Challenges With Part Formability, Spring back Compensation, Yield Improvements & Product design Support

By Godrej Tooling
Sameer Chudnaik &
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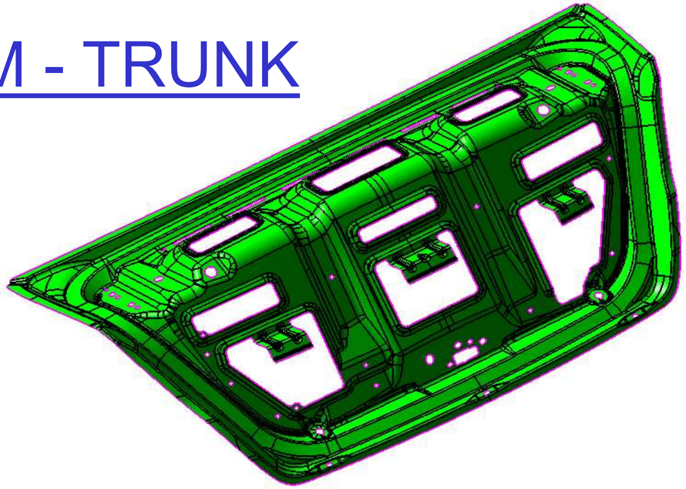
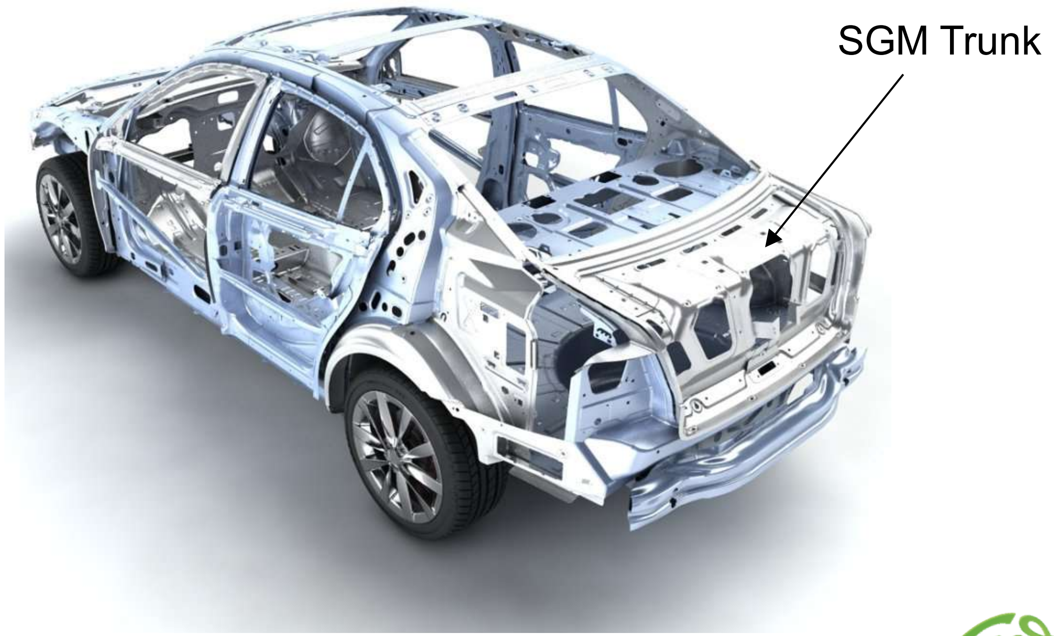
Challenges During Formability Analysis

SGM - TRUNK



Part Name : SGM Trunk
Material : GMW – 2M-ST-S-CR4 (310MPa)
Thickness : 0.65 mm



Die Process -
OP10 – Draw
OP20 – Trim, C' Trim, Pierce, C'Pierce
OP30 – C' Trim, C'Pierce,
OP40 – Pi, Flange, C'Pierce, C'Trim

Challenges During Formability Analysis

Process as Follows

OP10 - DRAW

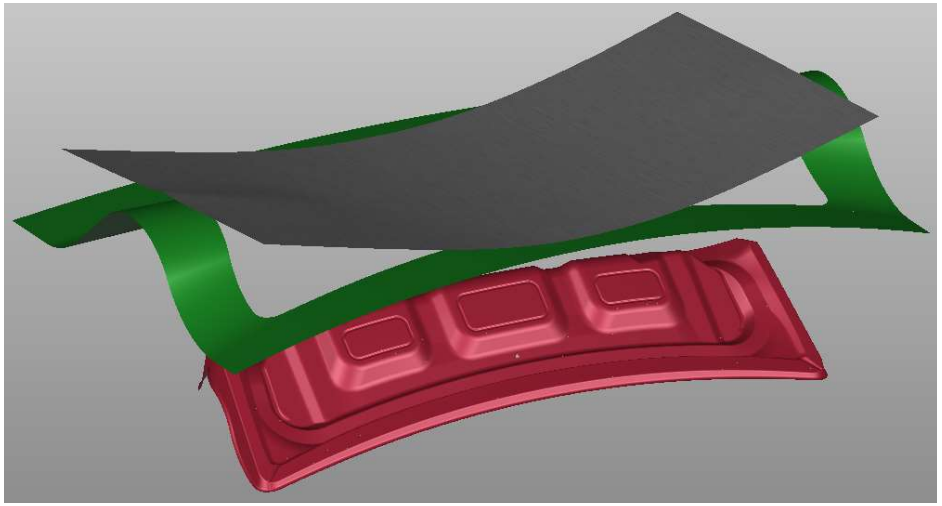
OP20 – PIE, C'PIE, TRIM, C'TRIM

OP30 – C'PIE, C'TRIM

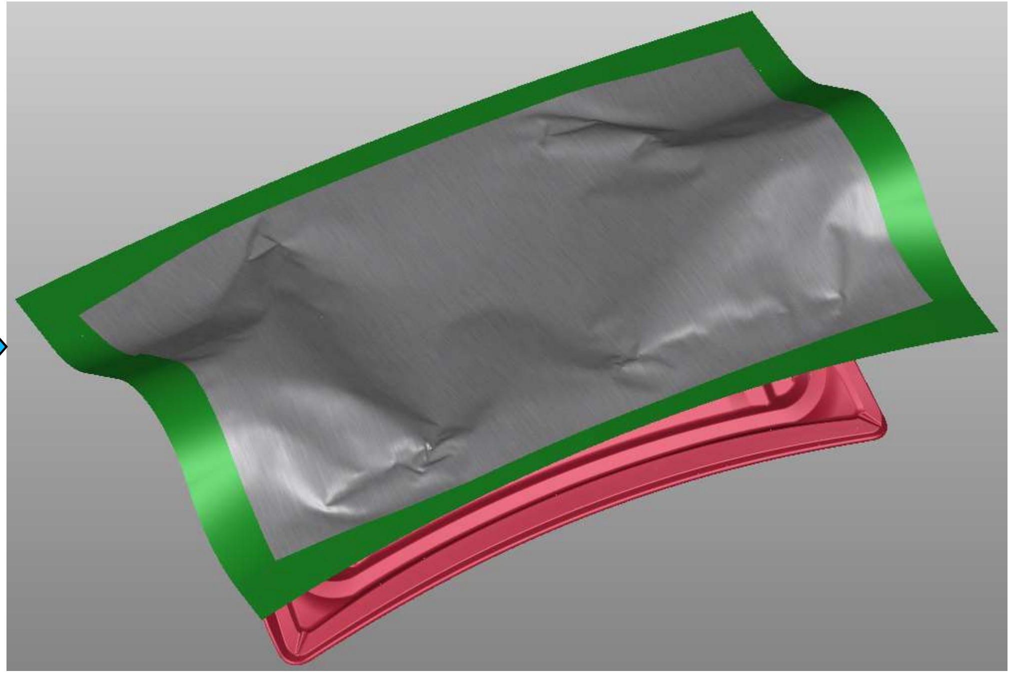
OP40 – PIE, RESTRIKE, FLG RESTRIKE

Die Process - Folds & Wrinkles during closing

Challenge : Heavy wrinkles observed while blank holder closing.



Sagging Of Blank due to Gravity



Blank Holder Closing

Result : Sagging resulted in waves, which results in heavy wrinkles

Die Process - Folds & Wrinkles during closing

Challenge : Heavy wrinkles observed while blank holder closing.

Option Tried 01 : Punch Support Given To Blank While Closing

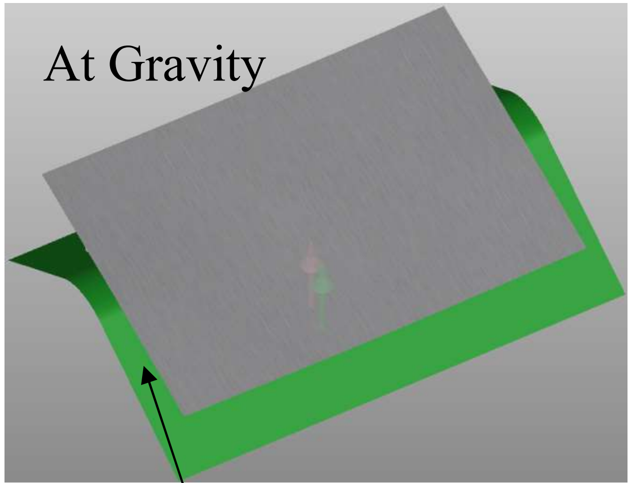
Heavy Wrinkles

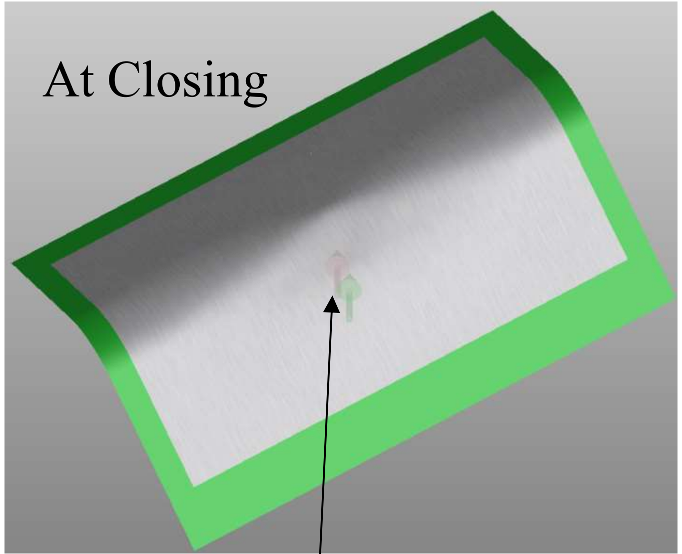
Result : Blank Holder Curvature results in wrinkles.

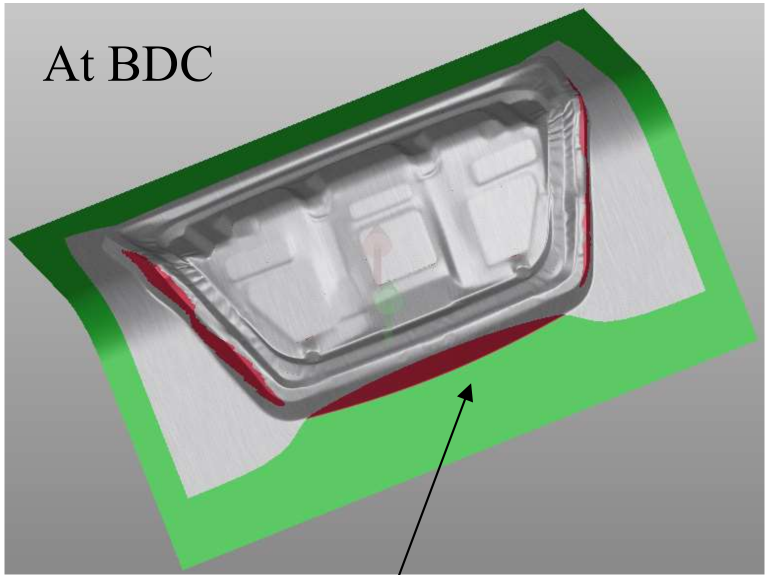
Die Process - Folds & Wrinkles during closing

Challenge : Heavy wrinkles observed while blank holder closing.

Option Tried 02 : Single Curved Blank Holder Shape made







Binder shape made smooth

Closing is Good

Part Yield Reduced

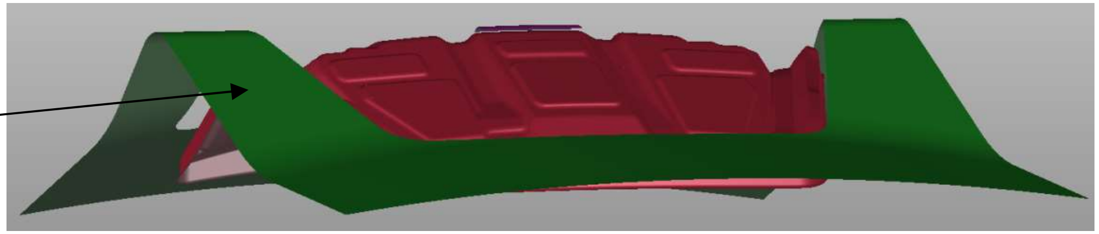
Result : Single Curved Blank Holder resulted in lower yield. (More Blank Size Required)

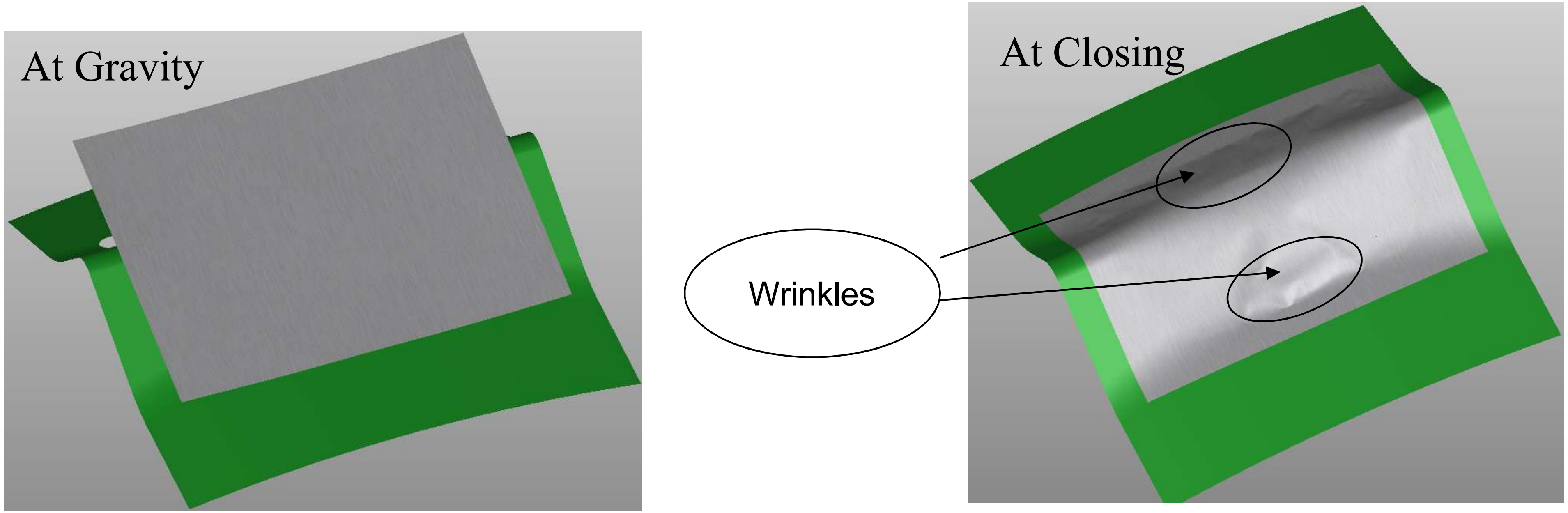
Die Process - Folds & Wrinkles during closing

Challenge : Heavy wrinkles observed while blank holder closing.

Option Tried 03 : Double curved Blank Holder Shape made. (same as component profile)

Double Curved
Blank Holder



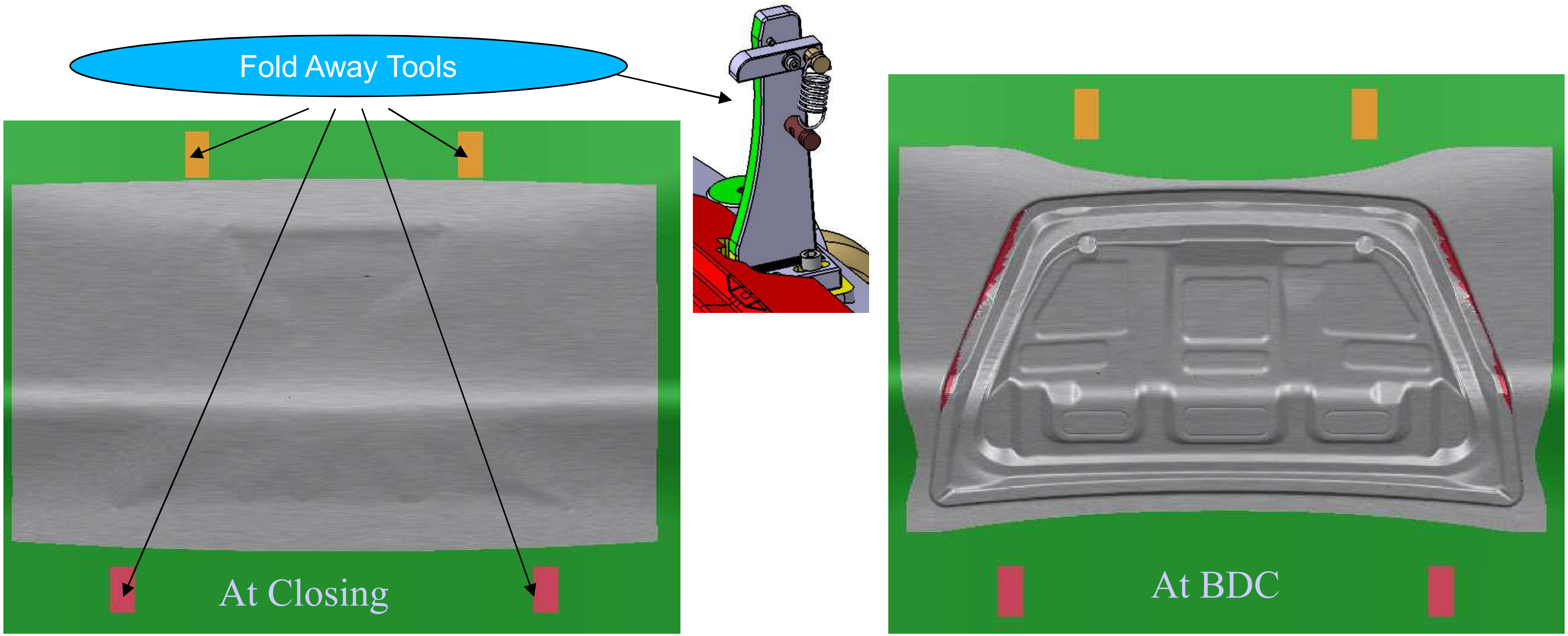


Result : Wrinkles are seen which are affecting formability

Die Process - Folds & Wrinkles during closing - Fold Away Tools

Challenge : Heavy wrinkles observed while blank holder closing.

Option Tried 04 : Fold Away Tools added with Rectangular Blank and Punch Support.

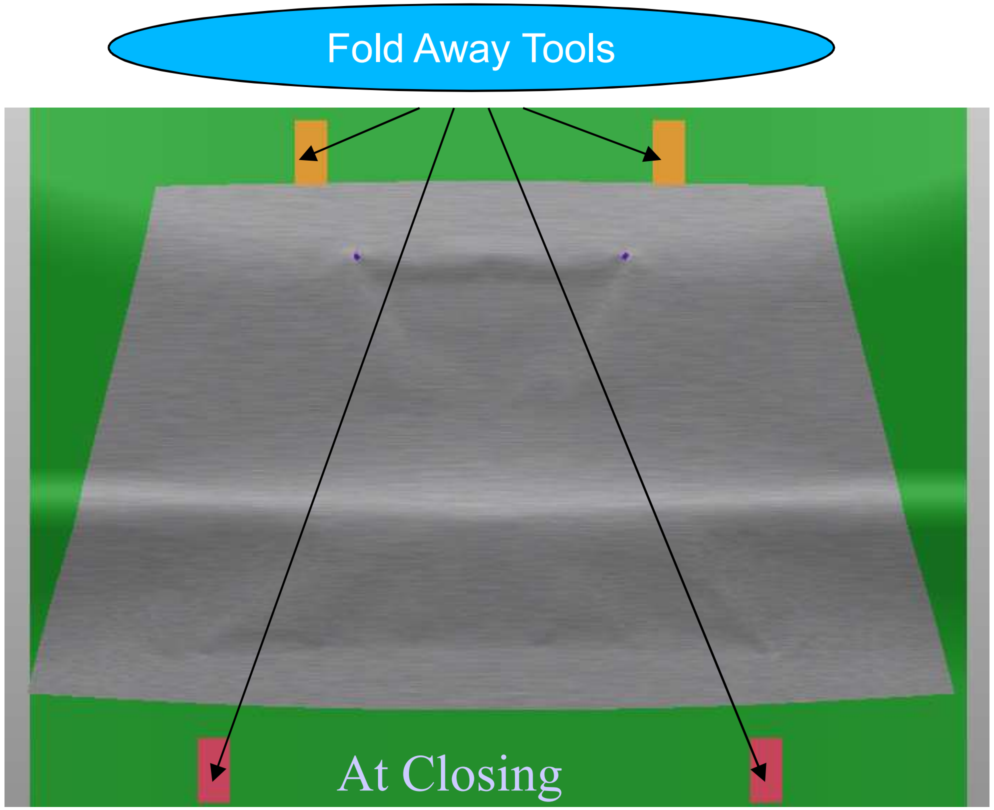


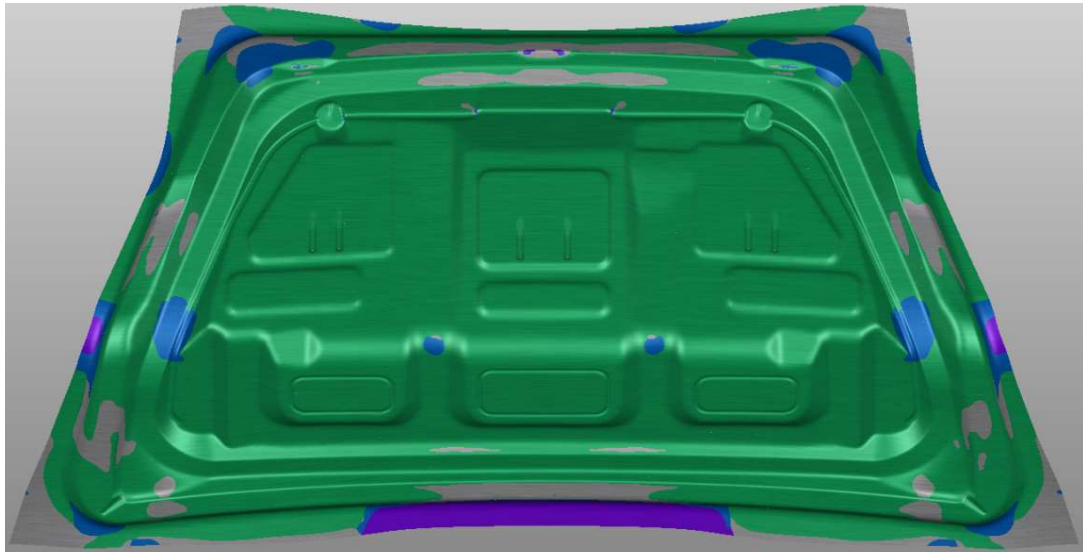
Result : Cracks observed due to rectangular blank

Springback Compensation - Results Comparison

Challenge : Heavy wrinkles observed while blank holder closing.

Option Tried 05 : Fold Away Tools added with Trapezoidal Blank and Punch Support.





Final Product

Result : Formability is OK

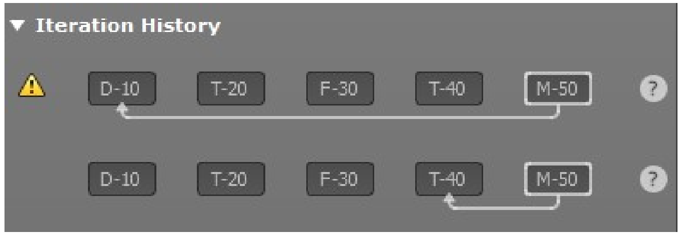
Springback Compensation Statergy

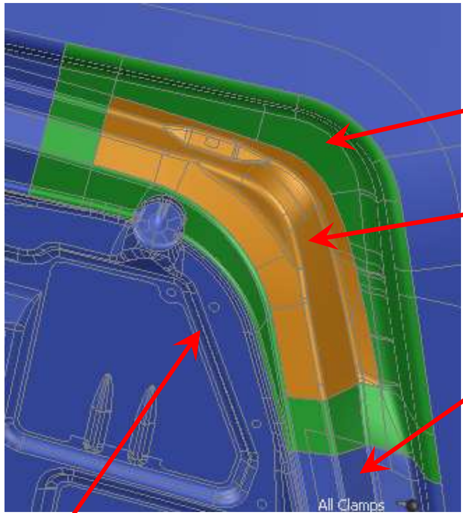
Compensation Strategy

OP 10 | OP 20 | OP 30 | OP 40 | SB

1.0 - Local | 0,0 | 0,0 | 1,0 - Local

OP10 – Local Compensation
OP20 – Nominal Surface
OP30 – Nominal Surface
OP40 – Local Compensation

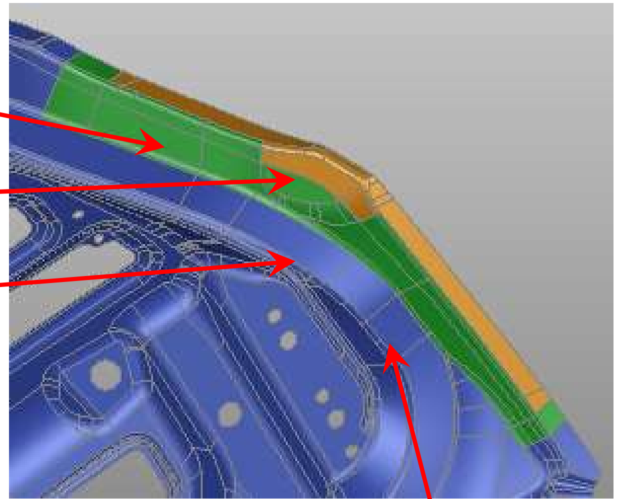




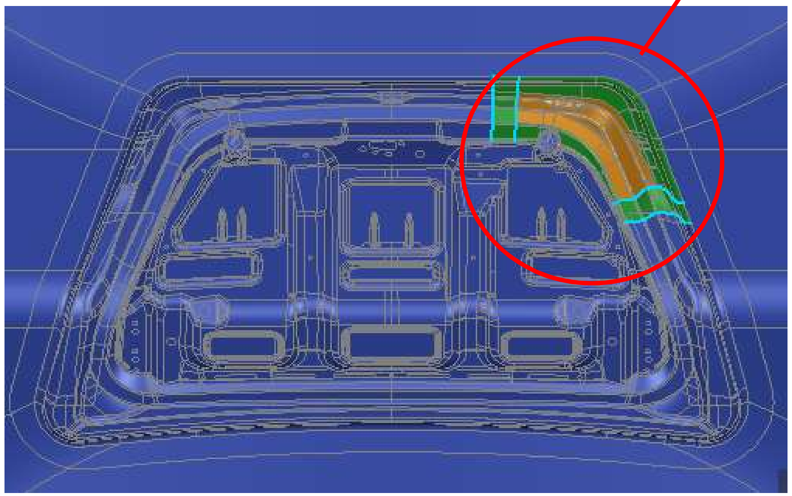
Transition

Direct

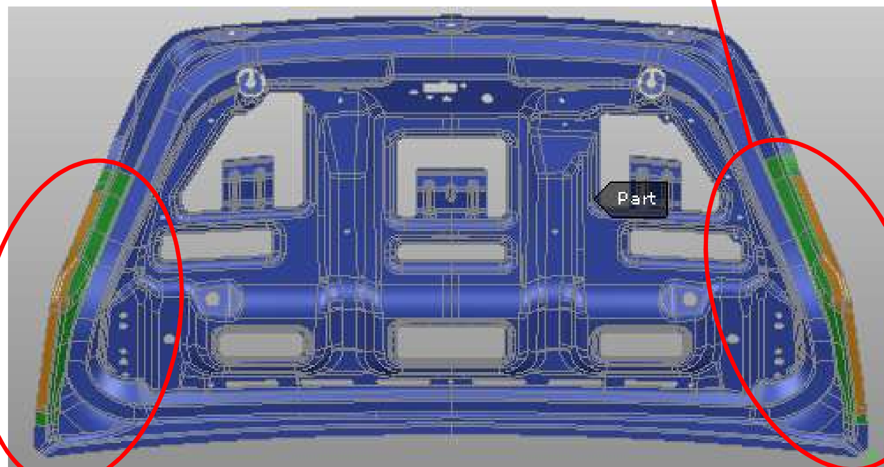
Fixed



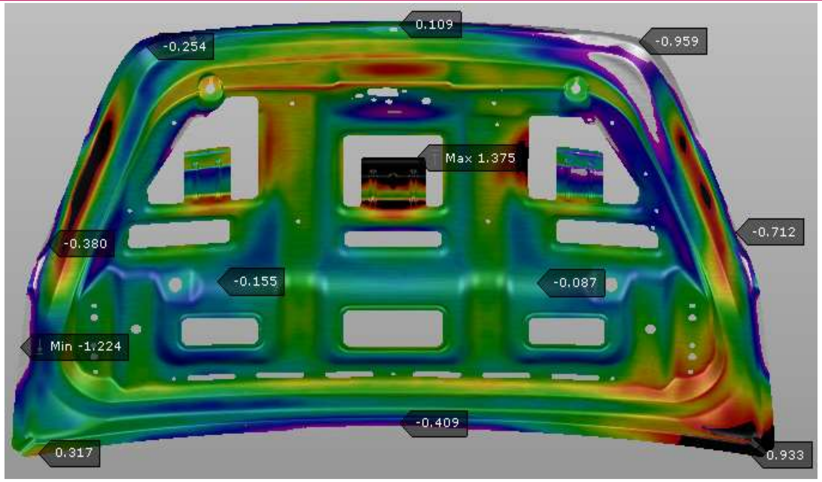
OP10 – Local Compensation



OP40 – Local Compensation

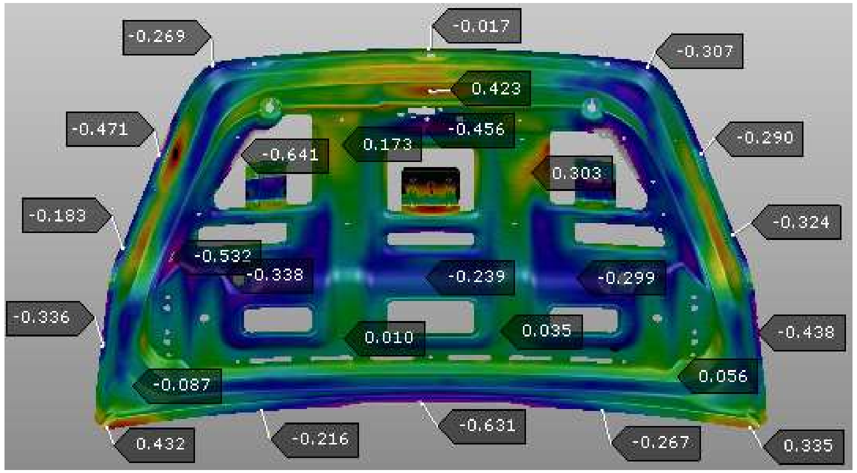


Springback Compensation - Results Comparison



Spring Back results w/o compensation
Deviation from nominal surface in the range of
+1.4 mm to -1.2 mm

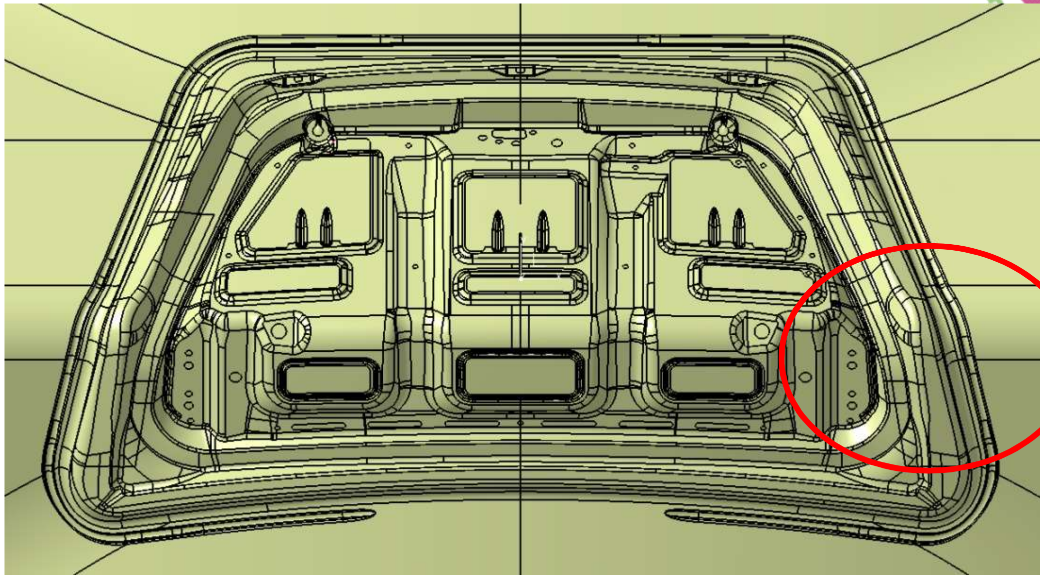
Spring Back results after compensation in Auto Form
Deviation from nominal surface in the range of
-0.50 mm to +0.50 mm

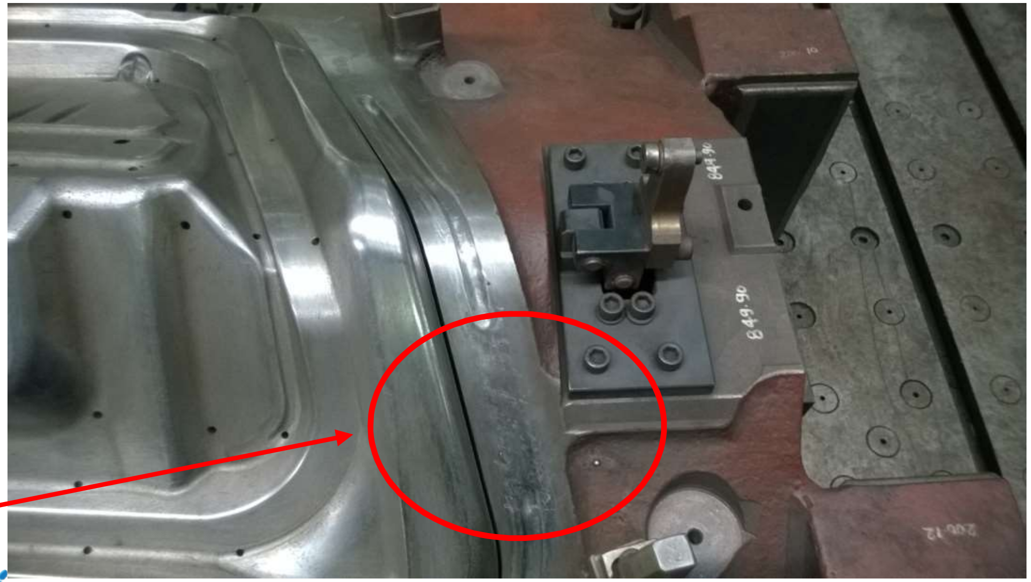


Actual Results
Part Accuracy after T0
Overall :84%

Springback Compensation - Results Comparison

Wrinkles Observed during trial

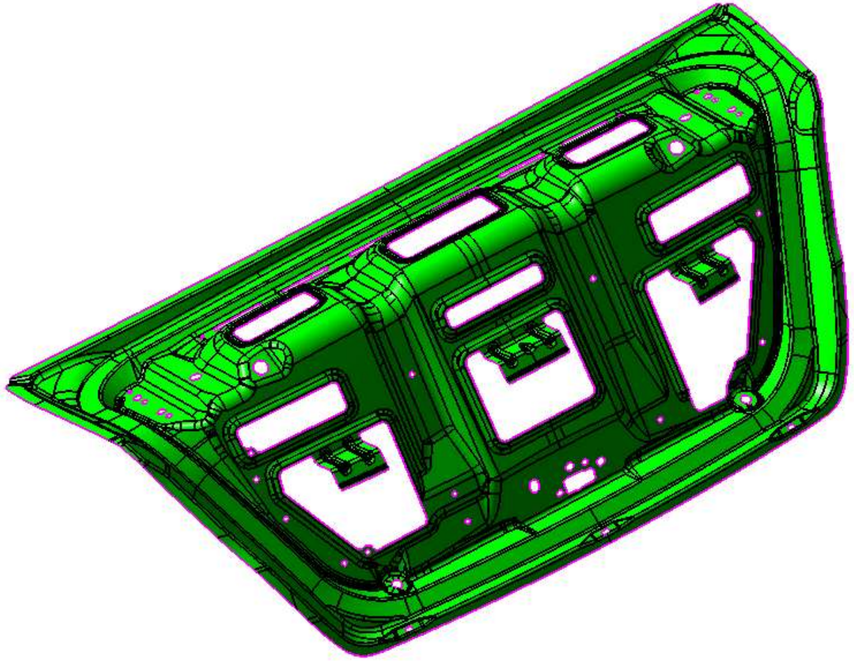




Wrinkles Observed during trial

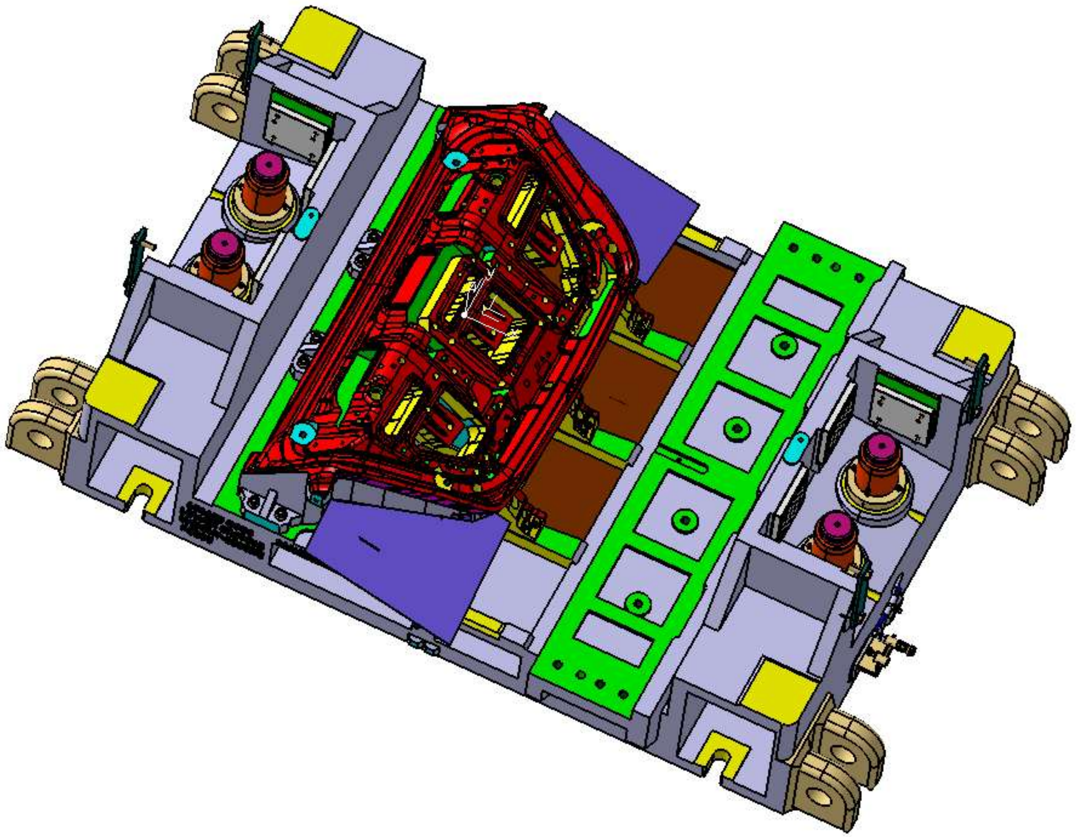
Beads were removed during trial

Learning's / Benefits



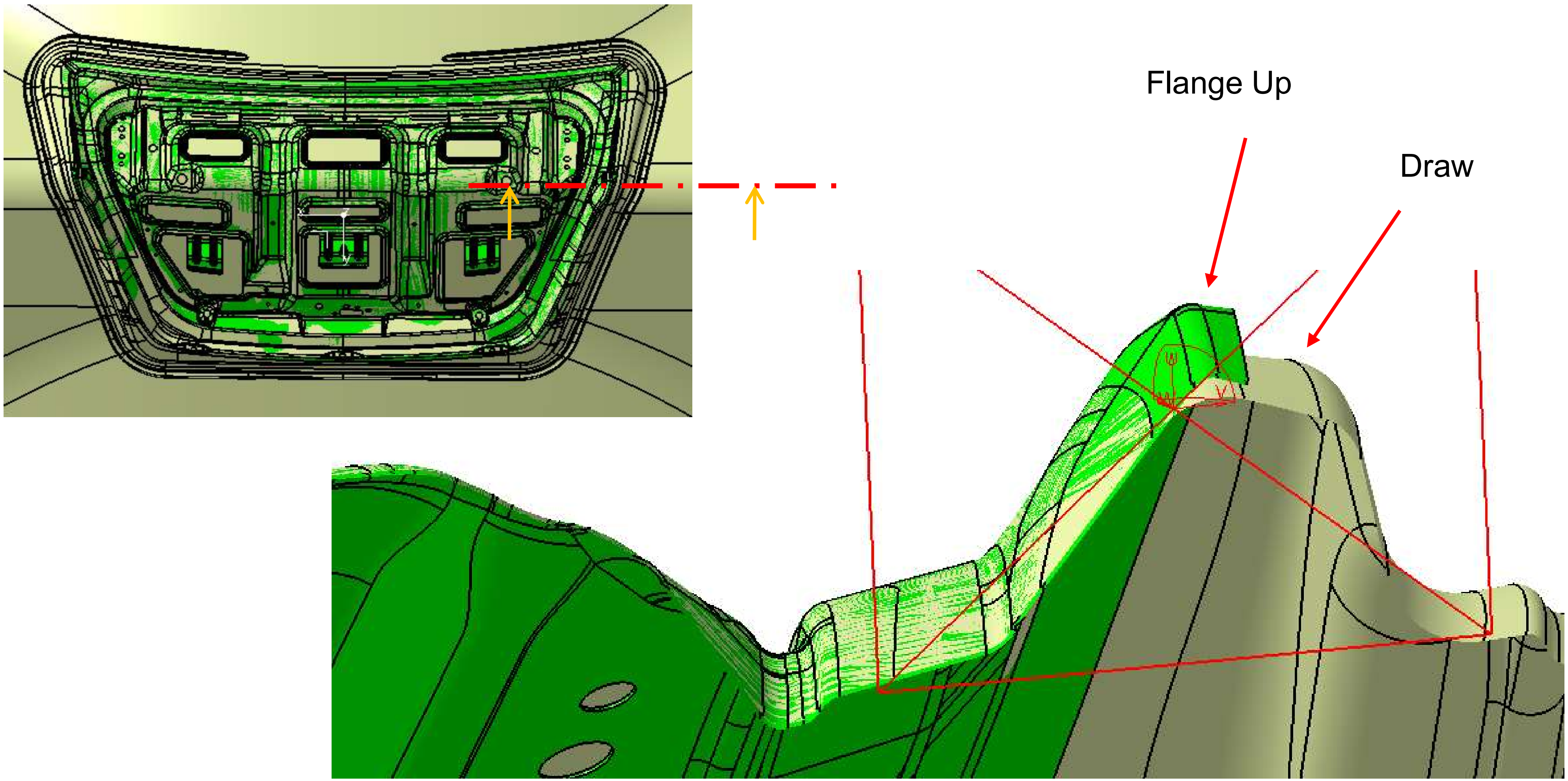
- Proved the process virtually first with the help of simulation software (Auto Form).

- Done nearly 60 iterations to virtually prove the part.



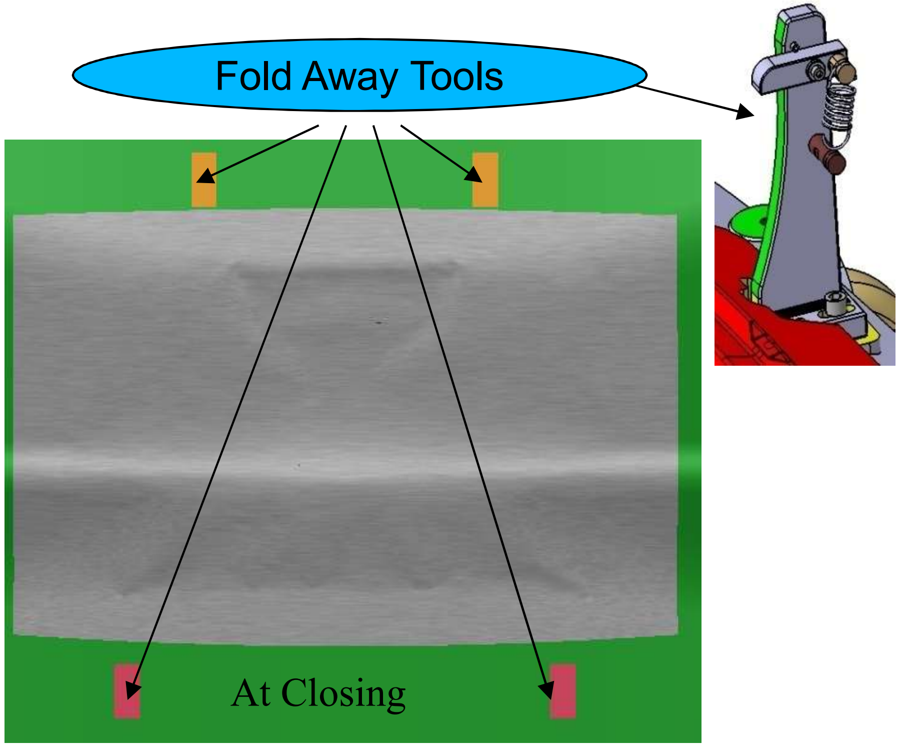
- Cutting on only one side of die for better scrap flow & die strength

Learning's / Benefits

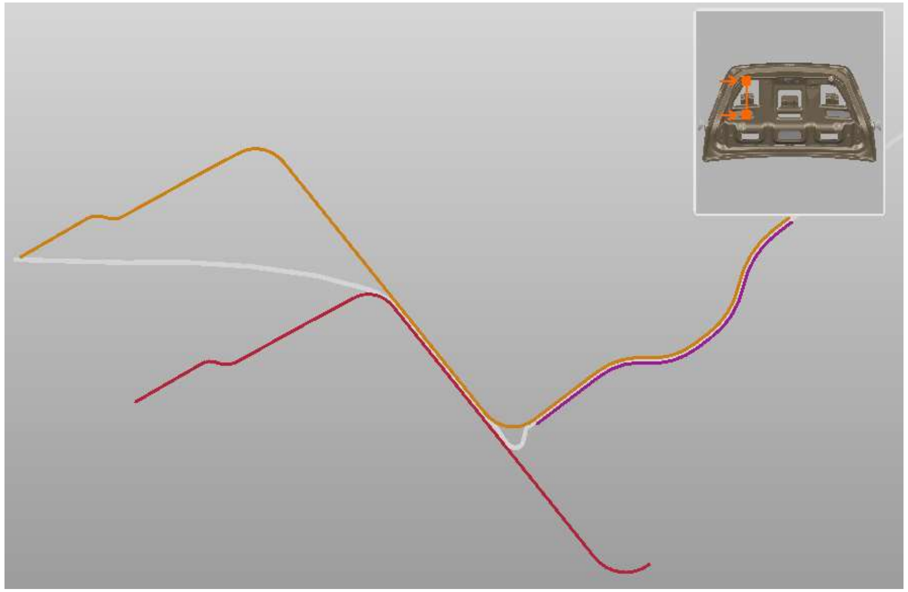


- Process improvement
- Incorporation of flange up process

Learning's / Benefits



- Use of fold away tools, addressed concern of folding during drawing



- Re strike flange to be preferred over wiping flange

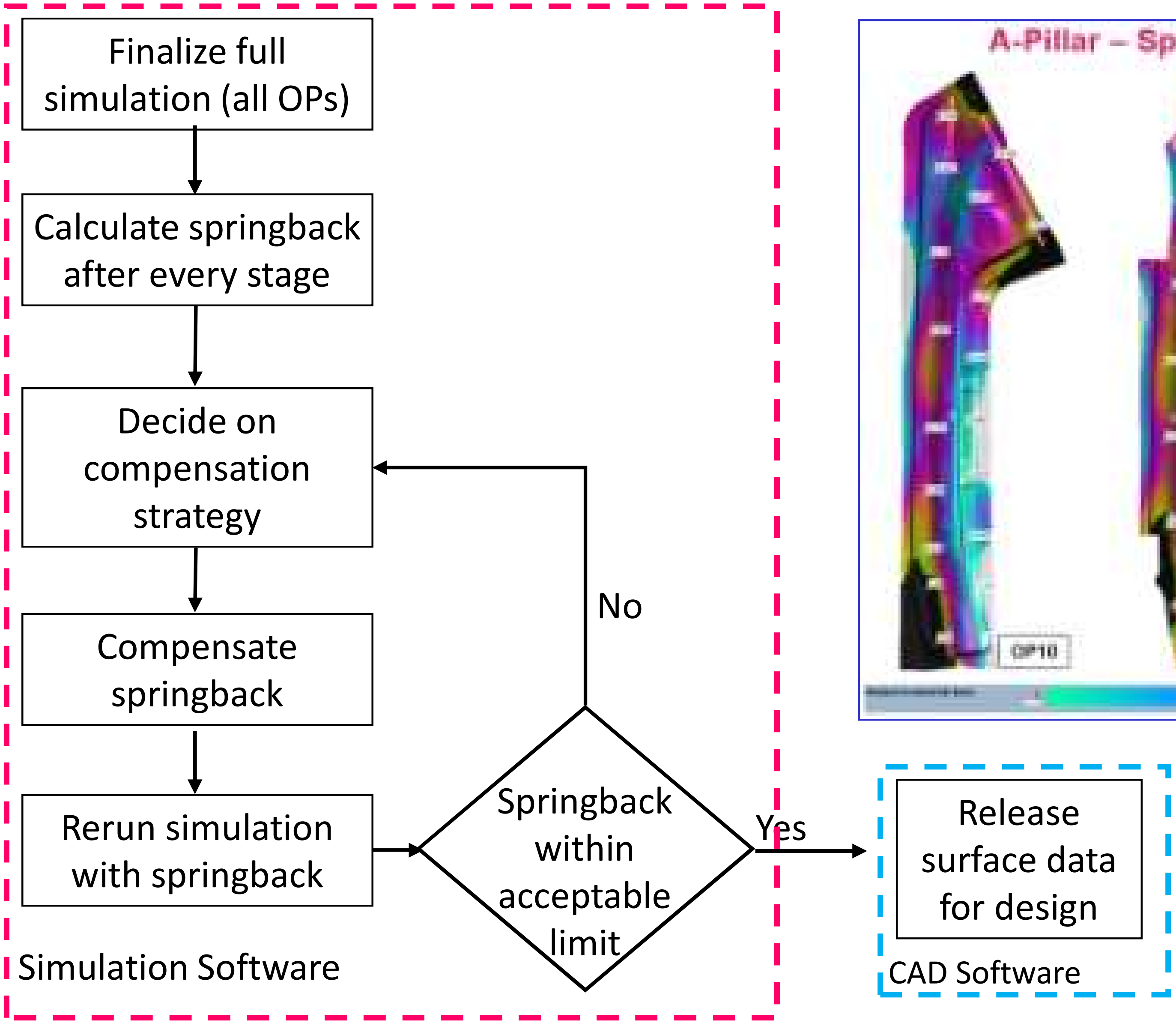
Improvement in part yield

	For existing dies for same model	Made by Godrej Tooling
Blank size	Trapezoidal Blank	Trapezoidal Blank
Blank surface area	1133262 mm2	976950 mm2
Blank Weight	5.79 Kg	4.99 Kg
Part surface area (With Holes)	679773 mm2	679773 mm2
Yield % (With Holes)	59.98 %	69.60 %
Part surface area (Without Holes)	763460 mm2	763460 mm2
Yield % (Without Holes)	67.37 %	78.20 %

Improved part yield as compared to existing dies = 10.83 %

Sheet steel saved / Blank = 0.8 Kg
For 10 Lacks parts = 0.8 x 10,00,000 = 80,000 Kg steel saved.

New Technologies - Advanced Spring-back Compensation



Highlights of using Process - Spring-Back Compensation

- Proved the process virtually first with the help of AutoForm.
- Done nearly 60 iterations to virtually prove the part.
- De-Risking done by keeping provision for re-cut of dies.
- Able to dispatch First level accuracy parts with laser cut samples.
- Re-Cut of dies not required, as T0 to Final quality maturity part produced with die spotting by minimum manual work.
- Reduced lead time for T0 to Final Quality maturity part as re-machining of dies not required.

Quality Improvement through feature addition

GE STAMP –CENTRE_PILLAR_INNER_RH

Material – TRC400Y690T

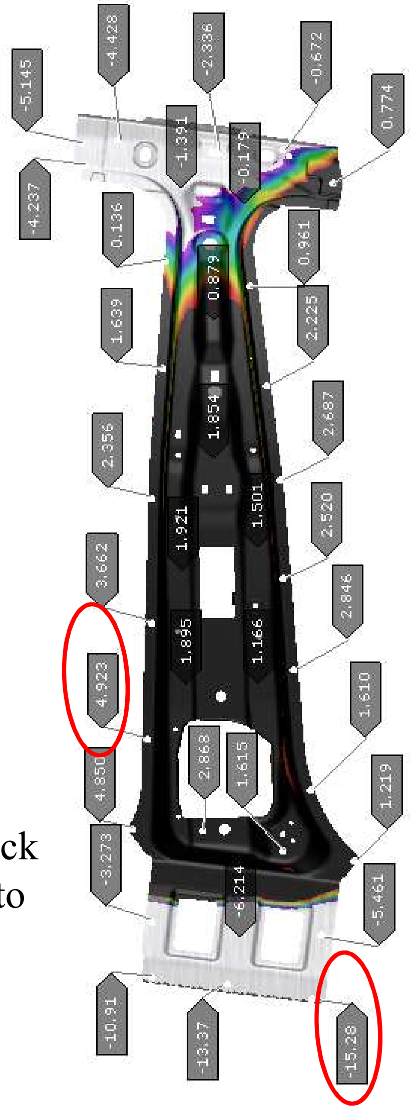
Actual Tensile Strength – 743 MPa

Material Thickness – 1.0 mm

σ_0:	457.5 MPa	n:	0.19
R_m:	743.3 MPa	A_G:	20.4 %

Quality Improvement through feature addition

Initial Spring-back result



Initial Spring back range +4.9 mm to -15.3 mm

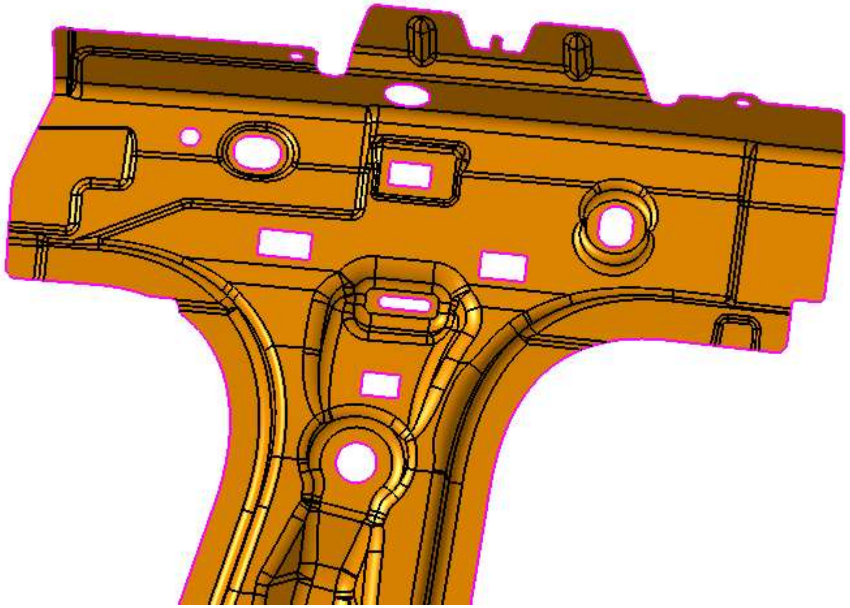
Final Spring-back Result

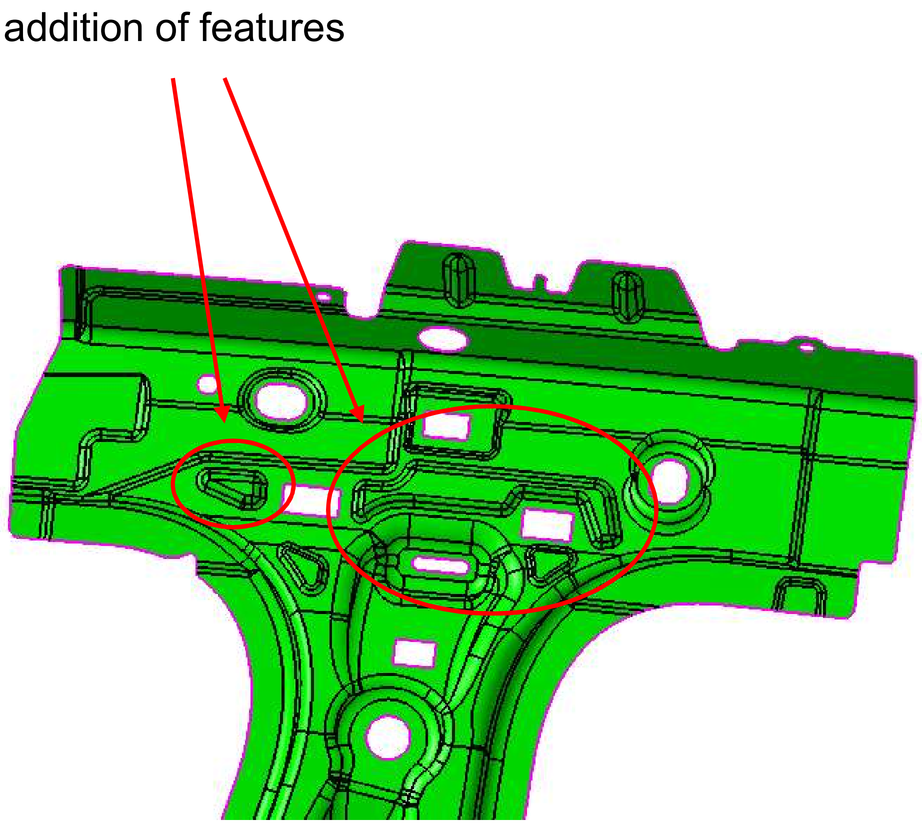
Final Spring-back after compensation is within range of +1.3 mm to -0.7 mm. GTD will further optimize the results during trials.

Quality Improvement through feature addition

Main focus on addition of features in component to control / minimize the springback rather than compensating the springback.

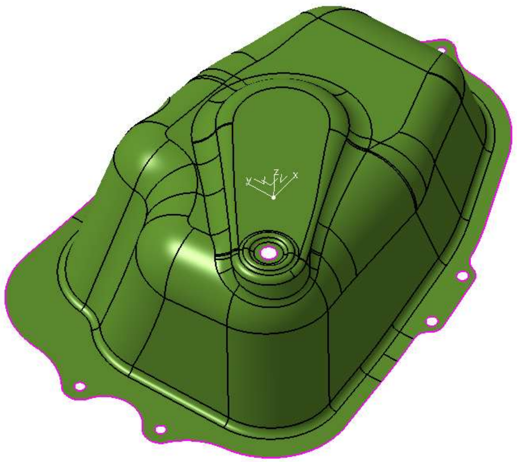
Along with other options we have used same option in GE Stamp B Pillar project to control springback form 19mm to +/-0.8mm in mating zones.





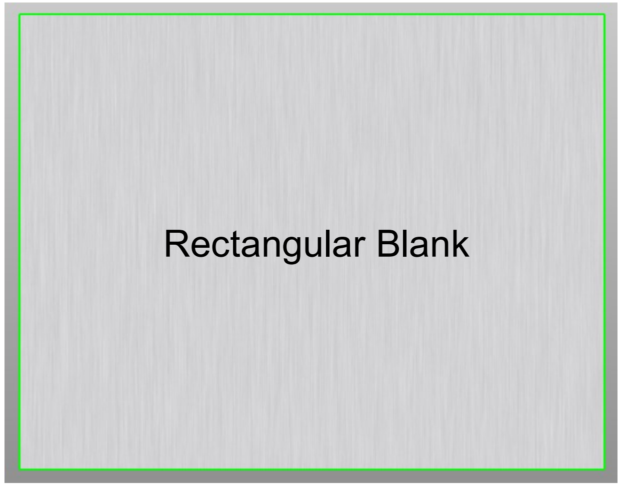
Product design Support & Yield Improvements

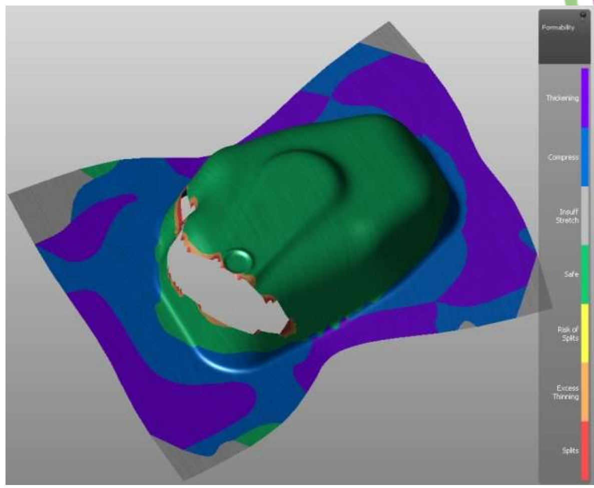
Product Design Inputs For Formable Components



Option – 1

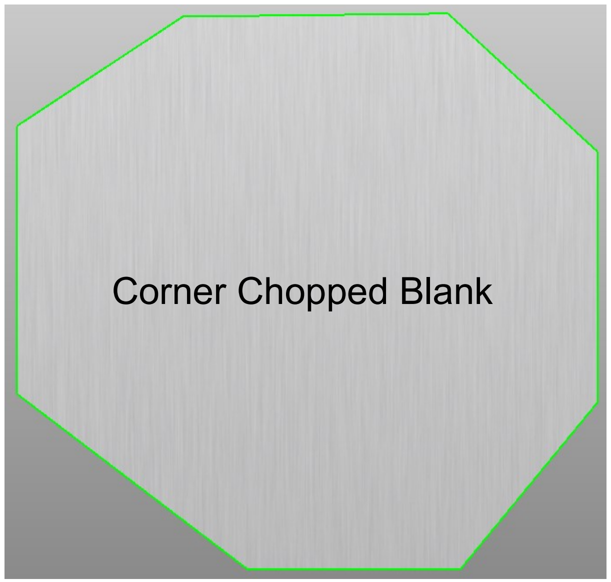
Rectangular Blank

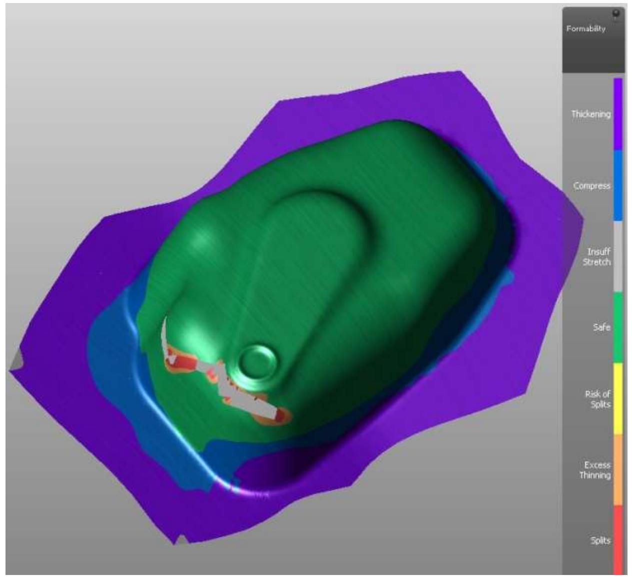




Option – 2

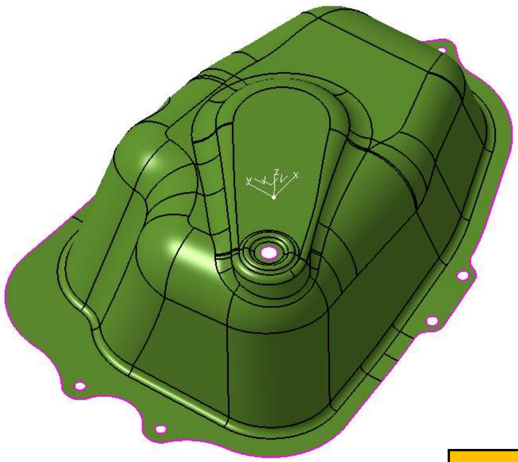
Corner Chopped Blank





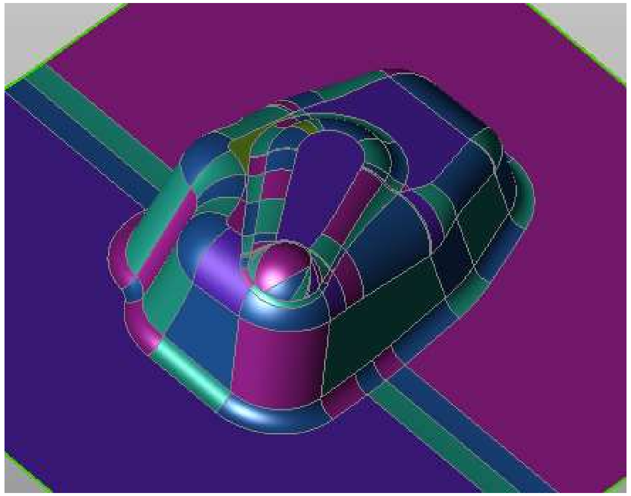
Result : Component cracks with rectangular & corner chopped blanks.

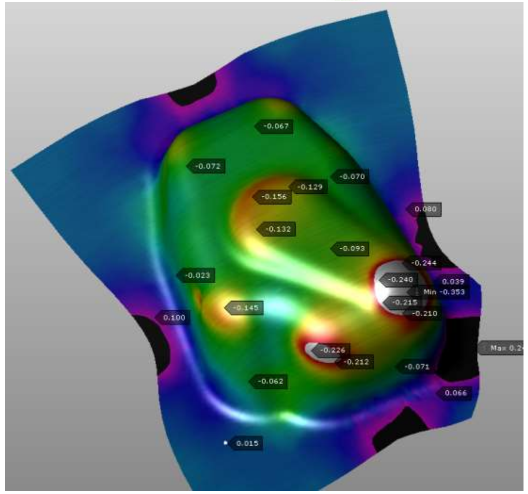
Product Design Inputs For Formable Components



Option – 3

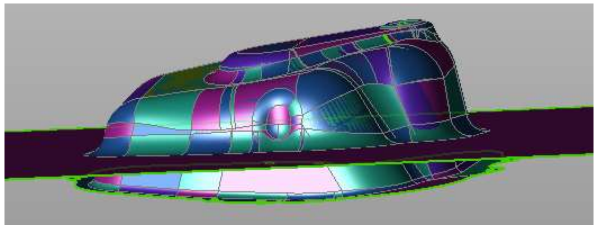
Smooth balloon shape made at first touch point

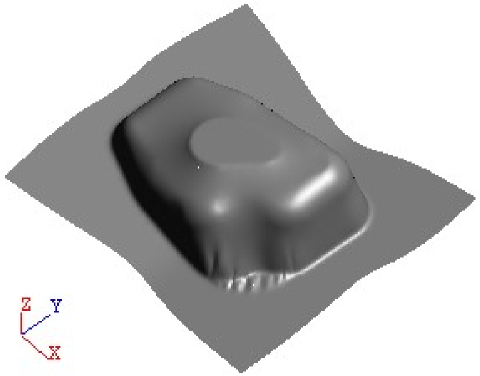


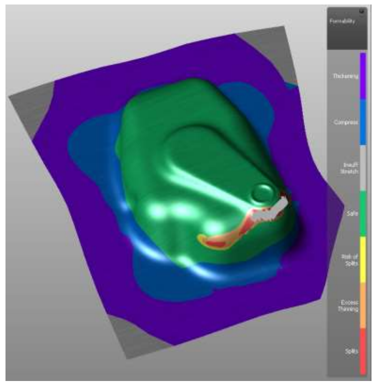


Option – 4

Draw depth reduced





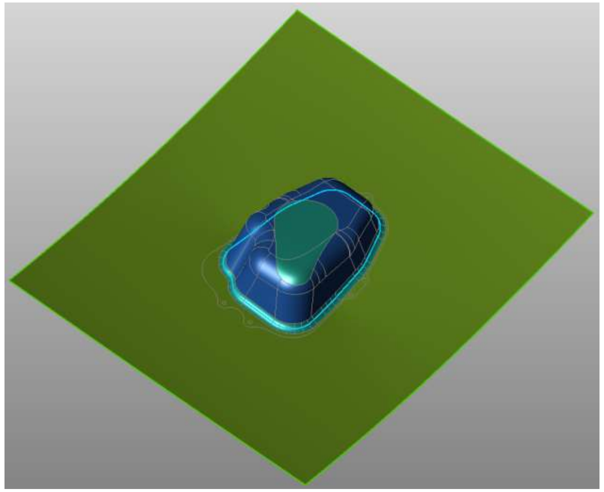


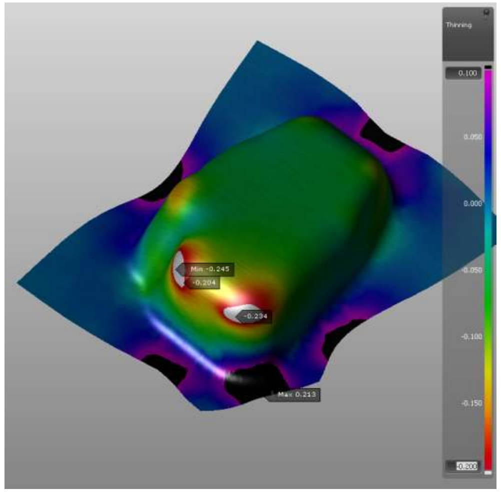
Result : Component cracks with both the options.

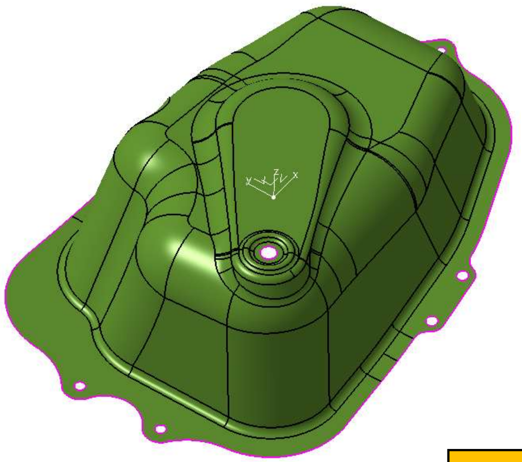
Product Design Inputs For Formable Components

Option – 5

Top high points removed, die radius increased

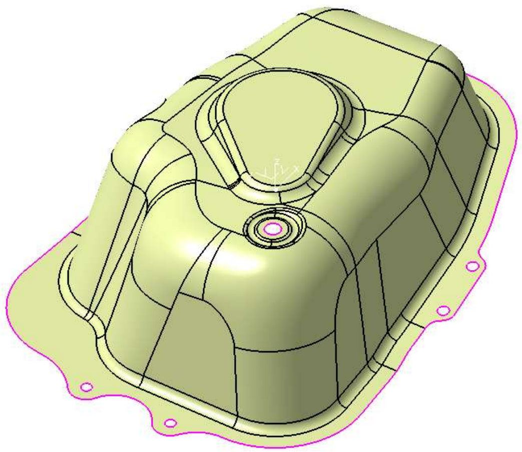


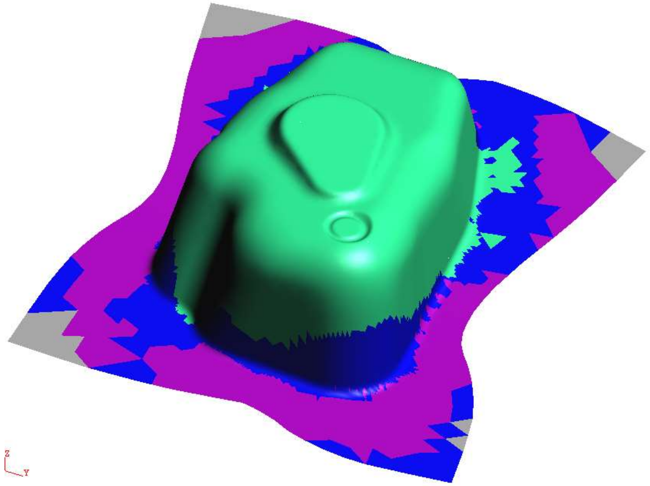




Option – 6

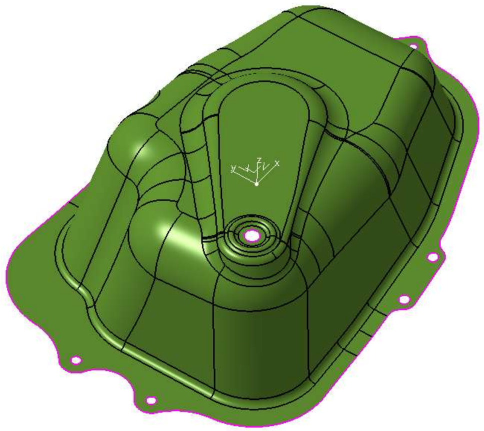
Product changes made



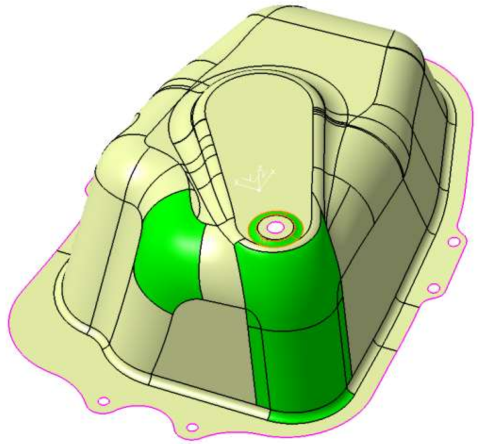


Result : Results improved after product changes.

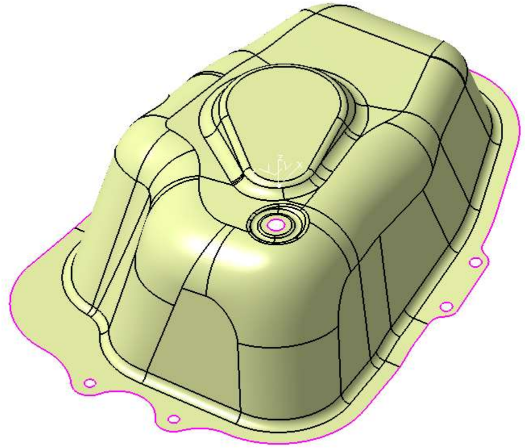
Product Design Inputs For Formable Components – Hero Motors



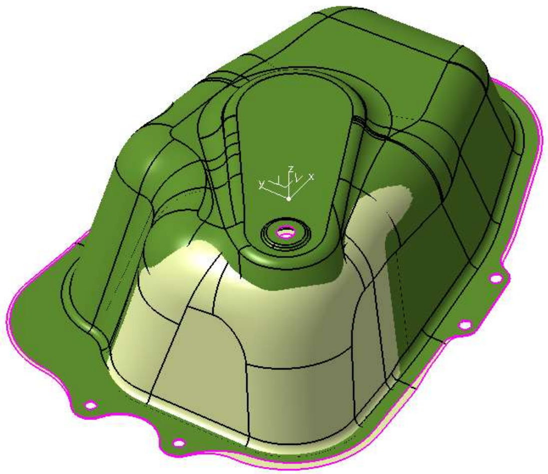
Initial data by HMCL



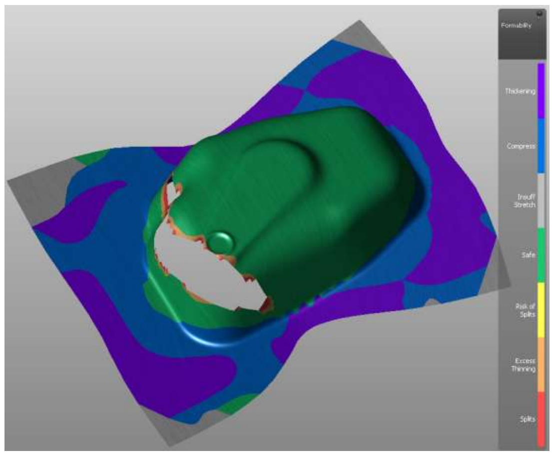
Modified data by HMCL



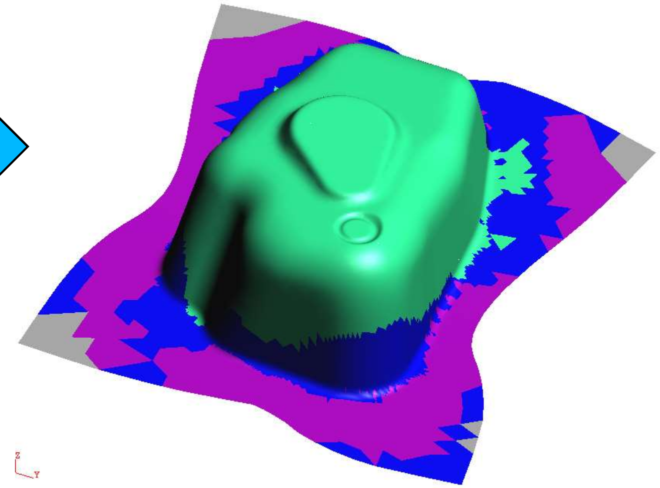
Modified data by Godrej



Data Comparison
HMCL & Godrej

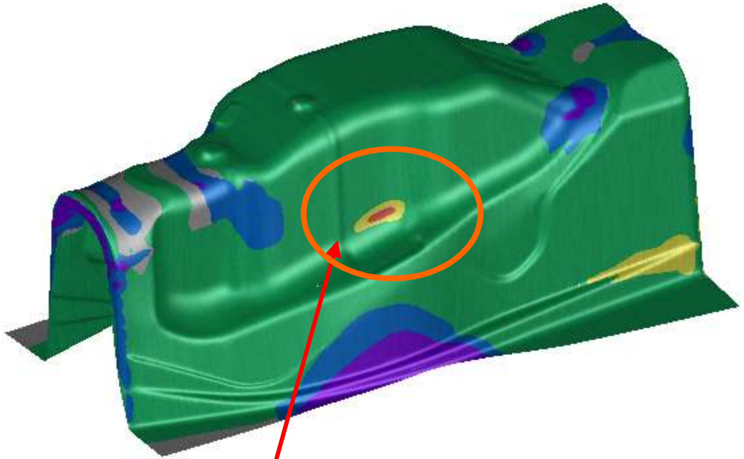


Cracks in initial part data

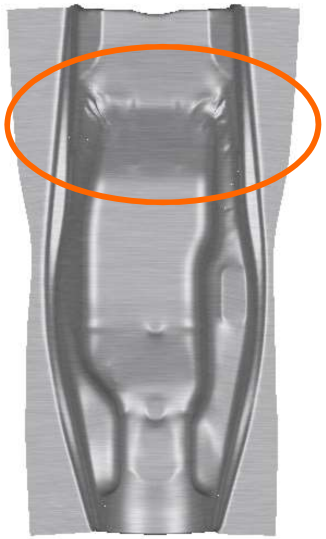


Optimized results with GTD
modified part data

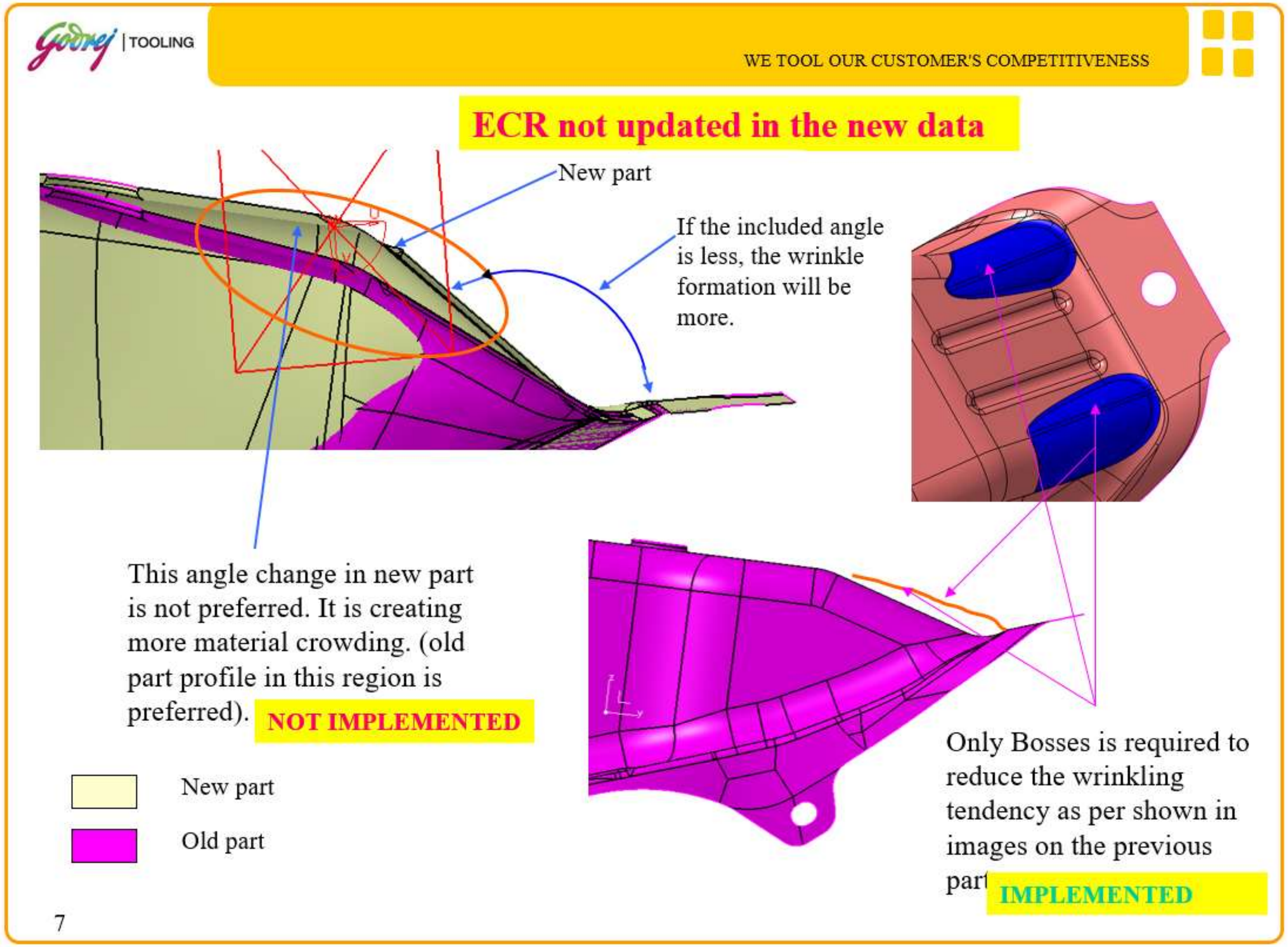
Product Design Inputs For Formable Components - TVS



Cracks and folds are seen

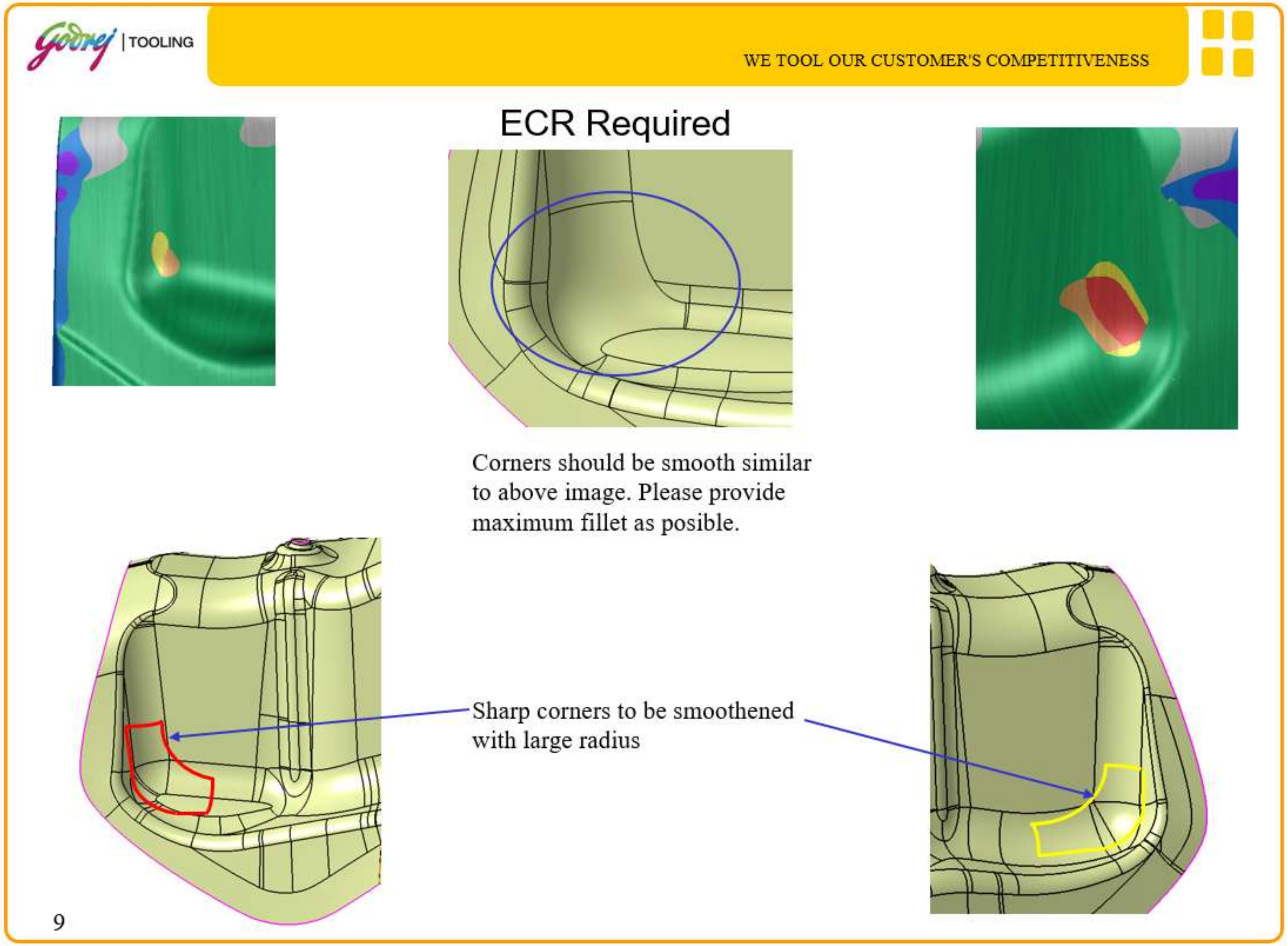


3 mm before BDC



Suggested product changes to control wrinkle and folds.

Product Design Inputs For Formable Components - TVS



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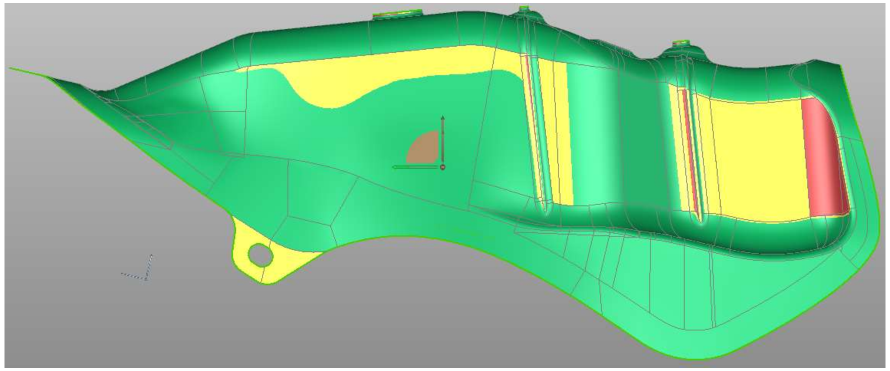
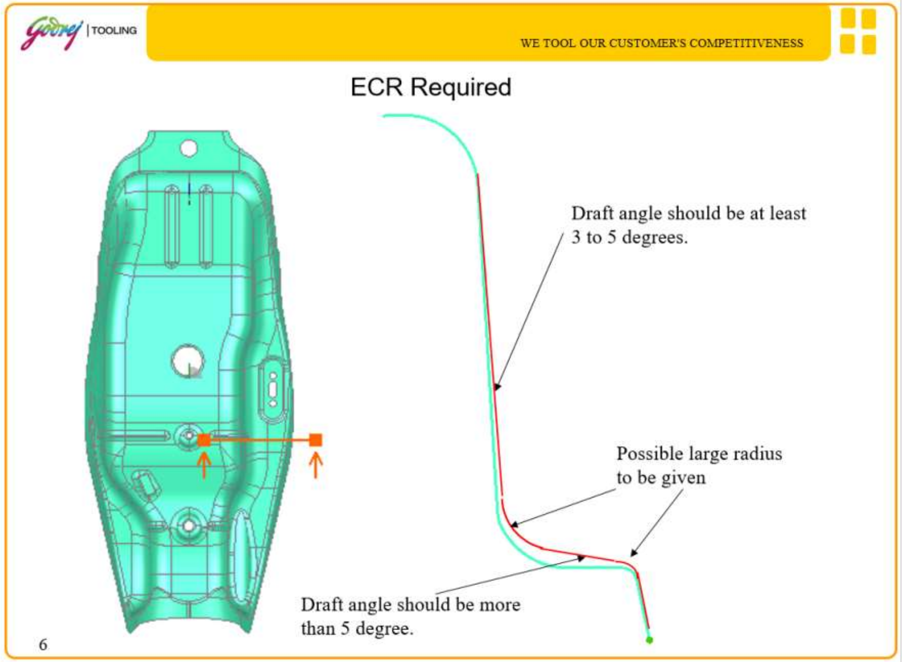
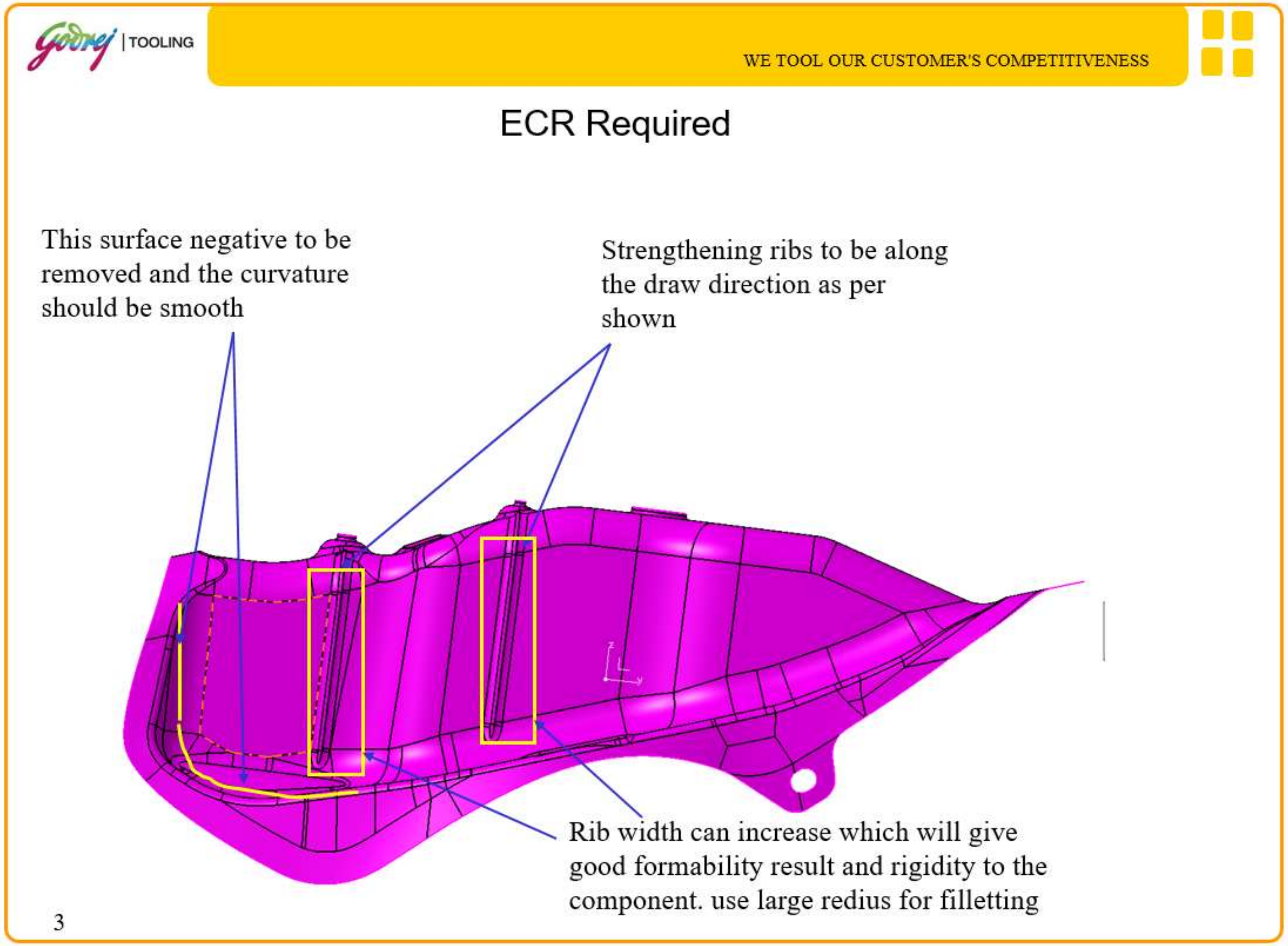
Product Design Inputs For Formable Components - TVS



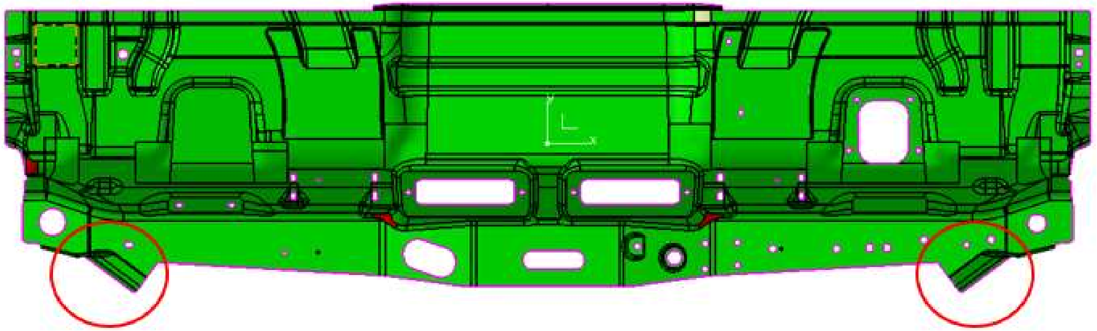
Suggested product changes to control undercut zones.

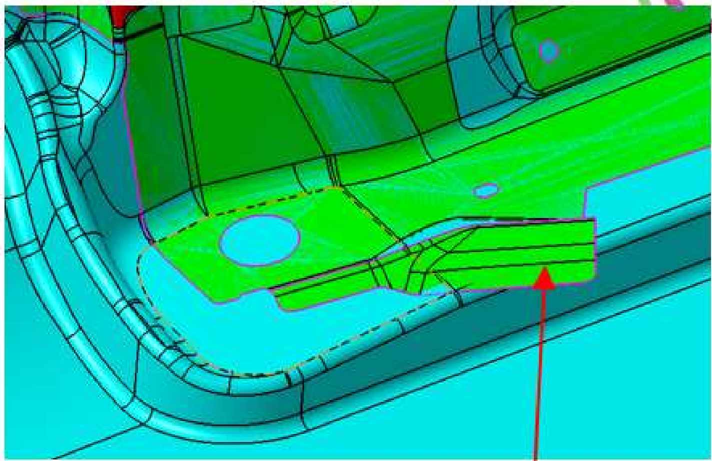


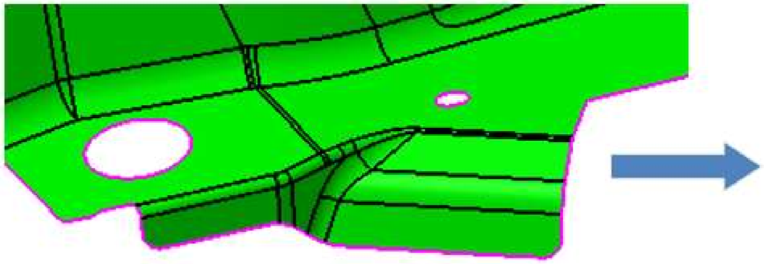


Yield Improvements – M&M

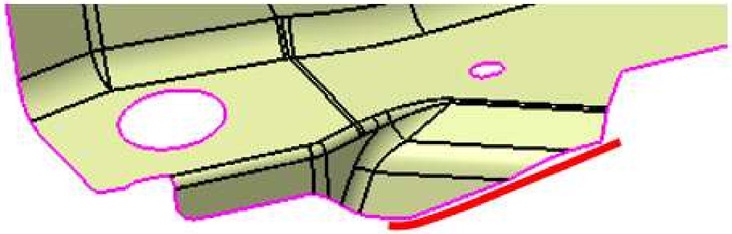
ECR Required - 03







Existing

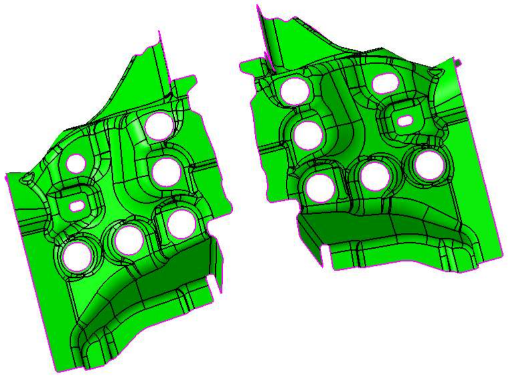


ECR required

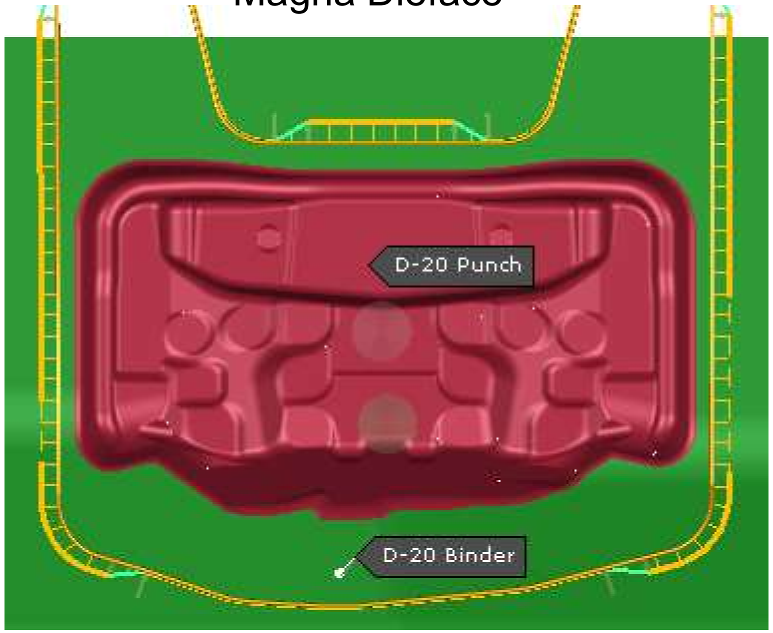
GTD suggests to shorten both flanges.

To accommodate this current flange, addendum needs to be shifted outside. Due to this blank size will increased by at least 35mm & this will reduce the part yield.

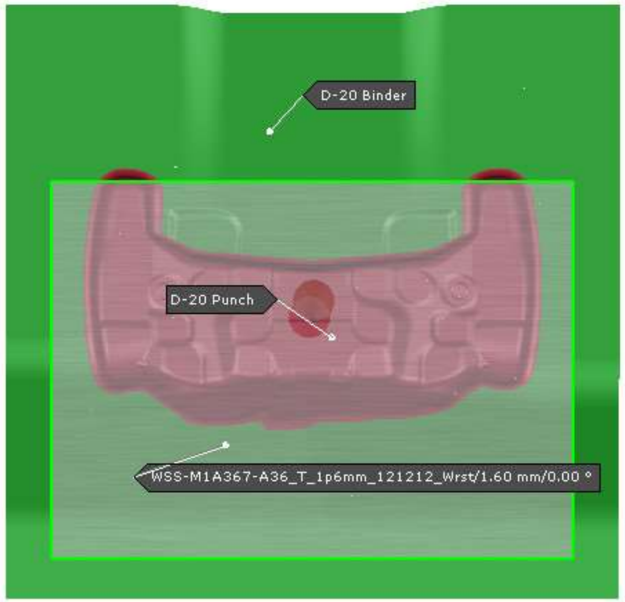
Yield Improvements – Magna Cosma / Ford



Magna Dieface



Godrej Dieface



	Magna Dieface	GTD Dieface
Blank Size	680 x 570 x 1.6 Thk	665 x 480 x 1.6 Thk
Yield	44 %	53.5 %

Material saving per set = 0.86 Kg
Life of a die set for part production = Approx. 10,00,000 nos (One million)

Material Cost saving / million parts (As per GTD process) = 0.86 Kg x Rs 60 per Kg x 10,00,000 = 5,16,00,000 (5.16 Cr Rupees)

Issues with Customer die - Part is having heavy wrinkles

1. Part is proved by resolving all issues in part
2. GTD has improved yield by 9.5%

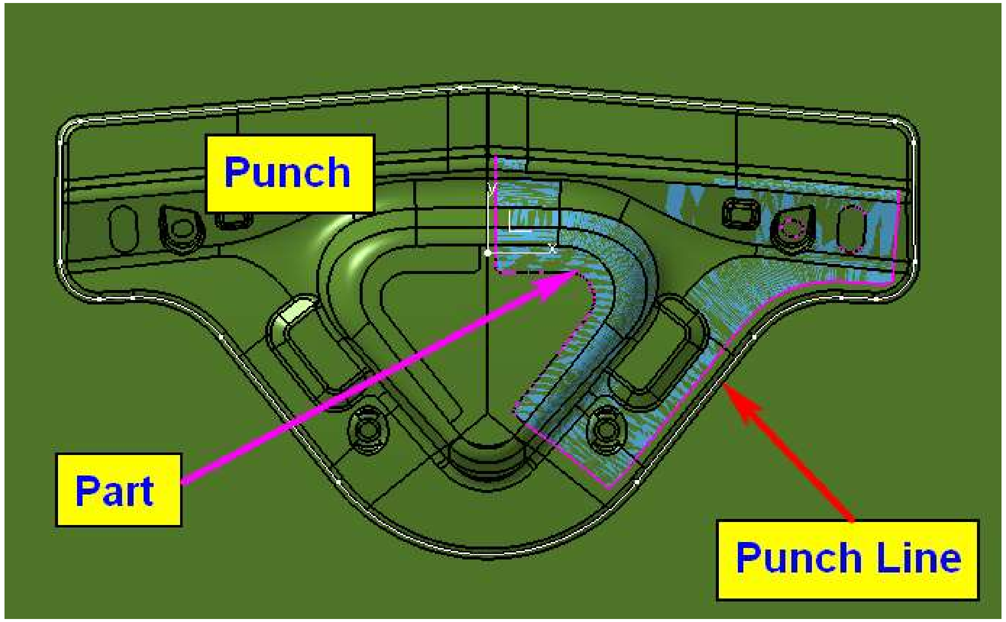
Saving 8,60,000 Kg Steel for lifespan

Yield Improvements – GeStamp / Renault

Option -1

Blank size (LH+RH):- 460 X 892 X 1 Thick

Punch line outside part



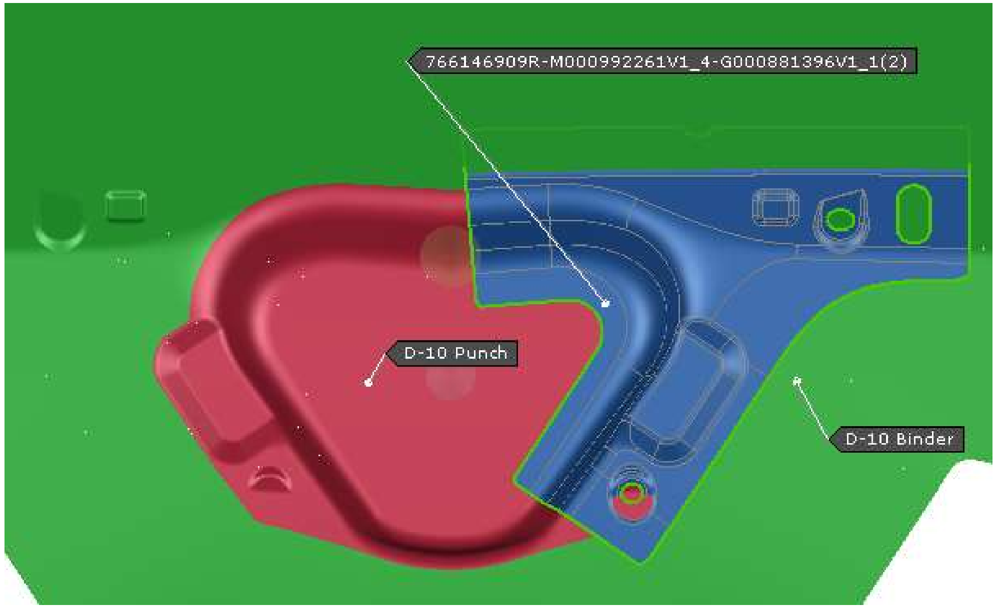
Yield % (With Holes):- 43.4%

Material saving per set = 0.48 Kg
Life of a die set for part production = Approx 10,00,000 nos. (One million)

Option -2

Blank size (LH+RH):- 425 X 820 X 1 Thick

Punch line taken inside part to improve yield



Yield % (With Holes):- 51.1%

With option 2:- GTD has improved yield by 7.7%

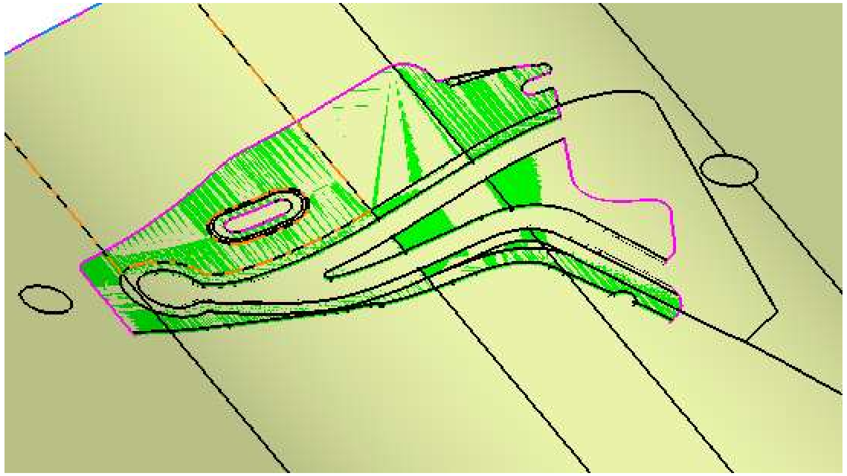
Saving 4,80,000 Kg Steel for lifespan

Yield Improvements - GeStamp / Renault

Option -1

Blank surface area 71675 mm2 (For 1 part)

Draw die face design for one part



Yield % (With Holes):- 52%

Material saving per set = 0.15 Kg
Life of a die set for part production = Approx 10,00,000 nos. (One million)

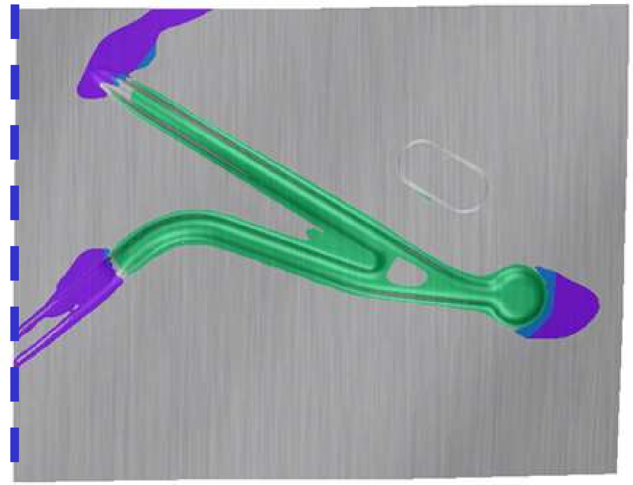
Saving 1,50,000 Kg Steel for lifespan

Option -2

Blank surface area:- 133000mm2(For 2 part)
i.e. 66500mm2/ part

Draw Die face design for two part

Symmetry Line



Yield % (With Holes):- 56%

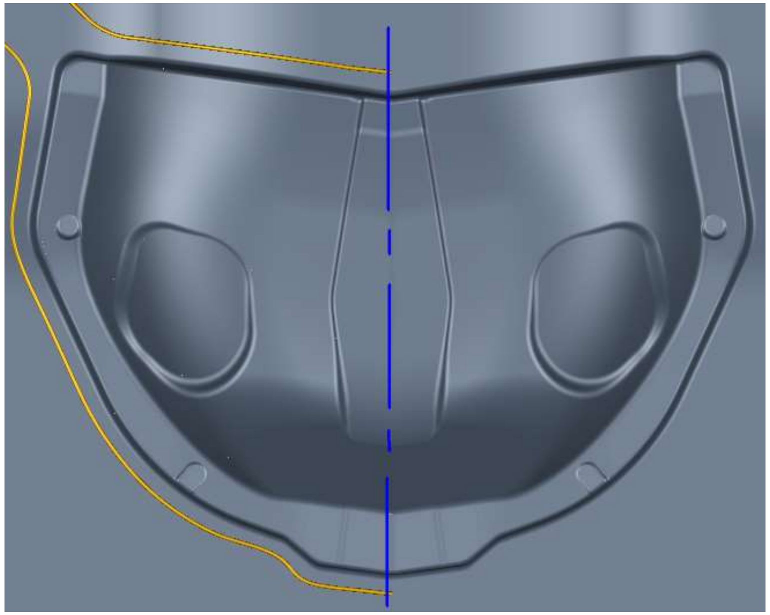
With Option 2:- GTD has improved yield by 4%

Yield Improvements - MSIL

Option -1

Blank size:- 563 X 790 X 0.65 for 2 part

Die face with 2 part out option



Yield %:- 71.2%

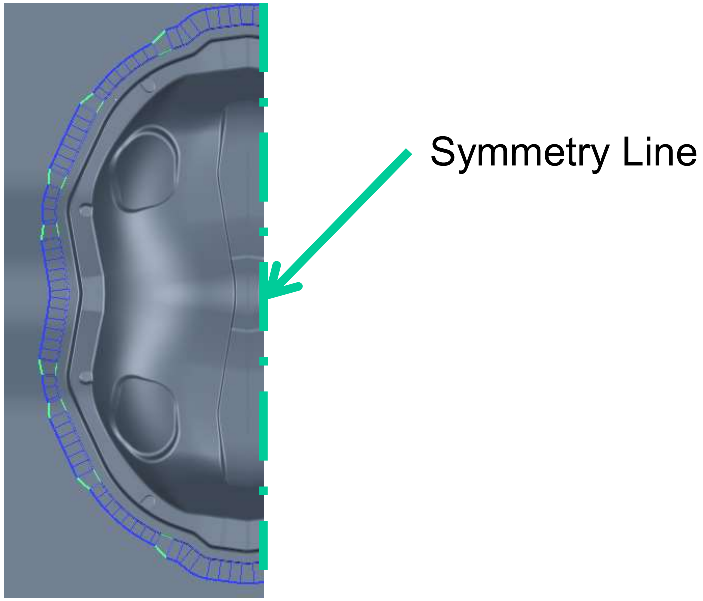
Material saving per set = 0.19 Kg
Life of a die set for part production = Approx 10,00,000 nos. (One million)

Saving 1,90,000 Kg Steel for lifespan

Option -2

Blank size:- 1080 X 790 X 0.65 for 4 part

Die face with 4 part out option



Yield %:- 75.6%

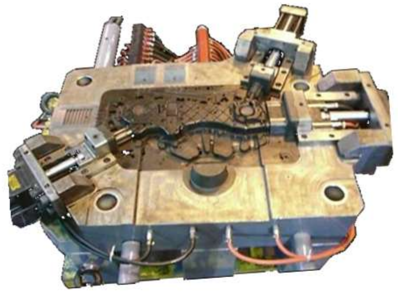
With option 2:- GTD has improved yield by 4.4%

GODREJ TOOLING

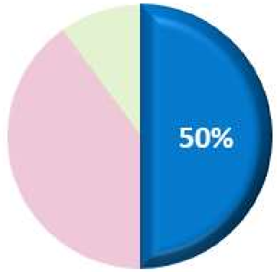
Introduction

Line Of Businesses

Die Casting

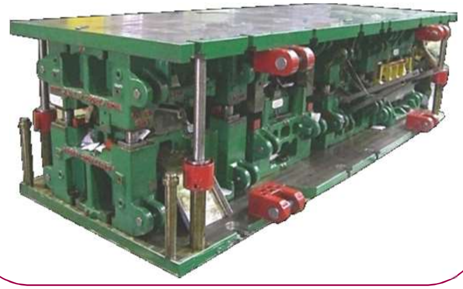


Power Train & Engine Castings for 2-wheelers & 4-wheelers OEM & Foundries

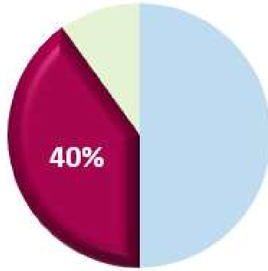


DC Revenue Share

Press Tools



Press tools/stamping dies for OEMs & tier-1 stampers

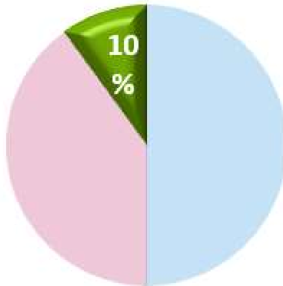


PT Revenue Share

Industrial Machines

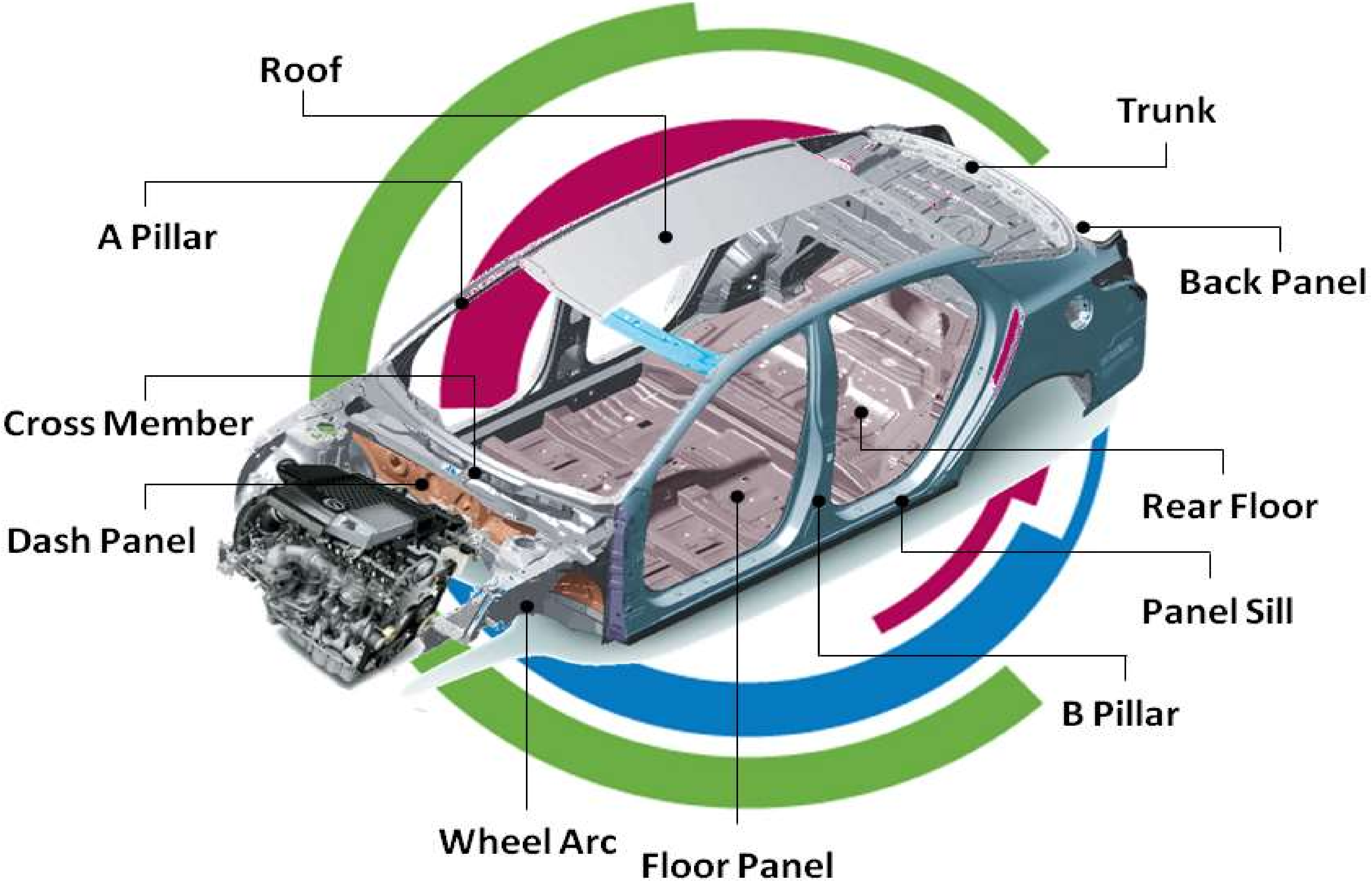
Welding Fixtures for Metros and Railways

Turnkey projects



IM Revenue Share

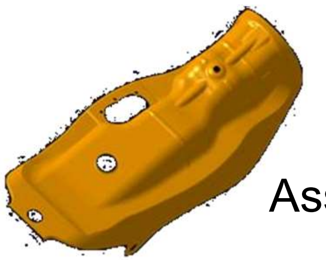
Press Tools Business Portfolio – Four Wheelers



Press Tools Business Portfolio – Two Wheelers

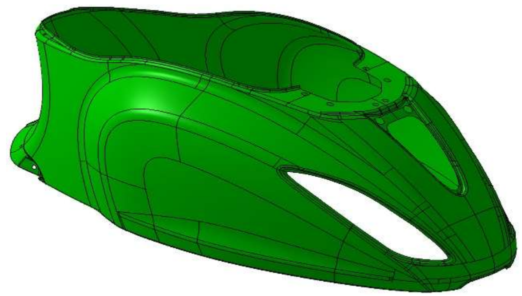
Fuel Tank Outer

Fuel Tank Inner



Assembly of Motorcycle Fuel Tank

Assembly of scooter Fuel Tank



Side Covers

Infrastructure - Tryout

Press Tool Assembly

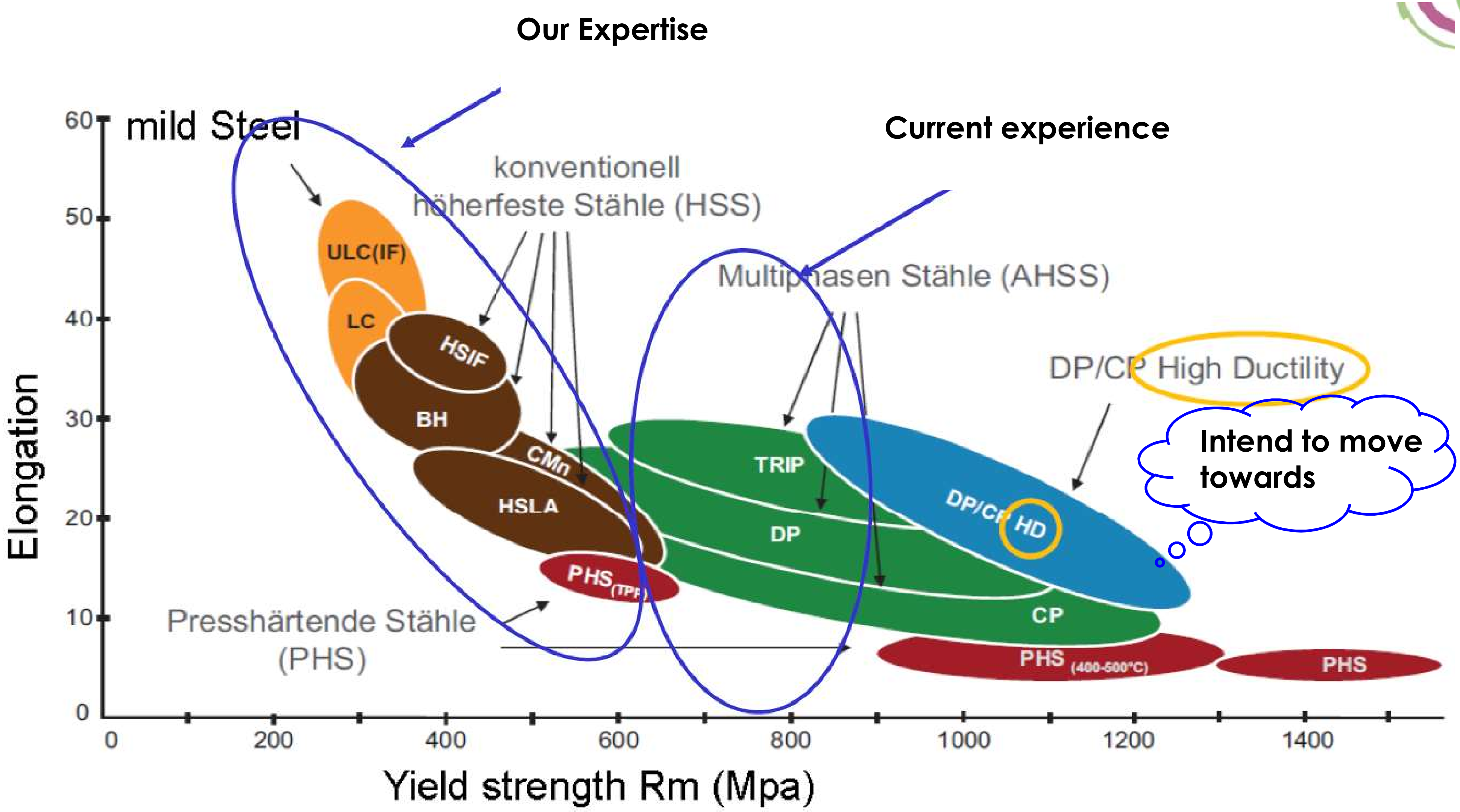
Team
- Toolmakers - 60
- Managers - 5
- Contract – 6

(working in 2 Shifts)

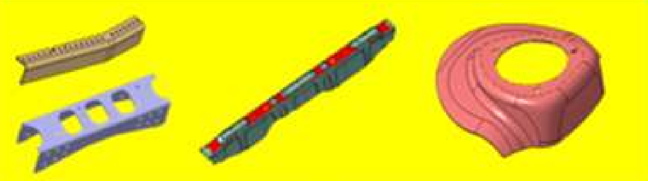
Stamping Tryout

Tryout machines
- Erfurt 800 T Mechanical Press - 2
- HPM Hydraulic Press - 1
- Spotting Press – 2

GT Capabilities – HSS parts – Current / Projected



GT Capabilities – HSS parts – Current / Projected

Steel Categories		GTD's Presense	Tensile Strength (Mpa)	Parts
	Commertial Grade steel	Already present		
HSS	**High strength steel (325 to 590 Mpa)**	Started	325 to 400 Mpa	
			400 to 590 Mpa	
			400 to 590 Mpa	
AHSS	**Advance high strength steels (590 to 1000 Mpa)**	Aming at	590 to 1000 Mpa	
UHSS	**Ultra high strength steels (>1000 Mpa)**	Presently not in strategy	1000 Mpa and above	

Godrej Tooling – First Gold rated Green Co Toolroom

Reduction in energy consumption
Reduction in Sp. Water Consumption
Water positive
Zero Waste to landfill
Waste generation reduction
Reduction in Hazardous & Non. Hazardous Waste
Emphasises on Green Product right from design stage till it is in usage
Ensures all its products are environment compliant

THANK YOU FOR YOUR TIME
AND CONSIDERATION.

Questions ?