Designed to roll

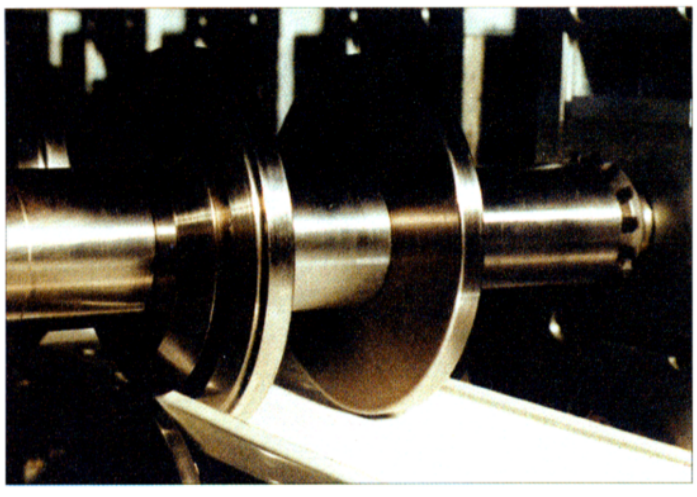
A sophisticated CAD system is essential for designing accurate roll tools for cold rolled profiles. **Roland Brandegger**, president of Ubeco GmbH, points the way

The designer of cold rolled profiles needs not only much experience but also must be prepared for a lot of tiresome, tedious work. Many drawings have to be made and although these can be done more quickly by CAD, they still need time.

The designer can automate most of this work by using a special CAD system for the design of cold rolled profiles. Because of this, he saves time and safety is improved. He can concentrate on his actual task, the design and optimising of the flower pattern and the geometry of the roll tools.

Software for the design of cold rolled profiles and roll tools won't replace the engineer. This is neither wise nor possible but it can allow better design. Improving quality reduces customer's complaints.

The software has to be practical and must be easy to learn, preferably without training. For this, the software must run under an operation system, that nearly everybody knows: Windows 95, 98 or NT. Furthermore the user must be able to adapt the software to his own needs. The development of the software must permanently continue: both the adaptation to new computer generations and new operating system releases must be supported. The developers have to react quickly to requirements of the market and results from research institutes have to be included.



For designing the roll tools for cold-rolled profiles a special CAD system is required

The benefit to the user should be: the designer needs less experience because the software contains information about previous methods of design. The designer is able to get through his work quicker because all necessary calculations eg developed length or the spring back are done by the software itself quickly and precisely. The drawings are automatically created. The single pass, the flower pattern and the roll tools can be transferred to any CAD-system. The safety of the design is improved. By means of simulation of the rollforming process, weak points are recognised and the designer can correct them. It is very important to pay attention to the feasible stress of the band edge for avoiding scrap. This all results in reducing costs of the design. If new profiles are to be designed, that are similar to existing ones, design is possible by simple modification.

The software should be suited to companies that use rollformers to produce cold rolled profiles, either as semi-finished or for finished products or for manufacturers of rollformers, that have to equip the machine with roll tools for a custom profile. Another user group are the freelancers, that design roll tools for customers.

The first step is to define the geometry of the profile. Three ways are available:

Design the toolbox: It contains tools for designing standard profiles like U-, C-, Z- or hat profiles. After entering the dimensions into the empty input fields the profile is defined. If desired, basic elements like line or arc or combinations of both can be attached.

Direct numerical input: A table on the screen can be filled out by the lengths, angles and radii of the profile elements. This method is suited for all rectangular profiles and tubes. While entering the data, the drawing is immediately created for direct feedback.

CAD-sketch: Inside a CAD-system (eg AutoCAD) a sketch is made, that represents the lower contour of the profile (without sheet thickness). The sketch is transferred and the desired profile is defined. This method is suitable for all kinds of profiles, especially complicated ones.

After the geometry of the profile (and with it the final pass L01) is defined, the designer proceeds backwards against the sheet running direction and creates the last but one pass L02 simply by copying the profile list. Afterwards single arcs can be identified by mouse click and bent step-by-step by using a special tool box. The step interval can be set individually; it can be selected whether either angle or radius should be modified; direct input of the desired angle or radius is possible, too. This step is repeated for all passes and the designer gets the flower pattern. If the 'stress of band edge' window is opened, he can check whether the

safe load is kept; if the stress exceeds the yield point of the material, the designer can correct already in this early stage.

Each arc element can be selected separately, whether it is bent by using one of the following methods:

- constant developed length method: While the developed length is constant, either the angle is preset and the radius is calculated or the radius is preset and the angle is calculated.
- constant radius method: While the radius is constant, the angle is preset and a new length is calculated. Because the whole developed length does not have to be modified, the length of the previous element or the length of the next element is corrected.

First it has to be defined which rolls should be designed for the discharged state or for the loaded state and which is necessary for compensating the spring back.

Automatic: This fast method can be used if the geometry of the rolls is the same as that of the pass, especially in the first stands, where the profile is only bent a little and is not yet folded.

With CAD: The drawing of the pass is transferred to the CAD-system (eg AutoCAD) and the contour of the rolls is drawn by modifying and/or extending the existing drawing. After the contour is transferred back, the rolls are defined. This method is suited for all kinds of rolls, especially for rolls for folded profiles.

From roll stock: Rolls from the roll stock can be selected and newly assembled.

Afterwards the designer can modify the rolls as he likes. Possible modifications are: splitting of rolls, appending of conical or cylindrical extensions, fillets, clearance angles.

The developed length and with it the strip width is calculated automatically.

If the bent profile leaves the machine, the legs of the profile spring back. This spring back is calculated dependent on the material, the sheet thickness and the bending radius and angle.

If a profile is designed for a load-bearing construction and the strength calculation is necessary, the static parameters of the cross-section of the profile are needed. These are calculated automatically and are displayed in a separate window.

Strain and stress in the edges

If the legs of a profile are bent step-by-step from one stand to another, the edges travel a longer way than the web of the profile. This causes a strain and a stress in the edges. If this process is limited to the elastic area of the material (Hook's law), the strain and stretching will return to the original length again, as the profile leaves the stand. In the other case, if the stress of edge has exceeded the yield point between two bending steps, this will cause a remaining strain in the material causing problems like twists or waves at the edge of the profile. The relative stress related to the yield point is calculated and displayed in a separate window. By this, the designer can watch while bending if the safe load of the band edges is kept.

The calculation of the stress of the band edge gives quick and estimated information about the load of the profile within the rollforming machine. However, finite element analysis allows the very precise calculation of the stress and the longitudinal deformation within the whole profile.

For seamed tubes, the passes for the calibrating stands, the welding station and the bending stands are automatically created. Additions for welding are considered. The integrated forming method generates a regular and optimised bending process and is suitable especially for tubes with larger dimensions.

All necessary drawings are created automatically. Either a single pass (loaded or discharged) or a complete flower pattern in different views or roll tools for a stand can be displayed. All drawings can be saved into a file and different standard file formats can be selected (DXF, IGES or MI). The drawings can then be transferred to any CAD-system. In the case of AutoCAD R14, the modern ActiveX-interface is used for direct data exchange.

For reducing costs re-using of old rolls may be wise. The roll stock management facility enables quick searching for suited rolls. The designer can define any search filter by his own, save them and recall them. While browsing through the database the drawings of the rolls are displayed in a separate window.

For all the rolls of the machine a parts list (sawing list) is created. This list contains the blank size and the gross and final weight. Additions for the blank size are taken from user defined addition lists.

A pure CAD-system is not sufficient, if cold rolled profiles and roll tools have to be designed, because the necessary calculation methods and design tools are absent. Optimal is the connection of a CAD-system (AutoCAD, ME10 or any other) and a special software system, that is designed for the requirements of the profile designer. Such a system has been developed from experts in rollforming and modern software technology. SMI

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Continuous, tile-effect roofing sheet

Northern Ireland-based GRQ says it is the first UK company to develop tile-effect crimped metal sheet for continuous production.

The company is targeting the Eastern European market where it estimates that 12M homes will be built this year. This metal sheet is said to provide a continuous ridge-to-eaves membrane. As a result, GRQ believes there is a great need for roll forming machines that can produce any length of cover sheet that can be handled safely.

GRQ adds that it has recently invested in its own chroming facility. The plant has rafts that can have their tooling chromed in-situ without the tooling having to be removed.

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