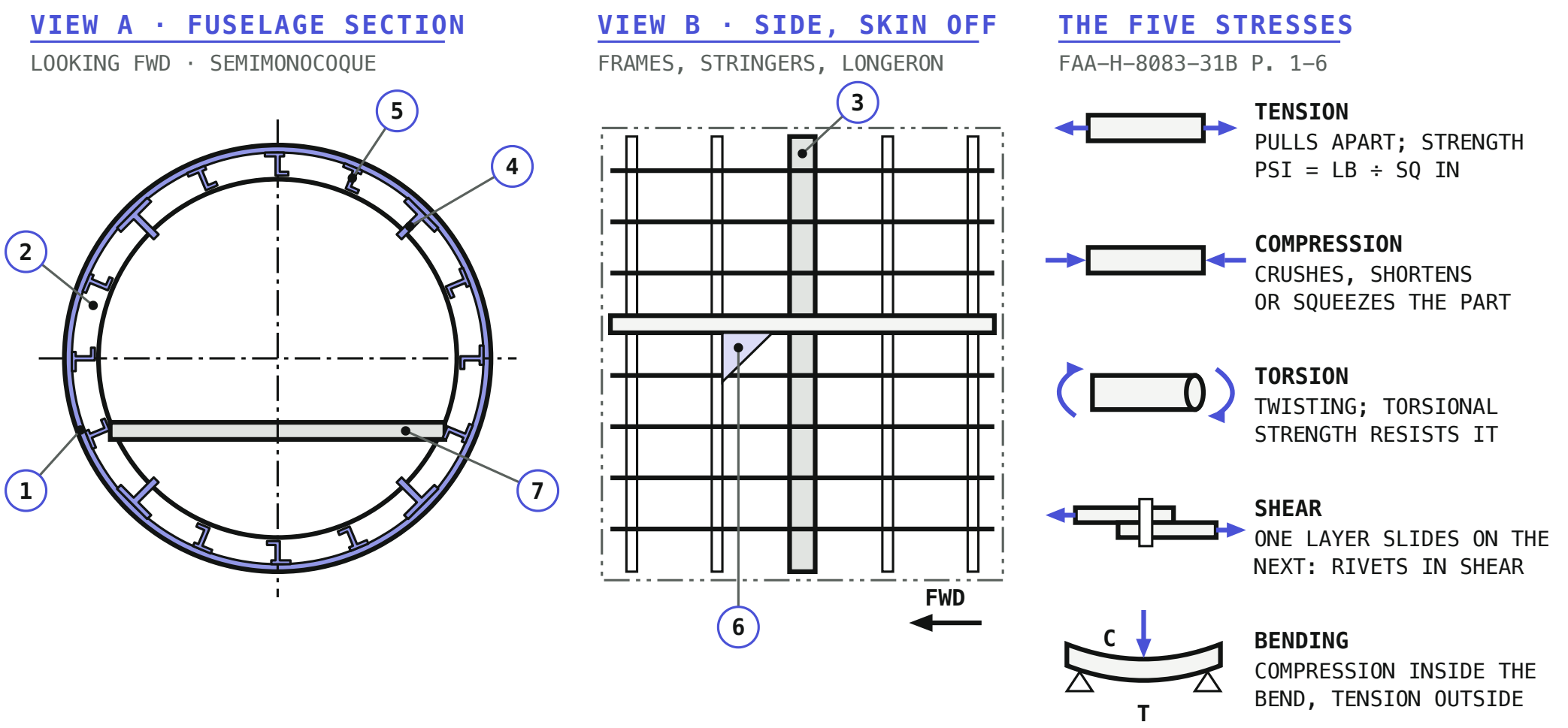
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Airframe Structures: How the Load Goes, and Why the Repair Must Keep It

Members · stresses · classification · safe-life, fail-safe, damage tolerance · aging programs · symmetry

1 Identification

REFERENCE DRAWING — NOT APPROVED DATA · THE SRM ALWAYS GOVERNS



#	MEMBER	WHAT IT DOES	31B
1	SKIN	CARRIES PART OF THE FLIGHT AND GROUND LOADS; ITS THICKNESS FOLLOWS THE LOAD	PP. 1–9, 1–16
2	FRAME, FORMER, RING	GIVES THE SHAPE; THE HEAVIEST WHERE CONCENTRATED LOADS COME IN	PP. 1–7, 1–8
3	BULKHEAD	SHAPE AND CONCENTRATED LOADS, LIKE THE HEAVIEST FRAMES	PP. 1–7, 1–15
4	LONGERON	RUNS ACROSS SEVERAL FRAMES; HELPS THE SKIN CARRY PRIMARY BENDING	P. 1–8
5	STRINGER	LIGHTER AND MORE NUMEROUS; GIVES SHAPE AND HOLDS THE SKIN	P. 1–8
6	GUSSET	CONNECTING BRACKET THAT ADDS STRENGTH AT A JUNCTION	PP. 1–8, 1–9
7	FLOOR BEAM	— LOADS AND LIMITS ARE IN THE AIRCRAFT SRM	P. 7–1

NOTES

1. Inches; [ ] = millimeters, reference only. Typical: the SRM governs.
2. For reference. The applicable manual always governs.
3. Based on FAA-H-8083-31B ch. 1 and p. 7-1.

REVISIONS

REV	DESCRIPTION	YEAR
A	First issue	2026

The Aviation Point.	Structural repair reference		
TITLE: Structures concepts: members			
DRAWING NO.: TAP-DWG-SC02	REV: A · 2026	SCALE: NTS	SHEET: 1 OF 1
APPLIES TO: Semimonocoque airframes in general			
DO NOT SCALE DRAWING			

No single piece is failure critical in a semimonocoque structure: skin, frames, longerons and stringers share the load, so a repair restores the member it cuts and the path that member carried.

Structural classification

Class	Meaning
Primary structure; principal structural element (PSE)	Contributes significantly to carrying flight, ground or pressurization loads. The certification evaluation identifies the elements whose failure could be catastrophic. Example: highly loaded skins and the understructure
Secondary structure	Carries less load. The example given is fairings, whose cracks go to the maintenance officer for appraisal; cowlings and fairings need shape more than strength
Tertiary structure	—: named in the Part-66 syllabus, not defined in the documents used here. The aircraft SRM gives the class of each part
Single load path	The load goes through one member
Multiple load path	The load is spread through redundant members

Educational reference only, not approved data. Always consult the applicable SRM, AMM, or AC 43.13-1B and your certifying authority.

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Safe-life, fail-safe, damage tolerance

Concept	Meaning
Safe-life	A number of flights, landings or hours during which there is a low probability that fatigue cracking takes the strength below design. The part must reach it without detectable cracks, with scatter factors. Used where damage tolerance is impractical
Fail-safe	After the failure or partial failure of one PSE the structure keeps its required residual strength for a period of unrepaired use. Example: a spar made of two spliced halves; if one breaks, the other carries the load
Damage tolerance	The structure keeps its required residual strength with fatigue, corrosion or accidental damage present, until an inspection finds it. Those inspections go into the Airworthiness Limitations section
Widespread fatigue damage (WFD)	Cracks at many details at once, big and dense enough that the structure no longer meets its residual strength. MSD: in the same element; MED: in adjacent elements
Limit of validity (LOV)	Flight cycles or hours, or both, up to which it is shown that WFD will not occur; the maintenance program is valid up to it

2 Allowable damage

Alignment and symmetry checks

Item	What the handbook says
When	Dihedral and incidence after hard landings or abnormal flight loads, to show nothing is distorted
Before	Jack and level the aircraft; weight and loading as the manual says, never above the maximum jacking weight; in a closed hangar, or nose into wind
Leveling	Spirit level and straight edge on the leveling pegs or blocks; on large aircraft, a grid plate and plumb bob
The checks	Wing dihedral and incidence, fin verticality, engine alignment, symmetry, stabilizer incidence and dihedral
Dihedral	The maker's boards, or a straight edge and inclinometer, at the specified positions, normally on the front spar
Incidence	At least two positions on the wing, to show it is free from twist
Fin verticality	From set points on each side of the fin top to set points on each stabilizer; similar within limits
Symmetry	Steel tape between the checkpoints, with a spring scale for equal tension: about 5 lb [22 N] pull. Large aircraft: plumb bobs and chalk marks on the floor
Tolerances	—

3 Repair

1. Locate it.
2. Name the member and its class.
3. Trace the load path.
4. Keep the original design.
5. Restore the protection.
6. Plan the inspections and record.

Key points

- **Semimonocoque:** skin, stringers, longerons, frames and bulkheads share the load.
- **Five stresses:** tension, compression, torsion, shear, bending.
- **The SRM classifies** each part; the limit follows class and zone.
- **Damage tolerance** counts on inspection: a repair may need its own.
- **Symmetry:** tape with about 5 lb pull; tolerances from the manual.

MAIN SOURCES · FAA-H-8083-31B, Aviation Maintenance Technician Handbook — Airframe · 14 CFR 25.571, Damage-tolerance and fatigue evaluation of structure · EASA CS-25, AMC 25.571 · FAA AC 91-56B, Continuing Structural Integrity Program for Airplanes · EASA AMC 20-20B, Continuing structural integrity program · FAA AC 120-73, Damage Tolerance Assessment of Repairs to Pressurized Fuselages · FAA AC 120-93, Damage Tolerance Inspections for Repairs and Alterations · FAA AC 120-104, Establishing and Implementing Limit of Validity to Prevent Widespread Fatigue Damage · TO 1-1A-1 / NAVAIR 01-1A-1, General Manual for Structural Repair · AC 43.13-1B with Change 1 · 14 CFR Part 43, par. 43.9 · EASA Part-66 Appendix I 2023/989) and FAA-S-ACS-1

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