



Investigation Report

Identification

Type of Occurrence:	Serious incident
Date:	21 August 2008
Location:	Frankfurt/Main
Aircraft:	Transport aircraft
Manufacturer / Model:	Airbus Industry / A340-313
Injuries to Persons:	None
Damage to aircraft:	Minor damage to airplane
Other damage:	Vehicle (passenger bus) damaged
Source of information:	Investigation by BFU
State File Number:	BFU 5X015-08

Factual Information

At 0622¹ hrs, an Airbus A340-313 (A340) collided with a passenger bus on the apron in the area of the crossing of taxiway G and the taxi area road proceeding parallel to taxiway N of Frankfurt/Main Airport (EDDF).

¹All times local, unless otherwise stated

History of the Flight

The Airbus A340 was on a scheduled flight from Teheran (Iman Khomeini International) to Frankfurt (Rhein-Main). 224 passengers and 12 crew members were on board. According to the flight plan, landing was scheduled at 0600 hrs after a flight time of 5:15 hours. There were no flight passengers in the passenger bus.

After landing on runway 25L, the Airbus taxied over taxiways C and G until reaching the taxi holding position of runway 25R, at 0616 hrs. After a waiting time of almost two minutes, the ground controller gave clearance for crossing the runway and for leaving the radio frequency. At 0620 hrs, the Airbus crew contacted Frankfurt Apron on the radio frequency with the words: „Frankfurt, good morning, Airbus A340² heavy, 25R is clear in Golf (incomprehensible) in sight.“ Apron control gave the following clearance: “Airbus A340, no delay (incomprehensible) number one via Golf to Bravo 26.” This was read back by the co-pilot with the words “Number one, Golf, Bravo 26, Airbus A340“.

According to the statements of the crew and the recordings of the Cockpit Voice Recorder (CVR), the pilot in command (PIC) was on the controls und steered the airplane to the yellow guide-line of the parking position B26. During this, the co-pilot noticed a passenger bus on the taxi area road at the right sight of the airplane. He commented the situation with the words: “The bus stops”; the PIC answered: “By now he will know we are coming in”. A few seconds later, the co-pilot saw a follow-me car quickly approaching the airplane from the front. Immediately after the exclamation of the co-pilot: “Pay attention, the follow-me”, an abrupt braking manoeuvre was initiated. Immediately after the complete stop of the aircraft, the pilot apologized to the passengers for the braking manoeuvre. He explained that a vehicle had suddenly been driven in front of the airplane. The co-pilot complained about the behaviour of the follow-me car via radio communications to apron control. Afterwards – approximately one minute after the complete stop of the airplane – the co-pilot noticed the collision with the passenger bus when looking through the right cockpit window. He informed the PIC that engine No. 4 had collided with the bus and had to be switched off.

The evacuation procedure was announced in the cockpit. Via the public address system, the captain gave the order: “Attention crew on station“.

² anonymised callsign

Approximately at the same time, at 0622:58 hrs, apron control instructed: “Airbus A340 shut down the engines please.”

As a precautionary measure the fire brigade was requested. The passengers and the crew could leave the airplane without injuries via stairways.

Incident from the PIC's Point of View

The pilot in command explained the situation to the BFU as follows: He could see the parking position B26 for the first time when his airplane had entered the area between taxiway A and taxiway N. At that time he saw the passenger bus on the taxi area road in front of a red stop line. From his point of view, the distance was sufficient, thus, the bus did not pose any danger to him.

After crossing taxiway N, he had steered the airplane to the yellow taxi guide line for parking position B26. Due to the length of the A340, he had to use the so-called “oversteering” procedure. For this, he crossed the guide line B26 with the nose wheel and started to steer back later. The PIC explained that with this parking position it was the only way to position the main landing gear of the A340 correctly. After crossing the guide line with the nose wheel, the passenger bus was behind the airplane, thus invisible from the cockpit.

According to the PIC's statement, the clearance given by apron control and the activated docking system (AGNIS/PAPA) also meant that a clearance for taxiing towards the parking position was given.

Incident from the Co-pilot's Point of View

The co-pilot reported to the BFU that the light of the docking system was switched on during the taxiing. He had given this information to the captain, who was on the controls of the airplane.

When reaching the yellow taxi guide line leading to parking position B26, he caught a glimpse of a follow-me car approaching the airplane with high speed from the area of the parking position B25. He had recognized this car as a big danger and called out “Stop”, after which the PIC abruptly braked the airplane.

He only noticed the collision with the passenger bus after the airplane had come to a stop and after the follow-me car could be seen again on the right side of the airplane.

The co-pilot explained to the BFU that from his point of view the clearance given by apron control and the switched-on docking system (AGNIS/PAPA) also included the

taxiing clearance towards the parking position. He further explained that the fluorescent light of the docking system was switched on. He had not noticed the yellow warning light. He did not know that there were two stop line markings on the taxi area road abeam of parking position B26.

Incident from the Marshaller's Point of View

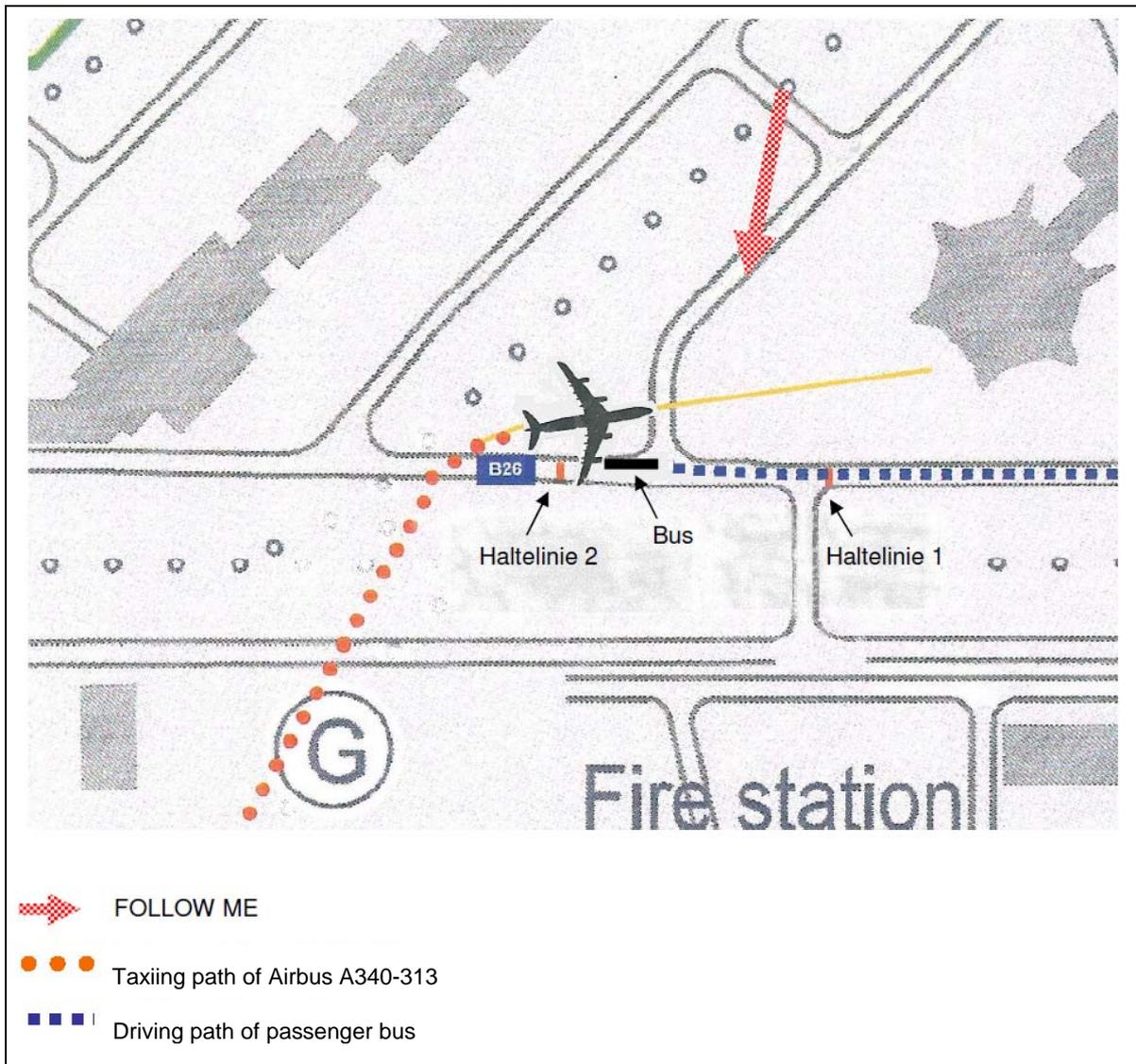
When interviewed by the BFU, the marshaller (follow-me) stated that he had the instruction to guide a docking process at parking position A1. The subsequent assignment was to report that the position B26 is clear for the approaching Airbus A340. When driving to B26, he had considered the obstacle clearance as given, reporting this to apron control. According to his statement, the guidance system AGNIS with the stop device was not activated. He stated that he had not seen the passenger bus.

Incident from the Bus Driver's Point of View

The passenger bus driver had the instruction to pick up passengers at parking position A17. He stated that he had initially seen the Airbus A340 when his bus was between two stop line markings on the taxi area road. When he stopped a few meters away from the second stop line, the Airbus A340 turned into parking position B26 and the engine of the airplane collided with the bus.

When he saw the airplane coming toward the bus, he tried to pull back, but did not succeed. The automatic transmission did not respond quickly enough.

He had not seen a marshaller at the parking position.



Reconstructed taxiing and driving paths

Source: BFU

Personnel Information

Pilot in Command

The 40-year-old pilot in command held an Airline Transport Pilot Licence (ATPL (A)) issued according to the JAR-FCL regulations, German. He was authorized to operate the Airbus A340 as pilot in command. He was licenced for flights according to

Instrument Flight Rules and landings according to CAT III. His total flight time was 10,766 hours; of which 555 hours were on the type. Frankfurt Airport was his base airport.

Co-pilot

The 28-year-old co-pilot held an Airline Transport Pilot Licence (ATPL (A)) issued according to the JAR-FCL regulations, German. He was authorized to operate the Airbus A340 as co-pilot and licenced for flights according to Instrument Flight Rules and landings according to CAT III. His total flight time was 1,994 hours; of which 466 hours were on the type. Frankfurt Airport was his base airport.

Apron Controller

The 35-year-old apron controller was an employee of the airport operator and instructed as apron controller.

Bus driver

The 37-year-old passenger bus driver held a valid driving licence and a valid driving licence for the apron area.

He was a trained dispatcher; since one year, he was passenger bus driver in the apron area of Frankfurt Airport.

Marshaller (follow-me)

The 35-year-old marshaller and driver of the follow-me car held a valid driving licence and a valid driving licence for the apron area.

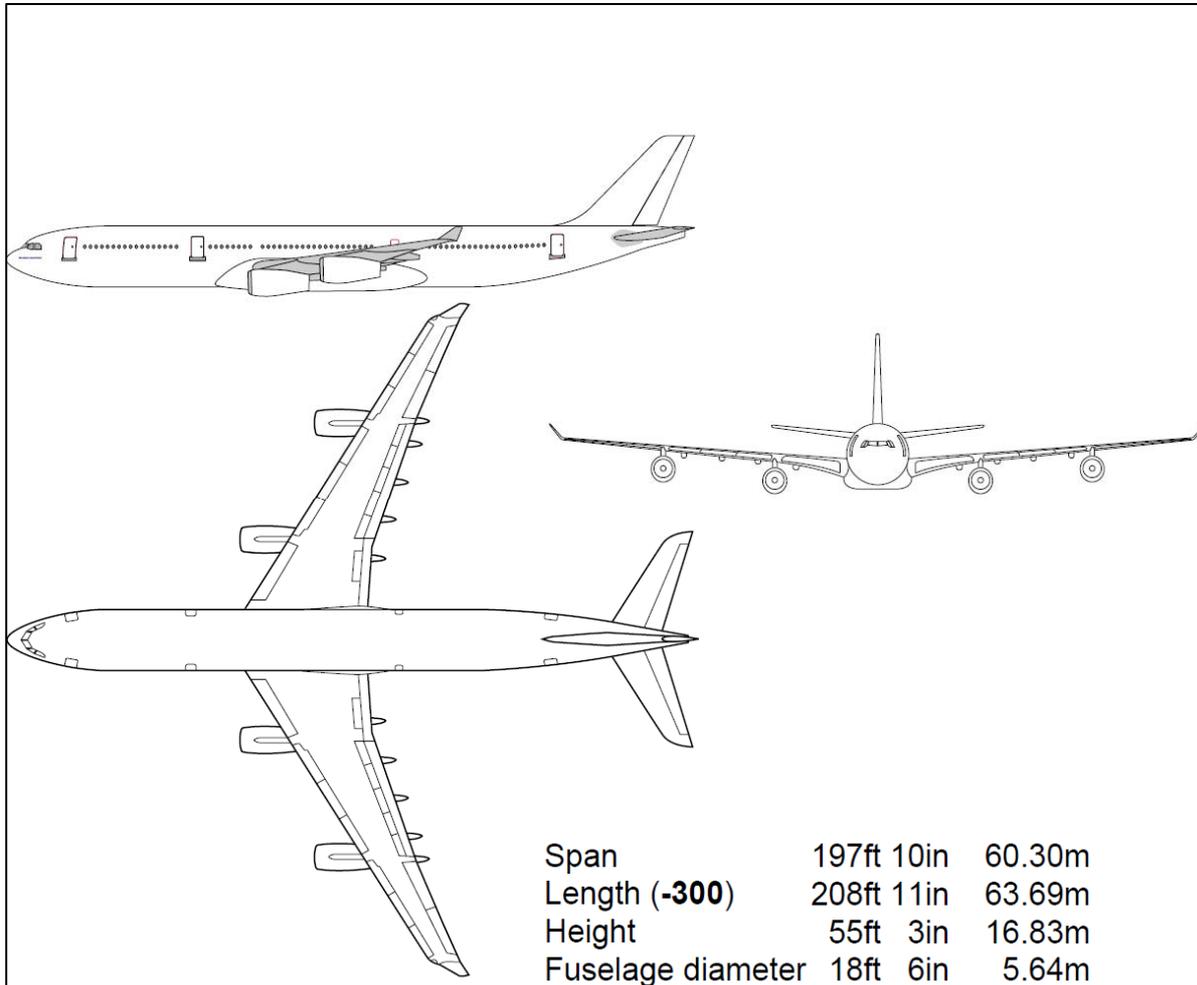
He was a trained dispatcher; since six years, he was working as a marshaller at Frankfurt Airport.

Aircraft Information

The Airbus A340 is a four-engined wide-body aircraft for long-range operations. The version A340-300 can transport a maximum of 247 passengers over a distance of 11,500 km.

The aircraft has a length of 63.69 m and a wingspan of 60.30 m. Maximum take-off mass is 271,000 kg.

The aircraft had a valid German certificate of registration and was operated by a German operator.



Dimensions

Source: Airbus Industrie

Meteorological Information

The Meteorological Aviation Report (METAR) indicated CAVOK (clouds and visibility ok) for the validity period starting at 0620 hrs. Sunrise was at 0622 hrs.

Aids to Navigation

The position B26 was equipped with a visual guidance system in order to support pilots during the approach to the parking position and the parking of the airplane. The guidance system consisted of the AGNIS device (Azimuth Guidance for Nose-In Stands), the stop device PAPA (Parallax Parking Aid), a yellow warning light on the parking position, and a yellow centre line marking on the pavement.

The overall system was remote-controlled by apron control. The marshaller (follow-me) had to forward a clearance to apron control after checking the parking position. As an alternative, the marshaller could operate the system on site.

The operating status of the visual guidance system was monitored and documented in the system itself. It showed that the AGNIS/PAPA was not operating at the time of incident.



AGNIS / PAPA at parking position B26

Source: BFU

Communications

After the airplane landed, there were radio communications on frequency 119.900 MHz between the airplane and the ground controller of the air traffic control. When taxiing to the parking position, communication was changed to apron control on 121.700 MHz.

The radio communication was recorded. The transcripts were available for the investigation.

Airport Information

Frankfurt/Main Airport has two runways (07L/25R, 07R/25L), and one runway 18, which is only available for take-offs.

The runways and aprons are connected by a network of taxiways. In this section taxiways carry yellow guide line markings as an aid for taxiing airplanes.

The air traffic control service provider has the operational responsibility for the taxiways and the runways belonging to the manoeuvring area. The airport operator is responsible for the apron, consisting of areas for parking of airplanes and boarding and deboarding of passengers.

The apron in the area of Terminal 1 with the parking positions B20 – B28 and B41 – B48 was reconstructed last year and adapted to the operational requirements of the wide-bodied airplane Airbus A380. The yellow guide line markings were replaced accordingly. Apart from the Airbus A380, the parking positions were also used for other airplane types.

Two stop line markings for vehicles are on the taxi area road which runs parallel to taxiway N. Vehicles coming from the east are supposed to stop at the first stop line when airplanes taxi over taxiway G to parking position B26. Vehicles are supposed to stop at the second stop line marking 122 m further to the west, when there is taxiing traffic from and to the parking positions A11 to A25 and the opposite B positions.

Flight Data Recording

Cockpit Voice Recorder (CVR)

The airplane was equipped with a Cockpit Voice Recorder FA 2100 manufactured by L3Com.

The CVR has a recording time of 30 minutes for four separated channels, and of 2 hours for connected channels. The CVR was read out at the BFU flight data recorder laboratory; parts of the recorded communication were transcribed.

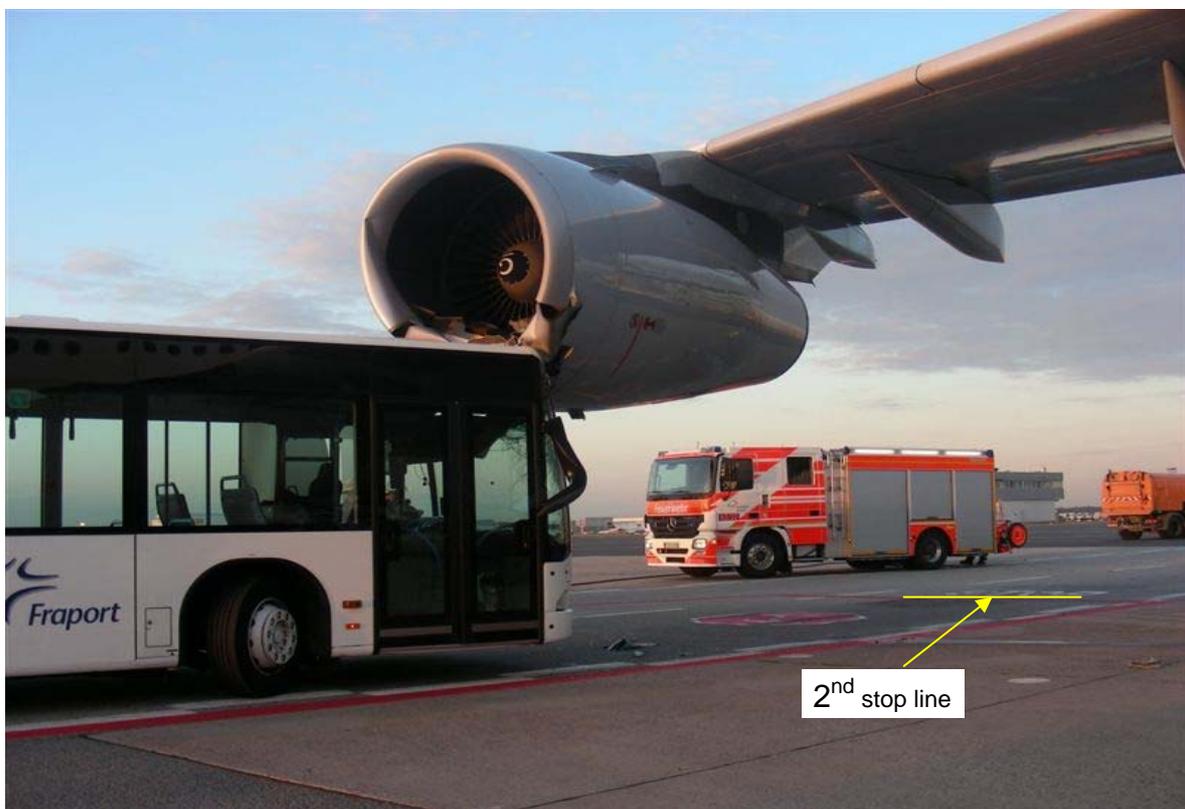
Digital Flight Data Recorder (DFDR)

The airplane was equipped with a Digital Flight Data Recorder F1000 manufactured by Fairchild. The DFDR was read out at the BFU flight data recorder laboratory.

According to the DFDR, the airplane stopped at 0619:31 hrs on taxiway G in front of runway 25. It started to move again at 0620:15 hrs. Ground speed was approximately 10kt; it was increased to approximately 20kt for a period of 20 seconds, and then reduced again to 10kt. At 0622:00 hrs, the airplane was brought to a stop by full brake application.

Accident Site and Findings

Engine No. 4 of the Airbus A340 rested with the bottom side of the engine cowling on the upper front part of the passenger bus. The airplane was on the yellow guide line for parking position B26, and the passenger bus was on the taxi area road approximately 8 m in front of the second stop line marking for vehicles.



Airplane and passenger bus on the apron

Source: BFU

The lower part of the cowling of the airplane's engine No. 4 was compressed; parts of the damaged cowling were found in the engine. The interior of the engine was damaged. It had to be removed for further damage identification and repair.

The passenger bus's upper front carriage was deformed. The rear view mirror and cover panels were torn out of their fixings and damaged.

Neither the airplane nor the passenger bus showed technical deficiencies.

Fire

There was no fire.

Additional Information

Apron Procedures

The Aeronautical Information Publication (AIP), chapter AD 2 EDDF 2.20, 3.3.1, includes the following procedures for the apron of Frankfurt Airport:

3. Aircraft guidance on the apron

Aircraft guidance on the apron and the parking areas of Frankfurt/Main Airport is subject to apron control of Fraport AG and is performed by means of aeronautical stations with the call sign FRANKFURT APRON. If required, follow-me cars will be available.

Follow-me cars are identifiable by a functioning red omni-directional light / flashing light.

3.3.1 General

Positions for aircraft on the apron are assigned by the "Verkehrszentrale" of Fraport AG. Apron control guides the aircraft via radio and/or by follow-me cars to the positions allocated

3.3.1.1 Parking of aircraft at the positions is performed either according to the signals of the marshaller or by means of AGNIS.

3.3.1.2 Parking of aircraft at positions not provided with AGNIS is only permitted according to the signals of the marshaller.

[...]

3.6.4 Taxiing on aircraft stand taxi lanes

[...]

Due to reduced wing-tip-clearance, adhere strictly to the yellow taxi guide lines. Taxi speed to be adjusted accordingly

[...]

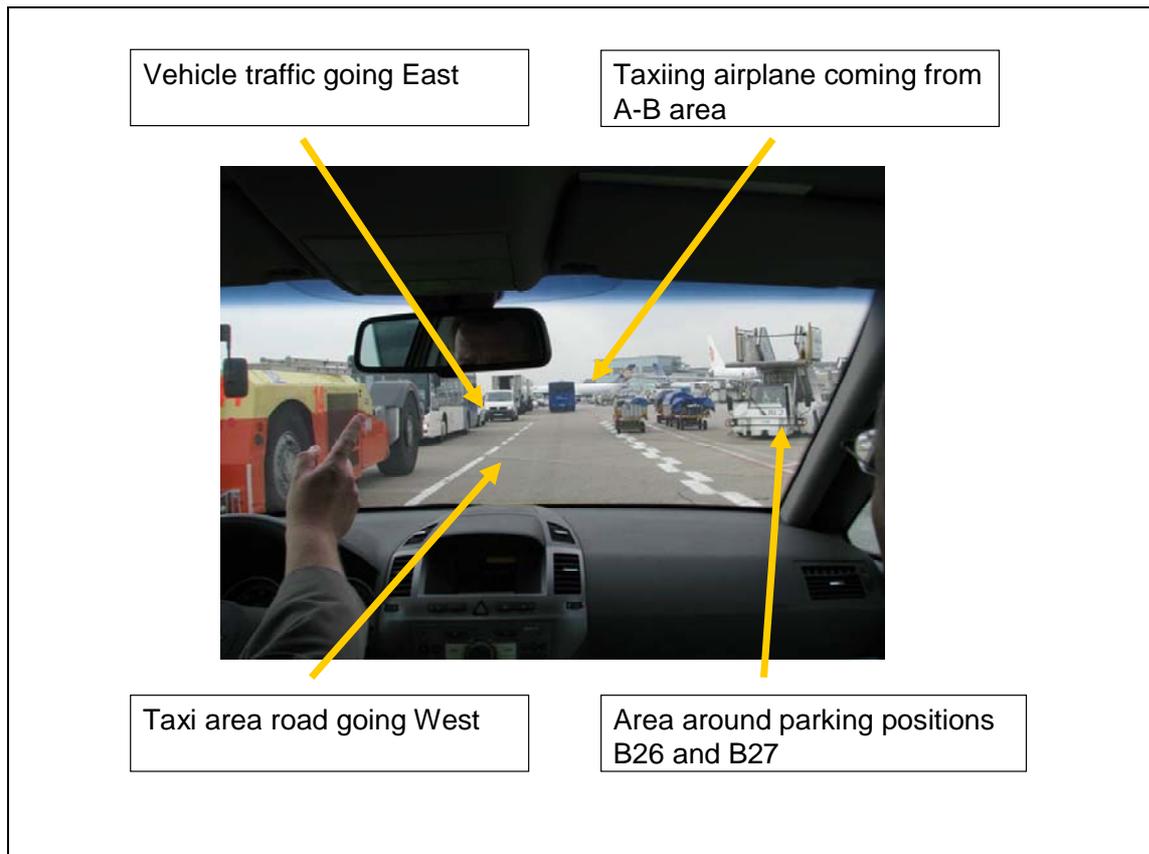
Traffic and Registration Rules for Automobile Traffic

The airport operator has set up traffic and registration rules for road users in the non-public operating areas and on the flight operating surfaces. These were compiled in a brochure and handed out to the employees having a driving licence for the apron.

On 5 February 2007, the airport operator informed the road users about the special traffic situation in the area of airplane position B26 and the associated additional ground markings by means of a circular letter.

Traffic Density in the Crossing Area of Taxiway G with the Taxi Area Road

It was part of the BFU investigation to document the traffic density with a photo.



Traffic situation on the taxi area road

Source: BFU

Analysis

Operational factors:

Airplane

The landing of the Airbus A340 on runway 25L and the taxiing via taxiways C and G up to the crossing of taxiway G with runway 25R was uneventful and conducted

according to the clearance given by the ground controller. The clearance for crossing runway 25R corresponded to the designated procedures and was performed correctly by the Airbus A340 crew. The waiting time of almost 2 minutes at the taxiing stop on taxiway G in front of runway 25R was caused by the traffic situation common for that time of day and did not influence the subsequent taxiing process.

The transfer from ground control to apron control (Frankfurt Apron) was performed according to the competence regulations between the air traffic control service provider and the airport operator.

The subsequent clearance given by apron control with the words "Airbus A340, no delay number one via Golf to Bravo 26" was partially incomprehensible and did not correspond to the designated phraseology. The co-pilot read back this clearance with the words "Number one, Golf, Bravo 26, Airbus A340", and the crew interpreted this as a clearance for taxiing to and docking on to Bravo 26.

The conversation recorded by the CVR showed that the crew had noticed the passenger bus on the taxi area road. The crew had observed a stopped bus, but could not detect that the distance to the airplane would be insufficient after turning into the parking position.

The abrupt braking manoeuvre was initiated because the co-pilot saw the follow-me car quickly approaching the airplane from the front. This was not a reaction of approaching or the collision with the passenger bus. The crew only became aware of the collision with the passenger bus approximately one minute after the airplane stopped. The immediate switch-off of engine No. 4 corresponded to the situation.

The explanation of the PIC according to which a taxiing clearance towards the parking position was given by apron control as well as by the switched-on AGNIS/PAPA, was incorrect with respect to the system AGNIS/PAPA. It is proven that the system was switched off at that time.

Due to the fact that the guidance systems AGNIS/PAPA were not activated and no marshaller was at the parking position B26, the airplane would have had to be stopped in front of the airplane parking position after crossing the taxi area road. The airplane collided with the passenger bus when crossing the taxi area road.

There was no established procedure which determines at which point at the very latest an aircraft has to be stopped in case of taxiing clearance given by apron control and deactivated AGNIS/PAPA.

Marshaller

The marshaller was well aware of the procedure and task. He ought to have checked the obstacle clearance at the planned docking position B26 prior to the clearance to apron control. The reason for the early clearance was a high workload. After he fulfilled his last instruction, controlling a docking process at parking position A1, he knew that he would reach position B26 with a delay and that the approaching Airbus A340 therefore would have to wait.

It remains doubtful whether the marshaller would have been able to see the passenger bus on the taxi area road had he arrived in time at parking position B26. There were several dispatching vehicles, containers and other equipment at the parking position which might have blocked the view to the taxi area road.

The marshaller's statement of not having activated the AGNIS guidance system was confirmed by the operating status log of the device.

The crew of the Airbus A340 was forced to stop the airplane abruptly as the marshaller drove hastily toward the airplane. He could not avoid the collision.

Apron control

As published in the AIP, apron control had assigned the parking position via radio communications to the Airbus A340 and given taxiing clearance which led the airplane to the assigned position. The clearance "Airbus A340, no delay (incomprehensible) number one via Golf to Bravo 26" was partially incomprehensible and did not correspond to the designated phraseology. However, the crew understood the clearance and followed it as intended by the apron controller.

Due to the report given by the marshaller to apron control during his ride, the apron controller could assume obstacle clearance at parking position B26, and thus also give the taxiing clearance.

Passenger bus

Traffic regulation on the taxi area road abeam of taxiway G stipulated that traffic coming from the East on the taxi area road should stop on the first stop line marking

whenever an aircraft was taxiing via taxiway G to parking position B26. Therefore, two stop line markings were drawn on the taxi area road.

The investigation revealed that it might be impossible for a vehicle stopped at the first stop line marking on the taxi area road to physically see an aircraft taxiing via taxiway G to parking position B26 due to oncoming traffic. Therefore, the passenger bus driver had no reason, in this case, to stop at the first stop line marking and give the airplane the right of way. After he had noticed the Airbus A340 and brought his vehicle to a stop, the bus already was at a position where the collision was unavoidable.

The driver recognized the critical situation immediately before the collision but was unable to avoid the collision by backing up the bus due to technical reasons.

Licencing

All persons involved in the incident were licenced for their respective tasks and had sufficient experience.

Specific Conditions at the Time of the Incident

There was no significant influence by weather phenomena at the time of the incident. Visibility was unrestricted in the terminal area. The persons involved did not even consider the rising sun from the eastern direction an influencing factor.

The taxi guidance for airplanes to dock on to the jetway of parking position B26 was marked by a yellow guide line. The crew of the airplane followed the guide line almost completely. In order to position the airplane correctly, the PIC had to cross over the guide line with the nose wheel and steer back later. The "Oversteering" was described in the aircraft's operation manual as a possible procedure for the positioning of the airplane in cramped spaces and was adhered to by the pilot as he taxied into the parking position. The cockpit of the airplane protruded further into the A-B area of the terminals than intended by the yellow guide line so that the crew could not visually observe the vehicle traffic on the taxi area road during this phase of the docking process. It would have taken the co-pilot a great effort to twist his body far enough to observe this particular area. In order to do so he would have had to neglect some of his duties during the docking process.

The aircraft crew was familiar with the guide lines which were modified due to the reconstructions for the Airbus A380.

The actual traffic density at the time of the incident at the crossing area of taxiway G with the parallel to taxiway N running taxi area road could not be determined by the investigation. From BFU's point of view, the traffic guidance and traffic situation in this apron area was generally complex. The reasons for this were the different traffic flows of vehicles and taxiing airplanes. Almost the entire apron vehicle traffic between the airport's east and west side and vice versa passed through this taxi area road. The taxi area road running from east to west was crossed by taxiing aircraft coming and going to and from Gate B or docking in one of the gates in the A-B area. Ground operations vehicles necessary for the dispatch of aircraft added to the congestion. When considering the traffic density in this area it becomes a general rule that the traffic density increases the more aircraft dock on and the bigger aircraft and gates become.

In the scope of the investigation an on-site inspection revealed that the traffic situation caused by taxiing aircraft and vehicles becomes confusing especially during peak periods.

Caused by the reconstructions including the modified guide lines for the docking of A380s and other wide-body aircraft, the risk situation in the crossing area of taxiway G and parking position B26 has intensified. The gate can only be reached if aircraft use the taxi area road with the outer most tips of their wings for longer than would be necessary if the taxi area road were crossed at a right angle. Another solution was not possible given the road and taxiway direction and the spatial situation.

Defences

The airport operator had recognized the demanding and risky traffic situation around parking position B26 already during the planning and construction phase of the reconstructions for the future dispatch of Airbus A380s. Therefore, a second stop line marking had to be implemented on the taxi area road for all traffic coming from the East. This safety measure was to ensure that with the modified guide line (yellow line) the necessary obstacle clearance for all aircraft docking on to parking position B26 was given.

The BFU is of the opinion that this safety measure, whereby traffic coming from the East should stop at the first stop line marking whenever an aircraft is taxiing to

parking position B26 and continue on to the second stop line marking only if an aircraft is taxiing into the A-B area, can only work to a limited extent. Especially in peak periods taxiing aircraft are not always recognized in time.

There is a weak point in the fact that the driver of the vehicle on the taxi area road has to decide whether to stop at the first or the second stop line. The incident showed that the driver of the passenger bus, when at the first stop line, had not physically noticed the taxiing airplane. When he saw the airplane and brought his vehicle to a stop, the obstacle clearance for the airplane was no longer given.

The additional safety measure that the Follow-me driver issue a docking clearance after the obstacle clearance is given did not take effect either.

The follow-me driver did not know about the circular letter of the airport operator with the information on the special traffic situation in the area around B26.

Clearance Procedure

An additional safety mechanism was the clearance and guidance procedures for airplanes docking on to the jetway. It was the responsibility of the airport operator and was also published in the AIP.

The procedure described in the AIP „Parking of aircraft at the positions is performed either according to the signals of the marshaller or by means of AGNIS“ left room for the interpretation that the activated AGNIS/PAPA system could have given the clearance for docking-on if no marshaller would have been in position.

In the case at hand, the A340 on taxiway G, with neither a marshaller nor a clearance from apron control via radio communications, could have expected to receive a clearance from the visual guidance system AGNIS. The investigation revealed that the crew of an airplane standing on taxiway G could not have reliably recognized the AGNIS display due to the distance and the line of sight.

According to the AGNIS/PAPA specification, the yellow warning light did not have any meaning and function in conjunction with the clearance or as navigation aid. It was only installed for the protection of the staff working in the parking position.

Taxiing on Aircraft Stand Taxi Lanes

The BFU is of the opinion that the information published in the AIP under 3.6.4 (AD2 EDDF 1-16) whereby the effective guidelines are absolutely to be adhered to, could be interpreted differently by airplane crews. It was not defined which part of the airplane (cockpit, nose landing gear, centre between main landing gears) had to be above the yellow taxi guide line.

Conclusions

- All persons involved in the incident were licenced and qualified for performing their respective tasks.
- Neither the airplane nor the passenger bus showed technical deficiencies which would have had any influence on the incident.
- The airplane was cleared for taxiing to parking position B26 by apron control.
- During taxiing towards the parking position, no marshaller was in that area, and the visual guidance system AGNIS/PAPA was not switched on.
- The collision occurred when the passenger bus was on the taxi area road within the obstacle clearance area of the taxiing Airbus A340.
- The airplane crew noticed a stopped bus, but could not detect that the distance to the airplane would be insufficient after turning into the parking position.
- The passenger bus coming from the east did not stop at the first stop line on the taxi area road. The passenger bus driver could not see the airplane from this position.
- The passenger bus driver noticed the airplane only after he was already behind the first stop line. After braking, the bus came to a stop approximately 8 m in front of the second stop line.
- The visual guidance system AGNIS/PAPA was not activated and did not have any direct influence on the incident.

Causes

Immediate Cause:

An insufficient distance between the passenger bus and the taxiway of the Airbus A340 caused the collision.

Systemic Causes:

- The spatial separation between the taxi area road and the taxiway G towards parking position B26 was insufficient.
- Coming from the east, the position of the first stop line marking on the taxi area road did not allow for an unrestricted view of the parking position B26.
- The vehicle drivers coming from the east had to decide during the drive on the taxi area road whether to stop at the first or second stop line marking. They also had to take into consideration whether an aircraft was taxiing to parking position B26 or to the A-B area.

Safety Recommendations

The BFU has issued the following safety recommendations:

Safety Recommendation No. 28/2009

The operator of the Frankfurt/Main Airport should ensure a spatial separation of the taxiing traffic and the vehicle traffic on the apron in the area of the crossing of taxiway G with the taxi guide line to position B26 by means of infrastructural measures (e. g. change of traffic routing).

Safety Recommendation No. 29/2009

The operator of the Frankfurt/Main airport should revise the procedure for the assignment of dispatch and parking positions published in the Aeronautical Information Publication (AIP) in chapter AD 2 EDDF 2.20, 3.3. Thereby making it clear that the AGNIS / PAPA system is a visual guidance system for taxiing and parking airplanes, and that its activation does not substitute the taxiing clearance into the parking position.

Investigator in charge: Johann Reuß
Assistance: Christian Blanke
Braunschweig, 5 June 2010

This investigation was conducted in accordance with the Federal German Law Relating to the Investigation into Accidents and Incidents Associated with the Operation of Civil Aircraft (Flugunfall-Untersuchungs-Gesetz - FIUUG) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

The present document is the translation of the German Investigation Report. Although efforts were made to translate it as accurate as possible, discrepancies may occur. In this case the German version is authentic.

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