Australian Government
Australian Transport Safety Bureau

Collision with aerobridge involving Boeing 747-422, N119UA

Melbourne Airport, Victoria | 22 April 2013

Investigation

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Addendum

Page	Change	Date

Safety summary

What happened

On 22 April 2013, the flight crew of a United Airlines Incorporated Boeing 747-422, registered N119UA, flew from Sydney, New South Wales to Melbourne, Victoria. At Melbourne, the crew taxied to gate D5 and stopped, applying the parking brake. Shortly after stopping, the aircraft started to move forward again slowly. The flight crew realised the aircraft was moving and re-applied the brakes. The aircraft's left wing collided with the aerobridge before the movement had stopped. No one was injured during the occurrence and the aircraft sustained minor damage.

Boeing 747 N119UA

Source: Benedikt Mathweis

What the ATSB found

After stopping at the gate, the aircraft parking brake was likely inadvertently released before the nose wheels were chocked and the engines shut down. The flight crew's attention was inside the cockpit, focused on shutting down the engines. As such they were not actively monitoring aircraft movement, nor was that required at this stage. In addition, the parking guidance system at the gate was set to emergency stop mode by ground personnel when the aircraft first arrived, removing the possibility of an alert for the flight crew that the aircraft had moved. The flight crew became aware of the movement when the captain detected motion through peripheral vision. The very slow acceleration, combined with a lack of visual cues available to the flight crew made it difficult for the crew to detect the movement in time to prevent the collision.

Safety message

This occurrence highlights the importance of flight crew remaining aware of the possibility of aircraft movement whenever the engines are running as aircraft movement, particularly if it is slow, is difficult to detect. Additionally, ground support crew are reminded of the need to leave the parking guidance system in normal mode, unless an emergency stop is required.

Contents

The occurrence

On 22 April 2013, at about 1025 Eastern Standard Time (EST)[1], a United Airlines Incorporated Boeing Company 747-422 (B747) aircraft, registered N119UA, arrived at Melbourne Airport, Victoria from Sydney, New South Wales. After landing, the aircraft was taxied to gate D5. On board the aircraft were 12 crew and 146 passengers.

As part of the preparations for departing Sydney, the ground crew pushed the aircraft back from the gate prior to the flight crew starting the engines. After pushback, the parking brake was set to hold the aircraft for engine start up and release from the pushback tug. After the captain, who was the pilot flying for the sector,[2] set the parking brake, the first officer noticed it had released again. The captain reset the parking brake, which was reported to have remained engaged for the remainder of the start up/tug disengagement.

After landing at Melbourne and once the aircraft was clear of the runway, the crew initiated the after-landing sequence of actions. The captain's first after-landing action was normally to retract the speed brakes[3]. However, recorded data showed that, in this instance, that action was not completed until shortly after the aircraft had stopped at the gate. The captain later reported that he did not recall when the speed brakes were retracted.

The taxi from the runway to gate D5 was short. The captain reported that that it was a busy and congested environment and that they were focussed on collision avoidance.

The aircraft arrived at the gate and the flight crew used the visual docking guidance system (VDGS) to bring the aircraft to a stop at the designated parking position (see the section titled *Airport information*). All four engines were still operating at the ground idle thrust setting when the flight crew set the parking brake and verified that it had engaged.

Recorded data showed that 4 seconds after stopping, the aircraft started to move slowly forward and the speed brakes were retracted. The flight crew were conducting the parking flow actions at that time. These included shutting down the engines. Fifteen seconds later, the left wing inboard leading edge contacted the aerobridge (Figure 1). The aircraft had moved forward about 12 m.

The ground crew reported placing chocks behind the nose wheel and being in the process of placing chocks in front of the nose wheel when the aircraft commenced moving.

The captain reported detecting movement in their peripheral vision when moving their attention from the overhead panel to the centre console, which is located between the crew seats. In contrast, the first officer, who reported glancing at the VDGS during the time that the aircraft was rolling forward, indicated that there was no visual indication of movement when looking forward from the flight deck, as the aircraft movement was too slow and the VDGS display remained on STOP.

There were no reported injuries to the aircraft occupants or to the ground staff awaiting the arrival of the aircraft. After the aircraft was moved back to the correct parking position, the passengers disembarked.

The aircraft sustained minor damage at the left wing inboard leading edge.

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1 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

2 Pilot Flying (PF) and Pilot Monitoring (PM) are procedurally-assigned roles with specifically-assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and aircraft flight path.

3 Speed brakes are aerodynamic devices. They can be extended from the upper wing surface to reduce the aerodynamic lift produced by the wing. Speed brakes are normally extended after touchdown to increase the weight on the wheels, allowing increased wheel braking. Speed brakes can be manually controlled by a lever that moves in the cockpit when the speed brakes extend.

Figure 1: Underside view of aircraft's impact with the aerobridge, showing damage to the left inboard landing light and wing inboard leading edge

Source: Melbourne Airport

Context

Personnel information

Flight crew

The captain had about 28,000 hours aeronautical experience with 15 years flying Boeing 747 aircraft.

The first officer (FO) had about 10,000 hours aeronautical experience and had recently completed training for the Boeing 747 type rating, having 16 hours experience on this aircraft type. The flight from Sydney to Melbourne was part of the initial operating experience[4] requirement and was the FO's first flight as pilot monitoring under the captain's supervision.

Fatigue

Both crew reported that they were well rested after having about 25 hours rostered time off prior to commencing duty for the 1.5 hour flight from Sydney to Melbourne. They had been rostered together for the previous 3 days. The FO's roster and reported sleep during that period indicated that fatigue should not have been an issue.

The captain's sleep history was not obtained. However, as they had been working to the same rostered schedule as the FO, there was nothing to indicate that fatigue would have been an issue.

Workload

The captain reported feeling that there was a slight increase in their workload because this was the FO's first flight as pilot monitoring. That workload increase was expected and the captain reported no problem in handling it.

Aircraft information

Wheel brake system

The Boeing 747 has independent left and right side, hydraulically-powered wheel brakes to all the main landing gear wheels.

The wheel brakes are controlled by applying force at the top of the captain's or FO's rudder pedals. The rudder pedals for each pilot are mechanically interconnected. Therefore, either pilot can apply input to all wheel brakes as required.

Activating the brakes allows the brake metering valves to supply hydraulic pressure to the wheel brakes. Removing the force from the tops of the rudder pedals returns the metering valves to neutral through the action of the return springs (Figure 2). This relieves the hydraulic pressure to the wheel brakes.

Flight crew normally position their feet to operate the rudder with their heels on the floor. In that position, the height of the rudder pedals above the floor makes it necessary for them to slide their feet up the rudder pedals to apply the wheel brakes.

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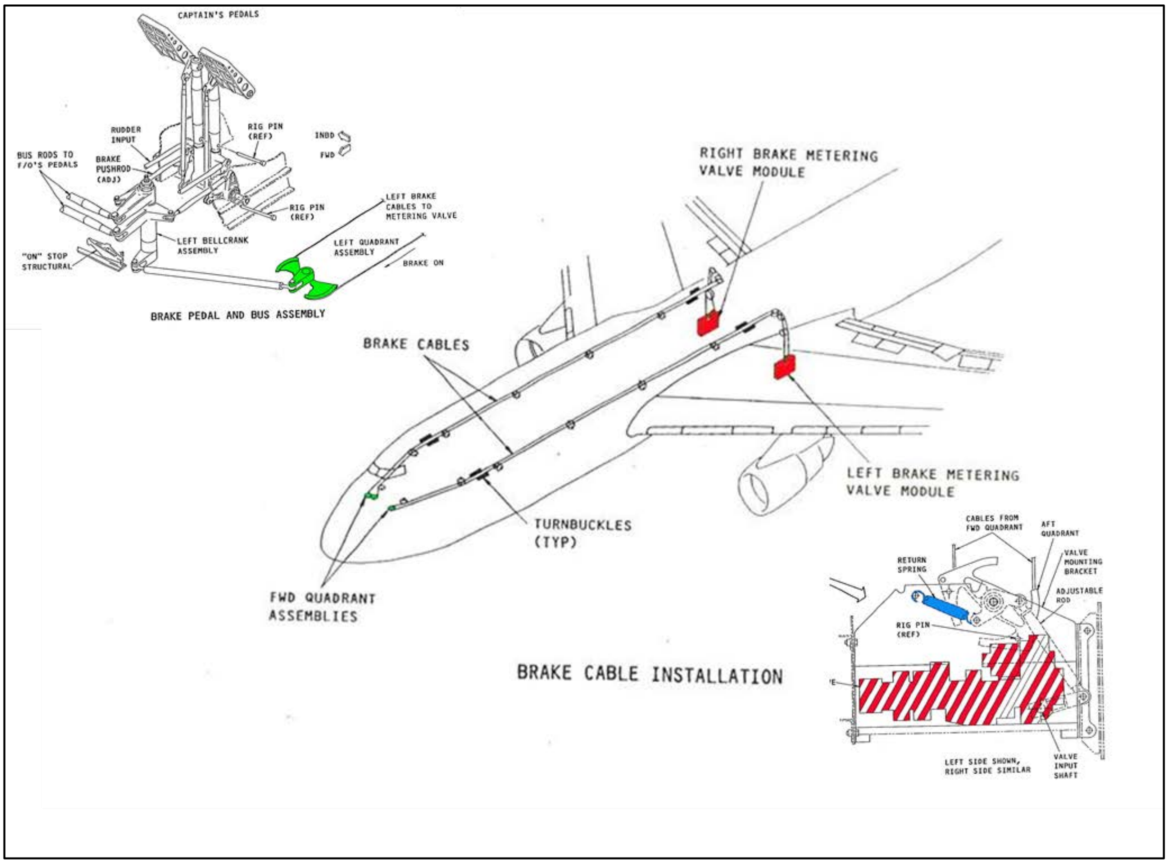
4 The operator required that recently endorsed pilots were to undergo a minimum of four sectors and 25 hours supervised experience on the aircraft in actual line operations. Three sectors were to be flown as pilot flying the aircraft for take-off and landing, and one sector was to be undertaken as the pilot monitoring the flying pilot.

Figure 2: Boeing B747-400 wheel brake system schematic. The upper-left image shows the mechanical interconnection between depressing the top of the rudder pedal and the movement of the brake cables, the centre image the wheel brake cables' layout and the lower-right image a hydraulic metering valve (the return spring is shown in blue)



Source: Boeing, modified by the ATSB

Parking brake

The 747-400 wheel brake system incorporates a parking brake function that retains hydraulic pressure in the wheel brakes. The parking brake is used during:

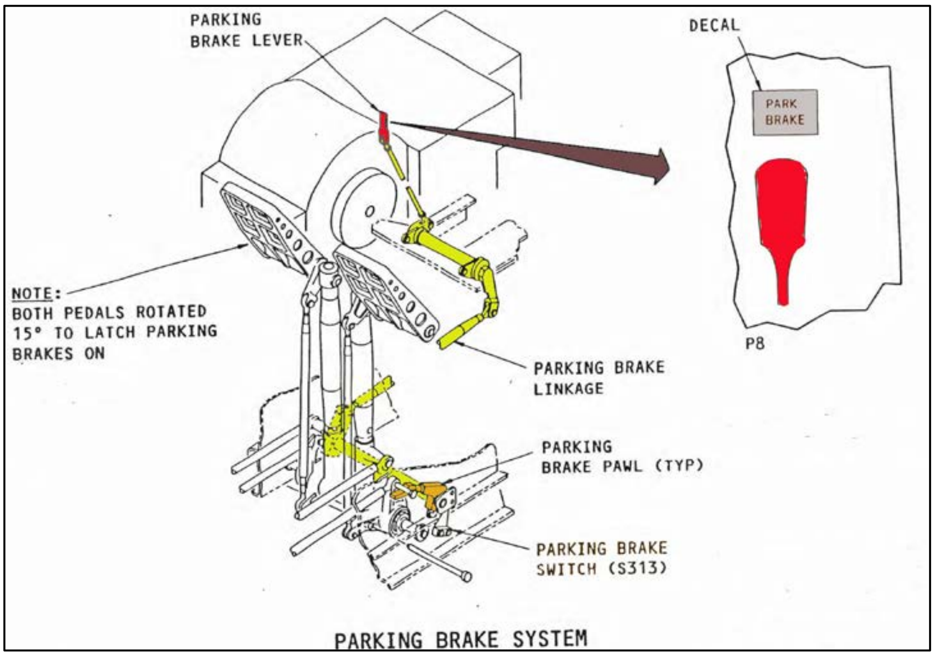
- the installation or removal of chocks after an aircraft stops or is about to move in the bay
- taxi manoeuvres, when the aircraft must wait for other traffic to clear
- short-term parking.

The parking brake system is controlled using a parking brake lever situated on the left (captain's) side of the flight deck centre console. The lever is connected mechanically to a pawl at the rudder pedals (Figure 3). Once the tops of either pilot's rudder pedals are pressed to at least 15°, the lever can be raised allowing engagement of the pawl. The pawl retains the rudder pedals in this position and the metering valves allow continued supply of hydraulic pressure to the brakes.

The pawls are themselves held in position by the force applied by the metering valve return springs. Applying additional force to the tops of the rudder pedals results in the pawls moving away from the 'locked' position, releasing the wheel brakes.

The parking brake also activates an isolation valve to trap the hydraulic pressure in the brake lines at the wheel brakes. As a result, once the parking brake is set, fluctuations in hydraulic system pressure do not have an effect on the wheel brakes.

Figure 3: Boeing B747-400 Parking brake system, showing the mechanical interconnection (in yellow) between the parking brake lever (in red) and the parking brake pawl (in orange) and the location of parking brake switch (switch S313)



Source: Boeing, modified by the ATSB

Parking brake engagement activates the parking brake switch that in turn annunciates the 'Park brake set' message on the engine indicating and crew alerting system (EICAS)[5]. The captain reported seeing this message when the parking brake was engaged.

Aircraft wheel brake system examination

Following the occurrence, a review of data recorded on the aircraft's central maintenance computer found no defects for the aircraft's wheel brake system.

United Airlines Incorporated (United) inspected the aircraft's wheel brake system and conducted a number of functional tests in accordance with the manufacturer's maintenance manual. No anomalies or defects were found in the aircraft's wheel brake and parking brake systems.

Airport information

Visual docking guidance system

Gate D5 was equipped with a visual docking guidance system (VDGS). The VDGS provided guidance for crew in terms of aircraft centre-line position and nose wheel position.

Crew use the guidance system to bring the aircraft to a stop at the correct point for an aerobridge disembarkation of passengers. After the aircraft has stopped, the aerobridge is moved forward to the aircraft fuselage.

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5 The EICAS consolidates engine and aircraft system indications and is the primary means of displaying system indications and alerts to the flight crew.

The normal sequence of operation for the VDGS is as follows:

- prior to an aircraft's arrival, a ground engineer selects the aircraft type on the VDGS control panel
- the VDGS starts scanning for the aircraft
- the VDGS matches the approaching aircraft with the selected aircraft type and:
  - if correct, the VDGS guides the aircraft using directional and speed arrow messages
  - if incorrect, the VDGS displays STOP and the aircraft is stopped short (up to about 20 m).
- at the correct stop position, the VDGS displays STOP and:
  - if the aircraft stops in time, the VDGS waits for 5 seconds and then signals OK, alerting flight crew that parking is complete
  - if the aircraft does not stop in time or moves forward more than 30 cm within 5 seconds, the VDGS displays TOO FAR, alerting flight crew that the aircraft has overshot the stop position.

The VDGS control panel includes an emergency stop button that can be activated by ground crew at any time. Once the emergency stop button is activated, the VDGS displays the STOP signal and ceases monitoring the aircraft's position and movement.

The displayed STOP signal is the same for normal and emergency stopping conditions. However, the STOP signal is displayed for more than 5 seconds for an emergency selection.

Flight crew procedures for use of the VDGS

The VDGS instructions available to the flight crew stated that the OK signal indicated that the aircraft was parked in the correct position but did not provide information about the TOO FAR signal display. The flight crew's procedures also stated that once the aircraft was chocked, ground staff would manually change the display to CHOCK ON. However, the CHOCK ON message was not available at gate D5. This meant that any communication about the position of the chocks would be verbal.

Ground procedures and actions for use of the VDGS

The ground standard operating procedures (SOP) applicable to gate D5 stated that ground personnel could initiate the emergency stop signal if required. Under those circumstances, once the emergency had been addressed, the ground engineers would marshal the aircraft to complete the parking procedure manually.

As an aircraft approaches the relevant gate, one of the ground crew stands near the VDGS control panel, ready to press the emergency stop button if the need arose. In this occurrence, the VDGS equipment log recorded that, almost immediately after the normal STOP signal was displayed, the emergency stop button was pressed. As a result, the STOP message remained displayed, even though the aircraft started to move again shortly after and collided with the aerobridge about 15 seconds later.

The ground engineers stated that they sometimes pressed the emergency stop button to ensure the STOP message was displayed in good time.

Flight Recorders

Cockpit voice recorder

The aircraft's cockpit voice recorder[6] continued to record for some time after the aircraft collided with the aerobridge as it remained powered. As a result, the recorder had recorded over the events from the time of the aircraft's arrival at gate D5, until the collision.

Recorded flight data

The aircraft was equipped with a digital flight data recorder, and a digital aircraft condition monitoring system recorder[7]. Analysis of data from those media showed:

- slight movement of the rudder pedals while the aircraft was stopped at the gate
- all four engines were running at idle thrust while the aircraft was stopped at the gate
- the aircraft was stationary for 4 seconds before commencing forward movement
- the forward movement commenced at the same time as the speed brakes were stowed
- once the aircraft started to move, there was hardly any further movement on the rudder pedals
- all engines were shut down about 5 seconds after the aircraft started to move
- about 15 seconds after the aircraft commenced moving, it collided with the aerobridge
- at the same time as the aerobridge collision, the wheel brakes were applied.

Flight recorder sampling of the parking brake lever position data occurred once every 64 seconds. At the time the aircraft started to move, the parking brake lever was recorded as being 'not on'. However, as the occurrence happened between two recorded samples, the actual position of the parking brake lever for the 4 seconds between when the aircraft stopped and commenced movement again, could not be determined.

Additionally, the recorded data indicated that sufficient hydraulic pressure was available to the aircraft wheel brake systems throughout the occurrence.

Selected parameters from the recorded flight data are at appendix A.

Wreckage and impact information

Damage to the aircraft

The left wing inboard leading edge was damaged by the collision with the aerobridge (Figure 4). A landing light cover was also damaged. Before the aircraft was ferried to United's home base, the leading edge and landing light covers were temporarily repaired. Permanent repairs were carried out in the United States.

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[6] A continuous loop recording device that automatically records all crew radio and inter-crew communications, plus background sounds.

[7] The digital aircraft condition monitoring system recorder recorded the aircraft's ground speed from one of its inertial reference navigation units. Due to the mode of operation of the inertial reference unit following a long flight, it can indicate a ground speed even though the aircraft is stationary. As a consequence of this potential error, in this occurrence data indicating movement of the aircraft was sourced from the longitudinal g parameter.

Figure 4: Close up of the damage to the left wing inboard leading edge and landing light cover

Source: United

Organisational and management information

Ground handling

Another airline was contracted to provide ground handling services to United at Melbourne Airport. There were three ground engineers awaiting the arrival of the aircraft at gate D5. They included a licenced aircraft maintenance engineer (LAME) and two unlicensed aircraft maintenance engineers. Other ground crew were located outside the aircraft's designated parking area. Additionally, ground staff were positioned at the entrance and halfway along the aerobridge.

The SOP for ground personnel actions upon arrival of an aircraft contained the following steps (in part):

> …
>
> 4. When meeting an arriving aircraft the person who is assigned to communicate with the flight crew on the headset must ensure:
>   a. The aircraft has stopped and brakes are on before connecting the headset.[8]
>   b. All engines are shut down and no abnormal conditions exist (such as tail pipe fire, wheel or brake fire etc) before disconnecting from the headset.
>   c. Chocks are placed just Fwd and Aft of the tires on the nose landing gear once the park

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8 When the park brake is set, a light is illuminated on the nose landing gear, enabling the ground crew to know the parking brake status.

brake has been set.

Place chocks Fwd and Aft of the outboard (or inboard) set of tires of each main landing gear.

…

The engineers stated that they provided ground handling services for a number of different operators and aircraft types. They stated that some operators were proactive with communicating to the ground crew on arrival while others were not.

The LAME reported that the aircraft came to a stop at the designated parking location. The two aircraft mechanical engineers then moved into a position to place a chock at the rear of the nose wheel.[9] After placing the rear chock, they moved to place the forward chock in position. At that moment, the aircraft started to move forward. The engineers expected the aircraft to stop again quickly, but it did not. They became aware of the aircraft's engines nearing their positions and abandoned any further attempt to chock the wheels.[10] Instead, they rapidly moved clear of the aircraft.

The LAME also reported that they had not spoken to the flight crew before the aircraft started to move again. The LAME stated they had insufficient time or opportunity[11] to connect ground communications to the aircraft.

Flight crew after landing procedures

According to United's procedures, the after landing flow can be conducted any time after landing, when time permits. The flight crew indicated that it was usually conducted as soon as the aircraft had exited the runway. The procedures stated that the captain's first action was to stow the speed brake by moving the speed brake lever to the forward stowed position (see the section titled *Additional information*).

Recorded flight data indicated that all the after landing flow actions were completed by the crew soon after landing, except for retracting the speed brakes. The speed brakes were retracted by the captain after the aircraft stopped at the gate.

The concept of prospective memory is described as 'remembering to perform an action that cannot be executed when the intention is formed' (Dismukes, 2006), and is typified by:

- an intention to perform an action at some later time when circumstances permit
- a delay between forming and executing the intention, typically filled with activities not directly related to the deferred action
- the absence of an explicit prompt indicating that it is time to retrieve the intention from memory.

The crew reported that after landing, their focus was on remaining clear of ground traffic and on specific aircraft parking requirements. This focus on different activities may have distracted the crew from retracting the speed brakes until the aircraft arrived at the gate. The captain's retraction of the speed brake after arriving at gate D5 was consistent with a lapse in prospective memory.

Flight crew parking procedures

The flight crew parking procedures required that once the aircraft had stopped at its intended parking position, the flight crew were to start the parking flow sequence of actions. In this

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9 There is a slight upslope at gate D5 and ground crew reported that it was routine to place the rear chocks first.

10 The ground staff reported that there was a significant danger in placing or throwing a chock in front of a moving aircraft, as the chock can be ejected with considerable force from the wheel.

11 The ground communication equipment connection point on the B747 was located in the nose wheel well and required the ground crew to place themselves near the nose wheel to gain access. The ground crew indicated that normal practice was to ensure that the forward chock was safely in position before moving near the nose wheel to connect to the aircraft.

sequence, the captain conducted 11 actions and the FO conducted nine actions. A notice at the start of the actions stated that:

> Ground personnel expect the right engines to be shut down, or ready for immediate shut down, upon arrival at the parking location.

The captain's first action was to set the parking brake lever. The procedure for setting the parking brake stated:

> The parking brake lever is pulled to set the brakes, after both pedals are fully depressed.

The captain stated that when applying the parking brake they feel for the 'click' in the parking brake lever, and felt that had occurred in this case. In order to feel a click in the parking brake lever, the parking brake lever would already have to be pulled when the brake pedals were pressed. This would have meant that the engaging pin was in contact with the pawl as the pin was moved by pedal depression. That action may have influenced the likelihood of an incomplete parking brake engagement.

To minimise the likelihood of the parking brake not being engaged, the procedure incorporated the following verification actions:

- The captain was to check:
  - the parking brake lever position
  - an EICAS memo message PARK BRAKE SET was displayed
  - the BRAKE SOURCE light was off
  - there was no aircraft movement.
- The FO's second action was to verify:
  - the parking brake lever position
  - there was no aircraft movement.

Aside from the status of the BRAKE SOURCE light, which was not mentioned at interview, the crew stated that they conducted all of these actions to verify that the parking brake was set and the aircraft was not moving.

The remaining actions directed both pilots' attention inside the cockpit. They mostly involved the overhead control panel or the centre console between the pilots' seats. None related to aircraft movement, brake or chock status. Despite both crew having their attention inside, the captain did notice aircraft movement through peripheral vision and the FO reported that the VDGS STOP indication appeared closer, although any change was insidious. In the event, the captain's perception of the aircraft's movement did not occur in sufficient time to prevent the collision.

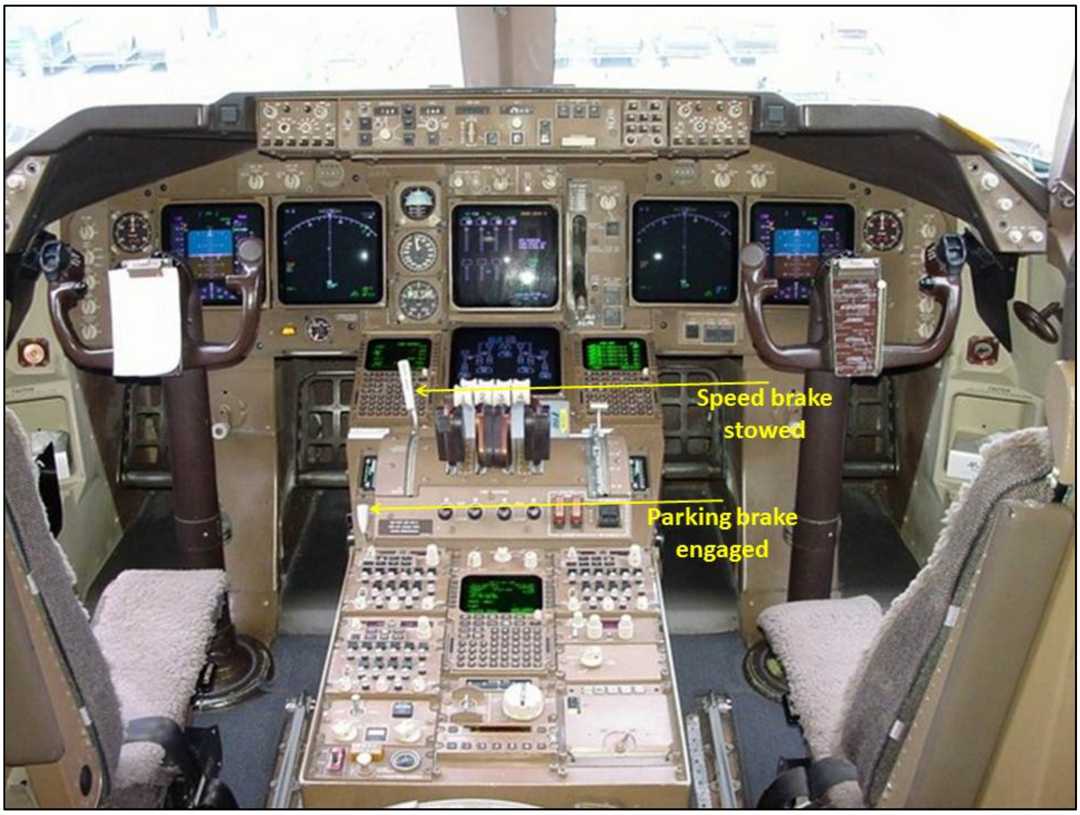
Additional information

Parking brake and speed brake controls

The speed brake lever and the parking brake lever are in the same area of the flight deck, however they are different in size and shape (Figure 5). While the speed brake lever can be moved without any additional action, the parking brake lever only operates in coordination with pressing the brake pedals.

The FO reported paying specific attention to the captain setting the parking brake in Melbourne because of the unintended wheel brake disengagement at Sydney. The FO recalled the parking brake lever remained raised (brake engaged) after the captain removed their hand from the lever.

Figure 5: Cockpit control layout, showing the location of the speed brake and parking brake controls



Source: Boeing, modified by the ATSB

Other occurrences

The aircraft manufacturer reported that it had been notified of an occurrence when a Boeing 747-400 aircraft started to move after the parking brake had been incompletely engaged. No defect was identified in the aircraft.

A review of the ATSB occurrence database identified seven reported occurrences between 2008 and 2013 in which jet aircraft moved after coming to a stop during parking. Of these:

- In one occurrence, the park brake was reportedly set and the aircraft rolled forward on a downslope during engine shutdown. No fault was found with the brake system.
- Another occurrence involved a mechanical issue with the park brake, which led to it disengaging.
- The remaining five occurrences involved the wheels not being chocked prior to park brake release or having the chocks in the incorrect position.

There were no occurrences relating to inadvertent park brake release.

Safety analysis

Introduction

A review of past occurrences showed that undetected movement following inadvertent disengagement of the parking brake is a rare event. In this occurrence, the aircraft started moving 4 seconds after it was stopped at the gate.

The flight crew reported that the parking brake was set after stopping and an inspection of the aircraft's wheel brake system and a number of functional checks by United Airlines Incorporated found no anomalies or defects with the aircraft's wheel or parking brake systems to explain the unintended aircraft movement. The application of the wheel brakes by the captain on detecting the movement would have disengaged the park brake. This was consistent with the as-found position of the park brake handle after the aircraft collided with the aerobridge.

This analysis will examine the defences in place to prevent such an occurrence and the human performance factors identified during the investigation as having influenced the flight crew's actions and ability to detect the aircraft movement.

Parking brake

When parking at an aerobridge, the wheel brakes are applied and locked on with the parking brake system. The parking brake is the primary means of restraint for the aircraft and is regularly used when the engines are operative.

The captain's parking brake engagement technique was not entirely consistent with the documented procedure. Despite this, the crew's subsequent verification checks should have identified if the parking brake did not engage properly. The crew reported that the engine indication and crew alerting system indicated that the parking brake had engaged and both crew reported verifying visually that the aircraft was not moving. As such, it is likely the parking brake had engaged correctly.

The reason why the parking brake disengaged could not be determined. However, recorded data showed rudder pedal movement when the aircraft started to move after the parking brake was initially set. A properly-engaged parking brake cannot be released unless force is applied to the brakes at the top of the rudder pedals. However, the recorded flight data does not record brake pedal movement, preventing confirmation of this action from the recorded data.

Sufficient force to disengage the parking brake is more likely to be applied if a crew member has their feet positioned on the top of the rudder pedals. The captain would have had their feet in this position a short time before, in order to apply the parking brake on arrival at the gate.

The speed brakes were lowered at the same time as the aircraft started to move and this action would have put a demand on the hydraulic system. However, recorded data indicated that sufficient hydraulic pressure remained available to operate the wheel brakes. The parking brake system was independent of the hydraulic supply system, therefore changes to hydraulic pressure would not have affected the parking brake engagement.

Reason (1990) stated that 'a necessary condition for the occurrence of a slip of action is the presence of attentional "capture" associated with either distraction or preoccupation. This means that wherever else the limited attentional resource is being directed at that moment, it will not be focused on the routine task at hand'. Reason outlined that there are two conditions necessary for a slip of action: the performance of some largely automatic task in familiar surroundings, and a marked degree of attentional capture by something other than the job in hand. The concept of 'automatic' action refers to the way that certain tasks can be executed without conscious oversight, thereby limiting the use of processing resources.

Stowing the speed brake was not part of the captain's usual actions after stopping at the gate. However, this out of sequence action may have been sufficiently distracting to result in the captain's slip of action to unintentionally activate the wheel brake pedals and release of the parking brake. At other times (such as when setting the parking brake), activating the wheel brake pedals would be intentional.

Aircraft movement

Installation of the wheel chocks

Ground staff normally installed the nose wheel chocks once the aircraft stopped and the parking brake was set. They were in the process of placing them in position when the aircraft moved forward, preventing installation of the forward chock.

The only means of communication between the ground and flight crews on the status of the wheel chocks was via hand or other visual signals, or after the ground crew plugged in their headset. The height of the pilots' seating, and position of the ground crew generally below the aircraft, meant that visual signalling was generally not practicable in the busy/congested tarmac environment because:

- one of the ground crew would need to move away from underneath the nose of the aircraft and into one of the pilot's view
- that pilot would need to establish and maintain visual contact with the ground crew member.

The ground crew's headset could not be plugged into the nose wheel landing gear intercom socket to allow communication with the flight crew until the aircraft stopped and the parking brake was engaged. The movement of the aircraft before the forward chock was in place prevented ground crew from establishing the intercom link with the crew. This lack of communication, and therefore flight crew understanding of the status of the wheel chocks, emphasised the flight crew's reliance on the parking brake and on comprehending any subsequent aircraft movement should that brake fail or disengage.

If the ground crew had been able to complete the installation of the nose wheel chocks before the aircraft recommenced moving, the chocks may have prevented that movement. Alternately, if the chocks were unable to prevent the aircraft's movement, the 'bump' as the aircraft rolled up or over the forward chock would likely have alerted the flight crew of the movement.

Flight crew focus

After commencing the parking flow actions, the flight crew's focus was predominantly inside the flight deck. These actions involved shutting down the engines, which at that stage remained at idle but, until shut down:

- given the aircraft's weight, provided sufficient thrust to move the aircraft if unrestrained
- prevented ground crew from approaching the main landing gears and installing the associated wheel chocks.

Therefore, although not inherently conducive to looking outside the flight deck, shutting down the engines was a priority task for the flight crew.

The captain first detected movement via peripheral vision when moving their attention from the overhead panel down to the centre console. One of the main functions of peripheral vision is to detect motion (Monaco and Kalb, 2007). This ability depends on the velocity and duration of the movement, the size of the moving object and its location in the peripheral vision.

Consistent with the first officer's report of the insidious nature of any movement when glancing out of the cockpit and seeing the VDGS, there was no salient visual stimulus when looking forward from the flight deck. The aircraft's movement was too slow for the terminal wall to appear to move and, as a result of the ground crew activating the emergency stop function on the visual docking guidance system (VDGS), the VDGS displayed the same STOP message as when the crew first stopped the aircraft.

Utility of the VDGS

Activation of the emergency stop button on the VDGS by the ground crew provided a means for the ground crew to instruct the flight crew to stop immediately. This function was only available until the aircraft stopped at its intended parking position.

In this case, the emergency stop button was pressed immediately after the aircraft stopped the first time. As a result, in addition to the ongoing display of the STOP message, display of the TOO FAR message in the case of the aircraft recommencing moving was inhibited. This meant that, although the first officer reported periodically glancing outside the flight deck and seeing the VDGS, its display would not have assisted the crew identify any aircraft movement.

Findings

From the evidence available, the following findings are made with respect to the collision between an aerobridge and a Boeing Company B747-422, registered N119UA, at Melbourne Airport, Victoria on 22 April 2013. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- A likely inadvertent disengagement of the parking brake, prior to the aircraft being chocked and while the engines were operating at idle thrust, allowed the aircraft to recommence moving forward.
- While the crew were conducting the parking flow, procedural task requirements drew both flight crew members' attention inside the flight deck. This, combined with the limited visual cues available, reduced their ability to detect the aircraft's movement in time to prevent the collision.

Other factors that increased risk

- The activation of the Visual Docking Guidance System emergency stop function inhibited display of a 'TOO FAR' message, reducing the cues available to crew and increasing the risk that any aircraft movement would not be detected.

General details

Occurrence details

Date and time:	22 April 2013 – 1025 EST	
Occurrence category:	Incident	
Primary occurrence type:	Collision on ground	
Location:	Melbourne Airport, Victoria	
	Latitude: 37° 40.40' S	Longitude: 144° 50.60' E

Aircraft details

Manufacturer and model:	The Boeing Company	
Registration:	N119UA	
Operator:	United Airlines Incorporated	
Serial number:	28812	
Type of operation:	High Capacity Scheduled International Passenger Transport	
Persons on board:	Crew – 12	Passengers – 146
Injuries:	Crew – 0	Passengers – 0
Damage:	Minor	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the flight crew of N119UA
- United Airlines Incorporated (United)
- ground staff
- Melbourne airport
- data from the flight recorders on N119UA.

References

Dismukes, K 2006, ‘Concurrent task management and prospective memory: pilot error as a model for vulnerability of experts’ *Proceedings of the Human Factors and Ergonomics Society 50th Annual Meeting – 2006*, pp.909-913.

Monaco, W & Kalb, J 2007, *Motion detection in the far peripheral visual field*, U.S. Army Research Laboratory, Maryland, United States.

Reason, J 1990 *Human Error*, Cambridge University Press, Cambridge, United Kingdom.

Submissions

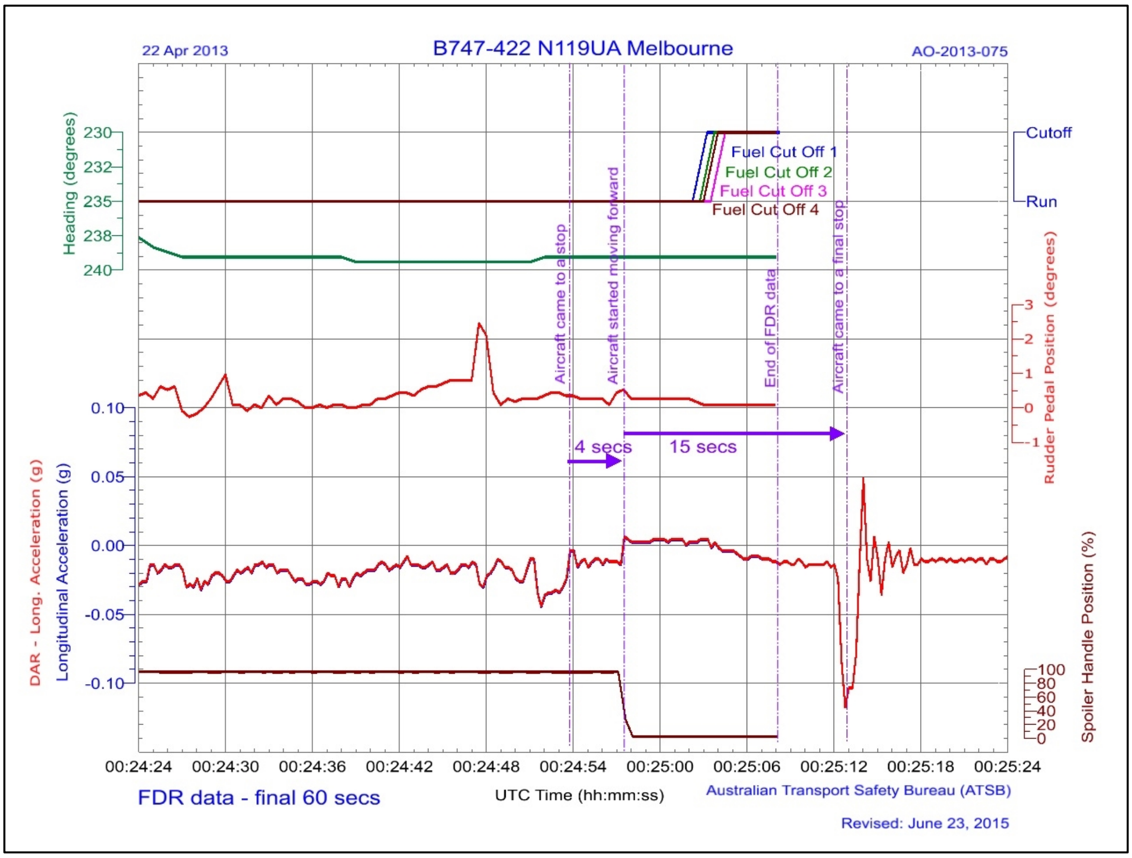
Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to United, the flight crew of N119UA and the Civil Aviation Safety Authority.

A submission was received from United. The submission was reviewed and where considered appropriate, the text of the report was amended accordingly.

Appendices

Appendix A - Selected parameters from the recorded flight data when the aircraft arrived at gate D5



Source: ATSB

Explanation

Recorded data

In accordance with the normal aircraft shut down procedures, the digital flight data recorder ceased recording shortly after the engines were shut down. The digital aircraft condition monitoring system recorder is normally switched off later in the shut down sequence. Therefore, the digital monitoring system recorder continued to record information including the longitudinal g[12] parameter. The plot of recorded data above shows data from both flight recorder systems and indicates the sequence of events beginning with the aircraft turning into the parking bay.

Movement

The ATSB derived the aircraft's speed from variations in longitudinal g, correlated with video recordings from the airport terminal. This showed that:

- From 0024:24, the aircraft turned into the parking bay, turning slightly right. As the aircraft approached the parking bay, there were variations in rudder pedal position and longitudinal g.

12 G Load is the nominal value for acceleration. In flight, g load values represent the combined effects of flight manoeuvring loads and turbulence. This can be a positive or negative value.

- At 0024:52, there was an increasing negative longitudinal g, or deceleration, which reduced as the aircraft stopped at 0024:54. About 4 seconds later, a positive change of about 0.02 longitudinal g indicated that the aircraft began to move forward again.
- The aircraft gradually decelerated as the engines were shut down by the fight crew actioning the fuel cut-off for each engine, although a video recording indicated the aircraft continued to move forward.
- At 0025:13, a sharp deceleration indicated the aircraft was being stopped.

Rudder pedal position

Rudder pedal position has no influence on the aircraft when taxying at slow speed. At this speed, the aircraft is steered by a separate control, the tiller, which controls nose wheel steering. However, while taxying an aircraft, the handling pilot’s feet rest on the rudder pedals. This is done so the pilot can operate the wheel brakes by applying force to the tops of the respective rudder pedals. The continuous slight movement in the rudder pedals between when the aircraft came to a stop until the aircraft started to move again is consistent with someone having their feet resting on the rudder pedals until that time.

Speed brake position

The speed brakes are hinged panels on the upper surface of the wing that may be extended to reduce aerodynamic lift from a wing. A speed brake may also be called a spoiler, as can be seen in this plot. The spoiler handle position was moved from 100 per cent to 0 per cent, commanding a retraction of the spoilers at the same time as the aircraft started to move.

Australian Transport Safety Bureau

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
Collision with aerobridge involving Boeing 747-422, N119UA
Melbourne Airport, Victoria, 22 April 2013

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