Education in Structural Engineering Using Small Computers

Enseignement du génie civil à l'aide de micro-ordinateurs

Lehre im konstruktiven Ingenieurbau mit Hilfe von Kleincomputern

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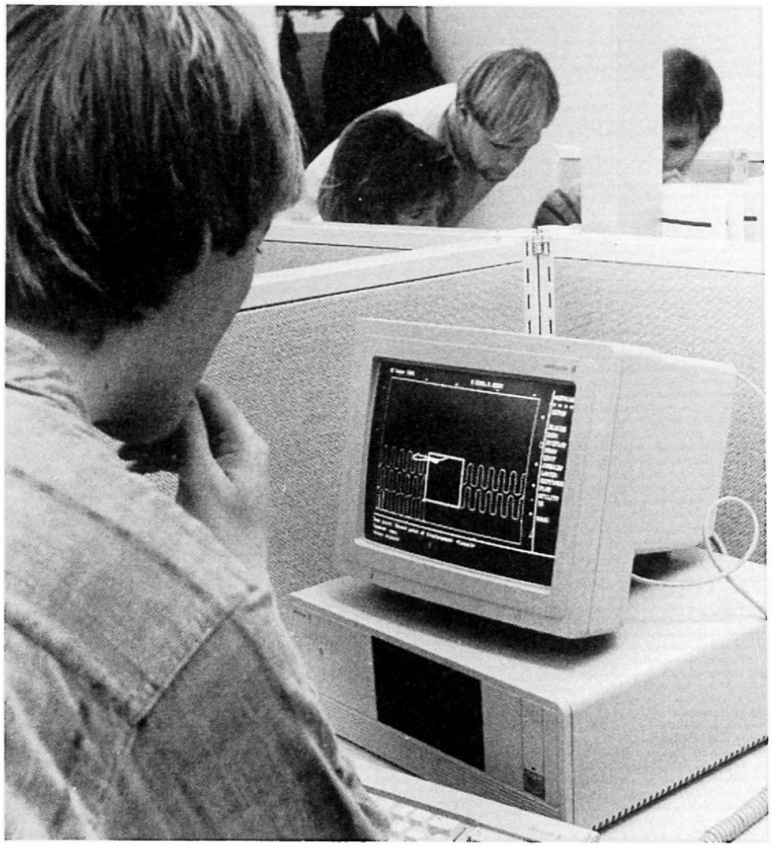
Is it really suitable to teach structural and computer aided engineering using small, personal computers?

At the School of Civil Engineering, Chalmers University of Technology, we have built a teaching environment based on 16-bit personal computers as a platform for computer training of our students. We have invested in two "computer laboratories", each containing 20 personal computers. From each computer there is printing, plotting and digitizing possibilities.

Fig. 1 View from one of the "computer laboratories"

In a relatively short time several applications have been developed and the laboratories are used quite extensively in several subjects. Typical applications are drafting, design exercises and simulations. The software AutoCAD is used both as a drafting tool and as a platform for the development of structural applications. Some of these developments have been carried out as diploma works. Some examples are:

- Preliminary design of a prestressed concrete beam. AutoCAD is utilized for the interaction with the user. At the end of a session the outlines of the beam is written into the AutoCAD database. Further, an input file to a special FEM-program is automatically generated.



- Calculation by yield-line theory of the load carrying capacity of reinforced concrete slabs. In this case the user draws the slab and defines the boundary conditions and the yield line geometry within AutoCAD. As result the load carrying capacity is presented both as a graph and as a numeric value. It is very easy to change any part of the input data and to perform a recalculation.

Fig. 2 Working with AutoCAD

Special graphics libraries have been developed to manipulate the screen from FORTRAN programs. This feature has been used to write interactive, graphics-oriented structural applications. Some examples are:

- Calculation of the load-carrying capacity in the post-buckling range of thin-walled trapezoidal steel sheets in bending.

- A training program used in a basic course in Structural Mechanics. The program enables the study of moment and shear force distributions in a three-span continuous beam. It is possible to interactively move the supports and to change the boundary conditions as well as the load acting on the beam.

In one course in Structural Mechanics the students get familiar with the principles of a FEM-program. In this exercise, a library with several sub-routines has been prepared by the teacher. The students write a subroutine of their own and then assemble the different routines together at linking time. They will end up with a simple, hopefully working, FEM-program.

Today there are also several commercial and general FEM-packages available for personal computers. It is our intention to, within half a year, install such a package and to have it available to our teachers and students.

In a future step our personal computers will be connected in a local area network and some 32-bit engineering workstations will be added. These work-stations will be used to analyse larger problems.

We believe that the use of personal computers and highly interactive software is a pedagogically strong tool, when teaching students the fundamentals of structural engineering. However, for design exercises involving the analysis of "real" structures the power of bigger computers will often be needed.