

FINAL REPORT

**TAKE-OFF INCIDENT INVOLVING
BOEING 747-300, REGISTRATION HZ-AIT
SINGAPORE CHANGI AIRPORT
2 JUNE 2007**

AIB/AAI/CAS.040

**Air Accident Investigation Bureau of Singapore
Ministry of Transport
Singapore**

4 August 2008

The Air Accident Investigation Bureau of Singapore

The Air Accident Investigation Bureau (AAIB) is the air accidents and incidents investigation authority in Singapore responsible to the Ministry of Transport. Its mission is to promote aviation safety through the conduct of independent and objective investigations into air accidents and incidents.

The AAIB conducts the investigations in accordance with the Singapore Air Navigation (Investigation of Accidents and Incidents) Order 2003 and Annex 13 to the Convention on International Civil Aviation, which governs how member States of the International Civil Aviation Organization (ICAO) conduct aircraft accident investigations internationally.

The investigation process involves the gathering, recording and analysis of all available information on the accidents and incidents; determination of the causes and/or contributing factors; identification of safety issues; issuance of safety recommendations to address these safety issues; and completion of the investigation report.

In carrying out the investigations, the AAIB will adhere to ICAO's stated objective, which is as follows:

"The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability."

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GLOSSARY OF ABBREVIATION

AIP SUP	:	Aeronautical Information Publication Supplement
AIS	:	Aeronautical Information Service
ATCO	:	Air Traffic Control Officer
ATIS	:	Automated Terminal Information Service
CVR	:	Cockpit Voice Recorder
DME	:	Distance Measuring Equipment
FDR	:	Flight Data Recorder
FO	:	First Officer or copilot
FE	:	Flight Engineer
GTOW	:	Gross Take-off Weight
GTSU	:	Gas Turbine Starter Unit
ILS	:	Instrument Landing System
GACA	:	General Authority of Civil Aviation of the Kingdom of Saudi Arabia
mb	:	millibars (atmospheric pressure)
MTTL	:	Module Table Take-off and Landing
NOTAM	:	Notice To Airmen
OAT	:	Outside Air Temperature
PIC	:	Pilot-in-Command
QAR	:	Quick Access Recorder
QNH	:	Altitude above mean sea level based on local station pressure
SIC	:	Second-in-Command
TORA	:	Take-off Run Available
UTC	:	Universal Time Coordinate
VHF	:	Very High Frequency
VOR	:	VHF Omni-directional Range

SYNOPSIS

On Saturday, 2 June 2007, at about 2012 hours local time, a Boeing B747-300 aircraft took off from Runway 20C at Singapore Changi Airport. The Take-off Run Available (TORA) of Runway 20C had been reduced to 2,500 m owing to runway resurfacing work. After the aircraft had taken off, the runway controller observed that the runway end marker board lights had gone off. Subsequent inspection found that the marker boards were badly damaged. According to the operator, the aircraft was inspected on arrival in Riyadh but the inspection did not reveal any damage. No passengers or crews were injured.

The Air Accident investigation Bureau of Singapore classified this occurrence as a serious incident.

AIRCRAFT DETAILS

Aircraft type:	Boeing B747-300
Aircraft registration:	HZ-AIT
Numbers and type of engines:	4 Rolls Royce RB211-524D4
Type of flight:	Scheduled passenger flight
Date and time of incident:	2 June 2007, 2012 hours local time
Place of accident:	Singapore Changi Airport
Runway in use:	20C
Phase of flight:	Take-off
Persons on board:	388

1 **FACTUAL INFORMATION**

Unless otherwise stated, all times quoted in this report are based on Singapore local time, which is 8 hours ahead of Coordinated Universal Time (UTC).

1.1 **History of the flight**

- 1.1.1 The aircraft operated from Singapore to Riyadh. The flight crew's duty time for the flight started at 1740 hours when they were fetched from their hotel and transported to the airport. They had a six-day layover in Singapore and were well rested. They arrived at the airport at approximately 1810 hours and proceeded to the aircraft parking bay at gate C1.
- 1.1.2 The First Officer (FO) and Flight Engineer (FE) arrived at the aircraft first, and the flight operation handling agent's despatcher started her preflight briefing. The Pilot-in-Command (PIC) arrived shortly and the despatcher repeated her briefing to the PIC and handed him the flight planning documents. The flight planning documents contained the following:
- Flight Plan
 - Company NOTAMs (known as Asean¹ and Destination NOTAMs) generated by the airline's Bangkok despatch office
 - Module Table Take-off and Landing (MTTL) charts
 - Weather Forecast.
- 1.1.3 In the briefing, the despatcher briefed the crew about the shortening of Runway 20C which was not reflected in the company's Asean and Destination NOTAMs.
- 1.1.4 According to the interview by the General Authority of Civil Aviation (GACA) of the Kingdom of Saudi Arabia, the FE listened to the 1900 hours broadcast of the Changi Airport's Automated Terminal Information Service (ATIS) and heard from ATIS "A" that the runway in use for departure was Runway 20C and the Take-off Run Available (TORA) was 2,500 m.
- 1.1.5 When interviewed by the GACA, the flight crew indicated that they were aware of the shortened runway. The PIC indicated that he was aware as the information was highlighted by the flight despatcher.
- 1.1.6 The crew used computer generated MTTL charts to determine the take-off performance of the aircraft. The charts were provided by the airline's despatch office in Bangkok and were faxed to the flight operation handling agent in Singapore for the MTTL charts to be included in the flight planning package

¹ Association of South East Asia Nations, whose members are Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

delivered by the despatcher.

1.1.7 The MTTL charts (each corresponding to a particular flap setting) supplied to this crew included a numerical table consisting of eight columns. These columns were (see **Appendices 1a** and **1b**):

- Column 1 – Outside Air Temperature (OAT)
- Column 2 – Climb Limit
- Column 3 – 2C-² (for take-off from Runway 02C)
- Column 4 – 2CT² (for take-off from Runway 02C)
- Column 5 – 2L² (for take-off from Runway 02L)
- Column 6 – 20C² (for take-off from Runway 20C)
- Column 7 – 20C-² (for take-off from Runway 20C)
- Column 8 – 20CT² (for take-off from Runway 20C)

Thus, the table allowed flight crew to determine a zero wind take-off weight limit corresponding to a particular OAT value and a particular direction of take-off (02C/02L/20C). The runway length information was given below the table. However, as the table spread over two pages, the runway length information appeared only on the second page of the MTTL charts (see **Appendix 1b**).

1.1.8 According to the flight crew, the format of the MTTL charts provided was different from the one that they were familiar with. The format that they were familiar with contained OAT versus take-off weight limits data for only one particular runway and runway length. The flight crew was not briefed on the change of the MTTL chart format.

1.1.9 At the time of departure, the gross take-off weight of the aircraft was 337,504 kg and the FO used the MTTL chart corresponding to a 20-degree flap take-off. As he was not familiar with the format of the MTTL chart, he consulted the PIC.

1.1.10 According to the GACA, the PIC identified correctly to the FO the column to be used (20CT) but the FO read the data off the wrong column (20C), which was meant for full runway length take-off. The FO did not notice the runway length indicated at the bottom of the 20C column which was on the second page of the chart.

1.1.11 At 1943 hours, the crew called Clearance Delivery and

² These columns provided the aircraft take-off weight limits corresponding to the following runway lengths (see **Appendix 1c**):

- 2C- : Full runway length of 4,000 m (13,123 ft)
- 2CT : Reduced runway length of 2,040 m (6,692 ft) when taking off from taxiway intersection E6
- 2L- : Full runway length of 4,000 m
- 20C : Full runway length of 4,000 m
- 20C- : Reduced runway length of 2,230 m (7,316 ft) when taking off from taxiway intersection E2
- 20CT: Reduced runway length of 2,500 m (8,201 ft) when taking off from taxiway intersection E1

requested for flight level 330. Clearance Delivery read back and informed them to expect Runway 20C and mentioned twice that TORA was 2,500 m. Clearance Delivery subsequently cleared them for flight level 280.

- 1.1.12 At 1947 hours, the crew called Ground Controller for clearance to start one engine at the parking bay as their Auxiliary Power Unit was inoperative. One engine was started by using an external Gas Turbine Starter Unit (GTSU). After starting one engine, they were cleared by Ground Controller to push back the aircraft and taxi to Runway 20C.
- 1.1.13 At 2009 hours, the Runway Controller contacted the crew and cleared them to line up on Runway 20C and repeated the information of TORA 2,500 m. The controller then cleared them for take-off and climb to 3,000 ft.
- 1.1.14 According to the GACA, during the take-off, the PIC, who was the pilot flying, saw the red runway end lights. The FO, the pilot monitoring, said that he saw red runway edge lights. The FE said that he only saw the red runway end lights. He also added that at the moment he saw the runway end lights, he sensed that the aircraft was too low and was expecting to feel or hear some indication of the aircraft hitting the lights.
- 1.1.15 The crew reported that they did not feel or hear anything during the take-off. The Runway Controller saw the runway end lights go off after the aircraft took off. He reported it to his Watch Manager.
- 1.1.16 At the time when the aircraft took off, there was a group of workers doing runway re-surfacing work at the end of Runway 20C. They were in the work zone which was an area situated after the end of the safety zone (500 m from temporary runway end lights, see **Figure 1** and **Figure 2**). The workers interviewed by the investigation team reported that the aircraft flew overhead low enough for them to squat down in reaction.
- 1.1.17 The work supervisor also observed that the first row of marker board lights located in the safety zone at 260 m from the temporary runway end lights went off after the aircraft took off. He went to check them and found that the first row of 13 marker boards was badly damaged. The second row of five marker boards remained intact but the red cones that were positioned on both sides of the five marker boards were blown off.

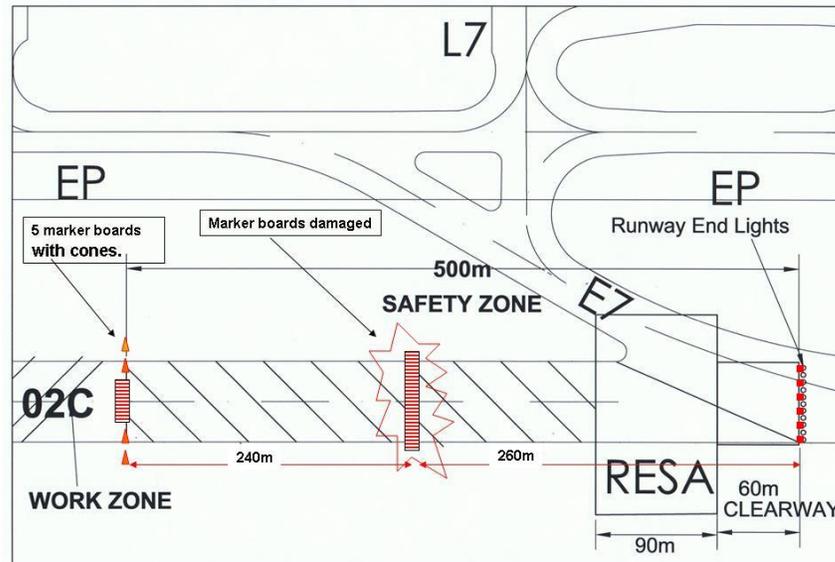


FIGURE 1 - Position of the first row and second row of marker boards



FIGURE 2 – A typical row of marker boards and lights, as placed at 260 m from the temporary runway end lights

- 1.1.18 The crew became aware of the incident when they were queried by a Kuala Lumpur Centre air traffic controller as to whether they had a normal take-off. The controller informed them that Singapore tower controller had reported that they had struck the runway end marker boards and lights on departure.
- 1.1.19 The flight crew realised later in the flight that they had read the

take-off weight limit from the wrong column 20C³ and that they had exceeded the take-off weight limit for the shortened Runway 20C.

- 1.1.20 The crew proceeded to Riyadh. An inspection of the aircraft was carried out after landing in Riyadh and no damage was found. The aircraft then proceeded to Jeddah.
- 1.1.21 The airport operator did not contact the AAIB immediately after the incident. The incident site was cleaned up by the airport operator's contractor. The airport operator could not tell the investigation team which airport official had authorised the contractor to clean up the debris. The contractor took some photographs of the debris but did not record or take any measurements of the debris spread. The pictures taken could not provide enough details for the investigating team to determine the size and spread of the debris.
- 1.1.22 The AAIB became aware of the incident on 4 June 2007 through the routine abnormal operation report that was disseminated via email by the Changi Airport air traffic control service.
- 1.1.23 The air traffic services (ATS) provider of the airport said that its Duty Watch Manager had activated the Emergency Paging System (EPS) at 2230 hours⁴ and that AAIB was on the EPS distribution list. None of AAIB's three officers who were on the distribution list received the EPS. The ATS provider's EPS records cannot be retrieved to confirm whether the message was sent to the three AAIB officers as the EPS records have already been cleared from the system.
- 1.1.24 The damaged marker boards and broken pieces were removed and stacked in the open at a temporary worksite situated at the end of the runway. The storage arrangement further compromised the evidence.

1.2 Injuries to persons

- 1.2.1 None of the 388 persons on board was injured. There were no other people on the ground injured.

³ The PIC in his Air Safety Report submitted to GACA after the incident opined that the non-applicable columns of data, particularly the 20C column should not have been included in the chart as it was not applicable for that flight and the mistake would not have happened if it was not included in the charts.

⁴ The Watch Manager's log book has an entry at 1430 UTC which states that "EPS was activated to inform senior officers of runway closure".

1.3 Damage to aircraft

1.3.1 Nil.

1.4 Other damage

1.4.1 The runway end marker boards and light assemblies were damaged. Of the 13 triangular marker boards that were laid across the runway at 260m from the runway end, 11 were destroyed and some⁵ of the concrete blocks used to weigh down the boards were also damaged (See **Figure 3** and **Figure 4**).



FIGURE 3 - Damaged marker boards and concrete blocks



FIGURE 4 - Debris spread (photo taken against direction of take-off)

⁵ The exact number of damaged concrete blocks was not recorded by the airport operator.

1.5 Personnel information

1.5.1 Pilot-in-Command

Gender: Male

Age: 58

Nationality: Sudanese

Licence: Airline Transport Pilot Licence issued by the GACA

Aircraft rating: AMEL B737/B747

Medical certificate: Date of examination 21 April 2007
Medical certificate First Class
Limitation: Corrective glasses for near and distant vision

Proficiency check: Last check on 31 August 2006

Line Check: Last check on 27 August 2006

Rest period before flight: 6 days layover in Singapore

Duty time before incident: 1 hour 35 minutes

Flight time before incident: Nil

Total flying experience: 13,625 hours (9,454 hours on B737 as Pilot-in-Command and 4,181 hours on B747)

Flying in last 3 months: 115 hours

Flying in last 24 hours: Nil

1.5.2 First Officer

Gender: Male

Age: 43

Nationality: Saudi Arabian

Licence: Commercial Pilot Licence issued by the GACA

Aircraft rating: B747 SIC right hand seat only

Medical certificate: Date of examination 13 March 2007

Medical certification First Class
Limitation: Nil

Proficiency check: Last check on 31 January 2007

Line check: Last check on 27 July 2006

Rest period before flight: 6 days layover in Singapore

Duty time before incident: 1 hour 35 minutes

Flight time before incident: Nil

Total flying experience: 4,302 hours (1,270 hours on MD-90,
523 hours on B737 and 2,509 hours
on B747. All types as First Officer)

Flying in last 3 months: 125 hours

Flying in last 24 hours: Nil

1.5.3 Flight Engineer

Gender: Male

Age: 60

Nationality: Egyptian

License: Flight Engineer Licence issued
by the GACA

Aircraft rating: Turbojet powered

Medical certificate: Date of examination 1 October 2006
Medical certificate Second Class
Limitation: Corrective glasses for
near and distant vision

Proficiency check: Last checked on 7 January 2007

Line check: Last checked on 14 September 2006

Rest period before flight: Layover for 6 days in Singapore

Duty time before incident: 1 hour 35 minutes

Flight time before incident: Nil

Total flying experience: 6,442 hours (1,627 hours on L1011
and 4,815 hours on B747 as Flight
Engineer)

Flying in last 30 days: 46 hours

Flying last 24 hours: Nil

1.5.4 Flight Despatcher

Gender: Female

Nationality: Singaporean

Company approval as a flight despatcher valid until August 2007.

1.6 **Aircraft information**

1.6.1 **General**

1.6.1.1 The certification weight limits of the aircraft were as follows:

Maximum zero fuel weight	247,207 kg
Maximum take-off weight	377,842 kg
Maximum landing weight	285,763 kg

1.6.1.2 The aircraft had no significant technical defect except for an inoperative auxiliary power unit.

1.6.2 **Take-off data**

1.6.2.1 The flight crew took off at a take-off weight of 337,504 kg with a 20-degree flap setting on Runway 20C. The surface wind was 5 knots at 180 degrees and QNH was 1008 mb.

1.6.2.2 The FO used the 20C column of the MTTL chart with an assumed ambient temperature of 43°C⁶ to determine that the corresponding take-off weight limit was 344,000kg, well above the 337,504 kg of take-off weight. The FO concluded that the runway length was adequate for the take-off (See **Appendix 1a**).

1.6.2.3 However, using the correct 20CT column of the MTTL chart for a 20-degree flap setting, the take-off weight limit would be 305,300 kg at 43°C and 325,800 kg at 29°C. As the aircraft's take-off weight was 337,504 kg, this means that the TORA of 2,500 m of the shortened Runway 20C was not adequate for the take-off (See **Appendix 1a**).

⁶ The FO used 43°C as it was a common temperature in the region he operated from. Using a higher OAT value would result in a more penalising take-off weight limit, but if the aircraft take-off weight is below this more penalising take-off weight limit at 43°C, it will certainly be below the take-off weight limit at 29°C.

1.7 Meteorological information

1.7.1 The incident occurred at night with visual meteorological condition. Weather information was provided in Singapore by the Meteorological Services Division of the National Environment Agency. The weather information was available from the ATIS.

1.7.2 ATIS "D" was current at the time of the incident and contained the following information :

- Departure Runway 20C, TORA is 2,500 m
- Arrival Runway 20R
- Taxiway E7 is the last exit taxiway on Runway 20C
- Taxiway W8 closed due work in progress
- METAR 1230Z
- Wind direction 190 degrees at 3 knots, direction variable between 150 degrees to 230 degrees
- Visibility 9,999 m
- Temperature 28°C
- Dew point 25°C
- QNH 1008

1.7.3 The FE reported listening to the 1900 hours ATIS "A" before departure. The ATIS "A" contained the following information:

- Departure Runway 20C, TORA is 2,500 m
- Arrival Runway 20R
- Taxiway E7 is the last exit taxiway on Runway 20C
- Taxiway W8 closed due work in progress
- METAR 1100Z
- Wind direction 170 degrees at 4 knots, direction variable between 140 degrees to 200 degrees
- Visibility 9,999 m
- Temperature 29 °C
- Dew point 25 °C
- QNH 1006

1.7.4 Control Tower had also informed the crew prior to giving clearance for take-off that the surface wind was 180 degrees at 5 knots.

1.8 Aids to navigation

1.8.1 All navigation aids at Singapore Changi Airport required for aircraft operations were working normally at the time of the accident.

1.9 Communications

1.9.1 All communication between the flight crew and ATC was normal.

1.10 Aerodrome information

1.10.1 Runway 20C of Changi Airport has a length of 4,000 m and a width of 60 m. At the time of the incident, the runway was shortened to 2,500 m owing to runway resurfacing work. The work on the runway commenced on 25 May 2007. AIP SUP 48/07 issued by Changi AIS contained information on the shortened runway.

1.10.2 A temporary row of runway end lights were positioned to indicate the end of runway at 2,500 m (**Figure 1** and **Figure 2**) with a row of blue edge lights indicating the edge of the last taxiway (E7) out of the runway. A safety zone of 500 m was established after the temporary runway end lights before the work zone started.

1.10.3 A row of 13 marker boards with lights was positioned across the runway about half way within the safety zone (260 m from the temporary runway end lights). The second row of 5 marker boards and rubber cones marking the start of the work zone were positioned 500m from the end of the temporary runway end lights (240 m from the first row of marker boards) (**Figure 1**).

1.10.4 Along Taxiways E1 and E2, lighted signs were in operation to remind flight crew of the shortened runway (**Figure 5**).



FIGURE 5 - Lighted sign at taxiway intersections

- 1.10.5 The active shortened Runway 20C had distance coded lightings that were in compliance with ICAO Annex 14 standards and recommended practices.

1.11 Flight Recorders

- 1.11.1 The investigation team requested the local representative of the airline concerned as well as the airline's safety department in Jeddah to quarantine the flight data recorder (FDR) and the cockpit voice recorder (CVR) for data download to assist in the investigation but did not receive any reply from the airline's safety department.
- 1.11.2 Subsequently the Accredited Representative appointed by the GACA to participate in the AAIB investigation informed the investigation team that the FDR and CVR data had been overwritten.
- 1.11.3 Although the airline had indicated that it had QAR recording for that flight, repeated attempts by the Accredited Representative from the GACA to obtain the QAR data from the airline were unsuccessful. He was subsequently informed by the airline that the QAR disk was misplaced.

1.12 Medical and pathological information

- 1.12.1 The three flight crew members flew the aircraft back to Riyadh without further event. The investigation team did not have the opportunity to get the crew to undergo medical/toxicological examination.

1.13 Tests and research

- 1.13.1 Two pieces of marker boards that were recovered from the debris had traces of black smears. The shape of the damage on the boards fitted the profile of aircraft tires. Both pieces of marker board debris together with a control sample of rubber⁷ were sent to a laboratory in Singapore for analysis.
- 1.13.2 The analysis results showed that the composition of the black smears on both marker boards were consistent with that of the rubber control sample.

⁷ The rubber control sample was taken from a spare tyre from the airline's store in Singapore.

2 **Analysis**

The analysis by the investigation team covered the following areas:

- (1) Flight crew procedure
- (2) MTTL chart format
- (3) Response from airline
- (4) Airport operator

2.1 **Flight Crew Procedure**

- 2.1.1 The FO computed the aircraft take-off weight limit using the wrong column in the MTTL chart.
- 2.1.2 The PIC did not cross-check the FO's computation. As the aircraft's take-off weight of 337,504 kg was close to its certified maximum take-off weight of 377,842 kg, it would have been prudent for the PIC to check the FO's computation.
- 2.1.3 It was not the airline's requirement that its pilots cross-check each other's computation. However, if the PIC had performed a cross-check, he might have discovered the FO's error.

2.2 **MTTL chart format**

- 2.2.1 The crew claimed that they were not familiar with the format of the MTTL charts provided to them as they were not informed of the change in the MTTL chart format. Prior briefing or orientation of the chart before implementing the new format MTTL charts would have benefited the flight crew. It would also be prudent for the flight crew to take time to study the charts in detail before proceeding with the computation.
- 2.2.2 As the table of data in the MTTL charts was spread over two pages, the runway length information was only indicated at the bottom of each column on the second page. The FO computed the take-off weight limit using only the first page of the MTTL chart and so did not see the runway length figure which could have reminded him that he was reading off the wrong column of data.

2.3 **Response from the airline**

- 2.3.1 Paragraph 5.16 in Chapter 5 of Annex 13 to the Convention on International Civil Aviation states that "When an aircraft involved in an accident or a serious incident lands in a State other than the State of Occurrence, the State of Registry or the State of the Operator shall, on request from the State conducting the investigation, furnish the latter State with the flight recorder

records and, if necessary, the associate flight recorders.”

- 2.3.2 The airline did not respond to requests made by the investigation team for the flight recorder data. The Accredited Representative from the GACA, representing the State of Registry attempted unsuccessfully to secure the recorder data. It appears that the airline did not have a system of preserving recorder or QAR data for investigation purposes.

2.4 Airport operator

- 2.4.1 The airport operator could not identify who had given the clearance to clean up the debris at the incident site and apparently did not assess the event to determine if the event was an accident or a serious incident with a view to notifying the AAIB and discharging its obligation under paragraph 4(1) of Singapore Air Navigation (Investigation of Accident and Incident) Order. Even if the debris had to be cleared for a justifiable reason, it would be advisable for the airport operator to ensure that collection, preservation and documentation of basic evidence is carried out. This would ensure that evidence is available should an investigation be determined to be necessary subsequently.

3 CONCLUSIONS

3.1 Significant factors

- 3.1.1 The FO used a wrong column of data in the MTTL chart to compute the take-off weight limit.
- 3.1.2 The flight crew was not familiar with the format of the MTTL charts and apparently did not take time to study the MTTL charts in detail before using them.
- 3.1.3 The PIC did not cross-check the FO's take-off data computation.
- 3.1.4 The airline did not have any procedure requiring flight crews to perform cross-checks of critical computations such as take-off weight limits.

3.2 Other findings

- 3.2.1 The NOTAMs provided by the airline's Bangkok despatch office did not contain any information on the shortened runway in Changi Airport.
- 3.2.2 The airport operator did not notify the AAIB of the occurrence nor ensure the collection, preservation and documentation of basic evidence relevant to the occurrence.

4 **SAFETY ACTION**

- 4.1 Arising from a suggestion by the investigation team, the airline's flight operation handling agent in Singapore implemented on 22 June 2007 a checklist for their despatchers to ensure that all necessary flight documents are provided to the flight crews during pre-flight briefing by the despatchers. The checklist serves also as a record of what has been provided to the flight crews.
- 4.2 Following the incident, the airport operator reviewed its incident management and investigation system to ensure that an incident manager will take charge of an occurrence and will classify, if necessary, the occurrence as accident or serious incident in accordance with Annex 13 to the Convention on International Civil Aviation. The airport operator also took steps to ensure that its personnel will promptly collect and preserve as necessary the relevant evidence and information relating to an occurrence.
- 4.3 Following the incident, the airport operator has also required its airfield maintenance contractors to seek clearance from the relevant airport authorities before removing any debris from the affected runway/taxiway, take photographs of the site conditions, preserve evidence and make sketches of deposition of FOD, to facilitate subsequent investigation. The airport operator has also designated a storage area for large debris pieces that are required to be preserved as evidence for investigation.

5 SAFETY RECOMMENDATIONS

It is recommended that:

- 5.1 The airline review its flight operation documentation procedure to ensure that flight crews are informed and briefed before implementing changes to MTTL charts/document used for flight planning. [AAIB Recommendation R-2008-004]
- 5.2 The airline review its flight crew procedures to ensure that computation of critical data by flight crews is cross-checked to eliminate error. [AAIB Recommendation R-2008-005]

6 ATTACHMENTS

Appendix 1a – Module Table Take-off and Landing page 1 (MTTL chart)

QU SINOJSQ SINOPSO
 .BKKDDSV 020909 JUN,07 FOIS SYS XLA 921 020909
 - REF ID: 0920788 START TOP 0001 : FOR SAUDIA AIRLINES
 WSSS ELEVATION 23 FT SINGAPORE
 747-368 DER I PACKS OFF CHANGI
 DATED 2 JUN 07

OAT	CLIMB	MAXIMUM	ZERO WIND	WEIGHT-(100 KG)	AND	LIMIT	CODE
DEG C	LIMIT	2C-	2CT	2L-	20C	20C-	20CT
-15	3818	3836?	3189W	3854?	3854?	3289F	3450F
-10	3818	3829?	3170W	3854?	3854?	3269F	3430F
-5	3818	3822?	3151W	3854?	3854?	3248F	3408F
0	3818	3815?	3133W	3854?	3854?	3227F	3386F
5	3818	3808?	3111W	3854?	3854?	3204F	3362F
10	3818	3801?	3088W	3854?	3854?	3180W	3339F
12	3818	3798?	3081W	3854?	3854?	3172W	3331F
14	3818	3796?	3073W	3854?	3854?	3164W	3323F
16	3818	3793?	3065W	3854?	3854?	3156W	3315F
18	3818	3791?	3057W	3854?	3854?	3148W	3307F
20	3818	3788?	3049W	3854?	3854?	3140W	3299F
22	3818	3785?	3041W	3854?	3854?	3130W	3290F
24	3818	3783?	3032W	3850?	3854?	3121W	3281F
26	3818	3780?	3023W	3845?	3854?	3112W	3271F
28	3818	3777?	3015W	3841?	3854?	3103W	3262F
30	3786	3745?	3014W	3806?	3824?	3096W	3253F
31	3756	3718?	3000W	3782?	3791?	3081W	3238F
32	3726	3691?	2986W	3758?	3758?	3067W	3223F
33	3695	3665?	2971W	3727?	3727?	3053W	3208F
34	3665	3639?	2957W	3696?	3696?	3039W	3193F
35	3634	3613?	2943W	3665?	3665?	3025W	3178F
36	3606	3587?	2928W	3635?	3635?	3010W	3162F
37	3577	3562?	2913W	3605?	3605?	2995W	3146F
38	3548	3536?	2898W	3576?	3576?	2980W	3130F
39	3519	3511?	2883W	3548?	3547?	2965W	3115F
40	3491	3487?	2868W	3520?	3520?	2949W	3099F
41	3462	3463?	2853W	3492?	3492?	2935W	3083F
42	3434	3439?	2838W	3466?	3466?	2920W	3068F
43	3405	3416?	2823W	3440?	3440?	2905F	3053F
44	3377	3393?	2809W	3414?	3414?	2891F	3037F
45	3349	3370?	2794W	3389?	3389?	2876F	3022F
46	3320	3345?	2777W	3360?	3360?	2859F	3004F
47	3292	3319?	2761W	3333?	3333?	2842F	2987F
48	3264	3294?	2745W	3305?	3305?	2826F	2969F
49	3235	3269?	2728W	3278?	3278?	2809F	2951F
50	3207	3245?	2712W	3251?	3251?	2792F	2933F
51	3176	3216?	2695W	3218?	3218?	2776F	2916F
52	3145	3187?	2679W	3187?	3187?	2759F	2899F

...REF ID: 0920788 BOTM 0001

020912 JUN07 CTC 368

OAT 29°C

Assumed temp of 43° used by First Officer

Appendix 1b – Modular Table Take-off and Landing page 2 (MTTL)

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020914 JUN07 SIS 269
@NNNN

QU SINDJSQ SINOPSO
.BKKDDSV 020909 JUN,07 FOIS SYS XLA 922 020909
- REF ID: 0920788 CONT TOP 0002
53 3114 3157? 2662W 3157? 3157? 2743F 2881F
54 3082 3127? 2646W 3127? 3127? 2727F 2864F
ADD KG/KT HDW 0 400 0 0 500 500
SUB KG/KT TWD 1400 0 1600 1500 2200 2200
MIN FLP ALT 823 823 823 823 823 823
RWY LGTH-FT 13123 6692 13123 13123 7316 8201
RWY SLP-PCT 0.00 0.00 -0.06 0.00 0.00 0.00
CLEARWAY-FT 0 885 0 0 196 196
MIN RWY-FT 7000 6692 7000 7000 7000 7000
REDUCE ZERO WIND WEIGHT 20000 KG PER 1000 FT REDUCTION OF ORIGINAL
LENGTH
LOW ALTIMETER SETTING: FOR EACH 6 MB BELOW 1006 USE 1 DEG HOTTER
TEMP FOR
MAX THRUST WEIGHT LIMITS, OR 1 DEG COLDER TEMP FOR REDUCED
THRUST EPR
NOTES: 1. FOR RUNWAYS DENOTED BY (-) OR (?),SEE RUNWAY NOTES IN P?P
MANUAL
2. FOR ANTI-SKID INOP, REFER TO P?P MANUAL.
3. FOR ONE OR TWO BRAKES DEACTIVATED, REFER TO P?P MANUAL.

LIMIT CODE:F:FIELD,T:TIRE,B:BRAKE,?:OBS.,W:TAILWIND TAKEOFF NOT
ALLOWED
WSSS ELEVATION 23 FT SINGAPORE
FLAPS 20 PACKS OFF CHANGI
B747-368 DER I DATED 2 JUN 07
OAT CLIMB MAXIMUM ZERO WIND WEIGHT-(100 KG) AND LIMIT CODE
DEG C LIMIT 20R

-15 3818 3854?
-10 3818 3854?
-5 3818 3854?
0 3818 3854?
5 3818 3854?
10 3818 3854?
12 3818 3854?
14 3818 3854?
16 3818 3854?
18 3818 3854?
20 3818 3854?
22 3818 3854?
24 3818 3854?
26 3818 3854?
28 3818 3854?
30 3786 3824?
...REF ID: 0920788 BOTM 0002

020914 JUN07 SIS 269
@NNNN

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Appendix 1c – Modular Table Take-off and Landing (Runway Notes)

QU SINQJSQ SINQPSQ
 .BKKDDSV 020909 JUN,07 FOIS SYS XLA 924 020910
 - REF ID: 0920788 FINISH TOP 0004
 PORT C90916 SAUDI ARABIAN AIRLINES DATE 02JUN2007 TIME 09.09.17
 RUNWAY NOTES PAGE 1

CITY	RNWX	NOTES
WSSS	02C-	USE WHEN NO SHIP IN CHANNEL OR SHIPS IN CHANNEL WITH MAST ELEV LESS THAN 69M. ATC WILL ADVZ MAST HEIGHT WHEN EXCEED 69M.
	02CT-	T/D TXY E6 TIL 30JUN07 REF AIP SUPP 48/07. USE WHEN SHIP IN CHANL MST ELEV LESS 69M. ATC ADZ MST HT WHEN EXCEED 69M.
	02L-	USE WHEN NO SHIP IN CHANNEL OR SHIPS IN CHANNEL WITH MAST ELEV LESS THAN 69M. ATC WILL ADVZ MAST HEIGHT WHEN EXCEED 69M.
	20C-	TEMP RWY DUE WIP. TKOFF FROM TXY INT ?E2? TILL 30 JUN 2007 REF AIP SUPP 48/07
	20CT	TEMP RWY DUE WIP. TKOFF FROM TXY INT ?E1? TILL 30 JUN 2007 REF AIP SUPP 48/07

...REF ID: 0920788 BOTH 0004
 ---- E N D O F R E P O R T ----

020914 JUN07 SIS 271
 @NNNN