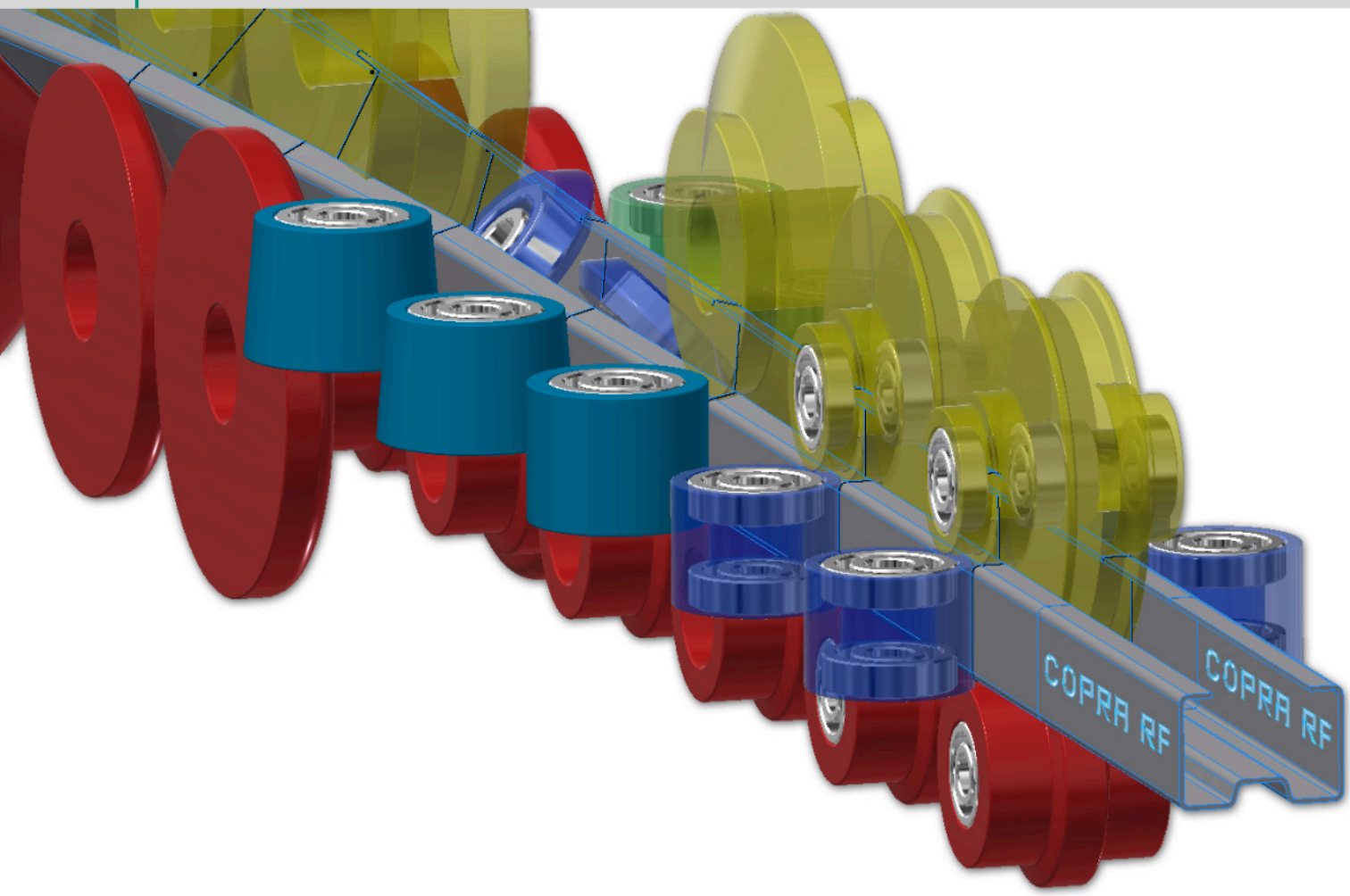
COPRA® RF Sections

Our software module COPRA® RF Sections is tailor-made for the design and development of open as well as closed profile cross sections. It's equally suited for simple as well as complex profiles. Together with the optional analysis modules and COPRA® RF Roll Design, roll formers have everything they need for consistent processing of high quality roll formed sections.



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Section design with COPRA® RF Sections

COPRA® RF Sections provides several convenient possibilities for the design of the final profile. The user either draws the contour, extracts geometry from a 2D customer drawing, uses a 3D CAD model or generates elements from predefined section components. If it's a punched section, even the punch hole pattern from the 3D model will be adapted. The position of the punch holes on a flat strip will be automatically adjusted, with the calculated material neutral line considered.

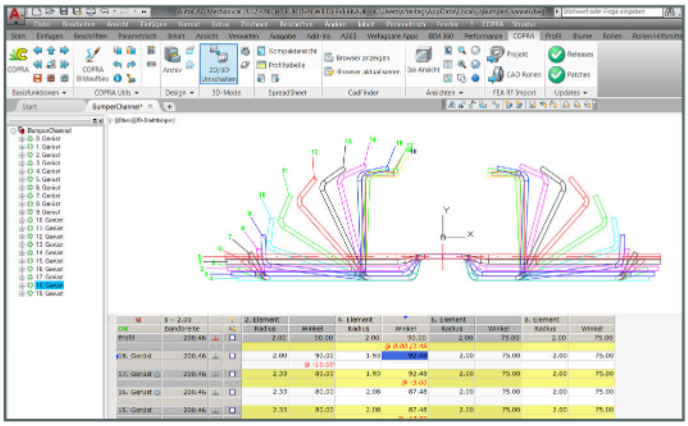


Fig. 1: Easy and quick section design with COPRA® RF Sections

COPRA® RF SpreadSheet and COPRA® RF Trapeze/Corrugated

COPRA® RF Spreadsheet is a very powerful tool for quick and easy parametric flower design in table form. The program automatically updates any changes across the whole flower pattern, without additional input from the user. You can not only modify any geometric data of the final cross section, but even the type of strip width calculation or the calibration method. COPRA® RF SpreadSheet calculates the new flower and also automatically adjusts the bending angles in case a station has been modified in the meantime.

COPRA® RF Trapeze / Corrugated is another technology module that provides special functions for trapezoidal- or corrugated sheet metal. It calculates the optimal bending pattern for trapeze-like sections by (dependent on the bending angle) making sure a constant transverse material flow for a minimum necking in the bends.

Furthermore, there is also the option for automatic roll design, whereby the feature "clone rolls" will be applied efficiently.

COPRA® RF Flower Technology and COPRA® RF DTM – Simulation- and analytics modules for the optimal flower

In addition to the basic functionality of COPRA® RF Sections, data M offers other optional program components for analysing and optimizing the roll forming process.

COPRA® RF Flower Technology incorporates technical calculations like the determination of the theoretical elastic recovery or down-hill-forming with minimal elongations. It also allows the sequential depiction of the individual bending pattern after input of the necessary parameters. Furthermore, different forming curves can be selected for the calculation of the strains.

Unwanted plastic longitudinal elongations across the strip edges are an unavoidable side effect in roll forming. Usual consequences are various defects across the profile like twist, bow or end flare. To prevent this, the module COPRA® RF DTM provides calculation of the theoretical elongations. Because a three dimensional visualization of the forming process not only exposes the path of the strip edge from different perspectives, but also other parts of the section that more importantly are quickly calculated and visualized.

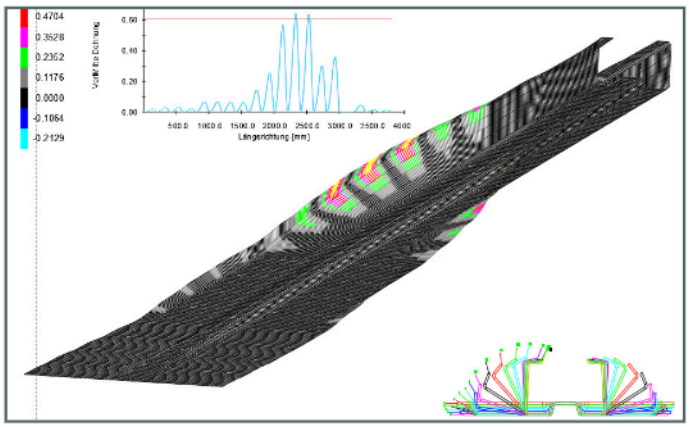


Fig. 2: COPRA® RF shows values and positions of longitudinal elongations

COPRA® RF DTM uses a plain geometric approach based on the theory of thin shells. The module determines the highest occurring values of longitudinal deformations. Due to a minimum of processing time, it is particularly helpful for initial evaluation of the feasibility of a project. With COPRA® RF DTM, you can pre-optimize an entire roll set prior to conducting a subsequent FEA simulation.

Essentially all that is required is data such as roll diameter and horizontal centers as well as the section flower. Until today, COPRA® RF DTM is the only software solution available worldwide that can calculate the strip strain that is inherent to roll forming. By doing so, it considers the important influence of the forming roll tool diameter. Above that, the module calculates the influence of further factors like material thickness and shows the distribution of longitudinal deformations in areas of compression as well as the occurring material curvatures in the forming areas.

COPRA® RF Roll Design

After completion of the flower design, the associated roll tools must be designed. An accurate roll design is eminent for the quality and the manufacturing cost for the final product. COPRA® RF Roll Design provides several section specific functionalities that no other software solution can offer. Particularly noteworthy is the „SmartRolls“ functionality. It allows the accomplishment of the whole roll design without further construction lines. The number of required clicks can thus be reduced to a minimum. Following profile and flower optimization, the first roll contour will be generated. The available contours of the flower pattern itself serve as respective starting points. Also, the designed cross sections can be layed out automatically as a rough draft and will be ready for completion with targeted graphical functions quickly and safely. Following completion of the roll design, both the individual roll as well as the assembly plan dimensioning will be conducted automatically by COPRA® RF.
Additionally, your engineers can rely on pre-made roll design functions for many standard sections like U-, C-channel or top hat profiles. For this, the software calculates the roll contours including all details and not only the rough contours. In order to conduct a precise cost calculation, COPRA® RF Roll Design furthermore works out the weights of the finished tools, reduced by the mass of the boreholes.

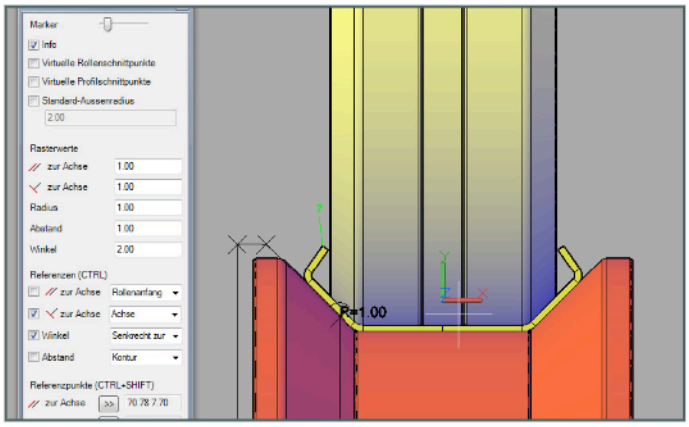
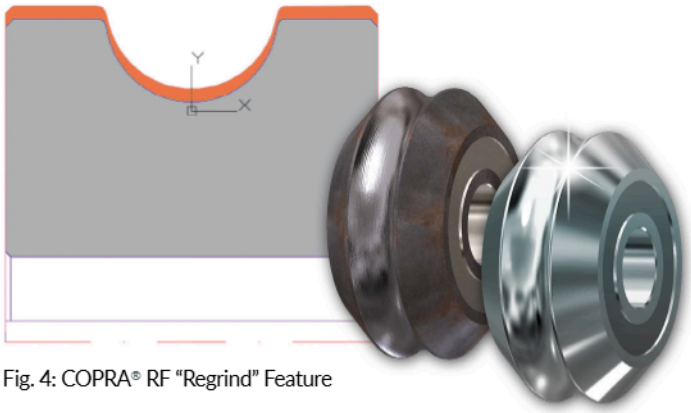


Fig. 3: Dynamic modification of roll design with COPRA® RF SmartRolls

AssemblyCheck – Implementation of Roll Forming system without mishaps

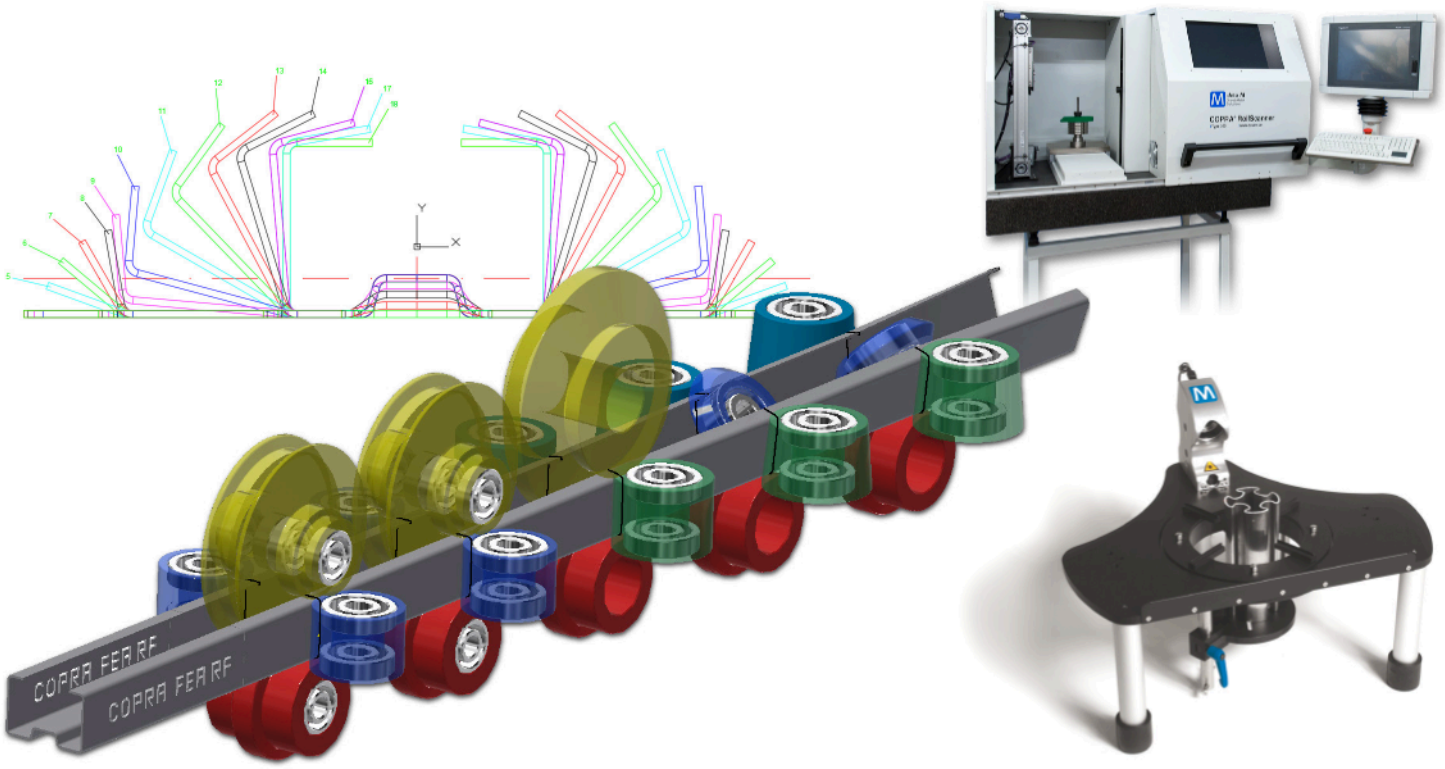
The newly added function AssemblyCheck (COPRA® RF 2017) helps your technicians significantly with the start-up of a roll formed product. After design of the required roll set, the delivered rolls need to be measured with the COPRA® RollScanner. Following the transfer of the contours to the data base COPRA® RLM, the designed and scanned rolls will be overlapped and compared in COPRA® RF. Thus, all deviations regarding roll widths or radii will be exposed instantly. They would have otherwise caused incorrect positioning in the bending area. The first roll will be aligned with the machine side, all further rolls along their respective predecessor. If the rolls need to be adjusted during implementation, the whole design will be updated straight away. AssemblyCheck also provides detailed information regarding roll positions. Displacements of single rolls due to faulty roll widths are also easily identified.


Fig. 4: COPRA® RF “Regrind” Feature

Design of combination roll tooling

Due to greater variety of section forms and rising tool cost, manufacturers increasingly exploit combination roll tooling, thus enhancing the tooling utilization rate significantly. COPRA® RF for sections offers various applications for different scenarios. For instance, should identical section forms with varying measurements have to be produced, COPRA® RF adjusts the available flower automatically to the newly required dimensions. Hence, sections of similar shape only need to be handled once. Due to the overlay of the modified cross sections with the related roll tooling, the designer can then easily determine which rolls only need repositioning, width or diameter adjustments or where spacer rings might have to be inserted. Should it be desired, both the repositioning of the rolls as well as the width adjustments can be done automatically by COPRA® RF, the designer only needs to adjust the necessary roll diameters.

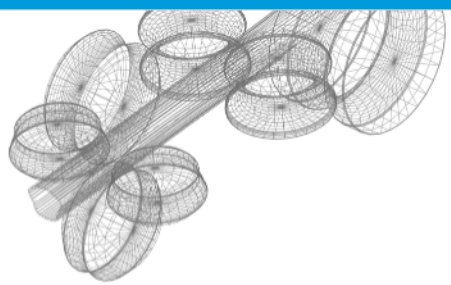
- CAD Finder Project- and document-management
- SpreadSheet – parametric flower design
- Punch Hole Editor: modification of 2/3D model
- Analytic simulation with COPRA® RF FTM
- Effective roll design with SmartRolls
- Automatic generation of drawings
- Direct link to COPRA® FEA RF
- RLM – data base powered Roll Lifecycle Management



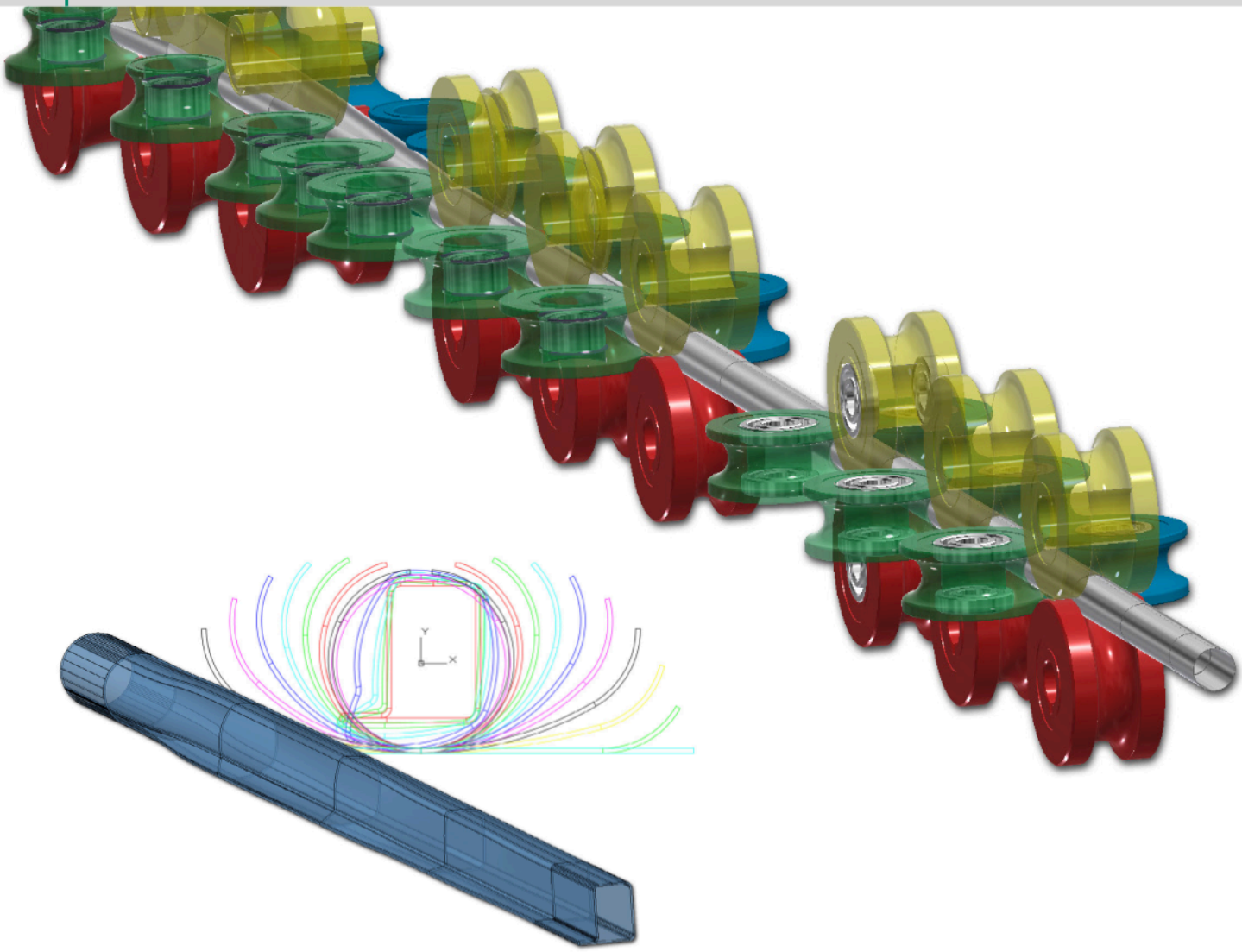
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COPRA® RF TUBES



COPRA® RF Tubes is the leading software solution for the design of roll tools in tube mills. The program comprises design and flower calculation for the production of standard as well as complex round- and rectangular tubes and also shaped tubes. The designer simply needs to adjust the predefined setup to the actual conditions of the tube mill.



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Challenges in Tube Production

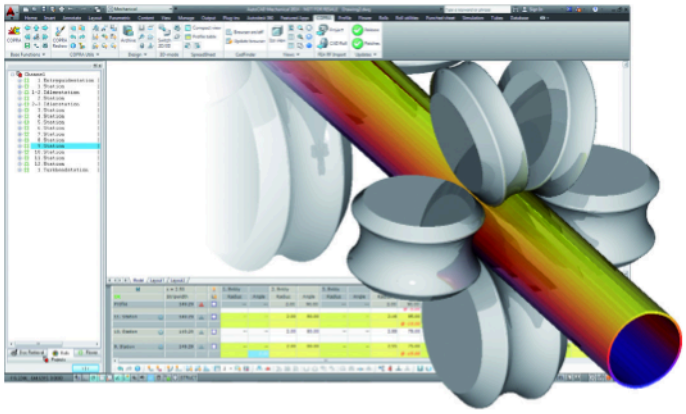
The market for tubes has been suffering from overcapacities as well as small profit margins from standard products. Although there was an all-time high in revenues, there were less tubes produced. Efficient process execution especially in complex tube production with high-strength material and small wall thicknesses is growing ever more important. The higher the ratio of diameter to wall thickness gets, the higher are the requirements for an efficient design of the roll tool set. data M has been supporting tube manufacturers and producers of tube mills for almost 30 years in process optimization with tailored soft- and hardware products as well as with competent consulting.

The COPRA® Tube Mill

An essential part for successful implementation of a tube project is the so called flower. It arises out of the underlying reshaping steps as well as the previously defined product parameters. COPRA® RF Tubes already contains pre-made strategies that can be adjusted to company specific requirements with maximum flexibility. Integrated calculation methods allow the definition of angles and radii from a given fin width as well as process specific additions like welding and sizing addition. A cross section can consist of up to eight different arcs. The respective angles, radii or arc lengths can either be calculated or defined individually. Common stand types are also available within the machine definitions of COPRA® RF Tubes.

Additionally, you can define any number of variants for round- and rectangular tubes. In this way, the rolls can be adjusted automatically and at any time to modified wall thicknesses.

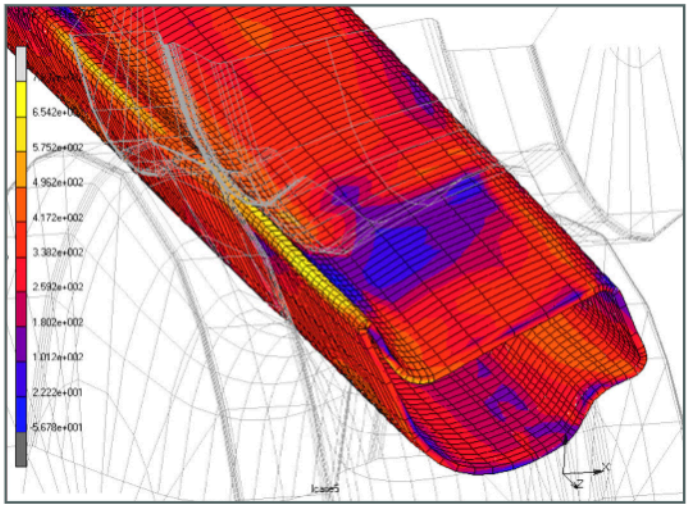
Hence, each variant corresponds to an own dedicated COPRA® Project in a way that all functions like automatic roll setup or model processing for a Finite Elements Simulation are available. Numerous other functions allow your designers to focus on the essentials: The optimal design of forming strategy and roll geometry. You can for instance define bending sequences for the automatic tube processing or various forming and machine parameters. Furthermore, COPRA® RF contains an award-winning (International Tube Association) optimization program that can calculate the ideal down-hill forming curve. This allows a strain-minimized forming of tubes.



Parametric 5-Roll Welding Station

COPRA® RF Shaped Tubes

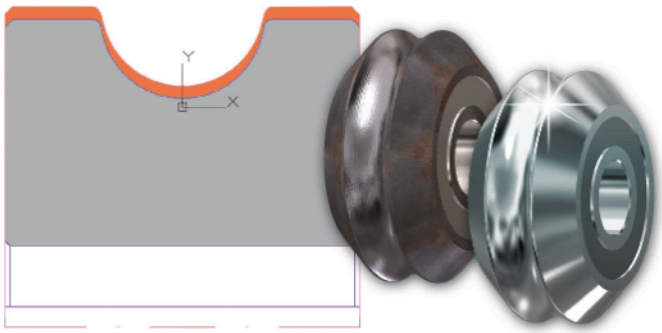
Our module for shaped tubes conducts the necessary calculations for the reshaping of round- to shaped tubes. The designer merely needs to define the number of shaping steps. The specification of the reshaping degree or the percental compression within the respective stations are optional. COPRA® RF calculates and optimizes the individual calibration steps, the basis for the subsequent roll design. There are two mathematic methods available for the calculation of the reshaping steps: The calculation of the respective angle values or the topographical method. With the targeted distribution of compressions, so-called undercuts can be better controlled.



FEA Simulation of Shaped Tube with COPRA® FEA RF

Efficient reworking of rolls with „Regrind“

In most cases, tube makers simply replace worn roll tools. It is however far more efficient to not scrap the old rolls, but to rework and thus recycle them.
Nonetheless, the correct capturing of the roll contours is too big a challenge, so that manufacturers shy away from the risk. With the integrated products COPRA® RF Tubes, COPRA® RollScanner as well as the Roll database RLM, roll tools can be reworked quickly and easily which can lead to a significant time- and cost-reduction. COPRA® RollScanner captures the roll contours with high precision and transfers them to the RLM database. They will of course also be available for the roll design.
COPRA® RF subsequently calculates the necessary degree of reshaping, identifies the roll with the highest wearout and conducts the repositioning of the axis automatically.



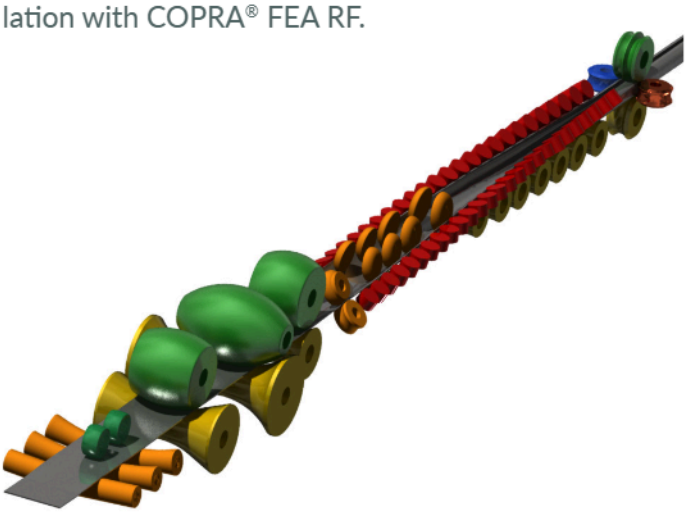
COPRA® RF “Regrind” Feature

COPRA® RF Drawing Dies

The module COPRA® Drawing Dies calculates the forming steps required for the reshaping of round tubes to shaped tubes. It is the only dedicated software worldwide for this specific design problem. As a first step, the final cross section of the shaped tube will be outlined with a drawing of the contour. The respective reshaping steps will subsequently be defined by these cross sections. For the individual cross section supporting points a compression coefficient can be defined allowing a curvature in the drawing die surfaces. Conclusively, COPRA® RF calculates the cross sections, by which the material will be distributed across the stations. This method allows an optimal material flow.

COPRA® RF CageForming: Tube Cage Forming Technology

Cage Forming Technology enables a flexible process for the manufacturing of tubes with various diameters and minimized tool changes. The forming is done by a group of roll tools arranged on a cage working from the outside of the tube. More tools are for instance located within or under the tube. With the integrated parametrics, all common types of roll cages can be designed with COPRA® RF. This method saves tool cost and furthermore allows a faster setup of the tube mill as the rolls don’t need to be changed. The rolls and their respective locations are stored in a special database und will be automatically refreshed in case of modified parameters. The geometry of the roll cage and the respective cage rolls will automatically be converted into an FEA model for subsequent simulation with COPRA® FEA RF.



Cage Forming Model

Optional Analytics Tool: COPRA® RF DTM

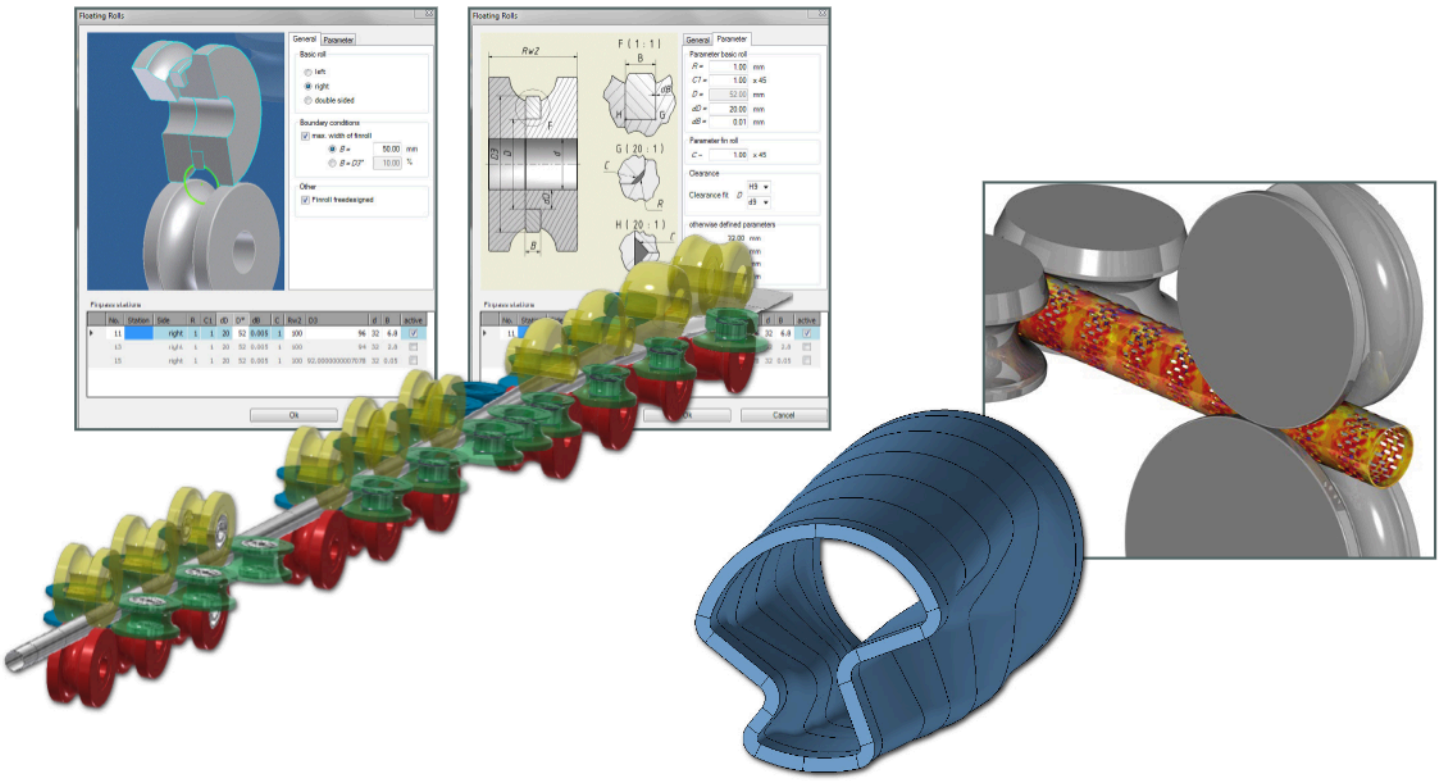
COPRA® RF DTM determines the maximum deformation values in longitudinal direction. Particularly in case of complex products, manufacturers can quickly and safely evaluate if the project can be implemented even without an FEA simulation. The Model is based on the theory of thin shells and allows a comparatively short processing time. The roll set can thus be optimized quickly and sufficiently precise in order to subsequently deploy an FEA simulation.
COPRA® RF DTM is ideal for the pre-optimization of a reshaping process and thus a fitting addition to COPRA® FEA RF.

Focus on design: Easy to use and organize

Through longstanding cooperation with our customers around the world, we have been improving COPRA® RF Tubes constantly. Particularly the design of complex tube mills with pre- and post-operations can get confusing quickly. An integrated Browser simplifies the Navigation across the stations with specification of stands distances. The respective station types will also be labelled automatically.

Beyond the classic control elements, COPRA® RF can also be operated with tool bars, the so-called ribbons. Furthermore, the integrated COPRA® RF CADFinder contains a management tool for projects and documents including revision control which helps organizing your COPRA® projects.

- Leading software for the design of roll tools in tube mills
- CADFinder: Integrated management tool for projects and documents
- Predefined and easily adjustable shaping strategies
- Pre-Optimization of shaping possible with cage forming technology
- Tailor-made parametric for the design of roll tools
- The perfect solution for the design of round- and rectangular tubes as well as shaped tubes



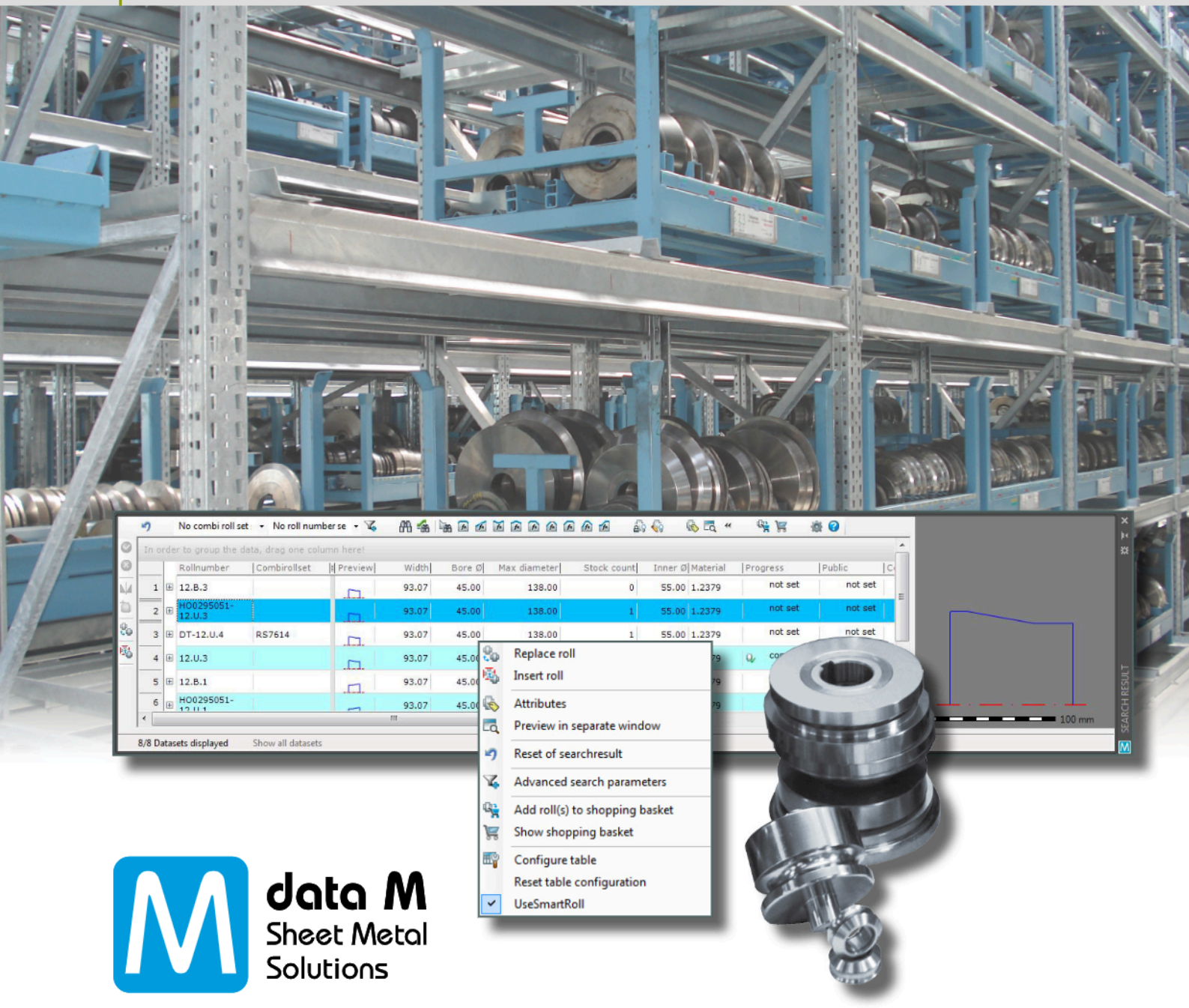
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www.copra.info/en/crf/

COPRA®
Roll Lifecycle Management

Keep track even of large stocks by intelligent roll management features with COPRA® RLM. Save time and expenses through flexible reusing of discarded rolls. The new feature SmartSearch allows a fully automatic real-time search during the design process.

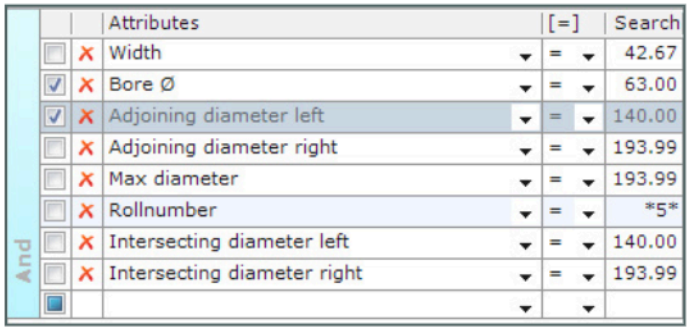


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www.copra.info/en/rlm/

Manage large roll stockings easily and quickly

Nowadays, roll formers face the problem of having to stock and manage large amounts of roll tool sets. As many rolls are needed for the production of new profiles, manufacturers frequently encounter delays due to time consuming manual search of the required rolls. With intelligent stock management, bottlenecks will be avoided and suitable roll sets can be composed by the data base.
COPRA® RLM allows searching of the inventory by means of definable categories and thus facilitates finding the required rolls quickly. The software is based on Microsoft SQL Server. Rolls can be returned and further processed to design through full integration into the COPRA® workflow.

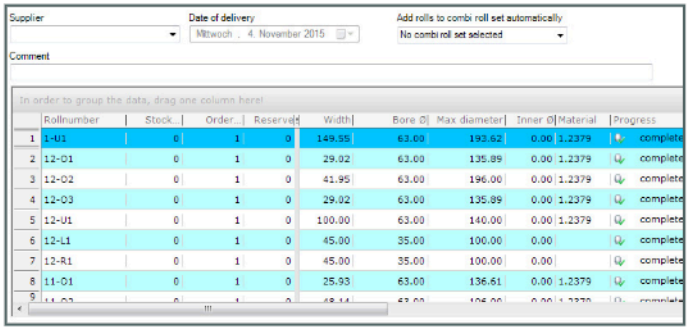


RLM *SmartSearch* – quick real-time search during design

To handle time pressure between incoming orders and delivery, engineers often resort to copying CAD drawings of standard rolls into the new design. In some cases, time can be saved compared to defining roll parameters and searching the data base. But the roll will then not be available as a COPRA® object. That means that the complete roll design has to be converted in case of a required FEA-simulation. Also, the composing of order lists and other steps cannot be processed automatically. The actual advantages of an efficient stock management are therefore reduced to absurdity. Additionally, further costs arise due to production and stocking of supplemental rolls.
RLM *SmartSearch* allows automatic search of the relevant rolls simply by clicking on the profile element. The user can then select the matching rolls from the visually displayed search results. Definition of roll parameters in this way becomes obsolete and up to 30% of designing time can be saved. Additionally, it unburdens stock management and the life cycle of a roll can be traced in detail.

Creation of order lists and checking out rolls

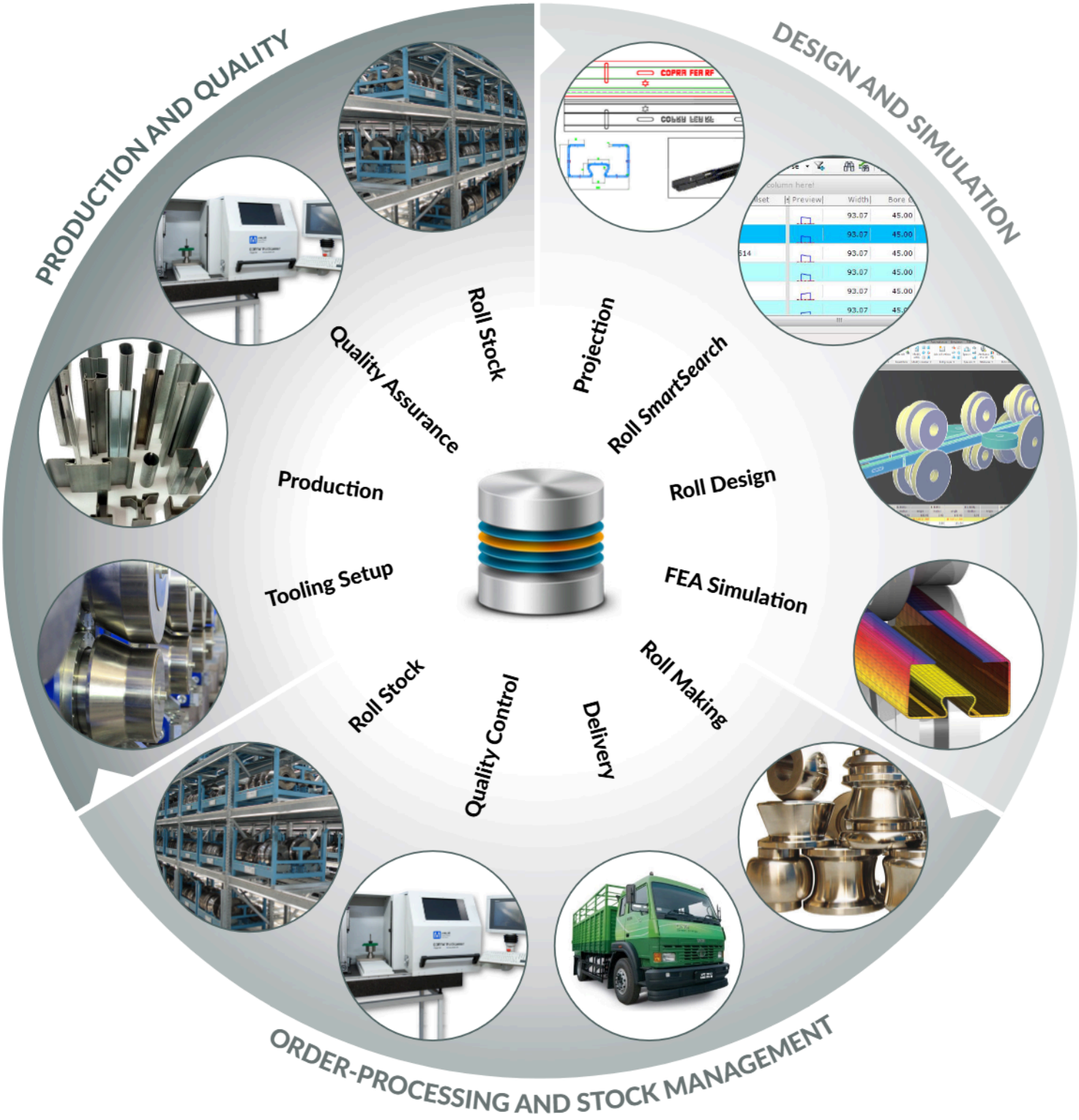
With reference to the current roll stock and information about the required rolls, RLM automatically creates order lists. For frequent changing of tool sets, rolls can be classified for usage, reworking or scrapping by common handheld scanners. It is thus ensured that the stock is kept up to date and only the actually needed rolls will be ordered.



Save cost through consistent usage of roll stock

RLM furthermore offers the possibility to efficiently reuse existing rolls. During roll design for new profiles or tubes, the data base can be continuously accessed. It is thus possible to verify if rolls within the required dimensions are in stock. The roll contour is displayed in a preview – behind it the already existing roll that could be used for the tool set.
Worn rolls can also be reintegrated into the production process by intelligent roll management. Respective inventories are often unused for years, although rolls could be used again by means of simply returning them. By definable attributes like bore diameter or roll width, the rolls will be loaded from the data base, adjusted and thus be recycled. This potential is frequently ignored in the industry, although significant cost reduction can be achieved by reworking instead of making of a new roll. This is because 70% of manufacturing costs are related to raw material and hardening, only the remaining 30% for design and turning. Our experience shows that the total cost can be reduced to approximately 15% by reworking of a used roll as it can be produced with only little cutting effort. Particularly companies with a large stock of recycling rolls will benefit from a significant cost reduction for equipping roll forming machines. This is achieved mainly by time savings through recycling instead of producing new rolls.

Closed Loop Roll Management with COPRA® RLM

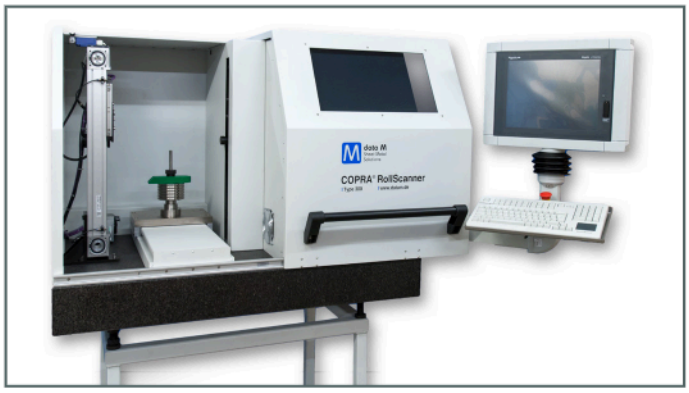


Transparency in Design, Manufacturing and Production

www.copra.info/en/rlm/

Industry 4.0 with RLM and COPRA® RollScanner – efficient stock management and quality control

If rolls are self-made or ordered: With COPRA® RollScanner, even large numbers of tools are easily and quickly checked regarding their quality. The designed roll contours will automatically be loaded from the RLM data base in order to compare them with the scanned data. After the completion of a project and before registering to the stock, rolls are once again scanned so the roll contours can be updated. With this procedure, not only the nominal but also the current roll contours will be available. Even old roll stocks without dimensioned drawings can be reintegrated into the production process.
With our innovative data base, we provide a true industry 4.0 application. Be prepared for the future and save time and cost with intelligent roll management.



COPRA® RLM - Stay cost efficient in the long run

Like other branches, the roll form industry faces tremendous time- and cost pressure. The setup of an efficient and integrated roll management is often omitted or incomplete. With long term experience in process optimization, we steadily enhanced the RLM data base. Our intelligent and interconnected roll management helps you keep competitive in the long run.

COPRA® RLM – intelligent roll management

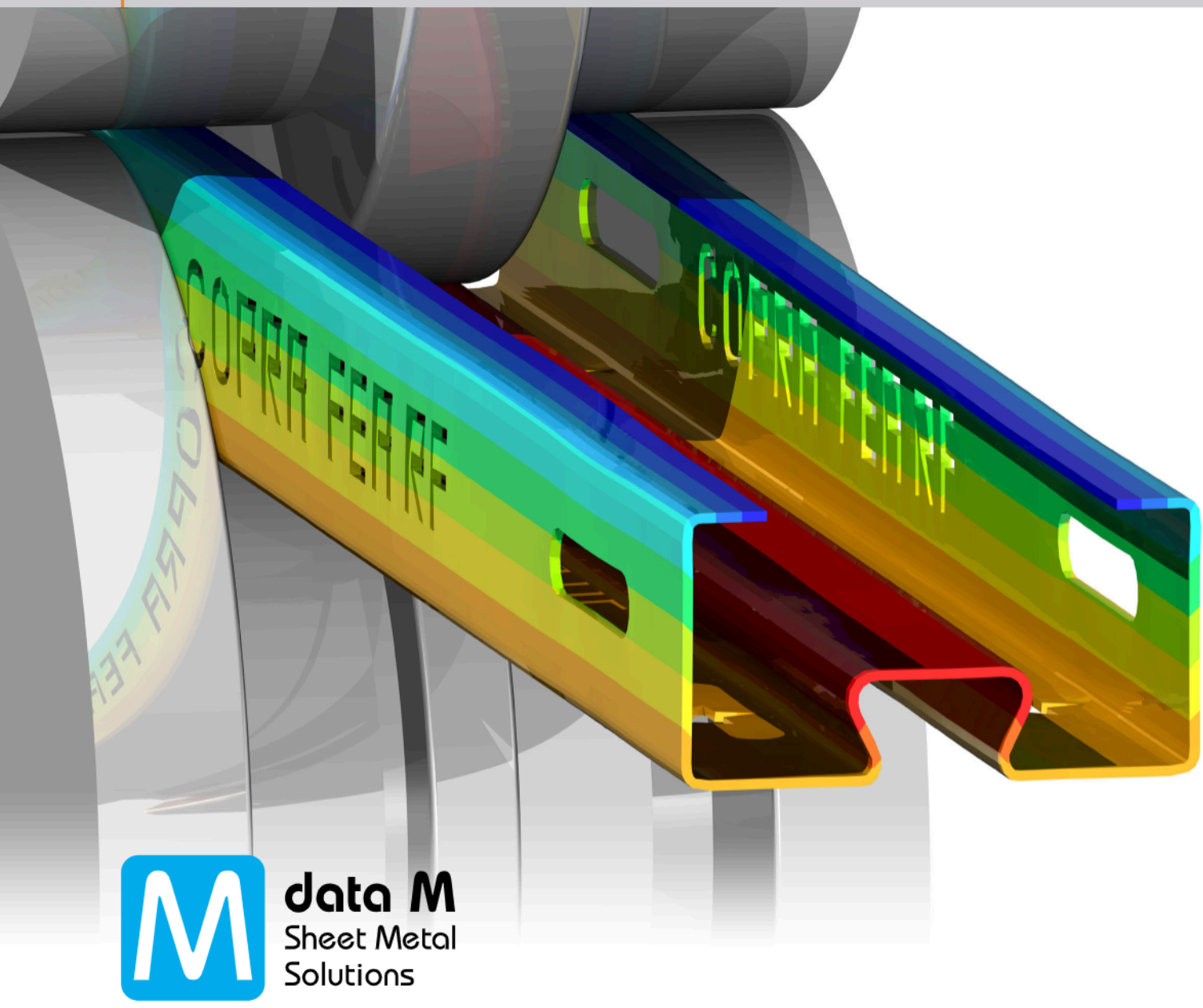
- Full integration into the COPRA® *workflow*
- Real-time roll search during design with RLM *SmartSearch*
- Basic and advanced search function based on the required roll attributes
- Functions for reuse of existing rolls
- Definable parameters (bore diameter, roll width etc.)
- Grouping of frequently used rolls to combination toolings
- Automatic compiling of order lists based on current stock
- Roll management tools (Booking in/out, scrapping)

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COPRA® FEA RF

Our Simulation Module COPRA® FEA RF is the world leading software solution for the simulation of Roll Forming processes. The program calculates the entire process including pre and post operations and screens for possible design errors. Through the intelligent interconnectedness of our COPRA® products, simulation results will be available for design review immediately. Due to our intelligent menus there is no need for a dedicated FEA specialist.



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Prevent trial and error by simulation of the manufacturing process

More often than not, roll formers operate along the lines of trial and error. After production of the entire roll set, the machine is activated in order to find mistakes or weaknesses during the roll forming process or even to test the feasibility of the entire project. Naturally, this method often causes high expenses. To prevent scenarios of this kind, companies of various manufacturing branches conduct process simulations. With methods like these, producers predict results of planned manufacturing processes by reference to virtual models. data M has been developing and enhancing COPRA® FEA RF for 20 years. The software computes the roll forming process with the so called non-linear elastoplastic calculation method.

With this approach, even the most complex production processes can be verified and the results thus be predicted with sufficient accuracy. COPRA® FEA RF imports the required data directly from the design module COPRA® RF. The results in turn will be available for design optimizations right after simulation. All the important information like forming forces, driving torque, elongations etc. can be viewed and applied accordingly.

However, preventing defects and bad product quality with consistent simulation is only the most straight-forward advantage of COPRA® FEA RF. Product development and the design process can be optimized and thus also profit hugely from verification.

One also shouldn't underestimate the increased know-how within the company through testing of various forming strategies within a virtual roll forming machine. We must remember a "classic" trial and error approach generates high cost only by testing a single strategy.

COPRA® FEA RF - The virtual Roll Forming Machine

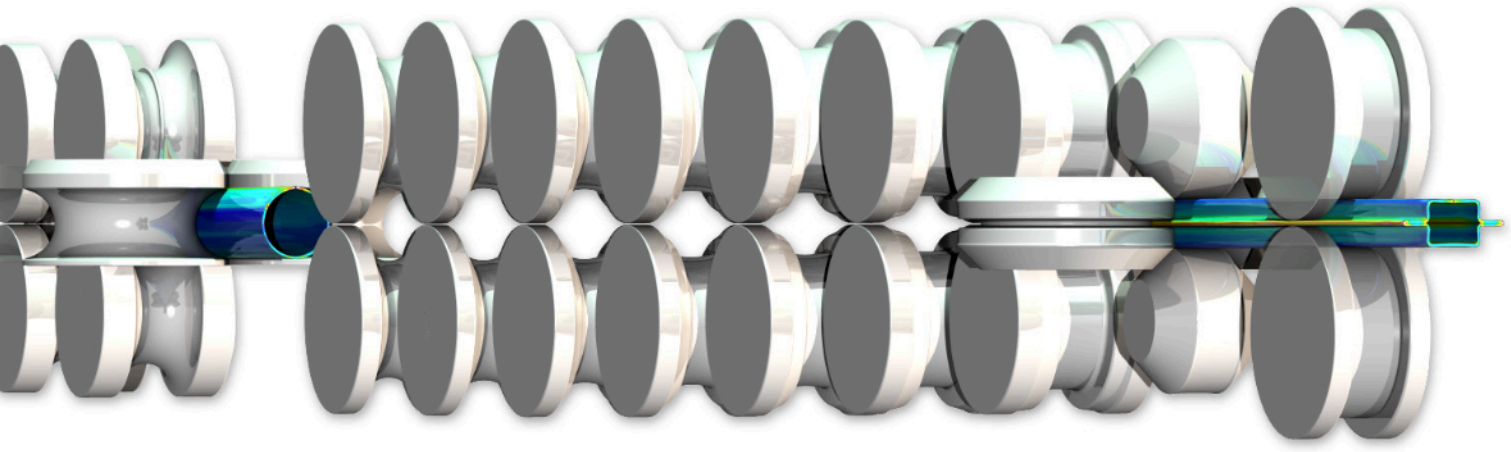
In order to understand the functionality of COPRA® FEA RF, it is helpful to imagine the program as a virtual roll forming line since our software enables you to test new roll designs at will before the actual roll manufacturing process. Sometimes even more important: It is particularly suited to test if complex projects are feasible after all. Many of our customers were able to achieve significant cost reductions by consistent utilisation of our simulation tools.

Contrary to common believe, manufacturers don't need a dedicated FEA specialist. Rather, any designer with experience in the field of roll forming can operate the software because COPRA® FEA RF automatically generates the FE model out of the design data. There is also the assumption that processing would take as long as simple test procedures. This may have been true around ten years ago. Nowadays even desktop CPUs provide enough performance to simulate even complex roll forming processes in only a few hours.

Provided a complete roll set costs circa 30 000 € and the ability to reduce tool wearout to a minimum through consistent simulation will alone recover the capital expenditure for the software, even in the mid-term. Additionally, machine down times as well as the required times for equipping and implementing will also be reduced, thus the machine can actually be used for bread and butter production with the time saved.

Increased product quality through non-linear Finite Element Simulation

Material changes that occur during manufacturing processes frequently present producers with huge challenges. COPRA® FEA RF simulates these changes



reliably and quickly. Also the usual defects like strip edge waviness, twist or bow can be prevented beforehand by verification of the design. After the simulation, COPRA® FEA RF provides a dynamic animation of the roll forming process as well as a graphic depiction of the results.

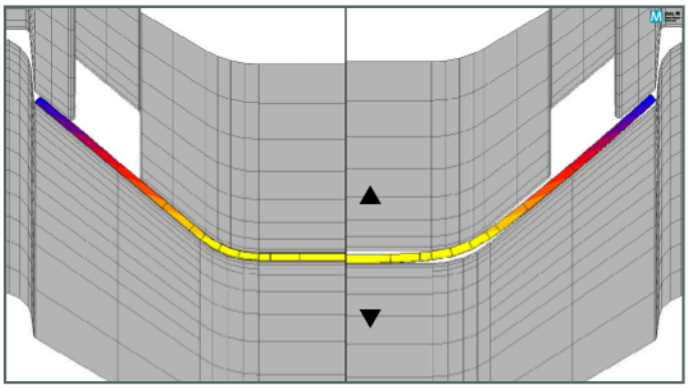
Various auxiliary functions and customizable templates facilitate a quick and automated breakdown of results, so the designer profits from significant time savings. The so called “Automatic Report” feature also allows all evaluation parameter of interest to be broken down to each individual station, providing detailed insights into the manufacturing process.

You can follow how the material is behaving during the actual manufacturing process. Furthermore, the software provides important information of the applied forces, torsional moments, pressure and tension values as well as lastly a complete 3D-visualization of the finished (virtual) product. Of course, the applied pressures can also be broken down by the respective axis.

Calculation of station stiffness

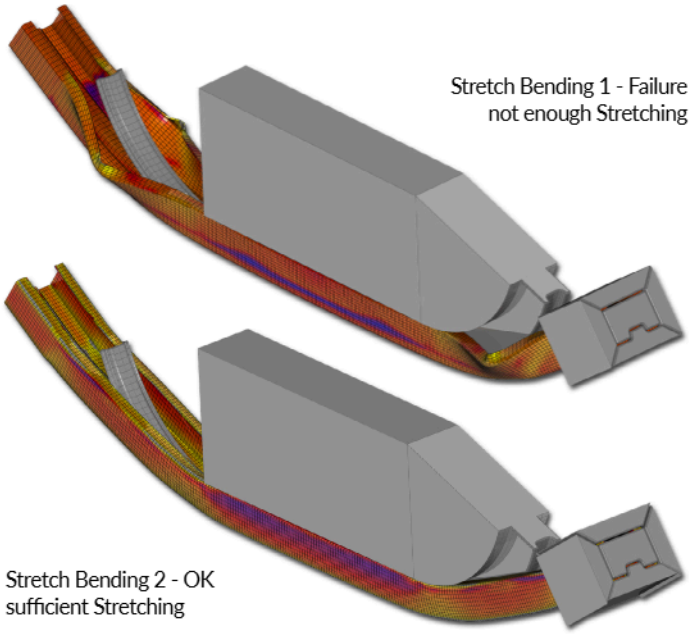
With the possibility of taking station stiffness into account, the quality of the simulation results is enhanced even further. Thus, COPRA® FEA RF can simulate the alteration of the roll gap reliably.

By contrast, assuming of fixed roll positions and neglecting of shaft deflection would lead to higher forming forces than in reality. The accurate calculation of the roll gap is particularly important for the product quality when using high strength materials because of different bending angles and radii.



Station stiffness **not** taken into account: Roll gap is constant

Station stiffness **is** taken into account: Roll gap changes due to forming forces



Stretch Bending 1 - Failure not enough Stretching

Stretch Bending 2 - OK sufficient Stretching

COPRA® FEA RF as a fundamental element of the process chain

The consistently enhanced user interface allows your designers to navigate naturally though the forming stations. After output of the simulation results, the respective positions of the relevant cross sections will be identified by “Roll-Planes” and compared to the required cross section. You can of course export the data for further use with other CAD programs. Your designers will then be able to test new roll tools or complete sets for the effects on the manufacturing process. Like all COPRA® products, the simulation methods are tailored to the roll forming process – and for highest efficiency.

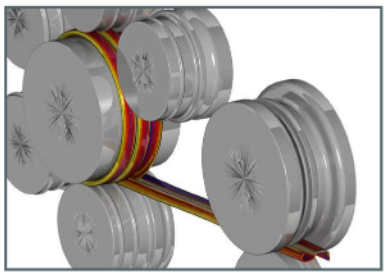
COPRA® FEA RF not only simulates the roll forming process, but is furthermore able to calculate all common pre and post-operational manufacturing steps including stretch-bending. For this, you can use the extended import functions and import new formats like STEP and SAT. The software is thus a central part of our integrated solution concept for roll formers. Repeated verification through FEA simulation is inevitable for subsequent calculations. Particularly stresses and tensions caused by roll forming influence the calculation results significantly. In case of a car bumper for instance, all process steps will be simulated reliably, so that the roll set can be adjusted quickly and easily as required.

Why COPRA® FEA RF?

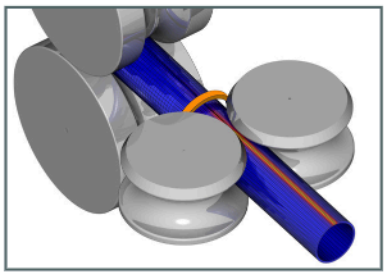
COPRA® FEA RF is a software solution for the simulation of roll forming processes as well as pre and post-operational manufacturing steps. However, roll formers profit in multiple ways: Additionally to reduced machine- and tool-cost as well as the avoidance of total losses, COPRA® FEA RF generates genuine innovation within companies.

Various forming strategies can be tested within virtual roll forming machines and thus optimize the production process in the mid- and long-term. Stay competitive with software verification instead of expensive trial and error.

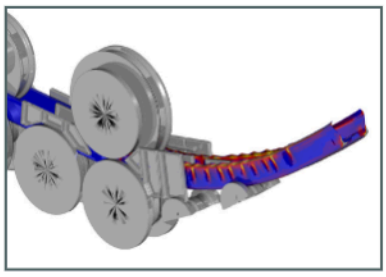
- FEA-Model generation within seconds
- Easy and quick optimization of roll set
- Virtual implementing of roll designs
- Advanced Restart - adaption of grid at any time during simulation
- Station Stiffness – calculates alteration of roll gap by forming forces
- Besides IGES, new formats like STEP and SAT can be imported
- Marc / Mentat included (also for COPRA® FEA RF WireRolling)



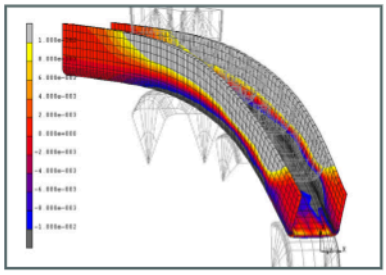
Winding



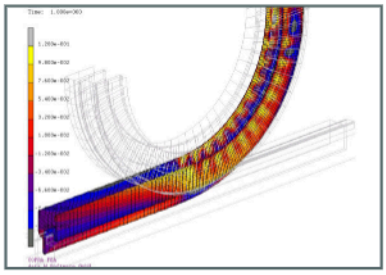
High-frequency Welding



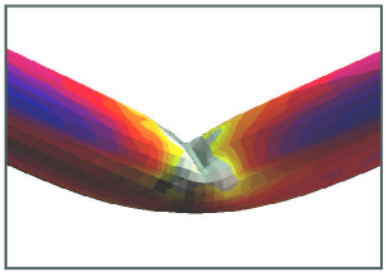
Inline-Bending



Sweeping



Stretch Bending



Crash Simulation

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