DATA SUMMARY

LOCATION

Date and time	**Thursday, 14 January 2010; 10:09 UTC**
Site	**Girona Airport (Girona, Spain)**

AIRCRAFT

Registration	**EI-EBL**	**EI-DWT**
Type and model	**BOEING 737-800**	**BOEING 737-800**
Operator	**Ryanair**	**Ryanair**

Engines

Type and model	**CFM 56 7B**	**CFM 56 7B**
Number	**2**	**2**

CREW

	Pilot	Copilot	Pilot	Copilot
Age	**43 years old**	**29 years old**	**37 years old**	**35 years old**
License	**ATPL(A)**	**CPL(A)**	**ATPL(A)**	**CPL(A)**
Total flight hours	**7,600 h**	**430 h**	**8,700 h**	**2,800 h**
Flight hours on the type	**2,500 h**	**150 h**	**7,000 h**	**2,000 h**

INJURIES

	Fatal	Serious	Minor/None	Fatal	Serious	Minor/None
Crew			**4**			**6**
Passengers			**73**			**75**
Third pesons						

DAMAGE

Aircraft	**Significant**	**Minor**
Third parties	**None**	**None**

FLIGHT DATA

Type of operation	**Comm. Air Transport – Scheduled – International – Passenger**	**Comm. Air Transport – Scheduled – Domestic – Passenger**
Phase of flight	**Taxi**	**Taxi**

REPORT

Date of approval	**21 February 2011**

1. FACTUAL INFORMATION

1.1. Description of event

On 14 January 2010, two Boeing 737-800 aircraft, registrations EI-EBL and EI-DWT, operated by Ryanair, were parked at stands 3A and 4A, respectively, at Girona Airport (LEGE). The runway in use was 20.

Aircraft EI-EBL, callsign 9111, was carrying 73 passengers and its destination was Turin (Italy). Aircraft EI-DWT, callsign 9727, was carrying 75 passengers and was going to Las Palmas (Spain).

At around 10:00 UTC[1] both airplanes were pushed back, after which they conducted the engine start-ups. Both were facing north, with EI-EBL situated in front of EI-DWT, since stand 3A is closer to the runway 20 threshold.

Both started to taxi toward the runway 20 threshold, first via the apron and then via the taxiway. Aircraft EI-EBL was cleared to taxi at 10:03 in order to satisfy a 10:13 calculated takeoff time (CTOT). At 10:06, as it neared the runway 20 hold point, the crew reported that it was ready for takeoff, to which ATC replied that they were number 2 for takeoff.

Aircraft EI-DWT was taxiing behind EI-EBL. During its taxi phase, its crew also reported being ready for takeoff. They were informed by ATC that they were first for takeoff. The crew acknowledged receipt of the communication and prepared to pass EI-EBL on the right. EI-EBL had come to a stop at the leftmost of the two stop bar positions.

As EI-DWT was overtaking EI-EBL, it struck the latter's horizontal stabilizer with its left winglet. Following the impact, the crew of aircraft EI-DWT reported it to both the control tower and to the other aircraft. The tower cleared both aircraft to return to parking via the runway. EI-EBL did so first, followed by EI-DWT.

There was no emergency evacuation of either aircraft.

Aircraft EI-EBL exhibited impact damage to the right part of the horizontal stabilizer along its trailing edge, some 1.42 m from the right edge. The damage affected both the fixed surface as well as the elevator. The damage to the other aircraft was limited to the fracture of the left winglet.

[1] Unless otherwise specified, all times in this report are UTC. To obtain local time, add one hour to UTC.

Figure 1. Damage to aircraft

1.2. Personnel information

1.2.1. Crew of aircraft EI-EBL

The Captain, 43, had a valid airline transport pilot license ATPL(A), as well as the corresponding medical certificate.

At the time of the accident he was the pilot flying. This means that in addition to steering the airplane on the ground, which he was doing in accordance with the aircraft procedures, he was also going to conduct the takeoff.

He had 7,600 h of flying experience, of which 2,500 had been on the type.

He had flown 220 h in the ninety days prior to the incident, 75 h in the thirty days prior and 7:30 h in the twenty-four hours prior. He had had 13 h of rest time prior to the flight.

The copilot was 29 years old and had a valid commercial pilot license CPL(A) and the corresponding medical certificate. He had passed the theory exam for the airline transport pilot license. He had 430 h of flying experience, of which 150 had been on the type.

He had flown 334:46 h in the ninety days prior to the incident, 114:25 h in the thirty days prior and 10:42 h in the twenty-four hours prior. He had had 13:13 h of rest time prior to the flight.

1.2.2. *Crew of aircraft EI-DWT*

The Captain, 37, had an airline transport pilot license ATPL(A). Both his license and medical certificate were valid. He had a total flying experience of 8,700 h, of which 7,000 had been on the type.

He had flown 177 h in the ninety days prior to the incident, 56 h in the thirty days prior and had not flown in the twenty-four hours prior. He had had 23:53 h of rest time prior to the flight.

The operator reported that in keeping with the aircraft procedures, the captain was steering the airplane during the taxi phase.

The copilot was 35 years old and had 2,800 h of flying experience, of which 2,000 had been on the type. He had a commercial pilot license CPL(A) and had passed the theory exam for the airline transport pilot license.

He had flown 224:07 h in the ninety days prior to the incident, 104:04 h in the thirty days prior and 8:03 h in the twenty-four hours prior. He had had 19:47 h of rest time prior to the flight.

He was the pilot flying, meaning that he was going to conduct the takeoff, though he had not steered the aircraft during the taxi phase.

1.3. Aircraft information

Both aircraft were the same Boeing 737-800 model, and both were equipped with the same engine type, the CFM 56 7B. Aircraft EI-EBL was manufactured in 2009 and had serial number 37529, and aircraft EI-DWT in 2008 with serial number 33626. Both had valid airworthiness certificates and had passed their maintenance inspections.

The dimensions of this airplane model are shown in Figure 2.

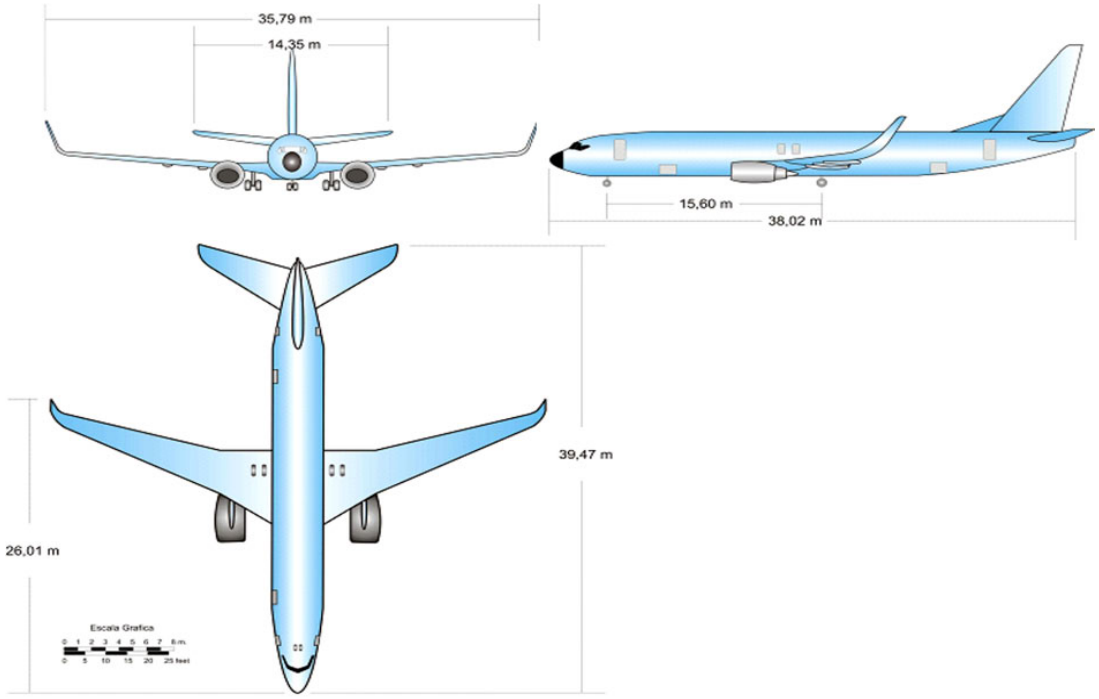


Figure 2. Aircraft dimensions

1.3.1. *Steering the airplane on the ground*

On the ground, the airplane is steered by means of steering pedals that command the nose gear wheels. This action is complemented with the brake pedals, which stop the main gear wheels allowing the airplane to pivot on them to either side. There is also a tiller that is used to steer just the nose wheels. This tiller is only accessible from the captain's (LH) seat. The control exerted by this tiller prevails over that exerted by the pedals in the event of a conflict between the two. This implies that while taxiing, the airplane must necessarily be steered from the captain's seat, as indicated in the airplane procedures. The aircraft flight manual repeatedly warns that the tiller must not be used at speeds in excess of 20 kt.

1.4. Aerodrome information

The Girona Airport (LEGE) has an ICAO classification of 4-E[2]. Its master plan was approved by ORDER FOM/2614/2006 and its main activity is scheduled international passenger traffic.

According to the information in the AIP (Aeronautical Information Publication), its reference point is at coordinates 41° 54' 03" N – 2° 45' 38" E and at an elevation of 143 m (469 ft).

It has one runway designated as 02-20. It is 2,400 m long and 45 m wide. It slopes upward from the 02 threshold to the 20 threshold at 1.25% over the first 500 m, 1% over the next 1,100 m, 0.60% in the next 640 m and –0.26% in the last 160 m. The taxiway is parallel to the runway. Their centerlines are separated by 184.42 m. The taxiway is separated into six sections designated T1 to T6 (see Figure 3). The width of T1, T2 and T6 is 23 m, and sections T3, T4 and T5, which provide access to the platform, are 31.5 m wide. At the end of T1 the taxiway widens to accommodate the stop bar for runway 20. In this area, the taxiway centerline divides into two sections that form a 45° angle (see Figure 5) [3].

The runway 20 threshold is accessed via entry E1 and the 02 threshold via entry E4. Exit taxiway E2 is located between taxiway segments T1 and T2, while exit E3 is between segments T4 and T5.

The width of the taxi lanes leading to the platform, G-1, G-2 and G-3, is 30.5 m, while taxi lane G-4 is 32 m wide.

[2] (4) Runway length 1,800 m and over. (E) Wing span of 52 to 65 m, and outer main gear wheel span of 9 to 14 m.
[3] Image taken from Google Earth.

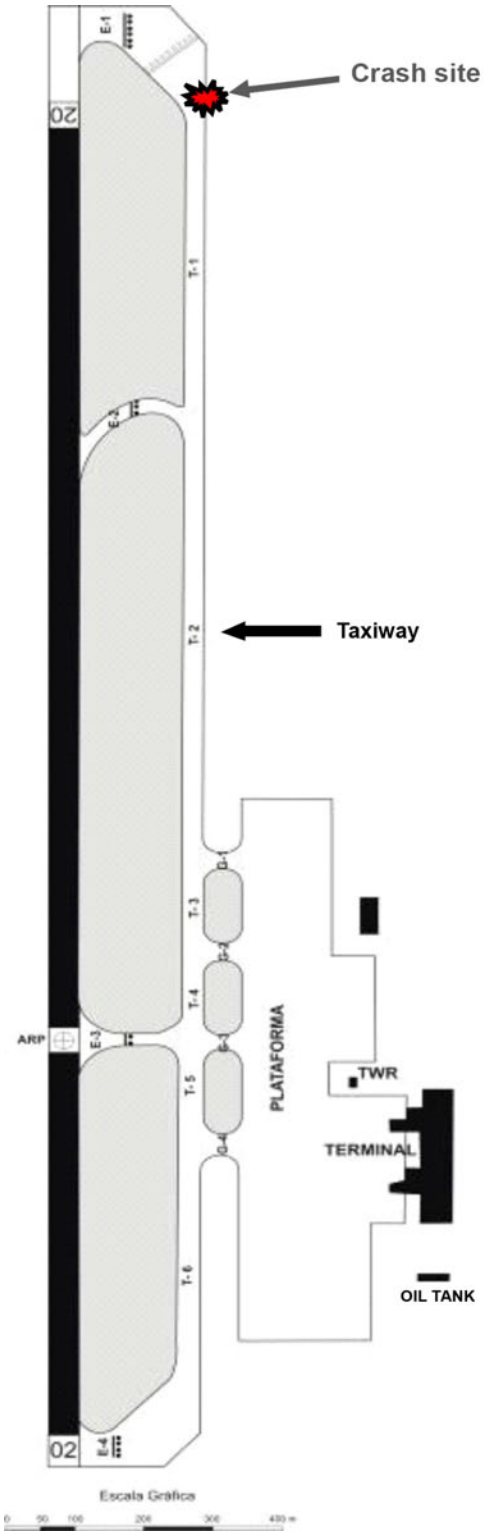


Figure 3. Diagram of aerodrome

The aerodrome map for ground movements shown in the AIP on the day of the incident had the stop bar for runway 20 in a position different from its actual location. The same was true for the other threshold.

The airport reported that the location of the stop bar was changed in October 2009, when the ILS Cat II/III went into service, and that the information regarding the location of the stop bar was sent to the AIS (Aeronautical Information System) for publication in the AIP on 19 August 2009, though no NOTAM was published in this regard.

On the day of the incident the AIP still showed the position of the old stop bar. The position of the new bar was not reflected in the AIP ground movement chart until 29 July 2010. The information published in the AIP on the day of the incident did include the new ILS category (Cat II/III).

As part of the change in ILS category, AENA conducted a safety study of the ILS category II/III maneuver for runway 20 as well as a Functional Hazard Assessment of the modifications associated with moving the runway 20 threshold at Girona Airport.

This assessment did not analyze the risks associated with the airport infrastructure.

Figure 4 shows a close-up of the parking area with the stands occupied by the two aircraft prior to start-up. Aircraft EI-EBL was in stand 3A and taxied first, followed by EI-DWT, which left from 4A.

Although prior to the incident the airport was relying on a topographic survey conducted as part of the change in ILS category, after the incident a new survey was commissioned to determine the actual dimensions of the taxiway and the exact position of the stop bar (see Figure 6).

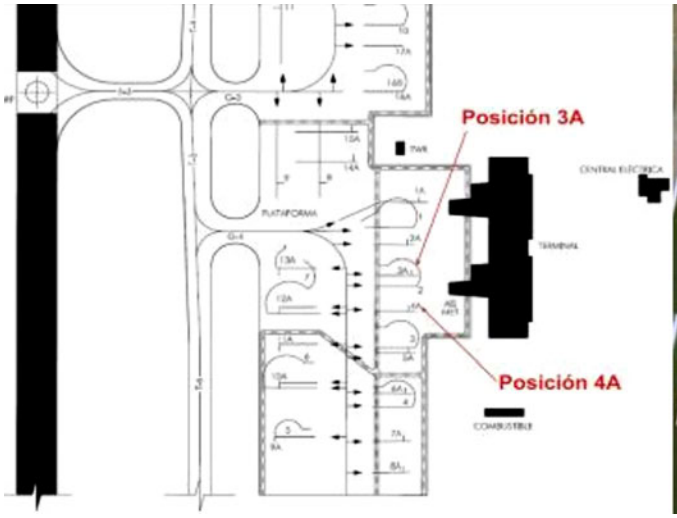


Figure 4. Parking area

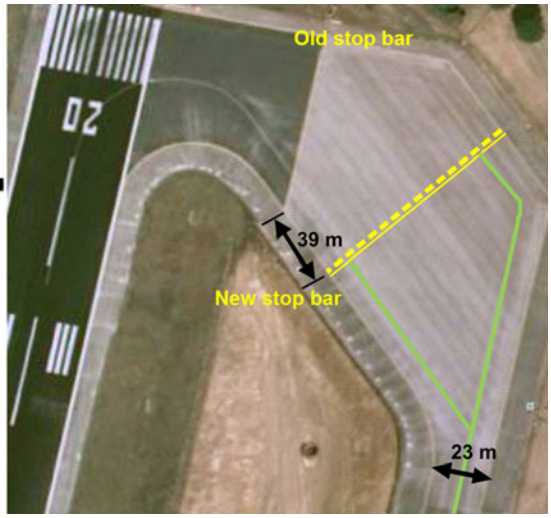


Figure 5. Stop bar

Figure 6 shows the clearances that existed for two airplanes of the same type as those involved this incident before the stop bar was moved.

The smallest clearance, 37.25 m, would have been between the nose of the airplane on the left and the left wingtip of the airplane on the right.

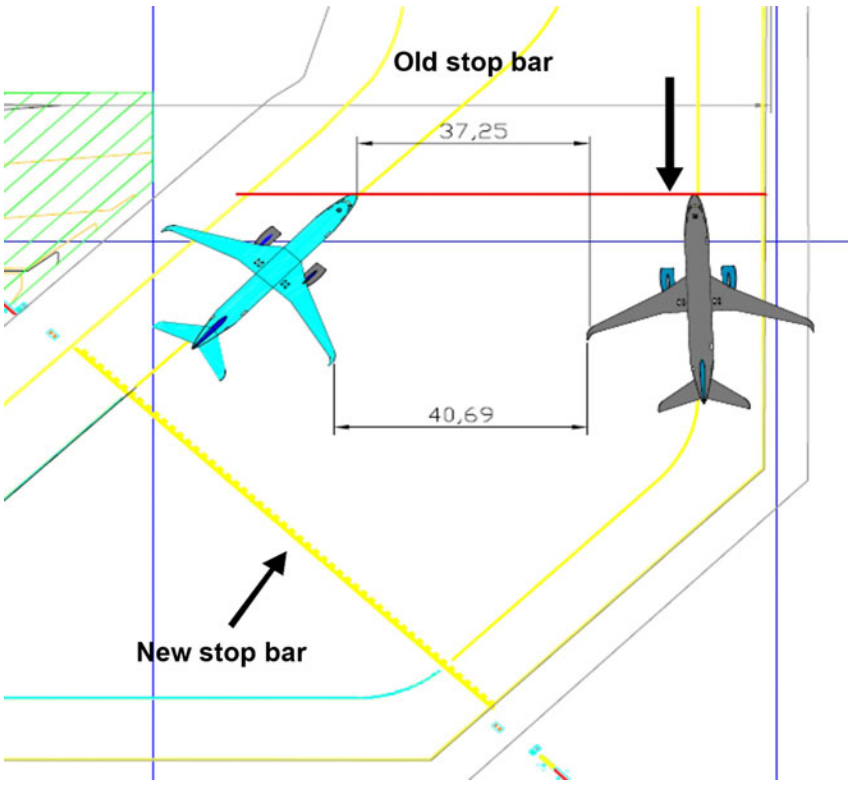


Figure 6. Positions at old stop bar

The minimum distance between their wings was 40.69 m. Based on the dimensions of the airplanes and on the values obtained from the measurements, the theoretical separation between the two airplanes during the overtake maneuver, that is, with the nose of EI-EBL situated above the stop bar and its longitudinal axis over the taxi line, and EI-DWT with its longitudinal axis likewise above the taxi line, was verified to have been 4.7 m. This is the distance that would have separated the left wingtip of the overtaking airplane (EI-DWT) and the right edge of the horizontal stabilizer on the stationary airplane (EI-EBL). See Figure 7.

If airplane EI-EBL had stopped to the right of the stop bar, the margin for overtaking would have been greater, as shown in Figure 8.

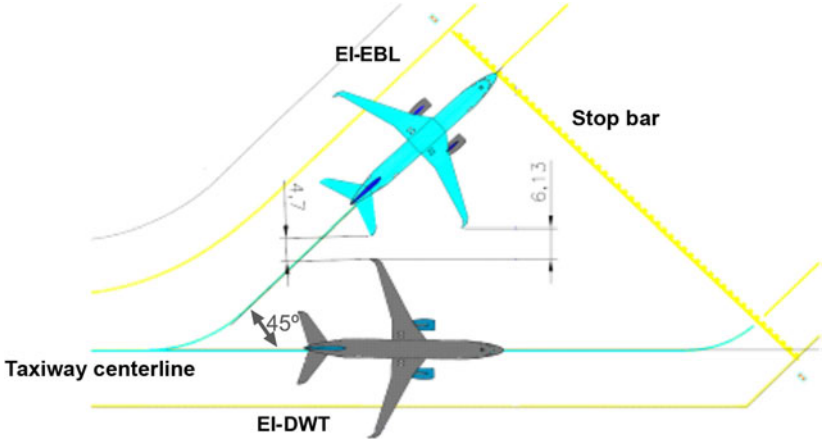


Figure 7. Theoretical positions of airplanes during overtake

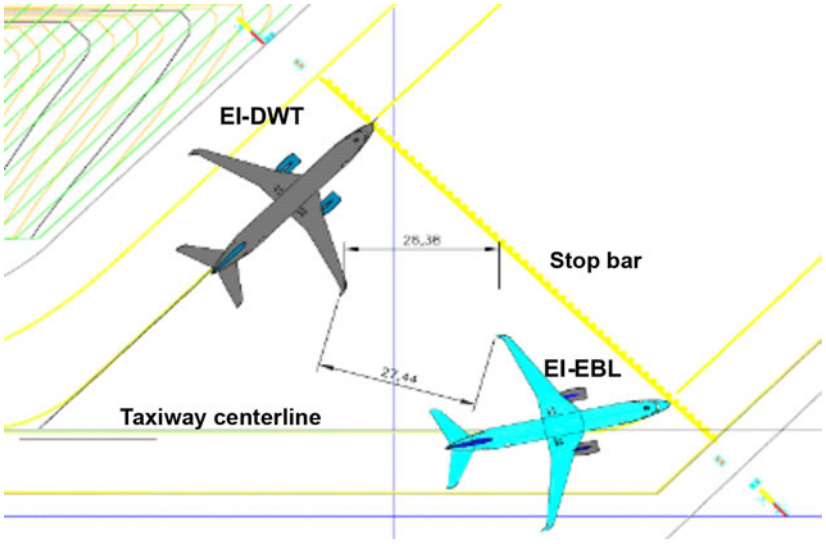


Figure 8. Another possible overtaking position

The local aerodrome regulations listed in the AIP on the date of the incident specified the following:

TAXIING PROCEDURES AT APRON

1. Engine start-up

A. Pilots shall request clearance for engine start-up on GMC frequency,reporting the apron stand number.
B. Permission will be issued as soon as requested, unless more than 15 minutes delays are foreseen, in which case, ATC will notify the engine start-up time. Then, ATC authorization will be informed.
C. When an aircraft is ready for push-back and/or taxiing, pilots shall request for permission on GMC frequency before starting it.

GROUND MOVEMENT

1. General

A. All surface movements of aircraft, towed aircraft, personnel and vehicles on the manoeuvring area are subject to previous ATC clearance.
B. All movements of aircraft, towed aircraft, personnel and vehicles on apron are regulated by the Apron Safety Guidelines.
C. Collision avoidance with other aircraft or obstacles is responsibility of:

1. Pilots taxiing in the apron.
2. Handling companies during push-back manoeuvring or exit the stand and towing.

1.5. Meteorological information

The 10:00 METAR for Girona Airport was as follows:

METAR LEGE 141000Z 00000KT 8000 FEW005 SCT15 10/09 Q996 TEMPO RA=

The METAR reported no wind, a horizontal visibility of 8,000 m, few clouds at 500 ft and scattered clouds at 1,500 ft, a temperature of 10 °C, a dewpoint of 9 °C and QNH of 996 hPa, all of which corresponded to visual flight conditions.

1.6. Communications

The most relevant communications between the tower and the two airplanes are shown below:

Time	Station	Message
09:58:18	Control	RYANAIR 9111, Girona?
09:58:22	RYR9111	Go ahead.
09:58:24	Control	New slot at 10:13.
09:58:26	RYR9111	10:13, requesting start-up, RYANAIR 9111.
09:58:31	Control	RYANAIR 9111, start-up and push-back approved, according to your CTOT al 10.13, and copy clearance, to destination...
09:58:54	RYR9111	Push and start approved...
09:59:04	Control	RYANAIR 9111 read-back correct.
09:59:21	RYR9727	Girona, RYANAIR 927, we are already for push and start, from stand 4[a], information D.
09:59:35	Control	RYANAIR, 9727 standby, break, RYNAIR 9111, Girona?
09:59:43	RYR9111	9111 Go ahead.
09:59:45	Control	9111, Push-back straight back.
09:59:48	RYR9111	Push-back straight back 9111.
09:59:56	Control	RYANAIR 9727 standby, break, RYNAIR 9111, Girona?
10:00:00	RYR9727	9727, Go ahead
10:00:02	Control	RYANAIR 9727, the traffic at your left is gonna be pushed straight back. When clear of this traffic, start-up and push-back, approved facing north.
10:00:11	RYR9727	When cleared on traffic on our left, cleared for, start and push facing north, RYANAIR 9727.
10:00:17	Control	RYANAIR 9727, copy clearance, to destination...
10:00:28	RYR9727	Cleared to destination...
10:00:35	Control	RYANAIR 9727, read-back correct.
10:03:08	RYR9111	RYANAIR 9111 request taxi, please.
10:03:11	Control	**RYANAIR 9111, taxi to holding point runway 20.**
10:03:15	RYR9111	Taxi to holding point runway 20, RYANAIR 9111.
10:04:47	RYR9727	RYANAIR 9727 request taxi.
10:04:50	Control	**RYANAIR 9727, taxi to holding point runway 20.**
10:04:54	RYR9727	Taxi to holding point runway 20, RYANAIR 9727.
10:07:38	RYR9111	RYANAIR 9111 is ready for departure.
10:07:42	Varios	Conversations with other traffic.
10:07:57	RYR9111	RYANAIR 9111 is ready for departure.

Time	Station	Message
10:08:00	Control	**RYANAIR 9111, roger, you'll be number two.**
10:08:05	RYR9111	**Number two, RYANAIR 9111.**
10:08:11	RYR9727	RYANAIR 9727, we are fully ready for departure sequence.
10:08:17	Control	**RYANAIR 9727, you will be number one, confirm ready for departure?**
10:08:23	RYR9727	**Affirm, fully ready, RYANAIR 9727.**
10:08:26	Control	RYANAIR 9727, wind 200... wind calm, cleared for take-off runway 20.
10:08:33	RYR9727	Cleared for take-off runway 20, RYANAIR 9727.
10:09:41	**RYR9727**	**RYANAIR 9727, we hit to the other aircraft, we need to go back to the gate.**
10:09:48	**Control**	**RYANAIR 9727, confirm the problem you have?**
10:09:51	**RYR9727**	**We hit the aircraft, we have a ground collision.**
10:09:57	CONTROL	RYANAIR 9727, roger, can you overtake the other traffic to continue by runaway?
10:10:05	RYR9727	Of course.
10:10:06	Control	Ok, enter the runway and taxi back to the apron, at your discretion.
10:10:16	Control	Roger, 9727, then hold position and call me back when able to do whatever you wish to do. Break, break, RYANAIR 9111, lin-up and wait runway 20.
10:10:30	RYR9111	Negative, sir, RYANAIR 9111, we are asking to go back to the terminal, RYNAIR 9111
10:10:39	**Control**	**RYNAIR 9111, did the company traffic hit you?**
10:10:44	**RYR9111**	**Affirm RYANAIR 9111.**
10:10:46	Control	RYANAIR 9111, roger, then taxi to the apron via the runway 20.
10:10:56	RYR9111	Taxi back to the apron via runway 20, RYNAIR 9111.

1.7. Flight recorders

The solid-state HONEYWELL S-031 flight recorders (SSFDR) were recovered from both aircraft.

The airplane positional data for this report were obtained from the DFDR, which records this information based on data provided by the Inertial Reference Units (IRU). The IRUs measure, among other parameters, the airplane accelerations. Integrating the accelerations and speeds allowed investigators to obtain the paths for both airplanes over their entire trajectories, although the actual paths could not be determined accurately due to the accumulation of errors inherent to the inertial system as a data source. The diagram in Figure 9 shows the paths for the airplanes leaving the gates,

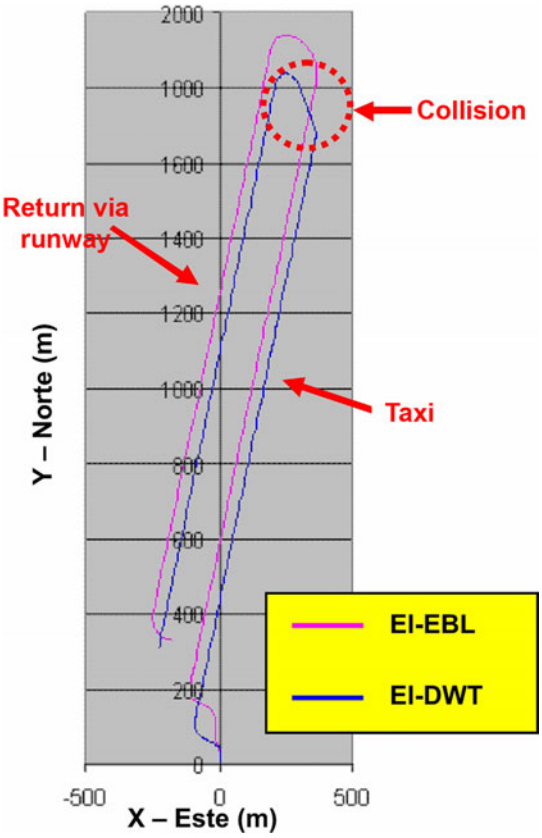


Figure 9. Diagram of trajectories

taxiing to the runway prior to the collision, and finally returning to the stands via the runway.

The exact position of the two aircraft at the time of impact could not be determined.

The coordinates obtained for aircraft EI-EBL were 41° 54' 51.12" N - 2° 46' 01.848" W, and 41° 54' 48.6" N – 2° 46' 01.848" W for aircraft EI-DWT. If these coordinates are overlaid on a map of the airport, the positions are inconsistent with the actual positions of the aircraft and yield a separation of 80 m between them, more than double the airplane's wingspan.

1.7.1. *Aircraft EI-EBL*

After analyzing the most significant parameters, it was determined that the airplane stopped at 10:08:20 with its longitudinal axis facing 331.523°. It remained in this position until the time of impact. Based on variations in the longitudinal and lateral accelerations, the time of impact was fixed at 10:09:25, at which moment the airplane's brake was set and exerting a pressure of 3,108.15 psi on the left brake and 3,080.14 psi on the right.

The graph in Figure 10 shows the longitudinal and lateral accelerations for the time interval between 10:09:19 and 10:09:35, which includes the period immediately before and after the impact. The variation in vertical acceleration was considerably less significant.

Figure 11 shows the airplane's heading as it taxied on the taxiway prior to coming to a halt at the stop bar.

1.7.2. *Aircraft EI-DWT*

A study of the parameters revealed that at the time of impact, 10:09:25, the airplane was moving at a speed of 5.11 kt and that the top speed before the impact during the taxi phase had been 24 kt, between 10:08:35 and 10:08:39.

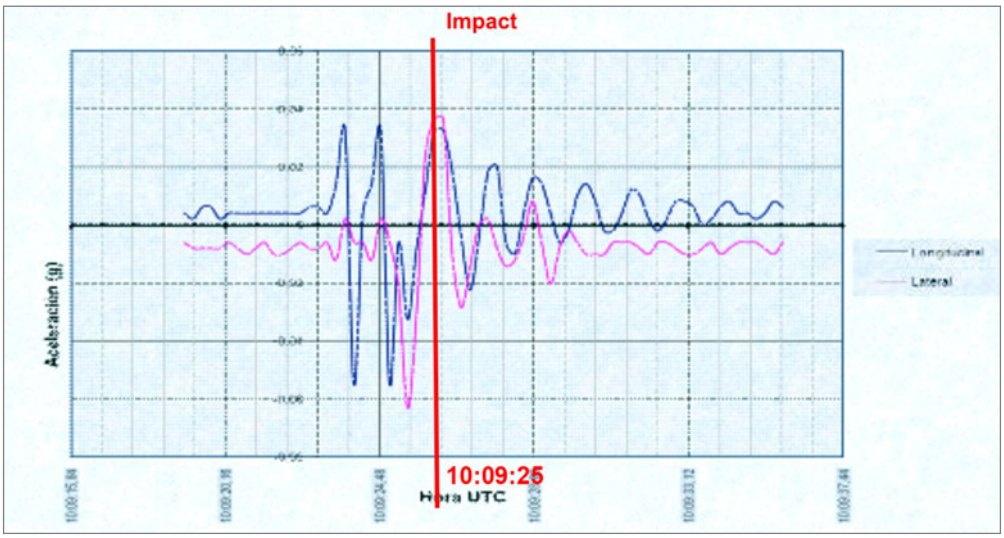


Figure 10. Longitudinal and lateral accelerations of EI-EBL

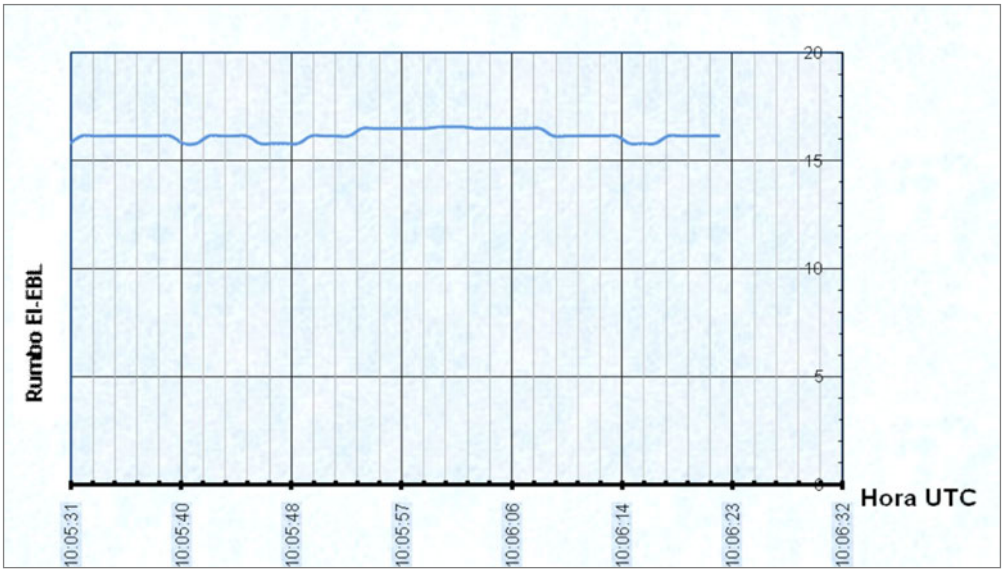


Figure 11. Heading of airplane EI-EBL on taxiway

At the moment of impact, the brake pressure exerted on the left brake was 620.906 psi and 375.249 psi on the right.

The graph in Figure 12 shows the longitudinal and lateral accelerations for the time period between 10:09:19 and 10:09:35, and includes the instants immediately before and after the impact. The change in the longitudinal acceleration was greater than that in the lateral acceleration.

As was the case with the stopped airplane, the variation in vertical acceleration was much lower.

The airplane entered the taxiway at around 10:06:23. During the time prior to the impact it was taxiing on a heading slightly to the left of the taxiway centerline (017º), except at two specific times, as shown in Figure 13.

The airplane was on a course of 14.0625° at the moment of impact, meaning it was 2.9375° left of the taxiway centerline, which is on a heading of 017°.

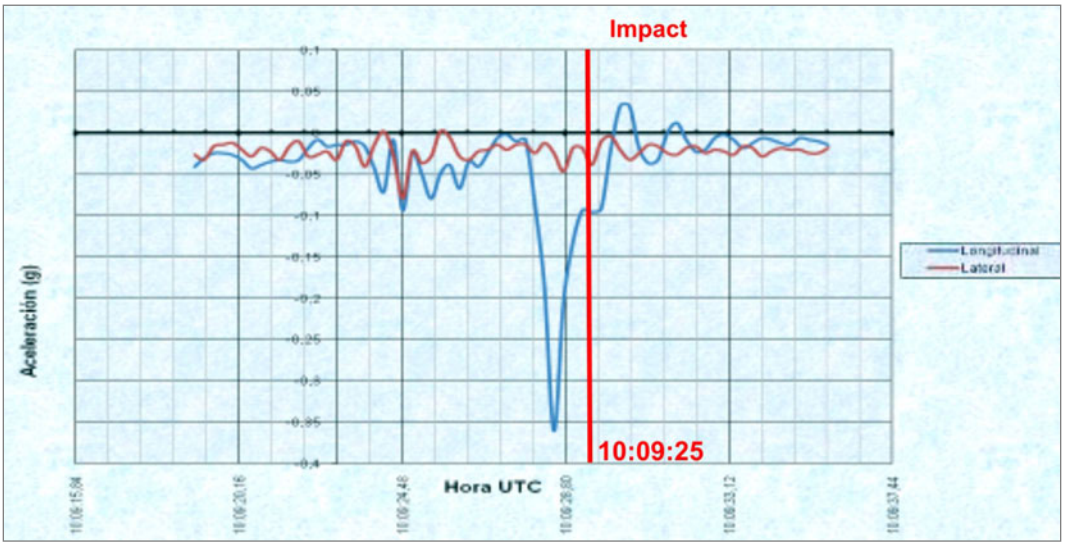


Figure 12. Longitudinal and lateral accelerations of EI-DWT

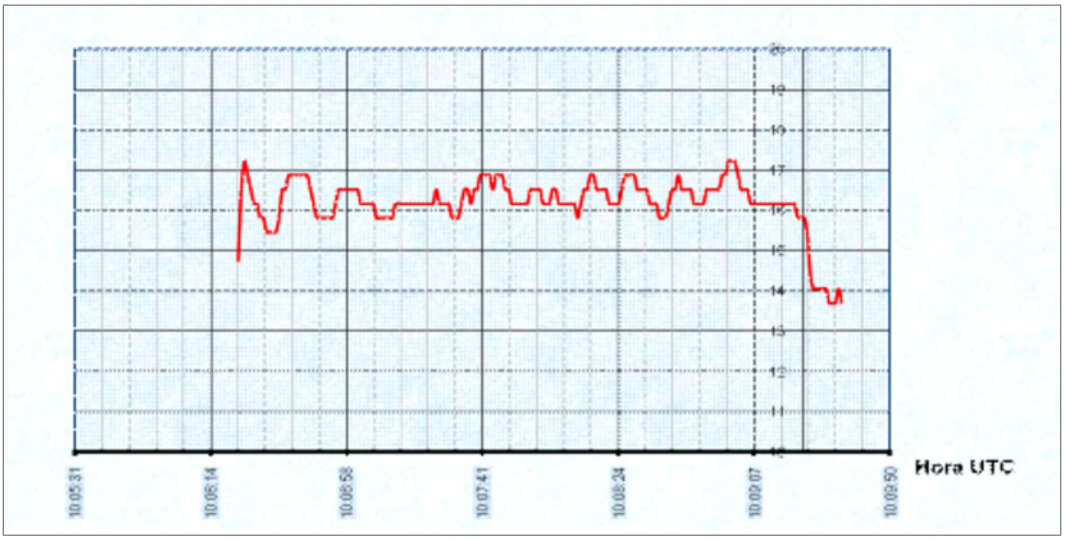


Figure 13. Heading of airplane EI-DWT on taxiway

The graph in Figure 14 shows the speeds at which the airplane was moving while on the taxiway.

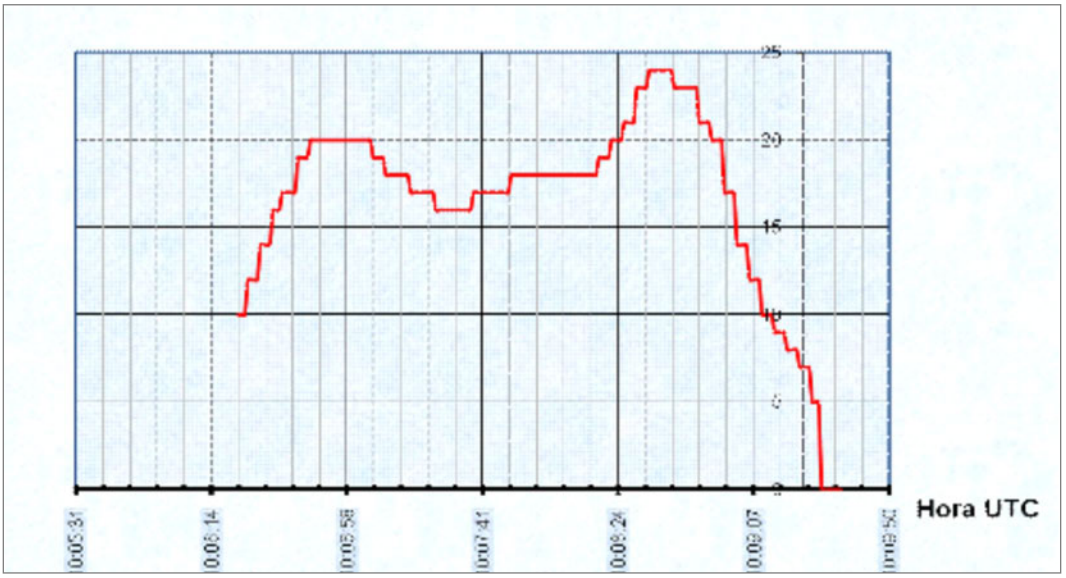


Figure 14. Speed of EI-DWT while taxiing

1.8. Organizational and management information

1.8.1. *Aerodrome design*

The sole reference published in Spain involving the design of aerodromes is the Technical Regulation on Aerodromes, which is a literal transposition of the text in ICAO Annex 14, Volume I. In practice, either one can be used as a reference source.

Annex 14 specifies that aerodromes categorized as 4E can accommodate aircraft with a maximum wingspan of between 52 and 65 m (exclusive) or whose maximum outer main gear wheel span is between 9 and 14 m (Table 1.1, Annex 14).

This reference on aerodrome design recommends a width of 23 m for the taxiways in class E airports. It also recommends that straight portions of a taxiway where the code letter is E should be provided with shoulders that extend symmetrically on each side of the taxiway so that the overall width of the taxiway and its shoulders on straight portions is not less than 44 m.

With regard to the runway hold points, it recommends that one or more runway hold points be provided on the taxiway and at the intersection of the taxiway and a runway.

The Annex also recommends that a runway hold point be established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or vehicle can infringe an obstacle limitation surface or interfere with the operation of radio navigation aids.

In order to protect the runway, the minimum distance between the runway centerline and a runway hold point for category-4 aerodromes with category I, II and III precision approaches must be 90 m (Table 3.2, Annex 14). The distance between the runway centerline and a taxiway centerline for an instrument runway at a 4E aerodrome must be 182.5 m (Table 3.1, Annex 14).

1.8.2. *Taxi phase considerations*

Chapter 3, General Rules, in Book Two, Air Regulations, of Spain's Air Traffic Regulations, states the following:

> 2.3.2. Preventing collisions
>
> In order to prevent possible collisions, it is *vital that crews remain alert* while the aircraft is in flight, regardless of the type of flight or the class of air space in which the aircraft is flying, or *even while moving in the movement area of an aerodrome.*

In BOOK FOUR, PROCEDURES FOR AIR NAVIGATION SERVICES, specifically in CHAPTER 5, AERODROME CONTROL SERVICES, it states:

> 4.5.10. Control of taxiing aircraft
>
> 4.5.10.1. The pilot's vision while taxiing is limited. *It is essential, therefore, that aerodrome air traffic control services provide the pilot with concise instructions and sufficient information to aid in determining the proper taxiway and to avoid collisions with other aircraft or objects.*
>
> 4.5.10.2. So as to expedite air traffic, aircraft may be permitted to taxi on the runway in use as long as doing so does not entail risks or delays for other aircraft.
>
> 4.5.10.3. Except as stipulated in 4.5.10.3.1, or unless otherwise prescribed by the competent ATS authority, *aircraft shall not wait at a distance from the runway in use that is closer than a taxiway hold point.*

BOOK SEVEN – REQUIREMENTS FOR THE OPERATION OF AIRCRAFT, CHAPTER 1 – COMMERCIAL AIR TRANSPORT, states that:

> 7.1.3. Flight operations
>
> 7.1.3.5. Obligations of aircraft Captain

7.1.3.5.1. During the flight, the Captain shall be responsible for the operation and safety of the airplane as well as for the safety of everyone onboard..

The company's Operations Manual specifies in point 8.3.0.1.2 that, among other things:

1. The taxi phase shall be regarded as a "Critical phase of flight".

2. Before positioning the airplane to start taxiing, the crew should inquire as to the route to be taken at those airports with which they are not familiar. Always inquire about temporary routes and restrictions.

3. Write down every taxi instruction. The pilot in the RHS must ensure that the Captain is aware of the taxi instructions before acknowledging.

4. 5. The maximum taxi speeds must never be exceeded.

[...] b. 30 kts on taxiways

[...] d. 10 kts when executing a turn of 45° or more

[...] If in doubt as to the taxi route, stop the airplane and request clarification from ATC.

2. ANALYSIS

2.1. Operational conditions at the airport

At every airport where scheduled passenger operations are conducted it is normal for airplanes, when informing ATC that they are ready for takeoff, to be given priority over other airplanes that had previously reported being ready for takeoff and that are awaiting takeoff clearance. This is often done in order to comply with the calculated takeoff times (CTOT) assigned to the airplanes. Each aircraft type needs a different amount of time to complete its pre-takeoff operations, and the time required to proceed to the hold point after clearance is received varies considerably depending on its parking location. As a result, it is normal for ATC to instruct airplanes to pass each other.

Visibility conditions were good, and can thus be ruled out as having had any influence on the collision.

The investigation revealed that the dimensions of the taxiway at Girona Airport were in compliance with the stipulations of ICAO Annex 14, as was the distance separating the runway and taxiway centerlines.

2.2. Markings and information provided to crews

The Air Traffic Regulations note that the pilot's view while taxiing is limited and highlight the importance of having ATC stations provide the crews with concise instructions and sufficient information to prevent collisions with other aircraft or with objects.

Likewise, special mention is made of the fact that prior to taxi, the crew must obtain the information necessary to familiarize itself with the airport and with any temporary changes or restrictions.

Along these lines, it should be noted that AENA had changed the position of the runway 20 stop bar without this information having been included in the AIP, even though the airport had sent the information with the new location of the stop bar to the publishing service at least four months prior to the incident.

As a result of the above, the Commission believes a recommendation is in order for AENA to inform of changes to markings affecting airport operations as soon as possible via the method deemed most suitable, such as the issuing of a NOTAM, whenever the publication of the AIP that details said changes is delayed.

In the case of the runway 20 stop bar at Girona Airport, should the aircraft come to a stop at the right side of the stop bar, the area available for another aircraft to pass it on the left is much larger than if it stops on the left and the advancing aircraft has to pass on the right, as happened in this incident. This difference was not considered by ATC when positioning the aircraft at the hold point, even though the distance separating the aircraft is much greater when the stationary aircraft is passed on the left than on the right.

ATC did not give specific instructions to aircraft EI-EBL to stop at either end of the stop bar, nor was aircraft EI-DWT, which was taxiing behind, informed regarding the exact location at which the preceding aircraft had come to a stop. Whether the passing maneuver took place to the left or right was undoubtedly considered irrelevant to the safety of the operation, nor were controllers aware of the existence of a collision risk.

The fact that it was not considered important is certainly due to the fact that the stop bar had been further forward before, which had avoided any problems. ATC personnel were no doubt unaware that the stop bar had been moved, which is why when the safety assessment was conducted for the runway 20 ILS category II/III maneuver and for the modifications associated with moving the runway 20 threshold, no thought was given to conducting a risk analysis that included those risks stemming from changes to the infrastructures, including the moving back of the stop bar.

As a result the Commission believes it prudent to issue a recommendation to AENA that it review the risk analysis methods of the safety studies it conducts so as to ensure that said analyses take into consideration any aspects affecting air navigation activities as well as those that affect airport infrastructures.

Thus, and in order to increase safety margins, it would be advisable for controllers at Girona Airport to instruct aircraft that are to be overtaken while stopped at the stop bars at either end of the runway, to position themselves, whenever possible, on the side of the stop bar that provides the greatest clearance for the passing maneuver.

2.3. Analysis of EI-DWT maneuver while taxiing

The Air Traffic Regulations note that so as to prevent collisions, it is essential that crews remain alert while aircraft are airborne or in the maneuvering area of aerodromes. They also clearly specify the Captain's responsibility in terms of the operation and safety of the airplane during the flight.

The data obtained after the collision were insufficient to determine the exact position of the aircraft at the moment of impact. The accuracy of the DFDR data also proved inadequate to determining the real position of the aircraft.

It was, however, possible to determine that airplane EI-EBL was stopped at the time of impact, and that it deviated by less than 0.5° from the theoretical heading it had to maintain while stationary at the stop bar. As a result, its orientation can be regarded as proper. It was not possible to ascertain whether it was on the taxiway centerline or whether it was shifted to either side. Nor was it possible to determine whether the nose was forward or aft of the stop line or if it was, by how much.

The distance from the tip of the horizontal stabilizer on the stationary airplane to the impact point (1.2 m) and the headings of the aircraft allowed investigators to establish the relative positions of the two airplanes. Figure 15 shows two of the possibilities for the positions in which the airplanes had to be to result in an impact; specifically, the two most extreme positions.

The left side of the figure shows airplane EI-EBL located atop the taxiway centerline with the nose over the stop bar and a heading practically equal to that which, in theory, it should have had. The other airplane, then, would have had to be outside of its required position. In contrast, the right side of the figure shows airplane EI-DWT over the taxiway centerline, which is the position where in theory it should have been, and 3° off course, meaning the other airplane would have had to be behind the stop bar.

Bearing in mind that both were slightly deviated from the course they should have taken (more so EI-DWT), the diagrams in Figure 15 show the most extreme cases from among many possible scenarios that could have occurred involving the likely positions of the two aircraft, namely that airplane EI-EBL was properly positioned and the other off the centerline (left), or that EI-DWT was over the centerline with EI-EBL well back from the stop bar (right).

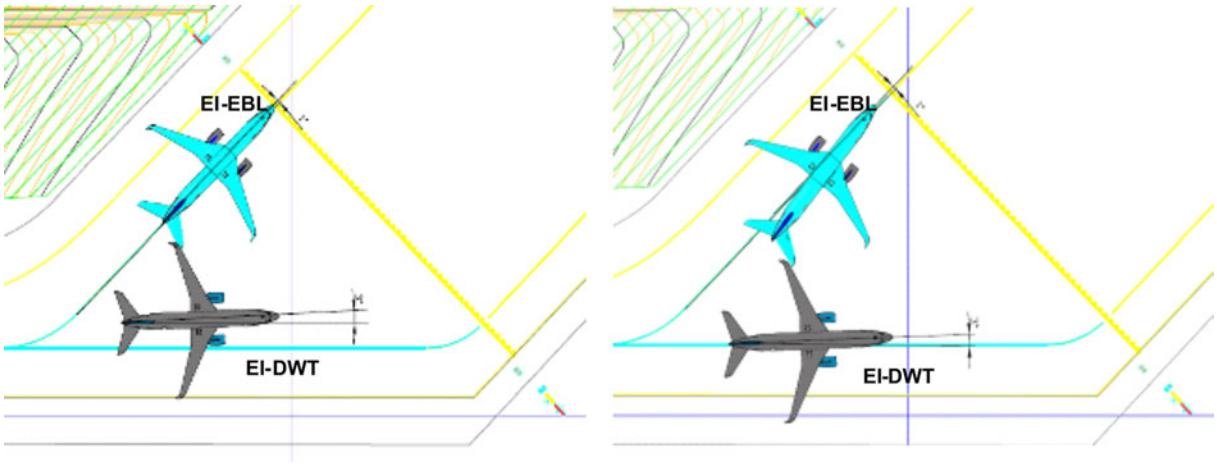


Figure 15. Relative positions of the airplanes

These relative positions could have given rise to all types of situations with respect to that which, in theory, should have existed. At any rate, it seems clear that once airplane EI-EBL came to a stop, the crew of airplane EI-DWT misjudged the distance separating both aircraft.

3. CONCLUSION

3.1. Findings

- The stop bar at the runway 20 threshold was moved without the new location being published in the AIP. The same thing happened with the runway 02 threshold.
- Both aircraft were cleared to taxi to the runway 20 hold point. Aircraft EI-EBL was cleared first.
- Once stopped at the hold point, aircraft EI-EBL was informed at 10:08:00 that it was number two for takeoff, which its crew acknowledged.
- At 10:08:17 aircraft EI-DWT was informed that it was number one for takeoff. Its crew also acknowledged the report.
- Airplane EI-DWT passed airplane EI-EBL on the right. EI-EBL was stopped at the left end of the runway 20 threshold stop bar.
- During the overtaking maneuver, the left wingtip of airplane EI-DWT struck the trailing edge of the horizontal stabilizer on airplane EI-EBL at a point that was 1.42 m from the right edge of the stabilizer.
- If both aircraft had been in the positions where, in theory, they should have been during the takeover maneuver, the distance between the right edge of the horizontal stabilizer on the stationary plane (EI-EBL) and the left wingtip of the overtaking airplane (EI-DWT) would have been 4.7 m.
- The clearance for overtaking an airplane that has stopped at the stop bar is much

greater if the airplane is positioned to the right of the bar and is overtaken on the left than in the opposite situation, as was the case in this incident.
- It could not be determined whether airplane EI-EBL was stationary with its nose section over the stop bar and its longitudinal axis exactly atop the taxiway centerline (the position that, in theory, it should have had).
- Airplane EI-EBL was on a heading of 331.523°, which was 0.477° left of the centerline heading (332º) for that section of taxiway.
- The course of airplane EI-DWT had been variable while traveling over the taxiway, and was 14.0625° at the moment of impact, or 2.9375° left of the taxiway centerline (17°).

3.2. Causes

The incident is determined to have been caused by a combination of two factors:

First, by the misjudgment on the part of the crew of aircraft EI-DWT of the distance separating their left wingtip and the nearest part of the stationary aircraft (the right edge of the horizontal stabilizer).

The decreased room available for overtaking in the transition zone between the taxiway and the holding area at the head of the runway as a consequence of having moved the stop bar backward.

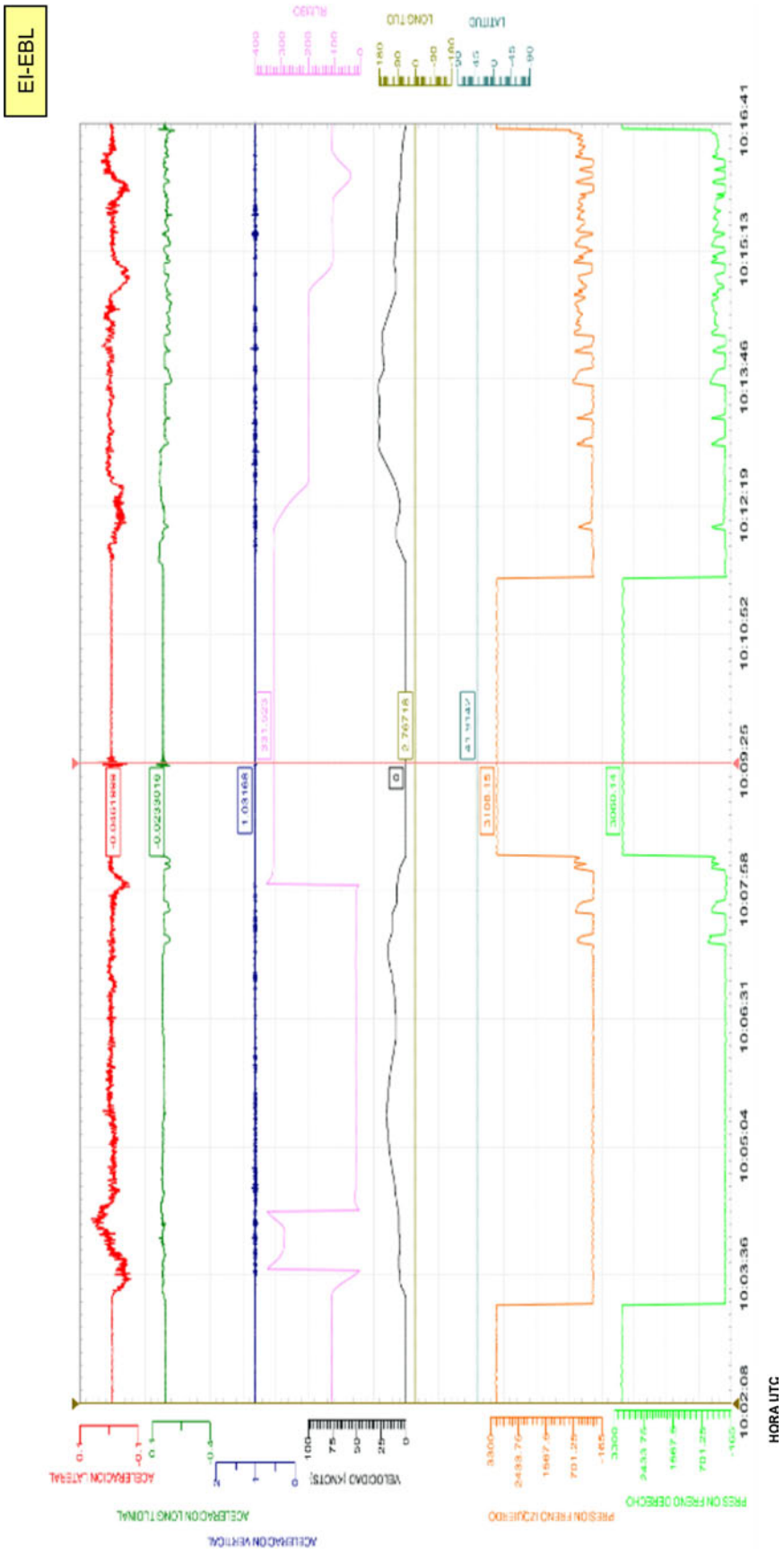
4. SAFETY RECOMMENDATIONS

REC 05/11. It is recommended that AENA report changes to markings affecting airport operations, as well as of any possible consequences to aircraft operations, as soon as possible via the method deemed most suitable, such as the issuing of a NOTAM, whenever the publication of the AIP that details said changes is delayed.

REC 06/11. It is recommended that AENA review the risk analysis methods of the safety studies it conducts so as to ensure that said analyses consider the risks to both air navigation activities and airport infrastructure. In particular, an additional margin shall be included before the stop bar or hold point for the pilot to stop and from which he can see the stop bar or hold point. For a 4-C category airplane, this distance shall be approximately 5 m.

APPENDICES

APPENDIX A
Graphical representation of various parameters for airplane EI-EBL


EI-EBL
LATITUD
LONGITUD
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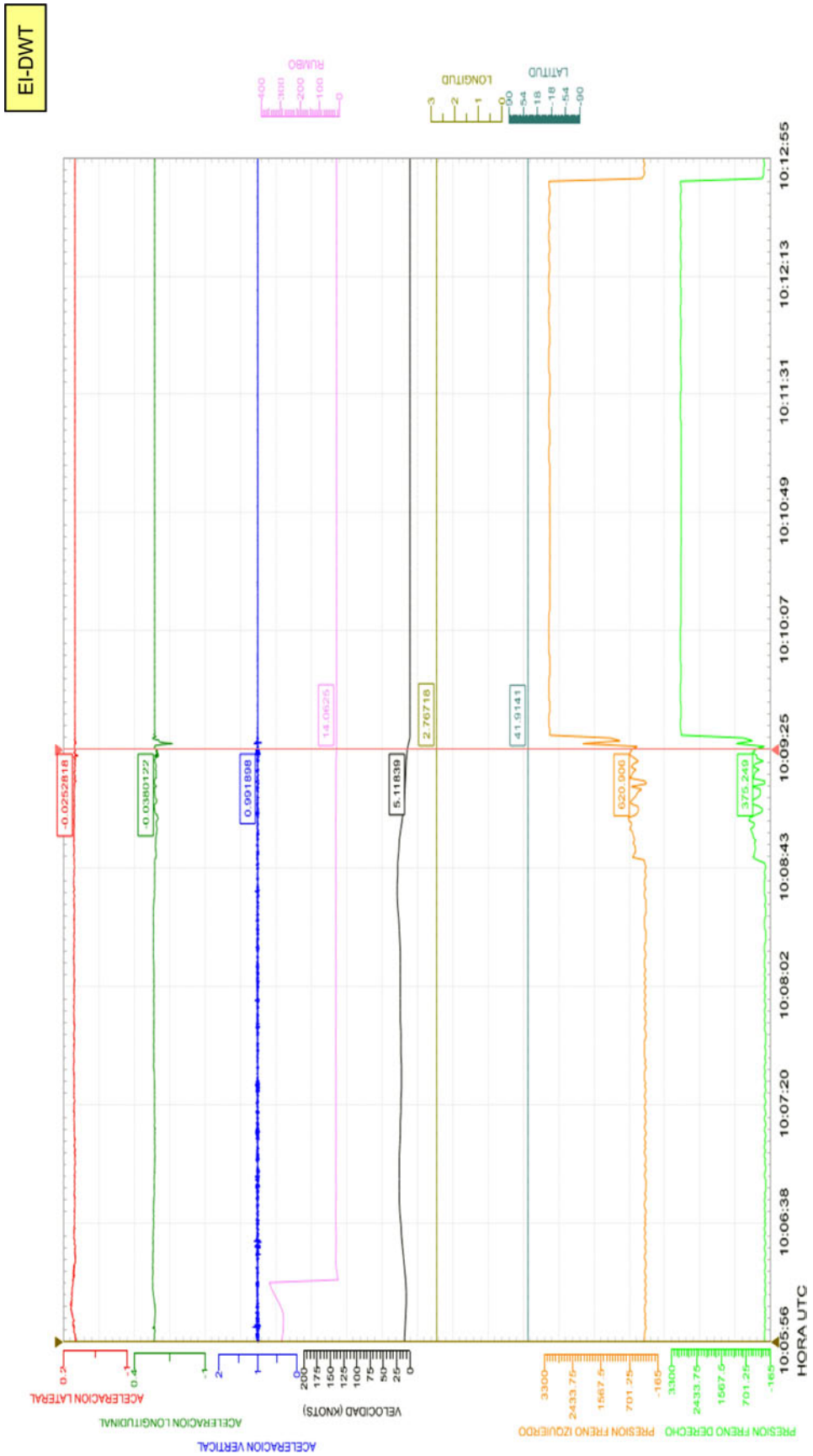
10:16:13
10:13:46
10:12:19
10:10:52
10:09:25
10:07:58
10:06:31
10:05:04
10:03:36
10:02:08
HORA UTC

APPENDIX B
Graphical representation of various parameters for airplane EI-DWT


EI-DWT
RUMBO
LONGITUD
LATITUD
-0.0252818
-0.0380122
0.991806
14.0626
5.11839
2.76716
41.9141
620.906
375.249
10:12:55
10:12:13
10:11:31
10:10:49
10:10:07
10:09:25
10:08:43
10:08:02
10:07:20
10:06:38
10:05:56
HORA UTC
ACELERACION LATERAL
ACELERACION LONGITUDINAL
ACELERACION VERTICAL
VELOCIDAD (KNOTS)
PRESION FRENO DERECHO
PRESION FRENO IZQUIERDO