GM 14-40

CIVIL AVIATION AUTHORITY OF BANGLADESH

Guidance Manual

Assessment of Runway Surface Friction Characteristics

Version 2.0
21 August 2024

AERODROME STANDARD DIVISION

GM 14-40

Civil Aviation Authority of Bangladesh

Guidance Manual

on

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RECORD OF REVISIONS

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REVISION HISTORY

Revision / Version	Date	Chapter / Section	Details
1.0	10 March, 2010	All	AC(AD) No-03: Assessment of Runway Surface Friction Characteristics
2.0	2023	All	Guidance material on assessment of runway surface friction characteristics

Contents

Foreword

This guidance material on assessment of runway surface friction characteristics is the issue-2 which has been prepared by Aerodrome Standard Division for the use and guidance of assessment of runway surface friction characteristics in the performances of their duties. All matters pertaining to aerodrome operator duties, responsibilities and procedures have been covered to the extent possible in this Guide.

Aerodrome Operators are expected to use good judgment in dealing with matters with where specific guidance is unavailable or be aware of changes in aviation technology, legislation and developments within the industry that may necessitate changes to requirements and the relevant procedures followed by CAAB.

The guidance contains the Standards, Policies & Procedures that pertain to Aerodrome Operator. The contents of the guidance on assessment of runway surface friction shall not be deemed to supersede any instructions contained in the following documents: Aerodrome manual; CARs; ANOs; Rules & Regulations; AIP; AICs; Aerodrome Handbook; Standard Circulars; Aerodrome maintenance manual; Aerodrome emergency manual.

All the Aerodrome Operators are required to be fully conversant with the relevant contents of this book. The content of this guide are mainly extracted from Annexes, Documents, Aerodrome manuals, CARs, ANOs, Rules & Regulations, AIP, AICs, Aerodrome Handbook, Standard Circulars, Aerodrome maintenance manual, Aerodrome emergency manual.

The undersigned certifies that this aerodrome operator guidance on assessment of runway surface friction satisfies all the regulatory requirements. The responsibility to publish, make revisions and amendments and to control of the guidance shall be vested in and done according to the instructions and procedures described.

This guidance material on assessment on runway surface friction will be updated from time to time in relation to the changes in rules, regulations and or based on received suggestive ideas. Comments and recommendations are welcome and should be forwarded to the undersigned.

21-8-2024

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Glossary

For the purpose of a runway surface friction assessment the following definitions apply:

Continuous Friction Measuring Equipment (CFME)	A device designed to produce continuous measurement of runway friction values.
Design Objective Level (DOL)	The target friction level to be achieved on a new or resurface runway within one year.
Friction Level	The overall average friction value calculated from a minimum of 10 average friction values obtained over a rolling distance of 100 meters within a portion of the pavement.
Maintenance Planning Level (MPL)	The friction level below which a runway maintenance programme should be undertaken.
Minimum Friction Level (MFL)	The friction level below which a runway shall be notified as 'may be slippery when wet.
Portions Of The Pavement	One third of the declared runway width, referred to as the 'central' trafficked portion and two 'outer' portions.
Runway Surface Friction Assessment	The assessment of friction carried out under conditions of self-wetting using a CFME.
Wet Runway Surface	A runway that is soaked but no significant patches of standing water are visible. **Note:** standing water is considered to exist when water on the runway surface is deeper than 3mm.

Chapter 1

Introduction

1 General

1.1 Manual of Aerodrome Standard outlines the requirement to undertake regular tests of runway surface friction characteristics and to ensure that the friction level does not fall below an acceptable level.

1.2 This document describes the minimum level of assessment that should be employed for the Continuous Friction Measuring Equipment (CFME) commonly used in Bangladesh the surface fiction tester vehicle. Other types of CFME may be used if their performance can be demonstrated, to the satisfaction of CAA, to provide comparable results with currently accepted CFME.

1.3 The criteria, which are given in this guidance, reflect the CAAB's interpretation of the Standards and Recommended Practices of Annex 14 to the Convention on International Civil Aviation in so far as these have been adopted by the Bangladesh in respect of runway surface friction testing.

2 Purpose

2.1 The purpose of this document is to outline the procedures for undertaking runway surface friction assessments and to define the criteria by which friction values should to ensure that the runway condition is adequate for aircraft to operate safely.

2.2 This document also provides guidance to aerodrome operations on how they may assess the friction of runway surfaces in order to adjust maintenance schedules to ensure that the runway condition is adequate for aircraft to operate safely.

3 Scope

3.1 The criteria in this document apply to all paved runways exceeding 1200 meters in length and all paved runways used for public transport operations. It is not applicable to grass runways or helicopter landing sites.

3.2 On pave runways of 1200 meters or less, where public transport operations are not carried out, the application of the procedures is at the discretion of the aerodrome operator.

3.3 The procedures in this document are only to be used for the acquisition of friction levels of a runway surface for maintenance purposes.

3.4 An aerodrome operator should carry out additional friction testing as an integral part of their Safety Management System to establish friction readings during adverse weather conditions and to identify those areas of the runway where contamination may build up over a short period of time. These tests should be conducted under natural conditions with the CFME self-wetting system switched off.

Chapter 2

Runway Surface Friction Assessments

1 A runway surface friction assessment is conducted under controlled conditions using self-wetting CFME, to establish the friction characteristics of a runway and to identify those areas of a runway surface that may require attention.

2 Friction readings for the survey run are collected by the CFME along the line of the entire pavement length. An average friction value is determined every 10 meters along a run, enabling a 100-metre rolling average to be calculated. This is best visualized by the use of a sliding 100 meter cursor passing over the surface. The runway width should be divided into equal thirds; these portions of the pavement are referred to as 'central' and 'outer' trafficked portions. The friction level for each portion is determined by the lowest of the rolling averages. The procedure for calculating the rolling average for each run is repeated in a similar fashion for each of the three portions across the runway. In each case, the applicable runs across the width of each portion are first averaged before undertaking the rolling average calculation as described above.

3 The aerodrome operator should determine the frequency of the assessments that will enable any significant change in runway surface friction characteristics to be identified and, if appropriate, for remedial maintenance to be conducted before the friction level falls below the MFL.

4 The recommended periodicity of runway surface friction assessments is outlined in Table 1.

Table 1 Recommended interval Between Runway Surface Friction Assessments

Average number of movements on the runway per day	**Interval between assessments**
Less than 150	6 months
150 or more	3 months

Note: The average number of movements on a runway is determined by the total number of movements, on both runway directions.

5 The friction characteristics of a runway vary over time as the runway is subject to wear and tear, rubber deposits and to the effects of weather and other

environmental conditions. Aerodrome operators should monitor the results of assessments and should vary the interval between assessments depending on the results. If historical data indicates that the surface is deteriorating relatively quickly, more frequent monitoring may be required in order to ensure that maintenance is arranged before the friction characteristics deteriorate to an unacceptable level. The aerodrome operator should record the justification for any variation from the recommended periodicity for assessments, for example **Assessment Report No. 2 - see Table 5.**

6. The friction characteristics of a runway can also alter significantly following maintenance activities, even if the activity was not intended to affect the friction characteristic. Therefore, a runway surface friction assessment should be conducted following any significant maintenance activity conducted on the runway and before the runway is returned to service. Runway surface friction assessments should also be conducted following pilot reports of perceived poor braking action, if there are visible signs of runway surface wear, or for any other relevant reason.

Chapter 3

Runway Surface Friction Assessment Procedures

3.1 Introduction

3.1.1 Runway friction testing requires the use of continuous friction measuring equipment (CFME) together with trained personnel to conduct the tests. If an aerodrome operator does not have CFME and trained staff to operate it, arrangements should be in place to access a unit with trained operators whenever testing is required.

3.1.2 If a contractor is used it is important that that the CFME is appropriate for runway surface testing, and the operators are trained to perform runway friction testing.

3.2 Equipment requirements

3.2.1 There are a variety of CFME on the market, however, all use on the same principles to determine the runway friction characteristics. The Mu-Meter and the Grip Tester can be the predominant makes used in CAAB.

3.2.2 Irrespective of whether the aerodrome owns the CFME or has hired a contractor, before conducting friction surveys the aerodrome operator should ensure—

(a) the equipment has been serviced and maintained in accordance with the manufacturer’s requirements, and is in full working order; and

(b) the friction measuring system and components have been calibrated in accordance with the manufacturer's instructions and its performance has been confirmed to be within the manufacturer’s specified tolerances; and

(c) for CFME fitted with self-wetting systems—

(i) the water flow rate is correct; and
(ii) the amount of water produced for the required water depth is consistent and applied evenly in front of the friction measuring wheel(s).

3.2.3 It is recommended that, before and after undertaking the runway friction tests, the CFME is checked on a defined test strip of pavement that is not used for aircraft operations. Comparison of the sample readings with previous results will quickly verify the CFME performance.

3.3 Personnel working on aerodromes

3.3.1 All personnel undertaking runway friction tests need to comply with the general requirements for personnel working on operational areas of an aerodrome, or be accompanied and supervised at all times by someone who does. In particular they must—

(a) be familiar with, and follow the established procedures for working on an operational aerodrome; and

(b) be trained in radio procedures, including ATC phraseology and the importance of complying immediately with any instructions to vacate the manoeuvring areas; and

(c) be provided with a two-way radio for communications with the air traffic services unit at the aerodrome; and

(d) have a vehicle equipped with a flashing or rotating beacon or a chequered flag for day time testing, or a flashing or rotating beacon for night time testing.

3.3.2 Before any work starts personnel should be fully briefed operational procedures, method of work plans (MOWP) and safety plans, and any other matters relevant to the work being carried out.

3.4 CFME operators

3.4.1 The success of friction measurement in delivering reliable friction data depends heavily on the personnel, who are responsible for operating the equipment. It is important that CFME operators are fully trained and competent, to use the equipment and are aware of the critical factors affecting the accuracy of friction measurements.

3.4.2 Where a contractor carries out the testing it is the responsibility of the aerodrome operator to be satisfied as to the competency and experience of the CFME operator.

3.4.3 CFME operators should have been—

(a) trained to—

(i) service and maintain the equipment; and

(ii) check its calibration and verifying it is working properly; and

(iii) operate the machine and carry out friction testing; and

(b) understand—

(i) runway friction testing procedures; and

(ii) requirements and procedures when working on operational areas; and

(c) assessed as competent to carry out runway friction testing; and

(e) where appropriate, have received recurrent training and assessments.

3.4.4 Records must be kept as evidence that training and competency assessments have been completed.

3.5 Environmental conditions for friction testing

3.5.1 Environmental conditions can affect the friction testing results. The test should be conducted when—

(a) the runway surface is dry, free from precipitation, and has no wet patches; and

(b) the ambient air temperature is above 2° C.

3.5.2 Dampness, fog and mist conditions may affect the outcome of the test and cross-winds may affect self-wetting testing.

3.5.3 Where necessary, aerodrome operators should seek advice on any environmental issues from the CFME manufacturer.

3.6 Runway surface friction testing procedure

3.6.1 Friction readings for the survey run are collected by the CFME along the entire pavement length. Several runs are made along the runway, offset on either side of the centreline, and in both directions.

3.6.2 The runway is normally divided into zones 100 metres in length with an average friction value determined every 10 metres along a run, enabling a 100-metre rolling average to be calculated. Another method uses discrete averaging for interpretation immediately after the testing.

3.7 Location of friction testing runs

3.7.1 The friction measurements are to be taken on tracks parallel to the runway longitudinal centreline, at right and left offsets, and in both landing directions.

3.7.2 The right and left offsets from runway centreline specified for friction measurements are based on the type and/or mix of aircraft operating on the runway. The lowest friction levels will generally occur in the wheel path areas, as a result of the wearing action of aircraft tires on the pavement surface texture characteristics, and the build-up of surface contaminants such as tire rubber.

Runways serving only narrow body aircraft: Friction testing should be conducted 3 metres from the runway centreline.

Runways serving narrow body and wide body aircraft: Friction testing should be conducted at both 3 and 6 metres from the runway centreline, to determine the worst-case condition. If, due to the undercarriage widths of certain aircraft operating, measurements at 5 and 7 metres can be used.

If the worst-case condition is found to be consistently limited to one track, future surveys may be limited to this track. Care should be exercised, however, to account for any future and/or seasonal changes in aircraft mix.

3.7.3 It is recommended that two friction measurement runs be performed at each of the right and left three and six metre offsets, as applicable. Results of the four measured runs can be averaged to determine "100 Metre Section Average Friction" values along the length of the runway and the overall "Runway Average Friction" value. The use of discrete values can be applied if the software is available, allowing a quick assessment of problem areas.

3.8 Friction testing work schedule

3.8.1 Ideally each runway direction should be tested separately, with friction test runs on either side of the runway centreline. The practice of one circular run for the whole runway results in only the friction values for one side of each direction of a runway being assessed.

3.8.2 If there are operational difficulties in conducting bi-directional tests, the aerodrome operator may implement a series of single direction tests to complete the testing programme. Appropriate processes should be in place to ensure the tests in both directions are completed.

3.9 Low friction values

3.9.1 When friction values below maintenance planning levels are measured, additional friction runs should be performed outside the wheel path area in order to assess the degree to which wear and contaminants have lowered friction levels in the centre trafficked area. A test track profile located 5 to 10 metres from the outer edge of the paved runway surface is normally optimum for the purposes of wear and contaminant comparison tests.

3.10 Vehicle testing speed

3.10.1 The tests should cover the maximum area of the runway, subject to the test vehicle having sufficient area to accelerate to the required speed and decelerate and stop safely. Standard runs should be carried out along the entire pavement length at a constant speed, starting with the run closest to the runway edge.

3.10.2 The friction test runs should be performed at two speeds, 65 km/h (40 mph) and 95 km/h (60 mph). The lower speed determines the overall mix of macro-texture and micro-texture/contaminant/-drainage condition of the pavement surface. The higher speed provides a further indication of the condition of the surface's macro-texture alone.

3.10.3 A complete survey should include tests at both speeds although operational requirements may limit this.

Table 2 Recommended Format for Runway Surface Friction Assessment Standard Runs Based on Nominal Runway Width

Runway Width	**Recommended lateral displacement of standard runs each side of the centerline (meters)**					
18 m	1.5	3.5	6			
23 m	1.5	3	6	9		
30 m	1.5	4	7	12		
45 m	1.5	4	7	11	17	
60 m	1.5	4	7	11	17	23

3.11 Record

3.11.1 Aerodrome Operators should keep records of all runway surface friction assessments. The following items should be recorded for each assessment, and made available upon request to the CAAB:

- Date and time of assessment.
- Runway assessed.
- Run number and runway direction.
- Distance from the center line and on which side of center lines the run was performed.
- Constant run speed (Km/h) for each run.
- Run length.
- Self-wetting system on/off (refers to check runs only),
- Surface condition.
- Average friction level per run.
- Friction levels for each portion of the pavement.
- Overall friction level.

Tables 4 and 5 depict typical assessment report sheets that can be used and retained as a record for each runway surface friction assessment.

3.12. Trend analysis

3.12.1 Friction testing results should be systematically recorded to allow the results to be monitored to identify trends and patterns. This enables analysis of the condition of the runway surface so timely preventative and/or corrective actions can be taken and, where appropriate, adjustments to the intervals between friction testing can be

made.

3.12.2 Any trend analysis must take into account the effects of using different CFME, equipment tyre wear and environmental factors. Effective interpretation of results can require normalization of test result data and factoring in issues that might affect the measurement data.

Chapter 4

Evaluation of Runway Surface Friction Assessment Results

4.1 Introduction

4.1.1 The friction level values obtained should be compared with the following criteria:

- The Design Objective Level (DOL)
- The maintenance Planning Level (MPL)
- The Minimum Friction Level (MFL)

4.1.2 The friction level values produced by different CFME vary slightly for any given runway surface friction characteristics; therefore, Table 3 indicates the correlation between the assessment criteria of CFME devices commonly in use Bangladesh.

Table 3 CFME and Friction Level Values

Test Equipment	Test Tire		Test Speed (Km/ h)	Test Water Depth (mm)	Design Objective for new Surface	Maintenance Planning Level	Minimum Friction Level
	Type	Pressure (kPa)					
Surface Friction Test Vehicle	B	210	65	1	0.82	0.60	0.50
	B	210	95	1	0.74	0.47	0.34

4.2 Action to be taken as a result of a runway friction assessment

4.2.1 The aerodrome operator should review the results of each runway friction assessment and where appropriate take the following action:

4.2.2 If the friction level is below the MPL, maintenance should be arranged to restore the friction level, ideally to a value equal to or greater than the DOL.

4.2.3 If the friction level indicates a falling trend, the Aerodrome Operator should increase the frequency of runway friction assessments in order to identify and further or rapid deterioration and, if appropriate, the action to be taken.

4.2.4 If the friction level is below the MFL, maintenance should be arranged urgently in order to restore the friction level and, in accordance with ICAO Annex 14 Volume 1 Paragraph 2.9.5, a NOTAM shall be issued advising that the runway

may be slippery when wet.

4.2.5 If the friction level is significantly below the MFL, the aerodrome operator should consider withdrawing the runway from use for take-off and/or landing when wet or lubricant/oil.

4.3 Assessments made following maintenance activities

4.3.1 The friction characteristics of some runway surface materials can improve over time, commonly as a result of the dispersal of oils in the surface layers. However, if the runway surface friction assessment indicates that the friction characteristics of an area of the runway that has been subject to maintenance work are poorer than anticipated or fall below the MPL, additional assessments should be performed over a period of time to ascertain whether the friction characteristics remain stable, improve, or if additional work should be carried out.

Table 4 Assessment Report No. 1

Runway Surface Friction Assessment

Summary of Runs

Airport	
Runway	
Date	

Run No.	Rwy Direction	Time UTC	Dist from C/L	Side of C/L	Speed (Km/h)	Run Length	Self-Wet On/Off	Surface Condition	Average Friction Value
Check 1									
Check 2									

Remarks

Table 5 Assessment Report No. 2

Runway Surface Friction Assessment

Results

Airport	
Runway	
Date	

Description	Applicable Runs	Friction Level
Friction Level for Central Portion	Run Numbers:	
Friction Level for Outer Portion (Right)	Run Numbers:	
Friction Level for Outer Portion (Left)	Run Numbers:	
Overall Friction Level	Average Value taken from all Standard Runs	

Is any portion of the runway below the MFL?	YES/NO
Remarks	
Action to be taken	
Recommended date of next assessment	

APPENDIX A – SAMPLE FRICTION TEST REPORT

A.1 Sample report

A sample friction test report showing typical test results follows.

2.0.1 Table: ICAO Friction Levels

	Design Objective Level	Above Maintenance Planning Level	Maintenance Planning Level	Minimum Friction Level
65 km/h	Greater than **0.73**	Between **0.73 & 0.52**	Between **0.52 & 0.42**	Less than **0.42**
95km/h	Greater than **0.63**	Between **0.63 & 0.36**	Between **0.36 & 0.24**	Less than **0.24**

*Swedish rounding has been used on the values presented in this report

5.1 Runway 02/20 65km/h

5.1.1 Table: Thirds averages Runway 02/20 - Testing at 65km/h

20/02 L6m 65km	20/02 L3m 65km	Zone	02/20 L3m 65km	02/20 L6m 65km
0.68	0.71	**First Third**	0.70	0.70
0.54	0.52	**Mid Third**	0.52	0.54
0.47	0.47	**Last Third**	0.50	0.51

5.1.2 Table: 100m averages Runway 02/20 - Testing at 65km/h

20/02 L6m 65km	20/02 L3m 65km	Chainage (m)			02/20 L3m 65km	02/20 L6m 65km
02 End						
0.93	0.78	0	>	100	0.75	0.70
0.80	0.85	100	>	200	0.68	0.76
0.78	0.82	200	>	300	0.69	0.72
0.72	0.79	300	>	400	0.78	0.73
0.67	0.68	400	>	500	0.71	0.75
0.66	0.63	500	>	600	0.72	0.68
0.60	0.64	600	>	700	0.73	0.71
0.58	0.65	700	>	800	0.70	0.65
0.59	0.61	800	>	900	0.65	0.65
0.60	0.66	900	>	1000	0.66	0.69
0.60	0.66	1000	>	1100	0.67	0.63
0.62	0.58	1100	>	1200	0.60	0.57
0.56	0.58	1200	>	1300	0.56	0.57
0.55	0.55	1300	>	1400	0.55	0.54
0.57	0.54	1400	>	1500	0.57	0.61
0.49	0.53	1500	>	1600	0.52	0.52
0.49	0.47	1600	>	1700	0.48	0.48
0.48	0.47	1700	>	1800	0.46	0.47
0.54	0.51	1800	>	1900	0.48	0.49
0.54	0.54	1900	>	2000	0.51	0.56
0.55	0.51	2000	>	2100	0.53	0.56
0.54	0.50	2100	>	2200	0.46	0.58
0.55	0.49	2200	>	2300	0.48	0.51
0.50	0.52	2300	>	2400	0.49	0.47
0.42	0.45	2400	>	2500	0.47	0.51
0.51	0.51	2500	>	2600	0.63	0.47
0.49	0.46	2600	>	2700	0.53	0.50
0.47	0.48	2700	>	2800	0.50	0.47
0.47	0.46	2800	>	2900	0.46	0.49
0.42	0.45	2900	>	3000	0.47	0.49
0.41	0.38	3000	>	3100	0.51	0.53
0.45	0.43	3100	>	3200	0.50	0.61
20 End						

Sample friction test report – Page 1 of 6

5.2 Runway 02/20 95km/h

5.2.1 Table: Thirds averages Runway 02/20- Testing at 95km/h

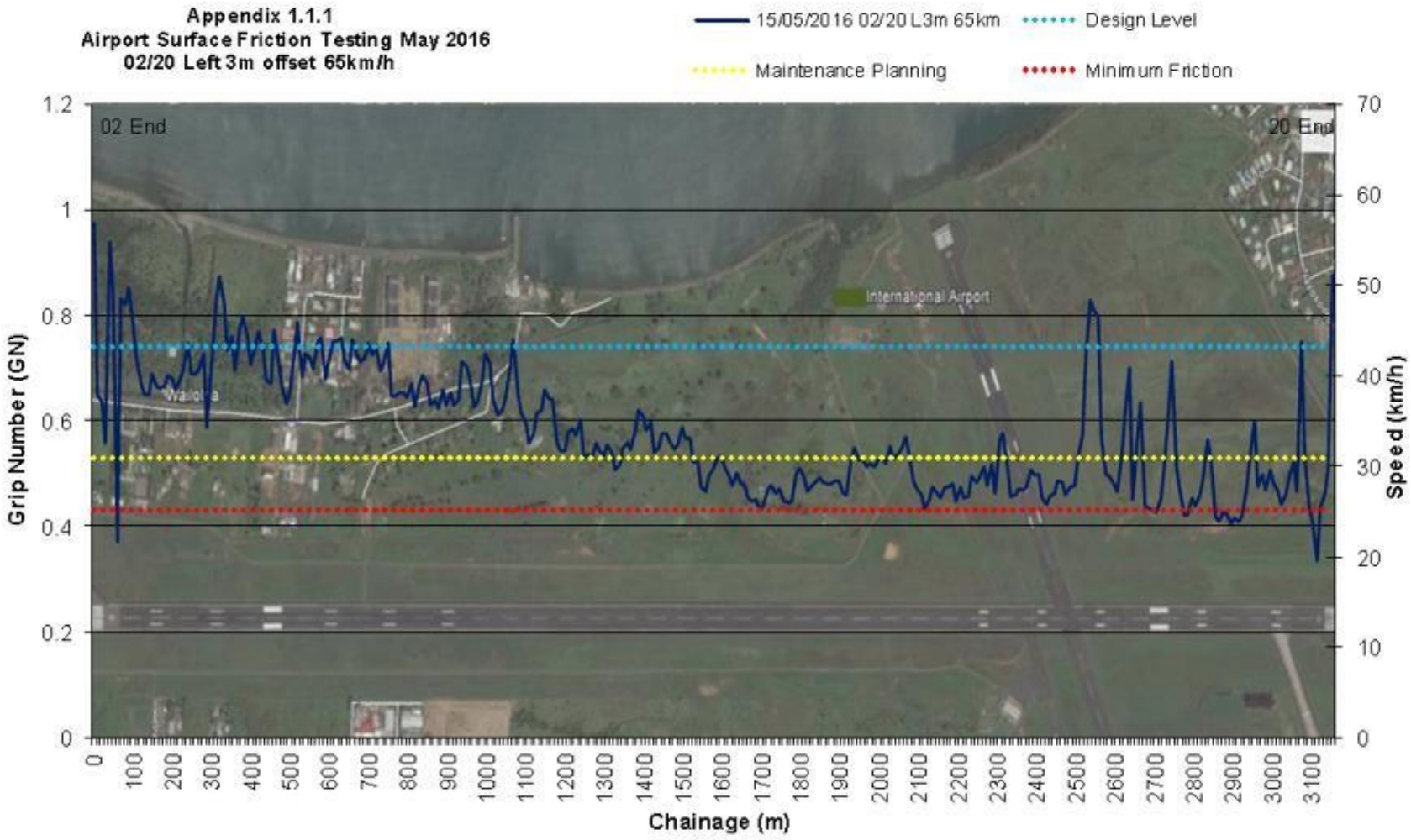
20/02 L6m 95km	20/02 L3m 95km	Zone	02/20 L3m 95km	02/20 L6m 95km
0.59	0.58	**First Third**	0.61	0.59
0.49	0.50	**Mid Third**	0.47	0.48
0.45	0.44	**Last Third**	0.50	0.45

5.2.2 Table: 100m averages Runway 02/20 – Testing at 95km/h

20/02 L6m 95km	20/02 L3m 95km	Chainage (m)	02/20 L3m 95km	02/20 L6m 95km
		02 End		
0.73	0.66	0 > 100	0.72	0.74
0.65	0.75	100 > 200	0.70	0.72
0.68	0.71	200 > 300	0.67	0.63
0.57	0.64	300 > 400	0.61	0.66
0.53	0.52	400 > 500	0.62	0.61
0.55	0.43	500 > 600	0.51	0.50
0.57	0.44	600 > 700	0.58	0.56
0.54	0.53	700 > 800	0.59	0.55
0.57	0.57	800 > 900	0.55	0.52
0.58	0.56	900 > 1000	0.57	0.57
0.56	0.56	1000 > 1100	0.54	0.48
0.55	0.54	1100 > 1200	0.54	0.61
0.53	0.52	1200 > 1300	0.51	0.51
0.49	0.49	1300 > 1400	0.49	0.48
0.51	0.49	1400 > 1500	0.49	0.49
0.45	0.48	1500 > 1600	0.46	0.44
0.45	0.46	1600 > 1700	0.44	0.46
0.46	0.44	1700 > 1800	0.42	0.43
0.47	0.51	1800 > 1900	0.41	0.45
0.50	0.51	1900 > 2000	0.52	0.50
0.47	0.59	2000 > 2100	0.46	0.43
0.50	0.46	2100 > 2200	0.42	0.50
0.48	0.44	2200 > 2300	0.52	0.49
0.47	0.45	2300 > 2400	0.48	0.43
0.48	0.52	2400 > 2500	0.43	0.53
0.52	0.51	2500 > 2600	0.53	0.49
0.48	0.43	2600 > 2700	0.55	0.48
0.46	0.45	2700 > 2800	0.47	0.43
0.43	0.42	2800 > 2900	0.44	0.44
0.43	0.42	2900 > 3000	0.50	0.45
0.36	0.36	3000 > 3100	0.61	0.46
0.43	0.39	3100 > 3200	0.50	0.31
		20 End		

Sample friction test report – Page 2 of 6

Appendix 1 Runway 02/20



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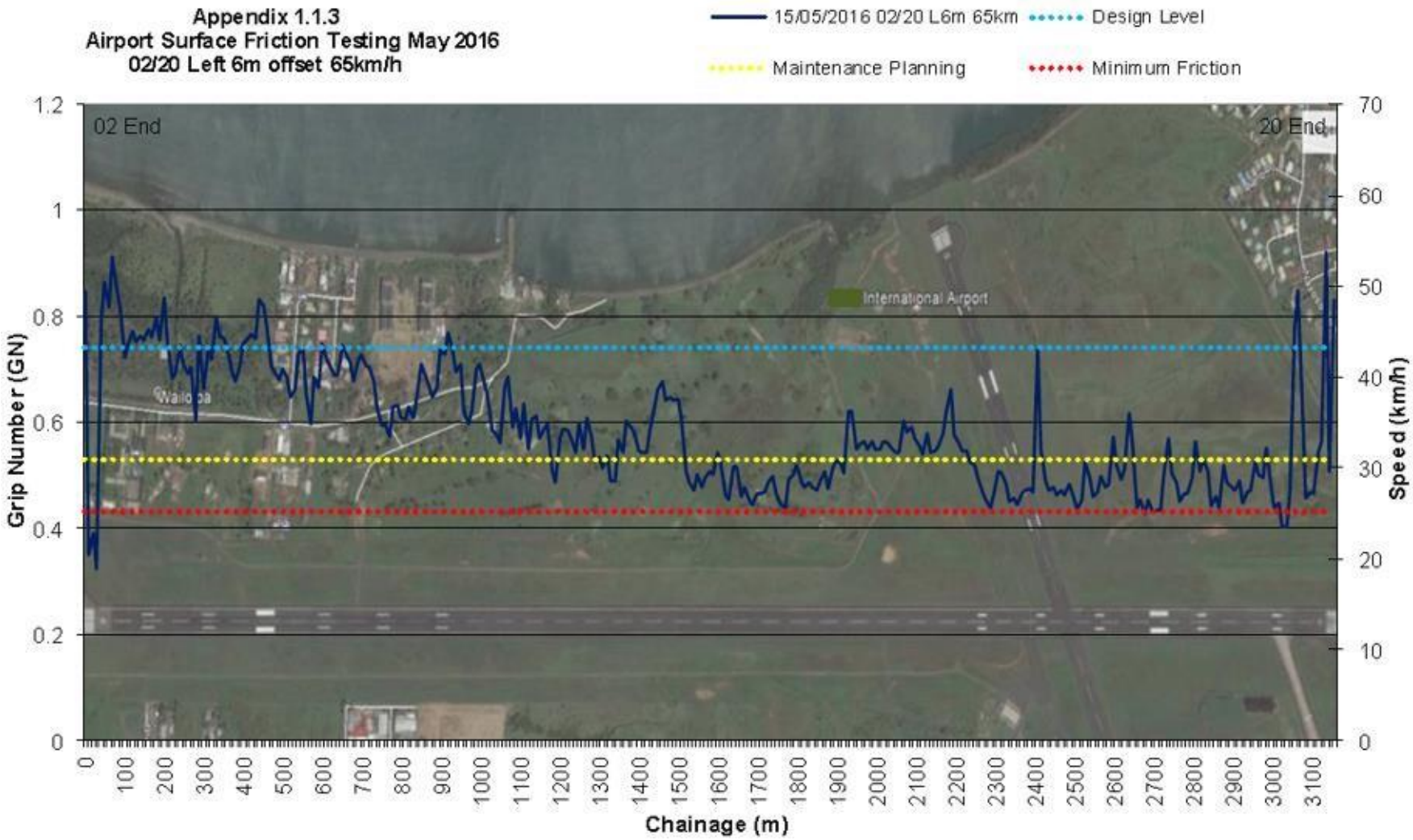
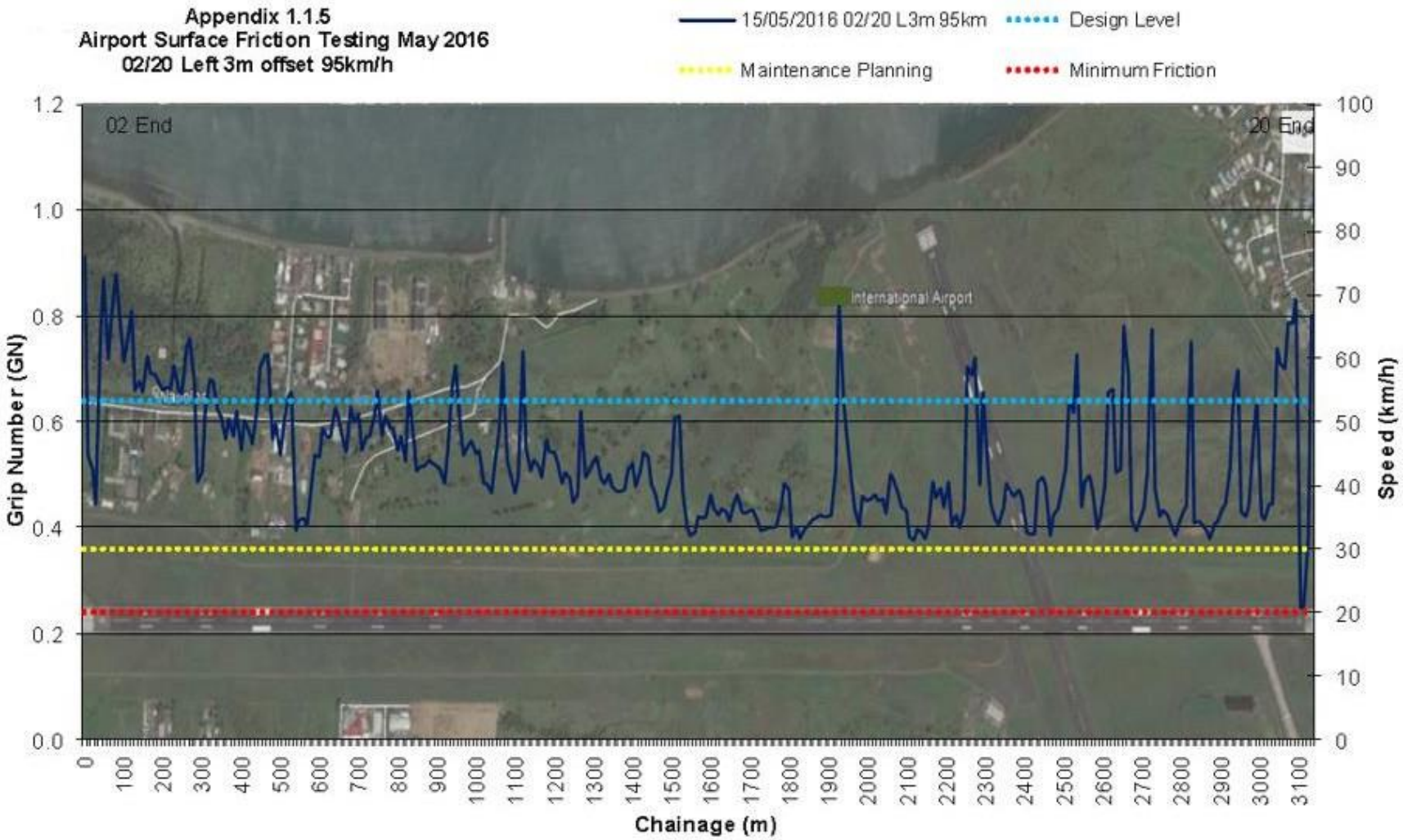


Sample friction test report – Page 4 of 6



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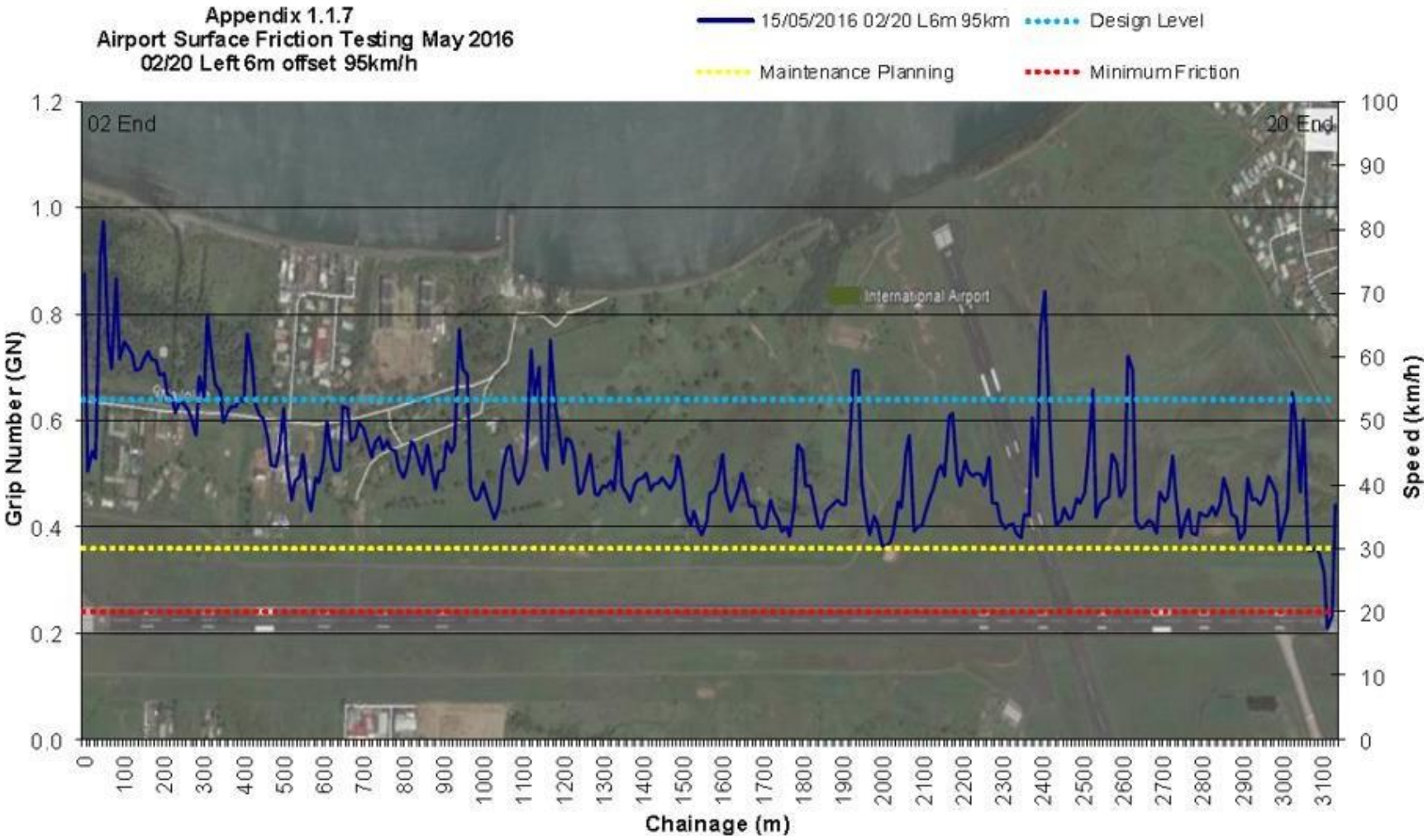

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