Aluminet: A Study in Technology Transfer and Radiant Barriers Post-Sputnik

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INTRODUCTION

The 1950's were a time of great discovery. It was a time of great optimism and forward thinking, a time where architecture, the arts, science, and technology all took parallel leaps forward. The space program, the glass skyscraper, Jackson Pollock and Elvis Presley, all innovative representatives of an era of prosperity. In the aftermath following World War II, America was coming off one of its darkest periods in history, but in some respects, also its brightest, in that it forced American industry to collectively focus on new materials, methods, and technologies to aid in the common good. Now, in the time after the war, much of this focused militaristic progress could be digested, re-contextualized, and incorporated into the buildings, the music, the everyday life of Americans. Many of the technologies that we take for granted in the building industry today, from curtain walls to monocoque structures, were direct descendants of a post war adaptation.[1]

During that time period, architecture benefited greatly from the notion of technology transfer, especially as architecture itself had not defined itself as an industry. Since that time, or possibly because of that time, architecture has failed to amass the same synergy between seemingly disparate technological worlds, and in effect has become a commodity industry. Architecture is now its own separate realm, and architectural innovation and research is now seen as its own discipline, selectively coupling and splitting from other avenues of research in other fields where it sees fit. This leads to the stigma that architectural research is soft. Since World War II, America has not been faced with such a culminating series of events, which both challenged and inspired our technological prowess, and therefore architects can still afford to be soft.

However, architects are now presented with an environmental call to arms. As a society, we are at war with the environment, and we are being tasked by our peers, our children, and the human race, to do better. It is a different context, but architects, as stewards of the built environment, must react accordingly. This new call to arms does not follow the typical model of cause and effect, does not follow the "theory of grand super cycles" that predicated the response to WWII.[2] The current situation is different in that there is an attempt to have a societal change before a catalyzing event. These are preventative measures rather than responsive. Architects must understand that unlike WWII, instead of innovation informing societal behavior, societal behavior is creating the demand for innovation. Therefore, it is an architect's jobs, in being the creator of the single largest energy profile by industry sector, to preemptively reflect on the methods of inquiry and innovation of the 1950's to see what went right. This will require a re-calibration between architecture and science, one that fosters successful technology transfer and design integration.

Then and Now – Radiant Barriers and Technology Transfer

Many architects are already discussing technology transfer underneath the larger umbrella of interdisciplinary research, where much of the focus is placed on the latter. However the opportunity of technology transfer in architecture almost always

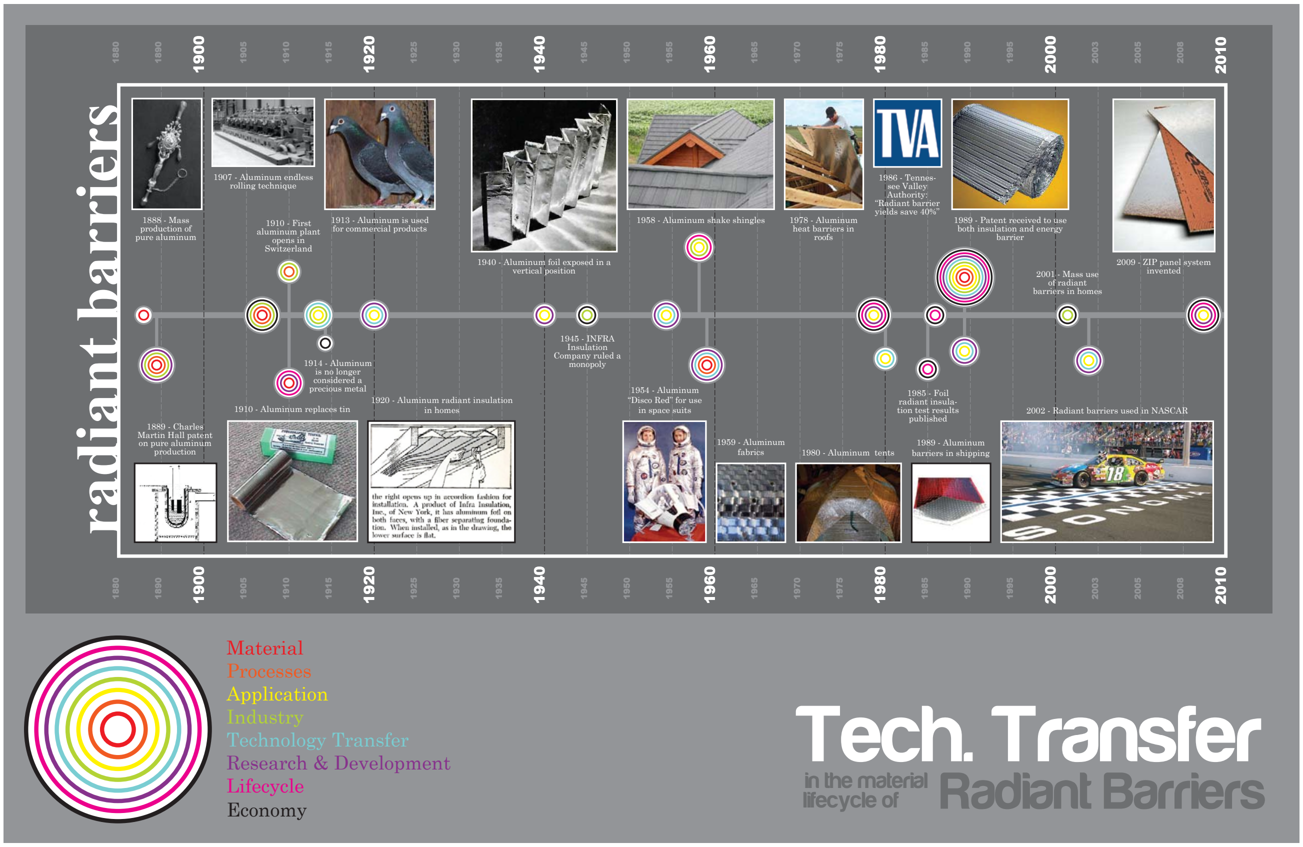


Figure 1. Radiant barrier development timeline.

opens up the realm to an interdisciplinary exploration. Technology transfer is an assured way to initiate interdisciplinary design. The transfer of technologies requires an entire team from multiple disciplines to understand, analyze, and adapt technologies. Architects cannot continue to advance technologies by their own measures alone, they must regain the collective. This research investigation analyzes one of those very materials developed at that crucial intersection between technology transfer and architecture over 50 years ago, and through a modern lens of interdisciplinary collaboration, challenges the material to reconsider its role in an environment that has allowed it to remain unchanged to this day.

Radiant barriers were popularized in 1954, when Clark E. Beck, PE, of Wright-Patterson Air Force Base engineered the development of radiant barrier technology for the dual purpose of shielding spacecraft, equipment, and astronauts from external radiation, as well as insulating internally from extreme fluctuating temperatures found in the vacuum of space.[3] After a series of highly publicized launches and missions, domestic insulation companies began to see striking similarities between the problems of radiation in space and issues of radiation in built environments. Soon, millions of square feet of radiant barrier material were being specified by architects and engineers all over the country for domestic home use.

Today, radiant barriers are installed in homes, usually in attics, marketed primarily to reduce summer heat gain in warm climates and winter heat loss in cold climates, helping to keep energy costs low. Barriers consist of a highly reflective material, typically aluminum that re-emits radiant heat from the sun back into the environment, rather than absorbing it. When the sun heats a roof, it is primarily the sun's radiant energy that makes the roof hot. A large portion of this heat travels by conduction through the roofing materials to the attic side of the roof. The hot roof material then radiates its gained heat energy onto the cooler attic surfaces, including the air ducts and the attic floor. A radiant barrier reduces the radiant heat transfer from the underside of the roof to the other surfaces in the attic. A radiant barrier's performance is determined by three factors: emissivity, reflectivity, and the angle of radiation. Emissivity is the ratio of the radiant energy leaving a surface to that of a black body at the same temperature and with the same area. It is expressed as a number between 0 and 1, the higher the number, the greater the emitted radiation. The second factor is reflectivity, a measure of how much radiant heat is reflected by a material. It is also expressed as a number between 0 and 1, the higher the number, the greater the reflectivity. The third factor is the angle at which the incident radiation strikes the surface—a right angle (perpendicular) usually works best. All radiant barriers must have a low emissivity (0.1 or less) and high reflectivity (0.9 or more).[4]

The current market for radiant barriers has two main functional types in the form of foil chips and foil rolls. Both types are made of the same materials, but are used in different applications within the housing industry. Studies have shown these products are successful, and according to Danny Parker, Principal Research Scientist at the Florida Solar Energy Center (FSEC), typically have a 15-20 year life.[5] However, maintenance issues have proved to be an area of concern for both chips and rolls due to the accumulation of dust. Chips must be blown into attic spaces, increasing installation costs, and thus reducing their penetration into the radiant barrier market.

In recent years, the widespread use of radiant barriers has fallen out of favor in the building industry. Much of this is due to a lack of quantifiable results, and a technology that was rushed to market and not fully re-engineered or properly calibrated for building applications. According to experimental results, the theory behind radiant barriers is sound, but the material itself has never quite developed enough to scale to the temperatures seen in terrestrial applications. The proposed research takes another look at radiant barriers, triggered simultaneously by a renewed interest in technology transfer, a recent to market high performance material, interdisciplinary collaboration, and growing concern over predictions of climate change.

Climate Change and Growing U.S. Population Densities

As of right now, 12 states qualify as having hot-humid or hot-arid climates, and 11 states qualify as having cold climates, where the use of currently available radiant barrier technology could potentially be beneficial. This statistic accounts for approximately 33% of the total US population. The majority of the US population (67%) lives in what is defined as a temperate climate, where current radiant barrier technologies are not cost effective due to their singular performance (only work in hot climates or cold climates based on material and installation characteristics).

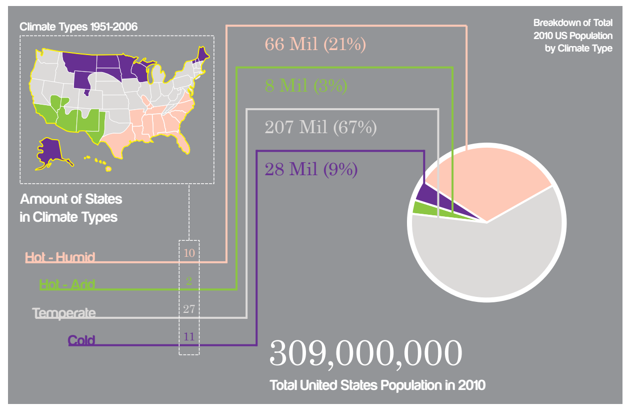


Figure 2. 2010 US climate typology and affected population.[6]

According to conservative climate change reports, it is estimated that by 2050, roughly 55% of the projected total US population will transition to a hot-humid or hot-arid climate type. Furthermore, the amount of states in a cold climate zone drops from a 2010 count of 11 to a 2050 level of only 6, which at that moment will account for less than 2% of the projected 2050 population. Temperate climates typologies replace this decline in cold states,

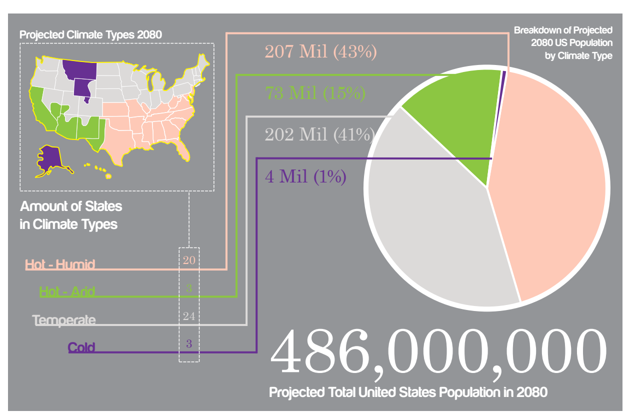


Figure 3. Projected 2050 US climate typology and affected population.[7]

and at the 2050 levels comprise approximately 43% of the total projected US population.

By 2050, an estimated 218,000,000 US residents would benefit from hot climate radiant barriers, 173,000,000 currently have no radiant barrier options, as the temperate climate is too dynamic for current radiant barrier technologies, and less than 7,000,000 can benefit from cold climate radiant barrier technologies.[8] Based on these shifting numbers, this research looks into the development of both better performing hot climate radiant barrier, and the possibility of creating a multi-performance radiant barrier that can deal with the complexities of temporal shifts and the dual radiant needs of a temperate climate.

The research develops the multiple performance metrics needed for a temperate climate radiant barrier through the lens of technology transfer, specifically a new high-performance engineered mesh, through a quantifiable architectural proof of concept model utilizing an interdisciplinary collaboration with the Auburn University Department of Kinesiology and the Auburn University Design-Build Program that aims to understand the issues regarding material appropriateness, ease of construction, maintainability, and price points in the architectural radiant barrier industry.

THE RECURSIVE EXPERIMENT: COLLABORATIVE EDUCATION

The Master of Design-Build program at Auburn University takes a cross-disciplinary approach, collaborating among the School of Architecture and the McWhorter School of Building Science. It proposes to blur the lines of disciplinary boundaries by featuring partnerships and shared expertise. The Master of Design-Build is offered through two tracks: one based on a studio teaching format and designed for graduates aiming for a design-based career path (Design Track); the other grounded in construction management and designed for graduates interested in a construction-based career path (Construction Track.) Each track seeks to foster

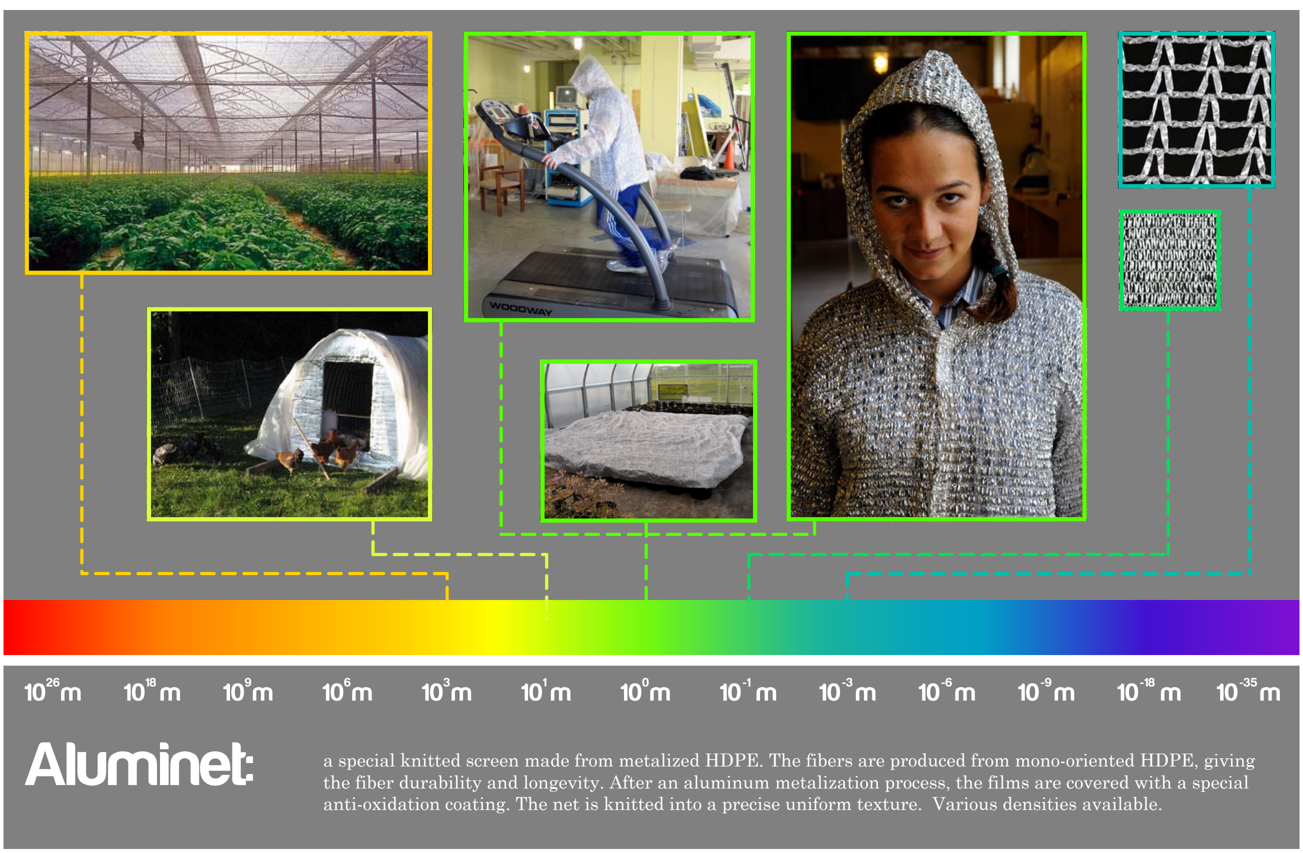


Figure 4. Aluminet areas of scalar inquiry.[11]

an integrated delivery of projects in the built environment, leveraging the most current strategies in project development, risk analysis, and digital tools.[9] In the spring 2011 semester, 12 graduate students, 6 Design Track and 6 Construction Track, are enrolled in Sustainability for Integrated Project Delivery. The course's focus is on the principles, terminology, and methods of sustainable design and construction, with an emphasis on the role of interdisciplinary design collaboration. Additional faculty involvement includes faculty from the Kinesiology Department, who contribute through experience with the material under investigation, Aluminet, and the use of the program's heat chamber laboratory. This team structure is thus diverse, and the course benefits from the varied perspectives and insights.

Technology Transfer Vessel: Aluminet

Aluminet is a reflective mesh fabric (designed to be used on greenhouses) that is unique in that it reflects sunlight while still allowing airflow. It was originally patented in Israel and first used in the country's large expanse agricultural sites, specifically for its multifaceted benefits, simultaneously reflecting unwanted sunlight and harmful radiant heat during the summer and insulating during the winter months. Aluminet is made from a metalized high-density polyethylene (HDPE) thermoplastic knitted into the form of a screen. It is specially treated to prevent oxidation and due to its material and woven characteristics, lends itself to protecting against frost radiation damages, repelling pests, moderating day/night temperatures, and preventing condensation build-up. The use of reflective material also provides maximum radiation reflection on both sides day or night, reduces heat buildup inside the structure, provides effective heat preservation under the screen, increases light, and has uniform irradiation transfer in the range from ultra-violet to far infra-red while being highly resistant to ultra-violet radiation. As a benchmark of its performance, Aluminet has been proven in laboratory testing to reduce greenhouse temperatures 9-14%.[10]

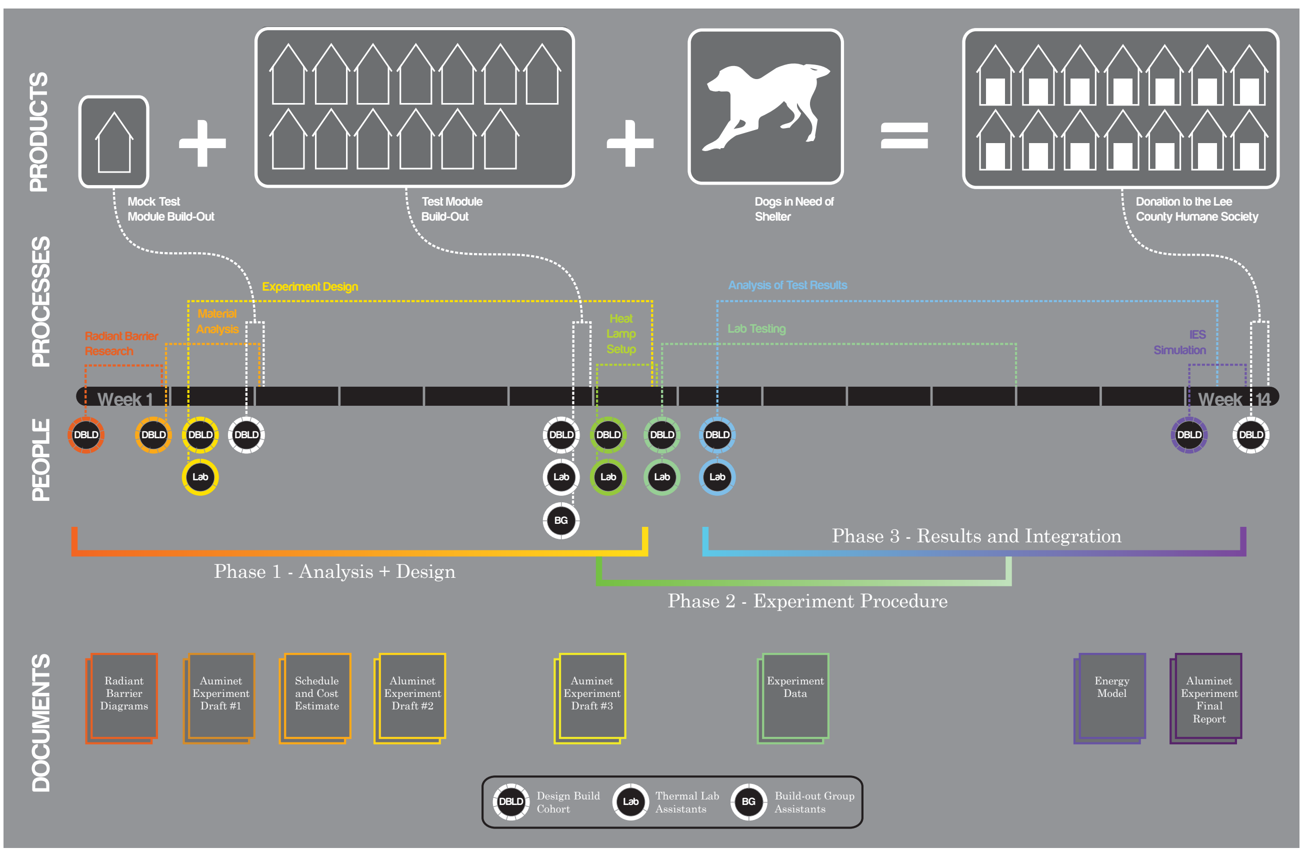


Figure 5. Experiment organizational semester timeline.

The knitted composition of Aluminet also lends itself to being easily adapted as a building material. It is durable and will not unravel and can be cut and sewn at any angle with no fraying or damage to the cloth under normal use. Aluminet is available in five varieties, categorized by the percent shade provided. They are characterized as Aluminet R 30 (%), 40 (%), 50 (%), 60 (%), and 70 (%). Standard widths range from 6.5 to 28 feet and roll lengths are available up to 1600 feet. It is an extremely resilient material, and maintains a five-year warranty against ultra-violet exposure in greenhouse applications. [12]

The collaboration with the department of Kinesiology is vital to the success of this project. Through a technology transfer initiative, potential is spotted for the use of the Aluminet material in buildings. Although the material is originally marketed for agriculture, e.g. greenhouses, the Kinesiology department has explored alternative uses. Of particular interest is the material's thermal protection for humans. A garment of Aluminet was constructed and one conceptualization was for its use in football to keep athletes cool while standing on the sidelines in the heat of the day. The Kinesiology Department regularly uses its environmentally controlled thermal chamber to monitor human subjects in a variety of conditions. The use of this thermal chamber allows the Design-Build students to conduct a wide range of tests and monitor a number of critical values while investigating Aluminet.

Disciplinary Is the Driver of Interdisciplinary

The premise of this course is to challenge the students with an open-ended problem that they are to tackle as a class team. They are allowed the freedom to approach the problem as they see fit, using whichever resources they deem necessary, as long as they co-develop it with students and faculty within the Auburn University Department of Kinesiology. The class meets twice a week for a total of 3 hours. Tuesdays are allotted to the design/presentation/implementation of the class experiment, and Thursdays are devoted to other non-related class material, which include theoretical readings, case studies, and presentations.

During the Tuesday sessions, Architecture and Kinesiology faculty along with a group of four graduate students from the Kinesiology department sit in on the class, which is conducted as a class long charrette. The Kinesiology group is selected based on their familiarity with the Aluminet material and experience with testing within the Kinesiology department's thermal chamber. The group directs and contributes to discussions that relate to the experiment in class. For all intents and purposes they are consultants. The faculty knows only that the students need to conduct an experiment within a semester's time that uses the Aluminet material in an architectural application and are able to utilize the Kinesiology department's equipment and expertise in the testing process. As the Design/Build students quickly find out, their disciplinarity and expertise becomes the driver focusing the direction of interdisciplinary collaboration, and in effect, limiting their freedom by creating productive restraints. After weeks of back and forth discussions, emails, and meetings, the students' particular objective is to explore the integration of this alternative type of radiant barrier, Aluminet, in new construction and retrofit.

The students ground this exploration on the basis that traditional home insulation limits heat transfer into and out of the home via conduction and neglects radiation. [13] [14] Based on initial research the teams find data showing that homes in hot locales such as Florida have seen energy savings by utilizing radiant barriers restricting heat transfer into the house. [15] It is therefore the initiative of this group to enlarge the market for radiant barriers with the use of a new material, which blocks radiation in both hot and cold climates and possibly leads to use in temperate climates as well.

EXPERIMENTAL DESIGN

The experiment studies the performance of Aluminet in comparison to the current market radiant barriers installed using the four typical methods depicted below in Figure 4, above rafters, under rafters, above ceiling, and on sheathing. The project begins by constructing thirteen model houses used to simulate a typical house. Each house is constructed utilizing a typical bubble foil radiant barrier, a sample of Aluminet 50% Screen, or a sample of Aluminet 70% Screen. All tests are conducted against a control model house that contains no radiant barrier to ensure the most accurate end results. The following is a list of the combinations of radiant barriers and the installation methods being utilized:

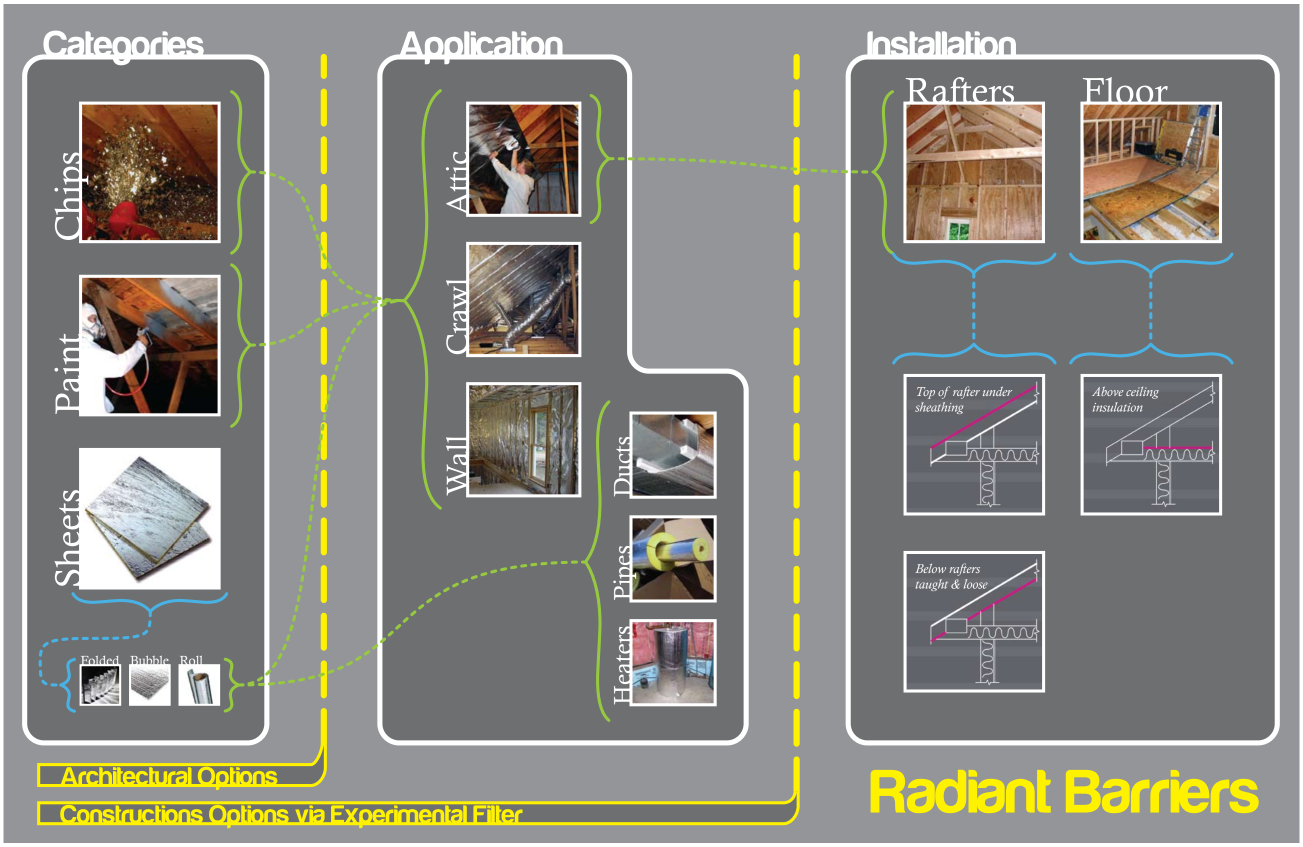


Figure 6. Barrier type, application, and installation.

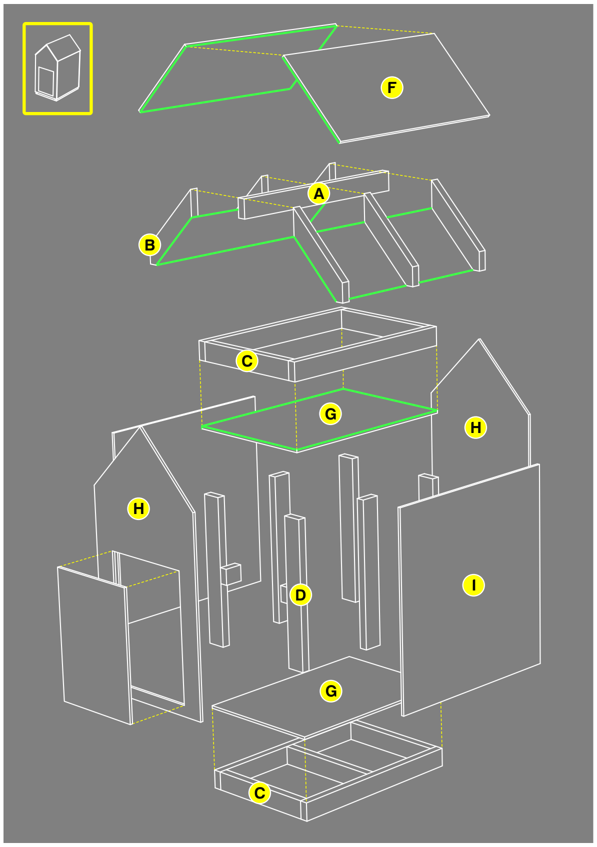
In addition to the combinations of the different types of radiant barriers, two climate types are simulated to represent the areas of typical use for radiant barriers. The climate simulations are determined by laboratory constraints. The lowest achievable temperature in the testing facility is 2°C and will be representative of an average cold temperature day in a temperate climate. The warm temperature is defined as 38°C to simulate a typical warm day in a hot-arid climate. A number of different testing tools are utilized to obtain results, as well as different software applications. The testing is conducted in the laboratory of the Auburn University Kinesiology Department in a temperature controlled lab space by a group of Kinesiology graduate and PhD students.

In order to determine how well heat reflects out of the attic space, the test room is set to 38°C to simulate the warm climate. Heat lamps are placed directly over the individual model houses to simulate the sun and heat radiation experienced during the day, in both the hot and cold environment testing.

In order to determine how well heat enters and stays in the materials of the attic space, the test room temperature is set at 2°C to simulate a cold climate. The four model houses are placed in the general lab space, outside of the thermal chamber, to acclimate to room temperature at approximately 24°C. Once the interior temperatures reach 24°C, the modules are moved into the thermal test chamber and observations are made to determine the duration for heat to dissipate through the roof.

Scale Prototypes Construction

The first step in the build-out of the experiment is the design and construction of thirteen model houses. After a series of charrettes with the Kinesiology students and professors, it was determined that experiment is best suited in the simulation of the effectiveness of a radiant barrier on a house by testing multiple radiant barrier types in different installation locations on model houses. By simulating an actual house, the design augments a standard model house to include some typical features found in residential



	Description	Material	Qty.	Unit	Cost/ Unit	Total Cost
A C D	Lumber	12' x 2" x 4"	44	Each	$4.49	$197.56
B	Lumber	10' x 2" x 4"	12	Each	$5.00	$60.00
E	Lumber	12' x 1" x 4"	13	Each	$2.96	$38.48
F G H I	Sheathing	Plywood 1/2"	32	Each	$11.97	$383.04
	Roofing	Asphalt Shingles	5	Bundle	$18.65	$93.25
	Wood Screws	#25, 3"	1	Box	$89.74	$89.74
	Wood Screws	#5, 1-5/8"	3	Box	$25.54	$76.62
	Caulk	Alex Ultra White	4	Each	$3.98	$15.92
	Insulation	R13, 15" x 93"	2	Each	$72.28	$144.56
	Roofing Nails	#1 Galv, 1"	2	Box	$2.74	$5.48
	Radiant Barrier	4' x 125'	1	Roll	$138.99	$138.99
	Aluminet	50I, 5' x 26'	1	Roll	$32.50	$32.50
	Aluminet	70I, 5' x 26'	1	Roll	$32.50	$32.50

Projected Purchases: $1,104.65

Figure 7. Testing variables and materials list.

construction. The Kinesiology students created a checklist of zones that include: a ceiling to simulate the difference in attic space and living space, an elevated floor to enclose the building envelope and decreases air leakage, and a zoning envelope of R-13 batt insulation lining the interior walls and the ceiling in the attic space. Also, the Kinesiology students recommend that the front panel of the model house is removable to allow ease of access for the thermal probes and to decrease acclimation time.

The Design/Build project team ensure accuracy and improve efficiency by calculating materials needed and costs expected to construct thirteen model houses as displayed above in Figure 7.

Testing Procedures

To maintain a controlled environment and ensure equal testing conditions, the four model houses, exhibiting the four modes of radiant barrier installations are examined simultaneously. The houses are placed in the testing facility early to acclimate to temperature equilibrium. The measurement of the initial temperature and humidity level is taken for consistency between the different sets of houses. Throughout the experiment, the Kinesiology students monitors the setup and record temperature readings on 15-minute intervals for 90 minutes upon exposure to the imposed hot or cold climate.

To determine how well heat either enters and stays in the materials or reflects out of the attic space, test results are collected using Infrared Technology by the Department of Kinesiology. Computerized Thermal Imaging, Inc. (CTI) software and a CTI Processor Camera are used by Kinesiology grad students to provide a real-time computer image of the model house surfaces color-coded by temperature. The computer software offers an exact surface temperature reading for each pixel in the image. Since only surface temperature readings are available from the CTI camera, probes are inserted into each model house, one in the attic and one in the living space, for interior temperature readings using an YSI Precision 4000 Thermom-

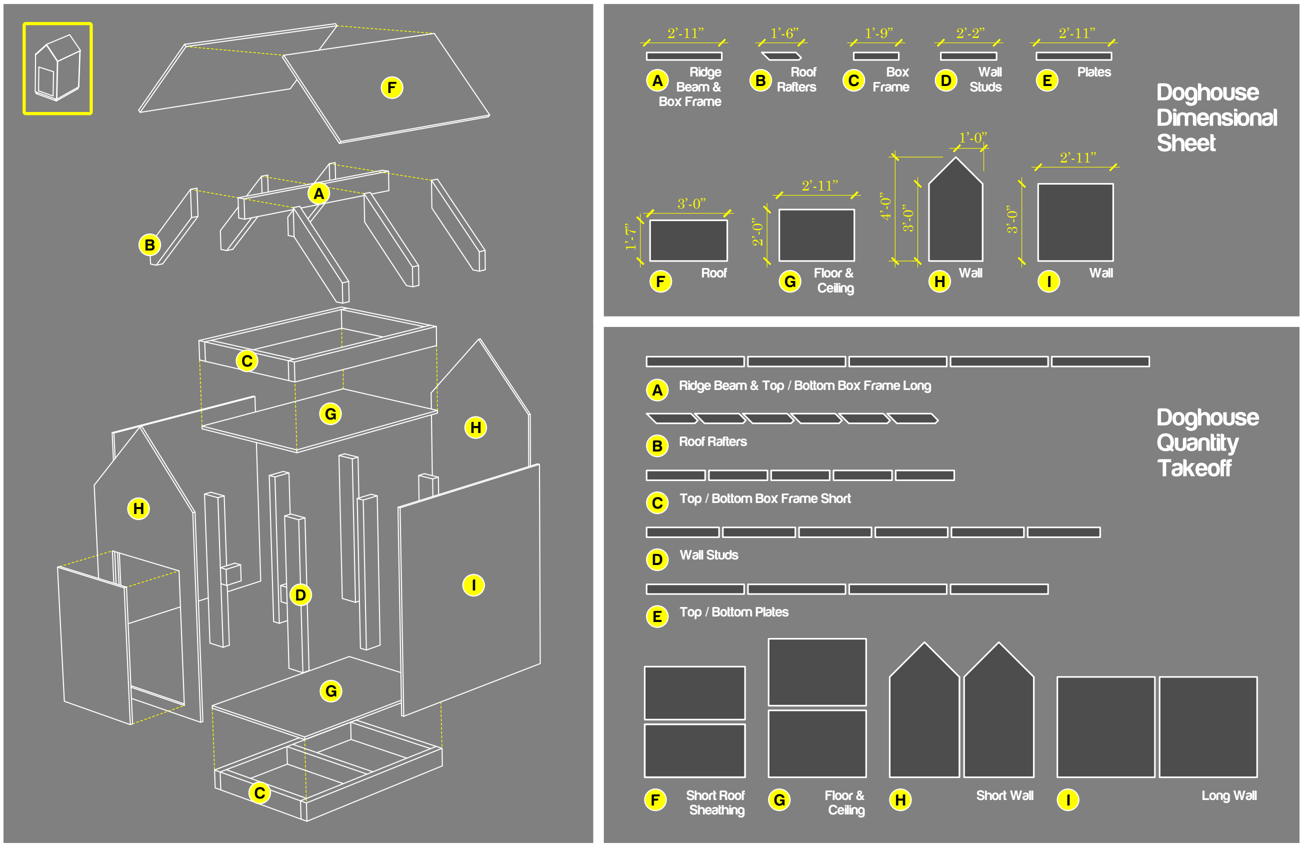


Figure 8. Templates for scale model build-out.

eter. The interior temperature readings may also be determined using the WIBGET Camera on a tripod equipped with a heat stress monitor. Thermal reading access in test houses is carefully coordinated by collaboration between the Design/Build and Kinesiology students, to ensure that the houses are built with the end goal of testability.

The test documents the temperature readings in four locations: the environment outside the structure, the roof surface, the attic space, and the living space of the house, as depicted in Figure 11. To achieve an accurate reading, the individual probes are secured in the individual spaces of each house avoiding surface contact, mitigating heat conduc-

Figure 9. 13 doghouses in 8 hours.

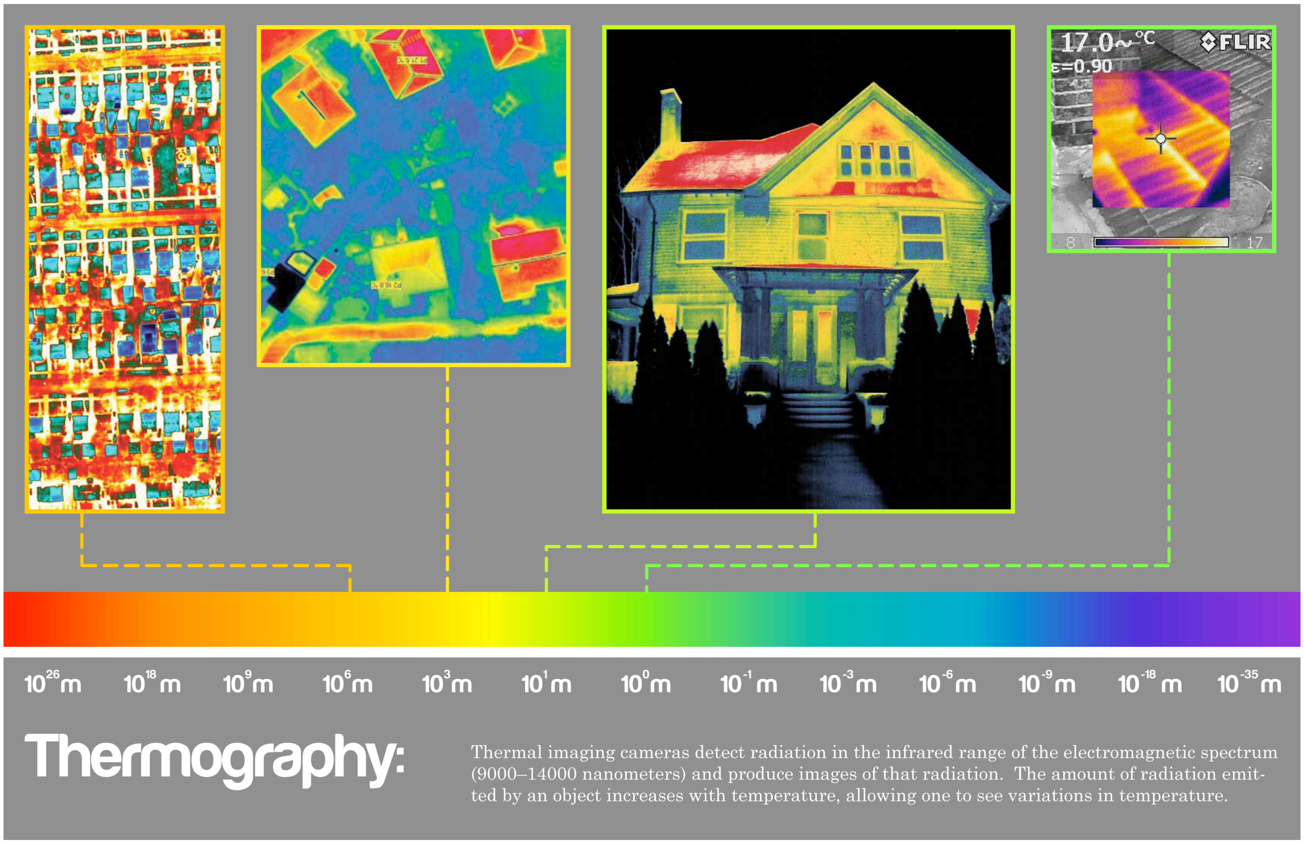


Figure 10. Thermography areas of scalar inquiry.

tion. The temperatures are recorded manually and are then exported into Microsoft Excel, producing a dataset of results in spreadsheet format. Camera images are also exported for further, visual documentation. The temperature range and pixel increments are set the same within each test, and allow the Kinesiology students access to mean, standard deviation, and maximum/minimum temperatures over a selected zone of the image. The center shingle is the zone selected for the image to analyze temperature distribution.

EXPERIMENTAL RESULTS

In order to accurately represent the results in a clear and concise manner, the main summary tables are shown and discussed in this section. The results are broken down into charts based on the either the locations of the probes or representative climate type. The data in the charts is organized by installation methods and the material applied.

Cold Environment Chamber Data

Cold Temperature Change in Attic (°C/min.)				
Test	Alum 50	Alum 70	Bubble	Control
Below_Rafters	(0.23)	(0.25)	(0.29)	(0.21)
Above_Rafters	(0.21)	(0.14)	(0.25)	(0.22)
Above_Ceiling	(0.27)	(0.27)	(0.31)	(0.24)
On_Sheathing	(0.22)	(0.23)	(0.22)	(0.23)

The most significant piece of data in the above table is the performance of the Aluminet 70 when installed above the rafters. This test performs far better than the control house with a (0.14 °C/min.) change in temperature. The next trend to notice is the poor performance of the bubble radiant barrier throughout all application methods.

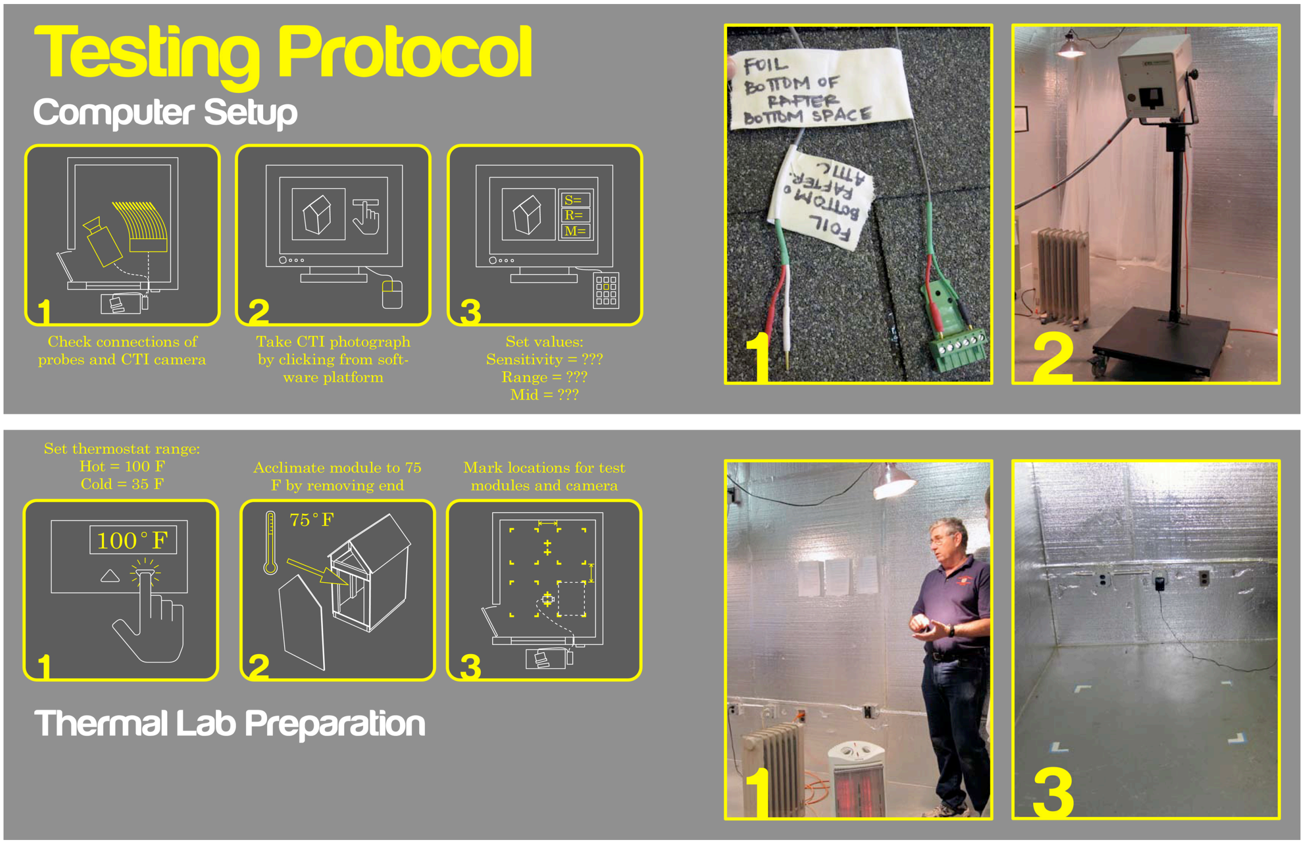


Figure 11. Test protocol – computer setup.

Cold Temperature Change in **Living** (°C/min.)				
Test	Alum 50	Alum 70	Bubble	Control
Below_Rafters	(0.18)	(0.13)	(0.13)	(0.10)
Above_Rafters	(0.14)	(0.14)	(0.16)	(0.11)
Above_Ceiling	(0.16)	(0.19)	(0.17)	(0.12)
On_Sheathing	(0.13)	(0.17)	(0.16)	(0.12)

All radiant barrier types tests taken in the living space perform to some degree worse than the control house. The closest to the control house's performance numbers are the Aluminet 70 in both rafter installations, with only a 0.3 deviation from the control house benchmarks. Although no test sample performs as well as the control house, it is notable in the discussion of the combined temperate performance to note that the differences are not significant between the Aluminet 70 and the control. Based on both cold sets of data, neither of the Aluminet test materials are suggested for use in a strictly cold climate.

Hot Environment Chamber Data

Hot Temperature Change in **Attic** (°C/min.)				
Test	Alum 50	Alum 70	Bubble	Control
Below_Rafters	0.24	0.24	0.21	0.25
Above_Rafters	0.26	0.23	0.20	0.26
Above_Ceiling	0.28	0.27	0.27	0.29
On_Sheathing	0.20	0.20	0.16	0.21

The bubble radiant barrier performs the best amongst these tests, with the results being significantly lower than the control house. Both Aluminet products produce temperatures changes lower than that of the control house, and in some instances, match the performance of the highly insulated bubble foil. The

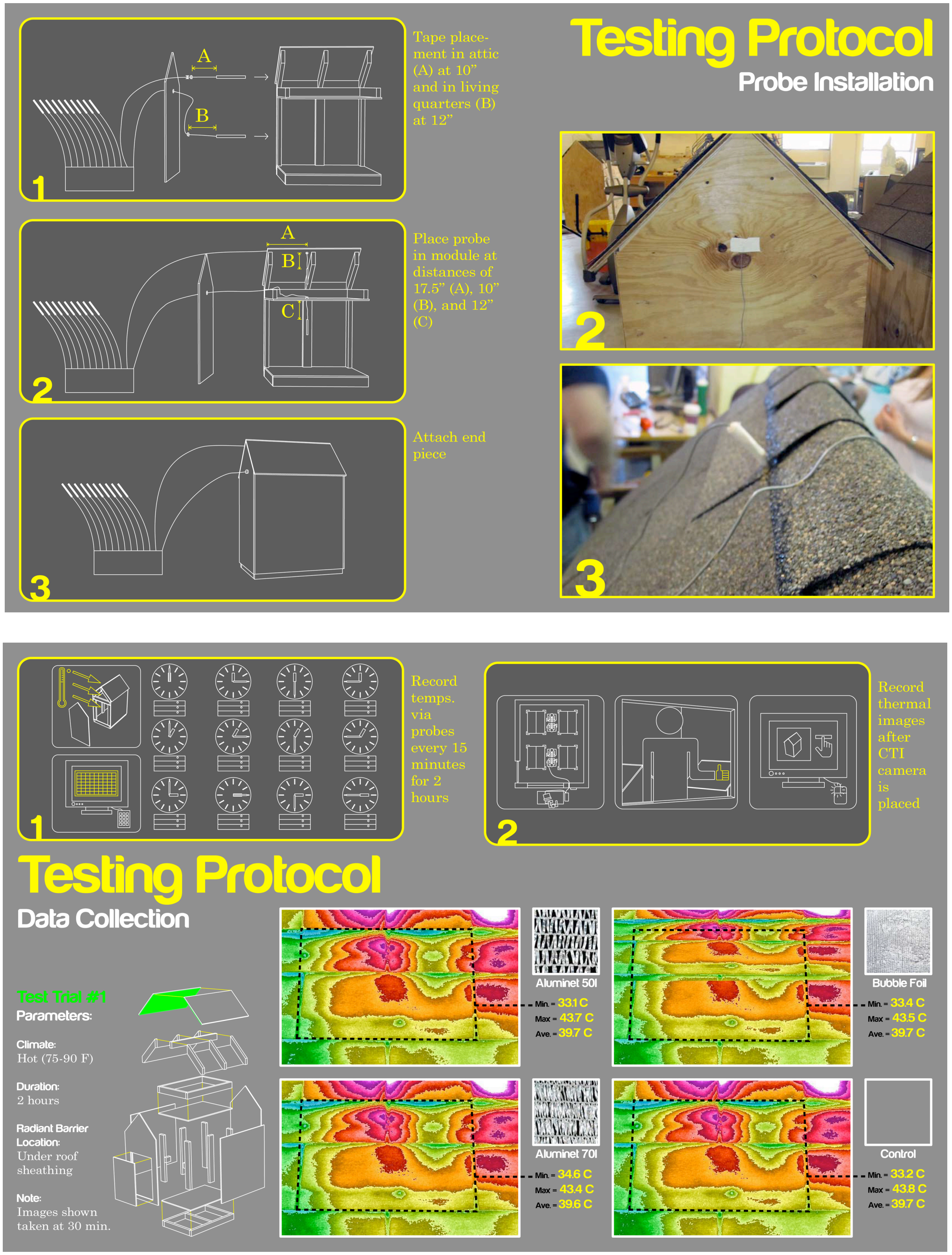


Figure 12. Test protocol – data collection.

trend throughout this data is that any type of installed radiant barrier is better than the control.

Hot Temperature Change in Living (°C/min.)				
Test	Alum 50	Alum 70	Bubble	Control
Below_Rafters	0.09	0.08	0.08	0.09
Above_Rafters	0.10	0.08	0.10	0.13
Above_Ceiling	0.09	0.09	0.07	0.10
On_Sheathing	0.08	0.08	0.07	0.08

This data is very similar to the data presented in the attic tests, but the temperature changes are not as significant. The most noteworthy piece of data is the temperature change of the Aluminet 70 radiant barrier installed above the rafters. This change was (.08), which is much lower than the control house temperature change of (0.13). Throughout the tests the Aluminet products performed the same if not better than the control house.

Synthetic Temperate Climate Data

Based on the two-tiered nature of the problem scope, the analysis of performance of radiant barriers in a temperate climate with consistent temporal swings is more complicated than the thermal chamber is capable of accurately representing. After discussing the issues of projecting performance without the availability of specific testing capabilities, the Kinesiology team worked with Architecture team in the development of algorithms to synthesize results based on the previous tests. The Architecture team then worked in developing a graphic way of displaying this algorithm to aid in presenting the proposed results. The projected temporal climate performance comes in the form of synthesizing the results from all tests to arrive at, which, if any, radiant barriers have a satisfactory blended average between hot and cold weather temperature performance.

All of the above data is plotted on a four-quadrant rose matrix in regard to material, installation location, and temperature change (°C/min.) and then

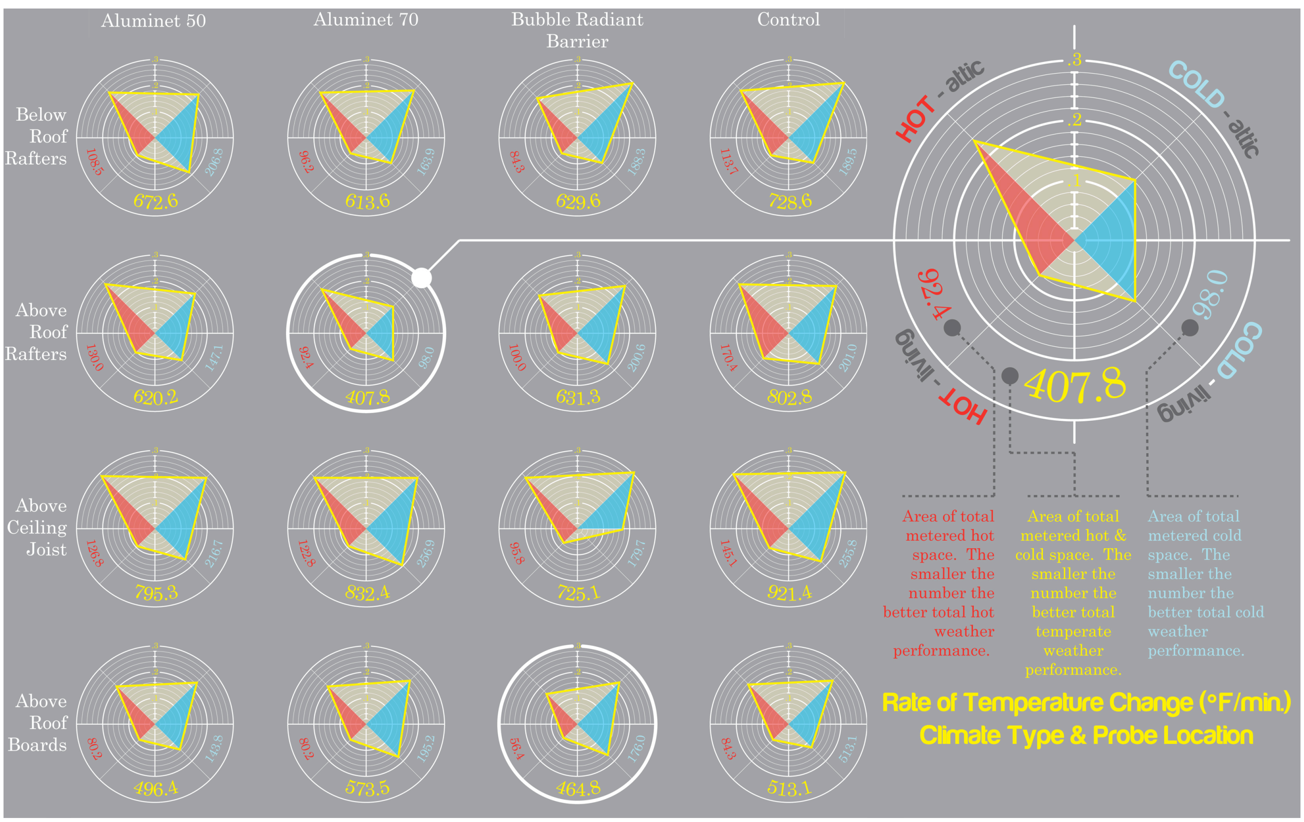


Figure 13. *Synthetic climate analysis matrix*

the four plot coordinates are connected to form a quadrilateral. By calculating the area of the inscribed quadrilateral, the research team arrives at a way of quantitatively comparing the blended climate performance of each material in each location through the course of all the tests.

The smaller the area of the quadrilateral, the better the material in the installed position performed all around, and therefore would perform best in a temperate climate.

According to this proposed metric, the Aluminet 70 installation above the roof rafters is projected to perform significantly better than any other material/installation cocktail. This sequence also has the lowest combined change in temperature for both space zones (living and attic space), and has excellent heat temperature change characteristics. The experimental team finds this to be an exciting discovery, and the positive performance of the radiant barrier in the large spectrum of temperatures is a testament to the density of the mesh and its installation above the roof rafters. As of yet, the team does not fully understand the implications of this, but take it as an area for further research. But, the team does know that given the dynamic performance characteristics of the Aluminet material as both a radiant barrier and insulator, there is great potential in the material performing in varied climatic conditions simultaneously.

Future Research

The current research project acts as an effective proof of concept for the use of Aluminet in residential insulation applications and is the first of its kind. There are many avenues for future research directions for both the Architecture and Kinesiology departments. For the Design/Build team, the most obvious research track is to continue to test performance for both hot and cold climates as singular performance conditions. In this regard the experimental team feels that scaling the model houses to more accurate sizes will yield more representative results. Integrating venting into the housing will also have an impact, especially since the Aluminet is a vented material, thus conducive to natural convection.[16] In regards to testing environment, future tests can more accurately portray real-life conditions. Most specifically, they can involve internal temperature control of the models. This can be achieved through portable heaters and air-conditioners being placed within the models. This will provide more realistic heat transfer rates in the latter stages of testing, because the structural materials will develop a temperature gradient.[17]

The Kinesiology team is looking into the engineering of the material itself. This experimental team is currently in the process of incorporating Auburn University's Textile Engineering Department in the development of a proprietary modification of the Aluminet material that would begin to address specific issues in heat transfer relative to the built environment. These include varying the mesh density for easy installation and maintenance, locally varying mesh density based on install location and performance requirements, the creation of hybrid products (marrying roof sheathing and modified Aluminet into a single building component), and engineering scales of economy to reduce production costs of the material.

The final avenue for further research, and to both teams, the most exciting, is the potential to continue to develop a temperate climate applicable radiant barrier system. As it would be the first radiant barrier ever to perform in such a dynamic manner is incredibly exciting to all involved. Further research in this regard will develop much in the same manner as outlined above for the evolution of the single performance climate tests, however there are many variables that need to be addressed in the testing methodology in order to develop a single, comprehensive test that can test all temperatures concurrently. The Kinesiology team is in the process of developing a new procedure and possibly locate a new facility where this type of testing protocol is feasible. This series of tests will be the main focus of the next incoming Design/Build cohort in the spring of 2012.

APPLICATION TO EDUCATORS

The course serves as a great example for successful technology transfer implementation within the class setting. The extensive collaboration between the departments of Kinesiology and Architecture are instrumental in the success of the experiment and the class as a whole. It is to be noted that it is not just Architecture that can use this technique; and in fact one would be hard-pressed to identify a field that cannot benefit from interdisciplinary curriculum. Education is a prime area in which to use technology transfer. Universities are commonly at the cutting edge of research in many fields and a university has nothing to lose by sharing technologies among departments. Inter-institution intellectual property agreements can enhance progress even further. As the bridge between academics and industry continues to shrink, hopefully architecture schools around the country will begin to see the inherent opportunity in partnering with the private sector in the development of new building technologies. It is through this model that highly commoditized building industries can again afford to re-integrate research and development into the business model. The authors hope that first and foremost, spreading knowledge of the success of this particular course will encourage other similar institutions and their respective programs to adopt similar courses in an effort to proliferate the practice of technology transfer that was once common practice.

ENDNOTES

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