Performance and Form: new pedagogical approaches to designing the building envelope as an adaptive interface

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Abstract
Architecture pedagogy plays a significant role in building a sustainable world. Sustainable design requires a thorough understanding of building energy performance, while the urging issue of a changing climate demands for higher energy efficiency and improved energy conservation. This demand challenges conventional ways to program buildings as well as purely formal approaches to the design of their envelope and spatial composition. It is no longer the question to build for one climate instead with the lifespan of a building, design concepts might need to integrate the ability to adapt to at least two climate conditions: current and future. The question is how to educate students to creatively address those challenges, when especially natural ventilation and day-lighting are complex and dynamic phenomena. Architects in general need to be better equipped during the early design phase with knowledge and design tools to integrate and predict dynamic performances of light and air movement to achieve these sustainable high performance buildings

Disciplines
Architecture | Art Education

Comments
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Introduction
Architecture pedagogy plays a significant role in building a sustainable society by shaping a thorough understanding of building performance, while the emerging issue of a changing climate demands for higher energy efficiency and improved comfort. To achieve this, the demand for new pedagogical concepts of teaching and learning result in vertical ways to program buildings as well as purely formal approaches to form-making. Yet, the ultimate compositional goal is achieved only if the new buildings are sustainable.

Challenges of a Changing Climate to Architecture
Because of its dominant factor to mitigate climate change, energy efficiency is no longer seen as the end in itself, but as a prerequisite to designing buildings that are adaptable to change. This in turn implies that architects need to design with climate data from the future rather than the past. Designers need to design with climate data from the future rather than the past. The need for changing climate data is obvious for several reasons:
- The changing climate can lead to changes in temperature, humidity, and precipitation patterns.
- The changing climate can lead to changes in the frequency and intensity of extreme weather events.
- The changing climate can lead to changes in the availability of natural resources such as water and energy.

Performance and optimization as form-givers in an urban context.

The workshop was designed as a five-week intensive course in which students had the opportunity to gain hands-on experience in the design and implementation of sustainable, high-performance buildings.

Typology of the block: Flexibility beyond function
Understanding the contemporary and historic urban typology of Berlin.

The workshop was designed to help students understand the functional requirements of buildings in an urban context, and to develop an understanding of the challenges and opportunities presented by designing in a changing climate.

New parameters - New tools

Berlin's climate is characterized as humid continental, according to the Köppen climate classification system with distinct seasons ranging from cold winters to warm summers. The city is known for its high humidity and day-night temperature difference.

Sustainable design is integrative design
This interdisciplinary program developed as a part of the Sustainable Urban Building Envelope (SUEBE) project, which is an international collaboration between the University of California, Berkeley and the Technical University of Munich.

Urban strategies for a changing climate
Following the analysis of Berlin's urban typology the workshop took the position that flexible and adaptive structures are more resilient to climate change and social change. Therefore the teams were asked to explore program scenarios, which could be retrofitted to adaptive future living or working situations or a combination of both. The strategy is also backed by economic analysis and development models, which are programmed to respond to changes in human behavior, the economy, and the environment.

The SUEBE project involved the development of a comprehensive set of guidelines and tools for the design and development of sustainable, high-performance buildings.

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tion of Berlin's former gas works and the area is still domina-
ted by the 60m high gasometer, which now hosts television talk
shows. Following the historic connection of the site to energy
issues a think tank and research platform for future energy and
mobility solutions is currently emerging. The urban strategies
are based on large scale blockis, while the energy strategies are
focused on a climate neutral mix of onsite renewable energy
resources ranging from geothermal to wind, while the architec-
ture is nondescript, if not to say bland. The master site plan also
follows other parameters apart from carbon neutrality. First of
all there is the orientation of the site, which faces southeast-
west due to the historically inscribed urban infrastructure.
Secondly the site has highly contaminated soils therefore use of
ground was limited, which determined the building footprints to
a large degree.

The urban goal was to develop typological strategies, which
challenged structured parameter of building depth, current buil-
ding codes and investigated innovative models of circulation
and foremost adaptability of the envelope as interface for the
changing climate and changing seasons, while the urban space
could well develop into an in between space, which would be
able to mediate the outside extreme climate conditions.

Form, Performance and Adaptability
In the final workshop all efforts culminated in an iterative pro-
cess to optimize the building envelope performance on multiple
levels by balancing solar radiation through shading strategies,
day lighting and natural ventilation and by rethinking the inter-
face between occuplants, the city and its natural environment.
Iterations mediated between least heat gain and maximum quali-
ty daylight from the inside out and from the outside in using
daylight simulation and parametric models and a physical mo-
del of a prototype envelope component. Based on the first
four workshops each team tested a set of parameters for this
interface between desired interior comfort and urban exterior
space applying climate data and future trends. Finally based on
simulation and optimization some teams challenged the current
master plan and proposed alternatives usually by morphing the
envelope to reduce radiation impact.

Conclusion / Suggestion for practice
The success of this integrative workshop can be noted on mul-
tiple levels. The intercultural study abroad experience provided
career shaping benefits for all of the students and insights into
sustainable design pedagogy. Secondly the program furthered
each participant's understanding of performance parameters as
design tools, which encouraged an iterative form finding pro-
cess above mere form application processes. Daylight perfor-
mance is not often properly understood and distinguished from
sunlight, but the iterative workflow between the two main par-
eters highlighted the difference, elevated concept over form
and facilitated creative application of complex matter. The future
of the program lies in integrating this experimental approach into
a thorough evaluation of contemporary design studio teaching
and the next step for the program would be to integrate spatial
variations into the evaluation and go beyond established orga-
nization diagrams.

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Legenda (Image Captions)
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Fig. 1,1: Aerial site photo (Google Earth)
Fig. 1,2: European Energy Forum (EUREF) site plan (with per-
mission)
Fig. 1,4: European Energy Forum (EUREF) urban space rende-
ring (with permission)
Fig. 1,5: Site context (Photo: Robert Demel)

Fig. 2: Berlin Genoa Barcelona_Analyses on the Urban Scale:
Maps
Fig. 2,1: Berlin Genoa Barcelona_Analyses on the Urban Scale
(Google Earth)
Fig. 2,2: Berlin Genoa Barcelona_Radiation and proportion
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Fig. 3: Berlin Genoa Barcelona_Analyses on the Urban Scale:
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Fig. 4: Form and performance: Student work for the EUREF
campus
Fig. 4.1:Suncica Jasarovic_ Leonardo Brilli_Alice Rosini_Thibault Toudjui

Fig. 4.2: Jie Tian_Haixi Peng_ Mario Krell

Fig. 4.3: Stephane Hallegatte

Fig. 4.4: Google Earth

Fig. 4.5: Nurna, Tsitiridis ws 10/2

Fig. 4.6: Google Earth

Fig. 4.7: Suncica Jasarovic_Leonardo Brilli_Alice Rosini_Thibault Toudjui

Fig. 4.8: Jie Tian_Haixi Peng_ Mario Krell

Fig. 4.9: Stephane Hallegatte

Fig. 4.10: Area Context