Landing Gear Integration

in

Aircraft Conceptual Design

by

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MAD 96-09-01

September 1996
(rev. March 1997)

Supported by NASA Ames Research Center

under

Grant NAG-2-919

an electronic version of this report is available at:
http://www.aoe.vt.edu/aoe/faculty/Mason_f/M96SC.html

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Abstract

The design of the landing gear is one of the more fundamental aspects of aircraft design. The design and integration process encompasses numerous engineering disciplines, *e.g.*, structure, weights, runway design, and economics, and has become extremely sophisticated in the last few decades. Although the design process is well-documented, no attempt has been made until now in the development of a design methodology that can be used within an automated environment. As a result, the process remains to be a key responsibility for the configuration designer and is largely experience-based and graphically-oriented. However, as industry and government try to incorporate multidisciplinary design optimization (MDO) methods in the conceptual design phase, the need for a more systematic procedure has become apparent.

The development of an MDO-capable design methodology as described in this work is focused on providing the conceptual designer with tools to help automate the disciplinary analyses, *i.e.*, geometry, kinematics, flotation, and weight. Documented design procedures and analyses were examined to determine their applicability, and to ensure compliance with current practices and regulations. Using the latest information as obtained from industry during initial industry survey, the analyses were in terms modified and expanded to accommodate the design criteria associated with the advanced large subsonic transports. Algorithms were then developed based on the updated analysis procedures to be incorporated into existing MDO codes.

Acknowledgments

This work would not have been possible without the support of NASA Ames Research Center, under grant NAG-2-919. Paul Gelhausen and Shahab Hassan served as technical monitors. At Virginia Tech Dr. Eric R. Johnson assisted with the analysis supporting the weight estimation methodology and Dr. Antonio A. Trani helped us develop the pavement thickness requirements analysis. We also were helped by a number of other individuals in the business, including Mr. Bill Perrella and Mr. John Rice at the Federal Aviation Administration, Mr. Edward Gervais, Mr. Jerry Kileer, Mr. Bob Nielson, Mr. Dave Nielson, Mr. Scott Perkins, and Mr. John Potter at Boeing Commercial Aircraft Group, Mr. Al Kernik at McDonnell Douglas, Mr. Gene Stuczynski at Cleveland Pneumatic, Mr. Bill Luce at Menasco Aerosystems, Mr. Derek Duxbury at British Aerospace, Mr. Ron Olds, Mr. Dean Peters, and Mr. Paul Snyder at B.F. Goodrich, Mr. Joe Pacuit at the Tire and Rim Association, Inc., Mr. Richard Vandame of the SAE A-5 Committee, Mr. James Gallivan at United Airlines, and Mr. Steve Lydon at Northwest Airlines for their assistance and valuable input during the initial industry survey. Last but not least, Mr. Nathan Kirschbaum at Virginia Tech for his insight into landing gear design considerations at the aircraft conceptual design stage. This work was funded by NASA Grant NAG-2-919 and is gratefully acknowledged.

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Nomenclature

Symbols

A	Area
ACN	Aircraft classification number
AR	Aspect ratio
C	Clearance, moment component
C_L	Lift coefficient
CBR	California bearing ratio
D	Drag, diameter
$ESWL$	Equivalent single wheel load
E	Energy, modulus of elasticity
F	Fillet radius, force
$F.S.$	Factor of safety
H	Height
I	Moment of inertia, second area moment
KE	Kinetic energy
L	Lift, length
M	Bending moment
$MTOW$	Maximum takeoff weight
N	Landing load factor, axial force
P	Pressure, load
R	Radius of centerline curve, offset
S	Safety margin, wing area, stroke, offset
T	Thrust, torque
V	Speed, volume, shear force
W	Weight, width, offset
X	Distance
a	Acceleration

b	Wheelbase
c	Constant
cg	Center of gravity
d	Displacement
e	Deflection
f	Constant
g	Gravitational acceleration
h	Height
k	Modulus of subgrade reaction, machinability factor
l	Length, direction cosine, radius of relative stiffness
m	Direction cosine
mac	Mean aerodynamic chord
n	Direction cosine, aircraft load factor
q	Shear flow
r	Radius
s	Span
t	Wheel track, thickness
u	Deflection
v	Deflection
w	Deflection, flange width

Greek Letters

Γ	Dihedral angle
Λ	Sweep angle
Ψ	Turnover angle
α	Angle of attack, repetition factor
β	Steering angle
δ	Main assembly offset angle
ϕ	Roll angle, retraction angle
η	Efficiency factor

φ	Castor angle, rotation angle
μ	Poisson's ratio
π	Pi
θ	Pitch angle, axle inclination angle
ρ	Sea-level air density, radius of gyration
σ	Stress
τ	Stress

Acronyms

ACN-PCN	Aircraft-Pavement Classification Number
ACSYNT	AirCraft SYNThesis
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
LCN	Load Classification Number
MDO	Multidisciplinary Design Optimization
NASA	National Aeronautic and Space Administration
PCA	Portland Cement Association
FLOPS	Flight Optimization System
DIS	Dynamic Integration System