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Peer Review File

Evaluating Plant Coverage and Thermal Benefits of Green Walls for Sustainable Design

Mark Ostendorf[1], Susan Morgan[1], William Retzlaff[1], Serdar Celik[1]

[1]SIUE Living Architecture Regional Center of Excellence,
Southern Illinois University Edwardsville, Edwardsville, Illinois, USA

Editors
Sara W. McMillan, Editor in Chief
Iowa State University

Mauricio E. Arias, Associate Editor
University of South Florida

Reviewers
Marty Matlock[1,2]
University of Arkansas

Anonymous[1,2]

Anonymous[1]

[1]Round 1
[2]Round 2

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Round 2
Associate Editor Summary

Both reviewers requested minor revisions, and they have again provided a list of comments for the authors to address.

With regards to the reviewer's comment "Lines 210-221: Data analyses should be performed in R and the code and data should be included as an appendix to the manuscript. This provides robust transparency of assumptions." I agree that the authors should add more details about the data analysis, including appending the code and data as supplementary material. However, I do not think that is fair to ask the author to repeat the statistics in R; they have used a well established and documented software package (SAS), and the use of that software (or any other, for that matter) is not against our publication policies.

Best,
Mauricio

Mauricio E. Arias, PhD, PE
Associate Editor
Journal of Ecological Engineering Design

Reviewer 1: Marty Matlock, University of Arkansas
This manuscript represents a positive addition to the science of ecological engineering design by characterizing the ordinal and seasonal thermal performance of green wall systems. The design of the experiment was simple, elegant, and well executed. There are very few longitudinal studies of green wall performance. This may be the first. This is exemplary work.

Lines 141-143: Clarify if, and to what extent, buildings created shade conditions on the experimental walls. Also clarify surrounding ground cover to address concerns about radiant reflected heat from nearby surfaces. Address irrigation schedules (if any) for the surrounding lawns and impacts those might have on thermal properties of the experimental units.
Lines 210-221: Data analyses should be performed in R and the code and data should be included as an appendix to the manuscript. This provides robust transparency of assumptions.
Lines 225-232: A summary table of results of each statistical test should be provided to support the graphic presentation of the data. The summary table should include the relevant probability data.

Reviewer 2: Anonymous
The authors have done a commendable job of addressing previous reviewer comments and revising the manuscript. My overall recommendation is "accept with minor revisions", and additional details can be found in the attached review.

Kudos to the authors and thank you to editorial team!

2nd Review of JEED Submission - Evaluating Plant Coverage and Thermal Benefits of Green Walls for Sustainable Design

This article investigates the differences in surface temperature between planted and unplanted retaining wall blocks. The authors test three hypotheses: 1) different varieties of Sedum would result in different levels of vegetative coverage on planted walls; 2) the level of vegetative coverage would influence surface temperatures; and 3) the surface temperature of planted walls would be cooler than the surface temperature of unplanted walls. Ultimately, the hypotheses were generally confirmed, but only for certain types of Sedum, orientations (i.e., North, South, East, West), times of day (i.e., dawn, midday, dusk), and seasons (i.e., spring, summer, fall, winter).

The authors have done a commendable job addressing previous reviewer comments. The revised manuscript is well written, provides interesting insights into the link between vegetative coverage and surface temperatures, and helps inform the design of green infrastructure applications in the Midwestern United States. As detailed below, there are two additional comments/suggestions for the authors to consider. Otherwise, the manuscript appears to be suitable for publication.

General Comments/Suggestions

Echoing comments from the previous round of reviews, there still appears to be an opportunity for additional insights by including some results based on the full day average daily temperature (in addition to the morning, midday, and dusk results that are already included in the manuscript). In particular, speaking to whether species that provide more cooling at midday are different (or similar) to species that provide more cooling over the course of the day would provide beneficial insights to the reader – especially since speaking to this point still aligns with the author's original hypotheses and shouldn't warrant much additional analysis or write-up.

Figure 12: It appears the caption is describing the original version of the figure instead of the revised version. Specifically, references to morning and dusk can be removed from the caption.

Round 1
Associate Editor Summary

The three reviewers acknowledge this study's innovative experimental design, and agree that it would be a good contribution to the journal. They all recommend minor/major revisions, and two of them have provided a commented version of the manuscript, which the authors should carefully review and address.

One of the reviewers recommended that the statistics are repeated in R so that the code can be openly shared. I do not necessarily think that the authors need to repeat the statistical analysis just because of the software choice, but to the reviewer's point, the authors need to provide sufficient information so that the reviewer or anyone else could replicate the analysis on SAS, R, or any other type of statistical software.

One particularly important aspect that is obviously not addressed is the fact that this study was performed more than a decade ago. This is not necessarily a reason to invalidate the study, but it is something that requires two actions. First, it would be beneficial for the authors to add 1-2 sentences acknowledging the age of the data and explicitly discussing whether they think it may have any tangible impact on the outcome of the study. Second, the manuscript needs to be updated with newer references (they are all at least 13 years old, with the exception of one self-citation from 2021) that would ensure that the study is framed around the most recent literature and that it helps the authors demonstrate that this study is still an important contribution today.

In addition to the comments from the reviewers, here are a few other items to keep in mind: 1. Scientific naming: Make sure there is a consistent nomenclature and style when providing scientific (Latin) names of plants. 2. For multi-frame figures like 7 and 10, make sure there is consistency among frames, they all should have the same dimensions. I suggest editing this in a image software and then importing one single high resolution image. 3. Please consider merging Fig 10 and 11 into a 4-frame figure.

Best,
Mauricio E. Arias, PhD, PE
Associate Editor
Journal of Ecological Engineering Design

The authors would like to thank the reviewers for their valuable and constructive comments. These comments have carefully been reviewed and changes that are pertinent have been made where appropriate. The changes can be seen in the second copy of the manuscript (TRACKED) that has these changes tracked. Our responses to the reviewers' comments are given in blue fonts following each comment.

Reviewer 1: Marty Matlock, University of Arkansas
The experimental design was elegant and clearly presented. The number of replicates could have been increased by testing fewer variables. The recommended statistical analyses should be reported in the Results section. The results of tests for normality (Shapiro-Wilk's test or others) and covariance should be presented in the Results section.

This is an elegant and creative design research project. The statistical analyses should be expanded, and the analyses should be performed in R with the data and code provided as an appendix to the research. This will address several shortcomings of the analytical approach. For example, with a high n (greater than 100) the assumption of normality is reasonable but it still should be tested for every dataset and reported in the first paragraph of results. Similarly, the results of covariance should be presented tabularly.

Reviewer 2: Anonymous
This article investigates the differences in surface temperature between planted and unplanted retaining wall blocks. The authors test three hypotheses: 1) different varieties of Sedum would result in different levels of vegetative coverage on planted walls; 2) the level of vegetative coverage would influence surface temperatures; and 3) the surface temperature of planted walls would be cooler than the surface temperature of unplanted walls. Ultimately, the hypotheses were generally confirmed, but only for certain types of Sedum, orientations (i.e., North, South, East, West), times of day (i.e., dawn, midday, dusk), and seasons (i.e., spring, summer, fall, winter).

Overall, the manuscript is fairly well written, provides some interesting insights into the link between vegetative coverage and surface temperatures, and generates results that can help inform the design of green wall and green roof applications in the Midwestern United States. However, as detailed in the attached comments, the manuscript would benefit from additional revision and refinement before publication.

Please see attached file for detailed comments...

Review of JEED Submission - Evaluating Plant Coverage and Thermal Benefits of Green Walls for Sustainable Design

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Overarching Comments/Suggestions

This may fall outside the scope of this article, but there appears to be an opportunity to include additional analysis/discussion on the relationship between vegetation coverage and temperature. For example, some form of regression analysis appears feasible without too much extra effort and could provide additional insights into the specific relationship between temperature changes and vegetative coverage. For example, it may be possible with the data the authors have to say something to the effect of "an X% increase in vegetative coverage corresponds to a y% decrease in surface temperature."

This is a very good point. The only concern we had was that the plant coverage is not uniformly distributed, hence relating it to the block surface temperature could be misleading. The suggested analysis, however, can be applied to a set of samples all having same plant coverages with varying plant distribution.

I appreciate the author's examination of differences and nuances across time of day – particularly with an emphasis on midday. However, it would also be beneficial to include some results based on the full day average daily temperature (i.e., take the average of the morning, midday, and dusk readings for each day and then compare the differences across treatments). This might illuminate some additional insights about the effectiveness of the plant species that may not be captured by

focusing on a specific time of day. Relatedly, it would also be beneficial to highlight the most "extreme" conditions: how do surface temperatures change with treatment in the context of south facing walls at midday during the summer? Inclusion of these additional "lenses" might also provide some additional content for the discussion section (see comment below). For instance, the results could connect directly to recommendations for addressing both the chronic (average) and "extreme" aspects of urban heat island.

This also is a great suggestion. We intended to focus on the hypotheses we had while not adding too much into the paper due to the nature of the significant amount of data we have. The authors would be happy to entertain this idea in another work where extreme scenarios are explored.

The discussion section rehashes a lot of what is included in the results section. The authors are encouraged to revise the discussion section to make it more distinct from the results section. One possible approach for doing so could be to include more concrete recommendations based on the results. Some example recommendations might include:
If someone has an east or north facing wall, they can probably forgo a green wall (at least with this type of vegetation) and/or if UHI mitigation is the primary focus…
If someone has a west facing wall, there are 3 options available…
If someone has a south facing wall, mixed sedum appears to be the only viable choice…

Another option would be to discuss ways in which the results/analysis of this study may (or may not) be applicable to other contexts. For instance, if analysis/results were to be applied outside of the Midwest, what might be "transferrable" and what wouldn't? How might one go about balancing colder winters and summers in the Midwest vs. milder winters and hotter summers in the south/west?

We believe the discussion following sections 4.1 and 4.2, before the Conclusion section, is in a similar fashion as suggested here.

<u>Additional Suggestions/Revisions (in chronological order):</u>

Lines 110-112: It would be beneficial to include some citations related to the reputed benefits of green walls.
Additional citations were added to this section of the literature review.

Lines 133-134: Are there any references/citations that can be added to support the statement that "a green landscaping wall may even serve as additional slope reinforcement"?

Yes. The additional citation can be found in lines 126-127.

Figure 2: It would be beneficial to revise the color scheme…especially for the "control" and "mixed sedum" categories. Currently, those two categories are a little difficult to distinguish from one another in the figure.

The figure has been redesigned as suggested.

Lines 196-197: Some additional clarification regarding what constitutes an "empty hole" might be beneficial. For example, the text states that "…vegetation completely concealed the wall blocks and growth media." Does this imply that a hole containing some vegetation (but not enough to completely obscure the wall blocks) would be considered an empty hole?

This has been addressed in line 191.

Lines 205-206: It is indicated that the reading range for the infrared thermometer is 50C to 400C. However, all the reported results are of temperatures ~0-40C – which is below the lower-bound threshold (50C) indicated for the thermometer…some additional clarification is needed.

The range of the thermometer was corrected. Thank you for pointing this out.

Lines 208-210: It would be beneficial to add 1-2 sentences describing the total number of temperature readings that were taken and the time period in which they were taken. This information can currently be inferred from some of the Figures, but it would be helpful to also include explicitly in the text.
This has been addressed in lines 193-194.

Lines 247-248: Small grammar issue…remove "the"…"Similar to ~~the~~ analyzing…"
This has been addressed. Thank you.

Figures 7-11: It is not immediately clear how readers should interpret some of the bars in the bar graphs…specifically the ones labelled with multiple letters (AB, BC, ABC…). Is the correct interpretation that a bar labeled "AB" is not statistically significant from other bars labeled "A", "B", and "AB"? The authors might consider adding an example to provide further clarification.
That is true. The samples that stood out to be statistically different or indifferent have been identified and mentioned following each graph.

Figure 12: Considering that none of the results for Dusk or Morning were found to be significant, the authors might consider removing these data points from the figure…that will make the figure a little easier to read/interpret and help readers focus on the midday time periods when significant differences were observed.
The figure was redesigned as suggested.

Reviewer 3 (Anonymous)

The authors report on an experimental investigation that looked at the affects of plant species on coverage of a retaining block wall and on the effect of plant species on cooling effect. This is solid contribution to the field and should be published in JEED. However, there were some improvements that can be made to the paper.

See detailed markup on attached file.
1. Abstract should be re-written as "stand alone" doc with data/results included.
2. Lit review is too old and out of date. It MUST be updated.
3. It would have been an excellent paper if authors added regression analysis of coverage vs cooling effect so engineers could see effect across range of coverages?

Responses to reviewer/editor comments

Comment - Lines 141-143: Clarify if, and to what extent, buildings created shade conditions on the experimental walls. Also clarify surrounding ground cover to address concerns about radiant reflected heat from nearby surfaces. Address irrigation schedules (if any) for the surrounding lawns and impacts those might have on thermal properties of the experimental units.
Response - Additional text added lines 151-153 to explain clearly site conditions.

Comment - Lines 210-221: Data analyses should be performed in R and the code and data should be included as an appendix to the manuscript. This provides robust transparency of assumptions.
Response – The data has been attached to the submission in two spreadsheets, one for plant coverage and one for thermal measurements.

Comment (statistics/data analysis) - Lines 225-232: A summary table of results of each statistical test should be provided to support the graphic presentation of the data. The summary table should include the relevant probability data.
Response – Added table with ANOVA values of DF, F-Value, and Pr>F from every ANOVA in Figures 5-12 (table at Line 333). Each Figure description includes text pointing to additional statistical information in Table 1.

Comment - Echoing comments from the previous round of reviews, there still appears to be an opportunity for additional insights by including some results based on the full day average daily temperature (in addition to the morning, midday, and dusk results that are already included in the manuscript). In particular, speaking to whether species that provide more cooling at midday are different (or similar) to species that provide more cooling over the course of the day would provide beneficial insights to the reader – especially since speaking to this point still aligns with the author's original hypotheses and shouldn't warrant much additional analysis or write-up.
Response – While an excellent point, as a preliminary exploration of green wall systems this experiment only measured thermal values at Morning (anticipating coolest temperatures), Midday (increasing to maximum heat-load), Dusk (anticipating residual thermal mass). We do not have full-day data to share.

Comment - Figure 12: It appears the caption is describing the original version of the figure instead of the revised version. Specifically, references to morning and dusk can be removed from the caption.
Response – Figure 12 description corrected as noted.