



Crew Lands B-777 on Runway Section Closed for Construction

The flight crew had received several advisories about displaced-threshold operations at the New Zealand airport. The aircraft was observed on a low approach by the work-party coordinator, who kept the workers clear of the construction area.

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FSF Editorial Staff

A serious incident involving a Boeing 777-200 that was landed on a section of a runway designated for use by a work party prompted the New Zealand Transport Accident Investigation Commission (TAIC) in May 2005 to call for replacement of “stepped” nonprecision approach procedures with constant-angle nonprecision approach procedures and for a review of training requirements to achieve English language proficiency.

No one was injured, and the aircraft was not damaged in the serious incident, which occurred in daytime visual meteorological conditions on Nov. 16, 2004, at Auckland International Airport.

“Despite repeated air traffic control advice to the crew about the displaced threshold on Runway 23L, [the aircraft was] landed short of the displaced threshold in an area where the runway workers could have been,” said TAIC in its final report on the incident.¹

“An unobstructed runway and the crew flying a *stepped approach*, which placed them below the normal glide path for the displaced threshold, probably contributed to the crew’s actions,” the report said. “Poor communication skills may have also been a factor.”

The aircraft was being operated by Asiana Airlines as Flight AAR 607, a scheduled flight from Incheon, South Korea, to Auckland. There were 200 passengers and 17 crewmembers



aboard the aircraft for the estimated 11-hour to 12-hour flight. The flight crew included four pilots who comprised a primary crew and a relief crew. The primary crew were on the flight deck for the initial five-hour to six-hour segment of the flight, as well as the final hour of the flight. The relief first officer remained on the flight deck to assist the primary crew during the arrival.

“The crew were appropriately rested and had ample time to prepare for the approach and landing,” the report said.

The primary captain, 46, had 8,499 flight hours, including 693 flight hours in type. He had conducted 11 flights to Auckland between Nov. 12, 2003, and Sept. 6, 2004.

The primary first officer, 35, had 3,894 flight hours, including 1,637 flight hours in type. The relief first officer, 34, had 2,616 flight hours, including 1,650 flight hours in type. Both first officers also had conducted 11 flights to Auckland. The primary first officer’s last flight to Auckland was Oct. 1, 2004; the relief first officer’s last flight to Auckland was Sept. 1, 2004.

The morning of the incident, at 1020 local time, the primary first officer established radio communication with Auckland Control and reported that the aircraft was at Flight Level 390 (approximately 39,000 feet) and nearing an intersection 200 nautical miles (370 kilometers) northwest of Auckland.

Auckland Control cleared the crew to conduct a published arrival procedure for Runway 23L. The first officer acknowledged the clearance and said that they had automatic terminal information service (ATIS) Information Hotel.

ATIS Information Hotel, issued at 0956, advised that special operations were being conducted at the airport and that flight crews should refer to the “flight guide or Jeppesen yellow pages.” The information also advised that the Runway 23L threshold was displaced and that the available landing distance was 2,535 meters (8,317 feet). Reported weather conditions included surface winds from 280 degrees at 16 knots, 25 kilometers (16 statute miles) visibility with haze, few clouds at 2,300 feet, scattered clouds at 3,000 feet, temperature 20 degrees Celsius (C; 68 degrees Fahrenheit [F]) and dew point 14 degrees C (57 degrees F).

The report said that the available landing distance on Runway 23L was “more than sufficient for a Boeing 777 to land safely.”

To facilitate a major construction project begun in the mid-1990s, Auckland International Airport and Airways Corporation of New Zealand (ACNZ) developed procedures to close sections of the runway to aircraft.

“When work on either end of the runway was required, the remaining two-thirds or thereabouts would still be available for operations,” the report said. “Should the center section or the full runway be closed, then the former taxiway would be utilized as a temporary runway. To facilitate this, the taxiway was widened to 45 meters [148 feet] and marked and designated as Runway 05L/23R.”

ACNZ published color-coded charts for the various operating procedures. For example, white charts depicted procedures for full-length operations on Runway 05R/23L; yellow charts depicted procedures for displaced-threshold operations on either Runway 05R or Runway 23L. The charts were published in the *Aeronautical Information Publication (AIP; “flight guide”)*.

Additional runway-lighting systems had been installed for guidance to flight crews during displaced-threshold operations. The systems included runway end identifier lights (REILs) and precision approach path indicators (PAPIs) at the displaced thresholds. The PAPIs provided guidance for a three-degree glide path and a displaced-threshold crossing height of 73 feet.

“The threshold-crossing height was from a pilot’s eye to the ground,” the report said. “For the B-777-200, this would give a minimum wheel height above the threshold of 30.2 feet.”

During displaced-threshold operations, the glideslope for the instrument landing system/distance-measuring equipment (ILS/DME) approach was decommissioned. For Runway 23L, the resulting localizer (LOC)/DME approach procedure was identified as “23L Zulu LOC DME Rwy 23L” in the *AIP* and the Jeppesen yellow pages.

A notice to airmen (NOTAM) in effect the day of the incident said that work was in progress on the northeast end of Runway 05R/23L, that the full length of the runway was not available for landing and that crews of landing aircraft must use the PAPI “to avoid works area.” The NOTAM said that the full length of the runway was available for takeoff by “long-haul international aircraft with 15 minutes prior notification.”

The NOTAM was not included in the flight information provided to the flight crew of AAR 607 before the flight began. Asiana Airlines told investigators that the dispatcher who had collated the flight information for the crew was “new to the job” and had mishandled the NOTAM. The company said that it was developing procedures to prevent mishandling of NOTAMs.

The absence of the NOTAM from the flight information provided to the flight crew “should not have limited their understanding of the approach-and-landing procedure,” the report said. “The three pilots on the flight deck during the approach and landing were familiar with Auckland, each having flown there on 11 occasions. ... The Jeppesen instrument approach chart used for the approach clearly stated in a caution box that it was only to be used when the runway threshold was displaced by 1,100 meters [3,609 feet]. The chart was color-coded yellow to reinforce the special conditions that applied, namely work on the runway and a displaced threshold.”

Although Asiana Airlines, which is based in Seoul, South Korea, had no specific check requirements for pilots operating at Auckland, the company in April 2004 and May 2004 conducted pilot briefings on the construction project at the airport and how it affected flight operations. The company said that all B-777 pilots had attended a briefing.

As the crew of the incident aircraft continued the flight to Auckland, they were cleared in stages to descend to 11,000 feet. At 1043, Auckland Control told the crew to establish radio communication with Auckland Arrivals.

Between 1044 and 1050, Auckland Arrivals issued radar vectors to position the aircraft for the published 23L Zulu LOC DME Rwy 23L (“Zulu approach”) to Runway 23L.

At 1045, ATIS Information Hotel was replaced by ATIS Information India.

Additional runway-lighting systems had been installed for guidance to flight crews during displaced-threshold operations.

“The information remained essentially the same but noted a deterioration in the conditions with ‘showers in the vicinity,’ scattered cloud at 2,300 feet, a dew point of 13 degrees C [55 degrees F] and a two-knot reduction in the surface wind,” the report said.

At 1052, Auckland Arrivals told the crew to turn right to a heading of 200 degrees and cleared the crew to conduct the Zulu approach to Runway 23L. After the first officer read back the instructions, Auckland Arrivals told the crew to establish radio communication with Auckland Tower.

The first officer told Auckland Tower that the aircraft was “approaching Runway 23L.”

The tower controller said, “Asiana 607, good morning. Continue approach Runway 23L, displaced threshold, number one.”

The first officer said, “Continue approach 23L, number one.”

Between 1053 and 1055, the controller cleared the crew of a preceding aircraft to land on Runway 23L and cleared the crew of a B-767 to take off using the full length of Runway 23L. Nevertheless, the radio transmission between the controller and the B-767 crew did not include any reference to the fact that the crew would use the full length of the runway for takeoff.

At 1056, after the B-767 had departed, an Auckland Ground controller cleared the work party to return to the work area on Runway 23L. “Asiana should be for the displaced threshold,” the ground controller told the work-party coordinator.

The work-party coordinator said, “Works party moving on back for displaced threshold.”

A few seconds later, the tower controller told the B-777 crew, “Asiana 607, surface wind 290 degrees, 14 knots, displaced threshold Runway 23L, cleared to land.”

The first officer said, “Cleared to land 23L, Asiana 607.”

At 1057:45, the tower controller observed that the B-777 appeared to be on a relatively shallow approach. “Asiana 607, confirm displaced threshold,” he said.

The first officer said, “Asiana 607.”

The report said, “[Air traffic service had] informed the crew of the displaced threshold on seven separate occasions, either directly or indirectly through reference to the ATIS or type of instrument approach to be flown, but AAR 607 still landed short. Why the crew did not recognize or register the presence of a displaced threshold could not be determined.”

The report cited the work-party coordinator’s vigilance in recognizing a potentially hazardous situation.

“After being cleared onto the runway by the ground controller, the work-party coordinator saw AAR 607 approaching at below what he considered to be the expected approach path for the displaced threshold,” the report said. “He therefore decided to wait until AAR 607 had landed before allowing the work party onto the runway. The tower controller continued to monitor the approach of AAR 607 and saw that the runway work party was remaining clear of the runway.”

The report said that the controller’s decision to not tell the B-777 flight crew to go around was reasonable.

“The tower controller ... was able to see that the runway was clear and [that] there was no danger to the aircraft or runway work party,” the report said. “He therefore elected not to intervene and allowed AAR 607 to continue to land.”

The B-777 touched down about 720 meters (2,362 feet) from the threshold of Runway 23L (Figure 1, page 4). The touchdown point was about 380 meters (1,247 feet) from the displaced threshold.

Another flight crew flew the aircraft back to Incheon later that day. The incident flight crew remained in Auckland for two nights before returning to Incheon on Nov. 18, 2004.

TAIC received notification of the incident after the aircraft and the incident flight crew departed from New Zealand.

“As a result, TAIC was unable to interview the crew immediately after the event and so could not accurately determine all the contributory factors to the incident,” the report said. “The crew of AAR 607 and the [aircraft] operator were not aware that there had been an incident until advised by TAIC some 10 days [after the incident].”

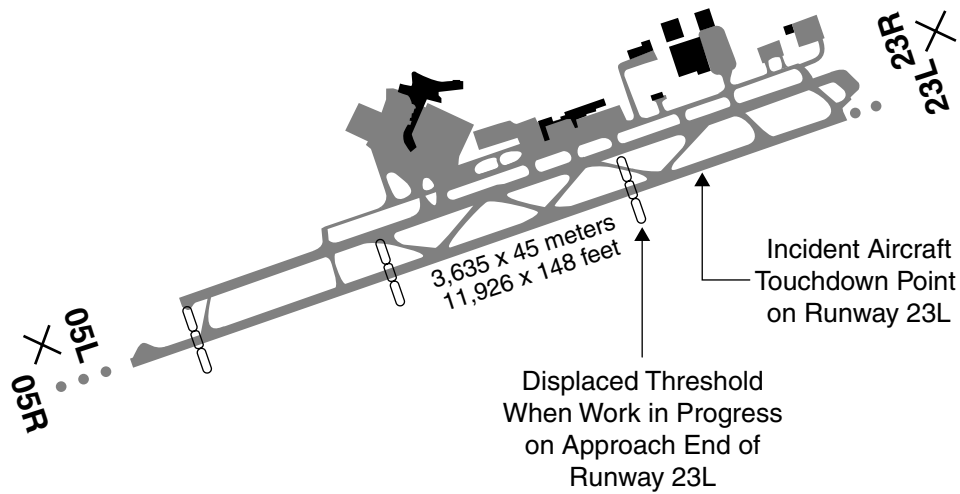
The aircraft was equipped with a cockpit voice recorder and a flight data recorder. “However, the [incident] information from the recorders was not retrieved as it had been overwritten before the operator was advised [that] a possible incident had occurred,” the report said.

The incident flight crew had used Jeppesen approach charts. The report said that the Jeppesen charts also were color-coded and contained the same factual information as the *AIP* charts but differed in their presentation of the Zulu approach procedure.

“One obvious difference was that the descent profile for the *AIP* chart was depicted as a constant angle,” the report said. “DME altitude limits during the approach were written along the constant-angle profile. The Jeppesen chart approach profile was drawn in steps, with a descent after each DME altitude limit, followed by a level portion before the next DME limit was reached.”²

The stepped approach procedure required the flight crew to descend to 1,200 feet after crossing a nondirectional beacon

Asiana Airlines Boeing 777; Auckland, New Zealand; Nov. 16, 2004



Note: Runway 05L/23R was closed and was being used as a taxiway.

Source: New Zealand Transport Accident Investigation Commission

Figure 1

(NDB) 11.2 nautical miles (20.7 kilometers) from the displaced threshold, then to 760 feet after crossing the DME 5.0 fix (5.4 nautical miles [10.0 kilometers] from the displaced threshold) and to 430 feet (the minimum descent altitude [MDA]) at the DME 0.5 fix (3.4 nautical miles [6.3 kilometers] from the displaced threshold).

Although some charts depict a constant angle for a nonprecision approach, the charts also present information enabling flight crews to conduct a stepped approach.

“Once cleared for an instrument approach, it is up to the pilot to manage the aircraft during the approach and ensure [that the published approach minimums] are not infringed,” the report said. “A constant-angle [profile] or stepped profile [typically] is at the pilot’s discretion.”

At the time of the incident, however, Asiana Airlines required its flight crews to fly stepped approaches. One advantage of conducting a stepped approach is that the aircraft typically is flown to the MDA earlier than it would be if a constant-angle approach was conducted.

Nevertheless, the report said that studies have shown that constant-angle approach procedures are conducive to conducting a stabilized approach and, thus, are preferable to stepped approaches.

“Studies undertaken by aviation organizations, including Flight Safety Foundation and the International Civil Aviation Organization (ICAO), into controlled-flight-into-terrain

(CFIT) accidents have identified that a large percentage of these accidents occurred in the final approach phase of flight, with a majority occurring on nonprecision approaches (NPAs),” the report said.³ “NPAs that contained a distance-measuring reference — for example, DME — were traditionally based on the stepped-approach methodology to ensure the required obstacle clearance was maintained as the aircraft approached a runway.

“The studies further identified that a constant-angle approach, based on a specified datum or aiming point — for example, 50 feet over the threshold, was preferable to a stepped approach. While this could result in the aircraft crossing some approach-check heights above the minimum permitted, the constant-angle approach had the advantage of providing a smoother, stable flight path to landing and helped avoid any undershooting tendency that might occur.”

The report said that the stepped approach conducted by the incident flight crew prevented them from achieving a stabilized approach and might have contributed to the aircraft landing short of the displaced threshold.

“By flying a stepped approach, the crew continuously placed themselves below the normal profile for the displaced threshold,” the report said. “Once past the last check altitude of 760 feet at three nautical miles [six kilometers], the pilot was able to descend immediately to the MDA of 430 feet. With about three nautical miles to fly to the displaced threshold, the pilot would have needed to apply significant power to arrest the descent and [to] intercept the three-degree glide path to land safely.”

ICAO and the New Zealand Civil Aviation Authority (CAA) categorize a landing touchdown before a displaced threshold as a serious incident. ACNZ notified CAA of the AAR 607 incident on Nov. 16, 2005.

“However, ACNZ accorded the incident a lower priority, as they considered [that] there was no possibility of an accident due to the vigilance of the ground-party coordinator,” the report said. “Accordingly, CAA did not immediately act on the low-priority message, despite the message narrative identifying it as a likely serious incident. TAIC became aware of the incident on 24 November from another source.”

The report said that the incident investigation identified the following safety issues:

- “The benefit of flying constant-angle approaches;
- “The presentation of instrument approach charts;
- “The effect on compliance and competency of crews having English as a second language;
- “The need to improve runway markings for displaced-threshold operation; [and,]
- “The timely notification of serious incidents.”

Based on the findings of the incident investigation, TAIC in May 2005 made the following recommendations to the chief executive of Asiana Airlines:

- “Direct that, where possible, the flying of stepped-approach profiles be discontinued and replaced with constant-angle approaches for nonprecision instrument approaches; [and,]
- “Review training requirements, particularly English-competency levels, for crews who fly to international destinations.”

The general manager of the Asiana Airlines Preventative Safety Team in June 2005 said that the company was implementing both recommendations.

“After completing ground-school requirements, pilots will conduct VNAV (vertical navigation) approaches instead of using step-down approaches,” the general manager said. “This will be included in revised aircraft operations manuals and is subject to Korean Civil Aviation Safety Authority (CASA) requirements. All Asiana Airlines B-747, B-777 and Airbus aircraft are well-equipped for VNAV operations.”

The general manager said that the company was preparing to meet ICAO language-proficiency requirements.⁴

“Flight crew are given structured training in English, including a two-day course and recurrent training ... supervised by CASA,”

the general manager said. “Additional training is also available and planned. Only qualified pilots are cleared to [conduct] international flights.”

TAIC in May 2005 recommended that the chief executive of Auckland International Airport “examine runway visual indications with the objective of providing additional visual reminders to pilots that a displaced threshold is in operation.”

The airfield operation manager for Auckland International Airport in June 2005 replied that the airport “intends to implement the safety recommendation ... and has already been looking for possible solutions. However, as there is no standard fix for this type of operation, it will not be something that can be implemented immediately. While we are unsure of the size of the task at this stage, it is likely to take at least six months, with perhaps a progressive roll-out of different aspects in the interim.”

TAIC in June 2005 recommended that the director of the CAA “complete a review of accident and incident notification procedures to ensure notifications, especially those requiring immediate action, are processed in a timely manner.”

The CAA director in June 2005 accepted the recommendation and said that the CAA’s manager of safety investigation “will review procedures to ensure information is correctly categorized and processed. In addition, after normal working hours, processes will be enhanced to detect serious incidents in a timely manner.”♦

Notes

1. New Zealand Transport Accident Investigation Commission (TAIC). *Boeing 777-200, HL7597, Landed Short of Displaced Threshold, Auckland International Airport, 16 November 2004*. Report no. 04-006.
2. TAIC said, in the incident report, that Jeppesen in April 2004 announced that it would begin to depict a constant-angle descent path on charts depicting nonprecision approach procedures in countries that provide profile-descent information. At the time of the incident, Jeppesen had not published a constant-angle descent path for the nonprecision approach to Runway 23L at Auckland International Airport.
3. Controlled flight into terrain (CFIT), as defined by the Flight Safety Foundation CFIT Task Force, occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew.
4. The International Civil Aviation Organization (ICAO) in 2003 adopted requirements for pilots, air traffic controllers and aeronautical radio-station operators to demonstrate, by March 2008, at least a minimum level of proficiency in the use of the English language. Six proficiency levels were established: 1, pre-elementary; 2, elementary; 3, pre-operational; 4, operational (the minimum proficiency level); 5, extended; and 6, expert. Details were published in Document 9835, *Manual on the Implementation of the ICAO Language Proficiency Requirements*.



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