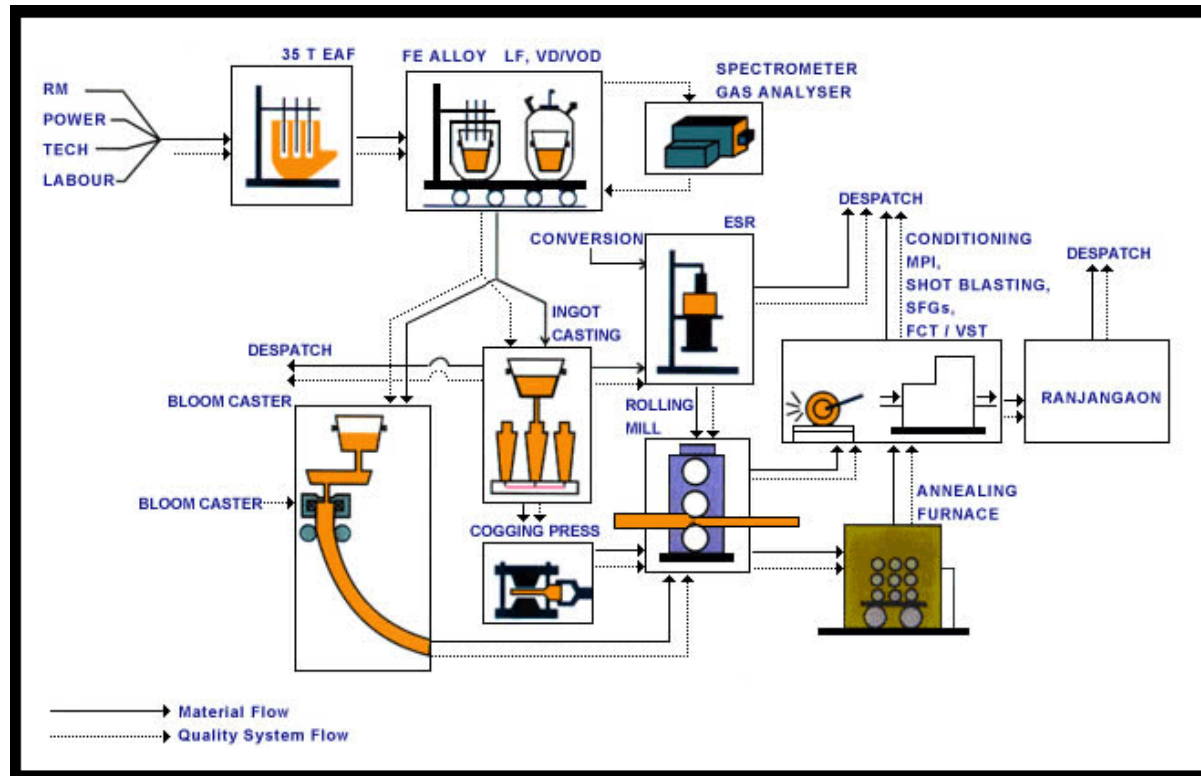


INTEGRATED CASTING AND ROLLING SIMULATION: PROCESS CHAINING APPROACH

Valente ing. Lorenzo – Viscardi ing. Cristian
ECOTRE VALENTE – TECNOLOGIE D'AVANGUARDIA – BRESCIA ITALIA

PROCESSES SIMULATED BY SOFTWARES



ProCAST

CURVE CONTINUOUS
 CASTING

VERTICAL
 C.CASTING

HORIZONTAL
 C.CASTING

INGOT

HEAT
 TREATMENT

DEFORM

ROLLING

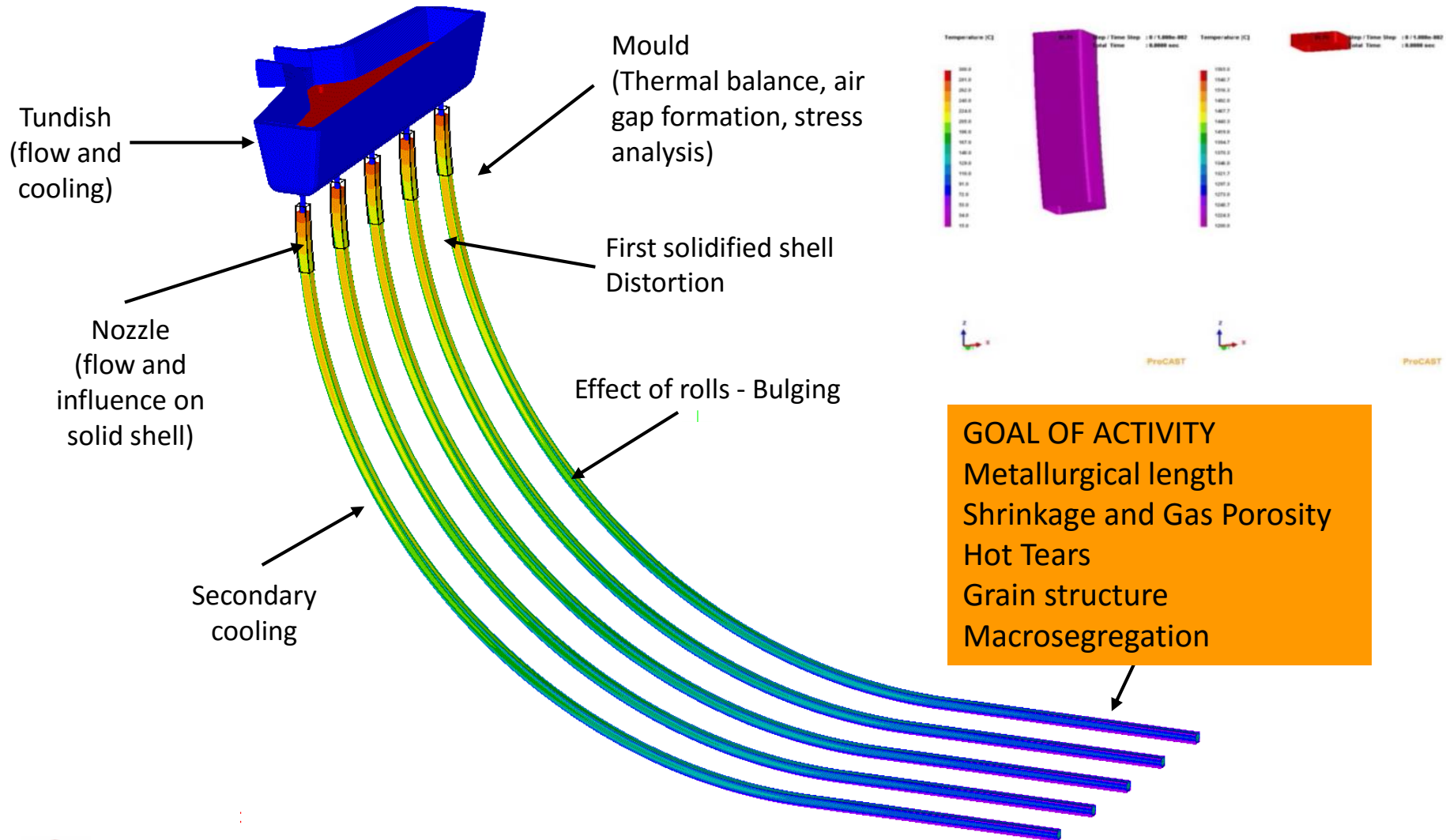
DRAWING

EXTRUSION

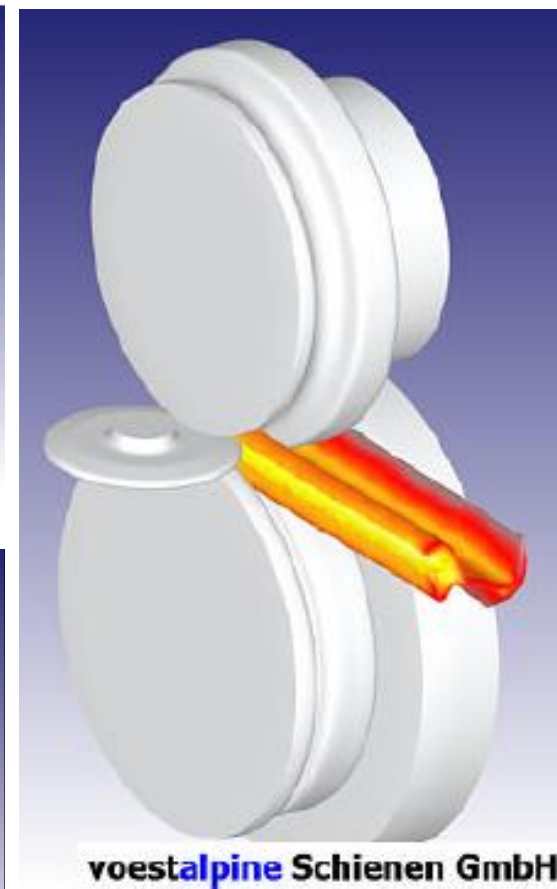
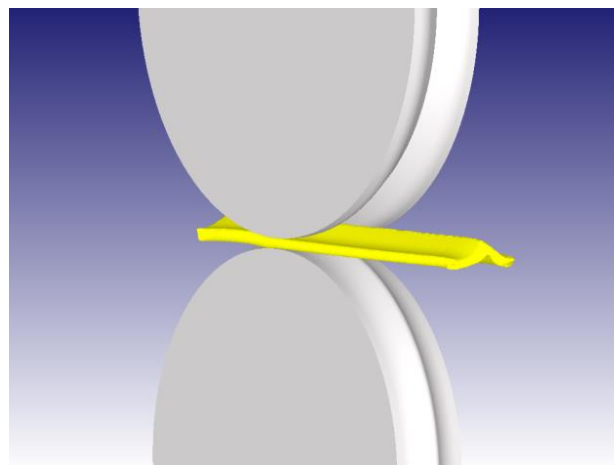
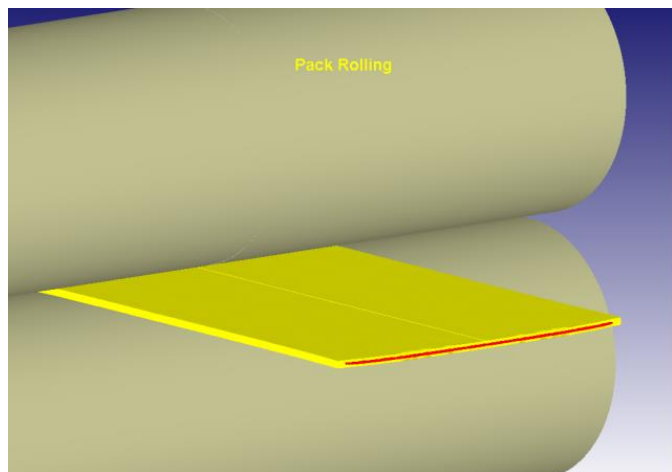
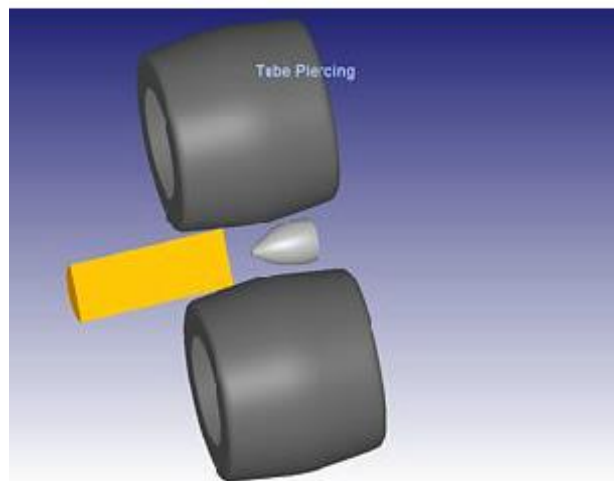
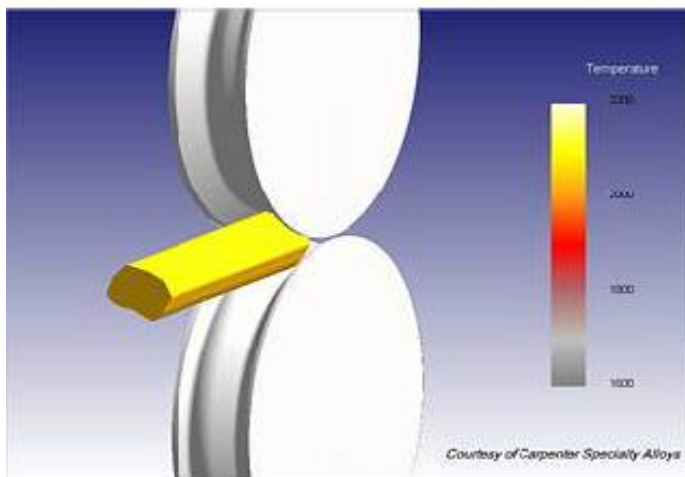
COGGING



CONTINUOUS CASTING SIMULATION



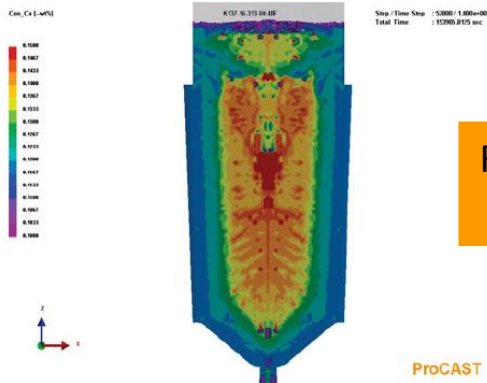
ROLLING SIMULATION



HEAT TREATMENT, MICROSTRUCTURE & GRAIN SIZE

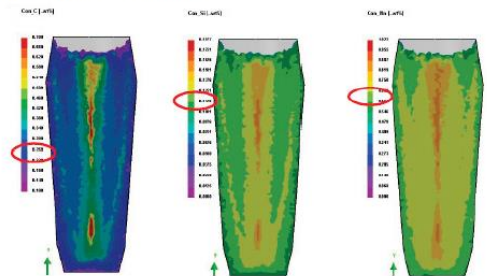
CONTINUOUS CASTING & INGOT SIMULATION

Final Distribution of Cu

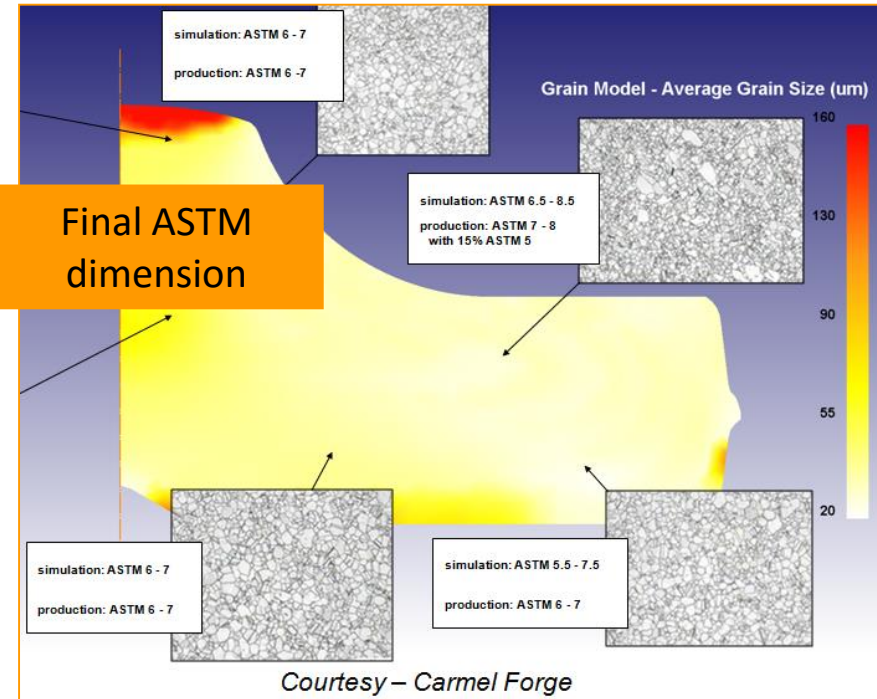


Final distribution
of Cu

Final Distribution of C, Si and Mn



FORGING SIMULATION

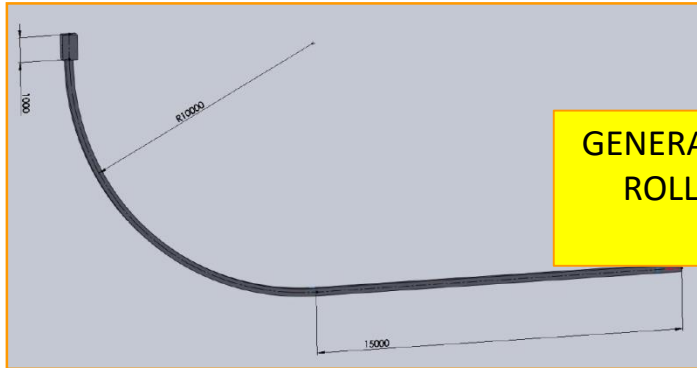


Courtesy – Carmel Forge

MACROSEGREGATION PREDICTION

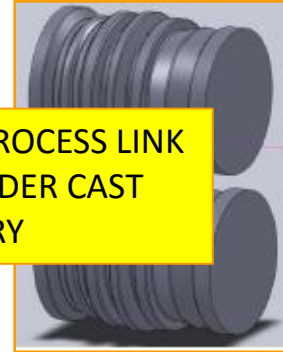
GRAIN SIZE PREDICTION

CASE STUDY

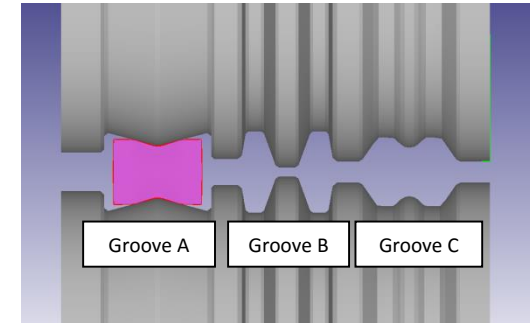


CASTING SIMULATION

GENERAL APPROACH: NO PROCESS LINK
ROLLING DOESN'T CONSIDER CAST
PRODUCT HISTORY



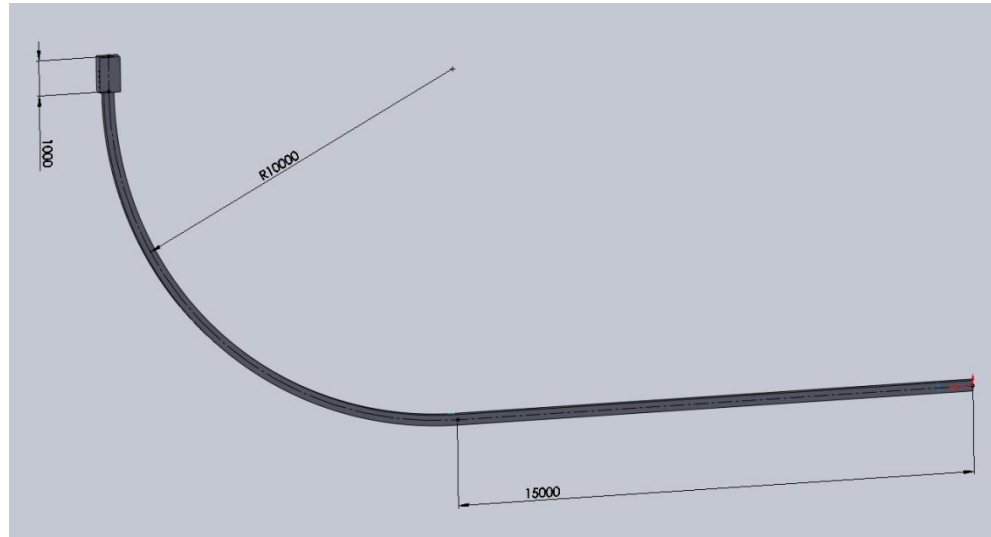
ROLLING SIMULATION



GOAL OF THIS WORK

“PROCESS CHAINING APPROACH”
ROLLING IMPORTS CAST PRODUCT HISTORY

CONTINUOUS CASTING SIMULATION



Steel grade = 42 CrMo4

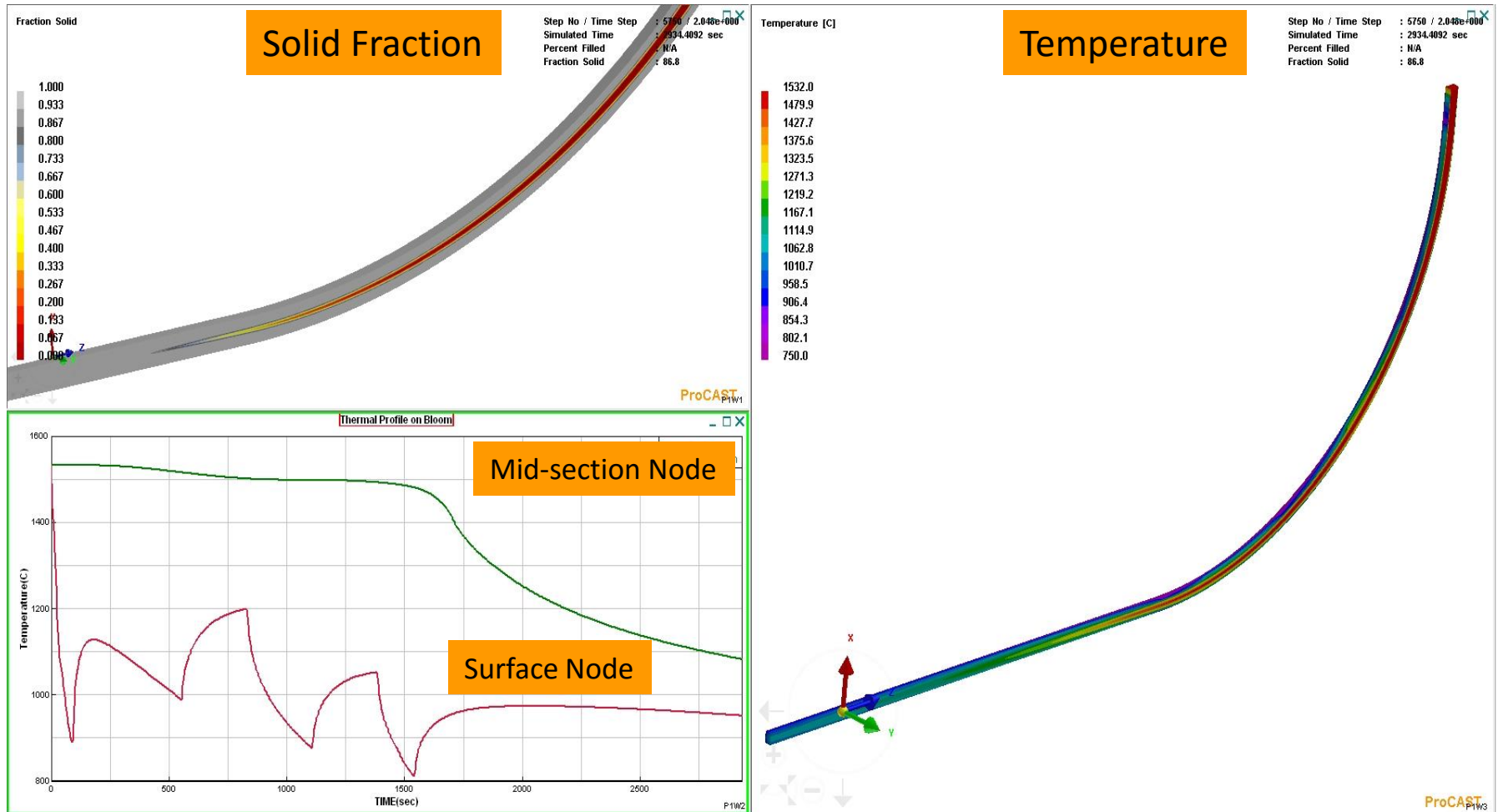
Chemical composition

Element	C	Si	Mn	V	Cr	Ni	Mo
%	0.38	0.23	0.64	0.01	0.99	0.08	0.16

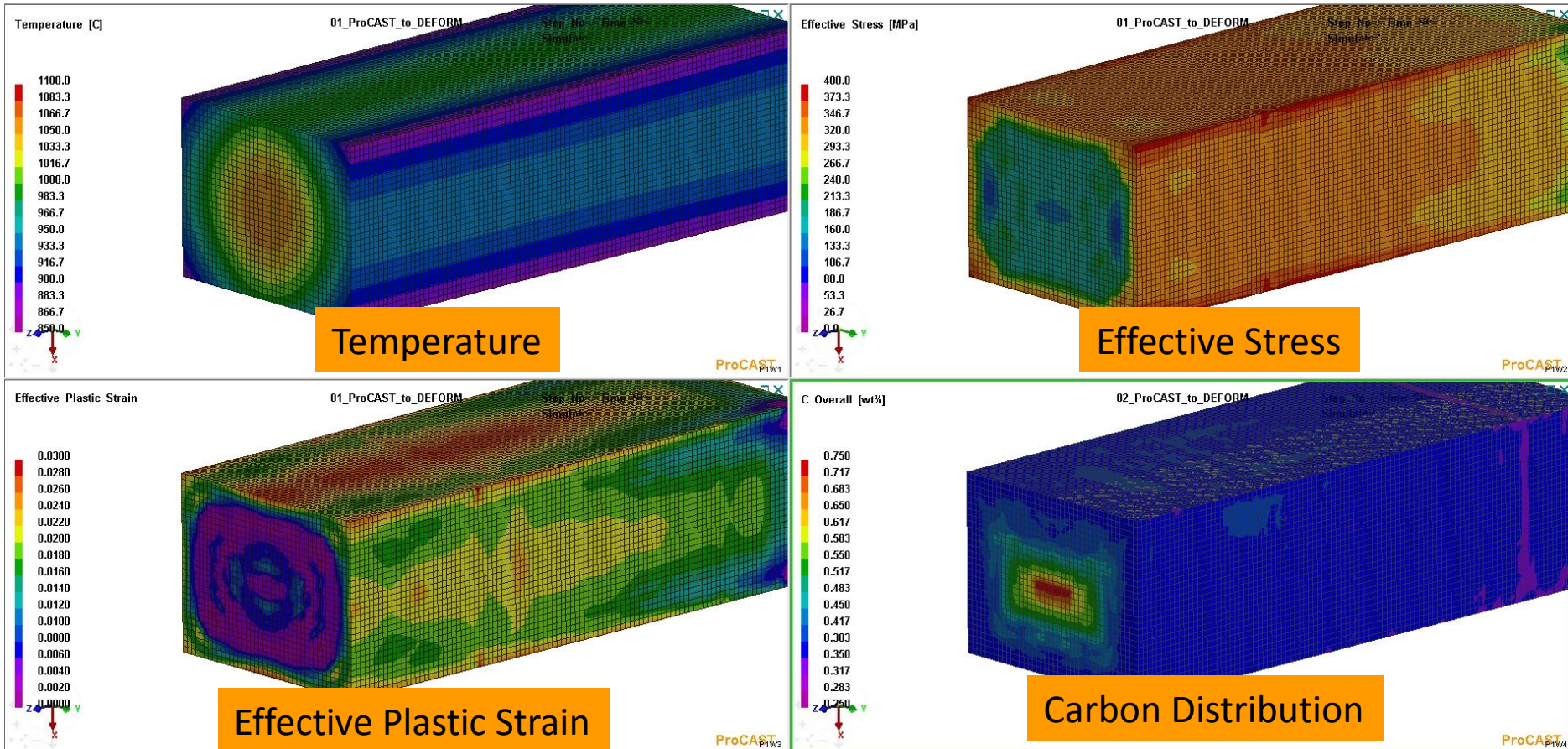
Casting Speed = 650 mm/min

Pouring Temperature = 1532 °C

CONTINUOUS CASTING SIMULATION

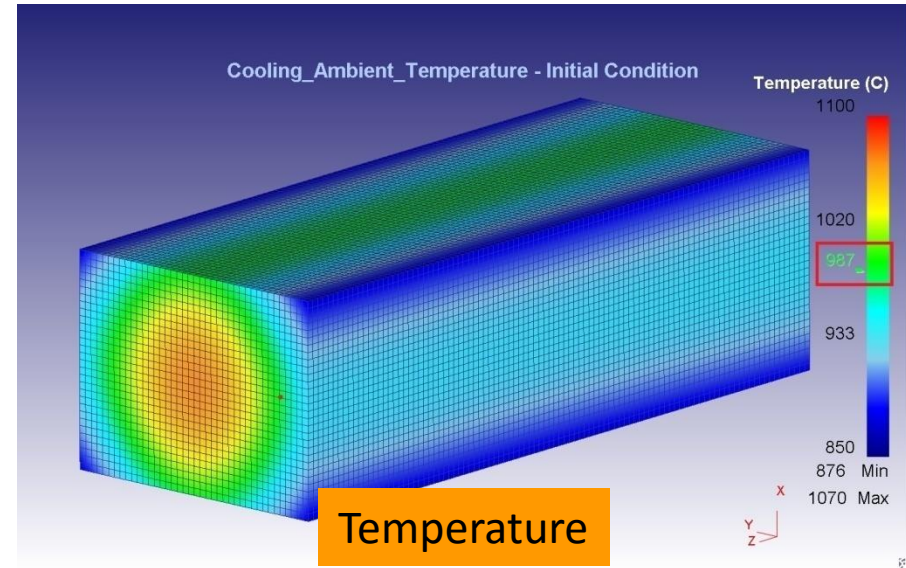
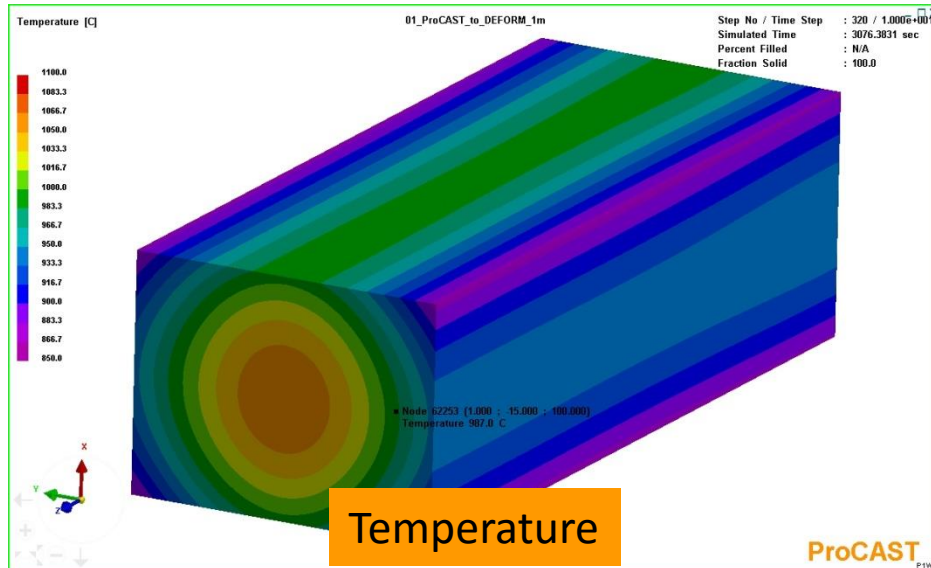


CONTINUOUS CASTING SIMULATION



ProCAST results after cutting operation

PROCESS CHAINING APPROACH



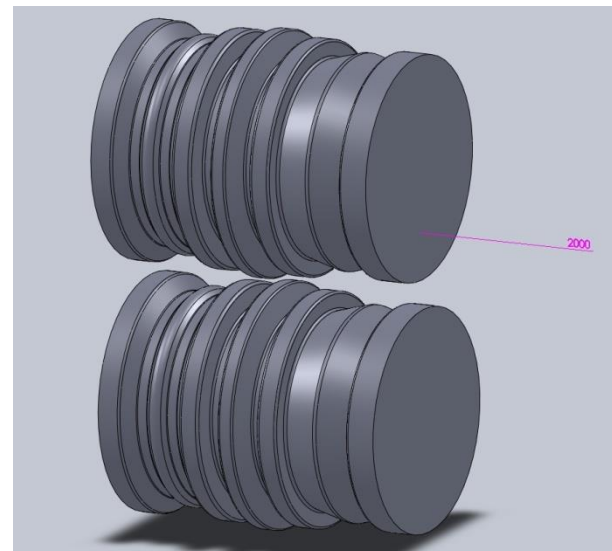
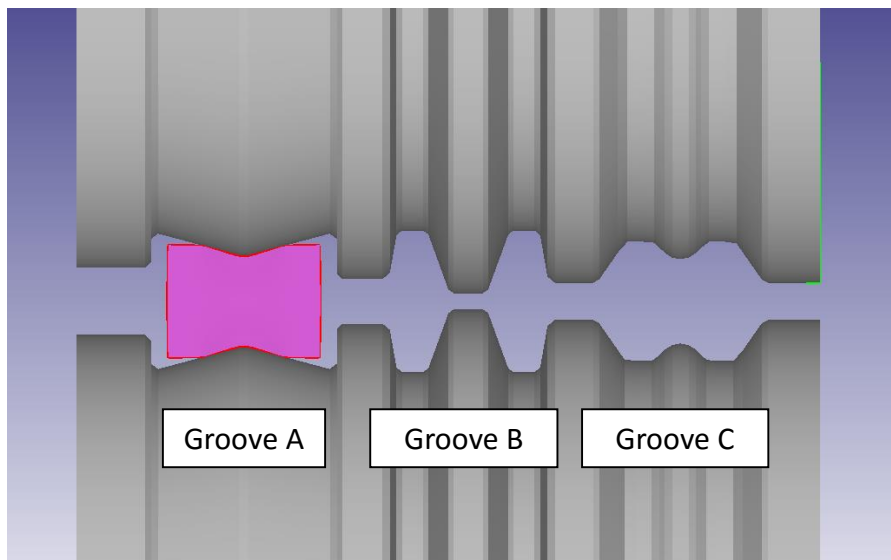
PROCAST
CONTINUOUS CASTING SIMULATION



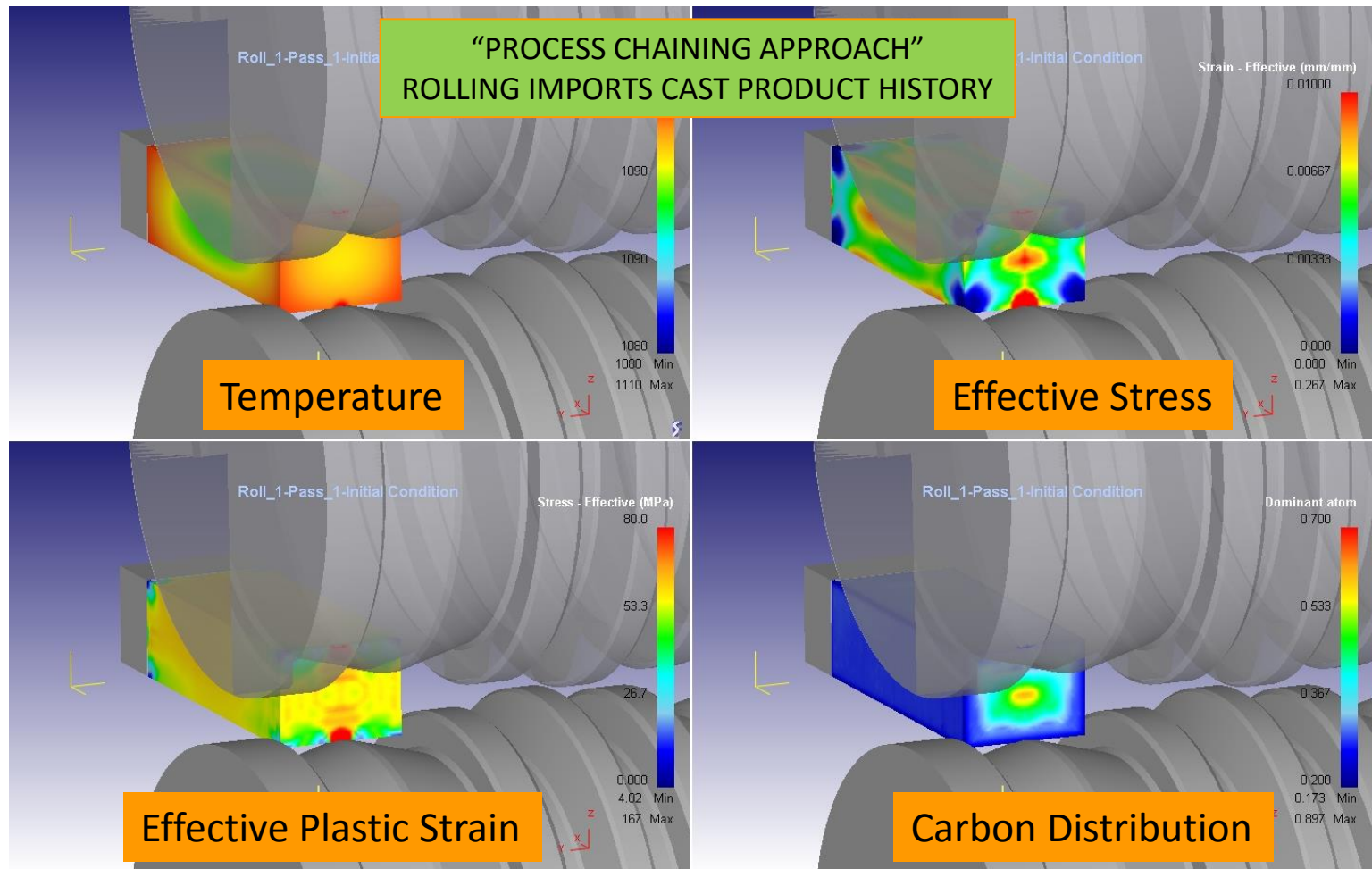
DEFORM
ROLLING SIMULATION

ProCAST shares the same mesh with DEFORM and all results are exported:
Temperature, Stress, Strain and Alloying element Distribution

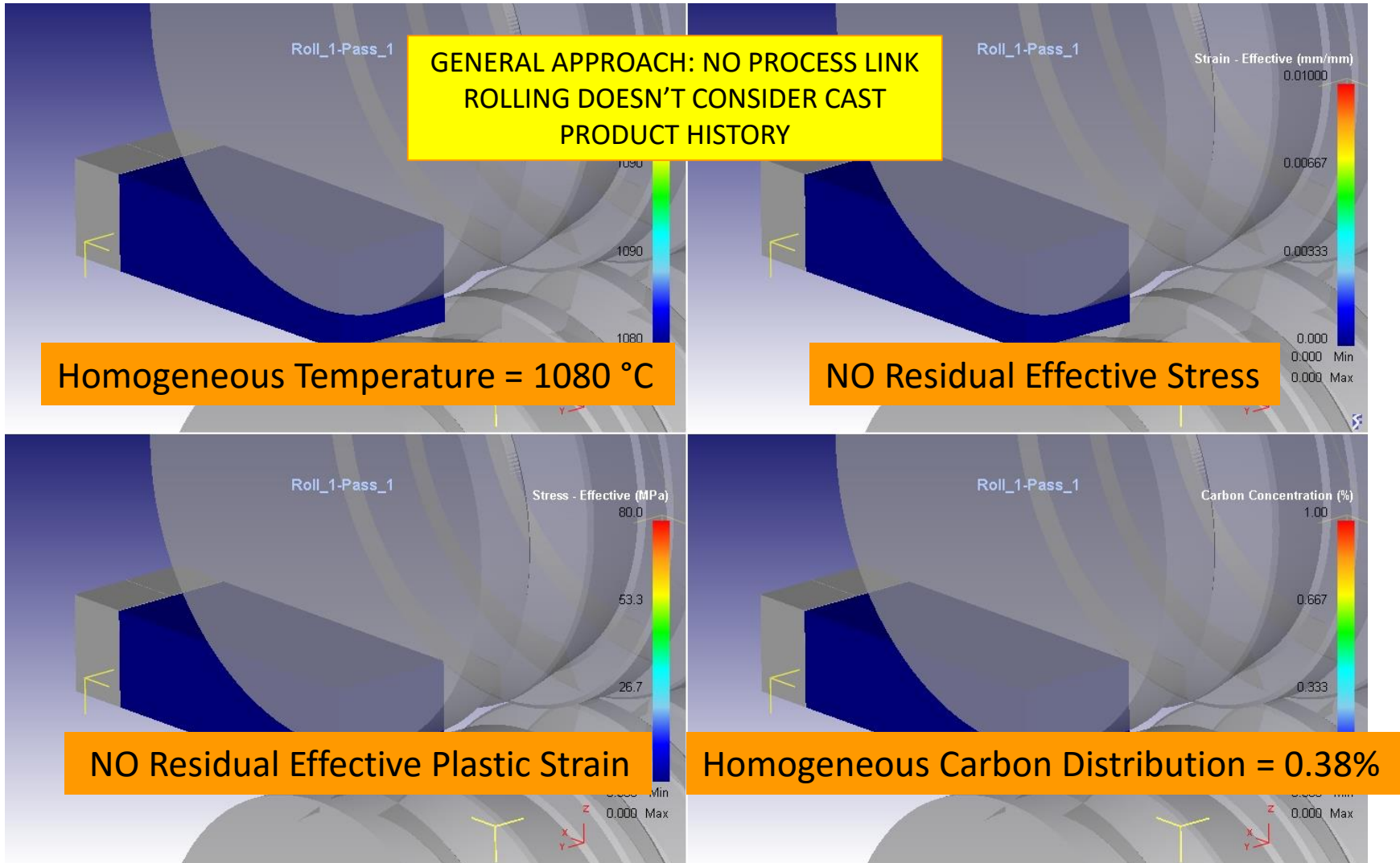
SHAPE ROLLING SIMULATION



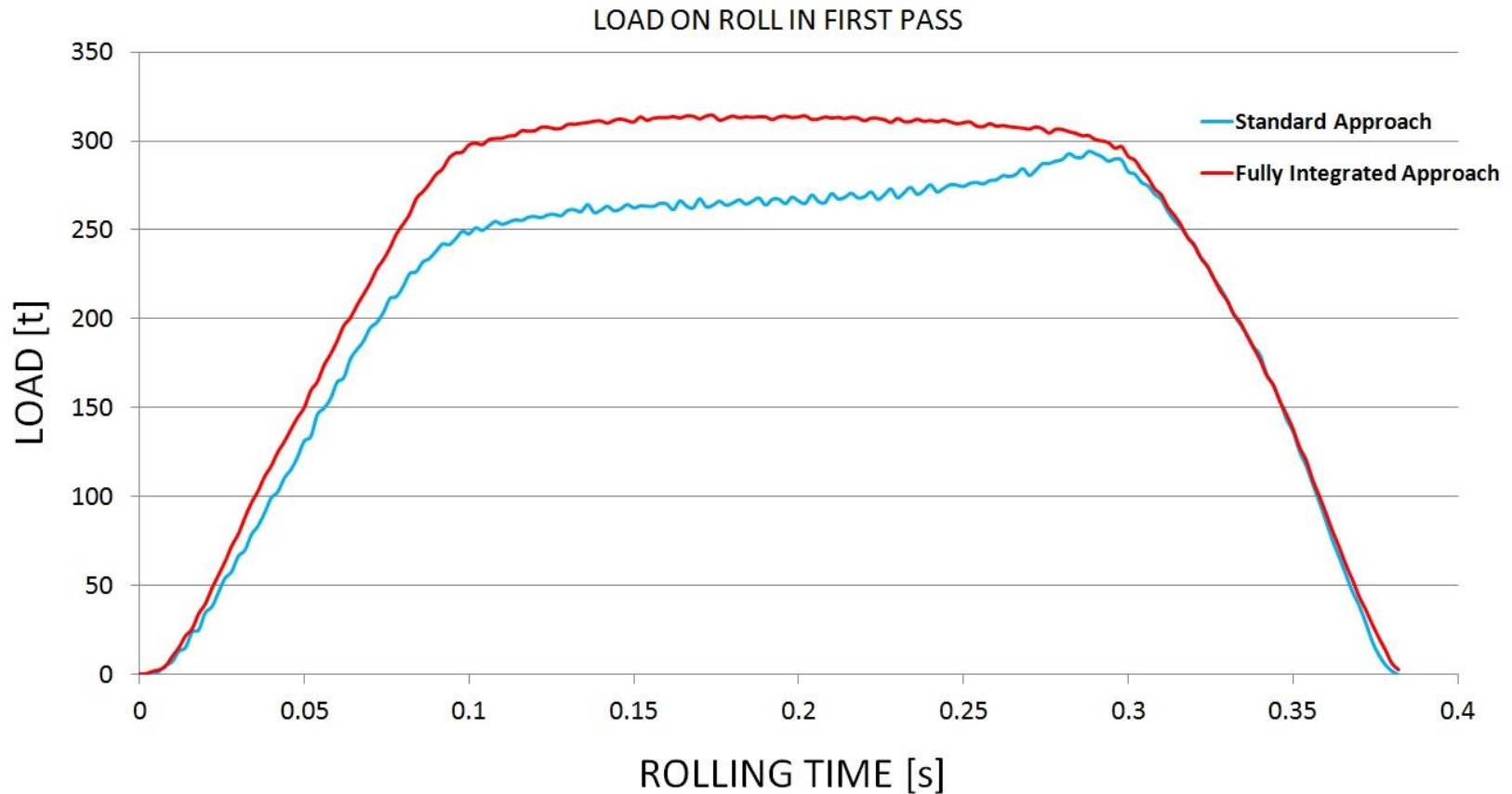
PASS	GROOVE	ROLL GAP [mm]	SPEED [rpm]	INTERVAL TIME [s]
1	A	100	45	7
2	C	100	48	5
3	B	130	47	5
4	C	110	49	5
5	B	110	55	10

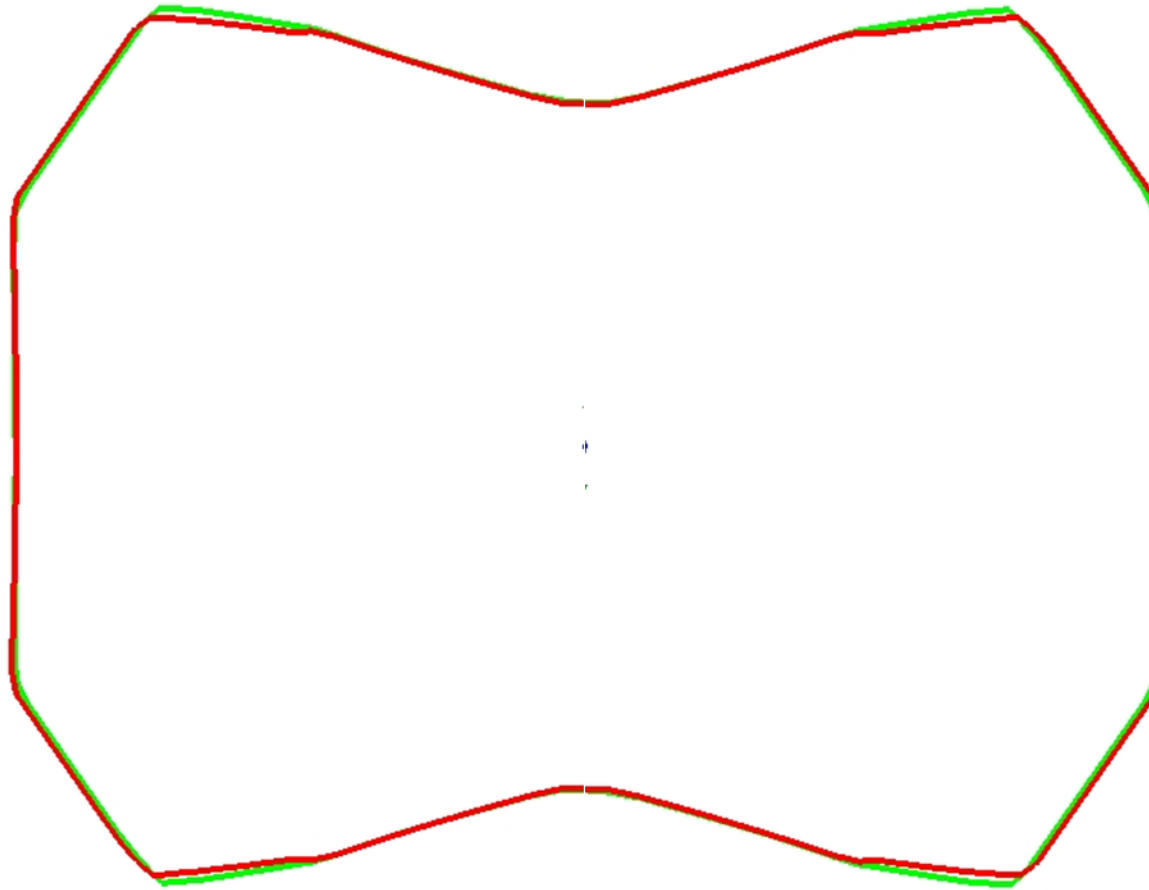


DEFORM Shape Rolling simulation at first pass: Initial State with Process Chaining Approach



DEFORM Shape Rolling simulation at first pass: Initial State without link to Cast Product Properties

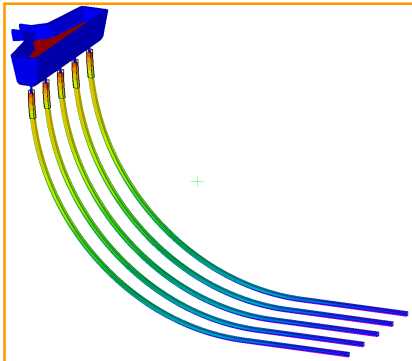




Groove Filling - slice: Standard Approach (Red) VS Process Chaining Approach (Green)

CONCLUSIONS

1. Rolling Simulation with Standard Approach is done using homogeneous value for input data; there are important information about Continuous Casting which get lost, like Residual Stresses and Strains and Alloy Element Distribution
2. New “Process Chaining Approach” wants to takes into account manufacturing operations before Rolling: Continuous Casting, Cooling and Heating Furnace to best fit reality
3. Software ProCAST exports directly mesh and results into DEFORM native format
4. This approach is useful to the Continuous Casting and Rolling industry to increase the quality and the productivity of their plants, processes and products



**“PROCESS CHAINING APPROACH”
ROLLING IMPORTS CAST PRODUCT HISTORY**

