



Aviation Investigation Final Report

Location:	Reno, Nevada	Accident Number:	SEA08FA196
Date & Time:	September 6, 2008, 09:06 Local	Registration:	N102MB
Aircraft:	Debus J / Mountain S / Bowes E DEBUS-CASST-SNOSHOO	Aircraft Damage:	Substantial
Defining Event:	Aircraft structural failure	Injuries:	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

During an air race class qualification flight, the pilot was performing a series of maneuvers required to obtain a class license. During a required roll maneuver, as the airplane passed through about 90 to 120 degrees of roll at an estimated speed of 220 to 230 miles per hour, the right wing separated from the airframe, followed almost immediately by the left wing. The amateur built experimental airplane was fitted with an in-flight adjustable pitch trim system, which was a deviation from the original ground-only trim adjustment design. The trim system, designed by the airplane's builder, allowed the pilot to adjust the pitch trim by moving the horizontal stabilizer in flight. The in-flight system was composed of a lever attached to the fuselage structure, and its movement was restricted with friction washers between the fuselage and the lever. Full travel of the lever resulted in one inch of vertical movement of the horizontal stabilizer's leading edge. The manufacturer of the airframe kit stated that the trim system installed on the accident airplane was not of their design. They further stated that any movement of the horizontal stabilizer during an abrupt maneuver could produce an extremely high amount of G-forces and possibly exceed the structural design limits of the airplane. Post accident examination of the wreckage revealed no evidence of pre-existing anomalies with the airframe or flight control system. The wooden wing spar was tested and found to be of proper grade wood. No anomalies were noted with the spar material. The fracture surfaces of both the left and right wing forward wing spars were consistent with a "substantial upward force" and overload. It is unknown if the horizontal trim system was moved in-flight by commanded or uncommanded action. Amateur built airplanes with experimental certificates are not subject to the airworthiness standards in 14 CFR Parts 23 and 47 of the Federal Aviation Regulations, and builders and owners are free to make any modifications to the airplane at will.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The movement of the airplane's modified horizontal stabilizer trim system during an intentional high speed aerobatic maneuver that resulted in exceedence of the design stress limits of the airplane and an in-flight structural failure. Contrubuting to the accident was that the builder's deviation from the airplane designer's original trim system.

Findings

Aircraft	Spar (on wing) - Capability exceeded
Aircraft	Horizontal stabilizer - Not specified
Aircraft	(general) - Capability exceeded
Aircraft	Dynamic load - Capability exceeded
Personnel issues	Modification/alteration - Owner/builder

Factual Information

History of Flight

Maneuvering-aerobatics	Aircraft structural failure (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On September 6, 2008, about 0906 Pacific daylight time, an amateur-built Debus J/Mountain S/Bowes E Debus-Casst-Snoshoo experimental airplane, N102MB, was substantially damaged when it impacted terrain following an in-flight breakup while maneuvering at the Reno/Stead Airport (4SD), Reno, Nevada. The commercial pilot, the sole occupant of the airplane, was killed. The airplane was registered to Miss Lynn Racing LLC of Lincoln, Nebraska and operated by the pilot under the provisions of Title 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed and no flight plan was filed for the local personal flight that originated from 4SD about 10 minutes prior to the accident.

Information obtained from a Federal Aviation Administration (FAA) inspector revealed that the pilot was participating in an International Formula One (IF1) Pylon Air Race Class pilot qualification flight. The flight was intended to be composed of a series of maneuvers which included a 360-degree roll to the left, 360-degree roll to right, and a 180-degree roll to the left followed by a 180-degree roll to the right. These maneuvers were being observed by Formula One Class personnel located on the ramp of 4SD for the purposes of the pilot obtaining an IF1 Racing Pilot License.

Several IF1 personnel located on the ramp of 4SD reported observing the airplane depart from runway 8 and enter a normal climb into the demonstration area. The airplane was observed on an east to west heading parallel to runway 8 about 1,500 to 1,800 feet above ground level (agl), and the pilot performed a 360-degree roll to the left at an estimated airspeed in excess of 200 miles per hour. The witnesses stated that at the completion of this first roll, the airplane seemed to "bobble" and "pitch downwards" prior to abruptly leveling off. The witnesses added that it appeared the aileron roll was similar to an International Aerobatic Club (IAC) style slow roll and seemed uncoordinated. The witnesses estimated the roll rate was about 400-degrees per second.

The airplane made a climbing 360-degree turn to the left in order to setup for a second pass parallel to runway 8. The witnesses further reported that the airplane exited the 360-degree turn, leveled off, pitched downwards in order to gain airspeed, leveled off, and proceeded to enter a roll to the right at an estimated airspeed in excess of 200 miles per hour (MPH) with no pitch changes noted. Two witnesses estimated the airspeed from 220 mph to 240 mph. As the airplane rolled through about 90 to 120 degrees, witnesses stated the right wing separated

from the airframe followed by the left wing separating shortly after. Subsequently, the airplane impacted terrain and came to rest on its left side west of runway 32/14 and north of runway 26/08.

One witness stated that prior to the accident flight; the pilot had briefed him that she intended on performing all three rolls during the same pass. Another witness stated that he was "surprised" when the pilot did not complete all three rolls on the initial pass.

PERSONNEL INFORMATION

The 32 year old pilot held an airline transport pilot certificate with airplane multi-engine land rating, a commercial pilot certificate with airplane single-engine land and glider ratings, and a private pilot certificate with an airplane single-engine sea rating. In addition, the pilot possessed type ratings in the BE-1900, CE-525, and CE-560XL aircraft. A first-class airman medical certificate was issued on April 4, 2008 with the limitation "must wear corrective lenses." The pilot's flight logbooks were not located during the investigation.

The pilot reported on her 2008 National Championship Air Races entry form that she had accumulated in excess of 7,000 hours of flight time, of which 100 hours were in the previous 90 days. A family member of the pilot reported that she had accumulated about 4 hours in the accident make/model airplane. Logbook entries within the aircraft maintenance logbook indicated that the pilot had logged 3.5 hours of flight time in the accident airplane as of July 19, 2008. According to an FAA inspector, the pilot had conducted a flight on September 5, 2008 that was about 0.5 hours in length.

AIRCRAFT INFORMATION

The single seat, mid-wing, fixed-gear, amateur-built experimental airplane, serial number (S/N) DMB-001, was powered by an experimental Continental O-200-A engine. Review of the aircraft logbooks indicated that the airplane was originally built and completed in July 2002 in accordance to Cassutt plans and Snoshoo SR-1 plans and subsequently issued an airworthiness certificate on August 8, 2002. A logbook entry dated May 29, 2005, stated in part "1st heat 2 of 3 laps, pulled out of race, crash, aircraft destroyed" at a total airframe time of 91.8 hours. A logbook entry dated July 2, 2008, stated in part "rebuild N201MB, serial # DMB-001, as follows: replace fuselage truss with stock Cassutt truss. Empennage replaced with stock Cassutt empennage, replaced Snoshoo SR-1 wing with Cassutt 111M wing, replace ST-1 engine cowl with stock Cassutt Cowl. Rebuilt turtle deck and canopy deck. Replace Experimental Continental O-200 engine, replaced Twisted Composites propeller, rebuilt motor mount."

An additional logbook entry dated July 5, 2008, stated in part "flight operations will be conducted VFR day only, inflight test area for a minimum of 5 hours to re-establish compliance with FAR 91.319 (b)." The entry was followed by an additional logbook entry on July 9, 2008 stating in part "...this aircraft has been inspected in accordance with the scope and detail of

Appendix 'D' of Part 41 and found to be in condition for safe operation."

According to the builder of the accident airplane, a complete rebuild of the airplane was completed in the spring of 2008. He stated that the original registered airplane was comprised of a Cassutt fuselage with Snoshoo wings and was substantially damaged during an accident in 2005. The accident airplane was rebuilt using a new Cassutt fuselage and empennage. The wing was built using Cassutt design plans.

The Cassutt is an IF1 race airplane. The accident airplane had a tube and fabric fuselage. The fuselage was a tubular steel truss structure that tapered in the cross-section toward the aft end of the airplane. The one-piece wing was of a twin spar configuration and manufactured with wood spars, ribs and skins. The ailerons extended the full length along the trailing edge of each wing. The forward wing spar was made of laminated spruce and extended from wingtip to wingtip. The spruce rear spars extended from the fuselage attach fitting to the wingtip on each side. When installed, the forward spar sits on top of the fuselage truss structure at the forward end of the cockpit and is fastened to the fuselage with two vertical tension bolts and a cap plate on each side. The inboard end of each rear spar had a metal clevis fitting that attached to the fuselage lug with a longitudinal bolt.

The vertical stabilizer, rudder, horizontal stabilizer, and elevator were fiberglass covered foam core structures with tubular steel internal frames. The horizontal stabilizer had a twin tube forward spar and a single tube rear spar. The horizontal stabilizer and elevator were one-piece units. The horizontal stabilizer on the accident airplane was designed to be trimmable in flight and attached to the fuselage truss at the rear spar through a lateral pivot pin. The forward spar was attached to the fuselage frame through two vertical bolts and allowed to move up and down a total of about 1 inch.

The horizontal stabilizer trim was controlled with a lever installed on the left side of the cockpit (All of the directions in the following are referenced while viewing the control system from the left side of the airplane). The lever was attached to the outboard side of one of the fuselage tubes with a bolt. A friction washer was installed between the tube and the lever. Two control cables were attached to the lever, one above the attach point and one below. A placard in the cockpit indicated that nose down trim was accomplished with the lever in the forward position. The control cable attached to the lever above the pivot point traversed aft through the fuselage, around a pulley installed at the aft end of the fuselage, and attached to the aft side of a bell crank installed below the horizontal stabilizer forward spar. The control cable attached to the lever below the pivot point traversed aft through the fuselage and attached to the forward side of the bell crank. The bell crank had one arm with two legs pointed down and attached to the control cables and another two arms pointed up and aft and attached to the forward spar of the horizontal stabilizer.

Forward movement of the lever pulled the aft side of the bell crank which resulted in a counter-clockwise rotation of the bell crank and upward movement of the forward spar. Aft movement of the lever pulled the forward side of the bell crank causing a clockwise rotation of the bell

crank and downward movement of the forward spar. The forward spar translated up and down along two pins installed in a fuselage cross tube. From top to bottom, the pins were arranged with a castellated nut and cotter pin, a stack of 4 washers, the forward spar, a 1-inch stop bushing, a washer, a jam nut, the fuselage cross tube, a washer, and a castellated nut and cotter pin. The upper cotter pin and the washer between the bushing and jam nut were not installed on the left pin. Upward movement of the forward spar was limited by the forward spar contacting the 4-washer stack and downward movement was limited by the forward spar contacting the upper side of the bushing.

METEOROLOGICAL INFORMATION

Recorded data from the Reno/Tahoe International Airport's automated surface observation station, located about 11 miles southeast of the accident site indicated that at 0855 weather conditions were wind calm, visibility 10 statute miles, clear sky, temperature 18 degrees Celsius, dew point 1 degree Celsius, and an altimeter setting of 30.14 inches of Mercury.

WRECKAGE AND IMPACT INFORMATION

Examination of the accident site by an FAA inspector revealed that the airplane impacted terrain and came to rest on its left side near runway 32/14 and north of runway 08. The horizontal stabilizer, elevator, vertical stabilizer, and rudder remained attached to their respective attach points. The right wing was located about 2,159 feet west of the main wreckage and the left wing was located about 1,838 feet west of the main wreckage, both remaining north of runway 08. The wreckage was recovered to a secure location for further examination.

MEDICAL AND PATHOLOGICAL INFORMATION

The Washoe County Medical Examiner's office conducted an autopsy on the pilot on September 8, 2008. The medical examiner determined that the cause of death was "multiple injuries due to blunt force trauma."

The FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City, Oklahoma, performed toxicology tests on the pilot. According to CAMI's report, carbon monoxide, cyanide, volatiles, and drugs were tested, and had negative results.

TESTS AND RESEARCH

Examination of the recovered wreckage by NTSB investigators revealed that the forward wing spar was fractured in two places, each about 3-4 inches outboard of the fuselage attach point. Both fractures were similar in appearance. The lower three-quarters of the fractures exhibited a splintered appearance with the individual wood fibers fractured at different spanwise locations. The upper one quarter of the fracture surfaces appeared to be flatter with the individual wood fibers all fractured within about 1 inch (spanwise) of each other. The center

area of the forward wing spar remained positioned on top of the fuselage truss structure at the forward end of the cockpit. The center spar area remained fastened to the fuselage with two vertical tension bolts and a cap plate on the left side. The right forward tension bolt was fractured and separated from the cap plate and located at the accident site. The fracture surface of the bolt displayed features consistent with overload. The right side of the center section of the forward wing spar, right cap plate, and right side of the instrument panel were displaced aft and upward.

The plywood upper wing skin was deformed upwards adjacent to the wing spar fractures on both wings. The left wing remained intact with little damage. The aft inboard corner of the left aileron was deformed downward. The upper surface of the left wing was intact with the exception of a small area forward of the aileron and adjacent to the inboard end. The bottom side of the left wing skin was intact with the exception of a 3 to 4 inch hole just forward of the main spar about 3 inches outboard from the wing root.

The right wing tip and about half of the right aileron were separated from the wing. A large section of the lower skin comprising about a third of the area was separated from the right wing between the forward and rear spars that extended to about the mid span point. The separated skin exhibited inter-layer separation with little adhesive bond failure at the rib locations. About a fifth of the right aileron and torque tube remained attached to the aileron control torque tube assembly at the side of the fuselage.

The right side of the fuselage was intact with minimal damage. The right side of the turtle back aft of the canopy and the right nacelle was separated along the fastener lines. The left side of the fuselage exhibited impact damage along its entire length and the wood spacers between the truss tubes and fabric skin were fractured with fragments found in the fuselage. Two vertical truss members, one on each side, forward of the horizontal stabilizer exhibited inward buckling deformation that was not coincident with any external impact damage. The aft end of the fuselage was deformed clockwise as viewed looking forward. The right main landing gear was deformed inboard and the left main landing gear was intact.

The empennage and control surfaces all remained attached to the airplane. The left horizontal stabilizer and elevator exhibited damage to the tips. The right horizontal stabilizer and elevator were intact. The horizontal stabilizer and elevator assembly was deformed coincident with the clockwise rotation of the rear fuselage. The horizontal stabilizer forward spar was fractured just inboard of the left pin and the rear spar and elevator were fractured adjacent to the right fuselage tube. Both horizontal stabilizer translation pins were fractured between the jam nut and fuselage tube and deformed to the right. The horizontal stabilizer pivot pin was fractured adjacent to the right fuselage tube.

The upper arms of the bell crank were deformed to the right and the right arm exhibited circular deformation consistent with the fuselage tube. The two legs of the lower bell crank arm were deformed with no definitive direction. The vertical stabilizer remained attached to the fuselage and was deformed to the left. The rudder remained attached and was deformed such

that the lower portion was in line with the aft fuselage and the upper portion was in line with the vertical stabilizer. The horizontal stabilizer trim lever was in the full forward position and was locked in place by the fuselage damage. The lever could be moved and the control system was intact to the horizontal stabilizer.

The inboard portions of the left and right wing forward wing spar and center section of the forward wing spar were sent to the United States Department of Agriculture (USDA) Forest Products Laboratory, Madison, Wisconsin, for further examination.

On March 5, 2009, the forward spar was examined by engineers at the USDA Forest Products Laboratory under the supervision of NTSB personnel. The examination revealed that the cellular structure of the wing spar was that of Sitka Spruce and exhibited no evidence of decay. The fracture surface of the inboard side of the right forward wing spar exhibited compression signatures at the top of the fracture and tension signatures on the bottom area of the fracture. The failure surface of the left spar was less symmetrical about the horizontal axis of the spar. The fracture surfaces of both the left and right wing forward wing spars were consistent with a "substantial upward force."

ADDITIONAL INFORMATION

Interviews with the IF1 class president and other air racers revealed that they had never seen a Cassutt, or any other IF1 airplane, with a trimmable horizontal stabilizer. An IF1 Cassutt airplane, Race 66, was examined by representatives from the NTSB on September 13, 2008. The airplane was essentially a stock Cassutt with no major modifications. The horizontal stabilizer of this airplane was a tubular steel structure with a twin tube forward spar and single tube rear spar. There were two tube ribs equally spaced along the span and the entire assembly was dope and fabric covered. The stock Cassutt horizontal stabilizer did not have a foam core. The elevator was a foam core tubular steel structure with a fabric covering. The dimensions of the horizontal stabilizer and elevator were the same between the stock Cassutt and the accident airplane. The horizontal stabilizer was attached to the fuselage with 4 bolts, 2 each on the forward and rear spars. The horizontal stabilizer was trimmable on the ground by the addition or removal of washers between the forward spar and fuselage cross tube. Typically, an operator will try different numbers of washers to attain the best possible trim for the weight and center-of-gravity (CG) conditions normally encountered during racing. Once set, the trim is usually not changed unless there are major changes to the weight or CG.

During a telephone interview, a representative of National Aeronautics Company, Arvada, Colorado, who produces the Cassutt kit, stated that there is no published maneuvering speed or never exceed speed for the Cassutt. The representative estimated that if they were to place a maneuvering speed on the airplane, it would be around 200 miles per hour.

The representative further stated they felt that the trim system which was installed in the accident airplane was not of their design and that "any movement of the horizontal stabilizer during an abrupt maneuver could produce an extremely high amount of G-forces and possibly

exceed the structural design limits of the airplane." They also felt that full deflection of the elevator itself could not impose loads that would exceed the design limits of the wing.

In further conversation, the representative stated that he believes the horizontal stabilizer should be securely mounted to the airframe and not movable. In their opinion, if a trim system was to be installed in the Cassutt, "it should be a trim tab and not a moveable horizontal stabilizer."

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	Age:	32,Female
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	Seat Occupied:	Center
Other Aircraft Rating(s):	Glider	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Glider; Instrument airplane	Toxicology Performed:	Yes
Medical Certification:	Class 1 With waivers/limitations	Last FAA Medical Exam:	April 4, 2008
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	
Flight Time:	7000 hours (Total, all aircraft), 4 hours (Total, this make and model), 100 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Debus J / Mountain S / Bowes E	Registration:	N102MB
Model/Series:	DEBUS-CASST-SNOSH00	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	Yes
Airworthiness Certificate:	Experimental (Special)	Serial Number:	DMB-001
Landing Gear Type:	Tailwheel	Seats:	1
Date/Type of Last Inspection:	July 9, 2008 Continuous airworthiness	Certified Max Gross Wt.:	
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:	911 Hrs as of last inspection	Engine Manufacturer:	Continental
ELT:	Not installed	Engine Model/Series:	O-200-A
Registered Owner:	Miss Lynn Racing LLC	Rated Power:	100 Horsepower
Operator:	Erica Simpson	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	RNO,5050 ft msl	Distance from Accident Site:	12 Nautical Miles
Observation Time:	08:55 Local	Direction from Accident Site:	154°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	/	Turbulence Type Forecast/Actual:	/
Wind Direction:		Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.13 inches Hg	Temperature/Dew Point:	18°C / 1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Reno, NV (4SD)	Type of Flight Plan Filed:	None
Destination:		Type of Clearance:	None
Departure Time:	08:56 Local	Type of Airspace:	Unknown

Airport Information

Airport:	Reno/Stead Airport 4SD	Runway Surface Type:	
Airport Elevation:	5050 ft msl	Runway Surface Condition:	
Runway Used:		IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Substantial
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Fatal	Latitude, Longitude:	39.667221,-119.876113(est)

Administrative Information

Investigator In Charge (IIC):	Cawthra, Joshua
Additional Participating Persons:	William C Kunder; Federal Aviation Administration; Reno, NV Clint Crookshanks; National Transportation Safety Board; Denver, CO
Original Publish Date:	September 30, 2009
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=68890

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The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).