (IN.)	DEV FORCE (KIPS)	
6.0	64.21	4.0-IN CONNECTER
5.0	58.62	
4.0	50.87	

RIGID FRAME ANALYSIS AND DESIGN

VULCRAFT -- DIVISION OF NUCOR CORPORATION

SEPTEMBER 1984 RELEASE

TITLE - 53' X 13-5 0/0 X 0-0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 06/04/85

JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR# 2

DESIGN PARAMETERS:

NUMBER OF DEGREES OF FREEDOM	=	68
NOMINAL NUMBER OF MEMBERS	=	71
NUMBER OF DEAD + LIVE LOADS	=	15
NUMBER OF WIND LOADS	=	24
DEAD LOAD	=	0.6 PSF
LIVE LOAD	=	7.6 PSF
WIND LOADS: 0.0 0.0 0.0		0.0 PSF
UPLT LOAD	=	0.0 PSF
BAY DEPTH	=	0.0 FT

COLUMNS SYMMETRIC

KEY MEMBERS FOR COLUMN REACTIONS:

LBOC -	1
LBW -	37
LBIC -	21
RBIC -	36
RBW -	71
RBOC -	20

MEMBER GEOMETRY--

MEMBER	NP1	NP2	NP3	NP4	HORZ (IN)	VERT (IN)	LENGTH (IN)	AREA (IN**2)	SEC SIZE
1	69	69	1	2	0.00	20.13	20.13	3.560	48
2	1	2	5	6	0.00	40.25	40.25	3.560	48
3	5	6	9	10	0.00	40.25	40.25	3.560	48
4	9	10	13	14	0.00	40.25	40.25	3.560	48
5	13	14	17	18	0.00	20.13	20.13	3.560	48
6	17	18	19	20	0.00	30.00	30.00	3.560	48
7	19	20	21	22	16.00	0.67	16.01	4.580	54
8	21	22	25	26	61.00	2.54	61.05	4.580	54
9	25	26	29	30	120.00	5.00	120.10	4.580	54
10	29	30	33	34	120.00	-5.00	120.10	4.580	54
11	33	34	39	40	120.00	-5.00	120.10	4.580	54
12	39	40	43	44	120.00	-5.00	120.10	4.580	54
13	43	44	47	48	61.00	-2.54	61.05	4.580	54
14	47	48	49	50	16.00	-0.67	16.01	4.580	54
15	51	52	49	50	0.00	30.00	30.00	3.560	48
16	55	56	51	52	0.00	20.13	20.13	3.560	48
17	59	60	55	56	0.00	40.25	40.25	3.560	48
18	63	64	59	60	0.00	40.25	40.25	3.560	48
19	67	68	63	64	0.00	40.25	40.25	3.560	48
20	69	69	67	68	0.00	20.13	20.13	3.560	48
21	69	69	3	4	0.00	40.25	40.25	3.560	48
22	3	4	7	8	0.00	40.25	40.25	3.560	48

XXX-X-XXXX ** RIGID FRAME ANALYSIS ** 06/04/85

FR1
2

MEMBER GEOMETRY--

MEMBER	NP1	NP2	NP3	NP4	HORZ (IN)	VERT (IN)	LENGTH (IN)	AREA (IN**2)	SEC SIZE
23	7	8	11	12	0.00	40.25	40.25	3.560	48
24	11	12	15	16	0.00	40.25	40.25	3.560	48
25	15	16	23	24	31.00	0.00	31.00	3.560	48
26	23	24	27	28	90.00	0.00	90.00	3.560	48
27	27	28	31	32	120.00	0.00	120.00	3.560	48
28	31	32	35	36	60.00	0.00	60.00	3.560	48
29	35	36	37	38	60.00	0.00	60.00	3.560	48
30	37	38	41	42	120.00	0.00	120.00	3.560	48
31	41	42	45	46	90.00	0.00	90.00	3.560	48
32	45	46	53	54	31.00	0.00	31.00	3.560	48
33	53	54	57	58	0.00	-40.25	40.25	3.560	48
34	57	58	61	62	0.00	-40.25	40.25	3.560	48
35	61	62	65	66	0.00	-40.25	40.25	3.560	48
36	65	66	69	69	0.00	-40.25	40.25	3.560	48
37	1	2	69	69	16.00	-20.13	25.71	0.746	16
38	1	2	3	4	16.00	20.13	25.71	0.669	26
39	5	6	3	4	16.00	-20.13	25.71	0.669	26
40	5	6	7	8	16.00	20.13	25.71	0.669	26
41	9	10	7	8	16.00	-20.13	25.71	0.669	26
42	9	10	11	12	16.00	20.13	25.71	0.669	26
43	13	14	11	12	16.00	-20.13	25.71	0.669	26
44	13	14	15	16	16.00	20.13	25.71	0.669	26
45	17	18	15	16	16.00	0.00	16.00	0.962	20
46	17	18	21	22	16.00	30.67	34.59	1.748	31
47	21	22	15	16	0.00	-30.67	30.67	3.560	48
48	21	22	23	24	31.00	-30.67	43.61	2.374	39
49	23	24	25	26	30.00	33.21	44.75	2.374	39
50	25	26	27	28	60.00	-33.21	68.58	1.748	31
51	27	28	29	30	60.00	38.21	71.13	1.892	33
52	29	30	31	32	60.00	-38.21	71.13	1.058	22
53	31	32	33	34	60.00	43.21	73.94	1.058	22
54	35	36	33	34	0.00	43.21	43.21	0.373	16
55	33	34	37	38	60.00	-43.21	73.94	1.058	22
56	37	38	39	40	60.00	38.21	71.13	1.058	22
57	39	40	41	42	60.00	-38.21	71.13	1.892	33
58	41	42	43	44	60.00	33.21	68.58	1.748	31
59	43	44	45	46	30.00	-33.21	44.75	2.374	39
60	45	46	47	48	31.00	30.67	43.61	2.374	39
61	47	48	53	54	0.00	-30.67	30.67	3.560	48
62	47	48	51	52	16.00	-30.67	34.59	1.748	31
63	53	54	51	52	16.00	0.00	16.00	0.962	20
64	53	54	55	56	16.00	-20.13	25.71	0.669	26
65	57	58	55	56	16.00	20.13	25.71	0.669	26
66	57	58	59	60	16.00	-20.13	25.71	0.669	26
67	61	62	59	60	16.00	20.13	25.71	0.669	26
68	61	62	63	64	16.00	-20.13	25.71	0.669	26
69	65	66	63	64	16.00	20.13	25.71	0.669	26
70	65	66	67	68	16.00	-20.13	25.71	0.669	26
71	69	69	67	68	16.00	20.13	25.71	0.746	16

LOADS AND DEFLECTIONS--

NP	LC	LOAD DEAD+LIVE (KIP)	DEFLECTION DEAD+LIVE (IN)	LOAD WIND (KIP)	DEFLECTION WIND (IN)
1		0.000	-0.037	0.000	0.016
2		0.000	-0.009	0.000	0.005
3		0.000	-0.076	0.000	0.043
4		0.000	-0.001	0.000	-0.007
5		0.000	-0.125	0.000	0.077
6		0.000	-0.017	0.000	0.011
7		0.000	-0.161	0.000	0.117
8		0.000	-0.011	0.000	-0.011
9		0.000	-0.196	0.000	0.160
10		0.000	-0.015	0.000	-0.014
11		0.000	-0.208	0.000	0.204
12		0.000	-0.030	0.000	-0.012
13		0.000	-0.205	0.000	0.248
14		0.000	-0.004	0.000	0.014
15		0.000	-0.170	0.000	0.288
16		0.000	-0.056	0.000	-0.010
17		0.000	-0.156	0.000	0.285
18		0.000	0.006	0.000	0.012
19		0.000	-0.083	0.000	-0.304
20		0.000	0.006	0.000	0.012
21	3	0.000	0.174	0.000	0.304
22		0.000	-0.080	0.000	-0.007
23		0.000	-0.180	0.000	0.291
24		0.000	-0.391	0.000	-0.019
25	3	0.000	0.186	0.000	0.303
26		-8.200	-0.689	0.000	-0.030
27		0.000	-0.154	0.000	0.297
28		-8.200	-1.287	0.000	-0.038
29	3	0.000	0.159	0.000	0.302
30		-8.200	-1.717	0.000	-0.044
31	5	0.000	-0.145	0.000	0.302
32		-8.200	-1.989	0.000	-0.034
33	3	0.000	0.096	0.000	0.301
34		0.000	-2.000	0.000	-0.025
35		0.000	0.000	0.000	0.303
36		0.000	-2.000	0.000	-0.025
37	3	0.000	0.145	0.000	0.305
38		-8.200	-1.989	0.000	-0.010
39	5	0.000	-0.159	0.000	0.303
40		-8.200	-1.717	0.000	0.003
41		0.000	0.154	0.000	0.306
42		-8.200	-1.287	0.000	0.010
43		0.000	-0.108	0.000	0.307
44		-8.200	-0.689	0.000	0.011
45		0.000	0.180	0.000	0.304
46		0.000	-0.391	0.000	0.009
47		0.000	-0.037	0.000	0.310

LOADS AND DEFLECTIONS--

NP	LC	LOAD DEAD+LIVE (KIP)	DEFLECTION DEAD+LIVE (IN)	LOAD WIND (KIP)	DEFLECTION WIND (IN)
48		0.000	-0.080	0.000	0.004
49		0.000	-0.083	0.000	0.309
50		0.000	0.006	0.000	-0.010
51		0.000	0.156	7.000	0.303
52		0.000	0.006	0.000	-0.010
53		0.000	0.170	0.000	0.303
54		0.000	-0.056	0.000	0.008
55		0.000	0.206	0.000	0.263
56		0.000	-0.004	0.000	-0.013
57		0.000	0.208	0.000	0.219
58		0.000	-0.030	0.000	0.012
59		0.000	0.196	0.000	0.173
60		0.000	-0.015	0.000	-0.015
61		0.000	0.161	0.000	0.127
62		0.000	-0.011	0.000	0.012
63		0.000	0.125	0.000	0.085
64		0.000	-0.017	0.000	-0.012
65		0.000	0.076	0.000	0.047
66		0.000	-0.001	0.000	0.008
67		0.000	0.037	0.000	0.018
68		0.000	-0.009	0.000	-0.005

XXX-X-XXXX ** RIGID FRAME ANALYSIS ** 06/04/85
FRX2

MEMBER LOADS FOR STANDARD UBC LOAD CASES

ALL LOADS ARE IN KIPS.
LOADS INVOLVING WIND ARE REDUCED BY 25%.

MEMBER	LC	I D+L	D	II D+W	III D+L+W/2	IV D+L/2+W	MAXIMUM COMP.	MAXIMUM TENSION
1		-40.18	2.99	14.97	-21.47	1.03	-40.18	14.97
2		-18.42	1.35	10.12	-8.22	3.75	-18.42	10.12
3	4	3.33		5.26	5.03	6.42	0.00	7.60
4		25.08	1.89	0.41	18.28	9.08	0.00	25.08
5		46.84	3.43	-4.45	31.53	11.75	-4.45	46.84
6		-0.00	0	-0.00	-0.00	-0.00	-0.00	0.00
7		-0.00		-0.00	-0.00	-0.00	-0.00	0.00
8	4	-8.37		-3.66	-7.86	-6.55	-11.51	0.00
9		-76.44		-6.18	-58.18	-32.61	-76.44	0.00
10		-103.34		-6.22	-77.59	-41.95	-103.34	0.00
11		-103.34		-4.90	-76.93	-40.63	-103.34	0.00
12		-76.44		-1.65	-55.92	-28.03	-76.44	0.00
13	4	-8.37		3.92	-4.07	1.03	-8.37	5.98
14		-0.00		-0.00	-0.00	-0.00	-0.00	0.00
15		0.00		0.00	0.00	0.00	0.00	0.00
16		46.84		12.42	39.97	28.62	0.00	46.84
17		25.08		4.07	20.12	12.75	0.00	25.08
18	4	-3.33		-4.27	0.26	-3.12	-4.31	3.33
19	4	-18.43		-12.62	-19.59	-18.99	-20.17	0.00
20		-40.18		-20.97	-39.44	-34.86	-40.18	0.00
21	4	-3.50		-14.02	-9.53	-15.23	-22.12	0.00
22		-25.25		-9.16	-22.78	-17.89	-25.25	0.00
23		-47.01		-4.31	-36.03	-20.56	-47.01	0.00
24		-68.76	-5.03	0.55	-49.28	-23.23	-68.76	0.55
25		-33.08	2.42	4.25	-21.72	-7.19	-33.08	4.25
26		29.03		6.78	24.31	16.81	0.00	29.03
27		88.48		8.50	68.02	39.09	0.00	88.48
28		88.63		7.16	67.46	37.81	0.00	88.63
29		88.63		7.16	67.46	37.81	0.00	88.63
30		88.48		5.69	66.62	36.28	0.00	88.48
31		29.03		0.30	21.07	10.33	0.00	29.03
32		-33.09		-4.55	-26.12	-15.99	-33.09	0.00
33		-68.76		-10.62	-54.87	-34.39	-68.76	0.00
34		-47.01		-2.27	-35.01	-18.52	-47.01	0.00
35		-25.25		6.08	-15.16	-2.65	-25.25	6.08
36	4	-3.50		14.43	4.69	13.22	-3.50	20.11
37		13.90		-3.10	8.46	1.70	-3.10	13.90
38		-13.90		3.10	-8.46	-1.70	-13.90	3.10
39		13.90	1.02	-3.10	8.46	1.70	-3.10	13.90
40		-13.90		3.10	-8.46	-1.70	-13.90	3.10
41		13.90		-3.10	8.46	1.70	-3.10	13.90
42		-13.90		3.10	-8.46	-1.70	-13.90	3.10
43		13.90		-3.10	8.46	1.70	-3.10	13.90
44		-13.90	0.97	3.10	-8.46	-1.70	-13.90	3.10

XXX-X-XXXX ** RIGID FRAME ANALYSIS ** 06/04/85
FRX2

MEMBER LOADS FOR STANDARD UBC LOAD CASES--

ALL LOADS ARE IN KIPS.
LOADS INVOLVING WIND ARE REDUCED BY 25%.

MEMBER	LC	I D+L	II D+W	III D+L+W/2	IV D+L/2+W	MAXIMUM COMP.	MAXIMUM TENSION
45		-24.44 1.79	2.32	-16.45	-6.13	-24.44	2.32
46		52.83 3.87	-5.01	35.57	13.25	-5.01	52.83
47		-79.64 5.83	2.97	-55.91	-24.56	-79.64	2.97
48		46.14 3.38	1.88	34.19	17.83	0.00	46.14
49		-43.73	-1.78	-32.41	-16.90	-43.73	0.00
50		44.23	1.52	32.63	16.81	0.00	44.23
51		-24.61	-0.47	-17.97	-8.98	-24.61	0.00
52	5	7.26	-0.42	5.02	2.09	-3.87	7.92
53	5	7.36	1.21	5.91	3.76	-6.46	17.59
54		0.00	0.00	0.00	0.00	0.00	0.00
55	5	7.36	-0.42	5.10	2.13	-9.66	12.35
56	5	7.26	1.35	5.90	3.86	-1.98	11.70
57		-24.61	-2.49	-18.98	-11.00	-24.61	0.00
58		44.23	3.76	33.75	19.05	0.00	44.23
59		-43.73	-3.41	-33.22	-18.53	-43.73	0.00
60		46.14 3.30	3.60	35.06	19.55	0.00	46.14
61		-79.64	-14.79	-64.79	-42.32	-79.64	0.00
62		52.83	14.01	45.08	32.28	0.00	52.83
63		-24.44	-1.23	-18.23	-9.68	-24.44	0.00
64		-13.90	-5.33	-12.68	-10.14	-13.90	0.00
65		-13.90	5.33	12.68	10.14	0.00	13.90
66		-13.90	-5.33	-12.68	-10.14	-13.90	0.00
67		13.90	5.33	12.68	10.14	0.00	13.90
68		-13.90	-5.33	-12.68	-10.14	-13.90	0.00
69		13.90	5.33	12.68	10.14	0.00	13.90
70		-13.90	-5.33	-12.68	-10.14	-13.90	0.00
71		13.90	5.33	12.68	10.14	0.00	13.90

RIGID FRAME ANALYSIS AND DESIGN
VULCRAFT - DIVISION OF NUCOR CORPORATION
SEPTEMBER 1934 RELEASE

COLUMN REACTIONS-- (REACTIONS WITH WIND ARE NOT REDUCED BY 25%).

ALL LOADS ARE IN KIPS.
POSITIVE DIRECTIONS ARE UPWARD AND TO THE RIGHT.

TITLE - 53' X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 06/04/85

JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR2

LOAD CASE	LEFT VERTICAL REACTION	LEFT HORIZONTAL REACTION	RIGHT VERTICAL REACTION	RIGHT HORIZONTAL REACTION	INTERIOR COLUMN REACTION
I - D+L	32.80	8.65	32.80	-8.65	
II - D+W	1.96	-2.57	3.16	-4.42	
III - D+L+W/2	32.50	7.02	33.10	-10.52	
IV - D+L/2+W	17.08	1.41	18.28	-8.41	

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

TITLE - 53° X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 06/04/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR#2

BAY WIDTH = 53 FT.
FULL WIDTH = 52-10 0/0.
OVERALL WIDTH = 53- 0 0/0.
GIRTL = 0- 1 0/0, GIRTR = 0- 1 0/0.

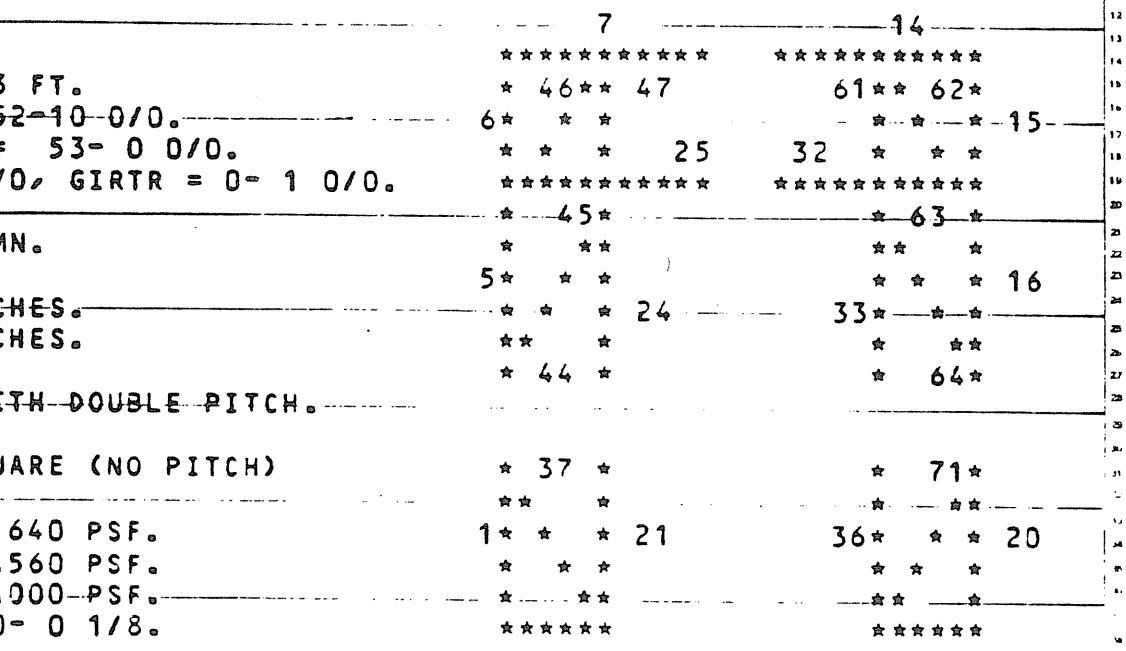
NO CENTER COLUMN.

HAUNCH = 16 INCHES.
BASE = 16 INCHES.

FRAME DESIGN WITH DOUBLE PITCH.

COLUMNS ARE SQUARE (NO PITCH)

DEAD LOAD = 0.640 PSF.
LIVE LOAD = 7.560 PSF.
UPLF LOAD = 0.000 PSF.
BAY SIZE = 0- 0 1/8.



WIND LOADS: 0.00 0.00 0.00 0.00 PSF.

VELOCITY = 40, EXP = C, E/O = E.

WEB FACTOR = 1.0000 W2, W2R, COL W2R. FILLET = 0.3125, CLIP = 4.0.

RAFTER VERTICALS HAVE BEEN LOADED-- CENTER VERTICAL BISECTS BC.

TC	BC	WB	TC	BC	WB	TC	BC	WB	BND CV	PX
8	7	8	25	13	48	4	21	6	1	11	37	4	33	6	15	11	61	10	54	34

P-X	LOAD	P-X	LOAD	P-X	LOAD	P-X	LOAD
20	0.0000	24	-0.0000	30	0.0000	29	0.0000
22	0.0000	28	-8.2000	34	0.0000	33	0.0000
26	-8.2000	32	-8.2000	40	0.0000	39	0.0000
30	-8.2000	38	-8.2000	44	0.0000	43	0.0000
34	0.0000	42	-8.2000	48	0.0000	47	0.0000
40	-8.2000	46	0.0000	50	0.0000	47	0.0000
44	-8.2000	20	0.0000	19	0.0000	5	0.0000
48	0.0000	22	0.0000	21	0.0000	13	0.0000
50	0.0000	26	0.0000	25	0.0000	19	0.0000
						63	0.0000
						55	0.0000
						51	7.0000

CASE 1 LOAD CHECK: COLUMNS - 65.60, RAFTER - 65.60, DELTA = 0.00.

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

TITLE = 53° X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY = DRH
DATE = 06/04/85
JOB = RIGID FRAME TEST #2
XXX-X-XXXX
MARK = FR 2

MULTIPLE LOADING CONDITION--

P-X	UPLIFT	P-X	1/2 LEFT	P-X	1/2 L WW	P-X	1/2 R WW	P-X	SPECIAL
20	0.0000	20	0.0000	20	0.0000	20	0.0000		
22	0.0000	22	0.0000	22	0.0000	22	0.0000		
26	0.0000	26	-8.2000	26	-8.2000	26	-0.6400		
30	0.0000	30	-8.2000	30	-8.2000	30	-0.6400		
34	0.0000	34	0.0000	34	0.0000	34	0.0000		
40	0.0000	40	-0.6400	40	-0.6400	40	-8.2000		
44	0.0000	44	-0.6400	44	-0.6400	44	-8.2000		
48	0.0000	48	0.0000	48	0.0000	48	0.0000		
50	0.0000	50	0.0000	50	0.0000	50	0.0000		
24	0.0000	24	0.0000	24	0.0000	24	0.0000		
28	0.0000	28	-8.2000	28	-8.2000	28	-0.6400		
32	0.0000	32	-8.2000	32	-8.2000	32	-0.6400		
38	0.0000	38	-0.6400	38	-0.6400	38	-8.2000		
42	0.0000	42	-0.6400	42	-0.6400	42	-8.2000		
46	0.0000	46	0.0000	46	0.0000	46	0.0000		
0	0.0000	0	0.0000	20	0.0000	20	0.0000		
0	0.0000	0	0.0000	22	0.0000	22	0.0000		
0	0.0000	0	0.0000	26	0.0000	26	0.0000		
0	0.0000	0	0.0000	30	0.0000	30	0.0000		
0	0.0000	0	0.0000	34	0.0000	34	0.0000		
0	0.0000	0	0.0000	40	0.0000	40	0.0000		
0	0.0000	0	0.0000	44	0.0000	44	0.0000		
0	0.0000	0	0.0000	48	0.0000	48	0.0000		
0	0.0000	0	0.0000	50	0.0000	50	0.0000		
0	0.0000	0	0.0000	19	0.0000	19	0.0000		
0	0.0000	0	0.0000	21	0.0000	21	0.0000		
0	0.0000	0	0.0000	25	0.0000	25	0.0000		
0	0.0000	0	0.0000	29	0.0000	29	0.0000		
0	0.0000	0	0.0000	33	0.0000	33	0.0000		
0	0.0000	0	0.0000	39	0.0000	39	0.0000		
0	0.0000	0	0.0000	43	0.0000	43	0.0000		
0	0.0000	0	0.0000	47	0.0000	47	0.0000		
0	0.0000	0	0.0000	53	0.0000	51	7.0000		
0	0.0000	0	0.0000	5	0.0000	5	0.0000		
0	0.0000	0	0.0000	13	0.0000	13	0.0000		
0	0.0000	0	0.0000	19	0.0000	19	0.0000		
0	0.0000	0	0.0000	63	0.0000	63	0.0000		
0	0.0000	0	0.0000	55	0.0000	55	0.0000		
0	0.0000	0	0.0000	51	7.0000	53	0.0000		

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

TITLE - 53' X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 06/04/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR2

DEFLECTIONS FOR MULTIPLE LOADING CONDITIONS--

	NORMAL		UPLIFT		1/2 LEFT		1/2 L WW		1/2 R WW	
NP	D+L	WIND	D+L	WIND	D+L	WIND	D+L	WIND	D+L	WIND
1	-0.037	0.016	0.000	0.000	-0.020	0.000	-0.020	0.016	-0.021	0.016
2	-0.009	0.005	0.000	0.000	-0.004	0.000	-0.004	0.005	-0.005	0.005
3	-0.076	0.043	0.000	0.000	-0.036	0.000	-0.036	0.043	-0.046	0.043
4	-0.001	-0.007	0.000	0.000	-0.004	0.000	-0.004	-0.007	-0.003	-0.007
5	-0.125	0.077	0.000	0.000	-0.056	0.000	-0.056	0.077	-0.079	0.077
6	-0.017	0.011	0.000	0.000	-0.008	0.000	-0.008	0.011	-0.010	0.011
7	-0.161	-0.117	0.000	0.000	-0.066	0.000	-0.066	-0.117	-0.108	-0.117
8	-0.011	-0.011	0.000	0.000	-0.013	0.000	-0.013	-0.011	0.001	-0.011
9	-0.196	0.160	0.000	0.000	-0.073	0.000	-0.073	0.160	-0.138	0.160
10	-0.015	0.014	0.000	0.000	-0.006	0.000	-0.006	0.014	-0.010	0.014
11	-0.208	0.204	0.000	0.000	-0.064	0.000	-0.064	0.204	-0.160	0.204
12	-0.030	-0.012	0.000	0.000	-0.027	0.000	-0.027	-0.012	-0.005	-0.012
13	-0.205	0.248	0.000	0.000	-0.046	0.000	-0.046	0.248	-0.176	0.248
14	-0.004	0.014	0.000	0.000	0.000	0.000	0.000	0.014	-0.005	0.014
15	-0.170	0.288	0.000	0.000	-0.006	0.000	-0.006	0.288	-0.177	0.288
16	-0.056	-0.010	0.000	0.000	-0.045	0.000	-0.045	-0.010	-0.016	-0.010
17	-0.156	0.285	0.000	0.000	0.002	0.000	0.002	0.285	-0.170	0.285
18	0.006	0.012	0.000	0.000	0.006	0.000	0.006	0.012	0.000	0.012
19	0.083	0.304	0.000	0.000	0.171	0.000	0.171	0.304	-0.081	0.304
20	0.006	0.012	0.000	0.000	0.006	0.000	0.006	0.012	0.000	0.012
21	0.087	0.304	0.000	0.000	0.174	0.000	0.174	0.304	-0.080	0.304
22	-0.080	-0.007	0.000	0.000	-0.060	0.000	-0.060	-0.007	-0.026	-0.007
23	-0.180	0.291	0.000	0.000	-0.011	0.000	-0.011	0.291	-0.182	0.291
24	-0.391	-0.019	0.000	0.000	-0.279	0.000	-0.279	-0.019	-0.142	-0.019
25	0.108	0.303	0.000	0.000	0.186	0.000	0.186	0.303	-0.070	0.303
26	-0.689	-0.030	0.000	0.000	-0.487	0.000	-0.487	-0.030	-0.256	-0.030
27	-0.154	0.297	0.000	0.000	0.014	0.000	0.014	0.297	-0.180	0.297
28	-1.287	-0.038	0.000	0.000	-0.882	0.000	-0.882	-0.038	-0.505	-0.038
29	0.082	0.302	0.000	0.000	0.159	0.000	0.159	0.302	-0.071	0.302
30	-1.717	-0.044	0.000	0.000	-1.139	0.000	-1.139	-0.044	-0.712	-0.044
31	-0.051	0.302	0.000	0.000	0.090	0.000	0.090	0.302	-0.145	0.302
32	-1.989	-0.034	0.000	0.000	-1.214	0.000	-1.214	-0.034	-0.930	-0.034
33	0.000	0.301	0.000	0.000	0.096	0.000	0.096	0.301	-0.096	0.301
34	-2.000	-0.025	0.000	0.000	-1.078	0.000	-1.078	-0.025	-1.078	-0.025
35	0.000	0.303	0.000	0.000	0.118	0.000	0.118	0.303	-0.118	0.303
36	-2.000	-0.025	0.000	0.000	-1.078	0.000	-1.078	-0.025	-1.078	-0.025
37	0.052	0.305	0.000	0.000	0.145	0.000	0.145	0.305	-0.090	0.305
38	-1.989	-0.010	0.000	0.000	-0.930	0.000	-0.930	-0.010	-1.214	-0.010
39	-0.082	0.303	0.000	0.000	0.071	0.000	0.071	0.303	-0.159	0.303

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

DEFLECTIONS FOR MULTIPLE LOADING CONDITIONS--

	NORMAL		UPLIFT		1/2 LEFT		1/2 L WW		1/2 R WW	
NP	D+L	WIND	D+L	WIND	D+L	WIND	D+L	WIND	D+L	WIND
40	-1.717	0.003	0.000	0.000	-0.712	0.000	-0.712	0.003	-1.139	0.003
41	0.154	0.306	0.000	0.000	0.180	0.000	0.180	0.306	-0.014	0.304
42	-1.287	0.010	0.000	0.000	-0.505	0.000	-0.505	0.010	-0.882	0.010
43	-0.108	0.307	0.000	0.000	-0.070	0.000	0.070	0.307	-0.186	0.307
44	-0.689	0.011	0.000	0.000	-0.256	0.000	-0.256	0.011	-0.487	0.011
45	0.180	0.304	0.000	0.000	0.182	0.000	0.182	0.304	0.011	0.304
46	-0.391	0.009	0.000	0.000	-0.142	0.000	-0.142	0.009	-0.279	0.009
47	-0.087	0.310	0.000	0.000	0.080	0.000	0.080	0.310	-0.174	0.310
48	-0.080	0.004	0.000	0.000	-0.026	0.000	-0.026	0.004	-0.060	0.004
49	-0.083	0.309	0.000	0.000	0.081	0.000	0.081	0.309	-0.171	0.309
50	0.006	-0.010	0.000	0.000	0.000	0.000	0.000	-0.010	0.006	-0.010
51	0.156	0.303	0.000	0.000	0.170	0.000	0.170	0.303	-0.002	0.303
52	0.006	-0.010	0.000	0.000	0.000	0.000	0.000	-0.010	0.006	-0.010
53	0.170	0.303	0.000	0.000	0.177	0.000	0.177	0.303	0.006	0.303
54	-0.056	0.008	0.000	0.000	-0.016	0.000	-0.016	0.008	-0.045	0.008
55	-0.206	0.263	0.000	0.000	0.176	0.000	0.176	0.263	-0.046	0.263
56	-0.004	-0.013	0.000	0.000	-0.005	0.000	-0.005	-0.013	0.000	-0.013
57	0.208	0.219	0.000	0.000	0.160	0.000	0.160	0.219	0.064	0.219
58	-0.030	0.012	0.000	0.000	-0.005	0.000	-0.005	0.012	-0.027	0.012
59	0.196	0.173	0.000	0.000	0.138	0.000	0.138	0.173	0.073	0.173
60	-0.015	-0.015	0.000	0.000	-0.010	0.000	-0.010	-0.015	-0.006	-0.015
61	0.161	0.127	0.000	0.000	0.108	0.000	0.108	0.127	0.066	0.127
62	-0.011	0.012	0.000	0.000	0.001	0.000	0.001	0.012	-0.013	0.012
63	0.125	0.085	0.000	0.000	0.079	0.000	0.079	0.085	0.056	0.085
64	-0.017	-0.012	0.000	0.000	-0.010	0.000	-0.010	-0.012	-0.008	-0.012
65	0.076	0.047	0.000	0.000	0.046	0.000	0.046	0.047	0.036	0.047
66	-0.001	0.008	0.000	0.000	0.003	0.000	0.003	0.008	-0.004	0.008
67	0.037	0.018	0.000	0.000	0.021	0.000	0.021	0.018	0.020	0.018
68	-0.009	-0.005	0.000	0.000	-0.005	0.000	-0.005	-0.005	-0.004	-0.005

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

TITLE - 53' X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 06/04/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR2

MULTIPLE LOADING CONDITION--

	NORMAL		UPLIFT		1/2 LEFT		1/2 L WW		1/2 R WW	
MEM	COMP	TEN	COMP	TEN	COMP	TEN	COMP	TEN	COMP	TEN
1	-40.18	14.97	0.00	0.00	-20.08	0.00	0.00	2.27	-0.10	0.00
2	-18.42	10.12	0.00	0.00	-8.35	0.00	0.00	4.93	0.00	2.53
3	0.00	6.42	0.00	0.00	0.00	3.37	0.00	7.60	0.00	5.25
4	0.00	25.08	0.00	0.00	0.00	15.10	0.00	10.27	0.00	7.90
5	-4.45	46.84	0.00	0.00	0.00	26.83	0.00	12.93	0.00	10.56
6	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00
7	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00
8	-8.37	0.00	0.00	0.00	-11.12	0.00	-11.51	0.00	-1.60	0.00
9	-76.44	0.00	0.00	0.00	-59.98	0.00	-46.69	0.00	-18.53	0.00
10	-103.34	0.00	0.00	0.00	-66.77	0.00	-50.25	0.00	-33.65	0.00
11	-103.34	0.00	0.00	0.00	-44.64	0.00	-32.33	0.00	-48.93	0.00
12	-76.44	0.00	0.00	0.00	-22.43	0.00	-14.00	0.00	-42.16	0.00
13	-8.37	3.92	0.00	0.00	-0.00	2.09	-0.00	5.98	-3.92	0.00
14	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00
15	0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00
16	0.00	46.84	0.00	0.00	0.00	23.67	-0.00	27.43	-0.00	29.80
17	0.00	25.08	0.00	0.00	0.00	11.94	0.00	11.56	0.00	13.93
18	-4.27	3.33	0.00	0.00	0.00	0.22	-4.31	0.00	-1.94	0.00
19	-19.59	0.00	0.00	0.00	-11.51	0.00	-20.17	0.00	-17.81	0.00
20	-40.18	0.00	0.00	0.00	-23.24	0.00	-36.04	0.00	-33.68	0.00
21	-15.23	0.00	0.00	0.00	-11.08	0.00	-22.12	0.00	-8.33	0.00
22	-25.25	0.00	0.00	0.00	-22.81	0.00	-24.79	0.00	-11.00	0.00
23	-47.01	0.00	0.00	0.00	-34.54	0.00	-27.46	0.00	-13.66	0.00
24	-68.76	0.55	0.00	0.00	-46.26	0.00	-30.13	0.00	-16.33	0.00
25	-33.08	4.25	0.00	0.00	-18.66	0.00	-7.81	0.00	-6.57	0.00
26	0.00	29.03	0.00	0.00	0.00	28.88	0.00	26.74	0.00	6.88
27	0.00	88.48	0.00	0.00	0.00	65.32	0.00	52.31	0.00	25.86
28	0.00	88.63	0.00	0.00	0.00	47.77	0.00	37.81	0.00	37.81
29	0.00	88.63	0.00	0.00	0.00	47.77	0.00	37.81	0.00	37.81
30	0.00	88.48	0.00	0.00	0.00	30.07	0.00	23.06	0.00	49.56
31	0.00	29.03	0.00	0.00	0.00	2.42	0.00	0.41	0.00	20.26
32	-33.09	0.00	0.00	0.00	-17.01	0.00	-15.37	0.00	-16.61	0.00
33	-68.76	0.00	0.00	0.00	-27.86	0.00	-27.49	0.00	-41.29	0.00
34	-47.01	0.00	0.00	0.00	-16.14	0.00	-11.62	0.00	-25.42	0.00
35	-25.25	6.08	0.00	0.00	-4.41	0.00	0.00	4.25	-9.55	0.00
36	-3.50	14.43	0.00	0.00	0.00	7.31	0.00	20.11	0.00	6.32
37	-3.10	13.90	0.00	0.00	0.00	7.49	0.00	1.70	0.00	1.70
38	-13.90	3.10	0.00	0.00	-7.49	0.00	-1.70	0.00	-1.70	0.00
39	-3.10	13.90	0.00	0.00	0.00	7.49	0.00	1.70	0.00	1.70

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

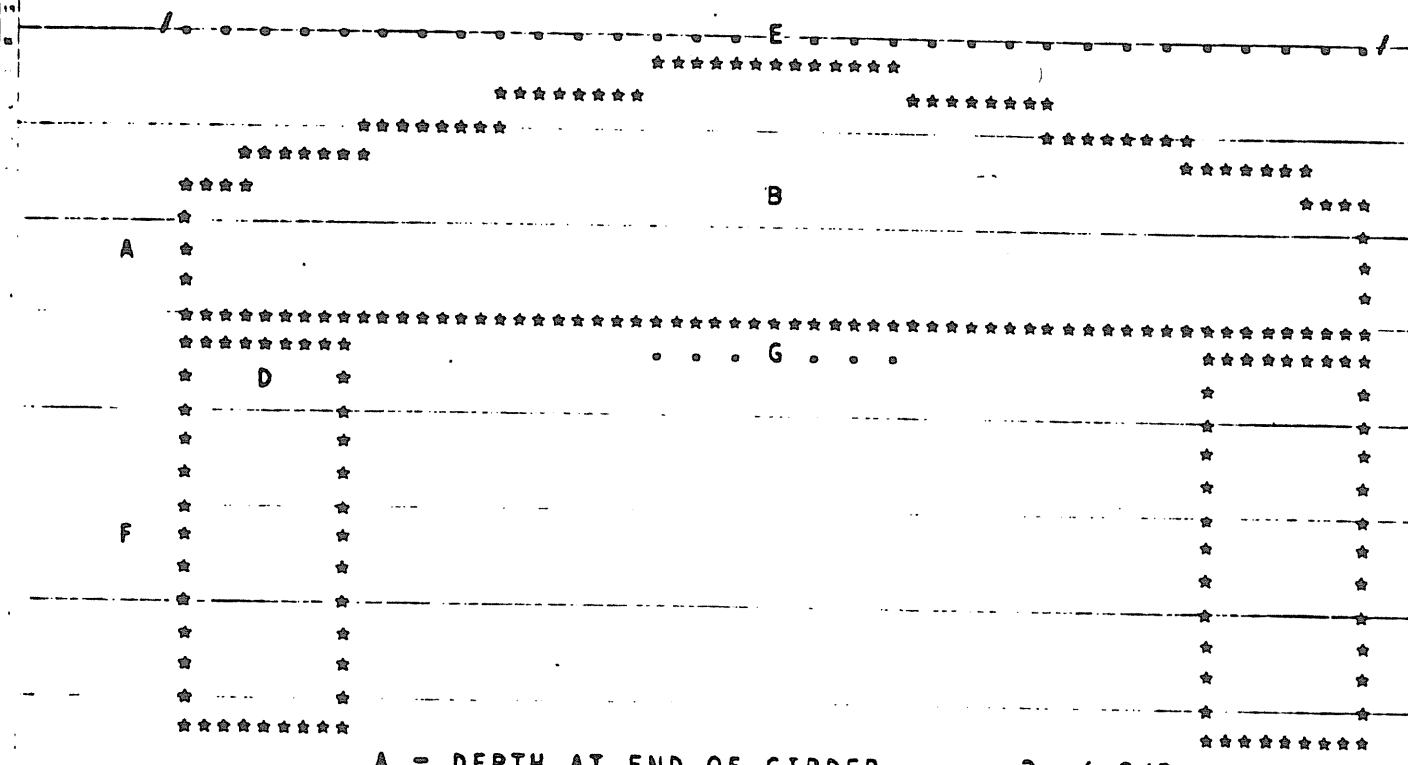
MULTIPLE LOADING CONDITION--

	NORMAL		UPLIFT		1/2 LEFT		1/2 L WW		1/2 R WW	
MEM	COMP	TEN	COMP	TEN	COMP	TEN	COMP	TEN	COMP	TEN
40	-13.90	3.10	0.00	0.00	-7.49	0.00	-1.70	0.00	-1.70	0.00
41	-3.10	13.90	0.00	0.00	0.00	7.49	0.00	1.70	0.00	1.70
42	-13.90	3.10	0.00	0.00	-7.49	0.00	-1.70	0.00	-1.70	0.00
43	-3.10	13.90	0.00	0.00	0.00	7.49	0.00	1.70	0.00	1.70
44	-13.90	3.10	0.00	0.00	-7.49	0.00	-1.70	0.00	-1.70	0.00
45	-24.44	2.32	0.00	0.00	-14.00	0.00	-6.75	0.00	-5.51	0.00
46	-5.01	52.83	0.00	0.00	0.00	30.26	0.00	14.59	0.00	11.91
47	-79.64	2.97	0.00	0.00	-52.13	0.00	-31.46	0.00	-17.66	0.00
48	0.00	46.14	0.00	0.00	0.00	35.31	0.00	25.66	0.00	10.00
49	-43.73	0.00	0.00	0.00	-33.47	0.00	-24.32	0.00	-9.47	0.00
50	0.00	44.23	0.00	0.00	0.00	30.15	0.00	21.54	0.00	12.07
51	-24.61	0.00	0.00	0.00	-11.92	0.00	-7.97	0.00	-9.99	0.00
52	-0.42	7.26	0.00	0.00	-3.87	0.00	-3.75	0.00	0.00	7.92
53	0.00	7.36	0.00	0.00	0.00	17.59	0.00	13.97	-6.46	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	-0.42	7.36	0.00	0.00	-9.66	0.00	-8.09	0.00	0.00	12.35
56	0.00	7.26	0.00	0.00	0.00	11.70	0.00	9.70	-1.98	0.00
57	-24.61	0.00	0.00	0.00	-14.61	0.00	-12.01	0.00	-9.99	0.00
58	0.00	44.23	0.00	0.00	0.00	17.53	0.00	14.31	0.00	23.78
59	-43.73	0.00	0.00	0.00	-13.66	0.00	-11.11	0.00	-25.95	0.00
60	0.00	46.14	0.00	0.00	0.00	14.43	0.00	11.72	0.00	27.36
61	-79.64	0.00	0.00	0.00	-33.73	0.00	-35.42	0.00	-49.22	0.00
62	0.00	52.83	0.00	0.00	0.00	26.69	0.00	30.94	0.00	33.67
63	-24.44	0.00	0.00	0.00	-12.35	0.00	-9.06	0.00	-10.30	0.00
64	-13.90	0.00	0.00	0.00	-7.49	0.00	-10.14	0.00	-10.14	0.00
65	0.00	13.90	0.00	0.00	0.00	7.49	0.00	10.14	0.00	10.14
66	-13.90	0.00	0.00	0.00	-7.49	0.00	-10.14	0.00	-10.14	0.00
67	0.00	13.90	0.00	0.00	0.00	7.49	0.00	10.14	0.00	10.14
68	-13.90	0.00	0.00	0.00	-7.49	0.00	-10.14	0.00	-10.14	0.00
69	0.00	13.90	0.00	0.00	0.00	7.49	0.00	10.14	0.00	10.14
70	-13.90	0.00	0.00	0.00	-7.49	0.00	-10.14	0.00	-10.14	0.00
71	0.00	13.90	0.00	0.00	0.00	7.49	0.00	10.14	0.00	10.14

ANALYSIS II
PINNED COLUMN BASES

RIGID FRAME ANALYSIS AND DESIGN
VULCRAFT - DIVISION OF NUCOR CORPORATION
SEPTEMBER 1984 RELEASE

TITLE - 53° X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 05/30/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR2



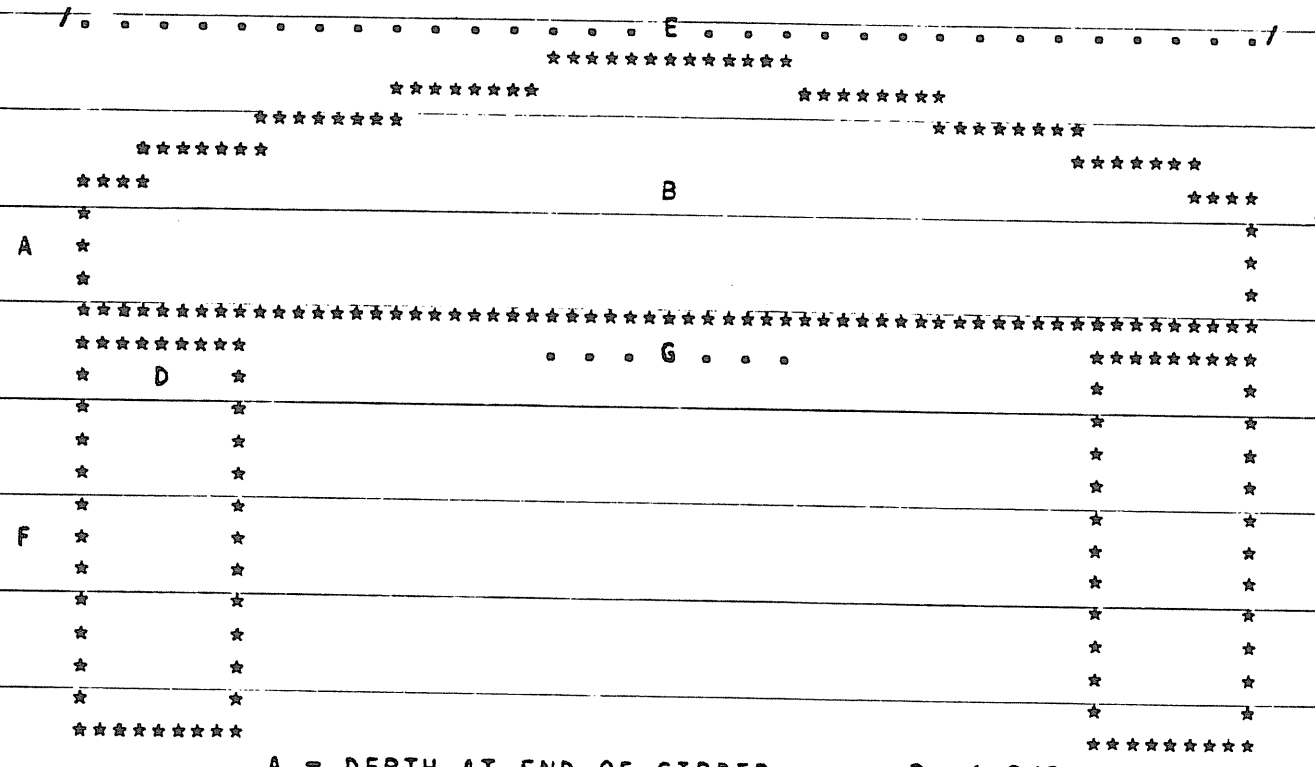
A - DEPTH AT END OF GIRDER. . . 2- 6 0/0
B - DEPTH AT CENTER OF GIRDER . . 3- 7 1/4
C - BASE OF COLUMN. 1- 4 0/0
D - TOP OF COLUMN 1- 4 0/0
E - FULL WIDTH OF FRAME 52-10 0/0
F - CLEAR HEIGHT. 13- 5 0/0
G - CLEAR WIDTH AT TOP. 50- 2 0/0

ROOF PITCH = 0.501 INCH TO 1 FOOT.
EAVE HEIGHT = F + A + JOIST SEAT DEPTH (STD 8 IN)
= 16- 0 0/0.
OVERALL BLDG WIDTH = E + WALL GIRTS
= 53- 0 0/0.
WALL GIRTS = 0- 1 0/0 AND 0- 1 0/0

LIVE LOAD = 7.56 PSF, DEAD LOAD = 0.64 PSF, UPLIFT LOAD = 0.00 PSF.
WIND LOADS: 0.00, 0.00, 0.00, 0.00 PSF, 1982 UBC.
BAY DEPTH = 0- 0 1/8.

RIGID FRAME ANALYSIS AND DESIGN
VULCRAFT - DIVISION OF NUCOR CORPORATION
SEPTEMBER 1984 RELEASE

TITLE - 53' X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 03/18/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR1



A - DEPTH AT END OF GIRDER. . . 2- 6 0/0
B - DEPTH AT CENTER OF GIRDER . 3- 7 1/4
C - BASE OF COLUMN. 1- 4 0/0
D - TOP OF COLUMN 1- 4 0/0
E - FULL WIDTH OF FRAME 52-10 0/0
F - CLEAR HEIGHT. 13- 5 0/0
G - CLEAR WIDTH AT TOP. 50- 2 0/0

ROOF PITCH = 0.501 INCH TO 1 FOOT.
EAVE HEIGHT = F + A + JOIST SEAT DEPTH (STD 8 IN)
= ~~16- 0 0/0~~. 15'-11"
OVERALL BLDG WIDTH = E + WALL GIRTS
= 53- 0 0/0.
WALL GIRTS = ~~0- 1 0/0~~ AND ~~0- 1 0/0~~

LIVE LOAD = ~~7.56~~ PSF, DEAD LOAD = ~~0.64~~ PSF, UPLIFT LOAD = 0.00 PSF.
WIND LOADS: 0.00, 0.00, 0.00, 0.00 PSF, 1982 UBC.
BAY DEPTH = ~~0- 0 1/8~~.

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 03/18/85
FR1

GIRDER SECTION FY = 50 KSI FOR ANGLES.

TOP CHORD = 54 - L3-1/2X3-1/2X.344

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
7	16.01	-0.00	0.00	-131.98	137.40	16.0	14.9
8	61.05	-22.62	0.00	~~-121.00~~ 125.00	137.40	~~38.5~~ 31.1	~~35.7~~ 28.8
9	120.10	-81.71	0.00	-107.34	137.40	60.1	55.7
10	120.10	-107.96	0.00	-107.34	137.40	60.1	55.7
11	120.10	-107.96	0.00	-107.34	137.40	60.1	55.7
12	120.10	-81.71	2.73	-107.34	137.40	60.1	55.7
13	61.05	-14.26	12.06	~~-121.00~~ 125.00	137.40	~~38.5~~ 31.1	~~35.7~~ 28.8
14	16.01	-0.00	0.00	-131.98	137.40	16.0	14.9

MAX COMP. FORCE REQD = -107.96 KIPS.
LY DEVD AT 5- 0 0/0 = -122.94 KIPS. LY/RY = 32.5

LY	COMP	LY/RY
5- 0 0/0	-122.94	32.5
7- 6 0/0	-112.46	48.7
10- 0 0/0	-100.12	64.9
15- 0 0/0	-70.11	97.4

BOT CHORD = 48 - L 3 X 3 X.313

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
25	31.00	-21.79	14.50	-95.03	106.80	31.0	33.6
26	90.00	0.00	39.86	-54.30	106.80	90.0	97.6
27	120.00	0.00	98.56	-31.38	106.80	120.0	130.2
28 } 120.0	~~60.00~~	0.00	98.14	-31.38 ~~-77.72~~	106.80	120.0 ~~50.0~~	130.2 ~~65.1~~
29 }	~~60.00~~	0.00	98.14	~~-77.72~~	106.80	~~60.0~~	~~65.1~~
30	120.00	0.00	98.56	-31.38	106.80	120.0	130.2
31	90.00	-5.74	39.85	-54.30	106.80	90.0	97.6
32	31.00	-22.22	0.00	-95.03	106.80	31.0	33.6

MAX COMP. FORCE REQD = -22.22 KIPS.
LY DEVD AT 10- 0 0/0 = -72.72 KIPS. LY/RY = 72.7

LY	COMP	LY/RY
5- 0 0/0	-93.74	36.4
7- 6 0/0	-84.11	54.5
10- 0 0/0	-72.72	72.7
15- 0 0/0	-44.67	109.1

NOTE: SIGN CONVENTION (-) COMPRESSION.

GIRDER WEBS

FY = 50 KSI FOR ANGLES.

NO	LGTH	SEC	DESCRIPTION	Q	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		L/R	WELD REQD	WELD DEVD
48	40.2	39	L2-1/2X2-1/2X.250	2S	0.0	45.8	-55.9	71.2	55.0	16.4	19.0
49	41.3	39	L2-1/2X2-1/2X.250	2S	-43.4	0.0	-55.4	71.2	56.4	15.6	18.8
50	66.3	31	L 2.00X2.00X0.232	2S	-0.9	43.8	-21.3	52.4	110.7	15.7	18.6
51	68.2	33	L 2.50X2.50X0.197	2	-24.2	1.7	-31.0	56.8	90.3	10.2	13.6
52	68.6	22	L 2.00X2.00X0.1370	2	-5.9	6.9	-12.5	31.7	112.3	7.8	14.2
53	71.3	22	L 2.00X2.00X0.1370	2	-4.7	17.9	-11.6	31.7	116.7	8.8	13.5
~~54~~ SHIFT	~~42.2~~	~~16~~	~~L1-1/2X1-1/2X.130~~	~~1~~	~~0.0~~	~~0.0~~	~~-2.9~~	~~0.0~~	~~138.7~~	~~2.0~~	~~4.2~~
55	71.3	22	L 2.00X2.00X0.1370	2	-9.8	10.9	-11.6	31.7	116.7	8.8	13.5
56	68.6	22	L 2.00X2.00X0.1370	2	-0.4	11.7	-12.5	31.7	112.3	7.8	14.2
57	68.2	33	L 2.50X2.50X0.197	2	-24.2	0.0	-31.0	56.8	90.3	10.2	13.6
58	66.3	31	L 2.00X2.00X0.232	2S	0.0	43.8	-21.3	52.4	110.7	15.7	18.6
59	41.3	39	L2-1/2X2-1/2X.250	2S	-43.4	0.0	-55.4	71.2	56.4	15.6	18.8
60	40.2	39	L2-1/2X2-1/2X.250	2S	0.0	45.8	-55.9	71.2	55.0	16.4	19.0

VERTICALS

MEM	LGTH	SEC		Q	FORCE REQD IN KIPS		FORCE DEVD IN KIPS		L/R	WELD REQD	WELD DEVD
~~V1 LD~~	32.1	16	L1-1/2X1-1/2X.130	1	0.0	~~-2.2~~	-5.1		103.8	2.0	3.9
V2	34.7	27 ~~16~~	~~L1-1/2X1-1/2X.130~~	1	-8.2	~~-2.2~~	-12.7	~~-4.3~~	~~113.6~~	3.0 ~~2.0~~	4.2
V3	39.7	29 ~~16~~	~~L1-1/2X1-1/2X.130~~	1	-8.2	~~-2.2~~	-12.0	~~-3.3~~	~~130.4~~	3.0 ~~2.0~~	4.2
V5	39.7	29 ~~16~~	~~L1-1/2X1-1/2X.130~~	1	-8.2	~~-2.2~~	-12.0	~~-3.3~~	~~130.4~~	3.0 ~~2.0~~	4.2
V6	34.7	27 ~~16~~	~~L1-1/2X1-1/2X.130~~	1	-8.2	~~-2.2~~	-12.7	~~-4.3~~	~~113.6~~	3.0 ~~2.0~~	4.2
~~V7 RD~~	32.1	16	L1-1/2X1-1/2X.130	1	0.0	~~-2.2~~	-5.1		103.8	2.0	3.9

NOTE: VERTICALS BISECT TOP CHORD PANELS.
ENDPANEL VERTICALS MAY BE DIAGONAL (LD OR RD).

2DL DISTANCE ~~FROM~~ END OF RAFTER = 3- 2 1/2

2DR DISTANCE ~~FROM~~ END OF RAFTER = 3- 2 1/2

NOTE: SIGN CONVENTION (-) COMPRESSION.

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 03/18/85
FR1

LEFT COLUMN

FY = 50 KSI
FOR ANGLES.

COLUMNS ARE SYMMETRIC ABOUT CENTER LINE OF FRAME

INSIDE LEG = 46 - L 3 X 3 X.281

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
21	40.25	-37.18	2.40	-81.43	96.42	40.3	43.5
22	40.25	-45.96	8.24	-81.43	96.42	40.3	43.5
23	40.25	-54.73	14.07	-81.43	96.42	40.3	43.5
24	40.25	-63.50	19.91	-81.43	96.42	40.3	43.5
47	30.67	-67.89	22.83	-86.00	96.42	30.7	33.1

MAX COMP. FORCE REQD = -67.89 KIPS.
LY DEVD AT 7- 6 0/0 = -75.76 KIPS. LY/RY = 54.9

PINNED COL BASE LX DEVD AT 14- 8 0/0 = -78.83 KIPS. KLX/RXX = 48.9

LY	COMP	LY/RY
5- 0 0/0	-84.53	36.6
7- 6 0/0	-75.76	54.9
10- 0 0/0	-65.38	73.2
15- 0 0/0	-39.84	109.8

OUTSIDE LEG = 46 - L 3 X 3 X.281

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
1	20.13	0.00	0.00	0.00	0.00	0.0	0.0
2	40.25	-5.84	8.77	-81.43	96.42	40.3	43.5
3	40.25	-11.67	17.54	-81.43	96.42	40.3	43.5
4	40.25	-17.51	26.32	-81.43	96.42	40.3	43.5
5	20.13	-23.35	35.09	-90.36	96.42	20.1	21.7
6	30.00	-0.00	0.00	-86.30	96.42	30.0	32.4

MAX COMP. FORCE REQD = -23.35 KIPS.
LY DEVD AT 7- 6 0/0 = -75.76 KIPS. LY/RY = 54.9

LY	COMP	LY/RY
5- 0 0/0	-84.53	36.6
7- 6 0/0	-75.76	54.9
10- 0 0/0	-65.38	73.2
15- 0 0/0	-39.84	109.8

COLUMN MOMENT OF INERTIA = 333.74

NOTE: SIGN CONVENTION (-) COMPRESSION.

LEFT COLUMN WEBS

FY = 50 KSI
FOR ANGLES.

NO	LGTH	SEC	DESCRIPTION	Q	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		L/R	WELD REQD	WELD DEVD
37	23.6	16	L1-1/2X1-1/2X.130	2	-3.7	5.6	-17.5	22.4	53.0	5.8	13.9
38	23.8	16	L1-1/2X1-1/2X.130	1	-5.6	3.7	-6.8	11.2	82.8	3.4	6.0
39	23.8	16	L1-1/2X1-1/2X.130	1	-3.7	5.6	-6.8	11.2	82.8	3.4	6.0
40	23.8	16	L1-1/2X1-1/2X.130	1	-5.6	3.7	-6.8	11.2	82.8	3.4	6.0
41	23.8	16	L1-1/2X1-1/2X.130	1	-3.7	5.6	-6.8	11.2	82.8	3.4	6.0
42	23.8	16	L1-1/2X1-1/2X.130	1	-5.6	3.7	-6.8	11.2	82.8	3.4	6.0
43	23.8	16	L1-1/2X1-1/2X.130	1	-3.7	5.6	-6.8	11.2	82.8	3.4	6.0
44	23.8	16	L1-1/2X1-1/2X.130	1	-5.6	3.7	-6.8	11.2	82.8	3.4	6.0
45	14.8	19	L1-1/2X1-1/2X.156	2	-18.3	12.2	-24.0	26.6	31.0	7.9	11.4
46	32.5	31	L 2.00X2.00X0.232	2S	-26.3	39.6	-41.1	52.4	55.3	16.8	19.8

NOTE: SIGN CONVENTION (-) COMPRESSION.

-- THE WELDING OF THE HAUNCH --

REQD FORCE = ~~45.60~~ 21.67 KIPS

WELD (IN.)	DEV FORCE (KIPS)	
6.0	64.21	4.0-IN CONNECTER
5.0	58.62	
4.0	50.87	

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 03/18/85
FR1

RIGHT COLUMN

FY = 50 KSI
FOR ANGLES.

COLUMNS ARE SYMMETRIC ABOUT CENTER LINE OF FRAME

INSIDE LEG = 46 - L 3 X 3 X.281

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
36	40.25	-37.19	0.00	-81.43	96.42	40.3	43.5
35	40.25	-45.96	0.00	-81.43	96.42	40.3	43.5
34	40.25	-54.73	0.00	-81.43	96.42	40.3	43.5
33	40.25	-63.51	0.00	-81.43	96.42	40.3	43.5
61	30.67	-67.89	0.00	-86.00	96.42	30.7	33.1

MAX COMP. FORCE REQD = -67.89 KIPS.
LY DEVD AT 7- 6 0/0 = -75.76 KIPS. LY/RY = 54.9

PINNED COL BASE LX DEVD AT 14- 8 0/0 = -78.83 KIPS. KLX/RXX = 48.9

LY	COMP	LY/RY
5- 0 0/0	-84.53	36.6
7- 6 0/0	-75.76	54.9
10- 0 0/0	-65.38	73.2
15- 0 0/0	-39.84	109.8

OUTSIDE LEG = 46 - L 3 X 3 X.281

MEM	LENGTH (IN)	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		LX	LX/RX
20	20.13	0.00	0.00	0.00	0.00	0.0	0.0
19	40.25	0.00	10.38	-81.43	96.42	40.3	43.5
18	40.25	0.00	20.77	-81.43	96.42	40.3	43.5
17	40.25	0.00	31.15	-81.43	96.42	40.3	43.5
16	20.13	0.00	41.54	-90.36	96.42	20.1	21.7
15	30.00	0.00	0.00	-86.30	96.42	30.0	32.4

MAX COMP. FORCE REQD = 0.00 KIPS.
LY DEVD AT 7- 6 0/0 = -75.76 KIPS. LY/RY = 54.9

LY	COMP	LY/RY
5- 0 0/0	-84.53	36.6
7- 6 0/0	-75.76	54.9
10- 0 0/0	-65.38	73.2
15- 0 0/0	-39.84	109.8

COLUMN MOMENT OF INERTIA = 333.74

NOTE: SIGN CONVENTION (-) COMPRESSION.

XXX-X-XXXX ** RIGID FRAME MEMBER DESIGN ** 03/18/85
FR1

RIGHT COLUMN WEBS

FY = 50 KSI
FOR ANGLES.

NO	LGTH	SEC	DESCRIPTION	Q	FORCES REQD IN KIPS		FORCES DEVD IN KIPS		L/R	WELD REQD	WELD DEVD
71	23.6	16	L1-1/2X1-1/2X.130	2	0.0	6.6	-17.5	22.4	53.0	5.8	13.9
70	23.8	16	L1-1/2X1-1/2X.130	1	-6.6	0.0	-6.8	11.2	82.8	3.4	6.0
69	23.8	16	L1-1/2X1-1/2X.130	1	0.0	6.6	-6.8	11.2	82.8	3.4	6.0
68	23.8	16	L1-1/2X1-1/2X.130	1	-6.6	0.0	-6.8	11.2	82.8	3.4	6.0
67	23.8	16	L1-1/2X1-1/2X.130	1	0.0	6.6	-6.8	11.2	82.8	3.4	6.0
66	23.8	16	L1-1/2X1-1/2X.130	1	-6.6	0.0	-6.8	11.2	82.8	3.4	6.0
65	23.8	16	L1-1/2X1-1/2X.130	1	0.0	6.6	-6.8	11.2	82.8	3.4	6.0
64	23.8	16	L1-1/2X1-1/2X.130	1	-6.6	0.0	-6.8	11.2	82.8	3.4	6.0
63	14.8	19	L1-1/2X1-1/2X.156	2	-18.3	0.0	-24.0	26.6	31.0	7.9	11.4
62	32.5	31	L 2.00X2.00X0.232	2S	0.0	46.9	-41.1	52.4	55.3	16.8	19.8

NOTE: SIGN CONVENTION (-) COMPRESSION.

-- THE WELDING OF THE HAUNCH --

REQD FORCE = ~~45.60~~ 21.67 KIPS

WELD (IN.)	DEV FORCE (KIPS)	
6.0	64.21	4.0-IN CONNECTER
5.0	58.62	
4.0	50.87	

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*                                                                    *
*****          RIGID FRAME ANALYSIS AND DESIGN                  *****
   **      VULCRAFT - DIVISION OF NUCOR CORPORATION             **
     **          SEPTEMBER 1984 RELEASE                       **
       **                                                     **
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TITLE - 53° X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 03/18/85

JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR1

DESIGN PARAMETERS:

NUMBER OF DEGREES OF FREEDOM	=	68
NOMINAL NUMBER OF MEMBERS	=	71
NUMBER OF DEAD + LIVE LOADS	=	15
NUMBER OF WIND LOADS	=	24
DEAD LOAD	=	0.6 PSF
LIVE LOAD	=	7.6 PSF
WIND LOADS: 0.0 0.0 0.0		0.0 PSF
UPLT LOAD	=	0.0 PSF
BAY DEPTH	=	0.0 FT

COLUMNS SYMMETRIC

KEY MEMBERS FOR COLUMN REACTIONS:

LBOC -	2
LBW -	37
LBIC -	21
RBIC -	36
RBW -	71
RBOC -	19

MEMBER GEOMETRY--

MEMBER	NP1	NP2	NP3	NP4	HORZ (IN)	VERT (IN)	LENGTH (IN)	AREA (IN**2)	SEC SIZE
1	69	69	69	69	0.00	20.13	20.13	3.214	46
2	1	2	5	6	0.00	40.25	40.25	3.214	46
3	5	6	9	10	0.00	40.25	40.25	3.214	46
4	9	10	13	14	0.00	40.25	40.25	3.214	46
5	13	14	17	18	0.00	20.13	20.13	3.214	46
6	17	18	19	20	0.00	30.00	30.00	3.214	46
7	19	20	21	22	16.00	0.67	16.01	4.580	54
8	21	22	25	26	61.00	2.54	61.05	4.580	54
9	25	26	29	30	120.00	5.00	120.10	4.580	54
10	29	30	33	34	120.00	5.00	120.10	4.580	54
11	33	34	39	40	120.00	-5.00	120.10	4.580	54
12	39	40	43	44	120.00	-5.00	120.10	4.580	54
13	43	44	47	48	61.00	-2.54	61.05	4.580	54
14	47	48	49	50	16.00	-0.67	16.01	4.580	54
15	51	52	49	50	0.00	30.00	30.00	3.214	46
16	55	56	51	52	0.00	20.13	20.13	3.214	46
17	59	60	55	56	0.00	40.25	40.25	3.214	46
18	63	64	59	60	0.00	40.25	40.25	3.214	46
19	67	68	63	64	0.00	40.25	40.25	3.214	46
20	69	69	69	69	0.00	20.13	20.13	3.214	46
21	69	69	3	4	0.00	40.25	40.25	3.214	46
22	3	4	7	8	0.00	40.25	40.25	3.214	46

MEMBER GEOMETRY--

MEMBER	NP1	NP2	NP3	NP4	HORZ (IN)	VERT (IN)	LENGTH (IN)	AREA (IN**2)	SEC SIZE
23	7	8	11	12	0.00	40.25	40.25	3.214	46
24	11	12	15	16	0.00	40.25	40.25	3.214	46
25	15	16	23	24	31.00	0.00	31.00	3.560	48
26	23	24	27	28	90.00	0.00	90.00	3.560	48
27	27	28	31	32	120.00	0.00	120.00	3.560	48
28	31	32	35	36	60.00	0.00	60.00	3.560	48
29	35	36	37	38	60.00	0.00	60.00	3.560	48
30	37	38	41	42	120.00	0.00	120.00	3.560	48
31	41	42	45	46	90.00	0.00	90.00	3.560	48
32	45	46	53	54	31.00	0.00	31.00	3.560	48
33	53	54	57	58	0.00	-40.25	40.25	3.214	46
34	57	58	61	62	0.00	-40.25	40.25	3.214	46
35	61	62	65	66	0.00	-40.25	40.25	3.214	46
36	65	66	69	69	0.00	-40.25	40.25	3.214	46
37	1	2	69	69	16.00	-20.13	25.71	0.746	16
38	1	2	3	4	16.00	20.13	25.71	0.373	16
39	5	6	3	4	16.00	-20.13	25.71	0.373	16
40	5	6	7	8	16.00	20.13	25.71	0.373	16
41	9	10	7	8	16.00	-20.13	25.71	0.373	16
42	9	10	11	12	16.00	20.13	25.71	0.373	16
43	13	14	11	12	16.00	-20.13	25.71	0.373	16
44	13	14	15	16	16.00	20.13	25.71	0.373	16
45	17	18	15	16	16.00	0.00	16.00	0.888	19
46	17	18	21	22	16.00	30.67	34.59	1.748	31
47	21	22	15	16	0.00	-30.67	30.67	3.214	46
48	21	22	23	24	31.00	-30.67	43.61	2.374	39
49	23	24	25	26	30.00	33.21	44.75	2.374	39
50	25	26	27	28	60.00	-33.21	68.58	1.748	31
51	27	28	29	30	60.00	38.21	71.13	1.892	33
52	29	30	31	32	60.00	-38.21	71.13	1.058	22
53	31	32	33	34	60.00	43.21	73.94	1.058	22
54	35	36	33	34	0.00	43.21	43.21	0.373	16
55	33	34	37	38	60.00	-43.21	73.94	1.058	22
56	37	38	39	40	60.00	38.21	71.13	1.058	22
57	39	40	41	42	60.00	-38.21	71.13	1.892	33
58	41	42	43	44	60.00	33.21	68.58	1.748	31
59	43	44	45	46	30.00	-33.21	44.75	2.374	39
60	45	46	47	48	31.00	30.67	43.61	2.374	39
61	47	48	53	54	0.00	-30.67	30.67	3.214	46
62	47	48	51	52	16.00	-30.67	34.59	1.748	31
63	53	54	51	52	16.00	0.00	16.00	0.888	19
64	53	54	55	56	16.00	-20.13	25.71	0.373	16
65	57	58	55	56	16.00	20.13	25.71	0.373	16
66	57	58	59	60	16.00	-20.13	25.71	0.373	16
67	61	62	59	60	16.00	20.13	25.71	0.373	16
68	61	62	63	64	16.00	-20.13	25.71	0.373	16
69	65	66	63	64	16.00	20.13	25.71	0.373	16
70	65	66	67	68	16.00	-20.13	25.71	0.373	16
71	69	69	67	68	16.00	20.13	25.71	0.746	16

LOADS AND DEFLECTIONS--

NP	LC	LOAD DEAD+LIVE (KIP)	DEFLECTION DEAD+LIVE (IN)	LOAD WIND (KIP)	DEFLECTION WIND (IN)
1		0.000	-0.091	0.000	0.227
2		0.000	-0.064	0.000	0.172
3		0.000	-0.173	0.000	0.461
4		0.000	-0.016	0.000	0.003
5		0.000	-0.243	0.000	0.685
6		0.000	-0.055	0.000	0.164
7		0.000	-0.289	0.000	0.901
8		0.000	-0.036	0.000	0.009
9		0.000	-0.314	0.000	1.097
10		0.000	-0.038	0.000	0.148
11		0.000	-0.309	0.000	1.279
12		0.000	-0.060	0.000	0.019
13		0.000	-0.271	0.000	1.431
14		0.000	-0.013	0.000	0.123
15		0.000	-0.200	0.000	1.566
16		0.000	-0.087	0.000	0.032
17		0.000	-0.188	0.000	1.555
18		0.000	0.004	0.000	0.107
19		0.000	0.088	0.000	1.611
20		0.000	0.004	0.000	0.107
21	4	0.000	0.227	0.000	1.614
22		0.000	-0.109	0.000	0.044
23		0.000	-0.206	0.000	1.572
24		0.000	-0.452	0.000	0.005
25	4	0.000	0.240	0.000	1.610
26		-8.200	-0.779	0.000	-0.026
27		0.000	-0.171	0.000	1.587
28		-8.200	-1.416	0.000	-0.055
29	3	0.000	0.211	0.000	1.604
30		-8.200	-1.878	0.000	-0.072
31	5	0.000	-0.198	0.000	1.597
32		-8.200	-2.161	0.000	-0.052
33	3	0.000	0.146	0.000	1.600
34		0.000	-2.177	0.000	-0.029
35		0.000	0.000	0.000	1.598
36		0.000	-2.177	0.000	-0.029
37	3	0.000	0.198	0.000	1.600
38		-8.200	-2.161	0.000	-0.001
39	5	0.000	-0.211	0.000	1.605
40		-8.200	-1.878	0.000	0.023
41		0.000	0.172	0.000	1.596
42		-8.200	-1.416	0.000	0.020
43		0.000	-0.113	0.000	1.613
44		-8.200	-0.779	0.000	0.002
45		0.000	0.207	0.000	1.587
46		0.000	-0.452	0.000	-0.018
47	4	0.000	0.128	0.000	1.619

LOADS AND DEFLECTIONS--

NP	LC	LOAD DEAD+LIVE (KIP)	DEFLECTION DEAD+LIVE (IN)	LOAD WIND (KIP)	DEFLECTION WIND (IN)
48		0.000	-0.109	0.000	-0.047
49		0.000	-0.087	0.000	1.617
50		0.000	0.004	0.000	-0.105
51		0.000	0.189	7.000	1.575
52		0.000	0.004	0.000	-0.105
53		0.000	0.200	0.000	1.582
54		0.000	-0.087	0.000	-0.035
55		0.000	0.272	0.000	1.450
56		0.000	-0.013	0.000	-0.122
57		0.000	0.309	0.000	1.299
58		0.000	-0.060	0.000	-0.020
59		0.000	0.314	0.000	1.115
60		0.000	-0.038	0.000	-0.149
61		0.000	0.289	0.000	0.918
62		0.000	-0.036	0.000	-0.009
63		0.000	0.244	0.000	0.699
64		0.000	-0.055	0.000	-0.166
65		0.000	0.173	0.000	0.471
66		0.000	-0.016	0.000	-0.003
67		0.000	0.091	0.000	0.231
68		0.000	-0.064	0.000	-0.175

MEMBER LOADS FOR STANDARD UBC LOAD CASES--

ALL LOADS ARE IN KIPS.
LOADS INVOLVING WIND ARE REDUCED BY 25%.

MEMBER	LC	1. I D+L	2. II D+W	III D+L+W/2	IV D+L/2+W	MAXIMUM COMP.	MAXIMUM TENSION
2		8.77	-5.84	3.40	-2.80	-5.84	8.77
3		17.54	-11.67	6.81	-5.61	-11.67	17.54
4		26.32	-17.51	10.21	-8.41	-17.51	26.32
5		35.09	-23.35	13.61	-11.22	-23.35	35.09
6		0.00	-0.00	-0.00	-0.00	-0.00	0.00
7		-0.00	-0.00	-0.00	-0.00	-0.00	0.00
8	4	-14.26	-12.20	-16.38	-17.13	-22.62	0.00
9		-81.71	-11.42	-64.60	-39.67	-81.71	0.00
10		-107.96	-8.01	-81.82	-45.33	-107.96	0.00
11		-107.96	-3.87	-79.75	-41.20	-107.96	0.00
12		-81.71	2.73	-57.53	-25.52	-81.71	2.73
13	4	-14.26	11.51	-4.52	6.58	-14.26	12.06
14		-0.00	-0.00	-0.00	-0.00	-0.00	0.00
15		0.00	0.00	0.00	0.00	0.00	0.00
16		35.09	29.41	40.00	41.54	0.00	41.54
17		26.32	22.06	30.00	31.15	0.00	31.15
18		17.55	14.70	20.00	20.77	0.00	20.77
19		8.77	7.35	10.00	10.38	0.00	10.38
21		-37.18	2.40	-25.60	-10.46	-37.18	2.40
22		-45.96	8.24	-29.00	-7.65	-45.96	8.24
23		-54.73	14.07	-32.41	-4.85	-54.73	14.07
24		-63.50	19.91	-35.81	-2.04	-63.50	19.91
25		-21.79	14.50	-8.46	6.97	-21.79	14.50
26		39.86	14.52	35.99	28.30	0.00	39.86
27		98.56	12.29	77.18	46.37	0.00	98.56
28		98.14	7.91	74.69	41.84	0.00	98.14
29		98.14	7.91	74.69	41.84	0.00	98.14
30		98.56	3.49	72.78	37.56	0.00	98.56
31		39.85	-5.74	25.85	8.04	-5.74	39.85
32		-21.80	-13.02	-22.22	-20.55	-22.22	0.00
33		-63.51	-29.05	-60.30	-51.01	-63.51	0.00
34		-54.73	-21.70	-50.30	-40.62	-54.73	0.00
35		-45.96	-14.35	-40.30	-30.24	-45.96	0.00
36		-37.19	-7.00	-30.30	-19.85	-37.19	0.00
37		5.60	-3.73	2.17	-1.79	-3.73	5.60
38		-5.60	3.73	-2.17	1.79	-5.60	3.73
39		5.60	-3.73	2.17	-1.79	-3.73	5.60
40		-5.60	3.73	-2.17	1.79	-5.60	3.73
41		5.60	-3.73	2.17	-1.79	-3.73	5.60
42		-5.60	3.73	-2.17	1.79	-5.60	3.73
43		5.60	-3.73	2.17	-1.79	-3.73	5.60
44		-5.60	3.73	-2.17	1.79	-5.60	3.73
45		-18.31	12.18	-7.10	5.85	-18.31	12.18
46		39.57	-26.33	15.36	-12.65	-26.33	39.57

MEMBER LOADS FOR STANDARD UBC LOAD CASES--

ALL LOADS ARE IN KIPS.
LOADS INVOLVING WIND ARE REDUCED BY 25%.

MEMBER	LC	1. I D+L	2. II D+W	III D+L+W/2	IV D+L/2+W	MAXIMUM COMP.	MAXIMUM TENSION
47		-67.89	22.83	-37.51	-0.64	-67.89	22.83
48		45.79	0.01	33.01	15.85	0.00	45.79
49		-43.40	-0.01	-31.29	-15.02	-43.40	0.00
50		43.77	-0.90	31.10	14.23	-0.90	43.77
51		-24.20	1.71	-16.59	-6.66	-24.20	1.71
52	4	6.90	-2.34	3.80	0.05	-5.92	6.90
53	5	7.69	2.97	7.03	5.63	-4.70	17.92
54		0.00	0.00	0.00	0.00	0.00	0.00
55	5	7.69	-2.12	4.48	0.54	-9.80	10.87
56	5	6.90	3.20	6.57	5.59	-0.37	11.67
57		-24.20	-4.61	-19.75	-12.97	-24.20	0.00
58		43.77	6.10	34.60	21.24	0.00	43.77
59		-43.40	-5.12	-33.84	-20.13	-43.40	0.00
60		45.79	5.40	35.71	21.24	0.00	45.79
61		-67.89	-32.73	-65.30	-56.20	-67.89	0.00
62		39.58	33.17	45.11	46.85	0.00	46.85
63		-18.31	-10.09	-18.24	-16.42	-18.31	0.00
64		-5.60	-4.70	-6.39	-6.63	-6.63	0.00
65		5.60	4.70	6.39	6.63	0.00	6.63
66		-5.60	-4.70	-6.39	-6.63	-6.63	0.00
67		5.60	4.70	6.39	6.63	0.00	6.63
68		-5.60	-4.70	-6.39	-6.63	-6.63	0.00
69		5.60	4.70	6.39	6.63	0.00	6.63
70		-5.60	-4.70	-6.39	-6.63	-6.63	0.00
71		5.60	4.70	6.39	6.63	0.00	6.63

RIGID FRAME ANALYSIS AND DESIGN
VULCRAFT - DIVISION OF NUCOR CORPORATION
SEPTEMBER 1984 RELEASE

COLUMN REACTIONS-- (REACTIONS WITH WIND ARE NOT REDUCED BY 25%).

ALL LOADS ARE IN KIPS.
POSITIVE DIRECTIONS ARE UPWARD AND TO THE RIGHT.

TITLE - 53' X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 03/18/85

JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR1

LOAD CASE	LEFT VERTICAL REACTION	LEFT HORIZONTAL REACTION	RIGHT VERTICAL REACTION	RIGHT HORIZONTAL REACTION	INTERIOR COLUMN REACTION
I - D+L	32.80	3.49	32.80	-3.49	
II - D+W	0.69	-3.09	4.43	-3.90	
III - D+L+W/2	31.86	1.80	33.73	-5.30	
IV - D+L/2+W	15.81	-1.49	19.55	-5.50	

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

TITLE - 53' X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 03/18/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR1

BAY WIDTH = 53 FT.
FULL WIDTH = 52-10 0/0.
OVERALL WIDTH = 53- 0 0/0.
GIRTL = 0- 1 0/0, GIRTR = 0- 1 0/0.

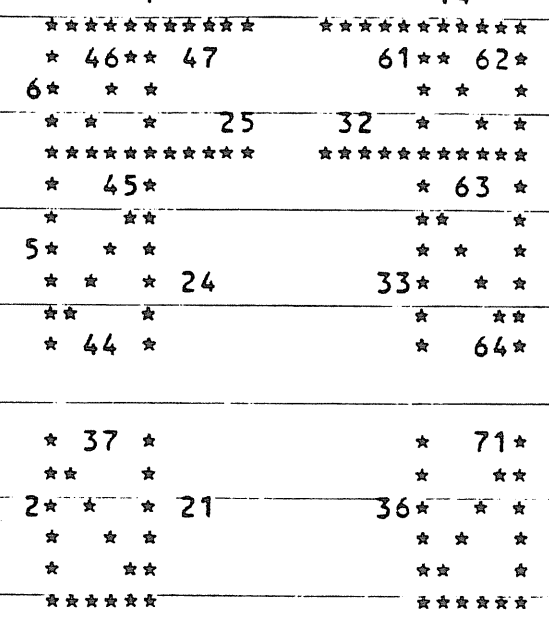
NO CENTER COLUMN.

HAUNCH = 16 INCHES.
BASE = 16 INCHES.

FRAME DESIGN WITH DOUBLE PITCH.

COLUMNS ARE SQUARE (NO PITCH)

DEAD LOAD = 0.640 PSF.
LIVE LOAD = 7.560 PSF.
UPLF LOAD = 0.000 PSF.
BAY SIZE = 0- 0 1/8.



WIND LOADS: 0.00 0.00 0.00 0.00 PSF.

VELOCITY = 40, EXP = C, E/0 = E. --PINNED COLUMN BASE--

WEB FACTOR = 1.0000 W2, W2R, COL W2R. FILLET = 0.3125, CLIP = 4.0.

RAFTER VERTICALS HAVE BEEN LOADED-- CENTER VERTICAL BISECTS BC.

TC	BC	WB	TC	BC	WB	TC	BC	WB	BND	CV	PX
8	7	8 25	13 48	4 21	6	1 11 37	4 33	6 15	11 61	10 54	34

P-X	LOAD	P-X	LOAD	P-X	LOAD	P-X	LOAD
20	0.0000	24	0.0000	30	0.0000	29	0.0000
22	0.0000	28	-8.2000	34	0.0000	33	0.0000
26	-8.2000	32	-8.2000	40	0.0000	39	0.0000
30	-8.2000	38	-8.2000	44	0.0000	43	0.0000
34	0.0000	42	-8.2000	48	0.0000	47	0.0000
40	-8.2000	46	0.0000	50	0.0000	47	0.0000
44	-8.2000	20	0.0000	19	0.0000	5	0.0000
48	0.0000	22	0.0000	21	0.0000	13	0.0000
50	0.0000	26	0.0000	25	0.0000	19	0.0000
						63	0.0000
						55	0.0000
						51	7.0000

CASE 1 LOAD CHECK: COLUMNS = 65.60, RAFTER = 65.60, DELTA = 0.00.

** RIGID FRAME ANALYSIS AND DESIGN **

INPUT SPECIFICATION SHEET

TITLE - 53° X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 03/18/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR1

MULTIPLE LOADING CONDITION--

P-X	UPLIFT	P-X	1/2 LEFT	P-X	1/2 L WW	P-X	1/2 R WW	P-X	SPECIAL
20	0.0000	20	0.0000	20	0.0000	20	0.0000		
22	0.0000	22	0.0000	22	0.0000	22	0.0000		
26	0.0000	26	-8.2000	26	-8.2000	26	-0.6400		
30	0.0000	30	-8.2000	30	-8.2000	30	-0.6400		
34	0.0000	34	0.0000	34	0.0000	34	0.0000		
40	0.0000	40	-0.6400	40	-0.6400	40	-8.2000		
44	0.0000	44	-0.6400	44	-0.6400	44	-8.2000		
48	0.0000	48	0.0000	48	0.0000	48	0.0000		
50	0.0000	50	0.0000	50	0.0000	50	0.0000		
24	0.0000	24	0.0000	24	0.0000	24	0.0000		
28	0.0000	28	-8.2000	28	-8.2000	28	-0.6400		
32	0.0000	32	-8.2000	32	-8.2000	32	-0.6400		
38	0.0000	38	-0.6400	38	-0.6400	38	-8.2000		
42	0.0000	42	-0.6400	42	-0.6400	42	-8.2000		
46	0.0000	46	0.0000	46	0.0000	46	0.0000		
0	0.0000	0	0.0000	20	0.0000	20	0.0000		
0	0.0000	0	0.0000	22	0.0000	22	0.0000		
0	0.0000	0	0.0000	26	0.0000	26	0.0000		
0	0.0000	0	0.0000	30	0.0000	30	0.0000		
0	0.0000	0	0.0000	34	0.0000	34	0.0000		
0	0.0000	0	0.0000	40	0.0000	40	0.0000		
0	0.0000	0	0.0000	44	0.0000	44	0.0000		
0	0.0000	0	0.0000	48	0.0000	48	0.0000		
0	0.0000	0	0.0000	50	0.0000	50	0.0000		
0	0.0000	0	0.0000	19	0.0000	19	0.0000		
0	0.0000	0	0.0000	21	0.0000	21	0.0000		
0	0.0000	0	0.0000	25	0.0000	25	0.0000		
0	0.0000	0	0.0000	29	0.0000	29	0.0000		
0	0.0000	0	0.0000	33	0.0000	33	0.0000		
0	0.0000	0	0.0000	39	0.0000	39	0.0000		
0	0.0000	0	0.0000	43	0.0000	43	0.0000		
0	0.0000	0	0.0000	47	0.0000	47	0.0000		
0	0.0000	0	0.0000	53	0.0000	51	7.0000		
0	0.0000	0	0.0000	5	0.0000	5	0.0000		
0	0.0000	0	0.0000	13	0.0000	13	0.0000		
0	0.0000	0	0.0000	19	0.0000	19	0.0000		
0	0.0000	0	0.0000	63	0.0000	63	0.0000		
0	0.0000	0	0.0000	55	0.0000	55	0.0000		
0	0.0000	0	0.0000	51	7.0000	53	0.0000		

INPUT SPECIFICATION SHEET

TITLE - 53° X 13- 5 0/0 X 0- 0 1/8 OVERALL WIDTH = 53- 0 0/0
BY - DRH
DATE - 03/18/85
JOB - RIGID FRAME TEST #2
XXX-X-XXXX
MARK - FR1

MULTIPLE LOADING CONDITION--

	NORMAL		UPLIFT		3. 1/2 LEFT		4. 1/2 L WW		5. 1/2 R WW	
MEM	COMP	TEN	COMP	TEN	COMP	TEN	COMP	TEN	COMP	TEN
2	-5.84	8.77	0.00	0.00	0.00	4.73	-2.80	0.00	-2.81	0.00
3	-11.67	17.54	0.00	0.00	0.00	9.46	-5.61	0.00	-5.61	0.00
4	-17.51	26.32	0.00	0.00	0.00	14.19	-8.41	0.00	-8.42	0.00
5	-23.35	35.09	0.00	0.00	0.00	18.92	-11.21	0.00	-11.22	0.00
6	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00
7	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00
8	-17.13	0.00	0.00	0.00	-15.00	0.00	-22.62	0.00	-11.65	0.00
9	-81.71	0.00	0.00	0.00	-63.24	0.00	-54.07	0.00	-25.27	0.00
10	-107.96	0.00	0.00	0.00	-69.38	0.00	-53.72	0.00	-36.94	0.00
11	-107.96	0.00	0.00	0.00	-47.01	0.00	-32.80	0.00	-49.59	0.00
12	-81.71	2.73	0.00	0.00	-24.85	0.00	-11.13	0.00	-39.92	0.00
13	-14.26	11.51	0.00	0.00	-0.37	0.00	0.00	12.06	0.00	1.09
14	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00
15	0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00
16	0.00	41.54	0.00	0.00	0.00	18.91	0.00	41.54	0.00	41.54
17	0.00	31.15	0.00	0.00	0.00	14.18	0.00	31.15	0.00	31.16
18	0.00	20.77	0.00	0.00	0.00	9.46	0.00	20.77	0.00	20.77
19	0.00	10.38	0.00	0.00	0.00	4.73	0.00	10.38	0.00	10.39
21	-37.18	2.40	0.00	0.00	-27.58	0.00	-16.11	0.00	-4.80	0.00
22	-45.96	8.24	0.00	0.00	-32.31	0.00	-13.30	0.00	-2.00	0.00
23	-54.73	14.07	0.00	0.00	-37.04	0.00	-10.50	0.00	0.00	0.81
24	-63.50	19.91	0.00	0.00	-41.77	0.00	-7.70	0.00	0.00	3.61
25	-21.79	14.50	0.00	0.00	-11.75	0.00	0.00	6.96	0.00	6.97
26	0.00	39.86	0.00	0.00	0.00	35.32	0.00	38.68	0.00	17.92
27	0.00	98.56	0.00	0.00	0.00	71.01	0.00	59.78	0.00	32.95
28	0.00	98.14	0.00	0.00	0.00	52.90	0.00	41.84	0.00	41.84
29	0.00	98.14	0.00	0.00	0.00	52.90	0.00	41.84	0.00	41.84
30	0.00	98.56	0.00	0.00	0.00	35.24	0.00	24.15	0.00	50.98
31	-5.74	39.85	0.00	0.00	0.00	7.64	-2.34	0.00	0.00	18.42
32	-22.22	0.00	0.00	0.00	-11.75	0.00	-20.55	0.00	-20.55	0.00
33	-63.51	0.00	0.00	0.00	-26.69	0.00	-45.35	0.00	-56.66	0.00
34	-54.73	0.00	0.00	0.00	-21.96	0.00	-34.97	0.00	-46.28	0.00
35	-45.96	0.00	0.00	0.00	-17.24	0.00	-24.59	0.00	-35.89	0.00
36	-37.19	0.00	0.00	0.00	-12.51	0.00	-14.20	0.00	-25.51	0.00
37	-3.73	5.60	0.00	0.00	0.00	3.02	-1.79	0.00	-1.79	0.00
38	-5.60	3.73	0.00	0.00	-3.02	0.00	0.00	1.79	0.00	1.79
39	-3.73	5.60	0.00	0.00	0.00	3.02	-1.79	0.00	-1.79	0.00
40	-5.60	3.73	0.00	0.00	-3.02	0.00	0.00	1.79	0.00	1.79
41	-3.73	5.60	0.00	0.00	0.00	3.02	-1.79	0.00	-1.79	0.00

INPUT SPECIFICATION SHEET

MULTIPLE LOADING CONDITION--

MEM	NORMAL COMP	NORMAL TEN	UPLIFT COMP	UPLIFT TEN	3. 1/2 LEFT COMP	3. 1/2 LEFT TEN	4. 1/2 L WW COMP	4. 1/2 L WW TEN	5 1/2 R WW COMP	5 1/2 R WW TEN
42	-5.60	3.73	0.00	0.00	-3.02	0.00	0.00	1.79	0.00	1.79
43	-3.73	5.60	0.00	0.00	0.00	3.02	-1.79	0.00	-1.79	0.00
44	-5.60	3.73	0.00	0.00	-3.02	0.00	0.00	1.79	0.00	1.79
45	-18.31	12.18	0.00	0.00	-9.87	0.00	0.00	5.85	0.00	5.85
46	-26.33	39.57	0.00	0.00	0.00	21.34	-12.65	0.00	-12.66	0.00
47	-67.89	22.83	0.00	0.00	-44.13	0.00	-6.30	0.00	0.00	5.01
48	0.00	45.79	0.00	0.00	0.00	34.96	0.00	23.56	0.00	8.14
49	-43.40	0.00	0.00	0.00	-33.14	0.00	-22.33	0.00	-7.71	0.00
50	-0.90	43.77	0.00	0.00	0.00	29.70	0.00	18.81	0.00	9.65
51	-24.20	1.71	0.00	0.00	-11.51	0.00	-5.51	0.00	-7.81	0.00
52	-2.34	6.90	0.00	0.00	-4.23	0.00	-5.92	0.00	0.00	6.01
53	0.00	7.69	0.00	0.00	0.00	17.92	0.00	15.96	-4.70	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	-2.12	7.69	0.00	0.00	-9.63	0.00	-9.80	0.00	0.00	10.87
56	0.00	6.90	0.00	0.00	0.00	11.67	0.00	11.55	-0.37	0.00
57	-24.20	0.00	0.00	0.00	-14.58	0.00	-14.13	0.00	-11.82	0.00
58	0.00	43.77	0.00	0.00	0.00	17.49	0.00	16.66	0.00	25.82
59	-43.40	0.00	0.00	0.00	-13.65	0.00	-12.82	0.00	-27.44	0.00
60	0.00	45.79	0.00	0.00	0.00	14.40	0.00	13.53	0.00	28.95
61	-67.89	0.00	0.00	0.00	-29.06	0.00	-50.55	0.00	-61.86	0.00
62	0.00	46.85	0.00	0.00	0.00	21.33	0.00	46.85	0.00	46.86
63	-18.31	0.00	0.00	0.00	-9.87	0.00	-16.42	0.00	-16.42	0.00
64	-6.63	0.00	0.00	0.00	-3.02	0.00	-6.63	0.00	-6.63	0.00
65	0.00	6.63	0.00	0.00	0.00	3.02	0.00	6.63	0.00	6.63
66	-6.63	0.00	0.00	0.00	-3.02	0.00	-6.63	0.00	-6.63	0.00
67	0.00	6.63	0.00	0.00	0.00	3.02	0.00	6.63	0.00	6.63
68	-6.63	0.00	0.00	0.00	-3.02	0.00	-6.63	0.00	-6.63	0.00
69	0.00	6.63	0.00	0.00	0.00	3.02	0.00	6.63	0.00	6.63
70	-6.63	0.00	0.00	0.00	-3.02	0.00	-6.63	0.00	-6.63	0.00
71	0.00	6.63	0.00	0.00	0.00	3.02	0.00	6.63	0.00	6.63

Table A.1

VULCRAFT Steel Inventory
(Brigham City, Utah)

SEC	ANGLE	AREA	RX	RZ	RY-1	SL	SS	Y	Q	INX	WELD
3	1.00X.109	0.206	0.3066	0.1962	0.8464	0.067	0.027	0.290	1.0000	0.019	1619
4	1.25X.111	0.265	0.3880	0.2500	0.9373	0.113	0.044	0.353	0.9841	0.040	1648
12	1.50X.139	0.319	0.4675	0.2972	1.0278	0.166	0.063	0.415	0.9050	0.069	1619
14	1.50X.115	0.332	0.4670	0.2990	1.0296	0.174	0.067	0.418	0.9277	0.072	1708
16	1.50X.130	0.373	0.4660	0.2980	1.0336	0.191	0.075	0.424	0.9753	0.080	1856
17	1.50X.138	0.395	0.4660	0.2970	1.0357	0.200	0.079	0.426	0.9964	0.085	1856
18	1.50X.143	0.416	0.4660	0.2979	1.0353	0.207	0.083	0.429	1.0000	0.089	1856
19	1.50X.156	0.444	0.4610	0.2950	1.0403	0.217	0.089	0.433	1.0000	0.096	1856
20	1.50X.170	0.481	0.4590	0.2960	1.0430	0.232	0.095	0.437	1.0000	0.101	2060
22	2.00X.137	0.529	0.6245	0.3967	1.2223	0.375	0.142	0.551	0.8796	0.206	1856
23	2.00X.148	0.570	0.6229	0.3960	1.2250	0.399	0.153	0.555	0.9129	0.221	1856
25	2.00X.163	0.625	0.6208	0.3951	1.2295	0.430	0.167	0.560	0.9522	0.241	1856
26	2.00X.175	0.669	0.6191	0.3946	1.2322	0.454	0.179	0.565	0.9788	0.257	2136
27	2.00X.186	0.717	0.6170	0.3940	1.2337	0.478	0.190	0.569	1.0000	0.272	2320
28	2.00X.200	0.760	0.6156	0.3932	1.2379	0.502	0.202	0.574	1.0000	0.288	2320
9	2.00X.213	0.807	0.6140	0.3930	1.2405	0.526	0.214	0.579	1.0000	0.304	2320
..	2.00X.232	0.874	0.6113	0.3918	1.2455	0.558	0.231	0.585	1.0000	0.327	2517
33	2.50X.197	0.946	0.7769	0.4963	1.4279	0.819	0.317	0.699	0.9389	0.571	2320
36	2.50X.212	1.015	0.7740	0.4930	1.4309	0.866	0.339	0.703	0.9673	0.609	2320
38	2.50X.235	1.097	0.7720	0.4920	1.4356	0.921	0.365	0.710	0.9964	0.654	2487
39	2.50X.250	1.187	0.7690	0.4910	1.4399	0.980	0.396	0.717	1.0000	0.703	2786
42	3.00X.227	1.310	0.9330	0.5930	1.6293	1.369	0.527	0.834	0.9223	1.142	2442
43	3.00X.250	1.437	0.9300	0.5920	1.6321	1.473	0.577	0.842	0.9607	1.240	2794
46	3.00X.281	1.607	0.9260	0.5907	1.6404	1.614	0.642	0.854	1.0000	1.378	3246
48	3.00X.313	1.780	0.9220	0.5890	1.6500	1.738	0.707	0.869	1.0000	1.510	3712
51	3.50X.287	1.927	1.0860	0.6910	1.3365	2.315	0.902	0.981	0.9543	2.273	3333
52	3.50X.313	2.093	1.0800	0.6900	1.8414	2.475	0.976	0.990	0.9866	2.450	3712
54	3.50X.344	2.290	1.0781	0.6883	1.8483	2.657	1.065	1.002	1.0000	2.661	4179
57	3.50X.375	2.484	1.0700	0.6870	1.8535	2.842	1.150	1.010	1.0000	2.870	4646
59	4.00X.375	2.859	1.2300	0.7880	2.0530	3.825	1.520	1.140	1.0000	4.360	4646
61	4.00X.438	3.312	1.2300	0.7850	2.0631	4.284	1.750	1.163	1.0000	4.970	5568
63	4.00X.500	3.750	1.2200	0.7820	2.0749	4.712	1.970	1.180	1.0000	5.560	5568
64	5.00X.438	4.188	1.5500	0.9860	2.6563	7.092	2.790	1.413	0.9792	0.000	5568
66	5.00X.500	4.750	1.5400	0.9830	2.6706	7.902	3.160	1.430	1.0000	1.300	5568
67	5.00X.563	5.313	1.5310	0.9801	2.6846	8.562	3.512	1.457	1.0000	2.665	5568
69	6.00X.500	5.750	1.8500	1.1800	2.8659	11.345	4.610	1.680	0.9607	19.900	5568
70	6.00X.563	6.439	1.8500	1.1900	2.8838	12.923	5.140	1.719	1.0000	22.100	5568
71	6.00X.625	7.109	1.8400	1.1900	2.8943	13.938	5.560	1.733	1.0000	24.200	5568
72	6.00X.688	7.772	1.8400	1.1800	2.9041	14.930	6.160	1.750	1.0000	26.200	5568
	6.00X.750	8.438	1.8300	1.1700	2.9234	15.843	6.660	1.780	1.0000	28.200	5568

APPENDIX B

WORKING LEVEL FULL LIVE LOAD

(TEST LL)

VULCRAFT FRAME TEST SUMMARY

Project: Vulcraft FR-2

Test No: Test 1

Test Date: 21 May 1985

Purpose: Test of working level live load

Maximum Test Load: live load = 7.94 kips

Failure Mode: No failure was intended

Discussion:

- This test was confined to working load level and was considered as the warmup for the testing sequence. Full live load was incrementally applied to the east test frame and the performance of the instrumentation was checked.

- The applied load versus frame centerline deflection plot was compared to the theoretical load versus centerline deflection curve and was found to be in agreement.

- Some yielding was seen near the base of the knee clip angles at the reentrant corners.

- Maximum midspan vertical deflection was 2.16 kips at 7.94 kips load applied at each load point.

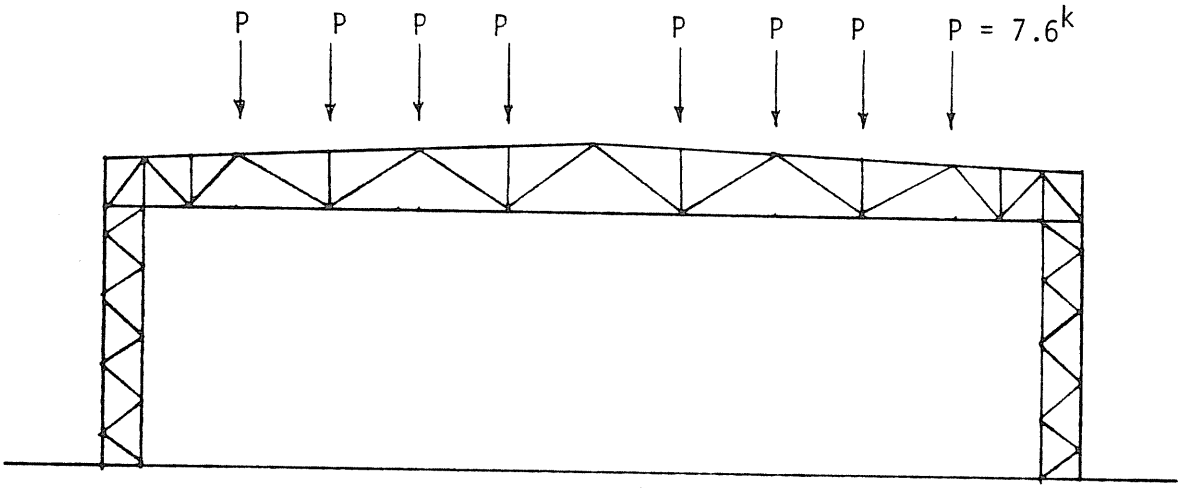


FIGURE B.1 FULL LIVE LOAD

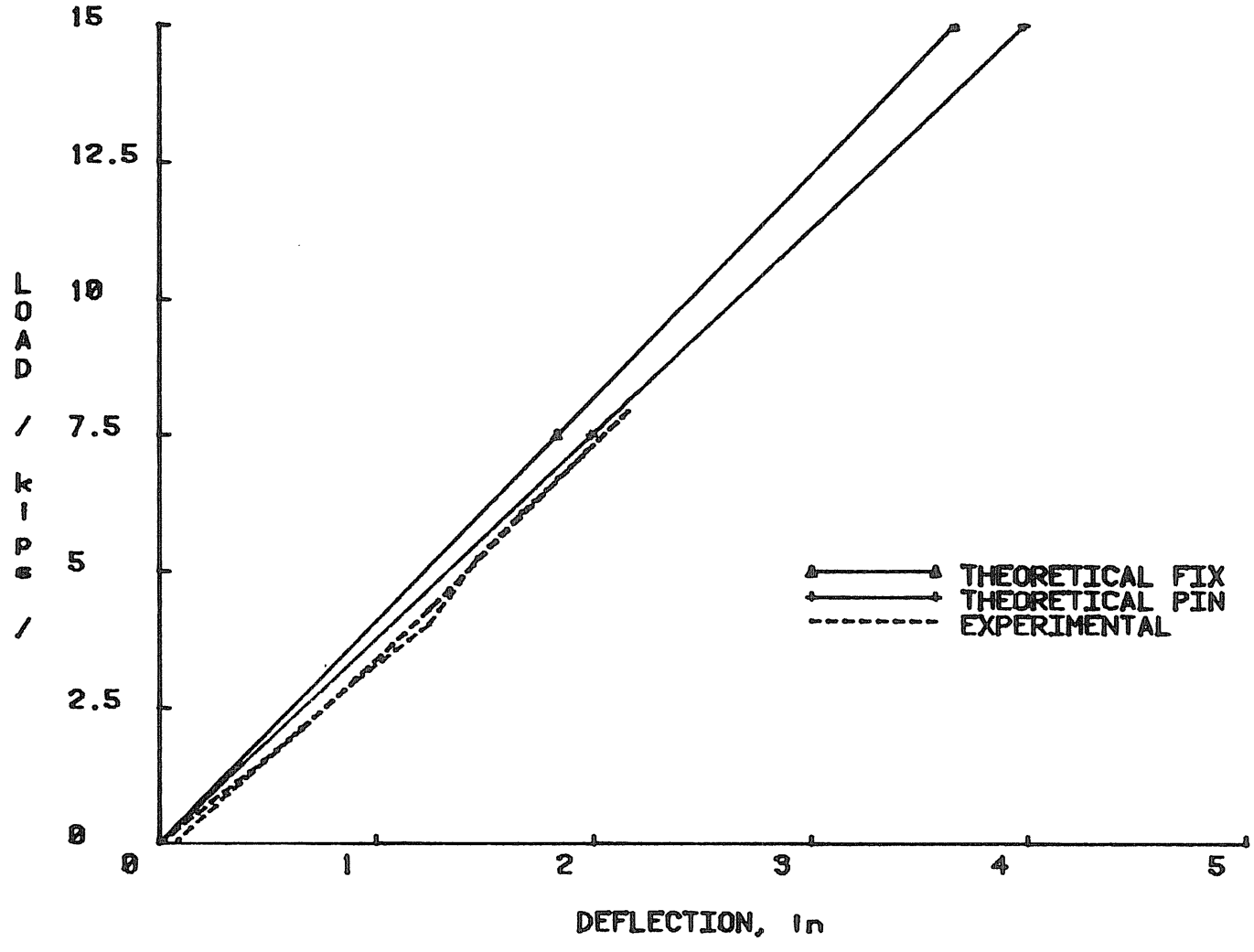


FIGURE B.2 LOAD VS. CENTERLINE DEFLECTIONS, LL

APPENDIX C

WIND LOAD

(TEST WL)

VULCRAFT FRAME TEST SUMMARY

Project: Vulcraft FR-2

Test No: Test 2

Test Date: 28 May 1985

Purpose: Test of working level wind load

Maximum Test Load: 7.05 kips

Failure Mode: No failure was intended

Discussion:

- Equal wind load was incrementally applied at the north end of both frames. The sidesway curves of both frames and all member forces but member 48 were bounded by the theoretical curves obtained assuming fixed column bases and pinned bases.

- The columns on the north end of the frames were observed to be in double curvature.

- No major yielding was observed during this test. The frames behaved generally as elastic frames.

- Maximum sidesway deflection was 0.7 inches at 7.05 kips wind load.

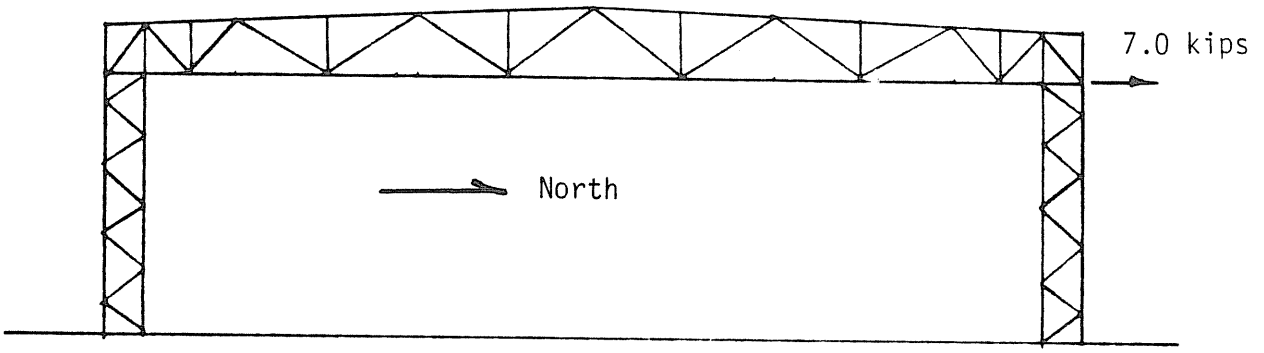


FIGURE C.1 WIND LOAD

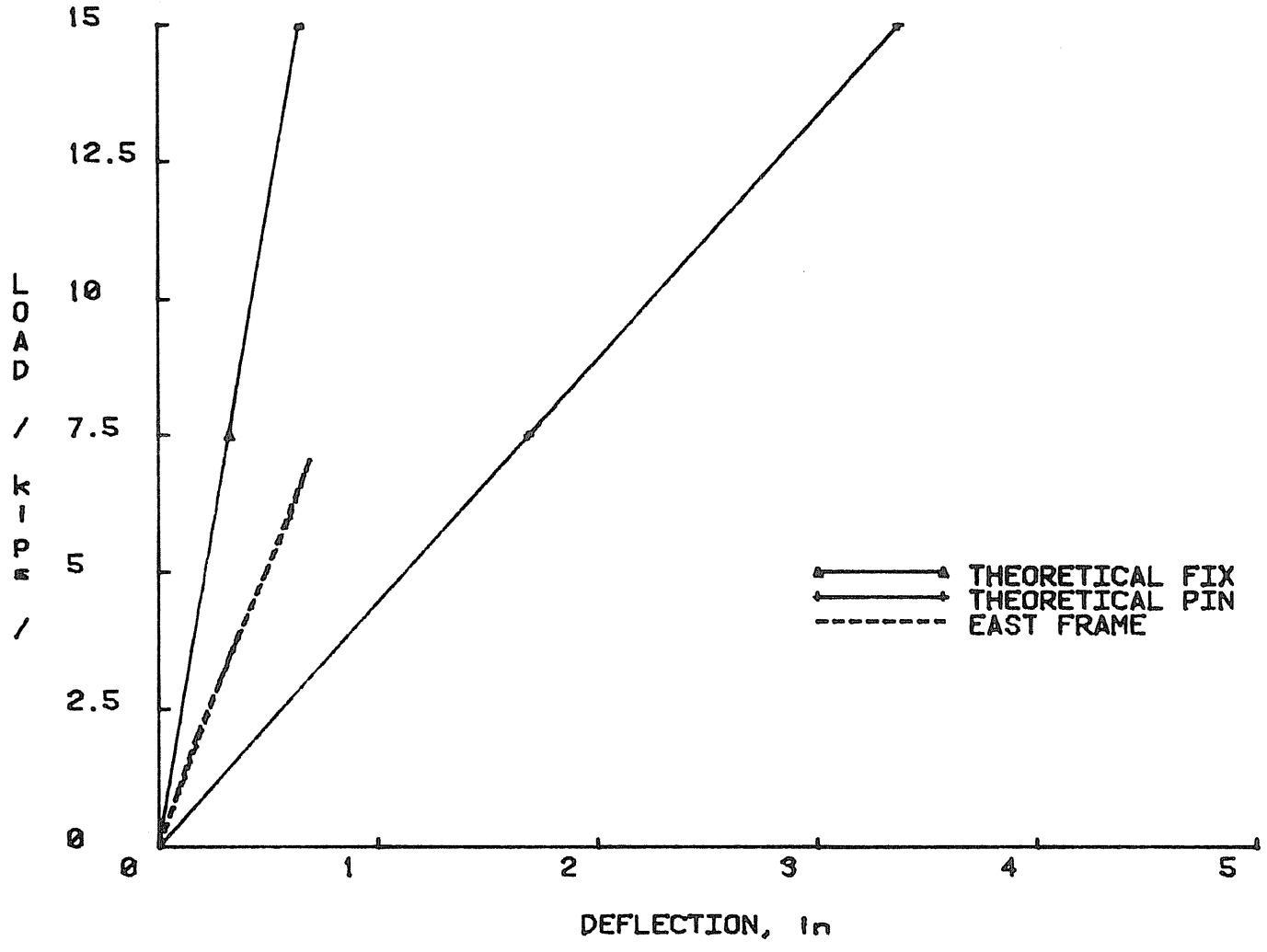


FIGURE C.2 LATERAL LOAD VS. SIDESWAY, WL: EAST FRAME

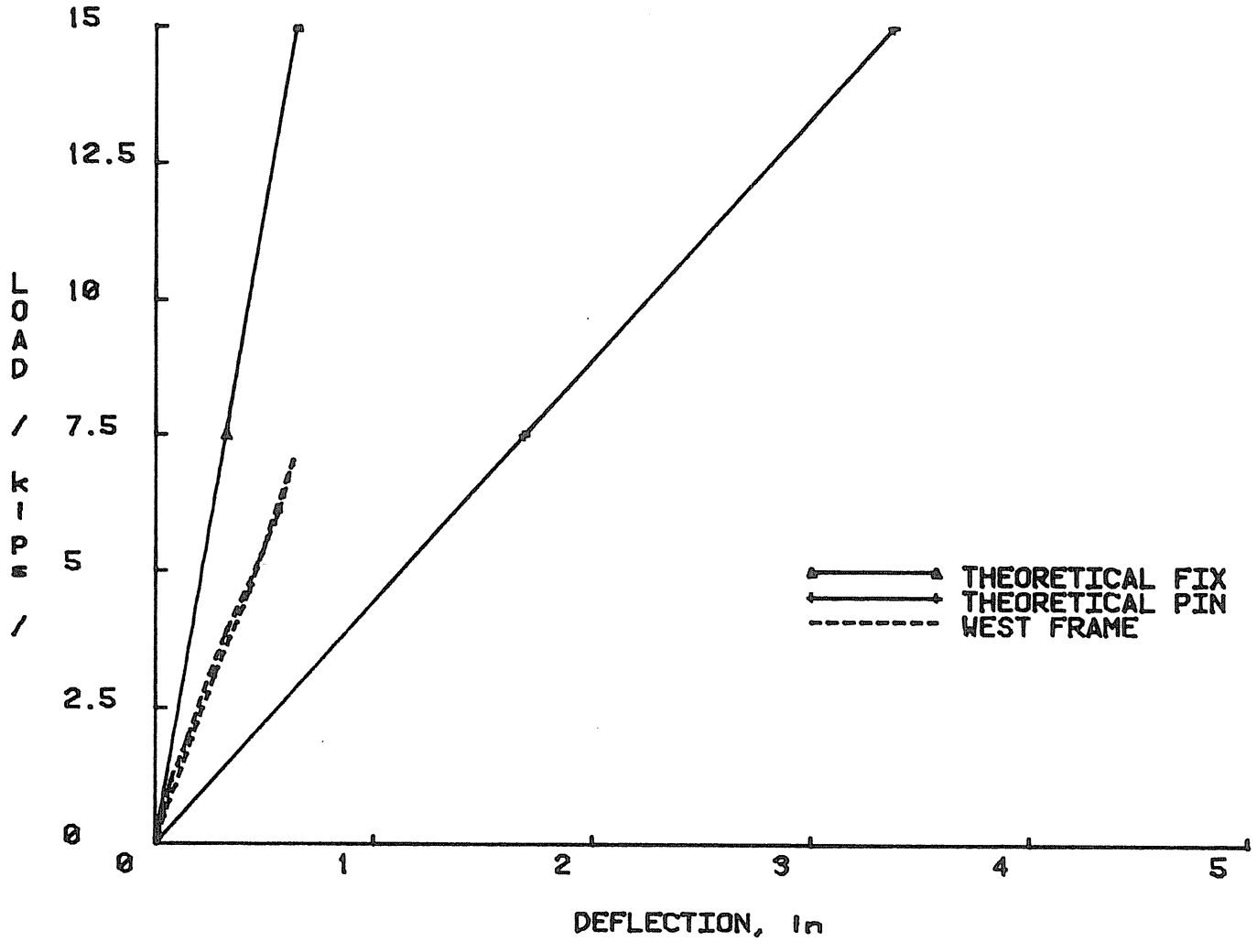


FIGURE C.3 LATERAL LOAD VS. SIDESWAY, WL: WEST FRAME

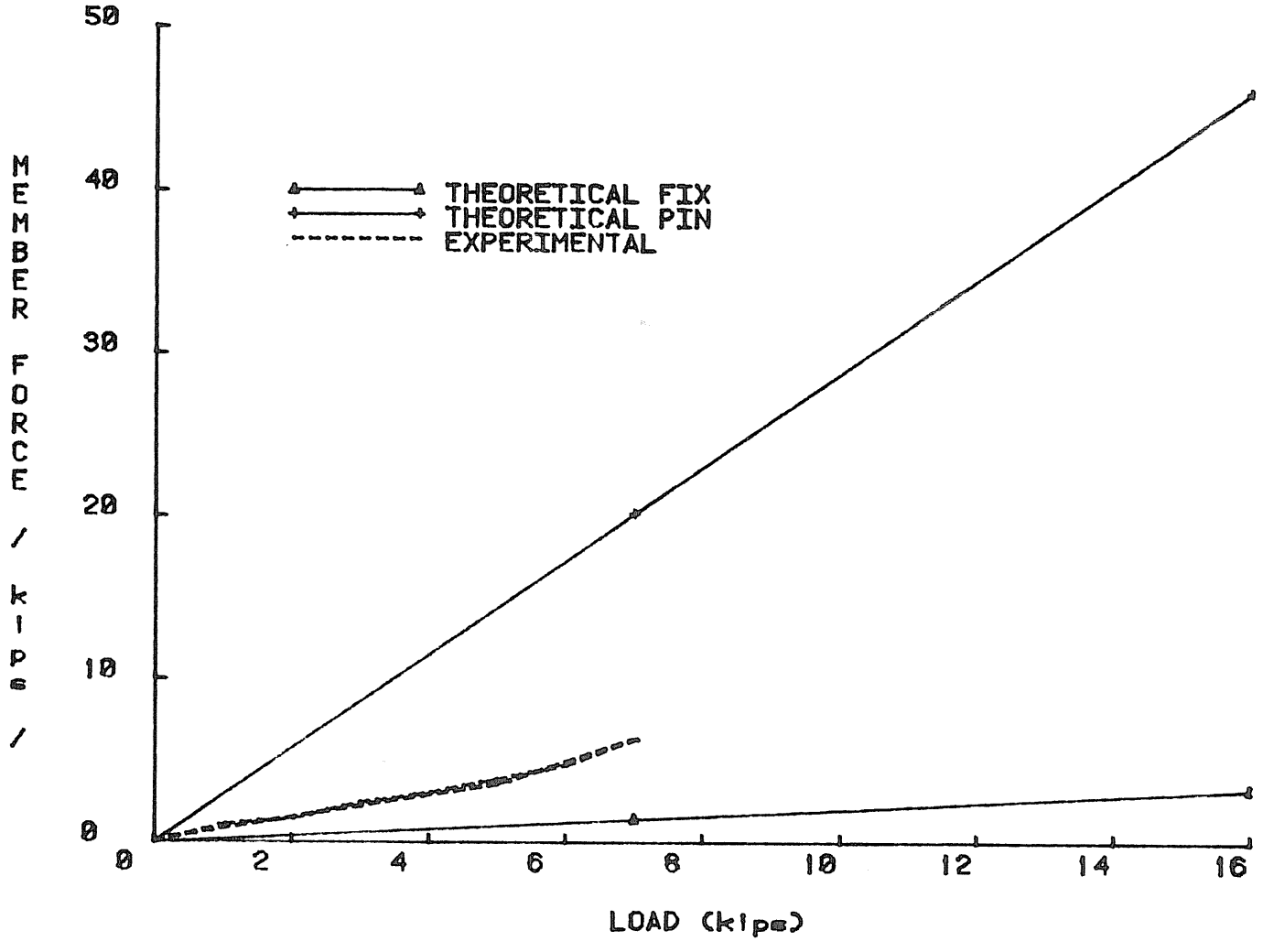


FIGURE C.4 MEMBER (#4) FORCE VS LOAD, WL

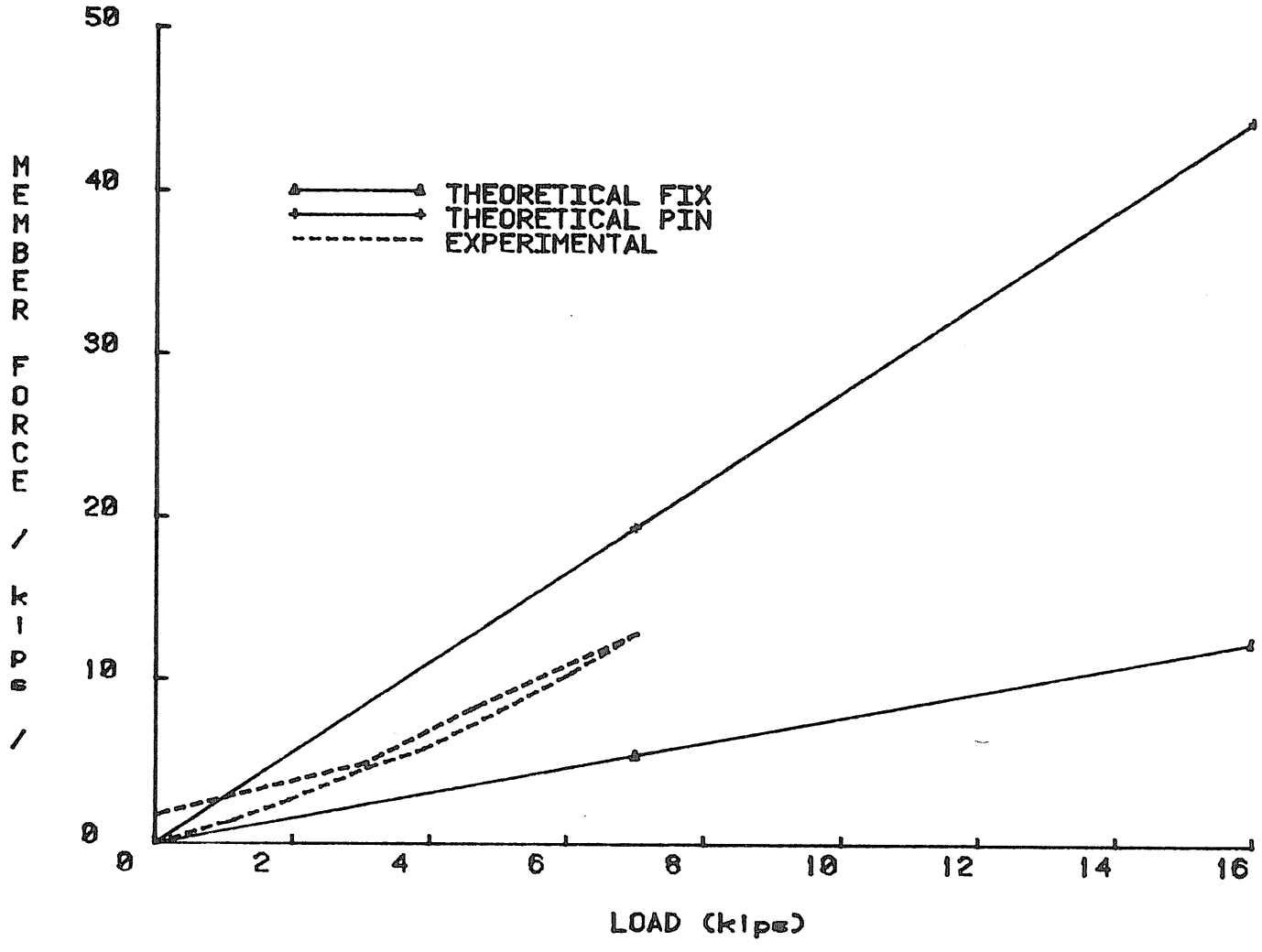


FIGURE C.5 MEMBER (#17) FORCE VS LOAD, WL

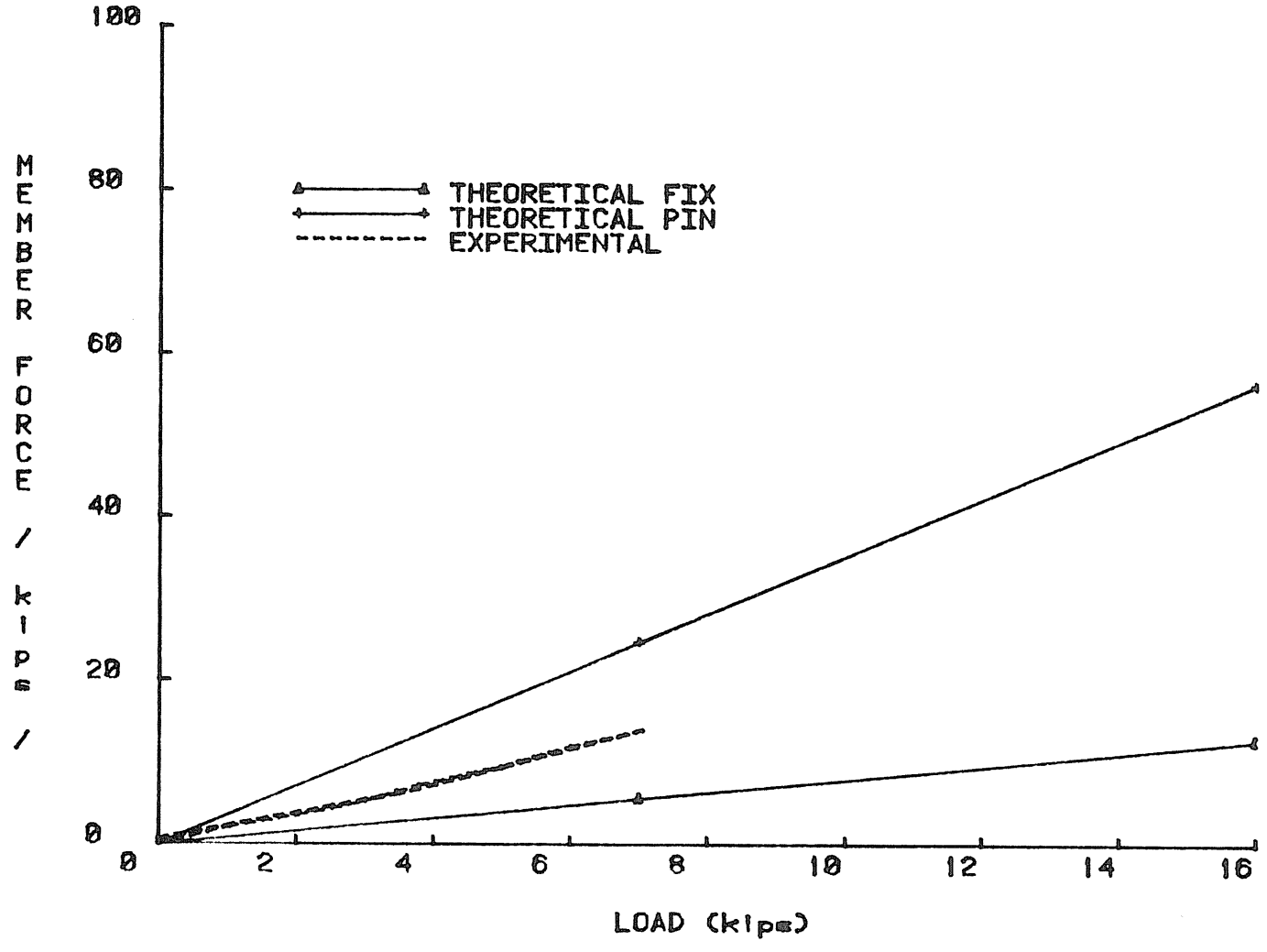


FIGURE C.6 MEMBER (#24) FORCE VS LOAD, WL

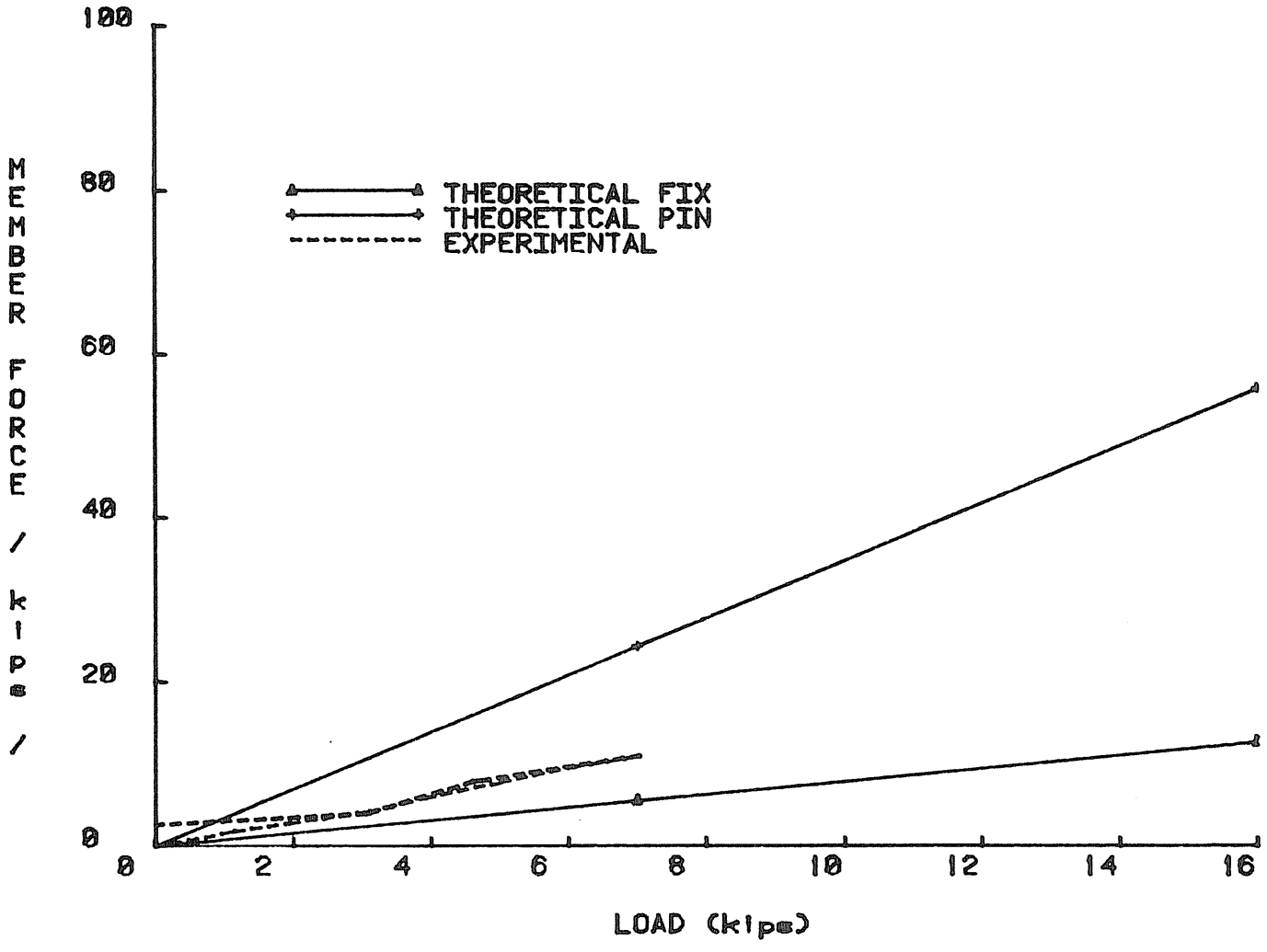


FIGURE C.7 MEMBER (#33) FORCE VS LOAD, WL

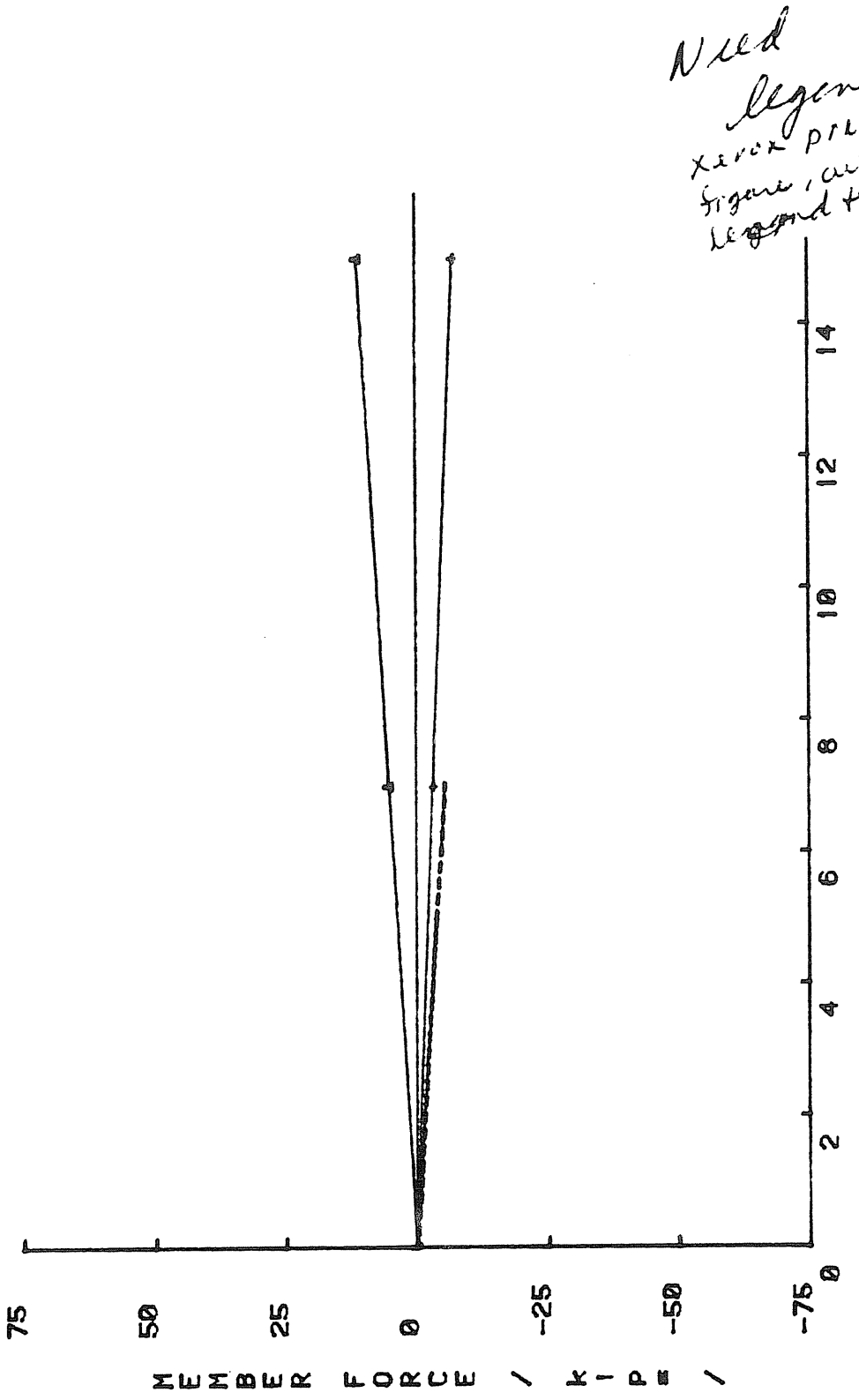


FIGURE C.8 MEMBER (#48) FORCE VS LOAD

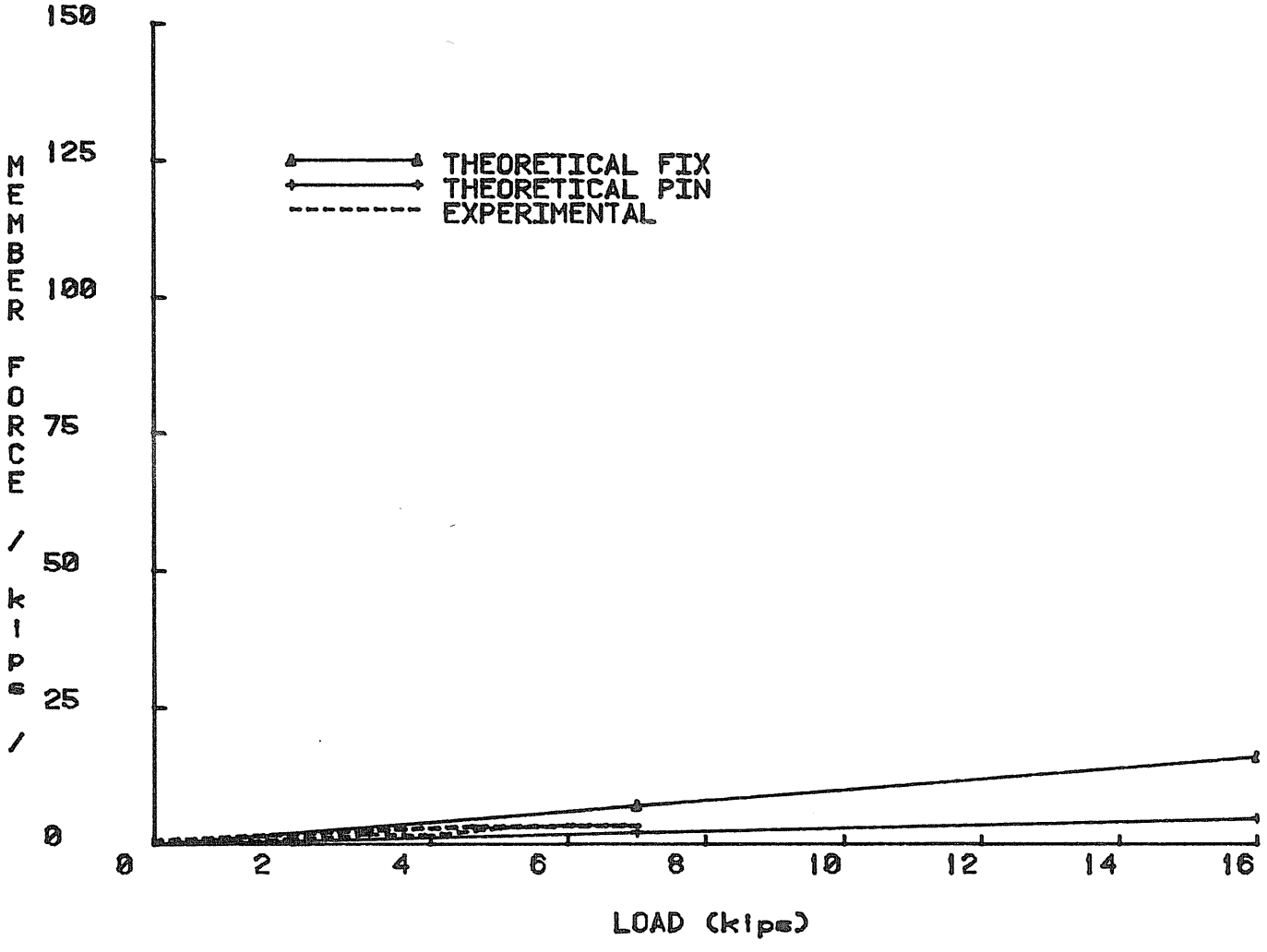


FIGURE C.9 MEMBER (#60) FORCE VS LOAD, WL

APPENDIX D

UNBALANCED LIVE LOAD

(TEST ULL)

VULCRAFT FRAME TEST SUMMARY

Project: Vulcraft FR-2

Test No: Test 3

Test Date: 31 May 1985

Purpose: Test of working level unbalanced live load

Maximum Test Load: Live load = 7.62 kips

Failure Mode: No failure was intended

Discussion:

- Unbalanced live load was applied equally to both frames.
- The applied load versus vertical deflection curve of the frame compared reasonably well with the theoretical curve.
- The member forces did not have close agreement with the predicted values.
- No major yielding was observed during the tests. The frames behaved elastically.
- Maximum centerline deflection was 1.0 inches at 7.62 applied live load.

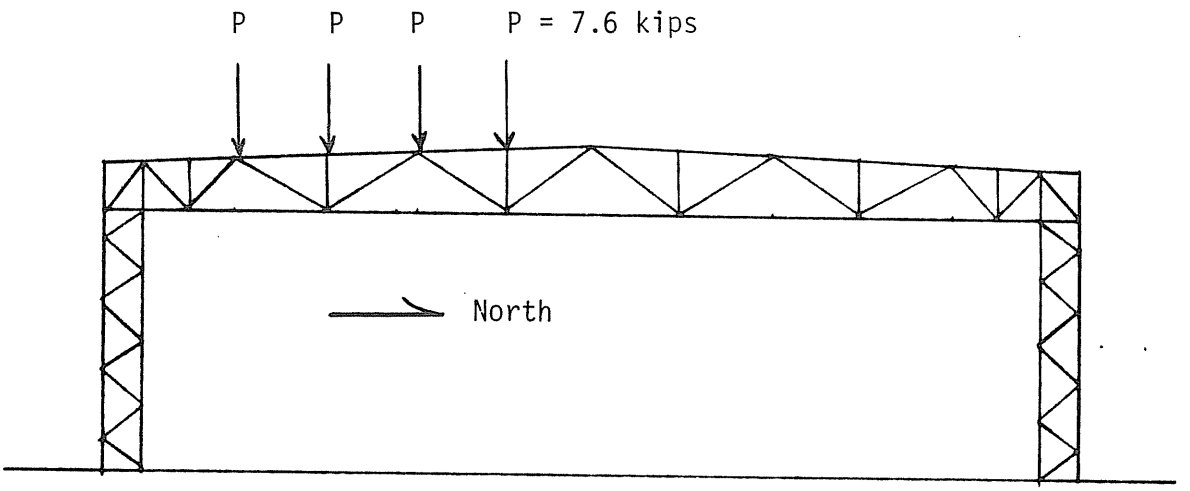


FIGURE D.1 UNBALANCED LIVE LOAD

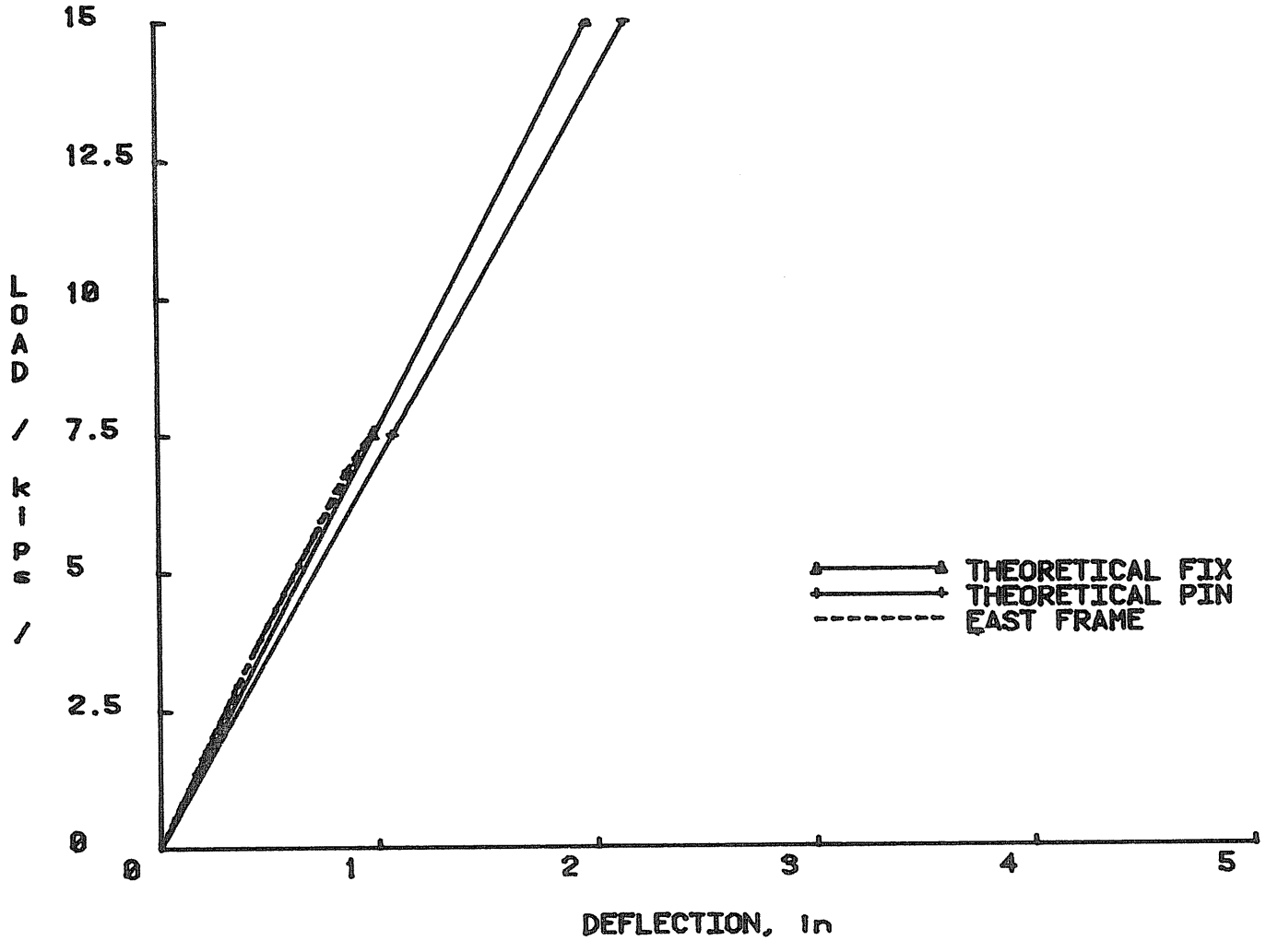


FIGURE D.2 LOAD VS. CENTERLINE DEFLECTION, ULL: EAST

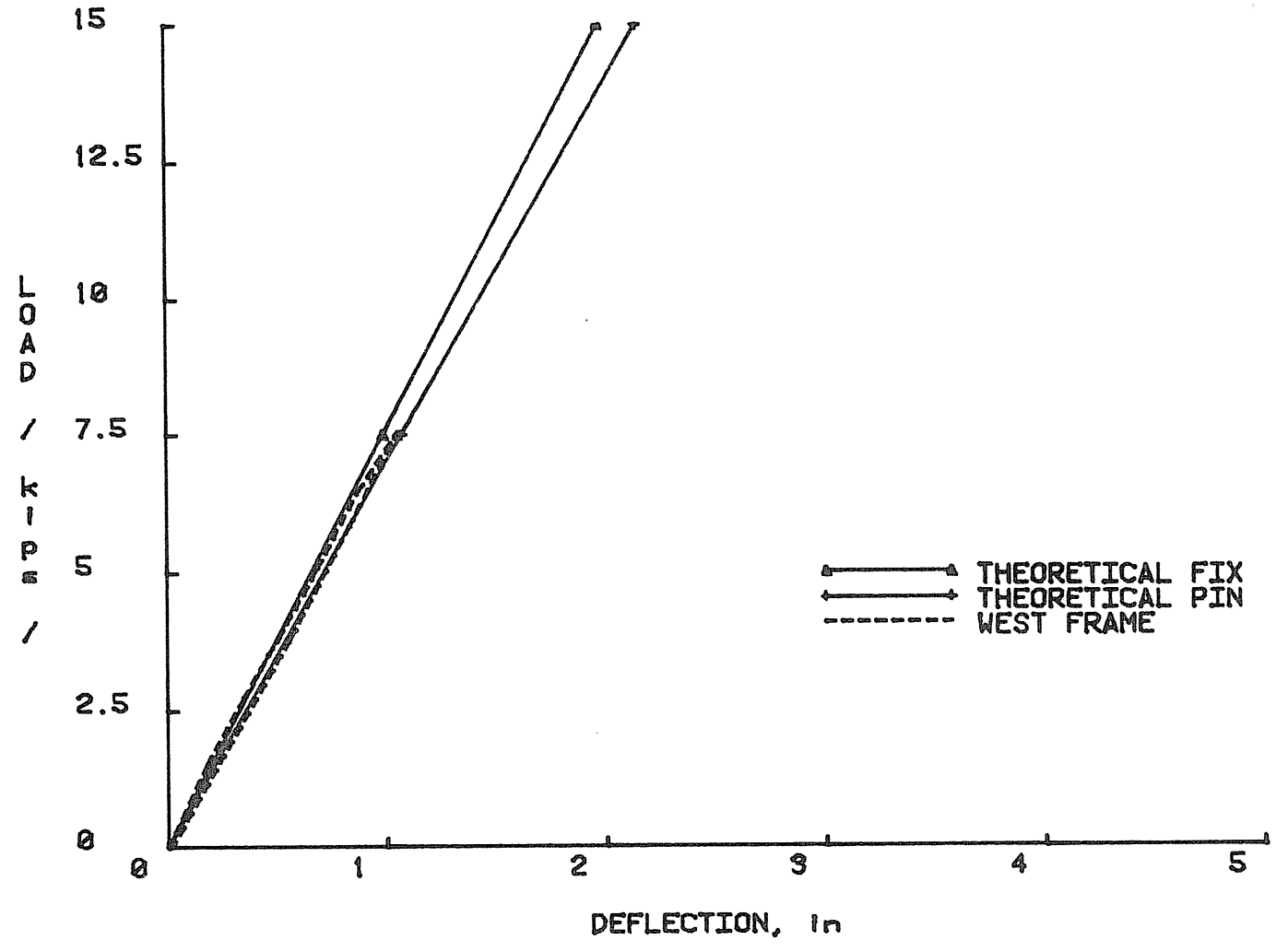


FIGURE D.3 LOAD VS. CENTERLINE DEFLECTION, ULL: WEST

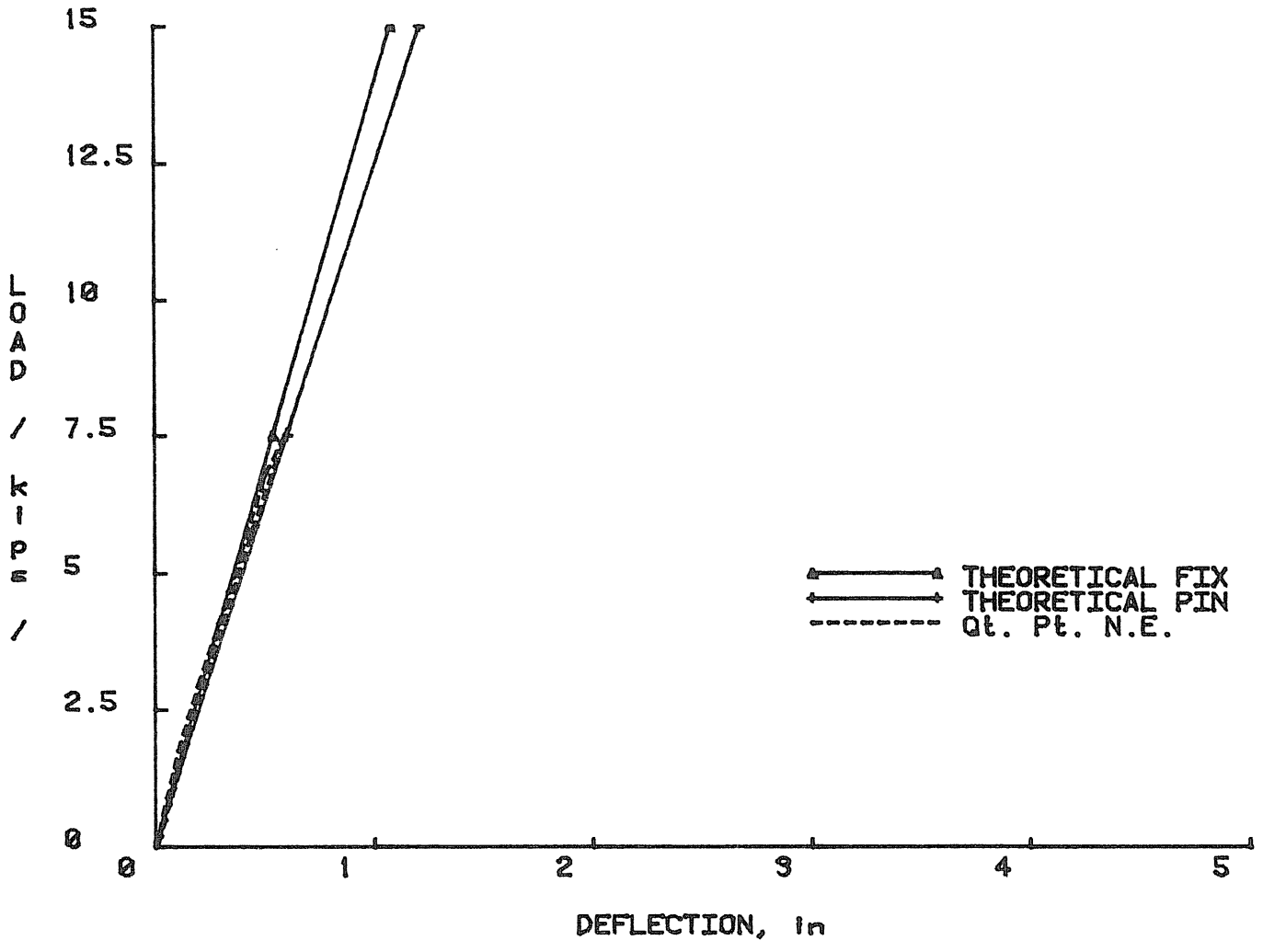


FIGURE D.4 LOAD VS. QUARTERPOINT DEFLECTION, ULL: NORTHEAST

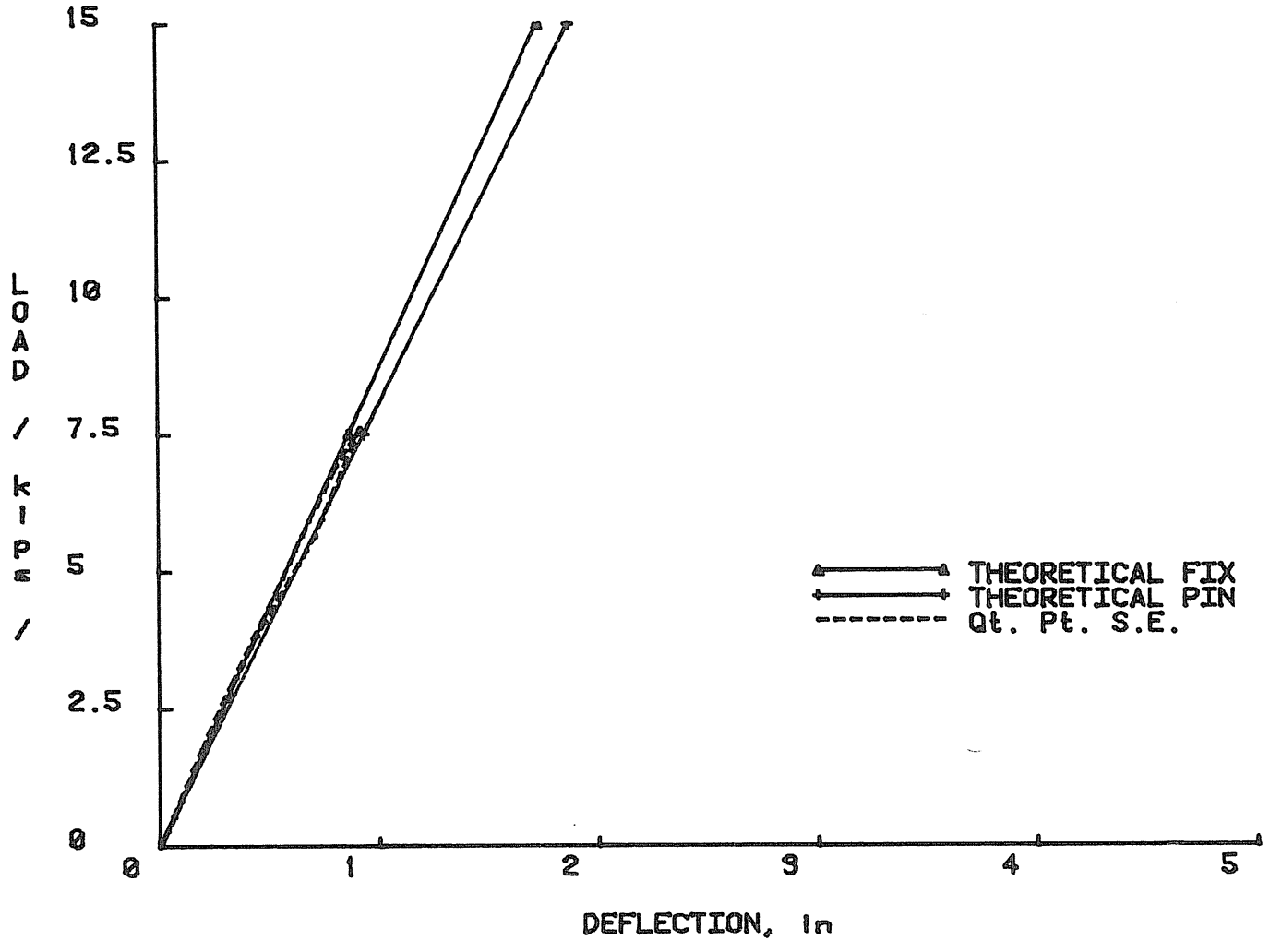


FIGURE D.5 LOAD VS. QUARTERPOINT DEFLECTION, ULL: SOUTHEAST

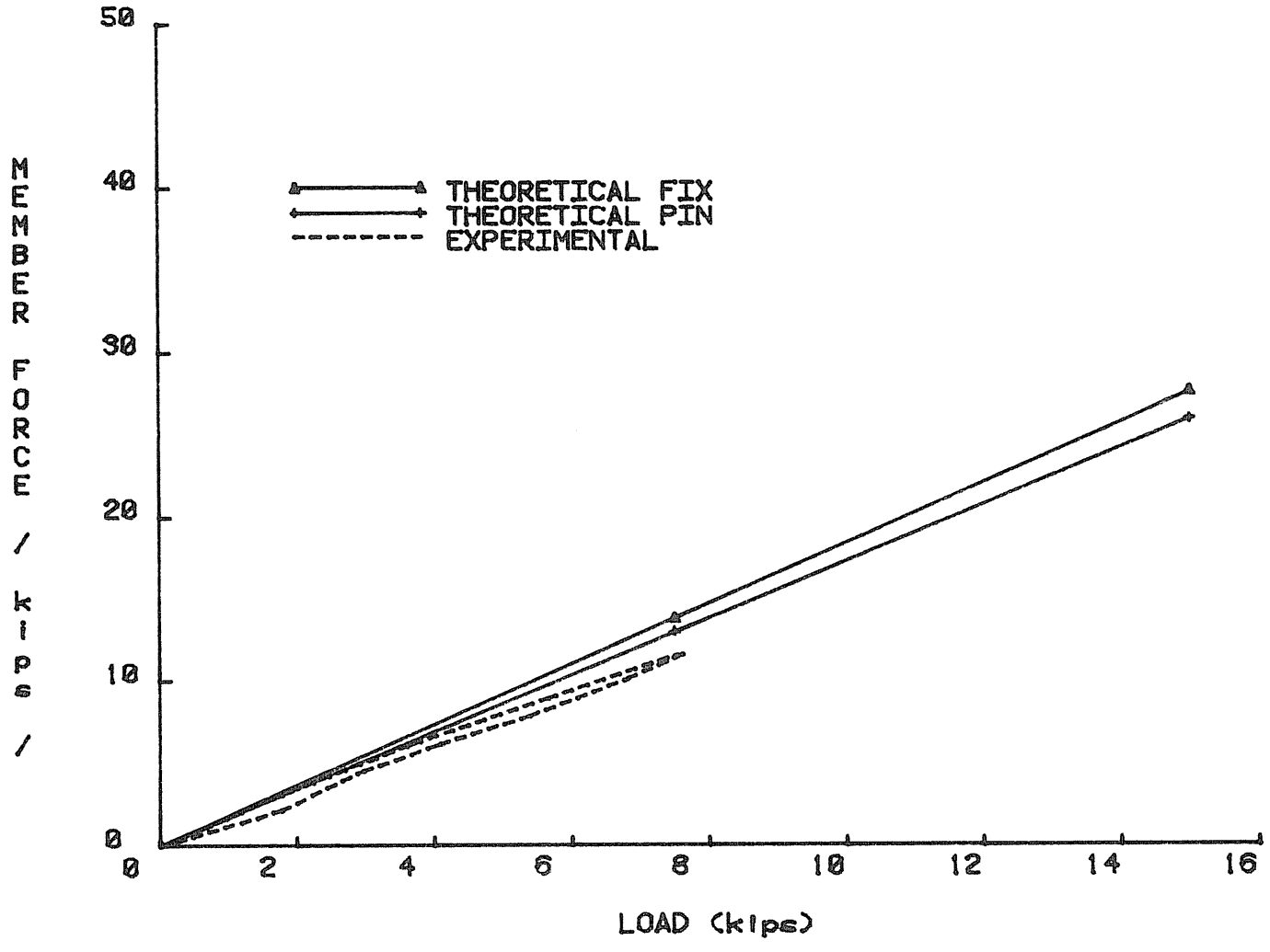


FIGURE D.6 MEMBER (#4) FORCE VS LOAD, ULL

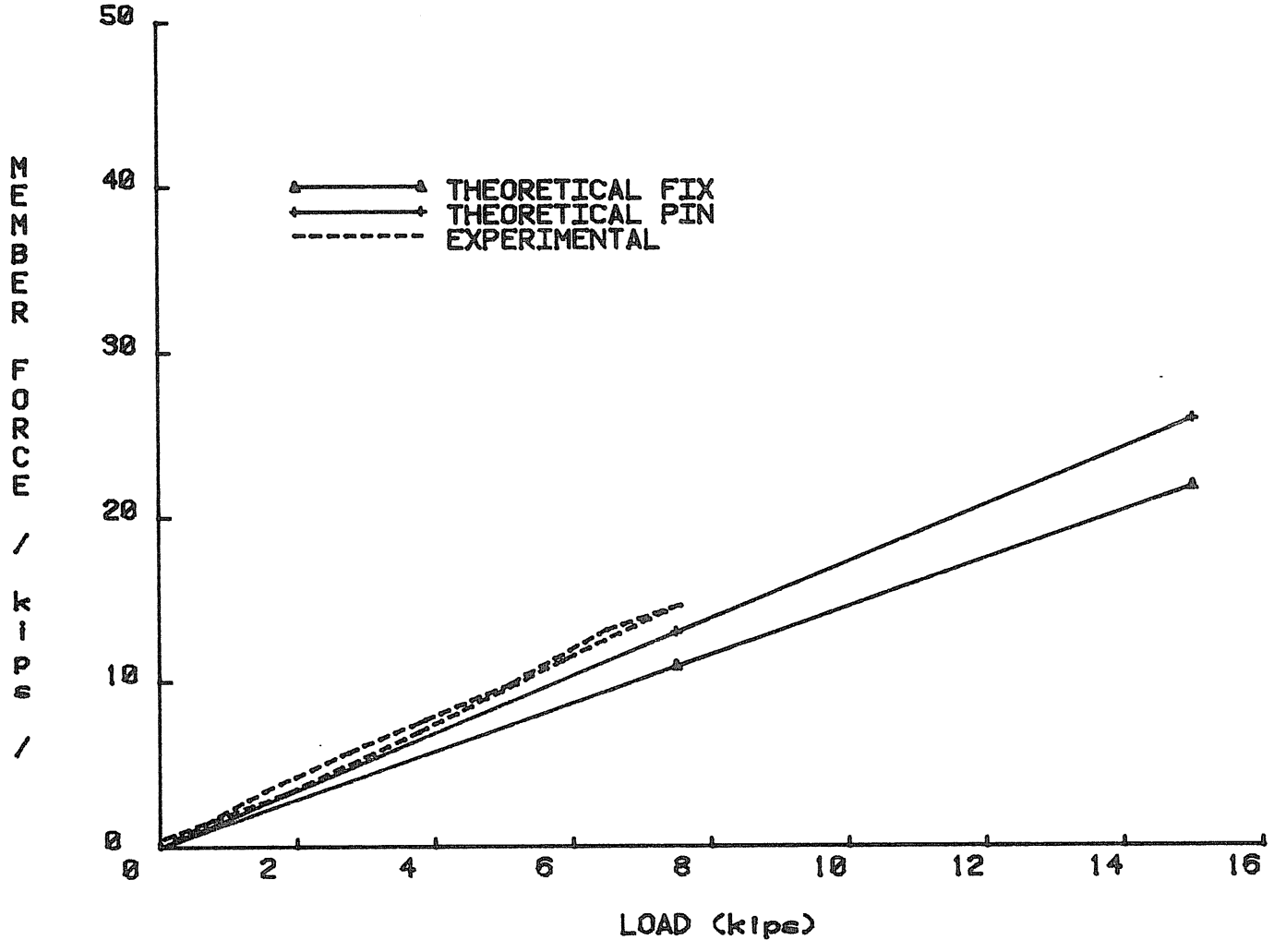


FIGURE D.7 MEMBER (#17) FORCE VS LOAD, ULL

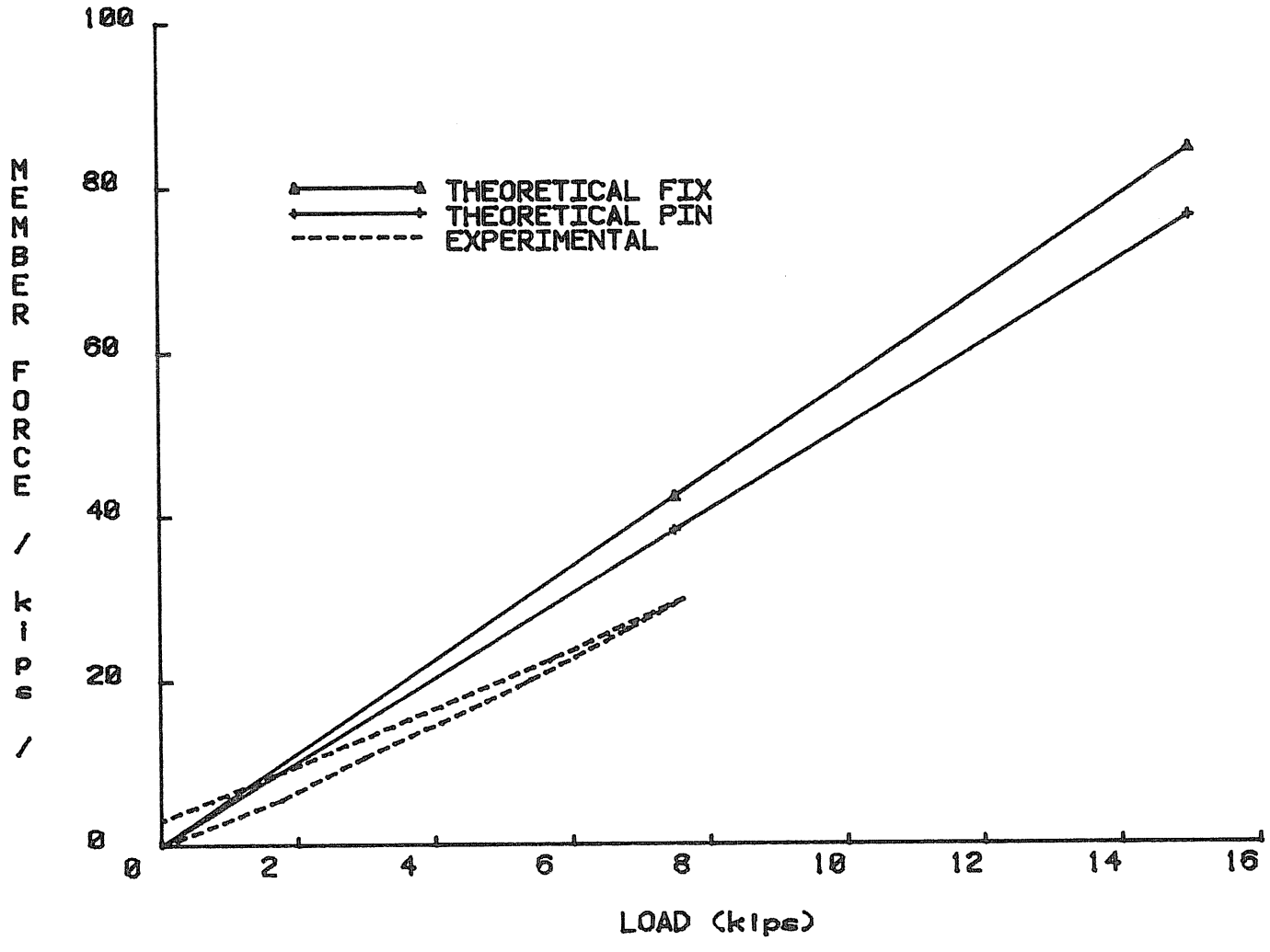


FIGURE D.8 MEMBER (#24) FORCE VS LOAD, ULL

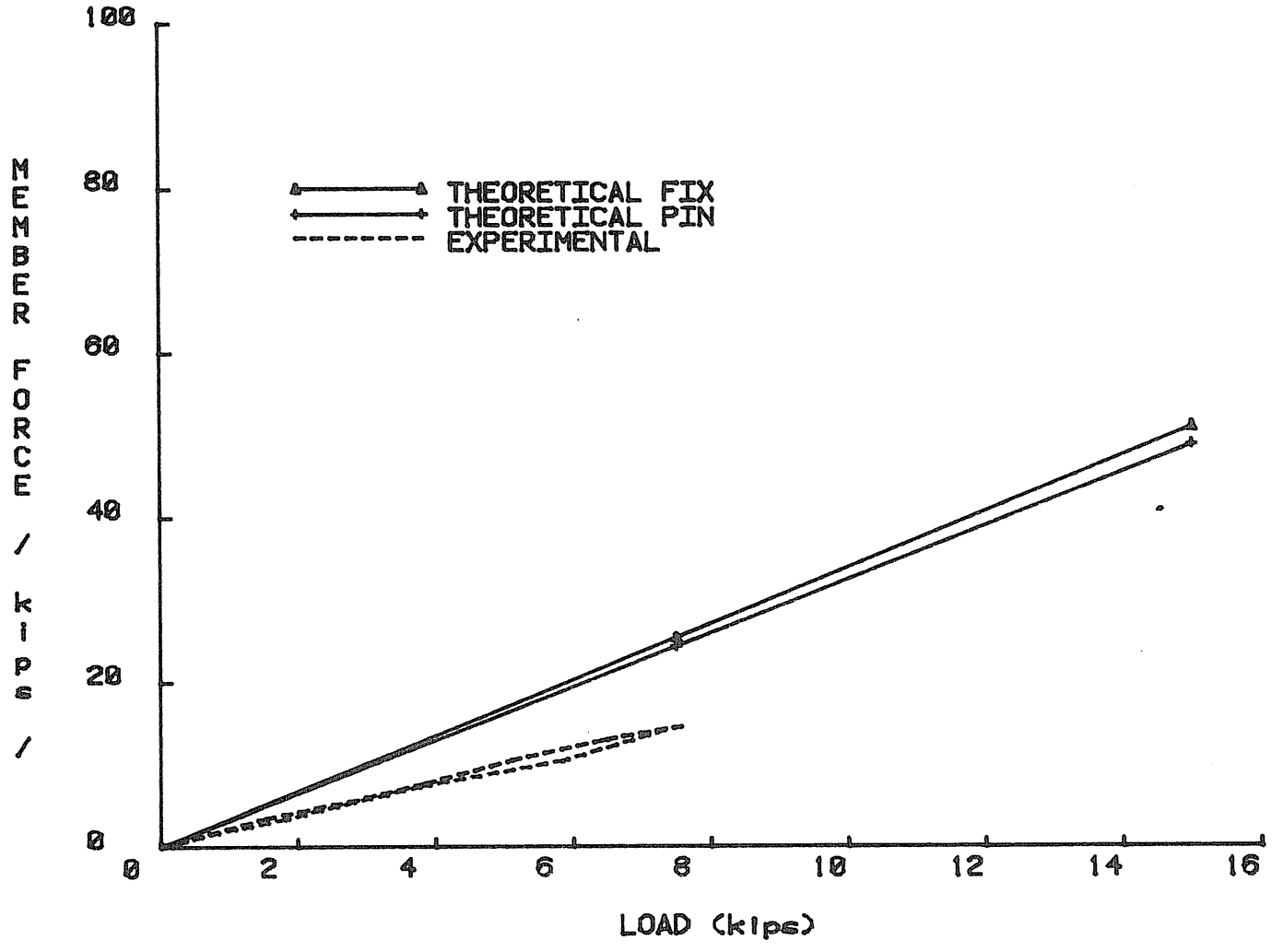


FIGURE D.9 MEMBER (#33) FORCE VS LOAD, ULL

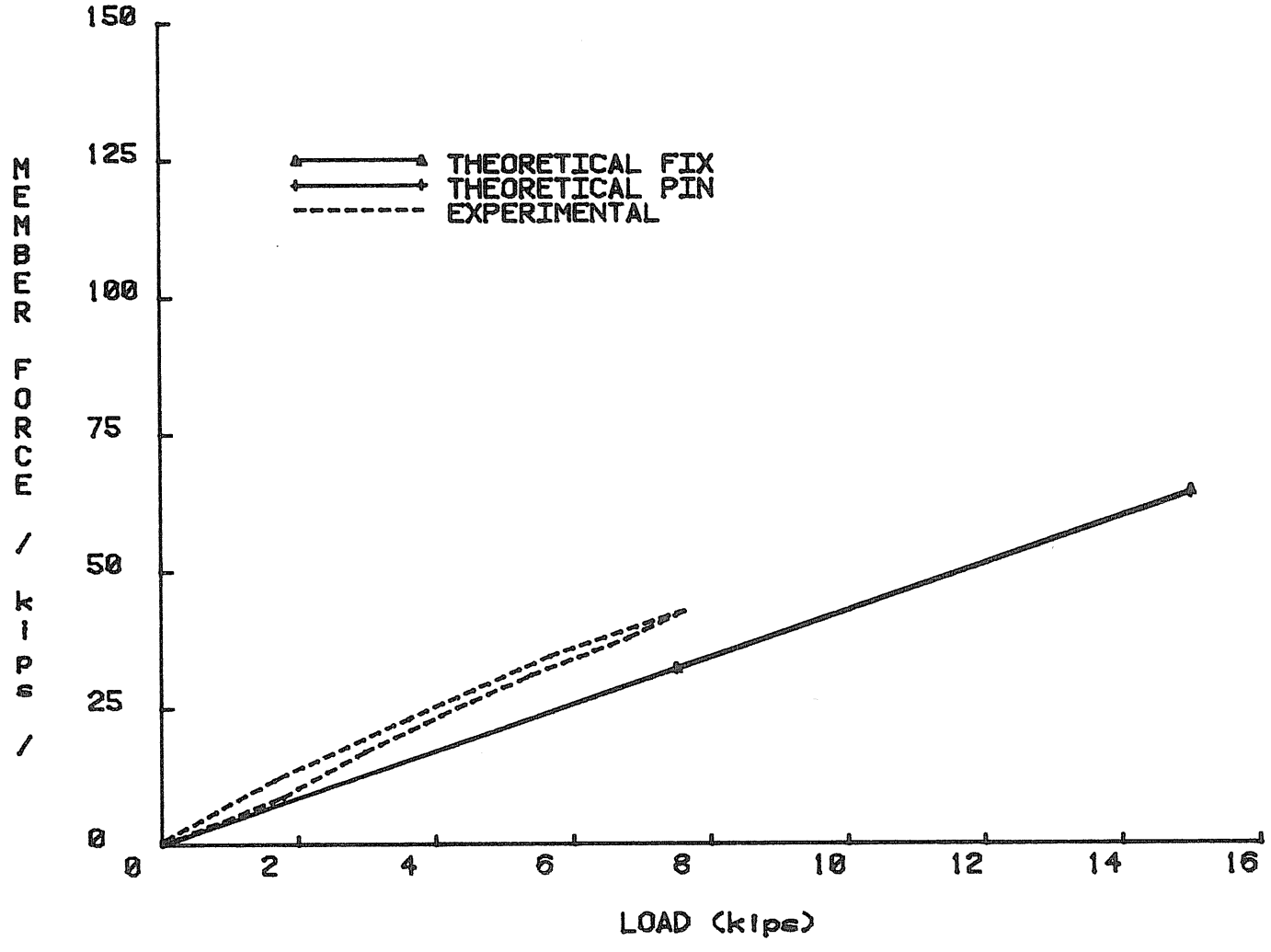


FIGURE D.10 MEMBER (#48) FORCE VS LOAD, ULL

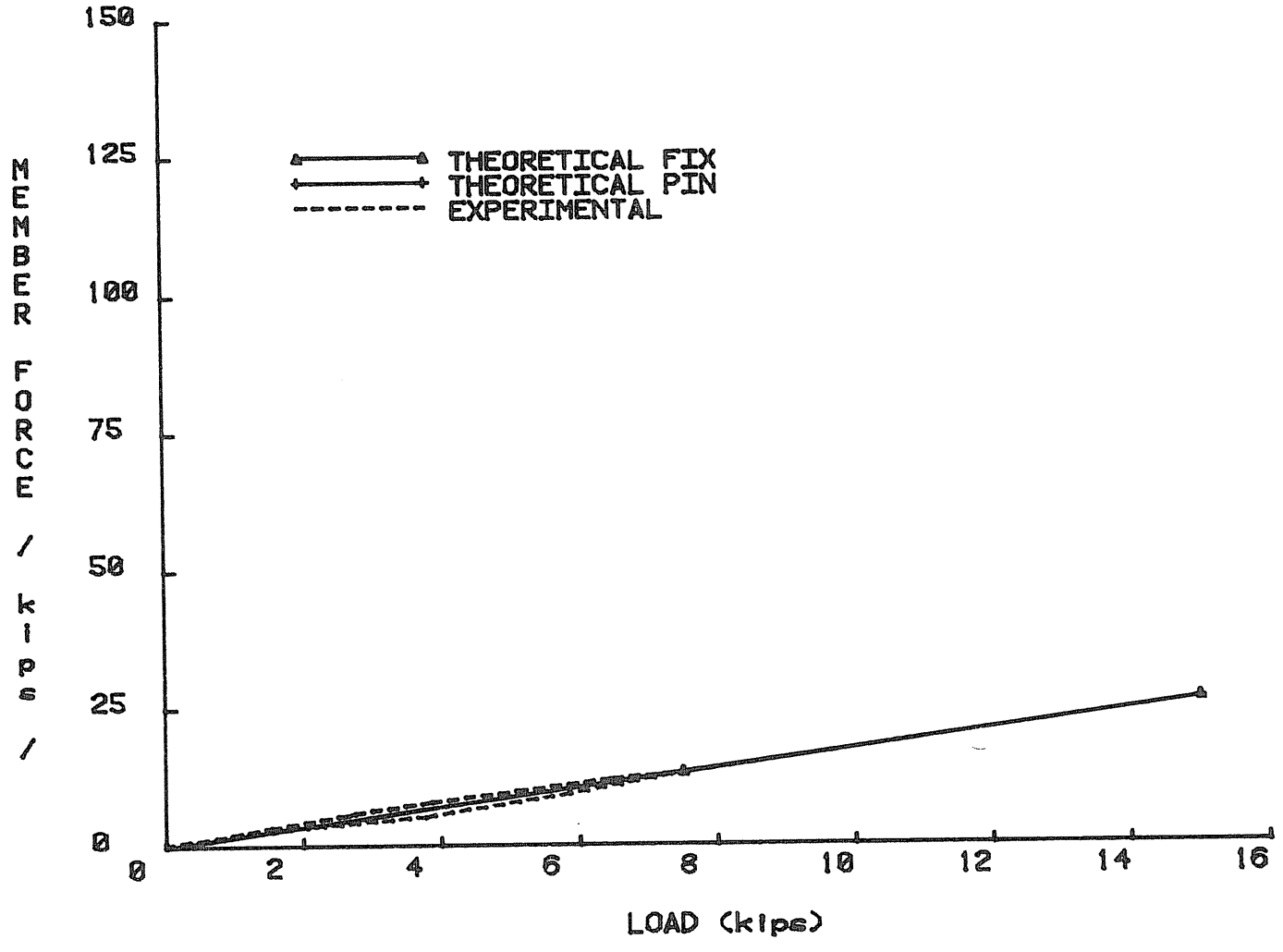


FIGURE D.11 MEMBER (#60) FORCE VS LOAD, ULL

APPENDIX E

UNBALANCED LIVE LOAD (WINDWARD) PLUS WIND LOAD

(TEST ULL_W + WL)

VULCRAFT FRAME TEST SUMMARY

Project: Vulcraft FR-2

Test No: Test 4

Test Date: 3 June 1985

Purpose: Test of working level wind load with working level live load applied on the windward side of the frames.

Maximum Test Load: Live load = 7.7 kips; Wind load = 7.2 kips

Failure Mode:

Discussion:

- Working level live load was applied to the south half of both frames, then wind load was applied at the north end to both frames.

- The applied load versus vertical deflection curves of the frames agreed with the theoretical curves obtained for fixed column bases and pinned column bases.

- The applied wind load versus sidesway deflection curves were bounded by the theoretical curves obtained for fixed column bases and pinned column bases.

- A slight increase in yielding was observed at the knee clip angles and at the column brace points.

- Maximum midspan deflection was 1.0 inches at 7.7 kips applied live load and 7.2 kips wind load.

- Maximum sidesway deflection was 0.83 inches at 7.7 kips applied live load and 7.2 kips wind load.

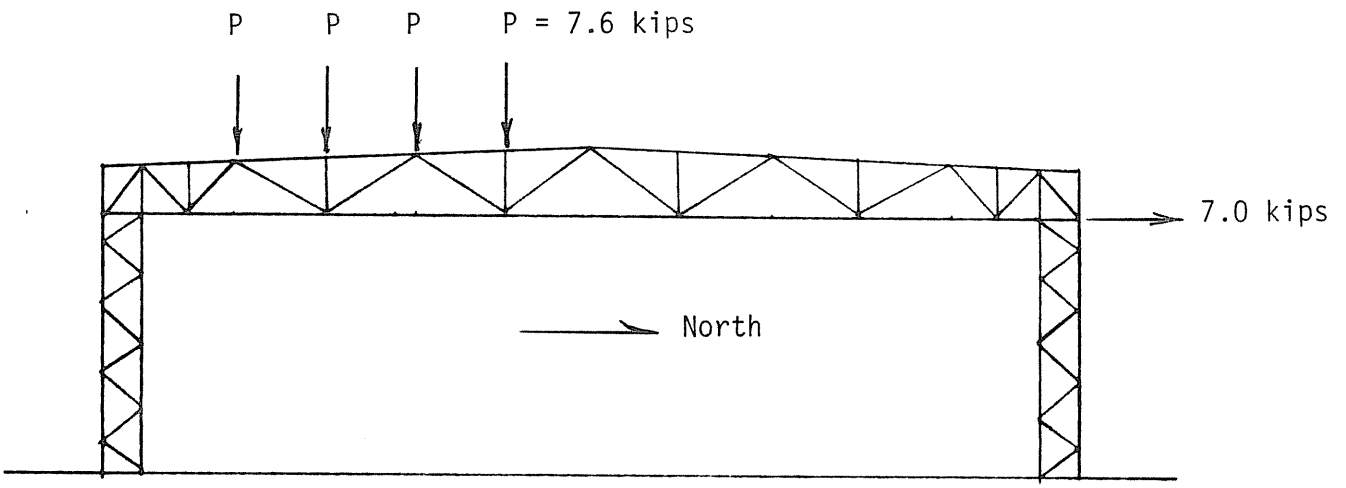


FIGURE E.1 UNBALANCED LIVE LOAD (WINDWARD) PLUS WIND LOAD

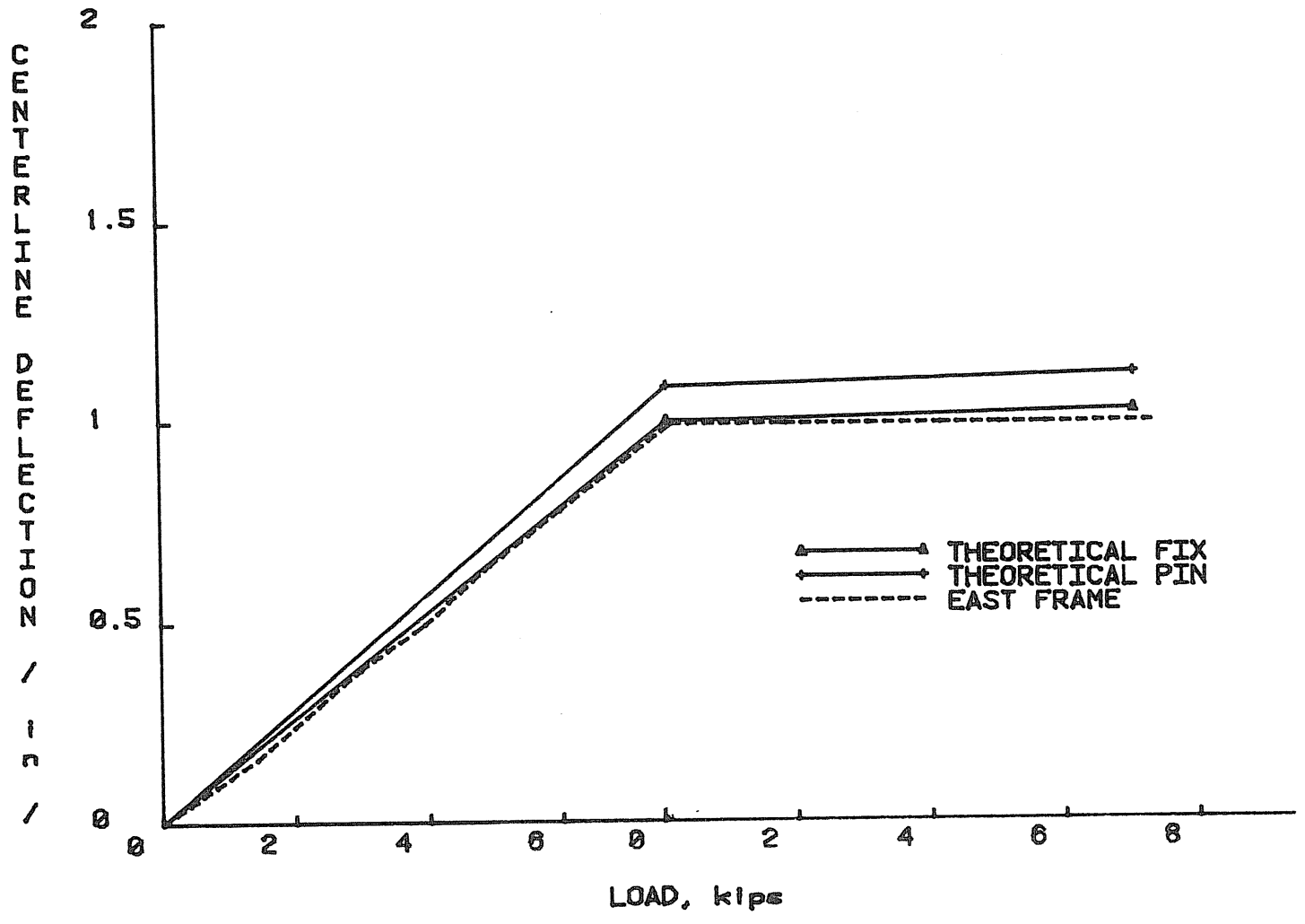


FIGURE E.2 CENTERLINE DEFLECTION VS. LOAD, ULL_W + WL: EAST

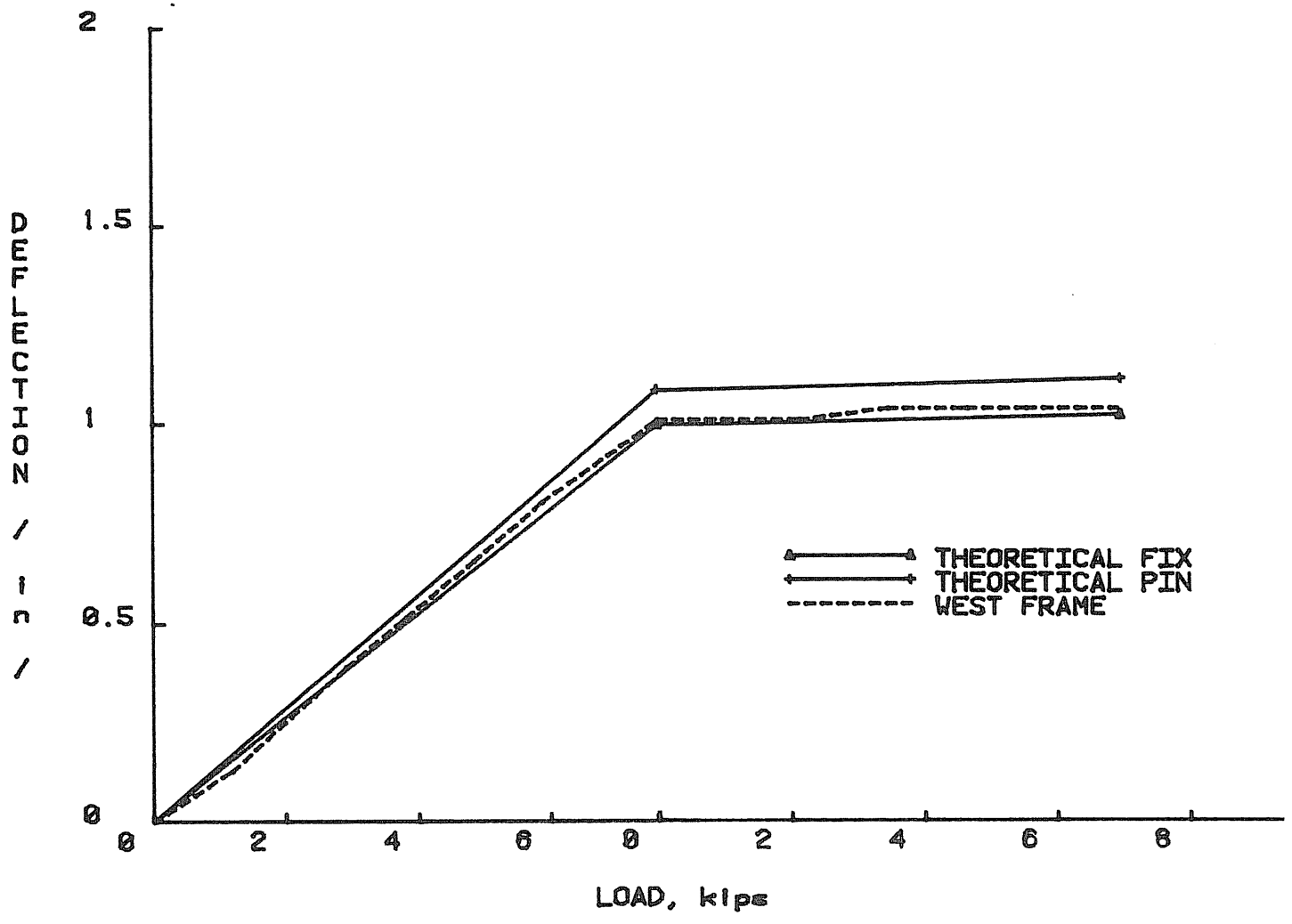


FIGURE E.3 CENTERLINE DEFLECTION VS. LOAD, ULL_W + WL: WEST

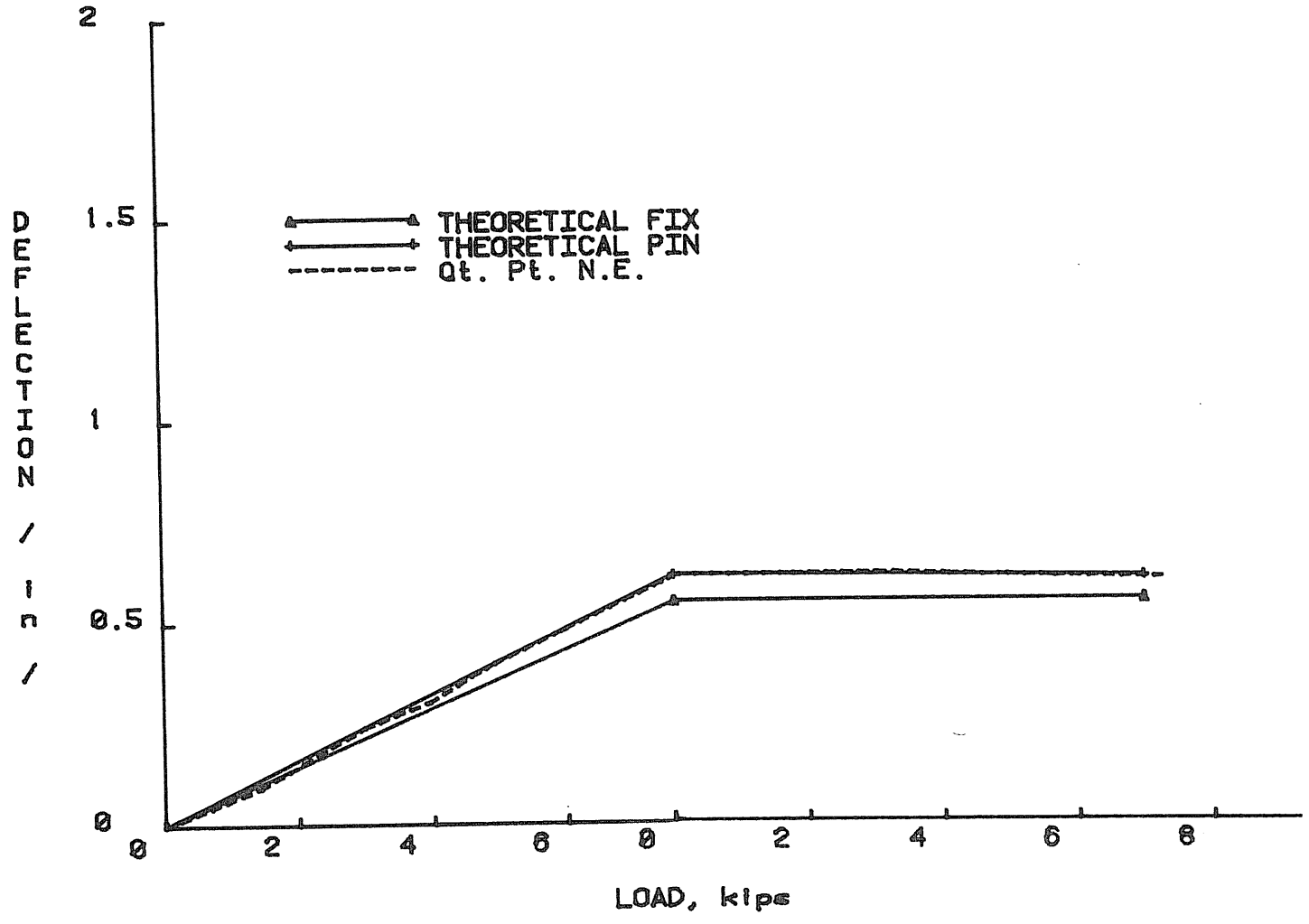


FIGURE E.4 QUARTERPOINT DEFLECTION VS. LOAD, ULL_W + WL: NORTHEAST

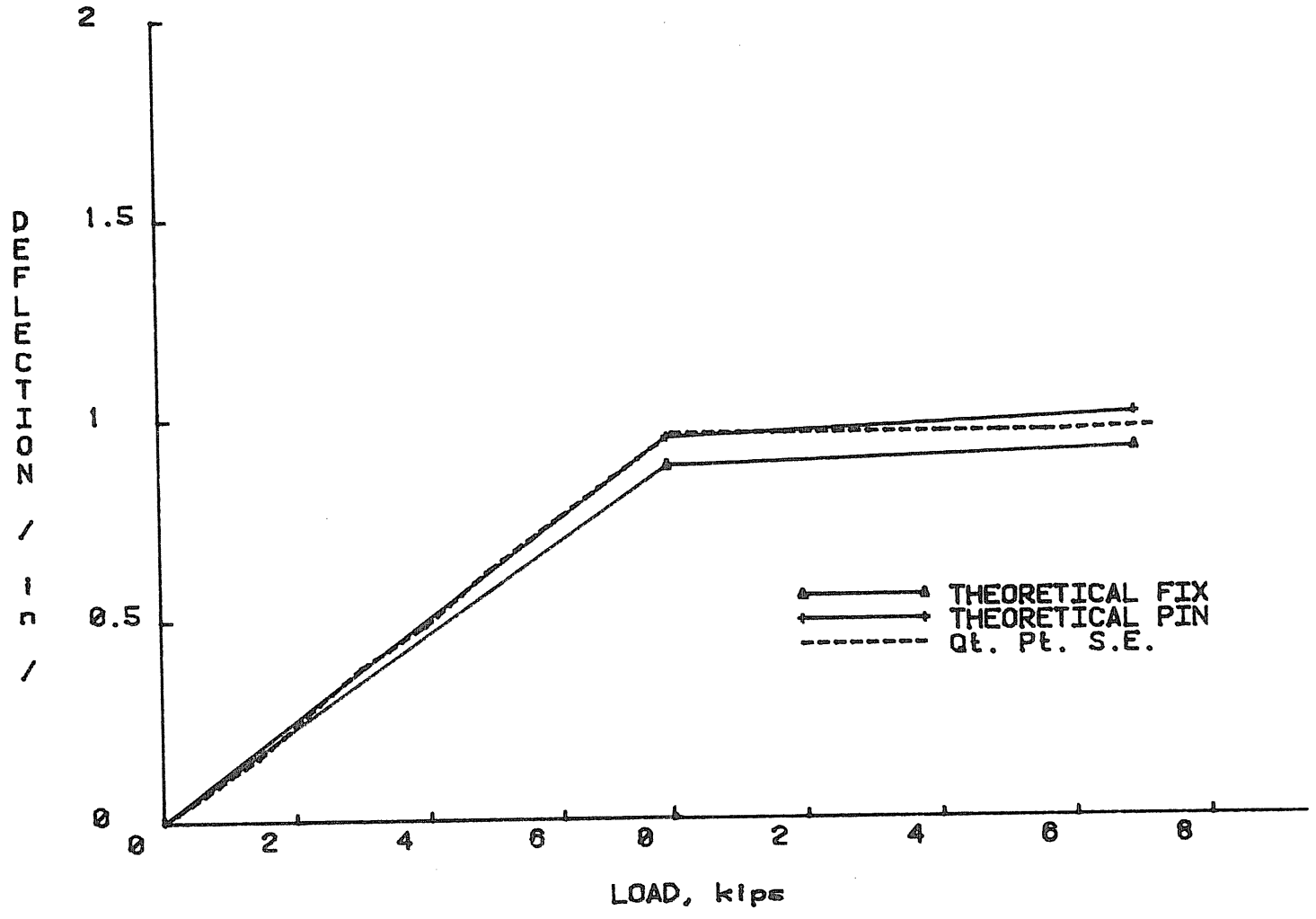


FIGURE E.5 QUARTERPOINT DEFLECTION VS. LOAD, ULL_W + WL: SOUTHEAST

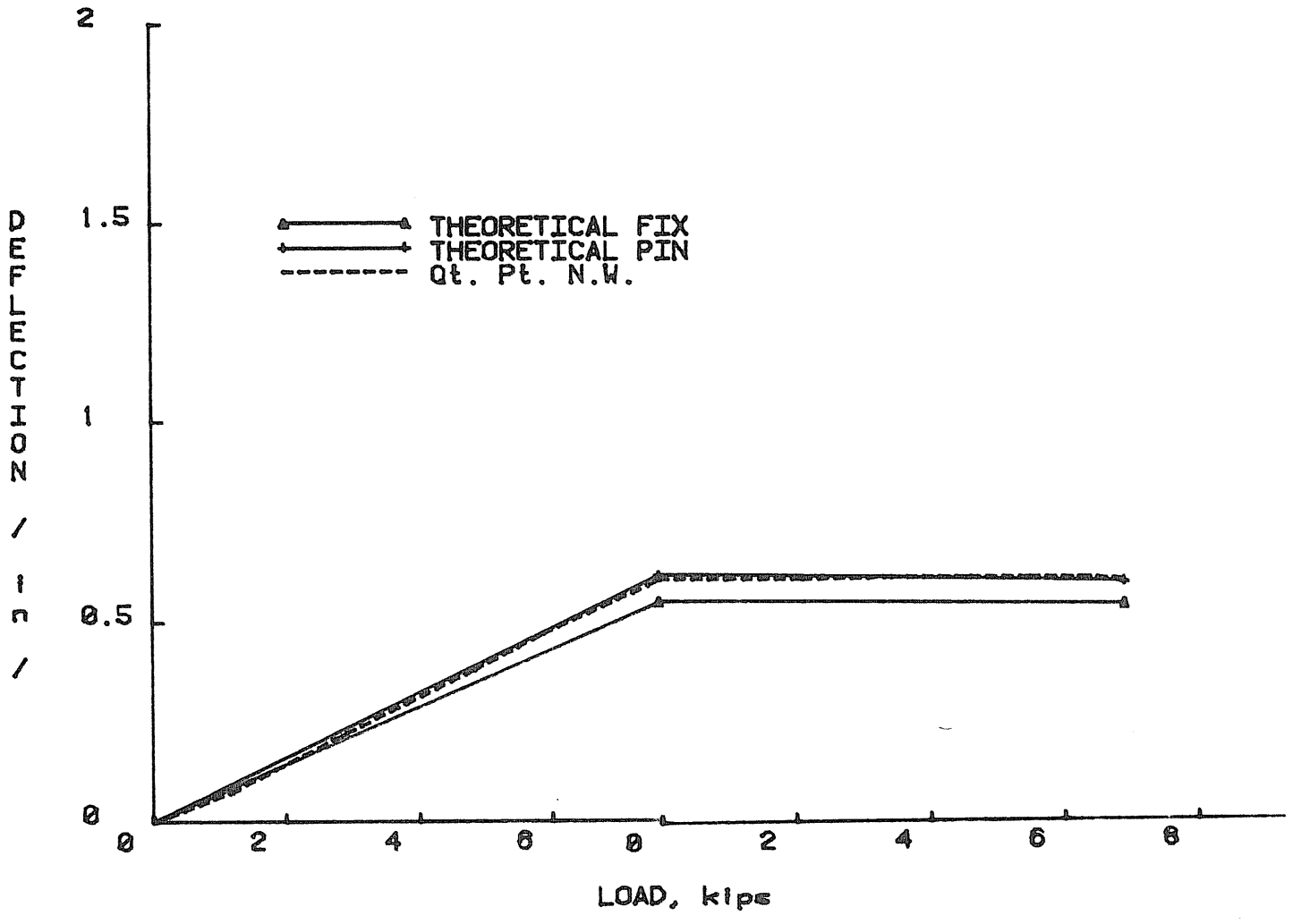


FIGURE E.6 QUARTERPOINT DEFLECTION VS. LOAD, ULL_W + WL: NORTHWEST

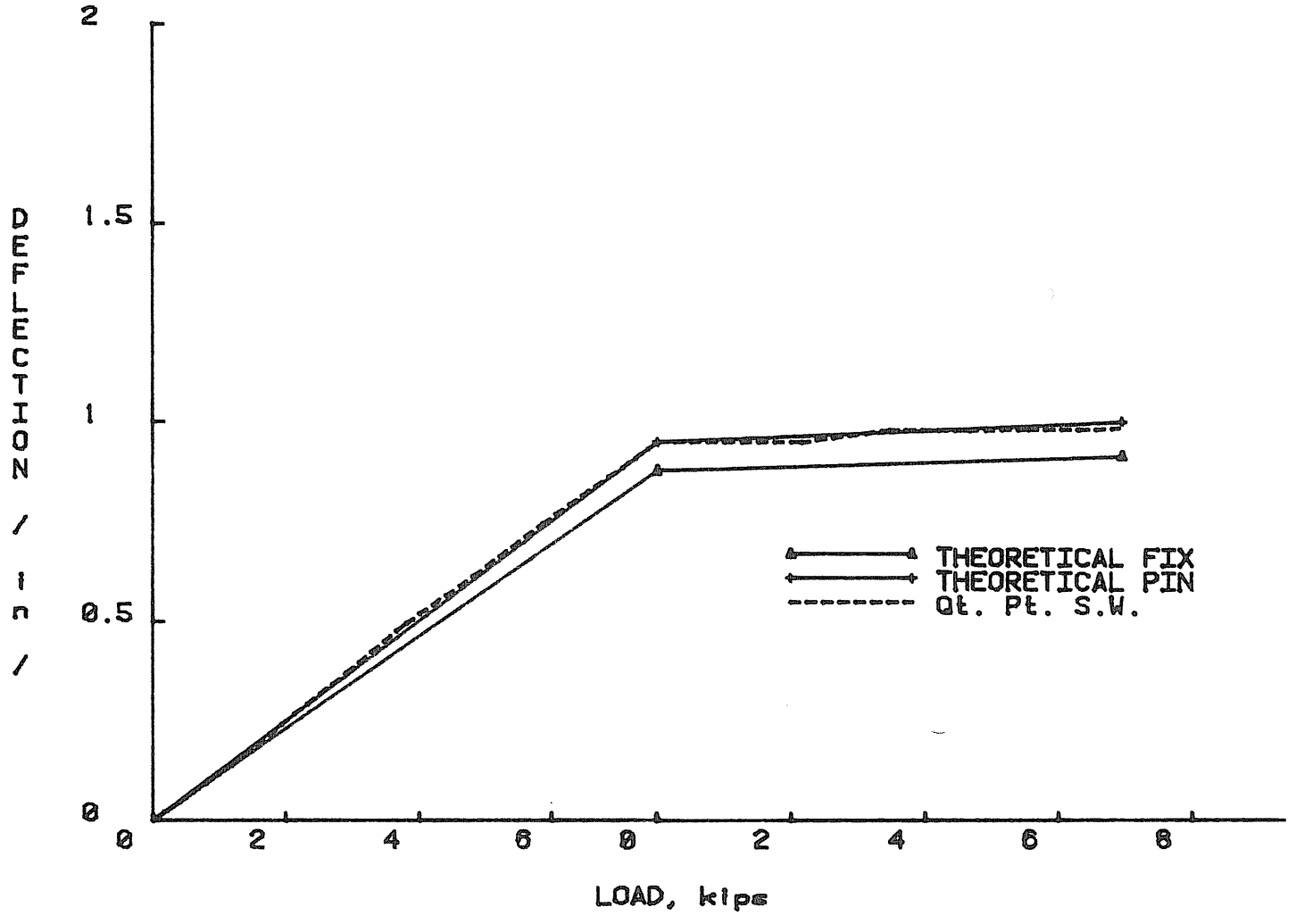


FIGURE E.7 QUARTERPOINT DEFLECTION VS. LOAD, ULL_W + WL: SOUTHWEST

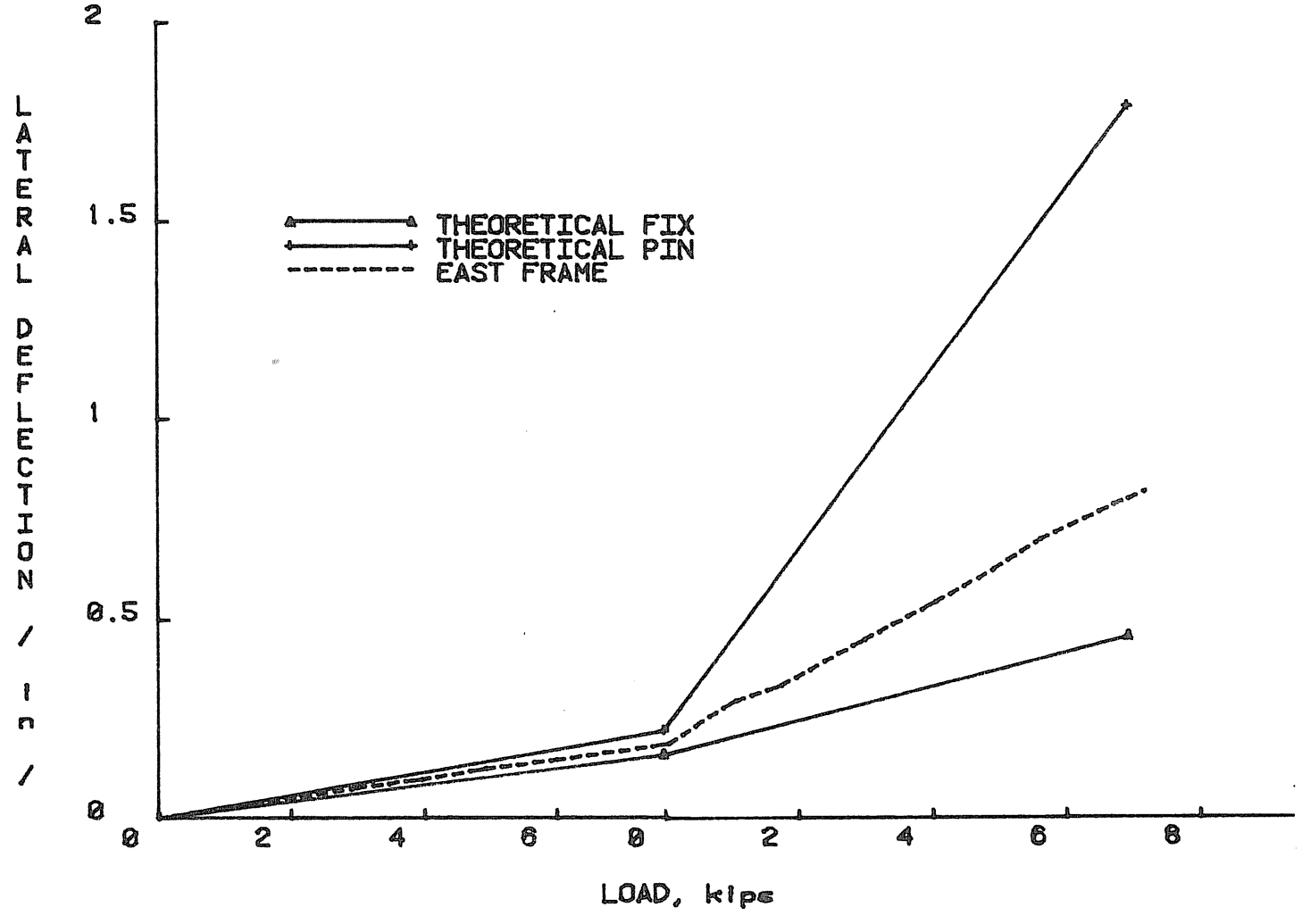


FIGURE E.8 SIDESWAY VS. LOAD, ULL_W + WL: EAST

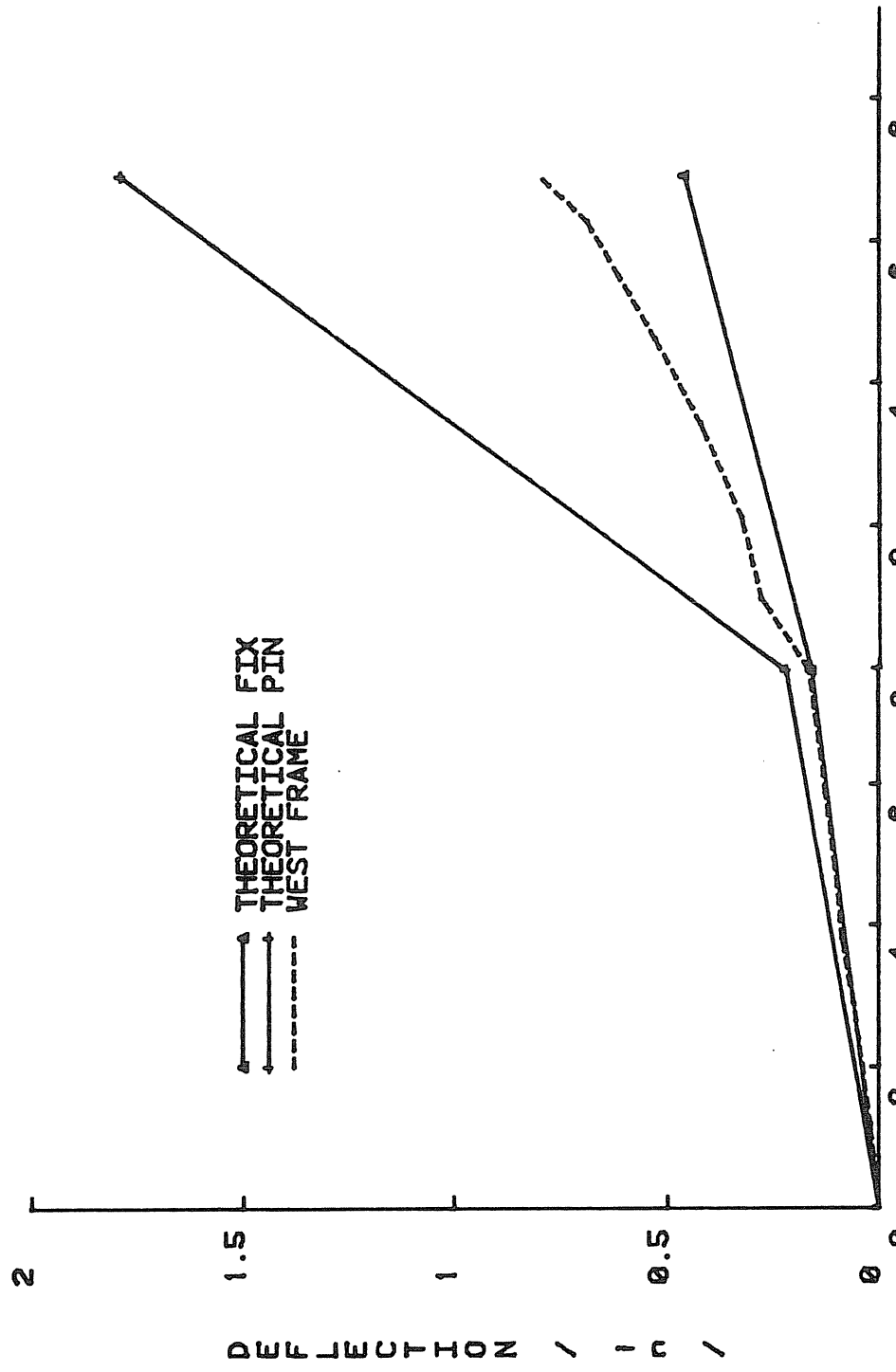


FIGURE E.9 SIDESWAY VS. LOAD, ULL_W + WL: WEST

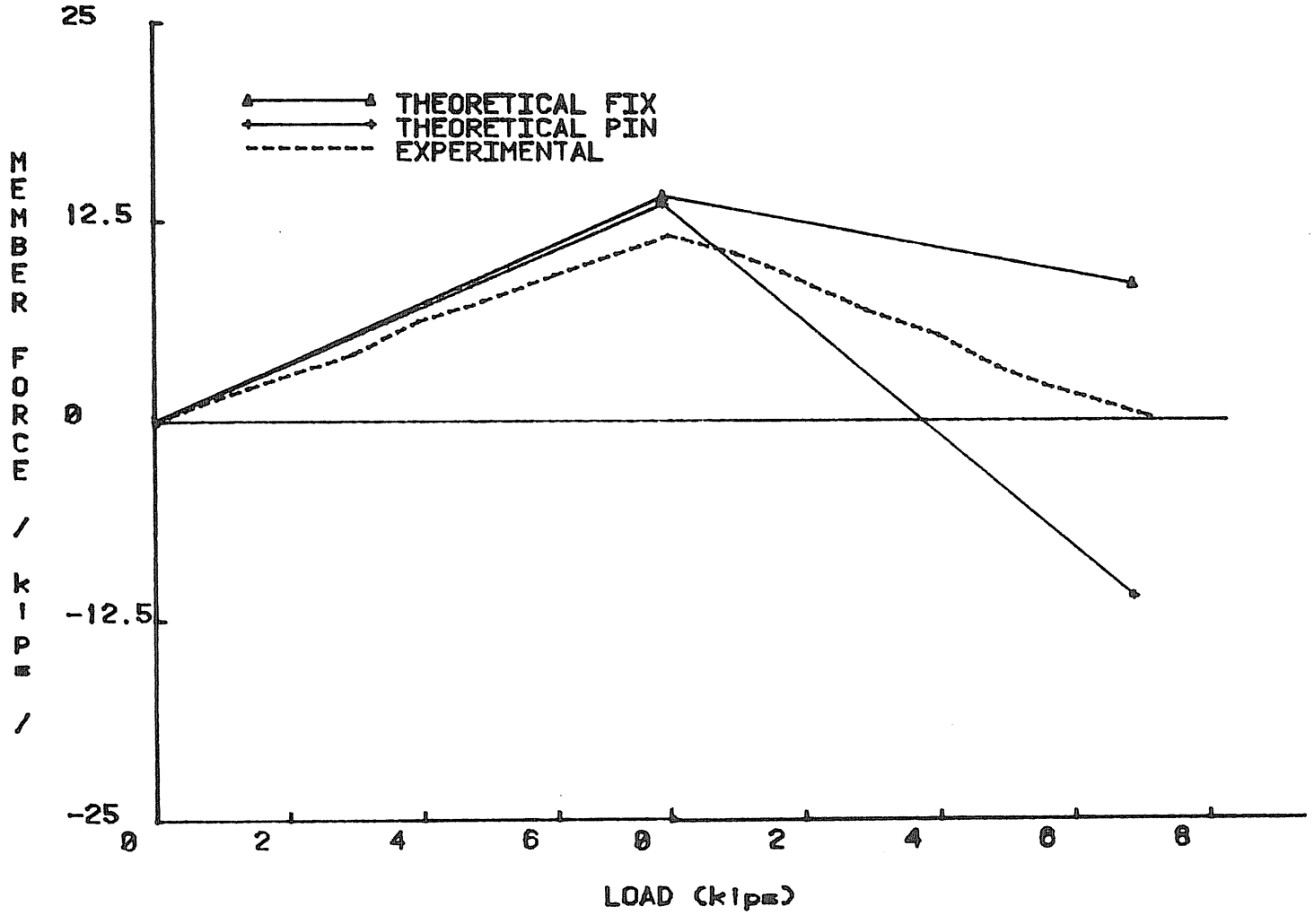


FIGURE E.10 MEMBER #4 FORCE VS. LOAD, ULL_W + WL

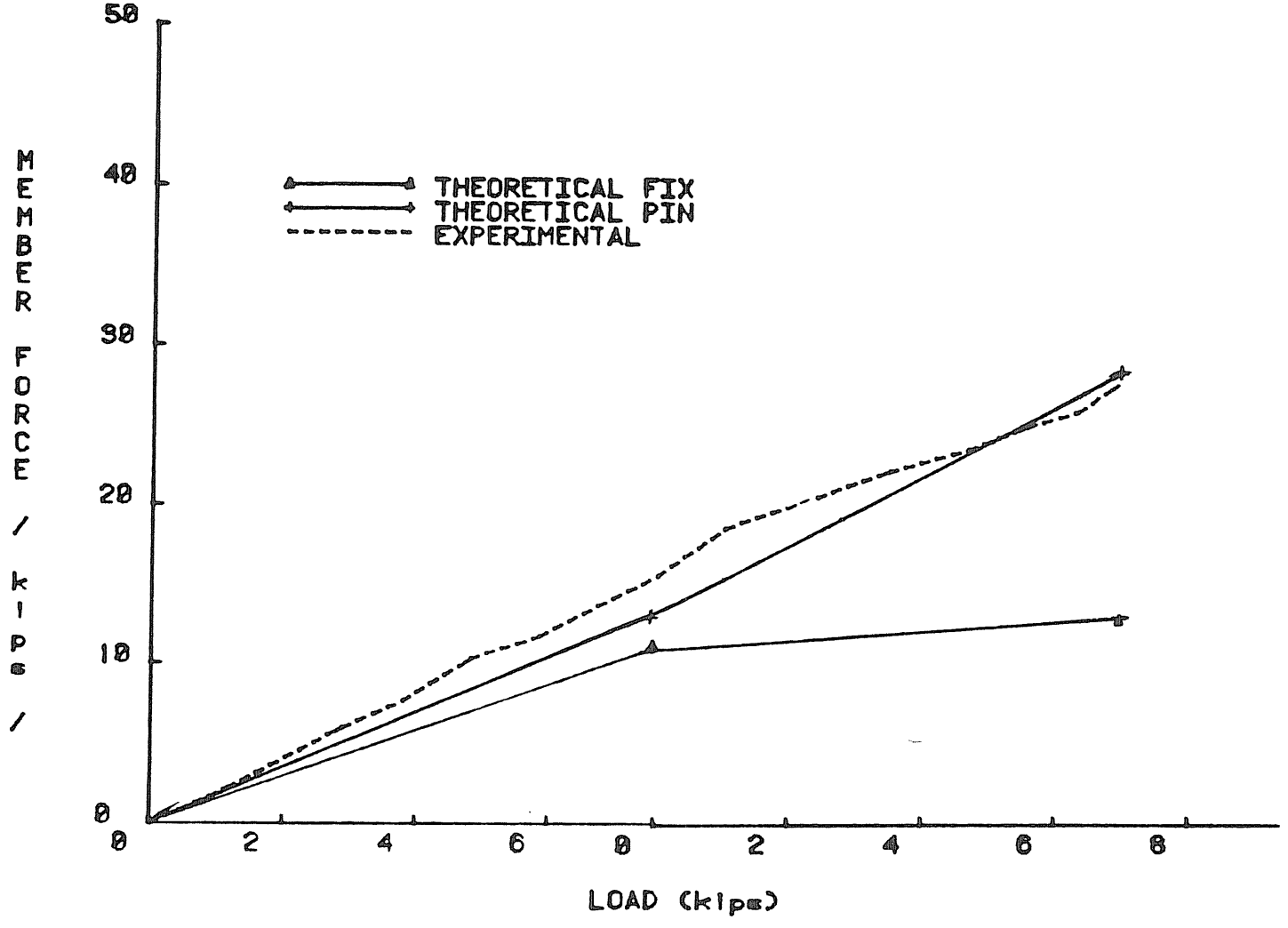


FIGURE E.11 MEMBER #17 FORCE VS. LOAD, ULL_W + WL

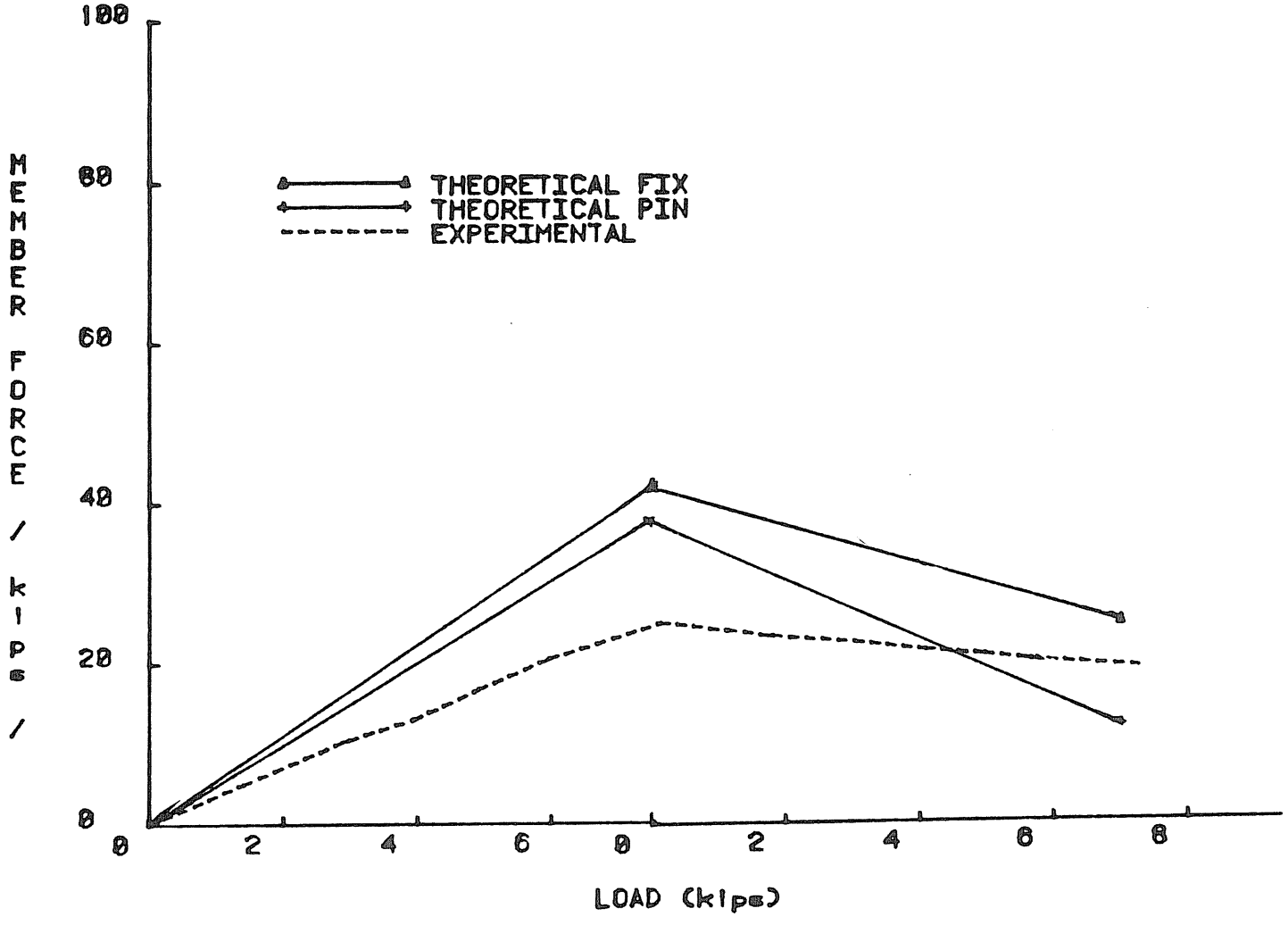


FIGURE E.12 MEMBER #24 FORCE VS. LOAD, ULL_W + WL

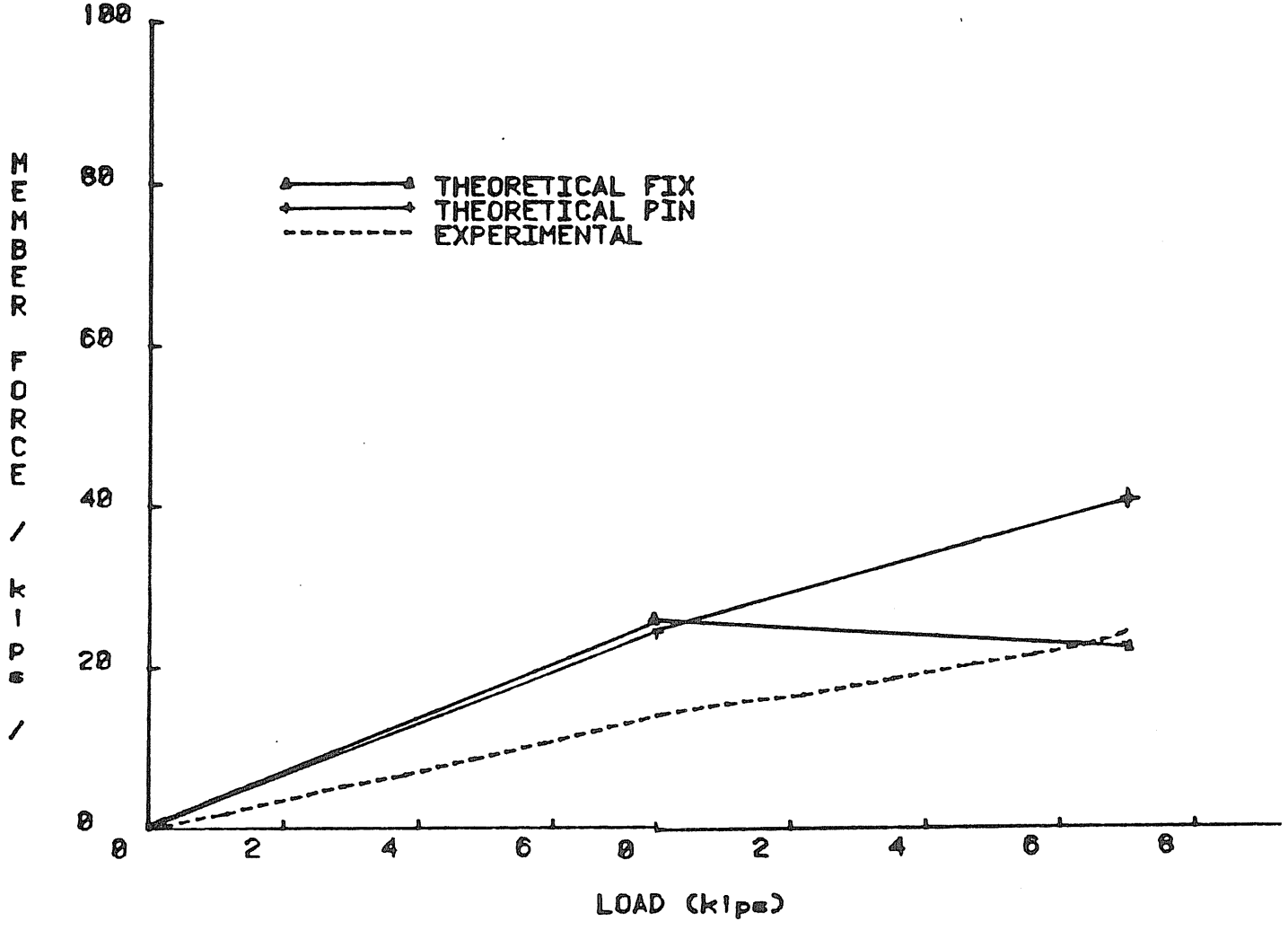


FIGURE E.13 MEMBER #33 FORCE VS. LOAD, ULL_W + WL

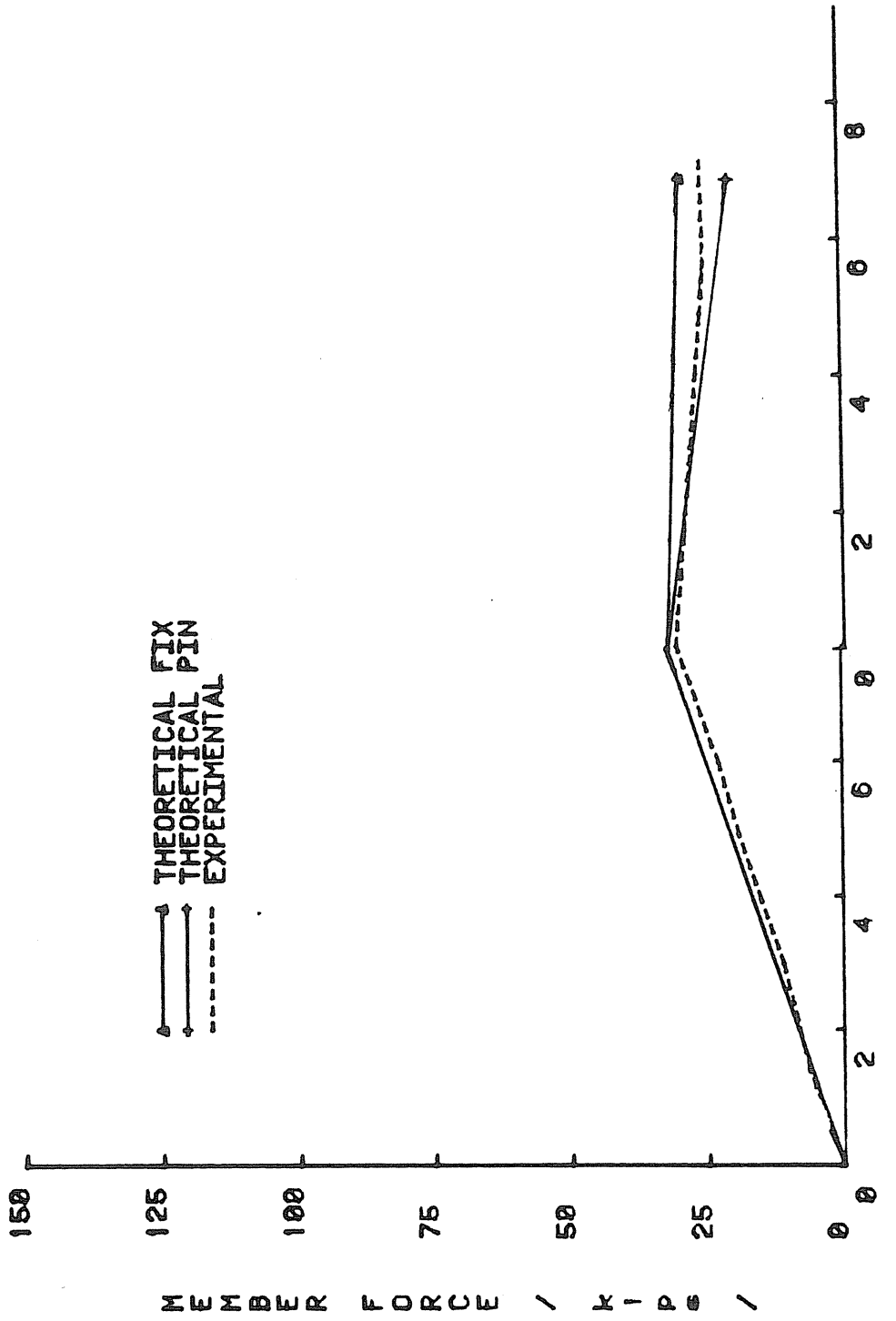


FIGURE E.14 MEMBER #48 FORCE VS. LOAD, $ULL_W + WL$

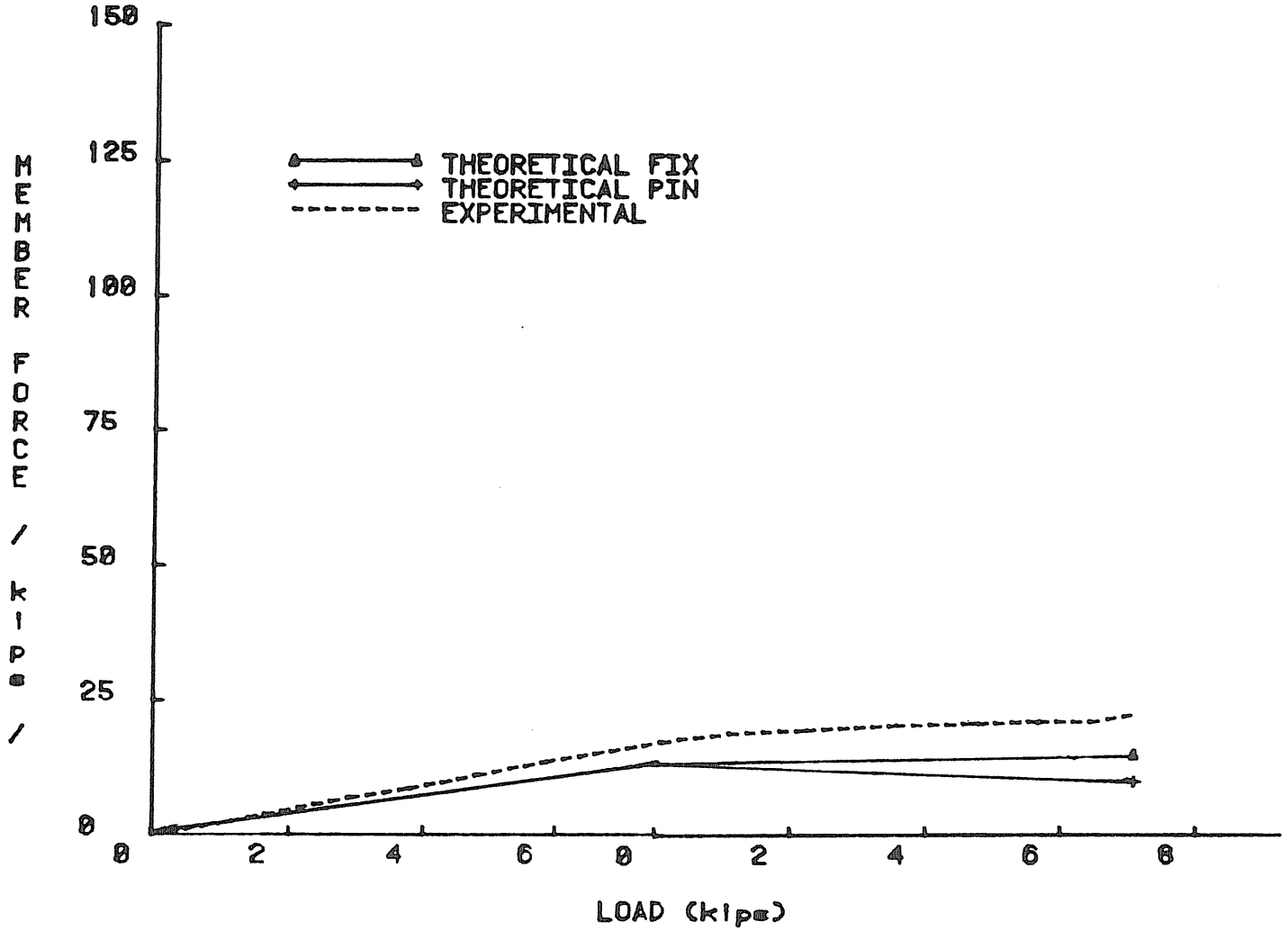


FIGURE E.15 MEMBER #60 FORCE VS. LOAD, ULL_W + WL

APPENDIX F

UNBALANCED LIVE LOAD (LEEWARD) PLUS WIND LOAD

(TEST ULL_L + WL)

VULCRAFT FRAME TEST SUMMARY

Project: Vulcraft FR-2

Test No: Test 5

Test Date: 31 May 1985

Purpose: Test of working level wind load with working level live load applied on the leeward side of the frame.

Maximum Test Load: Live load = 7.7 kips; Wind load = 7.43 kips

Failure Mode: No failure was intended

Discussion:

- Working level live load was applied to the north half of both frames; then wind load was applied on the same end to both frames.

- The applied load versus vertical deflection curves of the frames agreed with the theoretical curves which were similar for fixed column bases and pinned column bases.

- The applied load versus sidesway deflection curves were bounded by the theoretical curves.

- At 7.6 kips live load and 1.0 kip wind load, some yielding occurred at the knife plate areas of both north knees. Yielding at column brace points was observed.

- At 7.6 kips live load and 3.0 kips wind load, slight yielding at column web member joints was observed. Double curvature of the north columns was apparent.

- Maximum midspan deflection was 1.06 inches at 7.70 kips applied live load and 7.43 kips wind load.

- Maximum sidesway deflection was 0.61 inches at 7.70 kips applied live load and 7.43 kips wind load.

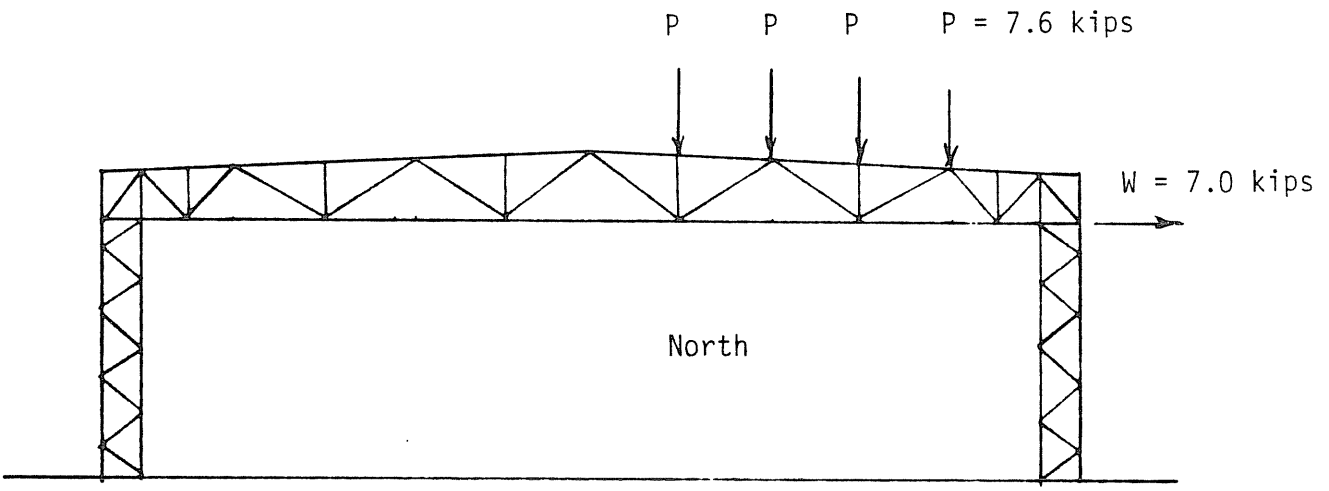


FIGURE F.1 UNBALANCED LIVE LOAD (LEEWARD) PLUS WIND LOAD

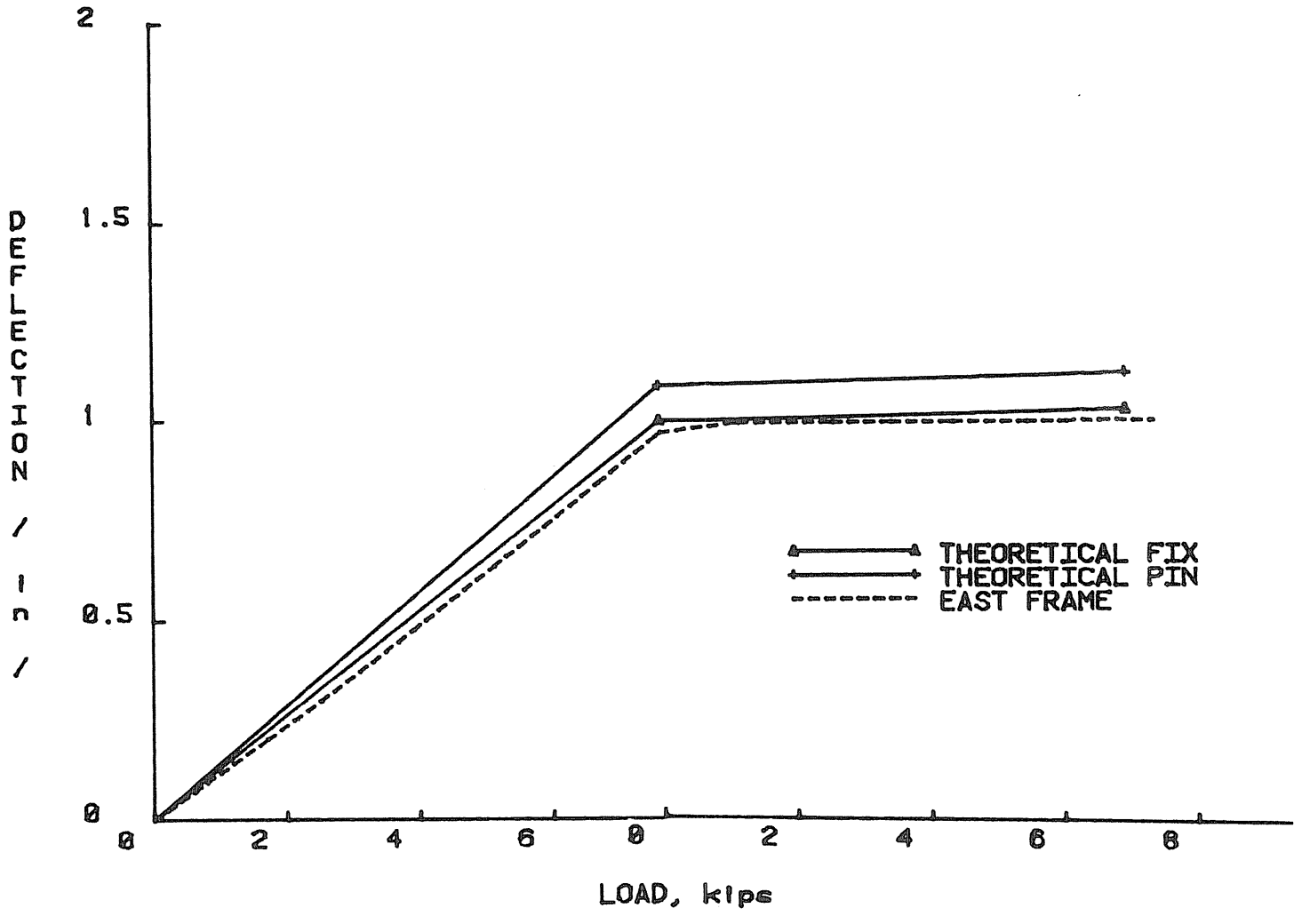


FIGURE F.2 CENTERLINE DEFLECTION VS. LOAD, ULL_L + WL: EAST

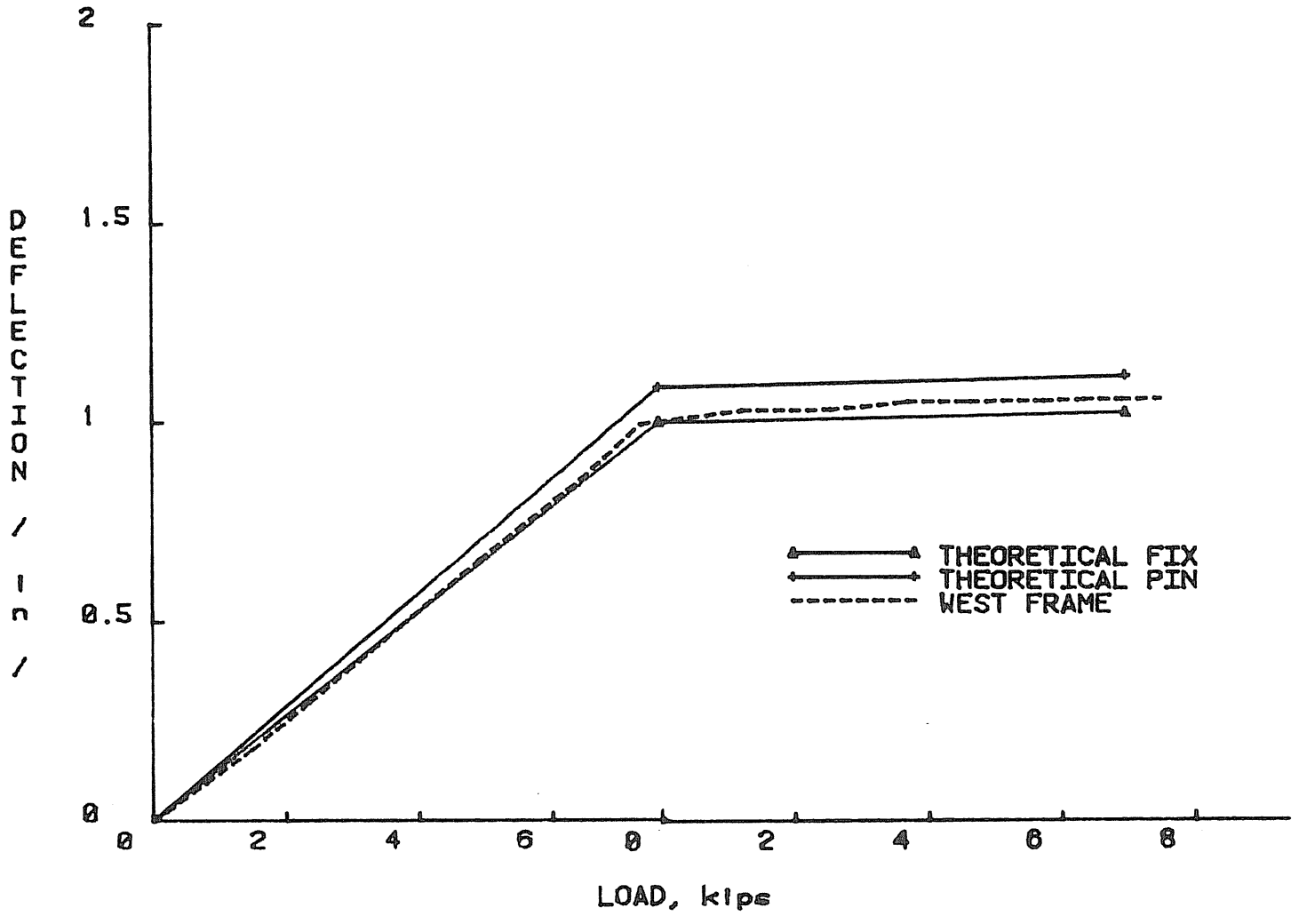


FIGURE F.3 CENTERLINE DEFLECTION VS. LOAD, ULL_L + WL: WEST

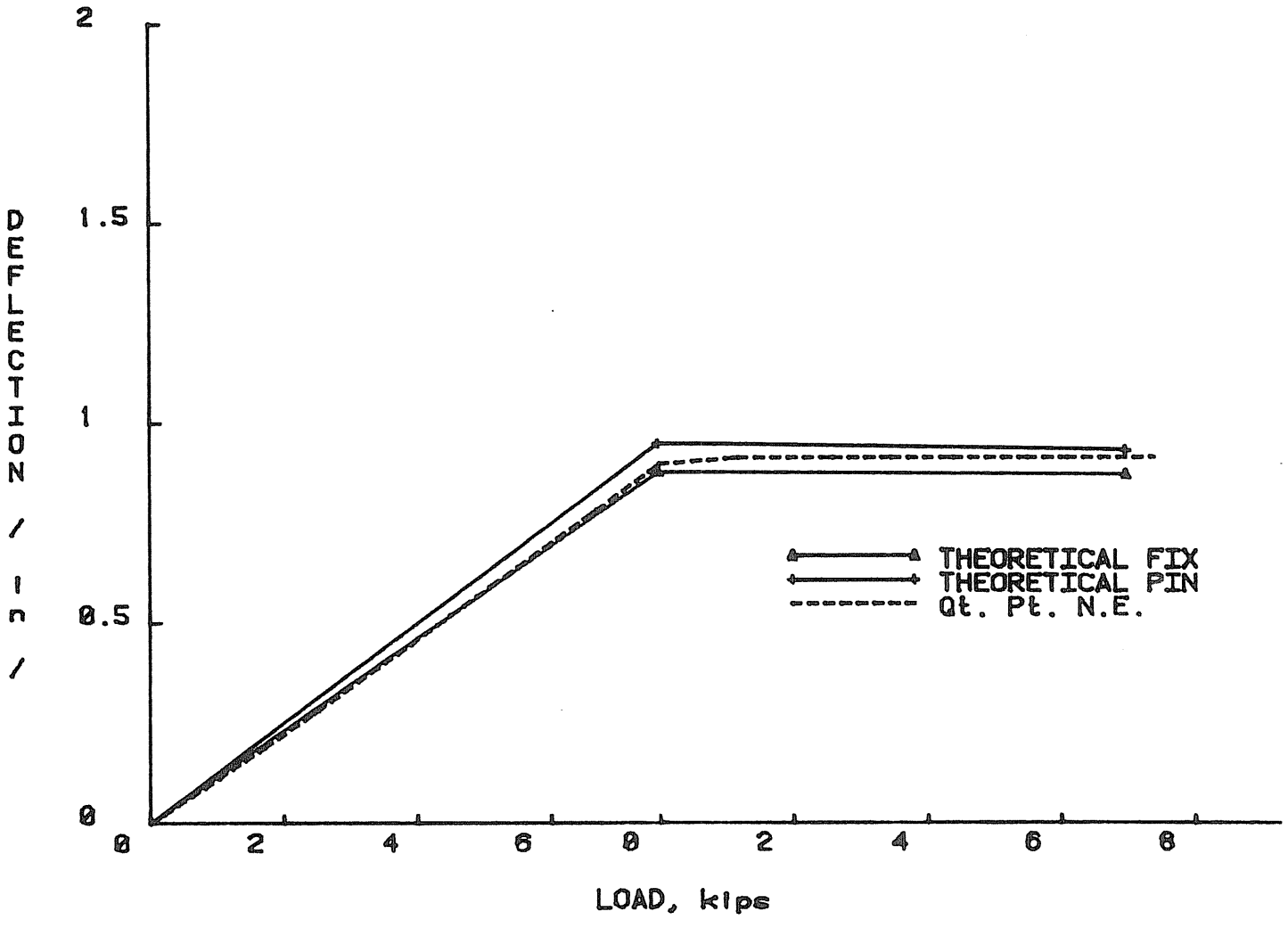


FIGURE F.4 QUARTERPOINT DEFLECTION VS. LOAD, ULL_L + WL: NORTHEAST

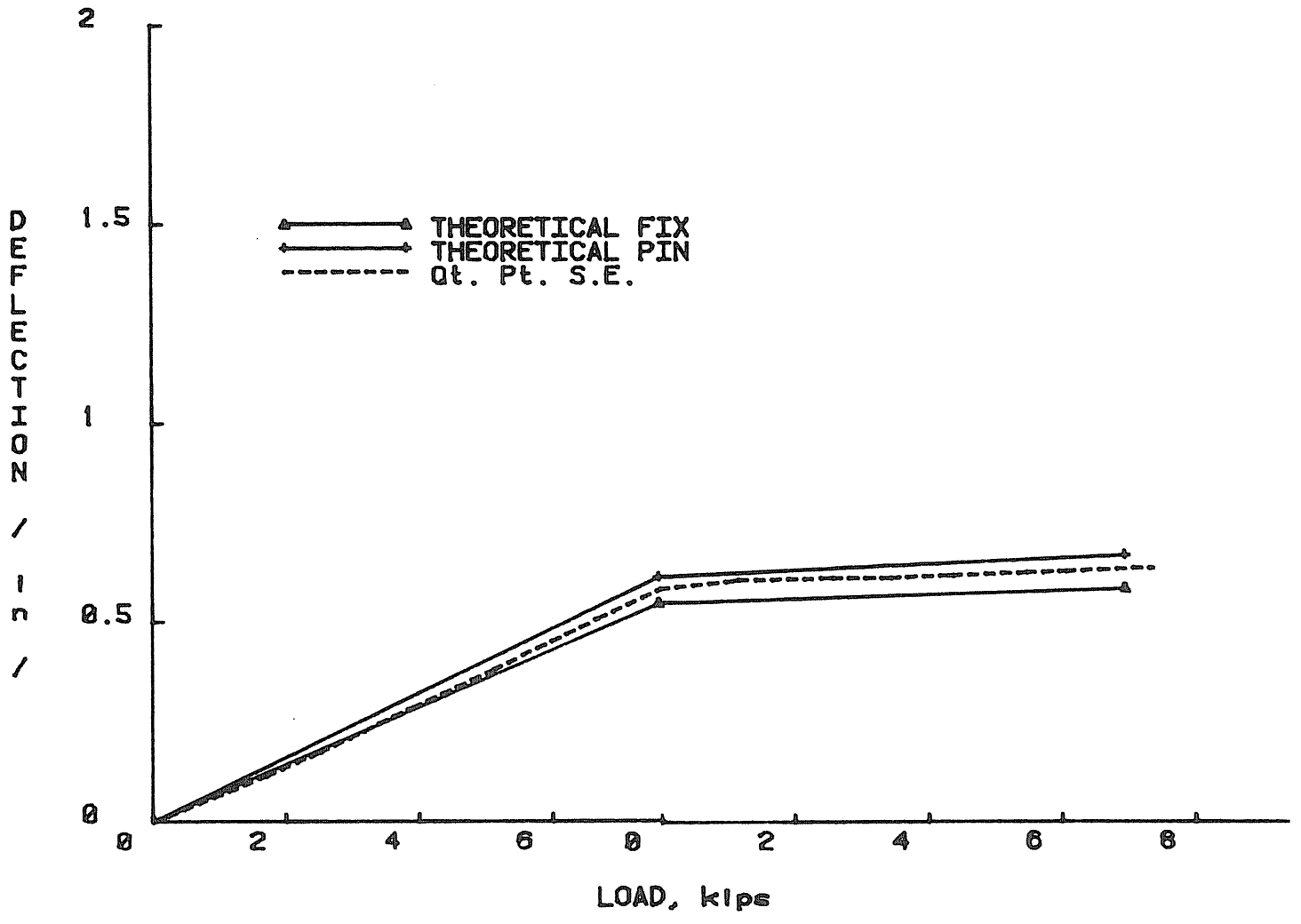


FIGURE F.5 QUARTERPOINT DEFLECTION VS. LOAD, ULL_L + WL: SOUTHEAST

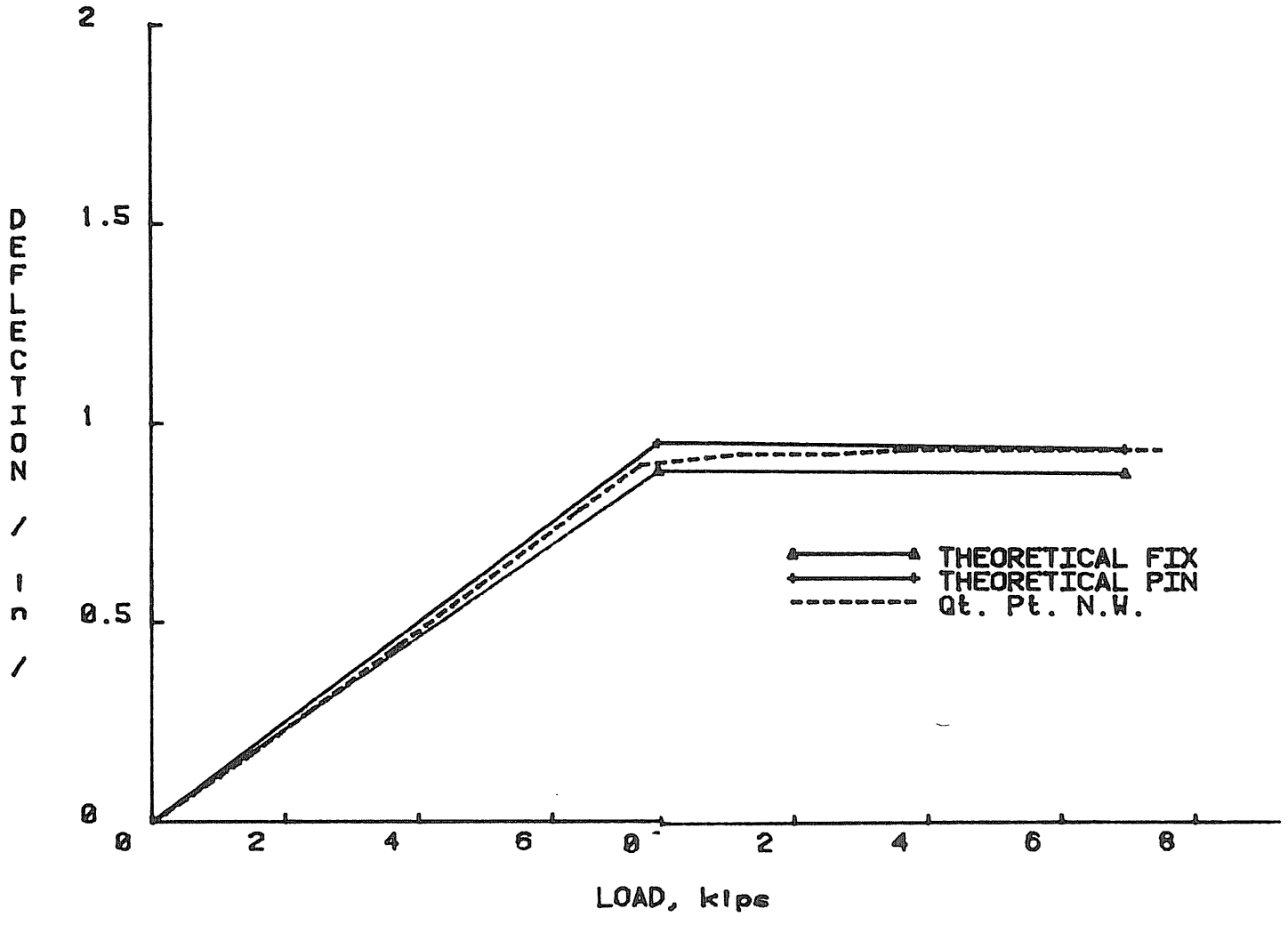


FIGURE F.6 QUARTERPOINT DEFLECTION VS. LOAD, ULL_L + WL: NORTHWEST

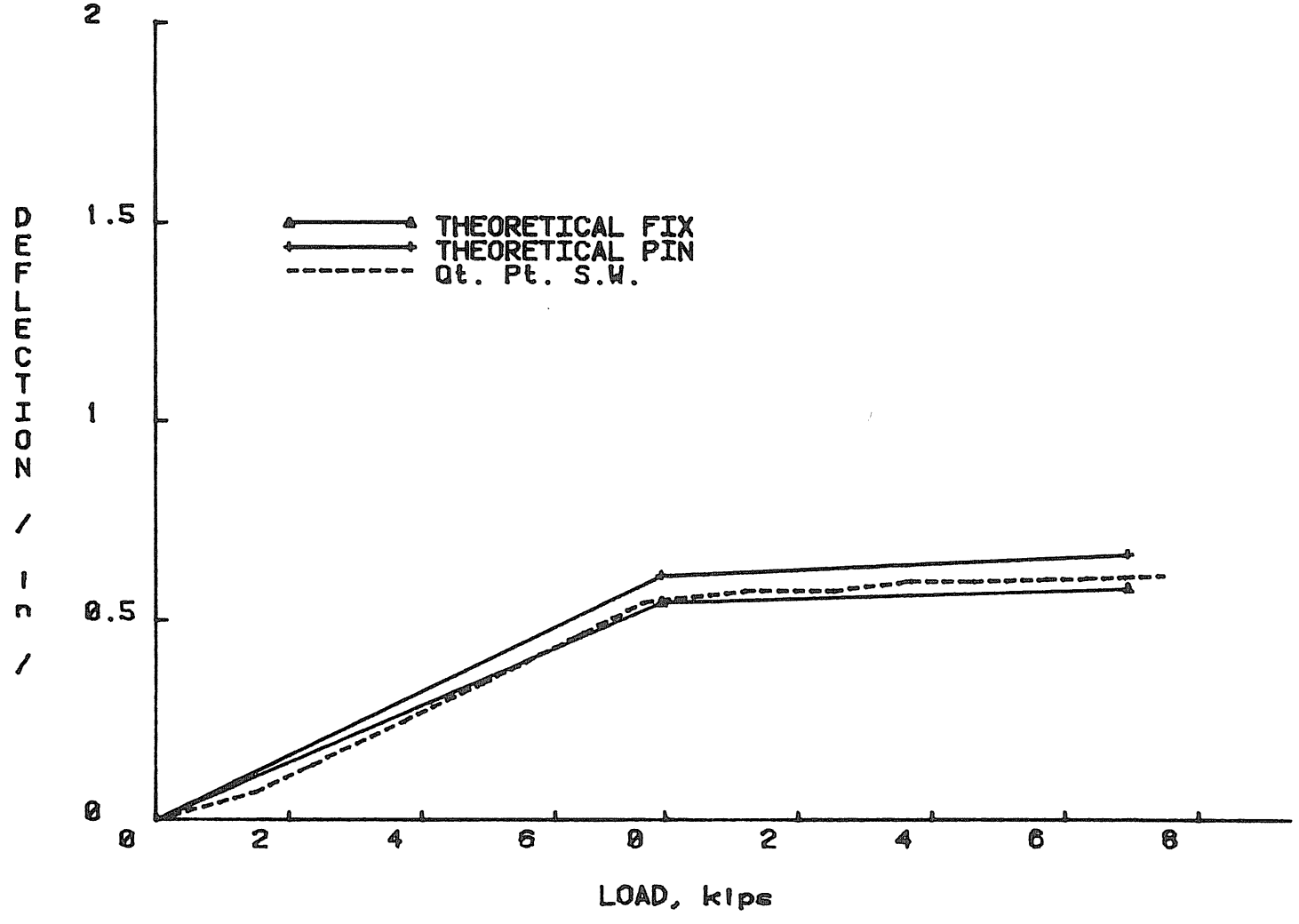


FIGURE F.7 QUARTERPOINT DEFLECTION VS. LOAD, ULL_L + WL: SOUTHWEST

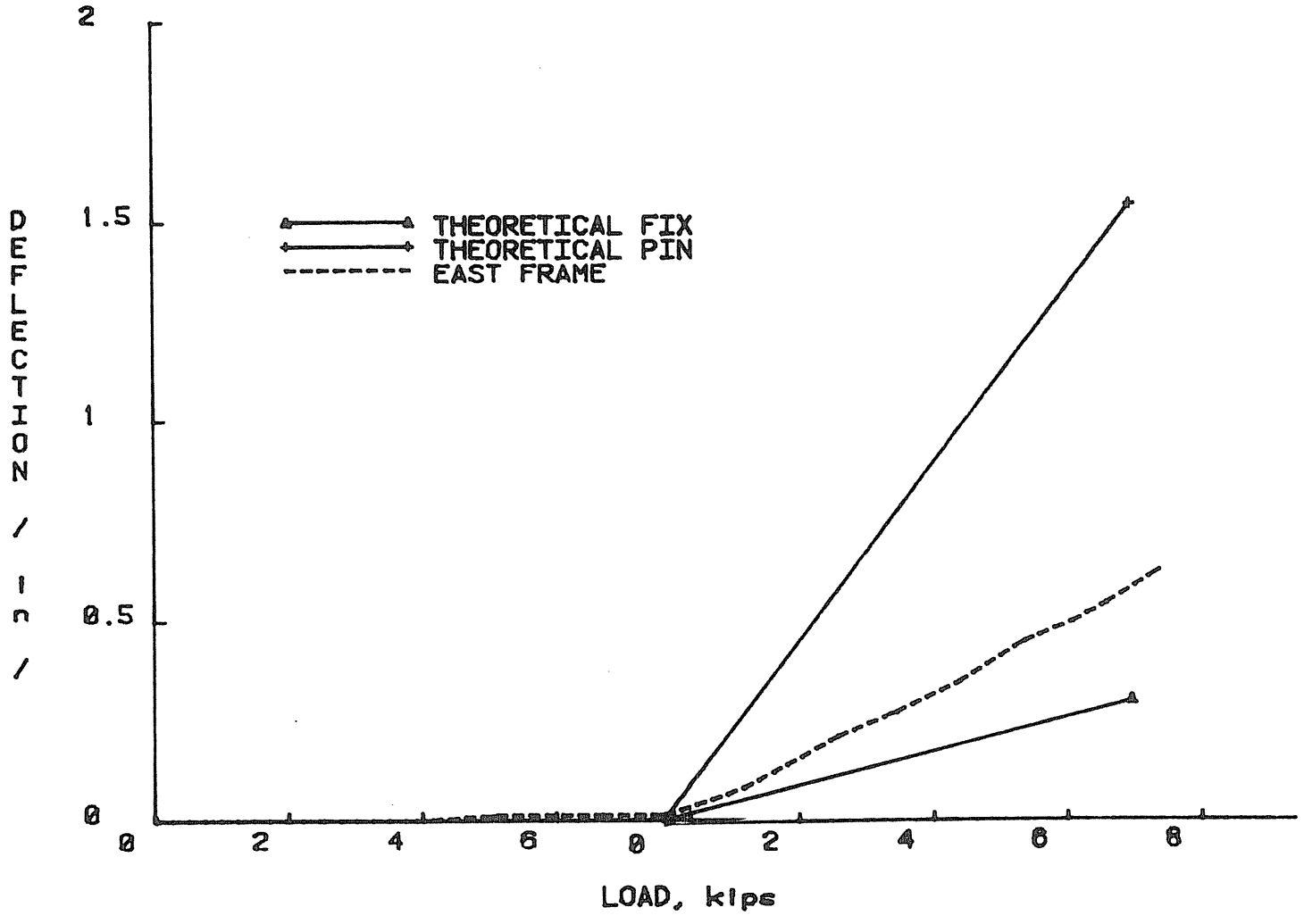


FIGURE F.8 SIDESWAY VS. LOAD, ULL_L + WL: EAST

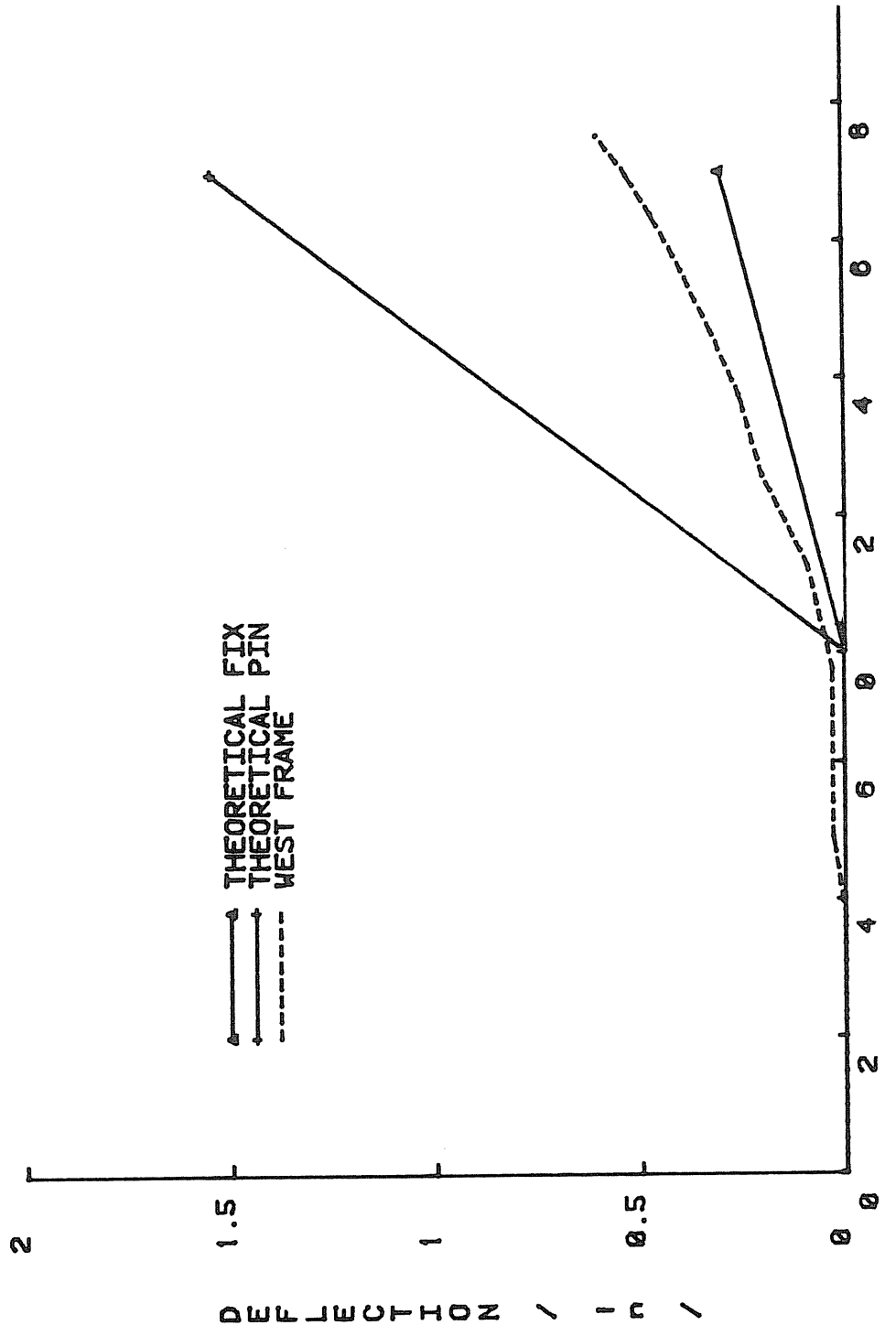


FIGURE F.9 SIDESWAY VS. LOAD, ULL_L + WL: WEST

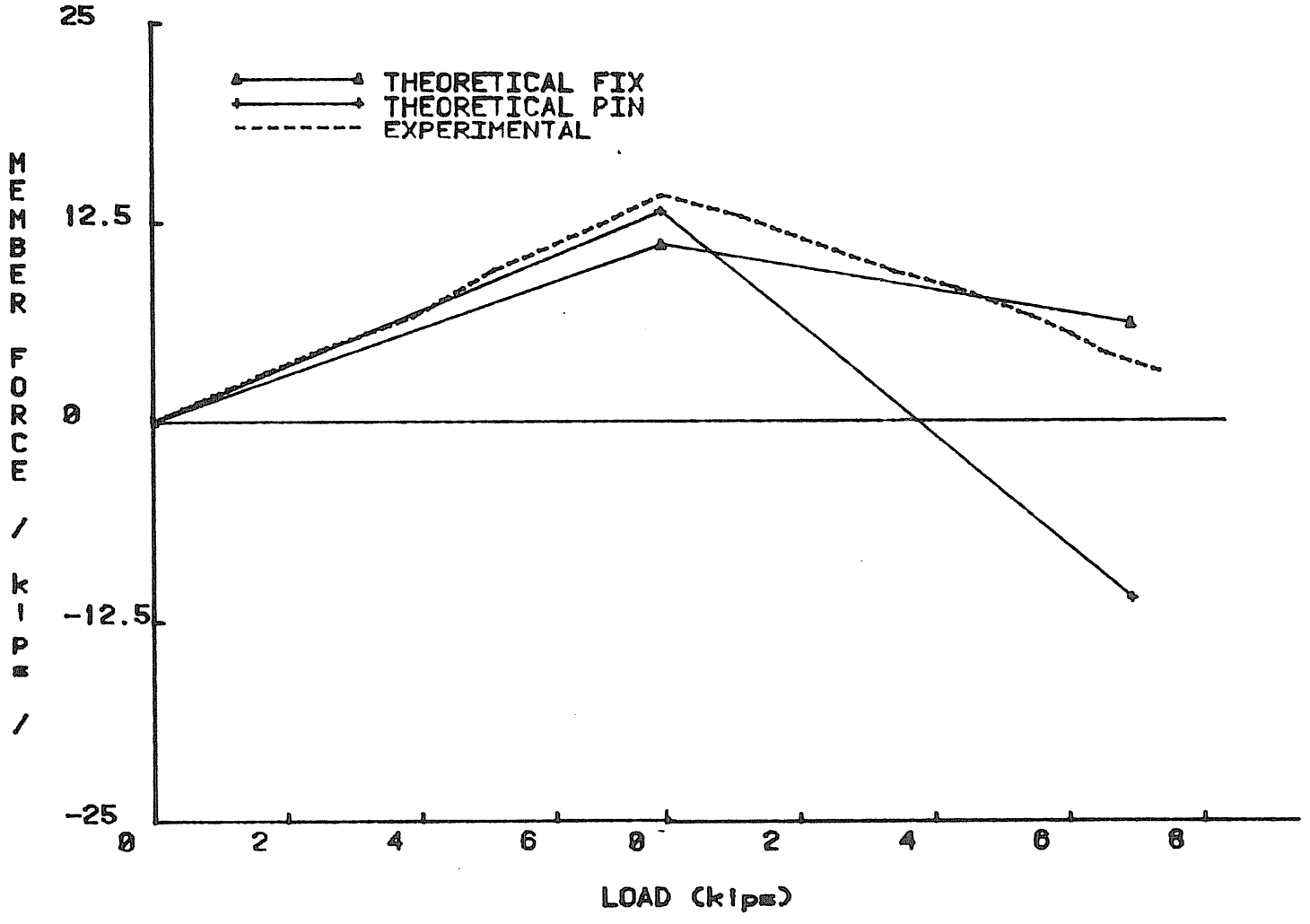


FIGURE F.10 MEMBER #4 FORCE VS. LOAD, ULL_L + WL

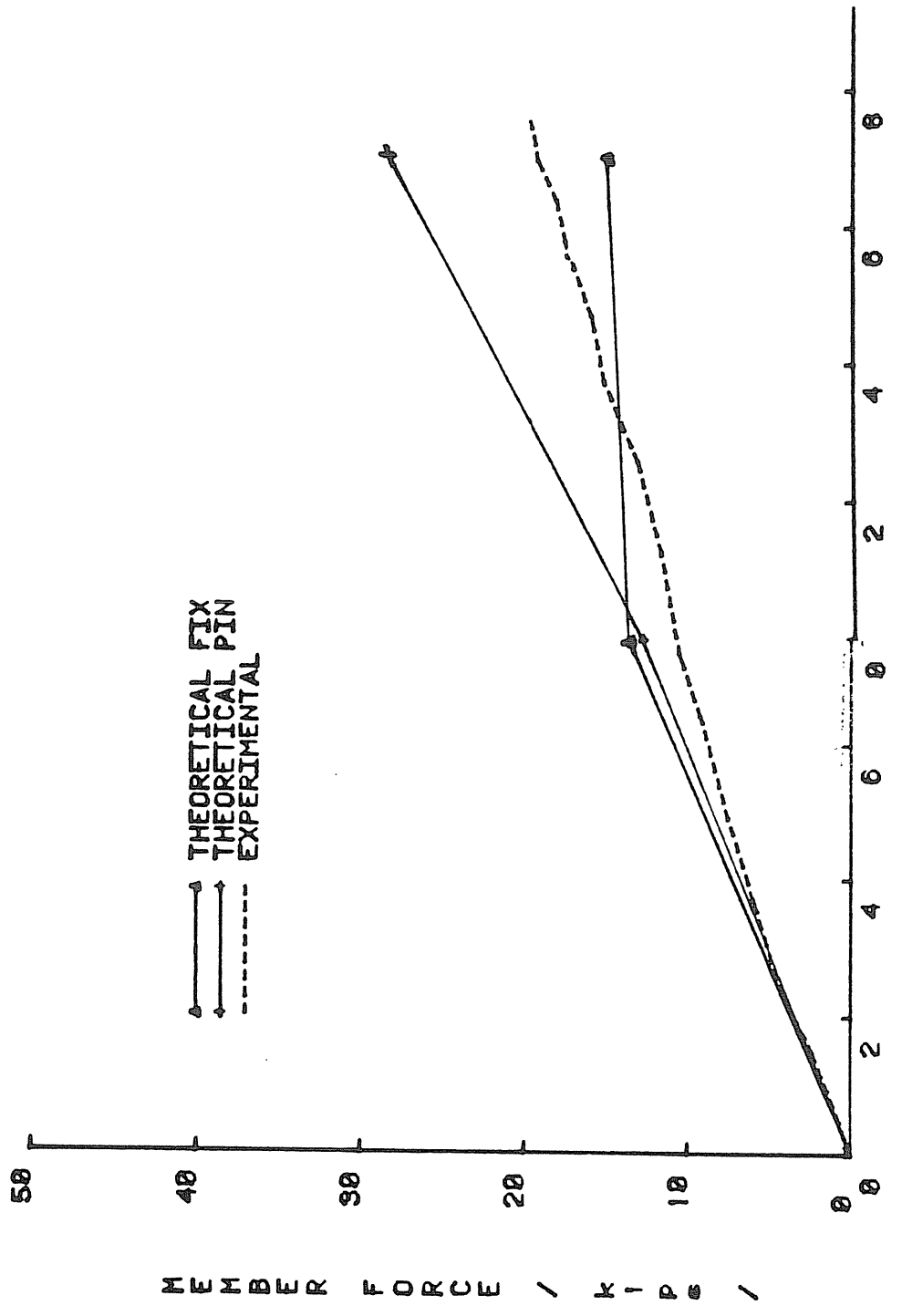


FIGURE F.11 MEMBER #17 FORCE VS. LOAD, $ULL_L + WL$

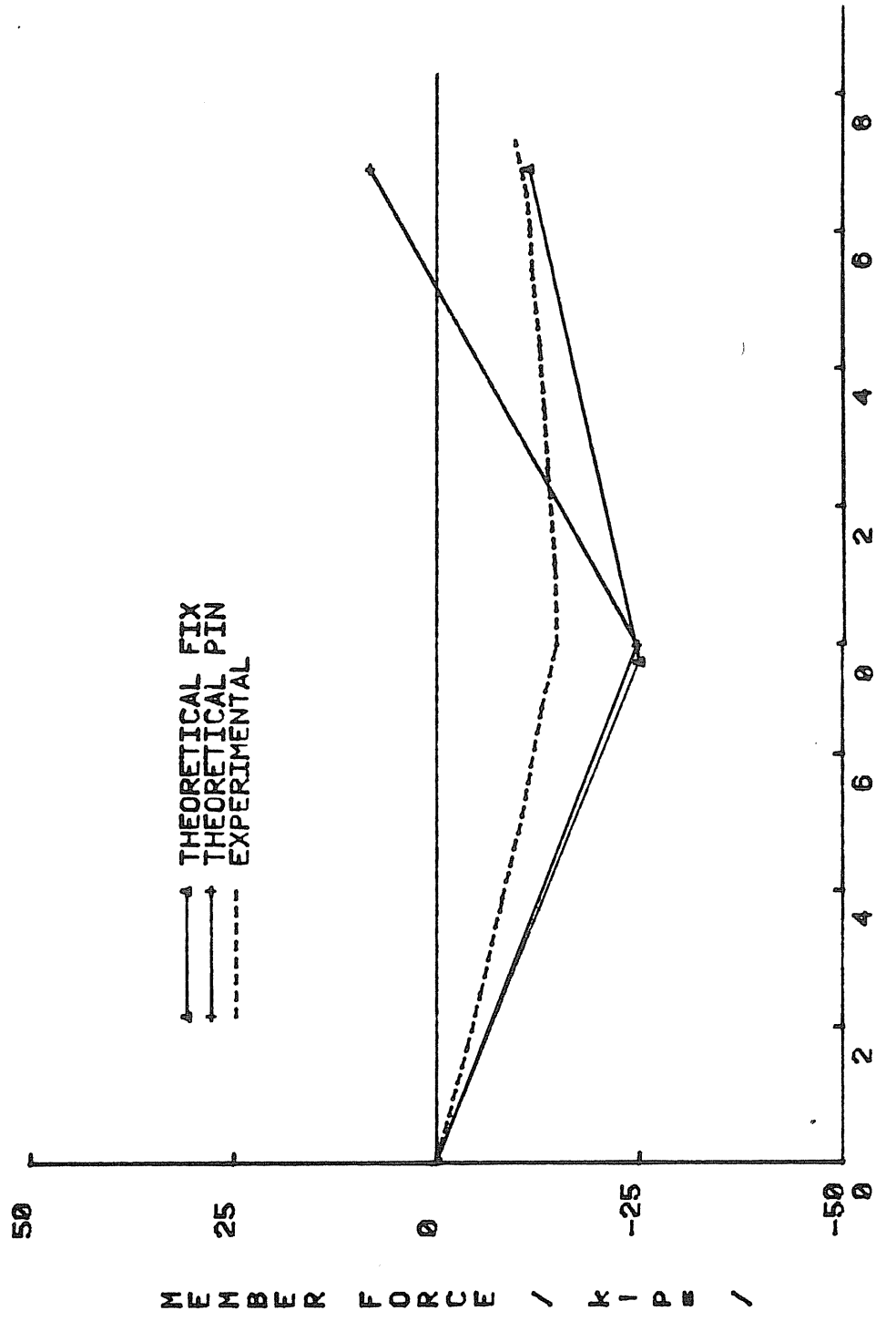


FIGURE F.12 MEMBER #24 FORCE VS. LOAD, ULL_L + WL

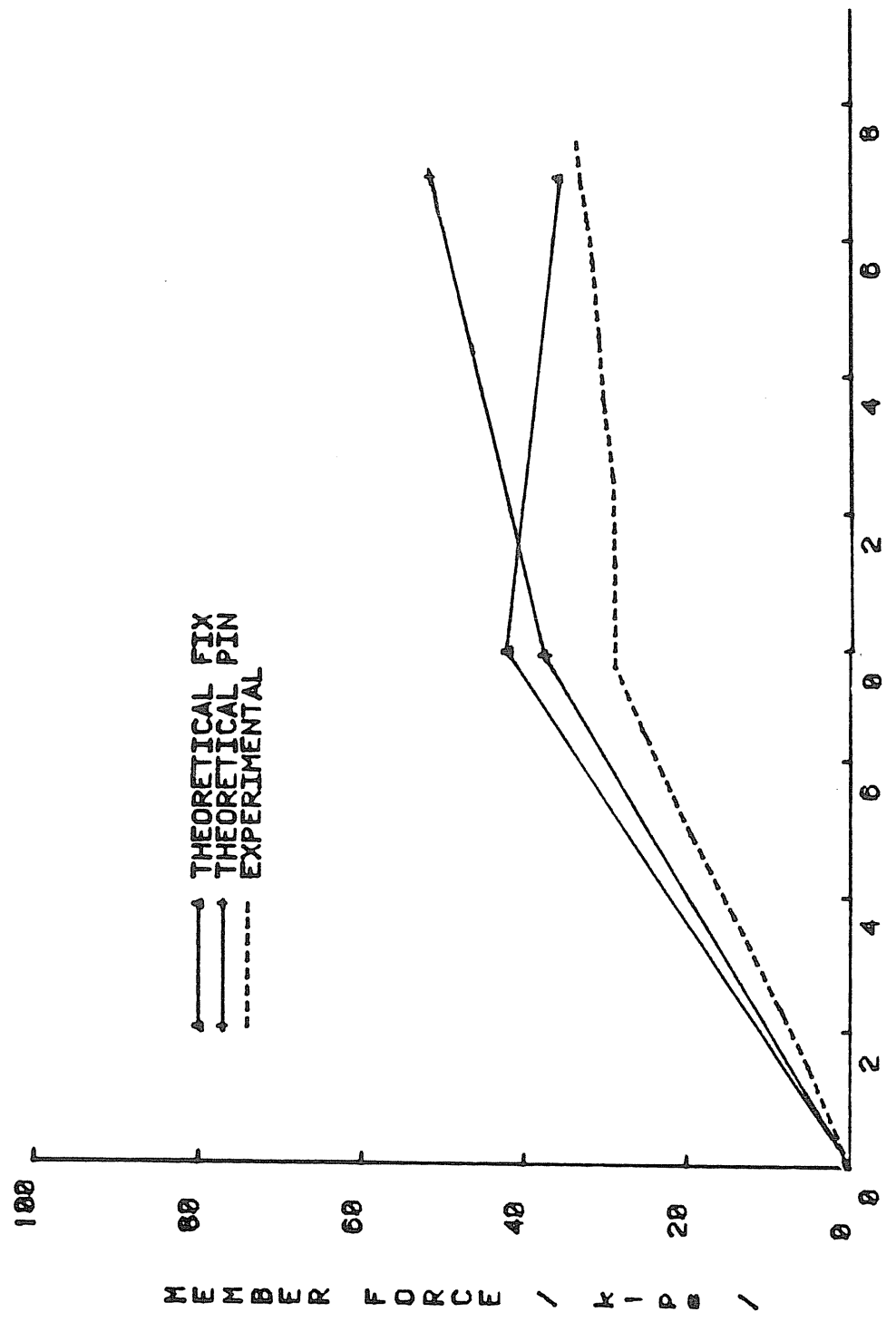


FIGURE F.13 MEMBER #33 FORCE VS. LOAD, $ULL_L + WL$

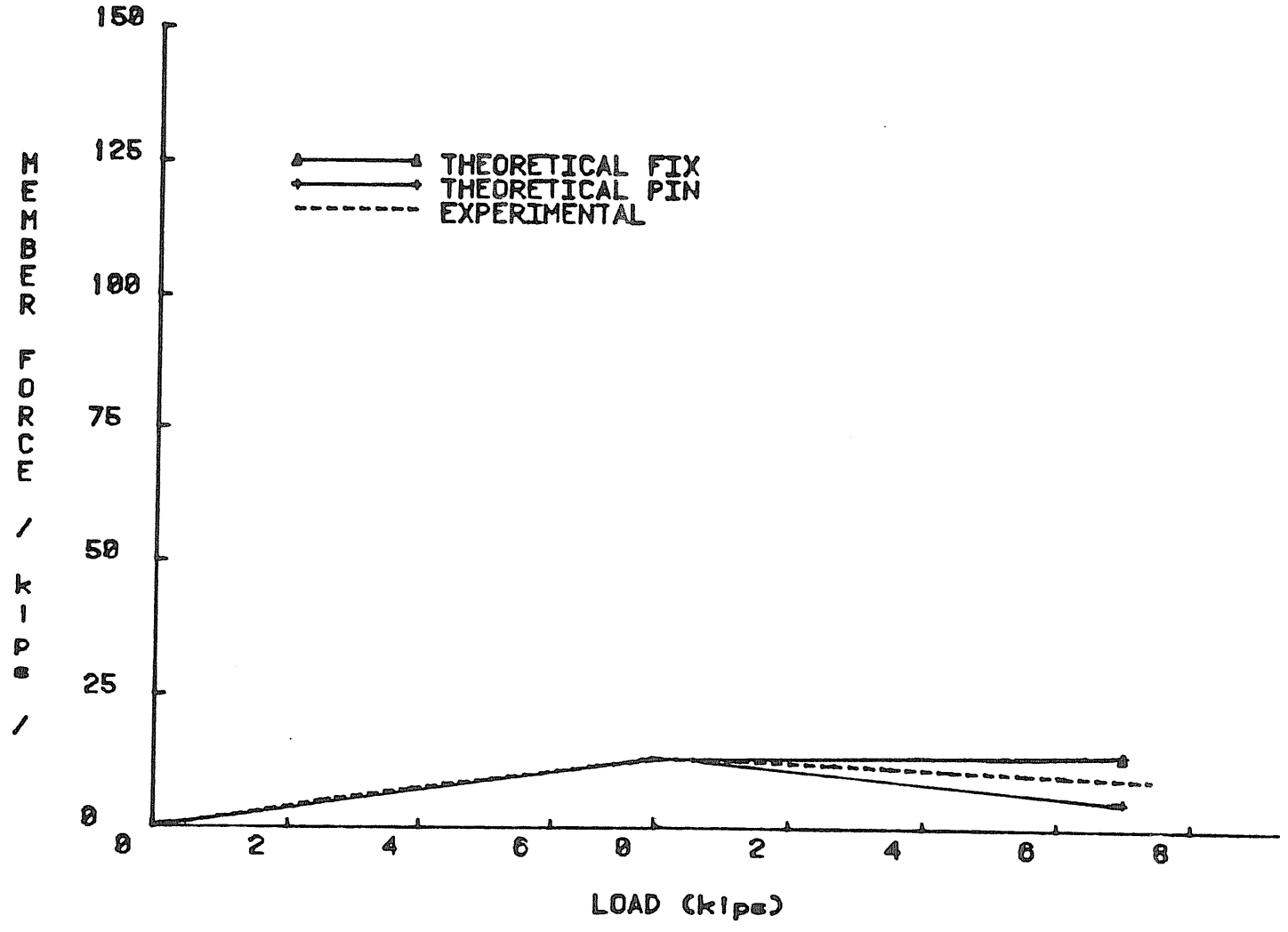


FIGURE F.14 MEMBER #48 FORCE VS. LOAD, ULL_L + WL

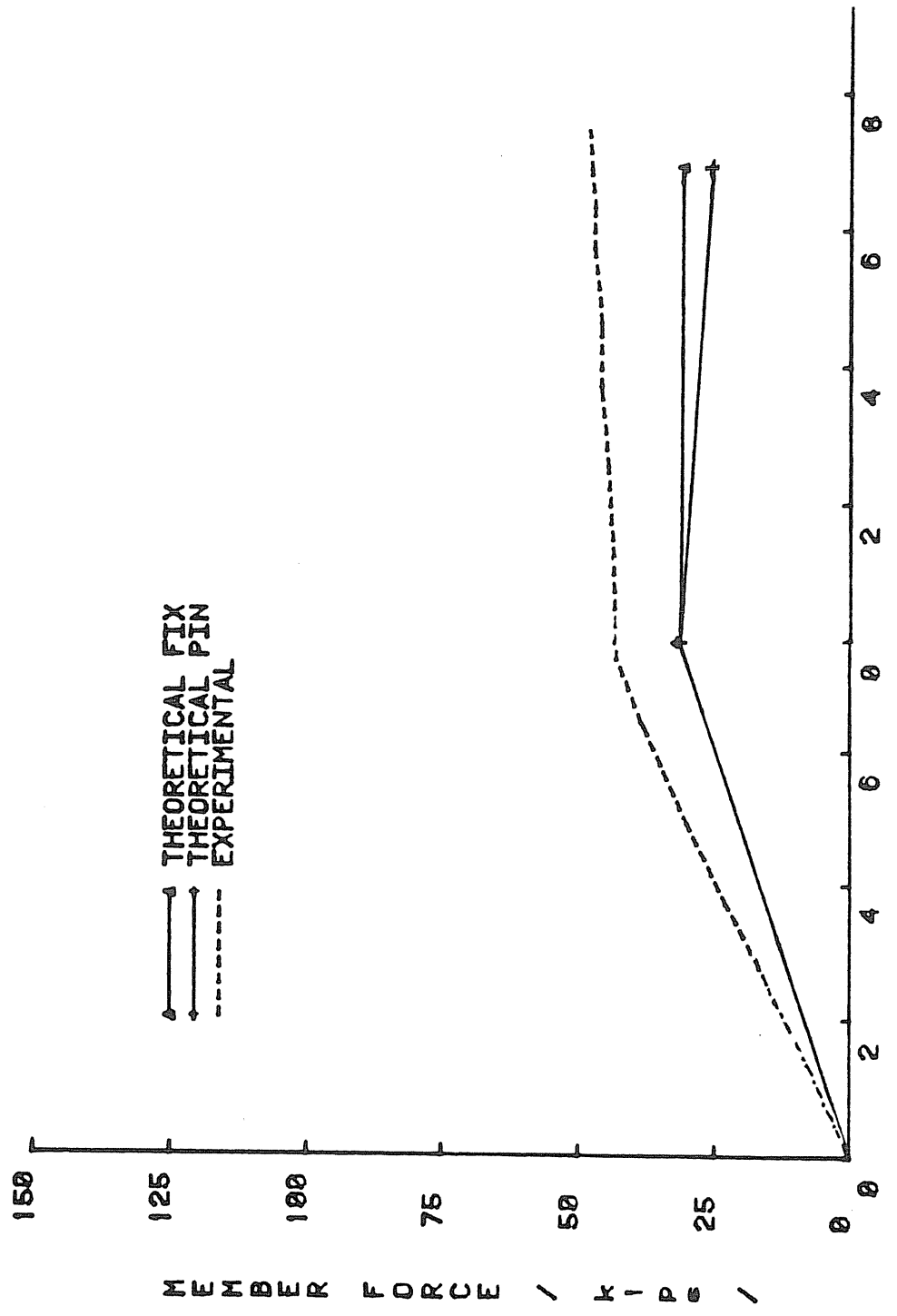


FIGURE F.15 MEMBER #60 FORCE VS. LOAD, $ULL_L + WL$

APPENDIX G

ULTIMATE FULL LIVE LOAD, EAST FRAME

(TEST $1.86LL_E$)

VULCRAFT FRAME TEST SUMMARY

Project: Vulcraft FR-2

Test No: Test 6

Test Date: 4 June 1985

Purpose: Failure of the east frame

Maximum Test Load: Live load = 14.11 kips which was 1.86 x working load

Failure Mode: Buckling of column web members

Discussion:

- The plot of the centerline deflection of the frame shows a softening which was due to yielding in the frame.
- The plot of the sidesway deflection of the frame shows a marked increase of sidesway at 12.5 kips applied load.
- At 7 kips, yielding at base plates near the column inside chords and yielding of column web members was observed.
- At 9 kips, yielding at all knee member joints was observed.
- At 12.5 kips, members 68 and 40 buckled at their respective column inside chords. No yielding had been observed prior to buckling. Yielding along member 49 was also observed.
- At 13.4 kips, members 66 and 70 buckled.
- At 14.0 kips, marked yielding was observed at the reentrant corner along the column.
- Maximum midspan deflection was 4.6 inches at 14.11 kips applied live load.

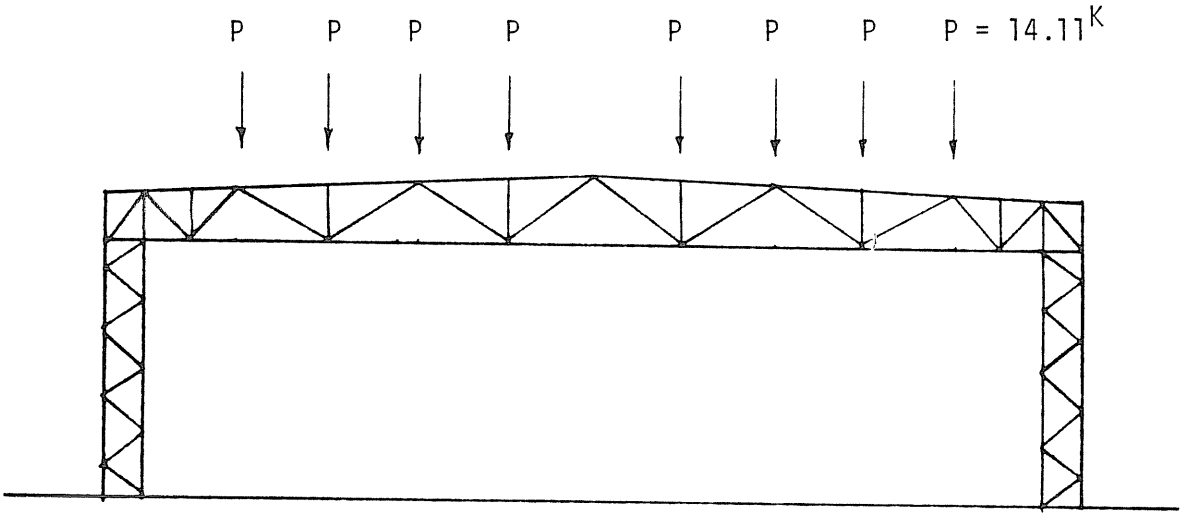


FIGURE G.1 EAST FRAME, FULL LIVE LOAD TO FAILURE

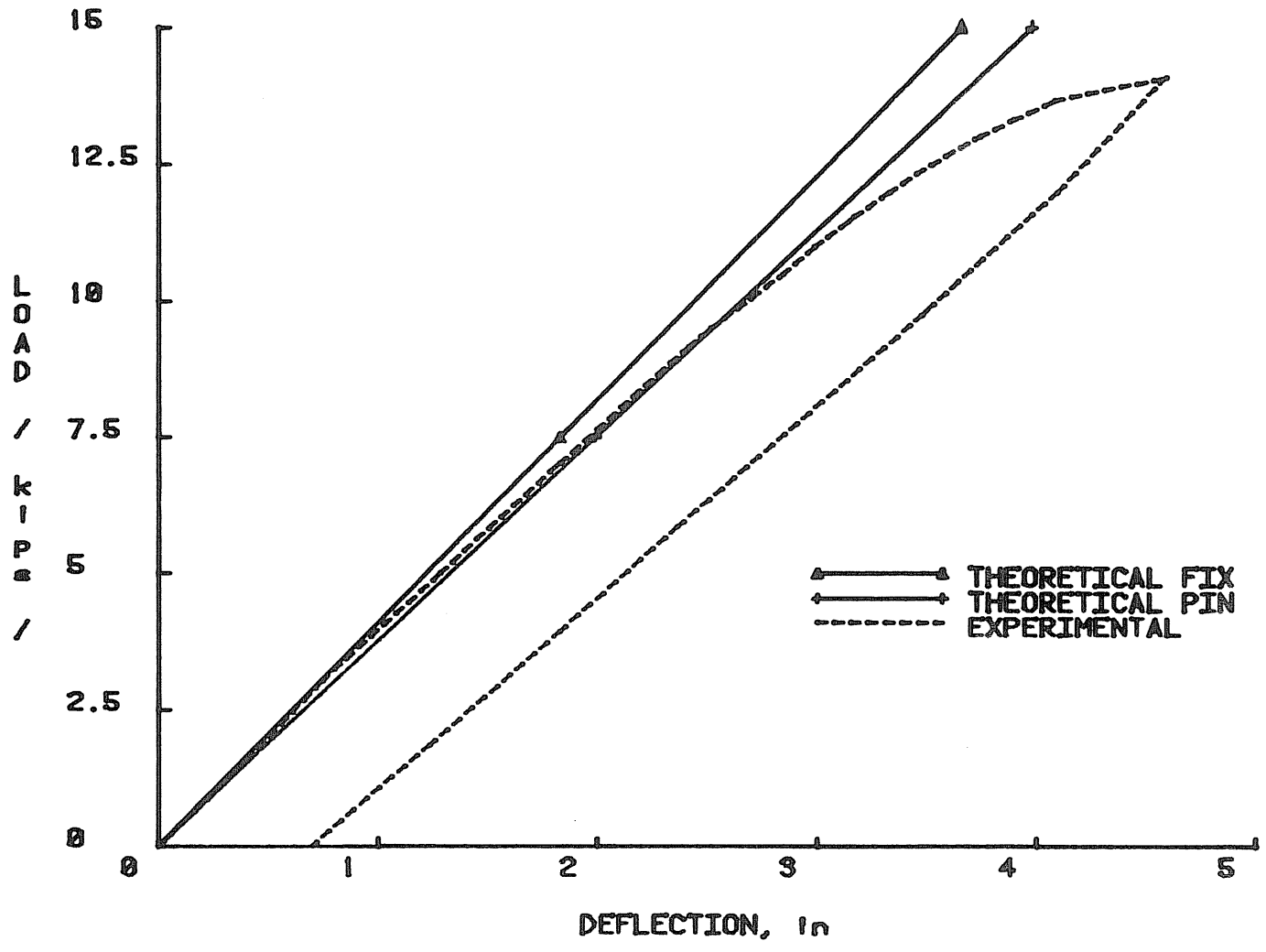


FIGURE G.2 LOAD VS. CENTERLINE DEFLECTION, $1.86LL_E$

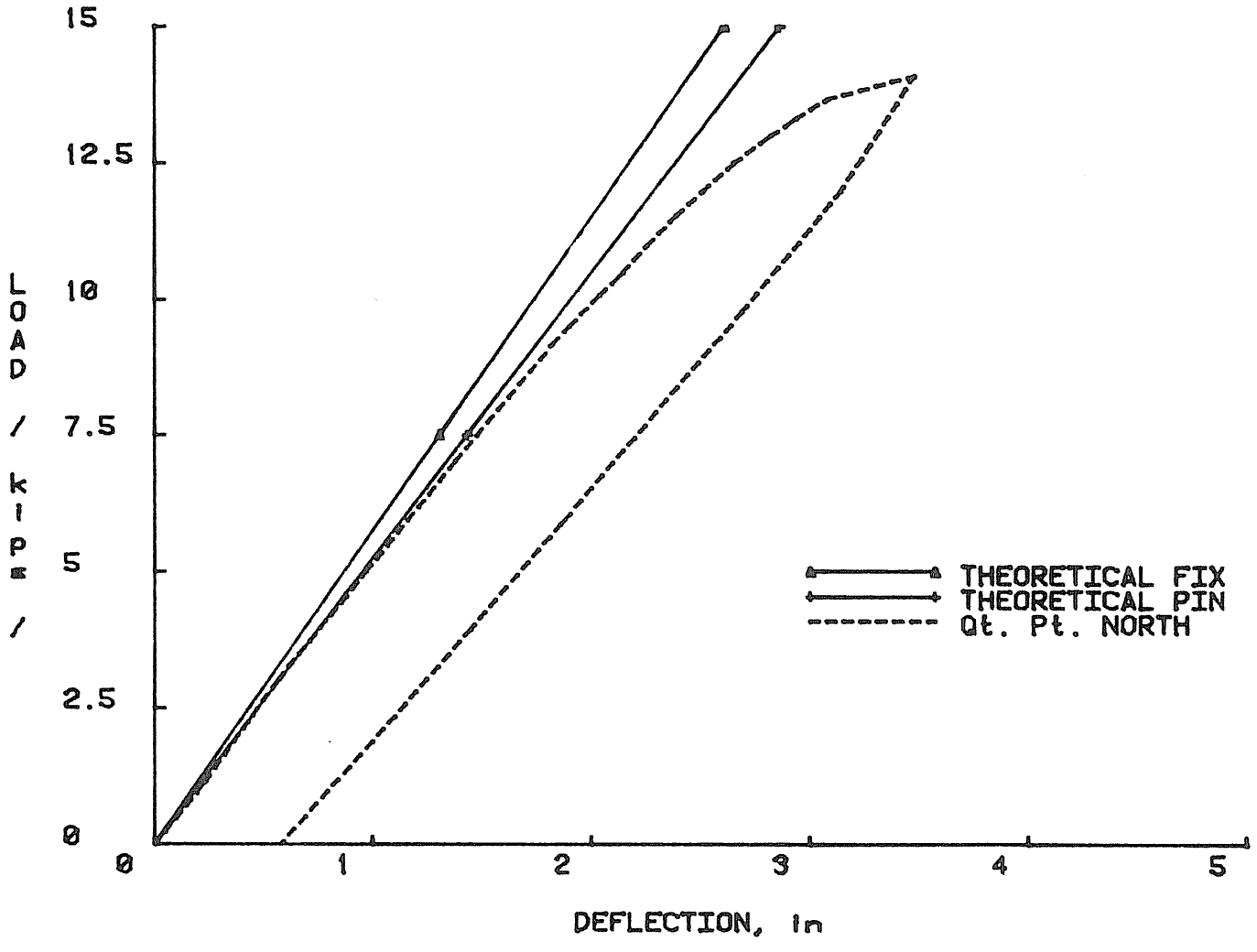


FIGURE G.3 LOAD VS. QUARTERPOINT DEFLECTION, $1.86LL_E$: NORTH

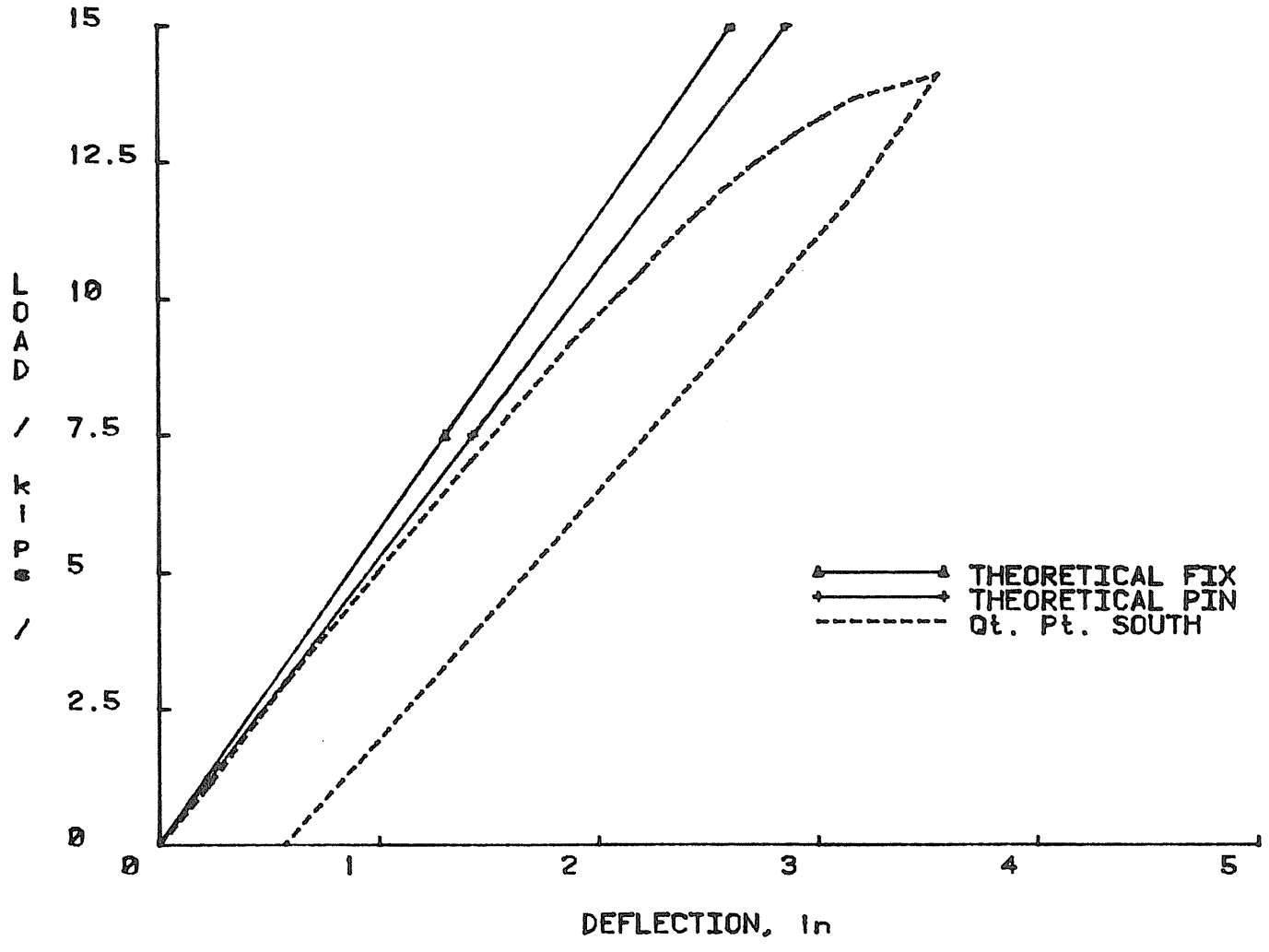


FIGURE G.4 LOAD VS. QUARTERPOINT DEFLECTION, $1.86LL_E$: SOUTH

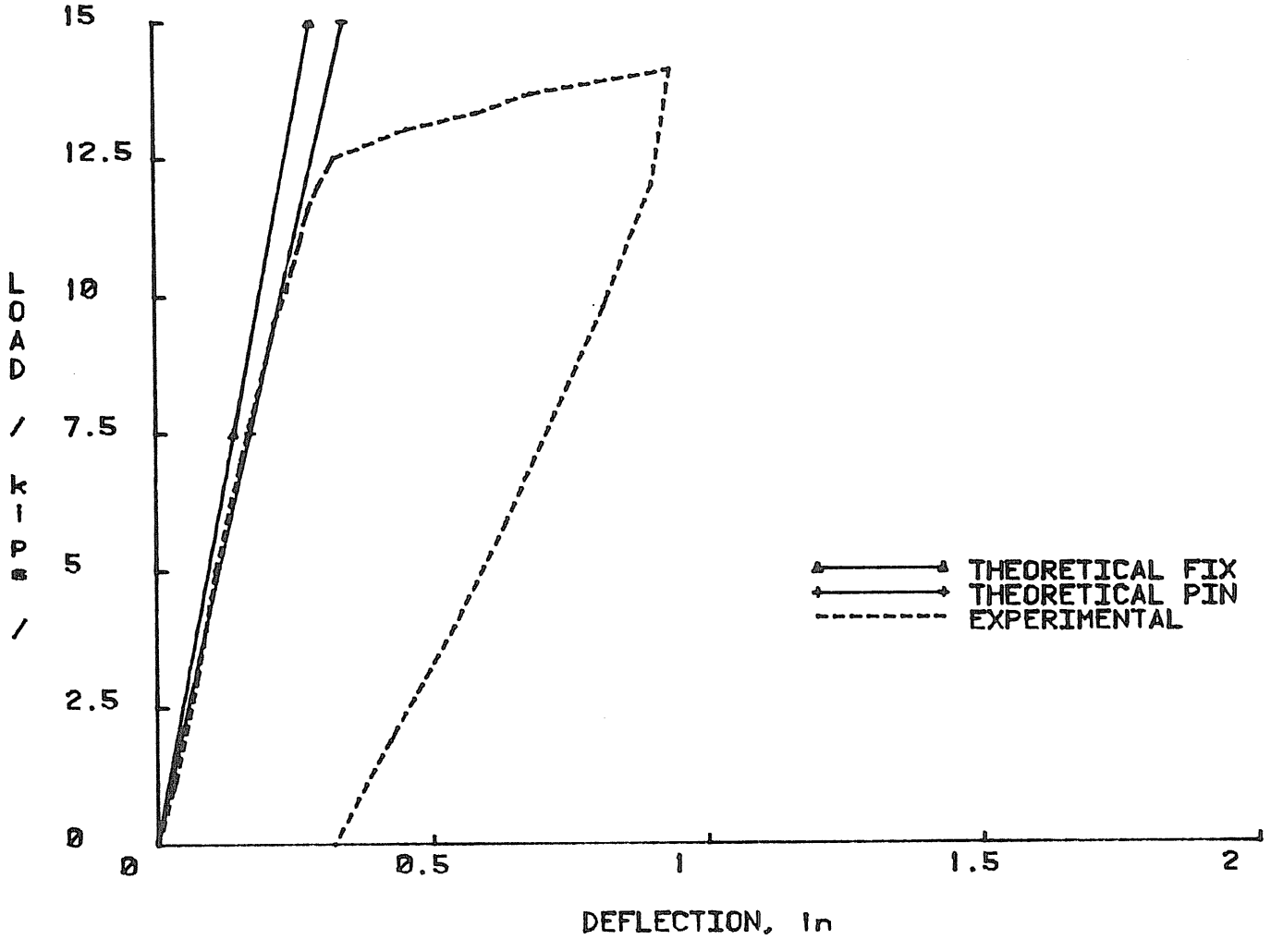


FIGURE G.5 LOAD VS. SIDESWAY, $1.86LL_E$

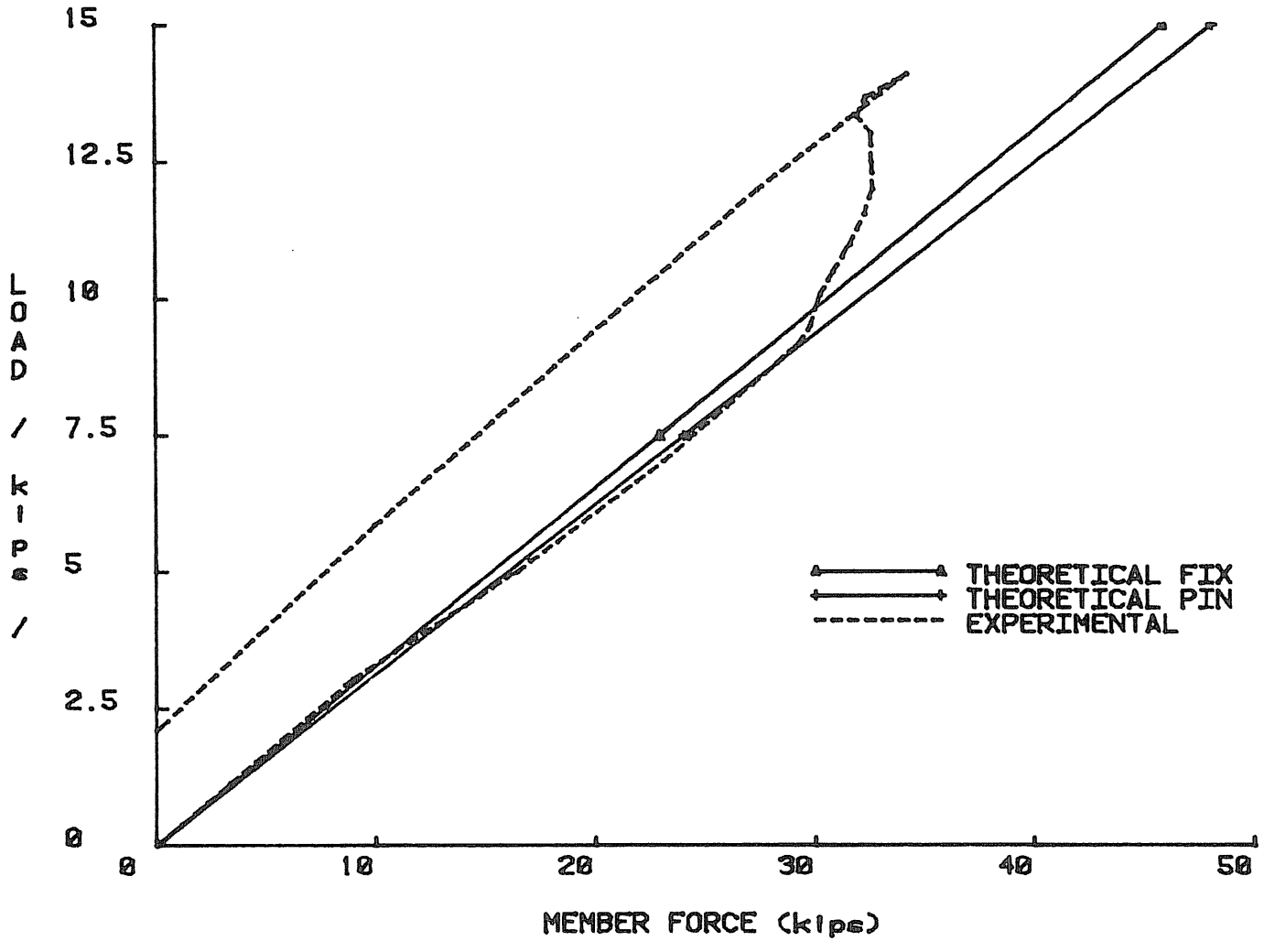


FIGURE G.6 LOAD VS. MEMBER #4 FORCE, $1.86LL_E$

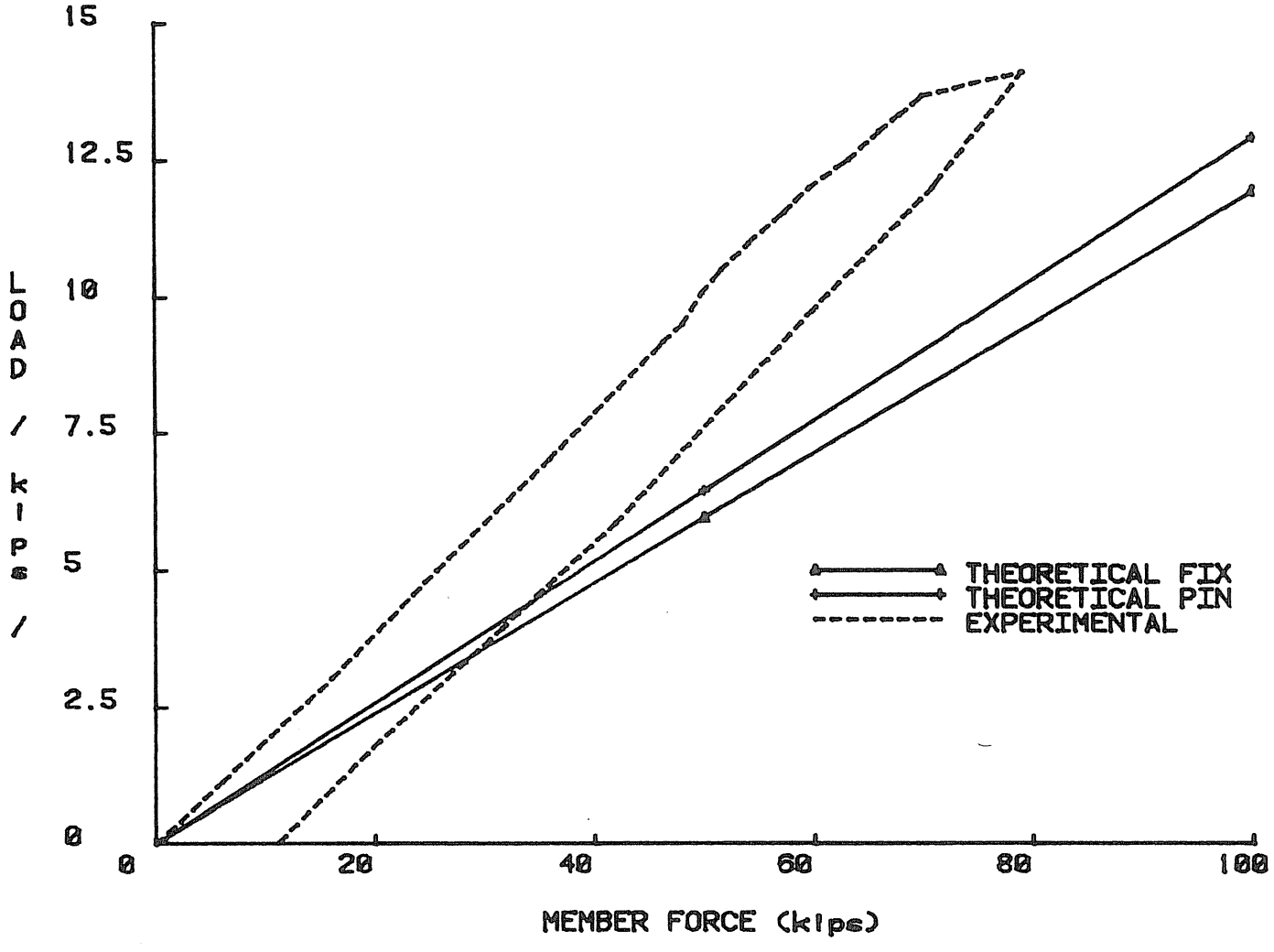


FIGURE G.7 LOAD VS. MEMBER #24 FORCE, $1.86LL_E$

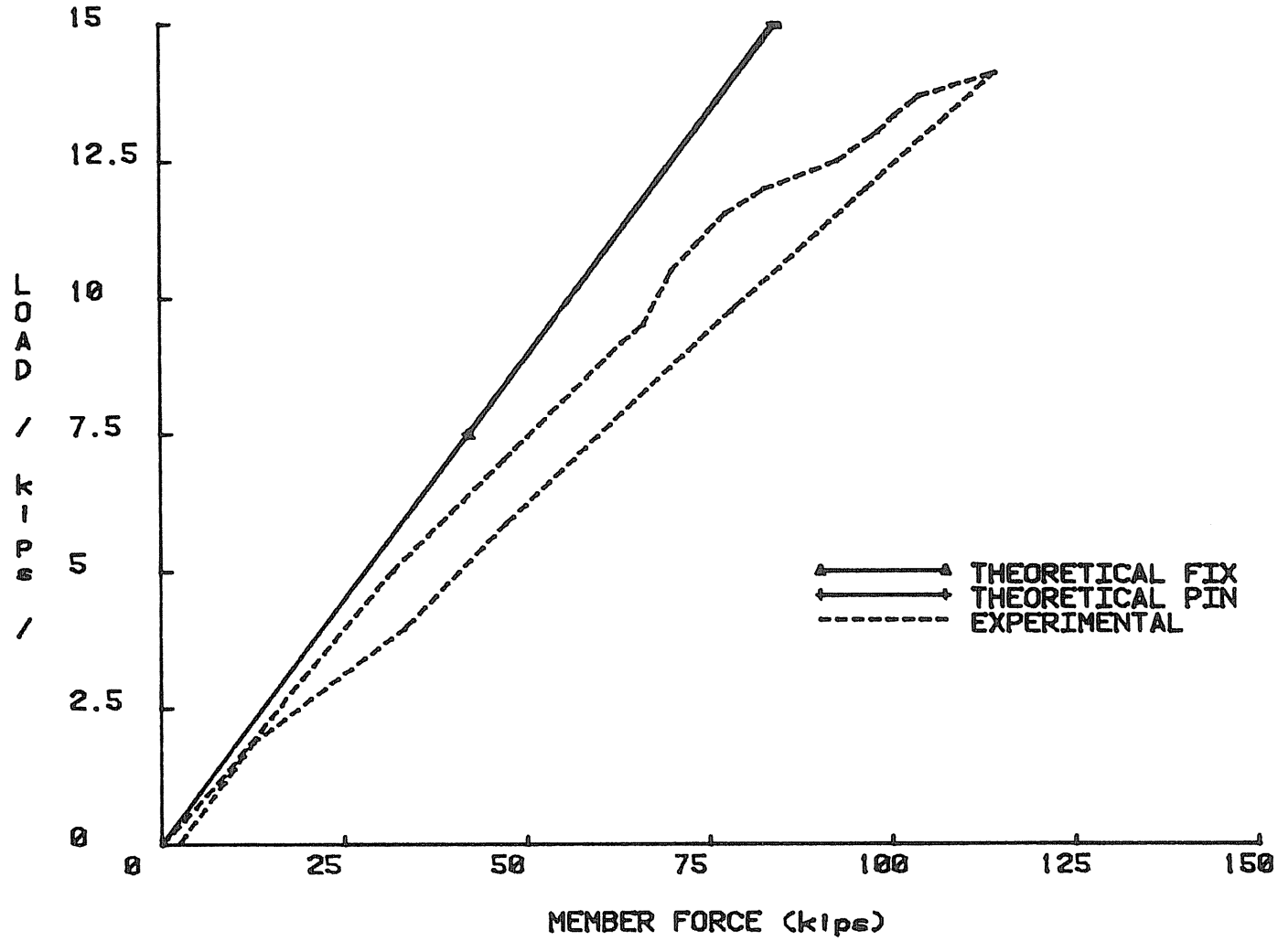


FIGURE G.8 LOAD VS. MEMBER #48 FORCE, $1.86LL_E$

APPENDIX H

ULTIMATE FULL LIVE LOAD, WEST FRAME

(TEST $1.64LL_W$)

VULCRAFT FRAME TEST SUMMARY

Project: Vulcraft FR-2

Test No: Test 7

Test Date: 6 June 1985

Purpose: Failure of west frame

Maximum Test Load: Applied Load = 12.5 kips

Failure Mode: Weld fracture and subsequent buckling of rafter vertical along degree of freedom number NP42.

Discussion:

- The members of the west frame which corresponded to the buckled members of the east frame were increased in size to prevent buckling.
- The centerline deflection of the frame agreed with the theoretical up to the failure of the vertical member.
- At 5.0 kips, marked yielding was observed under the clip angle at the north reentrant corner. Some yielding occurred at the base plate near the column inside chord.
- At 7.0 kips, yielding was observed where the column compression web members joined the column compression chord.
- At 8.0 kips, yielding at most knee member joints was observed.
- At 9.0 kips, marked yielding occurred at the lower column compression flange brace points.
- At 12.5 kips, the vertical member at NP42 buckled and the test was stopped.
- Maximum deflection was 3.33 inches at 12.0 kips applied live load. This load and deflection point was the last recorded before failure of the frame.

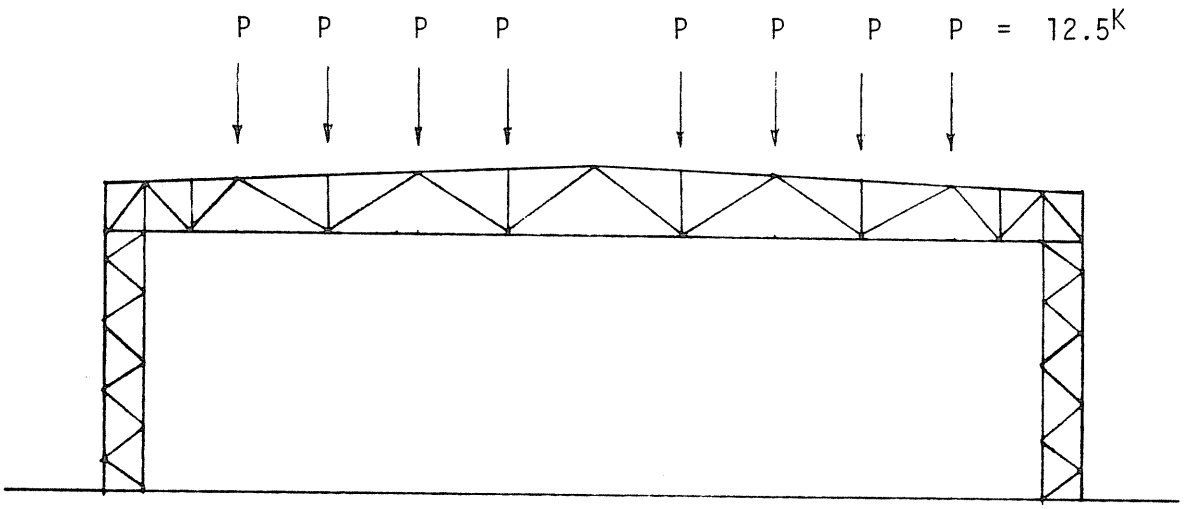


FIGURE H.1 WEST FRAME, FULL LIVE LOAD TO FAILURE

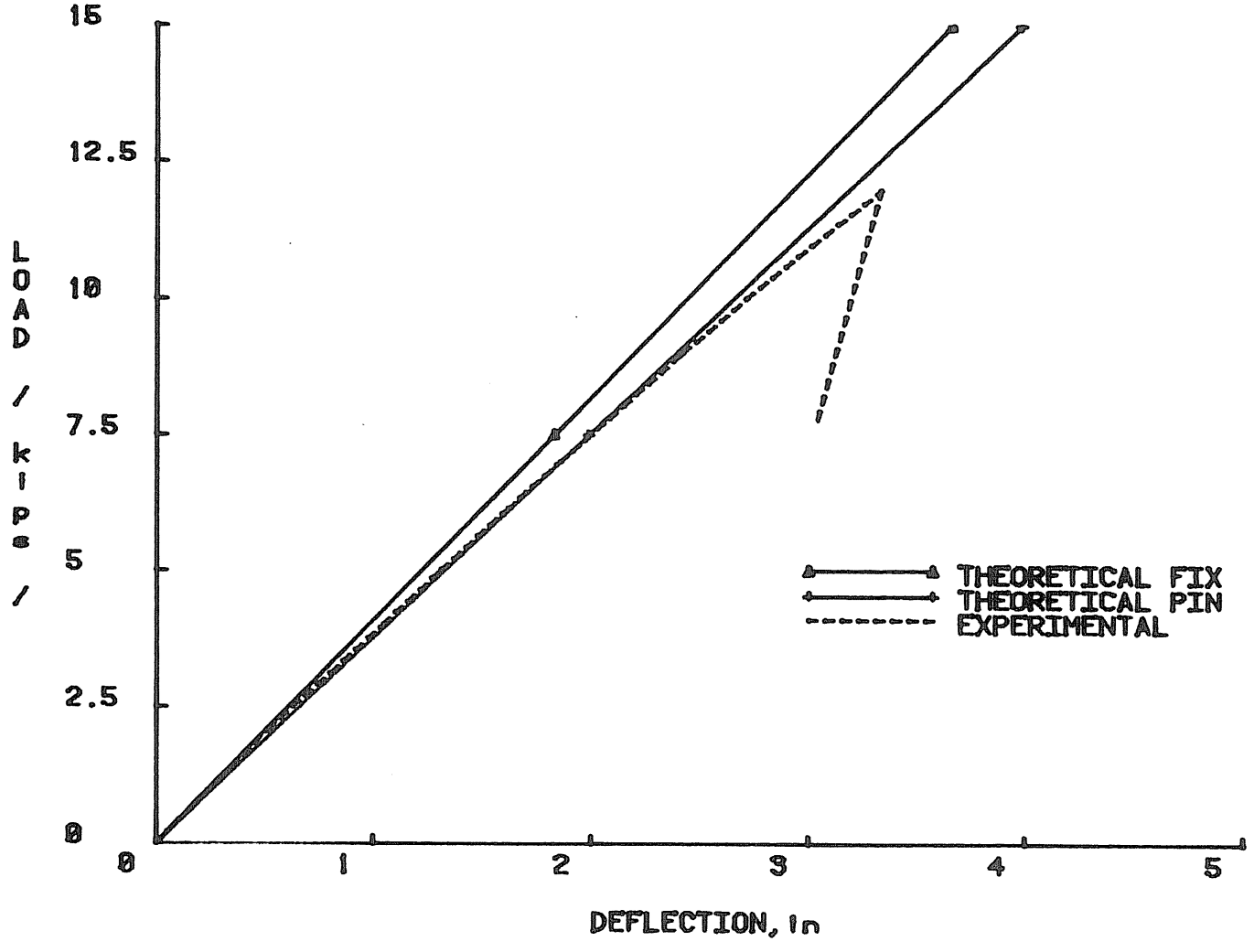


FIGURE H.2 LOAD VS. CENTERLINE DEFLECTION, $1.64LL_W$

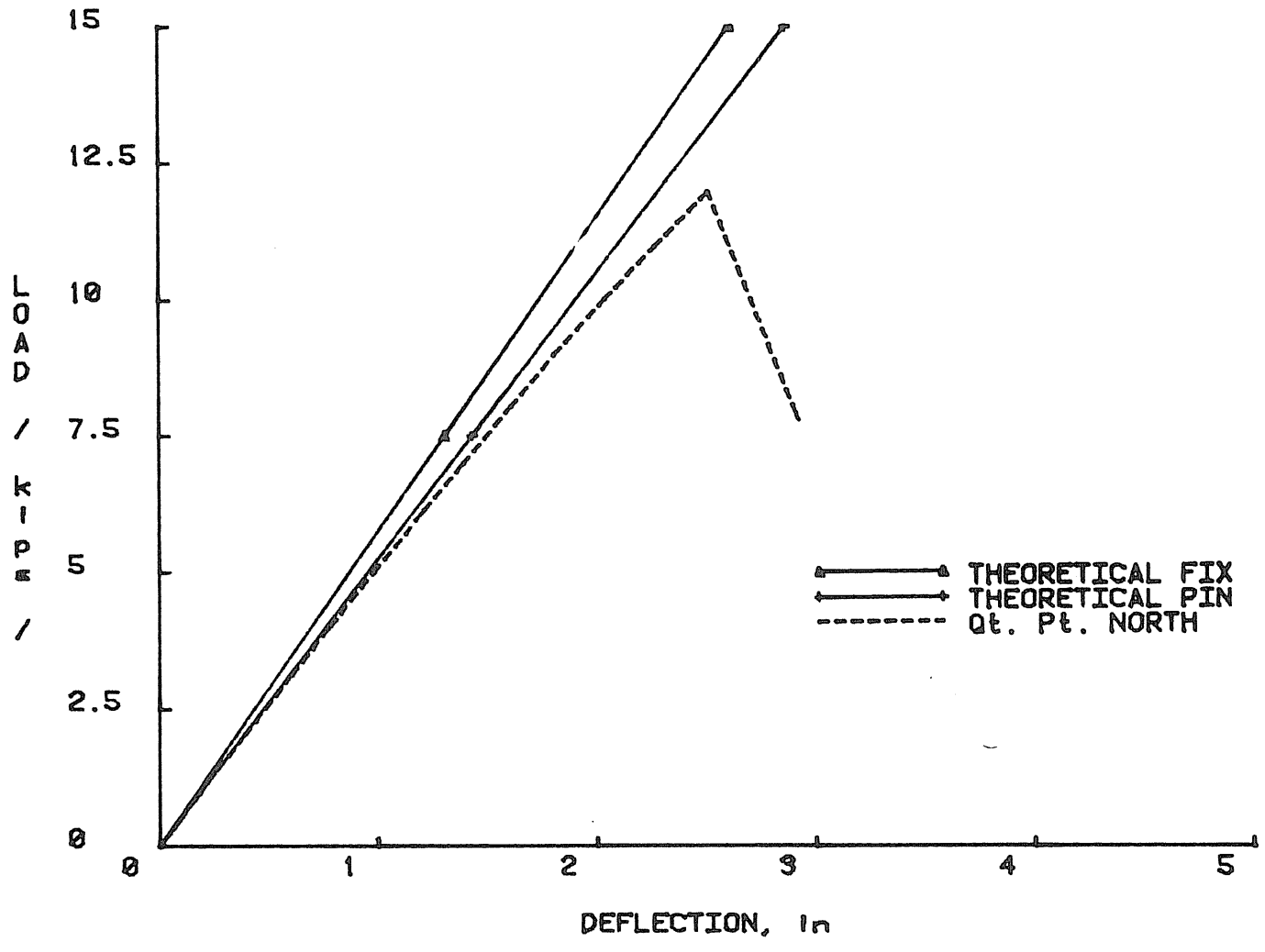


FIGURE H.3 LOAD VS. QUARTERPOINT DEFLECTION, $1.64LL_W$: NORTH

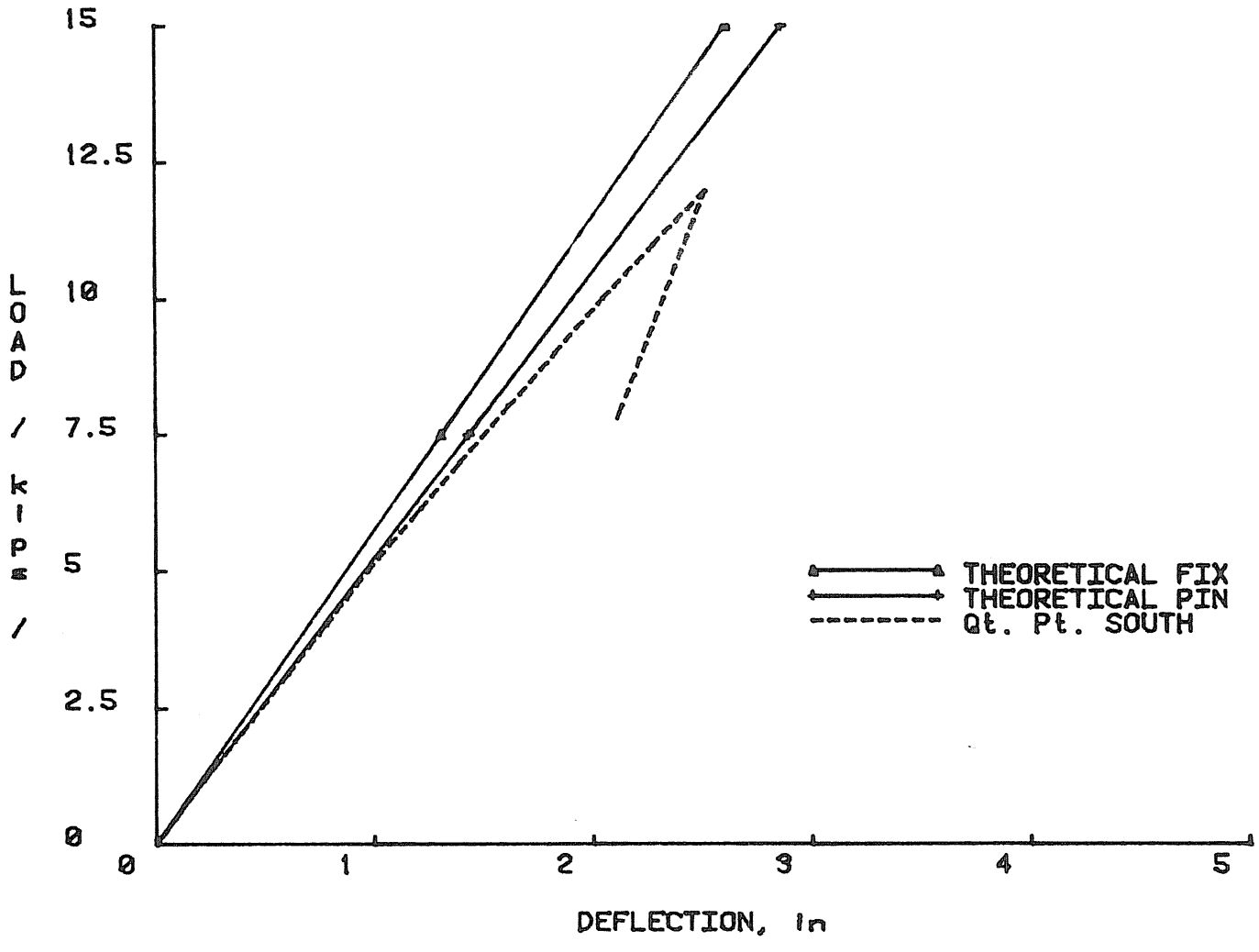


FIGURE H.4 LOAD VS. QUARTERPOINT DEFLECTION, $1.64LL_W$: SOUTH

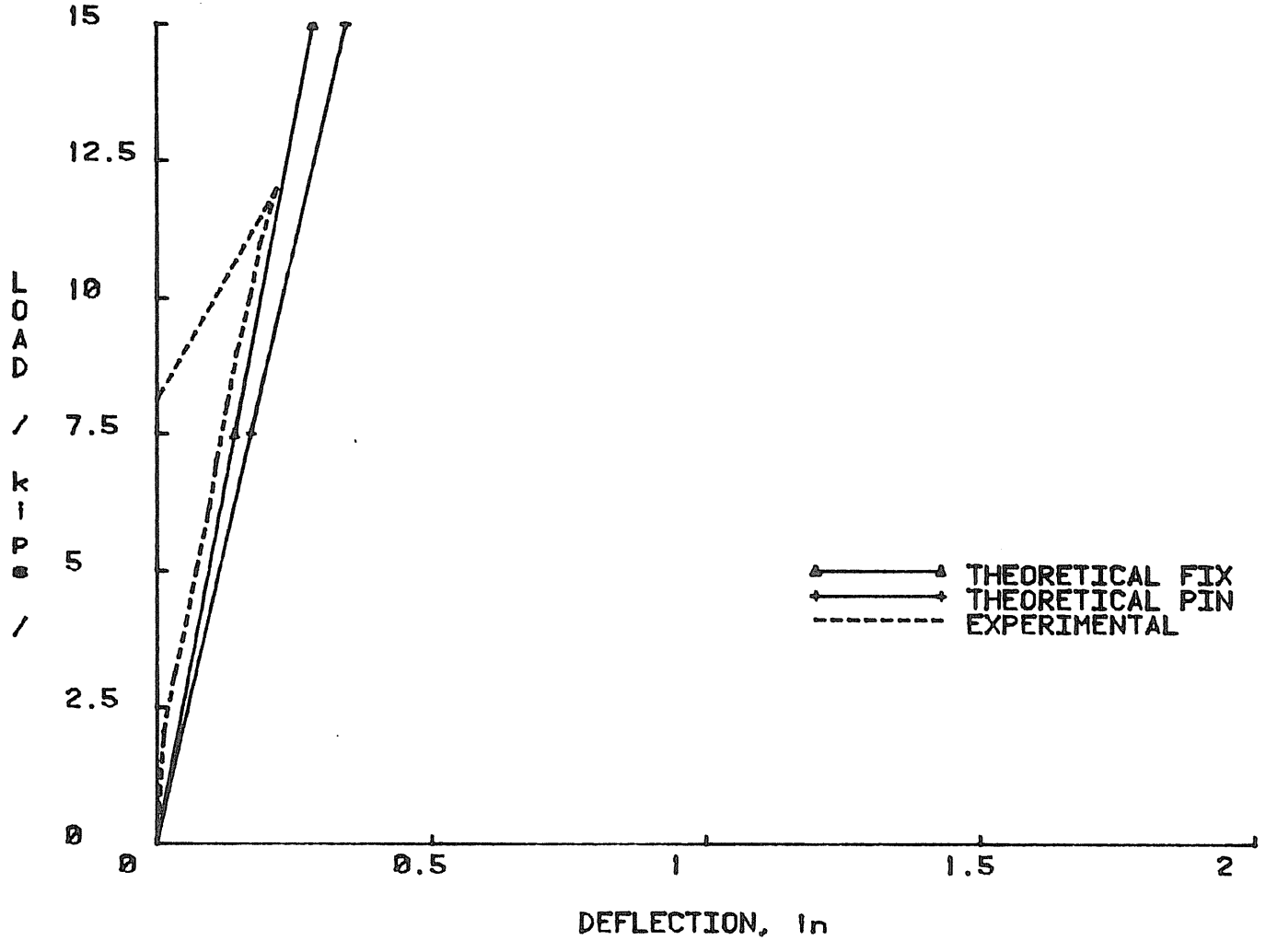


FIGURE H.5 LOAD VS. SIDESWAY, $1.64LL_W$

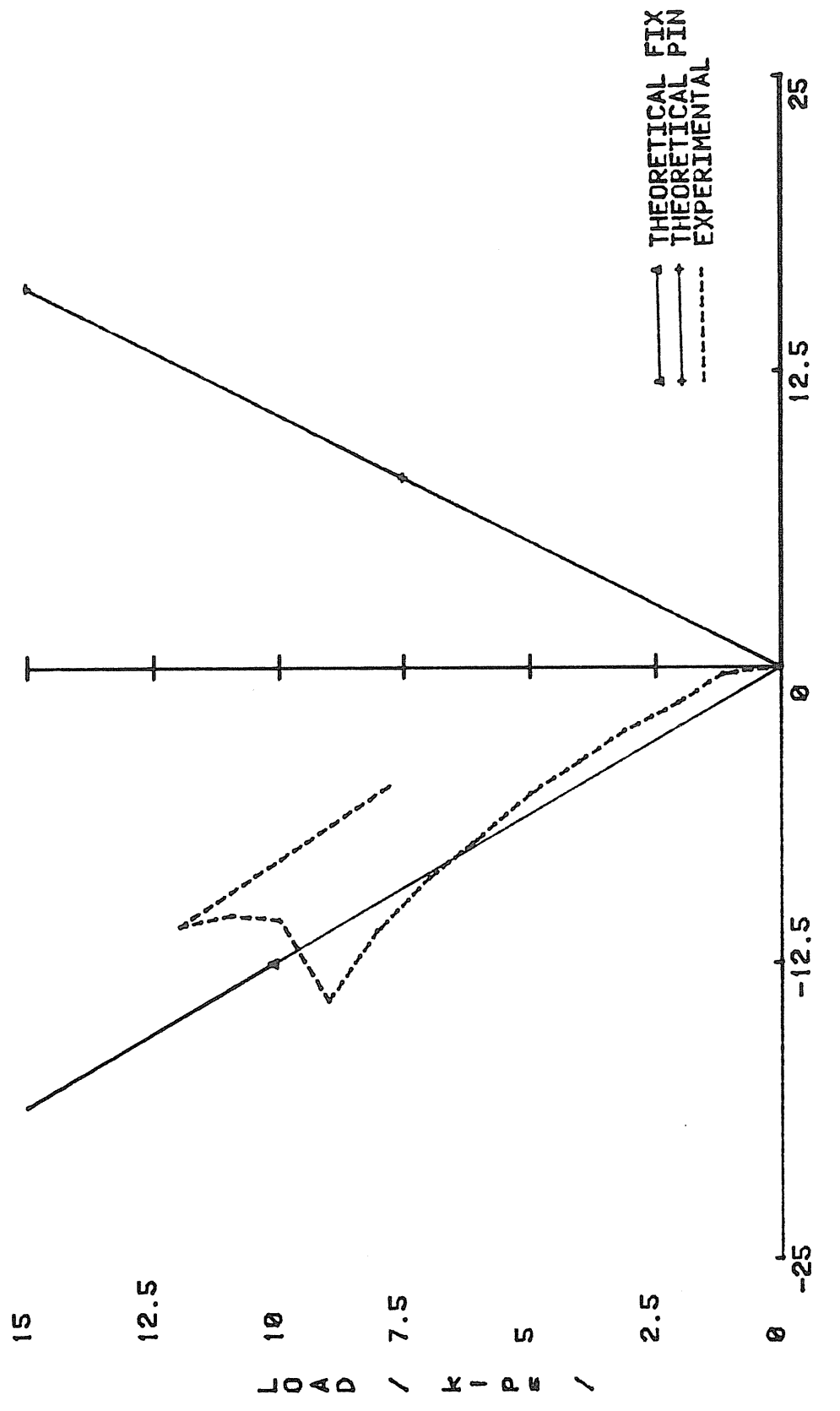


FIGURE H.6 LOAD VS. MEMBER #2 FORCE, $1.64LL_W$

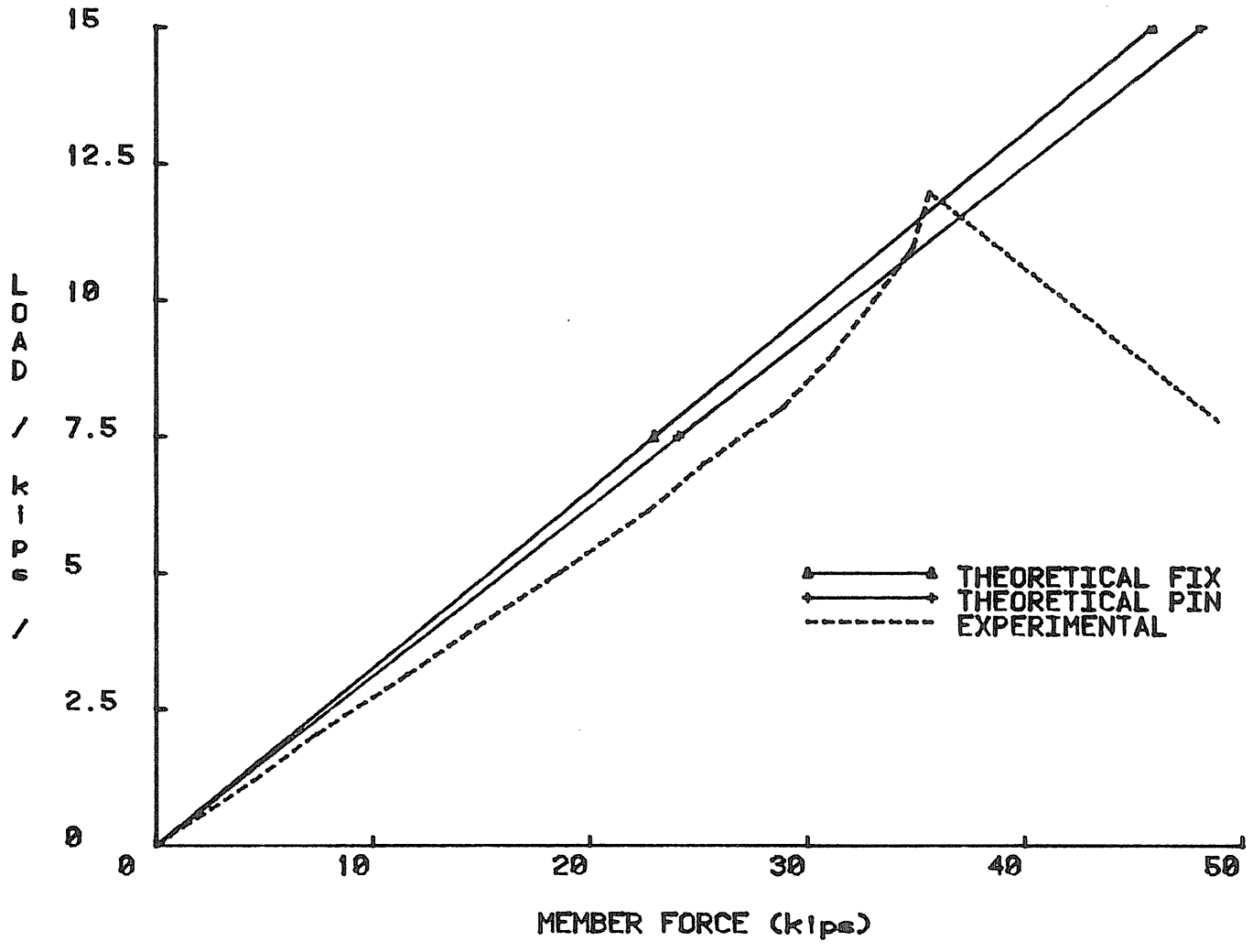


FIGURE H.7 LOAD VS. MEMBER #17 FORCE, $1.64LL_W$

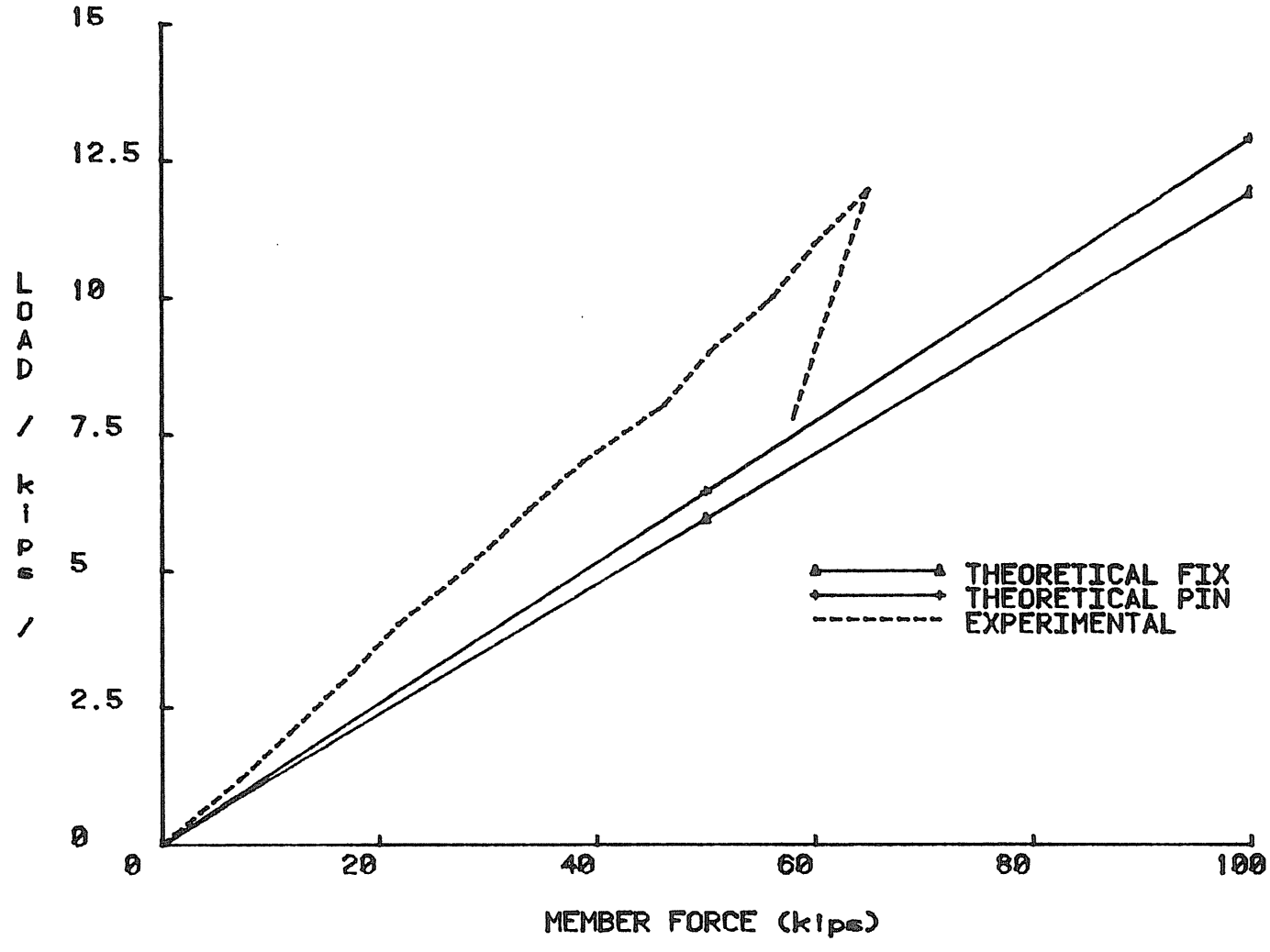


FIGURE H.8 LOAD VS. MEMBER #33 FORCE, $1.64LL_W$

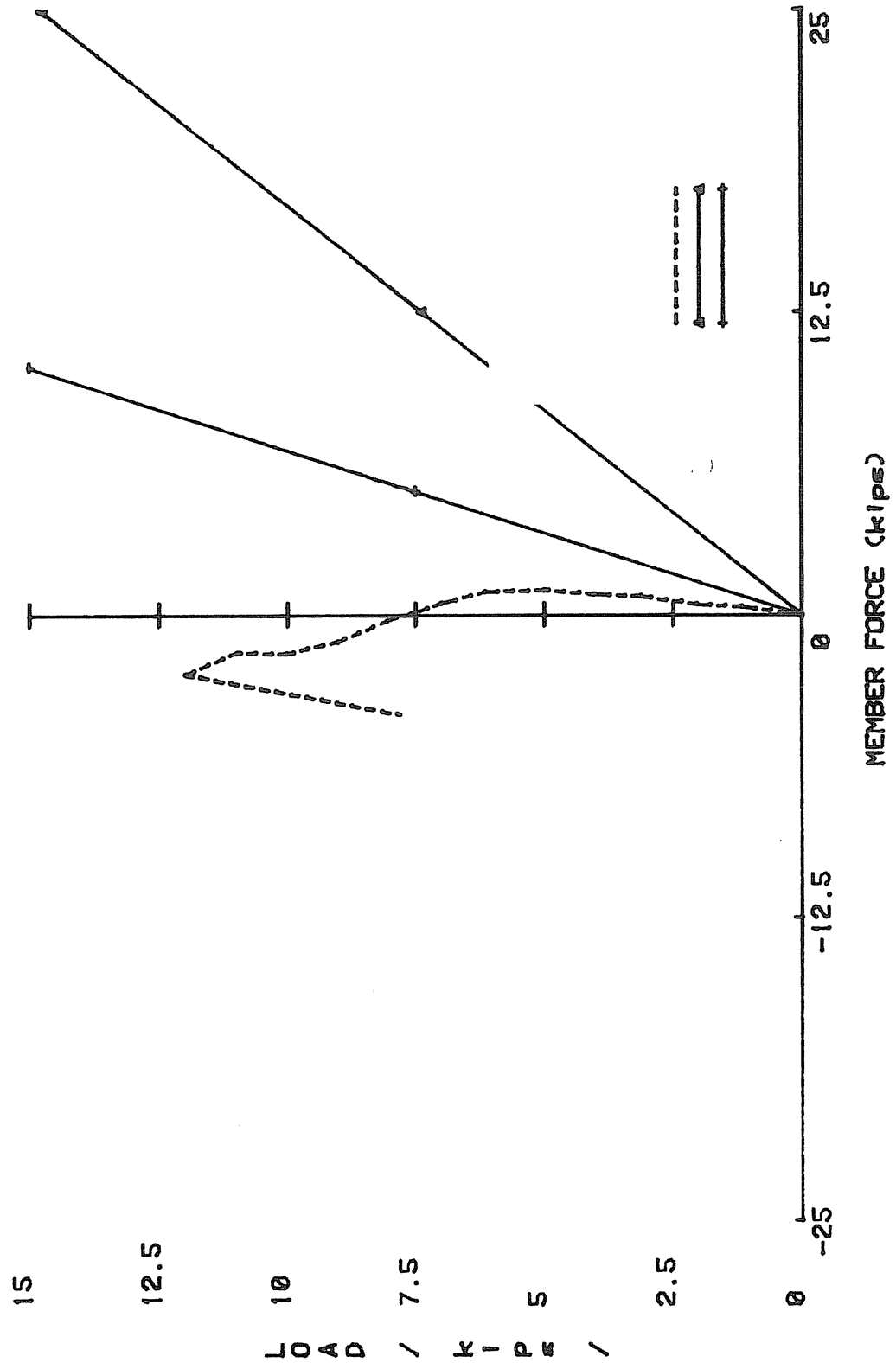


FIGURE H.9 LOAD VS. MEMBER #39 FORCE, $1.64LL_W$

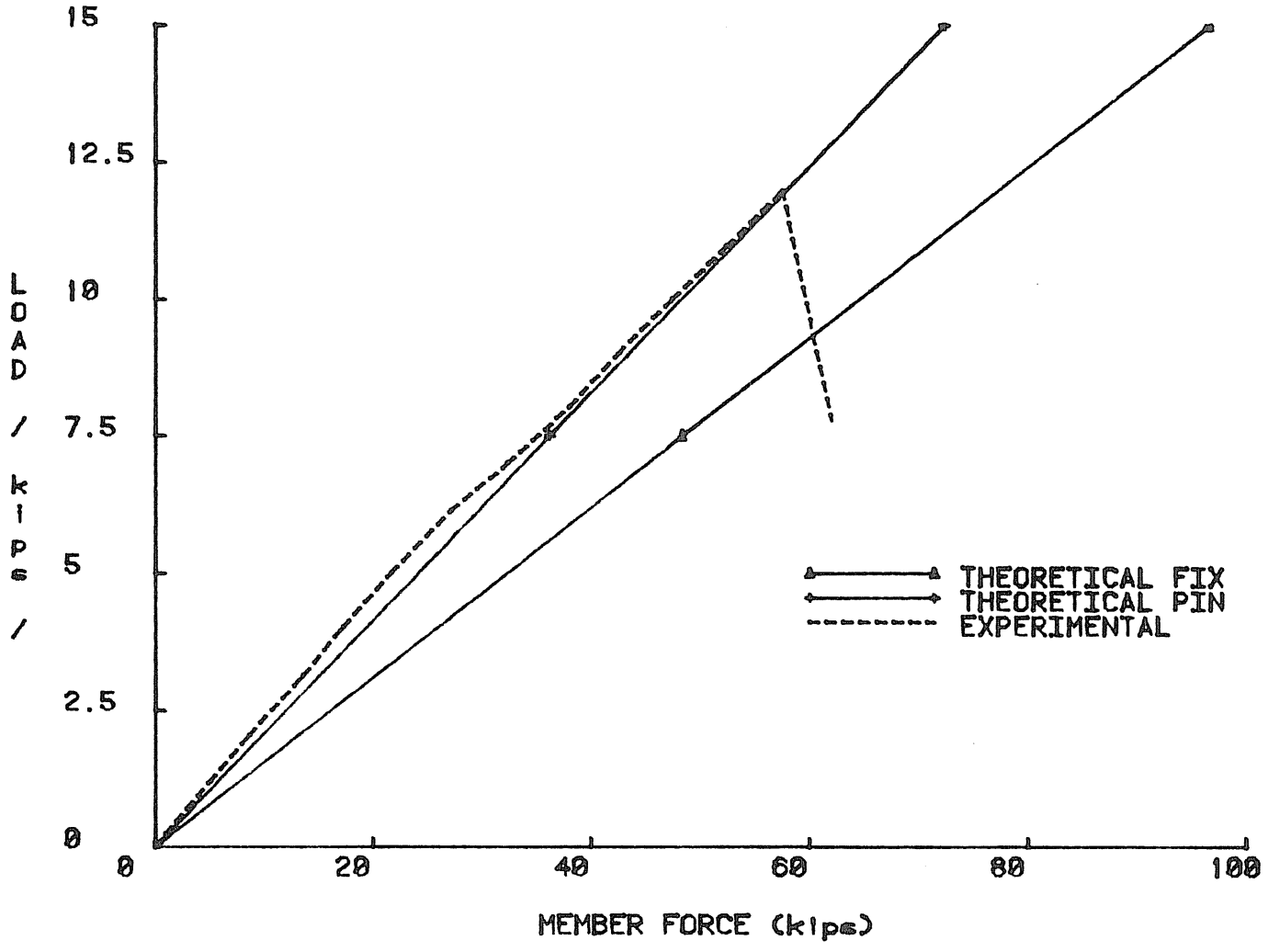


FIGURE H.10 LOAD VS. MEMBER #46 FORCE, $1.64LL_W$

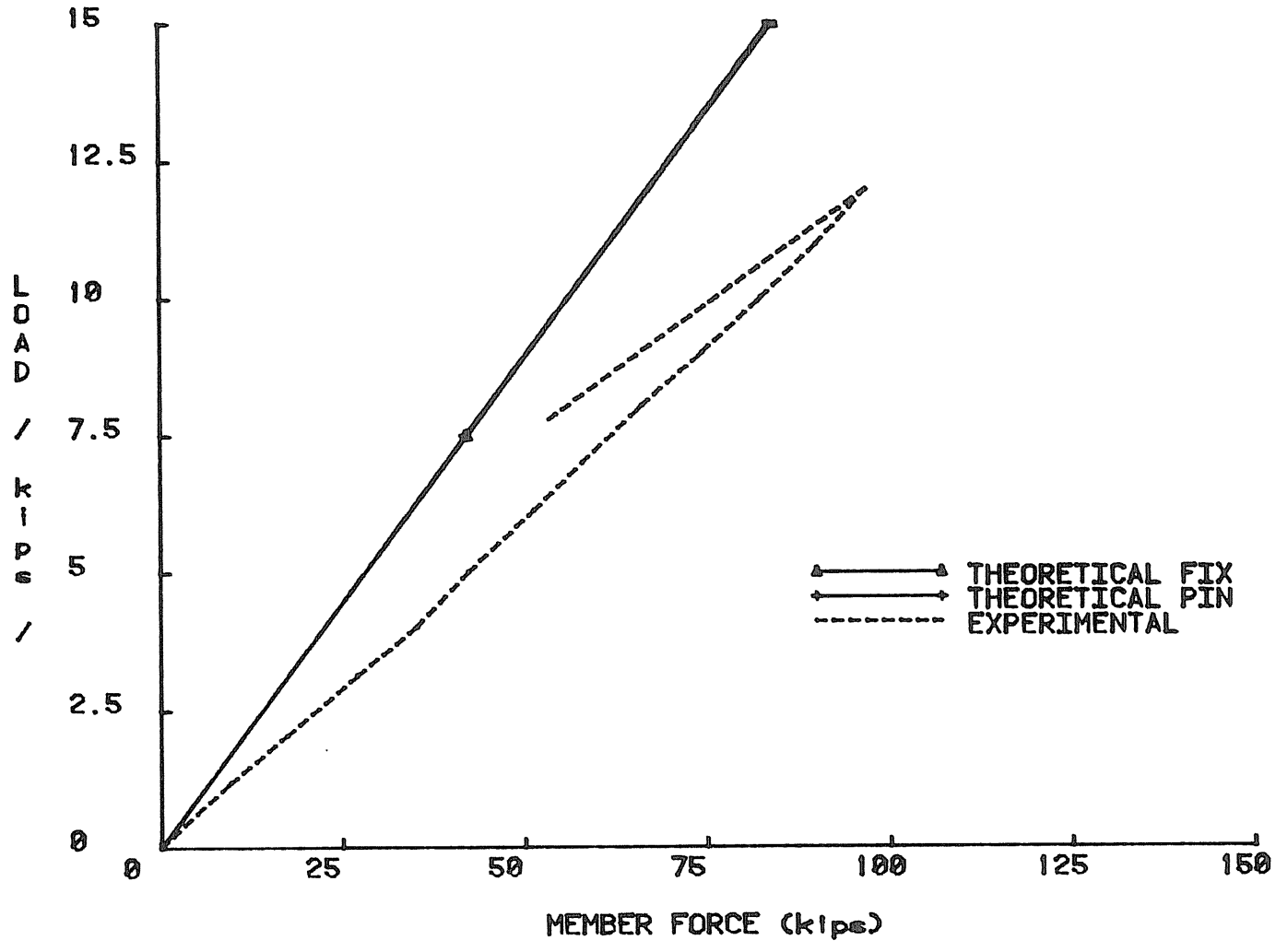


FIGURE H.11 LOAD VS. MEMBER #60 FORCE, $1.64LL_W$