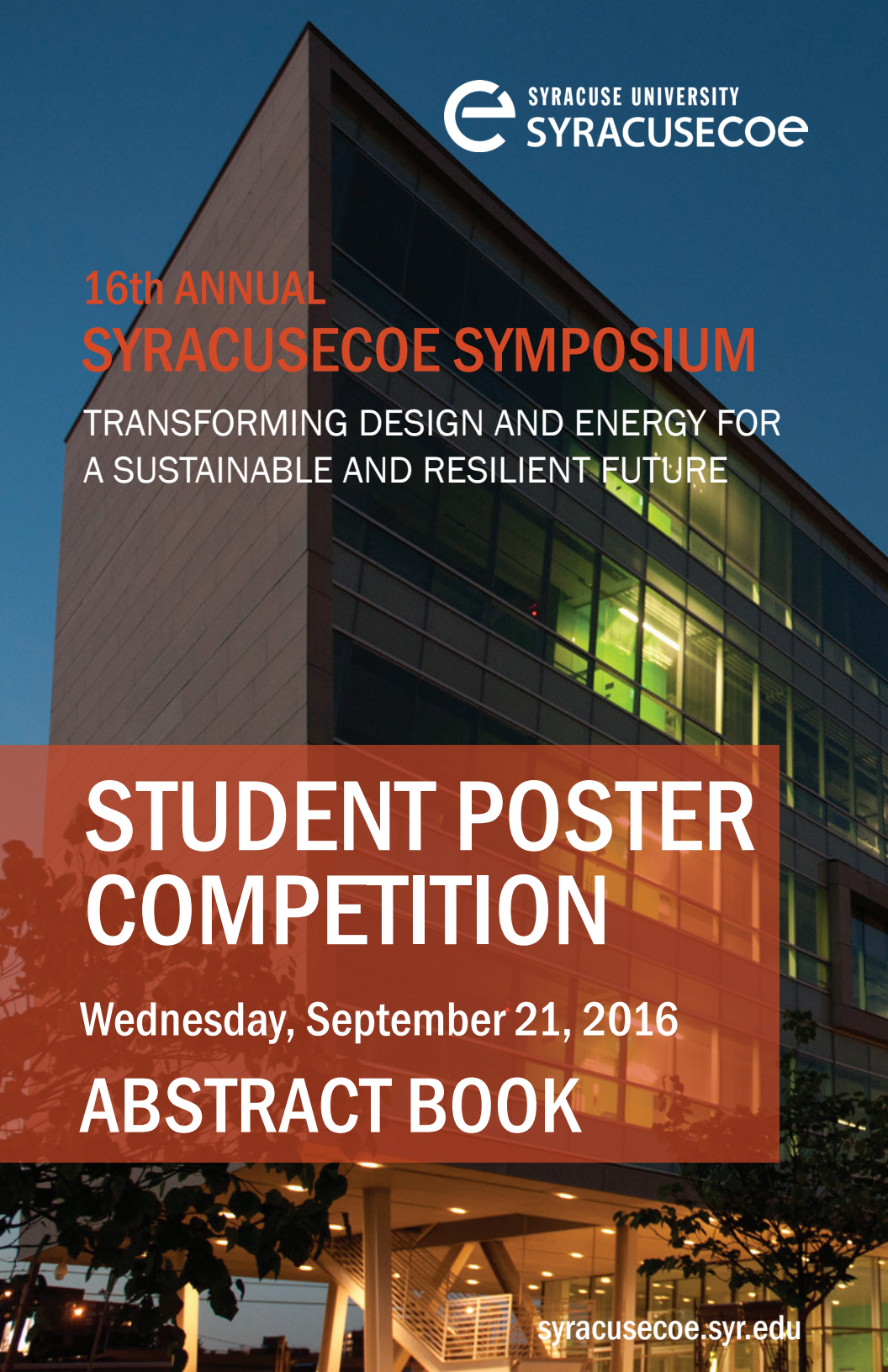

SYRACUSE UNIVERSITY
SYRACUSECOE

16th ANNUAL
SYRACUSECOE SYMPOSIUM

TRANSFORMING DESIGN AND ENERGY FOR
A SUSTAINABLE AND RESILIENT FUTURE

STUDENT POSTER COMPETITION

Wednesday, September 21, 2016

ABSTRACT BOOK

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STUDENT POSTER COMPETITION

STUDENT ABSTRACTS ARRANGED BY DEGREE LEVEL

UNDERGRADUATE STUDENTS 2

MASTER'S STUDENTS 10

PHD STUDENTS 15

UNDERGRADUATE STUDENTS

1. Solar Chimney's Application in Architecture Design in Hot Summer and Cold Winter Zone

Jun Zhang, Prof. Menghao Qin
Syracuse University, Architecture

The solar chimney is an effective way of improving the natural ventilation of buildings by using convection of air heated by passive solar energy. In its simplest form, the solar chimney consists of a black-painted chimney. During the day solar energy heats the chimney and the air within it, creating an updraft of air in the chimney. The suction created at the chimney's base can be used to ventilate and cool the building below.

So far, many researches focused on the principle of the solar chimney have already been done, while the application of the solar chimney is still rarely seen. During the process of our study, we find that the integrated design of building and solar chimney is the vital problem, which will discuss how solar chimney intervene the design process from the beginning as an architectural element and explore various possibilities for the combination of solar chimney and architecture design.

2. Jettison

Chelsea Andrews
Syracuse University, Industrial & Interaction Design

Recycling is an ambiguous process that is often swept aside, due to confusion or laziness, leaving recyclables compiling in landfills. By continuing the dining experience and utilizing a new disposal procedure; we can reduce the amount of recyclables in landfills and create educated recyclers within the process.

3. RecycleHub - Improving Local Recycling Through a Location Based Service

Vasilios Lambos
Syracuse University, Industrial & Interaction Design

RecycleHub was a project designed to help improve the sales process for a local recycler in Syracuse NY. I spent three months with Russ at CNY Resource Recovery understanding his business and using qualitative methods to design a consumer experience that would improve the user experience and transpar-

ency for recycling scrap metal. The research exposed different opportunities and put the user experience of recycling at the forefront of a very opaque system.

4. Urban Forests Fail to Provide Adequate Habitat for Native Woodpecker Species

Kimberly Badger
SUNY ESF, Conservation Biology

Woodpeckers play a key role in the maintenance of forest ecosystems; however, forest habitats are susceptible to urbanization, thus putting woodpecker species at risk. This study is the first to investigate the impacts of urbanization on woodpecker abundance and habitat makeup along an urban-rural gradient in lower New York State. Forest inventories and woodpecker surveys were completed to analyze the abundance and species richness of woodpeckers and to reveal changes in forest structure along this urban-rural gradient, which was characterized using GIS software. The most prevalent species, the pileated woodpecker and red-bellied woodpecker, were modeled for detection and occupancy. Pileated woodpeckers are more likely to be found in suburban areas, while red-bellied woodpeckers are unaffected by urbanization level. Woodpecker abundance and species richness were highest at suburban sites. We found a positive correlation between woodpecker species richness and number of decaying trees ($r = 0.267$, $p < 0.001$), while the contrary was found between species richness and healthy trees ($r = -0.220$, $p < 0.0001$).

5. UV Method for Total Mercury Analysis

Olivia Chen
Syracuse University, Chemical Engineering

A systematic UV method has been developed for determination of total mercury concentrations in water samples. Cold vapor atomic fluorescence spectrometry (CVAFS) was applied along with UV photochemical irradiation to break down persistent bonds between mercury and sulfur, carbon and other organic matters which may be present in natural water. The method involves two different wavelengths of UV lamps, UV-C (100-280nm) and UV-B (280-315nm) to complete oxidation and reduction reactions, respectively, converting ionic mercury (Hg2+) to elemental mercury (Hg0) with a detection limit of as low as 0.2 ng/L. Samples flow through quartz or borosilicate coil under exposure to UV lamps. It is hypothesized that UV irradiation incurs radical reactions with low molecular weight of carboxylic acids needed as precursors to produce H2 and CO1, which are effective factors to reduce Hg2+ to Hg0. Experiments were conducted without the addition of traditional chemical reagents, such as bromine monochloride (BrCl) and stannous chloride (SnCl2)2

with both UV-C and UV-B lamps on. Instead, formic acid, acetic acid and propionic acid with concentrations of 0.25M, 0.5M, 1M, and 1.5M were added into Continued Calibration Verification standards (CCV, 5ng/L) and tested in separate runs. Additionally, mercury response of each lamp was obtained by turning on one lamp at a time and the same concentrations of the precursors were tested again. The results revealed that formic acid is the optimal precursor with the 1.5M concentration being ideal. UV method can yield a greater recovery of 99% with formic acid. Quartz coil works better compared to borosilicate coil due to higher mercury response area. At large, this approach reduces cost and contamination of traditional chemical reagents. Also, this method increases the possibility of in-situ mercury analysis, the advances of which will help diminish cross contamination and the need for sample storage.

6. The Effects of Corn Residue Removal on Soil Moisture

Emma Palermo, Virginia Jin, Marty Schmer, Robert Mitchell
SUNY ESF, Environmental Health

This work is analyzing the amount of plant available water over the growing season in an attempt to determine how residue removal affects soil moisture and how to determine if residue should be removed. The availability of water in the soil for plant uptake according to stover removal will also be analyzed. The study includes moisture level readings from Watermark sensors from two sets of corn plots from 2012 and two sets of corn plots from 2014. Each year includes a set of fields with maximum residue removal; the other plot has received no residue removal treatment. All plots within this study were no-till.

7. Monitoring Calcium Chloride in Denali National Park

Kyle Turchick, Sarah Stehn
SUNY ESF, Environmental Science

Wilderness adjacent to the road is exposed to multiple stressors. Of particular interest is the effect of the dust suppressant Calcium chloride (CaCl2) on the gravel section of Denali's Park Road. Application of aqueous Calcium chloride causes the finer particles in the gravel road to adhere. This additional adhesion helps to prevent particles from entering the atmosphere. Application of dust palliatives is a balance between management goals and environmental consequences. Environmental consequences of no suppression are accelerated loss of habitat, roadside soil alteration, vegetation loss and increased risk for colonization by invasive plant species. With no suppression management reduces maintenance cost and effort, preserves the authentic visitor experience, and avoids environmental/permitting issues. Environmental consequences of complete suppression include reduction in habitat loss, roadside vegetation loss, increased risk for colonization by invasive plant species, and

improved air quality in road vicinity. With complete suppression management reduces road surface loss and borrow site expansion, improves road safety, and improves the visitor experience (figure). Temporal application rates of Calcium chloride on the Park Road are known. The focus of this study is to quantify the effects of the Calcium chloride on roadside vegetation, soil water, surface water, and soil.

8. Characterizing the Growth Medium on an Extensive Green Roof

Katie Duggan
Syracuse University, Environmental Engineering

The vegetation and growth medium (artificial soil) of a green roof absorb excess stormwater that would otherwise drain into the sewer system. This is especially important where combined sewer systems are in place because the flow of stormwater and sewage can exceed the capacity of the sewage treatment plant during large rain events, and must be released untreated into natural receiving waters. The performance of the growth medium plays a major role in the overall effectiveness of the green roof. Many green roofs use artificial soils because they are lightweight; natural soils can sometimes collapse roof systems when they become saturated.

The purpose of this research is to enhance understanding of artificial soils by characterizing important parameters (porosity and field capacity) of the growth medium on a local green roof. The green roof studied is located in Syracuse, New York, on the Nicholas J. Pirro Convention Center. Soil samples were saturated to measure void volume and calculate porosity. A small plot from the roof was saturated and drained to collect water content data and determine field capacity. The average porosity obtained was 27.2% and the average field capacity was 0.323. A higher porosity and a lower field capacity are expected from a coarse growth medium such as this because larger pore space can absorb more water, but cannot hold it easily. In the future, the methods used will be revised to improve the accuracy. The results of these measurements will be compared with other green roof growth media and used to determine ways to improve the effectiveness of green roofs.

9. Design and Calibration of a Rainfall Simulator for Plot Scale Experiments

Joshua Saxton, Dr. Cliff Davidson, Mallory Squier
Syracuse University, Civil Engineering

One of the main functions of a green roof is to retain incoming precipitation, which in turn reduces the amount of runoff entering the combined sewer system. Analyzing this type of green infrastructure is of value to understand if

it is behaving as intended. Developing a method to test the many hydrologic characteristics of a green roof can further our understanding of the fundamental processes affecting water flow in a green roof. One measurement method for these tests is to use a drip-type rainfall simulator. The simulator has characteristics and design choices to enable delivery of raindrop sizes and rainfall intensities similar to those of Syracuse NY, as well as forming larger and less frequent rainfall intensities. Raindrop size is determined through the use of specific drop formers and fall heights. A plot (35cmx58cm) is being taken from the green roof on the J. Pirro Convention Center in Syracuse NY. Using the simulator at different intensities on these plots will yield data that show direct relationships between intensity, growth medium, porosity, and the other variables on the amount and timing of drainage. Rainfall simulator choices like adjustable legs and removable mesh screens should be implemented to create an effective and portable simulator. Three rainfall intensities with different hydrographs and different time scales will be tested to study the performance of the green roof growth medium.

10. Stem Water Potential in Desert Willow Grown in Clinoptilolite Zeolite or In-situ Riparian Soil

Kristina Macro, Aldo Pinon-Villarreal, Dr. A. Salim Bawazir
SUNY ESF, Environmental Resources Engineering

Inadequate rainfall, river channelization, invasive species, and irrigation costs hinder riparian zone restoration efforts in the southwestern U.S. Revegetation methods could be improved by using clinoptilolite zeolite (CZ) as a wicking material. This study focused on measuring stem water potential (SWP) as a water stress indicator in desert willow (Chilopsis linearis) grown in CZ cores or in-situ riparian soil (RS) as part of an ongoing study at an urban test bed near Sunland Park, NM. Determining if desert willows planted in CZ cores have lower levels of water stress than those planted in RS under similar conditions is the main research objective. The effects of two depth to groundwater (DGW) zones on water stress will also be explored. It is expected that shrubs planted in RS will experience higher water stress and that water stress will increase as DGW increases. In February 2016, DGW for CZ boreholes in zones 1 and 2 were 1.4 and 2 m, respectively. Measurements of DGW, soil moisture content, health condition, survival, SWP, and leaf chlorophyll content for selected desert willow plants were taken from June 7 to July 7, 2016. Plants grown in CZ in Zone 2 had much lower water stress levels than those grown in RS in the same zone. Measurements of SWP for plants grown in RS in Zone 1 and CZ treatments in both zones were not significantly different. This indicated that plants grown in CZ with a deeper DGW did not experience high water stresses like those grown in RS. Water stress increased as DGW increased for plants grown in RS. Soil moisture content was negatively correlated with SWP, but this relationship was weaker for CZ treatments. These results

can be used to determine the appropriate groundwater conditions where CZ should be used in future urban riparian restoration projects.

11. The Impact of Extreme Weather Events: How Flooding in Syracuse Impacts the Community

Andree Finkelstein, Janet Mardsen, David Chandler
Syracuse University, Geography

Climate change is happening and often triggers extreme weather events. According to the Intergovernmental Panel on Climate Change, an increased number and frequency of precipitation may cause increased flooding in the 21st century (Lubchencho and Karl, 2012). Many areas in the Northeast are prone to flooding. Syracuse in particular is vulnerable to flooding due to large amounts of precipitation from rain and snow melt. It is important for communities to be prepared for these extreme weather events for the safety of their citizens and to alleviate stresses on gray infrastructure. A study of the topography, demographics, locations of gray and green infrastructure and public areas of Syracuse, New York, was completed. A map was created in Esri ArcMap 10.3 to show spatially where flooding could potentially occur along Onondaga Creek. Once potential flood areas were identified, a web-based application was generated for desktops and smartphones to alert the public on important information such as where to obtain supplies, seek refuge, and additional emergency information as needed. This application will produce an alert and be updated when there is a flood risk. This could be applied to other extreme events. Future work will be focused on generating an application, a clearinghouse, to send information to public officials, alerting them of potential infrastructure failure due to an extreme weather event. Additional work will also include modeling to better understand the impact of flooding on gray and green infrastructure in flood zones. A community that is well-informed of potential extreme events can adequately facilitate an evacuation when necessary, and reduce its loss of lives, personal and public property, and save money and infrastructure losses due to an extreme event. To help prevent such losses, and keep the public well-informed it is necessary to create an interactive web-based map for the public, government and private sector.

12. Thermal Transpiration Based Pumping and Power Generation

Thomas Welles, Amrish Baskaran, Ryan J. Milcarek, Jeongmin Ahn, Paul D. Ronney
Syracuse University, Aerospace Engineering

This poster involves integrated power generation and thermal transpiration pumping, combining results already achieved through previous work on thermal transpiration based pumping and introduce low temperature SOFCs

to generate power. The poster also illustrates low temperature ignition using a two-stage combustion system in which the exothermic energy from a combustion reaction, initiated at lower temperatures, is used to ignite the primary fuel.

The combustor was successfully applied in a self-sustaining gas pump system having no moving parts and using common hydrocarbon fuel. Thermal transpiration was accomplished by meeting two key conditions: (1) gas flow in the transitional or molecular regime using glass microfiber filters as transpiration membranes and (2) a temperature gradient through the membrane using combustion downstream of the membrane achieved by using a thermal guard. The effect of the transpiration membrane pore size on the performance of the gas pump was studied. The gas pump system was then combined with a SCSOFC to create a portable power generation system.

Low temperature cells have been fabricated using Gadolinium-Doped-Ceria (GDC) as the electrolyte, a cermet mixture of nickel and SDC (Ni-SDC) as the anode and Lanthanum strontium cobalt ferrite (LSCF) as the cathode, producing power densities of up to 840 mW/cm2 at 550 ËšC and up to 964 mW/cm2 at 600 ËšC.

Another challenge is to ignite the fuel at low temperatures. This can be overcome by using a secondary fuel which can be ignited at lower temperatures. Experiments show that hydrocarbons such as Diethyl ether can be ignited at temperatures as low as 160 °C without the use of any catalyst and can attain temperatures high enough to ignite common, available hydrocarbons such as propane and methane.

13. Combustion Characteristics of Fuel-Air Mixtures via Spark Ignition

Aurea Riboroso, Dr. Benjamin Akih-Kumgeh
Syracuse University, Aerospace Engineering

Many current technologies in transportation and power generation require an ignition source through a spark. Spark plugs are the most commonly used device to induce a spark within a system in order to ignite fuel-air mixtures. Spark plugs have nearly reached optimal design and efficiency, causing researchers to find more efficient and clean ways of burning for the combustion process. In this study, the limits of spark ignition are investigated through the propagation of a flame from a spark plug in order find the threshold of its capabilities compared to other forms of ignition currently being researched. Using Schlieren imaging, the burning fuel-air mixtures in a constant volume chamber was recorded and analyzed using image processing techniques. In order to calculate the flame propagation rate, the source of the spark was set as the reference and the outer edge of the flame was followed in order to

calculate the radius of the flame. From the analysis done, the flame propagation for methane and heptane gases were compared. With the same initial conditions and similar equivalence ratios, heptane burned faster and longer than methane. When burning heptane at different equivalence ratios, ranging from lean to rich, the cases closer to stoichiometric burned faster. Burning at different equivalence ratios is of interest for the study of spark plug limitations since the range of the gas's flammability can change depending on the type of ignition. Limitations of the spark plug studied during the duration of the experiments include failed ignition due to the set-up of the experiment and the composition of the fuel-air mixtures. Since the plasma breakdown of the spark is dependent on the temperature, pressure, and density of its surroundings, the composition of the mixture played a part into the failed ignition phenomenon. Due to a poor connection between the connector of the spark plug and the ignition coil, this also contributed to the multiple instances of failed ignition.

14. Improving Energy Efficiency of Hot Water Supply for a Campus Residence Hall

Christina Herkenham, Harlan Toussaint
Syracuse University, Mechanical Engineering

Dormitories consume a large amount of domestic hot water. Energy savings may be realized by using the condensate from the steam boilers to preheat incoming cold water. This may be accomplished by installing a condensate/water heat exchanger and results in steam and monetary savings for the building.

15. Design and Testing of a Micro Scroll Compressor

Bryan Morris, Brian Carter, Timothy LaBreche, J. William Bush, and H. Ezzat Khalifa
Syracuse University, Mechanical Engineering

Controlling the thermal conditions in the personal micro environment around a person, rather than in a large, multi-occupant building zone can both enhance occupant comfort and productivity and reduce HVAC energy consumption. However, such near-range control of the occupant's thermal environment requires the use of micro environmental control systems (μX) that are smaller than any HVAC system or spot cooler currently in use. Among the most efficient of those are micro vapor-compression systems. The heart of such systems is a micro compressor that is designed specifically for such applications. This poster presents the design and performance attributes of a first-of-a-kind micro scroll compressor designed by Bush Technical LLC specifically for a novel micro-environmental control system that is currently under

development by a team led by Syracuse University though a DOE-funded ARPA-E project. The compressor has a volumetric displacement of only 1.5 cc/revolution and delivers >60W of cooling using ~12W of power and a low-GWP refrigerant. Calorimeter testing of the compressor at SyracuseCoE confirmed its excellent performance under the specified µX operating conditions.

MASTER'S STUDENTS

16. Tower C

Yenhsi Tung, Yuchi Kuo, Andi Li, Elizabeth Krietemeyer, David Shanks
Syracuse University, Master of Architecture

Tower C project pursues the integrated high-rise design which includes clustered modular units design, passive design and heating, ventilation and air conditioning design.

Tower C has diverse unit types and aggregates variously to form the organic cluster. The multi-layer organic cluster creates the self-shading and private terrace and semi-public opened green space for family units. Tower C takes advantage of not only as a passive design strategy that uses daylight and wind penetrate into the residential area, but also provides the social interaction within the semi-public space.

In addition, green roof design regards as a package attached to specific unit that contributes to the whole modular system. In heating, ventilation and air conditioning design, Tower C has centralized and decentralized system for public area and private unit for providing the efficient installation work. By this way, the modular units can be considered as the high efficiency and flexible installation.

17. Light Breeze

Sebastien Simonnet, Christine Robillard
Syracuse University, Master of Architecture I

The building is strategically formed to fit into the existing urban macro climate and fabric while balancing the single individual micro climate of a single module unit and the desired comforts of any individual. Taking into account the variability of comfort among groups of individuals the louver system can be control from each unit so that each tenant can live within their own comfort environment. In addition we aimed to give each unit as much transparency to the surrounding views of Manhattan and Brooklyn while the louvers

can still allow for a tenant to control their own privacy. It was important to create individuality among the units considering they were all of the same to efficiently streamline the modular construction process.

The tower is located on church land where the church's rectory once stood. We replaced the rectory by placing it still behind the church but moving the event space to its side and up above the sidewalk level. What this echoes is the stoop level of the brownstones of the Brooklyn neighborhood while keeping open all important view corridors to the church.

18. House C

Yuchi Kuo, Yenhsi Tung, Andi Li, Elizabeth Krietemeyer, David Shanks
Syracuse University, Architecture

House C project is inspired by the existing trees on the site (Brooklyn) and aims to create a universal modular residence which strategically utilizes available spaces based on the environmental concern. By this way, the tree not only becomes a core part of forming the courtyard shape and programming the spatial arrangement between public and private, but also has significant impact on micro-climate of the site.

According to the basic environmental analyzing, House C opens to south and enclose the tree to receive the brightest sunlight passing through with the tree canopy, and the warmer wind in the summer. The roof inclines for the ventilation with the wind from south, and for receiving the sunlight more efficiently. In addition, the application of roof garden receives the rainfall water and connects to the green belt for the site climate adaption.

19. Straw Bale Building: Envelope Monitoring

Alexandra (Sasha) Batorsky
SUNY ESF, Sustainable Construction

This research is furthering our understanding of moisture movement through Straw Bale construction. Our current understanding is sufficient for basic straw bale walls however as building science progresses, hybrid straw bale wall systems are becoming more prevalent and a better understanding of moisture movement is critical for efficient hybrid systems.

A moisture meter, specifically the SmartWand system created by "Building Sensors," will help to identify where moisture is getting in, lingering, and exiting a straw bale wall system. This research will gather data to 1) calibrate this sensor and 2) gather initial information related to moisture movement.

The experiment will begin by placing a bale of straw in a temperature and relative humidity controlled environment. Sensors will be placed in various locations in the bale and temperature and relative humidity will be set. Once the sensors are turned on, we will wait for equilibrium to be reached. This will be repeated with various sets of temperature and relative humidity. With this, we will begin to understand how long it takes for moisture to penetrate a bale.

This study will further our collective knowledge of moisture movement through Straw Bale Construction to assist in the progress of building healthy, resilient, sustainable and efficient wall systems.

20. Smart Housing Project: Designing New Feedback Options to Improve Motivation and Conservation

Alan Schay, Amanda Sherman, Susan Powers, Lisa Lagault, Stephen Bird, Daqing Hou, Kerop Janoyan
Clarkson University, Electrical Engineering

College student housing represents significant resource consumption in the United States. For the past three years, the Smart Housing Project at Clarkson University has been examining the interaction between motivation and feedback on energy consumption behavior. In the project, students living in on-campus apartments were exposed to varying conditions of motivational messaging and energy consumption feedback. Occupants had their electricity and water consumption measured by an extensive metering network to provide feedback, while educational workshops were used to develop personalized motivational messaging. While results have been promising, there is still room to improve. To that end, work has begun on redesigning the feedback system to better integrate the motivational component of the project, while improving the general usability of the feedback system. The feedback system was redesigned in consultation with partners at IBM, with a focus on usability, and an examination of which features of the existing feedback system proved most engaging with project subjects. Preliminary results of the redesign were evaluated for usability by volunteers, and those results are being used to continue moving design work forward.

21. Comparing Water Source Knowledge in Cities that exceed the Lead Action Level

Leah Harnish, Adam T. Carpenter, Sharon Moran
SUNY ESF, Environmental Studies

The authors studied the level of people's knowledge about their water source,

their level of concern for it, and how this relates to living in a city were lead levels exceed action levels. Results show that, depending on how respondents perceived the issue, knowledge level and perception of a problem both are dominating factors in a person's knowledge of their water source. Using a survey to identify relationships, the study found that those from cities with lead levels that exceeded action level showed higher concern for their tap water quality; this increased when the respondents could not identify their water source. Looking at these results in the context of the theory of planned behavior (specifically perception, knowledge, and behavior), showed that the more a person knows about their source water, the less likely they are to express unnecessary concern due to a misperception of an issue.

22. Lignin Determination in Biomass Before and After Hot-Water Extraction

Chengyan Jing, Kuo-Ting Wang, Biljana Bujanovic
SUNY ESF, Paper and Bioprocess Engineering

Along with cellulose and hemicelluloses, lignin is a structural constituent of lignocellulosic biomass. Lignin may be defined as an amorphous, polyphenolic material arising from an enzyme-mediated dehydrogenative polymerization of three cinnamyl alcohols: p-coumaryl, coniferyl, and sinapyl alcohols. By far the most commonly used method for determining lignin content is the Klason or acid hydrolysis procedure which is a gravimetric method (a two-step H2SO4 treatment of pre-extracted biomass). In this method, however, compounds such as proteins and unhydrolyzed polysaccharides can interfere with measurements and result in an overestimation of the lignin content. On the other hand, this method includes a UV spectral analysis of the soluble lignin using an absorption coefficient (Beer's Law) which varies depending on the type of biomass. Johnson developed a method based on lignin solubilization in acetyl bromide and acetic acid and determination of the UV- absorption of the resulting solution at 280nm. This method is simpler and less time consuming than the Klason method. However, a critical parameter in this method is an accurately measured lignin absorption coefficient.

In this research, the acetyl bromide spectrophotometric method was compared with the Klason lignin method in a series of experiments using xylan-rich biomass, such as sugar maple, willow, Miscanthus and wheat straw, before and after hot-water extraction which is suggested as a hydrothermal pretreatment of xylan-rich lignocellulosics for use in biorefineries. The milled wood lignin was isolated to represent lignin in-situ and to obtain the correct absorption coefficient for quantifying lignin in samples. The results of these studies are expected to help quantifying lignin in raw and hot-water extracted biomass and also clarifying lignin modifications during hot-water extraction.

23. Minimization of PT-410 Cryocooler Vibrations Under Impulsive Pressure

Xu Cao, He Tian, Prof. Hamid Dalir, Dr. Chao Wang
Syracuse University, Mechanical and Aerospace Engineering

To achieve low temperatures as low as 4K, a two-stage pulser tube cryocooler has been developed by Cryomech Inc. The cold head with multiple tubes are connected to the PT-410 cryocooler compressor system via a rotary valve.

When the system is operating, vibration and noise caused by gas pulsation inside of the cold head are quite noticeable. Our study shows that the system is operating close to one of its natural frequencies.

The objective of this project was to modify the local stiffness of the structure by changing its geometry to minimize the noise and vibration of the whole system while keeping its thermal performance intact. A detailed analysis was done using Finite Element Analysis (FEA) in Abaqus and the results were correlated to the experimental measurements.

24. Exploring the Performance of Dual-Phase Oxygen Transport Membranes for Carbon Capture Purposes

Matthew Rushby, Ryan Falkenstein-Smith, Dr. Jeongmin Ahn
Syracuse University, Mechanical and Aerospace Engineering

There is a rising pressure on the industry to meet the steady climb of energy demand while concurrently reducing harmful emissions exhausted into the atmosphere. One solution is oxygen transport membrane reactor (OTM), which has the potential to capture harmful emissions at minimal energy cost. Despite its novelty, OTMs have some restrictions that could potentially limit its application. OTMs are comprised of perovskite materials with the chemical structure (ABO3-δ´) giving the material mixed ionic and electronic conductive properties (MIEC). In the presence of enriched CO2 environments, A sites, mainly comprised of alkaline earth metals, tend to form carbonates, ultimately jeopardizing the stability of OTMs. In order to improve chemical stability, some researches examine dual-phase membranes which includes the addition of highly oxygen ionic conductive materials (IC) exhibiting substantial CO2 tolerance. This work examines the oxygen permeation performance of dual-phase OTMs, combining mixed conductive and ionic conductive materials for long term stability in potentially degrading atmospheres. Due to its reported high oxygen permeation performance, SrSc0.1Co0.9O3-δ´ (SSC) was selected as the studied perovskite material. Additionally, due to its high conductivity, stability, and common use Sm0.2Ce0.8O1.9 (SDC) was chosen as the IC material. In order to investigate the influence of the additional IC mate-

rial to the oxygen permeation performance, the combination of SSC and SDC were varied based on a weight ratio ranging from pure SSC to 50SSC-50SDC on increments of 10 wt%. Although, pure SSC material was able to achieve a higher oxygen permeation value with an inert sweeping gas 2.92 ml.min-1. cm-2, its stability was jeopardized when introduced to a CO2 sweeping gas. A 60SSC-40SDC was able to demonstrate some stability over a longer period of time achieving a value of 0.697+0.005 ml.min-1.cm-2 for the last 20 hours

PhD STUDENTS

25. Occupancy Based Controls Using Open Source Software and Organizational Databases

Lourdes Gutierrez Aliaga
Rochester Institute of Technology, Sustainability

Energy is wasted on ventilation by oversupply of air. There is potential to reduce energy consumption by correcting the air supply according to real-time occupancy data. Airflow levels are calculated by designers based on assumptions on occupation and safety factors. Most buildings operate under this design value, when in fact the actual number of occupants is usually lower than assumptions used in the design stage. On a campus, this results in a high quantity of energy wasted in ventilation by oversupply of air. We will provide the minimum airflow that should be met in a lecture classroom according to real occupancy data and the class schedule. We will build models for heating and cooling and use the equations from the ventilation and indoor air quality standard - ASHRAE 62.1 combined with campus information from the building inventory data (area), class schedule (occupation), registered student data (population) and review the occupation data provided by CO and occupancy sensors. To integrate different databases to the existing building automation system (BAS), we will use the VOLTTRON, an open source software from the U.S. Department of Energy. We estimate that this application could provide direct savings of 10-20% consumption of Air Handling Units over 5,000 million sqft of educational buildings. This energy efficiency was demonstrated the last Auguts and was awarded as the Most Innovate project using VOLTTRON at the PNNL Connected Buildings Challenge.

26. Introduction to the Well Living Lab: Human Health & Wellness in the Built Environment

Chuan He
Syracuse University, Civil and Environmental Engineering

The Well Living Lab (WLL) is a scientific research center that uses exclusively human-centered research to understand the interaction between health, well-being, and indoor environments. WLL is a collaboration between real estate firm Delos Living LLC and Mayo Clinic. The Lab offers a comprehensive control over research variables through a modular, reconfigurable space that simulates a wide variety of real-world environments. Americans spend more than 90% of their time indoors€"from homes to office or work environments, schools, retail stores, fitness centers, health care facilities and more€"which means exposure to indoor environments is at an all-time high. But what many people don't realize is that buildings, and everything in them, can affect human health and well-being. The purpose of the Well Living Lab is to study these indoor environments and foster the creation of healthier indoor spaces in which to live, work and play. The research approach of the Lab will leverage and expand upon the principles of the WELL Building Standard®, which sets performance requirements in seven Concepts relevant to indoor health: air, water, nourishment, light, fitness, comfort and mind. The WLL aims to partner with companies that want to help generate new knowledge, and interact with experts from a wide range of scientific, medical and technical backgrounds.

Our one-of-a-kind research facility is completely reconfigurable and features advanced sensor technology and remote monitoring that allows people who participate in our studies to move about freely "as they normally would"unencumbered by wires, devices and monitors. But research is not limited to the Lab environment: our remote monitoring control center allows us to observe and track study participants outside the Lab, at home, work or play.

27. Characterization of the Growth Medium on an Extensive Green Roof

Yige Yang, Cliff Davidson
Syracuse University, Civil and Environmental Engineering

Natural landscapes allow rainwater to infiltrate the soil and recharge the groundwater. However, urbanization in the past century has altered the land and increased impervious surface area in cities. Thus surfaces such as parking lots, roads, and building roofs have modified the natural water cycle, resulting in flooding and impaired water quality. Infrastructure projects such as storm drainage systems and sewer pipes were developed to convey rainwater to rivers, lakes, and other receiving waters to avoid flooding. However, impervious surface area has continued to increase, putting a strain on the existing infrastructure. To reduce these problems by taking advantage of ecosystem services, green infrastructure was developed. For example, green roofs offer a more sustainable stormwater management method compared with traditional piped drainage systems. The vegetation and growth medium are designed

to reduce and delay peak runoff by water retention and subsequent evapotranspiration. Green roof growth media are engineered to be light weight and highly porous, with the ability to hold nutrients to nourish the plants. Due to competition for green roof construction contracts, companies designing green roofs usually keep their growth medium formulas confidential.

The object of this research is to determine the hydrologic conductivity, porosity, and organic content of the growth medium on a local green roof, namely the roof of the Onondaga County Convention Center in downtown Syracuse, NY. These properties are key to explaining the water balance on the roof and to improving the performance of green roofs such as this one.

28. Increased Salinity in Central New York Headwater Catchments Associated with Long-Term Road Salt Application

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Concentrations of chloride (Cl) in surface water have increased at an alarming rate since the 1950's, when the application of road salts became widespread in the United States (Kaushal et al. 2005, Kelly et al. 2008, Kelly et al. 2010, Corsi et al. 2015). The objective of our study is to characterize the sources of salinity in two branches of the Tioughnioga River, with contrasting land use, in central New York. The Tioughnioga River is a main headwater catchment to the Upper Susquehanna River Basin - a major sub-catchment to the Chesapeake Bay System. We use ratios of Cl/Br and linear discriminant analysis (LDA) as two independent means to differentiate among sources. A previously developed LDA modeling approach (Lautz et al. 2014) is modified to identify the most probable sources of salinity in the Tioughnioga River watershed from that of Appalachian Basin Brines, road salts, and animal waste. Seasonal and decadal scale variations in downstream Cl concentration profiles are examined in order to elucidate hydrogeologic controls on the spatial distribution of Cl. Additionally, we assess the impacts that the completion of interstate 81 (I-81) and subsequent application of de-icing salts has had on the water chemistry. Ratios of Cl/Br, LDA, and longitudinal stream Cl concentration profiles suggest that road salt is the dominant source of salinity in both branches, but is more pronounced in the West Branch €" which is consistent with a greater area of urban land and the catchment's proximity to I-81.

29. Modeling and Experimental Study of Using Micro-Environment Control for Thermal Comfort

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Micro-environment is defined as the perceived real and imaginary space around a person that directly impacts one's thermal sensation. However, most of the conventional HVAC systems condition the air in the entire indoor space assuming that the air is well mixed. It leaves a big potential to save energy by changing the set-point in the unoccupied space and conditioning directly the micro-environment. Expanding the neutral band of temperature set-point in buildings from 70-75 °F to 66-79 °F requires the control of the micro-environment so that people do not have hot or cold stress. This work aims at designing an efficient terminal device, which is able to remove sufficiently more heat in summer and less heat in winter from the human body in an appropriate movement range by delivering cooling or heating to maintain the heat balance of the occupant. Within the design scope, variable configurations of the heating or cooling delivering systems mounted in an Indoor Environment Quality (IEQ) chamber with different combinations of supply air flow rate and temperature, were tested using a Computational Fluid Dynamics (CFD) Model as well as experiments. The performance to ensure proper heat balance and minimal discomfort, as well as satisfy acceptable ergonomic/aesthetic considerations, was evaluated.

30. Micro-Tubular Solid Oxide Fuel Cells

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Micro tubular solid oxide fuel cells (mT-SOFC) are small diameter (less than 2-3 mm) tubes composed of ceramic materials. These mT-SOFCs have advantages over other geometries, including ease of sealing, high volumetric power density, and rapid thermal cycling. Therefore, the development of mT-SOFCs is of interest using various manufacturing techniques including: extrusion, dip coating and wet powder spraying. In this work, different binders, solvents and dispersants are explored to develop an effective dip coating recipe for yttria-stabilized zirconia (YSZ) and lanthanum strontium manganite + YSZ (LSM + YSZ). Dip coating allows for the uniform application of YSZ and LSM layers in a time efficient manner. The final sintered ceramic is characterized using microscopy to visually inspect for surface cracking, densification, and uniformity. The fuel cell electrochemical performance was characterized using hydrogen, the ideal fuel for fuel cells, using the four probe method with a source meter. The material properties of solid oxide fuel cells make them suitable for use in high temperature combustion environments. Combustion reforming can result in hydrogen, carbon monoxide and heat generation for mT-SOFC use. By varying the combustion equivalence ratio, mT-SOFCs are capable of utilizing fuel-rich combustion byproducts as a fuel source for electrical power generation. Their simplicity and flexibility makes mT-SOFCs advantageous over other combined heat and power systems.

31. Flame-Assisted Fuel Cells for Combined Heat and Power and Jet Engine Applications

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Solid Oxide Fuel Cells (SOFCs) operating in a Flame-assisted Fuel Cell (FFC) setup have potential for micro-Combined Heat and Power (μCHP) and jet engine applications. For example, SOFCs can be integrated into a gas-fired, up-flow furnace to enable the generation of both electricity and heat from the fuel, transforming the furnace into a FFC μCHP system. The FFCs will be integrated with the furnace burners in a modified setup to allow staged combustion with a slightly fuel-rich 1st stage/FFC, then a fuel-lean 2nd stage to complete combustion in the flues. Combustion in both stages will produce the heat needed for the heat exchanger as well as the heat needed for SOFC operation. Other applications include combining the FFC with a rich-burn, quick-mix, lean-burn (RQL) combustor in a jet engine or combined cycle plant. This poster shows experimental and analytical results of fuel-rich combustion exhaust composition for hydrocarbon fuels, single fuel cell and stack results for operating in the fuel-rich combustion exhaust and a fully integrated RQL combustor and FFC. Peak power densities of 240 mW.cm-2 were achieved for both a single fuel cell and a 9-cell stack operating in fuel-rich combustion exhaust. The results demonstrate recent breakthroughs in FFCs including their ability to achieve high fuel flexibility, rapid startup and shutdown, simplified sealing, high fuel utilization, good performance and long term stability.

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