# Energy Scheming:
# Macintosh Software for Preliminary Design

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## Abstract

This paper describes software for the Apple Macintosh microcomputer that aids architecture students and professionals in incorporating energy considerations in the earliest phases of the design process. The user interface is a "sketch pad" environment that has been designed to foster design activities rather than analysis and allows users to input a building by drawing it at any level of detail. It provides a schematic evaluation of the building's energy performance and a complete annual energy loads analysis. Calculation algorithms are simplified, both to speed up the computer's response time and to minimize the amount of specification the user must be burdened with. By seeing evaluations of their work frequently and easily, users may make preliminary decisions about a design idea and develop a familiarity with, and an intuition for, the effect of energy considerations on their design process.

The paper will discuss several areas in which our software is unique among energy analysis programs:

**The Graphic Interface** allows the user to input a building design graphically and include several features that are specific to architectural drawing habits. The program is the medium for design drawing as well as for the input for analysis. Drawing tools look and behave like the physical objects they represent rather than the mathematical equivalents found in most CAD programs.

**Design Aids.** Rule-of-Thumb evaluations can be performed on building components. The optimal window size is determined by the criteria of solar heating, cross-ventilation, stack-ventilation and daylighting. Interactive, on-screen displays show the user graphically how well their design-in-progress is performing. See Figure 1.

**Graphic and Numeric Input.** The primary input procedure for this program is graphic: the user draws the building on the screen or imports it from another Macintosh program. Material specification is accomplished by selection from "Chinese Menus". See Figure 2. Information may be reviewed or edited numerically. This section has been carefully designed to conform to a designer's concept of the building rather than a programmer's concept of the energy formulas.

**Annual Loads Analysis.** The program calculates loads for the building for twenty-four hours, for each of four representative days in the year. Loads include heating and cooling and take into consideration the effects of thermal mass, natural ventilation, and daylighting. We are currently developing a simulation of the building loads which is displayed graphically by the building elements themselves.

**Progress.** The design specifications for Energy Scheming were substantially complete as of April, 1988. A functional version of this software was finished in November, 1988, and was beta tested in 1989. The program is currently being revised in response to beta testing. The program is written in 'C' and will run on the Macintosh SE or Mac II.

**Percent of Target Area Achieved:**

```
        0%              100%              200%
          20  40  60  80    120 140 160 180
```

☐ ⬆⬇ Solar Gain in Btu

☐ ⬆⬇ Cross Vent Inlet
    Cross Vent Outlet

☐ ⬆⬇ Stack Vent Inlet
    Stack Vent Outlet

☐ ⬆⬇ Daylight Area 1
                  2
                  3
                  4
                  5

**Review Parameters:**

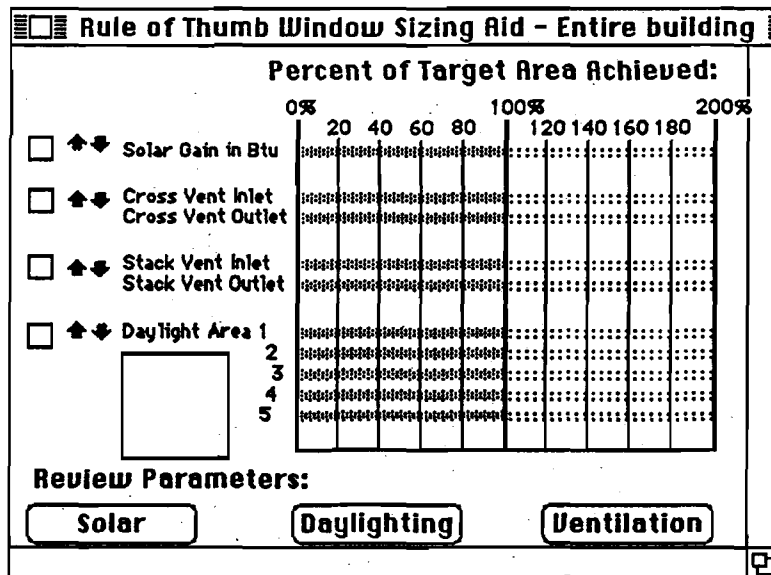( **Solar** )    ( **Daylighting** )    ( **Ventilation** )

**Figure 1. Measuring and evaluating the glass in a building.** After a building has been drawn with this program (or imported from any graphic Macintosh program), the user enters "take-off" mode, to measure the windows for solar performance. The bar chart represent the optimum window size for each of several functions (solar heating, ventilation, daylighting) and each bar represents the area of glass which the user has measured. Thus the user can decide whether a building has enough glass for the various functions, while optimizing between them, without leaving the highly graphic, non-numeric drawing mode.
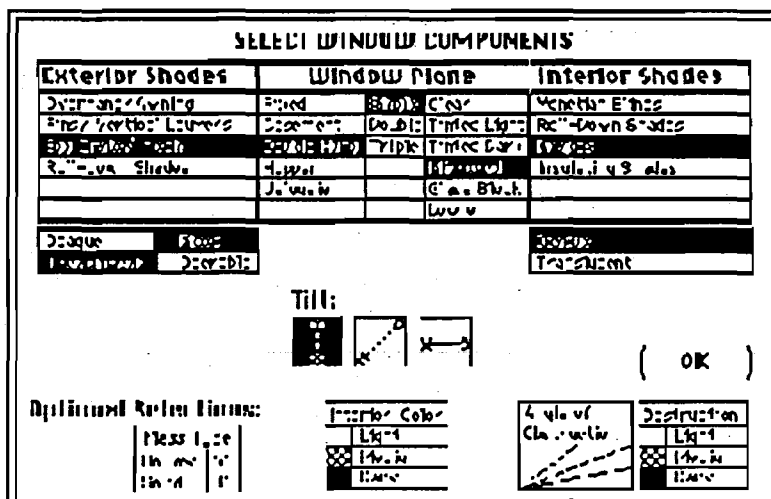
**Figure 2. A "Chinese Menu" for Material Specification.** In this example, a user defines the components of a window by selecting from a series of lists.