



Quality Control Inspection of Homes with Thermal Imaging

Sampling of Thermal Images collected during a study of construction quality of homes built recently in the five most populous parishes of Louisiana

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Study was completed in the Fall of 2001

INTRODUCTION

- A random sample of approximately 20 homes from Caddo, Calcasieu, East Baton Rouge, Jefferson, and St. Tammany Parishes, each were inspected using a Blower Door, Duct Blaster, and an Infrared Radiometer to determine the overall quality of construction by builders across the state. In total 79 homes were checked.



Note temperature difference between insulated section and void – approximately 5.4 degrees.

Knee wall void @ top

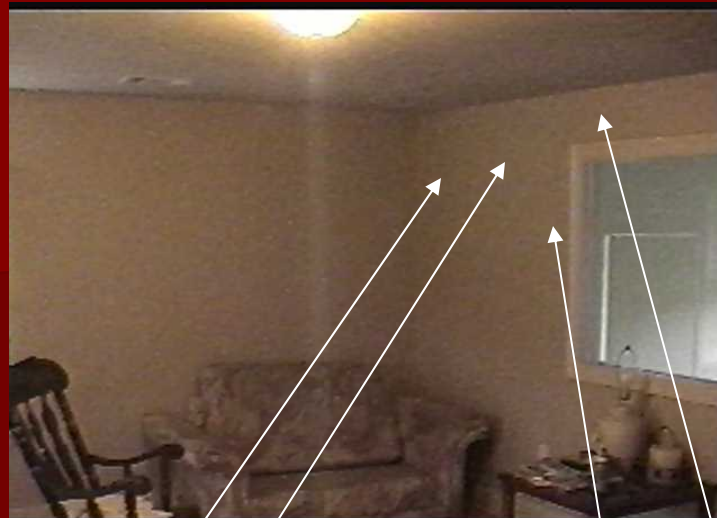
Outside porch ceiling line

INTRODUCTION

- The blower door determines the air infiltration concerns
- The Duct Blaster determines if any ducts leak
- The Infrared Radiometer detects voids in insulation, leaking air around windows, doors, ceiling fixtures, roof leaks, electrical hot spots, and numerous other problems.

INTRODUCTION

- The blower door is used to create a small vacuum in the home. Leaking top plates & outlets, windows, doors, cabinet, furred down areas all become evident.
- When combined with thermal imaging these concerns become more visible.



The black lines are studs in an interior partition separating a spa room from a game room. The studs should be continuous to the ceiling. But hot air seeping down into the partition is causing the sheet rock to heat up hiding the cooler stud pattern.

INTRODUCTION

- Thermal images (contrary to popular belief) are not red. They are monochromatic-meaning one color & usually black & white. If the display is red then they will be varying shades of red. If green then shades of green, etc. Often a color spectrum is applied to help understanding. These colors are arbitrary however. Usually white is hot and black cold.

INTRODUCTION

- An Infrared Radiometer (thermal imager) is a temperature measuring camera that determines temperature changes across an object by displaying these small changes in gray scale shades in the image. Most IR cameras are at least 1/10 of a degree Celcius sensitive at 30 degrees ambient temperature. So 256 shades of gray means 256 changes of temperature in a given temperature range setting. It could be only a 10 degree range. This means that there could be 25.6 shade changes for each degree.

INTRODUCTION

- The way a defect in construction is found with IR is when looking at a material whose composition is homogeneous or known and having a warmer or cooler temperature on the other side. If any temperature anomalies are seen they are defects-whether warmer or cooler. If a framed wall, studs will be expected so not anomalous however, an insulation void will be much hotter or cooler than the insulated areas. A cool pattern on a ceiling surrounded by warmer insulated areas indicates moisture or a paint blister.

INTRODUCTION

- The following images are typical concerns found in the homes of the parishes in the study.
- They are just samples and mostly were found by scanning the ceilings and walls both interior and exterior.

CADDO CEILINGS



Insulation voids caused by poorly attached fiberglass batts. Note the odd pattern below the ridge beam in the left image. This is a knee wall with the batt against the drywall where the dark area is showing but hot spots on either side from poor contact between the studs. The other images show voids in the cathedral ceiling along the other side of the ridge beam. Note the nail heads acting as thermal bridges in the rafters and studs of each image.

CADD0 CEILINGS



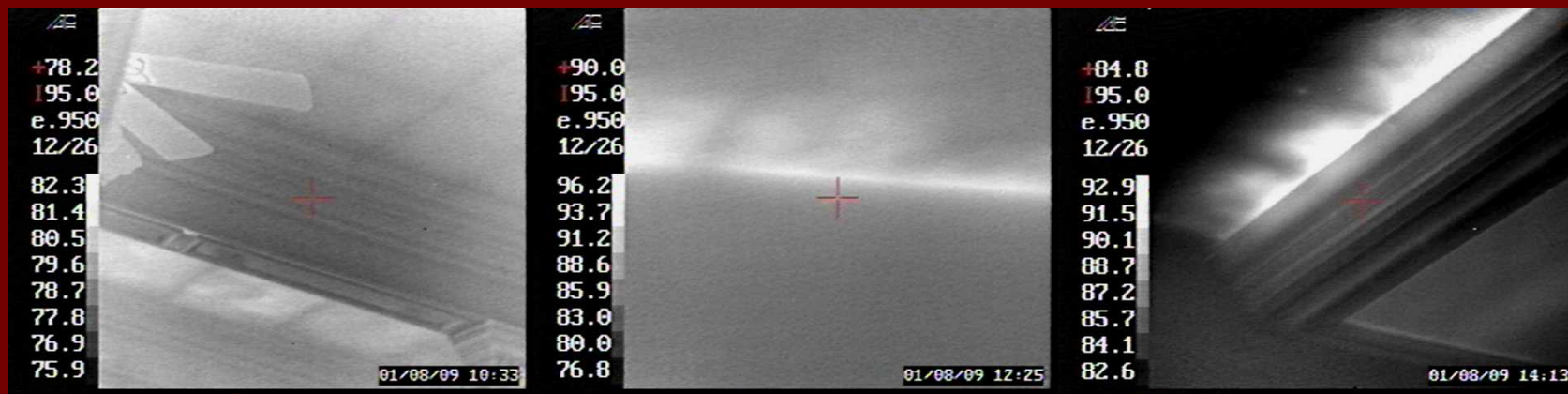
Insulation voids

CADD0 CEILINGS



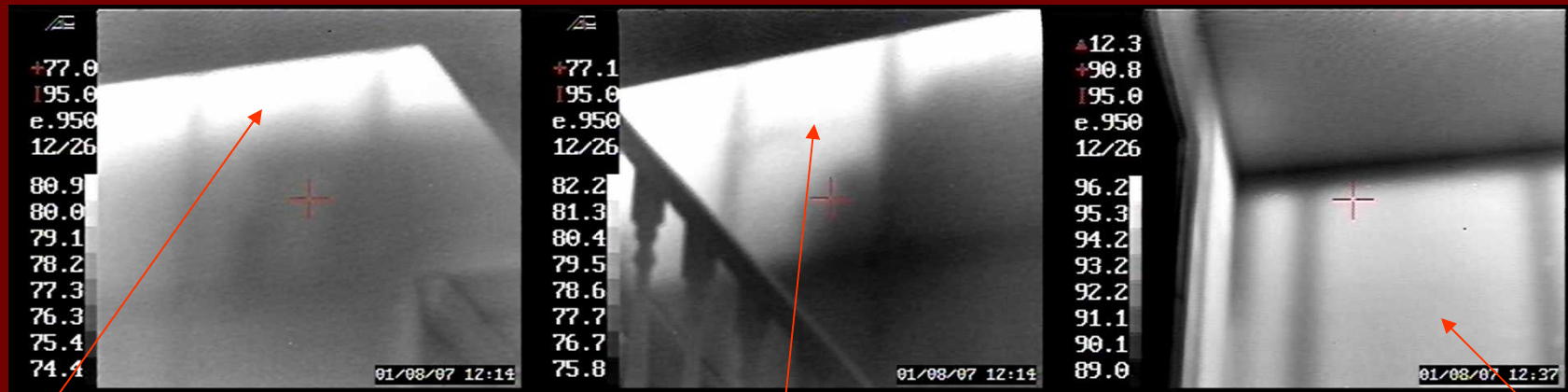
Unsealed down lights & leaking escutcheons

CADDO CEILINGS



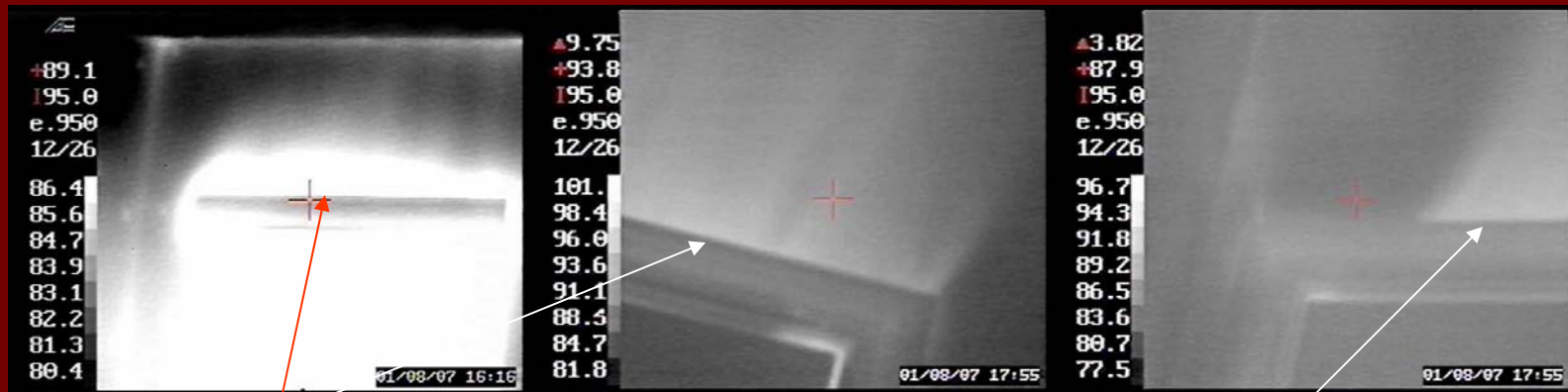
Poorly distributed blown-in insulation

CADDO WALLS



Insulation voids that are actually knee walls since the attic is on the other side. This is a stairwell.

CADDO WALLS



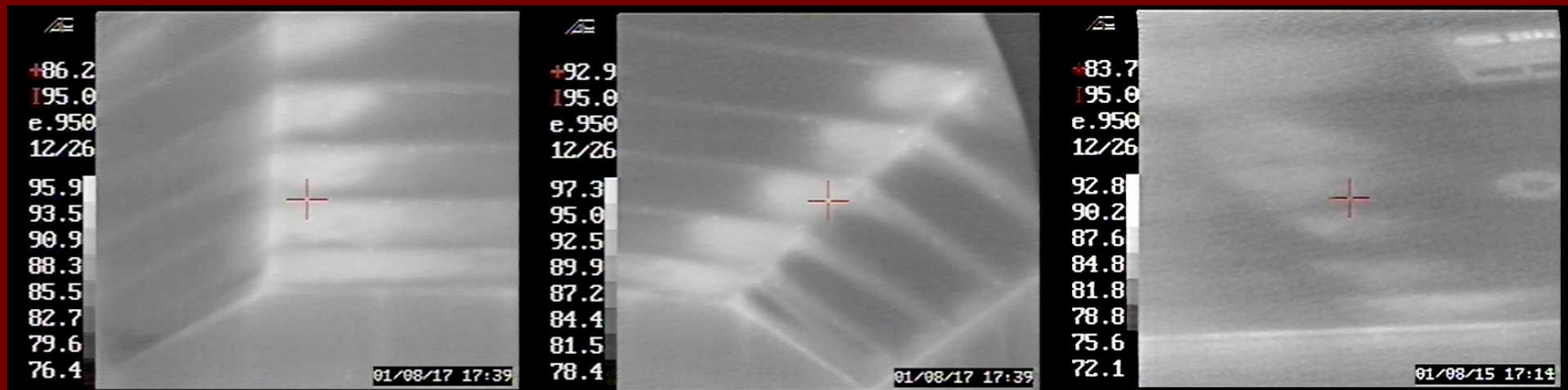
Air leaks at window and door frames from poor caulking jobs.

CADDO WALLS



Insulation voids and leaking top plate.

CALCASIEU CEILINGS



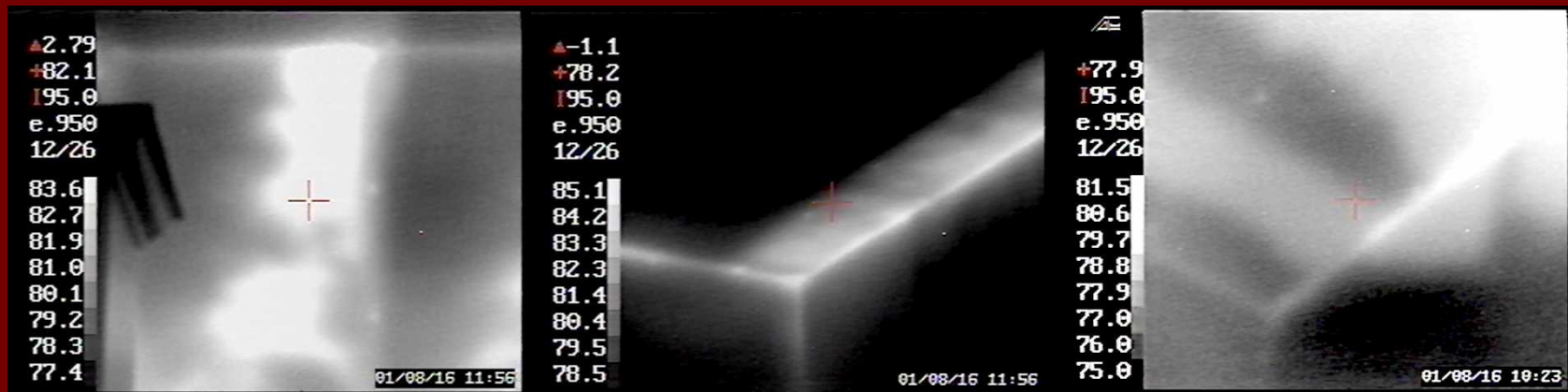
Poorly distributed blown insulation

CALCASIEU CEILINGS



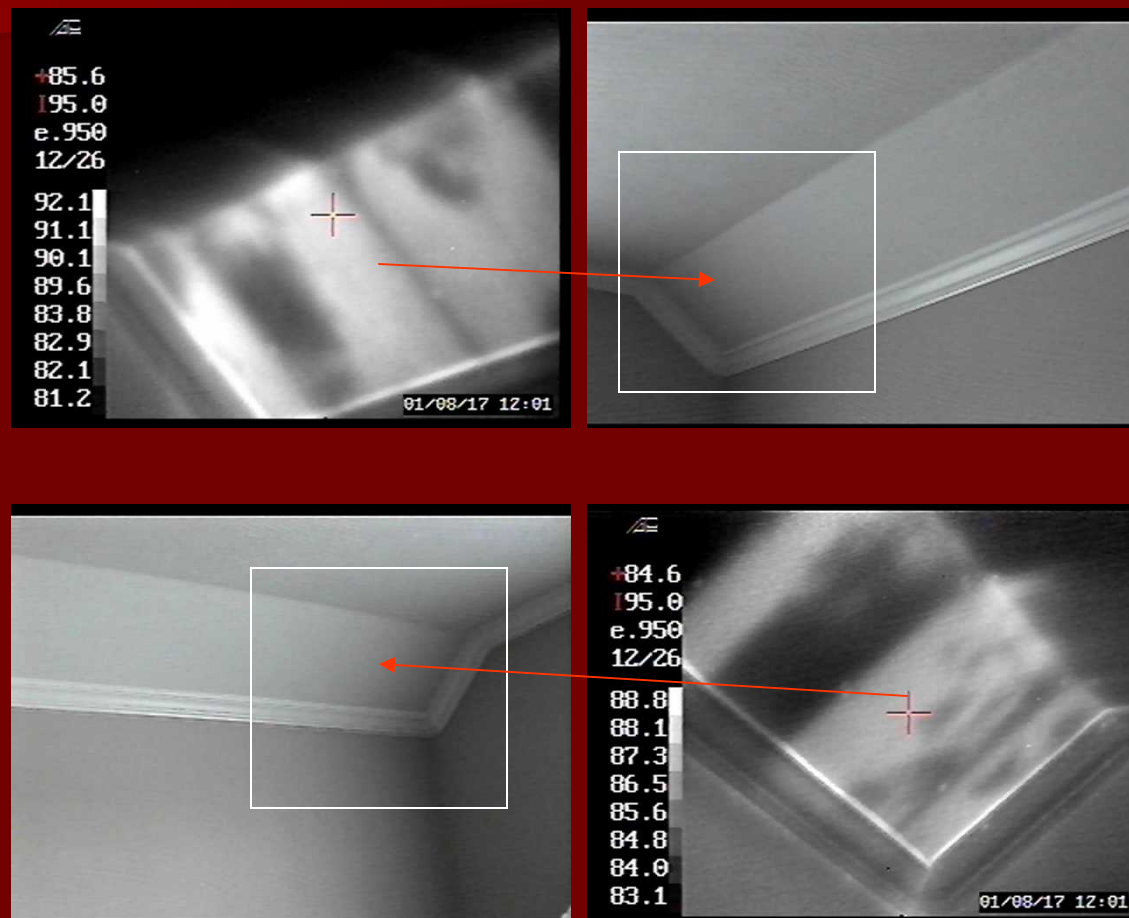
Roof leaks showing from evaporation pattern in ceiling.

CALCASIEU CEILINGS



Poorly distributed blown insulation

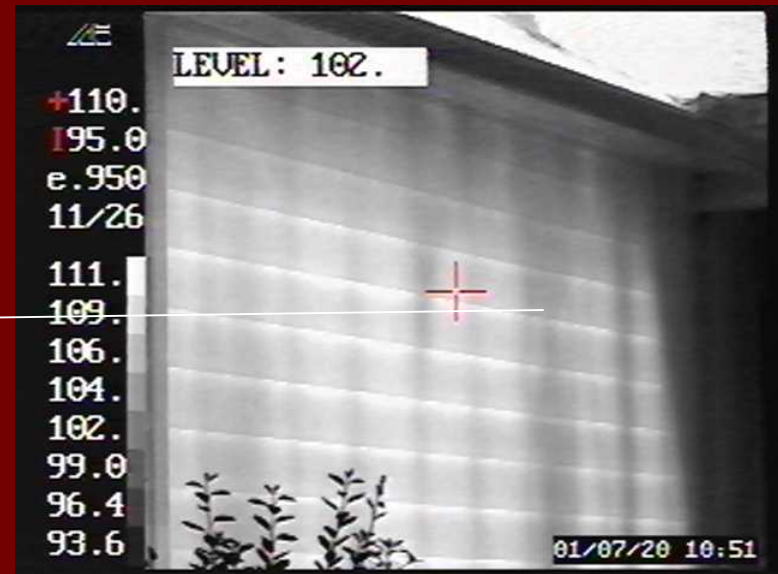
CALCASIEU CEILINGS



More blown insulation defects.

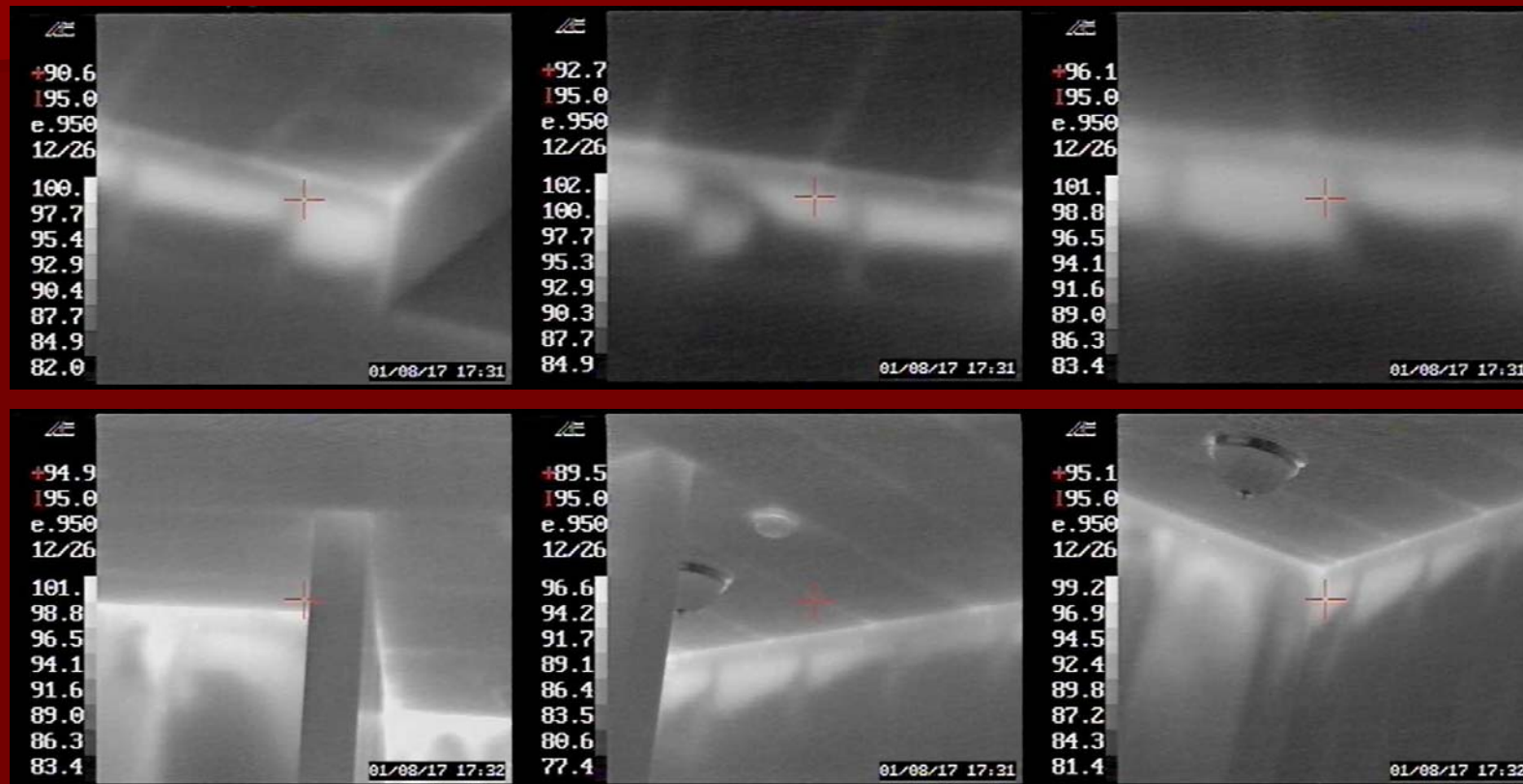
Energy Section
Technology Assessment

CALCASIEU WALLS



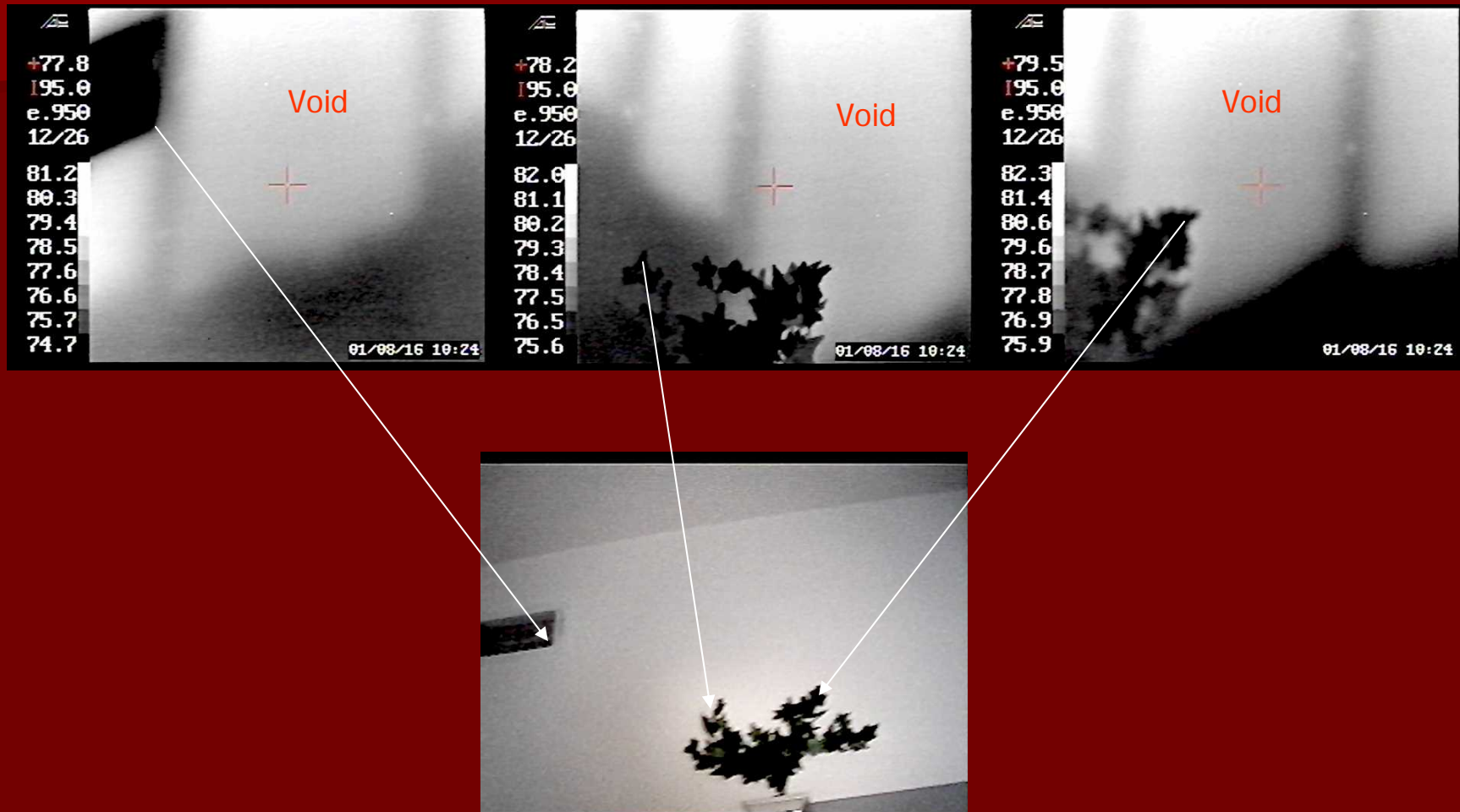
Insulation voids

CALCASIEU KNEE WALLS



Hot spots from voids at the top of the walls in the Great Room.

CALCASIEU KNEE WALLS

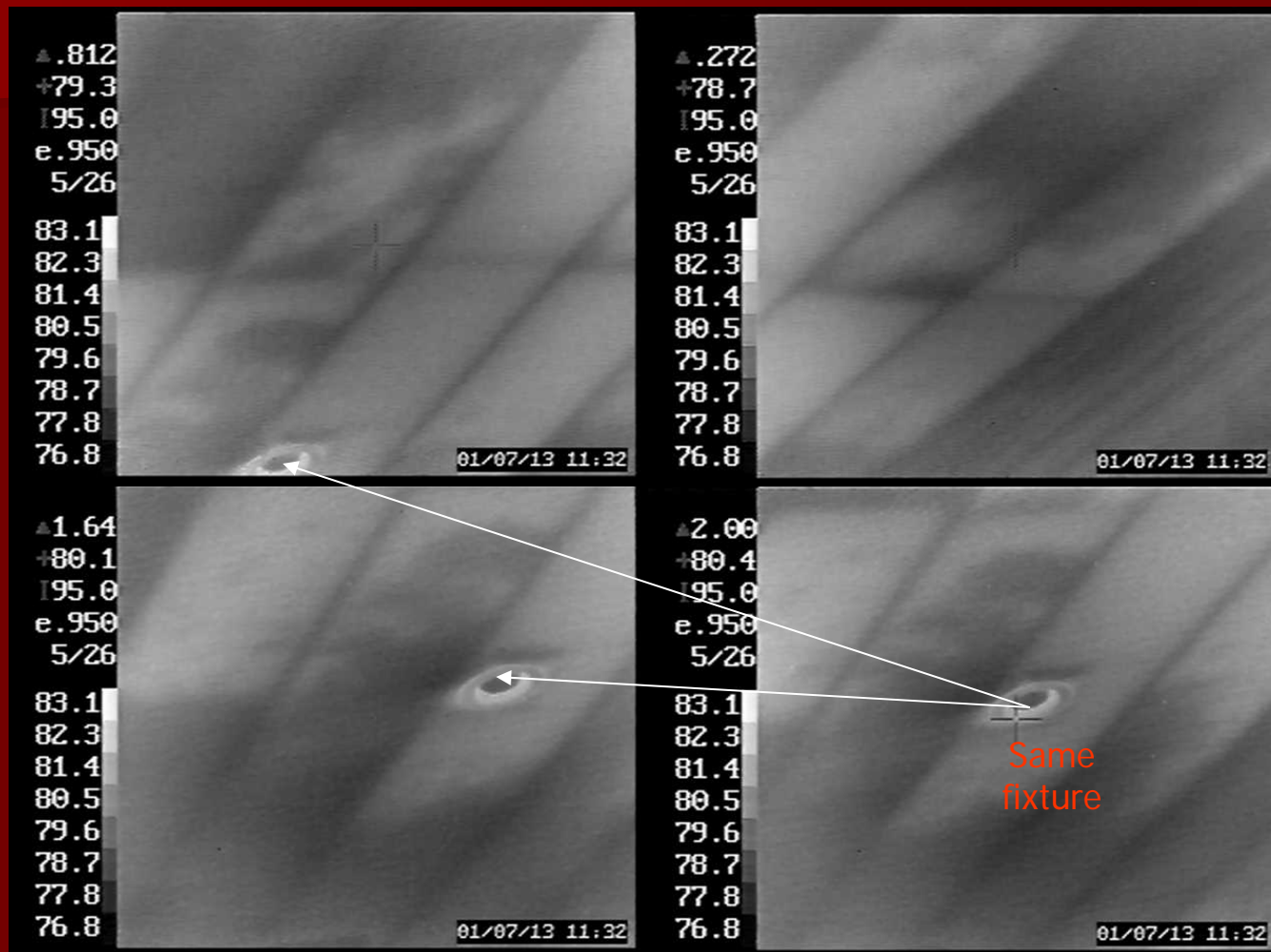


Reference Image
Energy Section
Technology Assessment

EAST BATON ROUGE CEILINGS



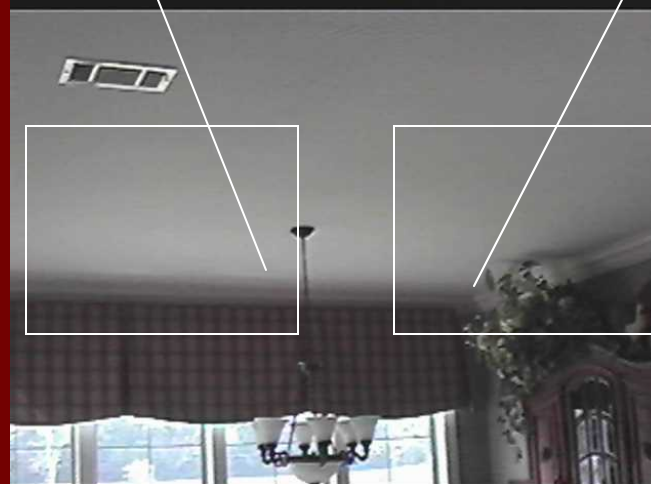
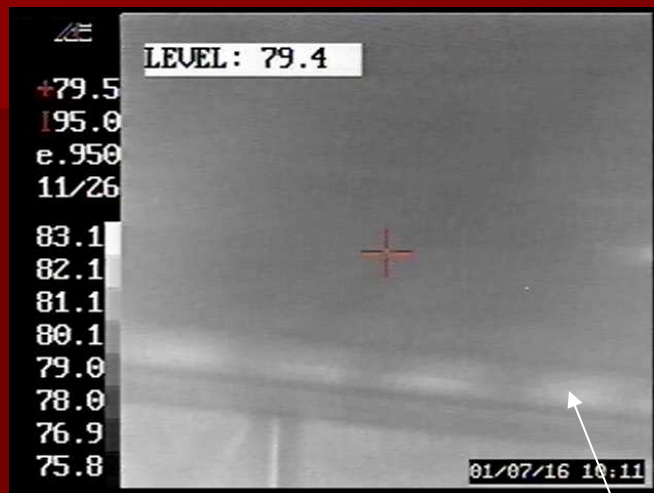
EAST BATON ROUGE CEILINGS



Never install an attic floor before the insulation is blown in.

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EAST BATON ROUGE CEILINGS



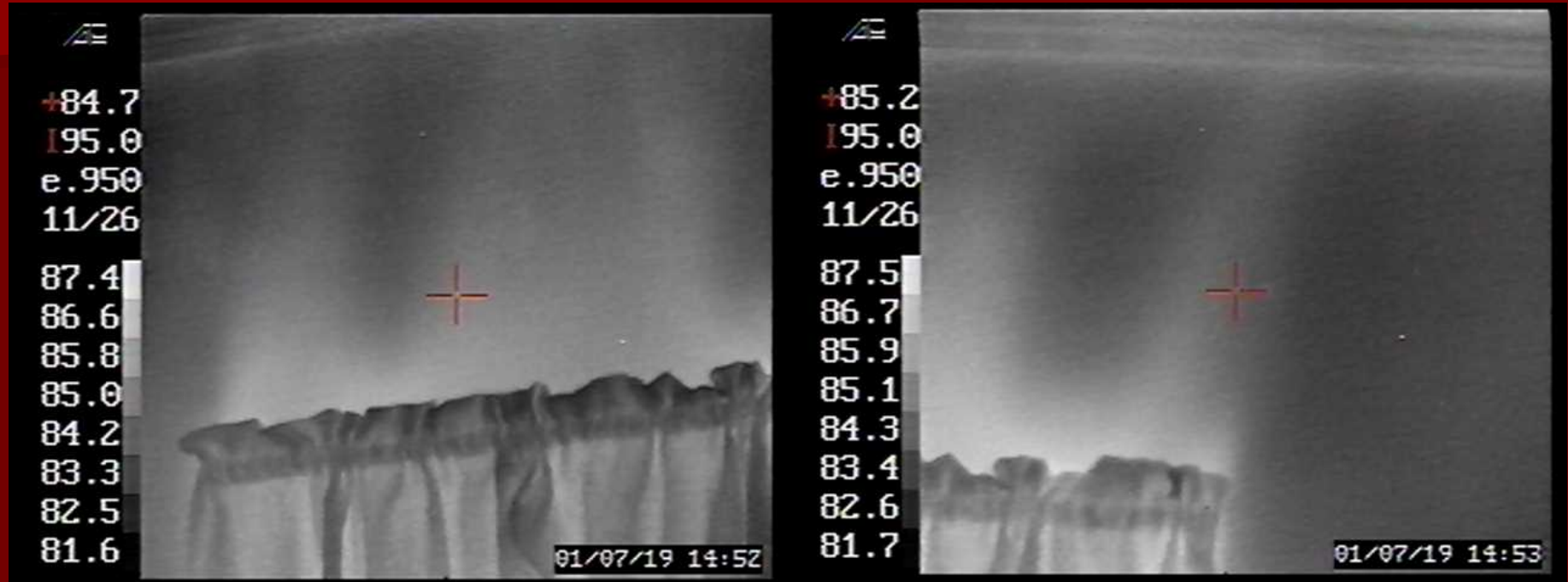
If you don't check the workmanship this is what you get.

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EAST BATON ROUGE WALLS

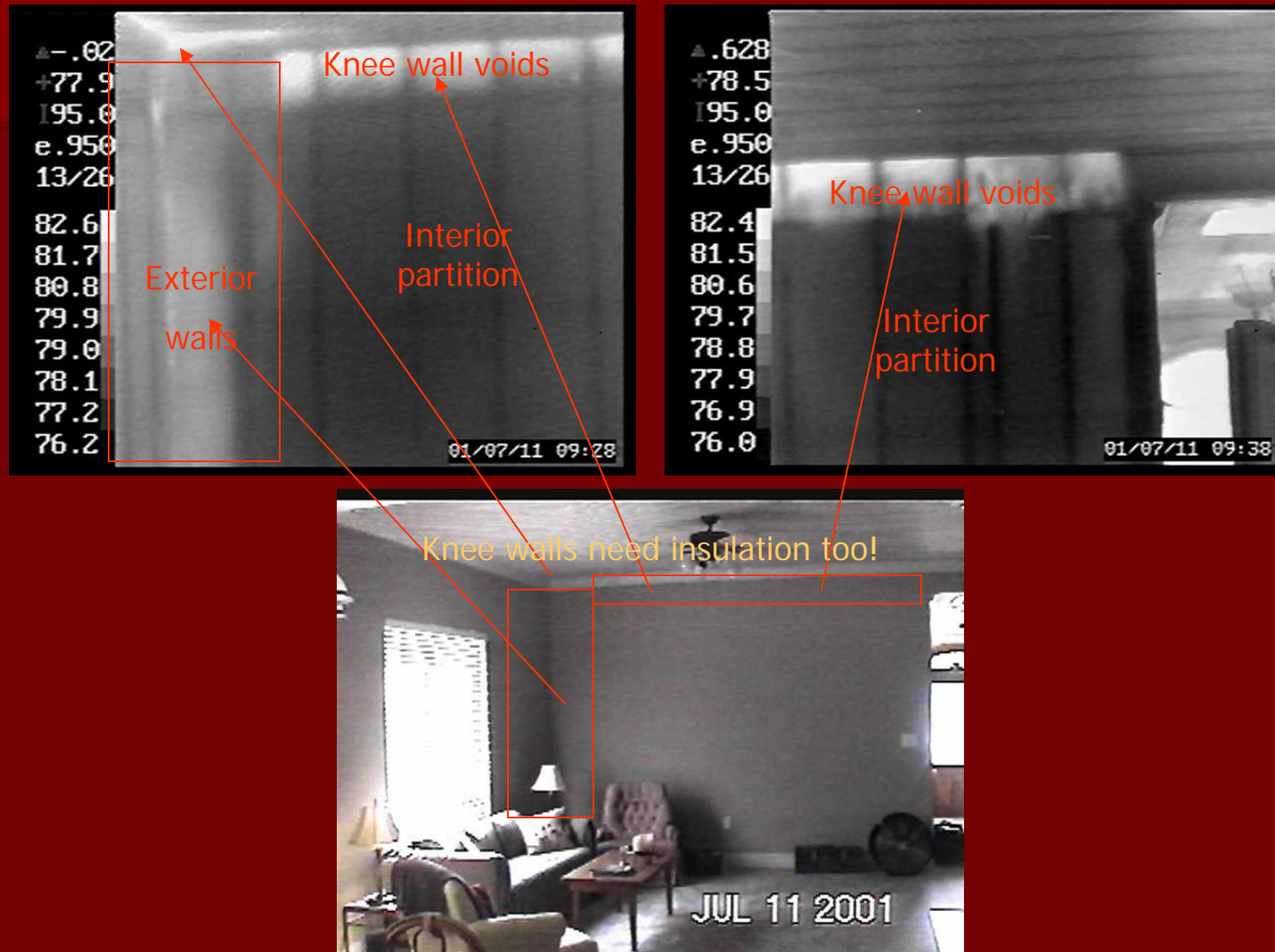


EAST BATON ROUGE WALLS



Why pay \$100+ per square foot when caulking is so cheap and so forgotten?

EAST BATON ROUGE KNEE WALLS



EAST BATON ROUGE KNEE WALLS



Yes, hot air rises, so why not insulate the stairwell to keep it as cool as possible?

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EAST BATON ROUGE KNEE WALLS



Crown moldings need insulation behind them when it's a knee wall.

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EAST BATON ROUGE KNEE WALLS



The above knee wall extends from one side of the house to the other! If you spend \$250,000 for your home, does this mean that you can afford to pay high utility bills?

JEFFERSON CEILINGS



Fiberglass batts should cover the whole exposed areas of drywall.

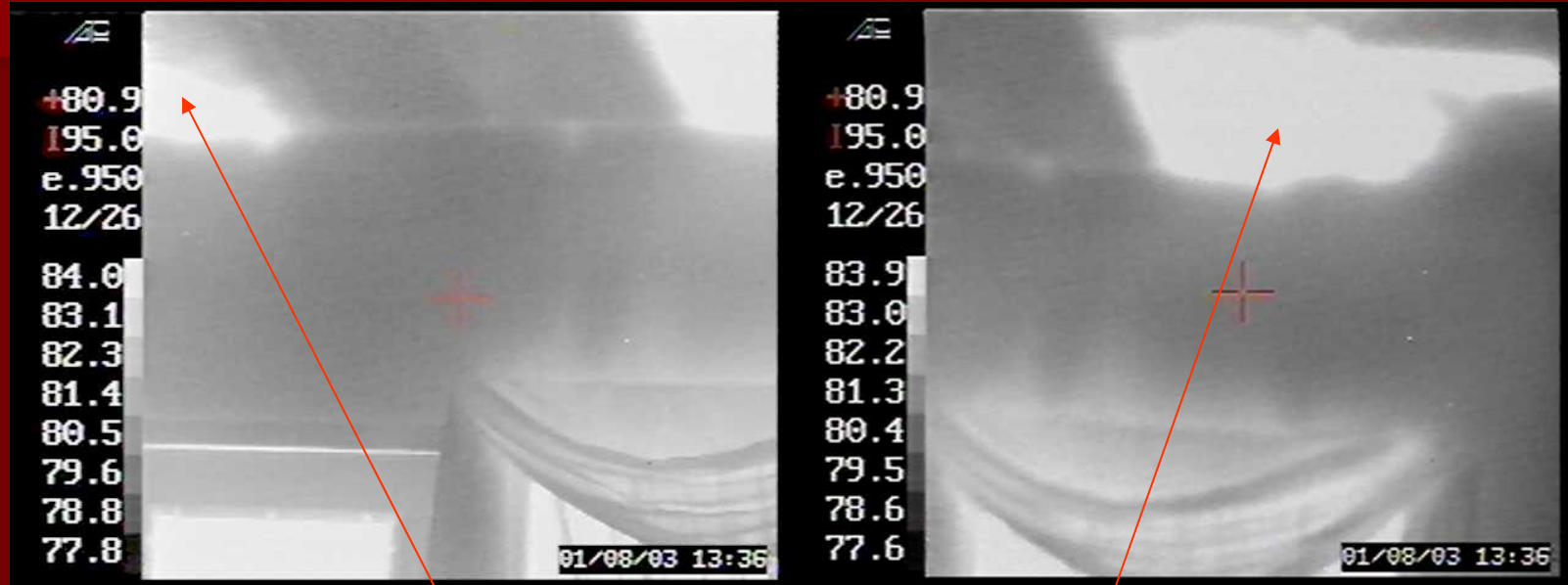
JEFFERSON CEILINGS



Cathedral ceilings and loose blown insulation aren't a good combination.

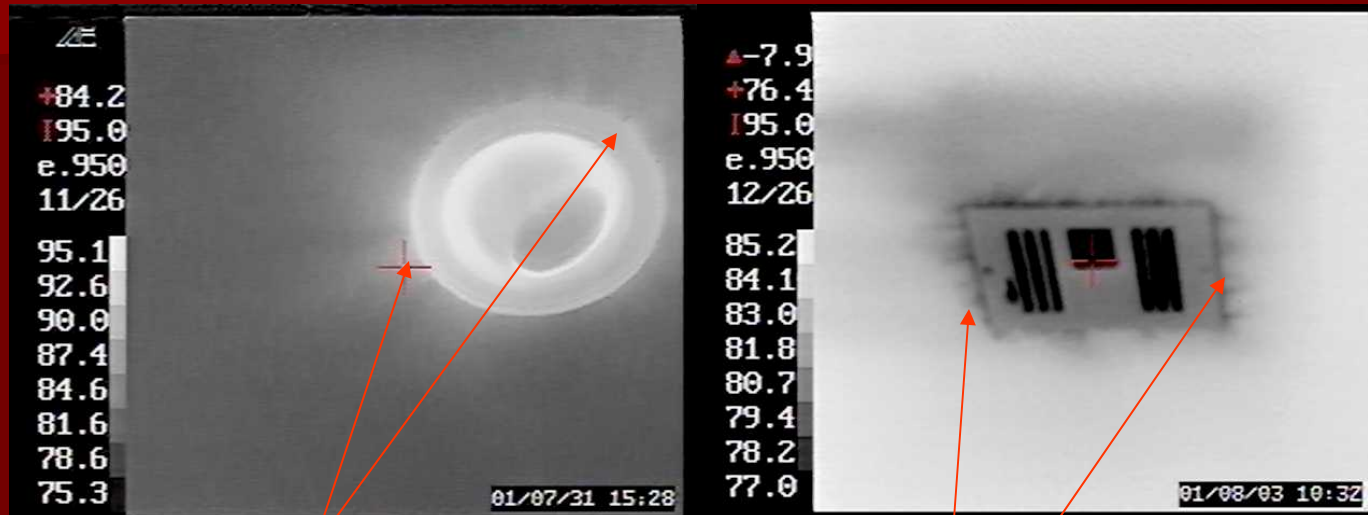
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JEFFERSON CEILINGS



Sloppy workmanship is across the state.

JEFFERSON CEILINGS



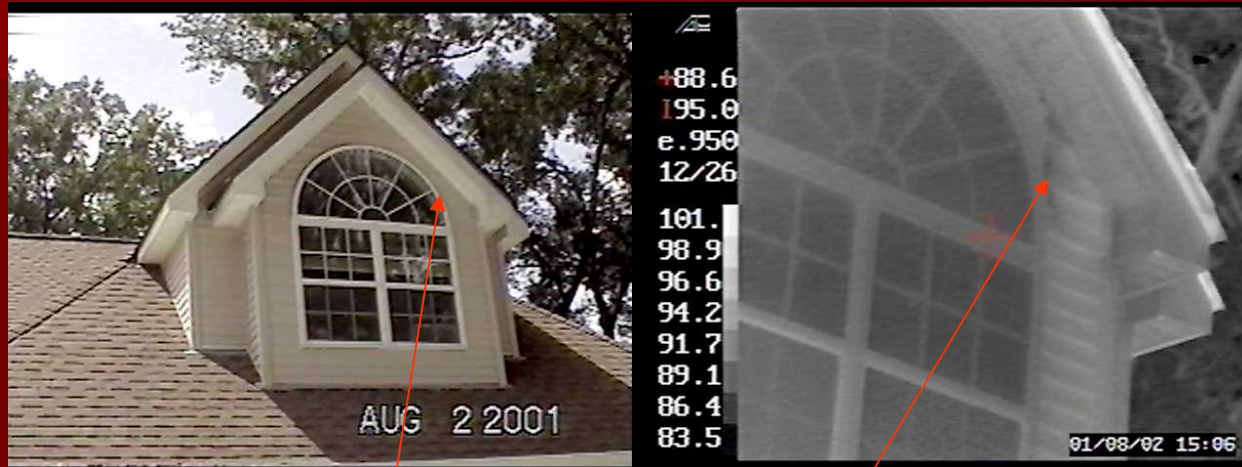
Escutcheon plates leak too without gaskets!

JEFFERSON CEILINGS



Overlapping images show the extent of voids in a hallway around an non-insulated stair hatch.

JEFFERSON WALLS



Leak above dormer window!



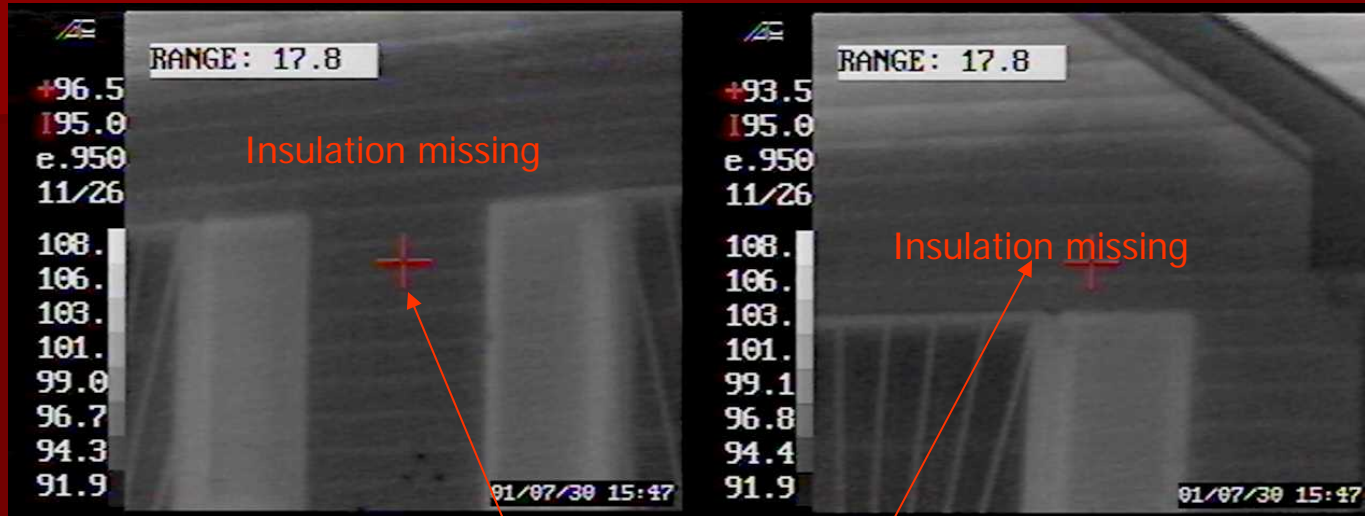
Window leak!

JEFFERSON WALLS



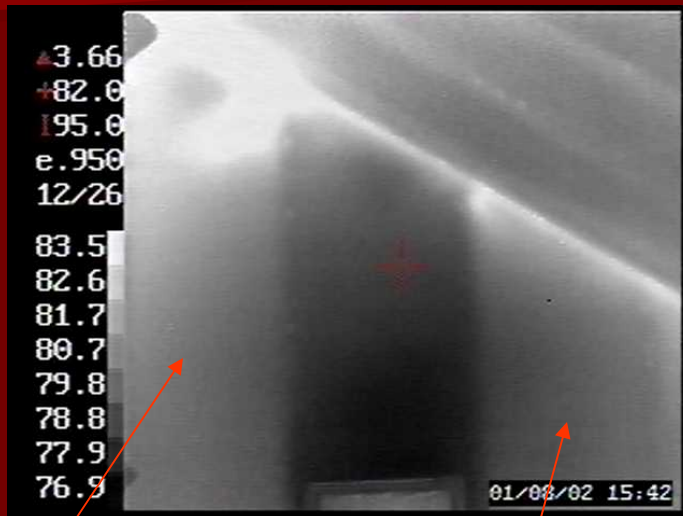
Chimney chase that is open to the attic and therefore a knee wall.

JEFFERSON WALLS

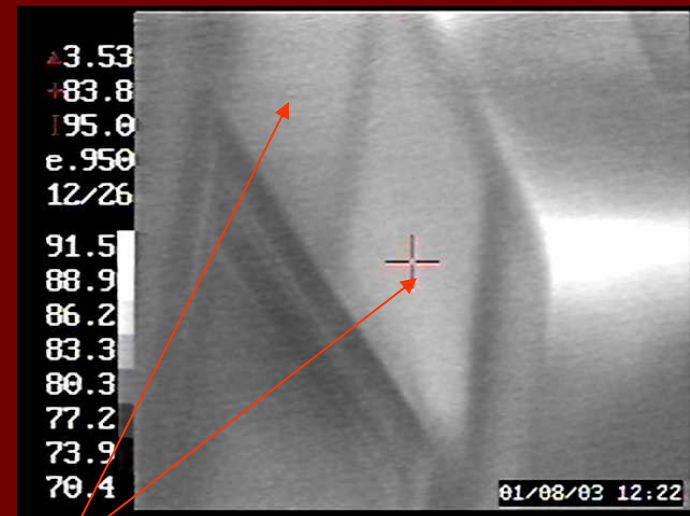


This room is hot in the summer and cold in the winter.

JEFFERSON WALLS

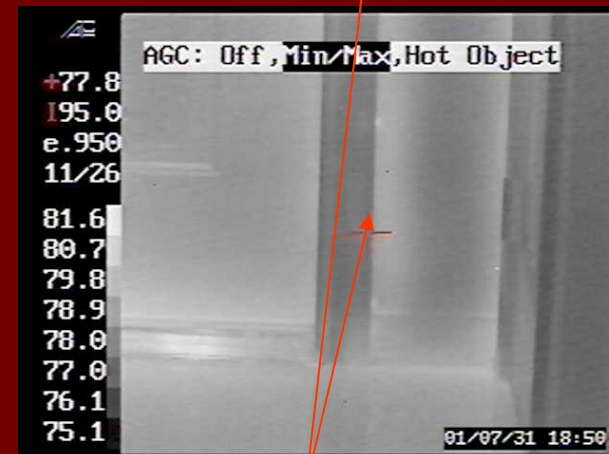
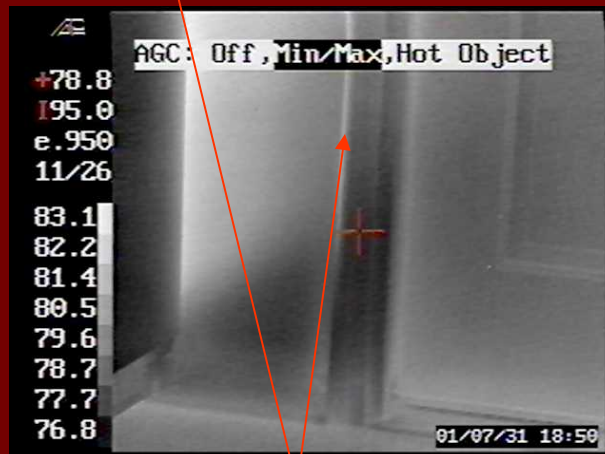


One out of three insulated sections isn't a good average.



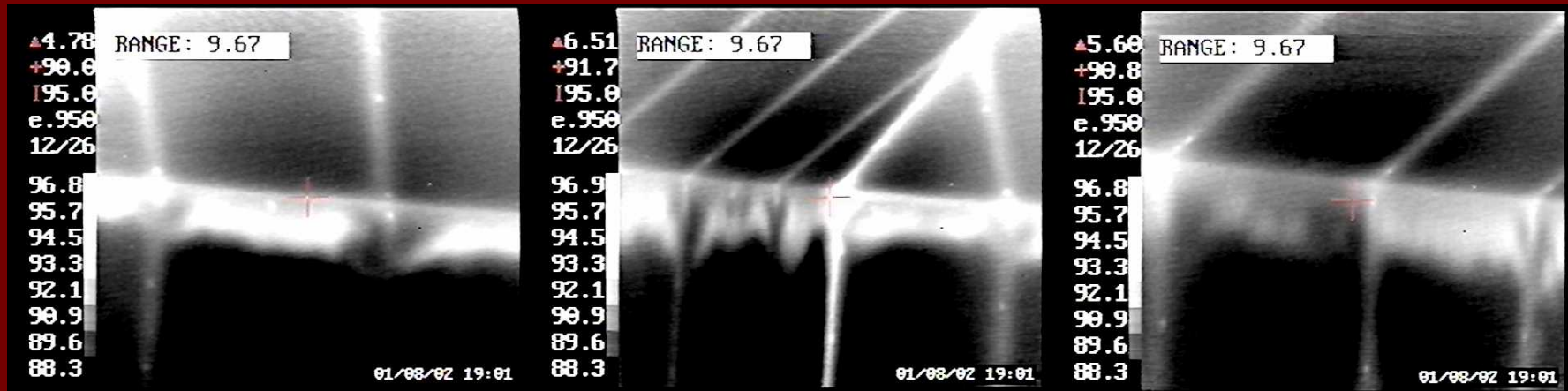
Air handler closet walls open to the attic are knee walls that need insulation.

JEFFERSON WALLS



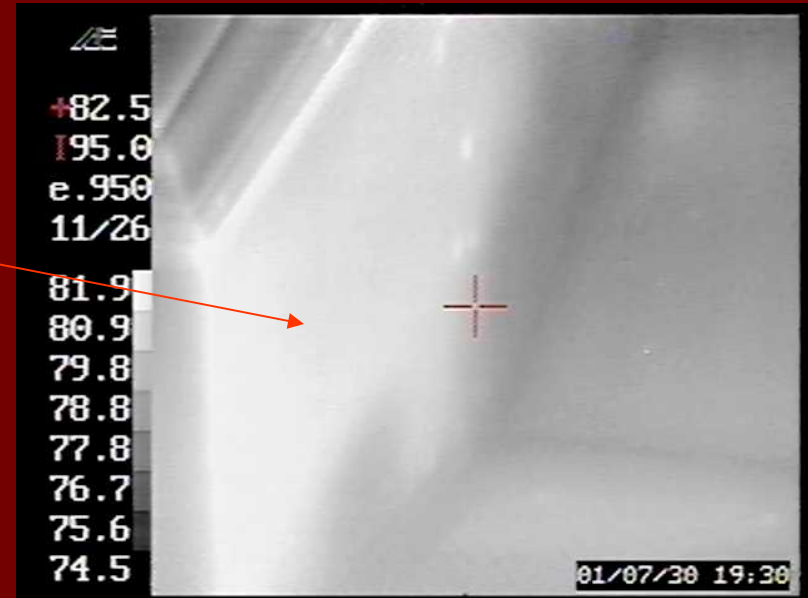
Doors need to be caulked in this parish too.

JEFFERSON KNEE WALLS



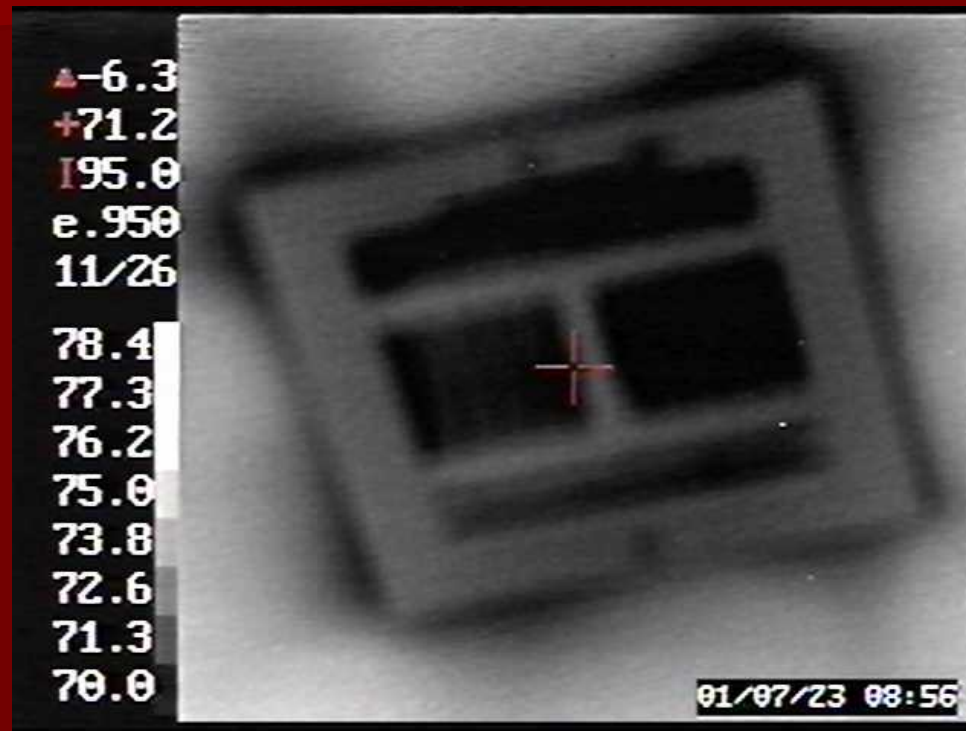
No wonder this room was so hot!.

JEFFERSON KNEE WALLS



Furred-down areas need insulation if open to the attic.

ST. TAMMANY CEILINGS

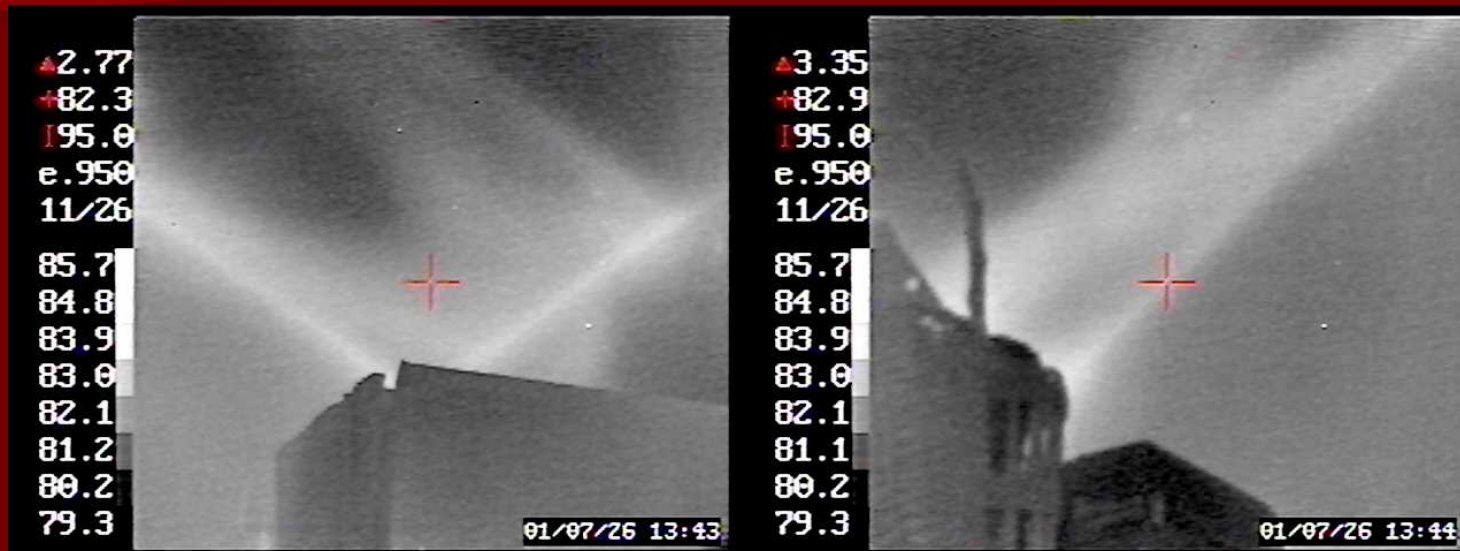


Missing gasket around escutcheon allows leaking.

ST. TAMMANY CEILINGS

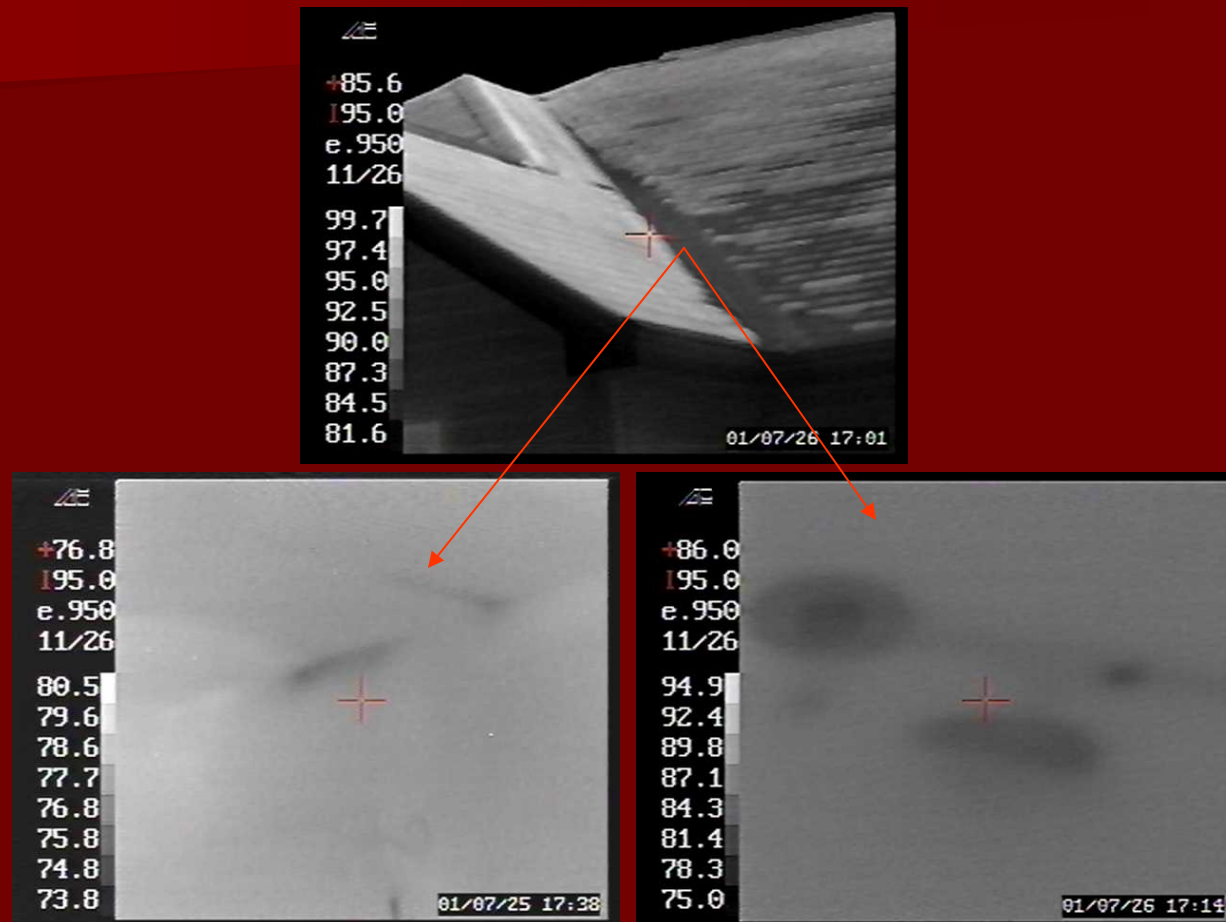


ST. TAMMANY CEILINGS



Master bedroom closets need ceiling insulation installed correctly too.

ST. TAMMANY CEILINGS



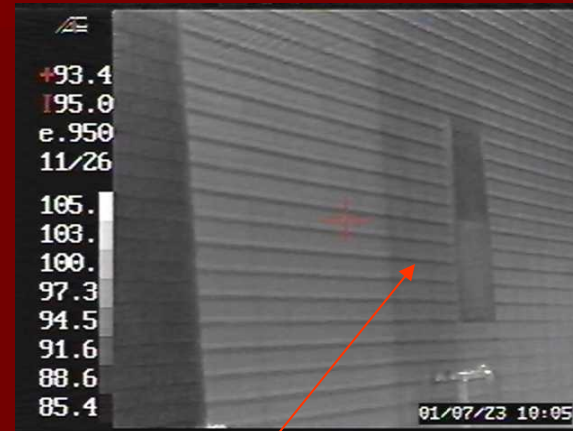
Leaking valleys cause wet ceilings.

ST. TAMMANY WALLS



Odd condensation patterns on the surface of the vinyl siding across the back of this house may indicate a lack of insulation in the wall behind it.

ST. TAMMANY WALLS



ST. TAMMANY WALLS



Vinyl siding leaks unmasked.

ST. TAMMANY KNEE WALLS



Insulation void

CONCLUSIONS

- Thermal imaging unmaskes defective construction
- Quality of construction is not any better in one region than another.
- High ticket spec. homes have just as many defects as modest homes.
- The combination of blower door testing with thermal imaging creates a better understanding of the need for sealing top plates around all penetrations as well as showing how well air flows through fiberglass batt insulation in walls.