

CAD/CAM in the footwear industry

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CAD/CAM in the footwear industry is the use of computers and graphics software for designing and grading of shoe upper patterns and, for manufacturing of cutting dies, shoe lasts and sole moulds. CAD/CAM software is a PC-based system, which is made up of program modules. Today, there are 2D and 3D versions of CAD/CAM systems in the shoe industry.

Computer aided design was introduced in the shoe industry in 1970s. Initially it was used primarily for pattern grading. It enabled manufacturers to perform complex grading relatively easily and quickly. CAD systems today have been developed with a much wider range of functions. Logos, textures and other decorations can be incorporated into product designs of both the uppers and soles to help reinforce branding on all areas of the model. It automates routine procedures, increasing speed and consistency whilst reducing the possibility of mistakes. CAD data can now be used effectively for a wide variety of activities across footwear manufacturing business. CAD/CAM generates data at the design stage, which can be used right through the planning and manufacturing stages.

CAD/CAM software is able to:

- Create last data from solid lasts by scanning,
- Create 3D shoe designs to advertising quality,
- Create 2D pattern data, (optionally from 3D design),
- Get real time pattern samples (in 2D or 3D),
- Create manufacturing documentation,
- Get analytical costing information for graded parts.

Latest improvements in the CAD/CAM technology are:

- Graphic capabilities and interconnectivity have improved enormously,
- Software developments have progressively made systems more intuitive and easier to use,
- With 2D sketch and paint modules, a serviceable sketch can be produced and then color and texture can be added.
- 3D systems enable the last and design to be viewed from any perspective and several angles even simultaneously.

With CAD/CAM software, footwear manufacturers can cut their time to market dramatically and so increase market share and profitability. In addition, the power and flexibility of the software can overcome restrictions to the designer's creativity imposed by traditional methods.

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Shoe upper pattern design

CAD in 2D is realized by digitization of the model basic lines with the help of digitizer tablet cursor or mouse. The designer creates then individual upper patterns interactively on screen using a number of special functions for effective work at all stages. Patterns can be also edited and combined with already designed parts. Zooming, measurement of distances, lengths and areas etc. can be done very accurate and easily.

To design in 3D, the shoe last geometry data has to be input first by a special scanning device. The upper pattern can then be sketched on the image of the last on monitor. The software module flattens the 3D parts in 2D for further use.

The patterns, a complete documentation for shoe design and models for cutting die production, can be cut on cardboard directly with a table cutter connected to the CAD workstation.

Most systems can import and export various graphics data formats enabling further data processing by other CAD systems or database programs.

Pattern grading

Shoe upper patterns need to be graded for the whole scale of the assortment of the required shoe sizes, which can be French, English or American sizing. Individual parts are graded instantaneously, which enables the designer to check the graded parts on the monitor. If any discrepancies are found, the designer can change the grading specifications immediately and re-grade the parts in no time.

Die making

Cutting dies made of steel are used in the shoe production to cut uppers from leather, textile or synthetics. Some CAD systems offer modules, which enable long-distance transfer of data for shoe production preparation via modem or the Internet. The graphics data of patterns designed can then be transmitted easily to the die producer. The system calculates also the circumference of the die, which is the key factor of the die cost.

Automated leather cutting

Automated cutting machines are widely used today in the footwear industry to cut uppers from leather, when die costs are relatively high for samples or low quantity styles. Computerized cutting systems use graphics data output of CAD systems as input.

Cost calculation

Using the graphics data generated and materials database stored, the CAD software can perform instant and highly accurate calculations for material consumption and product cost of the shoe, eliminating grueling and time-consuming work. It helps also introduction of detailed documentation and supports effective staff training.

Shoe last design

Lasts can now be produced on a selection of numerically controlled lathes and milling machines using data output from footwear manufacturers' CAD systems. Last shapes can be modified and new lasts created in the CAD systems and the machining controlled with their data. Variations in toe shape, heel curve and toe spring are easily achievable. Combining parts of different lasts also takes a few minutes with CAD technology. It is possible to develop shoe design and tooling before the last physically exists because they are all derived from the same source data in the CAD system.

Easy modification of last shapes through CAD has enabled the development of software and procedures for orthopedic and customized footwear. Modules for materials and labor costing, lay planning and style specification sheets can be used early in the development of shoe styles.

Complex shapes can be generated, both speedily and accurately, from the 3D computer representation of the appropriate last.

Sole design

CAD/CAM software can be used to generate machining data for shoe sole models and moulds. Shoe sole mould makers are able to strengthen their capabilities of mould design and production techniques to meet the market demands for shorter product life cycle, quality improvement and handling versatile pattern design. This helps especially sports shoe producers to manufacture products rapidly and to introduce them earlier than their competitors.

3D CAD/CAM is the core technology for shoe sole mould in the footwear industry and develops towards specialization.

Benefits of CAD/CAM in the mould manufacturing are:

- Total modeling for rapid generation of design concepts and variations,
- Reverse engineering from existing models or parts,
- Easy design modification and morphing capability,
- Completely accurate designs regardless of complexity,
- Group grading of soles and uppers,
- Advanced decorating techniques,
- Realistic onscreen visualization,
- Rapid generation of molds from product designs.

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