COMPOSITES DESIGN TUTORIALS 1 AND 2

Two similar versions of the Composites Design Tutorial, a comprehensive tutorial, were offered, respectively from September 4 to November 20, 2007, and from April 8 to June 24, 2008. The goal was to develop a global network for training and rapid dissemination of discoveries in composites design through the Internet. The 12 weekly sessions were offered twice each Tuesday at 08:00 and 20:00 California time. The early session reached the Americas and Europe; the later session, Asia.

Each session was ended by live Question/Answer in English, and followed by further discussion in French on Tuesdays, Spanish on Wednesdays and Portuguese on Fridays all at 08:00 within the same week. Native languages facilitated broadening exchanges of ideas among many participants. Software demo sessions were conducted on Mondays at 08:00 and 20:00. Group learning was an attractive feature that allowed companies to train many engineers under one payment. As many as 57 participants were in a group. Travel was not necessary. The cost of the tutorial was US$1,500 for the first WebEx connection for newcomers and $500 for additional connections and returnees for Tutorial 2. Each participant over the first one was charged US$150. All lectures, design tool demonstration and Q&A in English and native languages could be downloaded and viewed at participants own leisure, place and pace. Q&A through chat lines, forum webpage and exchanges of e-mails were accomplished effectively. Included in the tutorial fee were the electronic version of Tsai's *Theory of Composites Design*, a student edition of Simulia-Abaqus 6.7, and software packages of Mic-Mac's, Super Mic-Mac and Super Mic-Mac+.

TOPICS COVERED

There were two outstanding keynote lectures: one on the first 100 years of composites by Billy Roeseler of the Boeing Company; another on wind turbine blade technology by Dr. Paul Veers of Sandia National Laboratory. Both speakers provided answers to many frequently asked questions.

Dr. Antonio Miravete, a visiting professor at MIT and Stanford, gave two lectures on basic knowledge on fiber and matrix materials and their processing. The importance of integrating design and manufacturing was made clear.

Prof. Stephen W. Tsai gave three lectures on the fundamental mechanics of composite materials and also introduced Mic-Mac calculators (for micro-macromechanics) to simply design as well as opening up design space. The drive to use fewer ply angles, rigid-body rotation and more finely dispersed plies symmetric and unsymmetric laminates were options leading to stronger composites, less weight and/or lower cost.

Bruce Kovac (Tutorial 1) and Pranav D. Shah & Jin Park (Tutorial 2) demonstrated the power of Simulia-Abaqus 6.7, even for the student edition which was limited to 1000 nodes. Many practical problems can be give insight of the technical challenge.

Prof. T. E. Tay of the National University of Singapore gave his lecture on modeling of progressive damage from his office in Singapore. It is an exceptionally difficult task to track failure of from element to element that strikes a balance between computation time and desired accuracy. Prof. Tay's EFM (element failure method) is one powerful tool for this purpose.

Prof. Yasushi Miyano of Kanazawa Institute of Technology, has pioneered in ATM (accelerated testing methodology) that converts temperature-dependent deformation into time-dependent creep and fatigue, gave his lecture on predictions of strength and life in various combinations of temperatures and times for use in practical design

Prof. Sung Ha of Hanyang University in Ansan, Korea, developed MMF (micromechanics of failure). He gave two lectures: the first explaining the theory behind the MMF concept; the second, its implementation on the software Super Mic-Mac, which also incorporates life prediction.

By extension to master curves (time and temperature dependent properties) of constituents, Dr. Sangwook Sihn of University of Dayton Research Institute outlined a fully integrated computational platform of MAE: integration of MMF, ATM and Evolution of Damage that included Prof. Tay's EFM. He demonstrated the damage process of a double-edge notched specimen under creep loading with the MAE implemented by the student edition of Simulia/Abaqus, and yielded useful insight of the damage process.

NUMBER OF INSTITUTIONS AND PARTICIPANTS

A total of 80 institutions and 304 participants signed up for the first tutorial and 40 institutions and 200 participants for the second. Although there was a significant growth in European institutions from Tutorial 1 to Tutorial 2, regions outside the US were still lagging.

TUTORIAL 3 (September 2 – November 18, 2008)

Two new speakers on Satellite Applications by Steve Huybrechts of DoD, and Test Methods by Ran Kim of UDRI have been added to broaden our coverage. A 2/3 reduction in fee for small business and professors is now available for the first time to reach out for more participants. Full-time students are free when taking the tutorial with his/her professor sponsorship, and can obtain this book ½ price ($75).

Carlos Cimini

Manager Composites Design Tutorial