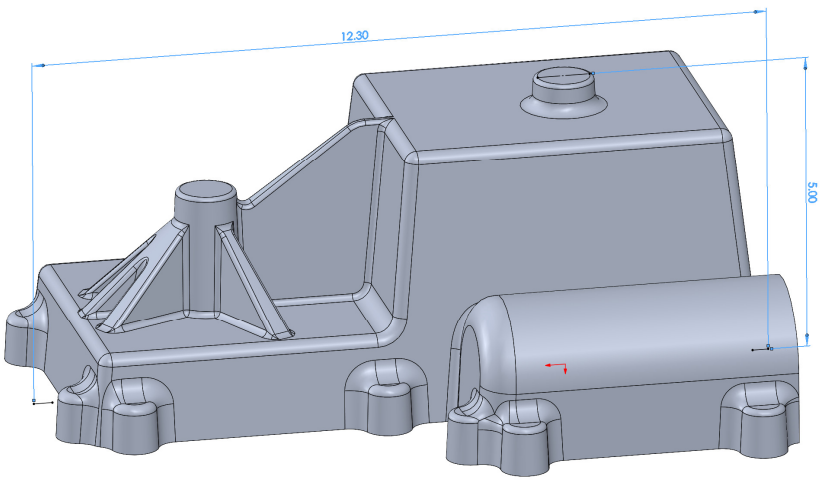
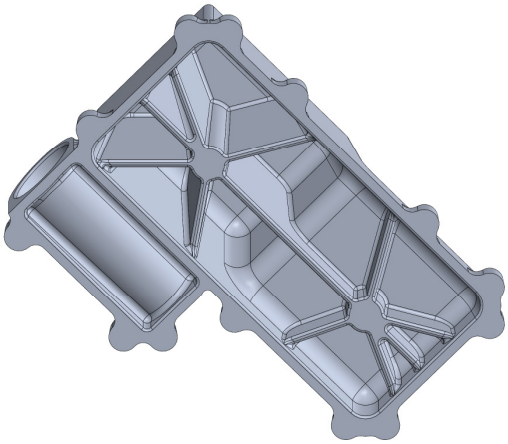
Casting Die Set

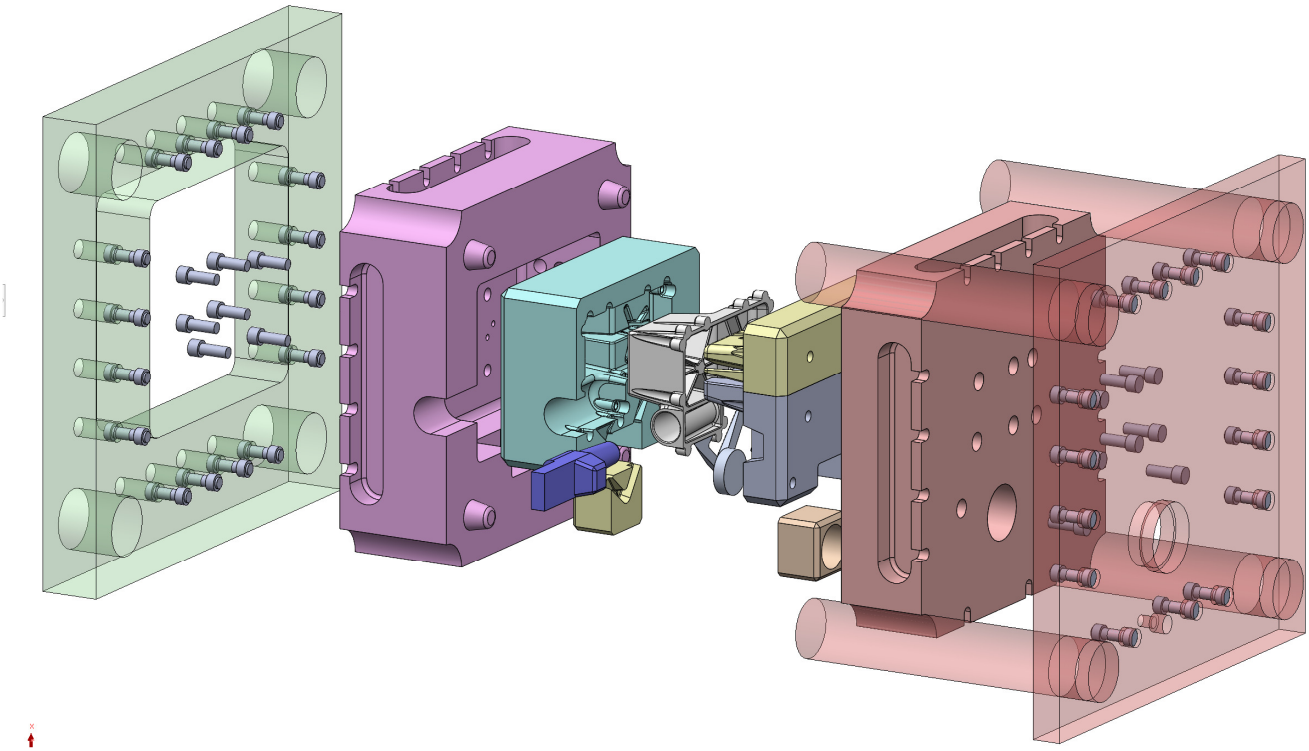
Thermal Stress in Die and Holders With Pressure

An aluminum cover casting is to be made in a high pressure die cast process. A pattern of ribs brace deep pockets in the cover side. Net weight is about 9 pounds in a 12x5x9 inch envelope.





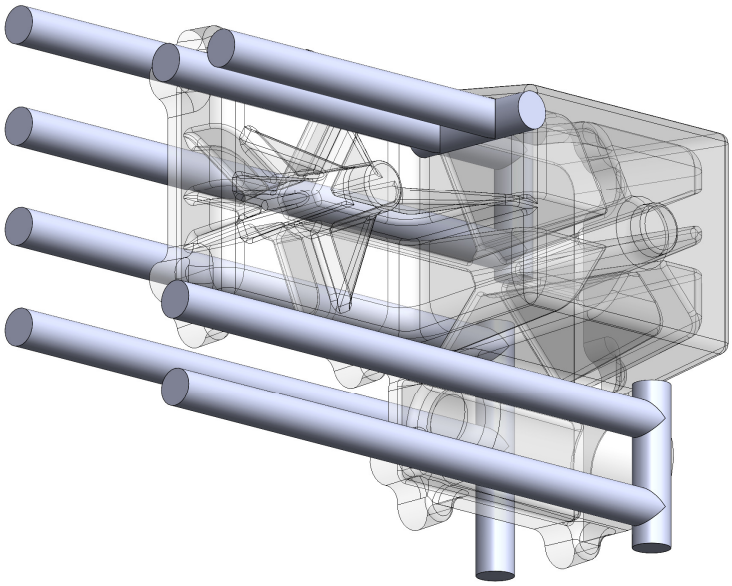
A die set is developed with multiple inserts, one slide, cover and ejector holders, and simplified platens. Bolts are modeled as solids for holding of inserts and clamping holders to the platens.



A simple set of cooling loops is cut into the model cavity inserts.

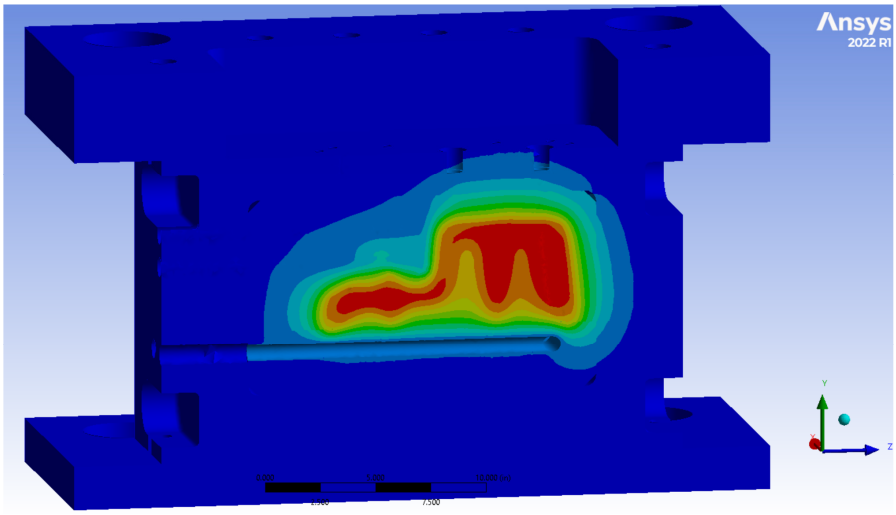
The objective is to see stress in the die set from thermal loading in addition to fluid pressure.

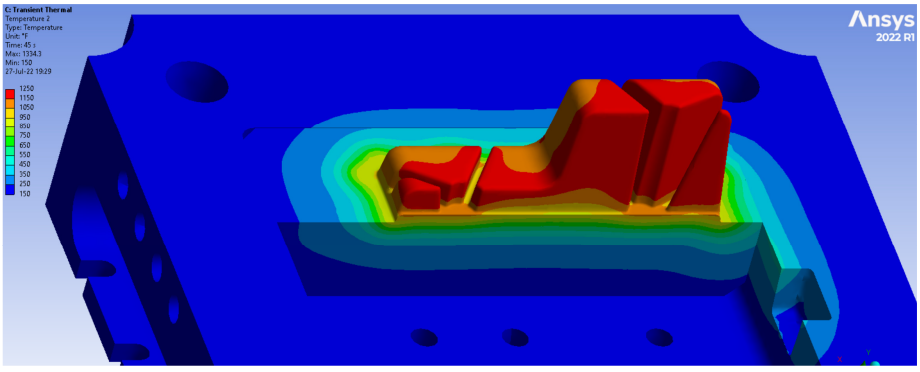
To generate a thermal load for this demonstration a simple casting cycle is simulated several times in Ansys transient thermal, without latent heat or solidification. It is strongly recommended that the client use a true solidification system like from EKK. Stone Lake can import temperature fields from most professional packages.



A temperature field is developed through the die set.

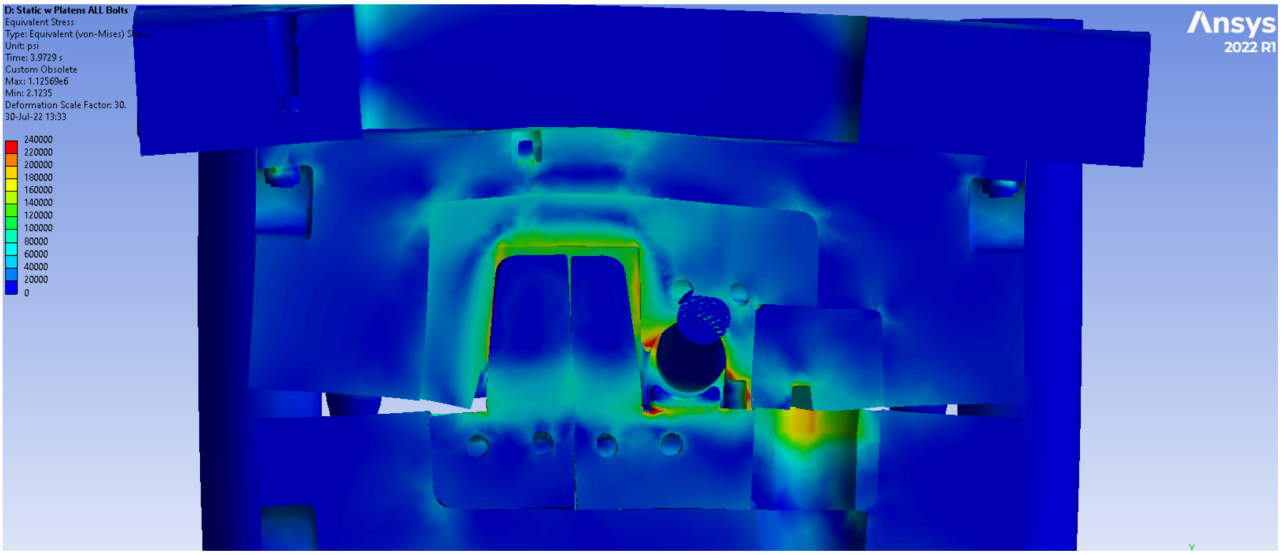
Action of the cooling lines can be seen in section view.





Of particular interest are temperatures in the cover side inserts. The deep pocket in the part translate into isolated towers in the mold shape. These towers can get very hot, leading to temperature imbalance with the bulk material of the insert.

Die component temperatures become one input into an Ansys structural model of the assembled set. All parts are in contact. Bolt preload and fluid pressure are included.
A section view of stress in the assembly, with exaggerated displacement, shows problems in machine sizing and ejector side support [this was intended for the demonstration].



Stress plots on cavity inserts show hot spots on locations with thin walls, high thermal gradient, and geometric transition.

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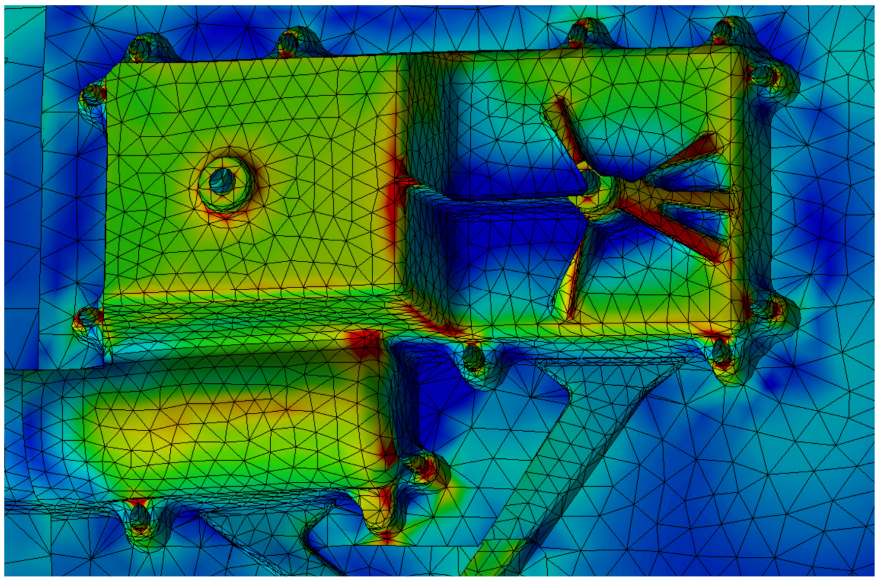
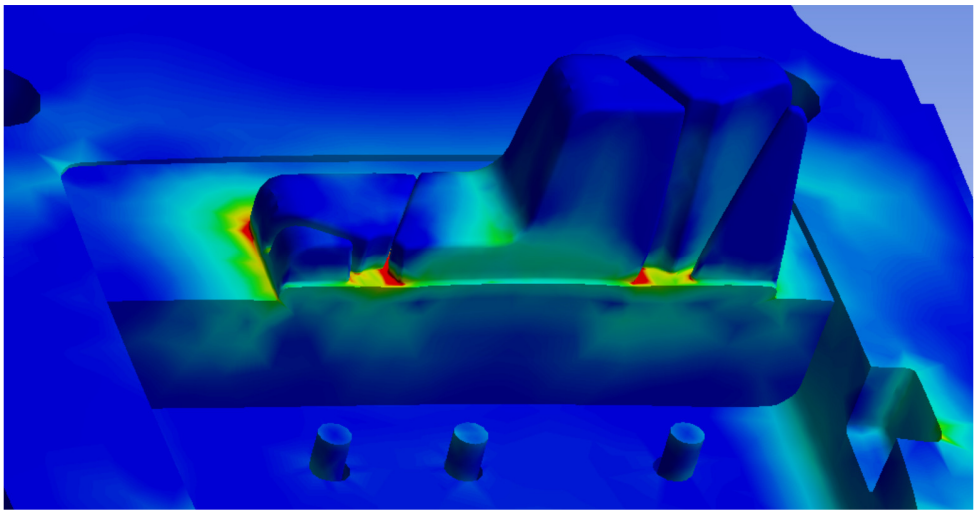
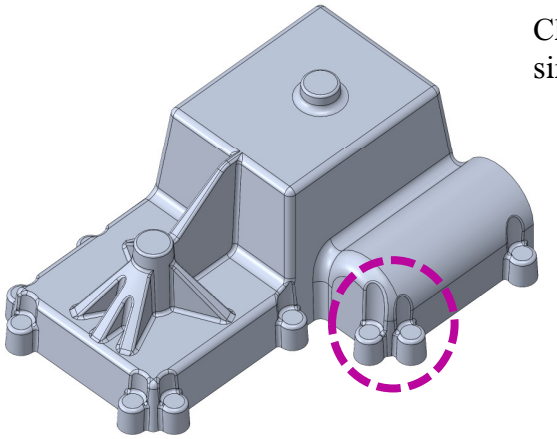
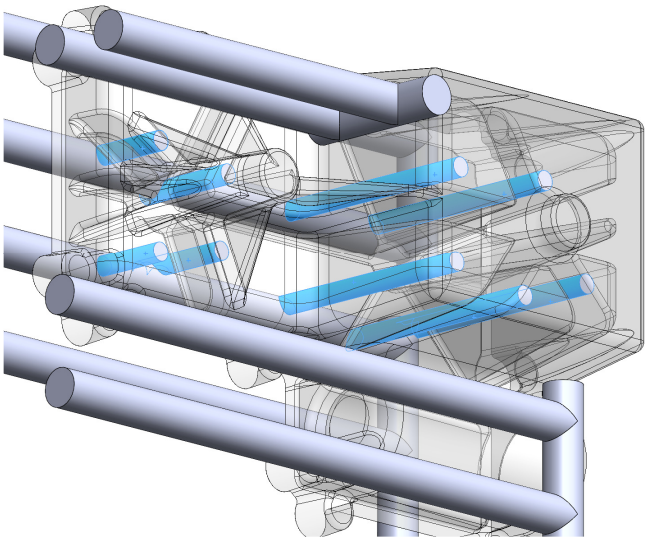
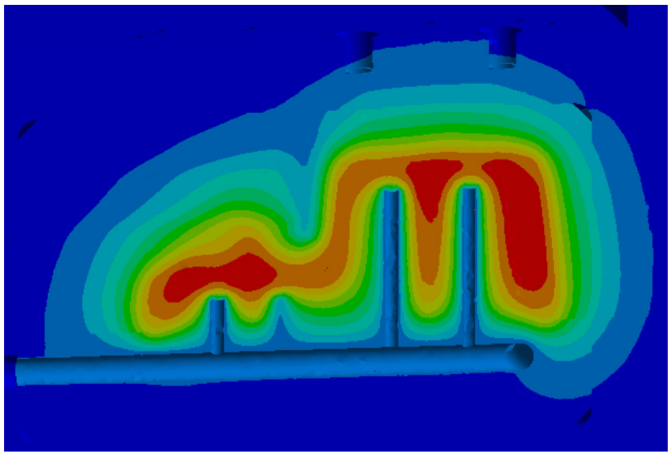


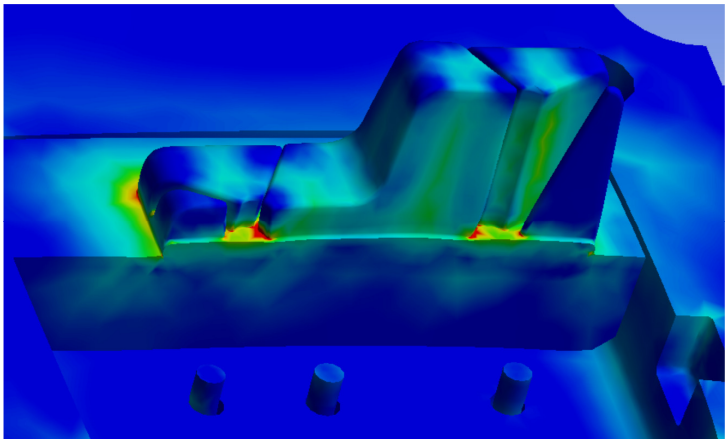




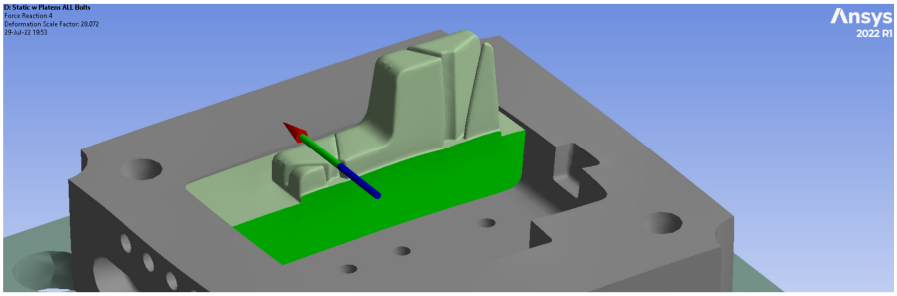
Changes to geometry and cooling are fed into a new simulation iteration.







Changes in the results are small but clear in this high-fidelity model. The added cooling is found to reduce primary forces from thermal loads in the cavity inserts by over 30%.



With accurate casting simulation and further design work this die can be readily improved.

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