Ansys

CASE STUDY /

Ansys + Rocket Propulsion Team

"The incorporation of Ansys into our work at USC's Rocket Propulsion Lab has helped our team forge ahead with new confidence and new sophistication into projects that just years ago we thought were out of reach. Beyond its technical contributions, using Ansys simulation software has also encouraged RPL members to gain a deep understanding of engineering analysis, developing them into some of the best engineers to graduate from our nation's universities."

Mark McDermott
Analysis Lead / University of Southern California Rocket Propulsion Lab

CASE STUDY

Ansys Software Drives Innovation in RPL Student Designs and Maximizes Educational Experience

As the first undergraduate student team to send a rocket to space, the University of Southern California's Rocket Propulsion Lab (RPL) must analyze complex problems across many technical areas. Since incorporating Ansys software, RPL has gained new insights into the behavior of critical systems to predict and optimize component performance. Ansys software is now incorporated as a standard analysis technique to assess phenomena that can't be effectively analyzed by hand and to verify predicted behavior.

Challenges

Using Ansys has enabled RPL to expand beyond its expertise in solid propulsion with the design of a new liquid-fueled rocket engine they are building from the ground up. This project has challenged the team with new fluid flow, heat transfer, vibration, structural and data acquisition problems. While hand calculations can be helpful in the brainstorming stage of the design, Ansys simulations make it possible to turn brainstorming ideas into a design that is test ready.

Ansys Products Used

- Ansys Fluent
- Ansys Mechanical

Engineering Solution

- Ansys Fluent was used to confirm that the pintle injector geometry sized with hand calculations for the liquid engine provided adequate mixing, even flow distribution and a pressure gradient that prevents backflow from the combustion chamber and remains within the limitations of upstream piping.
- Ansys Mechanical transient thermal simulations ensured that insulation and temperature management elements maintain key components within required temperature envelopes.
- Parameterized inputs and outputs in the Ansys Workbench interface enabled rapid validation of the design in multiple possible environments.
- Structural simulations confirmed bolt sizing and manifold material selection.

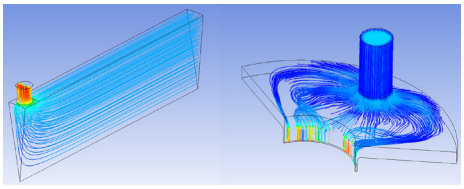
Benefits

By enabling rapid iteration and confirmation of design choices, RPL's use of Ansys software provided the technical understanding and documentation to pass a design review, gain funding and begin construction of its first attempt at liquid propulsion in just nine months.

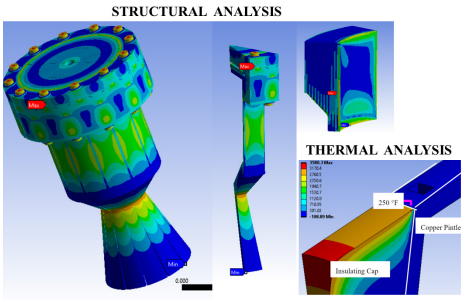
Having real-world, hands-on experience with Ansys tools has also prepared RPL members for work in industry. By rapidly analyzing physical phenomena and demonstrating the need for a thorough understanding of a component environment to establish an accurate simulation, Ansys software hones engineering judgement.

Company Description

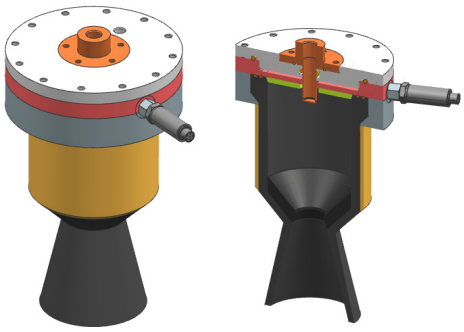
Armed with determination and the goal of putting a scratch-built rocket into space, the University of Southern California's Rocket Propulsion Laboratory (RPL) was the world's first student organization to successfully launch and recover an entirely student-designed and student-fabricated rocket (Traveler IV) past the Karman line, the recognized boundary of space at 100 km (328,084 ft). Now, the lab pushes forward with new goals, both in our atmosphere and beyond.



Ansys Fluent simulations verified discharge coefficient research and pressure drop estimation from hand calculations.



The Ansys Mechanical environment enabled consideration of structural margins within a bolted joint and an angled composite layup.



The assembly of the thrust chamber, including a pressure transducer for measurements during a hot fire.

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