SECURITY CLASSIFICATION OF THIS PAGE

AD-A209 827

DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1b. RESTRICTIVE MARKINGS

DTIC FILE COPY

3. DISTRIBUTION / AVAILABILITY OF REPORT
Approved for public release; distribution unlimited.

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE

4. PERFORMING ORGANIZATION REPORT NUMBER(S)

5. MONITORING ORGANIZATION REPORT NUMBER(S)
AFOSR-TR- 89 0956

6a. NAME OF PERFORMING ORGANIZATION
Stanford University
Division of Applied Mechanics

6b. OFFICE SYMBOL (If applicable)

7a. NAME OF MONITORING ORGANIZATION
AFOSR

6c. ADDRESS (City, State, and ZIP Code)
Stanford, CA 9 805

7b. ADDRESS (City, State, and ZIP Code)
BLDG 410
BAFB DC 20332-6448

8a. NAME OF FUNDING / SPONSORING ORGANIZATION
AFOSR

8b. OFFICE SYMBOL (If applicable)

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
AFOSR 77-3403

8c. ADDRESS (City, State, and ZIP Code)
BLDG 410
BAFB DC 20332-6448

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
61102F	2307	B1	

11. TITLE (Include Security Classification)
MECHANICAL RESPONSE OF STRUCTURAL ELEMENTS TO DYNAMIC LOADS

12. PERSONAL AUTHOR(S)
GEORGE HERRMANN

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 9/1/77 TO 12/31/78	Jan 79	3

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL

22b. TELEPHONE (Include Area Code)
767-4987

22c. OFFICE SYMBOL
NA

DD Form 1473, JUN 86 Previous editions are obsolete. SECURITY CLASSIFICATION OF THIS PAGE

FINAL SCIENTIFIC REPORT

covering the period

September 1, 1977 to December 31, 1978

of work performed under

Grant No. AFOSR 77-3403

MECHANICAL RESPONSE OF STRUCTURAL ELEMENTS TO DYNAMIC LOADS

at

Stanford University

Research sponsored by

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

submitted by

Professor George Herrmann

Division of Applied Mechanics

Department of Mechanical Engineering

Stanford University

Stanford, California 94305

January 1979

1. INTRODUCTION

This final report covers the period from September 1, 1977 through December 31, 1978, and contains a summary of the work performed under AFOSR Grant 77-3403 entitled "Mechanical Response of Structural Elements to Dynamic Loads." Section 2 summarizes the technical results achieved under the grant, Section 3 lists the research personnel and a listing of publications is given in Section 4.

2. TECHNICAL RESULTS

The general objectives of the activities under ~~the~~ This grant consisted of acquiring more detailed and complete knowledge of dynamic response of laminated composites. Specifically, wave propagation in a periodically layered elastic body in plane strain was studied and a considerable amount of numerical results were worked out. Both real and complex branches of the dispersion spectrum were considered. The spectrum was shown to be multivalued and quite intricate in detail. Some analytical properties of the Floquet surface were also established.

An analytical study of a plane wave in plane strain is exceedingly involved due to the coupling between longitudinal and shear waves. The dispersion equation is given by an 8 x 8 functional determinant which in general requires a numerical evaluation. It was shown in a separate study that the dispersion equation for plane strain can be expanded in closed form. Instead of treating this expanded form numerically, one can introduce the simplifying assumption that the reinforcing layers of the composite are thin as compared to the matrix layers. It was shown that in this case the dispersion relation uncouples into two independent equations representing two separate surfaces in the frequency-wave number space. Several properties of these surfaces were established and comparisons with waves in antiplane strain studied earlier were drawn.

In the area of approximate theories for dynamic response of laminated composites, an approximate theory has been constructed which may be known as the Effective Dispersion Theory. It is based in part on concepts of linear elasticity with microstructure. It contains not only the dispersive properties of the periodically layered medium, but describes also the filtering property of a periodic structure. Such an approximate theory has been developed for motions normal to the layering as well as two-dimensional motions in anti-plane strain.

3. RESEARCH PERSONNEL

The following persons, in addition to the principal investigator, contributed to the project: Prof. Raj. K. Kaul, Dr. A. A. Golebiewska and Dr. Terry J. Delph.

4. REPORTS AND PUBLICATIONS

T.J. Delph, G. Herrmann and R.K. Kaul, "Harmonic Wave Propagation in a Periodically Layered, Infinite Elastic Body; Plane Strain, Numerical Results", submitted for publication.

A.A. Golebiewska, "On Dispersion of Periodically Layered Composites in Plane Strain", submitted for publication.

T.J. Delph, G. Herrmann and R.K. Kaul, "An Approximate Theory for Wave Propagation Normal to the Layers of a Laminated Composite". Report in final stages of preparation.

T.J. Delph and G. Herrmann, "An Approximate Theory for SH-Wave Propagation in a Periodically Layered Elastic Body". Report in final stages of preparation.