STRUCTURES E-BOOK

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Introduction

Although understanding structures is central to the education of the architect, the engineering-based instructional materials currently in use are fundamentally inappropriate for the vast majority of architecture students. The teaching of structures is constrained by content, teaching methods and texts, which are increasingly ineffective in the classroom. Non-engineering (especially architecture) faculty and their student's struggle with an aging, engineering-based approach to instruction, which is inappropriately quantitative, abstract and unrelated to the practical and creative aspects of design. The consequences of using this pedagogy are that many architecture students fail to master basic structural concepts, much less the more demanding aspects of practical application.

Because architects are no longer directly involved in developing the science of structural engineering, the structures curriculum, concepts, teaching methods and instructional tools are borrowed wholesale from engineering programs with little modification. As such they are not conceived, developed or aimed an architects and architectural instructional needs. The basic applied-engineering approach to teaching structures and building technology uses a methodology which consecutively dismantles a structure into extremely small sub-components, focusing on a particular element, detaching it from all other connected structural members, and then reducing it to a notation system of structural symbols, mathematical formulae and annotations. Architecture students have neither the background, disposition, nor time to master the mathematics skills required to understand or utilize a system based on highly abstract mathematical models and quickly become uninterested, frustrated or intimidated by the structures curriculum and its texts.

Project description

If architecture students are to effectively learn and apply sophisticated structural analysis and design, teaching materials must respond to the needs, capabilities and perspective of the architecture student. Using a small seed grant from the State University of New York at Buffalo, I have developed a prototype for a multimedia instructional software package that utilizes a wide range of graphics, animation and sound to demonstrate the principles and application of structural analysis and building technology. The software attempts to overcome the limitations of two-dimensional, abstracted representations of structural mechanics and provide the means to study structure within a real building context. The development of the program is based on five principles:

- structures instruction should facilitate comprehension of fundamental principles of the ***practical*** aspects of structural design as well as the ***creative possibilities*** of applied structure within the built environment;
- instruction in structures should be always be grounded and referenced to complete buildings and/or structural systems which connects principles of sub-component analysis to broader issues of building design;
- particularly for architecture students, the instruction of structures should be ***visually*** grounded, using real-world examples to demonstrate basic principles of analysis and design, and;
- Classroom activities and the communication of basic theory and principles should focus on reinforcing and demonstrating principles of ***application***.

The full version of the multimedia package will divide the study of structures into five concept areas:

1. ***The architects***: biographies, excerpts from written works, drawings and spoken interviews of the great architects, designers and engineers. This section also includes a searchable, interactive database of their most significant works, presented using photographs; movies and computer generated models.
2. ***Basic Concepts***: general structural analysis and design concepts, definitions and working principles;
3. ***Structural Systems***: a searchable database of structural subsystems (trusses, cables, arches, beams & columns, etc.) which includes construction details, models of structural behavior under various loading scenarios, analytical procedures for structural investigation and design;
4. ***Technical Reference Library***: a complete technical reference of analytical formulae, member properties, sizing guides and selected national building code guidelines for specific materials, and
5. ***Assignments***: combining electronic homework with graphics and animation, this section includes interactive example problems, examination aids and tabulated information.

Each concept area is not a separate study module but rather constitutes a starting point from which to study the different aspects of structural performance, design, and analysis. For example, a user will typically begin by selecting a single architect and a single work (building). Clicking on any part of the building structure reveals the Basic Concepts of its structural design. The student can further examine in detail the performance of the building's structural system under various conditions of stress and loading using the Structural Systems button/link. Through the use of linked menus and hypertext, all concept areas are linked and accessible from within each other, but the student can also move from the more specific to the more general. Additionally, successive layers of information (mathematical formulas, analytical results, graphic representations of behavior, etc.) can be accessed and overlain onto the buildings, issues and sub-systems currently being studied. The graphic images used are three-dimensional. And, most images are animated to simulate behavior under conditions of structural stress.

The completed package will be made available on CD-ROM or directly accessible over the Internet as a distance learning product.

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This new book provides a concise and engaging introduction to Java and object-oriented programming with an abundance of original examples, use of Unified Modeling Language throughout, and coverage of the new Java 1.5. Addressing critical concepts up front, the book's five-part structure covers object-oriented programming, linear structures, algorithms, trees and collections, and advanced topics.