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Finite Element Model of SCOLE Laboratory Configuration

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**FINITE ELEMENT MODEL OF SCOPE
LABORATORY CONFIGURATION**

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MODEL DESCRIPTION

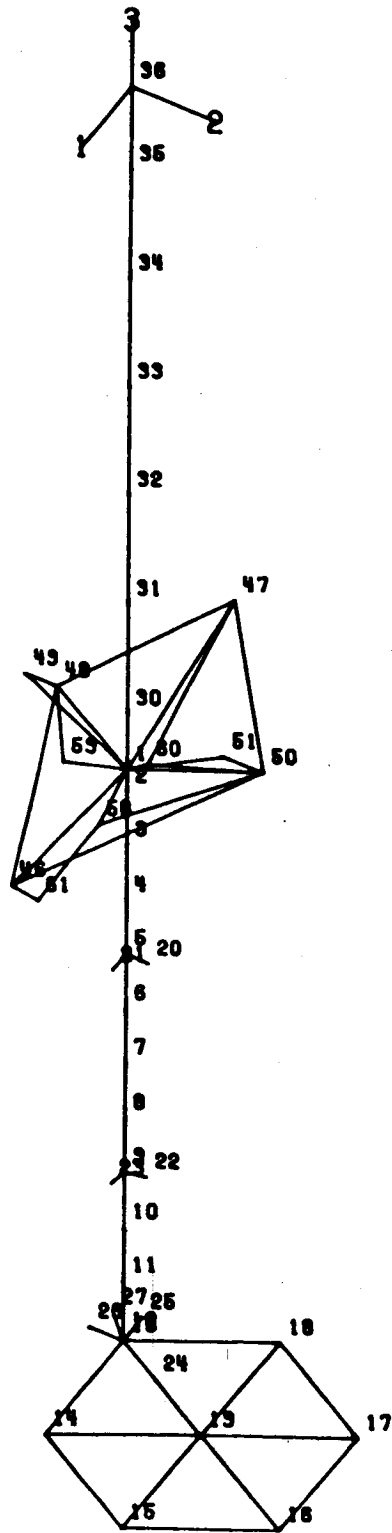
DEFINE ELEMENT PROPERTIES :

- MATERIAL CONSTANTS
MODULUS OF ELASTICITY,
POISSON'S RATIO,
DENSITY
- MAST, REFLECTOR, RIGID LINKS AS BEAM
ELEMENTS
- CABLE AS BAR ELEMENT (AXIAL STIFFNESS
ONLY)
- SHUTTLE AS VERY STIFF BEAM (ASSUME
RIGID)

JOINT LOCATIONS AND CONNECTIONS :

- 44 JOINTS TOTAL, 7 FOR CABLE, 12 FOR
MAST, 6 FOR REFLECTOR AND REST FOR
RIGID MASSES

JOINT LOCATIONS



SCALE

152

0 SCALE 3

MODEL DESCRIPTION (Continued)

TWO BOUNDARY CONDITIONS MODELLED:

**CASE 1—SUSPENDED (6 DOF FOR ALL JOINTS
EXCEPT TOP OF CABLE)**

**CASE 2— CANTILEVERED CABLE, SHUTTLE
PLATFORM FIXED IN ALL DOF**

INCLUDE RIGID MASSES AND CONNECTIONS :

- ACTUATORS**
- SENSORS**
- SHUTTLE PLATFORM AND COMPONENTS**

CALCULATIONS :

- STIFFNESS AND MASS MATRICES**
- INITIAL STRESSES (DUE TO GRAVITY
LOADING)**
- STATIC DISPLACEMENTS AND REACTIONS**
- EIGENSOLUTIONS — FREQUENCIES AND
MODE SHAPES**

FREQUENCY DATA FOR CANTILEVERED CASE (FIG 1,2)

MODE	FREQ (HZ)		DELTA-%	EAL/LAB RATIO
	EAL	LAB		
1	0.443	0.44	0.7	1.01
2	0.447	0.44	1.6	1.02
3	1.504	1.54	2.3	0.98
4	2.913	3.00	3.0	0.97
5	4.345	4.36	0.3	0.99
6	6.821	3.08	121.5	2.21

FREQUENCY DATA FOR SUSPENDED CASE (FIG 3,4)

MODE	FREQ (HZ)		DELTA-%	EAL/LAB RATIO
	EAL	LAB		
6	0.566	0.55	2.9	1.03
7	0.638	0.65	1.8	0.98
8	1.514	1.62	6.5	0.93
9	2.940	3.10	5.0	0.95

RATIO OF SUSPENDED TO CANTILEVERED FREQUENCIES (FIG 5,6)

MODE*	EAL	LAB
1	1.28	1.25
2	1.43	1.48
3	1.01	1.05
4	1.01	1.03

* NOTE: SUSPENDED MODES 6-9 CORRESPOND TO CANTILEVERED MODES 1-4

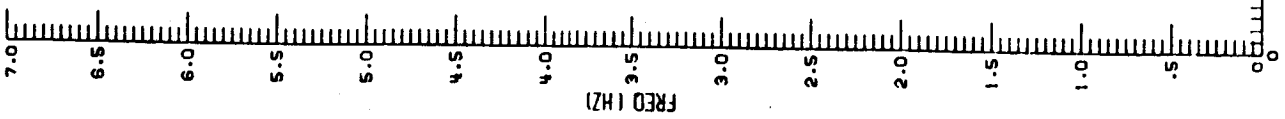


FIG. 1 EAL & LAB FREQUENCIES
CANTILEVERED CASE

○ - EAL DATA
◇ - LAB DATA

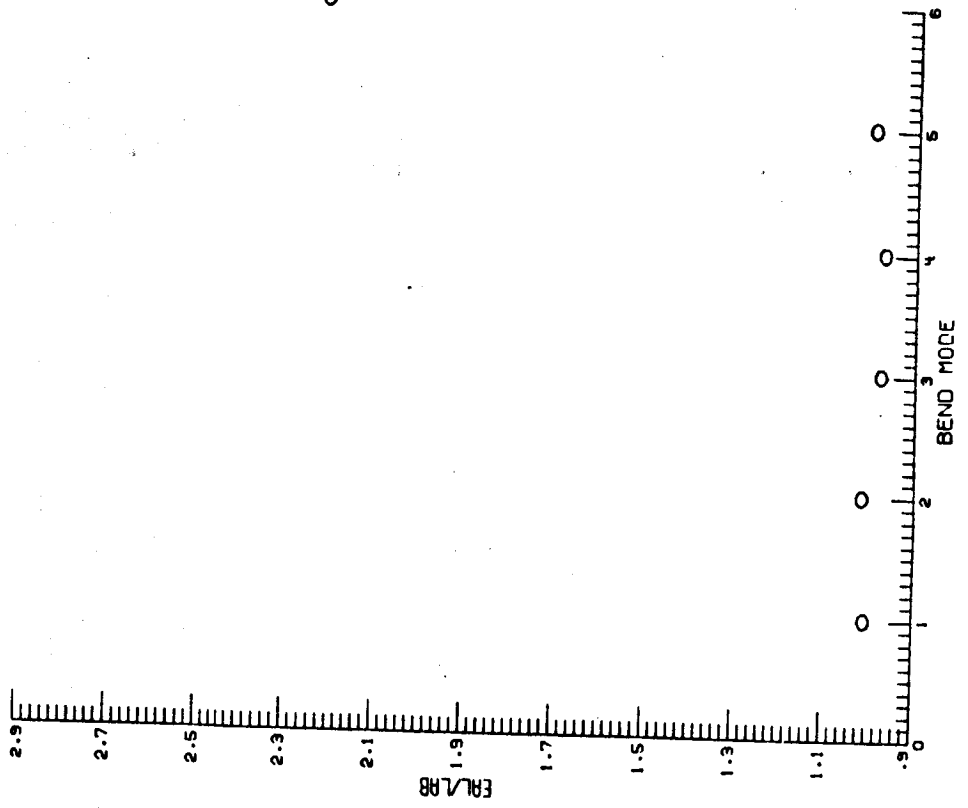


FIG. 2 RATIO OF EAL TO LAB FREQUENCIES
CANTILEVERED CASE

FIG. 4 RATIO OF EAL TO LAB FREQUENCIES
SUSPENDED CASE

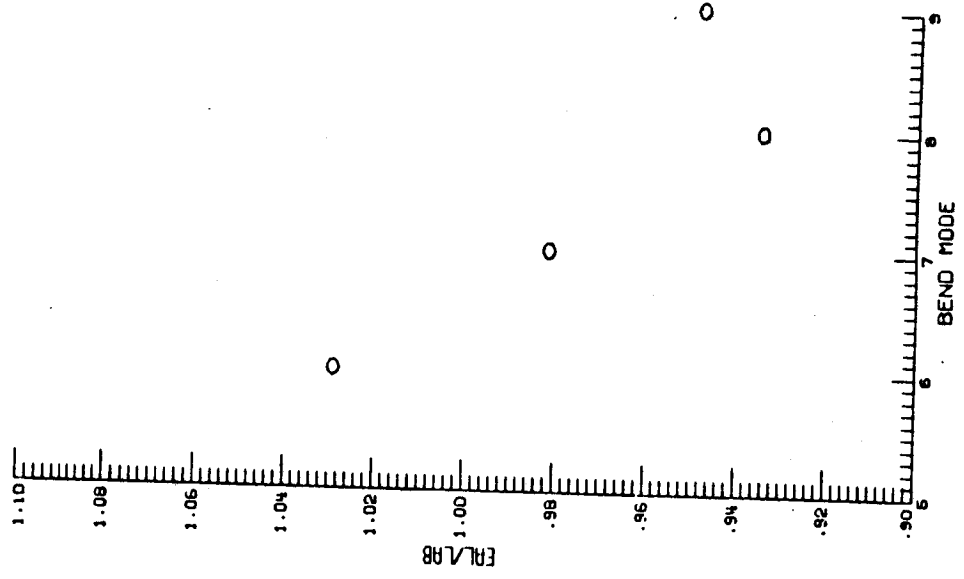
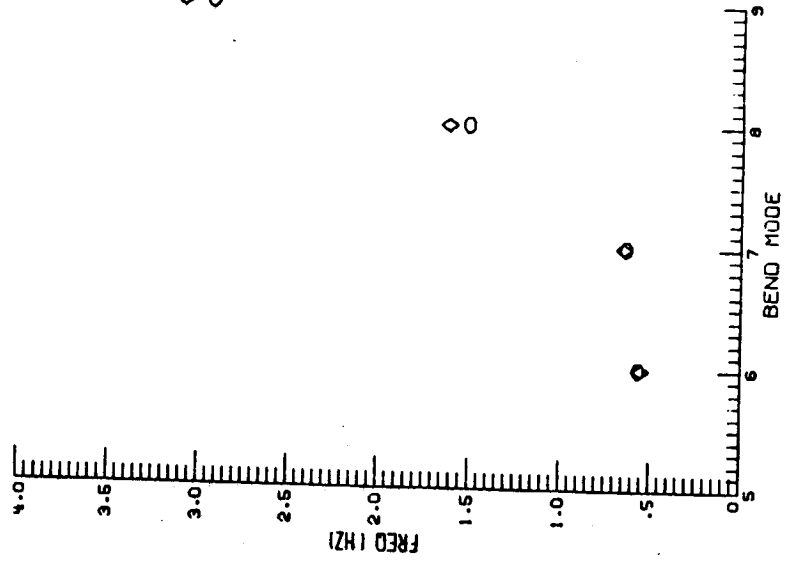


FIG. 3 EAL & LAB FREQUENCIES
SUSPENDED CASE

○ - EAL DATA
◇ - LAB DATA

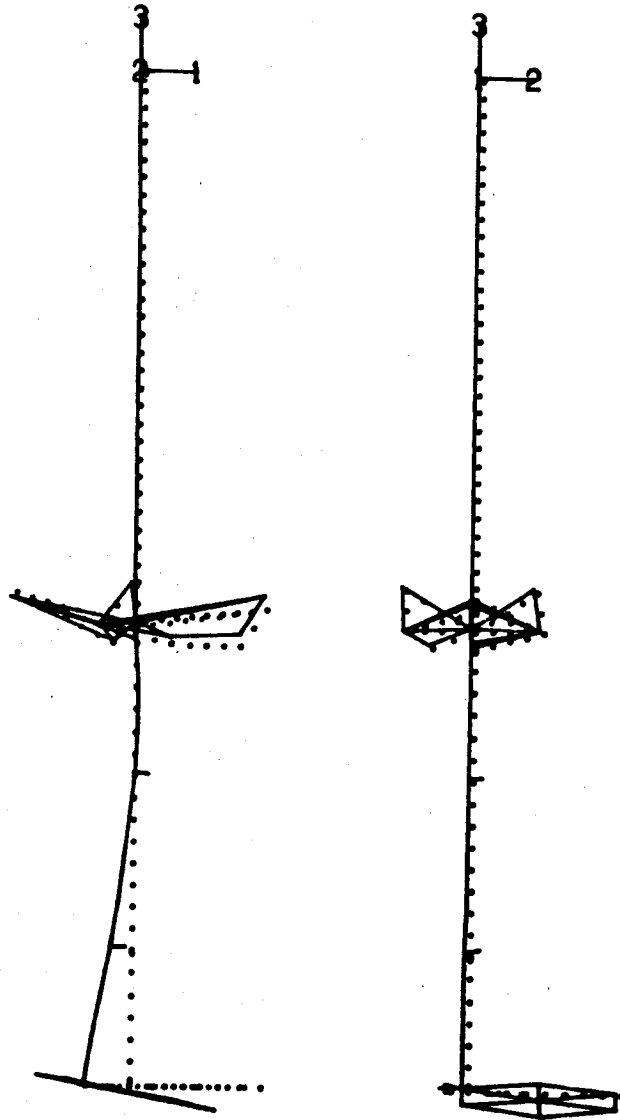
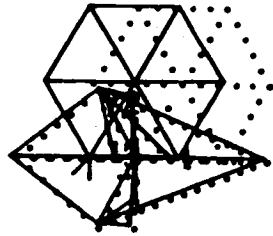


EAL PLOT 1st PITCH
SUSPENDED CASE

MODE. FREQ (HZ)

. 5657 X10 + 00

ID= 1 / 1 / 6



SCALE VIBRATIONAL MODE SHAPE 6

157

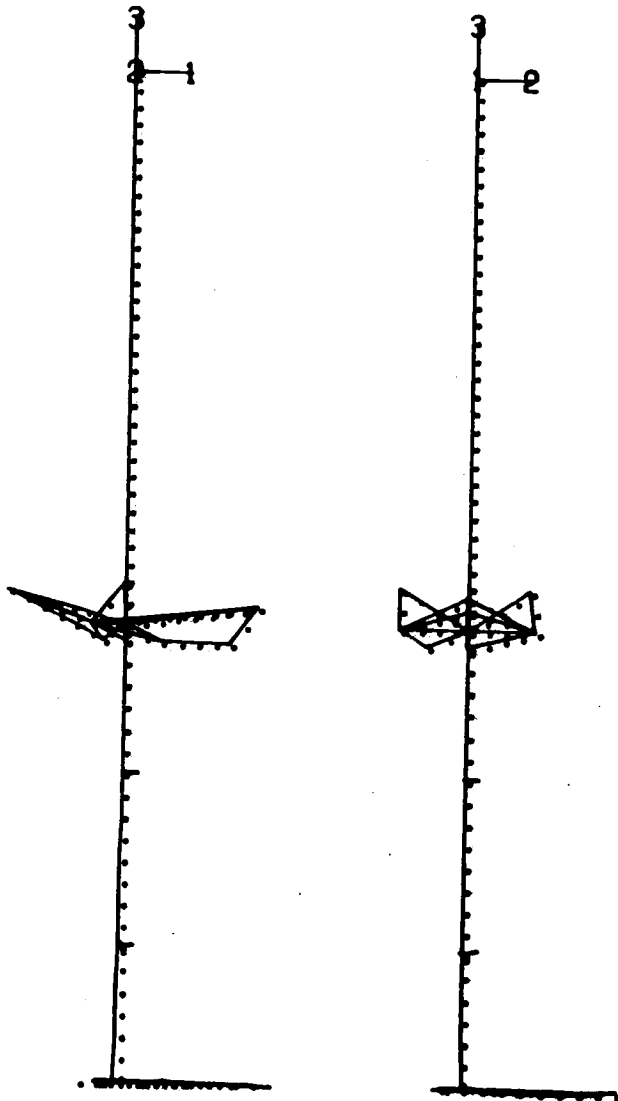
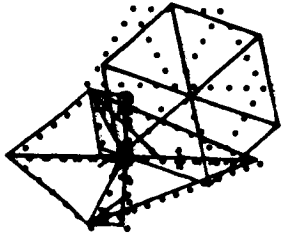
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SCALE

EAL PLOT 1st TORSIONAL
SUSPENDED CASE

MODE. FREQ (HZ)

. 1513 X10 + 01

ID= 1 / 1 / 8



SCALE VIBRATIONAL MODE SHAPE 8

158
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SCALE

FIG. 6 RATIO OF EAL FREQUENCIES
SUSPENDED/CANTILEVERED

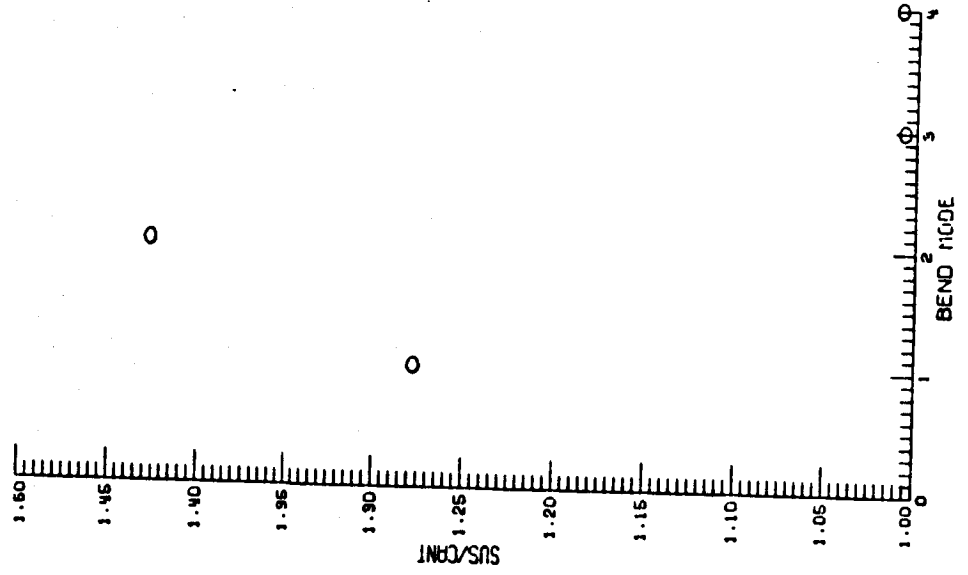
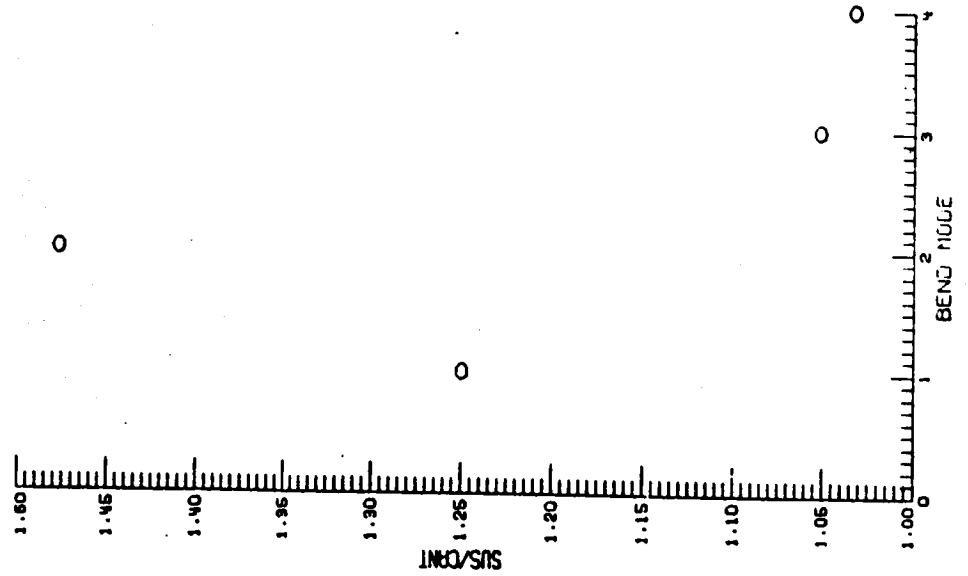


FIG. 5 RATIO OF LAB FREQUENCIES
SUSPENDED/CANTILEVERED



COMMENTS

- EAL, LAB DATA IN GOOD AGREEMENT
- HIGHER MODES TEND TO HAVE SLIGHTLY LARGER DIFFERENCES BETWEEN EAL & LAB RESULTS
- FOR HIGHER MODES, FREQUENCIES OF THE SUSPENDED AND CANTILEVERED CASES ARE SIMILIAR; THE MODE SHAPES ARE ALSO CLOSE

CONCLUSIONS

- EAL, LAB FREQUENCY DATA MATCH WELL**
- NEED TO GET MORE ACCURATE MEASUREMENTS FROM LAB, AND WITH MORE MODES FOR BETTER COMPARISON COMPUTER MODEL & LAB**
- FOR HIGHER MODES, THE CANTILEVERED CONDITION MAY BE SUBSTITUTED FOR THE SUSPENDED, THUS REDUCING THE NUMBER OF NODES AND DOF'S IN COMPUTATION**