



### 刚塑性扁球壳受弹体冲击时动力学响应的近似解

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#### APPROXIMATE SOLUTION TO DYNAMIC RESPONSE FOR RIGID-PLASTIC FLAT SPHERICAL SHELLS UNDER IMPACT BY PROJECTILE

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#### 摘要

研究扁球壳在弹体局部冲击载荷作用下的响应问题. 首先, 在球壳材料为刚塑性模型的假设下, 基于现有球壳理论的研究基础, 对球壳的变形能模型进行改进, 仅考虑凹陷区域变形能和棱区膜变形能, 根据能量守恒原理, 得到了球壳在冲击载荷下的理论结果; 其次, 在棱区的宽度和凹陷区半径之间引入近似关系式  $l \approx 0.05a$ , 以此为基础给出了刚塑性球壳在低速弹体冲击下的显式近似理论解; 进一步, 将近似解与实验的各种情况进行对比, 误差均小于10%; 最后, 采用LS-DYNA 有限元软件进行数值模拟, 也取得了与近似解一致的结果.

关键词: 扁球壳 冲击 动力学响应 数值模拟 近似解

#### Abstract:

The response of flat spherical shell is studied under local impact by a projectile. Firstly, the model of deformation energy of the flat spherical shell is improved based on the available dynamic theoretical research on spherical shell and the assumption of rigid-plastic material. The energy associated with dimple deformation and membrane deformation in the ridge is considered only. The theoretical result of spherical shell is obtained under impact loading according to the law of energy conservation. Next, the approximate relationship, i.e.  $l \approx 0.05a$  between radius of the dimple and width of the ridge is introduced and the explicit approximate theoretical solution of the shell is given under the impact of low velocity. Then, a comparison is made between the theoretical and experimental results, which indicates that the relative errors are less than 10%. Finally, a simulation is carried out using finite element software LS-DYNA. The numerical results are in good agreement with the corresponding approximate theoretical ones.

Key words: flat spherical shell impact dynamic response numerical simulation approximate solution

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