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Finding Termites With Thermal Imaging Cameras

Ken James and David Rice

Termicam Pty Ltd, Melbourne, Australia

ABSTRACT

State of the art thermal imaging technology is being used to locate termite infestations in buildings and houses. Termicam is a company using this technology to inspect houses and locate termite infestations. This technology gives homeowners visible proof of termite infestation and a record of how great the problem is. Owners can often be unaware of the extent of any termite problems in their homes and may be over-charged by operators who do not accurately identify the termite problems and subsequent treatment.

Keywords: Termites, thermal imaging, white ants, Termicam, inspection

1. INTRODUCTION

Termites are a huge problem because they eat wood and damage houses and buildings. Detection is difficult and traditional methods rely on knocking on wood. Thermal imaging cameras are being used to successfully locate termites in buildings in a non-destructive manner.

In the United States termites cause enormous economic damage to buildings. The most important termites are subterranean termites of the family Rhinotermitidae are those most commonly injuring structures (Metcalf and Metcalf 1993). Another foreign termite invader is causing major problems in the southern states. The Formosan termite, Coptotermes formosanus Shiraki, was introduced into Hawaii in 1906 and into Houston, Texas, in 1965.

Finding termites can be difficult, yet knowing where they are located is important when deciding on the correct eradication program. The traditional method is to simply tap on the wood with the back of a screwdriver, or to poke holes in walls or even pull them apart. There are some new technologies that aid termite detection, using moisture meters, sound or even microwaves, but none of these offers the advantages of thermal imaging.

Thermal imaging cameras offer a new, high technology detection system that is quick, effective, and does not require any damage to houses such as drilling.

2. HEAT PATTERNS OF TERMITES IN BUILDINGS

Thermal imaging technology detects heat patterns. When termites invade buildings, the normal heat patterns of the walls, floors and roof are changed due the presence of termites. The thermal imaging camera records this change in heat pattern and indicates the exact location of any termite infestation. A color image shows hot spots as red or yellow and cold spots as blue or purple and these heat patterns indicate termite infestations. The operator is trained to interpret the images and understands the building construction and can analyze the image.

The images in **Figure 1** below are an example of how thermal images from an infrared camera can detect heat patterns and can be compared to visible images to identify the location of a termite infestation. The images were taken in a house in Australia, in May 2002 during an inspection and show the top section of a doorway. The normal visible image taken with a conventional camera does not indicate any termite activity but a thermal imaging camera reveals a hot spot that shows as yellow in the top right hand corner of the door jam. This is where the termites were very active and had eaten away most of the wood material. This technology allowed an early detection of the termite problem, and eradication could proceed before the damage was too great, thus saving the owner thousands of dollars in repairs at some future date.

Fig 1a. Visible image of door jam, no evidence of termite infestation

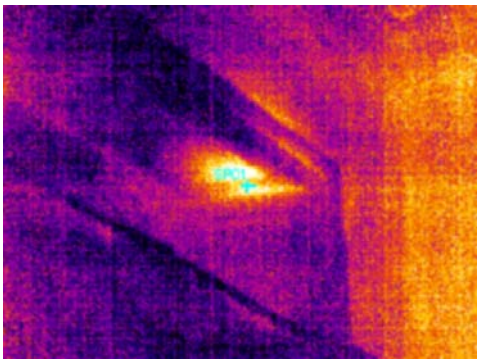

Fig 1b. Thermal image of door jam, with yellow hot spot indicating termite activity.

Termites are a type of insect that is considered to be cold-blooded creatures, so how can they generate heat? Termites are hosts to bacteria, which live in their gut, and these bacteria help break down and digest cellulose, the main component of wood. It is this digestion and chemical reaction that generates heat. A close up thermal image of a termite queen (**Figure 2**), shows that even though the temperature of the queen is essentially constant, as is the inside of a termite colony, there are still variations in temperature that are indicated by the different colors in the thermal image. Modern thermal imagers have a very fine resolution, some better than 1/10th of a degree and this can find these small temperature changes.

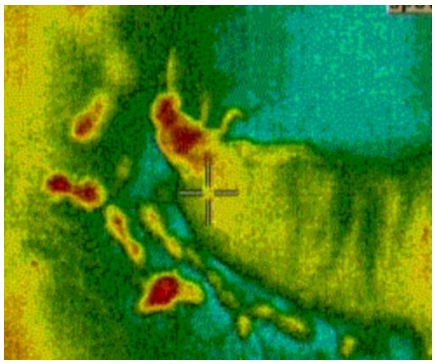

Fig 2a. Close up thermal image of a termite Queen termite. Colors indicate different temperature. Note Queen, soldiers and small worker termites

Fig 2b. Termite Queen can lay thousands of eggs per day. Note Queen, soldiers (with large heads) and small worker termites (which eat the wood).

Termites get their food by eating wood, which is made up mainly of cellulose. A special bug called protozoa, lives in the stomach of termites and these protozoa helps to break down the cellulose. The digestion of cellulose generates heat and when large numbers of termites in nests get together, there is a lot of heat concentrated in one place. This heat moves through the walls or floor of a house and it is this thermal pattern that can be detected with a thermal imaging camera.

If termites invade a building, in as little as six weeks, a small colony can form and considerable damage can be done as the termites eat through the timber parts of the building and start colonizing. They must stay out of the light and keep to the darker and damper areas inside the walls, floor and roof spaces. They need to control their temperature and may do this by generating heat as they stay in large groups, or building moist mud structures to keep cool in hot conditions. They are attracted to warm areas around power points and washing machines. An inspection with a

thermal imaging camera will detect these changes in heat patterns and an image of a termite colony in a floor is shown in **Figure 3**.

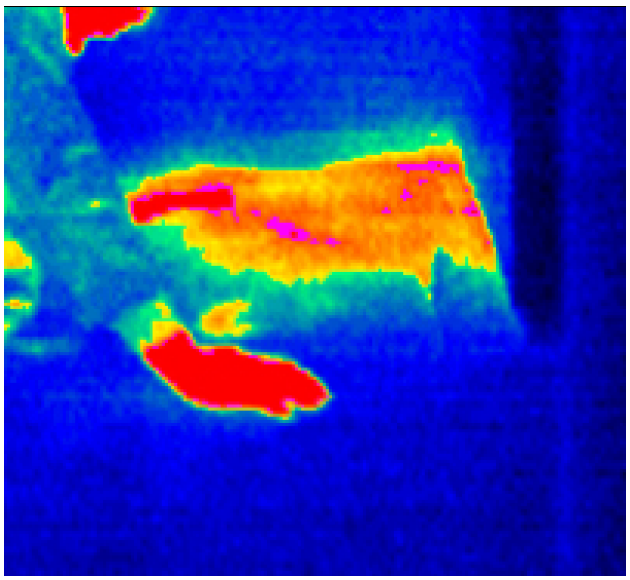

Fig 3. Thermal image of a termite infestation in the floor of a house, near a corner in a room. Termite activity shows as red and yellow indicating a hot area. The hand and face of the inspector also appear red indicating heat of the body.

3. ADVANTAGES OF THERMAL DETECTION OF TERMITES

When looking for termites in a house or building, it is important that all areas are inspected as quickly and effectively as possible. With thermal imaging technology, an infrared camera is used to scan the entire wall, floor and ceiling areas of a room quickly and without any damage to the structure. The heat patterns of the structure are recorded as digital images in the memory of the infrared camera. These images are downloaded at the end of the day to a computer and give a permanent record of the inspection and what was detected.

The thermal imaging camera detects heat patterns so there is no radiation emitted from the camera, and no chemicals are used, so the technology is very environmentally friendly. The images can be used to verify termite infestation and can be used at some later date if there is a need establish the extent of a problem at that date. In summary the advantages of the Termicam system are;

- Rapid an effective scanning for termites
- Non-destructive.
- Scans all areas, walls, floors, ceilings, and outdoor areas.
- Environmentally friendly
- No radiation or chemicals used
- No damage to the building
- Quick and immediate information on termite infestation,
- Accurately locates where to put chemicals for best effect.
- Picture provides evidence and proof of infestation. Good for later reference.

4. TERMITE PROBLEM COSTS MILLIONS

Estimates of the annual termite damage to human-made structures in the United States, is greater than that caused by fire and storms. Up to 1% of the total value of housing in the United States and 10% in the tropics (Metcalf and Metcalf 1993). Some estimates put the annual damage to buildings in Australia as more than $70 million.

The problem of termites is getting worse due to banning of chemicals and resistance build up in termites. Many environmentally unsafe chemicals, which have been used for eradication for many years, are now being banned. In Melbourne, Australia, some councils are refusing to acknowledge the termite problem and are refusing to declare their municipality a termite zone, in the hope that the problem will go away. Many homeowners also do not want to face a termite problem and tend to ignore it and hope it will go away.

In the United States the most important species belong to the subterranean group. These termites inhabit the soil where a colony forms after swarming. The subterranean termites of the family Rhinotermitidae are those most commonly injuring structures (Metcalf and Metcalf 1993). A few of the most important species are:

- The eastern subterranean termite Reticulitermes flavipes (Kollar), is common throughout the region east of the Mississippi River
- The arid-land subterranean termite, Reticulitermes tibialis Banks, ranges from the Pacific Coast to the Mississippi River and from Montana to Mexico.
- The western subterranean termite Reticulitermes hesperus Banks, ranges along the Pacific Coast from British Colombia to Mexico and eastward to Idaho and Nevada.
- The Formosan termite, Coptotermes formosanus Shiraki, was introduced into Hawaii in 1906 and into Houston, Texas, in 1965. This immensely destructive species has spread across the southern United States.

Experience on detecting termites has been limited to Australian species and Singapore species in the tropics. This new technology is being trialed on other species of termites, such as the ones mentioned above, and based on current results, is proving most effective in locating groups of termites, infestations in houses and nests. Whilst it will not detect individual termites yet, it has helped locate larger infestations so that pest controllers can apply their fixing remedies more accurately and effectively. All mainland Australian cities have termites and the problem is getting worse. Often new houses have more problems than older houses, especially if the new estate is built in termite infested areas that have recently been cleared. The number of termite inspections using thermal imaging is rapidly increasing as this technology becomes more effective and accepted.

5. MANAGING TERMITE PROBLEMS (FIND/ FIX/ FOLLOW UP)

Termites pose a serious risk to property and can dramatically affect the value of a house. There can be no guarantees with termites so it is important to manage the risk that they pose, by developing some management plan. Termicam has summarized a termite management strategy with the phrase “Find, Fix and Follow-up”. Find the termite problem with Thermal Imaging. Fix the problem with the best available eradication (and prevention) methods. Then Follow-up the fixing with a further thermal inspection to make sure that the problem is fixed and the termites have gone away.

Thermal inspections are great to find the problem and accurately locate the site of major termite infestations. The property owner can make an informed decision based on graphic images, to select the preferred method of fixing the termite problem. Some people prefer chemicals, other use physical barriers, and some change the materials used in the building. Finally a follow-up inspection is made to ensure that the termites have been eradicated from the property. As a general rule, properties in termite prone areas, particularly in the warmer months, need to have an annual inspection.

One example of this is parliament house in Brisbane, Australia. TermiCam started thermal imaging at Brisbane parliament house in 1999. After finding a heat pattern out on the balcony in March 2001, a large nest in the floor of the balcony was indicated. This was around about the second floor in what they call the reading room. The balcony was pulled up in September 2001 (**Figure 4**) by cutting a hole in the concrete slab and a termite nest was revealed.

Fig 4. Hole in concrete floor, to destroy termites found with thermal imaging.

Part of the follow-up service, is to provide an inspection after 6 months. As we inspected the building, a routine thermal scan of the internal part of the library found a rather large hot spot or thermal activity in the top of the door head. After a through inspection it was decided to pull down the doorframe and a large termite working was found, which ran back into the lime stonewalls to the corner of the building. It took some time and effort for the pest controller to treat for termites to remove all the infestation. Another follow-up inspection in March 2002 gave the area the all clear.

This technology is proving to be so good, a company named Termicam was formed in 2001, to develop the concept into a commercial service. Franchises are now operating in Australia and Singapore and soon to start in the United States.

6. SUMMARY

Thermal imaging is being successfully used to detect termite infestations in buildings. The heat patterns from termite colonies are detected by the sensitive thermal imaging cameras and the changes in the thermal patterns can be detected in floors, walls and ceiling spaces. Trained operators can interpret the images and locate termite infestations accurately, so pest controllers can be more effective in their eradication measures.

Insects are considered as cold-blooded creatures but heat is associated with their presence, due to the metabolic processes of digesting wood and cellulose. Termites also control their thermal environment by building moist mud structures, which can show up on thermal imaging equipment as cool spots in a wall cavity.

In the United States, there is a significant and growing problem with termite damage to houses and buildings, due to subterranean termites. New invasions from foreign termites, such as the Formosan termite are creating additional problems since its introduction in Houston in 1965.

7. REFERENCES

1. Heinrich, B. 1996 Thermal Warriors. Harvard University Press.
2. Metcalf, R.L. and Metcalf, R. A. 1993 Destructive and useful insects, 5th Ed. McGraw Hill.
3. Tanada, Y, and Kaya, H.K. 1993 Insect pathology. Academic Press.
4. Termicam website. www.termicam.com 2002.