The University of Nottingham
Faculty of Engineering
Department of Architecture and Built Environment

List of corrections

For the thesis entitled: Study of a Simplified Parametric Control of Split Louver and Its Combination with Bifacial PV Technology in Architectural Environmental Design

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Supervised by

Prof Yuehong Su
Dr Mohamed Gadi

Dear Professor Li Shao and Professor Yupeng Wu,

I would like to express my sincere appreciation for taking the time to review my work and providing valuable feedback. Your insights and suggestions have been influential in helping me enhance the quality of my work. Please find my responses to the corrections list below starting with the examiners' joint report, followed by the internal examiner, and the external examiner:

Examiners' joint report on the thesis examination:

Correction 1:

There are some suggestions for improving the narrative for the work. e.g. The thesis needs to be restructured to have the model validation starting before introducing the various simulations.

Response:

This point has already been discussed in viva and it was determined that the current narrative, where model validation is introduced before the various simulations, is appropriate. However, it is important to maintain the current narrative work as it follows a logical research progression. By presenting the simulations first, readers can gain a comprehensive understanding of the theoretical framework and methodology. This accumulated knowledge sets the stage for the subsequent model validation, creating a contextualized examination of the results. Moreover, placing the experimental validation at the end of the thesis creates anticipation and maintains reader engagement, while ensuring that the validation is presented as a conclusive outcome. Overall, the current narrative structure provides coherence, clarity, and reader satisfaction, making it the most effective approach for presenting the research findings.

Correction 2:

In the methodology section, various software, method that suitable for daylight simulation should be highlighted and summarised with the key equations/methods behind the software. The pros and cons for these software's should also be discussed.

Response:

Thank you for your suggestion, I agree that the methodology section should highlight and summarize the key method used in the software for daylight simulation, and discuss some pros and cons of the tool as well. Therefore, the methodology section has been revised accordingly, specifically in (section 3.4 on page 55). In this revised section, a clear overview of the software's methodology for daylight simulation was provided, emphasizing its main features and advantages. Additionally, a discussion on the potential limitations or drawbacks of the tool was included to provide a balanced perspective. This ensured that the methodology section was comprehensive and provided readers with a thorough understanding of the software's capabilities and potential implications. Thank you again for your valuable suggestion.

Correction 3:

What are the key outcomes from your work? Are there any recommendation/design guidance for the future louver design?

Response:

Thank you for the clarification. I sincerely apologize for any confusion caused. I want to emphasize that the key outcomes of my work involved a rigorous evaluation of the performance of the split louver and PV glazing design components. The significance of this evaluation lies in its ability to provide valuable insights and recommendations for future louver designs. I want to assure you that in the specific section dedicated to recommendations, which can be found in (section 8.2.1 on pages 174 and 175), I have indeed provided

comprehensive design guidance for future louver designs. These recommendations are backed by thorough analysis and are intended to contribute significantly to the advancement of the field. Once again, I apologize for any misunderstanding and appreciate your attention to this matter.

Correction 4:

The luminance range selected for study was not standard range, more discussion, rationale to support this selection range should be demonstrated.

Response:

Thank you for your feedback. I acknowledge that the luminance range selected useful daylight illuminance ($UDI_{150\sim750\ lux}$) for the study may not have been within the standard range. I agree that it would have been beneficial to provide a more comprehensive discussion and rationale to support the selection of this particular range. This would have helped in justifying the chosen luminance range and providing a better understanding of its relevance to the research objectives. To address this issue, more detailed discussion and rationale have been added in (section 4.4 and on pages 53 and 54). This helped clarify the justification for the chosen luminance range and provided It is worth mentioning that the thesis also took into consideration additional commonly used ranges of UDI bins such as $UDI_{300\sim500\ lux}$, in certain places, for example, (section 4.5, section 6.3.2). This indicates that the research acknowledged the importance of evaluating daylight levels within various UDI ranges and considered the specific requirements of different settings.

Thank you for bringing this to my attention, and I appreciate your understanding.

Correction 5:

The objectives of the thesis will need to be improved, e.g. some of them are not clear, and there are so many objectives, which are impractical.

Response:

Thank you for your feedback. I apologize for the lack of clarity and the excessive number of objectives in the thesis. I have revised and refined the objectives to make them more concise, specific, and practical. By doing so, the objectives provided a clear focus for the research and ensured that they were achievable within the scope of the study. These improvements have been implemented in (section 1.4, on pages 6 and 7). The thesis has been refined as a result of your valuable feedback, and your contribution is sincerely appreciated.

Internal examiner report by Professor Yupeng Wu:

The thesis is generally well written: introduction describing the background to the research leading to the aim and objectives; Chapter 2 presented a review for daylighting and PV-integrated shading devices, and parametric design; Chapter 3 discussed research methodology and a general parametric study of the split louver in the study location; Chapter 4 introduced the simplified parametric control of the split louver; Chapter 5 employed various parametric controls and surface materials with selected split louver section combinations of scheduled slat angle; Chapter 6 introduced bifacial PV as split louver section for further investment. Chapter 7 carried out experiment and validation for the numerical model; Chapter 8 concluded the main findings with recommendations for future work. There is also a substantial list of references cited for the thesis.

To summarise, the candidate knows the research area very well, this can be seen from the introduction and literature review sections, where previous research or relevant designs were well acknowledged. There is some evidence of originality

and a contribution to knowledge. However, there are some suggestions for improving the narrative for the work. e.g. The thesis needs to be restructured to have the model validation starting before introducing the various simulations. In the methodology section, various software, method that suitable for daylight simulation should be highlighted and summarised with the key equations/methods behind the software. The pros and cons for these softwares should also be discussed. What are the key outcomes from your work? A there any recommendation/design guidance for the future louver design? The luminance range selected for study was not standard range, more discussion, rationale to support this select range should be demonstrated.

I look forward to debating these at the viva voce.

Response:

Thank you for your suggestions. I have taken all the key points into consideration and incorporated them throughout the sections of the thesis. Additionally, I have given special attention to the main points highlighted in the joint examination report. Your feedback has greatly contributed to improving the quality and coherence of the thesis. I appreciate your valuable input and the thorough examination report.

External examiner report by Professor Li Shao

on the PhD thesis entitled “Study of a Simplified Parametric Control of Split Louver and Its Combination with Bifacial PV Technology in Architecturaal Environmental Design” by PhD student Muna Alsukkar

The PhD research involved extensive computer simulation of the louvre daylighting system for application in the climate of Jordan but also UK in some aspects. The candidate has clearly carried out a large body of work and appears to be enthusiastic and imaginative in devising various elements of an extensive programme of research.

There are clearly innovations, e.g., the Retro louvre slats which appear to be the best performing design and the assessment of innovative bifacial PV as integrated with the building with advanced louvre systems.

Although the thesis title refers prominently to control of split louvre, this control is not concerned with the adjustment of the louvre system in response to e.g., environmental conditions, but about the control of daylight performance in buildings by using the louvre system.

Thus, the title could be potentially confusing, and some modification is required.

While it is reasonably clear that the daylight simulation and experiments were the candidate’s own work and the student has made significant and broadly good efforts to present the results clearly, the general writing would benefit from more careful and systematic checking and refinement.

For example, an opening statement of the thesis “In reality, the impact of over-reliance on the use of fossil fuels for energy generation is becoming more evident in our world today [1, 2].” is confusing and lacks specific meaning.

As a further example, the very first figure of the thesis, Fig 1.1 is entitled: “Energy resources compared to world energy demand” yet there is no information at all in

the figure about energy demand? The thesis should be checked and improved throughout to ensure figure captions are accurate.

The specific objectives listed in the thesis included no less than 9 items but upon detailed inspection, some of them are repetitive, and others would be readily merged for greater clarity.

The literature review is extensive and covered over 200 publications. There is however a relative lack of review on daylighting control. Although there is a control section, it actually presents various types of daylighting systems. Control technologies such as electro-chromic glazing should be given sufficient cover.

The assumption of single glazing in the simulation work should be adequately justified - is this realistic in the real world?

Some of the louvre features studied should be better explained otherwise they could appear as ad hoc rather than due to significant technological advancement they represent, or real world benefits they might bring.

Likewise, the use of three days in the assessment of the technologies proposed appear arbitrary and would benefit from justification, particularly in view of the computing power and data analytics tools available today for more in-depth and more detailed analysis.

In the discussion about experimental verification of simulation results, Pearson correlations are presented. These should be accompanied by p factor data.

There appears to be much discrepancy between test and simulation. Does that mean the main conclusions could be undermined? This and other questions will be explored in the viva.

Response:

I would like to sincerely thank the examiner for the positive feedback provided in their evaluation. Your overall assessment of the work is greatly appreciated. It is encouraging to receive acknowledgement of the efforts and accomplishments made throughout the research journey.

Regarding the main points mentioned, I would like to highlight these points and how they are addressed and incorporated into the thesis. The necessary revisions have been appropriately resolved as follows:

- Thank you for your suggestion regarding modifying the title due to potential confusion. However, it is important to note that the title accurately reflects the content and focus of the thesis. The title includes the mention of the simplified parametric method, which is indeed applied throughout the thesis, encompassing the gradual improvements made to the split louver. The title serves as a concise representation of the research objectives and scope, providing readers with a clear indication of the thesis' subject matter. Therefore, keeping the current title is essential to maintain consistency and accurately represent the work conducted in the thesis.
- Thank you for your feedback regarding the need for more careful and systematic checking and refinement in the general writing of the thesis. I appreciate your observation, and I want to assure you that overall refinement has been conducted throughout the entire thesis. A comprehensive review and editing process has been undertaken to enhance the clarity, coherence, and overall quality of the writing. This includes checking for grammar, sentence structure, and overall readability.
- The assumption of using single glazing in the simulation work was made to simplify the analysis and focus on specific aspects of the research. While it may not represent all real-world scenarios, it provides insights into the limitations of single glazing and the potential benefits of alternative solutions. Future studies could consider incorporating more realistic glazing configurations to provide a comprehensive understanding of their impact.
- I appreciate your suggestion regarding the analysis. I have made the necessary modifications to the analysis, specifically by including the p-

value. This modification has been implemented in (section 7.4.2), where the analysis is presented in a more comprehensive and informative manner.

- I appreciate your attention to detail and for highlighting additional points of concern. The viva served as a valuable opportunity to engage in a comprehensive discussion and address any concerns or questions related to the research for example (the louver features and the rationale behind selecting the three-day assessment period, and some other experimental limitations) which have been highlighted throughout the related thesis sections.

Best regards,
Muna Alsukkar