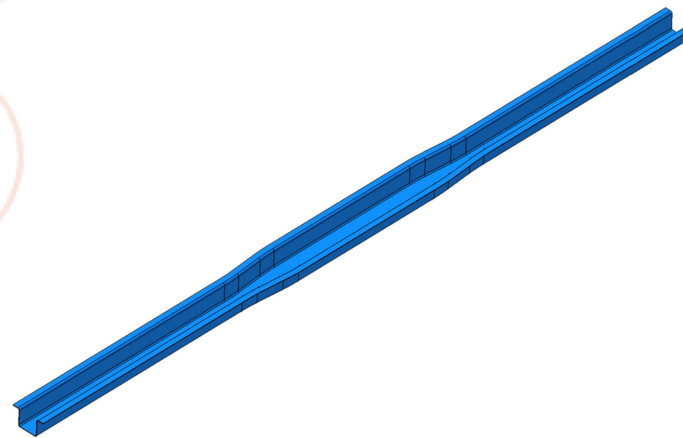



Electromagnetic Forming of Longitudinal Strengthening Ribs in Roll Formed Automotive Profiles

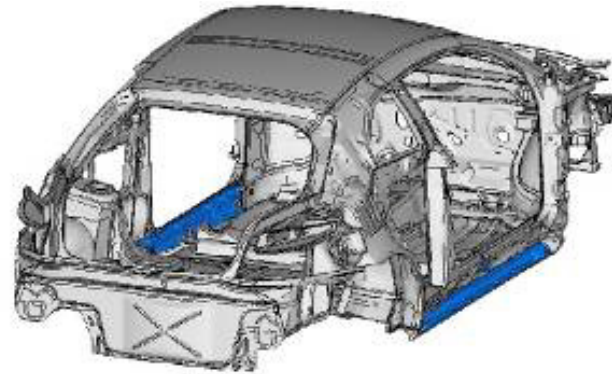


Iñaki Eguia
Automotive Unit
Labein-Tecnalia



- 
- A vertical collage of four circular images on the left side of the slide. From top to bottom: a silver car, a close-up of a car's interior dashboard and steering wheel, a yellow car chassis, and a yellow car on a road.
- **Overview Project & Objectives**
 - **EMF Target & Experiments**
 - **Project Results**
 - **Conclusions**

Performance



Materials of interest

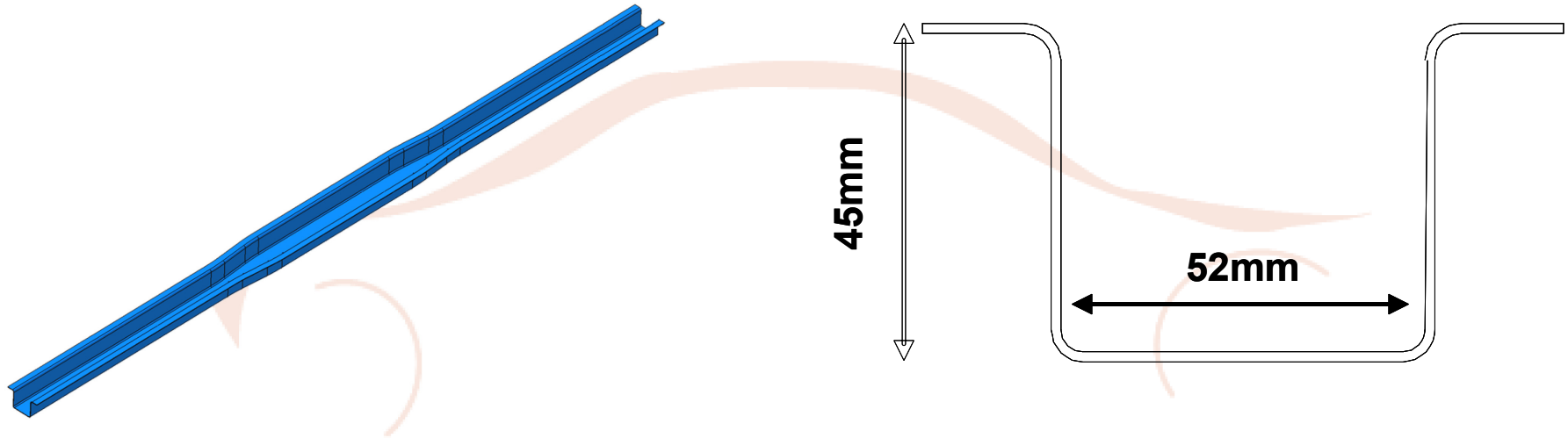
STEEL GRADES for structural applications

from 360 to 1200 MPa

Thickness 0,8 to 2 mm

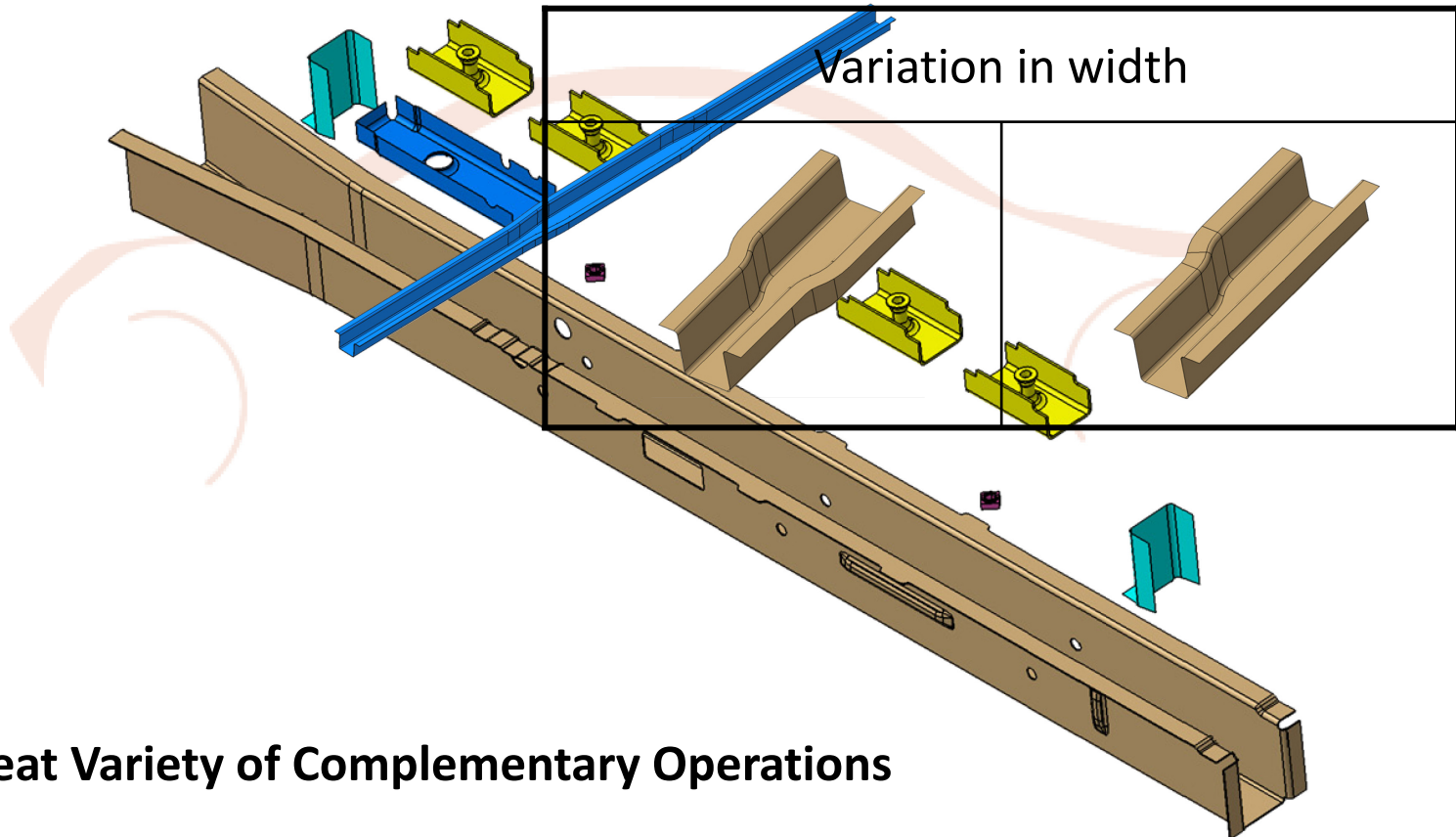
zinc coated

FLEXIBLE ROLL FORMING



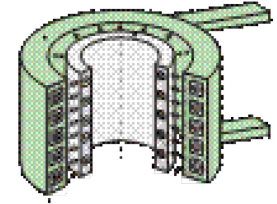
	σ_{Yield} (MPa)	σ_{UTS} (MPa)	$\sigma_{Yield} /$ σ_{UTS}	$\epsilon_{uniform}$ (%)	E (MPa)	Poisson's Coefficient ν	Thickness (mm)
Zste340	270	355	0.76	38	210000	0.3	1.35

➤ Automotive Structural Part



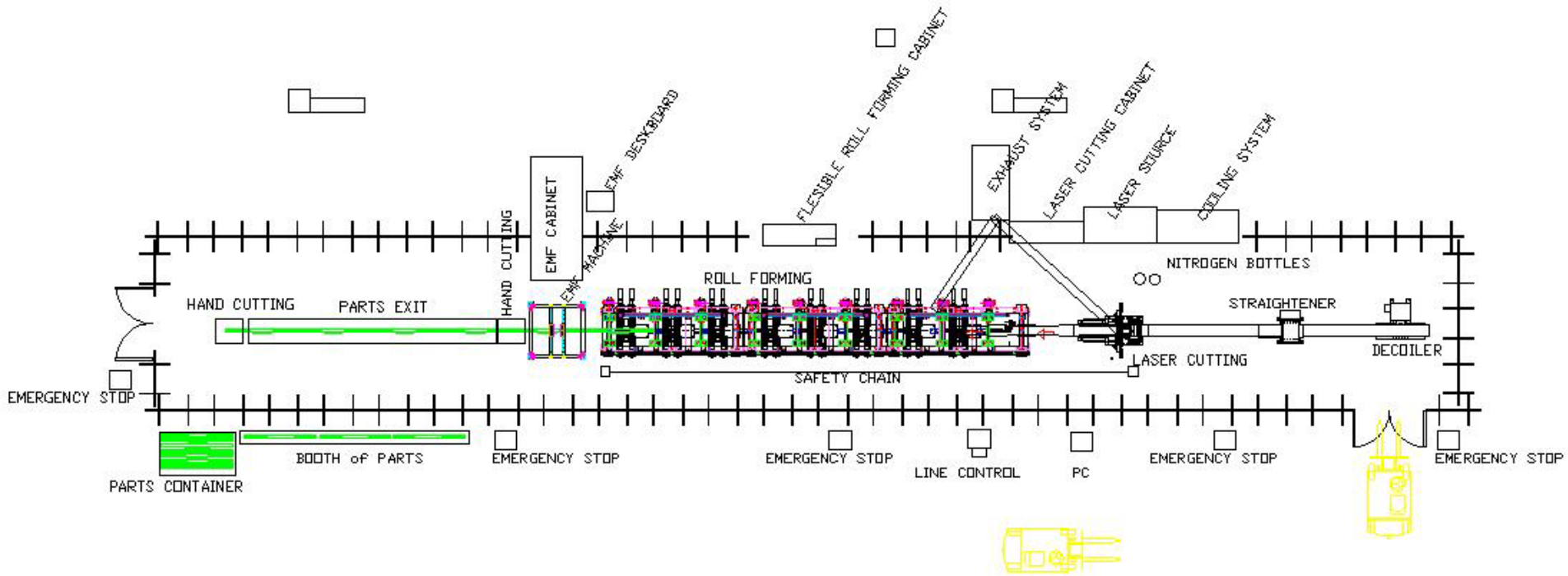
Great Variety of Complementary Operations

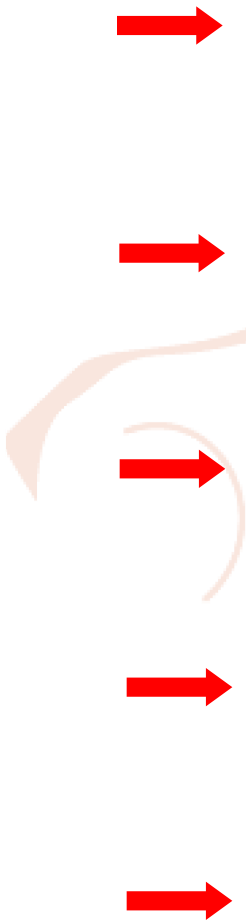
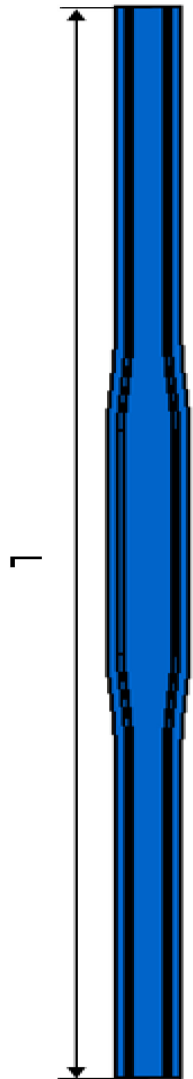
GENERAL OBJECTIVES



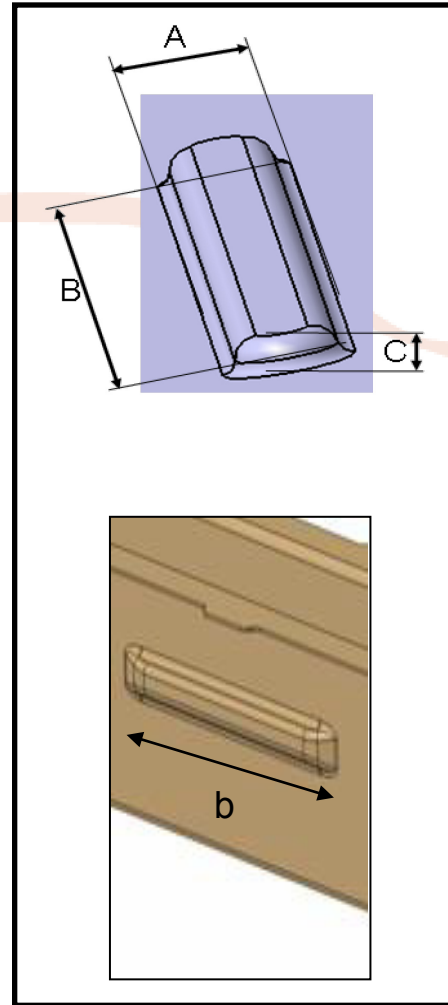
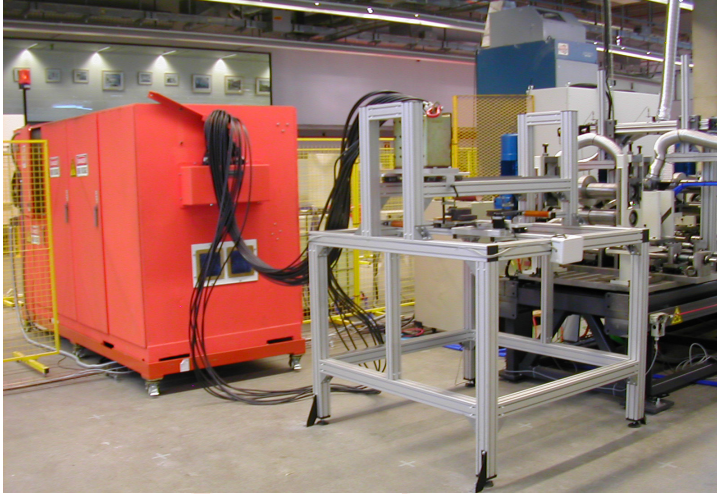
1. Development of efficient electromagnetic forming technology.
2. Development of a simultaneous engineering strategy for the design and production of components for body in white based on roll forming semi-finished parts customized with EMF and LF technologies.
3. Establishment of the industrial viability of the engineering concept for the production of vehicle body structures.

LAY OUT of PROTOTYPE INSTALLATION



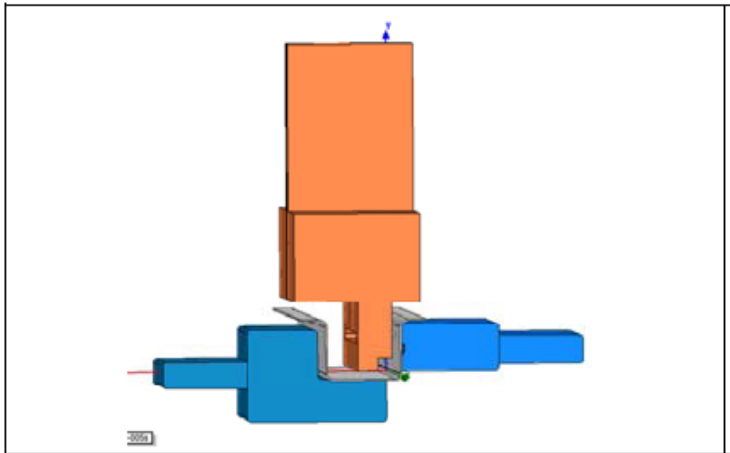


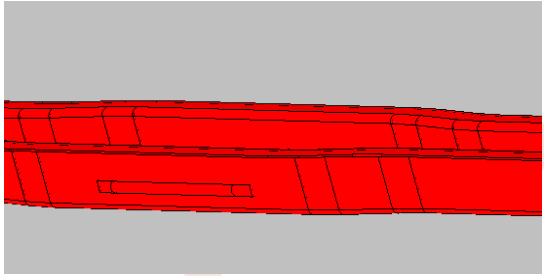
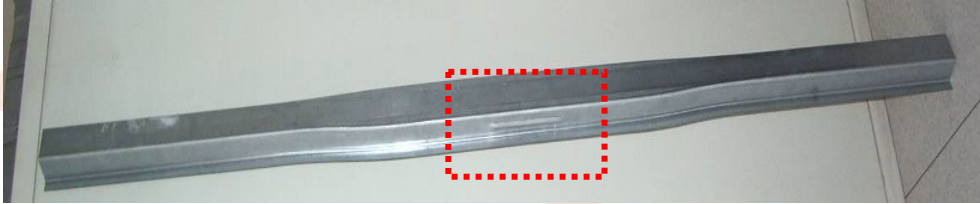
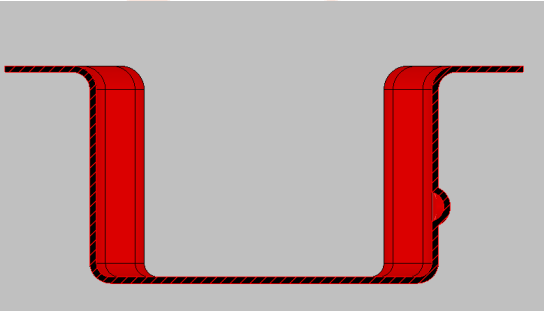
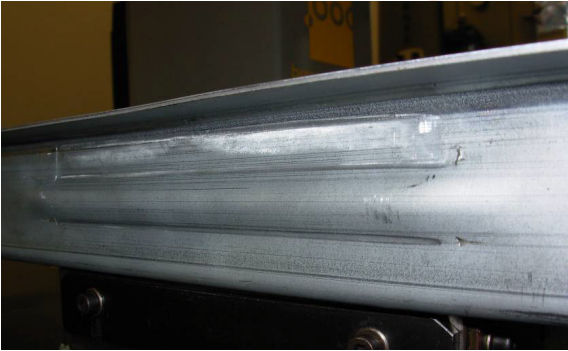
<p>Longitudinal Rib</p>		
<p>Flanging</p>		
<p>Piercing</p>		
<p>Cutting</p>		
<p>Bending</p>		



A=10 mm
B=130 mm
C=3.5-4 mm

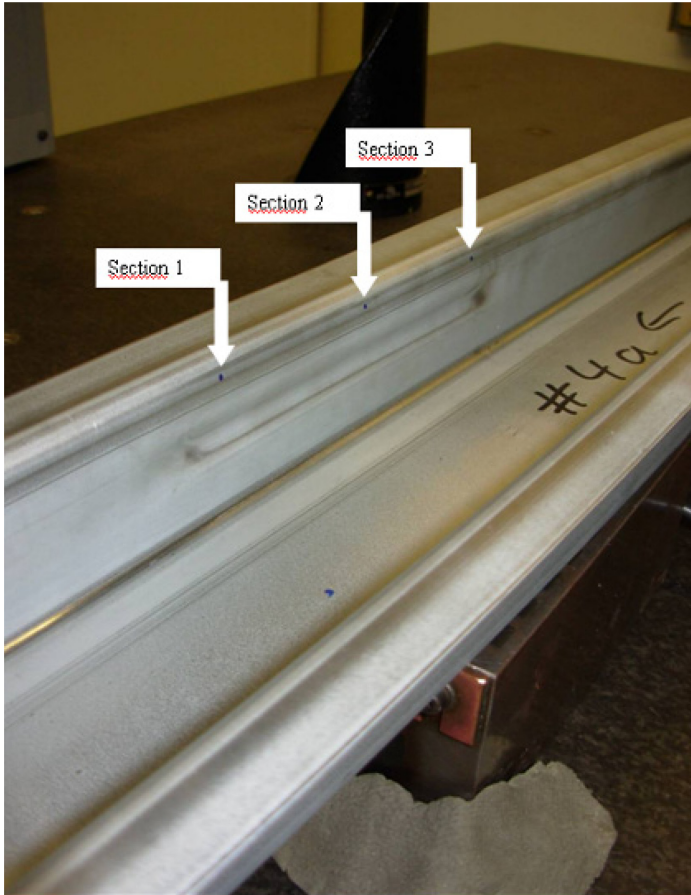
0.5mm COPPER
DRIVER



TARGET PART	FORMED PART
	
	

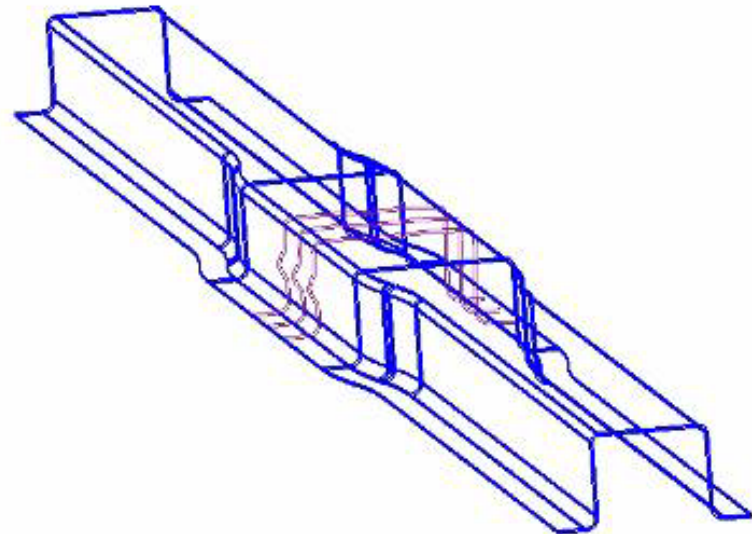
- The dimensional properties must not exceed prescribed tolerances (± 0.5 mm)
- The material coating must not be damaged
- The surface quality must not be damaged

- Dimensional properties



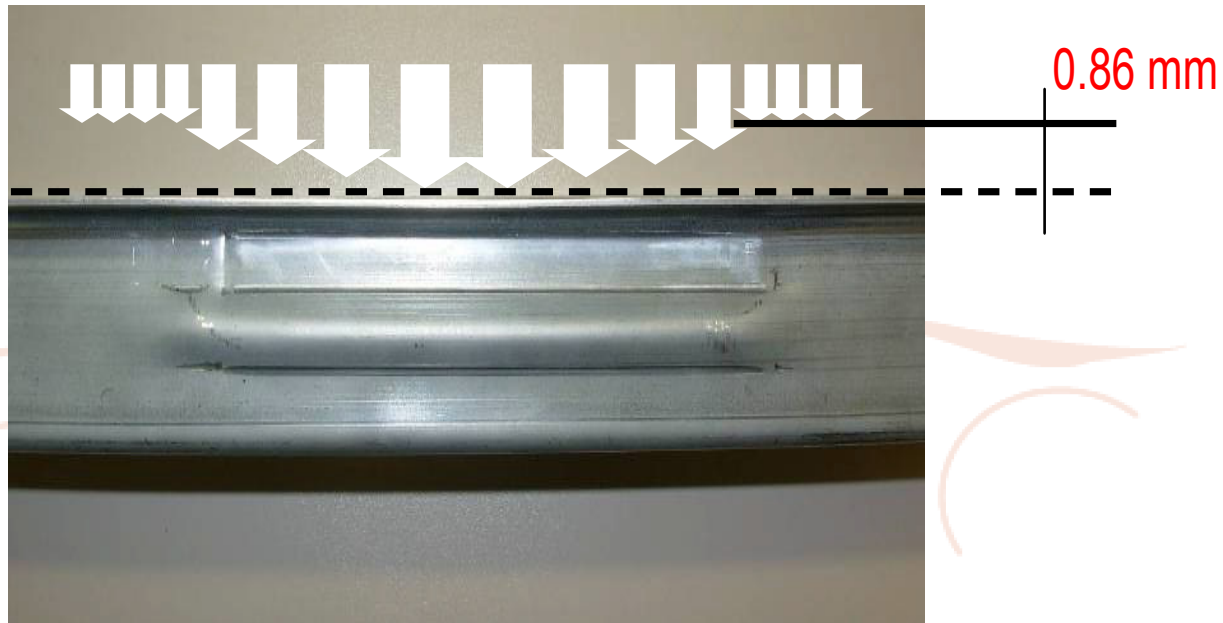
Internal and external walls measured

Pc-dmis v4.2 software



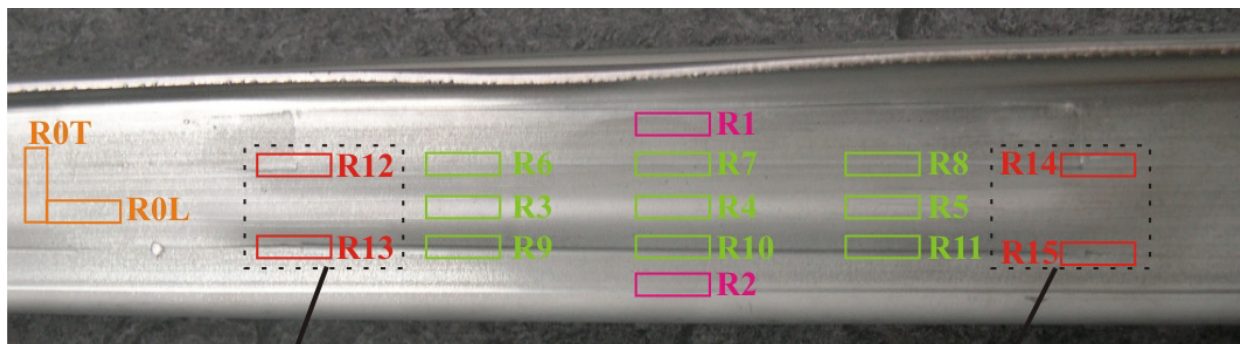
SECTION 1	SECTION 2	SECTION 3
<p>Thickness 1.24 mm Thinning 8%</p>	<p>Thickness 1.27 mm Thinning 6%</p>	<p>Thickness 1.24 mm Thinning 8%</p>
<p>Flange deflection</p> <p>+0.1 -0.25 2.8° -0.4</p>	<p>Flange deflection</p> <p>-0.16 -0.3 3° -0.8</p>	<p>Flange deflection</p> <p>+0.1 -0.15 3° -0.3</p>

Longitudinal detachment from the theoretical profile



1. Exceeds industrial requirements
2. Adjustments in the blankholder system required

	Ra [μm]	Rz [μm]	short description	Assessment
R0L	2,24	10,5	longitudinal reference beyond forming zone	
R0T	2,28	11,1	transversal reference beyond forming zone	
R1	2,15	10,6	constant roughness in upper intersection	OK
R2	2,19	10,2	constant roughness in lower intersection	OK
R3	2,12	10,8	constant roughness on stiffener crest	OK
R4	2,11	10,9	constant roughness on stiffener crest	OK
R5	2,08	10,7	constant roughness on stiffener crest	OK
R6	1,82	9,9	little smoothing due to local surface pressure	OK
R7	1,90	10,3	little smoothing due to local surface pressure	OK
R8	1,85	9,8	little smoothing due to local surface pressure	OK
R9	1,35	8,7	distinct smoothing due to local surface pressure	OK
R10	1,36	8,7	distinct smoothing due to local surface pressure	OK
R11	1,31	8,4	distinct smoothing due to local surface pressure	OK
R12	4,05	26,4	distinct roughness and surface step of $-83\mu\text{m}$	NOK
R13	4,66	31,6	distinct roughness and surface step of $+52\mu\text{m}$	NOK
R14	5,17	28,6	distinct roughness and surface step of $+105\mu\text{m}$	NOK
R15	3,98	26,8	distinct roughness and surface step of $-51\mu\text{m}$	NOK

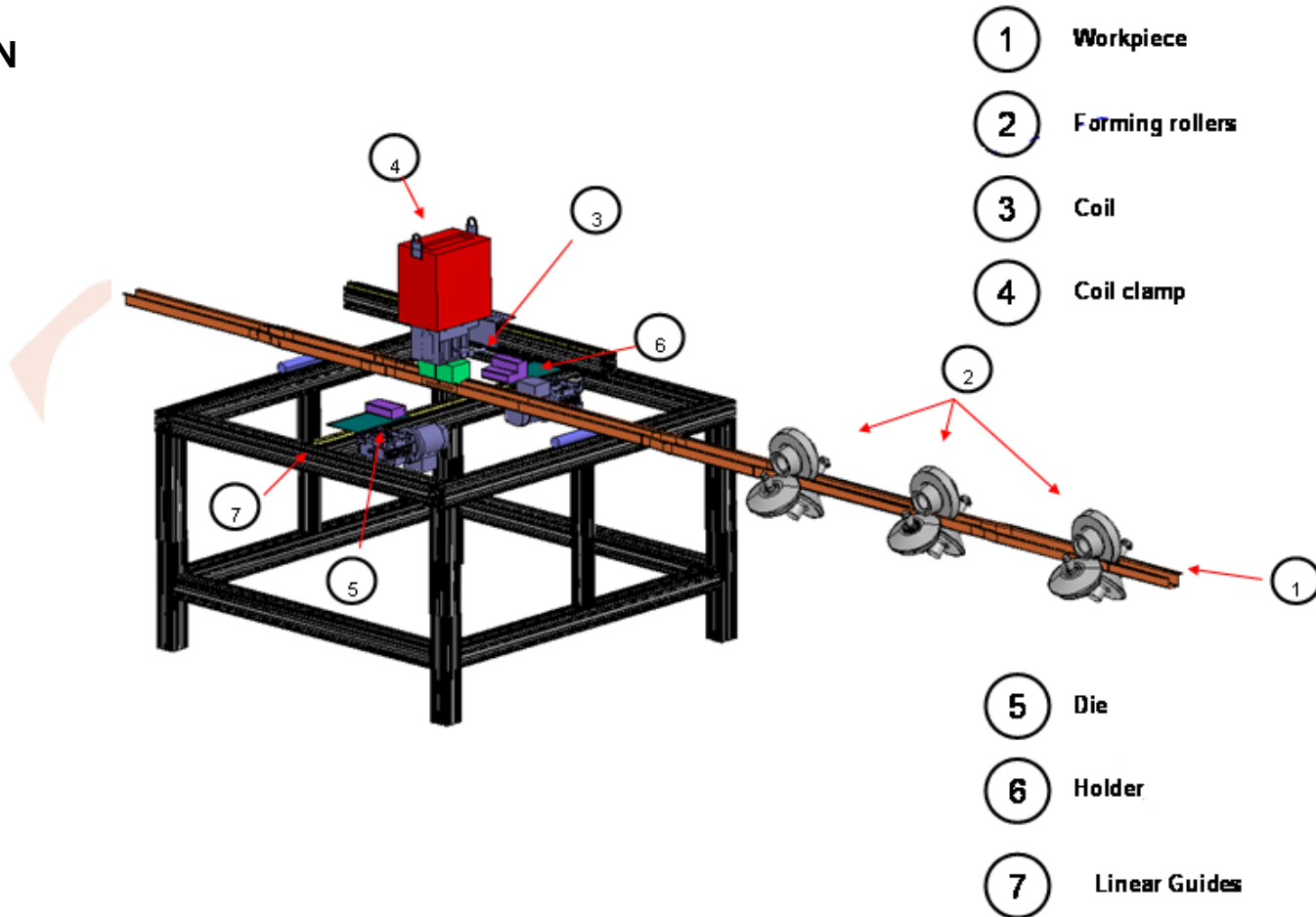


EXPLOITABLE RESULTS

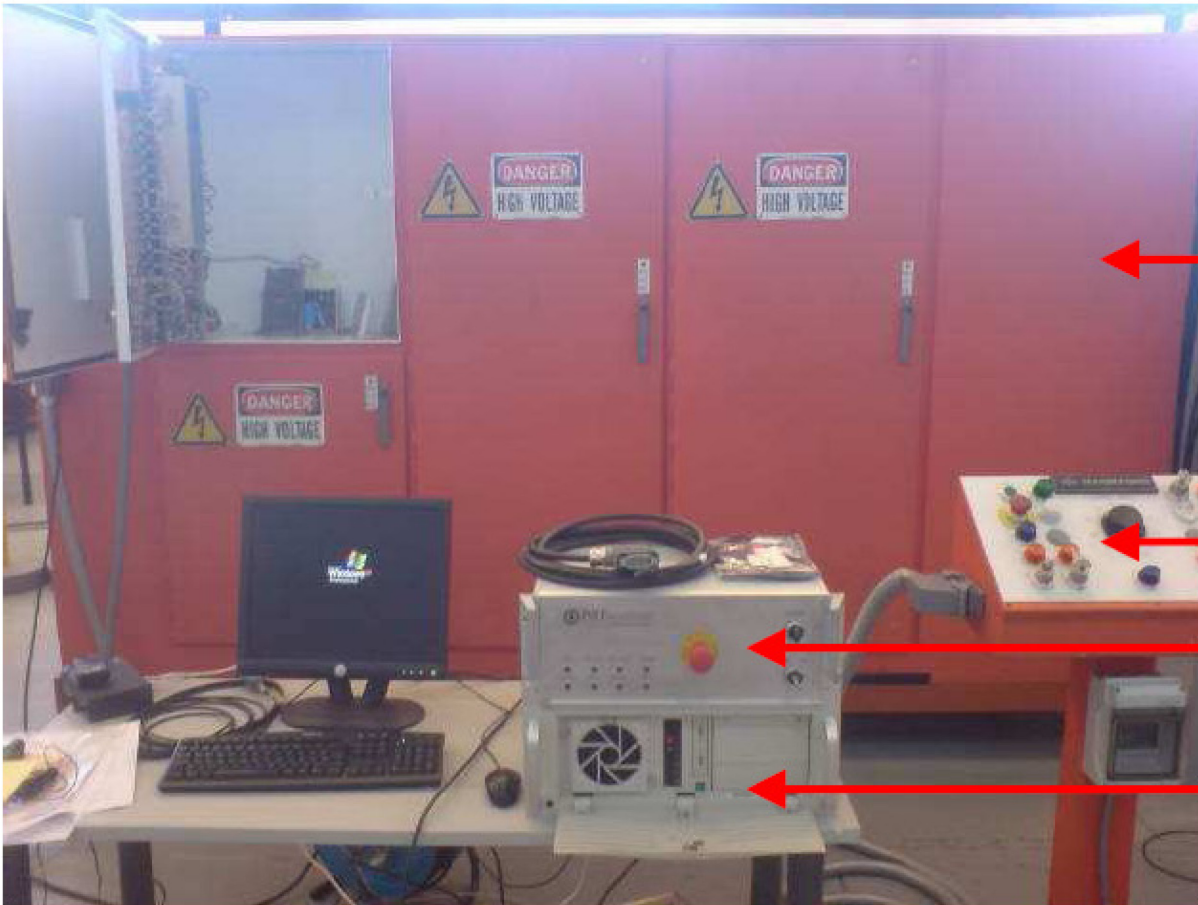
		TYPE
1	EMF unit for its application and integration into Roll Forming	Concept
2	Electromagnetic Forming Coils for roll forming lines	Item
3	Resins for Electromagnetic Forming coils	Item
4	Multilayered coils for general EMF operations	Item
5	EMF coils manufactured using stratoconception	Item
6	Simulation procedure of EMF	Process

1	EMF unit for its application and integration into Roll Forming
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LABEIN



EMF unit for its application and integration into Roll Forming



← EMPT-Unit „Magneform“

← Pedestal Panel of „Magneform“

← Remote Control Box by PSTproducts

← Industrial Personal Computer

2-3-4-5

Electromagnetic Forming Coils for roll forming lines & ITEMS

ANTEC



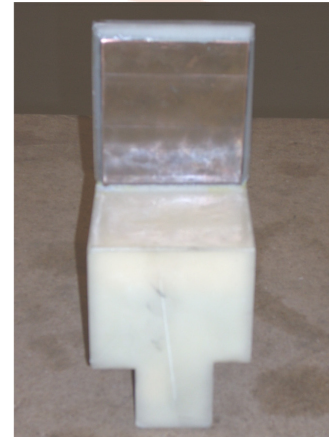
Coil

CIRTES + EXIMET



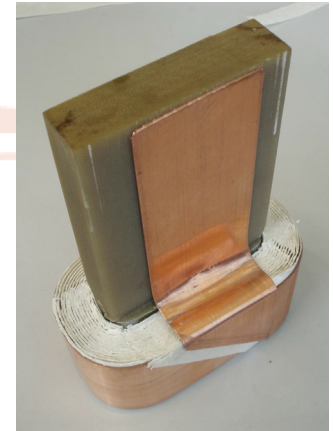
**Multiple layers
&
Cooling ducts**

AXYAL + INASMET



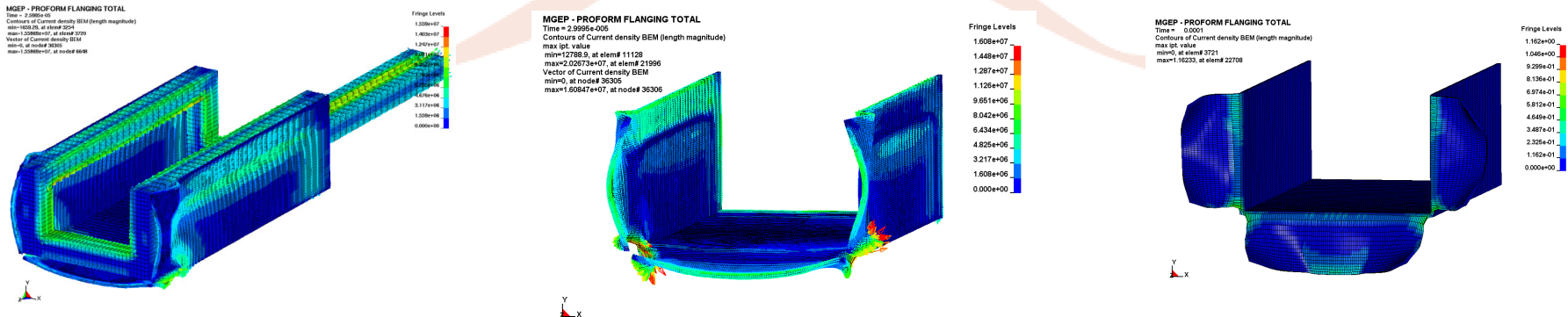
Reinforcement

EXIMET



**Decrease in
Reaction Force**

University of Mondragon



Consideration of Mechanical, Thermal and Electromagnetic Effects
 ANSYS Subroutines- Sequential Coupling
 Characterization at High Strain Rates

CONCLUSIONS AND FUTURE WORK

- The technology has a beneficial effect on the parts by improving the initial stiffness of the component.
- Part evaluation works suggest that the blankholder system needs to be improved to avoid deviations and distortions in roughness.
- As a result of the development several exploitable items have been detected. (Conceptual items and physical items).
- Assessment of benefit the results bring in terms of cost yet to be determined.

