

# PERICLES: THEOCARIS: ON A GENERAL THEORY OF FAILURE OF ANISOTROPIC MATERIALS.

BY

JOHN G. HARRISON

PH.D., F.R.S.

PROFESSOR OF APPLIED

MATERIALS,

UNIVERSITY OF TORONTO,

AND MEMBER OF THE

ROYAL SOCIETY.

WITH A PRACTICAL

APPENDIX,

AND INDEX.

LONDON:

PRINTED FOR THE AUTHOR

AT THE UNIVERSITY PRESS.

1900.













T

I



5

4

3

2

1



**J<sub>2</sub>**

**W**

**f**

**W**

**I**

**F**

**m**

**th**

**C**

**st**

**th**

**S<sub>i</sub>**

**W**



Y  
u  
i  
c  
o  
d  
r  
e  
t  
f  
v  
t  
l  
c  
y  
s  
y  
p  
c  
i  
r  
y  
c  
n  
a  
d  
b  
d  
C



1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

73

74

75

76

77

78

79

80

81

82

83

84

85

86

87

88

89

90

91

92

93

94

95

96

97

98

99

100



and

in

cy

du

el

st

be

tc

th

th

el

st

be

tc



the first

and second

and third

and fourth

and fifth

and sixth

and seventh

and eighth

and ninth

and tenth

and eleventh

and twelfth

and thirteenth

and fourteenth

and fifteenth

and sixteenth

and seventeenth

and eighteenth

and nineteenth

and twentieth

and twenty-first

and twenty-second

and twenty-third

and twenty-fourth

and twenty-fifth

and twenty-sixth

and twenty-seventh

and twenty-eighth

and twenty-ninth

and thirty-first

and thirty-second

and thirty-third

and thirty-fourth

and thirty-fifth

and thirty-sixth

and thirty-seventh

and thirty-eighth

and thirty-ninth

and forty-first

and forty-second

and forty-third

and forty-fourth

and forty-fifth

and forty-sixth

and forty-seventh

and forty-eighth

and forty-ninth

and fifty-first

and fifty-second

and fifty-third

and fifty-fourth

and fifty-fifth

and fifty-sixth

and fifty-seventh

and fifty-eighth

and fifty-ninth

and sixty-first

and sixty-second

and sixty-third

and sixty-fourth

and sixty-fifth

and sixty-sixth

and sixty-seventh

and sixty-eighth

and sixty-ninth

and seventy-first

and seventy-second

and seventy-third

and seventy-fourth

and seventy-fifth

and seventy-sixth

and seventy-seventh

and seventy-eighth

and seventy-ninth

and eighty-first

and eighty-second

and eighty-third

and eighty-fourth

and eighty-fifth

and eighty-sixth

and eighty-seventh

and eighty-eighth

and eighty-ninth

and ninety-first

and ninety-second

and ninety-third

and ninety-fourth

and ninety-fifth

and ninety-sixth

and ninety-seventh

and ninety-eighth

and ninety-ninth

and one hundred and first

and one hundred and second

and one hundred and third

and one hundred and fourth

and one hundred and fifth

and one hundred and sixth

and one hundred and seventh

and one hundred and eighth

and one hundred and ninth

and one hundred and eleventh

and one hundred and twelfth

and one hundred and thirteenth

and one hundred and fourteenth

and one hundred and fifteenth

and one hundred and sixteenth

and one hundred and seventeenth

and one hundred and eighteenth

and one hundred and nineteenth

and one hundred and twenty-first

and one hundred and twenty-second

and one hundred and twenty-third

and one hundred and twenty-fourth

and one hundred and twenty-fifth

and one hundred and twenty-sixth

and one hundred and twenty-seventh

and one hundred and twenty-eighth

and one hundred and twenty-ninth

and one hundred and thirty-first

and one hundred and thirty-second

and one hundred and thirty-third

and one hundred and thirty-fourth

and one hundred and thirty-fifth

and one hundred and thirty-sixth

and one hundred and thirty-seventh

and one hundred and thirty-eighth

and one hundred and thirty-ninth

and one hundred and forty-first

and one hundred and forty-second

and one hundred and forty-third

and one hundred and forty-fourth

and one hundred and forty-fifth

and one hundred and forty-sixth

and one hundred and forty-seventh

and one hundred and forty-eighth

and one hundred and forty-ninth

and one hundred and fifty-first

and one hundred and fifty-second

and one hundred and fifty-third

and one hundred and fifty-fourth

and one hundred and fifty-fifth

and one hundred and fifty-sixth

and one hundred and fifty-seventh

and one hundred and fifty-eighth

and one hundred and fifty-ninth

and one hundred and sixty-first

and one hundred and sixty-second

and one hundred and sixty-third

and one hundred and sixty-fourth

and one hundred and sixty-fifth



of the

i) and

co-

en-

m-

ii) the

no-

di-

the

di-

to-

the



F  
de

S

H  
i

C  
a

f  
s

2  
E

S  
e

F  
d



1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

73

74

75

76

77

78

79

80

81

82

83

84

85

86

87

88

89

90

91

92

93

94

95

96

97

98

99

100



the  
sin-  
ell  
the

en-  
M

as  
ty  
(σ  
if t  
tha

10  
no  
tha

the  
m  
pl

the  
c  
A  
W  
y

the  
T



**Fi**

**be**

**Fi**

**be**



like the envelope of the spiral may be the same as the envelope of the spiral in the case of the axial flow. It is found that the degree of divergence of the spiral envelope is about 10 degrees.

Because of the divergence of the spiral envelope, the axial flow is more effective than the radial flow in the case of the axial flow.

The axial flow is more effective than the radial flow in the case of the axial flow. The axial flow is more effective than the radial flow in the case of the axial flow.

The axial flow is more effective than the radial flow in the case of the axial flow. The axial flow is more effective than the radial flow in the case of the axial flow.

The axial flow is more effective than the radial flow in the case of the axial flow. The axial flow is more effective than the radial flow in the case of the axial flow.



Fig  
pla

spec

ten  
for

of t

is in

the  
are

cre

pat

for

orie

voi

crea

unia



and  
the  
vo  
com  
shar  
elli  
cle  
dra  
voi  
cer

Me

ba

its

sco

po

ele

im

wh

loa

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle

dra

voi

cer

and

arr

arc

this

num

vot

com

shar

elli

cle



**Fig.**  
and  
**dev**







the  $\sigma_m$  value

is the same as

the  $\sigma_m$  value



Fig

po

co

me

yie

Su

po

3.

3.1

gic

inv

any

sol



in  
C  
in  
(  
e  
te  
h  
c  
sp  
re  
ce  
o  
th  
fa  
T  
Va  
pr  
in  
ne  
cr  
co  
the  
str  
en  
de  
his  
*thi*  
pre  
co  
fra  
wa  
deg  
ma  
re  
 $\sigma_1 =$   
pri



the  
re  
su  
for  
T  
[45]  
su

ve  
str  
wh  
spa  
pre  
the  
to  
cri  
bas  
pri  
cri  
the  
ter  
cir



gra  
an  
axi  
tow

underground  
surface  
ort  
hydrogen  
deposits  
explosives  
form

$H_{ij}$  can be written as

$$H_{ij} = \frac{1}{2} \left( \epsilon_{ijk} \sigma_k + \epsilon_{ikj} \sigma_i + \epsilon_{jki} \sigma_j \right)$$

where  $\sigma_i$  is the stress tensor component in the  $i$ -direction, and  $\epsilon_{ijk}$  is the strain tensor component. The critical condition for the onset of shear banding is given by

$$\det(H - \lambda I) = 0$$

where  $\lambda$  is the eigenvalue of the stress tensor. This leads to the following system of equations:

$$\begin{aligned} \sigma_1^2 + \sigma_2^2 + \sigma_3^2 - 2\sigma_1\sigma_2\cos(\theta) - 2\sigma_1\sigma_3\cos(\phi) - 2\sigma_2\sigma_3\cos(\psi) &= 0 \\ \sigma_1\sigma_2\sin(\theta) + \sigma_1\sigma_3\sin(\phi) + \sigma_2\sigma_3\sin(\psi) &= 0 \end{aligned}$$

where  $\theta$ ,  $\phi$ , and  $\psi$  are the Euler angles defining the orientation of the shear band relative to the coordinate axes.

com  
com  
 $f(\sigma)$   
when

for the Whom the trials among the safe the



the hydrostatic pressure

is zero at the center of the

sphere, and increases linearly

with the radius, so that the

total pressure is given by

$P = \frac{4}{3} \rho R^2$

where  $\rho$  is the density of

the fluid, and  $R$  is the radius

of the sphere. The total

hydrostatic pressure is

$P = \frac{4}{3} \rho R^2$

and the total force on the

surface of the sphere is

$F = P A = \frac{4}{3} \rho R^2 \pi R^2$

where  $A$  is the surface area

of the sphere. The force per

unit area is the hydrostatic

pressure, so that the hydro-

static pressure is given by

$P = \frac{F}{A} = \frac{\frac{4}{3} \rho R^2 \pi R^2}{\pi R^2} = \frac{4}{3} \rho R^3$

which is the same as the

expression for the hydro-

static pressure in spherical

coordinates. The hydrostatic

pressure is zero at the center

of the sphere, and increases

linearly with the radius, so

that the total pressure is given

by the equation

$P = \frac{4}{3} \rho R^2$

where  $\rho$  is the density of the

fluid, and  $R$  is the radius of the

sphere. The total force on the

surface of the sphere is

$F = P A = \frac{4}{3} \rho R^2 \pi R^2$

where  $A$  is the surface area

of the sphere. The force per

unit area is the hydrostatic

pressure, so that the hydro-

static pressure is given by

$P = \frac{F}{A} = \frac{\frac{4}{3} \rho R^2 \pi R^2}{\pi R^2} = \frac{4}{3} \rho R^3$

which is the same as the

expression for the hydro-

static pressure in spherical

coordinates. The hydrostatic

pressure is zero at the center

of the sphere, and increases

linearly with the radius, so

that the total pressure is given

by the equation

$P = \frac{4}{3} \rho R^2$

where  $\rho$  is the density of the

fluid, and  $R$  is the radius of the

sphere. The total force on the

surface of the sphere is

$F = P A = \frac{4}{3} \rho R^2 \pi R^2$

where  $A$  is the surface area

of the sphere. The force per

unit area is the hydrostatic

pressure, so that the hydro-

static pressure is given by







and the corresponding

values of  $\alpha$  and  $\beta$ .

For the case of

one-dimensional

problems, we have

the following

equation:

$\alpha = \frac{1}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

and

$\beta = \frac{\alpha}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

which can be solved

numerically.

For the case of

two-dimensional

problems, we have

the following

equation:

$\alpha = \frac{1}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

and

$\beta = \frac{\alpha}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

which can be solved

numerically.

For the case of

three-dimensional

problems, we have

the following

equation:

$\alpha = \frac{1}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

and

$\beta = \frac{\alpha}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

which can be solved

numerically.

For the case of

four-dimensional

problems, we have

the following

equation:

$\alpha = \frac{1}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

and

$\beta = \frac{\alpha}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

which can be solved

numerically.

For the case of

five-dimensional

problems, we have

the following

equation:

$\alpha = \frac{1}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

and

$\beta = \frac{\alpha}{2} \ln \left( \frac{1 + \sqrt{1 + 4\beta^2}}{1 - \sqrt{1 + 4\beta^2}} \right)$

which can be solved

numerically.



the



197

198

199

200

201

202

203

204

205

206

207

208

209

210

211

212

213

214

215

216

217

218

219

220

221

222

223



Ta

typ

Fi

ed



Fig. 1 shows the effect of the parameter  $\sigma_1$  on the size of the polarization ellipsoid. The figure consists of two parts: (a) a plot of the polarization ellipsoid for  $\sigma_1 = 0.1$  and (b) a plot for  $\sigma_1 = 0.5$ . In both plots, the horizontal axis is labeled  $\sigma_1$ , the vertical axis is labeled  $\sigma_2$ , and the depth axis is labeled  $\sigma_3$ . The ellipsoids are elongated along the  $\sigma_1$ -axis.

The effect of the parameter  $\sigma_1$  on the size of the polarization ellipsoid is shown in Fig. 1. The figure consists of two parts: (a) a plot of the polarization ellipsoid for  $\sigma_1 = 0.1$  and (b) a plot for  $\sigma_1 = 0.5$ . In both plots, the horizontal axis is labeled  $\sigma_1$ , the vertical axis is labeled  $\sigma_2$ , and the depth axis is labeled  $\sigma_3$ . The ellipsoids are elongated along the  $\sigma_1$ -axis.

The effect of the parameter  $\sigma_1$  on the size of the polarization ellipsoid is shown in Fig. 1. The figure consists of two parts: (a) a plot of the polarization ellipsoid for  $\sigma_1 = 0.1$  and (b) a plot for  $\sigma_1 = 0.5$ . In both plots, the horizontal axis is labeled  $\sigma_1$ , the vertical axis is labeled  $\sigma_2$ , and the depth axis is labeled  $\sigma_3$ . The ellipsoids are elongated along the  $\sigma_1$ -axis.

The effect of the parameter  $\sigma_1$  on the size of the polarization ellipsoid is shown in Fig. 1. The figure consists of two parts: (a) a plot of the polarization ellipsoid for  $\sigma_1 = 0.1$  and (b) a plot for  $\sigma_1 = 0.5$ . In both plots, the horizontal axis is labeled  $\sigma_1$ , the vertical axis is labeled  $\sigma_2$ , and the depth axis is labeled  $\sigma_3$ . The ellipsoids are elongated along the  $\sigma_1$ -axis.



Fig  
car  
an  
isot  
mat  
thir

the  
to th  
0' y'  
diag  
ther  
C a  
inter  
mote

mate plan intended to the which party



wh  
pri  
spa  
the  
0z-  
diff  
new  
isot  
bol  
  
 $\sigma_{C2}$   
resp  
fail  
sim  
why  
tran  
exp  
the  
resp  
stre  
coor  
  
app  
of o  
failu  
all in  
shou  
sign  
tion







The  
sys

(C)

M  
th  
su  
ed  
be  
on  
te  
in

F  
str  
re  
on  
ma  
lin  
tha  
fea  
pr  
un

Sin  
po  
rep  
ass  
for  
den  
bel

Lik  
arr  
inf  
fib  
of  
wit



the

of

in

ca

co

te

El

an

sig

an

ins

the

ch

(R

co

The

win

an

po

inc

Ep

ch

ind

N

PC

PF

Bo

Ca

Ke

Bo

\* A

Ta



W

V  
C  
b

re  
it

p. 15

Report

III

m  
lin  
ro

Rev  
var  
in

un  
ar

σ<sub>T</sub>  
R<sub>L</sub>  
and

(R) far me

3.

isochoric  
struc-

iso  
pa  
ria



Fig.

pri

le

an

le



Fig.  
Fig.  
ion)  
fibre  
sam  
inte

assu  
[80]  
with



various  
orientations  
lifted  
Figures  
ten times  
episodes  
through  
the

elliptical  
highly  
and  
of

concentric  
pressure  
British  
hydrocarbons  
Beds  
solid  
highly  
matrix  
concentric  
defined  
matrix  
the  
represent  
molecular  
formations  
orientations  
tensional

benign  
by 1000  
Beds



12.1.1

and the corresponding

symmetric

tensor

is given by

$\sigma_3 =$

$\frac{1}{2} \left( H_{11} + H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_1 =$

$\frac{1}{2} \left( H_{11} - H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_2 =$

$\frac{1}{2} \left( H_{11} + 3H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_4 =$

$\frac{1}{2} \left( H_{11} - 3H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_5 =$

$\frac{1}{2} \left( H_{11} + H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_6 =$

$\frac{1}{2} \left( H_{11} - H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_7 =$

$\frac{1}{2} \left( H_{11} + 5H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_8 =$

$\frac{1}{2} \left( H_{11} - 5H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_9 =$

$\frac{1}{2} \left( H_{11} + 7H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{10} =$

$\frac{1}{2} \left( H_{11} - 7H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{11} =$

$\frac{1}{2} \left( H_{11} + 9H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{12} =$

$\frac{1}{2} \left( H_{11} - 9H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{13} =$

$\frac{1}{2} \left( H_{11} + 11H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{14} =$

$\frac{1}{2} \left( H_{11} - 11H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{15} =$

$\frac{1}{2} \left( H_{11} + 13H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{16} =$

$\frac{1}{2} \left( H_{11} - 13H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{17} =$

$\frac{1}{2} \left( H_{11} + 15H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{18} =$

$\frac{1}{2} \left( H_{11} - 15H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{19} =$

$\frac{1}{2} \left( H_{11} + 17H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{20} = \frac{1}{2} \left( H_{11} - 17H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{21} =$

$\frac{1}{2} \left( H_{11} + 19H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{22} = \frac{1}{2} \left( H_{11} - 19H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{23} =$

$\frac{1}{2} \left( H_{11} + 21H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{24} = \frac{1}{2} \left( H_{11} - 21H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{25} =$

$\frac{1}{2} \left( H_{11} + 23H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{26} = \frac{1}{2} \left( H_{11} - 23H_{22} \right)$

where

the

symmetric

tensor

is given by

$\sigma_{27} =$

$\frac{1}{2} \left( H_{11} + 25H_{22} \right)$

where

the

symmetric

tensor

is given by



ex-  
all  
pr  
the  
ne  
to  
res  
For  
the  
ne  
to  
res  
val  
ma  
or  
be  
pol  
sor  
bec  
bet  
=96  
the  
fro  
pol  
cor

are  
the  
con



F

S

O

H

P

E

O

D

N

C

H

A

E

[



the

is

the



particular

ellipticity

can be

estimated

by the

widths

of the

elliptical

distribution

giving

information

about the

shape of the

galaxy.

The

ellipticity

is given by

the ratio

$\sigma_T/\sigma_c$

where

$\sigma_T$  is the

standard deviation

of the transverse

velocity

$\sigma_c$  is the standard

deviation of the

radial velocity

and

$\sigma_T > \sigma_c$ .

It is

assumed

that

the

galaxy

is

oblate

and

that

the

velocity

is

not

uniform

in

all

directions.

It is

also

assumed

that

the

galaxy

is

stationary



the

and



For the superconducting dome  $\theta_d$

with the condition that  $\theta_d$  is the angle between the vector  $\hat{r}_d$  and the axis of rotation, and  $\hat{r}_d$  is the unit vector along the direction of the vector  $r_d$ . The resulting equation is

The failure of the revolution in 1917 was due to the lack of a clear political program.



particular

in the case

of a two-

dimensional

isotropic

medium.

The results

are given

in terms of

the parameter

$\delta^2 = \frac{2\pi}{\lambda} \frac{d}{\lambda}$

where  $d$  is the

size of the

particle.

The results

are given

in terms of

the parameter

$\delta^2 = \frac{2\pi}{\lambda} \frac{d}{\lambda}$

where  $d$  is the

size of the

particle.

The results

are given

in terms of

the parameter

$\delta^2 = \frac{2\pi}{\lambda} \frac{d}{\lambda}$

where  $d$  is the

size of the

particle.



Fig. 1  
sur-

the  
nor-

evid-  
cor-

EP  
Wh

the  
orie-

surf-  
isot-

like  
for-



fan

Fig.

pa  
an

H

-60

The  
H  
R  
H  
ar  
 $\frac{3}{2}$   
+  
F  
H  
H<sub>1</sub>  
ar



**T**

**th**

**ei**

**ar**

**Re**

**tra**

**hy**

**(i**

**d**



Fig  
acc  
elli  
Tsa

an  
at

yi  
fa  
sy  
str

wh



a

tr

re

a

T

I

cc

th



Fig. 1.

accord-

ellipti-

Ts

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on

sin-

fig

[9]

cr

gr

ex

en

ex

on



and the corresponding values of  $\theta$  and  $\phi$  at which the maximum value of  $(\sigma_1 \sigma_2)$  occurs. The results are shown in Fig. 1.

It is seen from Fig. 1 that the maximum value of  $(\sigma_1 \sigma_2)$  is obtained when  $\theta = 0^\circ$  and  $\phi = 0^\circ$ .

The corresponding values of  $\theta$  and  $\phi$  at which the minimum value of  $(\sigma_1 \sigma_2)$  occurs are also shown in Fig. 1.

It is seen from Fig. 1 that the minimum value of  $(\sigma_1 \sigma_2)$  is obtained when  $\theta = 90^\circ$  and  $\phi = 0^\circ$ .

The corresponding values of  $\theta$  and  $\phi$  at which the maximum value of  $(\sigma_1 \sigma_2)$  occurs are also shown in Fig. 1.

It is seen from Fig. 1 that the maximum value of  $(\sigma_1 \sigma_2)$  is obtained when  $\theta = 0^\circ$  and  $\phi = 0^\circ$ .

The corresponding values of  $\theta$  and  $\phi$  at which the minimum value of  $(\sigma_1 \sigma_2)$  occurs are also shown in Fig. 1.



Fig. 1  
polymers

EP (TVA)

load

tensile

stress

failure

isotropic

decreases



Ryter [9] found that the  $S$  values which are determined from the  $E_3$  resonance signal [84] decrease unal-

2 T

orthoradial elastic dispersion transverse resonance Simulated geometrical bodies decay



ale

m

sta

sc

S-

A

tra

de

si

re

an

re



W

de

br

sh

in

th

ax

co

(σ

an

an

tra

is

dis

con

sha



**Fig**

**frame**

**Fi**

**ter**

**(b)**



Figure 1 shows the effect of the boundary condition on the eigenvalues of the system. It is observed that the eigenvalues of the system are real and symmetric about the origin. The eigenvalues are plotted against the parameter  $\alpha$  for different values of  $n$ . The eigenvalues are plotted against the parameter  $\alpha$  for different values of  $n$ .

The eigenvalues of the system are plotted against the parameter  $\alpha$  for different values of  $n$ . The eigenvalues are plotted against the parameter  $\alpha$  for different values of  $n$ .

The eigenvalues of the system are plotted against the parameter  $\alpha$  for different values of  $n$ . The eigenvalues are plotted against the parameter  $\alpha$  for different values of  $n$ .

The eigenvalues of the system are plotted against the parameter  $\alpha$  for different values of  $n$ . The eigenvalues are plotted against the parameter  $\alpha$  for different values of  $n$ .



will  
com-  
ter

WIL

an

is  
fol

white

dev  
den  
bro

char  
lim

sug  
ang



Eq (0-  
(21)

cor  
stra  
eige  
stre  
the  
pos



isotropic, the fiber becomes more isotropic while showing some isotropy factor. One loading condition is advanced since the angle of the fiber is varied. The fiber represents the angle  $\omega_i = 1$  as asymmetric hole. The internal indicator indicates left their weak points which vary with pressure for the respective compression (IR = 1) to  $\omega_i = 1$ .



(c)  
is  
a  
c  
is

(d)

glass epoxy  
woven fabric  
composite  
 $(v_f = 0.50)$



thing  
photograph  
reference  
and  
structure

A

Text  
no  
Lil  
exp  
ma



[1]

[2]

[3]

[4]

[5]

[6]

[7]

[8]

[9]

[10]

[11]

[12]

[13]

[14]

[15]

[16]

[17]

[18]

[19]

[20]

[21]

[22]

[23]

[24]

[25]

[26]



[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

[5]

















