OPTIMAL DESIGN OF MODERATE THICK LAMINATED COMPOSITE PLATES UNDER STATIC CONSTRAINTS USING REAL CODING GENETIC ALGORITHM

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ABSTRACT

The objective of the current research is to find an optimum design of hybrid laminated moderate thick composite plates with static constraint.

The stacking sequence and ply angle is required for optimization to achieve minimum deflection for hybrid laminated composite plates consist of glass and carbon long fibers reinforcements that impeded in epoxy matrix with known plates dimension and loading. The analysis of plate is by adopting the first-order shear deformation theory and using Navier's solution with Genetic Algorithm to approach the current objective. A program written with MATLAB to find best stacking sequence and ply angles that give minimum deflection, and the results comparing with ANSYS.

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Navier .   MATLAB

ANSYS.

Keywords: optimization, moderate thick plates, genetic algorithms, Navier's solution

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1.INTRODUCTION

Structural optimization is a process by which the optimum design is aimed while satisfying all the defined constraints. In recent years, using of moderate thick hybrid laminated composite materials in fabrication of mechanical, airspace, marine and machine industries are of major concern, due to their high strength and light weight. The design variables could be stacking sequence, orientation, thickness and other design variables. The evolutionary optimization technique such as genetic algorithms is easier and reduces searching and solving time of optimization problem. The use of real coding genetic algorithm is easier to deal with than binary encoding and faster and it's used in this paper to find optima stacking sequence and ply angles of hybrid moderate thick laminated composite plates. The use of first order shear deformation theory in the analysis of moderate thick plates is widely used and acceptable as a very good solution from many authors and researchers, so it's used with modified genetic algorithms to find the objective of this research.

At (**1981 Stround, S. et al**)., developed a programming solution using Fortran77 based on linear programming to find the optimal design for composite laminates for buckling constraints. There is many researchers study the study of optimization of composite plates, (**Kim, S. J. and Goo, N. S. 1992**), studied the use of Fuzzy Environment to find optimal design of laminated composite plates. There goal was minimize weight design for composite laminate plates. At (**1993 Kam, T. Y**.) et al. published their paper that deals with dynamic programming with finite element method to find the optimum aspect ratio for laminated composite plates that give maximum stiffness and low weight and find the natural frequencies for the plates. At (**2007, Paluch, B. et al**), combine finite element method with genetic algorithm to optimize composite hybrid moderate thick and thick structures with variable thickness. (**Apalak, M. Kamel et al 2007**), studied layer optimization and stacking sequence using a model of hybrid artificial intelligence method based on a genetic algorithm foundation and accelerated by use artificial neural network with use finite element method as a evaluation technique to find maximum fundamental frequency. They also made a numerical sequence to optimize layer sequences for maximum fundamental frequency using

genetic algorithm with evaluation technique that Ritz-based layerwize.

2.MECHANICS OF MODERATE THICK LAMINATED PLATES

The static analyses of orthotropic plates have been topics of continued interest; a variety of analytical and discrete mathematical models based on different theories have been proposed. Generally, the models are based on classical plate theory in which plane sections remain plane and normal to the midsurface after deformation, and first order shear theory which includes the transverse shear deformation. The classical plate theory can be regarded as a special case of the first order shear theory. According to both theories, the displacements, $u(x,y,z), v(x,y,z)$ and $w(x,y,z)$, at an arbitrary point in the plate can be represented as functions of midsurface displacements and angular rotations

$$u(x,y,z) = u^o(x,y) + z\Psi_x(x,y)$$
$$v(x,y,z) = v^o(x,y) + z\Psi_y(x,y) \qquad (1)$$
$$w(x,y,z) = w^o(x,y)$$

It is well known that when the aspect ratio of the plate increases, the applicability of the classical plate theory becomes questionable. If, in addition, the plate material is with the magnitude of the transverse shear, the inadequacy of the classical plate theory is even more pronounced (**Ten, K. K. et al 1983**).

As before the analysis of plates using classical laminated plate theory (CLPT) use for thin plate. The define of thin plates is not unique. There's a different standards use by researcher of different countries based on academic relations and actual needs of those countries, but the major characteristic that use to define thin or thick plates is the aspect ratio. This research use the scale of Dr. J. N. Reddy that consider aspect ratio over $(1/50)$ is thin plate, aspect ratio less than $(1/20)$ is thick plate and in between is so called moderate thick plate which is in this subject is used and studied.

In the First–order Shear Deformation plate Theory (FSDT), the Kirchhoff hypothesis is relaxed by assume that the transverse normal do not remain perpendicular to the midsurface after deformation(**Reddy, J. N. 2004**). This amount to including transverse shear strains in the theory.

Under the same and restrictions as in the classical laminate theory, the displacement field of the first-order theory is

$$u(x, y, z) = u^o(x, y) + z\Phi_x(x, y)$$

$$v(x, y, z) = v^o(x, y) + z\Phi_y(x, y) \tag{2}$$

$$w(x, y, z) = w^o(x, y)$$

Where $(u^o, v^o, w^o, \Phi_x, \Phi_y)$ are unknown function to be determined, and (u^o, v^o, w^o) are denote the displacements of a point on plane $z = 0$, and

$$\Phi_x = \frac{\partial u}{\partial z}$$

$$\Phi_y = \frac{\partial v}{\partial z} \tag{3}$$

Which indicate that Φ_x and Φ_y are the rotation of a transverse normal about the y and x axis respectively.

Constitutive equations are that relate the force and moment resultants to the strain of laminate.

First, the resultants direct forces (not transverse) acting on a laminate are obtained by integration of the stresses in each layer of lamina through the laminate thickness.

As before

$$[N] = \sum_{k=1}^{n} \int_{z_k}^{z_{k+1}} [\sigma]\, dz \tag{4}$$

Direct stresses made of direct and bending loads so

$$\begin{bmatrix} N_x \\ N_y \\ N_z \end{bmatrix} = \sum_{k=1}^{n} \int_{z_k}^{z_{k+1}} \begin{bmatrix} \overline{Q}_{11} & \overline{Q}_{12} & \overline{Q}_{16} \\ \overline{Q}_{12} & \overline{Q}_{22} & \overline{Q}_{26} \\ \overline{Q}_{16} & \overline{Q}_{26} & \overline{Q}_{66} \end{bmatrix}^{(k)} \begin{bmatrix} \varepsilon_x^{(0)} + z\varepsilon_x^{(1)} \\ \varepsilon_y^{(0)} + z\varepsilon_y^{(1)} \\ \gamma_{xy}^{(0)} + z\gamma_{xy}^{(1)} \end{bmatrix} dz \tag{5}$$

Or in other words

$$\begin{bmatrix} N_x \\ N_y \\ N_z \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{16} \\ A_{12} & A_{22} & A_{26} \\ A_{16} & A_{26} & A_{66} \end{bmatrix} \begin{bmatrix} \varepsilon_x^{(0)} \\ \varepsilon_y^{(0)} \\ \gamma_{xy}^{(0)} \end{bmatrix} + \begin{bmatrix} B_{11} & B_{12} & B_{16} \\ B_{12} & B_{22} & B_{26} \\ B_{16} & B_{26} & B_{66} \end{bmatrix} \begin{bmatrix} \varepsilon_x^{(1)} \\ \varepsilon_y^{(1)} \\ \gamma_{xy}^{(1)} \end{bmatrix} \tag{6}$$

Where $\varepsilon^{(0)}$ and $\varepsilon^{(1)}$ are vectors of the membrane and bending strains

$$\begin{bmatrix} \varepsilon_x^{(1)} \\ \varepsilon_y^{(1)} \\ \gamma_{xy}^{(1)} \end{bmatrix} = \begin{bmatrix} \dfrac{\partial \Phi_x}{\partial x} \\ \dfrac{\partial \Phi_y}{\partial y} \\ \dfrac{\partial \Phi_x}{\partial y} + \dfrac{\partial \Phi_y}{\partial x} \end{bmatrix} \tag{7}$$

For moments it is not different from above so

$$\begin{bmatrix} M_x \\ M_y \\ M_{xy} \end{bmatrix} = \sum_{k=1}^{n} \int_{z_k}^{z_{k+1}} \begin{bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{bmatrix} z\, dz \tag{8}$$

$$\begin{bmatrix} M_x \\ M_y \\ M_{xy} \end{bmatrix} = \sum_{k=1}^{n} \int_{z_k}^{z_{k+1}} \begin{bmatrix} \overline{Q}_{11} & \overline{Q}_{12} & \overline{Q}_{16} \\ \overline{Q}_{12} & \overline{Q}_{22} & \overline{Q}_{26} \\ \overline{Q}_{16} & \overline{Q}_{26} & \overline{Q}_{66} \end{bmatrix}^{(k)} \begin{bmatrix} \varepsilon_x^{(0)} + z\varepsilon_x^{(1)} \\ \varepsilon_y^{(0)} + z\varepsilon_y^{(1)} \\ \gamma_{xy}^{(0)} + z\gamma_{xy}^{(1)} \end{bmatrix} z\, dz \tag{9}$$

$$\begin{bmatrix} M_x \\ M_y \\ M_{xy} \end{bmatrix} = \begin{bmatrix} B_{11} & B_{12} & B_{16} \\ B_{12} & B_{22} & B_{26} \\ B_{16} & B_{26} & B_{66} \end{bmatrix} \begin{bmatrix} \varepsilon_x^{(0)} \\ \varepsilon_y^{(0)} \\ \gamma_{xy}^{(0)} \end{bmatrix} + \begin{bmatrix} D_{11} & D_{12} & D_{16} \\ D_{12} & D_{22} & D_{26} \\ D_{16} & D_{26} & D_{66} \end{bmatrix} \begin{bmatrix} \varepsilon_x^{(1)} \\ \varepsilon_y^{(1)} \\ \gamma_{xy}^{(1)} \end{bmatrix} \tag{10}$$

A_{ij} is called extensional stiffness matrix, B_{ij} the bending-extensional coupling stiffness matrix and D_{ij} is bending stiffness matrix.

A_{ij}, B_{ij} and D_{ij} matrices can be written as

$$A_{ij} = \sum_{k=1}^{n} \overline{Q}_{ij}^{(k)} (z_{k+1} - z_k)$$

$$B_{ij} = \frac{1}{2} \sum_{k=1}^{n} \overline{Q}_{ij}^{(k)} (z^2_{k+1} - z_k^2) \tag{11}$$

$$D_{ij} = \frac{1}{3} \sum_{k=1}^{n} \overline{Q}_{ij}^{(k)} (z^3_{k+1} - z_k^3)$$

Now equations (6) and (11) can be written in a compact form as

$$\begin{bmatrix} [N] \\ [M] \end{bmatrix} = \begin{bmatrix} [A] & [B] \\ [B] & [D] \end{bmatrix} \begin{bmatrix} [\varepsilon^{(0)}] \\ [\varepsilon^{(1)}] \end{bmatrix} \tag{12}$$

And the transverse force resultant across the lamina of thickness (h) be as

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$$\begin{bmatrix} Q_x \\ Q_y \end{bmatrix} = \int_{-\frac{h}{2}}^{\frac{h}{2}} \begin{bmatrix} \tau_{xz} \\ \tau_{yz} \end{bmatrix} dz \qquad (13)$$

Since the transverse shear strains are represented as constant through the laminate thickness, it follows that the transverse shear stresses will also be constant. In composite laminated plates, the transverse shear stresses vary at least quadratically through layer thickness. This discrepancy between the actual stress state and the constant stress state predicted by the (FSDT) is often corrected in computing the transverse shear force resultants (Q_x, Q_y) by multiplying the integrals in equation (14) with a parameter K, called shear correction coefficient, so

$$\begin{bmatrix} Q_x \\ Q_y \end{bmatrix} = K \int_{-\frac{h}{2}}^{\frac{h}{2}} \begin{bmatrix} \tau_{xz} \\ \tau_{yz} \end{bmatrix} dz \qquad (14)$$

These amounts to modifying the plate transverse shear stiffness. The factor K is computed such that the strain energy due to transverse shear stresses in equation (15) equals the strain energy due to the true transverse stresses predicted by the three-dimensional elasticity theory (Reddy, J. N. 2004).

The constitutive equation for transverse shear forces be

$$\begin{bmatrix} Q_x \\ Q_y \end{bmatrix} = K \begin{bmatrix} A_{44} & A_{45} \\ A_{45} & A_{55} \end{bmatrix} \begin{bmatrix} \dfrac{\partial w_o}{\partial y} + \Phi_y \\ \dfrac{\partial w_o}{\partial x} + \Phi_x \end{bmatrix} \qquad (15)$$

3.ANALYSIS OF MODERATE THICK PLATES

The case that used here is simply supported plates with constraint load in the middle, and the objective is to find the best design that give minimum value of deflection.

Navier present a solution of bending of simply supported plates by double trigonometric series **(Ventsel, Edward et al 2001).**

The aim of this section is develop analytical solution of rectangular laminates using (FSDT) using Navier solution and that analysis, what is used in this research.

For simply supported laminated plate with (FSDT) analysis and had $a*b$ area **Fig.(1)**, the boundary conditions be

$$u_o(x,0) = 0 \qquad\qquad N_x(0,y) = 0$$
$$u_o(x,b) = 0 \qquad\qquad N_x(a,y) = 0$$

$$v_o(0,y) = 0 \qquad\qquad N_y(x,0) = 0$$
$$v_o(a,y) = 0 \qquad\qquad N_y(x,b) = 0$$
$$w_o(x,0) = 0 \qquad\qquad M_x(0,y) = 0$$
$$w_o(x,b) = 0 \qquad\qquad M_x(a,y) = 0$$
$$w_o(0,y) = 0 \qquad\qquad M_y(x,0) = 0$$
$$w_o(a,y) = 0 \qquad\qquad M_y(x,b) = 0$$
$$\Phi_x(x,0) = 0$$
$$\Phi_x(x,b) = 0$$
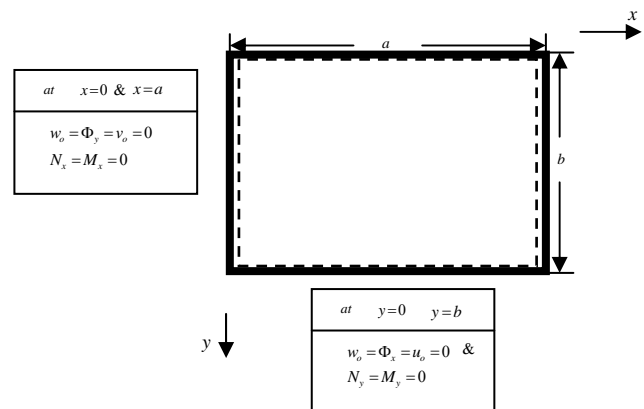$$\Phi_y(0,y) = 0 \qquad\qquad \Phi_y(a,b) = 0$$

Fig. (1) Simply supported boundary conditions for laminated plate using FSDT

The boundary condition above are satisfied by the following excretions

$$u_o(x,y) = \sum_{n=1}^{\infty}\sum_{m=1}^{\infty} U_{mn} \cos\alpha x \sin\beta y$$

$$v_o(x,y) = \sum_{n=1}^{\infty}\sum_{m=1}^{\infty} V_{mn} \sin\alpha x \cos\beta y$$

$$w_o(x,y) = \sum_{n=1}^{\infty}\sum_{m=1}^{\infty} W_{mn} \sin\alpha x \sin\beta y$$

$$\Phi_x(x,y) = \sum_{n=1}^{\infty}\sum_{m=1}^{\infty} X_{mn} \cos\alpha x \sin\beta y$$

$$\Phi_y(x,y) = \sum_{n=1}^{\infty}\sum_{m=1}^{\infty} Y_{mn} \sin\alpha x \cos\beta y \qquad (17)$$

Where $\alpha = m\pi/a$ and $\beta = n\pi/b$

The mechanical load are also expanded in double Fourier sine series

$$q(x, y) = \sum_{n=1}^{\infty} \sum_{m=1}^{\infty} Q_{mn} \sin \alpha x \sin \beta y \qquad (18)$$

Where

$$Q_{mn}(t) = \frac{4}{ab} \int_0^a \int_0^b q(x, y) \sin \alpha x \sin \beta y \ dxdy \quad (19)$$

The final form express as

$$
\begin{bmatrix}
\hat{S}_{11} & \hat{S}_{12} & 0 & \hat{S}_{14} & \hat{S}_{15} \\
\hat{S}_{12} & \hat{S}_{22} & 0 & \hat{S}_{24} & \hat{S}_{25} \\
0 & 0 & \hat{S}_{33} & \hat{S}_{34} & \hat{S}_{35} \\
\hat{S}_{14} & \hat{S}_{24} & \hat{S}_{34} & \hat{S}_{44} & \hat{S}_{45} \\
\hat{S}_{15} & \hat{S}_{25} & \hat{S}_{35} & \hat{S}_{45} & \hat{S}_{55}
\end{bmatrix}
\begin{bmatrix}
U_{mn} \\ V_{mn} \\ W_{mn} \\ X_{mn} \\ Y_{mn}
\end{bmatrix}
=
\begin{bmatrix}
0 \\ 0 \\ Q_{mn} \\ 0 \\ 0
\end{bmatrix}
\quad (20)
$$

Where $\hat{S}_{ij}$ matrix is

$$\hat{S}_{11} = (A_{11}\alpha^2 + A_{66}\beta^2)$$

$$\hat{S}_{12} = (A_{12} + A_{66})\alpha\beta$$

$$\hat{S}_{14} = (B_{11}\alpha^2 + B_{66}\beta^2)$$

$$\hat{S}_{15} = (B_{12} + B_{66})\alpha\beta$$

$$\hat{S}_{22} = (A_{66}\alpha^2 + A_{22}\beta^2)$$

$$\hat{S}_{24} = \hat{S}_{15}$$

$$\hat{S}_{25} = (B_{66}\alpha^2 + B_{22}\beta^2)$$

$$\hat{S}_{33} = K(A_{55}\alpha^2 + A_{44}\beta^2)$$

$$\hat{S}_{34} = KA_{55}\alpha^2$$

$$\hat{S}_{35} = KA_{44}\beta$$

$$(21)$$

$$\hat{S}_{44} = (D_{11}\alpha^2 + D_{66}\beta^2 + KA_{55})$$

$$\hat{S}_{45} = (D_{12} + D_{66})\alpha\beta$$

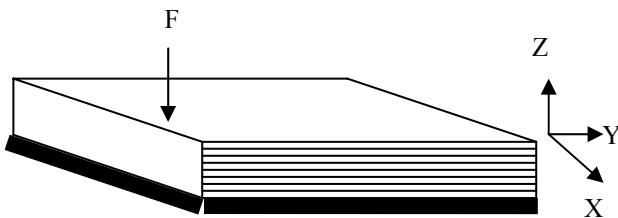$$\hat{S}_{55} = (D_{66}\alpha^2 + D_{22}\beta^2 + KA_{44})$$

Fig. (2) Simply supported plate

4.GENETIC ALGORTHIM

Genetic algorithms are search and optimization algorithms that mimic the process of natural evolution, unlike conventional algorithms (Tabakov, P. Y. 2004), Genetic algorithms start from population of strings, each representing a solution in the search space. Moreover, there is no need of any derivative information and there is no requirement in terms of convexity of the search space. An evaluation function rates each string according to some kind of fitness measure. Starting from a population of strings, the successive application of so-called genetic operators (Crossover, mutation and reproduction, generates new populations. The search is performed, in such way that the best strings have increasing portability of being present, in the next generation. The algorithms stop at the end of the prescribed numbers of generations. The risk of the algorithms being trapped in a local minimal, since the research performed from a pool of points. In spite of using probabilistic transitional rule to perform the search, Genetic algorithms are distinct from a simple random walk, since the information embodied in the most successful strings, is passed to future generations.

The basic requirements for building Genetic algorithms are:
1. Encoding Technique
2. Evaluation Function
3. Initialization Procedure
4. Genetic Operators

Encoding Technique

The coding technique that used in this research is real coding, so it's used two kinds of fiber reinforcement, glass-fibers and carbon-fibers, embedded in polyester resin. The stacking sequence and ply angles are required. The material reinforcement types has the coding value (0 refers to glass-fiber and 1 refers to carbon-fibers) and ply angle for each laminate is vary from 0 to 180. The real coding of ply angle was done by putting the same real values of angles, and that making checking and evaluation easier.

A chromosomes made of material-ply angle sequence are selected from population. The case here taking as 8 (symmetry and unbalanced) stacking laminates, for example:

1	25	0	90	1	132	1	66

Evaluation Function

A function made from combining first-order shear deformation theory and Navier's solution is used as evaluation function. The case that taken in Navier's solution is concentrated load as said before.

Initialization Procedure

Genetic algorithm requires an initial population. This population is randomly

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generated, and in the present work, its just random generation of bit strings.

Genetic Operators

The exploration of the search space is done through the successive application of the genetic operators. The most usual operators are crossover, mutation and reproduction.

Crossover

Crossover is one of the most important ways by which a genetic algorithm shuffles the information contained in the gene pool, in order to generate new chromosomes, i.e., new points in the search space. For example lets there are two chromosomes Selected randomly from the population, and the bit in between the two are randomly selected points in each strings, are swapped. That show below

1	25	0	90	1	132	1	66
0	156	1	22	1	12	0	45

The crossover operation here is by transfer some of bits between string 1 and 2, so let us transfer bits from bit 1 to bit 4. The new genes that generate is shown below

0	156	1	22	1	132	1	66

1	25	0	90	1	12	0	45

Mutation

The mutation operator selects a random position in the strings, and with a given probability, changes the corresponding bit. For example, the string that shows below

1	25	0	90	1	12	0	45

Be after mutation as in bit 5

1	25	0	90	0	12	0	45

As the search proceeds through the generations, the less fit members of the population are discarded. Thus, mutation prevents that some information is permanently lost. This occasional random change in the strings assures that new regions of the search space are explored, which

could not be done exclusively with crossover and reproduction.

Reproduction

The strings for the next generation mating pool are copied with probability proportional to their fitness value. In the present case, let us consider four strings, representing different solution to the problem; the fitness value is evaluated through Navier's solution that based on first-order shear deformation theory.

In order to minimize the objective function, these solutions are ranked in suck way that, the best solution has the highest rank. Thus, the probabilities of each these strings being present in the next generation are, respectively, the ratio of the individual rank the sum of the ranks **(Brighenti, Roberto 2001)**. **Fig. (3)** Show structure of G.A.
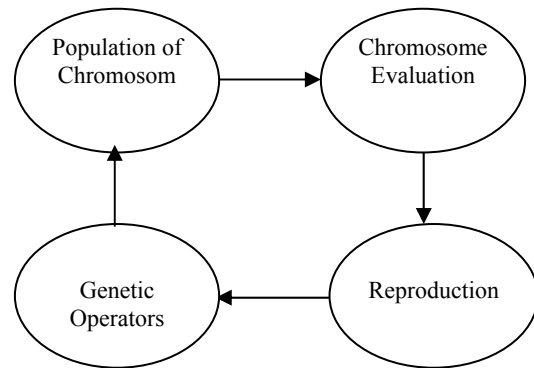

Fig. (3) Presents the general GA structure

5.THE PROGRAMING AND FINAL RESULT

Using MATLAP® version 7.4 to programming genetic algorithm program that use roulette wheel selection technique with real coding to reduce operation time, and with computer its hardware are: 2.4 gigabyte, 256 kilobyte cash processor, 1024 DDR1, bus 400 ram, Motherboard Gigabite SIS 651 and 80 gigabyte hard, and as said before the evaluation technique based on Navier's solution of FSDT (The window of programs shown in Fig. (4), and the flow chart of the program show in Fig. (5).
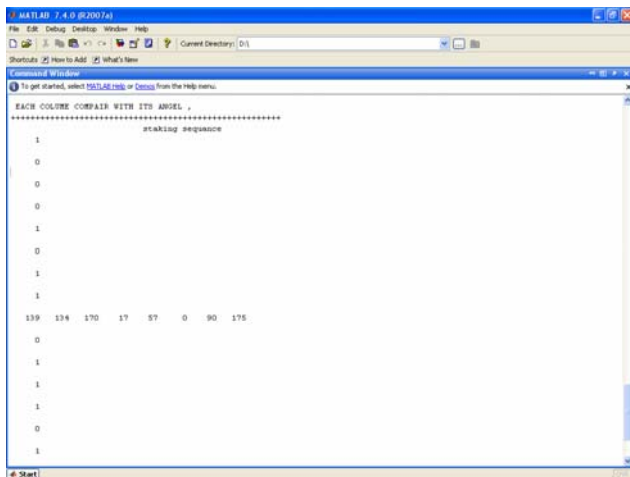
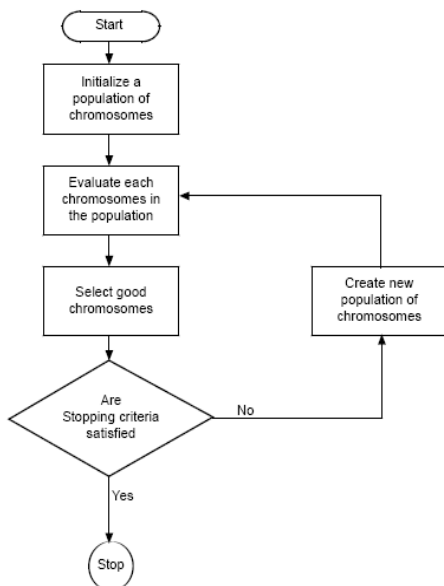**Fig. (4)** MATLAP® Window that show the solution

Fig. (5) Flow chart of G.A. program

For example use 500 Newton central load for simply supported moderate thick plate, and with the use laminates of epoxy-carbon fiber(see **Table1** and **Table2** for mechanical properties), and epoxy-glass fiber, taking there mechanical properties from [COMPOSITE MATERIALS HANDBOOK]that Published by Department of Defense, USA.]

Table (1) Show the properties of carbon-epoxy

$E_x(N/m^2)$	$E_y(N/m^2)$	$E_z(N/m^2)$	V_{12}	V_{23}	V_{31}	$G_{12}(N/m^2)$	$G_{23}(N/m^2)$	$G_{31}(N/m^2)$
181e9	10.3e9	10.3e9	0.3	0.29	0.28	7.17e9	7.17e9	10.1e9

Table (2) Show the properties of glass-epoxy

$E_x(N/m^2)$	$E_y(N/m^2)$	$E_z(N/m^2)$	V_{12}	V_{23}	V_{31}	$G_{12}(N/m^2)$	$G_{23}(N/m^2)$	$G_{31}(N/m^2)$
38.6e9	8.27e9	8.27e9	0.3	0.28	0.28	5.59e9	4.11e9	4.14e9

The final result is shown below for 8 unsymmetrical unbalanced plates.

1	139	0	90	0	75	0	149	1	57	0	7	1	90	1	175

and its deflection (Evaluation) 0.8072e-009 meter. **Fig. (6)** show minimization operation with genetic algorithm
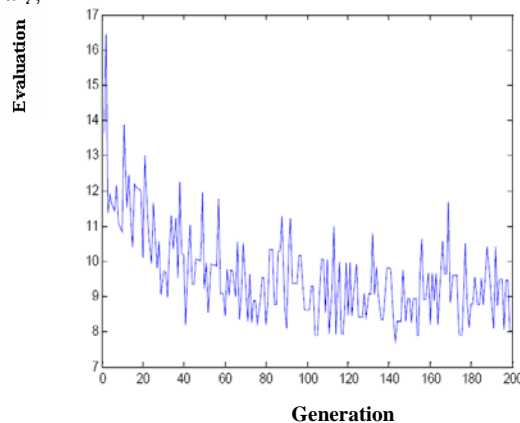

Fig. (6) Minimization operation with genetic algorithm

Using Finite element program *ANSYS* ® version 11.0 (**Fig.(7)**) for simulation of solution and comparing. **Table (3)** and **(4)** show eight cases of solution for six difference loads
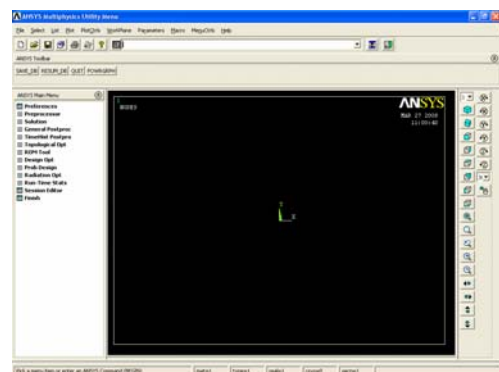

Fig. (7) ANSYS® Window that show the solution

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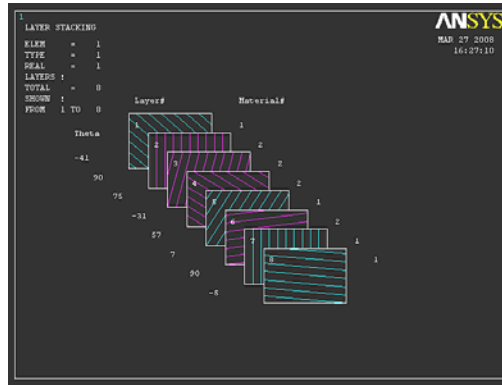USING REAL CODING GENETIC ALGORITHM

Fig. (8) ANSYS representation of the plate (the example**)**

The ANSYS resultant (Fig.(8)) is .78e-9 meter and its give a difference about .0372 from MATLAP program and that about 4%.

Table (3) Final results for some of cases (loads)

Load Value (N)	Load Condition	Area (cm²)	Number of Stacking Laminate	G.A Best Displacement w(m)	ANSYS Test W(m)
1000	Central Load	225	8	1.3660 e-10	1.330 e-10
3000	-	-	-	4.0975 e-10	4.10 e-10
6000	-	-	-	8.1924 e-10	7.598 e-10
9000	-	-	-	1.2293 e-9	1.009 e-9
12000	-	-	-	1.5246 e-9	1.4e-9
15000	-	-	-	1.9057 e-9	2.02e-9
18000	-	-	-	2.4588 e-9	2.28 e-9
21000	-	-	-	2.6691 e-9	2.805 e-9

Table (4) Final results for some of cases (stacking sequence and angles)

loading	Material sequence								Angles							
1000	1	1	1	1	0	0	1	1	118	139	21	0	96	66	107	101
3000	1	1	1	0	1	0	1	1	141	68	142	52	40	37	123	145
6000	1	1	0	1	1	1	0	1	94	8	86	23	140	87	175	105
9000	1	1	1	0	1	1	0	1	6	8	48	19	95	100	72	177
12000	1	1	1	1	1	0	1	1	134	155	128	63	71	76	65	60
15000	1	1	1	1	1	0	1	1	64	102	136	160	108	11	70	98
18000	1	1	0	1	1	0	1	1	108	60	160	137	147	155	52	136
21000	1	1	1	1	1	0	1	1	168	131	126	147	162	101	112	171

6.DISCUSSION

It can be seen in **Fig.(6)**[as example] that the instability of evaluation of real coding genetic algorithm, an that notice by many authors and researchers like, M. Kemal Apalak et al., Mohammed Reza and Zafer Gurdal et al, but the real coding G.A. more quicker than binary coding so it's widely used. The analysis done by using data taking from [COMPOSITE MATERIALS HANDBOOK] that Published by Department of Defense, USA. The time that taking from GA program is about 7 hours according to hardware that used and that time depend on number of variables and the population of the case to e study. Another computer used to apply GA program and its hardware specification are: 2.2 Dual Core LGA processor and 2 gigabyte, DDR2, bus 800MHz, Mainboard 965 Intel chipset, hard SATAII 200 Gigabyte and that reduce time of working to 9 hours and then using 3.6 Dual core LGA processor and the same previous hardware it improve time saving so that it take 4 hours to do the process. The analysis of plates comparing with ANSYS shows a good match for the analysis of plates (about 4% and less difference).

7.CONCLUSIONS

It can be seen in Table (3) and (4) the final results of central loads for simply supported composite plates, and the final results gives the minimum deflection that can be found and design of laminated plates (stacking sequence and ply angle).The use of genetic algorithms is so effective than other methods of optimization, but the classical genetic algorithms more slow, so modifying GA to real coding strategy be more efficient and fast. Programming of GA is more suitable for many purposes, and form of functions than GA tool box that built in MATLAB but it is slower in finding solution, but the benefit of Varity of Evaluation function for classic programming making it more common. Using ANSYS to analyzed and optimized plates show a god approach in results. Most of authors used symmetric and balanced plates to reduce the population, but the final result be guided by their choices, here, in this research, the use of angles (0 to 180) make more chances to approach the best solution to have the requirements.

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List of Symbols

a	Height of Plate	m
b	Width of Plate	m
E	Young's modulus	N/m^2
K	Shear correction factor	unit less
N	Force	N
M	moment	N.m
S_{ij}	Compliance matrix	unit less
Q	Shear force	N
u	Deflection in x direction	m
v	Deflection in y direction	m
w	Deflection perpendicular to the plate(z direction)	m
$\varepsilon^{(0)}$	Vectors of the membrane strain	unit less
$\varepsilon^{(1)}$	Bending strains	unit less
σ	stress	N/m^2