



A Crystal Ball for Rollformers

Creating Real-world Situations with Dynamic Simulation Software

By Bernie Doyle and Bob Repovs

Back in the day, the idea of risk mitigation or dead lines didn't mean much. Take the Wright brothers, for example. They had a dream, and by-golly they were going to prove that it could become a reality. "For some years I have been afflicted with the belief that flight is possible to man," Wilber said. And on Dec. 17, 1903, he bravely placed himself into his invention and traveled through the air for almost 60 seconds assisted by the power of the internal combustion engine and the Bernoulli principle. Risking life and limb he succeeded (where many had failed). The result was fantastic and changed the world, but you have to admit it was pretty risky. I wonder what his wife thought about the whole thing.

Or take Thomas Edison, who persisted through literally thousands of iterations toward a working incandescent light bulb. He got there in the end, but it took an awful long time. I suppose he didn't have a "deadline," but if he did, then you might very well be reading this article by candle light.

Things are a little different today. We need to be able to identify and minimize risk as much as possible and produce real-life working solutions inside tight deadlines. New profiles are being developed as you read this, and the race is on to get those ideas to market as useable materials for construction.

The need to differentiate your profile from what already exists is crucial to carving your own niche and building your brand. However, the process of going from a profile concept to a full mill setup can be a daunting prospect. How can the costs and risks in the development of a profile be mitigated, and how can the process be done faster?

Returning to our industrial pioneers, what do you think Wilber or Thomas would have to say if they were offered a computer program that could almost completely remove the cost and risk of real-world product trials and accelerate the design process, all at the touch of a button? I think they would say "What is a computer?" But other than that objection, they would think the idea was incredible.

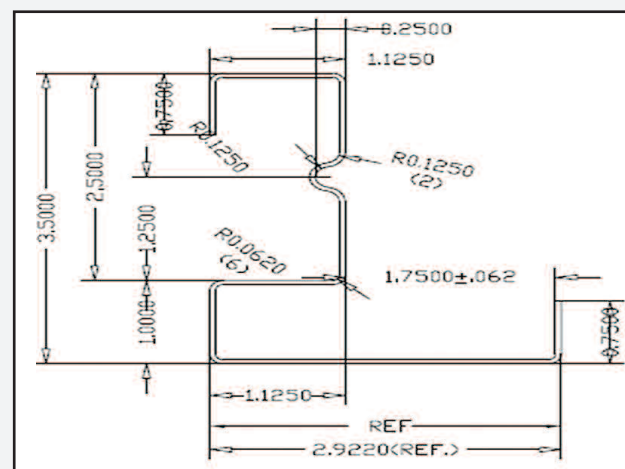
Luckily for today's innovative companies there is such technology, known as dynamic simulation software. In essence, dynamic simulation software is a powerful tool to help us understand what actually happens in real-world circumstances when materials and forces interact with each other in dynamic processes. For Wilber it would mean building the plane in a CAD program and then being able to analyze the true-to-life behaviors of what stresses and strains would do to the aircraft under different conditions, like being propelled by one propeller rather than two or what if the structure of the

Case Study

As a rollformer manufacturing company, we get a lot of very technically demanding projects; the kind that others just won't touch with a 10-foot pole. What follows is a real-world example of how FEA saved the day.

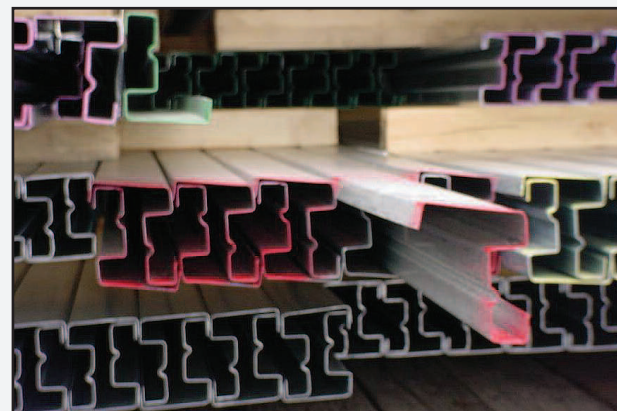
Customer requirements

- Form three sizes of roof truss for NA market
- 3 1/2-, 5 1/2- and 7 1/4-inch (89-, 140- and 184-mm) height
- 12 to 20 gauge (1 mm to 2.75 mm)
- No roll changes allowed
- No manual gap changes ... automated gapping only
- Unsymmetrical part
- No manual adjustments
- Can't adjust inboard/outboard separately



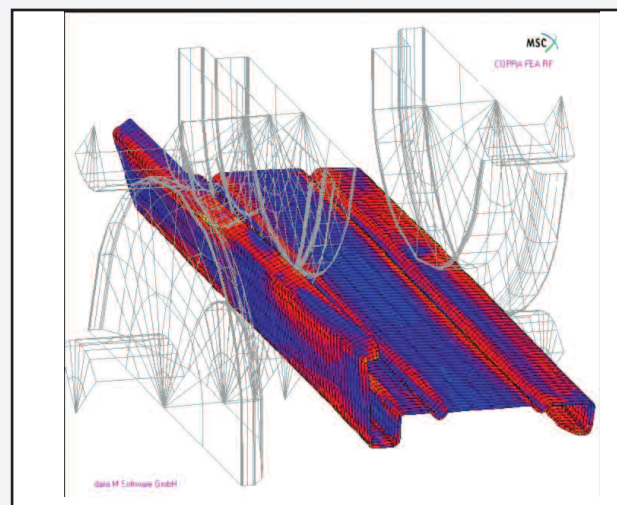
First attempt without FEA

- No repeatability
- Too much "tweaking" along the way
- Couldn't do the lighter gauges well
- Too much twist
- Too much flare
- Unacceptable outcome



Second Attempt using FEA

- Used COPRA FEA RF
- Utilized data M for consulting and guidance
- Ran many simulations in FEA and found out a lot!
- Material stretch was a major concern
- Found that holding one rib was key during simulation
- Proceeded to make new rolls



frame was oak rather than spruce. Thomas could have run an almost infinite number of tests to discover what temperatures a filament would be able to withstand, all on his computer monitor rather than his laboratory bench.

For the rollforming industry, dynamic simulation software means being able to understand the different stresses that will be induced into a material during each pass through a rollformer and, therefore, being able to make the correct adjustments to the design of the roll, all without ever having to haul 1 pound of steel onto the mill. It can all be done virtually in a sophisticated digital environment using a state-of-the-art process known as finite element analysis.

Simply stated, FEA is a monster of a computer program that can crunch enormous amounts of data producing incredibly accurate understandings of the behaviors of known materials (coil stock) in specified processes (rollforming). FEA is a program that can piggyback on the 3-D designing software known as CAD. It does require advanced training to be used successfully, but the benefits are realized as soon as the program is used. No more grind-set up-test-teardown-regrind-set up-test again with real rolls. FEA allows engineers to chase out edge wave, oil canning, flair or any other unwanted material characteristic even before a coil has been loaded or a roll mounted.

By virtually breaking the material into many small parts (elements) and designating specific material properties (yield strength, thickness, composition) the computer program and engineer running it are able to build a virtual mill and run a variety of situations as test cases. The data that is produced is represented in animated 3-D images and graphical data tables showing almost exactly where the material will be manipulated and to what result (elastic vs. plastic). Even being able to show where there are internal stresses induced. All this is then used by the engineer to help analyze and redesign the rolls or stands or profile. It doesn't end there though, the entire mill can be analyzed to help determine shaft diameter or even bed properties.

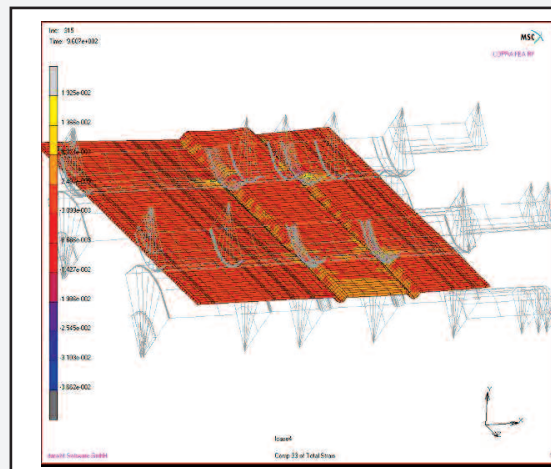
Don't get too excited now thinking that all you need to do is get the software and you are in the rollforming business. Like a lot of technology, FEA and dynamic simulation software is a tool that complements an already existing deep understanding of rollforming and is not a substitute for it. FEA is the technological future of effective rollform design. Currently it has only been adopted as a tool by the most progressive engineering groups, but in time, it will become an industry norm. To actually go the distance and integrate the FEA technology into the engineering department of a rollform machine manufacturing company requires significant financial and human resources to be invested, not to mention a vigorous and profound desire to offer customers nothing but the best.

We like to think that Wilber and Thomas would have used dynamic simulation software to help change the world, and that's why Samco Machinery Ltd., Toronto, uses FEA as part of its People Promise to all its customers. **MGN**

Bernie Doyle is a sales representative for Samco Machinery Ltd., Toronto, and Bob Repovs is president of the company. More information can be found at samco-machinery.com.

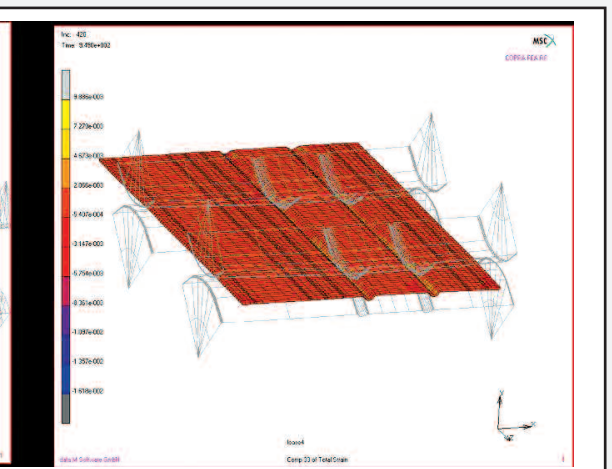
Case Study

Before



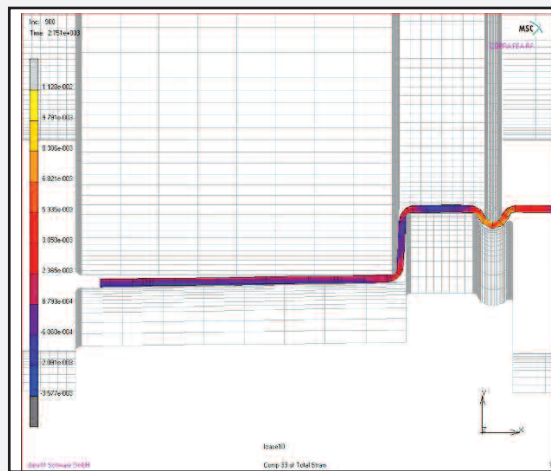
Forming of the ribs: longitudinal strains up to ~2%

After



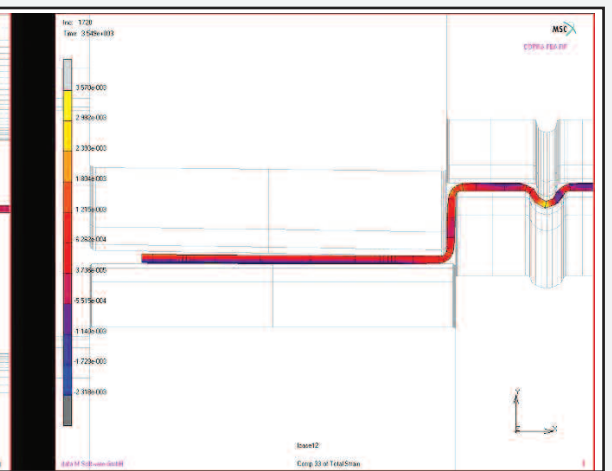
Forming of the ribs: longitudinal strains reduced to < 1% using "trapezoidal forming"

Before



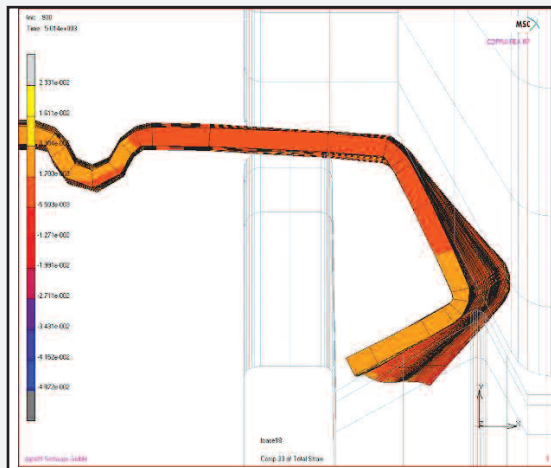
Necking in the radii on the left side

After



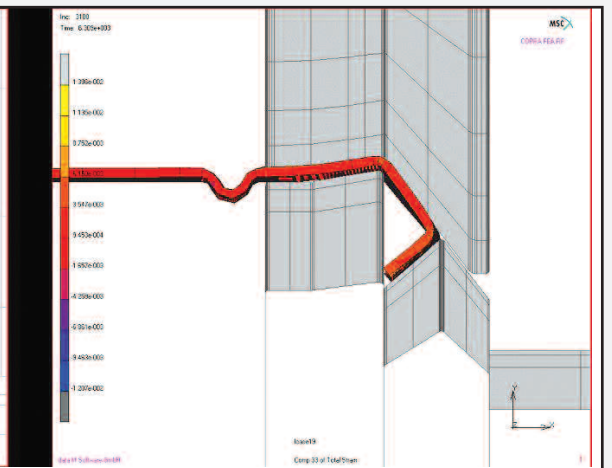
Necking in the radii reduced considerably

Before



Bottom roll cannot reach radius when bending the vertical leg; underfined behavior at the horizontal leg

After



Over bending of the inner leg to enable the bottom roll to form the radius

The final result—success!

Using state-of-the-art dynamic simulation software, combined with the deep experience of a seasoned roll design engineer, we were able to deliver what most would claim can't be done.

