Linking CAD with MSC/pal 2

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ABSTRACT

The upsurge of sales of microcomputer-based Computer-Aided Design (CAD) systems has created a large demand for microcomputer-based Finite Element Analysis (FEA) systems and tools to move data between the two. This paper shows some of the tools MSC has developed for interfacing MSC/pal 2 with several CAD systems.

The MacNeal-Schwendler Corporation (MSC) made its first foray into the microcomputer software market in 1984 with MSC/pal, a Finite Element Analysis program for the IBM PC. In the last 2-1/2 years, the microcomputer hardware and software industries have changed and matured as more powerful hardware and software systems have appeared on the market. This change has been especially evident in the engineering software industry.

Microcomputers were looked upon as toys when they were first introduced; interesting, but not powerful enough for "real work." This perception has been largely reversed in the last several years by the introduction of the IBM PC, then the PC XT, and then the PC AT. The hardware, of course, is only half the story. The popularity of these machines in engineering is largely due to the emergence of inexpensive, powerful design software that allows the user to do work that once was either done on a mainframe or workstation costing many times more than the PC, or done laboriously by hand. Autodesk's AutoCAD package led the pack into the PC-based CAD market, and it remains the best-selling CAD system on the PC. Several other packages have garnered significant attention from designers; among these are CADKEY from Micro Control Systems, VersaCAD from T & W Systems, RoboCAD from Robo Systems, and Generic CADD from Generic Software. These systems range in price from $99.95 to over $3000.00, and each has advantages to offer. The choice of a CAD system depends on the tastes of the user and what features are desired, because MSC/pal 2 can be used with almost all of them.

Finite Element Analysis is, of course, the "next step" from CAD, from the viewpoints of both the design cycle and the sophistication level of the user. Once the product has been designed, it needs to be tested, and FEA is the natural candidate for computer simulation of structural testing. The problem that occurs is one of translation: a CAD drawing is comprised of lines, text, dimensions, and other drafting-oriented information, while a finite element model is comprised of nodal points, elements, material properties, constraints, and loads. In addition, of course, a CAD drawing is not meshed into finite elements, so a mesh must be developed before the translation can take place.

The simplest way to interface the drawing file with MSC/pal 2 is to examine all the lines of the drawings and turn any area surrounded by three lines into a triangular element, any area surrounded by four lines into a quadrilateral element, and any area surrounded by five or more lines into a hole. Any lines left over are considered beam elements in this scheme, and the plate elements that are generated may or may not be bordered by beam elements, according to the wishes of the user. This method is embraced by ADCAD2, MSC's free CAD interface utility available to all MSC/pal 2 users. The main drawbacks in this system are that the user must mesh the drawing by hand (unless the CAD system is able to do this) and that it does not handle complicated cases, such as structures made of more than one material. Loads and constraints must be added by the user after the translation, and there is no check made for coincident nodes or elements.

MSC/AutoFEM takes this concept one logical step further by actually integrating Finite Element Modeling (FEM) features into AutoCAD. The program is comprised of two parts: one part that works within AutoCAD using the AutoLISP language, and one part that is a separate program for joining two-dimensional faces into a three-dimensional structure and generating the MSC/pal 2 input file. Using MSC/AutoFEM, the user can take an AutoCAD drawing and, while still in AutoCAD, generate a finite element mesh for it using MSC/AutoFEM's mesh generation features. The program also has facilities for constraining extraneous degrees of freedom out of the problem. Hence, MSC/AutoFEM works with AutoCAD to create a very powerful Finite Element Modeling program.

MSC is dedicated to providing integrated solutions for engineers, linking the best CAD packages to MSC/pal 2 to provide an optimal design environment on a personal computer. With the release of ADCAD2 Version 2 at this World Users Conference, we have taken the level of integration one step further: now, drawings can be transferred from CAD to MSC/pal 2 and then the deformed and undeformed shapes can be transferred back to the CAD program for closer examination and plotting. Since MSC/pal 2 does not provide direct plotter support, this provides a way to plot the deformed structural shapes that MSC/pal 2 generates. We shall continue to improve the level of integration between CAD systems and MSC/pal 2 to provide the user with the best, easiest to use, and most comprehensive analysis packages available.

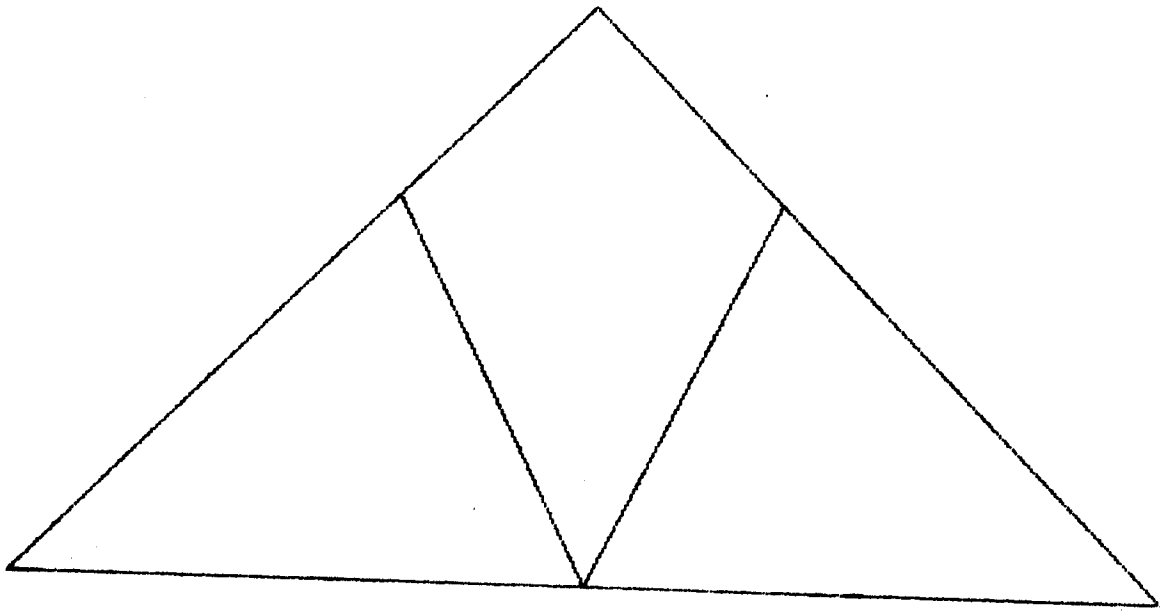

Figure 1: Drawing in CAD system

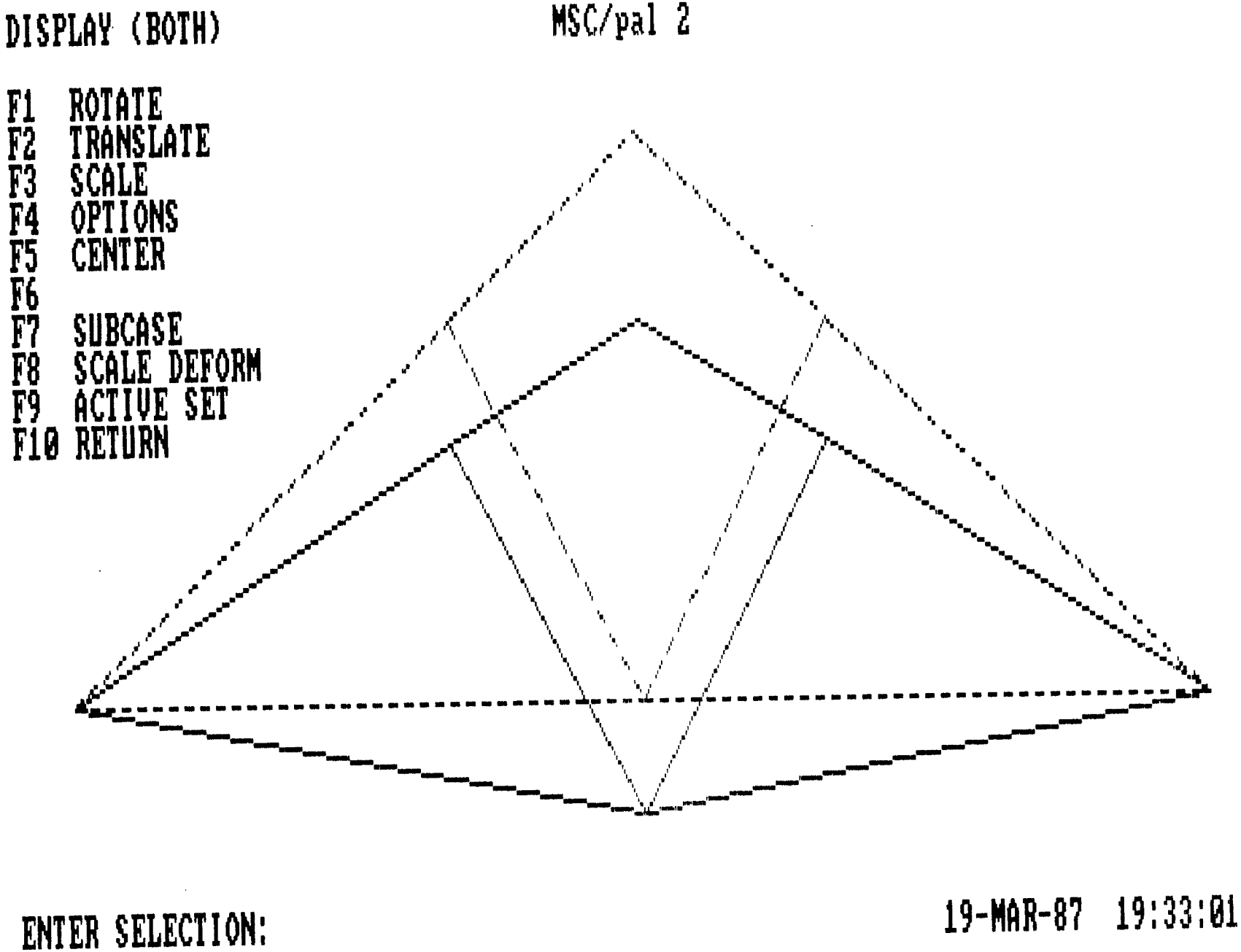

Figure 2: Deformed plot from MSC/pal 2

VIEW: 0.0, 0.0, 0.0

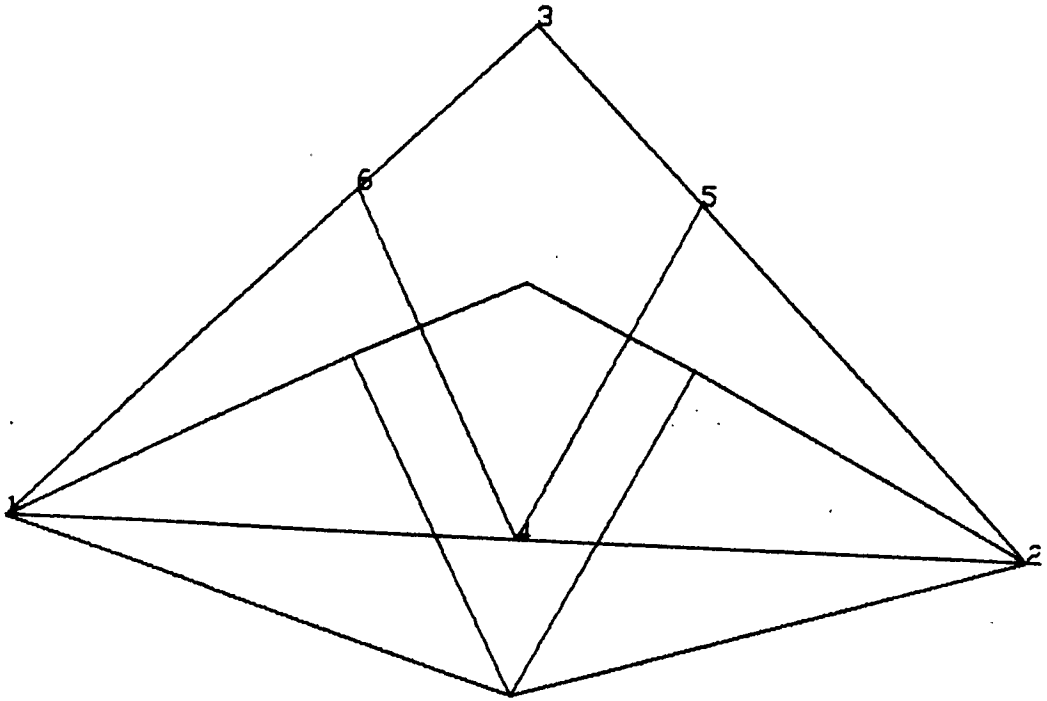

Figure 3: Deformed plot from CAD system

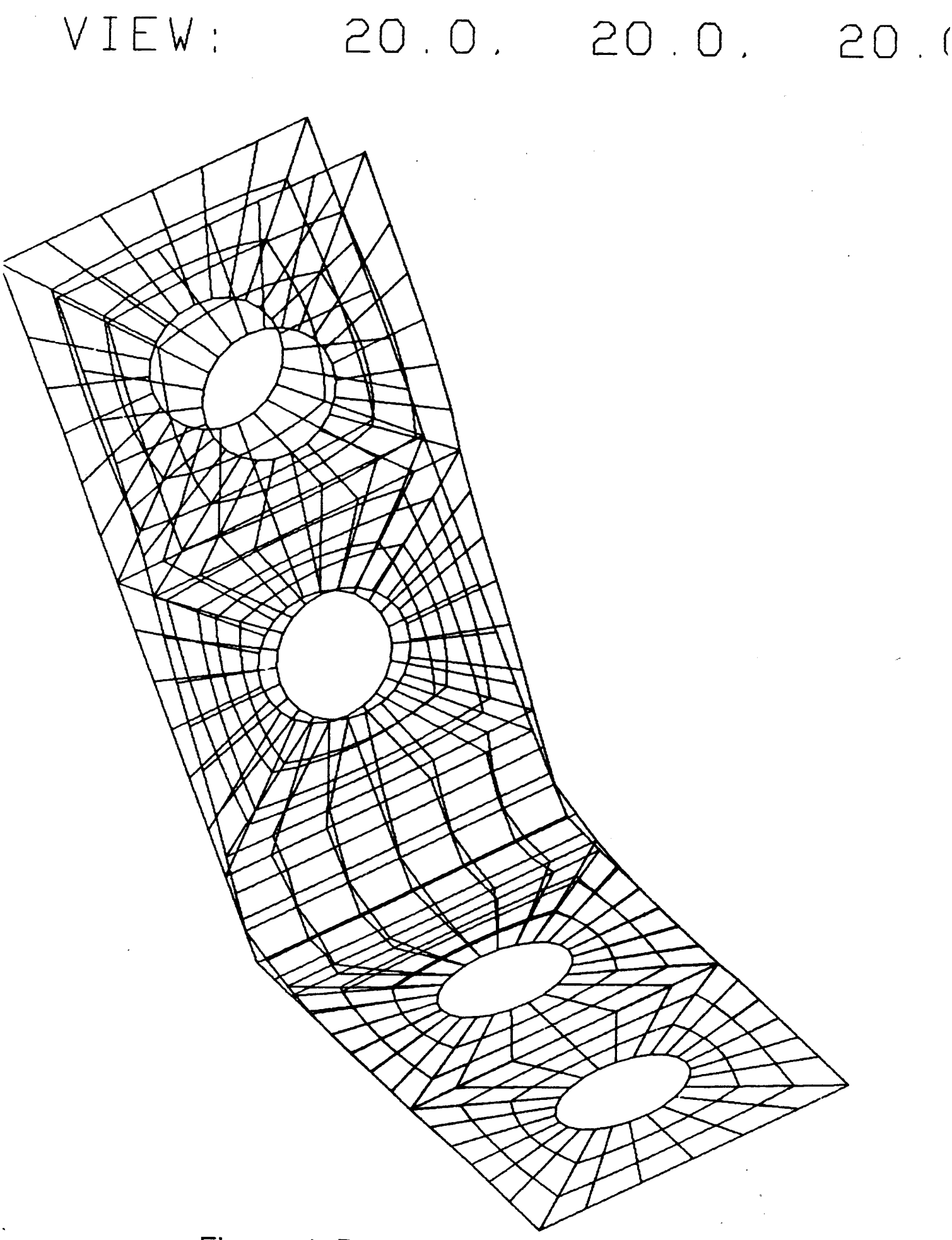

Figure 4: Deformed plot from CAD system