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ScienceDirect

Procedia Engineering 142 (2016) 42 – 47

Procedia Engineering

www.elsevier.com/locate/procedia

Sustainable Development of Civil, Urban and Transportation Engineering Conference

Design Transformation for the Sustainability of High-Rise Residential Buildings

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Abstract

The design of high-rise residential buildings in Shanghai has been changing in recent years. This transformation encompassed the changes in: building shape, floor plan composition, the number of apartments on each floor, the functionality of each apartment and living habits. Gianfranco Caniggia's architectural composition and building typology methodology was used to study Shanghai's architectural transformation. The author has found the following trends: 1. Shanghai's high-rise residential buildings are increasingly following the trend of combined apartment buildings that leads to high economic benefit; 2. Auxiliary area, shared between apartments, are accounting for larger portion of a typical floor plan (additional 12-18% of external auxiliary area). Understanding the causes and effects of this transformation in design will provide valuable lessons for other developing metropolitans in China and other countries in the region.

Peer-review under responsibility of the organizing committee of CUTE 2016

Keywords: Shanghai; combined apartment building; transformation; floor plan

1. Introduction

Caniggia laid the foundation for morphology analysis of architectural transformation [1]. This methodology focuses on the analysis of formation and transformation of both buildings and structural components. In floor plan design, there are four levels of analysis: structural, apartment, urban area, and the region [2]. In this study,

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Peer-review under responsibility of the organizing committee of CUTE 2016
doi:10.1016/j.proeng.2016.02.011

morphology analysis methodology is applied to study the geometric structure and floor plan design of high-rise residential buildings in Shanghai during its developmental periods.

In Shanghai (China), from the 1990s to present day, high-rise residential buildings have grown rapidly as a result of multicipal development policies associated with the market economy. The advantages of high-rise housing include: land saving, larger construction area, can accommodate larger population, higher social investment effectiveness, better location and more convenient transportation. However, high-rise buildings requires much higher capital investment in comparison to multiple storey buildings due to higher cost of elevator system, emergency exit, public transportation, management works and other complex devices.

Typically, Shanghai high-rise buildings have relatively enclosed exterior layers, especially the one that is facing the North direction [3]. All windows, doors, balcony, and corridor are made of reinforced glass to withstand strong wind. This feature is the remarkable characteristic that distinguishes Shanghai high-rise buildings from South China regions and Hanoi.

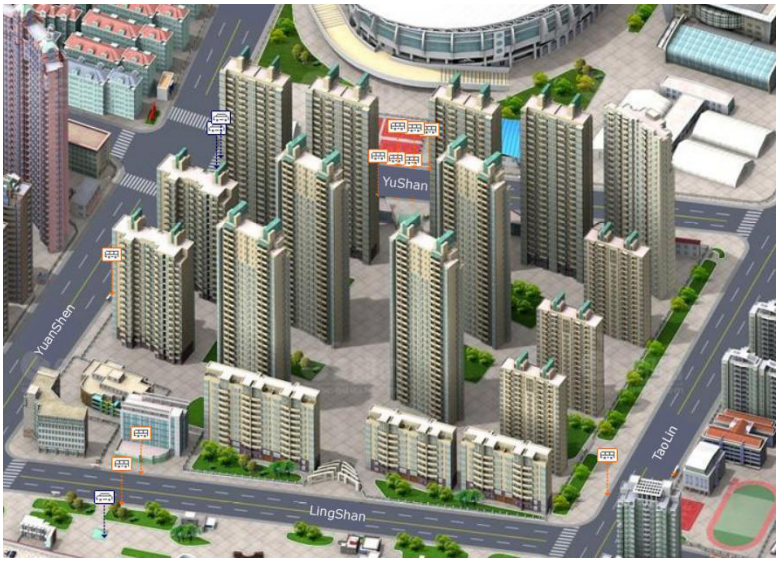

Fig. 1. A high-rise residential building in Pudong, Shanghai [4]

2. The transformation of floor plan design of high-rise apartment buildings

Before 1995, high-rise apartment buildings in Shanghai were almost single tower-shaped buildings. From 1995 up to now, the design has changed from residential tower-shaped buildings into combined apartment buildings. This is the first transformation in the building shape. This floor plan design achieves better solar radiation, reduced heat losses and better natural ventilation. With small depth, the desgin also possesses other advantages such as: better utilization of natural light (instead of artificial light), ease on design arrangement, and improved privacy for the residents. Bedrooms, living rooms are arranged to face the South direction and other rooms to face the opposite direction.

According to Shanghai Department of Architecture and Urban Planning, combined apartment building is at least nine floors high. It consists of many individual departments with each block has its own stair and elevator. The combined apartment building has two edges: the long edge is facing the North-South direction to obtain more sunlight in cold weather; the other one is facing the East-West direction [4].

The “1T2” design, a floor plan that has two apartments sharing one intersection, was popular in the first period of combined apartment building development. In the “1T2” design, shown in Fig. 3, the two apartments share an elevator and exist stairs.