



STUDENT SUSTAINABILITY COMMITTEE

Funding Application – Step II

Funding Criteria

A. General Rules

1. Students, faculty, and staff are encouraged to submit requests for funding. Student-led projects require a faculty or staff sponsor in order to have funds awarded.
2. Funding can only go to university-affiliated projects from students, faculty, staff, and departments.
3. All SSC projects must make a substantial impact on students. This may be a direct impact or an impact through education and engagement. All SSC funding is 100% from student green fees, so the projects funded by the students must benefit them.
4. SSC encourages innovation and new technologies – creative projects are encouraged to apply.
5. Unless a type of expense is specifically listed below as having restrictions, SSC can generally fund it. The items referenced below should not be taken as comprehensive list.

B. Things SSC Can Fund, On A Case-By-Case Basis

1. SSC can fund feasibility studies and design work; however, it must work toward ultimately addressing a sustainability need on campus.
2. SSC can fund staff positions that are related to improving campus sustainability. Strong preference will be given to proposals receiving matching funding from departments and/or plans for maintaining continuity of the position after the end of the initial grant.
3. SSC can fund outreach events with a central theme of sustainability, provided their primary audience is the general campus community.
4. SSC discourages funding requests for food and prizes but will consider proposals on a case by case basis that prove significant reasoning.
5. SSC can fund repairs and improvements to existing building systems as long as it works toward the goal of improving campus sustainability; however, a preference is shown to projects utilizing new or innovative ideas.
6. SSC can provide departments with loans for projects with a distinct payback on a case by case base. Loans will require a separate memorandum of understanding between SSC and departmental leadership pledging to repay the award in full and detailing the payback plan.

C. Things SSC Will Not Fund:

1. SSC will not fund projects with a primary end goal of generating revenue for non-University entities.
2. SSC will not fund personal lodging, food, beverage, and other travel expenses.
3. SSC will not fund any travel expenses.
4. SSC will not fund tuition or other forms of personal financial assistance for students beyond standard student employee wages.

Your Step 2 funding application should include this application, the supplemental budget form, and any letters of support.

Please submit this completed application and any relevant supporting documentation to Sustainability-Committee@illinois.edu. The Working Group Chairs will be in contact with you regarding any questions about the application. If you have any questions about the application process, please contact the Student Sustainability Committee at sustainability-committee@illinois.edu.

General & Contact Information

Project Name: Low-cost Inspection and Sustainable Repair of Campus Pavements.

Total Amount Requested from SSC: \$ 106,000.00

Project Topic Areas: Land & Water Education Energy
 Transportation Food & Waste

Applicant Name: Nishant Garg

Campus Affiliation (Unit/Department or RSO/Organization): Department of Civil Engineering

Email Address: nishantg@illinois.edu

Check one:

- This project is solely my own **OR**
- This project is proposed on behalf of (name of student org., campus dept., etc.):

Project Team Members

Name	Department	Email
Prof. Nishant Garg	CEE, Asst. Prof.	nishantg@illinois.edu
Dr. Hamza Samouh	CEE, Postdoc	hsamouh@illinois.edu
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Student-Led Projects (Mandatory):

Name of Faculty or Staff Project Advisor:

Advisor’s Email Address:

Financial Contact (Must be a full-time University of Illinois staff member)

Contact Name: Nishant Garg
 Unit/Department: Civil engineering
 Email Address: nishantg@illinois.edu

Project Information

Please review the proposal materials and online content carefully. It is highly recommended you visit a working group meeting sometime during the proposal submission process.

Please provide a brief background of the project, its goals, and the desired outcomes:

You may copy and paste your Step 1 application answer if nothing has changed.

On the UIUC campus, the total pavement network is approximately 1.2 million ft². Monitoring this pavement network is commonly done through condition assessments to maintain their sustainability and structural integrity [1]. It has been proven that early detection of cracks is needed for essential maintenance tasks. However, the traditional inspection techniques require experienced field personnel to classify the cracking, which comes at a cost. Furthermore, the inspection quality is primarily controlled by how the field personnel is trained [2], [3]. Therefore, there is potential in having pavements inspected using robust, low-cost smartphone and drone-based imaging techniques independent of the skills of the operator. Secondly, frequent repairs of these pavements are not sustainable from a cost and environmental point of view and hence durable sealants need to be prepared for long-term sustainability.

Project's deliverables:

- 1) New, faster, and cheaper technology based on smartphone and drone imaging for cracks can be done via involving the campus students.
- 2) New sustainable and durable sealant for the rapid repair of the pavement cracks.

Where will the project be located? Are special permissions required for this project site?

If special permission is required for this location, please explain and submit any relevant letters of support with the application.

The project will be located on the roads on the campus. For the inspection phase, we will seek permission from the University of Illinois Public Safety division for the use of drones to collect data and images. This authorization can generally be obtained within 24 h (<https://police.illinois.edu/services/drones/>). Concerning the second phase of repairs, the F & S team which is a part of this project, should be notified before any intervention at the pavements' level.

Other than the project team, who will have a stake in the project? Please list other individuals, groups, or departments affiliated directly or indirectly by the project. This includes any entity providing funding (immediate, future, ongoing, matching, in-kind, etc.) and any entities that benefit from this project.

Please attach letters of commitment or support at the end of the application.

At this point, no external entity will have a stake in this project. However, due to their 2-ECO (ECONomic and ECOlogic) advantages, such developed approaches know an increasing attraction to different agencies. Eventually, the Illinois Center for Transportation (ICT) and the Illinois Department Of Transportation (IDOT) can be indirectly involved. Indeed, a complementary project with ICT/IDOT is being executed by Prof. Garg's group, studying the issue of crack inspection and crack repair on state bridge decks.

This project will be of direct benefit to the F&S on campus and a letter of support from them is attached.

How will this project involve and/or benefit students?

This includes both direct and indirect impact.

Benefits for the students:

- Better conditions of the pavement network in the campus for the everyday use
- Less financial resources needed for campus infrastructure repair (annual spending is about \$1.5 million [4]) which will provide the university more capacity for other important investments related to the students.

Students' involvement:

- 1 Ph.D. student and 1 MS will be directly involved in this project for respectively 2 years and 1 year.
- Involvement of the campus students in the detection of the cracks through their smartphones and drones

Educational components:

- Teaching students about computer vision and automated crack detection of important campus infrastructure
- Education of the students about the importance of pavement inspection and repair for the campus sustainability

How will you bring awareness and publicize the project on campus? In addition to SSC, where will information about this project be reported?

On the campus, the involvement of the students at different levels of the project, as explained in the previous paragraph, will bring good publicity for the project.

The performed work related to this project will be reported in different peer-reviewed journals with international scientific renown in this field.

The different advances made in this project will also be presented and shared in different national and international workshops and conferences.

Financial Information

In addition to the below questions, please submit the supplemental budget spreadsheet available on the Student Sustainability Committee [website](#). Submission of both documents by the submission deadline is required for consideration of your project.

Have you applied for funding from SSC before? If so, for what project?

No, this is the first application.

If this project is implemented, will you require any ongoing funding required? What is the strategy for supporting the project in order to cover replacement, operation, or renewal costs?

Please note that SSC provides funding on a case by case basis annually and should not be considered as an ongoing source of funding.

For this project, we are not planning to request any ongoing funding from the SSC.

The achievements that will be realized through this project, will constitute an important milestone in our vision related to the roads and infrastructures. In fact, the results will be central proof for the practical applicability of our approaches in making greener roads with lower costs. Our strategy is to apply for more grants at state and national levels to generalize our findings. These new projects will not only cover the replacement, operation, and renewal costs but will also aim to update and improve the different tools, training, and materials at our disposal on the campus.

Please include any other obtained sources of funding. Have you applied for funding elsewhere?

Please attach any relevant letters of support as needed in a separate document.

Some funding has been obtained from IDOT and ICT for a different project related to the inspection of cracks on concrete bridge decks and the development of a sealing procedure.

Environmental, Economic, and Awareness Impacts

How will the project improve environmental sustainability at the Urbana-Champaign campus? If applicable, how does this project fit within any of the Illinois Climate Action Plan (iCAP) goals?

According to the transportation chapter of the iCAP 2020 [4], optimizing road surfaces should be taken just as seriously as optimizing the efficiency of the vehicles. Smooth pavements encourage the use of bicycles and are more aesthetically pleasing for the campus. Poorly maintained roads constrain mobility, significantly raise vehicle operating costs, increase accident rates and their associated human and property cost [5]. To reach and conserve a good condition of the pavements, a preventive maintenance approach has been proven to provide significant improvement of their performance and reduce their deterioration rate [6]. Although this preventive maintenance program will also save money in the long run, the dedicated budget is generally limited [5]. This project aims to maximize the service life and safety benefits for each dollar by facilitating more eco-efficient performance-based maintenance than time or usage-based maintenance. The service life of the pavements will be increased and then the need for new roads (major maintenance) which consume non-renewable resources will be reduced. Thus, a large amount of emissions and energy could be saved from the extraction and manufacturing of raw materials to their placement at the worksite.

How will you monitor and evaluate the project's progress and environmental outcomes? What short-term and long-term environmental impacts do you expect?

Some examples include carbon emissions, water conservation, green behavior, and reduced landfill waste.

The low-cost inspection of the roads (before and after repair) performed with drones and smartphones will generate an important database of the development of the cracks in the campus. The sections targeted by this program can be compared to other sections in addition to the history of repair and reconstruction. This comparison will allow us to monitor and evaluate the efficiency of such an approach. In this case, the life cycle analysis can be performed in both cases to show the realized economy in non-renewable resources.

The developed good practices for maintaining the roads will provide very smooth surfaces. Therefore, the expected short-term environmental impacts will be less discomfort for the drivers and safer roads. The tire-road noise is the predominant component of the traffic noise for the urban speed range. Therefore, the traffic noise will be reduced for well-maintained roads providing a more pleasant environment in the campus [7].

The most expected long-term environmental impact will be the preservation of the non-renewable resources corresponding to building new roads and/or making major repairs. In addition, the noise reduction will provide better conditions to promote wildlife (birds, squirrels, etc.) in the campus [8].

What are your specific outreach goals? How will this project inspire change at UIUC?

The results obtained from this project will prove the environmental and economic interest of a maintenance strategy for the pavements. In addition, they will be a source of inspiration to integrate new technologies like drones and AI in this process. For the F & S, we believe they can be very helpful to convince us to orient a part of the future funds towards the inspection and the repair of the existing roads. Finally, the involvement of the students in this project will sensitize the next generations of the decision-makers about the impact on our environment of the infrastructures-related strategies.

If applicable, how does this project impact environmental injustice or social injustice?

Not applicable.

References:

- [1] P. Prasanna *et al.*, "Automated Crack Detection on Concrete Bridges," *IEEE Trans. Autom. Sci. Eng.*, vol. 13, no. 2, pp. 591–599, 2016.
- [2] X. Tong, J. Guo, Y. Ling, and Z. Yin, "A new image-based method for concrete bridge bottom crack detection," *Proc. 2011 Int. Conf. Image Anal. Signal Process. IASP 2011*, no. 1, pp. 568–571, 2011.
- [3] H. J. Lee, J. H., Yoon, S., Kim, B., Gwon, G. H., Kim, I. H., & Jung, "A new image-quality evaluating and enhancing methodology for bridge inspection using an unmanned aerial vehicle," *Smart Struct. Syst.*, vol. 27, no. 2, p. 209, 2021.
- [4] University of Illinois Urbana-Champaign, "Illinois Climate Action Plan 2020," 2020.
- [5] S. Burningham and N. Stankevich, "Why road maintenance is important and how to get it done," *Transp. notes*, vol. TRN-4, pp. 1–10, 2005.
- [6] F. Giustozzi, M. Crispino, and G. Flintsch, "Multi-attribute life cycle assessment of preventive maintenance treatments on road pavements for achieving environmental sustainability," *Int. J. Life Cycle Assess.*, vol. 17, no. 4, pp. 409–419, 2012.
- [7] E. Freitas, H. Torres, C. Vuye, and P. Pereira, "Effect of road pavement defects on tyre-road noise," in *INTER-NOISE 2019 MADRID - 48th International Congress and Exhibition on Noise Control Engineering*, 2019.
- [8] C. J. W. McClure, H. E. Ware, J. Carlisle, G. Kaltenecker, and J. R. Barber, "An experimental investigation into the effects of traffic noise on distributions of birds: Avoiding the phantom road," *Proc. R. Soc. B Biol. Sci.*, vol. 280, no. 1773, 2013.

Single Image (to accompany the Step-II application)

