

INTRODUCTION

Concrete structures are often vulnerable to internal delamination and debonding of render coatings or other surface finishes. This is frequently a result of the corrosion of the internal reinforcing bars.

Corrosion of steel reinforcement bars can occur for a number of reasons. Some of the most common are:

- 1) Carbonation - this occurs where the concrete has become permeable or the depth of cover is low enough to enable moisture to reach the reinforcing steel.
- 2) Sulphate attack - this is where sulphates in solution react with the calcium hydroxide and calcium aluminate present in hardened concrete to form gypsum and calcium sulphoaluminate, which represent increases in volume of 124% and 227% respectively.

Corrosion of the reinforcing steel results in the volume of the steel increasing, slowly forcing the concrete apart. This internal movement causes cracks and voids to appear within the concrete - often long before they are visible at the surface. Moisture can then seep into these voids and make matters even worse through freeze/thaw cycles and differential expansion.

Even if no corrosion of the reinforcement has taken place, it is quite possible that voids have been present in the concrete since the day it was cast - usually as a result of poor compaction. Once again, the action of freeze/thaw cycles and differential expansion can result in further cracking and delamination.

HOW THERMOGRAPHY HELPS

Infrared Thermography, or thermal imaging as it is sometimes known, provides a cost effective and accurate method of detecting delamination and debonding in concrete structures. It works because the delaminations or voids are filled with air or water, each of which has a different density and thermal conductivity to the surrounding concrete. The surface temperature of the concrete varies as the structure is subjected to a normal daily heating and cooling cycle as a result of the solar radiation and air temperature changes. Where the concrete is sound it tends to heat up and cool down at a slower rate due to the mass involved. However, where there is a 'thermal break' caused by a delamination, the concrete between the delamination and the surface is effectively isolated from the larger mass of concrete by the insulating layer of air. The surface temperature at the delaminated area therefore responds far more quickly to ambient temperature and solar radiation changes (see Figure 1).

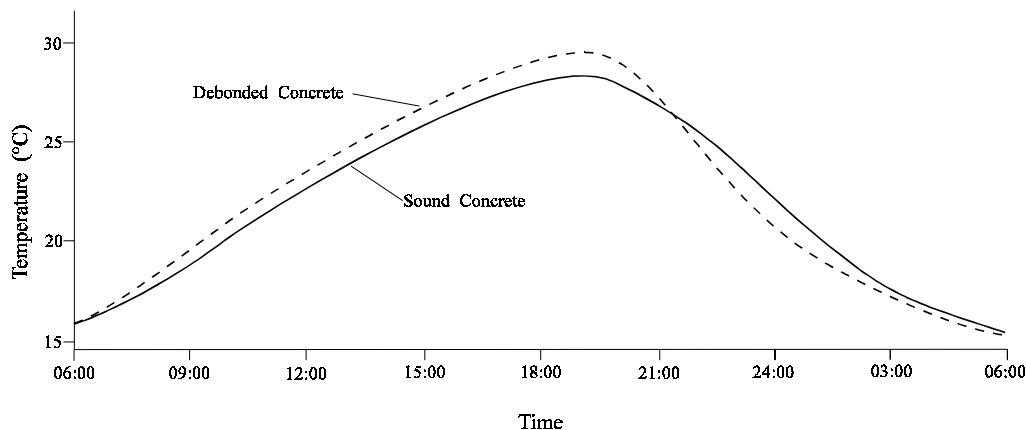


Figure 1 - Thermal response of sound and delaminated concrete

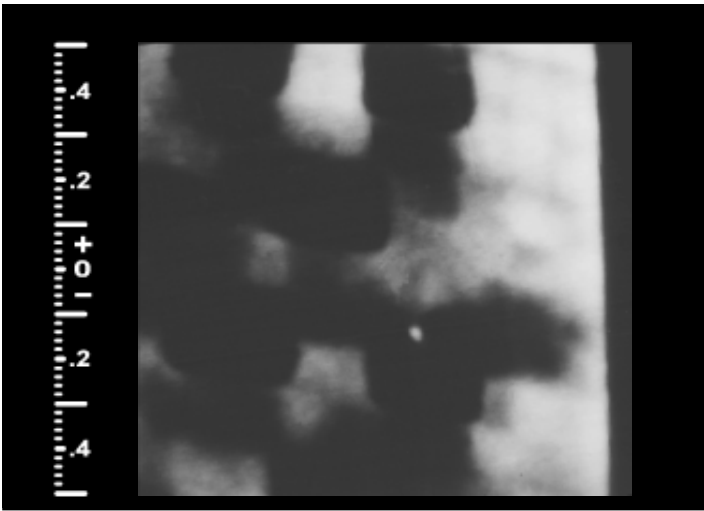


Figure 2 - Typical thermogram of delaminated areas

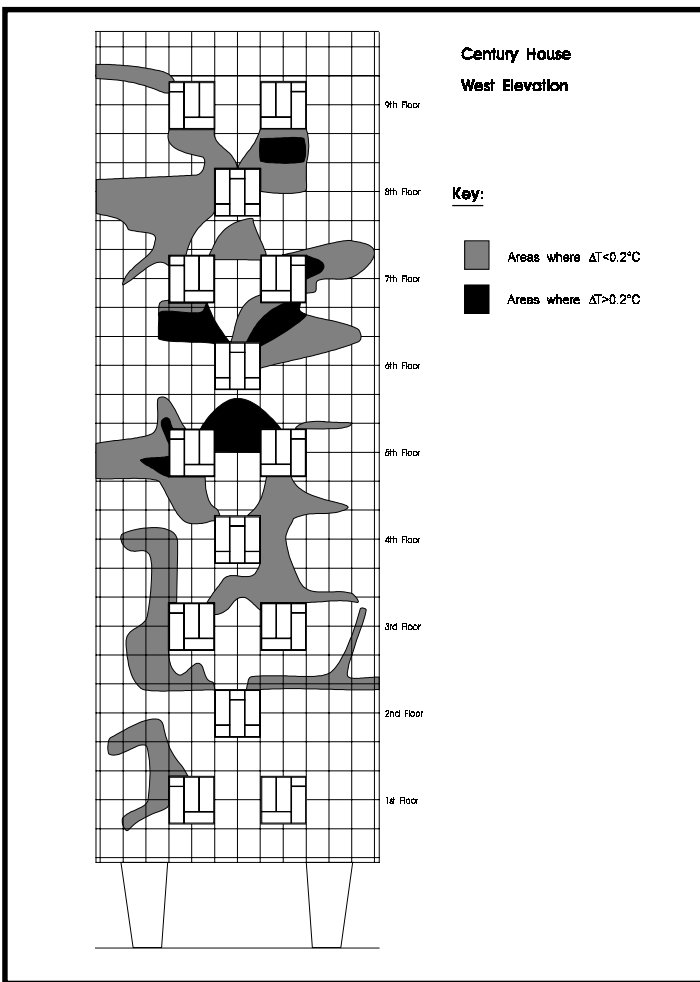


Figure 3 - Typical drawing showing delaminated areas

Thermal imaging allows these temperature changes to be measured and recorded in an accurate form. Analysis of the images then allows the delaminated areas to be identified and a repair program to be initiated. One particularly significant advantage of using thermography to detect the delaminations is that, in addition to being accurate and non-destructive, the technique does not require physical contact with the structure. This has major advantages in that the building does not need to be scaffolded and the disruption to occupants and passers-by is minimised. Indeed, it is usually possible to carry out the survey from vantage points on the ground and adjacent buildings.

The results of the survey can then be presented in a number of forms - the most common being hard-copy thermograms (i.e. photographs) like that shown in Figure 2, or a drawing like that shown in Figure 3.

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