Simulation of Roll Forming

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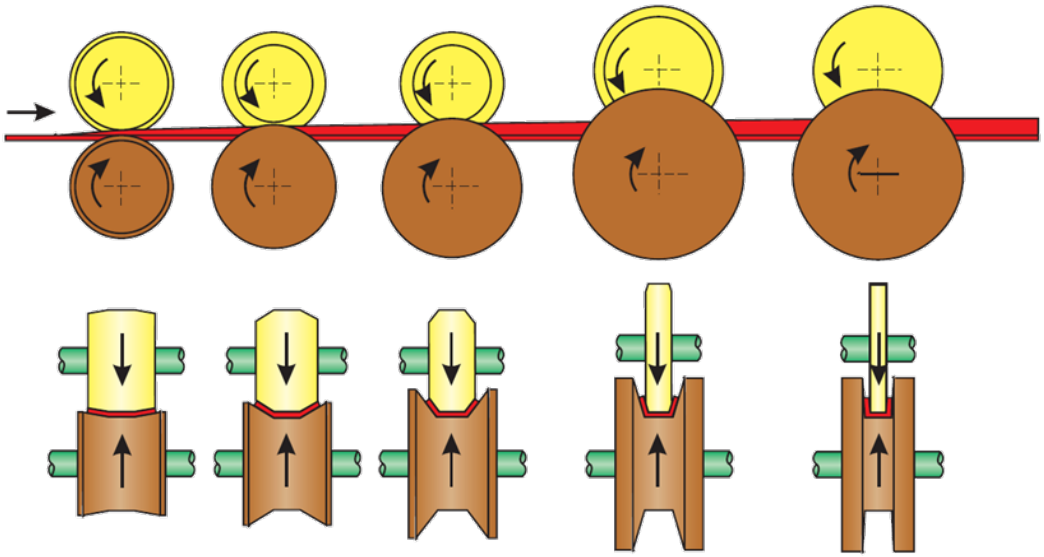
Outline

- Introduction
- Roll forming
- New developments
- Simulation of U-channel
- Summary and future work

Roll Forming

- Bending process
- Angle introduced continuously along straight line
- Set of contoured rolls
- Strip motion applied by rotation of rolls (friction)
- Alternatively, pulling of strip
- Unlimited length



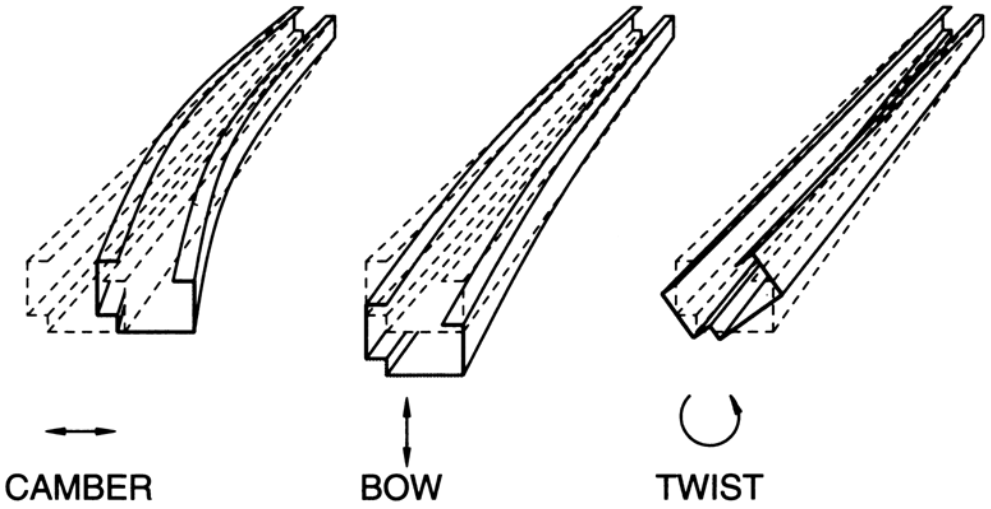
Source: Schuler

Roll Forming - Boundaries

- Generally, materials that can be bent can also be roll formed
- Steel:
  - Thickness 0.1mm to 20mm
  - Width 3mm to 2m
  - Velocity 20m/min to 80m/min, some up to 160m/min
  - More demanding for higher yield strengths
- Product is prismatic

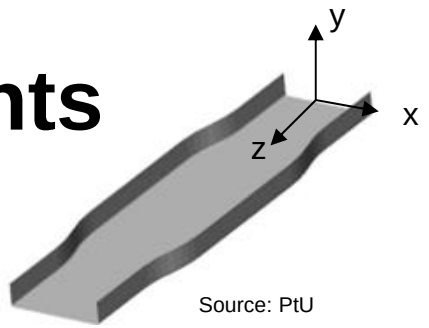
Typical Defects in Roll Forming

- Camber
  - Curving in horizontal plane
- Bow
  - Curving in vertical plane
- Twist
  - Rotation around longitudinal axis



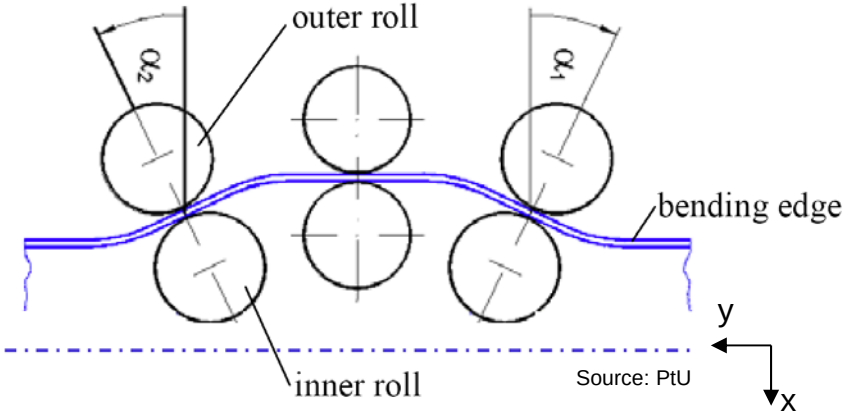
Source: Halmos

Roll Forming – Latest Developments

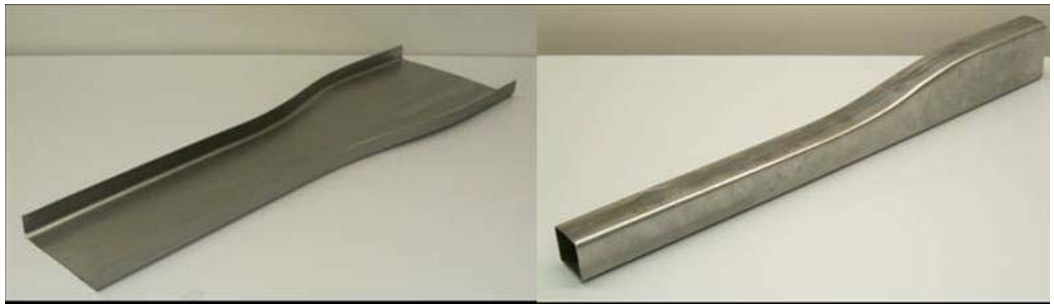


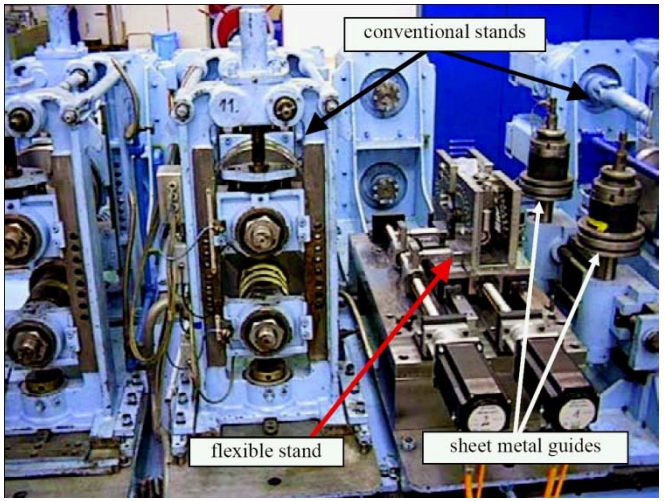
Source: PtU

- Flexible roll forming
- Rolls with addition DOF
  - Rotation
  - Lateral translation
- NC
- Variable cross sections



Source: PtU

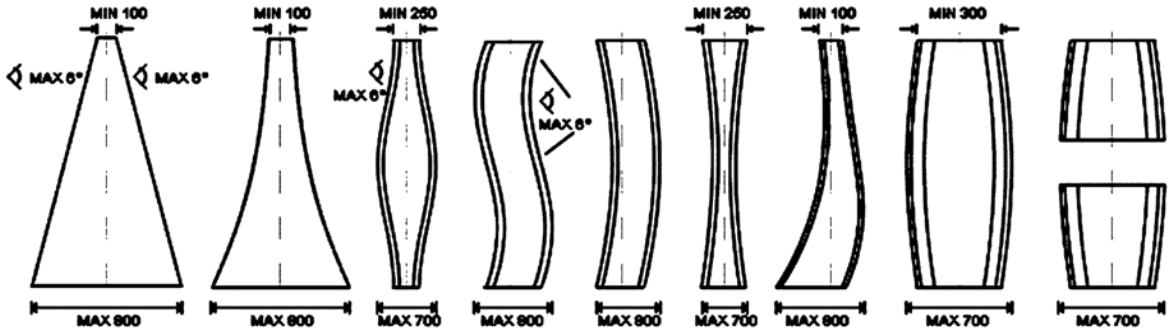

Source: PtU



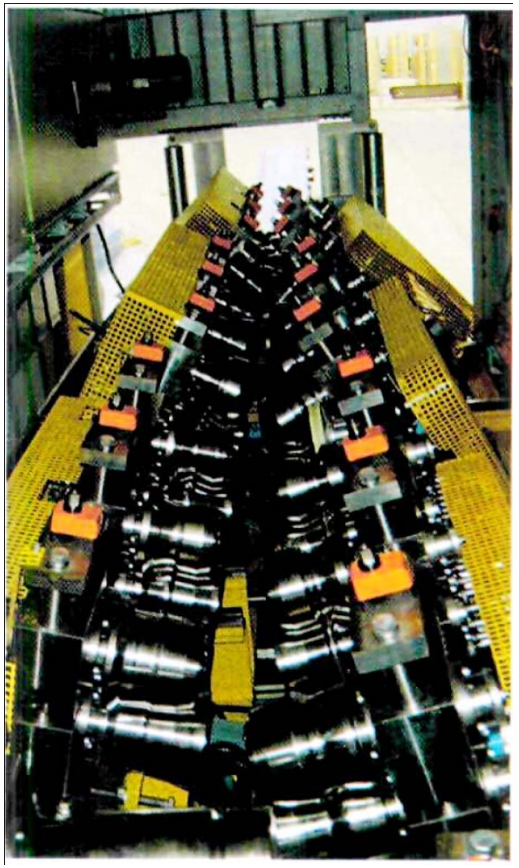
Source: PtU

Roll Forming – Latest Developments

- MONRO
- Variable cross-section, different scale
- Stands separated, each side movable
- Applied as cladding of large buildings



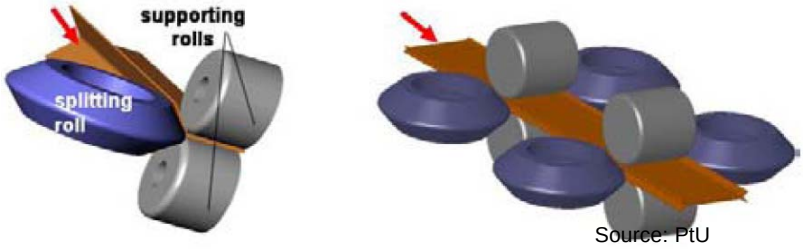
Source: BEMO Systems



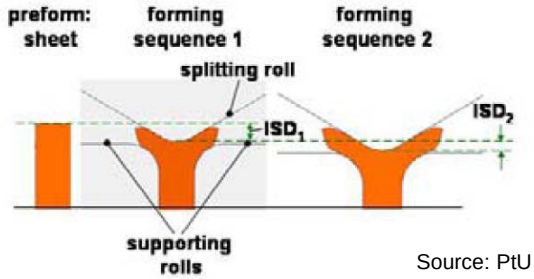
Source: The Fabricator

Forming specialities

- Linear flow splitting



Source: PtU



Source: PtU

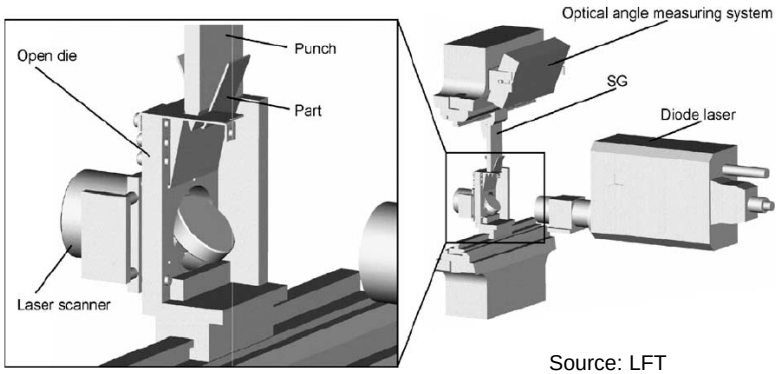
- Double-sided flanges without joints
- Cold forming
- Excellent surface quality
- Considerable increase in hardness

Source: PtU

Integration of processes

Laser assisted bending

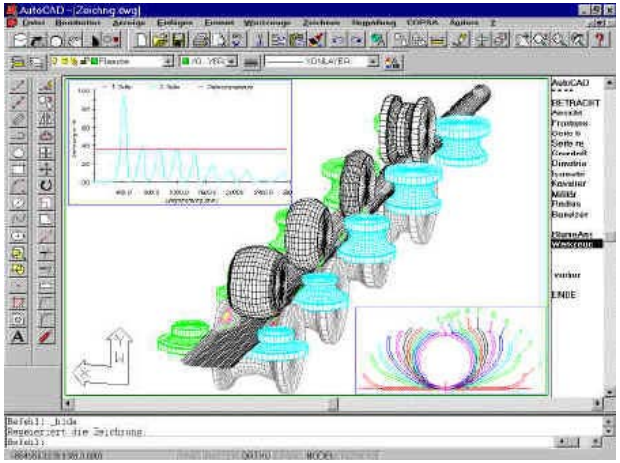
- Appreciable extension of forming limits of high strength steel (up to 200%)
- Hardly any permanent softening of steel



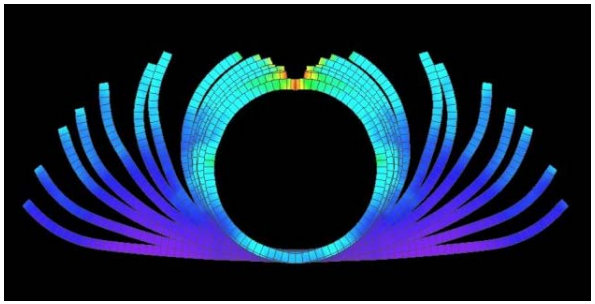
Source: LFT

Aides for Manufacturing

- Simulation of forming process
  - Several software packages specialised on roll forming
    - PROFIL (Ubeco)
    - COPRA (dataM)
    - Shape-RF (SHAPE Co)
    - Simply Roll Design (Delta Engineering)
    - VTTube (VTT)



Source: dataM



Source: SHAPE

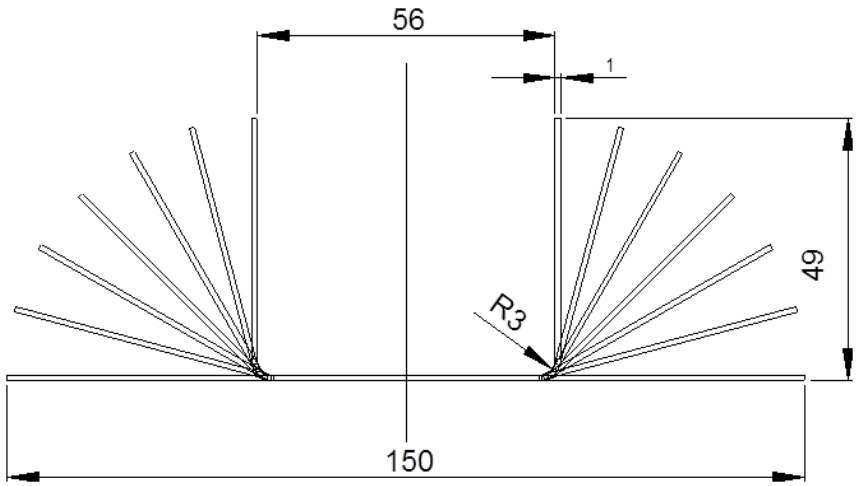
Simulation of U-channel

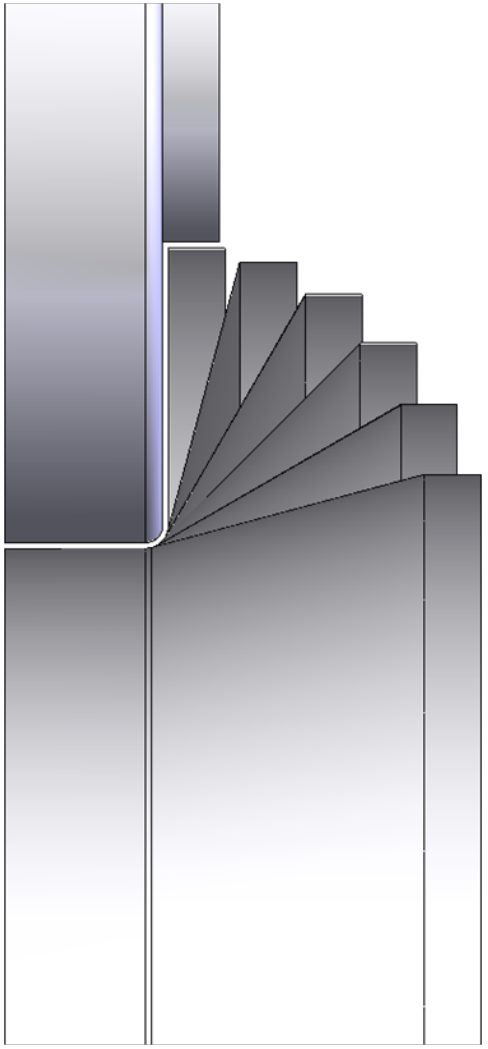
- Abaqus explicit
- 6 stands
- Stand spacing 300mm
- 4-node shell elements (S4R)
- Symmetric

Model parameters	
Material	Isotropic, linear hardening
Young's modulus	210GPa
Yield strength	300MPa
Strip Thickness	1mm
Strip Velocity	1mm/ms
Coefficient of Friction	0
Roll diameter	200mm
Roll material	Analytically rigid

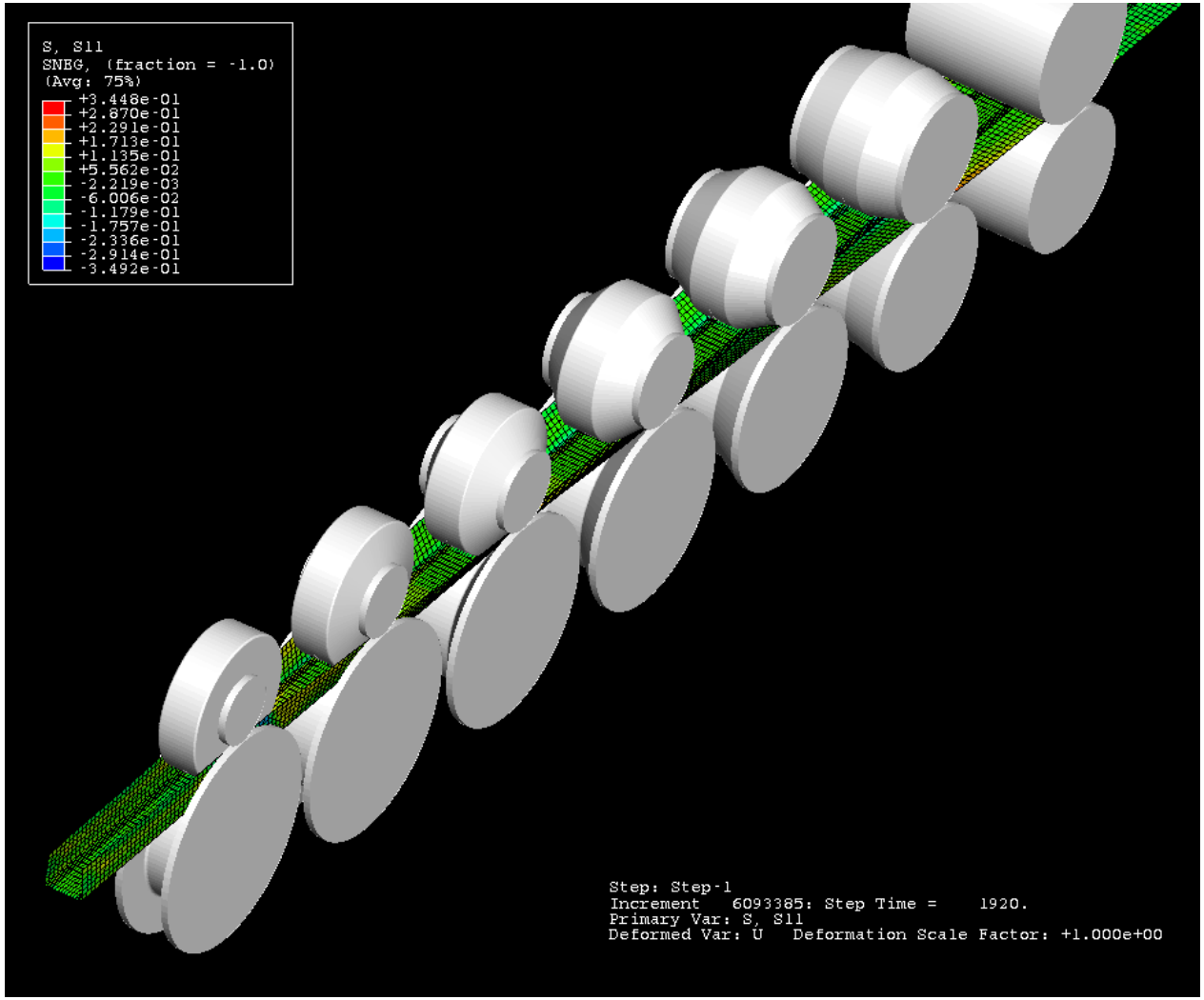
Tool

- Constant Radius
- 15° angle increment

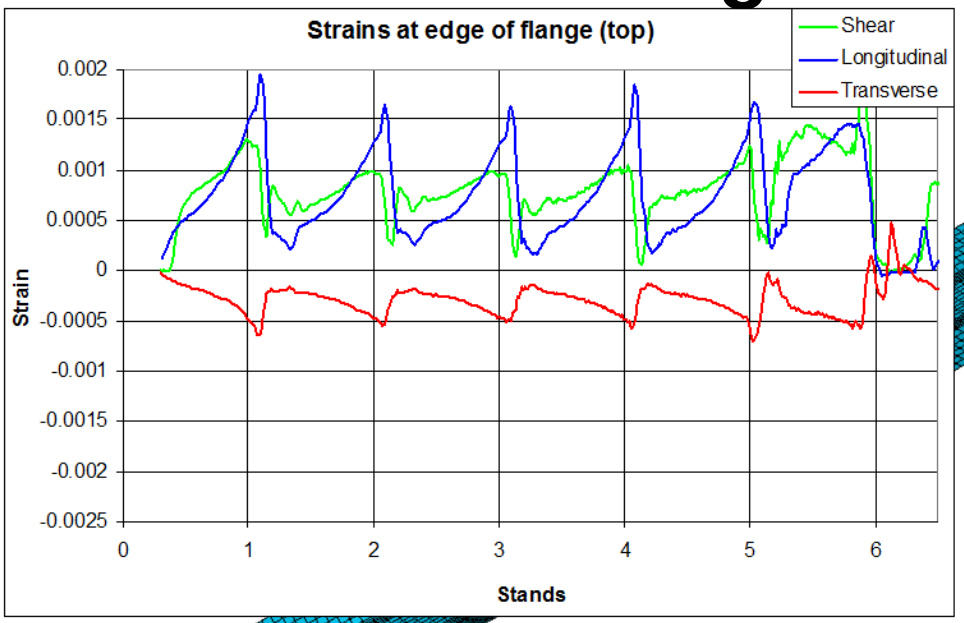


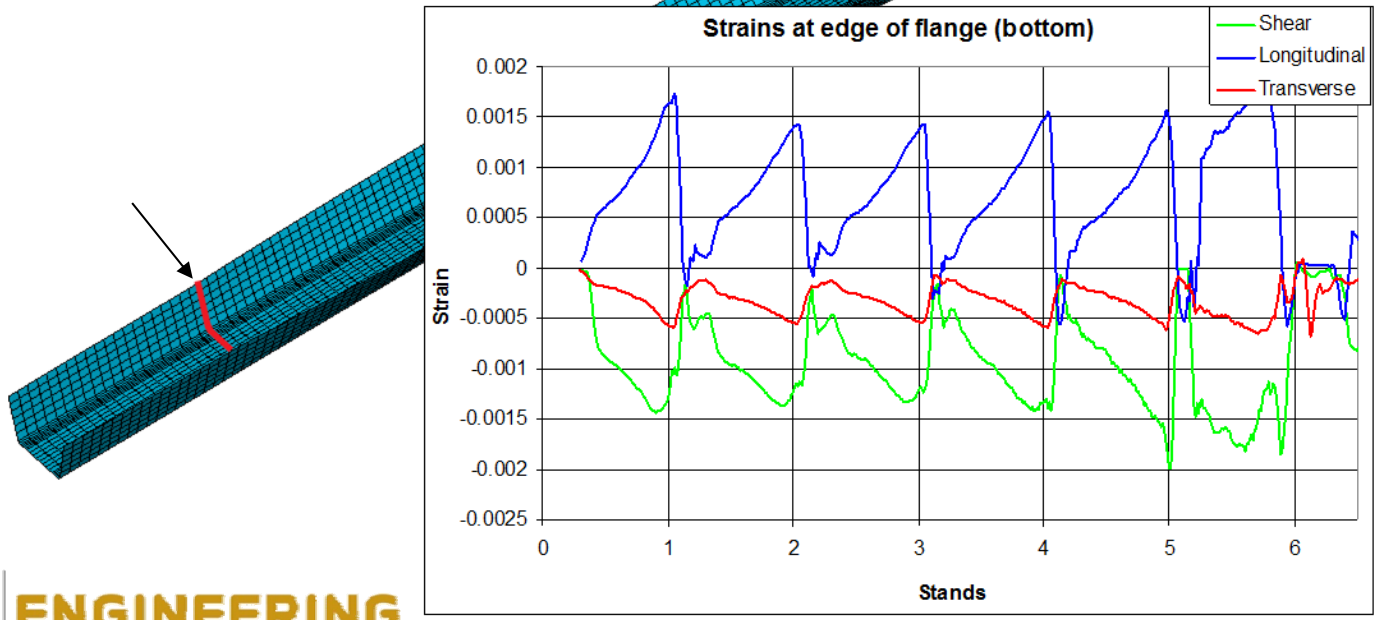


Simple U-Channel

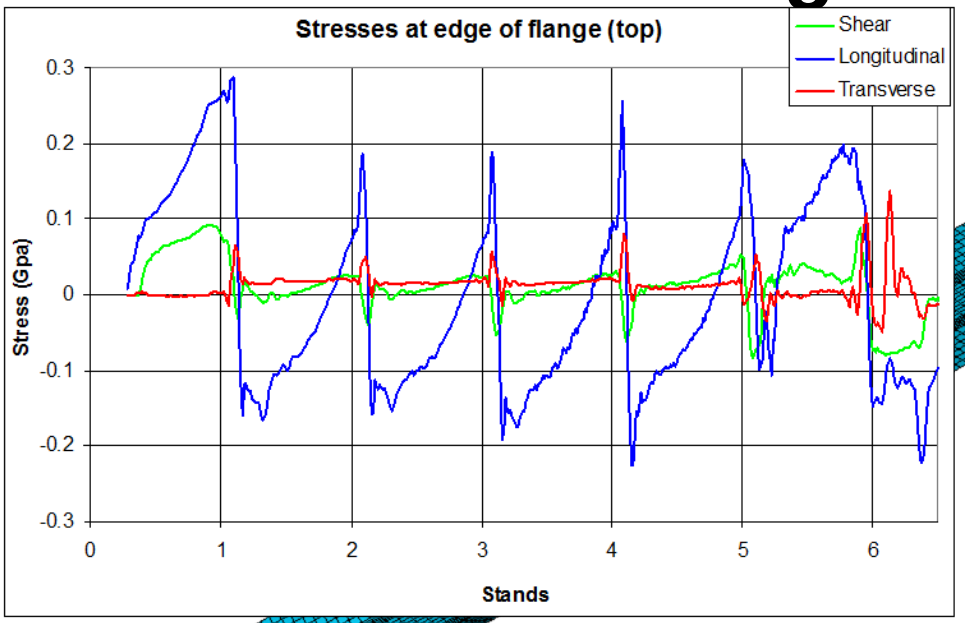


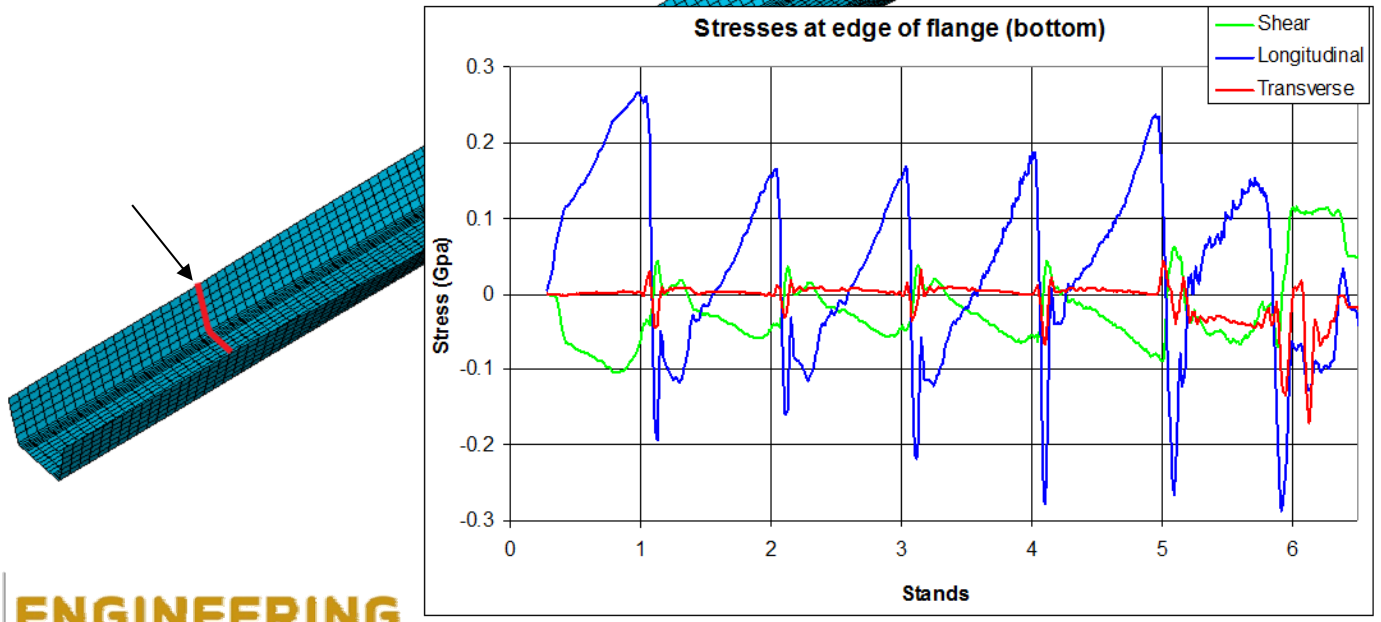
Results: Strains at channel edge





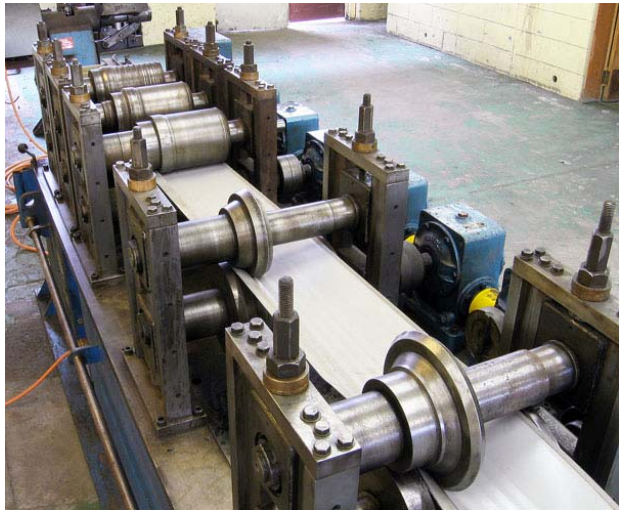
Results: Stresses at channel edge



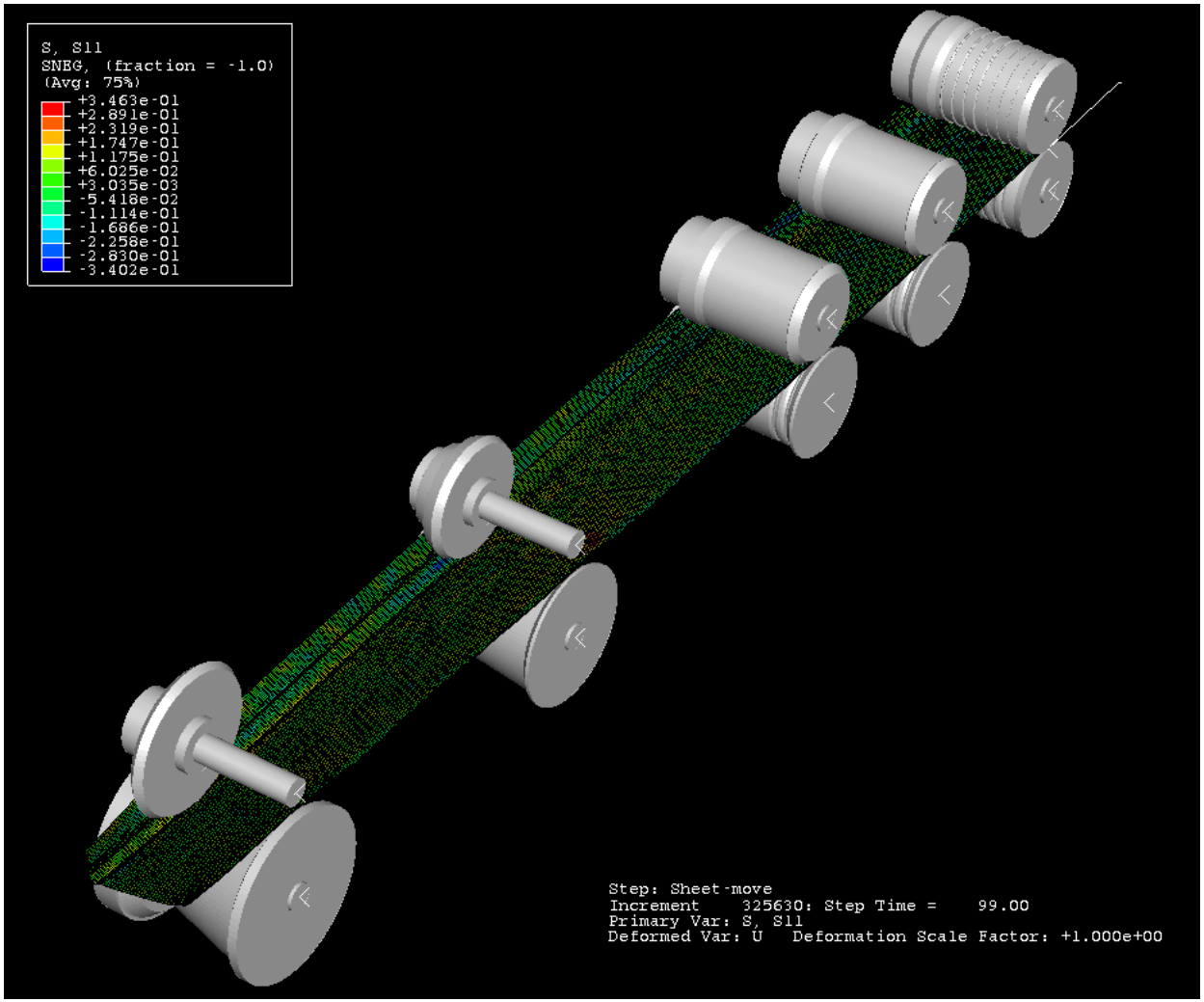


Roll Former at AUT

- 7 Stands (5 currently in use)
- Rolls supported at both ends (Standard design)
- All lower and first upper roll driven (line of transfer gear-boxes)
- Max. strip width: 350mm
- Old production tool installed
- Cut-off die
- Decoiler



Simulation of existing tool



Summary and future work

- New developments
- Created simulation of
  - U-channel and
  - Production tool
- Develop versatile research tool
- Verify simulation
- Progress to more complex geometry
- Develop design aide for roll forming

Thank you