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Interview article

AI and BPS: Where do we stand?

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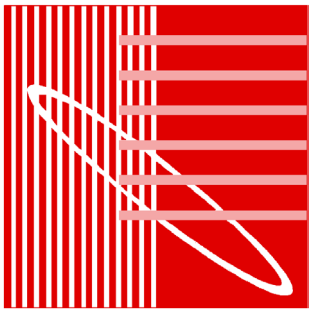

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The International Building Performance Simulation Association exists to advance and promote the science of building performance simulation in order to improve the design, construction, operation and maintenance of new and existing buildings worldwide.

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President's message

Dear IBPSA Colleagues and Friends

Finally, it's spring in the northern hemisphere! Here, where I live in Washington, D.C., the cherry trees were out 2 weeks earlier than normal after a mild winter (again). As I write this, though, historical heat in the southern hemisphere and even more than a meter of snow in Colorado continue to extremes. After a globally hot year last year, it appears we're continuing to set records.

I want to point out a few new things that are happening at IBPSA:

- First, if you haven't been to our website recently, check it out – **https://ibpsa.org** – updated and reorganized to make it easier to find the information you're looking for. We welcome any feedback that you may have.
- Second, spend some time on the Publications pages which archive all the proceedings of the 18 Building Simulation conferences from 1989 through the recently added Proceedings of Building Simulation 2023 in Shanghai. The Publications pages are easily searchable, and all papers have DOIs. Proceedings from the regional conferences are also available – ASim (China, Japan, and Korea), BauSIM (IBPSA-DACH), BSA (Italy), BSO (England), SimBuild (USA), eSIM (Canada), uSIM (Scotland), and BS-Cairo (Egypt). The Publications site also includes links to the Journal of Building Performance Simulation and its 17 volumes of building simulation articles. Thanks to the IBPSA Publications committee for all their hard work and persistence. This is a great resource for the building simulation community.
- At our board meeting in March, we were pleased to welcome a new affiliate – IBPSA-Colombia-Ecuador. This new affiliate is led by Jaime Roca, ASOLBA Engineyria & Arquitectura in Ecuador.
- If you have the opportunity, participate in one of the many regional conferences happening this year – see the list on **page 17** – in France, USA, Canada, Finland, Ireland, Italy, Austria, England, Scotland, and Japan.
- In late April/May look out for information and a call for nominations for our annual election held in early summer (June/July). Usually, the election covers 5 directors-at-large and about half of the affiliate directors.

Membership and participation in our committees is open to all IBPSA members. If you are interested and can participate in regular committee meetings, please contact the committee chair (see the website **https://ibpsa.org/about/contacts** for specific contacts).

Finally, watch for the call for papers and presentations for Building Simulation 2025 coming out in the next few months. Go to the **https://bs2025.org** website for more info and updates!

Check out the forthcoming calendar of events on **page 17.** Also, of note in this issue of the newsletter, an interview article on the relation between AI and BPS, and the full programme of our Education webinar series on occupant-centric simulation. Other useful items include software updates, book announcements, and the open call for submissions to the Journal of Building Performance Simulation.

I hope to see you and the IBPSA community this year.

Dru Crawley
President IBPSA

Best of 'Ask a Modeler':

BEM practitioners share tips and updates

'Ask a Modeler' is an advice column for the building simulation community. Each month, a question posed by the IBPSA community is answered by recognized building professionals to get their expert perspectives. The Ask a Modeler Subcommittee's mission is to disseminate building energy modeling (BEM) ideas and knowledge by bringing world-class BEM experts, practitioners, and enthusiasts to an accessible, curated advice column. Below, we are reprinting an answer to a recent question. For everything from updating energy-modeling software to strategic advice for leveling-up your BEM career, you can find it in Ask a Modeler!

Where can you go to learn about energy modeling and simulation as someone new to the industry?

— New Bee

Dear New Bee,

This is a great question, and one that IBPSA-USA has been evaluating for some time. I'm excited to share an update about a great place to learn and contribute knowledge about energy modeling. After you've read this article, please take a moment to share your feedback at **https://forms.gle/iPJtVC8Tt3yNYLCZ6** !

Dimitri Contoyannis, PE, CEM, LEED AP
President, Model Efficiency

A bit of background

A few years ago, IBPSA-USA led an extensive outreach effort to its members and the broader A&E design community. The goal was to gather information through forums, one-on-one interviews, and surveys to learn how firms are using BEM, and how individuals learned to become modelers.

The key takeaway was that BEM is not commonly taught to undergraduate students, and learning on the job is very difficult! Training resources exist, but they tend to have a specific focus, so a broad understanding is difficult to achieve.

This study pointed to the need for a more structured collection of educational information that is easily accessible, especially for practitioners early in their careers.

And that led to the idea for BEMcyclopedia **https://bemcyclopedia.com/wiki** —a project sponsored by the U.S. Department of Energy (DOE) and Lawrence Berkeley National Laboratory to develop a centralized collection of information about BEM, how it works, and how to apply it effectively to the design of buildings and their systems.

BEMcyclopedia overview

BEMcyclopedia is an online hub for teaching practitioners how to effectively perform building energy modeling (BEM) activities. The goal of BEMcyclopedia is to collect the BEM body of knowledge and make it easily accessible to practitioners.

Content is presented in a wiki, which is a great format for creating a knowledge base. It is easy to create content, link content, and have multiple collaborators working together. The "seed content" that currently populates the website was created with the support of DOE by a group of industry experts, but the long-term goal is for the site to expand through crowdsourcing. I'll come back to this in a bit.

The website is organized in three main areas called Essential BEM Concepts, Learn by Design Task, and an interactive data browsing tool that supports BEM inputs.

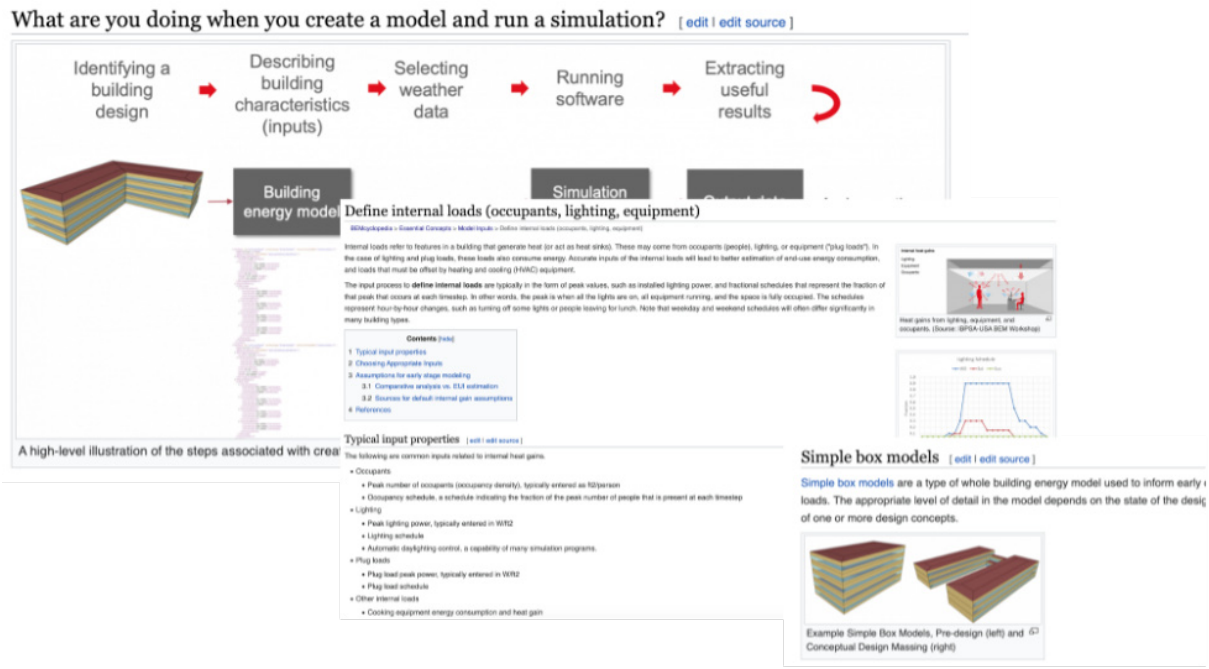
Essential BEM concepts

The Essential BEM Concepts section is a collection of fundamental information to provide a solid understanding of:

- How buildings work
- How building features and systems are represented in a model
- How to provide inputs to the model
- How to interpret results effectively

It covers a range of topics such as:

- Introduction to BEM
- Building Science topics
- An overview of different types of energy models
- Tutorials on how to prepare model inputs and analyze outputs
- A primer on codes and standards that are relevant to energy modelers
- Resources on automation approaches



Example "Essential BEM Concepts" Tutorials

Learn by Design Task

While the 'Essential Concepts' section provides a broad understanding of various aspects of BEM, the 'Learn by Design Task' section is highly focused on how to actually use BEM effectively throughout a design project.

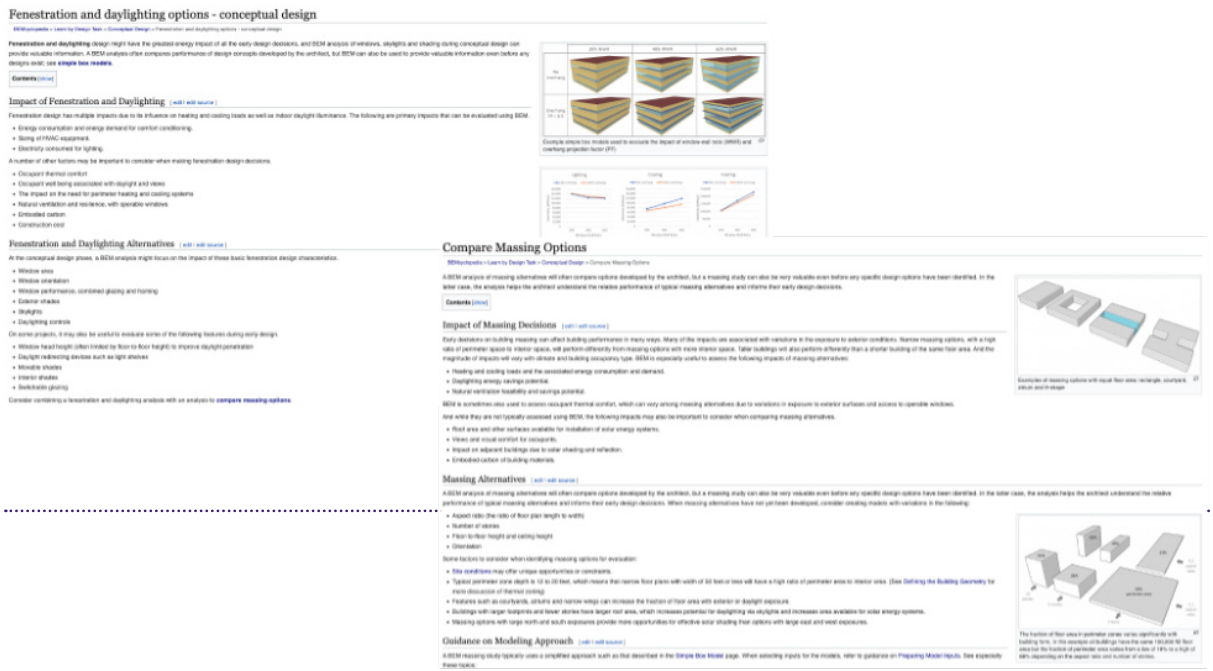
These tutorials are organized by the phases of a design project. Within each design phase, tutorials present information about the types of design tasks that occur, design decisions that must be made, and describe how BEM can be used to answer these specific questions.

So rather than simply teaching how to prepare models, the goal is to help users understand how to apply the models to answer timely questions and have the greatest impact.

Much of the content in this section is currently focused on early-stages of design (pre-design, conceptual design, and schematic design) but will soon be expanded to cover the more detailed stages.

Some examples of tutorials in this section include:

- How to research performance benchmarks for your project using different sources for that information
- Identifying how site conditions may influence the design and performance of the building
- Identifying which energy codes or other programs apply to the project and what modeling rules must be followed to comply
- Comparison of massing options
- Evaluating different façade construction materials and how those choices may impact the performance
- And, everyone's favorite, the window-to-wall ratio analysis, examining the interplay between thermal and daylight performance.



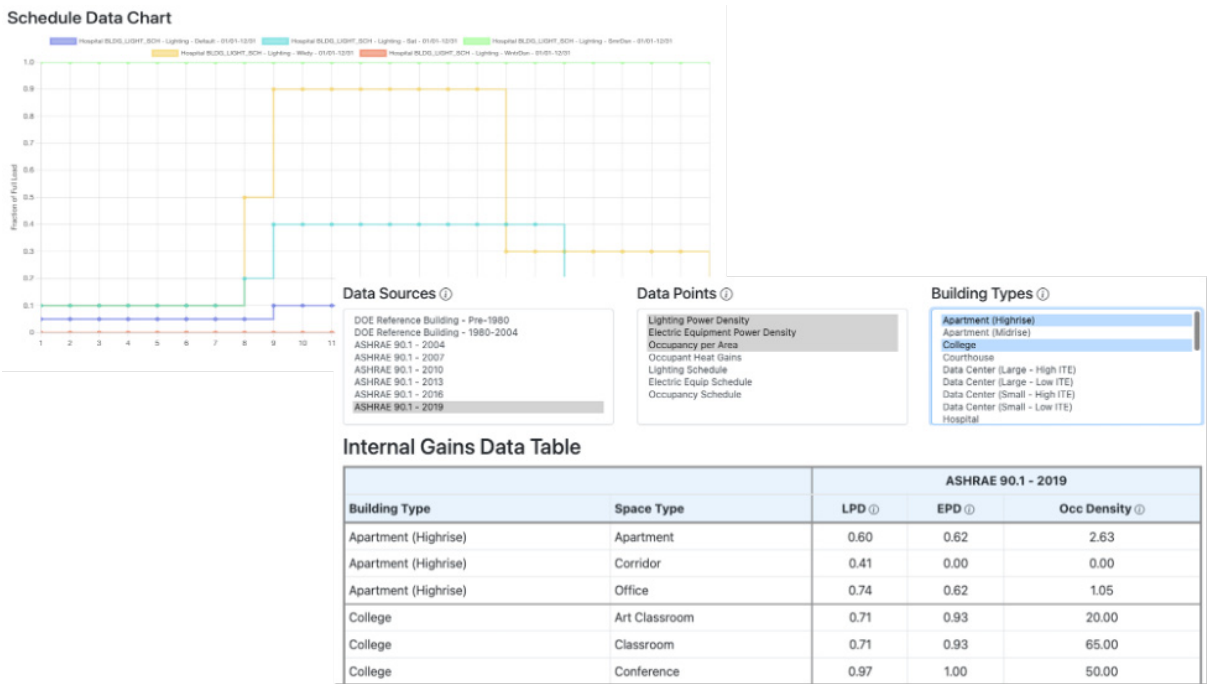
Example "Learn By Design Task" Tutorials

Interactive Data Lookup Tables and Charts

Finally, the third area of the website is an interactive tool to help make meaningful assumptions for input data during early stage projects.

This data comes from various vintages of the DOE prototype models **www.energycodes.gov/prototype-building-models** and can be filtered by vintage, type of data you're interested in (such as internal gain types and associated schedules), and also by building type.

Lookup tables are available for internal gains data, and schedule data.



		ASHRAE 90.1 - 2019		
Building Type	**Space Type**	**LPD**	**EPD**	**Occ Density**
Apartment (Highrise)	Apartment	0.60	0.62	2.63
Apartment (Highrise)	Corridor	0.41	0.00	0.00
Apartment (Highrise)	Office	0.74	0.62	1.05
College	Art Classroom	0.71	0.93	20.00
College	Classroom	0.71	0.93	65.00
College	Conference	0.97	1.00	50.00

Examples of the interactive lookup data tools

Share your knowledge!

You can see that BEMcylopedia has a lot of great content to explore, but for it to really take off, we need your help! The goal of BEMcyclopedia is to serve as a centralized collection of information, drawing on the collective knowledge of the community, and we welcome you to become a contributor!

It is very easy to get started:

- Create an account and send an email to **admin@bemcyclopedia.com** - the site administrator will grant you editing rights
- Instructions for creating an account are right on the front page of the wiki

Really, no contribution is too big or too small.

- Start by finding a page that's interesting to you and read it.
- If you feel the content needs some tweaking, then tweak away.
- If you feel like more detail could be helpful, go ahead and add some detail.

- If you feel that another section of a page could add value or help to address a specific concept that hasn't been covered yet, go ahead and add a new section.
- If you feel especially motivated and want to create an entirely new page to discuss a topic not currently addressed on the site, then go for it!

We have developed a tutorial with detailed guidance **https://bemcyclopedia.com/wiki/Help_Guide_for_Contributing_to_BEMcyclopedia** on how to edit a wiki page to help you get started.

Let us know what you think

We are reaching out to ask for your assistance - please complete this 2-minute survey to share your feedback on how we should prioritize ongoing development to provide the most value to our industry. Please take a moment to respond to the survey at **https://forms.gle/iPJtVC8Tt3yNYLCZ6** !

It is great to consider advanced assemblies in our building designs, and it's important to consider the steps one must take in order to accurately represent the emerging envelope technology. Luckily, there is a significant body of past and ongoing research on developing tools and models to estimate the performance of these emerging technologies to help inform the industry and begin designing buildings that utilize these technologies.

Dimitri Contoyannis, PE, CEM, LEED AP is the president of Model Efficiency, a consulting company specializing in energy modeling, BEM education, and using BEM analysis for research and development of energy codes. He has served on the IBPSA-USA board of directors for 6 years, is a member of the IBPSA-USA Education Committee, and is the chair of IBPSA-USA's Certification Committee. He is the lead developer of BEMcyclopedia, https://bemcyclopedia.com/wiki

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We want to hear your interesting, entertaining, or just-plain-odd questions about life and building performance simulation. Submit your questions to **askamodeler@ibpsa.us** *to be answered by prominent building performance simulation experts. Note that questions requiring an immediate response should be submitted to the community of experts at* **https://unmethours.com**. *Read our other past columns at* **www.ibpsa.us/ask-a-modeler**. *If you are interested in replying to a question as a featured expert or have any other feedback about Ask a Modeler, please email* **askamodeler@ibpsa.us**. ■

AI and BPS: Where do we stand?

Interviews with researchers working in the field

Eleonora Brembilla, TU Delft, The Netherlands

It is hard to miss the increasing presence of Artificial Intelligence (AI)-powered tools in our everyday life. Along with this, discussions around ethical and economic consequences of these technological developments are urgently needed, and have already led for example to new legislation in the EU - see **https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence**

It is no surprise that research and tools developed in the Building Performance Simulation (BPS) field are now using AI methods for more and more applications. Expertise in such methods is growing in our community and, with it, awareness of their strengths and limitations. In this article, I asked a few authors of AI-related research presented at the Building Simulation 2023 conference in Shanghai to answer four questions:

1. Can you briefly explain how you use AI in your academic work? What is the main scope and which AI technique do you typically apply?
2. What are the added benefits of this approach?
3. In your opinion, what's the relationship between AI and BPS? Will BPS tools as we know them be replaced by AI tools in the long run?
4. There are many ethical concerns raised in relation to the widespread use of AI techniques, especially non-explainable ones. Do you see this as a potential threat in our field?

All answers highlighted the synergy that can be established between AI methods and 'traditional' BPS methods, leading to better data understanding, the development of complex models, and quicker computation times. The importance of maintaining first principle laws, rules and constraints was actually stressed a few times. Another important point made by several authors was the fundamental role of training data – and their quality – in constructing any sensible AI model. This leads to a question for the entire IBPSA community: Should we have a more relevant role in collecting, assessing and providing data on building performance worldwide?

You can find the full interviews below; enjoy!

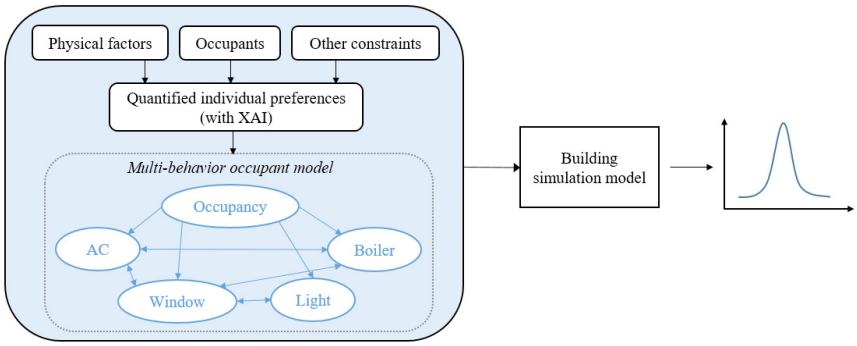
Sunghyun Kim and Cheol-Soo Park, Seoul National University, Republic of Korea

Authors of 'Correlation analysis between indoor/outdoor environment and occupants' window adjustment behaviour using explainable AI (XAI)' (https://doi.org/10.26868/25222708.2023.1193)

Eleonora Brembilla (EB): Can you briefly explain how you use AI in your academic work? What is the main scope and which AI technique do you typically apply?

Sunghyun Kim and Cheol-Soo Park (SK/CSP): In our research, AI techniques are utilized to model human-building interactions in residential apartments in South Korea. AI learns occupants' behavioral patterns from the measured data from in-situ experiments. We found that AI is advantageous for predicting multi-modal occupant behavior (OB) that is difficult to explain with traditional mathematical techniques.

In our study, we paid special attention to the AI's explainability to understand how each personal and environmental variable influences the OB model's prediction results. Explainable AI (XAI) techniques were able to quantify how each occupant responds to indoor/outdoor environmental and time-related factors, including personal differences, related uncertainties, and random factors.



EB: What are the added benefits of this approach?

SK/CSP: XAI techniques can help us to assess data-driven models not only in terms of absolute metrics (e.g., accuracy, F1-score, MSE) but also on domain metrics assessing how well the model reflects occupant behavior. Moreover, this promotes the transparency/explainability of the model, offering crucial information for rational decision-making when applying the model to different scenarios, such as various occupants or buildings. Down the road, the application of XAI techniques will allow for the quantification of the influence of each input feature, which can be utilized for model reduction or refinement through feature selection. In other words, incorporating XAI will allow us to capture the best of both worlds: leveraging AI's high predictive performance while enhancing the model's explainability. As a result, we can develop building performance simulations that are both more reliable and more transparent, ensuring that these advanced tools are as accountable as they are powerful.

EB: In your opinion, what's the relationship between AI and BPS? Will BPS tools as we know them be replaced by AI tools in the long run?

SK/CSP: The potential of AI in our field is significant, particularly due to its capacity to analyze vast amounts of data more quickly and efficiently than traditional methods. AI can predict scenarios that might be challenging to explain with conventional physical equations, showcasing its vast potential within our domain. However, relying solely on AI has certain limitations. The current AI approaches often fall short in generalization or extrapolation beyond the training data, as well as in interpretability and reliability compared to traditional BPS tools. Moreover, the issue of data availability is also a concern that cannot be overlooked.

To address these challenges, one solution we are focusing on is the concept of physics-informed AI. We all acknowledge the immutable laws of physics. In areas where physics works, it should be there; AI should be used where it can give additional benefits. In this regard, we believe this hybrid approach combining the 1st principles and AI will mitigate the drawbacks by leveraging their complementary strengths. Even in scenarios with limited data, effective learning is possible based on physical laws acting as constraints in the AI learning process. By integrating AI with physics-based tools, simulations can become more efficient and comprehensive, thus incorporating a wide range of variables and scenarios. This leads to improved predictions of building performance under various conditions.

In this way, the future relationship between AI and BPS tools will be collaborative rather than competitive. As AI technologies continue to evolve rapidly, AI will help us to solve more complex simulation problems and provide deeper insights, giving rise to a new generation of BPS tools. This integration not only enhances the capabilities of BPS tools but also opens up new possibilities for optimizing building performances, making buildings more sustainable, and improving the well-being of their occupants.

EB: There are many ethical concerns raised in relation to the widespread use of AI techniques, especially non-explainable ones. Do you see this as a potential threat in our field?

SK/CSP: As previously mentioned, AI has a high dependency on training data, which means AI-based BPS models will be influenced by any biases inherent in the training data. For instance, if the data is limited to specific types of occupants or buildings, the model may mislead us to a wrong decision or conclusion. Therefore, it is essential to check any existing potential biases inside the training data or trained model, and great care should be taken in the use of non-explainable AI in practical applications related to any human safety or legal issue, e.g. fire escape simulation.

To address these issues, we believe that our field requires the development of processes to reduce biases by utilizing a variety of data sources, as well as the development of tools and methodologies that increase the transparency and explainability of models. This approach is crucial to ensure that integration of AI with BPS will advance both technological capabilities and ethical/safety standards, thereby maintaining trust and reliability in AI-enhanced building performance analyses. □

Changqi Li[1], Yiqun Pan[1], Yumin Liang[1,2], Ling Fu[3], Jing Li[3], Tianrui Sun[3], and Mingya Zhu[3], [1]School of Mechanical Engineering, Tongji University, Shanghai, China, [2]Department of Civil Engineering, The University of Hong Kong, Pokfulam, Hong Kong, China and [3]Siemens Ltd., Shanghai, China

Authors of 'Regression models for predicting carbon emission reduction potentials in existing office buildings' (https://doi.org/10.26868/25222708.2023.1740)

EB: Can you briefly explain how you use AI in your academic work? What is the main scope and which AI technique do you typically apply?

Changqi Li et al (CL et al): Our academic work focuses on achieving low-carbon design and energy-efficient retrofitting of buildings through AI-based data-driven approaches. AI is applied for two main purposes: regression and optimization. On one hand, based on a large amount of building information and energy consumption data, AI algorithms for regression purposes (e.g., linear regression, neural networks, and support vector machines) are used to create black-box models for predicting building energy consumption and carbon emissions. Heavy workloads for complicated software simulations are thereby unnecessary. Quickly and efficiently deducing the building's energy consumption and operational carbon emissions is achievable with known building information. On the other hand, AI algorithms for optimisation purposes (e.g., genetic algorithms and Particle Swarm Optimization (PSO) algorithms) are used to optimise factors that influence a building's energy consumption to minimise operational carbon emissions. The two AI methods combined allow for the quick assessment of a building's potential for carbon emission reduction. This approach can guide decisions on retrofitting existing buildings and optimizing the design of new buildings to meet certain energy and carbon emission goals.

EB: What are the added benefits of this approach?

CL et al: The added benefits of combining AI in building energy-saving analysis include the increased efficiency of the building energy simulation and the expansion of the scope that can be covered by the optimisation scenarios. On one hand, simulating building energy consumption using a white-box approach often requires a significant amount of input information to construct a detailed building model for an accurate simulation result. However, this process is time-consuming and requires a high level of expertise. AI-based black-box modelling reduces the time required for building energy simulations and makes high-volume calculations achievable for optimization algorithms. On the other hand, the AI approach driven by data can capture the intricate relationships of the building system with greater accuracy and flexibility in practical applications. This is due to its ability to overcome the complexities and non-linearities that traditional physical models struggle to handle. In this way, optimisation algorithms can consider a wider range of measures by combining and updating building variables, compared to the individual scenario analysis. Consequently, global optimization is achievable within decision boundaries to enable the identification and full utilization of a building's overall energy and carbon reduction potential.

EB: In your opinion, what's the relationship between AI and BPS? Will BPS tools as we know them be replaced by AI tools in the long run?

CL et al: AI offers new possibilities for BPS and broadens the range of its application. The traditional white-box-based BPS method often requires detailed building information and design parameters as inputs, which may limit its applications. The accuracy of simulation results can be significantly reduced due to the lack of building information. The use of AI approaches for prediction or regression can overcome the complex relationship between building characteristics and energy consumption with existing energy use data. This provides the possibility of a wide range of applications for BPS technology. The data-driven AI approach can be seen as a derivation and compensation for the traditional physical rule-based BPS approach. However, it is important to note that AI models heavily rely on data quality, and their interpretability is often weak due to their reliance on data mining patterns rather than established physical laws. As a result, there is a pressing need to enhance the adaptability and interpretability of data-driven models to meet the increasingly complex modelling requirements in the construction industry. Therefore, we believe that the traditional BPS tools will not be replaced by AI tools, and the complementarity of AI and BPS tools is the future direction of the building energy simulation field. The hybrid model that combines the traditional BPS method and the novel AI method integrates the advantages of both physical and data-driven models. This not only allows the model to search for laws based on physical principles but also improves the model using actual observational data. As a result, the model's applicability and predictability can be effectively improved.

EB: There are many ethical concerns raised in relation to the widespread use of AI techniques, especially non-explainable ones. Do you see this as a potential threat in our field?

I agree that using non-explainable AI techniques may raise ethical concerns, especially when algorithms rely on data-mining patterns instead of known physical laws. Such algorithms can be challenging to interpret, making it difficult for stakeholders to assess the validity of simulation results. This lack of transparency can undermine trust in the technology and make it difficult to identify potential errors or biases. In the field of building performance simulation, this potential threat can be addressed by incorporating rule-based prior knowledge into AI approaches. This is similar to teaching a child a jigsaw puzzle by providing basic rules and hints as a guide (i.e. prior knowledge) rather than allowing them to find the answer through repeated attempts (i.e. data-driven). By incorporating prior knowledge, AI approaches can become more efficient and reflective of the real world.

Prior knowledge is mainly embedded in AI methods in the form of constraints. Physically constrained neural networks are a well-known example of integrating prior knowledge into the loss function to ensure that the model's output adheres to specific physical constraints. Knowledge embedding techniques are currently widely used in various fields, including the solution of partial differential equations, simulation of fluid flow, time series prediction, and robot control. This serves as a link between field knowledge and AI techniques, offering a novel approach to solving practical problems. Incorporating prior knowledge not only enhances the model's generalisation ability but also guarantees that its output is highly consistent with the physical world. As a result, AI models with 'common sense' can better assimilate human knowledge and produce results that are more compatible with the real world, thereby compensating for their lack of transparency and explainability. □

Yunbo Yang[1], Johannes Brozovsky[2], Peng Liu[2] and Francesco Goia[1], [1]Department of Architecture and Technology, Norwegian University of Science and Technology, Trondheim, Norway, [2]Architecture, Materials and Structures, SINTEF Community, Trondheim, Norway

Authors of "Data-driven energy management of a neighborhood with renewable energy sources" (https://doi.org/10.26868/25222708.2023.1490)

EB: Can you briefly explain how you use AI in your academic work? What is the main scope and which AI technique do you typically apply?

Yunbo Yang et al (YY et al): In our research, we leveraged Artificial Intelligence (AI) to coordinate energy production and storage in a community powered by renewable energy sources and the grid. Our primary focus was on harnessing deep reinforcement learning (DRL) techniques to strategically manage renewable energy production schedules and optimize the charge and discharge schedules of the Energy Storage Systems (ESS) within each building. The overarching objective is to reduce the total electricity purchased from the grid. DRL learns optimal policies by trial-and-error iterations with the environment and exhibits its flexibility in terms of changes in the optimization problems. The specific algorithm we employed is the Soft Actor-Critic (SAC), a successor of Q-learning, known for its efficacy in handling complex, multi-dimensional decision-making scenarios.

Additionally, our investigation expands on the utilization of Artificial Neural Network (ANN) models for addressing the challenge of missing data in time-series - a common challenge in real-world data acquisition and analytics. This DRL+ANN dual approach offers a comprehensive strategy for enhancing energy flexibility in renewable energy utilization within residential neighborhoods.

EB: What are the added benefits of this approach?

YY et al: The management of energy systems in neighborhoods can be a very complex task. The system is characterized by a high degree of interdependence between the players, but at the same time there can be different aims at the single building/house owners' level and the micro-grid level. Specifically, individual property owners normally aim at minimizing their energy bills while the micro-grid seeks to flatten the aggregate energy profile. This leads to a sophisticated optimization problem in the building energy domain. Traditionally, solving optimization problems in the context of energy and building management necessitates the use of models grounded in physics, essential to finding optimal solutions within analytical or model predictive control (MPC) methods. However, developing these models and formulating the problems is expertise-intensive and time-consuming. Deep Reinforcement Learning (DRL) offers a paradigm shift through its data-driven

approach, effectively bypassing the need for intricate physical models. This capability streamlines the modelling process and significantly reduces the computational time involved.

EB: In your opinion, what's the relationship between AI and BPS? Will BPS tools as we know them be replaced by AI tools in the long run?

YY et al: The relationship between AI and BPS is inherently complementary, and BPS tools are unlikely to be entirely replaced by AI solutions. AI technologies, such as machine learning (ML) and deep learning (DL), significantly augment BPS capabilities by introducing advanced data analysis, predictive insights, and optimization strategies. Together, AI and BPS can integrate seamlessly within the same workflow, sharing a common framework yet applying their unique strengths across various stages and scenarios to maximize their benefits. Specifically, BPS is predominantly utilized in the initial and design phases, setting the groundwork for system configuration and preliminary planning. In contrast, AI comes into play during the later stages and operational phase, where its data-driven capabilities are maximized with the availability of simulated or real-world data. This is due to AI's reliance on data, which makes it challenging to implement effectively during the early stages when such data may not be available.

AI's ability to process both historical and real-time data allows for the forecasting of future building performance metrics, such as energy use, thermal comfort, and HVAC system efficiency. These predictive capabilities lead to more precise building performance simulations and optimization across a range of scenarios. Furthermore, BPS can serve to benchmark or validate AI-generated outcomes, thanks to its physically explainable models and deeper understanding of building physics. This synergy fosters efficiency, effectiveness, predictability, responsiveness, and sustainability in the building energy area.

EB: There are many ethical concerns raised in relation to the widespread use of AI techniques, especially non-explainable ones. Do you see this as a potential threat in our field?

YY et al: As with any emerging technology, improper utilization and implementation of AI in BPS can lead to challenges. However, we believe that issues such as the lack of interpretability and explainability can be addressed through the development and application of physically interpretable and explainable AI algorithms. Notable examples include techniques like LIME (Local Interpretable Model-agnostic Explanations), SHAP (SHapley Additive exPlanations), and Layer-wise Relevance Propagation (LRP), which help demystify the decision-making processes of AI models. Furthermore, in many cases, the approach begins with fundamental physics—acknowledging established phenomena. And subsequently extends through data for AI use without the need for precise understanding of the underlying mechanisms as long as the resulting model's output is sufficiently accurate for its intended purpose. Consequently, the outcomes offer a degree of physical interpretability since AI algorithms learn from those data. Examples of such applications include model-based Reinforcement Learning (RL) in control tasks, and supervised learning techniques for prediction, clustering, and classification tasks. This strategy ensures that even without exhaustive knowledge of the 'why' and 'what', the models can still deliver pragmatic and interpretable solutions.

Concerns regarding the reliability of AI models can be mitigated through careful model selection, construction, and training processes. Ensuring that models are neither overfitting nor underfitting is crucial to their performance and reliability. Moreover, in scenarios characterized by significant risks and uncertainties, the integration of AI with hybrid technologies and human oversight can provide a robust safety net. □

Saman Mostafavi[1], Chihyeon Song[2], Aayushman Sharma[3], Raman Goyal[1] and Alejandro E. Brito[1], [1]Palo Alto Research Center Inc, USA, [2]Korea Advanced Institute of Science and Technology, [3]Texas A&M University

Authors of "Benchmarking model predictive control algorithms in Building Optimization Testing Framework (BOPTEST)" (https://doi.org/10.26868/25222708.2023.1371)

EB: Can you briefly explain how you use AI in your academic work? What is the main scope and which AI technique do you typically apply?

Saman Mostafavi et a; (SM et al): AI is a broad umbrella term. My focus is on using deep learning frameworks like PyTorch and JAX for solving forward and inverse problems. This has two primary aspects: a) employing surrogate modeling and parallelization to expedite simulations, and b) utilizing gradients through automatic differentiation to address optimization problems in design and control. More recently, my work has expanded to exploring Auto Regressive Generative Models, ranging from diffusion models to Large Language Models, within design and modeling processes. These have the potential to enable more efficient design space exploration and to parse and synthesize physics-based models using hierarchical modeling languages such as Modelica.

EB: What are the added benefits of this approach?

SM et al: The primary benefits of this approach include significantly faster simulation and optimization. Surrogate models are orders of magnitude quicker compared to traditional physics-based solvers used in simulation tools like EnergyPlus and Modelica. A key component of this method is automatic differentiation, which computes the derivative of a performance measure relative to numerous parameters. This differentiation greatly enhances the discovery of improved performance in large-scale models, a task that was previously challenging or unfeasible.

EB: In your opinion, what's the relationship between AI and BPS? Will BPS tools as we know them be replaced by AI tools in the long run?

With the rapid pace of technological breakthroughs, predicting the landscape of AI and BPS in the next 10-20 years is challenging. In the short term, it's highly probable that we'll witness the integration of AI, particularly Generative AI and its variants, into the modeling interfaces regularly used by engineers. This integration could span various stages of engineering, ranging from the exploration of design possibilities and accelerating simulations via surrogate modeling, to control synthesis and verification. Given their compatibility with human cognition and speech, the potential for language and vision-based AI tools seems boundless at the moment.

EB: There are many ethical concerns raised in relation to the widespread use of AI techniques, especially non-explainable ones. Do you see this as a potential threat in our field?

SM et al: Absolutely, ethical concerns are significant in our field, particularly with the current limitations of AI tools. A major issue is that all AI tools today are susceptible to 'hallucinating' or generating uncontrolled errors due to limited training samples. For the foreseeable future, it's crucial that users verify the outcomes of these models. This necessitates an effective visualization suite around the AI processes, allowing experts to remain in the loop and scrutinize results.

Furthermore, there's a Catch-22 scenario emerging: future engineers trained with AI tools might become overly reliant on them, potentially losing the ability to verify and understand their outputs independently. As these tools become more integrated into our daily workflows, it's vital to be more vigilant about how we design, deploy, and control them. ■

Forthcoming events

Date(s)	Event	Further information
2024		
13-17 May 2024	**Conférence Francophone de IBPSA** La Rochelle / Oléron, France	**https://conference2024.ibpsa.fr**
21-23 May 2024	**SimBuild** **IBPSA-USA Conference** Denver, Colorado, USA	**www.ibpsa.us/simbuild-2024**
29-30 May 2024	**IBPSA-Ireland Research Symposium** Munster Technological University Cork, Ireland	**www.ucd.ie/buildingenergyinformatics/ibpsa-ireland/2024munstertechnologicaluniversity**
05-07 June 2024	**eSIM** **IBPSA-Canada Conference** Edmonton, Alberta, Canada	**https://idobe.engineering.ualberta.ca/esim-2024**
09-11 June 2024	**BuildSim Nordic** **IBPSA-Nordic Conference** Espoo, Finland	**https://buildsimnordic2024.ibpsa-nordic.org**
26-28 June 2024	**Building Simulation Applications Conference 2024** Bozen-Bolzano, South Tyrol, Italy	**https://bsa.events.unibz.it**
26-28 Aug 2024	**International Radiance Workshop** Salt Lake City, Utah, USA	
23-27 September 2024	**BauSIM** Vienna, Austria	**https://bausim2024.conf.tuwien.ac.at**
25 November 2024	**uSIM Conference** Edinburgh, Scotland, UK	**https://usim2024.org**
08-10 Dec 2024	**ASim2024** Osaka, Japan	**www.asim2024.org**
2025		
01 April 2025	**Building Simulation & Optimisation** **IBPSA-England Conference** London, England, UK	
04-06 June 2025	**CLIMA World Congress 2025** Milan, Italy	**www.climaworldcongress.org**
24-27 August 2025	**BS 2025** **18th IBPSA International Conference & Exhibition** ***Carbon and Climate Responsive*** Brisbane, Australia	**www.BS2025.org**

Note that the dates in this calendar may, but do not necessarily, include pre and/or post-conference workshop days

21-23 May 2024
Denver, Colorado, USA
www.ibpsa.us/simbuild-2024
www.ibpsa.us/hacksimbuild-2024

SimBuild 2024 Conference

Celebrating Two Decades of SimBuild

SimBuild is the premiere US conference for building performance simulation users, researchers, and developers. IBPSA-USA hosts the conference every other year, in alternation with IBPSA's international Building Simulation conferences. After joint conferences with ASHRAE from 2014 to 2022, IBPSA-USA returns to hosting SimBuild as an independent conference in May 21st to 23rd 2024 in Denver, Colorado.

Commemorating the 20th anniversary of the first SimBuild conference, this year's theme is *Celebrating Two Decades of SimBuild*. Following this theme, IBPSA-USA is delighted to announce the keynote lineup:

- **Exploring the Past**: Chip Barnaby, Consultant and past IBPSA President; Dru Crawley, Bentley Systems and IBPSA President; Ellen Franconi, PNNL. Panel moderated by Conference Co-Chairs Carrie Brown, Resource Refocus and Supriya Goel, PNNL
- **Present State of the Industry**: Amy Jiron, Director of Building Decarbonization, Colorado Energy Office.
- **Revolutionizing the Future**: Christopher Mackey, Ladybug Tools; Alejandra Menchaca, AIRLIT studio; Zoltan Nagy, University of Texas. Panel moderated by Scientific Committee Chair and IBPSA-USA President, Nathaniel Jones, Arup

The conference program will include four parallel session tracks with over 150 technical and practitioner paper presentations, engaging discussions, and daily networking and social opportunities. This year's five presentation theme areas are Climate Resilience and Forecasting, Intelligent Building Operations, Workflows and Simulation Case Studies, Simulation Technologies and Applications, and Human Factors. Attendees will have the opportunity to participate in small-group and one-on-one sessions in addition to traditional seminar and lecture-type sessions. Formats include conversation and debate topics, short lightning talks and full presentations, and special small-group interactions to let you discuss current building performance simulation topics directly with leaders in industry and research.

From May 19-20, the conference will also include pre-conference workshops, tours, and HackSimBuild '24, **www.ibpsa.us/hacksimbuild-2024** a 24-hour buildathon where participants develop and test creative new approaches to building performance

simulation. With modelers, programmers, students, academics, designers, and engineers of all types collaborating in a design sprint, this event is bound to be fun and immersive. Teams with the most original, innovative, and market-ready tools, metrics, ideas, or other hacks will be recognized during the IBPSA-USA Awards Banquet, along with other IBPSA-USA awards.

Denver, known for attracting "architecture aficionados," is the perfect choice of location to celebrate Simbuild's Platinum Anniversary. The town had its beginnings in 1858, and since the Gold Rush era it has evolved to be one of the most exciting urban skylines in the country. From Union Station to the Fredric C. Hamilton Building: Denver Art Museum, we invite you to take a trip through time and discover Denver's history through some of its most striking architecture.

Join us as we commemorate IBPSA-USA's contributions to sustainability and building performance simulation and look toward the future. The program will highlight the work of IBPSA-USA and its members and provide a platform to envision the future of simulation, as we explore emerging technologies, trends, and strategies that will continue to drive building performance excellence in the years ahead.

Don't forget to follow us on our website **www.ibpsa.us/simbuild-2024**

For questions, please contact **events@ibpsa.us**

We can't wait to meet you at SimBuild 2024! □

Join the Adventure at HackSimBuild '24: A Buildathon for the Simulation Community!

www.ibpsa.us/hacksimbuild-24-join-the-adventure

Are you ready to embark on an electrifying adventure where innovation knows no bounds? Challenge yourself to build something new and useful, and meet industry leaders and innovators of all sorts along the way, at HackSimBuild '24 **www.ibpsa.us/hacksimbuild-2024** – the ultimate Buildathon for the Simulation Community!

Why Join the Adventure?

HackSimBuild '24 **www.ibpsa.us/hacksimbuild-2024** invites you to be part of something extraordinary. Picture yourself networking with industry experts, forming dynamic teams, and delving into a world of endless possibilities. From creating groundbreaking metrics to bridging the gap between theory and practice, every moment at HackSimBuild is a chance to make your mark on the simulation community.

Over the course of 24 action-packed hours, you'll join forces with fellow modelers, programmers, students, academics, designers, and engineers to unleash your creativity, tackle challenges, and push the boundaries of what's possible.

When: 19-20 May 2024
Where: Big Ladder Software, Denver, Colorado

The doors open at noon on May 19th for a workshop with the founders of Ladybug Tools, and the competition starts at 3pm.

Why You?

You'll find people with diverse skill sets and backgrounds at HackSimBuild, and no matter your background, there's something that you can bring to the table. By leveraging your strengths and collaborating effectively with your team, you can tackle challenges and drive innovation in building performance simulation.

Maybe you are…

The Visionary: You're someone who sees the big picture and is driven by a passion for innovation. You thrive on exploring new ideas and envisioning how technology can shape the future of building performance simulation. At HackSimBuild, embrace your creativity and forward-thinking nature to inspire your team and pursue ambitious solutions to complex challenges.

The Designer: You're a creative thinker with a keen eye for aesthetics and user experience. You excel at translating complex concepts into intuitive designs that will delight users and the judges. At HackSimBuild, contribute to the team by crafting user interfaces, designing prototypes, and molding the user experience of your team's creation.

The Director: You're a natural leader who excels at organizing and coordinating teams. Your strong communication skills and ability to guide your team towards a common goal make you invaluable. At HackSimBuild, take charge of team dynamics, ensuring that everyone stays focused, motivated, and on track to deliver a successful project within the 24-hour timeframe.

The Programmer: You're a coding aficionado who loves to dive into algorithms, data structures, and software development. Your knack for turning ideas into reality through the power of code is unparalleled. At HackSimBuild, leverage your technical expertise to develop innovative solutions and troubleshoot any technical challenges that arise during the event.

The Analyst: You're a data-driven problem solver who enjoys diving deep into datasets to uncover insights and trends. You like to find the needle in the haystack and weave charts together to tell stories. At HackSimBuild, find and interpret building performance data, then use your data-driven insights to inform decision-making and optimize simulation models.

The Engineer: You're a practical thinker who thrives on solving real-world problems with practical solutions. Your strong understanding of engineering principles makes you an invaluable asset to any team. At HackSimBuild, navigate your team through technical challenges, troubleshoot issues, and ensure that their solutions are both innovative and feasible.

Join the Adventure

Curious what it might be like to participate? Get details and register now at **www.ibpsa.us/hacksimbuild-2024** to secure your spot at HackSimBuild '24 and leave your mark on the field of building performance simulation.

- Meet peers, share ideas, and create teams on site.
- Dive into a 24-hour design sprint where innovation takes center stage.
- Showcase your creativity to industry-leading jurors and SimBuild attendees.
- Collaborate with diverse teams comprising students, analysts, designers, architects, engineers, and programmers.
- Network with industry leaders and the developers of softwares that you use.
- Utilize any software or combination thereof to bring your ideas to life – open-source projects are highly encouraged!

Got questions or need more information? Don't hesitate to reach out to us at **hackathon@ibpsa.us**. We're here to help you embark on your HackSimBuild adventure!

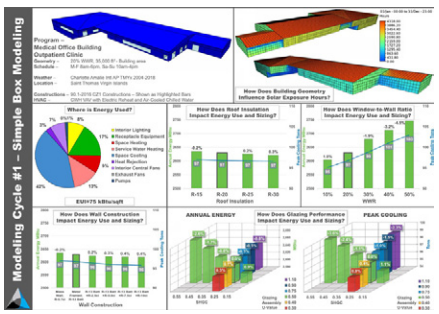
Join us as we unlock the untapped potential of building performance simulation. The adventure awaits – are you ready to seize it? □

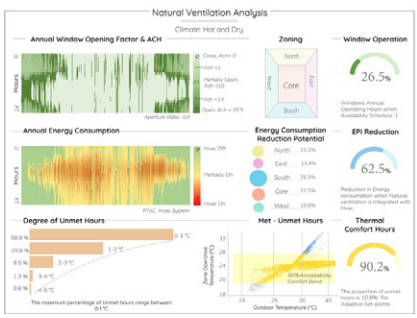
PROJECT StaSIO

Project StaSIO, an initiative of IBPSA-USA's Research Committee, is a web-based crowd-sourced repository of simulation graphics and case studies organized around the ASHRAE 209 framework. Project StaSIO is envisioned as a resource for building performance simulators to look for ways that can graphically communicate their simulation outputs in a clear and compelling manner, empowering them to make a real impact on the performance of a future building. Two examples are shown below.

Project StaSIO holds an Annual Challenge. The deadline for submissions was the end of March, and the winner will be announced at Simbuild 2024 in the panel session titled *Great Graphics Lead to Great Design*. Details of Project StaSIO and the 2024 Annual Challenge can be found at **https://projectstasio.com** and **https://projectstasio.com/competition/2024-annual-challenge**.

Meanwhile, we will be hosting a workshop titled *Impactful Data Visualization* during the pre-conference workshops on 20 May; the details are on the conference website at **www.ibpsa.us/simbuild-2024** . ■





International Building Performance Simulation Association

IBPSA-Ireland Research Symposium 2024

Building Performance Analysis

May 29th & 30th 2024

The Berkeley Centre

Munster Technological University Cork

MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University

Symposium Aim

The overall aim of the symposium is to bring together graduate students and researchers from Irish third-level institutions who are engaged in research related to analysis and simulation of the built environment. Given the diversity of ongoing research, the symposium will act as a unique forum to highlight both the breadth and depth of activity in the building performance analysis arena, as well as providing an opportunity for researchers to share their experiences. Invited keynote speakers at the symposium will be **Prof. Wangda Zuo**, Pennsylvania State University, USA and **Dr Spencer Dutton**, Lawrence Berkeley National Laboratory, USA.

Presentation/Poster Submission

Researchers and graduate students are invited to give a short presentation or submit a poster on their latest research findings. There will be a prize for best presentation and best poster.

Thesis in 3 Minutes

Designed to showcase the world-class research in a short amount of time. Present an overview of your thesis in 3 minutes, and be in a chance of winning a share of the €150 prize money.

Symposium Dinner & Networking Event

To facilitate networking opportunities amongst participants, a symposium dinner, provided by IBPSA-Ireland, will take place on the evening of the May 29th.

Registration:
To register your interest please complete the registration form here before April 16th, 2024. There is no registration fee to attend the symposium.
All building performance analysis stakeholders are invited to attend.

Organising Committee: Maha Sohail (MTU), Dr. Paul O'Sullivan (MTU), Dr. Adam O'Donovan (MTU), Prof. James O'Donnell (UCD), Prof. Donal Finn (UCD), Dr Ciara Ahern (TUD), Prof. Marcus Keane (UOG)
Contact: ibpsa2024@mtu.ie

05-07 June 2024
Edmonton, Alberta, Canada
https://idobe.engineering.ualberta.ca/eSim-2024

IBPSA Canada

The Canadian Chapter of the *International Building Performance Simulation Association*

Le chapitre canadien de *International Building Performance Simulation Association*

eSim 2024 Conference

Stimulating Sustainability Together

We are excited to announce eSim 2024, an event that promises to be a continuation of eSim's successful legacy. eSim conferences cover important and arising topics in building performance simulation, including modeling methodologies, design practices, and case studies. eSim 2024 focuses on *Stimulating Sustainability Together*, hoping to engage a wide variety of stakeholders in advancing building performance.

Located at the University of Alberta, Edmonton, eSim 2024 will have in-person presentations and a hybrid audience. Highlights will include:

- Around 100 presentations from industry experts, researchers, and practitioners
- Workshops and tutorials
- A group trip to Jasper National Park after the conference
- Interactive discussions on emerging trends, challenges, and opportunities in building simulation.

We invite you to contribute your research and expertise by submitting an abstract for consideration.

Key dates

The deadlines for submission of abstracts and final papers have passed. The remaining dates are:

- Notification of paper acceptance — 15 April 2024
- Camera-ready submission — 15 May 2024
- Early Bird registration — now until 03 May 2024

For updates regarding the conference program, keynote speakers, and additional details, and to register for eSim 2024, please visit our conference website at **https://idobe.engineering.ualberta.ca/eSim-2024**. We encourage you to register early to take advantage of the discounted rates.

If you have any questions or require further information, please do not hesitate to contact us at **idobe@ualberta.ca**.

Thank you for your continued support, and we hope to see you at eSim 2024! ■

09-11June 2024
Espoo, Finland
https://buildsimnordic2024.ibpsa-nordic.org

BuildSim Nordic 2024 is the 11th BuildSim Nordic and 3rd International IBPSA-Nordic conference. We warmly welcome members and non-members of IBPSA-Nordic, and practitioners from the AEC industry, to join us for this exciting opportunity to be updated on the newest ideas and research.

The conference programme includes around 65 presentations of scientific papers in eight sessions, four keynote sessions and three workshops. Topics include: Building acoustics; Building Information Modelling (BIM); Building physics; CFD and air flow; Commissioning; Daylighting, fenestration and lighting; Digital twins; Demand-side flexibility; Developments in simulation; Education in building performance simulation; Renewable energy and energy storage; Human behavior in simulation; Hybrid systems; Indoor Environmental Quality (IEQ); Developments in software; System optimization; Urban-scale simulation; Smart buildings; Validation, calibration and uncertainty; Weather data & Climate adaptation; Zero Energy Buildings (ZEB); and Emissions and Life Cycle Analysis.

Please visit the conference website **https://buildsimnordic2024.ibpsa-nordic.org** for information about the conference, the venue and registration. ■

26-28 June 2024
Bozen-Bolzano, South Tyrol, Italy
https://bsa.events.unibz.it

BSA 2024: 6th Building Simulation Applications Conference

IBPSA-Italy and the Free University of Bozen-Bolzano announce the 6th Building Simulation Applications Conference, BSA 2024, which will take place at the Free University of Bozen-Bolzano, South Tyrol, Italy on 26-28 June 2024. The official language is English.

Target audience

Participation is welcomed from researchers in the general sector of building simulation and energy modelling, policy makers and public agencies & utilities, all sectors of industry, and building designers. International attendance is warmly welcome.

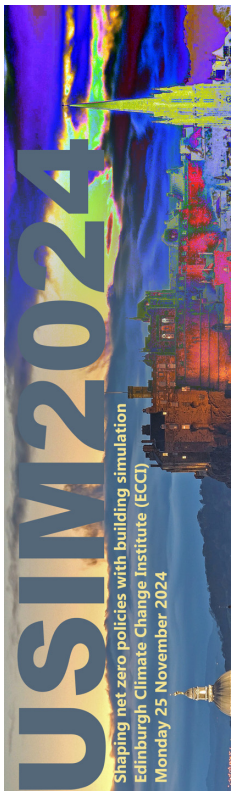
Key dates

The deadline for submission of abstracts has passed. The remaining dates are:

- Full paper review notification 30 April 2024
- Final submission 20 May 2024

Please visit **https://bsa.events.unibz.it** for updates about BSA conferences! ■

25 November 2024
Edinburgh, Scotland, UK
https://usim2024.org



uSIM'24

Shaping net zero policies with building simulation

uSIM is IBPSA-Scotland's biennial conference, which looks 'beyond the building' to the application of building simulation for community and urban energy modelling. The theme of this year's conference is the application of building simulation to help shape net zero policies. With governments everywhere struggling with the immense challenge of meeting mid-century net zero targets, the need for robust modelling and simulation to guide policy development has never been more apparent. The conference will bring together building simulation experts from the realms of academia and industry, along with the policy and standards community to explore key challenges, highlight new developments, and share best practice to help realise our net zero ambitions.

uSIM'24 will be hosted by the University of Edinburgh, Monday 25 November 2024 at the Edinburgh Climate Change Institute (ECCI) **https://edinburghcentre.org** .

Given this year's topic, in addition to uSIM's usual technical and application-focused papers, contributions that highlight Net Zero built environment policy and social challenges are encouraged.

Original contributions from researchers, practitioners and policy makers are also welcome in the following areas.

- Building simulation at scale – stock modelling, energy networks, city and regional modelling
- Built environment energy policy landscape
- Calibration, validation and the application of uncertainty at scale
- Case-studies of modelling for policy development and support
- Case studies in urban energy modelling
- Modelling outputs for non-technical audiences
- Data acquisition at scale
- Multi-domain simulation for sustainable cities and communities
- Future energy compliance
- Software developments - new technical and policy support tools, models, and metrics
- Supporting a just transition to net zero
- Characterising urban energy resources

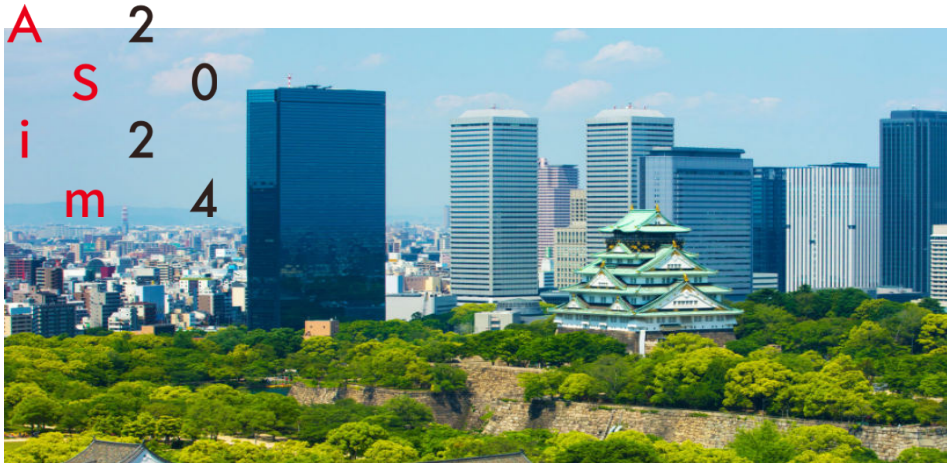
Abstracts of up to 500 words can be now be submitted via the uSIM conference website: **https://usim2024.org**.

Key dates

Abstract submission	12 April 2024
Full paper submission	14 June 2024
Final accepted papers	16 August 2024

08-10 December 2024
Osaka, Japan
www.asim2024.org

ASim2024



We are excited to announce ASim2024, which will be held as an in-person conference in Osaka, Japan, on 8-10 December 2024. ASim is a regional conference series of IBPSA held in the Asian region in cooperation with the Asian affiliates. ASim2024 will provide a forum for scholars, students, professionals, consultants, designers, and engineers to exchange ideas, knowledge, and information on building performance simulation. We invite you to submit abstracts up to 300 words on your contribution by 10 May 2024.

Highlights

- Between 100 and 150 papers have been presented at the past ASim conferences
- ASim conferences are a place for learning and experiment. They offer opportunities for students and early career researchers in particular to be exposed to an international audience and peers and to try something new.
- They are a place for networking - a good size conference to connect with your peers

Key dates

Abstract submission	10 May 2024
Abstract acceptance notification	5 June 2024
Draft paper submission	15 August 2024
Paper acceptance notification:	14 September 2024
Early bird registration	31 October 2024

For updates regarding the conference program and additional details, please visit our conference website at **www.asim2024.org**. In addition, we warmly welcome your proposals and suggestions on activities related to ASim. Please do not hesitate to contact us at **asim2024@conftool.com**. We hope to see you at ASim2024! ■

04-06 June 2025
Milan, Italy
www.climaworldcongress.org

CLIMA 2025: Buildings for the climate of the future

The REHVA HVAC World Congress CLIMA is a leading event for professionals, academics, and companies in the HVAC sector. CLIMA 2025 will take place in Milan, Italy, from 04-06 June 2025. The theme this time is *Decarbonized, healthy, and energy-conscious buildings in future climates*, a topic highlighting the multi-aspect importance of HVAC.

Decarbonizing the European building stock by 2050 will require deep energy renovation of buildings and neighbourhoods without compromising health. We need to improve our design approach to reduce the carbon footprint of buildings, to take account of health and threats such as COVID-19, and to take advantage of digitization and sensors to optimize the design, operation, and indoor environmental quality of new and refurbished net-zero buildings. Advanced sensor-based measurement and control pose numerous challenges. We know the climate is changing: will more cooling or heating capacity be needed? What energy conservation technologies will work best?

For updates on the programme, paper submission, venue, delegate registration and more visit **www.climaworldcongress.org** ■

24-27 August 2025
Brisbane, Australia
www.bs2025.org

BS 2025

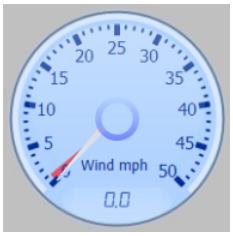
Following the 2023 Building Simulation Conference in Shanghai, China, Australia will take the reins in hosting the next conference, BS 2025, in Brisbane from August 24–27, with the theme *Carbon and Climate Responsive*. The conference will be jointly hosted by IBPSA-Australasia and AIRAH, and aims to bring together the interests of academics, practitioners, students, and policy-makers from around the world.

BS 2025 will focus on the leading issues that drive the use of simulation in the built environment, including how simulation relates to achieving net zero energy and carbon both now and in the future, without compromising health and wellbeing. Scientific research will be presented alongside practical examples and the latest in innovation.

In addition to the technical program, the conference will include workshops, site visits, panel sessions, a conference dinner and awards ceremony, social functions and a partner program.

Visit **www.bs2025.org** for more information ■

Software news



New current and future climate data for Ireland and updated global simulation climate data set soon available from Climate.OneBuilding.Org

A set of weather and climate data files developed by Met Éireann is now available on **https://Climate.OneBuilding.org**. These data include Test Reference Year (TRY) and Design Summer Year (DSY) data for six locations in Ireland, as well as three sets of future data:

- 2021-2050 (RCP 8.5 -- Low, Mid, High for TRY and three DSYs)
- 2041-2070 (RCP 4.5 and 8.5 – Low, Mid, and High TRY and three DSYs)
- 2071-2100 (RCP 2.6, 4.5, and 8.5 -- Low, Mid, and High TRY and three DSYs).

Griffin, S., Mateus C., and Lambkin, K. 2023. Climate data for use in building design – Past and Future weather files for overheating risk assessment. Climatological Note No. 21. Met Éireann **www.met.ie/climate/available-data/climate-data-for-thermal-modelling-of-buildings**.

https://climate.onebuilding.org

In March 2024, **Climate.OneBuilding.org** began processing new climate data from 2022 and 2023 to create updated TMYx. As 2023 is the hottest global year on record, we expect to see increased cooling when using these files in building simulation. These include weather station meteorology data through 2023 and corresponding solar radiation from the ERA5 reanalysis data set (**www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5**). The ERA5 data, courtesy of Oikolab (**https://oikolab.com**), provides a comprehensive, worldwide gridded solar radiation data set based on satellite data. The new data (and all other weather files on the site including the 2009-2023 TMYx) include the latest ASHRAE 2021 design conditions. We plan to release these new data as regions are completed.

The TMYx are derived from hourly weather station meteorology data through 2023 in the ISD (US NOAA/NCEI's Integrated Surface Database) and gridded solar radiation data from ERA5 reanalysis using the TMY2/ISO 15927-4:2005 methodologies. Often, there are two TMYx for a location, for example, for:

Washington Dulles Intl AP: USA_VA_Dulles-Washington.Dulles.Intl.AP.724030_TMYx, *and*
USA_VA_Dulles-Washington.Dulles.Intl.AP.724030_TMYx.2009-2023.

In these cases, there's a TMY for the entire period of record and a second TMY for the most recent 15 years (2009-2023). Not all locations have recent data. The older 2007-2021 data remains on the web site.

While we don't yet have a final count on the number of locations possible with the new years of data, we expect that the Climate.OneBuilding.org TMYx data set will include more than 17,000 locations in more than 250 countries. There are another 21,000 files from other data sources. All data have been through extensive quality checking to

https://climate.onebuilding.org/papers/EnergyPlus_Weather_File_Format.pdf

http://www.strath.ac.uk/research/energysystemsresearchunit/applications/esp-r

https://web.mit.edu/sustainabledesignlab/software.html

https://www.pvsyst.com/

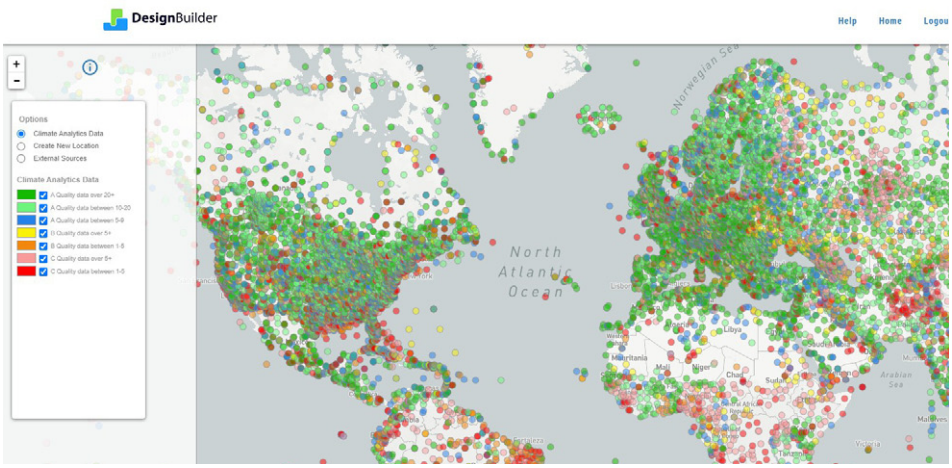
identify and correct data errors and out of normal range values where appropriate.

Each climate location .zip contains: EPW (**EnergyPlus weather format**), CLM (**ESP-r weather format**), WEA (**Daysim weather format**), and PVSyst (**PV solar design weather format**) along with DDY (ASHRAE 2021 design conditions in EnergyPlus format), RAIN (hourly precipitation in mm, where available), and STAT (expanded EnergyPlus weather statistics).

Climate.OneBuilding.org thanks the building simulation community for their support – we are now seeing more than 4,000 weather files downloaded daily, more than 2.5 GB.

For more information or to download any of the climate data (no cost), go to **https://Climate.OneBuilding.org** ■

Introducing DesignBuilder Climate Analytics



With growing concerns over the progressive impacts of climate change, access to weather data is an increasingly important consideration for energy modellers. DesignBuilder Climate Analytics has been specifically developed to provide the key inputs for building energy, comfort, and daylighting simulations. It enables modellers to access a vast database of high-quality hourly weather data through an easy-to-use web platform. However, Climate Analytics is more than just a database. It also includes a wide range of analysis tools to help you select the most appropriate data for your projects.

The key features include:

- A comprehensive set of global weather data and analysis tools for building performance simulation.
- Access to hourly weather data for any site worldwide.
- The ability to create your own location-specific weather files for applications such as calibration of existing buildings.

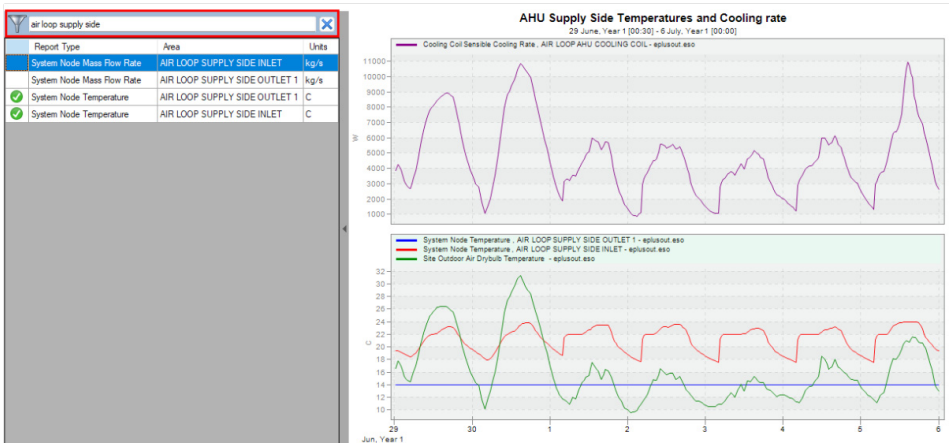
- Access to design, actual, and typical year weather data from over 43,000 stations across the globe.
- Built-in tools for data selection, climate analysis, visualising climatic trends, and checking data quality.
- Options to override measured data with design values and/or offsets for temperature, sky type, wind etc.
- Access to the weather data libraries from Climate.OneBuilding, White Box Technologies, and EnergyPlus.
- Custom morphing for future climate, Urban Heat Island (UHI), and extreme weather scenarios.

A recent overview webinar **https://app.gotowebinar.com/unified/index.html#/embedded/recording/3cad371907da4f1d9c9f946f4e1204cb** provides more information about this unique tool.

In the recent update, the full global "Design Year" dataset for 2023 has been added, so you can include last year's data in your design simulations and climate analysis work. Note that "Actual Year" data is updated monthly, ensuring that you always have access to the latest data for post-occupancy modelling and other work requiring recent weather data.

To start a trial, simply register on the website (**https://analytics.designbuilder.co.uk**) using the special guest activation code 12345678. When evaluating Climate Analytics with a trial licence, you can now access the "Design Year" and "Actual Year" datasets for 12 "trial" stations located in the USA, Ireland, Australia, and Egypt. This allows you to check that the data, morphing, and analysis capabilities meet your requirements before ordering a full licence. For more information on Climate Analytics trial licences, see the Licensing section of the help: **https://designbuilder.co.uk/cahelp/Content/Licensing.htm**

Introducing report filtering in Results Viewer v4.2



The DesignBuilder Results Viewer provides an extensive list of EnergyPlus-generated reports in grid format. Navigating that can be challenging in larger models, so our v4.2 release includes a new option to filter the reports to make it easier to find the relevant information.

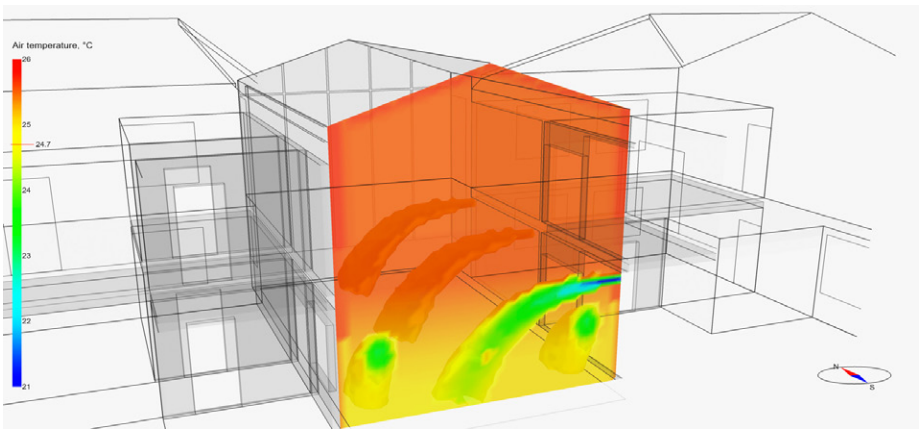
To filter the displayed reports, click anywhere on the grid and press <Ctrl-F>. This displays the Filter text box at the top of the grid, allowing you to input specific filter text. Rows containing Report Type, Area or Schedule data matching the filter text will be displayed, while non-matching rows are hidden.

For example, if you need to view data for a particular zone, type its name in the Filter box. This will display only the reports related to that zone, along with any reports for connected HVAC or other associated components. Likewise, to view data related to a specific air or plant loop, type in the name of the loop.

For more information on using the new filter feature, refer to the Program help (**https://designbuilder.co.uk/helpv7.3/#ResultsViewerDataDisplay.htm**).

You can download Results Viewer v4.2 from our website - **https://designbuilder.co.uk/download/release-software** ■

EQUA release IDA ICE 5



EQUA Simulation AB has released a major update to its simulation software: IDA ICE 5. IDA ICE 5 focuses on three primary areas: indoor climate predictions, the building as an energy 'prosumer', and the use of cloud high-performance computing in optimizing designs.

Indoor climate predictions

IDA ICE 5 offers more precise indoor climate predictions, allowing for holistic studies and optimization of both new buildings and refurbishments within defined financial and physical boundaries.

Building as an energy 'prosumer'

IDA ICE 5 helps designers to move beyond simply meeting legal minimum requirements by introducing the concept of the building as an energy 'prosumer' actively contributing to energy production and efficiency.

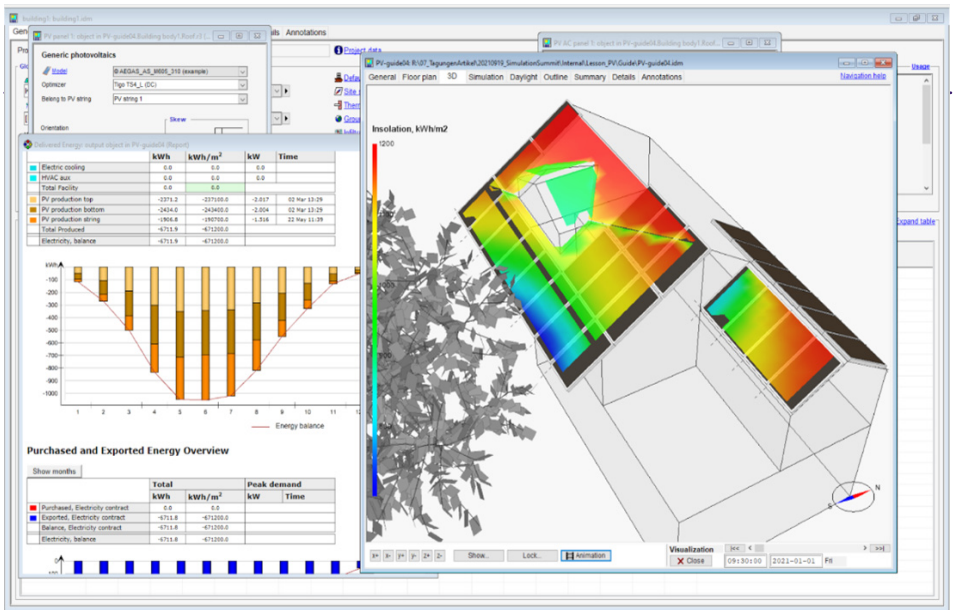
Cloud high-performance computing optimization

Using the simulation model for optimizing window properties, supply air temperature or the size and slope of solar collectors has been possible since IDA ICE 4.8. With the virtually unlimited resources in the cloud, hundreds or thousands of cases can now run concurrently, providing quick and cost-effective results.

Advanced simulation capabilities

IDA ICE 5 contains many other new features, and EQUA has an experienced support team to help designers exploit them effectively to optimize their designs.

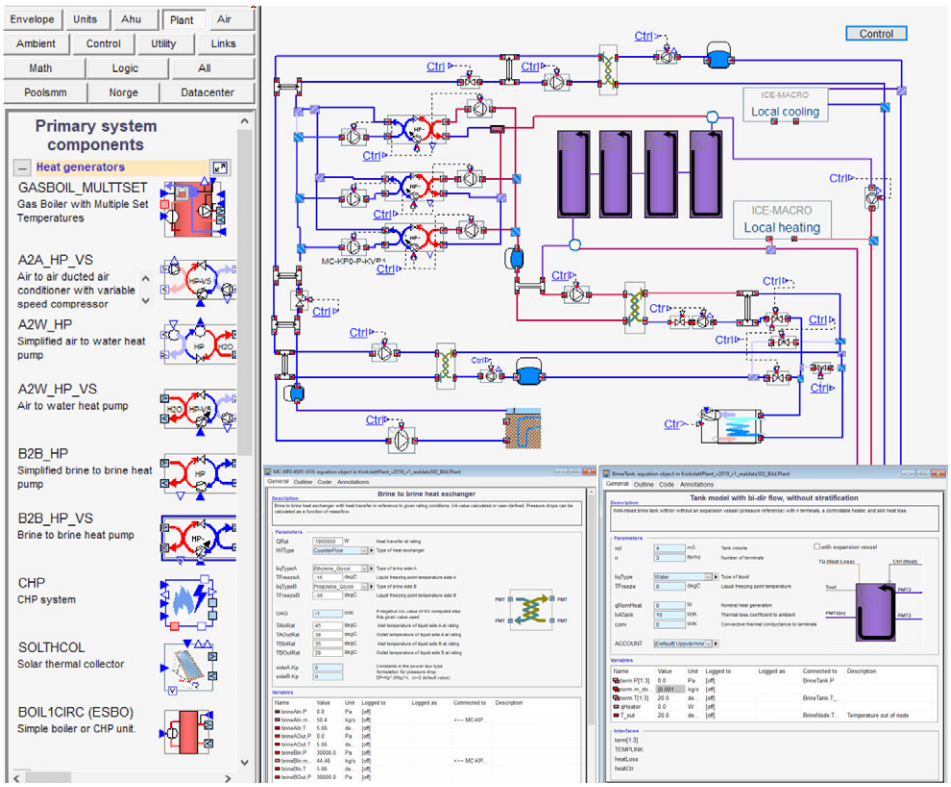
State-of-the-art zone modelling for heating, cooling and ventilation



IDA ICE 5 includes a new zone model for detailed indoor climate analysis with results visualized in a 2D/3D-grid of the zone volume (air temperature, air velocity, operative temperature, draught risk, CO2, PPD, PMV). The new model supports detailed radiation for arbitrary room geometry (also non-convex) with detailed view factor calculation, for long-wave and diffuse solar radiation exchange between surfaces and between surfaces and occupants. Other improvements in IDA ICE 5 HVAC modeling include:

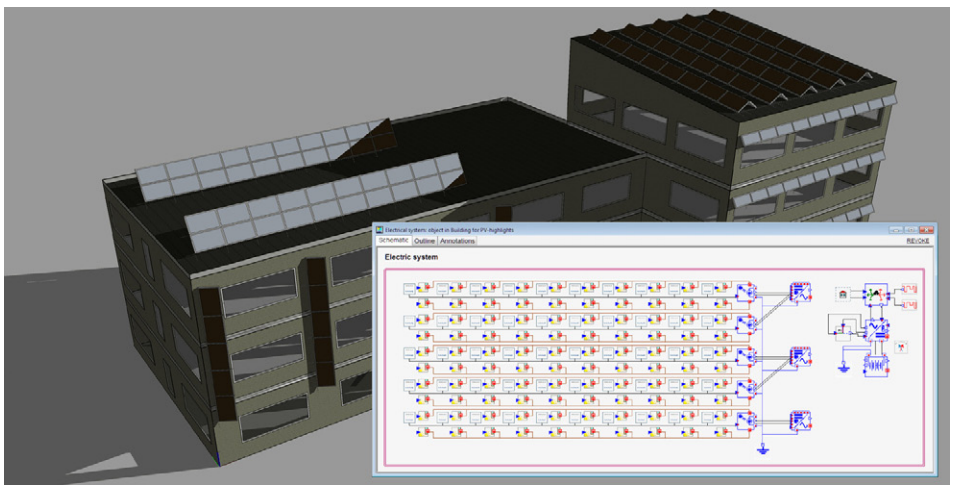
- Air stratification based on flow elements such as jets, plumes, and wall currents, e.g. cold air draft close to window in winter.
- Operative temperature with, optionally, direct and diffuse short-wave radiation taken into account.
- Equipment and other loads with position in the zone.
- Position dependent sensors.

Improved and powerful plant modelling makes it easier to calculate new flow node models, plug flows and circuit checks.



Improved photovoltaics and battery storage

The demand for renewable energy solutions continues to grow, and IDA ICE 5 supports the integration of renewable energy systems into building designs with a brand new tool enabling analysis of building-integrated PV-systems with arbitrary location and multiple arrays. The effect of shading on electricity production due to row-to-row self-shading and shading from surrounding objects is analyzed at cell level.



This new tool supports AC modules (PV module + micro inverter), DC modules in string configuration with different levels of DDC optimizers, DC optimizers just for

shaded modules, invertor power clipping and load sharing between inputs, battery storage and energy management systems, building to module thermal interaction, electrical energy reports and easy logging of time series, and calculation and reports of load matching indicators according to ISO/FDIS 52000-1:2016(E) Annex G.

Cutting-edge capabilities

In today's digital age, interoperability is key to driving innovation and collaboration within the architecture and construction industries. IDA ICE 5 seamlessly integrates with Building Information Modeling (BIM) platforms, allowing users to leverage existing building models and data throughout the design and analysis process. This level of precision enables architects and engineers to make informed decisions early in the design process, leading to more sustainable and cost-effective outcomes.

Meeting regulatory requirements and sustainability standards is paramount. IDA ICE 5 offers comprehensive support for a wide range of industry standards and regulations. Whether it's LEED, BREEAM, or local energy codes, the software equips users with the tools and insights needed to ensure compliance and achieve certification for their projects.

EQUA Simulation AB is committed to continuing innovation, to keeping abreast of emerging energy technologies, and to giving users every possible assistance every step of the way. EQUA values and addresses user feedback.

More information on IDA ICE 5 is available at **www.equa.se/en/ida-ice** .

> *"As we strive towards a greener and more future-proof environment, our customers demand powerful technology to shape a better world. IDA ICE 5 provides reliable analytical simulation data to Architects, Engineers, and many other dedicated building professionals." Max Tillberg, Head of Product Management - EQUA Simulation AB* ■

IBPSA Education Seminars

Occupant-centric simulation-aided building design webinar series

The important influence occupants have on the performance and energy consumption of buildings is well-established. However, understanding and representation of occupant needs and behaviours remains limited in building design. This webinar series draws on the book *Occupant-centric Simulation-aided Building Design* to promote the consideration of occupants as active and dynamic participants in buildings and their performance. Each webinar focuses on a different chapter, and leading experts draw on international research in this field conducted over the last decade to complement the application-orientated approach of the textbook. Details are as follows:

18 Jan 17.00 UTC: Occupant-Centric Simulation-Aided Building Design - An introduction
William O'Brien and Farhang Tahmasebi
https://www.youtube.com/watch?v=sb8CS1FweA4

15 Feb 15.00 UTC: Fundamentals of IEQ and Occupant Needs
Marcel Schweiker
www.youtube.com/watch?v=Ke52X83G0SQ

26 Feb 13.30 UTC: Occupants in the building design decision-making process
Clarice Bleil de Souza
www.youtube.com/watch?v=CURXcnC7tGU

20 March 15:00 UTC: Methods to obtain the occupant perspective
Clinton Andrews
www.youtube.com/watch?v=yOqZlaAwfrY

18 April 17:00 UTC: Occupant-centric performance metrics and performance targets
Tianzeng Hong
https://bit.ly/IBPSA_webinars_thong

6 May 19:00 UTC: Introduction to occupant modelling
William O'Brien
https://bit.ly/IBPSA_webinars_wobrien

14 May 12:00 UTC: Fit-for-purpose occupant modelling: Choosing the right approach
Ardeshir Mahdavi
https://bit.ly/IBPSA_webinars_amahdavi

30 May 13:00 UTC: Advanced simulation methods for occupant-centric building design
Farhang Tahmasebi
https://bit.ly/IBPSA_webinars_ftahmasebi

20 June 19:00 UTC: Building interfaces: Design and considerations for simulation
Julia Day
https://bit.ly/IBPSA_webinars_jday

26 June 16:00 UTC: Design of sequences of operation for occupant-centric controls
Burak Gunay
https://bit.ly/IBPSA_webinars_bgunay

News from IBPSA affiliates

New affiliate: IBPSA-Colombia/Ecuador

IBPSA-Colombia/Ecuador was created on the initiative of Colombian and Ecuadorian professionals aware of the value of existing technological knowledge for sustainable development and environmental protection in our territories. Our main objective is to provide a forum for the exchange of information between professionals, researchers, developers, and practitioners operating in the area of building performance simulation and related issues, and our goal is to sensitize people of Colombia and Ecuador about the importance of Energy Efficiency in energy consumption and environmental protection. We're glad to be part of IBPSA World and have the opportunity to learn and share experiences with other countries. ■

IBPSA affiliates are asked to submit a report to the IBPSA Board each year to keep Board members informed about their activities and membership. These are too detailed to include in ibpsaNEWS, so affiliates have been asked to make their latest annual report available through their web sites, and this section includes only selected, recent news. Other news from affiliates may be available from their websites; the URLs for these are available on the IBPSA Central web site at https://ibpsa.org/about/affiliates.

IBPSA on social media

IBPSA has several internet presences on social media in addition to its main web site, its webinars, and affiliates' sites. Thanks to Mike Barker for collating the list below:

Main IBPSA web site	**https://ibpsa.org**
*There is a wealth of material on the main web site, including past editions of ibpsa*NEWS *back to 1988 and* ***links to affiliates' web sites at:***	**https://ibpsa.org/about/affiliates**

Linkedin:	
IBPSA	**www.linkedin.com/company/ibpsaworld**
IBPSA Group	**www.linkedin.com/groups/75552**
IBPSA - Daylighting & BIPV & Fenestration	**www.linkedin.com/groups/78517**
IBPSA - EnergyPlus + Modelica	**www.linkedin.com/groups/2085105**
JBPS	**www.linkedin.com/company/journal-of-building-performance-simulation**

YouTube (IBPSA University)	**www.youtube.com/@IBPSAUniversity**

IBPSA affiliates

See the IBPSA Central web site at **https://ibpsa.org/about/affiliates** for details of affiliate websites and contacts. Affiliate representatives are voting members of the IBPSA Board except where marked *.

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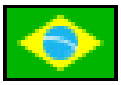

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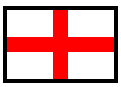

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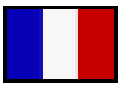

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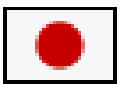

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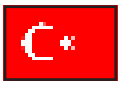

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For additional information about IBPSA, please visit the Association's web site at **https://ibpsa.org**. **For information on joining, contact your nearest regional affiliate.**

Members can subscribe to the IBPSA mail list (and, if desired, unsubscribe or edit) via a web interface which is available at **http://lists.onebuilding.org/listinfo.cgi/bldg-sim-onebuilding.org**. Note that this mailing list is solely for IBPSA-related notices and to ensure that you receive future important IBPSA updates (including the election process and announcements of IBPSA News releases).

For any other purposes, please use the BLDG-SIM list. BLDG-SIM is a mailing list for users of building energy simulation programs worldwide, including weather data and other software support resources. BLDG-SIM is intended to foster the development of a community of those users. Experienced and inexperienced users of building energy simulation programs are welcome and are expected to share their questions and insights about these programs.

If you have any questions with respect to the BLDG-SIM, please contact the list owner:
Jason Glazer at **jglazer@gard.com** or +1 847 698 5686. This list is made possible courtesy of GARD Analytics, Inc., Ridge Park, IL, USA. For further information about this list server, see the web page located at **http://lists.onebuilding.org/listinfo.cgi/bldg-sim-onebuilding.org**. ■


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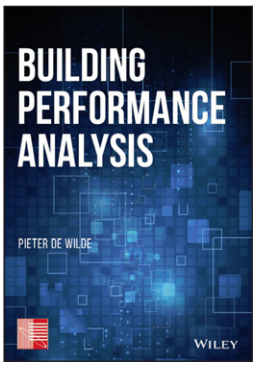
Books by IBPSA Fellows

Building Performance Analysis (Wiley, 2018)



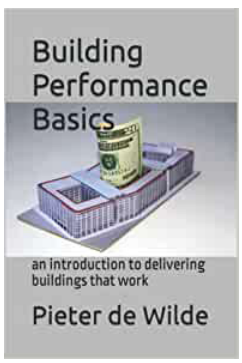
Building Performance Analysis is the go-to resource for those who want to have a deep understanding of what building performance is. The book is endorsed by IBPSA.

Offering a comprehensive and systematic overview of the concept of building performance analysis, *Building Performance Analysis* brings together many existing notions and ideas in one title. A substantial book, it has 11 chapters, 600 pages, and cites over 1600 references. Part I deals with the foundations of building performance, Part II deals with performance assessment, and Part III with the impact of applying of building performance analysis throughout the building life cycle. The book concludes with an epilogue that presents an emerging theory of building performance analysis.

Written for the building science community, it aims to make the following contributions to the field:

1. It reviews the significant body of knowledge on building performance that already exists.
2. It emphasizes that building performance has many aspects, and challenges the community to address those that get less prominence in the literature.
3. Going beyond simulation as a tool for building performance analysis, it also discusses physical measurement approaches, expert judgment, and stakeholder evaluation. It offers a review of the many analysis approaches available in each of these categories.
4. The emergent theory in the epilogue is intended as a key resource for researchers seeking to develop questions and hypothesis. This is intended as matter for discussion, debate, and deeper exploration. ■

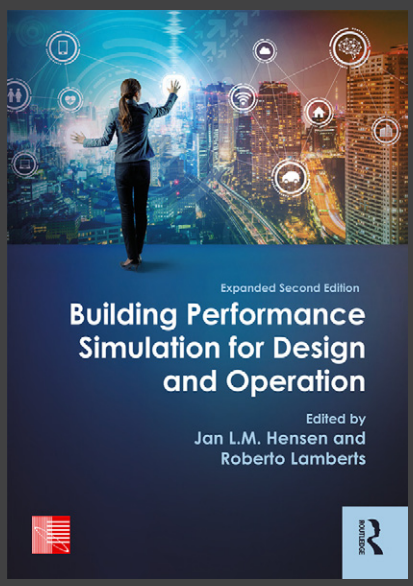
Building Performance Basics (Amazon KDP, 2022)



Building Performance Basics is a short book intended as an introductory text for students at BSc and MSc level, a primer for those entering the industry, and a refresher for those who are already in practice but want to sharpen their view. As *Building Performance Analysis* (above) is rather encyclopaedic, this booklet has been written with a different tone and set-up: short and cheerful, published with Amazon KDP in order to be quick to market, brief and to the point, and more persuasive in order to champion the importance and role of building performance.

Building Performance Basics deals with core questions about building performance: Why is it important? What exactly is it? Where does it play a role? Who should champion building performance? How do we quantify it? And how much performance should we aim for?

Building Performance Basics aims to provide a solid foundation for further professional development and learning about building performance, and for claiming leadership about building performance in practice. In academic courses, it provides context to modules that introduce students to hands-on performance quantification efforts using simulation, measurement and occupant surveys. In industry, this book can be used at any time where there is a wish to refresh a role as building performance champion. ■



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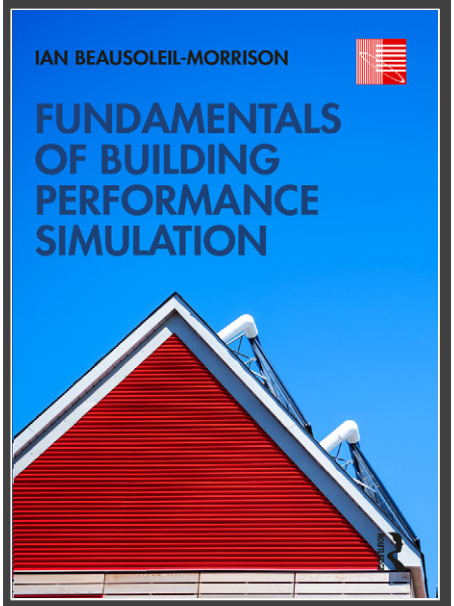

Fundamentals of Building Performance Simulation

Ian Beausoleil-Morrison, Carleton University
Ottawa, Ontario, Canada

Fundamentals of Building Performance Simulation pares the theory and practice of a multi-disciplinary field to the essentials for classroom learning and real-world applications. Authored by a veteran educator and researcher, this textbook equips graduate students and emerging and established professionals in architecture and engineering to predict and optimize buildings' energy use. Each subject is introduced without reference to particular modelling tools while problems at the end of each chapter provide hands-on experience with the tools of the reader's choice.

August 2020: 372pp
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Special Issue: Multi-source Data Integration to Digital World Modeling

Recently published articles *(since previous IBPSA News)*

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Sen Huang, Robert Lutes, Cary A. Faulkner, Draguna L. Vrabie, Srinivas Katipamula & Wangda Zuo (2023) An open-source framework for simulation-based testing of buildings control strategies, Journal of Building Performance Simulation, 16:6, 631-643, DOI: 10.1080/19401493.2023.2191220

Rebecca I. Pinto & Ian Beausoleil-Morrison (2023) Experimental validation of a numerical model for a sand-based seasonal thermal energy storage, Journal of Building Performance Simulation, 16:6, 644-659, DOI: 10.1080/19401493.2023.2191338

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A. Carratt, G. Kokogiannakis & D. Daly (2023) Development and performance evaluation of a minimum input model calibration methodology for residential buildings, Journal of Building Performance Simulation, 16:6, 680-704, DOI: 10.1080/19401493.2023.2195828

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Special Issue: Multi-source data integration to digital world modeling

Manuscript deadline: 15 September 2024 *(the abstract deadline has passed)*

Context:

In an era characterized by the widespread adoption of Building Management Systems (BMS) and Internet of Things (IoT) devices, coupled with advancements in data storage and processing technologies, the data landscape within the realm of building infrastructure has grown increasingly diverse. Data is drawn from various sources and sensors, including Building Information Modeling (BIM), BMS, IoT sensors, and simulations, which collectively capture both the static and dynamic attributes of buildings. The former encompasses geographical, geometric, and thermal characteristics, such as location, building dimensions, and envelope materials, while the latter primarily originates from BMS or field sensors, providing insight into operational data trends.

Recent developments in data-driven methodologies have paved the way for precise digital world modeling, fostering intricate mappings between virtual models and physical systems within the framework of a Cyber-Physical System (CPS). Within the domain of building management, these data-driven algorithms have found applications in energy management, energy consumption/load forecasting, and fault detection and diagnosis.

The amalgamation of multi-source building data offers a wealth of multidimensional information to fuel data-driven digital models, enabling the capture of both spatial and temporal nuances in target buildings. Moreover, the cross-validation of data from diverse sources enhances reliability. Consequently, the fusion and utilization of such multi-source data becomes indispensable in digital modeling, bridging the divide between single-source data-driven simulations and real-world physical systems.

However, multi-source data is often characterized by disparate formats, naming conventions, and granularities, introducing complexity and protracted development timelines. The creation and deployment of algorithms frequently necessitate substantial manual effort, tailored to the idiosyncrasies of each building.

Efforts to address these challenges should include:

- Exploration of multi-source data fusion techniques, such as the establishment of standardized Building Model Integration (BMI) structures.
- The development of comprehensive multi-source data integration strategies for digital twin modeling.
- The formulation of multi-source data integration approaches to enhance building performance simulations, encompassing energy consumption/load prediction, thermal modeling, indoor air quality modeling, and energy systems modeling.
- The design of multi-source data integration strategies to bolster performance evaluation and fault detection.
- The investigation of multi-source data integration methods for intelligent building energy management, encompassing optimization of supply-side system operations and demand-side management, among other areas of exploration.

These endeavors collectively constitute a promising avenue for research and innovation within the field of multi-source data integration for digital world modeling.

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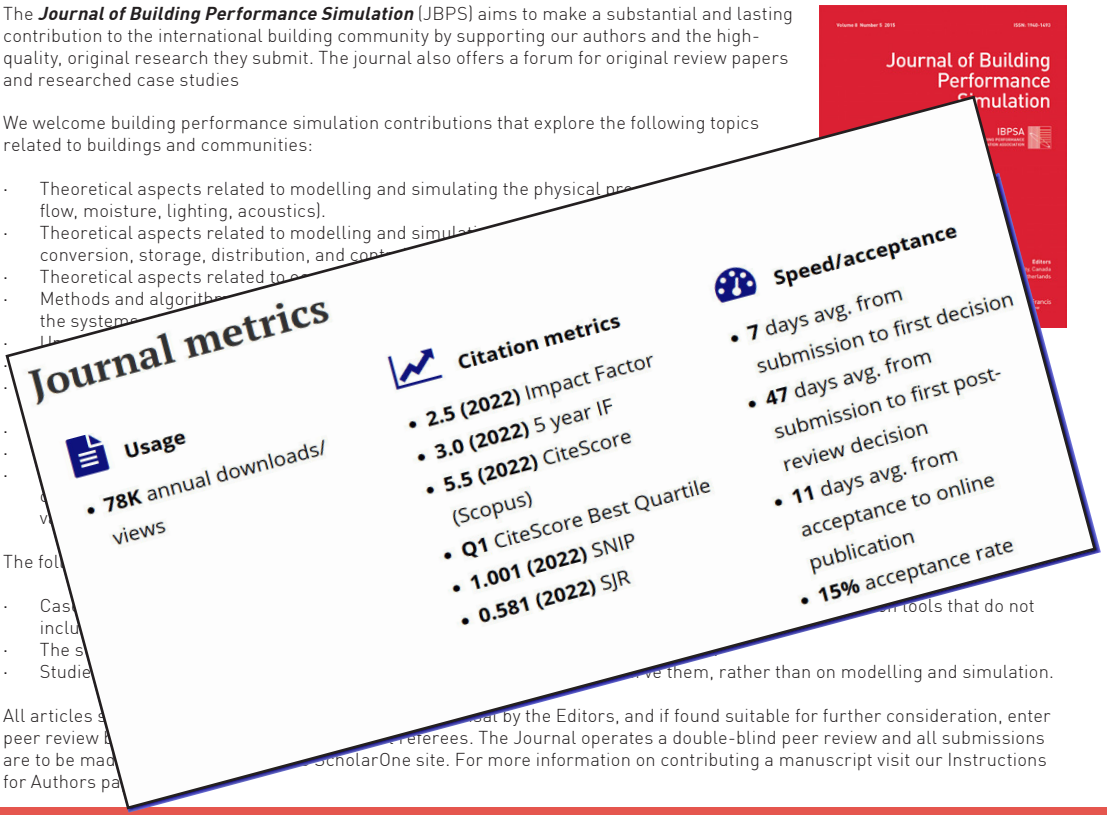

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