Knowledge Based Expert System
Computer Aided Climate Responsive Integrated Approach to Architectural Design

PROF. DR. ARVIND KRISHAN
Former Dean & Head Dept. of Architecture School of Planning & Architecture New Delhi
Currently: Principal Architect: Center for Architectural Systems Alternatives, New Delhi
arvindkrishan@vsnl.com & arvindkrishan@gmail.com
Web: http//www.arvindkrishan.com

ABSTRACT: *Architectural design is indeed a complex process. Can this process be translated into design decision making process through a knowledge based expert system and achieve ecologically responsive architecture ? is the quest of this paper. The computer aided system presented offers a system that supports such architectural design decision making.*
Keywords: *Knowledge, Architecture*

1.0 CLIMATE RESPONSIVE ARCHITECTURE - THE TOOL AND THE PROCESS

Process of architectural design is a complex exercise, involving interactive relationships between parameters of diverse nature and varying magnitude. Yet, it is the prime generator of architecture as we see and experience.

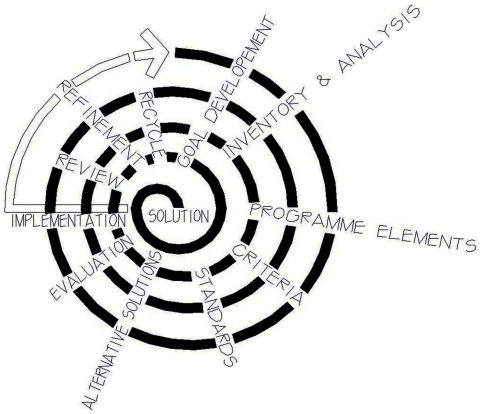


Fig 1.0 Graphical Representation of Process of Design

2.0 HISTORICITY:

Various ideas have dominated architectural thought from time to time. **Yet, the fundamental issue of energy as an embodiment of Sun, Wind and Light – the ecological context - have not been a basic paradigm of design**. Therefore relationship between built-form and ecology should become the driving force behind the process, based on a scientific methodology – leading to climate Responsive Architecture.

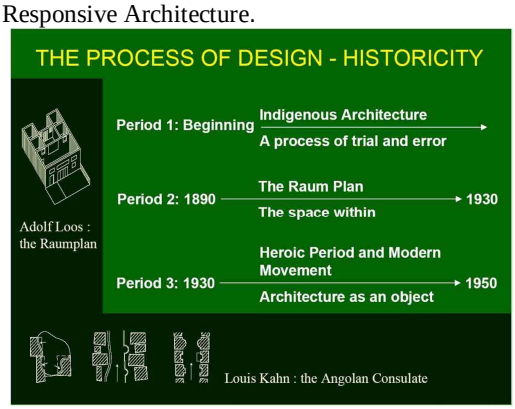


Fig 2.0

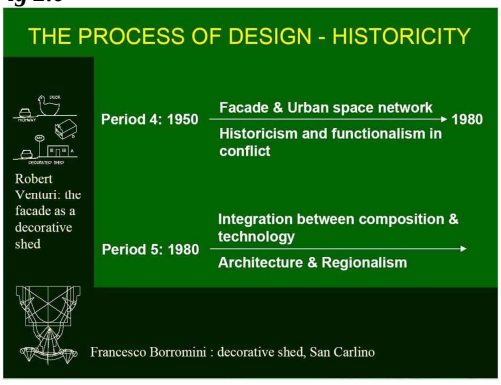


Fig. 3.0

3.0 ECOLOGICAL PROCESS OF DESIGN:

The idea of climatically responsive design is to modulate the conditions such that they are always within or are as close as possible to the band of appropriate design.

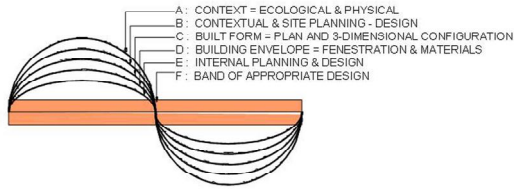


Fig. 4.0Ecological Process of Design

3.1 KNOWLEDGE BASED EXPERT SYSTEM

Architectural design decision making is based on a knowledge based expert system presented below in the form of a '**Design Matrix'**. Based on climate analysis the user can make design decisions proceeding in a sequential manner through the design matrix. At every step, design decisions relating to the following can be taken. Site Analysis, Built Form, Street Patterns, Surface Textures, Vegetation, Water bodies, Plan form, Roof Form, Fenestration configuration, Day-light distribution, Building element i.e. roof / wall layering and Building Control details. These decisions are supported by a quantitative and qualitative data base.

Conceptual planning and design decisions taken through the above expert system are stored in a '**Design File**' which are then used to arrive at a final design through a graphic package

.

3.0 DESIGN MATRIX AND THE EXPERT SYSTEM

Design and more so architectural design is intrinsically a decision making process. Computer aided knowledge based expert system based on a 'Design matrix' presented below enables design decision making to achieve ecologically responsive architecture.

Climate Responsive Architecture 1.0 An integrated approach to design is a software developed to achieve ecologically responsive architecture.

3.0 CLIMATE ANALYSIS

A comprehensive data base of climate for India i.e. its various parameters, is built into the system as reference and for use in various computational sections of the software. Climate is analysed and presented in the form of 'Eco-Charts', 'Comfort Charts', 'Solar Charts', 'Radiation Charts', 'Mahoney Tables'. These are available for a select number of locations – one for each climate zone of India. These charts can be generated through the software based on the climatic parameters data base. The data base can be expanded by the user, at any point in time, to include any global location.

These 'charts' are not only indicators of climatic parameter variations but are used in the process of development of design strategies and design decisions.

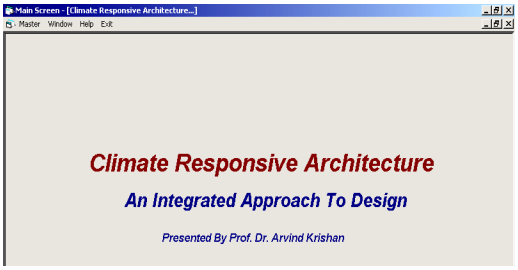
3.3 ANALYTICAL SECTION - EXPERT SYSTEM:

Conceptual and final design can be analysed for thermal performance and day-light distribution through following modules. All modules are user-friendly and graphic in presentation and results.

- Thermal Performance parametric analysis
- Ventilation
- Day-light distribution

4.0 DESIGN DECISION MAKING MODULES:

SCREEN 1:



Master Screen for accessing Various modules

Screen II:

Step 1:To access Climate Analysis through Eco-Charts, Comfort Charts, Solar Charts, Radiation Charts, Mahoney Tables.

Step 2: Location Details

Step 3: Generate Design and References

Step 4: Quantitative Analysis

Screen III:

Design File indicating selections from Design Matrix.

Screen IV:

Step 1: Design Space (Zone) parameters.

Step 2: Quantitative assessment of Conductive Heat Gain, Daylight Factor, Ventilation, Radiation Gain for Glazed Surfaces, Radiation Gain for Opaque Surfaces and Ventilative Heat Gain.

Screen V:

Daylight Factor Calculations. Initial (SC), Final (SC), ERC, IRC, Initial (DF), Glazing Factors (GF), Framing Factors (FF), Dirt on Glass (D), Final (DF), Target DF.

Screen VI:

Establishing Initial Sky Component From Section

Screen VII:

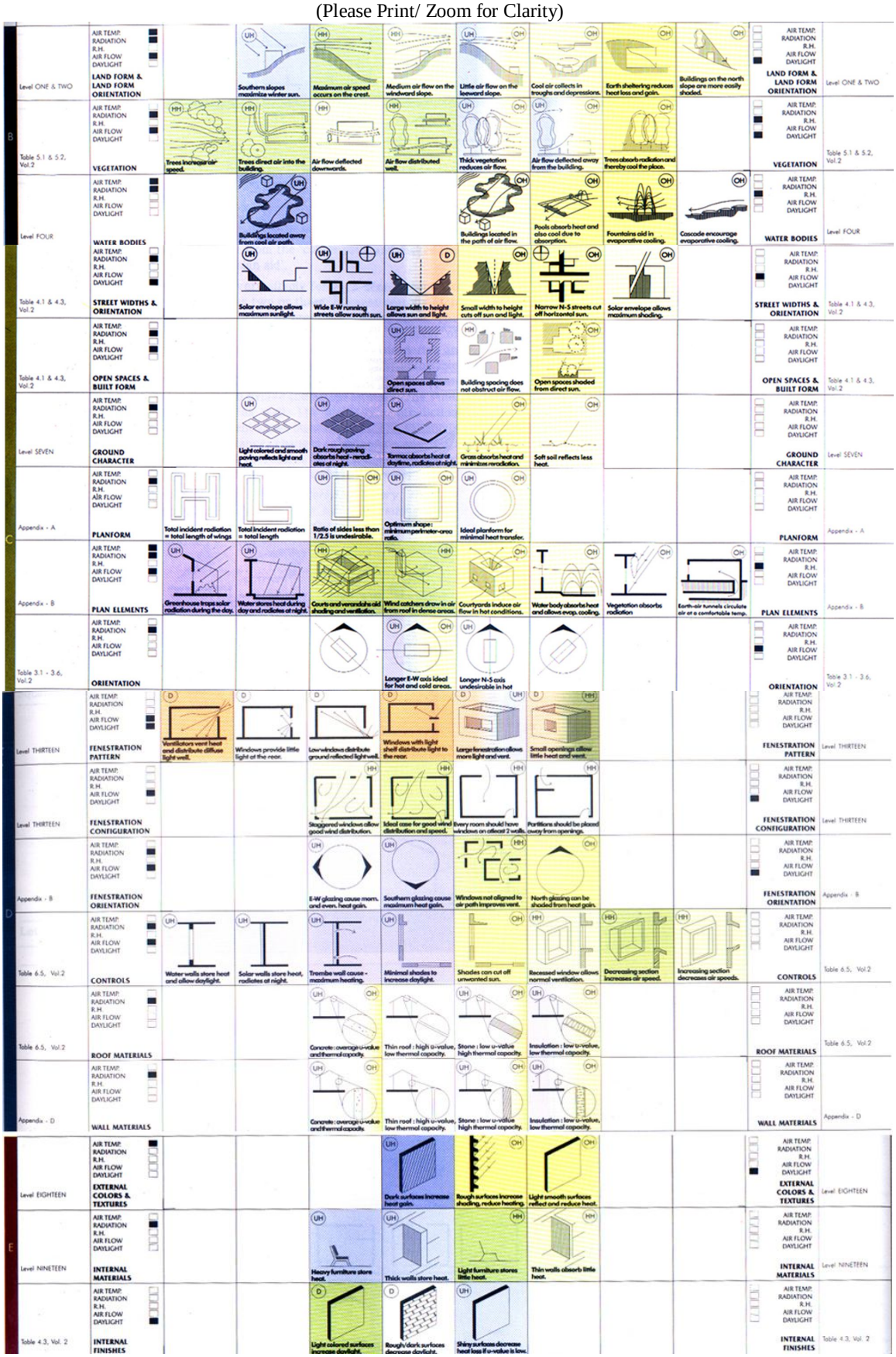
Nomogram for Average Internally Reflected Component.

5.0 CONCLUSION

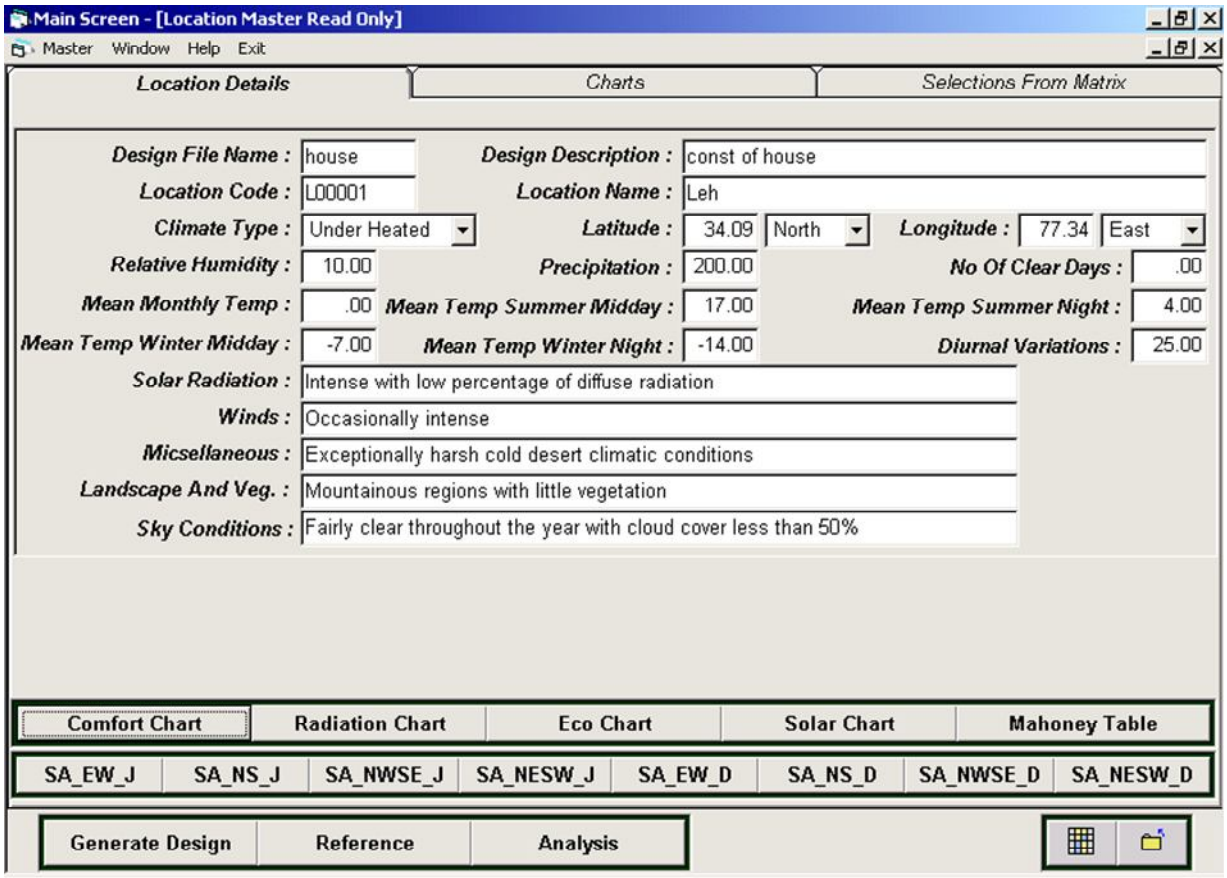
In a user-freindly interactive manner this expert system allows analysis, design decision making to achieve climate responsive architecture which leads to sustainable solutions.

DESIGN MATRIX

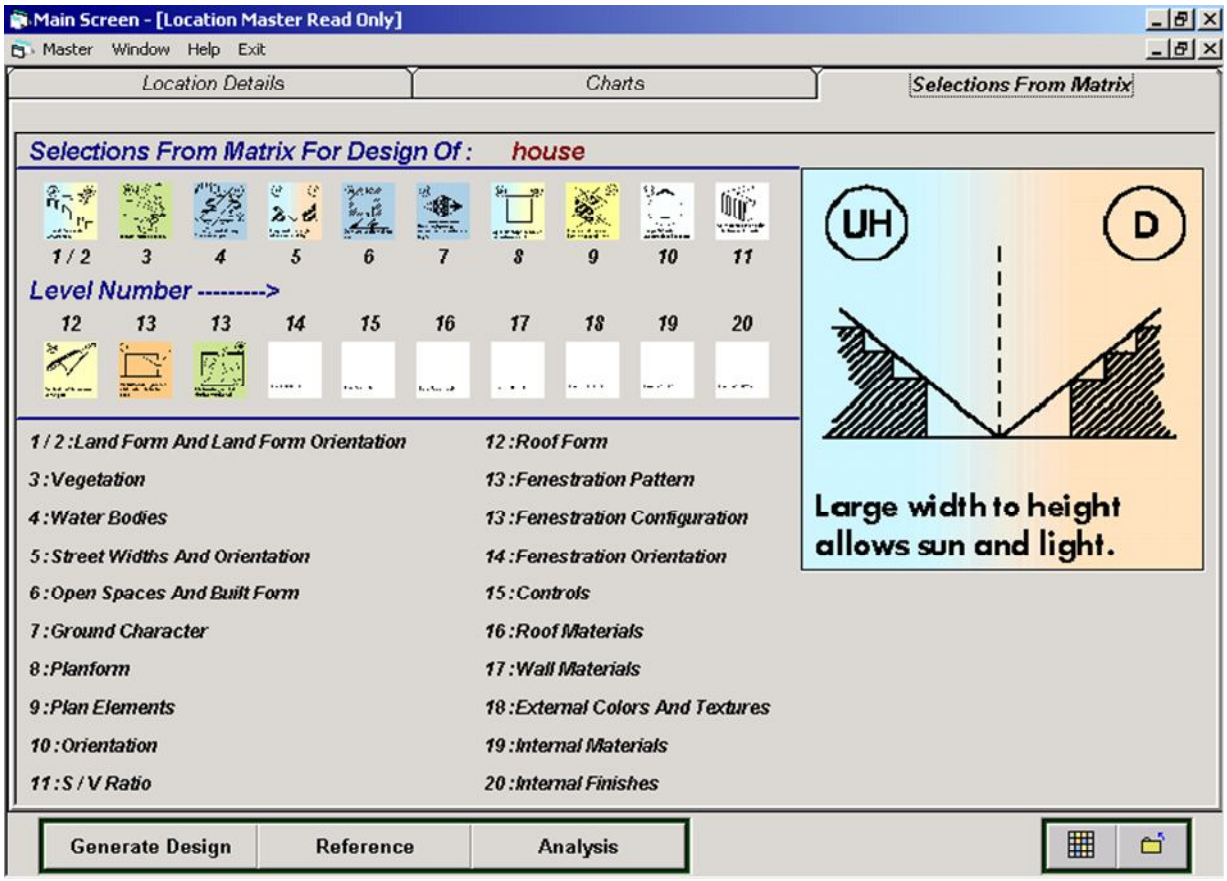
(Please Print/ Zoom for Clarity)



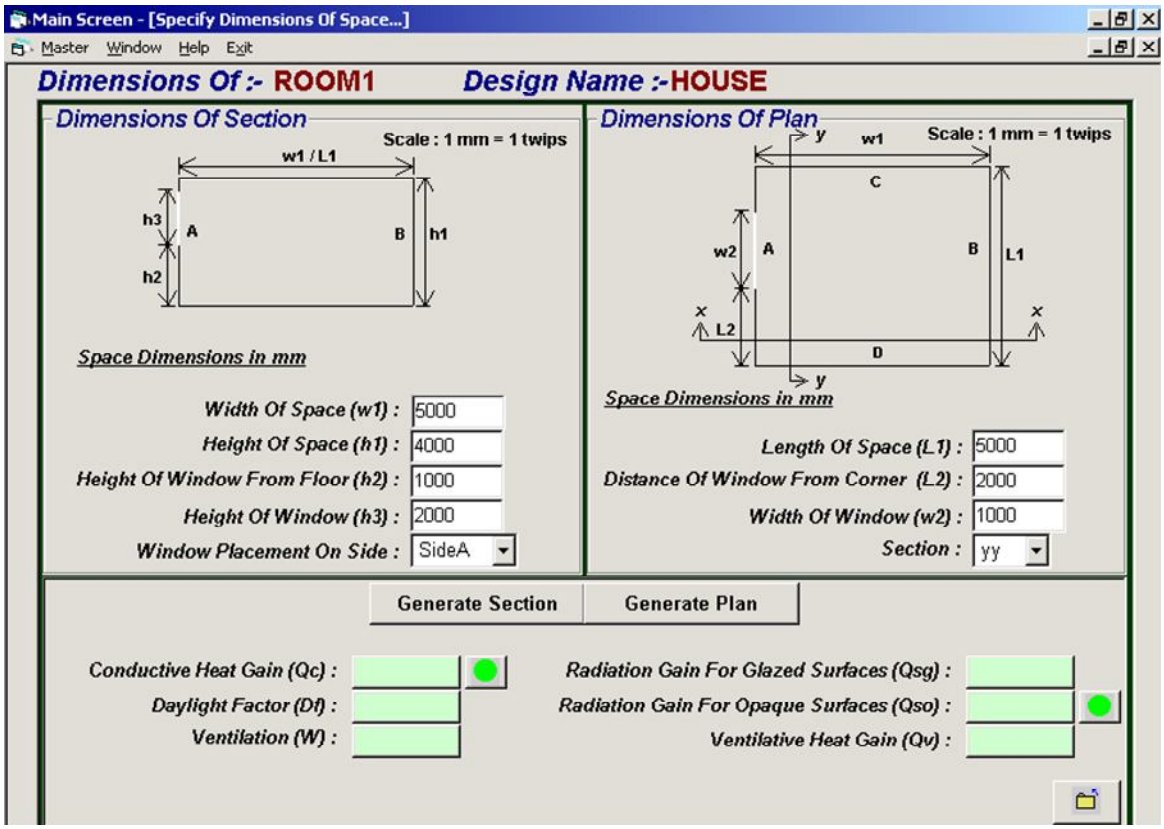
SCREEN - II:



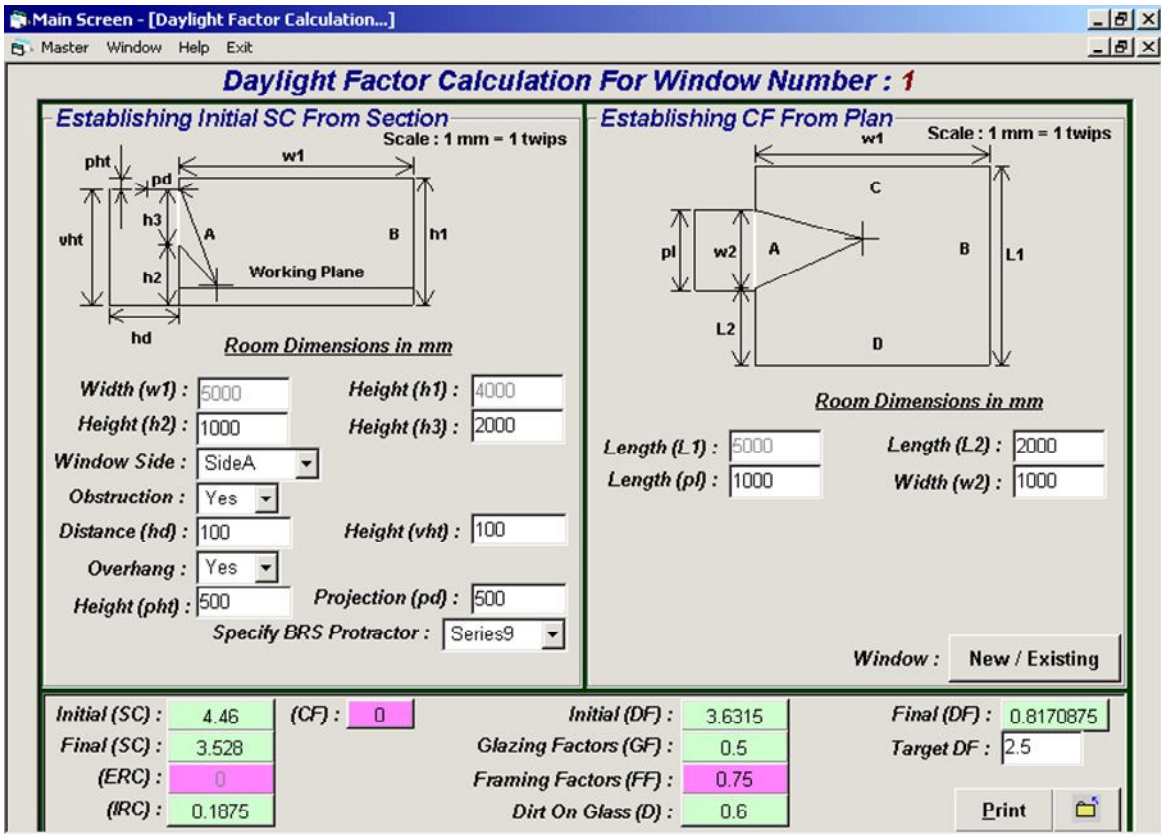
SCSCREEN - III:



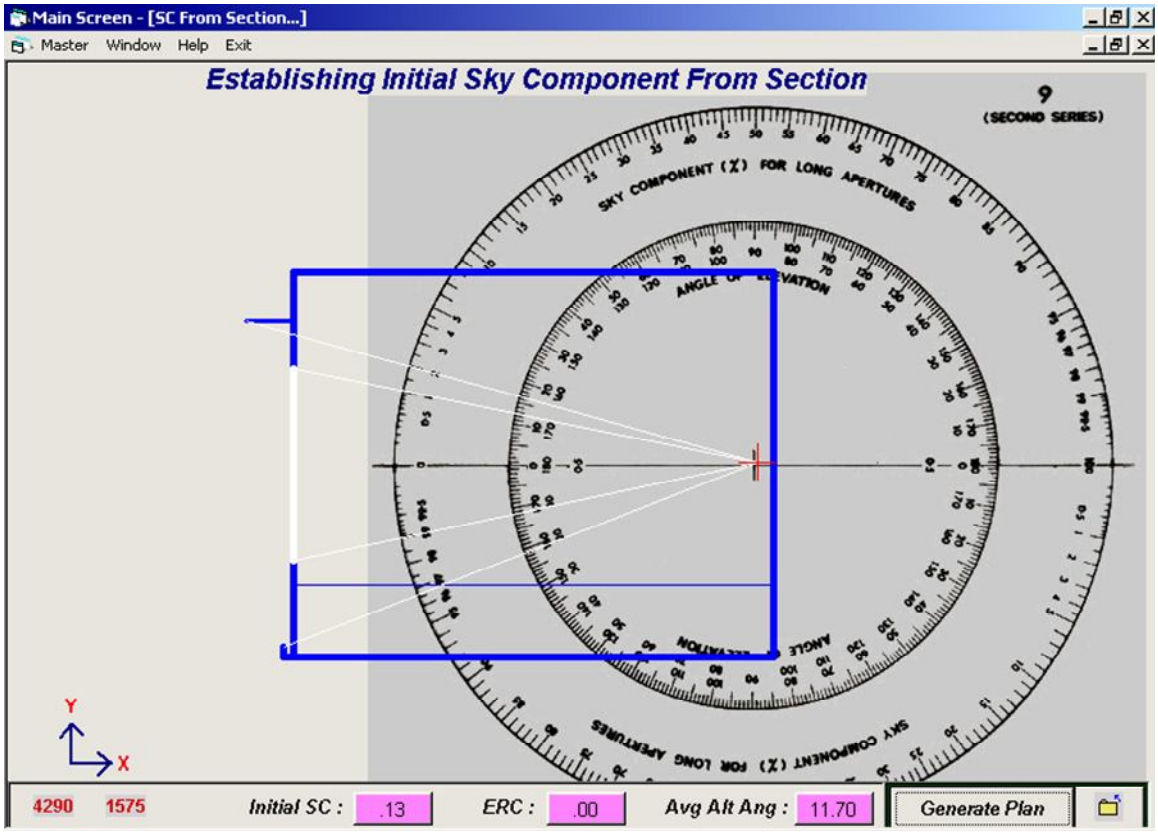
SCREEN IV:



SCREEN V



SCREEN VI:



SCREEN VII: