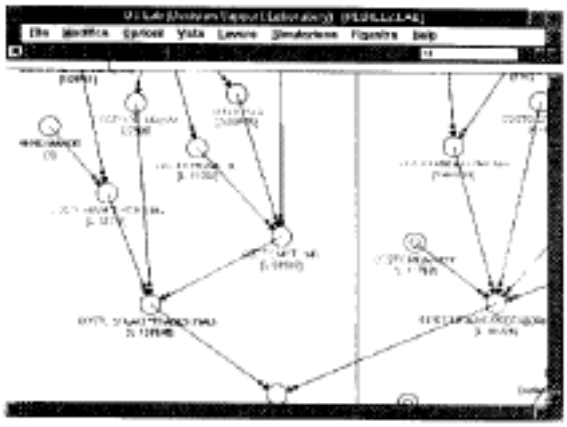
CAAD in Education experience at Politecnico di Milano – DISET

Alfredo M. Ronchi - DISET Politecnico di Milano - Italy



ABSTRACT

The subject of this presentation may be resumed in a preface about the relevance of CAAD in Education and the main objectives of teaching. This part of paper give details on students curricula and skills.

The evolution of the program of the course "Progettazione Edile Assistita" is presented pointing out the method used in education and the main software adopted; particular relevance is reserved to some particular works of the students concerning both software development and application programs results.

The third paragraph presents in detail the main results obtained using diagrams and other outputs.

The last part of the presentation is devoted to conclusions and the main projects for the future developments of the course.

Preface

Nowadays is becoming even more important the application of Computer Aided Design technologies on the workplace so the same relevance is transferred to educational field this is the reason why Education in Computer Aided Architectural Design is so actual and relevant in Europe.

The standardization of engineering studies in Europe plans two courses about information technology. At Diset of Politecnico di Milano we offer a course Galled 'Fondamenti d'informatica' [Information Science Fundamentals] and a second course called 'Progettazione Edile Assistita' [Computer Aided Building Design].

Fondamenti d'informatica is a theoretical course about, as tells the title, the fundamentals of information science. This course gives a solid base of knowledge to all the students attending to civil engineering courses.

Progettazione edile assistita is the natural extension of the first course, it is devoted to practical application starting from a brief history of computing, summarizing the main steps in hardware and software evolution.

The main goal of this course is to explore both in theory and practice the universe of computer aided design solution and office automation implementation.

Starting from the skill of the auditorium we can consider that who attend to this course has no doubt the capacity to understand hardware and software subject and is able to design small application software working with C++, Modula 2 or Visual Basic.

Let we start from the first edition of this subject in first '80ies .

The main theme presented concerned about drafting and solid modeling applications moving from minicomputer to workstations toward personal computer. The earlier works were in fact developed on minicomputer like HP 1000 / A900 using GBG Draft maker and Shape maker software. Seventy percent of the lessons were devoted to graphic applications and the remaining part was to point out the use of computer in technical data base management. A typical use of these procedures was the creation of a complete set of drawings about the case of study in Architettura Tecnica [Building Technology and Architecture], a simple 3d wire-frame representation of the building [sometimes directly implemented by the students using transformation arrays and geometry database]. Other typical laboratory product may be synthetic application of bill of materials and cost analysis procedures, project and cost management via software procedures like Hp Project Management for 9000/200 series and later Ms Project. Quite in the meantime some students start to work on workstations using CAD procedures especially for thesis.

Teaching in this period was pointed out to show special algorithms for computer graphics and explain the use of CAD applications characterized by hard man/machine interfaces based on complex string of commands and right hand rule. Students spent a lot of time to gain acquaintance with such software, on the other hand the system architecture of mini computer even though not so powerful to manage many graphic terminals [a maximum of four users each computer], was very smart for users account, security and storage device management.

In middle '80ies we turned our strategy on PCs opening a new laboratory of CAAD completely based on PCs sharing resources via LAN. The policy was a Client/Server architecture achieved using one power server equipped with 12Mb ram, 50OMb HD and OS2 plus Lan Manager and Client 386. The last one equipped with 4Mb ram and 40 or 80 Mb HD running MS DOS + Windows.

This architecture enforced the productivity of the laboratory and shorted up the training of students.

At the end of '91 we turn to Windows for Workgroups peer to peer LAN system software reaching a better integration between network environment, graphic user interface and application.

The actual implementation of this project enforces the use of windows applications versus DOS character or proprietary GUI interface aiming to a better office automation solution via the real integration of application. This kind of integration and synergetic effect may be achieved by DDE and OLE technologies or Visual Basic for Application and further implemented in Windows. Our goal in the case of study is to join and link together existing general purpose or vertical application to achieve better results in CAAD field. Generally speaking about the criteria of choice we encourage the use of 'standard' [de facto or by law] hardware or software.

All the above preferring a standard wide range solution, simple to implement even in the real life than a high end solution based on 'top' hardware and software.

The real aim of this course is to let the student touch in preview the current state of art with a good visibility of further evolution and strategies.

Laboratory

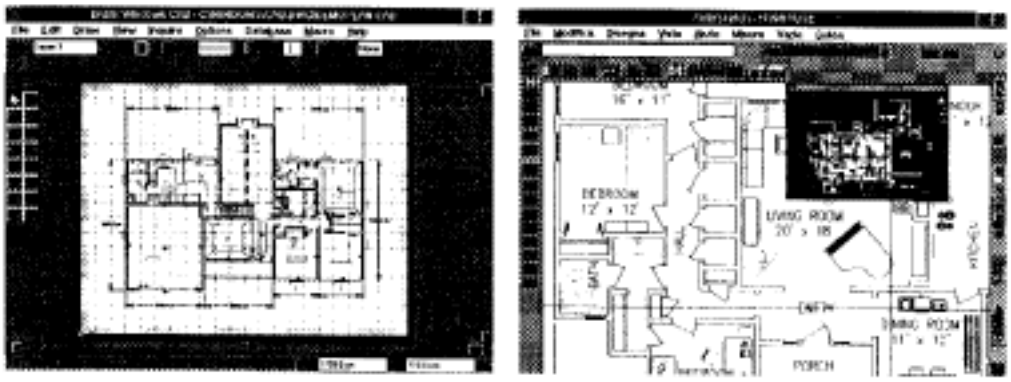
The laboratory [1] sessions of the course may be summarized as:

first part - drafting, 3d modelling, rendering and animation

second part - design and development of applications.

Let us speak now about some examples of work carried out by the students in the last two years.

Drafting & 3d modeling :Tadao Ando - kouskino house



The first example is a pure application of drafting, 3d modeling and walktrough animation as required in the first session of laboratories. The student became familiar with a drafting procedure starting with an architectural theme from Architectural Design, Building Technology or some special houses like this one. We have a complete set of drawings representing the house, a 3d model 'dressed' with patterns, materials and physic characteristics to became the kernel of the animation. Four hundred frames in medium resolution with 32k colors is the final result of this gouroud and phong shaded scene.

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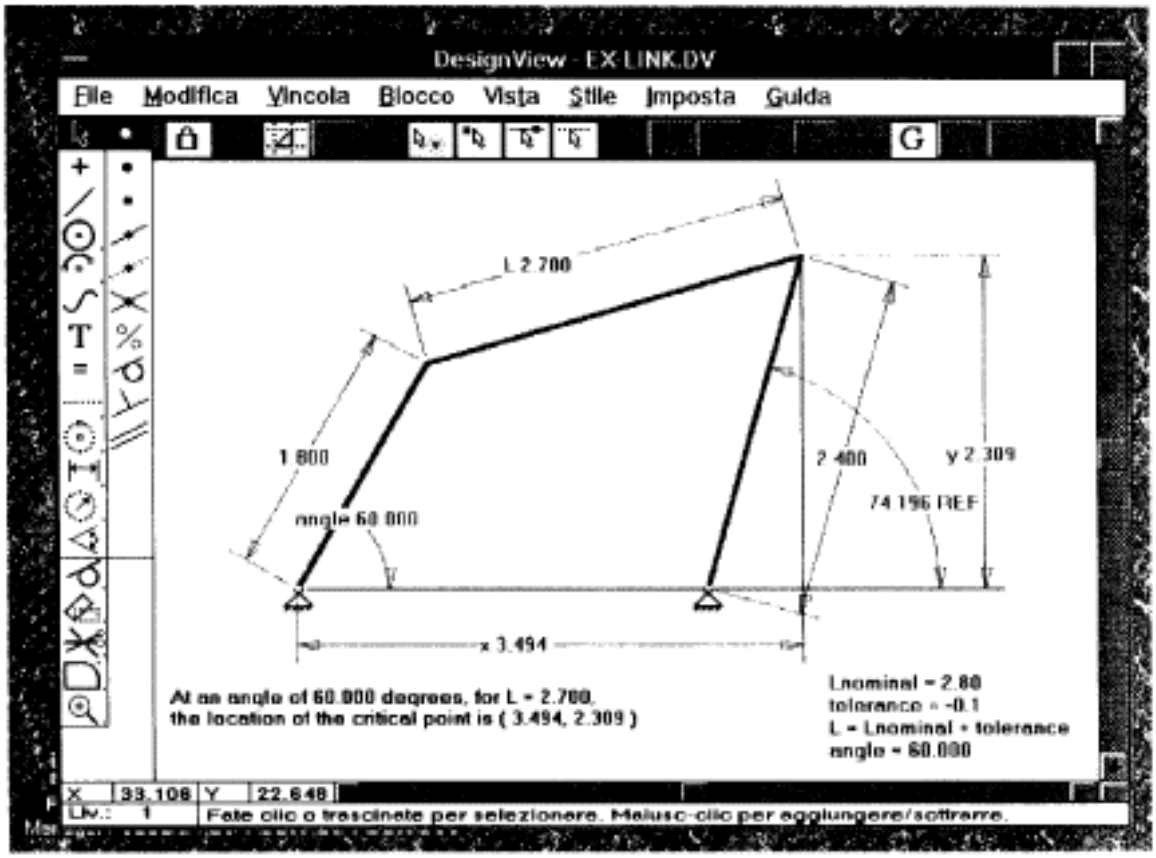
[1] A complete description of subject is enclosed in appendix A1

More recently some students start to use real CAD procedures like Computervision DesignView. Such product let the designer start dimensioning while he is drafting.



Virtual Reality

The second case of study is, for example, a work concerning virtual reality application to civil engineering. Three years ago the students start to experiment Virtual Reality in a 'passive' manner (form). They worked side by side with some VR companies testing virtual 'worlds' with HMD (head mounted display) and gloves. A further approach was start studying developing environment and the capabilities of such systems, so they start to test some develop tool kits running on PC platform. The main interest in addition to the design of a Virtual Space/Place editor [2] is no doubt the support in knowledge process. As we know the process of knowledge is perceptive/motory or symbolic/re constructive. The first one is typical for children (try & error) while the second one is typical in high studies (abstraction). The first one is a typical application of VR changing from abstraction level to try & error level many applications.

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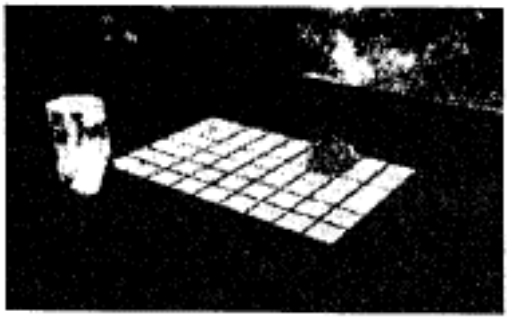
[2] for further information about "Virtual Place/Space Editor" see the proceedings of "Realtà Virtuale Workshop" DSI May'93

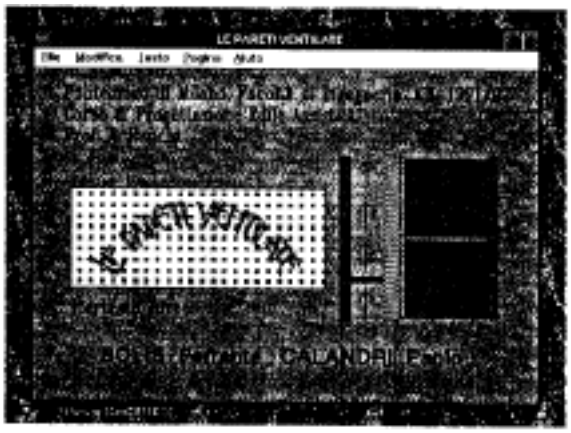


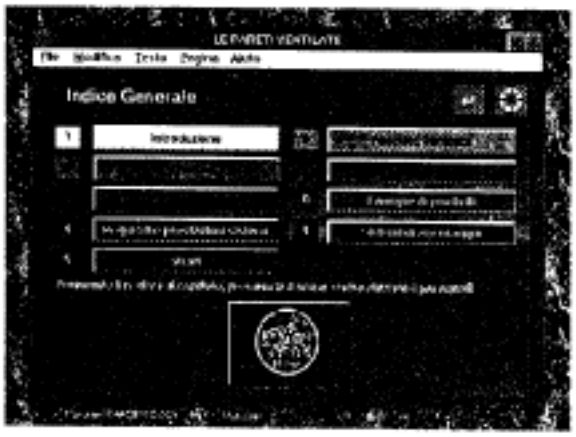
Software solutions [3]

The third case of study consists in a procedure for digital photogrammetry. Starting from pictures took by a non metric camera and a set of measure for pass point and control point directly took "in situ" the procedure, completely developed and running under Windows, Compute the morphing of the picture to equalize and resample the image. User can choose the level of precision needed, the measured points and the format of the bit map image (BMP, TIFF, PCX, TGA, WMF etc.)

Hypermedia

A very common subject for laboratories is hypermedia titles. Using authoring software on authoring workstation [4] Students create their own multimedia title on architectural or technical subject. A collection of monography closely related to generate a sort of 'on-line' handbook. Someone tries to adopt this technology to present building design.





Simulation & decision support systems

These applications are very interesting because you can easily simulate a model using a graphics approach and than declaring the rules for each node the user can simulate for a defined number of cycles the entire system. Typical examples are hi-end project management, cost management, programmed maintenance, energy distribution etc.

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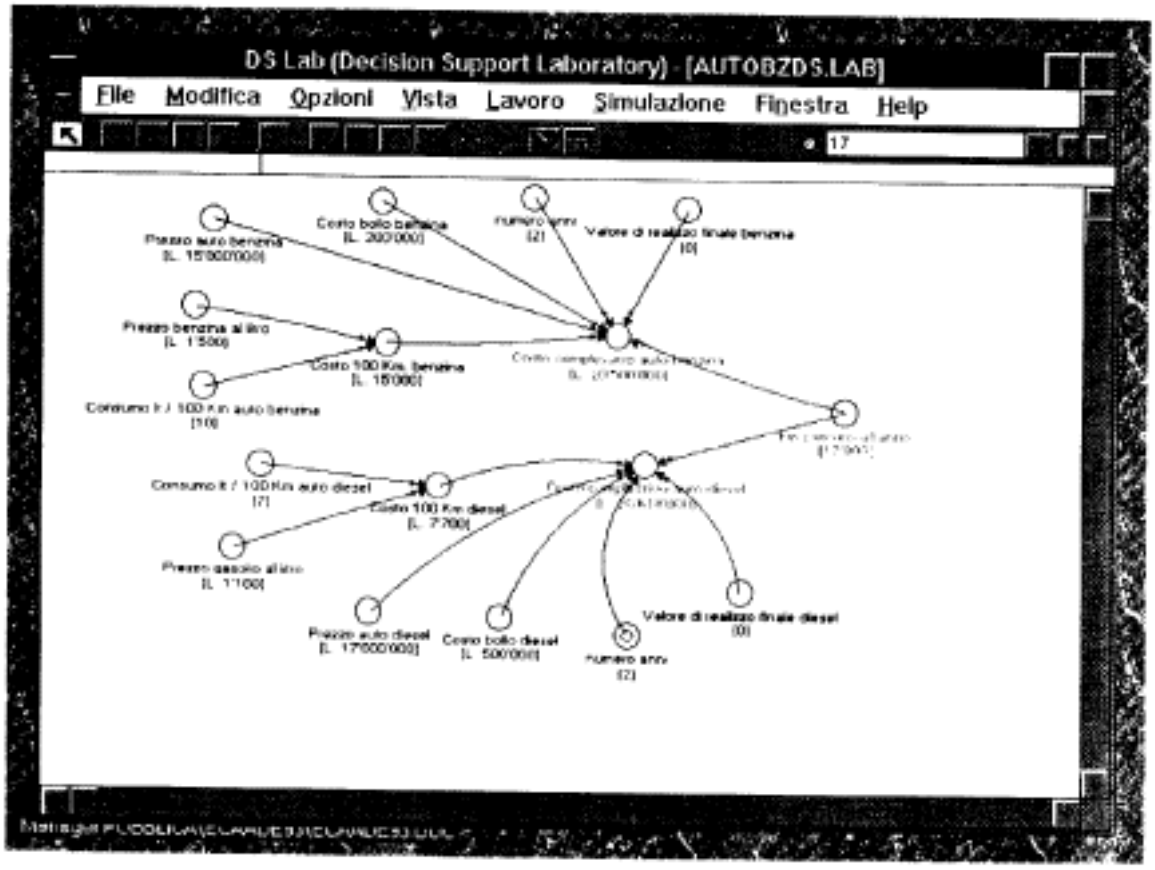
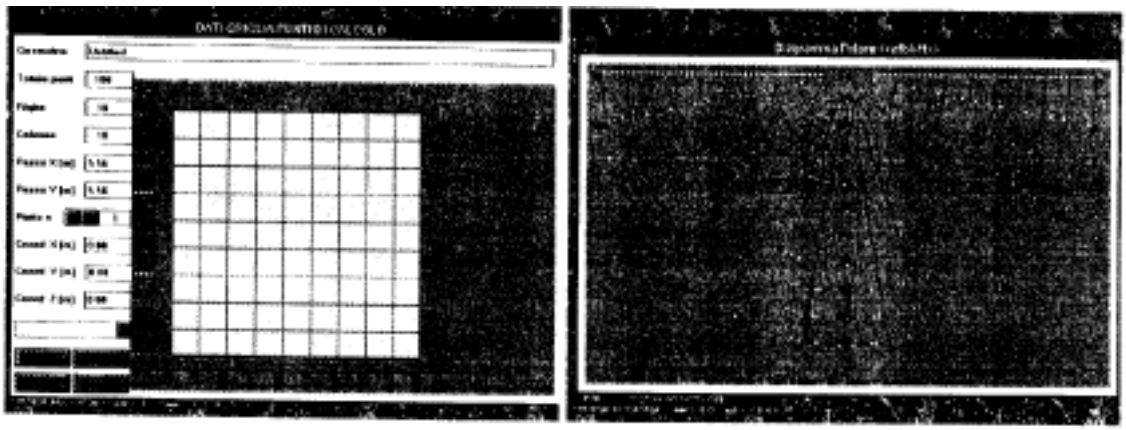
[3] For more information see the tables in appendice B

[4] Powerful 486 PC equipped with audioboard, videograbber, color scanner, cd reader, etc. etc.



URCA: Unbelievable Radiosity Cad Assistant [5]

This work is now under development. The main aim is to create a lighting design computer aided system. The system will run on Windows NT systems like DEC Alpha AXP or multiprocessors NT platforms. This software will use multi-tread and multi-tasking capability of NT.



The design system starts from photometric data in CIE or spreadsheet format and geometric modeling made by DXF file or keyboard. Using preview tools the designer may control the result of

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[5] ask for separate brochure for more information

fittings' installation and made up modification even requiring numerical maps about energy distribution. The last part of design is a full rendering using radiosity and ray tracing techniques.

The ultimate idea is to connect such system to a virtual reality engine, modifying or trimming real time the scene.

These are in summary some typical works carried out by the students of DISET.

Milano, October '93

APPENDICE A
description of subject

COMPUTER AIDED ARCHITECTURAL DESIGN AJO103

[PROGETTAZIONE EDILE ASSISTITA] Prof. Alfredo M. Ronchi

Introduction to computer aided architectural design, a brief perspective of the computer aided architectural design, base methods and tools, computer system architecture, software systems architecture. The algorithm concept, operating systems, application software. A preliminary functional description of an elementary computer system. A short account of some operating systems used in CAAD's field, introduction to base operating procedures.

Main hardware and software components used in CAAD solutions, state of art. Main operating systems used in CAAD solutions. Brief description of man/machine interface, main operating environment (CUA, SAA, GUI). Graphic interfaces, windows operating environment. Brief description about main filing and data retrieval technics. Design methods for technical data bases.

Introduction to computer aided architectural design procedures, electronic drafting table tridimensional solid modeling, interactive graphics. Vector vs/ raster graphic.

Introduction and description of main computer graphics algorithms, a prototype of graphical system. More about architectural solid modelling technics, rendering and shading models (Gouraud, Phong, ray tracing e radiosity). A short account on main architectural 3D models animation technics, walktrough, virtual reality systems in CAAD applications.

Main output systems, plotters, printers, animations and video tapes. Real examples in working environment, engineering companies, building companies etc.

Critical analysis about productivity of computer aided architectural design solutions.

Introduction to bill of materials, cost evaluation and cost analysis. Bridge software solutions between drafting / solid modelling procedures and design methods of main building sub-systems.

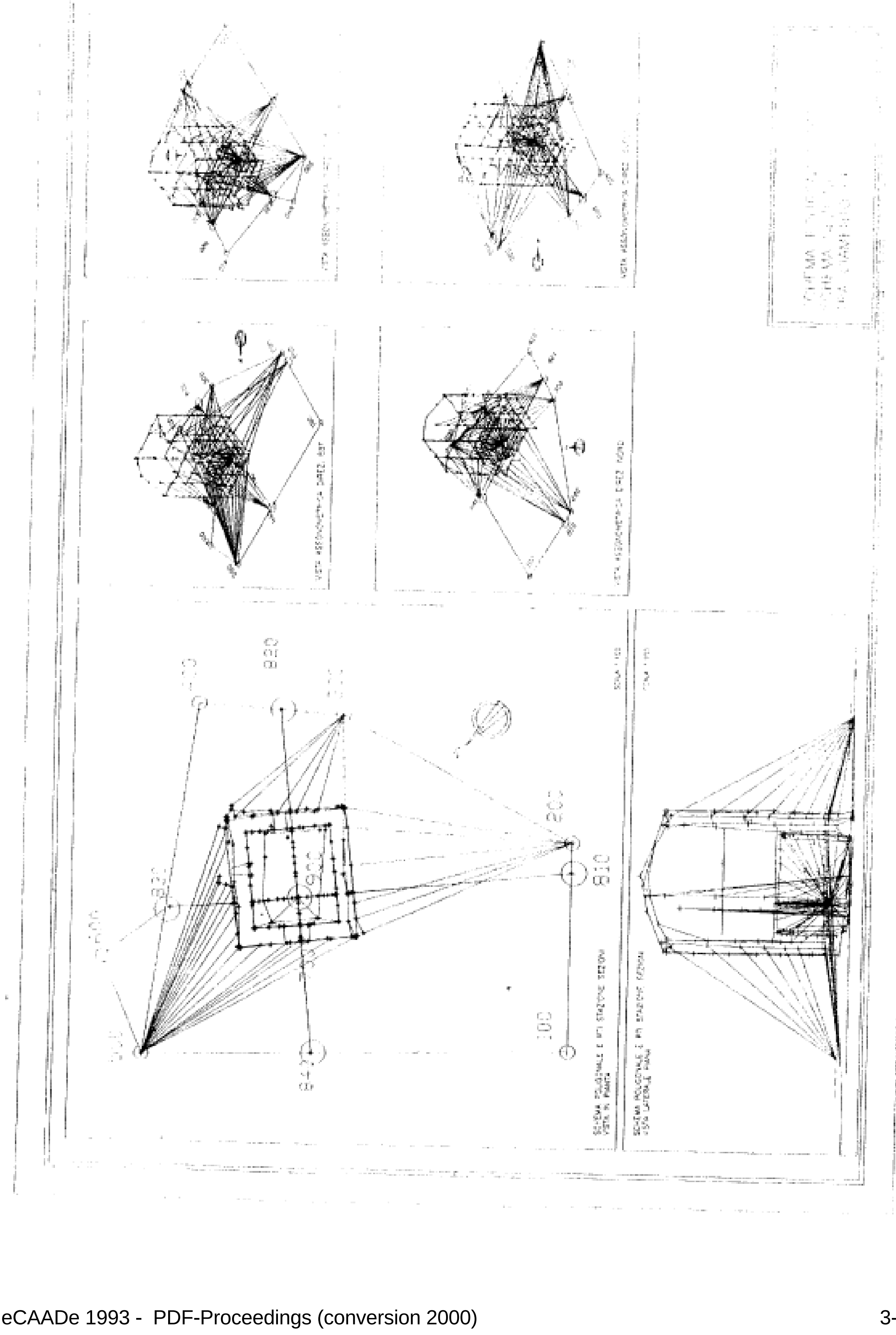
State of art in office automation for building technology and architecture. Project management in building technology. Cost detection and management in building technology. Introduction to environmental design and control main procedures. Simulation and optimization technics applied to building technology. Hypertext and Multimedia application to CAAD. Artificial Intelligence and Expert Systems application in building design. Site preparation and environmental control for computer rooms and data management installations.

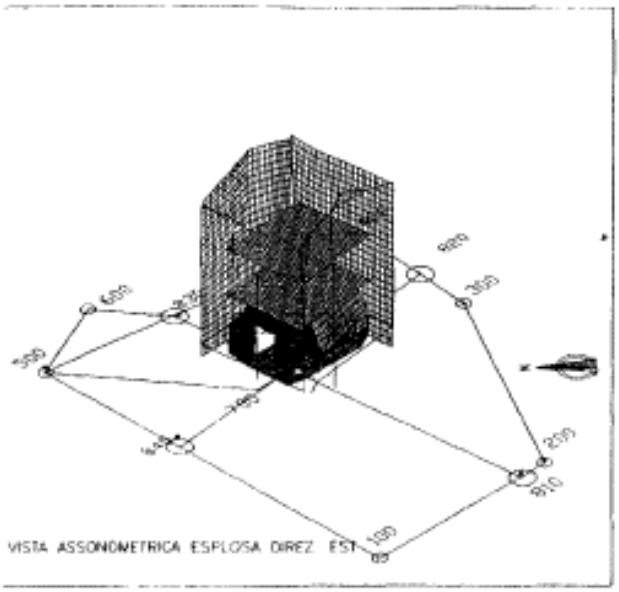
Total number of lectures: 60 hours - Total number of classwork sessions: 80 hours

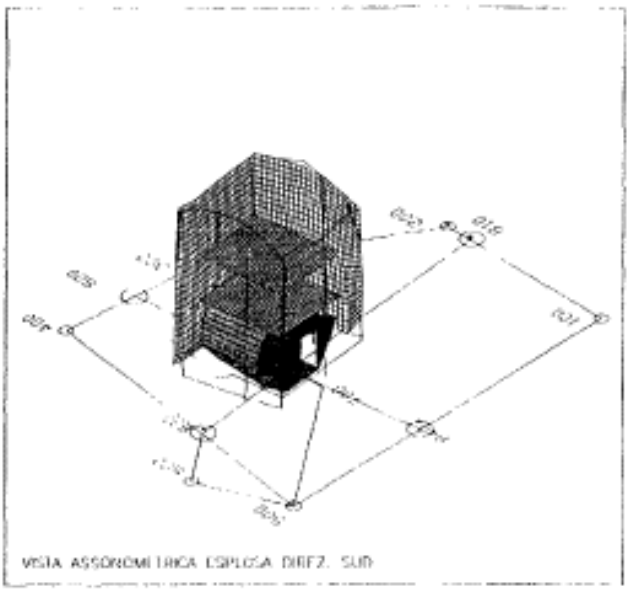
Total number of laboratory sessions: 40 hours

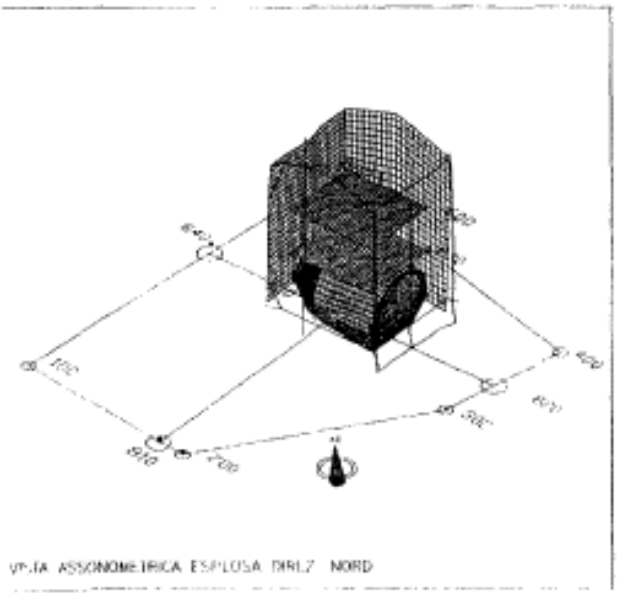
APPENDICE B

SCHEMA GENERALE DI FUNZIONAMENTO DI UN PROGRAMMA DI RADDRIZZAMENTO DIGITALE
IMMAGINE DIGITALE
COORDINATE DI PUNTI NOTI
TRASFORMAZIONE PROSPETTICA
IMMAGINE DIGITALE RADDRIZZATA
RECUPERO EDILIZIO
ANALISI PATOLOGIE
RESTAURO
CATALOGAZIONE
CONTR. QUALITA'
ANALISI MORFOLOG
V.I.A.
SIMULAZIONI PROG.
REALTA' VIRTUALE
ANALISI ECONOMICA
MANUTENZ.PROGR.
GESTIONE IMMOBILI




VISTA ASSONOMETRICA ESPLOSA DIREZ. EST


VISTA ASSONOMETRICA ESPLOSA DIREZ. SUD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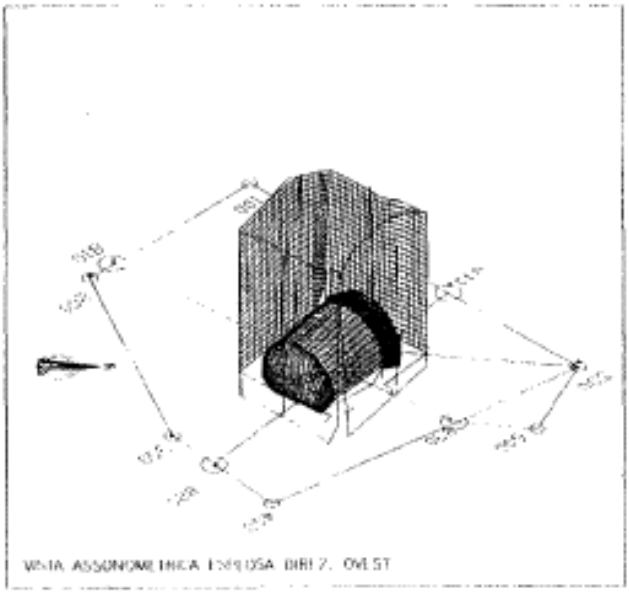
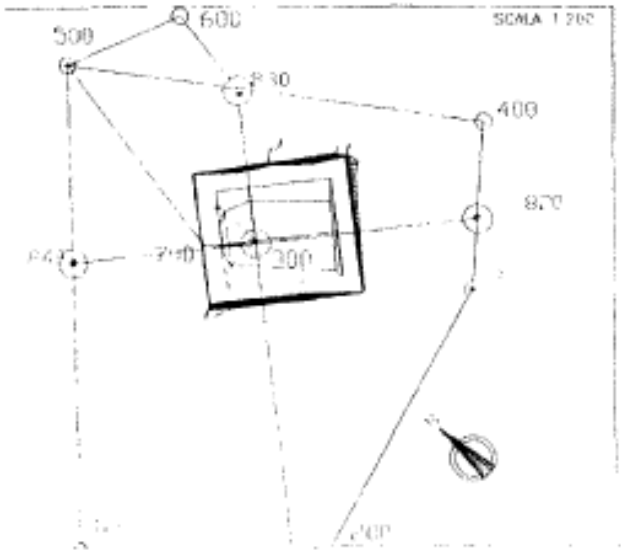
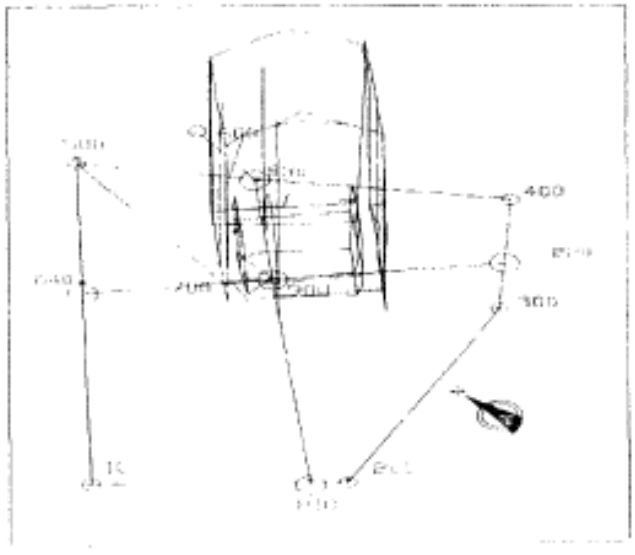

VISTA ASSONOMETRICA ESPLOSA DIREZ. OVEST


SCALA 1:20
500
600
400
870
200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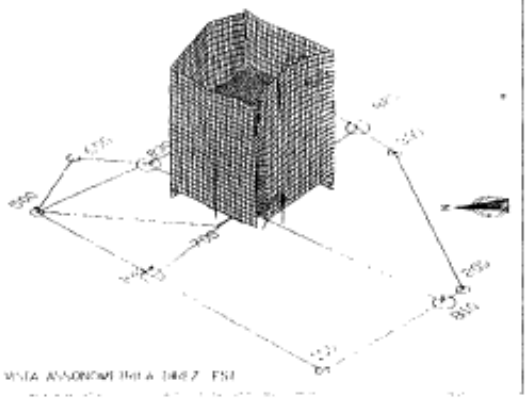

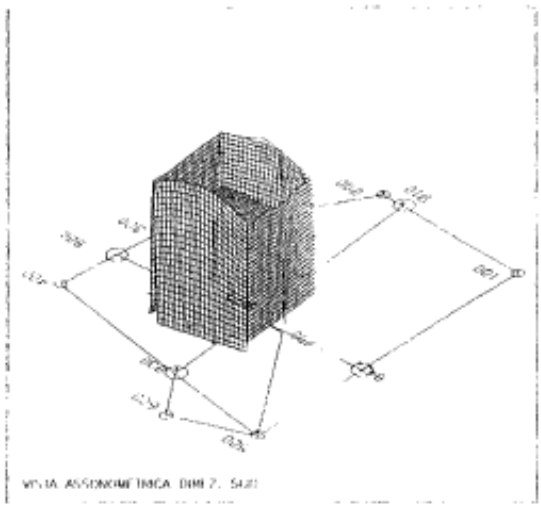

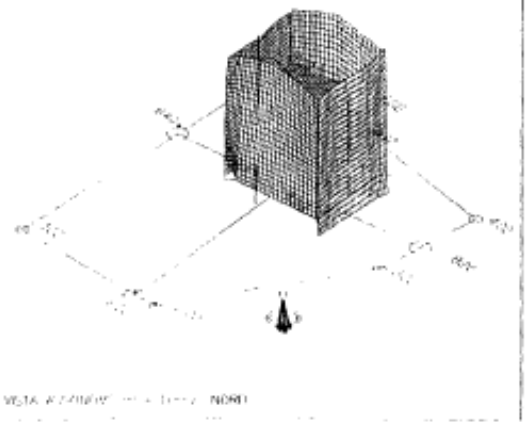

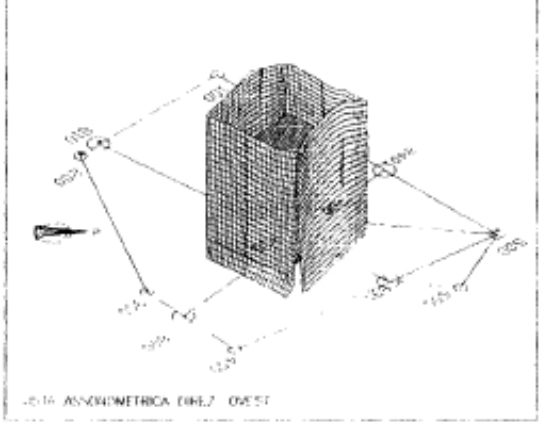

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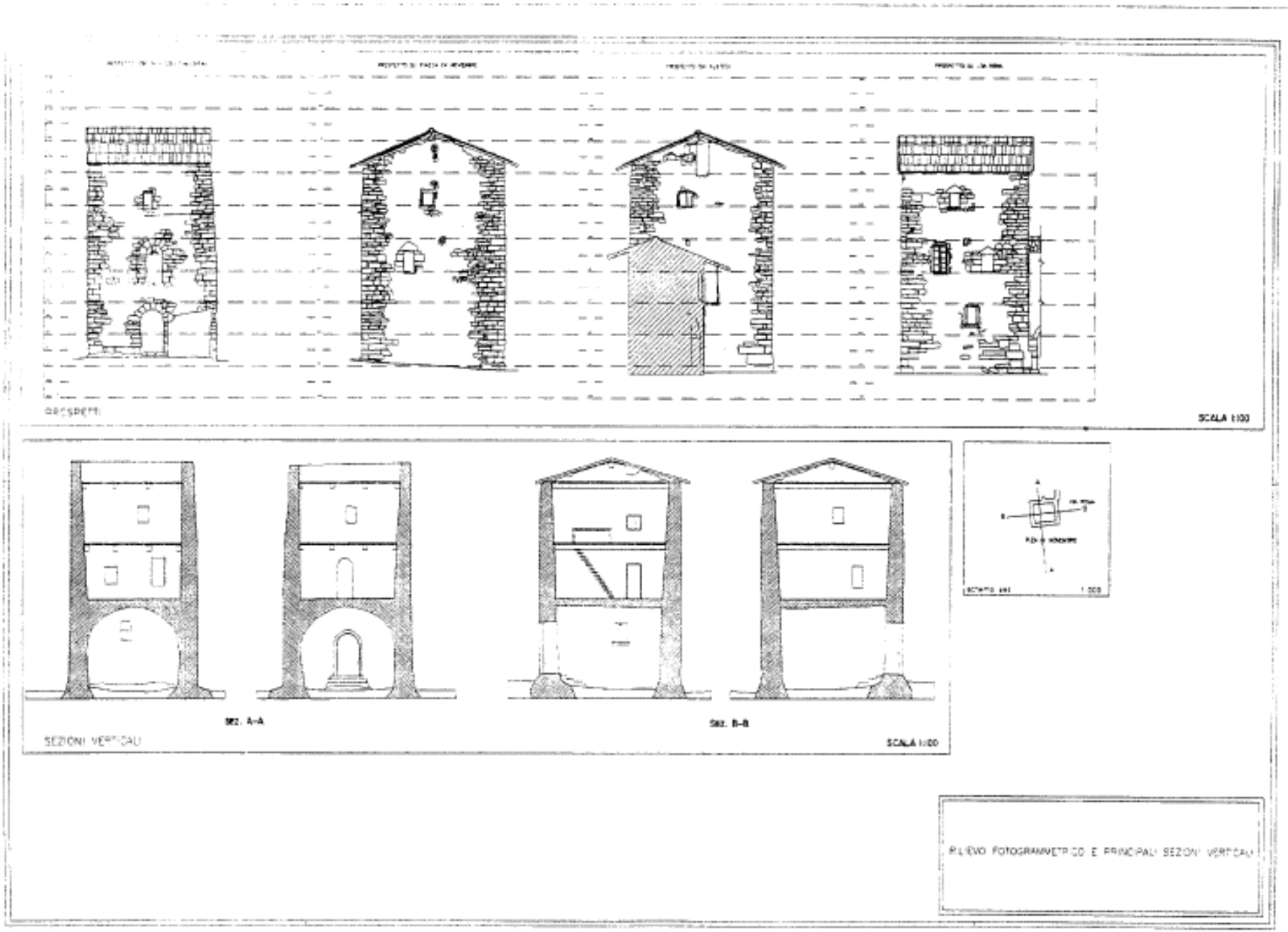
ANA[illegible] DEI PROFILI E DELLE SEZIONI
MOD[illegible] SPAZIALE [illegible]


PROSPETTI
SCALA 1:100
Sez. A-A
Sez. B-B
SEZIONI VERTICALI
SCALA 1:100
RILIEVO FOTOGRAMMETRICO E PRINCIPALI SEZIONI VERTICALI

SEZIONI ORIZZONTALI 4-4, 5-5, 6-6

SITE MODELLING ANALYSI PLANIVOLUMETRICA

SITE MODELLING ANALISI PLANIVOLUMETRICA