Opening Address

8:30 a.m. - 9:15 a.m.
OTANI MEMORIAL LECTURE

Macroscopic and Microscopic Scale Effects in Mechanical Behavior of Materials
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Various simulation techniques are employed using different scale models in practical engineering fields, including mechanical, thermal, electrical and other problems. The simulations can be analytical, numerical or experimental. It sometimes raises questions whether the simulation using different scale truly represent the actual engineering phenomenon. In some cases, the inconsistency arises due to the mechanical field change with changing scales; however, in some other cases, the simulation may not be valid even without changing the mechanical fields. There are also other problems that can be interpreted only by considering microscopic mechanism. In this paper, problems of scale effects are analyzed using the concept of macroscopic aspects and microscopic aspects in mechanics. Scale effects in various fields are studied, including deformation and fracture of materials and material processing. The mechanism of scale effects is analyzed and explained in each case. Non-dimensional method is introduced to meet the scale effect in actual problems.

9:15 a.m. - 10:00 a.m.
PLENARY LECTURE I

Composite Materials for the 787
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The 787 Program is defining the future of commercial transport aviation through its recent selection of advanced composite materials for the airframe structure. Although all composite airframe designs have been demonstrated on regional jets, many technical challenges are now being solved for the application of these materials more broadly to commercial transport class aircraft. The composite experience gained on the 777 empennage and previous airplane models has positioned Boeing to deliberately pursue composites more extensively on the 787 Program. Composite use on 787 primary structures includes the fuselage monocouque, outboard and center wing box, trailing edge structures and the empennage. The improved fatigue properties and corrosion resistance of composite materials enables Boeing to deliver an airplane with enhanced passenger experience such as a 6000 ft cabin altitude and larger windows.

The 787 Program has set extremely aggressive cost and weight targets that dictate the need for innovation design and manufacturing solutions. Boeing is pursuing joint airframe and technology development activities with international partners capturing the experience and capabilities of a global supplier base. This presentation will discuss the design and manufacturing technologies that will enable Boeing to develop the 787 family of aircraft providing a new standard for airplane operational efficiency and market effectiveness.

Coffee Break

10:30 a.m. - 12:00 noon
Room A
PMC-I: POLYMERS AND POLYMER MATRIX COMPOSITES

PMC-01: Making a Complex Three-dimensional Shape from Bamboo
O. YAMASHITA, H. YOKOCHI, Nagoya University; H. IMANISHI, K. KANAYAMA, National Institute of Advanced Industrial Science and Technology,
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The flow properties of air-dried and oven-dried bamboo powder were investigated by a capillary rheometer. Air-dried bamboo powder started to flow immediately after applying pressure in the range of 180-220°C while oven-dried bamboo powder required a certain amount of time to start flowing under the same condition. Heat pretreatment of oven-dried bamboo powder in open system decreased the fluidity. It suggests that oven-dried bamboo powder attributes its flow to its thermal decomposition product. Injection molding of bamboo powder was performed. A complex three-dimensional shape with smooth surface was obtained.

PMC-02: Evaluation of Interfacial Strength Using Model Composites
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The validity of usage of a cruciform specimen as an evaluation method of interfacial strength is discussed. To avoid the stress singularity at the free edge, an experimental method which is similar to the cruciform specimen method is considered. Both experimental approach which uses a model composite and analytical approach which uses finite element analysis are employed to discuss the validity of the method.

PMC-03: On Statistical Strength Characterizations of Kenaf Bast Fibers with Variable Cross-Sectional Geometries and Mesoscopic Internal Structures (A Preliminary Numerical Investigation from 2-D FEM Approach)
K. SUZUKI, Chiba Institute of Technology; K. GODA, Yamaguchi University,
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Recently kenaf (Hibiscus cannabinus L.) bast fibers (KBFs) have been using for one of the promising reinforcing agents of environmentally friendly polymer composites. However, these kind of natural plant fibers usually exhibit large scatters in terms of their geometries and mechanical properties, and hence a margin of safety for products including such natural plant fibers will become unnecessarily large. In this study, in order to investigate factors affecting the fiber strength variation, a statistical finite element modeling framework by combining beam and solid elements was proposed for KBFs with variable cross-sectional geometries and so-called mesoscopic internal structures, and applied to the tensile stress analysis and statistical strength simulations for KBF monofilaments under tension. From the numerical results for stress distributions obtained by using a preliminary two-dimensional finite element method (2-D FEM) model, the mesoscopic internal structures in KBFs, which consist of elementary fibrous cells (EFC) and inter-cell material (ICM), were found to give rise to axial stress concentrations in EFCs and so-called free-edge shear stresses in ICM, both of which could initiate the fiber fracture. Furthermore, by applying two-parameter Weibull analysis to the numerical simulation data, the dependency of fiber strength and its initiating failure modes