

# GREAT DESIGNS IN **STEEL**

## **NON-LINEAR TAILOR WELDED BLANKS APPLICATION IN CHASSIS FRAME**

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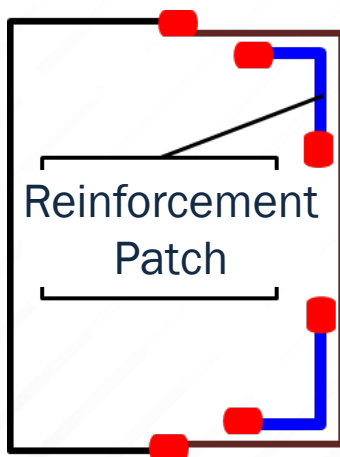
# BACKGROUND AND PURPOSE

To Maintain the Competitiveness of Frame Vehicle

Fuel Economy Regulation (C A F E)  
→ Mass Reduction  
Carbon Neutral  
→ Improve natural resources usage efficiency

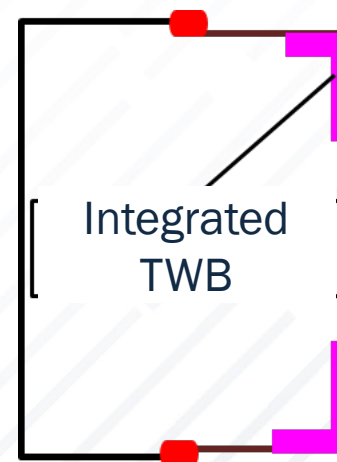
Necessary to **Optimize the Design by Tailored Blank Method**

【Current】



Overlap Reinforcement (R/F)

【New Development】



Integrated Tailor Welded Blank (TWB)

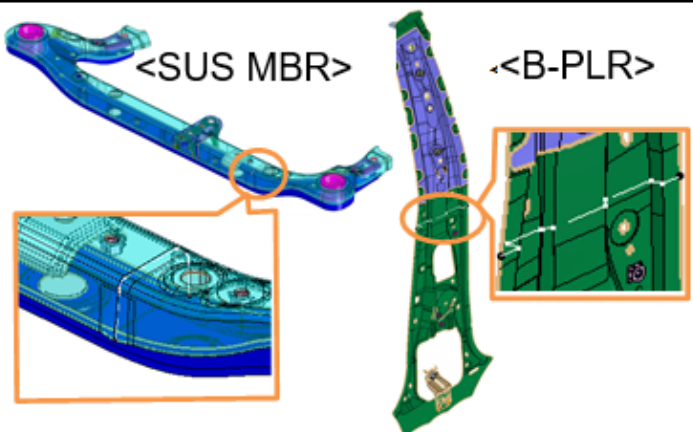
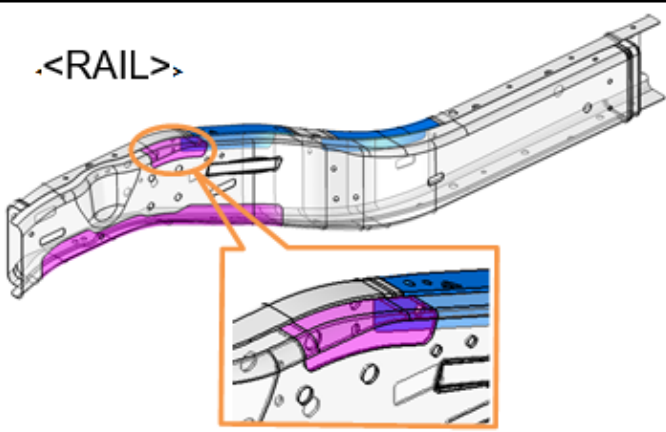
# PROCESS SELECTION OF VARIED THICKNESS FRAME PANEL

	Manufacturing method with differing panel thickness	Workability			Accuracy	Freedom of shape	Crash strength	Fatigue strength	Anti-rust	Investment	Material cost
		stamping	welding	machining							
Development	Welding 	○	○	—	○	◎	◎ Different strength materials	○	○	△ Laser welding machine	△ Waste material
	Cutting 	○	—	○	○	◎	△ Same strength materials	○	×	×	× × Shavings from increased cutting
	Plasticity Plastic working (build-up) 	△ Hardening	—	—	×	×	△ Same strength materials	△ Hardening	○	○	○
Current	Plasticity Rolling (Mubea) Tailored rolled blank 	○	—	—	○	×	△ Same strength materials	○	○	×	○

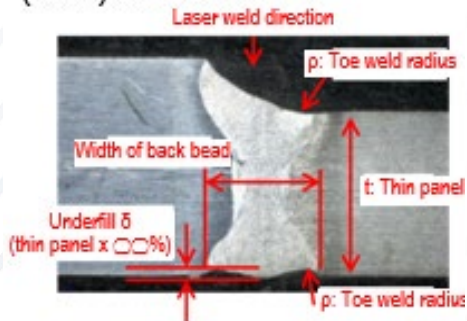
- Superior
- Good
- Concern
- × Negative

Adoption of “**Tailored Welded Blank**” from the viewpoint of flexibility of shape and material grade combination

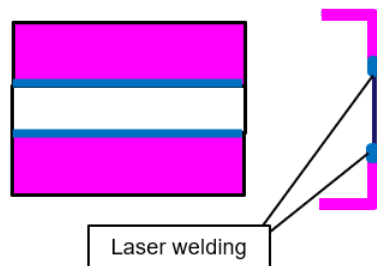
# COMPARISON WITH CURRENT PROCESS

	Current: Thin-panel laser welding	Development: Thick-panel laser welding
Usage area	 <p>&lt;SUS MBR&gt;      &lt;B-PLR&gt;</p>	 <p>&lt;RAIL&gt;</p>
Panel thickness	t2.3 or less	t2.6 or more
Impact on fatigue strength	Small	Large (compound input)
Underfill $\delta$	$\leq 0.2t$ (20% of thin panel) set from stamping process limits	Greatly reduced set from fatigue strength

(Ref.) Underfill

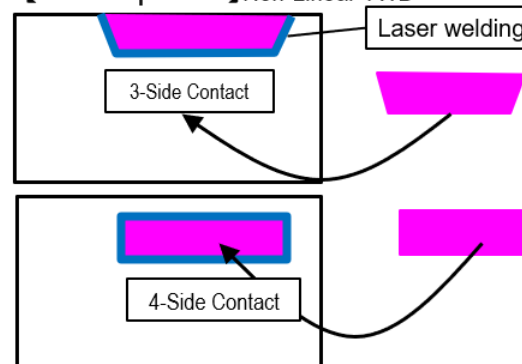


【Current】 Linear TWB



Linear welding (line only)

【Development】 Non-Linear TWB

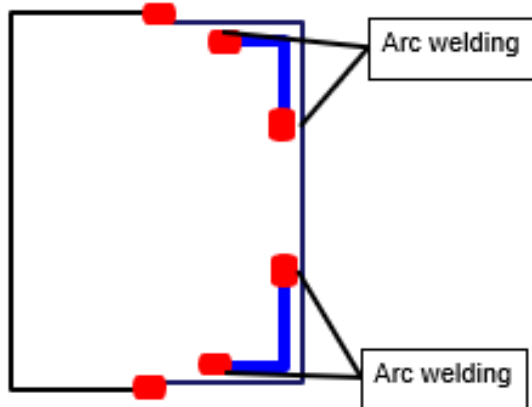
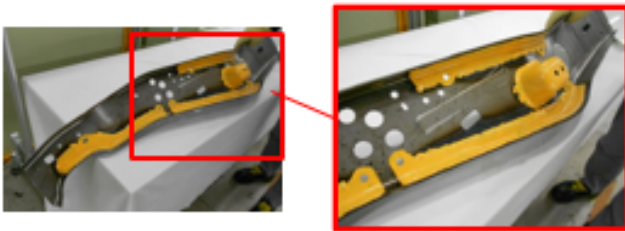


**Non-linear welding** (line + curve)

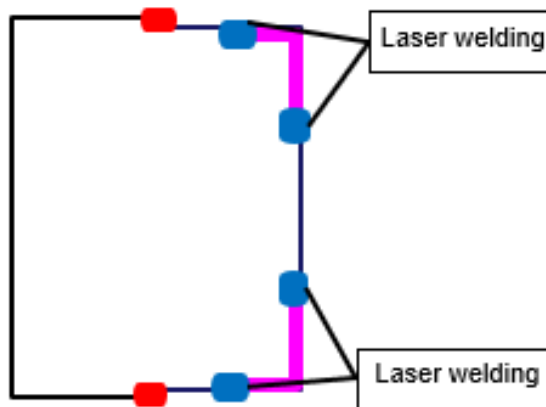
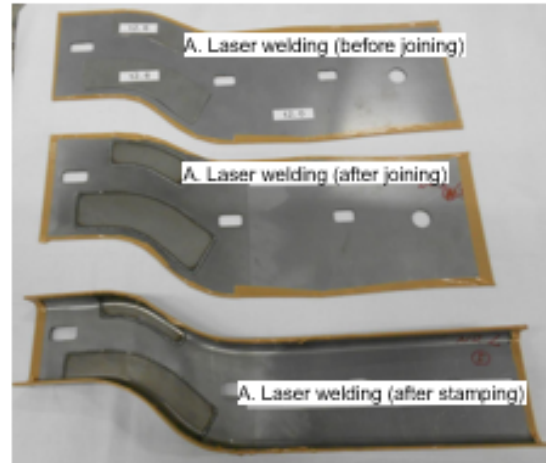
# COMPARISON WITH CURRENT PROCESS

TOYOTA

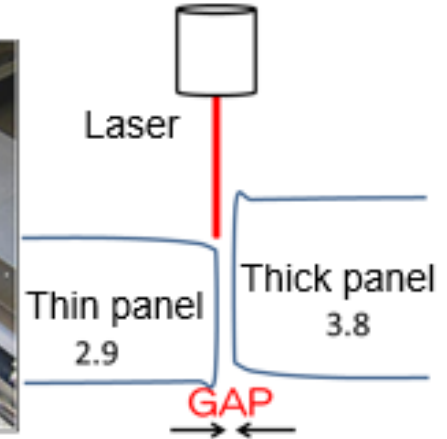
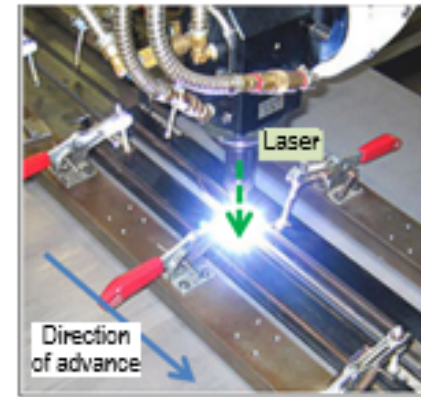
【Current】  
R/F (overlapped structure)  
Arc welding



【Development】  
Thick-panel laser welding  
Laser Tailored Blank (LTB)



(Ref.) Laser welding

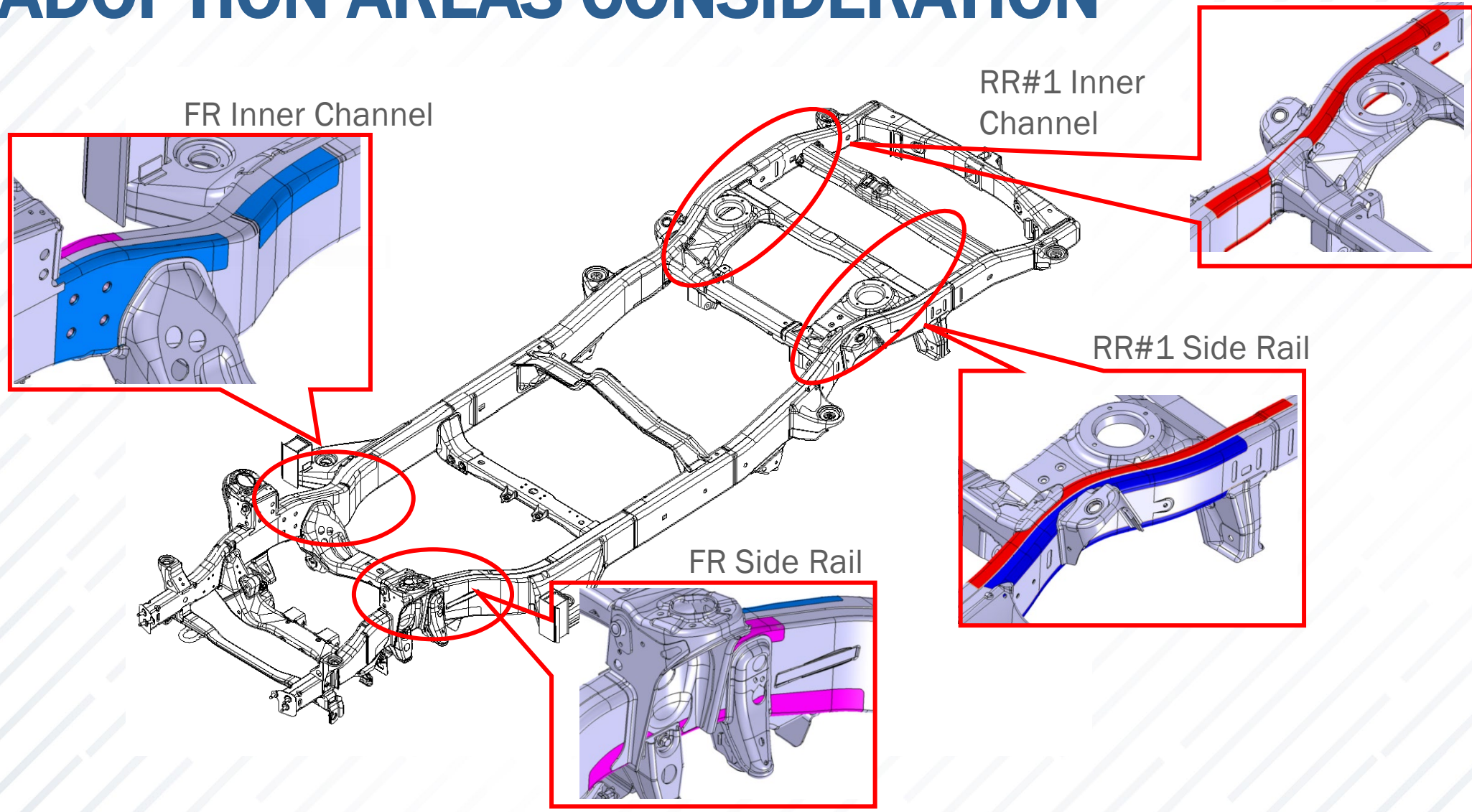


(Ref.) Processes

	Laser welding processes					Stamping process
	Process 1	Process 2	Process 3	Process 4	Process 5	
Process	Punching	Assembly	Laser welding	Deoxidizing	Bead inspection	Bending
Photos						

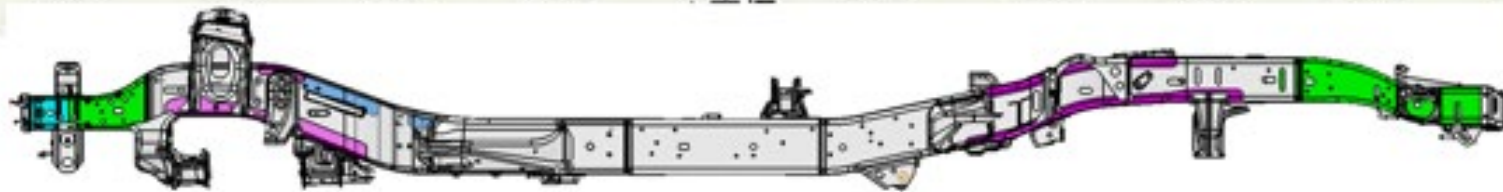
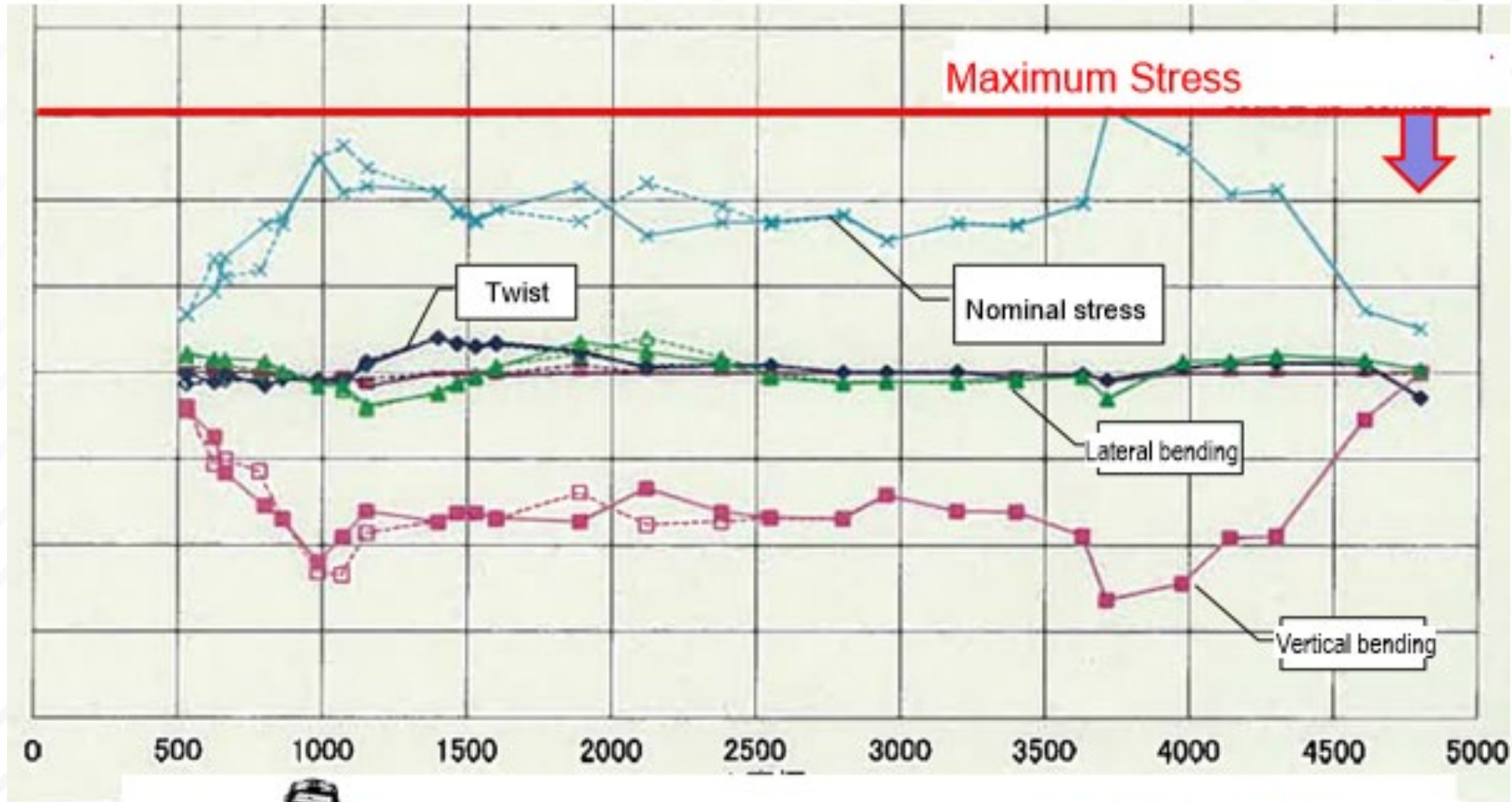
**Strict tolerance control** (for gaps, unevenness, etc.) is needed.

# ADOPTION AREAS CONSIDERATION



Adopt TWB in **high normal stress areas (suspension attachment areas)**

# ADOPTION AREAS CONSIDERATION

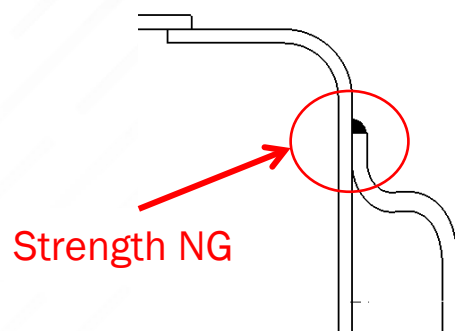
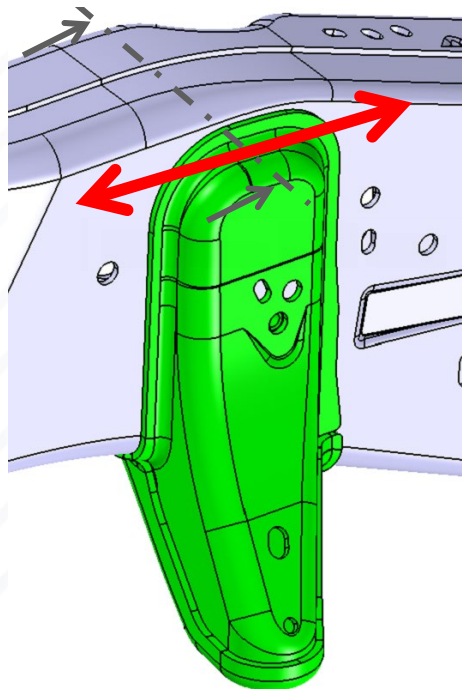


The basic structure satisfies normal stress criteria by appropriate cross section

**Use non-linear TWB to countermeasure high local stress**

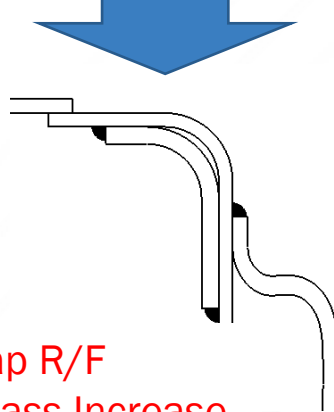
# ADOPTION AREAS CONSIDERATION

Required C/M area

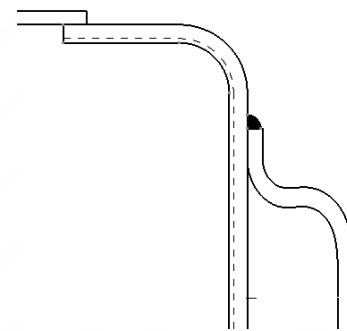


Strength NG

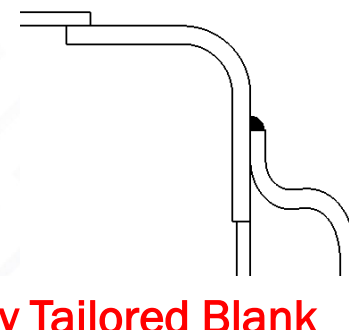
Current



Add overlap R/F  
⇒ Large Mass Increase



Thickness UP (entire panel)  
⇒ Large Mass Increase



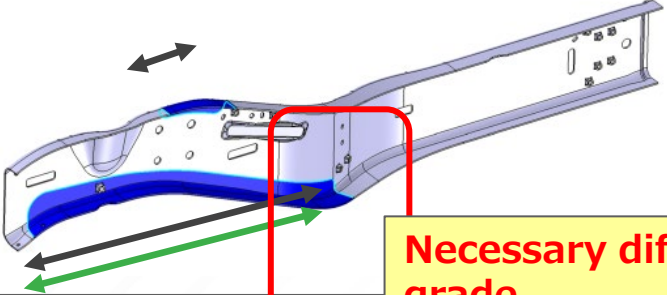
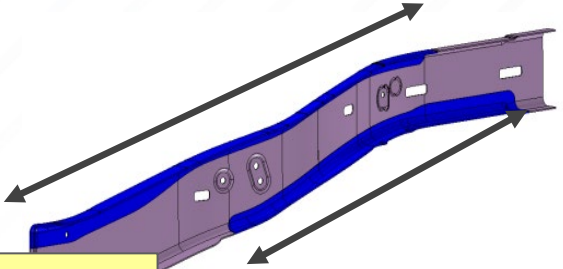
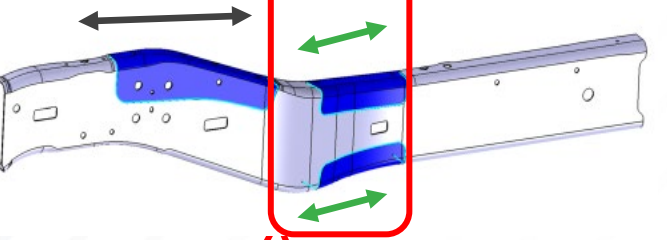
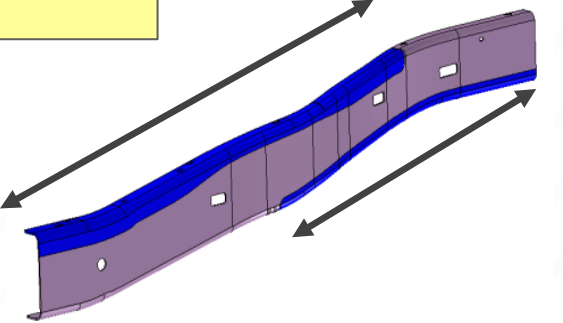
Partially Tailored Blank  
⇒ Good mass efficiency

## Additional benefits:

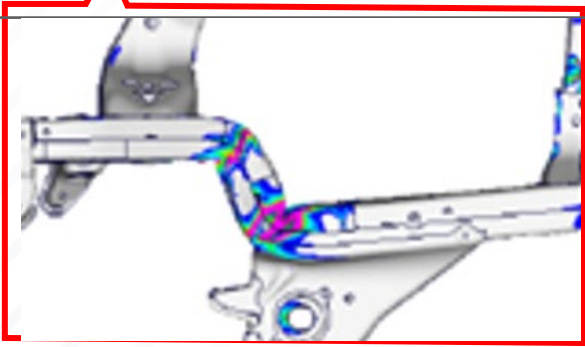
- Remove overlap R/F **Improve ECOAT coverage**
- Reduce heat effect area **Improve ECOAT performance**
- Possible to use different material grade **Improve crash performance**

# ADOPTION AREAS CONSIDERATION

Local Stress  
Crash mode

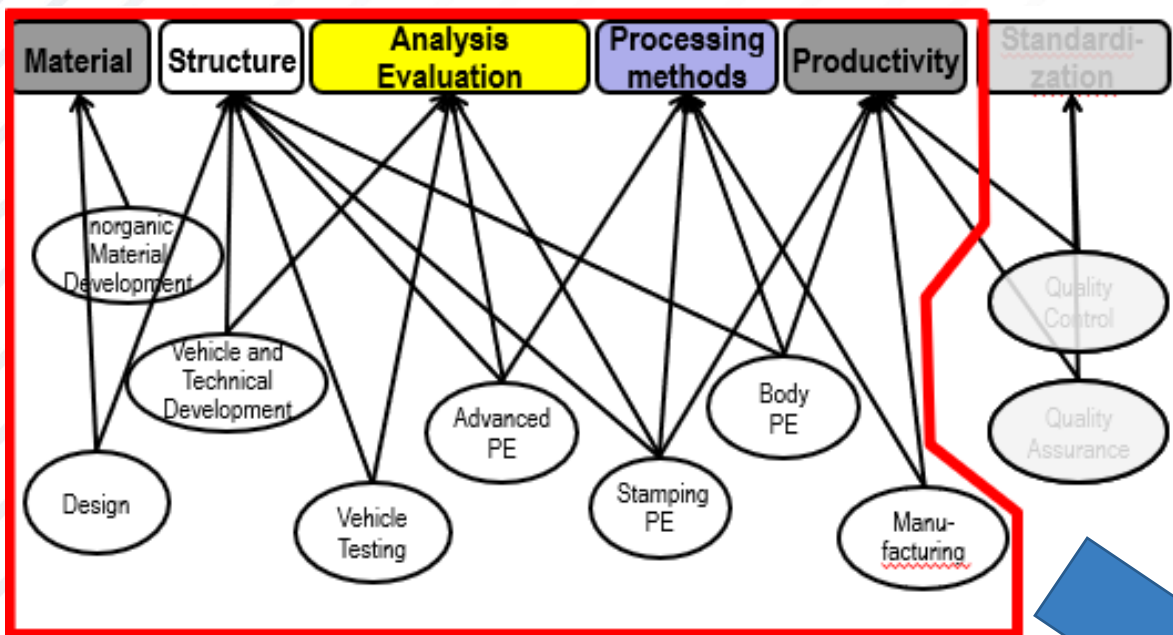
	FR	RR
S/R		
I/C		

**Necessary different material grade for Crash performance**



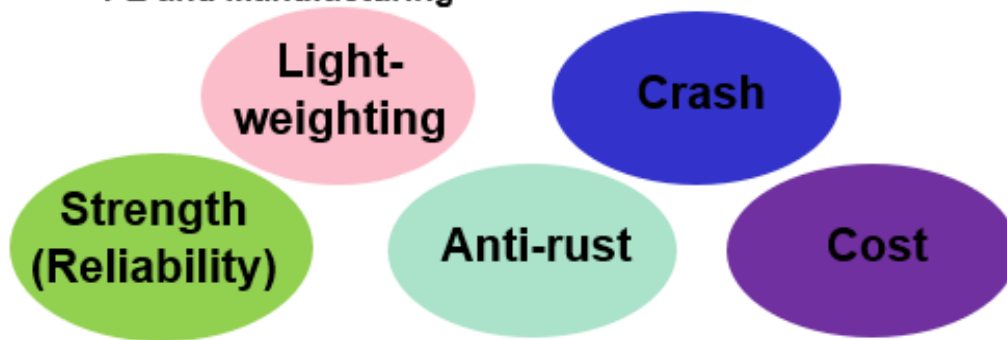
Control crash deformation mode by different material grade combination

# CROSS FUNCTION COLLABORATION



Technical development and vehicle development are simultaneously carried out; early participation of PE and Manufacturing

Study streamlining through collaboration of all departments

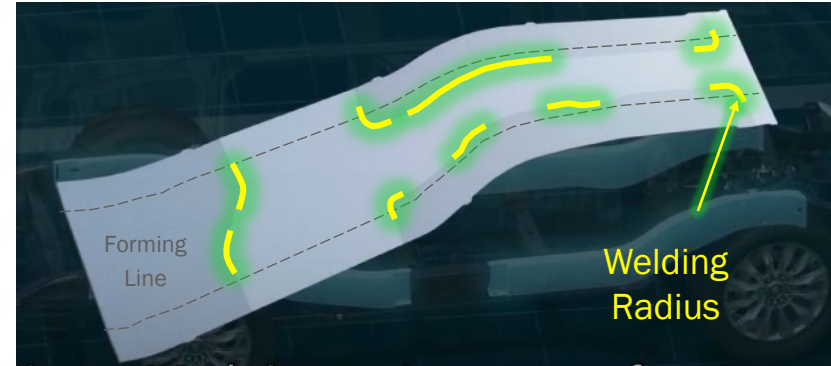


# WEIGHT REDUCTION CHALLENGE

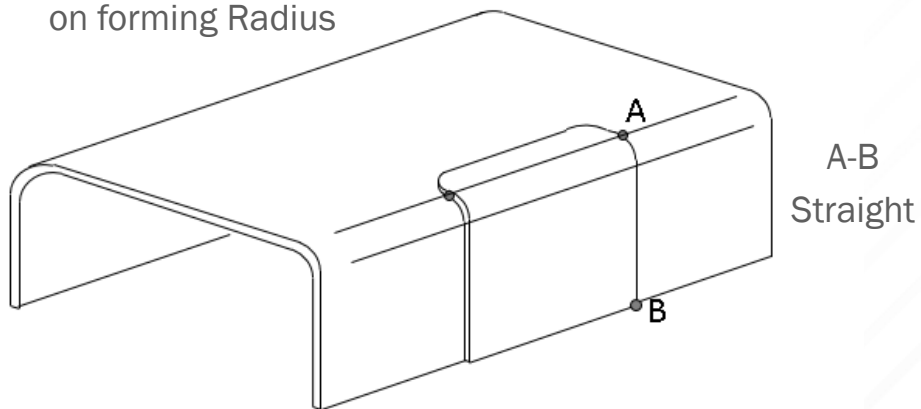
## FORMING



## WELDING

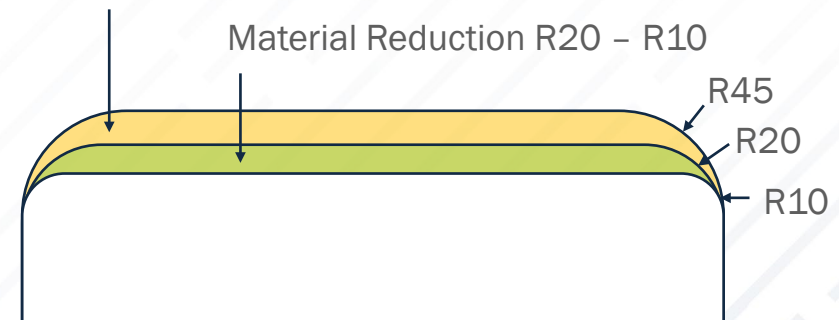


Weld Radius Cannot be on forming Radius



Material Reduction R45 - R20

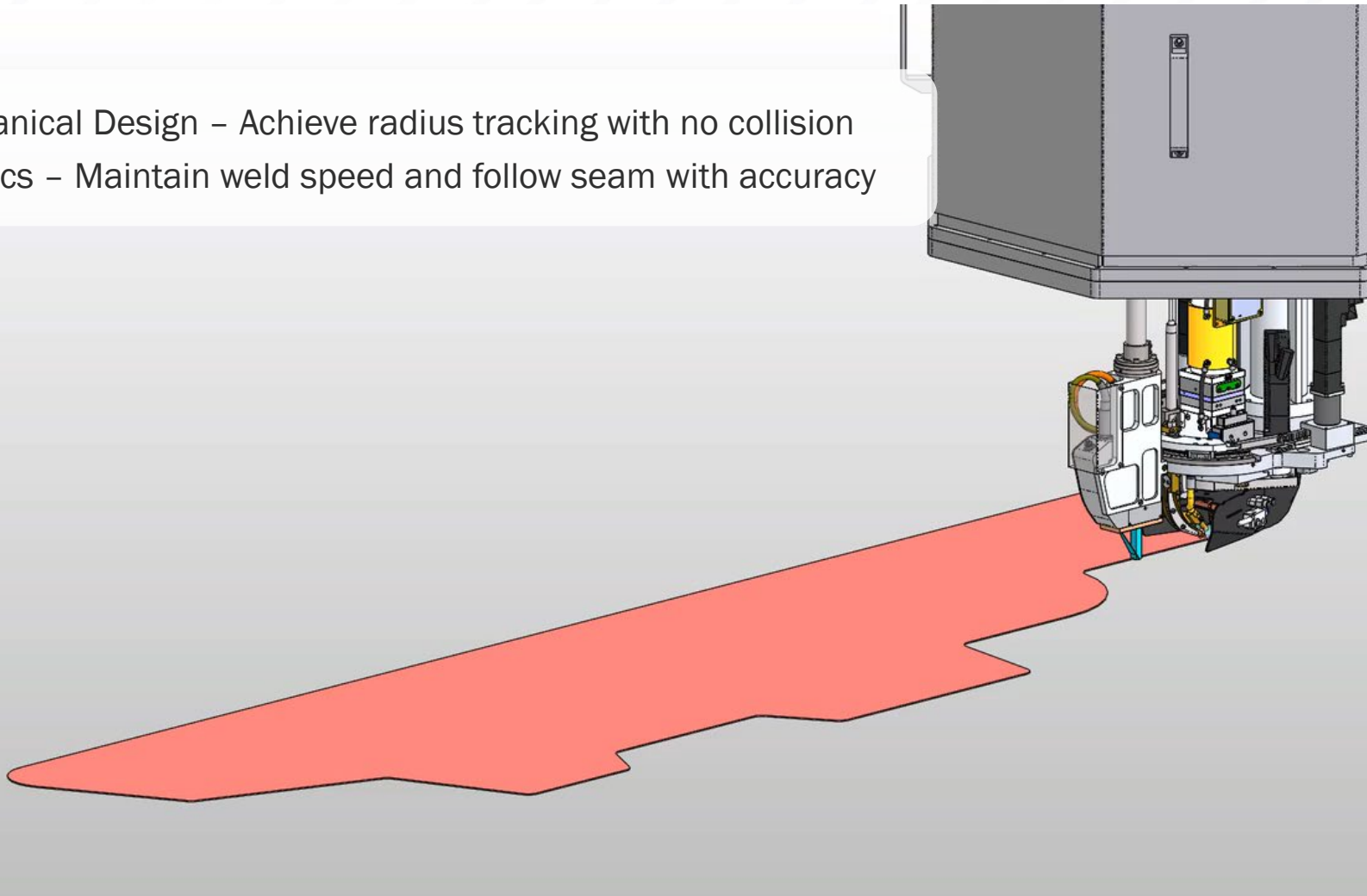
Material Reduction R20 - R10



To Maximize weight reduction requires to Minimize welding radius

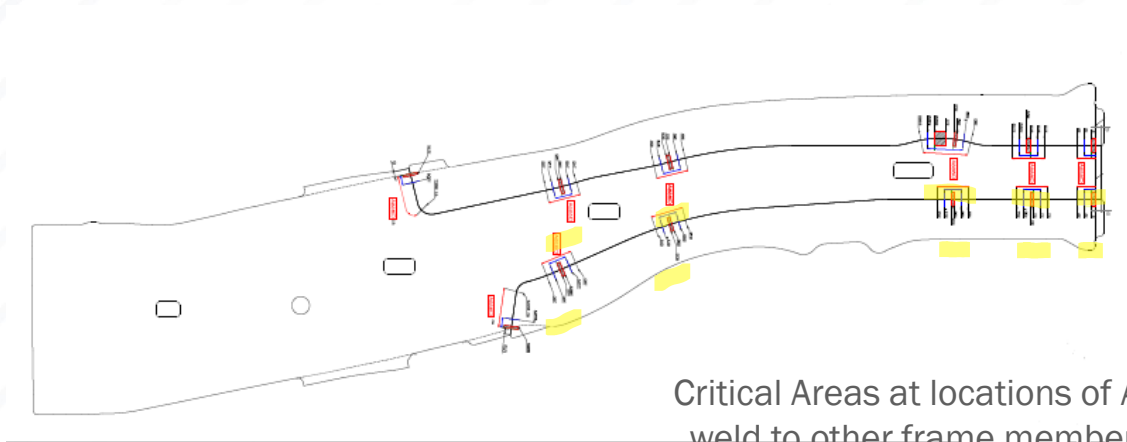
# WELD HEAD DYNAMICS

Mechanical Design – Achieve radius tracking with no collision  
Dynamics – Maintain weld speed and follow seam with accuracy

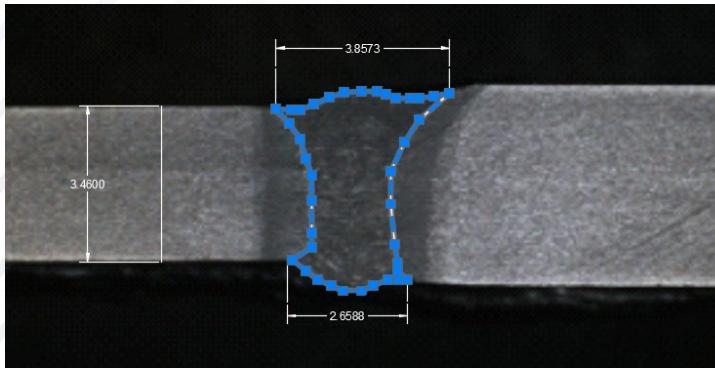


Collaboration with Andritz Soutec to Develop new welding head and motion algorithms

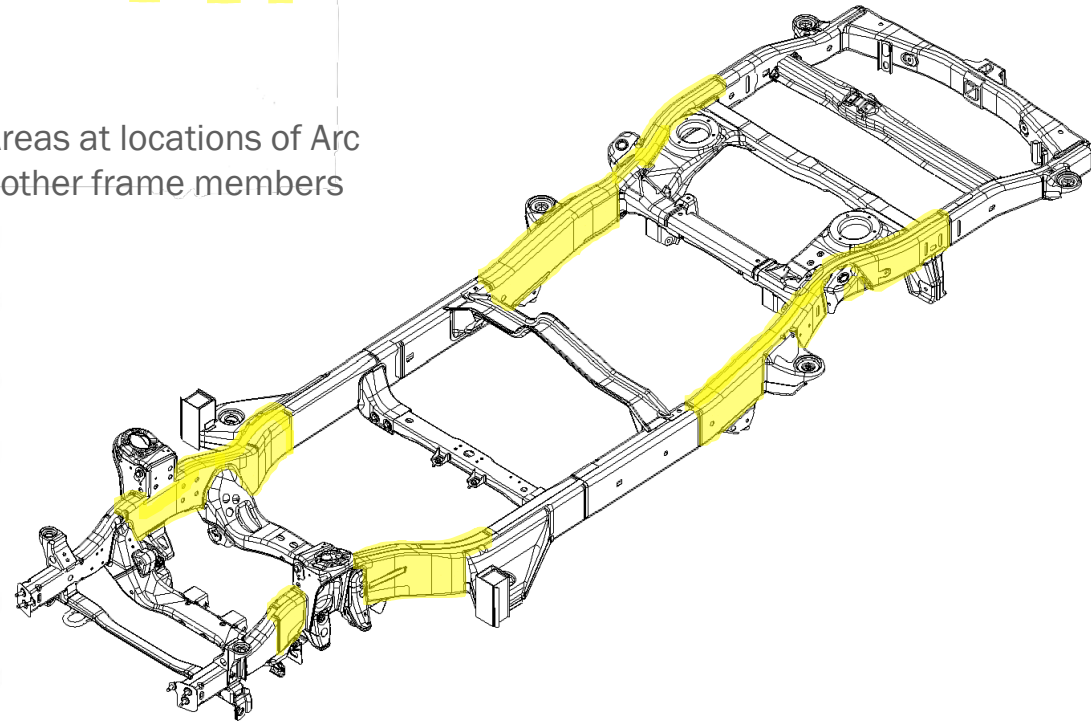
# QUALITY REQUIREMENTS



Critical Areas at locations of Arc weld to other frame members



Underfill required in these areas held to tighter tolerance than standard TWB

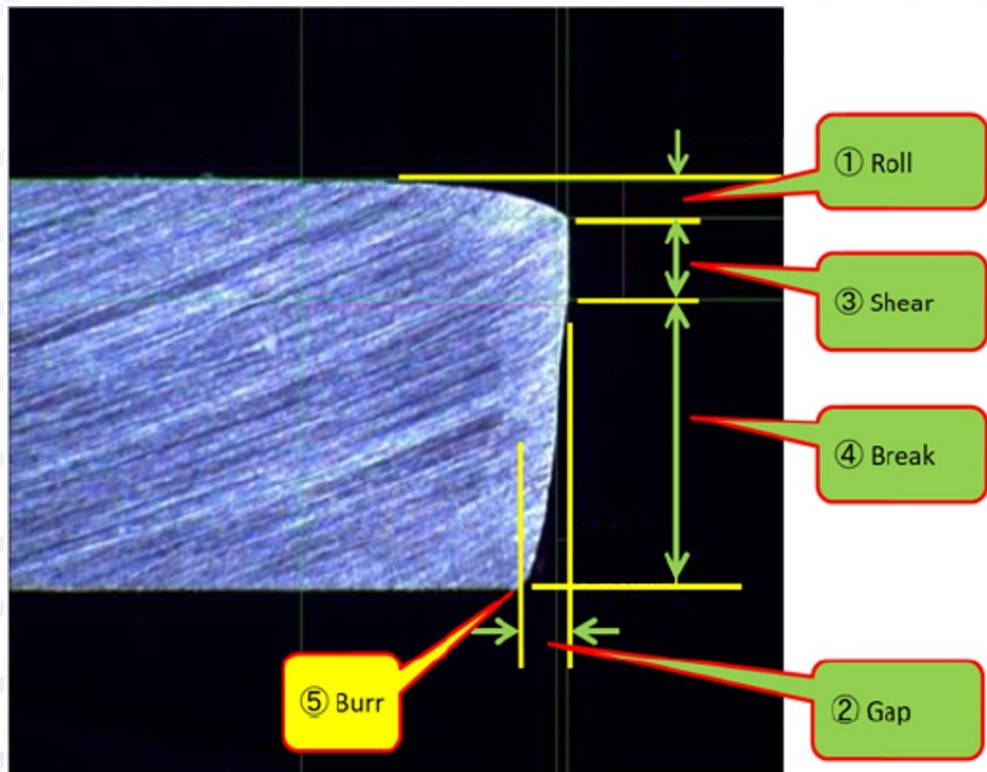


Developed new inspections system to support 100% inline inspection

# BLANK EDGE QUALITY

Thicknesses up to 195% thicker than previous TWB applications

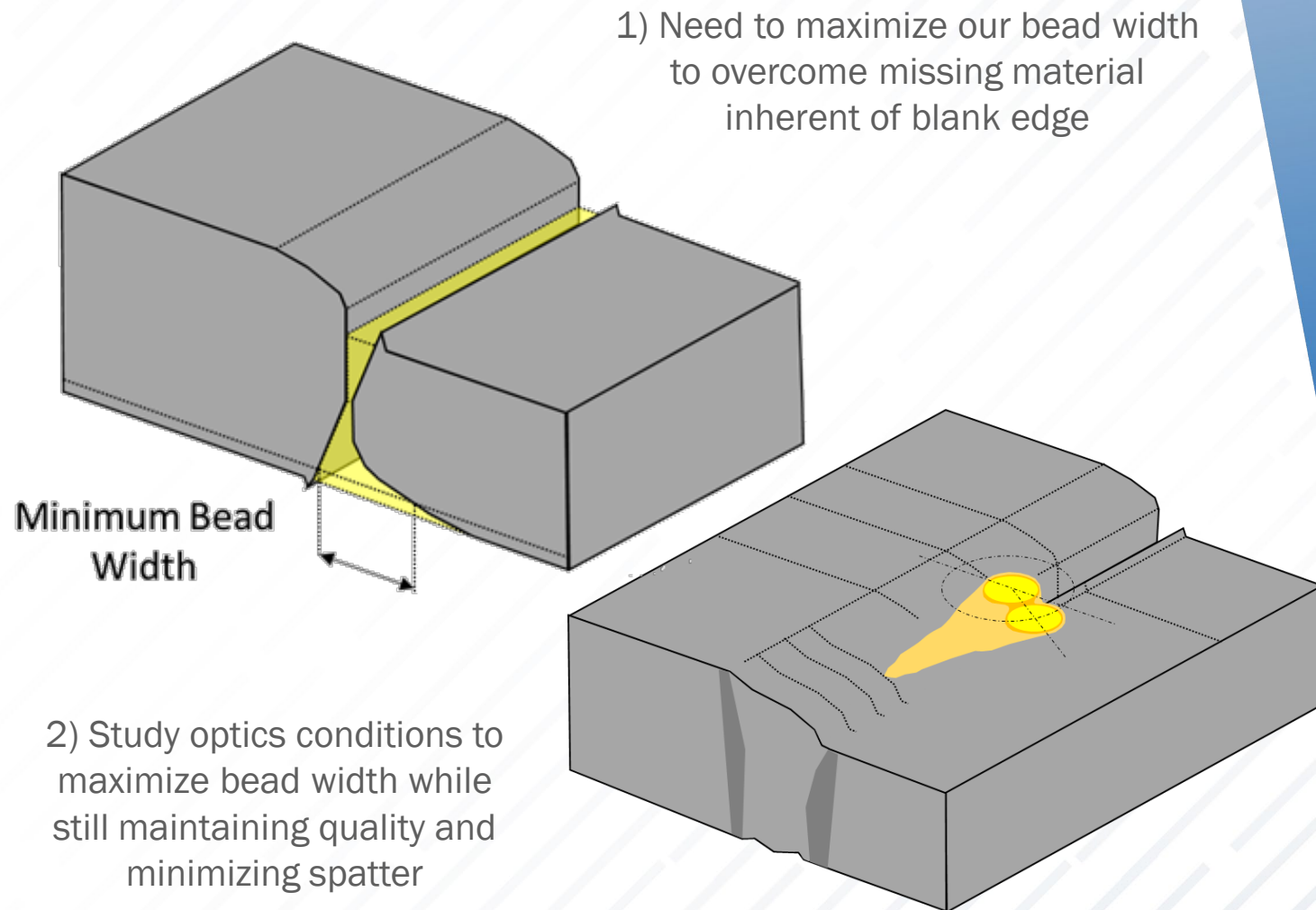
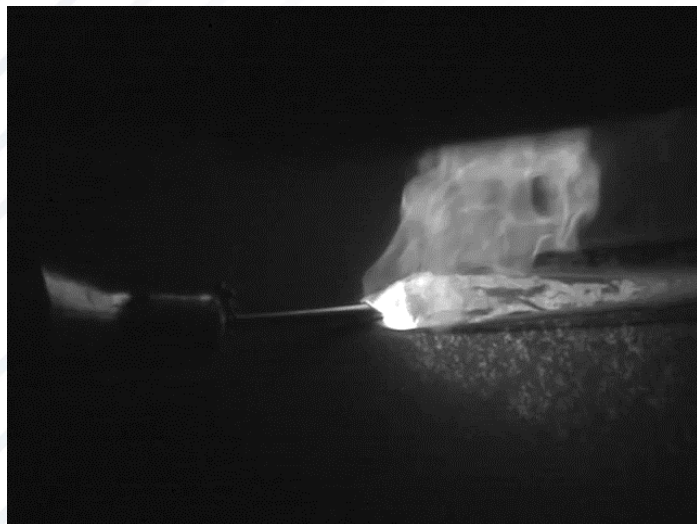
Combining materials with varying strengths from 270 – 780 MPa



Use ATOS Q technology to ensure blank quality and adjust machine parameters for blank quality and weld quality based on output.

Thicker & higher strength steel more challenging for edge quality - required ability to measure for quick feedback to die maintenance and blanking line

# WELDING TECHNICAL CHALLENGE



Optimized optics configuration in order to maximize bead width and minimize UF



# FOR MORE INFORMATION

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