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15 Thermal Effects		

15 Thermal Effects

The purpose of this section is to provide guidance on the analysis of structure in the presence of thermal loads. In structures where external temperatures are high due to airspeed or the presence of systems (e.g. engines) stresses due to the thermal loading can be a significant, if not dominant, contributor to the overall stress state. If there are dissimilar materials, with significantly different coefficients of thermal expansion, (for example aluminum and graphite epoxy) thermal stresses can be larger than mechanical stresses. Further complicating this analysis is the reduction in both metallic and composite material allowables under elevated temperature.

Currently this Section refers the analyst to the appropriate sections of the Lockheed Martin Stress Memo manual (SM131), Reference 15.1-1, or the General Dynamics Structural Analysis Manual (Section 19), Reference 15.1-2, for guidance.

15.1 References

- 15.1-1. anon., [*Lockheed Martin Engineering Stress Memo Manual*](#), Lockheed Martin Aeronautical Systems, Marietta, GA (October 1998 Release; April 2002 Revision)
- 15.1-2. anon., [*Structures Analysis Manual, Volume 1 and Volume 2*](#), General Dynamics Convair and Space Structures Divisions (1988).
- 15.1-3. Staff, *LTV Structures Manual*, LTV Aircraft Products Group, Grand Prairie, TX (June 1989 Revision)
- 15.1-4. anon., "Metallic Materials And Elements For Aerospace Vehicle Structures," *MIL-HDBK-5¹*, Battelle Memorial Inst., Secretariat (2001).

15.2 Beams and Columns

Refer to Program-specific and customer-generated guidance and/or the LM Stress Memo Manual SM131, Reference 15.1-1 and the GD Structural Analysis Manual, Section 19.2, Reference 15.1-2.

15.3 Flat Plates

Refer to Program-specific and customer-generated guidance and/or the LM Stress Memo Manual SM131, Reference 15.1-1, and the GD Structural Analysis Manual, Section 19.3, Reference 15.1-2.

15.4 Box Beams

Refer to Program-specific and customer-generated guidance and/or the LM Stress Memo Manual SM131, Reference 15.1-1 and the GD Structural Analysis Manual, Section 19.4, Reference 15.1-2.

15.5 Bolted Joints

Refer to Program-specific and customer-generated guidance and/or the LM Stress Memo Manual SM131, Reference 15.1-1 and the GD Structural Analysis Manual, Section 19.5, Reference 15.1-2. The IDAT suite of analysis tools contains the program SPRING which can perform analysis on a one dimensional bolted joint with thermal loading.

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

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15.6 Thermal Buckling

Refer to Program-specific and customer-generated guidance and/or LM Stress Memo Manual SM131, Reference 15.1-1 and the GD Structural Analysis Manual, Section 19.6, Reference 15.1-2.

15.7 Unix/PC Based Calculations

Reserved for future use.