What is Roll forming?

Roll forming is a continuous bending operation in which sheet or strip metal is gradually formed in tandem sets of rollers until the desired cross-sectional configuration is obtained.

Roll forming is ideal for producing parts with long lengths or in large quantities.
Application spectrum of roll formed profiles:

U and C channels, door frames, shutter profiles, trapezoidal profiles, corrugated sheet, screen doors, wall and roof cladding, roof bows and trusses, panels, gutters, purlins, fence posts, greenhouse profiles, grape stakes, logistic tracks, drawer slides, studs, beams, beads, shelf racks, sheet piling, guard rails, seat tracks, bumpers, truck and trailer components, window guide channel, seal retainer, cross-members, heat transfer pipes, garage doors, rack beams, duct flanges, drywall profiles, cable trays.

Preparing the roll forming operation
Roll Forming Simulation with PROFIL and LS-DYNA
by Roland Brandegger, UBECO GmbH, Iserlohn (Germany)

- defining the desired profile or tube cross-section and calculating the initial strip width
- defining the bending steps (flower pattern) dependent on the permissible longitudinal strain
- designing of the roll tools
- verifying the design by finite element analysis
- export of the manufacturing data

Problem:
- different profile segments take routes of different lengths
- this causes longitudinal strain especially at the edge
- exceeding the yield point leaves residual stress, causing unwanted deformations

Strain in the longitudinal direction:
Fixing the Problem: 3-step Quality Management Concept

Step 1: Calculation of the stress of the edge

- Approximate calculation
  - Useful during flower pattern creation, when rolls not yet exist
  - Calculation at the edge only

Step 2: Profile Stress Analysis (PSA)

- Distance between stands,
- Yield point and Young’s modulus of the material,
- Center line or bottom line forming

Step 3: Virtual Rollforming Machine (Finit Element Analysis FEA)
Step 2 of the 3-step quality management concept.
Calculation of the estimated longitudinal stress within the whole profile.
Without FEA.

**Profile Stress Analysis (PSA)**

Approximate calculation
- Useful during flower pattern creation, when rolls not yet exist
- Calculation in the whole profile cross-section

Important for folded corners (hems)

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**Simulation of the Roll Forming Process**

with FEA (Finite Element Analysis)
Step 3 of the 3-step quality management concept

“Virtual Roll Forming Machine“
Interface to the FEA-System LS-DYNA
Developed in co-operation with DYNAmore

Proceeding the simulation:

1. Entering the FEA parameter
2. Running the solver
3. Analyzing the result
Defining bore holes and cut-outs

Restart after modifying a certain stand:

Entering the material properties

Stress-strain-curve generator

Analyzing the result of the FEA simulation with UBECO PROFIL

Representing the Results:
- Stress x/y
- Stress z
- Strain
- Sheet Thickness Reduction

at the:
- Top and Bottom Sheet Surface
- Sheet Center
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Reality:
Nearly unlimited length, decoiled from a coil

Simulation:
Sheet with finite length, thus deformations at the front and rear edge

Evaluation:
Trimmed sheet

Result:
Unrealistic deformations have no influence.

Analysing the results:
• Display the 2D cross section
• Check if dimensions are within specified tolerances

If unwanted deformations are shown:
• Step backwards to determine which stand causes the problem
• Modify the design
• Restart simulation

All this happens before the rolls are manufactured!