4.1.7. A NEW APPROACH FOR THE DEFINITION OF "PROBABILITY OF DETECTION" CURVES

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Considering components subjected to fatigue loads, it is licit to predict crack nucleation and consequent propagation at the most critical sections, at production defects or in aggressive environments. From this point of view, it is possible to employ the "Damage Tolerant" design approach whose philosophy consists [1, 2] in determining the most opportune inspection interval given the "Probability of Detection" (POD) curve [3] of the adopted Non-Destructive Testing (NDT) technique or, alternatively, in defining the needed NDT specifications given a programmed inspection interval. Structural integrity of safety components during service is then strictly related to different factors such as (fig. 1):

1) the performance of non-destructive testing ("NDT");
2) the crack propagation behaviour of the adopted material;
3) the reliable knowledge of service loads.

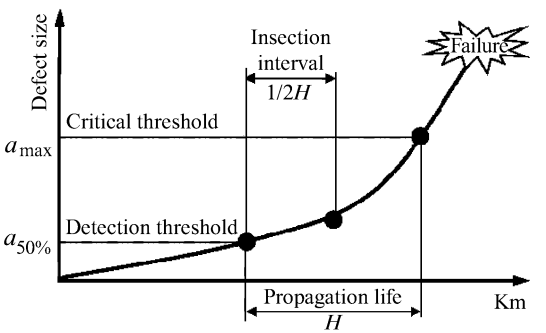

Fig. 1. "Defect Tolerant" design for mechanical components

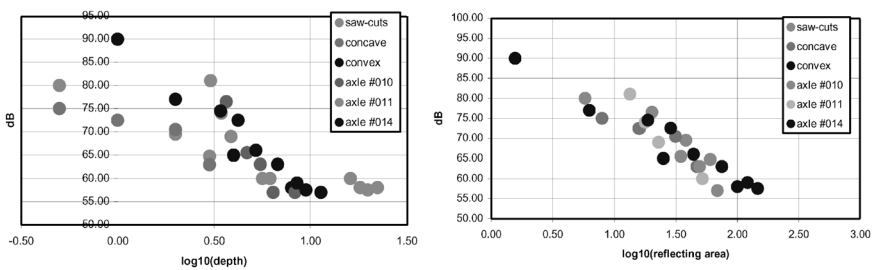

Fig. 2. UT echo responses in terms of linear dimension (a) and reflecting area (b) for artificial and natural defects

Up till now, the performance of a given NDT technique in detecting cracks and defects has been quantified and summarised by the corresponding POD curve relating the probability to detect the defect to its characteristic linear dimension (diameter, length, depth, etc.). Recent results published by the authors [4] showed that such "linear dimension" approach is not the most effective in order to categorise the response of artificial and natural defects having different dimensions and shapes. In particular, artificial defects obtained by traditional machining (saw-cuts) and EDM (concave and convex shaped) on sample blocks obtained from railway axles and fatigue cracks propagated into full-scale axles were considered and compared. Better results in correlating ultrasonic echoes, for all the shapes, dimensions and artificial or natural defects, could be achieved (fig. 2) adopting, as a characteristic parameter, the reflecting area.

The present paper, based onto such results, proposes a novel and more efficient approach to the definition of POD curves in terms of reflecting area of defects instead of their linear dimension. To this aim, together with experimental evidences, numerical analyses will be carried out by means of a software for the simulation of UT propagation and defect response. The usefulness of the new POD curves should be, first of all, the possibility to directly compare artificial and natural defects and, for example, a more efficient way to design sample blocks for calibrating NDT techniques.

References:

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