COMPUTER AIDED ARCHITECTURAL DESIGN

West Sussex County Council

Designing buildings by computer

- The system was designed and implemented at West Sussex County Architect's department in the early 1970s.
- Limitations of the hardware, software and file structures available at that time
- System design challenges and solutions

Examples of designs using system

- Block C Chichester College - First prototype
- Crawley Broadfield Middle School
- East Preston Infants School
- Glebe House Care Home Southbourne
- Angmering Comprehensive School
- Bognor Fire Station
- County Buildings Tower Street Chichester – Last project

County Buildings Tower Street Chichester

Design team

- Inspiration - Deputy County Architect John Paterson
- MIS manager - architect's systems
- Systems team – 4 analyst / programmers
- Architect
- Architectural technician
- Quantity surveyors – 3 QS
- Building surveyor
- Engineer
- Data organisers – 3
- Collaborative outsiders

Building System developed by Architect's Department West Sussex CC

The computer system follows the traditional design and production process of building design.

It produces for the contractor:-

- Site plans and layout drawings;
- Bills of quantities;
- Time scaled networks of activities;
- Site survey plan with contours

SCOLA system building

Initially the buildings that used this computer system were of **SCOLA** design

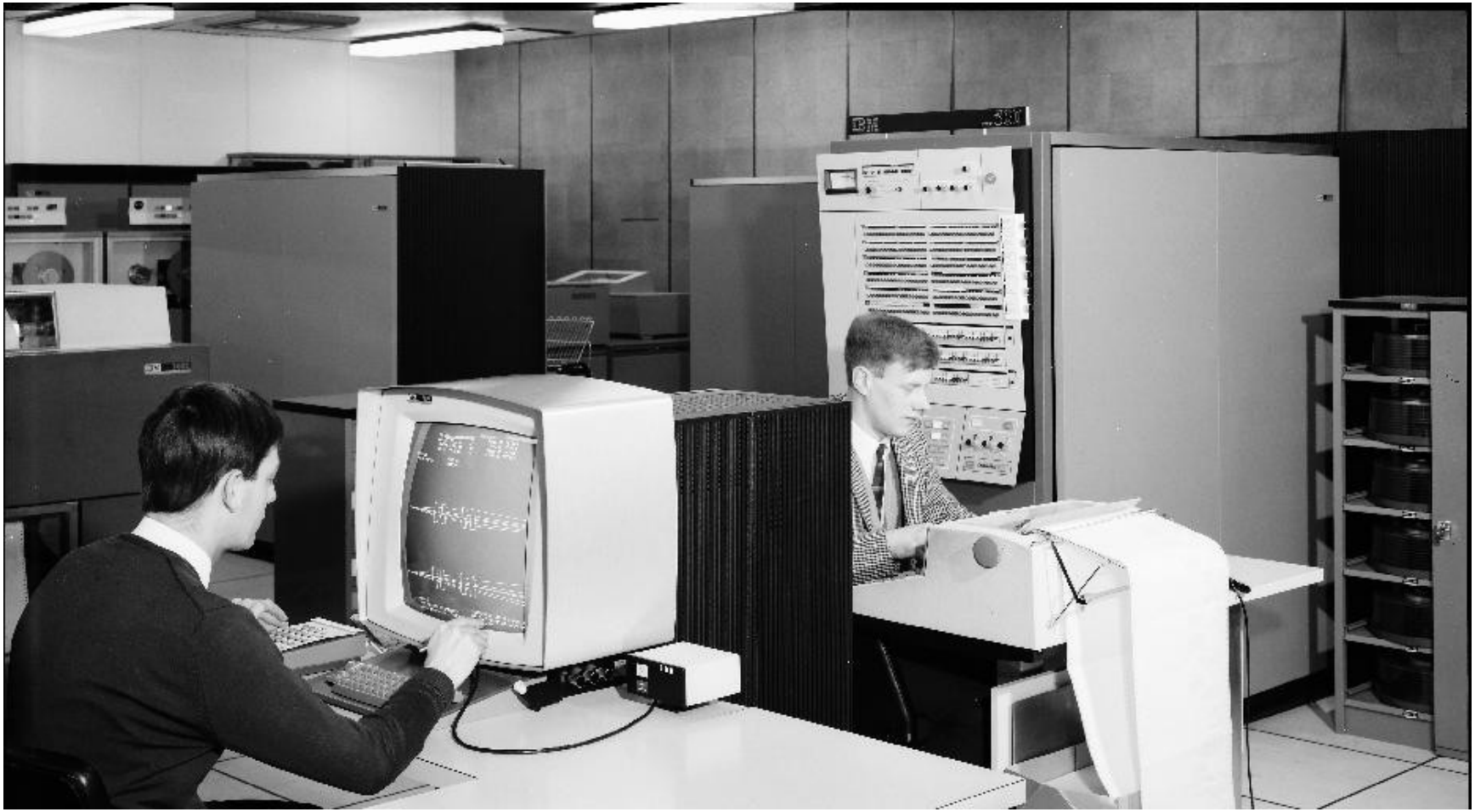
- SCOLA = Second Consortium of Local Authorities
- Dimensionally coordinated structural frmework
- Many of the components were specified and were of a negotiated price
- 40% schools in Hampshire are SCOLA system

Hardware

- Mainframe IBM 360 – 40 (256K)
- IBM 2250 Graphic terminal [only 5 in the country]
- Disk drives – IBM 2311 and IBM 2314
- Magnetic tape drive – IBM 2400
- Card reader – IBM card reader
- Line printer – IBM 1403

- Magnetic tape drive – Calcomp 750
- 30” Drum plotter – Calcomp 663

Mainframe IBM 360 – 40 (256K)



IBM 2250 Graphic terminal

Programming languages

- **Graphics**
- Software provided by IBM with 2250 terminal for I/O
- Assembler language
- Fortran
- Calcomp plotter software to convert tape data to coordinates for the plotter

- **Procedural software**
- PL1
- COBOL
- Assembler

Object oriented programming - history

- Objects were being discussed in research labs in MIT in 1960s
- Foundational OOPs construction was written about in 1988 by Meyer
- OOPs developed as the dominant programming methodology in the early and mid 1990s when programming languages supporting the techniques became widely available.

Object or Blobs

Any building can be analysed into design objects called **blobs.**

Blobs are dimensionally coordinated aspects of space in the system e.g.

- Window
- Manhole
- Floor covering
- Roofing

Blob input guide

Blob – ‘types’

Unit

- Window
- Manhole
- Hand basin

Linear

- Skirting
- Trench
- Facia

Area

- Ceiling
- Cladding of elevation
- Roofing

Blob logic or ‘rules’

- Blobs could **infer** others e.g
  - Manhole would infer a manhole cover

- Blobs could **deduct** from others e.g
  - Inserting a window would reduce cladding area.

Blob infills

Blob infills are the many units available to the designer

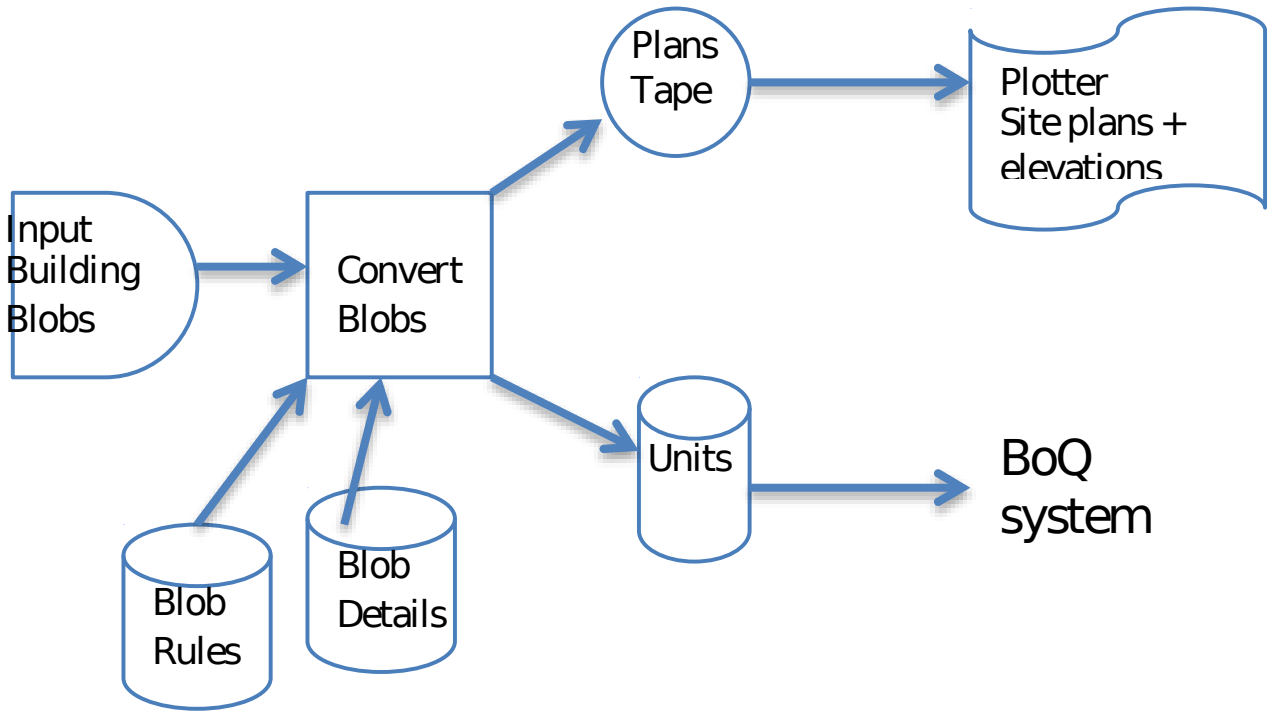
These are stored on the computer and each can be broken down into the amount of:

- Material within the blob
- Activity time to install the blob
- Manpower times to fix the blob
- Plant needed to install the blob

Design Process - overview

- **Sketch plan** stage – iterative design process for estimated cost, heat loss, air changes, lighting levels
- Inputting **structural steelwork** –creates outline plans
- Inputting **Blobs** with their infill details
- Producing **site plans**
- Producing **Bills of Quantity**

Graphics system

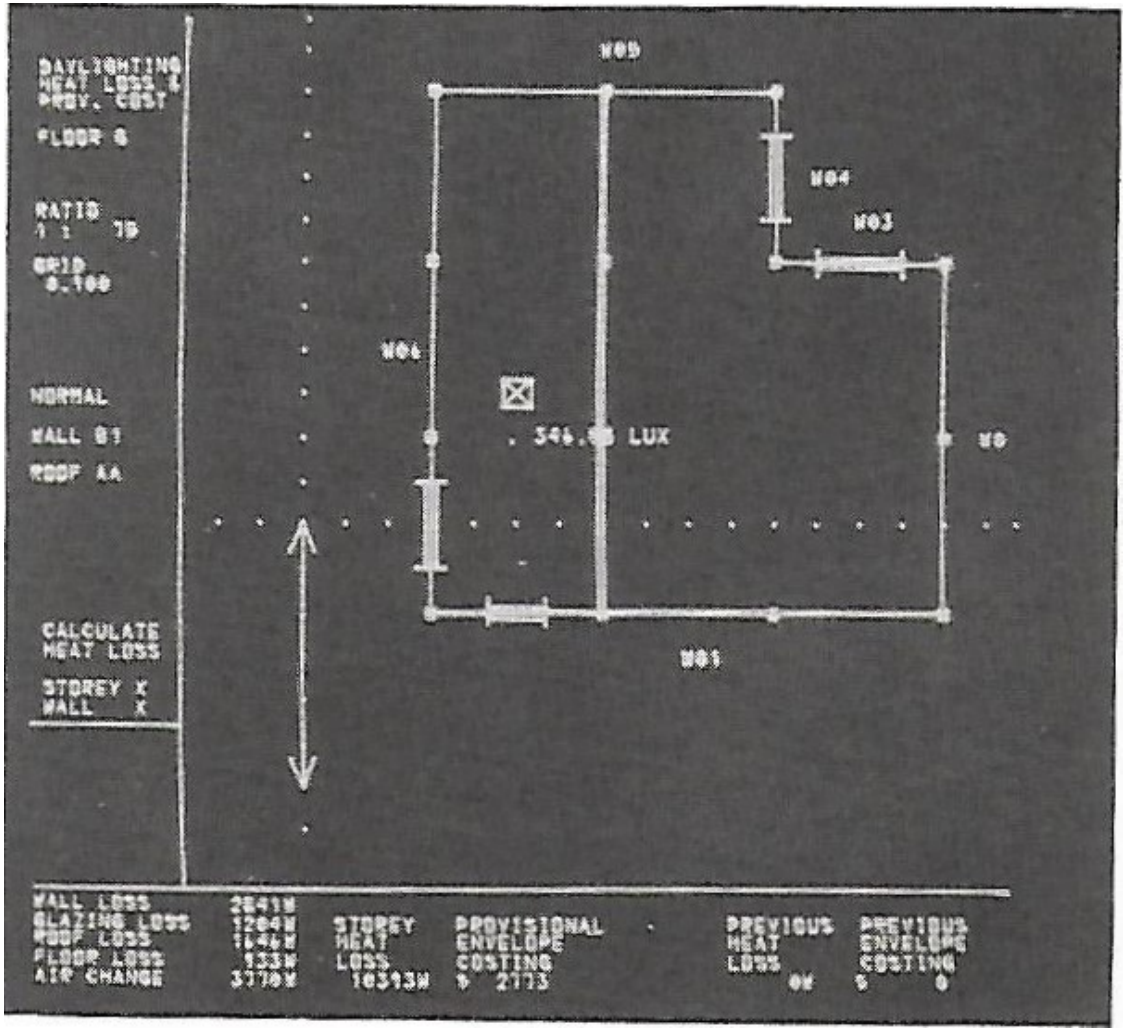


Inputs for a new building

- Steelwork structure
- Blobs including:-
  - Roofing
  - Flooring
  - Finishing
  - Windows and roof lights
  - Services
  - Fittings

As each Blob is chosen a menu of options appears at bottom of screen and enables the designer to choose the one required

Sketch Plan



Designer inputs sketch plan and then tests for such things as estimated cost, heat loss, air changes, lighting levels.

Steelwork

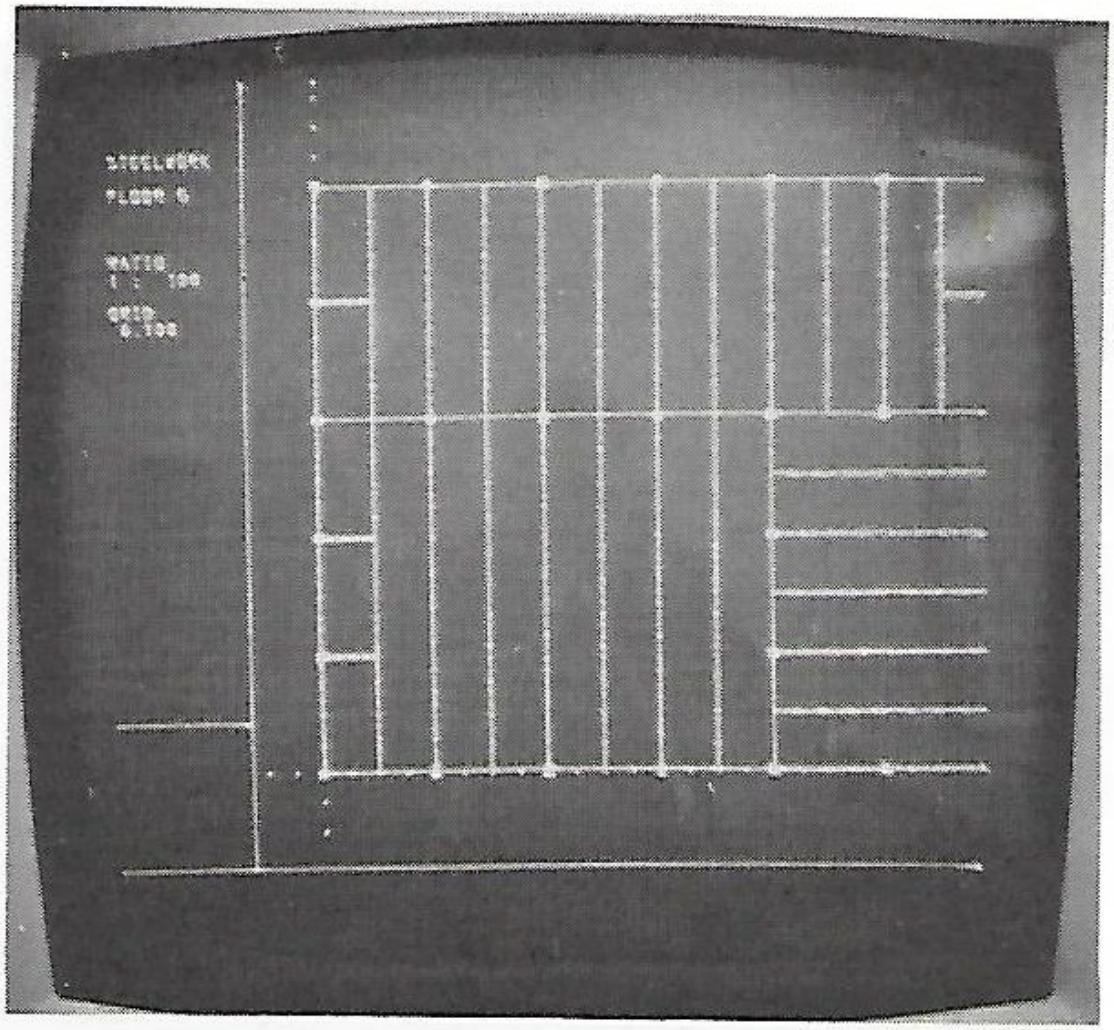
The designer inputs his proposed steelwork via the VDU

From this the computer checks that it conforms to the structural requirements of the SCOLA system and produces the steelwork plans

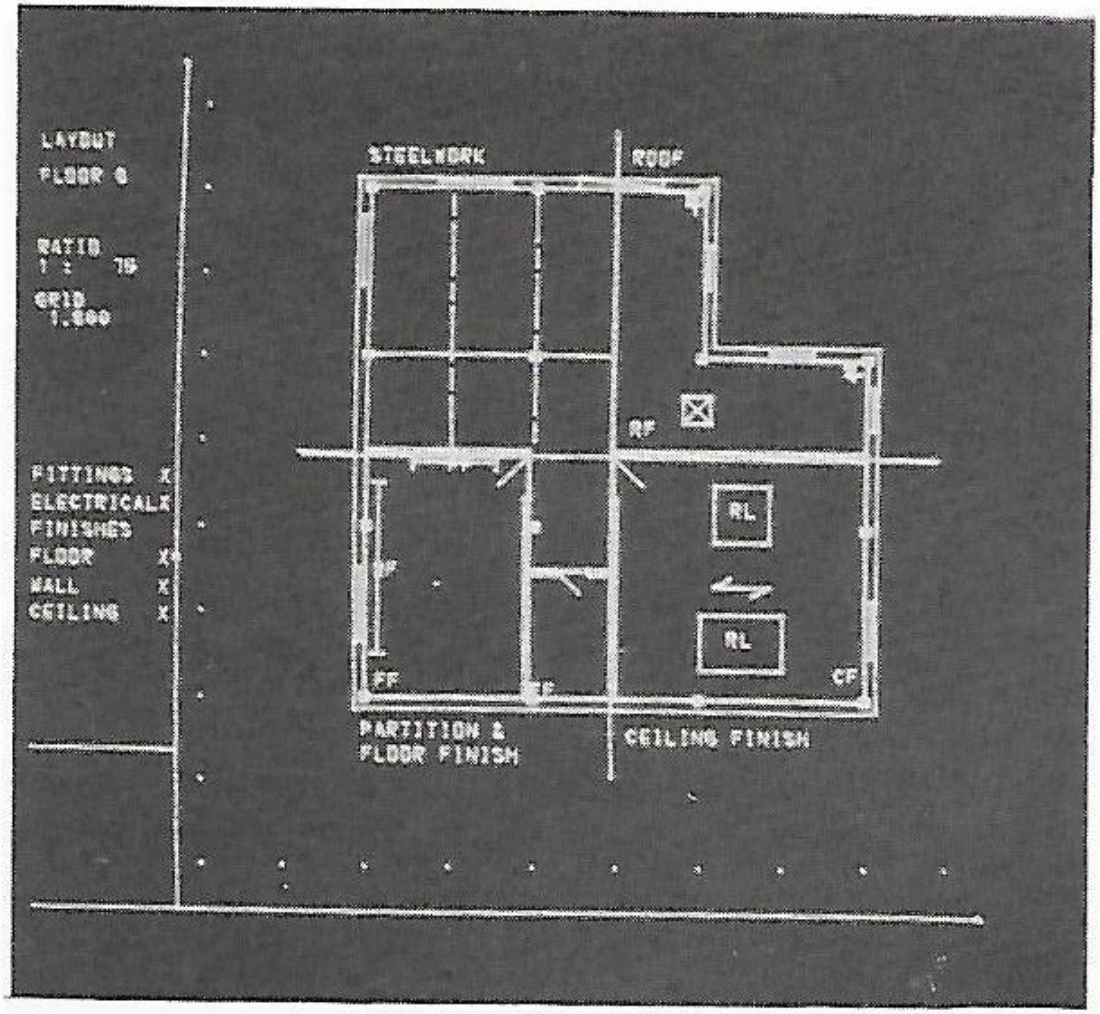
Then the computer produces outline plans for:-

- Foundations
- Each floor
- Roof

Structural system developed

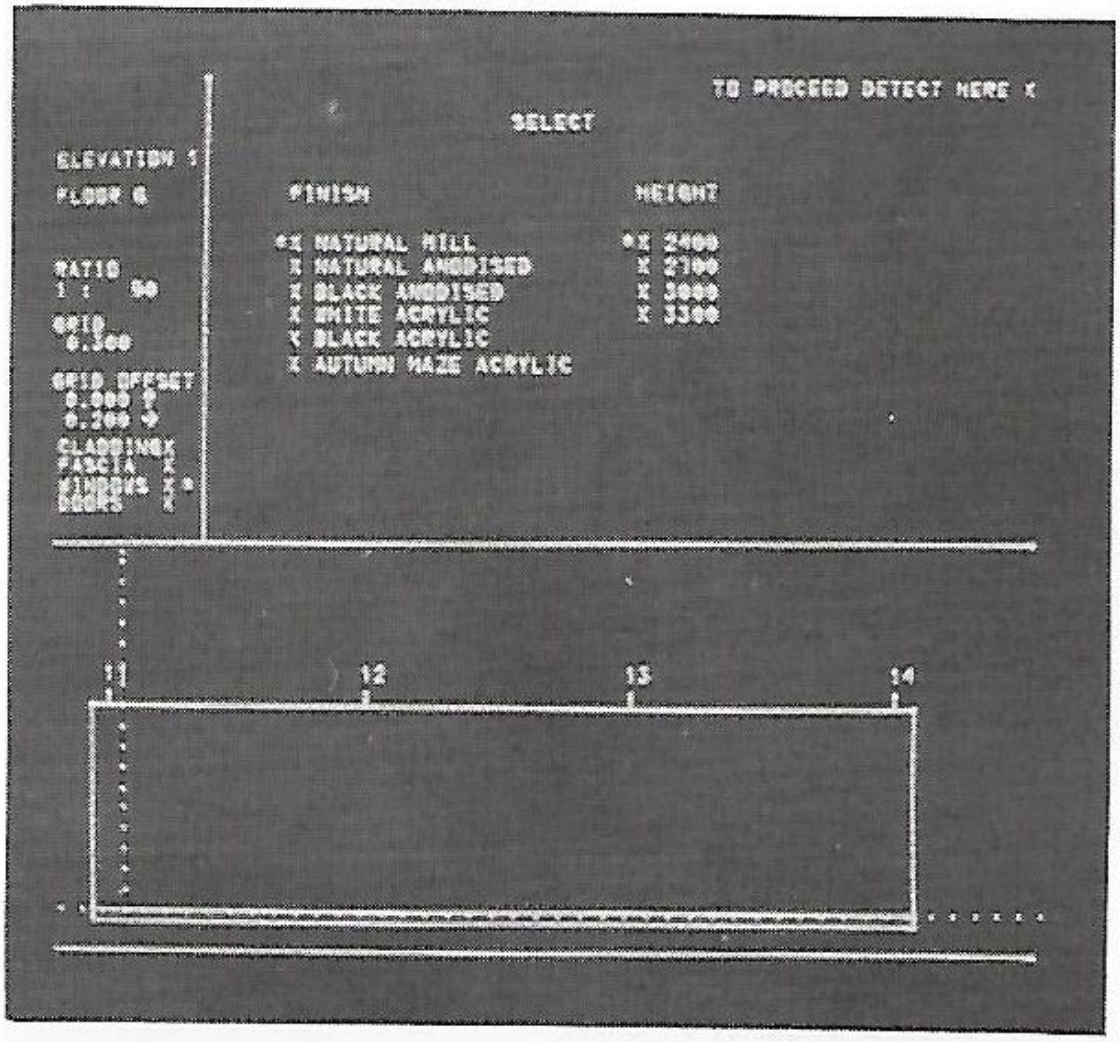


Each quarter demonstrates inserting:-

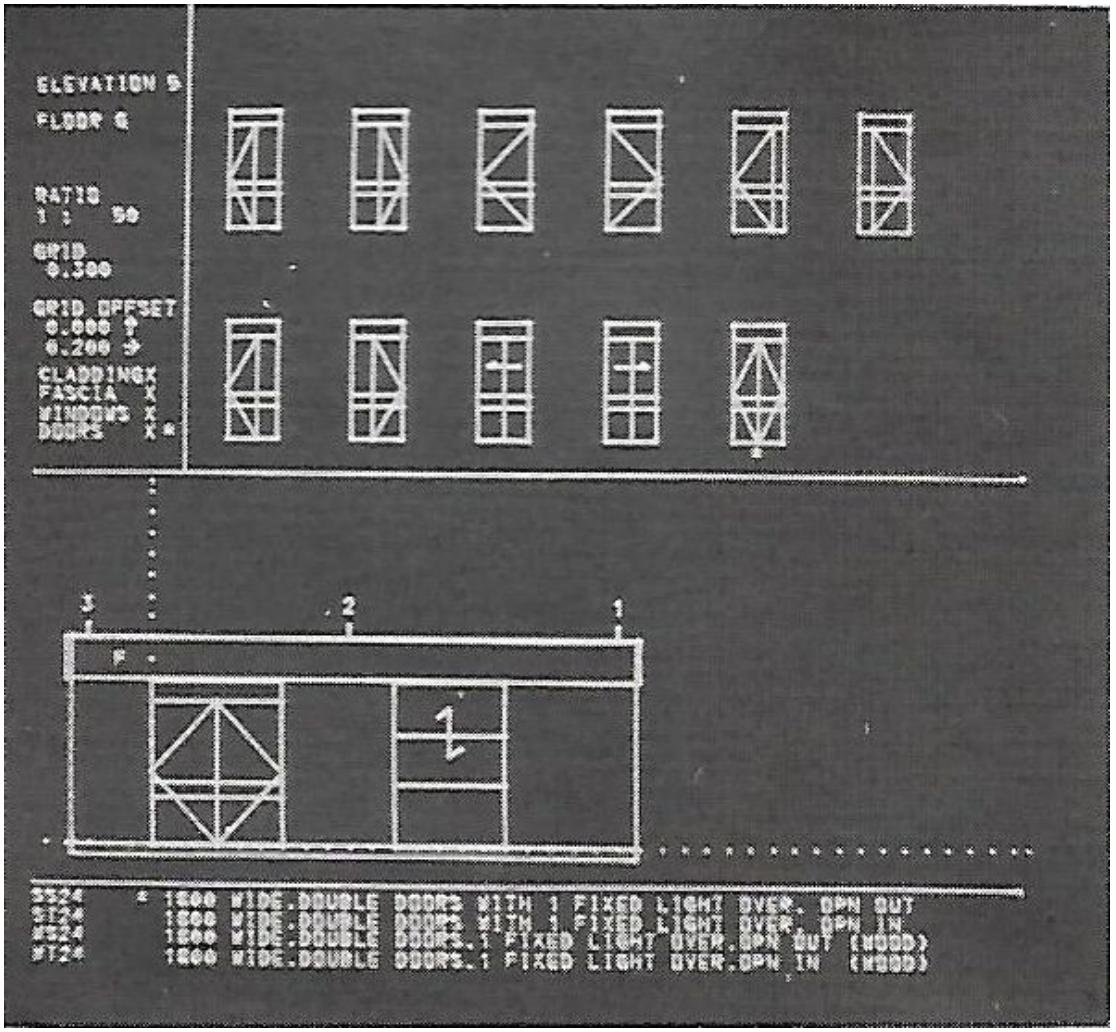


- Structure
- Roof
- Ceiling
- Space dividers and finishes

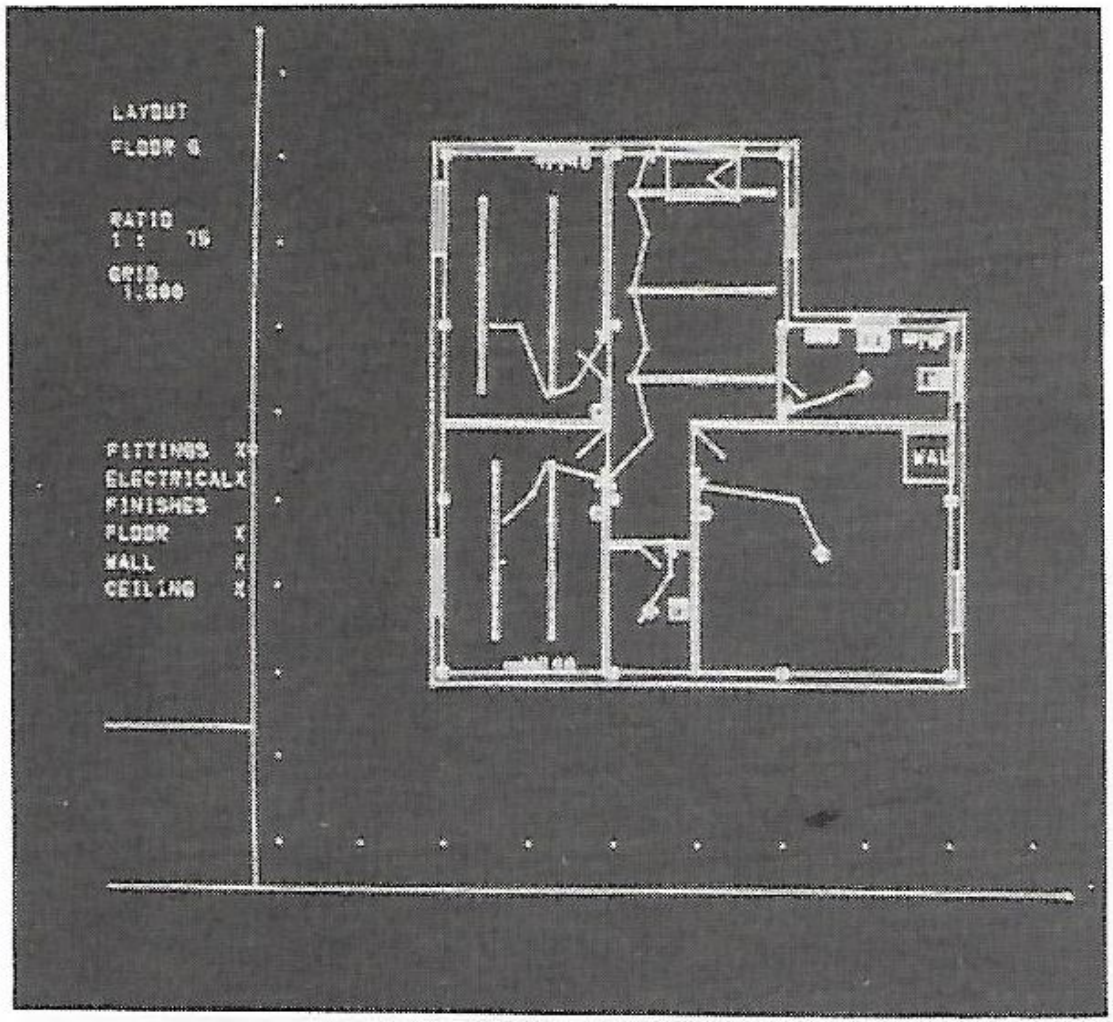
Computer offers materials for elevation



Inserting windows into an elevation



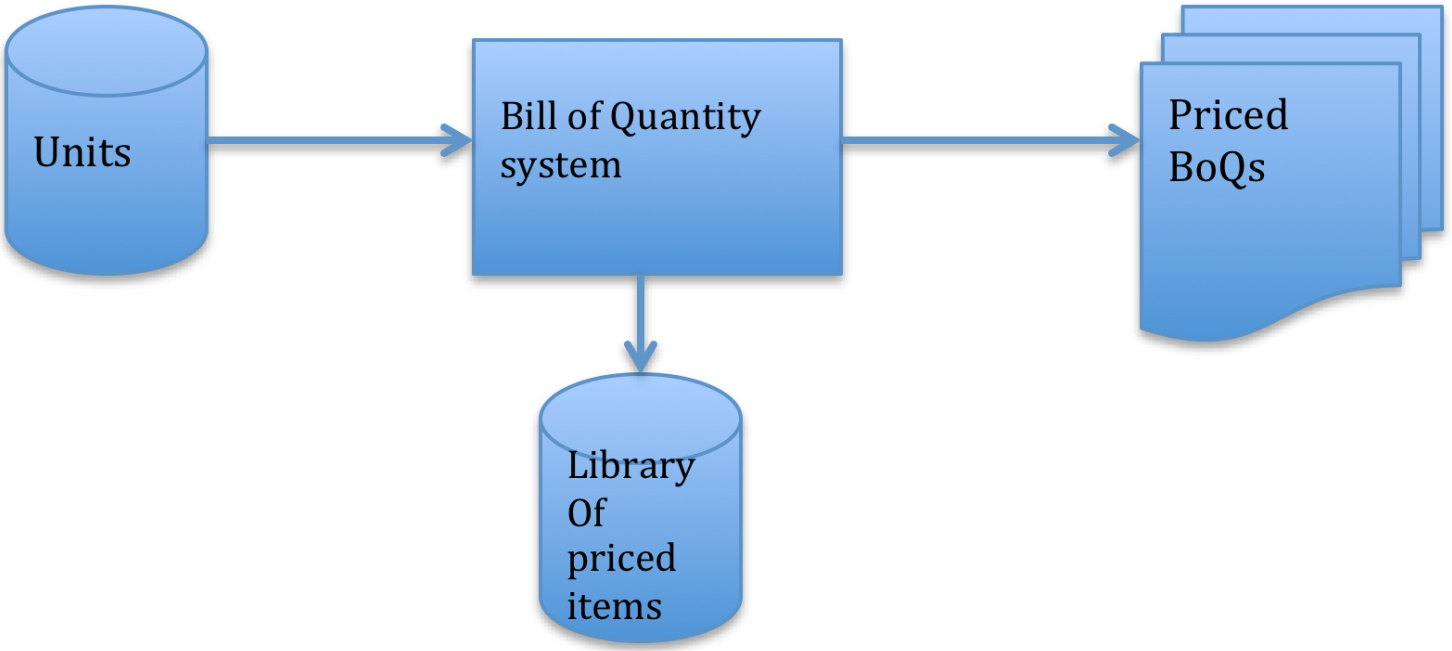
Electrical Engineering details



Outputs for a building from plotter

- Steelwork plans
- Sketch plans - Lighting levels, heat loss
- Floor plans with flooring spec
- Roof plans
- Elevations external and internal
- Fitting layouts
- Perspectives
- Site layouts
- Services
- Critical path network

Bill of Quantity System



Outputs from printer

- Priced Bills of Quality (BoQ) by:-
  - Trade
  - Network
  - Functional group
  - Work sections

- List of items to be bought (prime cost items) and their suppliers and their prices

Master Files

Blobs Rules– coordinates and vectors of each blob with any inferences for other blobs

Blob details – Full range of options available to designer

Priced Library of Items with breakdown (updated by QS):-

- Material
- Activity time
- Plant
- Manpower

Design files

Units – chosen units for a design

Plans – tape of all coordinates for the production of site plans for the design

Library of items with their MAMP

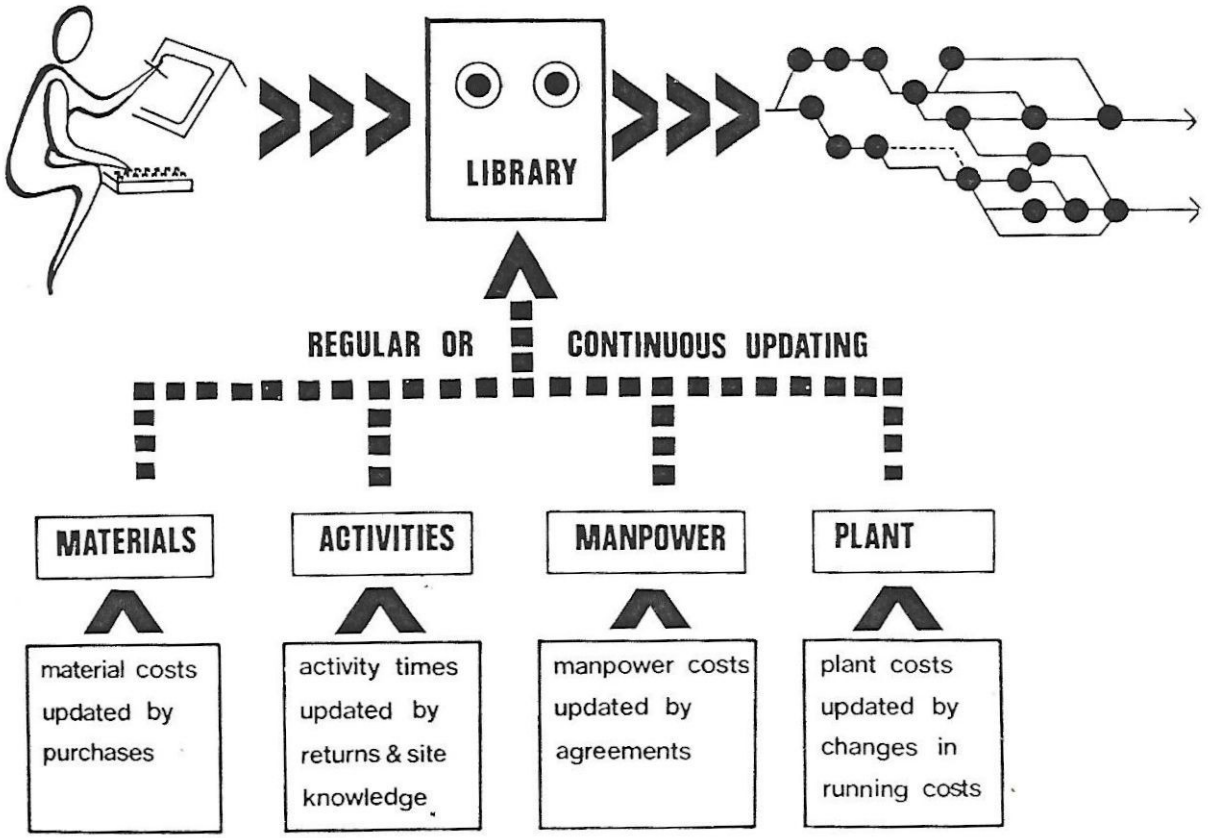


Figure 38

File structures – all IBM standard

- Sequential – fixed length records
- Sequential – variable length records
- Indexed sequential
- Hierarchical database structure

Associated documents

The following documents were used by architects and contractors:-

- Dimensional rules of design
- Catalogue of building components
- Assembly drawings fully detailed for construction
- Building Specification – standards of workmanship
- Schedule of works
- MAMP and prices

Tender process

- Much faster tender process than traditionally due to the BoQ being priced

- Tendering Contractors receive documents:-
  - Priced BoQ with total cost
  - Plans
  - Elevations
  - Costed and time scaled networks of estimated resources

- Contractors tender is:-
  - A percentage to be added or deducted from total cost
  - Lump sum to be used if tie break needed

Associated systems

- **Site survey system** – survey feeds his survey data and plotter produced a site pan with contours

- **County properties data base** – included an enquiry system based on attributes of performance or material. [Long before relational database systems were available].

…….afterwards

- This system was ceased when the County Council was reformed in the mid 70's for many political reasons
- It was taken to Harwell and loaded on their computers and stored for posterity!
- Reading University continued to develop it for microcomputers when they became available.
- Due to the development of all aspects of technology there are now many similar systems available for architects.
- However none have gone the route of fixed price tendering.