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SMALL AND LARGE DEFLECTION OF CLAMPED SKEW SANDWICH PLATES

by

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LIST OF SYMBOLS

E	Young's modulus.
G_{xz}, G_{yz}, $G_{\xi z}$, $G_{\eta z}$	Shear moduli of core.
h	Total thickness of composite plate.
N_x, N_y, N_{xy}	Resultants of stress in the faces.
M_x, M_y, M_{xy}	Bending moments in the faces.
Q_x, Q_y	Shear force resultants in the core.
q	External load per unit area.
Q	Dimensionless parameter of load.
t	Thickness of one face.
u, v, w	Displacements along the x, y and z axes respectively.
U, V, W	Dimensionless parameter of displacements.
W_o	Dimensionless deflection at center of the plate.
w_i, r_i, s_i, u_i, v_i	Dimensionless functions.
ε_x, ε_y, ε_{xy}	Components of strain in the faces.
γ_{xz}, γ_{yz}	Components of shearing strain in the core.
σ_x, σ_y, σ_{xy}	Components of stress in the faces.
τ_{xz}, τ_{yz}	Components of shearing stress in the faces.
ν	Poisson's ratio of the faces.
x, y	Rectangular coordinates.
ξ_o, η_o	Skew coordinates.
ξ, η	Dimensionless parameters of skew coordinates.
$\bar{t}$	Thickness of the core.
ψ_x, ψ_y, ψ_ξ, ψ_η	Angular displacements of the cross section of core.

∇^2	Laplacian operator.
a, b	One-half length of plate in ξ, η-directions.
λ	Ratio of a/b.
θ	Ratio of $\bar{t}$/a.
μ	Ratio of t/a.
α	Angle of skew.
D	Flexural rigidity of homogeneous plate.

The ', ", and - superscripts with parameters denote upper facing, lower facing, and core respectively.

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ABSTRACT

The problem of the small and large deflection behaviour of skew sandwich plates with built-in edges and subjected to a uniformly distributed load is investigated. Non-linear partial differential equations governing the load-displacement relationship for such plates are derived using the principle of minimum potential energy. In the derivation of these equations, the effects of transverse shear deformation, curvature and elastic anisotropy on the deflection of the plates have all been taken into account. These equations have been linearized and solved numerically by means of the small parameter perturbation technique in conjunction with successive approximations.

A computer programme coded in Fortran is written for the IBM 360/65. Clamped skew sandwich plates, with any arbitrary geometric dimension and material properties of the core and skins, can be solved by this programme.

From the present study, it has been found that the high order strain terms from the strain-displacement relationship play an important role in the load-deflection characteristic for sandwich panels whose core is relatively soft and thick in comparison with the facings. It is also noted that the high order approximations become increasingly important as the angle of skew increases.

CHAPTER I

INTRODUCTION

1.1 Sandwich constructions.

Sandwich constructions are the type of composite constructions where plates are composed of thin metal or wood facings bonded to each side of a thick light-weight core. By themselves, the components have limited load-carrying-capacity; once bonded together, however, they act as a stiff light-weight structural member.

As far as the structural behaviour is concerned, a sandwich member is comparable to an I-beam. The object of the sandwich construction is to place a high density, high strength material as far from the neutral axis as possible in order to get a high section modulus. Like the web of the I-beam, the core of the sandwich resists the shear loads and supports the flanges, allowing them to act as a unit. The core, unlike the web, maintains a continuous support for the facings, allowing them to develop yield strength without crimping and buckling. Both the facings of sandwich plates and the flanges of I-beam are responsible for carrying the bending or tensile and compressive loads. From the structural standpoint, the function of the core of a sandwich element is twofold. First, the core keeps the faces apart and stabilizes them. Secondly, the core must enable the facings to act more or less as the outer layers of a beam or plate, and to this end it must possess a certain shearing rigidity in planes perpendicular to the facings.

The most popular type of structural sandwich utilizes a honeycomb core fabricated of 1-3 mil foil between two face sheets. Most aircraft sandwich has utilized aluminium alloys assembled with a structural adhesive. This construction is suitable for long exposure up to 400°F, and for higher temperature at much shorter time. However, as heat resistance requirements have mounted, increased attention has been given to brazed or welded sandwich constructions based on stainless steel. As titanium and other alloy become available in foil form they most certainly will be exploited in sandwich constructions.

1.2 Advantages of sandwich constructions.

Before the Second World War, conventional aircrafts were predominatly made of stressed-skin construction, which is characterised by a system of stringers and ribs or frames covered with thin sheet. Such a covering buckles under small loads, which is not objectionable as far as the strength of the structure is concerned, since the load-carrying-capacity is not exhausted when the sheet buckles. However, if the wing is fabricated in such a manner that it is perfectly smooth and accurate before loading, the smoothness of airflow over the surface is destroyed by the buckling of the sheet; in order to prevent an inadmissible rise in drag at high speeds, types of construction that do not buckle under load should be developed. Also, the reduction in shear stiffness as a consequence of sheet buckling increases the difficulties caused by aeroelastic phenomena (flutter, reduced aileron effectiveness, etc.) (see ref. 20).

Sandwich constructions are particularly suitable for airplane and missle structures, when the remaining problems of strength and stability in relation to weight, manufacture, protection against atmospheric attack, etc. are satisfactorily solved.

The main advantages of sandwich constructions in comparison with conventional types of constructions can be concluded as follows:

1. Much higher strength to weight ratio can be achieved.

2. The good surface finish and the resistance to local deformations prevent the rise in drag at high speed, thus giving a high aerodynamic efficiency.

3. Outstanding rigidity.

4. Good fatigue properties.

5. Good thermal and acoustical insulation.

6. Ease of mass production.

7. Increased interior space and ease of equipment installation.

1.3 Applications of sandwich constructions.

High stiffness at low weight combined with surface smoothness and excellent fatigue characteristic of sandwich constructions have accounted for their acceptance in the airframe industry for wing and control surfaces, rotor blades for helicopters, flooring, bulkheads, spar web, ribs, radomes, fuselage skins, etc. And a number of lesser applications have been made of this type of construction in commercial enterprises. They are, for examples, building wall panels, flooring for house trailers, small boat hulls, shipboard doors and table tops, furniture, truck trailer panels, doors, stressed skin buildings, etc.

1.4 The skew sandwich plates.

Skew sandwich plates occur frequently as parts of swept wings. The analysis of such plates is generally more challenging than that for rectangular sandwich plates. Explicit solutions to skew sandwich plate problems are not yet available.

1.5 Nonlinear behaviour of sandwich plates.

In the analvsis of light weight structures, such as sandwich plates, the geometric non-linearities are frequently involved. This is especially true in the case of sandwich plates, where the range of deflections, for which small deflection theory is valid, decreases, as the ratio of the stiffness of core to that of the facings decreases (ref. 2).

Furthermore, the desire for minimum weight optimum structural designs has resulted in the development and application of structural synthesis techniques for the design of load carrying systems.

Naturally, the use of these new design optimization methods requires more exact deformation-displacement relations.

1.6 Goal of the present study.

The present study is motivated by the fact that skew sandwich plates have fairly wide applications in the aerospace industry and yet solutions to the analysis of such plates are unknown. Moreover, the most popular type of sandwich plates are those with a honeycomb core. The honeycomb core always possesses different shear properties in different directions. Therefore, the anisotropic property of the core should be taken into consideration.

The goal of this study is to develop a theory for the non-linear deflection analysis of skew sandwich plates and to find a suitable numerical solution for it.

The theoretical formulation of this study is derived by application of the principle of minimum potential energy. The numerical method chosen in this analysis is the pertubation method.

1.7 Principle of minimum potential energy.

The principle of minimum potential energy is stated as: "Of all displacements satisfying given boundary conditions, those that satisfy the equilibrium conditions make the potential energy a minimum" (ref. 19).

In the present study, differential equations governing the small and large deflection of anisotropic sandwich plates are derived by means of the principle of minimum potential energy from the essential parts of the strain energy stored in the sandwich plate. The strain energy quantities considered as essential are those caused in the faces by extensions in the x- and y-directions(see Fig. 1 for the notation) and by shear in the xy-plane, the strain energy of bending in the faces, and the strain energy of shear caused in the core by angular changes in the xz- and yz-planes. Consequently the stresses in the xy- plane in the core are assumed to contribute only negligible amount to the total strain energy. This assumption is justifiable when the moduli E and G of the core are small as compared with those of the faces. Moreover, normal strains in the core in the z-direction are disregarded. Early investigations of the sandwich beam proved this procedure to be satisfactory. Finally, the strain energy stored in the faces because shear perpendicular to the faces is neglected. This is permissible just as the shear strain energy stored in a beam subjected to bending can be disregarded provided the beam is long enough. In the case of the sandwich plate the ratio of the length or width of the plate to the thickness of a face is always large(ref. 3).

1.8 Perturbation method.

The perturbation method has been frequently employed to solve non-linear partial differential equations. Here a solution is assumed in the form of an infinite series where one or more of the variables in the given problem are used as perturbation parameters. Useful approximations utilizing this technique have been obtained in fluid mechanics (ref. 21). In solid mechanics problems, such as bending and buckling of thin elastic plates(ref. 12), the ratio of the lateral center deflection to the thickness of the plate is usually taken as the dimensionless perturbation parameter. The solution to the problem is assumed as a series in ascending powers of the perturbation parameter. The basic principle of this method lies in the fact that since the assumed power expansion is by construction an asymptotic series for arbitary values of the perturbation parameter, terms of like powers of this parameter must separately satisfy each equality.

1.9 The scope and approach of the present study.

Since sandwich plates behave quite differently from the conventional homogeneous types of plates, a different approach of analysis is required.

The present work comprises an analytical study of the small and large deflection problem of skew isotropic and anisotropic sandwich plates. In this work, all the effects of transverse shear deformation, curvature and elastic anisotropy on the deflection of such plates are considered. Terms due to bending moments, although small compared to other terms, are not neglected in the derivation. The following chapter concerns the derivation of a set of differential equations based on non-linear strain-displacement relations using the principle of minimum potential energy. The differential equations so obtained are transformed into skew co-ordinates.

Due to the nature of skew, the sandwich properties and inherent non-linearity of strain in the large deflection theory of plates, the problem of bending and stretching of sandwich skew plates is a complicated one. In order to obtain an approximate numerical solution to the problem, the non-linear coupled differential equations governing the small and large deflection of anisotropic skew sandwich plates are solved by means of the perturbation method.

Skew sandwich plates with isotropic and anisotropic core and clamped edges subjected to uniformly distributed loads are taken as numerical examples for this analysis. Results are obtained for such plates having various core and skin properties, aspect ratios and angles of skew. The first step of the analysis is to transform the governing differential equations into dimensionless form and take the diemnsionless center deflection as a perturbation parameter. By equating like powers of the dimensionless oblique co-ordinates, the non-linear differential equations are reduced to several sets of linear differential equations. Next, certain polynomials with undefined coefficients satisfying the boundary conditions of the plates are assumed as the plate displacement functions. Substituting these polynomials into the differential equations, several sets of algebraic simultaneous equations are obtained. The solution of these matrix equations yields the values of the undetermined coefficients in the assumed displacement functions thus defining the in-plane and lateral displacements of the plate together with the shear deformation in the core. From the well-known stress-displacement relation in the theory of plates, the corresponding stresses at any point within the plate domain can be determined by proper differentiation of displacement functions.

1.10 Computer programme.

A computer programme is written to assist the computation of this analysis. The input data are: (i) modulus of elasticity of the facing material, (ii) shear modulus of core in ξ-direction, (iii) shear modulus of core in η-direction, (iv) Poisson's ratio for the facing material, (v) the angle of skew, (vi) thickness of skin divided by half the width of plate, (vii) thickness of core divided by half the width of plate, (viii) ratio of width of plate to length.

CHAPTER II

LITERATURE SURVEY

Various authors have attemped to develop a new theory for sandwich plates. Among these, as early as 1948, Libove and Botdorf(ref. 1) developed both the energy expression and the differential equations for such plates. Boundary conditions corresponding to simply supported, clamped and elastically restrained edges were considered. In the derivation of such equations the deflection due to shear and the orthotropic stretching properties of the skins and core were taken into consideration. Three uncoupled sixth order differential equations were obtained.

The same year, Reissner(ref. 2) realizing the inadequacy of the linear small deflection theory in the treatment of sandwich panels with a relatively soft core, derived a system of differential equations for the finite deflctions of sandwich plates.

1950, Hoff(ref. 3) used the principle of minimum potential energy and obtained a similar set of differential equations.

1951, Eringen(ref. 4) considered also the the effect of flattening of the core on the bending of plates, taking into account the three dimensional stress distribution in the core. In the meantime, Wang(ref. 5) also developed a theory for the finite deflections of sandwich plates using the principle of complementary energy.

1952, Yen, Gunturkun and Polile(ref. 6) using the governing differential equations proposed by Hoff, made a Fourier series solution for a simply supported rectangular sandwich plate; both the upper bound and lower bound solutions were presented in his work.

1962, Cheng(ref. 7) derived a system of differential equations governing the small deflections of sandwich plates using the variational theorem of complementary energy in conjunction with the Lagrangian multipliers technique. From these equations a governing linear differential equation of sixth-order for the deflection was derived. This has the same role as the equation $\nabla^2\nabla^2 w = q/D$ in the theory of thin homogeneous plates. It was found that, if only two boundary conditions are required to be satisfied, the problems of bending of sandwich plates may be readily solved through the use of techniques that have already been developed in the classical theory of homogeneous plates.

Numerical methods for various plate problems can perhaps be classified into the following general categories:

i) Approaches based on minimum principles;

Perhaps the most popular method in this category is the so called Ritz energy method used successfully by Way(ref. 8) for the uniformly loaded clamped rectangular plate, and by Weil and Newmark(ref. 9) for the uniformly loaded clamped elliptical plate. Application of this technique reduces the problem to finding the solution of simultaneous non-linear algebraic equations. The newly developed finite element methods also belong to this category.

ii) Approaches based on finite difference equations;

Wang(ref. 10) among others, has presented solutions for simply supported rectangular plates of various aspect ratios using this method.

iii) Approaches based on successive linearization;

In this category the method normally chosen to obtain a solution to the finite deflection equations is the perturbation procedure and it has been successfully applied in the case of uniform load to a variety of plate problems. For the simply supported plates, Stippes and Hausrath(ref. 11) solve the governing fourth order equations using a non-dimensionalized loading as the perturbation parameter. All other investigators have used a dimensionless central deflection as their perturbation parameter.

Since the perturbation procedure is to be used in this investigation, some important papers employing this scheme are listed chronologically below:

Author(s)	Geometry	Co-ordinate system
Chien(1947)	circular	polar
Nash & Cooley(1959)	elliptical	rectangular
Ng & Kennedy(1966)	skew	skew

The author feels that in order to carry out the numerical calculation and meet the special conditions of the present study, certain modification and extension of the theories mentioned previously should be necessary. For example, in Reissner's work(ref. 2) the system of equations is expressed in Airy's stress function and transverse deflection, where the boundary conditions with respect to Airy's stress function cannot be explicitly defined, which complicates the numerical solution of these equations to some extent. Thus, the development of the present theory to ensure a simple numerical solution for the clamped boundary condition is justified. In the derivation of the differential equations of the present study, the author follows the similar procedure Hoff used for the linear analysis of bending of rectangular sandwich plates (ref. 3), but further considers the anisotropic property of the core and extends the theory to the non-linear range.

In the papers published by Chien, Nash & Cooley, Ng & Kennedy, the solutions of non-linear deflection problems of various types of homogeneous plates have been found by applying the perturbation method and their results are in close agreement with experiments. For that reason, it is believed that this method should also give good results for sandwich plates, while the displacement functions assumed in the present study are essentially following the same fashion as in those papers mentioned above.

CHAPTER III

GOVERNING DIFFERENTIAL EQUATIONS

3.1 Assumptions:

This work consists of a study of the behaviours of skew sandwich plates with built-in edges and subjected to a uniformly distributed load. The upper face t' and the lower face t" are made of metal sheets, while the core is composed of a relatively thick layer of soft material. Thus, the facings are assumed to carry all the bending moments while the transverse shear is taken up by the core.

For the derivation of the governing differential equations the following assumptions are made:

1. Hooke's law holds, i.e., the plate is made of elastic material.
2. The facings are isotropic.
3. The core is anisotropic.
4. The facings are of equal thickness.
5. The plate is relatively thin in comparison with its length.
6. The plate undergoes finite deformation.
7. The transverse deflection is constant.

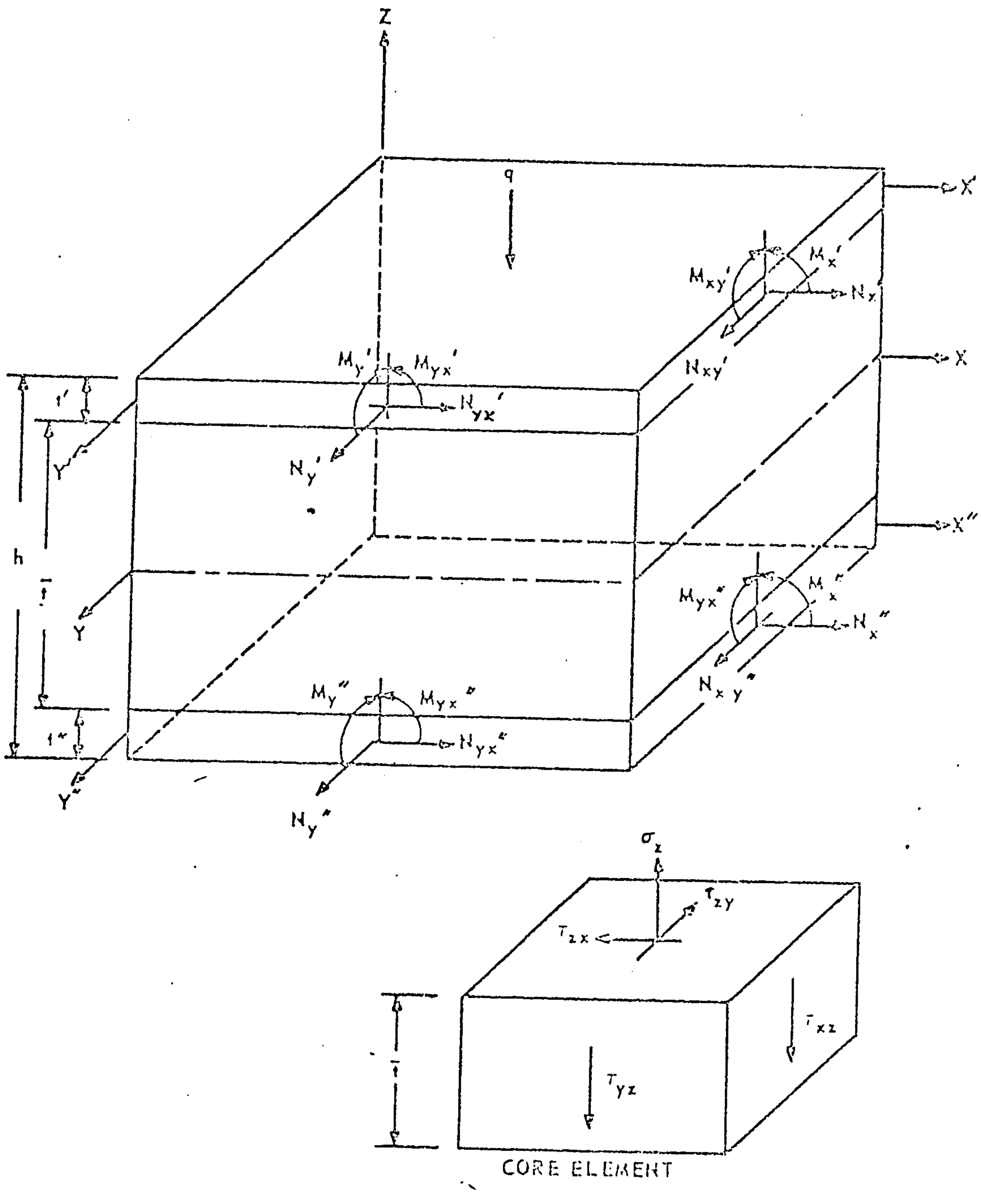

Fig.1 Sandwich plate element.

throughout the composite structure.

8. The bond between facings and core is perfect.

9. Planes perpendicular to the x-y plane remain perpendicular after deformation.

10. The transverse shear is carried by the core.

11. The bending moments are resisted by the facings.

3.2 The strains and displacements.

From the theory of elasticity, the strain-displacement relations can be as follows:

For upper facing:

$$\epsilon_x' = \frac{\partial u'}{\partial x'} + \frac{1}{2}\left(\frac{\partial w'}{\partial x'}\right)^2 \tag{3.2.1}$$

$$\epsilon_y' = \frac{\partial v'}{\partial y'} + \frac{1}{2}\left(\frac{\partial w'}{\partial y'}\right)^2 \tag{3.2.2}$$

$$\epsilon_{xy}' = \frac{1}{2}\left(\frac{\partial u'}{\partial y'} + \frac{\partial v'}{\partial x'} + \frac{\partial w'}{\partial x'}\frac{\partial w'}{\partial y'}\right) \tag{3.2.3}$$

For lower facing:

$$\epsilon_x'' = \frac{\partial u''}{\partial x''} + \frac{1}{2}\left(\frac{\partial w''}{\partial x''}\right)^2 \tag{3.2.4}$$

$$\epsilon_y'' = \frac{\partial v''}{\partial y''} + \frac{1}{2}\left(\frac{\partial w''}{\partial y''}\right)^2 \tag{3.2.5}$$

$$\epsilon_{xy}'' = \frac{1}{2}\ \frac{\partial u''}{\partial y''} + \frac{\partial v''}{\partial x''} + \frac{\partial w''}{\partial x''}\frac{\partial w''}{\partial y''} \tag{3.2.6}$$

For core:

$$\bar{\gamma}_{xz} = \frac{1}{2}\left(\frac{\partial \bar{w}}{\partial \bar{x}} + \frac{\partial \bar{u}}{\partial \bar{z}} + \frac{\partial \bar{w}}{\partial \bar{x}}\frac{\partial \bar{w}}{\partial \bar{z}}\right) \tag{3.2.7}$$

$$\bar{\gamma}_{yz} = \frac{1}{2}\left(\frac{\partial \bar{w}}{\partial \bar{y}} + \frac{\partial \bar{v}}{\partial \bar{z}} + \frac{\partial \bar{w}}{\partial \bar{y}}\frac{\partial \bar{w}}{\partial \bar{z}}\right) \tag{3.2.8}$$

Where ϵ_x, ϵ_y, ϵ_{xy} denote the strain components in the facings, $\bar{\gamma}_{xz}$, $\bar{\gamma}_{yz}$ denote the shearing strain components in the core, and u, v, w, are the components of displacement with respect to x, y, z axes. The ', ", and — superscripts with parameters denote upper facing, lower facing and core respectively.

3.3 Compatibility of displacements, strains and stresses.

It is desirable to express the components of displacement with respect to a single reference frame, i.e., the x-, y-, z- co-ordinte system (see Fig. 1).

Let u_o', v_o' be the in-plane displacements on the x'-y' plane (the neutral plane of the upper facing before deformation occurs), u_o'', v_o'' be the in-plane displacements on the x"-y" plane and $\bar{u}_o$, $\bar{v}_o$ are defined likewise. Thus, the following relations can be established.

For upper facing:

$$u' = u_o - z'\frac{\partial w'}{\partial x} \qquad (3.3.1)$$

$$v' = v_o' - z'\frac{\partial w'}{\partial y'} \qquad (3.3.2)$$

For lower facing:

$$u'' = u_o'' - z''\frac{\partial w''}{\partial x''} \qquad (3.3.3)$$

$$v'' = v_o'' - z''\frac{\partial w''}{\partial x''} \qquad (3.3.4)$$

For core:

$$\bar{u} = \bar{u}_o + \bar{z}\,\psi_x \qquad (3.3.5)$$

$$\bar{v} = \bar{v}_o + \bar{z}\,\psi_y \qquad (3.3.6)$$

Recall that the Assumption 7 stated as:

$$w = w' = w'' = \bar{w} \qquad (3.3.7)$$

From the geometry of Figure 1, we obtain;

$$z = z' + \left(\frac{\bar{t} + t'}{2}\right) \quad , \quad x = x' \ , \ y = y' \tag{3.3.8}$$

$$z = z' - \left(\frac{\bar{t} + t''}{2}\right) \quad , \quad x = x'' \ , \ y = y'' \tag{3.3.9}$$

Substituting Equations (3.3.7) through (3.3.9) into Equations (3.3.1) through (3.3.6) yields

$$u' = u_o' - z\frac{\partial w}{\partial x} + \frac{\bar{t}}{2}\frac{\partial w}{\partial x} + \frac{t'}{2}\frac{\partial w}{\partial x} \tag{3.3.10}$$

$$v' = v_o' - z\frac{\partial w}{\partial y} + \frac{\bar{t}}{2}\frac{\partial w}{\partial y} + \frac{t'}{2}\frac{\partial w}{\partial y} \tag{3.3.11}$$

$$u'' = u_o'' - z\frac{\partial w}{\partial x} - \frac{\bar{t}}{2}\frac{\partial w}{\partial x} - \frac{t''}{2}\frac{\partial w}{\partial x} \tag{3.3.12}$$

$$v'' = v_o'' - z\frac{\partial w}{\partial y} + \frac{\bar{t}}{2}\frac{\partial w}{\partial y} + \frac{t''}{2}\frac{\partial w}{\partial y} \tag{3.3.13}$$

$$\bar{u} = \bar{u}_o + z\psi_x \tag{3.3.14}$$

$$\bar{v} = \bar{v}_o + z\psi_y \tag{3.3.15}$$

$$u'\Big|_{z=\frac{\bar{t}}{2}} = \bar{u}\Big|_{z=\frac{\bar{t}}{2}} \tag{3.3.16}$$

$$u''\Big|_{z=-\frac{\bar{t}}{2}} = \bar{u}\Big|_{z=-\frac{\bar{t}}{2}} \tag{3.3.17}$$

$$V'\Big|_{z=\frac{\bar{t}}{2}} = \bar{V}\Big|_{z=\frac{\bar{t}}{2}} \tag{3.3.18}$$

$$V''\Big|_{z=-\frac{\bar{t}}{2}} = \bar{V}\Big|_{z=-\frac{\bar{t}}{2}} \tag{3.3.19}$$

(Note that ψ_x, ψ_y are the components of angular displacement of the cross section of core).

Combining Equations (3.3.10) through (3.3.19) yields;

$$u_o' = \bar{u}_o + \frac{\bar{t}}{2}\psi_x - \frac{t'}{2}\frac{\partial w}{\partial x} \tag{3.3.20}$$

$$u_o'' = \bar{u}_o - \frac{\bar{t}}{2}\psi_x - \frac{t''}{2}\frac{\partial w}{\partial x} \tag{3.3.21}$$

$$v_o' = \bar{v}_o + \frac{\bar{t}}{2}\psi_y - \frac{t'}{2}\frac{\partial w}{\partial y} \tag{3.3.22}$$

$$v_o'' = \bar{v}_o - \frac{\bar{t}}{2}\psi_y - \frac{t''}{2}\frac{\partial w}{\partial y} \tag{3.3.23}$$

Substituting Equations (3.3.20) through (3.3.23) into Equations (3.3.10) through (3.3.13) yields;

$$u' = \bar{u}_o + \frac{\bar{t}}{2}\psi_x - z\frac{\partial w}{\partial x} + \frac{\bar{t}}{2}\frac{\partial w}{\partial x} \tag{3.3.24}$$

$$u'' = \bar{u}_o - \frac{\bar{t}}{2}\psi_x - z\frac{\partial w}{\partial x} - \frac{\bar{t}}{2}\frac{\partial w}{\partial x} \tag{3.3.25}$$

$$v' = \bar{v}_o + \frac{\bar{t}}{2}\psi_x - z\frac{\partial w}{\partial y} + \frac{\bar{t}}{2}\frac{\partial w}{\partial x} \tag{3.3.26}$$

$$v'' = \bar{v}_o - \frac{\bar{t}}{2}\psi_y - z\frac{\partial w}{\partial y} - \frac{\bar{t}}{2}\frac{\partial w}{\partial y} \tag{3.3.27}$$

Substituting Equations (3.3.7) through (3.3.9) and Equations (3.3.24) through (3.3.27) into Equations (3.2.1) through (3.2.8) yields;

$$\epsilon_x' = \frac{\partial \bar{u}_o}{\partial x} + \frac{\bar{t}}{2}\frac{\partial \psi_x}{\partial x} - \left(z - \frac{\bar{t}}{2}\right)\frac{\partial^2 w}{\partial x^2} + \frac{1}{2}\left(\frac{\partial w}{\partial x}\right)^2 \tag{3.3.28}$$

$$\epsilon_y' = \frac{\partial \bar{v}_o}{\partial y} + \frac{\bar{t}}{2}\frac{\partial \psi_y}{\partial y} - \left(z - \frac{\bar{t}}{2}\right)\frac{\partial^2 w}{\partial y^2} + \frac{1}{2}\left(\frac{\partial w}{\partial y}\right)^2 \tag{3.3.29}$$

$$\epsilon_{xy}' = \frac{1}{2}\left[\frac{\partial \bar{u}_o}{\partial y} + \frac{\partial \bar{v}_o}{\partial x} + \frac{\bar{t}}{2}\left(\frac{\partial \psi_x}{\partial y} + \frac{\partial \psi_y}{\partial x}\right)\right. \tag{3.3.30}$$

$$\left. - 2\left(z - \frac{\bar{t}}{2}\right)\frac{\partial^2 w}{\partial x \partial y} + \frac{\partial w}{\partial x}\frac{\partial w}{\partial y}\right]$$

$$\epsilon_x'' = \frac{\partial \bar{u}_o}{\partial x} - \frac{\bar{t}}{2}\frac{\partial \psi_x}{\partial x} - \left(z + \frac{\bar{t}}{2}\right)\frac{\partial^2 w}{\partial x^2} + \frac{1}{2}\left(\frac{\partial w}{\partial x}\right)^2 \tag{3.3.31}$$

$$\epsilon_y'' = \frac{\partial \bar{v}_o}{\partial y} - \frac{\bar{t}}{2}\frac{\partial \psi_x}{\partial y} - \left(z + \frac{\bar{t}}{2}\right)\frac{\partial^2 w}{\partial y^2} + \frac{1}{2}\left(\frac{\partial w}{\partial y}\right)^2 \tag{3.3.32}$$

$$\epsilon_{xy}'' = \frac{1}{2}\left[\frac{\partial \bar{u}_o}{\partial y} + \frac{\partial \bar{v}_o}{\partial x} - \frac{\bar{t}}{2}\left(\frac{\partial \psi_x}{\partial y} + \frac{\partial \psi_y}{\partial x}\right)\right. \tag{3.3.33}$$

$$\left. - 2\left(z + \frac{\bar{t}}{2}\right)\frac{\partial^2 w}{\partial x \partial y} + \frac{\partial w}{\partial x}\frac{\partial w}{\partial y}\right]$$

$$\bar{\gamma}_{xz} = \left(\frac{\partial w}{\partial x} + \psi_x \right) \tag{3.3.34}$$

$$\bar{\gamma}_{yz} = \left(\frac{\partial w}{\partial y} + \psi_y \right) \tag{3.3.35}$$

From Hooke's law the components of stresses ϵ_x', ϵ_y', ... etc. can be as follows;

$$\sigma_x' = \frac{E}{1-\nu^2} \left(\epsilon_x' + \nu \epsilon_y' \right) \tag{3.3.36}$$

$$\sigma_y' = \frac{E}{1-\nu^2} \left(\epsilon_y' + \nu \epsilon_x' \right) \tag{3.3.37}$$

$$\sigma_{xy}' = \frac{E}{1+\nu} \; \epsilon_{xy}' \tag{3.3.38}$$

$$\sigma_x'' = \frac{E}{1-\nu^2} \left(\epsilon_x'' + \nu . \epsilon_y'' \right) \tag{3.3.39}$$

$$\sigma_y'' = \frac{E}{1-\nu^2} \left(\epsilon_y'' + \nu \epsilon_x'' \right) \tag{3.3.40}$$

$$\sigma_{xy}'' = \frac{E}{1+\nu} \; \epsilon_{xy}'' \tag{3.3.41}$$

$$\bar{\tau}_{xz} = \bar{G}_{xz} \left(\bar{\gamma}_{xz} \right) \tag{3.3.42}$$

$$\bar{\tau}_{yz} = \bar{G}_{yz} \left(\bar{\gamma}_{yz} \right) \tag{3.3.43}$$

3.4 Derivation of the governing equations.

Let T', T", $\bar{T}$ be the parts of strain energy stored in the upper face, lower face, core respectively, $\iint q\,w\,dx\,dy$ is the external potential energy due to the uniformly distributed load. And for every virtual displacement consistent with the constrain, the first variation of total potential energy should vanish, i.e.;

$$\delta T' + \delta T'' + \delta \bar{T} - \iint q\,\delta w\,dx\,dy = 0 \qquad (3.4.1)$$

Since the strain energy is the integration of strain energy density (refer to ref. 19) throughout the body of the sandwich plate element, we see that

$$\delta T' = \iiint_{\frac{\bar{t}}{2}}^{\frac{\bar{t}}{2}+t'} (\sigma_x'\,\delta\epsilon_x' + \sigma_y'\,\delta\epsilon_y' + 2\,\sigma_{xy}'\,\delta\epsilon_{xy}')\,dx\,dy\,dz \qquad (3.4.2)$$

$$\delta T'' = \iiint_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} (\sigma_x''\,\delta\epsilon_x'' + \sigma_y''\,\delta\epsilon_y'' + 2\,\sigma_{xy}\,\delta\epsilon_{xy})\,dx\,dy\,dz \qquad (3.4.3)$$

$$\delta \bar{T} = \iiint_{-\frac{\bar{t}}{2}}^{\frac{\bar{t}}{2}} (\bar{\tau}_{xz}\,\delta\bar{\gamma}_{xz} + \bar{\tau}_{yz}\,\delta\bar{\gamma}_{yz})\,dx\,dy\,dz \qquad (3.4.4)$$

Substituting Equations (3.3.28) through (3.3.30) into (3.4.2), yields

$$\delta T' = \iint \Big\{ N_x' \Big[\delta\Big(\frac{\partial \bar{u}_o}{\partial x}\Big) + \frac{\bar{t}}{2}\delta\Big(\frac{\partial \psi_x}{\partial x}\Big) + \frac{\partial w}{\partial x}\delta\Big(\frac{\partial w}{\partial x}\Big)\Big] - M_x'\Big(\frac{\partial^2 w}{\partial x^2}\Big) \tag{3.4.5}$$

$$+ N_y'\Big[\delta\Big(\frac{\partial \bar{v}_o}{\partial y}\Big) + \frac{t}{2}\delta\Big(\frac{\partial \psi_y}{\partial y}\Big) + \frac{\partial w}{\partial y}\delta\Big(\frac{\partial w}{\partial y}\Big)\Big] - M_y'\delta\Big(\frac{\partial^2 w}{\partial y^2}\Big)$$

$$+ N_{xy}'\Big[\delta\Big(\frac{\partial \bar{u}_o}{\partial y}\Big) + \delta\Big(\frac{\partial \bar{v}_o}{\partial x}\Big) + \frac{\bar{t}}{2}\delta\Big(\frac{\partial \psi_x}{\partial x}\Big) + \frac{t}{2}\delta\Big(\frac{\partial \psi_y}{\partial x}\Big)$$

$$+ \frac{\partial w}{\partial x}\delta\Big(\frac{\partial w}{\partial y}\Big) + \frac{\partial w}{\partial y}\delta\Big(\frac{\partial w}{\partial x}\Big)\Big] - 2 M_{xy}'\delta\Big(\frac{\partial^2 w}{\partial x \partial y}\Big) dx\,dy$$

Substituting Equations (3.3.31) through (3.3.33) into Equation (3.4.3), yields

$$\delta T'' = \iint \Big\{ N_x''\Big[\delta\Big(\frac{\partial \bar{u}_o}{\partial x}\Big) - \frac{\bar{t}}{2}\delta\Big(\frac{\partial \psi_x}{\partial x}\Big) + \frac{\partial w}{\partial x}\delta\Big(\frac{\partial w}{\partial x}\Big)\Big] \tag{3.4.6}$$

$$- M_x''\delta\Big(\frac{\partial^2 w}{\partial x^2}\Big) + N_y''\Big[\delta\Big(\frac{\partial \bar{v}_o}{\partial y}\Big) - \frac{\bar{t}}{2}\delta\Big(\frac{\partial \psi_y}{\partial y}\Big) + \frac{\partial w}{\partial y}\delta\Big(\frac{\partial w}{\partial y}\Big)\Big]$$

$$- M_y''\delta\Big(\frac{\partial^2 w}{\partial y^2}\Big) + N_{xy}''\Big[\delta\Big(\frac{\partial \bar{u}_o}{\partial y}\Big) + \delta\Big(\frac{\partial \bar{v}_o}{\partial x}\Big)$$

$$- \frac{\bar{t}}{2}\delta\Big(\frac{\partial \psi_x}{\partial y}\Big) - \frac{\bar{t}}{2}\delta\Big(\frac{\partial \psi_y}{\partial x}\Big) + \frac{\partial w}{\partial x}\delta\Big(\frac{\partial w}{\partial y}\Big) + \frac{\partial w}{\partial y}\delta\Big(\frac{\partial w}{\partial x}\Big)\Big]$$

$$- 2 M_{xy}''\delta\Big(\frac{\partial^2 w}{\partial x \partial y}\Big)\Big\} dx\,dy$$

Substituting Equations (3.3.34) and (3.3.35) into Equation (3.4.4), yields

$$\delta\bar{T} = \iint \Big\{ \bar{Q}_x \Big[\delta\Big(\frac{\partial W}{\partial x}\Big) + \delta\psi_x \Big] \tag{3.4.7}$$

$$+ \bar{Q}_y \Big[\delta\Big(\frac{\partial W}{\partial y}\Big) + \delta\psi_y \Big] \Big\} dx\, dy$$

Where

$$N_x' = \int_{\frac{\bar{t}}{2}}^{\frac{\bar{t}}{2}+t'} \sigma_x'\, dz \tag{3.4.8}$$

$$N_y' = \int_{\frac{\bar{t}}{2}}^{\frac{\bar{t}}{2}+t'} \sigma_y'\, dz \tag{3.4.9}$$

$$N_{xy}' = \int_{\frac{\bar{t}}{2}}^{\frac{\bar{t}}{2}+t'} \sigma_{xy}'\, dz \tag{3.4.10}$$

$$M_x' = \int_{\frac{\bar{t}}{2}}^{\frac{\bar{t}}{2}+t'} \sigma_x'\Big(z - \frac{\bar{t}}{2}\Big)\, dz \tag{3.4.11}$$

$$M_y' = \int_{\frac{\bar{t}}{2}}^{\frac{\bar{t}}{2}+t'} \sigma_y'\Big(z - \frac{\bar{t}}{2}\Big)\, dz \tag{3.4.12}$$

$$M_{xy}' = \int_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} \sigma_{xy}'\Big(z + \frac{\bar{t}}{2}\Big)\, dz \tag{3.4.13}$$

$$N_x'' = \int_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} \sigma_x'' \, dz \tag{3.4.14}$$

$$N_y'' = \int_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} \sigma_y'' \, dz \tag{3.4.15}$$

$$N_{xy}'' = \int_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} \sigma_{xy}'' \, dz \tag{3.4.16}$$

$$M_x'' = \int_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} \sigma_x''\left(z+\frac{\bar{t}}{2}\right) dz \tag{3.4.17}$$

$$M_y'' = \int_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} \sigma_y''\left(z+\frac{\bar{t}}{2}\right) dz \tag{3.4.18}$$

$$M_{xy}'' = \int_{-(\frac{\bar{t}}{2}+t'')}^{-\frac{\bar{t}}{2}} \sigma_{xy}''\left(z+\frac{\bar{t}}{2}\right) dz \tag{3.4.19}$$

$$\bar{Q}_x = \int_{-\frac{\bar{t}}{2}}^{\frac{t}{2}} \bar{\tau}_{xz} \, dz \tag{3.4.20}$$

$$\bar{Q}_y = \int_{-\frac{t}{2}}^{\frac{\bar{t}}{2}} \bar{\tau}_{yz} \, dz \tag{3.4.21}$$

The variation of strain energy for the upper facing is obtained by applying the divergence theorem. Referring to Equation (3.4.5), we see that

$$
\begin{aligned}
\delta T' = {} & \oint N_x' \bar{u}_o \, dy - \iint \frac{\partial N_x'}{\partial x} \delta \bar{u}_o \, dx\, dy \\
& + \frac{\bar{t}}{2} \oint N_x' \delta \psi_x \, dy - \frac{\bar{t}}{2} \iint \frac{\partial N_x}{\partial x} \delta \psi_x \, dx\, dy \\
& + \oint N_x' \frac{\partial w}{\partial x} \delta w \, dy - \iint \frac{\partial}{\partial x}\left(N_x' \frac{\partial w}{\partial x} \right) \delta w \, dx\, dy \\
& - \oint M_x' \delta \left(\frac{\partial w}{\partial x} \right) dy + \oint \frac{\partial M_x'}{\partial x} \delta w \, dy \\
& - \iint \frac{\partial^2 M_x'}{\partial x^2} \delta w \, dx\, dy + \oint N_y' \delta v_o \, dx \\
& - \iint \frac{\partial N_y'}{\partial y} \delta v_o \, dx\, dy + \frac{\bar{t}}{2} \oint N_y' \delta \psi_y \, dx \\
& - \frac{\bar{t}}{2} \iint \frac{\partial N_y}{\partial y} \delta \psi_y \, dx\, dy + \oint N_y' \frac{\partial w}{\partial y} \delta w \, dx \\
& - \iint \frac{\partial}{\partial y}\left(N_y' \frac{\partial w}{\partial y} \right) \delta w \, dx\, dy - \oint M_y' \delta \left(\frac{\partial w}{\partial y} \right) dx \\
& + \oint \frac{\partial M_y'}{\partial y} \delta w \, dx - \iint \frac{\partial^2 M_y'}{\partial y^2} \delta w \, dx\, dy
\end{aligned}
\qquad (3.4.22)
$$

$$+ \oint N_{xy}' \delta \bar{u}_o dx - \iint \frac{\partial N_{xy}}{\partial y} \delta u_o dx dy$$

$$+ \oint N_{xy} \delta \bar{v}_o dy - \quad \frac{\partial N_{xy}'}{\partial x} \delta \bar{v}_o dx dy$$

$$+ \frac{\bar{t}}{2} \oint N_{xy}' \delta \psi_x dx - \frac{\bar{t}}{2} \iint \frac{\partial N_{xy}'}{\partial y} \delta \psi_x dx dy$$

$$+ \frac{\bar{t}}{2} \oint N_{xy}' \delta \psi_y dy - \frac{\bar{t}}{2} \iint \frac{\partial N_{xy}'}{\partial x} \delta \psi_y dx dy$$

$$+ \oint N_{xy}' \frac{\partial w}{\partial x} \delta w dx - \iint \frac{\partial}{\partial y} \left(N_{xy}' \frac{\partial w}{\partial x} \right) \delta w dx dy$$

$$+ \oint N_{xy}' \frac{\partial w}{\partial y} \delta w dy - \iint \frac{\partial}{\partial x} \left(N_{xy}' \frac{\partial w}{\partial y} \right) \delta w dx dy$$

$$- 2 \left(M_{xy}' \delta w \right) \Bigg|_{\substack{x=-a \\ y=-b}}^{\substack{x=a \\ y=b}} + 2 \oint \frac{\partial M_{xy}'}{\partial y} \delta w dy \qquad (3.4.22)$$

$$+ 2 \oint \frac{\partial M_{xy}'}{\partial x} \delta w dx - 2 \iint \frac{\partial^2 M_{xy}}{\partial x \partial y} \delta w dx dy$$

Similarly the variation of strain energy for the lower facing can be obtained likewise. Referring to Equation (3.4.6), we see that

$$\delta T'' = \oint N_x'' \delta \bar{u}_o dy - \iint \frac{\partial N_x''}{\partial x} \delta \bar{u}_o dx dy \qquad (3.4.23)$$

$$- \frac{\bar{t}}{2} \oint N_x'' \delta \psi_x dy + \frac{\bar{t}}{2} \iint \frac{\partial N_x''}{\partial x} \delta \psi_x dx dy$$

$$
\begin{aligned}
&+ \int N_x'' \frac{\partial w}{\partial x} \delta w \, dy - \iint \frac{\partial}{\partial x}\left(N_x'' \frac{\partial w}{\partial x}\right) \delta w \, dx \, dy \\
&- \oint M_x'' \delta\left(\frac{\partial w}{\partial x}\right) dy + \oint \frac{\partial M_x''}{\partial x} \delta w \, dy \\
&- \iint \frac{\partial^2 M_x''}{\partial x^2} \delta w \, dx \, dy + \oint N_y'' \delta \bar{v}_0 \, dx \\
&- \iint \frac{\partial N_y''}{\partial y} \delta \bar{v}_0 \, dx \, dy - \frac{\bar{t}}{2} \oint N_y'' \delta \psi_y \, dx \\
&+ \frac{\bar{t}}{2} \iint \frac{\partial N_y''}{\partial y} \delta \psi_y \, dx \, dy + \oint N_y'' \frac{\partial w}{\partial y} \delta w \, dx \qquad (3.4.23) \\
&- \iint \frac{\partial}{\partial y}\left(N_y'' \frac{\partial w}{\partial y}\right) \delta w \, dx \, dy - \oint M_y'' \delta\left(\frac{\partial w}{\partial y}\right) dx \\
&+ \oint \frac{\partial M_y''}{\partial y} \delta w \, dx - \iint \frac{\partial^2 M_y''}{\partial y^2} \delta w \, dx \, dy \\
&+ \oint N_{xy}'' \delta \bar{u}_0 \, dx - \iint \frac{\partial N_{xy}}{\partial y} \delta \bar{u}_0 \, dx \, dy \\
&+ \oint N_{xy}'' \delta \psi_x \, dx + \frac{\bar{t}}{2} \iint \frac{\partial N_{xy}}{\partial y} \delta \psi_x \, dx \, dy \\
&- \frac{\bar{t}}{2} \oint N_{xy}'' \delta \psi_y \, dy + \frac{\bar{t}}{2} \iint \frac{\partial N_{xy}''}{\partial x} \delta \psi_y \, dx \, dy \\
&+ \oint N_{xy}'' \frac{\partial w}{\partial x} \delta w \, dx - \iint \frac{\partial}{\partial y}\left(N_{xy}'' \frac{\partial w}{\partial y}\right) \delta w \, dx \, dy
\end{aligned}
$$

$$+\oint N_{xy}''\frac{\partial w}{\partial y}\delta w\,dy-\iint\frac{\partial}{\partial y}\left(N_{xy}''\frac{\partial w}{\partial y}\right)\delta w\,dx\,dy$$

$$+\oint N_{xy}''\frac{\partial w}{\partial y}\delta w\,dy-\iint\frac{\partial}{\partial y}\left(N_{xy}\frac{\partial w}{\partial y}\right)\delta w\,dx\,dy$$

$$-2\left(M_{xy}''\delta w\right)\Bigg|_{\substack{x=-a\\y=-b}}^{\substack{x=a\\y=b}}+2\oint\frac{\partial M_{xy}''}{\partial y}\delta w\,dy$$

$$+2\oint\frac{\partial M_{xy}''}{\partial x}\delta w\,dx-2\iint\frac{\partial^2 M_{xy}}{\partial x\partial y}\delta w\,dx\,dy \qquad (3.4.23)$$

The variation of strain energy for the core also can be obtained likewise. Referring to Equation (3.4.7), we see that

$$\begin{aligned}\delta\bar{T}=&\int\bar{Q}_x\delta w\,dy-\iint\frac{\partial\bar{Q}}{\partial x}\delta w\,dx\,dy\\&+\iint\bar{Q}_x\delta\psi_x\,dx\,dy+\int\bar{Q}_y\delta w\,dx\\&-\iint\frac{\partial\bar{Q}_y}{\partial y}\delta w\,dx\,dy+\iint\bar{Q}_y\delta\psi_y\,dx\,dy\end{aligned} \qquad (3.4.24)$$

Substitute Equations (3.4.22) through (3.4.24) into Equation (3.4.1).

$$-\iint \left(\frac{\partial N_x'}{\partial x} + \frac{\partial N_x''}{\partial x} + \frac{\partial N_{xy}'}{\partial y} + \frac{\partial N_{xy}''}{\partial y} \right) \delta \bar{u}_o \, dx\, dy \qquad (3.4.25)$$

$$-\iint \left(\frac{\bar{t}}{2} \frac{\partial N_x'}{\partial x} - \frac{\bar{t}}{2} \frac{\partial N_x''}{\partial x} + \frac{\bar{t}}{2} \frac{\partial N_{xy}'}{\partial y} - \frac{\bar{t}}{2} \frac{\partial N_{xy}''}{\partial y} - Q_x \right) \delta \psi_x \, dx\, dy$$

$$-\iint \left[\frac{\partial}{\partial x}\left(N_x' \frac{\partial w}{\partial x}\right) + \frac{\partial}{\partial x}\left(N_x'' \frac{\partial w}{\partial x}\right) + \frac{\partial^2 M_x'}{\partial x^2} + \frac{\partial^2 M_x''}{\partial x^2} \right.$$

$$+ \frac{\partial}{\partial y}\left(N_y' \frac{\partial w}{\partial y}\right) + \frac{\partial}{\partial y}\left(N_y'' \frac{\partial w}{\partial y}\right) + \frac{\partial^2 M_y'}{\partial y^2} + \frac{\partial M_y''}{\partial y^2}$$

$$+ \frac{\partial}{\partial y}\left(N_{xy}' \frac{\partial w}{\partial x}\right) + \frac{\partial}{\partial x}\left(N_{xy}' \frac{\partial w}{\partial y}\right) + \frac{\partial}{\partial x}\left(N_{xy}'' \frac{\partial w}{\partial y}\right)$$

$$+ \frac{\partial}{\partial y}\left(N_{xy}'' \frac{\partial w}{\partial x}\right) - 2 \frac{\partial^2 M_{xy}'}{\partial x \partial y} + 2 \frac{\partial^2 M_{xy}''}{\partial x \partial y} + \frac{\partial \bar{Q}}{\partial x}$$

$$\left. + \frac{\partial \bar{Q}}{\partial y} + q \right] \delta w \, dx\, dy - \iint \left(\frac{\partial N_y'}{\partial y} + \frac{\partial N_{xy}'}{\partial x} \right.$$

$$\left. + \frac{\partial N_y''}{\partial y} + \frac{\partial N_{xy}''}{\partial x} \right) \delta \bar{v}_o \, dx\, dy$$

$$-\iint \left(\frac{\bar{t}}{2} \frac{\partial N_y'}{\partial y} + \frac{\bar{t}}{2} \frac{\partial N_{xy}}{\partial x} - \frac{\bar{t}}{2} \frac{\partial N_y''}{\partial y} - \frac{\bar{t}}{2} \frac{\partial N_{xy}}{\partial x} \right.$$

$$\left. - \bar{Q}_y \right) \delta \psi_y \, dx\, dy + \oint \left(N_x' + N_x'' \right) \delta \bar{u}_o \, dy$$

$$+ \frac{\bar{t}}{2} \oint \left(N_x' - N_x'' \right) \delta \psi_x \, dy + \oint \left(N_x' \frac{\partial w}{\partial x} \right.$$

$$+ N_x{}'' \frac{\partial w}{\partial x} + \frac{\partial M_x'}{\partial x} + \frac{\partial M_x''}{\partial x} + N_{xy}' \frac{\partial w}{\partial y}$$

$$+ N_{xy}'' \frac{\partial w}{\partial y} + 2 \frac{\partial M_{xy}'}{\partial y} + 2 \frac{\partial M_{xy}''}{\partial y} + \bar{Q}_x \Big) \delta w \, dy$$

$$+ \oint \Big(N_y' \frac{\partial w}{\partial y} + N_y'' \frac{\partial w}{\partial y} + \frac{\partial M_y'}{\partial y} + \frac{\partial M_y''}{\partial y} + N_{xy}' \frac{\partial w}{\partial x}$$

$$+ N_{xy}'' \frac{\partial w}{\partial x} + 2 \frac{\partial M_{xy}'}{\partial x} + 2 \frac{\partial M_{xy}''}{\partial x} + \bar{Q}_y \Big) \delta w \, dx$$

$$+ \oint (N_y' + N_y'') \, \delta \bar{v}_o \, dx + \frac{\bar{t}}{2} \oint (N_y' - N_y'') \, \delta \psi_y \, dx$$

$$+ \oint (N_{xy}' + N_{xy}'') \, \delta \bar{u}_o \, dx + \oint (N_{xy}' + N_{xy}'') \, \delta \bar{v}_o \, dy$$

$$+ \frac{\bar{t}}{2} \oint (N_{xy}' - N_{xy}'') \, \delta \psi_x \, dx + \frac{\bar{t}}{2} \oint (N_{xy}'$$

$$- N_{xy}'') \, \delta \psi_y \, dy - \oint (M_x' + M_x'') \, \delta \left(\frac{\partial w}{\partial x} \right) dy$$

$$- \oint (M_y' + M_y'') \, \delta \left(\frac{\partial w}{\partial y} \right) dx - 2 \, (M_{xy}' \delta w$$

$$+ M_{xy}'' \delta w \Bigg|_{\substack{x=-a \\ y=-b}}^{\substack{x=a \\ y=b}} = 0 \qquad (3.4.25)$$

The coeficients of the terms, $\delta\bar{u}_o$, $\delta\psi_x$, $\delta\bar{v}_o$, $\delta\psi_y$ and δw in the surface integrals vanish since these are independent variation.

Therefore, from Equation (3.4.25) the equilibrium Equations are obtained as follows:

$$\delta u_o: \quad \frac{\partial N_x'}{\partial x} + \frac{\partial N_x''}{\partial x} + \frac{\partial N_{xy}'}{\partial y} + \frac{\partial N_{xy}''}{\partial y} = 0 \qquad (3.4.26)$$

$$\delta\psi_x: \quad \frac{\bar{t}}{2}\left(\frac{\partial N_x'}{\partial x} - \frac{\partial N_x''}{\partial x} + \frac{\partial N_{xy}'}{\partial y} - \frac{\partial N_{xy}''}{\partial y}\right) - \bar{Q}_x = 0 \qquad (3.4.27)$$

$$\delta\bar{v}_o: \quad \frac{\partial N_y'}{\partial y} + \frac{\partial N_y''}{\partial y} + \frac{\partial N_{xy}'}{\partial x} + \frac{\partial N_{xy}''}{\partial x} = 0 \qquad (3.4.28)$$

$$\delta\psi_y: \quad \frac{\bar{t}}{2}\left(\frac{\partial N'}{\partial y} - \frac{\partial N''}{\partial y} + \frac{\partial N_{xy}'}{\partial x} - \frac{\partial N_{xy}''}{\partial x}\right) - \bar{Q}_y = 0 \qquad (3.4.29)$$

$$\delta w: \quad \frac{\partial}{\partial x}\left[\left(N_x' + N_x''\right)\frac{\partial w}{\partial x}\right] \qquad (3.4.30)$$

$$+ \frac{\partial}{\partial y}\left[\left(N_y' + N_y''\right)\frac{\partial w}{\partial y}\right]$$

$$+ \frac{\partial^2}{\partial x^2}\left(M_x' + M''\right) + \frac{\partial^2}{\partial y^2}\left(M_y' + M_y''\right)$$

$$+ \frac{\partial}{\partial y}\left[\left(N_{xy}' + N_{xy}''\right)\frac{\partial w}{\partial x}\right]$$

$$+ \frac{\partial}{\partial x}\left[\left(N_{xy}' + N_{xy}''\right)\frac{\partial w}{\partial y}\right]$$

$$+2\frac{\partial^2}{\partial x \partial y}\left(M_{xy}' + M_{xy}''\right)$$

$$+\frac{\partial \bar{Q}_x}{\partial x} + \frac{\partial \bar{Q}_y}{\partial y} + q = 0 \qquad (3.4.30)$$

Introducing,

$$N_x = N_x' + N_x'' \qquad (3.4.31)$$

$$N_y = N_y' + N_y'' \qquad (3.4.32)$$

$$N_{xy} = N_{xy}' + N_{xy}'' \qquad (3.4.33)$$

$$M_x = \frac{\bar{t}}{2}\left(N_x' - N_x''\right) \qquad (3.4.34)$$

$$M_y = \frac{\bar{t}}{2}\left(N_y' - N_y''\right) \qquad (3.4.35)$$

$$M_{xy} = \frac{\bar{t}}{2}\left(N_{xy}' - N_{xy}''\right) \qquad (3.4.36)$$

Substituting Equations (3.4.31) through (3.4.36) into Equations (3.4.26) through (3.4.30), we find

$$\frac{\partial N_x}{\partial x} + \frac{\partial N_{xy}}{\partial y} = 0 \qquad (3.4.37)$$

$$\frac{\partial N_y}{\partial y} + \frac{\partial N_{xy}}{\partial x} = 0 \qquad (3.4.38)$$

$$\frac{\partial M_x}{\partial x} + \frac{\partial M_{xy}}{\partial y} - \bar{Q}_x = 0 \qquad (3.4.39)$$

$$\frac{\partial M_y}{\partial y} + \frac{\partial M_{xy}}{\partial x} - \bar{Q}_y = 0 \qquad (3.4.40)$$

$$N_x \frac{\partial^2 w}{\partial x^2} + N_y \frac{\partial^2 w}{\partial y^2} + 2 N_{xy} \frac{\partial^2 w}{\partial x \partial y} + \frac{\partial^2 (M_x' + M_x'')}{d x^2} \qquad (3.4.41)$$

$$+ \frac{\partial^2 (M_y' + M_y'')}{\partial y^2} + 2 \frac{\partial^2 (M_{xy}' + M_{xy}'')}{\partial x \partial y}$$

$$+ \frac{\partial \bar{Q}_x}{\partial x} + \frac{\partial \bar{Q}_y}{\partial y} + q = 0$$

For clamped edges, the boundary conditions are obtained from the surface integrals of equation (3.4.24). The derivation of boundary conditions here are similar to the Kirchhoff's derivation of boundary conditions for clamped homogeneous plates, the details of this method can be found in Timoshenko's "Theory of Plates and Shells", p. 88.

$\bar{u}_o = 0$ at boundary $\bar{v}_o = 0$ at boundary

or $N_x = 0$ at $x = \pm b$ or $N_y = 0$ at $x = \pm a$

and $N_{xy} = 0$ at $x = \pm a$ and $N_{xy} = 0$ at $x = \pm b$

$\psi_x = 0$ at boundary $\psi_y = 0$ at boundary

$M_x = 0$ at $x = \pm b$ or $M_y = 0$ at $y = \pm a$ (3.4.42)

and

$M_{xy} = 0$ at $y = \pm a$ and $M_{xy} = 0$ at $x = \pm b$

$w = 0$ at boundary

or

$$N_x \frac{\partial w}{\partial x} + \frac{\partial (M_x' + M_x'')}{\partial x} + N_{xy} \frac{\partial w}{\partial y}$$

$$+ 2 \frac{\partial (M_{xy}' + M_{xy}'')}{\partial y} + \bar{Q}_x = 0 \quad \text{at} \quad y = \pm a$$

and

$$N_y \frac{\partial w}{\partial y} + \frac{\partial (M_y' + M_y'')}{\partial y} + N_{xy} \frac{\partial w}{\partial x} \tag{3.4.43}$$

$$+ 2 \frac{\partial (M_{xy}' + M_{xy}'')}{\partial y} + \bar{Q}_y = 0 \quad \text{at} \quad x = \pm b$$

and

$$M_{xy}' + M_{xy}'' = 0 \quad \text{at} \quad (a, b), (-a, -b)$$

$$\frac{\partial w}{\partial x} = 0 \quad \text{at boundary} \qquad \frac{\partial w}{\partial y} = 0 \quad \text{at boundary}$$

$$(3.4.44)$$

or

$$M_x' + M_x'' = 0 \quad \text{at} \quad x = \pm b \quad \text{or} \quad M_y' + M_y'' = 0 \quad \text{at} \quad y = \pm a$$

Substituting Equations (3.3.28) through (3.3.35) into Equations (3.3.36) through (3.3.43), and subsequent results into Equations (3.4.7) through (3.4.20). The resulting expressions are then substituted into Equations (3.4.30) through (3.4.35) and integrated to obtain following:.

$$N_x = \frac{2Et}{1-\nu^2}\left\{\frac{\partial \bar{u}_o}{\partial x} + \frac{1}{2}\left(\frac{\partial w}{\partial x}\right)^2 + \nu\left[\frac{\partial \bar{v}_o}{\partial y} + \frac{1}{2}\left(\frac{\partial w}{\partial y}\right)^2\right]\right\} \qquad (3.4.45)$$

$$N_y = \frac{2Et}{1-\nu^2}\left\{\frac{\partial \bar{v}_o}{\partial y} + \frac{1}{2}\left(\frac{\partial w}{\partial y}\right)^2 + \nu\left[\frac{\partial \bar{u}_o}{\partial x} + \frac{1}{2}\left(\frac{\partial w}{\partial x}\right)^2\right]\right\} \qquad (3.4.46)$$

$$N_{xy} = \frac{Et}{1+\nu}\left(\frac{\partial \bar{u}_o}{\partial y} + \frac{\partial \bar{v}_o}{\partial x} + \frac{\partial w}{\partial x}\ \frac{\partial w}{\partial y}\right) \qquad (3.4.47)$$

$$M_x = \frac{Et\bar{t}}{2(1-\nu^2)}\left[\bar{t}\,\frac{\partial \psi_x}{\partial x} + t\,\frac{\partial^2 w}{\partial x^2} + \nu\left(\bar{t}\,\frac{\partial \psi_y}{\partial y} - t\,\frac{\partial^2 w}{\partial y^2}\right)\right] \qquad (3.4.48)$$

$$M_y = \frac{E t \bar{t}}{2(1-\nu^2)}\left[\bar{t}\,\frac{\partial \psi_y}{\partial y} - t\,\frac{\partial^2 w}{\partial y^2} + \nu\left(\bar{t}\,\frac{\partial \psi_x}{\partial x} - t\,\frac{\partial^2 w}{\partial x^2}\right)\right] \tag{3.4.49}$$

$$M_{xy} = \frac{E t \bar{t}}{2(1+\nu)}\left(\frac{\bar{t}}{2}\,\frac{\partial \psi_x}{\partial y} + \frac{\bar{t}}{2}\,\frac{\partial \psi_y}{\partial x} - t\,\frac{\partial^2 w}{\partial x \partial y}\right) \tag{3.4.50}$$

$$M_x' + M_x'' = \frac{E t^2}{2(1-\nu^2)}\left[\bar{t}\,\frac{\partial \psi_x}{\partial x} - \frac{4}{3}t\,\frac{\partial^2 w}{\partial x^2} + \nu\left(\bar{t}\,\frac{\partial \psi_y}{\partial y} - \frac{4}{3}t\,\frac{\partial^2 w}{\partial y^2}\right)\right] \tag{3.4.51}$$

$$M_y' + M_y'' = \frac{E t^2}{2(1-\nu^2)}\left[\bar{t}\,\frac{\partial \psi_y}{\partial y} - \frac{4}{3}t\,\frac{\partial^2 w}{\partial y^2} + \nu\left(\bar{t}\,\frac{\partial \psi_x}{\partial x} - \frac{4}{3}t\,\frac{\partial^2 w}{\partial x^2}\right)\right] \tag{3.4.52}$$

$$M_{xy}' + M_{xy}'' = \frac{E t^2}{2(1+\nu)}\left(\frac{\bar{t}}{2}\,\frac{\partial \psi_x}{\partial y} + \frac{\bar{t}}{2}\,\frac{\partial \psi_y}{\partial x} - \frac{4}{3}t\,\frac{\partial^2 w}{\partial x \partial y}\right) \tag{3.4.53}$$

$$\bar{Q}_x = G_{xz}\,\bar{t}\left(\frac{\partial w}{\partial x} + \psi_x\right) \tag{3.4.54}$$

$$\bar{Q}_y = G_{yz}\,\bar{t}\left(\frac{\partial w}{\partial y} + \psi_y\right) \tag{3.4.55}$$

Combining these expressions with the equilibrium equations, i.e. substituting Equations (3.4.45) and (3.4.47) into Equation (3.4.37) yields

$$\frac{2Et}{(1-\nu^2)}\left[\frac{\partial^2 \bar{U}_0}{\partial x^2} + \frac{\partial w}{\partial x}\,\frac{\partial^2 w}{\partial x^2} + \nu\left(\frac{\partial^2 \bar{V}_0}{\partial x \partial y} + \frac{\partial w}{\partial y}\,\frac{\partial^2 w}{\partial x \partial y}\right)\right] \tag{3.4.56}$$

$$+ \frac{Et}{(1+\nu)}\left(\frac{\partial^2 \bar{U}_0}{\partial y^2} + \frac{\partial^2 \bar{V}_0}{\partial x \partial y} + \frac{\partial w}{\partial x}\,\frac{\partial^2 w}{\partial y^2} + \frac{\partial w}{\partial y}\,\frac{\partial^2 w}{\partial x \partial y}\right) = 0$$

Substituting Equations (3.4.46) and (3.4.47) into Equation (3.4.38) yields

$$\frac{2Et}{(1-\nu^2)}\left[\frac{\partial^2 \bar{V}_o}{\partial y^2}+\frac{\partial w}{\partial y}\frac{\partial^2 w}{\partial y^2}+\nu\left(\frac{\partial^2 \bar{U}_o}{\partial x \partial y}+\frac{\partial w}{\partial x}\frac{\partial^2 w}{\partial x \partial y}\right)\right] \tag{3.4.57}$$

$$+\frac{Et}{(1+\nu)}\left(\frac{\partial^2 \bar{U}_o}{\partial x \partial y}+\frac{\partial^2 \bar{V}_o}{\partial x^2}+\frac{\partial w}{\partial x}\frac{\partial^2 w}{\partial x \partial y}+\frac{\partial w}{\partial y}\frac{\partial^2 w}{\partial x^2}\right)=0$$

Substituting Equations (3.4.48), (3.4.50) and (3.4.54) into Equation (3.4.39) yields

$$\frac{Et\bar{t}}{2(1-\nu^2)}\left[\bar{t}\,\frac{\partial^2 \psi_x}{\partial x^2}-t\frac{\partial^3 w}{\partial x^3}+\nu\left(\bar{t}\,\frac{\partial^2 \psi_y}{\partial x \partial y}-t\,\frac{\partial^3 w}{\partial x \partial y^2}\right)\right] \tag{3.4.58}$$

$$+\frac{Et\bar{t}}{2(1+\nu)}\left(\frac{\bar{t}}{2}\,\frac{\partial^2 \psi_x}{\partial y^2}+\frac{\bar{t}}{2}\,\frac{\partial^2 \psi_y}{\partial x \partial y}-t\frac{\partial^3 w}{\partial x \partial y^2}\right)-G_{xz}\,\bar{t}\left(\frac{\partial w}{\partial x}+\psi_x\right)=0$$

Substituting Equations (3.4.49), (3,4,50) and (3.4.55) into Equation (3.4.40) yields

$$\frac{Et\bar{t}}{2(1-\nu^2)}\left[\bar{t}\,\frac{\partial^2 \psi_y}{\partial y^2}-t\frac{\partial^3 w}{\partial y^3}+\nu\left(\bar{t}\,\frac{\partial^2 \psi_x}{\partial x \partial y}-t\,\frac{\partial^3 w}{\partial x^2 \partial y}\right)\right] \tag{3.4.59}$$

$$+\frac{Et\bar{t}}{2(1+\nu)}\left(\frac{\bar{t}}{2}\,\frac{\partial^2 \psi_y}{\partial x \partial y}+\frac{t}{2}\,\frac{\partial^2 \psi_y}{\partial x^2}-t\frac{\partial^3 w}{\partial x^2 \partial y}\right)-G_{yz}\,\bar{t}\left(\frac{\partial w}{\partial y}+\psi_y\right)=0$$

Substituting Equations (3.4.45) through (3.4.47) and Equations (3.4.51) through (3.4.55) into Equation (3.4.41) yields

$$\frac{2Et}{1-\nu^2}\left\{\frac{\partial \bar{U}_o}{\partial x}+\frac{1}{2}\left(\frac{\partial w}{\partial x}\right)^2+\nu\left[\frac{\partial \bar{V}_o}{\partial y}+\frac{1}{2}\left(\frac{\partial w}{\partial y}\right)^2\right]\right\}\frac{\partial^2 w}{\partial x^2} \tag{3.4.60}$$

$$+\frac{2Et}{1-\nu^2}\left\{\frac{\partial \bar{V}_o}{\partial y}+\frac{1}{2}\left(\frac{\partial w}{\partial y}\right)^2+\nu\left[\frac{\partial U_o}{\partial x}+\frac{1}{2}\left(\frac{\partial w}{\partial x}\right)^2\right]\right\}\frac{\partial^2 w}{\partial y^2}$$

$$+ \frac{2Et}{1+\nu}\left(\frac{\partial \bar{U}_0}{\partial y} + \frac{\partial \bar{V}_0}{\partial x} + \frac{\partial w}{\partial x}\frac{\partial w}{\partial y}\right)\frac{\partial^2 w}{\partial x \partial y}$$

$$+ \frac{Et^2}{2(1-\nu^2)}\left[\bar{t}\frac{\partial^3 w}{\partial x^3} - \frac{4t}{3}\frac{\partial^4 w}{\partial x^4} + \bar{t}\frac{\partial^3 \psi_y}{\partial y^3} - \frac{4}{3}t\frac{\partial^4 w}{\partial y^4}\right.$$

$$\left. + \nu\left(\bar{t}\frac{\partial^3 \psi_y}{\partial x^2 \partial y} + \bar{t}\frac{\partial^3 \psi_x}{\partial x \partial y^2} - \frac{8}{3}t\frac{\partial^4 w}{\partial x^2 \partial y^2}\right)\right]$$

$$+ \frac{Et^2}{1+\nu}\left(\frac{\bar{t}}{2}\frac{\partial^3 \psi_x}{\partial x \partial y^2} + \frac{\bar{t}}{2}\frac{\partial^3 \psi_y}{\partial x^2 \partial y} - \frac{4}{3}t\frac{\partial^4 w}{\partial x^2 \partial y^2}\right)$$

$$+ G_{xz}\bar{t}\left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial \psi_x}{\partial x}\right) + G_{yz}\bar{t}\left(\frac{\partial^2 w}{\partial y^2} + \frac{\partial \psi_y}{\partial y}\right) + q = 0 \qquad (3.4.60)$$

In working with skew plates it is often advantageous to transform the governing differential equations, Equations (3.4.56) through (3.4.60), in skewed co-ordinates.

3.5 Transformation of the differential equations into skew dimensionless form.

Transforming the partial differential operators into skew co-ordinates yields

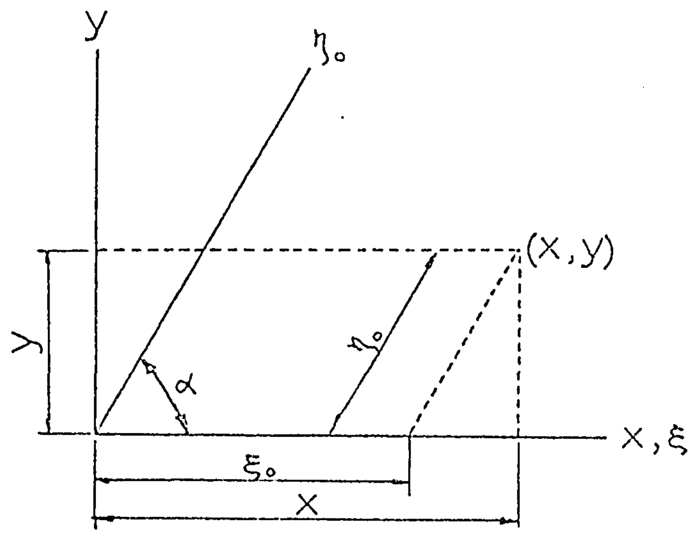

Fig. 2

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 & \cos\alpha \\ 0 & \sin\alpha \end{bmatrix} \begin{bmatrix} \xi_o \\ \eta_o \end{bmatrix} \qquad (3.5.1)$$

$$\begin{bmatrix} \frac{\partial}{\partial x} \\ \frac{\partial}{\partial y} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -\cot\alpha & \csc\alpha \end{bmatrix} \begin{bmatrix} \frac{\partial}{\partial \xi_o} \\ \frac{\partial}{\partial \eta_o} \end{bmatrix} \qquad (3.5.2)$$

$$\begin{bmatrix} \frac{\partial^2}{\partial x^2} \\ \frac{\partial^2}{\partial y^2} \\ \frac{\partial^2}{\partial x \partial y} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \cot^2\alpha & \csc^2\alpha & -2\cot\alpha\csc\alpha \\ -\cot\alpha & 0 & \csc\alpha \end{bmatrix} \begin{bmatrix} \frac{\partial^2}{\partial \xi_o^2} \\ \frac{\partial^2}{\partial \eta_o^2} \\ \frac{\partial^2}{\partial \xi_o \partial \eta_o} \end{bmatrix} \qquad (3.5.3)$$

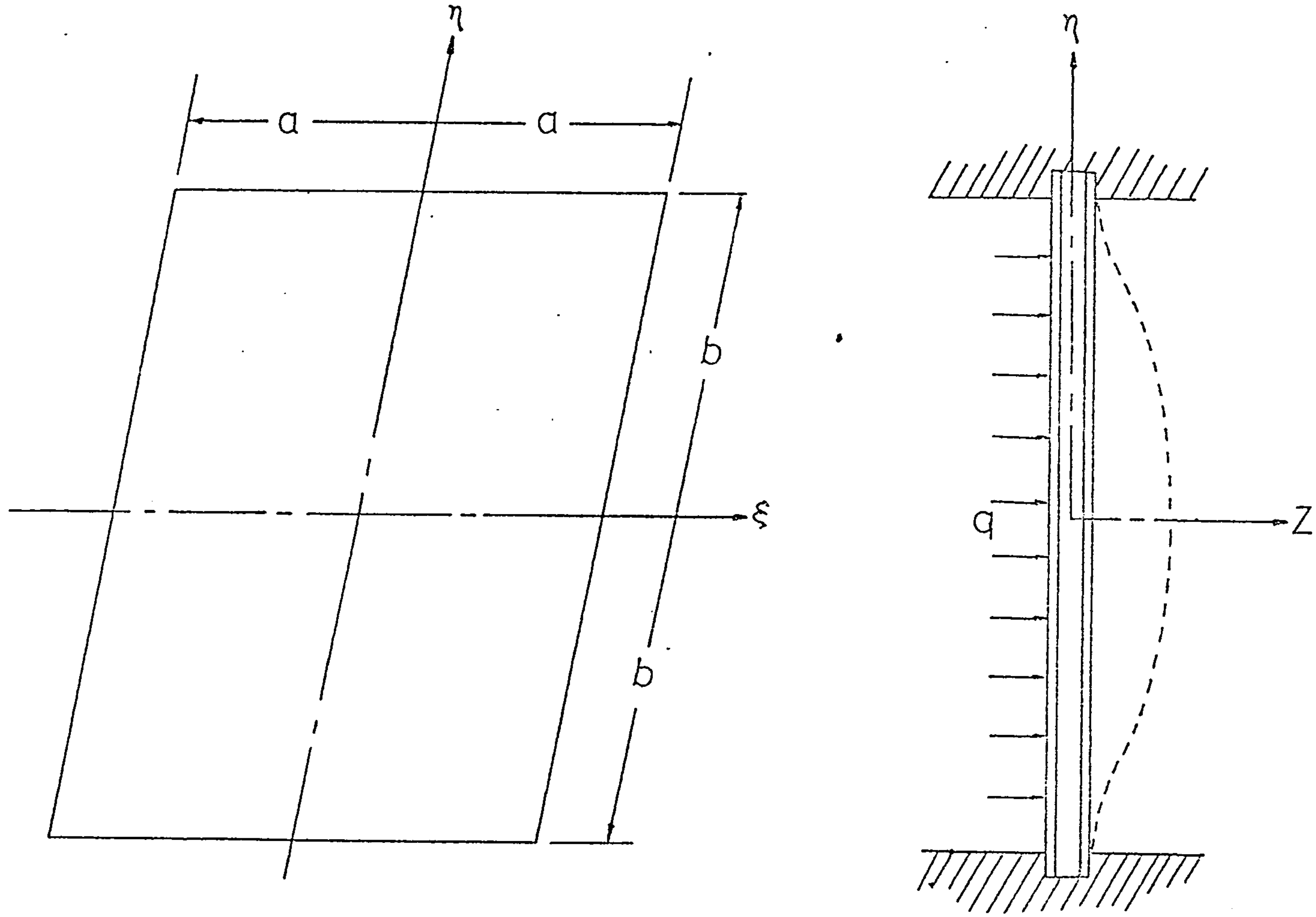

Fig. 3 Skew sandwich plate with uniform load and clamped edges

$$\begin{bmatrix} \frac{\partial^3}{\partial x^3} \\ \frac{\partial^3}{\partial y^3} \\ \frac{\partial^3}{\partial x^2 \partial y} \\ \frac{\partial^3}{\partial x \partial y^2} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ -\cot^3\alpha & \csc^3\alpha & 3\csc\alpha\cot^2\alpha & -3\csc^2\alpha\cot\alpha \\ -\cot\alpha & 0 & \csc\alpha & 0 \\ \cot^2\alpha & 0 & -2\cot\alpha\csc\alpha & \csc^2\alpha \end{bmatrix} \begin{bmatrix} \frac{\partial^3}{\partial \xi_0^3} \\ \frac{\partial^3}{\partial \eta_0^3} \\ \frac{\partial^3}{\partial \xi_0^2 \partial \eta_0} \\ \frac{\partial^3}{\partial \xi_0 \partial \eta_0^2} \end{bmatrix} \qquad (3.5.4)$$

$$\begin{bmatrix} \frac{\partial^4}{\partial x^4} \\ \frac{\partial^4}{\partial y^4} \\ \frac{\partial^4}{\partial x^3 \partial y} \\ \frac{\partial^4}{\partial x^2 \partial y^2} \\ \frac{\partial^4}{\partial x \partial y^3} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \cot^4\alpha & \csc^4\alpha & -4\cot^3\alpha\csc\alpha & 6\cot^2\alpha\csc^2\alpha & -4\cot\alpha\csc^3\alpha \\ -\cot\alpha & 0 & \csc\alpha & 0 & 0 \\ \cot^2\alpha & 0 & -2\cot\alpha\csc\alpha & \csc^2\alpha & 0 \\ -\cot^3\alpha & 0 & 3\csc\alpha\cot^2\alpha & -3\csc^2\alpha\cot\alpha & \csc^3\alpha \end{bmatrix} \begin{bmatrix} \frac{\partial^4}{\partial \xi_0^4} \\ \frac{\partial^4}{\partial \eta_0^4} \\ \frac{\partial^4}{\partial \xi_0^3 \partial \eta_0} \\ \frac{\partial^4}{\partial \xi_0^2 \partial \eta_0^2} \\ \frac{\partial^4}{\partial \xi_0 \partial \eta_0^3} \end{bmatrix} \qquad (3.5.5)$$

Substituting Equations (3.5.1) through (3.5.5) into Equation (3.4.56) yields

$$\left(\frac{2Et}{1-\nu^2} + \frac{Et}{1+\nu}\cot^2\alpha \right) \frac{\partial^2 \bar{U}_0}{\partial \xi_0^2} + \left(\frac{Et}{1+\nu}\csc^2\alpha \right) \frac{\partial^2 \bar{U}_0}{\partial \eta_0^2} \qquad (3.5.6)$$

$$+ \left(\frac{Et}{1+\nu} \right) (-2\cot\alpha\csc\alpha) \frac{\partial^2 \bar{U}_0}{\partial \xi_0 \partial \eta_0} + \left(\frac{2Et\nu}{1-\nu^2} + \frac{Et}{1+\nu} \right) (-\cot\alpha) \frac{\partial^2 \bar{V}_0}{\partial \xi_0^2}$$

$$+\left(\frac{2Et\nu}{1-\nu^2}+\frac{Et}{1+\nu}\right)\csc\alpha\;\frac{\partial^2\bar{V}_0}{\partial\xi_0\partial\eta_0}$$

$$+\left(\frac{2Et}{1-\nu^2}+\frac{2Et}{1+\nu}\cot^2\alpha+\frac{2Et\nu}{1-\nu^2}\cot^2\alpha\right)\left(\frac{\partial W}{\partial\xi_0}\right)\left(\frac{\partial^2 W}{\partial\xi_0^2}\right)$$

$$+\left(\frac{Et}{1+\nu}\csc^2\alpha\right)\left(\frac{\partial W}{\partial\xi_0}\right)\left(\frac{\partial^2 W}{\partial\eta_0^2}\right)$$

$$+\left[-3\cot\alpha\csc\alpha\left(\frac{Et}{1+\nu}\right)-\cot\alpha\csc\alpha\left(\frac{2Et\nu}{1-\nu^2}\right)\right]\left(\frac{\partial W}{\partial\xi_0}\right)\left(\frac{\partial^2 W_0}{\partial\xi_0\partial\eta_0}\right)$$

$$+\left(\frac{2Et\nu}{1-\nu^2}+\frac{Et}{1+\nu}\right)(-\cot\alpha\csc\alpha)\left(\frac{\partial W}{\partial\eta_0}\right)\left(\frac{\partial^2 W}{\partial\xi_0}\right)$$

$$+\left(\frac{2Et\nu}{1-\nu^2}+\frac{Et}{1+\nu}\right)\csc^2\alpha\left(\frac{\partial W}{\partial\eta_0}\right)\left(\frac{\partial^2 W}{\partial\xi_0\partial\eta_0}\right)=0 \qquad (3.5.6)$$

Substituting Equations (3.5.1) through (3.5.5) into Equation (3.4.57) yields

$$\left(\frac{2Et}{1-\nu^2}\cot^2\alpha+\frac{Et}{1+\nu}\right)\frac{\partial^2\bar{V}_0}{\partial\xi_0^2}+\left(\frac{2Et}{1-\nu^2}\csc^2\alpha\right)\frac{\partial^2\bar{V}_0}{\partial\eta_0^2} \qquad (3.5.7)$$

$$+\left(\frac{2Et}{1-\nu^2}\right)(-2\cot\alpha\csc\alpha)\frac{\partial^2\bar{V}_0}{\partial\xi_0\partial\eta_0}+\left(\frac{2Et}{1-\nu^2}\nu+\frac{Et}{1+\nu}\right)(-\cot\alpha)\frac{\partial^2\bar{u}_0}{\partial\xi_0}$$

$$+\left(\frac{2Et}{1-\nu^2}\nu+\frac{Et}{1+\nu}\right)\csc\alpha\;\frac{\partial^2\bar{u}_0}{\partial\xi_0\partial\eta_0}$$

$$+\left[\left(\frac{2Et}{1-\nu^2}\right)(-\cot^3\alpha)+\left(\frac{Et}{1+\nu}\right)(-\cot\alpha)+\left(\frac{2Et}{1-\nu^2}\nu+\frac{Et}{1+\nu}\right)\cot\alpha\right]\frac{\partial W}{\partial\xi_0}\frac{\partial^2 W}{\partial\xi_0^2}$$

$$+\left(\frac{2Et}{1-\nu^2}\right)(-\cot\alpha\csc^2\alpha)\left(\frac{\partial w}{\partial\xi_0}\right)\left(\frac{\partial^2 w}{\partial\eta_0^2}\right)$$

$$+\left[\left(\frac{2Et}{1-\nu^2}\right)(2\cot^2\alpha\csc\alpha)+\left(\frac{2Et}{1-\nu^2}\nu+\frac{Et}{1+\nu}\right)\csc\alpha\right]\frac{\partial w}{\partial\xi_0}\,\frac{\partial^2 w}{\partial\xi_0\partial\eta_0}$$

$$+\left(\frac{2Et}{1-\nu^2}\right)\csc^3\alpha\left(\frac{\partial w}{\partial\eta_0}\right)\left(\frac{\partial^2 w}{\partial\eta_0^2}\right)$$

$$+\left[\left(\frac{2Et}{1-\nu^2}\right)(-2\cot\alpha\csc^2\alpha)\right]\frac{\partial w}{\partial\xi_0}\,\frac{\partial^2 w}{\partial\xi_0\partial\eta_0}=0 \qquad (3.5.7)$$

Substituting Equations (3.5.1) through (3.5.5) into Equation (3.4.58) yields

$$\left[\frac{Et\bar{t}^2}{2(1-\nu^2)}+\frac{Et\bar{t}^2}{4(1+\nu)}\cot^2\alpha\right]\frac{\partial^2\psi_\xi}{\partial\xi_0^2}+\frac{Et\bar{t}^2}{4(1+\nu)}\csc^2\alpha\,\frac{\partial^2\psi_\xi}{\partial\eta_0^2} \qquad (3.5.8)$$

$$+\left[\frac{Et\bar{t}^2}{4(1+\nu)}\right](-2\cot\alpha\csc\alpha)\frac{\partial^2\psi_\xi}{\partial\xi_0\partial\eta_0}-G_{\xi z}\,\bar{t}\,\psi_\xi$$

$$+\left[\frac{Et\bar{t}^2\nu}{2(1-\nu^2)}+\frac{Et\bar{t}^2}{4(1+\nu)}\right](-\cot\alpha)\frac{\partial^2\psi_\eta}{\partial\xi_0^2}$$

$$+\left[\frac{Et\bar{t}^2\nu}{2(1-\nu^2)}+\frac{Et\bar{t}^2}{4(1+\nu)}\right]\csc\alpha\,\frac{\partial^2\psi_{\eta_0}}{\partial\xi_0\partial\eta_0}-G_{\xi z}\,\bar{t}\,\frac{\partial w}{\partial\xi_0}$$

$$-\left[\frac{Et^2\bar{t}}{2(1-\nu^2)}+\frac{Et^2\bar{t}}{2(1-\nu^2)}\cot\alpha+\frac{Et^2\bar{t}}{2(1+\nu)}\cot^2\alpha\right]\frac{\partial^3 w}{\partial\xi_0^3}$$

$$+\left[\frac{Et^2\bar{t}}{2(1-\nu^2)}+\frac{Et^2\bar{t}}{2(1+\nu)}\right](2\cot\alpha\csc\alpha)\frac{\partial^3 w}{\partial\xi_0^2\partial\eta_0}$$

$$-\left[\frac{Et^2\bar{t}}{2(1-\nu^2)}+\frac{Et^2\bar{t}}{2(1+\nu)}\right]\csc^2\alpha\frac{\partial^3 w}{\partial\xi_0\partial\eta_0^2}=0 \qquad (3.5.8)$$

Substituting Equations (3.5.1) through (3.5.5) into Equation (3.4.59) yields

$$\left[\frac{Et\bar{t}^2}{2(1-\nu^2)}\cot^2\alpha+\frac{Et\bar{t}^2}{4(1+\nu)}\right]\frac{\partial^2\psi_\eta}{\partial\xi_0^2}+\frac{Et\bar{t}^2}{2(1-\nu^2)}\csc^2\alpha\frac{\partial^2\psi_\eta}{\partial\eta_0^2} \qquad (3.5.9)$$

$$+\frac{Et\bar{t}^2}{2(1-\nu^2)}(-2\cot\alpha\csc\alpha)\frac{\partial^2\psi_\eta}{\partial\xi_0\partial\eta_0}-G_{\eta z}\bar{t}\psi_\eta$$

$$+\left[\frac{Et\bar{t}^2\nu}{2(1-\nu^2)}+\frac{Et\bar{t}^2}{4(1+\nu)}\right](-\cot\alpha)\frac{\partial^2\psi_\xi}{\partial\xi_0^2}$$

$$+\left[\frac{Et\bar{t}^2\nu}{2(1-\nu^2)}+\frac{Et\bar{t}^2}{4(1+\nu)}\right]\csc\alpha\frac{\partial^2\psi_\xi}{\partial\xi_0\partial\eta_0}$$

$$+G_{\eta z}\bar{t}\cot\alpha\frac{\partial w}{\partial\xi_0}-G_{\eta z}\bar{t}\csc\alpha\frac{\partial w}{\partial\eta_0}$$

$$+\left[\frac{Et^2\bar{t}}{2(1-\nu^2)}\cot^3\alpha+\frac{Et^2\bar{t}}{2(1-\nu^2)}\cot\alpha+\frac{Et^2\bar{t}}{2(1+\nu)}\cot\alpha\right]\frac{\partial^3 w}{\partial\xi_0^3}$$

$$-\frac{Et^2\bar{t}}{2(1-\nu^2)}\csc^3\alpha\frac{\partial^3 w}{\partial\eta_0^3}$$

$$-\left[\frac{Et^2\bar{t}}{2(1-\nu^2)}(3\csc\alpha\cot^2\alpha) + \frac{Et^2\bar{t}\,\nu}{2(1-\nu^2)}\csc\alpha + \frac{Et^2\bar{t}}{2(1+\nu)}\csc\alpha\right]\frac{\partial^3 w}{\partial\xi_0^2\partial\eta_0}$$

$$+\ 3\csc^2\alpha\cot\alpha\,\frac{Et^2\bar{t}}{2(1-\nu^2)}\,\frac{\partial^3 w}{\partial\xi_0\partial\eta_0^2} = 0 \tag{3.5.9}$$

Substituting Equations (3.5.1) through (3.5.5) into Equation (3.4.60) yields

$$\frac{2Et}{1-\nu^2}\left\{\frac{\partial\bar{u}_0}{\partial\xi_0} + \frac{1}{2}\left(\frac{\partial w}{\partial\xi_0}\right)^2 + \nu\left[-\cot\alpha\frac{\partial\bar{v}_0}{\partial\xi_0} + \csc\alpha\frac{\partial\bar{v}_0}{\partial\eta_0} + \frac{1}{2}\left(-\cot\alpha\frac{\partial w}{\partial\xi_0}\right.\right.\right.$$

$$\left.\left.\left.+\csc\alpha\frac{\partial w}{\partial\eta_0}\right)^2\right]\right\}\frac{\partial^2 w}{\partial\xi_0^2} \tag{3.5.10}$$

$$+\frac{2Et}{1-\nu^2}\left\{-\cot\alpha\frac{\partial\bar{v}_0}{\partial\xi_0} + \csc\alpha\frac{\partial\bar{v}_0}{\partial\eta_0} + \frac{1}{2}\left(-\cot\alpha\frac{\partial w}{\partial\xi_0} + \csc\alpha\frac{\partial w}{\partial\eta_0}\right)^2\right.$$

$$\left.+\nu\left[\frac{\partial\bar{u}_0}{\partial\xi_0} + \frac{1}{2}\left(\frac{\partial w}{\partial\xi_0}\right)^2\right]\right\}\left(\cot^2\alpha\frac{\partial^2 w}{\partial\xi_0^2} + \csc^2\alpha\frac{\partial^2 w}{\partial\eta_0^2} - 2\cot\alpha\csc\alpha\frac{\partial^2 w}{\partial\xi_0\partial\eta_0}\right)$$

$$+\frac{2Et}{1+\nu}\left[-\cot\alpha\frac{\partial\bar{u}_0}{\partial\xi_0} + \csc\alpha\frac{\partial\bar{u}_0}{\partial\eta_0} + \frac{\partial\bar{v}_0}{\partial\xi_0} + \frac{\partial w_0}{\partial\xi_0}\left(-\cot\alpha\frac{\partial w}{\partial\xi_0} + \csc\alpha\frac{\partial w}{\partial\eta_0}\right)\right]$$

$$\left(-\cot\alpha\frac{\partial^2 w_0}{\partial\xi_0^2} + \csc\alpha\frac{\partial^2 w_0}{\partial\xi_0\partial\eta_0}\right)$$

$$+\frac{Et^2}{2(1-\nu^2)}\left[\bar{t}\,\frac{\partial^3\psi_\xi}{\partial\xi_0^3} - \frac{4}{3}t\frac{\partial^4 w}{\partial\xi_0^4} + \bar{t}\left(-\cot^3\alpha\frac{\partial^3\psi_\xi}{\partial\xi_0^3} + \csc^3\alpha\frac{\partial^3\psi_\xi}{\partial\eta_0^3}\right.\right.$$

$$\left.\left.+\ 3\csc\alpha\cot^2\alpha\frac{\partial^3\psi_\xi}{\partial\xi_0^2\partial\eta_0} - 3\csc^2\alpha\cot\alpha\frac{\partial^3\psi_\xi}{\partial\xi_0\partial\eta_0^2}\right)\right.$$

$$- \frac{4}{3} t \left(\cot^4\alpha \frac{\partial^4 W}{\partial \xi_o^4} + \csc^4\alpha \frac{\partial^4 W}{\partial \eta_o^4} - 4 \cot^3\alpha \csc\alpha \frac{\partial^4 W}{\partial \xi_o^3 \partial \eta} \right.$$

$$\left. + 6 \cot^2\alpha \csc^2\alpha \frac{\partial^4 W}{\partial \xi_o^2 \partial \eta_o^2} - 4 \cot\alpha \csc^3\alpha \frac{\partial^4 W}{\partial \xi_o \partial \eta_o^3} \right) \Big]$$

$$- \left[\frac{E t^2 \bar{t} \nu}{2(1-\nu^2)} - \frac{E t^2 \bar{t}}{2(1+\nu)} \right] \left(-\cot\alpha \frac{\partial^3 \psi_\eta}{\partial \xi_o^3} + \csc\alpha \frac{\partial^3 \psi_\eta}{\partial \xi_o^2 \partial \eta_o} \right)$$

$$- \left[\frac{E t^2 \bar{t} \nu}{2(1-\nu^2)} - \frac{E t^2 \bar{t}}{2(1+\nu)} \right] \left(\cot^2\alpha \frac{\partial^3 \psi_\xi}{\partial \xi_o^3} - 2 \cot\alpha \csc\alpha \frac{\partial^3 \psi_\xi}{\partial \xi_o^2 \partial \eta_o} + \csc^2\alpha \frac{\partial^3 \psi_\xi}{\partial \xi_o \partial \eta_o^2} \right)$$

$$+ \left[\frac{8 E t^2 \bar{t}}{6(1-\nu^2)} - \frac{4 E t^2 \bar{t}}{3(1+\nu)} \right] \left(\cot^2\alpha \frac{\partial^4 W}{\partial \xi_o^4} - 2 \cot\alpha \csc\alpha \frac{\partial^4 W}{\partial \xi_o^3 \partial \eta_o} + \csc^2\alpha \frac{\partial^4 W}{\partial \xi_o^2 \partial \eta_o^2} \right)$$

$$+ G_{\xi z} \bar{t} \left(\frac{\partial^2 W}{\partial \xi_o^2} + \frac{\partial \psi_\xi}{\partial \xi_o} \right)$$

$$+ G_{\eta z} \bar{t} \left(\cot^2\alpha \frac{\partial^2 W}{\partial \xi_o^2} + \csc^2\alpha \frac{\partial^2 W}{\partial \eta_o^2} - 2 \cot\alpha \csc\alpha \frac{\partial^2 W}{\partial \xi_o \partial \eta_o} - \cot\alpha \frac{\partial \psi_\eta}{\partial \xi_o} + \csc\alpha \frac{\partial \psi_\eta}{\partial \eta_o} \right)$$

$$+ q = 0 \qquad (3.5.10)$$

Introducing the dimensionless ratios

$$\xi = \frac{\xi_o}{a}, \quad \eta = \frac{\eta_o}{b}, \quad \lambda = \frac{a}{b}, \quad \bar{u}_o = \frac{\bar{t}^2}{12a} U,$$

$$\bar{V}_o = \frac{\bar{t}^2}{12a} V, \qquad w = \frac{\bar{t}}{2\sqrt{3}} W,$$

$$\mu = \frac{t}{a}, \qquad \theta = \frac{\bar{t}}{a}, \qquad Q = \frac{24\sqrt{3}\, a^3 (1-\nu^2)}{E t \bar{t}^2} q$$

into Equations (3.5.6) through (3.5.10), the following governing differential equations are obtained in skew dimensionless form as:

$$\left[2+(1-\nu)\cot^2\alpha\right]\frac{\partial^2 U}{\partial \xi^2}+\left[(1-\nu)\csc^2\alpha\,\lambda^2\right]\frac{\partial^2 U}{\partial \eta^2} \tag{3.5.11}$$

$$-2\cot\alpha\csc\alpha(1-\nu)\lambda\frac{\partial^2 U}{\partial\xi\partial\eta}-\cot\alpha(1+\nu)\lambda^2\frac{\partial V}{\partial\xi^2}$$

$$+\csc\alpha(1+\nu)\lambda\frac{\partial^2 V}{\partial\xi\partial\eta}+2\csc^2\alpha\frac{\partial W}{\partial\xi}\frac{\partial^2 W}{\partial\xi^2}$$

$$+(1-\nu)\csc^2\alpha\,\lambda^2\frac{\partial W}{\partial\xi}\frac{\partial^2 W}{\partial\eta^2}-\cot\alpha\csc\alpha(3-\nu)\lambda\frac{\partial W}{\partial\eta}\frac{\partial^2 W}{\partial\xi^2}$$

$$+(1+\nu)\csc^2\alpha\,\lambda^2\frac{\partial W}{\partial\eta}\frac{\partial^2 W}{\partial\xi\partial\eta}=0$$

$$\left[2\cot^2\alpha+(1-\nu)\right]\frac{\partial^2 V}{\partial\xi^2}+2\csc^2\alpha\,\lambda^2\frac{\partial^2 V}{\partial\eta^2} \tag{3.5.12}$$

$$-4\cot\alpha\csc\alpha\,\lambda\frac{\partial^2 V}{\partial\xi\partial\eta}-\cot\alpha(1+\nu)\frac{\partial^2 U}{\partial\xi^2}$$

$$+\csc\alpha(1+\nu)\lambda\frac{\partial^2 U}{\partial\xi\partial\eta}+\left[-\cot^3\alpha+2\nu\cot\alpha\right]\frac{\partial W}{\partial\xi}\frac{\partial^2 W}{\partial\xi^2}$$

$$-2\cot\alpha\csc^2\alpha\,\lambda^2\frac{\partial W}{\partial\xi}\frac{\partial^2 W}{\partial\eta^2}$$

$$+\left[4\cot^2\alpha\csc\alpha + \csc\alpha\,(1+\nu)\right]\lambda\frac{\partial W}{\partial\xi}\frac{\partial^2 W}{\partial\xi\partial\eta}$$

$$+\left[2\cot^2\alpha\csc\alpha + \csc\alpha\,(1-\nu)\right]\lambda\frac{\partial W}{\partial\xi}\frac{\partial^2 W}{\partial\xi^2}$$

$$+\,2\csc^3\alpha\,\lambda^3\frac{\partial W}{\partial\eta}\frac{\partial^2 W}{\partial\eta^2}$$

$$+\left(-4\cot\alpha\csc^2\alpha\right)\lambda^2\frac{\partial W}{\partial\eta}\frac{\partial^2 W}{\partial\xi\partial\eta} = 0 \qquad (3.5.12)$$

$$\left(\frac{2E}{1-\nu^2}+\frac{E}{1+\nu}\cot^2\alpha\right)\theta\mu\frac{\partial^2\psi_\xi}{\partial\xi^2}+\frac{E}{1+\nu}\csc^2\alpha\,\theta\mu\lambda^2\frac{\partial^2\psi_\xi}{\partial\eta^2} \qquad (3.5.13)$$

$$+\left(\frac{E}{1+\nu}\right)(-2\cot\alpha\csc\alpha)\,\theta\mu\lambda\frac{\partial^2\psi_\xi}{\partial\xi\partial\eta} - 4\,G_{\xi z}\psi_\xi$$

$$+\left(\frac{2E\nu}{1-\nu^2}+\frac{E}{1+\nu}\right)(-\cot\alpha)\,\theta\mu\frac{\partial^2\psi_\eta}{\partial\xi^2}$$

$$+\left(\frac{2E\nu}{1-\nu^2}+\frac{E}{1+\nu}\right)\csc\alpha\,\theta\mu\lambda\frac{\partial^2\psi_\eta}{\partial\xi\partial\eta} - G_{\xi z}\frac{2\theta}{\sqrt{3}}\frac{\partial W}{\partial\xi}$$

$$-\left(\frac{E}{1-\nu^2}+\frac{E\nu}{1-\nu^2}\cot^2\alpha+\frac{E}{1+\nu}\cot^2\alpha\right)\theta\mu^2\frac{1}{\sqrt{3}}\frac{\partial^3 W}{\partial\xi^3}$$

$$+\left(\frac{E\nu}{1-\nu^2}+\frac{E}{1+\nu}\right)(2\cot\alpha\csc\alpha)\,\theta\mu^2\lambda\frac{1}{\sqrt{3}}\frac{\partial^3 W}{\partial\xi^2\partial\eta}$$

$$-\left(\frac{E\nu}{1-\nu^2}+\frac{E}{1+\nu}\right)\csc^2\alpha\,\theta\mu^2\lambda^2\frac{1}{\sqrt{3}}\frac{\partial^3 W}{\partial\xi\partial\eta^2} = 0$$

$$\left(\frac{2E}{1-\nu^2}\cot^2\alpha + \frac{E}{1+\nu}\right)\mu\theta\frac{\partial^2\psi_\eta}{\partial\xi^2} + \frac{2E}{1-\nu^2}\csc^2\alpha\,\mu\theta\lambda^2\frac{\partial^2\psi_\eta}{\partial\eta^2} \tag{3.5.14}$$

$$-\frac{4E}{1-\nu^2}\cot\alpha\csc\alpha\,\mu\theta\lambda\frac{\partial^2\psi_\eta}{\partial\xi\partial\eta} - 4G_{\eta z}\psi_\eta$$

$$-\left(\frac{2E\nu}{1-\nu^2} + \frac{E}{1+\nu}\right)\cot\alpha\,\mu\theta\frac{\partial^2\psi_\xi}{\partial\xi^2} + \left(\frac{2E\nu}{1-\nu^2} + \frac{E}{1+\nu}\right)\csc\alpha\,\mu\theta\lambda\frac{\partial^2\psi_\xi}{\partial\xi\partial\eta}$$

$$+ 2G_{\eta z}\cot\alpha\,\theta\frac{1}{\sqrt{3}}\frac{\partial W}{\partial\xi} - 2G_{\eta z}\csc\alpha\,\theta\lambda\frac{1}{\sqrt{3}}\frac{\partial^3 W}{\partial\xi^3}$$

$$-\frac{E}{1-\nu^2}\csc^3\alpha\,\mu^2\theta\lambda^3\frac{1}{\sqrt{3}}\frac{\partial^3 W}{\partial\eta^3}$$

$$-\left[\frac{3E}{1-\nu^2}\csc\alpha\cot^2\alpha + \frac{E\nu}{1-\nu^2}\csc\alpha + \frac{E}{1+\nu}\csc\alpha\right]\mu^2\theta\lambda\frac{1}{\sqrt{3}}\frac{\partial^3 W}{\partial\xi^2\partial\eta}$$

$$+ 3\csc^2\alpha\cot\alpha\frac{E}{1-\nu^2}\mu^2\theta\lambda^2\frac{1}{\sqrt{3}}\frac{\partial^3 W}{\partial\xi\partial\eta^2} = 0$$

$$\left\{2\theta\frac{\partial U}{\partial\xi} + \theta\left(\frac{\partial W}{\partial\xi}\right)^2 + \nu\left[-2\theta\cot\alpha\frac{\partial V}{\partial\xi} + 2\theta\lambda\csc\alpha\frac{\partial V}{\partial\eta}\right.\right. \tag{3.5.15}$$

$$\left.\left. + \theta\left(-\cot\alpha\frac{\partial W}{\partial\xi} + \lambda\csc\alpha\frac{\partial W}{\partial\eta}\right)^2\right]\right\}\frac{\partial^2 W}{\partial\xi^2}$$

$$+\left\{-2\theta\cot\alpha\frac{\partial V}{\partial\xi} + 2\theta\lambda\csc\alpha\frac{\partial V}{\partial\eta} + \theta\left(-\cot\alpha\frac{\partial W}{\partial\xi} + \lambda\csc\alpha\frac{\partial W}{\partial\eta}\right)^2\right.$$

$$\left. + \nu\theta\left[2\frac{\partial U}{\partial\xi} + \left(\frac{\partial W}{\partial\xi}\right)^2\right]\right\}\left(\cot^2\alpha\frac{\partial^2 W}{\partial\xi^2} + \csc^2\alpha\,\lambda^2\frac{\partial^2 W}{\partial\eta^2} - 2\cot\alpha\csc\alpha\,\lambda\frac{\partial^2 W}{\partial\xi\partial\eta}\right)$$

$$+ 20(1-\nu)\Big[-\cot\alpha\frac{\partial U}{\partial\xi} + \csc\alpha\,\lambda\frac{\partial U}{\partial\eta} + \frac{\partial V}{\partial\xi}$$

$$+ \frac{\partial W}{\partial\xi}\Big(-\cot\alpha\frac{\partial W}{\partial\xi} + \csc\alpha\,\lambda\frac{\partial W}{\partial\eta}\Big)\Big]\Big(-\cot\alpha\frac{\partial^2 W}{\partial\xi^2} + \csc\alpha\,\lambda\frac{\partial^2 W}{\partial\xi\partial\eta}\Big)$$

$$+ 12\sqrt{3}\frac{\mu}{\theta}\frac{\partial^3\psi_\xi}{\partial\xi^3} - 8\frac{\mu^2}{\theta}\frac{\partial W}{\partial\xi^4} - 12\sqrt{3}\frac{\mu}{\theta}\cot^3\alpha\frac{\partial^3\psi_\xi}{\partial\xi^3}$$

$$+ 12\sqrt{3}\frac{\mu}{\theta}\lambda^3\csc^3\alpha\frac{\partial^3\psi_\xi}{\partial\eta^3} + 36\sqrt{3}\frac{\mu}{\theta}\cot^3\alpha\frac{\partial^3\psi_\xi}{\partial\xi^3}$$

$$- 36\sqrt{3}\frac{\mu}{\theta}\lambda^2\csc^2\alpha\cot\alpha\frac{\partial^3\psi_\xi}{\partial\xi\partial\eta^2} - 8\frac{\mu^2}{\theta}\cot^4\alpha\frac{\partial^4 W}{\partial\xi^4}$$

$$- 8\frac{\mu^2}{\theta}\lambda^4\csc^4\alpha\frac{\partial^4 W}{\partial\eta^4} + 32\frac{\mu^2}{\theta}\lambda\cot^3\alpha\csc\alpha\frac{\partial^4 W}{\partial\xi^3\partial\eta} \qquad (3.5.15)$$

$$- 48\frac{\mu^2}{\theta}\lambda^2\cot^2\alpha\csc^2\alpha\frac{\partial^4 W}{\partial\xi^2\partial\eta^2} + 32\frac{\mu^2}{\theta}\lambda^3\cot\alpha\csc^3\alpha\frac{\partial^4 W}{\partial\xi\partial\eta^3}$$

$$+ \nu\Big[12\sqrt{3}\frac{\mu}{\theta}\Big(-\cot\alpha\frac{\partial^3\psi_\eta}{\partial\xi^3} + \csc\alpha\,\lambda\frac{\partial^3\psi_\eta}{\partial\xi^2\partial\eta}\Big)$$

$$+ 12\sqrt{3}\frac{\mu}{\theta}\Big(\cot^2\alpha\frac{\partial^3\psi_\xi}{\partial\xi^3} - 2\cot\alpha\csc\alpha\,\lambda\frac{\partial^3\psi_\xi}{\partial\xi^2\partial\eta} + \csc^2\alpha\,\lambda^2\frac{\partial^3\psi_\xi}{\partial\xi\partial\eta^2}\Big)$$

$$- 16\frac{\mu^2}{\theta}\Big(\cot^2\alpha\frac{\partial^4 W}{\partial\xi^4} - 2\lambda\cot\alpha\csc\alpha\frac{\partial^4 W}{\partial\xi^3\partial\eta} + \csc^2\alpha\,\lambda^2\frac{\partial^4 W}{\partial\xi^2\partial\eta^2}\Big)\Big]$$

$$+ 12\sqrt{3}(1-\nu)\frac{\mu}{\theta}\left(-\cot\alpha\frac{\partial^3\psi_\eta}{\partial\xi^3} + \csc\alpha\,\lambda\frac{\partial^3\psi_\eta}{\partial\xi^2\partial\eta}\right)$$

$$- 16(1-\nu)\frac{\mu^2}{\theta}\left(\cot^2\alpha\frac{\partial^4 W}{\partial\xi^4} - 2\cot\alpha\csc\alpha\,\lambda\frac{\partial^4 W}{\partial\xi^3\partial\eta} + \csc^2\alpha\,\lambda^2\frac{\partial^4 W}{\partial\xi^2\partial\eta^2}\right)$$

$$+ G_{\xi z}\left[\frac{12(1-\nu^2)}{\mu E}\frac{\partial^2 W}{\partial\xi^2} + \frac{24\sqrt{3}(1-\nu^2)}{E\mu\theta}\frac{\partial\psi_\xi}{\partial\xi}\right]$$

$$+ G_{\eta z}\left[\cot^2\alpha\,\frac{12(1-\nu^2)}{\mu E}\frac{\partial^2 W}{\partial\xi^2} + \csc^2\alpha\,\frac{12(1-\nu^2)\lambda^2}{\mu E}\frac{\partial^2 W}{\partial\eta^2}\right.$$

$$- 2\cot\alpha\csc\alpha\,\frac{12(1-\nu^2)\lambda}{\mu E}\frac{\partial^2 W}{\partial\xi\partial\eta}$$

$$\left. - \cot\alpha\,\frac{24\sqrt{3}(1-\nu^2)}{E\mu\theta}\frac{\partial\psi_\eta}{\partial\xi} + \csc\alpha\,\frac{24\sqrt{3}(1-\nu^2)\lambda}{E\mu\theta}\frac{\partial\psi_\eta}{\partial\eta}\right]$$

$$+ \frac{24\sqrt{3}\,a^3(1-\nu^2)}{Et\bar{t}^2}\,q = 0 \qquad (3.5.15)$$

For the case under consideration i.e. a skew sandwich plate with built-in edges, the boundary conditions become, from Equations (3.4.42) through (3.4.44):

$$W = U = V = \psi_\xi = \psi_\eta = 0 \quad \text{at} \quad \xi = \pm 1 \text{ and } \eta = \pm 1$$

or

$$\frac{\partial W}{\partial\xi} = 0 \quad \text{at} \quad \xi = \pm 1$$

or

$$\frac{\partial W}{\partial\eta} = 0 \quad \text{at} \quad \eta = \pm 1$$

CHAPTER IV

SOLUTION TO EQUATIONS

4.1 Linearization of governing differential equations.

The coupled non-linear partial differential equations, Equations (3.5.11) through (3.5.15), for a skew sandwich plate will now be linearized by using the perturbation method.

Choose the dimensionless central deflection

$$W_o=(W)_{\xi=\eta=0} \tag{4.1.1}$$

as a perturbation parameter.

Assume the solutions of the differential equations in the form of asending power of W_o as:

$$Q=a_1W_o+a_3W_o^3+\cdots\cdots \tag{4.1.2}$$

$$U=u_2(\xi,\eta)W_o^2+u_4(\xi,\eta)W_o^4+\cdots\cdots \tag{4.1.3}$$

$$V=v_2(\xi,\eta)W_o^2+v_4(\xi,\eta)W_o^4+\cdots\cdots \tag{4.1.4}$$

$$W=w_1(\xi,\eta)W_o+w_3(\xi,\eta)W_o^3+\cdots\cdots \tag{4.1.5}$$

$$\psi_\xi=r_1(\xi,\eta)W_o+r_3(\xi,\eta)W_o^3+\cdots\cdots \tag{4.1.6}$$

$$\psi_\eta=s_1(\xi,\eta)W_o+s_3(\xi,\eta)W_o^3+\cdots\cdots \tag{4.1.7}$$

Where a_1, a_3..... are undeterminated parameters relating the dimensionless cetral deflection W_o to the dimensionless load Q; u_2, u_4..., v_2, v_4...., w_1, w_3...., r_1, r_3...., s_1, s_3.... are functions of the dimensionless co-ordinates satisfying the boundary conditions of the plate and relating the in-plane ,lateral and angular displacements to the same perturbation parameter W_o.

Substituting (4.1.2) through (4.1.7) into (3.5.11) through (3.5.15) and equating like powers of W_o yields the following approximations:

The first order approximation:

$$F_{11}\frac{\partial^2 r_1}{\partial \xi^2} + F_{12}\frac{\partial^2 r_1}{\partial \eta^2} + F_{13}\frac{\partial^2 r_1}{\partial \xi \partial \eta} + F_{14} r_1 + F_{15}\frac{\partial^2 s_1}{\partial \xi^2} \tag{4.1.8}$$

$$+ F_{16}\frac{\partial^2 s_1}{\partial \xi \partial \eta} + F_{17}\frac{\partial w_1}{\partial \xi} + F_{18}\frac{\partial^3 w_1}{\partial \xi^3} + F_{19}\frac{\partial^3 w_1}{\partial \xi^2 \partial \eta}$$

$$+ F_{110}\frac{\partial^2 w_1}{\partial \xi \partial \eta^2} = 0$$

$$S_{11}\frac{\partial^2 s_1}{\partial \xi^2} + S_{12}\frac{\partial^2 s_1}{\partial \eta^2} + S_{13}\frac{\partial^2 s_1}{\partial \xi \partial \eta} + S_{14} s_1 + S_{15}\frac{\partial^2 r_1}{\partial \xi^2} \tag{4.1.9}$$

$$+ S_{16}\frac{\partial^2 r_1}{\partial\xi\partial\eta} + S_{17}\frac{\partial w_1}{\partial\xi} + S_{18}\frac{\partial w_1}{\partial\eta} + S_{19}\frac{\partial^3 w_1}{\partial\xi^3} + S_{111}\frac{\partial^3 w_1}{\partial\xi^2\partial\eta}$$

$$+ S_{112}\frac{\partial^3 w_1}{\partial\xi\partial\eta^2} = 0 \qquad (4.1.9)$$

$$T_{11}\frac{\partial^3 r_1}{\partial\xi^3} + T_{12}\frac{\partial^4 w_1}{\partial\xi^4} + T_{13}\frac{\partial^3 s_1}{\partial\xi^3} + T_{14}\frac{\partial^3 s_1}{\partial\eta^3} + T_{15}\frac{\partial^3 s_1}{\partial\xi^2\partial\eta} \qquad (4.1.10)$$

$$+ T_{16}\frac{\partial^3 s_1}{\partial\xi\partial\eta^2} + T_{17}\frac{\partial^4 w_1}{\partial\eta^4} + T_{18}\frac{\partial^4 w_1}{\partial\xi^3\partial\eta} + T_{19}\frac{\partial^4 w_1}{\partial\xi^2\partial\eta^2} + T_{110}\frac{\partial^4 w_1}{\partial\xi\partial\eta^3}$$

$$+ T_{111}\frac{\partial^3 r_1}{\partial\xi^2\partial\eta} + T_{112}\frac{\partial^3 r_1}{\partial\xi\partial\eta^2} + T_{113}\frac{\partial^2 w_1}{\partial\xi^2} + T_{114}\frac{\partial r_1}{\partial\xi_1} + T_{115}\frac{\partial^2 w_1}{\partial\eta^2}$$

$$+ T_{116}\frac{\partial^2 w_1}{\partial\xi\partial\eta} + T_{117}\frac{\partial s_1}{\partial\xi} + T_{118}\frac{\partial s_1}{\partial\eta} + a_1 = 0$$

The second order approximation:

$$F_{21}\frac{\partial^2 u_2}{\partial\xi^2} + F_{22}\frac{\partial^2 u_2}{\partial\eta^2} + F_{23}\frac{\partial^2 u_2}{\partial\xi\partial\eta} + F_{24}\frac{\partial^2 v_2}{\partial\xi^2} \qquad (4.1.11)$$

$$+ F_{25}\frac{\partial^2 v_2}{\partial\xi\partial\eta} + F_{26}\frac{\partial w_1}{\partial\xi}\frac{\partial^2 w_1}{\partial\xi^2} + F_{27}\frac{\partial w_1}{\partial\xi}\frac{\partial^2 w_1}{\partial\eta^2}$$

$$+ F_{28}\frac{\partial w_1}{\partial\xi}\frac{\partial^2 w_1}{\partial\xi\partial\eta} + F_{29}\frac{\partial w_1}{\partial\eta}\frac{\partial^2 w_1}{\partial\xi^2} + F_{210}\frac{\partial w_1}{\partial\eta}\frac{\partial^2 w_1}{\partial\xi\partial\eta} = 0$$

$$S_{21}\frac{\partial^2 V_1}{\partial\xi^2} + S_{22}\frac{\partial^2 V_2}{\partial\eta^2} + S_{23}\frac{\partial^2 V_2}{\partial\xi\partial\eta} + S_{24}\frac{\partial^2 U_2}{\partial\xi^2} \qquad (4.1.12)$$

$$+ S_{25}\frac{\partial^2 U_2}{\partial\xi\partial\eta} + S_{26}\frac{\partial W_1}{\partial\xi}\frac{\partial^2 W_1}{\partial\xi^2} + S_{27}\frac{\partial W_1}{\partial\xi}\frac{\partial^2 W_1}{\partial\eta^2}$$

$$+ S_{28}\frac{\partial W_1}{\partial\xi}\frac{\partial^2 W_1}{\partial\xi\partial\eta} + S_{29}\frac{\partial W_1}{\partial\eta}\frac{\partial^2 W_1}{\partial\xi^2} + S_{210}\frac{\partial W_1}{\partial\eta}\frac{\partial^2 W_1}{\partial\eta^2}$$

$$+ S_{211}\frac{\partial W_1}{\partial\eta}\frac{\partial^2 W_1}{\partial\xi\partial\eta} = 0$$

The third order approximation:

$$F_{11}\frac{\partial^2 r_3}{\partial\xi^2} + F_{12}\frac{\partial^2 r_3}{\partial\eta^2} + F_{13}\frac{\partial^2 r_3}{\partial\xi\partial\eta} + F_{14} r_3 + F_{15}\frac{\partial^2 s_3}{\partial\xi^2} \qquad (4.1.13)$$

$$+ F_{16}\frac{\partial^2 s_3}{\partial\xi\partial\eta} + F_{17}\frac{\partial W_3}{\partial\xi} + F_{18}\frac{\partial^3 W_3}{\partial\xi^3} + F_{19}\frac{\partial^3 W_3}{\partial\xi^2\partial\eta}$$

$$+ F_{110}\frac{\partial^3 W}{\partial\xi\partial\eta^2} = 0$$

$$S_{11}\frac{\partial^2 s_3}{\partial\xi^2} + S_{12}\frac{\partial^2 s_3}{\partial\eta^2} + S_{13}\frac{\partial^2 s_3}{\partial\xi\partial\eta} + S_{14} s_3 + S_{15}\frac{\partial^2 r_3}{\partial\xi^2} \qquad (4.1.14)$$

$$+ S_{16}\frac{\partial^2 r_3}{\partial\xi\partial\eta} + S_{17}\frac{\partial W_3}{\partial\xi} + S_{18}\frac{\partial W_3}{\partial\eta} + S_{19}\frac{\partial^3 W_3}{\partial\xi^3} + S_{110}\frac{\partial^3 W_3}{\partial\eta^3}$$

$$+ S_{111}\frac{\partial^3 W_3}{\partial\xi^2\partial\eta} + S_{112}\frac{\partial^3 W_3}{\partial\xi\partial\eta^2} = 0$$

$$T_{11}\frac{\partial^3 r_3}{\partial \xi^3} + T_{12}\frac{\partial^4 w_3}{\partial \xi^4} + T_{13}\frac{\partial^3 s_3}{\partial \xi^3} + T_{14}\frac{\partial^3 s_3}{\partial \eta^3} + T_{15}\frac{\partial^3 s_3}{\partial \xi^2 \partial \eta} \qquad (4.1.15)$$

$$+ T_{16}\frac{\partial^3 s_3}{\partial \xi \partial \eta^2} + T_{17}\frac{\partial^4 w_3}{\partial \eta^4} + T_{18}\frac{\partial^4 w_3}{\partial \xi^3 \partial \eta} + T_{19}\frac{\partial^4 w_3}{\partial \xi^2 \partial \eta^2} + T_{110}\frac{\partial^4 w_3}{\partial \xi \partial \eta^3}$$

$$+ T_{111}\frac{\partial^3 r_3}{\partial \xi^2 \partial \eta} + T_{112}\frac{\partial^3 r_3}{\partial \xi \partial \eta^2} + T_{113}\frac{\partial^2 w_3}{\partial \xi^2} + T_{114}\frac{\partial r_3}{\partial \xi}$$

$$+ T_{115}\frac{\partial^2 w_3}{\partial \eta^2} + T_{116}\frac{\partial^2 w_3}{\partial \xi \partial \eta} + T_{117}\frac{\partial s_3}{\partial \xi} + T_{118}\frac{\partial s_3}{\partial \eta}$$

$$+ a_3 + \phi_1 \frac{\partial u_2}{\partial \xi}\frac{\partial^2 w_1}{\partial \xi^2} + \phi_2\left(\frac{\partial w_1}{\partial \xi}\right)^2\frac{\partial^2 w_1}{\partial \xi^2} + \phi_3\frac{\partial v_2}{\partial \xi}\frac{\partial^2 w_1}{\partial \xi^2}$$

$$+ \phi_4\frac{\partial v_2}{\partial \eta}\frac{\partial^2 w_1}{\partial \xi^2} + \phi_5\frac{\partial w_1}{\partial \xi}\frac{\partial w_1}{\partial \eta}\frac{\partial^2 w_1}{\partial \xi^2} + \phi_6\left(\frac{\partial w_1}{\partial \xi}\right)^2\frac{\partial^2 w_1}{\partial \xi^2}$$

$$+ \phi_7\frac{\partial v_2}{\partial \xi}\frac{\partial^2 w_1}{\partial \eta^2} + \phi_8\frac{\partial v_2}{\partial \xi}\frac{\partial^2 w_1}{\partial \xi \partial \eta} + \phi_9\frac{\partial v_2}{\partial \eta}\frac{\partial^2 w_1}{\partial \eta^2}$$

$$+ \phi_{10}\frac{\partial v_2}{\partial \eta}\frac{\partial^2 w_1}{\partial \xi \partial \eta} + \phi_{11}\left(\frac{\partial w_1}{\partial \xi}\right)^2\frac{\partial^2 w_1}{\partial \eta^2} + \phi_{12}\left(\frac{\partial w_1}{\partial \xi}\right)^2\frac{\partial^2 w_1}{\partial \xi \partial \eta}$$

$$+ \phi_{13}\frac{\partial w_1}{\partial \xi}\frac{\partial w_1}{\partial \eta}\frac{\partial^2 w_1}{\partial \eta^2} + \phi_{14}\frac{\partial w_1}{\partial \xi}\frac{\partial w_1}{\partial \eta}\frac{\partial^2 w_1}{\partial \xi \partial \eta}$$

$$+ \phi_{15}\left(\frac{\partial w_1}{\partial \eta}\right)^2\frac{\partial^2 w_1}{\partial \eta^2} + \phi_{16}\left(\frac{\partial w_1}{\partial \eta}\right)^2\frac{\partial^2 w_1}{\partial \xi \partial \eta} + \phi_{17}\frac{\partial u_2}{\partial \xi}\frac{\partial^2 w_1}{\partial \eta^2}$$

$$+ \phi_{18}\frac{\partial u_2}{\partial \eta}\frac{\partial^2 w_1}{\partial \xi \partial \eta} + \phi_{19}\frac{\partial u_2}{\partial \eta}\frac{\partial^2 w_1}{\partial \xi^2} + \phi_{20}\frac{\partial u_2}{\partial \eta}\frac{\partial^2 w_1}{\partial \xi \partial \eta} = 0$$

For the sake of conciseness, the constants F_{11}, F_{12}....., S_{11},...., T_{11},...., etc. have been defined and listed in Part I of Appendix A.

4.2 The boundary conditions.

For a sandwich plate with all edges clamped, the boundary condition for the first approximation are as follows:

$$w_1 = r_1 = s_1 \quad \text{at} \quad \xi = \pm 1 \quad \text{and} \quad \eta = \pm 1$$

$$\frac{\partial w_1}{\partial \xi} = 0 \quad \text{at} \quad \xi = \pm 1$$

$$\frac{\partial w_1}{\partial \eta} = 0 \quad \text{at} \quad \eta = \pm 1 \qquad (4.2.1)$$

where

$$(w_1)_{\xi=\eta=0} = 1$$

The corresponding boundary conditions for the second approximation are:

$$u_2 = v_2 = 0 \quad \text{at} \quad \xi = \pm 1 \quad \text{and} \quad \eta = \pm 1 \qquad (4.2.3)$$

The boundary conditions for the third approximation are:

$$w_3 = r_3 = s_3 = 0 \quad \text{at} \quad \xi = \pm 1 \text{ and } \eta = \pm 1$$

$$\frac{\partial w_3}{\partial \xi} = 0 \quad \text{at} \quad \xi = \pm 1 \; ,$$

$$\frac{\partial w_3}{\partial \eta} = 0 \quad \text{at} \quad \eta = \pm 1 \; , \qquad (4.2.3)$$

where

$$(w_3)_{\xi=\eta=0} = 0$$

4.3 The assumed functions.

Approximate solutions are now assumed in accordance with the boundary conditions, i.e., Equations (4.2.1) through (4.2.3). Thus

$$w_1 = (1-\xi^2)^2(1-\eta^2)^2(1-\xi\eta)(1 + B_1\xi^2 + C_1\eta^2 + D_1\xi^4 + E_1\eta^4$$
$$+ F_1\xi^2\eta^2) \qquad (4.3.1)$$

$$r_1 = (1-\xi^2)(1-\eta^2)(1-\xi\eta)\,\xi\,(A_2 + B_2\xi^2 + C_2\eta^2 + D_2\xi^4$$
$$+ E_2\eta^4 + F_1\xi^2\eta^2) \qquad (4.3.2)$$

$$S_1 = (1-\xi^2)(1-\eta^2)(1-\xi\eta)\eta(A_3 + B_3\xi^2 + C_3\eta^2 + D_3\xi^4$$

$$+ E_3\eta^4 + F_3\xi^2\eta^2) \qquad (4.3.3)$$

$$u_2 = (1-\xi^2)(1-\eta^2)(1-\xi\eta)\xi(A_4 + B_4\xi^2 + C_4\eta^2 + D_4\xi^4$$

$$+ E_4\eta^4 + F_4\xi^2\eta^2) \qquad (4.3.4)$$

$$v_2 = (1-\xi^2)(1-\eta^2)(1-\xi\eta)\eta(A_5 + B_5\xi^2 + C_5\eta^2 + D_5\xi^4$$

$$+ E_5\eta^4 + F_5\xi^2\eta^2) \qquad (4.3.5)$$

$$w_3 = (1-\xi^2)^2(1-\eta^2)^2(1-\xi\eta)(B_6\xi^2 + C_6\eta^2 + D_6\xi^4$$

$$+ E_6\eta^4 + F_6\xi^2\eta^2) \qquad (4.3.6)$$

$$r_3 = (1-\xi^2)(1-\eta^2)(1-\xi\eta)\xi(A_7 + B_7\xi^2 + C_7\eta^2 + D_7\xi^4$$

$$+ E_6\eta^4 + F_6\xi^2\eta^2) \qquad (4.3.7)$$

$$S_3 = (1-\xi^2)(1-\eta^2)(1-\xi\eta)\eta(A_8 + B_8\xi^2 + C_8\eta^2 + D_8\xi^4$$

$$+ E_8\eta^4 + F_8\xi^2\eta^2) \qquad (4.3.8)$$

4.4 Solution to the linear small deflection problem (first order approximation).

Substituting Equations (4.3.1) through (4.3.3) into Equations (4.1.8) through (4.1.10) and equating like powers of ξ and η, yield eighteen simultaneous algebraic equations (listed in Part 11 of Appendix A).

$$\underset{18\times 18}{[U_1]}\underset{18\times 1}{\{K_1\}} = \underset{18\times 1}{\{V_1\}} \qquad (4.4.1)$$

Where the unknowns in the above equation are the elements in the column vector K_1, namely, a_1, B_1......, A_2, B_2,...., A_3, B_3,...., F_3. Hence, the solution to these equations defines the undetermined coefficients in the assumed displacement functions for the first order approximation.

4.5 Solution to the non-linear large deflection problem (second and third order approximations).

With the solution of first order approximation, successive approximations of higher order can be obtained in a similar manner. Substituting Equations (4.1.11) and (4.1.12) and equating powers of ξ and η yield sufficient linear algebraic equations for the second order approximation (listed in Part II of Appendix A) to define the undertermined ceofficients in the assumed displacement functions. Express these algebraic equations in matrix form as:

$$\underset{12\times12}{\left[U_2\right]}\ \underset{12\times1}{\left\{K_2\right\}}=\underset{12\times1}{\left\{V_2\right\}} \qquad (4.5.1)$$

Again, substituting Equations (4.3.6) through (4.3.8) into Equations (4.1.13) through (4.1.15) and equating powers of ξ and η yield eighteen linear algebraic equations (listed in Part II of Appendix A), i.e.,

$$\underset{18\times18}{\left[U_3\right]}\ \underset{18\times1}{\left\{K_3\right\}}=\underset{18\times1}{\left\{V_3\right\}} \qquad (4.5.2)$$

Where the column vectors K_2 and K_3 in the foregoing equations are again the undetermined coefficients in the assumed displacement functions.

Thus the solutions of Equations (4.4.1), (4.5.1) and (4.5.2) provide a means of determining uniquely the lateral, in-plane and angular displacements anywhere within the plate boundary, hence solution to linear and non-linear deflection problem of skew sandwich plates.

CHAPTER V

DISCUSSION OF RESULTS

In order to evaluate the effects of various parameters such as the angle of skew, the plate aspect ratio, shear moduli and the thickness of core on the large and small deflection of skew sandwich panels, seventy two cases of such panels have been analysed and results are listed in Appendix C. The linear and non-linear relationships between dimensionless center deflection and dimensionless load are presented graphically in Fig. 4 through Fig. 21.

From the results of different angle of skew, thickness of core, shear moduli of core, and plate aspect ratio, the following observations can be made:

(i) The maximum deflection at the center of the plate decreases with an increase in skew. This is mainly due to the increased rigidity of the obtuse corners with increase in skew, thus reducing the center deflection.

(ii) The maximum deflection at the center of the plate increases with a decrease in the thickness of the core. This is to be expected, since, in general, the rigidity of a sandwich plate is directly proportional to the thickness of the core.

Referring to Case 1 in Appendix C, a plate with

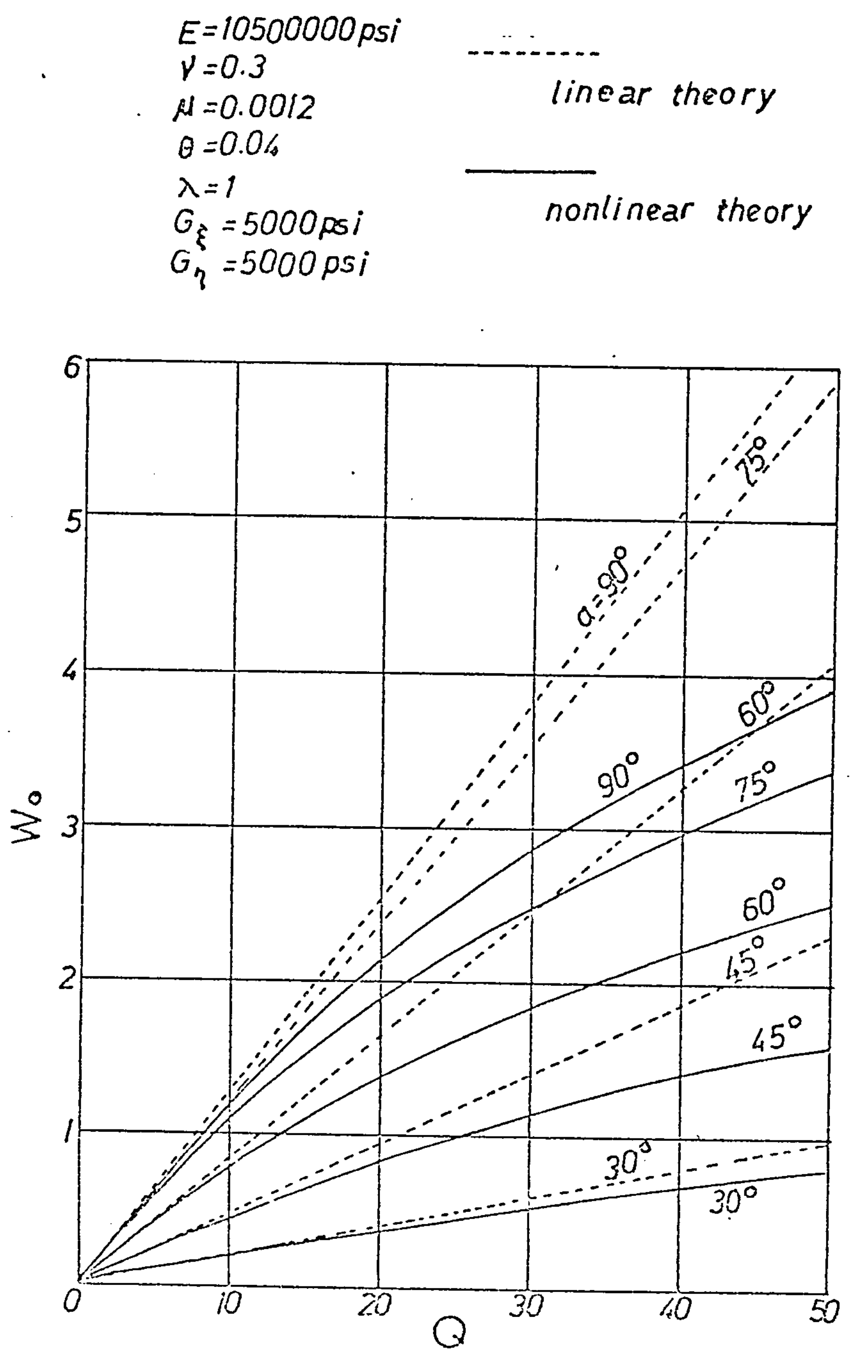

Fig. 4 Deflections of skewed sandwich plates.

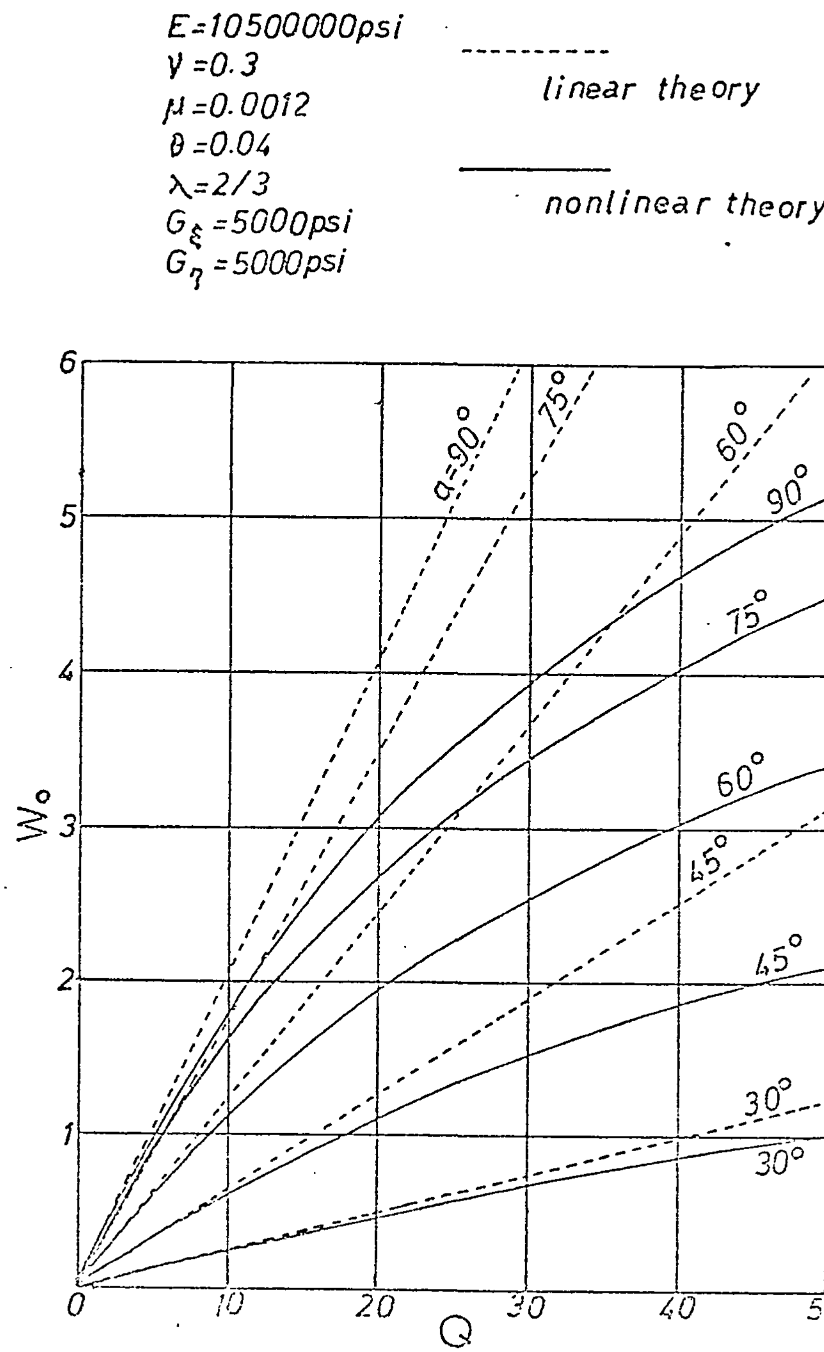

Fig. 5 Deflections of skewed sandwich plates.

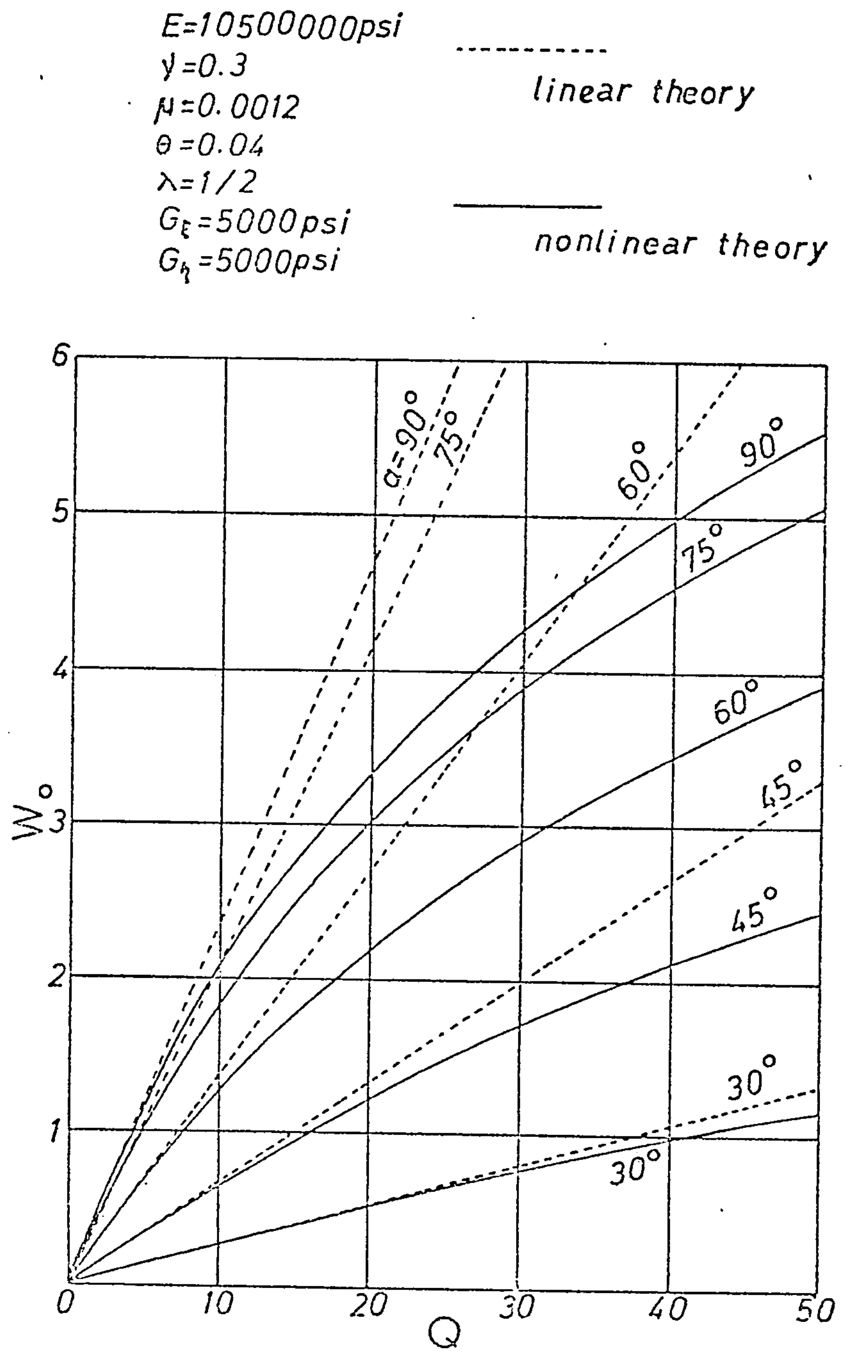

Fig. 6 Deflections of skewed sandwich plates.

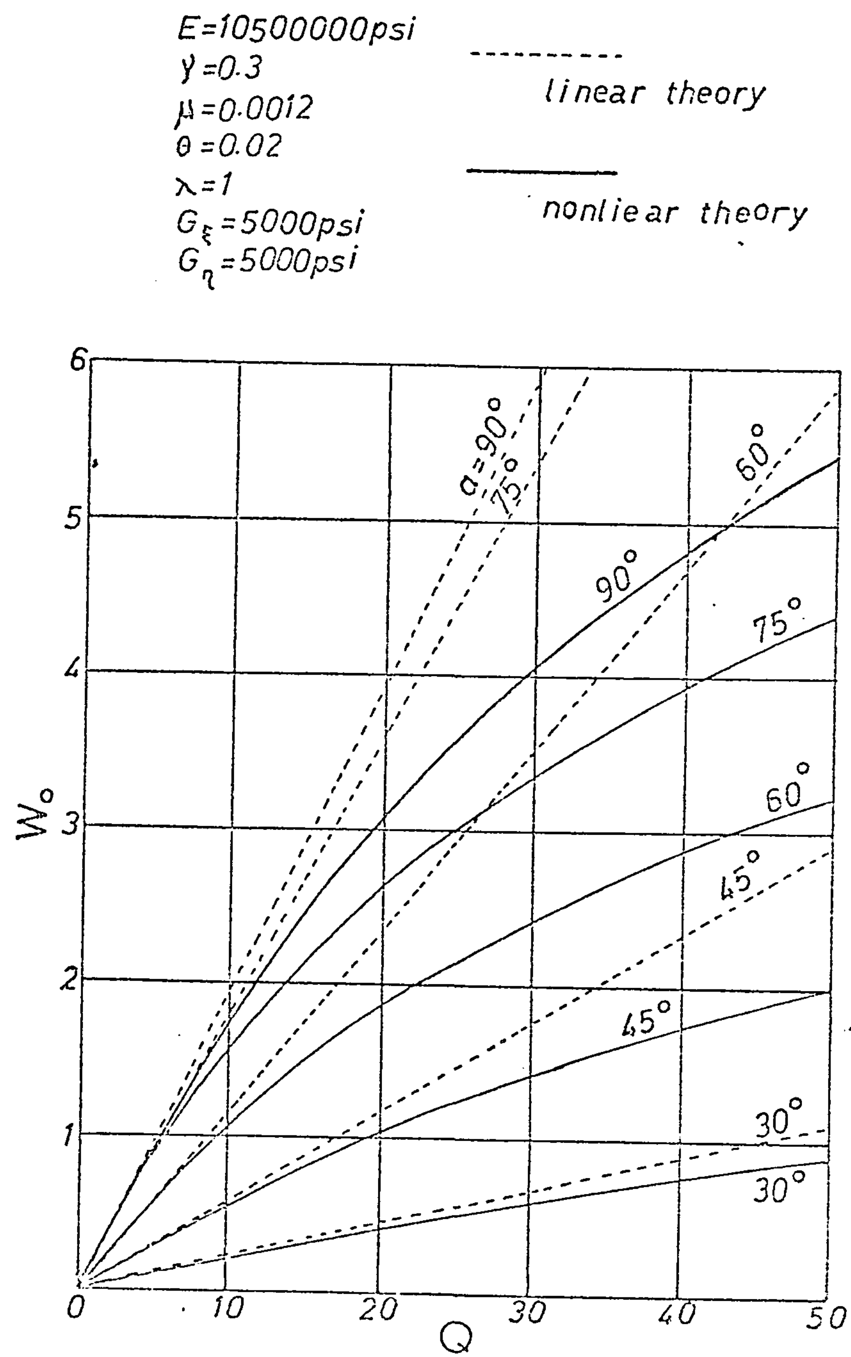

Fig. 7 Deflections of skewed sandwich plates.

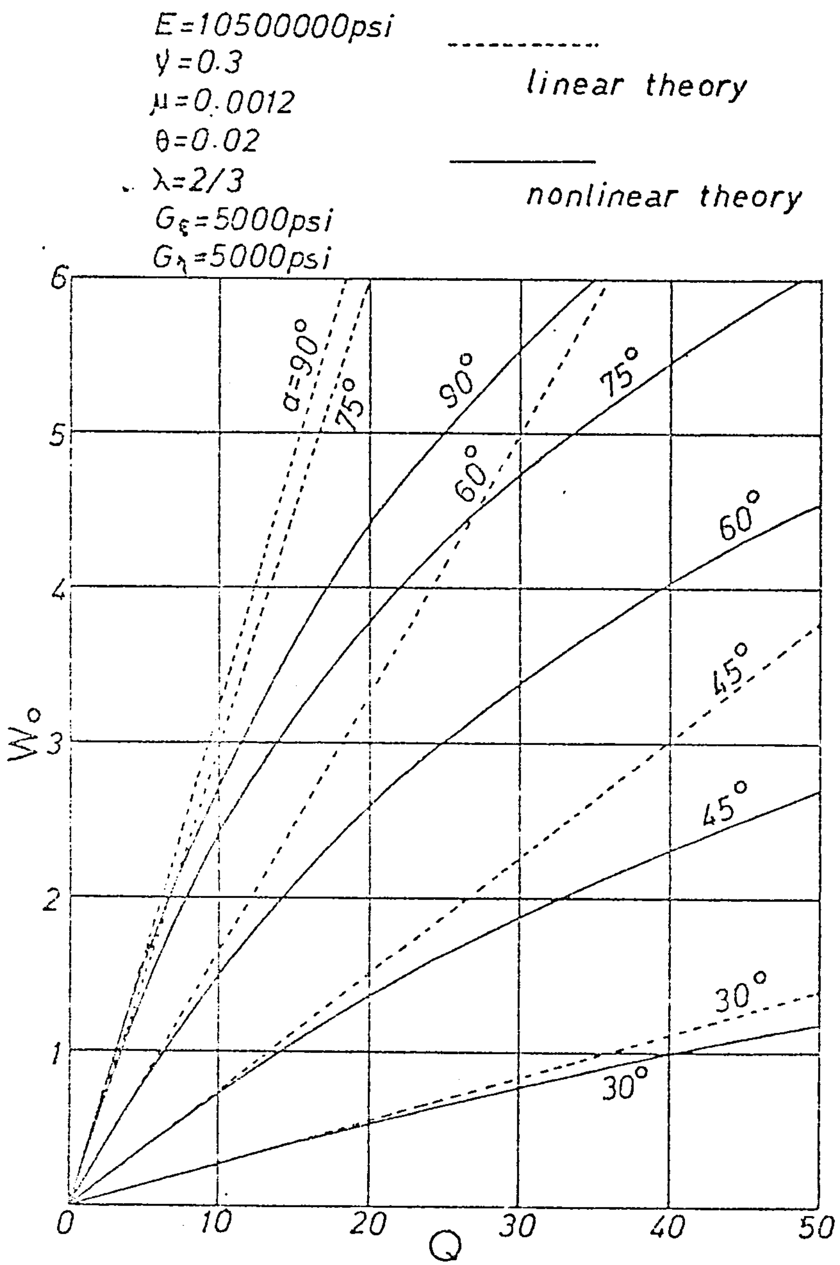

Fig. 8 Deflections of skewed sandwich plates

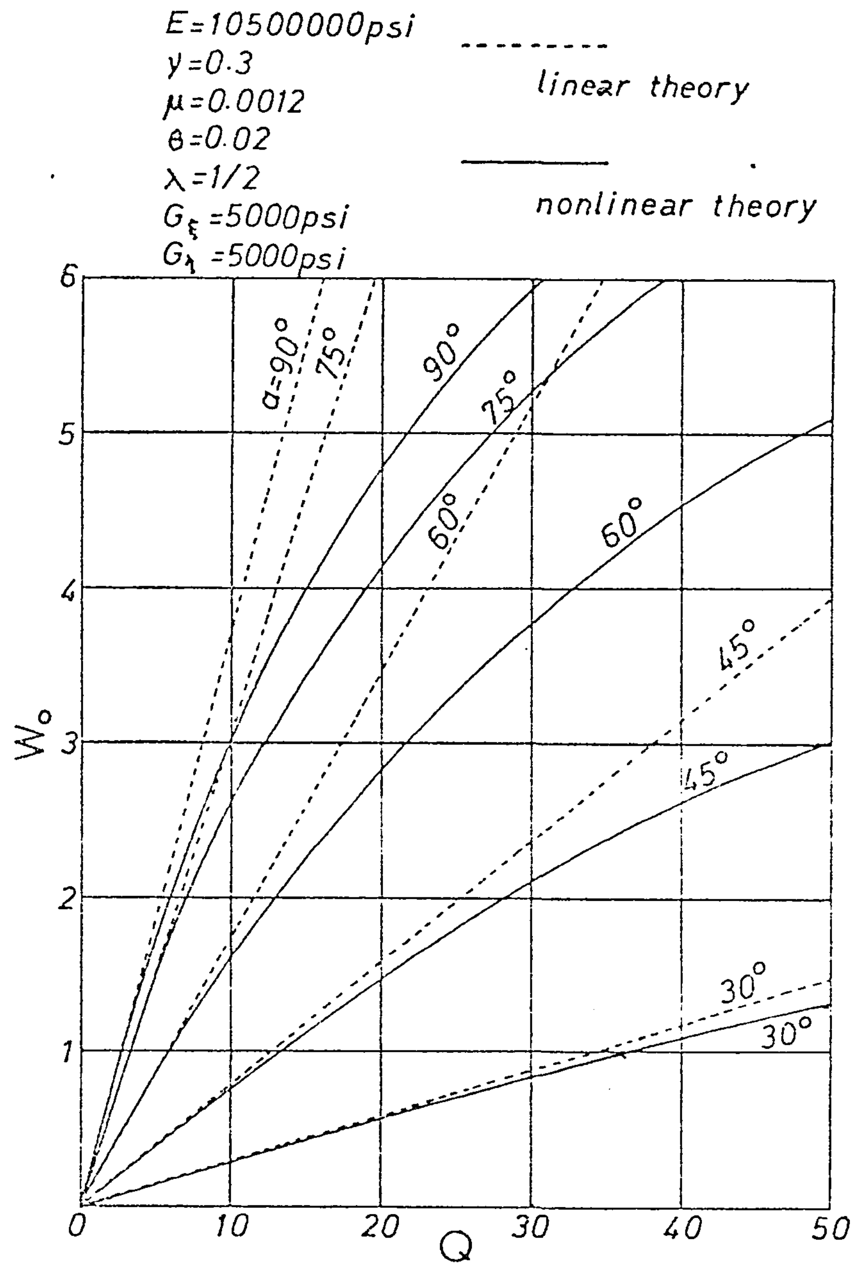

Fig. 9 Deflections of skewed sandwich plates.

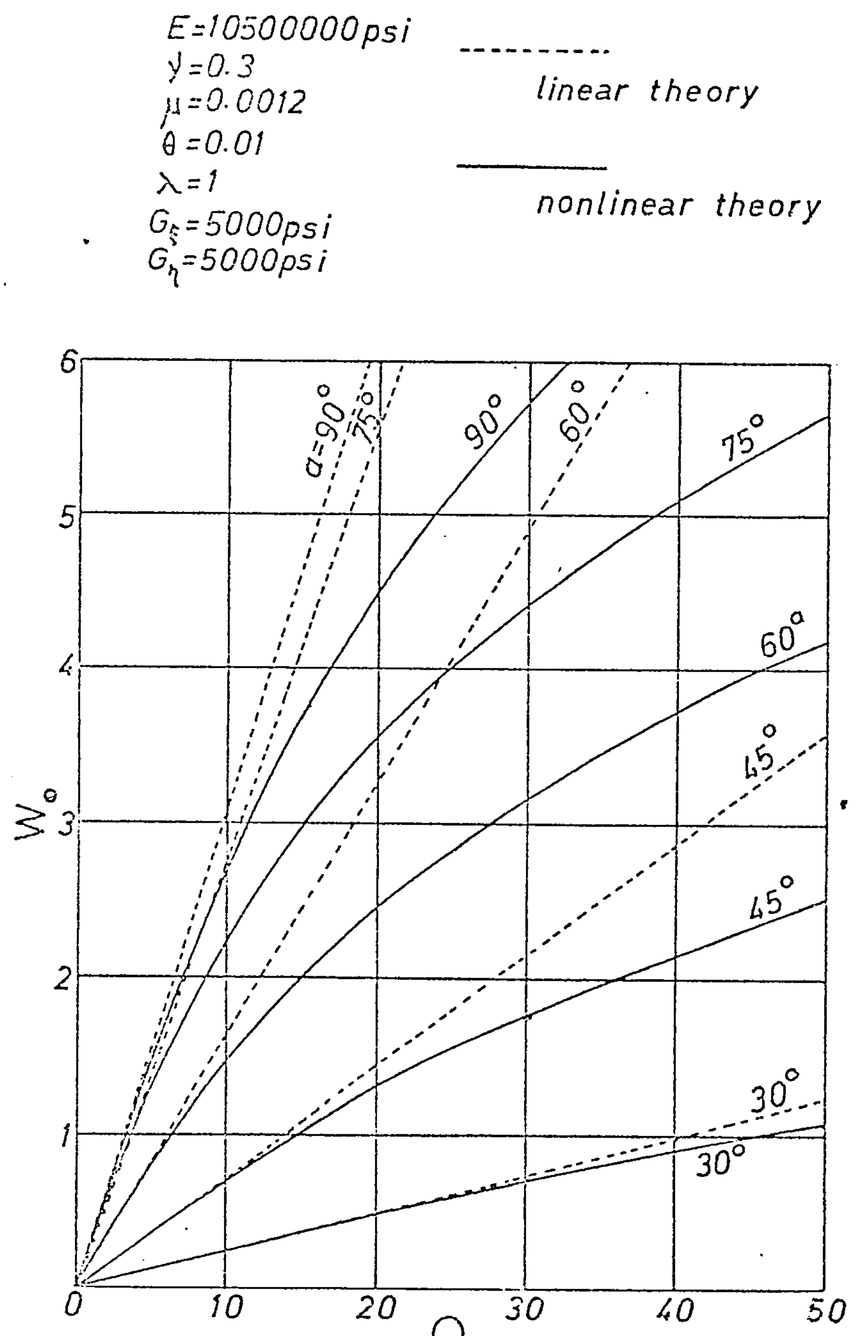

Fig. 10 Deflections of skewed sandwich plates.

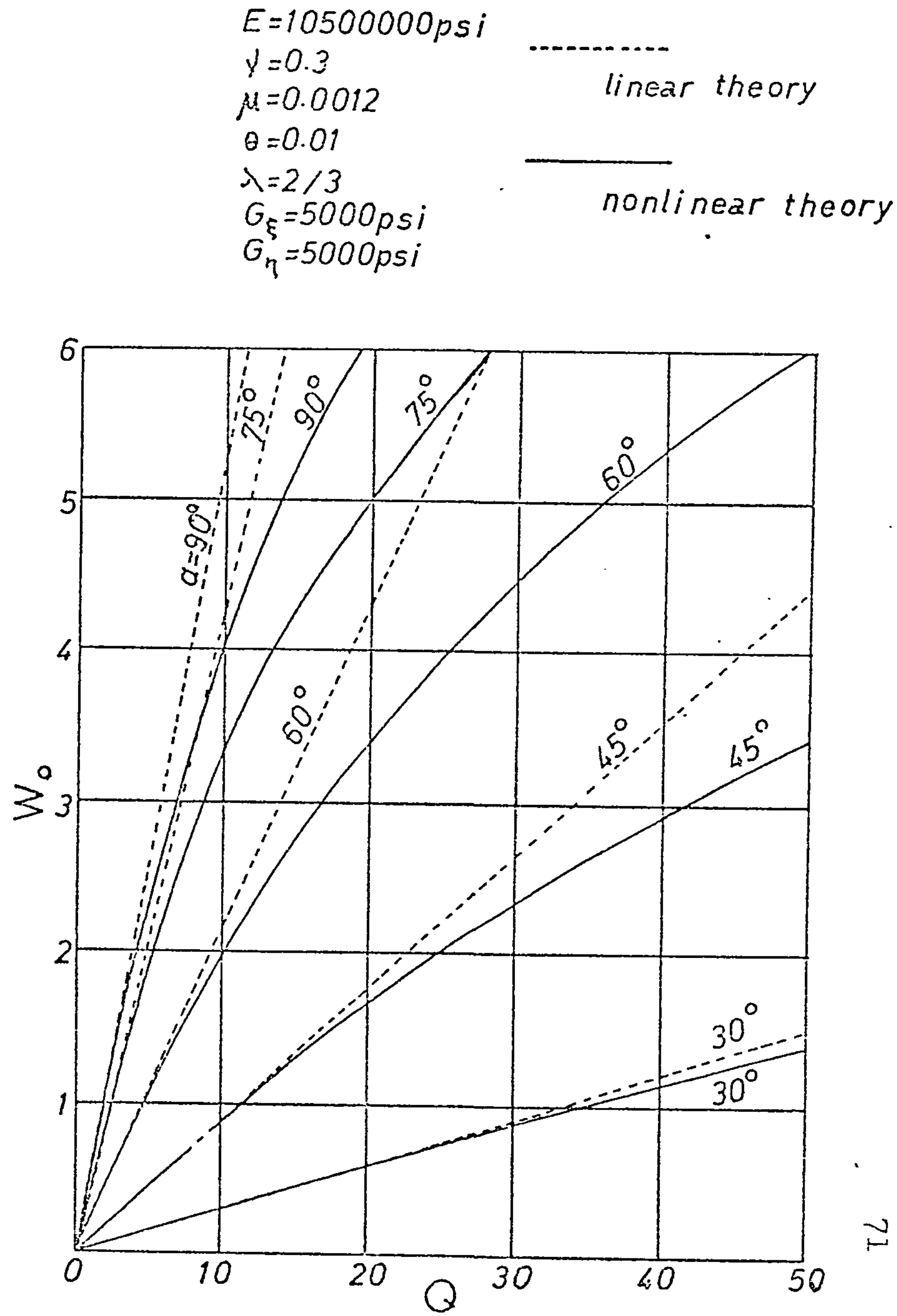

Fig. 11 Deflections of skewed sandwich plates.

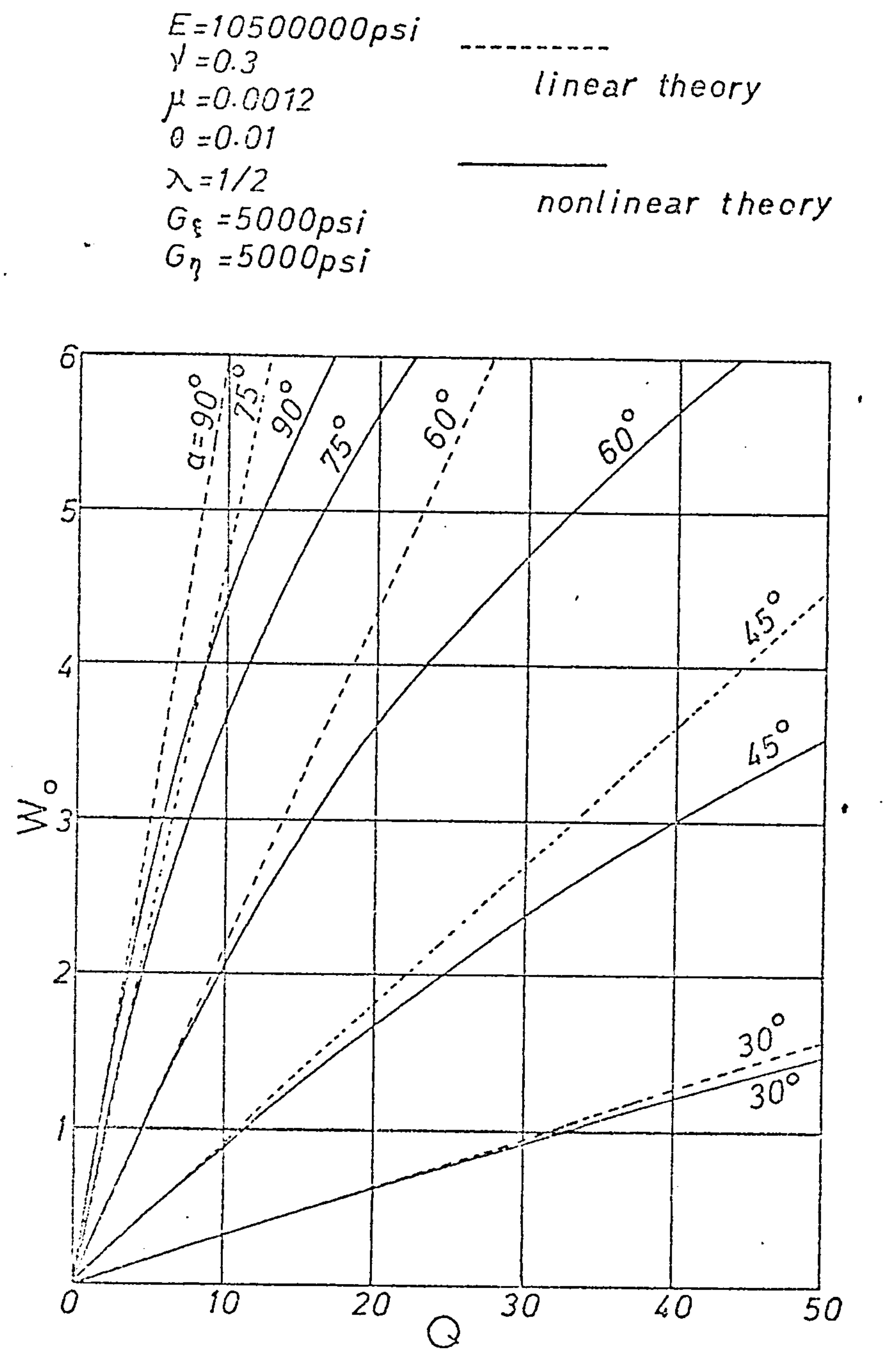

Fig. 12 Deflections of skewed sandwich plates.

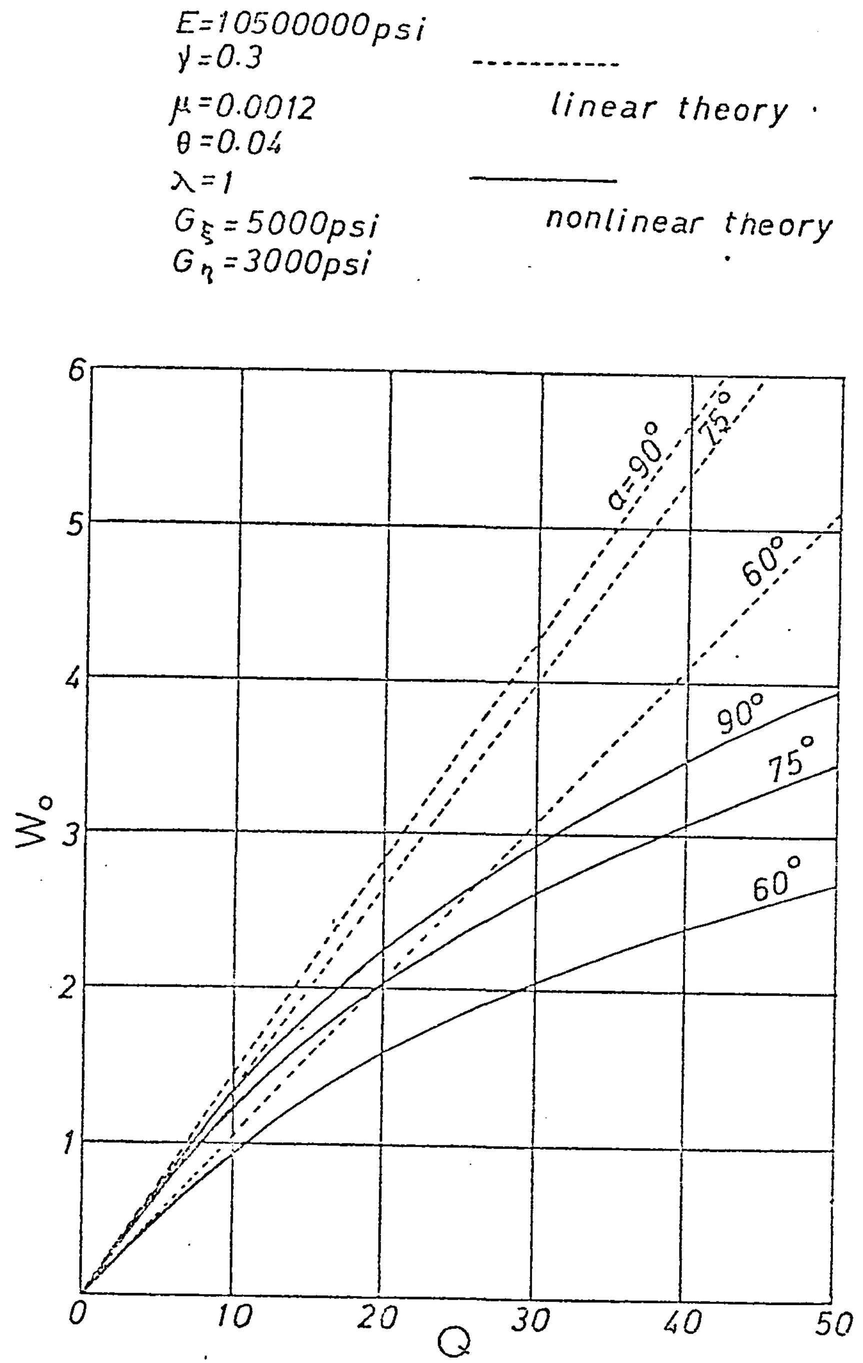

Fig. 13 Deflections of skewed sandwich plates.

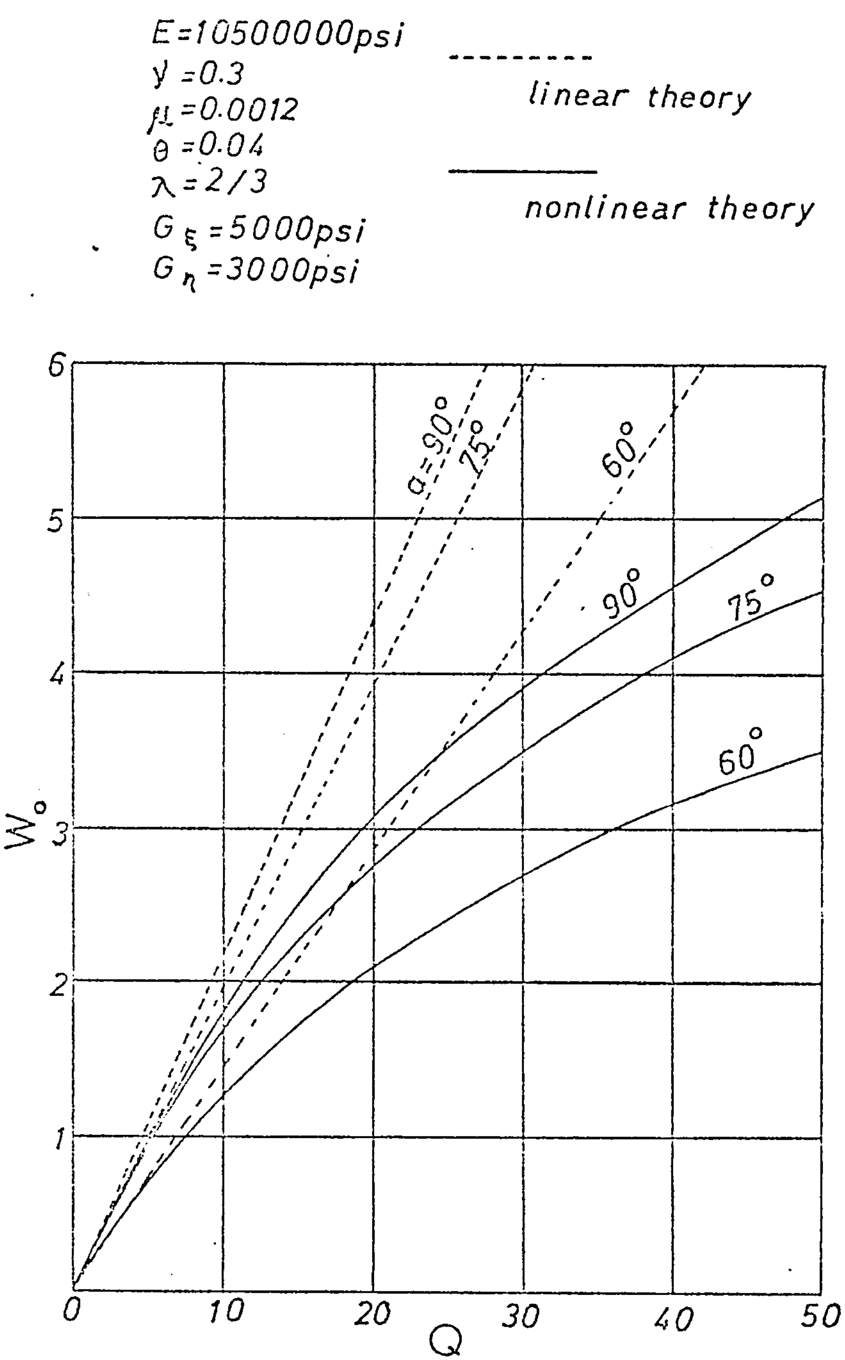

Fig. 14 Deflections of skewed sandwich plates

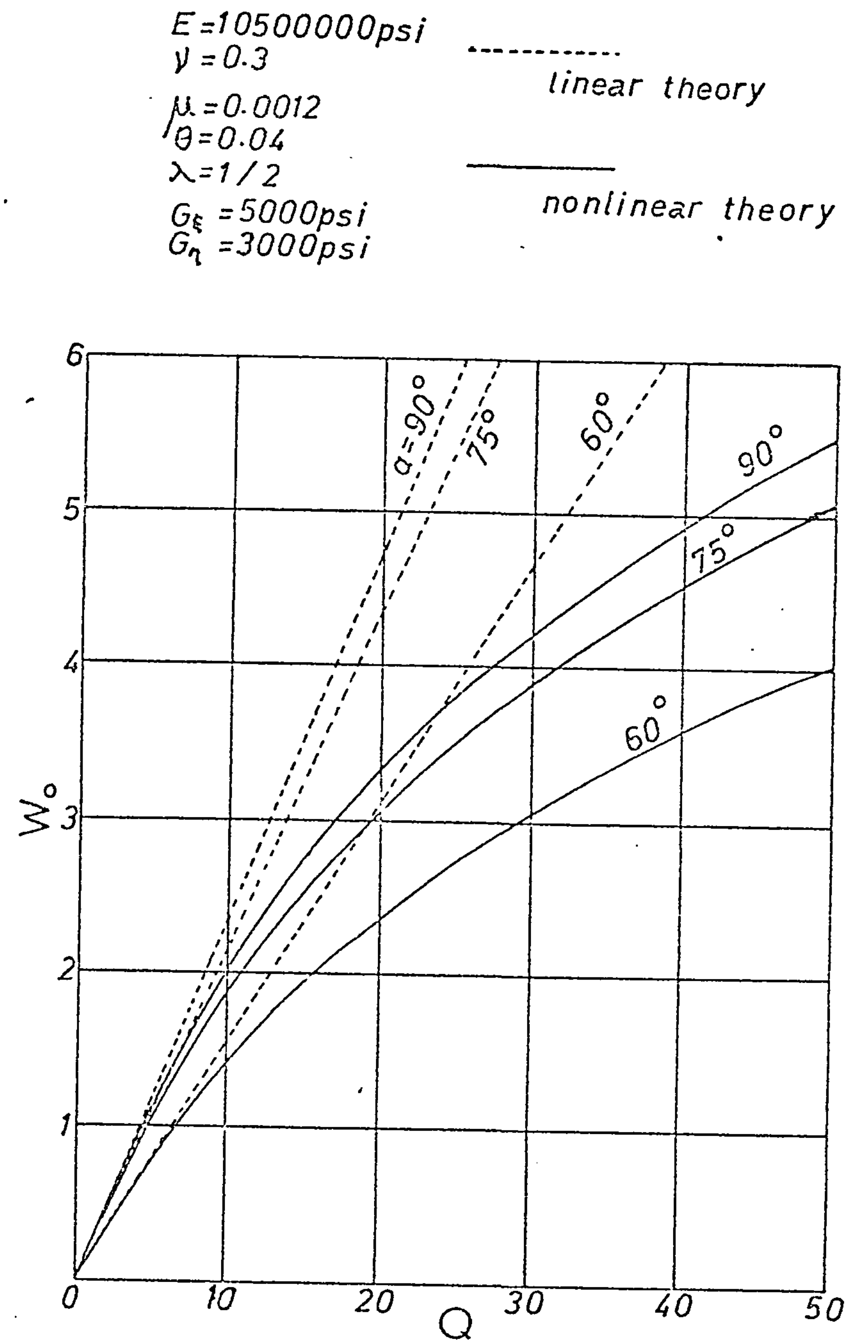

Fig. 15 Deflections of skewed sandwich plates

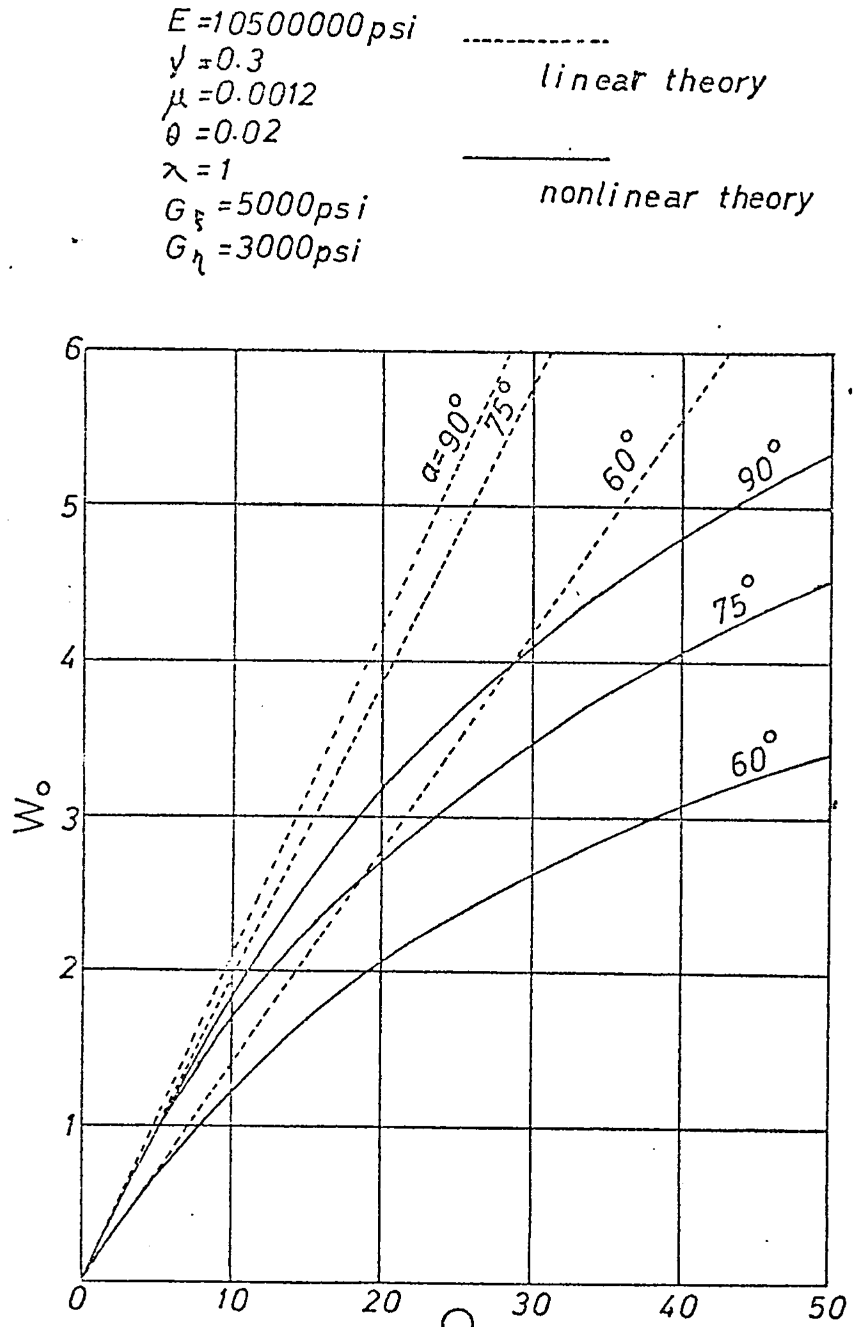

Fig. 16 Deflections of skewed sandwich plates.

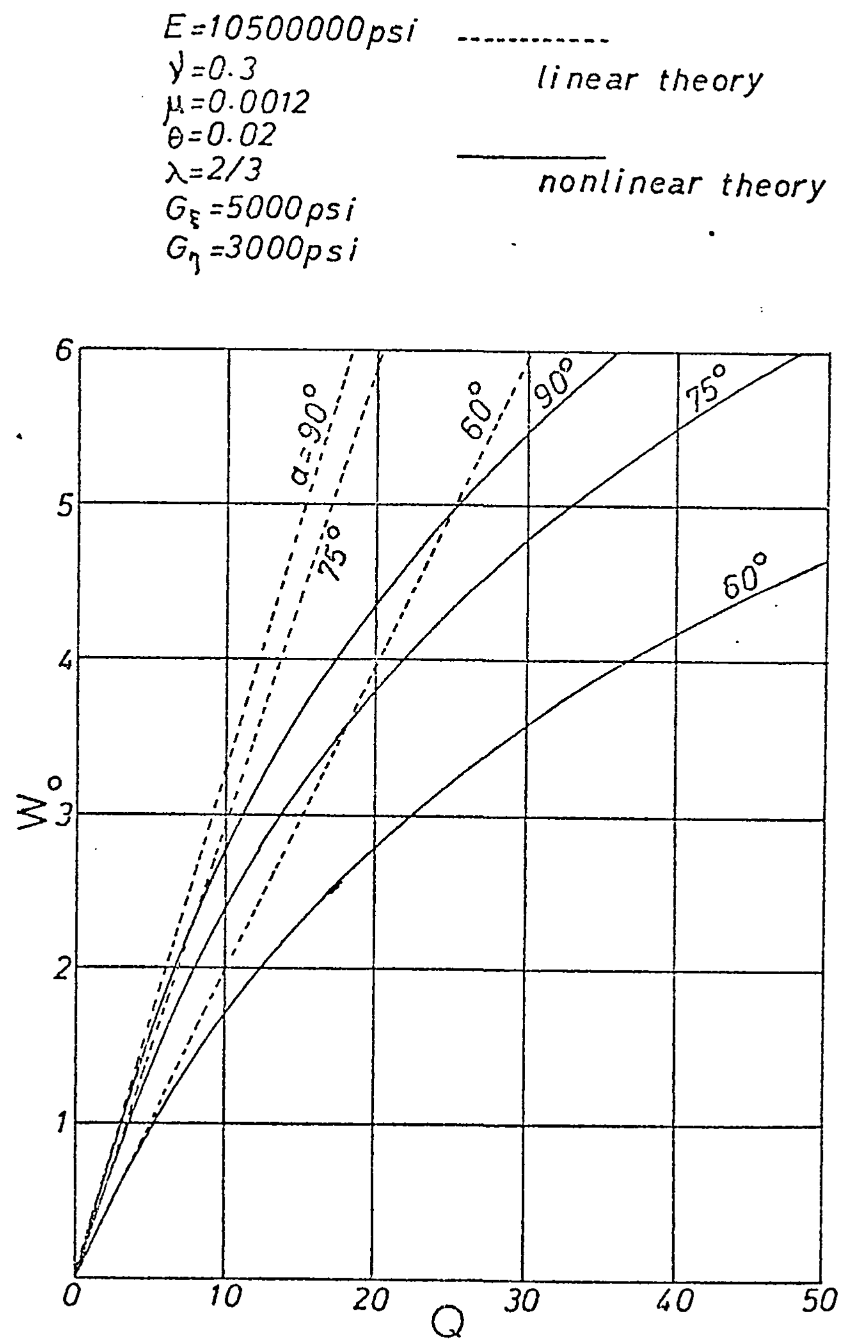

Fig. 17 Deflections of skewed sandwich plates.

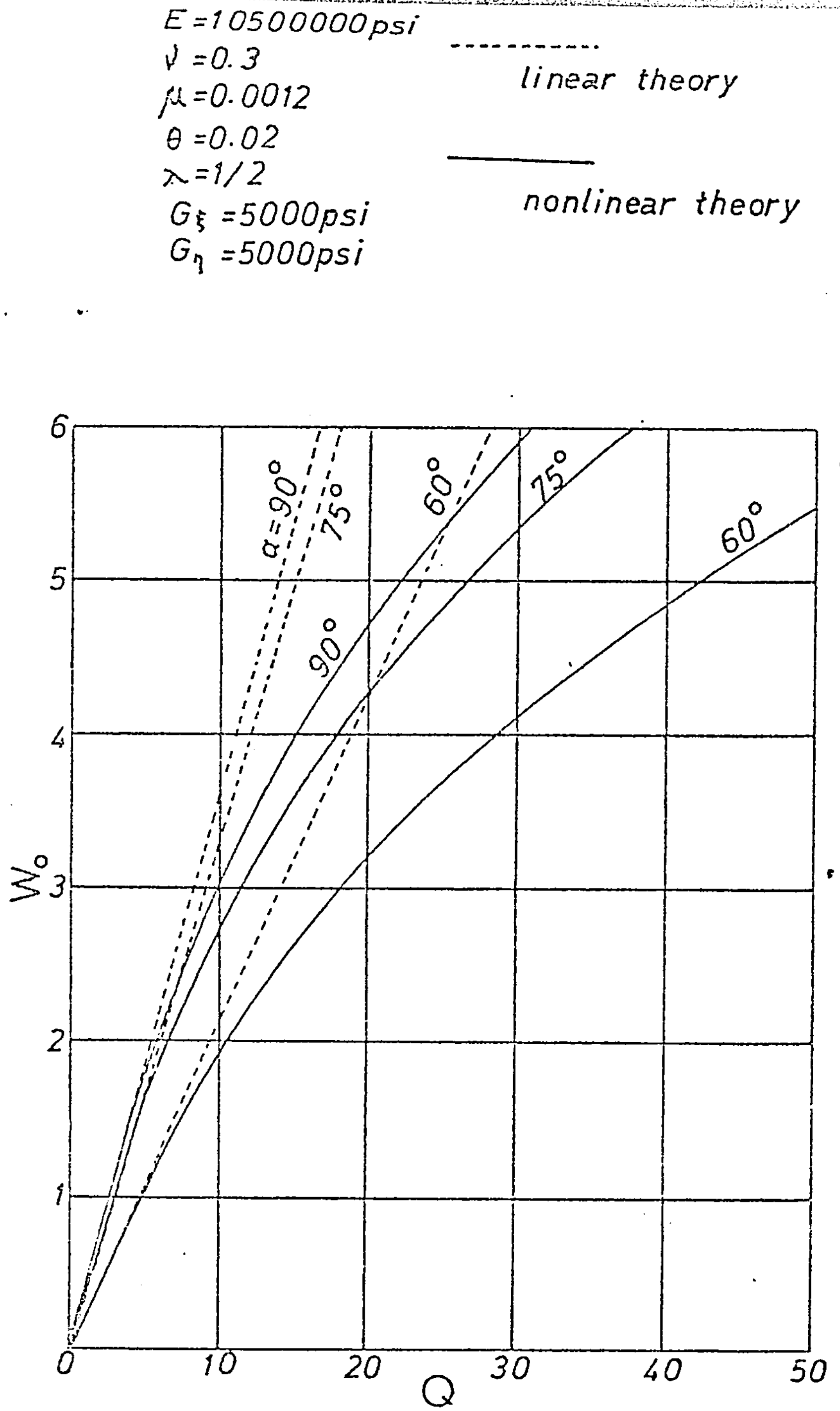

Fig. 18 Deflections of skewed sandwich plates.

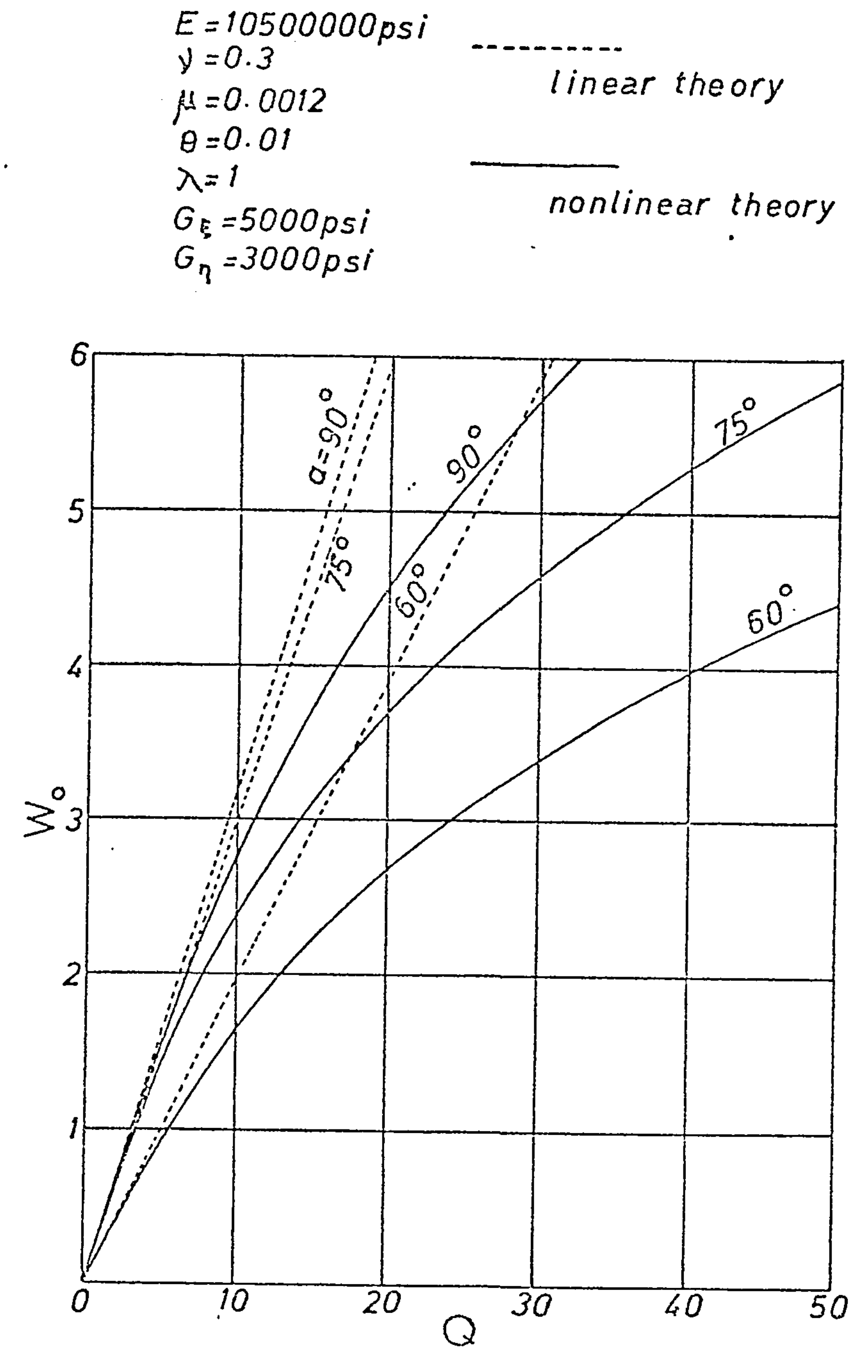

Fig. 19 Deflections of skewed sandwich plates.

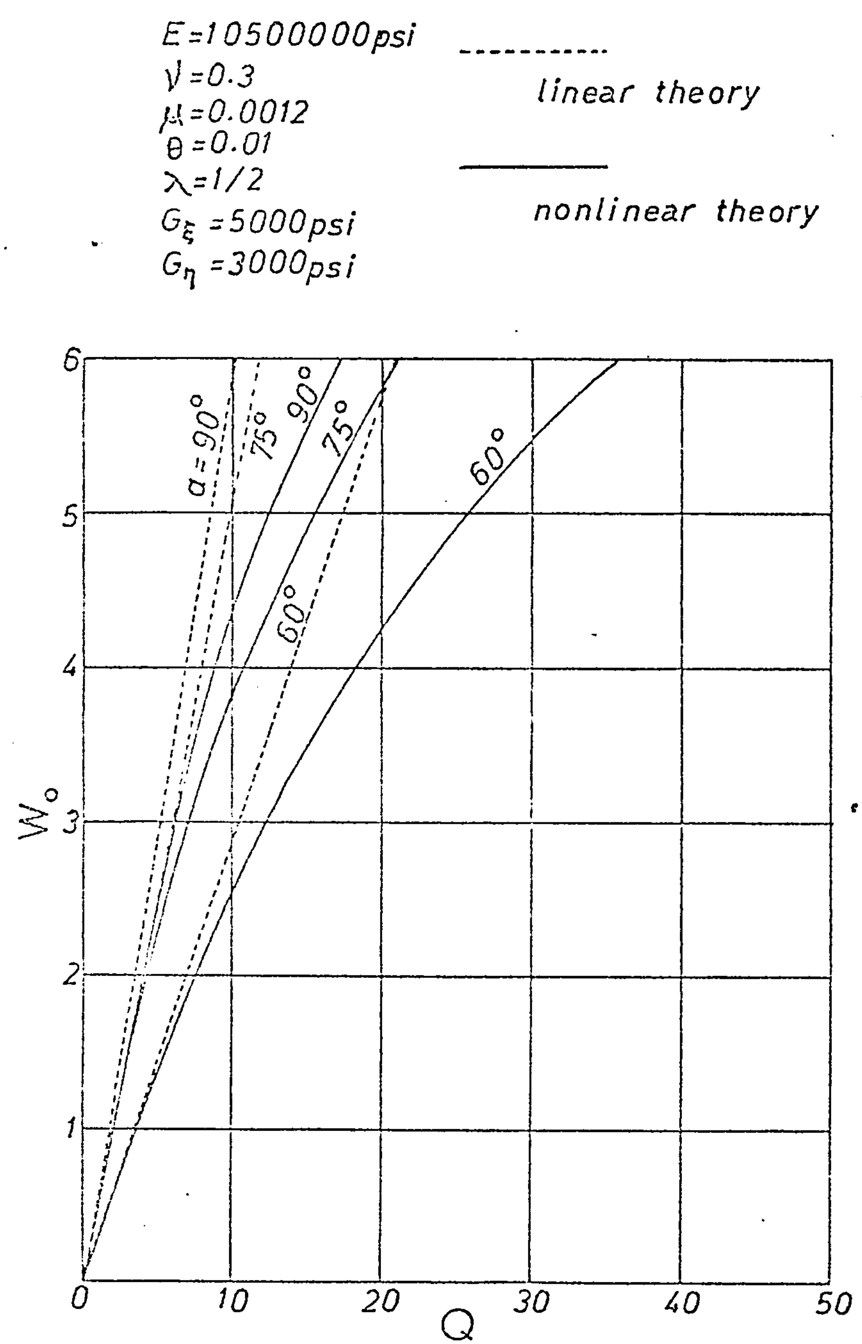

Fig. 20 Deflections of skewed sandwich plates.

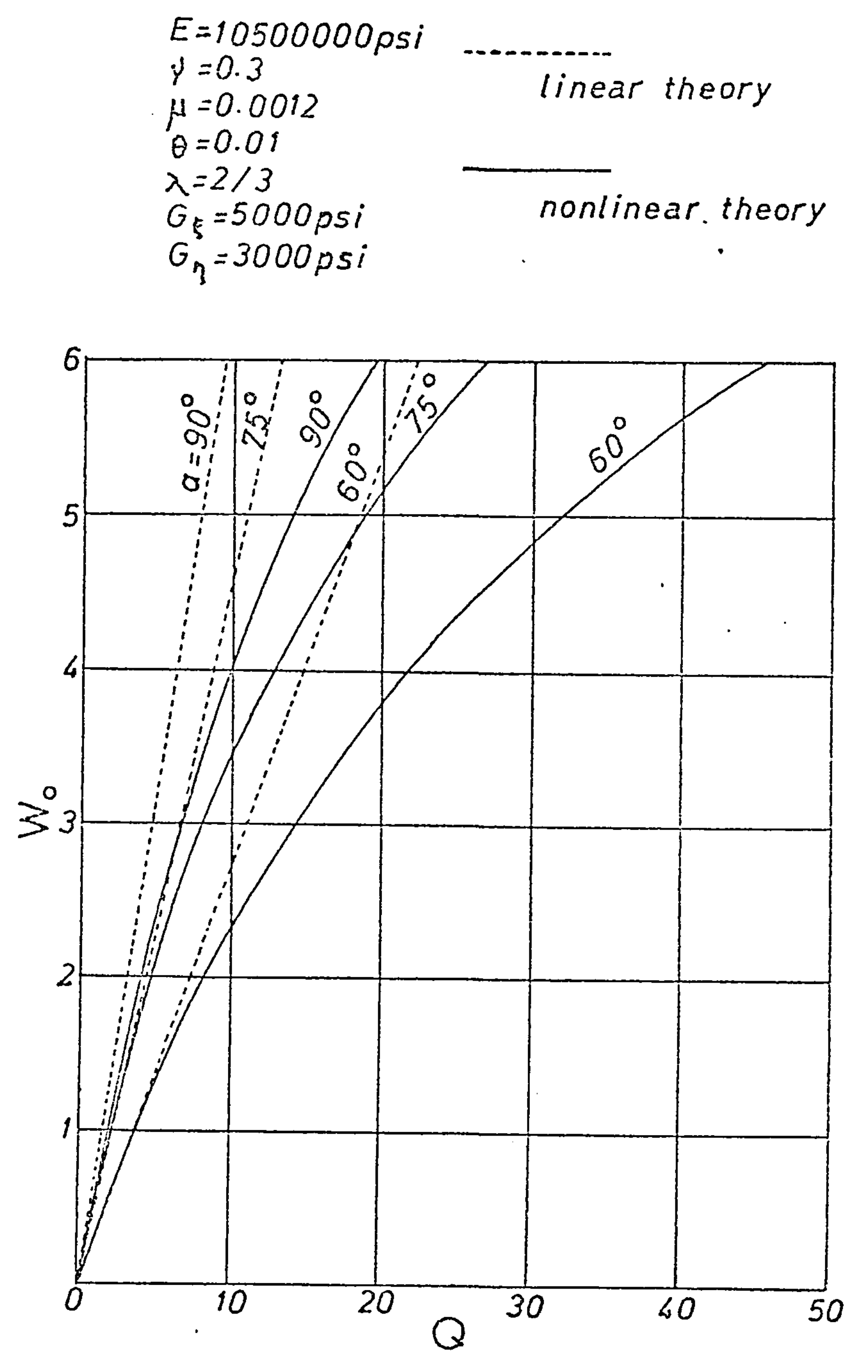

Fig. 21 Deflections of skewed sandwich plates.

$E = 10.5\times10^6$psi, $\nu=0.3$, $\mu=0.0012$, $\theta=0.04$, $\lambda=1$, $G_\xi = 5000$psi, $G_\eta=5000$psi, the load-deflection relationship is:

$$Q=7.88W_o+0.33W_o^3 \tag{5.1}$$

Again, referring to Case 16 in Appendix C, a plate with the same properties as those in Case 1, except $\theta=0.02$, (i.e., the thickness of core in this Case is one half of that in Case 1), the load-deflection relationship is:-

$$Q=5.13W_o+0.14W_o^3 \tag{5.2}$$

Similarly, in Case 31 (Appendix C), a plate with the same properties as those in Case 1, except $\theta=0.01$, (i.e., the thickness of core in this Case is one fourth of that in Case 1), the load-deflection relationship is:

$$Q=3.25W_o+0.06W_o^3 \tag{5.3}$$

Recall that the dimensionless load

$$Q=\frac{24\sqrt{3}\,a^3(1-\nu^2)}{Et\bar{t}^2}\,q \tag{5.4}$$

and the dimensionless center deflection

$$W_o=w_o/\bar{t} \tag{5.5}$$

where q is the intensity of uniformly distributed load; w_o is the center deflection; $\bar{t}$ is the thickness of core; parameters such as the half width of plate a, modulus of elasticity E, thickness of one facing t, and the Poisson's ratio ν, are invariables in those three Cases.

Therefore, by observing the linear part of the Equations (5.1) through (5.3) alone, it can be seen that, for a given load, the center deflection of Case 16 is about three times greater than that of Case 1, whereas, the center deflection of Case 31 is about three times greater than that of Case 16.

As predicted so far, the load-carrying-capacity of sandwich plates depends largely on how far the facings are placed apart from the neutral axis.

(iii) The maximum deflection at the center of the plate increases with a decrease in the shear moduli of the core; this is expected, since the deflection due to shear increases as the shear rigidity of core decreases. This can be seen by comparing the Cases shown in Fig. 4, where the shear moduli along and axes, i.e., G_ξ and G_η are both 5000psi, with the Cases shown in Fig. 13 where G_ξ is 5000psi and G_η is 3000psi.

(iv) Comparison of results for different aspect ratio λ indicates that the effect of skew on center deflection decreases with decreaseing λ; since the influence of the plate corners on the center deflection diminishes with decreasing λ.

Furthermore, recall that, "In the case of sandwich plates, where the range of deflections, for which small deflection theory is valid, decreases, as the ratio of stiffness of core to that of the facings decreases." as stated in Paragraph (1.5). This should also be verified here. By comparing the results listed below, it can be seen that the high order strain terms play an important role in the load-deflection characteristics for sandwich plates with a soft core. It is also noted that the high order approximations become increasingly important as the angle of skew increases.

*Case No.	W_o	**Q_L	***Q_N	$1-Q_L/Q_N$	Remarks
1	1	7.88	8.21	4.01%	rectangular sandwich plate
2	1	8.47	9.05	6.20%	skew, $\alpha = 75^o$ other the same as case 1
3	1	11.87	13.12	9.69%	skew, $\alpha = 60^o$ other the same as case 1
16	1	5.13	5.27	2.51%	rec., core thickness $\frac{1}{2}$ as in case 1
46	1	7.10	7.46	4.81%	rec., orthotropic, with G_n = 3000psi

* refer to Appendix C
** $Q_L = a_1 W_o$
*** $Q_N = a_1 W_o + a_3 W_o^3$

No data is yet available in the literature for the small and large deflection analysis of skew sandwich plates and, as a result, no comparison is possible for such plates. However, in the limiting case of zero skew (i.e., when the skewed plate degenerates into a rectangular plate), results of the present analysis, are compared with the analysis of rectangular sandwich plates using a precise finite element technique(ref. 18). Such compari-

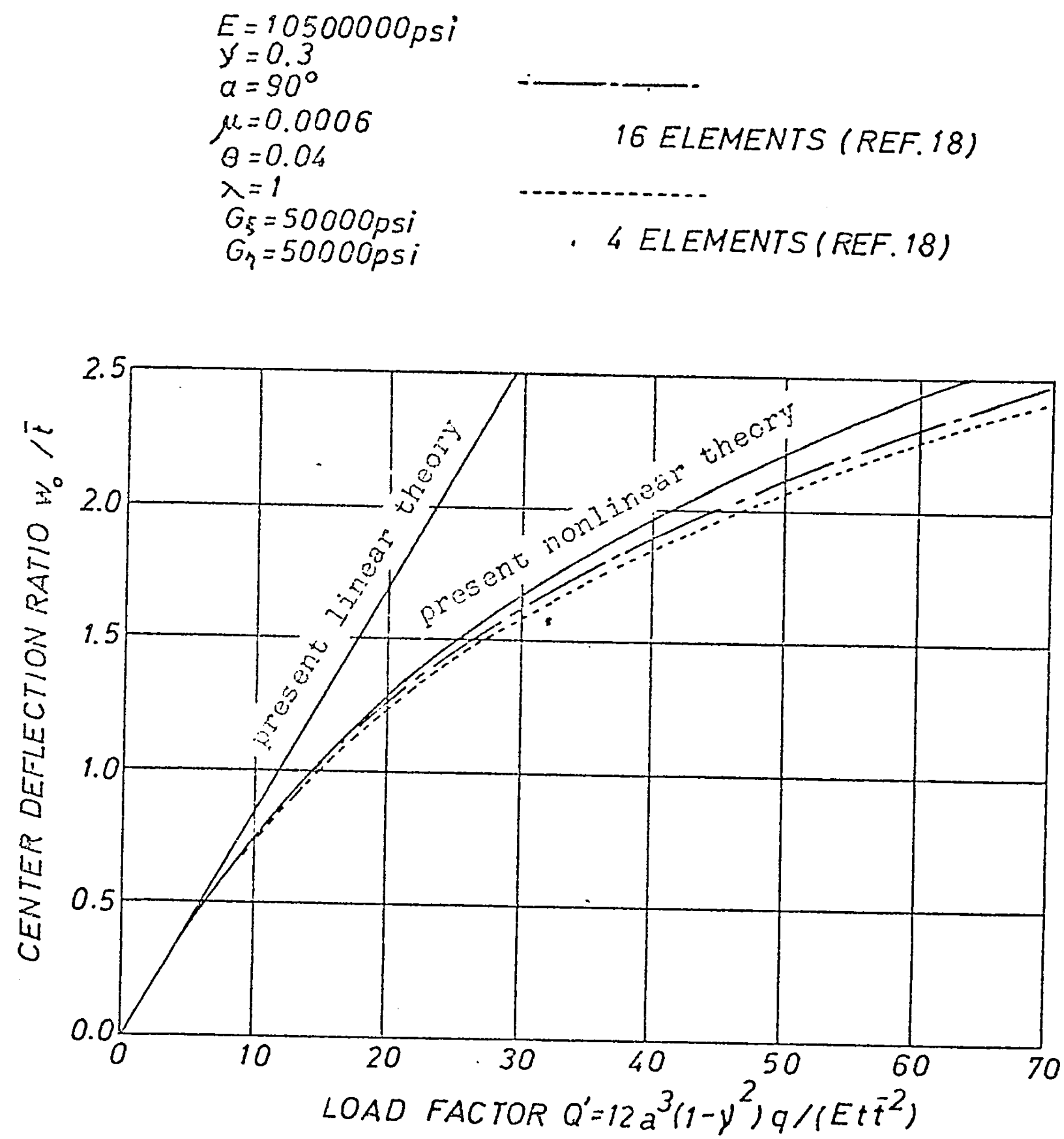

Fig. 22 Deflections of square sandwich plate.

son is shown graphically in Fig. 22. From this figure, it can be seen that the agreement is very favorable.

Moreover, by reducing the thickness of core to zero and comparing the linear part of results with the results obtained in ref. 23, good agreement is again demonstrated as follows:

Skew angle	R=1		R=0.667		R=0.5	
	Present method	ref. 23	Present method	ref. 23	Present method	ref. 23
85°	1.797	1.793	3.123	3.093	3.616	3.536
60°	1.219	1.181	2.096	2.050	2.400	2.352
45°	0.549	0.508	0.951	0.896	1.088	1.056
30°	0.128	0.120	0.230	0.216	0.275	0.259

Coefficients w for maximum small deflection at center for various skew angles and aspect ratios.

$R = b/a$; $W_{max} = wb^4q/D(10)^{-2}$.

CHAPTER VI

CONCLUSIONS

As a result of this analysis on the small and large deflection of skew sandwich plates, the following conclusions may be drawn:

1. For rectangular sandwich plates and homogeneous skew plates, this analysis yields results which closely agree with existing values obtained by other investigators.

2. The maximum center deflection of the plate increases with an increase in skew.

3. The maximum center deflection of the plate increases with a decrease in the thickness of the core.

4. The maximum center deflection of the plate increases with a decrease in the shear rigidity of the core.

5. The deviation of the non-linear results from the linear theory becomes more pronounced as the shear rigidity of core decreases.

6. The large deflection of sandwich plate becomes increasingly linear as the thickness of core decreases.

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APPENDIX A

ABBREVIATIONS AND ALGEBRAIC EQUATIONS

PART I

$$H_c = 1 - \nu \qquad H_a = E/(1-\nu^2)$$

$$H_d = (1-\nu^2)/(E\mu) \qquad H_b = E/(1+\nu)$$

$$F_{11} = (2H_a + H_b \cot^2\alpha)\,\theta\mu$$

$$F_{12} = H_b \csc^2\alpha\,\theta\mu\lambda^2$$

$$F_{13} = -2H_b \cot\alpha \csc\alpha\,\theta\mu\lambda$$

$$F_{14} = -4G_{\xi z}$$

$$F_{15} = -(2H_a\nu + H_b)\cot\alpha\,\theta\mu$$

$$F_{16} = (2H_a\nu + H_b)\csc\alpha\,\theta\mu\lambda$$

$$F_{17} = -2G_{\xi z}\,\theta/\sqrt{3}$$

$$F_{18} = -(H_a + H_a\nu\cot^2\alpha + H_b\cot^2\alpha)\,\theta\mu^2/\sqrt{3}$$

$$F_{19} = 2(H_a\nu + H_b)\cot\alpha\csc\alpha\,\theta\mu^2\lambda/\sqrt{3}$$

$$F_{110} = -(H_a \nu + H_b) \csc^2\alpha\, \mu^2 \theta \lambda^2 / \sqrt{3}$$

$$S_{11} = (2 H_a \cot^2\alpha + H_b) \mu \theta$$

$$S_{12} = 2 H_a \csc^2\alpha\, \mu \theta \lambda^2$$

$$S_{13} = -4 H_a \cot\alpha \csc\alpha\, \mu \theta \lambda$$

$$S_{14} = -4 G_{\eta z}$$

$$S_{15} = -(2 H_a \nu + H_b) \cot\alpha\, \mu \theta$$

$$S_{16} = (2 H_a \nu + H_b) \csc\alpha\, \mu \theta \lambda$$

$$S_{17} = 2 G_{\eta z} \cot\alpha\, \theta / \sqrt{3}$$

$$S_{18} = -2 G_{\eta z} \csc\alpha\, \theta \lambda / \sqrt{3}$$

$$S_{19} = (H_a \cot^3\alpha + H_a \cot\alpha\, \nu + H_b \cot\alpha) \mu^2 \theta / \sqrt{3}$$

$$S_{110} = -H_a \csc^3\alpha\, \mu^2 \theta \lambda^3 / \sqrt{3}$$

$$S_{111} = -\left(3H_a \csc\alpha \cot^2\alpha + H_a \csc\alpha\, \nu + H_b \csc\alpha\right)\mu^2\theta\lambda/\sqrt{3}$$

$$T_{11} = 12\sqrt{3}\,\mu/\theta + 12\sqrt{3}\,\mu\nu\cot^2\alpha/\theta + 12\sqrt{3}\,H_c\mu\cot^2\alpha/\theta$$

$$T_{12} = -8\mu^2/\theta - 8\mu^2\cot^4\alpha/\theta - 16\mu^2\nu\cot^2\alpha/\theta - 16H_c\mu^2\cot^2\alpha/\theta$$

$$T_{13} = -12\sqrt{3}\,\mu\cot^3\alpha/\theta - 12\sqrt{3}\,\mu\nu\cot\alpha/\theta - 12\sqrt{3}\,H_c\mu\cot\alpha/\theta$$

$$T_{14} = 12\sqrt{3}\,\mu\csc^3\alpha\,\lambda^3/\theta$$

$$T_{15} = 36\sqrt{3}\,\mu\lambda\cot^2\alpha\csc\alpha/\theta + 12\sqrt{3}\,\mu\nu\csc\alpha\,\lambda/\theta$$

$$+ 12\sqrt{3}\,H_c\mu\lambda\csc\alpha/\theta$$

$$T_{16} = -36\sqrt{3}\,\mu\lambda^2\csc^2\alpha\cot\alpha/\theta$$

$$T_{17} = -8\mu^2\csc^4\alpha\,\lambda^4/\theta$$

$$T_{18} = 32\mu^2\lambda\cot^3\alpha\csc\alpha/\theta + 32\mu^2\nu\lambda\cot\alpha\csc\alpha/\theta$$

$$+ 32H_c\mu^2\lambda\cot\alpha\csc\alpha/\theta$$

$$T_{19} = -48\mu^2\lambda^2\cot^2\alpha\csc^2\alpha/\theta - 16\mu^2\nu\csc\alpha\,\lambda^2/\theta$$

$$-16\,H_c\mu^2\csc^2\alpha\,\lambda^2/\theta$$

$$T_{110} = 32\mu^2\lambda^3\cot\alpha\csc^3\alpha/\theta$$

$$T_{111} = -24\sqrt{3}\,\mu\nu\cot\alpha\csc\alpha\,\lambda/\theta - 24\sqrt{3}\,H_c\mu\lambda\cot\alpha\csc\alpha/\theta$$

$$T_{112} = 12\sqrt{3}\,\nu\mu\lambda^2\csc^2\alpha/\theta + 12\sqrt{3}\,H_c\mu\lambda^2\csc^2\alpha/\theta$$

$$T_{113} = 12\,H_d\,G_{\xi z} + 12\,H_d\,G_{\eta z}\cot^2\alpha$$

$$T_{114} = 24\sqrt{3}\,H_d\,G_{\xi z}/\theta$$

$$T_{115} = 1.2\,H_d\,G_{\eta z}\lambda^2\csc^2\alpha$$

$$T_{116} = -24\,H_d\,G_{\eta z}\lambda\cot\alpha\csc\alpha$$

$$T_{117} = -24\sqrt{3}\,H_d\,G_{\eta z}\cot\alpha\csc\alpha$$

$$T_{118} = 24\sqrt{3}\, H_d G_{\eta z} \lambda \csc\alpha / \theta$$

$$F_{21} = 2 + H_c \cot^2\alpha$$

$$F_{22} = H_c \lambda^2 \csc^2\alpha$$

$$F_{23} = -2 H_c \lambda \cot\alpha \csc\alpha$$

$$F_{24} = -(1+\nu) \cot\alpha$$

$$F_{25} = (1+\nu) \lambda \csc\alpha$$

$$F_{26} = -2 \csc^2\alpha$$

$$F_{27} = -H_c \lambda^2 \csc^2\alpha$$

$$F_{28} = (3-\nu) \lambda \cot\alpha \csc\alpha$$

$$F_{29} = (1+\nu) \lambda \cot\alpha \csc\alpha$$

$$F_{210} = -H_c \lambda^2 \csc^2\alpha$$

$$S_{21} = 2\cot^2\alpha + H_c$$

$$S_{22} = 2\lambda^2\csc^2\alpha$$

$$S_{23} = -4\lambda\cot\alpha\csc\alpha$$

$$S_{24} = -(1+\nu)\cot\alpha$$

$$S_{25} = (1+\nu)\lambda\csc\alpha$$

$$S_{26} = \cot^3\alpha - 2\nu\cot\alpha$$

$$S_{27} = 2\lambda^2\cot\alpha\csc^2\alpha$$

$$S_{28} = -4\lambda\cot^2\alpha\csc\alpha + (1+\nu)\lambda\csc\alpha$$

$$S_{29} = -2\lambda\cot^2\alpha\csc\alpha - \lambda\csc\alpha\, H_c$$

$$S_{210} = -2\lambda^3\csc^3\alpha$$

$$S_{211} = 4\lambda^2\cot\alpha\csc\alpha$$

$$T_{31} = -2\theta$$

$$T_{32} = -\theta$$

$$T_{33} = 2\nu\theta\cot\alpha$$

$$T_{34} = -2\theta\lambda\nu\csc\alpha$$

$$T_{35} = -\nu\theta\cot^2\alpha$$

$$T_{36} = 2\lambda\nu\theta\cot\alpha\csc\alpha$$

$$T_{37} = -\nu\theta\lambda^2\csc^2\alpha$$

$$T_{38} = 2\theta\cot^3\alpha$$

$$T_{39} = 2\theta\lambda^2\cot\alpha\csc^2\alpha$$

$$T_{310} = -4\theta\lambda^2\cot\alpha\csc^2\alpha$$

$$T_{311} = -2\theta\lambda\csc\alpha\cot^2\alpha$$

$$T_{312} = -2\,\theta\lambda^3 \csc^3\alpha$$

$$T_{313} = 4\,\theta\,\lambda^2 \csc^2\alpha\, \cot\alpha$$

$$T_{314} = -\theta\, \cot^4\alpha$$

$$T_{315} = -\theta\, \lambda^2 \cot^2\alpha\, \csc^2\alpha$$

$$T_{316} = 2\,\theta\lambda \cot^3\alpha\, \csc\alpha$$

$$T_{317} = 2\,\theta\,\lambda\, \cot^3\alpha\, \csc\alpha$$

$$T_{318} = 2\,\theta\,\lambda^3 \cot\alpha\, \csc^3\alpha$$

$$T_{319} = -4\,\theta\,\lambda\, \cot^2\alpha\, \csc^2\alpha$$

$$T_{320} = -\theta\,\lambda^2 \csc^2\alpha\, \cot^2\alpha$$

$$T_{321} = -\theta\,\lambda^4 \csc^4\alpha$$

$$T_{322} = 2\theta\lambda^2 \cot\alpha\, \csc^3\alpha$$

$$T_{323} = -2\nu\theta\cot^2\alpha$$

$$T_{324} = -2\nu\theta\lambda^2\csc^2\alpha$$

$$T_{325} = 4\nu\theta\cot\alpha\csc\alpha$$

$$T_{326} = -\nu\theta\cot^2\alpha$$

$$T_{327} = -\nu\theta\lambda^2\csc^2\alpha$$

$$T_{328} = 2\lambda\nu\theta\cot\alpha\csc\alpha$$

$$T_{329} = -2\theta H_c\cot^2\alpha$$

$$T_{330} = 2\theta H_c\lambda\cot\alpha\csc\alpha$$

$$T_{331} = 2\theta H_c\lambda\cot\alpha\csc\alpha$$

$$T_{332} = -2\theta\lambda^2 H_c\csc^2\alpha$$

$$T_{333} = 2\theta H_c\cot\alpha$$

$$T_{334} = -2\theta H_c \lambda \csc\alpha$$

$$T_{335} = -2\theta H_c \cot^2\alpha$$

$$T_{336} = 2\theta H_c \lambda \cot\alpha \csc\alpha$$

$$T_{337} = 2\theta H_c \lambda \csc\alpha \cot\alpha$$

$$T_{338} = -2\theta H_c \lambda^2 \csc^2\alpha$$

$$\Phi_1 = -T_{31} - T_{323} - T_{329}$$

$$\Phi_2 = -T_{32} - T_{35} - T_{314} - T_{316} - T_{335}$$

$$\Phi_3 = -T_{33} - T_{38} - T_{333}$$

$$\Phi_4 = -T_{34} - T_{333}$$

$$\Phi_5 = -T_{36} - T_{317} - T_{337}$$

$$\Phi_6 = -T_{37} - T_{320}$$

$$\phi_7 = -T_{39}$$

$$\phi_8 = -T_{310} - T_{334}$$

$$\phi_9 = -T_{312}$$

$$\phi_{10} = -T_{313}$$

$$\phi_{11} = -T_{315} - T_{327}$$

$$\phi_{12} = -T_{316} - T_{328} - T_{336}$$

$$\phi_{13} = -T_{318}$$

$$\phi_{14} = -T_{319} - T_{338}$$

$$\phi_{15} = -T_{321}$$

$$\phi_{16} = -T_{322}$$

$$\phi_{17} = -T_{324}$$

$$\phi_{18}' = -T_{325} - T_{330}$$

$$\Phi_{19} = -T_{331}$$

$$\Phi_{20} = -T_{332}$$

PART II

FIRST ORDER APPROXIMATION

$$(2F_{17} - 48F_{18} - 6F_{19} - 8F_{110})B_1 - 8F_{110}C_1$$

$$+ 24F_{18}D_1 + 4F_{110}F_1 + (-6F_{11} - 2F_{12} - 2F_{13} + F_{14})A_2$$

$$+ 6F_{11}B_2 + 2F_{12}C_2 - 2F_{16}A_3 + 2F_{16}B_3$$

$$= 4F_{17} - 24F_{18} - 12F_{19} - 16F_{110} \qquad \text{(1st. 1)}$$

$$(-8F_{17} + 120F_{18} + 40F_{19} + 32F_{110})B_1 - 8F_{110}C_1$$

$$+(4F_{17} - 240F_{18} - 20F_{19} - 16F_{110})D_1 - 16F_{110}F_1$$

$$+(2F_{12} - F_{14} + 4F_{13})A_2 + (-20F_{11} - 2F_{12} - 4F_{13} + F_{14})B_2$$

$$-2F_{12}C_2 + 20F_{11}D_2 + 2F_{12}F_2 - 4F_{16}B_3 + 4F_{16}D_3$$

$$= -4F_{17} + 20F_{19} + 16F_{110} \qquad \text{(1st 2)}$$

$$(-4F_{17} + 96F_{18} + 36F_{19} + 24F_{110})B_1$$

$$+(-4F_{17} + 24F_{18} + 36F_{19} + 96F_{110})C_1$$

$$-48F_{18}D_1 - 48F_{110}E_1 + (2F_{17} - 48F_{18} - 18F_{19} - 48F_{110})F_1$$

$$+(6F_{11} + 6F_{13} - F_{14})A_2 - 6F_{11}B_2 + (-6F_{11} - 12F_{12} - 6F_{13} + F_{14})C_2$$

$$+12F_{12}E_2 + 6F_{11}F_2 + (6F_{15} + 6F_{16})A_3 + (-6F_{15} - 6F_{16})B_3$$

$$-6F_{16}C_3 + 6F_{16}F_3 = -8F_{17} + 48F_{18} + 72F_{19} + 48F_{110}$$

$$\text{(1st 3)}$$

$$(6F_{17} - 42F_{19} - 24F_{110})B_1 + (-12F_{17} + 336F_{18} + 84F_{19} + 48F_{110})D_1$$

$$+12F_{110}F_1 + (2F_{12} + 6F_{13} - F_{14})B_2$$

$$+(-42F_{11} - 2F_{12} - 6F_{13} + F_{14})D_2 - 2F_{12}F_2 + 2F_{15}C_3$$

$$-6F_{16}D_3 - 2F_{15}E_3 - 2F_{15}F_3 = 0 \qquad \text{(1st. 4)}$$

$$(2F_{17} - 48F_{18} - 30F_{19})B_1 + (8F_{17} - 48F_{18} - 120F_{19}$$

$$-120F_{110})C_1 + 24F_{18}D_1 + (-4F_{17} + 24F_{18} + 60F_{19}$$

$$+240F_{110})E_1 + (-4F_{17} + 96F_{18} + 60F_{19} + 60F_{110})F_1$$

$$+(10F_{13} + 6F_{11} - F_{14})C_2 + (-6F_{11} - 30F_{12} - 10F_{13}$$

$$+F_{14})E_2 - 6F_{11}F_2 - 6F_{15}A_3 + 6F_{15}B_3$$

$$+(6F_{15} + 10F_{16})C_3 - 10F_{16}E_3 + (-6F_{15} - 10F_{16})F_3$$

$$= 4F_{17} - 24F_{18} - 60F_{19}. \qquad \text{(1st. 5)}$$

$$(16F_{17} - 240F_{18} - 240F_{19} - 96F_{110})B_1$$

$$+(4F_{17}-60F_{19}-96F_{110})C_1+(-8F_{17}+480F_{18}+120F_{19}$$

$$+48F_{110})D_1+48F_{110}E_1+(-8F_{17}+120F_{18}+120F_{19}$$

$$+192F_{110})F_1+(-12F_{13}+F_{14})A_2+(20F_{11}+12F_{13}-F_{14})B_2$$

$$+(12F_{12}+12F_{13}-F_{14})C_2-20F_{11}D_2-12F_{12}E_2$$

$$+(20F_{11}-12F_{13}+F_{14}-12F_{12})F_2+(20F_{15}+12F_{16})B_3$$

$$+(-20F_{15}-12F_{16})D_3-12F_{16}F_3$$

$$=8F_{17}-120F_{19}-48F_{110} \qquad \text{(1st 6)}$$

$$(-6S_{19}-8S_{111})B_1+(2S_{18}-48S_{110}-8S_{111}-6S_{112})C_1$$

$$+24S_{110}E_1+4S_{111}F_1+(-2S_{15}-2S_{16})A_2+2S_{16}C_2$$

$$+(-2S_{11}-6S_{12}-2S_{13}+S_{14})A_3+2S_{11}B_3+6S_{12}C_3$$

$$= S_{17} + 4 S_{18} - 12 S_{19} - 24 S_{110} - 16 S_{111} - 12 S_{112} \qquad \text{(1st 7)}$$

$$(12 S_{19} + 8 S_{111}) B_1 + (-S_{17} - 8 S_{18} + 12 S_{19} + 120 S_{110} + 32 S_{110}$$

$$+ 40 S_{112}) C_1 + (4 S_{18} - 240 S_{110} - 16 S_{111} - 20 S_{112}) E_1$$

$$+ (-6 S_{19} - 16 S_{111}) F_1 + 2 S_{15} A_2 + (-2 S_{15} - 4 S_{16}) C_2$$

$$+ 4 S_{16} E_2 + (2 S_{11} + 4 S_{13} - S_{14}) A_3 - 2 S_{11} B_3$$

$$+ (-2 S_{11} - 20 S_{12} - 4 S_{13} + S_{14}) C_3 + 20 S_{12} E_3 + 2 S_{11} F_3$$

$$= -2 S_{17} - 4 S_{18} + 24 S_{19} + 16 S_{111} + 20 S_{112} \qquad \text{(1st 8)}$$

$$(-3 S_{17} - 4 S_{18} + 120 S_{19} + 24 S_{110} + 36 S_{112}) B_1$$

$$+ (-4 S_{18} + 96 S_{110} + 24 S_{111} + 36 S_{112}) C_1 + (-60 S_{19} - 48 S_{111}) D_1$$

$$- 48 S_{110} E_1 + (2 S_{18} - 48 S_{110} - 48 S_{111} - 18 S_{112}) F_1$$

$$+ (12 S_{15} + 6 S_{16}) A_2 + (12 S_{15} - 6 S_{16}) B_2 - 6 S_{16} C_2$$

$$+ 6 S_{16} F_2 + (6 S_{12} + 6 S_{13} - S_{14}) A_3 + (-12 S_{11} - 6 S_{12}$$

$$- 6 S_{13} + S_{14}) B_3 - 6 S_{12} C_3 + 12 S_{11} D_3 + 6 S_{12} F_3$$

$$= -6 S_{17} - 8 S_{18} + 60 S_{19} + 48 S_{110} + 48 S_{111} + 72 S_{112}$$

(1st 9)

$$-6 S_{19} B_1 + (2 S_{17} + 6 S_{18} - 24 S_{19} - 24 S_{111} - 42 S_{112}) C_1$$

$$+ (-S_{17} - 12 S_{18} + 12 S_{19} + 336 S_{110} + 48 S_{111} + 84 S_{112}) E_1$$

$$+ (12 S_{111} + 12 S_{19}) F_1 + 2 S_{15} C_2 + (-2 S_{15} - 6 S_{16}) D_2$$

$$+ (2 S_{11} + 6 S_{13} - S_{14}) C_3 + (-2 S_{11} - 42 S_{12} - 6 S_{13} + S_{14}) E_3$$

$$- 2 S_{11} F_3 = S_{17} - 12 S_{19}$$

(1st 10)

$$(10 S_{17} + 8 S_{18} - 210 S_{19} - 48 S_{110} - 120 S_{111} - 120 S_{112}) B_1$$

$$+ (2 S_{18} - 48 S_{110} - 30 S_{112}) C_1 + (-5 S_{17} - 4 S_{18} + 240 S_{19}$$

$$+ 24 S_{110} + 240 S_{111} + 60 S_{112}) D_1 + 24 S_{110} E_1$$

$$+ (-4 S_{18} + 96 S_{110} + 60 S_{111} + 60 S_{112}) F_1$$

$$+ (30 S_{15} + 10 S_{16}) B_2 + (-30 S_{15} - 10 S_{16}) D_2$$

$$- 10 S_{16} F_2 + (6 S_{12} + 10 S_{13} - S_{14}) B_3$$

$$+ (-30 S_{11} - 6 S_{12} - 10 S_{13} + S_{14}) D_3 - 6 S_{12} F_3$$

$$= 5 F_{17} + 4 S_{18} - 24 S_{110} - 60 S_{112} \qquad \text{(1st 11)}$$

$$(6 S_{17} + 4 S_{18} - 96 S_{111} - 60 S_{112}) B_1 + (6 S_{17} + 16 S_{18}$$

$$- 60 S_{19} - 240 S_{110} - 96 S_{111} + 240 S_{112}) C_1 + (120 S_{19} + 48 S_{111}) D_1$$

$$+ (-8 S_{18} + 480 S_{110} + 48 S_{111} + 120 S_{112}) E_1$$

$$+ (-3 S_{17} - 8 S_{18} + 120 S_{110} + 192 S_{111} + 120 S_{112}) F_1$$

$$- 12 S_{15} A_2 + 12 S_{15} B_2 + (12 S_{15} + 12 S_{16}) C_2 - 12 S_{16} D_2$$

$$+ (-12 S_{15} - 12 S_{16}) F_2 + (-12 S_{13} + S_{14}) A_3 + (12 S_{11} + 12 S_{13}$$

$$- S_{14}) B_3 + (20 S_{12} + 12 S_{13} - S_{14}) C_3 - 12 S_{11} D_3$$

$$- 20 S_{12} E_3 + (-12 S_{11} - 20 S_{12} - 12 S_{13} + S_{14}) F_3$$

$$= 12 S_{17} + 8 S_{18} - 120 S_{19} - 48 S_{111} - 120 S_{112} \qquad \text{(1st 12)}$$

$$a_1 + (-48 T_{12} - 6 T_{18} - 8 T_{19} + 2 T_{113}) B_1 + (-48 T_{17} - 8 T_{19}$$

$$- 6 T_{110} + 2 T_{115}) C_1 + 24 T_{12} D_1 + 24 T_{17} E_1 + 4 T_{19} F_1$$

$$+ (-6 T_{11} - 2 T_{111} - 2 T_{112} + T_{114}) A_2 + 6 T_{11} B_2 + 2 T_{112} C_2$$

$$+ (-6 T_{14} - 2 T_{15} - 2 T_{16} + T_{118}) A_3 + 2 T_{15} B_3 + 6 T_{14} C_3$$

$$= -24 T_{12} - 24 T_{17} - 12 T_{18} - 16 T_{19} - 12 T_{110} + 4 T_{113} + 4 T_{115} + T_{116}$$

(1st 13)

$$(360 T_{12} + 24 T_{17} - 3 T_{116} + 120 T_{18} + 96 T_{19} + 36 T_{110} - 24 T_{113} - 4 T_{115}) B_1$$

$$+ (96 T_{17} + 24 T_{19} + 36 T_{110} - 4 T_{115}) C_1 + (-720 T_{12} - 60 T_{18} - 48 T_{19} + 12 T_{113}) D_1$$

$$- 48 T_{17} E_1 + (-48 T_{17} - 48 T_{19} - 18 T_{110} + 2 T_{115}) F_1 + (12 T_{111} + 6 T_{112} - 3 T_{114}) A_2$$

$$+ (-60 T_{11} - 12 T_{111} - 6 T_{112} + 3 T_{114}) B_2 - 6 T_{112} C_2 + 60 T_{11} D_2 + 6 T_{112} F_2$$

$$+ (6 T_{14} + 6 T_{16} - T_{118}) A_3 + (-6 T_{14} - 12 T_{15} - 6 T_{16} + T_{118}) B_3 - 6 T_{14} C_3$$

$$+ 12 T_{15} D_3 + 6 T_{14} F_3 = 48 T_{17} + 60 T_{18} + 48 T_{19} + 72 T_{110}$$

$$- 12 T_{113} - 8 T_{115} - 6 T_{116} \qquad \text{(1st 14)}$$

$$(96 T_{12} + 36 T_{18} + 24 T_{19} - 4 T_{113}) B_1 + (24 T_{12} + 360 T_{17} + 36 T_{18}$$

$$+ 96 T_{19} + 120 T_{110} - 4 T_{113} - 24 T_{115} - 3 T_{116}) C_1 - 48 T_{12} D_1$$

$$+ (-720 T_{17} - 48 T_{19} - 60 T_{110} + 12 T_{115}) E_1 + (-48 T_{12} - 18 T_{18} - 48 T_{19} \cdot\cdot$$

$$+ 2 T_{113}) F_1 + (6 T_{11} + 6 T_{111} - T_{114}) A_2 - 6 T_{11} B_2$$

$$+(-6T_{11}-6T_{111}-12T_{112}+T_{114})C_2+12T_{112}E_2+6T_{11}F_2$$

$$+(6T_{13}+6T_{15}+12T_{16}-T_{117}-3T_{118})A_3+(-6T_{13}-6T_{15})B_3$$

$$+(-60T_{14}-6T_{15}-12T_{16}-3T_{118})C_3+60T_{14}E_3+6T_{15}F_3$$

$$=48T_{12}+72T_{18}+48T_{19}+60T_{110}-8T_{113}-12T_{115}-6T_{116}$$

(1st 15)

$$(-48T_{17}-210T_{18}-120T_{19}-120T_{110}+30T_{113}+8T_{115}+10T_{116})B_1$$

$$+(-48T_{17}-30T_{110}+2T_{115})C_1+(1680T_{12}+24T_{17}+420T_{18}$$

$$+240T_{19}+60T_{110}-60T_{113}-40T_{115}-5T_{116})D_1$$

$$+(24T_{17}+60T_{110})E_1+(96T_{17}+60T_{19}+60T_{110}-4T_{115})F_1$$

$$+(30T_{111}+10T_{112}-5T_{114})B_2+(-210T_{11}-30T_{111}-10T_{112}+5T_{114})D_2$$

$$-10T_{112}F_2+(6T_{14}+10T_{16}-T_{118})B_3+(-6T_{14}-30T_{15}-10T_{16}+T_{118})D_3$$

$$-6T_{14}F_3=-24T_{17}-60T_{110}+4T_{115}+5T_{116}$$

(1st 16)

$$(-48T_{12} - 30T_{18} + 2T_{113})B_1 + (-48T_{12} - 120T_{18} - 120T_{19}$$

$$- 210T_{110} + 30T_{115} + 10T_{116} + 8T_{113})C_1 + 24T_{12}D_1$$

$$+ (24T_{12} + 1680T_{17} + 60T_{18} + 240T_{19} + 420T_{19} - 4T_{113}$$

$$- 60T_{115} - 5T_{116})E_1 + (96T_{12} + 60T_{18} + 60T_{19} - 4T_{113})F_1$$

$$+ (6T_{11} - 10T_{111} - 30T_{112} + T_{114})C_2 + (-6T_{11} - 10T_{111}$$

$$- 30T_{112} + T_{114})E_2 - 6T_{11}F_2 + (-6T_{13} + T_{117})A_3$$

$$+ 6T_{13}B_3 + (6T_{13} + 10T_{15} + 30T_{16} - T_{117} - 5T_{118})C_3$$

$$+ (-210T_{14} - 10T_{15} - 30T_{16} + 5T_{118})E_3 + (-6T_{13} - 10T_{15})F_3$$

$$= -24T_{12} - 60T_{18} + 4T_{113} + 5T_{116} \qquad \text{(1st 17)}$$

$$(-720T_{12} - 720T_{18} - 288T_{19} - 180T_{110} + 48T_{113} + 12T_{115}$$

$$+ 18T_{116})B_1 + (-720T_{17} - 180T_{18} - 288T_{19} - 720T_{110}$$

$$+ 12 T_{113} + 48 T_{115} + 18 T_{116}) C_1 + (1440 T_{12} + 360 T_{18}$$

$$+ 144 T_{19} - 24 T_{113}) D_1 + (144 T_{19} + 360 T_{110} - 24 T_{115}$$

$$+ 1440 T_{17}) E_1 + (360 T_{12} + 360 T_{17} + 360 T_{18} + 575 T_{19}$$

$$+ 360 T_{110} - 24 T_{113} - 24 T_{115} - 9 T_{116}) F_1 + (-36 T_{111}$$

$$+ 3 T_{114}) A_2 + (60 T_{11} + 36 T_{111} - 3 T_{114}) B_2 + (36 T_{111}$$

$$+ 36 T_{112} - 3 T_{114}) C_2 - 60 T_{11} D_2 - 36 T_{112} E_2$$

$$+ (-60 T_{11} - 36 T_{111} - 36 T_{112} + 3 T_{114}) F_2$$

$$+ (-36 T_{16} + 3 T_{117} + 3 T_{118}) A_3 + (60 T_{13} + 36 T_{15} + 36 T_{16}$$

$$- 3 T_{117} - 3 T_{118}) B_3 + (60 T_{14} + 36 T_{16} - 3 T_{118}) C_3$$

$$+ (-60 T_{13} - 36 T_{15}) D_3 - 60 T_{14} E_3 + (-60 T_{14} - 36 T_{15}$$

$$- 36 T_{16} + 3 T_{118}) F_3 = -360 T_{18} - 144 T_{19} - 360 T_{110}$$

$$+ 24 T_{113} + 24 T_{115} + 36 T_{116} \qquad \text{(1st 18)}$$

SECOND ORDER APPROXIMATION:

$$(-6F_{21}-2F_{22}-2F_{23})A_4+6F_{21}B_4+2F_{22}C_4-2F_{25}A_5$$

$$+2F_{25}B_5 = F_{26}SA_1SD_1+F_{27}SA_1SE_1+F_{28}SA_1SG_1$$

$$+F_{29}SB_1SD_1+F_{210}SB_1SG_1 \qquad \text{(2nd 1)}$$

$$2F_{22}A_4+(-20F_{21}-2F_{22}-4F_{23})B_4-2F_{22}C_4+2F_{22}F_4$$

$$-4F_{25}B_5+4F_{25}D_5 = F_{26}(SA_1SD_2+SA_3SD_1)$$

$$+F_{27}(SA_1SE_2+SA_3SE_1)+F_{28}(SA_1SG_2+SA_3SG_1)$$

$$+F_{29}(SB_1SD_2+SB_3SD_1)+F_{210}(SB_1SG_2+SB_3SG_1)$$

(2nd 2)

$$(6F_{21}+6F_{23})A_5-6F_{21}B_5+(-6F_{21}-12F_{22}-6F_{23})C_5$$

$$+12F_{22}E_5+6F_{21}F_5+(6F_{25}+6F_{24})A_6+(-6F_{25}-6F_{24})B_6$$

$$-6F_{25}C_6+6F_{25}F_6 = F_{26}(SA_1SD_5+SA_3SD_2+SA_7SD_1)$$

$$+F_{27}(SA_1SE_5+SA_3SE_2+SA_7SE_1)$$

$$+ F_{28} (SA_1 SG_5 + SA_3 SG_2 + SA_7 SG_1)$$

$$+ F_{29} (SB_1 SD_5 + SB_3 SD_2 + SB_7 SD_1)$$

$$+ F_{210} (SB_1 SG_5 + SB_3 SG_2 + SB_7 SG_1) \qquad \text{(2nd 3)}$$

$$(2F_{22} + 6F_{23}) B_4 + (-42 F_{21} - 2 F_{22} - 6 F_{23}) D_4$$

$$- 2F_{22} F_4 - 6 F_{25} D_5 = F_{26} (SA_1 SD_5 + SA_3 SD_2 + SA_7 SD_1)$$

$$+ F_{27} (SA_1 SE_5 + SA_3 SE_2 + SA_7 SE_1)$$

$$+ F_{28} (SA_1 SG_5 + SA_3 SG_2 + SA_7 SG_1)$$

$$+ F_{29} (SB_1 SD_5 + SB_3 SD_2 + SB_7 SD_1)$$

$$+ F_{210} (SB_1 SG_5 + SB_3 SG_2 + SB_7 SG_1) \qquad \text{(2nd 4)}$$

$$(10 F_{23} + 6 F_{21}) C_4 + (-6 F_{21} - 30 F_{22} - 10 F_{23}) E_4$$

$$-6F_{21}F_4 + 6F_{24}B_5 + (6F_{24} + 10F_{25})C_5 - 10F_{25}E_5$$

$$+ (-6F_{24} - 10F_{25})F_5 = F_{26}(SA_1SD_6 + SA_2SD_7 + SA_4SD_4$$

$$+ SA_6SD_3 + SA_9SD_1) + F_{27}(SA_1SE_6 + SA_2SE_7$$

$$+ SA_4SE_4 + SA_6SE_3 + SA_9SE_1) + F_{28}(SA_1SG_6$$

$$+ SA_2SG_7 + SA_4SG_4 + SA_6SG_3 + SA_9SG_1)$$

$$+ F_{29}(SB_1SD_6 + SB_2SD_7 + SB_4SD_4 + SB_6SD_3 + SB_9SD_1)$$

$$+ F_{210}(SB_1SG_6 + SB_2SG_7 + SB_4SG_4 + SB_6SG_3 + SB_9SG_1)$$

(2nd 5)

$$-12F_{23}A_4 + (20F_{21} + 12F_{23})B_4 + (12F_{22} + 12F_{23})C_4$$

$$-20F_{21}D_4 - 12F_{22}E_4 + (-20F_{21} - 12F_{23} - 12F_{22})F_4$$

$$+ (20F_{24} + 12F_{25})B_5 + (-20F_{24} - 12F_{25})D_5 - 12F_{25}F_5$$

$$= F_{26}(SA_1SD_9 + SA_2SD_8 + SA_3SD_3 + SA_5SD_4$$

$$+ SA_6 SD_2 + SA_{12} SD_1) + F_{27}(SA_1 SE_9 + SA_2 SE_8$$

$$+ SA_3 SE_3 + SA_5 SE_4 + SA_6 SE_2 + SA_{12} SE_1)$$

$$+ F_{28}(SA_1 SG_9 + SA_2 SG_8 + SA_3 SG_3 + SA_5 SG_4$$

$$+ SA_6 SG_2 + SA_{12} SG_1) + F_{29}(SB_1 SD_9 + SB_2 SD_8$$

$$+ SB_3 SD_3 + SB_5 SD_4 + SB_6 SD_2 + SB_{12} SD_1)$$

$$+ F_{210}(SB_1 SG_9 + SB_2 SG_8 + SB_3 SG_3 + SB_5 SG_4$$

$$+ SB_6 SG_2 + SB_{12} SG_1) \qquad (2nd\ 6)$$

$$(-2S_{24} - 2S_{25})A_4 + 2S_{25} C_4 + (-2S_{21} - 6S_{22} - 2S_{23})A_5$$

$$+ 2S_{21} B_5 + 6S_{22} C_5 = S_{26} SA_2 SD_1 + S_{27} SA_2 SE_1 - S_{28} SA_2 SG_1$$

$$+ S_{29} SB_2 SD_1 + S_{210} SB_2 SE_1 + S_{211} SB_2 SG_1 \qquad (2nd\ 7)$$

$$2S_{24}A_4 + (-2S_{24} - 4S_{25})C_4 + 4S_{25}E_4 + (2S_{21} + 4S_{23})A_5$$

$$-2S_{21}B_5 + (-2S_{21} - 20S_{22} - 4S_{23})C_5 + 20S_{22}E_5 + 2S_{21}F_5$$

$$= S_{26}(SA_2SD_3 + SA_4SD_1) + S_{27}(SA_2SE_3 + SA_4SE_1)$$

$$+ S_{28}(SA_2SG_3 + SA_4SG_1) + S_{29}(SB_2SD_3 + SB_4SD_1)$$

$$+ S_{210}(SB_2SE_3 + SB_4SE_1) + S_{211}(SB_2SG_3 + SB_4SG_1)$$

(2nd 8)

$$(12S_{24} + 6S_{25})A_4 + (-12S_{24} - 6S_{25})B_4 - 6S_{25}C_4 + 6S_{25}F_4$$

$$+ (6S_{22} + 6S_{23})A_5 + (-12S_{21} - 6S_{22} - 6S_{23})B_5 - 6S_{22}C_5$$

$$+ 12S_{21}D_5 + 6S_{22}F_5 = S_{26}(SA_1SD_4 + SA_2SD_2 + SA_5SD_1)$$

$$+ S_{27}(SA_1SE + SA_2SE_2 + SA_5SE_1) + S_{28}(SA_1SG_4$$

$$+ SA_2SG_2 + SA_5SG_1) + S_{29}(SB_1SD_4 + SB_2SD_2 + SB_5SD_1)$$

$$+ S_{210}(SB_1SE_4 + SB_2SE_2 + SB_5SE_1)$$

$$+ S_{211}(SB_1SG_4 + SB_2SG_2 + SB_5SG_1) \qquad \text{(2nd 9)}$$

$$2S_{24}C_4 + (-2S_{24} - 6S_{25})E_4 + (2S_{21} + 6S_{23})C_5$$

$$+ (-2S_{21} - 42S_{22} - 6S_{23})E_5 - 2S_{21}F_5$$

$$= S_{26}(SA_2SD_6 + SA_4SD_3 + SA_8SD_1) + S_{27}(SA_2SE_6$$

$$+ SA_4SE_3 + SA_8SE_1) + S_{28}(SA_2SG_6 + SA_4SG_3 + SA_8SG_1)$$

$$+ S_{29}(SB_2SD_6 + SB_4SD_3 + SB_8SD_1) + S_{210}(SB_2SE_6 + SB_4SE_3$$

$$+ SE_8SE_1) + S_{211}(SB_2SG_6 + SB_4SG_3 + SB_8SG_1) \qquad \text{(2nd 10)}$$

$$(30S_{24} + 10S_{25})B_4 + 6S_{24}C_4 + (-30S_{24} - 10S_{25})D_4$$

$$-10S_{25}F_4 + (6S_{22} + 10S_{23})B_5 + (-30S_{21} - 6S_{22} - 10S_{23})D_5$$

$$-6S_{22}F_5 = S_{26}(SA_1SD_8 + SA_2SD_5 + SA_3SD_4 + SA_5SD_2$$

$$+ SA_{10}SD_1) + S_{27}(SA_1SE_8 + SA_2SE_5 + SA_3SE_4 + SA_5SE_2$$

$$+ SA_{10}SE_1) + S_{28}(SA_1SG_8 + SA_2SG_5 + SA_3SG_4 + SA_5SG_2$$

$$+ SA_{10}SG_1) + S_{29}(SB_1SD_8 + SB_2SD_5 + SB_3SD_4 + SB_5SD_2$$

$$+ SB_{10}SD_1) + S_{210}(SB_1SE_8 + SB_2SE_5 + SB_3SE_4 + SB_5SE_2$$

$$+ SB_{10}SE_1) + S_{211}(SB_1SG_8 + SB_2SG_5 + SB_3SG_4 + SB_5SG_2$$

$$+ SB_{10}SG_1) \qquad \text{(2nd 11)}$$

$$-12S_{24}A_4 + 12S_{24}B_4 + (12S_{24} + 12S_{25})C_4 - 12S_{25}E_4$$

$$+ (-12S_{24} - 12S_{25})F_4 - 12S_{23}A_5 + (12S_{21} + 12S_{23})B_5$$

$$+ (20S_{22} + 12S_{23})C_5 - 12S_{21}D_5 - 20S_{22}E_5 + (-12S_{21}$$

$$-20S_{22} - 12S_{23})F_5 = S_{26}(SA_1SD_7 + SA_2SD_9 + SA_4SD_2$$

$$+ SA_5SD_3 + SA_6SD_4 + SA_{11}SD_1)$$

$$+S_{27}(SA_1SE_7+SA_2SE_9+SA_4SE_2+SA_5SE_3+SA_6SE_4+SA_{11}SE_1)$$

$$+S_{28}(SA_1SG_7+SA_2SG_9+SA_4SG_2+SA_5SG_3+SA_6SG_4+SA_{11}SG_1)$$

$$+S_{29}(SB_1SD_7+SB_2SD_9+SB_4SD_2+SB_5SD_3+SB_6SD_4+SB_{11}SD_1)$$

$$+S_{210}(SB_1SE_7+SB_2SE_9+SB_4SE_2+SB_5SE_3+SB_6SE_4+SB_{11}SE_1)$$

$$+S_{211}(SB_1SG_7+SB_2SG_9+SB_4SG_2+SB_5SG_3+SB_6SG_4+SB_{11}SG_1)$$

(2nd 12)

TERMS DEFINED FOR SECOND APPROXIMATION:

$SA_1 = -4 + 2B_1$

$SA_2 = -1$

$SA_3 = 4 - 8B_1 + 4D_1$

$SA_4 = 2 - C_1$

$SA_5 = 6 - 3B_1$

$SA_6 = 8 - 4B_1 - 4C_1 + 2F_1$

$SA_7 = 6B_1 - 12D_1$

$SA_8 = -1 + 2C_1 - E_1$

$$SA_9 = -4 + 2B_1 + 8C_1 - 4E_1 - 4F_1$$

$$SA_{10} = -12 + 6B_1 + 6C_1 - 3F_1$$

$$SA_{11} = -12 + 6B_1 + 6C_1 - 3F_1$$

$$SA_{12} = -8 + 16B_1 + 4C_1 - 8D_1 - 8F_1$$

$$SB_1 = -1$$

$$SB_2 = -4 + 2C_1$$

$$SB_3 = 2 - B_1$$

$$SB_4 = 4 - 8C_1 + 4E_1$$

$$SB_5 = 8 - 4B_1 - 4C_1 + 2F_1$$

$$SB_6 = 6 - 3C_1$$

$$SB_7 = -1 + 2B_1 - D_1$$

$$SB_8 = 6C_1 - 12E_1$$

$$SB_9 = -5 + 10C_1 - 5E_1$$

$$SB_{10} = -4 + 8B_1 + 2C_1 - 4D_1 - 4F_1$$

$$SB_{11} = -8 + 4B_1 + 16C_1 - 8E_1 - 8F_1$$

$$SB_{12} = -12 + 6B_1 + 6C_1 - 3F_1$$

$$SD_1 = -4 + 2B_1$$

$$SD_2 = 12 - 24B_1 + 12D_1$$

$$SD_3 = 8 - 4B_1 - 4C_1 + 2F_1$$

$$SD_4 = 12 - 6B_1$$

$$SD_5 = 30B_1 - 60D_1$$

$$SD_6 = -4 + 2B_1 + 8C_1 - 4E_1 - 4F_1$$

$$SD_7 = -24 + 12B_1 + 12C_1 - 6F_1$$

$$SD_8 = -20 + 40B_1 - 20D_1$$

$$SD_9 = -24 + 48B_1 + 12C_1 - 24D_1 - 24F_1$$

$$SE_1 = -4 + C_1$$

$$SE_2 = 8 - 4B_1 - 4C_1 + 2F_1$$

$$SE_3 = 12 - 24C_1 + 12E_1$$

$$SE_4 = 12 - 6C_1$$

$$SE_5 = -4 + 8B_1 + 2C_1 - 4D_1 - 4F_1$$

$$SE_6 = 30C_1 - 60E_1$$

$$SE_7 = -20 + 40C_1 - 20E_1$$

$$SE_8 = -24 + 12B_1 + 12C_1 - 6F_1$$

$$SE_9 = -24 + 12B_1 + 48C_1 - 24E_1 - 24F_1$$

$$SG_1 = -1$$

$$SG_2 = 6 - 3B_1$$

$$SG_3 = 6 - 3C_1$$

$$SG_4 = 16 - 8B_1 - 8C_1 + 4F_1$$

$$SG_5 = -5 + 10B_1 - 5D_1$$

$$SG_6 = -5 + 10C_1 - 5E_1$$

$$SG_7 = -16 + 8B_1 + 32C_1 - 16E_1 - 16F_1$$

$$SG_8 = -16 + 32B_1 + 8C_1 - 16D_1 - 16F_1$$

$$SG_9 = -36 + 18B_1 + 18C_1 - 9F_1$$

THIRD ORDER APPROXIMATION

$$(2F_{17} - 48F_{18} - 6F_{19} - 8F_{110})B_6 - 8F_{110}C_6 + 24F_{18}D_6$$

$$+ 4F_{110}F_6 + (-6F_{11} - 2F_{12} - 2F_{13} + F_{14})A_7 + 6F_{11}B_7$$

$$+ 2F_{12}C_7 - 2F_{16}A_8 + 2F_{16}B_8 = 0 \qquad \text{(3rd 1)}$$

$$(-8F_{17} + 120F_{18} + 40F_{19} + 32F_{110})B_6 - 8F_{110}C_6$$

$$+ (4F_{17} - 240F_{18} - 20F_{19} - 16F_{110})D_6 - 16F_{110}F_6$$

$$+ (2F_{12} - F_{14} + 4F_{13})A_7 + (-20F_{11} - 2F_{12} - 4F_{13} + F_{14})B_7$$

$$- 2F_{12}C_7 + 20F_{11}D_7 - 4F_{16}B_8 + 4F_{16}D_8 = 0 \qquad \text{(3rd 2)}$$

$$(-4F_{17} + 96F_{18} + 36F_{19} + 24F_{110})B_6 + (-4F_{17} + 24F_{18} + 36F_{19}$$

$$+ 96F_{110})C_6 - 48F_{18}D_6 - 48F_{110}E_6 + (2F_{17} - 48F_{18}$$

$$-18F_{19} - 48F_{110})F_6 + (6F_{11} + 6F_{13} - F_{14})A_7 - 6F_{11}B_7$$

$$+ (-6F_{11} - 12F_{12} - 6F_{13} + F_{14})C_7 + 12F_{12}E_7 + 6F_{11}F_7$$

$$+ (6F_{15} + 6F_{16})A_8 + (-6F_{15} - 6F_{16})B_8 - 6F_{16}C_8$$

$$+ 6F_{16}F_8 = 0 \qquad \text{(3rd 3)}$$

$$(6F_{17} - 42F_{19} - 24F_{110})B_6 + (-12F_{17} + 336F_{18} + 84F_{19}$$

$$+ 48F_{110})D_6 + 12F_{110}F_6 + (2F_{12} + 6F_{13} - F_{14})B_7$$

$$+ (-42F_{11} - 2F_{12} - 6F_{13} + F_{14})D_7 - 2F_{12}F_7 + 2F_{15}C_8$$

$$- 6F_{16}D_8 - 2F_{15}E_8 - 2F_{15}F_8 = 0$$

(3rd 4)

$$(2F_{17} - 48F_{18} - 30F_{19})B_6 + (8F_{17} - 48F_{18} - 120F_{19}$$

$$-120F_{110})C_6 + 24F_{18}D_6 + (-4F_{17} + 24F_{18} + 60F_{19} + 240F_{110})E_6$$

$$+(-4F_{17} + 96F_{18} + 60F_{19} + 60F_{110})F_6 + (10F_{13} + 6F_{11} - F_{14})C_7$$

$$+(-6F_{11} - 30F_{12} - 10F_{13} + F_{14})E_7 - 6F_{11}F_7 - 6F_{15}A_8$$

$$+6F_{15}B_8 + (6F_{15} + 10F_{16})C_8 - 10F_{16}E_8 + (-6F15$$

$$-10F_{16})F_8 = 0 \qquad \text{(3rd 5)}$$

$$(16F_{17} - 240F_{18} - 240F_{19} - 96F_{110})B_6$$

$$+(4F_{17} - 60F_{19} - 96F_{110})C_6 + (-8F_{17} + 480F_{18} + 120F_{19}$$

$$+48F_{110})D_6 + 48F_{110}E_6 + (-8F_{17} + 120F_{18} + 120F_{19}$$

$$+192F_{110})F_6 + (-12F_{13} + F_{14})A_7 + (20F_{11}$$

$$+ 12 F_{13} - F_{14}) B_7 + (12 F_{12} + 12 F_{13} - F_{14}) C_7$$

$$- 20 F_{11} D_7 - 12 F_{12} E_7 + (20 F_{11} - 12 F_{13} + F_{14}$$

$$- 12 F_{12}) F_2 + (20 F_{15} + 12 F_{16}) B_8$$

$$+ (- 20 F_{15} - 12 F_{16}) D_8 - 12 F_{16} F_8 = 0 \qquad \text{(3rd 6)}$$

$$(- 6 S_{19} - 8 S_{111}) B_6 + (2 S_{18} - 48 S_{110} - 8 S_{111} - 6 S_{112}) C_6$$

$$+ 24 S_{110} E_6 + 4 S_{111} F_6 + (- 2 S_{15} - 2 S_{16}) A_7$$

$$+ 2 S_{16} C_7 + (- 2 S_{11} - 6 S_{12} - 2 S_{13} + S_{14}) A_8 + 2 S_{11} B_8$$

$$+ 6 S_{12} C_8 = 0 \qquad \text{(3rd 7)}$$

$$(12S_{19}+8S_{111})B_6+(-S_{17}-8S_{18}+12S_{19}+120S_{110}+32S_{111}$$

$$+40S_{112})C_6+(4S_{18}-240S_{110}-16S_{111}-20S_{112})E_6$$

$$+(-6S_{19}-16S_{111})F_6+2S_{15}A_7+(-2S_{15}-4S_{16})C_7$$

$$+4S_{16}E_7+(2S_{11}+4S_{13}-S_{14})A_8-2S_{11}B_8$$

$$+(-2S_{11}-20S_{12}-4S_{13}+S_{14})C_8+20S_{12}E_8+2S_{11}F_8=0$$

(3rd 8)

$$(-3S_{17}-4S_{18}+120S_{19}+24S_{110}+96S_{111}+36S_{112})B_6$$

$$+(-4S_{18}+96S_{110}+24S_{111}+36S_{112})C_6+(-60S_{19}-48S_{111})D_6$$

$$-48S_{110}E_6+(2S_{18}-48S_{110}-48S_{111}-18S_{112})F_6$$

$$+(12S_{15}+6S_{16})A_7+(12S_{15}-6S_{16})B_7-6S_{16}C_7+6S_{16}F_7$$

$$+(6S_{12}+6S_{13}-S_{14})A_8+(-12S_{11}-6S_{12}-6S_{13}+S_{14})B_8$$

$$-6S_{12}C_8+12S_{11}D_8+6S_{12}F_8=0$$

(3rd 9)

$$- 6S_{19}B_6 + (2S_{17} + 6S_{18} - 24S_{19} - 24S_{111} - 42S_{112})C_6$$

$$+ (-S_{17} - 12S_{18} + 12S_{19} + 336S_{110} + 48S_{111} + 84S_{112})E_6$$

$$+ (12S_{111} + 12S_{19})F_6 + 2S_{15}C_7 + (-2S_{15} - 6S_{16})D_7$$

$$+ (2S_{11} + 6S_{13} - S_{14})C_8 + (-2S_{11} - 42S_{12} - 6S_{13} + S_{14})E_8$$

$$- 2S_{11}F_8 = 0 \qquad \text{(3rd 10)}$$

$$(10S_{17} + 8S_{18} - 210S_{19} - 48S_{110} - 120S_{111} - 120S_{112})B_6$$

$$+ (2S_{18} - 48S_{110} - 30S_{112})C_6 + (-5S_{17} - 4S_{18} + 240S_{19}$$

$$+ 24S_{110} + 240S_{111} + 60S_{112})E_6 + 24S_{110}E_6 + (-4S_{18}$$

$$+ 96S_{110} + 60S_{111} + 60S_{112})F_6 + (30S_{15} + 10S_{16})B_7$$

$$+ (-30S_{15} - 10S_{16})D_7 - 10S_{16}F_7 + (6S_{12} + 10S_{13} - S_{14})B_9$$

$$+(-30S_{11}-6S_{12}-10S_{13}+S_{14})D_9-6S_{12}F_9=0$$

(3rd 11)

$$(6S_{17}+4S_{18}-96S_{111}-60S_{112})B_6+(6S_{17}+16S_{18}-60S_{19}$$

$$-240S_{110}-96S_{111}+240S_{112})C_6+(120S_{19}+48S_{111})D_6$$

$$+(-8S_{18}+480S_{110}+48S_{111}+120S_{112})E_6+(-3S_{17}-8S_{18}$$

$$+120S_{110}+192S_{111}+120S_{112})F_6-12S_{15}A_7+12S_{15}B_7$$

$$+(12S_{15}+12S_{16})C_7-12S_{16}D_7+(-12S_{15}-12S_{16})E_7$$

$$+(-12S_{13}+S_{14})A_8+(12S_{11}+12S_{13}-S_{14})B_8$$

$$+(20S_{12}+12S_{13}-S_{14})C_8-12S_{11}D_8-20S_{12}E_8$$

$$+(-12S_{11}-20S_{12}-12S_{13}+S_{14})F_8=0$$

(3rd 12)

$$a_3+(-48T_{12}-6T_{18}-8T_{19}+2T_{113})B_6+(-48T_{17}-8T_{19}$$

$$-6T_{110}+2T_{115})C_6+24T_{12}D_6+24T_{17}E_6+4T_{19}F_6$$

$$+(-6T_{11}-2T_{111}-2T_{112}+T_{114})A_7+6T_{11}B_7+2T_{112}C_7$$

$$+(-6T_{14}-2T_{15}-2T_{16}+T_{118})A_8+2T_{15}B_8+6T_{14}C_8$$

$$=\phi_1 TD_1 TP_1+\phi_4 TG_1 TP_1+\phi_9 TG_1 TQ_1+\phi_{10} TG_1 TR_1$$

$$+\phi_{17} TD_1 TQ_1+\phi_{18} TD_1 TR_1 \qquad \text{(3rd 13)}$$

$$(360T_{12}+24T_{17}-3T_{116}+120T_{18}+96T_{19}+36T_{110}-24T_{113}-4T_{115})B_6$$

$$+(96T_{17}+24T_{19}+36T_{110}-4T_{115})C_6+(-720T_{12}-60T_{18}-48T_{19}$$

$$+12T_{113})D_6-48T_{17}E_6+(-48T_{17}-48T_{19}-18T_{110}+2T_{115})F_6$$

$$+(12T_{111}+6T_{112}-3T_{114})A_7+(-60T_{11}-12T_{111}-6T_{112}+3T_{114})B_7$$

$$-6T_{112}C_7+60T_{11}D_7+6T_{112}F_7+(6T_{14}+6T_{16}-T_{118})A_8$$

$$+(-6T_{14}-12T_{15}-6T_{16}+T_{118})B_8-6T_{14}C_8+12T_{15}D_8$$

$$+ 6T_{14}F_8 = \phi_1(TD_1TP_2 + TD_2TP_1) + \phi_2(TA_1TA_1TA_1)$$

$$+ \phi_4(TG_1TP_2 + TG_2TP_1) + \phi_5(TA_1TB_1TP_1)$$

$$+ \phi_6(TB_1TB_1TP_1) + \phi_9(TG_1TQ_2 + TG_2TQ_1)$$

$$+ \phi_{10}(TG_1TR_2 + TG_2TR_1) + \phi_{11}(TA_1TA_1TQ_1)$$

$$+ \phi_{12}(TA_1TA_1TR_1) + \phi_{13}(TA_1TB_1TQ_1)$$

$$+ \phi_{14}(TA_1TB_1TR_1) + \phi_{15}(TB_1TB_1TQ_1)$$

$$+ \phi_{16}(TB_1TB_1TR_1) + \phi_{17}(TD_1TQ_1 + TD_2TQ_1)$$

$$+ \phi_{18}(TD_1TR_2 + TD_2TR_1) + \phi_{19}(TE_1TP_1)$$

$$+ \phi_{20}(TE_1TR_1) \qquad \text{(3rd 14)}$$

$$(96T_{12} + 36T_{18} + 24T_{19} - 4T_{113})B_6 + (24T_{12} + 360T_{17}$$

$$+ 36T_{18} + 96T_{19} + 120T_{110} - 4T_{113} - 24T_{115} - 3T_{116})C_6$$

$$- 48 T_{12} D_6 + (-720 T_{17} - 48 T_{19} - 60 T_{110} + 12 T_{115}) E_6$$

$$+ (-48 T_{12} - 18 T_{18} - 48 T_{19} + 2 T_{113}) F_6 + (6T_{11} + 6T_{111} - T_{114}) A_7$$

$$- 6 T_{11} B_7 + (-6T_{11} - 6T_{11} - 12 T_{112} + T_{114}) C_7 + 12 T_{112} E_7 + 6 T_{11} F_7$$

$$+ (6T_{13} + 6T_{15} + 12 T_{16} - T_{117} - 3 T_{118}) A_8 + (-6T_{13} - 6T_{15}) B_8$$

$$+ (-60 T_{14} - 6 T_{15} - 12 T_{16} + 3 T_{118}) C_8 + 60 T_{14} E_8$$

$$+ 6 T_{15} F_8 = \phi_1 (TD_1 TP_3 + TD_3 TP_1) + \phi_2 (TA_2 TA_2 TP_1)$$

$$+ \phi_3 (TF_1 TP_1) + \phi_4 (TG_1 TP_3 + TG_3 TP_1) + \phi_5 (TA_2 TB_2 TP_1)$$

$$+ \phi_6 (TB_2 TB_2 TP_1) + \phi_7 (TF_1 TQ_1) + \phi_8 (TF_1 TR_1)$$

$$+ \phi_9 (TG_1 TQ_3 + TG_3 TQ_1) + \phi_{10} (TG_1 TR_3 + TG_3 TR_1)$$

$$+ \phi_{11} (TA_2 TA_2 TQ_1) + \phi_{12} (TA_2 TA_2 TR_1) + \phi_{13} (TA_3 TB_2 TQ_1)$$

$$+ \phi_{14} (TA_2 TB_2 TR_1) + \phi_{15} (TB_2 TB_2 TQ_1) + \phi_{16} (TB_2 TB_2 TR_1)$$

$$+ \phi_{17} (TD_1 TQ_3 + TD_3 TQ_1) + \phi_{18} (TD_1 TR_3 + TD_3 TR_1) \qquad \text{(3rd 15)}$$

$$(-48T_{17}-210T_{18}-120T_{19}-120T_{110}+30T_{113}+8T_{115}+10T_{116})B_6$$

$$+(-48T_{17}-30T_{110}+2T_{115})C_6+(1680T_{12}+24T_{17}+420T_{18}+240T_{19}$$

$$+60T_{110}-60T_{113}-40T_{115}-5T_{116})D_6+(24T_{17}+60T_{110})E_6$$

$$+(96T_{17}+60T_{19}+60T_{110}-4T_{115})F_6+(30T_{111}+10T_{112}-5T_{114})B_7$$

$$+(-210T_{11}-30T_{111}-10T_{112}+5T_{114})D_7-10T_{112}F_7$$

$$+(6T_{14}+10T_{16}-T_{118})B_8+(-6T_{14}-30T_{15}-10T_{16}+T_{118})D_8$$

$$-6T_{14}F_8=\phi_1(TD_1TP_5+TD_2TP_2+TD_5TP_1)+\phi_2(TA_1TA_1TP_2$$

$$+2TA_1TA_3TP_1)+\phi_4(TG_1TP_5+TG_2TP_2+TG_5TP_1)+\phi_5(TA_1TB_1TP_2$$

$$+TA_1TB_3TP_1+TA_3TB_1TP_1)+\phi_6(TB_1TB_1TP_2+2TB_1TB_3TP_1)$$

$$+\phi_9(TG_1TQ_5+TG_2TQ_2+TG_5TQ_1)+\phi_{10}(TG_1TR_5+TG_2TR_2$$

$$+TG_5TR_1)+\phi_{11}(TA_1TA_1TQ_2+2TA_1TA_3TQ_1)+\phi_{12}(TA_1TA_1TR_2$$

$$-48T_{12}D_6+(-720T_{17}-48T_{19}-60T_{110}+12T_{115})E_6+(-48T_{12}$$

$$-18T_{18}-48T_{19}+2T_{113})F_6+(6T_{11}+6T_{111}-T_{114})A_7-6T_{11}B_7$$

$$+(-6T_{11}-6T_{11}-12T_{112}+T_{114})C_7+12T_{112}E_7+6T_{11}E_7$$

$$+(6T_{13}+6T_{15}+12T_{16}-T_{117}-3T_{118})A_8+(-6T_{13}-6T_{15})B_8$$

$$+(-60T_{14}-6T_{15}-12T_{16}+3T_{118})C_8+60T_{14}E_8+6T_{15}F_8$$

$$=\phi_1(TD_1TP_3+TD_3TP_1)+\phi_5(TA_1TB_2TP_1)+\phi_6(TB_2TB_2TP_1)$$

$$+\phi_7(TF_1TQ_1)+\phi_8(TF_1TR_1)+\phi_9(TG_1TQ_3+TG_3TQ_1)$$

$$+\phi_{10}(TG_1TR_3+TG_3TR_1)+\phi_{11}(TA_2TA_2TQ_1)+\phi_{12}(TA_2TA_2TR_1)$$

$$+\phi_{13}(TA_2+TB_2+TQ_1)+\phi_{14}(TA_2TB_2TR_1)+\phi_{15}(TB_2TB_2TQ_1)$$

$$+\phi_{16}(TB_2TB_2TR_1)+\phi_{17}(TD_1TQ_3+TD_3TQ_1)+\phi_{18}(TD_1TR_3$$

$$+TD_3TR_1)$$

$$+ 2TA_1TA_3TR_1) + \phi_{13}(TA_1TB_1TQ_2 + TA_1TB_3TQ_1 + TA_3TB_1TQ_1)$$

$$+ \phi_{14}(TA_1TB_1TR_2 + TA_1TB_2TR_1 + TA_3TB_1TR_1) + \phi_{15}(TB_1TB_1TQ_2$$

$$+ 2TB_1TB_3TQ_1) + \phi_{16}(TB_1TB_1TR_2 + 2TB_1TB_3TR_1)$$

$$+ \phi_{17}(TD_1TQ_5 + TD_2TQ_2 + TD_5TQ_1) + \phi_{18}(TD_1TR_5 + TD_2TR_2$$

$$+ TD_5TR_1) + \phi_{19}(TE_1TP_2 + TE_3TP_1) + \phi_{20}(TE_1TR_2 + TE_3TR_1)$$

(3rd 16)

$$(-48T_{12} - 30T_{18} + 2T_{113})B_6 + (-48T_{12} - 120T_{18} - 120T_{19} - 210T_{110}$$

$$+ 30T_{115} + 10T_{116} + 8T_{113})C_6 + 24T_{12}D_6 + (24T_{12} + 1680T_{17}$$

$$+ 60T_{18} + 240T_{19} + 420T_{110} - 4T_{113} - 60T_{115} - 5T_{116})E_6$$

$$+ (96T_{12} + 60T_{18} + 60T_{19} - 4T_{113})F_6 + (6T_{11} - 10T_{111} - 30T_{112}$$

$$+ T_{114})C_7 + (-6T_{11} - 10T_{111} - 30T_{112} + T_{114})E_7 - 6T_{11}F_7$$

$$+ (-6T_{13} + T_{117})A_8 + 6T_{13}B_8 + (6T_{13} + 10T_{15} + 30T_{16} - T_{117}$$

$$- 5T_{118})C_8 + (-210T_{14} - 10T_{15} - 30T_{16} + 5T_{118})E_8 + (-6T_{13}$$

$$- 10T_{15})F_8 = \phi_1(TD_1TP_6 + TD_3TP_3 + TD_6TP_1) + \phi_2(TA_2TA_2TP_3$$

$$+ 2TA_4TA_2TP_1) + \phi_3(TF_1TP_3 + TF_3TP_1) + \phi_4(TG_1TP_6 + TG_3TP_3$$

$$+ TG_6TP_1) + \phi_5(TA_2TB_2TP_3 + TA_4TB_2TP_1 + TA_2TB_4TP_1)$$

$$+ \phi_6(TB_2TB_2TP_3 + 2TB_4TB_2TP_1) + \phi_7(TF_1TQ_3 + TF_3TQ_1)$$

$$+ \phi_8(TF_1TR_3 + TF_3TR_1) + \phi_9(TG_1TQ_6 + TG_3TQ_3 + TG_6TQ_1)$$

$$+ \phi_{10}(TG_1TR_6 + TG_3TR_3 + TG_6TR_1) + \phi_{11}(TA_2TA_2TQ_3 + 2TA_4TA_2TQ_1)$$

$$+ \phi_{12}(TA_2TA_2TR_3 + 2TA_4TA_2TR_1) + \phi_{13}(TA_2TB_2TQ_3 + TA_4TB_2TQ_1$$

$$+ TA_2TB_4TQ_1) + \phi_{14}(TA_2TB_2TR_3 + TA_4TB_2TR_1 + TA_2TB_4TR_1)$$

$$+ \phi_{15}(TB_2TB_2TQ_3 + 2TB_2TB_4TQ_1) + \phi_{16}(TB_2TB_2TR_3$$

$$+ 2TB_2TB_4TR_1) + \phi_{17}(TD_1TQ_6 + TD_3TQ_3 + TD_6TQ_1)$$

$$+ \phi_{18}(TD_1TR_6 + TD_3TR_3 + TD_6TR_1) \qquad \text{(3rd 17)}$$

$$(-720\,T_{12} - 720\,T_{18} - 288\,T_{19} - 180\,T_{110} + 48\,T_{113} + 12\,T_{115} + 18\,T_{116})B_6$$

$$+(-720\,T_{17} - 180\,T_{18} - 288\,T_{19} - 720\,T_{110} + 12\,T_{113} + 48\,T_{115} + 18\,T_{116})C_6$$

$$+(1440\,T_{12} + 360\,T_{18} + 144\,T_{19} - 24\,T_{113})D_6 + (144\,T_{19} + 360\,T_{110}$$

$$-24\,T_{115} + 1440\,T_{17})E_6 + (360\,T_{12} + 360\,T_{17} + 360\,T_{18} + 576\,T_{19}$$

$$+360\,T_{110} - 24\,T_{113} - 24\,T_{115} - 9\,T_{116})F_6 + (-36\,T_{111} + 3\,T_{114})A_7$$

$$+(60\,T_{11} + 36\,T_{111} - 3\,T_{114})B_7 + (36\,T_{111} + 36\,T_{112} - 3\,T_{114})C_7$$

$$-60\,T_{11}D_7 - 36\,T_{112}E_7 + (-60\,T_{11} - 36\,T_{111} - 36\,T_{112} + 3\,T_{114})F_7$$

$$+(-36\,T_{16} + 3\,T_{117} + 3\,T_{118})A_8 + (60\,T_{13} + 36\,T_{15} + 36\,T_{16} - 3\,T_{117}$$

$$-3\,T_{118})B_8 + (60\,T_{14} + 36\,T_{16} - 3\,T_{118})C_8 + (-60\,T_{13} - 36\,T_{15})D_8$$

$$-60\,T_{14}E_8 + (-60\,T_{14} - 36\,T_{15} - 36\,T_{16} + 3\,T_{118})F_8$$

$$= \phi_1(TD_1TP_9 + TD_2TP_3 + TD_3TP_2 + TD_4TP_4 + TD_9TP_1)$$

$$+\phi_2(TA_1TA_1TP_3 + TA_1TA_2TP_4 + TA_1TA_6TP_1 + TA_2TA_1TP_4$$

$$+ TA_2TA_2TP_2 + TA_2TA_5TP_1 + TA_5TA_2TP_1 + TA_6TA_1TP_1)$$

$$+ \phi_3(TF_1TP_2 + TF_2TP_4 + TF_6TP_1) + \phi_4(TG_1TP_9 + TG_2TP_3$$

$$+ TG_3TP_2 + TG_4TP_4 + TG_9TP_1) + \phi_5(TA_1TB_1TB_1 + TA_1TB_2TP_4$$

$$+ TA_1TB_6TP_1 + TA_2TB_6TP_1 + TA_2TB_1TP_4 + TA_2TB_2TP_2 + TA_2TB_5TP_1$$

$$+ TA_5TB_2TP_1 + TA_6TB_1TP_1) + \phi_6(TB_1TB_1TP_3 + TB_1TB_2TP_4$$

$$+ TB_1TB_6TP_1 + TB_2TB_1TP_4 + TB_2TB_2TP_2 + TB_2TB_5TP_1 + TB_5TA_2TP_1$$

$$+ TB_6TB_1TB_1) + \phi_7(TF_1TQ_2 + TF_2TQ_4 + TF_6TQ_1) + \phi_8(TF_1TR_2$$

$$+ TF_2TR_4 + TF_6TR_1) + \phi_9(TG_1TQ_9 + TG_2TQ_3 + TG_3TQ_2$$

$$+ TG_4TQ_4 + TG_9TQ_1) + \phi_{10}(TG_1TR_9 + TG_2TR_3 + TG_3TR_2$$

$$+ TG_4TR_4 + TG_9TR_1) + \phi_{11}(TA_1TA_1TQ_3 + TA_1TA_2TQ_4$$

$$+ TA_1TA_6TQ_1 + TA_2TA_1TQ_4 + TA_2TA_2TQ_2 + TA_2TA_5TQ_1$$

$$+ TA_5 TA_2 TQ_1 + TA_6 TA_1 TQ_1) + \phi_{12}(TA_1 TA_1 TR_3 + TA_1 TA_2 TR_4$$

$$+ TA_1 TA_6 TR_1 + TA_2 TA_1 TR_4 + TA_2 TA_2 TR_2 + TA_2 TA_5 TR_1$$

$$+ TA_5 TA_2 TR_1 + TA_6 TA_1 TR_1) + \phi_{13} (TA_1 TB_1 TQ_3 + TA_1 TB_1 TQ_4$$

$$+ TA_2 TB_2 TQ_2 + TA_2 TB_2 TQ_1 + TA_5 TB_2 TQ_1 + TA_6 TB_1 TQ_1)$$

$$+ \phi_{14} (TA_1 TB_1 TR_3 + TA_1 TB_2 TR_4 + TA_1 TB_6 TR_1 + TA_2 TB_1 TR_4$$

$$+ TA_2 TB_2 TR_2 + TA_2 TB_5 TR_1 + TA_5 TB_2 TR_1 + TA_6 TB_1 TR_1)$$

$$+ \phi_{15} (TB_1 TB_1 TQ_3 + TB_1 TB_2 TQ_4 + TB_1 TB_6 TQ_1 + TB_2 TB_1 TQ_4$$

$$+ TB_2 TB_2 TQ_2 + TB_2 TB_5 TQ_1 + TB_5 TB_2 TQ_1 + TB_6 TB_1 TQ_1)$$

$$+ \phi_{16} (TB_1 TB_1 TR_3 + TB_1 TB_2 TR_4 + TB_1 TB_6 TR_1 + TB_2 TB_1 TR_4$$

$$+ TB_2 TB_2 TR_2 + TB_2 TB_5 TR_1 + TB_5 TB_2 TR_1 + TB_6 TB_1 TR_1)$$

$$+ \phi_{17} (TD_1 TQ_9 + TD_2 TQ_3 + TD_3 TQ_2 + TD_4 TQ_4 + TD_9 TQ_1)$$

$$+\phi_{18}(TD_1TR_9 + TD_2TR_3 + TD_3TR_2 + TD_3TR_2 + TD_4TR_4 + TD_9TR_1)$$

$$+\phi_{19}(TE_1TP_3 + TE_2TP_4 + TE_6TP_1)$$

$$+\phi_{20}(TE_1TR_3 + TE_2TR_4 + TE_6TR_1) \qquad \text{(3rd 18)}$$

TERMS DEFINED FOR THIRD ORDER APPROXIMATION:

$TA_1 = -4 + 2B_1$

$TA_2 = -1$

$TA_3 = 4 - 8B_1 + 4D_1$

$TA_4 = 2 - C_1$

$TA_5 = 6 - 3B_1$

$TA_6 = 8 - 4B_1 - 4C_1 + 2F_1$

$TA_7 = 6B_1 - 12D_1$

$TA_8 = -1 + 2C_1 - E_1$

$TA_9 = -4 + 2B_1 + 8C_1 - 4E_1 - 4F_1$

$TA_{10} = -5 + 10B_1 - 5D_1$

$TA_{11} = -12 + 6B_1 + 6C_1 - 3F_1$

$TA_{12} = -8 + 16B_1 + 4C_1 - 8D_1 - 8F_1$

$TB_1 = -1$

$$TB_2 = -4 + 2C_1$$

$$TB_3 = 2 - B_1$$

$$TB_4 = 4 - 8C_1 + 4E_1$$

$$TB_5 = 8 - 4B_1 - 4C_1 + 2F_1$$

$$TB_6 = 6 - 3C_1$$

$$TB_7 = -1 + 2B_1 - D_1$$

$$TB_8 = 6C_1 - 12E_1$$

$$TB_9 = -5 + 10C_1 - 5E_1$$

$$TB_{10} = -4 + 8B_1 + 2C_1 - 4D_1 - 4F_1$$

$$TB_{11} = -8 + 4B_1 + 16C_1 - 8E_1 - 8F_1$$

$$TB_{12} = -12 + 6B_1 + 6C_1 - 3F_1$$

$$TP_1 = -4 + 2B_1$$

$$TP_2 = 12 - 24B_1 + 12D_1$$

$$TP_3 = 8 - 4B_1 - 4C_1 + 2F_1$$

$$TP_4 = 12 - 6B_1$$

$$TP_5 = 30B_1 - 60D_1$$

$$TP_6 = -4 + 2B_1 + 8C_1 - 4E_1 - 4F_1$$

$$TP_7 = -24 + 12B_1 + 12C_1 - 6F_1$$

$$TP_8 = -20 + 40B_1 - 20D_1$$

$$TP_9 = -24 + 48B_1 + 12C_1 - 24D_1 - 24F_1$$

$$TQ_1 = -4 + 2C_1$$

$$TQ_2 = 8 - 4B_1 - 4C_1 + 2F_1$$

$$TQ_3 = 12 - 24C_1 + 12E_1$$

$$TQ_4 = 12 - 6C_1$$

$$TQ_5 = -4 + 8B_1 + 2C_1 - 4D_1 - 4F_1$$

$$TQ_6 = 30C_1 - 60E_1$$

$$TQ_7 = -20 + 40C_1 - 20E_1$$

$$TQ_8 = -24 + 12B_1 + 12C_1 - 6F_1$$

$$TQ_9 = -24 + 12B_1 + 48C_1 - 24E_1 - 24F_1$$

$$TR_1 = -1$$

$$TR_2 = 6 - 3B_1$$

$$TR_3 = 6 - 3C_1$$

$$TR_4 = 16 - 8B_1 - 8C_1 + 4F_1$$

$$TR_5 = -5 + 10B_1 - 5D_1$$

$$TR_6 = -5 + 10C_1 - 5E_1$$

$$TR_7 = -16 + 8B_1 + 32C_1 - 16E_1 - 16F_1$$

$$TR_8 = -16 + 32B_1 + 8C_1 - 16D_1 - 16F_1$$

$$TR_9 = -36 + 18B_1 + 18C_1 - 9F_1$$

$$TD_1 = A_4$$

$$TD_2 = -3A_4 + 3B_4$$

$$TD_3 = -A_4 + C_4$$

$$TD_4 = -2A_4$$

$$TD_5 = -5B_4 + 5D_4$$

$$TD_6 = -5C_4 + E_4$$

$$TD_7 = 2A_4 - 2C_4$$

$$TD_8 = 4A_4 - 4B_4$$

$$TD_9 = 3A_4 - 3B_4 - 3C_4 + 3F_4$$

$$TE_1 = -A_4$$

$$TE_2 = -2A_4 + 2C_4$$

$$TE_3 = A_4 - B_4$$

$$TE_4 = -4C_4 + 4E_4$$

$$TE_5 = 2A_4 - 2B_4 - 2C_4 + 2F_4$$

$$TE_6 = 3A_4 - 3C_4$$

$$TF_1 = -A_5$$

$$TF_2 = -2A_5 + 2B_5$$

$$TF_3 = A_5 - C_5$$

$$TF_4 = 2A_5 - 2B_5 - 2C_5 + 2F_5$$

$$TF_5 = -4B_5 + 4 \cdot D_5$$

$$TF_6 = 3A_5 - 3B_5$$

$$TG_1 = A_5 .$$

$$TG_2 = -A_5 + B_5$$

$$TG_3 = -3A_5 + 3C_5$$

$$TG_4 = -2A_5$$

$$TG_5 = -B_5 + D_5$$

$$TG_6 = -5C_5 + 5E_5$$

$$TG_7 = 4A_5 - 4C_5$$

$$TG_8 = 2A_5 - 2B_5$$

$$TG_9 = 3A_5 - 3B_5 - 3C_5 + 3F_5$$

APPENDIX B

COMPUTER PROGRAMME

```
C   PROGRAM TO COMPUTE THE LARGE DEFLEXION OF SKEW SANDWICH PLATES.
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON U3,CC,C,E,PNU,AMU,ALPHA,THETA,ALAMA,
     1      GXIZ,GEZ,CT,CSC,CT2,CT3,CT4,CSC2,CSC3,CSC4,PE2,PE3,PE4
      DIMENSION U3(18,18),CC(18),C(18),V(18),CCC(18)
       ICO=0
    1  ICO=ICO+1
       WRITE(3,9501)ICO
 9501 FORMAT(//10X,'****** CASE'I4,'******'/)
      CALL PARTII
      HA=1.-PNU
      T1=-2.*THETA
      T2=-THETA
      T3=2.*PNU*THETA*CT
      T4=-2.*THETA*ALAMA*PNU*CSC
      T5=-PNU*THETA*CT2
      T6=2.*ALAMA*PNU*THETA*CT*CSC
      T7=-PNU*THETA*PE2*CSC2
      T8=2.*THETA*CT3
      T9=2.*THETA*CT*CSC2*PE2
      T10=-4.*THETA*CT2*CSC*ALAMA
       T11=-2.*THETA*ALAMA*CSC*CT2
       T12=-2.*THETA*PE3*CSC3
       T13=4.*THETA*PE2*CSC2*CT
      T14=-THETA*CT4
      T15=-THETA*PE2*CT2*CSC2
       T16=2.*THETA*CT3*CSC*ALAMA
      T17=2.*CT3*CSC*THETA*ALAMA
      T18=2.*PE3*THETA*CT*CSC3
      T19=-4.*CT2*CSC2*THETA*ALAMA
      T20=-THETA*PE2*CSC2*CT2
      T21=-THETA*PE4*CSC4
      T22=2.*THETA*PE2*CT*CSC3
      T23=-2.*PNU*THETA*CT2
      T24=-2.*PNU*THETA*CSC2*PE2
      T25=4.*PNU*THETA*CT*CSC
      T26=-PNU*THETA*CT2
      T27=-PNU*THETA*PE2*CSC2
      T28=2.*ALAMA*PNU*THETA*CT*CSC
      T29=-2.*THETA*HA*CT2
      T30=2.*THETA*HA*ALAMA*CT*CSC
      T31=2.*THETA*HA*ALAMA*CSC*CT
      T32=-2.*THETA*PE2*HA*CSC2
```

```
      T33=2.*THETA*HA*CT
      T34=-2.*THETA*HA*ALAMA*CSC
      T35=-2.*THETA*HA*CT2
      T36= 2.*THETA*HA*ALAMA*CT*CSC
      T37=2.*THETA*HA*ALAMA*CSC*CT
      T38=-2.*THETA*HA*PE2*CSC2
      O1=T1+T23+T29
      O2=T2+T5+T14+T26+T35
      O3=T3+T8+T33
      O4=T4+T11
      O5=T6+T17+T37
      O6=T7+T20
      O7=T9
      O8=T10+T34
      O9=T12
      O10=T13
      O11=T15+T27
      O12=T16+T28+T36
      O13=T18
      O14=T19+T38
      O15=T21
      O16=T22
      O17=T24
      O18=T25+T30
      O19=T31
      O20=T32
      D1=CC(1)
      D2=-3.*CC(1)+3.*CC(2)
      D3=-CC(1)+CC(3)
      D4=-2.*CC(1)
      D5=-5.*CC(2)+5.*CC(4)
      D6=-CC(3)+CC(5)
      D7=2.*CC(1)-2.*CC(3)
      D8=4.*CC(1)-4.*CC(2)
      D9=3.*CC(1)-3.*CC(2)-3.*CC(3)+3.*CC(6)
      E1=-CC(1)
      E2=-2.*CC(1)+2.*CC(3)
      E3=CC(1)-CC(2)
      E4=-4.*CC(3)+4.*CC(5)
      E5=2.*CC(1)-2.*CC(2)-2.*CC(3)+2.*CC(6)
      E6=3.*CC(1)-3.*CC(3)
      F1=-CC(7)
      F2=-2.*CC(7)+2.*CC(8)
```

```
      F3=CC(7)-CC(9)
      F4=2.*CC(7)-2.*CC(8)-2.*CC(9)+2.*CC(12)
      F5=-4.*CC(8)+4.*CC(10)
      F6=3.*CC(7)-3.*CC(8)
      G1=CC(7)
      G2=-CC(7)+CC(8)
      G3=-3.*CC(7)+3.*CC(9)
      G4=-2.*CC(7)
      G5=-CC(8)+CC(10)
      G6=-5.*CC(9)+5.*CC(11)
      G7=4.*CC(7)-4.*CC(9)
      G8=2.*CC(7)-2.*CC(8)
      G9=3.*CC(7)-3.*CC(8)-3.*CC(9)+3.*CC(12)
      A1=-4.+2.*C(2)
      A2=-1.
      A3=4.-8.*C(2)+4.*C(4)
      A4=2.-C(3)
      A5=6.-3.*C(2)
      A6=8.-4.*C(2)-4.*C(3)+2.*C(6)
      A7=6.*C(2)-12.*C(4)
      A8=-1.+2.*C(3)-C(5)
      A9=-4.+2.*C(2)+8.*C(3)-4.*C(5)-4.*C(6)
      A10=-5.+10.*C(2)-5.*C(4)
      A11=-12.+6.*C(2)+6.*C(3)-3.*C(6)
      A12=-8.+16.*C(2)+4.*C(3)-8.*C(4)-8.*C(6)
      B1=-1.
      B2=-4.+2.*C(3)
      B3=2.-C(2)
      B4=4.-8.*C(3)+4.*C(5)
      B5=8.-4.*C(2)-4.*C(3)+2.*C(6)
      B6=6.-3.*C(3)
      B7=-1.+2.*C(2)-C(4)
      B8=6.*C(3)-12.*C(5)
      B9=-5.+10.*C(3)-5.*C(5)
      B10=-4.+8.*C(2)+2.*C(3)-4.*C(4)-4.*C(6)
      B11=-8.+4.*C(2)+16.*C(3)-8.*C(5)-8.*C(6)
      B12=-12.+6.*C(2)+6.*C(3)-3.*C(6)
      P1=-4.+2.*C(2)
      P2=12.-24.*C(2)+12.*C(4)
      P3=8.-4.*C(2)-4.*C(3)+2.*C(6)
      P4=12.-6.*C(2)
      P5=30.*C(2)-60.*C(4)
      P6=-4.+2.*C(2)+8.*C(3)-4.*C(5)-4.*C(6)
```

```
      P7=-24.+12.*C(2)+12.*C(3)-6.*C(6)
      P8=-20.+40.*C(2)-20.*C(4)
      P9=-24.+48.*C(2)+12.*C(3)-24.*C(4)-24.*C(6)
      Q1=-4.+2.*C(3)
      Q2=8.-4.*C(2)-4.*C(3)+2.*C(6)
      Q3=12.-24.*C(3)+12.*C(5)
      Q4=12.-6.*C(3)
      Q5=-4.+8.*C(2)+2.*C(3)-4.*C(4)-4.*C(6)
      Q6=30.*C(3)-60.*C(5)
      Q7=-20.+40.*C(3)-20.*C(5)
      Q8=-24.+12.*C(2)+12.*C(3)-6.*C(6)
      Q9=-24.+12.*C(2)+48.*C(3)-24.*C(5)-24.*C(6)
      R1=-1.
      R2=6.-3.*C(2)
      R3=6.-3.*C(3)
      R4=16.-8.*C(2)-8.*C(3)+4.*C(6)
      R5=-5.+10.*C(2)-5.*C(4)
      R6=-5.+10.*C(3)-5.*C(5)
      R7=-16.+8.*C(2)+32.*C(3)-16.*C(5)-16.*C(6)
      R8=-16.+32.*C(2)+8.*C(3)-16.*C(4)-16.*C(6)
      R9=-36.+18.*C(2)+18.*C(3)-9.*C(6)
      DO 101 I=1,18
  101 V(I)=0.D0
      V(13)=O1*D1*P1+O4*G1*P1+O9*G1*Q1+O10*G1*R1
     1       +O17*D1*Q1+O18*D1*R1
      V(14)=O1*(D1*P2+D2*P1)+O2*(A1*A1*P1)
     1       +O4*(G1*P2+G2*P1)+O5*(A1*B1*P1)
     2       +O6*(B1*B1*P1)+O9*(G1*Q2+G2*Q1)
     3       +O10*(G1*R2+G2*R1)+O11*(A1*A1*Q1)
     4       +O12*(A1*A1*R1)+O13*(A1*B1*Q1)
     5       +O14*(A1*B1*R1)+O15*(B1*B1*Q1)
     6       +O16*(B1*B1*R1)+O17*(D1*Q2+D2*Q1)
     7        +O18*(D1*R2+D2*R1)+O19*(E1*P1)
     8       +O20*(E1*R1)
      V(15)=O1*(D1*P3+D3*P1)+O2*(A2*A2*P1)
     1       +O3*(F1*P1)+O4*(G1*P3+G3*P1)
     2        +O5*(A2*B2*P1)+O6*(B2*B2*P1)
     3       +O7*(F1*Q1)+O8*(F1*R1)
     4       +O9*(G1*Q3+G3*Q1)+O10*(G1*R3+G3*R1)
     5       +O11*(A2*A2*Q1)+O12*(A2*A2*R1)
     6       +O13*(A2*B2*Q1)+O14*(A2*B2*R1)
     7       +O15*(B2*B2*Q1)+O16*(B2*B2*R1)
     8       +O17*(D1*Q3+D3*Q1)+O18*(D1*R3+D3*R1)
```

```
      V(16)=01*(D1*P5+D2*P2+D5*P1)
     1       +02*(A1*A1*P2+2.*A1*A3*P1)
     2       +04*(G1*P5+G2*P2+G5*P1)
     3       +05*(A1*B1*P2+A1*B3*P1+A3*B1*P1)
     4       +06*(B1*B1*P2+2.*B1*B3*P1)
     5       +09*(G1*Q5+G2*Q2+G5*Q1)
     6       +010*(G1*R5+G2*R2+G5*R1)
     7       +011*(A1*A1*Q2+2.*A1*A3*Q1)
     8       +012*(A1*A1*R2+2.*A1*A3*R1)
     9       +013*(A1*B1*Q2+A1*B3*Q1+A3*B1*Q1)
     &       +014*(A1*B1*R2+A1*B3*R1+A3*B1*R1)
     1        +015*(B1*B1*Q2+2.*B1*B3*Q1)
     2       +016*(B1*B1*R2+2.*B1*B3*R1)
     3       +017*(D1*Q5+D2*Q2+D5*Q1)
     4       +018*(D1*R5+D2*R2+D5*R1)
     5       +019*(E1*P2+E3*P1)
     6       +020*(E1*R2+E3*R1)
      V(17)=01*(D1*P6+D3*P3+D6*P1)
     1       +02*(A2*A2*P3+2.*A4*A2*P1)
     2       +03*(F1*P3+F3*P1)
     3       +04*(G1*P6+G3*P3+G6*P1)
     4       +05*(A2*B2*P3+A4*B2*P1+A2*B4*P1)
     5       +06*(B2*B2*P3+2.*B4*B2*P1)
     6       +07*(F1*Q3+F3*Q1)
     7       +08*(F1*R3+F3*R1)
     8       +09*(G1*Q6+G3*Q3+G6*Q1)
     9       +010*(G1*R6+G3*R3+G6*R1)
     &       +011*(A2*A2*Q3+2.*A4*A2*Q1)
     1       +012*(A2*A2*R3+2.*A4*A2*R1)
     2       +013*(A2*B2*Q3+A4*B2*Q1+A2*B4*Q1)
     3       +014*(A2*B2*R3+A4*B2*R1+A2*B4*R1)
     4       +015*(B2*B2*Q3+2.*B2*B4*Q1)
     5       +016*(B2*B2*R3+2.*B2*B4*R1)
     6       +017*(D1*Q6+D3*Q3+D6*Q1)
     7       +018*(D1*R6+D3*R3+D6*R1)
      V(18)=01*(D1*P9+D2*P3+D3*P2+D4*P4+D9*P1)
     1       +02*(A1*A1*P3+A1*A2*P4+A1*A6*P1+A2*A1*P4+A2*A2*P2
     2          +A2*A5*P1+A5*A2*P1+A6*A1*P1)
     3       +03*(F1*P2+F2*P4+F6*P1)
     4       +04*(G1*P9+G2*P3+G3*P2+G4*P4+G9*P1)
     5       +05*(A1*B1*P3+A1*B2*P4+A1*B6*P1+A2*B1*P4+A2*B2*P2
     6       +A2*B5*P1+A5*B2*P1+A6*B1*P1)
     7       +06*(B1*B1*P3+B1*B2*P4+B1*B6*P1+B2*B1*P4+B2*B2*P2
```

```
     8       +B2*B5*P1+B5*A2*P1+B6*B1*P1)
     9      +D7*(F1*Q2+F2*Q4+F6*Q1)
     E      +D8*(F1*R2+F2*R4+F6*R1)
     1      +D9*(G1*Q9+G2*Q3+G3*Q2+G4*Q4+G9*Q1)
     2      +D10*(G1*R9+G2*R3+G3*R2+G4*R4+G9*R1)
     3      +D11*(A1*A1*Q3+A1*A2*Q4+A1*A6*Q1+A2*A1*Q4+A2*A2*Q2
     4        +A2*A5*Q1+A5*A2*Q1+A6*A1*Q1)
     5      +D12*(A1*A1*R3+A1*A2*R4+A1*A6*R1+A2*A1*R4+A2*A2*R2
     6        +A2*A5*R1+A5*A2*R1+A6*A1*R1)
     7      +D13*(A1*B1*Q3+A1*B2*Q4+A1*B6*Q1+A2*B1*Q4+A2*B2*Q2
     8      +A2*B5*Q1+A5*B2*Q1+A6*B1*Q1)
      V(18)=V(18)+D14*(A1*B1*R3+A1*B2*R4+A1*B6*R1+A2*B1*R4+A2*B2*R2
     1      +A2*B5*R1+A5*B2*R1+A6*B1*R1)
     2      +D15*(B1*B1*Q3+B1*B2*Q4+B1*B6*Q1+B2*B1*Q4+B2*B2*Q2
     3      +B2*B5*Q1+B5*B2*Q1+B6*B1*Q1)
     4      +D16*(B1*B1*R3+B1*B2*R4+B1*B6*R1+B2*B1*R4+B2*B2*R2
     5      +B2*B5*R1+B5*B2*R1+B6*B1*R1)
     6      +D17*(D1*Q9+D2*Q3+D3*Q2+D4*Q4+D9*Q1)
     7      +D18*(D1*R9+D2*R3+D3*R2+D4*R4+D9*R1)
     8      +D19*(E1*P3+E2*P4+E6*P1)
     9      +D20*(E1*R3+E2*R4+E6*R1)
      DO 103 I=1,18
      CCC(I)=0.D0
      DO 103 J=1,18
  103 CCC(I)=CCC(I)+U3(I,J)*V(J)
      WRITE(3,602)CCC(1),CCC(2),CCC(3),CCC(4),CCC(5),CCC(6),
     1          CCC(7),CCC(8),CCC(9),CCC(10),CCC(11),CCC(12),
     2          CCC(13),CCC(14),CCC(15),CCC(16),CCC(17),CCC(18)
  602 FORMAT(10X,'*3='D16.8/10X,'B6='D16.8/10X,'C6='D16.8/10X,'D6='D16.8
     1          /10X,'E6='D16.8/10X,'F6='D16.8/10X,'A7='D16.8/10X,'B7='D16.8
     2          /10X,'C7='D16.8/10X,'D7='D16.8/10X,'E7='D16.8/10X,'F7='D16.8
     3          /10X,'A8='D16.8/10X,'B8='D16.8/10X,'C8='D16.8/10X,'D8='D16.8
     4          /10X,'E8='D16.8/10X,'F8='D16.8)
      GO TO 1
      END
```

```
C   PART II.
C   PROGRAM TO COMPUTE THE LARGE DEFLEXION OF SKEW SANDWICH PLATES.
C   FAN,  AUG. 1969.
      SUBROUTINE PARTII
      IMPLICIT REAL*8(A-H,O-Z)
      COMMON U3,CC,C,E,PNU,AMU,ALPHA,THETA,ALAMA,
     1      GXIZ,GEZ,CT,CSC,CT2,CT3,CT4,CSC2,CSC3,CSC4,PE2,PE3,PE4
      DIMENSION U3(18,18),U2(18,18),CC(18),C(18),V(18)
      CALL PARTI
      HA=1.-PNU
      HB=1.+PNU
      PE2=ALAMA*ALAMA
      PE3=PE2*ALAMA
      F21=2.+HA*CT2
      F22=HA*CSC2*PE2
      F23=-2.*CT*CSC*HA*ALAMA
      F24=-CT*HB
      F25=CSC*HB*ALAMA
      F26=-2.*CSC2
      F27=-HA*CSC2*PE2
      F28=CT*CSC*(3.-PNU)*ALAMA
      F29=HB*CT*CSC*ALAMA
      F210=-HB*CSC2*PE2
      S21=2.*CT2+HA
      S22=2.*CSC2*PE2
      S23=-4.*CT*CSC*ALAMA
      S24=-CT*HB
      S25=CSC*HB*ALAMA
      S26=CT3-2.*PNU*CT
      S27=2.*CT*CSC2*PE2
      S28=-(4.*CT2*CSC+CSC*HB)*ALAMA
      S29=-(2.*CT2*CSC+CSC*HA)*ALAMA
      S210=-2.*CSC3*PE3
      S211=4.*CT*CSC2*PE2
C   FORMING U2 MATRIX.
      DO 10 I=1,18
      V(I)=0.D0
      DO 10 J=1,18
   10 U2(I,J)=0.D0
      U2(1,1)=-6.*F21-2.*F22-2.*F23
      U2(1,2)=6.*F21
      U2(1,3)=2.*F22
      U2(1,7)=-2.*F25
```

```
      U2(1,8)=2.*F25
      U2(2,1)=2.*F22
      U2(2,2)=-20.*F21-2.*F22-4.*F23
      U2(2,3)=-2.*F22
      U2(2,4)=20.*F21
      U2(2,6)=2.*F22
      U2(2,8)=-4.*F25
      U2(2,10)=4.*F25
      U2(3,1)=6.*F21+6.*F23
      U2(3,2)=-6.*F21
      U2(3,3)=-6.*F21-12.*F22-6.*F23
      U2(3,5)=12.*F22
      U2(3,6)=6.*F21
      U2(3,7)=6.*F25+6.*F24
      U2(3,8)=-6.*F25-6.*F24
      U2(3,9)=-6.*F25
      U2(3,12)=6.*F25
      U2(4,2)=2.*F22+6.*F23
      U2(4,4)=-42.*F21-2.*F22-6.*F23
      U2(4,6)=-2.*F22
      U2(4,10)=-6.*F25
      U2(5,3)=10.*F23+6.*F21
      U2(5,5)=-6.*F21-30.*F22-10.*F23
      U2(5,6)=-6.*F21
      U2(5,8)=6.*F24
      U2(5,9)=6.*F24+10.*F25
      U2(5,11)=-10.*F25
      U2(5,12)=-6.*F24-10.*F25
      U2(6,1)=-12.*F23
      U2(6,2)=20.*F21+12.*F23
      U2(6,3)=12.*F22+12.*F23
      U2(6,4)=-20.*F21
      U2(6,5)=-12.*F22
      U2(6,6)=-20.*F21-12.*F23-12.*F22
      U2(6,8)=20.*F24+12.*F25
      U2(6,10)=-20.*F24-12.*F25
      U2(6,12)=-12.*F25
      U2(7,1)=-2.*S24-2.*S25
      U2(7,3)=2.*S25
      U2(7,7)=-2.*S21-6.*S22-2.*S23
      U2(7,8)=2.*S21
      U2(7,9)=6.*S22
      U2(8,1)=2.*S24
```

```
      U2(8,3)=-2.*S24-4.*S25
      U2(8,5)=4.*S25
      U2(8,7)=2.*S21+4.*S23
      U2(8,8)=-2.*S21
      U2(8,9)=-2.*S21-20.*S22-4.*S23
      U2(8,11)=20.*S22
      U2(8,12)=2.*S21
      U2(9,1)=12.*S24+6.*S25
      U2(9,2)=-12.*S24-6.*S25
      U2(9,3)=-6.*S25
      U2(9,6)=6.*S25
      U2(9,7)=6.*S22+6.*S23
      U2(9,8)=-12.*S21-6.*S22-6.*S23
      U2(9,9)=-6.*S22
      U2(9,10)=12.*S21
      U2(9,12)=6.*S22
      U2(10,3)=2.*S24
      U2(10,5)=-2.*S24-6.*S25
      U2(10,9)=2.*S21+6.*S23
      U2(10,11)=-2.*S21-42.*S22-6.*S23
      U2(10,12)=-2.*S21
      U2(11,2)=30.*S24+10.*S25
      U2(11,3)=6.*S24
      U2(11,4)=-30.*S24-10.*S25
      U2(11,6)=-10.*S25
      U2(11,8)=6.*S22+10.*S23
      U2(11,10)=-30.*S21-6.*S22-10.*S23
      U2(11,12)=-6.*S22
      U2(12,1)=-12.*S24
      U2(12,2)=12.*S24
      U2(12,3)=12.*S24+12.*S25
      U2(12,5)=-12.*S25
      U2(12,6)=-12.*S24-12.*S25
      U2(12,7)=-12.*S23
      U2(12,8)=12.*S21+12.*S23
      U2(12,9)=20.*S22+12.*S23
      U2(12,10)=-12.*S21
      U2(12,11)=-20.*S22
      U2(12,12)=-12.*S21-20.*S22-12.*S23
      CALL MATINV(U2,12)
      A1=-4.+2.*C(2)
      A2=-1.
      A3=4.-8.*C(2)+4.*C(4)
```

```
      A4=2.-C(3)
      A5=6.-3.*C(2)
      A6=8.-4.*C(2)-4.*C(3)+2.*C(6)
      A7=6.*C(2)-12.*C(4)
      A8=-1.+2.*C(3)-C(5)
      A9=-4.+2.*C(2)+8.*C(3)-4.*C(5)-4.*C(6)
      A10=-5.+10.*C(2)-5.*C(4)
      A11=-12.+6.*C(2)+6.*C(3)-3.*C(6)
      A12=-8.+16.*C(2)+4.*C(3)-8.*C(4)-8.*C(6)
      B1=-1.
      B2=-4.+2.*C(3)
      B3=2.-C(2)
      B4= 4.-8.*C(3)+4.*C(5)
      B5=8.-4.*C(2)-4.*C(3)+2.*C(6)
      B6=6.-3.*C(3)
      B7=-1.+2.*C(2)-C(4)
      B8=6.*C(3)-12.*C(5)
      B9=-5.+10.*C(3)-5.*C(5)
      B10=-4.+8.*C(2)+2.*C(3)-4.*C(4)-4.*C(6)
      B11=-8.+4.*C(2)+16.*C(3)-8.*C(5)-8.*C(6)
      B12=-12.+6.*C(2)+6.*C(3)-3.*C(6)
      D1=-4.+2.*C(2)
      D2=12.-24.*C(2)+12.*C(4)
      D3=8.-4.*C(2)-4.*C(3)+2.*C(6)
      D4=12.-6.*C(2)
      D5=30.*C(2)-60.*C(4)
      D6=-4.+2.*C(2)+8.*C(3)-4.*C(5)-4.*C(6)
      D7=-24.+12.*C(2)+12.*C(3)-6.*C(6)
      D8=-20.+40.*C(2)-20.*C(4)
      D9=-24.+48.*C(2)+12.*C(3)-24.*C(4)-24.*C(6)
      E1=-4.+2.*C(3)
      E2=8.-4.*C(2)-4.*C(3)+2.*C(6)
      E3=12.-24.*C(3)+12.*C(5)
      E4=12.-6.*C(3)
      E5=-4.+8.*C(2)+2.*C(3)-4.*C(4)-4.*C(6)
      E6=30.*C(3)-60.*C(5)
      E7=-20.+40.*C(3)-20.*C(5)
      E8=-24.+12.*C(2)+12.*C(3)-6.*C(6)
      E9=-24.+12.*C(2)+48.*C(3)-24.*C(5)-24.*C(6)
      G1=-1.
      G2=6.-3.*C(2)
      G3=6.-3.*C(3)
      G4=16.-8.*C(2)-8.*C(3)+4.*C(6)
```

```
      G5=-5.+10.*C(2)-5.*C(4)
      G6=-5.+10.*C(3)-5.*C(5)
      G7=-16.+8.*C(2)+32.*C(3)-16.*C(5)-16.*C(6)
      G8=-16.+32.*C(2)+8.*C(3)-16.*C(4)-16.*C(6)
      G9=-36.+18.*C(2)+18.*C(3)-9.*C(6)
      V(1)=F26*A1*D1+F27*A1*E1+F28*A1*G1
     1        +F29*B1*D1+F210*B1*G1
      V(2)=F26*(A1*D2+A3*D1)+F27*(A1*E2+A3*E1)
     1        +F28*(A1*G2+A3*G1)+F29*(B1*D2+B3*D1)
     2        +F210*(B1*G2+B3*G1)
      V(3)=F26*(A1*D3+A2*D4+A6*D1)
     1        +F27*(A1*E3+A2*E4+A6*E1)
     2        +F28*(A1*G3+A2*G4+A6*G1)
     3        +F29*(B1*D3+B2*D4+B6*D1)
     4        +F210*(B1*G3+B2*G4+B6*G1)
      V(4)=F26*(A1*D5+A3*D2+A7*D1)
     1        +F27*(A1*E5+A3*E2+A7*E1)
     2        +F28*(A1*G5+A3*G2+A7*G1)
     3        +F29*(B1*D5+B3*D2+B7*D1)
     4        +F210*(B1*G5+B3*G2+B7*G1)
      V(5)=F26*(A1*D6+A2*D7+A4*D4+A6*D3+A9*D1)
     1        +F27*(A1*E6+A2*E7+A4*E4+A6*E3+A9*E1)
     2        +F28*(A1*G6+A2*G7+A4*G4+A6*G3+A9*G1)
     3        +F29*(B1*D6+B2*D7+B4*D4+B6*D3+B9*D1)
     4        +F210*(B1*G6+B2*G7+B4*G4+B6*G3+B9*G1)
      V(6)=F26*(A1*D9+A2*D8+A3*D3+A5*D4+A6*D2+A12*D1)
     1        +F27*(A1*E9+A2*E8+A3*E3+A5*E4+A6*E2+A12*E1)
     2        +F28*(A1*G9+A2*G8+A3*G3+A5*G4+A6*G2+A12*G1)
     3        +F29*(B1*D9+B2*D8+B3*D3+B5*D4+B6*D2+B12*D1)
     4        +F210*(B1*G9+B2*G8+B3*G3+B5*G4+B6*G2+B12*G1)
      V(7)=S26*A2*D1+S27*A2*E1+S28*A2*G1
     1        +S29*B2*D1+S210*B2*E1+S211*B2*G1
      V(8)=S26*(A2*D3+A4*D1)+S27*(A2*E3+A4*E1)
     1        +S28*(A2*G3+A4*G1)+S29*(B2*D3+B4*D1)
     2        +S210*(B2*E3+B4*E1)+S211*(B2*G3+B4*G1)
      V(9)=S26*(A1*D4+A2*D2+A5*D1)
     1        +S27*(A1*E4+A2*E2+A5*E1)
     2        +S28*(A1*G4+A2*G2+A5*G1)
     3        +S29*(B1*D4+B2*D2+B5*D1)
     4        +S210*(B1*E4+B2*E2+B5*E1)
     5        +S211*(B1*G4+B2*G2+B5*G1)
      V(10)=S26*(A2*D6+A4*D3+A8*D1)
     1        +S27*(A2*E6+A4*E3+A8*E1)
```

```
      2        +S28*(A2*G6+A4*G3+A8*G1)
      3        +S29*(B2*D6+B4*D3+B8*D1)
      4        +S210*(B2*E6+B4*E3+B8*E1)
      5        +S211*(B2*G6+B4*G3+B8*G1)
       V(11)=S26*(A1*D8+A2*D5+A3*D4+A5*D2+A10*D1)
      1        +S27*(A1*E8+A2*E5+A3*E4+A5*E2+A10*E1)
      2        +S28*(A1*G8+A2*G5+A3*G4+A5*G2+A10*G1)
      3        +S29*(B1*D8+B2*D5+B3*D4+B5*D2+B10*D1)
      4        +S210*(B1*E8+B2*E5+B3*E4+B5*E2+B10*E1)
      5        +S211*(B1*G8+B2*G5+B3*G4+B5*G2+B10*G1)
       V(12)=S26*(A1*D7+A2*D9+A4*D2+A5*D3+A6*D4+A11*D1)
      1        +S27*(A1*E7+A2*E9+A4*E2+A5*E3+A6*E4+A11*E1)
      2        +S28*(A1*G7+A2*G9+A4*G2+A5*G3+A6*G4+A11*G1)
      3        +S29*(B1*D7+B2*D9+B4*D2+B5*D3+B6*D4+B11*D1)
      4        +S210*(B1*E7+B2*E9+B4*E2+B5*E3+B6*E4+B11*E1)
      5        +S211*(B1*G7+B2*G9+B4*G2+B5*G3+B6*G4+B11*G1)
       DO 60 I=1,12
       CC(I)=0.D0
       DO 60 J=1,12
   60  CC(I)=CC(I)+U2(I,J)*V(J)
       WRITE(3,971)CC(1),CC(2),CC(3),CC(4),CC(5),CC(6),
      1        CC(7),CC(8),CC(9),CC(10),CC(11),CC(12)
  971  FORMAT(10X,'A4='D16.8/10X,'B4='D16.8/10X,'C4='D16.8/10X,'D4='D16.8
      1        /10X,'E4='D16.8/10X,'F4='D16.8/10X,'A5='D16.8/10X,'B5='D16.8
      2        /10X,'C5='D16.8/10X,'D5='D16.8/10X,'E5='D16.8/10X,'F5='D16.8
      3)
       RETURN
       END
```

```
C   PROGRAM TO COMPUTE THE LARGE DEFLEXION OF SKEW SANDWICH PLATES.
C   BY PERTUBATION METHOD.
C   FIRST ORDER APPROXIMATION.
      SUBROUTINE PARTI
      IMPLICIT REAL*8(A-H,O-Z)
C
      COMMON U1,CC,C,F,PNU,AMU,ALPHA,THETA,ALAMA,
     1       GXIZ,GEZ,CT,CSC,CT2,CT3,CT4,CSC2,CSC3,CSC4,PE2,PE3,PE4
      DIMENSION U1(18,18),CC(18),C(18),V(18)
C   DEFINE THE MATERIAL AND GEOMETRIC COEF. OF THE PLATE.
      NAMELIST/SHOW/E,PNU,AMU,ALPHA,THETA,ALAMA,GXIZ,GEZ
      READ(1,SHOW)
      ALPHA=ALPHA*.017453292519943
      PE2=ALAMA*ALAMA
      PE3=PE2*ALAMA
      PE4=PE2*PE2
      SN=DSIN(ALPHA)
      CS=DCOS(ALPHA)
      CT=CS/SN
      CSC=1./SN
      CT2=CT*CT
      CT3=CT2*CT
      CT4=CT2*CT2
      CSC2=CSC*CSC
      CSC3=CSC*CSC2
      CSC4=CSC2*CSC2
      RT3=DSQRT(3.D0)
      HA=E/(1.-PNU*PNU)
      HB=E/(1.+PNU)
      HC=1.-PNU
      HD=(1.-PNU*PNU)/(E*AMU)
      F11=(2.*HA+HB*CT2)*THETA*AMU
      F12=HB*CSC2*THETA*AMU*PE2
      F13=-2.*HB*CT*CSC*THETA*AMU*ALAMA
      F14=-4.*GXIZ
      F15=-(2.*HA*PNU+HB)*CT*THETA*AMU
      F16=(2.*HA*PNU+HB)*CSC*THETA*AMU*ALAMA
      F17=-2.*GXIZ*THETA/RT3
      F18=-(HA+HA*PNU*CT2+HB*CT2)*THETA*AMU*AMU/RT3
      F19=2.*(HA*PNU+HB)*CT*CSC*THETA*AMU*AMU*ALAMA/RT3
      F110=-(HA*PNU+HB)*CSC2*AMU*AMU*PE2/RT3*THETA
      S11=(2.*HA*CT2+HB)*AMU*THETA
      S12=2.*HA*CSC2*AMU*THETA*PE2
```

```
      S13=-4.*HA*CT*CSC*AMU*THETA*ALAMA
      S14=-4.*GEZ
      S15=-(2.*HA*PNU+HB)*CT*AMU*THETA
      S16=(2.*HA*PNU+HB)*CSC*AMU*THETA*ALAMA
      S17=2.*GEZ*CT*THETA/RT3
      S18=-2.*GEZ*CSC*THETA*ALAMA/RT3
      S19=(HA*CT3+HA*CT*PNU+HB*CT)*AMU*AMU*THETA/RT3
      S110=-HA*CSC3*AMU*AMU*THETA*PE3/RT3
      S111=-(3.*HA*CSC*CT2+HA*CSC*PNU+HB*CSC)*AMU*AMU*THETA*ALAMA/RT3
      S112=3.*CSC2*CT*HA*AMU*AMU*THETA*PE2/RT3
      T11=12.*RT3*AMU/THETA+12.*RT3*AMU/THETA*PNU*CT2+12.*RT3*HC*AMU
     1    /THETA*CT2
      T12=-8.*AMU*AMU/THETA-8.*AMU*AMU/THETA*CT4
     1     -16.*AMU*AMU/THETA*PNU*CT2
     2     -16.*HC*AMU*AMU/THETA*CT2
      T13=-12.*RT3*AMU/THETA*CT3-12.*RT3*AMU/THETA*PNU*CT
     1     -12.*RT3*HC*AMU/THETA*CT
      T14=12.*RT3*AMU/THETA*CSC3*PE3
      T15=36.*RT3*AMU/THETA*ALAMA*CT2*CSC
     1     +12.*RT3*AMU/THETA*PNU*CSC*ALAMA
     2     +12.*RT3*HC*AMU/THETA*ALAMA*CSC
      T16=-36.*RT3*AMU/THETA*PE2*CSC2*CT
      T17=-8.*AMU*AMU/THETA*CSC4*PE4
      T18=32.*AMU*AMU/THETA*ALAMA*CT3*CSC
     1     +32.*AMU*AMU/THETA*PNU*CT*CSC*ALAMA
     2     +32.*HC*AMU*AMU/THETA*CT*CSC*ALAMA
      T19=-48.*AMU*AMU/THETA*PE2   *CT2*CSC2
     1     -16.*AMU*AMU/THETA*PNU*CSC2*PE2
     2     -16.*HC*AMU*AMU/THETA*CSC2*PE2
      T110=32.*AMU*AMU/THETA*PE3*CT*CSC3
      T111=-24.*RT3*AMU/THETA*PNU*CT*CSC*ALAMA
     1     -24.*RT3*HC*AMU/THETA*ALAMA*CT*CSC
      T112=12.*RT3*PNU*CSC2*PE2*AMU/THETA+12.*RT3*HC*AMU/THETA*PE2*CSC2
      T113=12.*HD*GXIZ+12.*HD*GEZ*CT2
      T114=24.*RT3*HD/THETA*GXIZ
      T115=12.*HD*GEZ*PE2*CSC2
      T116=-24.*HD*GEZ*ALAMA*CT*CSC
      T117=-24.*RT3*HD/THETA*GEZ*CT
      T118=24.*RT3*HD/THETA*GEZ*ALAMA*CSC
C  FORMING THE U1MATRIX.
C
      DO 10 I=1,18
      V(I)=0.D0
```

```
      DO 10 J=1,18
   10 U1(1,J)=0.D0
      U1(1,2)=2.*F17-48.*F18-6.*F19-8.*F110
      U1(1,3)=-8.*F110
      U1(1,4)=24.*F18
      U1(1,6)=4.*F110
      U1(1,7)=-6.*F11-2.*F12-2.*F13+F14
      U1(1,8)=6.*F11
      U1(1,9)=2.*F12
       U1(1,13)=-2.*F16
       U1(1,14)=2.*F16
      U1(2,2)=-8.*F17+120.*F18+40.*F19+32.*F110
      U1(2,3)=8.*F110
      U1(2,4)=4.*F17-240.*F18-20.*F19-16.*F110
      U1(2,6)=-16.*F110
       U1(2,7)=2.*F12-F14+4.*F13
      U1(2,8)=-20.*F11-2.*F12-4.*F13+F14
      U1(2,9)=-2.*F12
      U1(2,10)=20.*F11
      U1(2,12)=2.*F12
      U1(2,14)=-4.*F16
      U1(2,16)=4.*F16
      U1(3,2)=-4.*F17+96.*F18+36.*F19+24.*F110
      U1(3,3)=-4.*F17+24.*F18+36.*F19+96.*F110
      U1(3,4)=-48.*F18
      U1(3,5)=-48.*F110
      U1(3,6)=2.*F17-48.*F18-18.*F19-48.*F110
      U1(3,7)=6.*F11+6.*F13-F14
      U1(3,8)=-6.*F11
      U1(3,9)=-6.*F11-12.*F12-6.*F13+F14
      U1(3,11)=12.*F12
      U1(3,12)=6.*F11
      U1(3,13)=6.*F15+6.*F16
      U1(3,14)=-6.*F15-6.*F16
      U1(3,15)=-6.*F16
      U1(3,18)=6.*F16
      U1(4,2)=6.*F17-42.*F19-24.*F110
      U1(4,4)=-12.*F17+336.*F18+84.*F19+48.*F110
      U1(4,6)=12.*F110
      U1(4,8)=2.*F12+6.*F13-F14
      U1(4,10)=-42.*F11-2.*F12-6.*F13+F14
      U1(4,12)=-2.*F12
      U1(4,15)=2.*F15
```

```
      U1(4,16)=-6.*F16
      U1(4,17)=-2.*F15
      U1(4,18)=-2.*F15
      U1(5,2)=2.*F17-48.*F18-30.*F19
      U1(5,3)=8.*F17-48.*F18-120.*F19-120.*F110
      U1(5,4)=24.*F18
      U1(5,5)=-4.*F17+24.*F18+60.*F19+240.*F110
      U1(5,6)=-4.*F17+96.*F18+60.*F19+60.*F110
      U1(5,9)=10.*F13+6.*F11-F14
      U1(5,11)=-6.*F11-30.*F12-10.*F13+F14
      U1(5,12)=-6.*F11
       U1(5,13)=-6.*F15
      U1(5,14)=6.*F15
      U1(5,15)=6.*F15+10.*F16
      U1(5,17)=-10.*F16
      U1(5,18)=-6.*F15-10.*F16
      U1(6,2)=16.*F17-240.*F18-240.*F19-96.*F110
      U1(6,3)=4.*F17-60.*F19-96.*F110
      U1(6,4)=-8.*F17+480.*F18+120.*F19+48.*F110
      U1(6,5)=48.*F110
      U1(6,6)=-8.*F17+120.*F18+120.*F19+192.*F110
      U1(6,7)=-12.*F13+F14
      U1(6,8)=20.*F11+12.*F13-F14
      U1(6,9)=12.*F12+12.*F13-F14
      U1(6,10)=-20.*F11
      U1(6,11)=-12.*F12
      U1(6,12)=-20.*F11-12.*F13+F14-12.*F12
      U1(6,14)=20.*F15+12.*F16
      U1(6,16)=-20.*F15-12.*F16
      U1(6,18)=-12.*F16
      U1(7,2)=-6.*S19-8.*S111
      U1(7,3)=2.*S18-48.*S110-8.*S111-6.*S112
      U1(7,5)=24.*S110
      U1(7,6)=4.*S111
      U1(7,7)=-2.*S15-2.*S16
      U1(7,9)=2.*S16
      U1(7,13)=-2.*S11-6.*S12-2.*S13+S14
      U1(7,14)=2.*S11
      U1(7,15)=6.*S12
      U1(8,2)=12.*S19+8.*S111
      U1(8,3)=-S17-8.*S18+12.*S19+120.*S110+32.*S111+40.*S112
      U1(8,5)=4.*S18-240.*S110-16.*S111-20.*S112
      U1(8,6)=-6.*S19-16.*S111
```

```
U1(8,7)=2.*S15
U1(8,9)=-2.*S15-4.*S16
U1(8,11)=4.*S16
U1(8,13)=2.*S11+4.*S13-S14
U1(8,14)=-2.*S11
U1(8,15)=-2.*S11-20.*S12-4.*S13+S14
U1(8,17)=20.*S12
U1(8,18)=2.*S11
U1(9,2)=-3.*S17-4.*S18+120.*S19+24.*S110+96.*S111+36.*S112
U1(9,3)=-4.*S18+96.*S110+24.*S111+36.*S112
U1(9,4)=-60.*S19-48.*S111
U1(9,5)=-48.*S110
U1(9,6)=2.*S18-48.*S110-48.*S111-18.*S112
U1(9,7)=12.*S15+6.*S16
U1(9,8)=12.*S15-6.*S16
U1(9,9)=-6.*S16
U1(9,12)=6.*S16
U1(9,13)=6.*S12+6.*S13-S14
U1(9,14)=-12.*S11-6.*S12-6.*S13+S14
U1(9,15)=-6.*S12
U1(9,16)=12.*S11
U1(9,18)=6.*S12
U1(10,2)=-6.*S19
U1(10,3)=2.*S17+6.*S18-24.*S19-24.*S111-42.*S112
U1(10,5)=-S17-12.*S18+12.*S19+336.*S110+48.*S111+84.*S112
U1(10,6)=12.*S111+12.*S19
U1(10,9)=2.*S15
U1(10,11)=-2.*S15-6.*S16
U1(10,15)=2.*S11+6.*S13-S14
U1(10,17)=-2.*S11-42.*S12-6.*S13+S14
U1(10,18)=-2.*S11
U1(11,2)=10.*S17+8.*S18-210.*S19-48.*S110-120.*S111-120.*S112
U1(11,3)=2.*S18-48.*S110-30.*S112
U1(11,4)=-5.*S17-4.*S18+240.*S19+24.*S110+240.*S111+60.*S112
U1(11,5)=24.*S110
U1(11,6)=-4.*S18+96.*S110+60.*S111+60.*S112
U1(11,8)=30.*S15+10.*S16
U1(11,10)=-30.*S15-10.*S16
U1(11,12)=-10.*S16
U1(11,14)=6.*S12+10.*S13-S14
U1(11,16)=-30.*S11-6.*S12-10.*S13+S14
U1(11,18)=-6.*S12
U1(12,2)=6.*S17+4.*S18-96.*S111-60.*S112
```

```
      U1(12,3)=6.*S17+16.*S18-60.*S19-240.*S110-96.*S111+240.*S112
      U1(12,4)=120.*S19+48.*S111
      U1(12,5)=-8.*S18+480.*S110+48.*S111+120.*S112
      U1(12,6)=-3.*S17-8.*S18+120.*S110+192.*S111+120.*S112
      U1(12,7)=-12.*S15
      U1(12,8)=12.*S15
      U1(12,9)=12.*S15+12.*S16
      U1(12,11)=-12.*S16
      U1(12,12)=-12.*S15-12.*S16
      U1(12,13)=-12.*S13+S14
      U1(12,14)=12.*S11+12.*S13-S14
      U1(12,15)=20.*S12+12.*S13-S14
      U1(12,16)=-12.*S11
      U1(12,17)=-20.*S12
      U1(12,18)=-12.*S11-20.*S12-12.*S13+S14
      U1(13,1)=1.D0
      U1(13,2)=-48.*T12-6.*T18-8.*T19+2.*T113
      U1(13,3)=-48.*T17-8.*T19-6.*T110+2.*T115
      U1(13,4)=24.*T12
      U1(13,5)=24.*T17
      U1(13,6)=4.*T19
      U1(13,7)=-6.*T11-2.*T111-2.*T112+T114
      U1(13,8)=6.*T11
      U1(13,9)=2.*T112
      U1(13,13)=-6.*T14-2.*T15-2.*T16+T118
      U1(13,14)=2.*T15
      U1(13,15)=6.*T14
      U1(14,2)=360.*T12+24.*T17-3.*T116+120.*T18+96.*T19
     1        +36.*T110-24.*T113-4.*T115
      U1(14,3)=96.*T17+24.*T19+36.*T110-4.*T115
      U1(14,4)=-720.*T12-60.*T18-48.*T19+12.*T113
      U1(14,5)=-48.*T17
      U1(14,6)=-48.*T17-48.*T19-18.*T110+2.*T115
      U1(14,7)=12.*T111+6.*T112-3.*T114
      U1(14,8)=-60.*T11-12.*T111-6.*T112+3.*T114
      U1(14,9)=-6.*T112
      U1(14,10)=60.*T11
      U1(14,12)=6.*T112
      U1(14,13)=6.*T14+6.*T16-T118
      U1(14,14)=-6.*T14-12.*T15-6.*T16+T118
      U1(14,15)=-6.*T14
      U1(14,16)=12.*T15
      U1(14,18)=6.*T14
```

```
      U1(15,2)=96.*T12+36.*T18+24.*T19-4.*T113
      U1(15,3)=24.*T12+360.*T17+36.*T18+96.*T19+120.*T110-4.*T113
     1       -24.*T115-3.*T116
      U1(15,4)=-48.*T12
      U1(15,5)=-720.*T17-48.*T19-60.*T110+12.*T115
      U1(15,6)=-48.*T12-18.*T18-48.*T19+2.*T113
      U1(15,7)=6.*T11+6.*T111-T114
      U1(15,8)=-6.*T11
      U1(15,9)=-6.*T11-6.*T111-12.*T112+T114
      U1(15,11)=12.*T112
      U1(15,12)=6.*T11
      U1(15,13)=6.*T13+6.*T15+12.*T16-T117-3.*T118
      U1(15,14)=-6.*T13-6.*T15
      U1(15,15)=-60.*T14-6.*T15-12.*T16+3.*T118
      U1(15,17)=60.*T14
      U1(15,18)=6.*T15
      U1(16,2)=-48.*T17-210.*T18-120.*T19-120.*T110+30.*T113+8.*T115
     1       +10.*T116
      U1(16,3)=-48.*T17-30.*T110+2.*T115
      U1(16,4)=1680.*T12+24.*T17+420.*T18+240.*T19+60.*T110
     1       -60.*T113-4.*T115-5.*T116
      U1(16,5)=24.*T17+60.*T110
      U1(16,6)=96.*T17+60.*T19+60.*T110-4.*T115
      U1(16,8)=30.*T111+10.*T112-5.*T114
      U1(16,10)=-210.*T11-30.*T111-10.*T112+5.*T114
      U1(16,12)=-10.*T112
      U1(16,14)=6.*T14+10.*T16-T118
      U1(16,16)=-6.*T14-30.*T15-10.*T16+T118
      U1(16,18)=-6.*T14
      U1(17,2)=-48.*T12-30.*T18+2.*T113
      U1(17,3)=-48.*T12-120.*T18-120.*T19-210.*T110+30.*T115
     1       +10.*T116+8.*T113
      U1(17,4)=24.*T12
      U1(17,5)=24.*T12+1680.*T17+60.*T18+240.*T19+420.*T110
     1       -4.*T113-60.*T115-5.*T116
      U1(17,6)=96.*T12+60.*T18+60.*T19-4.*T113
      U1(17,9)=6.*T11+10.*T111-T114
      U1(17,11)=-6.*T11-10.*T111-30.*T112+T114
      U1(17,12)=-6.*T11
      U1(17,13)=-6.*T13+T117
      U1(17,14)=6.*T13
      U1(17,15)=6.*T13+10.*T15+30.*T16-T117-5.*T118
      U1(17,17)=-210.*T14-10.*T15-30.*T16+5.*T118
```

```
      U1(17,18)=-6.*T13-10.*T15
      U1(18,2)=-720.*T12-720.*T18-288.*T19-180.*T110+48.*T113
     1       +12.*T115+18.*T116
      U1(18,3)=-720.*T17-180.*T18-288.*T19-720.*T110+12.*T113
     1       +48.*T115+18.*T116
      U1(18,4)=1440.*T12+360.*T18+144.*T19-24.*T113
      U1(18,5)=144.*T19+360.*T110-24.*T115+1440.*T17
      U1(18,6)=360.*T12+360.*T17+360.*T18+576.*T19+360.*T110
     1       -24.*T113-24.*T115-9.*T116
      U1(18,7)=-36.*T111+3.*T114
      U1(18,8)=60.*T11+36.*T111-3.*T114
      U1(18,9)=36.*T111+36.*T112-3.*T114
      U1(18,10)=-60.*T11
      U1(18,11)=-36.*T112
      U1(18,12)=-60.*T11-36.*T111-36.*T112+3.*T114
      U1(18,13)=-36.*T16+3.*T117+3.*T118
      U1(18,14)=60.*T13+36.*T15+36.*T16-3.*T117-3.*T118
      U1(18,15)=60.*T14+36.*T16-3.*T118
      U1(18,16)=-60.*T13-36.*T15
      U1(18,17)=-60.*T14
      U1(18,18)=-60.*T14-36.*T15-36.*T16+3.*T118
      V(1)=4.*F17-24.*F18-12.*F19-16.*F110
      V(2)=-4.*F17+20.*F19+16.*F110
      V(3)=-8.*F17+48.*F18+72.*F19+48.*F110
      V(5)=4.*F17-24.*F18-60.*F19
      V(6)=8.*F17-120.*F19-48.*F110
      V(7)=S17+4.*S18-12.*S19-24.*S110-16.*S111-12.*S112
      V(8)=-2.*S17-4.*S18+24.*S19+16.*S111+20.*S112
      V(9)=-6.*S17-8.*S18+60.*S19+48.*S110+48.*S111+72.*S112
      V(10)=S17-12.*S19
      V(11)=5.*S17+4.*S18-24.*S110-60.*S112
      V(12)=12.*S17+8.*S18-120.*S19-48.*S111-120.*S112
      V(13)=-24.*T12-24.*T17-12.*T18-16.*T19-12.*T110
     1       +4.*T113+4.*T115+T116
      V(14)=48.*T17+60.*T18+48.*T19+72.*T110
     1       -12.*T113-8.*T115-6.*T116
      V(15)=48.*T12+72.*T18+48.*T19+60.*T110
     1       -8.*T113-12.*T115-6.*T116
      V(16)=-24.*T17-60.*T110+4.*T115+5.*T116
      V(17)=-24.*T12-60.*T18+4.*T113+5.*T116
      V(18)=-360.*T18-144.*T19-360.*T110+24.*T113
     1       +24.*T115+36.*T116
      CALL MATINV(U1,18)
```

```
      DO 50 I=1,18
      C(I)=0.D0
      DO 50 J=1,18
   50 C(I)=C(I)+U1(I,J)*V(J)
      WRITE(3,997)C(1),C(2),C(3),C(4),C(5),C(6),
     1        C(7),C(8),C(9),C(10),C(11),C(12),
     2        C(13),C(14),C(15),C(16),C(17),C(18)
  997 FORMAT(10X,'A1='D16.8/10X,'B1='D16.8/10X,'C1='D16.8/10X,'D1='D16.8
     1        /10X,'E1='D16.8/10X,'F1='D16.8/10X,'A2='D16.8/10X,'B2='D16.8
     2        /10X,'C2='D16.8/10X,'D2='D16.8/10X,'E2='D16.8/10X,'F2='D16.8
     3        /10X,'A3='D16.8/10X,'B3='D16.8/10X,'C3='D16.8/10X,'D3='D16.8
     4        /10X,'E3='D16.8/10X,'F3='D16.8)
      RETURN
      END
```

```
      SUBROUTINE MATINV(A,N)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION A(18,18),INDEX(18,2)
      DO 108 I=1,N
  108 INDEX(I,1)=0
      II=0
  109 AMAX=-1.
      DO 110 I=1,N
      IF(INDEX(I,1))110,111,110
  111 DO112 J=1,N
      IF(INDEX(J,1))112,113,112
  113 TEMP=DABS(A(I,J))
      IF(TEMP-AMAX)112,112,114
  114 IROW=I
      ICOL=J
      AMAX=TEMP
  112 CONTINUE
  110 CONTINUE
      IF(AMAX)225,115,116
  116 INDEX(ICOL,1)=IROW
      IF(IROW-ICOL)119,118,119
  119 DO 120 J=1,N
      TEMP=A(IROW,J)
      A(IROW,J)=A(ICOL,J)
  120 A(ICOL,J)=TEMP
      II=II+1
      INDEX(II,2)=ICOL
  118 PIVOT=A(ICOL,ICOL)
      A(ICOL,ICOL)=1.
      PIVOT=1./PIVOT
      DO 121 J=1,N
  121 A(ICOL,J)=A(ICOL,J)*PIVOT
      DO 122 I=1,N
      IF(I-ICOL)123,122,123
  123 TEMP=A(I,ICOL)
      A(I,ICOL)=0.
      DO 124 J=1,N
  124 A(I,J)=A(I,J)-A(ICOL,J)*TEMP
  122 CONTINUE
      GO TO 109
  125 ICOL=INDEX(II,2)
      IROW=INDEX(ICOL,1)
      DO 126 I=1,N
```

```
      TEMP=A(I,IROW)
      A(I,IROW)=A(I,ICOL)
  126 A(I,ICOL)=TEMP
      II=II-1
  225 IF(II)125,127,125
  115 WRITE(6,1001)
 1001 FORMAT(1HO,2X,11H ZERO PIVOT)
  127 CONTINUE
      RETURN
       END
```

data

```
****CASE 1****
&SHOW E=.105D08,
      PNU=0.3
      ALPHA=90.,
      AMU=0.0012,
      THETA=0.04,
      ALAMA=1.,
      GXIZ=0.5D04,
      GEZ=0.5D04&END
****CASE 2****
&SHOW ALPHA=75.&END
****CASE 3****
&SHOW ALPHA=60.&END
****CASE 4****
&SHOW ALPHA=45.&END
****CASE 5****
&SHOW ALPHA=30.&END
****CASE 6****
&SHOW ALPHA=90.,ALAMA=0.66666666667&END
****CASE 7****
&SHOW ALPHA=75.&END
****CASE 8****
&SHOW ALPHA=60.&END
****CASE 9****
&SHOW ALPHA=45.&END
****CASE 10****
&SHOW ALPHA=30.&END
****CASE 11****
&SHOW ALPHA=90.,ALAMA=0.5&END
****CASE 12****
&SHOW ALPHA=75.&END
****CASE 13****
&SHOW ALPHA=60.&END
****CASE 14****
&SHOW ALPHA=45.&END
****CASE 15****
&SHOW ALPHA=30.&END
****CASE 16****
&SHOW ALPHA=90.,ALAMA=1.,THETA=0.02&END
****CASE 17****
&SHOW ALPHA=75.&END
****CASE 18****
&SHOW ALPHA=60.&END
****CASE 19****
&SHOW ALPHA=45.&END
****CASE 20****
&SHOW ALPHA=30.&END
****CASE 21****
```

```
&SHOW ALPHA=90.,ALAMA=0.6666666666667&END
****CASE 22****
&SHOW ALPHA=75.&END
****CASE 23****
&SHOW ALPHA=60.&END
****CASE 24****
&SHOW ALPHA=45.&END
****CASE 25****
&SHOW ALPHA=30.&END
****CASE 26****
&SHOW ALPHA=90.,ALAMA=0.5&END
****CASE 27****
&SHOW ALPHA=75.&END
****CASE 28****
&SHOW ALPHA=60.&END
****CASE 29****
&SHOW ALPHA=45.&END
****CASE 30****
&SHOW ALPHA=30.&END
****CASE 31****
&SHOW ALPHA=90.,ALAMA=1.,THETA=0.01&END
****CASE 32****
&SHOW ALPHA=75.&END
****CASE 33****
&SHOW ALPHA=60.&END
****CASE 34****
&SHOW ALPHA=45.&END
****CASE 35****
&SHOW ALPHA=30.&END
****CASE 36****
&SHOW ALPHA=90.,ALAMA=0.6666666666667&END
****CASE 37****
&SHOW ALPHA=75.&END
****CASE 38****
&SHOW ALPHA=60.&END
****CASE 39****
&SHOW ALPHA=45.&END
****CASE 40****
&SHOW ALPHA=30.&END
****CASE 41****
&SHOW ALPHA=90.,ALAMA=0.5&END
****CASE 42****
&SHOW ALPHA=75.&END
****CASE 43****
&SHOW ALPHA=60.&END
****CASE 44****
&SHOW ALPHA=45.&END
****CASE 45****
&SHOW ALPHA=30.&END
****CASE 46****
&SHOW E=.105D08,
```

```
      PNU=0.3,
      ALPHA=90.,
      AMU=0.0012,
     THETA=0.04,         ALAMA=1.,
      GXIZ=0.5D04,
      GEZ=0.3D04&END
****CASE 47****
&SHOW ALPHA=75.&END
****CASE 48****
&SHOW ALPHA=60.&END
****CASE 49****
&SHOW ALPHA=90.,ALAMA=0.666666666667&END
****CASE 50****
&SHOW ALPHA=75.&END
****CASE 51****
&SHOW ALPHA=60.&END
****CASE 52****
&SHOW ALPHA=90.,ALAMA=0.5&END
****CASE 53****
&SHOW ALPHA=75.&END
****CASE 54****
&SHOW ALPHA=60.&END
****CASE 55****
&SHOW ALPHA=90.,ALAMA=1.,THETA=0.02&END
****CASE 56****
&SHOW ALPHA=75.&END
****CASE 57****
&SHOW ALPHA=60.&END
****CASE 58****
&SHOW ALPHA=90.,ALAMA=.666666667&END
****CASE 59****
&SHOW ALPHA=75.&END
****CASE 60****
&SHOW ALPHA=60.&END
****CASE 61****
&SHOW ALPHA=90.,ALAMA=0.5&END
****CASE 62****
&SHOW ALPHA=75.&END
****CASE 63****
&SHOW ALPHA=60.&END
****CASE 64****
&SHOW ALPHA=90.,ALAMA=1.,THETA=0.01&END
****CASE 65****
&SHOW ALPHA=75.&END
****CASE 66****
&SHOW ALPHA=60.&END
****CASE 67****
&SHOW ALPHA=90.,ALAMA=0.666666666667&END
****CASE 68****
&SHOW ALPHA=75.&END
****CASE 69****
```

```
&SHOW ALPHA=60.&END
****CASE 70****
&SHOW ALPHA-90.,ALAMA=0.5&END
****CASE 71****
&SHOW ALPHA=75.&END
****CASE 72****
&SHOW ALPHA=60.&END
```

APPENDIX C

RESULTS

```
****** CASE    1******

*1=  0.78819390D 01
B1=  0.46646471D 00
C1=  0.46646471D 00
D1=  0.16980288D 00
E1=  0.16980288D 00
F1=  0.31304725D 00
A2=  0.25222755D-01
B2=  0.77660927D-02
C2= -0.11744792D-01
D2= -0.59642409D-03
E2=  0.80748346D-03
F2=  0.60780791D-04
A3=  0.25222755D-01
B3= -0.11744792D-01
C3=  0.77660927D-02
D3=  0.80748346D-03
E3= -0.59642409D-03
F3=  0.60780791D-04
A4=  0.10486512D 01
B4= -0.10733206D 01
C4=  0.73989416D 00
D4= -0.34314601D 00
E4=  0.15596126D 01
F4=  0.59717149D 01
A5=  0.10486512D 01
B5=  0.73989416D 00
C5= -0.10733206D 01
D5=  0.15596126D 01
E5= -0.34314601D 00
F5=  0.59717149D 01
*3=  0.33011160D 00
B6=  0.26185326D-01
C6=  0.26185326D-01
D6=  0.64438270D-02
E6=  0.64438270D-02
F6=  0.83513411D-01
A7= -0.16659531D-03
B7=  0.88431564D-03
C7=  0.43038071D-03
D7= -0.60865584D-04
E7=  0.39393007D-03
F7=  0.16091469D-02
A8= -0.16659531D-03
B8=  0.43038071D-03
C8=  0.88431564D-03
D8=  0.39393007D-03
E8= -0.60865584D-04
F8=  0.16091469D-02
```

```
****** CASE    2******

*1=  0.84649011D 01
B1=  0.36435552D 00
C1=  0.37892592D 00
D1=  0.13747626D 00
E1=  0.13059640D 00
F1=  0.48521932D 00
A2=  0.26033465D-01
B2=  0.42414501D-02
C2= -0.16649520D-01
D2= -0.13770127D-02
E2=  0.47123724D-02
F2=  0.10553798D-01
A3=  0.25383240D-01
B3= -0.11629756D-01
C3=  0.52617429D-02
D3=  0.47733161D-02
E3= -0.21074247D-02
F3=  0.59748916D-02
A4=  0.13829515D 01
B4= -0.15925448D 01
C4=  0.36137567D 01
D4= -0.17542735D-02
E4=  0.12014462D 01
F4=  0.74380639D 01
A5=  0.16420666D 01
B5=  0.29503907D 01
C5= -0.16179776D 01
D5= -0.64594026D-01
E5= -0.26845889D 00
F5=  0.10974265D 02
*3=  0.58045855D 00
B6=  0.28381087D-01
C6=  0.35004114D-01
D6=  0.48794646D-02
E6=  0.12068568D-01
F6=  0.37318994D-01
A7= -0.17411121D-03
B7=  0.89031765D-03
C7=  0.71270674D-03
D7= -0.13154242D-03
E7= -0.31169561D-03
F7= -0.45274549D-05
A8= -0.23401094D-03
B8=  0.49661318D-03
C8=  0.11320951D-02
D8= -0.15995607D-03
E8=  0.93889507D-04
F8=  0.22031090D-03
```

```
****** CASE    3******

*1=   0.11868365D 02
B1=   0.36092461D 00
C1=   0.33779306D 00
D1=   0.13378203D 00
E1=   0.10580822D 00
F1=   0.81174964D 00
A2=   0.25515478D-01
B2=   0.33229431D-02
C2=  -0.17936020D-01
D2=  -0.22099612D-02
E2=   0.10635872D-01
F2=   0.24168027D-01
A3=   0.25921004D-01
B3=  -0.80507641D-02
C3=   0.30807917D-02
D3=   0.82711468D-02
E3=  -0.41159587D-02
F3=   0.19733382D-01
A4=   0.15301291D 01
B4=  -0.20924558D 01
C4=   0.63121405D 01
D4=   0.52836193D 00
E4=  -0.35276949D 00
F4=   0.27079442D 01
A5=   0.26594406D 01
B5=   0.43049716D 01
C5=  -0.20126870D 01
D5=  -0.48918008D 01
E5=  -0.46735950D 00
F5=   0.23324354D 02
*3=   0.12545963D 01
B6=   0.20409675D-01
C6=   0.47333427D-01
D6=   0.13759446D-01
E6=   0.29409035D-01
F6=  -0.84894842D-01
A7=  -0.12242766D-03
B7=   0.45221338D-03
C7=   0.74622622D-03
D7=   0.34659318D-03
E7=  -0.21325943D-02
F7=  -0.37299556D-02
A8=  -0.33644957D-03
B8=   0.39813716D-03
C8=   0.14280414D-02
D8=  -0.15446285D-02
E8=   0.71505114D-03
F8=  -0.35229516D-02
```

```
****** CASE    4******

*1=   0.21526779D 02
B1=   0.40859993D 00
C1=   0.33614691D 00
D1=   0.14126510D 00
E1=   0.95915419D-01
F1=   0.11435471D 01
A2=   0.23802314D-01
B2=   0.25539998D-02
C2=  -0.13195261D-01
D2=  -0.29635650D-02
E2=   0.15680617D-01
F2=   0.33060247D-01
A3=   0.26711607D-01
B3=  -0.95758273D-03
C3=   0.17306525D-03
D3=   0.65590131D-02
E3=  -0.62845496D-02
F3=   0.39564519D-01
A4=   0.12732334D 01
B4=  -0.28942178D 01
C4=   0.70297254D 01
D4=   0.15645456D 01
E4=  -0.73171088D 00
F4=  -0.14141746D 02
A5=   0.44905598D 01
B5=   0.62334586D 01
C5=  -0.19288983D 01
D5=  -0.11241299D 02
E5=  -0.15922624D 01
F5=   0.47480972D 02
*3=   0.37144822D 01
B6=  -0.13265394D-02
C6=   0.78737325D-01
D6=   0.40530524D-01
E6=   0.71507683D-01
F6=  -0.32848830D 00
A7=  -0.11742335D-03
B7=  -0.38969918D-03
C7=  -0.54271482D-03
D7=   0.16512922D-02
E7=  -0.57558565D-02
F7=  -0.10317405D-01
A8=  -0.62492388D-03
B8=  -0.77130092D-03
C8=   0.23066428D-02
D8=  -0.40437276D-02
E8=   0.20136306D-02
F8=  -0.10407381D-01
```

****** CASE 5******

*1=	0.53007659D 02
B1=	0.46098362D 00
C1=	0.37327653D 00
D1=	0.14968283D 00
E1=	0.10067681D 00
F1=	0.14094246D 01
A2=	0.20198769D-01
B2=	-0.13611881D-02
C2=	-0.10577389D-02
D2=	-0.12727827D-02
E2=	0.14457389D-01
F2=	0.19152923D-01
A3=	0.26814412D-01
B3=	0.98376169D-02
C3=	-0.33764031D-02
D3=	-0.10391171D-01
E3=	-0.36650065D-02
F3=	0.80681906D-01
A4=	-0.82372909D 00
B4=	-0.47262791D 01
C4=	0.39332979D 01
D4=	0.44906404D 01
E4=	0.95751655D 01
F4=	-0.59134910D 02
A5=	0.82823622D 01
B5=	0.10391883D 02
C5=	-0.13204071D 01
D5=	-0.19737445D 02
E5=	-0.47756671D 01
F5=	0.89909882D 02
*3=	0.17736421D 02
B6=	-0.60442027D-01
C6=	0.17106881D 00
D6=	0.95539883D-01
E6=	0.18773093D 00
F6=	-0.87326443D 00
A7=	-0.58913349D-03
B7=	-0.13018110D-02
C7=	-0.59938191D-02
D7=	0.42451873D-02
E7=	-0.10134504D-01
F7=	-0.22898470D-01
A8=	-0.94186960D-03
B8=	-0.43354466D-02
C8=	0.50056912D-02
D8=	-0.86687228D-02
E8=	0.35570204D-02
F8=	-0.13164191D-01

****** CASE 6******

*1=	0.48696489D 01
B1=	0.30632094D 00
C1=	0.73794555D 00
D1=	0.12572235D 00
E1=	0.22824642D 0C
F1=	0.33294893D 00
A2=	0.28383049D-01
B2=	0.26717481D-02
C2=	-0.93471068D-02
D2=	-0.71772568D-03
E2=	-0.78055614D-02
F2=	0.45996345D-02
A3=	0.16634867D-01
B3=	-0.88610853D-02
C3=	0.17209142D-01
D3=	0.27981052D-02
E3=	0.28110389D-02
F3=	-0.58367476D-02
A4=	0.80397073D 00
B4=	-0.12677337D 01
C4=	0.15133014D 01
D4=	0.11467818D 00
E4=	-0.23761854D 00
F4=	0.68843101D 01
A5=	0.93567561D 00
B5=	-0.83801993D-01
C5=	-0.64577717D 00
D5=	0.16309727D 01
E5=	-0.46376208D 00
F5=	0.19090655D 01
*3=	0.17559831D 00
B6=	0.15820467D-01
C6=	0.36177349D-01
D6=	0.34099125D-02
E6=	0.23525174D-01
F6=	0.66021781D-01
A7=	-0.98479591D-04
B7=	0.53899967D-03
C7=	0.74112304D-03
D7=	-0.49811703D-04
E7=	0.38181993D-03
F7=	0.15391304D-02
A8=	-0.29553004D-03
B8=	0.25192289D-03
C8=	0.99991109D-03
D8=	0.26269541D-03
E8=	0.56960345D-03
F8=	0.10230075D-02

```
****** CASE  23******

*1=  0.60651442D 01
B1=  0.21998164D 00
C1=  0.58536943D 00
D1=  0.10297085D 00
E1= -0.57469579D-01
F1=  0.80963417D 00
A2=  0.17080139D-01
B2=  0.10877279D-02
C2= -0.12813742D-01
D2= -0.42947452D-03
E2= -0.35798968D-02
F2=  0.18446807D-01
A3=  0.91395405D-02
B3= -0.68226764D-03
C3=  0.12148875D-01
D3=  0.46037784D-02
E3= -0.41139032D-02
F3= -0.45270459D-02
A4=  0.90285361D 00
B4= -0.17684641D 01
C4=  0.86328507D 01
D4=  0.37379389D 00
E4=  0.46249082D 00
F4=  0.23600403D 01
A5=  0.37933822D 01
B5=  0.17162021D 01
C5= -0.17337159D 01
D5=  0.76726299D 00
E5= -0.26866517D 01
F5=  0.27790382D 02
*3=  0.23865871D 00
B6=  0.10375870D-01
C6=  0.97884998D-01
D6=  0.15619889D-02
E6=  0.11113937D 00
F6=  0.82358879D-02
A7= -0.10074167D-04
B7=  0.21983605D-03
C7=  0.17777996D-02
D7=  0.35869808D-05
E7= -0.29432987D-03
F7= -0.56264911D-03
A8= -0.60689023D-03
B8=  0.71447677D-03
C8=  0.12088364D-02
D8= -0.14612957D-03
E8=  0.28253533D-02
F8=  0.78332683D-03
```

```
****** CASE  24******

*1=  0.13324537D 02
B1=  0.31021152D 00
C1=  0.52676121D 00
D1=  0.14087014D 00
E1= -0.10941867D 00
F1=  0.97582023D 00
A2=  0.15958794D-01
B2=  0.18360542D-02
C2= -0.14414476D-01
D2= -0.87339450D-03
E2= -0.15610810D-02
F2=  0.22351302D-01
A3=  0.10441624D-01
B3=  0.22962255D-02
C3=  0.11641496D-01
D3=  0.47049726D-02
E3= -0.75203157D-02
F3= -0.73978966D-02
A4=  0.86307239D 00
B4= -0.17983320D 01
C4=  0.10501420D 02
D4=  0.33786489D 00
E4=  0.81778059D 01
F4= -0.99924302D 01
A5=  0.59650698D 01
B5=  0.12938574D 01
C5= -0.92254331D 00
D5= -0.57262885D 00
E5= -0.64855775D 01
F5=  0.49158908D 02
*3=  0.70175611D 00
B6=  0.62302984D-02
C6=  0.13400694D 00
D6=  0.55701232D-02
E6=  0.15591973D 00
F6= -0.42823788D-01
A7=  0.58570857D-04
B7=  0.74649869D-04
C7=  0.24386760D-02
D7=  0.18032160D-03
E7= -0.12868828D-02
F7= -0.23334958D-02
A8= -0.80369405D-03
B8=  0.12654741D-02
C8=  0.22729278D-02
D8= -0.77633575D-03
E8=  0.42803212D-02
F8=  0.12841381D-02
```

****** CASE 25******

*1=	0.36895912D 02
B1=	0.38494913D 00
C1=	0.47026340D 00
D1=	0.18063184D 00
E1=	-0.66463424D-01
F1=	0.10822654D 01
A2=	0.13876322D-01
B2=	0.76355246D-03
C2=	-0.13209188D-01
D2=	-0.16680186D-02
E2=	0.26975495D-02
F2=	0.24796838D-01
A3=	0.12757774D-01
B3=	0.36671935D-02
C3=	0.70966382D-02
D3=	0.21013767D-02
E3=	-0.98160806D-02
F3=	-0.35654444D-02
A4=	0.95923011D 00
B4=	-0.21175199D 01
C4=	0.12099256D 02
D4=	0.76351398D 00
E4=	0.28739565D 02
F4=	-0.33866627D 02
A5=	0.94757652D 01
B5=	0.18372444D 01
C5=	0.28410867D 00
D5=	-0.13777811D 01
E5=	-0.13012276D 02
F5=	0.79253083D 02
*3=	0.36928852D 01
B6=	-0.32963306D-02
C6=	0.19501465D 00
D6=	0.11919334D-01
E6=	0.23031112D 00
F6=	-0.15641682D 00
A7=	0.13755790D-03
B7=	-0.20827606D-03
C7=	0.23705978D-02
D7=	0.48234759D-03
E7=	-0.35979024D-02
F7=	-0.66255046D-02
A8=	-0.66748042D-03
B8=	0.15693205D-02
C8=	0.51349521D-02
D8=	-0.24589866D-02
E8=	0.56069062D-02
F8=	0.33587199D-02

****** CASE 26******

*1=	0.26805780D 01
B1=	0.16137187D 00
C1=	0.11628435D 01
D1=	0.67781816D-01
E1=	0.43635365D 00
F1=	0.30480720D 00
A2=	0.17919859D-01
B2=	0.51319309D-03
C2=	0.12608571D-02
D2=	-0.31684805D-03
E2=	-0.10733486D-01
F2=	0.39590098D-02
A3=	0.47234923D-02
B3=	-0.36350959D-02
C3=	0.13347840D-01
D3=	0.11779798D-02
E3=	0.69781534D-02
F3=	-0.73007873D-02
A4=	0.67514623D 00
B4=	-0.16162227D 01
C4=	0.20430936D 01
D4=	0.53640811D 00
E4=	-0.33267936D 01
F4=	0.67755983D 01
A5=	0.88292314D 00
B5=	-0.21648346D 00
C5=	-0.36537474D 00
D5=	0.15150184D 01
E5=	0.46089631D 00
F5=	-0.19773655D 01
*3=	0.67635622D-01
B6=	0.10040515D-01
C6=	0.39128040D-01
D6=	0.18941278D-02
E6=	0.59237566D-01
F6=	0.41098636D-01
A7=	-0.55359905D-04
B7=	0.22806289D-03
C7=	0.57749022D-03
D7=	-0.67245571D-06
E7=	0.62181726D-03
F7=	0.66028824D-03
A8=	-0.19157581D-03
B8=	0.12414933D-03
C8=	0.17373548D-03
D8=	0.72470402D-04
E8=	0.11254715D-02
F8=	0.49782663D-03

****** CASE 27******

*1=	0.31780351D 01
B1=	0.13111176D 00
C1=	0.11015369D 01
D1=	0.76927809D-01
E1=	0.22865441D 00
F1=	0.44807356D 00
A2=	0.18148980D-01
B2=	-0.46746897D-03
C2=	-0.14342159D-02
D2=	-0.12268029D-03
E2=	-0.12936491D-01
F2=	0.89243092D-02
A3=	0.41109631D-02
B3=	0.65227377D-03
C3=	0.14666119D-01
D3=	0.16802454D-02
E3=	0.38428787D-02
F3=	-0.72563149D-02
A4=	0.77155017D 00
B4=	-0.15612883D 01
C4=	0.42409721D 01
D4=	0.63339898D 00
E4=	-0.35110347D 01
F4=	0.71716064D 01
A5=	0.18954334D 01
B5=	0.12253536D 00
C5=	-0.81777179D 00
D5=	0.31238014D 01
E5=	-0.11602239D 00
F5=	0.39837398D 01
*3=	0.91013163D-01
B6=	0.11684073D-01
C6=	0.66280279D-01
D6=	0.27796825D-02
E6=	0.12579912D 00
F6=	0.38981028D-01
A7=	-0.56083715D-04
B7=	0.26925263D-03
C7=	0.11806061D-02
D7=	0.32093078D-04
E7=	0.12051771D-02
F7=	0.47179699D-03
A8=	-0.34461814D-03
B8=	0.25639883D-03
C8=	0.65878069D-04
D8=	0.80834068D-04
E8=	0.25111773D-02
F8=	0.10738886D-02

****** CASE 28******

*1=	0.57225702D 01
B1=	0.21680994D 00
C1=	0.11355397D 01
D1=	0.10600177D 00
E1=	0.70700672D-01
F1=	0.68984234D 00
A2=	0.17481088D-01
B2=	0.85024368D-03
C2=	-0.22826840D-02
D2=	-0.24289381D-03
E2=	-0.15427341D-01
F2=	0.13023124D-01
A3=	0.34643111D-02
B3=	0.54566174D-02
C3=	0.18012428D-01
D3=	0.18344510D-02
E3=	0.12714892D-02
F3=	-0.85327143D-02
A4=	0.70795109D 00
B4=	-0.14233204D 01
C4=	0.56815826D 01
D4=	0.25835547D 00
E4=	-0.18131451D 01
F4=	0.54554692D 01
A5=	0.30901028D 01
B5=	-0.54530292D 00
C5=	-0.14014919D 00
D5=	0.29862647D 01
E5=	-0.15232525D 01
F5=	0.11365189D 02
*3=	0.15204339D 00
B6=	0.10445276D-01
C6=	0.68888920D-01
D6=	0.55701739D-02
E6=	0.15556373D 00
F6=	0.43614239D-01
A7=	-0.38479262D-04
B7=	0.25014635D-03
C7=	0.13054769D-02
D7=	0.14995154D-03
E7=	0.16785349D-02
F7=	0.55618781D-03
A8=	-0.39910123D-03
B8=	0.30433980D-03
C8=	-0.45569378D-04
D8=	0.14360138D-03
E8=	0.33981318D-02
F8=	0.19325008D-02

```
****** CASE   29******

*1=   0.12692518D 02
B1=   0.31846303D 00
C1=   0.10684048D 01
D1=   0.14926420D 00
E1=  -0.33967298D-01
F1=   0.81052220D 00
A2=   0.16375516D-01
B2=   0.17426688D-02
C2=  -0.44563629D-02
D2=  -0.61317253D-03
E2=  -0.16475378D-01
F2=   0.13548096D-01
A3=   0.40892615D-02
B3=   0.92811404D-02
C3=   0.20223273D-01
D3=   0.35246215D-03
E3=  -0.18481481D-02
F3=  -0.12450709D-01
A4=   0.94029044D 00
B4=  -0.12121499D 01
C4=   0.63723408D 01
D4=  -0.16292182D-01
E4=   0.31833330D 01
F4=   0.35750701D 01
A5=   0.37313229D 01
B5=  -0.13634107D 01
C5=   0.35497584D 00
D5=   0.25255524D 01
E5=  -0.40113779D 01
F5=   0.16049088D 02
*3=   0.40603954D 00
B6=   0.77319672D-02
C6=   0.70621890D-01
D6=   0.73645774D-02
E6=   0.14609408D 00
F6=   0.49832859D-01
A7=  -0.19081609D-05
B7=   0.20951414D-03
C7=   0.13578241D-02
D7=   0.23317308D-03
E7=   0.13986975D-02
F7=   0.58992697D-03
A8=  -0.44003483D-03
B8=   0.41132536D-03
C8=   0.38617955D-03
D8=   0.13213632D-03
E8=   0.36943080D-02
F8=   0.24874573D-02
```

```
****** CASE   30******

*1=   0.34758064D 02
B1=   0.39596705D 00
C1=   0.34247573D 00
D1=   0.19577734D 00
E1=  -0.86472952D-01
F1=   0.35084021D 00
A2=   0.14273166D-01
B2=   0.50931643D-03
C2=  -0.92282318D-02
D2=  -0.15471308D-02
E2=  -0.13367053D-01
F2=   0.13537216D-01
A3=   0.70488897D-02
B3=   0.92673913D-02
C3=   0.16813955D-01
D3=  -0.18638542D-02
E3=  -0.76819763D-02
F3=  -0.16074019D-01
A4=   0.17162301D 01
B4=  -0.10420077D 01
C4=   0.79953233D 01
D4=  -0.58521747D-01
E4=   0.13318417D 02
F4=  -0.28687978D-01
A5=   0.45509363D 01
B5=  -0.15519473D 01
C5=   0.10742981D 01
D5=   0.26861435D 01
E5=  -0.32960788D 01
F5=   0.23348306D 02
*3=   0.15862414D 01
B6=   0.38768572D-03
C6=   0.13729556D 00
D6=   0.30033718D-02
E6=   0.17828585D 00
F6=   0.67850167D-01
A7=   0.98860760D-04
B7=   0.90430962D-04
C7=   0.22048504D-02
D7=   0.30171598D-03
E7=  -0.10365220D-03
F7=  -0.63038009D-04
A8=  -0.68333116D-03
B8=   0.93995338D-03
C8=   0.28638579D-02
D8=  -0.31243154D-03
E8=   0.49626176D-02
F8=   0.35183706D-02
```

```
****** CASE  31******

*1=   0.32469189D 01
B1=   0.32976444D 00
C1=   0.32976444D 00
D1=   0.66817868D-01
E1=   0.66817868D-01
F1=   0.24731969D 00
A2=   0.36811605D-02
B2=   0.32782352D-02
C2=  -0.61252812D-02
D2=  -0.96783966D-04
E2=  -0.56100069D-03
F2=  -0.21482824D-03
A3=   0.36811605D-02
B3=  -0.61252812D-02
C3=   0.32782352D-02
D3=  -0.56100069D-03
E3=  -0.96783966D-04
F3=  -0.21482824D-03
A4=   0.10787112D 01
B4=  -0.18546323D 01
C4=   0.20215372D 01
D4=  -0.48371764D 00
E4=   0.22711375D 01
F4=   0.87969230D 01
A5=   0.10787112D 01
B5=   0.20215372D 01
C5=  -0.18546323D 01
D5=   0.22711375D 01
E5=  -0.48371764D 00
F5=   0.87969230D 01
*3=   0.60264401D-01
B6=   0.19733713D-01
C6=   0.19733713D-01
D6=   0.64671760D-03
E6=   0.64671760D-03
F6=   0.62815163D-01
A7=  -0.76300160D-04
B7=   0.27947121D-03
C7=   0.42793925D-04
D7=  -0.31460203D-04
E7=   0.98041329D-04
F7=   0.51754216D-03
A8=  -0.76300160D-04
B8=   0.42793925D-04
C8=   0.27947121D-03
D8=   0.98041329D-04
E8=  -0.31460203D-04
F8=   0.51754216D-03
```

```
****** CASE  32******

*1=   0.36056105D 01
B1=   0.20188048D 00
C1=   0.24311068D 00
D1=   0.57245980D-01
E1=   0.23243465D-01
F1=   0.54755893D 00
A2=   0.91886371D-02
B2=   0.16213434D-02
C2=  -0.37393150D-02
D2=  -0.14647663D-03
E2=   0.14338818D-02
F2=   0.58477174D-02
A3=   0.87645791D-02
B3=  -0.64964124D-02
C3=   0.27976353D-02
D3=   0.23979321D-02
E3=  -0.86370387D-03
F3=   0.26400505D-02
A4=   0.18367086D 01
B4=  -0.25628458D 01
C4=   0.56150923D 01
D4=   0.22592855D 00
E4=   0.13720273D 01
F4=   0.12011154D 02
A5=   0.19324965D 01
B5=   0.59887296D 01
C5=  -0.27175758D 01
D5=   0.51505927D 00
E5=  -0.40550303D 00
F5=   0.16213778D 02
*3=   0.16031193D 00
B6=   0.19292730D-01
C6=   0.30108389D-01
D6=  -0.29372017D-02
E6=   0.32180462D-02
F6=   0.35003262D-01
A7=  -0.68074726D-04
B7=   0.28293802D-03
C7=   0.21084414D-03
D7=  -0.97211935D-04
E7=  -0.11639570D-03
F7=   0.12133731D-03
A8=  -0.11929667D-03
B8=   0.13612265D-03
C8=   0.40553278D-03
D8=   0.11607796D-04
E8=   0.32058779D-05
F8=   0.13092262D-03
```

```
****** CASE  33******

 *1=   0.61556482D 01
 B1=   0.26251390D 00
 C1=   0.22220558D 00
 D1=   0.78721060D-01
 E1=  -0.25262421D-01
 F1=   0.10040490D 01
 A2=   0.88596776D-02
 B2=   0.23628983D-02
 C2=  -0.10319502D-01
 D2=  -0.16247729D-03
 E2=   0.38252204D-02
 F2=   0.12060649D-01
 A3=   0.91497208D-02
 B3=  -0.59633044D-02
 C3=   0.31484202D-02
 D3=   0.54829306D-02
 E3=  -0.22300246D-02
 F3=   0.63724641D-02
 A4=   0.19660565D-01
 B4=  -0.31416642D 01
 C4=   0.96659326D 01
 D4=   0.34471669D 00
 E4=  -0.13457844D 01
 F4=   0.46120728D 01
 A5=   0.30045726D 01
 B5=   0.77347112D 01
 C5=  -0.32828888D 01
 D5=  -0.66463730D 01
 E5=  -0.91652923D 00
 F5=   0.32396231D 02
 *3=   0.32104398D 00
 B6=   0.94994444D-02
 C6=   0.37306129D-01
 D6=   0.51918268D-02
 E6=   0.14769872D-01
 F6=  -0.47329223D-01
 A7=  -0.22667347D-04
 B7=   0.31409194D-04
 C7=   0.46778981D-03
 D7=   0.66673249D-04
 E7=  -0.54396981D-03
 F7=  -0.81599271D-03
 A8=  -0.15247234D-03
 B8=   0.38240641D-03
 C8=   0.45802393D-03
 D8=  -0.33523086D-03
 E8=   0.21456886D-03
 F8=  -0.75721332D-03
```

```
****** CASE  34******

 *1=   0.13887594D 02
 B1=   0.35975751D 00
 C1=   0.20983280D 00
 D1=   0.10954382D 00
 E1=  -0.47239515D-01
 F1=   0.12893215D 01
 A2=   0.82871982D-02
 B2=   0.33432240D-02
 C2=  -0.10490298D-01
 D2=  -0.43781112D-03
 E2=   0.59448995D-02
 F2=   0.15780936D-01
 A3=   0.10202155D-01
 B3=  -0.45654041D-02
 C3=   0.28267033D-02
 D3=   0.85021790D-02
 E3=  -0.37786243D-02
 F3=   0.95972927D-02
 A4=   0.15183375D 01
 B4=  -0.39274223D 01
 C4=   0.94047998D 01
 D4=   0.20798987D 01
 E4=  -0.14667128D 01
 F4=  -0.17395443D 02
 A5=   0.48124947D 01
 B5=   0.93255975D 01
 C5=  -0.32018663D 01
 D5=  -0.14431163D 02
 E5=  -0.24377705D 01
 F5=   0.60290461D 02
 *3=   0.89739113D 00
 B6=  -0.54655611D-02
 C6=   0.49948377D-01
 D6=   0.15532375D-01
 E6=   0.32390721D-01
 F6=  -0.15239495D 00
 A7=   0.41258406D-04
 B7=  -0.21725262D-03
 C7=   0.67177107D-03
 D7=   0.29216777D-03
 E7=  -0.11923318D-02
 F7=  -0.20596800D-02
 A8=  -0.19891771D-03
 B8=   0.65468110D-03
 C8=   0.61912237D-03
 D8=  -0.11716310D-02
 E8=   0.54343685D-03
 F8=  -0.18817282D-02
```

```
****** CASE 35******

*1=  0.40624195D 02
B1=  0.44656448D 00
C1=  0.21966981D 00
D1=  0.12164559D 00
E1= -0.16083733D-01
F1=  0.14309147D 01
A2=  0.75821859D-02
B2=  0.32847415D-02
C2= -0.79742971D-02
D2= -0.16677381D-02
E2=  0.81918335D-02
F2=  0.17430047D-01
A3=  0.11920643D-01
B3= -0.49233199D-03
C3=  0.69601589D-03
D3=  0.93293198D-02
E3= -0.50641242D-02
F3=  0.18083839D-01
A4= -0.12605516D 01
B4= -0.59749800D 01
C4=  0.52460897D 01
D4=  0.55406391D 01
E4=  0.12732958D 02
F4= -0.72643765D 02
A5=  0.88738750D 01
B5=  0.12992384D 02
C5= -0.25017000D 01
D5= -0.24716037D 02
E5= -0.60321434D 01
F5=  0.10887943D 03
*3=  0.44924125D 01
B6= -0.33192591D-01
C6=  0.31884445D-01
D6=  0.32237832D-01
E6=  0.62452169D-01
F6= -0.31171783D 00
A7=  0.98984452D-04
B7= -0.66150404D-03
C7=  0.50228191D-03
D7=  0.74207985D-03
E7= -0.23635388D-02
F7= -0.40024290D-02
A8= -0.23554598D-03
B8=  0.37499922D-03
C8=  0.11878313D-02
D8= -0.31323547D-02
E8=  0.86638927D-03
F8= -0.22605968D-02
```

```
****** CASE 36******

*1=  0.19170696D 01
B1=  0.15567569D 00
C1=  0.70204549D 00
D1=  0.40458373D-01
E1=  0.15273013D 00
F1=  0.26560630D 00
A2=  0.96619245D-02
B2=  0.10477587D-02
C2= -0.37363221D-02
D2= -0.21420242D-03
E2= -0.38975284D-02
F2=  0.20178684D-02
A3=  0.47713766D-02
B3= -0.41659606D-02
C3=  0.60447891D-02
D3=  0.56212319D-03
E3=  0.12947135D-02
F3= -0.31227687D-02
A4=  0.74029649D 00
B4= -0.18146406D 01
C4=  0.26680787D 01
D4=  0.32792873D 00
E4= -0.62861576D 00
F4=  0.93993707D 01
A5=  0.10472560D 01
B5=  0.29188417D 00
C5= -0.11300846D 01
D5=  0.23258460D 01
E5= -0.65196058D 00
F5=  0.21783253D 01
*3=  0.33822502D-01
B6=  0.10477390D-01
C6=  0.32836101D-01
D6= -0.29331910D-03
E6=  0.20032922D-01
F6=  0.49048055D-01
A7= -0.39131053D-04
B7=  0.15186168D-03
C7=  0.18257345D-03
D7= -0.27898338D-04
E7=  0.84919122D-04
F7=  0.49052122D-03
A8= -0.10736582D-03
B8=  0.40272493D-04
C8=  0.24178332D-03
D8=  0.77633069D-04
E8=  0.24451998D-03
F8=  0.25378202D-03
```

```
****** CASE 37******

 *1=  0.23185070D 01
 B1=  0.10091349D 00
 C1=  0.63327431D 00
 D1=  0.55445394D-01
 E1=  0.86624088D-02
 F1=  0.54897675D 00
 A2=  0.98953165D-02
 B2=  0.17101583D-03
 C2= -0.60064715D-02
 D2=  0.30294186D-04
 E2= -0.33352823D-02
 F2=  0.72812642D-02
 A3=  0.45582772D-02
 B3= -0.26616403D-02
 C3=  0.66356977D-02
 D3=  0.19512373D-02
 E3= -0.40033769D-03
 F3= -0.24688112D-02
 A4=  0.10405173D 01
 B4= -0.18921740D 01
 C4=  0.66291143D 01
 D4=  0.66359659D 00
 E4= -0.14466130D 01
 F4=  0.98072410D 01
 A5=  0.22135303D 01
 B5=  0.19993110D 01
 C5= -0.20137934D 01
 D5=  0.28899102D 01
 E5= -0.11397176D 01
 F5=  0.11574938D 02
 *3=  0.64414643D-01
 B6=  0.10163972D-01
 C6=  0.64134714D-01
 D6= -0.20770538D-02
 E6=  0.59388498D-01
 F6=  0.32218892D-01
 A7= -0.31596216D-04
 B7=  0.15370641D-03
 C7=  0.56608630D-03
 D7= -0.57941322D-04
 E7=  0.22562093D-04
 F7=  0.21032414D-03
 A8= -0.21983951D-03
 B8=  0.17766570D-03
 C8=  0.34542795D-03
 D8=  0.44682258D-04
 E8=  0.79839318D-03
 F8=  0.23530627D-03
```

```
****** CASE 38******

 *1=  0.46768445D 01
 B1=  0.20486471D 00
 C1=  0.67851909D 00
 D1=  0.86914972D-01
 E1= -0.13320177D 00
 F1=  0.88126511D 00
 A2=  0.94414210D-02
 B2=  0.13309678D-02
 C2= -0.57244901D-02
 D2=  0.12148211D-03
 E2= -0.36502267D-02
 F2=  0.11088638D-01
 A3=  0.43305473D-02
 B3= -0.39368266D-03
 C3=  0.88012805D-02
 D3=  0.32144745D-02
 E3= -0.24921152D-02
 F3= -0.32530815D-02
 A4=  0.86426180D 00
 B4= -0.18581795D 01
 C4=  0.35292763D 01
 D4=  0.30978944D 00
 E4= -0.16955259D 01
 F4=  0.31172827D 01
 A5=  0.36780498D 01
 B5=  0.18537977D 01
 C5= -0.16995006D 01
 D5=  0.10197815D 01
 E5= -0.25729374D 01
 F5=  0.26385269D 02
 *3=  0.98379805D-01
 B6=  0.62517682D-02
 C6=  0.89682177D-01
 D6=  0.94101920D-03
 E6=  0.10219436D 00
 F6=  0.42646902D-02
 A7= -0.87071762D-05
 B7=  0.81802681D-04
 C7=  0.93598437D-03
 D7=  0.12936869D-04
 E7= -0.50169493D-04
 F7= -0.18444167D-03
 A8= -0.33625045D-03
 B8=  0.37766477D-03
 C8=  0.42137676D-03
 D8= -0.39937097D-04
 E8=  0.15223307D-02
 F8=  0.49040824D-03
```

****** CASE 39******

```
*1=  0.11386407D 02
B1=  0.31106825D 00
C1=  0.63523953D 00
D1=  0.12855144D 00
E1= -0.21184106D 00
F1=  0.99771575D 00
A2=  0.88934103D-02
B2=  0.22023275D-02
C2= -0.74816563D-02
D2=  0.53587850D-05
E2= -0.34694258D-02
F2=  0.11995589D-01
A3=  0.49641130D-02
B3=  0.19722179D-02
C3=  0.99568053D-02
D3=  0.40266441D-02
E3= -0.47697389D-02
F3= -0.57070864D-02
A4=  0.81644482D 00
B4= -0.17886434D 01
C4=  0.92799063D 01
D4=  0.16727803D 00
E4=  0.45029650D 01
F4= -0.80337525D 01
A5=  0.53963815D 01
B5=  0.12032158D 01
C5= -0.78869485D 00
D5= -0.27741423D 00
E5= -0.59609074D 01
F5=  0.43835550D 02
*3=  0.26750904D 00
B6=  0.33837400D-02
C6=  0.11071829D 00
D6=  0.29120255D-02
E6=  0.12295855D 00
F6= -0.12472990D-01
A7=  0.15860487D-04
B7=  0.30961606D-04
C7=  0.11962345D-02
D7=  0.70093235D-04
E7= -0.31050436D-03
F7= -0.55069724D-03
A8= -0.45699523D-03
B8=  0.62930311D-03
C8=  0.76705083D-03
D8= -0.19667803D-03
E8=  0.21136375D-02
F8=  0.10643795D-02
```

****** CASE 40******

```
*1=  0.33549000D 02
B1=  0.37831301D 00
C1=  0.47541011D 00
D1=  0.16422147D 00
E1= -0.17727391D 00
F1=  0.10439103D 01
A2=  0.31733358D-02
B2=  0.17836425D-02
C2= -0.87988682D-02
D2= -0.78645139D-03
E2= -0.72373873D-03
F2=  0.12985183D-01
A3=  0.71208611D-02
B3=  0.34235308D-02
C3=  0.75215804D-02
D3=  0.32618058D-02
E3= -0.70663858D-02
F3= -0.73115494D-02
A4=  0.92588839D 00
B4= -0.21657662D 01
C4=  0.11026167D 02
D4=  0.56750341D 00
E4=  0.25319242D 02
F4= -0.31254112D 02
A5=  0.35929640D 01
B5=  0.17033387D 01
C5= -0.12397733D 00
D5= -0.12227380D 01
E5= -0.12791020D 02
F5=  0.74389273D 02
*3=  0.13406858D 01
B6= -0.29696913D-02
C6=  0.15779823D 00
D6=  0.50249623D-02
E6=  0.14566675D 00
F6= -0.58291172D-01
A7=  0.69314134D-04
B7= -0.80897543D-04
C7=  0.15495636D-02
D7=  0.15813831D-03
E7= -0.12968606D-02
F7= -0.18066490D-02
A8= -0.58862487D-03
B8=  0.11299537D-02
C8=  0.21545236D-02
D8= -0.92233632D-03
E8=  0.26840853D-02
F8=  0.24698138D-02
```

```
****** CASE  41******

*1=   0.16671193D 01
B1=   0.10110946D 00
C1=   0.11727671D 01
D1=   0.36540192D-01
E1=   0.42443389D 00
F1=   0.25965233D 00
A2=   0.99022280D-02
B2=   0.29763247D-03
C2=   0.31613672D-03
D2=  -0.17008358D-03
E2=  -0.63847456D-02
F2=   0.23750852D-02
A3=   0.23584214D-02
B3=  -0.22312906D-02
C3=   0.72033558D-02
D3=   0.54476277D-03
E3=   0.39922351D-02
F3=  -0.46593873D-02
A4=   0.64806518D 00
B4=  -0.18059621D 01
C4=   0.23311318D 01
D4=   0.68475780D 00
E4=  -0.37323975D 01
F4=   0.74014695D 01
A5=   0.92128905D 00
B5=  -0.16457439D 00
C5=  -0.47914817D 00
D5=   0.16978180D 01
E5=   0.51735797D 00
F5=  -0.23217708D 01
*3=   0.31351823D-01
B6=   0.81187135D-02
C6=   0.35995361D-01
D6=   0.34049584D-03
E6=   0.53809211D-01
F6=   0.34189286D-01
A7=  -0.30905264D-04
B7=   0.11122407D-03
C7=   0.27669052D-03
D7=  -0.22198100D-05
E7=   0.31395550D-03
F7=   0.33938081D-03
A8=  -0.95825074D-04
B8=   0.57902219D-04
C8=   0.50845657D-04
D8=   0.37832123D-04
E8=   0.55833784D-03
F8=   0.23380369D-03
```

```
****** CASE  42******

*1=   0.21455506D 01
B1=   0.35471536D-01
C1=   0.11844643D 01
D1=   0.54530451D-01
E1=   0.21350216D 00
F1=   0.47246357D 00
A2=   0.10072743D-01
B2=  -0.76315511D-04
C2=  -0.15280330D-03
D2=   0.85007966D-04
E2=  -0.79009331D-02
F2=   0.59080837D-02
A3=   0.17807551D-02
B3=   0.35225136D-03
C3=   0.35488980D-02
D3=   0.10854614D-02
E3=   0.23890780D-02
F3=  -0.43912820D-02
A4=   0.75987568D 00
B4=  -0.17001712D 01
C4=   0.46082518D 01
D4=   0.74549318D 00
E4=  -0.46622449D 01
F4=   0.78084331D 01
A5=   0.19999072D 01
B5=   0.29064302D 00
C5=  -0.85204591D 00
D5=   0.35164138D 01
E5=   0.20151242D 00
F5=   0.31408310D 01
*3=   0.44231051D-01
B6=   0.92377570D-02
C6=   0.58700293D-01
D6=   0.17277663D-02
E6=   0.11838962D 00
F6=   0.26891695D-01
A7=  -0.33151171D-04
B7=   0.12413137D-03
C7=   0.57004765D-03
D7=   0.17111679D-04
E7=   0.66660292D-03
F7=   0.19765387D-03
A8=  -0.16524704D-03
B8=   0.13074386D-03
C8=  -0.89958181D-04
D8=   0.40768249D-04
E8=   0.12672378D-02
F8=   0.53259224D-03
```

****** CASE 43******

*1=	0.45843512D 01
B1=	0.21884648D 00
C1=	0.13787187D 01
D1=	0.90438215D-01
E1=	0.13541461D 00
F1=	0.77666993D 00
A2=	0.95222571D-02
B2=	0.14554533D-02
C2=	0.10281344D-02
D2=	0.21130323D-03
E2=	-0.97579535D-02
F2=	0.33320547D-02
A3=	0.82753404D-03
B3=	0.36338726D-02
C3=	0.11426744D-01
D3=	0.18163116D-02
E3=	0.24047096D-02
F3=	-0.39091624D-02
A4=	0.58739169D 00
B4=	-0.14707212D 01
C4=	0.52246460D 01
D4=	0.10030446D 00
E4=	-0.40643715D 01
F4=	0.58643301D 01
A5=	0.30818173D 01
B5=	-0.70875561D 00
C5=	0.47657568D 00
D5=	0.30822079D 01
E5=	-0.66614355D-01
F5=	0.74891109D 01
*3=	0.77609967D-01
B6=	0.71331676D-02
C6=	0.27312889D-01
D6=	0.38428072D-02
E6=	0.10432597D 00
F6=	0.29964108D-01
A7=	-0.26497345D-04
B7=	0.90205107D-04
C7=	0.25361793D-03
D7=	0.66814460D-04
E7=	0.38588495D-03
F7=	0.31544181D-03
A8=	-0.93635104D-04
B8=	0.42415395D-04
C8=	-0.28224973D-03
D8=	0.90675640D-04
E8=	0.12000703D-02
F8=	0.77245214D-03

****** CASE 44******

*1=	0.11184882D 02
B1=	0.33596135D 00
C1=	0.14226228D 01
D1=	0.13783753D 00
E1=	0.90403714D-01
F1=	0.91785772D 00
A2=	0.89891810D-02
B2=	0.24434194D-02
C2=	0.12093997D-02
D2=	0.24164321D-03
E2=	-0.10860263D-01
F2=	0.83741293D-02
A3=	0.48590222D-03
B3=	0.70422027D-02
C3=	0.14268037D-01
D3=	0.22138494D-02
E3=	0.25030077D-02
F3=	-0.37068798D-02
A4=	0.79356627D 00
B4=	-0.11894820D 01
C4=	0.54838425D 01
D4=	-0.24565716D 00
E4=	-0.12459966D 01
F4=	0.51177137D 01
A5=	0.37472334D 01
B5=	-0.14827744D 01
C5=	0.19348926D 01
D5=	0.25110635D 01
E5=	-0.96258136D 00
F5=	0.90844170D 01
*3=	0.23617060D 00
B6=	0.49731457D-02
C6=	-0.28230338D-02
D6=	0.44777394D-02
E6=	0.58899742D-01
F6=	0.31065498D-01
A7=	-0.19461229D-04
B7=	0.64612197D-04
C7=	-0.53795527D-04
D7=	0.30182417D-04
E7=	0.78222133D-03
F7=	0.41651304D-03
A8=	-0.79669103D-05
B8=	-0.50757494D-04
C8=	-0.31007488D-03
D8=	0.12869517D-03
E8=	0.77458426D-03
F8=	0.60049093D-03

```
****** CASE  45******

*1=  0.31897157D 02
B1=  0.39485655D 00
C1=  0.11033759D 01
D1=  0.17648882D 00
E1= -0.10940243D 00
F1=  0.39969536D 00
A2=  0.83872677D-02
B2=  0.18097427D-02
C2= -0.24609396D-02
D2= -0.55550339D-03
E2= -0.10525319D-01
F2=  0.68904999D-02
A3=  0.23959656D-02
B3=  0.89682005D-02
C3=  0.15312421D-01
D3=  0.27817308D-03
E3= -0.24670712D-02
F3= -0.75948932D-02
A4=  0.15371125D-01
B4= -0.11131665D 01
C4=  0.06563174D 01
D4= -0.30507935D 00
E4=  0.45502684D 01
F4=  0.34487729D 01
A5=  0.43224434D 01
B5= -0.14315668D 01
C5=  0.18771704D 01
D5=  0.27043417D 01
E5= -0.47027969D 01
F5=  0.14626323D 02
*3=  0.83368225D 00
B6=  0.14933690D-02
C6=  0.57892064D-01
D6=  0.51965292D-02
E6=  0.98062137D-01
F6=  0.40700076D-01
A7=  0.11794612D-04
B7=  0.40112518D-04
C7=  0.57879331D-03
D7=  0.11746386D-03
E7=  0.39073510D-03
F7=  0.29153331D-03
A8= -0.24016971D-03
B8=  0.28043245D-03
C8=  0.36380339D-03
D8=  0.96749329D-05
E8=  0.17465313D-02
F8=  0.15104780D-02
```

```
****** CASE  46******

*1=  0.71072368D 01
B1=  0.41851576D 00
C1=  0.58691643D 00
D1=  0.15222422D 00
E1=  0.24372114D 00
F1=  0.33022792D 00
A2=  0.26243352D-01
B2=  0.62890602D-02
C2= -0.10161314D-01
D2= -0.92358564D-03
E2= -0.15090779D-02
F2=  0.14129887D-02
A3=  0.19129837D-01
B3= -0.74533350D-02
C3=  0.63692636D-02
D3=  0.31401566D-02
E3= -0.44067694D-03
F3= -0.91293598D-03
A4=  0.96291721D 00
B4= -0.11078551D 01
C4=  0.62312435D 00
D4= -0.29349984D 00
E4=  0.74751526D 00
F4=  0.64394274D 01
A5=  0.11461872D 01
B5=  0.28421932D 00
C5= -0.64061107D 00
D5=  0.20677845D 01
E5= -0.26784579D 00
F5=  0.41452253D 01
*3=  0.35741680D 00
B6=  0.26969710D-01
C6=  0.26707963D-01
D6=  0.62765520D-02
E6=  0.97771933D-02
F6=  0.35687686D-01
A7= -0.18085628D-03
B7=  0.39988002D-03
C7=  0.43908803D-03
D7= -0.67142147D-04
E7=  0.52972289D-03
F7=  0.17805853D-02
A8= -0.70525228D-04
B8=  0.41837888D-03
C8=  0.65896176D-03
D8=  0.18195027D-03
E8= -0.36476258D-04
F8=  0.97559812D-03
```

```
****** CASE  47******

*1=   0.75215084D 01
B1=   0.34371747D 00
C1=   0.50546578D 00
D1=   0.13220627D 00
E1=   0.19623111D 00
F1=   0.47017286D 00
A2=   0.26354311D-01
B2=   0.33789900D-02
C2=  -0.14432388D-01
D2=  -0.13130127D-02
E2=   0.11326708D-02
F2=   0.10350549D-01
A3=   0.19216717D-01
B3=  -0.65209566D-02
C3=   0.43006104D-02
D3=   0.33549585D-02
E3=  -0.16700781D-02
F3=   0.52084230D-02
A4=   0.12589630D 01
B4=  -0.14544330D 01
C4=   0.28533493D 01
D4=  -0.35109289D-01
E4=   0.22149323D 00
F4=   0.73845830D 01
A5=   0.15981078D 01
B5=   0.20961167D 01
C5=  -0.11225622D 01
D5=   0.82465355D 00
E5=  -0.24353510D 00
F5=   0.32369028D 01
*3=   0.56734997D 00
B6=   0.28469461D-01
C6=   0.34240365D-01
D6=   0.43325391D-02
E6=   0.19457013D-01
F6=   0.37707527D-01
A7=  -0.19358419D-03
B7=   0.90051693D-03
C7=   0.80803833D-03
D7=  -0.14154655D-03
E7=  -0.10077364D-03
F7=   0.18668470D-04
A8=  -0.94083589D-04
B8=   0.20589462D-03
C8=   0.32234644D-03
D8=  -0.28371289D-03
E8=   0.17424320D-03
F8=   0.23779228D-03
```

```
****** CASE  48******

*1=   0.98576731D 01
B1=   0.33569760D 00
C1=   0.45919926D 00
D1=   0.13167340D 00
E1=   0.16381109D 00
F1=   0.73345430D 00
A2=   0.26380825D-01
B2=   0.19774705D-02
C2=  -0.15971520D-01
D2=  -0.16073715D-02
E2=   0.54559195D-02
F2=   0.21465354D-01
A3=   0.19348325D-01
B3=  -0.25983764D-02
C3=   0.21015003D-02
D3=   0.14870507D-02
E3=  -0.31652807D-02
F3=   0.17147993D-01
A4=   0.14296033D 01
B4=  -0.18568006D 01
C4=   0.50073298D 01
D4=   0.37192172D 00
E4=  -0.13187922D 01
F4=   0.36960052D 01
A5=   0.24678252D 01
B5=   0.33719933D 01
C5=  -0.14864376D 01
D5=  -0.28542515D 01
E5=  -0.40235462D 00
F5=   0.18345571D 02
*3=   0.11681940D 01
B6=   0.25578958D-01
C6=   0.46139351D-01
D6=   0.11169710D-01
E6=   0.41934035D-01
F6=  -0.76713691D-01
A7=  -0.18683999D-03
B7=   0.68955663D-03
C7=   0.11259361D-02
D7=   0.19586865D-03
E7=  -0.16740397D-02
F7=  -0.39562206D-02
A8=  -0.13584082D-03
B8=  -0.40868011D-03
C8=   0.10736505D-02
D8=  -0.98498484D-03
E8=   0.69597992D-03
F8=  -0.16829309D-02
```

```
****** CASE  49******

*1=   0.47498289D 01
B1=   0.28979663D 00
C1=   0.84640017D 00
D1=   0.12136744D 00
E1=   0.32416392D 00
F1=   0.33619336D 00
A2=   0.28777168D-01
B2=   0.20599343D-02
C2=  -0.63145308D-02
D2=  -0.75898444D-03
E2=  -0.90671319D-02
F2=   0.47420004D-02
A3=   0.13844725D-01
B3=  -0.52267390D-02
C3=   0.14720993D-01
D3=   0.33583858D-02
E3=   0.28640795D-02
F3=  -0.46590798D-02
A4=   0.77681322D 00
B4=  -0.12790210D 01
C4=   0.13769645D 01
D4=   0.16736383D 00
E4=  -0.30770344D 00
F4=   0.66915398D 01
A5=   0.99944822D 00
B5=  -0.23211579D 00
C5=  -0.31679037D 00
D5=   0.17172151D 01
E5=  -0.18537180D 00
F5=   0.78212139D 00
*3=   0.13855463D 00
B6=   0.16099067D-01
C6=   0.31680149D-01
D6=   0.41367935D-02
E6=   0.28086967D-01
F6=   0.61912760D-01
A7=  -0.10897739D-03
B7=   0.54045009D-03
C7=   0.67033076D-03
D7=  -0.19093505D-04
E7=   0.62667407D-03
F7=   0.14783997D-02
A8=  -0.15903926D-03
B8=   0.24737974D-03
C8=   0.77213976D-03
D8=   0.10110453D-03
E8=   0.58346955D-03
F8=   0.69171538D-03
```

```
****** CASE  50******

*1=   0.50879961D 01
B1=   0.24146742D 00
C1=   0.73870188D 00
D1=   0.11768572D 00
E1=   0.21028867D 00
F1=   0.45259294D 00
A2=   0.29150558D-01
B2=  -0.14873594D-03
C2=  -0.11764072D-01
D2=  -0.70646346D-03
E2=  -0.82667636D-02
F2=   0.13099719D-01
A3=   0.14007212D-01
B3=  -0.23505116D-02
C3=   0.13159455D-01
D3=   0.26002903D-02
E3=  -0.50338649D-03
F3=  -0.25880649D-02
A4=   0.38871791D 00
B4=  -0.13558117D 01
C4=   0.37713690D 01
D4=   0.29854410D 00
E4=  -0.79286887D 00
F4=   0.64138815D 01
A5=   0.18080156D 01
B5=   0.54687107D 00
C5=  -0.37733288D 00
D5=   0.20409633D 01
E5=  -0.53715881D 00
F5=   0.75924853D 01
*3=   0.28144899D 00
B6=   0.18137161D-01
C6=   0.44813577D-01
D6=   0.26269547D-02
E6=   0.64488953D-01
F6=   0.48620368D-01
A7=  -0.11309033D-03
B7=   0.59714180D-03
C7=   0.12071471D-02
D7=  -0.31917955D-04
E7=   0.39897106D-03
F7=   0.71270447D-03
A8=  -0.21739370D-03
B8=   0.23345617D-03
C8=   0.11493382D-02
D8=  -0.32942017D-04
E8=   0.16741626D-02
F8=   0.85086971D-03
```

****** CASE 51******

*1=	0.69416158D 01
B1=	0.25686301D 00
C1=	0.66098396D 00
D1=	0.13186439D 00
E1=	0.11969867D 00
F1=	0.66978094D 00
A2=	0.28340946D-01
B2=	-0.72177888D-03
C2=	-0.15604267D-01
D2=	-0.73403352D-03
E2=	-0.51807558D-02
F2=	0.22880846D-01
A3=	0.14603970D-01
B3=	0.75466720D-03
C3=	0.11187272D-01
D3=	0.48258288D-03
E3=	-0.44725909D-02
F3=	0.20447919D-02
A4=	0.91766130D 00
B4=	-0.14619103D 01
C4=	0.67518135D 01
D4=	0.33941629D 00
E4=	0.65163934D 00
F4=	0.21489841D 01
A5=	0.34397626D 01
B5=	0.96546380D 00
C5=	-0.10537342D 01
D5=	0.11264092D 01
E5=	-0.18651135D 01
F5=	0.22075633D 02
*3=	0.57376548D 00
B6=	0.20026596D-01
C6=	0.73204098D-01
D6=	0.52270274D-02
E6=	0.12818039D 00
F6=	0.26866644D-01
A7=	-0.92782274D-04
B7=	0.62632146D-03
C7=	0.21394327D-02
D7=	0.95564673D-05
E7=	0.10369518D-02
F7=	-0.68358205D-03
A8=	-0.25307359D-03
B8=	0.25558899D-03
C8=	0.22011294D-02
D8=	-0.36803274D-03
E8=	0.34727187D-02
F8=	0.10569356D-02

****** CASE 52******

*1=	0.42123921D 01
B1=	0.24557885D 00
C1=	0.12122536D 01
D1=	0.11346956D 00
E1=	0.55430201D 00
F1=	0.35677944D 00
A2=	0.29816408D-01
B2=	0.53192137D-03
C2=	0.39922884D-02
D2=	-0.54040190D-03
E2=	-0.15443500D-01
F2=	0.51171817D-02
A3=	0.84477424D-02
B3=	-0.27816982D-02
C3=	0.20258657D-01
D3=	0.23047812D-02
E3=	0.10043294D-01
F3=	-0.68504436D-02
A4=	0.71974781D 00
B4=	-0.13362372D 01
C4=	0.15251997D 01
D4=	0.37423193D 00
E4=	-0.27994379D 01
F4=	0.55499306D 01
A5=	0.35380050D 00
B5=	-0.32040273D 00
C5=	-0.15733454D-01
D5=	0.12430149D 01
E5=	0.59286423D 00
F5=	-0.18779642D 01
*3=	0.15882163D 00
B6=	0.12758471D-01
C6=	0.31382166D-01
D6=	0.40842944D-02
E6=	0.51425063D-01
F6=	0.46230237D-01
A7=	-0.89767889D-04
B7=	0.42703119D-03
C7=	0.33175754D-03
D7=	0.21193754D-04
E7=	0.13379721D-02
F7=	0.10901566D-02
A8=	-0.18328465D-03
B8=	0.18762450D-03
C8=	0.47389639D-03
D8=	0.31760368D-04
E8=	0.15978740D-02
F8=	0.72635829D-03

```
****** CASE  53******

*1=   0.45531706D 01
B1=   0.21281269D 00
C1=   0.11074922D 01
D1=   0.11468437D 00
E1=   0.36187335D 00
F1=   0.41995136D 00
A2=   0.30055321D-01
B2=  -0.11839429D-02
C2=  -0.10275005D-02
D2=  -0.42162264D-03
E2=  -0.18868186D-01
F2=   0.10286703D-01
A3=   0.33464979D-02
B3=   0.14549226D-02
C3=   0.20217930D-01
D3=   0.62413826D-03
E3=   0.52910892D-02
F3=  -0.55075671D-02
A4=   0.77505137D 00
B4=  -0.13040439D 01
C4=   0.31926796D 01
D4=   0.43103912D 00
E4=  -0.25195623D 01
F4=   0.57340613D 01
A5=   0.16581325D 01
B5=  -0.25937673D 00
C5=  -0.40287769D 00
D5=   0.25464224D 01
E5=  -0.20294073D-01
F5=   0.33638705D 01
*3=   0.20063909D 00
B6=   0.14816884D-01
C6=   0.46488401D-01
D6=   0.53619115D-02
E6=   0.11534847D 00
F6=   0.53929164D-01
A7=  -0.91061619D-04
B7=   0.51190696D-03
C7=   0.13995817D-02
D7=   0.72179553D-04
E7=   0.25317236D-02
F7=   0.11349670D-02
A8=  -0.29143878D-03
B8=   0.19930377D-03
C8=   0.72563801D-03
D8=  -0.11936634D-04
E8=   0.32849665D-02
F8=   0.14229101D-02
```

```
****** CASE  54******

*1=   0.63369850D 01
B1=   0.24232881D 00
C1=   0.99703254D 00
D1=   0.13323049D 00
E1=   0.18225526D 00
F1=   0.56589255D 00
A2=   0.29100310D-01
B2=  -0.13184379D-02
C2=  -0.62899075D-02
D2=  -0.51314290D-03
E2=  -0.19860417D-01
F2=   0.15995687D-01
A3=   0.89681730D-02
B3=   0.46120031D-02
C3=   0.19591116D-01
D3=  -0.19930238D-02
E3=  -0.84684288D-03
F3=  -0.63628786D-02
A4=   0.81203767D 00
B4=  -0.12586141D 01
C4=   0.52155754D 01
D4=   0.33845085D 00
E4=   0.33340419D 00
F4=   0.46303269D 01
A5=   0.29824126D 01
B5=  -0.62252404D 00
C5=  -0.21429480D 00
D5=   0.27802615D 01
E5=  -0.19759536D 01
F5=   0.12377146D 02
*3=   0.35684574D 00
B6=   0.16995739D-01
C6=   0.67590956D-01
D6=   0.95676534D-02
E6=   0.17146240D 00
F6=   0.31556417D-01
A7=  -0.70271312D-04
B7=   0.61583950D-03
C7=   0.20736680D-02
D7=   0.24462249D-03
E7=   0.37437338D-02
F7=   0.17753094D-02
A8=  -0.36648247D-03
B8=   0.25432786D-03
C8=   0.15549551D-02
D8=   0.46431049D-05
E8=   0.51780355D-02
F8=   0.24485931D-02
```

```
****** CASE  55******

*1=   0.47941173D 01
B1=   0.35299556D 00
C1=   0.47711446D 00
D1=   0.98909533D-01
E1=   0.16688830D 00
F1=   0.27968126D 00
A2=   0.15789768D-01
B2=   0.47277361D-02
C2=  -0.83614481D-02
D2=  -0.45863642D-03
E2=  -0.11499775D-02
F2=   0.40329112D-03
A3=   0.12932685D-01
B3=  -0.73746896D-02
C3=   0.46350622D-02
D3=   0.11275279D-02
E3=  -0.28485687D-03
F3=  -0.69655374D-03
A4=   0.99452532D 00
B4=  -0.15202655D 01
C4=   0.12707549D 01
D4=  -0.37471161D 00
E4=   0.12915630D 01
F4=   0.78321105D 01
A5=   0.11186492D 01
B5=   0.10289652D 01
C5=  -0.11704375D 01
D5=   0.23526823D 01
E5=  -0.38233497D 00
F5=   0.59859326D 01
*3=   0.14977342D 00
B6=   0.22522034D-01
C6=   0.24217117D-01
D6=   0.25151553D-02
E6=   0.55396550D-02
F6=   0.74579913D-01
A7=  -0.12666946D-03
B7=   0.52028592D-03
C7=   0.15780928D-03
D7=  -0.56695350D-04
E7=   0.25245834D-03
F7=   0.10493336D-02
A8=  -0.87584155D-04
B8=   0.18650984D-03
C8=   0.44351789D-03
D8=   0.14045275D-03
E8=  -0.33231371D-04
F8=   0.68574981D-03
```

```
****** CASE  56******

*1=   0.51446467D 01
B1=   0.26699168D 00
C1=   0.39170156D 00
D1=   0.81204422D-01
E1=   0.12285201D 00
F1=   0.47442530D 00
A2=   0.16339154D-01
B2=   0.27531138D-02
C2=  -0.11732250D-01
D2=  -0.79425950D-03
E2=   0.12751487D-02
F2=   0.74769437D-02
A3=   0.13028402D-01
B3=  -0.68475228D-02
C3=   0.34424407D-02
D3=   0.29170815D-02
E3=  -0.12477240D-02
F3=   0.33811269D-02
A4=   0.14032091D 01
B4=  -0.19948107D 01
C4=   0.42542837D 01
D4=   0.35888983D-02
E4=   0.67023713D 00
F4=   0.92493773D 01
A5=   0.17099839D 01
B5=   0.34818852D 01
C5=  -0.17674488D 01
D5=   0.75154279D 00
E5=  -0.32268888D 00
F5=   0.11250750D 02
*3=   0.28579767D 00
B6=   0.23042463D-01
C6=   0.32247682D-01
D6=   0.34764659D-03
E6=   0.11638378D-01
F6=   0.36014792D-01
A7=  -0.12145118D-03
B7=   0.51765469D-03
C7=   0.43596387D-03
D7=  -0.12061500D-03
E7=  -0.12607564D-03
F7=   0.13322813D-03
A8=  -0.11782180D-03
B8=   0.20066995D-03
C8=   0.56759059D-03
D8=  -0.94318777D-04
E8=   0.64159927D-04
F8=   0.16433711D-03
```

****** CASE 57******

*1=	0.71963313D 01
B1=	0.28045019D 00
C1=	0.35314149D 00
D1=	0.83447014D-01
E1=	0.92434726D-01
F1=	0.32648973D 00
A2=	0.16062335D-01
B2=	0.26961225D-02
C2=	-0.13667429D-01
D2=	-0.12262496D-02
E2=	0.49833715D-02
F2=	0.16508373D-01
A3=	0.13343874D-01
B3=	-0.46880525D-02
C3=	0.24549556D-02
D3=	0.44639223D-02
E3=	-0.25803732D-02
F3=	0.10638285D-01
A4=	0.15324192D 01
B4=	-0.25427017D 01
C4=	0.70135771D 01
D4=	0.48906264D 00
E4=	-0.12291596D 01
F4=	0.41298301D 01
A5=	0.27562892D 01
B5=	0.50346684D 01
C5=	-0.22013085D 01
D5=	-0.43805099D 01
E5=	-0.56009278D 00
F5=	0.24336762D 02
*3=	0.61644122D 00
B6=	0.17927584D-01
C6=	0.41523800D-01
D6=	0.84510378D-02
E6=	0.27724975D-01
F6=	-0.53855507D-01
A7=	-0.84896584D-04
B7=	0.29942576D-03
C7=	0.34495253D-03
D7=	0.14761928D-03
E7=	-0.10256871D-02
F7=	-0.20260043D-02
A8=	-0.13901077D-03
B8=	0.16364524D-03
C8=	0.67897489D-03
D8=	-0.71325050D-03
E8=	0.37392917D-03
F8=	-0.11993824D-02

****** CASE 58******

*1=	0.30397118D 01
B1=	0.20629691D 00
C1=	0.78490397D 00
D1=	0.72519134D-01
E1=	0.24675552D 00
F1=	0.28847189D 00
A2=	0.17376827D-01
B2=	0.15445182D-02
C2=	-0.51077570D-02
D2=	-0.44315000D-03
E2=	-0.64058965D-02
F2=	0.32454919D-02
A3=	0.31499084D-02
B3=	-0.51624905D-02
C3=	0.96705958D-02
D3=	0.17771136D-02
E3=	0.20069326D-02
F3=	-0.41362969D-02
A4=	0.74389241D 00
B4=	-0.15939995D 01
C4=	0.20330829D 01
D4=	0.27118461D 00
E4=	-0.83775497D 00
F4=	0.31478510D 01
A5=	0.10369672D 01
B5=	0.12065080D-01
C5=	-0.69451908D 00
D5=	0.20830434D 01
E5=	-0.37996995D 00
F5=	0.12778166D 01
*3=	0.80032984D-01
B6=	0.13061958D-01
C6=	0.32497528D-01
D6=	0.14045464D-02
E6=	0.25098051D-01
F6=	0.55582206D-01
A7=	-0.72244455D-04
B7=	0.30252778D-03
C7=	0.35271221D-03
D7=	-0.32680366D-04
E7=	0.28230169D-03
F7=	0.91024734D-03
A8=	-0.14542682D-03
B8=	0.11931704D-03
C8=	0.44880795D-03
D8=	0.94060349D-04
E8=	0.40806891D-03
F8=	0.42582652D-03

****** CASE 59******

*1=	0.33401958D 01
B1=	0.15574574D 00
C1=	0.67572079D 00
D1=	0.73432212D-01
E1=	0.12131016D 00
F1=	0.45876147D 00
A2=	0.17713419D-01
B2=	0.15281723D-03
C2=	-0.89178716D-02
D2=	-0.37623383D-03
E2=	-0.54521332D-02
F2=	0.96538756D-02
A3=	0.81605986D-02
B3=	-0.28004407D-02
C3=	0.92324107D-02
D3=	0.23247412D-02
E3=	-0.40574686D-03
F3=	-0.29956273D-02
A4=	0.91148394D 00
B4=	-0.16967285D 01
C4=	0.50746928D 01
D4=	0.45476756D 00
E4=	-0.96285280D 00
F4=	0.80285326D 01
A5=	0.20186567D 01
B5=	0.11964586D 01
C5=	-0.14092636D 01
D5=	0.25360745D 01
E5=	-0.80048072D 00
F5=	0.94670004D 01
*3=	0.13184497D 00
B6=	0.14269559D-01
C6=	0.54310818D-01
D6=	-0.29217116D-03
E6=	0.61636112D-01
F6=	0.42936341D-01
A7=	-0.68223113D-04
B7=	0.33176320D-03
C7=	0.34088580D-03
D7=	-0.84511936D-04
E7=	0.31227329D-03
F7=	0.47038105D-03
A8=	-0.25398418D-03
B8=	0.22816800D-03
C8=	0.68302013D-03
D8=	0.91456270D-05
E8=	0.11684507D-02
F8=	0.50770047D-03

****** CASE 60******

*1=	0.50296975D 01
B1=	0.19439152D 00
C1=	0.61035971D 00
D1=	0.90805688D-01
E1=	0.14395159D-01
F1=	0.74180355D 00
A2=	0.17265369D-01
B2=	0.49345243D-03
C2=	-0.11799012D-01
D2=	-0.48763435D-03
E2=	-0.35538435D-02
F2=	0.16942670D-01
A3=	0.85269947D-02
B3=	-0.18543675D-03
C3=	0.91628230D-02
D3=	0.23098475D-02
E3=	-0.33986052D-02
F3=	-0.19639451D-02
A4=	0.86705664D 00
B4=	-0.18382910D 01
C4=	0.84484954D 01
D4=	0.39565895D 00
E4=	0.50319207D 00
F4=	0.26668719D 01
A5=	0.38493091D 01
B5=	0.16476462D 01
C5=	-0.15828264D 01
D5=	0.12026382D 01
E5=	-0.24085537D 01
F5=	0.26495755D 02
*3=	0.25629532D 00
B6=	0.14002373D-01
C6=	0.89480434D-01
D6=	0.23266982D-02
E6=	0.11779023D 00
F6=	0.14554364D-01
A7=	-0.43490071D-04
B7=	0.29799019D-03
C7=	0.16311716D-02
D7=	0.53945298D-05
E7=	0.13044138D-03
F7=	-0.45853998D-03
A8=	-0.40383535D-03
B8=	0.49125132D-03
C8=	0.12571458D-02
D8=	-0.21862365D-03
E8=	0.24024090D-02
F8=	0.76208283D-03

```
******* CASE  61*******

*1=   0.26753269D 01
B1=   0.15784961D 00
C1=   0.12044303D 01
D1=   0.67214063D-01
E1=   0.50176146D 00
F1=   0.29390491D 00
A2=   0.17962410D-01
B2=   0.42369429D-03
C2=   0.21564902D-02
D2=  -0.32113129D-03
E2=  -0.10496416D-01
F2=   0.36659589D-02
A3=   0.44258771D-02
B3=  -0.28025827D-02
C3=   0.12327554D-01
D3=   0.12790807D-02
E3=   0.66331610D-02
F3=  -0.01251574D-02
A4=   0.57064827D 00
B4=  -0.16177481D 01
C4=   0.19518070D 01
D4=   0.55516157D 00
E4=  -0.33519449D 01
F4=   0.65253193D 01
A5=   0.39941541D 00
B5=  -0.24418858D 00
C5=  -0.23364277D 00
D5=   0.15016849D 01
E5=   0.60220237D 00
F5=  -0.22375351D 01
*3=   0.69605373D-01
B6=   0.10231331D-01
C6=   0.33804943D-01
D6=   0.20768636D-02
E6=   0.59094689D-01
F6=   0.40281597D-01
A7=  -0.58185781D-04
B7=   0.23085070D-03
C7=   0.48594293D-03
D7=   0.39865408D-05
E7=   0.72668446D-03
F7=   0.65552259D-03
A8=  -0.14619678D-03
B8=   0.10950304D-03
C8=   0.17814752D-03
D8=   0.39113977D-04
E8=   0.99310841D-03
F8=   0.42954016D-03
```

```
******* CASE  62*******

*1=   0.29940482D 01
B1=   0.12715944D 00
C1=   0.11126543D 01
D1=   0.72588236D-01
E1=   0.28770546D 00
F1=   0.39926993D 00
A2=   0.18177874D-01
B2=  -0.56103773D-03
C2=  -0.81766602D-03
D2=  -0.19653298D-03
E2=  -0.12510668D-01
F2=   0.76809512D-02
A3=   0.41313220D-02
B3=   0.73032928D-03
C3=   0.12975788D-01
D3=   0.87628039D-03
E3=   0.35510303D-02
F3=  -0.58014621D-02
A4=   0.75124719D 00
B4=  -0.15813291D 01
C4=   0.39658319D 01
D4=   0.62123951D 00
E4=  -0.33587979D 01
F4=   0.68711502D 01
A5=   0.18499790D 01
B5=   0.70228767D-01
C5=  -0.71999378D 00
D5=   0.31590150D 01
E5=  -0.20684340D-01
F5=   0.35339098D 01
*3=   0.90292015D-01
B6=   0.12323045D-01
C6=   0.58597463D-01
D6=   0.30928689D-02
E6=   0.12142132D 00
F6=   0.42652312D-01
A7=  -0.63492831D-04
B7=   0.28106499D-03
C7=   0.10100863D-02
D7=   0.35083787D-04
E7=   0.13424774D-02
F7=   0.57542577D-03
A8=  -0.26896302D-03
B8=   0.19987809D-03
C8=   0.20782562D-03
D8=   0.27372834D-04
E8=   0.21802978D-02
F8=   0.92703479D-03
```

```
****** CASE 63******

*1=   0.46507446D 01
B1=   0.18171411D 00
C1=   0.10456315D 01
D1=   0.93755028D-01
E1=   0.91381776D-01
F1=   0.60087102D 00
A2=   0.17644610D-01
B2=   0.89473578D-04
C2=  -0.34119623D-02
D2=  -0.23207077D-03
E2=  -0.13756578D-01
F2=   0.11783027D-01
A3=   0.41949290D-02
B3=   0.39982474D-02
C3=   0.14332491D-01
D3=  -0.18515700D-03
E3=  -0.62933296D-04
F3=  -0.66395618D-02
A4=   0.71610248D 00
B4=  -0.15385680D 01
C4=   0.60051789D 01
D4=   0.37187461D 00
E4=  -0.86524819D 00
F4=   0.55596497D 01
A5=   0.32069459D 01
B5=  -0.38636416D 00
C5=  -0.41807139D 00
D5=   0.32648968D 01
E5=  -0.19540907D 01
F5=   0.12643681D 02
*3=   0.14905279D 00
B6=   0.13425574D-01
C6=   0.80932898D-01
D6=   0.65779836D-02
E6=   0.17267289D 00
F6=   0.54566589D-01
A7=  -0.55957299D-04
B7=   0.30896931D-03
C7=   0.14632158D-02
D7=   0.15443987D-03
E7=   0.18545875D-02
F7=   0.70621154D-03
A8=  -0.38701835D-03
B8=   0.32711074D-03
C8=   0.44697402D-03
D8=   0.44750487D-04
E8=   0.33820837D-02
F8=   0.17872739D-02
```

```
****** CASE 64******

*1=   0.31214218D 01
B1=   0.30941052D 00
C1=   0.38811386D 00
D1=   0.60576045D-01
E1=   0.10401664D 00
F1=   0.25007820D 00
A2=   0.37984670D-02
B2=   0.30425134D-02
C2=  -0.57064328D-02
D2=  -0.17722794D-03
E2=  -0.34174806D-03
F2=  -0.32420271D-05
A3=   0.78272587D-02
B3=  -0.53813229D-02
C3=   0.29430743D-02
D3=   0.54914254D-04
E3=  -0.15854467D-03
F3=  -0.41916171D-03
A4=   0.10344667D 01
B4=  -0.18450499D 01
C4=   0.18701829D 01
D4=  -0.44598136D 00
E4=   0.18100266D 01
F4=   0.39481905D 01
A5=   0.11089956D 01
B5=   0.17202832D 01
C5=  -0.16196865D 01
D5=   0.25254600D 01
E5=  -0.46203061D 00
F5=   0.77002721D 01
*3=   0.54181291D-01
B6=   0.19112768D-01
C6=   0.20640780D-01
D6=   0.41718333D-03
E6=   0.22151796D-02
F6=   0.63217052D-01
A7=  -0.73660116D-04
B7=   0.27099551D-03
C7=   0.44800073D-04
D7=  -0.34306068D-04
E7=   0.10709498D-03
F7=   0.53728379D-03
A8=  -0.62134359D-04
B8=   0.62397945D-04
C8=   0.25169769D-03
D8=   0.77877915D-04
E8=  -0.25249349D-04
F8=   0.40719243D-03
```

****** CASE 65******	
*1=	0.33997014D 01
B1=	0.21061368D 00
C1=	0.30006248D 00
D1=	0.47367607D-01
E1=	0.60252531D-01
F1=	0.50582713D 00
A2=	0.92008816D-02
B2=	0.17561330D-02
C2=	-0.80615818D-02
D2=	-0.33979264D-03
E2=	0.89733168D-03
F2=	0.50404565D-02
A3=	0.79054919D-02
B3=	-0.52918427D-02
C3=	0.23672123D-02
D3=	0.19782311D-02
E3=	-0.31968277D-03
F3=	0.22020993D-02
A4=	0.15973577D 01
B4=	-0.24443697D 01
C4=	0.56975528D 01
D4=	0.79941517D-01
E4=	0.10539090D 01
F4=	0.11053611D 02
A5=	0.18446788D 01
B5=	0.49360450D 01
C5=	-0.23561125D 01
D5=	0.63199671D 00
E5=	-0.38518942D 00
F5=	0.14236831D 02
*3=	0.14745699D 00
B6=	0.19034200D-01
C6=	0.29181082D-01
D6=	-0.21122534D-02
E6=	0.58588013D-02
F6=	0.34003100D-01
A7=	-0.68320268D-04
B7=	0.27492787D-03
C7=	0.21135737D-03
D7=	-0.81258573D-04
E7=	-0.88042839D-04
F7=	0.12355681D-03
A8=	-0.38975297D-04
B8=	0.11847990D-03
C8=	0.33774638D-03
D8=	-0.12963930D-04
E8=	0.13198617D-04
F8=	0.11873593D-03

****** CASE 66******	
*1=	0.51764660D 01
B1=	0.25275494D 00
C1=	0.26773456D 00
D1=	0.54814168D-01
E1=	0.22300388D-01
F1=	0.93869686D 00
A2=	0.39595136D-02
B2=	0.22535552D-02
C2=	-0.96977203D-02
D2=	-0.53529228D-03
E2=	0.32951506D-02
F2=	0.10998000D-01
A3=	0.32105879D-02
B3=	-0.44817622D-02
C3=	0.21992218D-02
D3=	0.41786348D-02
E3=	-0.18733051D-02
F3=	0.63463274D-02
A4=	0.16784049D 01
B4=	-0.30891830D 01
C4=	0.38843560D 01
D4=	0.62896082D 00
E4=	-0.12223621D 01
F4=	0.43456939D 01
A5=	0.29893900D 01
B5=	0.66611065D 01
C5=	-0.28715267D 01
D5=	-0.60557147D 01
E5=	-0.76295557D 00
F5=	0.30037212D 02
*3=	0.31159789D 00
B6=	0.12389772D-01
C6=	0.36306482D-01
D6=	0.61216204D-02
E6=	0.17864143D-01
F6=	-0.50100688D-01
A7=	-0.36989739D-04
B7=	0.11831568D-03
C7=	0.49576372D-03
D7=	0.79119873D-04
E7=	-0.51366949D-03
F7=	-0.39382978D-03
A8=	-0.10570283D-03
B8=	0.25836145D-03
C8=	0.38701912D-03
D8=	-0.35380257D-03
E8=	0.18310785D-03
F8=	-0.61894061D-03

```
****** CASE   67******

*1=   0.19024525D 01
B1=   0.14987484D 00
C1=   0.74081357D 00
D1=   0.39191119D-01
E1=   0.19007439D 00
F1=   0.26019267D 00
A2=   0.96967205D-02
B2=   0.97250173D-03
C2=  -0.33452374D-02
D2=  -0.22943811D-03
E2=  -0.39830530D-02
F2=   0.19836749D-02
A3=   0.44909128D-02
B3=  -0.36559637D-02
C3=   0.56773739D-02
D3=   0.76534233D-03
E3=   0.12222753D-02
F3=  -0.29001594D-02
A4=   0.72990290D 00
B4=  -0.18135072D 01
C4=   0.25561453D 01
D4=   0.35389413D 00
E4=  -0.84800935D 00
F4=   0.92554532D 01
A5=   0.10659465D 01
B5=   0.21440033D 00
C5=  -0.98661892D 00
D5=   0.23516463D 01
E5=  -0.53268126D 00
F5=   0.16955450D 01
*3=   0.35365722D-01
B6=   0.10487650D-01
C6=   0.31323639D-01
D6=  -0.88941644D-04
E6=   0.21485513D-01
F6=   0.47917686D-01
A7=  -0.39458876D-04
B7=   0.15043057D-03
C7=   0.17231089D-03
D7=  -0.24212013D-04
E7=   0.11060091D-03
F7=   0.48025023D-03
A8=  -0.91510398D-04
B8=   0.48045260D-04
C8=   0.22477201D-03
D8=   0.59364078D-04
E8=   0.22883450D-03
F8=   0.21665688D-03
```

```
****** CASE   68******

*1=   0.21675944D 01
B1=   0.99965794D-01
C1=   0.64418295D 00
D1=   0.46209771D-01
E1=   0.50547768D-01
F1=   0.49423734D 00
A2=   0.99113042D-02
B2=   0.18441295D-03
C2=  -0.56567496D-02
D2=  -0.10681960D-03
E2=  -0.33424611D-02
F2=   0.64269861D-02
A3=   0.44114411D-02
B3=  -0.22015114D-02
C3=   0.58209842D-02
D3=   0.15919727D-02
E3=  -0.32563250D-03
F3=  -0.21254272D-02
A4=   0.95759811D 00
B4=  -0.19195932D 01
C4=   0.61703693D 01
D4=   0.58842529D 00
E4=  -0.12768817D 01
F4=   0.93593988D 01
A5=   0.21789411D 01
B5=   0.17456907D 01
C5=  -0.18282392D 01
D5=   0.28882668D 01
E5=  -0.10132405D 01
F5=   0.10892671D 02
*3=   0.62520882D-01
B6=   0.10824499D-01
C6=   0.58642141D-01
D6=  -0.17533169D-02
E6=   0.57400123D-01
F6=   0.35653954D-01
A7=  -0.35580887D-04
B7=   0.16135650D-03
C7=   0.50222599D-03
D7=  -0.53776819D-04
E7=   0.86359245D-04
F7=   0.25781370D-03
A8=  -0.17966624D-03
B8=   0.14800574D-03
C8=   0.34381109D-03
D8=   0.29011742D-04
E8=   0.58589292D-03
F8=   0.24945055D-03
```

***** CASE 69******

*1=	0.37050216D 01
B1=	0.17089588D 00
C1=	0.61437732D 00
D1=	0.66529581D-01
E1=	-0.83132508D-01
F1=	0.82842497D 00
A2=	0.95747000D-02
B2=	0.92786114D-03
C2=	-0.71750264D-02
D2=	-0.11990317D-03
E2=	-0.27121864D-02
F2=	0.10726605D-01
A3=	0.44867935D-02
B3=	-0.44061289D-03
C3=	0.67388688D-02
D3=	0.23160049D-02
E3=	-0.23354329D-02
F3=	-0.20801350D-02
A4=	0.81449775D 00
B4=	-0.20415654D 01
C4=	0.92745953D 01
D4=	0.35305149D 00
E4=	-0.31649387D 00
F4=	0.30296447D 01
A5=	0.39601769D 01
B5=	0.20016633D 01
C5=	-0.18696520D 01
D5=	0.11150958D 01
E5=	-0.27508872D 01
F5=	0.28554042D 02
*3=	0.10402002D 00
B6=	0.87769476D-02
C6=	0.93031358D-01
D6=	0.95578966D-03
E6=	0.10467522D 00
F6=	0.81409043D-02
A7=	-0.19125021D-04
B7=	0.11525699D-03
C7=	0.96027438D-03
D7=	0.52804254D-05
E7=	-0.31573226D-04
F7=	-0.17639049D-03
A8=	-0.29998509D-03
B8=	0.35503339D-03
C8=	0.56541183D-03
D8=	-0.75453189D-04
E8=	0.13759604D-02
F8=	0.49020324D-03

****** CASE 70******

*1=	0.16654484D 01
B1=	0.99219206D-01
C1=	0.11946762D 01
D1=	0.36248919D-01
E1=	0.46066493D 00
F1=	0.25187080D 00
A2=	0.10001571D-01
B2=	0.27114902D-03
C2=	0.10798393D-02
D2=	-0.17309287D-03
E2=	-0.62967464D-02
F2=	0.22692043D-02
A3=	0.22773133D-02
B3=	-0.19642862D-02
C3=	0.68770398D-02
D3=	0.60659678D-03
E3=	0.38397692D-02
F3=	-0.42401066D-02
A4=	0.64565857D 00
B4=	-0.18063193D 01
C4=	0.22669798D 01
D4=	0.69582033D 00
E4=	-0.37379429D 01
F4=	0.72451471D 01
A5=	0.92842208D 00
B5=	-0.18233896D 00
C5=	-0.40299138D 00
D5=	0.16881338D 01
E5=	0.59584659D 00
F5=	-0.24647280D 01
*3=	0.31903013D-01
B6=	0.82062859D-02
C6=	0.33284403D-01
D6=	0.92505050D-03
E6=	0.53631767D-01
F6=	0.33886391D-01
A7=	-0.31521718D-04
B7=	0.11185336D-03
C7=	0.25042218D-03
D7=	-0.83135904D-06
E7=	0.34117071D-03
F7=	0.33749402D-03
A8=	-0.83646660D-04
B8=	0.54646650D-04
C8=	0.57296761D-04
D8=	0.27244794D-04
E8=	0.51918408D-03
F8=	0.21329193D-03

```
****** CASE  71******

*1=   0.19649060D 01
B1=   0.75638390D-01
C1=   0.11425510D 01
D1=   0.46598997D-01
E1=   0.23293777D 00
F1=   0.41418993D 00
A2=   0.10112947D-01
B2=  -0.18541689D-03
C2=  -0.36182099D-03
D2=  -0.29276103D-04
E2=  -0.75426277D-02
F2=   0.51828352D-02
A3=   0.19386664D-02
B3=   0.32650811D-03
C3=   0.77059099D-02
D3=   0.73677575D-03
E3=   0.20779644D-02
F3=  -0.38708180D-02
A4=   0.74033768D 00
B4=  -0.17500463D 01
C4=   0.45166306D 01
D4=   0.74654232D 00
E4=  -0.42127752D 01
F4=   0.77149532D 01
A5=   0.19819289D 01
B5=   0.29386637D 00
C5=  -0.90254460D 00
D5=   0.35595417D 01
E5=   0.68629990D-01
F5=   0.34119341D 01
*3=   0.42260391D-01
B6=   0.98819103D-02
C6=   0.59924773D-01
D6=   0.17708630D-02
E6=   0.11706573D 00
F6=   0.31609335D-01
A7=  -0.35889432D-04
B7=   0.13278316D-03
C7=   0.56351325D-03
D7=   0.15838972D-04
E7=   0.66837376D-03
F7=   0.25452457D-03
A8=  -0.15916553D-03
B8=   0.12442947D-03
C8=   0.67864260D-06
D8=   0.28277771D-04
E8=   0.11859384D-02
F8=   0.49614069D-03
```

```
****** CASE  72******

*1=   0.35066601D 01
B1=   0.16654432D 00
C1=   0.11809193D 01
D1=   0.70047182D-01
E1=   0.48906344D-01
F1=   0.67801282D 00
A2=   0.97102868D-02
B2=   0.80025502D-03
C2=  -0.81721344D-03
D2=  -0.12481804D-04
E2=  -0.88689237D-02
F2=   0.77599715D-02
A3=   0.15745450D-02
B3=   0.28533722D-02
C3=   0.96060027D-02
D3=   0.73356930D-03
E3=   0.55726913D-03
F3=  -0.39976735D-02
A4=   0.60065767D 00
B4=  -0.16723622D 01
C4=   0.60251554D 01
D4=   0.25392305D 00
E4=  -0.27401729D 01
F4=   0.60948805D 01
A5=   0.32209444D 01
B5=  -0.40035236D 00
C5=  -0.20441162D 00
D5=   0.34087427D 01
E5=  -0.12771276D 01
F5=   0.10799710D 02
*3=   0.65630224D-01
B6=   0.96251443D-02
C6=   0.63466996D-01
D6=   0.45435265D-02
E6=   0.14498090D 00
F6=   0.36903724D-01
A7=  -0.33025626D-04
B7=   0.12157422D-03
C7=   0.61371618D-03
D7=   0.75844826D-04
E7=   0.92353145D-03
F7=   0.32666437D-03
A8=  -0.18858971D-03
B8=   0.15354012D-03
C8=  -0.56551499D-04
D8=   0.60535308D-04
E8=   0.16065008D-02
F8=   0.93958303D-03
```