复合材料帽型结构件制造的硅橡胶芯模预制调型孔仿真分析

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Abstract

复合材料帽型加筋结构在航空航天领域得到广泛应用，硅橡胶芯模是实现其共固化成型关键工装之一。预浸料固化加热过程硅橡胶的热膨胀需要通过预制调型孔来消除，以保证帽型加筋结构的成型质量。本文通过COMSOL Multiphysics 建立了硅橡胶芯模预制调型孔热力耦合有限元分析模型（图 1），采用传热和结构力学模块对不同结构硅橡胶芯模进行计算机仿真，得出实现复合材料帽型加筋结构形性协同制造的硅橡胶芯模预制调型孔的最佳尺寸范围（图 2）。综合分析硅橡胶芯模受热膨胀的可能影响因素，建立了考虑体积修正系数的预制调型孔计算模型.进一步利用有限元方法回归了芯模预调制型孔体积修正系数，利用回归出的修正系数对不同截面尺寸的帽型结构进行仿真验证，从而确定了较准确地预制调型孔理论计算模型（图 3）。最后，通过实验验证了该数学模型及有限元分析方法的正确性，为制造复合材料帽型加筋结构提供了理论与实验依据（图 4）。

Reference

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Figures used in the abstract

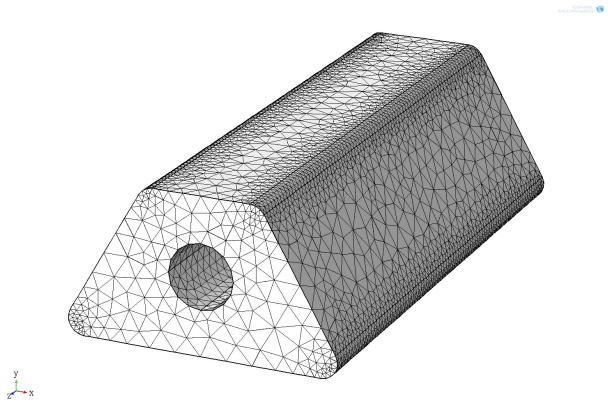

Figure 1: 帽型件芯模几何模型

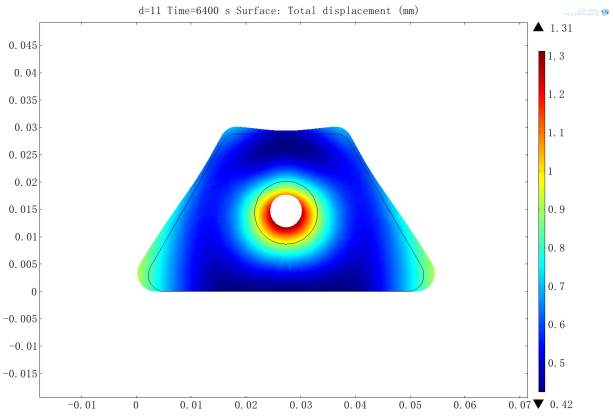

Figure 2: 计算结果位移云图

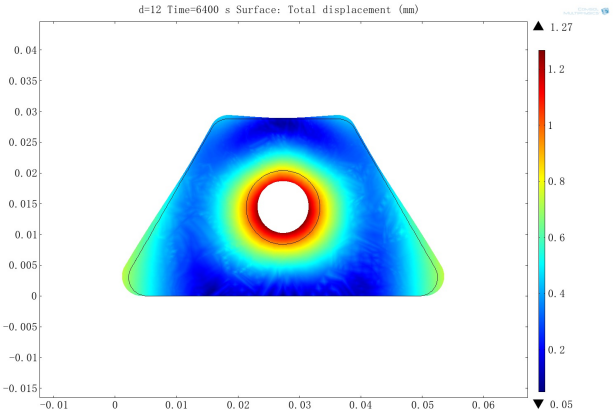

Figure 3: 修正后计算结果

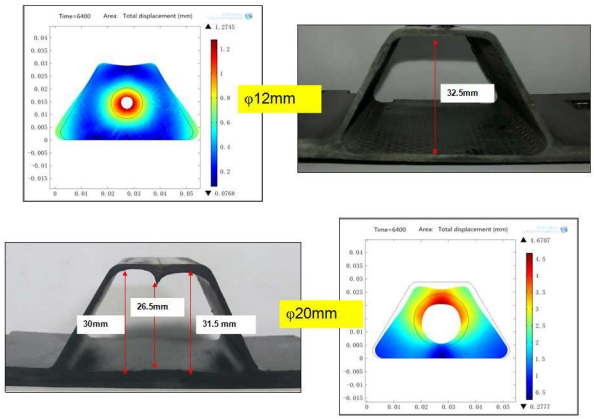

Figure 4: 仿真结果与实验对比