DATA SUMMARY

LOCATION

Date and time	**Thursday, 14 April 2011; 08:30 UTC**[1]
Site	**Barcelona Airport**

AIRCRAFT

Registration	**EI-EKB**	**N366AA**
Type and model	**BOEING 737-800**	**BOEING 767-300**
Operator	**Ryanair**	**American Airlines**

Engines

Type and model	**CFM 56-7B**	**CF6-80C2B6**
Serial Number	**2**	**2**

CREW

	Pilot	Copilot	Pilot	Copilot
Age	**34**	**29**	**57**	**51**
Licence	**ATPL(A)**	**CPL(A)**	**ATPL(A)**	**ATPL(A)**
Total flight hours	**6,500 h**	**750 h**	**14,995 h**	**10,010 h**
Flight hours on the type	**2,215 h**	**500 h**	**5,005 h**	**6,297 h**

INJURIES

	Fatal	Serious	Minor/None	Fatal	Serious	Minor/None
Crew			**6**			**14**
Passengers			**169**			**225**
Third persons						

DAMAGE

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

FLIGHT DATA

Operation	**Commercial Air Transport – Scheduled – International – Passenger**	**Commercial Air Transport – Scheduled – International – Passenger**
Phase of flight	**Taxiing**	**Taxiing**

REPORT

Date of approval	**3 May 2012**

[1] All times in this report are in UTC unless otherwise specified.

1. FACTUAL INFORMATION

1.1. History of the flight

On 14 April 2011 at around 08:30, a Boeing 737-800 (B737) operated by Ryanair was taxiing on taxiway K toward the runway 25L holding point at the Barcelona Airport. A Boeing 767-300 (B767), operated by American Airlines, was stopped at position G3, one of the three positions available at this holding point (G1, G2 and G3). In order to access one of the unoccupied positions, the B737 had to pass behind the American Airlines airplane.

As they neared the position of the B767, the captain of the B737 slowed, turned slightly to the left of the taxiway centerline and instructed the copilot to monitor the separation between the two aircraft.

At one point in the maneuver, and unsure as to whether the B737's right wingtip could strike the tail of the other aircraft, the copilot asked the captain to stop. The captain did so, got up from her seat and personally verified the separation by looking out the copilot's window.

The B767 advanced a few meters and the B737 continued taxiing, passing behind the B767 and reaching the G1 holding point.

Just after the maneuver, some of the passengers onboard the B737 reported to the cabin crew that the two aircraft had made contact. The cabin crew informed the flight crew of this, who nonetheless believed that the two aircraft had not touched.

ATC cleared both aircraft to take off, which they did, arriving at their destinations without further incident.

During the walk-around before the B737's next flight, the crew noticed damage to the winglet on the right wing (Fig. 1), which made them suspect that they had in fact made contact with the other aircraft.

Figure 1. Damage to the B737 winglet

Figure 2. Damage to the B767 stabilizer

Ryanair contacted American Airlines to inform it of the incident. After the arrival of the flight, American Airlines personnel verified the existence of damage to the outboard section of the left horizontal stabilizer (Fig. 2). This damage required that the aircraft be removed from service for repairs.

1.2. Aircraft information

The B737-800 is a short- to medium-range narrow body airplane with a 35.8-m wingspan. The B767-300 is a wide-body aircraft, with longer range and bigger capacity, a 47.6-m wingspan and a fuselage length of almost 55 m.

Within the system established by the ICAO to classify aircraft dimensions for the purpose of sizing movement areas in airports[2], they are classified as category C and D, respectively.

As part of its aircrafts' documentation on ground operations, Boeing provides the specifications concerning the external visibility from the cockpit. In the case of the Boeing 737-800, the winglets are not directly visible from the static position of the pilot or copilot, who must move sideways to increase their field of view. As for the B767, the pilots cannot see the ground immediately forward of the airplane. The pilots' vision of the first 50 ft forward of the nose is restricted (Appendix I).

1.3. Aerodrome information

1.3.1. *The runway 25L holding point*

The layout of the runway 25L threshold allows three aircraft to hold simultaneously at three holding positions labeled G1, G2 and G3 (Fig. 3). These points are accessed via a single taxiway, K, whose centerline branches into three to provide access to each point. The ability to use three points at the same time gives controllers flexibility when organizing takeoff sequences and allows for smoother operations.

So as to maintain separation between aircraft, only certain aircraft categories are allowed to access the most remote points (G1 or G2) via taxiway K when G3 and/or G2 are already occupied.

The combinations of maximum categories allowed are:

Taxiway «K»	—	B	C	D	E
Holding points	F	E	D	C	B

[2] So as to cross reference the numerous specifications involving aerodrome characteristics, ICAO Annex 14 includes a coding system that relates the characteristics and dimensions of the airplanes that an aerodrome is intended to accommodate, including the wingspan. Six categories are defined, in increasing wingspan: A (under 15 m), B (15 to 24 m), C (24 to 36 m), D (36 to 52 m), E (52 to 80 m) and F (over 80 m).

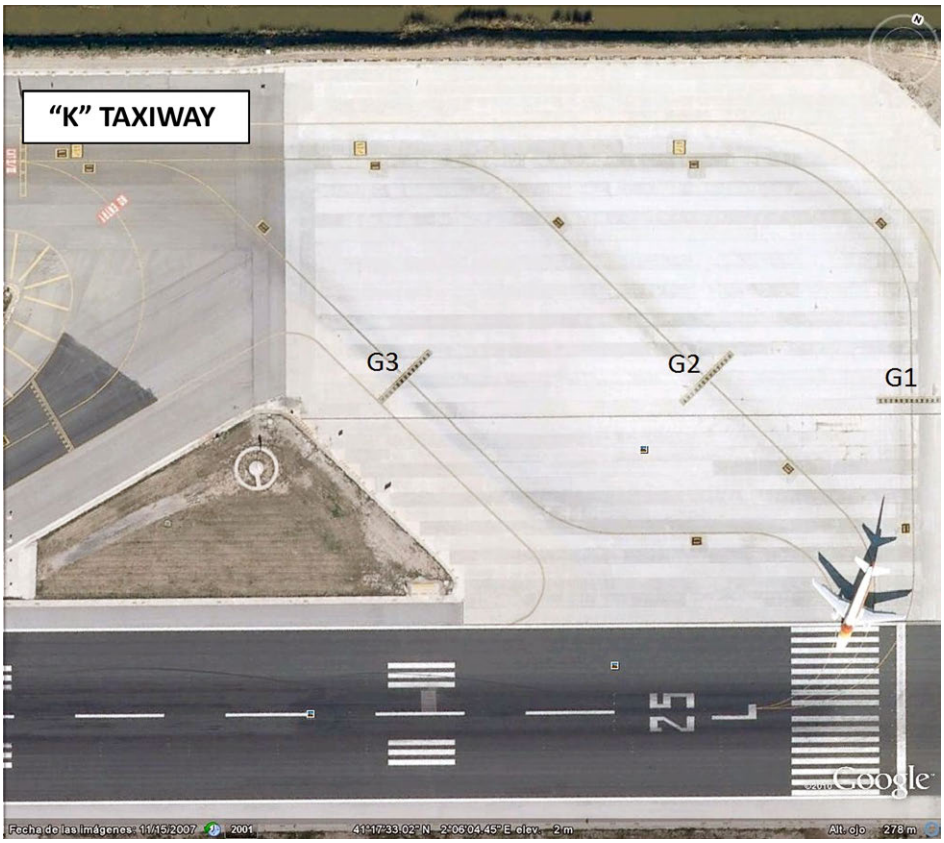


Figure 3. Triple holding point at runway 25L

These restrictions have been published as part of the airport information and are available through the AIP system.

1.3.2. *Ground control*

Aircraft movements on the ground are handled by Ground Movement Control (GMC). The flow of aircraft is arranged based on the active configuration in effect at the airport in keeping with specific procedures[3] that establish the paths that aircraft must take to reach the holding point for the runway in use. This document does not make any references to the restrictions applicable to aircraft accessing the holding points.

The GMC controllers are located in the control tower. The tower at the Barcelona Airport is some 600 m NW of the runway 25L holding point. The visibility of the area from the tower is ideal, though the distance and the relative geometry do not allow controllers to evaluate the separation between an aircraft at the G3 holding point and those moving into holding points G1 or G2 (Fig. 4).

[3] DORE-08-DTC-037-1.2. Ground Control Responsibility Areas and Taxi Procedures for the Operation of Terminal 1 at the Barcelona Airport.

Figure 4. View of the runway 25L holding point from the tower control room

The airport has a surface movement radar (SMR) that aids controllers in guiding aircraft traffic in the movement area.

The "ENGINE START-UP" section of the airport information published in the AIP establishes the requirement to report the aircraft type and series when requesting to start engines. If the controller identifies the aircraft as posing a conflict due to its size, a red flight progress strip is used to identify that aircraft.

1.5. Meteorological information

Horizontal visibility on the day of the incident was in excess of 10 km.

1.6. Communications

From engine start-up until takeoff, both aircraft were in normal radio contact with clearance delivery (CLR), with successive GMC controllers and finally with the tower controller in charge of departures (DEP) from runway 25L.

At 08:11:05, CLR authorized the American Airlines B767 to start its engines, followed five minutes later by the start-up clearance for the Ryanair B737 and four minutes after that by the start-up clearance for an Air France airplane.

The three aircraft were successively cleared to taxi from their parking stands to the runway 25L holding point.

At 08:25:39, GMC cleared the Ryanair aircraft to the holding point, without specifying a position. It did the same with the Air France airplane at 08:26:20.

The aircraft converged on taxiway K in the same order as their start-up clearances. This part of the movement area is handled by a single controller, and thus all three aircraft were on the same GMC frequency.

At 08:27:04, the American Airlines aircraft, which was the first to taxi, was specifically cleared to proceed to holding point G3.

At that point all three aircraft were transferred to the departures frequency (DEP).

At 08:32:04, ATC asked the B737 to proceed to G1. The crew replied by requesting *"Can we just stand by if you like in the aisle before to (garbled) start clearance... to after"*.

At 08:32:51, ATC once again asked the B737 to proceed to G1 so as to allow the Air France airplane behind it to access G2. The B737 remained stationary and requested *"could I wait and move forward if it fits... to make sure clearance"*.

At 08:33:20, the Air France crew asked ATC to "*confirm they are moving forward so that we can pass behind*", after which the American Airlines airplane moved forward without being specifically requested to do so by ATC.

At 08:33:56, ATC cleared the Air France airplane into position G2.

Finally, the American Airlines, Ryanair and Air France airplanes were cleared for takeoff in that order.

1.7. Flight recorders

The flight data recorders (FDR) were recovered from both aircraft and the information from the incident flight downloaded.

The information on the cockpit voice recorders (CVR) was lost as the CVRs continued to record on subsequent flights.

Graphs of some of the parameters recorded on both aircraft are shown in Appendix II.

For the B737, the graphs show an increase in brake pressure until 08:29:30 and a subsequent reduction in ground speed from 14 kt to a full stop at 08:30:45. Also shown

is the change in heading associated with the deviation from the taxiway centerline in an effort to maintain separation between the two aircraft.

As for the B767, the ground speed graph shows that it stopped in front of the bar at point G1 at 08:28:50, where it stayed until 08:33:20, at which time it moved forward a few meters and stopped again before finally entering the runway at around 08:34:35.

1.8. Reconstruction of ground paths

Given the minor nature of the collision, it was not possible to identify the time of contact from the acceleration data from either aircraft's FDR.

The inaccuracy of the FDR data also prevented reconstructing the paths taken by the aircraft with enough precision to yield a detailed analysis of the geometry of the collision.

Despite this, the magnitude and duration of the B737's course change was used to provide a rough estimate of the extent to which it deviated from its initial course, yielding a value of around 1 m, consistent with the crew's statements.

The B767's speed through the taxi line branch towards the holding point, as recorded by its FDR, was integrated to yield an estimate of the aircraft's position at its initial stopping point and of the distance covered during its subsequent displacement forward before stopping again. These calculations indicated that the B767 stopped some 50-60 ft before the marking and then moved forward about 15 ft. These figures are consistent with the crew's statements and with the information obtained from the ground radar (Appendix III).

1.9. Additional information

1.9.1. *Regulations on aerodrome design*

The technical regulation for the design of public use airports in Spain has adopted the standards and practices recommended in ICAO Annex 14[4].

So as to ensure separation between aircraft during ground operations, this document recommends a set of minimum distances to be taken into account when sizing different areas of an airport.

These distances depend on the size classification of the aircraft, as outlined in the same annex (A, B, C, D, E or F), that are expected to operate at the airport in question.

[4] Royal Decree 862/2009 of 14 May, which approves the technical design and operating standards for public-use aerodromes and regulates the certification of State-run airports.

The distances separating the centerline of a taxiway that provides access to a parking stand from any object are specified, as are the recommended separation distances for two aircraft located in adjacent parking stands. In the first case, a minimum distance of 24.5 m is recommended for Category C aircraft and 36 m for Category D aircraft. In the second case, the recommended margins are 4.5 m for Category C aircraft and 7.5 m for Category D aircraft.

1.9.2. *Ryanair operating procedures*

According to Ryanair's Operations Manual, the taxi phase must be regarded as a critical phase of flight. Any conversations that are not directly related to the safety of the aircraft are prohibited (sterile cockpit), as is the use of any frequency other than ground control's (GMC) (sterile comms). The pilot in charge of communications is to ensure that the captain confirms reception of all GMC clearances before acknowledging them.

Taxi speed is not to exceed 30 kt on taxiways or 15 kt on the apron.

If in doubt as to which path to take, the crew is to stop immediately and request clarification from ATC.

The Operations Manual underscores the importance to operational safety of good communications between the flight and cabin crews. Specifically, it states that the captain must instruct the cabin crew to keep the flight crew informed of any unusual event that takes place in the passenger cabin, particularly of any abnormal noises or reports about passengers.

The manual explicitly states that the cabin crew must not assume that the flight crew is aware of any serious problems, such as engine fires, losses of liquids or the loss of external structural components. If any of these situations should occur, the cabin crew is required to notify the flight crew via the intercom or by another means. The flight crew is to confirm receipt of this information, time permitting.

As part of its approved training programs and as required by CRM regulations, the airline holds training sessions that emphasize the importance of efficient communications between the flight and cabin crews, as well as the importance of the use of English as the operating language.

1.9.3. *Crew statements*

1.9.3.1. B737 flight crew

The pilot and copilot stated that upon arriving at the holding point, the position of the B767 surprised them a little. According to them, that position (G3) is normally occupied

by smaller aircraft. To ensure separation between the aircraft, the captain deviated somewhat from the taxiway centerline (about 50 cm) and told the copilot to monitor the separation distance. The copilot did not feel there was any danger of the wingtip hitting the area in the B767's tailcone where the APU (auxiliary power unit) is housed, but as the wingtip approached the end of the horizontal stabilizer, he asked the pilot to stop immediately. She did so and then got up from her seat to verify the separation distance personally. She expressed surprise at the short distance between the airplanes but reassured the copilot by confirming that they were not touching. Both the pilot and copilot subsequently believed that the contact must have taken place before stopping.

Shortly afterwards the intercom rang and a member of the cabin crew informed them that a passenger had reported seeing the two airplanes touch. ATC also called at this time asking them to advance to G1. The captain told the copilot to inform ATC that they would not move until the B767 moved forward. She also asked if he had seen the airplanes touch, to which the copilot replied no.

The captain was under the impression that only one passenger had witnessed the contact, and not several, as she later discovered. She said that her decision to continue with the flight would probably have been different if she had known that several passengers had reported contact.

The call from the cabin used a single chime. As the crew stated, Ryanair procedures require that in the event of a serious problem, three chimes are to be used. Moreover, the captain did not sense much concern in the flight attendant's (FA) voice, who started the report by saying "only for your information...".

They were unable to specify how far the B767 was from the G3 holding point marking, but they stated that it must have been "a lot". They also underscored how difficult it is to estimate the distance from the cockpit between the nose of any commercial transport airplane and ground markings.

After receiving clearance, they took off normally to their destination (Ibiza). There were no additional comments from any cabin crew members for the duration of the flight.

Though they stated being certain that there had been no contact, the captain decided to do the pre-flight walk around personally once they were parked at the Ibiza airport. During the inspection she noticed that the paint on the right winglet was scratched. She regarded the defect as minor, one that did not justify any actions by maintenance personnel, especially as they would have had to fly from Barcelona, since the airline does not have mechanics in Ibiza. She also did not make an entry of the defect in the aircraft logbook.

During the stopover at the Ibiza Airport, there were no additional comments from the cabin crew regarding the passengers' reports of potential contact.

After the return flight to Barcelona, as they were leaving the airplane, a cabin crew member informed the captain that several passengers had reported possible contact, which raised some concern during the flight to Ibiza. The captain was surprised to hear this since the FA who had called the cockpit, and who was very close to the cockpit, did not make any comments about it upon arriving in Ibiza. It was then that the captain called maintenance services who, after assessing the damage, opened a deferred maintenance item and dispatched the airplane.

1.9.3.2. B737 cabin crew

The crew stated that about 15 minutes after they started taxiing, a passenger stood and went to the rear of the cabin to talk to a FA. At the same time, several passengers nervously looked out the windows on the right side of the airplane. They were speaking in Spanish, so the cabin crew did not understand very well what they were saying. Another passenger told them in English that some passengers thought they had hit the other airplane. The FA spoke with the purser, who was at the front of the cabin, who told the FA to call the cockpit and inform them of the situation. The FA did so, starting the report with the phrase, "Sorry to bother you, I know I'm not supposed to...", to apologize for the interruption.

After receiving the report, the captain explained in, according to the FA, "aviation terminology", that they had come close but had not touched.

During the flight one passenger who identified himself as an engineer expressed his concern that they had taken off under those circumstances. After deplaning in Ibiza, several passengers also voiced their preoccupation over the situation.

1.9.3.3. B767 flight crew

Neither of the flight crew members onboard the B767 noticed any aircraft motion indicative of a collision while waiting at holding point G3. When they heard on the radio the B737 crew's refusal to continue to G1 due to the collision risk, they moved their aircraft closer to the holding point marking. They estimated they were some 50 ft away from the marking and that they advanced about 10 ft before stopping again.

2. ANALYSIS

2.1. The access to the holding point

The runway 25L holding points allow three aircraft to hold simultaneously, with some restrictions on the size of the aircraft. These restrictions are published in the AIP and should therefore be known and considered by GMC controllers when guiding aircraft.

These restrictions are intended to ensure adequate separation when one aircraft passes behind another that is already waiting at either of the nearer holding points (G3, G2).

An analysis of the separation requires taking into account both the wingspan of the aircraft on the taxiway that is attempting to access a holding point, as well as the length of the aircraft already at one of the holding points. While there is a certain relationship between an airplane's length and its wingspan, the ICAO classification does not consider aircraft length; therefore, limitations based on this classification cannot guarantee that the separation distances recommended by the ICAO will be maintained.

The length of the holding aircraft becomes more relevant the farther away that this aircraft stops from the holding point marking.

Figure 5 depicts the geometry of a hypothetical contact scenario between two aircraft of the type involved in this incident.

Assuming that both aircraft are perfectly aligned with their respective centerlines, a collision would take place if the B767 were a little over 16 m (54 ft) away from the holding point marking. This scenario would be even more restrictive if the airplane waiting at G3 were, for example, a B767-400, which is also a category D airplane but 6.4 m longer than the B767-300.

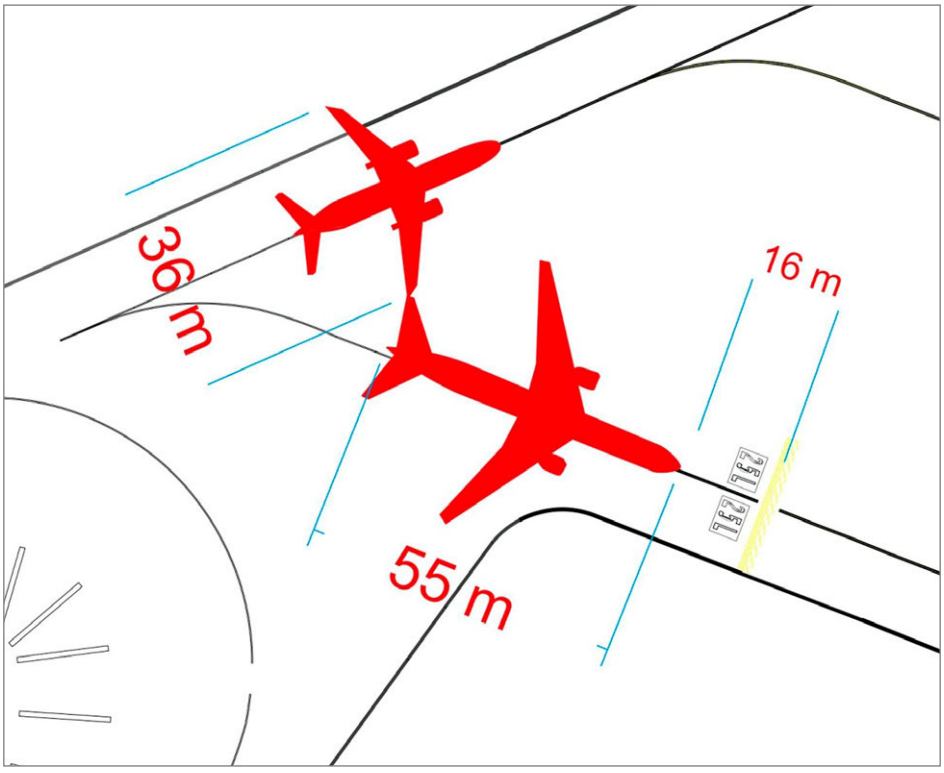


Figure 5. Collision geometry in the vicinity of G3

In this regard, we must bear in mind that when an airplane stops at a holding point, it does so some distance away from the marking at the pilot's discretion. From the pilot's point of view, the main concern is not to interfere with aircraft circulating on the runway at any time. A pilot will therefore give priority to this consideration over any potential problems involving tailing aircraft, and will keep the holding point marking well in sight and ahead of the nose of the airplane, barring any instruction to the contrary from ATC.

The distance will depend on the field of view that the crew has from the cockpit. For the B767 (Appendix I), the nearest point on the ground that can be seen from the pilot's seat is 50 ft away. The typical stopping distance, then, will be along the same order of magnitude so that the marking remains within the crew's field of vision. In this case, this figure also matches that expressed by the pilots in their statement and is consistent with the result of the integration of the speed recorded by the B767's FDR as it traveled over the taxiway en route to the holding point, and with the returns from the surface radar (SMR) (Appendix III).

Over the course of the transmissions between the three aircraft and the tower, the crew of the B767 moved forward a few meters so as to facilitate the passage of the Ryanair B737, even though the collision had already taken place. According to the crew's statements, they advanced about 10 ft. Calculations based on FDR data indicate a 15-ft displacement. In any event, the fact that they opted to move without first being instructed to do so by ATC indicates that they could in fact maneuver closer to the holding point.

Controllers in the tower have a direct line of sight to any aircraft movements in this area, but they cannot discern the separation that exists between aircraft. ATC handles access to the holding points and the subsequent entries into the runway in accordance with procedures. It is the crews who are responsible for avoiding collisions and for requesting assistance from ATC if necessary.

As evidenced by both the crew's statements and by the FDR data, the B737 moved between 0.5 and 1.5 m left of the taxiway centerline, based on FDR heading data and as confirmed by the crew. This heading change was not enough to avoid the collision.

By the time the crew of the B737 stopped the aircraft and expressed its concerns in its reports to the tower, the collision must have already taken place since the Ryanair airplane did not resume its course until after the B767 moved forward.

The preceding discussion highlights how the space available and adherence to published limitations do not ensure adequate separation when an aircraft attempts to access G1 or G2 behind another aircraft already waiting at G2 or G3 when the length of the latter is considerable and it stops a certain distance away from the holding point marking.

The same analysis is applicable to the runway 07R holding points, situated at the opposite threshold. The published geometry and access restrictions are identical to those for the 25L threshold.

A safety recommendation has been issued in this regard, a recommendation that is along the same lines as recommendation 06/11, which was issued by the CIAIAC in its incident report IN-001/2010 (see Appendix IV).

2.2. Communications between the B737 flight and cabin crews

While taxiing before takeoff, the cabin crew received reports from several passengers regarding a possible collision.

The Ryanair Operations Manual specifies that the cabin crew is not to assume that the pilots are aware of any incidents that occur during the flight, and indicates the need to communicate any abnormality affecting safety.

In keeping with airline procedures, the passengers' reports were relayed, albeit poorly, to the flight crew.

The FA seems to have been unaware of the safety implication of the information she was providing. First, she rang only once, instead of the three times that, as stated by the flight crew, are procedurally required if a condition poses a threat to safety. As the captain noted, this predisposed her to not place too much importance on the report. Secondly, the FA began her report with, "I'm sorry to bother you, I know I'm not supposed to...", as she stated, or with "For your information only", according to the captain's statement. In any event, either expression indicates hesitation regarding whether or not she should have interrupted the pilots' activities with this report.

Another indication of the poor communication is the fact that when recounting her conversation with the captain, the FA described the captain's explanation as involving "aviation terminology", which suggests that the FA was not familiar with the language used by the pilot.

The fact that the captain believed only one passenger, and not several, had reported the collision is further proof of this miscommunication and proved critical to her assessment of the situation, as she herself stated.

During the flight to Ibiza several passengers expressed their unease over the incident to the cabin crew, but at no point did the FAs contact the pilots to convey the passengers' concerns.

The airline has approved training programs that conform to applicable CRM regulations and that include the importance of cooperation and communication among the flight

and cabin crews. This incident, however, highlights deficiencies in the channels of communication between crew members, and a safety recommendation has been issued in this regard.

3. CONCLUSION

3.1. Findings

- Both aircraft were cleared to proceed to the runway 25L holding points in keeping with applicable procedures.
- Both aircraft taxied in accordance with ATC's instructions and without any apparent deviations from their own company procedures.
- The access to each of the assigned positions complied with the limitations published in the AIP.
- The B767 taxied into the assigned position and stopped sufficiently far away from the holding point marking so that it remained in view from the cockpit.
- The B737 deviated slightly from the taxiway centerline in an effort to maintain separation.
- This deviation was not sufficient and the right winglet on the Ryanair B737 struck the left end of the horizontal stabilizer on the American Airlines B767.
- The data obtained from the flight recorders (heading and GS) and from the surface radar (SMR) are consistent with the reconstruction of the incident.
- Several passengers saw the collision and reported it to the flight attendants.
- The flight attendants reported the collision to the flight crew, but did so ineffectively.
- The B737 flight crew ignored the information, believing that only one passenger had reported the collision and having visually confirmed the separation.
- The B767 flight crew did not feel any unusual motion of its aircraft while at the holding point.
- Both crews continued with their flights, unaware of the damage that had been caused.
- The B737 crew detected the damage during the walk-around prior to the next flight.
- Ryanair contacted American Airlines to report the incident.
- Maintenance personnel assessed the damage to the B737 and dispatched it with a deferred maintenance item. The B767 was removed from service for repairs.

3.2. Causes

The incident resulted from the crew of the Ryanair B737's misjudging of the distances as it passed behind the B767, which was stopped at the G3 position of the runway 25L holding point.

Assigning position G3 to an aircraft with a long fuselage, such as a B767-300, and the position of said aircraft, relatively far away from the holding point marking, contributed to the incident.

The deficiencies in the communications between the cabin and flight crews on the B737 resulted in the collision going unnoticed and in both aircraft continuing with their flights without an assessment of the damage produced.

4. SAFETY RECOMMENDATIONS

REC 06/12. It is recommended that AENA reassess the taxi limitations applicable to taxiway K and holding points G at both the runway 25L (points G2 and G3) and runway 07R (points G10 and G11) thresholds at the Barcelona Airport. Specifically, AENA is to take into account the effect that the length and position of aircraft situated at the holding points has on taxiing limitations and include these limitations, if any, in ATC procedures.

REC 07/12. It is recommended that Ryanair reassess those aspects of its training program involving flight and cabin crew communications and address the deficiencies noted, if any. Special emphasis should be placed on the benefits to safety that stem from the effective transmission of information from the passenger cabin to the flight deck.

APPENDICES

APPENDIX I
Visibility from the B767 flight deck

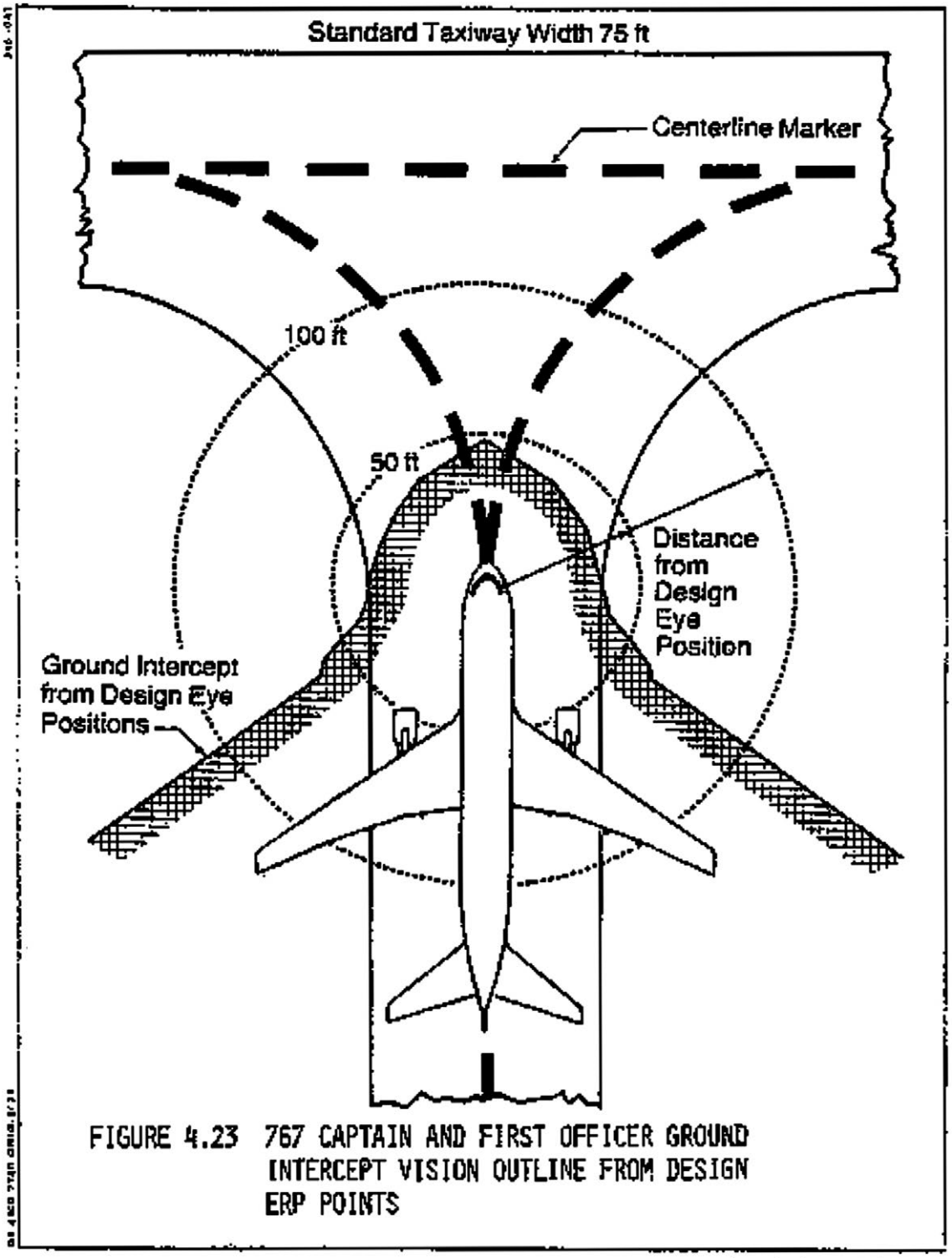
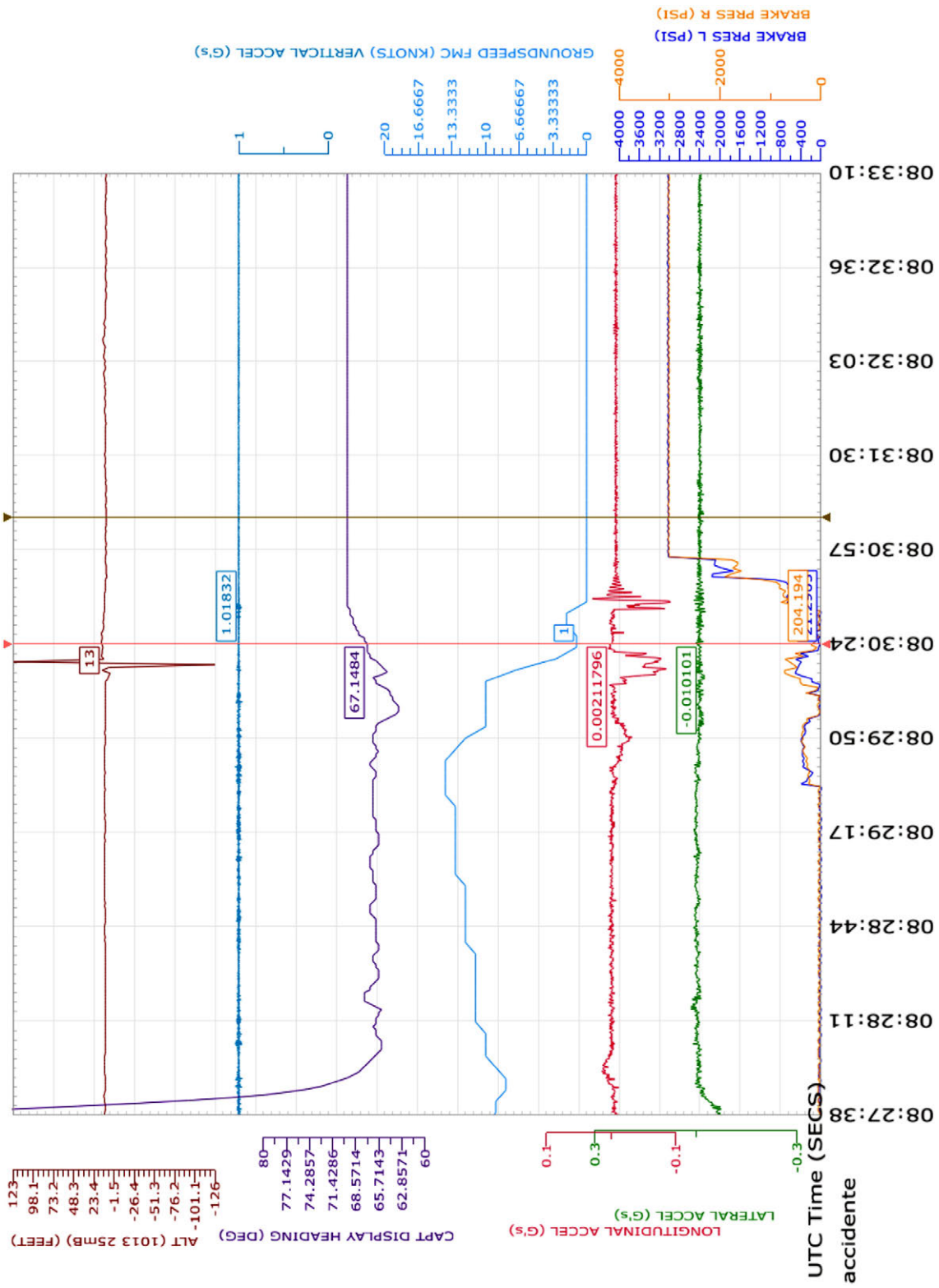


FIGURE 4.23 767 CAPTAIN AND FIRST OFFICER GROUND INTERCEPT VISION OUTLINE FROM DESIGN ERP POINTS

APPENDIX II
Graphs of flight parameters recorded by the FDR


BRAKE PRES R (PSI)
BRAKE PRES L (PSI)
GROUNDSPEED FMC (KNOTS) VERTICAL ACCEL (G's)
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2000
0
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
20
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13.3333
10
6.66667
3.33333
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1
0
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08:32:03
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08:27:38
UTC Time (SECS)
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1
123
98.1
73.2
48.3
23.4
-1.5
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-51.3
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-126
ALT (1013 25mB) (FEET)
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68.5714
65.7143
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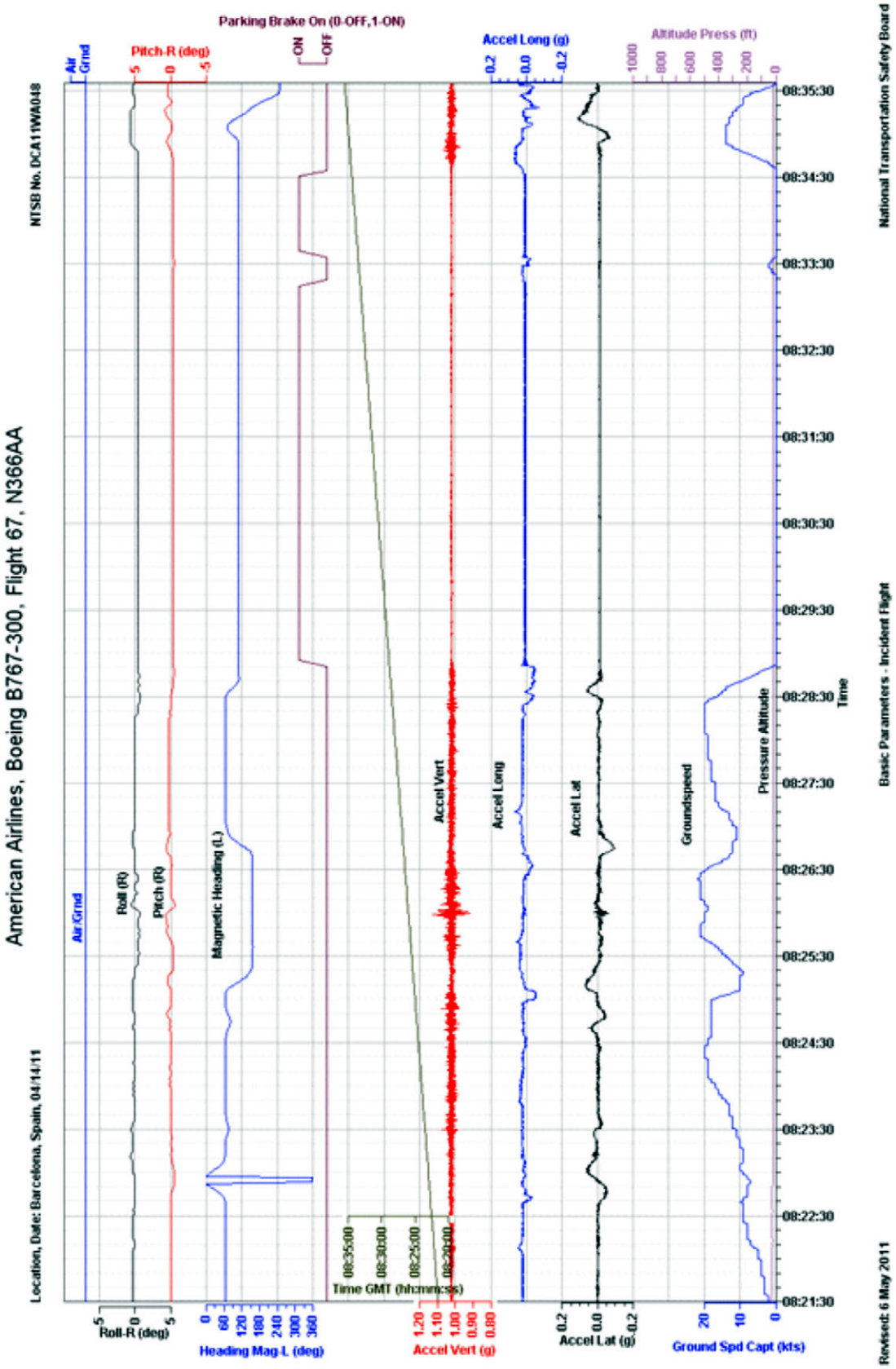
0.3
-0.1
-0.3
LONGITUDINAL ACCEL (G's)
LATERAL ACCEL (G's)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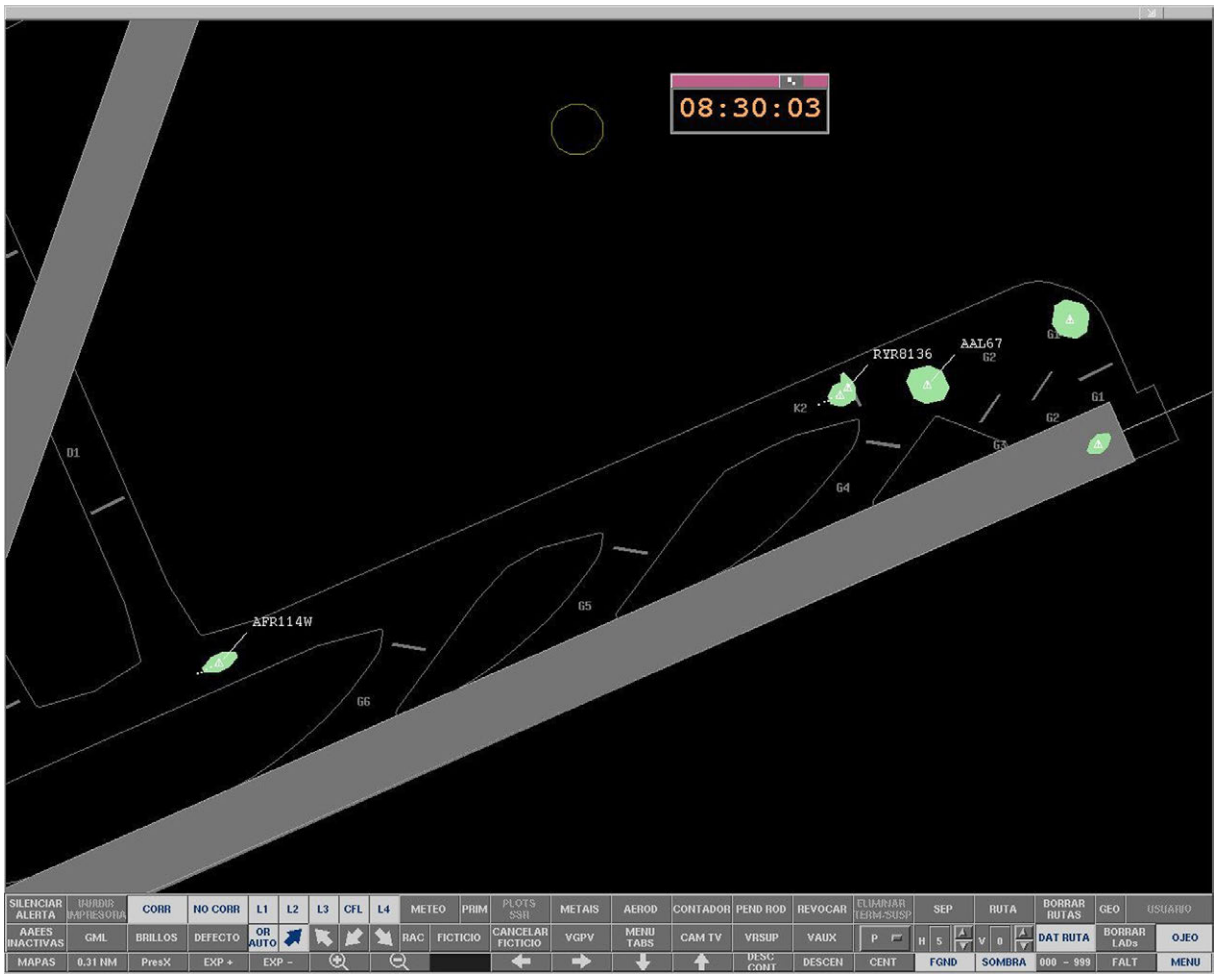
Location, Date: Barcelona, Spain, 04/14/11
NTSB No. DCA11WA048
National Transportation Safety Board
Basic Parameters - Incident Flight
Revised: 6 May 2011
Parking Brake On (0-OFF,1-ON)
Pitch-R (deg)
Accel Long (g)
Altitude Press (ft)
Air/Grnd
Roll (R)
Pitch (R)
Magnetic Heading (L)
Accel Vert
Accel Long
Accel Lat
Groundspeed
Pressure Altitude
Time
Time GMT (hh:mm:ss)
Roll-R (deg)
Heading Mag-L (deg)
Accel Vert (g)
Accel Lat (g)
Ground Spd Capt (kts)

APPENDIX III

Echoes from the SMR (Surface Movement Radar) around the 25L runway holding point, moments before the collision


08:30:03
RYR8136
AAL67
G2
K2
G1
G2
G3
G4
D1
G5
AFR114W
G6
SILENCIAR ALERTA
BORRAR RUTAS
GEO
USUARIO
AAEES INACTIVAS
GML
BRILLOS
DEFECTO
DAT RUTA
BORRAR LADs
OJEO
MAPAS
0.31 NM
PresX
EXP +
EXP -
FGND
SOMBRA
FALT
MENU

APPENDIX IV

Text of safety recommendation 06/11 included in CIAIAC report IN-001/2010

"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."