9 Rings, Frames, and Arches

The purpose of this chapter is to provide analysis methodologies for ring frames, frames and arches as used in aircraft construction. Currently this chapter refers the analyst to appropriate references.

Circular rings and arches are most often associated with semi-monocoque fuselage structure. Frames are not necessarily circular but are also generally found within fuselage structure. All of these are classified as statically indeterminate structure. The LM Stress Memo manual, SM118a, Reference 9.1-1, provides an analysis methodology for circular ring frames, while SM106 lists numerous Lockheed reports which provide insight into the analysis of rings. The GD Structural Analysis Manual Section 18, Reference 9.1-2, provides analysis methods for rings, frames and arches, while Niu's book, Airframe Structural Design, Reference 9.1-5, gives a good overview of fuselage design and construction.

9.1 References

9.1-1. anon., *Lockheed Martin Engineering Stress Memo Manual*, Lockheed Martin Aeronautical Systems, Marietta, GA (October 1998 Release; April 2002 Revision)

9.1-2. anon., *Structures Analysis Manual, Volume 1 and Volume 2*, General Dynamics Convair and Space Structures Divisions (1988).

9.1-3. Staff, *LTV Structures Manual*, LTV Aircraft Products Group, Grand Prairie, TX (June 1989 Revision)

9.1-4. anon., "Metallic Materials And Elements For Aerospace Vehicle Structures," *MIL-HDBK-5*[1], Battelle Memorial Inst., Secretariat (2001).

9.1-5. Niu, Michael, Airframe Structural Design, Technical Book Company,Los Angeles, CA (1990)

9.2 Basic Theory and Tabulated Results

This section is divided into subsections describing the analysis of rings, arches and redundant frames.

9.2.1 Rings

Refer to program specific or customer generated guidance and/or the LM Stress Memo Manual SM106f and SM118a, Reference 9.1-1 and the GD Structural Analysis Manual Sections 18.1 and 18.3, Reference 9.1-2.

9.2.2 Arches

Refer to program specific or customer generated guidance and/or the GD Structural Analysis Manual Section 18.2, Reference 9.1-2.

9.2.3 Redundant Frames

Refer to program specific or customer generated guidance and/or the GD Structural Analysis Manual Section 18.4, Reference 9.1-2.

[1] In 2003, MIL-HDBK-5 was superseded by the Metallic Materials Properties Development and Standardization (MMPDS) Handbook, Battelle Memorial Institute, Secreteriat (2003).

9.3 FEM-Based Calculation

This section reserved for future use.

9.4 Unix/PC-Based Calculation

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