

University of Alberta
Department of Civil &
Environmental Engineering



Structural Engineering Report No. 71

Experimental Data for Concrete Masonry Walls

by
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September, 1978

THE UNIVERSITY OF ALBERTA
EXPERIMENTAL DATA FOR CONCRETE MASONRY WALLS

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EDMONTON, ALBERTA

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ABSTRACT

As part of a research program to study the behaviour of "concrete masonry walls", 68 walls with h/t ratio varying from 12 to 22 (nominal) were tested at the I.F. Morrison Structural Engineering Laboratory of the University of Alberta.

The primary objective of these tests was to investigate the strength and the factors affecting the structural performance of the walls under various combinations of vertical load and bending moments. The analysis of the test results is presented in Structural Engineering Report No. 70 of the Civil Engineering Department of the University of Alberta.

In this report the data obtained from the experimental investigation are presented in the form of computer plotted figures of load-deflection, load-deformation and load-reinforcing steel strains.

ACKNOWLEDGEMENTS

This investigation was made possible through funds from both the Natural Sciences and Engineering Research Council of Canada and the Alberta Masonry Institute, with additional facilities provided by the Department of Civil Engineering.

This report was prepared by M. Hatzinikolas as a doctoral thesis under the joint direction of Profs. Longworth and Warwaruk.

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CHAPTER I

Introduction

The data presented in this report supplement the analysis and conclusions reached in Structural Engineering Report No. 70 of the Department of Civil Engineering of the University of Alberta. The data refers to full scale walls tested with pin-end conditions in axial compression or in double or single curvature. The data are presented in four groups namely deflected shapes, vertical deformations, reinforcing strains, masonry strains.

The test procedure and physical properties of the walls are given in Report No. 70, where also the instrumentation of the test specimens is described.

The investigation of the behaviour of plain and reinforced concrete masonry walls also included tests on small specimens and mortars, the results of which are included in Report No. 70.

CHAPTER II

Test Data

2.1 Introduction

The data were recorded and processed automatically using a NOVA computer. After processing the data were transferred to the AMDAHL 470 computer for further processing and it is in the form of computer plotting that the data are reported here. The data are also available in the form of tables but they are not included in this report.

2.2 Deflected Shapes

The deflected shape of each wall specimen was monitored at selected load levels. Figures 2.1 to 2.63 give the deflected shapes of most of the walls tested. The position of the load and reaction together with the length of the wall between supports is shown in a sketch.

2.3 Vertical Deformations

Vertical deformations were monitored by the movement of the piston of the M.T.S. testing machine with an accuracy of 0.0001" and were automatically recorded for selected load levels. The results are plotted in groups of similar walls in Figures 2.64 through 2.77.

2.4 Reinforcement Strains

Figures 2.78 to 2.107 show the strains in the reinforcement versus the total vertical load on the wall.

Strain gauges were attached to the reinforcing steel at locations where maximum strain was expected. In most cases, the values plotted are averages of three strain gauges positioned, one on each of the three reinforcing bars, at a particular height in the wall.

2.5 Masonry Strains

For a number of walls 4-inch concrete strain gauges were mounted in such a way as to include a mortar joint. One gauge was mounted on the compression face of the wall (when eccentrically loaded) and one on the tension side. Both strain gauges were at the same level. The results of these measurements are shown in Figures 2.108 to 2.115.

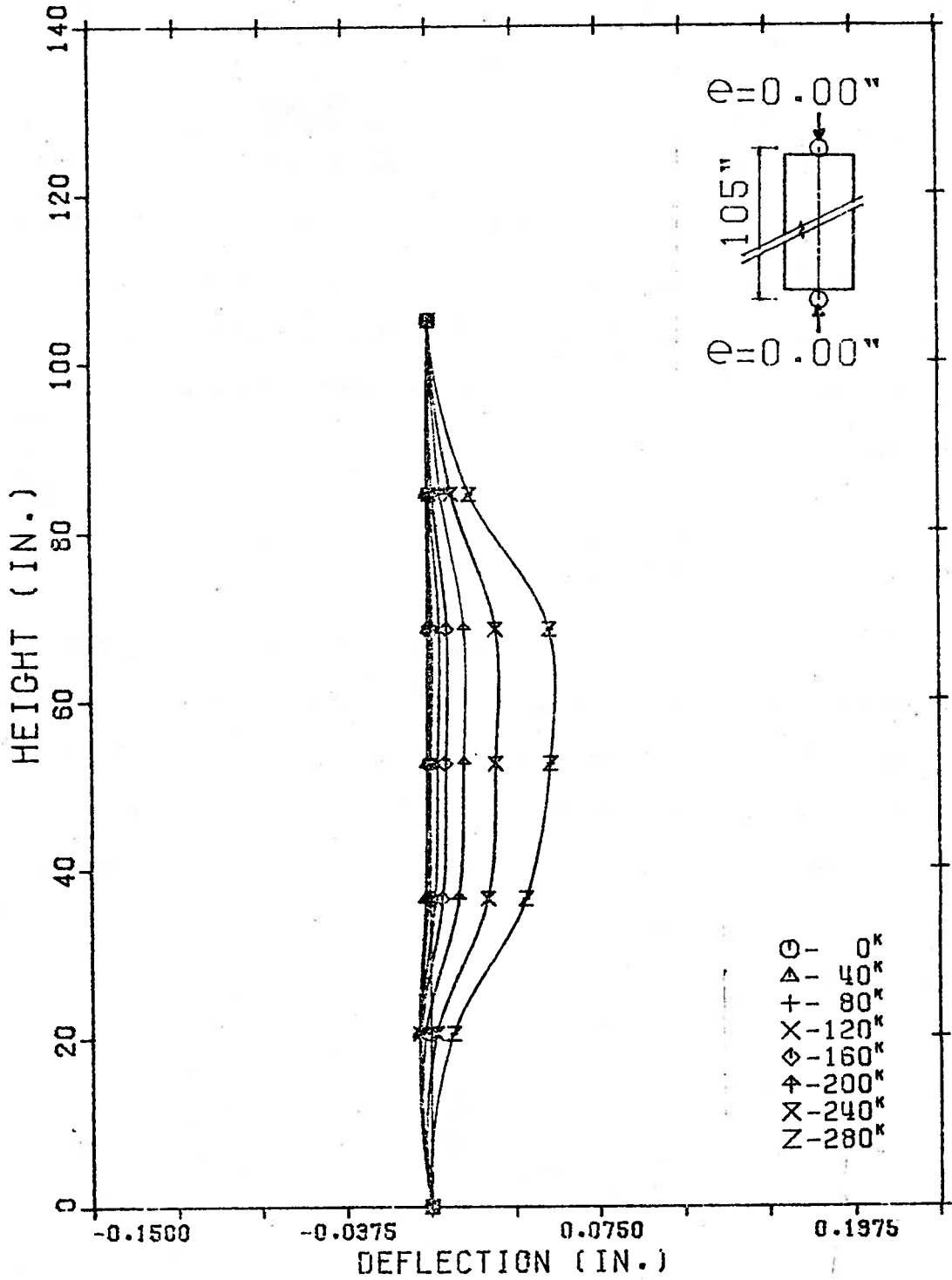


FIG. 2-1 Deflected Shape of Wall A1

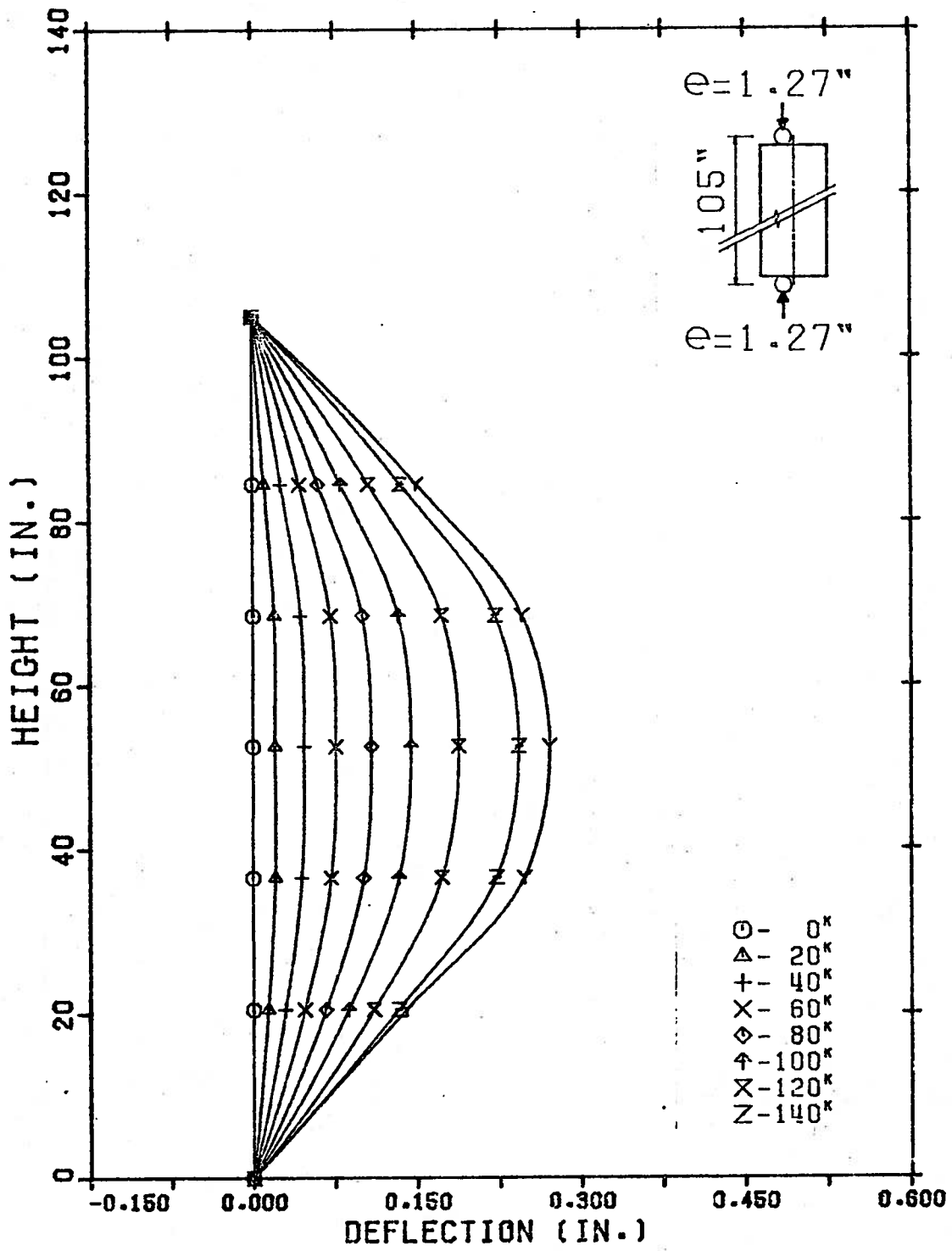


FIG. 2-2 Deflected Shape of Wall A2

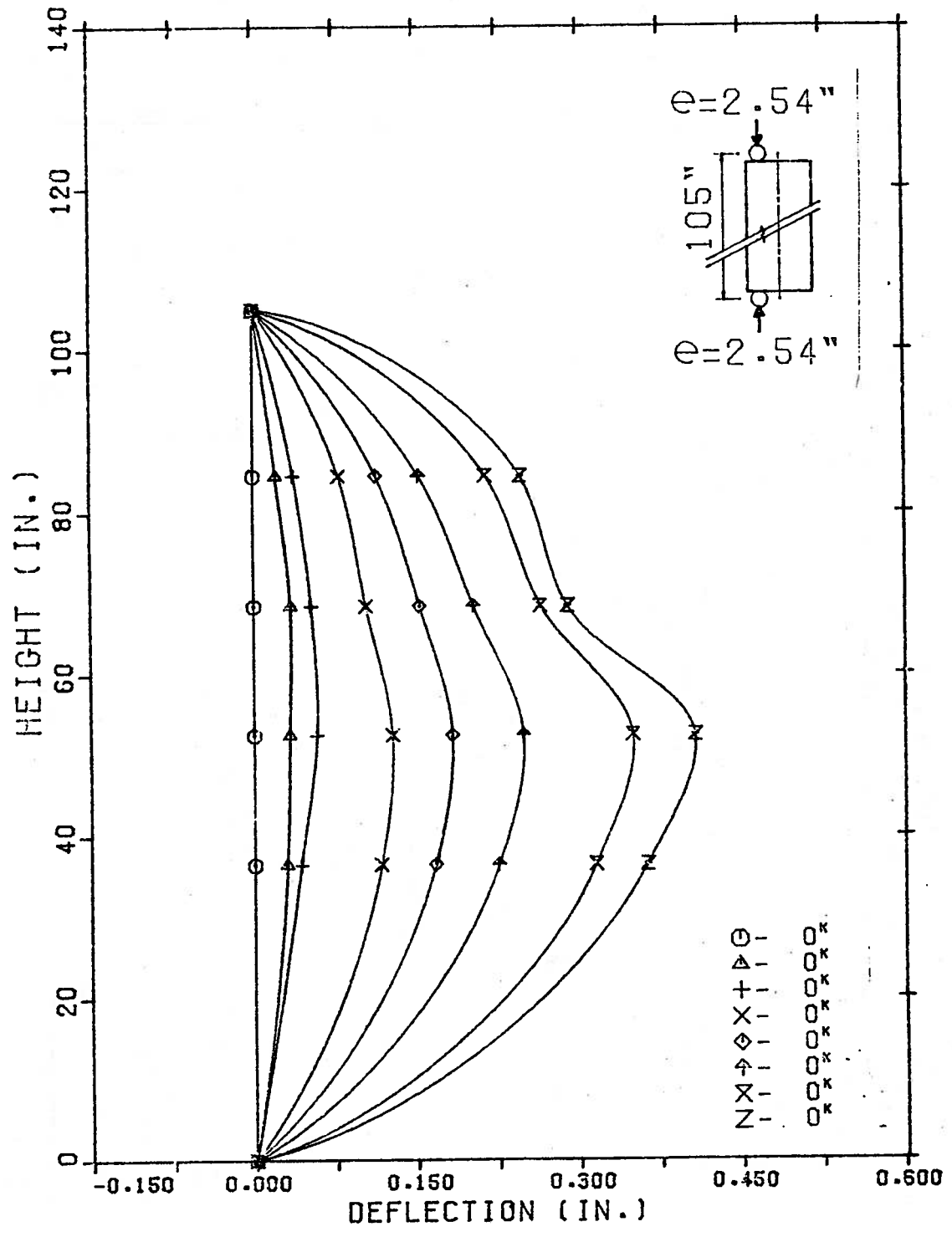


FIG. 2-3 Deflected Shape of Wall A3

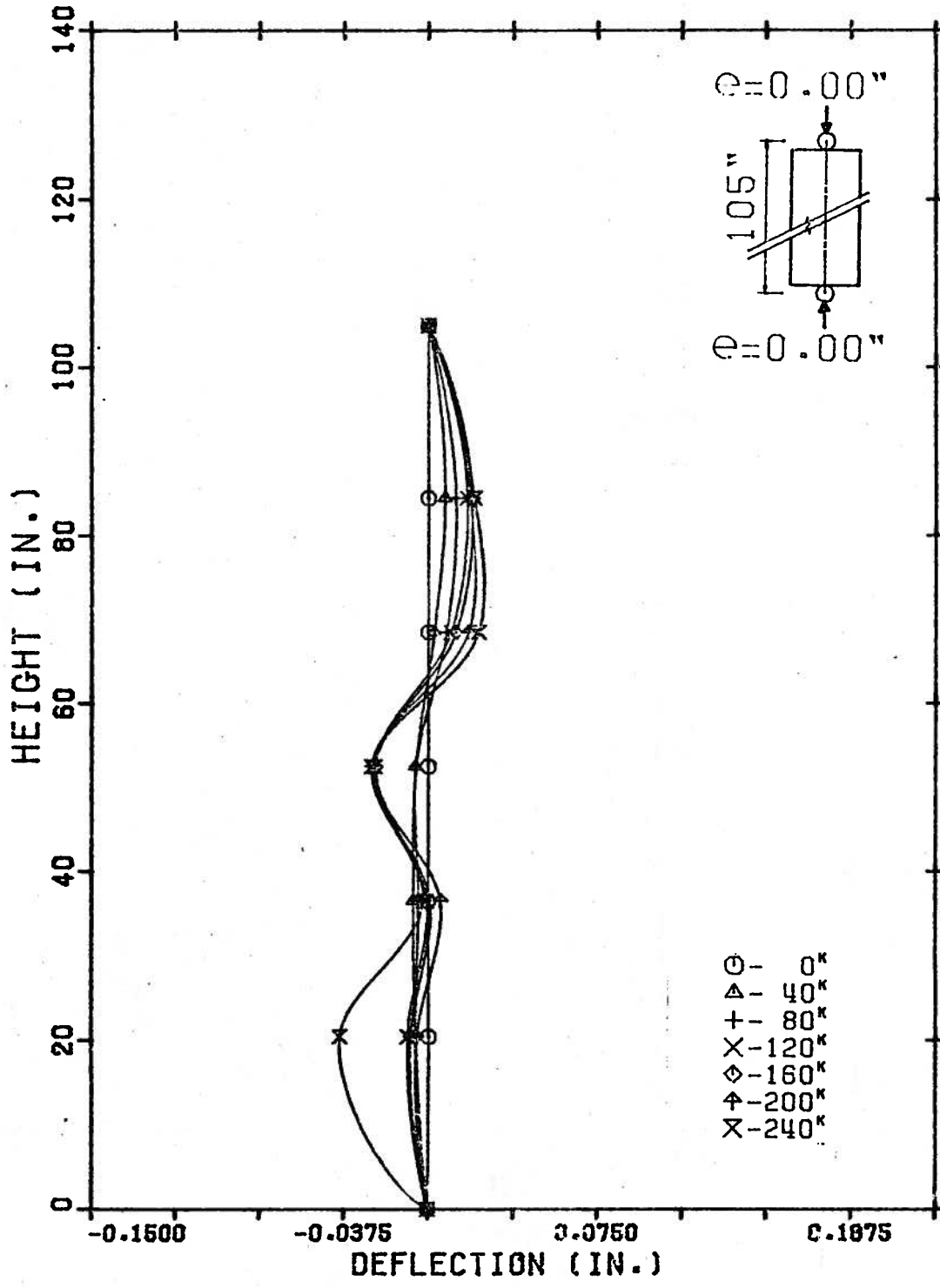


FIG. 2-4 Deflected Shape of Wall A4

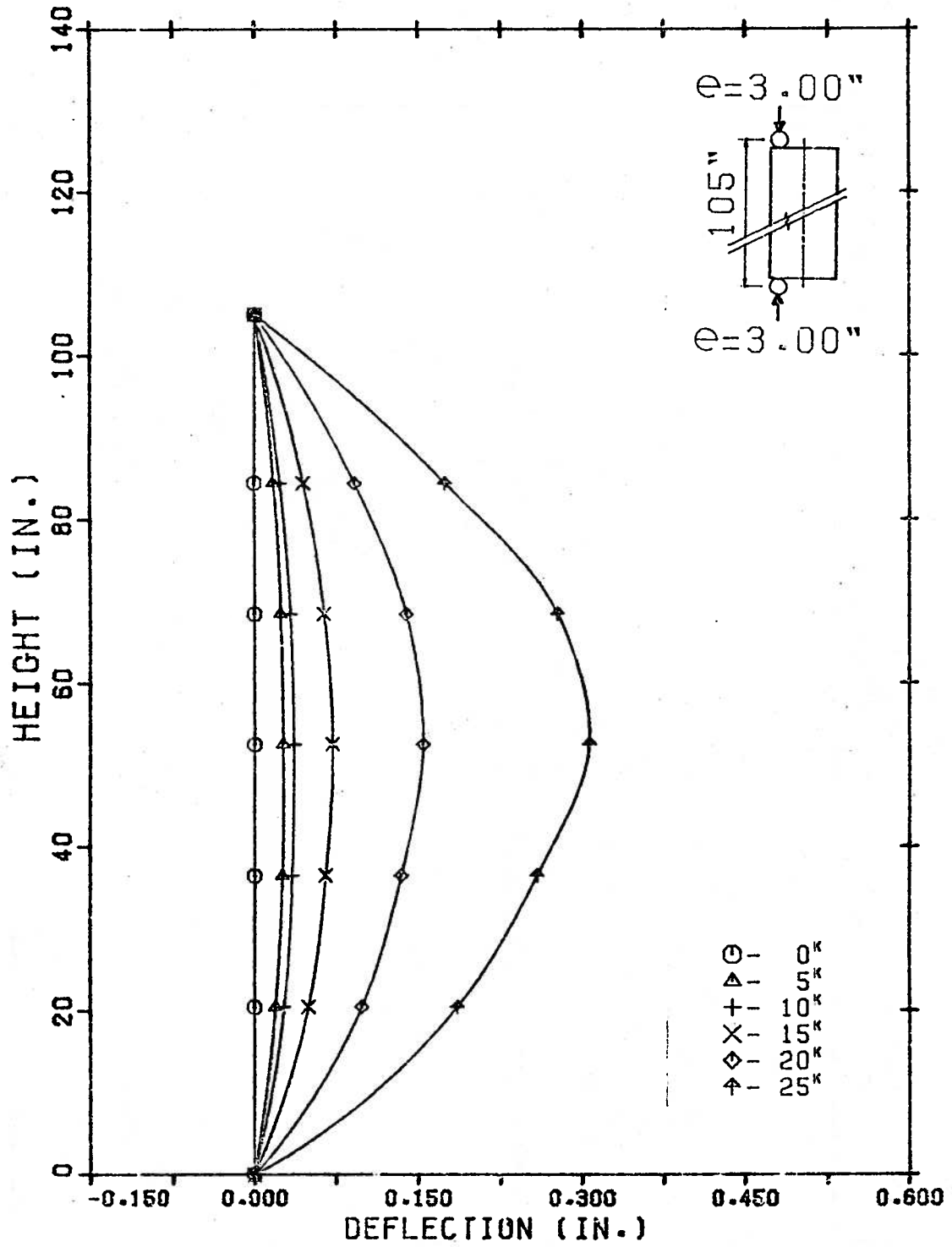


FIG. 2-5 Deflected Shape of Wall A5

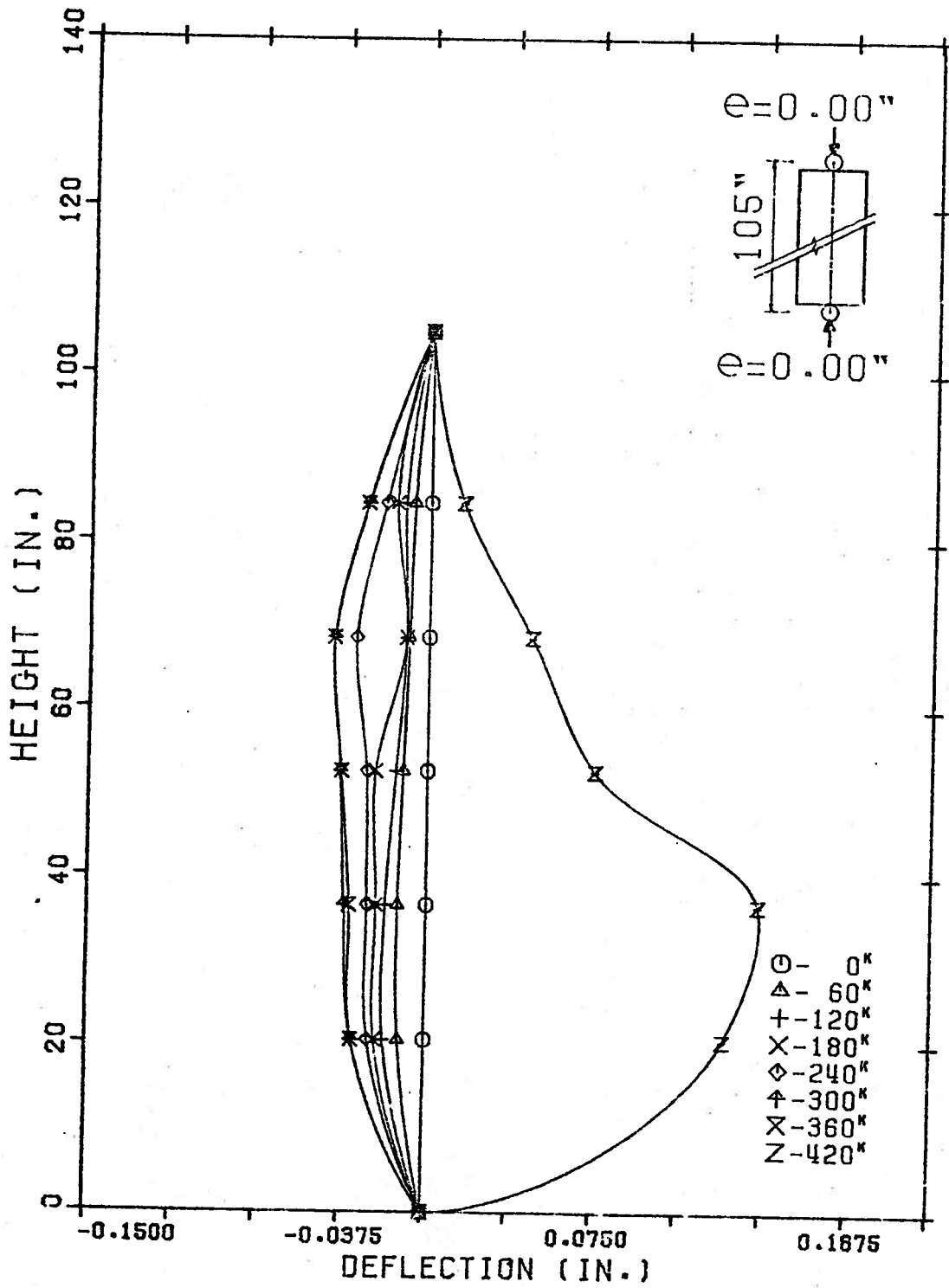


FIG. 2-6 Deflected Shape of Wall B1

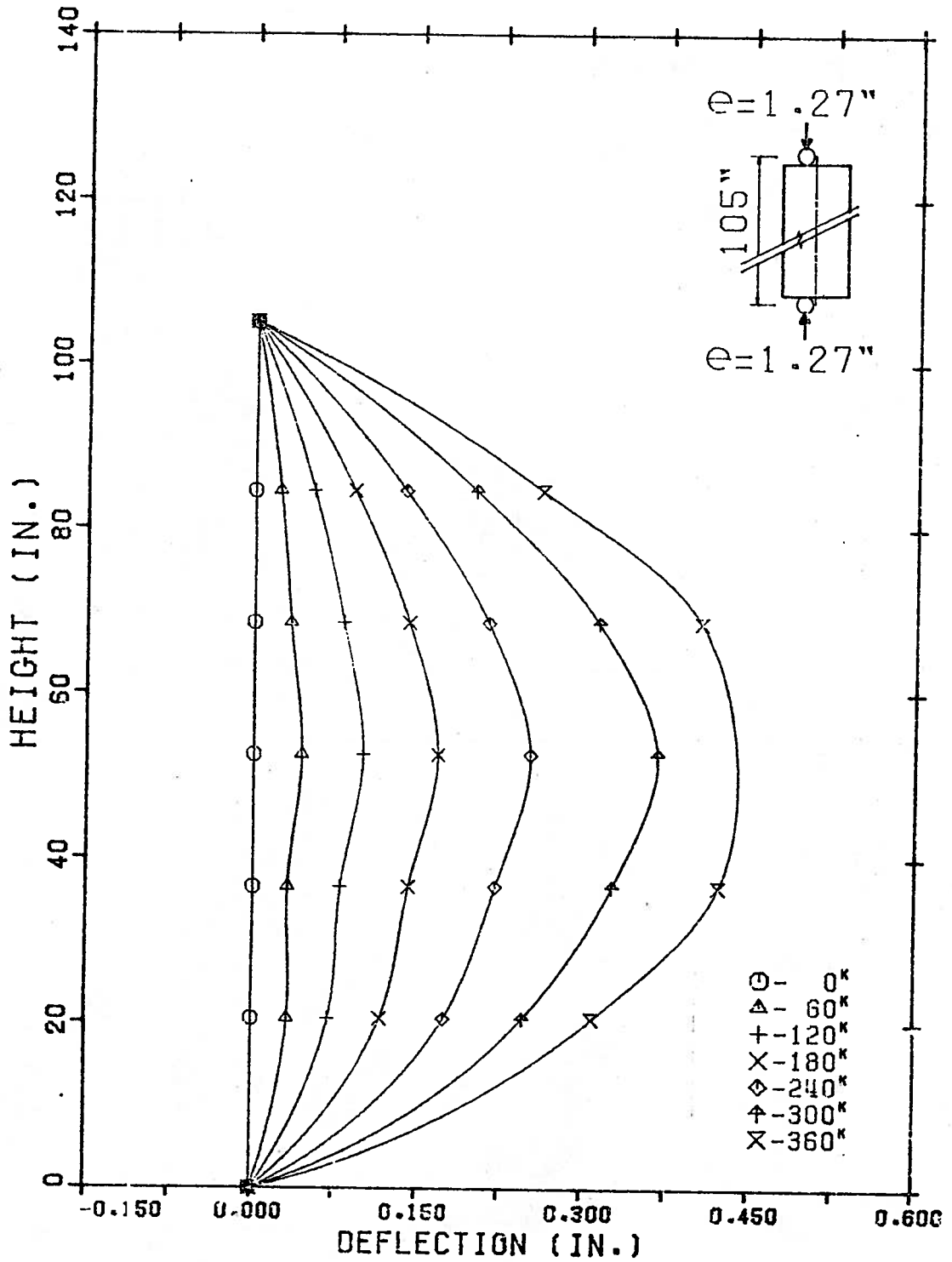


FIG. 2-7 Deflected Shape of Wall B2

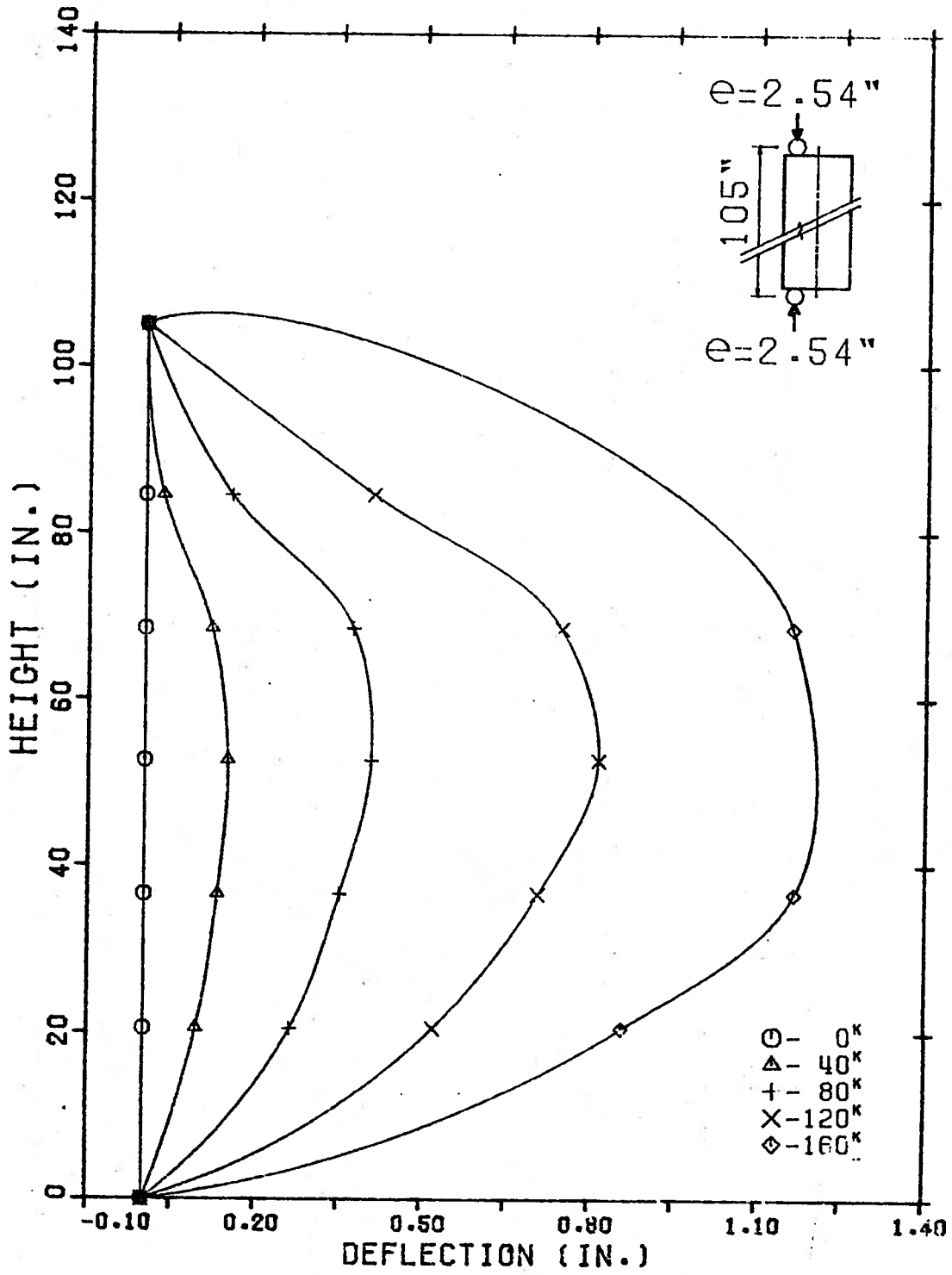


FIG. 2-8 Deflected Shape of Wall B3

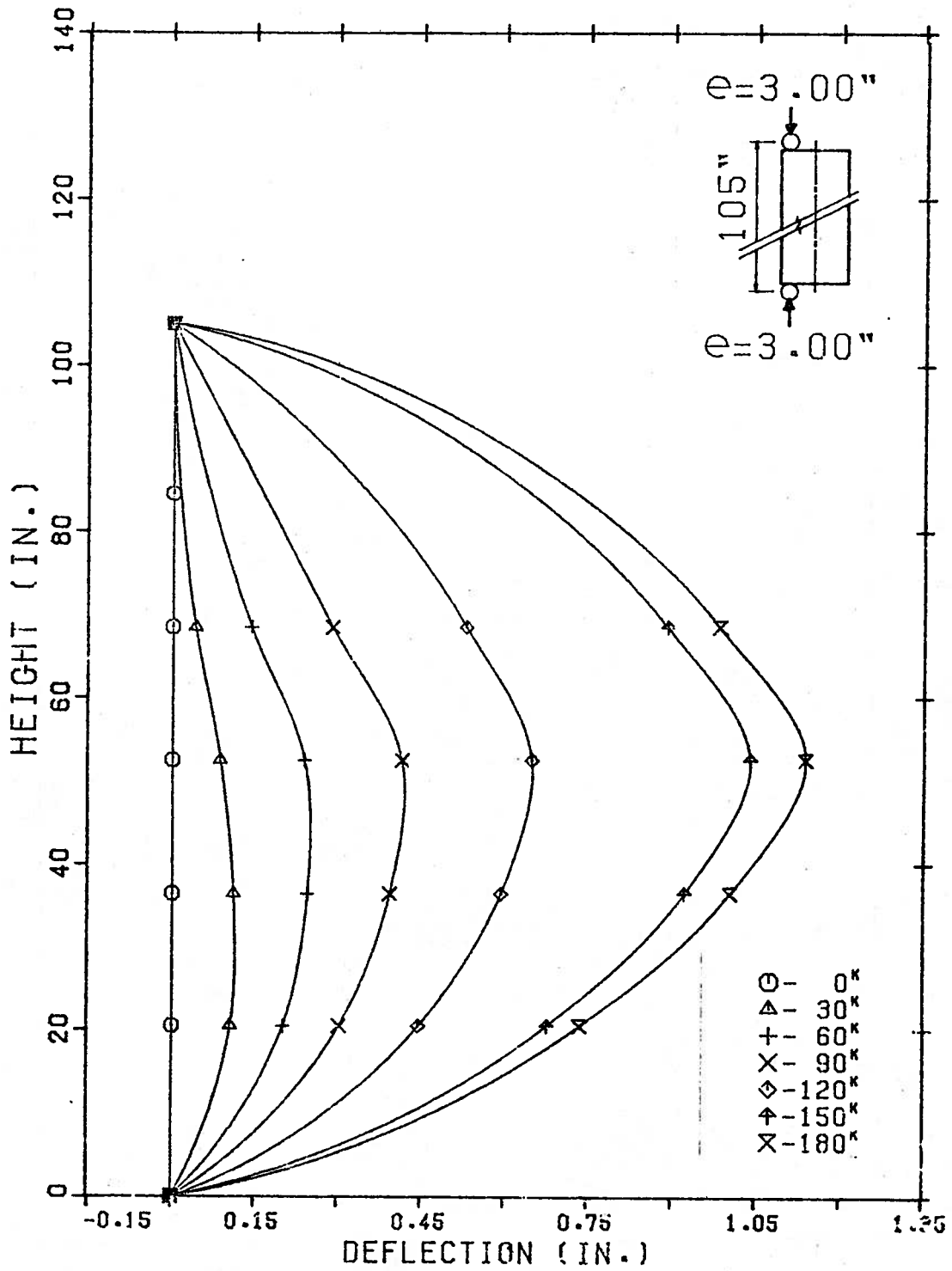


FIG. 2-9 Deflected Shape of Wall B4

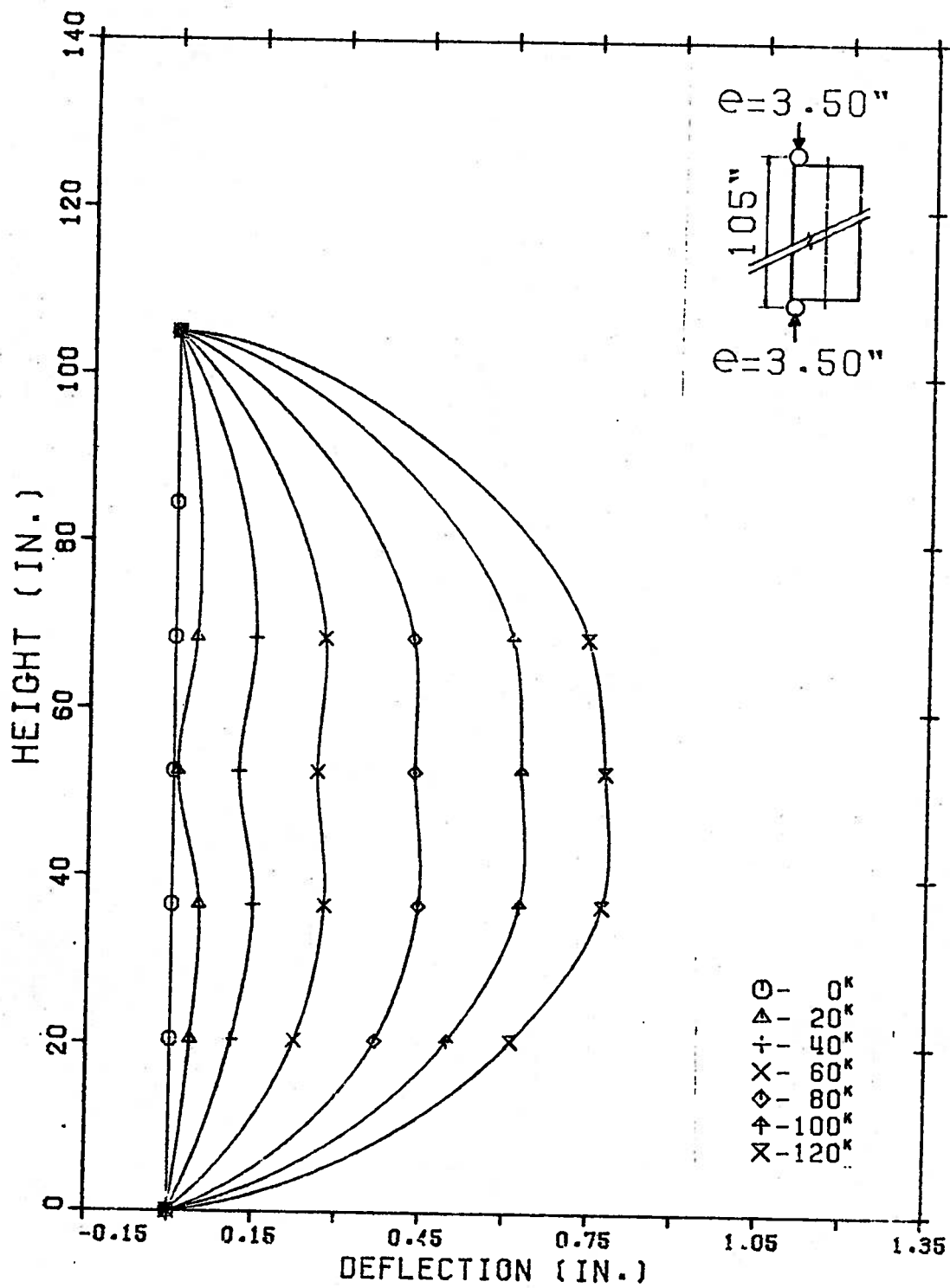


FIG. 2-10 Deflected Shape of Wall B5

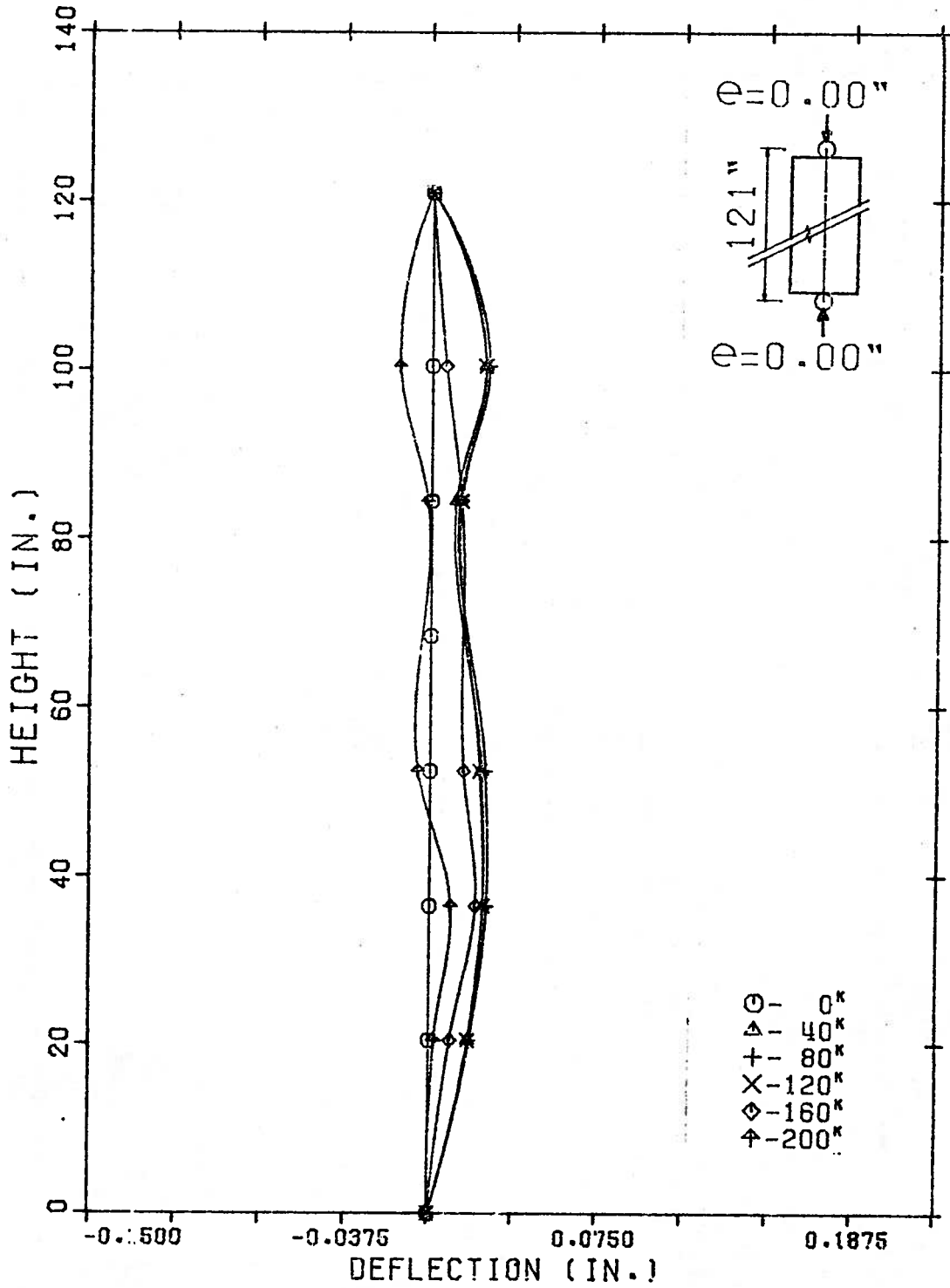


FIG. 2-11 Deflected Shape of Wall C1

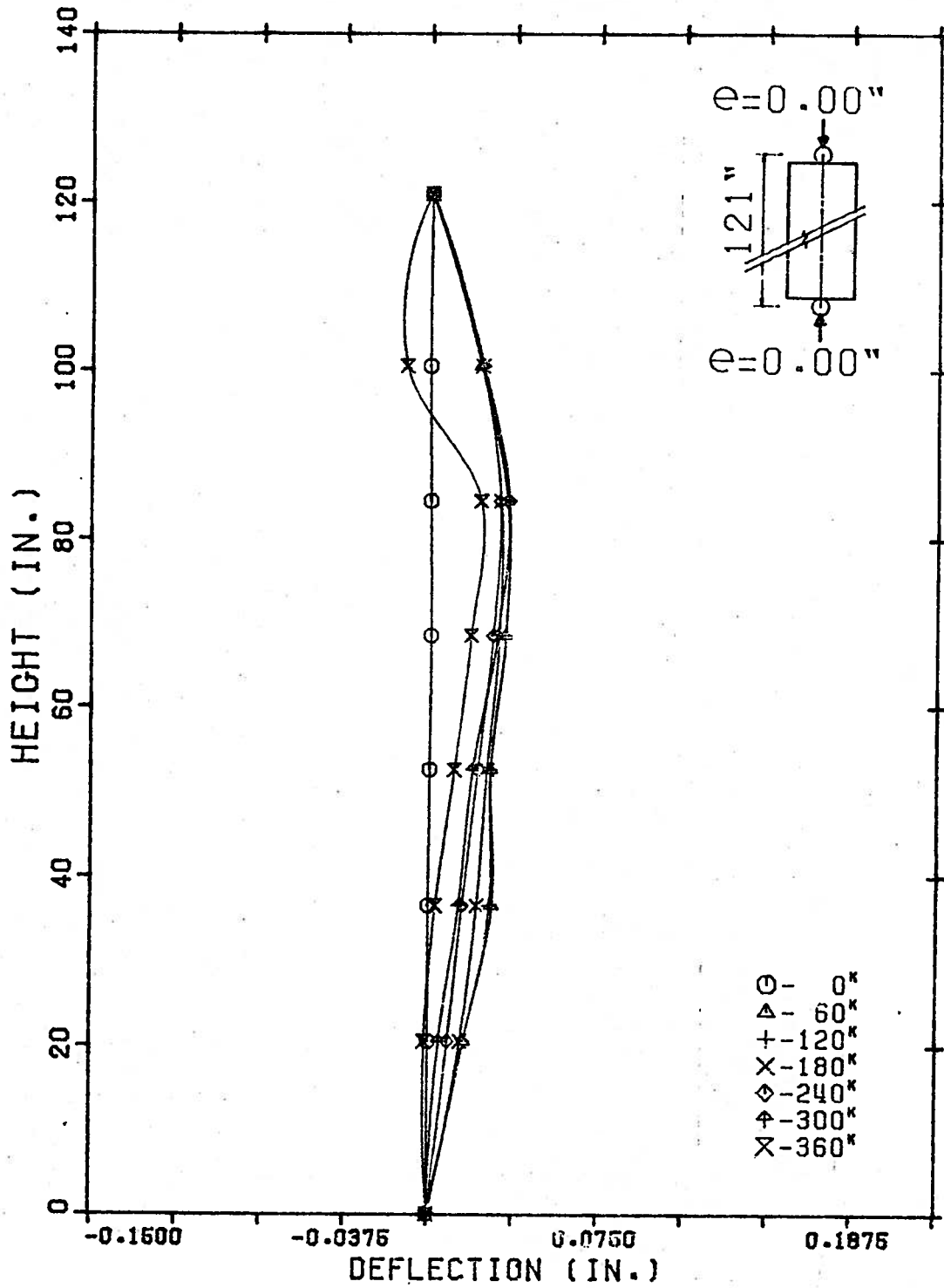


FIG. 2-12 Deflected Shape of Wall C2

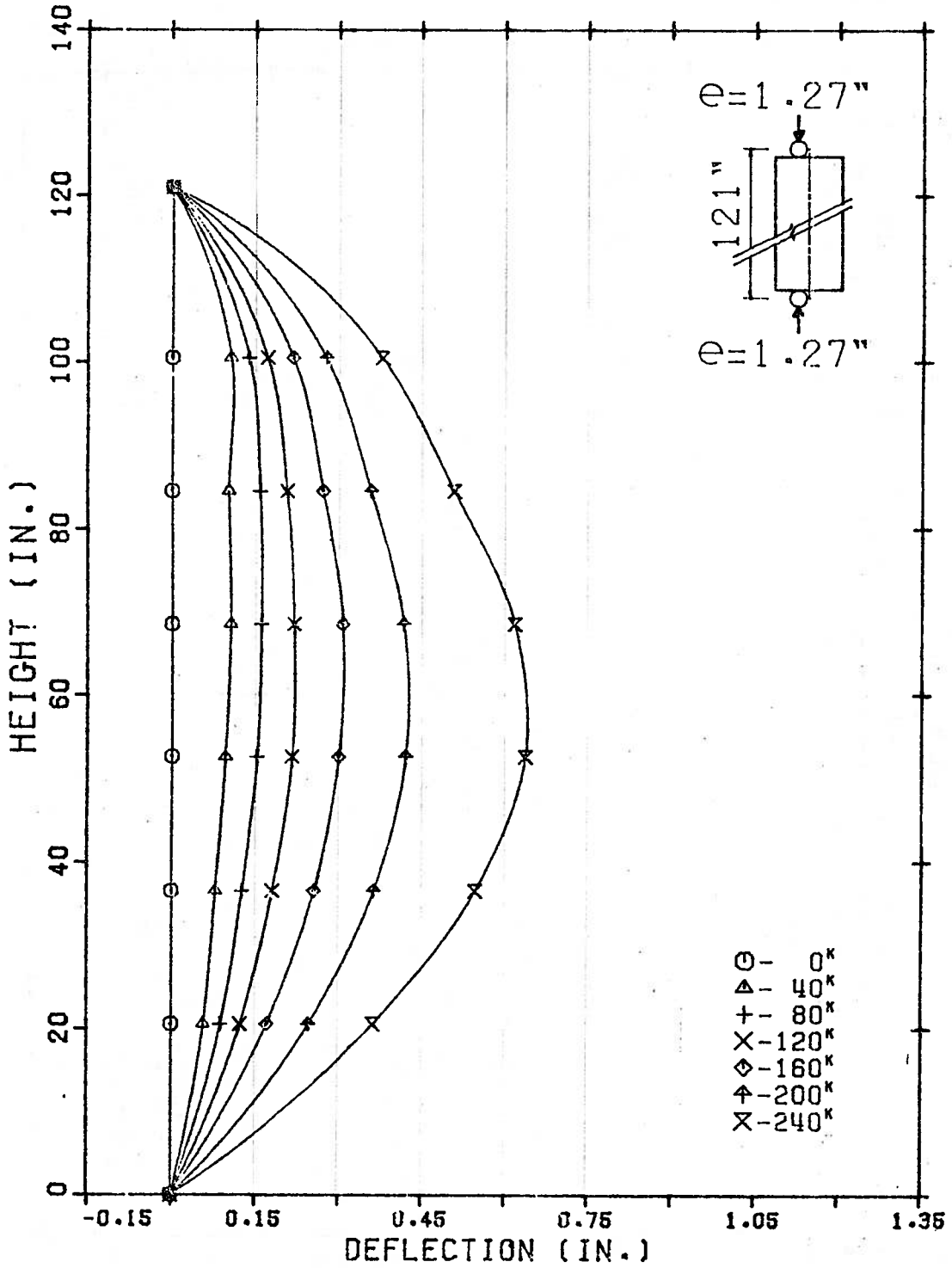


FIG. 2-13 Deflected Shape of Wall C3

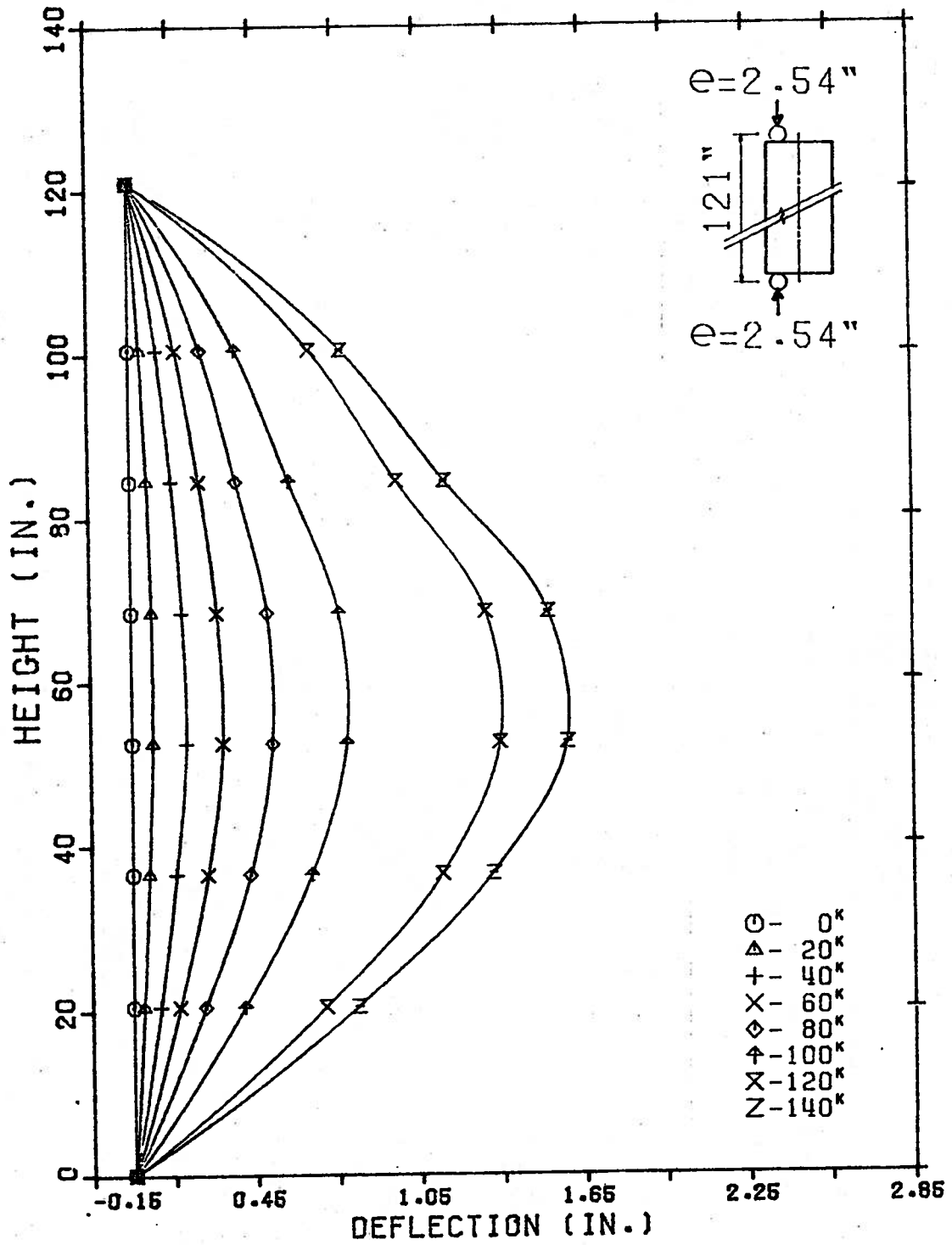


FIG. 2-14 Deflected Shape of Wall C4

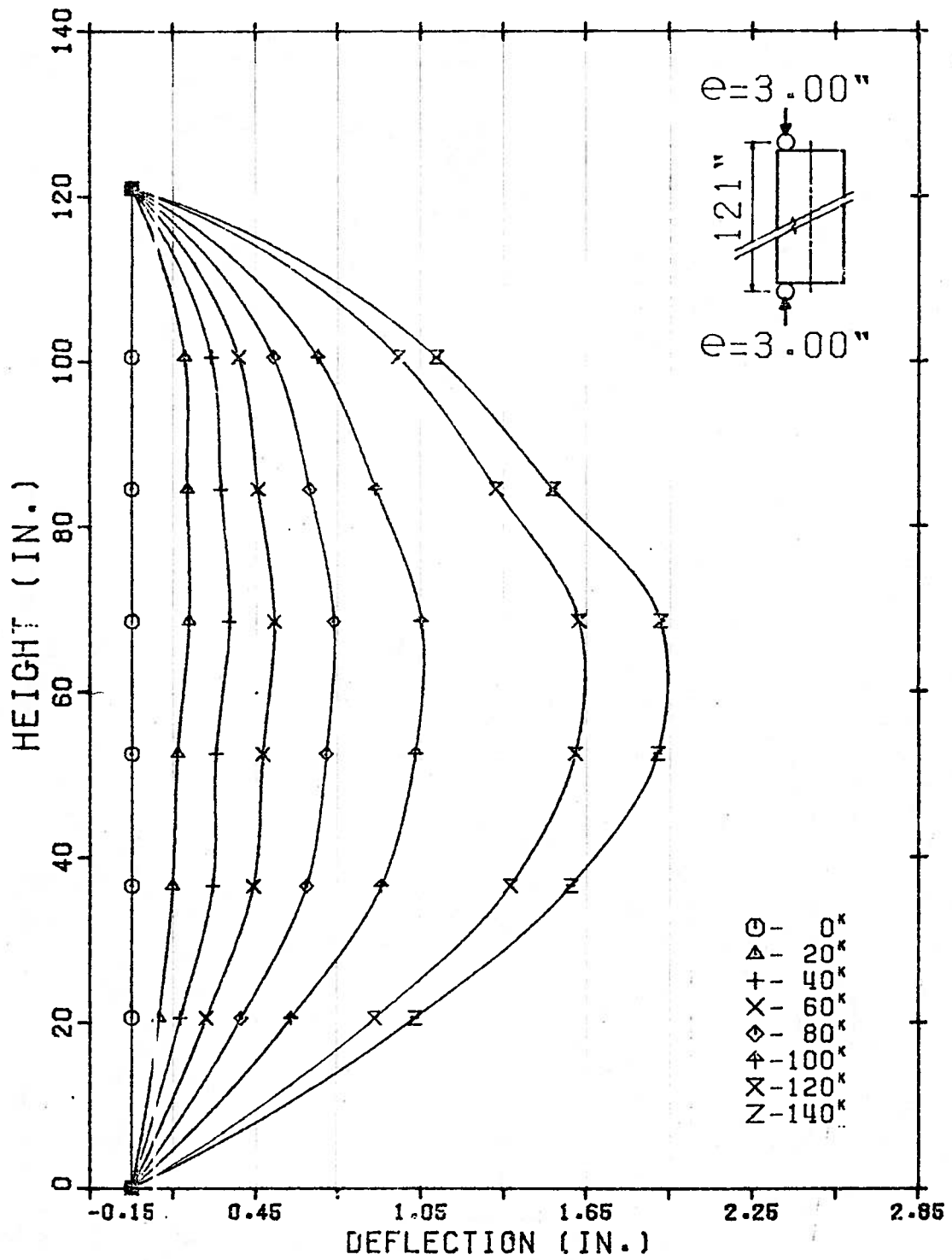


FIG. 2-15 Deflected Shape of Wall C5

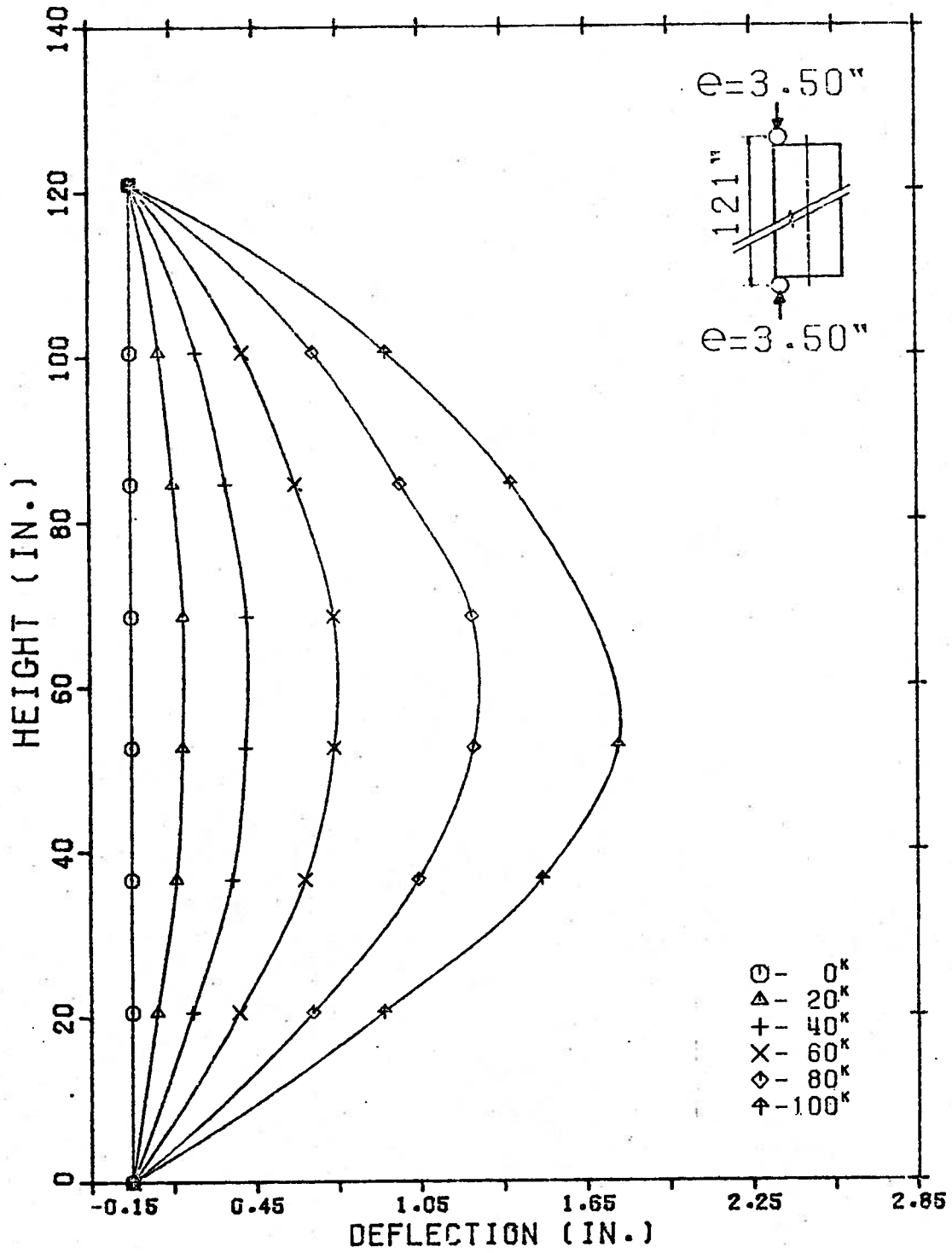


FIG. 2-16 Deflected Shape of Wall C6

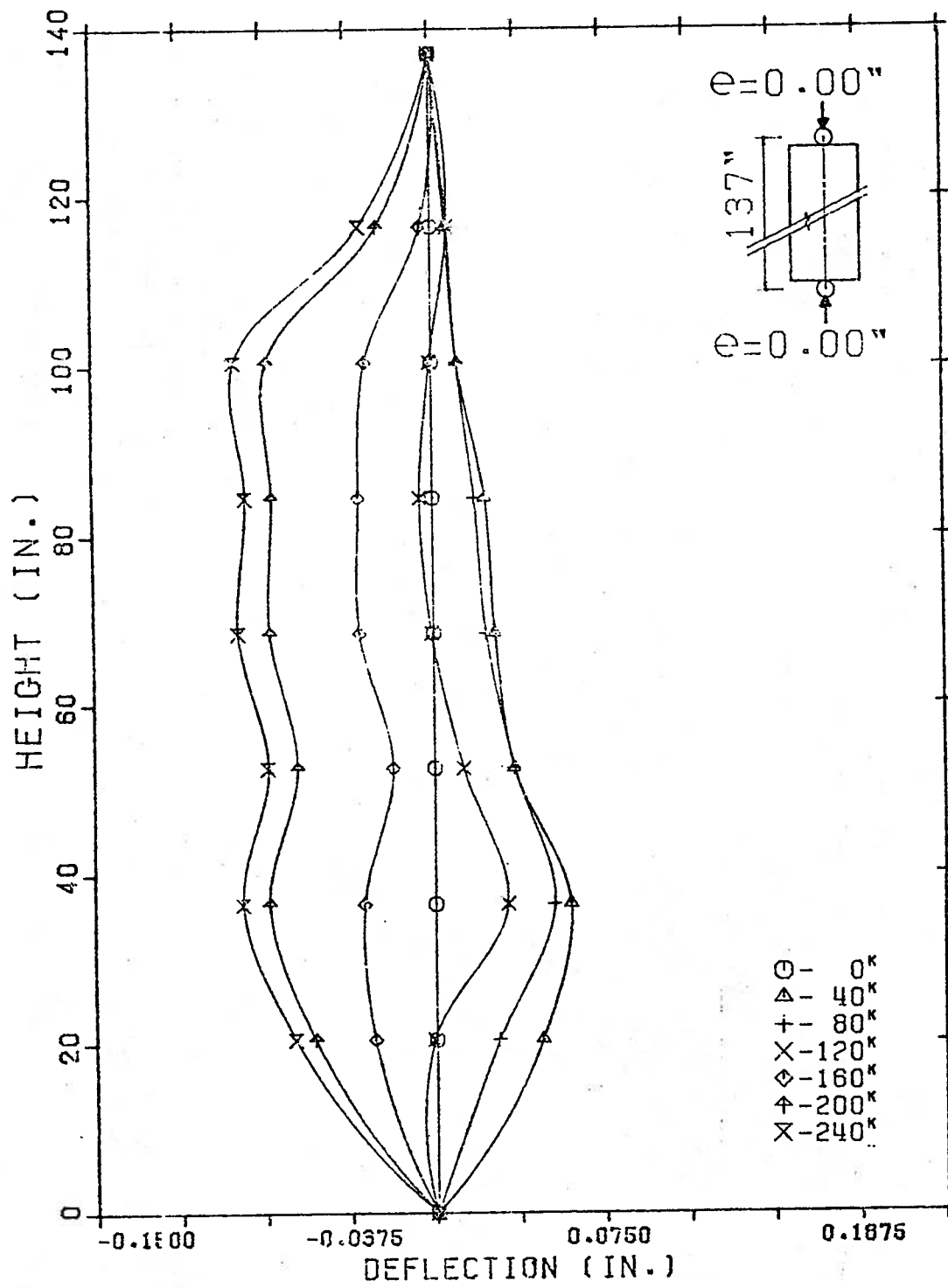


FIG. 2-17 Deflected Shape of Wall D1

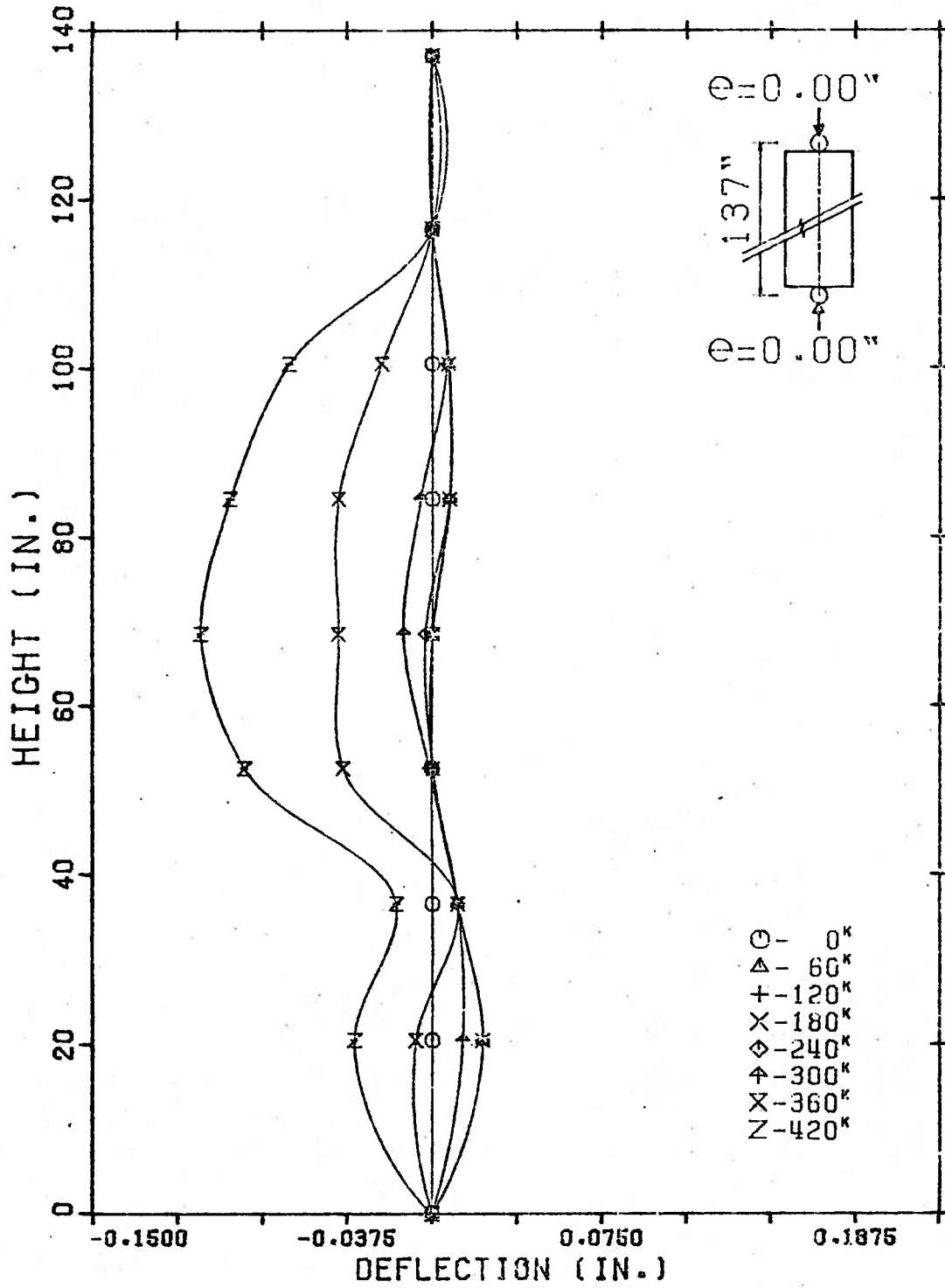


FIG. 2-18 Deflected Shape of Wall D2

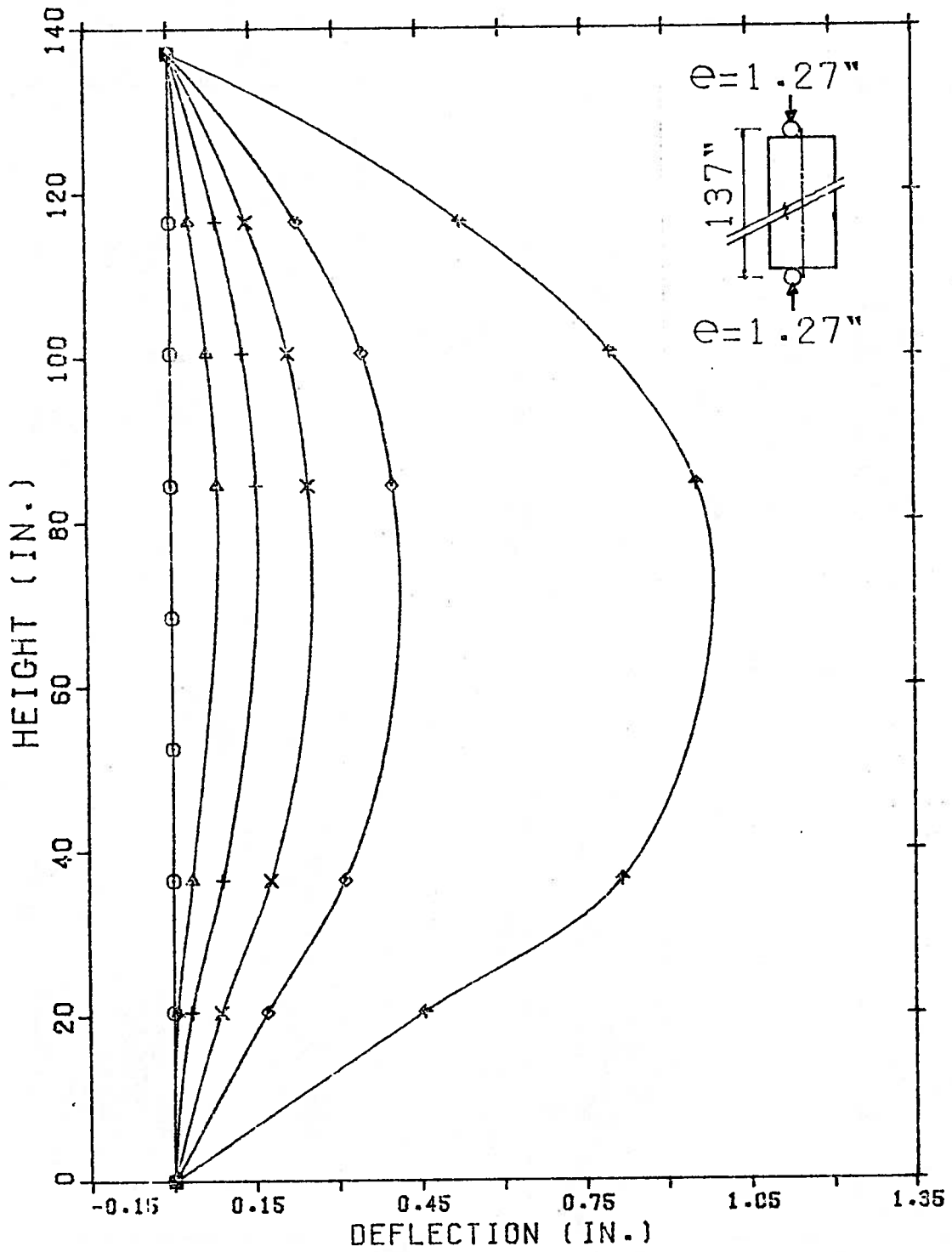


FIG. 2-19 Deflected Shape of Wall D3

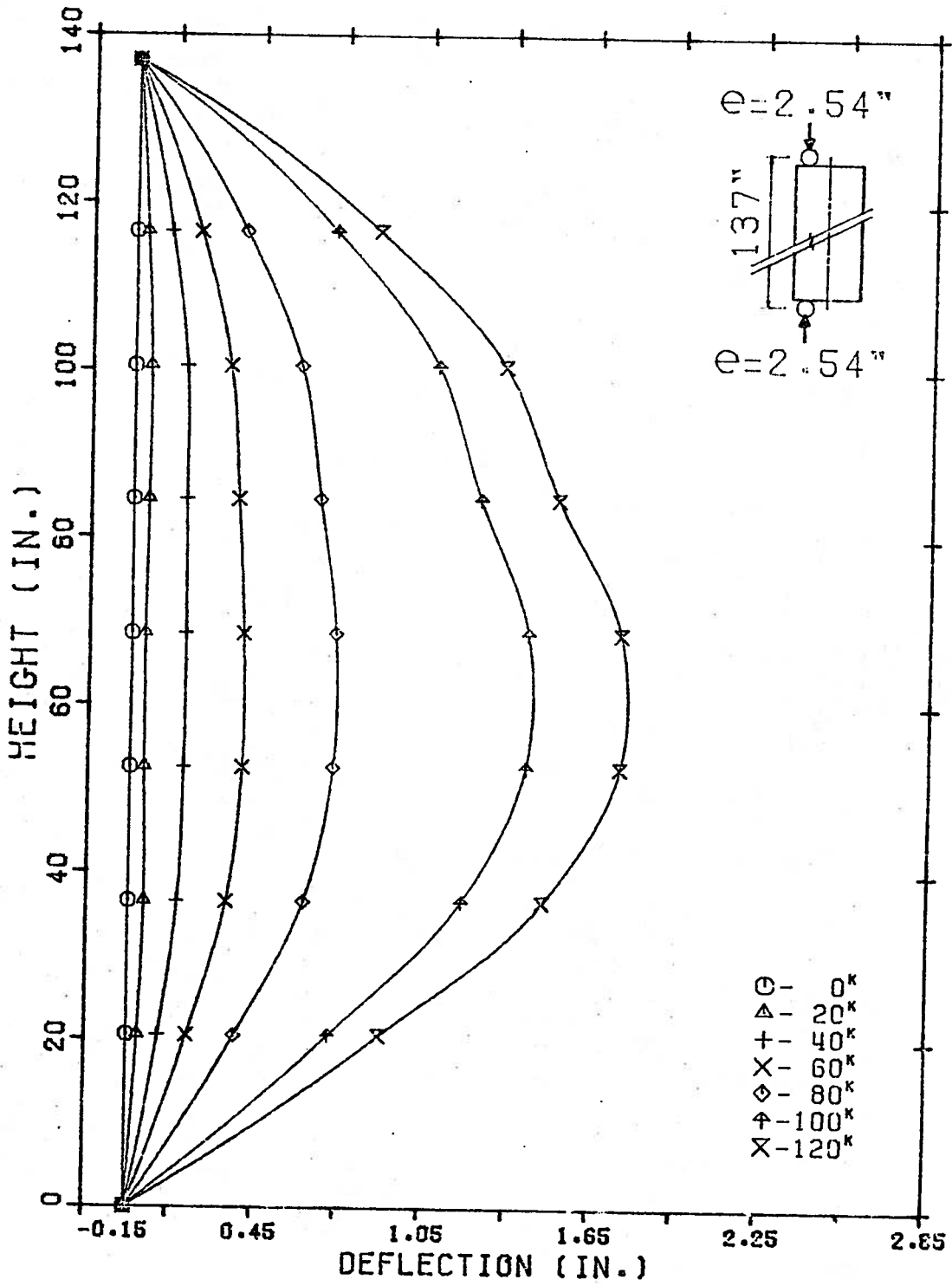


FIG. 2-20 Deflected Shape of Wall D4

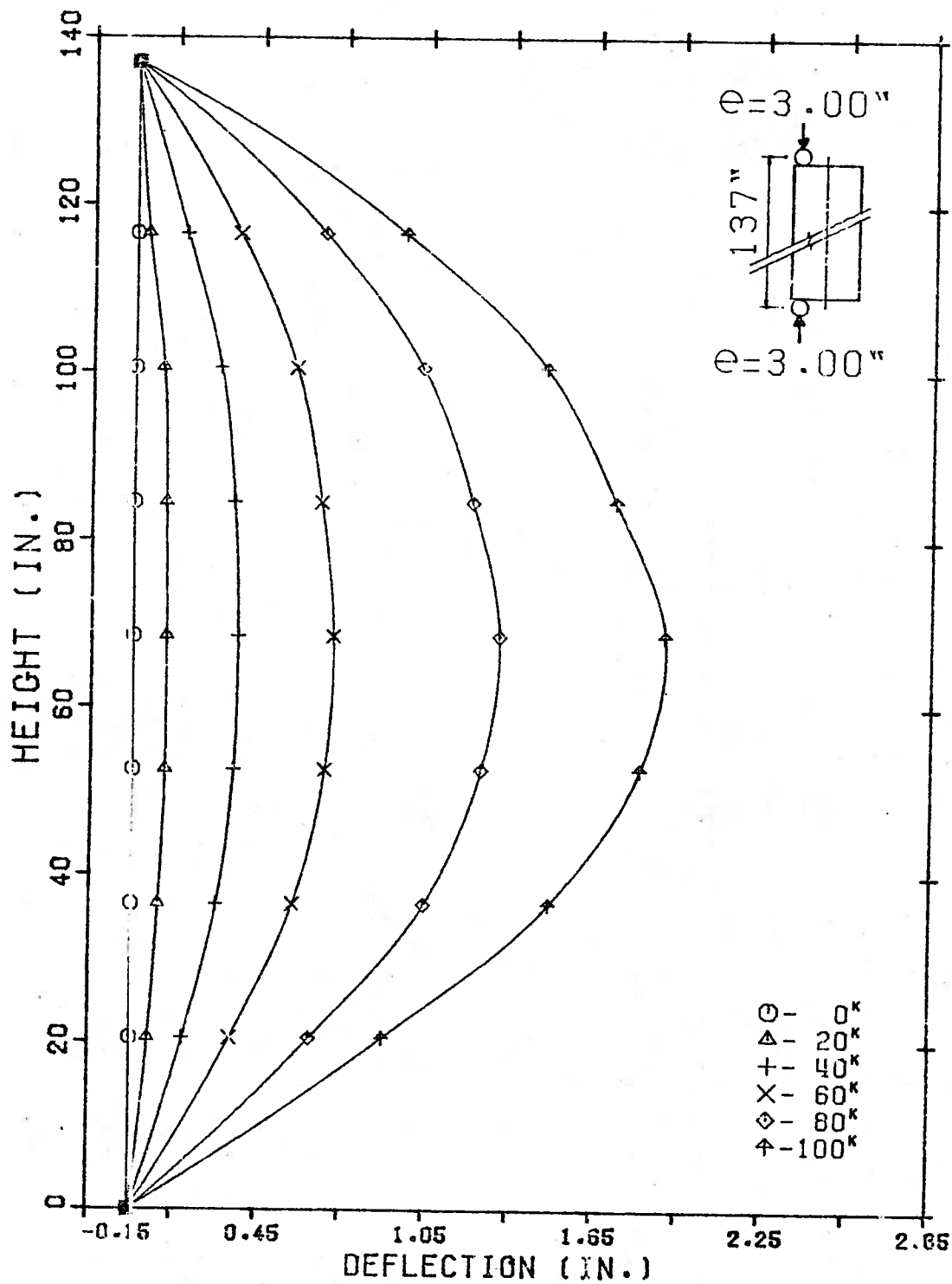


FIG. 2-21 Deflected Shape of Wall D5

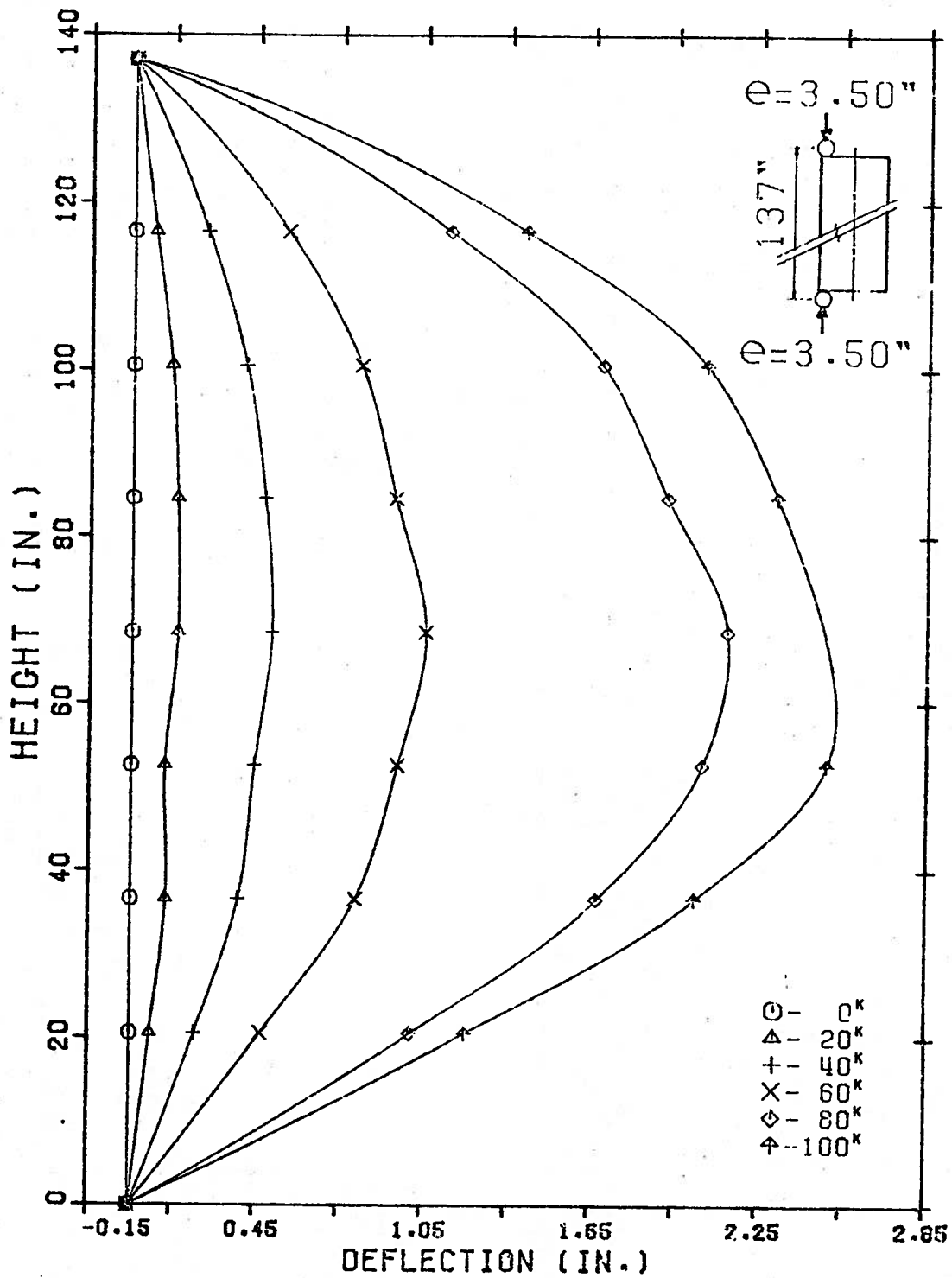


FIG. 2-22 Deflected Shape of Wall D6

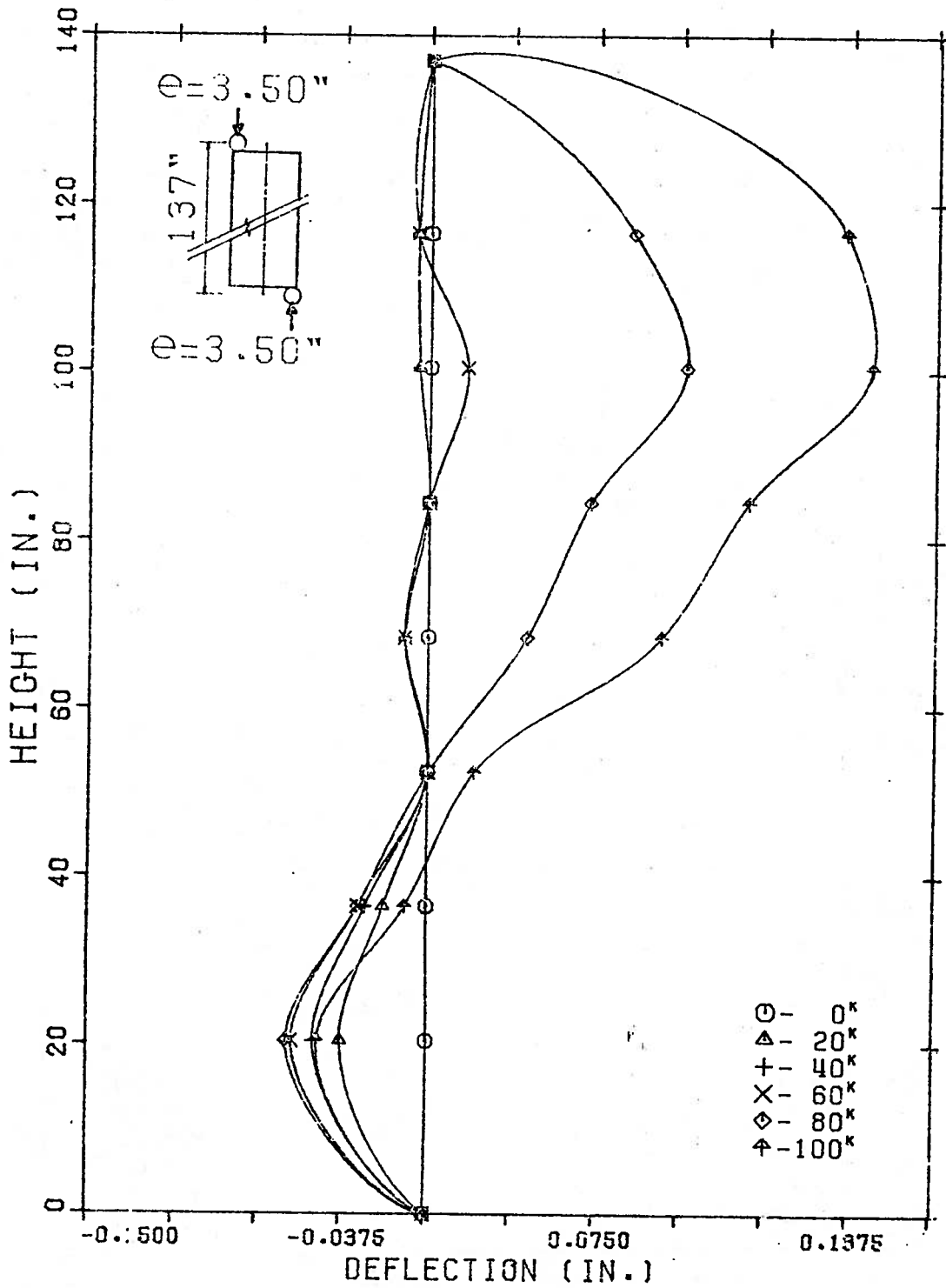


FIG. 2-23 Deflected Shape of Wall E1

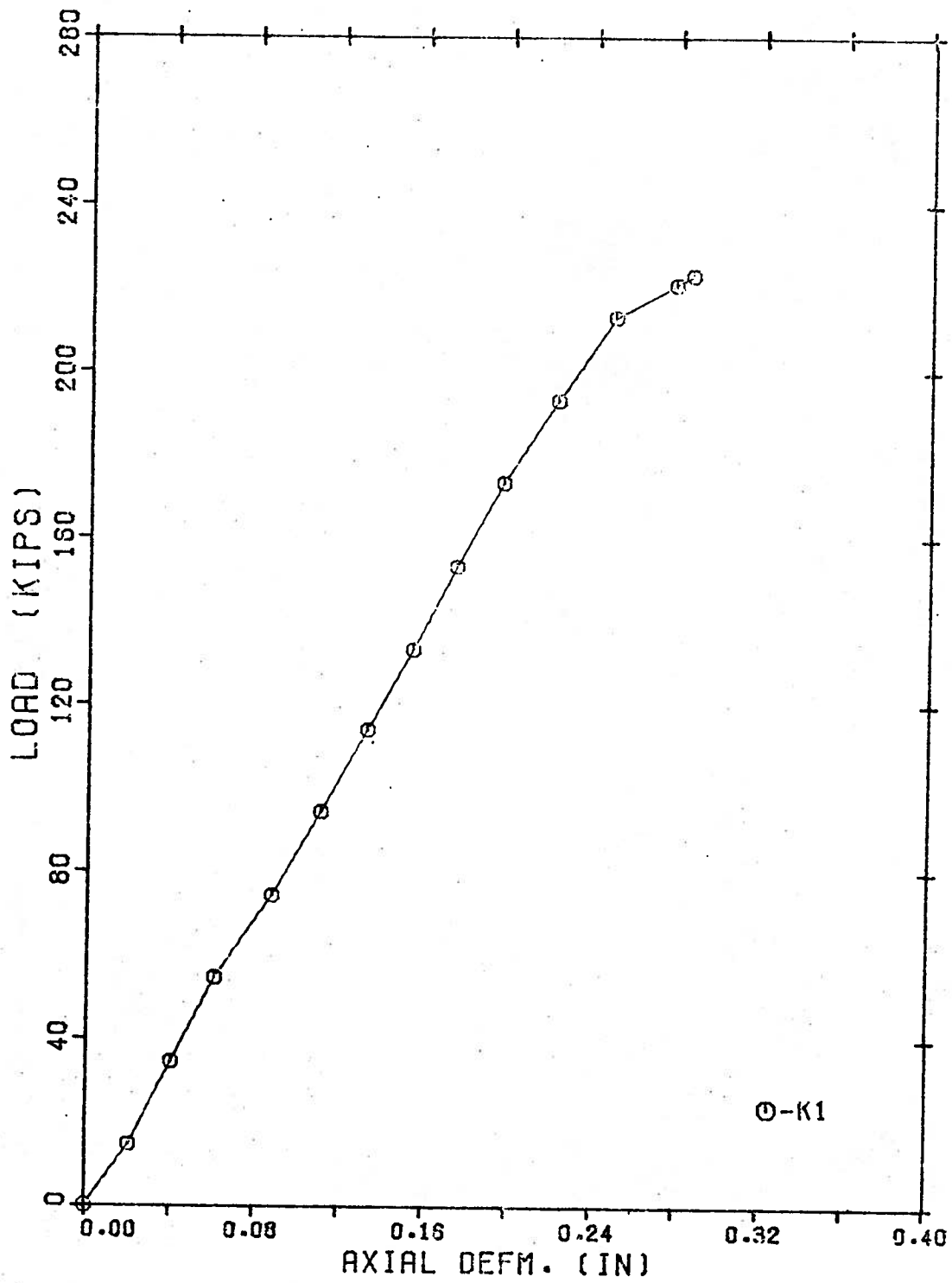


FIG. 2-75 Vertical Deformation of Series K

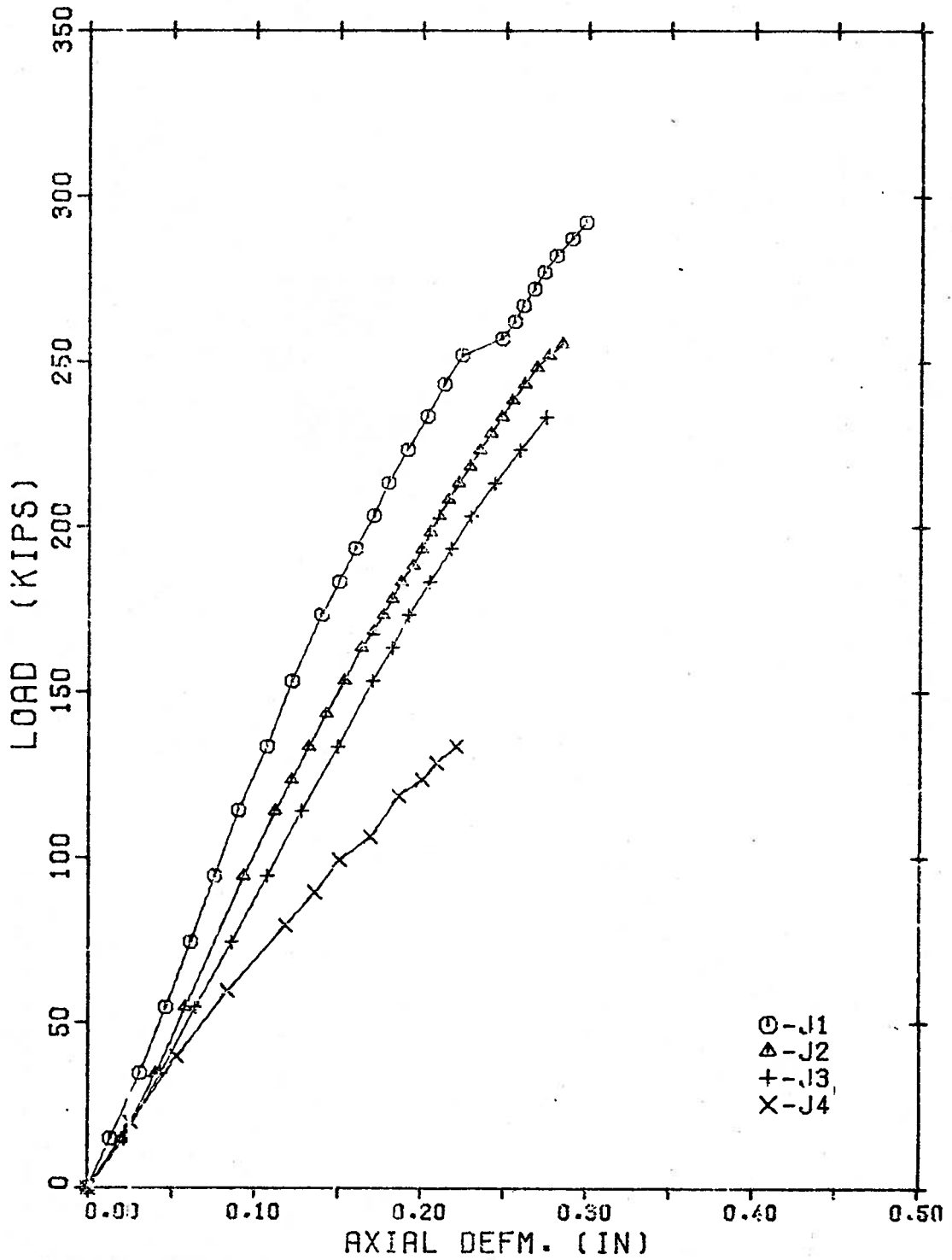


FIG. 2-74 Vertical Deformation of Series J

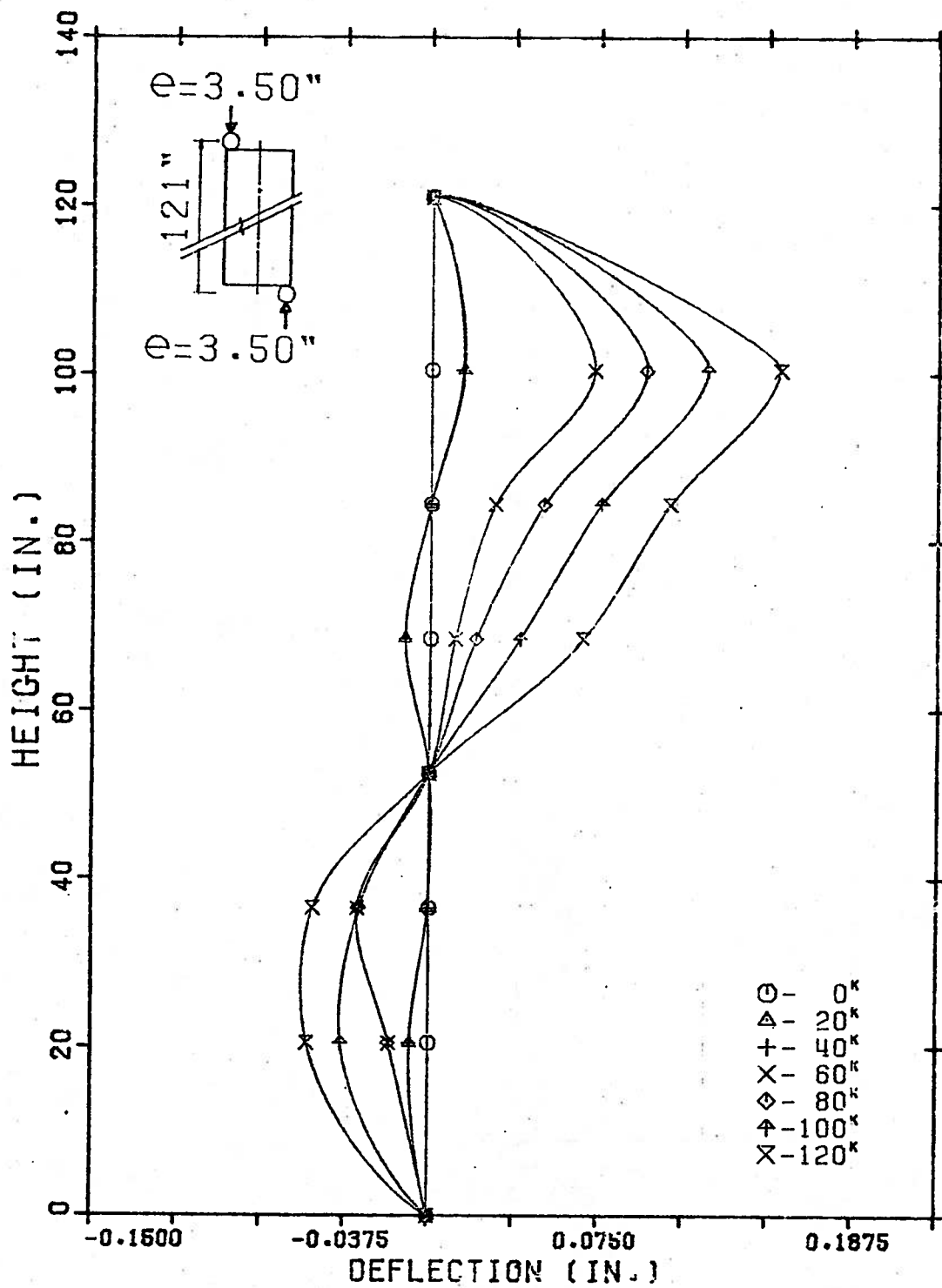


FIG. 2-24 Deflected Shape of Wall E2

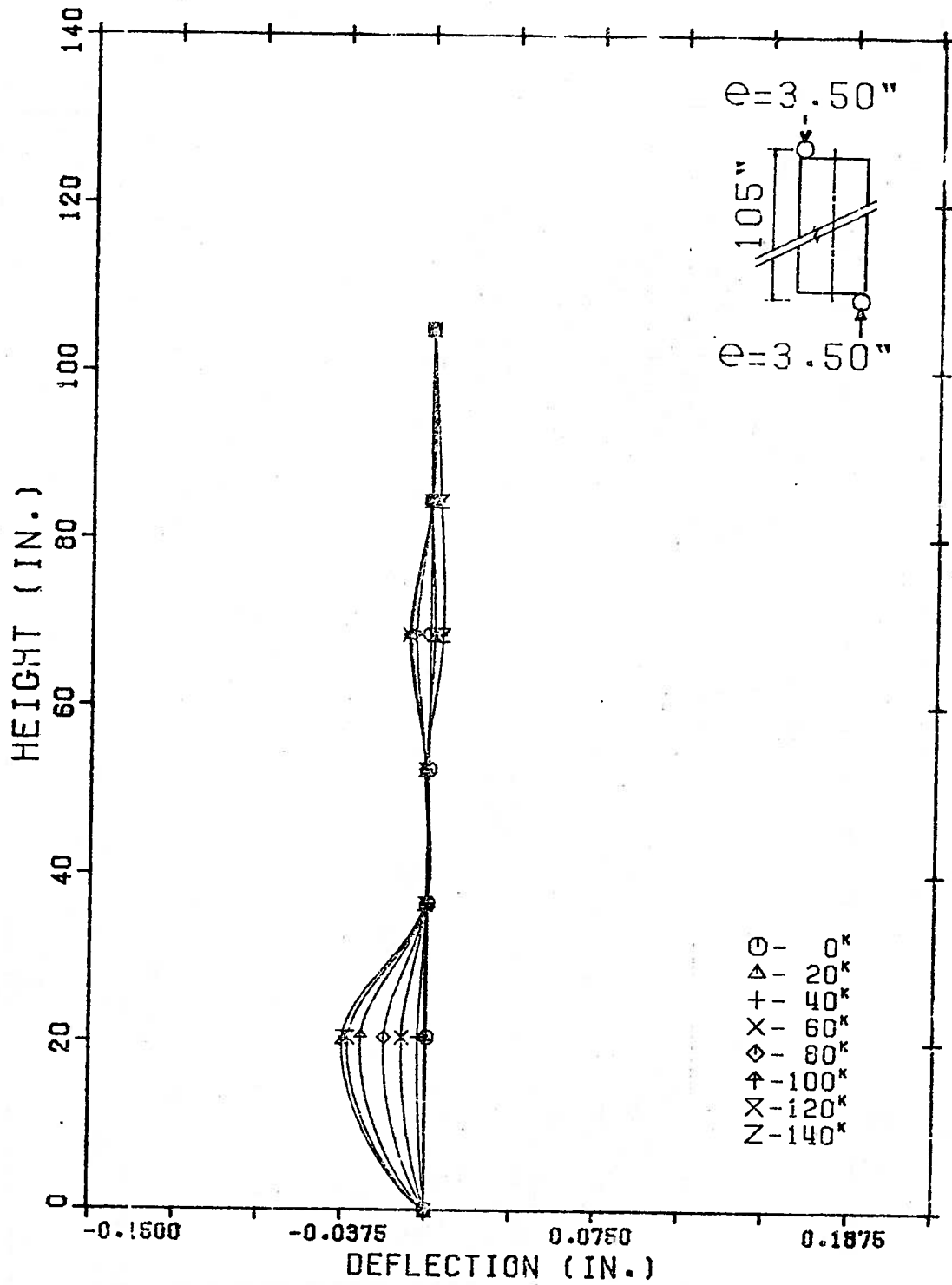


FIG. 2-25 Deflected Shape of Wall E3

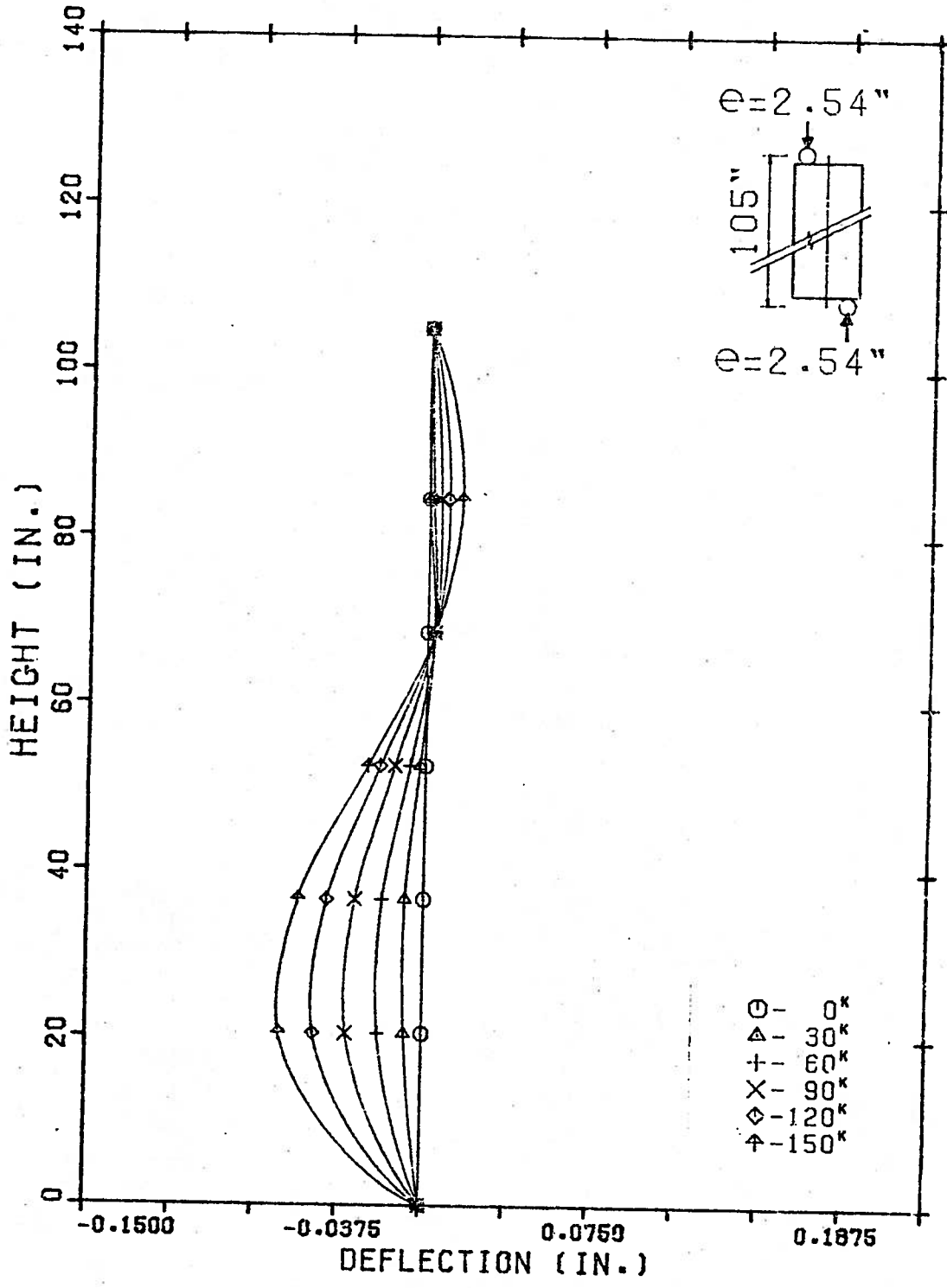


FIG. 2-26 Deflected Shape of Wall E4

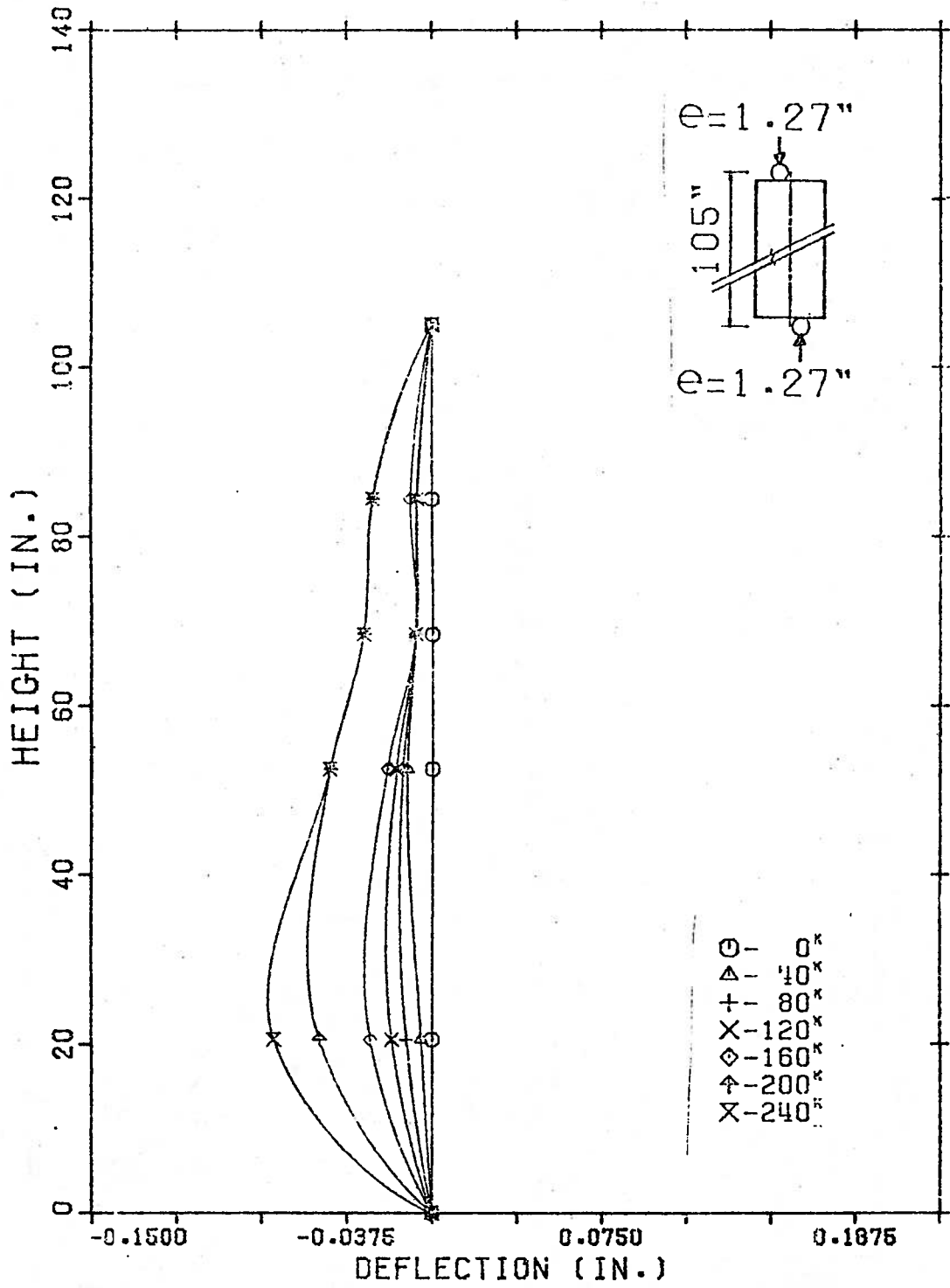


FIG. 2-27 Deflected Shape of Wall E5

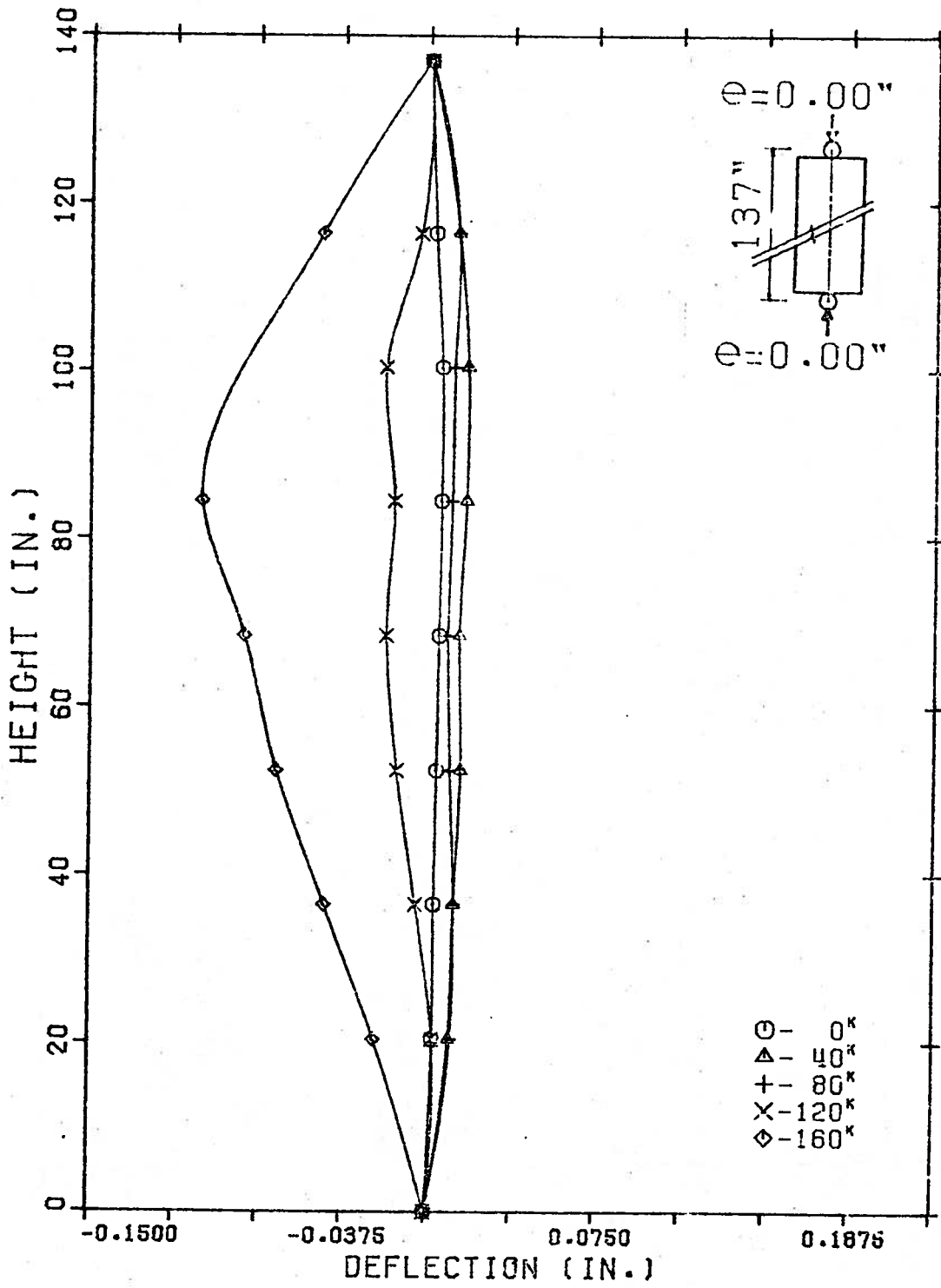


FIG. 2-28 Deflected Shape of Wall F1

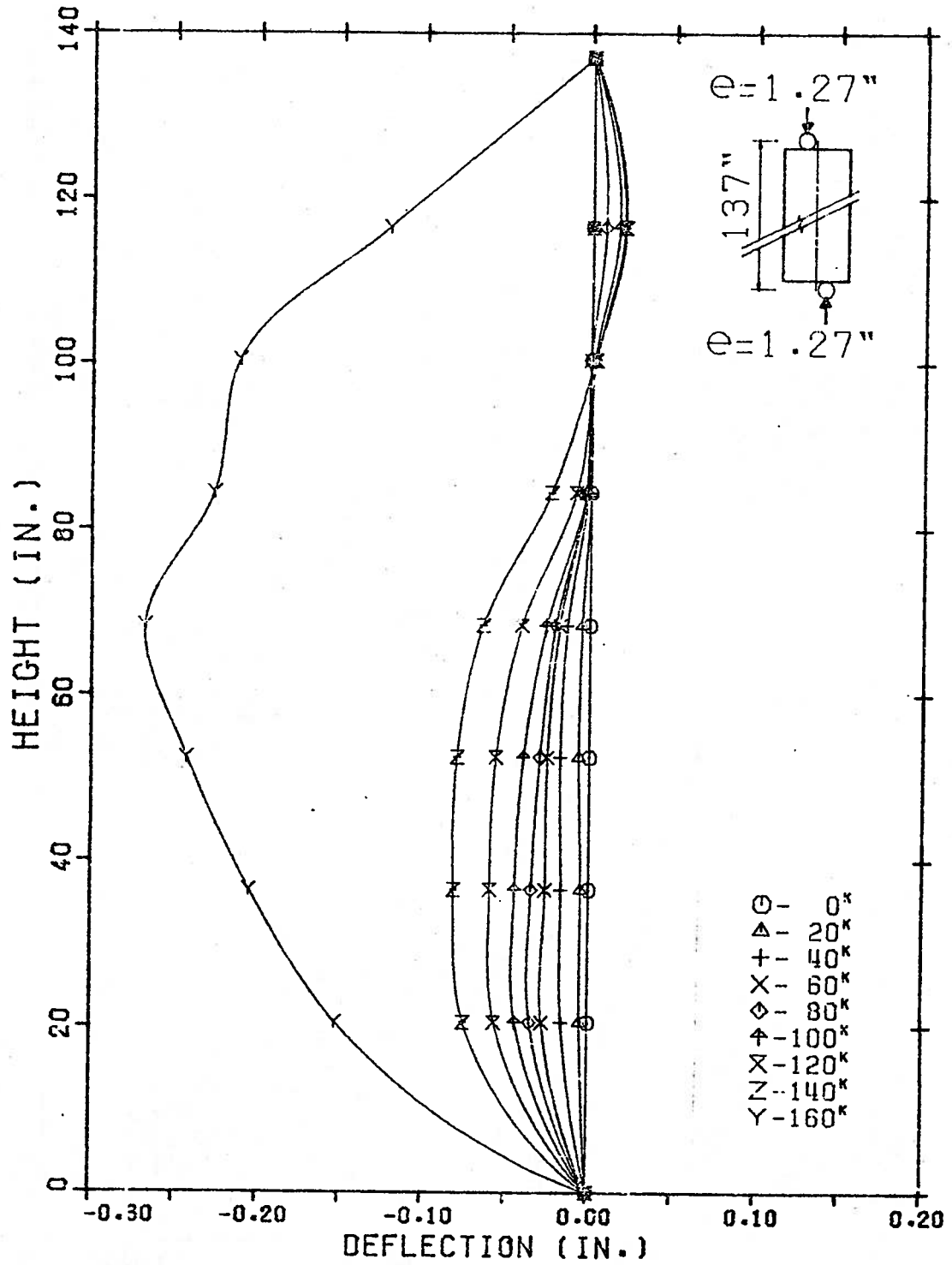


FIG. 2-29 Deflected Shape of Wall F2

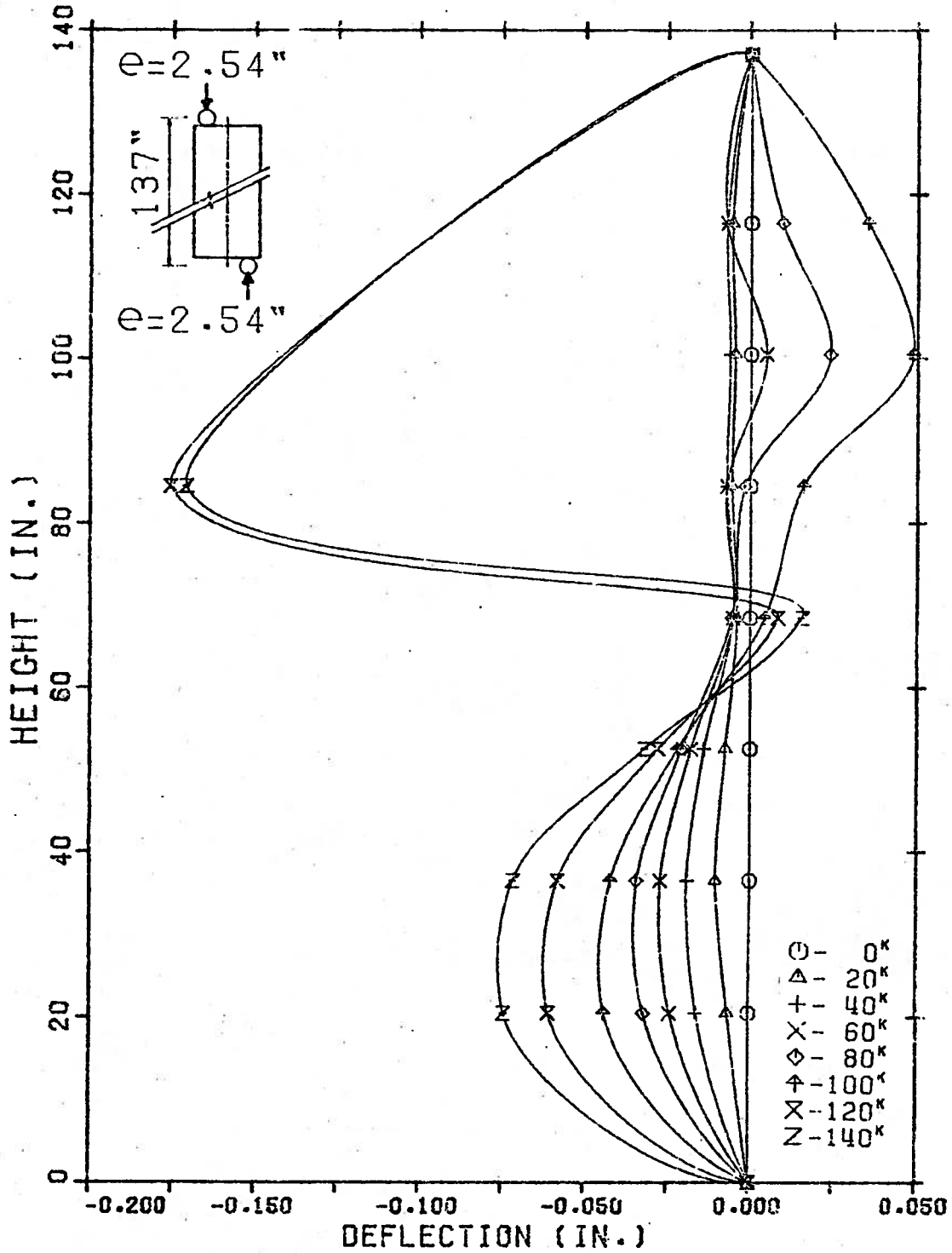


FIG. 2-30 Deflected Shape of Wall F3

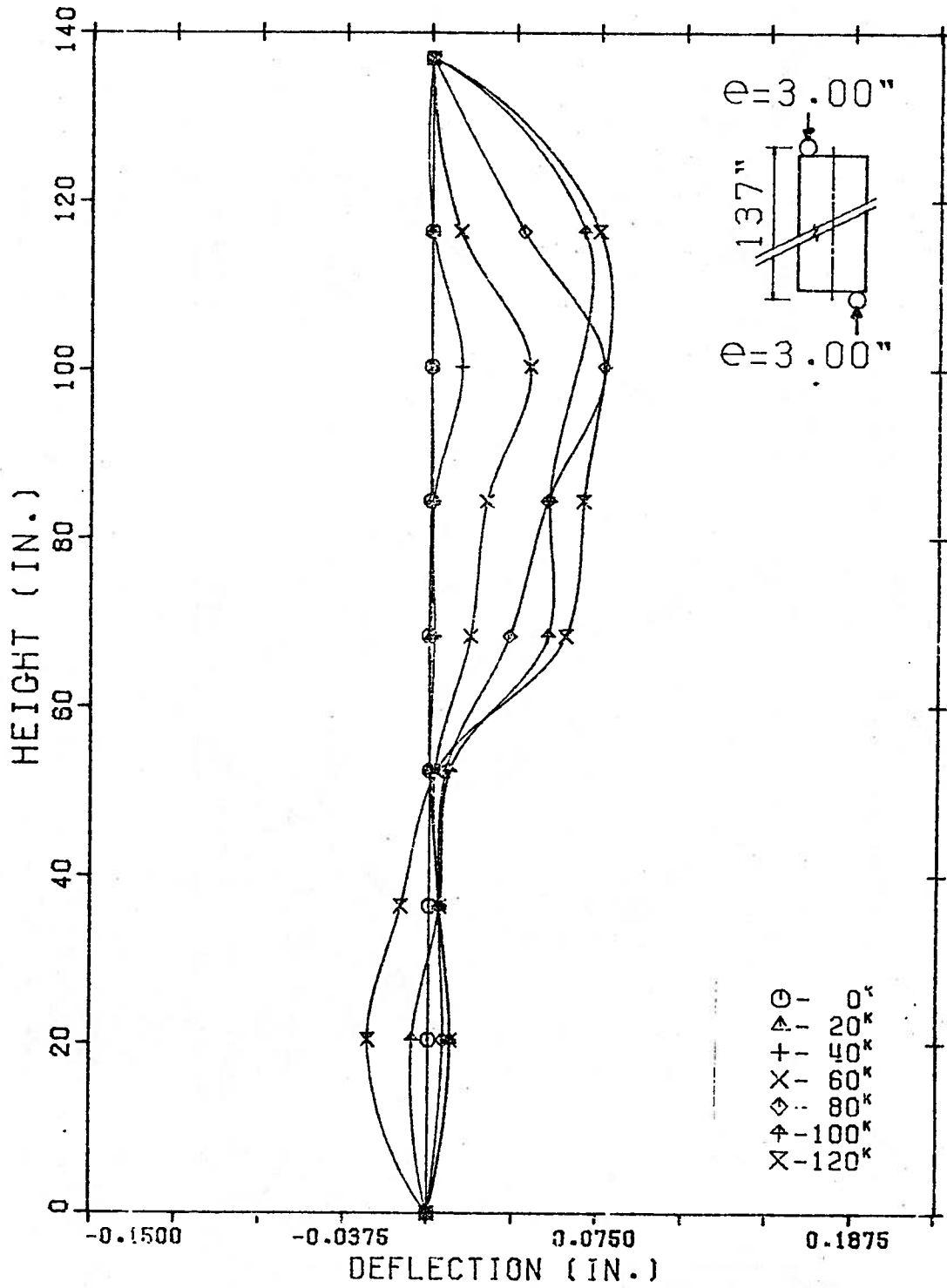


FIG. 2-31 Deflected Shape of Wall F4.

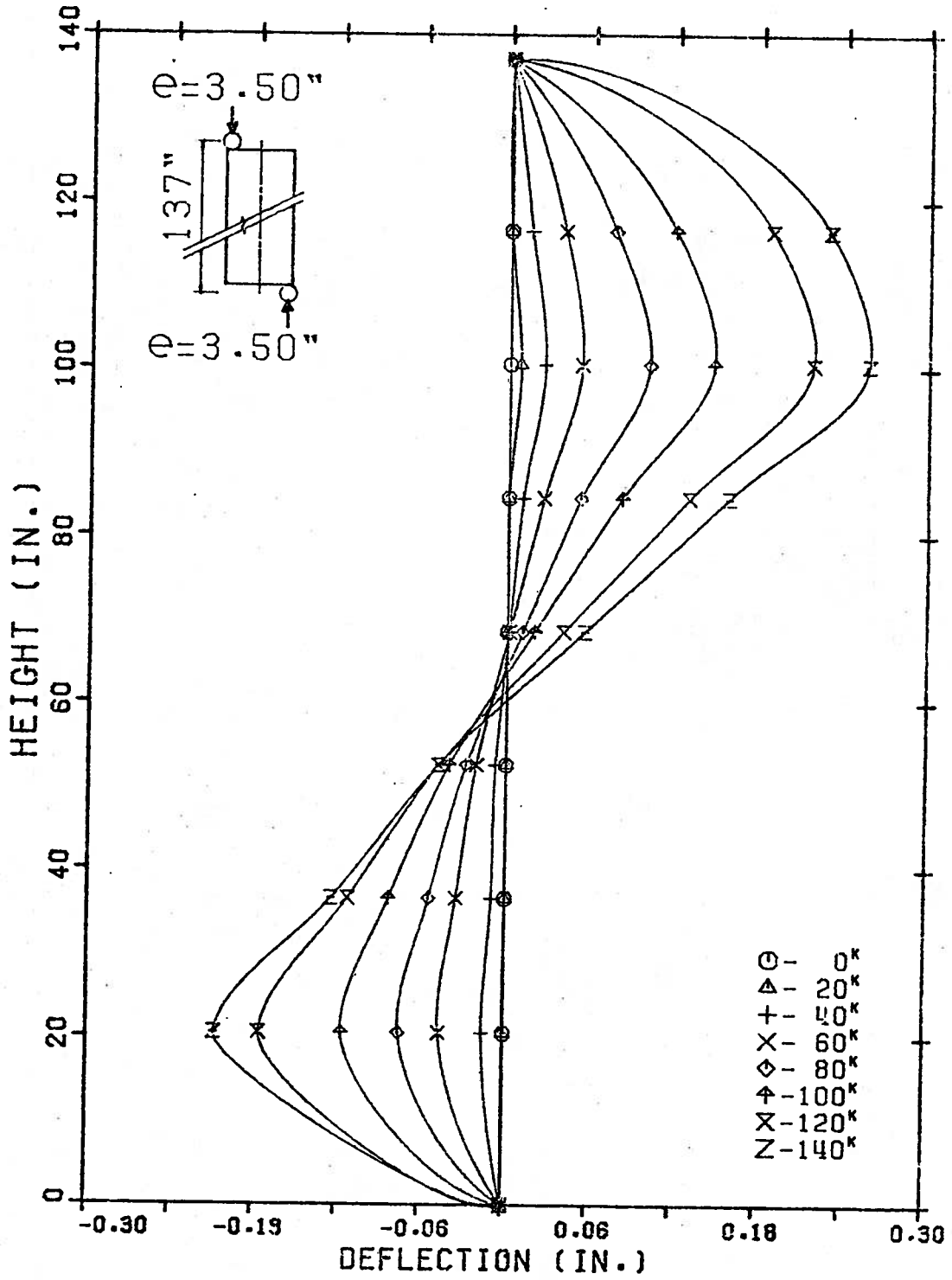


FIG. 2-32 Deflected Shape of Wall F5

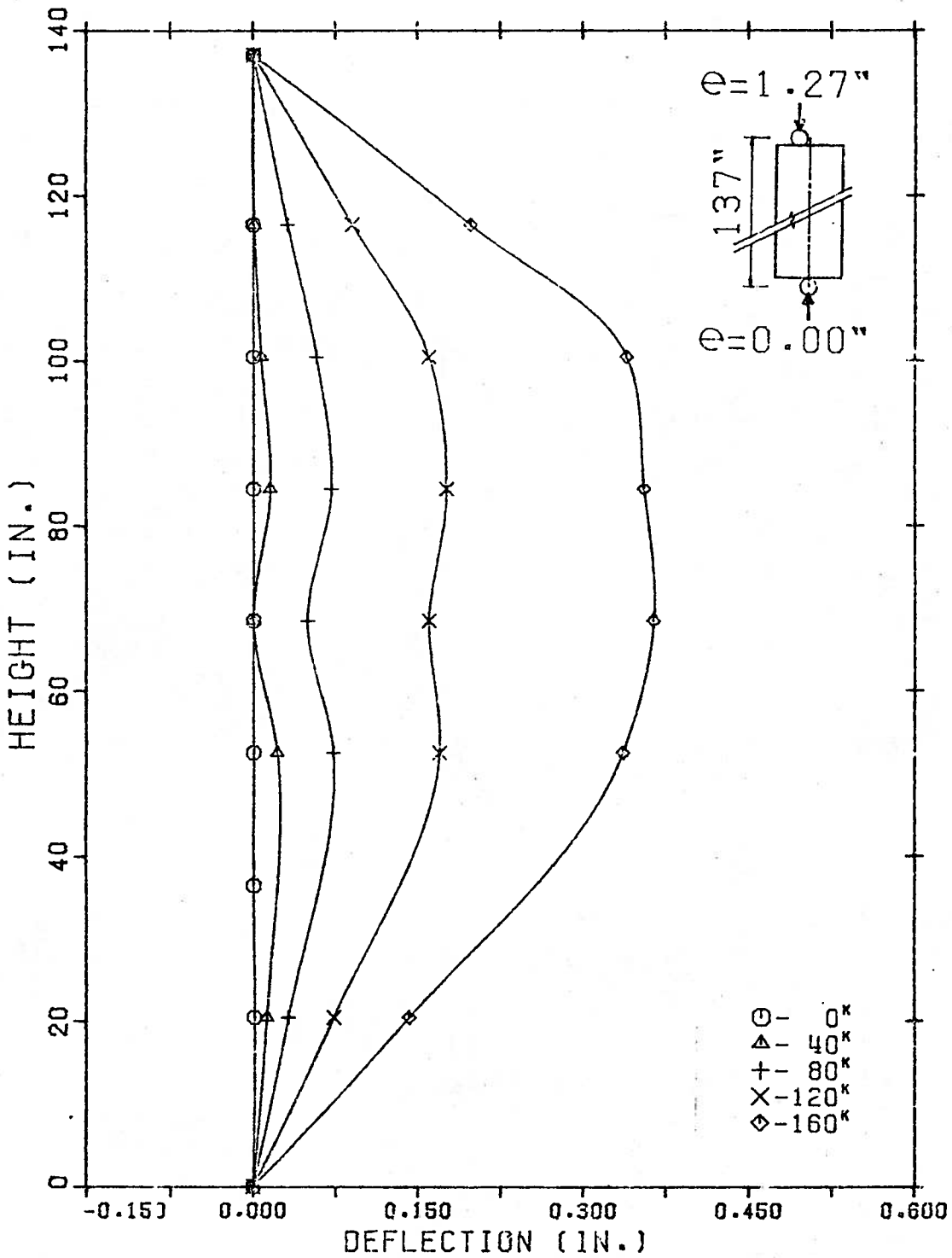


FIG. 2-33 Deflected Shape of Wall G1

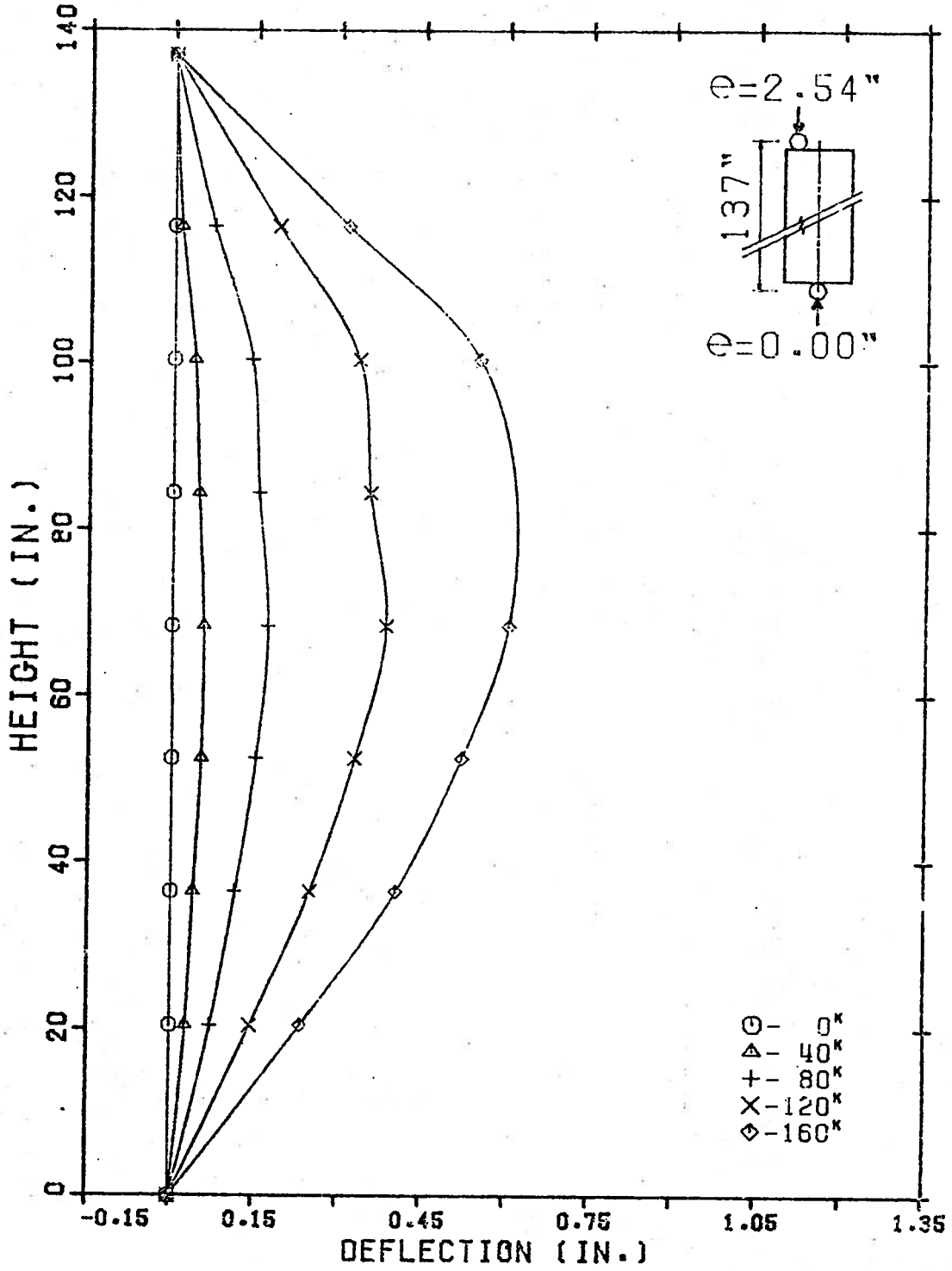


FIG. 2-34 Deflected Shape of Wall G2

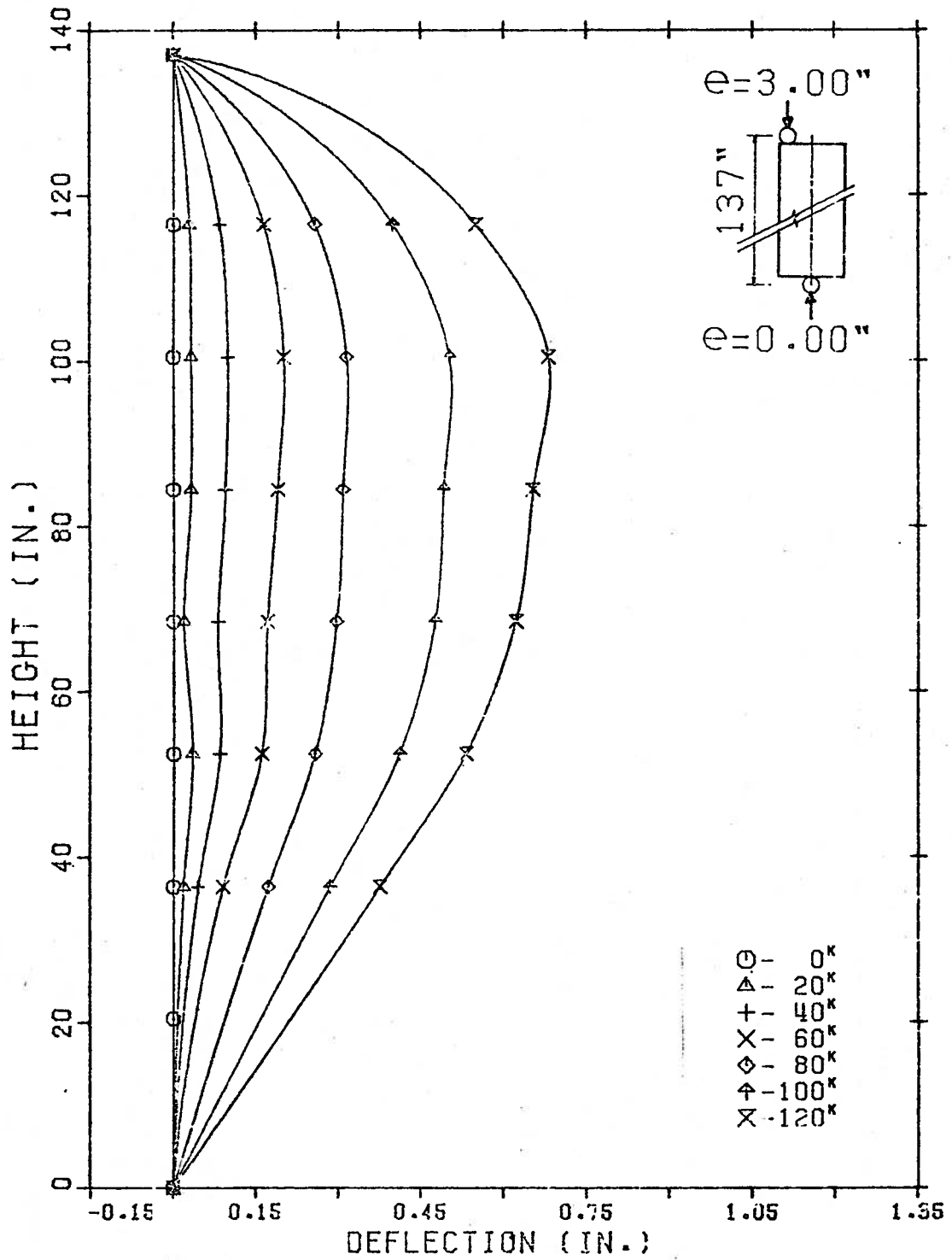


FIG. 2-35 Deflected Shape of Wall G3

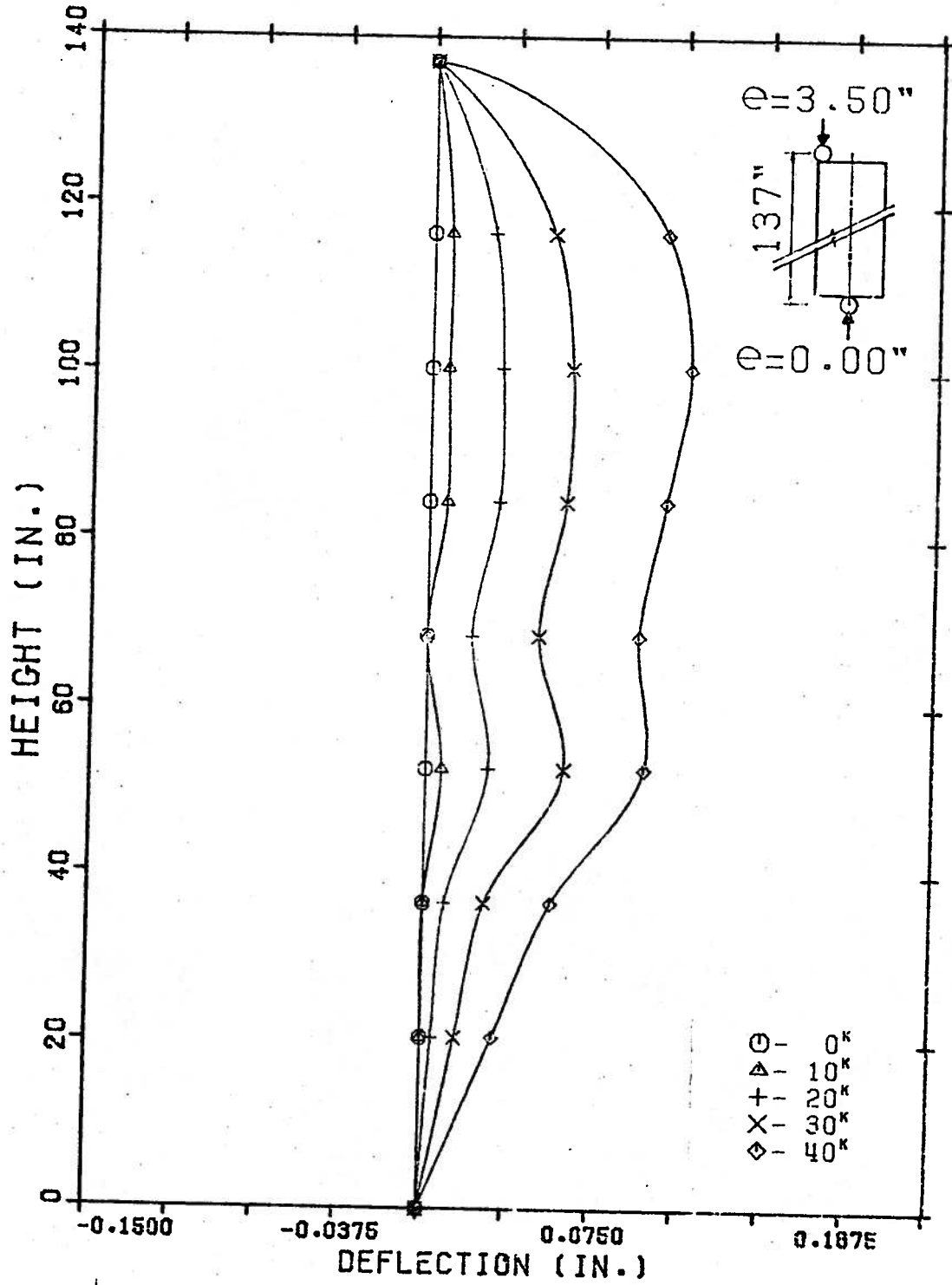


FIG. 2-36 Deflected Shape of Wall G4

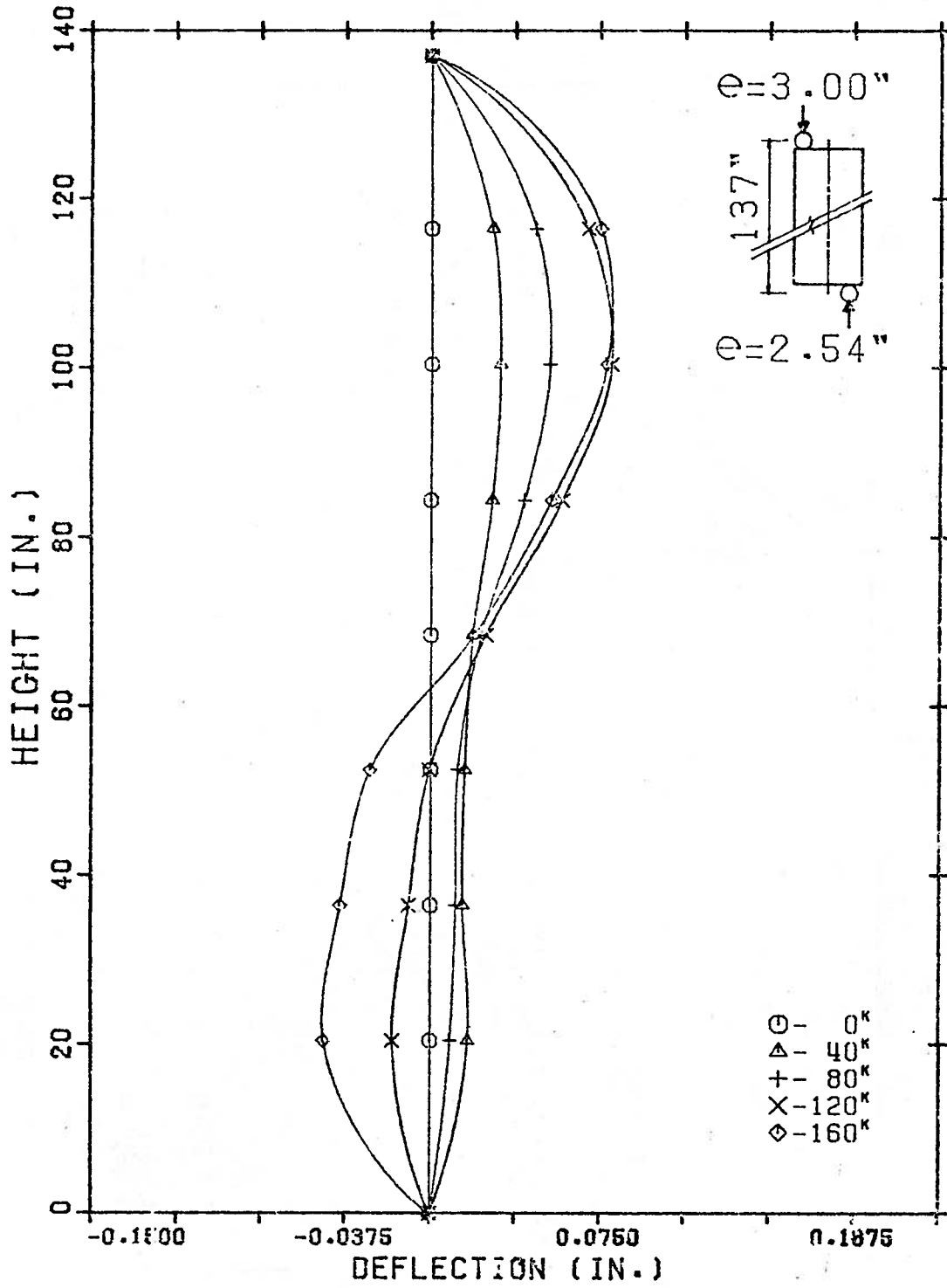


FIG. 2-37 Deflected Shape of Wall G5

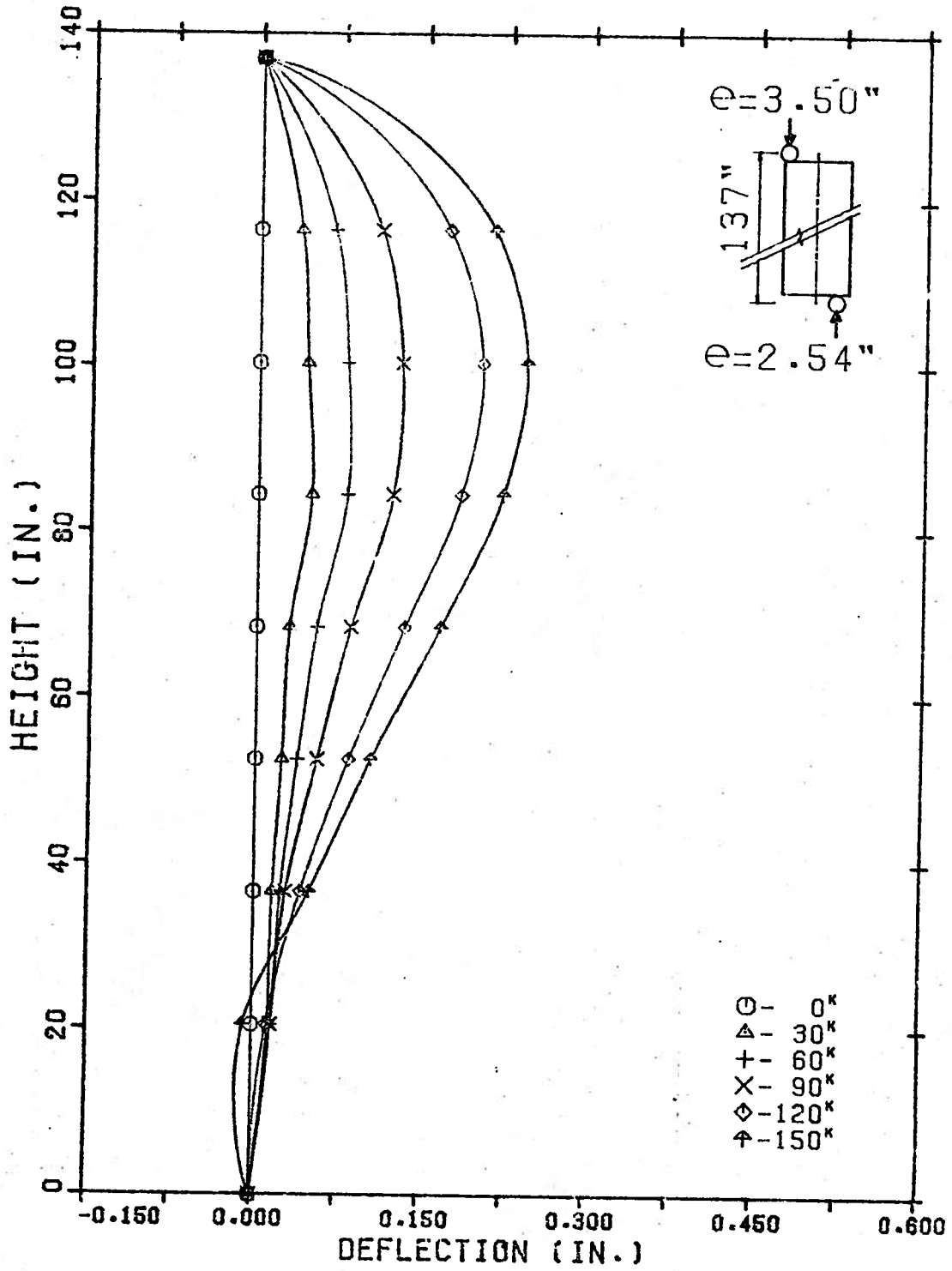


FIG. 2-38 Deflected Shape of Wall G6

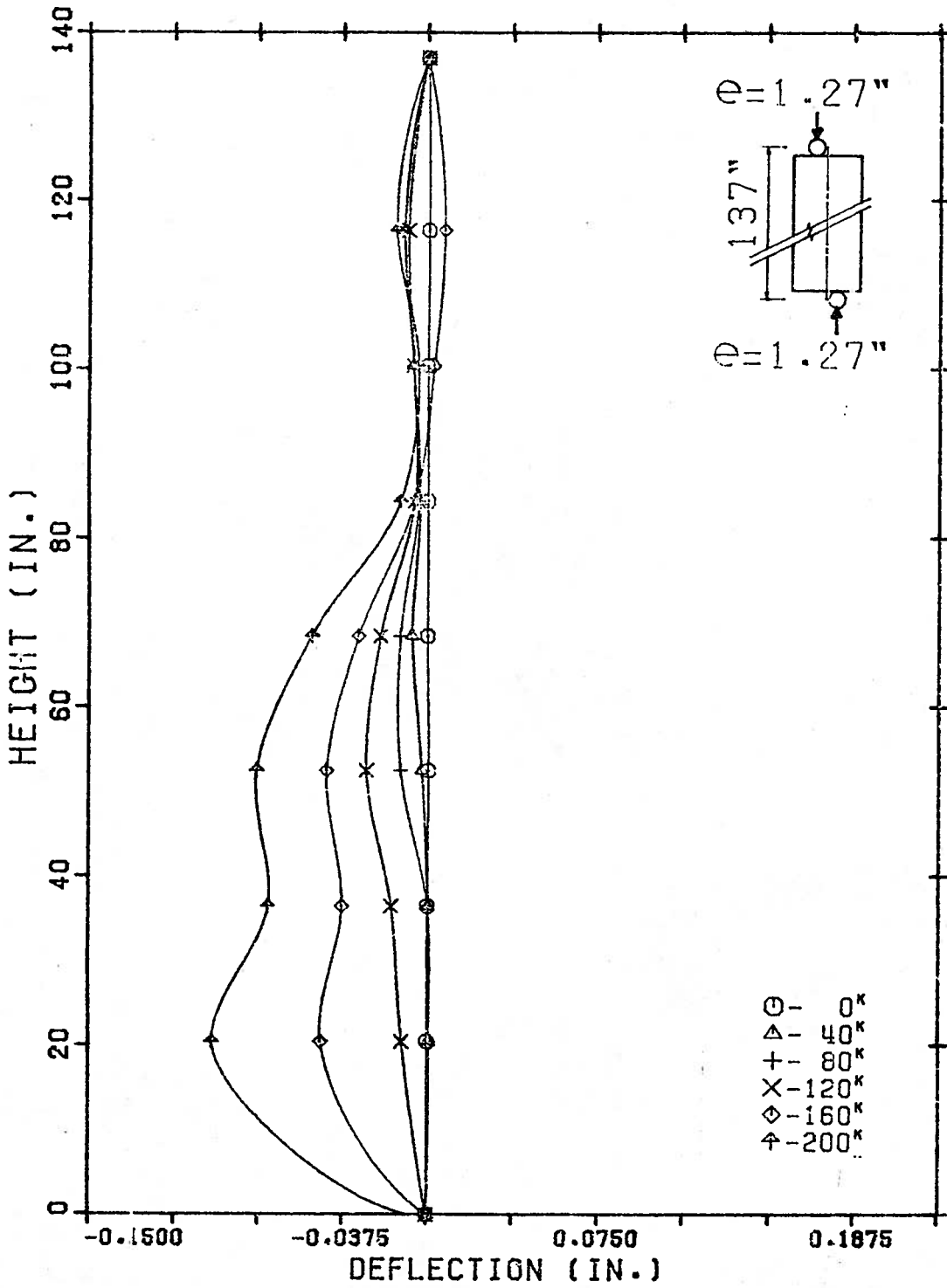


FIG. 2-39 Deflected Shape of Wall G7

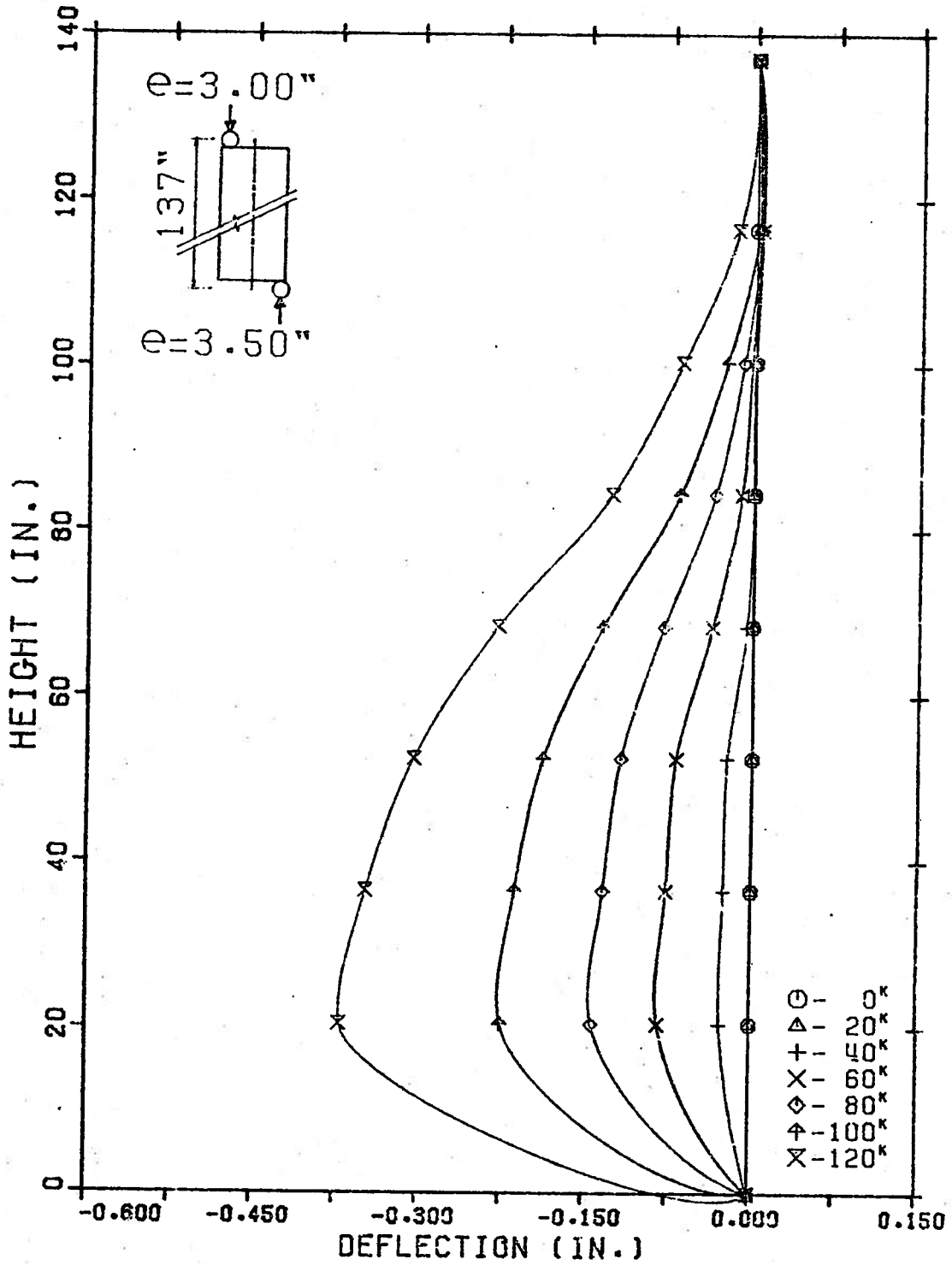


FIG. 2-40 Deflected Shape of Wall G8

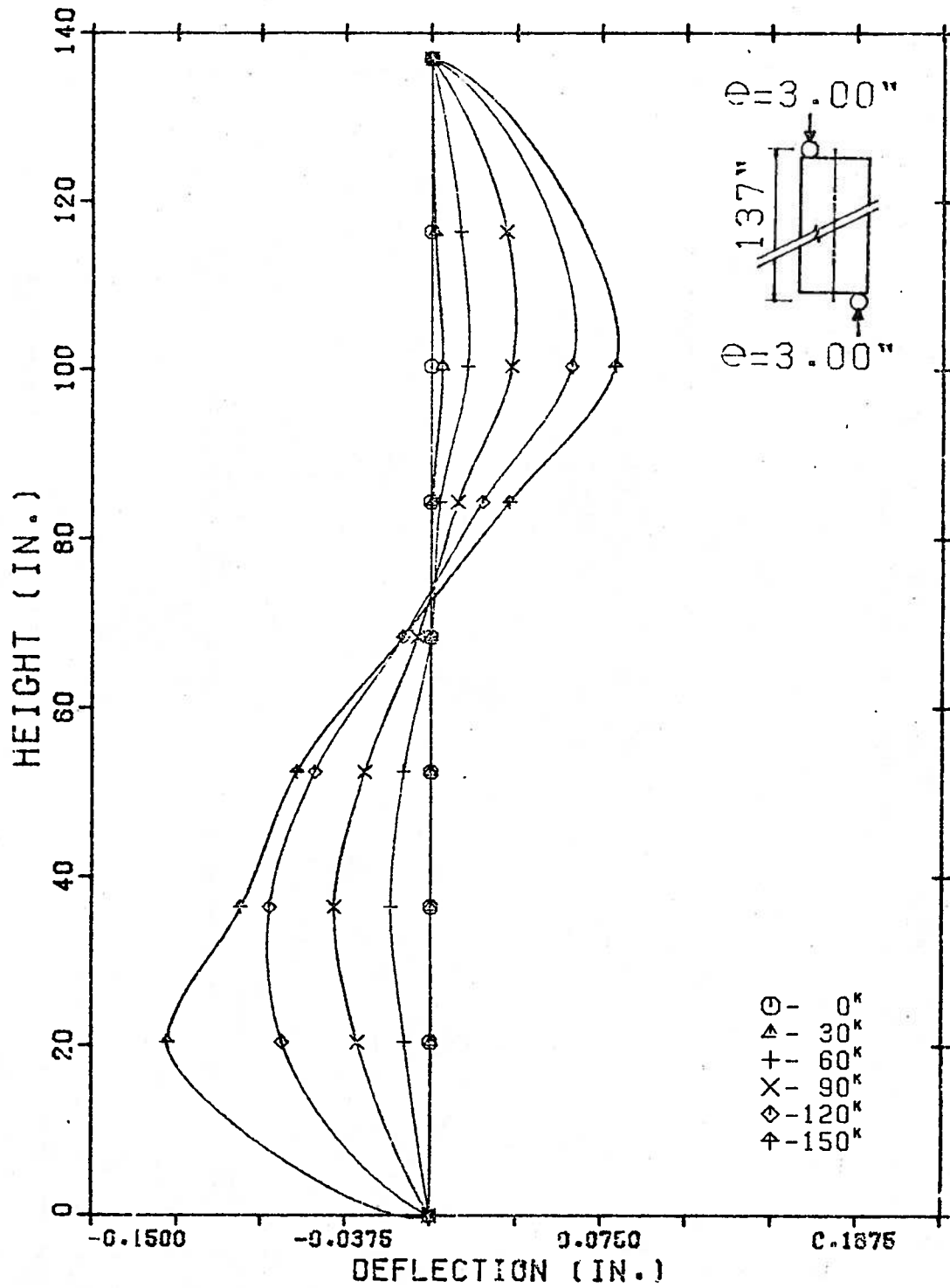


FIG. 2-41 Deflected Shape of Wall G9

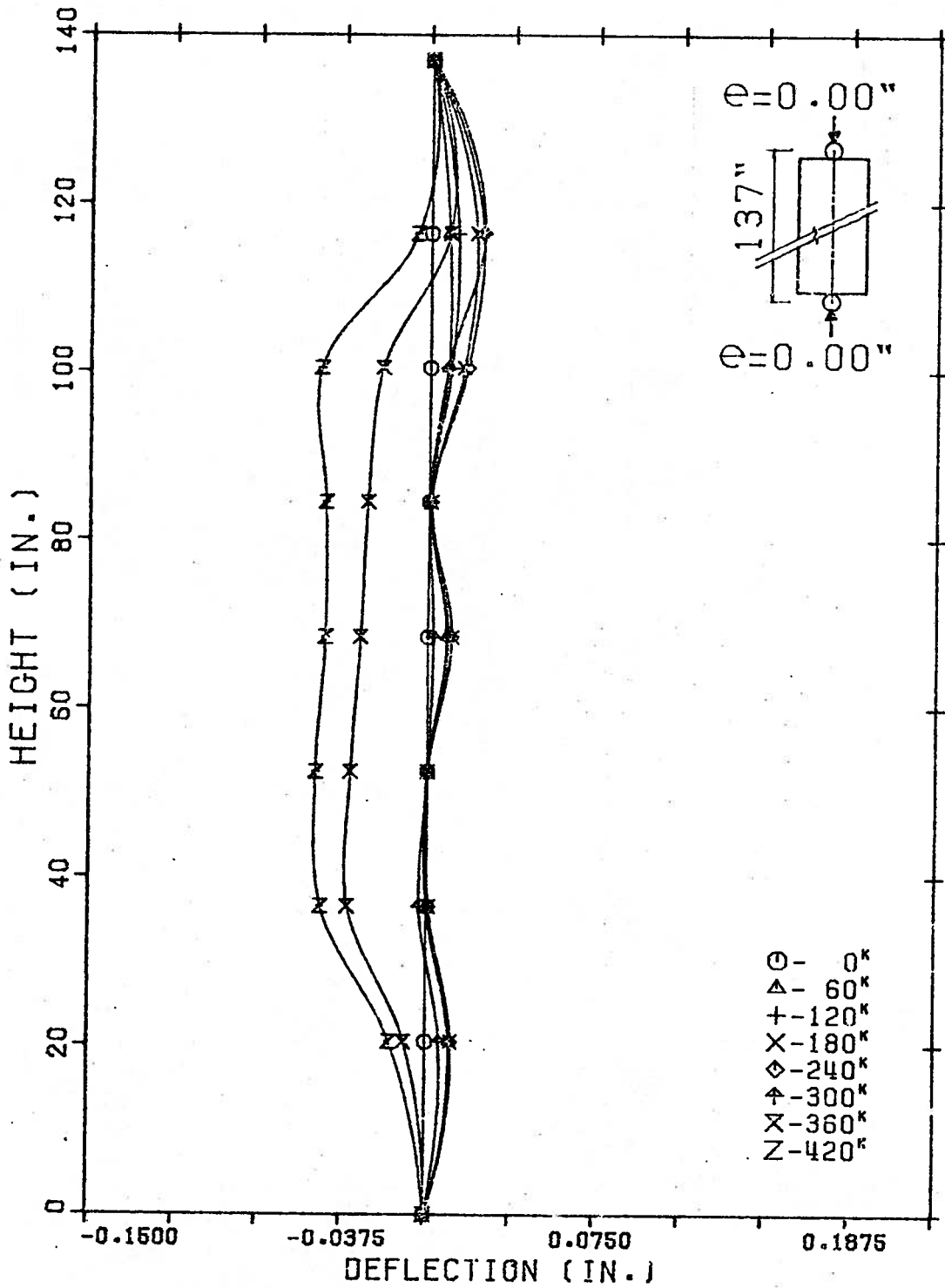


FIG. 2-42 Deflected Shape of Wall H1

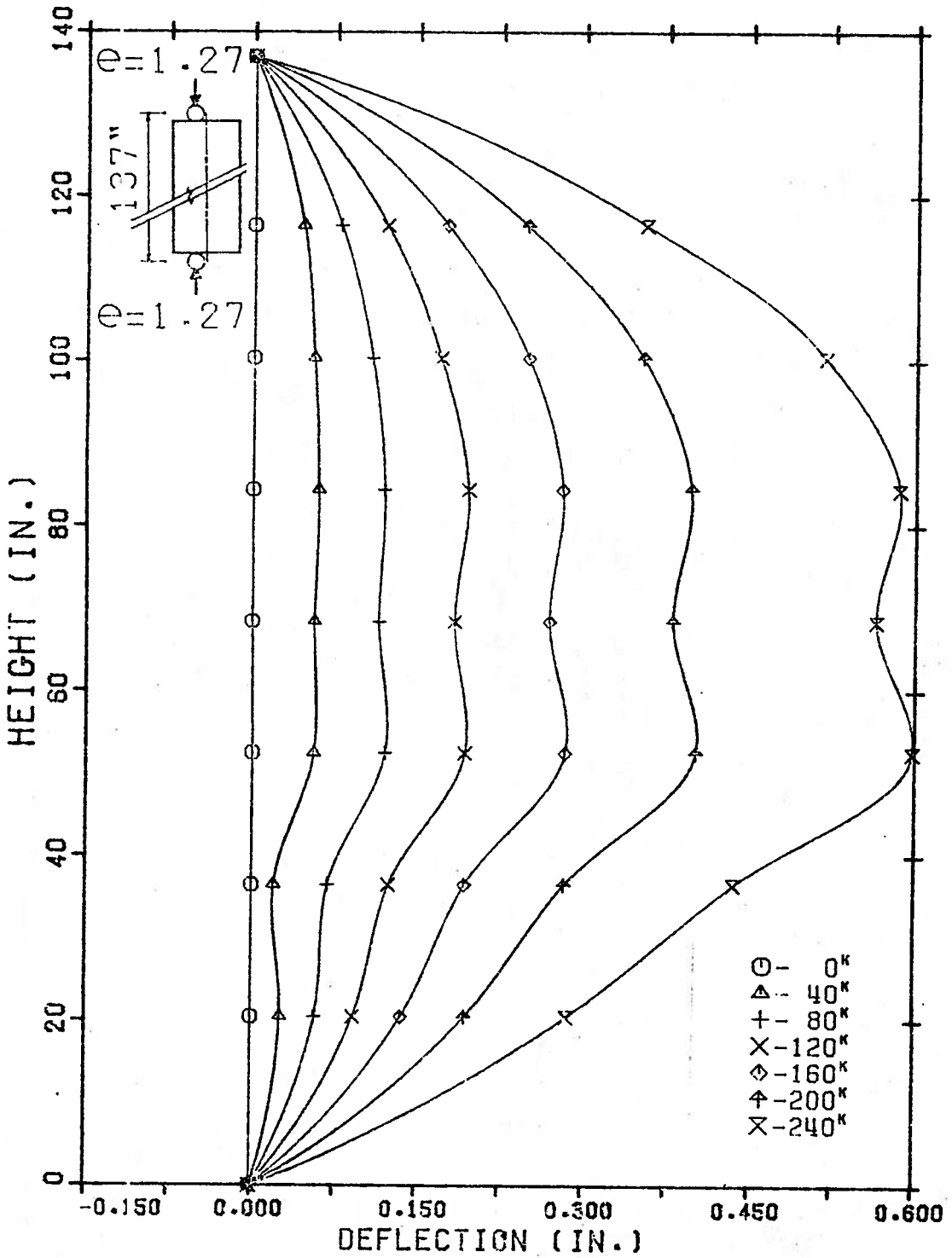


FIG. 2-43 Deflected Shape of Wall H2

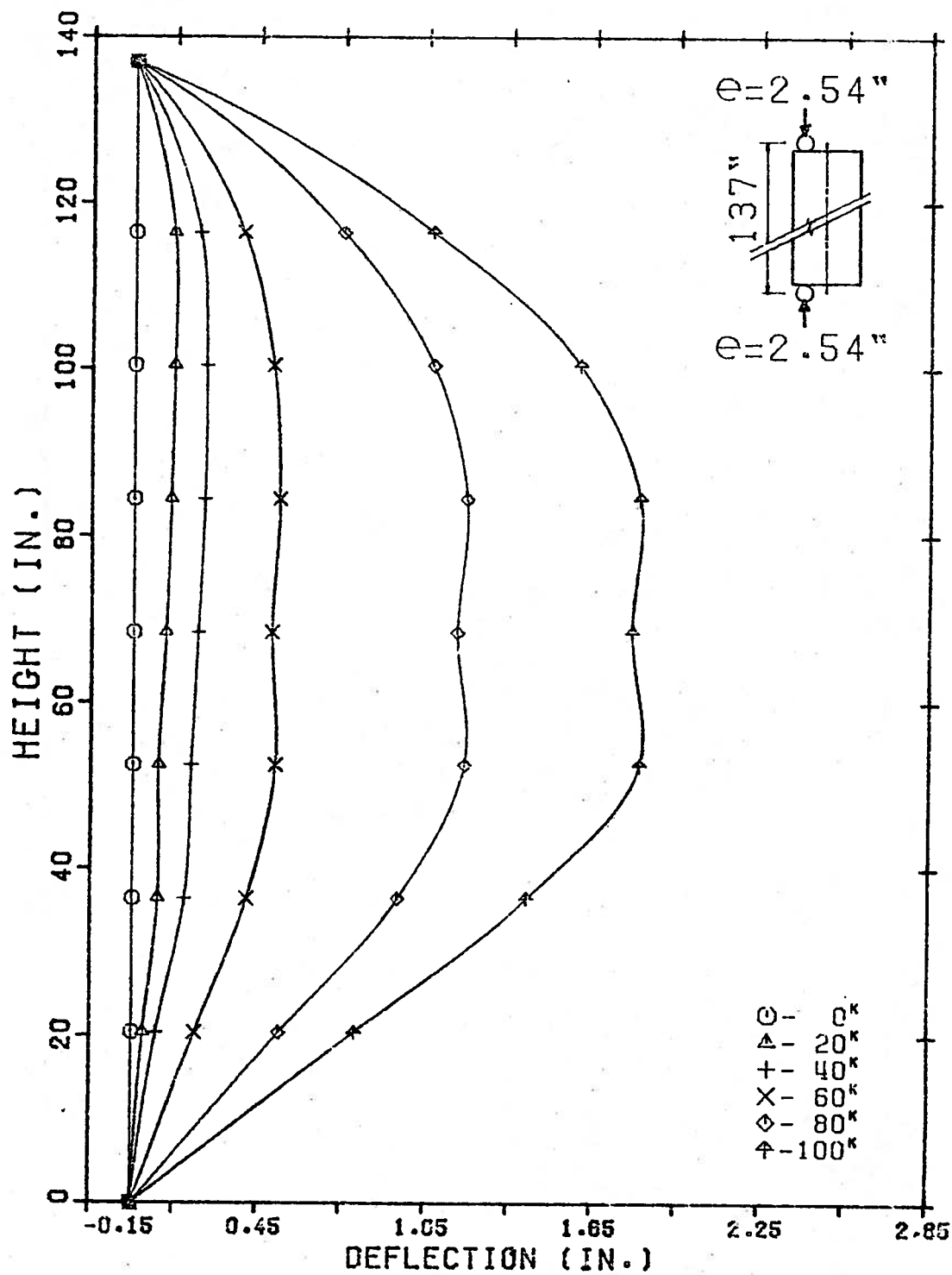


FIG. 2-44 Deflected Shape of Wall H3

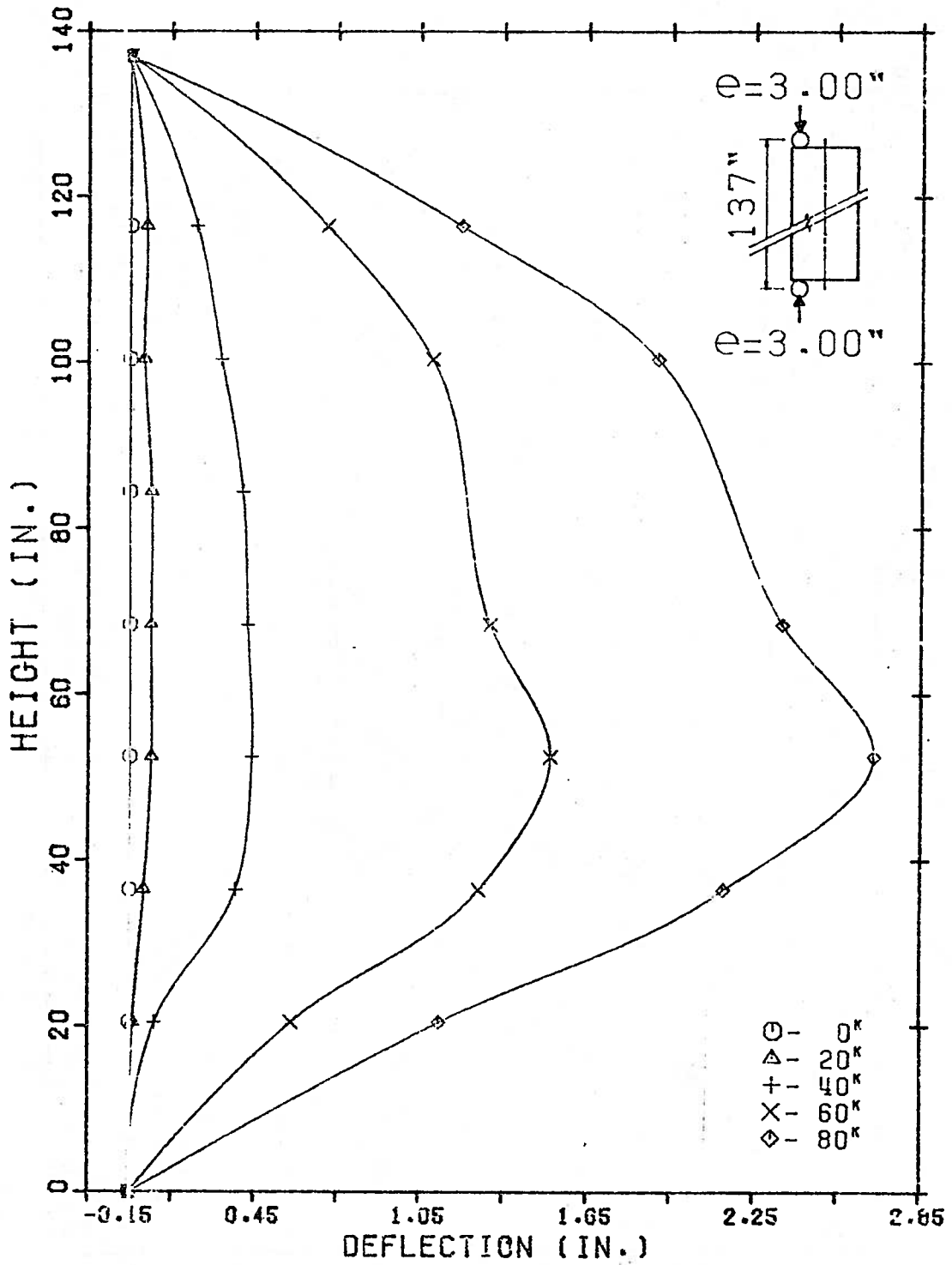


FIG. 2-45 Deflected Shape of Wall H4

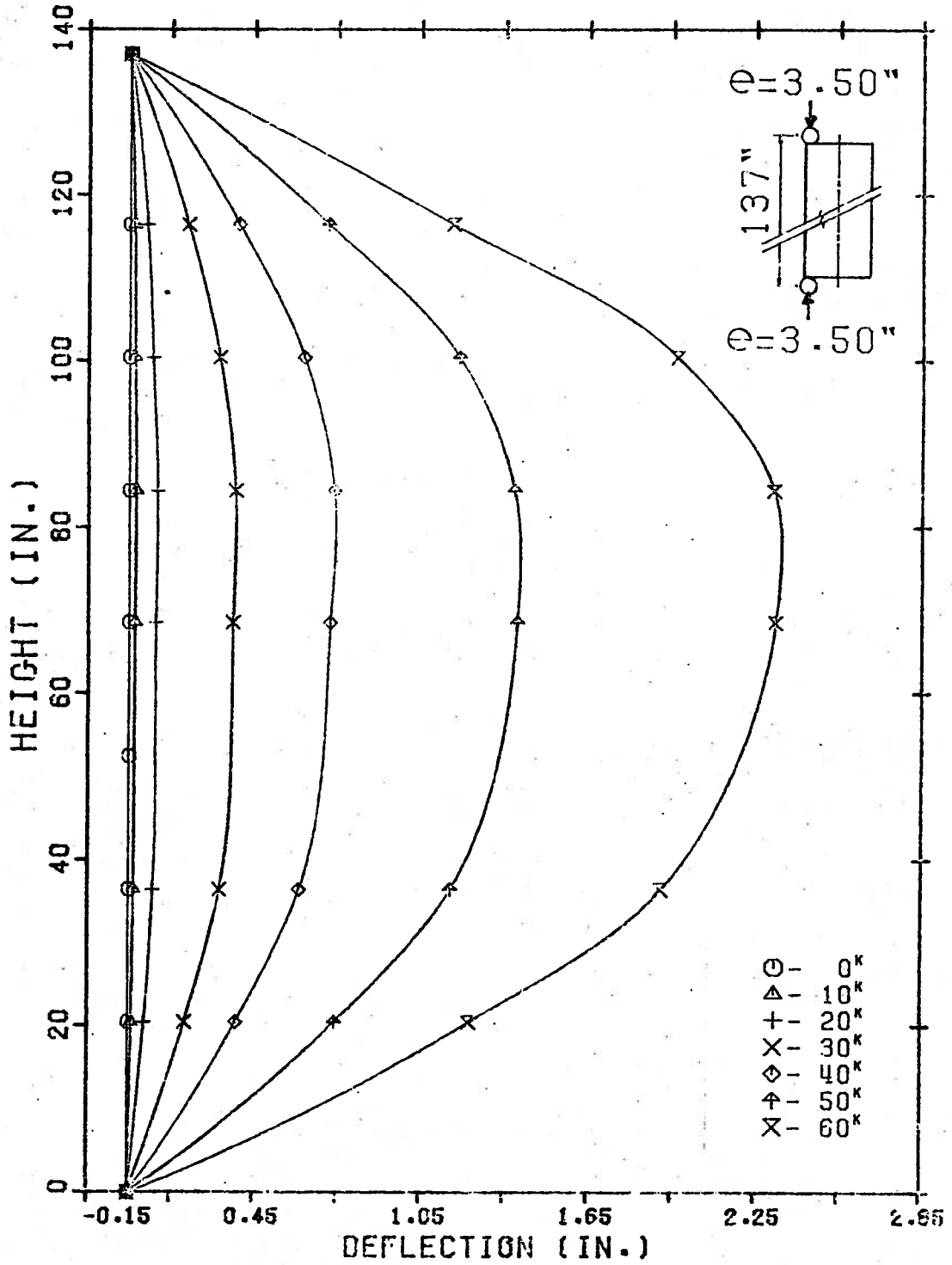


FIG. 2-46 Deflected Shape of Wall H5

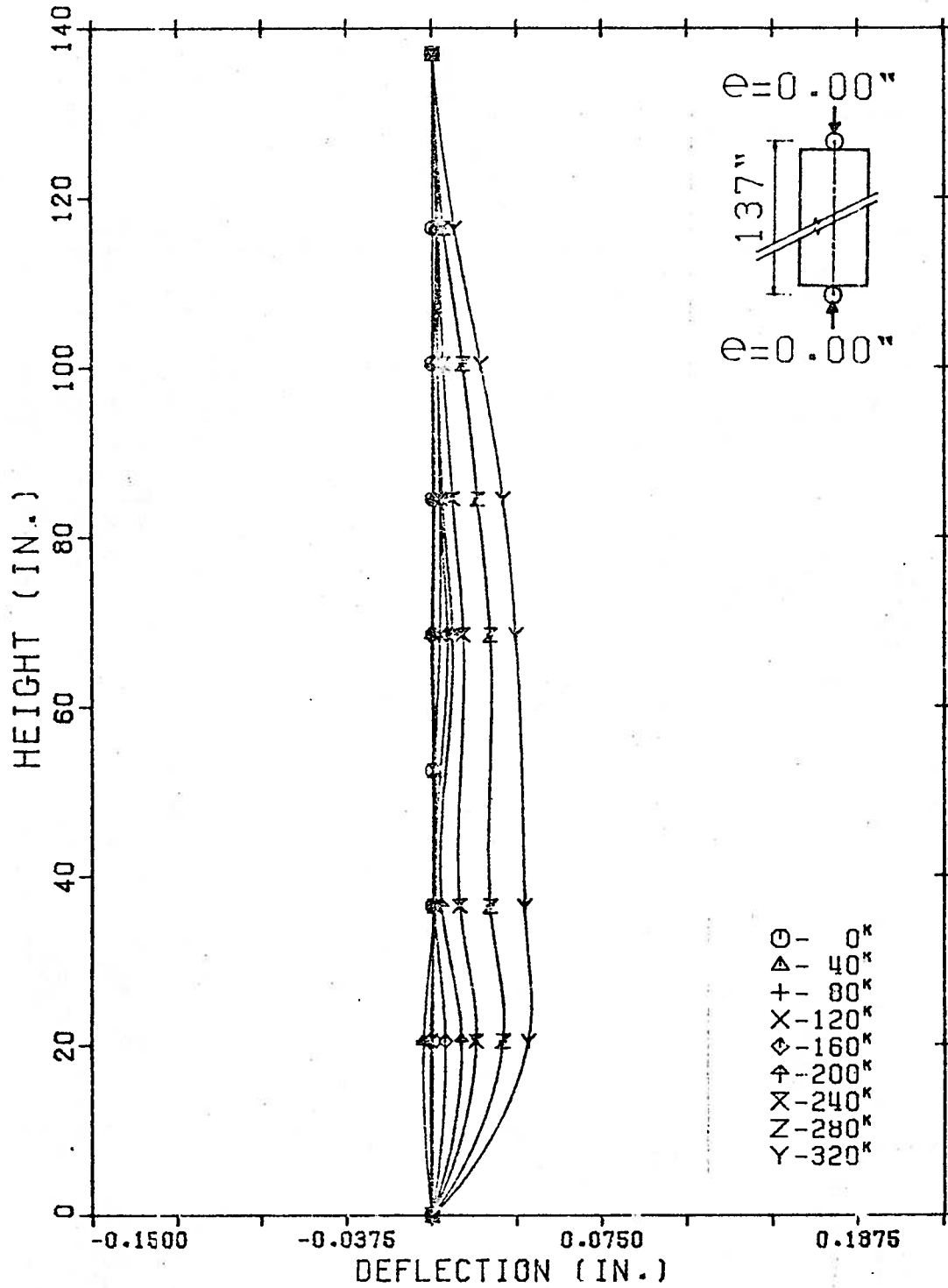


FIG. 2-47 Deflected Shape of Wall II

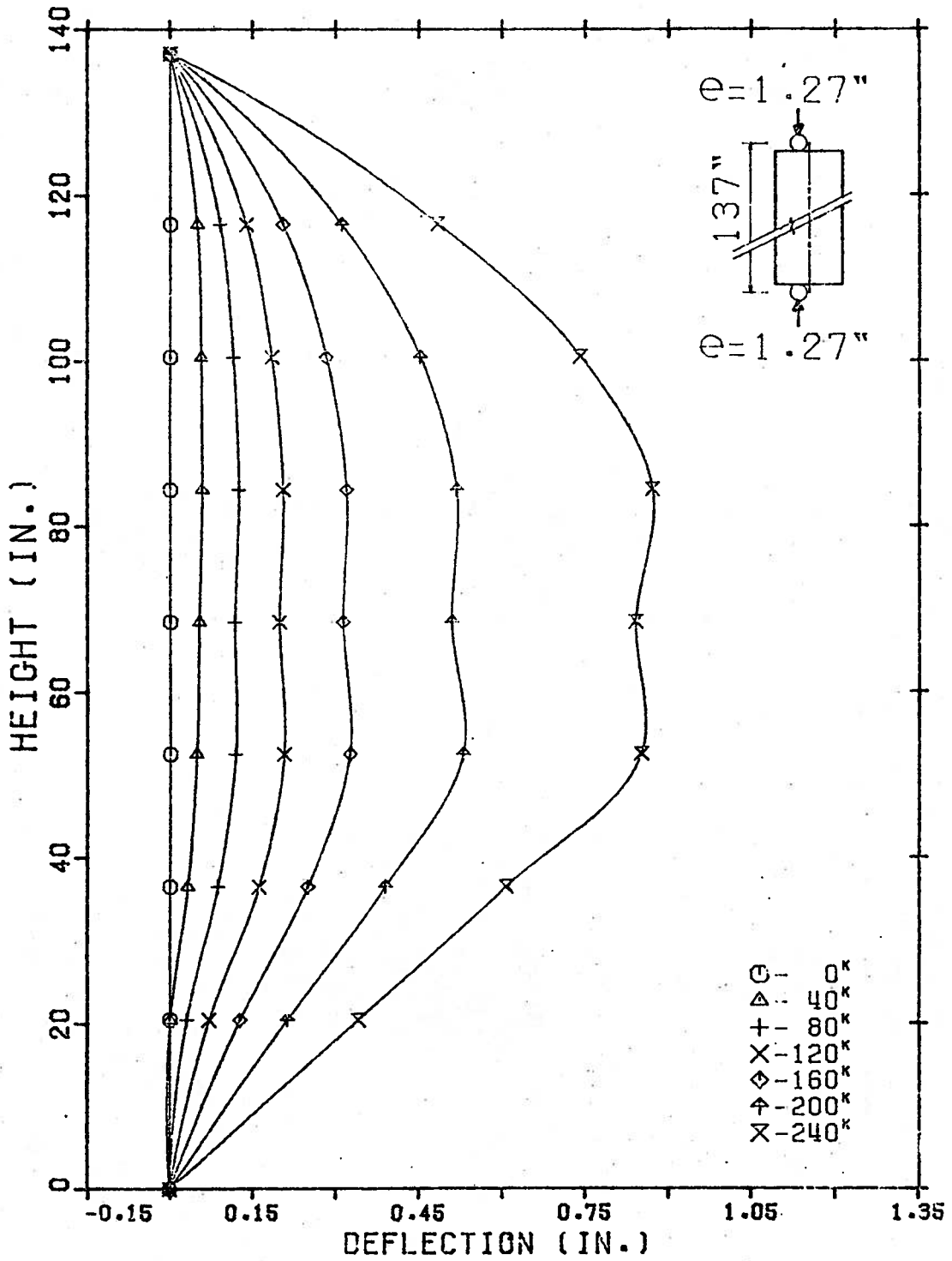


FIG. 2-48 Deflected Shape of Wall I2

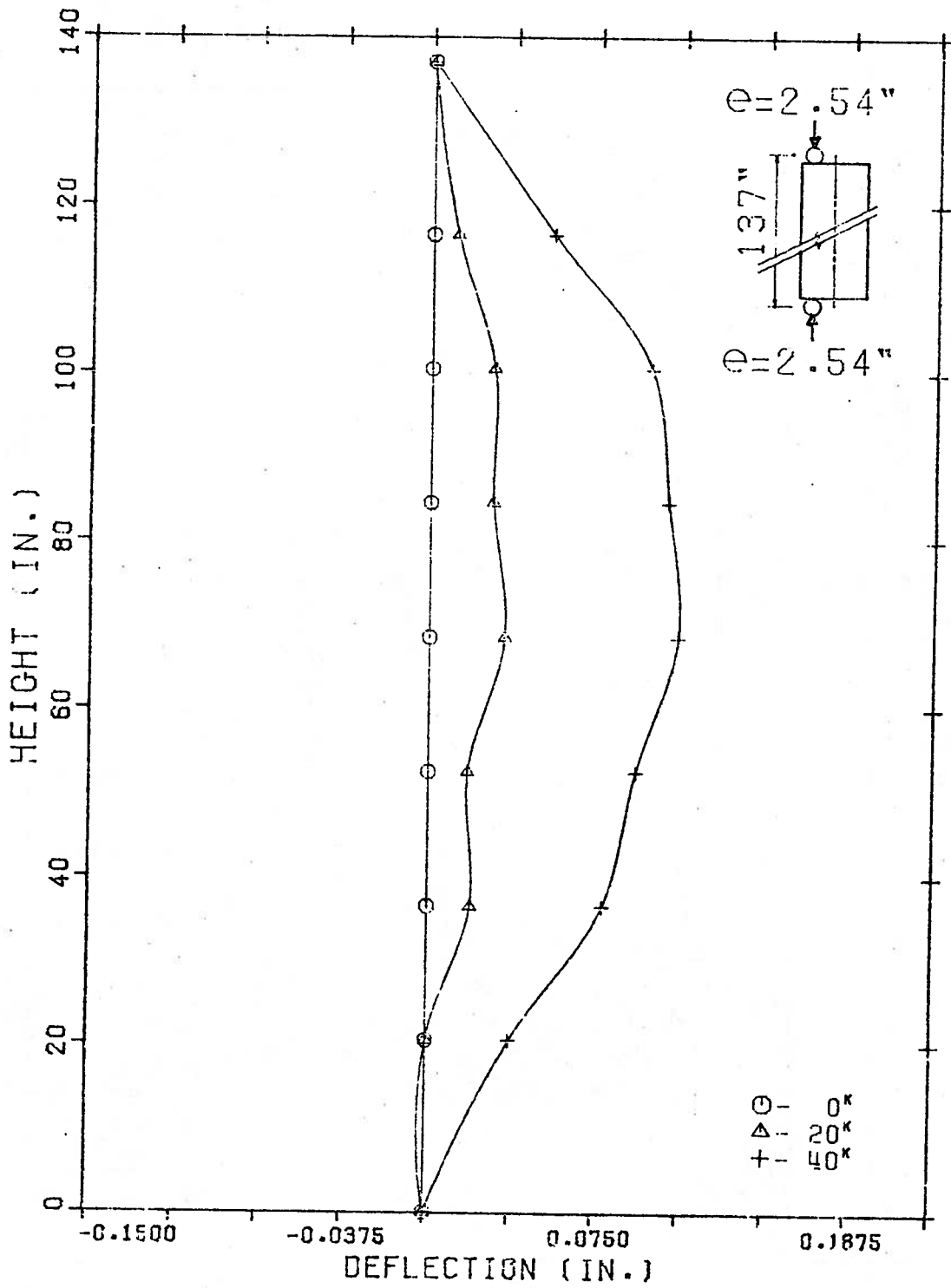


FIG. 2-49 Deflected Shape of Wall I3

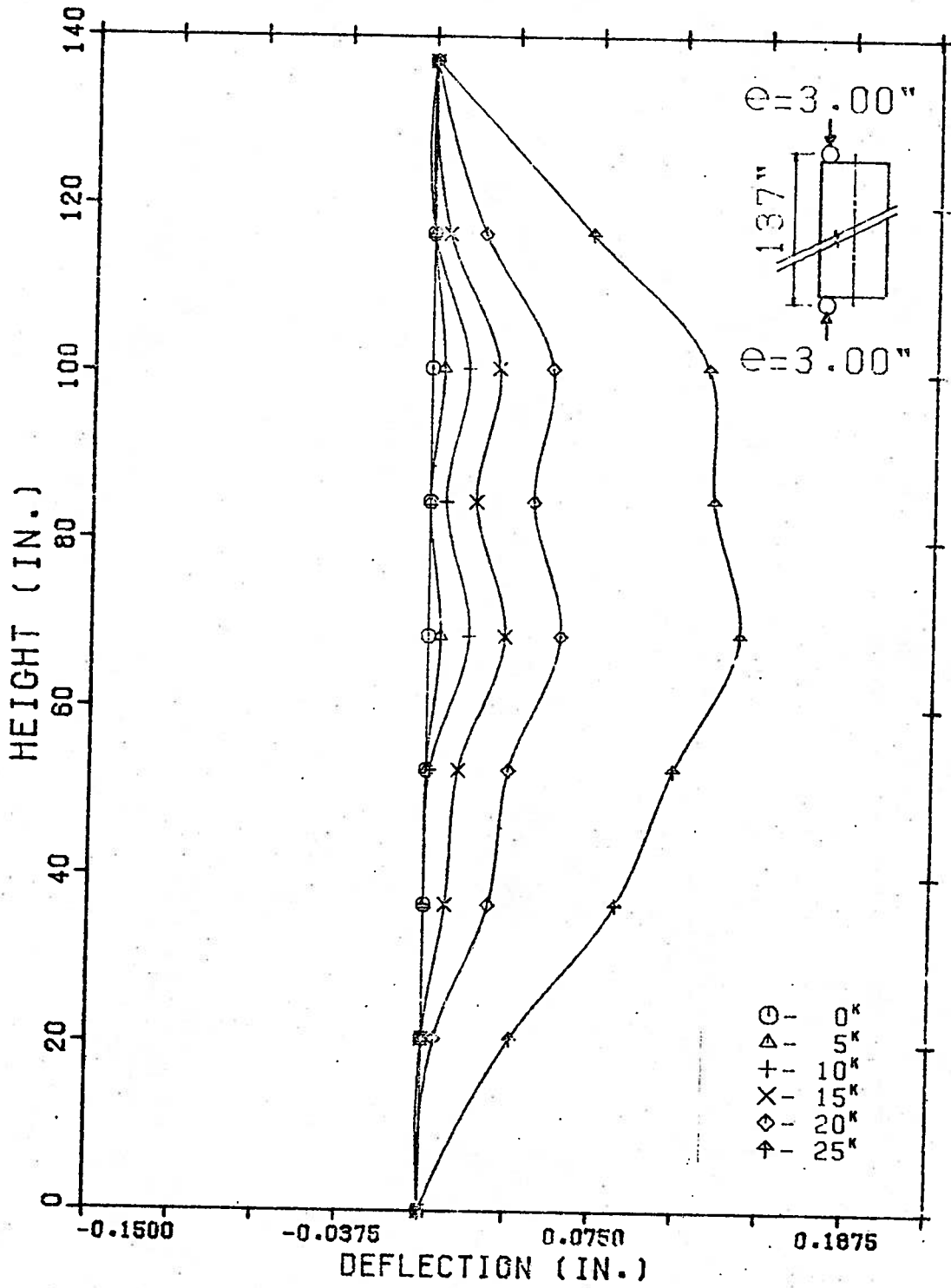


FIG. 2-50 Deflected Shape of Wall I4

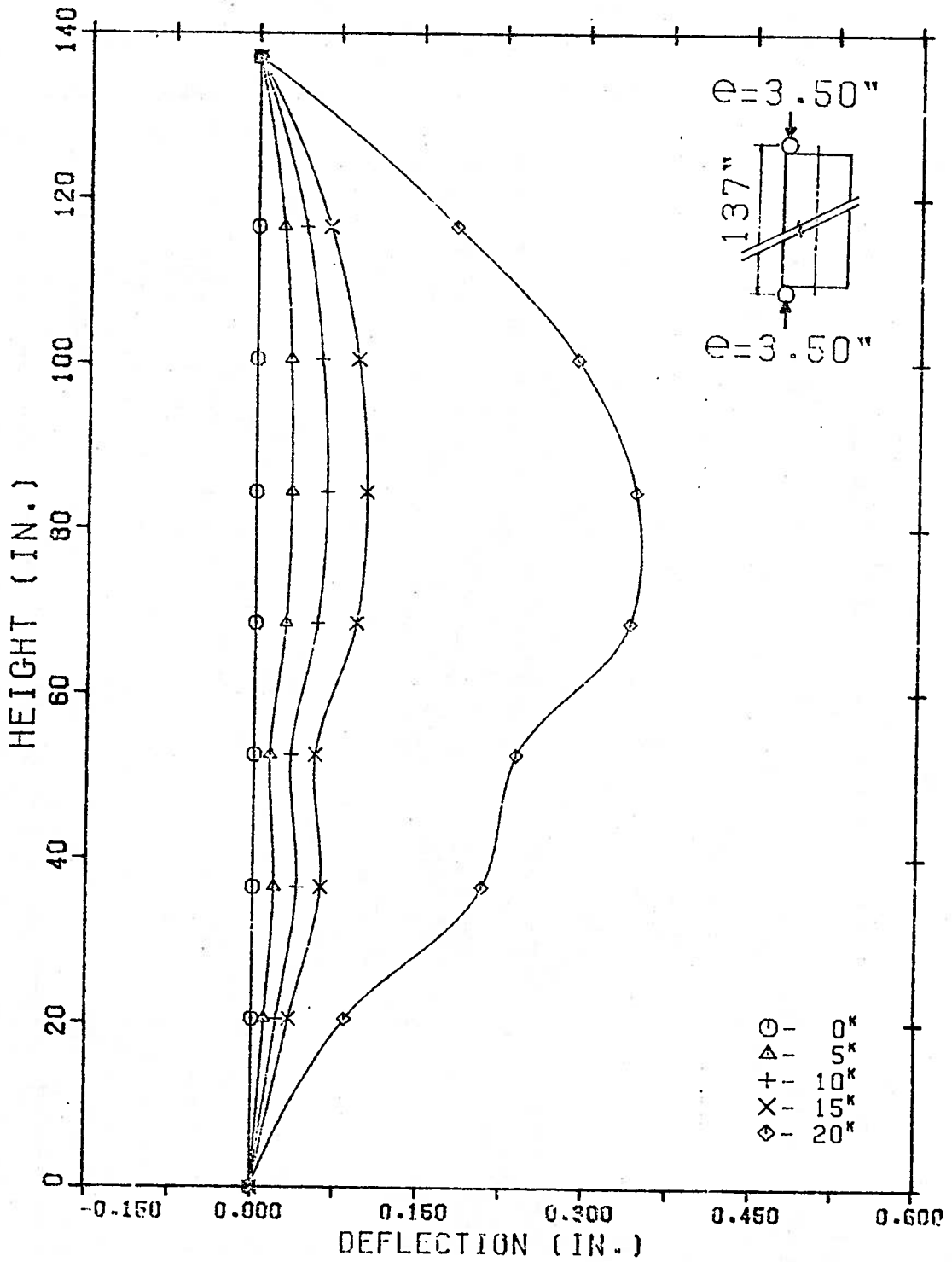


FIG. 2-51 Deflected Shape of Wall 15

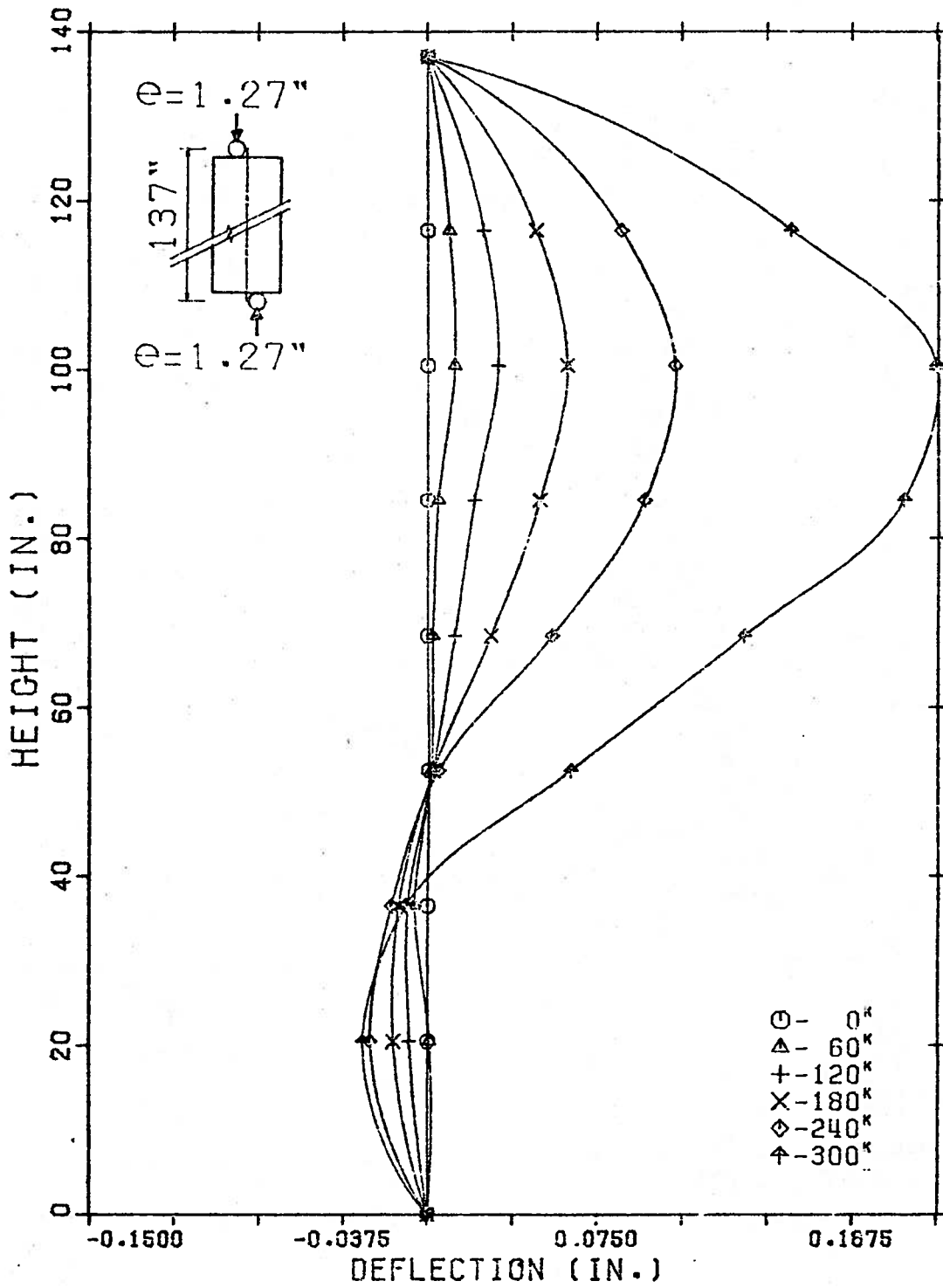


FIG. 2-52 Deflected Shape of Wall J1

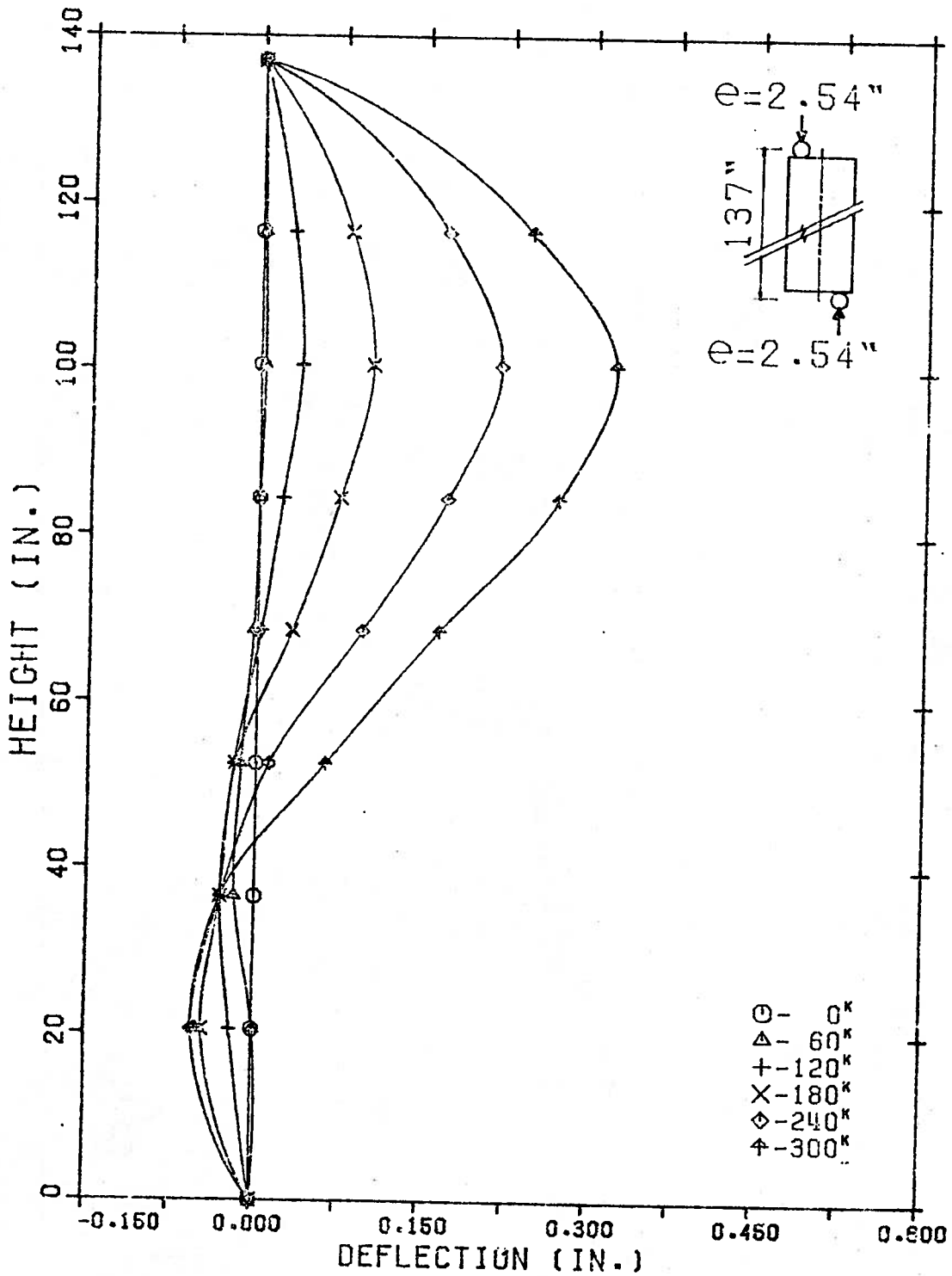


FIG. 2-53 Deflected Shape of Wall J2

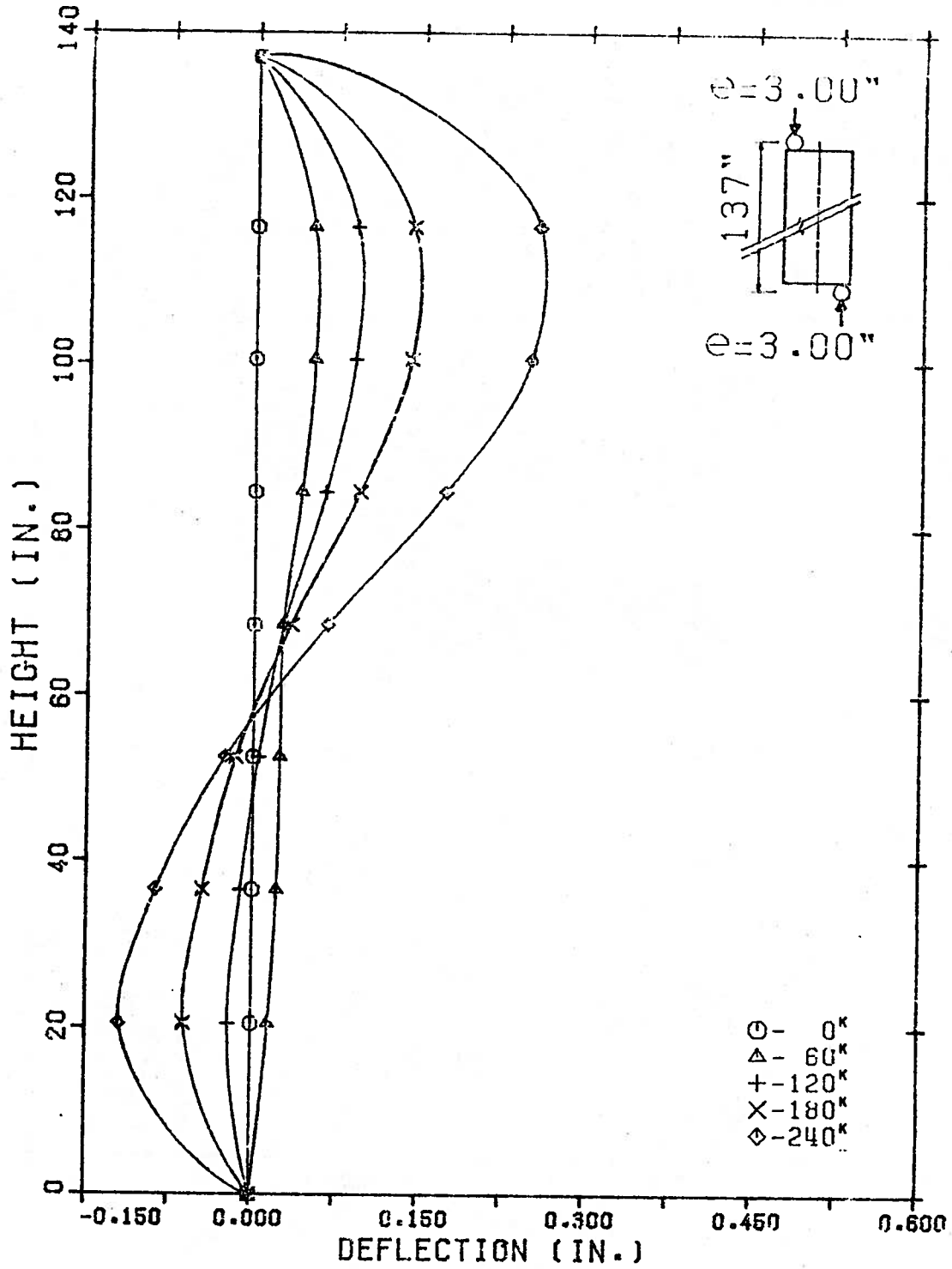


FIG. 2-54 Deflected Shape of Wall J3

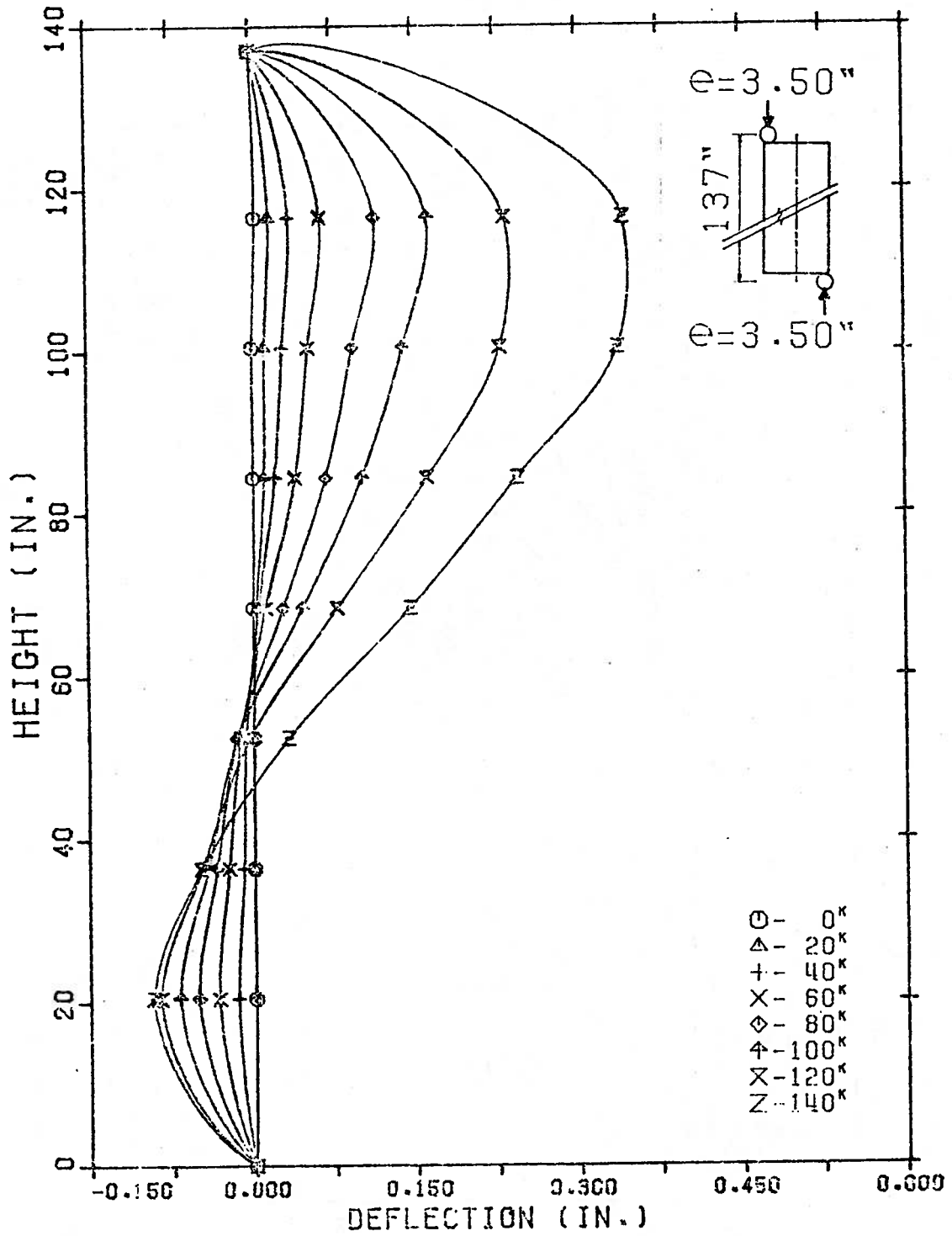


FIG. 2-55 Deflected Shape of Wall J4

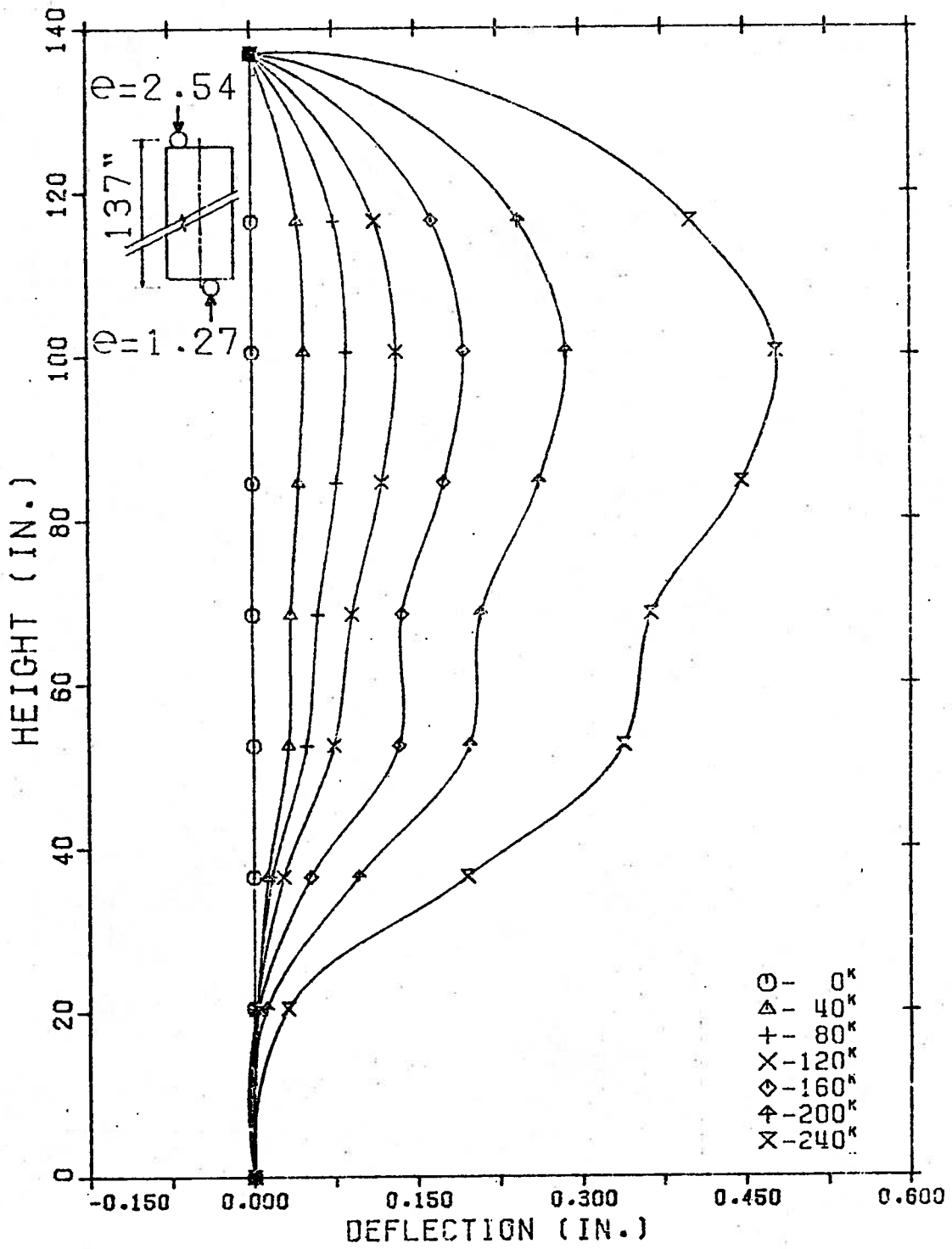


FIG. 2-56 Deflected Shape of Wall K1

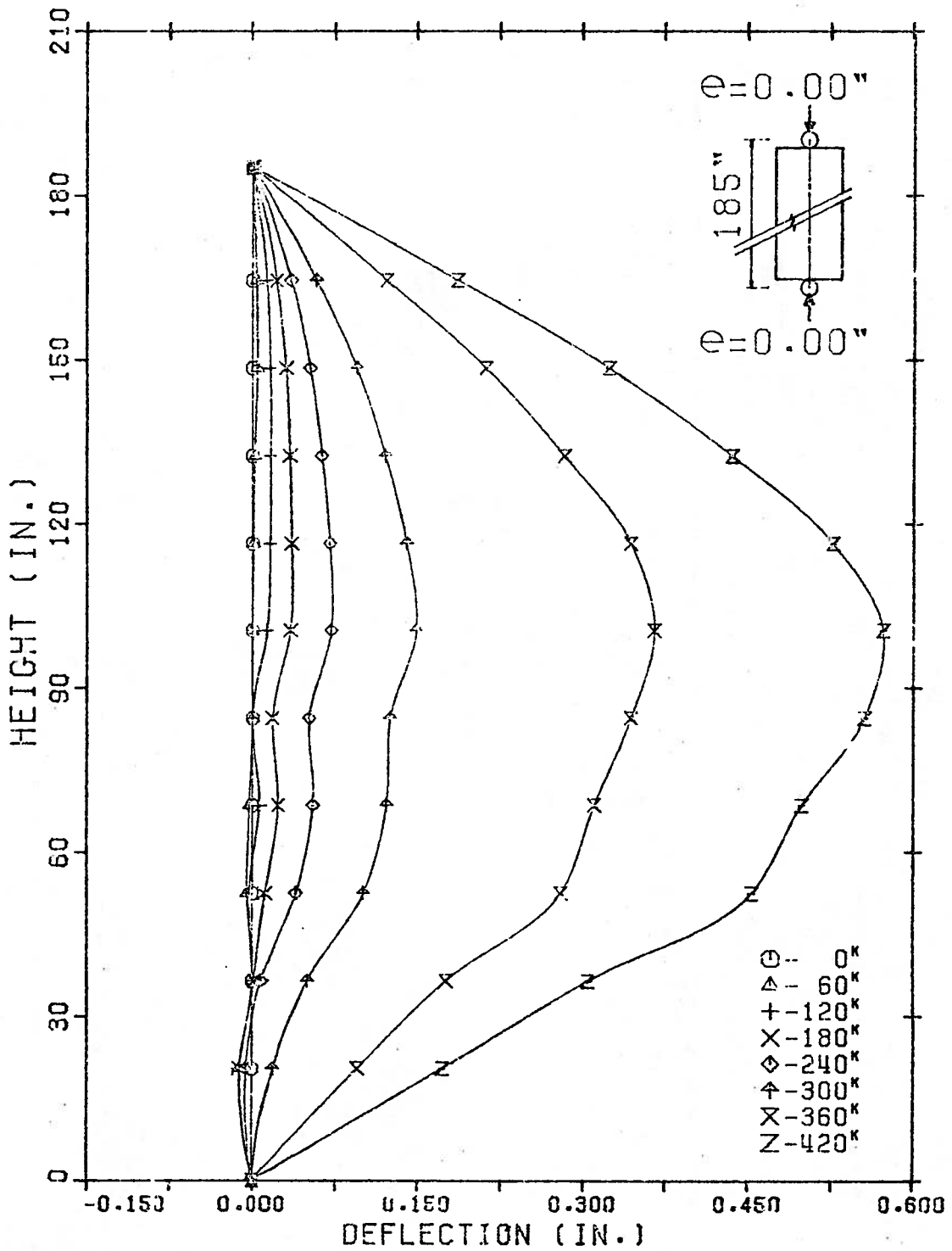


FIG. 2-57 Deflected Shape of Wall I.1

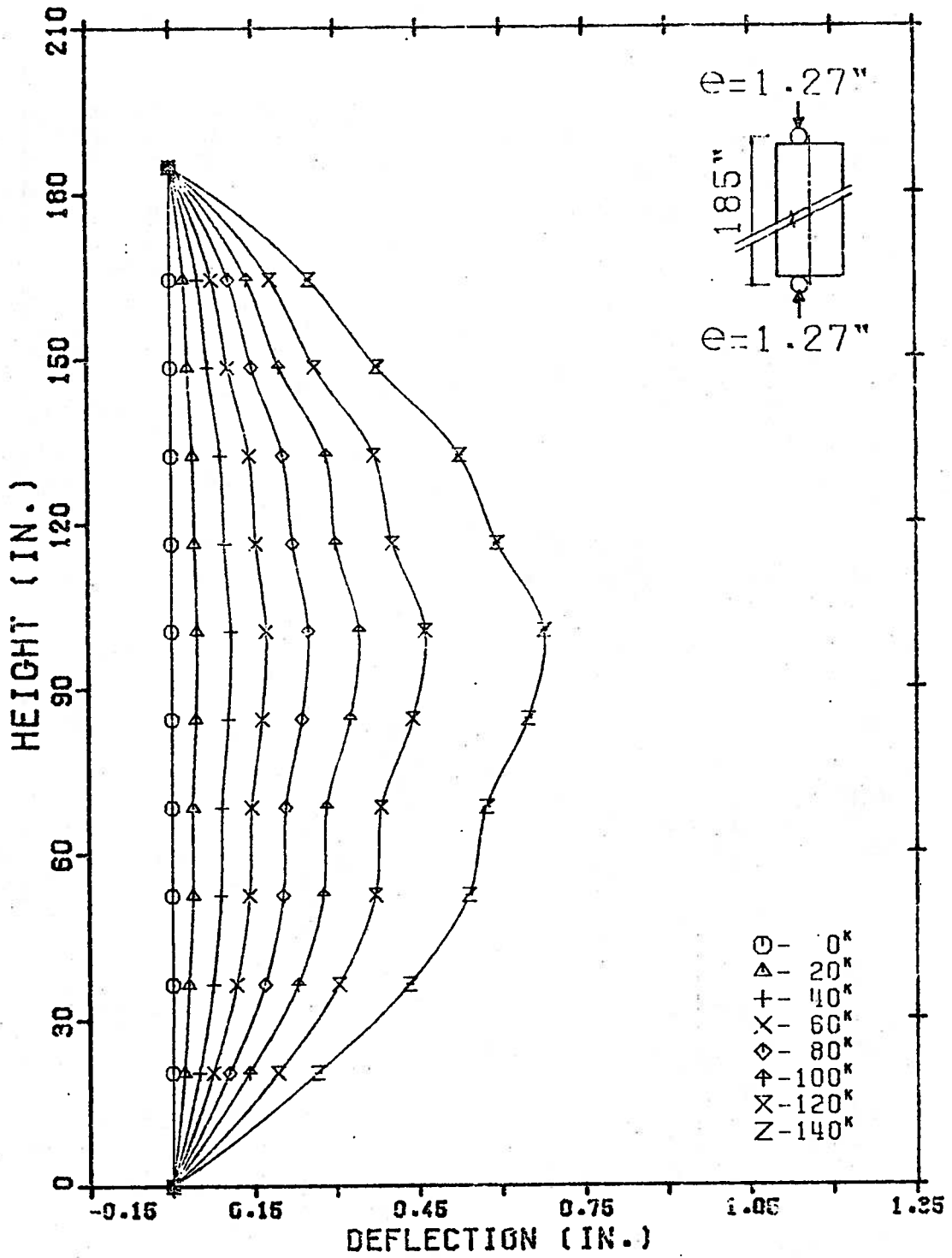


FIG. 2-58 Deflected Shape of Wall L2

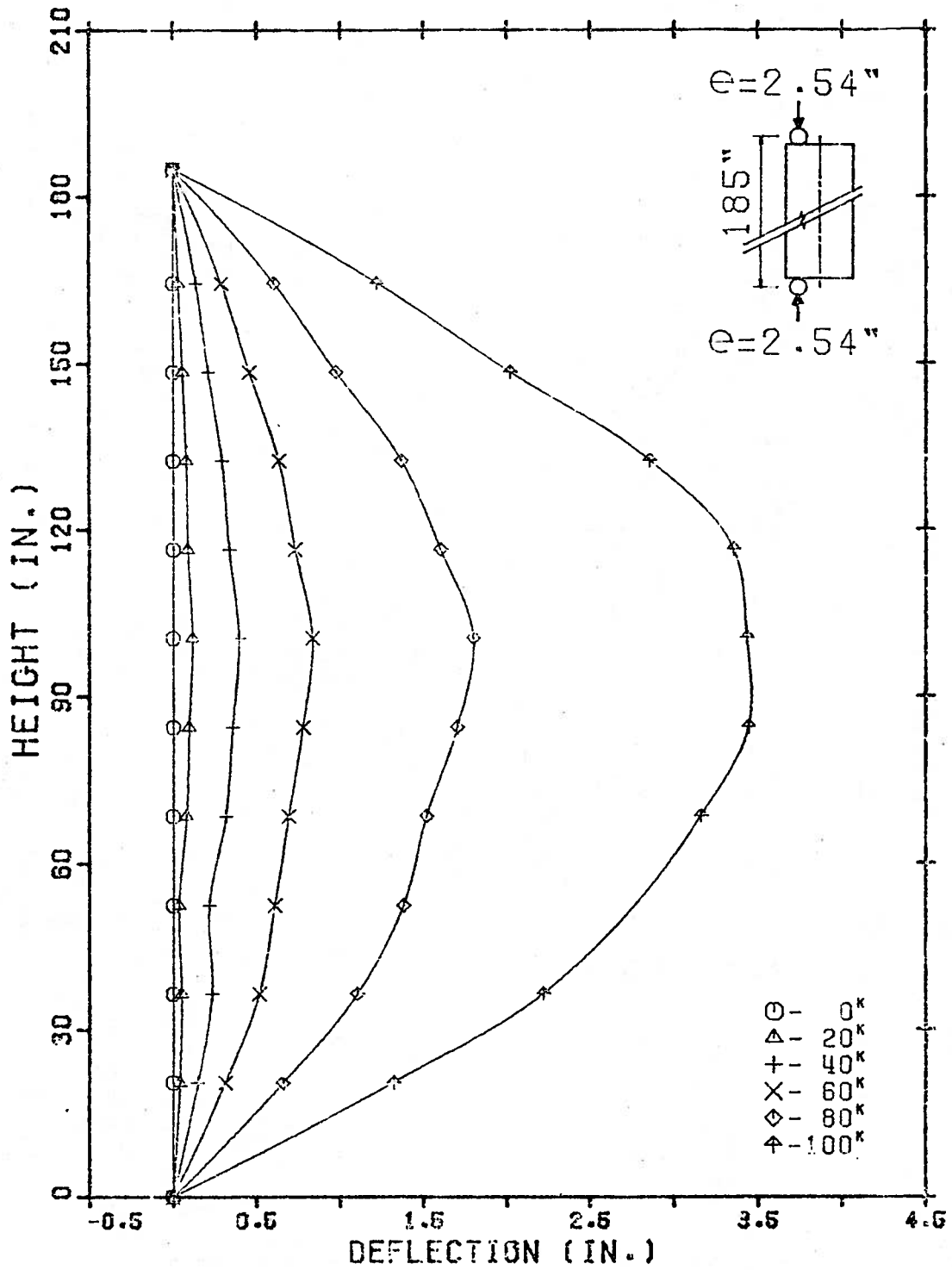


FIG. 2-59 Deflected Shape of Wall L3

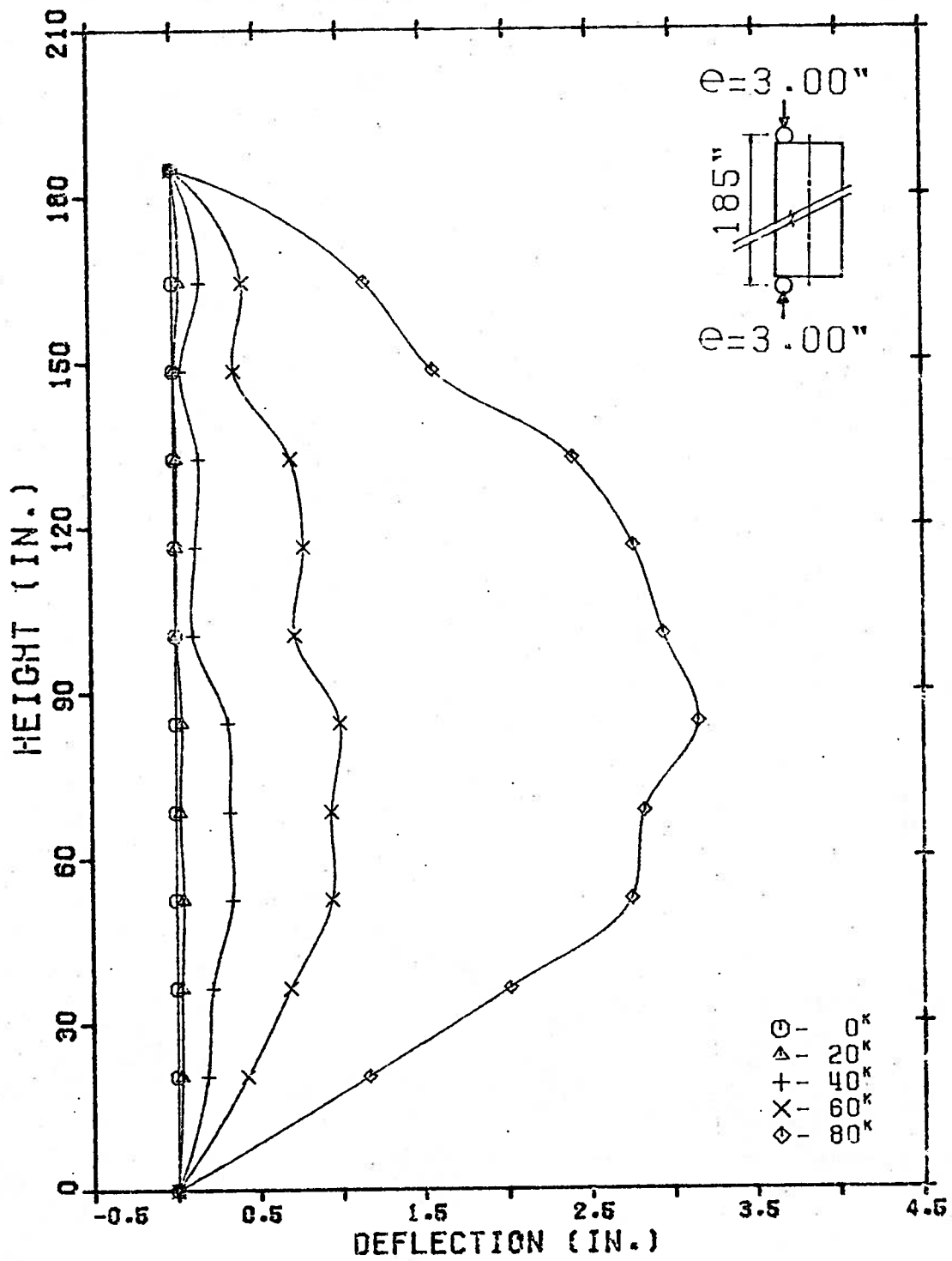


FIG. 2-60 Deflected Shape of Wall L4

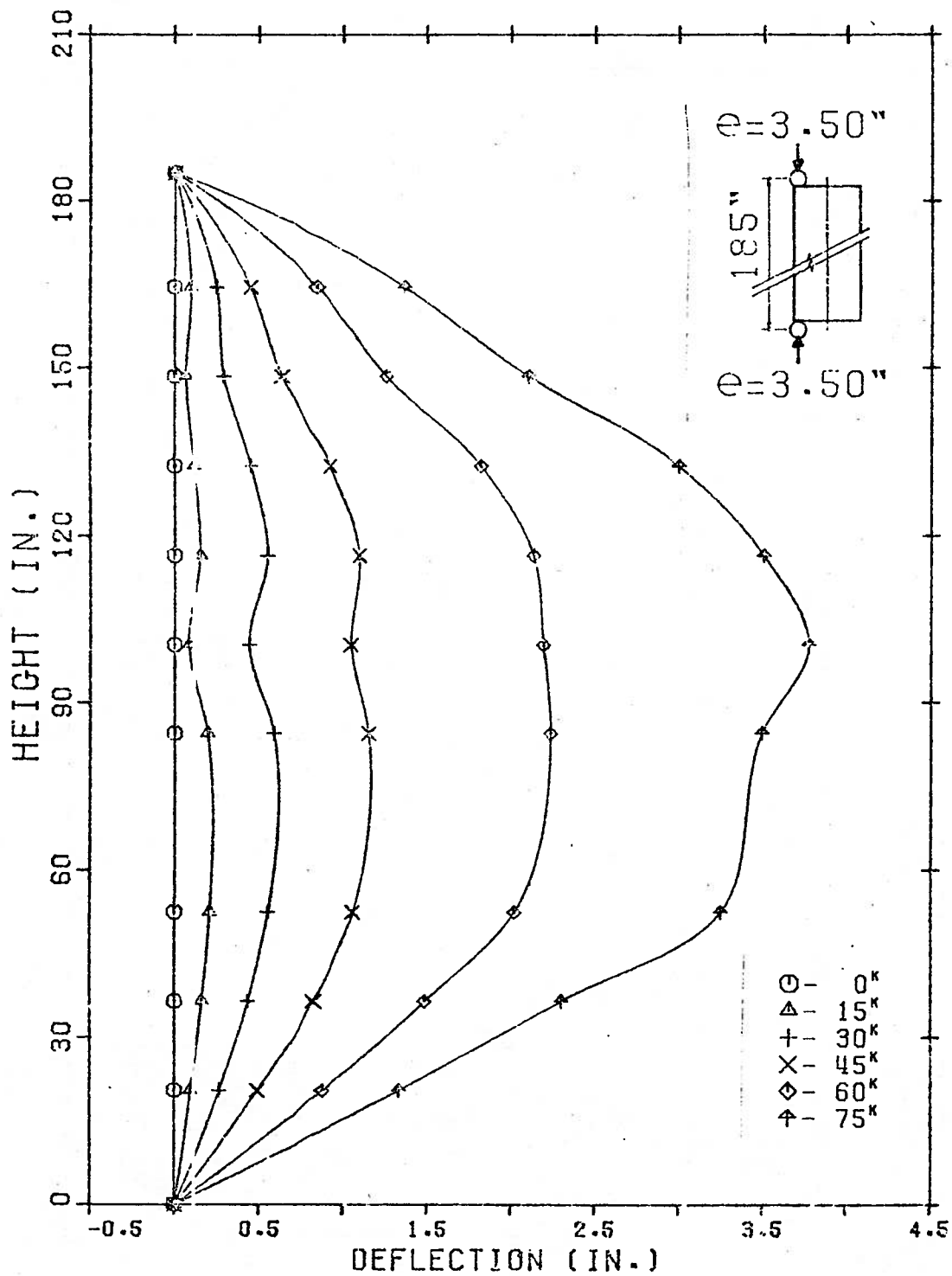


FIG. 2-61 Deflected Shape of Wall L5

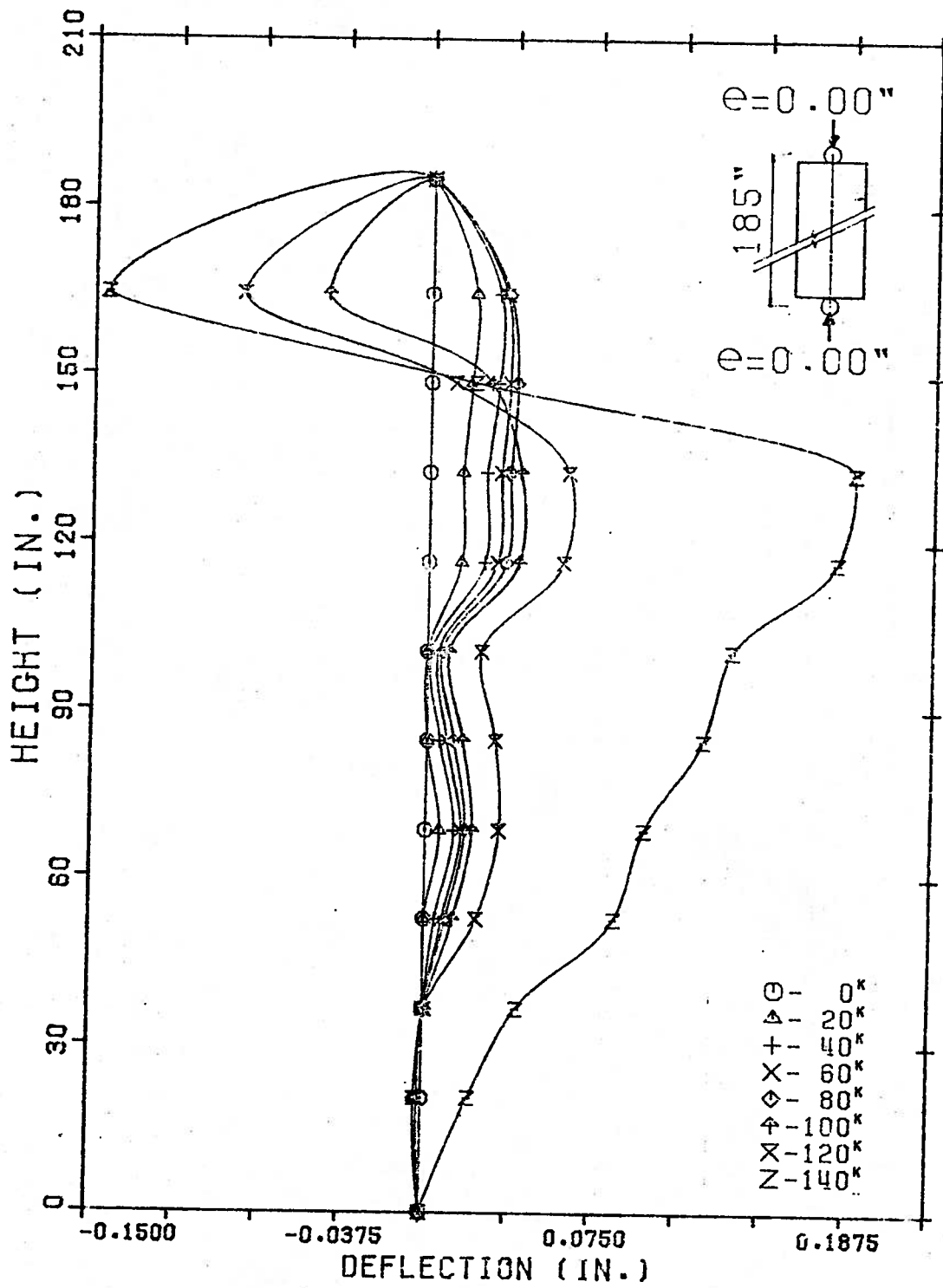


FIG. 2-62 Deflected Shape of Wall M1

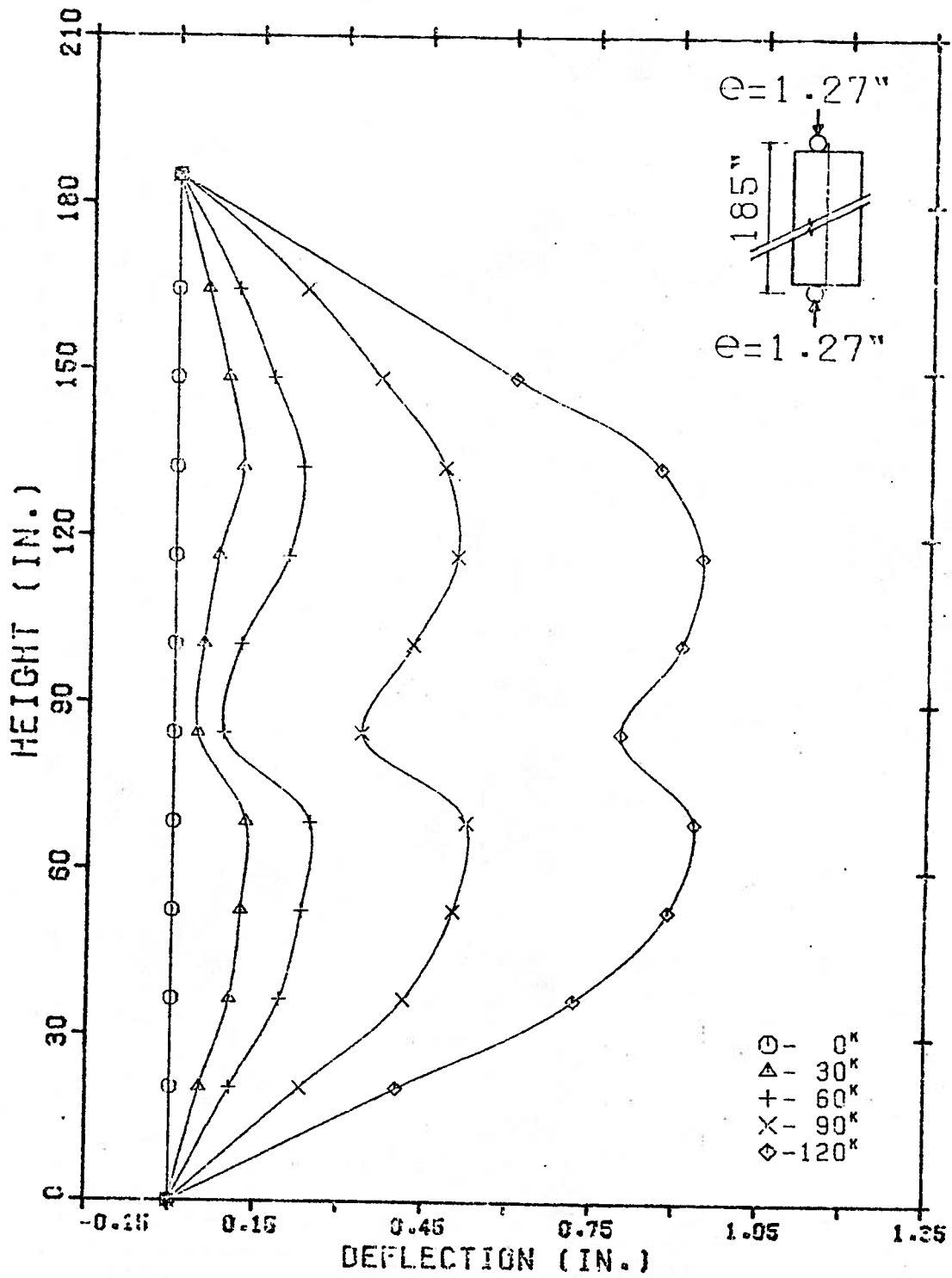


FIG. 2-63 Deflected Shape of Wall M2

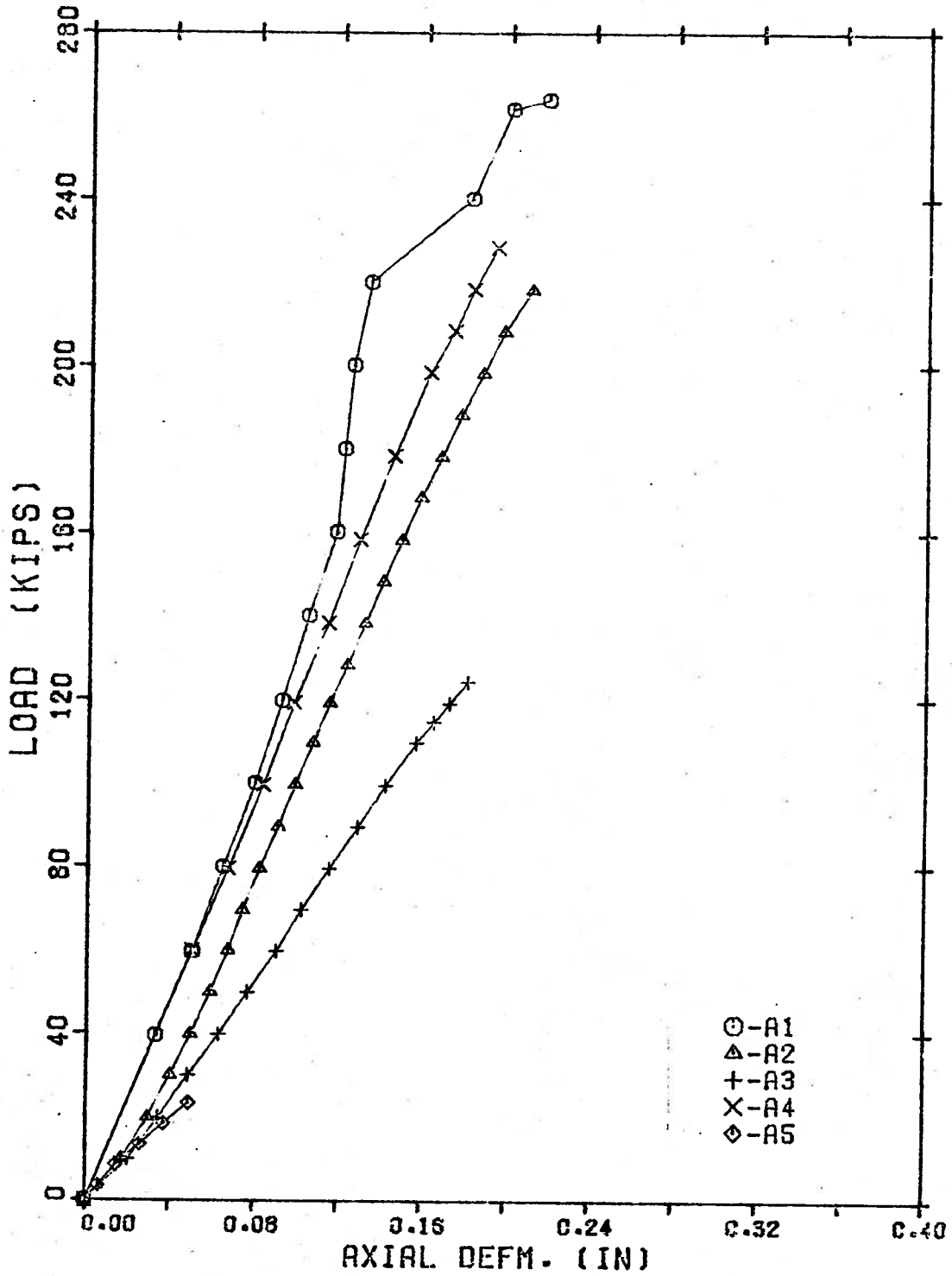


FIG. 2-64 Vertical Deformation of Series A

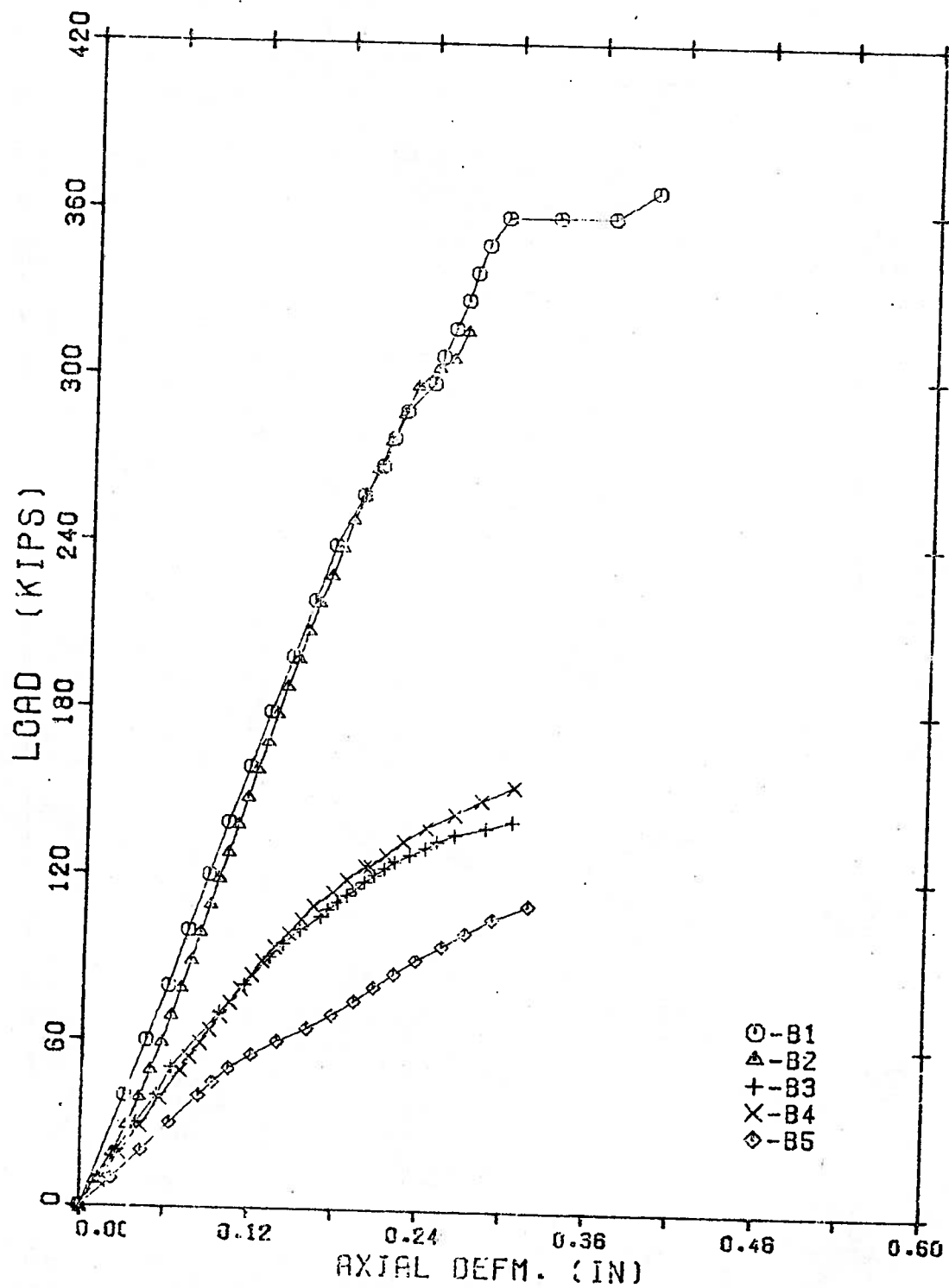


FIG. 2-65 Vertical Deformation of Series B

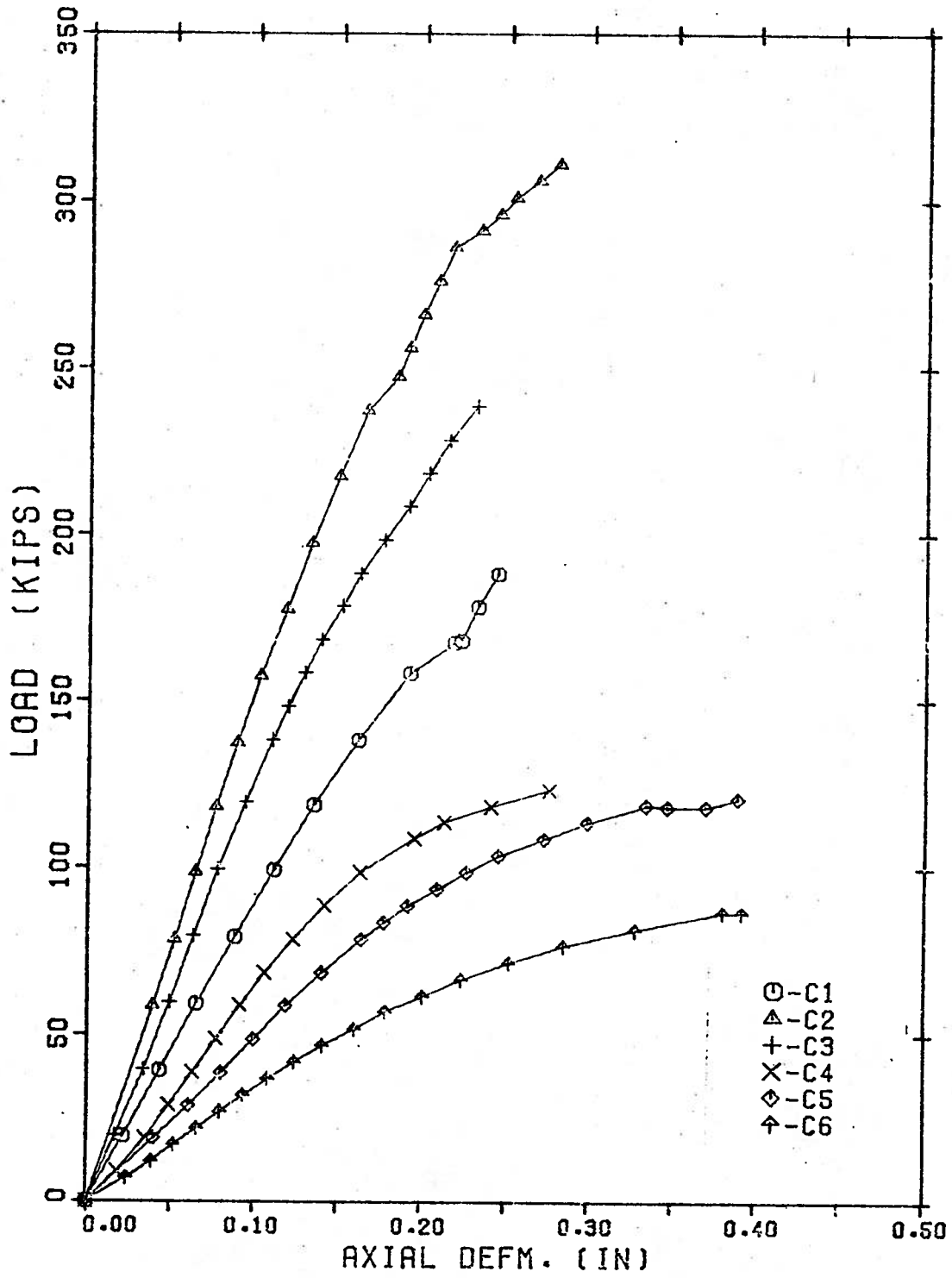


FIG. 2-66 Vertical Deformation of Series C

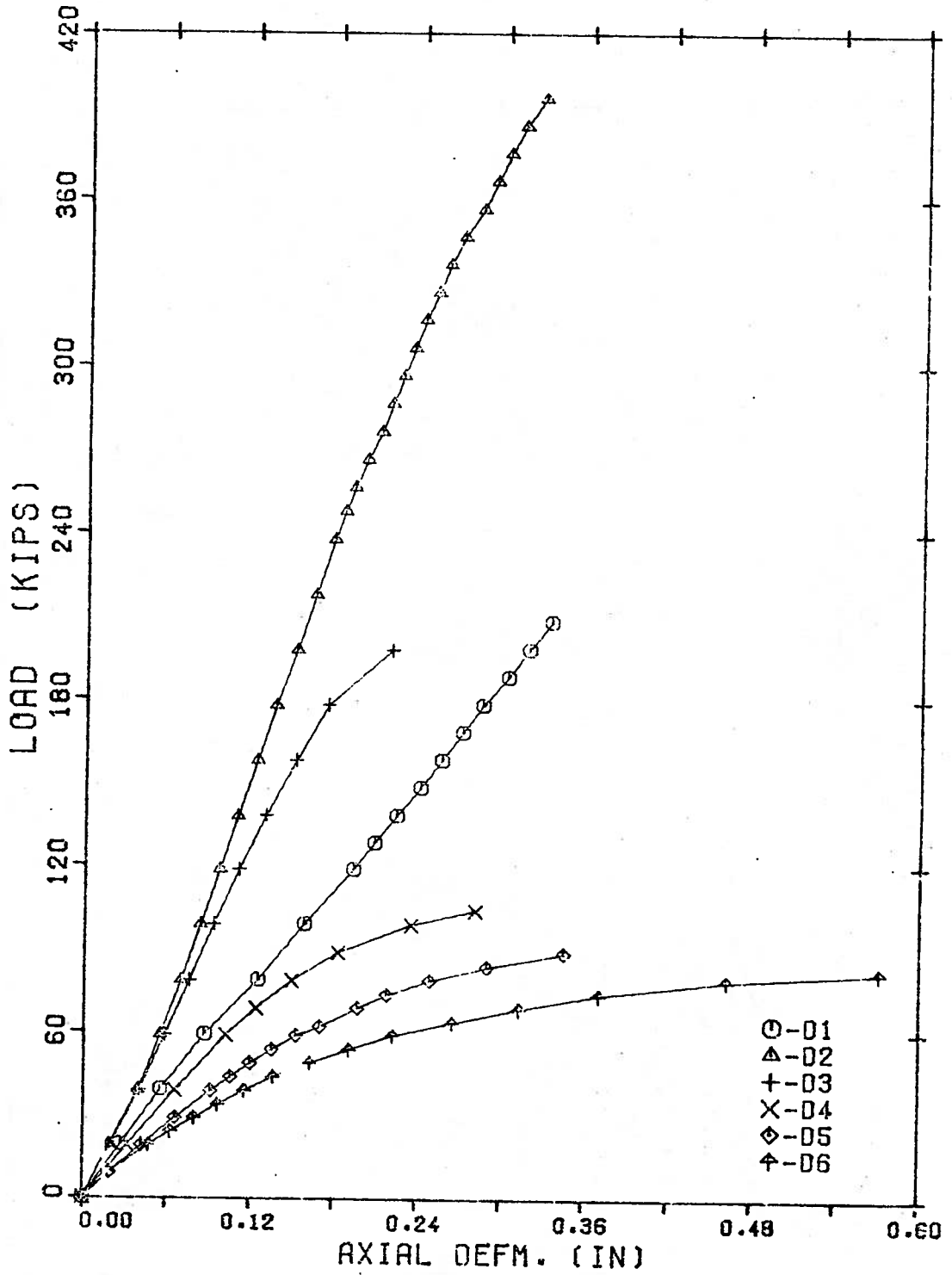


FIG. 2-67 Vertical Deformation of Series D

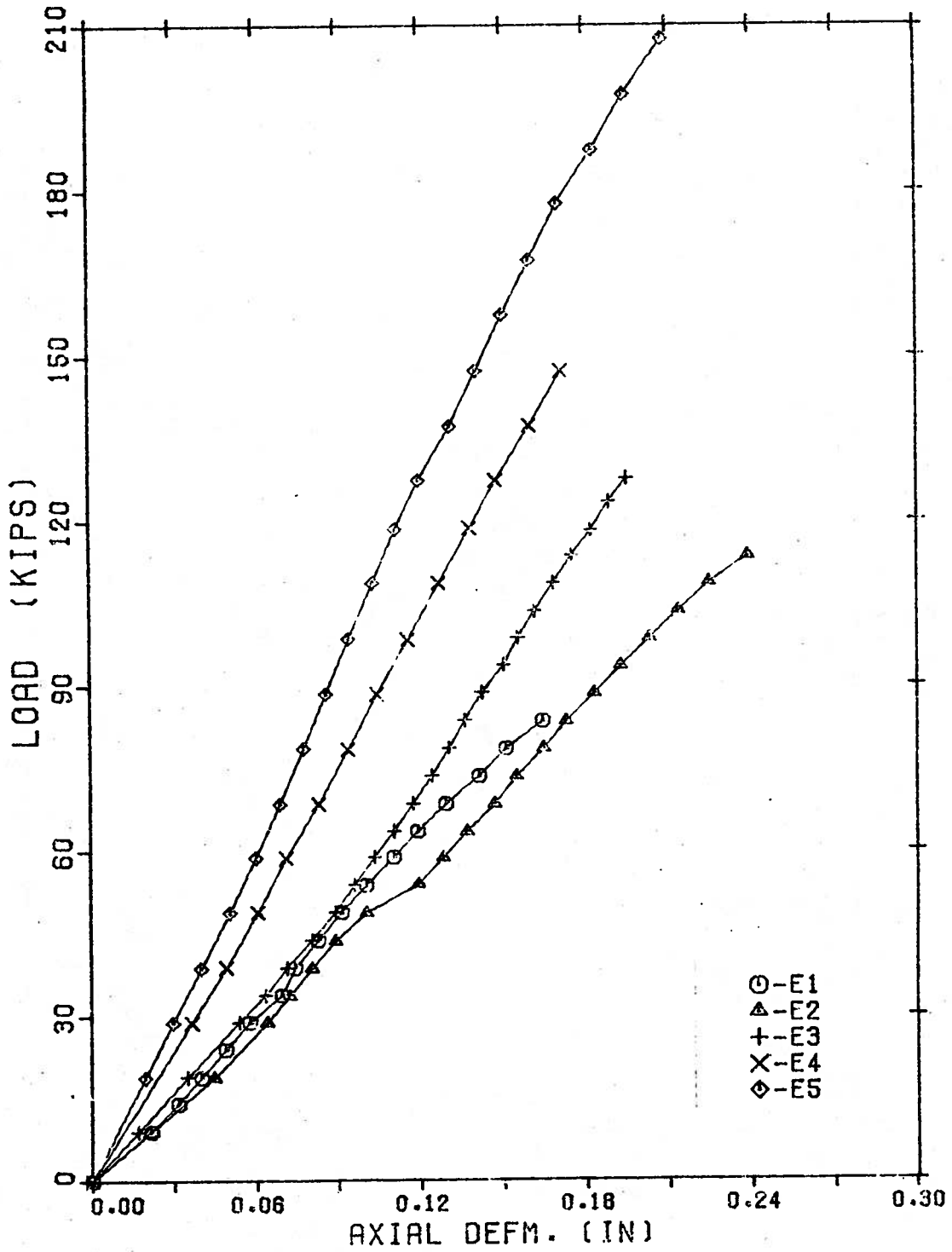


FIG. 2-68 Vertical Deformation of Series E

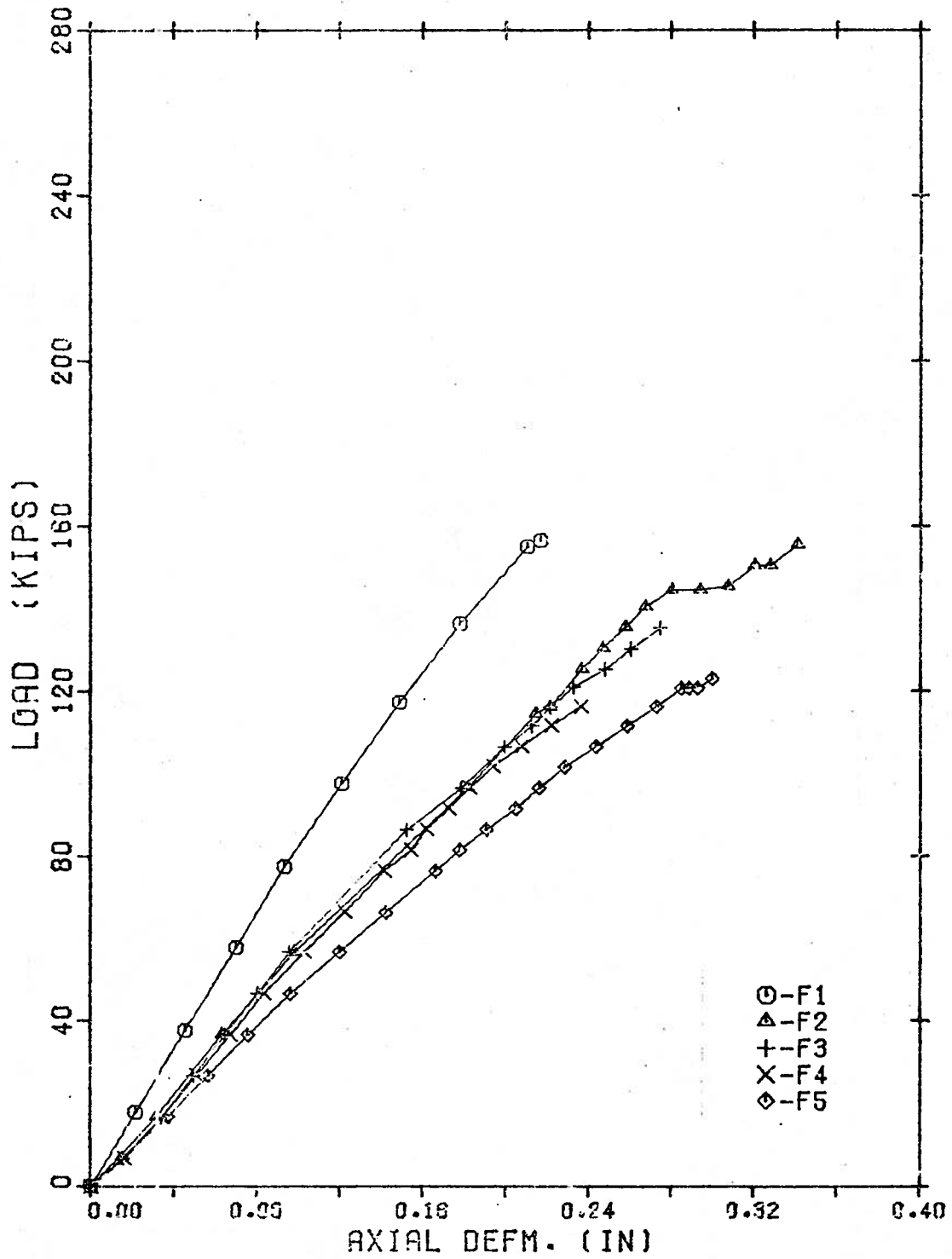


FIG. 2-69 Vertical Deformation of Series F

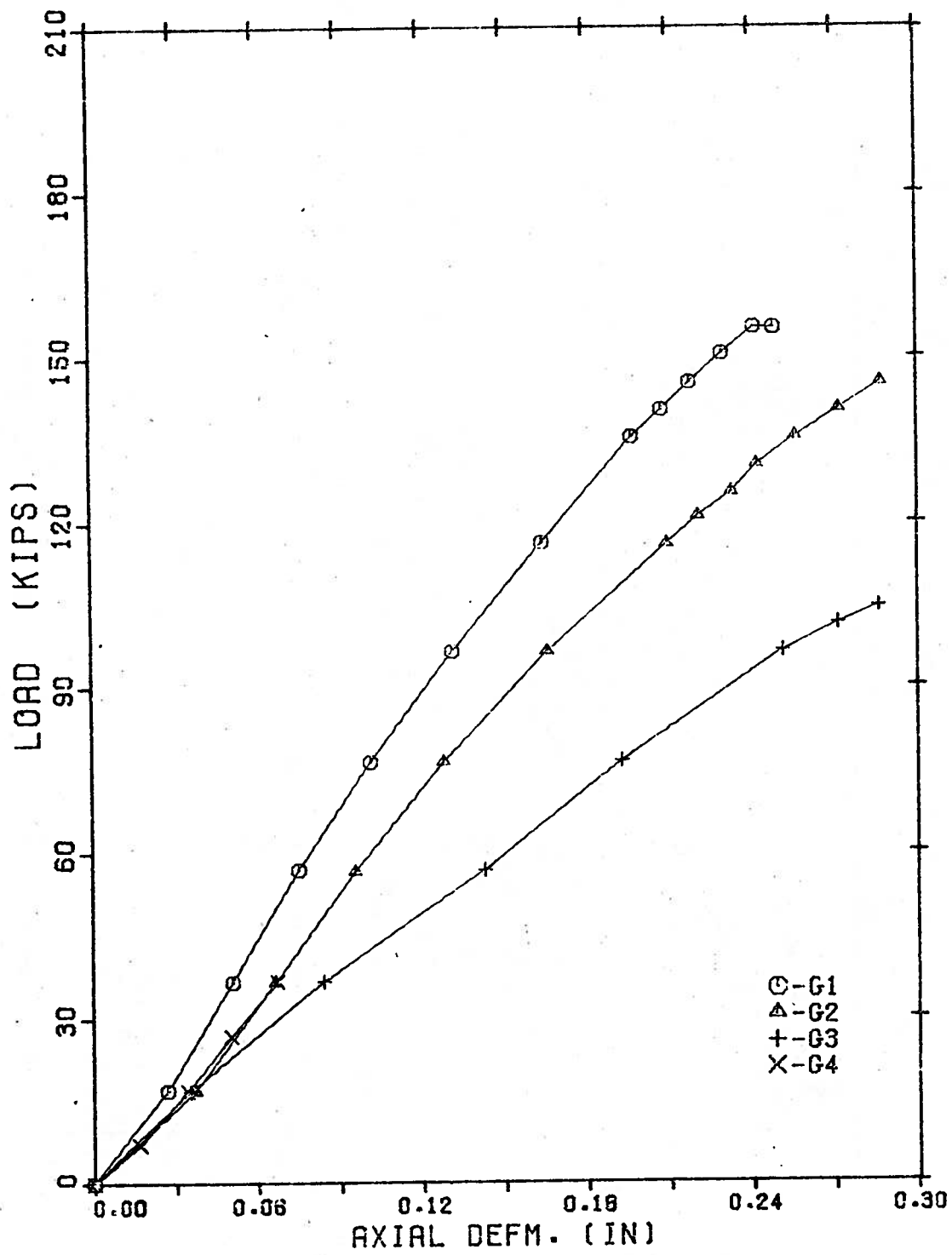


FIG. 2-70 Vertical Deformation of Series GA

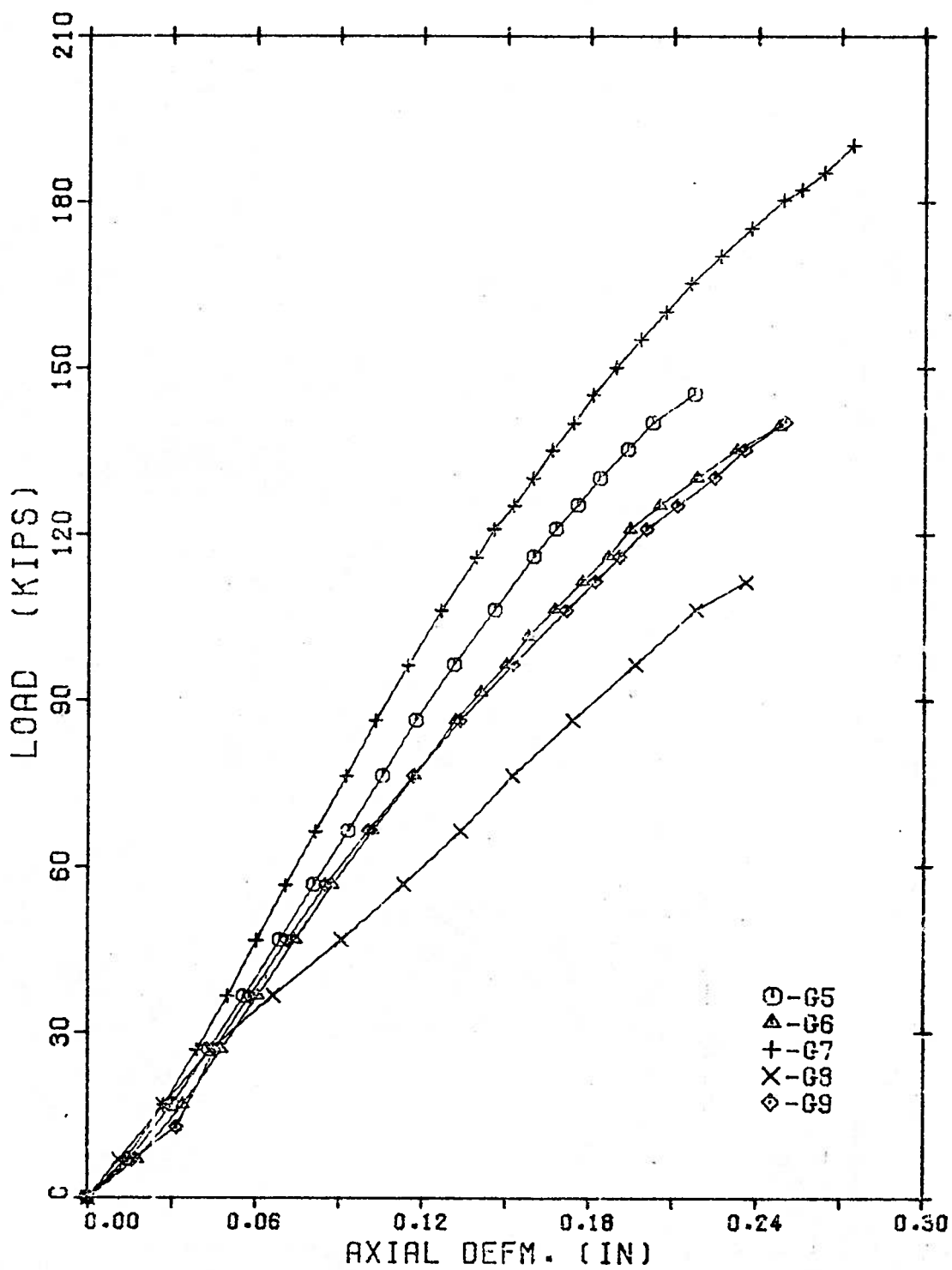


FIG. 2-71 Vertical Deformation of Series GB

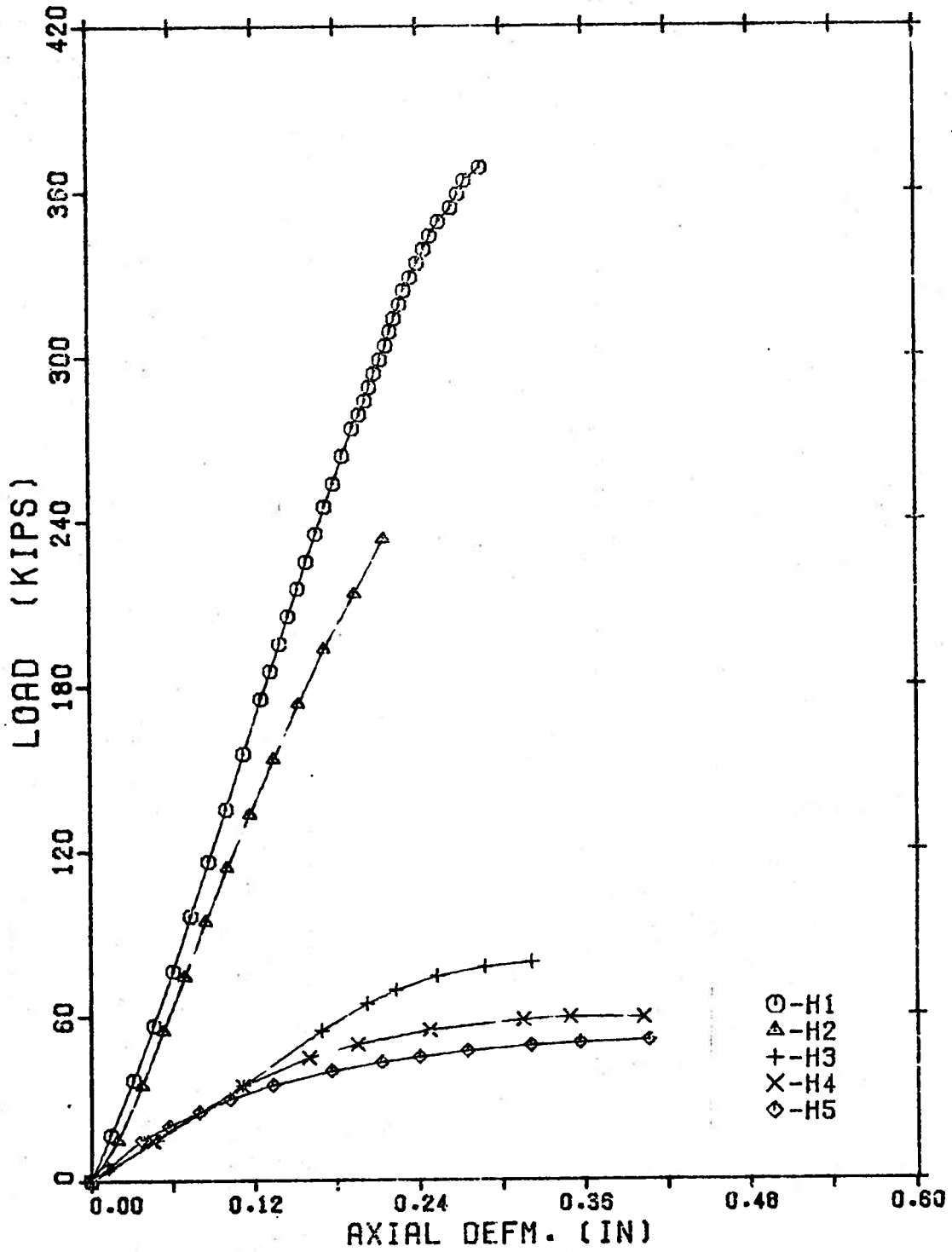


FIG. 2-72 Vertical Deformation of Series H

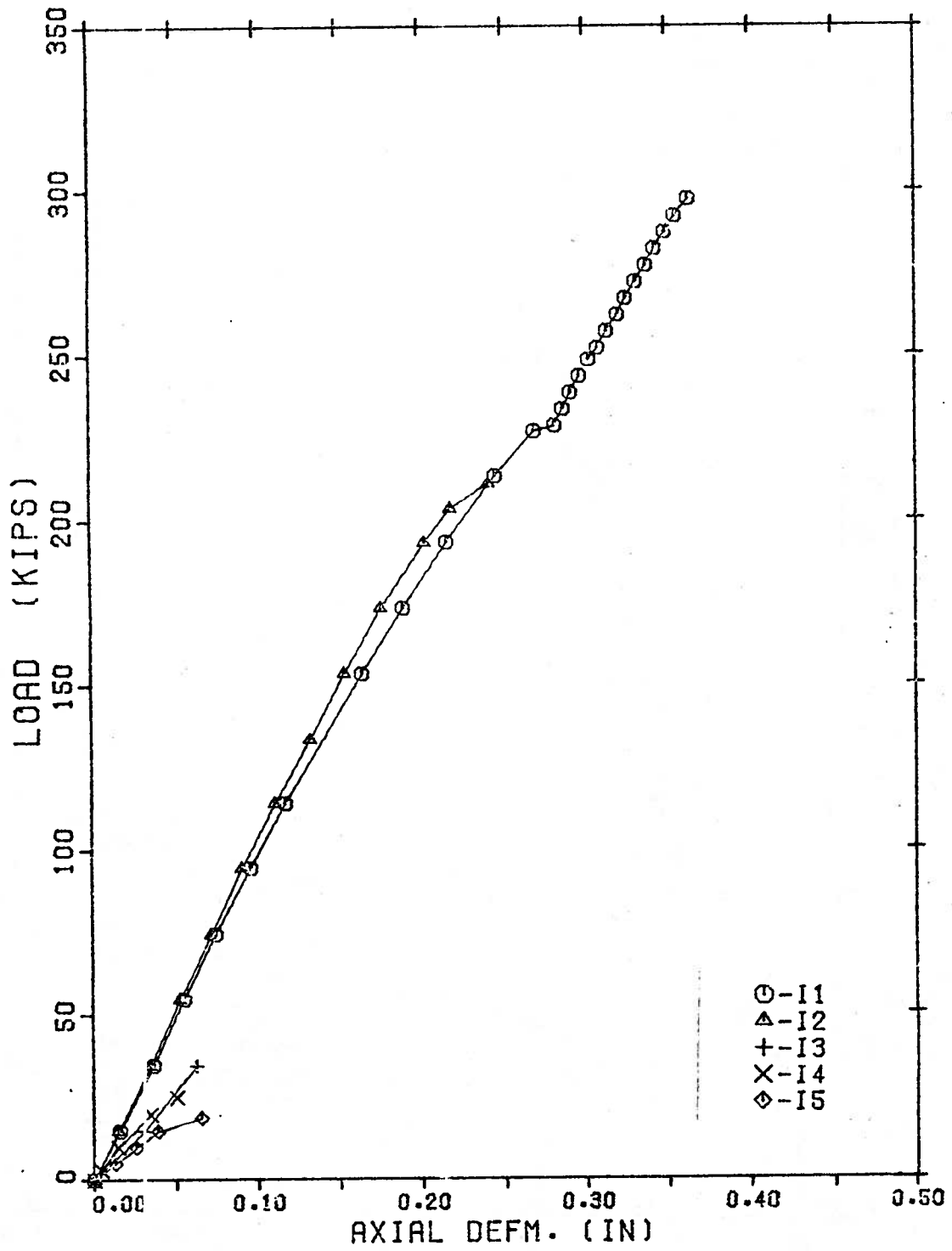


FIG. 2-73 Vertical Deformation of Series I

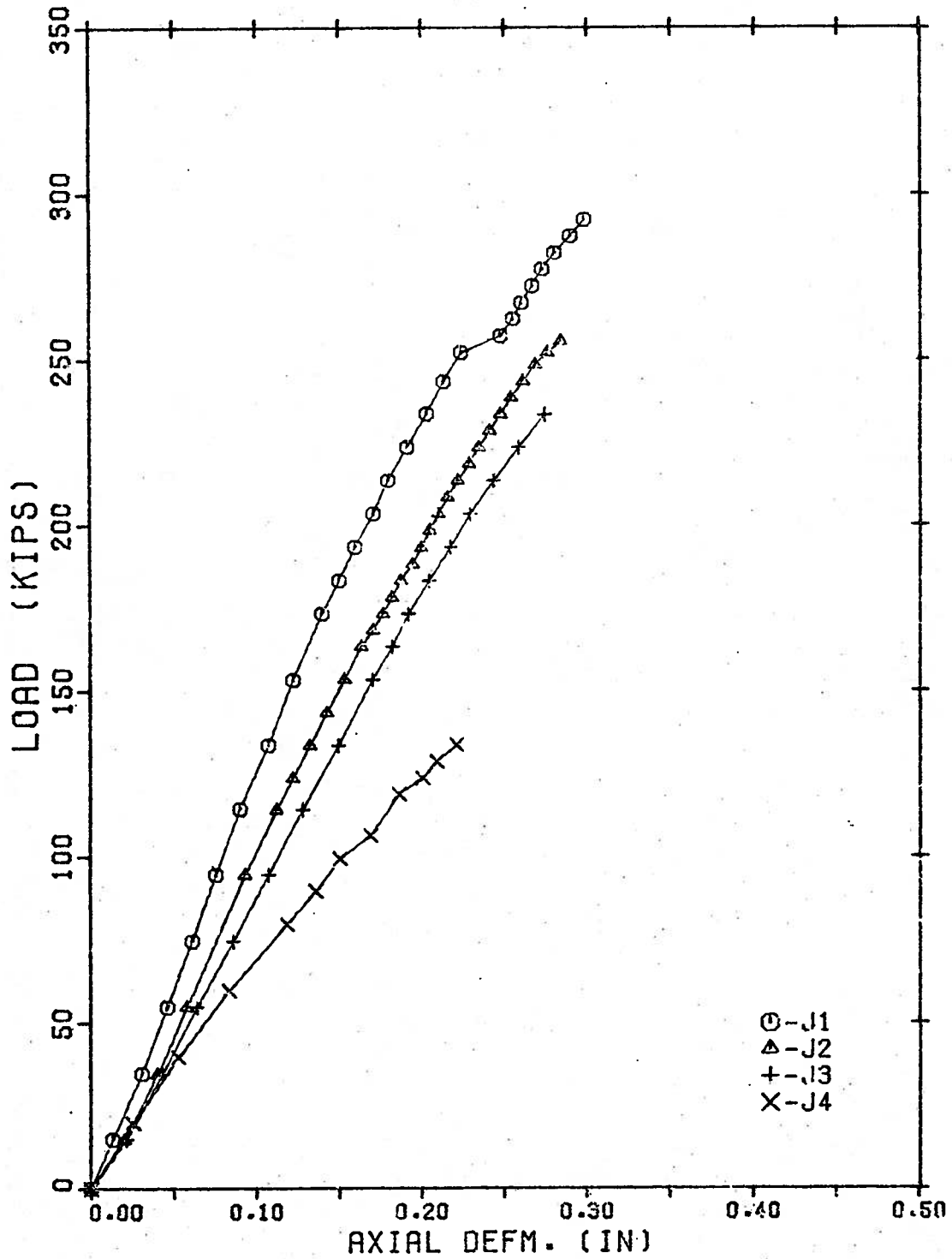


FIG. 2-74 Vertical Deformation of Series J

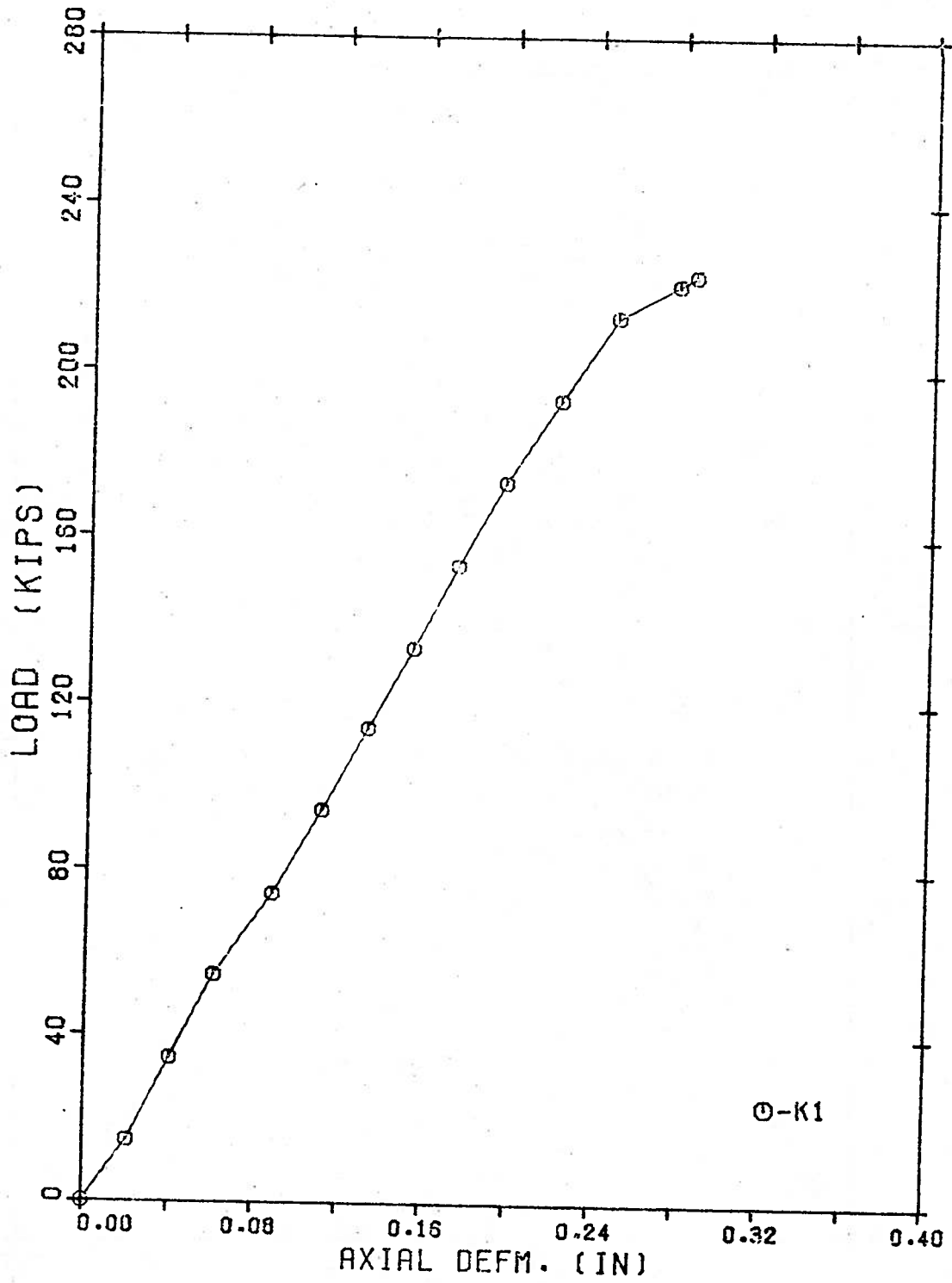


FIG. 2-75 Vertical Deformation of Series K

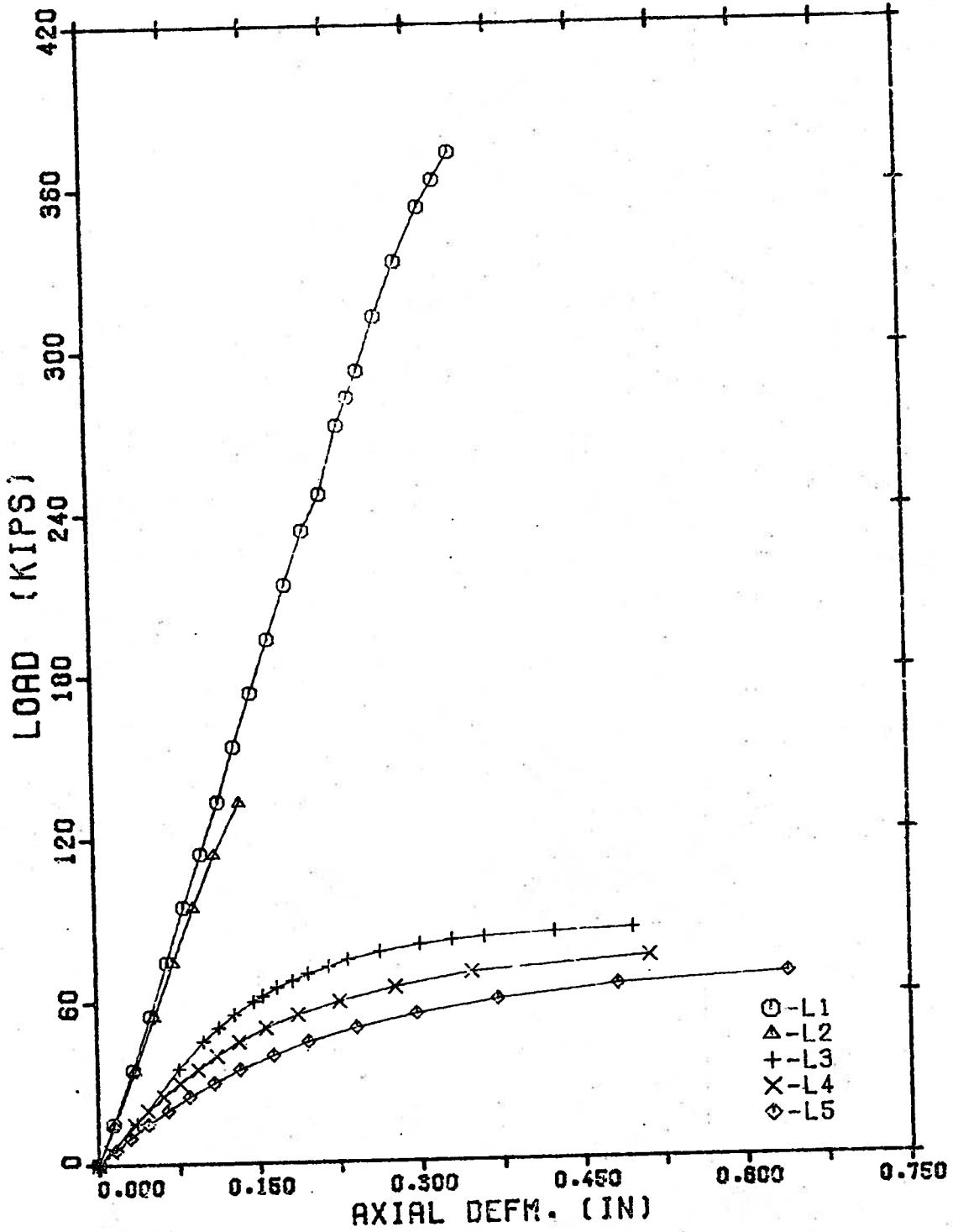


FIG. 2-76 Vertical Deformation of Series L

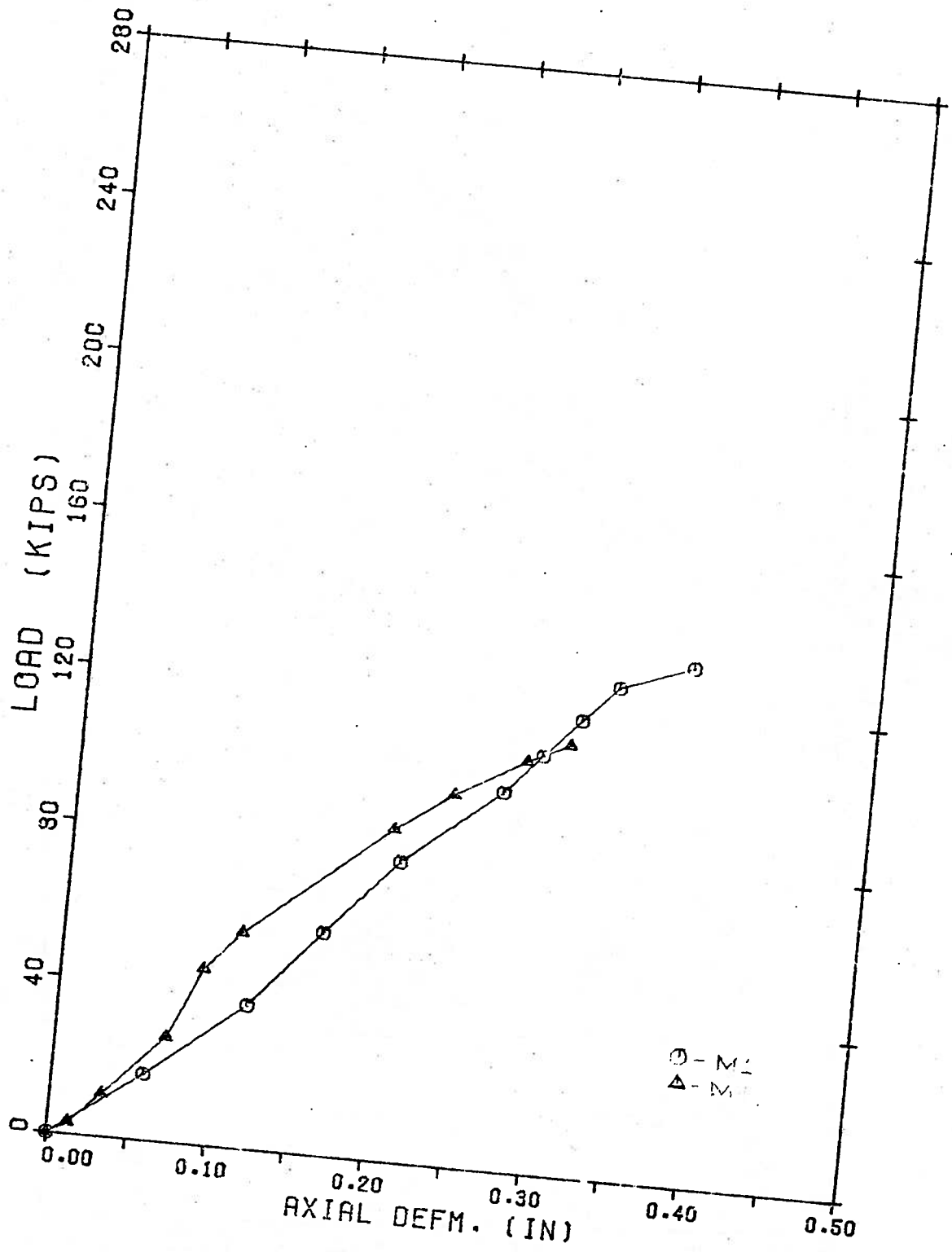


FIG. 2-77 Vertical Deformation of Series M

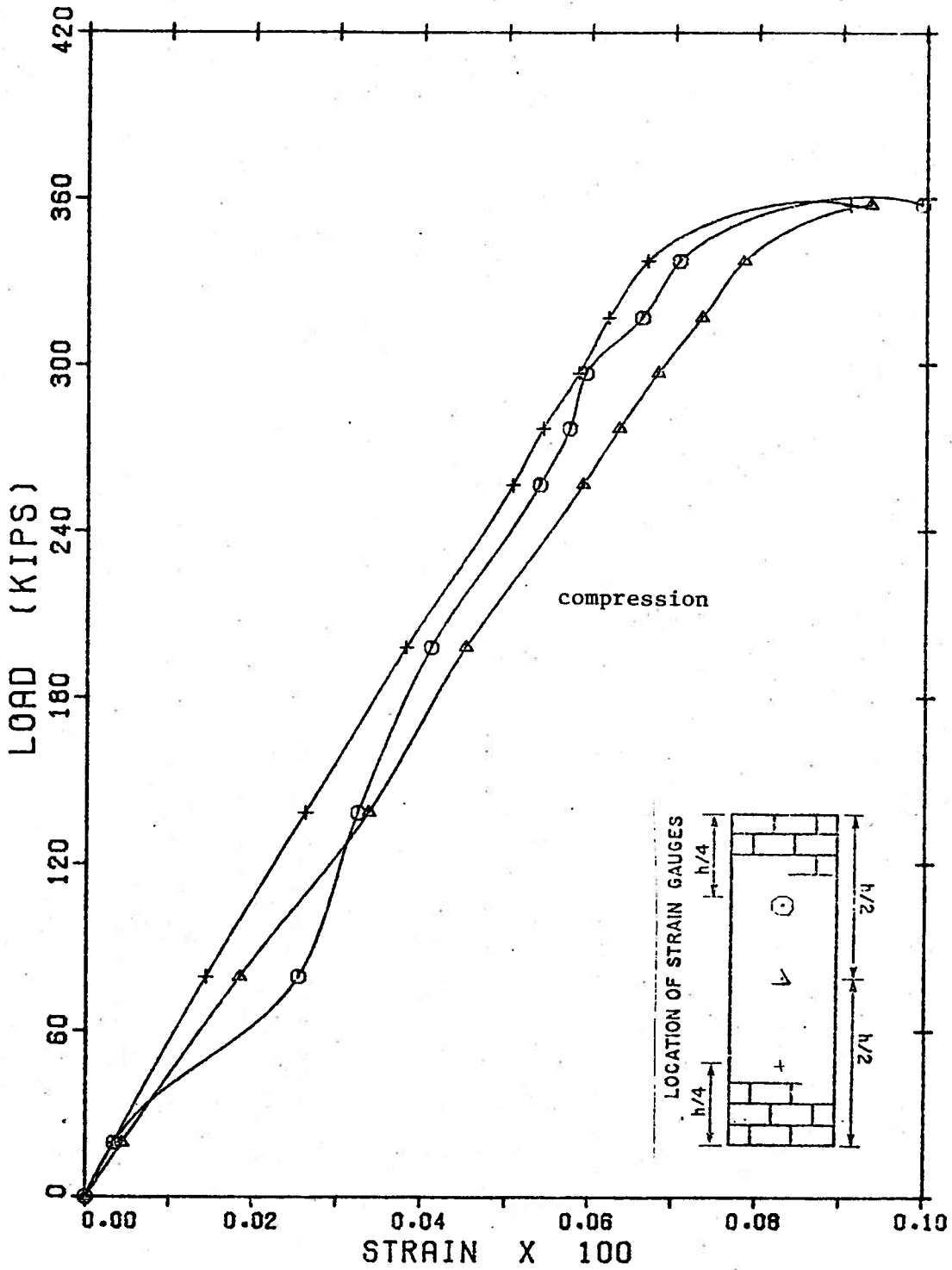


FIG. 2.78 Reinforcement Strain for Wall B1

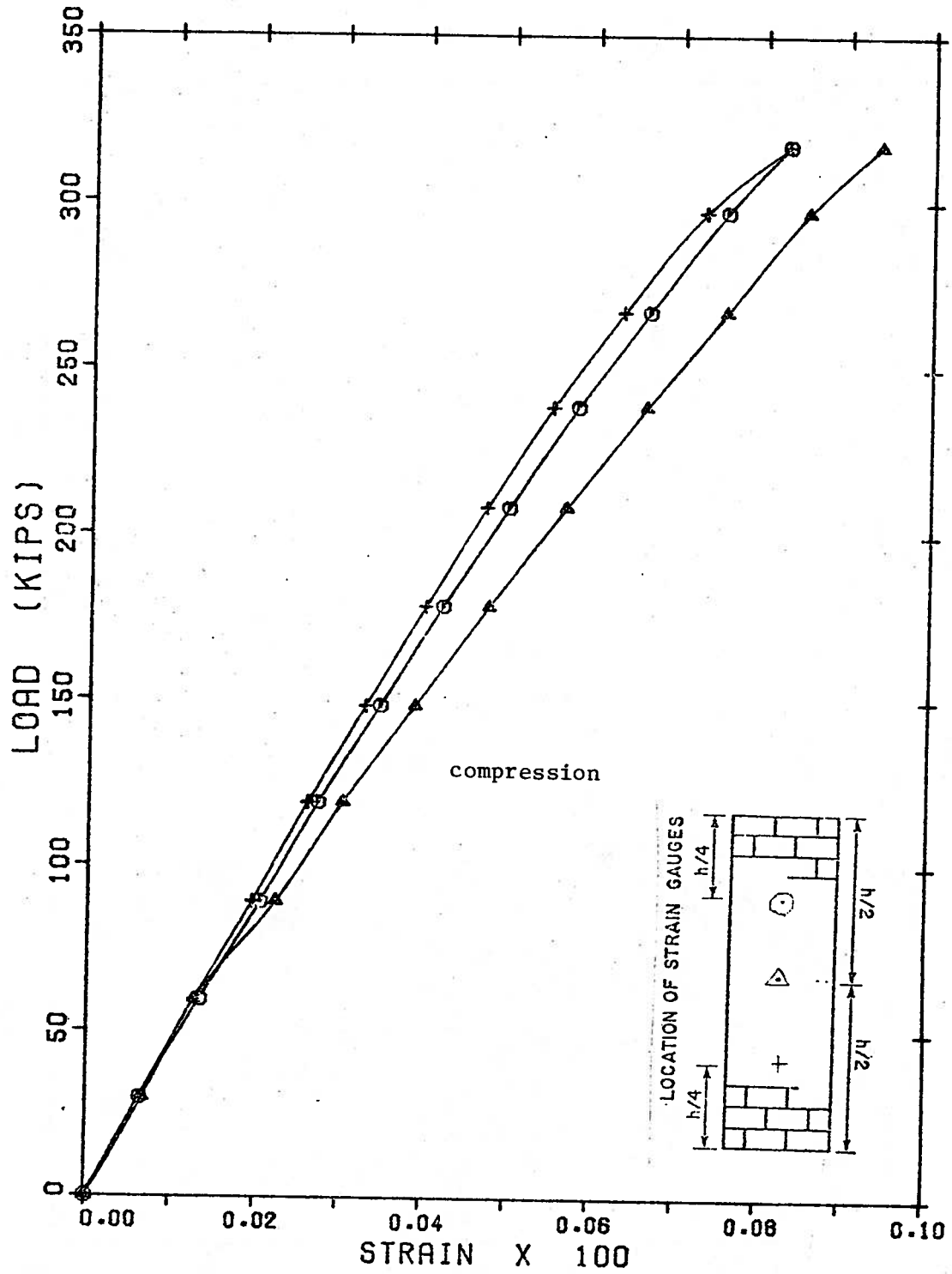


FIG. 2.79 Reinforcement Strain for Wall B2

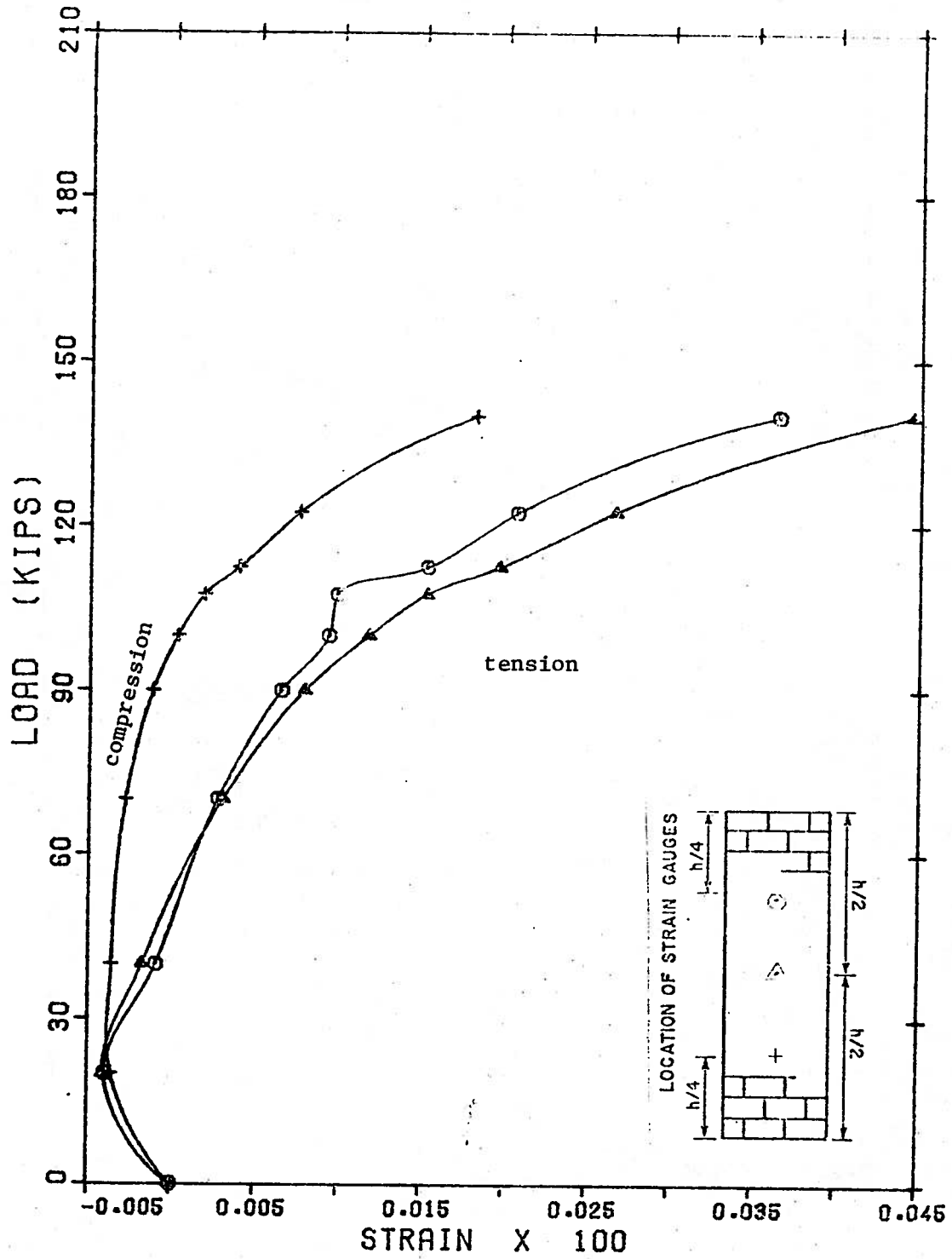


FIG. 2.80 Reinforcement Strain for Wall B3

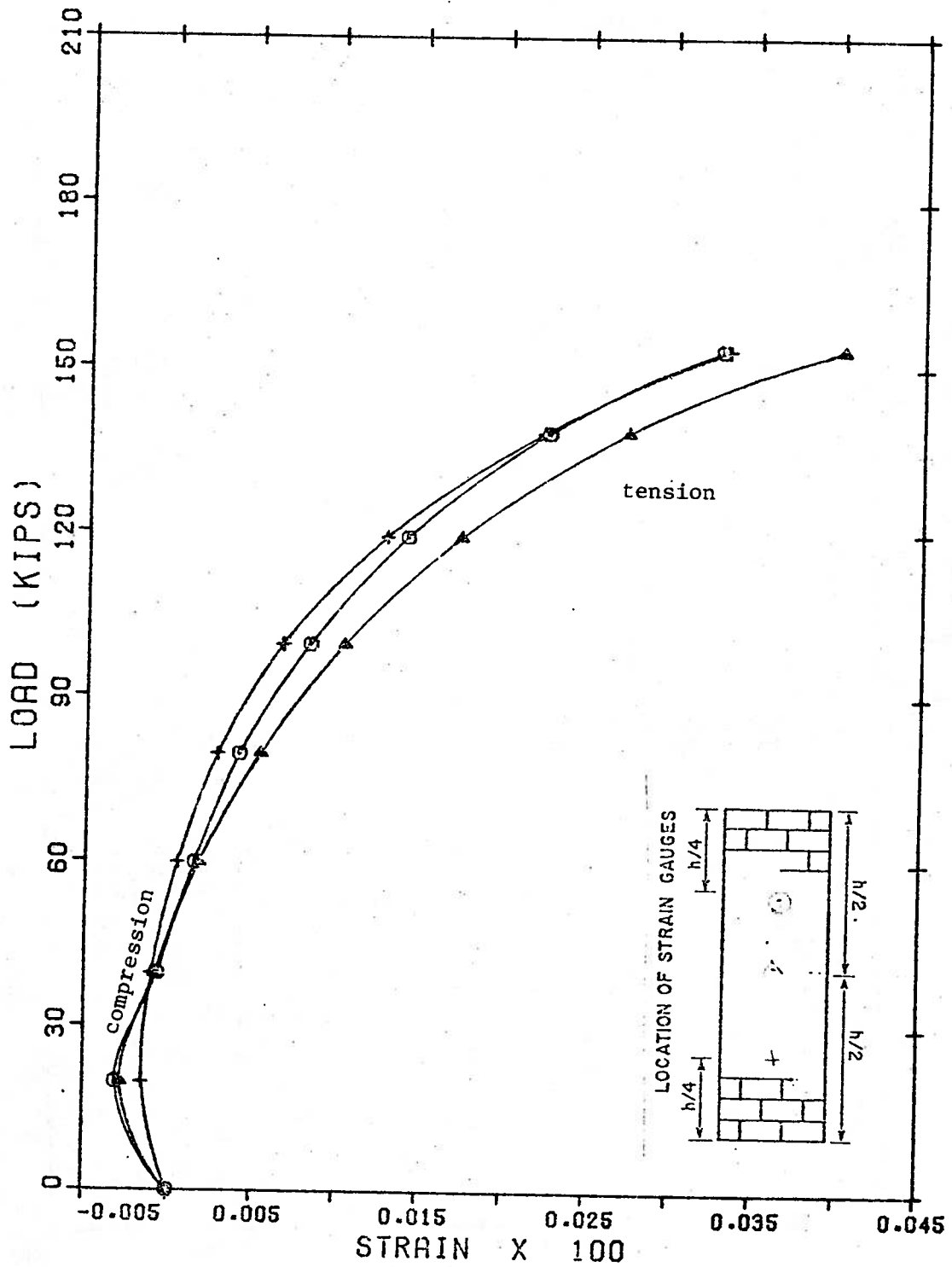


FIG. 2.81 Reinforcement Strain for Wall B4

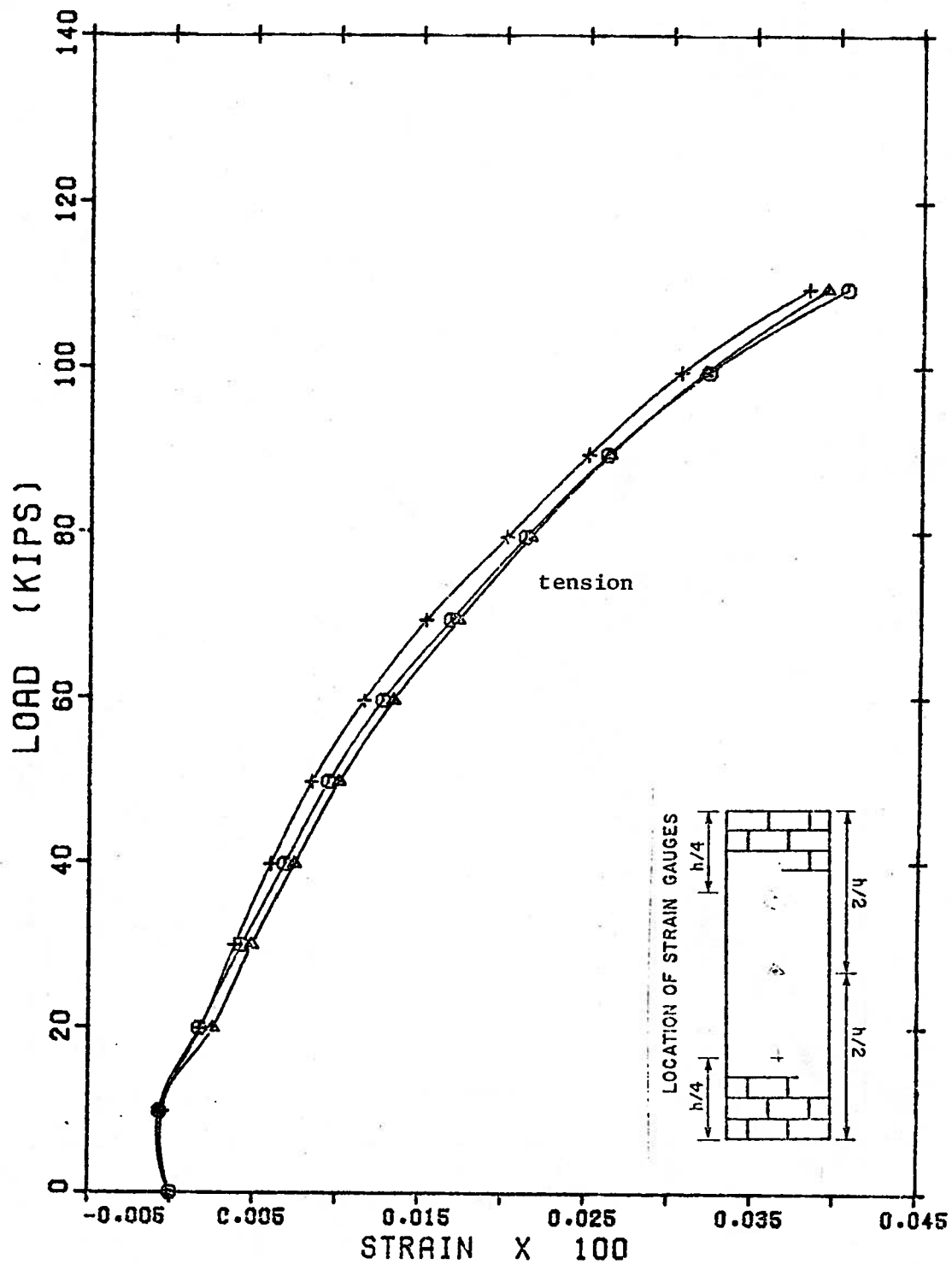


FIG. 2.82 Reinforcement Strain for Wall B5

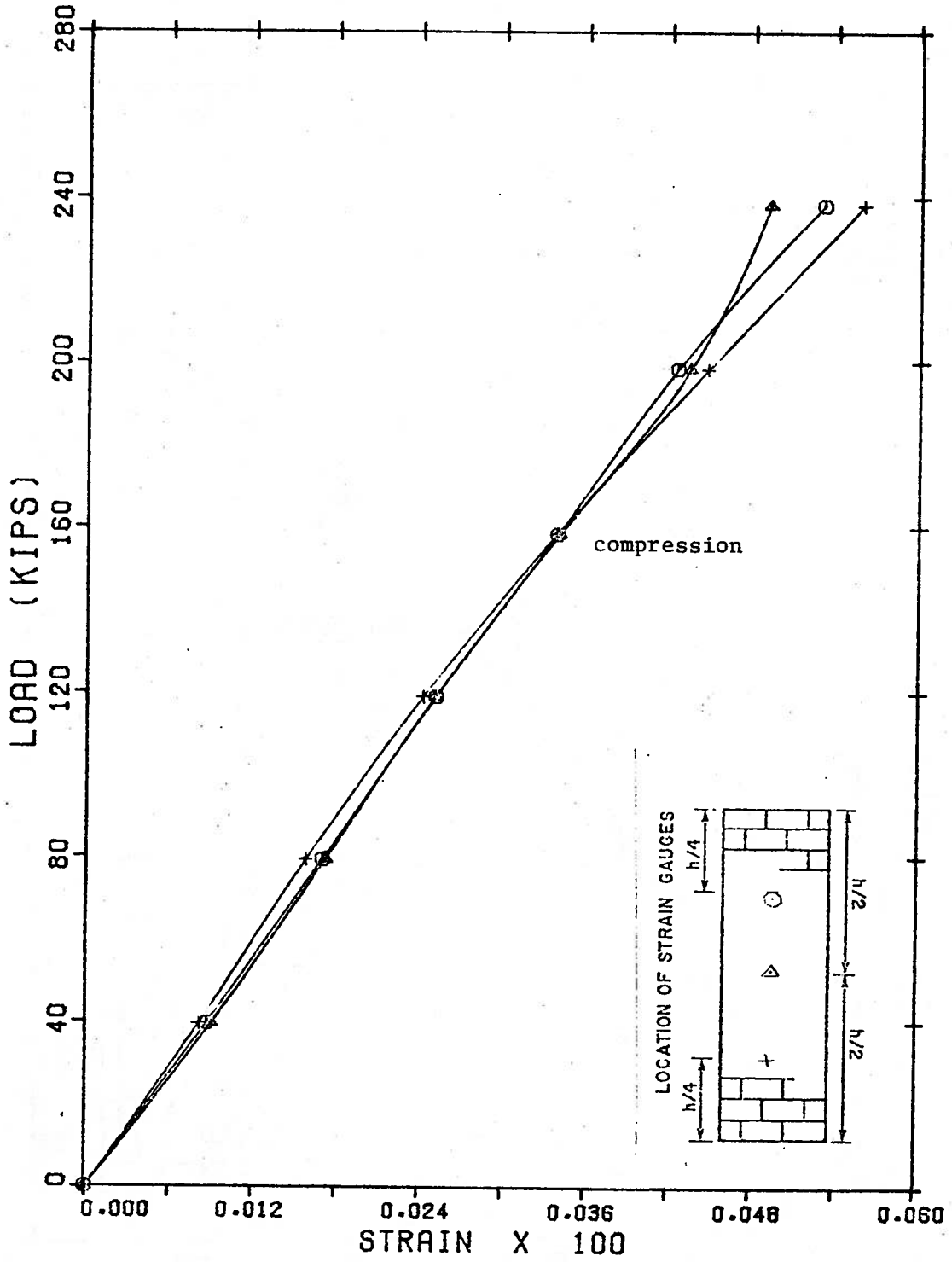


FIG. 2.83 Reinforcement Strain for Wall C2

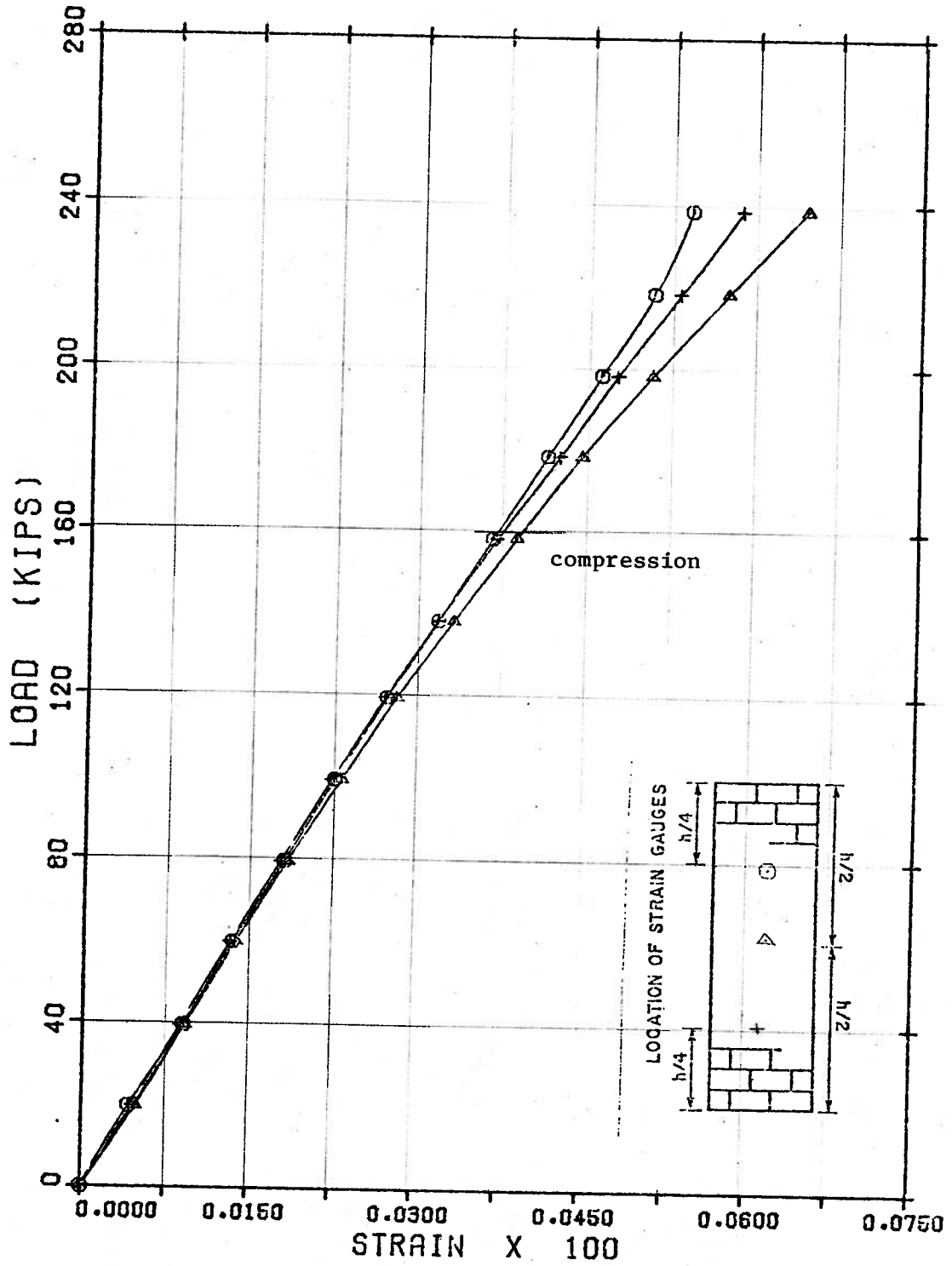


FIG. 2.84 Reinforcement Strain for Wall C3

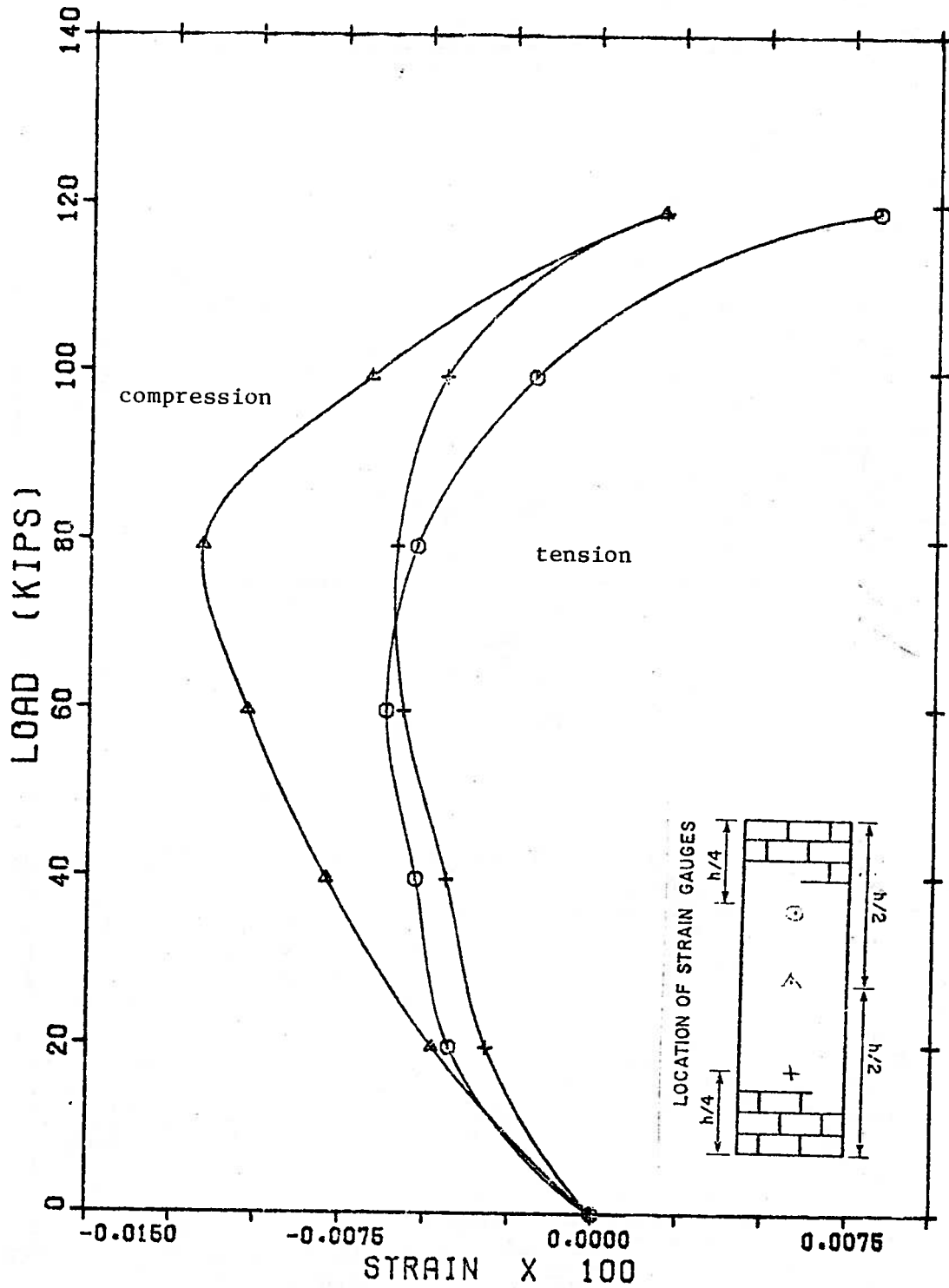


FIG. 2.85 Reinforcement Strain for Wall C4

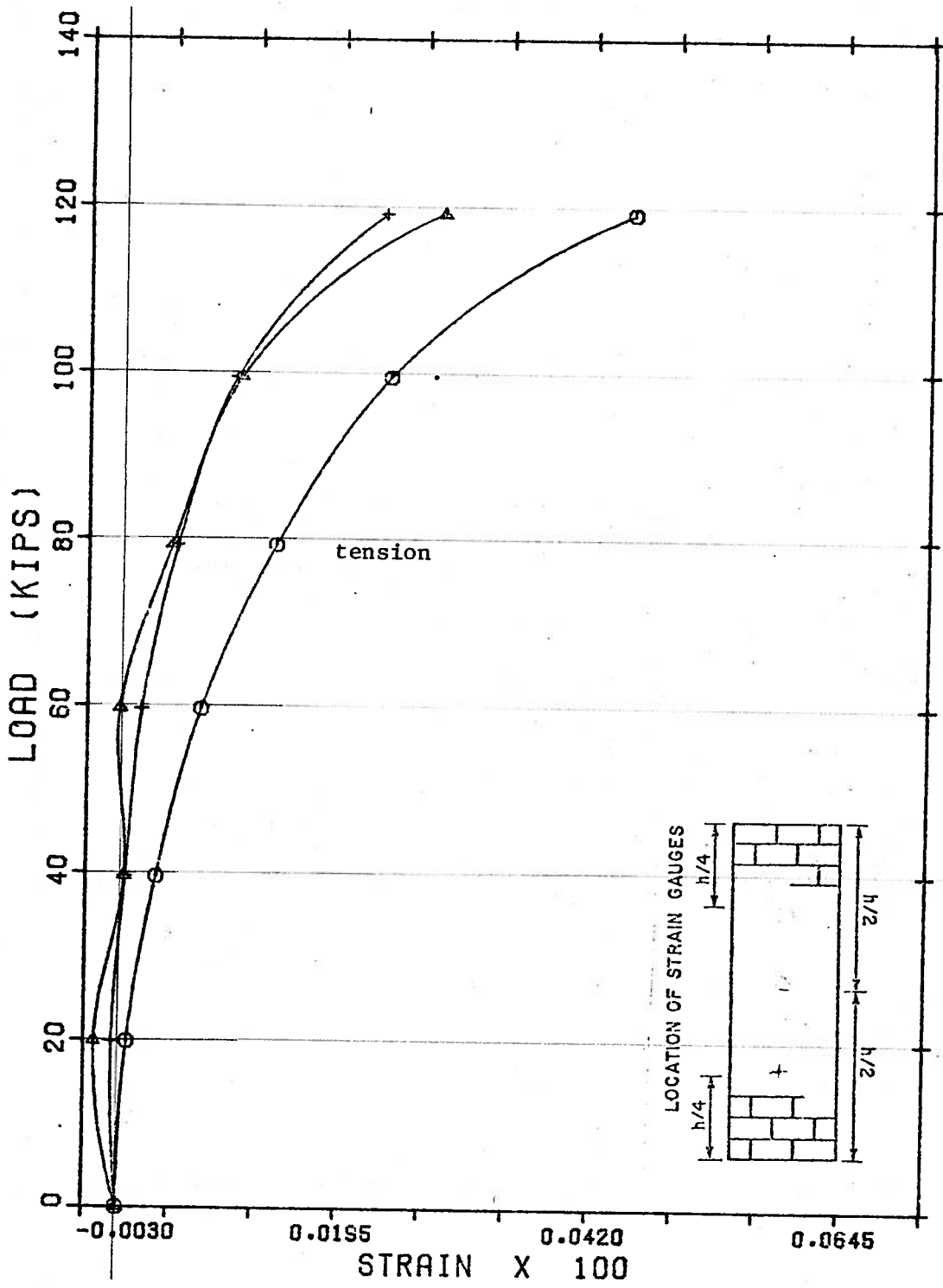


FIG. 2.86 Reinforcement Strain for Wall C5

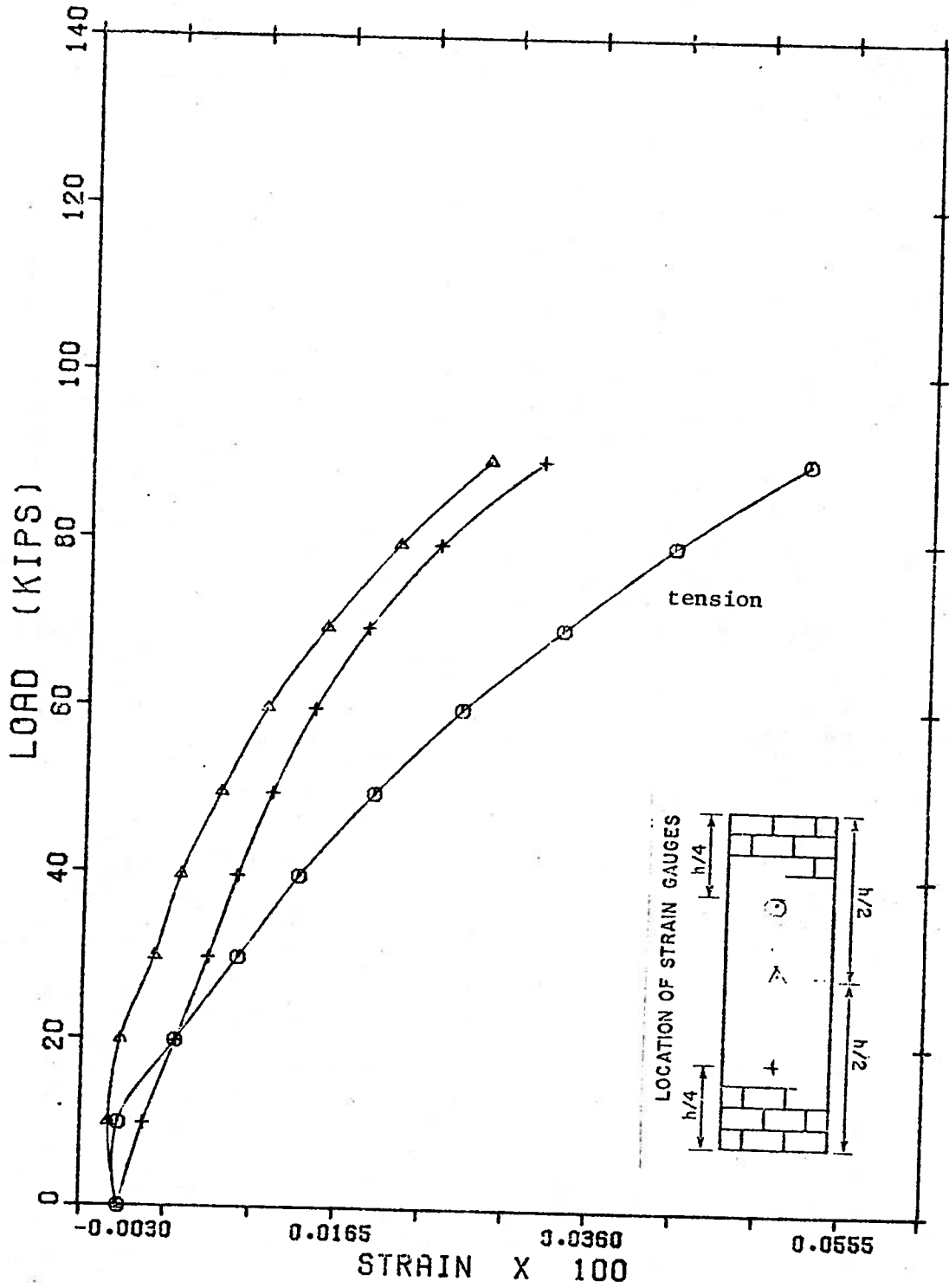


FIG. 2.87 Reinforcement Strain for Wall C6

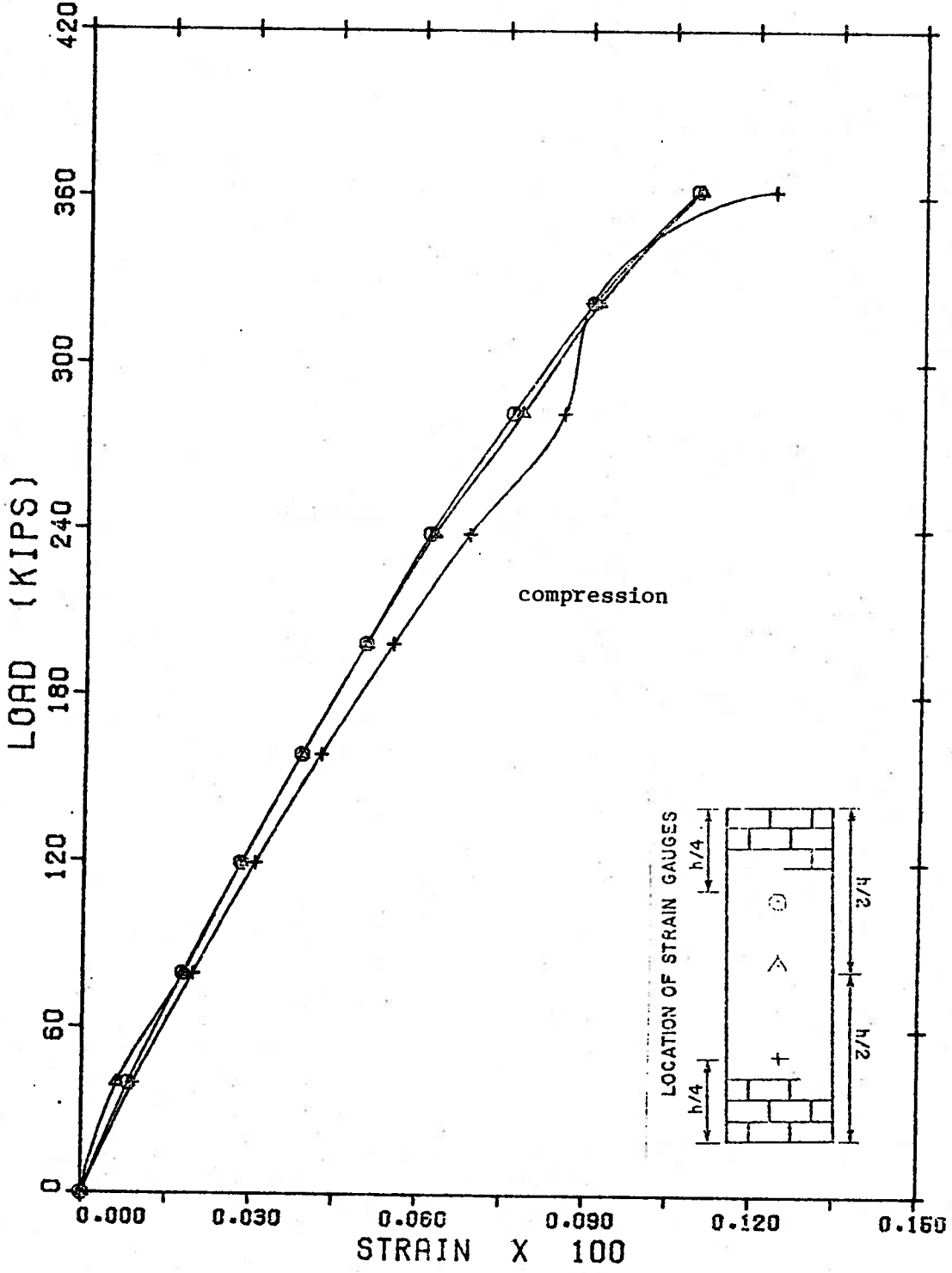


FIG. 2.88 Reinforcement Strain for Wall H1

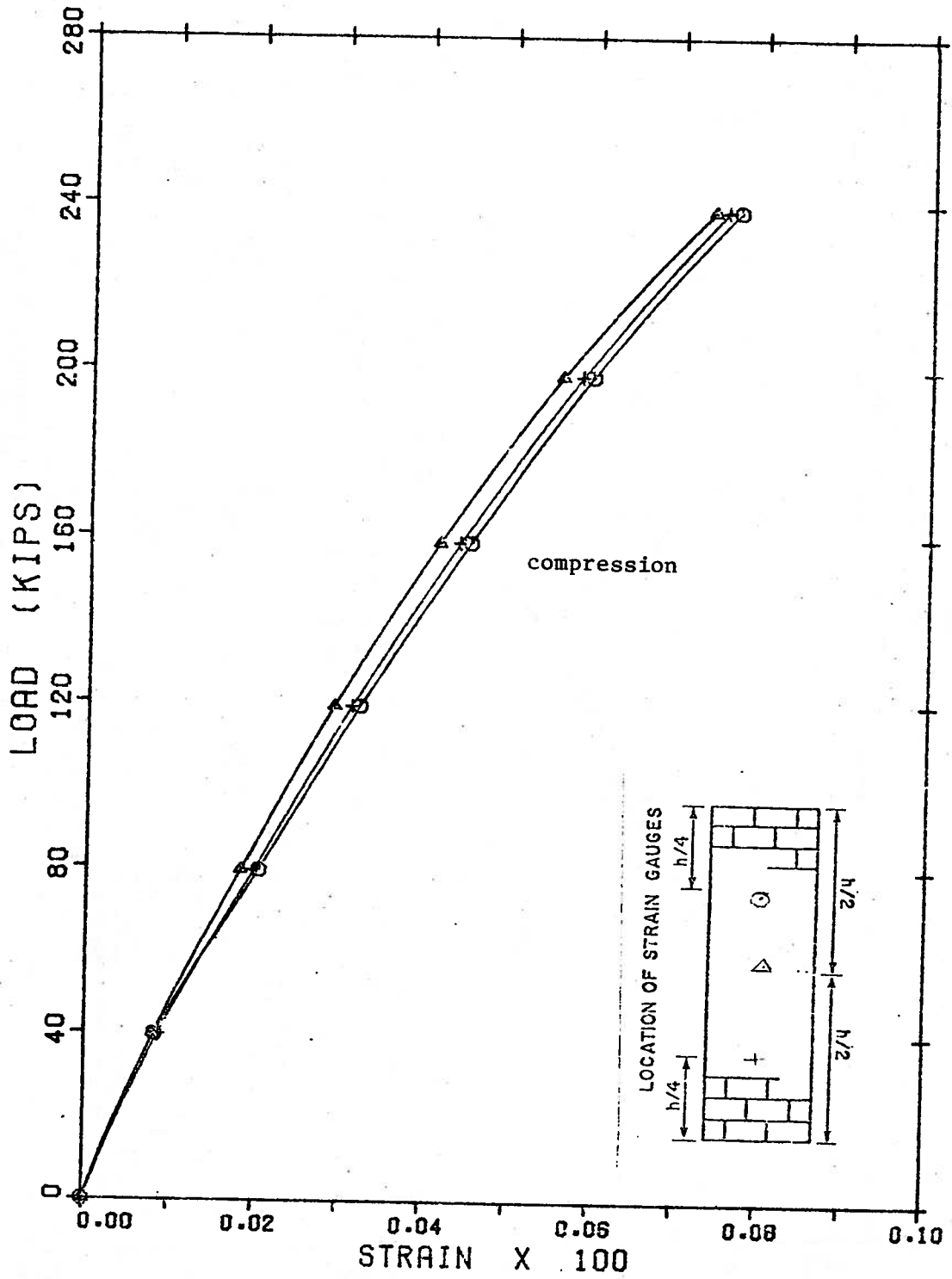


FIG. 2.89 Reinforcement Strain for Wall H2

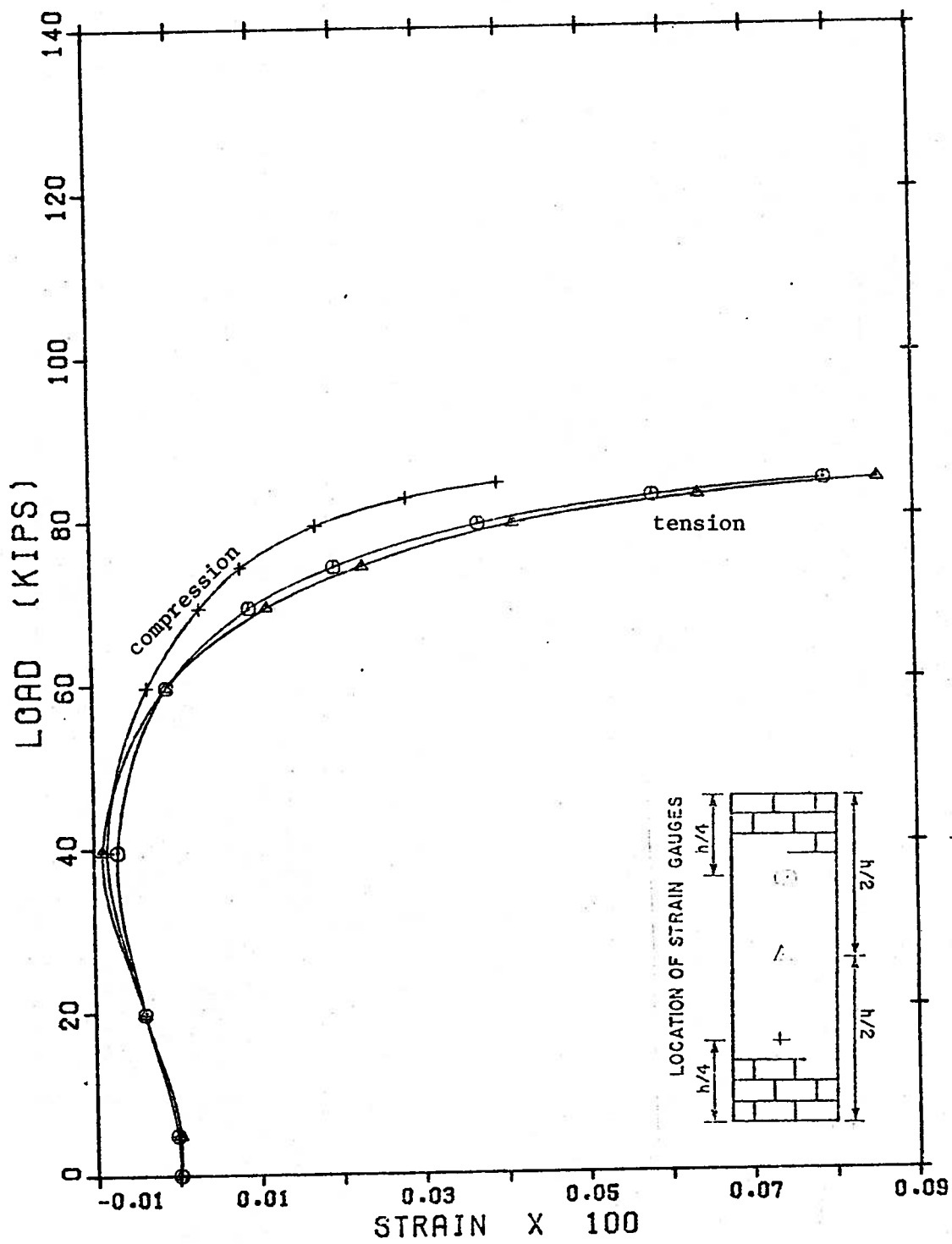


FIG. 2.90 Reinforcement Strain for Wall H3

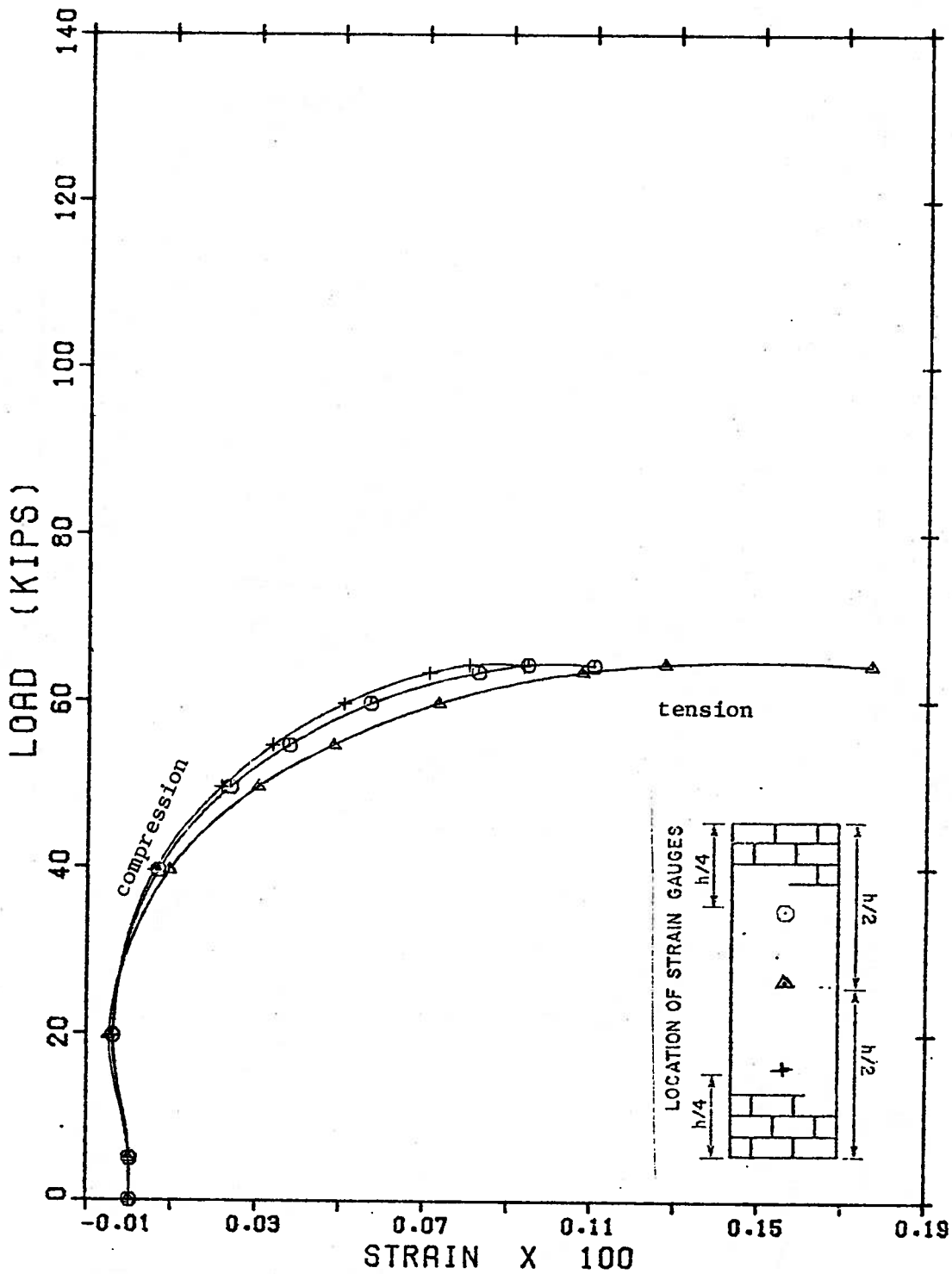


FIG. 2.91 Reinforcement Strain for Wall H4

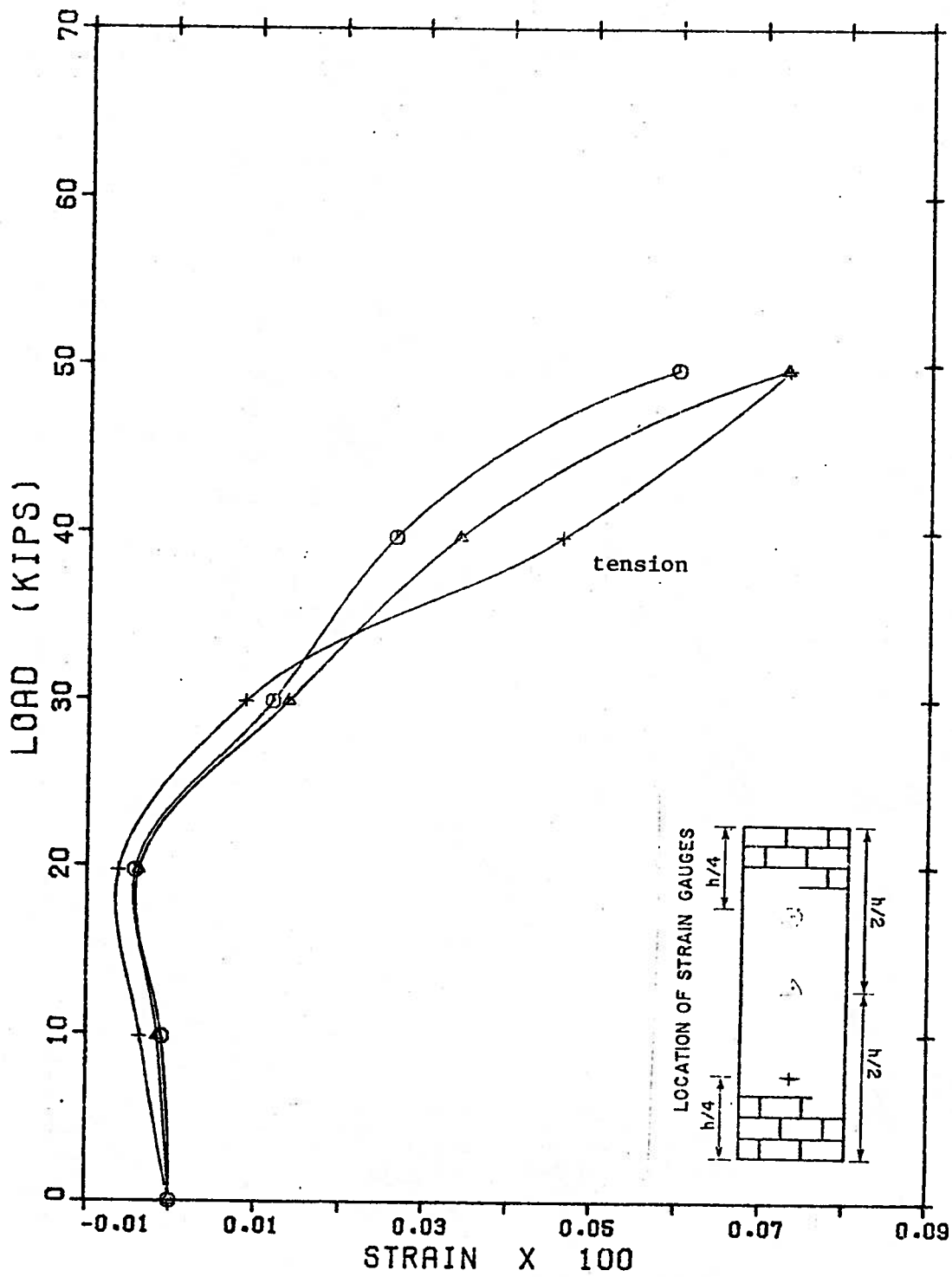


FIG. 2.92 Reinforcement Strain for Wall H5

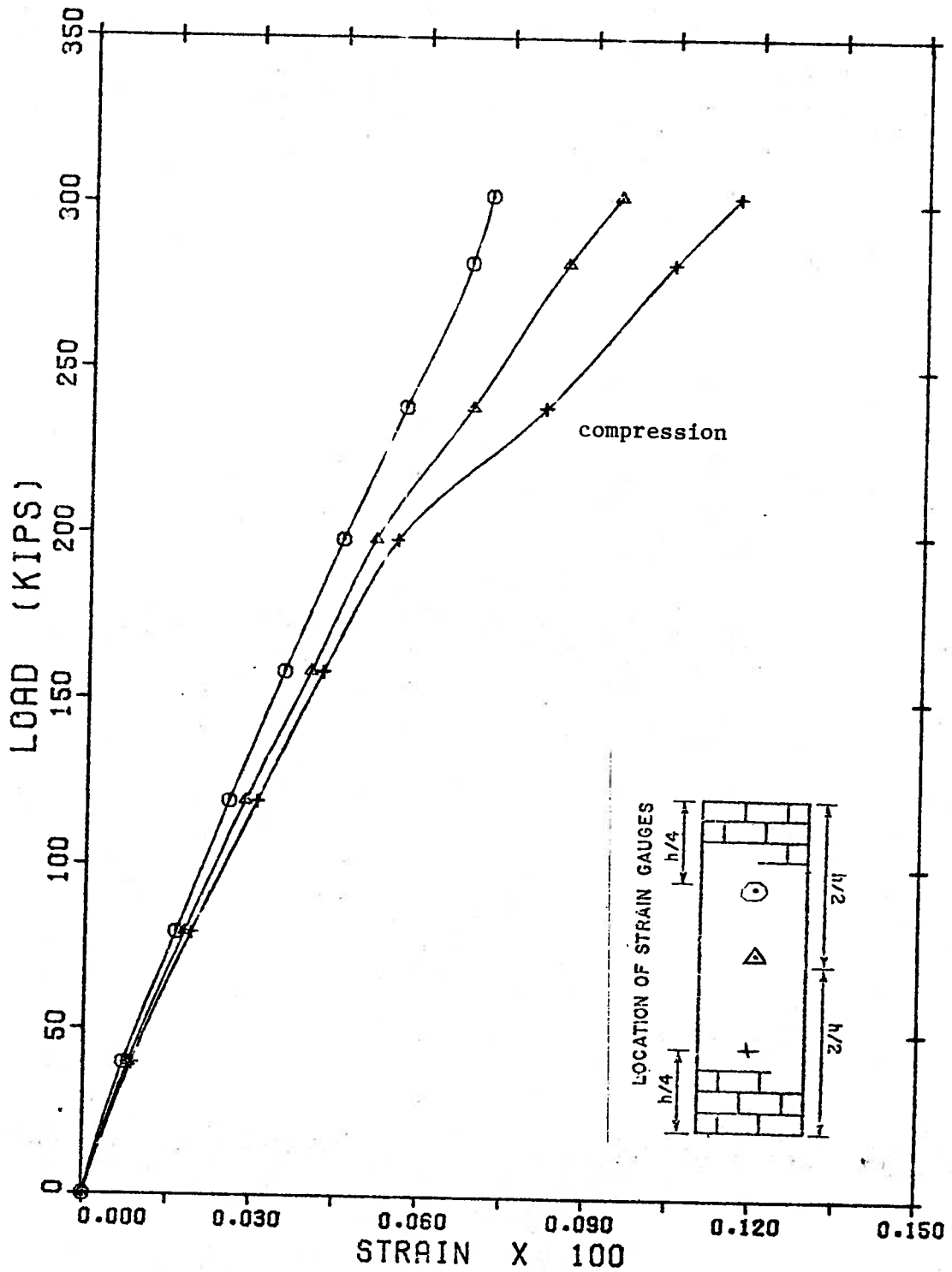


FIG. 2.93 Reinforcement Strain for Wall I1

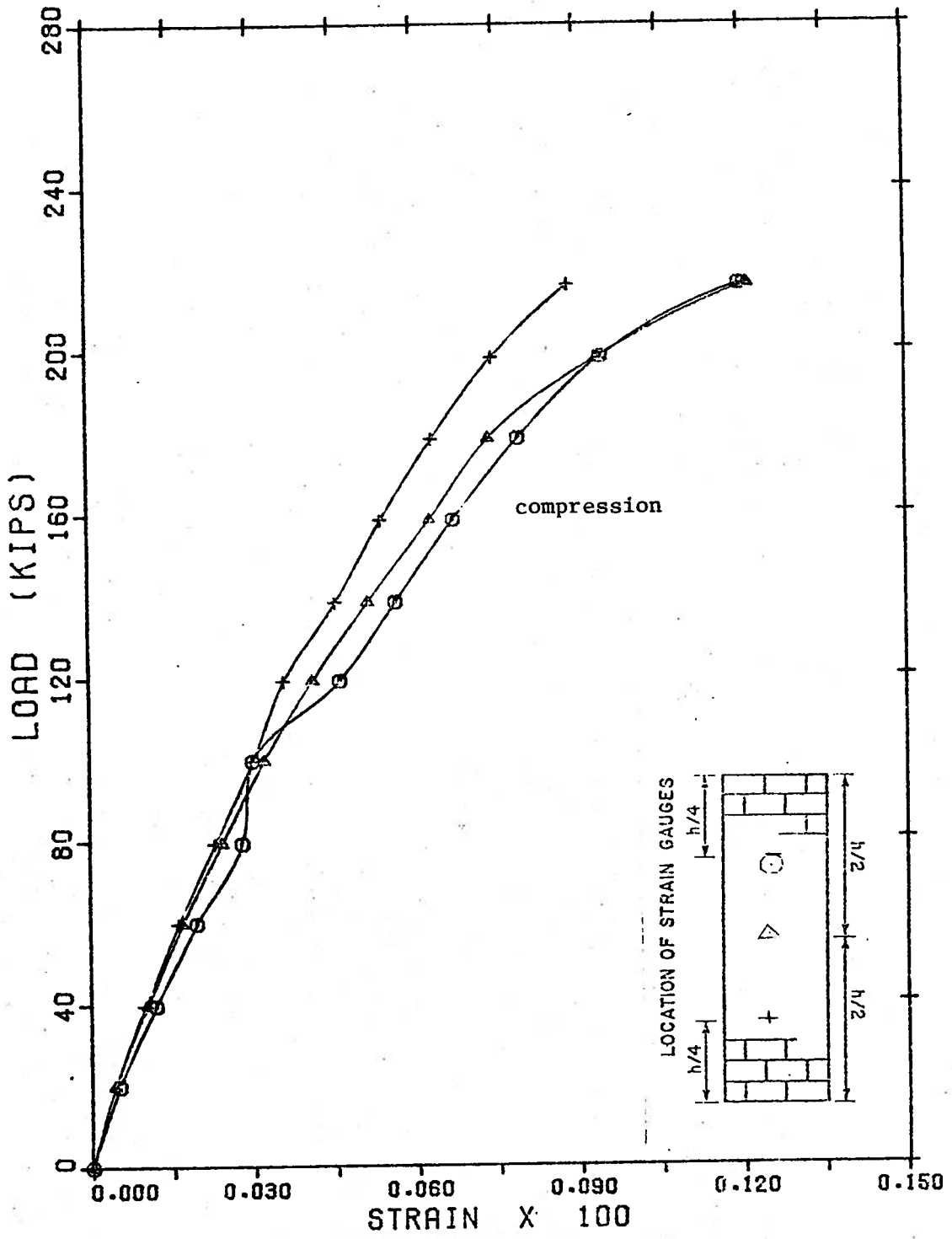


FIG. 2.94 Reinforcement Strain for Wall I2

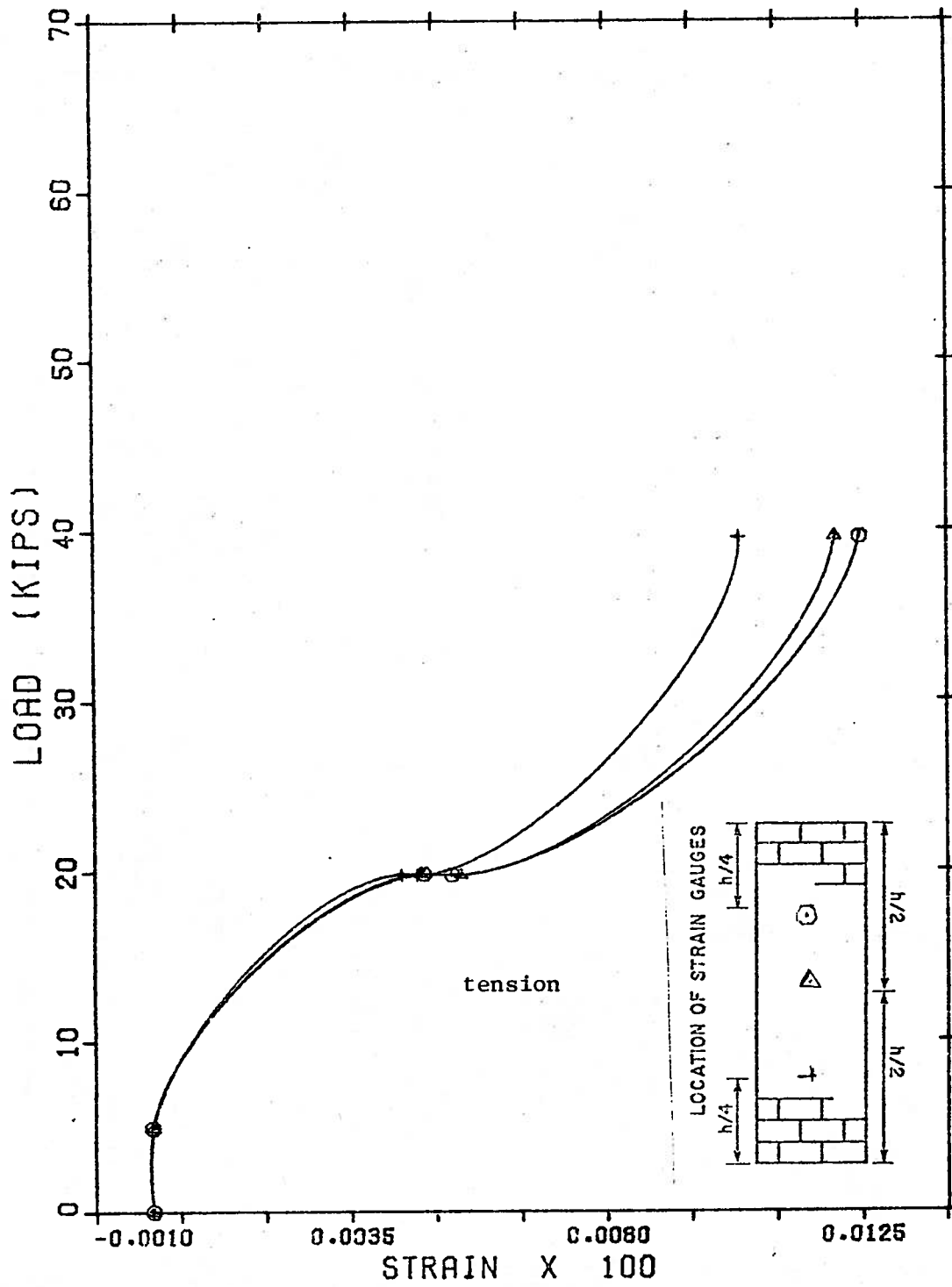


FIG. 2.95 Reinforcement Strain for Wall I3

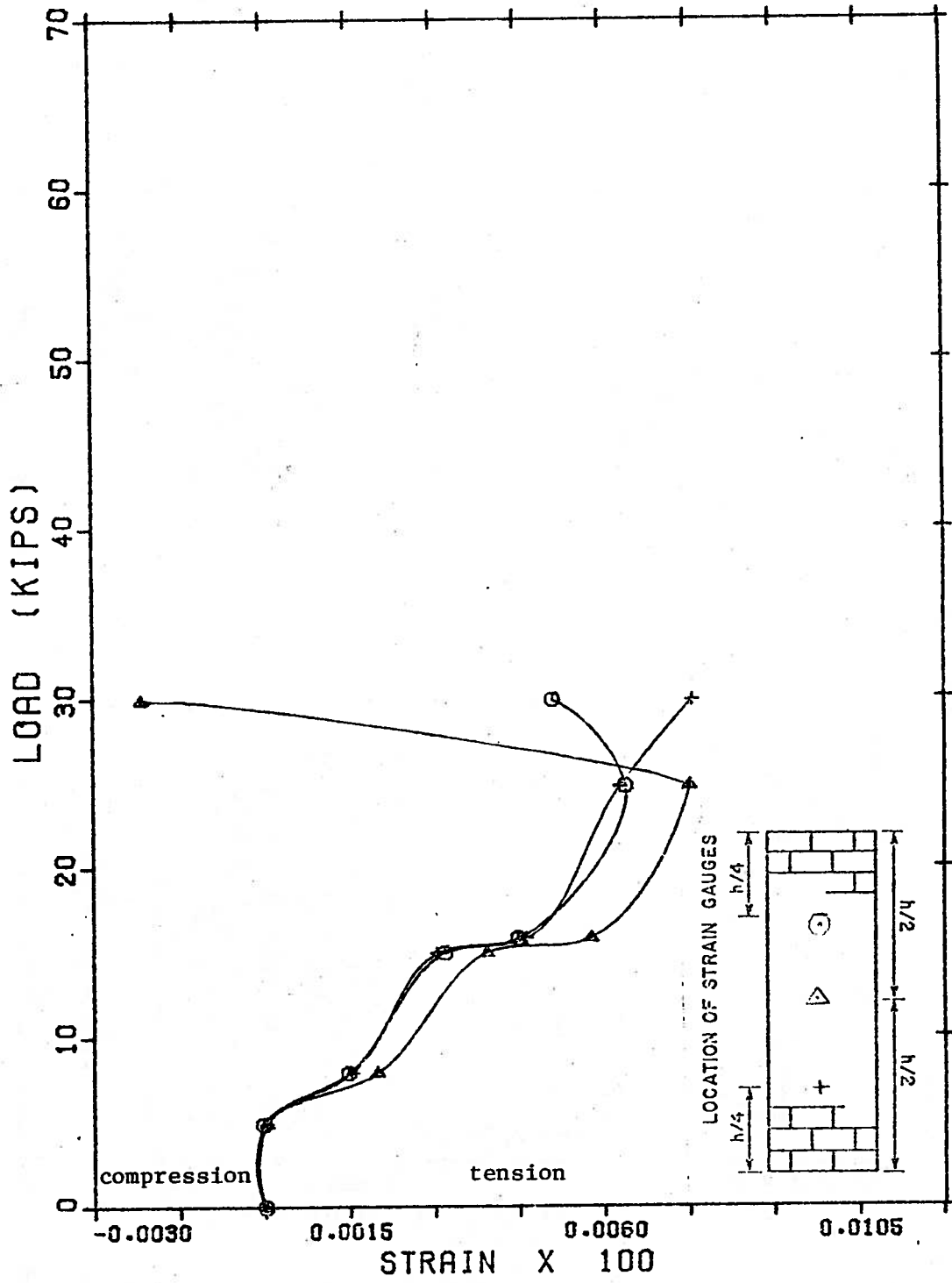


FIG. 2.96 Reinforcement Strain for Wall I4

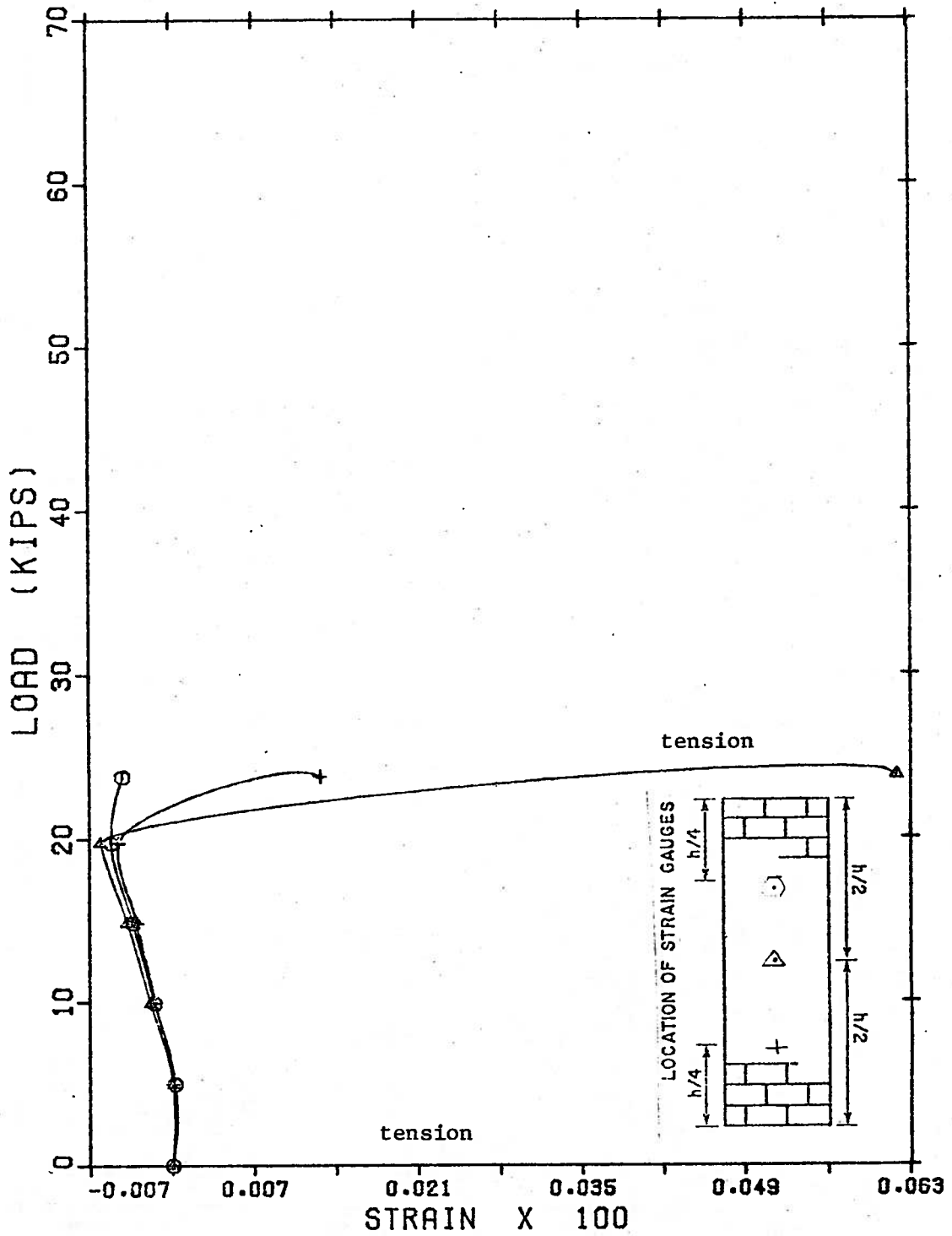


FIG. 2.97 Reinforcement Strain for Wall I5

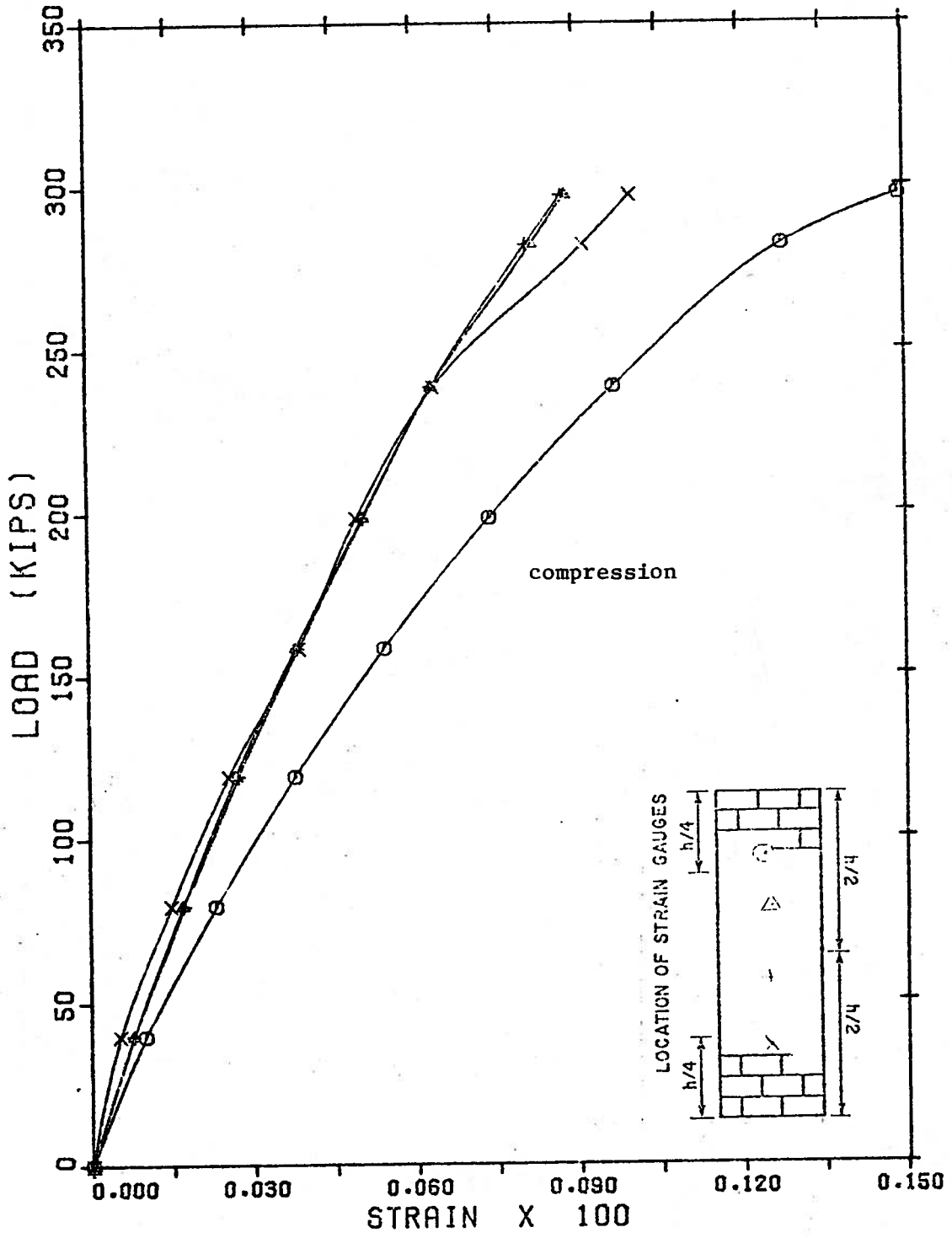


FIG. 2.98 Reinforcement Strain for Wall J1

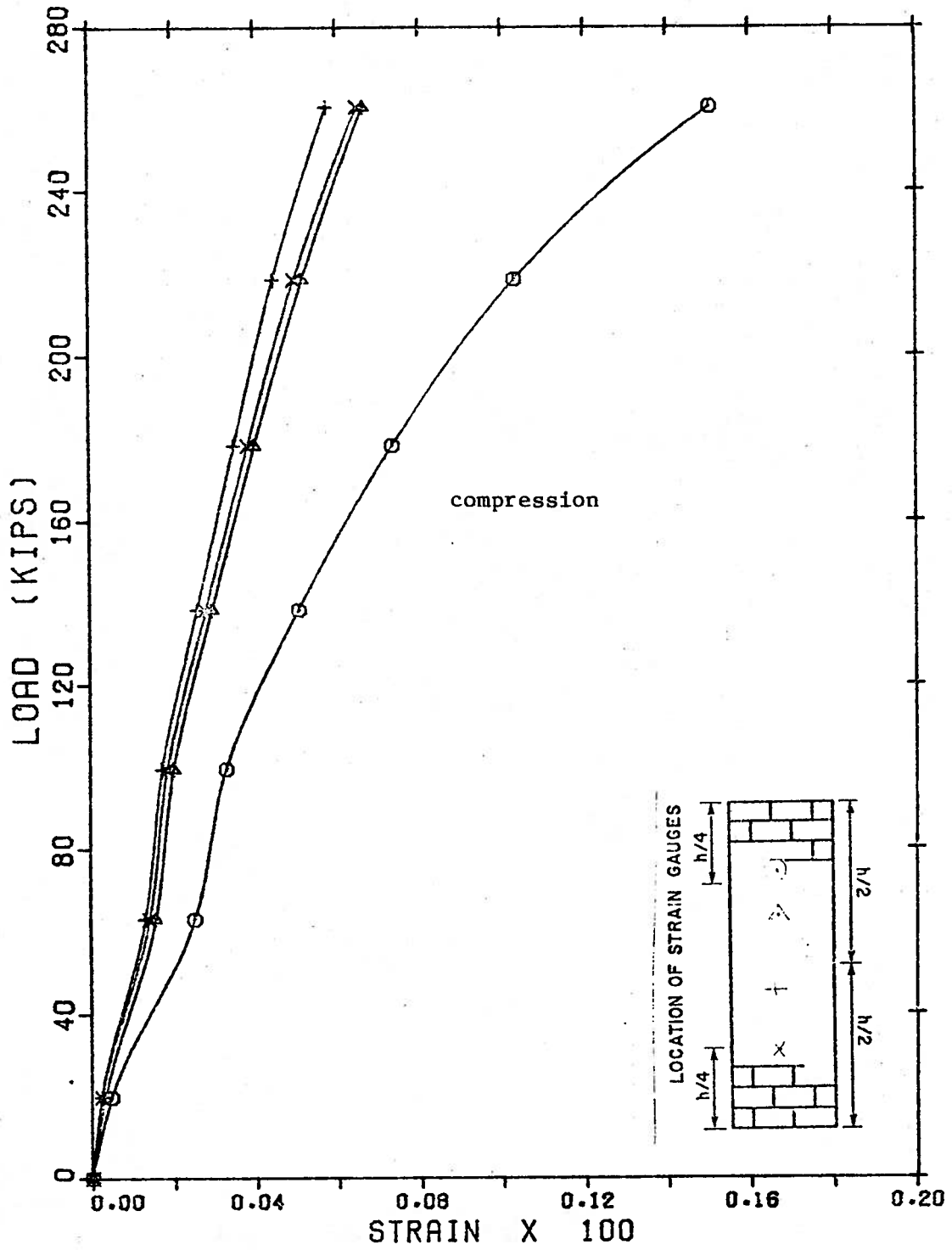


FIG. 2.99 Reinforcement Strain for Wall J2

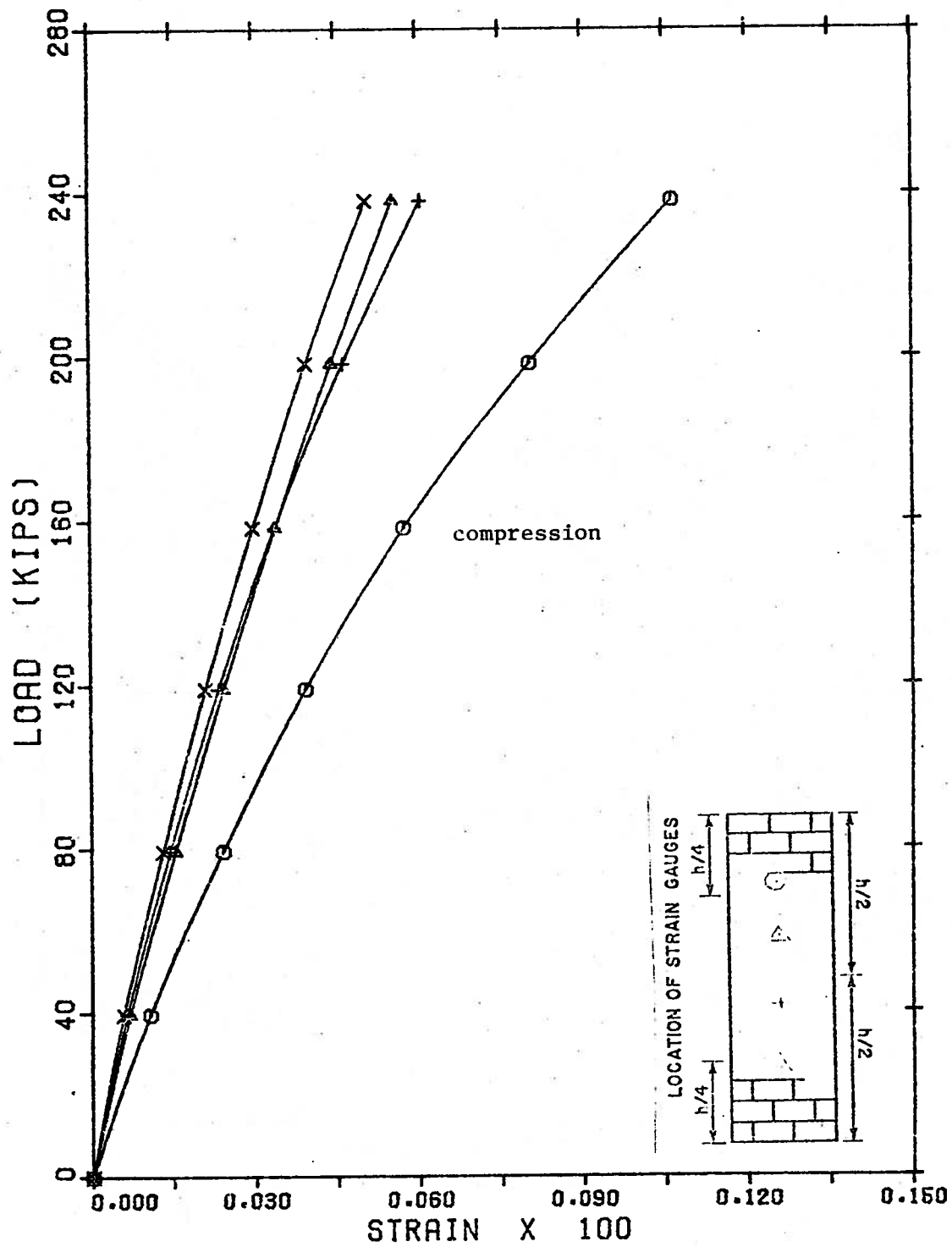


FIG. 2.100 Reinforcement Strain for Wall J3

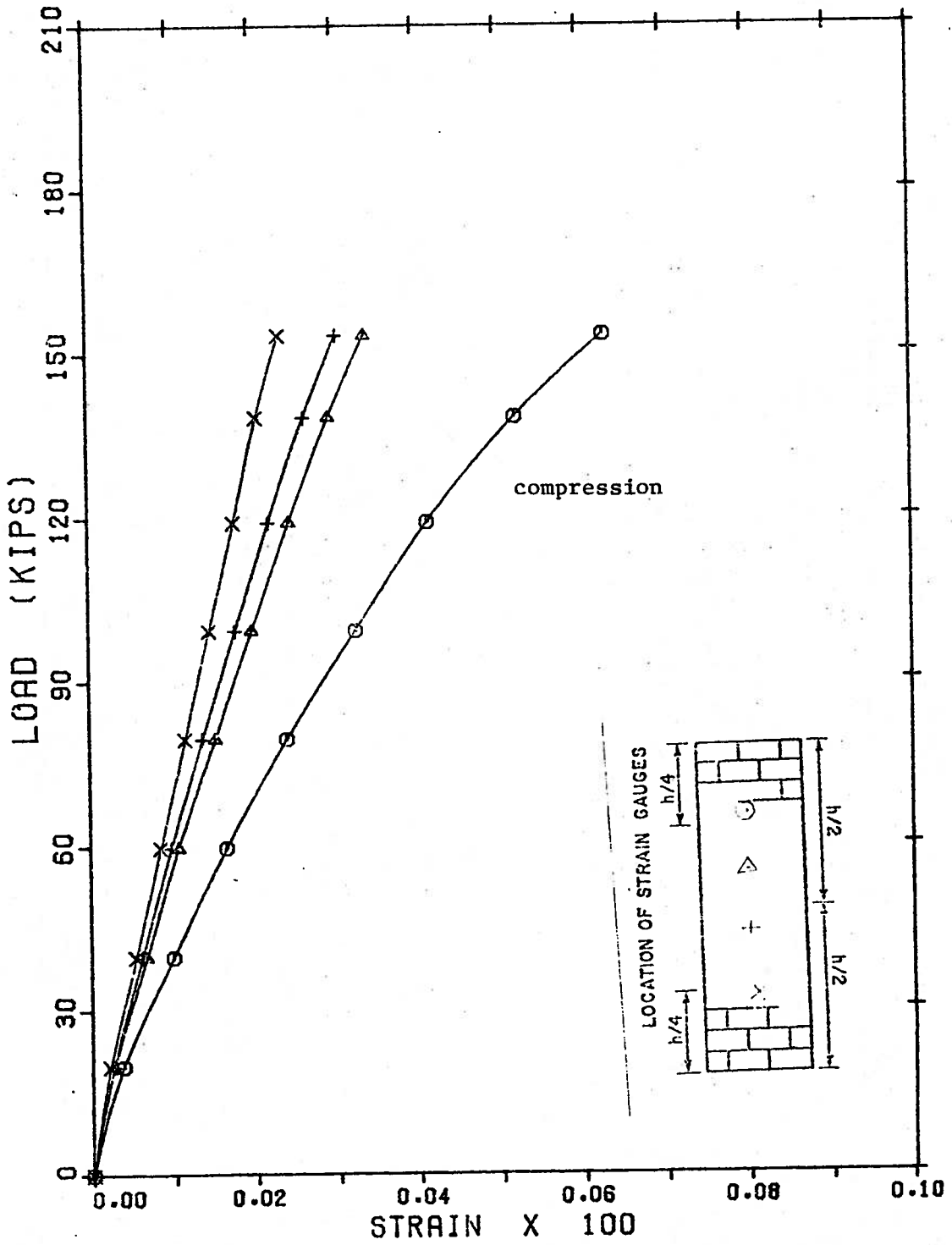


FIG. 2.101 Reinforcement Strain for Wall J4

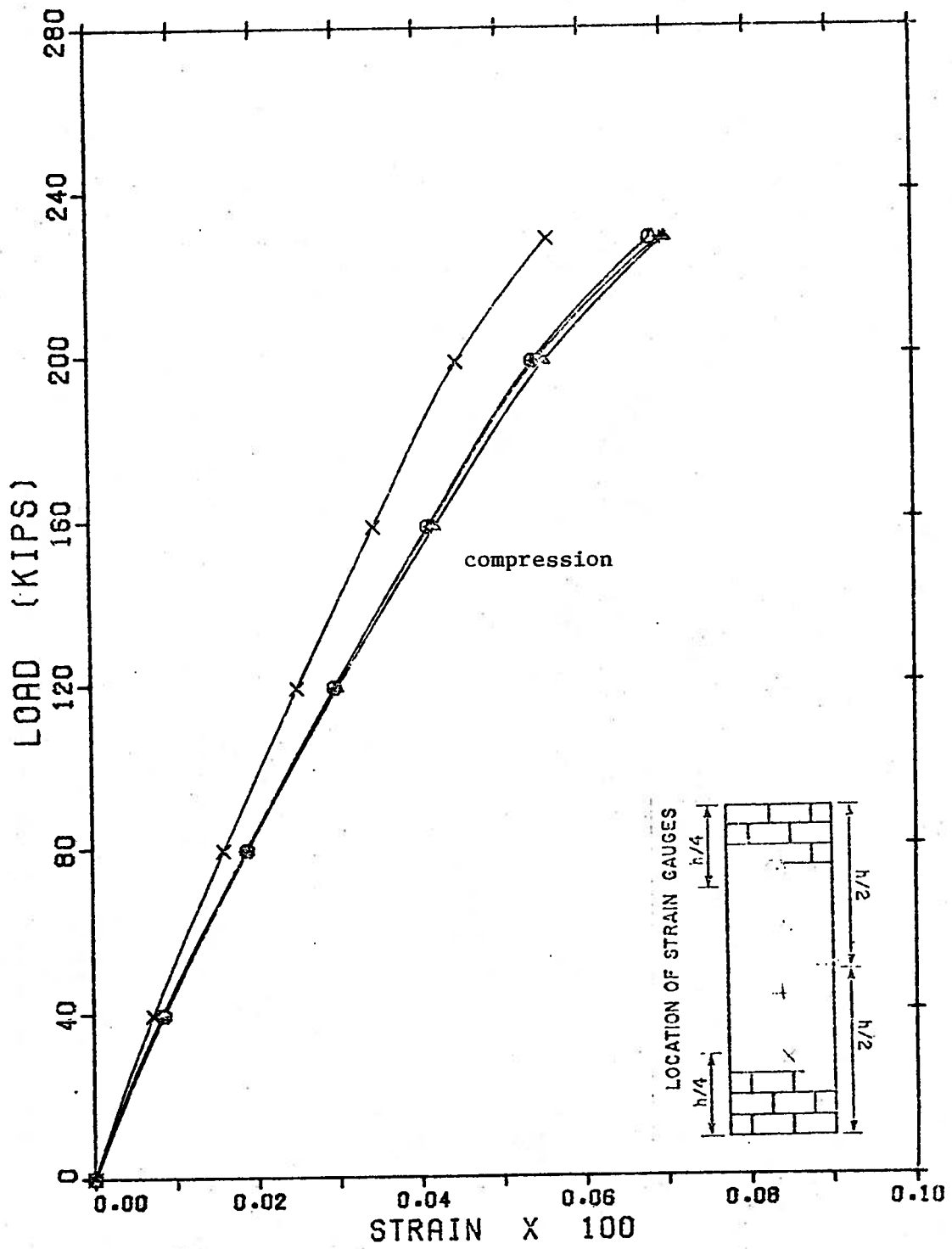


FIG. 2.102 Reinforcement Strain for Wall K1

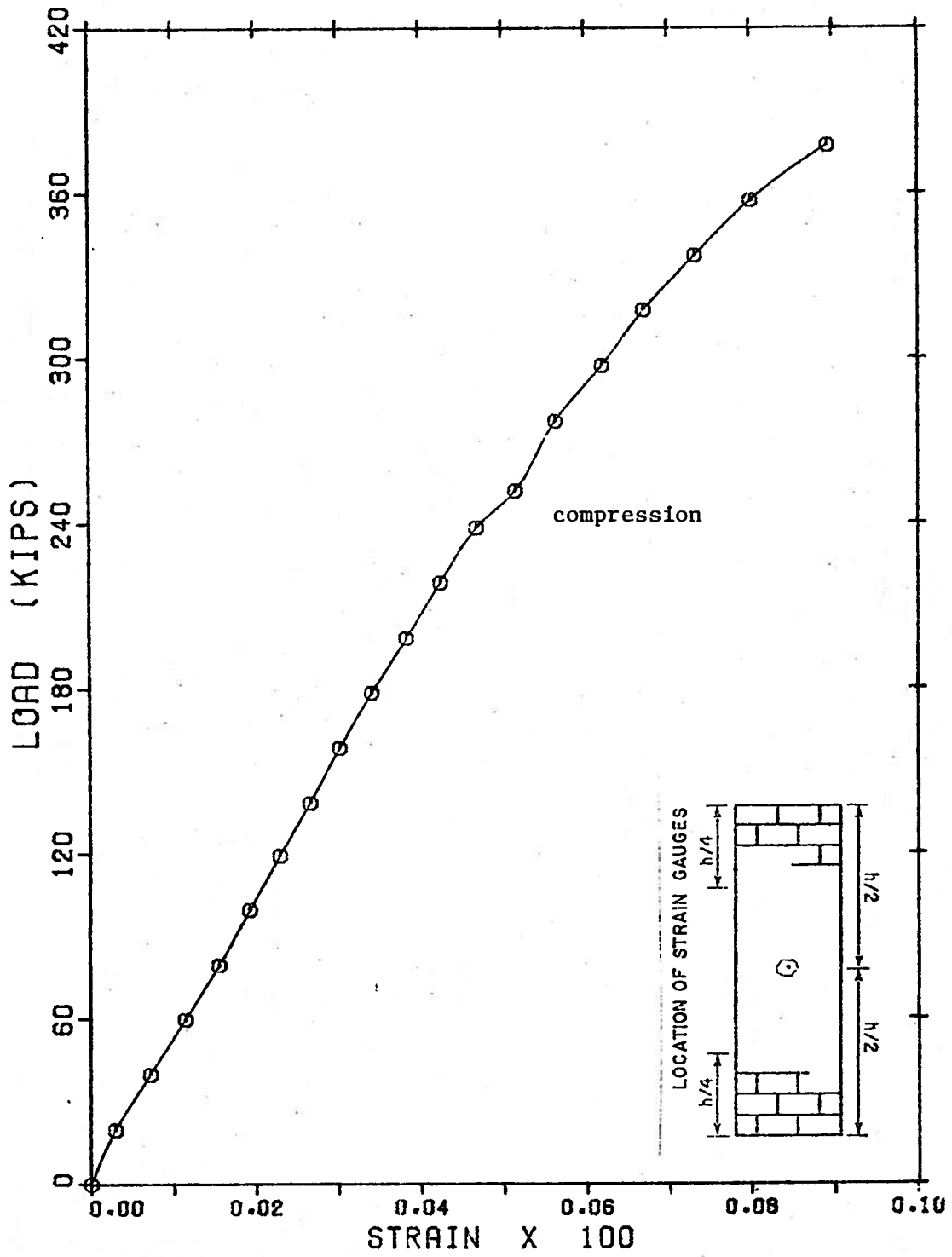


FIG. 2.103 Reinforcement Strain for Wall L1

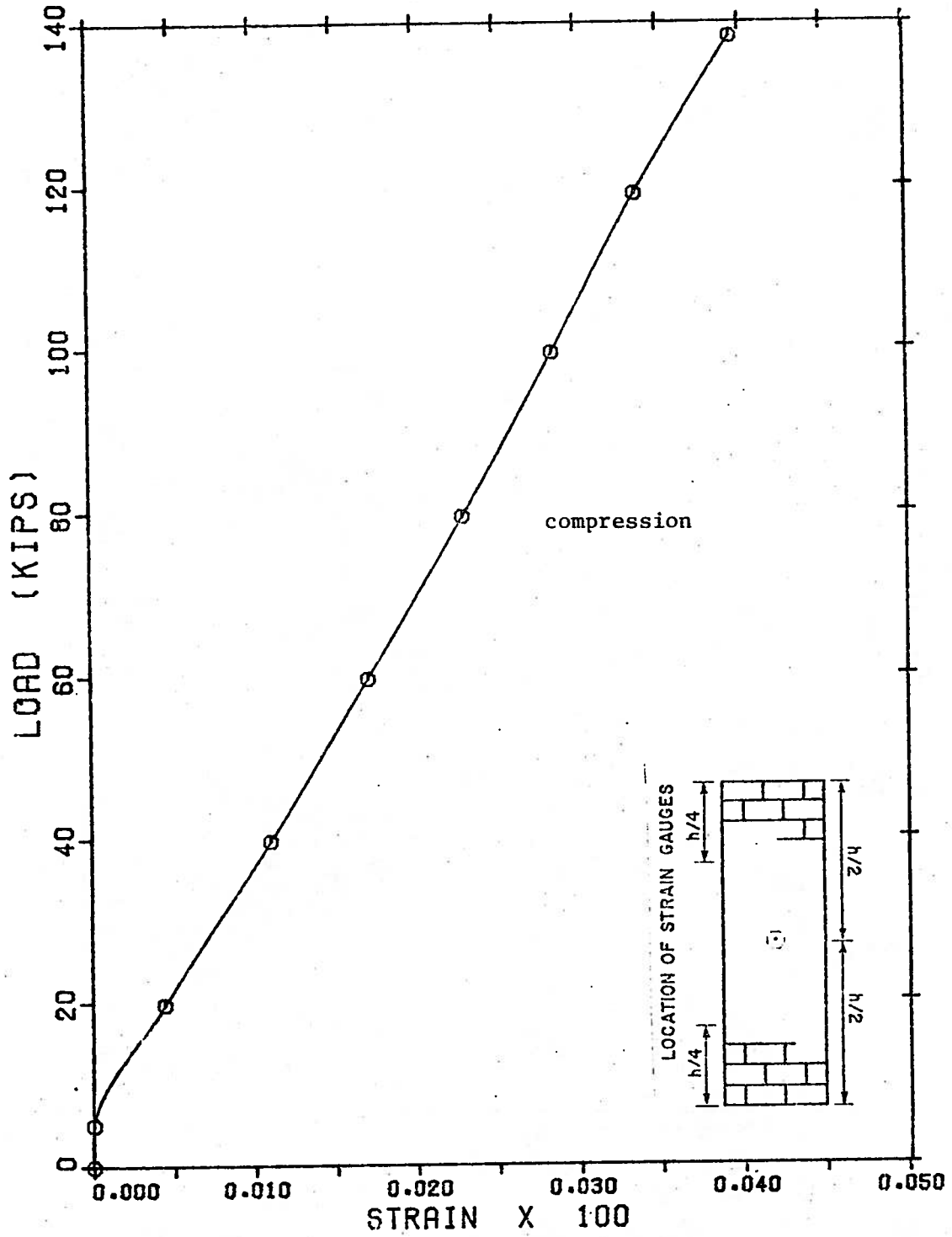


FIG. 2.104 Reinforcement Strain for Wall L2

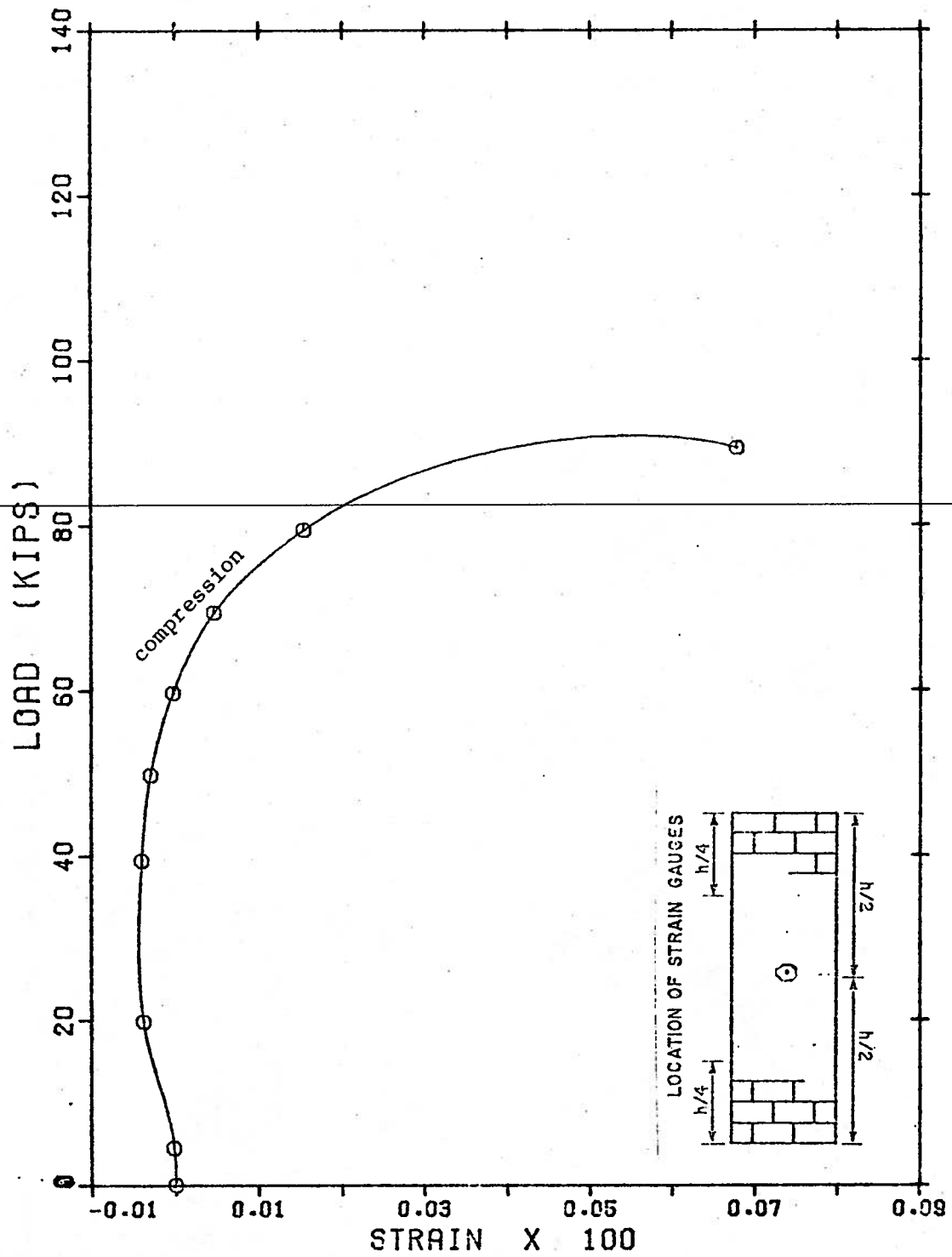


FIG. 2.105 Reinforcement Strain for Wall L3

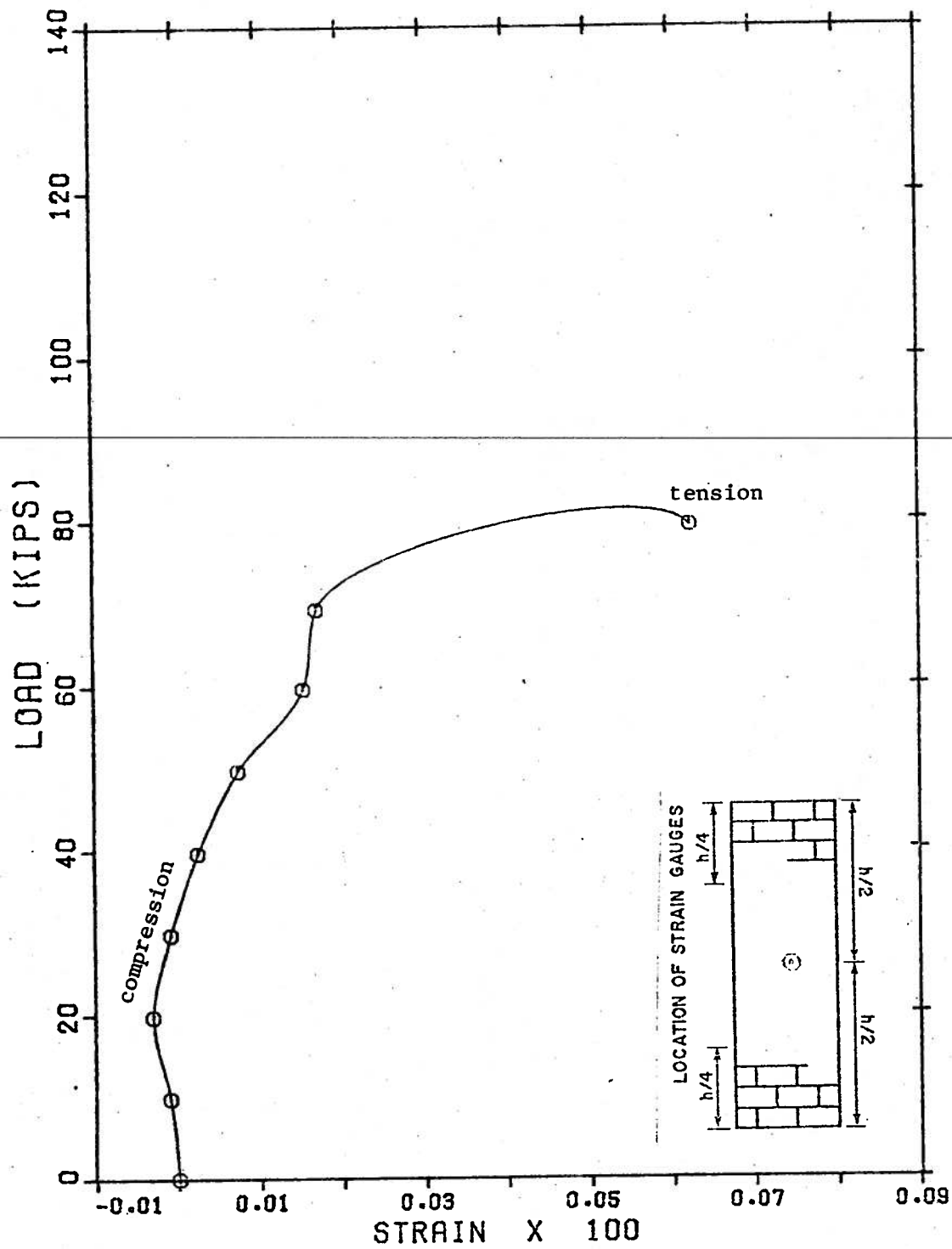


FIG. 2.106 Reinforcement Strain for Wall L4

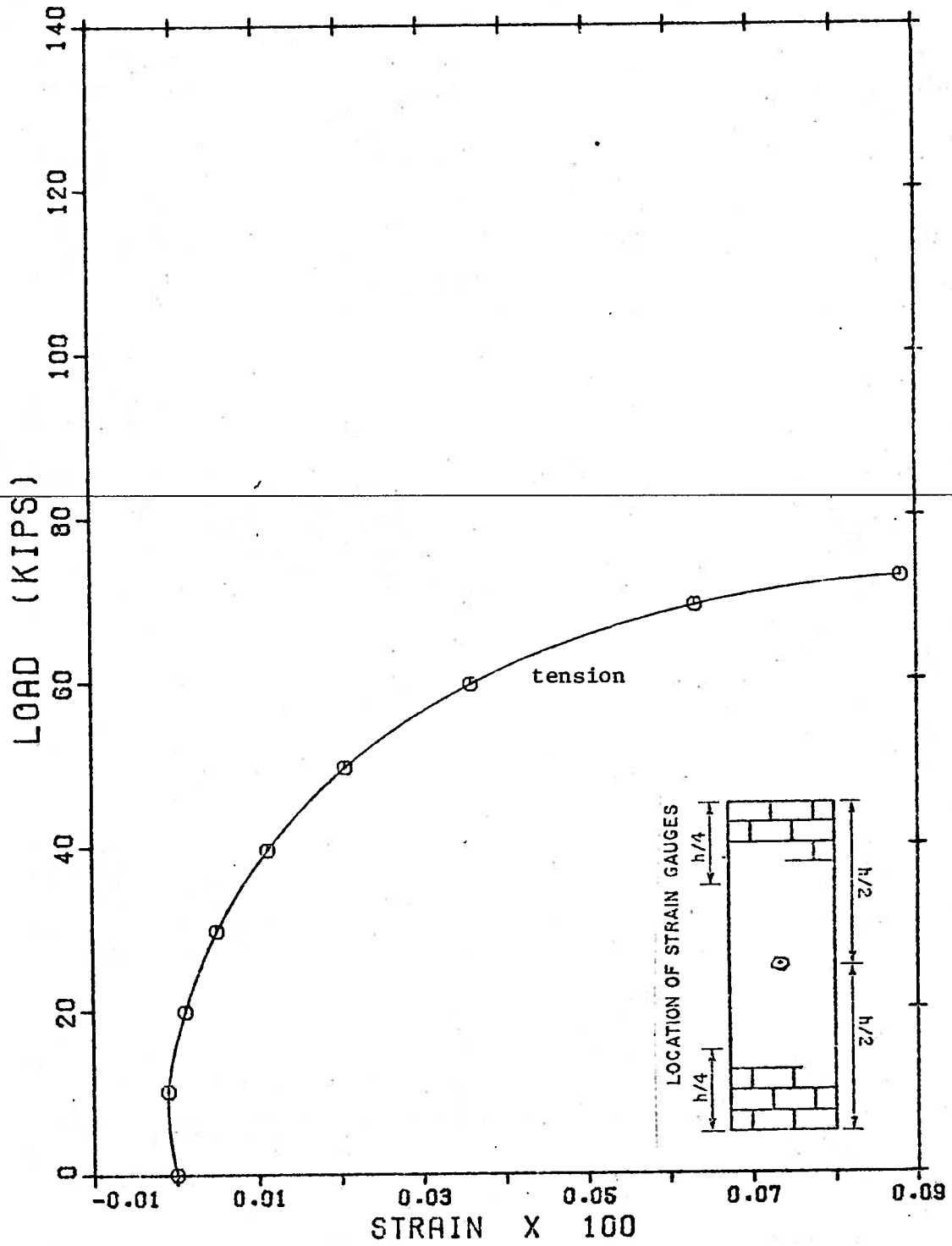


FIG. 2.107 Reinforcement Strain for Wall L5

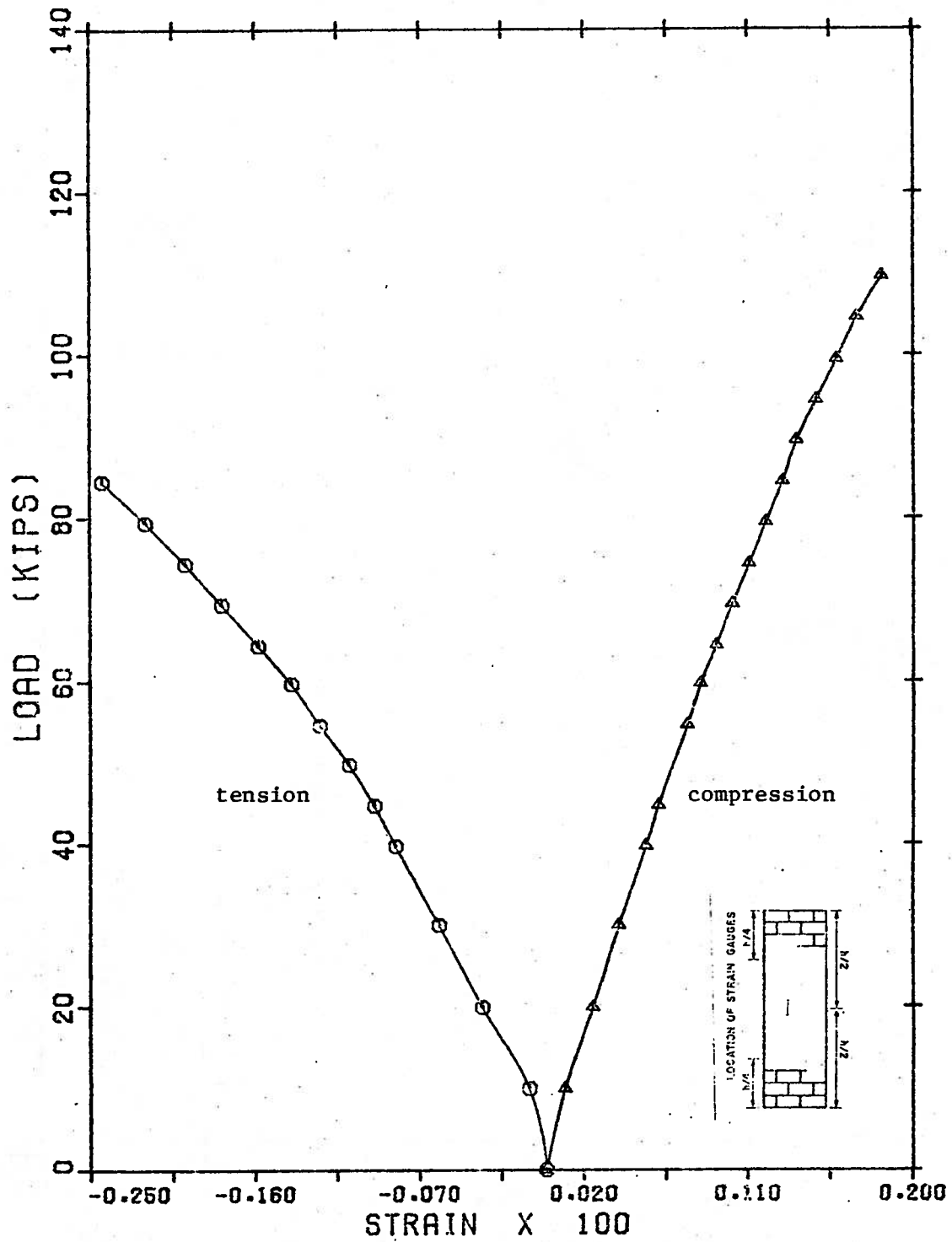


FIG. 2.108 Masonry Strain for Wall B5

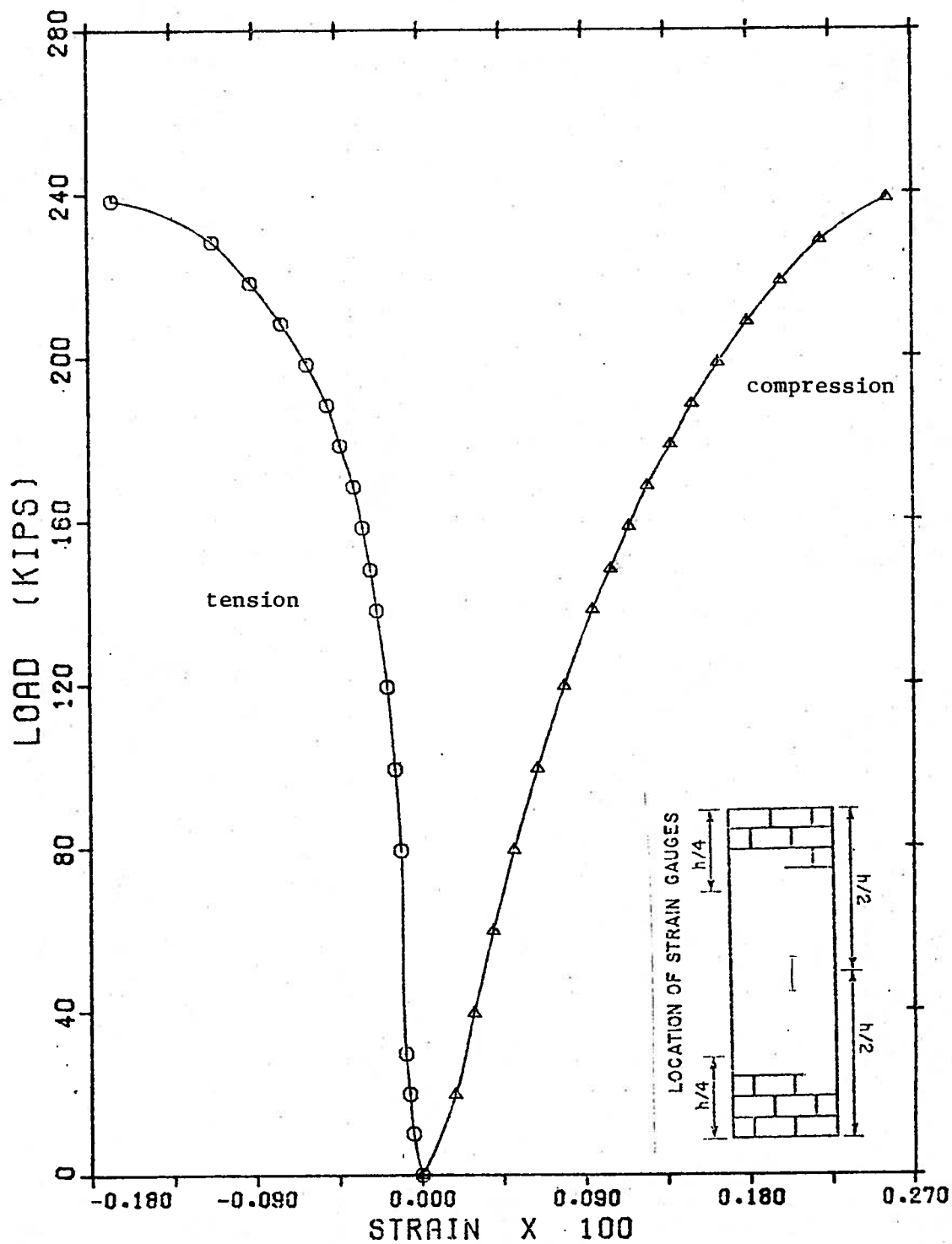


FIG. 2.109 Masonry Strain for Wall C3

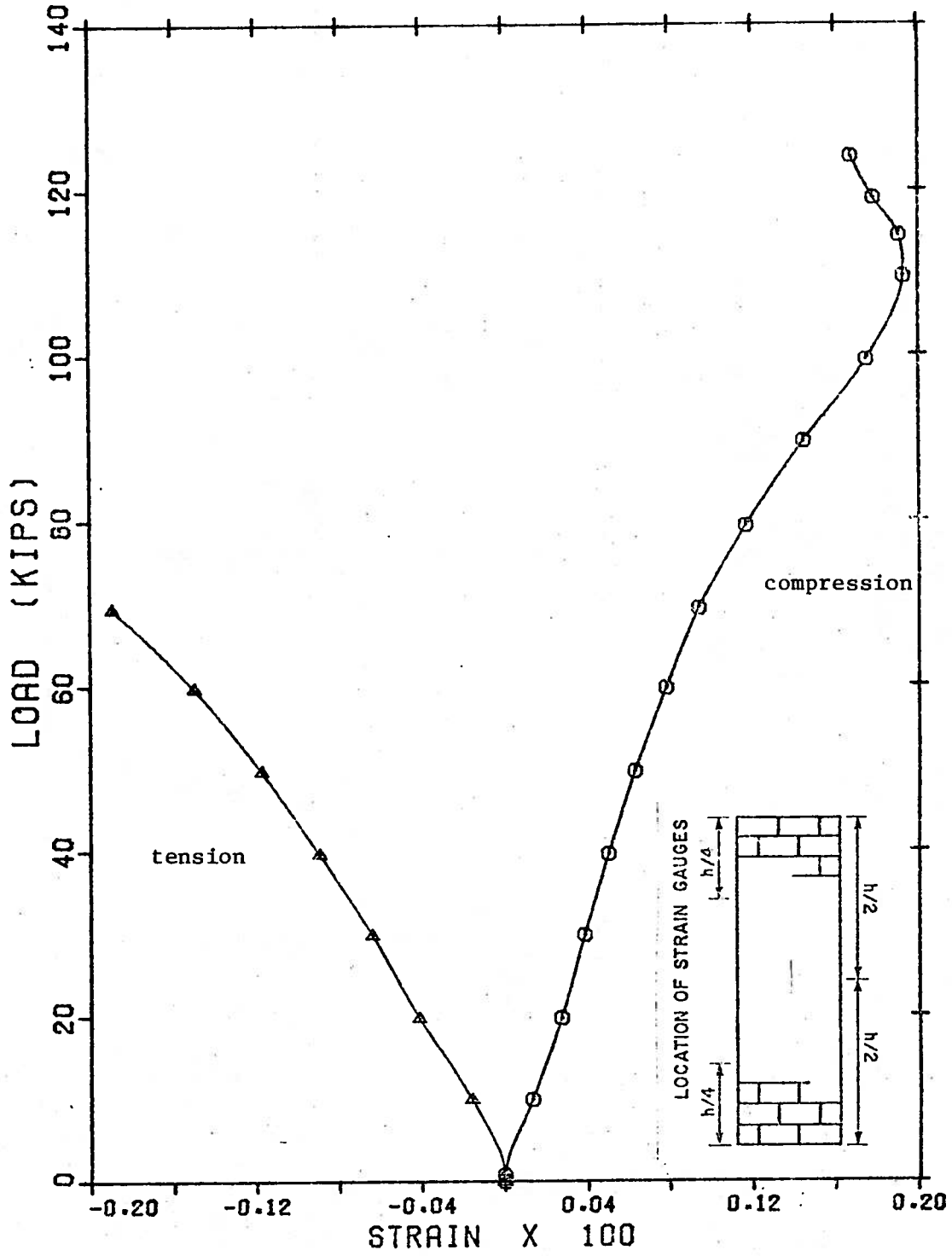


FIG. 2.110 Masonry Strain for Wall C4

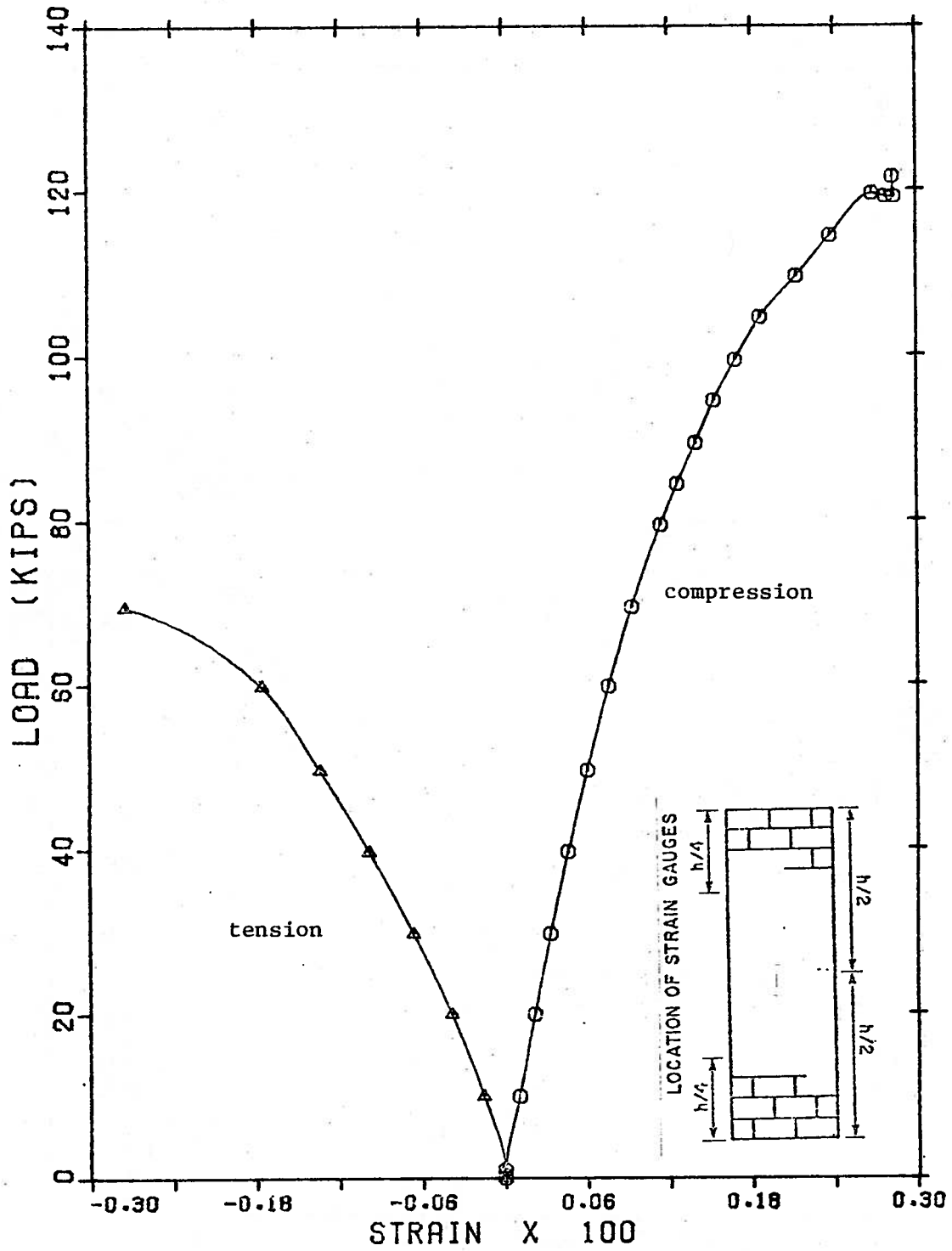


FIG. 2.111 Masonry Strain for Wall C5

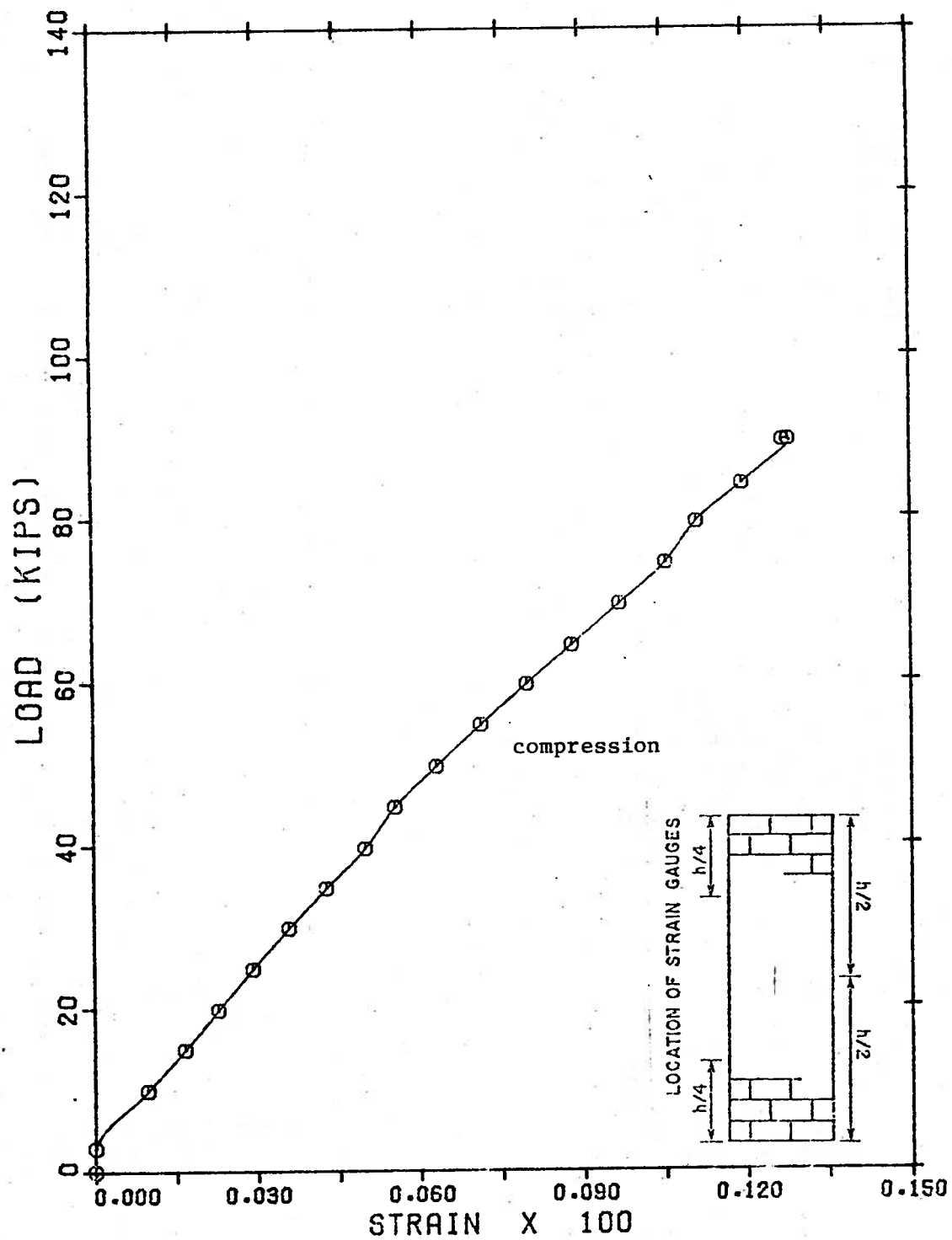


FIG. 2.112 Masonry Strain for Wall C6

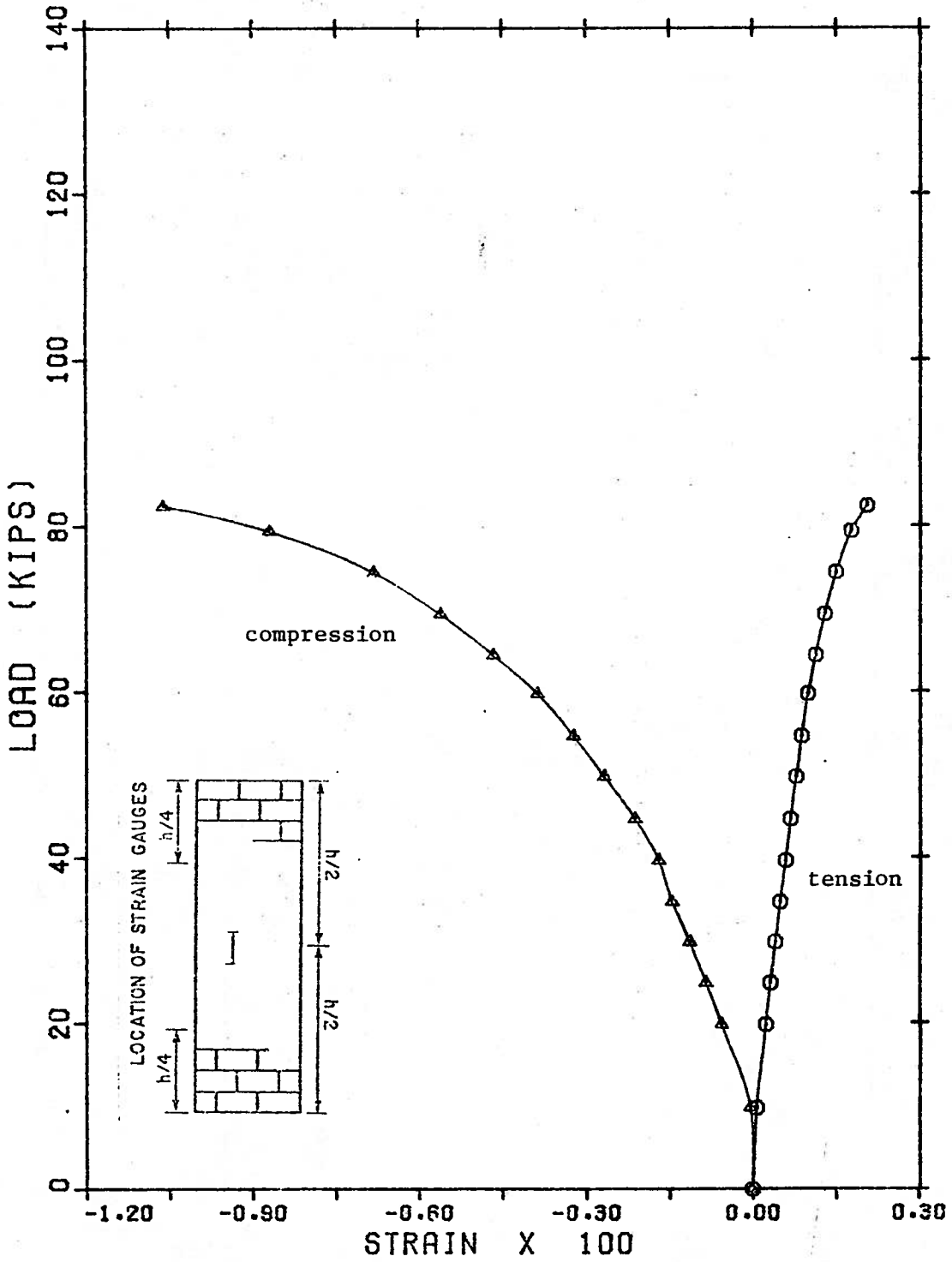


FIG. 2.113 Masonry Strain for Wall D6

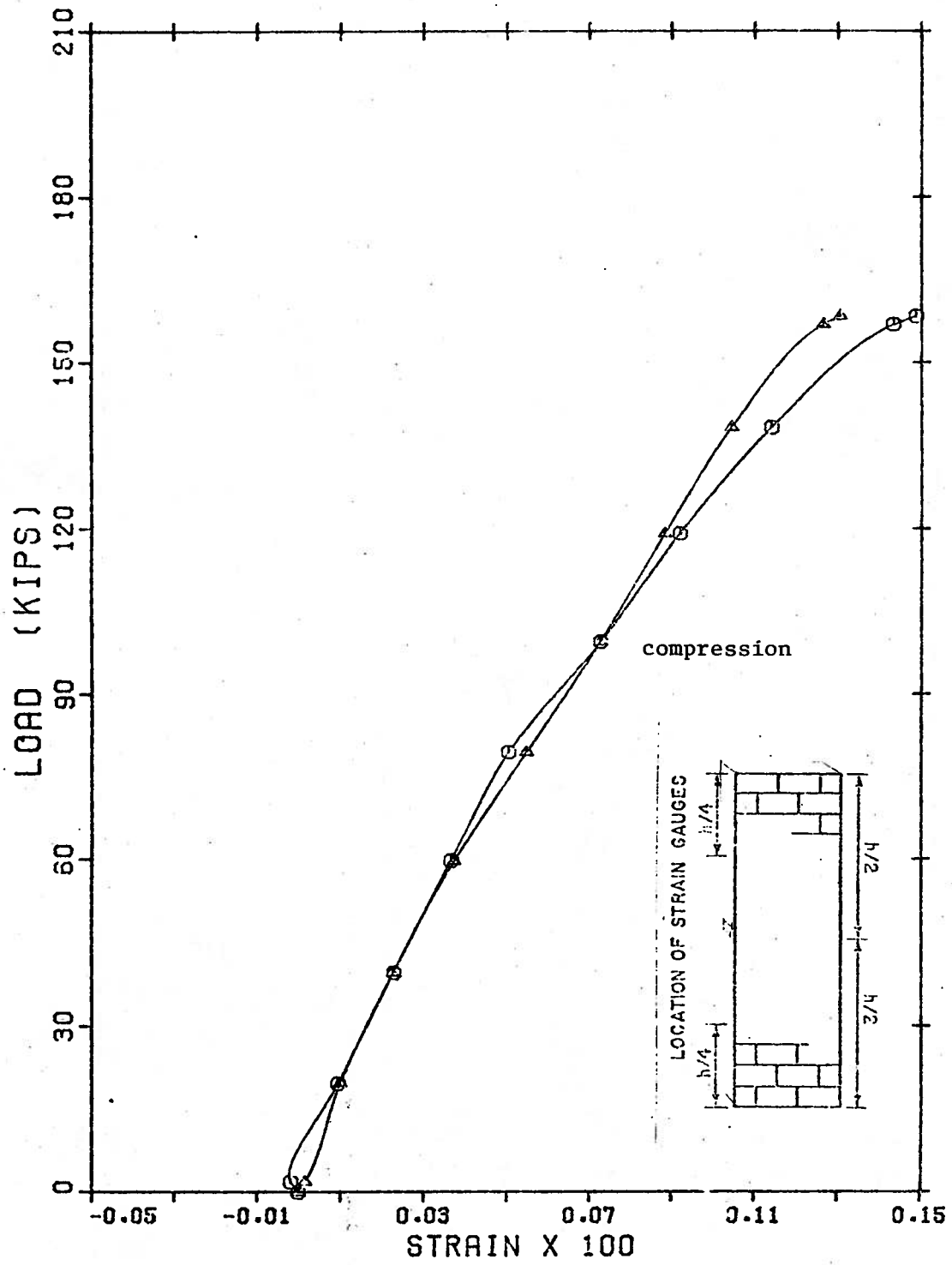


FIG. 2.114 Block Strain for Wall F1

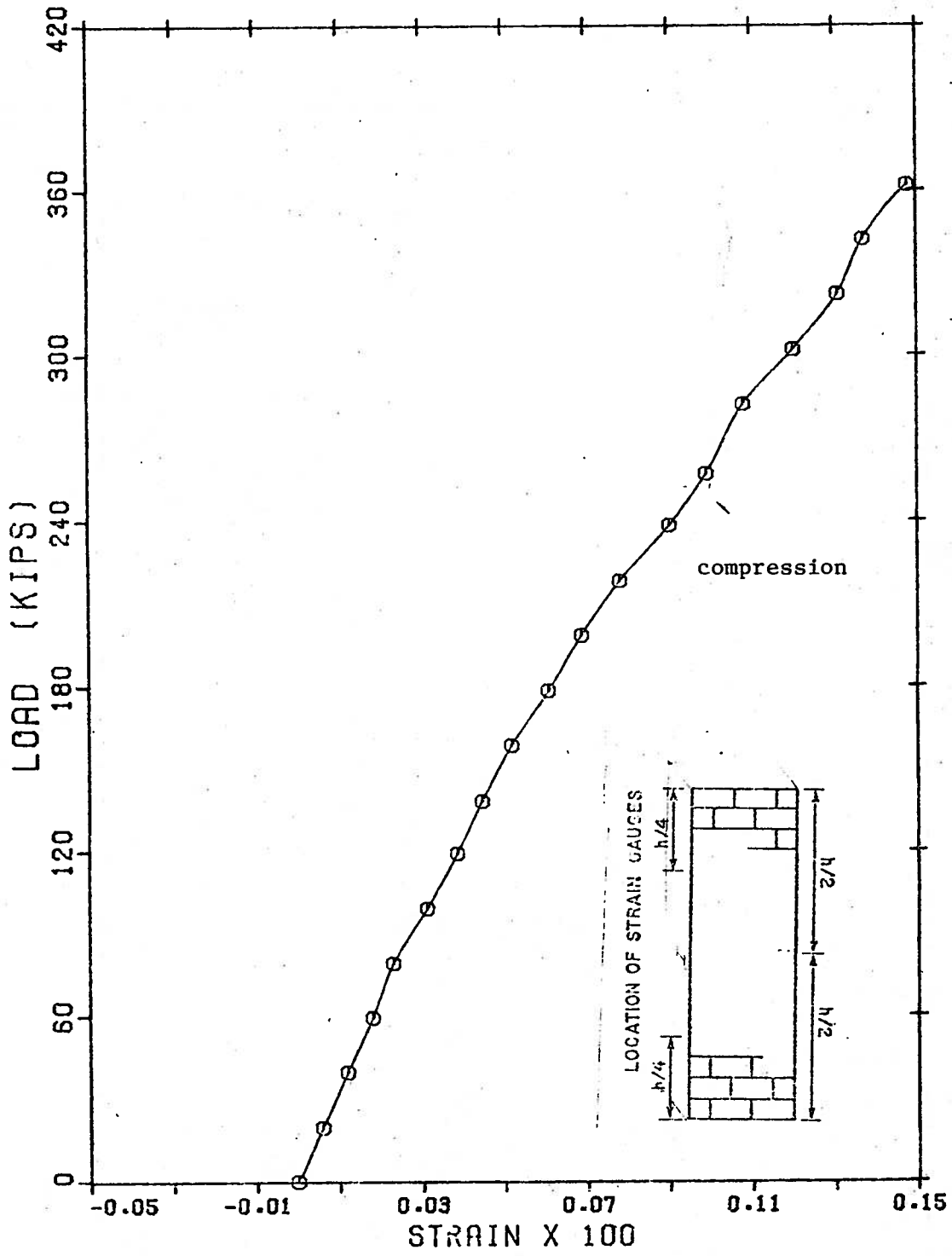


FIG. 2.115 Block Strain for Wall H1

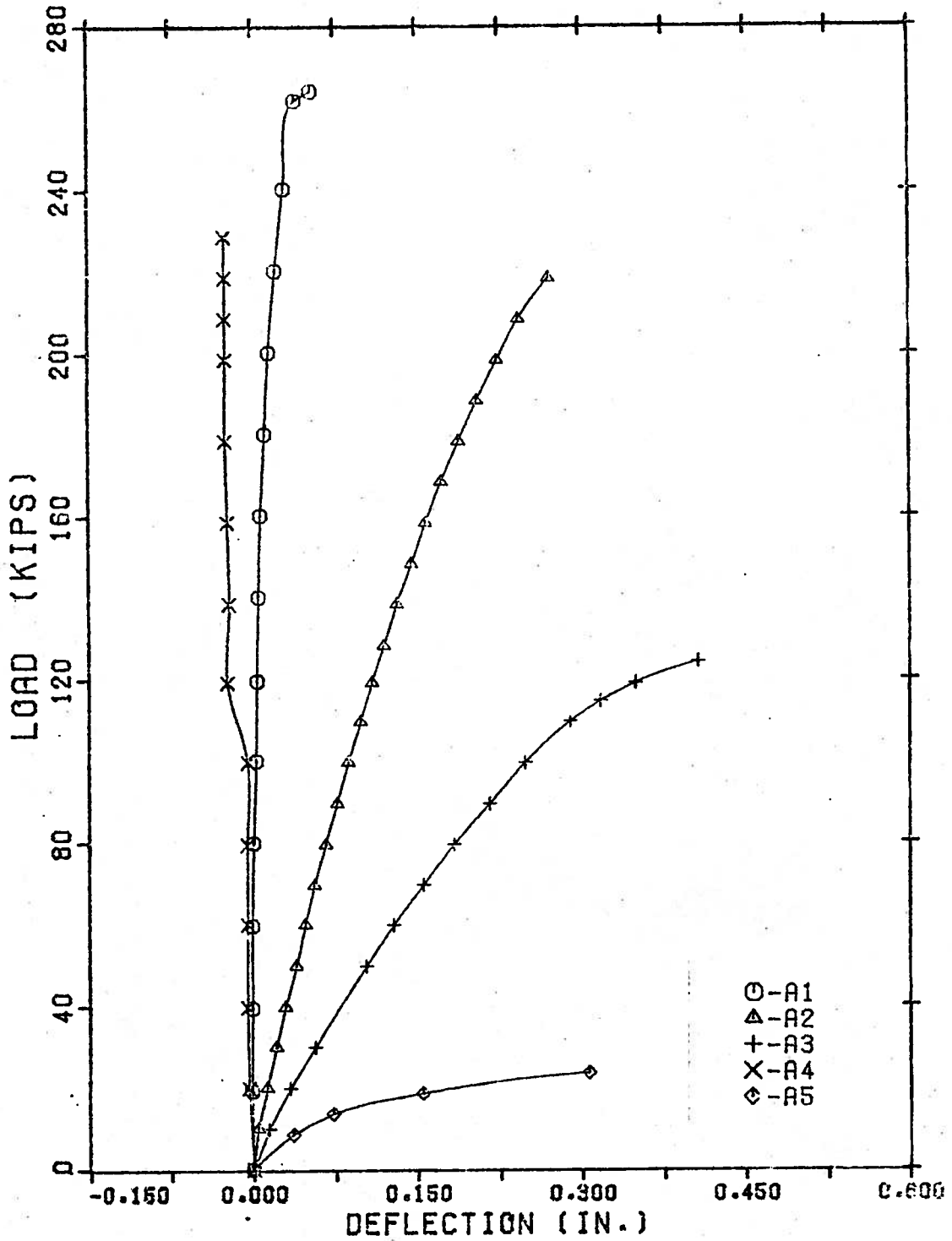


FIG. 2.116 Centerline Deflection of Series A

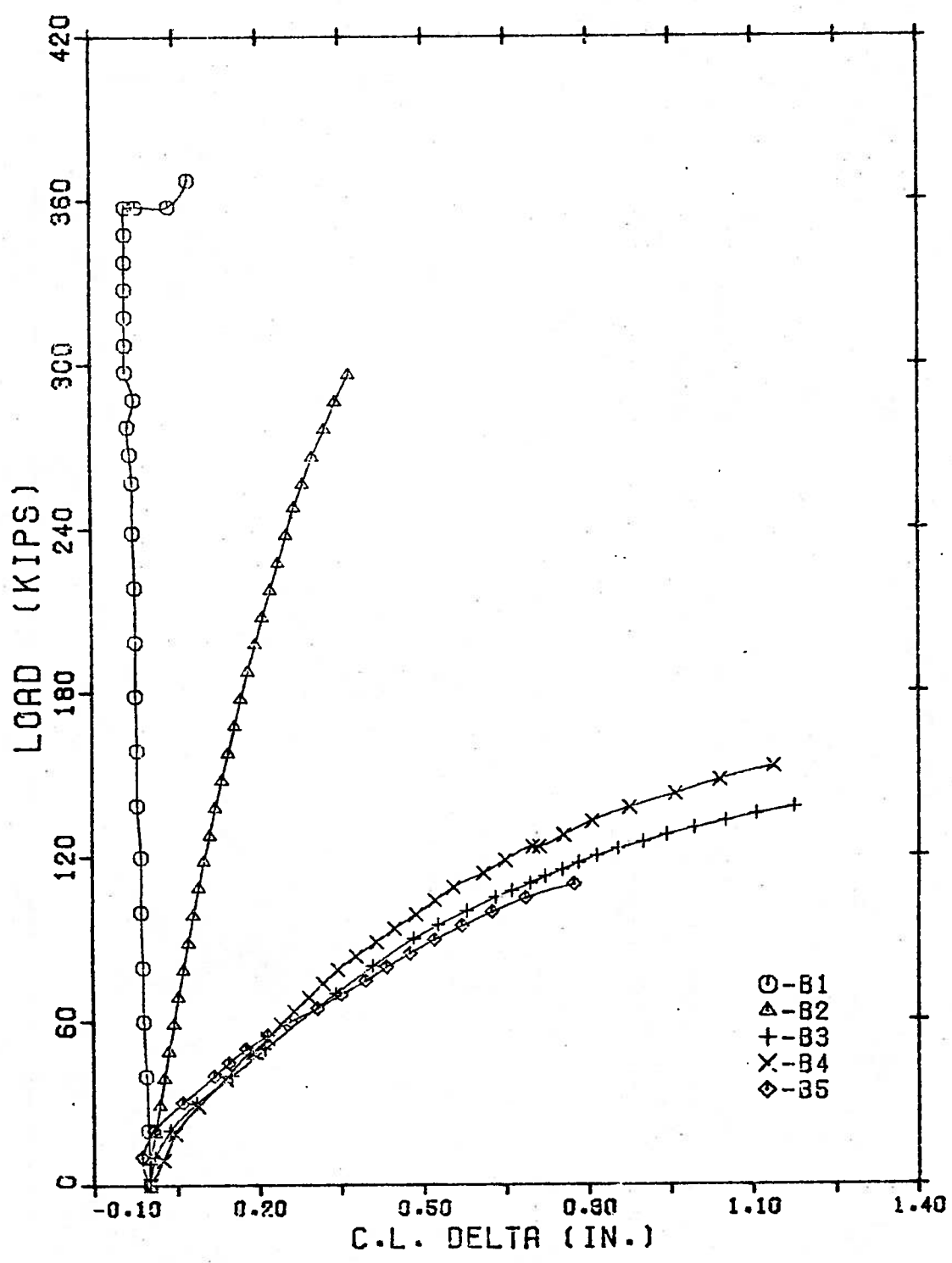


FIG. 2.117 Centerline Deflection of Series B

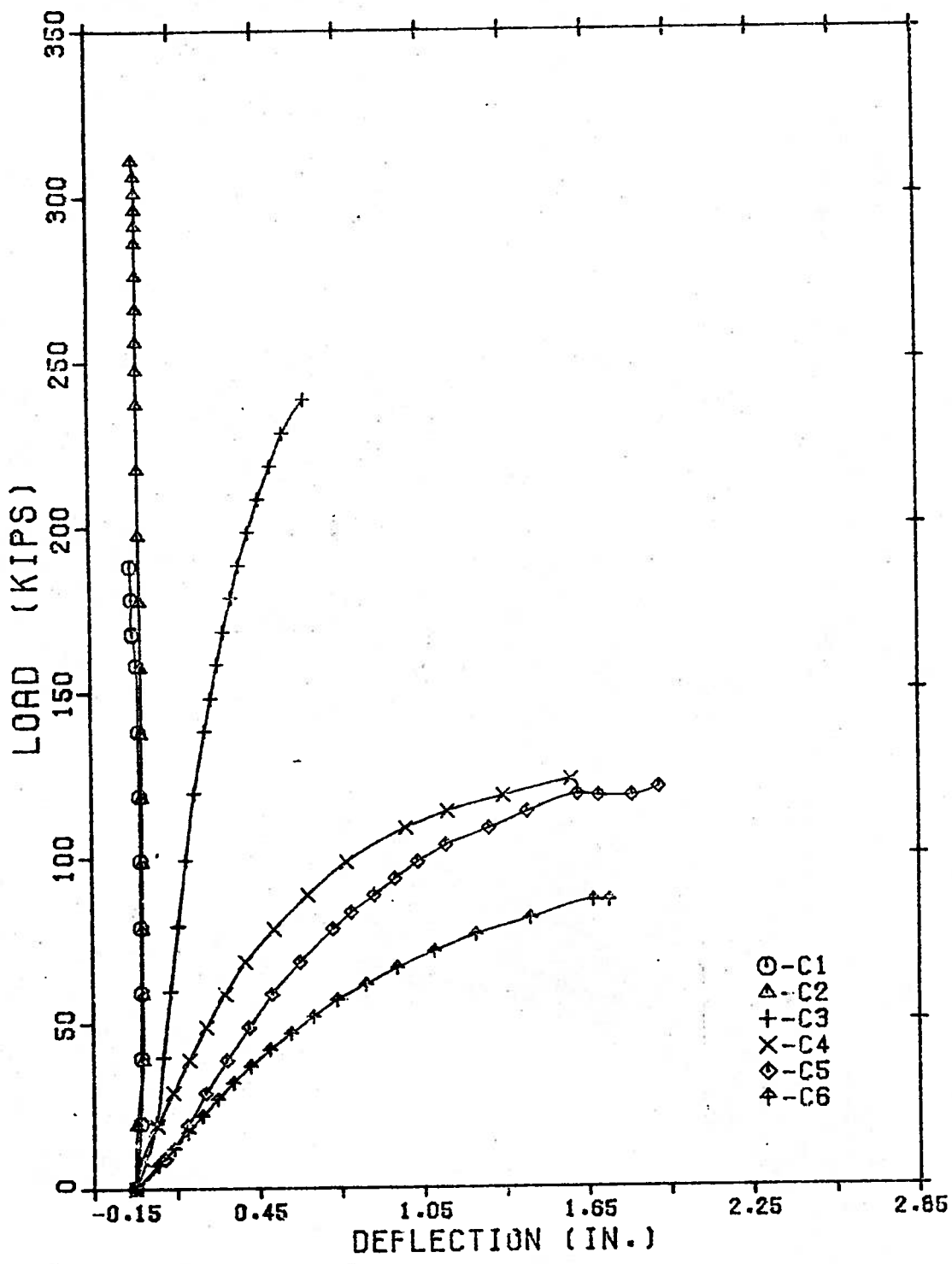


FIG. 2.118 Centerline Deflection of Series C

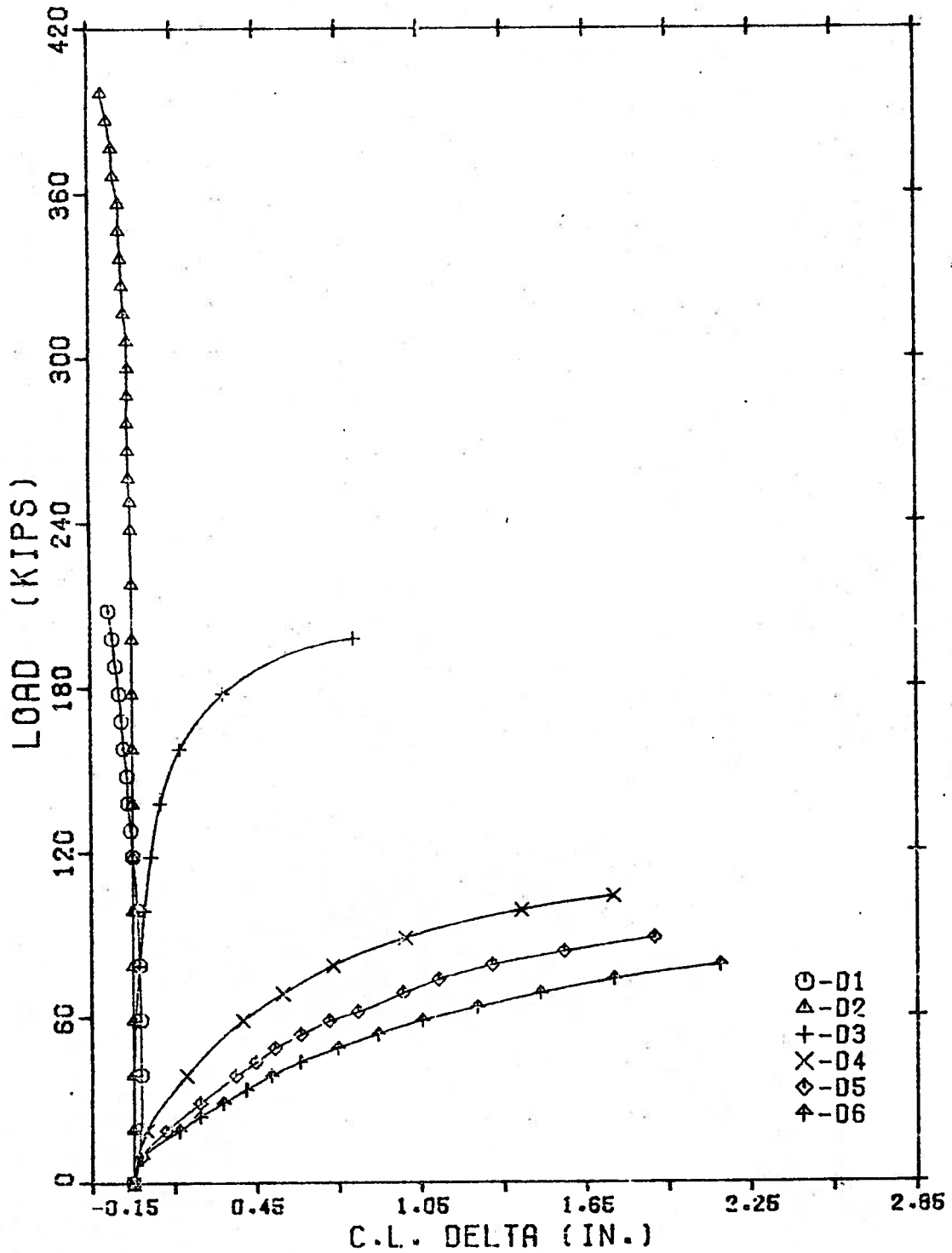


FIG. 2.119 Centerline Deflection of Series D

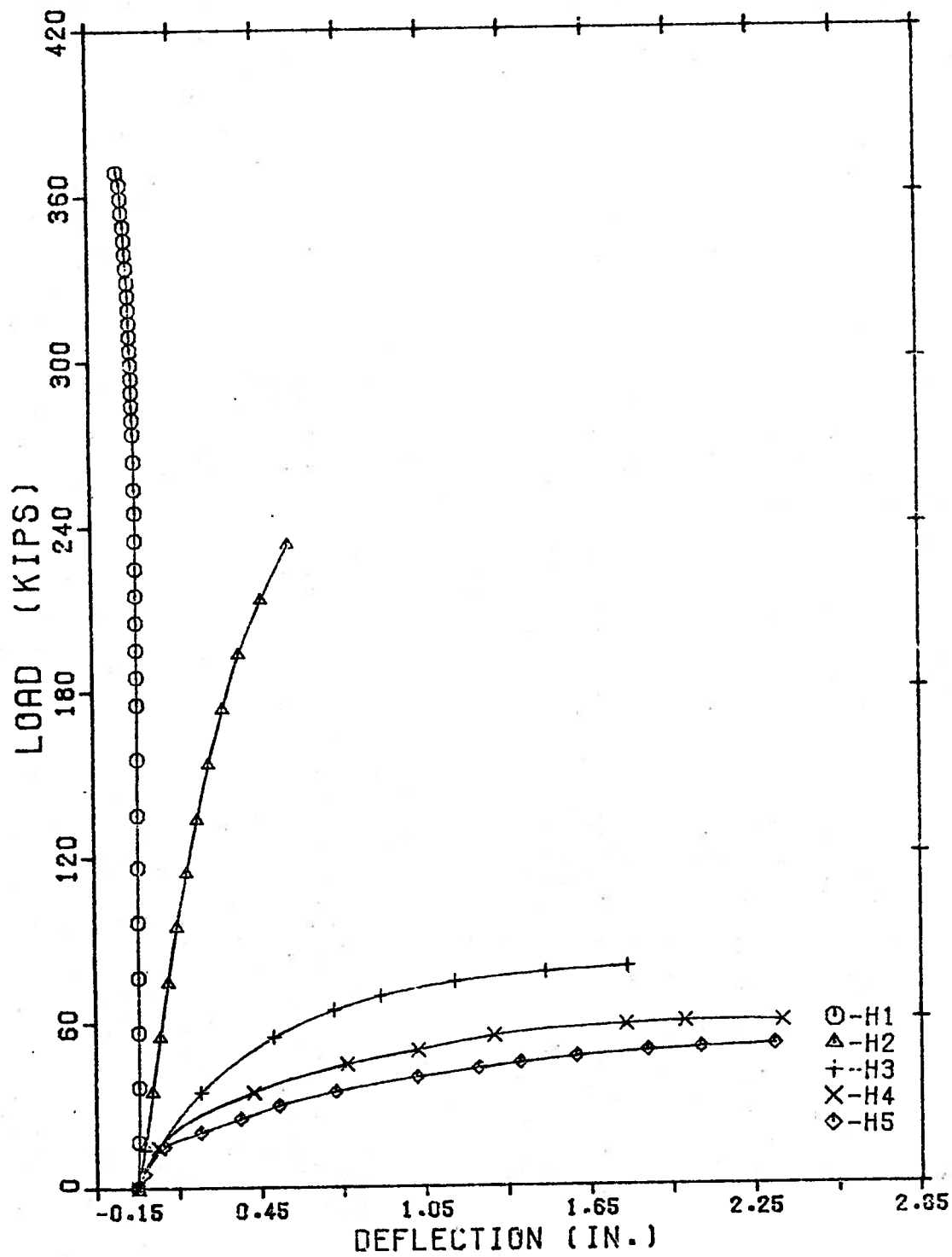


FIG. 2.120 Centerline Deflection of Series H

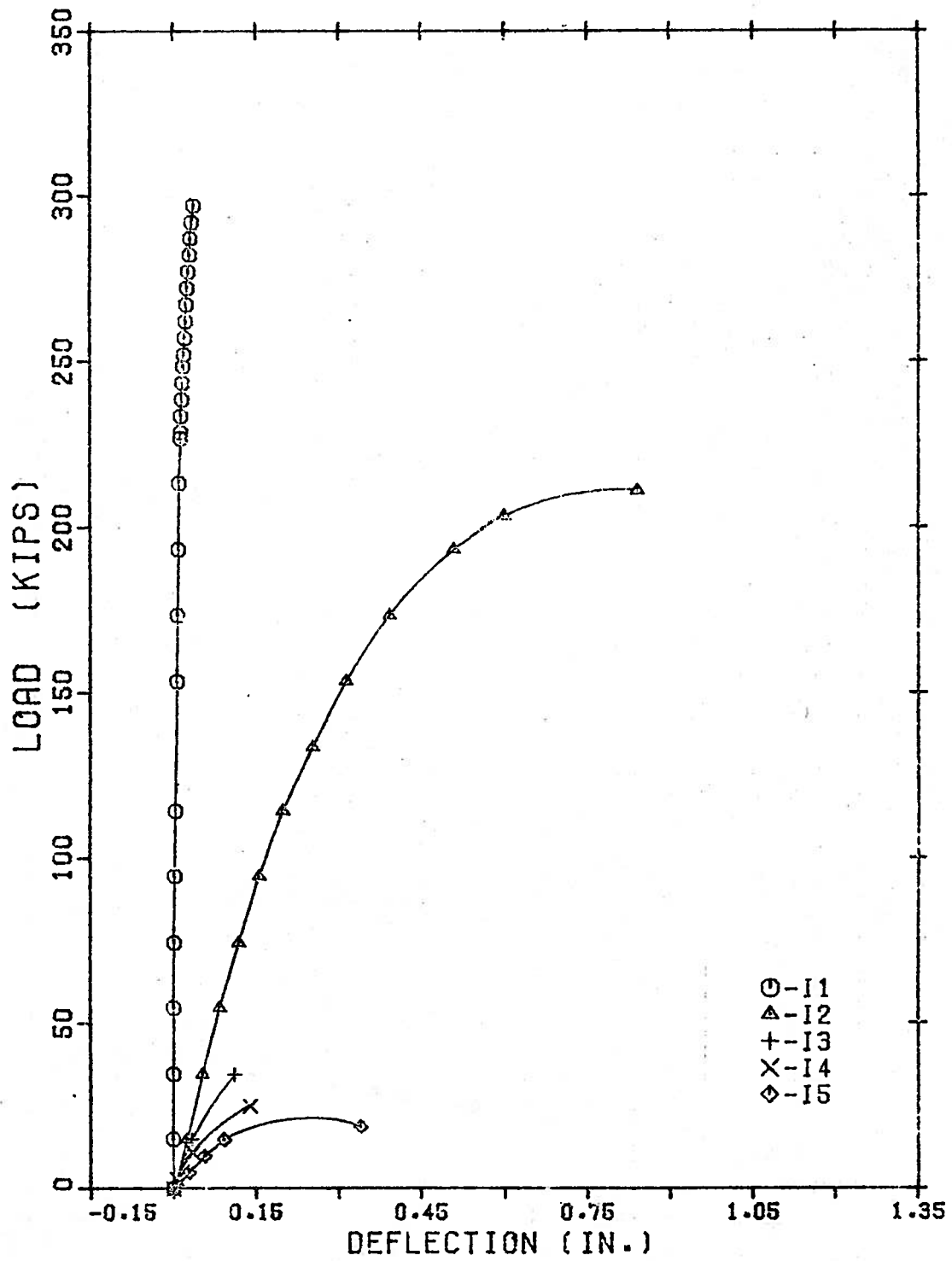


FIG. 2.121 Centerline Deflection of Series I

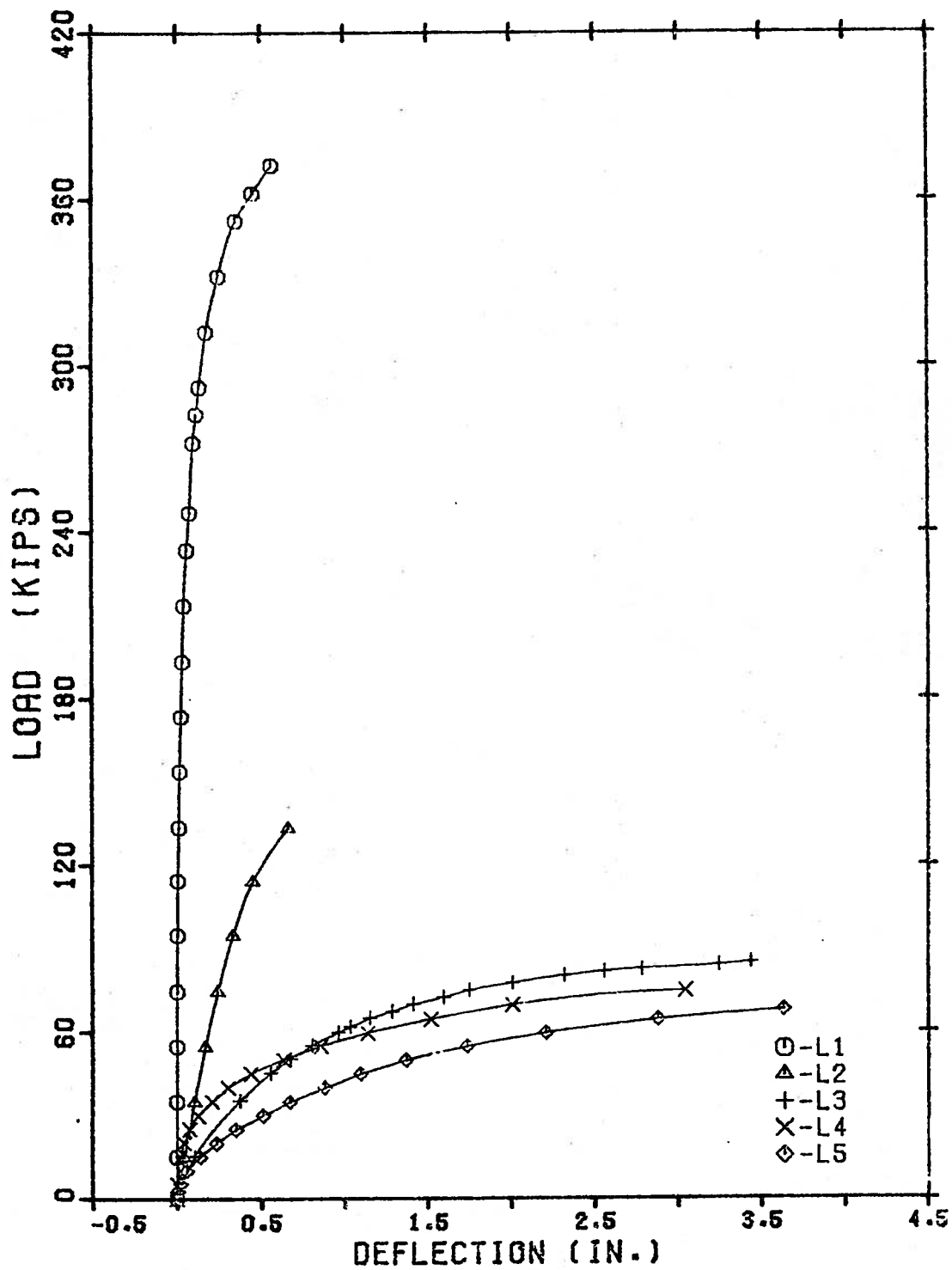


FIG. 2.122 Centerline Deflection of Series L

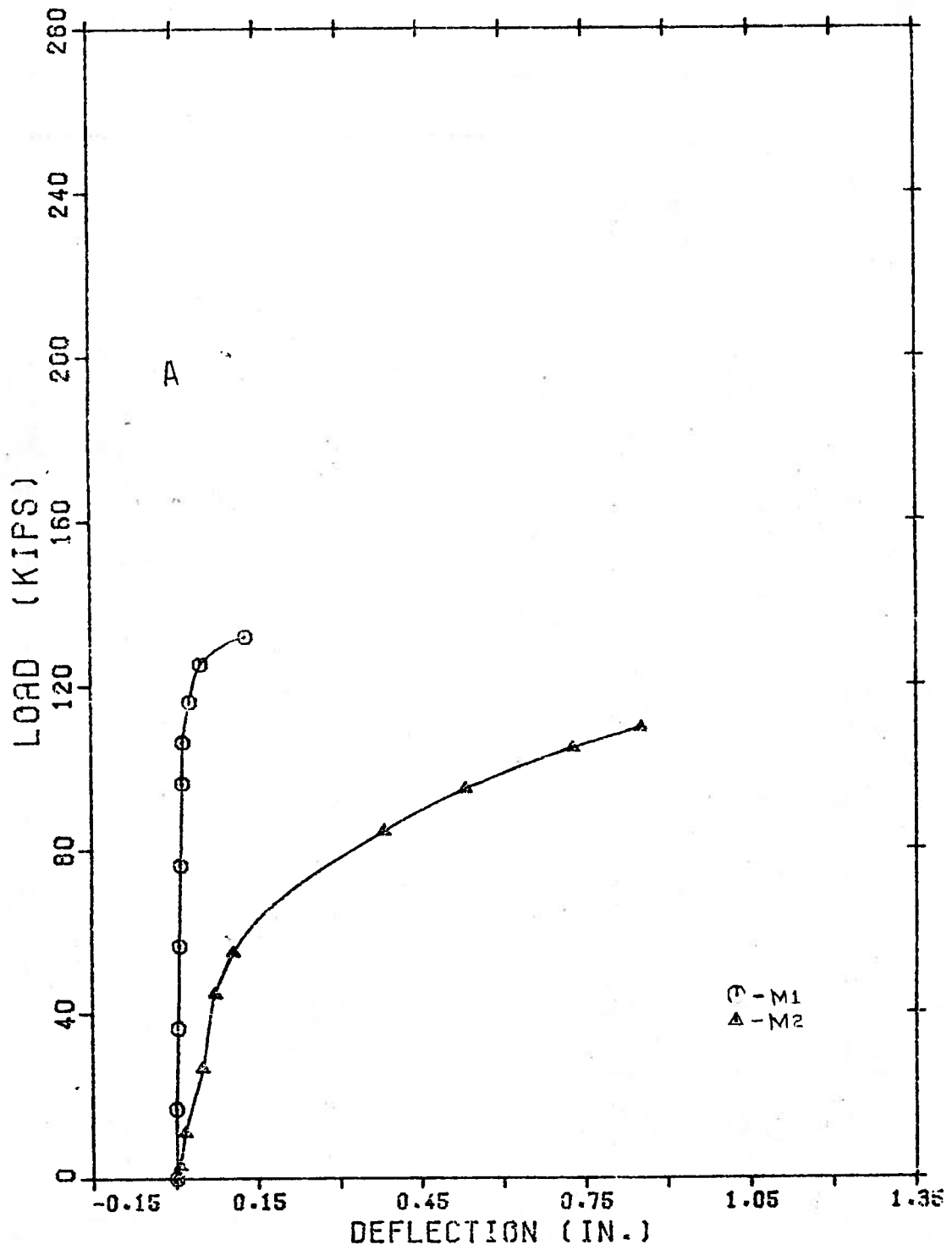


FIG. 2.123 Centerline Deflection of Series M