### PROPOSAL INFORMATION

Project Title: Development of a Pervious Concrete Pavement Test Site for Educational, Research, and Outreach Initiatives at the University of Georgia

### PRINCIPAL STUDENT INVESTIGATOR (PROPOSER) INFORMATION

Name: Tawfiq Bhuiyan  
Email: roketfiq@gmail.com  
Phone: (706) 248-9205  
Degree Program / Graduation Date: MS in Engineering / Spring 2014

### FACULTY / STAFF SPONSOR INFORMATION

Name: Stephan A. Durham, Ph.D., P.E.  
Email: sdurham@uga.edu  
Phone: (706) 542-9480  
Title / Department: Associate Professor / College of Engineering

### ADDITIONAL PROPOSAL INFORMATION

The proposal includes the following fields (check all that apply):

- [X] Academics / Education
- [X] Research
- [X] Service & Outreach
- [ ] Campus Operations

### Summary of Budget:

<table>
<thead>
<tr>
<th>Category</th>
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</thead>
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<tr>
<td>Personnel Funding</td>
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</tr>
<tr>
<td>Equipment</td>
<td>$1000</td>
</tr>
<tr>
<td>Supplies / General Expenses</td>
<td>$2500</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$5000</td>
</tr>
</tbody>
</table>
Pervious concrete has been produced dating back to the 1850s. Despite its long history, significant barriers have limited its use in engineering practice and public adoption. The majority of these barriers are a matter of perception, rather than a lack of technological know-how. Comments such as “pervious concrete clogs too easily,” “pervious concrete costs too much,” and “pervious concrete is not strong and durable” are frequently heard from decision makers. The often skewed perception of the technology presents a serious obstacle to support further innovation of the product. Currently, the principal investigator is pursuing a Master of Science (MS) degree in Engineering with an emphasis in Civil Engineering. The primary objectives of this research are to examine pervious concrete from sociological and technical perspectives. Specifically, identifying barriers that are most influential in limiting the use of PCP as a construction material. As part of this study, stakeholders (academics, industry, campus and local municipalities) will be surveyed for their perceptions and experiences with the product. This information will be carried forward to evaluate the product technically. Ultimately, this project will lead to an increased understanding of how technologies and sociological perspectives become interconnected when looking to a sustainable future.

This proposal and the funds provided will allow for the construction of a PCP test site that will be used for educational, research, and outreach initiatives. An 18ft. x 18ft. PCP system will be designed and constructed at the Engineering Research and Education Center (EREC). This test site will be comprised of a pervious concrete layer, a drainage layer, and underground piping to allow for water sampling. Ultimately, a series of tests will be performed on this site including compressive strength, durability, porosity (drain time), water quality, pavement surface temperature differential, etc… A test bed, used by students, faculty and staff, will explore the use of pervious concrete on the UGA campus and provide a living experiment aimed at delivering a long term, hands on research platform for classes and, later, public seminars and demonstrations here at UGA.

Implementation Plan
The proposed work will include four tasks. Task 1 will involve the design of the pervious concrete mixture (laboratory experimentation and testing for the optimum mixture design) and the pervious concrete pavement system (pervious concrete, free-draining rock, and sand layers). It is expected that the PCP system will be similar to that shown in Figure 1a. The principle investigator will devise a specific design for the pervious concrete system involving parameters such as thickness of the slab, drain size for piping and angle or grade of the concrete bed. In addition, the drains will flow into a small, accessible reservoir for the convenience of sampling and testing. Task 2 will be the identification of the test site area at the EREC. A preliminary proposed site selection is shown in Figure 1b. In addition, this task will include the construction of the PCP system by the principal investigator, faculty advisor, and study team. Task 3 will include the monitoring of the PCP test site. This will include sampling water for quality tests after storm events, evaluating clogging and porosity, compressive strength, and durability due to loads and traffic wear. Upon the completion of Task 3, Task 4 will include the gathering and

1 Note: The abstract "Enhancing Public Perception and Student Learning about Sustainable Technologies Using an Interdisciplinary Approach" has been accepted by the American Society for Engineering Education. (Authors: T. Bhuiyan, S. A. Durham, and N. Sochacka)
analysis of all data from the project, the writing of a final report, and dissemination to all stakeholders (Office of Sustainability, academic community, campus authorities, and local municipalities). In addition, the principal investigator will give a demonstration and a short seminar presentation on the design, construction, testing, benefits, and future opportunities for UGA using pervious concrete (identifying areas on campus where PCP might be useful).

**Figure 1. (a) PCP System Design (Hager, 2009) and (b) Preliminary Proposed Test Site (Google Maps, 2012)**

**Contribution to UGA**
The primary contribution for this project is to demonstrate the use of a sustainable technology that can effectively reverse the effects of urbanization on the UGA campus. PCP is a recognized sustainable technology. A reduction in impervious surfaces will lead to faster groundwater recharge which in turn will lead to cleaner water as water is filtered first by the PCP system and then by the soils and sands within the subgrade. In addition, this PCP offers a different approach to stormwater management. Contributions of this project occurs within education, research, and outreach:

**Education** - Classes such as CVLE 3310 (Materials), CVLE 3460 (Hydraulics), ENGR 3410 (Intro to Natural Resources) and ENGR 4660 (Sustainable Building Design) will benefit greatly from a pervious concrete test bed as students will be given a chance to visit the site and perform materials and water quality testing.

**Research** – The results of this study, in addition to being used for the principal investigators MS thesis research, will expand upon previous work on the subject and demonstrate the potential for this sustainable product to be used by the UGA campus and beyond. This technical evaluation of the proposed test bed with the sociological perspectives being researched will be extremely synergistic and provide the principle investigator with the means to educate and research beyond UGA and Athens.

**Outreach** – The proposed PCP test site will be used for public outreach. It will be used for demonstration and education of decision makers with the goal of them utilizing this technology for future development. In addition, the test site will be used for demonstrations of K-12 programs as a method of introducing STEM to these age groups.

**Expected Outcomes**
A pervious concrete test bed demonstrating the benefits of the technology would entice the public and UGA into supporting its expanded use and change how the technology is perceived. Technology is not always easily adopted and the principle investigator plans to study both why barriers are put in place and how to overcome them. Expanded use of pervious concrete would help UGA reach a higher level of sustainability on campus.

**Partner Organizations/Departments**
The principal investigator has reached out for collaboration with a number of individuals and organizations. The principal investigator is currently collaborating with Dr. Stephan A. Durham (faculty advisor) in the Civil Engineering program as well as Dr. Nicki Sochacka in the College of Engineering. Additional collaborations include Dr. Bruce Ferguson from the UGA College of Environment and Design, Mr. Josh Koons from Koons Environmental Design, Inc., John Dement from DSI Design and Construction, Inc., Dexter Adams and UGA Facilities Management, and Lara Mathes from the UGA University Architects office. Support from these partners is provided in the Appendix.
Campus Sustainability Grant Application – Compliance Form

Please answer all of the following questions, and explain in full where required.

Will this project require compliance review in any of the following areas?
Please place an “X” on the appropriate line to indicate “Yes” or “No” for all three compliance areas.

1. Animal Use
   ____ Yes
   ____ X No
If “Yes,” please reference the section and page number in the proposal describing animal use:

For more information contact:
706-542-5933

2. Biohazardous Materials
   ____ Yes
   ____ X No
If “Yes,” please reference the section and page number in the proposal describing biohazardous material use:

For more information contact:
706-542-9876

3. Human Subjects
   ____ Yes
   ____ X No
If “Yes,” please reference the section and page number in the proposal describing human subject use:

For more information contact:
706-542-5318

Name: Tawfiq Bhuiyan
Title: Principle Investigator
Date: 10/20/2012

____ X By placing an “X” on this line, I certify I will fulfill all requirements pertaining to compliance if this grant is approved.
Complete all sections.

### I. Personnel **,***

<table>
<thead>
<tr>
<th>Number</th>
<th>Amount/Person</th>
<th>Total Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractors 1</td>
<td>$1500/DSI Design and Construction, Inc.</td>
<td>$1500</td>
</tr>
<tr>
<td>UGA Staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UGA Student</td>
<td></td>
<td>$</td>
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<td>Other</td>
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</tr>
<tr>
<td><strong>Total Cost:</strong></td>
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<td>$1000</td>
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### III. Supplies/General Expenses**

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<th>Type of Supplies</th>
<th>Comment</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes, plastic liner, geosynthetic, sand, rock, pervious concrete (delivered), reservoir tank</td>
<td>Materials needed to construct the PCP test bed. The largest expense is expected to be the pervious concrete (delivered).</td>
<td>$2500</td>
</tr>
<tr>
<td><strong>Total Cost:</strong></td>
<td></td>
<td>$2500</td>
</tr>
</tbody>
</table>

**Acceptable personnel funding include: 1) hiring outside consultants or contractors to perform required project tasks, 2) UGA Facilities Management Division staff labor charges for project implementation, 3) UGA student workers managed by participating UGA department to perform required project tasks.**

**If more space is needed, please attach a separate document listing specific items and their costs**
IMPLEMENTATION PLAN

Introduction
Urban developments greatly alter the natural environment and as such provide distinct problems such as the heat island effect, increases in stormwater runoff, limited groundwater recharge, the introduction of contaminants, increased drainage requirements such as detention ponds, and safety issues such as ponding on impervious surfaces with poor drainage systems. Municipalities look to multiple solutions to help remedy such situations but none come close to the versatility of pervious concrete. Pervious concrete pavements generally consist of three layers: pervious concrete, free-draining rock, and sand layers. Each of these layers combined help to create a useful surface (ie. walking, driving, and parking) while allowing for rapid movement of water off of the pavement surface. Further, the system allows for detaining water until that water can seep into the underlying soil (if not piped to another area) thereby reducing the need for detention ponds as well as improving water quality with water flowing through the sand layer in the system. This proposal aims to design and construct a small PCP test bed that will be utilized for educational, research, and outreach programs.

PCP Background at UGA and Athens, GA
Approximately 6-7 PCP installations exist around the UGA campus and Athens area and vary in both quality and success. Most of these installations are parking lots; however, some are simply pedestrian areas meant for recreational use. The following sections provide a brief summary for three distinct PCP locations in Athens along with selected photographs and brief commentary on the condition and success of the sites.

The UGA Transit Facility on Riverbend Road is shown in Figure 2. This parking lot was managed by the UGA Office of University Architects. The site is in good condition but has experienced some raveling since construction.

Figure 2. UGA Transit Facility

The UGA Governmental Relations Building parking lot is shown in Figure 3. This small parking lot located on the north side of UGA Government Relations was the first installation of PCP at UGA. The site itself is in poor condition with clogging, prevalent raveling and structural failures. The principle investigator hopes to use research proposed by this project as a means of remedying such problems in the future.

Figure 3. UGA Government Relations Building Parking Lot
The UGA College of Environment and Design pedestrian area is shown in Figure 4. This site located behind the College of Environment and Design building is a pedestrian area and is less than one year old. This site is a success so far and is currently in very good condition.

Figure 4. UGA College of Environment and Design Pedestrian Areas

Mixture Design of Pervious Concrete
In pervious concrete, carefully controlled amounts of water and cementitious materials (typically very low) are mixed to create a paste that coats the aggregate particles. A pervious concrete mixture contains little-to-no fine aggregate (sand), thus creating a substantial void content of approximately 15-25% voids that achieves approximately 480 in/hr (Tennis, et. al., 2004). Pervious concrete exhibits similar or slightly less compressive strength when compared to conventional concrete. Typical compressive strengths for pervious concrete ranges from 500 to 4000 psi (Kosmata, et., al., 2002). Because specialty of the mixture (not all concrete designers and producers are knowledgeable on the material), care must be taken when designing, mixing, placing, and curing the pervious concrete. Numerous state and national organizations provide recommendations for the design of pervious concrete mixtures. A brief summary of these recommendations is shown in Table 1.

A thorough laboratory investigation will be conducted prior to the field installation of the PCP test bed. This laboratory investigation will include the design and batching of numerous concrete mixtures to identify which mixture and its proportion of constituents will be best suited for the field. The laboratory mixtures will be tested for compressive strength and porosity to help identify the optimum mixture. Variables that will be examined in the laboratory phase will include cementitious content, water content, cementitious type (ie. use of fly ash), fine aggregate content, aggregate size and type (ie. use of light-weight aggregate), etc… The use of a light-weight aggregate for the fine aggregate portion has shown to be beneficial to pervious concrete by allowing for internal curing (Majdoub and Durham, 2011).

Collaborators on this project such as the faculty advisor (Dr. Durham), College of Environment and Design collaborator Dr. Ferguson, and industry collaborators such as Koons Environmental, Inc., and DSI Design and Construction, Inc. will be consulted at various phases throughout the laboratory process. An initial meeting with the panel will be conducted to identify specifics of the variables listed previously. Future meetings will be held to provide interim and final results as well as to identify the optimum mixture(s) for field implementation.

Site Selection and Design
The principle investigator will identify a test site area at the EREC (also known as the Bioconversion Research and Engineering Center). A preliminary proposed site selection is shown in Figure 5A. This aerial photo shows an unused location very near to the main EREC building. This site has been chosen for its accessibility and visibility as well as the use of stormwater runoff from the adjacent asphalt access and parking area. A goal of this project, as mentioned before, is to educate through demonstration and the chosen site must reflect and aid this objective. Preliminary planning has set the plot surface dimensions at 18x18ft or the area of two large parking spaces. These dimensions were set as this would be the required area for two parking spaces.

Preliminary planning also put the PCP underground system dimensions at 8 inches per layer. A rough representation of how each layer will be placed can be seen above in Figure 5b. The pervious concrete system for the purposes of experimentation will also include an underdrain system. This system will include piping, placed at the borders of the PCP system, and an impervious membrane to direct water to drainage piping. The drainage system layout will look similar to the layout seen in Figure 6a. The finished system will look similar to Figure 6b.
Table 1. Recommendations for Pervious Concrete Mixture Design (Adapted from Hager, 2009)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Recommendation/Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Ready-Mixed Concrete Association</td>
<td>The dry rodded unit weight of the aggregate, measured in accordance with the jiggering procedure in ASTM C29 (2007)</td>
</tr>
</tbody>
</table>
| Portland Cement Association                       | Aggregate content = 2000 to 2500 lb/yd^3  
Aggregate to Cement Ratio (by mass) 4 to 4.5:1  
Fine to Coarse Aggregate Ratio (by mass) 0 to 1:1                                           |
| Georgia Concrete and Products Association          | The volume of aggregate per cu. yd. shall be equal to 27 cu. ft. when calculated as a function of the bulk unit weight determined in accordance with ASTM C 29, Jigging Procedure. If used, fine aggregate should not exceed three (3) bulk cu. ft., based on unit weight obtained by the Jigging Procedure, and shall be included as part of the 27 cu. ft of total aggregate volume. (2006) |
| National Ready-Mixed Concrete Association         | 500 to 600 pounds per cubic yard                                                                                                                              |
| Portland Cement Association                       | 450 to 700 pounds per cubic yard                                                                                                                              |
| Georgia Concrete and Products Association          | The total cementitious material shall not be less than 600lbs. per cu. yd. Flyash may be used in amounts not to exceed 25% of total cementitious material. GGBFS may be used in amounts not to exceed 50% by weight of total cementitious material. Slag content should be reduced to 30% when ambient temperatures fall below 50 F. If a ternary mix is used, the total replacement shall not exceed 50% of the mass of the portland cement. |
| National Ready-Mixed Concrete Association         | For pervious concrete the w/cm to obtain the needed workability usually falls within 0.26 to 0.35                                                                 |
| Portland Cement Association                       | 0.27 to 0.34. The correct water content has been described as giving the mixture a sheen, without flowing off of the aggregate. A handful of pervious concrete formed into a ball will not crumble or lose its void structure as the paste flows into the spaces between the aggregates. |
| Georgia Concrete and Products Association          | Mix water quantity shall produce a fully wetted paste with high viscosity. This condition occurs when the cement paste displays a wet, metallic sheen and does not flow from the aggregate. An insufficient amount of water yields a cement paste with a dull-dry appearance and insufficient water for hydration. |
| American Concrete Association                      | 0.35 to 0.45                                                                                                                                             |

Figure 5 - (a) Preliminary Test Site Location at EREC Lab at Whitehall (Google Maps, 2012) (b) Preliminary dimensions for PCP System.

PCP Construction
Construction of the PCP test bed will occur after the laboratory phase of this study. Site prep will be handled by the principle investigator and his faculty advisor though assistance may be obtained from John Dement of DSI Design and Construction who has agreed to collaborate on this study. John Dement is a certified installer. Construction will commence according to favorable weather conditions and will involve three major steps. **Step 1**
will involve demolishing the current pavement system and excavating the sub-grade to the designed depth (ie. 24in based on the scheme from Figure 5b). The principle investigator will also need to ensure elevations. The PCP system will need to be at a grade to allow water to flow down towards a designated area that allows for water sampling. Step 2 involves laying an impervious membrane (forming a “bath tub”) for the purposes of capturing water as it flows through the system. In addition, a trapezoidal trench will be excavated and filled with high strength piping and coarse aggregate that leads to a reservoir (Figure 6a). Stormwater is captured and contained through this system. After a liner is placed, the drainage piping must be placed and connected to the secure reservoir. This step includes placing the sub-base which consists of the free drain rock and sand layers but must be done with care to ensure no damage or punctures occur in the membrane as a result. Step 3 involves placing the pervious concrete layer. Because the test bed exceeds the recommended maximum width of placement (15ft), the test bed will be placed in two sections (Georgia Concrete and Products Association, 2006). Because of the small nature of this placement, a full width roller will be utilized, in place of a slipform compactive unit, to compact the pervious concrete layer. Other requirements of the GCPA guidelines will be met such as placement techniques and pavement elevation deviation. Jointing of the section will be considered, but is not required since the section is less than the 20ft required by the GCPA. A strict curing regimen will be followed to ensure proper cement hydration in the mixture and developing adequate strength gain. A 14 day cure is proposed for this study which exceeds those required by other organizations.

Figure 6. (a) Plan View of Test Bed with Pipes and Reservoir, (b) Elevation View of Proposed System (Hager, 2009)

Testing
A series of tests will be conducted on the PCP test section. These include, but are not limited to, compressive strength, porosity, water quality, and periodic inspections to examine condition and clogging. Compressive strength specimens will be fabricated at the time of placement, these will be cured per specifications and tested at the appropriate ages (ie. 28 days of age). Porosity testing will be conducted on these specimens prior to compressive strength testing. Tests for flow rate will be conducted on the PCP section using the Delatte test method (Delatte et. al., 2007). This is a simple drain time test method that includes a cylinder of water, plug, and stop watch. The study team will perform this test on other PCP sections on the UGA campus and Athens area for comparison. Water samples will be collected during periodic storm events to examine quality. Samples will be collected after water has filtered through the PCP system. In addition, efforts will be made to collect water samples from the adjacent asphalt parking area for comparison purposes. The primary objective of the testing phase will be to demonstrate the benefits of PCP systems and be able to provide ample documentation to support further use of the product on the UGA campus.

Conclusion
In summary, this multi-collaborative project will include two phases: laboratory investigation and field implementation. The laboratory phase will investigate various mixture designs ultimately leading to the selection of an optimum mixture. The field implementation will produce a test section for research testing, educational testing and demonstrations, and outreach (k-12, and public service) demonstrations and learning.
COMMUNICATIONS PLAN
As stated on the UGA Office of Sustainability’s website, the primary objective of this grant process is to advance campus sustainability. The principal investigator will accomplish this task in three areas: education, research, and outreach.

**Education** - Classes such as CVLE 3310 (Materials), CVLE 3460 (Hydraulics), ENGR 3410 (Intro to Natural Resources) and ENGR 4660 (Sustainable Building Design) will benefit greatly from a pervious concrete test bed as students will be given a chance to visit the site and perform materials and water quality testing. The principal investigator will be involved in working with instructors of these classes to have engineering students visit the test bed site, discuss how it was designed, the benefits of PCP systems, and perform routine tests (inspection, drain time, water quality, etc…).

In addition, it is possible that class outside engineering will benefit from this site as well since collaboration with the UGA College of Environment and Design has been established through this proposal. The principal investigator met with Dr. Bruce Ferguson of the College of Environment and Design on Friday, October 20, 2012, to discuss this study and there was considerable interest. Please see letter of support in the Appendix.

**Research** - The results of this study, in addition to being used for the principal investigators MS thesis research, will expand upon previous work on the subject and demonstrate the potential for this sustainable product to be used by the UGA campus and beyond. This technical evaluation of the proposed test bed with the sociological perspectives being researched will be extremely synergistic and provide the principle investigator with the means to educate and research beyond UGA and Athens.

The proposed test bed is an integral piece to principal investigators MS thesis research. The PI will be investigating sociological and technical aspects of PCPs. The work described in this proposal will aid in both of these areas as technical research (lab/field design, construction, testing) will be conducted as well as collaborating with others within and outside of UGA. In addition, the PI will give several presentations on the subject matter at local and national conferences. It is expected that at least one peer-reviewed journal paper will be published using the work described in this proposal.

**Outreach** - The proposed PCP test site will be used for public outreach. It will be used for demonstration and education of decision makers with the goal of them utilizing this technology for future development. In addition, the test site will be used for demonstrations of K-12 programs as a method of introducing STEM to these age groups. While writing this proposal, the principal investigator was able to solicit support and collaboration from individuals within engineering (Dr. Stephan Durham - faculty advisor and Dr. Nicki Sochoka), the College of Environment and Design (Dr. Bruce Ferguson), the UGA Facilities Management (Mr. Dexter Adams), the UGA University Architects Office (Ms. Lara Mathes), local landscape environmental firm (Koons Environmental Design, Inc.), and local certified PCP installer (DSI Design and Construction, Inc.). What is amazing is that all of these offices/companies and the individuals within want to support the work of this project. That means individuals are encouraged and want sustainable efforts made…..the next step is implementation!

Lastly, an educational component of this study has already been submitted as an abstract to the American Society of Engineering Education. The abstract was accepted and a paper has been requested. The principal investigator will write and submit this paper for presentation and publication at a national conference. In addition, the faculty advisor is the Vice President of the Northeast Georgia Section of the American Society of Civil Engineers. Because of this, it is expected that this work will be presented at a monthly chapter meeting to an audience of local engineers.

**Summary** - After establishing the aforementioned partnerships the principle investigator will continue with monitoring the pervious concrete test bed and develop a final report that analyzes all data to present to stakeholders. The final report will outline the benefits of pervious concrete and present suggestions on how and where pervious concrete could be used on the UGA campus. Additionally, the principle investigator and faculty advisor will work with the previously mentioned instructors on integrating the use of the test bed with their classes. Such integration would allow students regular live hands on demonstrations, materials testing and water quality testing.
Appendix A.

References


Office of Sustainability
University of Georgia

RE: Sustainability Grant Proposal Submitted by Tawfiq Bhuiyan

To whom it may concern,

I strongly support the proposal “Development of a Pervious Concrete Pavement Test Site for Educational, Research, and Outreach Initiatives at the University of Georgia,” by Tawfiq Bhuiyan. I have known Tawfiq since the spring 2012 semester when he was a senior in our Agricultural Engineering degree program. He completed that degree this past summer. I am a new faculty member to the UGA, coming from the University of Colorado Denver where I graduate over 20 MS and Ph.D. students over 7 years.

Tawfiq is my first graduate student at UGA since arriving in January. I have high expectations for all of my students, particularly graduate students. Tawfiq began working for me as a graduate research assistant pursuing his MS degree in civil engineering in August. Since that time, he has written an abstract that was accepted by the American Society of Engineering Education (ASEE). If the paper is in early 2013, Tawfiq will travel to present his work at the conference next summer. Since August, Tawfiq has developed a very clear plan for his MS thesis. He wants to examine sociological and technical aspects of pervious concrete pavement. I have had previous students research pervious concrete from a laboratory and field perspective looking at performance, but never looking at peoples perspectives, examination of barriers that limit implementation, and transferring of ideas and work. I feel that brings a unique aspect to his research. I am eager to see him complete this work.

In the short time that I have known Tawfiq, he has been an extremely hard worker. We have weekly meetings and he is timely for each and always prepared. If I ask him to complete a task, it is always well thought out and submitted on time.

I have completed a similar field implementation of a pervious concrete pavement at the University of Colorado Denver. With my previous experience and Tawfiq’s collaborators, I know that this will be a successful project. If you have any questions, please don’t hesitate to contact me by phone at (303) 803-8031 or by e-mail at s Durham@uga.edu.

Sincerely,

Stephan A. Durham, Ph.D., P.E (CO #44274)
Associate Professor, College of Engineering – Civil
University of Georgia
Appendix C – Additional Letters of Support

Bruce Ferguson – UGA College of Environment and Design
I am happy that this type of program is starting up in Engineering. Its will be beneficial to the university and to disciplines such as mine that would interface with it. I am willing to cooperate in the specific research project as shown. I bring to it many years of related research, teaching and practice, including authoring of the book *Porous Pavements*. I expect to contribute to the direction and oversight of the project, and its guidance toward strong and useful outcomes.

Here is the link for the next Georgia Water Resources Conference — it looks like an announcement must have gone around earlier this year:
http://www.gawrc.org

Attached are some additional recent papers, about further permeable materials and their importance.

Bruce K. Ferguson, FASLA
Franklin Professor of Landscape Architecture
College of Environment and Design
University of Georgia
285 Jackson Street
Athens GA 30602 USA
bfergus@uga.edu

Josh Koons – Koons Environmental Design, Inc.
We’d be happy to assist in any way we can. We’ve been promoting the use of PCP in a lot of our work, some of which has/is occurring on UGA campus. We also work closely with a local certified installer who may be able to lend some assistance to the project. His name is John Dement with DSI construction if you want to contact him (jdement@dsidesignconstruction.com).

Please keep us posted.
Thanks!
J>

Josh Koons
Koons Environmental Design, Inc.
675 Pulaski Street, Suite 2000
Athens, GA 30601
Ph: 706-353-3838
Fax: 800-291-3319
**John Dement – DSI Design and Construction, Inc.**
We would be glad to assist you with this. We have installed many pervious pavement systems in the area including one at the UGA Bus Maintenance facility on Riverbend Road.

I will email you a proposal Sunday. I do not see any issues getting this done for your budget.

DSI Design + Construction, Inc.
John DeMent
P: (706) 208-9778
F: (706) 208-9771

**Dexter Adams – UGA Facilities Management**
Absolutely, list us in the "support" column. Hope grant application is successful.
Regards.
--Dexter

*Connected by DROID on Verizon Wireless*

**Lara Mathes – UGA University Architects Office**
This sounds like a great project—perfect for a sustainability grant. OUA would certainly support the effort in whatever way we can. While we do not have a budget to offer monetary support, I would be happy to meet with you and discuss how we could help. We would certainly appreciate involvement in site selection. I must admit that I am not familiar with the proposed site. Is the EREC the same as the Bioconversion Research and Education Center on Whitehall?
Thanks,
Lara
REPORT OF GRANT METRICS
An accurate report of all project expenses will be documented and submitted to the UGA Office of Sustainability. Since the project has not commenced, no expenses have incurred, thus only the grant metrics will be discussed.

A set of metrics must be established to measure success of this project. Because so much of what I am hoping to do is not quantifiable, I must look more qualitatively than quantitatively. For example, how does this project influence individuals thoughts and understanding of pervious concrete pavements. Again, it is expected that this impact education, research, and outreach. I expect the following outcomes:

Education
- **A minimum of two classes incorporate this PCP test section into course discussion.** I expect demonstrations of how the PCP works (ie. drain tests) be given to students.
  - Note – because the civil engineering curriculum is new, several of the courses listed will not have been offered by the end of this proposed study period, thus this will not be completely measured until after the project period.
- Classes use the PCP test site for water quality testing. Current classes already include analysis of water. **It is expected that water filtering through the PCP system could be used by these same students** when testing water and compared to EPA regulations.
- **Give at least one presentation** to student clubs and other groups could be made to educate them on PCPs and how they are sustainable. This will help “spread the word” about PCP and potentially influence their decisions when they are practicing engineers.

Research
- **A laboratory and field phase will be conducted that will be incorporated into my MS thesis.**
  - Note – I will not graduate until spring 2014.
- **Publish at least one peer-reviewed journal article** on this work
- **Present and publish at one conference** (expecting this to be the American Society of Engineering Education conference)

Outreach
- **Provide the Office of Sustainability a final report** that supports the use of PCP on campus. In addition, there will be supporting information on how to better design, produce, and place PCP. The goal is to improve on current design practices.
- **Present to the local professional engineering organization.** Inform local engineers.
- **Give a demonstration for a K-12 class group.**