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## **NONDESTRUCTIVE INSPECTION OF MARINE WOODEN STRUCTURES**

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**Key Words:** Nondestructive inspection, Marine wooden structures

### **Introduction**

Wood is an engineering material which has wide application in marine structures, so its inspection, maintenance and repair need considerable importance. Similar to another engineering materials, during service life, wood as a member of marine structure is subjected to different types of degradation and destruction (chemical, physical, mechanical and biological) which decrease the residual strength of wooden members. Therefore, the assessment of defect and estimation of residual strength in wooden member is necessary to prevent the failure in structures. Since the inspection and evaluation of marine structures is an in situ (or in service) inspection, special methods which are applicable for in situ inspection without damage to inspected members are needed. Nondestructive techniques have such abilities.

Although nondestructive techniques are widely used for marine structures inspection, but generally nondestructive evaluation of wooden members in marine structures are quite different and more complicated from the other materials such as concrete, metals and plastics because of following reasons

- Wood is an heterogenic and orthotropic material and regarding to type of species it has very variable properties
- The type of defects and degradation in wood is quite different from the other materials
- Different types of non-wooden connectors( adhesive and mechanical connectors) are used for connection of wooden members in marine structures which are damaged in different form

Generally, despite of problems and complication, a relatively wide range of nondestructive methods are used for inspection of wooden structure, but special skill and knowledge and instruments are need for nondestructive evaluation of marine wooden structures which are considered in this paper.

### **Nondestructive techniques for marine wooden structures**

**Visual inspection:** This method which is limited to available surfaces of members, is the first and the most important stage of nondestructive inspection. With using visual inspection surface defects can be identified and also internal defects in members can be detected by some external marks. Some of defects which can be detected by visual inspection are:

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discoloration, defects caused by marine borers, cracks, creep and buckling, bacterial and fungus decay. For further inspection to detect the internal condition of members, visual inspection can help us to decide which nondestructive technique is used in where. The measurement of dimensional changes during service life is also an effective inspection of marine wooden structures.

**Semi-destructive methods:** In these methods, the members are slightly damaged. For this reason they are not fully nondestructive. The main methods are:

- Identification of species type of wooden member: a small piece of wood is removed and the species type of wood is identified by different type of microscope.
- Use of portable drill
- Drill resistance(DR) technique
- Tensile test
- Coring
- The screw withdrawal resistance meter

**Ultrasonic technique:** This is the most common and the most practical technique which is used for nondestructive testing of wooden materials because it is cheap, easy to use, fast, flexible and portable. Generally for the members which are not under water or alternately exit from underwater can be inspected by common ultrasonic technique which is used for wooden materials, but for inspection of wooden members under water we need special transducers (transmitter and receiver). Acoustic impedances of wood and water are similar and this is an advantage for inspection of wooden member underwater. Water acts as a coupling medium between transducers and wood. With ultrasonic parameters, internal defect can be detected and dynamic modulus of elasticity and residual strength can be estimated in wooden members.

**Radiography techniques:** with use of this method, not only the health of wooden member can be investigated but also we can evaluate the condition of connectors (nail, screw, ...) in wood members. Fig. 1 shows an image of corroded rod embedded in wooden member. The corrosion of metallic connectors of wooden structure in marine environment is very important.

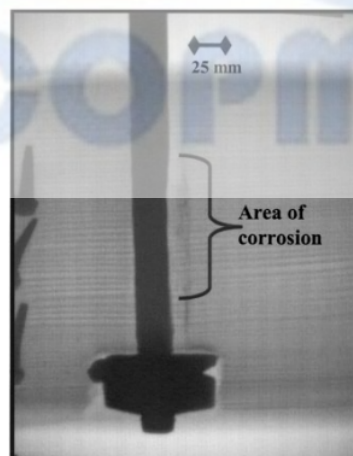


Fig 1) Radiograph of corroded rod embedded in wood