AIRPORT DESIGN AND OPERATION

Third Edition

AIRPORT DESIGN AND OPERATION

Third Edition

by

ANTONÍN KAZDA
University of Žilina, Žilina, Slovakia

ROBERT E. CAVES
Loughborough University, Loughborough, UK (Retired)

United Kingdom – North America – Japan
India – Malaysia – China

Emerald Group Publishing Limited
Howard House, Wagon Lane, Bingley BD16 1WA, UK

First edition 2000
Second edition 2007
Third edition 2015

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-1-78441-870-0 (Print)
ISBN: 978-1-78441-869-4 (Online)

Dedication

We have written this book for all the fools who love the beautiful fragrance of the burnt kerosene.

Tony Kazda and Bob Caves

We would like to thank our wives for their understanding during our writing, because the time involved for this work was stolen from our families. Also we thank 'little' Zuzana and Tom for their help with language and the manipulation of computer software.

ABBREVIATIONS

μm	Micrometres
A	Ampere
a/c	Aircraft
ABAS	Aircraft-Based Augmentation System
AC	Advisory Circular
A-CDM	Airport Collaborative Decision Making
ACARE	Advisory Council for Aeronautics Research in Europe
ACI	Airports Council International
ACLU	American Civil Liberties Union
ACMI	Aircraft, Crew, Maintenance, and Insurance
ACNSG	Aircraft Classification Number Study Group
ACRP	Airport Cooperative Research Program
AD	Aerodrome
ADF	Automatic Direction Finder
ADSG	Airport Design Study Group
AEA	Association of European Airlines
AFFF	Aqueous Film Forming Foam
AFTN	Aeronautical Fixed Telecommunication Network
AGA	Aerodromes, Air Routes and Ground Aids
AGNIS	Azimuth Guidance for Nose-in Stands
AIP	Air Information Publication
AIP	Airport Improvement Program
AMAN	Arrival Manager
AMC	Acceptable Means of Compliance
ANP	Aircraft Noise-Power
AODB	Airport Operations Database
API	Advance Passenger Information
APIS	Aircraft Parking and Information System
APN	Apron
APP	Approach
APP	Advanced Passenger Processing
APU	Auxiliary Power Unit
ARCP	Aerodrome Reference Code Panel
ASD	Addressable Switching Device
ASDA	Accelerate-stop Distance Available

A-SMGCS	Advanced Surface Movement, Guidance and Control Systems
ASPSL	Arrays of Segmented Point Source Lighting
ASTM	American Society for Testing and Materials
ATB	Automatic Ticket and Boarding
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
atm	Air Transport Movements
ATSA	Aviation and Transportation Security Act
AWB	Air Waybill
AWOP	All Weather Operation Panel
BAA	British Airports Authority
BANANA	Build Absolutely Nothing Anywhere Near Anything
BOD	Biochemical Oxygen Demand
BOLDS	Burroughs Optical Lens Docking System
C	Degrees Celsius (Centigrade)
CAA	Civil Aviation Authority
CAD	Computer Added Design
CAN	Aircraft Classification Number
CAP	Civil Aviation Publication
CAT	Category
CBP	Customs and Border Protection
CBR	Californian Bearing Ratio
CCR	Constant Current Regulators
CCS	Cargo Community System
CCTV	Close Circuit TV
cd	Candelas
CDA	Continuous Descent Approach
CDD	Charge-Coupled Devices
CDG	Charles de Gaulle Airport
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit
CFRP	Carbon Fibre Reinforced Polymer
CIP	Commercially Important Passengers
CL	Centre Line
CLOS	Command Line-of- Sight
cm	Centimetre
CMC	Cargo Movement Control
CNEL	Community Noise Equivalent Level
CNR	Composite Noise Rating
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPM	Computational Pipeline Monitoring

CRM	Collision Risk Model
CSA	Common Situational Awareness
CUSS	Common User Self Service
CUTE	Common Use Terminal Equipment
CWY	Clearway
DA	Decelerating Approaches
dB	Decibel
DC	Direct Current
DDF	Data and Documentation Flow
DDM	Difference in the Depth of Modulation
DH	Decision Height
DHS	Department of Homeland Security
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DLR	Deutschen Zentrums für Luft- und Raumfahrt (The National Aeronautics and Space Research Centre of the Federal Republic of Germany)
DM	Dual Mass
DMAN	Departure Manager
DME	UHF Distance Measuring Equipment
Doc	Document
DOT	Department of Transport
E	Dynamic Modulus of Elasticity
EASA	European Aviation Safety Agency
EC	European Commission
ECAC	European Civil Aviation Conference
EDDS	Explosive Device Detection System
EDI	Electronic Data Interchange
EDMS	Emissions and Dispersion Modelling System
EDS	Explosive Detection System
EFSO	Emergency Fuel Shutoff System
EGNOS	European Geostationary Navigation Overlay Service
EIA	Environmental Impact Assessment
EMA	East Midlands Airport
EMAS	Engineered Material Arresting System
EPA	Environmental Protection Agency
EQA	Equivalent Gates
ERCD	Environmental Research and Consultancy Department
ETDS	Explosive Trace Detection Equipment
ETV	Elevating Transfer Vehicles
EU	European Union
EUR	Europe or European
EXP	World Exports
FAA	Federal Aviation Administration of the USA
FAF	Final Approach Fix

FAR	Federal Aviation Regulation
FASG	Frangible Aids Study Group
FATO	Final Approach and Take-off Area
FFFP	Film Forming Fluoroprotein Foam
FIDS	Flight Information Display System
FLIR	Forward Looking Infrared
FMCW	Frequency Modulated Continuous Wave
FOD	Foreign Object Damage
ft	Feet
ftk	Freight Tonne Kilometres
g	Gram
GBAS	Ground-Based Augmentation System
GCA	Ground Controlled Approach
GHG	Greenhouse Gas
GLONASS	Globalnaya Navigatsionnaya Sputnikovaya Sistema
GNP	Gross National Product
GNSS	Global Navigation Satellite System
GP	Glide Path
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GRI	Global Reporting Initiative
HAPI	Helicopter Approach Path Indicator
HC	Hydrocarbons
HGS	Head up Guidance System
Hi-Lo	High-Loader
HOP	Helicopter Operations Panel
HOT	Hold Over Time
HV	High Voltage
Hz	Hertz
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ID	Identification
IEC	International Electrotechnical Commission
IFE	In-flight Entertainment
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
INM	Integrated Noise Model
IR	Infra-Red
ISBN	International Standard Book Number
ISO	International Standards Organization
Istr	Intensity in a Space Beam
IT	Information Technologies

JFK	John F. Kennedy International Airport
kHz	Kilohertz
km	Kilometre
kN	Kilo-newton
Kt	Knots
L_{AE}	Sound Exposure Level
LAN	Local Area Network
lb	Pound
LBS	Location Based Services
LCC	Low Cost Carrier
LCM	Lamp Control and Monitoring
LDA	Landing Distance Available
LED	Light Emitting Diode
L_{eq}	Equivalent Continuous Sound Level
LF	Low Frequency
LGT	Light, Lighting
LLZ	Localiser
LMS	Logistics Management Systems
LOC	Localiser
LOS	Level of Service
LP	Luminescent Panel
LTO	Take-off and Landing
LV	Low Voltage
LVO	Low Visibility Operations
LVTO	Low Visibility Take-Off
m	Metre
MAGLEV	Magnetic Levitation
MANPADs	Man-Portable Air Defence Systems
MCT	Maximum Continuous Thrust
MD	McDonnell-Douglas
MEL	Minimum Equipment List
MF	Medium Frequency
MHz	Megahertz
MIS	Management Information System
MKR	Marker
MLS	Microwave Landing System
mm	Millimetre
MM	Middle Marker
MoU	Memorandum of Understanding
MPa	Megapascal
mppa	Million Passengers per Annum
MTD	Mean Texture Depth
MTOM	Maximum Take-off Mass
NADP	Noise Abatement Departure Procedures

NASP	National Aviation Security Programme
NDB	Non-Directional Radio Beacon
NEF	Noise Exposure Forecast
NFC	Near Field Communications
NIMBY	Not in My Back Yard
NM	Nautical Mile
NNI	Noise and Number Index
NOTAM	Notice to Airmen
NOx	Nitrous Oxides
NPD	Noise-Power-Distance
NPIAS	National Plan of Integrated Airport Systems
NTK	Noise Monitoring and Track Keeping
OAS	Obstacle Assessment Surfaces
OAT	Outside Air Temperature
OCP	Obstacle Clearance Panel
O-D	Origin Destination
OFZ	Obstacle Free Zone
OM	Outer Marker
OPS	Aircraft Operations
p.a.	Per annum
Pa	Pascal
PANS	Procedures for Air Navigation Services
PAPA	Parallax Aircraft Parking Aid
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
PAX	Passenger
PBFM	Passenger and Bag Flow Model
PCN	Pavement Classification Number
PEDS	Primary Explosive Detection System
PETN	Pentaerytrytol Tetranitrate
PIN	Personal Identification Number
pkm	Passenger Kilometres
PLASI	Pulse Light Approach Slope Indicator
PMS	Pavement Management Systems
PNdB	Perceived Noise Decibel
PNL	Perceived Noise Level
PNR	Passenger Name Record
ppm	Parts Per Million
PSZ	Public Safety Zone
ptf	Propensity to Fly
QR code	Quick Response Code
RAVC	Reduced Aerodrome Visibility Conditions
RDF	Radio Direction Finders
RDX	Cyclotrimethylentrinithramin

RER	Regional Rapid
RESA	Runway End Safety Areas
RETIL	Rapid Exit Taxiway Indicator Light
RFF	Rescue and Fire Fighting
RFFS	Rescue and Fire Fighting Service
RFFSG	Rescue and Fire Fighting Study Group
RFID	Radio Frequency Identification
RMS	Root Mean Square
rpk	Revenue Passenger Kilometres
RPM	Revolutions Per Minute
rpm	Revenue Passenger Miles
RSA	Runway Safety Area
rtk	Revenue Tonne Kilometres
RVR	Runway Visual Range
RWY	Runway
SAE	Society of Automotive Engineers
SAGA	System of Azimuth Guidance Approach
SAMs	Surface-to-Air Missiles
SARPs	Standards and Recommended Practices
SAS	Scandinavian Airline Systems
SBAS	Satellite Based Augmentation System
SBR	Standard Busy Rate
SCC	Series Circuit Coupler
SEL	Single Event (Sound) Exposure Level
SeMS	Security Management System
SITA	Société Internationale de Télécommunications Aéronautiques
SLA	Service Level Agreements
SMB	Side Marker Board
SMR	Surface Movement Radar
SMS	Safety Management System
SNAP	Significant New Alternatives Policy
SPL	Sound Pressure Level
SRE	Surveillance Radar Element
SS	Settleable solids (mg/litre) - suspended solid after one hour quiescent settlement
SSI	Sensitive Security Information
SSR	Secondary Surveillance Radar
SVR	Slant Visual Range
SWY	Stopway
TDD	Telecommunications Display Device
TDZ	Touchdown Zone
TGV	Train à Grande Vitesse
TIP	Threat Image Projection
TLS	Transponder Landing System

TNT	Trinitrotoluene
TO	Take-off
TODA	Take-off Distance Available
TOGA	Take-off and Go-Around
TORA	Take-off Run Available
TPHP	Typical Peak Hour Passengers
TRA	Task and Resource Analysis
TSA	Transportation Security Administration
TSC	Terrorist Screening Center
TWY	Taxiway
UH	Unburned Hydrocarbons
UHF	Ultra High Frequency
UK	United Kingdom
ULD	Unit Load Devices
UPS	Uninterruptible Power Supply
US	United States
USA	United States of America
USAF	US Air Force
USD	United States Dollars
V	Volt
V	Velocity
V_1	Take-off Decision Speed
V_2	Take-off Safety Speed (Applicable to Larger Multi-engine Aircraft)
VA	Volt-ampere
VAGS	Visual Alignment Guidance System
VAP	Visual Aids Panel
VAT	Value Added Tax
VASIS	Visual Approach Slope Indicator System
VDGS	Visual Docking Guidance System
VFR	Visual Flight Rules
VHF	Very High Frequency
VLA	Very Large Aircraft
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Radio Range
VRLA	Valve-Regulated Lead Acid
W	Watt
WAAS	Wide Area Augmentation System
WCO	World Customs Organization
WECPNL	Weighted Equivalent Continuous Perceived Noise Level
Wi-Fi	Wireless Fidelity
WRS	Wide-area Reference Stations
WS	Wing Span

PREFACE

This book is titled 'Airport Design and Operation'. However, the reader will not find chapters devoted exclusively to airport design or airport operation. Airport design and airport operation are closely related and influence each other. A poor design affects the airport operation and results in increased costs. On the other hand it is difficult to design the airport infrastructure without sound knowledge of airport operations. This is emphasised throughout the book.

The book does not offer a set of simple instructions for solutions to particular problems. Every airport is unique and a simple generic solution does not exist. The book explains principles and relationships important for the design of airport facilities, for airport management and for the safe and efficient control of operations. We hope that we have been able to overcome the traditional view that an airport is only the runway and tarmac. An airport is a complex system of facilities and often the most important enterprise of a region. It is an economic generator and catalyst in its catchment area. However, this book is focused on one narrow part of the airport problem, namely design and operation, while bearing the other aspects in mind.

This third edition includes some important changes in the international regulations covering design and operations. It reflects the greater attention being given to security, safety and changes on the air transport market with respect to the impact of low cost carriers operations. The third edition contains new parts on airport long-term planning; Reduced Aerodrome Visibility Conditions operation; RESA and EMAS construction; aircraft performance; rapid exit taxiway specifications; dowelling technology in concrete pavement design; fuel storage and leak detection; impact of mobile and IT technologies on passenger terminal design and operations; developments in security risks and their impact on security SARPs; ground transport system improvements and their impact on airport attractiveness; new de-icing chemicals and procedures; changes in rescue and fire fighting and a new chapter on wildlife control. All these changes and additions strengthen the operational content of this book.

Tony Kazda and Bob Caves

Žilina, Slovakia and Loughborough, UK, January 2015

This page intentionally left blank

ACKNOWLEDGEMENTS

We appreciate all the help from the professionals who have contributed to the text or have given freely of their time and expertise to advise and correct our draft texts. Without their help, it would not have been possible to complete this book. We would like to express special thanks to:

Charles Allen, DHL
Zoltan Bazso, Heathrow Airport
Bill Blanchard, East Midlands airport
Petr Čiviš, AGA – Letiště, Prague
Zbyněk Hackl, Airport Systems Design Agency, spol. s r.o., Prague
Petr Hloušek, Prague Airport
Dr. Stephanie Hochreuther, BU ICS, Technical Application EMEA, Aviation, Clariant Produkte (Deutschland) GmbH
Dr. Martin Hromádka, Žilina Airport
Tomáš Hruška, Air Transport Europe
Abdul Nasser Chakra, Emirates Aviation University, Dubai
Bohdan Koverdynsky, Prague Airport
Dr. Libot Kurzweil, Prague Airport
Andrea L. Manning, Zodiac Aerospace
Matěj Mareth, Slovak Transport Authority
Darren Maynard, DHL
Richard Moxon, Cranfield University
Kai Nieruch, Lufthansa
Prof. Andrej Novák, University of Žilina
Jan Pojezny, Vestergaard Company A/S