الآيـــة

قال تعالى :

﴿ أَلَمْ يَرَوْا إِلَى الطَّيْرِ
مُسَخَّرَاتٍ فِي جَوِّ السَّمَاءِ مَا يُمْسِكُهُنَّ
إِلَّا اللَّهُ إِنَّ فِي ذَلِكَ لَآيَات
لِقَوْمٍ يُؤْمِنُونَ ﴾

سورة النحل {79}

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To every person gave us something to light our pathway, we thank them for believing in us.

Dedication

Our Teachers & Parents
Our Classmates & Families
With our Love & Respect

ABSTRACT:

Wing structure consists of skin, ribs and spars sections. The spars carries flight load and the weight of the wings while on the ground. Other structural and forming members such as ribs are attached to the spars, with stressed skin .The wings are the most important lift producing part of the aircraft. The design of wings may vary according to the type of aircraft and its purpose .Experimental testing of wing structure is more expensive and time consuming process. In the present study, both aerodynamic and structural design and analysis of a light aircraft wing are covered .The aerodynamic analysis is achieved by using Schrenk's Approximation Method simulated in MATLAB. In addition, finite element software package MSC/NASTRAN/PATRAN is implemented to perform static stress analysis on the wing configuration under consideration when subjected to the generated aerodynamic loads to examine its structural reliability .The stress analysis of the wing structure is carried out to compute the stresses at wing structure. On the other hand, and based on the finite element model, a free-vibration analysis is performed for the whole wing model. The frequencies for the first six modes and the corresponding mode shapes are presented .The purpose of this calculation is to correlate and validate the finite element model against the modal test in preparation for further complex analysis. The finite element results have shown that the suggested wing configuration is a safe candidate for the present light aircraft implementation.

المستخلص

يتكون الجناح من الغلاف,الاضلاع والدعامات الطولية. الدعامات الطولية تحمل الحمل الواقع على الطائرة أثناء الطيران وأيضا وزنها على الأرض. أجزاء هيكل الجناح الاخرى مثل الأضلاع مقحمة في الدعامات الطولية و مغطاة بالغلاف. الجناح من أهم أجزاء الطائرة المولدة لقوة الرفع، يختلف تصميم شكل الجناح وفقا لنوع الطائرة و الغرض منها. الأختبارات العملية التي تجرى على هيكل الجناح هى إختبارات مكلفة و تستغرق الكثير من الزمن.

هذه الدراسة غطت تصميم و تحليل الجناح من ناحية القوة الايروديناميكية ومن الناحية الهيكلية، التحليل الايروديناميكي تم بأستخدام (Schrenk,s Approximation Method) وطُبقت هذه الطريقة في (الماتلاب). اما من ناحية تصميم و تحليل الهيكل فتم بإستخدام طريقة العناصر المحددة بإستخدام برنامج (MSC/NASTRAN/PATRAN) لعمل تحليل الإجهاد السكوني علي الجناح بعد تعرضه للحمل الإيروديناميكي و ذلك لإختبار مدى تحمل الهيكل للحمل المسلط. تم عمل تحليل للإجهاد على الهيكل لحساب أقصى إجهاد يمكن للهيكل تحمله.

من ناحية أخرى و إعتمادا على النموذج المصمم بأستخدام طريقة العناصر المحددة، تم عمل تحليل الإهتزازات الحرة للجناح و تم توضيح أول ست أنماط وترددات للجناح ، و الغرض من هذه الحسابات التحضير لمقارنة وتقييم النتائج المتحصل عليها من تحليل النموذج المصمم مع الإختبارات العملية. النتائج المتحصل عليها من تحليل الجناح بإستخدام برنامج (MSC/NASTRAN/PATRAN) توضح أن هيكل الجناح آمن.

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List of Symbols:

AR	Aspect Ratio
b	Wing Span
cCla	Local Lift Coefficient
CL	Lift Coefficient
Cr_w	Wing Root Chord
Ct_w	Wing Tip Chord
e	Oswald off Factor
F	Matrix of the Externally Applied Loads
h	Service Celling
k	Stiffness Matrix
L	Lift Force
MAC	Wing Mean Aerodynamic Chord
q	Dynamic Pressure
R	Range
R/C	Rate of Climb
S	Wing Area
u	Displacement Matrix
V	Velocity
V_A	Maneuvering Speed
V_C	Cruise Speed
V_D	Dive Speed
$W_\circ$	A/C Gross TOF weight
Wy	Load
Y	Span Wise Distance
y^-	MAC location along Span
$\Lambda_{c/4}$	Quarter Chord Angle
Λ_{lE}	Leading Edge Angle
$\boldsymbol{\tau_{allowable}}$	Allowable Shear
$\boldsymbol{\sigma_{allowable}}$	Allowable Stress
λ	Taper Ratio

Abbreviations:

Alt	Altitude
BM	Bending Moment
CAD	Computer Aided Design
CFRP	Carbon Fiber Reinforced Polymer
Cos	Cosine Wave
FAR	Federal Aviation Regulation
FEA	Finite Element Analysis
FEM	Finite Elements Method
FOS	Factor of Safety
FVA	Free-Vibration Analysis
G	Gaga
GFRP	Glass Fiber Reinforced Polymer
HZ	Heartiz
Kg	Kilogram
M	Mega
m	Miter
max	Maximum
min	Minimum
MS	Margin of Safety
MSC	McNeal Schwendler Corporation
N	Newton
N.M.G	Numerical Master Geometry
Pa	Pascal
PC	Program Computer
S	Second
SF	Shear Force
sin	Sin Wave
SLA	Static Linear Analysis
TOF weight	Takeoff Weight
VMS	Von-Mises Stress