

Employer's Requirement for Temporary Apron Expansion and New Apron with Taxiways Design Aircraft Bombardier Global Express 6000

1. General Requirement of the Project

1.1 Scope

The project scope includes the Apron Expansion to east/west and New Apron with Taxiways including roads, shoulders and necessary AGL requirements. The infrastructural preparation such as excavation, dredging and transportation soil from designated borrow area for subbase preparation, backfill, grading, levelling and compaction, provision of water, electricity and the telecommunication service.

Structural designs shall be developed to the minimum standard and requirement for Global Express 6000 and complete in accordance with Maldives Civil Aviation Regulation MCARs 139.

1.2 Applicable Standards

1.2.1 All planning, design and construction works undertaken by the Developer/Contractor and his representatives shall, as a minimum, be in accordance with the laws, rules and regulations of the following Maldivian authorities:

Ministry of Transport and Civil Aviation (MoTCA)

Maldives Civil Aviation Authority (MCAA)

Island Aviation Services Limited. (IASL)

Environmental Protection Agency (EPA)

Other relevant bodies

In addition to the above, the following standards and recommended practices shall be adopted as the minimum requirements of all design and planning.

1.2.2 Maldives Civil Aviation Authority's (MCAA), Regulations: - MCAR, ASC, Civil Aviation Advisory Publications (CAAPs) & any other relevant regulations.

1.2.3 Where applicable, MCARs and ASCs take precedence over all other standards. When MCAA regulations do not exist, ICAO and other relevant standards shall be applied in that order of priority.

1.2.4 Applicable Regulation include, but are not limited to;

- ❖ Applicable MCARs include, but are not limited to :
 - ❖ MCAR 139 - Aerodrome Rules
 - ❖ MCAR 4 - Aeronautical Charts
 - ❖ Applicable Air Safety Circulars, but are not limited to:
 - ❖ ASC 139-5 Aerodrome Standards

 - ❖ ICAO Standards and Recommended Practices (SARPS)

1.2.5 The Developer shall ensure that at all times the planning, design and maintenance of the airside infrastructure and facilities of the Airport comply with the ICAO Standard and Recommended Practices (SARPs), including, but not restricted to the following:

ICAO Publications for reference:

Aerodrome Design Manual (Doc 9157)

Part 1 — *Runways*

Part 2 — *Taxiways, Aprons and Holding Bays*

Part 3 — *Pavements*

Part 4 — *Visual Aids*

Part 5 — *Electrical Systems*

Part 6 — *Frangibility*

Aeronautical Information Services Manual (Doc 8126)

Aero plane Performance Manual (Doc 10064)

Aircraft Type Designators (Doc 8643)

Airport Planning Manual (Doc 9184)

Part 1 — *Master Planning*

Part 2 — *Land Use and Environmental Control*

Part 3 — *Guidelines for Consultant/Construction Services*

Manual on Certification of Aerodromes (Doc 9774)

Procedures for Air Navigation Services — Aerodromes (PANS-Aerodromes) (Doc 9981)

*Procedures for Air Navigation Services — Aeronautical Information Management (PANS-AIM)
(Doc 10066)*

World Geodetic System — 1984 (WGS-84) Manual (Doc 9674)

2 Minimum Technical Requirements

2.1 Planning, designing and construction

2.1.1 Types of Aircraft expected to use the new apron area.

- ❖ Global Express 5000 with a seating capacity of 12-17 passengers
- ❖ Global Express 6000 with a seating capacity of 8-19 passengers
- ❖ Falcon 2000S/EX with a seating capacity of 10-17 passengers
- ❖ Challenger 650 with a seating capacity of 11 passengers
- ❖ Embraer Legacy 650E with a seating capacity of 12 passengers
- ❖ Falcon 8X with a seating capacity of 12-16 passengers
- ❖ Gulfstream G550 with a seating capacity of 19 passengers
- ❖ Gulfstream G650ER with a seating capacity of 13 passengers
- ❖ Global 7500 with a seating capacity of 19 passengers

2.1.2 Critical Aircraft

The Critical Aircraft selected for runway pavement design is Global Express 6000 with a seating capacity of 19 passengers.

2.1.3 Pavement Design:

All designs shall comply with ASC 139-5, ICAO Annex 14 and ICAO Aerodrome Design Manual Part 1,2,3 with respect to physical clearances and safeguarding, the British (BS), AASTHO, ASTM or equivalent Standard. The traffic mix of aircraft is proposed based on the understanding and discussion with the Employer the Island Aviation Services Limited (IASL) the present expectations for proposed Temporary Apron would require to design apron pavements for 25 business jets per week over the next ten years which is 13,000 total movements and the pavement life is considered 10 years as recommended and suggested. Based on the above assumption with a traffic figure prediction it has been decided to adopt Bombardier Global Express 6000, maximum take-off weight (MTOW) 45,200 as the design aircraft and the expected traffic figures as given shows less than 1018 equivalent movements a year.

The calculations for the pavement design will finalised and provide upon confirmation of CBR test results.

2.1.4 Slopes on Taxiways and Apron

- ❖ Taxiways and Apron shall comply with the requirements of ASC 139-5, ICAO Annex 14 and ICAO Aerodrome Design Manual Part 1 & 2 and, where stands are used for aircraft refueling with NFPA 415. In any case, apron slopes shall not be less than 0.5% in any direction to facilitate positive drainage.
- ❖ Pavement markings, signage and AGL shall be in accordance with the ASC 139-5, ICAO Annex 14, ICAO Aerodrome Design Manuals 4 & 5.

2.1.4 Airside roads

- a) Airside roads shall be provided to facilitate safe and efficient operation and movement of airside vehicles. The road system shall provide;
- ❖ Access to aprons
 - ❖ Connections between aprons passenger terminal building including, ground support equipment areas
 - ❖ Connections and approaches to rescue and firefighting stations
- b) The layout and operating strategy of the network shall be established in the master plan and developed during the design process to demonstrate the adequacy of the proposed system. It shall be designed to provide as direct a route as possible between facilities and shall have sufficient capacity to avoid traffic congestion at junctions at peak periods of operation.
- c) Road geometry and structure shall be designed to suit the characteristics of the vehicles operating and in compliance with relevant requirements of GOM highway design standards where appropriate. Clearances to roads from operational airside areas shall be in accordance with the minimum requirements of MCARs.
- d) Pavements shall be a flexible construction and shall be designed to GOM Highway Design Standards where these exist, otherwise to recognized international standards. Flexible pavements shall be designed to have a 10 year design life.
- e) Airside and Land side roads shall be suitably marked and signed be in accordance with the recommendations of MCAA, ICAO, Transport Authority of Maldives to ensure that priority of turn and direction is clearly shown

2.1.5 The basic parameters for facility planning.

The annual demand for Noonu Maafaru Airport is calculated based on traffic records for the last one year and are tabulated in the table below:

Type of Aircraft	Year	Arrivals	Departures
Bombardier Global Express 6000	2020	47	47
Falcon Series	2020	91	91
Challenger 650	2020	18	18
Embraer Legacy 650E	2020	16	16
Gulf Stream 200	2020	21	21
Gulf Stream 550	2020	19	19
Gulf Stream 450	2020	19	19
Gulf Stream 600	2020	24	24
Bombardier Global Express 5000	2020	139	139

2.1.6 Basic Aerodrome physical requirement

The Scope of the Airport is based on the requirements outlined below:

Assumed Elevation:	As shown in the drawings
Taxiway Length:	112.50 m
Taxiway Width:	15.00 m
Apron Length:	As shown in the Drawing
Apron Width:	As shown in the Drawing
Transverse gradient:	1.0% for Taxiway. 0.5% for Apron
Transitional surface:	1:7 slope
Pavement Classification (PCN)	Estimated PCN- 37

2.1.7 Flexible Pavement

Flexible pavements consist of a hot mix asphalt wearing surface placed on a base course and when required by subgrade conditions a sub grade. The entire flexible pavement structure is ultimately supported by the subgrade. Definitions of the function of the various components are given in the following paragraphs.

Soil Data

The proposed Design is prepared based on the visual inspection assuming that 10% CBR will be achieved at a minimum in all area required. Final Design will be issued upon confirmation of CBR Test Results.

Subgrade

The subgrade soil are subjected to lower stresses than the surface, base and subbase courses. Subgrade stresses attenuate with depth, and the controlling subgrade stress is usually at the top of the subgrade, unless unusual conditions exist. Unusual conditions such as a layered subgrade or sharply varying water contents or densities can change the location of the controlling stress. The ability of a particular soil to resist shear and deformation vary with

its density and moisture content. Such unusual conditions should be revealed during the soil investigation.

Specification Item P-152*, excavation and embankment, covers the construction and density control of subgrade soils. The CBR of sub-grade shall be 15% of field soil.

Subbase

A sub base and embankment layers are included as an integral part of the flexible pavement structure in all pavements except those on subgrades with CBR value of 20 or greater. The function of the subbase is similar to that of the base course. However, since it is further removed from the surface and is subjected to lower loading intensities, the material requirements are not as strict as for the base course. In the development of pavement thickness requirements, the CBR value of the subbase course is a variable. FAA has recommended the following material and Specifications covering the quality of components, gradations, manipulation control and preparation of various types of subbase courses for use on airport. The Item P-154* – Subbase Course GSBC (Granular Sub-base Course) material with CBR more than 20 is equivalent to P-154*. Dredged Sand material in Maldives is generally more than 20% CBR which is also equivalent to P-154 and can be used for the preparation of Sub –base and embankment layers. Therefore, Dredged Sand Material will be used for Sub-base and embankment layers.

CBR value of the sub-grade and sub-base are taken as 10% and 20% respectively.

(Normally CBR value of coarse sand is between 20-50%, but for dredged coral sand this is between 40-85%) as experienced throughout the Maldives.

Base Course

The base course is the principal structural component of the flexible pavement. It has the major function of distributing the imposed wheel loadings to the pavement foundation, the subbase and / or subgrade. The base course must be of such quality and thickness to prevent failure in the subgrade, withstand the stresses produced in the base itself, resist vertical pressures tending to produce consolidation and resulting in distortion of the surface course, and resist volume changes caused by fluctuations in its moisture content. The quality of the base course depends upon composition, physical properties and compaction. Many materials and combinations thereof have proved satisfactory as base courses. They are composed of select, hard and durable aggregates. Specifications covering the quality of components, gradation, manipulation control and preparation of various base materials for use on airports. FAA has recommended the material and item P-209* crushed aggregate for Base Course, meets to BS812 and in India the W.M.M/W.B.M. is also equivalent material of P-209*.

Hot Mix Asphalt Surfacing

The hot mix asphalt surface or wearing course must prevent the penetration of surface water to the base course provide a smooth, well bonded surface free from loose particles which might endanger airplanes or persons, resist the shearing stresses induced by airplane wheel loads and furnish a texture of nonskid qualities, yet not cause undue wear on tires. To successfully fulfill these requirements the surface must be composed of mixtures of aggregates and bituminous binders which will produce a uniform surface of suitable texture possessing maximum stability and durability. Since control of the mixture is of paramount importance, these requirements can be achieved by use of a central mixing plant where proper control can be most readily obtained. A dense graded hot mix asphalt concrete such as Item P-401/P-403* produced in a central mixing plant will most satisfactorily meet all the above requirements. Whenever a hot mix asphalt surface is subject to spillage of fuel, hydraulic fluid or other solvents such as at airplane fueling positions and maintenance areas, protection should be provided by a solvent resistant surface. In India the bitumen macadam semi dense asphalt concrete, dense asphalt concrete with (4% - 4.5%) to 5.5% Bitumen will be equivalent to P-401 & P-403*.

Design Life

The design life of pavement is considered 10 years as recommended and suggested.

Traffic Mix

Since the life of pavement is considered 10 years, traffic that is A.T.M (Annual Traffic Movement) shall be considered for 10 years with an annual departure movement (ATM) of the Aircraft given.

NO	AIRCRAFT	GEAR TYPE	FORECAST ANNUAL DEPARTURES	MAXIMUM TAKEOFF WEIGHT	
				(lb)	(kg)
1	Bombardier Global Express 6000	Dual wheel	141	99,570	45,200
2	Falcon Series	Dual wheel	273	70,492	32,000
3	Challenger 650	Dual wheel	54	42,295	19,200
4	Embraer Legacy 650E	Dual wheel	48	53,750	24,400
5	Gulf Stream 200	Dual wheel	63	35,466	16,100
6	Gulf Stream 550	Dual wheel	57	91,199	41,400
7	Gulf Stream 450	Dual wheel	57	74,898	34,000
8	Gulf Stream 600	Dual wheel	72	91,640	41,600
9	Bombardier Global Express 5000	Dual wheel	531	96,927	44,000

Consider the aircraft indicating their aircraft ATM (Air traffic movement) for design purpose.

NO	AIRCRAFT	FORECAST ANNUAL DEPARTURES	MAXIMUM TAKE-OFF WEIGHT	
			(lb)	(kg)
1	Bombardier Global Express 6000	141	99,570	45,200
2	Falcon Series	273	70,492	32,000
3	Challenger 650	54	42,295	19,200
4	Embraer Legacy 650E	48	53,750	24,400
5	Gulf Stream 200	63	35,466	16,100
6	Gulf Stream 550	57	91,199	41,400
7	Gulf Stream 450	57	74,898	34,000
8	Gulf Stream 600	72	91,640	41,600
9	Bombardier Global Express 5000	531	96,927	44,000

CBR Value & Soil investigations

It is observed that after moving top soil the mixture fine coral sand mixed with black soil and further the depth of layer with white soft bed of row the average density of soil 1.52g per mm³ and moisture content 13% with dry density 1.3g per mm³ The CBR value of the area various 21.7% to 41.3% at different places. For design purposed the CBR value has been taken 10% and equivalent K value 6.4kg.per cm³

Design Aircraft

It has been decided to adopt Global Express 6000 Aircraft for design purpose therefore gear wheel of all the aircraft shall be converted to Dual wheel arrangement Applying conversion factor that is consider 1 for dual wheel arrangement.

Equivalent Departure of aircraft that is Global Express 6000

As every Aircraft as different weight, the effect of each Aircraft will be change to equivalent departure of ATR 72-600 with the following formula: $\log R1 = \log R2 \times (w2/w1)^{1/2}$

Departure of Designed Aircraft that is Global Express 6000

As there are different weight of aircraft having dual wheel arrangement, the equivalent departure will be worked out for Global Express 6000

NO	AIRCRAFT	DUAL GEAR DEPARTURES, R2	WHEEL LOAD, W2		WHEEL LOAD OF DESIGN AIRCRAFT, W1		EQUIVALENT ANNUAL DEPARTURES OF DESIGN AIRCRAFT, R1
			(lb)	(kg)	(lb)	(kg)	
1	Global Express 6000	156	23,648	10,735	23,647.94	10,450	126
2	Falcon Series	302	16,742	7,600	23,647.94	10,450	122
3	Challenger 650	60	10,045	4,560	23,647.94	10,450	14
4	Embraer Legacy 650E	53	12,766	5,795	23,647.94	10,450	18
5	Gulf Stream 200	70	8,424	3,824	23,647.94	10,450	13
6	Gulf Stream 550	63	21,661	9,883	23,647.94	10,450	53
7	Gulf Stream 450	63	17,788	8,075	23,647.94	10,450	36
8	Gulf Stream 600	80	21,764	9,880	23,647.94	10,450	67
9	Global Express 5000	587	23,024	10,450	23,647.94	10,450	539
TOTAL							1018

Design Calculation

The flexible pavement is designed based on the requirement

Aircraft =Bombardier Global Express 6000 (Code-C), Weight – 45,200 kg.

Wheel Arrangement = dual

CBR of sub grade = 10% (Final Design will be issued upon confirmation of CBR Test Results)

Refer Figure 4-37 of Reference [1] International Civil Aviation Organization, "AERODROME DESIGN MANUAL – PART- 3. Page 3-151. The Pavement thickness over subgrade of CBR 10%is 450mm (say 45cm).

Sub Base Course

The thickness of the sub-base course is determined in a manner similar to the total pavement thickness. Combined thickness of sub-base, base course and bituminous surface needed over 10% CBR is 450mm (45cm), thus having base course and wearing course for CBR - 20% thickness of 170mm (17cm).

Base Course

The thickness of the base course & wearing course can be computed by subtracting the thickness of wearing course from the combined thickness of wearing course and base course determined above.

Note that, as per Para. 4.4.17.5 of page 3-162 of reference [1] the minimum base course thickness is + wearing course thickness is 250 mm(25cm).

Top Wearing Course

As indicated in Para. 4.4.17.4 of the page 3-162 of reference [1], the thickness of bituminous surface for critical areas is minimum 75mm (7.5cm) and for non-critical areas minimum 100mm (75cm)

2.1.8 Preliminary Pavement Structure

Pavement structure is assumed based on the visual existing records to estimate the project cost. Final pavement design calculations, Soil investigation data, detail drawings will be finalized upon the completion of site investigations and survey conformity assured by the Contractor. It is also the responsibility of Contractor to check the pavement details proposed for sub grade, sub base, base and wearing course for the conformity of the layer details stated under item – (a), (b), (c) (d) and (e). Any variation in quantity beyond 10% accepted by **Employers'** Consultant after the Contractor 'survey will be considered as a variation order.

The proposed final design thicknesses based on the above pavement calculations are shown below:

Sub-base	300mm
Aggregates Base Course (ABC)	150 mm
Asphalt Wearing Course (WC)	100 mm
Total Pavement Thickness	550 mm

a) Embankment & Subgrade

- ❖ Compacted sub grade
- ❖ Shall have min CBR Value 20%
- ❖ Embankment layers' thickness should not be exceeding 200 mm

- ❖ This Item shall consist of the construction of embankment layers in accordance with the Specification and in conformity with the lines, grades and dimensions shown on the approved plans or as finalized by the Design Consultant.

- ❖ Material for embankment layers shall consist crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand, dredged sand or other finely divided mineral matter.

- ❖ The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable sub base.
- ❖ The material used in preparation shall be dredged sand or crushed gravel and crushed stone and shall be approved by the Employer/Consultant material in placed.
- ❖ It is also the responsibility of the Contractor and verify the conformity of the material at site and sourcing the material for any additional requirement to complete the job. No additional payment shall be claimed for such quantity requirement.

b) Sub base Course

- ❖ Compacted sub base material
- ❖ Shall have min CBR Value 40%
- ❖ Layers thickness should not be exceeding 150 mm
- ❖ This item shall consist of furnishing, placing and compacting local material sub base course on a prepared subgrade in accordance with the Specification and the lines, grades and cross-sections shown on the approved plans, or as directed by the Design Consultant.
- ❖ Material shall have crushed stone, crushed gravel or combination of both and shall be free from organic or other deleterious constituent.
- ❖ The material passing from 425 microns/0.425mm Sieves shall have PI value and liquid limit not more than 6 and 25 respectably.
- ❖ The crushed gravel and crushed stone of size 53mm to 9.50mm shall be not more than 60 to 65% and material passing 4.75mm shall not be more than 35 to 40%.
- ❖ The material used in preparation shall be dredged sand or crushed gravel and crushed stone and shall be approved by the Employer/Consultant material in placed.
- ❖ Material for sub base shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand, dredged or other finely divided mineral matter.

- ❖ The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable sub base.
 - ❖ It is also the responsibility of the Contractor and verify the conformity of the material at site and sourcing the material for any additional requirement to complete the job. No additional payment shall be claimed for such quantity requirement.
- c) Aggregate Base Course
- ❖ Crushed aggregates compacted (ABC)
 - ❖ Shall have min CBR Value 80%
 - ❖ Shall have a crushed stone and crushed gravel or combination of both. It shall have at least two fractured face. The water observation value of the aggregate shall not be more than 2% and shall not be flaky.
 - ❖ The material passing from 425 microns/0.425mm Sieves shall have PI value and liquid limit not more than 6 and 25 respectably.
 - ❖ The crushed stone or gravel having a size 45 to 11.2mm and shall not be more than 60% and material passing 4.75mm shall not be more than 40%.
 - ❖ This Item shall consist of furnishing, placing and compacting crushed gravel, crushed stone or crushed rock on a prepared subgrade/sub base in one or more layers in accordance with this Specification and lines, grades, thickness and typical cross-sections shown on the approved plans, or as directed by the Design Consultant.
 - ❖ Material shall consist of hard, durable particles or fragments of stone or gravel crushed to the size and of the single requirements of this Item. It shall be clean and free from vegetable matters, lumps or balls of clay and other deleterious substances. The material shall be of such nature that it can be compacted readily to form a firm, stable base.
 - ❖ The base material shall conform to the grading requirements under BS 812, AASTHO-147, ASTM or Equivalent Standard acceptable to the Employer/Consultant.
- d) Asphalt Wearing Course
- ❖ This Item shall consist of Mixing, transporting, furnishing, placing and compacting the asphalt concrete material on a prepared base in one or more layers in accordance

with the Specification and lines, grades, thickness and typical cross-sections shown on the approved plans, or as directed by the Design Consultant.

- ❖ This layer shall be laid in 2 layers or as directed by Consultant upon conformity of materials. Aggregate – Stone aggregate shall be used 19mm to 13.2mm size and 45 to 50% of total quantity. The fine aggregate shall pass through 4.75mm and shall be used nearly 50 to 55%. Stone aggregate shall be used 25mm to 13.2mm size and 55% of total quantity. The fine aggregate shall pass through 4.75mm and shall be used nearly 45%.
 - ❖ Bitumen grade 60/70 nearly not more than 5.5% by weight of mix shall be used. Trial shall be conducted to arrive final percentage.
 - ❖ The TACK Coat of (CSS1), Bitumen shall be provided at the bottom of each layer asphaltic concrete.
 - ❖ The whole of the bituminous surfacing works shall be carried out by an experienced specialist work force / firm / sub-contractor organized by Contractor. The Contractor shall have satisfied the Employer/Consultant at the time of tendering that the type of plant(s) proposed for use has the necessary capacity and that the delivery facilities are adequate for the smooth progress of the Works. Details of work experience records, including plant specification shall submit to the **Employer/Consultant** for approval. Trial sections shall be conducted upon acceptance of approval procedures.
- e) Shoulder
- Taxiways, Apron & Roads
- ❖ Compacted dredged material as shown in cross section. ❖ CBR value shall be not less than 40%
- f) Cut-fill, grade & compaction
- ❖ Shoulder for runway, apron and, shall be graded and compacted to not less than CBR value 40%. The area effected due to the construction works shall also be graded and compacted to the requirement of **Consultant/Employer.**

2.1.9 Min Standard & Quality Acceptance

a) Quality Control Tests

- ❖ Design Consultant shall finalize and provide to the contractor minimum quality control tests requirements in the construction specification in accordance with BS, AASTHO, ASTM or Equivalent Standard acceptable to the Employer/Consultant upon completion

b) Embankment & Subgrade layer

- ❖ Max dry density (MDD) – 1/9000sqm
- ❖ Optimum Moisture Content (OMC) – 1/9000sqm
- ❖ Field density test (FDT) – 1/3000sqm
- ❖ CBR test soaked/un soaked – one test on each type of soil
- ❖ Level control – Tolerance plus/minus 20-30
- ❖ Subbase Course
- ❖ Max dry density (MDD) – 1/9000sqm
- ❖ Optimum Moisture Content (OMC) – 1/9000sqm
- ❖ Field density test (FDT) – 3/3000sqm
- ❖ CBR test soaked/un soaked – one test on each type of soil
- ❖ Los Angeles Abrasion test – one test on each type of soil
- ❖ Gradation – one test on each type of soil
- ❖ Level control – Tolerance plus/minus 10-20 mm

c) Base Course

- ❖ Max dry density (MDD) – 1/9000sqm
- ❖ Optimum Moisture Content (OMC) – 1/9000sqm
- ❖ Field density test (FDT) – 3/2000sqm
- ❖ CBR test soaked/un soaked – one test on each type of soil
- ❖ Impact Value
- ❖ Flakiness & Elongation
- ❖ Crushing Value
- ❖ Plasticity index & Liquid Limit
- ❖ Los Angeles Abrasion Value – one test on each type of soil
- ❖ Specific Gravity of Aggregates
- ❖ 10% fines Value
- ❖ Soundness of Aggregates
- ❖ Gradation – one test on each type of soil

- ❖ Level control – Tolerance plus/minus 10 mm

d) Asphalt Wearing Course

- ❖ Marshal Stability Test – 1/3000sqm
- ❖ Surface Regularity Test
- ❖ Impact Value
- ❖ Flakiness & Elongation
- ❖ Crushing Value
- ❖ Plasticity index & Liquid Limit
- ❖ Los Angeles Abrasion Value – one test on each type of soil
- ❖ Specific Gravity of Aggregates
- ❖ 10% fines Value
- ❖ Soundness of Aggregates
- ❖ Combine Gradation – one test on each type of soil
- ❖ Sieve Analysis
- ❖ Binder Content Test
- ❖ Bitumen Emulsion Test

e) Level control – Tolerance plus/minus 06 mm

- f) Pavement Strength Evaluation: - Pavement Clarification Number (PCN) – shall comply to the Standardized International Civil Aviation Organization (ICAO) method, and shall be to the acceptance of Maldives Civil Aviation Authority (MCAA).

2.1.10 Airfield Lighting System

Airfield Lighting System shall comply with the ICAO International standards and recommended practices for Aerodromes given in Annex 14, Volume 1 for Aerodrome Design and Operations. Reference should also be made to Aerodrome Design Manual Part 4 – visual aids and Part 5 – Electrical Systems and Maldives Civil Aviation Authority (MCAA).

The detailed design and preparation of shop drawings is the sole responsibility of the Contractor.

This specification and description is intended only to set out the minimum requirements and it is expressly understood and agreed by the Contractor that anything which is usually furnished as a part of such installation which is necessary for its proper completion, execution and function shall be furnished as a part of this specification without additional

costs and extension of time whether or not shown in details on the drawings or described in particular hereinafter.

The technical documentation shall include all layouts, calculations, shop drawings, material submittals, as built drawings etc. as necessary for complete installation.

Apron and Taxiway edge lights

Taxiway Edge Light (Retro-reflective blue markers). Should be spaced at intervals as shown in the drawing.

Apron Flood Lighting

Apron flood lighting has to be fixed on masts so as to minimize shadows and glare to the pilot. Apron flood Lights shall be fixed on three masts of height 12m. 02 lights on each mast aligned for best illumination. On each light 2 metal halide fittings and lamps are preferred. Mast should be painted with red and white.

An obstruction light shall also be fixed on top of the mast, if it is considered as an obstacle.

- ❖ Lamp Power rating: 4 x 2 x 400W
- ❖ Obstruction lamp rating: 60W
- ❖ Input Power supply: 220V connected to mains supply through a lamp Switching-gear box

Cabling and Cable Trench

The Contractor shall provide the following minimum guarantee for each cable that the cable has been supplied and shall perform in accordance with the manufacture's specification and that any defect in material or workmanship that may occur during proper and normal use during a period of 1 year from the date of installation or a maximum of 2 years from date of shipment will be corrected or replaced by the Contractor. Trenching is required only for Apron Flood Lights

Minimum size of the cable trench shall 300 mm wide and 600 mm deep. Cable route must be straight and the cable route layout shall be approved before trench excavation is done. After completion of the laying the cable the trench should be filled with suitable and acceptable sand including light compaction to the satisfaction of the **Employer / Consultant.**

Testing – General

Upon completion of the installation, the contactor shall perform field tests on all cables, materials and systems. All tests shall be conducted in the presence of the **Employer/Consultant's** Engineer for the purpose of demonstrating system compliance with the Specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the procedures, test observations and expected results.

All tests shall be made with proper regard for the protection of the personnel and equipment and the contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The costs of any damages or rectifications works due to any accident during the testing shall be the sole responsibility of the contactor. Copies of all test data and results certified by the Engineer shall be given to the **Employer/Consultant** for record purpose.

The witnessing of any tests does not relieve the contactor of his guarantees for materials, equipment's and workmanship or as any other obligations of the contact.

Earth Resistance Tests

Earth resistance tests shall be made by the contactor on the airfield earthing system, separating and reconnecting earth connection.

The complete lightning protection system shall be tested for continuity and earth resistance. The combined earth resistance at any point in the lightning protection system shall not exceed 10 ohms.

Other related Works

Other related works not specified shall be submitted for approval and approved before start the works. All the bases of the lights shall be design for Mass Concrete, RC Concrete shall be laid for Apron flood lights as per the approved design drawing and in accordance with Manufacture/Suppliers instruction.

Taxiway and Apron Marking

Marking Paint specification shall be approved from the **Employer/Consultant** before purchase. Taxiway markings shall be carried as shown in drawing. Apron Marking shall be done as per the requirement of the Employer.

3. Design Deliverables by Employer:

Employer is responsible to organize and submit design drawings and calculations with engineering detail drawings for Temporary Apron Expansion and New Apron with Taxiways including roads, shoulders and necessary AGL requirements.

3.1 The design deliverables shall include:

Design brief, preliminary design and technical specifications.

- a) Pavement Structural Design Analysis: (upon submission of site surveys) ref: 57 1)
Pavement Design Calculation Report,
 - 2) Construction Specification
- b) General Layout drawings as mentioned:
 - 3) Site Plan, for Temporary Apron Expansion & New Apron. Layout shall include Runway, Taxiways and Apron, Service roads, Shoulder Airfield Making, and other relevant structures in as required in the design,
 - 4) General Layout for Temporary Apron Expansion & New Apron. Layout shall include Runway, Taxiways and Apron, Service roads, Shoulder Airfield Making, and other relevant structures in as required in the design,
 - 5) Surface Level Layout for Temporary Apron Expansion & New Apron. Layout shall include Runway, Taxiways and Apron, Service roads, Shoulder and other relevant structures in as required in the design,
 - 6) Lighting Layout for, Temporary Apron Expansion & New Apron and Taxiways.
 - 7) Layout shall include Taxiways and Apron, Service roads, and other relevant structures in as required in the design,
 - 8) Service Duct Layout for Electrical Distribution for Lighting System & Lighting Protection System including general electrical, water supply and Sewerage disposal system as required,

- c) Detail Layout and construction detail drawings as mentioned:
 - 1) Detail Layout for Temporary Apron Expansion & New Apron. Layout shall include Taxiways and Apron, Service roads, Shoulder and other relevant structures in as required in the design, with construction details,
 - 2) Detail Surface Level Layout for Temporary Apron Expansion & New Apron. Layout shall include Runway, Taxiways and Apron, Service roads, Shoulder and other relevant structures in as required in the design, with construction details,
 - 3) Detail Marking Drawings for, Temporary Apron Expansion & New Apron and Taxiways. Layout shall include Taxiways and Apron, Service roads, and other relevant structures in as required in the design,
 - 4) Detail Service Duct Drawings for, Electrical Distribution for Lighting System & Lighting Protection System including general electrical, water supply and Sewerage disposal system as required, with construction details,
- c) Detail Layout and construction detail drawings as mentioned:
 - 1) Typical Cross Sections for Temporary Apron Expansion & New Apron. Layout shall include Taxiways and Apron, Service, Shoulder roads and other relevant structures in as required in the design, with construction details,
- d) All approved drawings in PDF format and upon request of the **Employer/Consultant** shall submit in CAD format,
- e) The approval of a design by Employers' Consultant does not alleviate the Contractor from his responsibility of providing quality and professional work to the satisfaction of the **Employer/Consultant**.

4. Design Compliance

The Design Consultant must ensure that the materials and aggregates which are incorporated into any pavement materials have been checked and approved by **Employers' Consultant** before incorporation into the works. No works will be allowed to start on site unless both the technical design and the Method statement are approved.

On completion of the works the Designer must sign a certificate which clearly states that all works have been completed in compliance with their design.

5. Main Responsibilities of the Contractor

5.1 The Contractor shall ensure that at all times the planning, design, construction and maintenance of the infrastructure and facilities of the Scope comply with the Standards and Recommended Practices specified under the following reference clauses:

a) The Contractor shall furnish all construction material and works as referred below:

- ❖ Ref Clause – Under 1.1 Project Scope
- ❖ Ref Clause – Under 1.2 Applicable Standards
- ❖ Ref Clause – Under 2. Minimum Technical Requirements ❖ Ref Clause – Under 3. Design Deliverables by Employer:
- ❖ Ref Clause – Under 4. Design Compliance

5.2 Contractor is responsible to check the conformity of the levels shown proposed drawings **approved** by the Employer. Any additional drawings that may require for the construction will done upon contractor's requirement after the completion of contractor's necessary surveys.

5.3 Full time representative shall be assigned to inspect the conformity of the works ready for construction to produce sign off certificates for the works have been completed in compliance with the design and standard **approved by the Employer.**

5.6 Perform all the works specified in the Bills of Quantities as per the drawings and specifications approved by **Employer's** Consultant.

5.7 Carry out all necessary site surveys and tests required to finalise and approve the detail design and drawings proposed for the construction.

5.8 The Contractor shall obtain all necessary environmental regulatory permits such as required to execute the works.

5.9 The Contractor shall appoint a Project Manage/Engineer to manage and execute the works during the project period.

5.10 The Contractor shall maintain all record of the deviations in construction of Permanent Works from Construction drawing for the preparation of As-built Drawings and these shall report to the **Employer's Consultant/ Representative at Site.**

5.11 These records shall be maintained in one master copy (paper copy) of the construction drawings and subsequently updated on the CAD drawings. Upon completion of the Works or at such time as agreed to or required by Consultant, the Contractor shall prepare drawings which, subject to the notice of Consultant, shall become As-Built Drawing. All such drawings shall be

endorsed by the **Employers'** Consultant and Contractor as true records of the construction of the Works and shall be submitted to the Employer.

As-built drawings shall be editable in CAD and PDF format.

5.12 Material for the sub base preparation shall be organized by Contractor within the boundaries allowed in the EIA Report.

6 Mobilization and Demobilization

6.1 Scope of Works

- a) This item includes mobilization and demobilization of all constructional plant, and equipment, including testing equipment deemed necessary to complete the Works.
- b) The Contractor shall mobilize and deliver all constructional plant and equipment required to undertake the works and all the materials for any temporary facilities required.
- c) Mobilization shall include the importation and transportation to the job-site of all equipment, constructional plant and all necessary items for the execution and completion of the works. Mobilization shall also be deemed to include any site clearance work that is necessary.
- d) It is the responsibility of the Contractor to ensure that all plant and equipment brought for the project are in working condition. In the event of a break-down of constructional plant/equipment when it is beyond the ability of the personnel or when there are insufficient tools or materials at site to affect a repair in a reasonable time, the Contractor will be instructed to provide a replacement for the same at no additional cost (including mobilization) to the Owner. In such a case, no extension will be given for completion of Works. The Contractor may also be required to remove the broken plant from the Site if it is hindering the completion of any components of the Project.
- e) Demobilization shall include the removal from site of all constructional plant and equipment and the removal of all temporary facilities erected by the Contractor for his convenience.
- f) Mobilization costs of plant and equipment referred to herein shall be paid after the Consultant / Engineer has certified and accepted that all equipment listed for the Project and material for Temporary Works have been delivered to site or part three off, as the requirement deemed necessary.
- g) Demobilization costs shall be paid after the Consultant / Engineer has certified and accepted that all equipment listed or as agreed has been removed form site and all temporary facilities dismantled and removed from the Site.

6.2 Temporary Facilities

6.2.1 Scope of Works

This item consists of the following:

- a) Furnishing, erection and maintenance of all site facilities such as Contractor's camp and yard, temporary utilities and services, safety provisions, temporary roads and temporary navigations aids required for the execution of the Works as specified below;
- b) Erection of all construction plant and equipment after being delivered to site; and,
- c) Disassembly and removal of all site facilities, constructional plant and equipment from the site for de-mobilization.

6.2.2 Provisions and Requirements

- a) The Contractor shall be responsible for temporary facilities, utilities, services and safeguards as required under the Contract.
- b) Temporary and permanent utility facilities used for the construction work shall be adequate for the intended use and not be overloaded or otherwise used or arranged in any manner which will endanger persons, premises or the works themselves.
 - 1. Upon completion of the Works, unless otherwise directed or required, all site facilities, installations, utility services, constructional plant and equipment shall be disconnected, disassembled and removed from the Site.
 - 2. The camp area shall be kept in a clean and tidy condition throughout the construction period. The Consultant / Engineer shall have the authority to order periodical clearings at the Contractor's cost, provided that the site for disposing of Garbage / Debris allocated by the owner and is within the stipulated distance from the work site.
 - 3. All accommodation, latrine and shower facilities and canteen, shall conform in every respect with regulations imposed by local health authorities.
 - 4. The Contractor shall provide and maintain the necessary equipment as specified in contract and accessories, for construction use for the entire construction period.

5. The Contractor shall be responsible to arrange water, electricity etc. as required to execute the work throughout the project.
6. The Contractor shall provide and maintain a temporary electricity service and distribution lines of adequate capacity for power, lighting and other construction needs.
7. All utility systems shall conform to local codes and regulations.
8. All costs associated with the provision of utilities shall be borne by the Contractor.
9. The Contractor shall maintain appropriate safety measures on site and around the work areas.
10. The Contractor shall adhere to all local codes and regulations with respect to work safety.
11. The Contractor shall maintain appropriate notices and safety measures to warn public of dangers on site.
12. The Contractor shall provide and maintain any temporary roads and access ways Project Site when required.

6.3 Site Expenses

6.3.1 Scope of Works

This item shall cover all expenses for the staff related to the management of the site and office.

6.3.2 Provisions and Requirements

The site costs shall include but not be limited to the following:

- a) Site office costs, including basic staff salary, overtime payments, bonuses, travel, medical fees, overseas and other allowances. Costs should also allow for stationery and office equipment.
- b) Communication Facilities, to include the costs telephone, as well as walkie-talkie communication between the job site proper and the site office. Communication costs for the Contractor's site office shall also be included here.

- c) Site safety costs to include all matters related to workplace health and safety issue.
- d) Site security costs.
- e) First aid, to include all reasonable first aid supplies and equipment.
- f) Insurance, costs of insuring the works and temporary facilities as required.
- g) Waste management, to include all costs incurred in keeping the site clean.

6.4 Environmental Requirements

6.4 Introduction

6.4.1 Investigations and Surveys

The Contractor shall satisfy himself of the existing site conditions and shall, as a minimum, undertake site investigation and topographic surveys of the site to gain accurate and complete records of the existing situation.

The investigation shall provide sufficient data to inform the design of structures, pavements, dredging and reclamation works, embankments underground services. and airfield pavements. It shall also be sufficiently detailed to identify any existing ground/groundwater pollutants which will require remediation and/or control measures.

The Contractor shall undertake a comprehensive and detailed topographic survey of the concession area, to fully understand the existing conditions for the use of airport planning, designing and construction.

Copies of all investigations and reports shall be provided, free of charge, Employer/Consultant in hard copy and electronic format.

6.4.2 Environment and Sustainability

The Contractor shall ensure that all planning, design, development works and airport operations are undertaken with full regard to and in compliance with GOM laws and regulations on environment, planning and sustainability. The Contractor shall demonstrate his understanding and awareness of the issues associated with the investment and, as required by the Maldives Environment Protection and Preservation Act, shall prepare all necessary environmental impacts assessments, compliance documentation and environmental management plans for the sustainable and efficient management of Airport. The Contractor shall comply with all relevant environmental and sustainability legislation including, but not limited to:

- ❖ The Environment Protection and Preservation Act (Law 4/93)
- ❖ The National Environmental Action Plan (NEAP 2009-2013)
- ❖ The Maldives National Strategy for Sustainable Development (NSDS)

Environmental Impact Assessment shall be prepared to the requirements of The Ministry of Environment. It is Contractor's requirement to prepare all documentation to the requirement of The Ministry of Environment including any monitoring that maybe required and to obtain all necessary permits. The contractor shall follow all Environmental laws and regulations of Maldives in design and during implementation of the project.

The proposed construction works are, under conditions given below, expected to have only minor impact on the surrounding coastal zone. However, this is to be expected only if relevant mitigation measures are incorporated during the construction phase as well as during the long term operational period. In this section the objectives, obligations and criteria of such mitigation measures will be outlined.

6.4.3 Feedback Monitoring

During the period of dredging and reclamation, working activities may have adverse effects on the coral reef community and the terrestrial coastal zone. One of the main activities will be the dredging of basin for the reclamation.

The most widespread and visible consequence of dredging and excavation is the generation of suspended sediments and turbidly, both of which affect the corals adversely.

Other main activities with possible adverse effects are the disposal of the dredge spoils, site clearance on land and transport on land and at sea.

The Contractor shall during the construction period carry out an environmental control program following a feedback design in order to ensure that adverse effects are detected before they become irreversible; The basic concept of a feedback monitoring program is that selected environmental key criteria, for instance live coral coverage or sedimentation rates, are observed regularly during the construction phase. If response, based on impact criteria indicating thresholds severe but yet not irreversible levels of impact, are crossed, steps of avoidance shall be enforced.

A metrology description for the environmental migration measures proposed for the environmental control program shall be prepared by the Contractor for the **Employer/Consultant's** approval prior to the implementation of the environmental control program and prior to any construction works on site. The environmental key criteria and possible response thresholds are specified in the following sections.

6.4.4 Operational Key Criteria for Acceptable Environmental Impact

During construction the response on the following operational key criteria for acceptable environmental impact shall be measured at the perimeter of the construction zone. The perimeter of the construction zone shall be clearly identified at site and shall be approved by the **Consultant / Engineer** before taking of the measurements.

The Response Threshold (RT) for the operational key criteria shall be:

- (a) Live coral coverage; No significant decrease shall occur at selected sites, representative of the coral reef community in the area, compared to likewise representative reference sites.
- (b) Concentration of suspended solids in surface waters over reef slope: less than 10 mg/l above ambient concentration during daylight hours and less than 20 mg/l at night.
- (c) Sedimentation rate on coral reef slope (5-10 m depth zone): less than 10 mg/cm² day.

6.4.5 Environmental Obligations

The Contractor has the obligations mentioned below. He shall address the issues in the methodology description for his environmental mitigation measures designed to meet the criteria mentioned in section 4.3 and the subjects listed in section 4.5:

- (a) To describe methodology of, and carry out, an appropriate feedback monitoring program, and see that the response thresholds given above are not surpassed. For this programme detailed and currently updated dredging schedules should be given currently calculate the amount of spill.
- (b) To describe, how possible adverse impacts related to subjects listed in section 4.5 are planned to be mitigated.
- (c) Establish emergency measures and procedures for accidental spills of hazardous substances during the construction period.
- (d) Make an assessment of the possible impact of any temporary physical structure on the hydraulic situation and any possible erosion following this, and take mitigation constructions into the planning of the dredging and reclamation.
- (e) Report to the Owner.

6.4.6 Subject of Environmental Concerns

The following list included subjects considered of environmental relevance for the construction or part thereof. The list shall be considered as guideline for the contractor in his selection of mitigating measures of relevance for his selected construction methods and they shall be subject to adjustment when experience obtained during the environmental feedback monitoring program should call for this.

- (a) Dredged material. Dredged material to be used for consumption purposes must not be deposited on the reef flats or on landsides areas outside the limit of working areas. The excavation scheme should be set up in such a way that slurry plumes are minimised as much as possible on and in the vicinity of the reefs.
- (b) Surface run off. During the construction period surface Water caused by heavy rainfall may carry larger amounts of sediment to the reefs. Such surface run off shall be minimized.
- (c) Fresh water supplies for any construction purpose or labour force are to be brought in by the Contractor.
- (d) Solid waste and sewage: as a main principle, all waste is to be removed from the island before any nuisance of dust, smell or visibility is generated.
- (e) Waste: waste oil from machinery, bilge pumping or other use as well as any waste of hazardous substances connected to the construction activities is to be collected and transported as directed by the Consultant / Engineer.
- (f) Dumping: No dumping of any kind from support vessels are allowed on the reef or in the upstream waters of the island (and should otherwise follow any national regulations on dumping).
- (g) Dust nuisance: Activities creating dust nuisance are to be conducts under wind conditions that can the dot out to sea.
- (h) Anchoring of carrier and supporting ships and vessels: anchor is not allowed to be dropped on the reef crest or reef slope outside the working areas li

6.4 The Contractor shall submit the following with the tender:

- a) Contractor's proposed equipment's to carry out the works.
 - 1. Proposed work construction methodology.
 - 2. Work schedule:

Proposed work schedule shall be submitted with Price Proposal. The work schedule shall indicate the major works to be carried out and the proposed date to start and complete the project.

- b) Detail design and EIA period shall be included within the total duration of the project.
- c) The total duration of the project shall not be more than 4 (four) months
- d) Contractor shall allow for yearly climatic conditions in the Maldives.

6.6 Other Information

- 1. It is contractor's responsibility to obtain all the permits required (from regulatory authorities, service providers etc.) for dredging, and construction works.
- 2. The metric system of units shall be used throughout.
- 3. A preliminary survey that may require preparing the proposal is a responsibility of the Contractor.

6.7 Contractor's Documents

The following documents shall be submitted to the **Employer/Consultant.**

- 1. Project survey report to finalize final calculations and construction drawings
- 2. Detail method statements as specified in items covered under the Main Responsibilities of the Contractor of this document.
- 3. EIA (to be submitted to EPA should be done to EPA requirement)

All approvals required in relation to the Environmental Impact Assessment shall be the responsibility of the contractor.

Drawings

**Price Proposal
(BOQ)**