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5.9 RADIOGRAPHY

5.9.1 Introduction

Radiography (RT) is used for evaluating the internal structure of a material. Similarly to an X-Ray, the method uses high energy high frequency electromagnetic particles to pass through the material and capture the particles on the opposite side on a film. The film is developed and offers an actual picture of the internal characteristics of the member being tested.

Radiography can use two types of sources for the electromagnetic radiation, man-made or naturally occurring. The man-made sources are high energy X-rays that are created through a device called an X-ray tube. Naturally occurring sources emit gamma rays. Two common sources include Iridium 192 and Cobalt 60. These sources require no outside power.

The method relies on the theory of electromagnetic radiation in that high energy photons (particles of electromagnetic radiation) will be able to pass through material but will be attenuated (slowed down or scattered) by changes in the material's properties. These properties include density, geometry, defects, holes or voids, etc. Higher density material will attenuate the photons more and therefore result in less photons passing through to the film. Generally on the film, denser materials or areas show up as lighter spots on the film, while areas of less density or less material will allow more photons to pass through and show up as darker areas on the film. Refer to Figure 5.9.1-1 for conceptual rendering of a radiographic test of a weld.

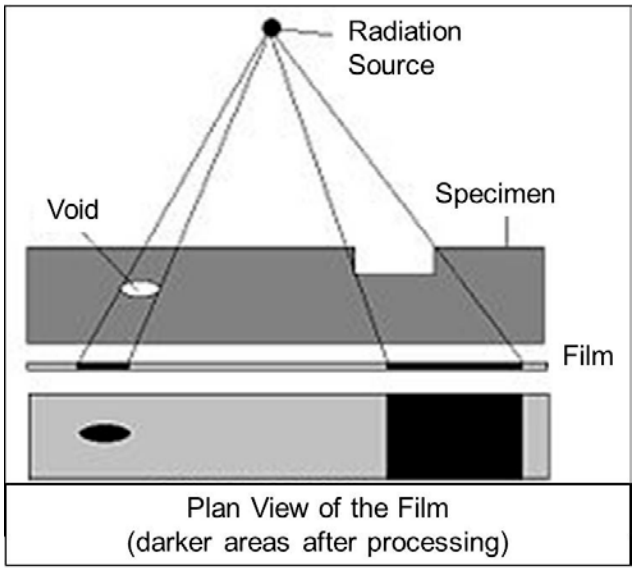

Figure 5.9.1- 1: RT of material with a void and notch. Note the darker areas on the film located below the test material.

RT can be performed on most materials that require internal evaluation, however the nondestructive evaluation test is typically performed on steel members and in particular welds, and on concrete members to determine reinforcing layout. Refer to Figure 5.9.1-2 for

an RT image of a weld with internal defects. Refer to Figure 5.9.1-3 for an RT image of a concrete slab with reinforcing steel shown.

Figure 5.9.1- 2: RT image of weld. Note slag inclusions located in the center of the image and a lack of fusion located at right center.

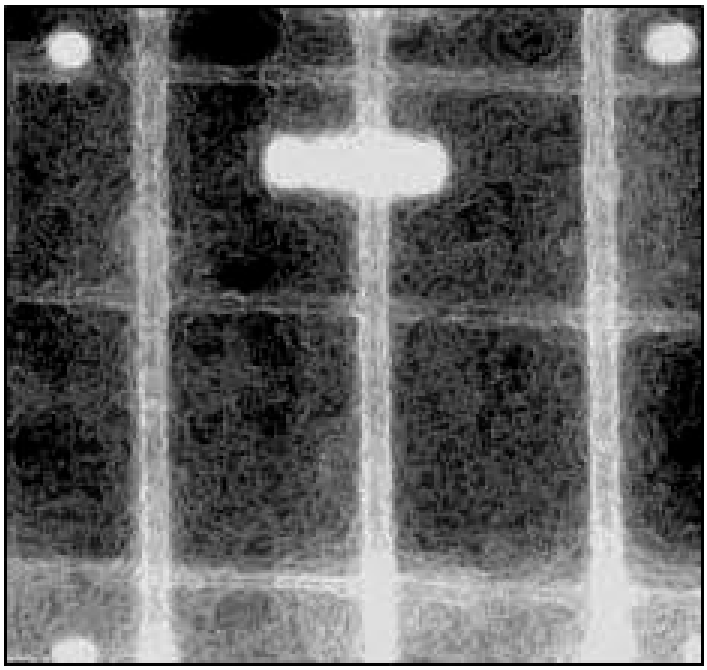

Figure 5.9.1- 3: RT image of concrete slab. Note reinforcing layout shown on film.

5.9.2 Applications

Radiography is used to determine the internal makeup of a member or portion of a member. Gamma ray radiography typically consists of a much smaller device since the source requires no power. The device itself is to protect the inspector from the high levels of radiation and to focus the radiation beam at the member. This type of RT is useful for field work as it is portable and easy to use.

X-Ray tubes can produce much higher energy photons and are typically used when high penetration through a material is required, that is highly dense material or very large members.

RT is most commonly used on concrete and steel members. It is highly effective at determining internal flaws within weldments. RT can detect slag inclusions, porosity, lack of fusion, and cracking. In order for RT to detect cracking, the length or depth of the crack must be oriented in line with the radiation beam from the source, otherwise the photons will pass across the crack rather than through the crack. To some degree RT can also be used to detect section loss as the less material will show up slightly darker than the surrounding material.

In concrete applications, RT is commonly used to determine reinforcing layouts. RT can also be used on concrete members to determine voids.

5.9.3 Limitations

Radiographic testing does have some limitations. The testing itself is rather expensive especially when dealing with thicker members. Furthermore, there are only a few licensed firms that can handle radioactive isotopes.

While the test will provide the inspector with an internal view of the member being inspected, it is only a 2D representation of a 3D object and therefore will not provide the depth dimension of where the defect is located. Lead tape and indicators are used as reference points on the film to try and remediate this issue.

Radiography testing also requires access to both sides of a member. The source must be on one side and the film on the other. In certain situations, this may be an impossible test due to inaccessibility.

Radiography is also a complex method that includes the safety hazard of working with a radioactive material which requires its own personal protective equipment. The equipment itself is also highly specialized and requires an experienced inspector to operate effectively.