FROM ROUGH ESTIMATION OF HEATING ENERGY TO DYNAMIC SIMULATION

PhD Research
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SUSTAINABILITY AND THERMAL COMFORT IN NEARLY ZERO ENERGY BUILDINGS: PARAMETRIC ANALYSIS FOR SUPPORTING DESIGN DECISIONS IN EARLY DESIGN STAGES

THE AIM OF THE RESEARCH
How to support architects to improve the integration of sustainability and thermal comfort in NZEBs for residential buildings from an early design stage onwards.

THE OBJECTIVES
To elaborate a simplified approach to visualize and optimize the impact of NZEBs design from an environmental and economic perspective. (Fig.1)

- Energy efficiency in buildings
- Optimization of comfort requirements for buildings
- Monetization of environmental impacts and life cycle cost

RESEARCH INFORMATION

KEYWORDS
Dynamic Equivalent Degree Day method, Energy efficiency, Design process, Design stages, User behaviours, residential buildings

INTRODUCTION
To achieve the target of NZEBs, architects should increasingly include energy efficiency in their design process from the early design phase on. Tools which produce rough energy estimations from the Pre-design stage and link to the detailed design stage, are required in order to share ideas and solutions between all stakeholders during the design processes. Furthermore, the performance of buildings depends not only on architectural design solutions but also deeply on user behaviours. Hence, this paper proposes a decision support tool including these two perspectives in the early design phase and linked to the later detailed design phase.

METHOD
- Dynamic Equivalent Heating Degree Day method (dynamic EHDD)
- Semi-dynamic solar gain calculation

DESIGN PROCESS

1. Preparation and Brief

- Pre-Design stage

- Undefined geometry

- User requirements
- Design target
- Floor area

2. Concept Design

- Sketch design stage

- Box geometry

- Compactness
- % of window
- Element type
- User behaviours

- Orientation
- Obstruction
- Shading device
- Solar radiation
- Detailed element type

3. Detailed Design

- Detailed stage

- Detailed geometry

- Internal condition
- Comfort/discomfort

- EnergyPlus

REFERENCES
1. Miyamoto, A., Nguyen Van, T., Trigaux, D., Allacker, K., De Troyer, F.: Visualisation tool to estimate the effect of design parameters on the heating energy demand in the early design

TOOL DESCRIPTION

"Dashboard" to navigate in the design space

The "Dashboard" allows to follow up the design decisions during the whole process and the "design history" remains visible. From "pre-design" stage on, the consequences of user behaviours and design targets (total floor area, compactness, insulation level, ventilation strategy) are simulated. Several "support sheets" allow to evaluate step by step in "sketch design" and "preliminary design" stages. The exploration of design space is investigated in the "Dashboard".

User behaviours

1. Setpoint temperature
2. Human activity
3. Use of appliances
4. Ventilation strategy

Obstructions: obstructions attitudes for 24 (360°/15°) and orientations

CONCLUSIONS

The strength of this tool is its capacity:
- to generate fast and comparative energy estimations following different design stages and considering occupant behaviours;
- to facilitate the architect’s design work for energy efficient buildings and communicate it with other stakeholders during the design process.