

Landing Gear Integration
in
Aircraft Conceptual Design

by

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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.

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Table of Contents

Abstract.....	iii
Acknowledgments.....	v
Table of Contents.....	vii
List of Figures.....	xiii
List of Tables.....	xv
List of Symbols.....	xvii
1 Introduction.....	1
1.1 Introduction.....	1
1.2 Overview.....	1
1.3 Objectives.....	4
2 Aircraft Center of Gravity.....	5
2.1 Introduction.....	5
2.2 Current Capabilities.....	5
2.3 Alternate Method.....	7
2.3.1 Establishment of Component CG Range.....	7
2.3.2 Generic Component Layout.....	8
2.3.3 Validation of Analysis.....	12
3 Landing Gear Concept Selection.....	14
3.1 Introduction.....	14
3.2 Configuration Selection.....	14
3.3 Landing Gear Disposition.....	15
3.3.1 Angles of Pitch and Roll During Takeoff and Landing.....	15
3.3.1.1 Pitch Angle Required for Liftoff.....	16
3.3.1.2 Pitch and Roll Angles During Landing.....	18
3.3.2 Stability at Touchdown and During Taxiing.....	18
3.3.2.1 Condition at Touchdown.....	19
3.3.2.2 Sideways Turnover Angle.....	20

	3.3.3	Braking and Steering Qualities.....	20
	3.3.4	Gear Length.....	21
	3.3.5	Landing Gear Attachment.....	22
	3.4	Ground Operation Characteristics.....	23
	3.4.1	Aircraft Turning Radius.....	23
	3.4.2	Centerline-guidance Taxiing.....	25
	3.5	Landing Gear Disposition Constraints.....	27
4		Tires, Wheels, and Brakes.....	30
	4.1	Introduction.....	30
	4.2	Type, Size and Inflation Pressure of the Tire.....	30
	4.2.1	Basic Tire Constructions.....	31
	4.2.2	Size of the Tire.....	32
	4.2.3	Inflation Pressure.....	33
	4.3	Wheel Design.....	34
	4.4	Brake Design.....	35
	4.4.1	Heat Sink Materials.....	36
	4.4.2	Brake Sizing.....	37
5		Shock Absorber Design.....	40
	5.1	Introduction.....	40
	5.2	Oleo-pneumatic Shock Absorber Design.....	40
	5.2.1	Stroke Calculation.....	41
	5.2.2	Compression Ratios.....	42
	5.2.3	The Load-stroke Curve.....	43
	5.2.4	Internal Cylinder Length.....	44
	5.2.5	Sample Calculation.....	44
6		Kinematics.....	46
	6.1	Introduction.....	46
	6.2	Retraction Scheme.....	46
	6.3	Mathematical Kinematic Analysis.....	47
	6.3.1	The Pivot Axis and Its Direction Cosines.....	47

	6.3.1.1	The Fuselage-mounted Assembly.....	48
	6.3.1.2	The Wing-mounted Assembly.....	49
	6.3.2	Retracted Position of a Given Point Location.....	52
6.4		Integration and Stowage Considerations.....	53
	6.4.1	Truck Assembly Clearance Envelope.....	54
7		Aircraft Flotation Analysis.....	56
	7.1	Introduction.....	56
	7.2	Design Pavement Thickness.....	57
	7.2.1	Flexible Pavements.....	57
	7.2.2	Rigid Pavements.....	61
	7.3	Pavement Thickness Estimates.....	62
	7.4	ACN-PCN Conversion.....	67
	7.4.1	ACN Estimates.....	68
8		Weight Estimation.....	72
	8.1	Introduction.....	72
	8.2	Current Capabilities.....	72
	8.3	Analytical Structural Weight Estimation.....	73
	8.3.1	Generic Landing Gear Model.....	75
	8.3.2	Applied Loads.....	76
	8.3.3	Forces and Moments Resolution.....	80
	8.3.3.1	Coordinate Transformation.....	81
	8.3.3.2	The Main Assembly.....	83
	8.3.3.3	The Nose Assembly.....	84
	8.3.3.4	The Trunnion.....	85
	8.3.4	Member Cross-sectional Area Sizing.....	86
	8.3.4.1	Normal and Shear Stresses In a Thin-walled Tube.....	86
	8.3.4.2	Design Criteria.....	88
	8.3.4.3	Sizing of the Cross-sectional Area.....	89
	8.3.5	Structural Weight Estimation.....	91
	8.3.6	Validation of the Analysis.....	91

8.4	Landing Gear Group Weight Estimation.....	92
9	Analysis Package.....	95
9.1	Introduction.....	95
9.2	Description of Programs.....	95
9.3	Organization of Analyses.....	97
9.3.1	Input/Output Data.....	98
9.4	Aircraft CG Estimation Spreadsheet.....	100
10	Parametric Studies.....	101
10.1	Introduction.....	101
10.2	The Ultra-High-Capacity Transports.....	101
10.3	Parametric Studies.....	103
10.4	Derivatives of the Baseline Aircraft.....	110
10.5	Landing Gear Weight Trend for Large Aircraft.....	112
11	Costs.....	115
11.1	Introduction.....	115
11.2	Maintenance and Overhaul.....	115
11.3	Cost Reduction.....	116
12	Future Considerations.....	117
13	Conclusion.....	118
	References.....	119
	Appendix A: Industry Survey.....	123
A.1.	Introduction.....	123
A.2.	The Questions.....	125
A.3.	The Contacts.....	125
A.3.	Findings.....	125
	Appendix B: Structural Analysis.....	132
B.1.	Introduction.....	132
B.2.	The Nose Assembly.....	132
B.3.	The Trunnion.....	134
B.4.	Normal and Shear Stresses In a Thin-walled Tube.....	137

Appendix C: Bibliography.....	143
C.1. Textbooks.....	143
C.2. AGARD Reports.....	143
C.3. Government/Industry Standards.....	144
C.4. Technical Papers/Reports.....	144
C.5. Related Articles.....	148
C.6. Aircraft Data.....	149
C.7. Simple Landing Gear Dynamics Models for Insight.....	150
C.8. Historical (pre 1970) and Miscellaneous.....	150
Appendix D: Aircraft Tire Database.....	151
Appendix E: Analysis Package User's Manual.....	159
E.1. Introduction.....	159
E.2. Package Organization.....	159
E.3. Input Variables.....	165
E.4. Sample Input Files.....	168

List of Figures

Figure	Page
1.1 Initial comparison of weight equations with aircraft weights data.....	2
2.1 Typical tailsizing chart with tip back limit becoming the aft cg limit for relaxed static stability. (after Holloway, et al, [10]).....	6
2.2 Ranges of available component <i>cg</i> locations.....	10
2.3 Actual and estimated aircraft <i>cg</i> range comparison.....	13
3.1 Geometric definitions in relation to the pitch and roll angles [5].....	17
3.2 Limits for the undercarriage disposition based on stability [5].....	19
3.3 Turnover angle calculation [2].....	21
3.4 Aircraft turning radii [7].....	25
3.5 Taxiway fillet design [7].....	27
3.6 Landing gear attachment location constraints [5].....	28
4.1 Forces acting on the aircraft during a braked roll [5].....	33
4.2 Basic configuration of wheel design [27].....	34
4.3 Aircraft wheel assembly weight [2].....	35
4.4 Brake assembly weight vs. kinetic energy level [2].....	38
4.5 Carbon brake cross-sectional view [2].....	39
5.1 Single-acting shock absorber [4].....	41
5.2 The load-stroke curve.....	45
6.1 Relationships between the aircraft and kinematic reference frames.....	48
6.2 Fuselage-mounted assembly pivot axis alignment.....	49
6.3 Vector representation of the wing-mounted landing gear.....	50
6.4 Wing-mounted assembly pivot axis alignment.....	52
6.5 Retraction path and swept volume of the landing gear.....	53
6.6 Clearance envelope for aircraft tires [25].....	55
7.1 Theoretical pavement cross-sections [33].....	56
7.2 Comparison of single- and dual-deflection profiles, 1.0-foot depth [7].....	58
7.3 Relationship between the tire-contact areas and the analysis locations.....	59

7.4	Deflection factor curves for Poisson's ratio of 0.5 [34].....	60
7.5	Aircraft load repetition factor [7].....	60
7.6	Actual and estimated pavement thickness comparison.....	64
7.7	Actual and calibrated pavement thickness comparison.....	66
7.8	Rigid pavement ACN conversion chart [33].....	67
7.9	Actual and estimated ACN comparison.....	68
7.10	Actual and calibrated ACN comparison.....	70
8.1	Landing gear weights comparison.....	74
8.2	Generic landing gear model.....	75
8.3	Mathematical representation of the landing gear model.....	76
8.4	Aircraft attitudes under dynamic and static loading conditions [20].....	77
8.5	Location of the applied ground loads.....	80
8.6	Orientation of the axes and the corresponding rotation angles.....	82
8.7	Idealized main assembly cylinder/drag/side struts arrangement.....	83
8.8	Idealized nose gear cylinder/drag/side struts arrangement.....	84
8.9	Trunnion modeled as a clamped-clamped bar.....	85
8.10	Shear flow around a tube.....	87
8.11	I-section truss bar.....	91
9.1	Organization of analyses.....	98
10.1	Changes in landing gear weight fraction due to design parameter variations.....	104
10.2	Changes in landing gear weight fraction due to aircraft configuration variations..	112
10.3	Landing gear weight fraction beyond one million pounds MTOW.....	114
B.1	Free-body diagram of the nose gear structure in the yz-plane.....	133
B.2	Trunnion modeled as a clamped-clamped end bar.....	135
B.3	Annular section showing positive shear forces and bending moments.....	139
B.4	Shear flow around a closed tube.....	140

List of Tables

Table	Page
2.1 Generic component location for conventional civil transports.....	9
2.2 Aircraft <i>cg</i> range.....	12
3.1 FAA airplane design group classification for geometric design for airports [5].....	24
3.2 FAA recommended taxiway exit geometry [5].....	26
4.1 Heat sink materials comparison [2].....	36
4.2 FAA commercial transport brake capacity requirements [19].....	37
4.3 Heat sink dimensions [2].....	39
5.1 Shock absorber sizing parameters.....	45
5.2 Calculations of isothermal and polytropic compression.....	45
7.1 Subgrade strength categories [32].....	62
7.2 Pavement thickness correction constants.....	65
7.3 ACN correction constants.....	70
8.1 Basic landing gear loading conditions [19].....	77
8.2 Selected structural nodes description.....	80
8.3 Sections description.....	86
8.4 Main assembly structural weight comparison.....	92
8.5 Nose assembly structural weight comparison.....	92
8.6 Landing gear weight breakdown [2].....	93
8.7 Landing gear group weight comparison.....	94
9.1 Required input data.....	99
9.2 Analysis-generated output data.....	99
10.1 Configuration characteristics of a conceptual UHCT	102
10.2 Baseline aircraft design characteristics.....	102
10.3 Baseline aircraft flotation characteristics.....	103
10.4 Number of main assembly tires, four-strut configuration.....	106

10.5	Number of main struts, 24-tire configuration.....	106
10.6	Tire selection criteria, 24-tire configuration.....	107
10.7	MTOW variations.....	109
10.8	Wing-mounted assemblies location variations, lateral.....	109
10.9	Strut length variations.....	110
10.10	Truck beam length variations.....	110
10.11	Axle length variations.....	111
10.12	Derivative configuration characteristics.....	111
10.13	Aircraft configuration variations.....	113
11.1	Description of selected aircraft tires [App. A].....	115
A.1	Industry/government contact list.....	126
D.1	Aircraft tire data [23].....	152
D.2	Aircraft wheel data [23].....	156

Nomenclature

Symbols

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

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

