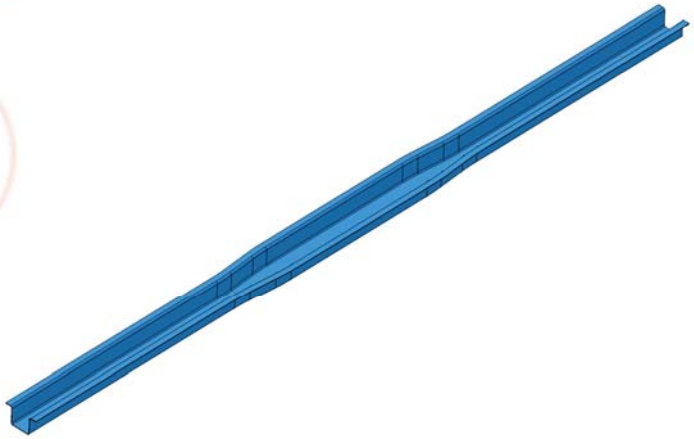
Electromagnetic Forming of Longitudinal Strengthening Ribs in Roll Formed Automotive Profiles



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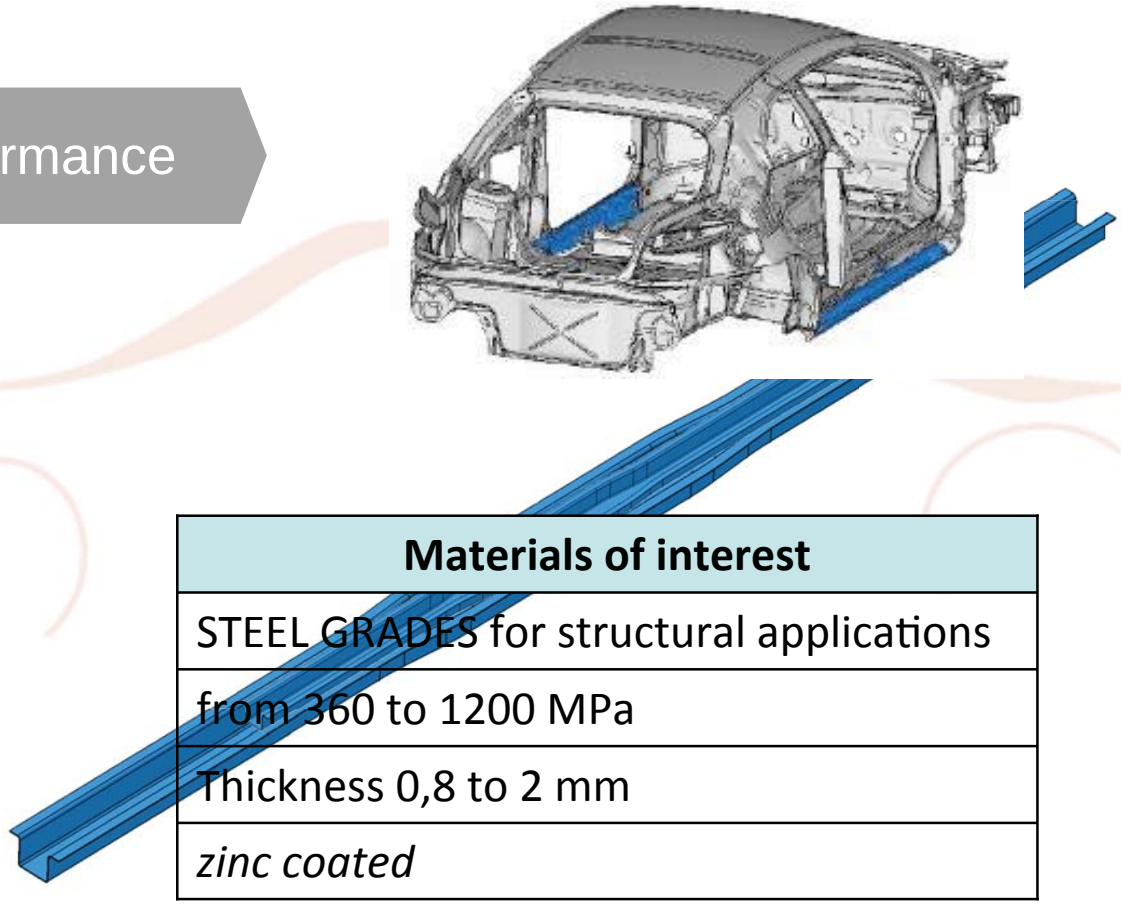
Automotive Unit
Labein-Tecnalia

CONTENTS

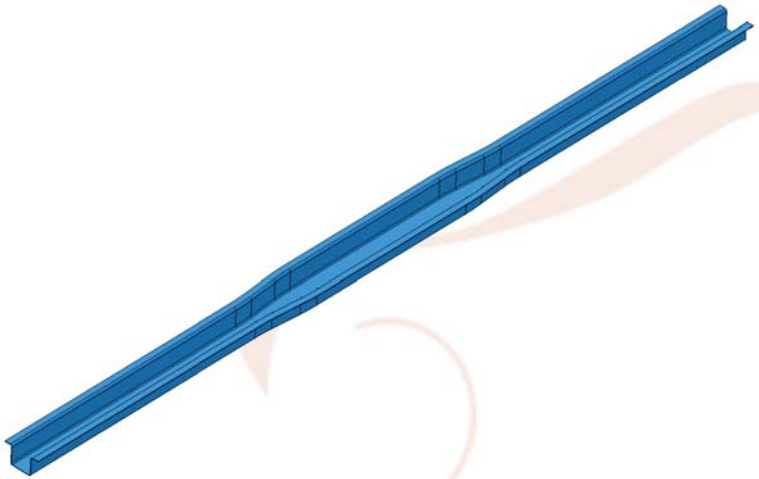
- Overview Project & Objectives
- EMF Target & Experiments
- Project Results
- Conclusions

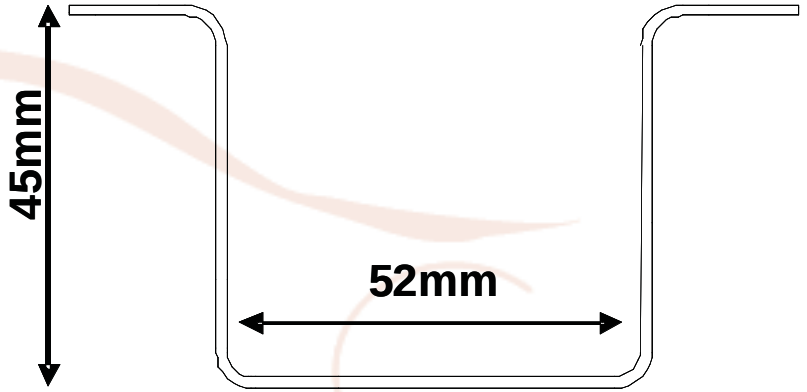
Performance



Materials of interest
STEEL GRADES for structural applications
from 360 to 1200 MPa
Thickness 0,8 to 2 mm
zinc coated

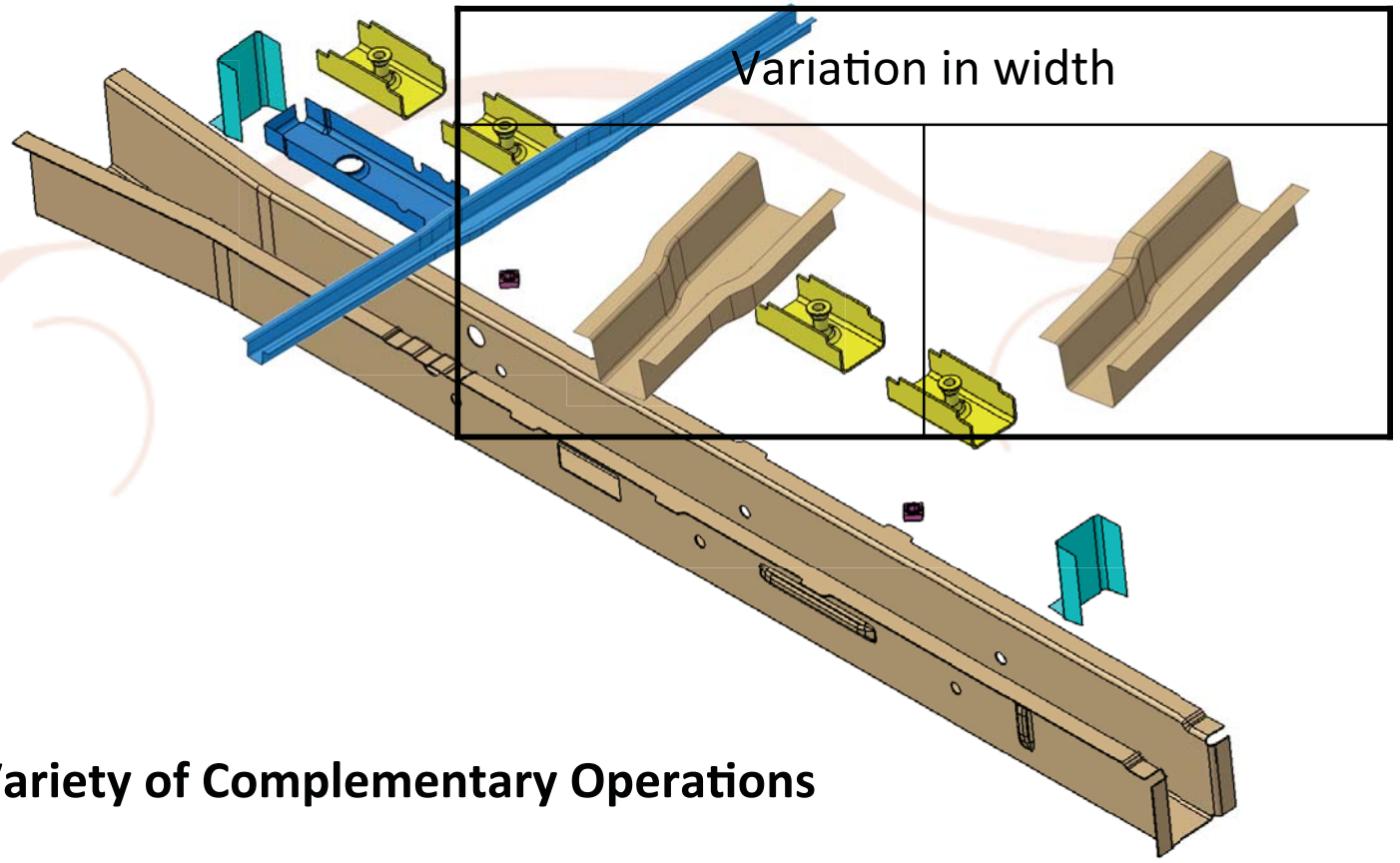
FLEXIBLE ROLL FORMING





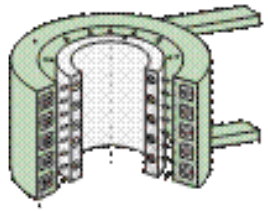
	σ_{Yield} (MPa)	σ_{UTS} (MPa)	σ_{Yield} / σ_{UTS}	εuniform (%)	E (MPa)	Poisson's Coefficient ν	Thickness (mm)
Zste340	270	355	0.76	38	210000	0.3	1.35

- Automotive Structural Part



Great Variety of Complementary Operations

GENERAL OBJECTIVES

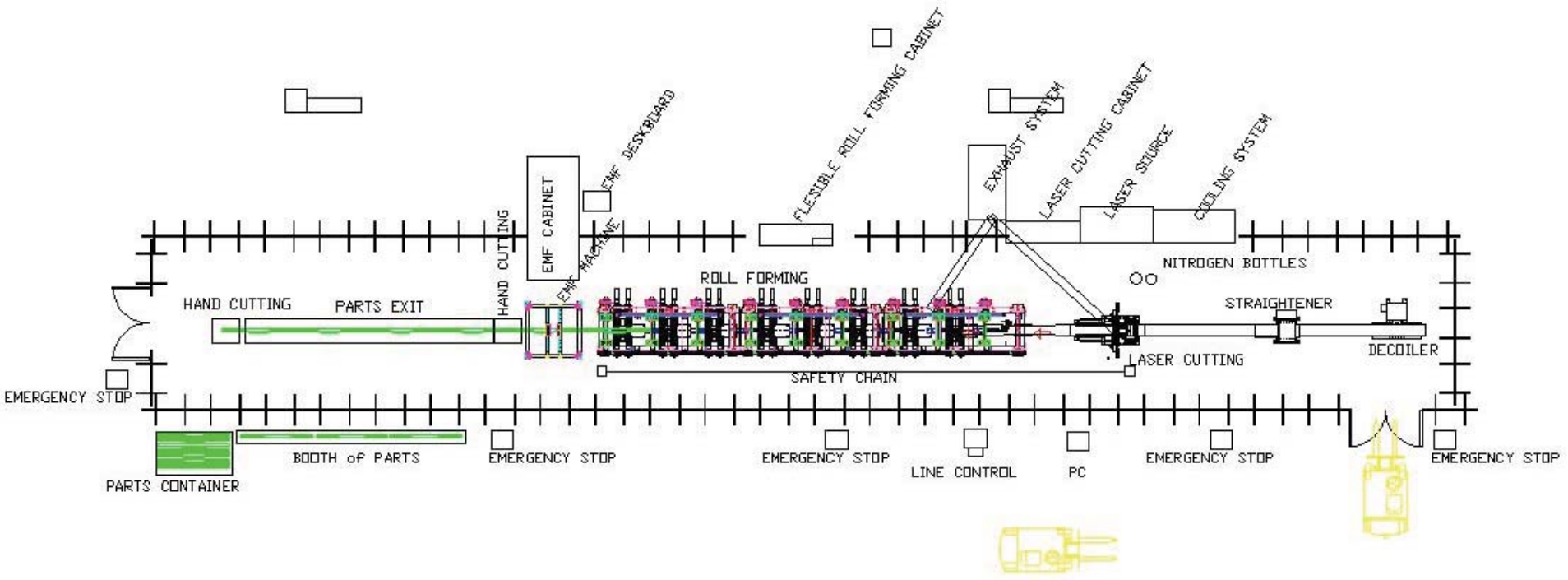


1. Development of **efficient electromagnetic forming** technology.

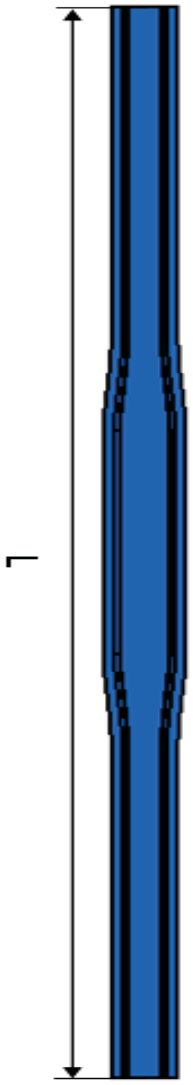
2. Development of a simultaneous engineering strategy for the design and production of components for body in white based on roll forming **semi-finished parts customized with EMF** and LF technologies.

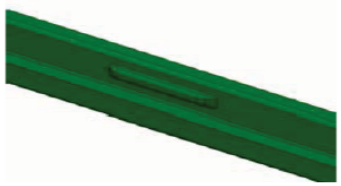
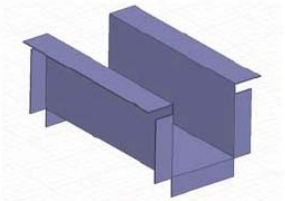
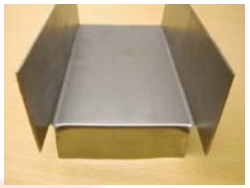
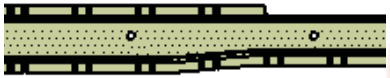
3. Establishment of the **industrial viability** of the engineering concept for the production of vehicle body structures.

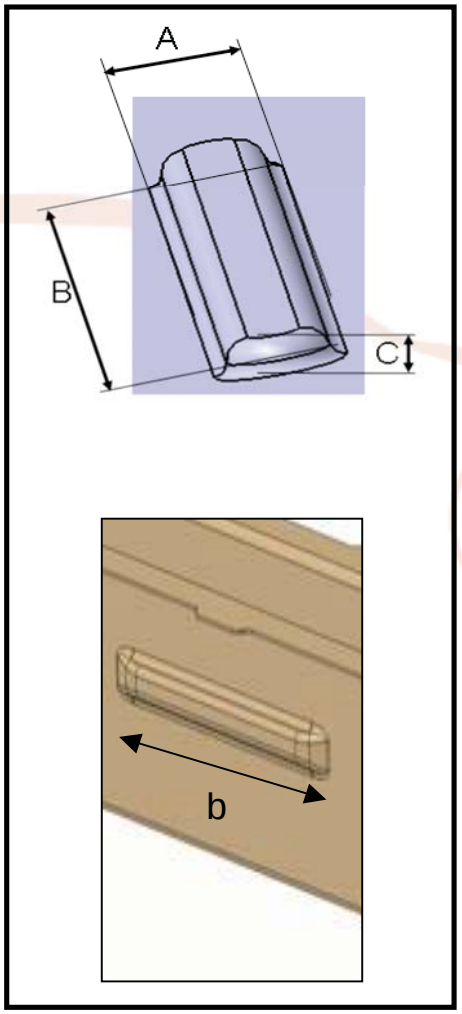
LAY OUT of PROTOTYPE INSTALLATION

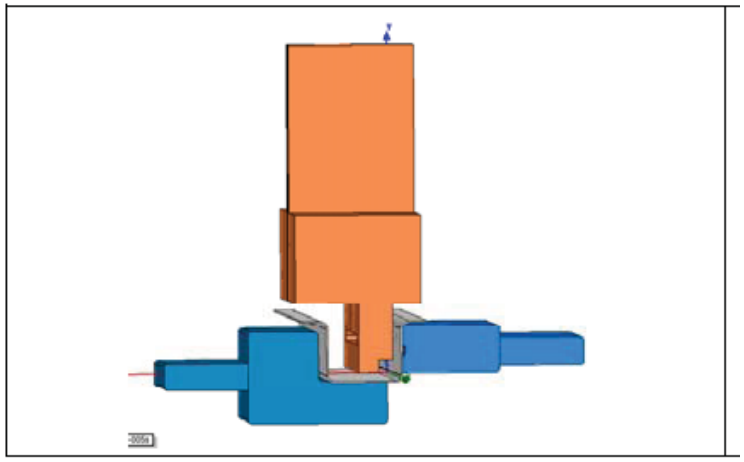


EMF TARGET



Longitudinal Rib		
Flanging		
Piercing		
Cutting		
Bending		



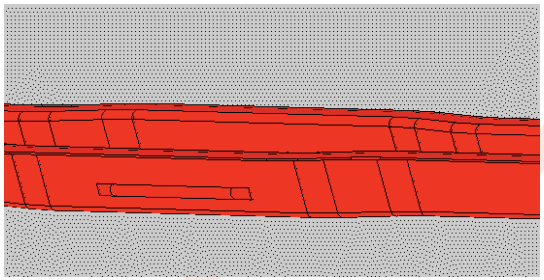
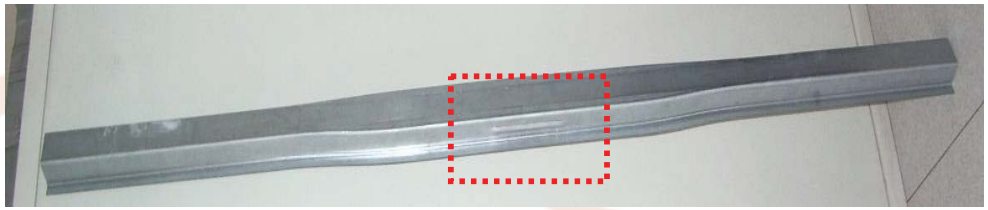
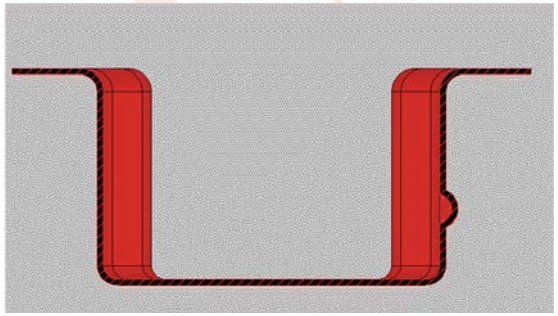


A=10 mm

B=130 mm

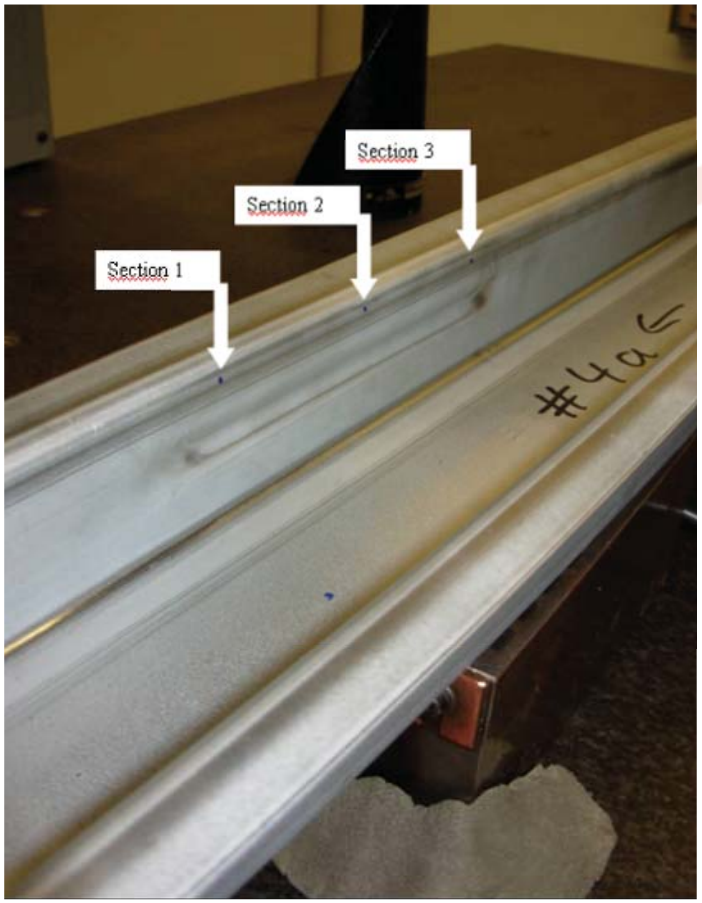
C=3.5-4 mm

0.5mm COPPER DRIVER

TARGET PART	FORMED PART
	
	

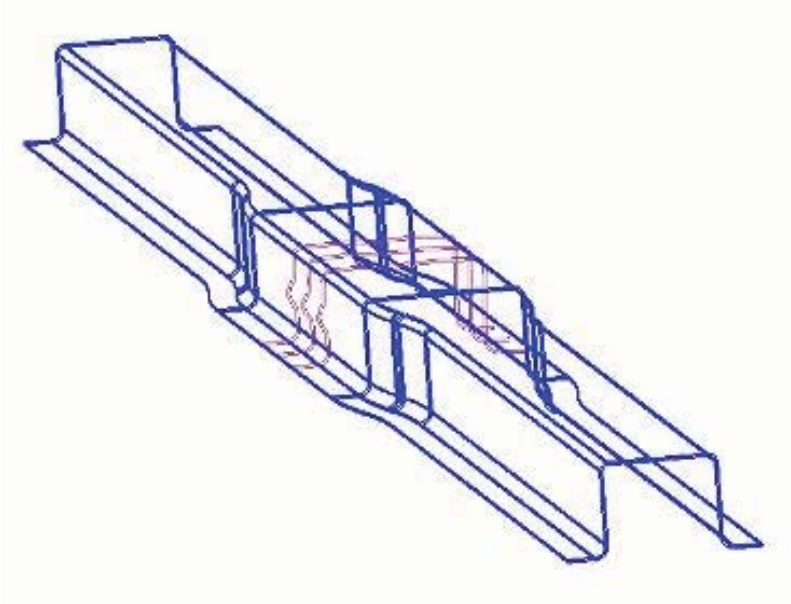
- The dimensional properties must not exceed prescribed tolerances (+/- 0.5 mm)
- The material coating must not be damaged
- The surface quality must not be damaged

- **Dimensional properties**

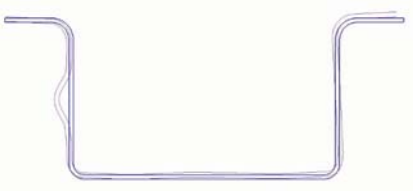
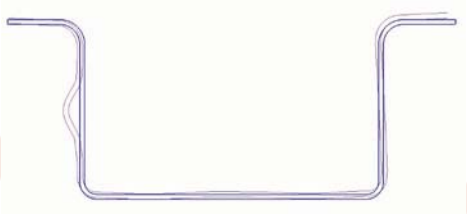
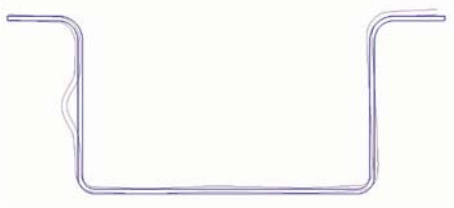
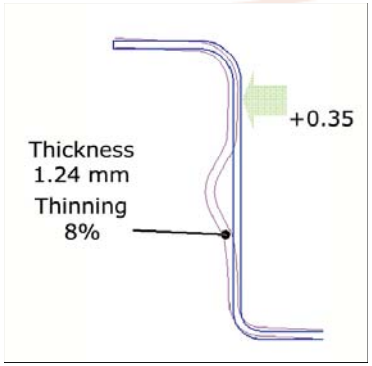
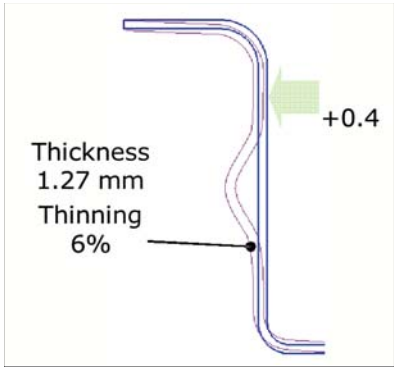
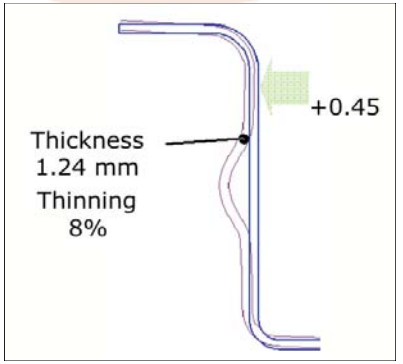
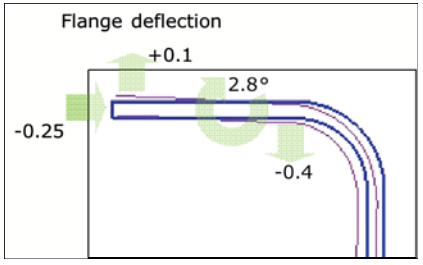
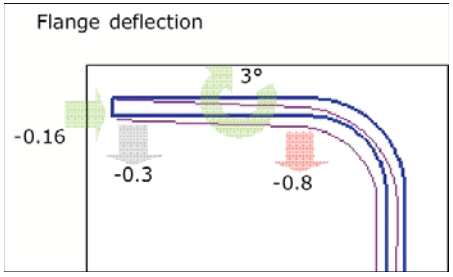
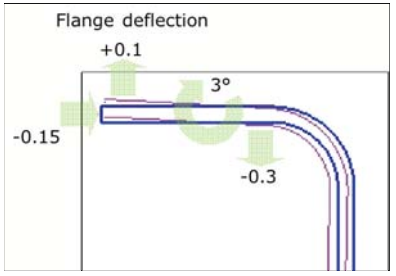


Internal and external walls measured

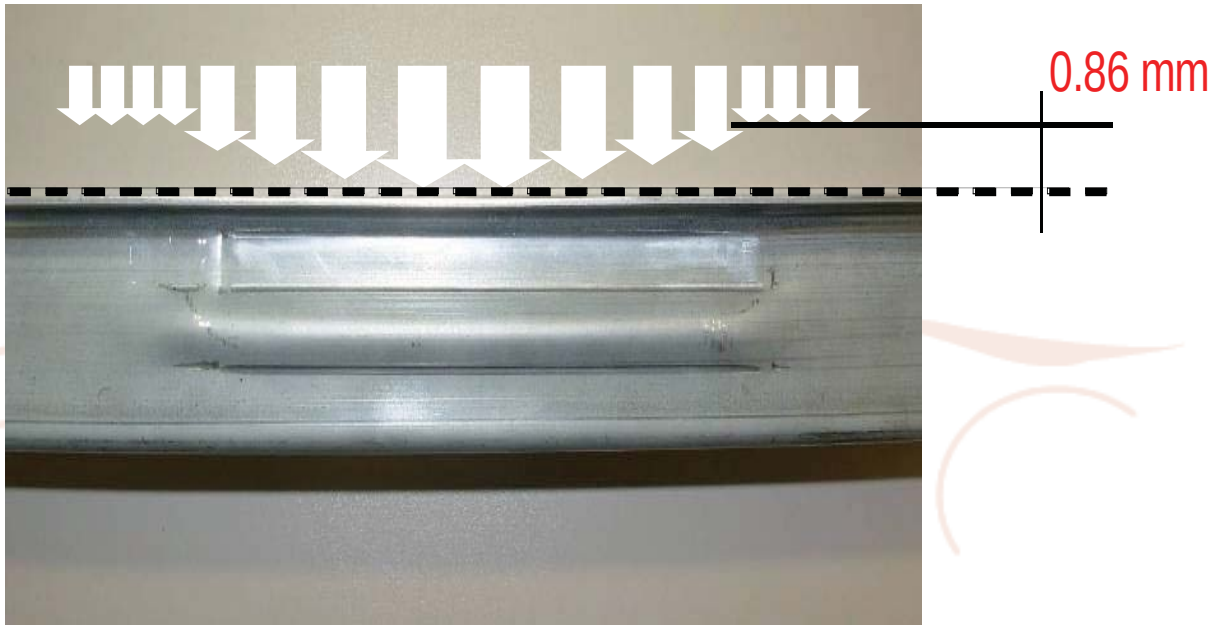
Pc-dmis v4.2 software



EVALUATION - DIMENSIONAL

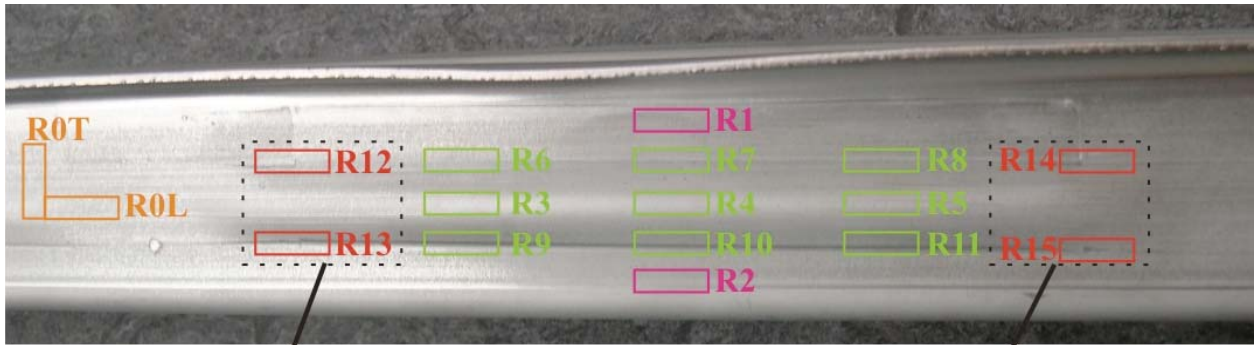
SECTION 1	SECTION 2	SECTION 3
		
		
		

Longitudinal detachment from the theoretical profile



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

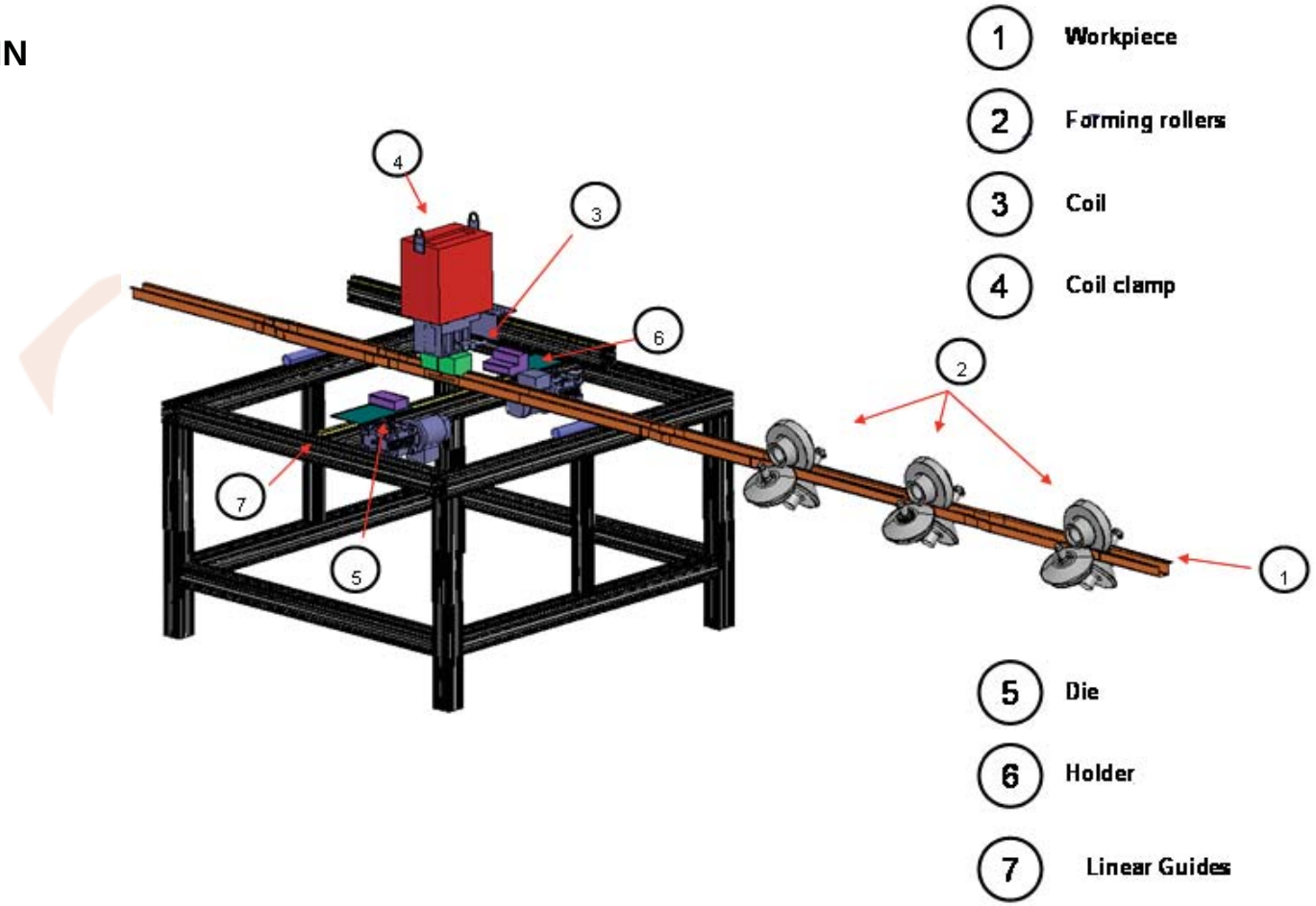
	Ra [µm]	Rz [µm]	short description	Assessment
R0L	2,24	10,5	longitudinal reference beyond forming zone	
R0T	2,28	11,1	transversal reference beyond forming zone	
R1	2,15	10,6	constant roughness in upper intersection	OK
R2	2,19	10,2	constant roughness in lower intersection	OK
R3	2,12	10,8	constant roughness 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 -83µm	NOK
R13	4,66	31,6	distinct roughness and surface step of +52µm	NOK
R14	5,17	28,6	distinct roughness and surface step of +105µm	NOK
R15	3,98	26,8	distinct roughness and surface step of -51µm	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

LABEIN



EMF unit for its application and integration into Roll Forming

EMPT-Unit „Magneform“

Pedestal Panel of „Magneform“

Remote Control Box by PSTproducts

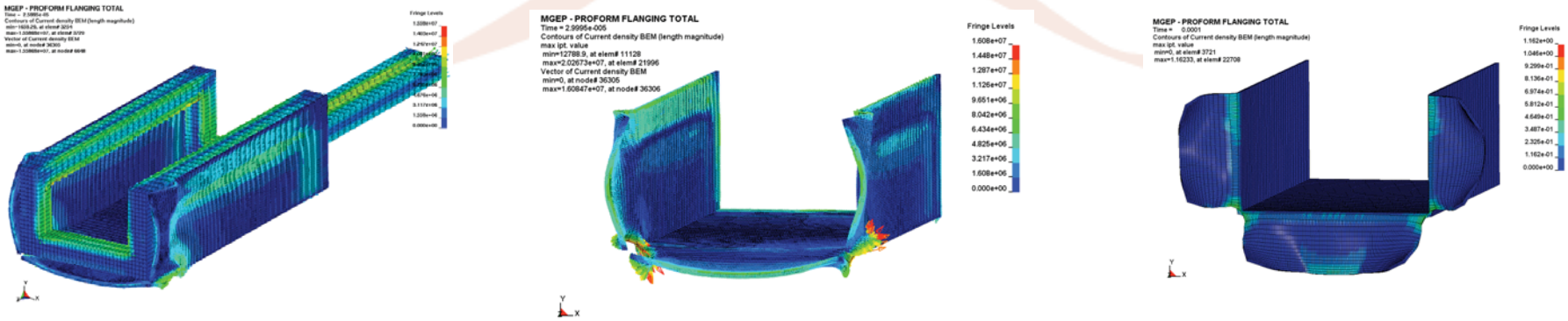
Industrial Personal Computer

2-3-4-5	Electromagnetic Forming Coils for roll forming lines & ITEMS

ANTEC	CIRTES + EXIMET	AXYAL + INASMET	EXIMET
			
Coil	**Multiple layers & Cooling ducts**	**Reinforcement**	**Decrease in Reaction Force**

6	Simulation procedure of EMF

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.

Thank You For Your Attention