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

ADDITIONAL FR2 FRAME TESTS

by

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ADDITIONAL TESTS--FR2

Upon completion of all loading tests described in Volume II of this report, three additional tests were performed on the east frame of the FR-2 setup. The tests, designated as PBP1, PBP2 and PBP3, were performed to determine the effects on frame behavior of a pinned (no moment restraint) column base plate connection. For Test PBP1, the anchor bolts were first loosened and then retightened to a "finger tight" condition. In addition, for Test PBP2 the 1 in. thick spacer plate at each column base was torch cut in the vertical plane with an approximately 3/4 in. gap left between the two pieces. And, in addition, for Test PBP3, an approximately 2 in. long segment of the outside chord of each column was removed by torch cutting.

Each test consisted of observing the behavior of the frame under incrementally applied full live load. The working live loading for the original frame is 7.6 kips applied at eight points, four on each roof slope. The maximum load applied at each application point was 13.2 kips in Tests PBP1 and PBP2 and 14.9 kips in Test PBP3. (The maximum applied to the frame during the original testing program was 14.1 kips per application point.)

Additional instrumentation over that described in Chapter II, Volume II of this report was used. In Tests

PBP1 and PBP2, dial gages were mounted at the north column base to measure base plate rotation. In Test PBP3, dial gages were used to measure the change in opening at the location of the removed chord section.

Test results, location of the torch cuts and location of the additional instrumentation are found in Appendices A, B and C of this report. Each Appendix consists of a test summary sheet, instrumentation location drawing, and plots of load versus centerline deflection, quarterpoint deflections, base plate rotation or column chord separation, and various member forces. Figure 1 shows the location of all members.

In general, the results of the three tests show that the frame centerline deflections were close to the pinned column base prediction and the quarterpoint deflections were slightly more than predicted. The column base plate rotation increased considerably when the 1 in. spacer plates at the column bases were cut, as shown in Figure 2. With the exception of the force in member #48, the member forces were less than predicted. In all three tests, the force in member #48 was greater than predicted.

Test PBP3 was conducted to failure. Failure was due to yielding of the rafter bottom chord resulting in a plateau in the load versus centerline and quarterpoint deflection plots, Figures C.2 to C.4.

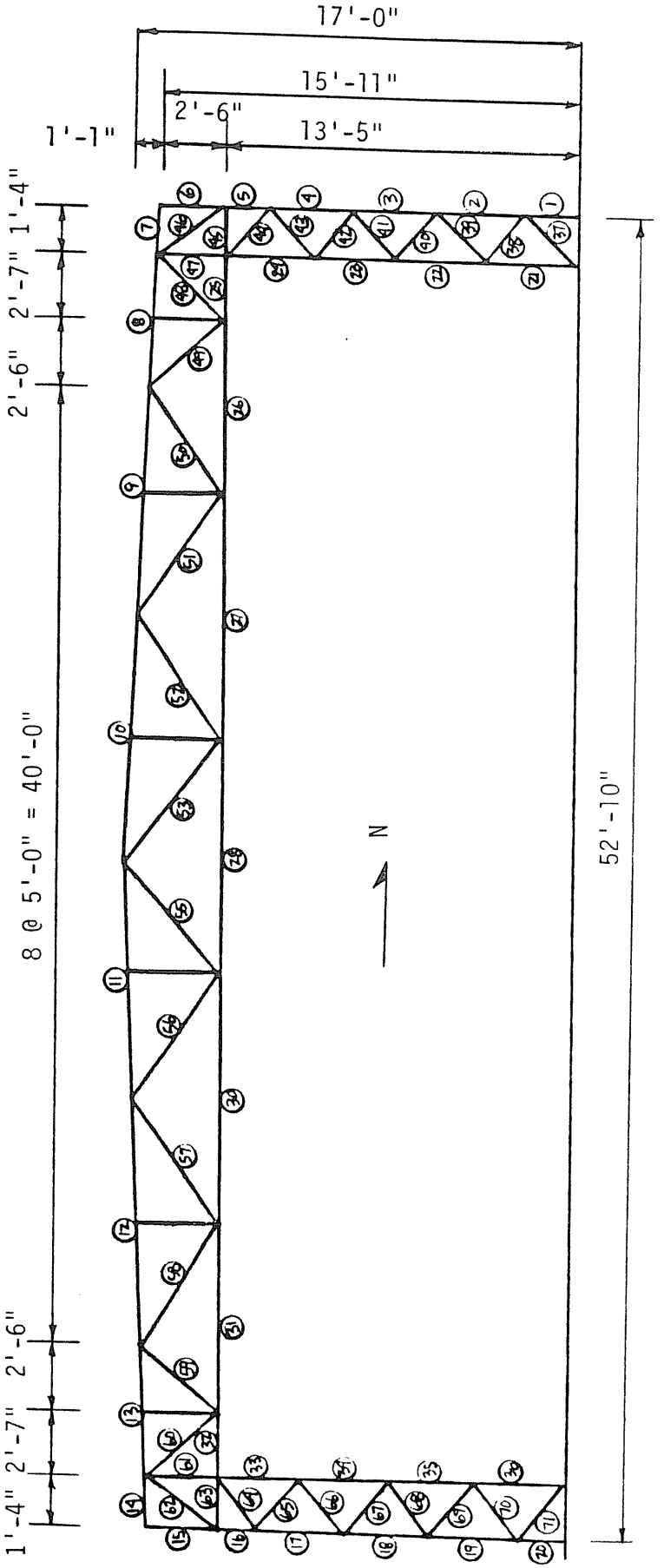


FIGURE 1 FRAME DIMENSIONS AND MEMBER LABELING

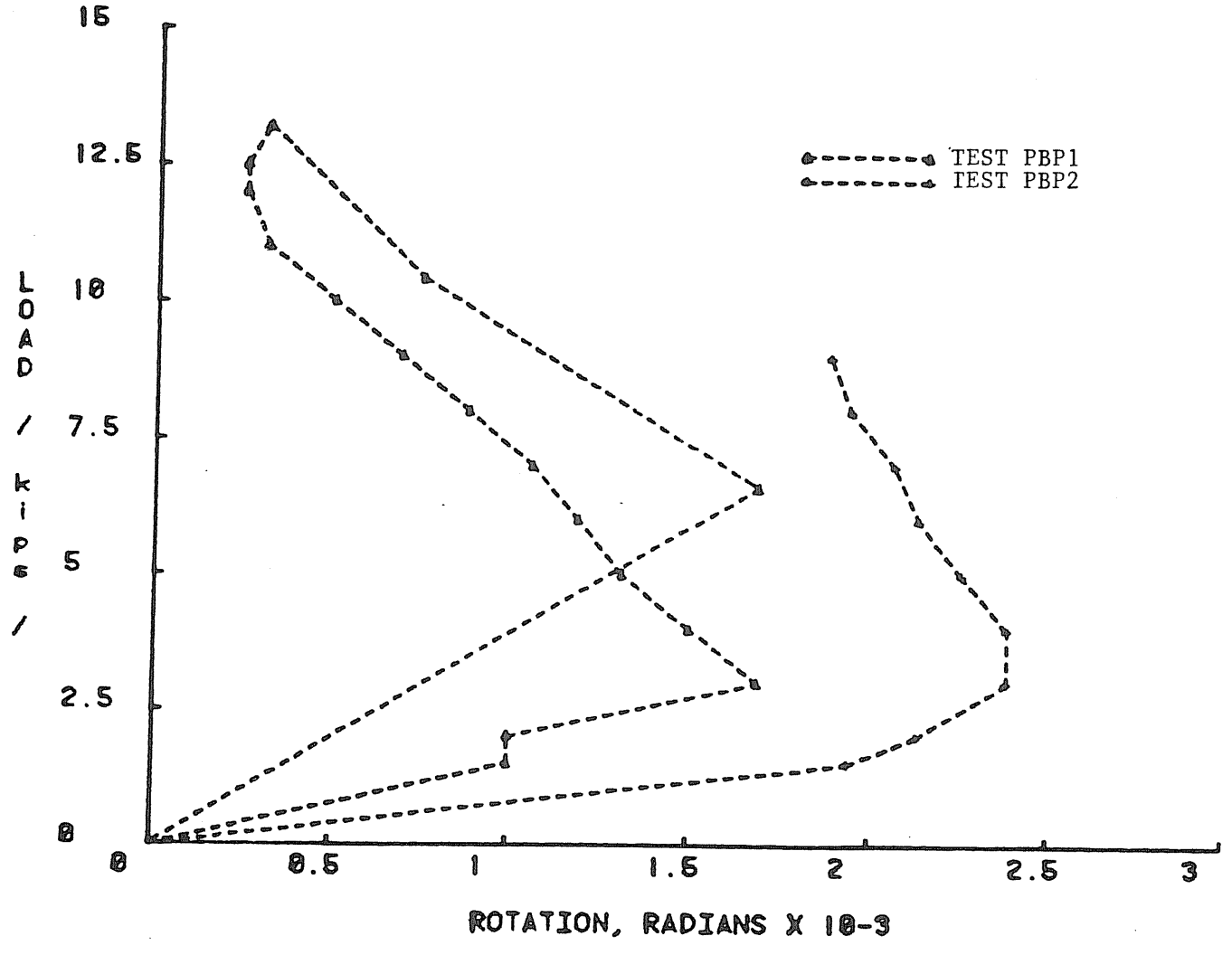


FIGURE 2 COMPARISON OF LOAD VERSUS BASE PLATE ROTATIONS, TESTS PBP1 AND PBP2

APPENDIX A

FULL LIVE LOAD EAST FRAME
WITH "FINGER TIGHT" ANCHOR BOLTS
TEST PBP1

VULCRAFT FRAME TEST SUMMARY

Project: VULCRAFT FR-2

Test No: Additional Test PBP1

Test Date: June 7, 1985

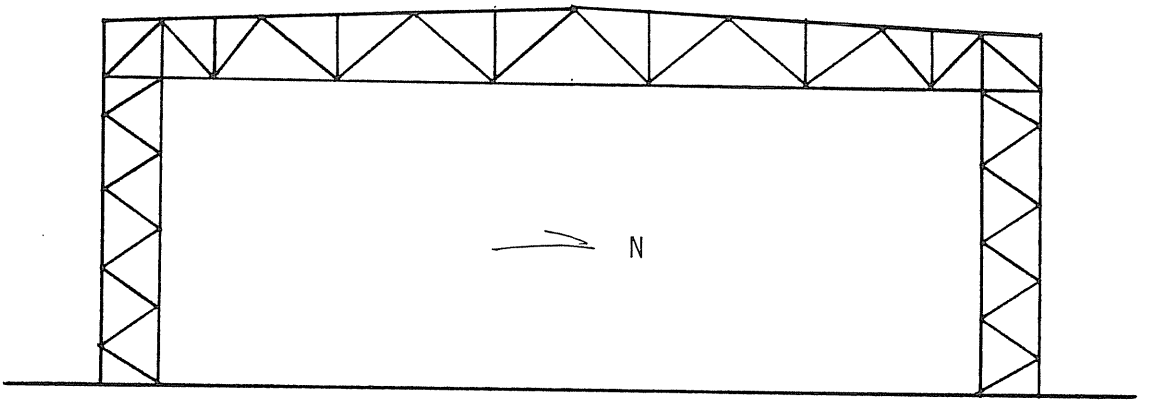
Purpose: To observe the behavior of the east frame under full live load with the anchor bolts "finger tight".

Maximum Test Load: 13.19 kips

Failure Mode: Not loaded to failure

Discussion:

- Column web members which had buckled during the first failure tests were strengthened.
- At both columns, the anchor bolts were loosened and then retightened to "finger tight".
- Full live load was incrementally applied to 13.19 kips, at which load the maximum centerline deflection was 3.63".
- The frame behaved elastically throughout the test and no major yielding was observed.
- Figures A.2 to A.4 show that the centerline deflection was close to the pinned base theoretical curve while both quarterpoint deflections were slightly greater than predicted.
- Figures A.6 to A.12 show that the member forces were less than predicted for all members except the force in member #48 which was greater than predicted.



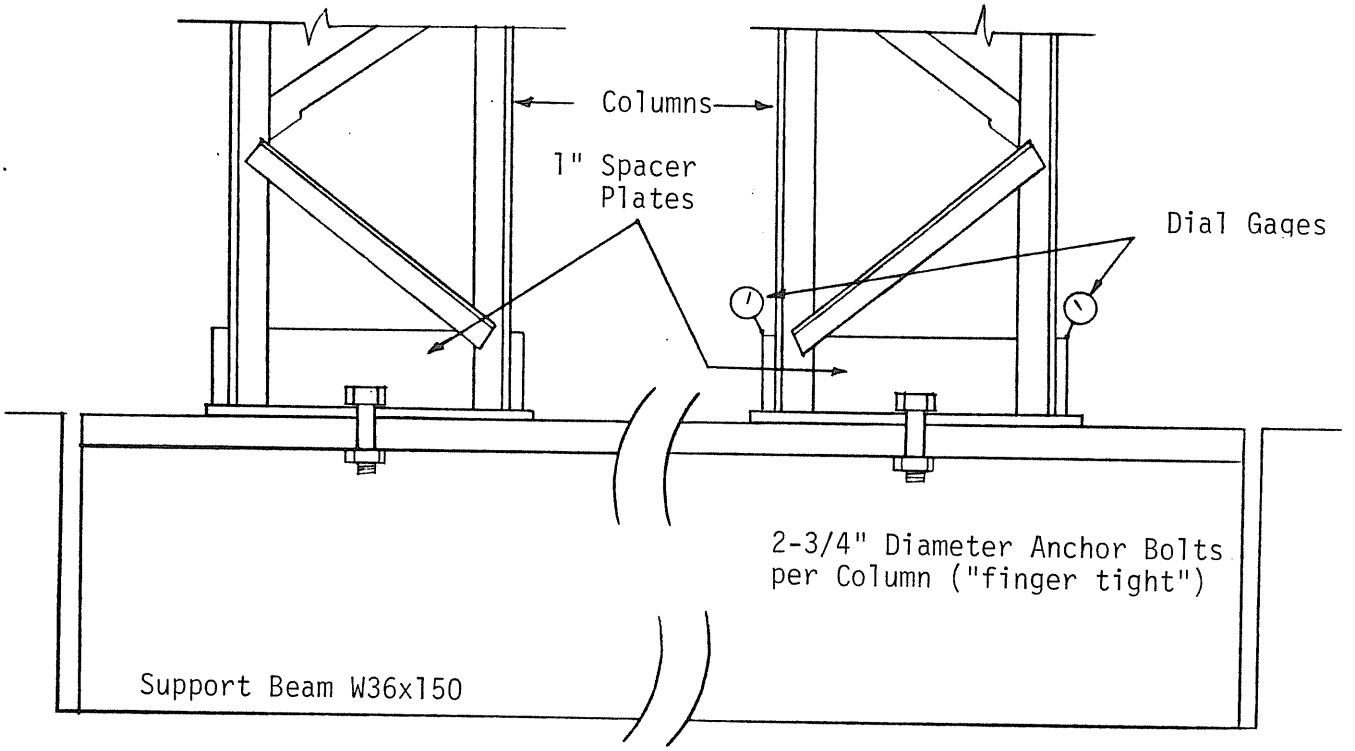


FIGURE A.1 COLUMN BASE DETAILS

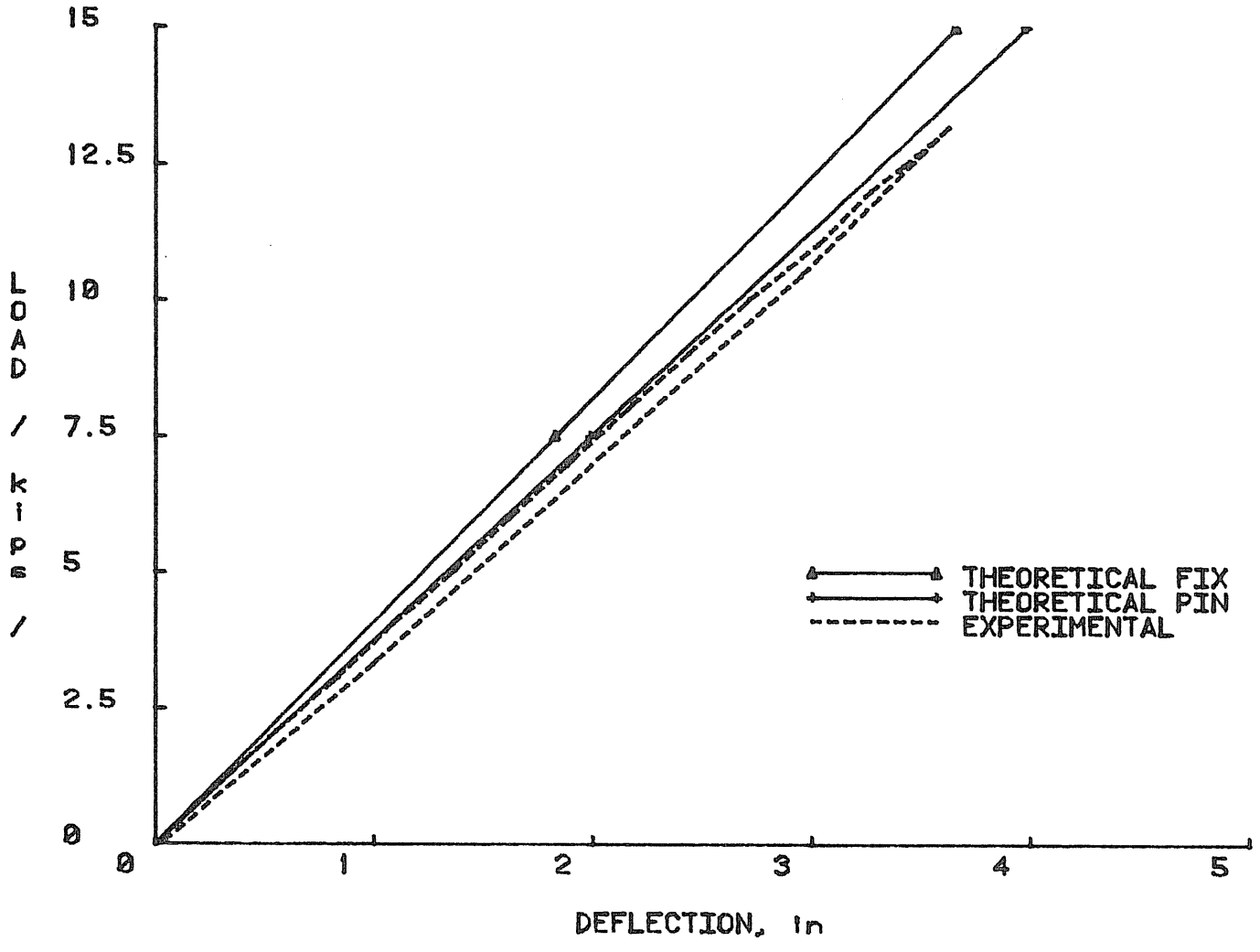


FIGURE A.2 LOAD VS. CENTERLINE DEFLECTION, TEST PBP1

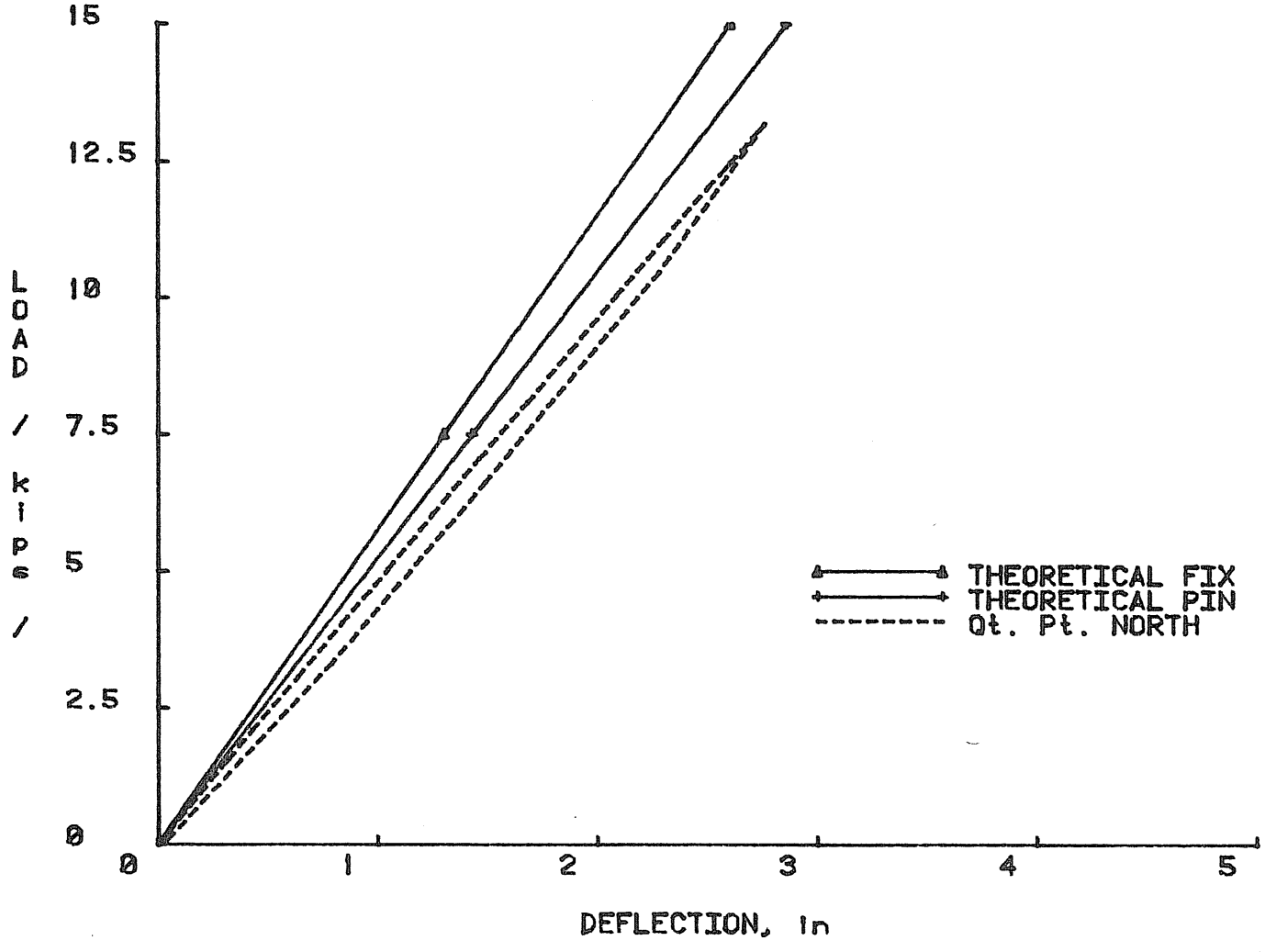


FIGURE A.3 LOAD VS. QUARTERPOINT DEFLECTION, TEST PBP1

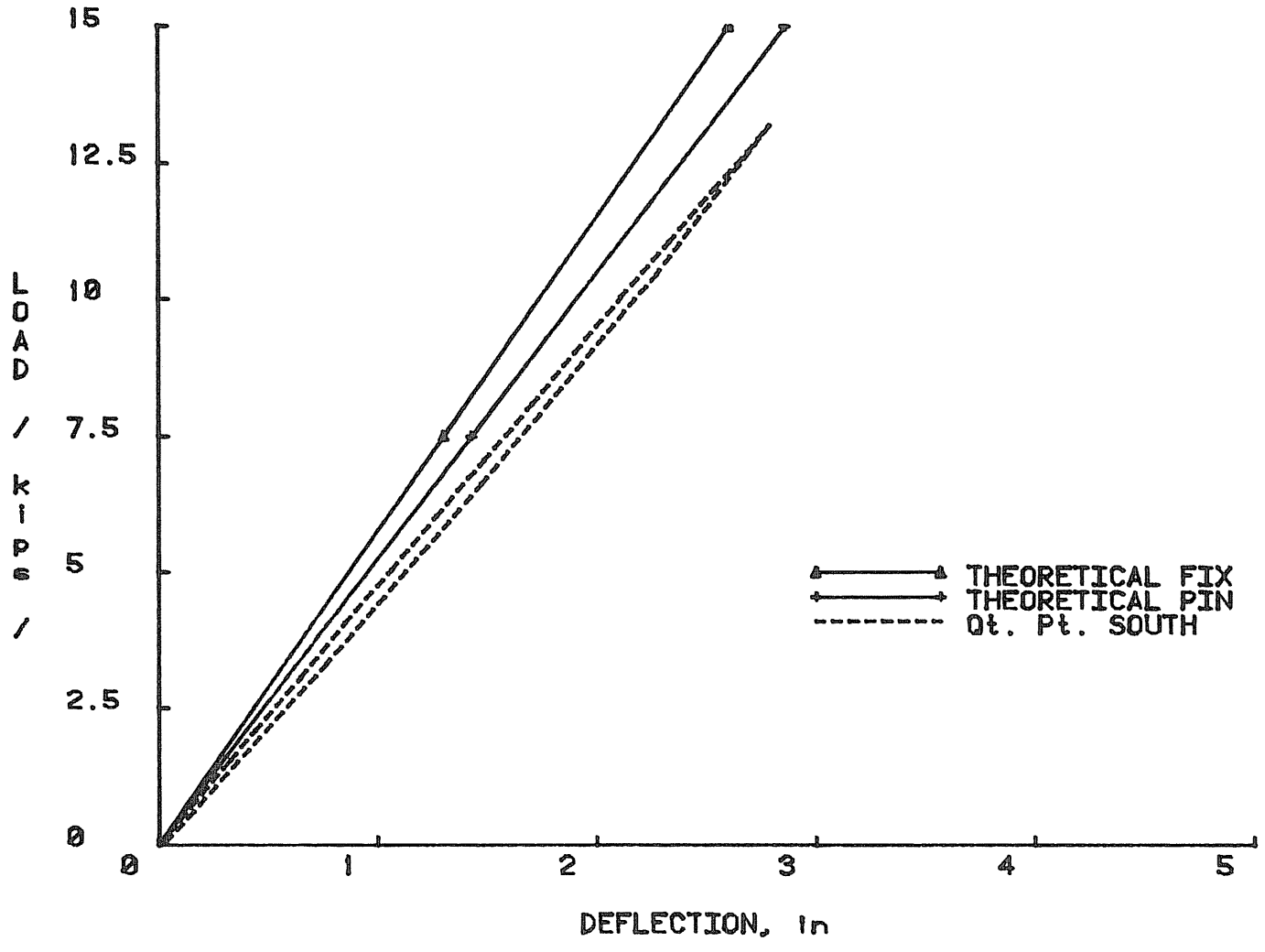


FIGURE A.4 LOAD VS. QUARTERPOINT DEFLECTION, TEST PBP1

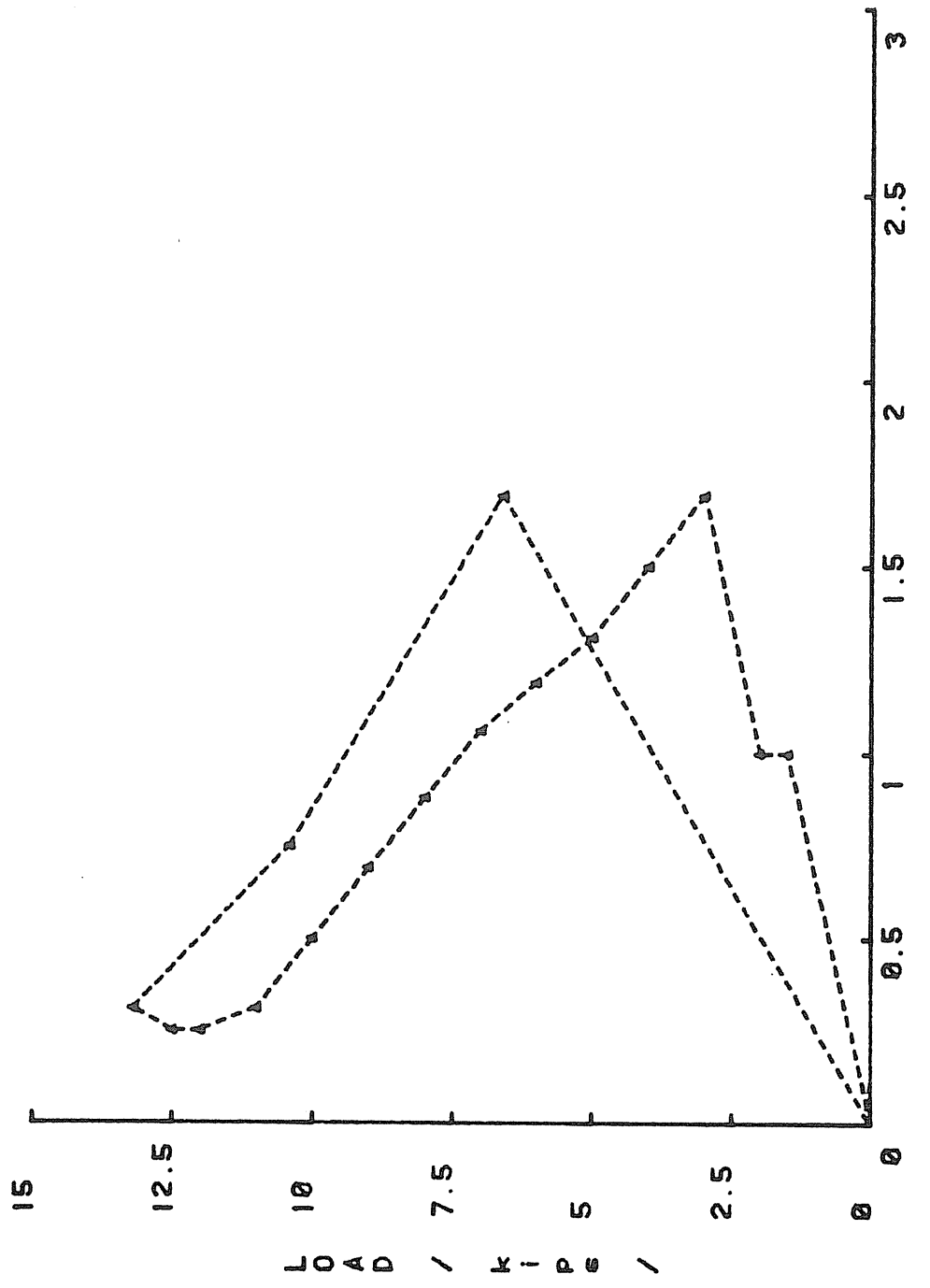


FIGURE A.5 LOAD VS. BASE PLATE ROTATION, TEST PBP1

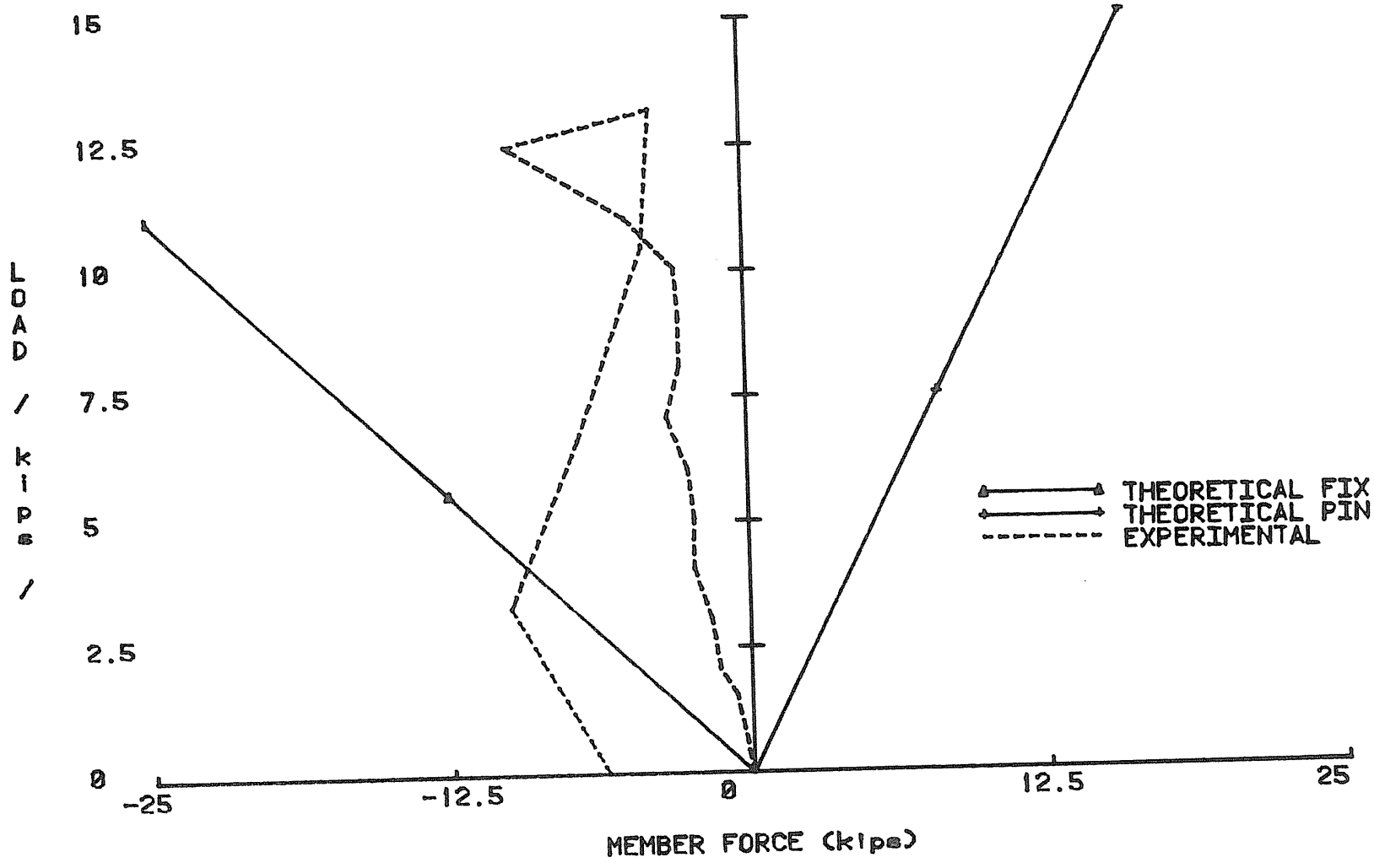


FIGURE A.6 LOAD VS. MEMBER #2 FORCE, TEST PBP1

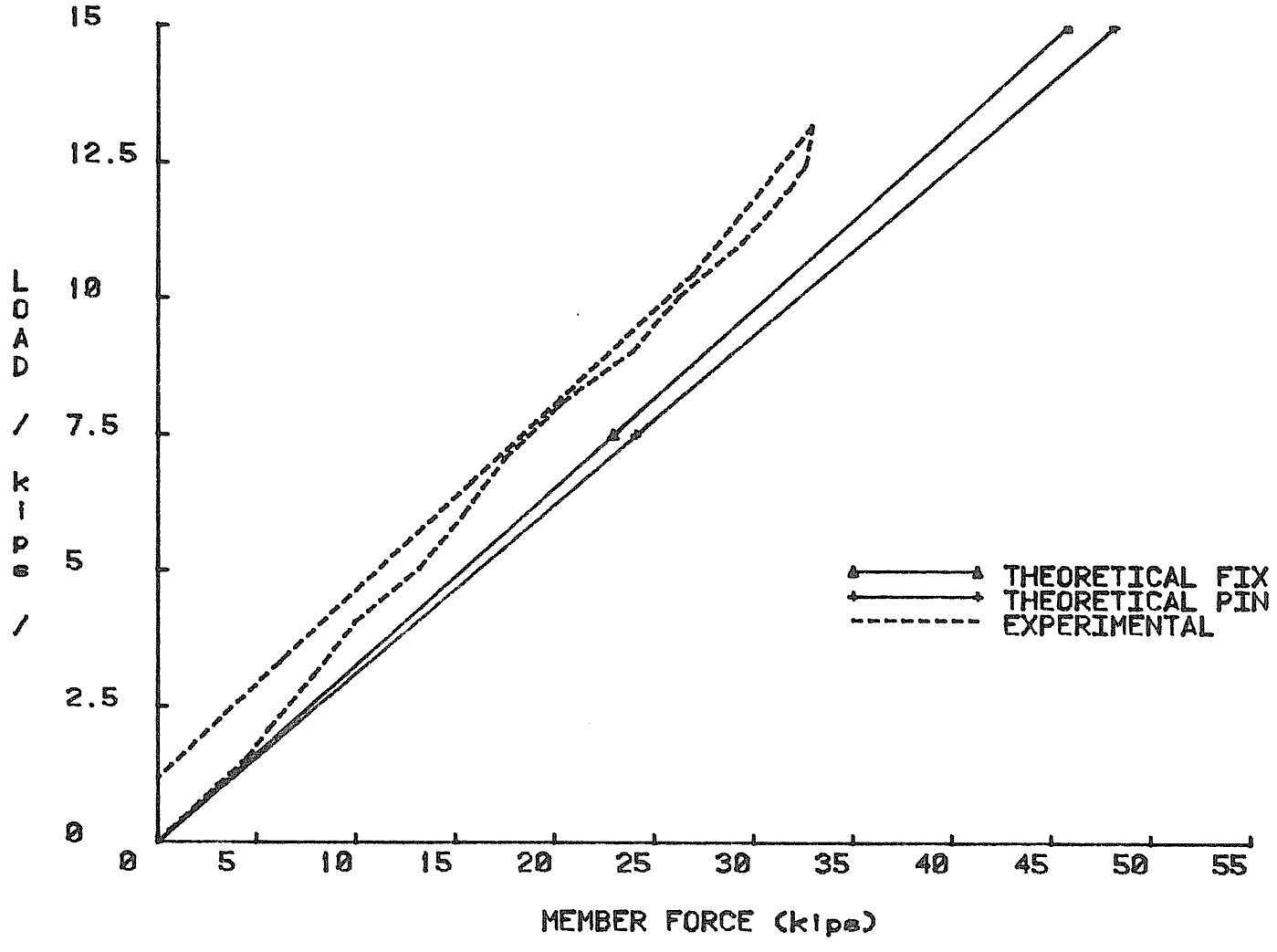


FIGURE A.7 LOAD VS. MEMBER #4 FORCE, TEST PBP1

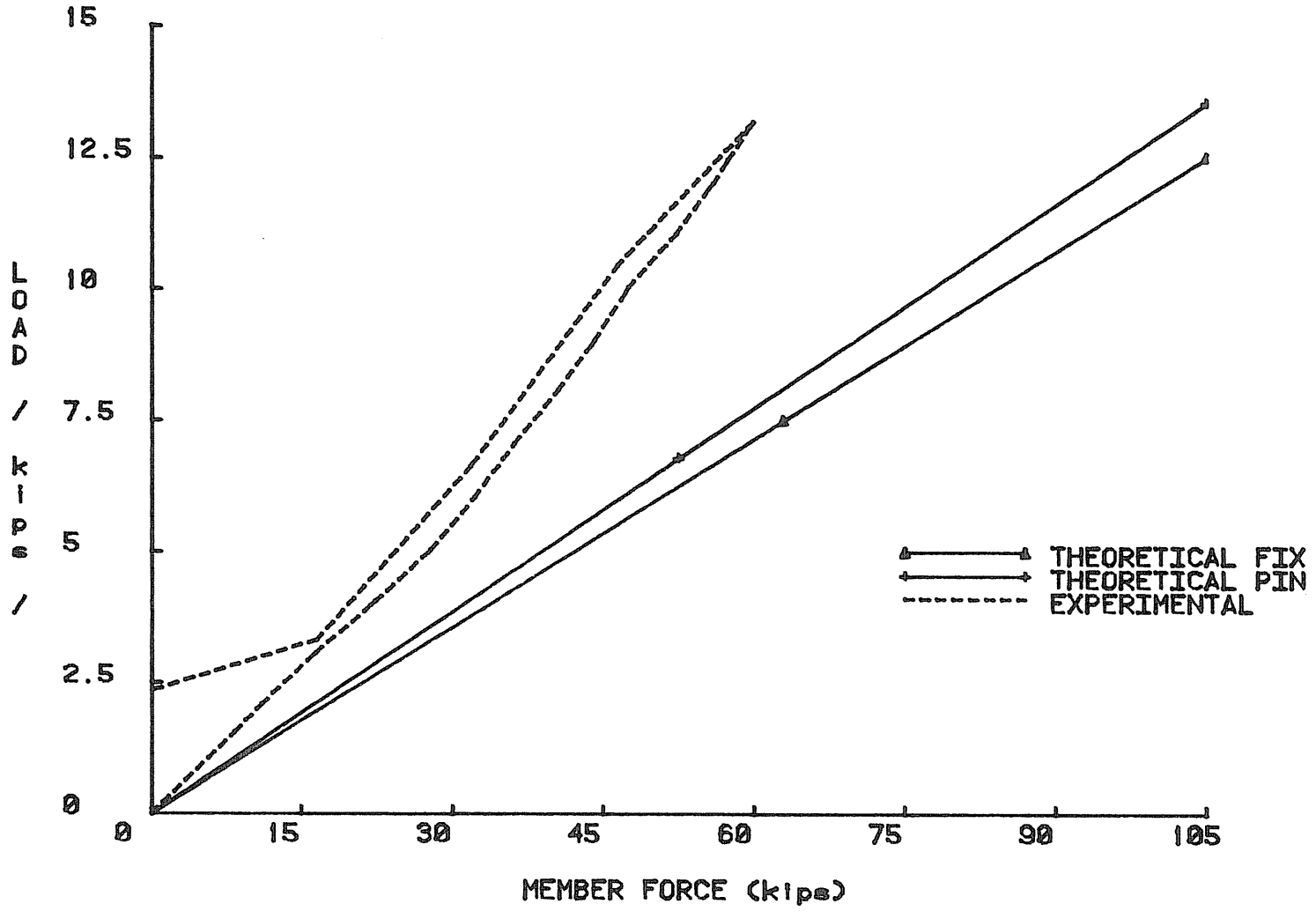


FIGURE A.8 LOAD VS. MEMBER #24 FORCE, TEST PBP1

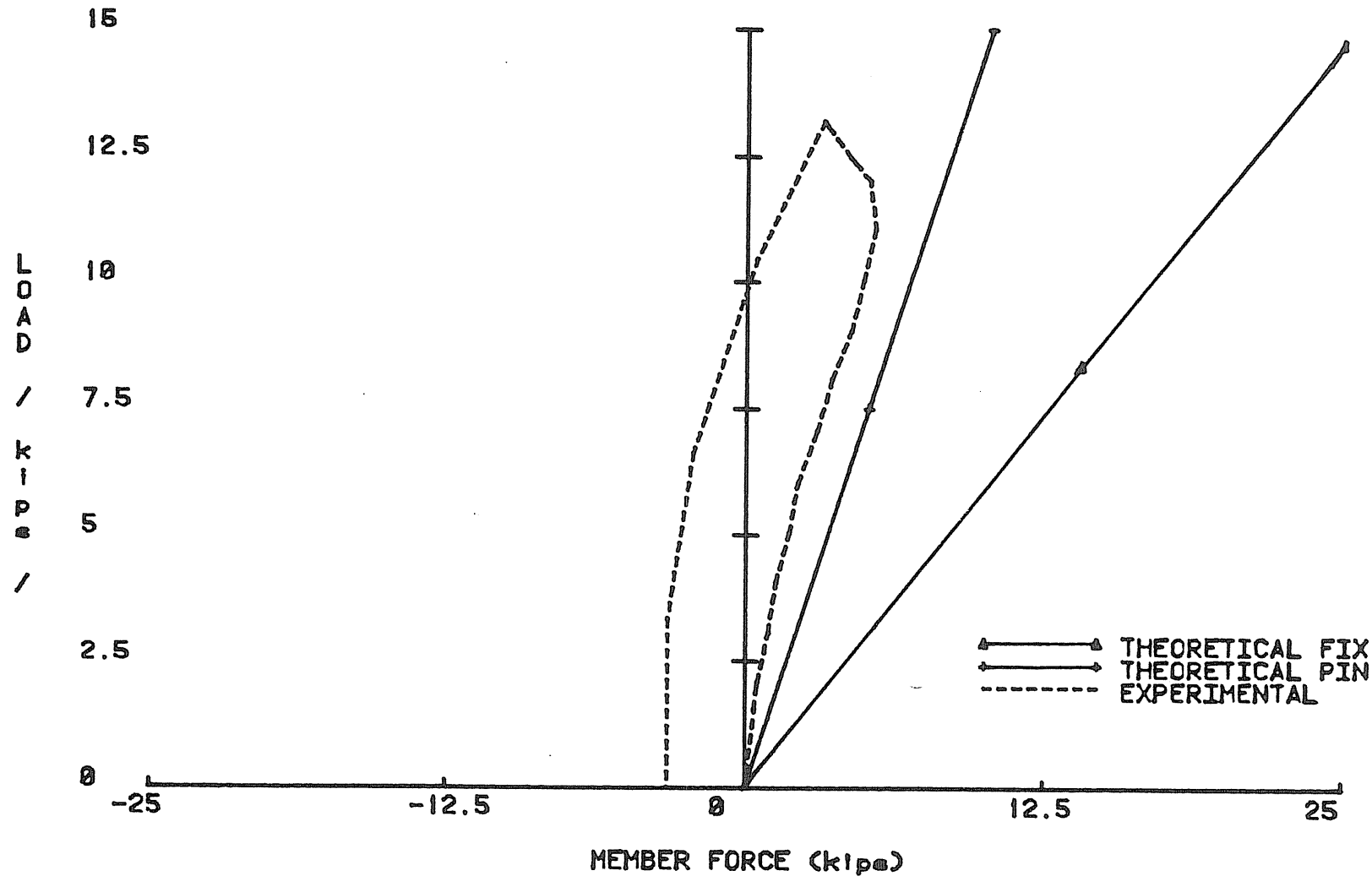


FIGURE A.9 LOAD VS. MEMBER #39 FORCE, TEST PBP1

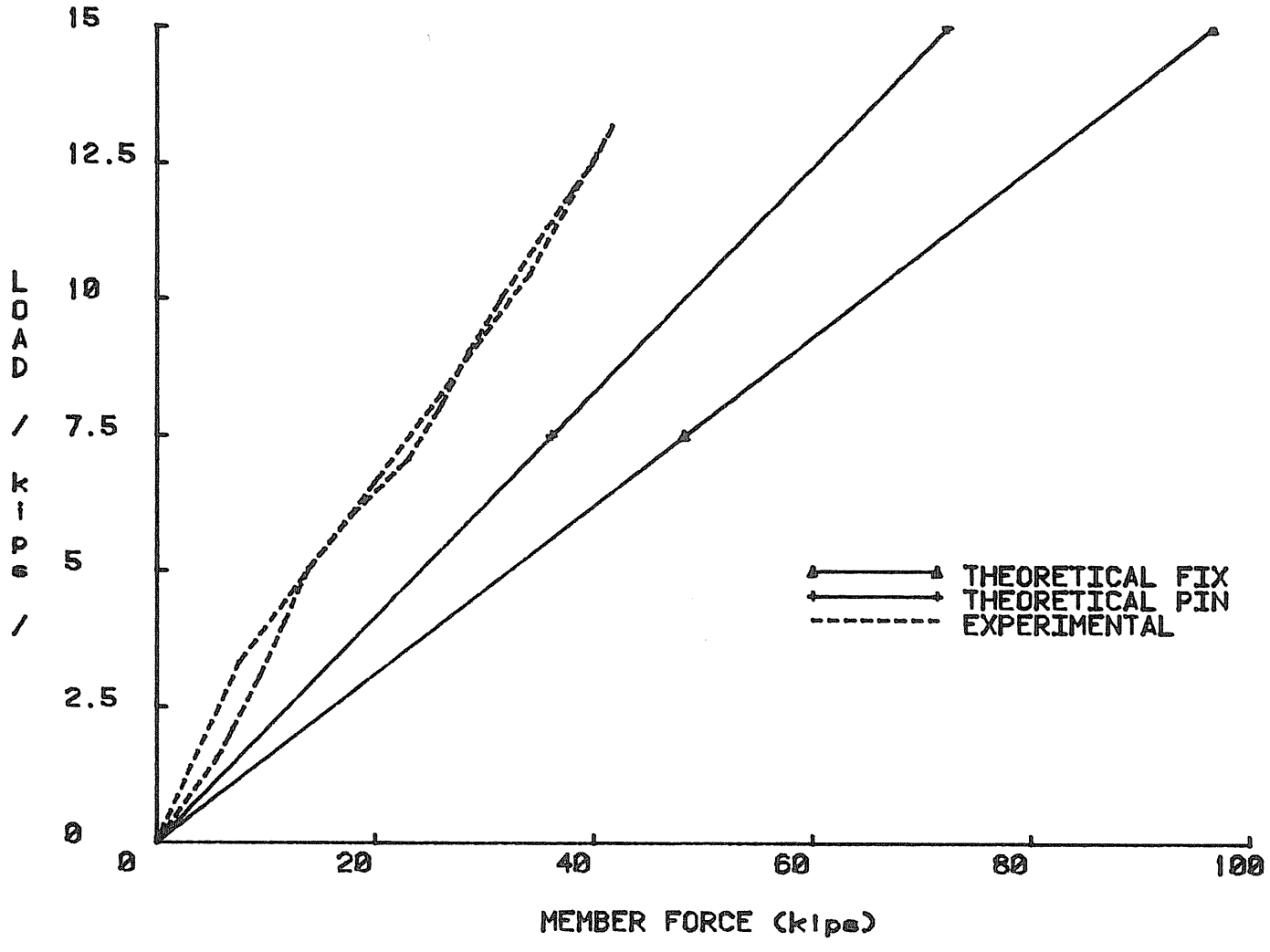


FIGURE A.10 LOAD VS. MEMBER #46 FORCE, TEST PBP1

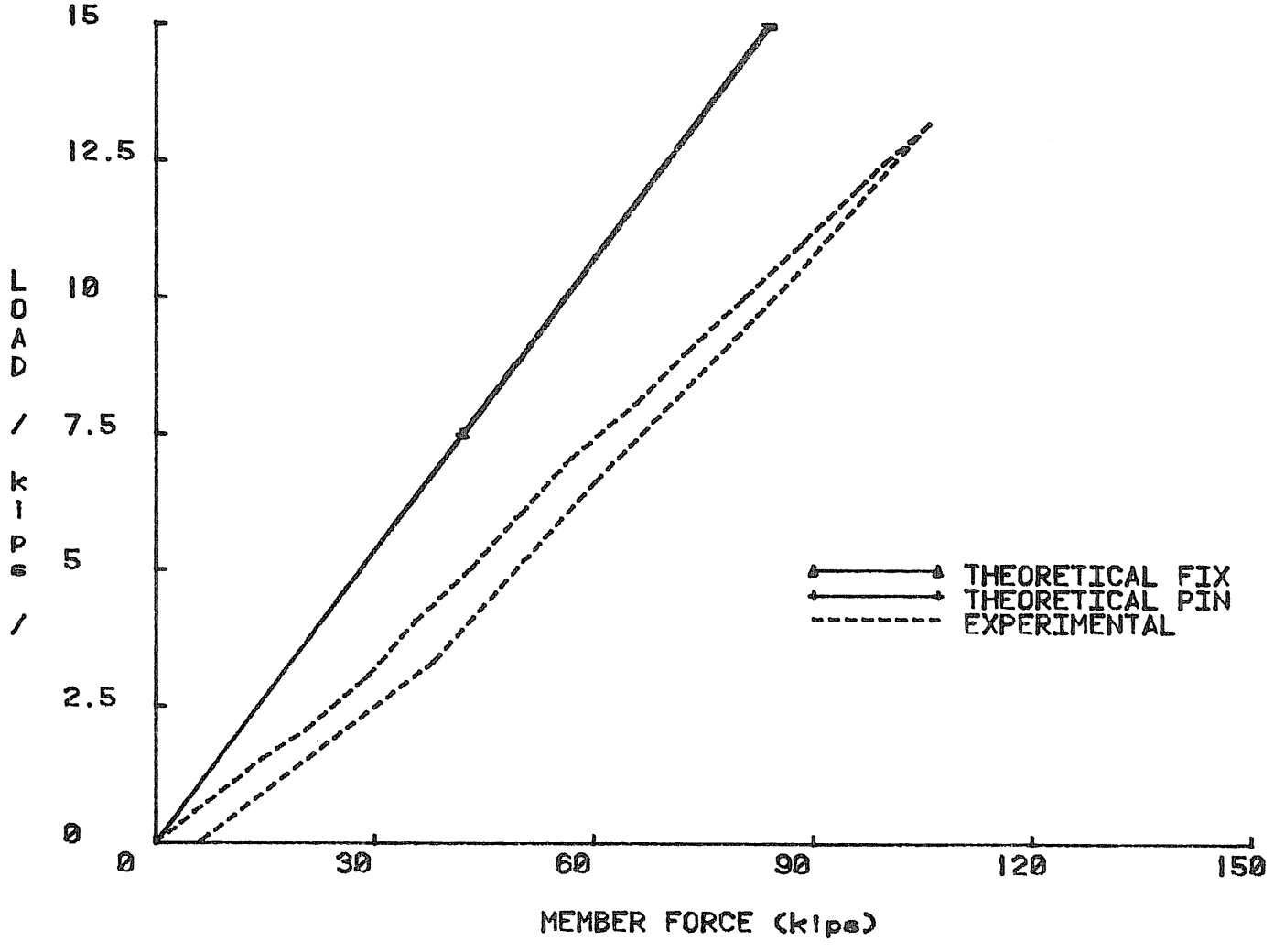


FIGURE A.11 LOAD VS. MEMBER #48 FORCE, TEST PBP1

APPENDIX B

FULL LIVE LOAD EAST FRAME
WITH CUT SPACER PLATE
TEST PBP2

VULCRAFT FRAME TEST SUMMARY

Project: VULCRAFT FR-2

Test No: Additional Test PBP2

Test Date: June 7, 1985

Purpose: To observe the behavior of the east frame under full live load with the 1" spacer plate cut and anchor bolts "finger tight".

Maximum Test Load: 13.18 kips

Failure Mode: No failure was intended

Discussion:

- In addition to the anchor bolts being "finger tight", both column base 1" spacer plates were cut vertically and separated by a 3/4" gap.
- Full live load was incrementally applied to 13.18 kips, at which load the maximum centerline deflection was 3.66".
- The frame behaved elastically throughout the test and no major yielding was observed.
- Figures B.2 to B.4 show that centerline deflection was close to the pinned base theoretical curve while both quarterpoint deflections were slightly greater than predicted.
- Figures B.6 to B.12 show that the member forces were less than predicted for all members except the force in member #48 which was greater than predicted.

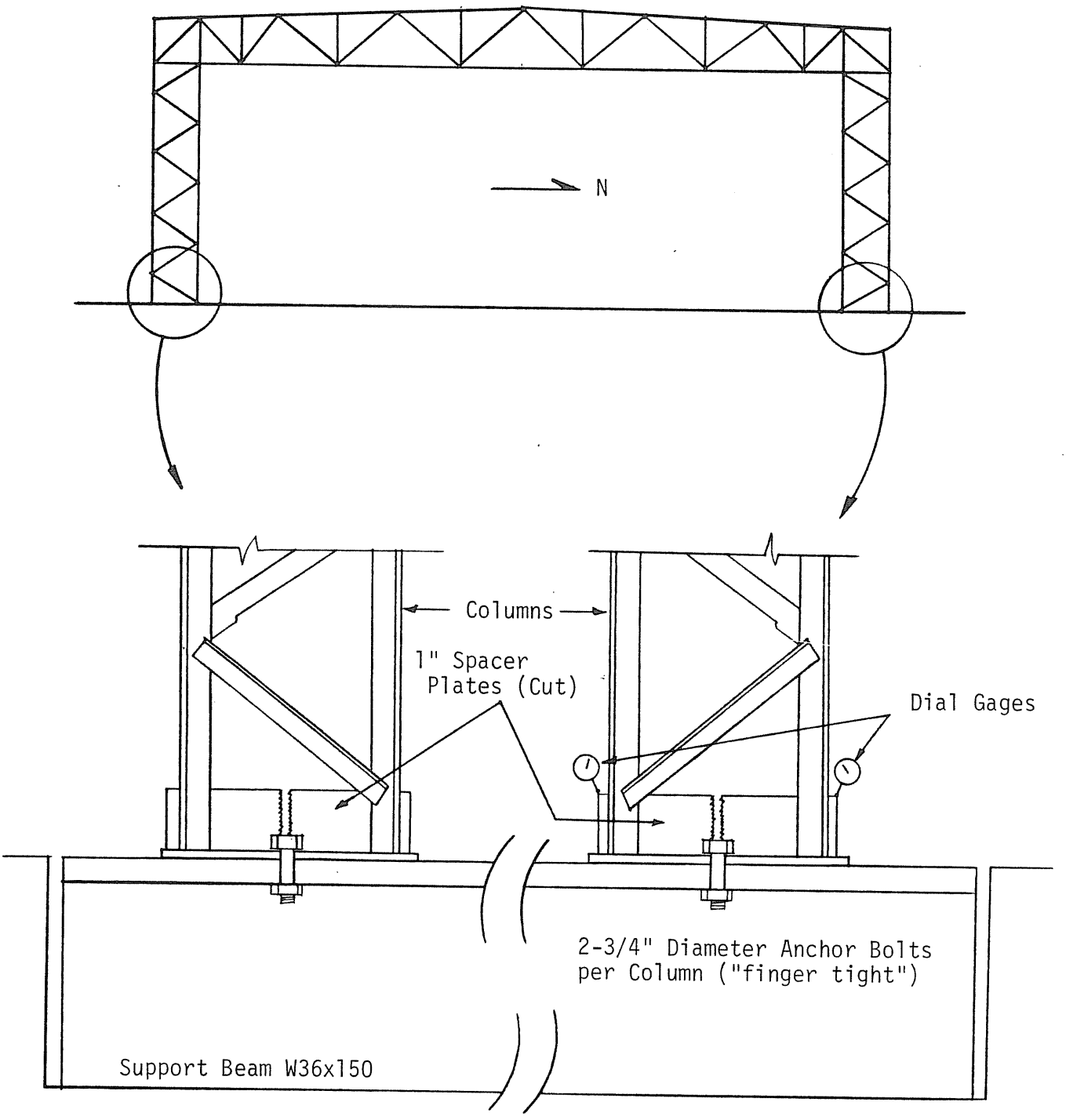


FIGURE B.1 COLUMN BASE DETAILS

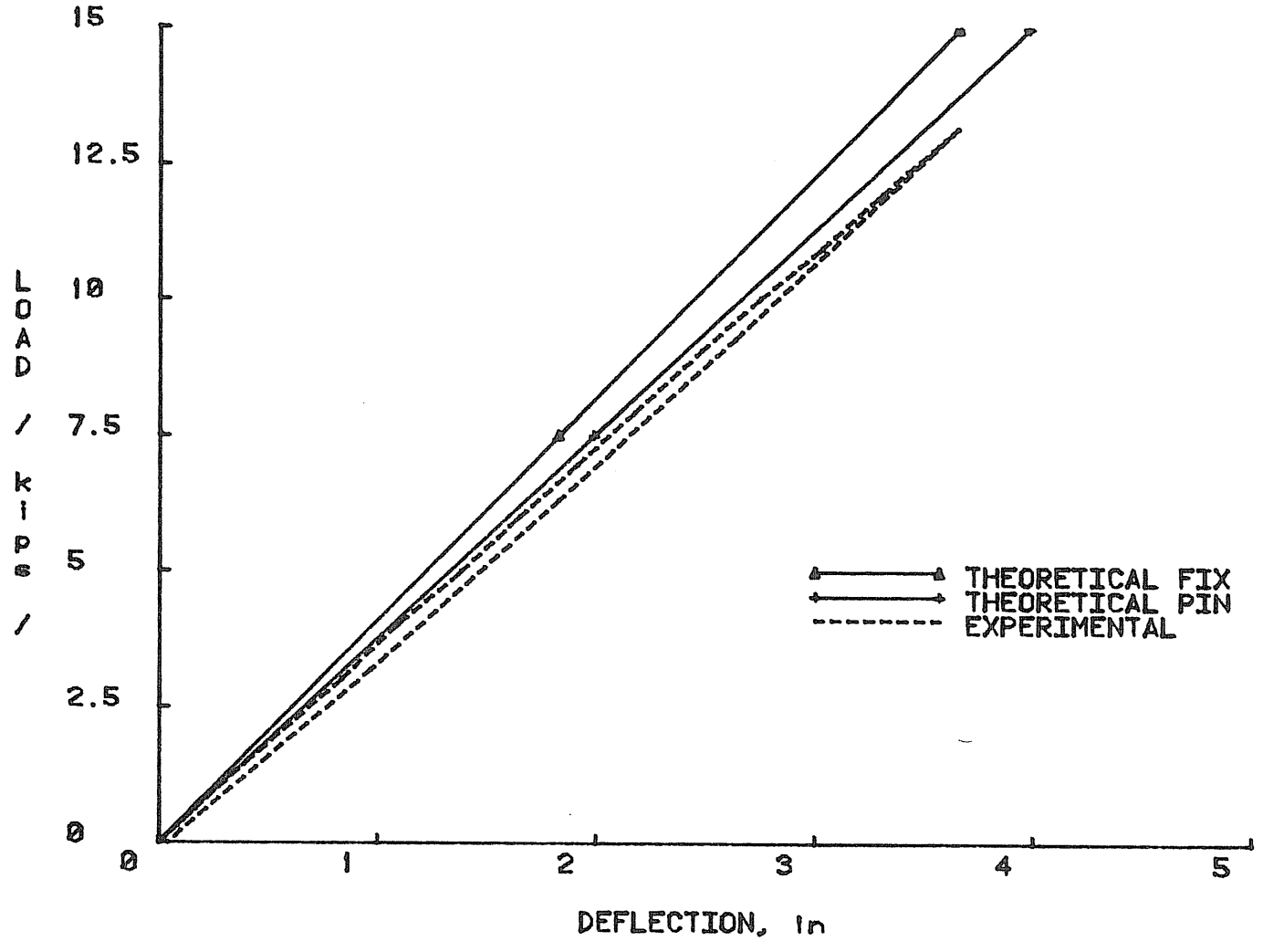


FIGURE B.2 LOAD VS. CENTERLINE DEFLECTION, TEST PBP2

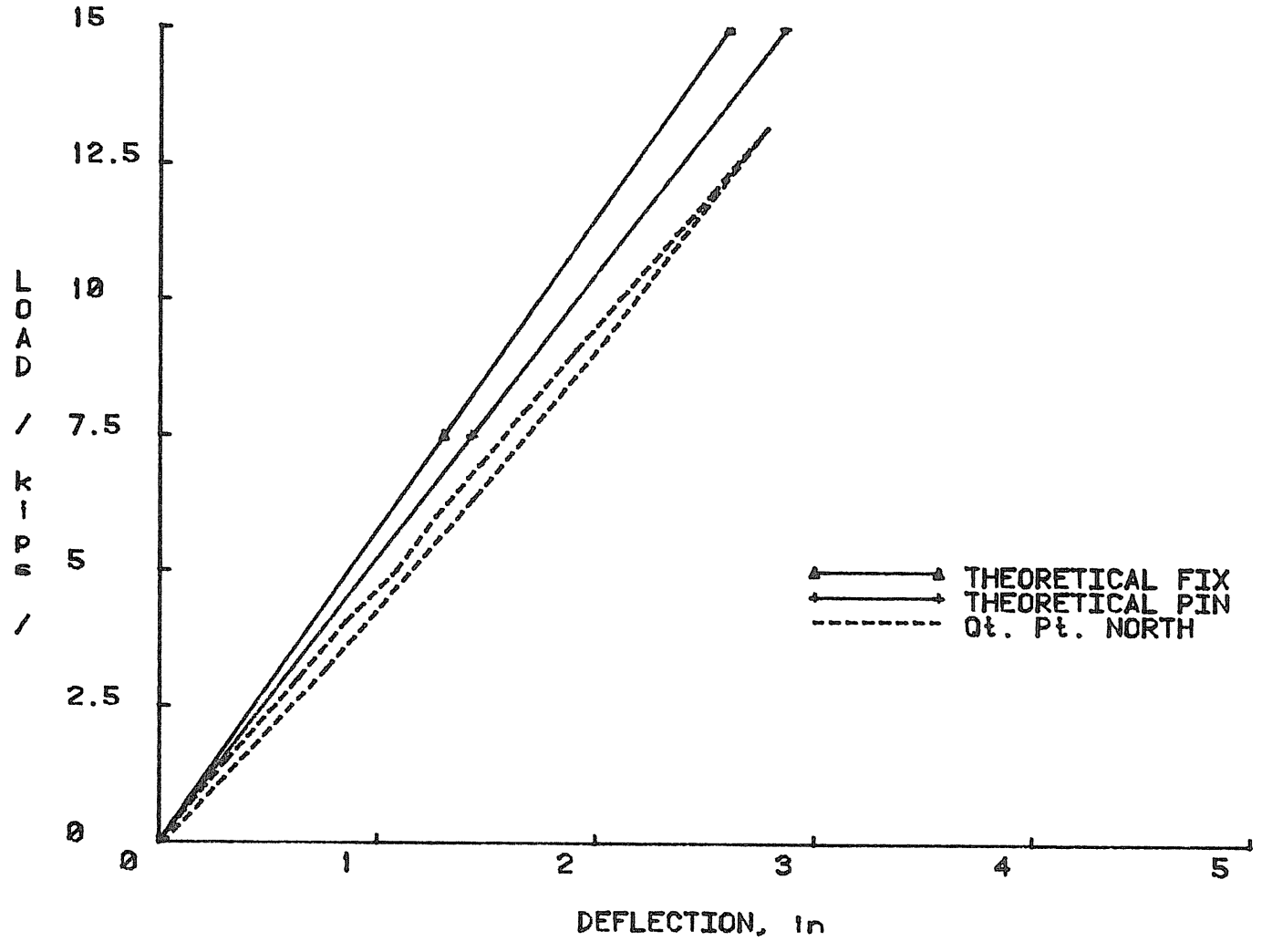


FIGURE B.3 LOAD VS. QUARTERPOINT DEFLECTION, TEST PBP2

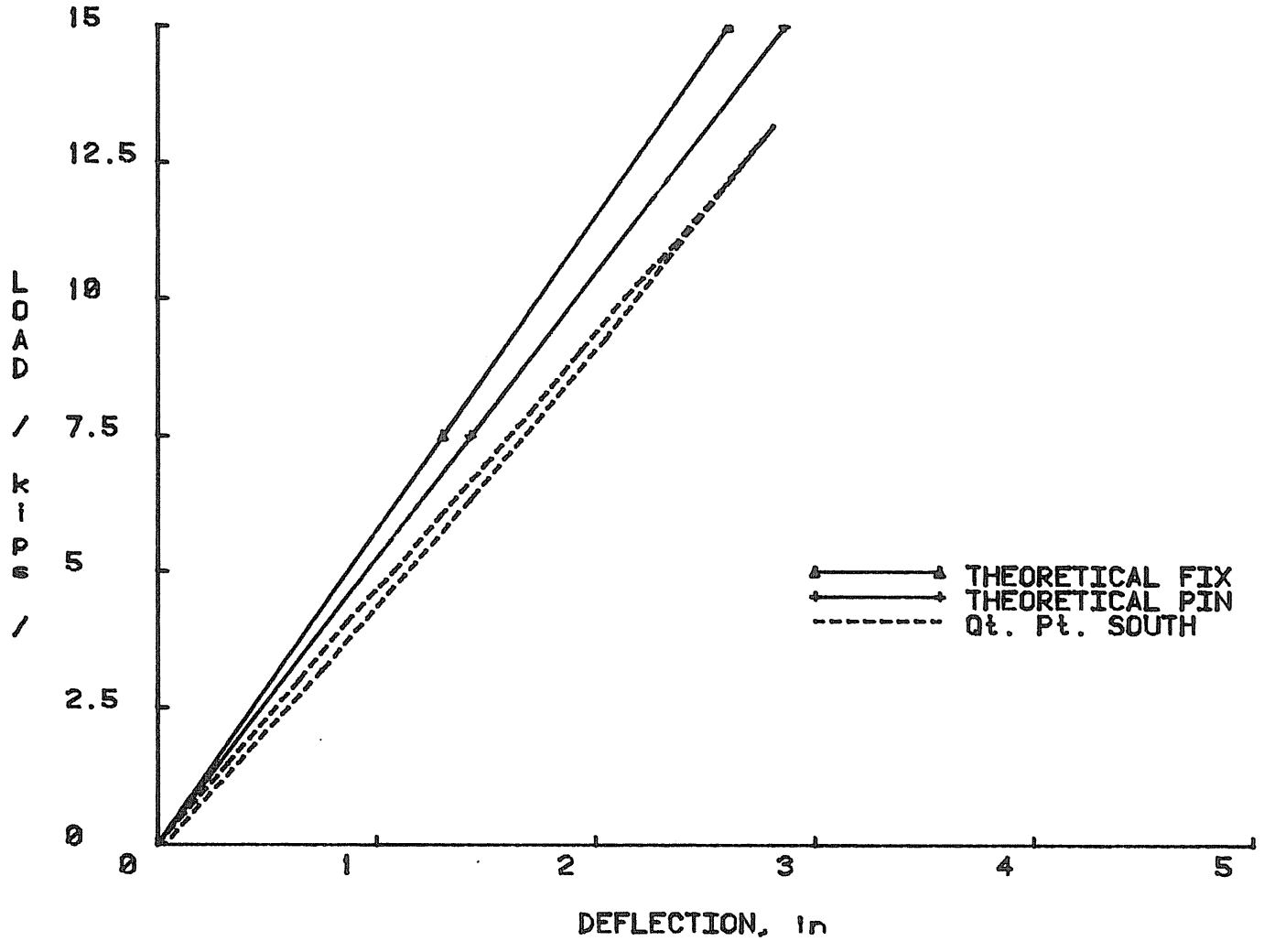


FIGURE B.4 LOAD VS. QUARTERPOINT DEFLECTION, TEST PBP2

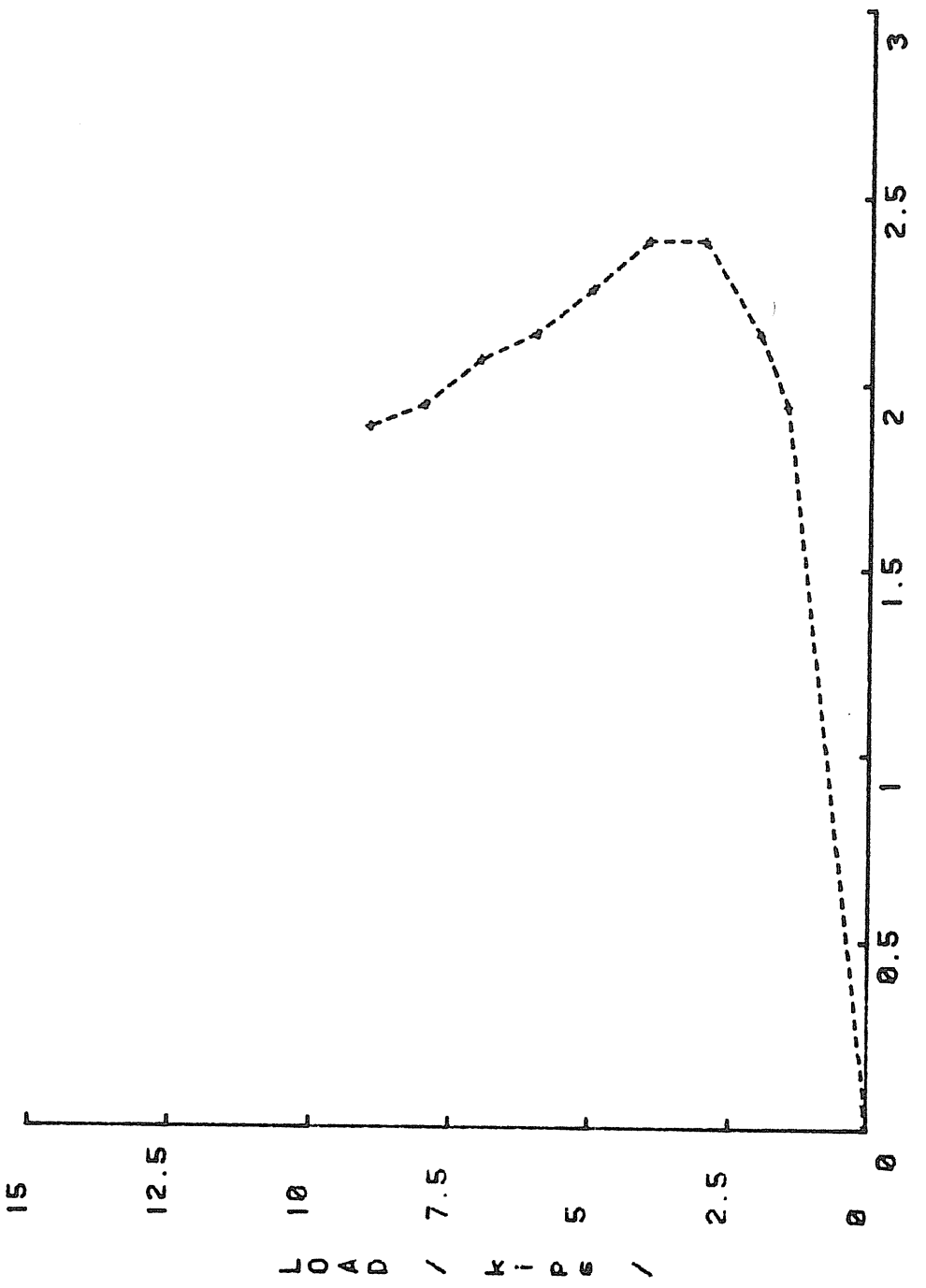


FIGURE B.5 LOAD VS. BASE PLATE ROTATION, TEST PBP2

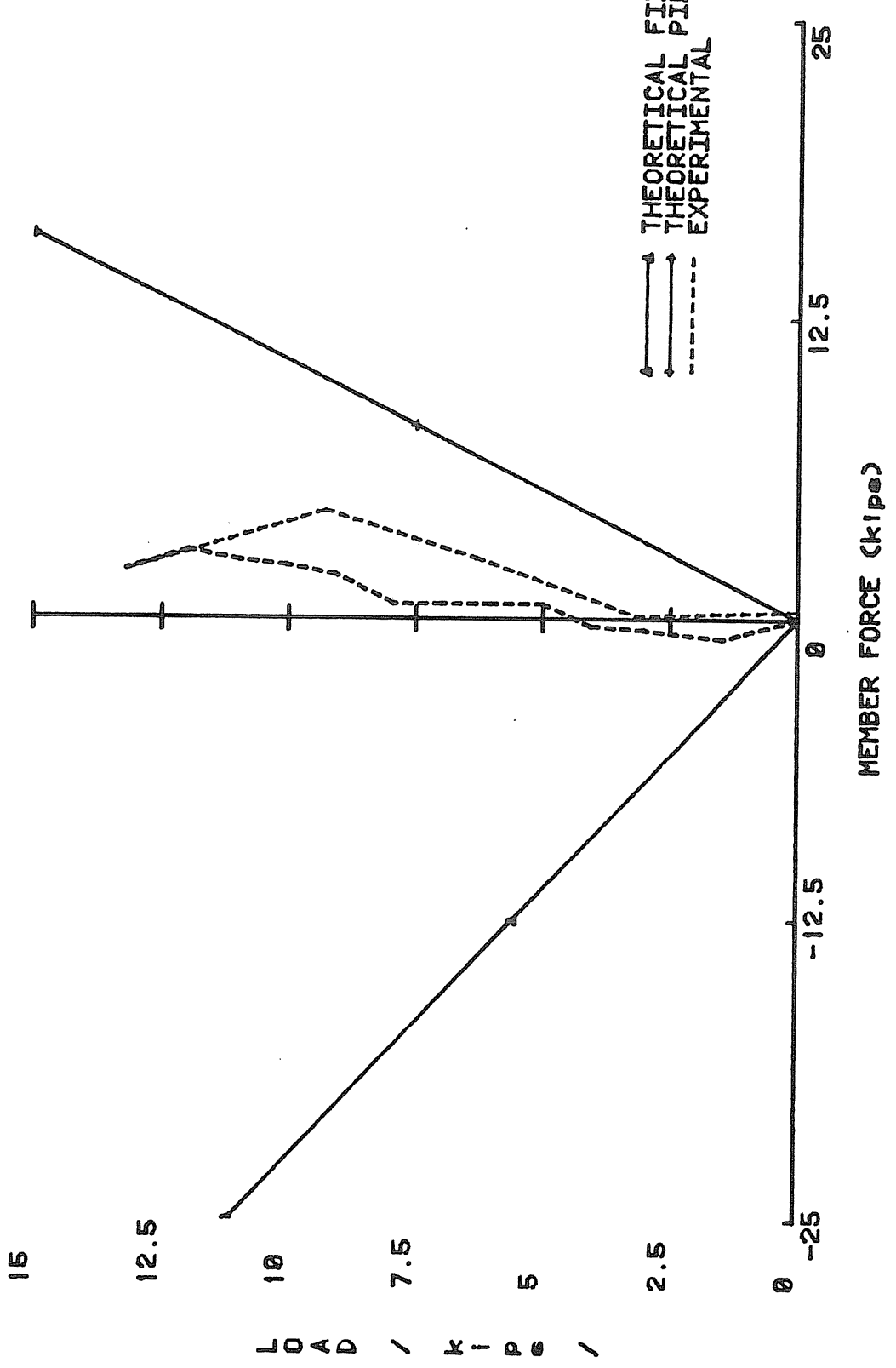


FIGURE B.6 LOAD VS. MEMBER #2 FORCE, TEST PBP2

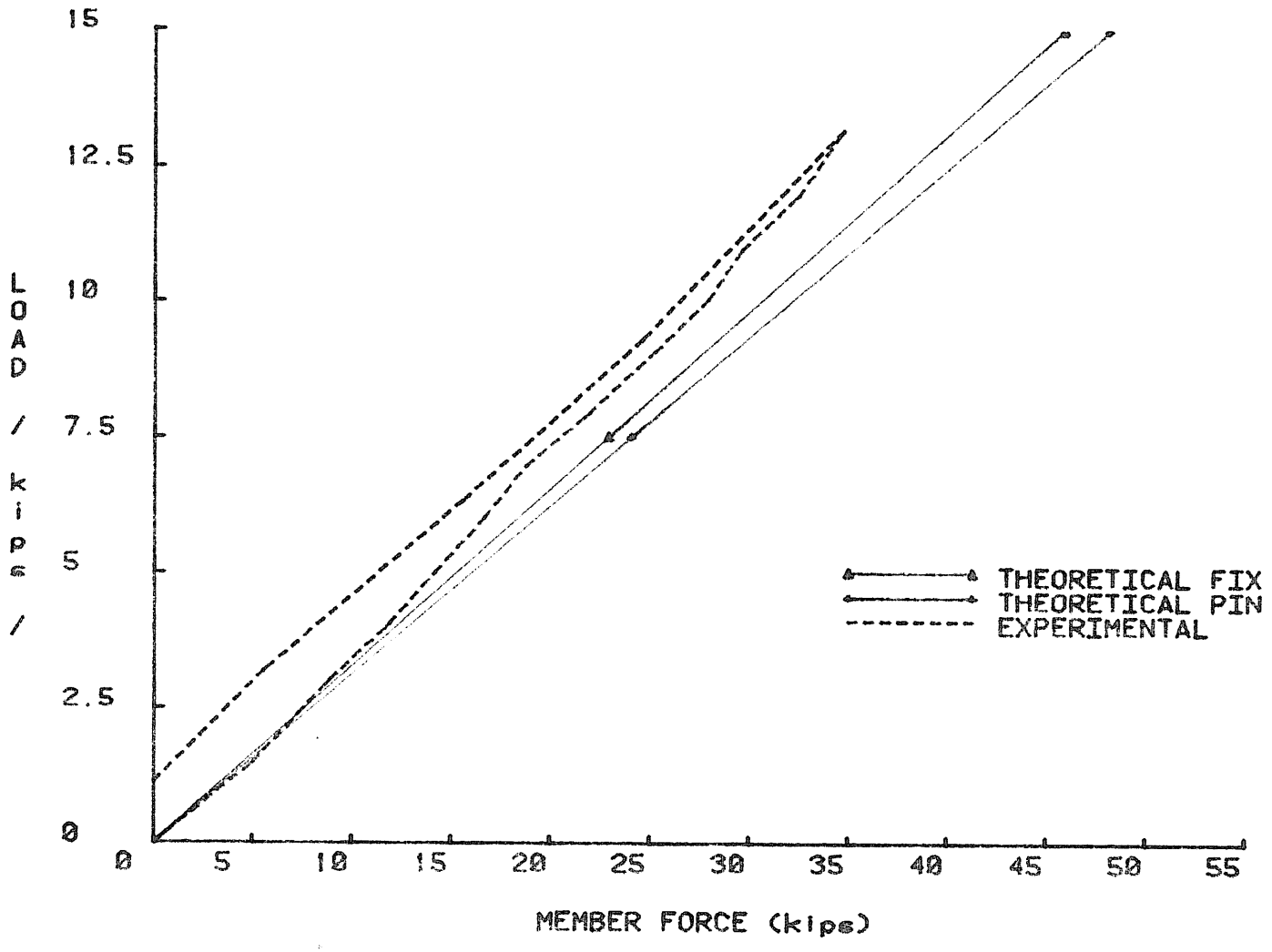


FIGURE B.7 LOAD VS. MEMBER #4 FORCE, TEST PBP2

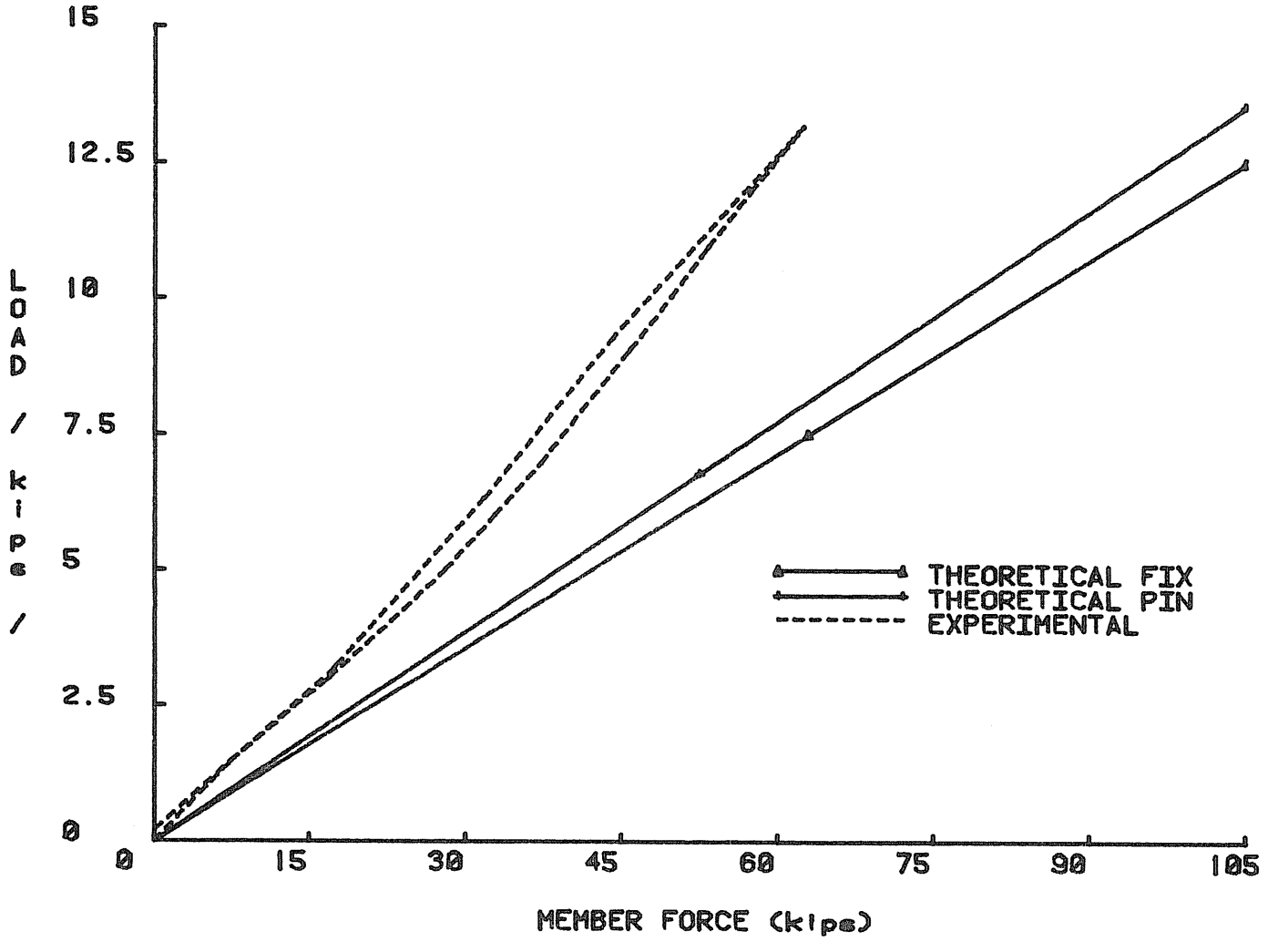


FIGURE B.8 LOAD VS. MEMBER #24 FORCE, TEST PBP2

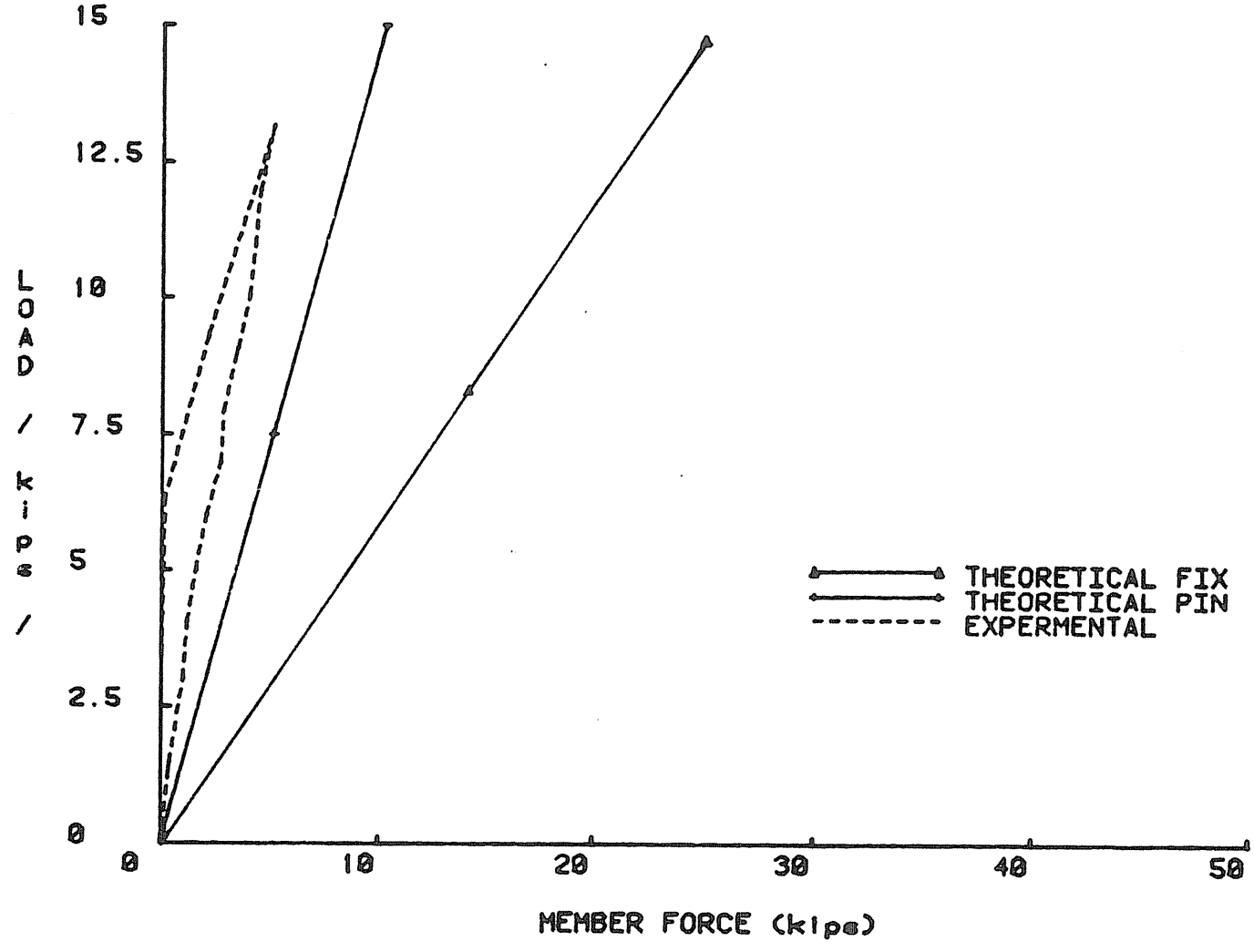


FIGURE B.9 LOAD VS. MEMBER #39 FORCE, TEST PBP2

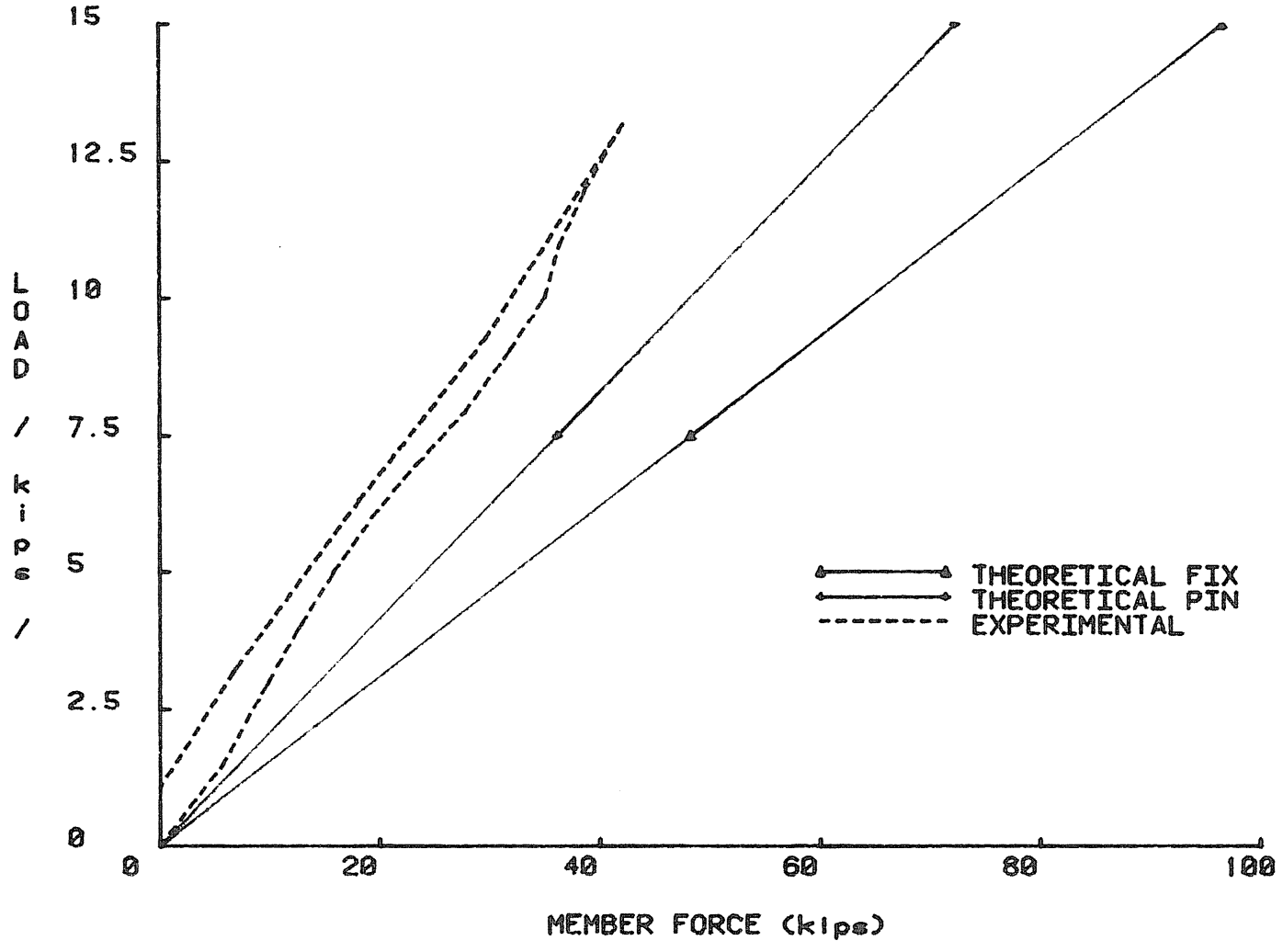


FIGURE B.10 LOAD VS. MEMBER #46 FORCE, TEST PBP2

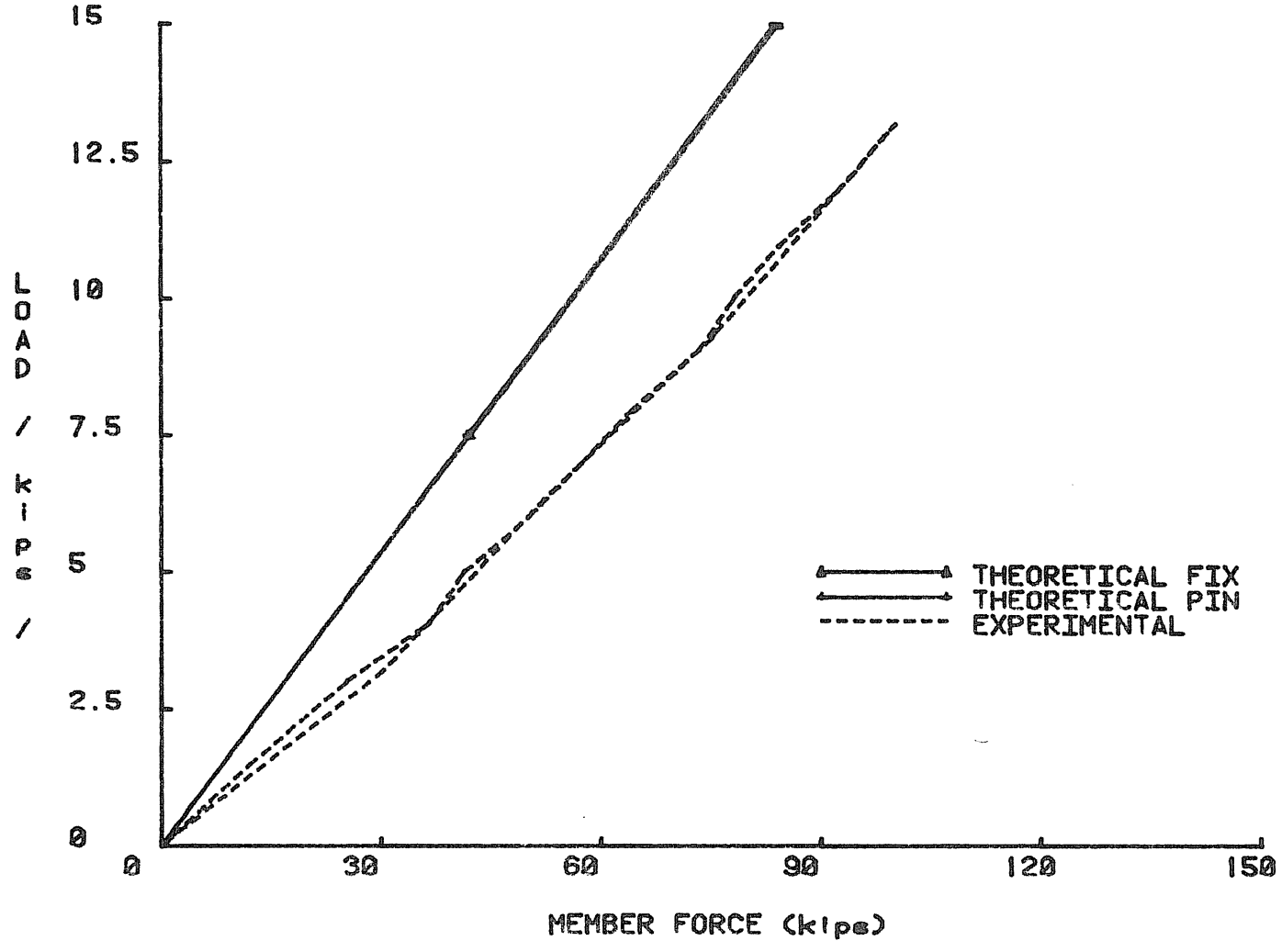


FIGURE B.11 LOAD VS. MEMBER #48 FORCE, TEST PBP2

APPENDIX C

FULL LIVE LOAD EAST FRAME
WITH CUT OUTSIDE COLUMN CHORD MEMBERS
TEST PBP3

VULCRAFT FRAME TEST SUMMARY

Project: VULCRAFT FR-2

Test No: Additional Test PBP1

Test Date: June 7, 1985

Purpose: To observe the behavior of the east frame under full live load with the column exterior chords cut.

Maximum Test Load: 14.93 kips

Failure Mode: Yielding of the rafter bottom chord with the accompanying softening of the load vs. centerline deflection curve.

Discussion:

- In addition to anchor bolts being "finger tight", and the cut column base 1" spacers, a 2" section of both column exterior chords was removed near the base plates.
- Full live load was incrementally applied to 14.93 kips at which load the maximum centerline deflection was 5.22".
- The failure of the frame was due to yielding of the bottom rafter chord.
- Figure C.2 shows that the centerline deflection was close to the pinned base theoretical curve up to the failure load of 14.93 kips, at which load the frame deflected with no increase in load, signifying failure.
- Figures C.3 and C.4 show that both quarterpoint deflections were slightly greater than predicted and increased with no increase in load at 14.93 kips of applied load.
- Figure C.5 shows that the opening of the column exterior chord member was essentially linear throughout the test and showed some permanent set upon the unloading of the frame.
- Figures C.6 to C.12 show that the member forces were less than predicted for all members except the force in member #48 which was greater than predicted. Members #24 and #48 showes signs of yielding at the maximum applied load.

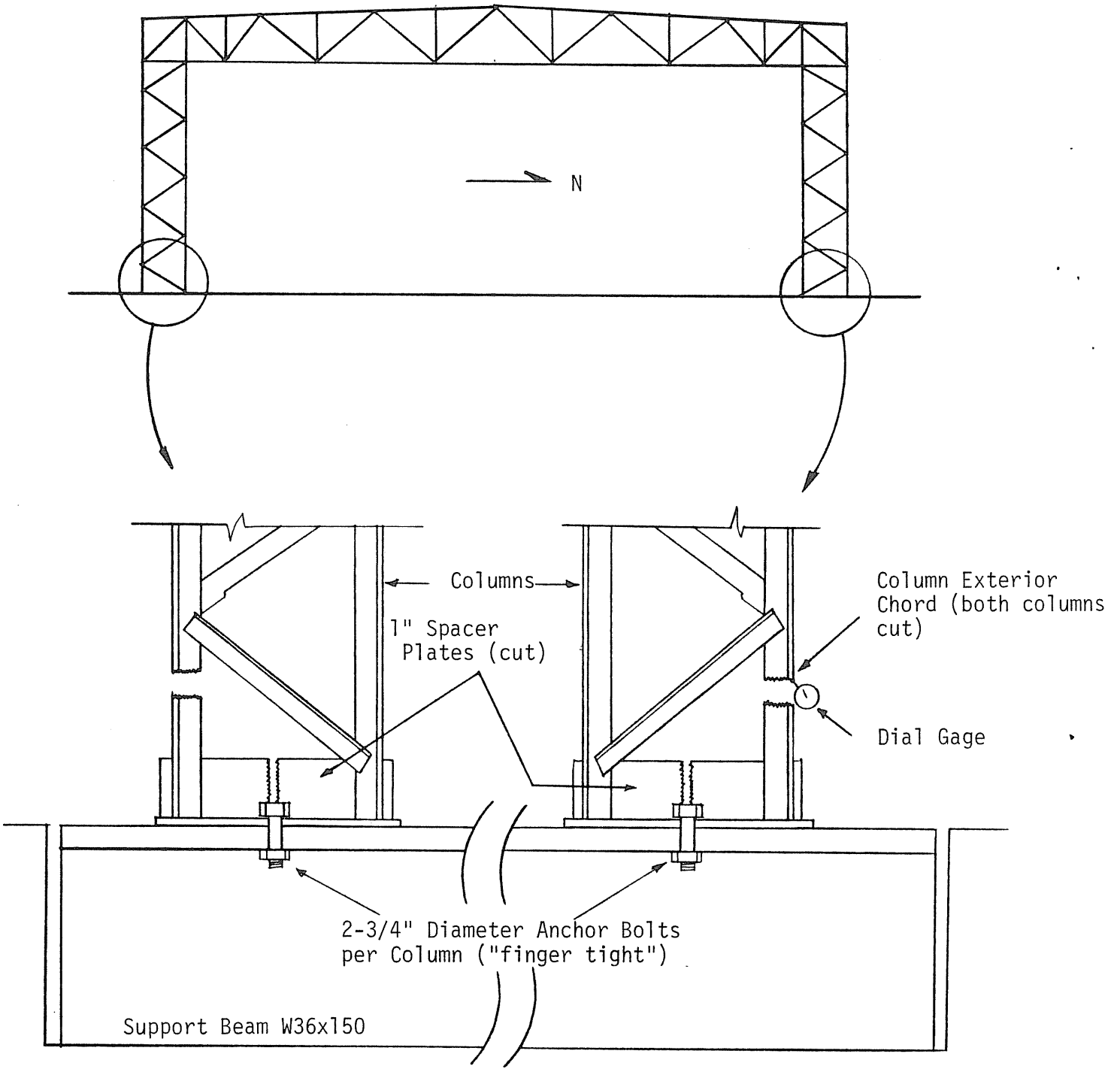


FIGURE C.1 COLUMN BASE DETAILS

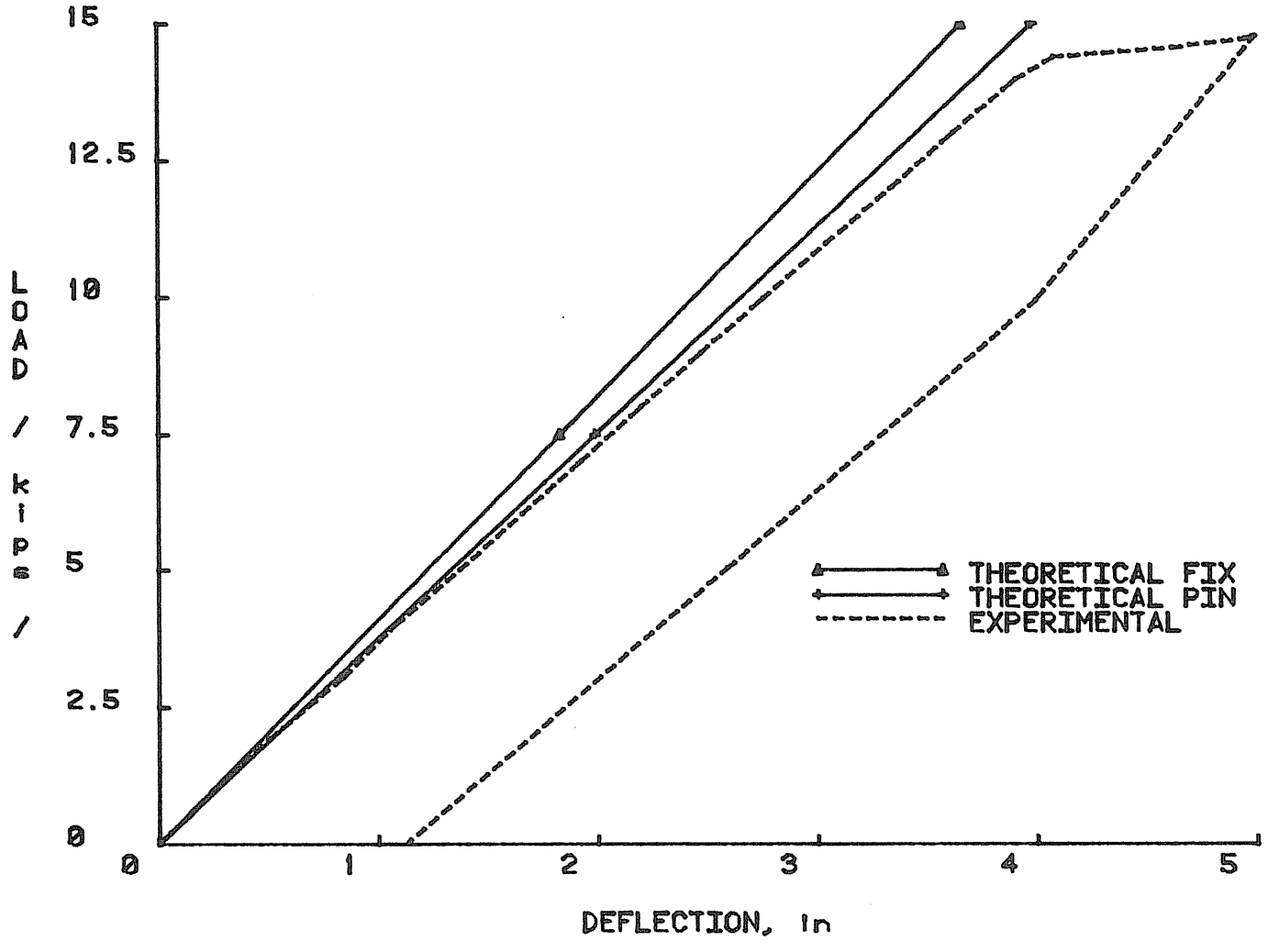


FIGURE C.2 LOAD VS. CENTERLINE DEFLECTION, TEST PBP3

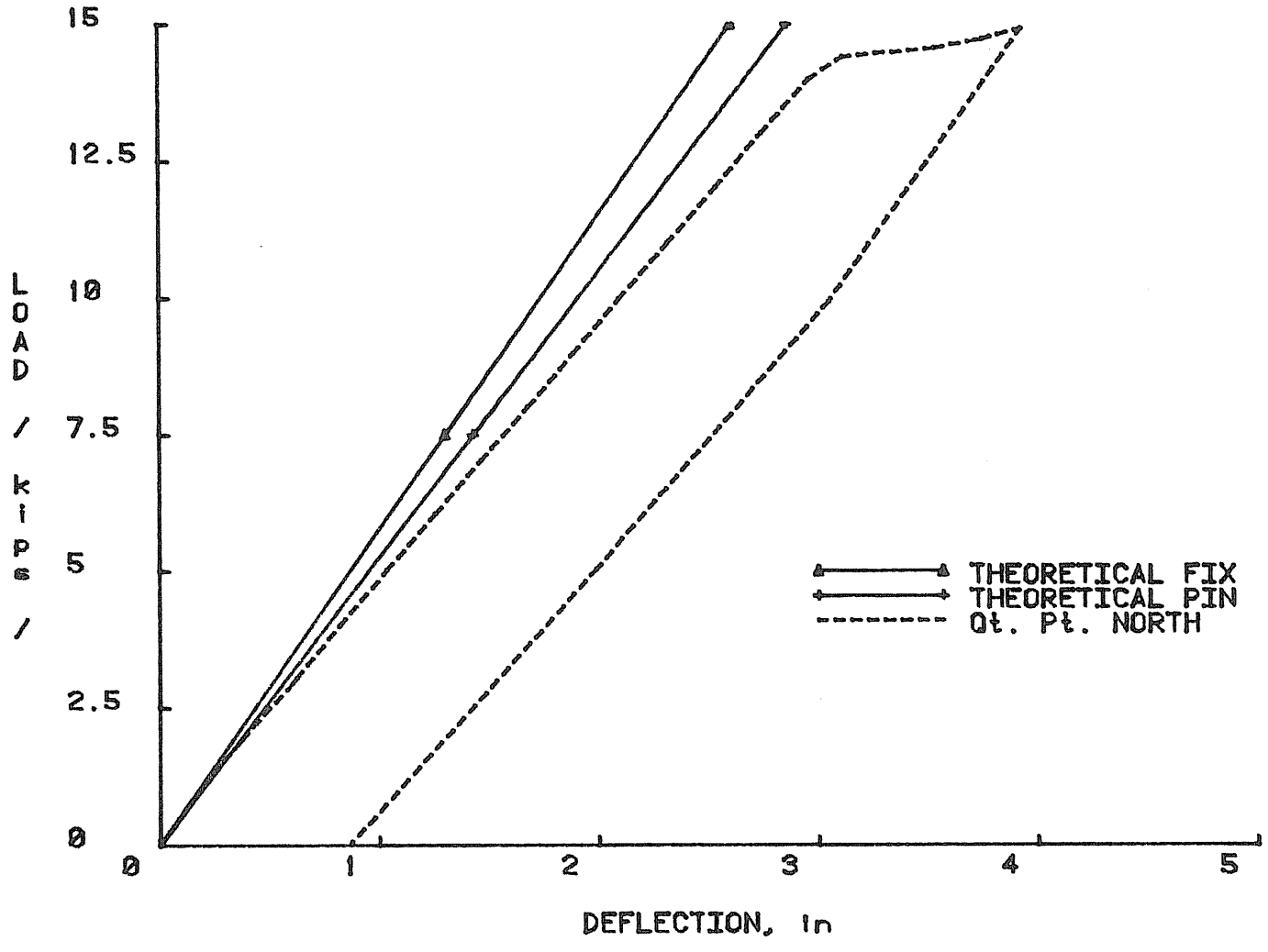


FIGURE C.3 LOAD VS. QUARTERPOINT DEFLECTION, TEST PBP3

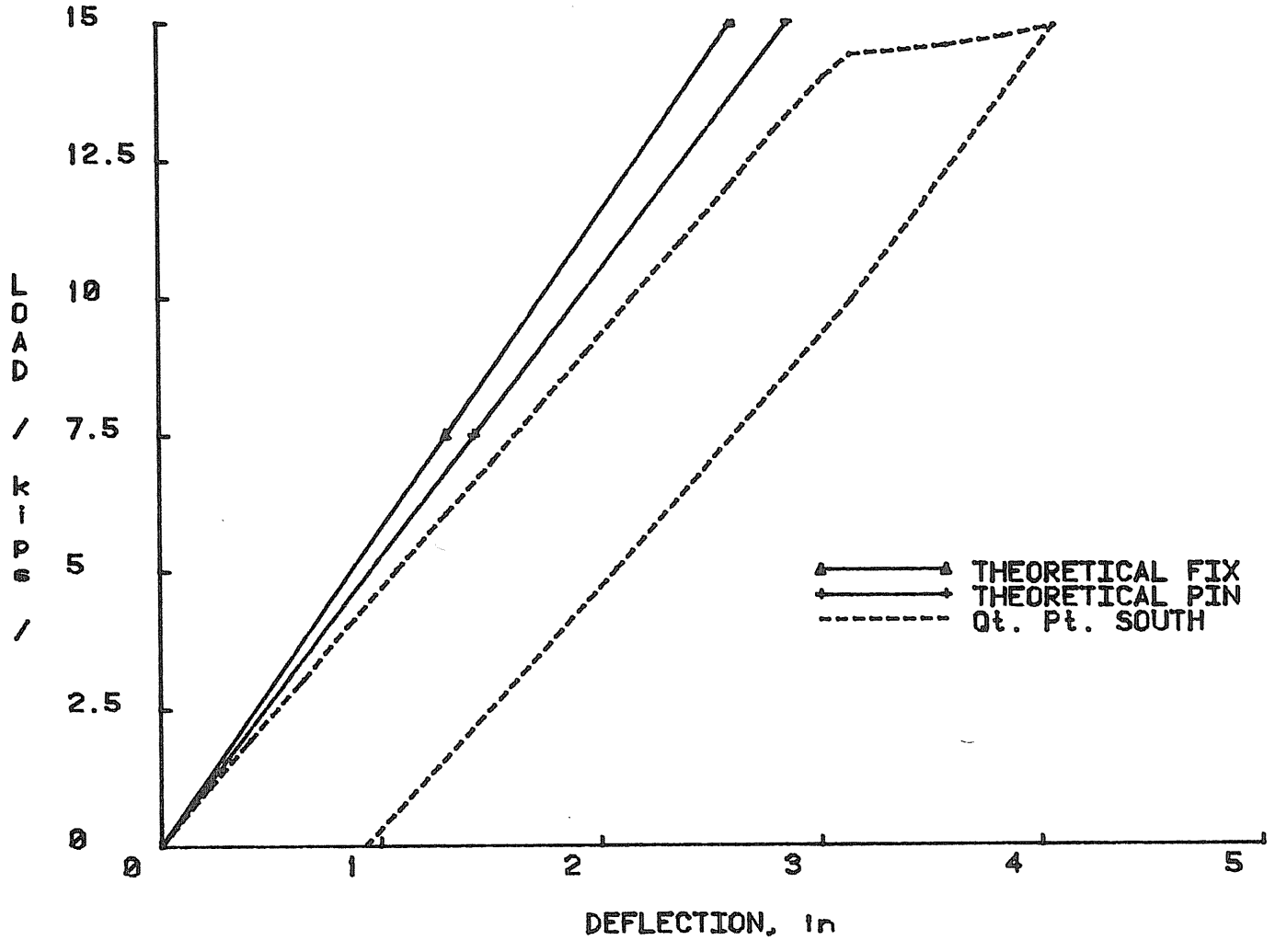


FIGURE C.4 LOAD VS. QUARTERPOINT DEFLECTION, TEST PBP3

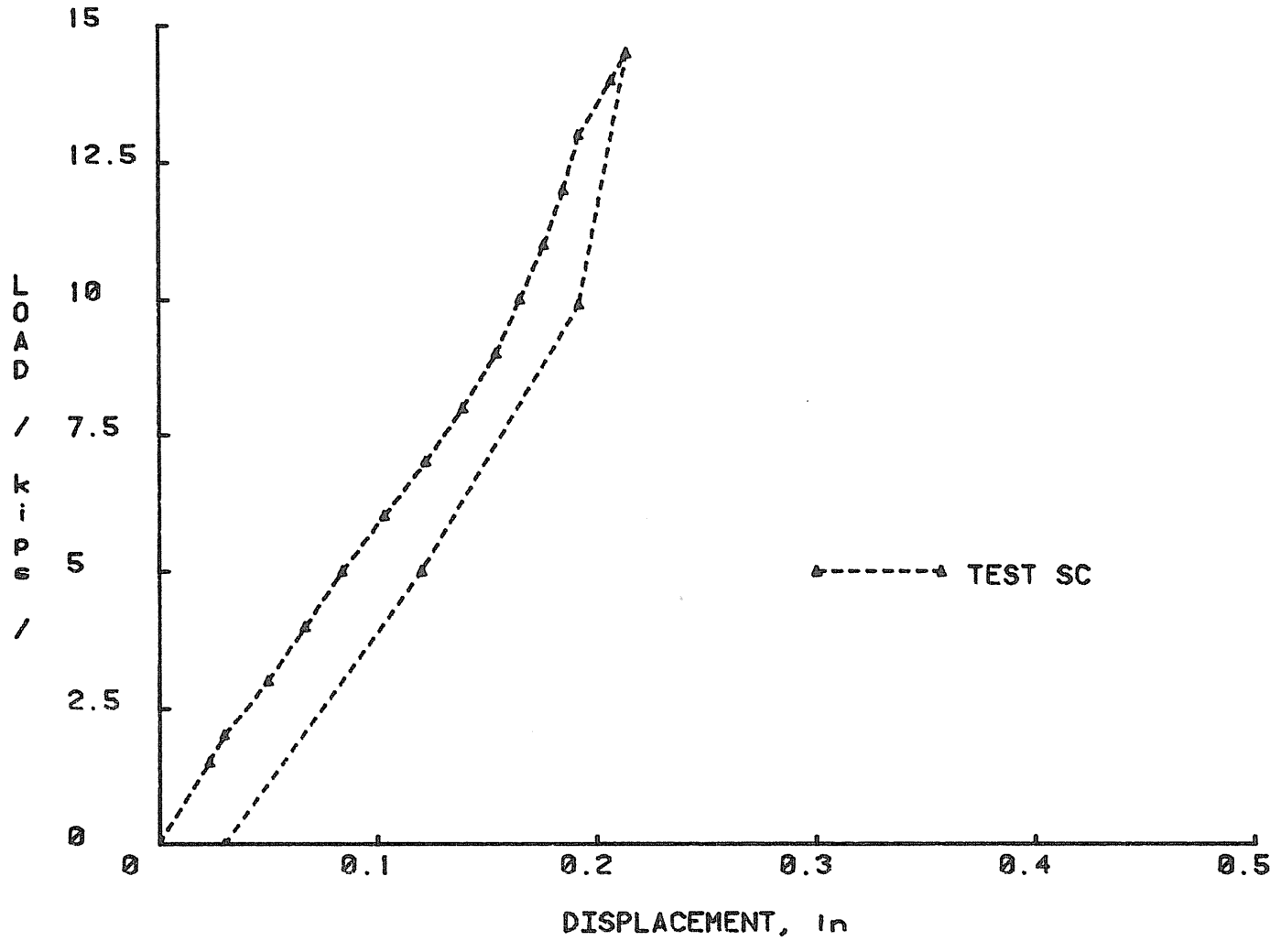


FIGURE C.5 LOAD VS. COLUMN EXTERIOR CHORD OPENING, TEST PBP3

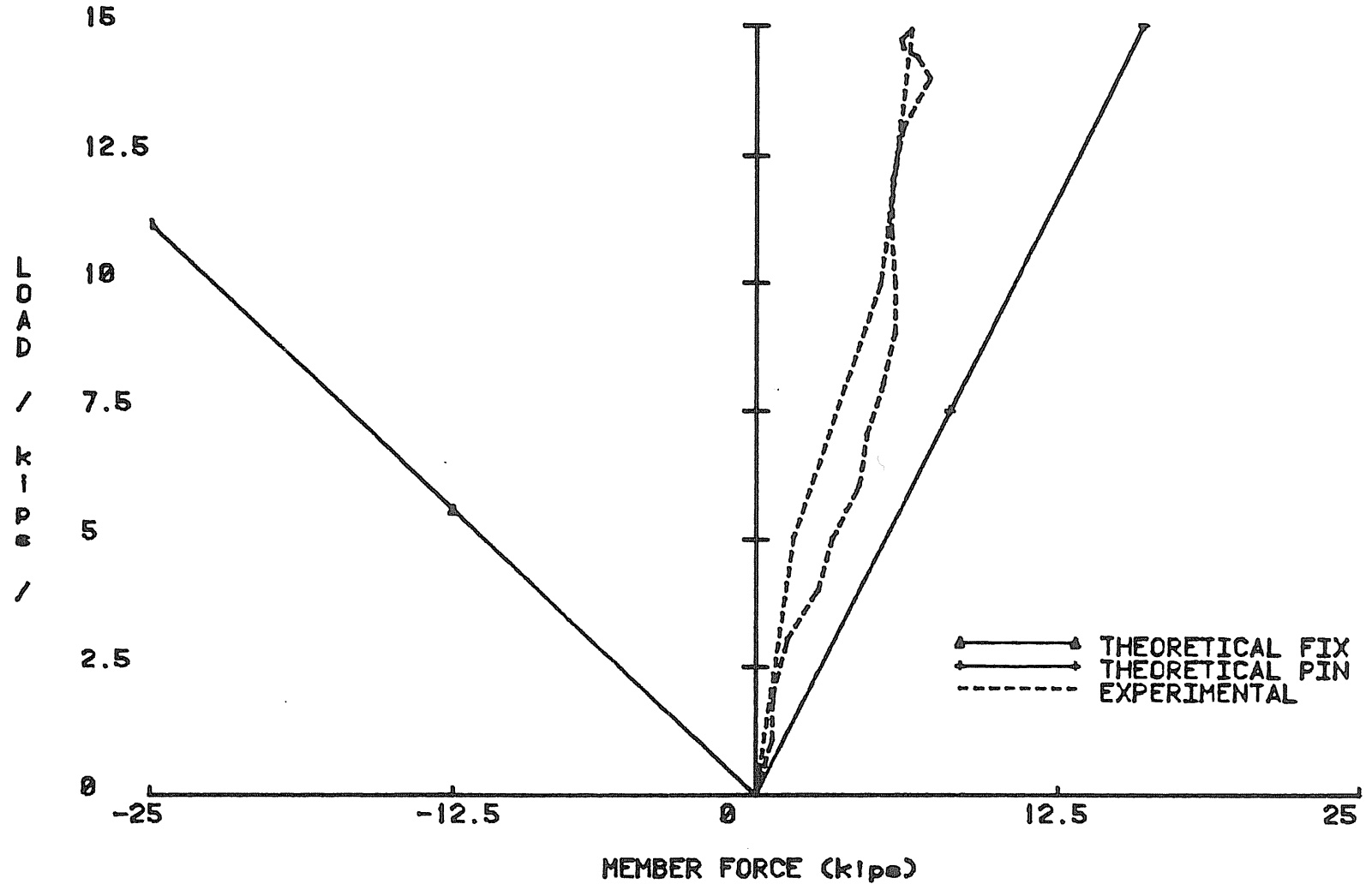


FIGURE C.6 LOAD VS. MEMBER #2 FORCE, TEST PBP3

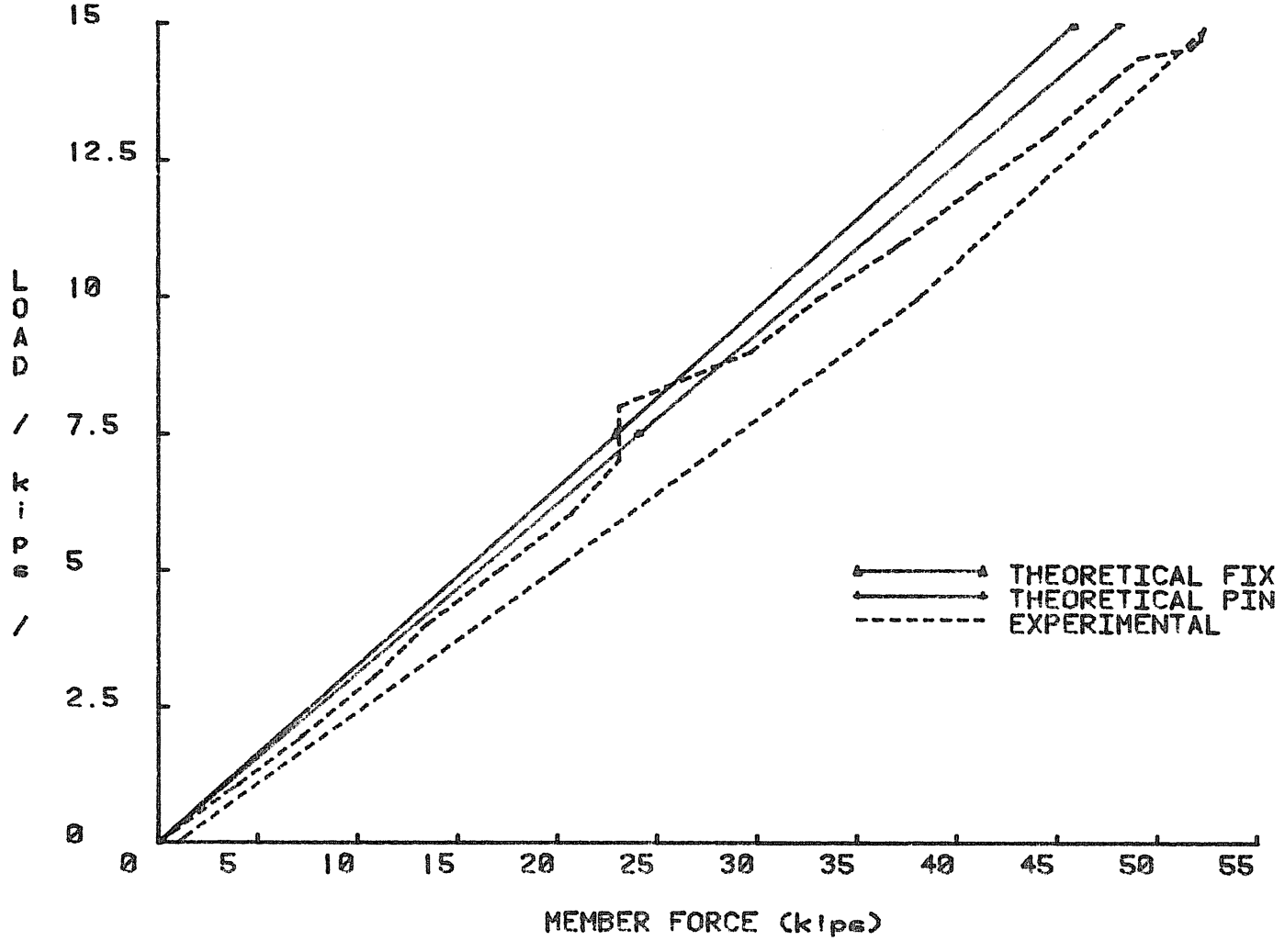


FIGURE C.7 LOAD VS. MEMBER #4 FORCE, TEST PBP3

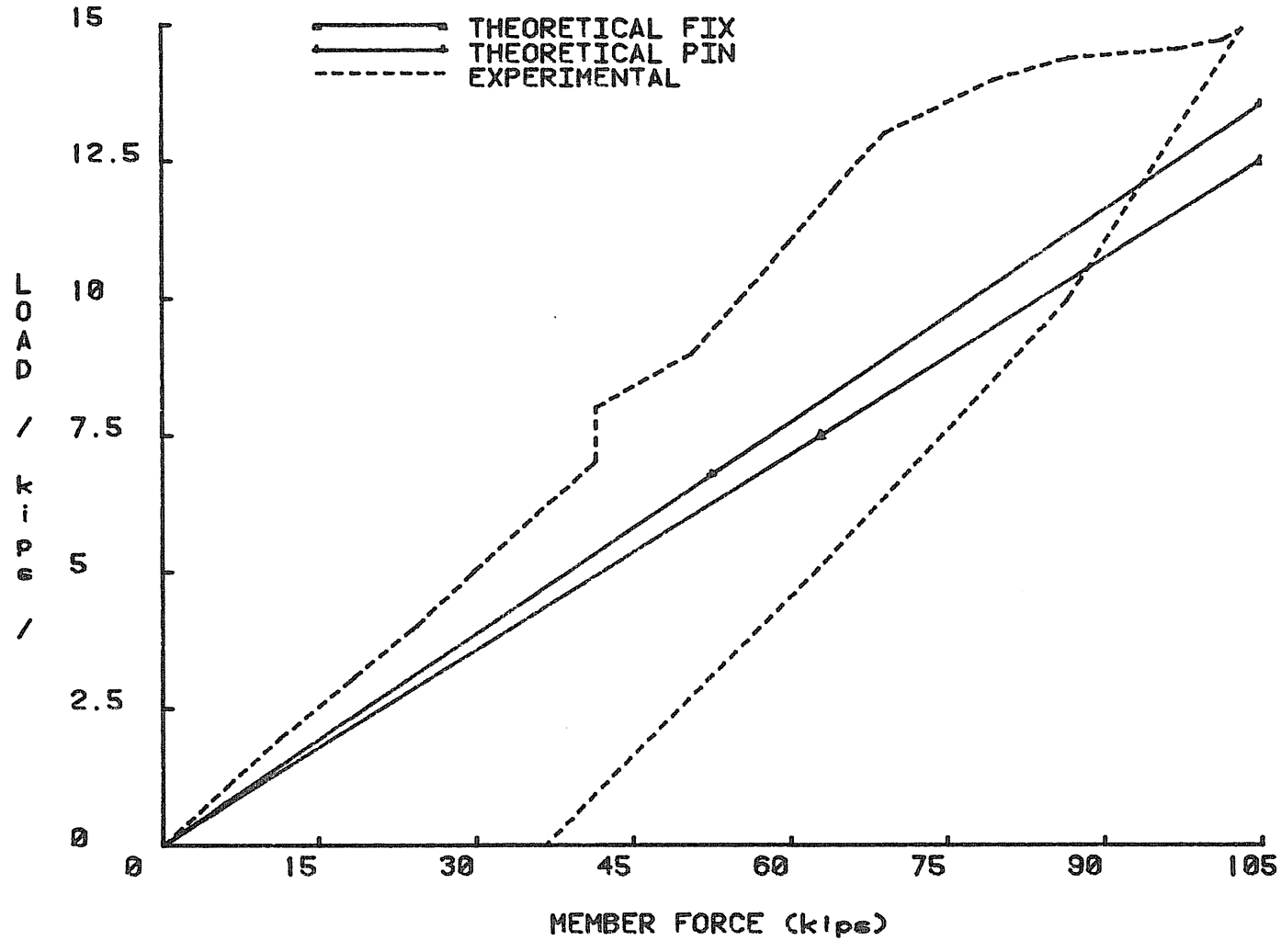


FIGURE C.8 LOAD VS. MEMBER #24 FORCE, TEST PBP3

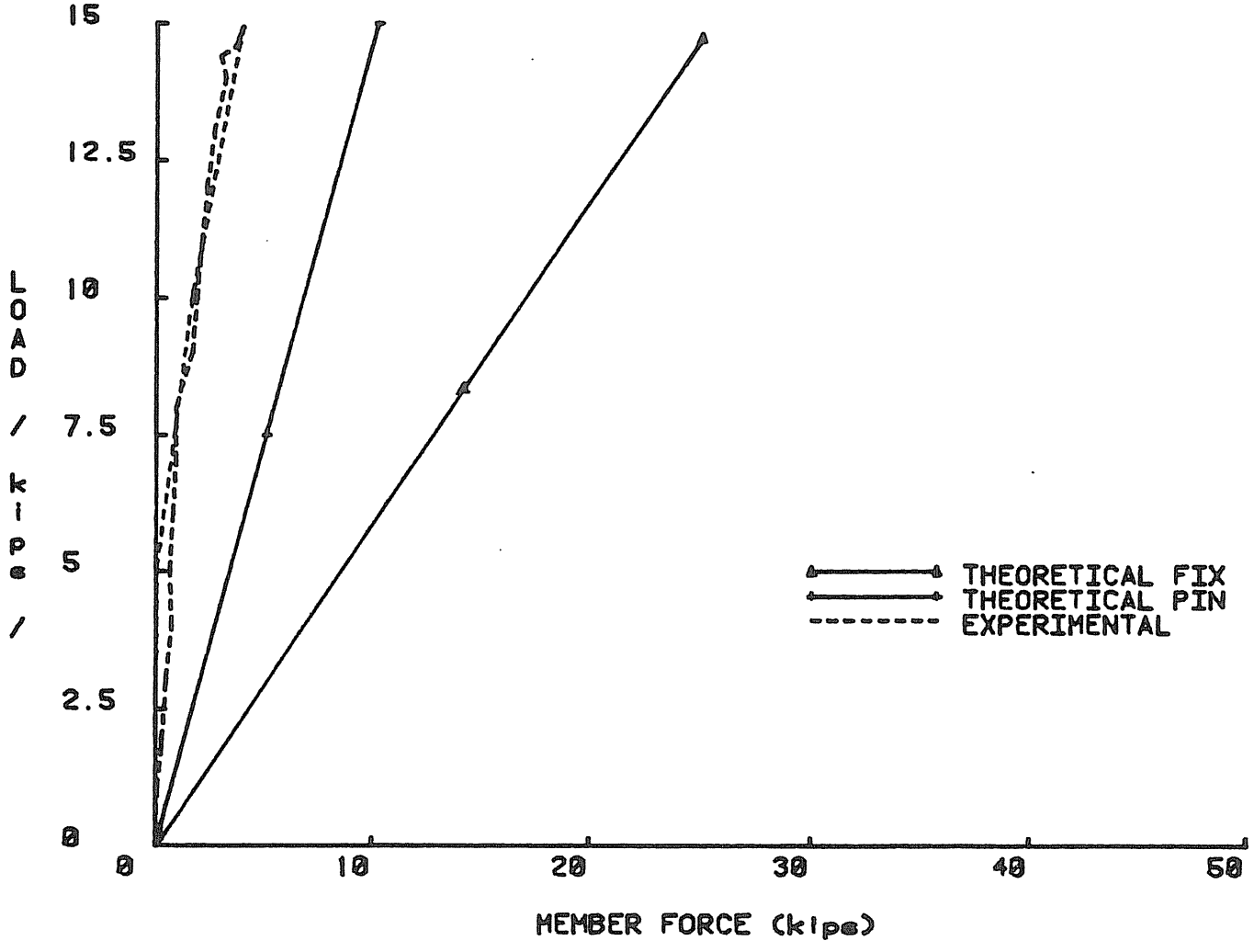


FIGURE C.9 LOAD VS. MEMBER #39 FORCE, TEST PBP3

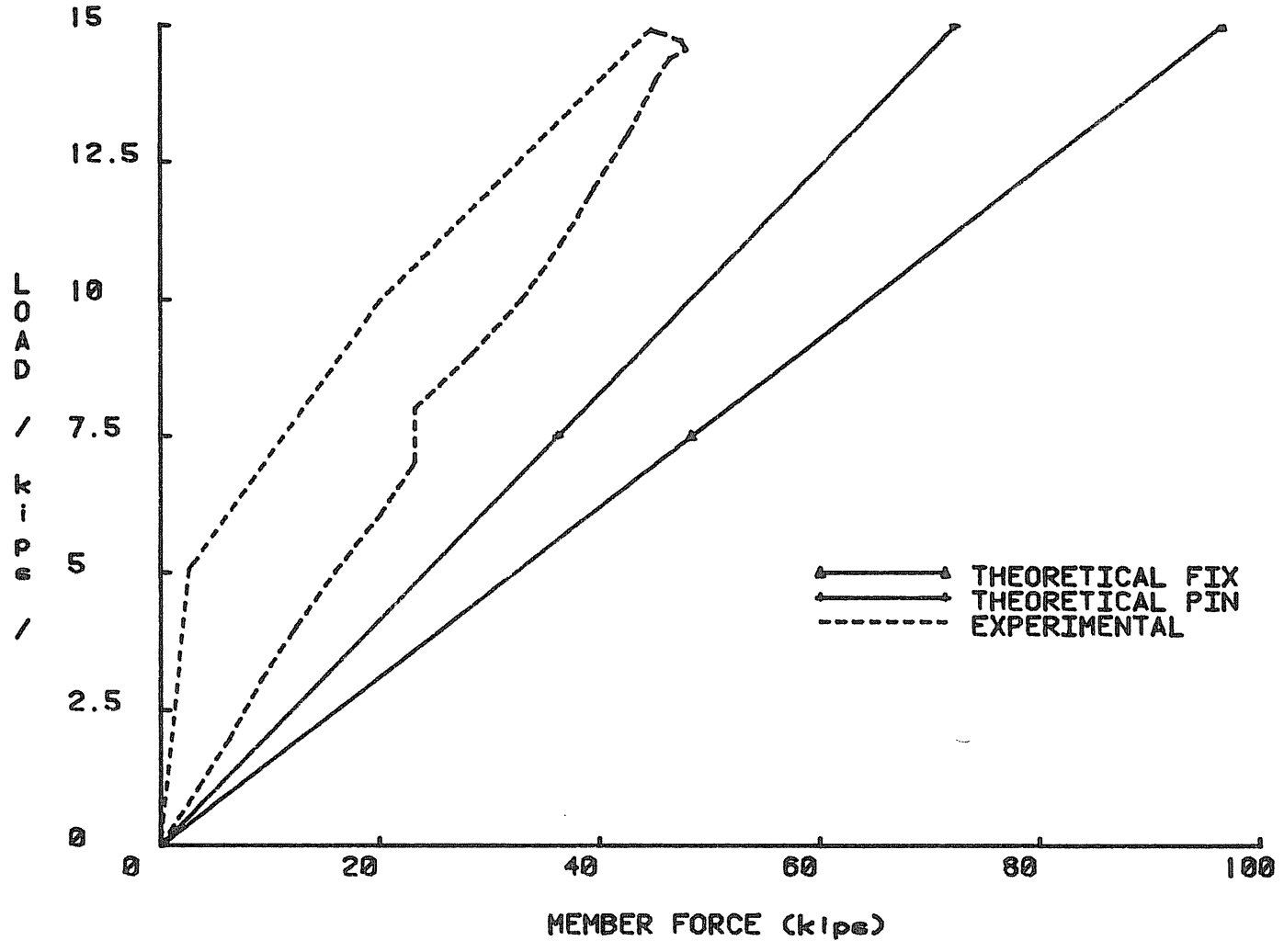


FIGURE C.10 LOAD VS. MEMBER #46 FORCE, TEST PBP3

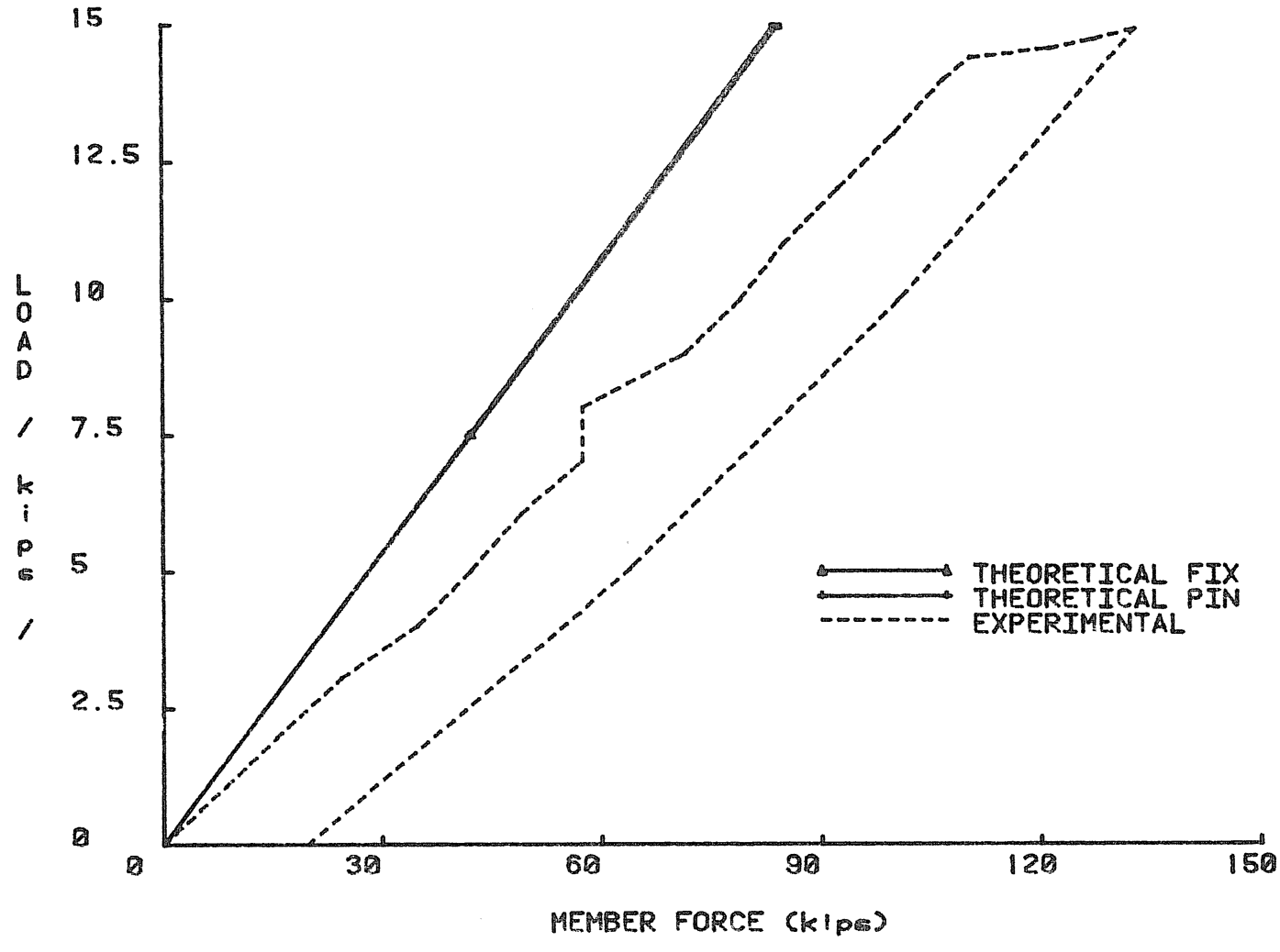


FIGURE C.11 LOAD VS. MEMBER #48 FORCE, TEST PBP3