OVERVIEW OF THE FATIGUE/FRACTURE/LIFE WORKING GROUP PROGRAM AT THE LEWIS RESEARCH CENTER

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The objective of the Fatigue/Fracture/Life Working Group at Lewis is to develop and verify constitutive and life prediction models for materials typically used in hot gas path components of reusable space propulsion systems over the range of relevant operating environments. The efforts at Lewis have centered on the development of crack initiation life prediction methods, while the efforts of our counterpart group located at the Marshall Space Flight Center have centered on the development of cyclic crack propagation life prediction methods.

The complexion of active tasks is shown in figure 1. The program is a blend of in-house, contract, and grant research. Significant progress has been made during the past year; the papers presented in this session represent contributions from most, but not all, of the tasks currently active in this program.

A significant new task started this year will incorporate the various material constitutive and life prediction models (including materials properties data) developed in this program into a comprehensive creep-fatigue damage analysis and life assessment computer code (fig. 2). The program will function as a postprocessor to general structural analysis programs (such as finite element or boundary element codes) using the output of such analyses (stress, strain, and temperature fields as functions of time) as the input to the damage analysis and life assessment code. The code will be designed to execute on engineering/scientific workstations and will feature a windowing, mouse-driven user interface. Current plans call for the code to be finished and made available for use in mid 1991.

CURRENT STRUCTURAL DURABILITY PROGRAMS AND GOALS

MACROSCOPIC EFFECTS OF HIGH PRESSURE HYDROGEN ON CONSTITUTIVE AND LIFE MODELS

- ESTABLISH VALIDITY OF STRUCTURAL DURABILITY MODELS DEVELOPED UNDER THE PROGRAM

HCF/LCF INTERACTION UNDER MISSION-RELATED LOADING

- INTERSPERSED HCF AND LCF LOADINGS
- TMF INTERACTION WITH HCF LOADINGS
- CUMULATIVE CREEP-FATIGUE INTERACTIONS

APPLICATION OF CONSTITUTIVE AND LIFE MODELS IN STRUCTURAL ANALYSIS

- APPLY MODELS DEVELOPED TO SSME COMPONENTS

THERMAL RATCHETING DAMAGE ANALYSES

- INTERACTION OF RATCHET STRAINS WITH TMF AND HCF
- APPLICATION TO MAIN COMBUSTION CHAMBER MATERIALS

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CURRENT STRUCTURAL DURABILITY PROGRAMS AND GOALS

ADVANCED CONCEPT MATERIALS MODELS DEVELOPMENT

- METAL MATRIX COMPOSITES MODELING: MATERIAL CONSTITUTIVE AND LIFE MODELS

CYCLIC CRACK GROWTH UNDER THERMOMECHANICAL LOADING CONDITIONS

- APPLICATION OF PATH INDEPENDENT INTEGRALS TO THE DESCRIPTION OF THE CRACK DRIVING FUNCTION

SINGLE CRYSTAL CONSTITUTIVE AND LIFE MODEL DEVELOPMENT

- ANISOTROPIC CONSTITUTIVE AND LIFE MODELS
- ANALYSIS METHODOLOGY FOR ADDRESSING BLADE ROOT ATTACHMENTS

CREEP-FATIGUE DAMAGE ANALYSIS PROCESSOR

- INTEGRATE CONSTITUTIVE AND LIFE PREDICTION MODELS, AS WELL AS RELEVANT MATERIALS PROPERTIES DATA INTO A DAMAGE ANALYSIS AND LIFE ASSESSMENT COMPUTER CODE

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CREEP-FATIGUE DAMAGE ANALYSIS PROCESSOR

- COMPREHENSIVE COMPONENT DAMAGE ANALYSIS AND LIFE ASSESSMENT SYSTEM
- MOUSE-DRIVEN WINDOWING USER INTERFACE IN A PORTABLE SOFTWARE PACKAGE

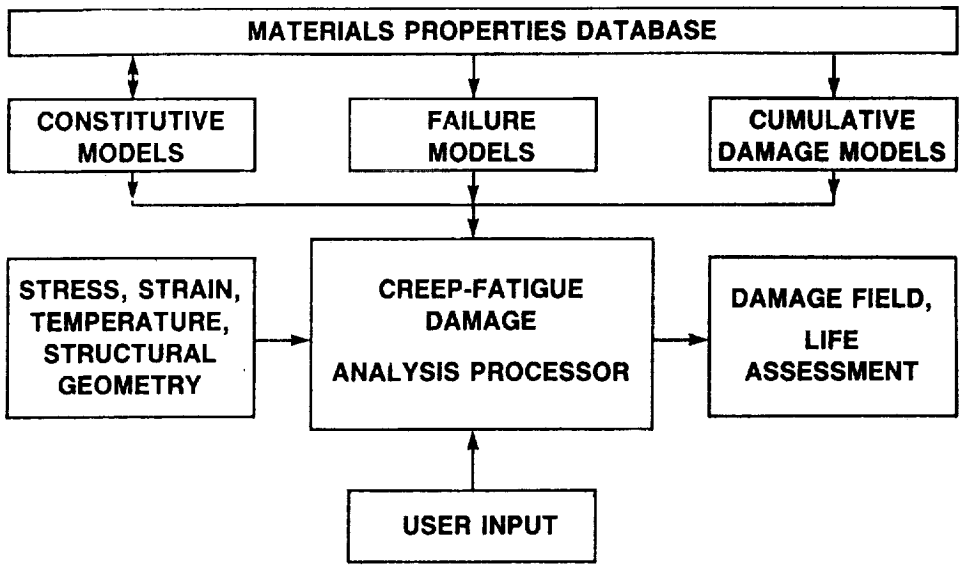

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Figure 2