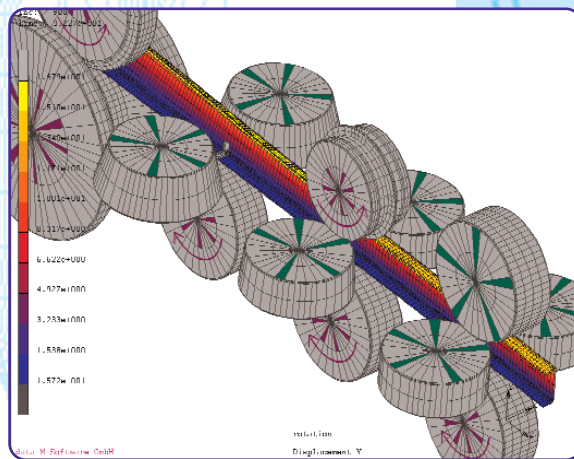
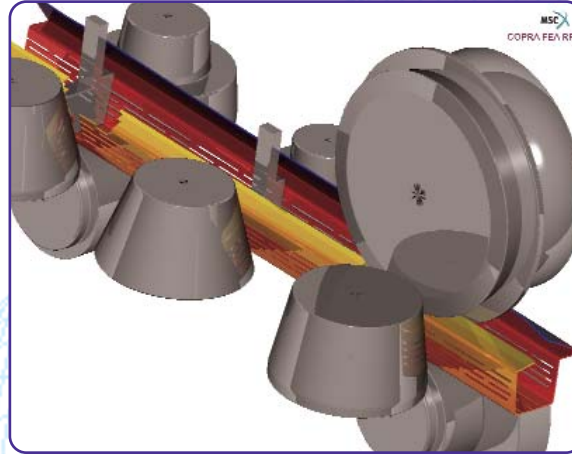


COPRA[®] FEA RF

Simulation Technology for the Roll Forming Process with DTM and Finite Element Analysis



COPRA® DTM

Deformation Technology Module

COPRA® Roll Form Simulation

In the past roll forming used to be treated as a kind of "black art". Difficulties such as appearing defects and problems in setting up new roll sets on the mill were not uncommon. In a trial & error approach one had to produce a whole roll set and do the machine setup in order to find potential weaknesses in the roll forming process – a costly and time-consuming cycle causing expensive machine down-times.

data M has been aware of this problem from an early stage and has concentrated its efforts into developing a simulation program to overcome these problems. It is now possible to predict the practical results with high accuracy with COPRA® Roll Form Simulation Technology.

A 2-step philosophy

data M offers two different software programs for simulating the roll form process:

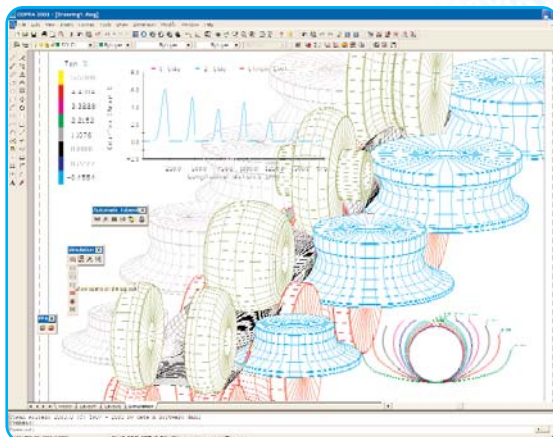
- 1) a static solution, based on the theory of thin shells (COPRA® DTM) and
- 2) a non-linear Finite Element Analysis (COPRA® FEA for Roll Forming).

COPRA® Deformation Technology Module (COPRA® DTM)

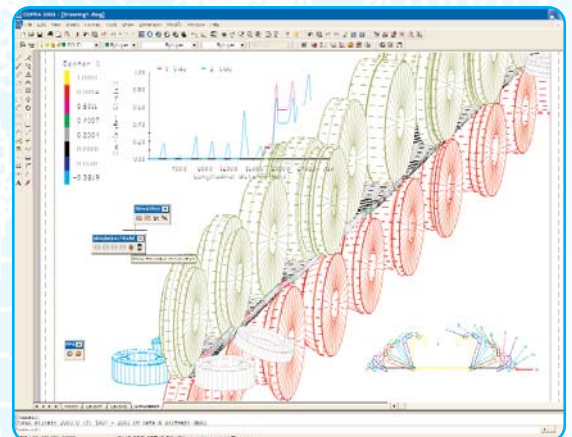
This module calculates occurring longitudinal (elastic and plastic) strains quickly and reliably with high accuracy. It takes into account parameters that are vital to the roll forming process such as material properties, sheet thickness, roll diameter, types of rolls, etc.

The geometry generated by COPRA®'s shaping feature enables the design engineer to optimise his own roll designs. He gets automatic feedback about feasibility and potential weaknesses of the design.

The simulation tool – as says its name – shows critical areas without touching a single piece of hardware. COPRA® DTM has been developed scientifically and has proven its practical use in thousands of cases.



Simulating the forming process in the first step: COPRA® DTM



Longitudinal plastic strain values: COPRA® DTM

Matjaz Knez, Alpos:

"Since we have been optimising our rolls with COPRA® DTM we were able to reduce our tooling costs significantly".

Johann Breytenbach, Bosal Africa:

"the roll design supplied by data M is as a roll design

should be!"

Lars-Gunnar Söderlind, AvertaPolarit Stainless Tube:

"Thanks for 10 years of cooperation with data M and usage of the excellent COPRA® Roll forming program."

COPRA® FEA RF

Simulation of the Roll Forming Process - (Non-linear 3D Finite Element Analysis)

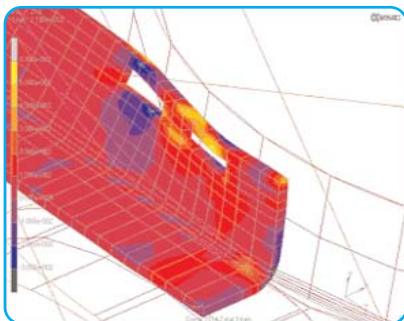
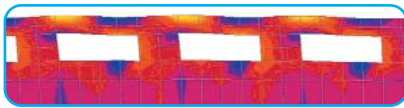
Non-linear Finite Element Analysis (COPRA® FEA RF)

With its COPRA® FEA RF software package data M continues to supply highly efficient software packages tailored to the roll forming industry's needs. The program imports data directly from COPRA® RF, which is used as a pre-processor for the Finite Element Simulation technique.

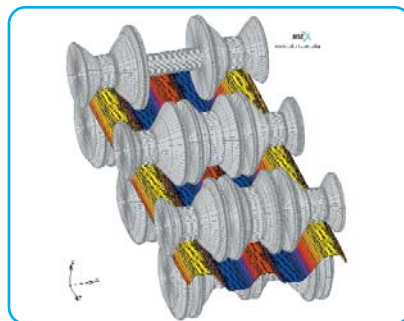
In addition to the COPRA® DTM simulation results, COPRA® FEA RF provides essential information about forces, torques, stresses and a 3D-visualization of the final product showing possible later defects. As a matter of fact, this module can be regarded as a "virtual roll forming mill" that allows the user to try out new roll sets even before the actual manufacturing process.

COPRA® FEA RF is easy to use and runs on a standard up-to-date personal computer. It does not require any time-consuming pre-processing or difficult post-processings. It is tailored to the roll former's needs – as are all of data M COPRA® products.

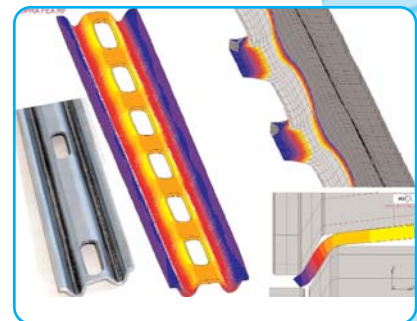
- With MSC.MARC solver - optimized for roll forming
- Comfortable managing of different simulations by the COPRA® FEA RF Project Manager
- Automatic preparation of FE model from existing COPRA® RF design data
- Automatic definition of respective roll form specific boundary conditions
- Calculation of forming forces and forming work: this will help you defining the machine (axis-diameter, required motor power)
- Tools for the analysis/ interpretation of simulation results (you do not need to be a FEA expert in order to be able to interpret the results...)
- Plotting of simulated cross sections at user defined positions. These can be compared with the designed cross sections in order to verify current cross section deviations (necking, springback, widening, etc.)
- Dynamic animation of roll form behavior
- Analysis of maximum and permanent longitudinal strain values as well as real forming lengths
- Investigation of behavior of the material after cut-off in the mill. This allows to visualize frozen inner stresses and respective influence on the final profiled shape (bow, twist, end flair, etc.)
- Shows defects due to wrong flower or roll design
- Shows forming lengths, longitudinal and transversal strain values in diagrams
- Other diagrams for investigating material changes (like work hardening), thickness changes, springback, unsymmetrical behavior, and failure of the material (FLD)
- Possibility to make a restart with the results from a specific station
- Semi-automatic report creation
- Simulation of pre-punched material: investigation of deformation of punch holes and surrounding material. Influence on cross sectional stiffness.



COPRA® FEA RF:
Deformation of prepunched material



Analysing trapezoidal sections



From art to part...

Duffy Armstrong, Webco Industries:

The FEA analysis that data M performed for us allowed us to see a visual representation of the process problem we were having, as well as providing a quantitative value to the stresses we were imparting to the product.

The visual representation was described by the machine operator as "exactly what I'm seeing coming out of the mill". This analysis showed us exactly where in the process our problems were occurring.

COPRA® FEA RF

Welding - tubes and

(un)symmetrical closed profiles:

- Calibration of round tubes / closed sections
- Round to (un)symmetrical shapes
- Shape to shape
- V-angle of weld
- Quality of weld
(e.g. investigation of the real welding addition)

Cage forming

- Investigating and defining smooth forming
- Controlling the cross sections
- Equalize force distribution
- Definition of optimal downhill forming

Drawing Dies

- Supporting air bending
- Cost reduction in tooling

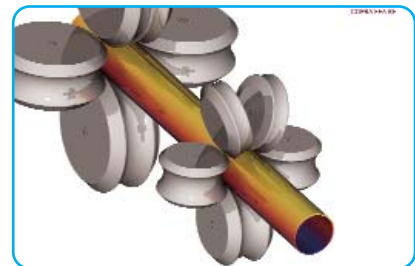
Interaction of driven/non-driven rolls and their influence on the forming process and quality of the shape:

- Investigating of driving diameter
- Frictional forces and losses
- Pulling force in material
- Better indication of surface damage
- Better investigation of required motor power

Future in COPRA® FEA RF - already proved by pilot projects/experience:

Coupled thermal/mechanical analysis of welding

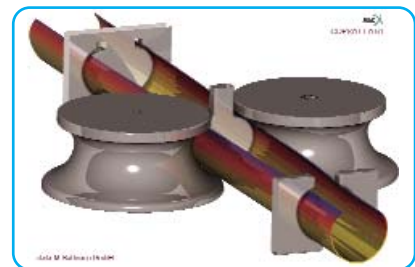
- Coupled Thermal / Mechanical Analysis
- Adaptive Meshing in Welding Area
- Welding Criterium
- Material Phase Transformation
- Geometry and Position of the Laser Heat Input
- Power of the Laser / HF Welding Equipment



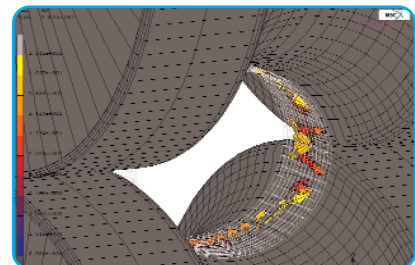
COPRA® FEA RF: Tube mill welding



COPRA® FEA RF: Cage forming



COPRA® FEA RF: Drawing dies



COPRA® FEA RF: Evaluating driven rolls

Additional Solutions from data M

- COPRA® RF Design and consultancy services
- COPRA® ProfileChecker (Quality Control Hardware)
- COPRA® RF Roll Design Software
- COPRA® WR for Wire Rolling
- COPRA® for Tube Drawing
- COPRA® RF DBMS (Database Management System)
- COPRA® MetalBender (Sheet Metal Design and unfolding Software)
- COPRA® LaserCheck (Sensor for Bending Machines)
- Vision Systems
- Hexapod Robots
- Software Development



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