NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, DC 20594

January 10, 1997

STRUCTURES GROUP - EMPENNAGE FACTUAL SUMMARY

ACCIDENT	:	**DCA96MA070**
Location	:	**East Moriches, New York**
Date	:	**July 17, 1996**
Time	:	**2031 Eastern Daylight Time**
Airplane	:	**Boeing 747-131, N93119**
		Operated as Trans World Airlines (TWA) Flight 800

GROUP

	Name/Organization
Chairman	**Deepak Joshi** **NTSB** **Washington, DC**
Member	for **Rob Harrower** **Boeing Commercial Airplane Group** **Seattle, WA**
	Other Boeing Members **Steve Chisholm** **Roy Hurlbut** **Bob Whittington**
Member	for **Ray Stettner** ALPA Coordinator **Air Line Pilots Association (ALPA)** **Herndon, VA**
Member	**Dennis Santiago** IAM 1/10/97 **International Association of Machinists (IAM)** **JFK Intl Airport, NY**
Member	**Dan Rehplo** TWA Structures 1-10-97 **Trans World Airlines (TWA)** **Kansas City, MO**
Member	**Tom Todino** FAA 1-10-97 **Federal Aviation Administration** **Garden City, NY**

1.0 EMPENNAGE

The horizontal and vertical stabilizers, elevators, and rudders fractured into numerous sections. These sections were found either floating or in the Green debris area.

Following are the acronyms used in this report:

Stab STA	Stabilizer Station
LBL/RBL	Left/Right Buttock Line
WL	Water Line
LHS/RHS	Left/Right Side

1.1 Horizontal Stabilizer

The horizontal stabilizer fractured in six large sections and numerous smaller sections. These sections were assembled on the hangar floor to document the damage and determine the mode of failure. All the fracture surfaces were examined and there was no evidence of any pre-existing cracking or corrosion. The fracture surfaces of the left (at approximately Stab STA 210) and right (at approx. Stab STA 335)sides of the horizontal stabilizer exhibit evidence of compression and tension type fractures on the upper and lower skins, respectively. The leading edge was severely damaged. Some of the items found in the horizontal stabilizer are sections of seat track, a turbine blade, and glitter.

1.1.1 Right Horizontal Stabilizer

The right horizontal stabilizer inboard section remained attached to the horizontal stabilizer center torque box (H-1). The outboard fracture of this section was located near Stabilizer Station (Stab STA) 360, approximately. The upper skin in this area exhibited evidence of slight buckling. A few of the lower skin stiffeners are bent in the forward direction. The rear spar remained attached to this section from the torque box to Stab STA 285 and exhibited bending in aft direction at STA 285. The leading edge from the inboard end to Stab STA 235 was damaged. The remaining leading edge ribs inboard of Stab STA 153 are bent inboard and the leading edge ribs between Stab STA 196 to 235 approximately are bent outboard. About 50 inches of the leading edge outboard of Stabilizer STA 235 remained attached.

The outboard section of the right Horizontal Stabilizer (H-3), from Stab STA 310 to the tip, remained in one section. The rear spar at the inboard end was bent aft. The front spar just inboard of the Stab STA 385 was bent forward. The leading edge from the tip to Stab STA 385 remained attached to this section. The leading edge exhibited numerous dents along its length and was crushed aft at the inboard end for about 8 inches in length. The outboard-most 12 inches of the leading edge was crushed aft and outboard. This area exhibited black rub marks on the leading edge skin in the lateral direction. An engine turbine blade penetrated the upper honeycomb surface near the outboard trailing edge.

The leading edge section (H-6) between H-1 and H-3 is comprised of leading edge skin and ribs. The ribs fractured and separated from the front spar. In general, the aft ends of the rib webs were bent slightly outboard. The bull nose skin was dented along its length.

The inboard nose section (H-7) of the right Horizontal Stabilizer included the leading edge to the auxiliary spar. The lower skin surface was torn and bent down and forward.

A section of the structure outboard of H-7 exhibited evidence of red paint transfer marks on the upper skin (H-8); only the remnants of the shattered logo light window remain in the window frame.

1.1.2 Center Torque Box

The torque box remained intact but had a few puncture holes on the upper skin. The rear spar of the torque box suffered no impact damage. When viewed from the rear, the RHS and the LHS stabilizer hinge fitting lugs were rotated approximately 10 and 5 degrees counterclockwise, respectively. The front spar web of the torque box between LBL 14.5 and RBL 14.5 was torn and bent forward. Along the front spar, the RHS of the torque box is displaced slightly upwards relative to the LHS.

The Jack screw extends above the Jack screw fitting by ten threads and is fractured at the bottom of the fitting. There was minor deformation observed on the support frames of the screw jack, the LHS upper support has an 1/8 inch gap between support frames.

1.1.3 Left Horizontal Stabilizer

The left Horizontal Stabilizer fractured into three large sections and numerous smaller sections. These sections were found in the Green debris area.

The aft portion of the left Horizontal Stabilizer from the torque box left side to Stab STA 187 (approx.) remained attached to the torque box. This section comprised the upper and lower skins and a 3-foot section of the rear spar. The upper and lower skins were bent up. The stringers from the lower skin were bent up and aft. The upper skin stringers remained attached to the skin and were bent up. The rear spar section remained attached to the torque box and was bent aft. There are local soot deposits on the exterior and interior surfaces of the upper stringers and skin.

A large inboard section of the leading edge of the horizontal stabilizer (H-5) included a section of the front spar from Stab STA 143.60 to leading edge STA 233 (approximately). The front spar web was bent slightly aft at the lower corner near the root; no deformation of the outboard end was observed. Just forward of the front spar, outboard end, the upper skin was torn and two pieces were bent up approximately 60 and 180 degrees, respectively.

Another section of inboard left Horizontal Stabilizer (H-4) comprised an area from Stab STA

198 to 271 and included a 5-foot section of rear spar, a small section of the upper skin, and a section of left elevator (LE-1A). The inboard portion of the rear spar section, from Stab STA 235 to 37 inches inboard, was bent aft approximately 20 degrees from the spar reference line. The outboard portion of the rear spar, from Stab STA 260 to 11 inches outboard, was curled aft approximately 45 degrees.

The outboard portion of the left Horizontal Stabilizer comprised the area from Stab STA 230 to the stabilizer tip. The upper and lower skins remained attached to the front and rear spar on (H-2A). The lower skin and the stringers at the inboard end are bent up at Stab STA 230 to 285. The corresponding upper stringers near the rear spar are bent forwards. The rear spar remained intact from the tip to Stab STA 275. The front spar remained intact from the tip to Stab STA 347 and exhibit slight aft bending at the bottom of the spar web. The leading edge remained attached to the front spar from Stab STA 372 to stabilizer tip. The outboard and inboard ends of the leading edge upper surface from Stab STA 372 to 390 and from STA 460 to tip were torn in numerous locations and directions. The leading edge bull nose was crushed aft from STA 525 to 560 and the inboard end exhibited evidence of witness marks in the lateral direction. There were numerous punctures on the upper skin surface.

1.2 Elevators

In general, all the elevators separated from the horizontal stabilizer at the hinges, while the hinges themselves remained attached to the stabilizer structure. The only place where the elevators remained attached to the stabilizer were at locations common to the actuator fittings (LE-1A, LE-2B, and H-1-right inboard actuator). On the LE-2B segment, the elevator was severely deformed. It remains in the upward direction relative to the stabilizer. At the hinge locations, the elevators leading edge upper skin was deformed up and aft, while the lower skin remained intact, except for LE-1A.

On both the left and right outboard elevators inboard of Elevator STA 356, the counterbalance weight structure is deformed or missing. Predominately, this structure is bent in the upwards direction. At these same locations the stabilzer lower panels between the hinge line and the stabilizer rear spar are missing. Outboard of Elev STA 356 the counter balance weight structure is bent upwards and the stabilizer panels between the hinge line and the rear spar remain with the stabilizer.

1.2.1 Right Elevator

The right, outboard elevator fractured into four large sections and two smaller sections. All of these sections were found floating. The outboard section (RE-2F) exhibited evidence of fire damage and soot on the upper skin outboard end. The RE-2E part exhibited evidence of slight fire damage and soot.

Only one section of the right inboard elevator (RE-1) was recovered and identified. This section is the inboard portion and exhibits evidence of fire damage on the honeycomb structure.

1.2.2 Left Elevator

The left outboard elevator fractured into three main sections and one small section. Two of these sections were found floating in the ocean, the third was attached to part H-2A. On the LHS elevators identified there was only minor sooting and no evidence of fire damage.

Only two large pieces of the left inboard elevator were identified/recovered. There is little evidence of soot or fire damage. One large section (LE-1A) remained attached to the left horizontal stabilizer section (H-4) and was found in the Green debris area. The other section was found floating.

1.3 Vertical Stabilizer

The vertical stabilizer forward of the front spar to the leading edge fractured into two large sections (upper and lower) and several smaller pieces in between. The upper section comprised the area from Fin STA 370 to Fin STA 582.65 and from the leading edge to the front spar (V-1). The front spar chords were fractured near Fin STA 370 and exhibited no lateral deformation. Some of the ribs extending aft from the front spar exhibited downward bending. The front spar web is torn and pushed forward below Fin STA 560 and aft above Fin STA 560. There is no evidence of damage to the leading edge except at Fin STA 370 and 570, where the leading edge skin was torn and bent.

The lower forward section (V-2) comprised the area from Fin Waterline (WL) 2.92 to Fin STA 220 and from the leading edge to the front spar. The right side of the front spar cap was bent slightly outboard at WL 2.92. There are two locations on the LHS skin along two Fin Station ribs where the panels are bowed outboard. The leading edge is crushed aft at numerous locations. A 14-inch leading edge section near fin STA 220 was crushed downward. About half of the front spar web was torn from the left and right spar chords and pushed forward.

The vertical stabilizer structure between the front and rear spars fractured into numerous sections. The right body fittings from the rear spar to stringer 9 of the vertical fin, separated with the right skin and stringers remaining attached (V-9). The right skin was bent outboard at the upper ends. Remnants of the body bulkheads were still attached below the body fittings and were were bent aft. Vertical skin panel V-8, which mates with V-9, was relatively flat except for slight bending outboard of the upper 10 inches of the panel. The left body fitting for the vertical fin separated, with the left skin and stringers remaining (V-6). The left skin and stringer panel (V-5), which mates with V-6, is relatively flat. The V-4 part consists of the upper vertical fin left skin panel and stringers between the front and rear spars from Fin STA 370 to 520. The lower panels (V-5, V-6, V-8, and V-9) exhibit an outward deformation at the lower fractured end, relative to the vertical fin surface.

1.4 Rudder

Four upper rudder segments and one lower rudder segment were identified. All were found in the Green debris area or floating.

Segment R-1 comprised the upper rudder from Rudder STA 332 to the top and from the leading edge to the trailing edge. The outer skins had some punctures and minor surface abrasions. The leading edge seal shroud below the hinge exhibited impact damage.

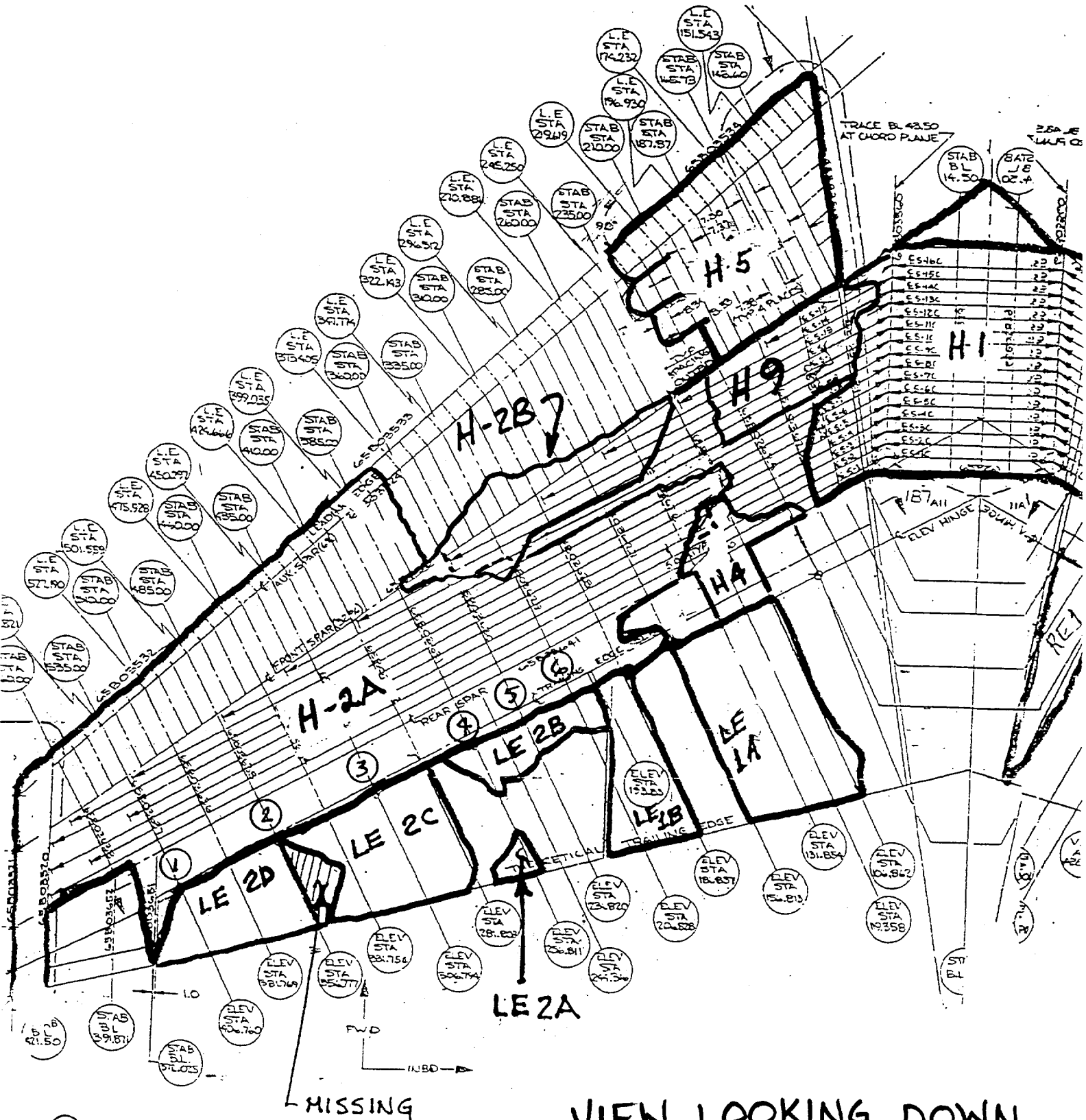
Segment R-2 comprised the upper rudder from Rudder STA 257 to 332.437 and from the leading edge to the trailing edge. The hinge fitting had minor impact damage and the hinge bolt remained attached to the hinge fitting. The outer skins had some minor punctures and surface abrasions and the right outer skin had a diagonal tear approximately 3 inches wide by 24 inches long. The leading edge seal shroud exhibited impact damage.

Segment R-3 comprised the upper rudder from Rudder STA 147.722 to 207.615 and from the leading edge to the trailing edge. The front spar had numerous areas of cracking and impact related damage. The leading edge seal shroud had a large amount of impact damage. The hinge fitting had negligible damage with the pivot bolt remaining. The outer skins are cracked.

Segment R-4 comprised a portion of the lower rudder from Rudder STA 82.792 to 107.757 and approximately 82 inches forward of the trailing edge. Portions of ribs at Rudder Stas 82.792 and 95.275 remained attached. The outer skins exhibited cracking, punctures, and minor surface abrasions, and a portion of the left skin was missing.

Segment R-5 comprised the upper rudder from rudder STA 182.651 to 232.579 and from leading edge to trailing edge. The rudder actuator assembly and the vertical stabilizer attach fittings remained attached to the front spar. The upper and lower rudder hinge fittings remained attached. The upper vertical stabilizer hinge fitting failed approximately four inches from the pivot, and the lower vertical stabilizer hinge fitting right half remained attached to the rudder but not to the vertical stabilizer. Outer skin panels have cracking, punctures, and minor surface abrasions.

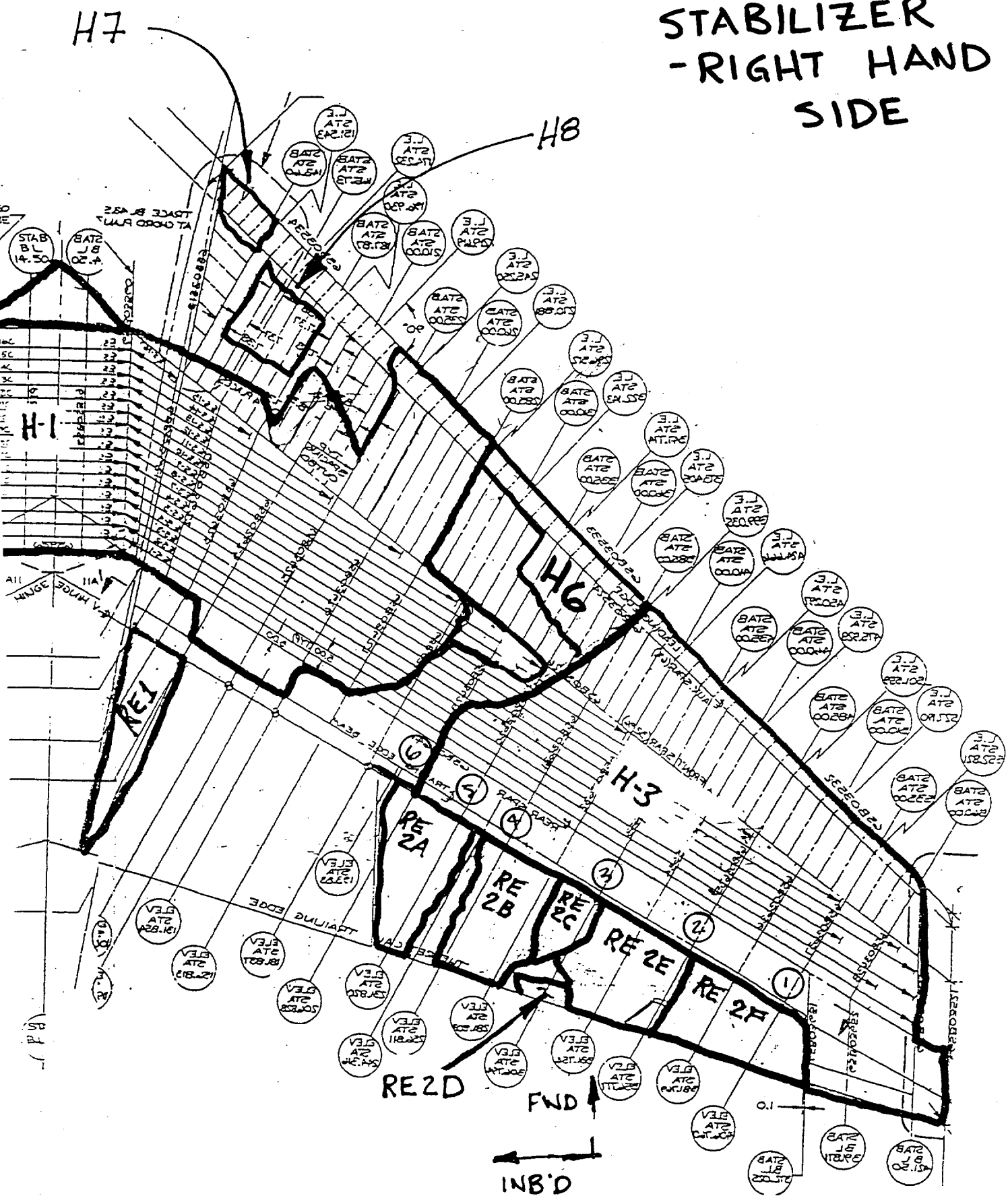
HORIZONTAL STABILIZER LEFT HAND SIDE



(X) = HINGE NO.

VIEW LOOKING DOWN

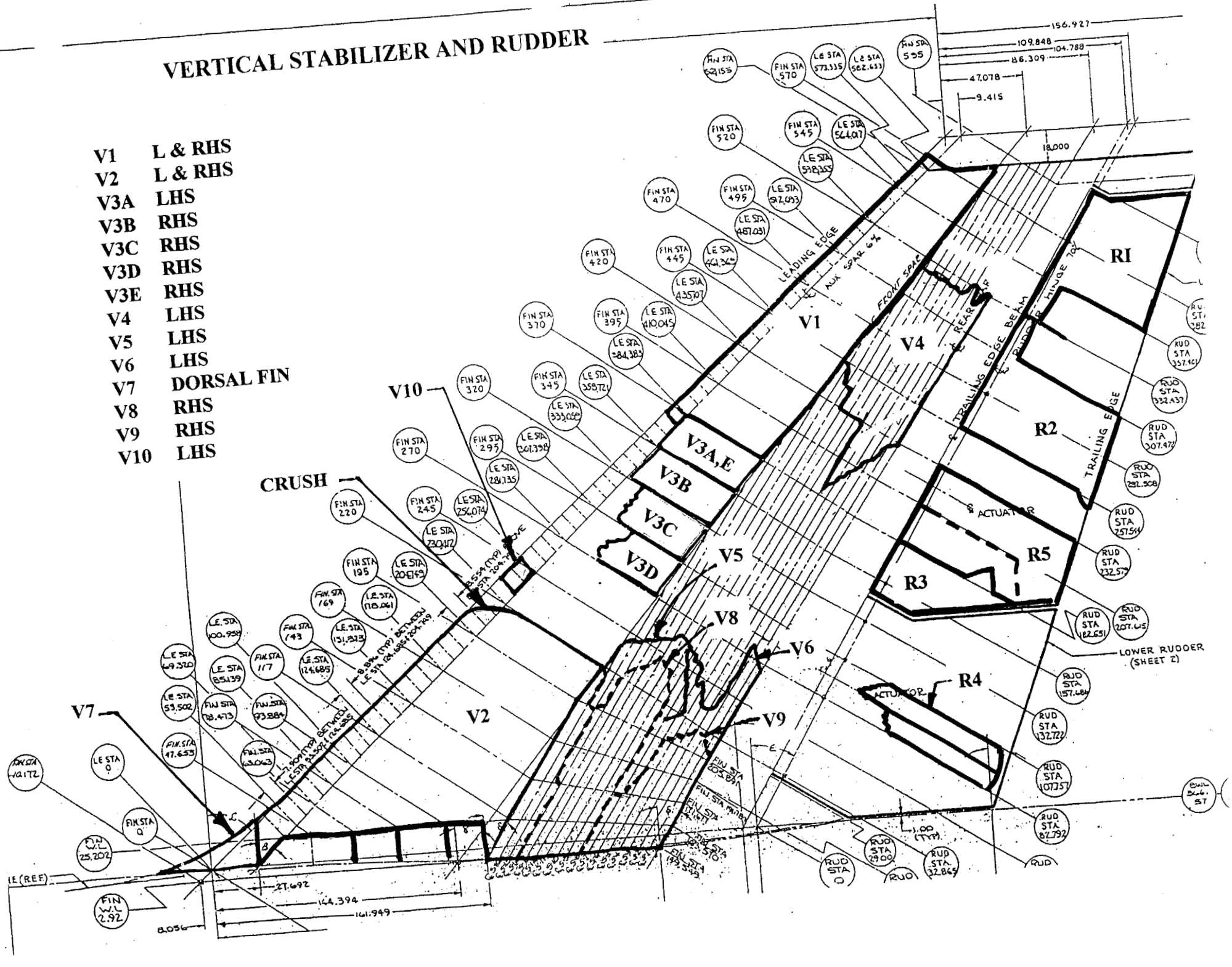
HORIZONTAL STABILIZER - RIGHT HAND SIDE



VIEW LOOKING DOWN

(X) = HINGE NO.

VERTICAL STABILIZER AND RUDDER



Fin/Body Attachment