

**Title**

Axial Compressor Rotor Report

Date

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Contents

1. File Report[Table 1](#) File Information for Rotor_37_001**2. Mesh Report**[Table 2](#) Mesh Information for Rotor_37_001[Table 3](#) Mesh Statistics for Rotor_37_001**3. Physics Report**[Table 4](#) Domain Physics for Rotor_37_001[Table 5](#) Boundary Physics for Rotor_37_001[Chart 1](#)[Chart 2](#)[Chart 3](#)[Figure 1](#)[Figure 2](#)[Table 6](#)**4. Tabulated Results**[Table 7](#) Compressor Performance Results[Table 8](#) Summary Data**5. Blade Loading Charts**[Chart 4](#) Blade Loading at 20% Span[Chart 5](#) Blade Loading at 50% Span[Chart 6](#) Blade Loading at 80% Span**6. Streamwise Charts**[Chart 7](#) Streamwise Plot of Pt and P[Chart 8](#) Streamwise Plot of Tt and T[Chart 9](#) Streamwise Plot of Absolute and Relative Mach Number[Chart 10](#) Streamwise Plot of Static Entropy**7. Spanwise Charts**[Chart 11](#) Spanwise Plot of Alpha and Beta at LE[Chart 12](#) Spanwise Plot of Relative Mach Number at LE[Chart 13](#) Spanwise Plot of Alpha and Beta at TE[Chart 14](#) Spanwise Plot of Relative Mach Number at TE[Chart 15](#) Spanwise Plot of Absolute Mach Number at TE[Chart 16](#) Spanwise Plot of Meridional Velocity at TE**8. Blade Geometry Plots**[Figure 3](#) Isometric 3D View of the Blade, Hub and Shroud[Figure 4](#) Meridional View of the Blade, Hub and Shroud**9. Blade Mesh Plot**[Figure 5](#) Mesh Elements at 50% Span**10. Blade to Blade Plots**[Figure 6](#) Contour of M rel at 20% Span[Figure 7](#) Contour of M rel at 50% Span[Figure 8](#) Contour of M rel at 80% Span[Figure 9](#) Velocity Vectors at 20% Span[Figure 10](#) Velocity Vectors at 50% Span[Figure 11](#) Velocity Vectors at 80% Span

[Figure 12](#) Contour of s at 20% Span

[Figure 13](#) Contour of s at 50% Span

[Figure 14](#) Contour of s at 80% Span

[11. Meridional Plots](#)

[Figure 15](#) Contour of Mass Averaged P on Meridional Surface

[Figure 16](#) Contour of Mass Averaged M rel on Meridional Surface

[Figure 17](#) Vector of Area Averaged Cm on Meridional Surface

[12. Circumferential Plots](#)

[Figure 18](#) Contour of P at Blade LE

[Figure 19](#) Contour of M rel at Blade LE

[Figure 20](#) Contour of s at Blade LE

[Figure 21](#) Contour of P at Blade TE

[Figure 22](#) Contour of M rel at Blade TE

[Figure 23](#) Contour of s at Blade TE

[13. Streamline Plot](#)

[Figure 24](#) Velocity Streamlines at Blade TE

1. File Report

Table 1. File Information for Rotor_37_001

Case	Rotor_37_001
File Path	C:/Users/Learn CAE/Desktop/Chapter_2_Axial compressor analysis/Rotor_37_001.res
File Date	18 August 2023
File Time	11:22:45 AM
File Type	CFX5
File Version	23.1

2. Mesh Report

Table 2. Mesh Information for Rotor_37_001

Domain	Nodes	Elements
R1	158309	147882

Table 3. Mesh Statistics for Rotor_37_001

Domain	Maximum Edge Length Ratio
R1	235.171

3. Physics Report

Table 4. Domain Physics for Rotor_37_001

Domain - R1	
Type	Fluid
Location	Passage
<i>Materials</i>	
Air Ideal Gas	
Fluid Definition	Material Library
Morphology	Continuous Fluid
<i>Settings</i>	
Buoyancy Model	Non Buoyant
Domain Motion	Rotating
Alternate Rotation Model	true
Angular Velocity	1.7189e+4 [rev min^-1]
Axis Definition	Coordinate Axis
Rotation Axis	Coord 0.1
Reference Pressure	0.0000e+0 [atm]
Heat Transfer Model	Total Energy
Include Viscous Work Term	True
Turbulence Model	k epsilon
Turbulent Wall Functions	Scalable
High Speed Model	Off
Domain Interface - R1 to R1 Internal	
Boundary List1	R1 to R1 Internal Side 1
Boundary List2	R1 to R1 Internal Side 2
Interface Type	Fluid Fluid
<i>Settings</i>	
Interface Models	General Connection
Mass And Momentum	Conservative Interface Flux
Mesh Connection	GGI
Domain Interface - R1 to R1 Periodic 1	
Boundary List1	R1 to R1 Periodic 1 Side 1
Boundary List2	R1 to R1 Periodic 1 Side 2
Interface Type	Fluid Fluid
<i>Settings</i>	
Interface Models	Rotational Periodicity
Axis Definition	Coordinate Axis
Rotation Axis	Coord 0.1
Mesh Connection	Automatic

Table 5. Boundary Physics for Rotor_37_001

Domain	Boundaries	
R1	Boundary - R1 Inlet	
	Type	INLET

Location	INFLOW
<i>Settings</i>	
Flow Direction	Normal to Boundary Condition
Flow Regime	Subsonic
Heat Transfer	Stationary Frame Total Temperature
Stationary Frame Total Temperature	2.8815e+2 [K]
Mass And Momentum	Stationary Frame Total Pressure
Relative Pressure	1.0000e+0 [atm]
Turbulence	Medium Intensity and Eddy Viscosity Ratio
Boundary - R1 to R1 Internal Side 1	
Type	INTERFACE
Location	SHROUD TIP GGI SIDE 1
<i>Settings</i>	
Heat Transfer	Conservative Interface Flux
Mass And Momentum	Conservative Interface Flux
Turbulence	Conservative Interface Flux
Boundary - R1 to R1 Internal Side 2	
Type	INTERFACE
Location	SHROUD TIP GGI SIDE 2
<i>Settings</i>	
Heat Transfer	Conservative Interface Flux
Mass And Momentum	Conservative Interface Flux
Turbulence	Conservative Interface Flux
Boundary - R1 to R1 Periodic 1 Side 1	
Type	INTERFACE
Location	PER1
<i>Settings</i>	
Heat Transfer	Conservative Interface Flux
Mass And Momentum	Conservative Interface Flux
Turbulence	Conservative Interface Flux
Boundary - R1 to R1 Periodic 1 Side 2	
Type	INTERFACE
Location	PER2
<i>Settings</i>	
Heat Transfer	Conservative Interface Flux
Mass And Momentum	Conservative Interface Flux
Turbulence	Conservative Interface Flux
Boundary - R1 Outlet	
Type	OUTLET
Location	OUTFLOW
<i>Settings</i>	
Flow Regime	Subsonic
Mass And Momentum	Average Static Pressure
Pressure Profile Blend	5.0000e-2
Relative Pressure	1.3000e+0 [atm]

Pressure Averaging	Average Over Whole Outlet
Boundary - R1 Blade	
Type	WALL
Location	BLADE
<i>Settings</i>	
Heat Transfer	Adiabatic
Mass And Momentum	No Slip Wall
Wall Roughness	Smooth Wall
Boundary - R1 Hub	
Type	WALL
Location	HUB
<i>Settings</i>	
Heat Transfer	Adiabatic
Mass And Momentum	No Slip Wall
Wall Roughness	Smooth Wall
Boundary - R1 Shroud	
Type	WALL
Location	SHROUD
<i>Settings</i>	
Heat Transfer	Adiabatic
Mass And Momentum	No Slip Wall
Wall Velocity	Counter Rotating Wall
Wall Roughness	Smooth Wall

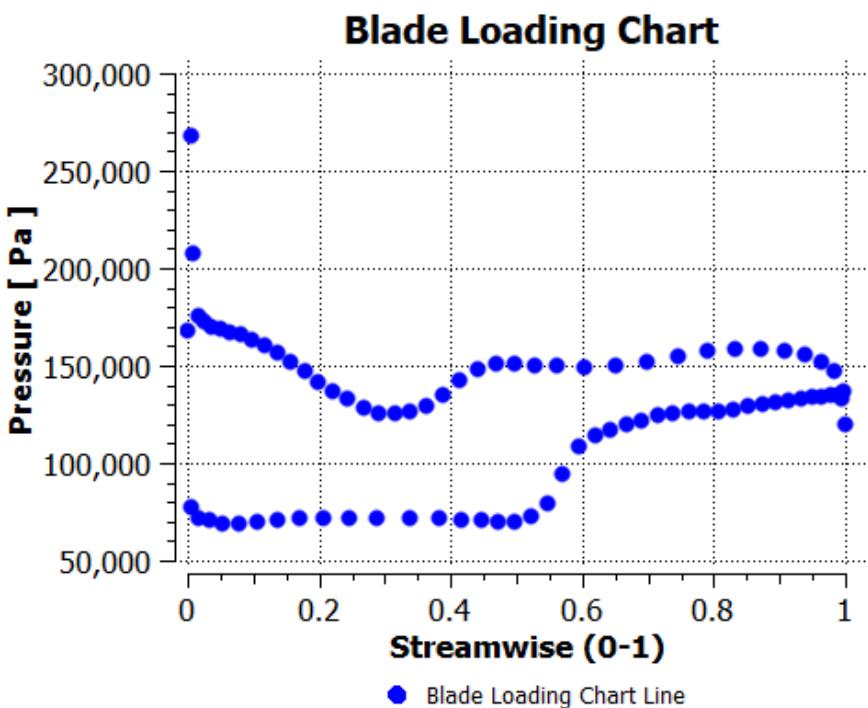
Chart 1.

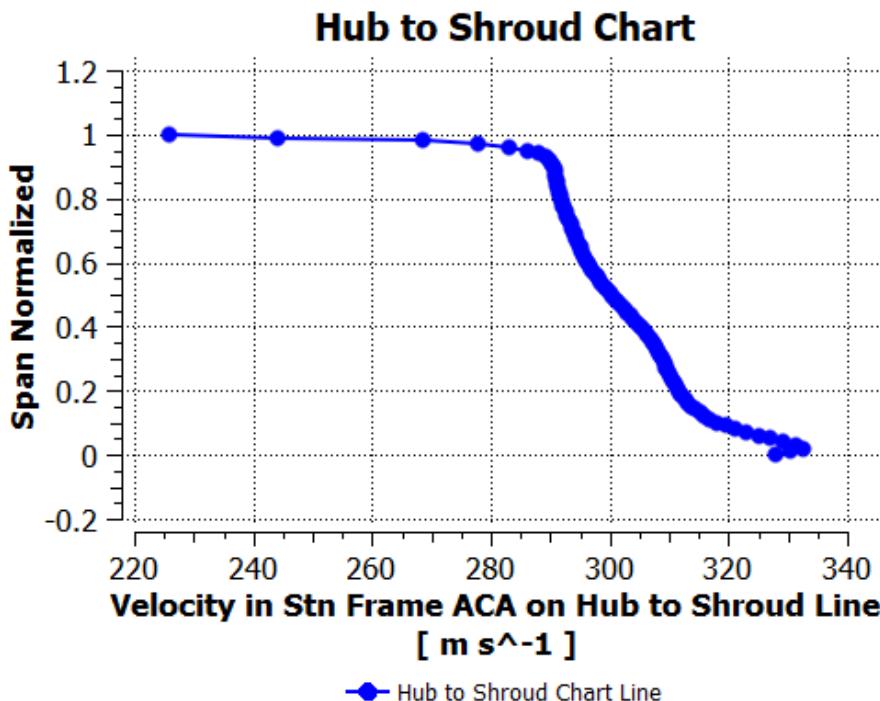
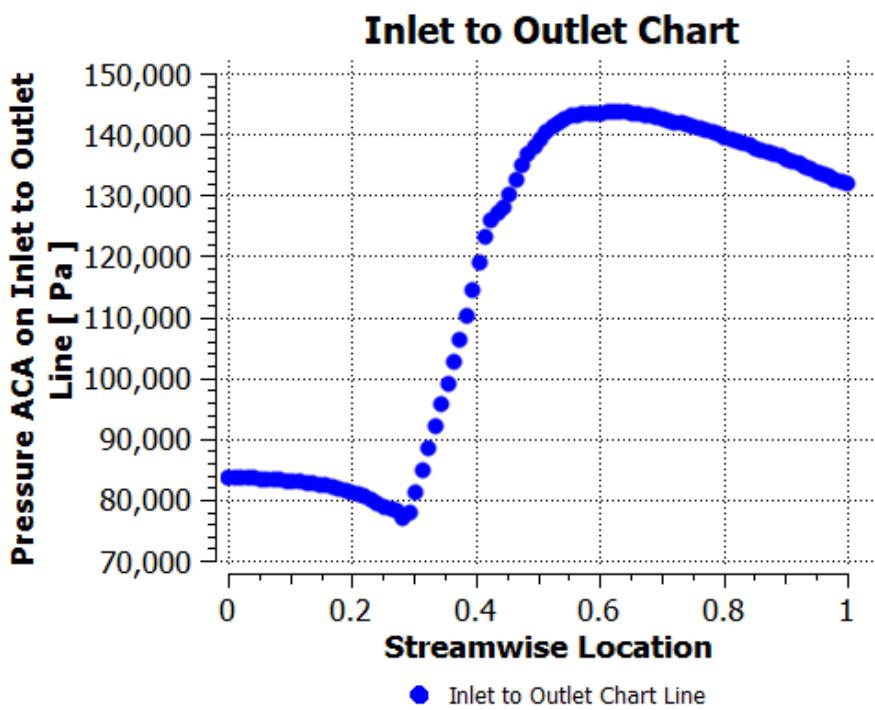
Chart 2.**Chart 3.**

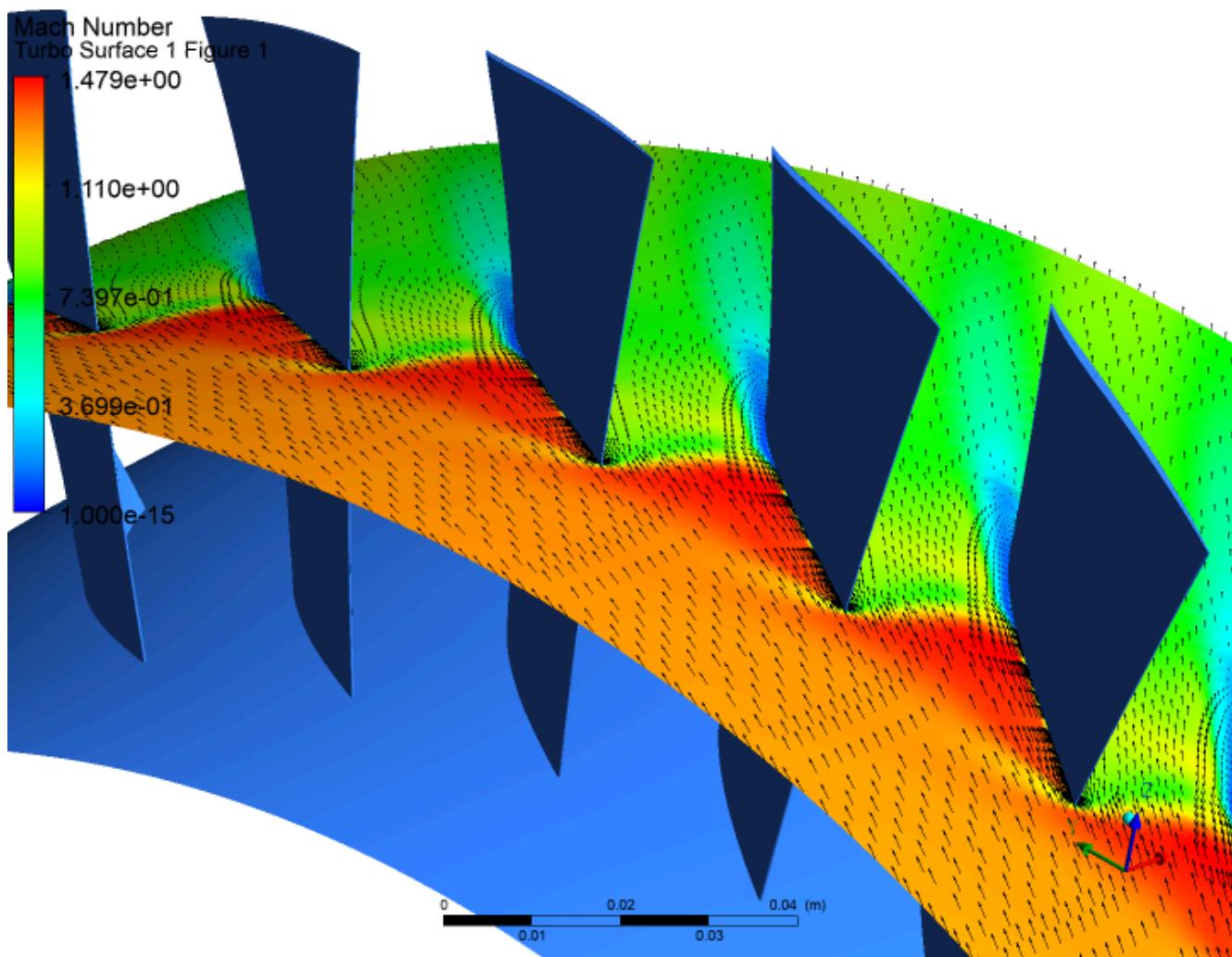
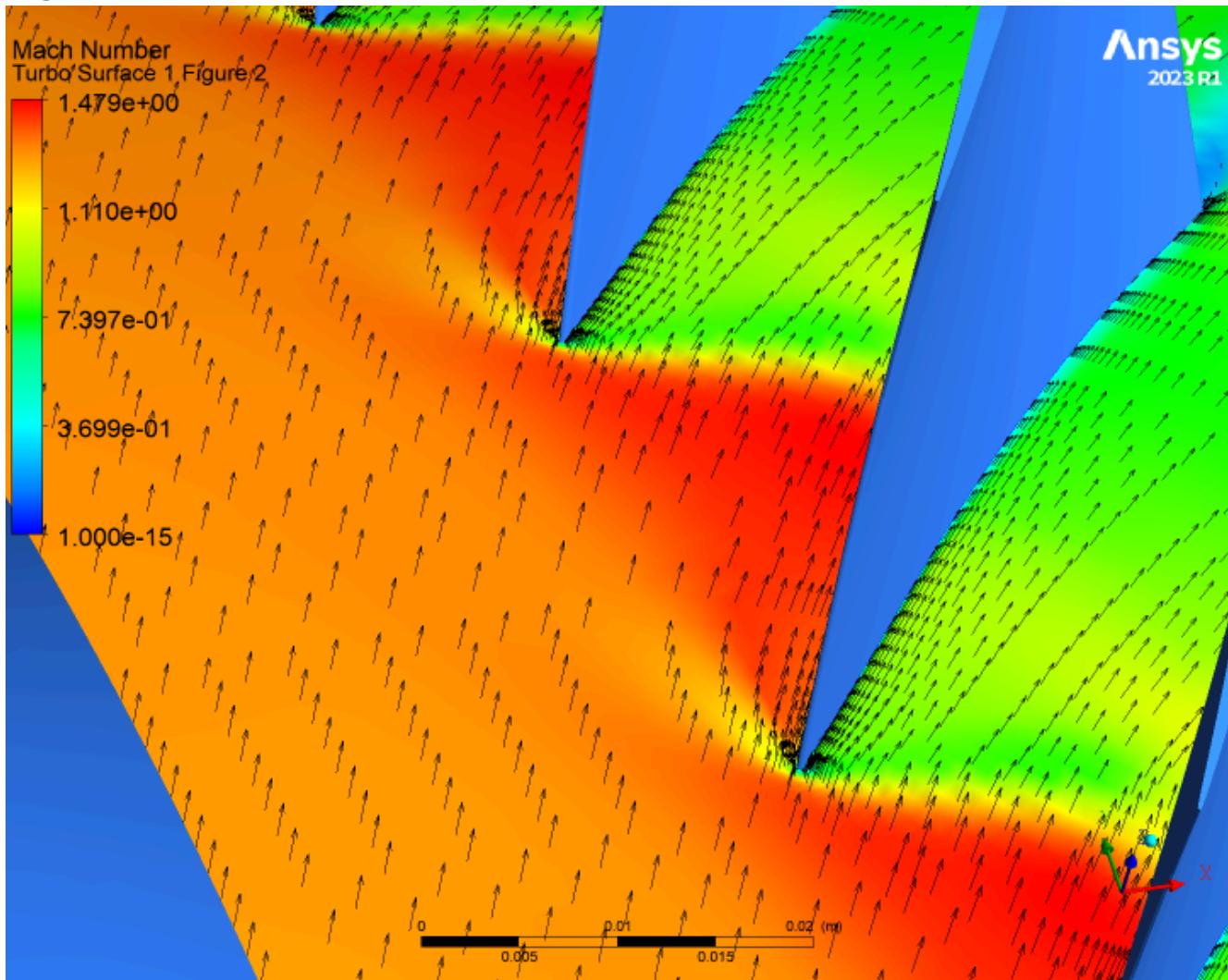
Figure 1.

Figure 2.**Table 6.**

Mass flow rate	20.66
Mass flow rate outlet	20.661
PR	2.101
TR	1.276
Efficiency	0.858
Pressure at inlet	83598.90

4. Tabulated Results

The first table below gives a summary of the performance results for the axial compressor rotor. The second table lists the mass or area averaged solution variables and derived quantities computed at the inlet, leading edge (LE Cut), trailing edge (TE Cut) and outlet locations. The flow angles Alpha and Beta are relative to the meridional plane; a positive angle implies that the tangential velocity is the same direction as the machine rotation.

Table 7. Compressor Performance Results

Rotation Speed	1800.0300	[radian s ⁻¹]
Mass Flow Rate	20.6613	[kg s ⁻¹]
Inlet Volume Flow Rate	16.8706	[m ³ s ⁻¹]
Input Power	1647470.0000	[W]
Reference Radius	0.2173	[m]
Inlet Flow Coefficient	0.4488	
Exit Flow Coefficient	0.5797	
Work Input Coefficient	0.5212	
Reaction	0.7390	
Total Pressure Ratio	2.1008	
Total Temperature Ratio	1.2755	
Total Isentropic Efficiency %	86.0566	
Total Polytropic Efficiency %	87.3896	

Table 8. Summary Data

Quantity	Inlet	LE Cut	TE Cut	Outlet	TE/LE	TE-LE	Units
Density	1.0680	0.9753	1.5139	1.4295	1.5522	0.5386	[kg m ⁻³]
Pstatic	83647.5000	74888.5000	143583.0000	131728.0000	1.9173	68694.2000	[Pa]
Ptotal	101319.0000	99066.5000	216075.0000	212850.0000	2.1811	117008.0000	[Pa]
Ptotal (rot)	101304.0000	98616.0000	92854.1000	91387.5000	0.9416	-5761.8500	[Pa]
Tstatic	272.7390	264.6460	327.4590	320.5340	1.2373	62.8131	[K]
Ttotal	288.1540	288.5780	367.4960	367.5420	1.2735	78.9179	[K]
Ttotal (rot)	288.1420	288.1450	288.2680	288.5550	1.0004	0.1229	[K]
Hstatic	-25523.2000	-33651.9000	29437.6000	22482.4000	-0.8748	63089.5000	[J kg ⁻¹]
Htotal	-10040.0000	-9613.6200	69651.6000	69696.8000	-7.2451	79265.2000	[J kg ⁻¹]
Rothalpy	-10052.3000	-10049.4000	-9925.9800	-9636.8700	0.9877	123.4480	[J kg ⁻¹]
Entropy	-34.2332	-26.2331	-7.6414	-2.7637	0.2913	18.5916	[J kg ⁻¹ K ⁻¹]
Mach (abs)	0.5310	0.6712	0.7791	0.8557	1.1608	0.1079	
Mach (rel)	1.3010	1.3745	0.7416	0.8277	0.5396	-0.6328	
U	393.2390	391.3520	391.1440	391.0040	0.9995	-0.2076	[m s ⁻¹]
Cm	175.5310	215.2510	178.9350	227.3770	0.8313	-36.3159	[m s ⁻¹]

Cu	0.0344	4.5085	219.2410	204.1110	48.6283	214.7330	[m s^-1]
C	175.5380	218.4340	289.2610	306.0940	1.3242	70.8275	[m s^-1]
Distortion Parameter	1.0060	1.0152	1.0416	1.0065	1.0260	0.0264	
Flow Angle: Alpha	0.0145	1.9432	50.3423	41.9746	25.9070	48.3991	[degree]
Wu	-393.2050	-386.8440	-171.9040	-186.8930	0.4444	214.9410	[m s^-1]
W	431.0760	443.3820	251.7950	295.9700	0.5679	-191.5870	[m s^-1]
Flow Angle: Beta	-65.7290	-59.8523	-41.7115	-39.0774	0.6969	18.1407	[degree]

5. Blade Loading Charts

Chart 4. Blade Loading at 20% Span

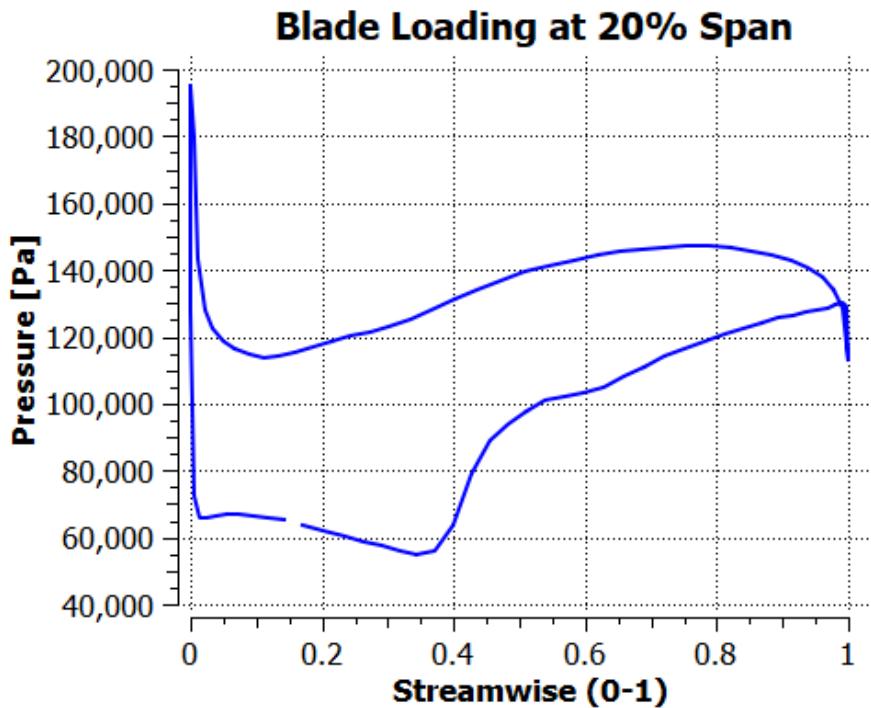


Chart 5. Blade Loading at 50% Span

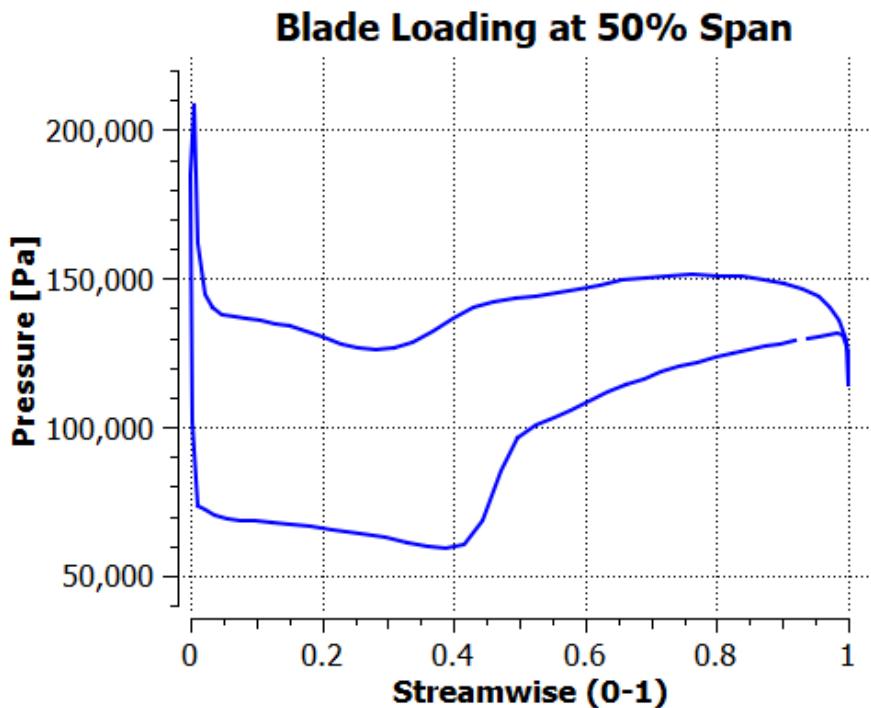
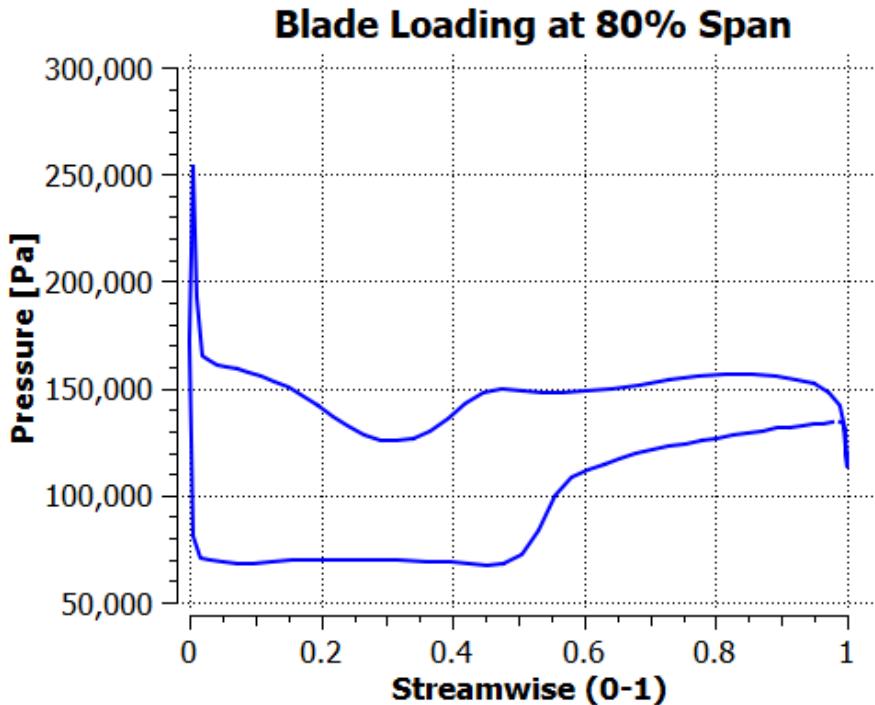


Chart 6. Blade Loading at 80% Span

6. Streamwise Charts

Chart 7. Streamwise Plot of Pt and P

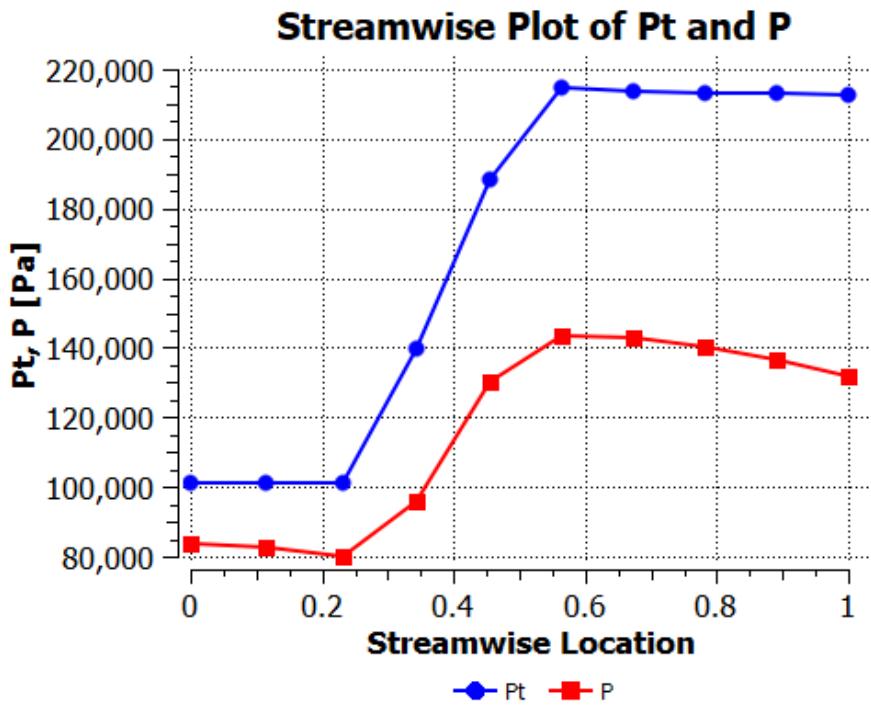


Chart 8. Streamwise Plot of Tt and T

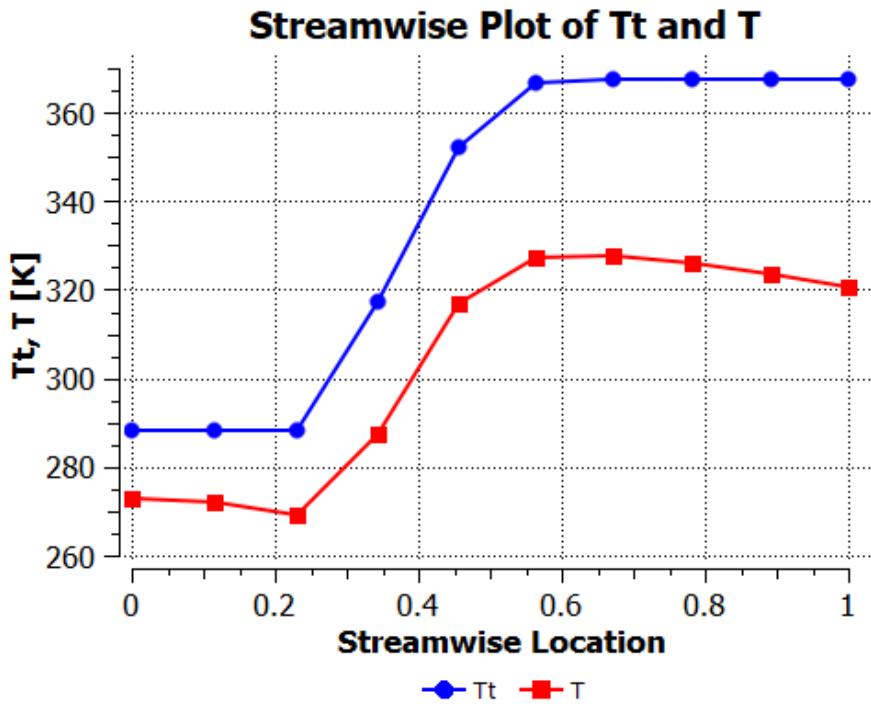
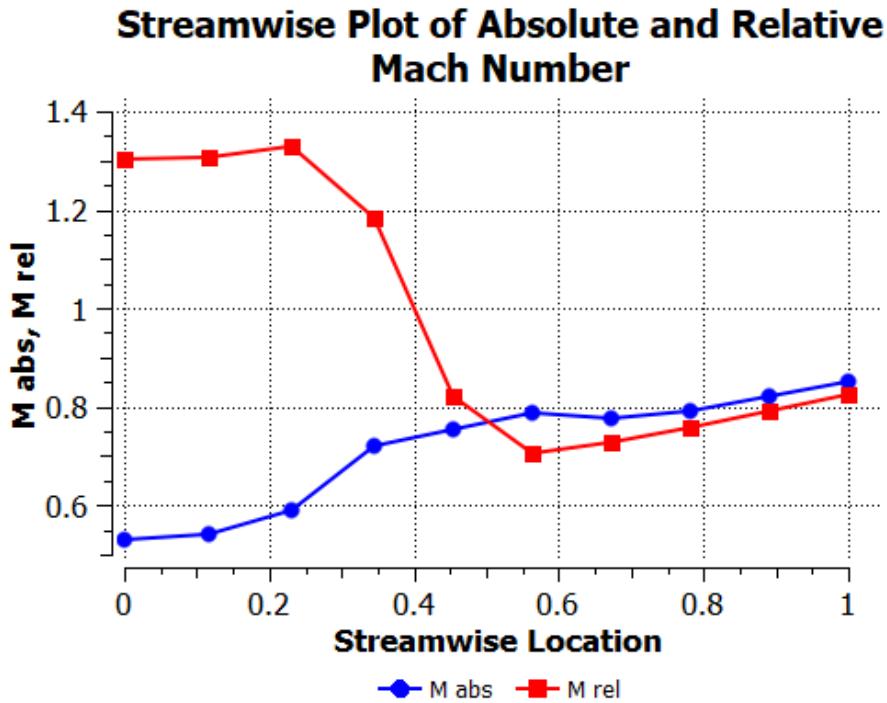
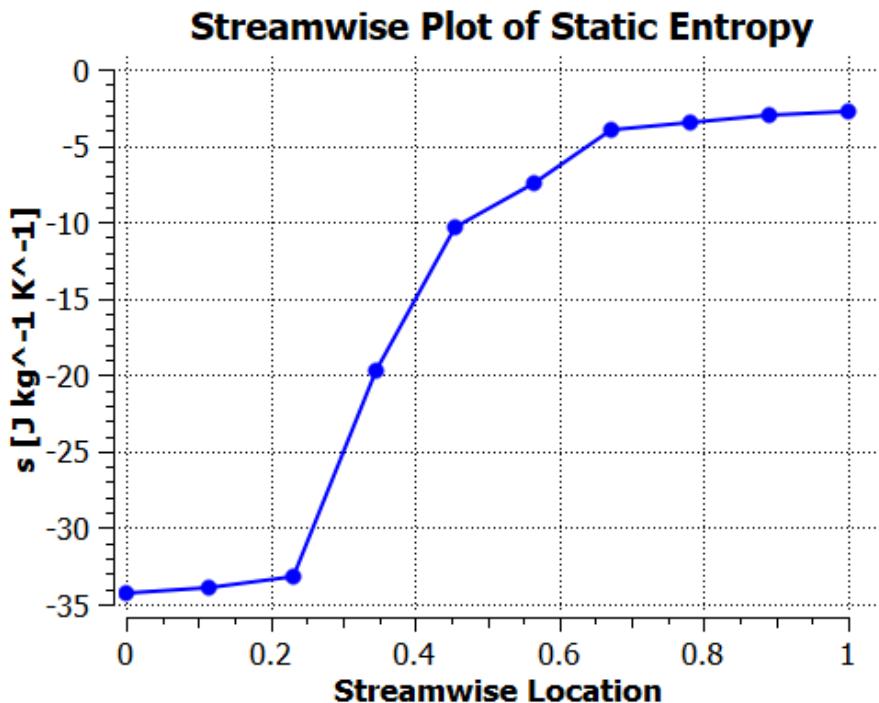


Chart 9. Streamwise Plot of Absolute and Relative Mach Number**Chart 10.** Streamwise Plot of Static Entropy

7. Spanwise Charts

Chart 11. Spanwise Plot of Alpha and Beta at LE

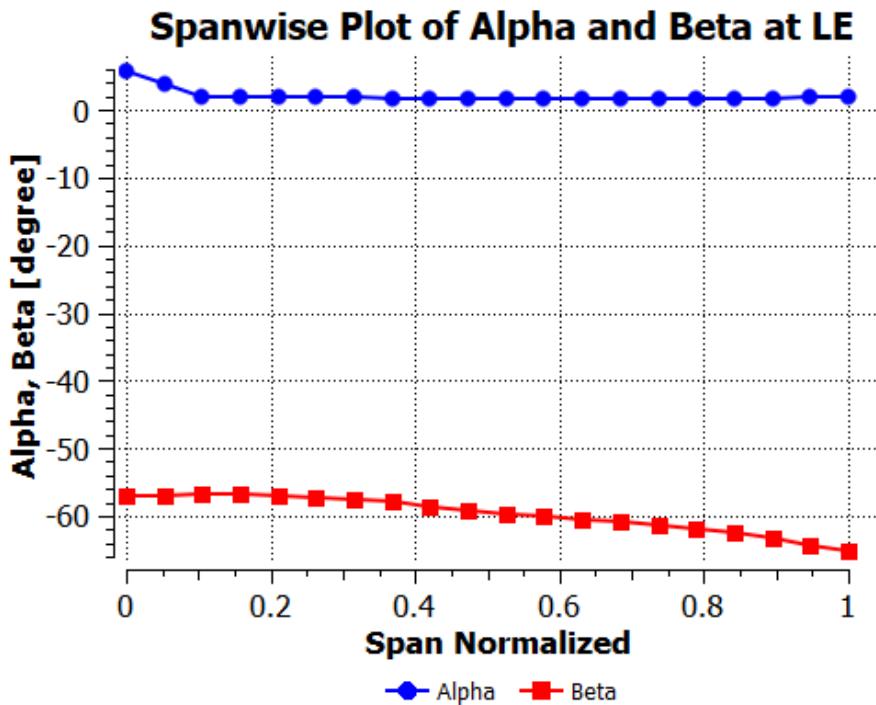


Chart 12. Spanwise Plot of Relative Mach Number at LE

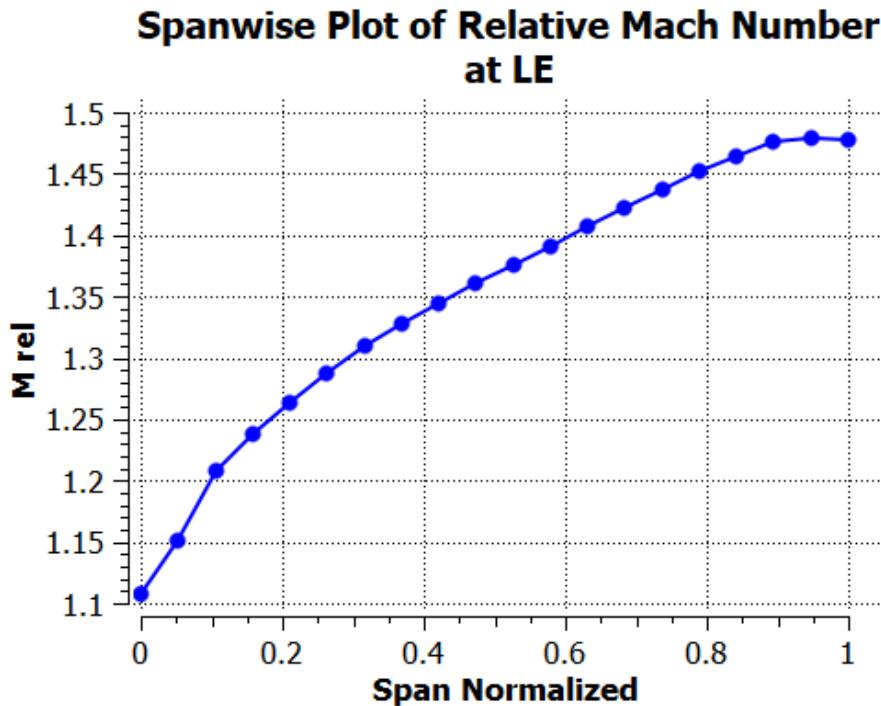


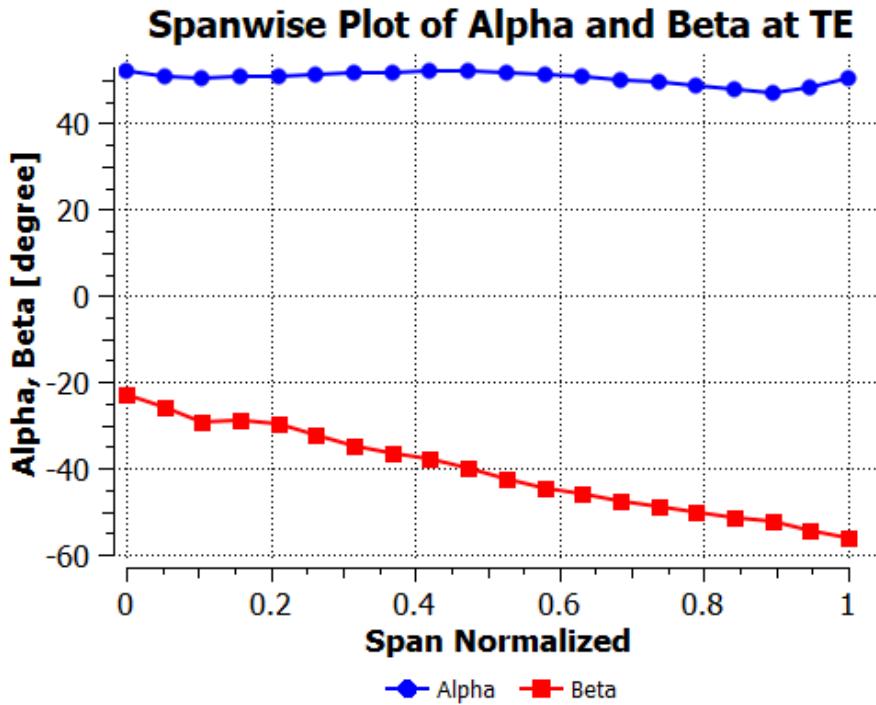
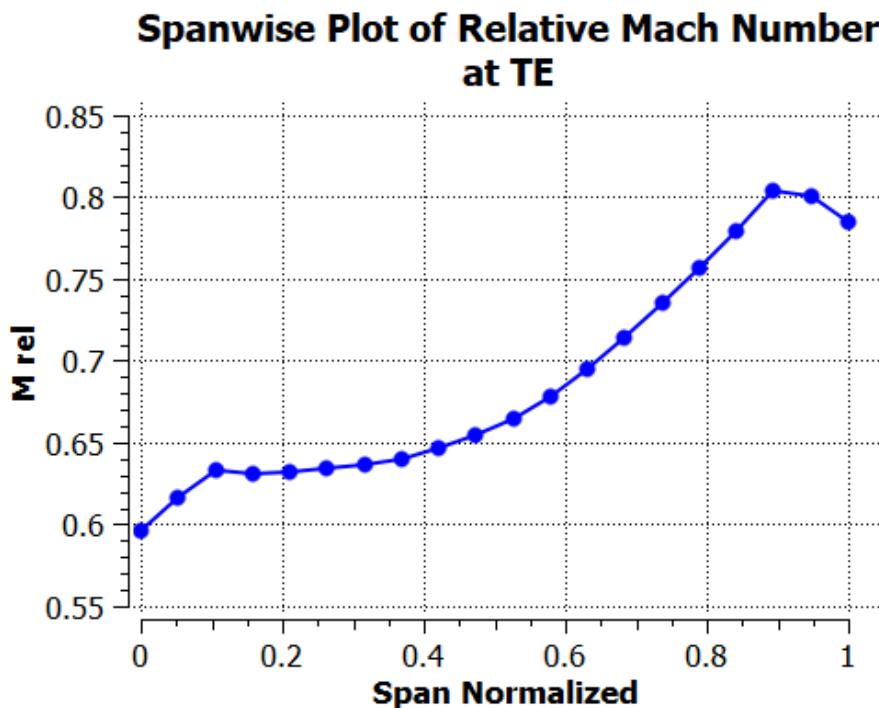
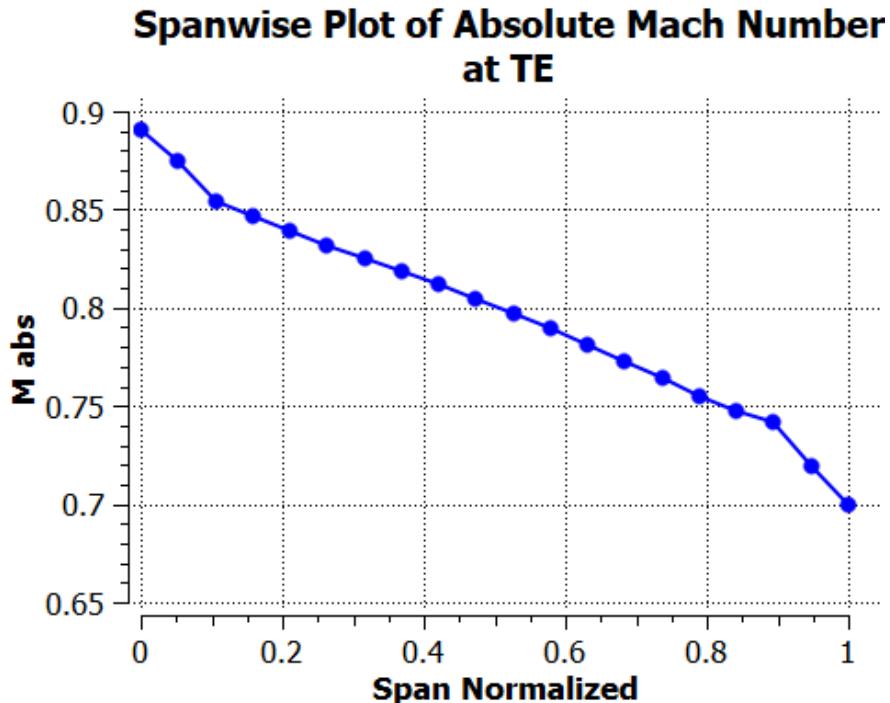
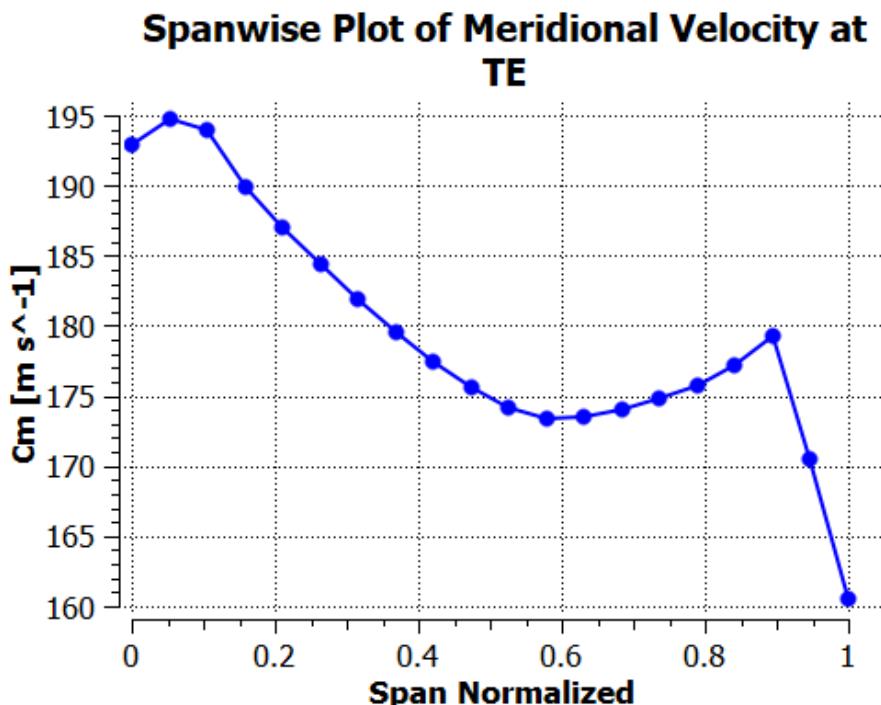
Chart 13. Spanwise Plot of Alpha and Beta at TE**Chart 14.** Spanwise Plot of Relative Mach Number at TE

Chart 15. Spanwise Plot of Absolute Mach Number at TE**Chart 16.** Spanwise Plot of Meridional Velocity at TE

8. Blade Geometry Plots

Figure 3. Isometric 3D View of the Blade, Hub and Shroud

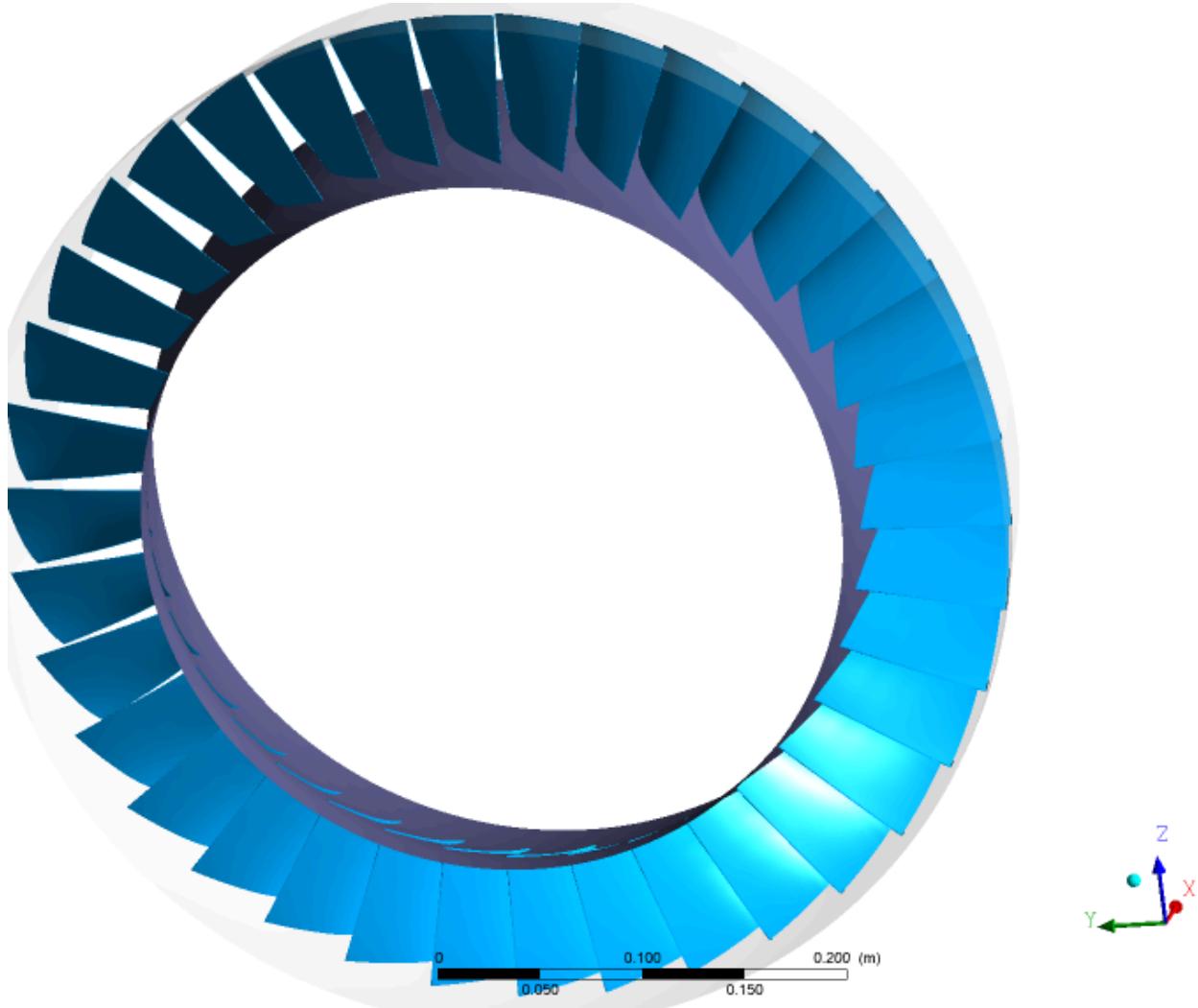
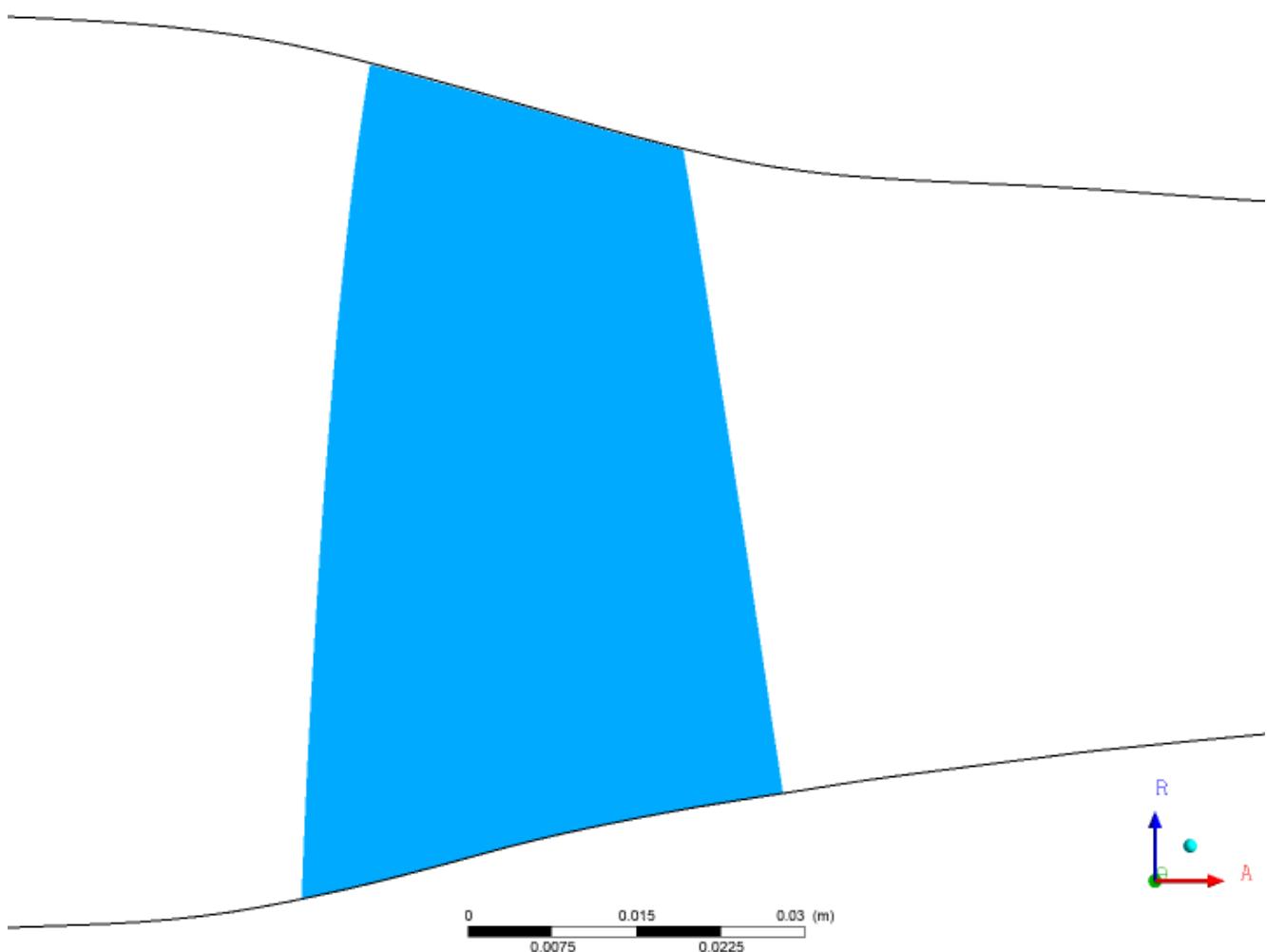
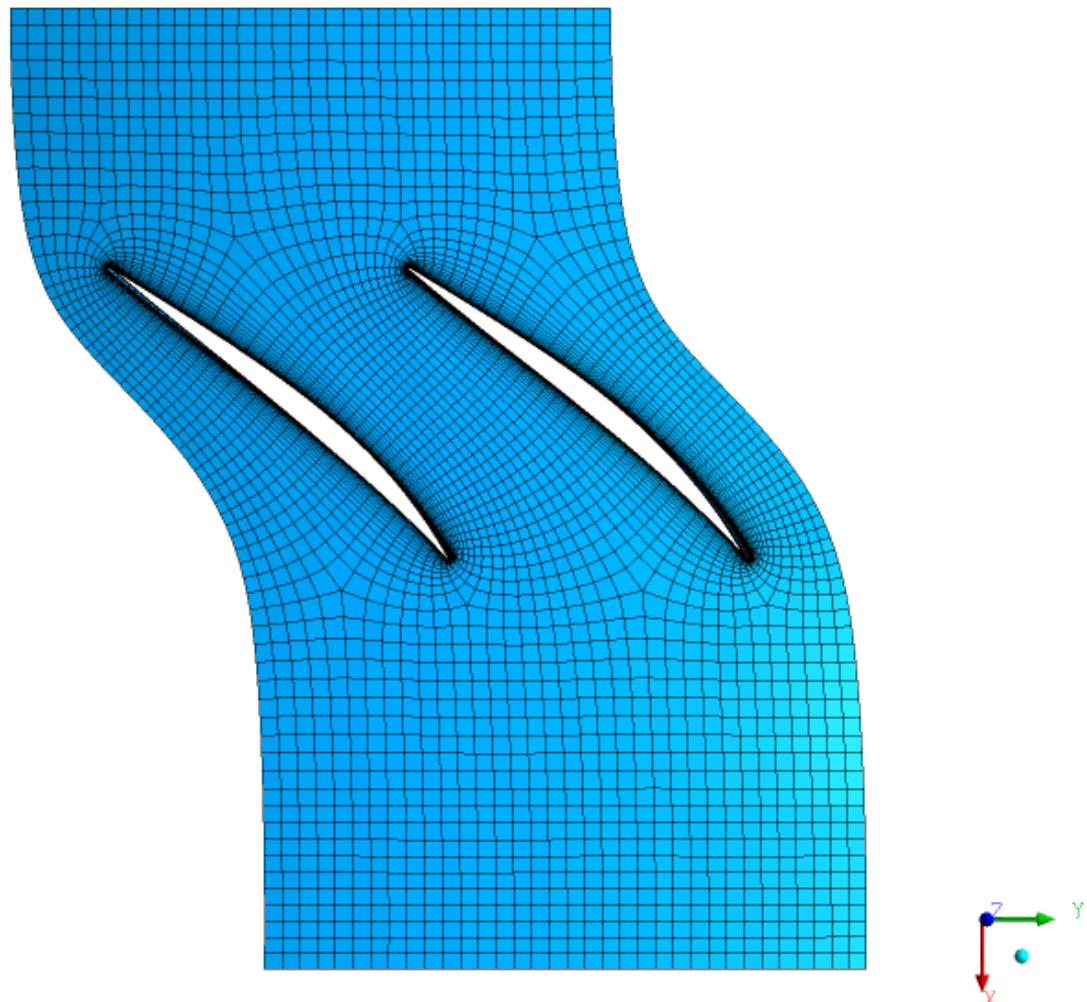


Figure 4. Meridional View of the Blade, Hub and Shroud

9. Blade Mesh Plot

Figure 5. Mesh Elements at 50% Span



10. Blade to Blade Plots

Figure 6. Contour of M rel at 20% Span

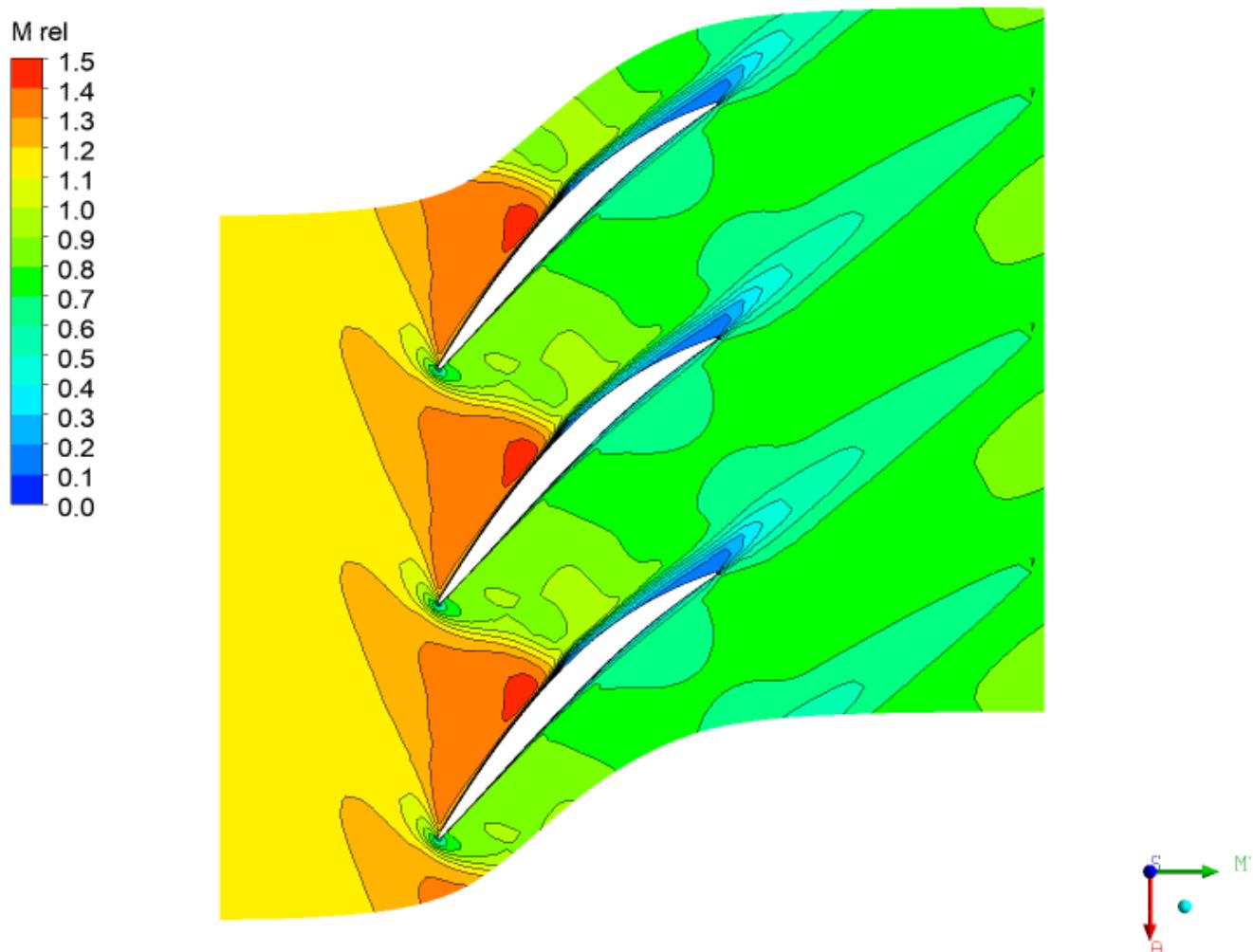


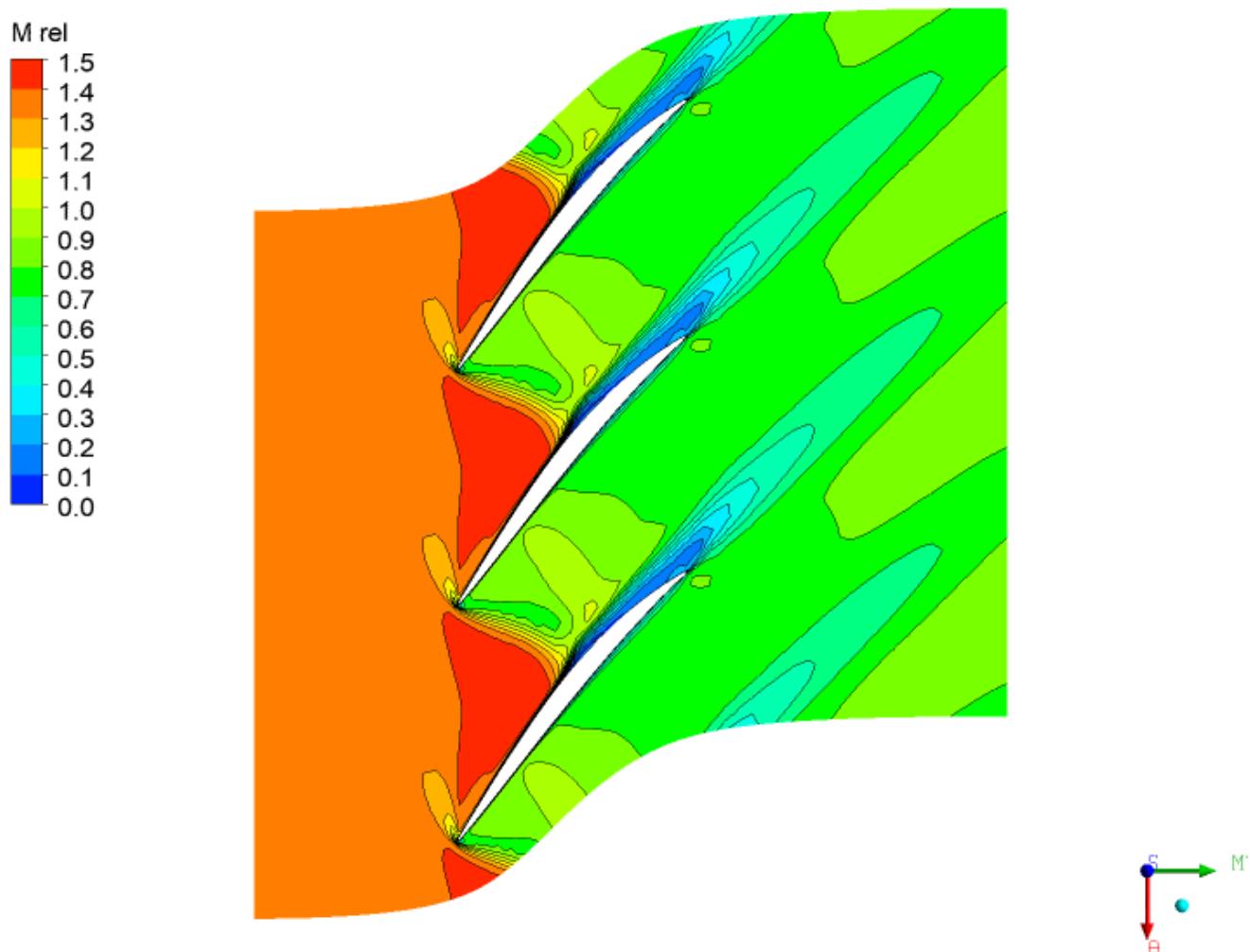
Figure 7. Contour of M rel at 50% Span

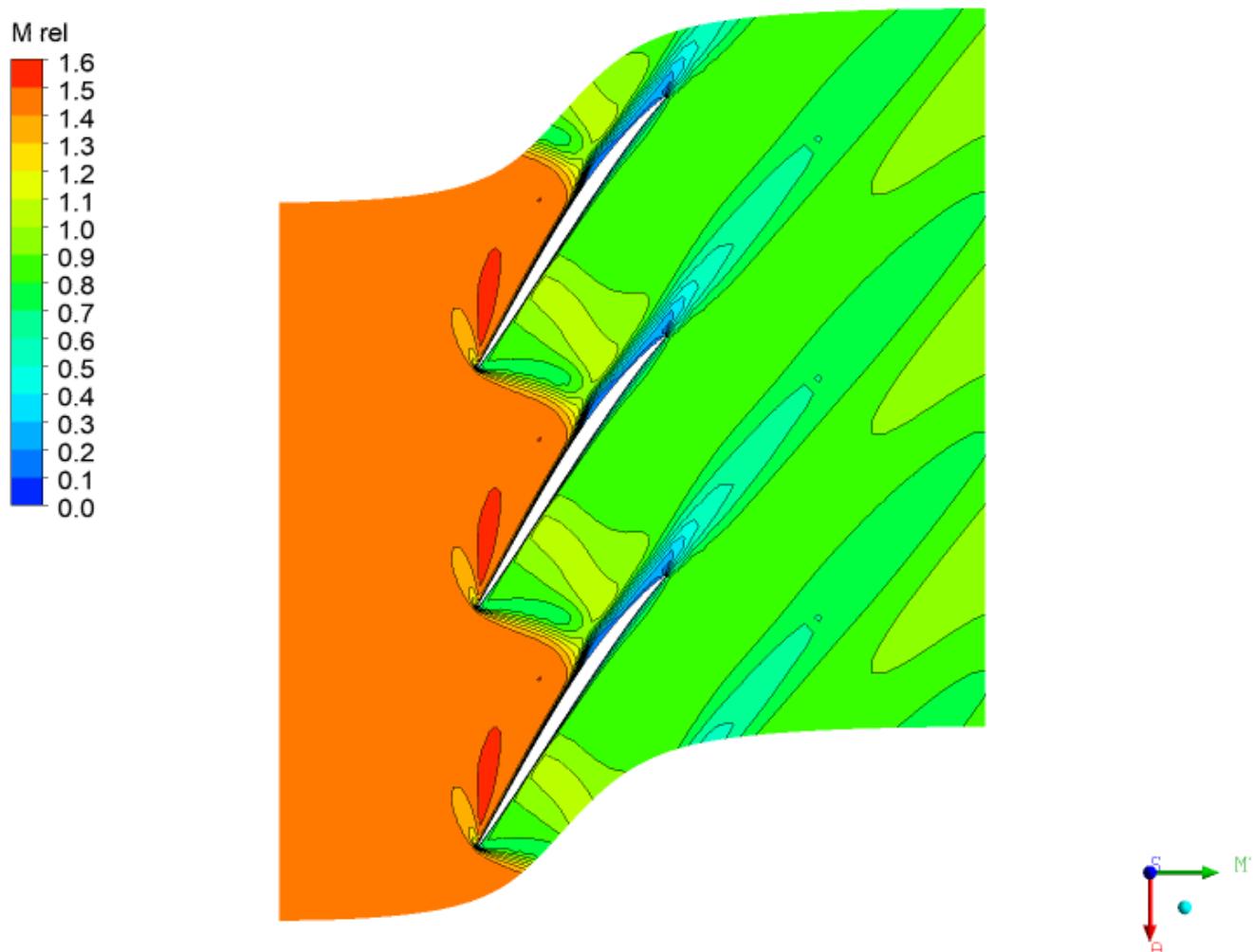
Figure 8. Contour of M rel at 80% Span

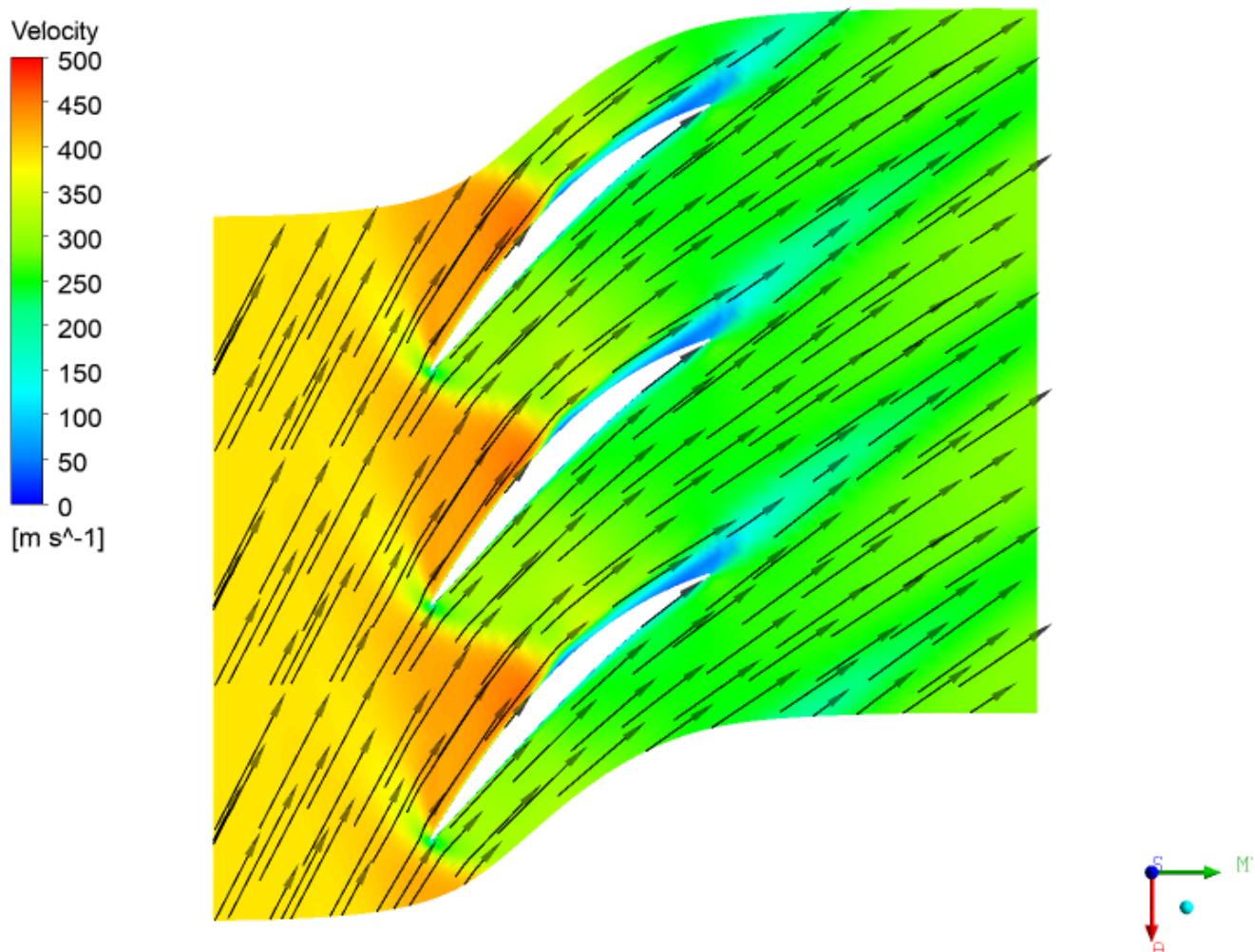
Figure 9. Velocity Vectors at 20% Span

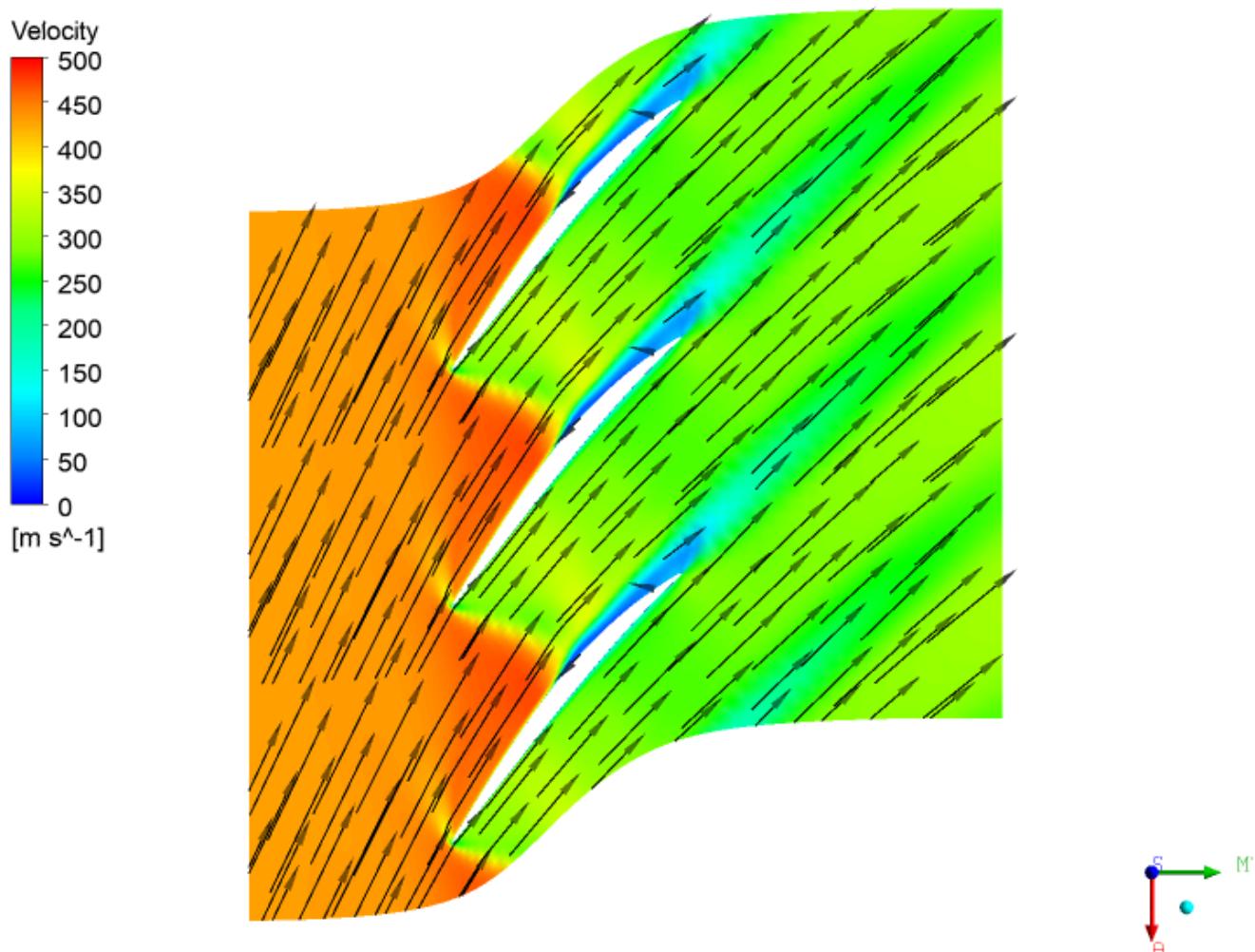
Figure 10. Velocity Vectors at 50% Span

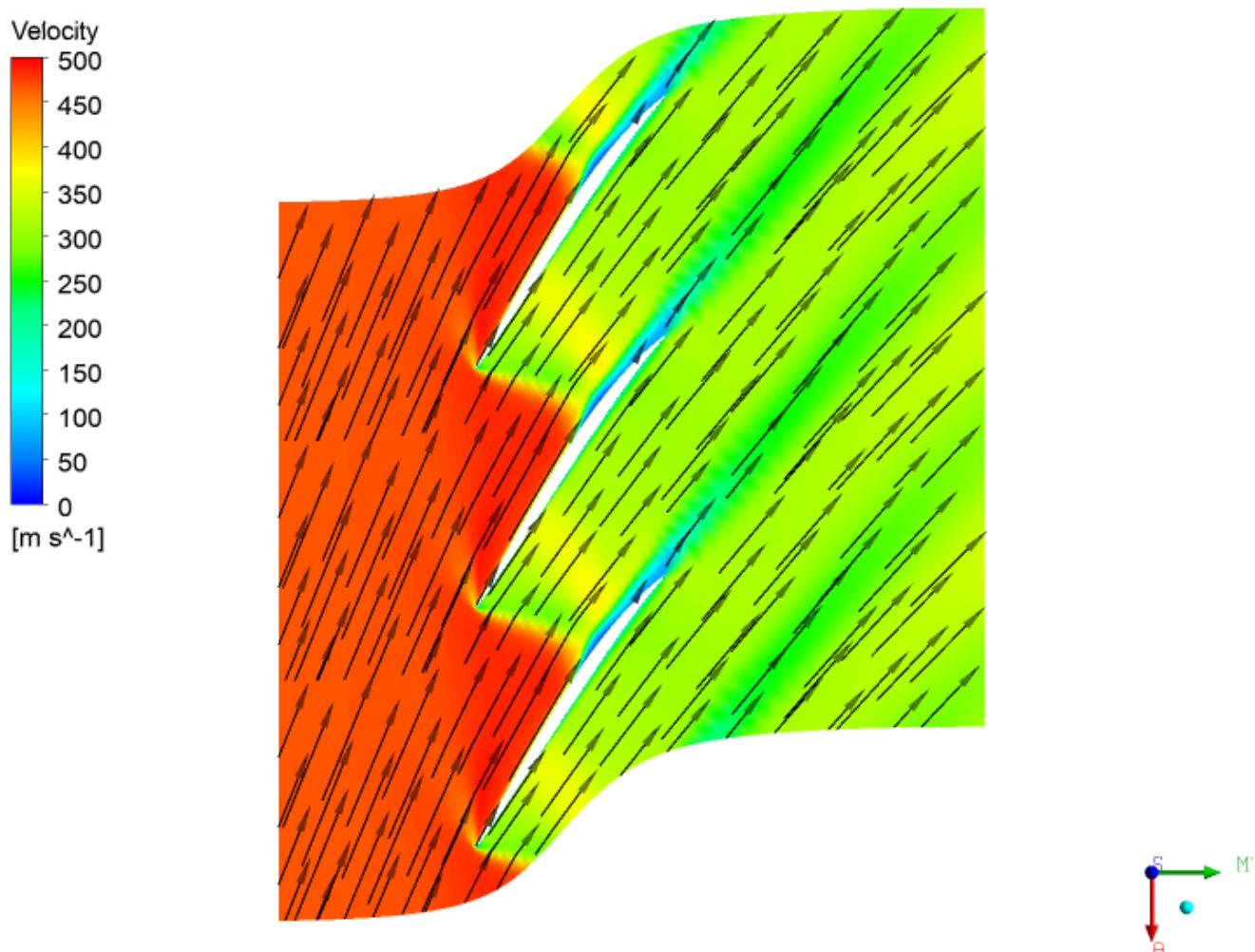
Figure 11. Velocity Vectors at 80% Span

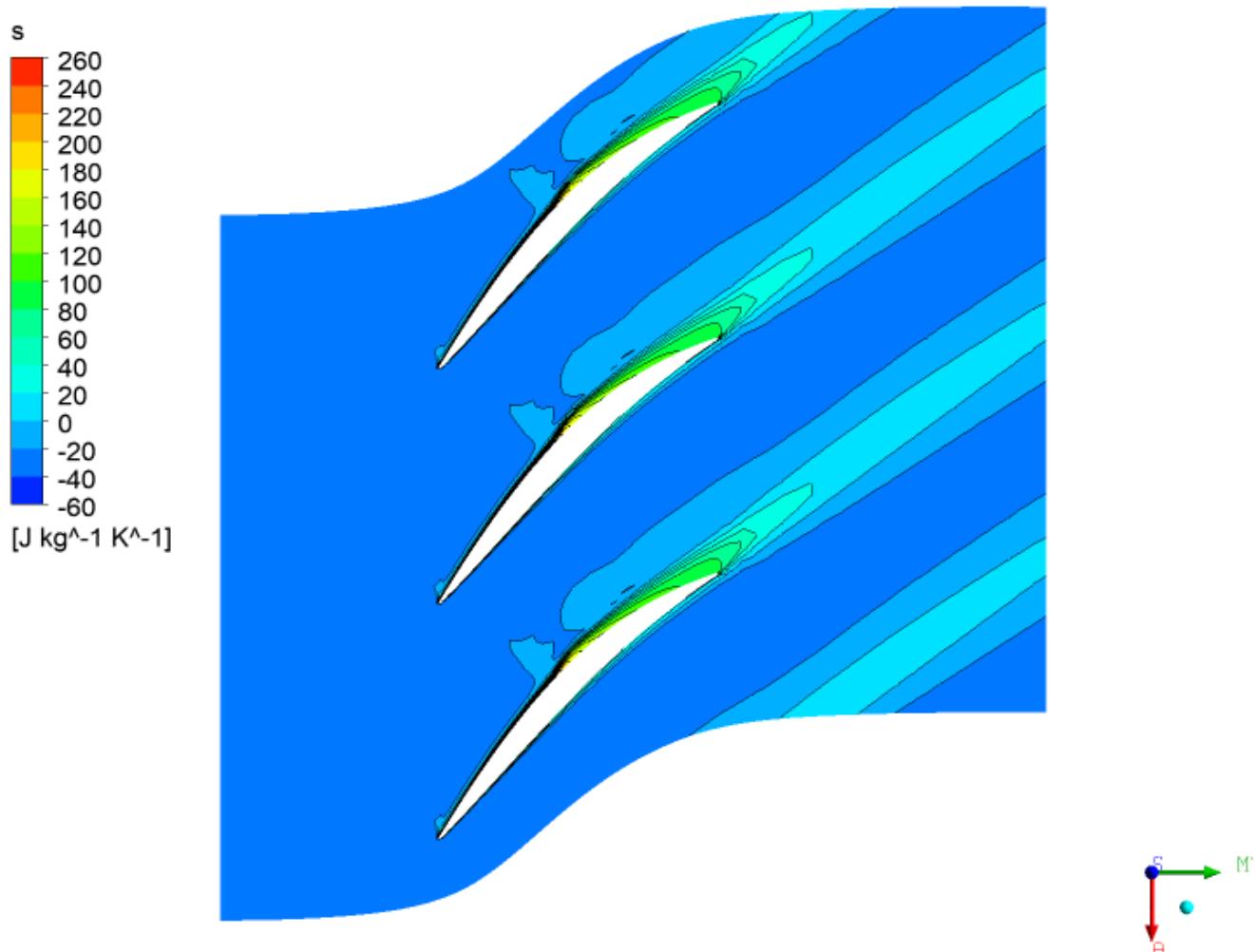
Figure 12. Contour of s at 20% Span

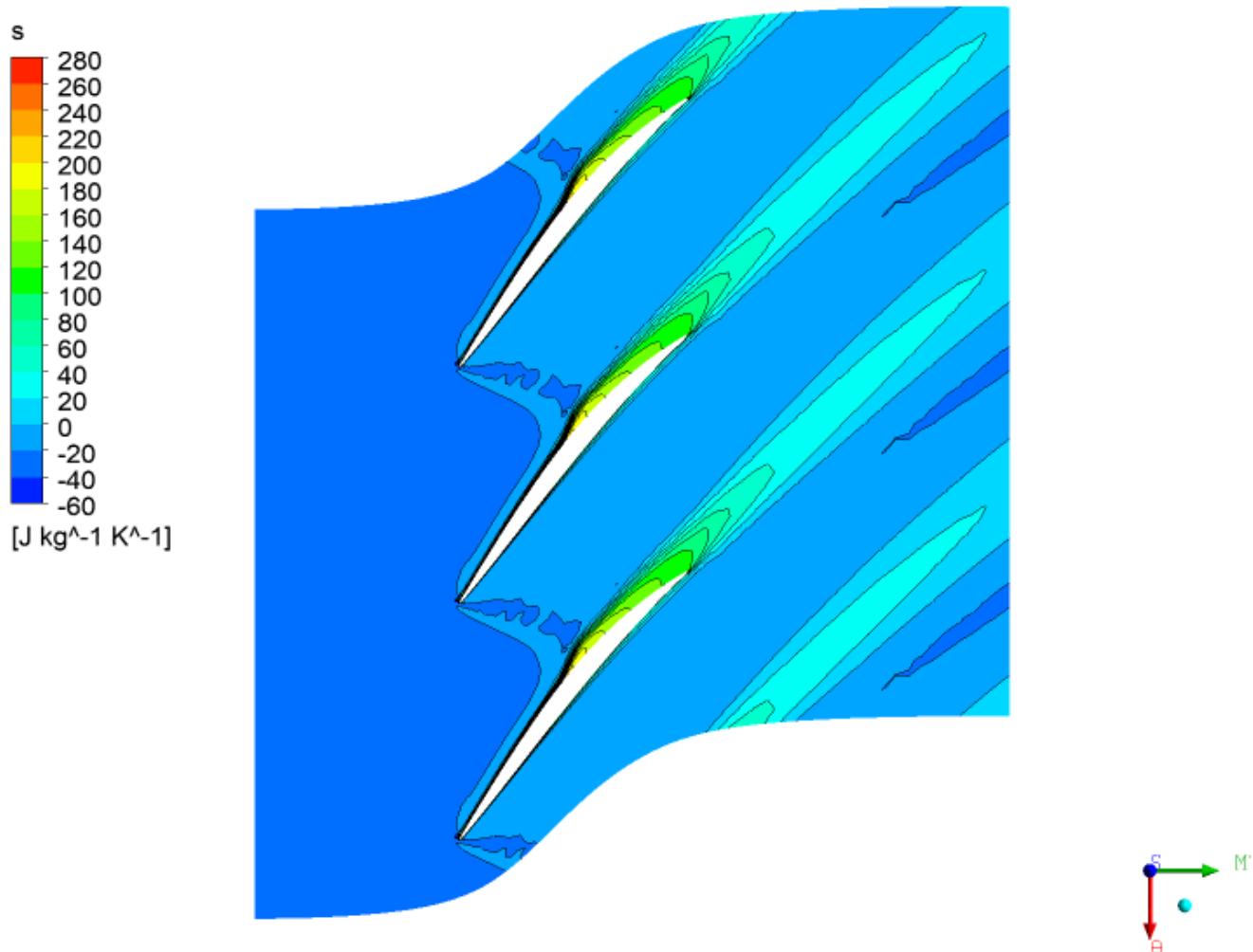
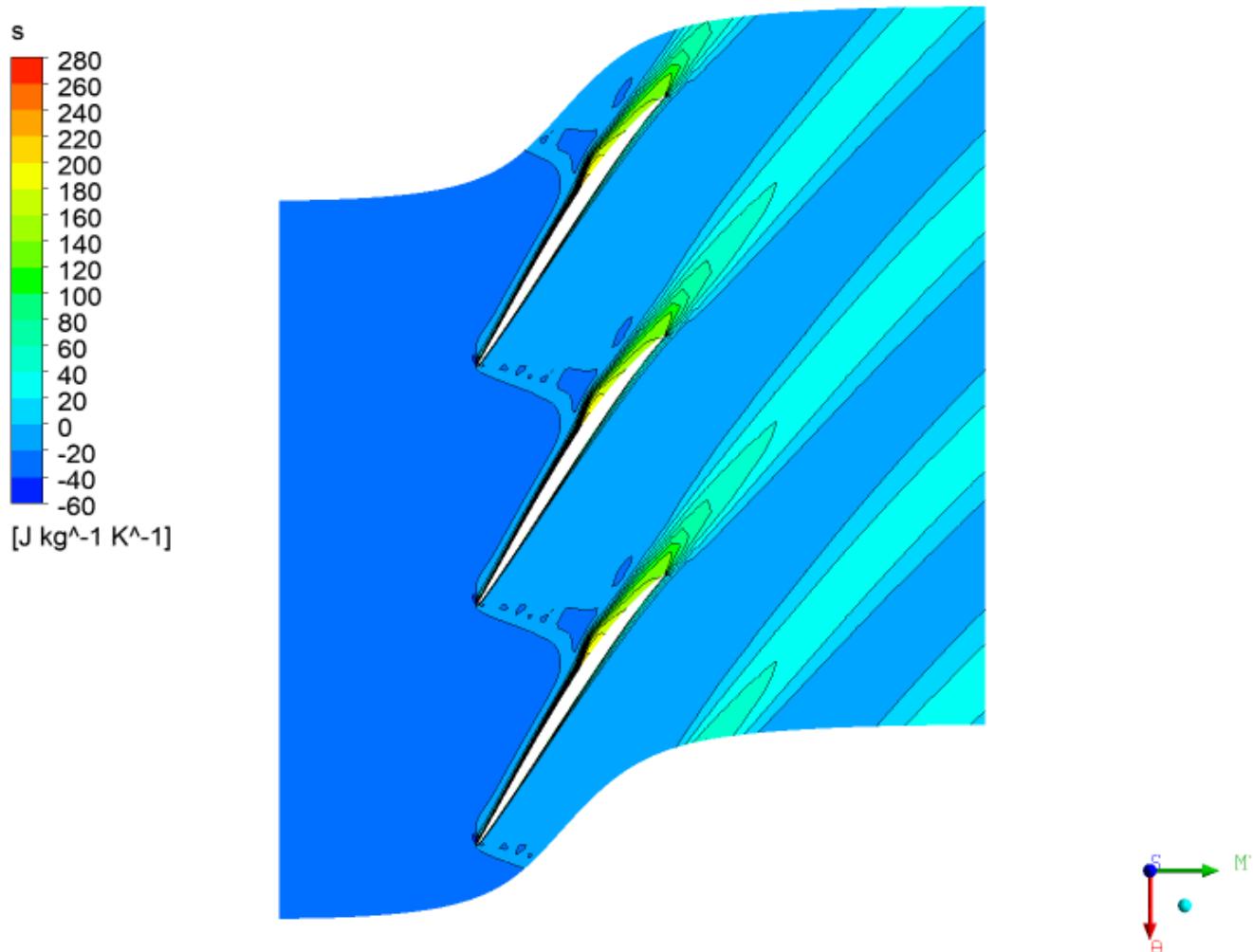
Figure 13. Contour of s at 50% Span

Figure 14. Contour of s at 80% Span

11. Meridional Plots

Figure 15. Contour of Mass Averaged P on Meridional Surface

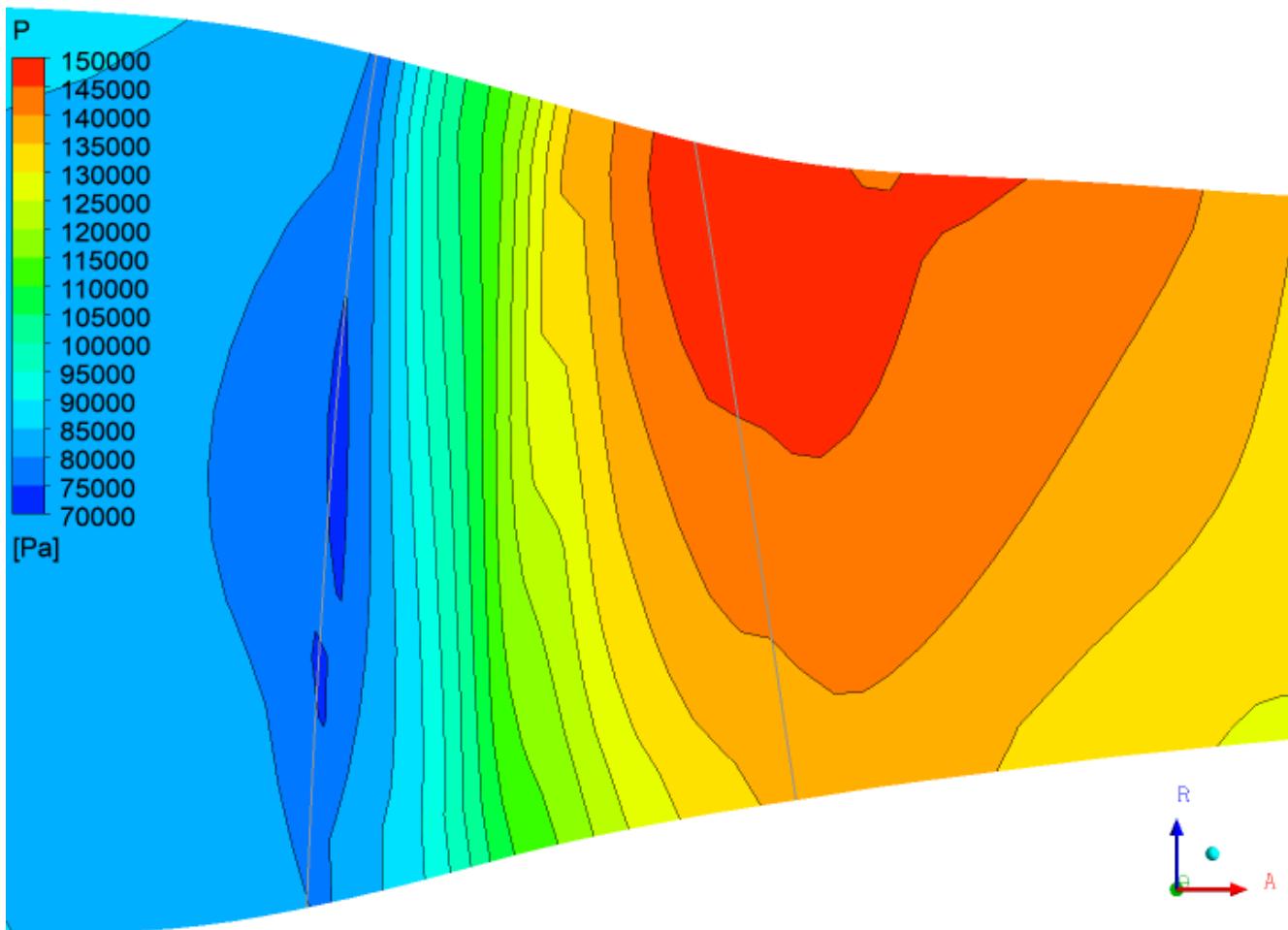


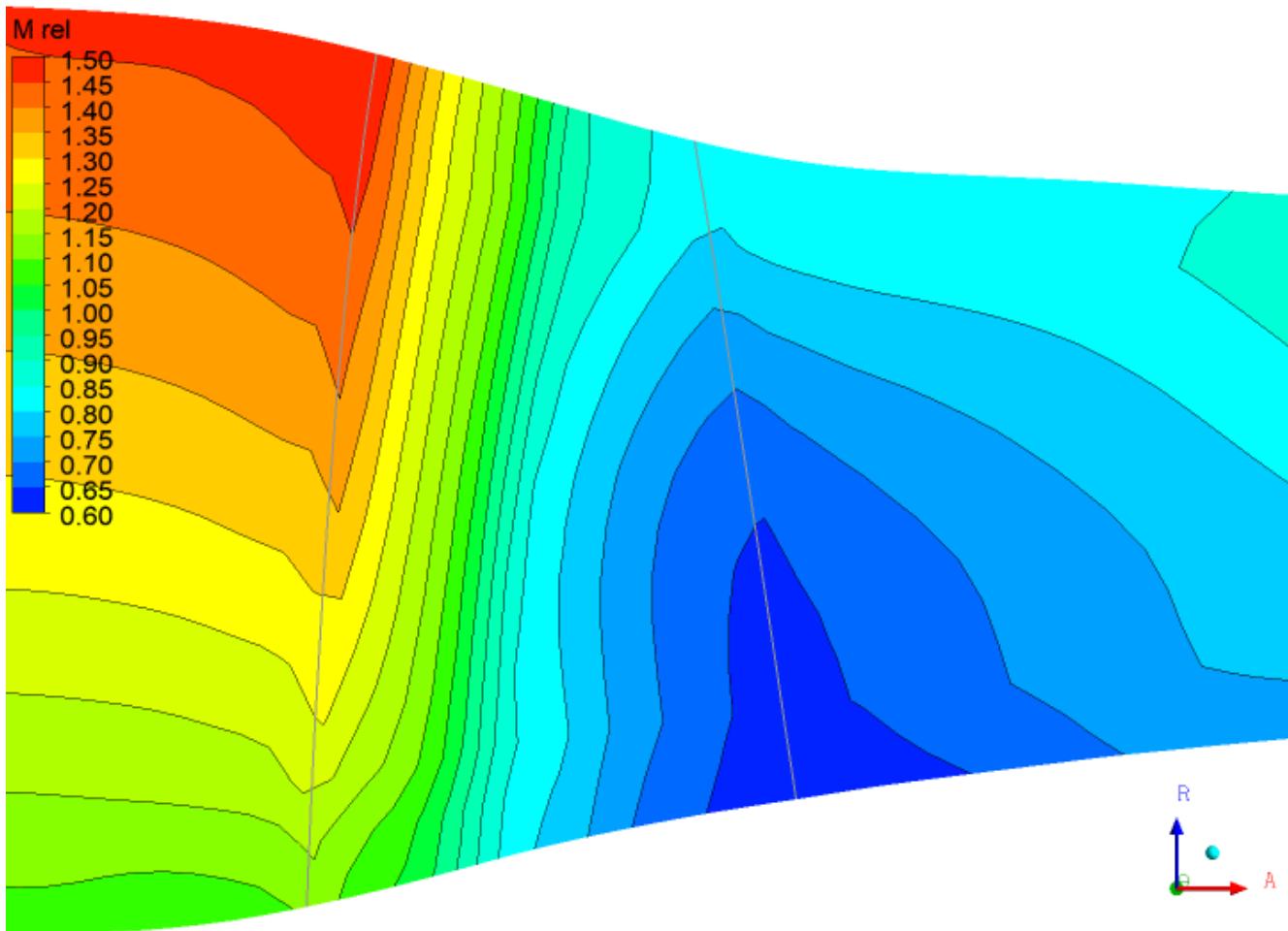
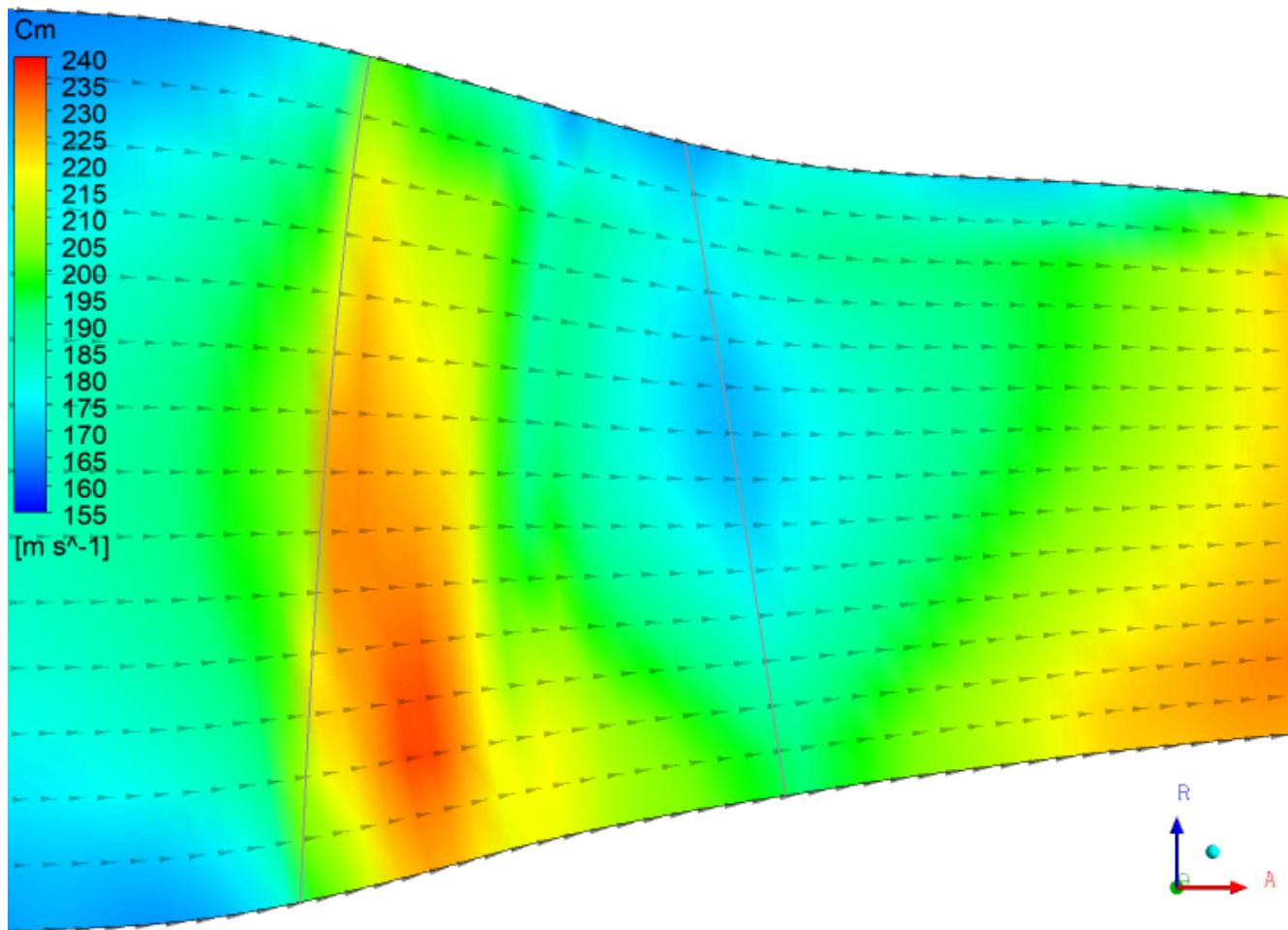
Figure 16. Contour of Mass Averaged M rel on Meridional Surface

Figure 17. Vector of Area Averaged C_m on Meridional Surface

12. Circumferential Plots

Figure 18. Contour of P at Blade LE

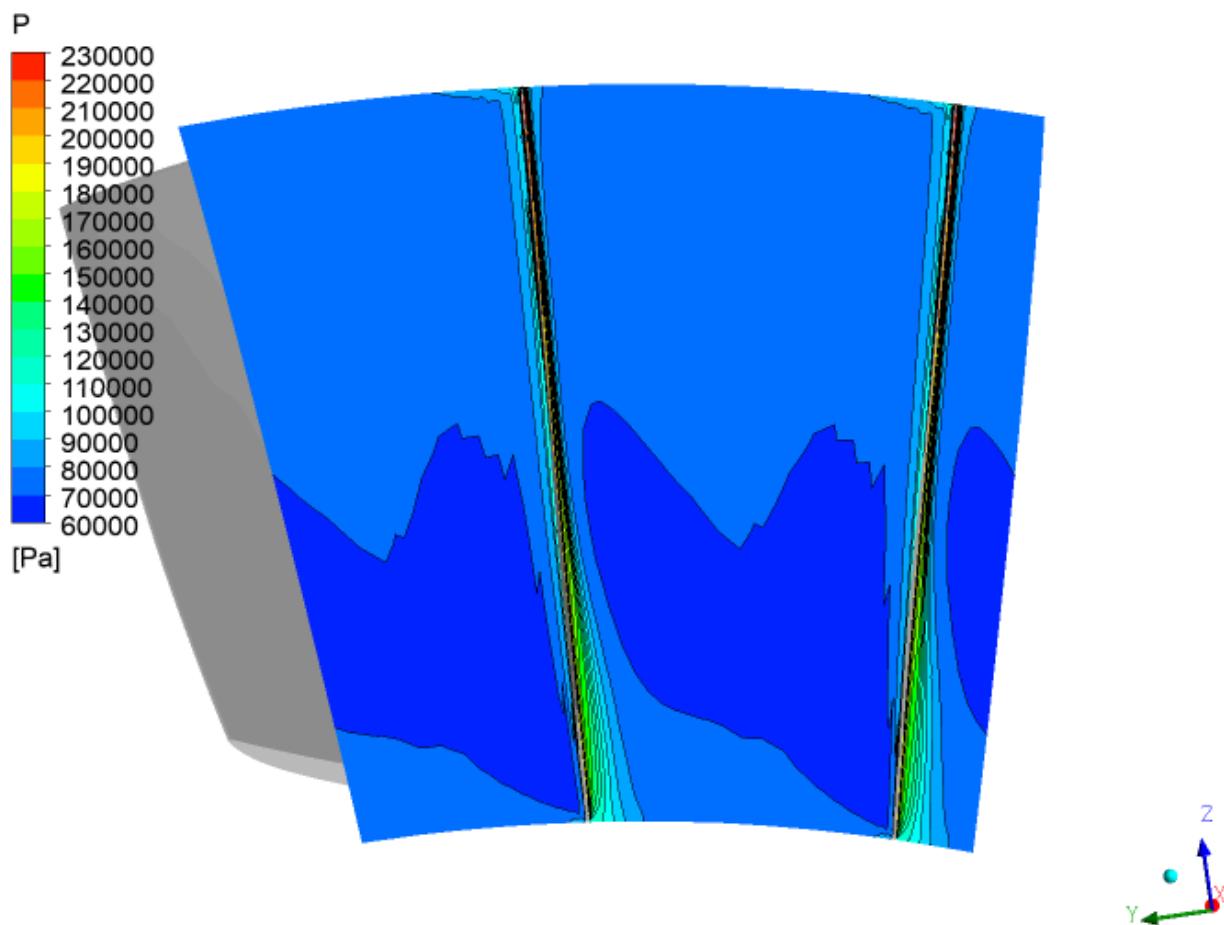


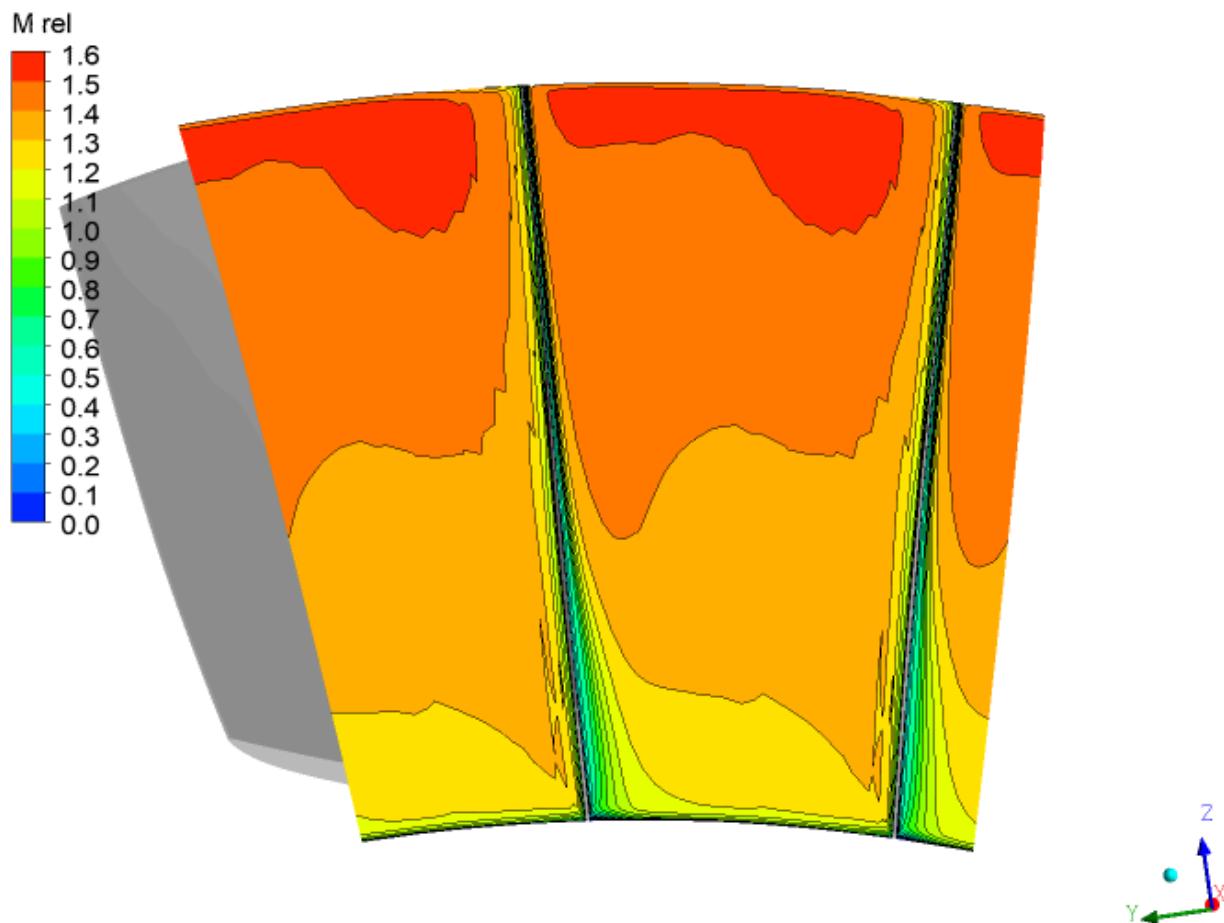
Figure 19. Contour of M rel at Blade LE

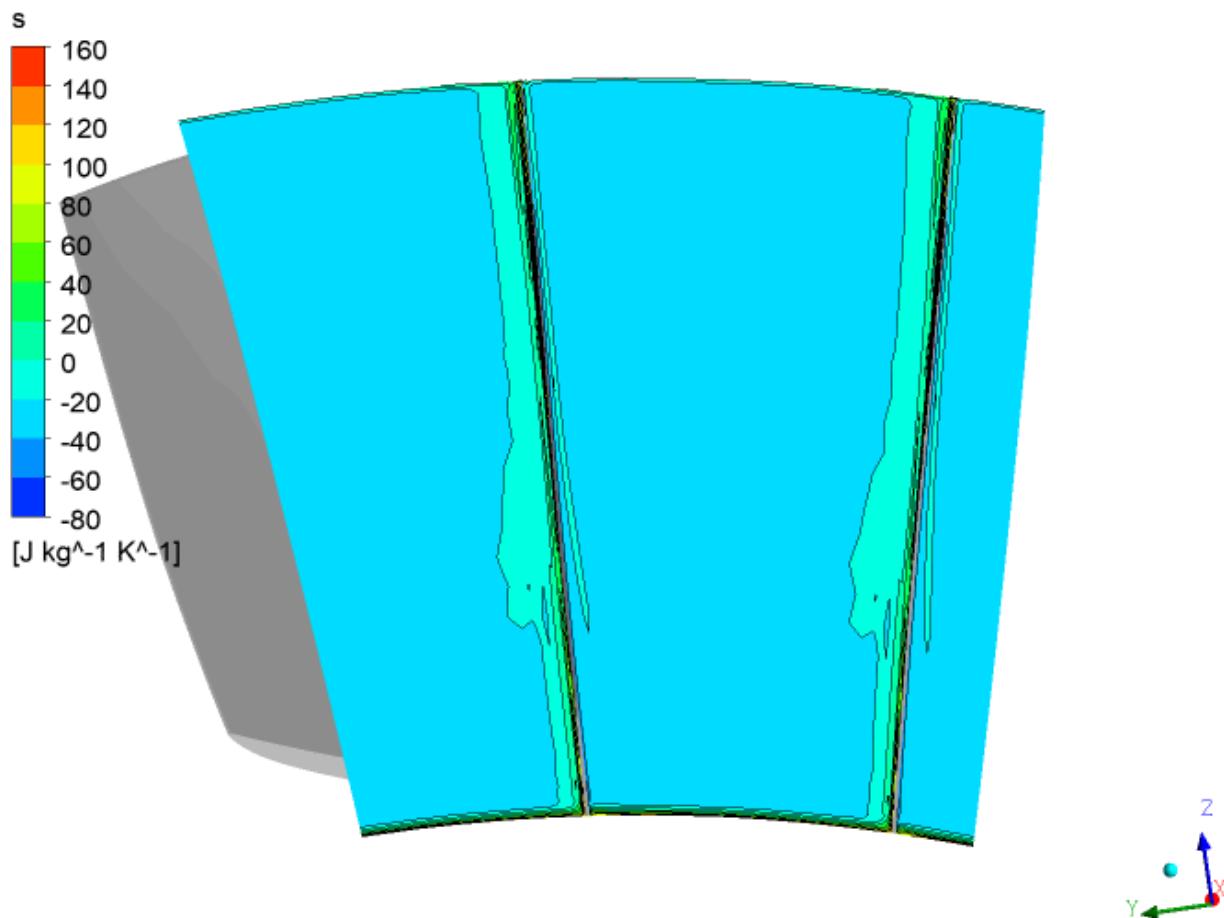
Figure 20. Contour of s at Blade LE

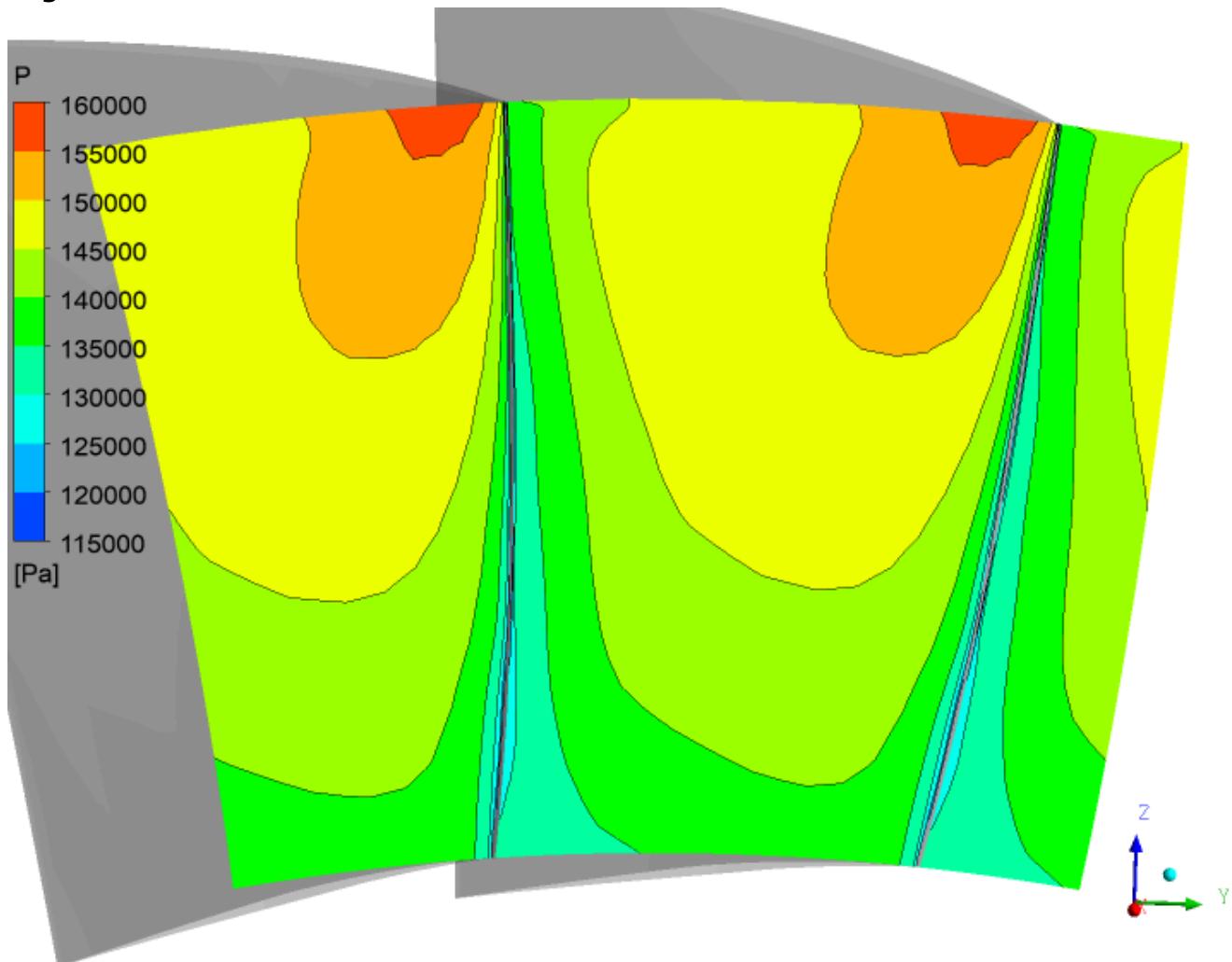
Figure 21. Contour of P at Blade TE

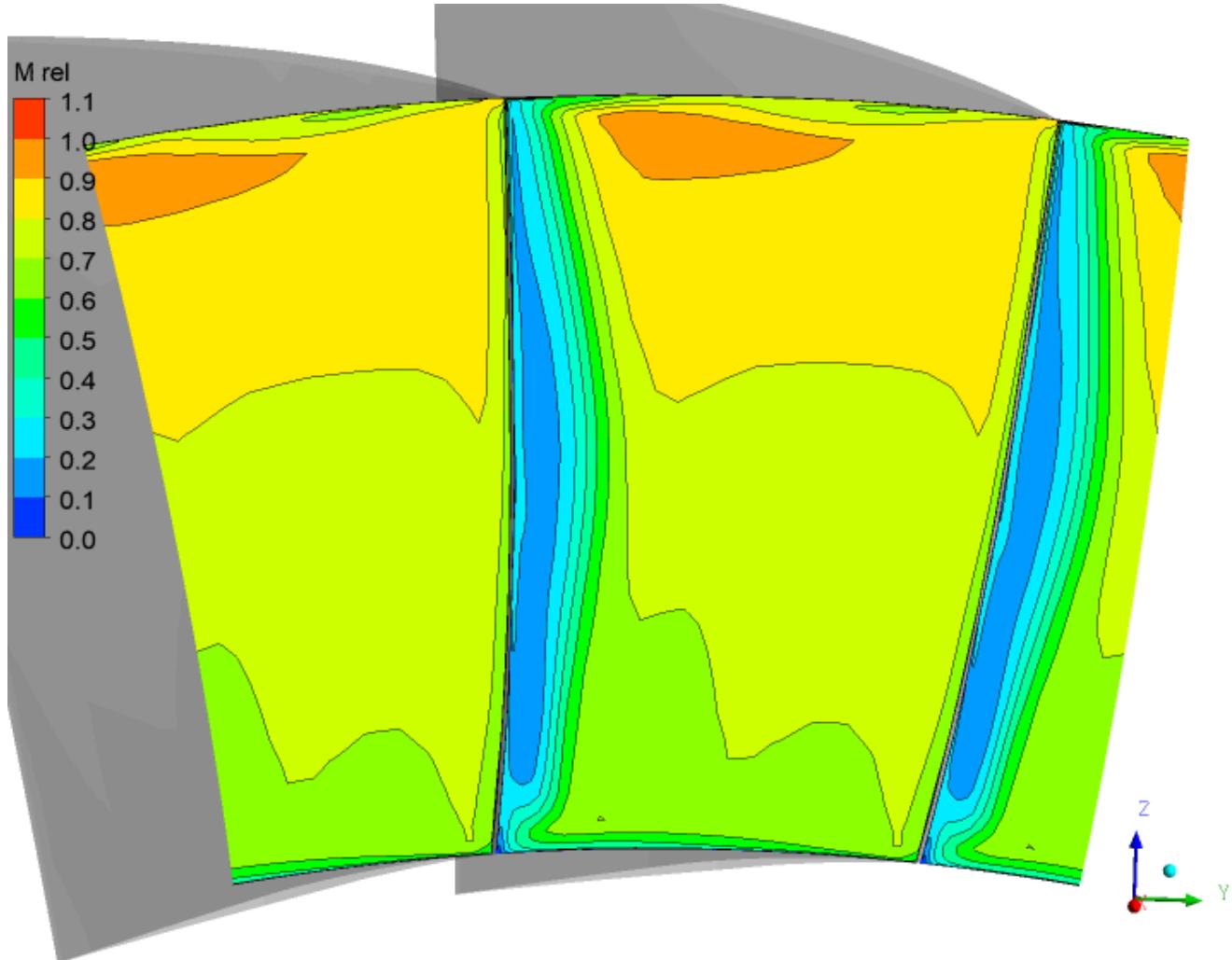
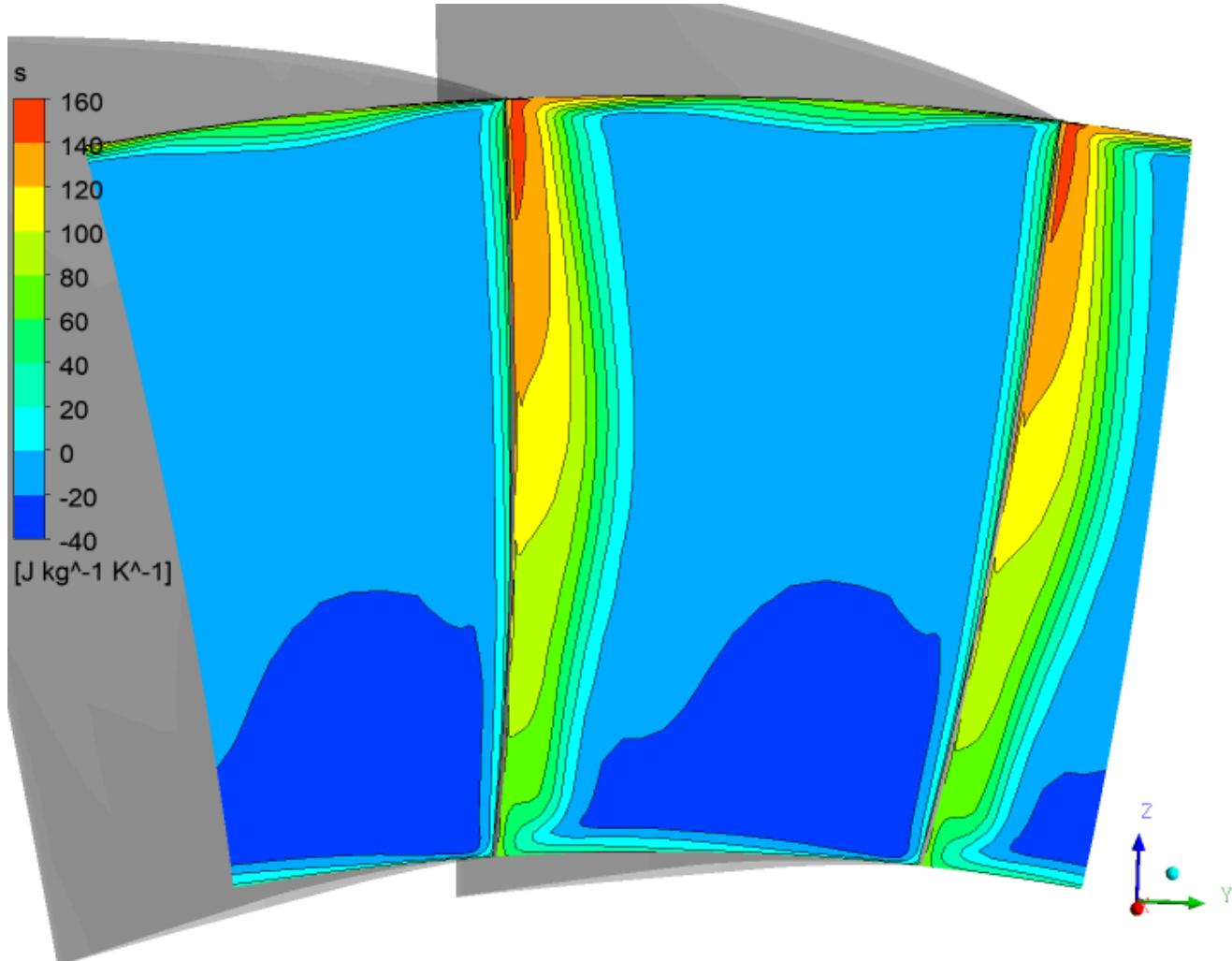
Figure 22. Contour of M rel at Blade TE

Figure 23. Contour of s at Blade TE

13. Streamline Plot

Figure 24. Velocity Streamlines at Blade TE

