AIRCRAFT ACCIDENT REPORT

KAL/2013/10/04/F

Accident Investigation Bureau

Report on the serious incident involving a Boeing 747-200 Aircraft with nationality and registration marks 5N-JRM, operated by Kabo Air Limited which occurred at Sultan Abubakar Airport, Sokoto (DNSO); Nigeria on the 4th October, 2013.

This report was produced by the Accident Investigation Bureau (AIB), Murtala Muhammed Airport Ikeja, Lagos. The report was based upon the investigation carried out by AIB, in accordance with Annex 13 to the Convention on International Civil Aviation, Nigerian Civil Aviation Act 2006 and Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2019. In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident/serious incident investigations to apportion blame or liability.

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Safety Recommendations in this report are addressed to the Regulatory Authority of the State, as well as other stakeholders, as appropriate. The Regulatory Authority is the authority that ensures implementation and enforcement.

Printed in Nigeria for the Accident Investigation Bureau (AIB)

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GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AIB	Accident Investigation Bureau
AOC	Air Operator Certificate
ATC	Air Traffic Control
CRM	Crew Resource Management
CVR	Cockpit Voice Recorder
DATCO	The Duty AirTraffic Controller
DNKN	Mallam Aminu Kano International Airport, Kano
DNSO	Sultan Abubakar Airport, Sokoto
FAA	Federal Aviation Administration
FAAN	Federal Airport Authority of Nigeria
FDR	Flight Data Recorder
IFR	Instrument Flight Rules
METAR	Meteorological Report
NAMA	Nigerian Airspace Management Agency
NAVAIDs	Navigational Aids
NCAA	Nigerian Civil Aviation Authority
NOTAMs	Notices to Airmen

NTSB	National Transportation and Safety Board
OEJN	King Abdul-Aziz Jeddah International Airport Saudi Arabia
PALS	Precision Approach Lighting System
PF	Pilot Flying
PM	Pilot Monitoring
SARPs	Standards and Recommended Practices
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules
VMC	Visual Meteorological Condition
VOR	Very high frequency Omni Directional radio range

5N-JRM

Aircraft accident report number:	KAL/2013/10/04/F
Registered owner and operator:	Kabo Air Limited
Aircraft type and model:	Boeing 747-200
Manufacturer:	Boeing Aircraft Company U.S.A
Date of manufacture:	1986
Nationality and registration marks:	5N-JRM
Serial number:	23549
Location:	Sultan Abubakar Airport, Sokoto (12° 54′ 58″ N, 5° 12′ 25″ E)
Date and Time:	4th October, 2013 at 21:40 h (*All Times in this report are local time (UTC+1) unless otherwise stated).*

SYNOPSIS

Accident Investigation Bureau (AIB) was notified of the occurrence on 5th October, 2013 by Kabo Air Limited, the operator. The preliminary investigation commenced on 7th October, 2013.

On 4th October, 2013 at about 20:59 h, a Boeing 747-200 aircraft with nationality and registration marks 5N-JRM, operated by Kabo Air Limited as a charter (Hajj) flight with call sign QNK617, departed Mallam Aminu Kano International Airport (DNKN) Nigeria, en route King Abdul-Aziz International Airport Jeddah (OEJN), Saudi Arabia via Sultan Abubakar Airport, Sokoto (DNSO), Nigeria, on an Instrument Flight Rules (IFR) Flight Plan.

There were 512 persons on board, inclusive of 18 crew members with seven hours' fuel endurance. The Captain was the Pilot Flying (PF) and the Co-pilot was the Pilot Monitoring (PM).

On contact with DNSO Air Traffic Control (ATC), flight QNK617 was cleared for ILS approach Runway 08. The crew reported field in sight and elected for visual straight-in approach Runway 26. During the approach to land, QNK617 impacted the Localizer Antenna/Approach Lighting System, touched down 100m short of RWY 26 threshold at 21:40 h and continued with the landing roll onto the runway until it came to a stop. The aircraft then taxied to the apron.

During transit walk-around, the crew found that two of the aircraft's right main wheel tyres had burst. There was no reported injury to persons on board.

The incident occurred at 21:40 h, at night.

The investigation identified the following causal and contributory factors:

Causal factor

Inappropriate visual approach profile at night with no vertical guidance.

Contributory factors

1. Unserviceable Visual Approach Slope Indicator (VASI) on Runway 26.
2. Decision to land on the non-precision runway 26 at night.

One safety recommendation was made

1.0 FACTUAL INFORMATION

1.1 History of the flight

On 4th October, 2013 at about 20:59 h, a Boeing 747-200 aircraft with nationality and registration marks 5N-JRM, operated by Kabo Air Limited as a charter (Hajj) flight with call sign QNK617, departed Mallam Aminu Kano International Airport, Kano (DNKN) Nigeria, en-route King Abdul-Aziz International Airport Jeddah (OEJN); Saudi Arabia via Sultan Abubakar Airport, Sokoto (DNSO); Nigeria, on an Instrument Flight Rules (IFR) Flight Plan.

There were 512 persons on board, inclusive of 18 crew members with seven hours' fuel endurance. The Captain was the Pilot Flying (PF) and the Co-pilot was the Pilot Monitoring (PM).

The flight was originally scheduled to route DNKN to OEJN. While in the cockpit preparing for the flight, the company advised the crew of a new routing from DNKN to OEJN via DNSO to pick additional passengers.

At 21:10 h, QNK617 contacted DNSO Air Traffic Control (ATC) and passed their traffic information. ATC acknowledged and cleared QNK617 as follows: QNK617 cleared Sokoto FL180, no delay. Expect ILS Approach Runway 08. Sokoto 20:00, Surface Wind calm, visibility 10km, Nil Weather, Few cumulonimbus North West at 750 m, QNH 1012.

At 21:12 h, Kano Control released QNK617 to Sokoto Control. At 21:24 h, QNK617 requested descent and was cleared to FL65 and instructed to report 25 DME SOK. At 41 DME SOK, QNK617 was re-cleared to 3500 ft on QNH 1012 and further cleared for ILS approach runway (RWY) 08 on reaching overhead SOK.

At 21:31 h, QNK617 reported field in sight and requested for straight-in Visual Approach for RWY 26. ATC replied as follows: *no objection, report final runway 26*. At 21:33 h, ATC cautioned QNK617 that the Approach Lights were of Low Intensity only and QNK617 acknowledged. At 21:36 h, QNK617 reported 8 miles final. ATC cleared QNK617 to land RWY 26 with reported surface wind calm.

During the landing approach, QNK617 impacted the Localizer Antenna/Approach Lighting System, touched down 100m short of RWY 26 threshold at 21:40 h and continued with the landing roll onto the runway until it came to a stop. The aircraft then taxied to the apron.

During the post incident interview, the crew stated that after shut down, they conducted a transit walk around and found two right main wheel tyres burst.

The Captain stated that the decision to land straight-in RWY 26 was to save fuel and that a 2.5 degree glide path was used for the approach. He also stated that the intention was to land at an appropriate point on the runway to avoid runway overrun, as the aircraft weight was close to maximum landing weight. He then added that he observed the absence of Touch Down Zone Lighting on the runway.

The Flight Engineer stated that the approach was normal until the Radio Altimeter call out of 10 ft, followed by a thudding sound and slight vibration.

After the post incident assessment, the crew disembarked the passengers. There was no injury to crew and passengers. The incident occurred at night in Visual Meteorological Condition (VMC).

1.2 Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor	Nil	Nil	Nil
None	Nil	Nil	Nil
TOTAL	18	494	512

1.3 Damage to aircraft

The aircraft was slightly damaged.

1.4 Other damage

During post incident assessment, the following were observed:

1. Six antenna elements with reflectors were damaged and the aluminium supports for the radiating elements were broken.
2. The Printed Circuit Board (PCB) cards and the protective synthetic fibre covering for the radiating elements were damaged.
3. 21 Low Intensity Approach Lighting fittings along runway 26 were crushed.

Figure 1: Damaged localizer antennae

1.5 Personnel information

1.5.1 Pilot (Captain)

Nationality:	Nigerian
Age:	52 years
License type:	Airline Transport Pilot Licence (A)
License validity:	5th November, 2013
Medical validity:	6th November, 2013

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Simulator validity:	21st October, 2013
Ratings:	Boeing B742, Boeing B727, BAC1-11, F28, PA-23, C172
Total flying experience:	13805 h
On type:	1331 h
Last 90 days:	43:45 h
Last 28 days:	Not Available
Last 7 days:	15:20 h
Last 24 hours:	00:55 h

1.5.2 Co-Pilot

Nationality:	Nigerian
Age:	27 years
License type:	Commercial Pilot Licence (A)
License validity:	7th July, 2014
Medical validity:	8th July, 2014
Simulator validity:	24th December, 2013
Type rating:	Boeing B747-200/300
Total flying experience:	977:46 h
On type:	649:56 h

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Last 90 days:	31:25 h
Last 28 days:	29:13 h
Last 7 days:	15:20 h
Last 24 hours:	00:55 h

1.5.3 Flight Engineer

Nationality:	Nigerian
Age:	66 years
License type:	Flight Engineer
License validity:	3rd Jan 2014
Medical validity:	4th Jan 2014
Simulator validity:	27th Jun 2014
Type rating:	Boeing B747-200/300, Douglas DC10, Boeing B707
Total flying experience:	21205 h
On Type:	2379 h
Last 90 days:	177 :15 h
Last 28 days:	40:20 h
Last 7 days:	19:05 h
Last 24 hours:	00:55 h

1.6 Aircraft information

1.6.1 General information

Type:	Boeing B747-200
Serial number:	23549
Operator:	Kabo Air Limited
Manufacturer:	Boeing Company U.S.A
Year of manufacture:	1986
Airframe time:	83356:05 h
Total landings/cycles:	11675
Certificate of Insurance:	18th October, 2013
Airworthiness validity:	23rd February, 2014
Maximum certificated take-off mass:	362800 kg
Maximum certificated landing mass:	265300 kg
Actual take-off mass:	270600 kg
Actual landing mass:	260600 kg

The mass and the centre of gravity (C.G) of the aircraft were within limits. See Appendix IA and IB for the aircraft weight and C.G determination and load sheet respectively.

The maintenance records revealed that the aircraft was maintained in accordance with existing regulations and approved procedures.

The Pilot-In-Command (PIC) confirmed the availability of aviation fuel at DNSO but decided to uplift additional fuel from Kano as he was not sure of getting fuel on landing at Sokoto.

1.6.2 Engines

Engine No.	**Number 1**	**Number 2**	**Number 3**	**Number 4**
Manufacturer	Pratt & Whitney	Pratt & Whitney	Pratt & Whitney	Pratt & Whitney
Type/Model	PW JT9D-7J	PW JT9D-7J	PW JT9D-7J	PW JT9D-7J
Serial number	P689575	P685942	P662527	P662629
Time Since New	67748	78209	63219	102067
Cycle Since New	15336	27045	15634	24315

Fuel Used: Jet A1

1.6.3 Aircraft landing performance evaluation

The following were the landing performance parameters for flight QNK617 for DNSO.

Temperature: 30^0

Field elevation: 1010 ft

Landing weight: 260600 kg/573202 lb

Flaps: 30^0

Deducted approach speed: 168

Landing field length:	6400 ft/1951 m

See appendix II.

1.7 Meteorological information

The meteorological information for DNSO on the day of the occurrence was as follows:

Time (DNSO):	**20:00 UTC**
Wind:	Calm
Visibility:	10Km
Weather:	Nil
Cloud:	Few CB NW 750M
Temp/DP:	30°C/22°C
QNH:	1012hPa

1.8 Aids to navigation

DNSO is equipped with Navaids and Landing facilities and their status on the day of the occurrence were as follows:

The VOR/DME "SOK" on 113.9MHz		Serviceable
"ISK" ILS on 109.5MHz RWY 08		Serviceable
VHF 122.1MHz	MAINS	Unserviceable

VHF 122.1MHz	STANDBY	Serviceable
VHF 121.7MHz	DOM.FREQUENCY	Serviceable
VOR/DME 113.9MHz		Serviceable
SATCOM AND GALAXY PHONES		Serviceable
ALDIS LAMP AND CHARGER		Serviceable
MTN AND ETISALAT LINES		Serviceable
WIND VELOCITY INDICATORS		Serviceable

Visual Approach Slope Indicators (VASI) were installed at both ends of the runway but not serviceable.

1.9 Communications

The DNSO Control Tower (CT) is equipped with Ground Based Automatic Voice Recording equipment for communications between aircraft and ATC. There was effective communication between the aicraft and Sokoto Air Traffic Control.

1.10 Aerodrome information

The DNSO is an IFR/VFR airfield with coordinates 12°54'57"N, 005°12'25"E about 7 km South of the city at an elevation of 308 m (1010ft). It has an asphalt/concrete surface Runway with orientation of 08/26, dimension of 3000m x 60m and slope of 1.2%. Runway 08/26 has a 120 m Stopway/Blast Pad at both ends.

Obstacles present on Approach path of RWY 26 are the Localizer antenna with a height of 312 m (1023 ft) and situated at a distance of 315 m from the threshold, VOR/DME antenna with a height of 317 m (1038 ft) and situated at a distance of 1000 m from the threshold.

Both RWY 08 and RWY 26 have Precision Approach Lighting System (PALS) Category II and there is also Visual Approach Slope Indicator System (VASI) installed. See Appendix III: Sokoto Aerodrome layout.

Runway 08 had a serviceable ILS with low intensity Approach Lighting System (ALS) and an unserviceable VASI.

The Runway selected for use by the crew was RWY 26, it had no ILS but had VOR/DME (SOK) which was aligned with the runway. It also had a low intensity ALS and an unserviceable VASI. See Appendix IV.

Efforts were made by the Bureau to determine if NOTAM[1] was issued in respect of the unserviceability of VASI as at the time of the occurrence.

1.11 Flight recorders

The two Flight Recorders fitted to the aircraft were retrieved and taken to the AIB Safety Laboratory. Inspections and download were carried out on the recorders by both AIB and the National Transportation and Safety Board (NTSB) of the United States. The FDR was unserviceable as the magnetic tape was found broken. The CVR data related to the

[1] A notice to airmen (NOTAM) is a notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

incident was found overwritten. Therefore, relevant data expected from both recorders were unavailable.

1.11.1 Flight Data Recorder (FDR)

Manufacturer	Duration of Recording
Model	209 DFDR
Part number	10077A500-103
Serial number	859
Numbers of parameters recorded	80-90
Recoding Medium	Magnetic Tape
Duration of Recording	25 hours continuous

1.11.2 Cockpit Voice Recorder (CVR)

Manufacturer	Fairchild
Model	A100
Part No.	93-A100-30
Serial No.	2770
Numbers of parameters recorded	4
Recoding Medium	Magnetic Tape
Duration of Recording	30 minutes

1.12 Wreckage and impact information

The aircraft impacted the Localizer Antenna/Approach Lighting Systems and touched down 100m short of threshold RWY 26. The following damages were sustained by the aircraft:

1. Damage on the Right Horizontal Stabilizer Leading Edge and a hole on the top surface.
2. Several damages on the right wing flaps' trailing edge surfaces.

3. A hole on the right bottom side of the bulk cargo door.Holes and dents on the right aft fuselage pressurized area
4. Damage to the right body gear door
5. Main wheel tyres No.9 and No.14 burst
6. Hydraulic lines No.9 and No.11 damaged; hydraulic fluid leakage
7. A hole on No. 4 engine nose cowling.

1.13 Medical and pathological information

Medical and pathological examinations were not carried out on the flight crew.

1.14 Fire

There was no pre or post impact fire.

1.15 Survival aspects

Not Applicable

1.16 Test and research

Not applicable

1.17 Organizational and management information

1.17.1 Kabo Air Limited

Kabo Air Limited (KAL) is owned by Kabo Holdings located at No. 67/73 Ashton road Kano, Kano state Nigeria. KAL was established in February 1980, Air Operator Certificate (AOC) number ABB/C/013 for Transport (Passenger) category was issued to KAL by Nigerian Civil Aviation Authority (NCAA) in accordance with Civil Aviation Act 2006 and the Nigerian Civil Aviation Regulations (Nig.CARs) KAL commenced operations in April 1981. The AOC was valid till 3rd March, 2015.

Currently, KAL operates a fleet of Boeing 747-200/300 aircraft mainly for Hajj and international charter flights.

1.17.1.1 Excerpt from Kabo Air Operations Manual Part A 8.1.3.2 *OPERATING MINIMA*

Kabo Air's operating minima for each airport of intended use shall be that established by the State in which the airport is located.

Unless they have been authorised by the competent Authority for operations to category II and III minima on landing, and for low visibility departures, company aeroplanes will be restricted to category I operations as outlined in the following paragraph. Specific minima for particular combinations of approach aid, runway and lighting will normally be as contained in the route guide for the aerodrome concerned or, if required, as stated in the commander's flight brief. If operations to category II and III minima are authorised, the details will be contained in the company's AWOPS submission for each aircraft type and the supporting training requirements.

Departure minima for a given aerodrome shall be not less than those for landing for the same aerodrome unless a take-off alternate aerodrome is available which meets all the relevant landing minima and performance requirements for the aerodrome type. If there

is a requirement to see and avoid obstacles on departure and/or for a forced landing, a cloud ceiling shall be specified in addition to the RVR/visibility. Minima in this case must be high enough to ensure that there is sufficient guidance to enable the aeroplanes to be controlled in the event of both a take-off in adverse circumstances and a continued take-off after failure of the critical power unit.

For multi-engine aeroplanes whose performance is such that in the event of a critical power unit failure at any point during take-off, the aeroplane can either stop or continue to a height of 1500 feet above the aerodrome while clearing all obstacles by the required margins, the take-off minima may not be less than those given in the Table 2, below.

RVR/Visibility criteria are either actual RVR as measured or factored Met. Visibility in accordance with Table 5 (8.1.3.2.7).

Non-Precision Approaches

Non-Precision Approach procedures are based on the use of ILS without glideslope (LLZ only), VOR, NDB, SRA or VDF. The acceptance of a Non-precision approach clearance is subject to minimum weather conditions and visibility required to continue an approach, operating conditions that require a missed approach to be initiated, approach-related duties of the PF and PNF and a minimum descent height on a non-precision approach which shall not be less than the highest of:

the obstacle clearance height(OCH) for the category of aeroplane;

the system minimum, as contained in the Table 3, below, or

any state minima if applicable.

The proper use of established constant descent profile during the final segment of a non-ILS (including non-precision) approach must be ensured.

Subsection 8.1.3.2 (g note 3) Required Runway Visual Range (RVR)

The minimum RVR for a non-precision approach depends on the MDH and on the approach lighting and runway lighting/marking available…

For night operations at least runway edge, threshold and runway end lights must be on.

Note 3

Basic facilities comprise runway markings, 420m of HI/MI approach lights, runway edge, threshold and edge lights. Lights must be on.

Subsection 8.1.3.2 (m note 3) Commencement and Continuation of an Approach

An approach may be started irrespective of the RVR, but it may not be continued past the outer marker or equivalent position unless the reported controlling RVR/visibility is equal to or better than the specified minimum. Once past the outer marker or equivalent position, the approach may be continued to the landing irrespective of reported RVR/ Visibility provided that the required visual reference has been established at the DH/MDH, and is maintained. Where no outer marker or equivalent position exists the pilot in command shall make the decision to continue or abandon the approach before descending below 1000 feet above the aerodrome on the final approach segment.

Note 3

Basic facilities comprise runway markings, 420m of HI/MI approach lights, runway edge, threshold and end lights. Lights must be on.

Subsection 8.1.3.2 (j) visual references

No pilot may continue a precision approach below a DH determined as in paragraph(h) above, unless at least one of the following visual references for the intended runway is distinctly visible to, and identifiable by the pilot;

(i) elements of the approach lighting system;
(ii) the threshold, or its markings, lights or identification lights;

(iii) the visual glideslope indicator(s);

(iv) the touchdown zone, zone markings or zone lights;

(v) the runway edge lights.

1.17.2 Nigerian Civil Aviation Authority (NCAA)

The NCAA is charged with regulation of airlines, Personnel, Equipment, and Organizations etc., in Nigeria. Below are some pertinent regulations to this investigation which the airline needed to comply with as an AOC holder.

1.17.2.1 *Excerpts from Nigeria Civil Aviation Regulations (Nig. CARs 2009)*

Operation of Cockpit Voice and Flight Data Recorders

8.5.1.24.-(a) The PIC shall ensure that whenever an aircraft has flight recorders installed, those recorders are operationally checked and operated continuously from the instant

(1) For a flight data recorder, the aircraft begins its take-off roll until it has completed the landing roll, and

(2) For a cockpit voice recorder, the initiation of the pre-start checklist until the end of the securing aircraft checklist.

(b) The PIC may not permit a flight data recorder or cockpit voice recorder to be disabled, switched off or erased during flight, unless necessary to preserve the data for an accident or serious incident investigation.

(c) In event of an accident or serious incident, the PIC shall act to preserve the recorded data for subsequent investigation upon completion of flight.

(1) The flight recorders shall be deactivated upon completion of flight time

following an accident or serious incident.

(2) The flight recorder shall not be reactivated before the Accident Investigation Bureau determines its disposition

ADEQUACY OF OPERATING FACILITIES

8.6.2.2 (a) No person may commence a flight unless it has been determined by every reasonable means available that the ground and/or water areas and facilities available and directly required for such flight and for the safe operation of the aircraft, are adequate, including communication facilities and navigation aids. "Reasonable means" as used here denotes the use, at the point of departure, of information available to the PIC either through official information published by the aeronautical information services or readily obtainable in other sources.

1.17.3 Nigerian Airspace Management Agency (NAMA)

NAMA is an Air Navigation Service Provider with a mandate to manage the Nigerian Airspace to a level consistent with the requirements of the ICAO Standards and Recommended Practices (SARPs).

The Electromech Officer on duty noticed some broken approach lights on his way to the VOR site and reported to the Airspace Manager. The Duty Air Traffic Controller (DATCO) was not aware of the incident when the Airspace Manager enquired from him.

1.17.4 Federal Airports Authority of Nigeria (FAAN)

FAAN is the Statutory Government Agency created to oversee the operations and maintenance of all Federal Airports in Nigeria.

Some landing facilities e.g Runway Lighting Systems, VASI etc in Sokoto airport were under the control of FAAN as at the time of this occurrence.

1.18 Additional Information

1.18.1 Excerpts from Federal Aviation Administration (FAA) Airplane Flying Handbook (FAA-H-8083-3B)

1.18.1.1 Night vision

Generally, most pilots are poorly informed about night vision. Human eyes never function as effectively at night as the eyes of animals with nocturnal habits, but if humans learn how to use their eyes correctly and know their limitations, night vision can be improved significantly.

The brain and eyes act as a team for a person to see well; both must be used effectively. Due to the physiology of the eye, limitations on sight are experienced in low light conditions, such as at night. To see at night, the eyes are used differently than during the day. Therefore, it is important to understand the eye's construction and how the eye is affected by darkness. The following items aid in increasing night vision effectiveness.

1. *Adapt the eyes to darkness prior to flight and keep them adapted. About 30 minutes is needed to adjust the eyes to maximum efficiency after exposure to a bright light.*
2. *If oxygen is available, use it during night flying. Keep in mind that a significant deterioration in night vision can occur at cabin altitudes as low as 5,000 feet.*
3. *Close one eye when exposed to bright light to help avoid the blinding effect.*
4. *Do not wear sunglasses after sunset as this impairs night vision.*
5. *Move the eyes more slowly than in daylight.*
6. *Blink the eyes if they become blurred.*
7. *Concentrate on seeing objects.*
8. *Force the eyes to view off center using scanning techniques.*
9. *Maintain good physical condition.*

10. Avoid smoking, drinking, and using drugs that may be harmful.

1.18.1.2 Night illusions

In addition to night vision limitations, night illusions can cause confusion and distractions during night flying. The following discussion covers some of the common situations that cause illusions associated with night flying.

On a clear night, distant stationary lights can be mistaken for stars or other aircraft. Cloud layers or even the northern lights can confuse a pilot and indicate a false visual horizon. Certain geometrical patterns of ground lights, such as a freeway, runway, approach, or even lights on a moving train, can cause confusion. As a result, pilots need to rely less on outside references at night and more on flight and navigational instruments.

Visual autokinesis can occur when staring at a single light source for several seconds on a dark night. The result is that the light appears to be moving. The autokinesis effect will not occur if the visual field is expanded through scanning techniques. A good scanning procedure reduces the probability of vision fixed on one source of light.

Distractions and problems can result from a flickering light in the flight deck, anti-collision light, or other aircraft lights and can cause flicker vertigo. If continuous, would cause grogginess, unconsciousness, headaches, or confusion. Try to eliminate any light source causing blinking or flickering problems in the flightdeck.

A black-hole approach occurs when the landing is made from over water or non-lighted terrain where the runway lights are the only source of light. Without peripheral visual cues to help, orientation is difficult. The runway can seem out of position (down-sloping or up-sloping) and in the worst case, results in landing short of the runway. If an electronic glide slope or visual approach indicator (VASI) is available, it should be used. If navigational aids (NAVAIDs) are unavailable, use the flight instruments to assist in

maintaining orientation and a normal approach. Anytime position in relation to the runway or altitude is in doubt, execute a go-around.

Bright runway and approach lighting systems, especially where few lights illuminate the surrounding terrain, may create the illusion of being lower or having less distance to the runway. In this situation, the tendency is to fly a higher approach. Also, flying over terrain with only a few lights makes the runway recede or appear farther away. With this situation, the tendency is to fly a lower-than-normal approach. If the runway has a city in the distance on higher terrain, the tendency is to fly a lower-than-normal approach. A good review of the airfield layout and boundaries before initiating any approach helps maintain a safe approach angle.

Illusions created by runway lights result in a variety of problems. Bright lights or bold colors advance the runway, making it appear closer. Night landings are further complicated by the difficulty of judging distance and the possibility of confusing approach and runway lights. For example, when a double row of approach lights joins the boundary lights of the runway, there can be confusion where the approach lights terminate and runway lights begin. Under certain conditions, approach lights can make the aircraft seem higher in a turn to final, than when its wings are level.

1.18.2 Airport and navigation lighting aids

The lighting systems used for airports, runway, obstructions, and other visual aids at night are other important aspects of night flying. Lighted airports located away from congested areas are identified readily at night by the lights outlining the runways. Airport located near or within large cities are often difficult to identify as the airport lights tend to blend with the city lights. It is important not to only know the exact location of an airport relative to the city, but also to be able to identify these airports by the characteristics of their lighting pattern.

Aeronautical lights are designed and installed in a variety of colors and configurations, each having its own purpose. Although some lights are used only during low ceiling and visibility conditions, this discussion includes only the lights that are fundamental to visual flight rules (VFR) night operation.

It is recommended that prior to a night flight, and particularly a cross-country night flight, that a check of the availability and status of lighting systems at the destination airport is made. This information can be found on aeronautical charts and in the Chart Supplements. The status of each facility can be determined by reviewing pertinent Notices to Airmen (NOTAMs).

As a result of technological advancements, runway lighting systems have become quite sophisticated to accommodate takeoffs and landings in various weather conditions. However, if flying is limited to VFR only, it is important to be familiar with the basic lighting of runways and taxiways.

1.18.3 Preparation and Pre-flight

Night flying requires that pilots are aware of, and operate within, their abilities and limitations. Although careful planning of any flight is essential, night flying demands more attention to the details of preflight preparation and planning.

Preparation for a night flight includes a thorough review of the available weather reports and forecasts with particular attention to temperature/dew point spread. A narrow temperature/dew point spread may indicate the possibility of fog. Emphasis should also be placed on wind direction and speed, since its effect on the airplane cannot be easily detected at night as during the day.

1.18.4 Orientation and navigation

Generally, at night, it is difficult to see clouds and restrictions to visibility, particularly on dark nights or under overcast. When flying under VFR, pilots must exercise caution to avoid flying into clouds.

Lighted runways, buildings, or other objects may cause illusions to the pilot when seen from different altitudes. At an altitude of 2,000 feet, a group of lights on an object may be seen individually, while at 5,000 feet or higher, the same lights could appear to be

one solid light mass. These illusions may become quite acute with altitude changes and, if not overcome, could present problems in respect to approaches to lighted runways.

1.18.5 Approaches and landings

When approaching the airport to enter the traffic pattern and land, it is important that the runway lights and other airport lighting be identified as early as possible. If the airport layout is unfamiliar, sighting of the runway may be difficult until very close-in due to the maze of lights observed in the area. To fly a traffic pattern of proper size and direction, the runway threshold and runway-edge lights must be positively identified.

Once the airport lights are seen, these lights should be kept in sight throughout the approach.

Distance may be deceptive at night due to limited lighting conditions. A lack of intervening reference on the ground and the inability to compare the size and location of different ground objects cause this. This also applies to the estimation of altitude and speed. Consequently, more dependance must be placed on flight instruments, particularly the altimeter and the airspeed indicator. When entering the pattern, always give yourself plenty of time to complete the before landing checklist.

1.19 Useful or effective investigation techniques

Not applicable

2.0 ANALYSIS

2.1 General

Information used in writing this report was obtained from the Crew, ATC statements, reports/recordings and eyewitness accounts. The lack of data from the FDR and CVR significantly constrained the determination of the aircraft approach profile and the details of the sequence of events.

At the time of the occurence, the Aerodrome Meteorological Report (METAR) at 20:00 UTC recorded the surface wind as calm, visibility 10km, few Cummulonimbus clouds north to west at 750 metres, temperature +30°C, dew point +22°C and QNH 1012Hpa. Therefore, weather was not considered a factor in this occurrence.

The Boeing 747 landing performance chart evaluation stipulates that even at maximum structural landing weight the aircraft was capable of landing safely within the available Runway length at DNSO.

The mass and the centre of gravity of the aircraft were within the prescribed limits.

The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

The flight crew members were licensed and qualified for the flight and were in compliance with the flight and duty time in accordance with existing regulations.

The investigation could not determine issues of CRM and individual crew member roles leading to this incident, due to the unavailability of CVR recording.

2.2 Runway selection

Runway 08 had a serviceable ILS with low intensity Approach Lighting System (ALS) and an unserviceable VASI.

The Runway selected for use by the crew was RWY 26, it had no ILS but had VOR/DME (SOK) which was aligned with the runway. It also had a low intensity ALS and an unserviceable VASI.

Taking into consideration the risks inherent in a visual approach at night, even with the prevailing conditions of wind calm, ceiling and visibility okay, the appropriate choice of landing runway for this category of aircraft (category D) would have been the runway equipped with both vertical and lateral guidance (ILS), that was Runway 08.

The absence of guidance by the company for non-precision visual approach at night for this category of aircraft leaves the crew with the discretion of choice even when a precision approach facility like an ILS is available.

2.3 Approach and landing

Having elected to do a visual approach on runway 26, lateral guidance presents no issues as the VOR is aligned with the runway, ceiling and visibility were okay and the aircraft can be aligned visually. The VASI was unserviceable therefore there was no vertical guidance. SOK was serviceable to provide distance information to the runway. During the approach briefing a continuous descent angle of 3 degrees should have been planned with distances to the threshold and the corresponding heights selected for distance/height cross checked so that the Pilot Monitoring can monitor and call out deviations.

Referring to B747–200 landing performance charts, using the same atmospheric conditions and information for the aircraft configuration at the time of the incident, the investigation determined the value of the required landing length limit obtained indicated that the runway is long enough for landing even at higher than maximum structural landing weight see Appendix II.

The captain reported that he wanted to land at the appropriate point because the aircraft is close to the maximum structural landing weight. This indicates probably that the briefing may not have considered the aircraft landing performance for that runway. The crew decided to conduct a visual approach and landing at night using a 2.5-degree continuous descent angle. Using the 2.5-degree glide path with distance/height crosschecks, the aircraft would have cleared the obstacles on the flight path. Therefore, the glide path flown must have been shallower resulting in the aircraft impacting the obstacles and touching down short of the runway.

3.0 CONCLUSION

3.1 Findings

1. The flight crew members were licensed and qualified for the flight in accordance with existing regulations.
2. The crew were initially notified, briefed and prepared to fly from Kano to Jeddah, however while they were on board the aircraft, the flight was rescheduled to fly from Kano to Jeddah via Sokoto to pick more passengers.
3. The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.
4. The mass and centre of gravity of the aircraft were within limits.
5. The CVR recording pertinent to the occurrence was over written.
6. FDR magnetic tape was found broken.
7. On initial contact with Sokoto ATC, flight QNK617 was cleared for ILS Approach Runway 08, but the crew opted for Visual Straight-in Approach Runway 26.
8. Runway 26 Approach Lights were of Low Intensity and the Visual Approach Slope Indicator (VASI) was unserviceable.
9. Efforts were made by the Bureau to determine if NOTAM was issued in respect of the unserviceability of VASI as at the time of the occurrence.
10. The aircraft impacted Localizer Antenna and some Approach Lights.
11. The aircraft touched down 100m short of the threshold and continued with the landing roll onto the runway until it came to a stop.
12. The aircraft taxied to the apron.
13. The aircraft was slightly damaged.

3.2 Causal factor

Inappropriate visual approach profile at night with no vertical guidance.

3.3 Contributory factors

1. Unserviceable Visual Approach Slope Indicator (VASI) on Runway 26.
2. Decision to land on the non-precision runway 26 at night.

4.0 SAFETY RECOMMENDATIONS

4.1 Safety Recommendation 2020-013

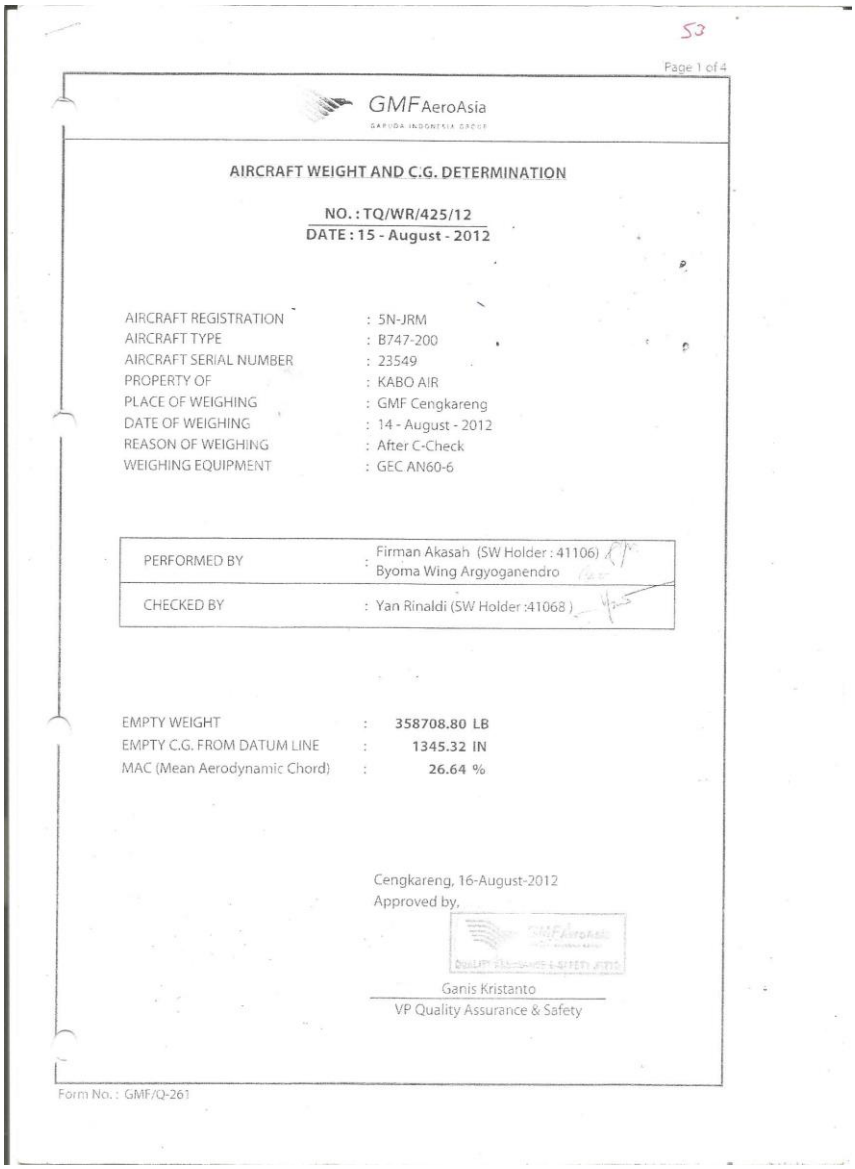
Kabo Air should ensure that flight recording devices (FDR and CVR) installed on all aircraft in its fleet are preserved, maintained, serviceable, and operated in accordance with the provisions of the existing Nigeria Civil Aviation Regulations (Nig. CARs) Parts 7.8.1.3, 7.8.1.4 (a), 8.5.1.24 (b)(c) and 8.14.10.3 (a).

SAFETY ACTION TAKEN

Nigerian Airspace Management Agency (NAMA) had issued Notice to Airmen (NOTAM) Number 1124/13 dated 07 October 2013 prohibiting the use of Runway 26 at night when the approach lighting system of the runway became unserviceable (refer to Appendix V).

APPENDICES

Appendix IA: Aircraft Weight and Center of gravity determination



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GMF AeroAsia
GARUDA INDONESIA GROUP

AIRCRAFT WEIGHT AND C.G. DETERMINATION

NO. : TQ/WR/425/12
DATE : 15 - August - 2012

AIRCRAFT REGISTRATION	: 5N-JRM
AIRCRAFT TYPE	: B747-200
AIRCRAFT SERIAL NUMBER	: 23549
PROPERTY OF	: KABO AIR
PLACE OF WEIGHING	: GMF Cengkareng
DATE OF WEIGHING	: 14 - August - 2012
REASON OF WEIGHING	: After C-Check
WEIGHING EQUIPMENT	: GEC AN60-6

PERFORMED BY	: Firman Akasah (SW Holder : 41106) Byoma Wing Argyoganendro
CHECKED BY	: Yan Rinaldi (SW Holder :41068)

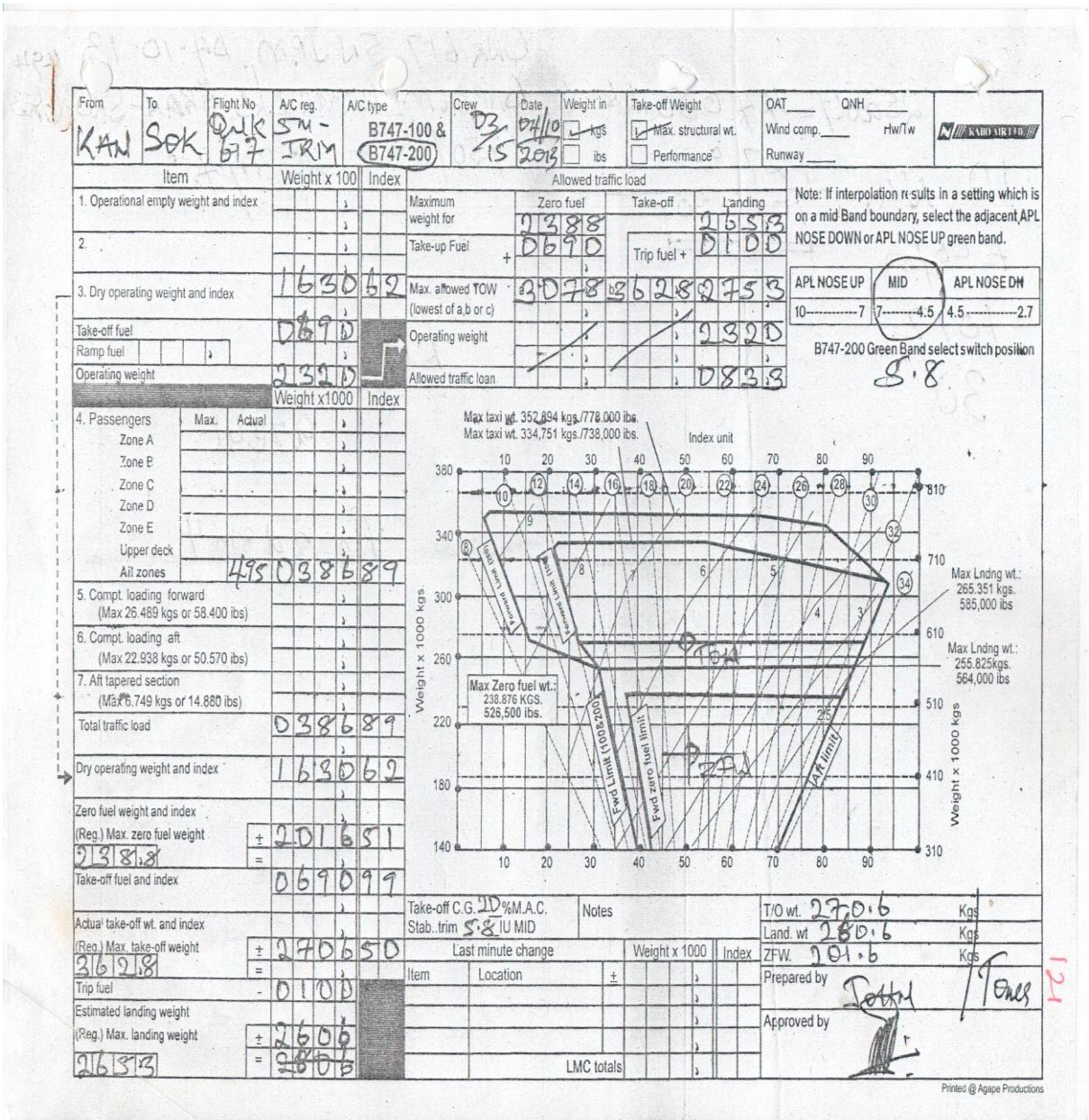
EMPTY WEIGHT	:	**358708.80 LB**
EMPTY C.G. FROM DATUM LINE	:	**1345.32 IN**
MAC (Mean Aerodynamic Chord)	:	**26.64 %**

Cengkareng, 16-August-2012
Approved by,

Ganis Kristanto
VP Quality Assurance & Safety

Form No. : GMF/Q-261

Appendix IB: Flight QNK617 Loadsheet



From	To	Flight No	A/C reg.	A/C type	Crew	Date	Weight in	Take-off Weight	OAT ____ QNH ____
KAN	SOK	QNK 617	5N-JRM	B747-100 & B747-200	D3/15	04/10/2013	☐ kgs ☐ lbs	☑ Max. structural wt. ☐ Performance	Wind comp. ____ Hw/Tw Runway ____

Item	Weight x 100	Index
1. Operational empty weight and index		
2.		
3. Dry operating weight and index	1630	62
Take-off fuel	0690	
Ramp fuel		
Operating weight	2320	

Allowed traffic load	Zero fuel	Take-off	Landing
Maximum weight for	2388		2653
Take-up Fuel +	0690	Trip fuel +	0100
Max. allowed TOW (lowest of a,b or c)	a 3078	b 2628	c 2753
Operating weight			2320
Allowed traffic load			0833

Note: If interpolation results in a setting which is on a mid Band boundary, select the adjacent APL NOSE DOWN or APL NOSE UP green band.

APL NOSE UP	MID	APL NOSE DN
10 ---------- 7	7 -------- 4.5	4.5 ---------- 2.7

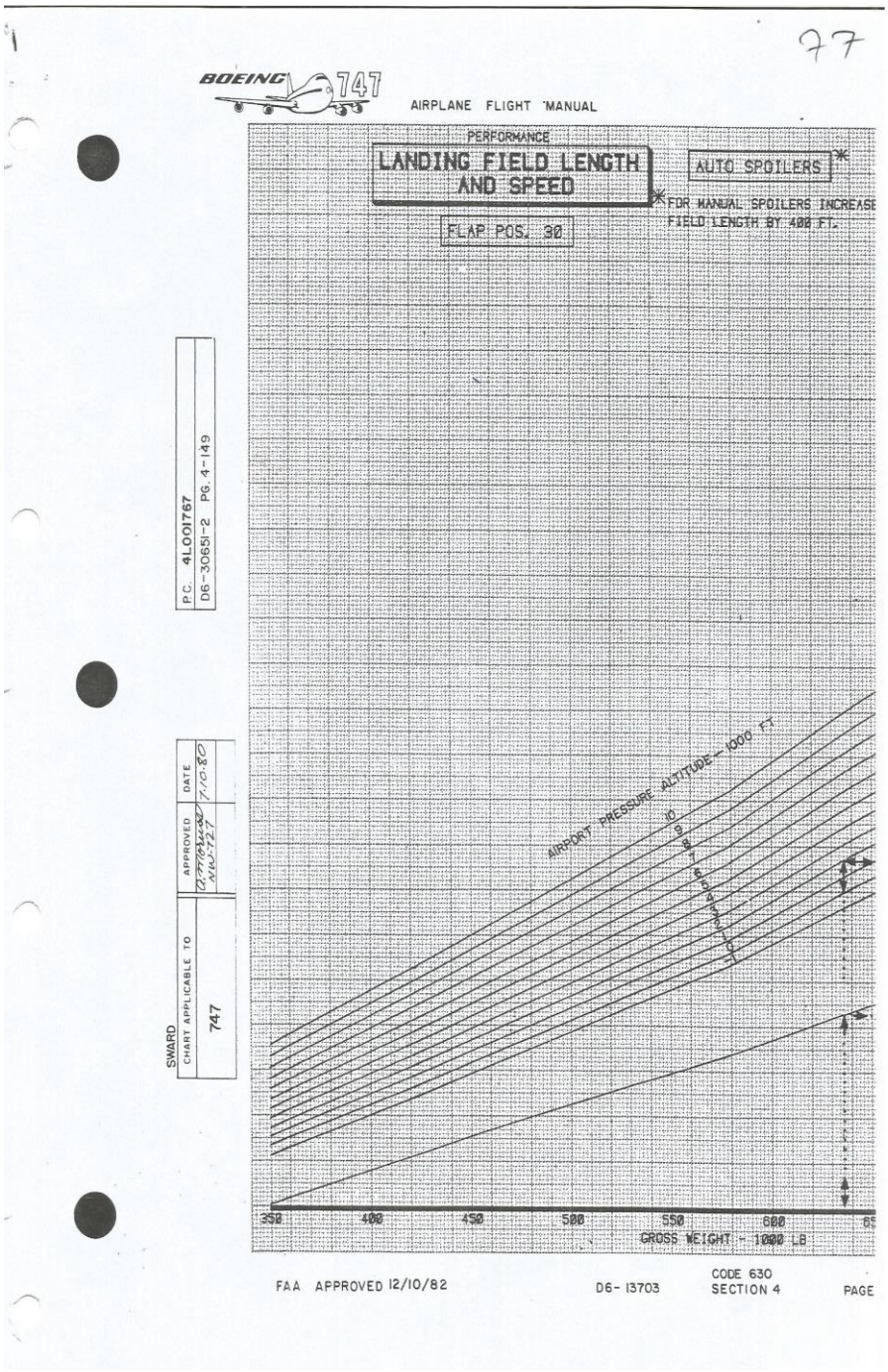
B747-200 Green Band select switch position 8.8

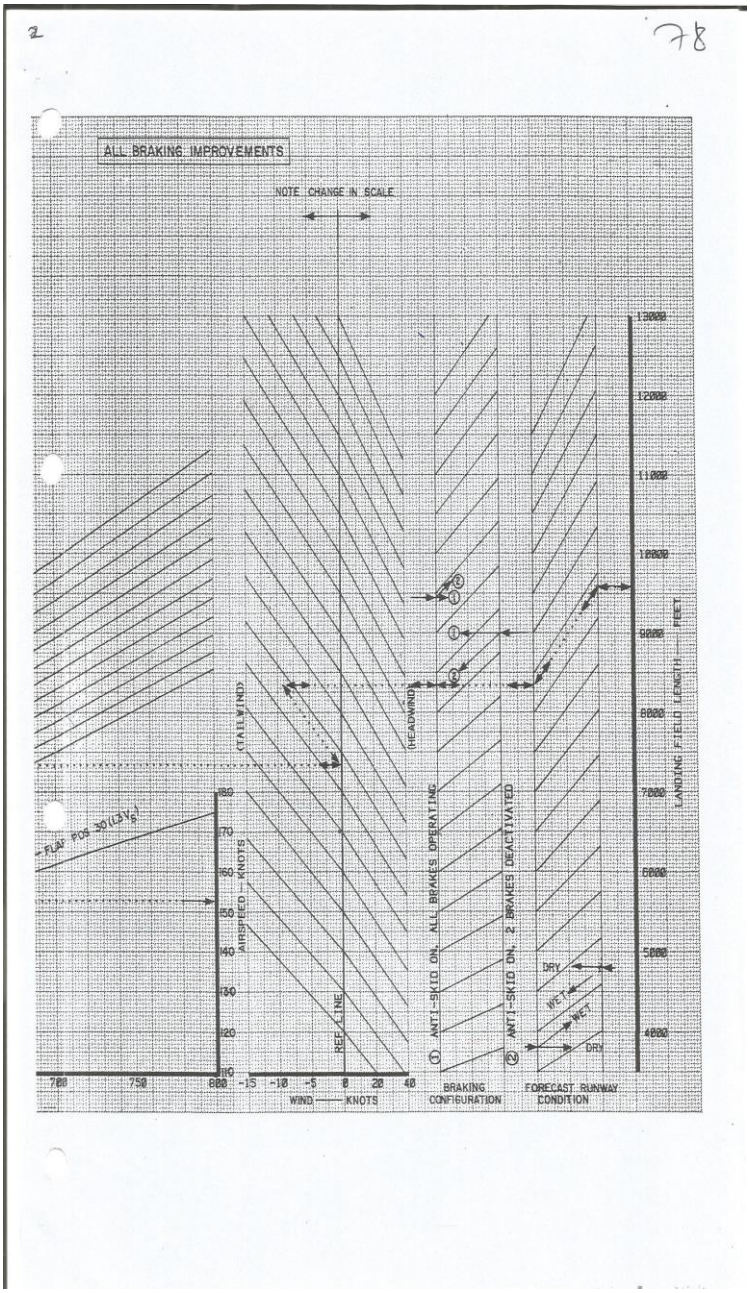
Item	Max.	Actual	Weight x1000	Index
4. Passengers				
Zone A				
Zone B				
Zone C				
Zone D				
Zone E				
Upper deck				
All zones		495	038	689
5. Compt. loading forward (Max 26.489 kgs or 58.400 lbs)				
6. Compt. loading aft (Max 22.938 kgs or 50.570 lbs)				
7. Aft tapered section (Max 6.749 kgs or 14.880 lbs)				
Total traffic load			038	689
Dry operating weight and index			1630	62
Zero fuel weight and index				
(Reg.) Max. zero fuel weight 238.8		± =	2016	51
Take-off fuel and index			0690	99
Actual take-off wt. and index				
(Reg.) Max. take-off weight 376.2		± =	2706	50
Trip fuel		-	0100	
Estimated landing weight			2606	
(Reg.) Max. landing weight 261.3		± =	2606	

Take-off C.G. 21 %M.A.C. Stab. trim 5.8 IU MID	Notes	T/O wt. 270.6 Kgs
		Land. wt 260.6 Kgs
Last minute change	Weight x 1000 / Index	ZFW. 201.6 Kgs
Item / Location / ±		Prepared by
LMC totals		Approved by

Printed @ Agape Productions

Appendix II: Aircraft landing performance chart

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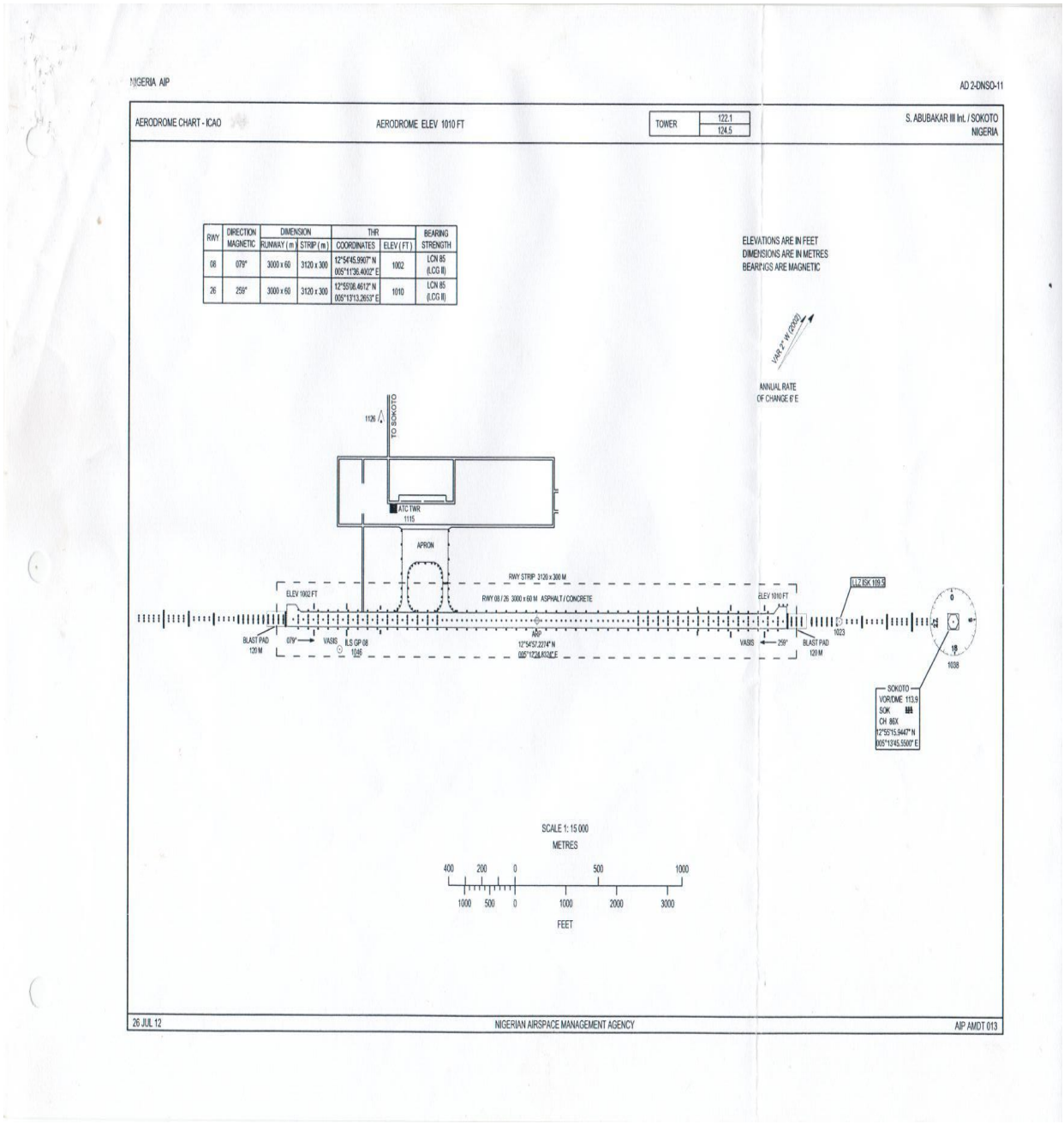
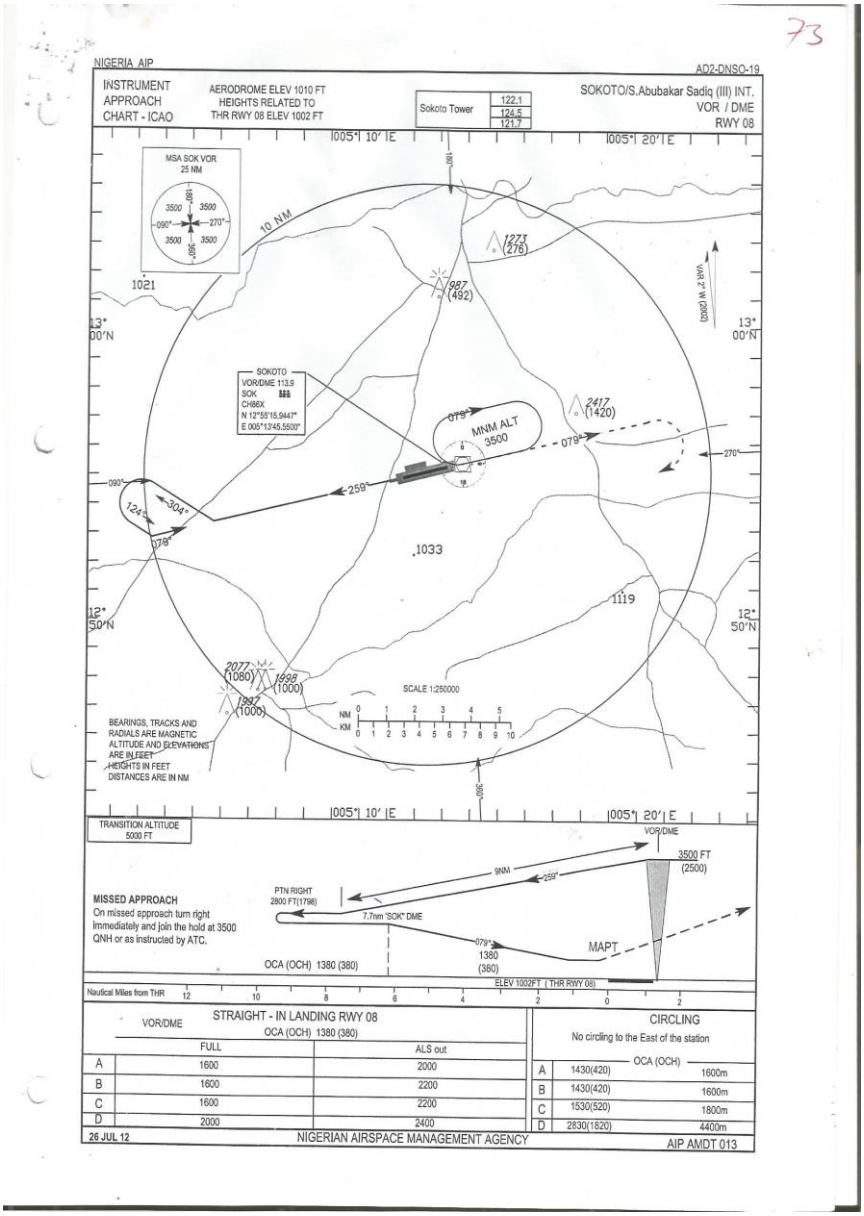
ALL BRAKING IMPROVEMENTS
NOTE CHANGE IN SCALE
LANDING FIELD LENGTH — FEET
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
(TAILWIND)
(HEADWIND)
REF. LINE
AIRSPEED - KNOTS
80
70
60
50
40
30
20
10
FLAP POS 30(L3)
700
750
800
-15
-10
-5
0
20
40
WIND —— KNOTS
① ANTI-SKID ON, ALL BRAKES OPERATING
② ANTI-SKID ON, 2 BRAKES DEACTIVATED
BRAKING CONFIGURATION
FORECAST RUNWAY CONDITION
DRY
WET
WET
DRY

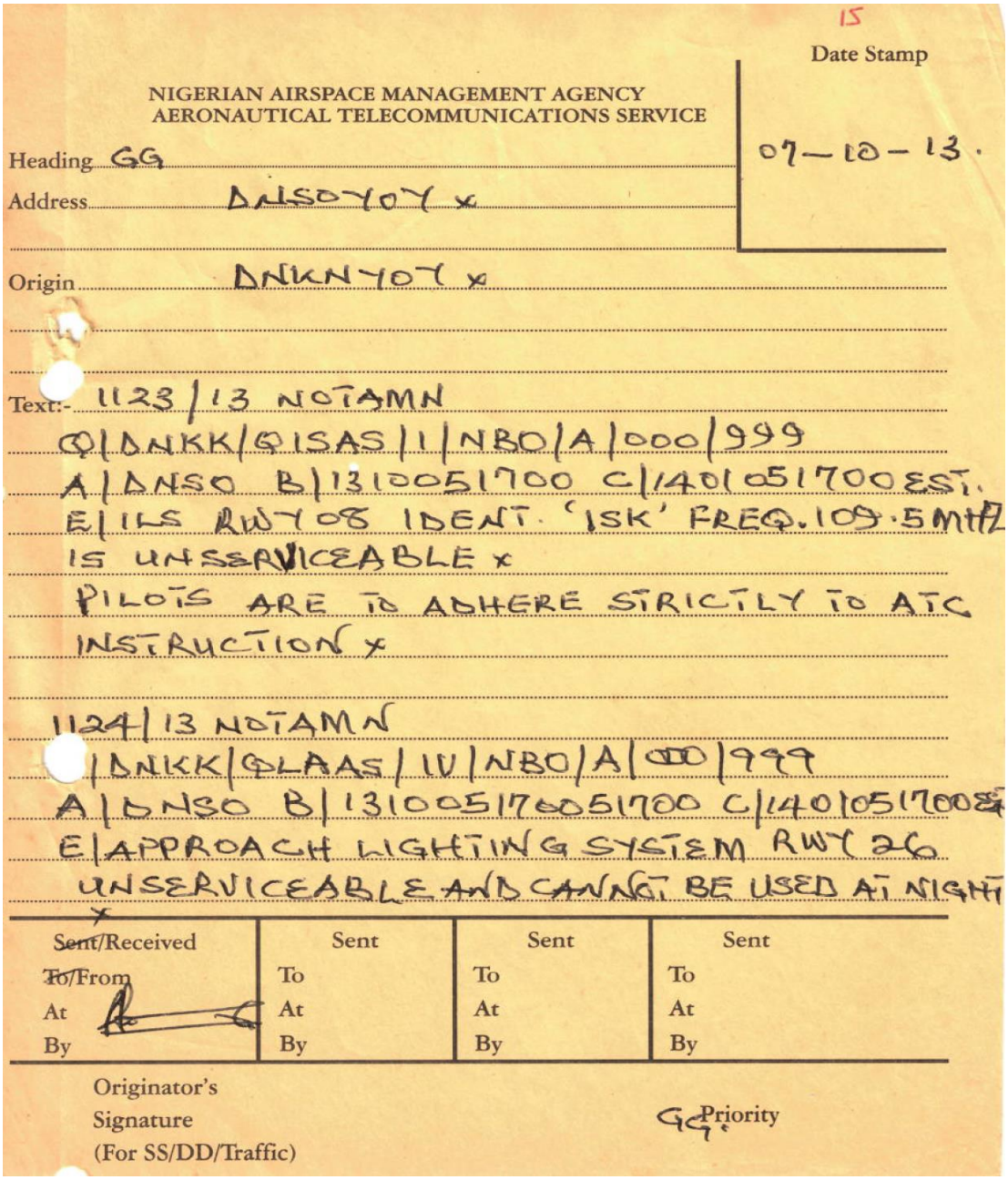
Appendix III: Sokoto aerodrome layout



Appendix IV: DNSO Instrument approach chart Runway 08



Appendix V: NOTAM (Prohibting the use of RWY 26 at night)



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Date Stamp

NIGERIAN AIRSPACE MANAGEMENT AGENCY
AERONAUTICAL TELECOMMUNICATIONS SERVICE

07-10-13.

Heading GG

Address DNSOYOYX

Origin DNKNYOYX

Text:- 1123/13 NOTAMN
Q)DNKK/QISAS/I/NBO/A/000/999
A)DNSO B)1310051700 C)1401051700EST.
E)ILS RWY08 IDENT. 'ISK' FREQ.109.5MHZ
IS UNSERVICEABLE X
PILOTS ARE TO ADHERE STRICTLY TO ATC
INSTRUCTION X

1124/13 NOTAMN
)DNKK/QLAAS/IV/NBO/A/000/999
A)DNSO B)1310051700 C)1401051700E
E)APPROACH LIGHTING SYSTEM RWY 26
UNSERVICEABLE AND CANNOT BE USED AT NIGHT
X

Sent/Received	Sent	Sent	Sent
~~To~~/From	To	To	To
At	At	At	At
By	By	By	By

Originator's Signature (For SS/DD/Traffic)

GG Priority