N. Gu, S. Watanabe, H. Erhan, M. Hank Haeusler, W. Huang, R. Sosa (eds.), *Rethinking Comprehensive Design: Speculative Counterculture, Proceedings of the 19th International Conference on Computer-Aided Architectural Design Research in Asia CAADRIA 2014,* 955–956.

DIFFERENTIATED SPACE: EVOLUTIONARY EXPLORATION OF SPATIAL CONFIGURATIONS FOR HIGH-RISE RESIDENTIAL BUILDINGS

RUI ZHANG [1] and PATRICK JANSSEN[2]
[1,2] *National University of Singapore, Singapore, Singapore*
zexi1007@hotmail.com, patrick@janssen.name

1. Introduction

This study attempts to test the feasibility of Evolutionary Algorithm as a design tool for exploring spatial configurations for high-rise residential buildings. The aim is to generate configurations where the individual flats and the communal spaces in the building are highly differentiated in terms of their spatial form. The context of this research is Singapore, and the residential buildings are proposed as social housing.

2. Hypothesis and Evolutionary Exploration Method

The premise is that there is no such thing as a 'standard' family, and therefore flats should also not be standardized. The differentiated spatial configurations give each flat and each communal space a distinct identity. The unique three-dimensional volumetric configuration creates a vibrant character for each flat unit, thereby giving the residences a sense of uniqueness. Within these spaces, each family could then develop their own innovative ways of inhabiting the space, by customizing the spatial subdivisions. Meanwhile, the unique interlocked three-dimensional communal space, which penetrates the whole building, not only provides circulation, also encourages the neighbourhood formation by serving as small play ground. To handle this complex design task, this research proposes to use evolutionary algorithm (Franzer 1995), which will allow the configurations to be explored in an automated way, taking into account certain evaluation criteria.

3. Experiment Design

In the demonstration, residential blocks are defined as three-dimensional masses, 27m x 72m, and 20 storey high. These blocks are then split into a cellular grid, with each cell measuring each 4.5m x 4.5m x 3m (Patrick 2004). Flats are then defined as aggregations of such cells. The plot ratio and daylight levels have been taken as key evaluation criteria in the process of optimization (Hanna and Mahdavi 2003; March 1976). These two evaluation criteria are conflicting in nature, interdependent on each other in opposite directions. In order to enable light to penetrate deeper into the blocks, voids are inserted into the massing of the buildings. These voids also create communal areas shared by the neighboring flats, thereby encouraging small communities within the building to form.

The evolved buildings combine a high plot ratio with good daylight availability. The developmental procedure (Figure1) results in flats with complex spatial configurations that allow for new modes of habitation for families in Singapore. Residents are able to select spatial configurations that suit their lifestyles and family sizes. With the particular exploration on the spatial volume and form of the flat units, this strategy can be applied for creating a quality living environment and vibrant living.

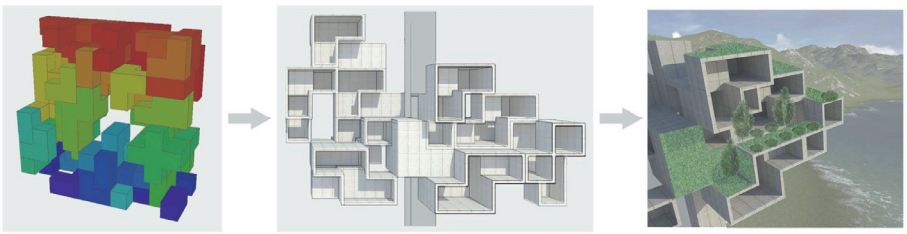

Figure 1. Developmental procedure for a new mode of high-rise residential building typology in Singapore

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