

**MSC/pai 2 APPLICATIONS**

**Presented By:**

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**Engineering Services Department**

**THE MACNEAL-SCHWENDLER CORPORATION**

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# **OVERVIEW OF MSC'S ENGINEERING SERVICES GROUP**

**MSC's Engineering Services Department (ESD) provides the following services to a wide variety of industries:**

- **Consulting**
- **Customized Software Development**
- **Training in the Use of MSC Software Products**
- **Internal Feedback on Using MSC Software**
- **Guidance for Clients New to Finite Element Technology**

## **MSC/pal 2 APPLICATIONS**

- **ESD has assisted several clients in using MSC/pal 2 to solve their analysis requirements in an efficient and cost-effective manner.**
- **To demonstrate the versatility of MSC/pal 2 in solving a broad class of problems, the remainder of this presentation will focus on several applications of MSC/pal 2 to solving ESD clients' problems in the fields of medicine, optics, building construction and automotive design.**

## **MSC/pal 2 APPLICATIONS - MEDICINE**

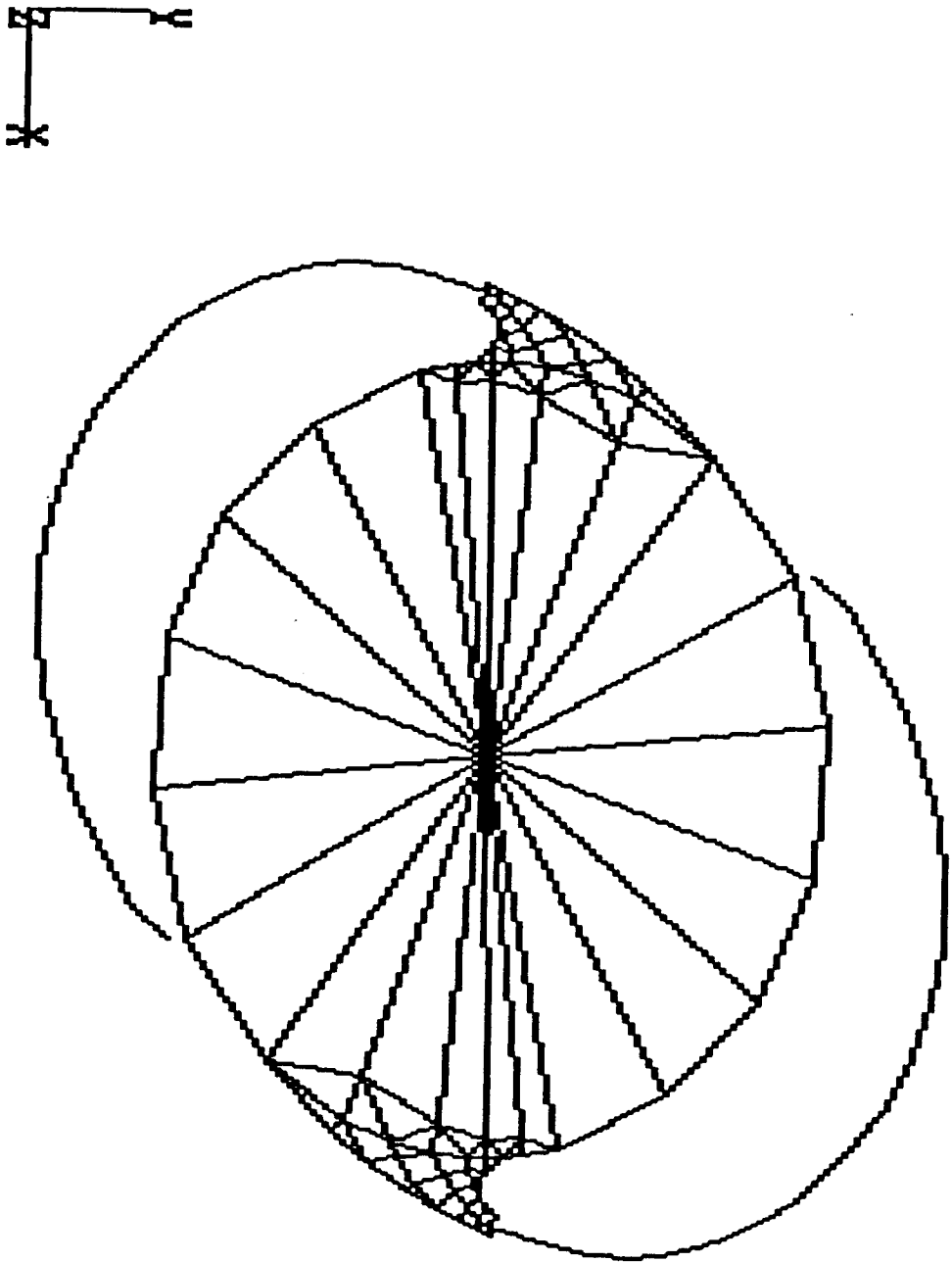
### **INTRAOCULAR LENS**

- **Intraocular lens (IOL) implants are used to replace the human lens in the eyes of cataract victims. (Cataract - a disease where the lens becomes opaque, resulting in partial or total blindness).**
- **Commonly, several IOL design configurations are prototype tested in laboratories to determine design limitations under handling, implantation, and in-service loading conditions.**

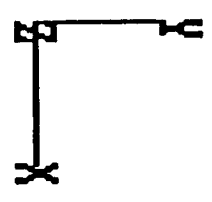
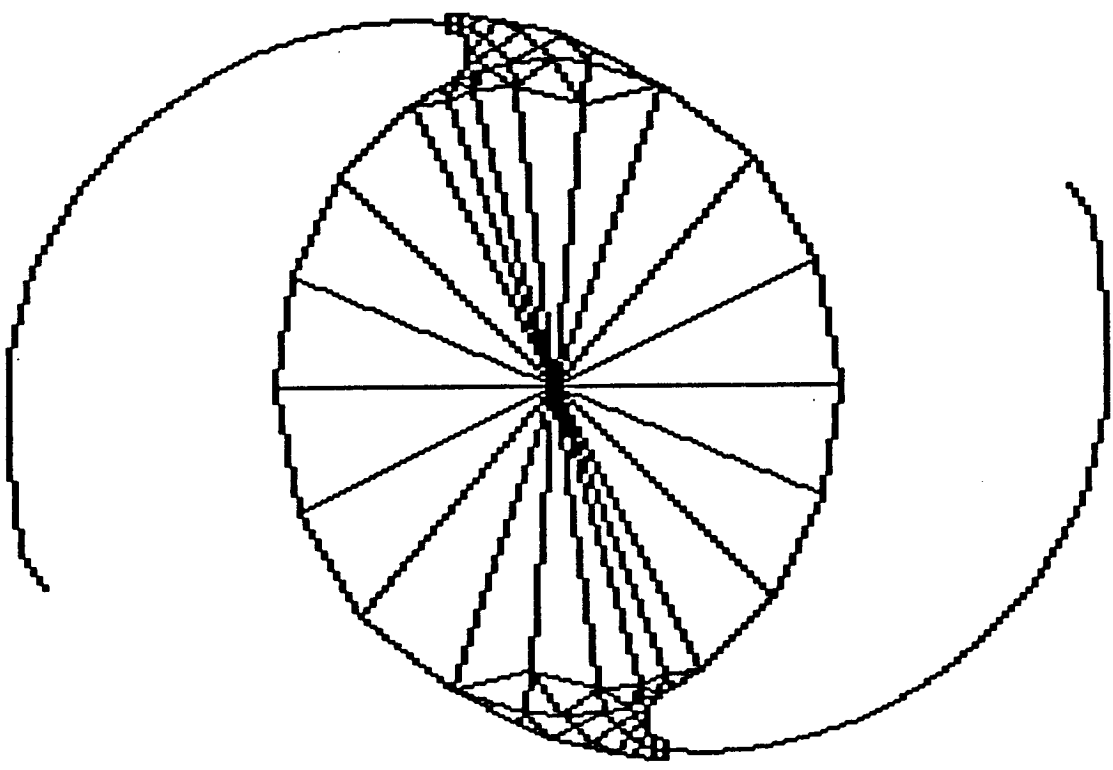
## **MSC/pal 2 APPLICATIONS - MEDICINE INTRAOCULAR LENS (Cont.)**

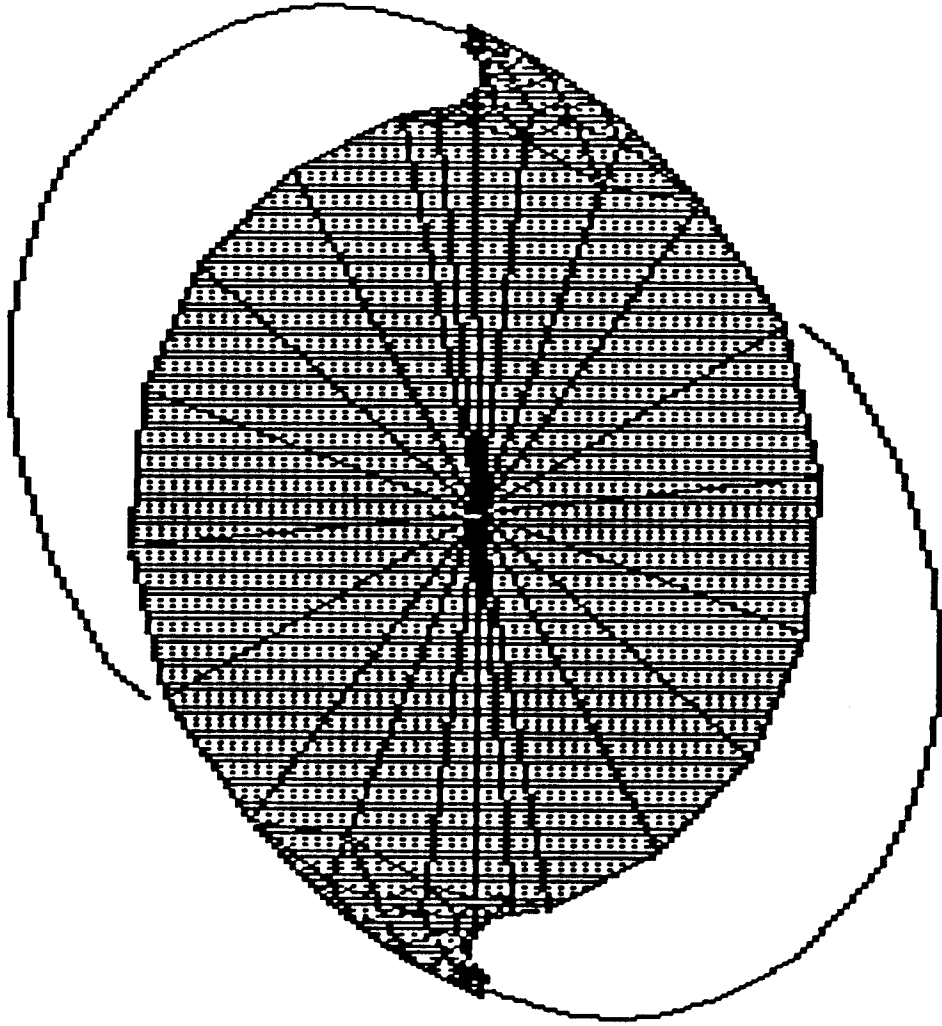
- **MSC/pal 2 has been used to supplement these expensive tests by simulating the anticipated loadings and producing results that helped predict potential weaknesses and/or failures in the various IOL designs.**
- **The use of MSC/pal 2 has enabled IOL manufacturing companies to conduct relatively inexpensive, in-house analyses of their designs, thereby limiting prototype tests to those configurations likely to pass.**

**101: HAPTIC COMPRESSION**

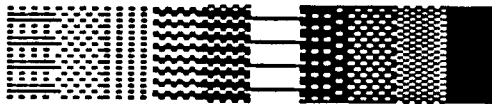
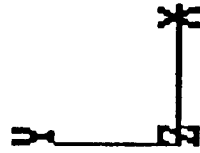


**PROVENS LINSVULLARK LENS MODEL**





0.0000E-01  
 1.5000E+00  
 3.0000E+00  
 4.5000E+00  
 6.0000E+00  
 7.5000E+00  
 9.0000E+00  
 1.0500E+01  
 1.2000E+01  
 1.3500E+01  
 1.5000E+01





# IOL GUSSET REGION

## MISES STRESS

0.0000E-01  
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5.0000E+00  
7.5000E+00  
1.0000E+01  
1.2500E+01  
1.5000E+01

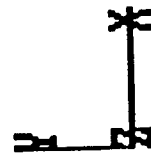
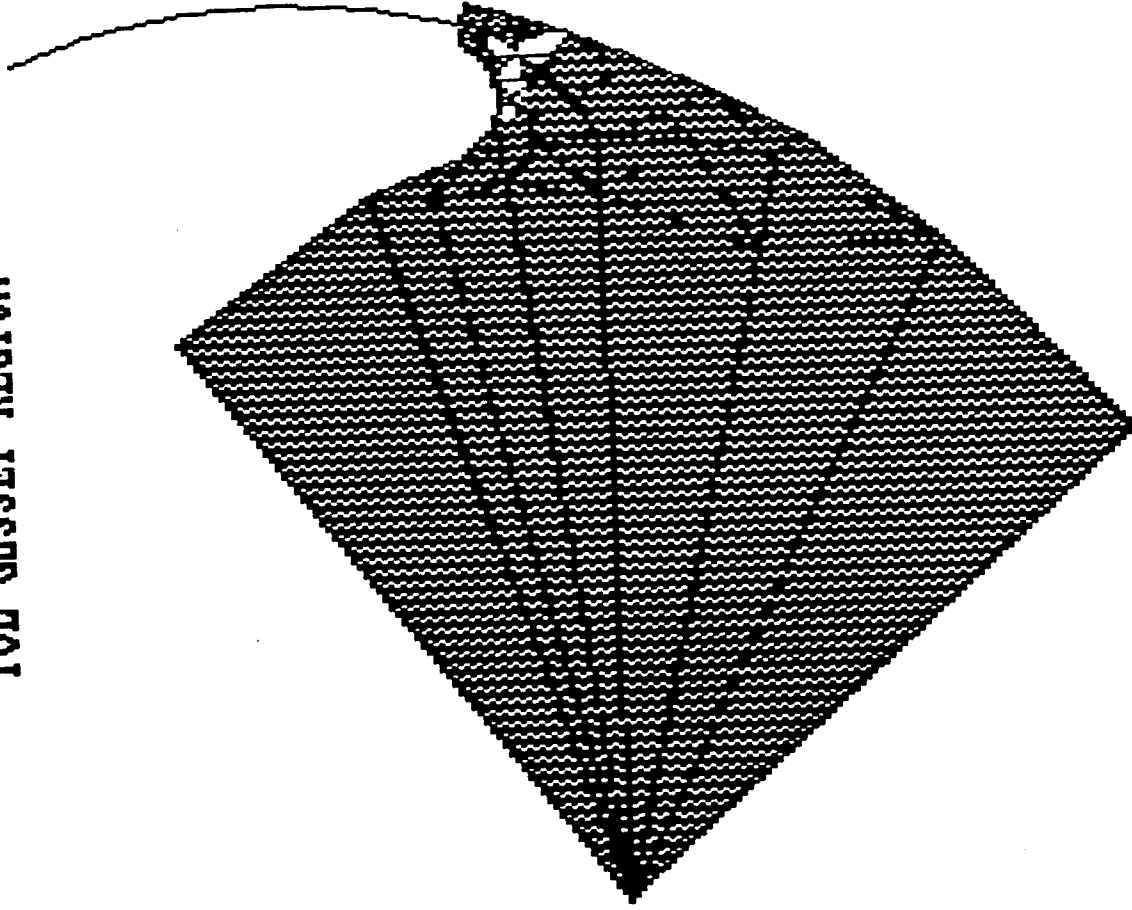
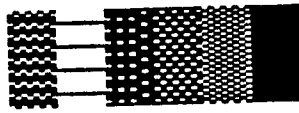
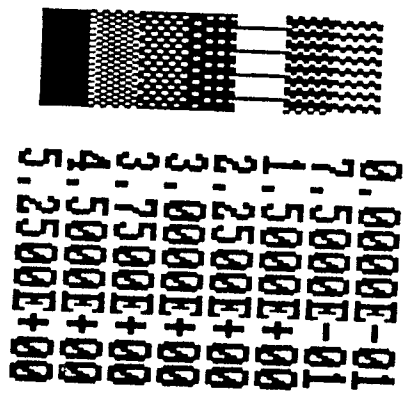
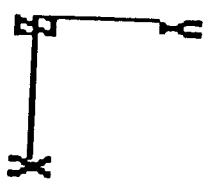
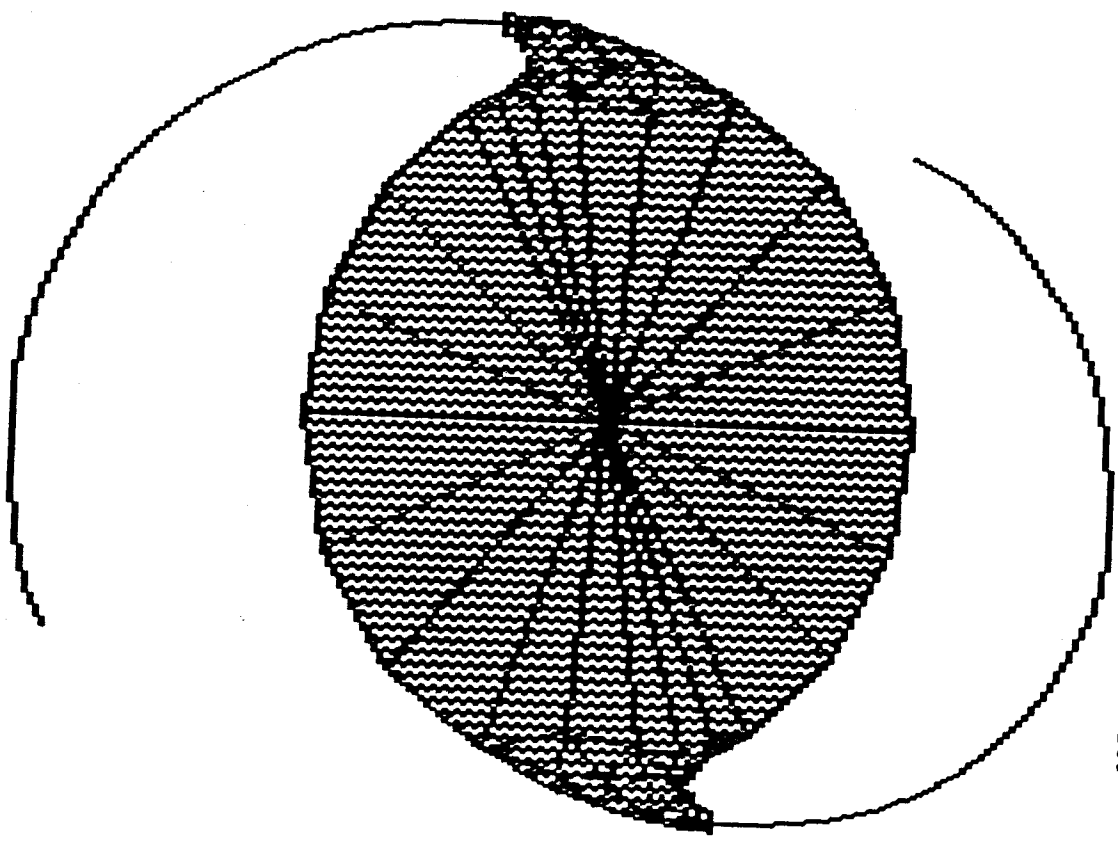


PLATE STRESS



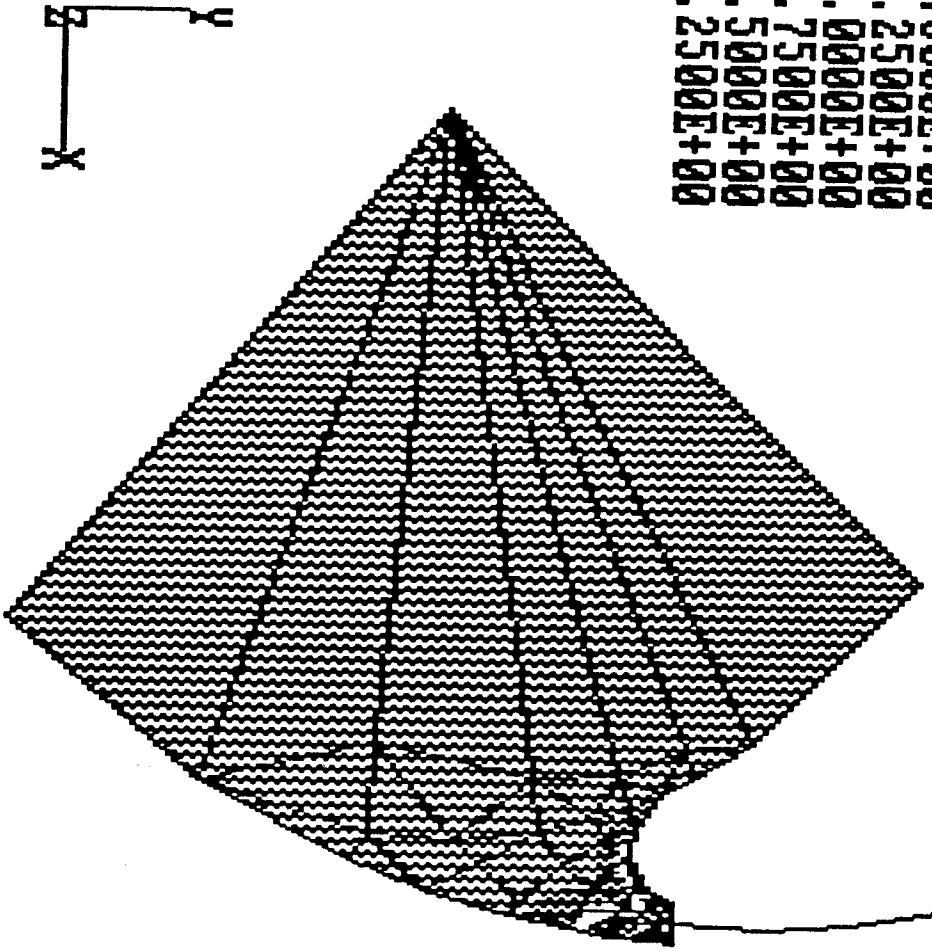
101: IMPLANTATION SIMULATION



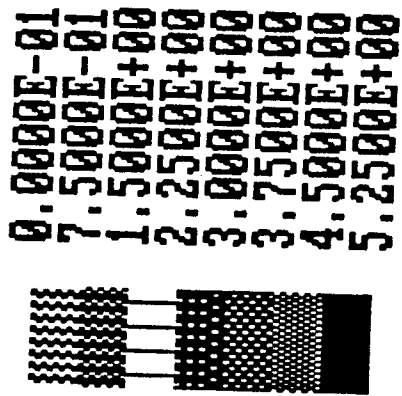
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101: IMPLANTATION SIMULATION

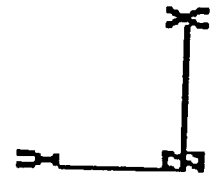
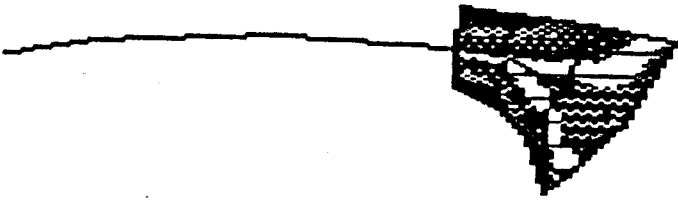
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MISES STRESS



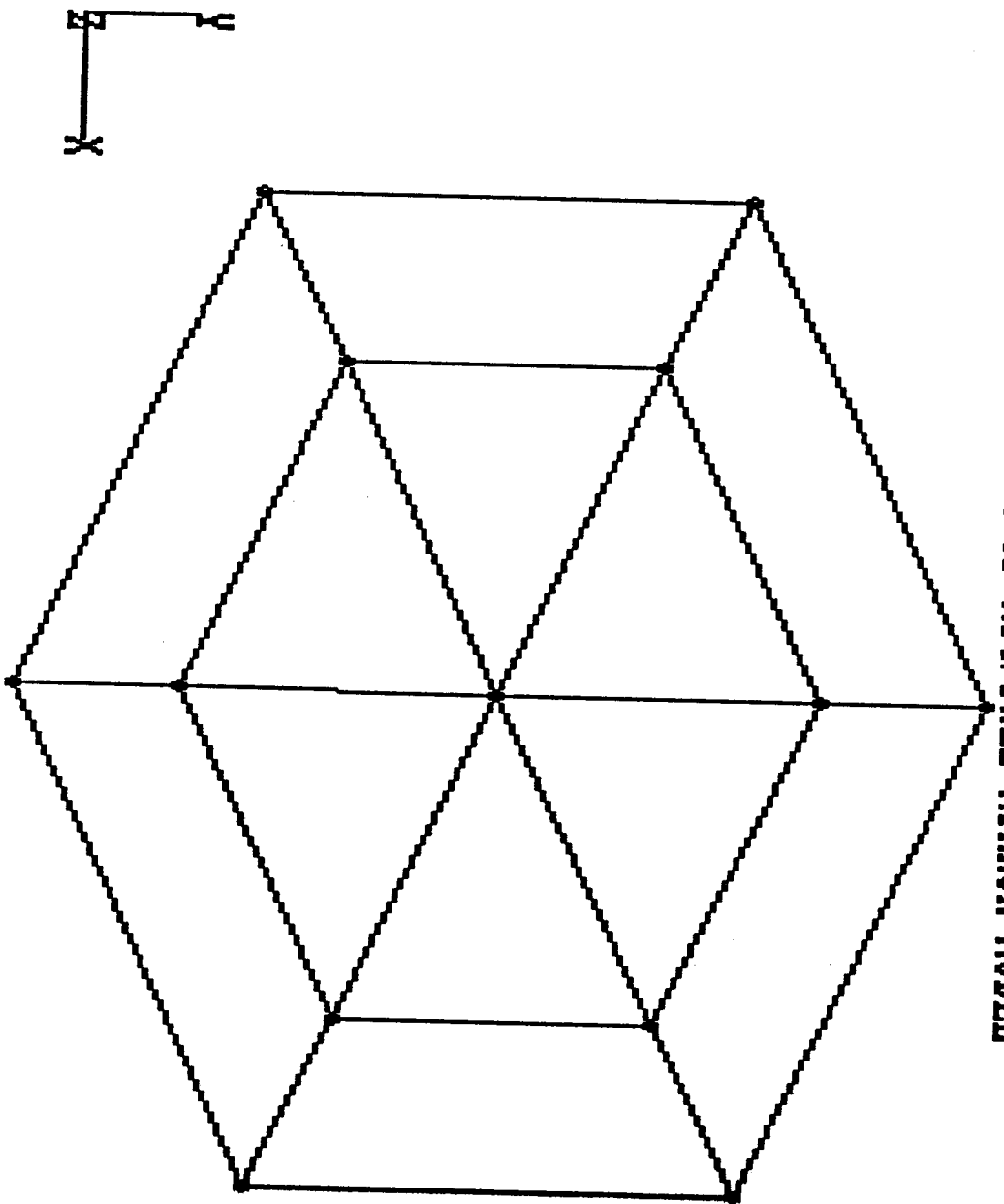
IOL: IMPLANTATION SIMULATION



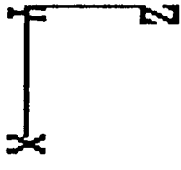
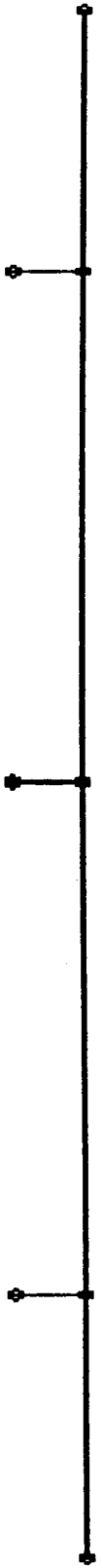
## **MSC/pal 2 APPLICATIONS - OPTICS**

- **Mirrors are used for communications and defense purposes. Deformations normal to the surface of these mirrors are critical and must be minimized to maintain the desired focal requirements of the mirror.**
- **MSC/pal 2 was used to evaluate the overall relative displacements of a mirror bolted to a base and subjected to gravity loading.**
- **The results of this analysis enabled the client to predict changes in mirror attitude from horizontal to vertical in an extremely inexpensive manner.**

**TOP VIEW OF MSC/PAL2 MIRROR MODEL**



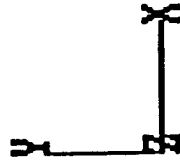
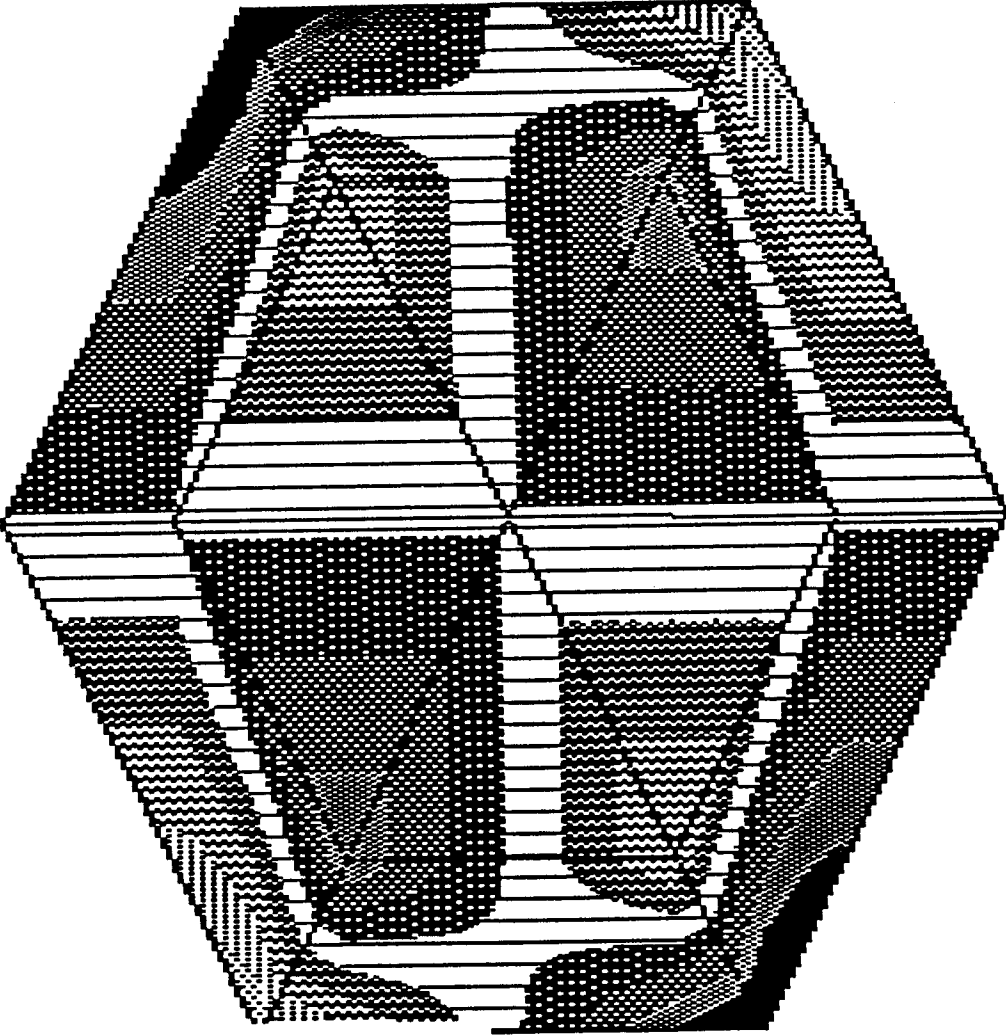
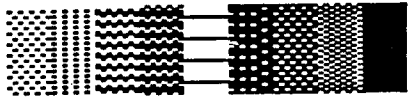
**SIDE VIEW OF MSC/PAL2 MIRROR MODEL**



MIRROR X TRANSLATIONAL DISPLACEMENTS

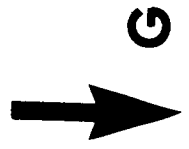
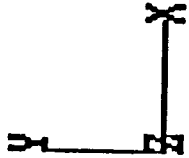
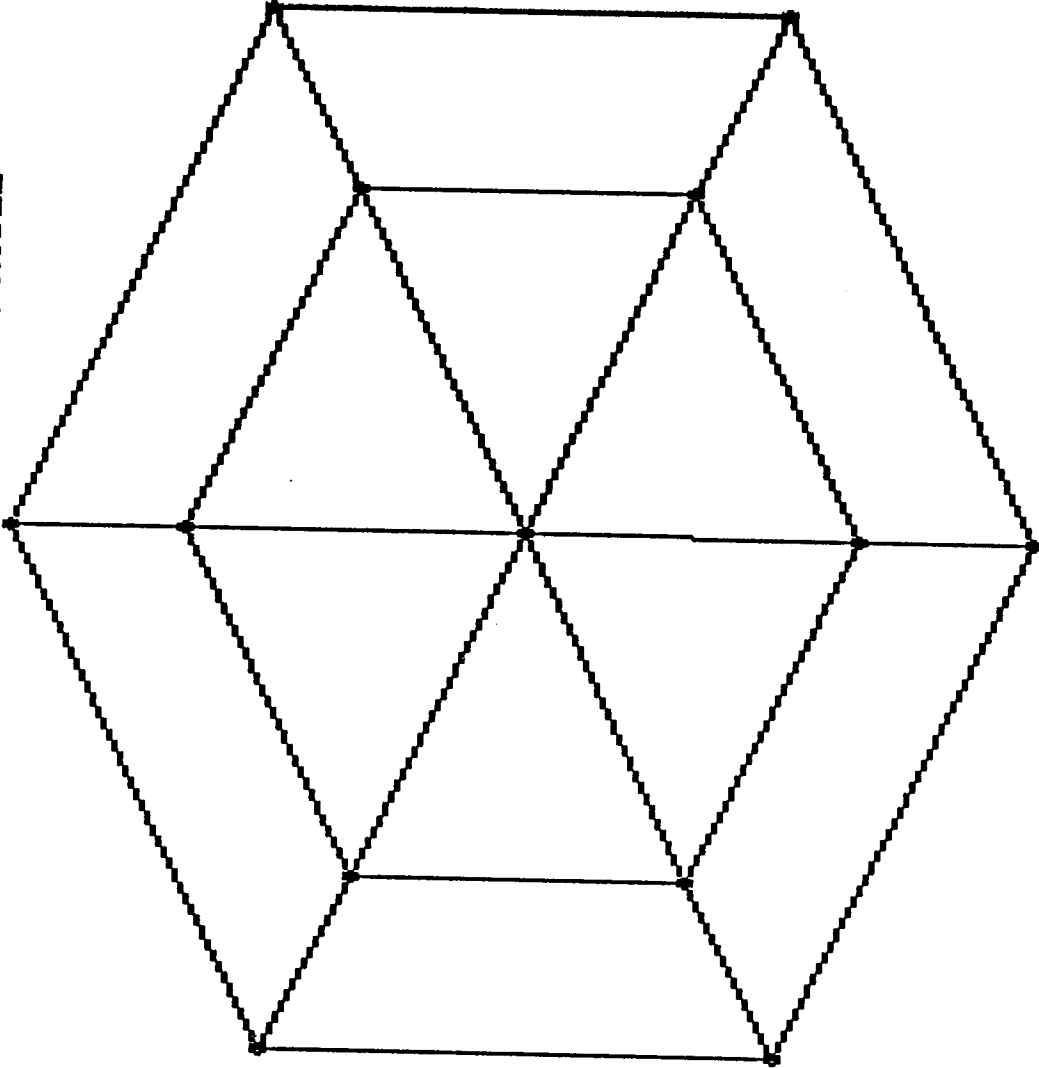
TRANS. DEFL. X

- 1.2000E-07
- 9.0000E-08
- 6.0000E-08
- 3.0000E-08
- 0.0000E-01
- 3.0000E-08
- 6.0000E-08
- 9.0000E-08
- 1.2000E-07
- 1.5000E-07



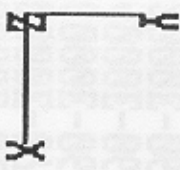
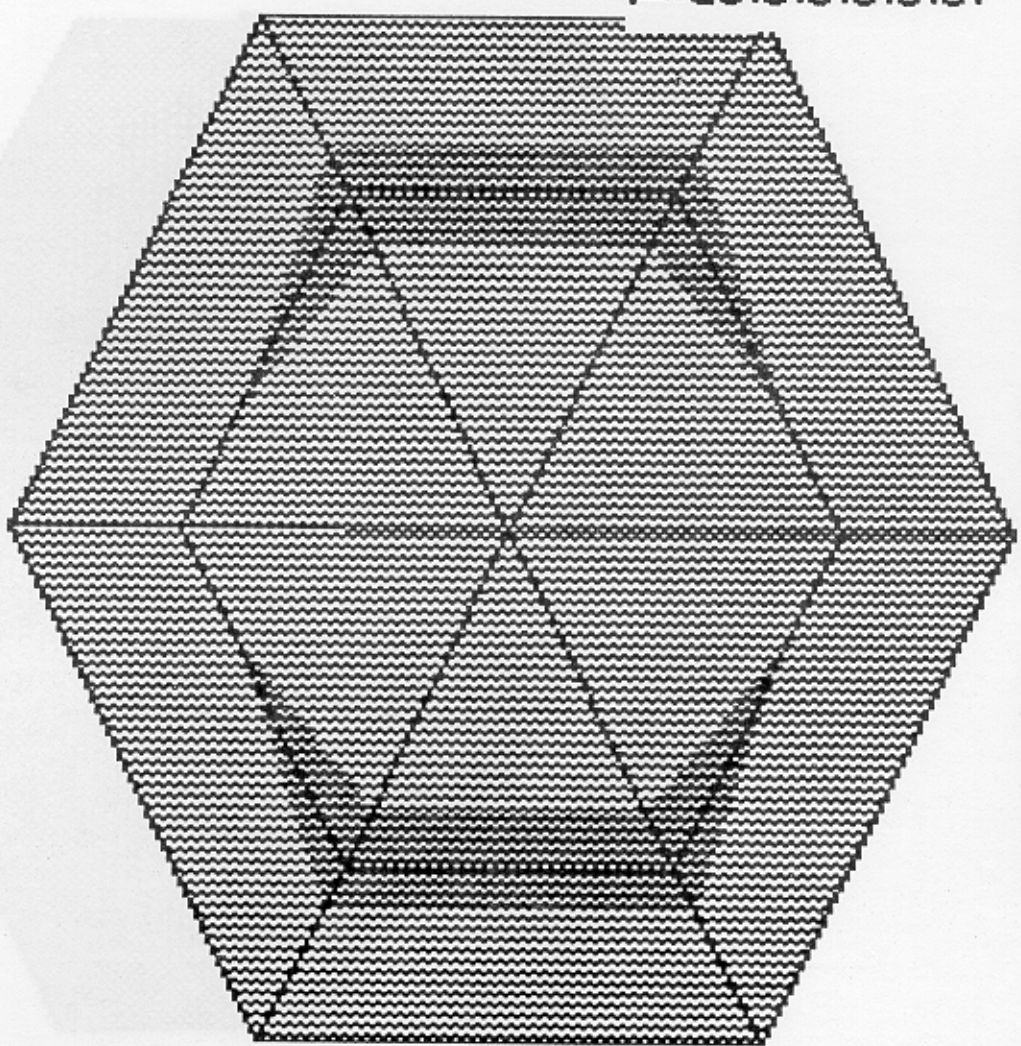
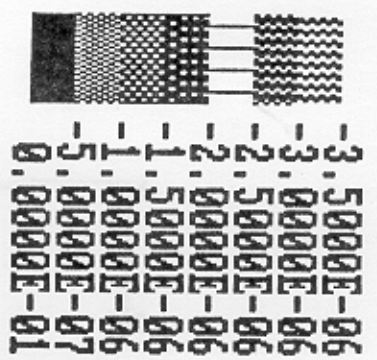


TOP VIEW OF MSC/PAL2 MIRROR MODEL



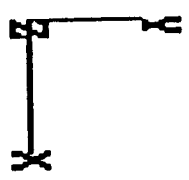
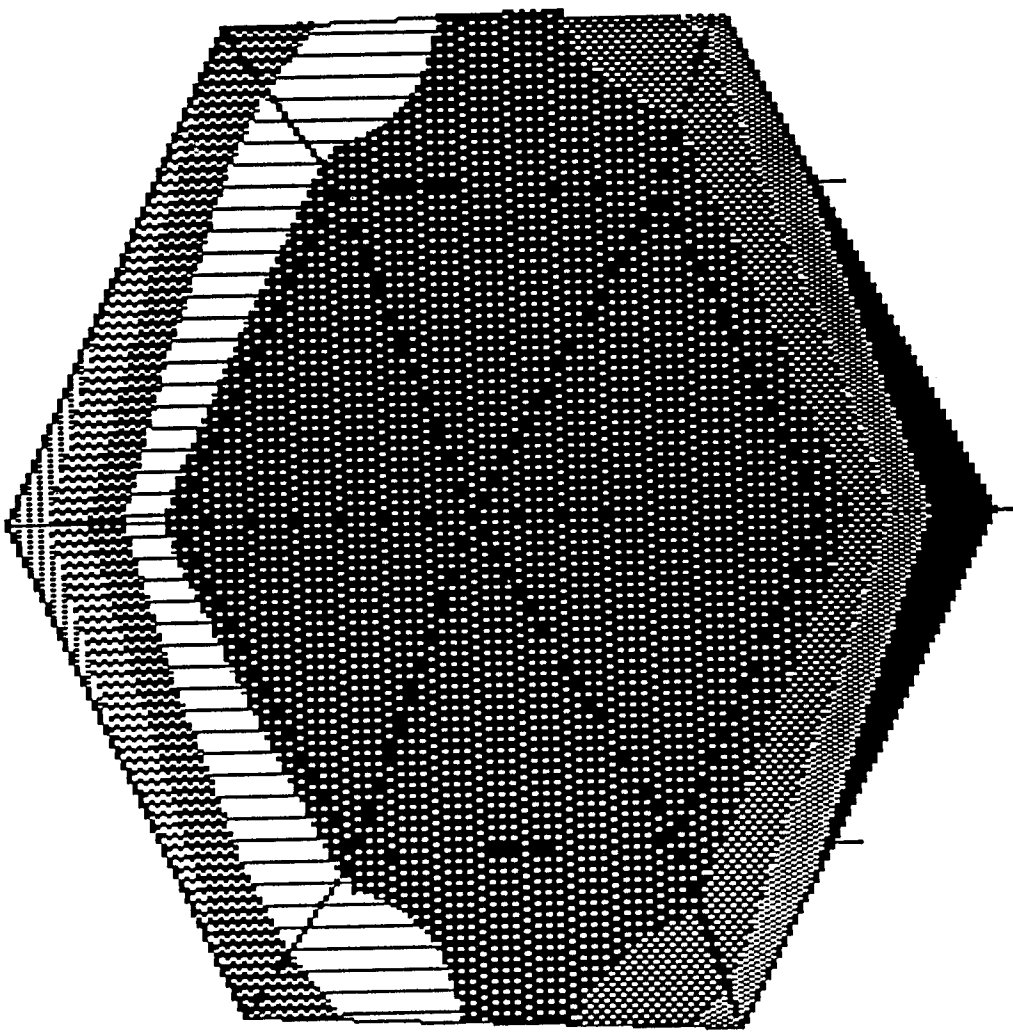
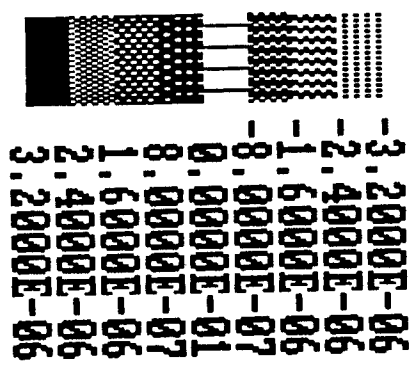
TRANS. DEFL. Y

MIRROR Y TRANSLATION DISPLACEMENTS



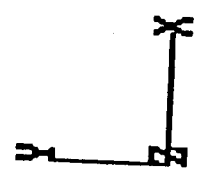
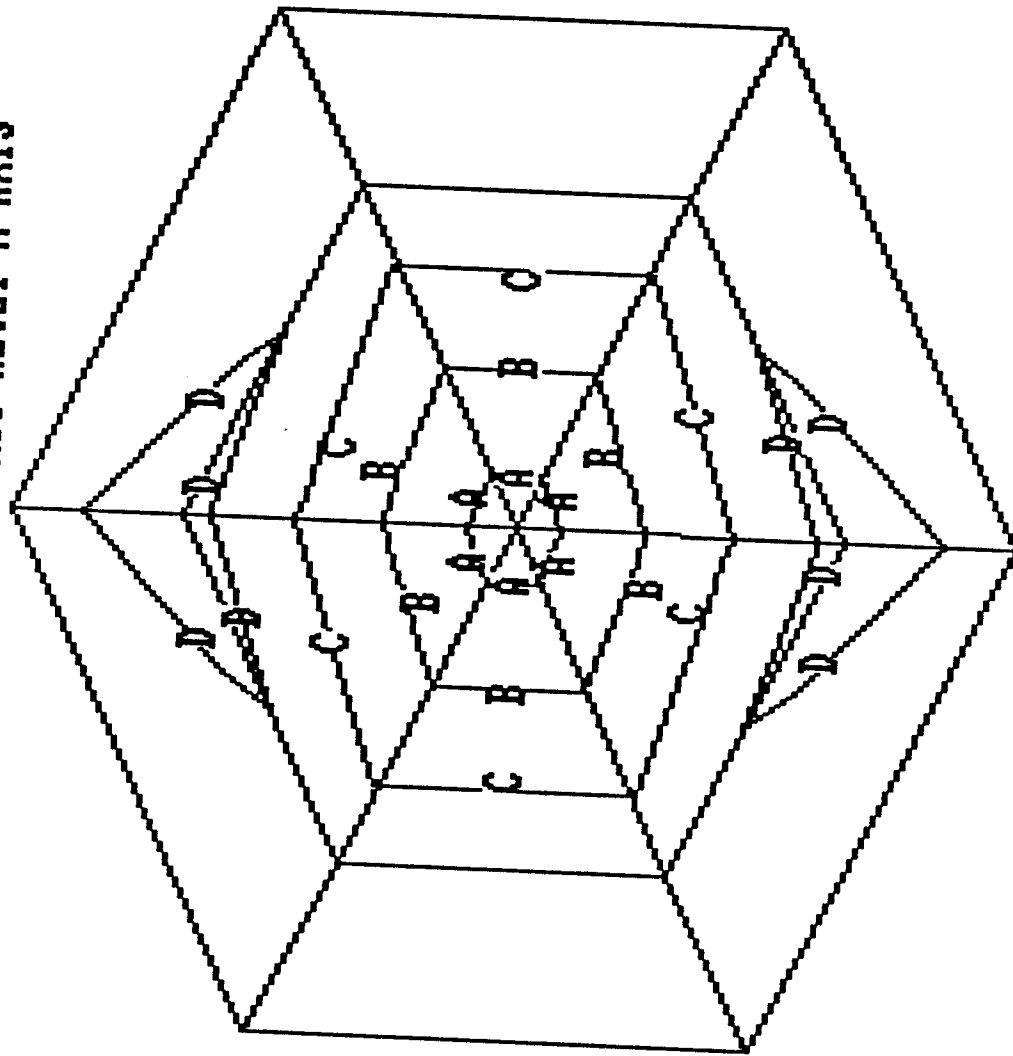
TRANS. DEFL. Z

MIRROR Z TRANSLATION DISPLACEMENTS



ROTATIONAL DISPLACEMENTS ABOUT X-AXIS

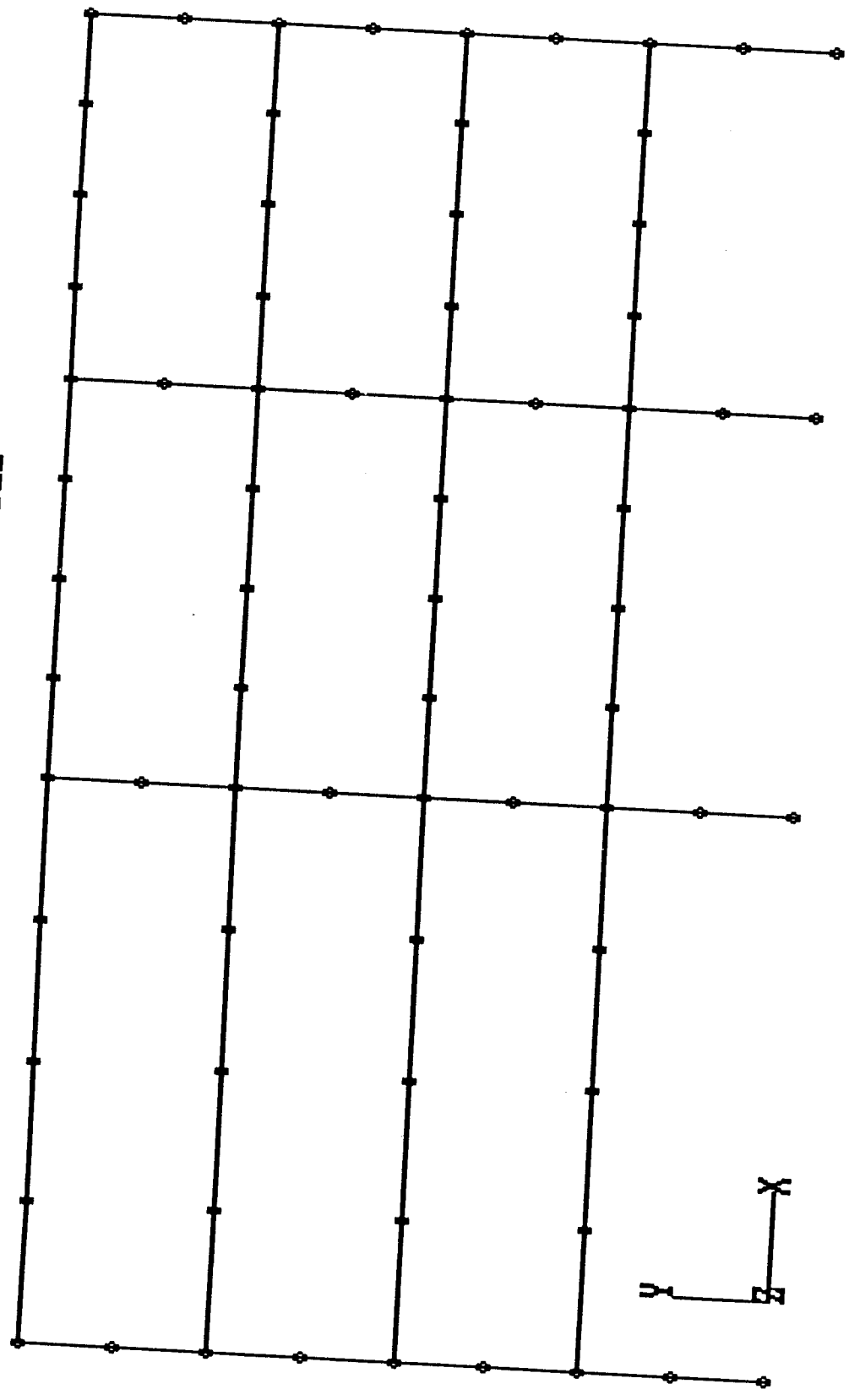
X	ROTAI.	DEFL.
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B	0.0000E-01	
C	3.0000E-07	
D	6.0000E-07	
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G	1.5000E-06	
H	1.8000E-06	
I	2.1000E-06	



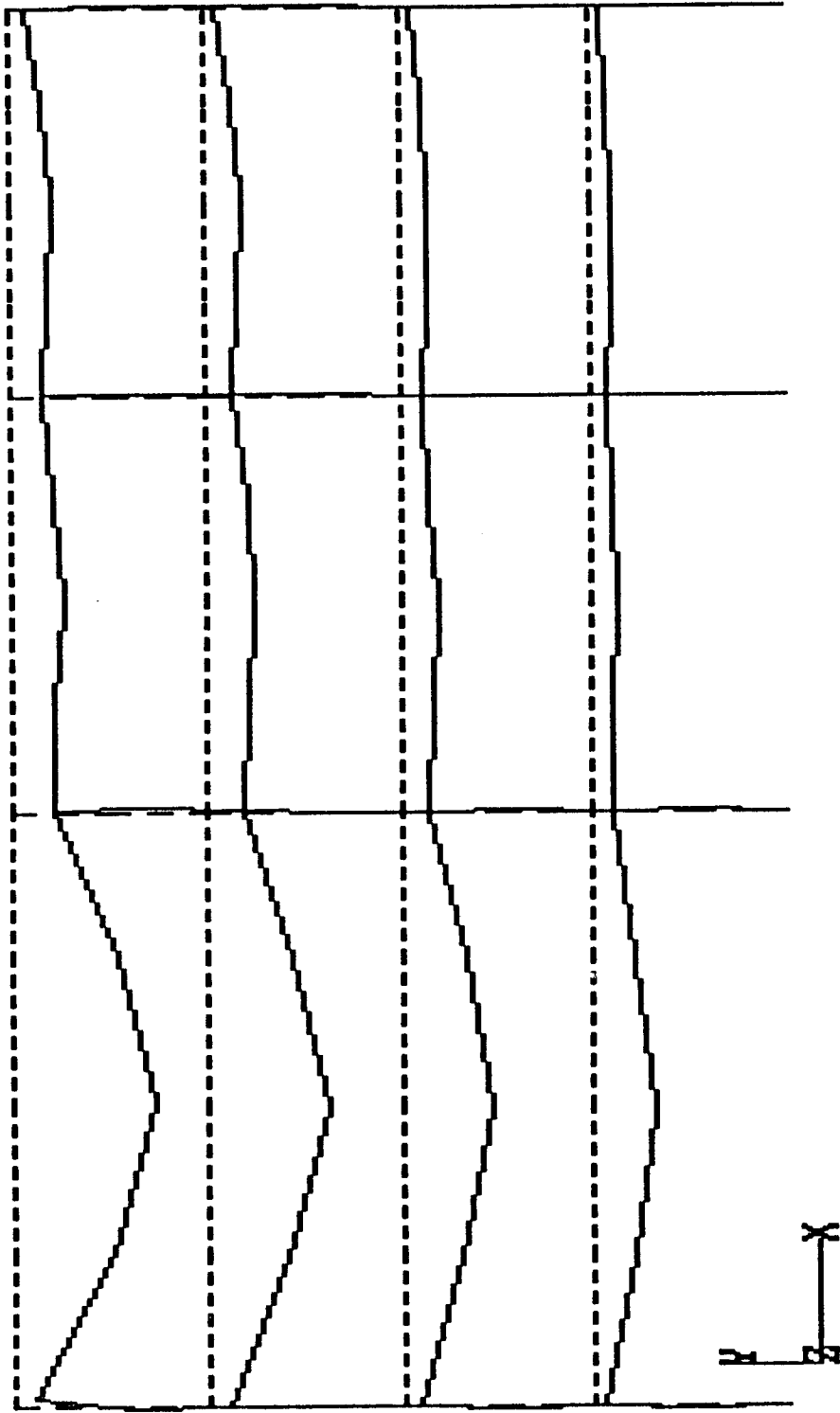
## **MSC/pal 2 APPLICATIONS - BUILDING CONSTRUCTION**

- **MSC/pal 2 was used to generate two-dimensional models of the structural frames of a commercial building.**
- **Dead loads, wind loads and statically simulated earthquake loads were applied to the models and the resultant displacements plotted.**
- **Client intended to use displacements to supplement his hand approximations and the displacement plots to enhance his presentation to the building authority when applying for permits.**
- **Unfortunately, client's funding was frozen and project was not carried through to completion.**

2-D BUILDING FRAME MODEL



DISPLACEMENTS DUE TO VARYING DEAD LOADS

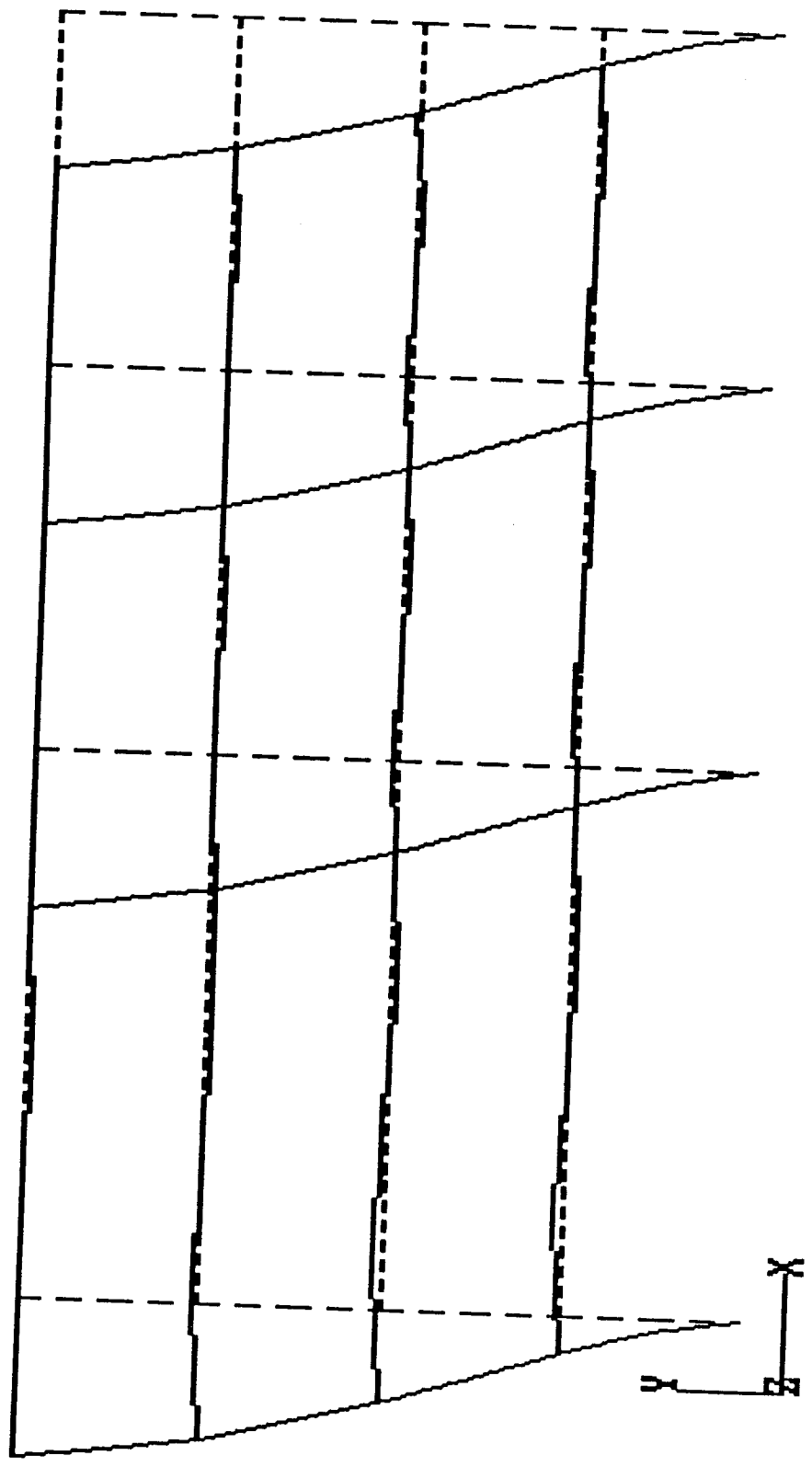


## **MSC/pal 2 APPLICATIONS - AUTOMOTIVE**

- **Client designed vehicle suspension springs and wanted to predict response of system for various springs and C.G. locations.**
- **Client had MSC/pal 2 in-house but had virtually no experience in finite element analysis or use of MSC/pal 2.**
- **ESD developed a FEM of the suspension system, springs and dampers and conducted a modal analysis to analyze one spring/C.G. configuration. Also performed a frequency response analysis to simulate the rear wheel hitting a bump.**
- **ESD forwarded model and results to client then talked them through the analysis explaining keystroke operations in MSC/pal 2 and aiding in interpretation of results.**



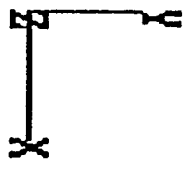
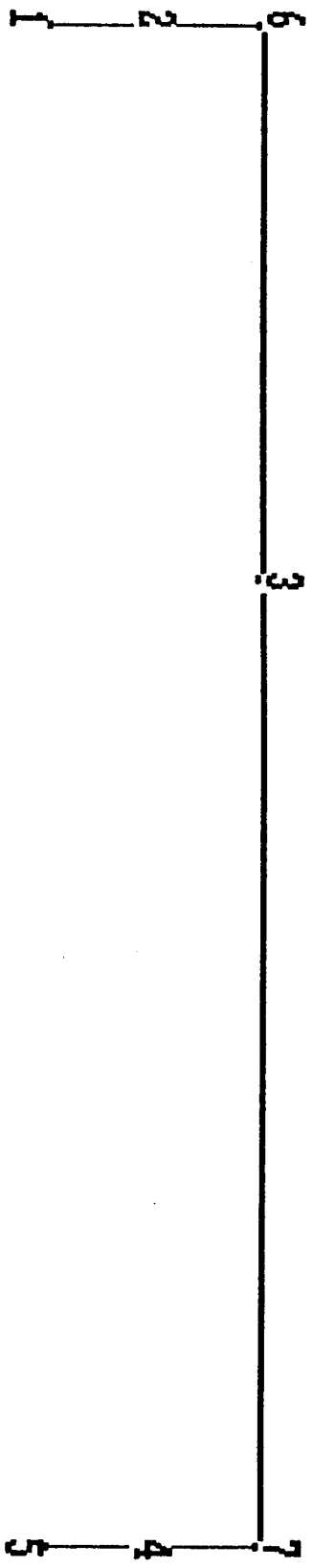
**DISPLACEMENTS DUE TO WIND/EARTHQUAKE**



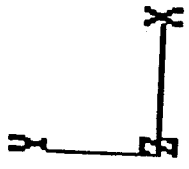
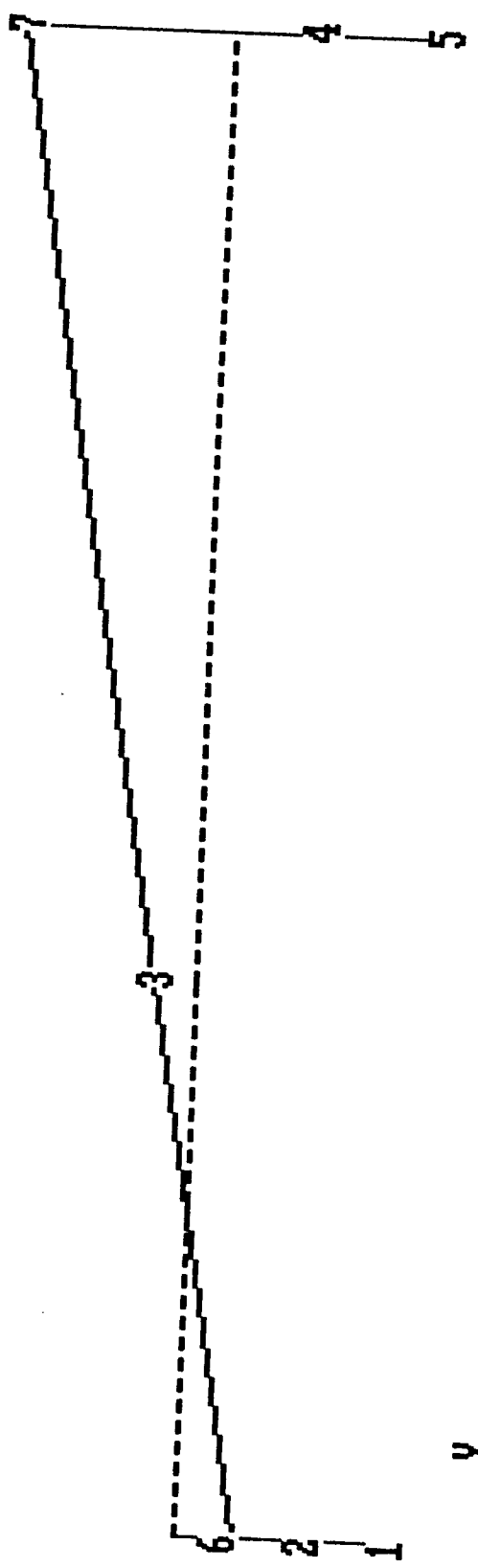
## **MISC/pa12 APPLICATIONS - AUTOMOTIVE (Cont.)**

- **ESD's Detroit office also offered advice to this client on various considerations involved in modeling their structures.**
- **Client used results to eliminate guess work and minimize testing required to determine system response, thereby making the testing more efficient and meaningful.**

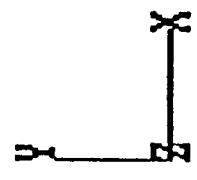
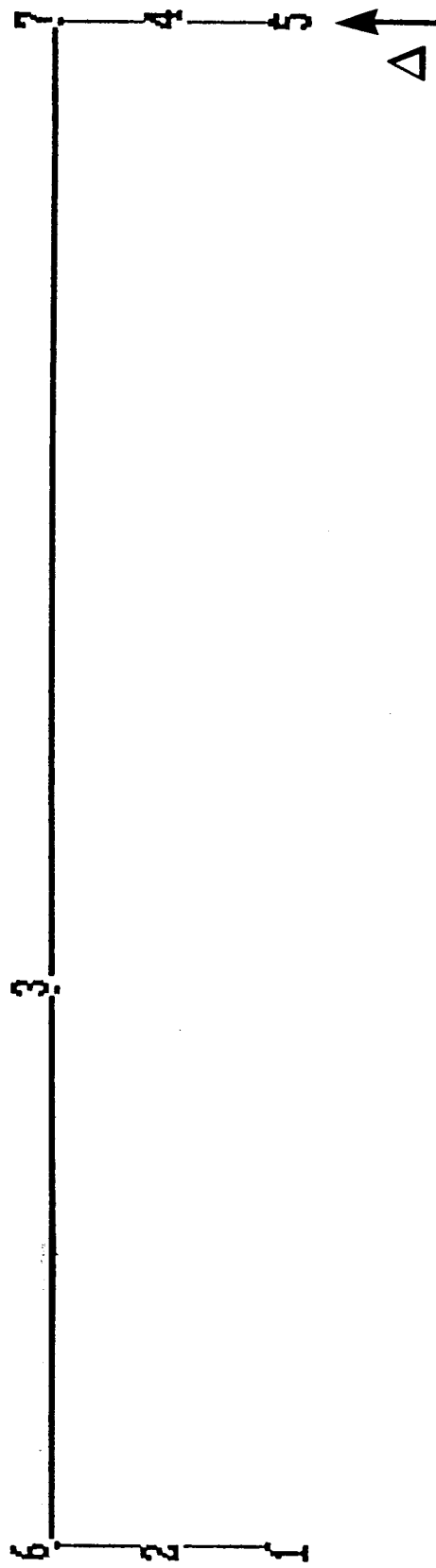
MSC/PAL2 MODEL: VEHICLE SUSPENSION SYSTEM

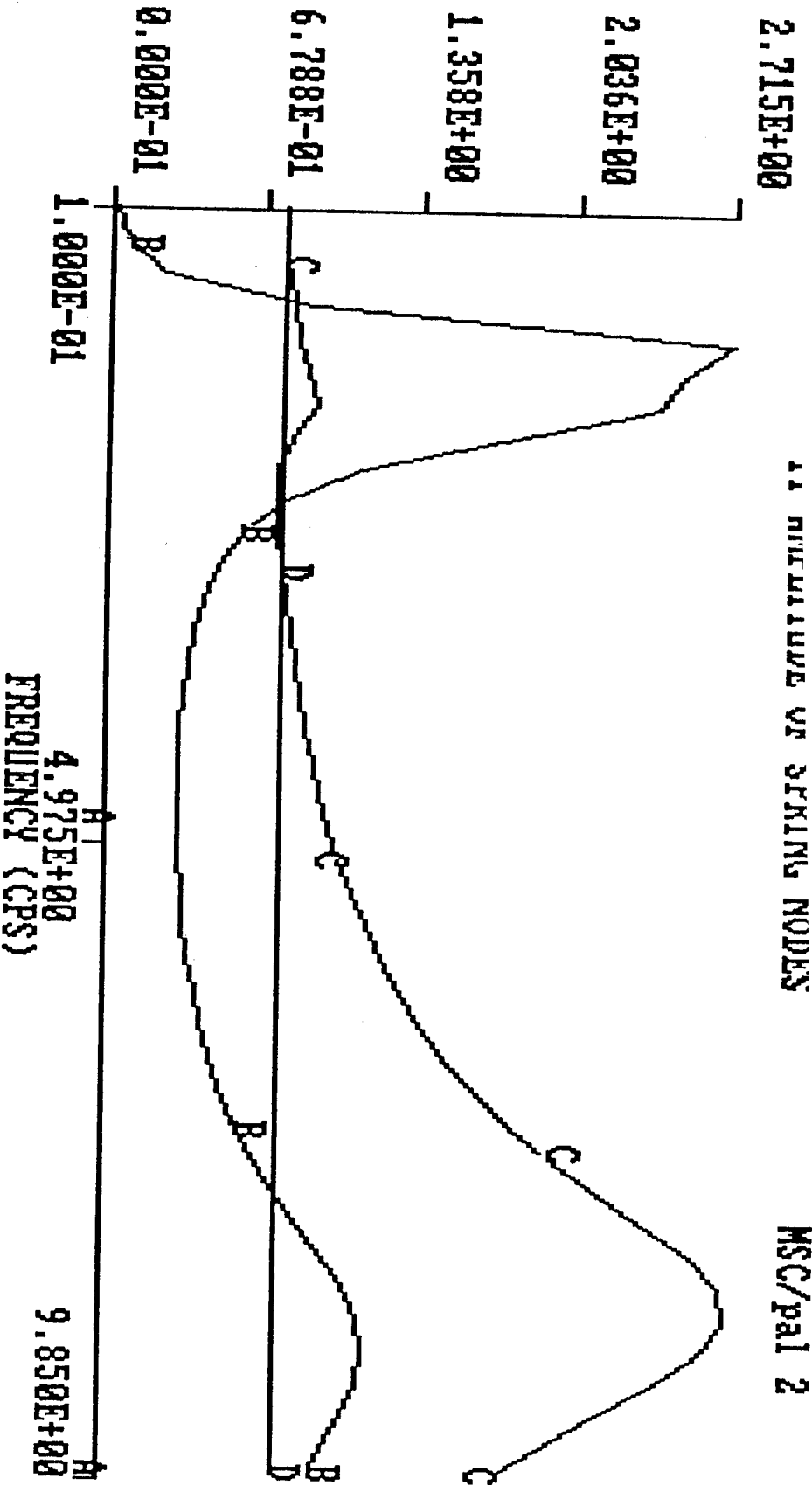


SYSTEM WITH TWO DEGREES OF FREEDOM: SECOND MODE



MSC/PAL2 MODEL: VEHICLE SUSPENSION SYSTEM

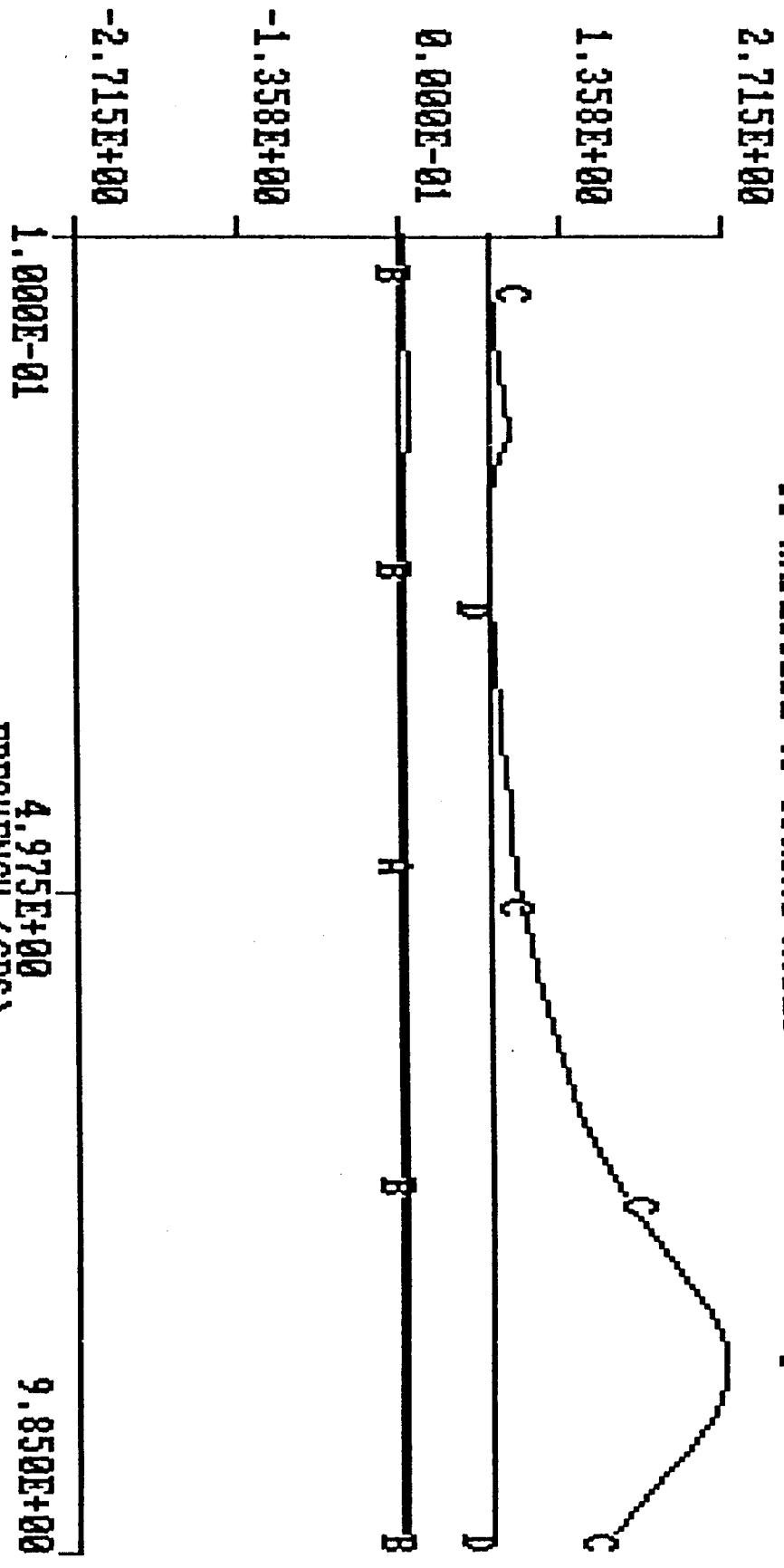




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TY AMPLITUDE OF SPRING NODES

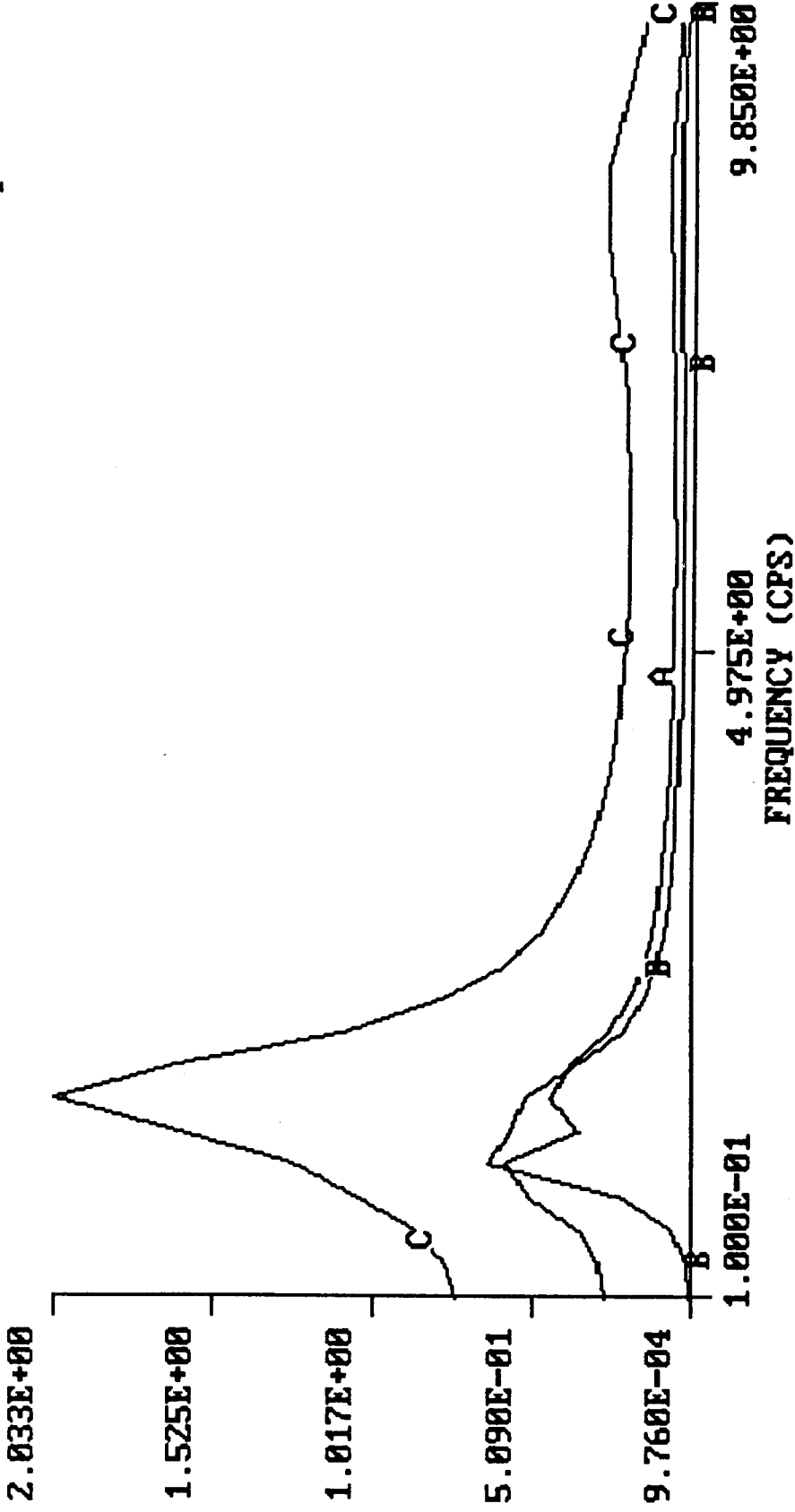
MSC/pal 2



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MSC/pal 2

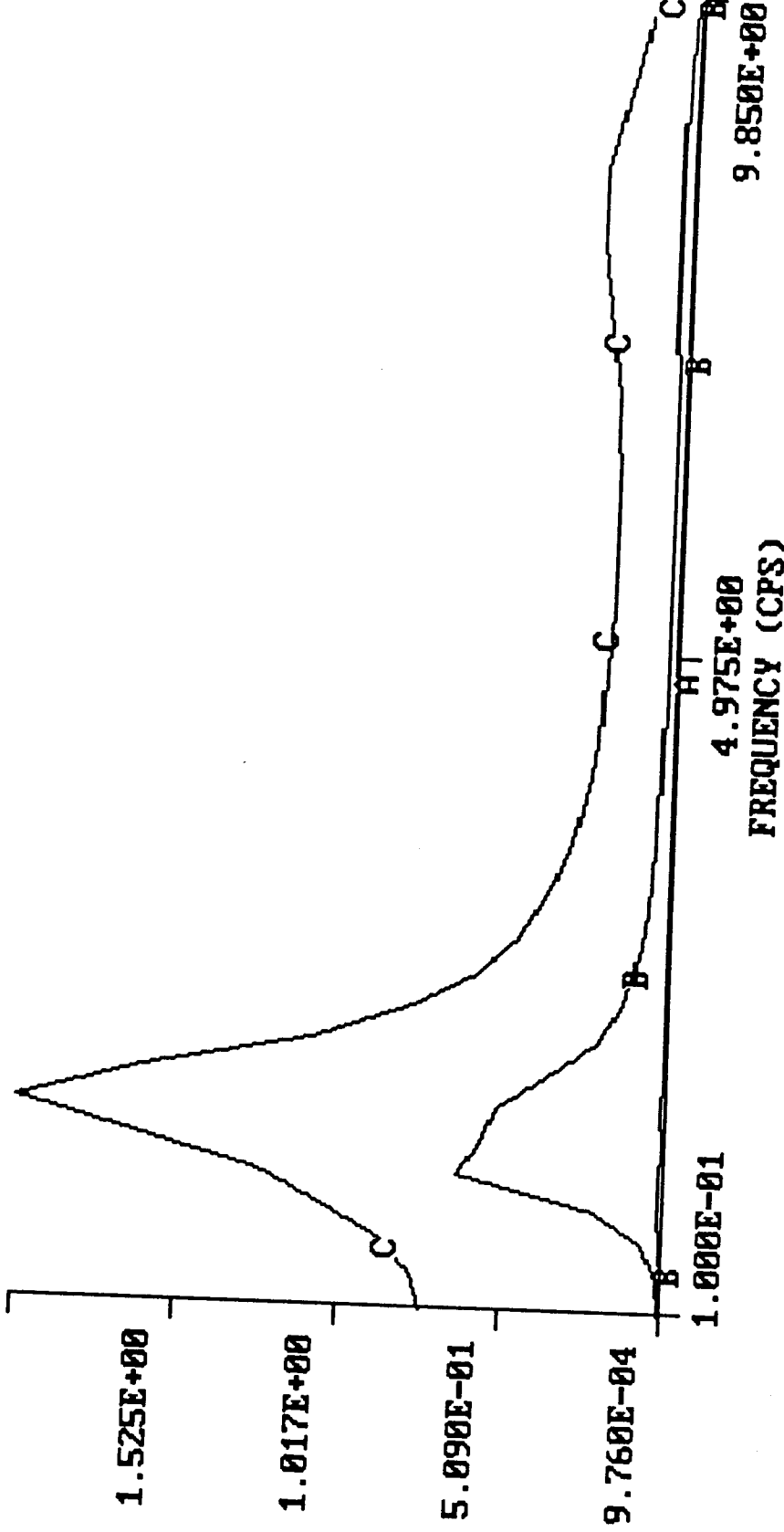


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TY AMPLITUDE OF FRAME NODES

MSC/pal 2



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2.352E-02

----- MATERIALS VE TIME INVLDS

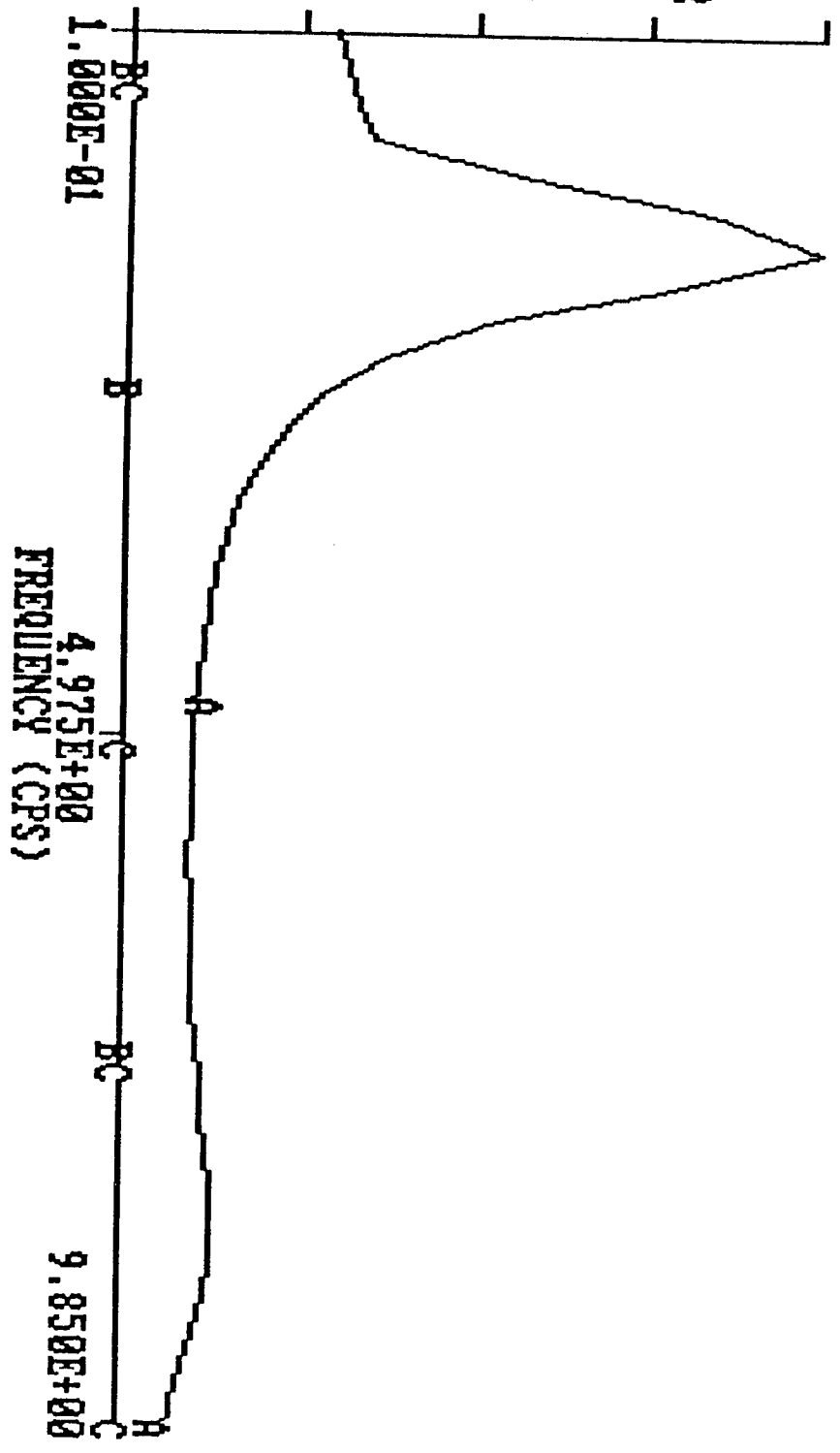
MSC/pal 2

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