A dynamic display of the work breakdown

in Civil Engineering projects

Carlos Tavares Ribeiro
Ph.D. in Civil Engineering.
Assistant Professor
Technical University of Lisbon, Civil Engineering Department, 1096 Lisbon Codex, Portugal

ABSTRACT

Displaying the progress of projects has been achieved by the use of planning outputs. Planning software, namely the well known WinProject™ , Time Line™ or Primavera™, allow chart displays, generally in the form of bar charts, logic diagrams and schedule reports to show it.

The aim of linking Planning and CAD systems is to display in real-time the progress of engineering projects, according its planning and control through their 2D or 3D architectural and engineering models.

This paper describes and illustrates, the development of an innovative software, that, in this way, links data from any Planning software to the popular AutoCAD producing colored 2D or 3D models of the multiple activities of an engineering project according the foreseen or real stages - *not yet done, being done, completely done*.

Same application examples to different engineering projects through some screen-shots of this software use, are illustrated.

INTRODUCTION

All rivers have a right local to build a bridge. The question is to find it.

It is through a similar way that a good architectural project have to be watched with the right engineering project

On the other hand, the development of a good engineering project is always related to a right planning process.

The project is a game that must surprise the constructing process as well as it goes on finding it.

Each step of the game is a planned activity for the right moment in the right time.

Thus, planning is to define the best way for a set of activities following each other according its development, until its release.

In, the same way of the project itself, Planning does have to match the building process.

DESIGNING AND PLANNING

The lay-out for a design, its building process and materials application, is not only a set of draft showing sets of lines and polylines.

The aid of CAD systems in the design process besides either its creation or production, became to highlight the in order to achieve objects with their own identity — the several blocks or activities clearly defined for the building process. The concept of block is even related to the right use of CAD systems according this idea and procedure.

Also through planning, the several blocks or activities can be matched with the drafting objects or entities in the same way a CAD system works.

The relationship between blocks while a main concept in CAD systems, the activities while a concept from planning and the different steps of the construction process must have the same link.

In a similar way, if in the building process is possible to separate the construction works for the structure, for the walls, and so on, and in the structure it is possible to separate the columns and the beams, also through the planning point of view each one of these elements is identified as an own activity.

If all the structure or each of its elements — beams, columns, one by one, or just the set of beams, is intended to mean one activity and the set of columns another activity it mainly depends on the detail according the dimension of the project through which the planning and control processes are intended to be.

In the design level this simulation must have already been identified. The drafting process that leads to a certain design according materials, to be built, is not anymore a set of independent lines, but geometric entities/objects as blocks that can be identified with the steps of the construction process (Fig. 1).

Thus, the design of a project using CAD systems must not be a set of geometric lines but as in the meaning of CAD systems a set of well connected blocks.

These blocks match the activities of the planning. The activities are the steps for control and survey of the construction while defining the construction process.

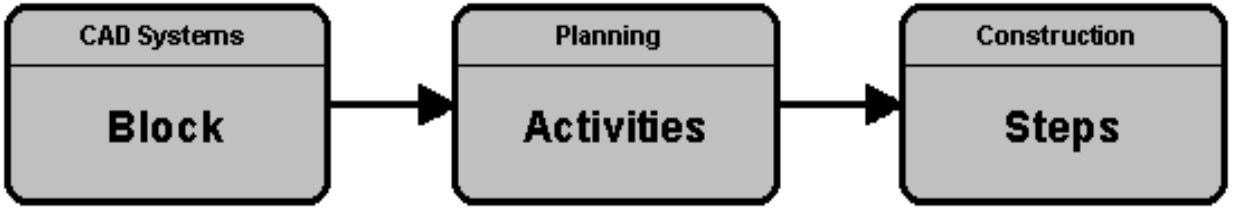


Fig. 1 - A standard process in an Engineering Project

A GEOMETRIC MODEL THROUGH THE PLANNING POINT OF VIEW

If the blocks in the design process are identified to each planning activity, than the attribute of a code, the same code that identifies the activity, can straightely relate that block as an element of the geometric model defined by the project and its definition as an activity of the planning to which a stage of the construction process has to be matched (Fig. 2).

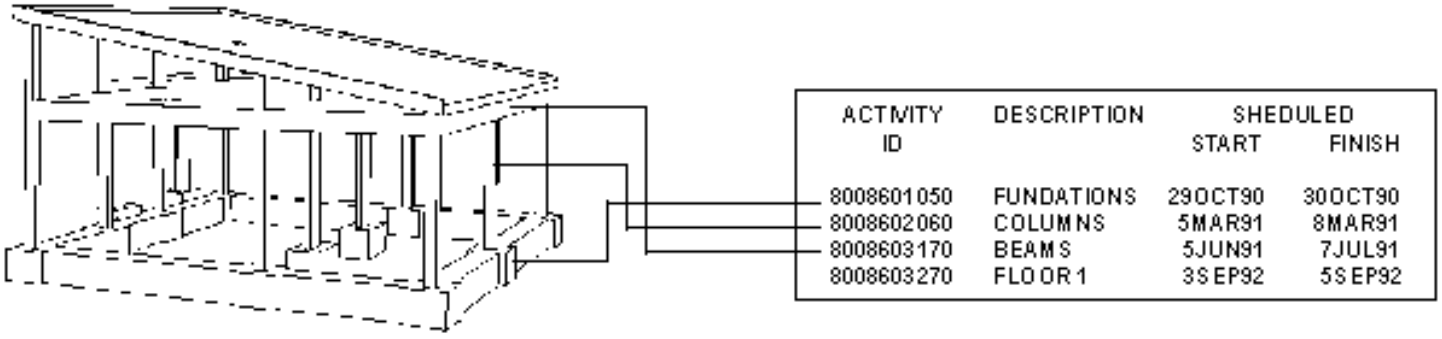


Fig. 2 - Linkage of drawing and planning databases

This means to attribute numerical codes to blocks of the geometric model. These must be the codes attributed to each of the planning activities.

In this way it is possible to have a database of codes linked to the geometric model.

On the other hand, the information of the planning model of a project is also a database. One of this fields is also the code of the activity whose value is an only one value in the database of the planning model of a Project.

So, all the planning database can be linked to the blocks defined in the geometric model through the common field - *activity code* attributed to the block.

Any information in the other fields of the database of the planning model, or even any operations among fields for each record can be reflected through a graphic symbol or changing color in the geometric model.

A GEOMETRIC MODEL THROUGH THE PLANNING POINT OF VIEW — A DYNAMIC GEOMETRIC MODEL

Through the planning point of view, the original geometric 2D or 3D model of a project is only the last moment in the planning

process, once the model is a dynamic process generating geometric models along.

One model for each moment — each "data date", concerning the date when the planning has been generated — each "planning date", for the date — the "time now" where the planner is pointed (surveying).

Each of the models generated through these time references is a geometric model of the stage (and geometry) that the constructing process of a project must present.

For instance, if the geometric model of a building displays a nice glass tower of forty floors, this model only will exists in the last second of the construction process.

For the planner the first geometric model may be the foundations of the building and other several models may be a two floors, seven floors, twenty floors, with or without walls, with or without piping networks and so on.

In this way there is the possibility to display for each of these models, at least three main stages at the same time, through different three colors concerning the planned activities — *concluded*, *in train*, *only planned*.

The sequence of geometric models according different dates, concerning each of a possible planning generation, may be the so called planning geometric model.

A PLANNING GEOMETRIC MODEL: LINKING PRIMAVERA AND AUTOCAD

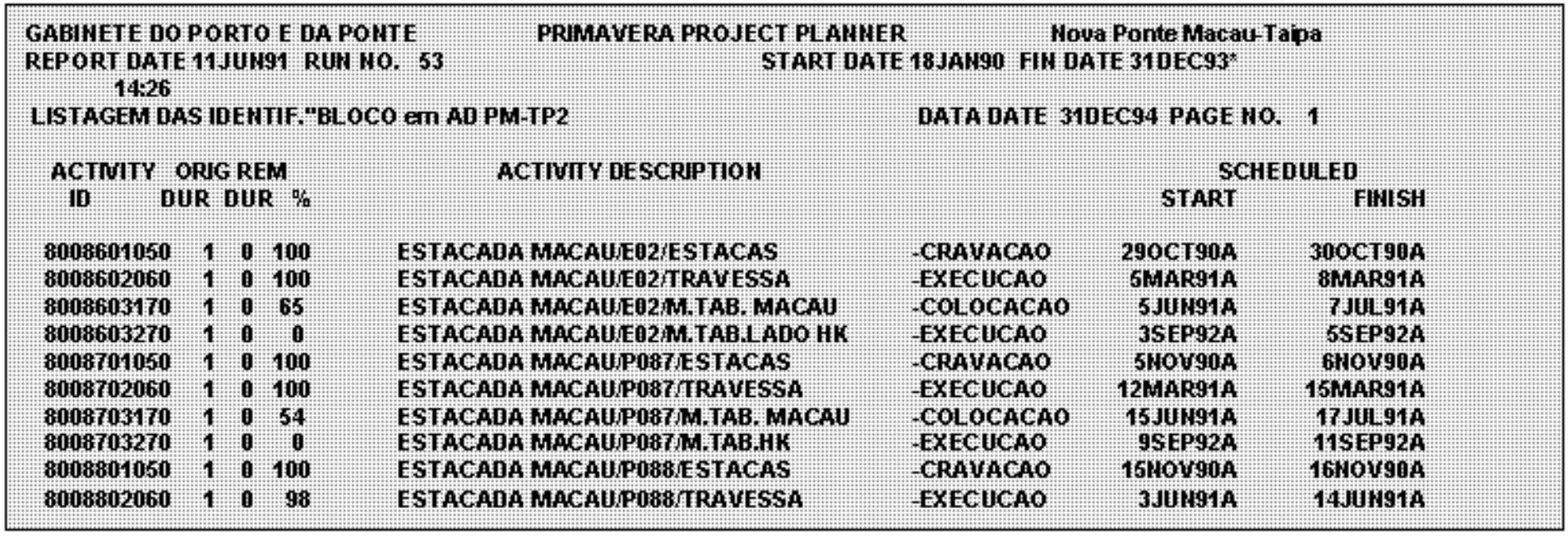
Based upon the procedures described it has been chosen PRIMAVERA as the planning system to support the development of this new tool.

AutoCAD has been chosen as the graphical display for the geometric models according each planning set of activities of a project.

The application linking these systems has been programmed in C++ and implemented in the AutoCAD environment.

Some manipulation on the planning geometric model has also been implemented, either to allow the user different displays for each planning geometric model as to prepare a fast output lay-out production.

The way is to have a planning report as a *..PRN file (Fig. 3) - The ASCII file describing a planning generation, by PRIMAVERA.



GABINETE DO PORTO E DA PONTE PRIMAVERA PROJECT PLANNER Nova Ponte Macau-Taipa
REPORT DATE 11JUN91 RUN NO. 53 START DATE 18JAN90 FIN DATE 31DEC93*
14:26
LISTAGEM DAS IDENTIF."BLOCO em AD PM-TP2 DATA DATE 31DEC94 PAGE NO. 1

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION		SCHEDULED START	SCHEDULED FINISH
8008601050	1	0	100	ESTACADA MACAU/E02/ESTACAS	-CRAVACAO	29OCT90A	30OCT90A
8008602060	1	0	100	ESTACADA MACAU/E02/TRAVESSA	-EXECUCAO	5MAR91A	8MAR91A
8008603170	1	0	65	ESTACADA MACAU/E02/M.TAB. MACAU	-COLOCACAO	5JUN91A	7JUL91A
8008603270	1	0	0	ESTACADA MACAU/E02/M.TAB.LADO HK	-EXECUCAO	3SEP92A	5SEP92A
8008701050	1	0	100	ESTACADA MACAU/P087/ESTACAS	-CRAVACAO	5NOV90A	6NOV90A
8008702060	1	0	100	ESTACADA MACAU/P087/TRAVESSA	-EXECUCAO	12MAR91A	15MAR91A
8008703170	1	0	54	ESTACADA MACAU/P087/M.TAB. MACAU	-COLOCACAO	15JUN91A	17JUL91A
8008703270	1	0	0	ESTACADA MACAU/P087/M.TAB.HK	-EXECUCAO	9SEP92A	11SEP92A
8008801050	1	0	100	ESTACADA MACAU/P088/ESTACAS	-CRAVACAO	15NOV90A	16NOV90A
8008802060	1	0	98	ESTACADA MACAU/P088/TRAVESSA	-EXECUCAO	3JUN91A	14JUN91A

Fig. 3 - Typical *.PRN File (Produced by PRIMAVERA)

Each record contains the activity code, its description and the *early start/late start*, and *early finish/late finish* dates for each activity.

In the meantime the geometric model has to be developed as a set of merged blocks.

To each block, a code — the same activity code used while creating the planning model, must be attributed.

The developed application has a nice C++ based interface for this:

- The user can pick in each block/activity or select it by its name. The window immediately opened asks for the code to be filled. Then, the application relates each record of the * PRN file to the block of the geometric model.
- For each activity (each record), the calculation of its stage, based on the chosen time now according the date range in the fields *early start/early finish* or *late start/late finish*, is done.
  The stage of the activity will be *concluded*, *in train*, *only planned*.

- Finally the application, changes the layer (and color) of the block according its stage.

The interface still allows only one, two or all the stages of the planning geometric model may be displayed in each *time now* considered, for each *data date* of each *planning date* (Fig. 4).

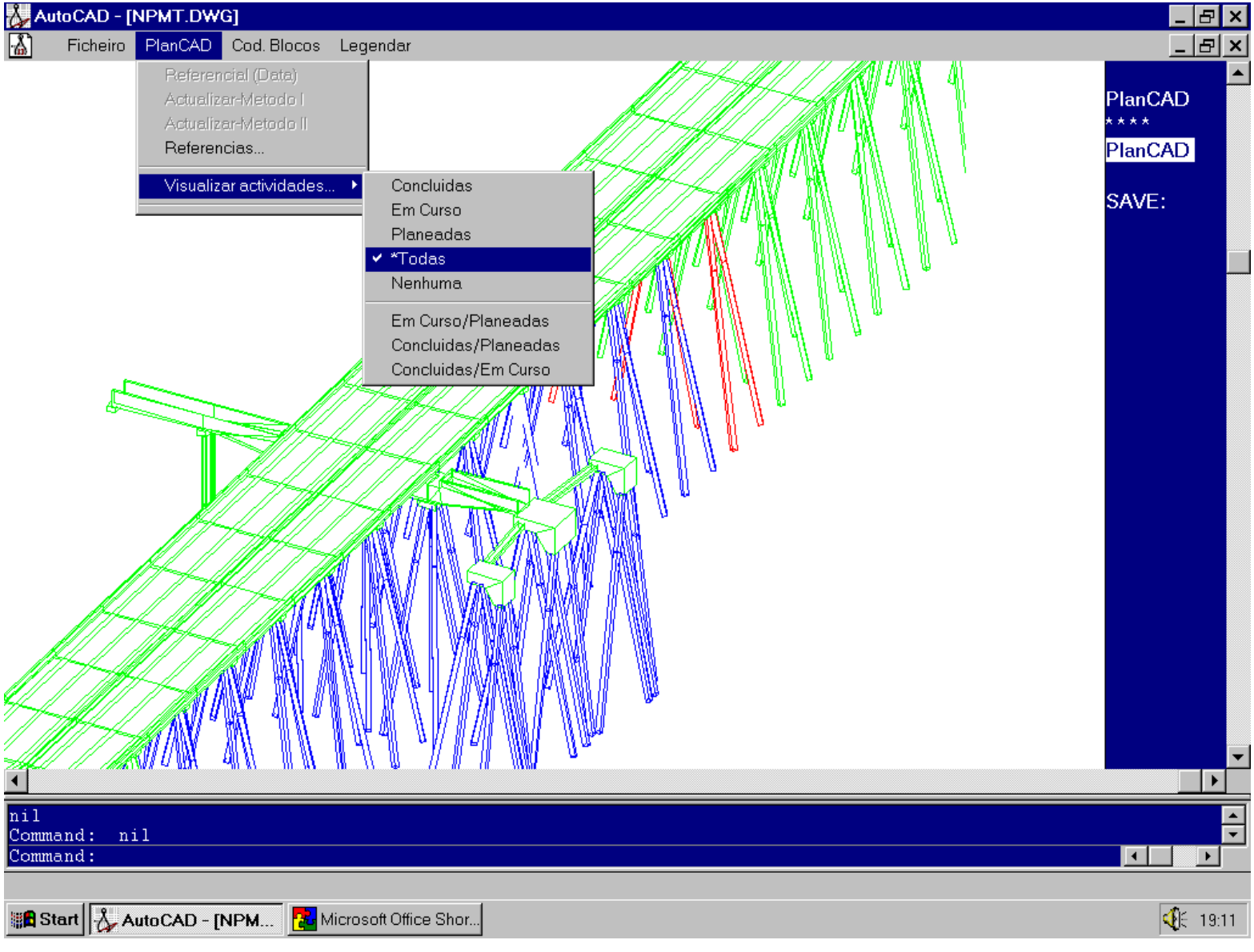


Fig. 4 - An operation to get the development stages of a project (Macau-Taipa Bridge)

Additionally it is still considered the capability for presenting a "shadow" of the global project. The system display it in gray color.

This is a very important feature when a generated model is intended to present just one kind of activities — for example the piping network of a building and for instance, they lay-out of only one stage, we mean, the same color.

Only a set of one color lines would be displayed, without any reference about its location. The "shadow" of the building to be chosen by the user using all the block he wants, makes the needed reference to watch the stage of the activities concerning the piping network. (Fig. 5).

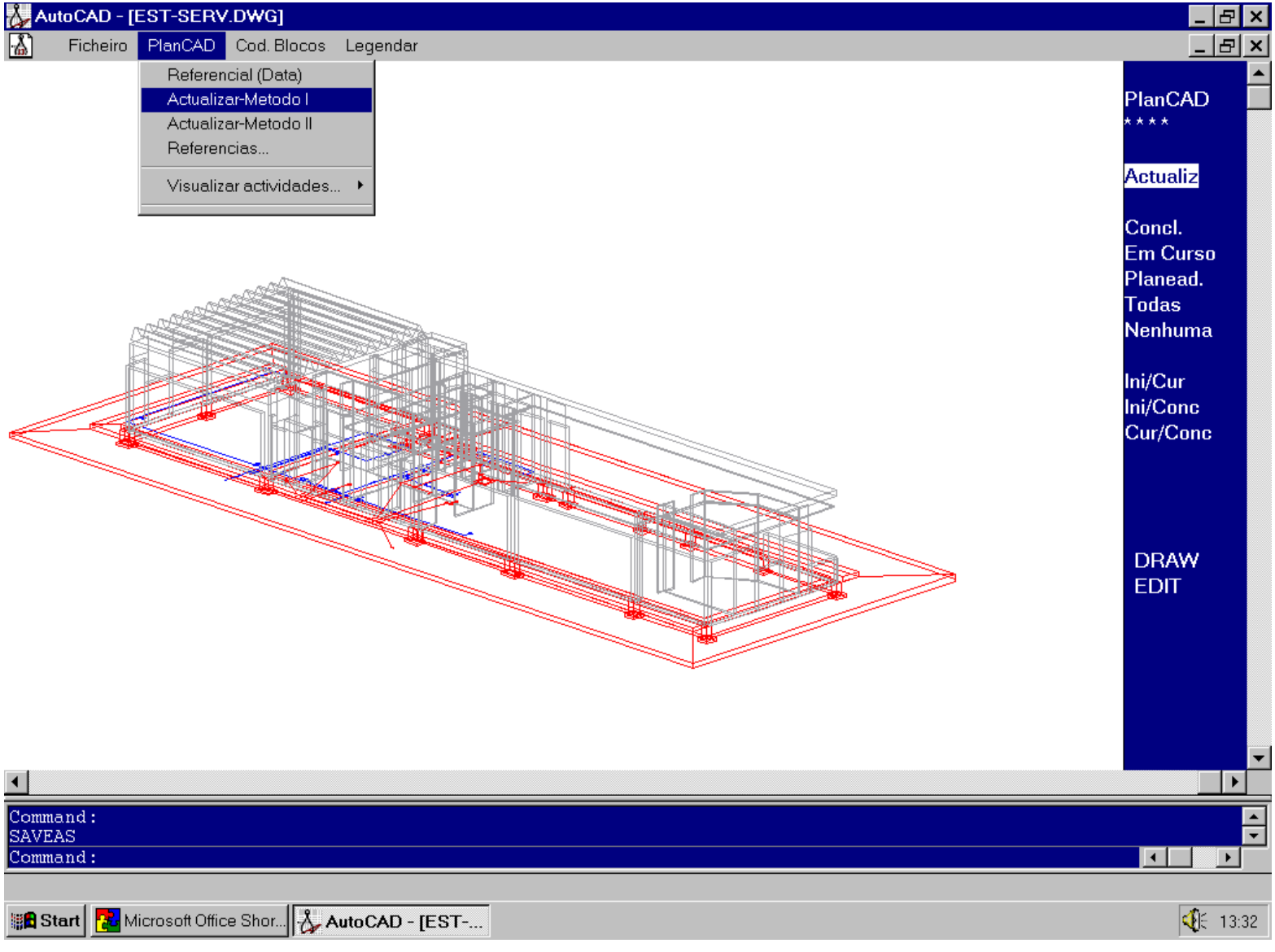


Fig. 5 - Stage of a piping network of a reference ("gray shadow") of its building

REFERENCES

AutoDesk, Inc. (1995), "AutoCAD user's manual",

AutoDesk, Inc. (1995), "Customizing AutoCAD", Sausalito, California, USA

Gurewich, O. and Gurewich, N., (1994), Master Visual C++ 1.5", SAMS Publishing, Indianapolis, Indiana, USA

PRIMAVERA User's Manual (1995), USA

Ribeiro, Carlos Tavares et al. (1996) "Conceber e representar com AutoCAD 13", McGraw Hill, Lisboa,