InfraMation

Energy Loss Study at Liberty Baptist Church Using Infrared Thermography

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ABSTRACT

This study was performed as a result of repeated complaints that the Sanctuary in Liberty Baptist Church would not stay cool during the afternoon and evening periods. This has been a continual problem for the evening services on Sundays and Wednesdays and for any evening activities utilizing the Sanctuary. The study was provided as a means of allowing the church to begin effecting repairs to make this portion of the building a more comfortable environment to use, and to reduce energy costs.

The inspection consisted of the interior and exterior of the sanctuary area looking specifically for energy intrusion through the building envelope. The scanning was conducted using a FLIR ThermaCAM® P65 infrared camera on August 24, 2008.

There were five findings as a result of the study that would have a direct impact on energy loss in this portion of the building. These included lack of roof insulation which is the major reason for the inability of the building to remain cool during the hottest part of the day. Other findings include missing wall insulation, misdirected HVAC vents, separated roof decking, and air infiltration at the roof/wall seams.

There were also two unexpected findings as a result of this study. These were finding evidence of ongoing carpenter bee damage to the exterior soffit boards, and evidence of continued moisture trapped in the ceiling deck boards, even after roof repairs had been completed.

INTRODUCTION

This study was performed as a result of repeated complaints that the Sanctuary in Liberty Baptist Church would not stay cool during the afternoon and evening periods. This is a continual problem for the evening services on Sundays and Wednesdays and for any evening activities utilizing the Sanctuary.

An Infrared Thermographic study was conducted of the Sanctuary on August 24, 2008. The scanning was conducted using a FLIR ThermaCAM P65 infrared camera. The inspection consisted of the interior and exterior of the Sanctuary area looking specifically for energy intrusion through the building envelope.

BACKGROUND

A heating and air conditioning contractor has been changing out the four HVAC units servicing this room over the past year. This work has not impacted the air conditioning of this room other than for the systems to remain functioning. In the past 4-5 years, another contractor adjusted the air vents leading into the Sanctuary to help provide for better air flow. Prior to that, other contractors attempted to help air flow through the room by adding return air vents through the rear wall at the floor level.

The entire building, including this portion of the building, was re-roofed in 2007 due to significant hail damage. The roof over the Sanctuary had a layer of insulating “ISO-Board” installed over the roof deck to help insulate the room at that time. Further, in July of 2008, a 40 year-old steeple was removed from the roof over the Sanctuary due to repeated water leaks.

SANCTUARY CEILING

Figure 1 thermogram/photo pair shows the effect of the solar loading on the east face of the roof deck. While the sun at the time of the inspection was facing the west, the east roof deck was still radiating more heat due to having absorbed more energy through the morning and into the early afternoon. This picture also shows the biggest reason as to why this room is difficult to regulate the interior temperature. The interior ceiling deck is also the exterior roof deck. There is no insulating space between the interior and exterior. The only insulation at the roof is the wood itself, the insulating "ISO-Board", and the roofing shingles.

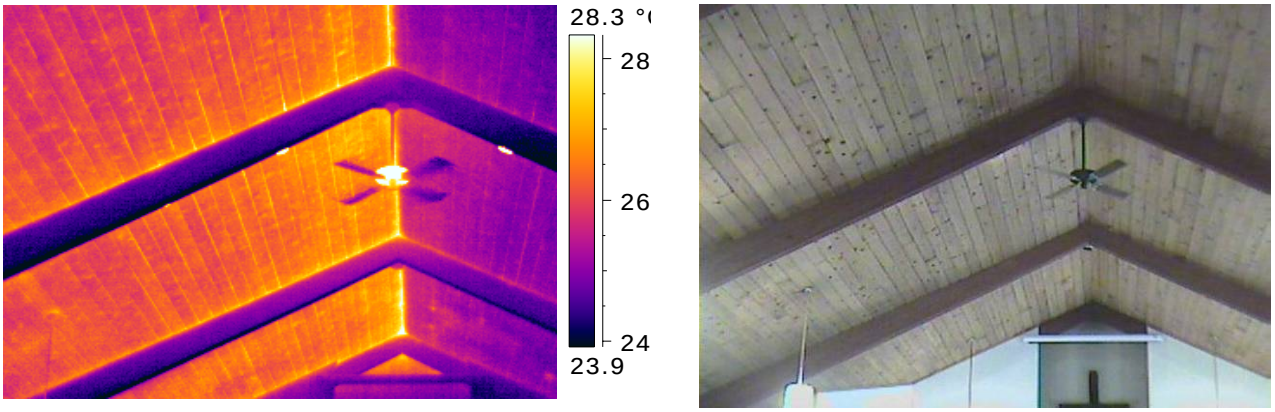


Figure 1. Thermogram/photo pair showing warming of east side of the roof due to solar loading.

One possible remedy for this situation is to install a false interior ceiling with an insulation layer between it and this roof deck. The support beams would provide adequate room for installation of such a false ceiling.

MISSING WALL INSULATION

The following images in Figures 2 and 3 show where insulation was either not installed, or has slipped out of place inside the wall cavity. This wall is the north wall and these areas are all located above the false ceiling above the Lobby area.

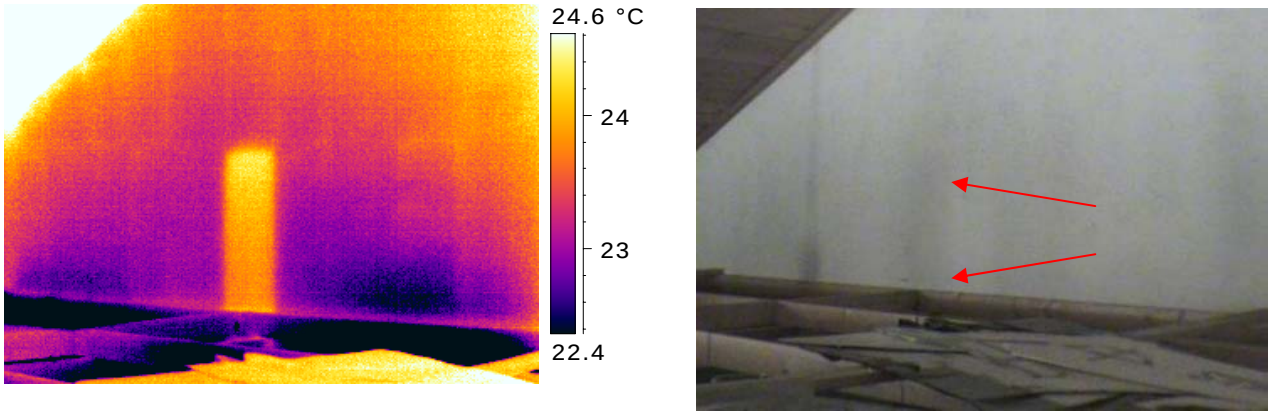


Figure 2. Thermogram/photo pair shows a warm rectangular region of missing or damaged insulation. The area is along the north wall towards the west edge of the wall.

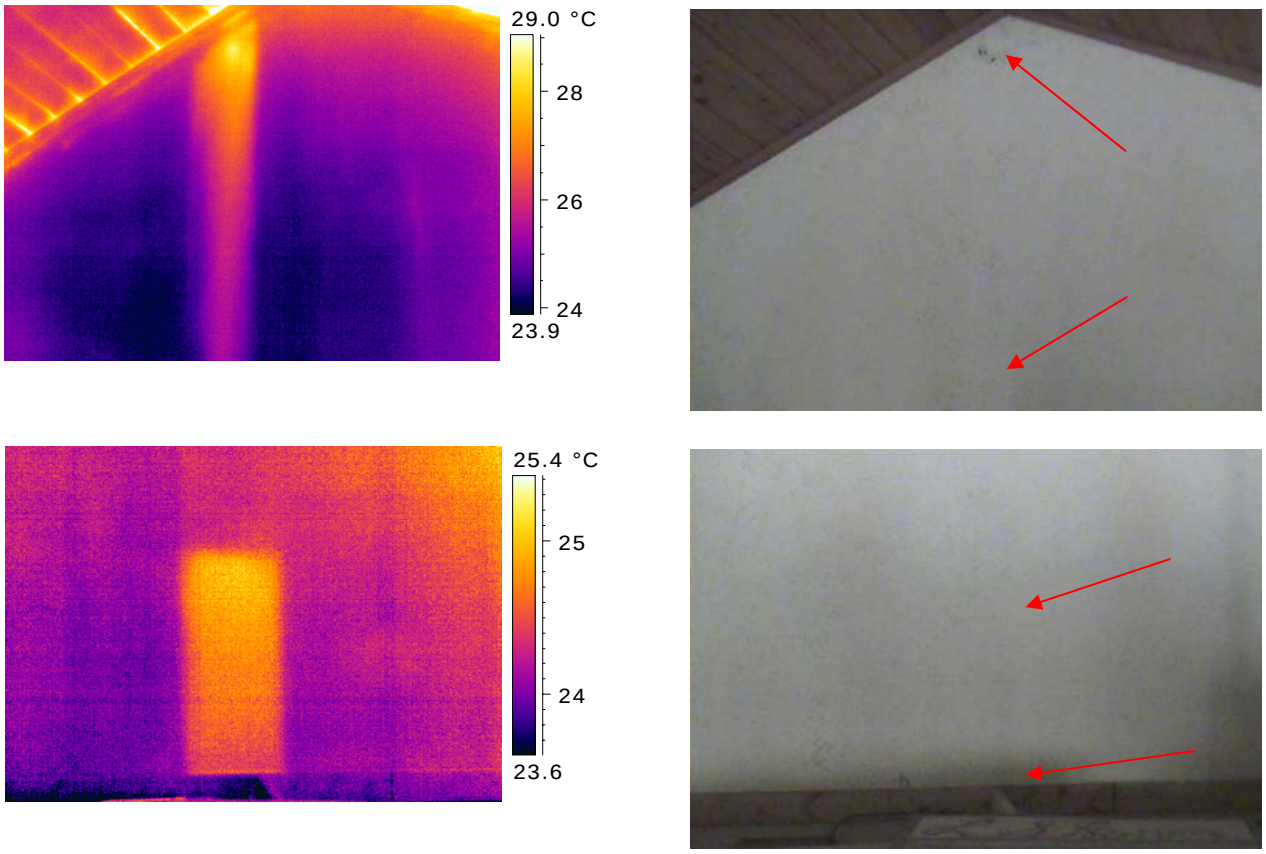


Figure 3. Top IR image and photo show the area of the north wall just west of the peak. Bottom IR image and photo show the north wall along the east edge of the wall. Warmer wall areas indicate missing/damaged insulation.

The remedy for this situation is to either remove the drywall and install new insulation (or repair the existing insulation), or to blow in new insulation into the cavity. Blowing in new insulation may be less intrusive.

MISDIRECTED HVAC VENTS

Thermogram/photo pairs in Figure 4 show where HVAC vents are directing cooling air onto the ceiling of the room and trapping it behind the structural beams. By trapping this air in this way, proper air circulation through the room is likely being impeded.

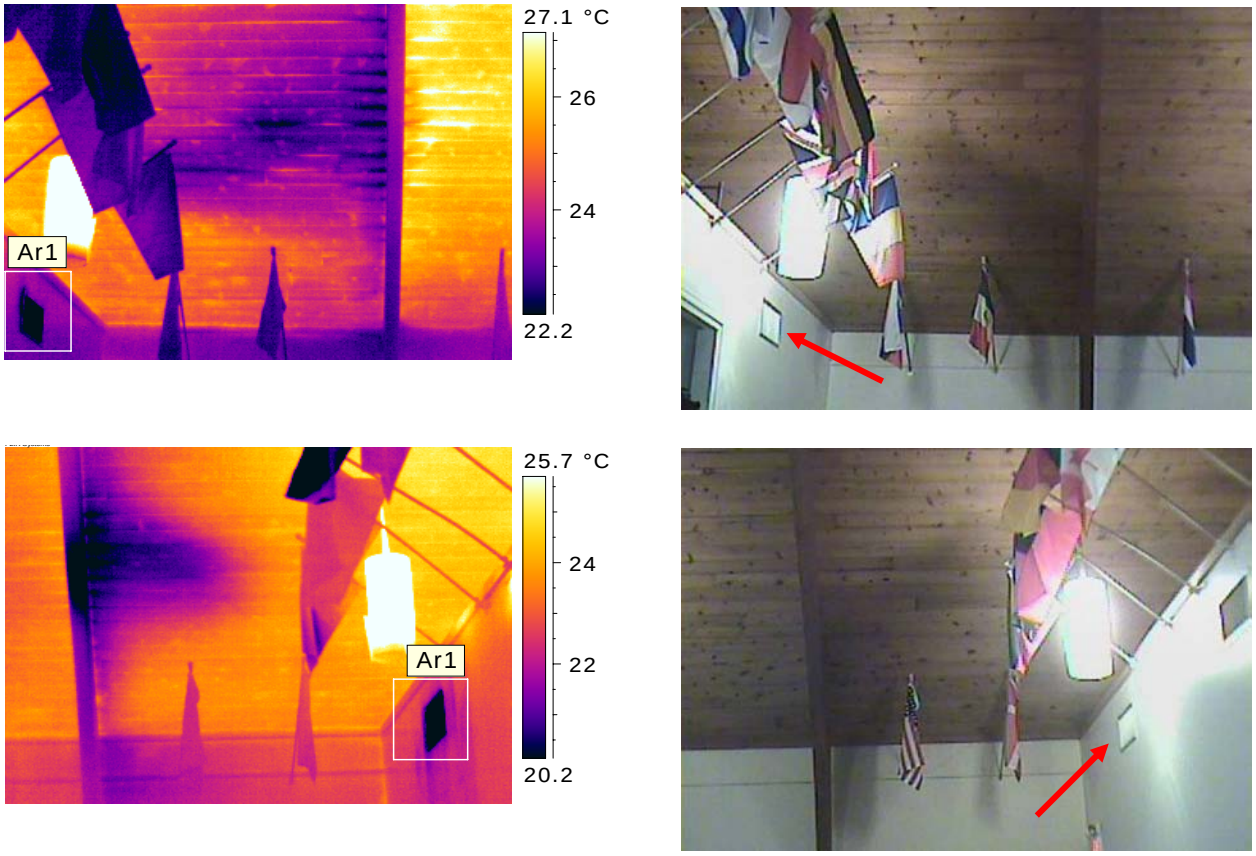


Figure 4. East Side of Sanctuary (Top). West side of Sanctuary (Bottom). Arrow indicates vents. Darker (cooler) regions on the ceiling indicate cooling by conditioned air.

Figure 4 images show the ceiling at the rear of the Sanctuary. Please note the area boxes (Ar1) in the IR images which show the HVAC vents and the red arrows in the digital pictures showing the same vents. The IR images show the difference in temperature at the ceiling on either side of the structural beams.

By redirecting the diffusers for these HVAC vents, the air flow might be directed so that is trapped less by these structural beams. This may allow for more of the air to flow through the room allowing for proper air circulation and cooling of the room.

AUTHORS NOTE:
The two diffusers have been redirected subsequent to this survey.

SEPARATED ROOF DECK

Figure 5 top thermogram/photo pair shows the peak of the ceiling at the south end of the Sanctuary above the baptistery (note the top of the decorative cross in the digital picture). The two area boxes in the IR image show areas where the roof deck has separated. These are areas where excessive heat is being allowed to enter the building.

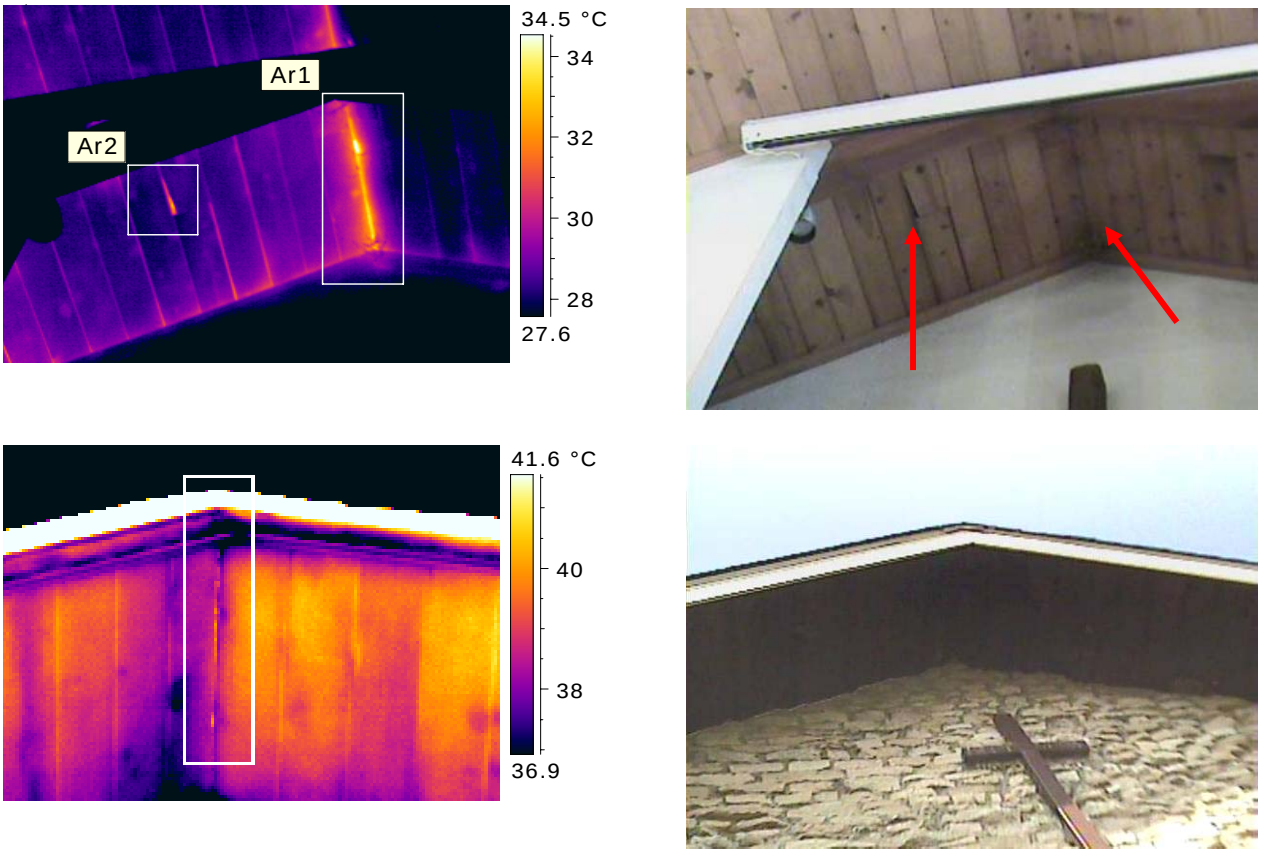


Figure 5. Interior View (Top). Exterior View (Bottom)

The remedy for this would be to reattach the separated board shown in Box Ar2 and add insulating material into the gap between boards at the peak of the ceiling shown in area Box Ar1.

Figure 5 bottom thermogram/photo pair shows the exterior view of this same peak. The boxed area in the IR image shows a continuation in the separation between the roof deck boards (shown in Box Ar1 of the Interior View) through the wall to the exterior of the building.

AIR AND HEAT INFILTRATION

Air and heat are infiltrating past the wall/roof interface along the north Sanctuary wall. This again is the wall above the false ceiling for the Lobby. It is being partially blocked by the wood trim, but is still infiltrating past this trim. This infiltration is shown in the series of thermogram/photo pairs given in Figure 6.

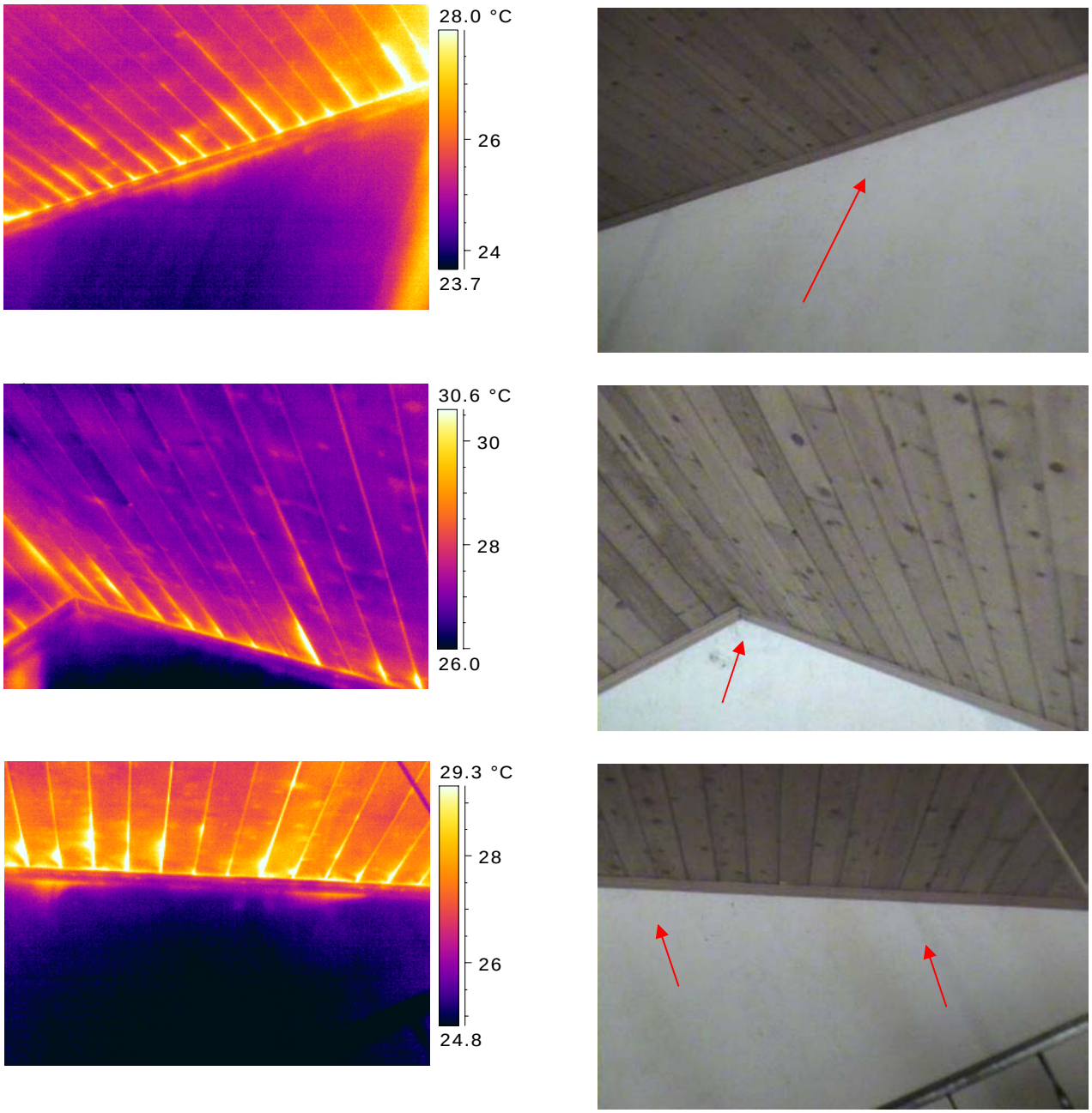


Figure 6. The thermogram/photo pairs from top to bottom progress along the north wall from the west to the east.

The air infiltration can be seen by the evidence of the air flow heating up the wall below the trim. Further, the heat is infiltrating along seams between the roof deck boards.

Figure 7 shows the exterior view of this same north wall under the roof overhang. The darker areas at the roof/wall interface show where the cooler air from inside the building is escaping through the seams in the roof deck boards.

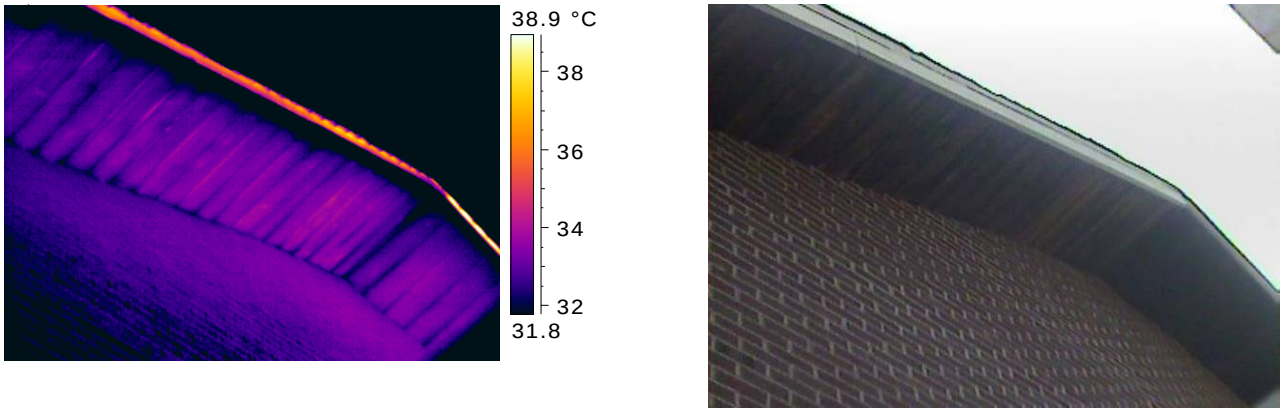


Figure 7. Exterior complementary thermogram/photo pair of Figure 6 images. Here, cooler regions indicate loss of cooling air to the outside.

The remedy for this condition would be to install insulating material or caulking along the roof/wall interface to stop the air movement.

CARPENTER BEE DAMAGE

This was a finding from the IR survey that was unexpected. The thermogram/photo pair of Figure 8 shows holes in the exterior soffit boards that have been caused by carpenter bees. The pictures are of the north overhang. There are several dozen of these holes throughout the boards in this overhang, as well as the south overhang. Figure 8 is just representative of these holes.

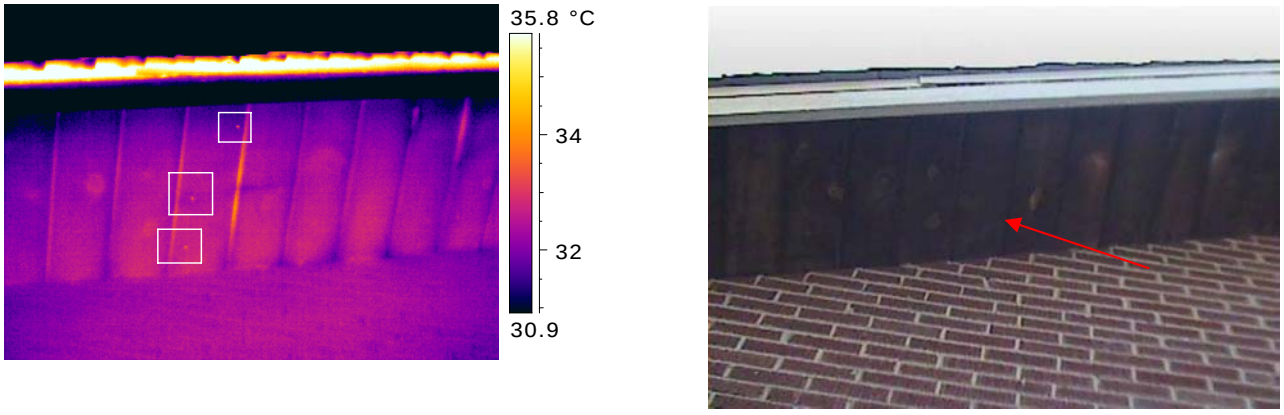


Figure 8. Thermogram/photo pair indicating carpenter bee damage indicated by boxes in IR image and arrow in photo.

I understand that there are plans to install siding under the north and south overhangs to keep the carpenter bees from inhabiting these areas in the future. Before this is done, the roof/wall interface should be sealed to eliminate the air movement as well.

AUTHORS NOTE:
The siding has been installed under the soffit areas subsequent to this survey. Insulating foam was used to seal the wall/roof interface prior to the siding being installed.

CEILING WATER INFILTRATION

Figures 9 and 10 show evidence of water infiltration into the roof deck boards. This water infiltration was from the steeple that had already been removed from the Sanctuary roof. The areas where the water infiltrated into the roof deck shows as the darker areas of the ceiling (white outlined regions in the IR images in Figures

9 and 10). The moisture is still trapped in the roof deck boards since I was able to detect its presence. This was another unexpected finding from this survey.

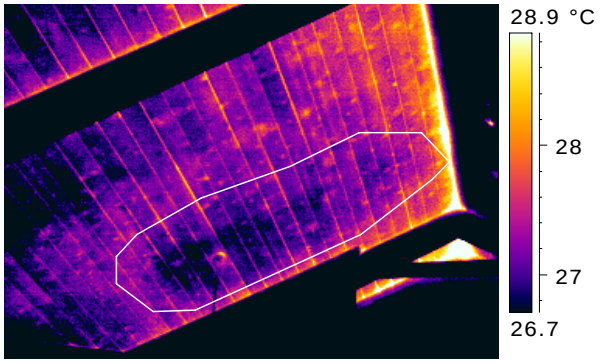
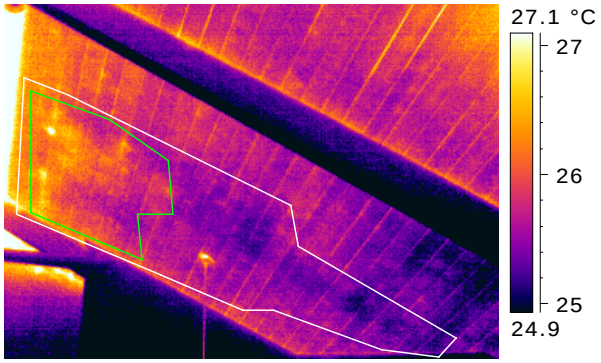


Figure 9. Water intrusion shown by outlined area in IR image and indicated by arrow in photo. East side.

The trapped moisture shows as darker, or cooler, areas in the IR images since it cools as it evaporates.



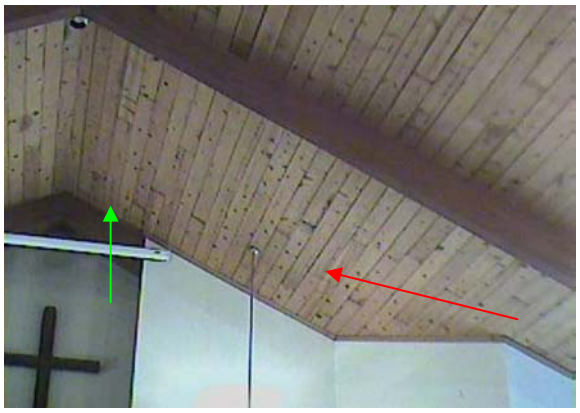


Figure 10. Water intrusion shown by outlined area in IR image and indicated by arrow in photo. West side.

The green outlined area inside the white outlined area of Figure 10 shows the bolt holes where the steeple was bolted to the roof. Due to the sun heating this side of the roof, the heat is able to conduct through the roof deck quicker through these holes and is heating up the moisture in the roof deck around these holes much faster.

I also took pictures of the roof from the exterior showing where the steeple used to be, Figures 11 and 12. This area has been shingled over to match the rest of the roof. However, you can still see that there is trapped moisture under the roofing materials.

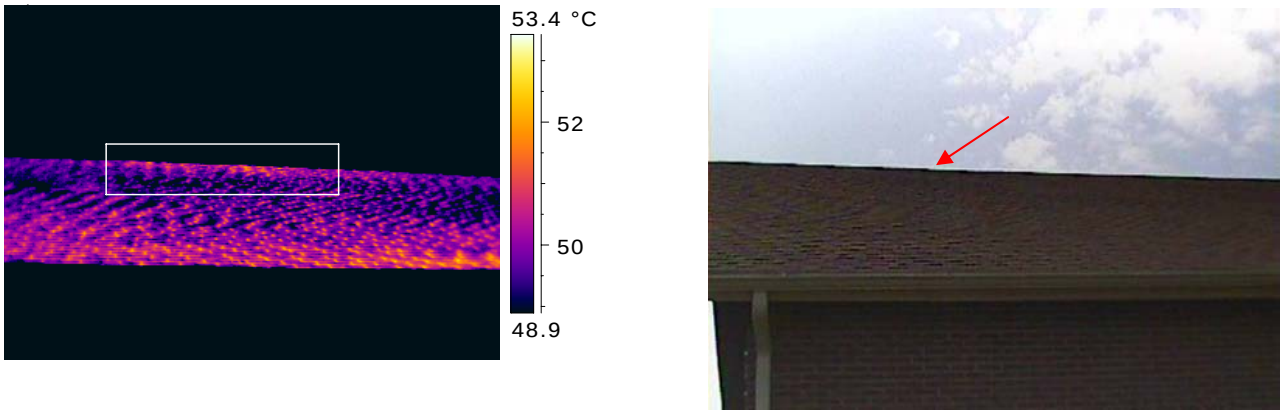


Figure 11.This thermogram/photo pair shows the east side of the Sanctuary roof.

The area shows warmer since the sun has moved off this side of the roof and this side has started cooling. The moisture underneath is retaining the heat longer and will show warmer than the surrounding roofing materials.

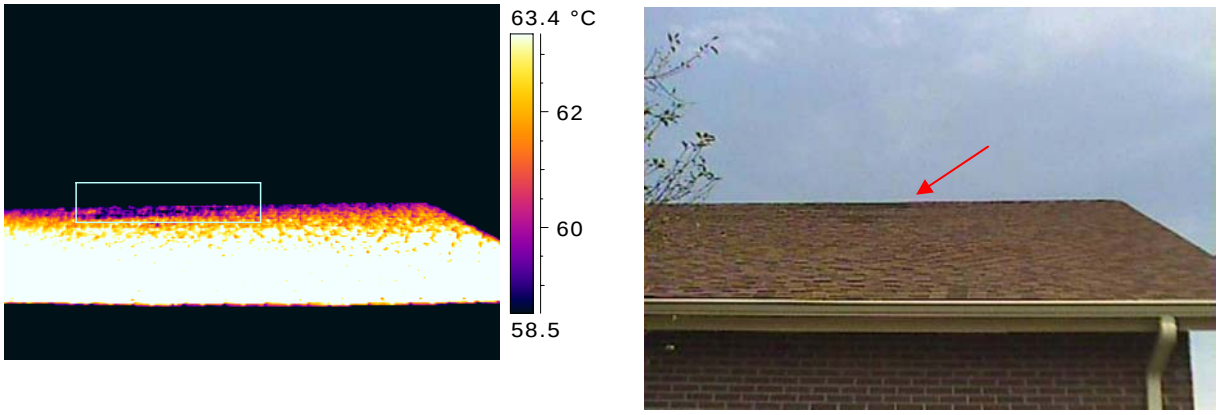


Figure 12. This thermogram/photo pair shows the west side of the Sanctuary roof.

The area shows cooler since the sun has now moved to this side of the roof and is now heating this side of the roof. The moisture underneath is taking longer to heat up than the surrounding roofing materials, thus will show cooler.

No action is needed for this condition. The moisture will eventually dry out of this material as the source of the water intrusion has been removed.

SUMMARY

The use of infrared thermography was a quick and efficient tool useful in spotting several causes for the continual problem with the inability to cool this portion of the building. Some of these causes may not have been identified by any other means.

While two of the items causing the original complaint have been corrected subsequent to this survey, the key cause of the energy loss in the building remains. This is the poorly insulated ceiling in the Sanctuary. The church is still investigating the best means to correct this situation.

ABOUT THE AUTHOR

Sean has been employed by CNA Insurance for 16 years as a Risk Control Consultant. He is a Level II Thermographer and a Certified Building Science Thermographer and has been providing infrared surveys for the clients of CNA Insurance since March of 2005.

ACKNOWLEDGEMENTS

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DISCLAIMER