METHODOLOGY FOR INCORPORATING AIRCRAFT ACCIDENT RISK CONSIDERATIONS IN AIRPORT HIGH SPEED EXIT TAXIWAY DESIGN

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DECLARATION OF THE CANDIDATE & SUPERVISOR

I declare that this is my own work, and this dissertation does not incorporate any material previously submitted for a degree or diploma in any other university or institute of higher learning without acknowledgement and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

High speed exit taxiways are used as a method of increasing runway operational capacities by means of reducing runway occupancy times of aircraft. With the increased utilization of high speed exits, the number of accidents that could take place at these exits in the future could increase. Following the research gap on high speed exit taxiways-related risk analyses, the study developed methodologies to evaluate the associated risk at high speed exit taxiways. These methodologies are to evaluate exit overrun risk at a given exit location (R2), aircraft veer-off risk during the turning maneuver (R4) and incursion risk at the high speed exit and parallel taxiway intersection (R6). Due to a lack of data for developing statistical models, the R4, and R6 followed a novel approach. For the R2, the existing landing overrun model was modified for planning risk-based exit locations against the aircraft's operational and metrological-related variables. A deterministic model was derived to evaluate aircraft veer-off risk at distinct operating conditions. The R4 was used to compare taxiway design characteristics such as acute angle, radius of curvature, etc. against veer-off risk. The analytical approach under R6 evaluated incursion risk due to violations of minimum separations between aircraft on the high speed exit taxiway and parallel taxiway. The methodology developed under this study could be used to evaluate aircraft risk at high speed taxiways and planning taxiway design elements. One of the key findings of this study was that every 250 m of displacement of high speed exit location towards the runway end reduces exit overrun risk by 30 percent with respect to the previous location. Further, a 30-percent increase in taxiway width and taxiway design radius result in 32-percent and 60-percent reductions in veer-off risk respectively. By incorporating risk, the methodology provides an approach for risk-based planning of high speed exit taxiways to improve runway capacity without compromising aircraft safety.

Keywords: High Speed Exit; Rapid Exits; Runway Occupancy Time; Taxiway

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LIST OF ABBREVIATIONS

Abbreviation	Description
GDP	Gross Domestic Product
ICAO	International Civil Aviation Organization
FTK	Freight Ton Kilometer
ACI	Airport Council International
IATA	International Air Transport Association
ADG	Aircraft Design Group
AAC	Aircraft Approach Categories
ILS	Instrument Landing System
GSIE	Global Safety Information Exchange
ASDE-X	Airport Surface Detection Equipment
ACRP	Airport Cooperative Research Program
NTSB	National Transport Safety Board
FAA	Federal Aviation Administration
VMC	Visual Metrological Conditions
IMC	Instrumental Metrological Conditions
REDIM	Runway Exit Design Improvement Model
TDG	Taxiway Design Group
FHA	Functional Hazard Analysis
RAS	Royal Aeronautical Society
ISO	International Standard Organization
TSB	Transportation Safety Board
JFK	John F. Kennedy International Airport (JFK)
TERPS	Terminal Instrument Procedures
ATSL	Air Transportation Systems Laboratory
CPDF	Cumulative Probability Density Function
SMGCS	Surface Movement Guidance and Control Systems
ATC	Air Traffic Control

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