

# Accepted Manuscript

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PII: S0360-1323(16)30062-2

DOI: [10.1016/j.buildenv.2016.02.018](https://doi.org/10.1016/j.buildenv.2016.02.018)

Reference: BAE 4404

To appear in: *Building and Environment*

Received Date: 23 September 2015

Revised Date: 18 February 2016

Accepted Date: 19 February 2016

Please cite this article as: Samuelson H, Claussnitzer S, Goyal A, Chen Y, Romo-Castillo A, Parametric Energy Simulation in Early Design: High-Rise Residential Buildings in Urban Contexts, *Building and Environment* (2016), doi: 10.1016/j.buildenv.2016.02.018.

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# Parametric Energy Simulation in Early Design: High-Rise Residential Buildings in Urban Contexts

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## 1 ABSTRACT

2 This paper presents a framework for the development of early-design guidance to inform architects and policy-makers  
3 using parametric whole-building energy simulation. It includes a case study of a prototype multifamily residential  
4 building, using an exhaustive search method and a total of 90,000+ simulations. The authors performed a simple sensitivity  
5 analysis to identify the most influential of the tested design parameters on energy use intensity, which included WWR,  
6 Glass Type, Building Rotation, Building Shape, and Wall Insulation, in that order. They identified synergies and trade-offs  
7 when designing for different energy objectives, including (a) decreasing Energy Use Intensity, (b) reducing peak-loads, and  
8 (c) increasing passive survivability – i.e., maintaining the safest interior temperatures in an extended power outage.

9 This paper also investigated the effect of urban context as a source of sun shading and found it to have a substantial impact  
10 on the design optimization. Ignoring urban context in energy simulation, a common practice, would mislead designers in  
11 some cases and result in sub-optimal design decisions. Since in generalized guidelines the future building site is unknown,  
12 the authors tested a method for generating urban contexts based on the floor area ratio and maximum building heights of an  
13 urban district.

## 14 Keywords

15 Energy Modeling; Parametric Simulation; Urban Context; Passive Survivability; Early Design; Resiliency; Peak-Load  
16 Reduction; Multi-Family Housing; Sensitivity Analysis; Cloud Simulation

## 17 1. INTRODUCTION

18 The United Nations expects the world's urban population to nearly double by 2050, increasing from 3.3 billion in 2007 to  
19 6.4 billion in 2050, with much of this growth occurring in developing megacities [1]. Because of this new growth, society  
20 cannot afford to simply replicate standard building practices. New buildings must respond to the local climate and urban

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