SUMMARY

These Notes for a Special Topics course presents the first complete implementation of the Finite Element method (FEM) in the *Mathematica* language.

The present document focuses on data structures, data flow, and programming modules for linear structural mechanics.

The data structures have been designed with three future extensions in mind: parallel computation, dynamic (linear and transient), nonlinear analysis, and coupled problems. The extensibility goal has been addressed through the following decisions.

- A clear distinction is made between source and computational data structures.
- Source data structures are designed for maximum flexibility using list structures.
- Computational data structures are designed for maximum efficiency using array structures.

The report is organized as follows. Chapter 1 is an overview of design principles, program organization, data classification, and nomenclature. Chapters 2 through 7 deal with problem definition data structures. Chapters 8, 9 and 10 deal with auxiliary data structures constructed in preparation for the computational phases. Chapters 11, 12 and 13 deal with solution data structures. Chapter 14 presents conclusions and recommendations. Sections containing advanced material that may be omitted on first reading are identified by an asterisk.

The material collected herein directly supports most of the syllabus of the course **Finite Element Programming with Mathematica** (ASEN 5519). The programming modules will also be used to support the implementation in C of the Finite Element method.