October 2013

Hartsfield-Jackson International Airport

ThermaCote Paint Study

THE INTERNATIONAL KNOWLEDGE AND RESEARCH CENTER FOR GREEN BUILDING
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INTERNATIONAL KNOWLEDGE AND RESEARCH CENTER FOR GREEN BUILDING

SPSU SOUTHERN POLYTECHNIC STATE UNIVERSITY

Hartsfield-Jackson Internation Airport: Thermacote Paint Study

International Knowledge and Research Center for Green Building

By: Ian Elmore

Introduction:

This report concerns an experiment on the effectiveness of ThermaCote in reducing the heat load on passengers boarding bridges which was conducted at Hartsfield-Jackson Atlanta Airport from July 12 to August 15 2013.

Existing Conditions

Passenger boarding bridges, air bridges, skyways and jet ways refer to the enclosed, adjustable bridges that provide direct passenger access between the terminal and aircraft. The bridge is mechanically driven, and able to pivot, telescope, raise and lower in order to accommodate a range of aircraft.

The boarding bridges are not directly air conditioned. Mounted under the bridge is an air handling unit, which provides pre-conditioned air to the aircraft while it is parked at the gate. During boarding and disembarking, air is exchanged between both the aircraft and the bridge, and the concourse and the bridge. As a result, conditioning the air in the bridges is inefficient and uncomfortable.

ThermaCote

ThermaCote is described by its manufacturer as "a single component spray applied thermal barrier coating encompassed of ceramics and acrylics (water based)." It claims to increase the R value of assemblies by reducing thermal bridging, as well as reducing solar and radiant heat gain. Applied to the boarding bridge, it should reduce heat gain, lower interior temperature, and provide energy savings.

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Procedure:

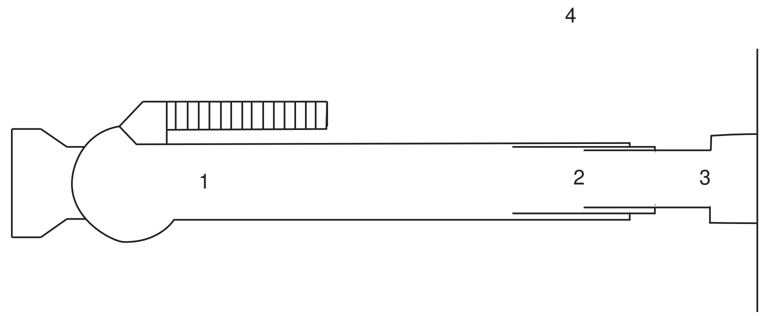


Figure 1

Two passenger boarding bridges were tested for a period of five weeks (July 12 to August 15). The bridge at gate E34 was treated with a 20 Mil (.5 mm) coat of ceramic thermal barrier (see Appendix A). The bridge at gate E36 was left untreated. Dry bulb temperature readings were taken at five minute increments at three points inside of each bridge, as well at outside of each bridge (see Figure 1, Appendix B).

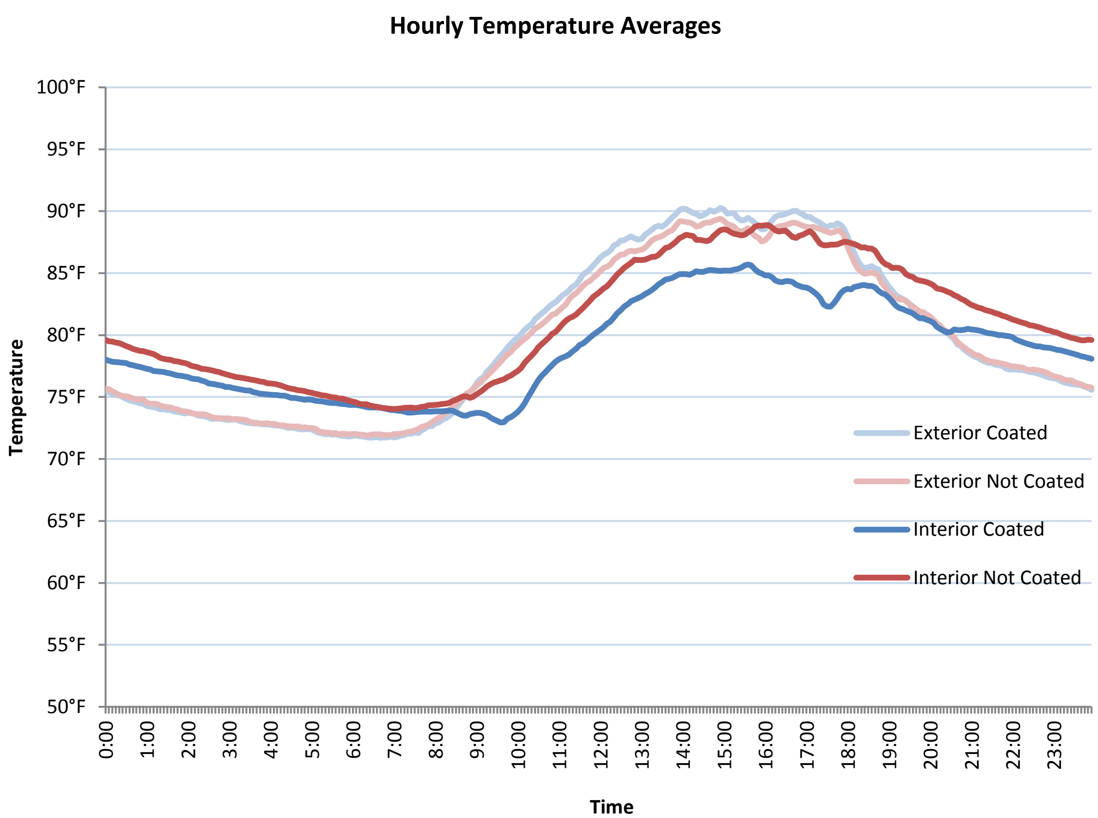
Results

Flights

During the sample period, the treated bridge experienced 125 arrivals and 114 departures, with a total of 130 unique flights and 103 flights with both arrival and departure times given. The uncoated bridge experienced 121 arrivals and 108 departures, with a total of 124 unique flights and 102 flights with both arrival and departure times given. There was an average of 3.7 and 3.5 aircraft in each gate respectively. Flights ranged from 7 am to 1 am. For aircraft with both arrival and departure times given, the average time in gate was 110 minutes, while the median was 79 minutes.

Temperature

During the sample period, outside temperatures ranged from 65°F (18.5° C) to 105° F (40.5° C). Outside temperatures at the treatment terminal were on average 0.23° F (.13° C) higher than at the control terminal. The average daily high was 95° F (35° C) while the average low was 71°F (21.5° C).



(Figure 2)

On average for the entire testing period, the interior temperature of the coated bridge was 2.3° F (1.3° C) lower than the uncoated bridge. While the average temperature inside of the uncoated bridge was 1.4° F (0.8° C) higher than the outside temperature, the temperature inside of the coated bridge was 0.9°F (0.5°C) lower than the outside temperature (see Figure 2)

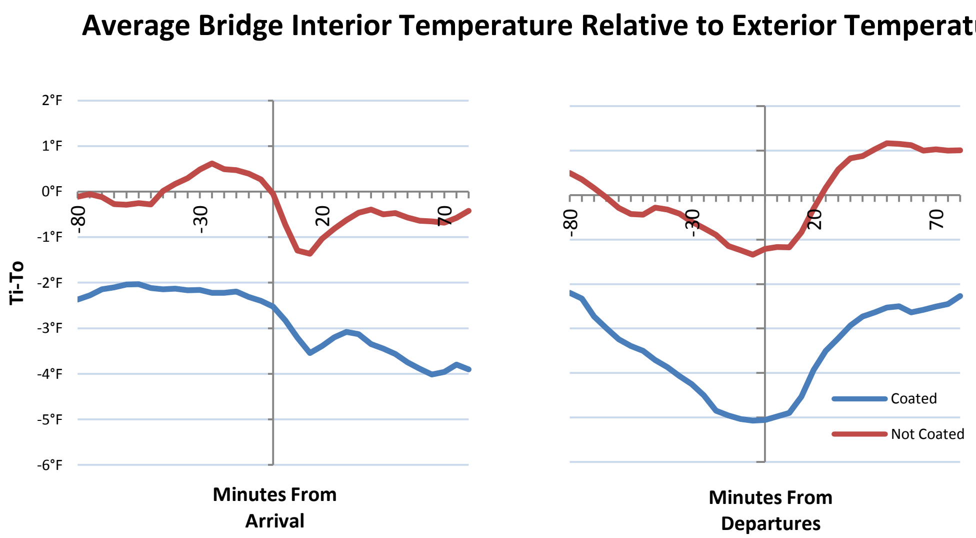


Figure 3

Since the length between arrivals and departures vary, looking at the temperatures before, during, and after each arrival and departure (figure 3) reveals the trends during these times (these charts are presented with greater detail in Appendix C).

As the graphs show, temperatures drop quickly in the 10 minutes after arrival, while passengers are disembarking the aircraft and the doors to the concourse are opened. While the non-coated bridge sees temperatures rise back to previous levels, the bridge coated with ThermaCote continues to decline in temperature until boarding (20-30 minutes before departure), when both temperatures drop again.

Heat Gain/Energy Savings

Without knowing the rate of air conditioning at either gate, we can calculate the heat load reduction from the difference in temperature change under equal AC power. For each flight with both arrival and departure time given, we can use the equation:

$$\frac{Temp_D - Temp_A}{Time_D - Time_A} \times M_{air} \times C_{air} = \frac{\Delta Energy}{\Delta Time}$$

Where

$Temp_d$ = Average interior temperature at departure

$Temp_a$ = Average interior temperature at arrival

$Time_d$ = Time of departure

$Time_a$ = Time of departure

M_{air} = The estimated mass of air in the bridge. As the bridge can vary in length from approximately 50 to 100 ft. in length (17.5-33.5 m), the volume of air at any given time must be estimated. For the purpose of calculation, the interior air volume will be assumed to average 5040 ft^3 (142.7 m^3), and the density of air will be averaged at 0.07 lb/ft^3 (1.15 kg/m^3).

C_{air} = The specific heat of air is 1.006 kJ/kg

This gives an average net heat gain of -142.7btu/h (-0.04kW) for the treated terminal, and -73.2 btu/h (-0.02kW) at the uncoated terminal. Thus, the coated bridge experienced a heat load reduction of 69.5 btu/h (0.02 kW).

Given the number of flights a day and the average turnaround time, the total energy savings would be around 450 BTUs (.13 kWh) per day. This average includes flights from 7AM to 1AM and represents the average energy savings throughout the day. These savings would be split between the concourse and the preconditioned air coming from the plane.

Conclusions

- Temperatures in the bridge coated with TermaCote was consistently at least 2-3°F (~1.5°C) lower than in the uncoated bridge. The temperature difference appears around 10am and lasts through the night.
- The coated bridge was cooler at arrival, and continued to get cooler until departure. The coated bridge was consistently closer to human comfort levels.
- The coating appeared to reduced heat gain by an average of 69.5 btu/h (0.02 kW).
- The energy savings from the coated bridge were ~450 BTUs (.13kWh) a day. Those savings are split between the concourse and the preconditioned air handlers attached to the bridge.
- Since the product works in part by reflecting solar radiation, the savings do not necessarily apply to cold weather.

APPENDIX A:

3891 Tradeport Blvd
Atlanta, GA 30354
404-361-6560
www.estesair.com

Lessons Learned during the application of ThermaCote on Hartsfield-Jackson Bridge E-34:

Background: Estes Services was contracted (PO 51305833) to coat a bridge of choice with 20 mils of a ceramic thermal barrier product ThermaCote. The subject of the study is to determine the effectiveness of the product in lowering the heat/cooling load on a bridge effectively lowering the required energy to heat/cool the bridge.

Summary:

1) Access badge process is cumbersome and time consuming. But once completed it works well.
2) There are many stakeholders in regards to scheduling
3) Work time schedules are open to change, due to air line delays
4) Characteristics of the product noticed while working on this project:
    a. Dry drop length increased
    b. Total dry time increased

   We feel these increases are due to the high humidity during the schedule.
5) The normal terminal lighting is insufficient on some areas of the bridge
6) The coating should stop at the rubber boot from the bridge to the terminal
7) All wiring should be lowered on the bottom side to ensure an even coating
8) The round about on either end should be allowed to dry completely before moving, requiring two shifts to cover
9) All auxiliary attachments will have to be covered before coating, handrail, bag slide, ect.
10) The extending sections clearance seal rub marks seem to be more visible on the coating than the previous painted surface

If a project to coat other bridges were to move forward none of the above mentioned would be a show stopper for the contractor coating the bridge. More time would have to be allotted per bridge than normal for drying, but if schedules worked out it should not delay the project significantly. It has also been discussed not to coat the under side of the bridge, this is an option and in our opinion would not have significant effect on the heat/cooling load due to the shade and height off the ground.

Materials used:

Primer	Kilz White Primer exterior oil based
ThermaCote	TCote original
Beige	SW7512
White	Behr Ultra Pure White 4850

Thank you for the opportunity to be a part of this study.

Dan Bramblett
Estes Services
678-300-3623

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APPENDIX B: Photos of Installation

Left Outer Side Entrance

Left Outer Side

Inside View From Entrance

Bridge Data Logger

Typical Data Logger installation

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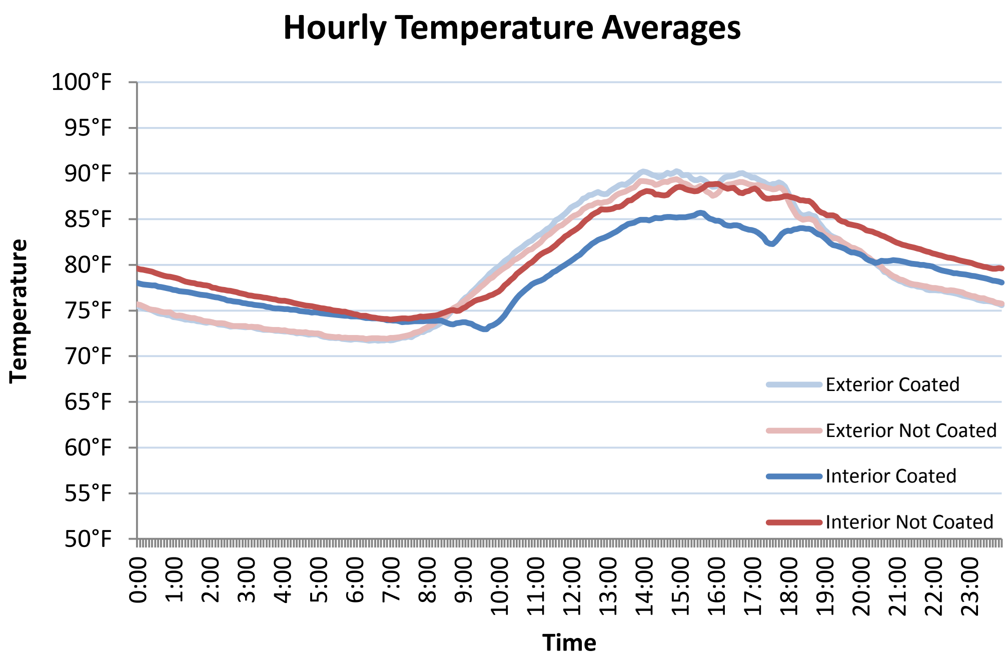
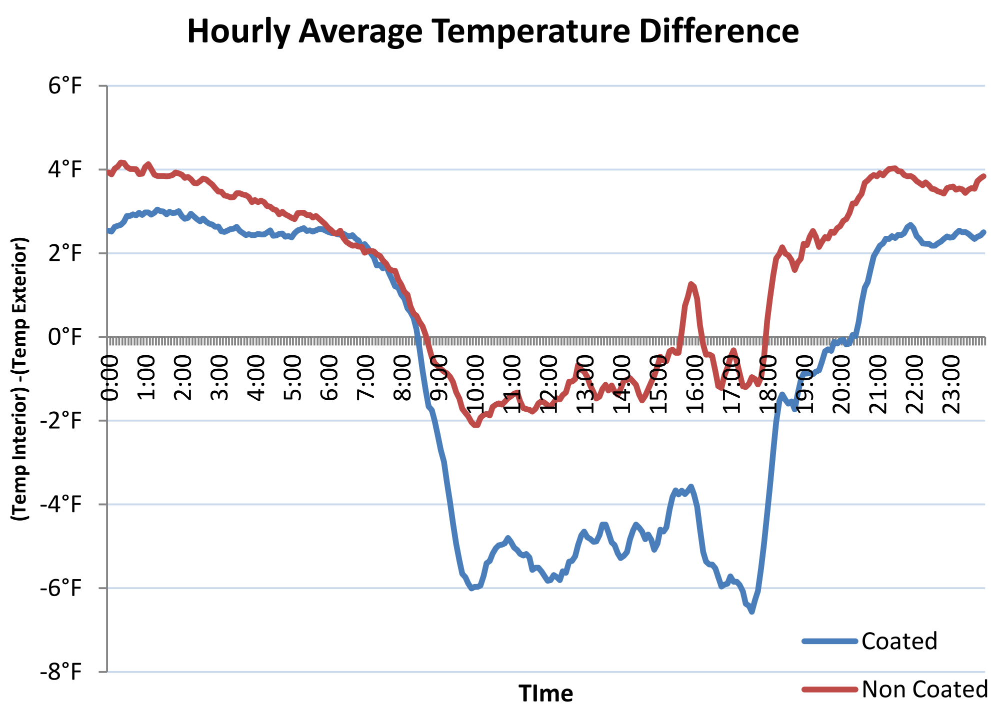
APPENDIX C: Graphs





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APPENDIX C: Graphs