COLLEGE OF ARCHITECTURE
DEPARTMENT OF LANDSCAPE ARCHITECTURE AND URBAN PLANNING
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2016-2017 Schob LAUP Mini-Grant Program Proposal

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CO-PRINCIPAL INVESTIGATOR:
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PROJECT TITLE:
The role of small green space on mitigating air temperature: An empirical study using a temperature-sensing unit with ventilated double cylinder shelter (TVC)

PROJECT ABSTRACT

The presence of green spaces in urban areas can mitigate negative impacts of urban heat island effect by creating cooling buffer zones. However, despite the expectation that small green spaces provide high cooling effects, making air temperatures drop such effect in urban areas has been less explored in comparison to larger parks and urban forests. The Schob Nature Preserve is proper study site to assess the influence of a small green space on mitigating air temperature. This project will use a temperature-sensing unit with ventilated double cylinder shelter (TVC) which is an advanced device to record temperature data more accurately using T-type thermocouple with ventilator (Appendix 1). Using TVC, this project will measure air temperatures in various landscape design features such as rain garden, shrubs, tall trees, and pavement in the Schob Nature Preserve (Appendix 2). This project is to develop a guidance to describe thermal environment with a finer scale and an experimental research design for identifying air temperature data with spatial analysis using TVC. This study will help students understand thermal environment and mitigation effect of small green spaces and apply the usage of TVC for their learning experience.

OBJECTIVES OF THE PROJECT

There have been challenging issues to capture precise spatial data of microclimate in a fine scale to assess the contribution of small green space to enhance microclimate in a community. The main purposes of this proposal are 1) to develop a measurement method to detect temperature of various small green spaces with TVC, 2) to produce thermal map of the study site and analyze temperature mitigation effect of each green space, and 3) to provide learning opportunities to graduate and undergraduate students in terms of thermal environment and microclimate related to green space design and planning.

WORK PLAN

Over the 2016~2017 academic year, both PI and Co-PI will conduct transect surveys twice a month after field survey on the site and develop a measurement framework based on their trial and error learning process. Then temperature data collected will be converted to spatial data and

analyzed to determine the most appropriate method to capture the thermal condition of the Schob Nature Preserve. Finally we will analyze the effectiveness of small green spaces in improving microclimate by reducing heat. This project will progress in four phases which will benefit the experiential learning elements. Several tasks in the four phases will be performed as described below:

SCHEDULE OF ACTIVITIES

Phases	Tasks	2016 Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	2017 Jul	Aug	Sep
Research & Site Analysis	**Task 1 - Site visit & field survey** • Visiting the site and gathering spatial data **Task 2 - Site analysis & Mapping** • Conducting site analysis and making a base map through site observation and inventory **Task 3 - Research & case study** • Conducting case study and research focusing on TVC applications											
Data Collection	**Task 4 - Collecting temperature data** • Conducting transect survey twice a month											
Data Analysis	**Task 5 - Spatial thermal pattern analysis** • About SGs and others through using ArcGIS **Task 6 – Spatial statistical analysis** • Detecting each SGs thermal mitigation by using spatial statistics											
Final Package Development	**Task 7 - Developing final package** • Producing the final measurement framework and results from the empirical study **Task 8 - Final presentation** • delivering the final package to faculty and guest reviewers including the Senior Schob Scholars											

STUDENT LEARNING OUTCOMES

This project will expand students' understanding and knowledge in landscape analysis considering thermal environments by using an advanced measurement specialized to capture microclimate. By participating in this project focusing on developing new measurement framework using TVC, both graduate and undergraduate students will learn how to create a thermal map using data collected by an objective method using TVC, and how to get precise and reliable temperature data through repeated transect surveys. This high-impact learning opportunity will bring a number of pedagogical benefits to students with an empirical research experience focused on microclimate observation in a small green space. In addition, this project will bring diverse opportunities to students for better understanding about landscape and thermal environment analysis process by hands-on learning experience, which will improve the ability to demonstrate problem-solving and critical thinking skills. This project aligns to the Texas A&M University's mission by meeting a number of the Aggie Commit Themes:

1. While participating in this project, students will have an opportunity to enhance *intellectual and practical skills* by learning how to identify and analysis problems to bring solutions for those problems, and how to execute the plan based on in-depth site analysis.
2. All students in this project will have *a high-impact learning opportunity* by being engaged in a sensitive and reliable data collection process to analyze thermal conditions of the site.
3. All students participating in this project will learn how to improve their *communication*

and analytical skills, since this project will offer students a unique opportunity to get exposed to challenges dealing with how to improve thermal environment analysis results using detailed spatial data considering the relationship between landscape design and microclimate statistically.

4. Developing a measurement framework with TVC will bring valuable opportunities to students to learn *process of solving problems with critical thinking*.

ANTICIPATED DELIVERABLES

The final deliverables of this project will include:

1. A hardcopy and PDF file of the final report
2. Digital files of the final analysis package including collected air temperature data and a thermal map for the Schob Nature Preserve during the study

HOW WILL THE MONEY BE USED

The funds will be used for data collection/field study during the project period.

Items	Costs
Fabricating TVC	*$1,000*
Data Collection and Field Study	*$1,200*
Printing Costs & Publications	*$500*
Contingencies	*$300*
Total Requested:	***$3,000***

References

- Asawa, T., Hoyano, A., Takezawa, H., & Shimizu, K. (2003). Field measurement of outdoor microclimates in a residential area having leafy canopies in seasonally hot and humid climate. In *Fifth International Conference on Urban Climate 1-5 September, 2003 Łódź, Poland: proceedings* (Vol. 2, No. 11, p. 241). Department of Meteorology and Climatology Faculty of Geographical Sciences University of Łódź.
- He, J., & Hoyano, A. (2010). Measurement and evaluation of the summer microclimate in the semi-enclosed space under a membrane structure. *Building and Environment*, *45*(1), 230-242.
- James R, A. M., Yuan, W., & Boyette, M. D. (2016). The Effect of Biomass Physical Properties on Top-Lit Updraft Gasification of Woodchips. Energies,9(4), 283.
- Murakawa, S., Sekine, T., Narita, K. I., & Nishina, D. (1991). Study of the effects of a river on the thermal environment in an urban area. Energy and buildings, 16(3), 993-1001.
- Zoulia, I., Santamouris, M., & Dimoudi, A. (2009). Monitoring the effect of urban green areas on the heat island in Athens. Environmental monitoring and assessment, 156(1-4), 275-292.

Appendix 1. Specification of a TVC

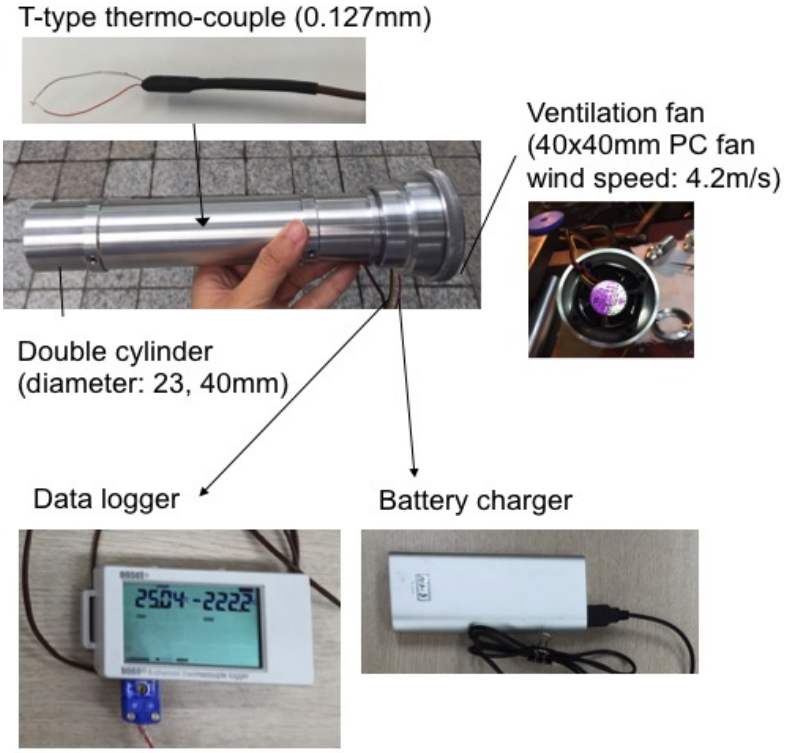

Figure 1. Specification of TVC for transect survey

The TVC consists of three parts; first part is double cylinder shelter which senses a thermoelectric effect with t-type thermocouple extracting heat on device by ventilator and covered by aluminum double cylinder; second part is data logger connected to double cylinder, converted the sensed temperature-dependent voltage to temperature, and recorded the temperature immediately; third part is a bag including a double cylinder, a battery, and a logger. With these measuring characteristics, temperature at a certain spatial point can be measured correctly because TVC makes collecting and recording data at the same time.

Specification

Device	Detail	Range	Accuracy	Application
Thermocouple	·T type (ø0.127mm) ·Constantan	-260° ~ 400°C	±0.5°C	Transect survey
HOBO logger	·UX120-014M ·Logging velocity : 1second ·Resolution : 0.024°C	-20° ~ 70°C	±0.21°C	
Portable charger	·22000Am & 5.8V			
Testo logger	·Testo 174H (Thermister) ·Logging velocity : 1minute ·Resolution : 0.05°C	-20° ~ 70°C	±0.5°C	Stationary survey

Appendix 2. Measurement plan

Figure 2. Air temperature collection locations in the project site

The study site will be classified into 5 areas based on land cover: residential/structural area, rain garden, open prairie, open lawn, and forest area as indicated in Figure 2. There will be two starting and ending points for our transect survey.