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大跨度钢桁桥模型的精细化损伤定位模拟和试验研究

Experimental and numerical studies on precise damage localization of a long-span steel truss bridge model

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中文关键词： 精细化定位　损伤识别　部分测点　SDLV法　钢桁桥

英文关键词: precise damage localization　damage identification　partial nodes　stochastic damage locating vector method　steel truss bridges

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中文摘要:

在役大跨钢桁桥数目众多,其杆件往往较长,所以识别出损伤杆并找出局部损伤所处位置对安全评定和加固尤为重要。针对这一问题,参考我国在役钢桁梁桥,基于健康监测的试验目的和相似理论设计制作了贝雷梁式简支钢桁桥Benchmark模型。根据其结构形式、具体尺寸,并经试验结果修正,建立了基准Matlab有限元模型。环境激励下,首先隔离一个三角形子结构为研究对象,基于随机损伤定位向量(SDLV)法识别出损伤杆后通过在其上附加传感器的方法来定位局部损伤。其次,由于SDLV法要求桁架待测区间内所有节点均为测点,花费较大而不便于应用。文中还初步探讨了基于部分节点数据的SDLV法的可能性。数值和试验结果均表明,SDLV法不但能识别损伤杆,还能对局部损伤进行精细化定位,效果良好,为进一步探讨基于部分测点的损伤识别奠定了基础。

英文摘要:

Large numbers of long-span steel truss bridges with long bars are in service. Therefore, it is imperative for their safety assessment and maintenance to obtain damaged bars and the location of local damage. To solve this problem, a simply supported bailey steel truss bridge Benchmark model for health monitoring was designed and constructed according to the highway and railway bi-purpose steel truss bridges employed in China. Based on structure form and detailed dimensions, a Matlab finite element model was established as the reference model due to the perfect match of the modal parameters with experimental results. Under ambient excitation, a triangular substructure was separated as a research object. Firstly, based on the Stochastic Damage Locating Vector (SDLV) method, the damaged bar was detected and additional sensors were installed on it to identify the local damage. Secondly, conventional SDLV method needs information from all nodes in a truss structure or a substructure of it, which results in high cost. Possibility of damage localization based on data from partial nodes in a substructure was discussed preliminarily. Both the numerical and experimental results indicate that the SDLV method can not only identify the damaged bars but also precisely locate the local damage; moreover, which lays a good foundation for damage detection based on the SDLV method using partial nodes.

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