National Transportation Safety Board
Aviation Accident Final Report

Location:	New York, NY	**Accident Number:**	DCA09FA045
Date & Time:	04/20/2009, 1524 EDT	**Registration:**	CN-RNT
Aircraft:	BOEING 767	**Aircraft Damage:**	Substantial
Defining Event:	Hard landing	**Injuries:**	220 None
Flight Conducted Under:	Part 129: Foreign		

Analysis

During the initial approach, gusty wind conditions could be seen in the recorder airspeed data consistent with the weather conditions broadcast to the flight crew (16 knots gusting to 24 knots). As a result, the flight crew added an appropriate wind additive to the reference landing speed (Vref). The airplane touched down in the touchdown zone approximately 1,600 feet from the threshold with a recorded normal acceleration (Nz) consistent with a "firm" landing. As the main gear touched down, a full nose down column was applied that produced a very high nose-down pitch rate, which resulted in a hard nose gear touchdown. The recorded normal acceleration at nose gear touchdown was 1.8 g, however, the actual load applied at the nose gear was much higher because the accelerometers are located in the main gear wheel well. The peak nose gear load experienced at nose gear contact exceeded the design-limit load by as much as 46%. The recorded normal and pitch accelerations, calculated data, and estimated nose gear loads confirm that the aircraft experienced a bending moment that exceeded both the design requirements and the structural capability of the fuselage.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The first officer's input of full nose down elevator at touchdown.

Contributing to the accident was the gusty wind conditions.

Findings

Personnel issues	Incorrect action performance - Copilot (Cause)
Environmental issues	Gusts - Contributed to outcome (Factor)

Factual Information

FACTUAL NARRATIVE

HISTORY OF FLIGHT

On April 20, 2009, Royal Air Maroc (RAM) flight 200, a Boeing 767-300, registration CN-RNT, experienced a buckling to its fuselage upper crown during landing on runway 4R at John F. Kennedy International Airport (JFK), New York, New York. There were no injuries to the 210 passengers or 10 crew members onboard but the airplane received substantial damage. The flight was operating under the provisions of 14 Code of Federal Regulations (CFR) Part 129 as a regularly scheduled passenger flight from Casablanca-Mohammed V International Airport (CMN), Casablanca, Morocco.

The first officer was the flying pilot. According to flight crewmembers statements, the takeoff, climb, en route, and descent, phases of the flight were normal. According to the air traffic control transcript, about 1519 eastern daylight time (EDT), flight 200 checked in on the tower frequency and the local controller (LC) cleared the flight to land on runway 4R.

According to flight data recorder (FDR) data, the airplane is coupled to the runway 4R instrument landing system (ILS) with all three autopilots engaged as the airplane descended through about 2,100 feet radio altitude (RA). Variations in the airspeed can be seen throughout the descent.

As the airplane descended through about 1,400 feet RA, the autopilot transitions to Land 3 mode and the mode control panel selected airspeed is 150 knots (the landing reference speed, Vref, for the airplane landing weight and Flaps 30, without wind additives, was 133 knots). The latest METAR reported winds were from 060 degrees at 16 knots gusting to 24 knots.

At about 770 feet RA, the autopilot and autothrottle were disengaged. The airspeed varied from this point until touchdown between about 166 knots and 142 knots.

The airplane crossed the runway threshold at 160 knots and 55 ft RA. The calculated wind components at this point were 13 knots headwind and 19 knots cross wind from the right.

The airplane touched down about 1,600 feet from the threshold in a 5 degree right bank at a calculated descent rate of about 5 feet per second. The recorded normal acceleration at main gear touchdown was 1.35g.

A full nose down control column input is initiated at main gear touchdown and the recorded normal acceleration at nose gear touchdown was 1.8g. The flight crew indicated in post accident interviews that there was any unusual noise from the forward part of the fuselage concurrent with nose gear touchdown.

The landing rollout and taxi to the gate was normal. After parking at the gate, the captain wrote up to accomplish a hard landing check in the maintenance log book.

DAMAGE TO AIRCRAFT

The fuselage skin between Station 610 to Station 654 exhibited numerous skin tears and wrinkles. This area was approximately midway between the nose landing gear and main landing gear. The damage was confined to the crown area of the fuselage above the window belts. No damage to the skin, stringers or frames was observed below the floor structure between Station 610 to Station 654.

The fuselage skin was dented and creased between Station 588 to Station 650 from Stringers 17L to 21L. There was light pillowing below Stringer 20 between Station 632 and Station 654.

The fuselage skin was dented and creased between Station 588 to Station 628 from Stringers 8L to 17L; between Station 588 to Station 650 from Stringers 8R to 16R; and between Station 576 to Station 632 from Stringers 8L to 2R and from Stringers 2R to 8R.

Numerous fuselage frame structures between Station 610 and Station 654 exhibited buckling, twisting and fracture. In some areas the frame web and inner chord exhibited deflection. The fuselage frames were buckled at Station 610 between Stringers 4L and 5L and between Stringers 11R and 12R; at Station 632 at Stringer1L; and at Station 654 at Stringer 15R.

The fuselage frame was twisted and cracked at Station 632 between Stringers 12L and 16L. At Station 654 the fuselage frame was buckled and cracked at Stringer 15L.

All stringers between Station 434 and Station 654 were bent, deformed or cracked. The mid entry door counter balance supports were buckled at Stringer 4L and 5L between Station 610 and Station 632.

At Station 632, the frame was twisted and cracked between Stringers 12L and 16L and between Stringers 1R and 16R.

The fuselage skin exhibited convex diagonal buckles between Station 287 and Station 303 from Stringers 24L to 26L and from Stringers 27L to 30L; and between Station 288 and Station 303 from Stringers 24R to 26R and from Stringers 28R to 33R.

At Station 287, the nose landing gear (NLG) aft bulkhead web exhibited buckling outboard of Stringer 36L upwards to Stringer 24L and outboard of Stringer 36R upwards to Stringer 24. This web exhibited diagonal pillowing.

There were no structural repairs found in the damage area of fuselage. All fracture surfaces that were examined exhibited evidence of overload failure with no evidence of corrosion.

PERSONNEL INFORMATION

The captain, age 53, was hired by Royal Air Maroc on October 15, 1975. He held an airline transport pilot certificate with airplane multiengine land and B-757/767 type rating. The captain held a first-class medical certificate dated November 20, 2008, with no limitations.

Royal Air Maroc records indicated that the captain had accumulated 21,754 total flight hours, including 2,288 hours in the Boeing 767 airplane. In the 90 days, 30 days, and 24 hours before the incident, the captain had flown 126, 21, and 8 hours, respectively. He received his last proficiency check on December 22, 2008.

The first officer, age 42, was hired by Royal Air Maroc on January 2, 1990. He held an airline transport pilot certificate with airplane multiengine land and B-757/767 type rating. The first officer held a first-class medical certificate dated January 21, 2009, with no limitations.

Royal Air Maroc records indicated that the first officer had accumulated 9,621 total flight hours, including 2,149 hours in the Boeing 767 airplane. In the 90 days, 30 days, and 24 hours before the incident, the first officer had flown 137, 59, and 8 hours, respectively. He received his last proficiency check on February 13, 2009.

FLIGHT CREW INTERVIEWS

The Captain and first officer were interviewed separately by investigators from the Morocco Direction Générale de l'Aviation Civile (DGAC). The flight crew confirmed that this was their scheduled flight and they were in good health and rested. They indicated that they had sufficient rest time in accordance with regulations and preparation and conduct of the flight was normal.

The flight crew indicated that there was good coordination and crew resource management between them throughout the flight and that all the briefings were conducted. Both crew members indicated they had emphasized the forecasted turbulence during their decent and approach briefings into JFK. They had also informed the cabin crew of the possibility of turbulence during the approach and landing. Both pilots indicated that the weather was relatively unstable during the approach and that the first officer was the flying pilot.

The pilots indicated that the stabilized approach parameters were maintained through the final approach phase. The first officer indicated that the de-crab took place after touchdown of the main gear and before the contact of the nose gear. The crew members stated that nose gear contact was accompanied by an unusual sound that seemed to come from the forward part of the airplane.

After at the gate and the passengers disembarked, the captain asked the maintenance engineer to conduct a hard landing check. The captain specified that the verification he asked for was just a precaution because the perceived load was not very high and there is no indication about the "G" load available to the crew.

The captain stated that he received a call at the hotel from the station manager about two hours later informing him about the structural damage to the fuselage.

METEOROLOGICAL INFORMATION

JFK has an automated surface observation system (ASOS) installed that was augmented by Federal Aviation Administration (FAA) contract National Weather Service certified weather observers. The following meteorological aerodrome reports (METAR) and specials (SPECI) reports were broadcast (automatic terminal information service (ATIS)) surrounding the time of the accident, with cloud height reported above ground level (agl):

JFK METAR at 1451 EDT (1851Z), winds 060 degrees at 16 knots gusts to 24 knots, visibility 5 miles in light rain, ceiling broken at 1,800 feet, overcast at 4,000 feet, temperature 7 degrees Celsius, dew point 4° Celsius, and altimeter setting 30.07 inches of Mercury.

JFK SPECI at 1536 EDT (1936Z), winds 070 degrees at 20 knots gusts to 26 knots, visibility 6 miles in light rain and mist, ceiling overcast at 1,400 feet, temperature 7 degrees C, dew point 5 degrees C, altimeter setting 30.04 inches of Mercury.

JFK also records ASOS 5-minute observations from 1500 through 1440 EDT in standard code are included below. Wind is averaged over a 2-minute period. The observation states in part, at 1425:31 EDT reported wind from 070 degrees at 21 knots gusting to 29 knots, remarks: automated observation system, peak wind from 070 degrees at 29 knots recorded at 1424 EDT, hourly precipitation 0.03 inches.

AIRPORT INFORMATION

JFK is located 1/2 mile southeast of the city of New York limits and has an elevation of 13 feet mean sea level. The airport has four runways. Runway 4R/22L is grooved asphalt, and it is

8,400 feet long and 150 feet wide with precision markings.

FLIGHT RECORDERS

The airplane was equipped with a solid-state Honeywell SSFDR model 980-4700 FDR. The recorder was in good condition and the data were extracted from it normally.

The airplane was equipped with a solid-state Honeywell model 6022 2-hour CVR. The CVR was in good condition and the audio information was extracted from it normally. The overall quality of the recording was very poor with most inter-cockpit communication in Arabic and there were no conversations that were considered material to the accident. As a result, the recording was not transcribed.

ADDITIONAL INFORMATION

NOSE GEAR AND FUSELAGE LOADS

Boeing conducted a basic performance study of the FDR data to examine the airplane loads during landing. The peak nose gear load experienced during the landing was estimated based upon the possible combinations of normal load factor, pitch acceleration, airplane weight/center-of-gravity and lift. The nose gear load was estimated at 135,100 to 189,600 pounds. The nose gear design-limit load is 130,000 pounds.

PREVIOUS EVENTS

Three events with similar characteristics (firm landing followed by an abrupt nose down elevator) have occurred on 767-300 airplanes:

On January 16, 1992, an Asian Airlines Boeing 767-300 received substantial damage to the upper fuselage crown during landing on runway 24 at Jeju International Airport, Jeju Island, South Korea. At the time of the accident, the reported winds were 300 degrees at 22 to 24 knots.

On October 27, 1992, an American Airlines Boeing 767-300 received substantial damage to the upper fuselage crown during landing on runway 9L at Sao Paulo International Airport, Sao Paulo, Brazil. At the time of the accident, the reported winds were was 360 degrees at 17 knots.

On December 31, 1993, a LOT Boeing 767-300 received substantial damage to the upper fuselage crown during landing on runway 11 at Warsaw-Frederic Chopin International Airport, Warsaw, Poland. At the time of the accident, the reported winds were 220 degrees at 18 knots.

AIRPLANE MODIFICATIONS

Nose Gear Metering Pin

The 767-300 nose gear metering pin was further optimized to absorb the energy produced during over-derotation events, thereby lowering the load on the nose gear. The metering pin device controls the flow of hydraulic fluid within the nose gear oleo strut. The modified design was incorporated into production airplanes in August 1994 and is available for retrofit on earlier 767-300s. The accident airplane had this modification installed.

Forward Fuselage Structural Strengthening

The upper crown stringers on the forward fuselage of the 767-300 were strengthened in the area where buckling often occurred following over-derotation. The modified design was incorporated into production airplanes in January 1995. The accident airplane had this

modification installed (the estimated loads in the Boeing loads analysis took into account the improved structural capability of the fuselage).

Flight Crew Training Aid

Boeing produced a training video to increase flight crew awareness of the potential for both nose gear and airframe damage as a consequence of over-derotation. The nine-minute video serves as a refresher for flight crews and was sent to all Boeing airline customers. It is unknown whether the accident flight crew had viewed the video.

ROYAL AIR MAROC PROCEDURES

Below is a translation of pertinent parts from the RAM approved policy manual related to incident and accident handling procedures including the reporting requirements.

11.3 Notification and Communication

11.3.1 Notification:

All operational incident / accident and incidents / accidents related to dangerous goods shall be reported to the civil aviation authorities within the seventy two hours following such event.

The notifications are performed by the concerned operational entity. The flight crew must duly complete an Air Safety Report before the commencement of the next flight but not later than 48 hours after the arrival of the concerned flight. The handling and transmission of ASRs must be done without delay.

11.3.2 Communication:

Without a formal authorization from RAM, flight and cabin crew members and the other categories of personnel must not make any declaration nor give any document or information related to the event except to the following:

- Investigators mandated by the local civil aviation authorities

- Entitled investigation agencies

- Investigators mandated by justice.

- Local law enforcement representatives.

- Representative entitled or mandated by RAM.

Note: Outside Morocco, declarations to the local authorities must be performed according to the local regulation in force. This is under the responsibility of the Station Manager.

11.4. Handling of accidents.

Role of the captain or other flight crew in case the captain is not available:

- Protect the CVR & FDR

- Once the aircraft is stopped pull the disconnect the circuit breakers of FDR and CVR

- Immediately inform ATC and/or the local authorities by the most appropriate and rapid means

- Informs RAM headquarters through OWAT (refer to the contact list)

Role of the station manager, or his representative, is to inform RAM headquarters

NTSB REGULATIONS

Notification requirements described in 49 Code of Federal Regulations Part 830 state, in part:

§ 830.5 Immediate Notification

The operator of any civil aircraft…or any foreign aircraft shall immediately, and by the most expeditious means available, notify the nearest National Transportation Safety Board (Board) field office when:

(a) An aircraft accident or any of the following listed incidents occur:

(1)…(7)

(b) …

NTSB was notified of the accident on Thursday, April 23, 2010.

History of Flight

Landing-flare/touchdown	Hard landing (Defining event)

Pilot Information

Certificate:	Airline Transport	**Age:**	52, Male
Airplane Rating(s):	Multi-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane Multi-engine; Instrument Airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without Waivers/Limitations	**Last Medical Exam:**	11/20/2008
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	12/22/2008
Flight Time:	21754 hours (Total, all aircraft), 3288 hours (Total, this make and model), 126 hours (Last 90 days, all aircraft), 21 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Co-Pilot Information

Certificate:	Airline Transport	**Age:**	41, Male
Airplane Rating(s):	Multi-engine Land	**Seat Occupied:**	Center
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without Waivers/Limitations	**Last Medical Exam:**	01/21/2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	02/13/2009
Flight Time:	9621 hours (Total, all aircraft), 2149 hours (Total, this make and model), 137 hours (Last 90 days, all aircraft), 59 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	BOEING	**Registration:**	CN-RNT
Model/Series:	767 300	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Transport	**Serial Number:**	
Landing Gear Type:	Retractable - Tricycle	**Seats:**	
Date/Type of Last Inspection:	04/20/2009, Continuous Airworthiness	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	2 Turbo Fan
Airframe Total Time:	29543 Hours	**Engine Manufacturer:**	General Electric
ELT:	Installed, not activated	**Engine Model/Series:**	CF6-80C2B7F
Registered Owner:	SVERIGE AIRCRAFT LEASING WORLDWIDE A.B	**Rated Power:**	lbs
Operator:	ROYAL AIR MAROC	**Air Carrier Operating Certificate:**	Foreign Air Carrier (129)
Operator Does Business As:		**Operator Designator Code:**	RMRF

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	KJFK	**Observation Time:**	1851 UTC
Distance from Accident Site:		**Direction from Accident Site:**	
Lowest Cloud Condition:		**Temperature/Dew Point:**	7°C / 4°C
Lowest Ceiling:	Broken / 1800 ft agl	**Visibility**	5 Miles
Wind Speed/Gusts, Direction:	16 knots/ 24 knots, 60°	**Visibility (RVR):**	
Altimeter Setting:	30.07 inches Hg	**Visibility (RVV):**	
Precipitation and Obscuration:			
Departure Point:	CASABLANCA (GMMN)	**Type of Flight Plan Filed:**	IFR
Destination:	New York, NY (KJFK)	**Type of Clearance:**	IFR
Departure Time:	1046 UTC	**Type of Airspace:**	

Airport Information

Airport:	John F. Kennedy International (KJFK)	**Runway Surface Type:**	Asphalt
Airport Elevation:	13 ft	**Runway Surface Condition:**	Wet
Runway Used:	04R	**IFR Approach:**	ILS
Runway Length/Width:	8400 ft / 200 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	10 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	210 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	220 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	Joseph M Sedor	**Adopted Date:**	12/23/2010
Additional Participating Persons:	Tony James; FAA; Washington, DC Mark Smith; The Boeing Company; Renton, WA Mbarek Lfakir; Morocco AAIB		
Publish Date:	12/23/2010		
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report.