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撞击载荷下泡沫铝夹层板的动力响应

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Dynamic response of foam sandwich plates subjected to impact loading

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摘要 应用泡沫金属子弹撞击加载的方式研究了固支方形夹层板和等质量实体板的动力响应,分别应用激光测速装置和位移传感器测量了泡沫子弹的撞击速度和后面板中心点的位移历史,给出了夹层板的变形与失效模式,研究了子弹冲量、面板厚度、泡沫芯层厚度及芯层密度对夹层板抗撞击性能的影响。结果表明,后面板中心点挠度最大,周边最小,整体变形为穹形,且伴有花瓣形的变形。参数研究表明,通过增加面板厚度或芯层厚度均能有效控制后面板的挠度,改善夹层板的能量吸收能力,结构响应对子弹冲量和芯层密度比较敏感。实验结果对多孔金属夹层结构的优化设计具有一定的参考价值。 更多还原

关键词： 固体力学 动力响应 撞击载荷 夹层板 金属泡沫

Abstract： Aluminum foam projectiles were used to dynamically load clamped quadrate sandwich plates with an aluminum foam core and monolithic solid plates. A laser Doppler velocimeter and a laser displacement transducer were applied to measure the impact velocities of the foam projectiles and the deflection-time histories at the midpoints of the back faces of the plates,respectively. Deformation and failure modes of the sandwich and monolithic plates were exhibited to discuss the effects of the projectile impulse,the face sheet thickness and the core density and thickness on the structural responses of the plates. It is found that there is the maximum permanent deflection at the midpoint of the back face,the deflection at the plate brim is the least and the whole deformation profile takes on a dome shape with flower-shaped deformation. The results indicate that the permanent deflection of the back face can be effectively controlled to improve the capacity of energy absorption of sandwich plates by increasing the face sheet or core thickness. The structural response is sensitive to the projectile impulse or the core density and the permanent deflection is proportional to the projectile impulse or the core density. The experimental results can provide help for the optimum design of cellular metallic sandwich structures.

Keywords： solid mechanics dynamic response impact loading sandwich plate metal foam

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