

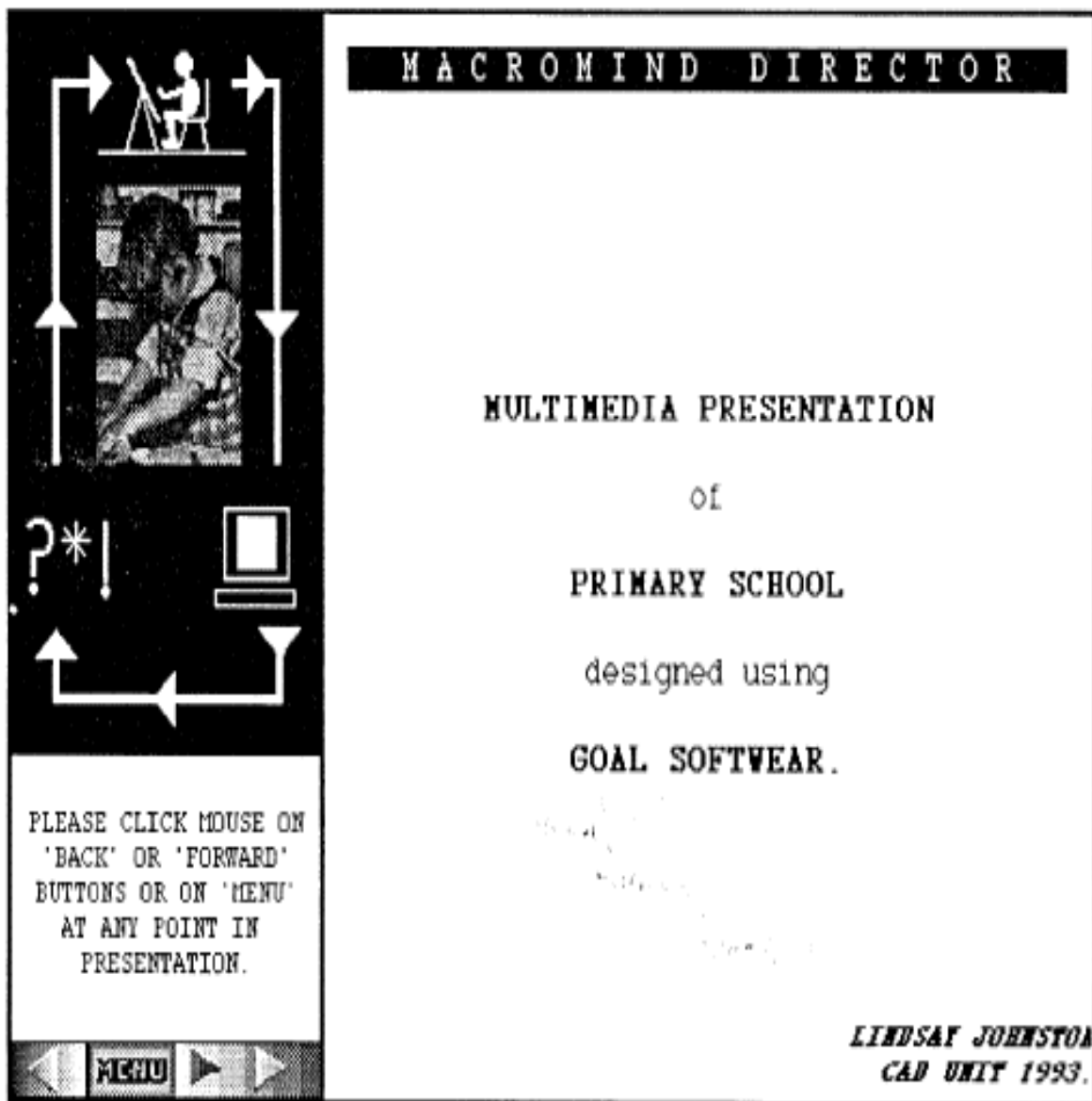
Dr Jelena Petric and Prof Tom Maver, ABACUS, University of Strathclyde

Introduction

This paper summarised a multi-media presentation which was authored without tuition by a 4th year student of the Department of Architecture & Building Science in the University of Strathclyde - Lindsay Johnston.

In it she gives a detailed account of a 12 week project to design a Primary School relying very heavily on computer aided design support.

It was a requirement of the brief that the design produced by the student should come within the (severe) cost, area and energy consumption constraints set out in the brief.



FRAME 1



FRAME 2

The process of design search was so complex and so closely related to the computer output that it was difficult to convey the process and product of the design activity using conventional drawings in a conventional crit. For this reason, Lindsay was encouraged to make her presentation in a multi-media environment.

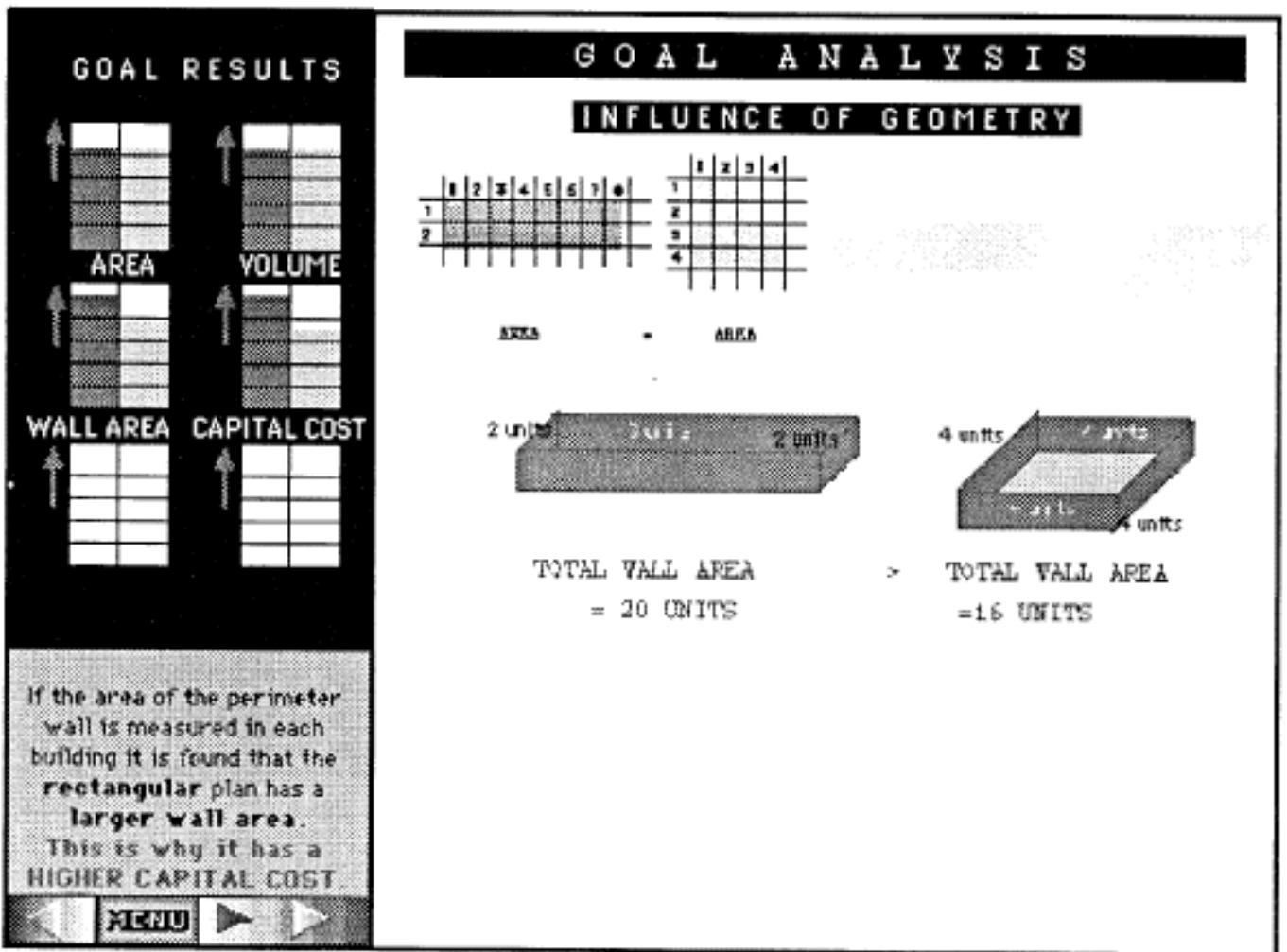
The multi-media presentation is in six sections. The **Introduction** explains the intentions and requirements of the project; the section on **GOAL Analysis** explains how she used the CAD software to investigate issues of geometry, construction and orientation; the section on **School Analysis** is concerned with modelling an existing school, **Conceptual Design** explains how she generated the original idea, **Design Process** explains how the CAD software guided her search for a good solution, and the last section presents her **Final Design**.

Initially, Lindsay used the CAD software known as GOAL (which was first devised in 1972 and is constantly being updated and improved) to investigate, in abstract, the impact of Geometry, Materials and Orientation on building cost and performance.

Frame 14 shows part of an animated sequence in which she compares the surface area of two equal volumes of different plan proportions and how the surface areas of the envelopes impact on cost of construction and energy consumption.

Frame 17 shows part of her investigation of the impact on cost and performance of alternative window, wall and roof constructions.

Frame 24 is part of an animation in which the building changes its orientation with corresponding changes in energy consumption.



FRAME 14

GOAL RESULTS

capital cost

running cost

heat loss

lights used

heat loss

lights used

Here are variations on window types:

GOAL ANALYSIS

INFLUENCE OF MATERIALS

Window

- 20% double glazing, timber frame.
- 20% double glazing, aluminium frame.
- 20% single glazing, timber frame.
- 30% double glazing, timber frame.

FRAME 17

GOAL RESULTS

heat loss

heat gains

peak heating

running cost

capital cost

cost in use

GOAL ANALYSIS

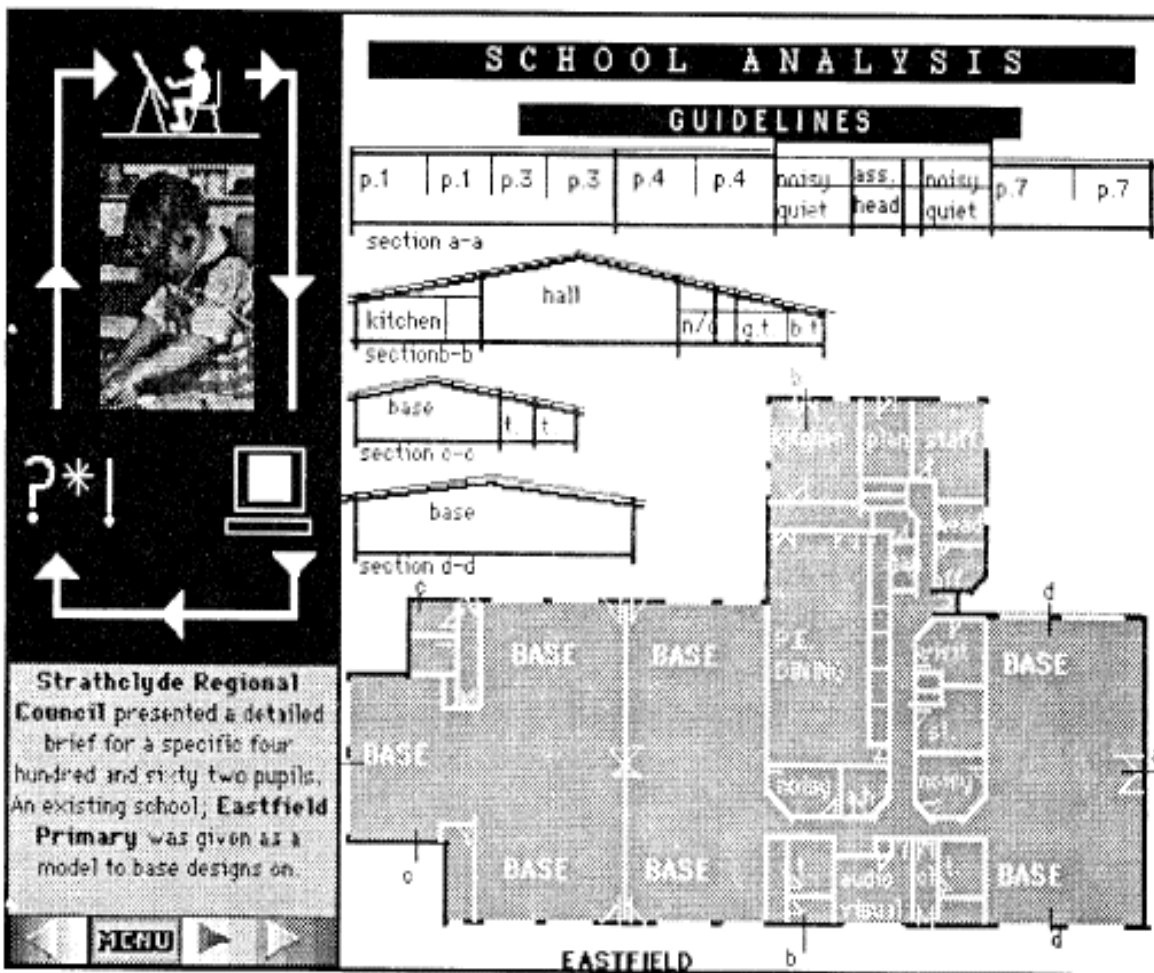
INFLUENCE OF ORIENTATION

FRAME 24

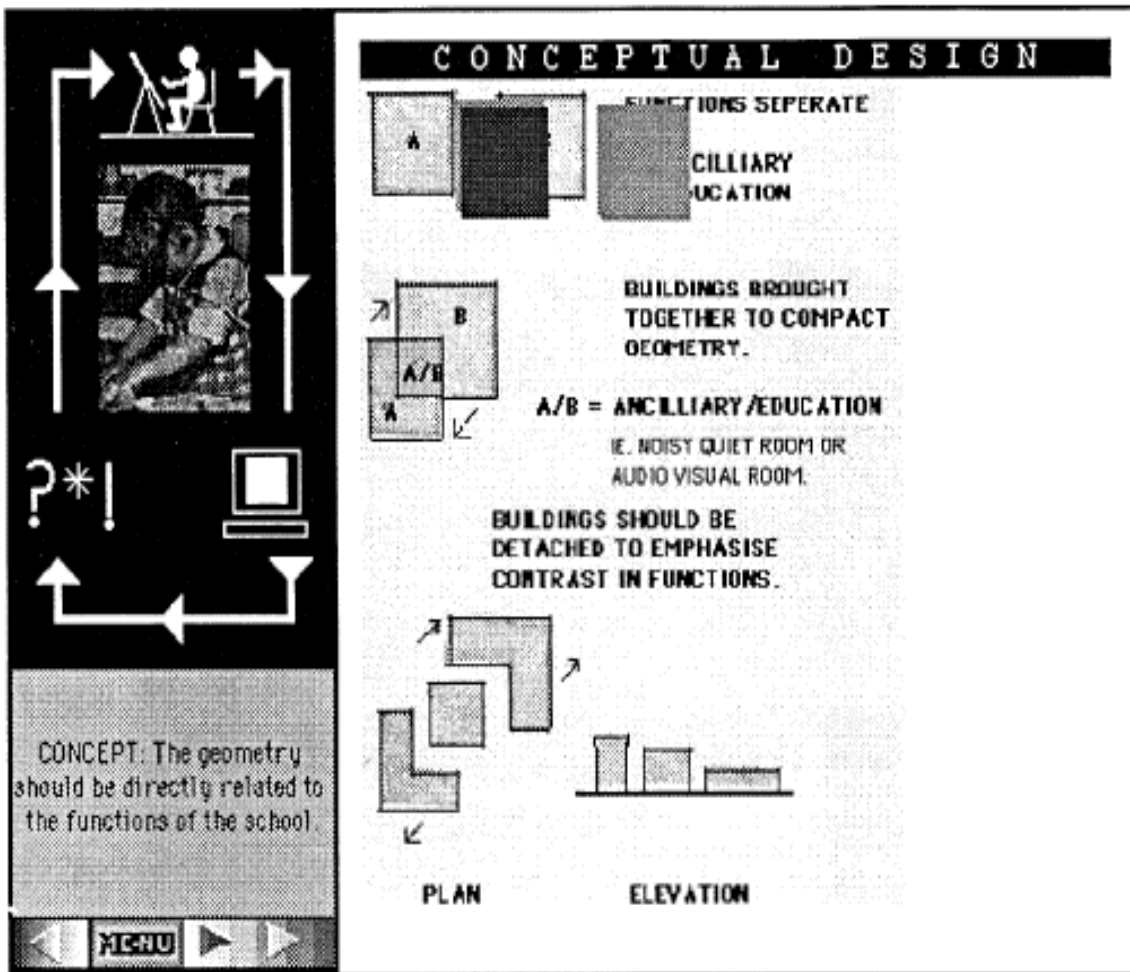
The 'benchmark' against which Lindsay was to test her design ideas was Eastfield, an existing Primary School designed to exactly the same brief. Lindsay (and the 15 other students in the CAD Design Unit) input the geometry and construction of Eastfield into GOAL to assess its cost and performance (Frame 27). This level of cost and performance then became the "target" or "benchmark" which the students were encouraged to match or to beat.

The students visited Eastfield School in order to assess, by observation and interview with teachers, the qualitative aspects of the design which were not predictable using GOAL.

An architect and an administrator from the client organisation Strathclyde Regional Council - contributed to the briefing process and took part in all subsequent crits.



FRAME 27



FRAME 35a

In Frame 35a, we see her concept emerging. She envisages two compact buildings, one housing the children's activities, the other housing the adult activities, overlapping to provide three distinct volumes, each of which should have an elevational scale appropriate to its occupants.

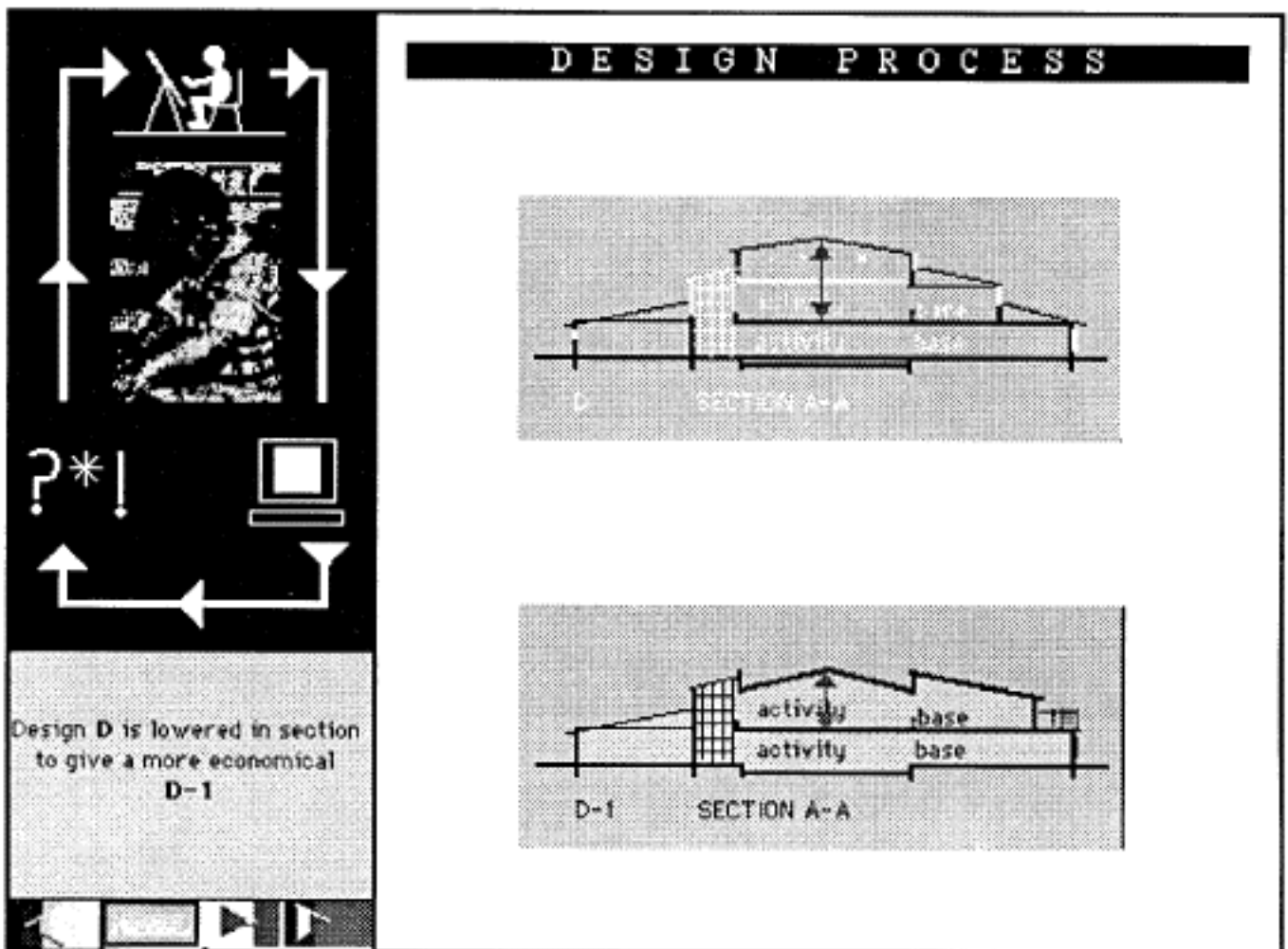
The concept was developed and a single storey plan form, Design A (Frame 51) produced. She also generated Design B and Design C which are on two storeys. Frame 54 shows the cost/performance profile generated by GOAL of Eastfield against Designs A, B and C.

Although Design A is the most economical, Lindsay develops two further variants of Design C which she identifies as C1 and C2.

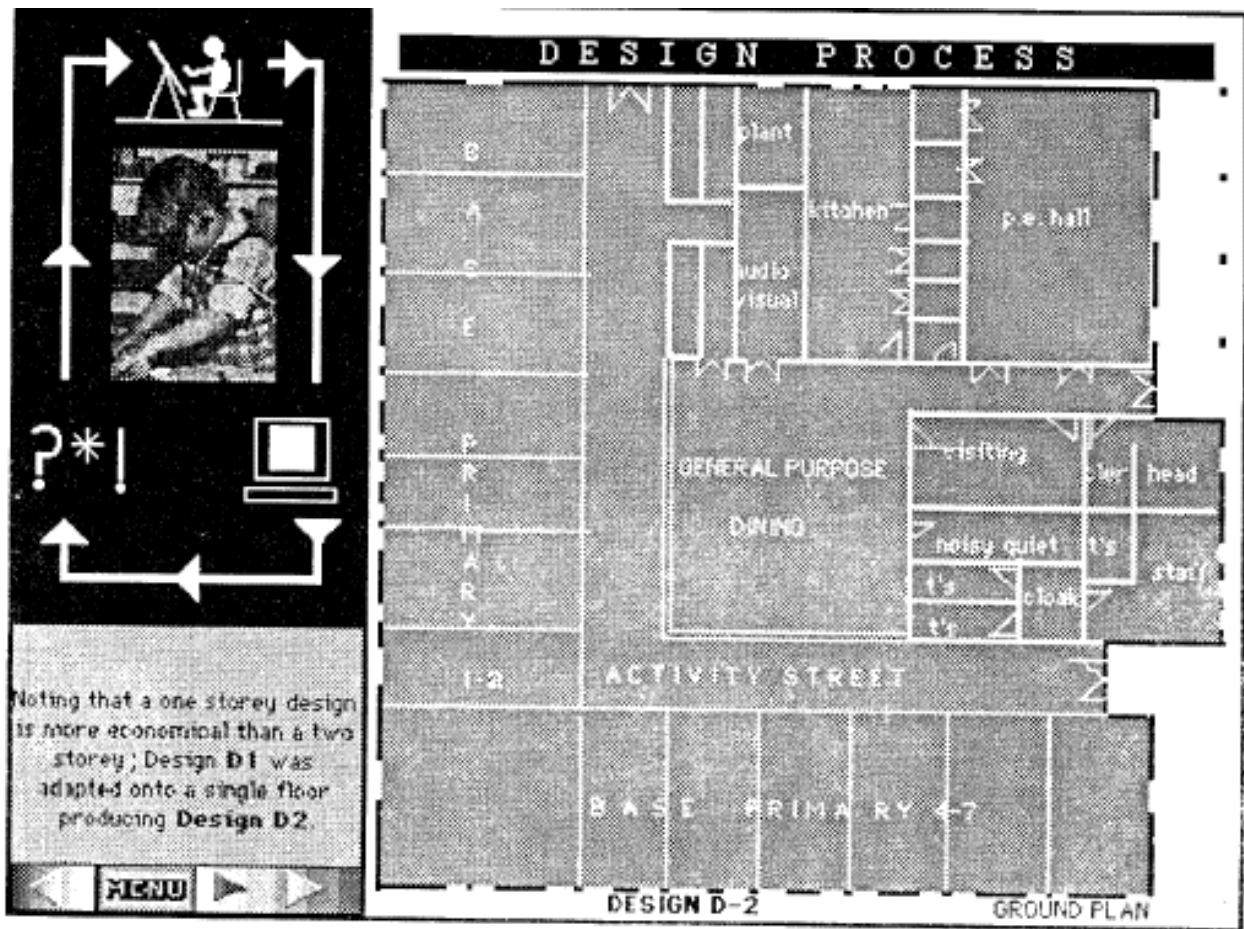
She also develops a family of designs identified as Designs D and D1 which again she compares, using GOAL, with Eastfield and with Design A. The detailed cost output from GOAL. suggests that the more economical schemes are those with a lower volume. Lindsay then compares the sections of D and D-1 (Frame 62) and goes on to develop Design D-2 (Frame 65).

Design D-2 compares very favourably with Eastfield (£60,000 lower in capital cost) so she then explores alternative constructions for D-2, arriving finally at a complete specification, in terms of geometry and materials for tier final design D-3 (which is £91,000 lower in capital cost).

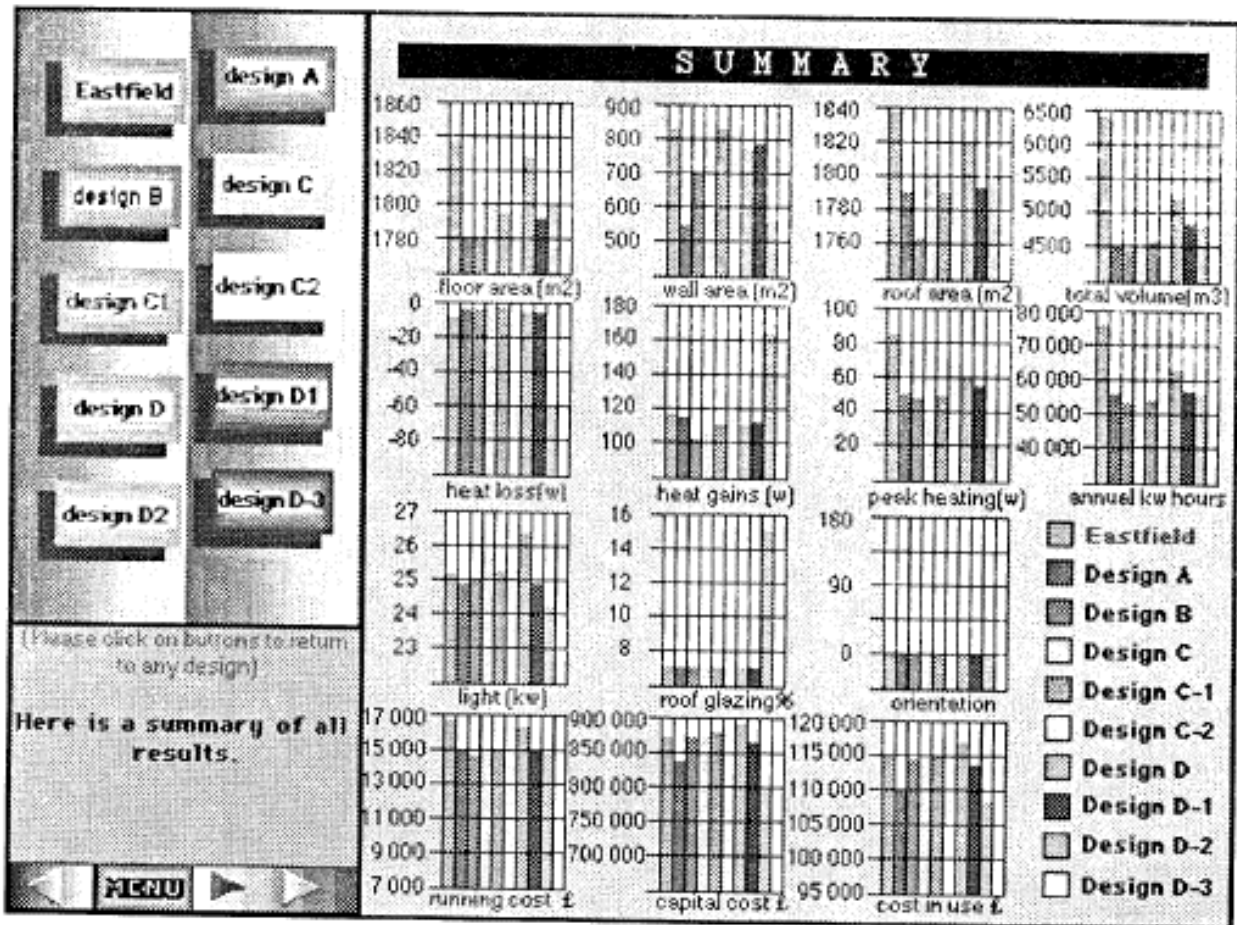
Frame 69 compares all designs. The buttons on the left side of the Frame allow the user to access plans and elevations of any scheme.



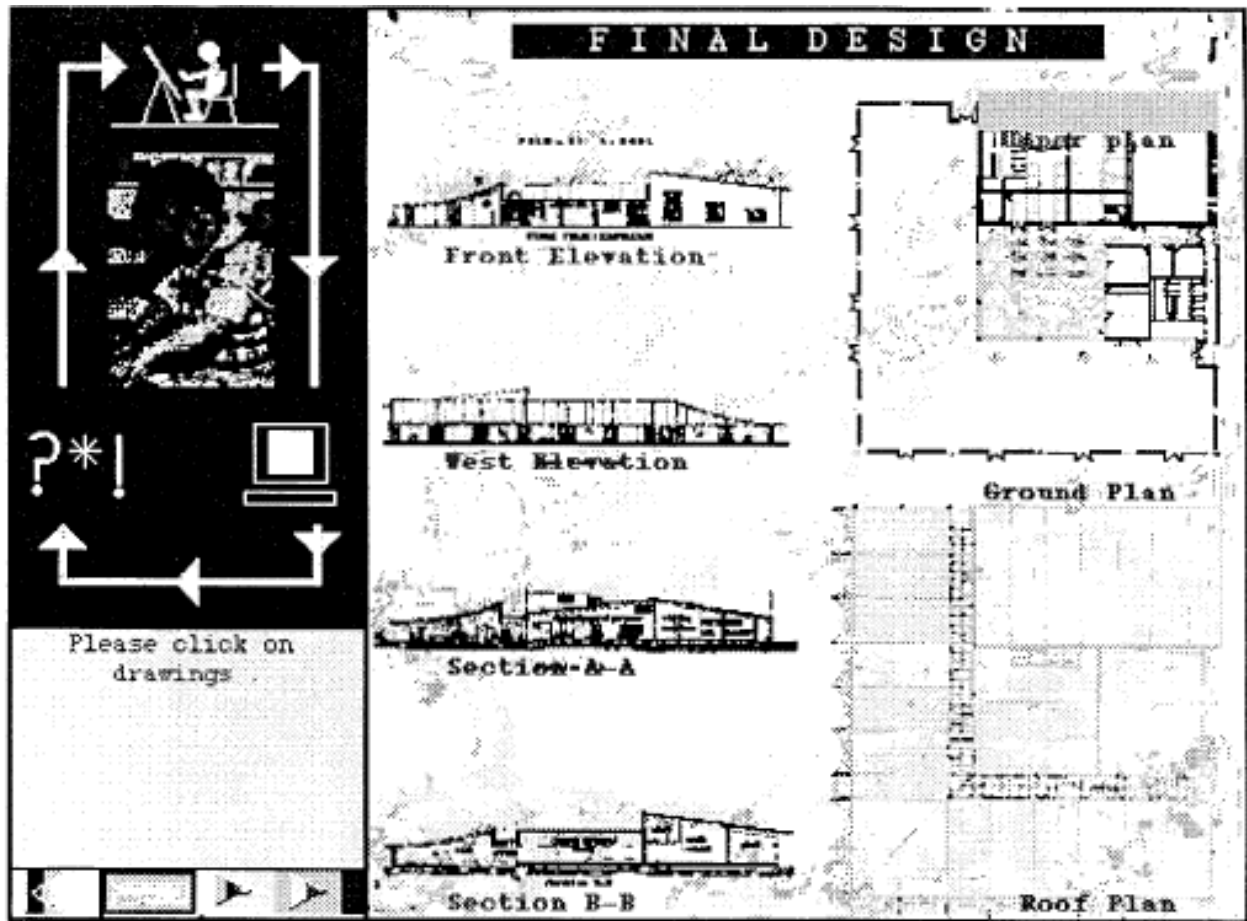
FRAME 62



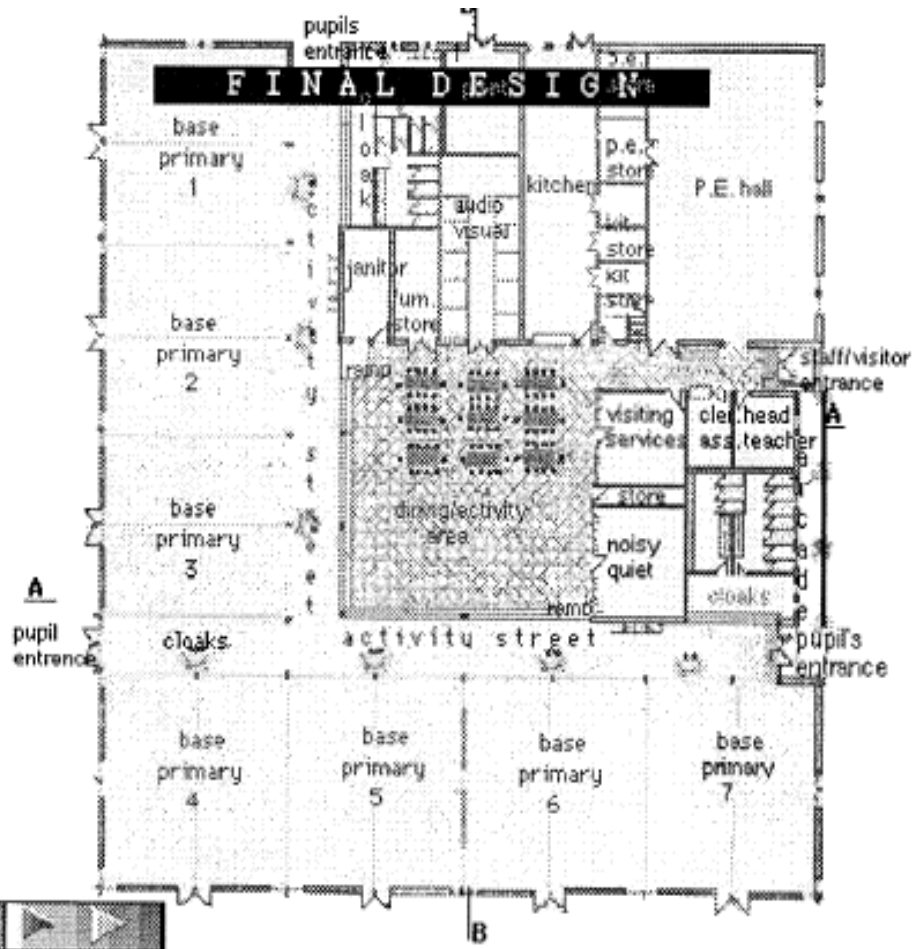
FRAME 65



FRAME 69



FRAME 70



FRAME 71

Frames 70, 71 and 72 are part of an animated sequence in which Lindsay shows the detail of her final design for the Primary School - a design judged by her tutors to be superior in form, function and cost-effectiveness than the existing school. Eastfield, which formed the benchmark.

It is clear from her presentation that her search for a good design was informed and guided by the cost-performance predictions of the program GOAL, without the CAD support it would not have been possible to find, and evidence the quality of such a good design

The authors gratefully acknowledge the excellent design skills of Lindsay Johnston, and of her intelligent use of the CAD and Multi Media technology.



FRAME 72

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