

MSC Software's Marc Nonlinear Finite Element Analysis Plays Key Role in Composite Research

SANTA ANA, CA--(July 10th, 2012) – MSC Software Corporation, the leader in multidiscipline simulation solutions that accelerate product innovation, today announced that MSC Software's [Marc](#) Nonlinear Finite Element Analysis (FEA) software is playing a central role in undergraduate teaching and composites research at Santa Clara University (SCU).

"The unique capabilities of Marc to simulate composite curing and shrinkage is critical in the development of an optimal curing cycle that minimizes curing cycle time and part warpage," said Adjunct Professor T. Kim Parnell of Santa Clara University (SCU).

Curing requirements are strongly dependent on both the part geometry and the resin system. Thermosetting resins are generally exothermic, meaning that they generate heat as they cure. This heat generation may be significant, particularly for thick parts. Likewise, the resin system undergoes shrinkage as it cures. There are competing effects of the need for sufficient external heat applied to initiate the curing, then heat generated by the curing itself, shrinkage associated with curing, and generally thermal expansion from the elevated temperature.

For these reasons, a coupled thermal-curing-mechanical analysis is essential to accurately predict the curing profile, time to cure, degree of cure, and ultimately any warpage, distortion, or residual stress in the final part. All of these effects are tightly coupled, and the capability in Marc is critical to create acceptable parts, according to Professor Parnell. As composites are taking a larger role at SCU in terms of both projects like the SAE Formula Hybrid vehicle, and in classes like Composite Materials and in Finite Element Theory & Applications, students are learning first-hand about the requirements and special considerations needed for composites.

About Professor T. Kim Parnell – Santa Clara University (SCU)

Dr. Parnell is an engineering consultant with Parnell Engineering & Consulting (PEC), and is an Adjunct Professor in Mechanical Engineering at Santa Clara University where he teaches materials, manufacturing, design, finite elements, failure analysis, and composite materials. He previously served as a Visiting Associate Professor at Stanford University. Dr. Parnell consults in a number of technology fields and applies his experience in failure analysis and reliability to improve products. He is active with the global team associated with the Composites Design Workshop at Stanford and presents on *Composite Delamination*,

Progressive Failure & Damage. Prior to starting PEC, Dr. Parnell spent 13 years with Exponent Failure Analysis Associates and was a Senior Managing Engineer.

About MSC Software

MSC Software is one of the ten original software companies and the worldwide leader in multidiscipline simulation. As a trusted partner, MSC Software helps companies improve quality, save time, and reduce costs associated with design and test of manufactured products. Academic institutions, researchers, and students employ MSC's technology to expand individual knowledge as well as expand the horizon of simulation. MSC Software employs 1,000 professionals in 20 countries. For additional information about MSC Software's products and services, please visit: www.mscsoftware.com

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