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Technical Report A-003/2017

Accident occurred on April 10, 2017,
to the Boeing 757-200 aircraft operated
by Jet2.com, registration G-LSAI,
during the landing manoeuvre
at Alicante-Elche airport (Spain)



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Warning

This current Report is a technical document reflecting the opinion of the Commission of Inquiry into Civil Aviation Accidents and Incidents regarding the circumstances of the event under investigation, its probable causes and its consequences.

In compliance with article 5.4.1 in Annex 13 of the International Civil Aviation Agreement; and as indicated in articles 5.5 Regulation (EU) No. 996/2010 of the European Parliament and Council, 20 October 2010; art. 15 of Law 21/2003 concerning Aviation Safety; and arts. 1, 4 and 21.2 of the R.D. 389/1998, such investigation being exclusively of a technical nature and carried out with the aim of preventing future aviation accidents and incidents through the making, where appropriate, of recommendations to avoid their recurrence. It is not intended to determine or establish any fault or liability, nor does it prejudice any decision that may be made in a judicial context. Consequently, and in accordance with the rules set out above, the investigation has been conducted through procedures that are not necessarily subject to the guarantees and rights that must underlie the evidence in a judicial proceeding.

Consequently, the use of this Report for any purpose other than the prevention of future accidents may result in erroneous conclusions and interpretations.

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Abbreviations

° ' "	Sexagesimal degree, minute and second
°C	Degree centigrade
AAL	Above aerodrome level
ACC	Area control centre
ATC	Air traffic control
ATIS	Automatic terminal information service
ATO	Approved training organisation
ATPL(A)	Airline Transport Pilot Licence (planes)
CAA	Civil Aviation Authority
CAS	Calibrated Airspeed
CBFR	Circuit Breaker Flight Recorder
CPL(A)	Commercial Pilot Licence (planes)
CVDR	Cockpit voice and data recorder
CVR	Cockpit voice recorder
E	East
EGHQ	Newquay Cornwall (Great Britain) Airport ICAO identification
EGNM	Leeds Bradford (Great Britain) Airport ICAO identification
EGPK	Glasgow Prestwick (Great Britain) Airport ICAO identification
EPR	Engine pressure ratio
FC	Flight cycles
FCTM	Flight crew training manual
FDR	Flight data recorder
FH	Flight hours
FL	Flight Level
ft	Foot
ft	Foot
G	Gravity value (1 G = 9,8 m/s ²)
GS	Glide slope
h	Hour
hPa	Hectopascal
ICAO	International Civil Aviation Organization
IFR	Instrumental flight rules

ILS	Instrumental landing system
IR(A)	Instrumental rating
Kg	Kilogram
km	Kilometre
kt	Knot
KIAS	Calibrated Airspeed in knots
lb	Pound
LEAL	Alicante-Elche Airport ICAO identification
LOC	Localizer
LPC	Line proficiency check
LVO	Low visibility operation
m	Metre
MEL	Minimum equipment list
METAR	Ordinary aerodrome weather report
MHz	Megahertz
N	North
NM	Nautical Mile
OCC	Operator Conversion Course
OFP	Operational flight plan
OPC	Operator proficiency check
PF	Pilot flying
PM	Pilot supervising
QNH	Adjustment of the altimeter subscale to obtain ground elevation
SOP	Standard operating procedure
TACC	Terminal Area Control Centre
TAF	Aerodrome forecast
TOAM	Taxi operations aircraft marshaller
UTC	Universal time coordinated
VHF	Very high frequency
VREF	Reference speed

Synopsis

Owner and Operator:	Jet2.com
Aircraft:	Boeing 757-200, G-LSAI
Date and time of the accident:	Monday April 10 2017; 10:39 UTC ¹
Place of the accident:	Alicante-Elche Airport (LEAL)
People onboard:	8 crew members. Uninjured 230 passengers Uninjured
Type of flight:	International, scheduled commercial passenger air transport.
Phase of flight:	Landing - levelling for landing
Flight rules:	IFR
Approval date:	25 April 2018

Summary of the accident

On Monday 10 April 2017, at 10:39 UTC, the B757-200 aircraft, registration number G-LSAI, operated by Jet2.com with 238 people on board, suffered a tailstrike at the Alicante-Elche airport during the landing manoeuvre.

The technical crew of the flight consisted of the line supervising captain (hereinafter referred to as the captain), the copilot and a line training captain. The copilot was undertaking his final evaluation for his completion of line training and acted as pilot flying, and the training captain, sitting in the observer's seat, was evaluating such assessment.

The aircraft had taken off from Leeds Bradford Airport (EGNM), UK, at 08:13 UTC. The flight was proceeding as planned with its scheduled flight plan without any incidents. During touchdown the aircraft reached a 10° pitch position which it held for two seconds, striking the runway with the lower part of its tail cone.

All the people on board disembarked normally without any medical attention being required.

The aircraft suffered significant damage to the tail area.

The investigation has determined that the cause of the accident was incorrect pitch position control during landing.

No safety recommendation has been issued.

¹ Time data in the report is expressed in UTC time. Local time is calculated by adding two hours to the given time.

1. FACTUAL INFORMATION

1.1. History of the flight

On Monday 10 April 2017, at 08:12:59 UTC, the B757-200 aircraft, registration number G-LSAI, operated by Jet2.com, left Leeds Bradford Airport with 238 people on board to go to Alicante-Elche Airport.

The crew consisted of the line supervising captain, the copilot and a line training captain, sitting in the observation seat, to evaluate the copilot for his completion of line training.

The copilot was the aircraft's pilot flying (PF) during the whole route. The flight went smoothly and the crew carried out the final ILS Z approach manoeuvre for runway 10 at the Alicante-Elche airport maintaining stabilized approach parameters as described in the operator's manual.

During the touchdown manoeuvre the aircraft reached a high pitch angle attitude which caused the rear of the aircraft to strike the runway surface.

After the tail area had struck the runway, the captain took control of the aircraft and continued the landing manoeuvre, completing it without any additional problems.

The technical crew were unaware that the aircraft's tail area had touched the runway until they were informed at the parking area by one of the cabin crew that they had heard an unusual noise when landing.

The aircraft suffered damage to the lower part of the tail cone. All the people on board disembarked normally without any medical attention being required.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total	Others
Mortal				
Seriously injured				
Slightly injured				
Uninjured	8	230	238	
TOTAL	8	230	238	

1.3. Damage to aircraft

The aircraft struck runway 10 at the Alicante-Elche airport with the bottom of its tail zone. Abrasive damage was caused to the underside of the fuselage, the rear sewage drainage probe and the VHF antenna located in the lower rear part. Damage to the partition bulkhead of the rear loading hold was additionally discovered.



Fig. 1. Damage to the rear underside of the fuselage.



Fig. 2. Details: VHF antenna and sewage drainage probe damages.

1.4. Other damage

Scratches and marks on the runway were caused by the impact (see sketch in section 1.12).

There was no additional damage.

1.5. Personnel information

1.5.1. *Technical crew*

The 52-year-old line supervising captain had an ATPL (A) airline transport pilot's license issued by the United Kingdom Civil Aviation Authority (CAA) on 11 April 2013, Instrumental rating IR(A) and B757/B767 type rating, both valid until 31 March 2018.

His total experience was 9431 h, of which 1000 h were of this type. He had been in the Jet2.com company for over three years, and had previously worked for two other air transport companies for 15 years.

In the last 90 days he had flown 95:20 h and in the last 30 days 53:53 h.

The Class 1 medical certificate was valid until 16 November 2017.

The 36-year-old copilot had a commercial aircraft pilot's license (CPL(A)) from 28 January 2011 plus instrumental and B757/B767-type flight ratings, IR(A), valid until 31 March 2018.

He had a cumulative flight experience of 657 h, and, of these, 285 h of this type. In the last 90 days he had flown 105:06 h and in the last 30 days 54:40 h.

The Class 1 medical certificate was valid until 6 January 2018.

He had been working for the company for more than 2 years, 10 months as a *Pilot Apprentice (non-flying position)*² & 14 months as copilot.

A verifying captain, whose function is to check the copilot's final line check training, was on board. This 60-year-old pilot had an ATPL (A) airline transport pilot's license issued by the United Kingdom Civil Aviation Authority on 22 February 2014, Instrumental rating IR(A) and B757/B767 type rating, both valid until 31 March 2018.

His total experience was 14680 h, of which 4455 h were of this type. He had been with

² This so-called company post implies that the employee does not perform in-flight functions.

Jet2.com for 12 years, and had worked for two other airline companies as a pilot for 17 years and 10 years as a flight engineer.

In the last 90 days he had flown 15:05 h, all of them in the last 30 days before the accident.

The Class 1 medical certificate was valid until 8 August 2017.

1.6. Aircraft information

The BOEING 757-200 G-LSAI aircraft was manufactured in 1987 with serial number 24016, and had two Rolls Royce RB211-535E4 engines installed. The aircraft had 68901:13 flight hours and 36628 cycles.

At the time of the accident, it had the corresponding certificate of airworthiness issued by the Civil Aviation Authority of the United Kingdom on 23 April 2007, its airworthiness review certificate being valid until 24 May 2017.

Maintenance Record

The maintenance inspection record carried out on the aircraft during the 18 months prior to the accident, i.e. from November 2015 to April 2017, has been verified.

The following general inspections are outlined and were successfully completed:

- Inter-Check inspections. In March, May, July, August, September and December 2016; and in February and March 2017.
- 28 March 2016: inspections A (EV 02), A1, C (1, 4 and 6) and S (1C, 4C and 6C). The aircraft had 67314 flight hours and 36073 cycles.
- 12 May 2016: inspections A (EV 03) and A1. The aircraft had 67397 flight hours and 36105 cycles.
- 19 July 2016: inspections A (EV 04) and A1. The aircraft had 67854 flight hours and 36275 cycles.
- 27 September 2016: inspections A (EV 05) and A1. The aircraft had 68481 flight hours and 36485 cycles.
- 3 February 2017: inspections A (EV 06) and A1. The aircraft had 68772 flight hours and 36580 cycles.

Note: The time intervals of the above inspections are:

Inter-Check: each 500 FH ³ or 90 days (whichever is first) or following type A

A1: every 750 FH or 375 FC ⁴ or 120 days (whichever is first)

C1: every 6000 FH or 24 months (whichever is first)

C4: every 24000 FH or 72 months (whichever is first)

C6: every 36000 FH or 108 months (whichever is first)

S1C: every 3000 FH or 24 months (whichever is first)

S4C: every 12000 FH or 72 months (whichever is first)

S6C: every 18000 FH or 108 months (whichever is first)

On the other hand, the only deferred aircraft in the accident aircraft had been recorded 3 days earlier and consisted of a CAT I limitation on the ILS, and could be deferred until August 5, 2017 according to its MEL.

1.7. Meteorological information

The METAR published for the time of the accident were as follows:

METAR LEAL 101000Z 09006KT 050V150 9999 FEW020 18/10 Q1026 NOSIG=

METAR LEAL 101030Z 10006KT 050V150 9999 FEW020 18/11 Q1026 NOSIG=

METAR LEAL 101100Z 09006KT 050V150 9999 FEW020 18/10 Q1026 NOSIG=

They showed a meteorological situation of winds with variable north-eastern - south-eastern 6 kt intensity, good visibility with few clouds at 2000 ft, 18 °C temperature and QNH of 1026 hPa.

In preparation for the approach manoeuvre the crew listened to the ATIS C information from Alicante-Elche airport, which coincides with the METAR information for that time.

On the other hand, the information received from the tower for its landing authorization was that the wind component was on course 080 with 5 kt of intensity.

³ FH: Flight hours.

⁴ FC: Flight cycles.

1.8. Aids to navigation

All the aids for approaching Alicante-Elche airport were operating correctly when the accident under investigation occurred.

1.9. Communications

The crew began their approach manoeuvre in contact with ACC Barcelona on frequency 129.125 MHz. Communication was transferred from level FL250 to frequency TACC Valencia on 124.750 MHz who, in turn, transferred the aircraft to Alicante-Elche Tower on frequency 118.15 MHz.

The communications were in English and there were no interferences or reception and transmission problems in either direction.

1.10. Aerodrome information

Alicante-Elche (LEAL) airport is located 9 km south-east of the city. Its reference point coordinates are 38° 16' 56" N - 003° 32' 29" E, with an elevation of 43 m (142 ft). It has a 10-28 nominated runway, 3000 m in length and 45 m in width.

1.11. Flight recorders

The flight data recorder (FDR) and cockpit voice recorder (CVR) were recovered from the aircraft.

1.11.1. *Flight data recorder*

The FDR equipment removed from the aircraft was a HONEYWELL model with part number 980-4700-042 and serial number 3449 and was of the solid state type.

During the analysis of the FDR data it was found that several parameters of the data set were erroneous or that their validity could not be confirmed. These parameters included, among others, wheel brake pressure data, air/ground mode changeover switch for the nose gear landing leg, various automatic braking parameters and automatic air-brake extension parameters. According to the aircraft manufacturer, these anomalies are most likely due to the aircraft not being wired to capture various parameters that have been added to the data acquisition software.

The following is a chronological description of the most relevant information concerning the accident taken from the recorder. The following chart summarizes the main parameters analysed during the event.

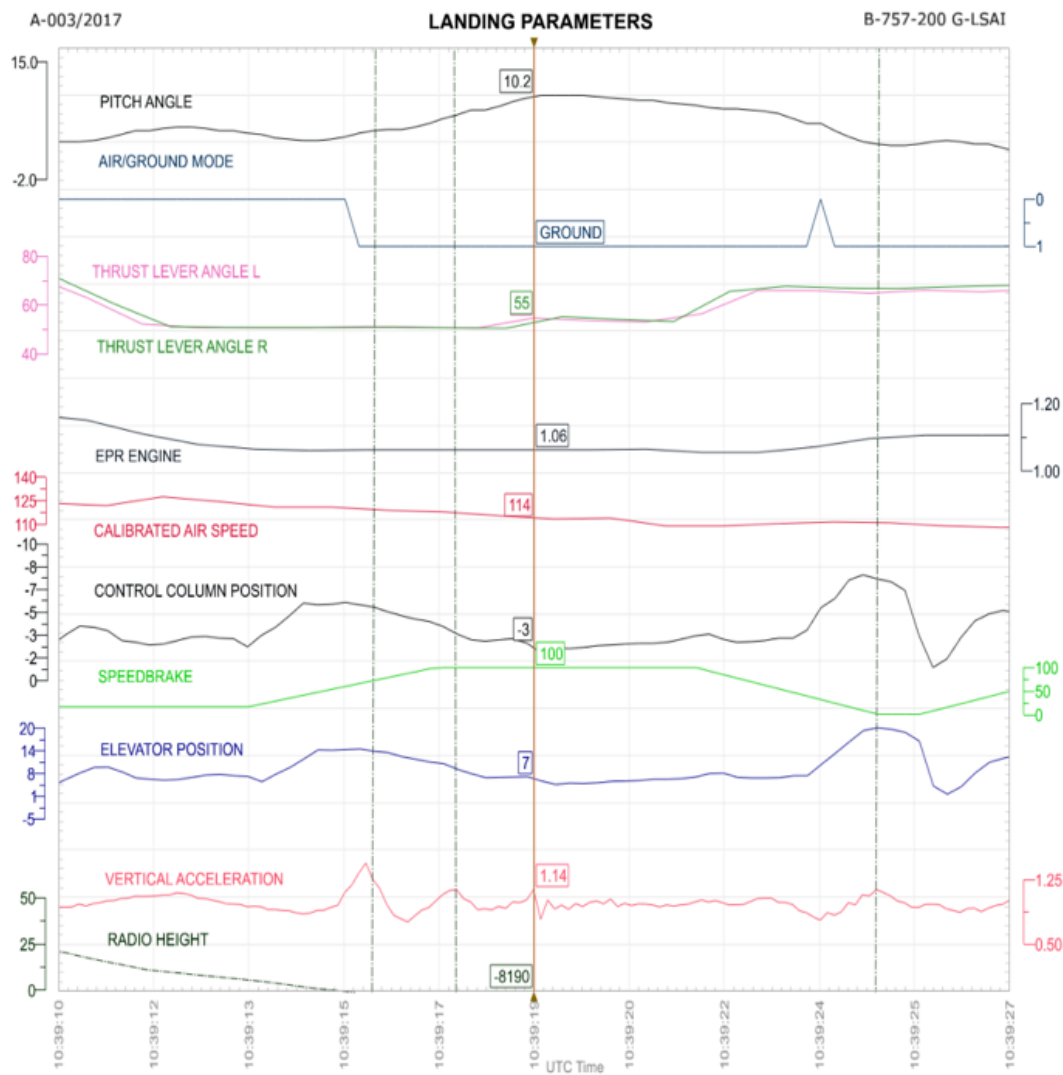


Fig. 3. Relevant parameters during landing.

The aircraft intercepted the ILS localizer on runway 10 at Alicante-Elche airport at 20 NM at an altitude of 5900 ft, at 10:29:57.

The crew configured the aircraft for a flap 30 landing with the autopilot engaged and the aerodynamic brakes set.

The parameters recorded indicated that the manoeuvre had been carried out in accordance with the stable approach criteria established by the operator (see Annex 1).

The crew selected a 130 kt approach speed⁵ which, in general, was maintained during the final approach manoeuvre. The winds recorded by the navigation system showed an average 10 kt headwind intensity.

The autopilot was disabled at 10:38:22 when the plane was descending at 400 ft of radio altitude.

At 10:38:55, when the aircraft was descending at 100 ft radio altitude, a movement of the control column was recorded resulting in a 3° increase in pitch angle to a value between 3-4°. This increase in pitch attitude reduced the descent rate from 600 to 300 fpm, and the calculated airspeed decreased below the selected 130 kt.

At 10:39:07 at 48 ft radio altitude, an additional movement of the control column was recorded which increased the pitch angle to 6°.

The thrust levers were reduced, reaching idle position at 10:39:12 when the aircraft was flying at a 10 ft radio altitude. The computed speed continued to decrease in response to reducing the thrust lever and increasing pitch angle.

Landing took place at 10:39:16 with a 5° pitch angle and 119 kt computed speed with a 1.45 G vertical acceleration. Recorded wind was 095° with an 8 kt intensity.

The aerodynamic brakes were extended approximately one second after touchdown was made. Since their triggering was recorded before landing and they were deployed immediately after landing, they are considered to have been automatically extended.

The control column position was slackened slightly after touchdown was made, but the pitch attitude increase tendency continued until it reached a value of 10.2° at 10:39:19, reaching a 1.14 G vertical acceleration value. This attitude continued for one second.

It was not possible to determine which applied braking intensity after touchdown was made as braking pressure data for the wheels had been abnormally recorded.

⁵ Based on an 82,138 kg (181,084 lbs) landing weight, the landing reference speed (VREF) was 126 kt.

At 10:39:22 the power levers were moved forward from the 50° idle position to 65° reaching a slight EPR increase from 1.07 to 1.13, and the aerodynamic brakes were retracted. At this point, when the pitch angle was 7°, it was recorded that the air-ground sensor went into air mode for 1 second.

It can be seen from the graph (Figure 3) that after aerodynamic brake retraction, the pitch attitude started to decrease at a faster rate. During this time, small continuous movements were recorded on the control column to lower the nose.

Shortly after the aerodynamic brakes were retracted, additional nose up movements occurred at 10:39:25, and the pitch attitude stopped its decreasing tendency at 3°. After that, control column movement suddenly eased, preventing the effect from reaching a value of more than 4°.

The aerodynamic brakes were again extended at 10:39:28 (probably manually), and pitch attitude decreased to a value of 0°, reaching it when the aircraft had a 100 kt ground speed, 13 seconds after touchdown. The landing roll continued without further incidence.

It took 4 minutes and 18 seconds from touchdown to the end of the FDR recording, coinciding with engine turn-off at the parking area.

1.11.2. *Cockpit voice data recorder*

The CVR was the FA2100 type manufactured by L3 Communications with part number 2100-1020-00 and serial number 000297648.

6 audio tracks were extracted after download. Four of them were recorded in high quality, half an hour long, corresponding to the pilot's microphone, the copilot's microphone, service intercom communications and the cockpit area microphone. No information about the event could be obtained from these tracks as they were recorded over by events following arrival at the parking point.

The other two tracks, of standard quality, were two hours long and had recorded a combination of both pilots' tracks and another from the ambient cockpit microphone. These records did contain valid accident flight information.

The analysis of the recordings showed that appropriate measures to preserve the flight recorders had not been taken until 54 minutes after the impact, which is why the high quality tracks were recorded over and the information useful in the investigation was lost.

It should be noted that just under four and a half minutes passed between the time of the impact and the time the plane was stopped on chocks.

A CVR and FDR preservation note was made in the aircraft status log at 11:30 UTC.

From listening to the CVR's two-hour tracks, it was noted that the flight was standard in terms of procedural performance, with a good crew atmosphere.

At the moment of touchdown, the captain can be heard telling the copilot to lower the nose position. The copilot was then heard to indicate that he was beginning the go around manoeuvre, at which point the captain took control of the aircraft and concluded the landing manoeuvre.

During taxiing to the parking area the crew did not comment on the abnormal landing, and only upon arriving at authorized parking position number 19 was a conversation recorded with an auxiliary crew member entering the cockpit who commented on hearing a strange noise while landing.

The CVR also recorded the communication between a TOAM and the tower indicating that the flight had landed making a "wheelie" and a tailstrike, so it requested permission to enter the runway and carry out an inspection.

1.12. Wreckage and impact information

The aircraft's lower tail cone section hit the pavement on runway 10 at Alicante-Elche airport. Dragging (just one) took place between beacons 15 and 16 on the runway axis (neither of them was damaged) about 2 m from the first one and slightly to the left of the runway axis.

The length of the trail left on the pavement was 4 m.

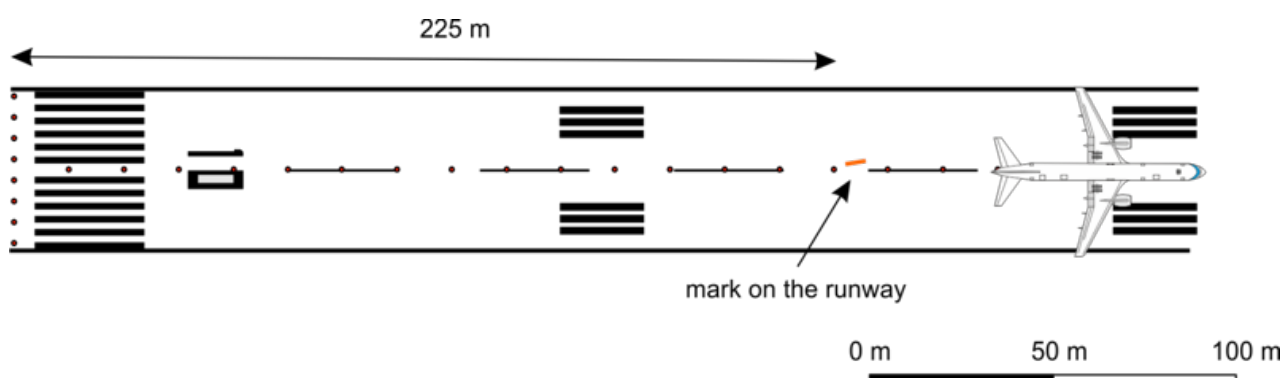


Fig. 4. Sketch of marks on the runway.

1.13. Medical and pathological information

Not applicable.

1.14. Fire

There was no fire.

1.15. Survival aspects

Not applicable in this case.

1.16. Tests and Research

1.16.1. *Information in Manuals*

In Chapter 6 of the Flight Crew Training Manual (FCTM) ⁶, provided by the operator (Revision No. 14 of 30/06/2015), the manufacturer indicates the proper technique for landing the B757-200 aircraft (see Annex 2).

The document includes a graph that links the pitch and warping attitude with the risk of the aircraft hitting the runway during the landing roll. This shows that with a pitch attitude of more than 10° and level wings, there is a risk of striking the lower rear section of the aircraft (red dot in the graph below).

⁶ FCTM: Flight Crew Training Material.

Ground Contact Angles - Normal Landing
757-200

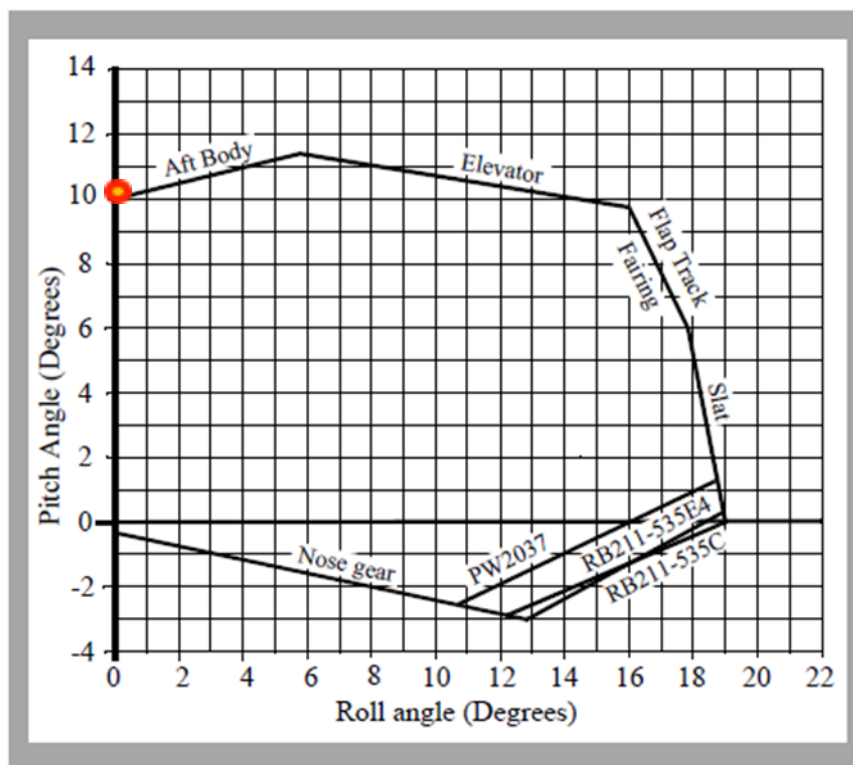


Fig. 5. Ground contact angle-normal landing.

It also includes the following graph about the landing pitch angle.

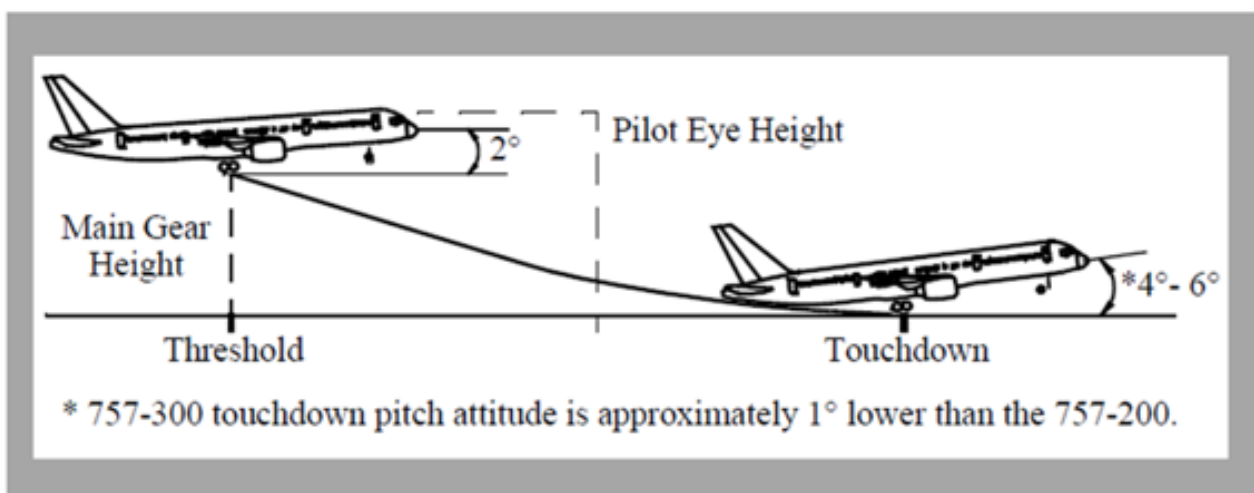


Fig. 6. Pitch attitude on landing.

And the following graph shows the attitude of the fuselage on touchdown according to the reference speed, weight and flaps.

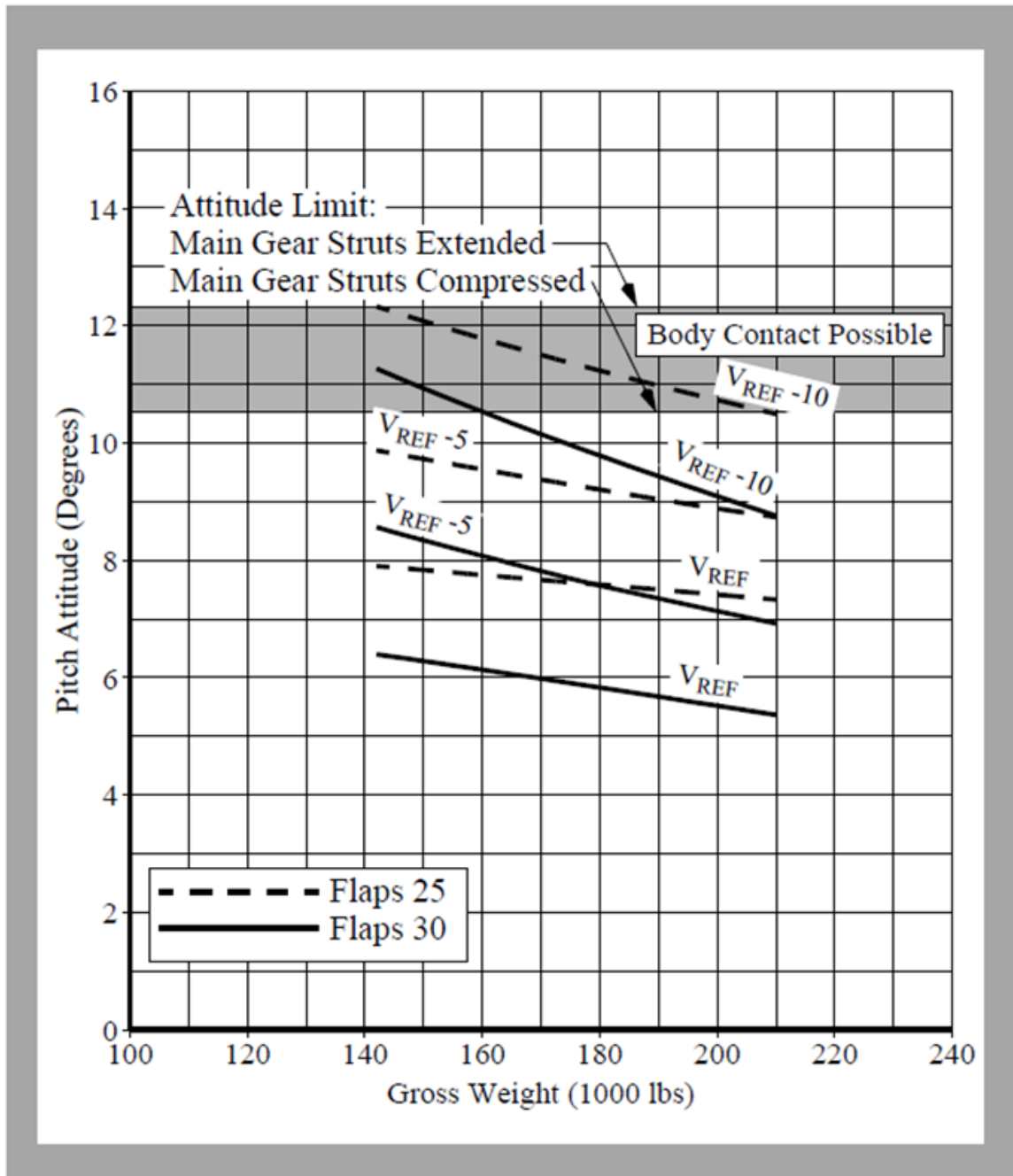


Fig. 7. Fuselage attitude on touchdown.

1.16.2. Load and trim sheet

The aircraft's load and trim sheet was verified by checking that the percentage value on the mean aerodynamic landing chord (MACLAW) of 24.4% was centred, close to the nominal 23%, and within the authorized operating limits for the FDR registered landing weight of 82.138 kg (181.084 lb) (between 13.5 and 34%).

```

PASSENGER/CABIN BAG 17129 98/111/ 21/ 1 TTL 231 230 +1
Y 230 SOC 0
BLKD 0
*****
TOTAL TRAFFIC LOAD 19629
DRY OPERATING WEIGHT 58377
ZERO FUEL WEIGHT ACTUAL 78006 MAX 83461 L ADJ
TAKE OFF FUEL 12584
TAKE OFF WEIGHT ACTUAL 90590 MAX 103599 ADJ
TRIP FUEL 8147
LANDING WEIGHT ACTUAL 82443 MAX 89811 ADJ
*****
BALANCE AND SEATING CONDITIONS * LAST MINUTE CHANGES
*DEST SPEC CL/CPT # - WEIGHT
BI -1.6 DOI -2.0 *
LIZFW 2.9 MACZFW 23.9 *
LITOW 14.7 MACLOW 27.0 *
LILAW 4.6 MACLAW 24.4 *
*****
FLAPS 1 & 5 3.5 UP*
FLAPS 15 & 20 3.5 UP*
AS3.BS4.C60.D57 *
*****
UNDERLOAD BEFORE LMC 5455 * LMC TOTAL
*****
LOADMESSAGE AND CAPTAINS INFORMATION BEFORE LMC

```

Fig. 8. Weight and balance sheet of the operation.

1.17. Organizational and management information

1.17.1 Training records

The Jet2.com company was certified as an Approved Training Organisation (ATO) under the GBR.ATO-0361 certificate issued by the UK Civil Aviation Authority.

The copilot's training records were checked, highlighting the following milestones:

Between February and March 2016 he undertook the generic type rating course at Boeing's facilities, as the Jet2.com simulator was out of service due to hardware/software updates.

In April 2016 he completed the operator conversion course focused on training the operator in the use of Jet2.com's standard operating procedures (SOP) and conversion to the IS&S instrument panel that the B757 is equipped with.

On May 2, 2016 he conducted an additional training session in the simulator to reinforce single-engine operation, a weakness detected in the OCC.

On May 4, 2016, he undertook the Operator Proficiency Testing Simulator test (OPC).

On the 9th of that month he was scheduled for base training but it had to be cancelled due to excessive crosswind weather conditions.

On May 12, 2016, he conducted a simulator session prior to base training. This training was conducted on May 18 at the EGPK airport (Glasgow Prestwick) completing only 1 out of 7 standard landings so therefore did not show the required capacity to pass.

On June 15, 2016, he conducted a simulator session prior to base training with the qualification of not apt, so the operator scheduled a remedial session for him on the 21st of that month.

On July 5 and 8, 2016, he undertook training and check in the low visibility operation simulator (LVO), an aspect that had not been covered in Boeing's generic qualification course.

On August 7, 2016, he was scheduled for an additional simulator training session prior to base training because one month had passed since his last training event. The delay was justified by the lack of aircraft availability for training as it was during operational peak season.

On August 9, he conducted base training at the EGHQ airport (Newquay Cornwall) with the result of apt and the recommendation to begin his line training to regain his confidence as soon as possible. Initially, 40 sectors were required to complete the line training.

He started his line training on August 23, 2016, doing 6 sectors in the following days until September 1, 2016, when he had to do a scheduled training in a simulator for the operator to verify his proficiency.

Until October 4, 2016, he had conducted 18 flight sectors, the instructor generally commenting that he was making steady progress given his level of experience. He performed a total of 12 sectors with safety pilot.

Up to the latter sector, the copilot had flown with 8 different line supervising captains.

His next supervised line flight was on November 5, 2016, one month later than the previous one, due to his vacations and the reduced flight schedule due to the end of the peak season. In these two sectors the supervisor saw a decline in his progress and recommended two more sectors with a safety pilot to be flown. It was concluded that there was a need to continue his training with regard to the assignment of line supervisors, limiting them to a maximum of two.

From November 10 to December 2, 2016, he flew 12 sectors, 10 of them with the same line supervisor. During this training period there was a continuous improvement in the copilot's skills.

On December 5, 2016, the last two sectors to complete his line training were completed. However, the supervisor and the copilot agreed that he had not reached a sufficient level to be referred for initial line check and therefore 14 additional sectors were requested to be carried out with the same two supervisors with whom he had concluded the previous phase.

These sectors were carried out between December 9, 2016 and January 7, 2017. The instructional observation regarding his progress was that the copilot's abilities had improved once he had been allowed to continue with his supervisors. Following the positive comments received, they suggested he carried out the initial line check.

On January 14, 2017, he carried out his initial line check with a result which was not reaching the required standard, since the supervising captain had to take over control of the aircraft during touchdown.

He was assigned 12 additional line training sectors, removing the flight restriction with only two supervisors as a wider range of feedback on the copilot's progress was being sought.

These additional sectors were carried out between 04 and 26 February 2017. Once again, records of continuous progress were obtained and he was proposed for check.

This check was carried out on March 2, 2017, with a result which was not reaching the required standard due to a hard landing below company standards.

The copilot was assigned 10 additional supervising sectors. Section 16.2.2 Part D in the Operator's Instruction Manual allows a maximum allocation of 1/3 of the total course's additional training at each revision stage, coming to a maximum of 100% of the allocated sectors. With this last allocation the copilot reached the foreseen maximum (including supervisions). The "Flight Crew Training Guidelines" document requires that at least 6 landings in all 10 sectors be carried out in this training, all in accordance with the required standards.

On March 20, 2017, after undertaking simulator training programmed for line proficiency check (LPC/OPC), he began his additional training which was conducted between March 18 and March 31, 2017. During this training, the requirements of the flight crew training guidelines were met. Most of the comments from the supervisors mentioned the copilot's progress towards the standard required for initial first flight check.

On April 7, 2017, the copilot carried out his completion of line training with a result which reached the required standard and was therefore proposed for final check which was carried out on the day of the accident resulting in failure to reach the required standard because the captain had to take over the controls on landing.

During the supervision phase, he had made a total of 60 landings, 11 of which required the intervention of the line supervising captain.

1.17.2 *Recorder preservation*

In the Operating Manual part A, section 11.2.1.3 on Serious Incidents, the operator specifies their policy on preservation of flight recorder recordings.

"If, following a serious incident, the aircraft lands away from base, a replacement CVR or CVDR, if appropriate, is to be installed before the aircraft flies again and the records installed at the time of the incident are to be returned to base for action. If the crew or engineers attending the incident know or suspect that an incident may be classified as 'serious', they should ensure that any CVR or CBFR, if fitted, is disabled after shutdown to prevent any relevant data being overwritten when power is re-applied to the aircraft."

1.18. Additional information

1.18.1 *Information provided by the supervising captain*

On 10 April 2017 they began their activity at Leeds Bradford airport (United Kingdom) at 07:00 h. On that day they were scheduled to fly to Alicante-Elche airport and back.

He was familiar with the operation and Alicante-Elche airport, having performed this route in August of the previous year.

The crew had their briefing in the company's crew room. The copilot was the pilot flying (PF) assigned to that sector as he was aiming to pass check for completion of line training.

He does not remember that the aircraft had any noteworthy defects in its logbook, nor does he remember any deferred item on taking over the aircraft.

The flight progressed exactly as planned and commented on in their previous briefing.

They commented on the meteorological information provided (METAR and TAF) for Alicante-Elche during their pre-flight briefing, and the meteorological conditions foreseen for the route were excellent.

En route they adjusted the altitude and speed flight parameters as planned in their Operational Flight Plan (OFP).

Before descending to Alicante-Elche airport they obtained the ATIS information and the copilot commented on the prevailing meteorological conditions and the requirements and procedures to carry out an aborted approach if needed.

They had no problem with the instructions received from ATC or with the communications.

The instrumental approach manoeuvre performed was the VLC2L, without any instructions to abort landing from the ATC.

All manoeuvres were carried out in the foreseen conditions and the configuration of the aircraft and speed profile were carried out according to the stipulations and requirements for the Alicante-Elche approach. During the course of the manoeuvre, they fulfilled stabilization criteria at the established points.

The landing manoeuvre was performed by the copilot. He took over control of the aircraft when it became apparent to him that the aircraft was performing an unsafe manoeuvre. This happened a couple of seconds after the aircraft seemed to rebound and adopt a nose-high position.

The spoilers had been set during approach. They were initially extended when the aircraft first made touchdown, and, when the aircraft appeared to be bouncing, the spoilers retracted. Once control had been taken over and the plane manually landed, he extended them again.

During landing, he was unaware that the tail area had touched the runway, although the supervising pilot supervisor commented that he thought that the aircraft's nose position had been very high during the rebound.

After taking control of the aircraft, the copilot indicated “go around”⁷. However, he ignored that instruction because he was in the process of re-establishing a safe landing at the time and considered that this was the best option.

As the first touchdown had not been particularly hard he instructed the copilot to add thrust to control the descent rate as indicated in the FCTM .

According to the aircraft manuals, the tail can strike the runway approximately 10.2° from nose up.

That same day they were sent to their home base on another company plane. The entire crew was suspended from flight duties until the result of the company’s safety investigation was known.

He considers he had previously rested enough and that fatigue had no influence on the outcome of the accident.

The whole event happened in 9 seconds. The controls were taken over after the aircraft had already struck the runway. If he had intervened earlier, perhaps it could have been avoided. However, there was no time to think. He commented that in the future he would be extremely cautious about pitch attitude on landing.

1.18.2 *Information provided by the copilot*

The copilot stated that the previous day he had been positioned in Manchester airport having a break prior to his 13.5 hour activity.

He was familiar with procedures at Alicante-Elche airport as he had flown there on the 26th and 27th of the month prior to the accident, as well as on other occasions.

Like the supervising captain, he commented that the flight had gone smoothly until landing.

Prior to the descent they performed a complete approach briefing including the aborted approach procedure and reviewing the meteorological information obtained by the supervising pilot (PM) in the ATIS.

After performing the VLC2L entry manoeuvre they made the ILS Z approach for runway 10 at Alicante-Elche airport.

⁷ The monitoring pilot supervisor said “no, no, no” when the copilot exclaimed “go around”.

The localizer captured the suitable 5° flap setting and 175 kt indicated speed, and performed the manoeuvre according to the company's stabilized approach criteria.

On landing, the spoilers extended as the main landing gear made contact. The aircraft quickly raised its nose as soon as the landing gear engaged and then he pushed the control lever forward. He increased power following the captain's instructions. The spoilers retracted on increasing power and the aircraft changed course left of the centre-line. Then the captain took control. At that moment he said "go around" because he thought that the aircraft was going to swerve sideways off the runway.

None of the three pilots noticed the impact of the aircraft's tail zone with the runway. It was at the parking area that one of the cabin crew informed the captain that they had heard an unusual noise on landing.

He commented that if the situation were to happen again he would push the control lever forward much harder, and, if necessary, to its limit. During his training period he had been instructed to keep the nose leg from touching the runway. At no time had he been told that the nose position could rise during landing.

Regarding the influence of fatigue, the copilot commented that he had not slept well for several nights prior to the flight of the accident, and that he was under considerable stress due to his extensive line training and the pressure from the operator's training staff.

He explained that his B757 training had been extended over time and that it lacked continuity. From the start of his Type Rating course to his final line supervision, 14 months had gone by. Different supervisors had taught him different landing techniques.

After the accident ⁸ on April 10, 2017, Jet2.com terminated his contract.

1.18.3 *Information provided by the training captain*

The training captain also commented on the normal conditions during the course of the flight. Weather conditions were normal on landing except for prevailing tailwind at the early stages of the approach followed by a headwind breeze during landing.

The ground spoilers had been set and they extended automatically on landing. They then automatically retracted caused by the high pitch attitude possibly from a weight-off-wheels signal but without causing any rebound. They were manually extended once the captain took control of the aircraft.

⁸ According to information supplied by Jet2.com, the line training captain had already failed the copilot because of high pitch attitude before he was aware of the tail strike.

He did not notice the tail striking the runway but he did notice the high pitch angle that was reached.

The copilot requested “go around” after the high pitch attitude incident when the aircraft was on the ground with the spoilers fully extended. A go around manoeuvre depends on the severity of the rebound and the amount of runway remaining.

From his position in the observer’s seat he could not intervene to avoid the impact.

He believes the captain’s judgment about when to take control may have been influenced by the fact that if he had taken control earlier the copilot would have failed his final line check immediately.

1.19. Useful or effective investigation techniques

Not applicable in this case.

2. ANALYSIS

2.1. General aspects

The aircraft crew were in possession of valid permits and licenses for the flight.

Likewise, their activity prior to the flight of the accident is considered normal.

The aircraft had all its documentation in force.

The overall maintenance condition of the aircraft was adequate, with only one deferred item on the day of the accident but not having any connection with it.

The aircraft took off from Leeds Bradford Airport (UK) at 08:12:59 on 10 April 2017 for Alicante-Elche airport with 238 people on board.

It was the first flight of the day, performed with a line supervising captain, a line training captain and a copilot being supervised for his final line check to complete his line training.

Weather during the flight had no restrictive or noticeable effect on the accident.

2.2. Analysis of the Operation

According to FDR records, the flight operation was conducted according to the company's operational procedures until landing.

The ILS Z manoeuvre on runway 10 at Alicante-Elche airport was performed following the required parameters for a stabilized approach.

According to the weight recorded at landing, 82138 kg, the reference speed in the 30° extended flap landing configuration was 126 kt.

The copilot, who was acting as pilot flying (PF), carried out control movements to increase pitch attitude from 100 ft height, at which point the speed began to decrease from the selected 130 kt, which corresponds to an additional 4 kt at the reference speed. At a height of 48 ft control movements were recorded on the control column to increase pitch attitude and power was reduced to idle four seconds later.

Nine seconds after starting the landing flare manoeuvre, touchdown was made with a pitch attitude of 5°, a calibrated speed of 119 kt and a vertical descent speed of 240 fpm. There was a vertical acceleration of 1.45 G corresponding to a firm impact. The nominal landing flare time range described in the FCTM is 4 to 8 seconds so the landing

flare manoeuvre is considered slow, which the manufacturer identifies as a risk factor for tail strike.

Landing attitude close to 5° is identified as within the normal range with the correct reference speed (fig 6). However, the manual specifies (fig 7) that with a VREF-7 kt (119 kt) touchdown and with a weight of 181084 lb (82138 kg) the touchdown attitude would be close to 9°.

The position of the control column was slackened slightly after touchdown was made, but the pitch attitude tendency continued to increase until it reached a value of 10.2° at 10:39:19, reaching a 1.14 G vertical acceleration value. This attitude was maintained for one second.

According to the FCTM, this is the indicated approximate pitch attitude for the rear of the aircraft to make touchdown with levelled wings. When the pitch attitude reached 10.2°, a peak in the normal load factor was observed, providing further evidence that the aircraft's tail probably hit the ground at this moment.

The Boeing manual warns about the aircraft's tendency to increase the pitch attitude after touchdown and warns of the risk of keeping the nose wheel in the air.

When the aircraft captain warned of the excessive attitude reached, induced⁹ because of the low speed (KIAS) on touchdown, he instructed the copilot to increase power, which he did by slightly advancing the thrust levers. The pushing of the thrust levers was insufficient to trigger the retraction of the ground spoilers (they need to be moved to 50% of their range, i.e. to the 80° position), but, as they retracted, it is considered that this could have been done manually by one of the crew members. The increase in lift produced, together with the aircraft's 7° attitude at the time, produced a momentary 1 second ground to flight mode sensor change which coincided with a high magnitude recorded movement of the control column.

This event was identified by the copilot as a rebound and, following the instructions in the manufacturer's manual, he decided to carry out a "go around manoeuvre" verbalizing his intentions.

At that time the captain took control of the aircraft's controls and the ground spoilers were again extended. Pitch attitude decreased towards 0°, reaching it when the aircraft had a ground speed of 100 kt, occurring 13 seconds after touchdown was made. The landing roll continued without further incidence.

⁹ With low speed, lift was being maintained at the expense of increasing the angle of attack, which was equivalent to increasing the pitch angle.

According to the crew's statements, the captain's action was conditioned by the fact that it was a line competency check flight and taking over the aircraft's controls would imply the copilot's failure.

The centre of gravity position was within limits during the flight. And it was especially centred during touchdown and had no influence on the aircraft's attitude during landing.

It is considered that the early start of the landing flare manoeuvre resulted in the VREF not being adequately controlled due to incorrect pitch attitude control during landing. Touchdown at a slower-than-adequate speed required a pitch attitude that reached the geometric limit that impedes the rear of the aircraft from coming into contact with the runway.

In addition, on not landing with the required attitude and speed, touchdown took place at a high vertical speed rate.

An earlier takeover of aircraft control by the supervising captain could have prevented the accident.

2.3. Instruction record analysis

El The copilot began his training by taking the generic B757 aircraft type rating course between February and March 2016.

Before his base training it was necessary to provide him with refresher sessions in a simulator to improve his flight technique in traffic, approach and landing.

During his training period, deficiencies were detected which led to the minimum requirements assigned after his base training, 40 flight sectors, being extended 3 times to a total of 100%, taking into account the failed supervised flights.

During this phase there were periods in which he was assigned permanent supervisors and other periods in which he was assigned different supervisors, so he could learn different operating styles.

The flight of the accident was the last chance the copilot had to complete his line training approval as he had reached the maximum number of authorized training sessions.

During the supervision phase, he had made a total of 60 landings, 11 of which required the intervention of the line supervising captain.

2.4. Record preservation analysis

On listening to the cockpit voice recorder, it was found that the high-quality 30-minute channels had been recorded over, so that only the standard quality 2-hour channels were of use in the investigation.

In the Operating Manual part A, the operator stresses that if the crew, or the engineers assisting the aircraft, know or suspect that the incident may be classified as serious, they shall ensure that any CVR is disabled after landing to prevent any relevant data from being overwritten when the aircraft is re-powered.

The recorders were not preserved by the crew until 54 minutes after the accident, i.e. about 50 minutes after the engine was shut down. This is why the information contained in the half-hour audio channels was lost.

3. CONCLUSIONS

3.1. Findings

- The aircraft crew were in possession of valid permits and licenses for the flight.
- Their activity prior to the flight of the accident is considered within norms.
- The aircraft had all its documentation in force.
- The overall maintenance condition of the aircraft was adequate, with only one deferred item on the day of the accident and unrelated to it.
- The centre of gravity position was within limits during the flight. And it was especially centred during touchdown and had no influence on the aircraft's attitude during landing.
- Weather during the flight of the accident had no restrictive or noticeable influence on it.
- The aircraft took off from Leeds Bradford Airport (EGNM), UK, at 08:13 UTC on 10 April 2017 for Alicante-Elche Airport with 238 people on board.
- The crew consisted of the line supervising captain, the copilot and a line training captain, sitting in the observation seat, to evaluate the copilot for his completion of line training.
- The flight of the accident was the last chance the copilot had to complete his line training, as he had reached the maximum amount of authorized training sessions.
- The copilot was the aircraft's pilot flying (PF) during the whole route. The flight continued without incidents and the crew performed the final ILS Z approach manoeuvre for runway 10 at Alicante-Elche airport following the required parameters for a stabilized approach.
- According to the weight recorded at landing, 82138 kg, the reference speed in the 30° extended flap landing configuration was 126 kt.
- The landing flare manoeuvre was long, during which speed was not properly controlled, and there was also incorrect pitch attitude control.
- Touchdown was made at 10:39 UTC at a high vertical speed rate, though with a lower than adequate indicated speed.
- Pitch attitude reached the geometric limit that impedes the rear of the aircraft from coming into contact with the runway, thus causing it to strike the runway.
- After the strike, due to the abnormal situation, the commander took control of the aircraft and concluded the landing manoeuvre.
- According to the captain's declaration, his action was conditioned by the fact that it was a line competency check flight and taking over the aircraft's controls would imply the copilot's failure.

- An earlier takeover of aircraft control by the captain could have prevented the accident.
- The technical crew were unaware of the strike until one of the passenger crew members informed the captain that they had heard an unusual noise on landing.
- The flight recorders were not preserved by the crew until 54 minutes after the accident, i.e. about 50 minutes after the engine was shut down. This is why the information contained in the high-quality half-hour audio channels was lost.
- The operator's Instruction Manual, Part A, contains the necessary instructions for their crew to preserve the flight recorders after a serious incident (or accident).
- The aircraft suffered damage to the bottom of the tail cone. There was no further damage except for marks and scratches on the runway surface.
- All the people on board disembarked normally without any medical attention being required.

3.2. Causes / Contributing factors

The investigation has determined that the cause of the accident was incorrect pitch position control during landing.

As a contributing factor, the fact that the aircraft captain (PM) could have intervened before the accident to correct the situation is highlighted.

4. SAFETY RECOMMENDATIONS

None.

5. ANNEXES

5.1. Annex 1: Approach stabilisation criteria

The Operating Manual part A, section 8.9.3.13 sets out the operator's criteria for carrying out stabilized approach manoeuvres.

All straight-in approaches should be stabilised by 1000 ft AAL. They **MUST** be stabilised by 500 ft AAL. (Circling: 300 ft AAL).

Approach Stabilisation Criteria

- All briefings, checks and cockpit procedures are complete.
- The aircraft is on the correct flight path.
- Only small changes in pitch and heading are required to maintain the steady-state flight path.
- The aircraft is in the landing configuration.
- Airspeed is between VREF and VREF +20.
- Vertical speed is 1000 fpm down or less.
- A thrust setting appropriate for the aircraft landing weight, approach speed and published approach gradient (not idle thrust).
- ILS: Within 1 dot of LOC and GS.
- Visual approach: Wings level by 500 ft AAL.
- Circling approach: Wings level by 300 ft AAL.

If these criteria are not met by 500 ft AAL (Circling: 300 ft AAL) a mandatory go-around must be flown.

5.2. Annex 2: B757-200 aircraft landing technique

In Chapter 6 of the Flight Crew Training Manual (FCTM), provided by the operator (Revision No.14 - 30/06/2015), the manufacturer indicates the proper technique for landing the B757-200 aircraft.

Regarding the rotation technique

"When the threshold passes under the airplane nose and out of sight, shift the visual sighting point to the far end of the runway. Shifting the visual sighting point assists in controlling the pitch attitude during the flare. Maintaining a constant airspeed and descent rate assists in determining the flare point. Initiate the flare when the main gear is approximately 20 to 30 feet above the runway by increasing pitch attitude approximately 2° - 3°. This slows the rate of descent.

After the flare is initiated, smoothly retard the thrust levers to idle, and make small pitch attitude adjustments to maintain the desired descent rate to the runway. A smooth thrust reduction to idle also assists in controlling the natural nose-down pitch change associated with thrust reduction. Hold sufficient back pressure on the control column to keep the pitch attitude constant."

Regarding the landing gear manoeuvre profile

"The following diagrams use these conditions:

- 3° approach glide path*
- flare distance is approximately 1,000 to 2,000 feet beyond the threshold*
- typical landing flare times range from 4 to 8 seconds and are a function of approach speed*
- airplane body attitudes are based upon typical landing weights, flaps 30, VREF 30 + 5 knots (approach) and VREF 30 + 0 (touchdown), and should be reduced by 1° for each 5 knots above this speed"*

And

"Prolonged flare increases airplane pitch attitude 2° to 3°. When prolonged flare is coupled with a misjudged height above the runway, a tail strike is possible. Do not prolong the flare in an attempt to achieve a perfectly smooth touchdown. A smooth touchdown is not the criterion for a safe landing."

Regarding pitch angle control during the landing roll

"Typically, the pitch attitude increases slightly during the actual landing, but avoid over-rotating. Do not increase the pitch attitude, trim, or hold the nose wheel off the runway after landing. This could lead to a tail strike.

After main gear touchdown, initiate the landing roll procedure. If the speedbrakes do not extend automatically move the speedbrake lever to the UP position without delay. Fly the nose wheels smoothly onto the runway without delay. Control column movement forward of neutral should not be required. Do not attempt to hold the nose wheels off the runway. Holding the nose up after touchdown for aerodynamic braking is not an effective braking technique and results in high nose gear sink rates upon brake application and reduced braking effectiveness.

To avoid the risk of a tail strike, do not allow the pitch attitude to increase after touchdown. However, applying excessive nose down elevator during landing can result in substantial forward fuselage damage. Do not use full down elevator. Use an appropriate autobrake setting or manually apply wheel brakes smoothly with steadily increasing pedal pressure as required for runway condition and runway length available. Maintain deceleration rate with constant or increasing brake pressure as required until stopped or desired taxi speed is reached."

Regarding the rebound recovery technique

"If the airplane should bounce, hold or re-establish a normal landing attitude and add thrust as necessary to control the rate of descent. Thrust need not be added for a shallow bounce or skip. When a high, hard bounce occurs, initiate a go-around. Apply go-around thrust and use normal go-around procedures."

The manufacturer stated that Revision 16 of the FCTM was published in June 2017. One of the changes included a change in landing roll instructions to emphasize flying the nose towards the runway. The amended text is as follows:

Revision 16 of the FCTM

"After main gear touchdown, initiate the landing roll procedure. Fly the nose wheels smoothly onto the runway without delay. If the speedbrakes do not extend automatically move the speedbrake lever to the UP position without delay. Control column movement forward of neutral should not be required. Do not attempt to hold the nose wheels off the runway. Holding the nose up after touchdown for aerodynamic braking is not an effective braking technique and results in high nose gear sink rates upon brake application and reduced braking effectiveness."