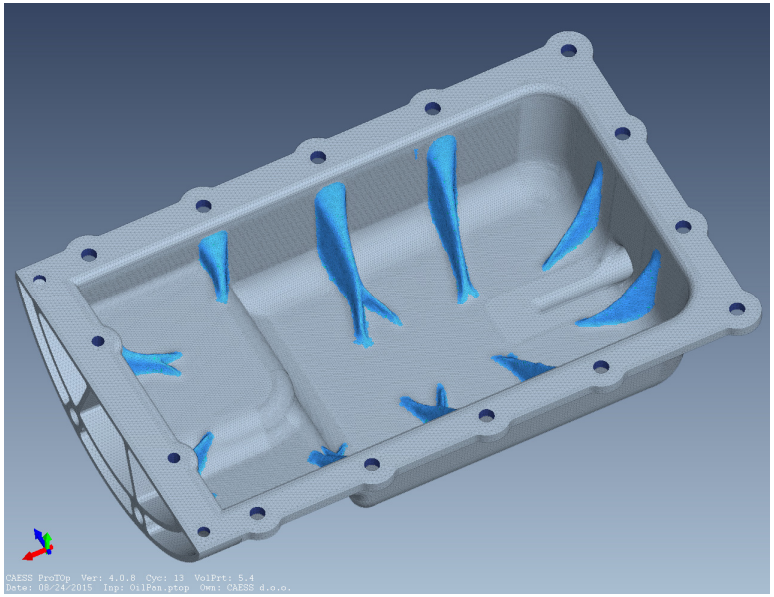
Case Study

Lowest eigenfrequency maximization of an oil pan by topology optimization



SOFTWARE

CAD and FEA model:

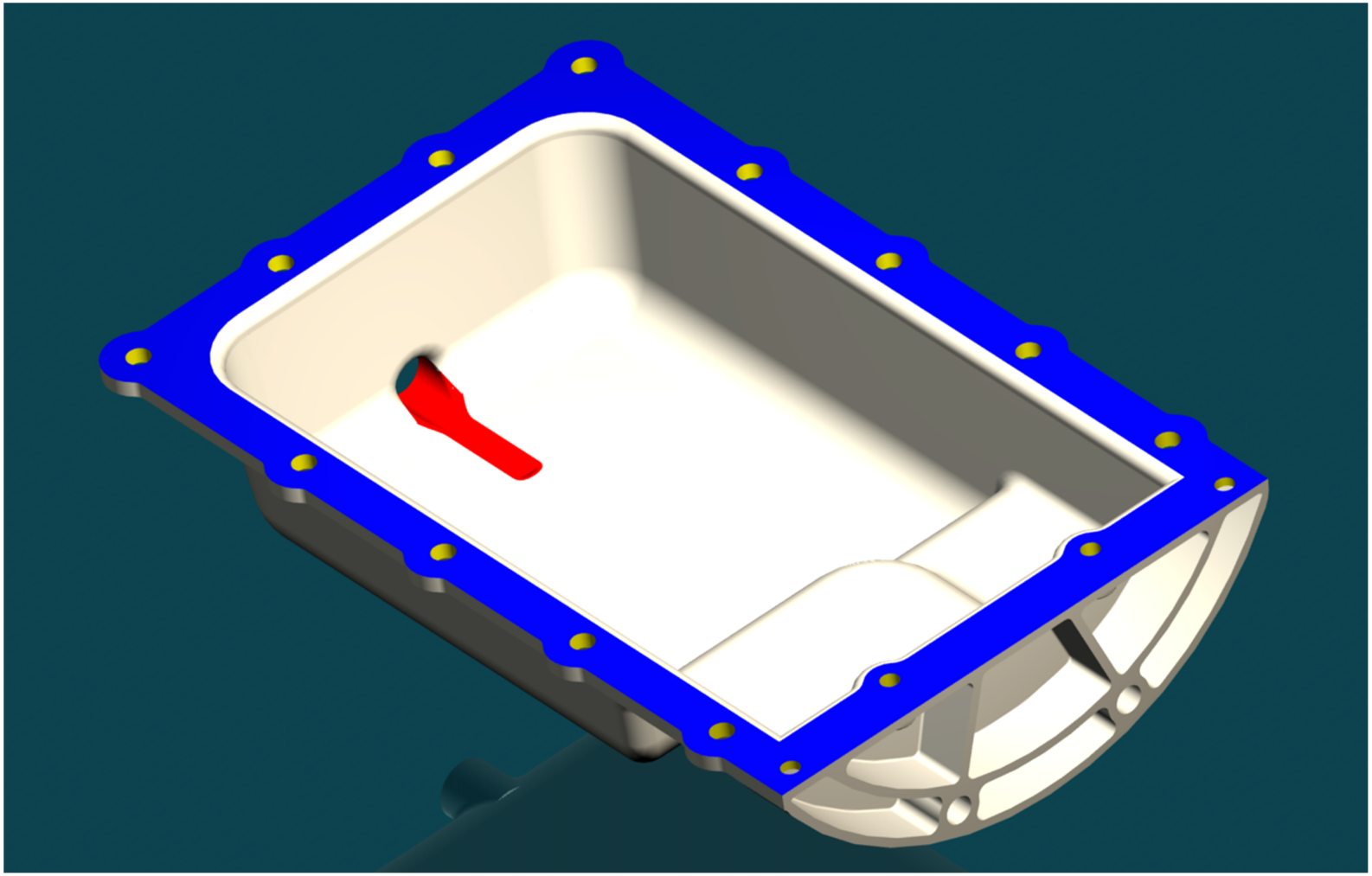
PTC Creo 3.0

Optimization:

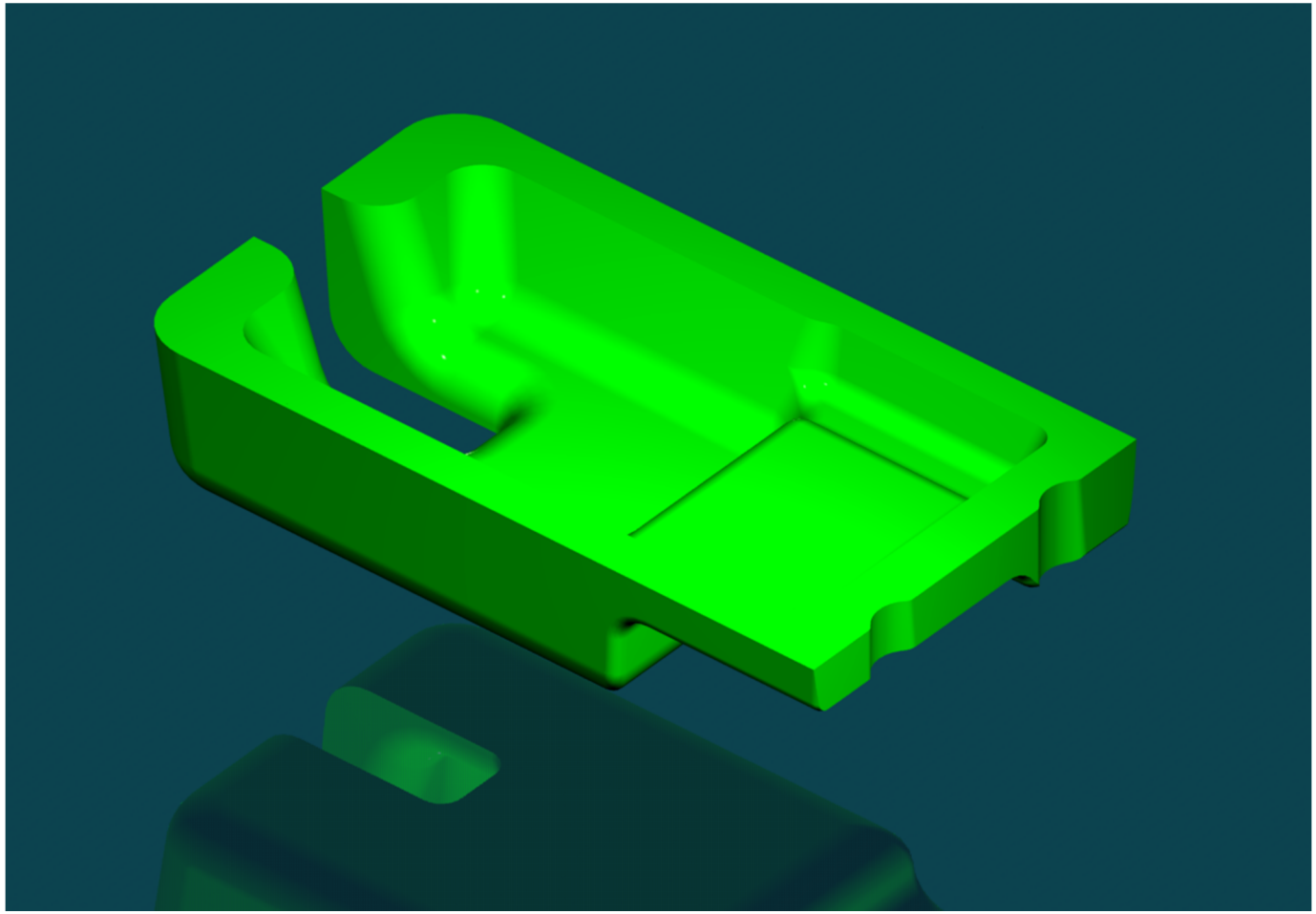
CAESS ProTOp 4.0.8

(extended with development modules for eigenfrequencies)

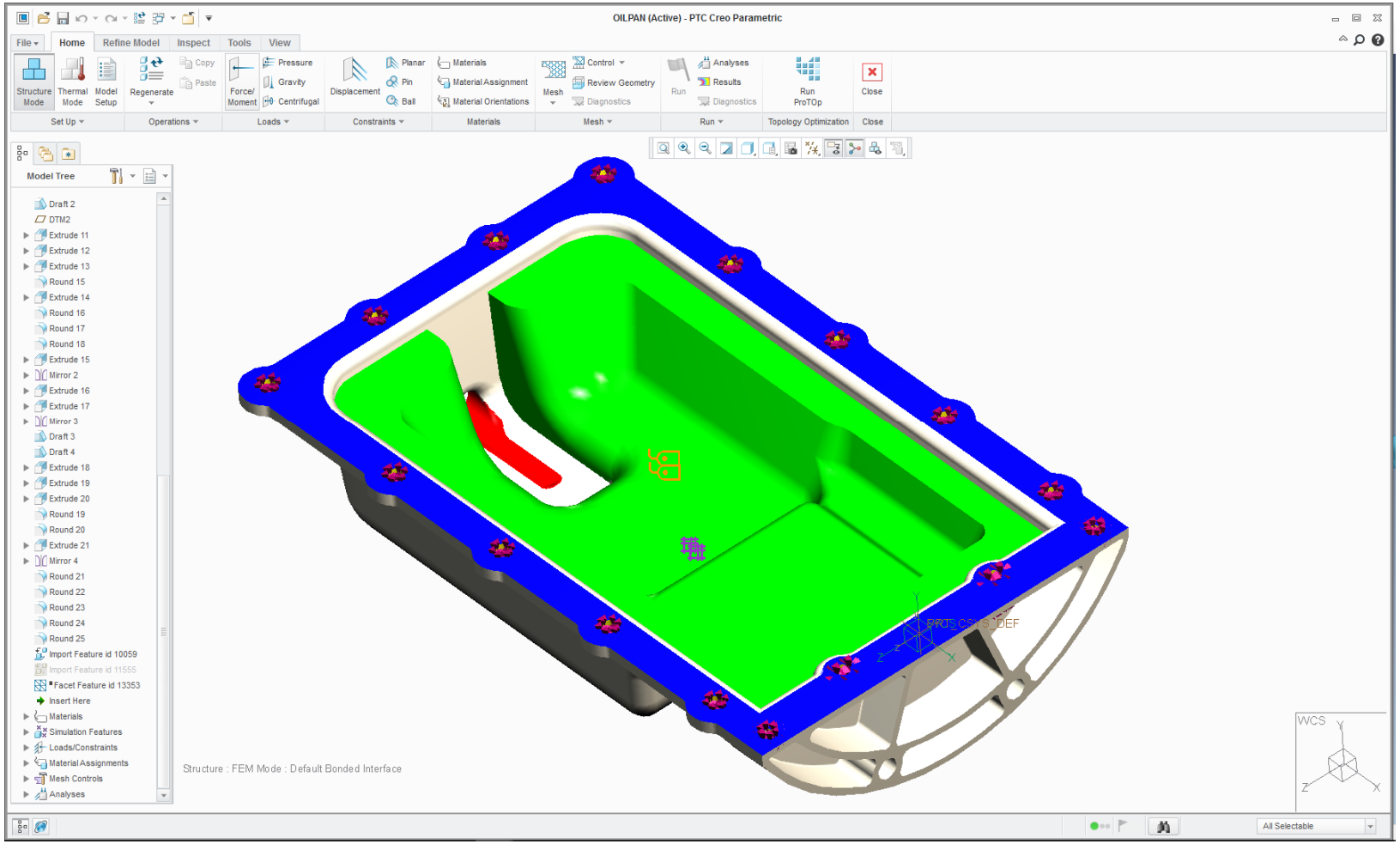
Model – Fixed domain



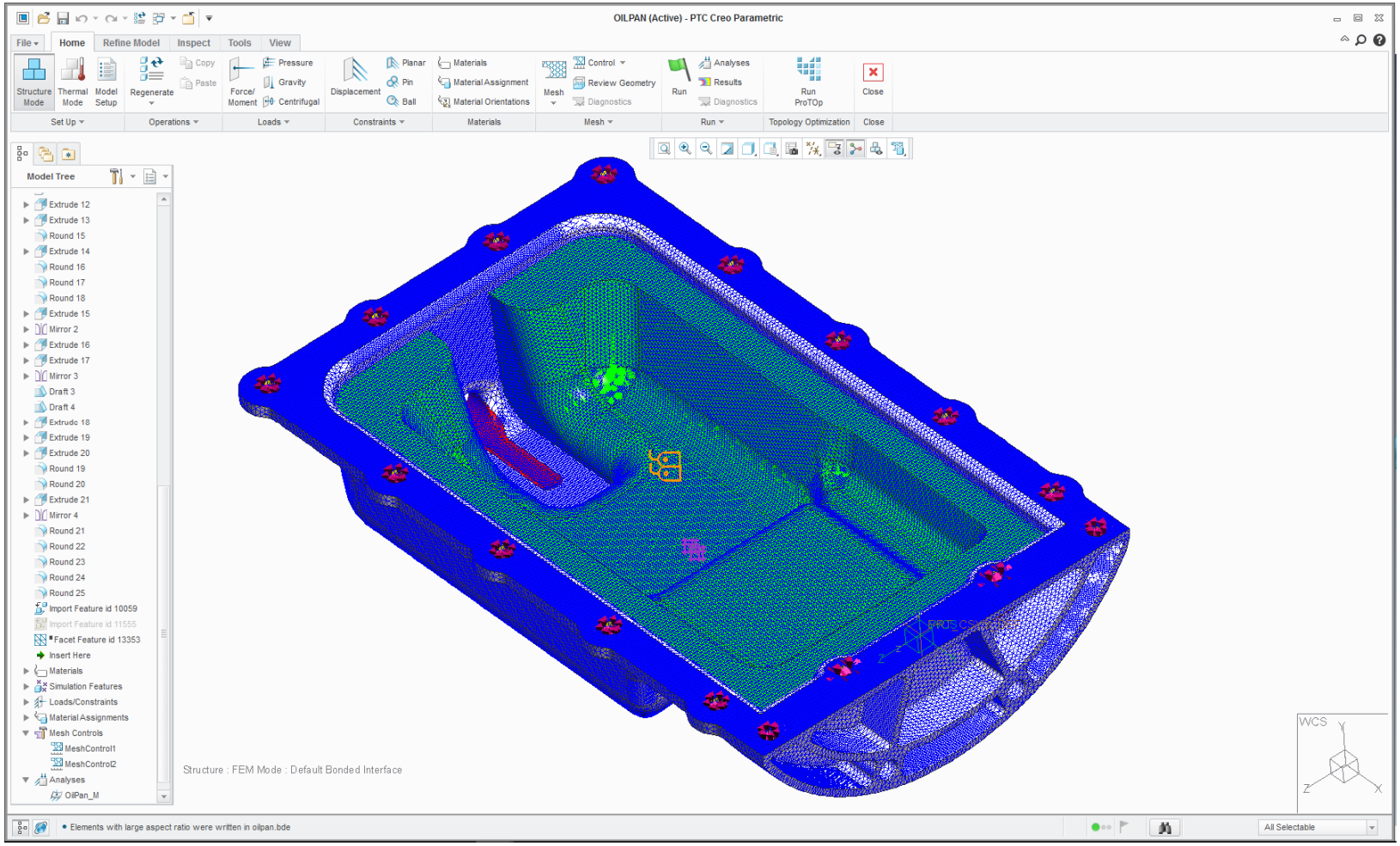
Model – Free (optimization) domain



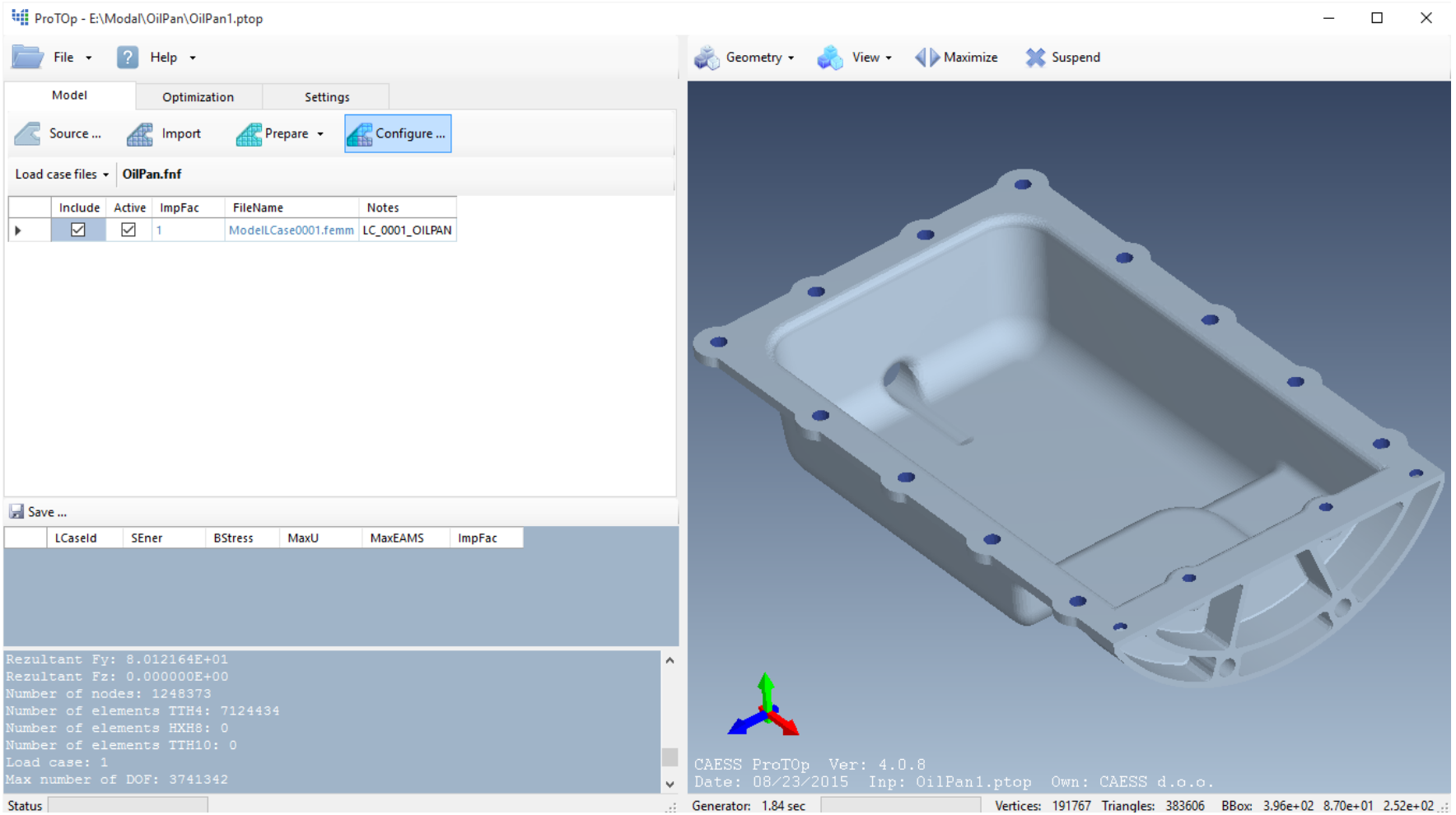
Model – Initial design with fixed (white) and free optimization (green) domains



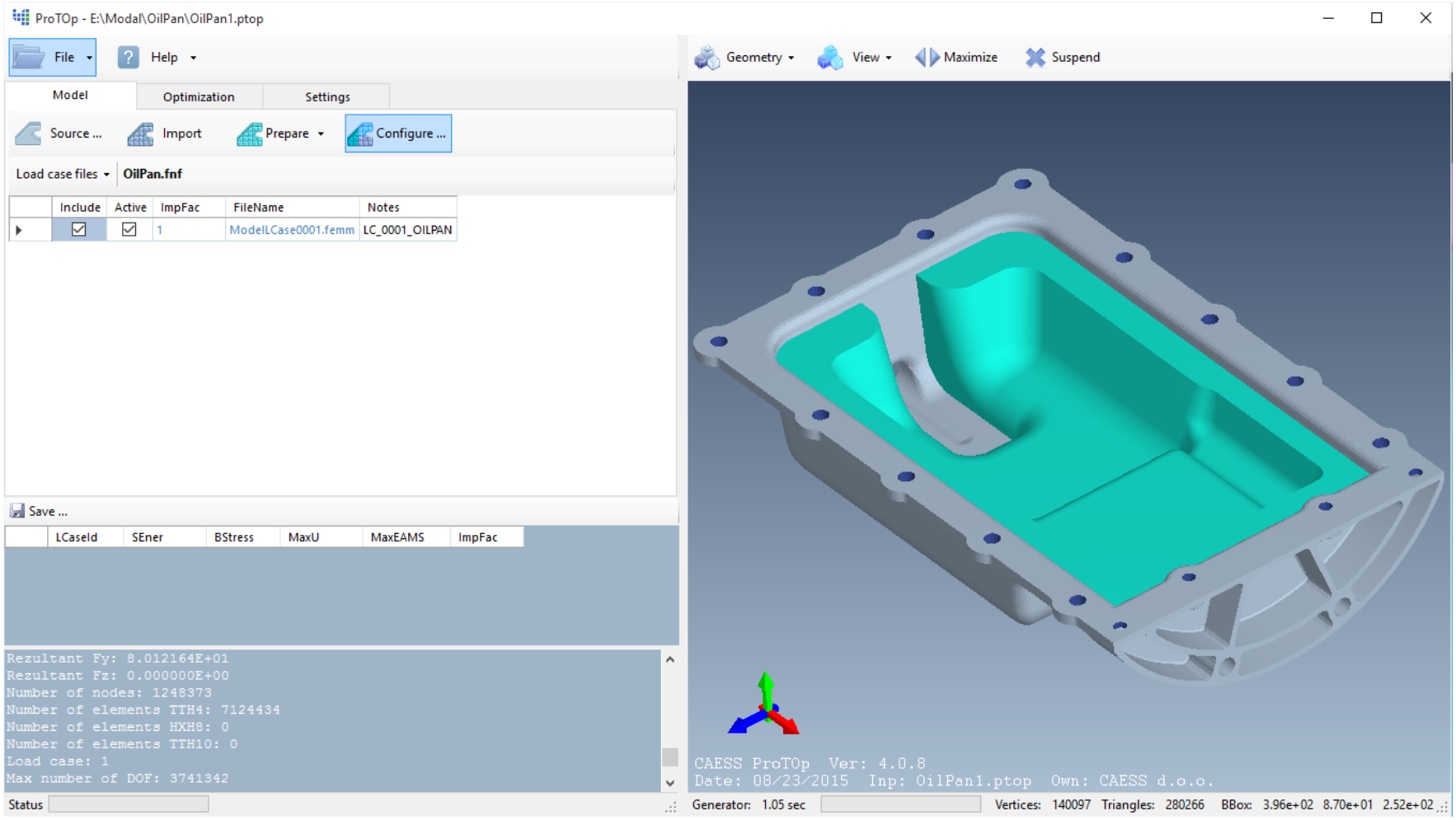
FEA model


OILPAN (Active) - PTC Creo Parametric
File
Home
Refine Model
Inspect
Tools
View
Structure Mode
Thermal Mode
Model Setup
Regenerate
Copy
Paste
Force/ Moment
Pressure
Gravity
Centrifugal
Displacement
Planar
Pin
Ball
Materials
Material Assignment
Material Orientations
Mesh
Control
Review Geometry
Diagnostics
Run
Analyses
Results
Diagnostics
Run ProTOp
Close
Set Up
Operations
Loads
Constraints
Materials
Mesh
Run
Topology Optimization
Close
Model Tree
Extrude 12
Extrude 13
Round 15
Extrude 14
Round 16
Round 17
Round 18
Extrude 15
Mirror 2
Extrude 16
Extrude 17
Mirror 3
Draft 3
Draft 4
Extrude 18
Extrude 19
Extrude 20
Round 19
Round 20
Extrude 21
Mirror 4
Round 21
Round 22
Round 23
Round 24
Round 25
Import Feature id 10059
Import Feature id 11555
Facet Feature id 13353
Insert Here
Materials
Simulation Features
Loads/Constraints
Material Assignments
Mesh Controls
MeshControl1
MeshControl2
Analyses
OilPan_M
Structure : FEM Mode : Default Bonded Interface
WCS
Elements with large aspect ratio were written in oilpan.bde
All Selectable

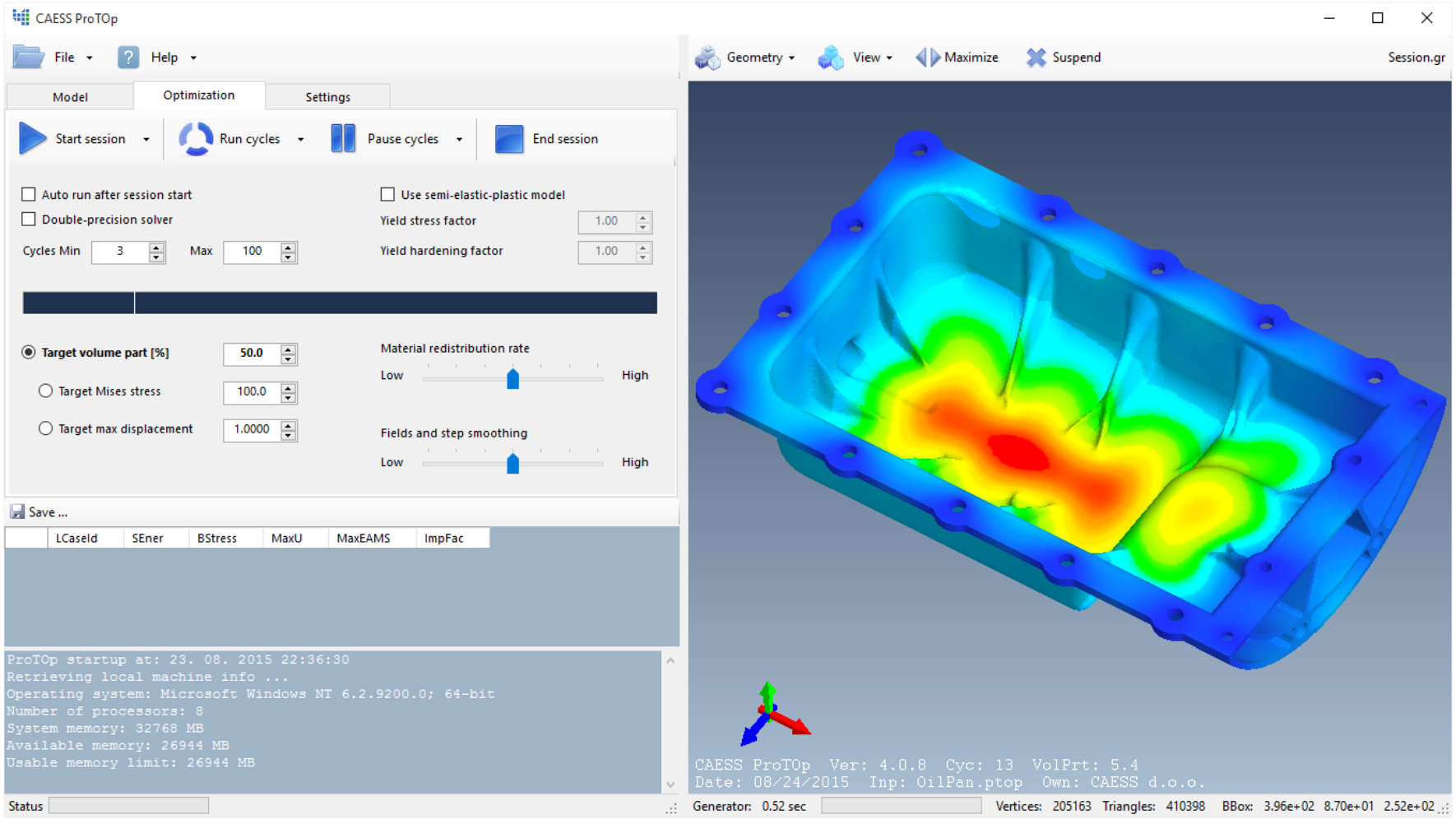
Optimization model – Fixed domain



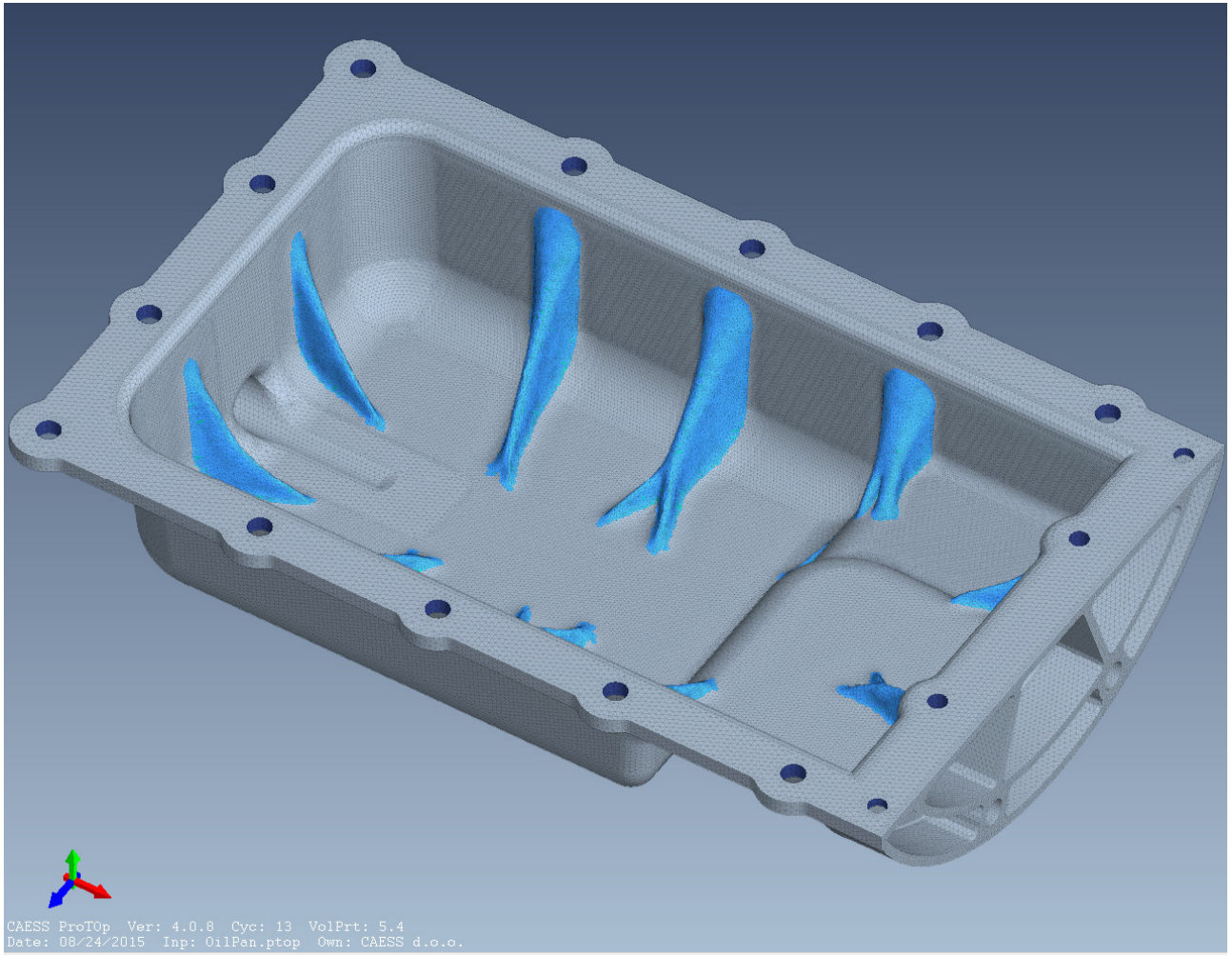
Optimization model – Fixed and free domains



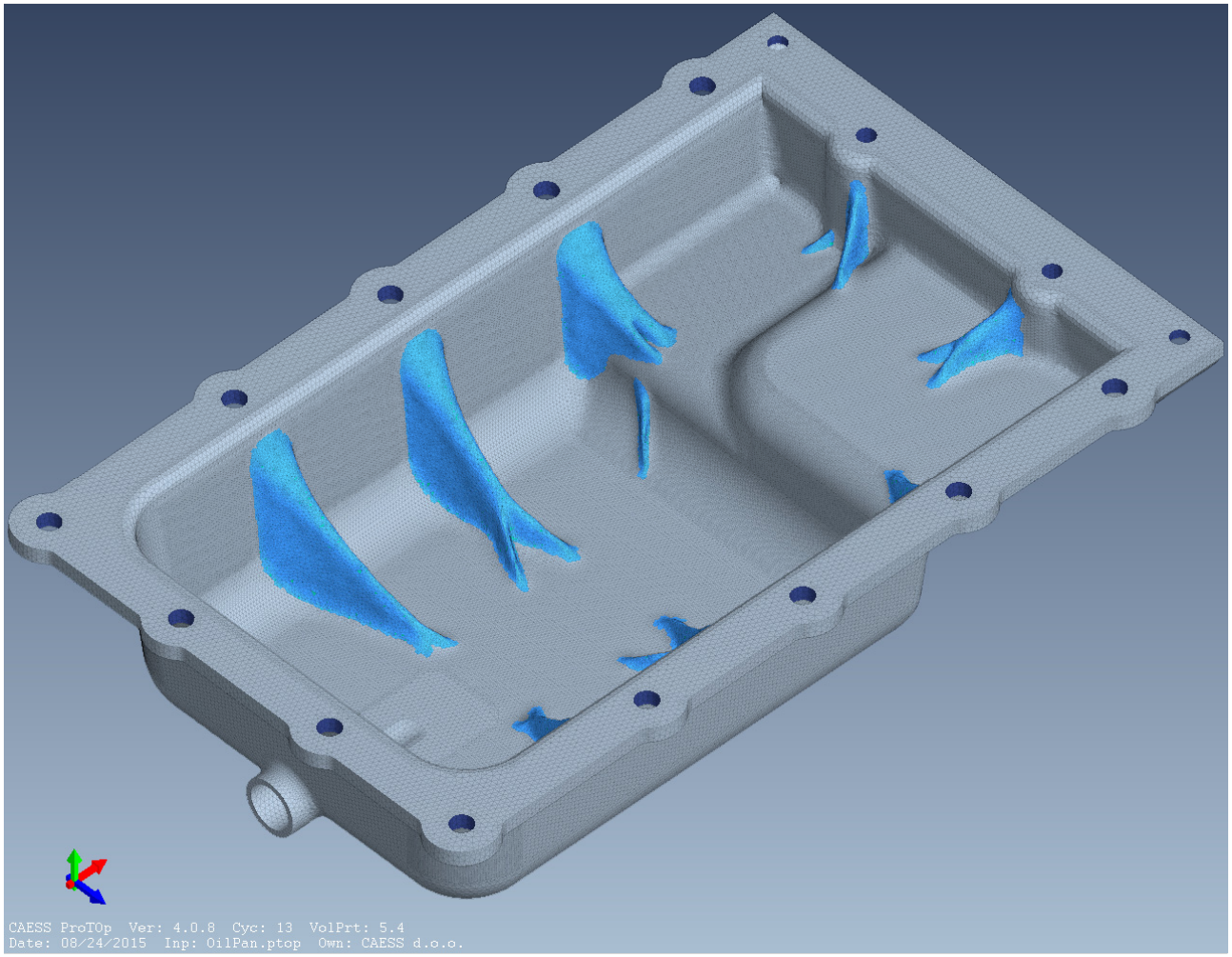
Results – Final design and lowest eigenmode



Results


CAESS ProTOp Ver: 4.0.8 Cyc: 13 VolPrt: 5.4
Date: 08/24/2015 Inp: OilPan.ptop Own: CAESS d.o.o.

Results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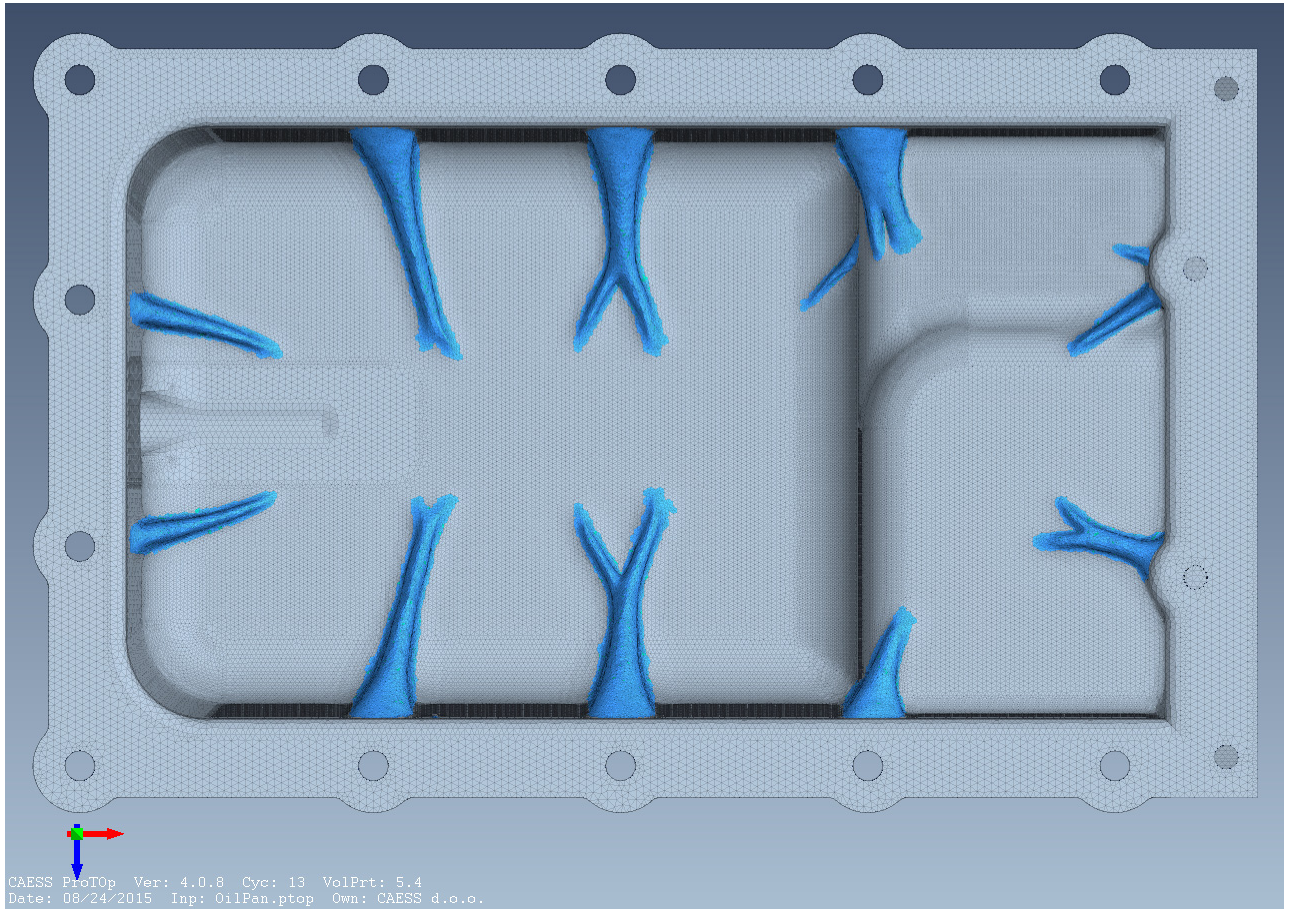
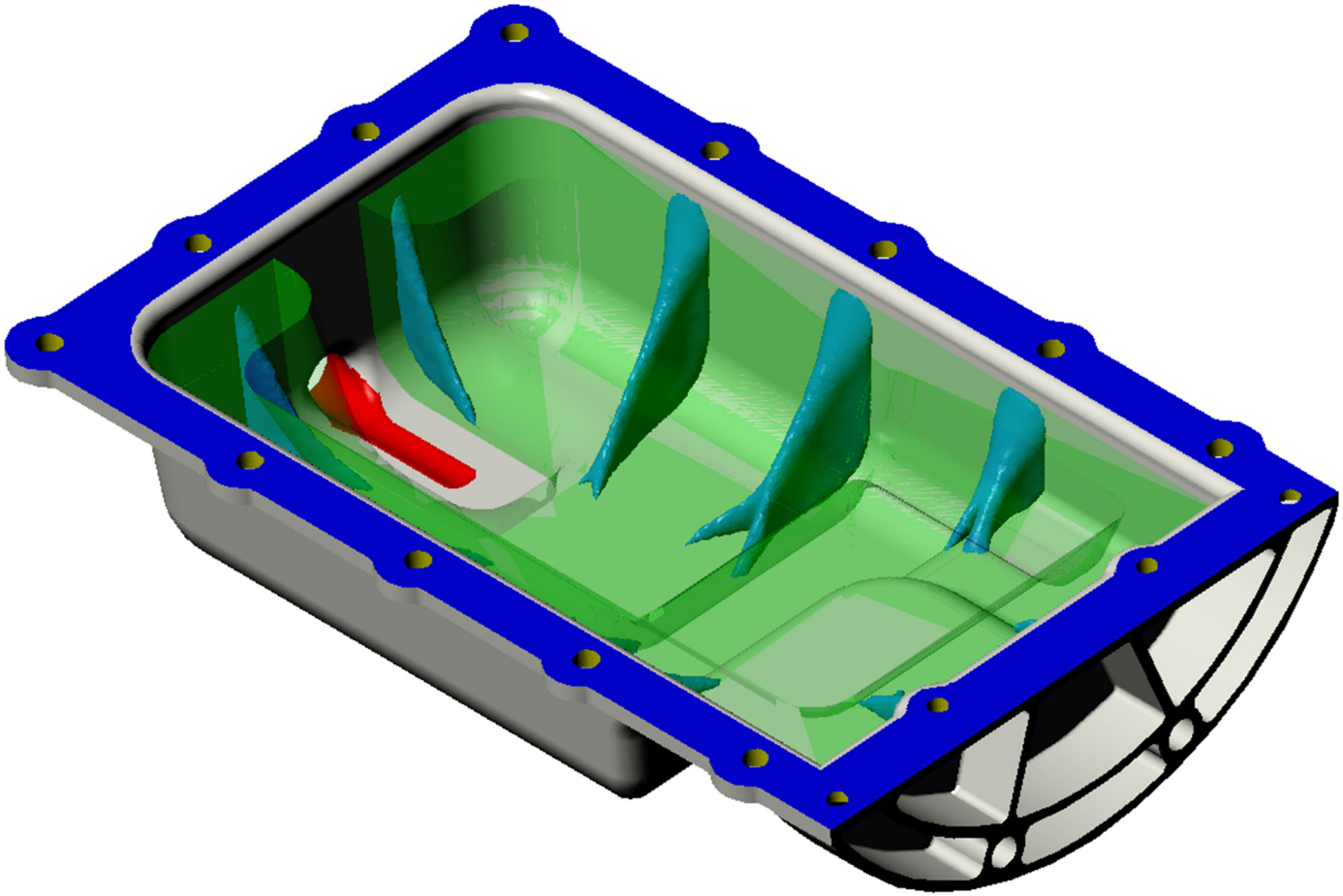
Date: 08/24/2015 Inp: OilPan.ptop Own: CAESS d.o.o.

Results


CAESS PtoTOp Ver: 4.0.8 Cyc: 13 VolPrt: 5.4
Date: 08/24/2015 Inp: OilPan.ptop Own: CAESS d.o.o.

Results – fixed, initial free, and optimal free design domains



Model data and results in numbers

FEA		
	Model 1	Model 2
Elements type and number	TTH4; 2.401.495	TTH4; 7.124.434
DOF	1.296.930	3.741.342

Structure		
	Initial – fixed domain	Optimal – fixed domain + ribs
Volume, mm3	7,936e+05	9,079e+05
Lowest eigenfrequency, Hz	917	2354

Optimization CPU time: 4 hours (PC with i7 3770K CPU, 32 GB of RAM)