

FLEXIBLE HOUSING
APPLICATION OF SCAFFOLDING SYSTEM AS A
TOOLS IN SUSTAINABLE DESIGN

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ABSTRACT

The residents of high-rise housing have rigid indoor layout that fail to respond to the user change. Thus, the unique identity of residents needs to be addressed through a flexible space and housing layout scheme that can adapt to the user needs and culture. The research aim is to study flexible housing that use scaffolding system as a tool for sustainable living which adapt to the user needs and growth. The flexibility of scaffolding as a tool in house units has been explored during the research. Scaffolding is the most common reusable material, having standardised components, a wide range of forms, and a very simple assembly technique. Case studies have been analysed as methodology for this paper that are based on flexible house and scaffolding structure for interior space flexibility. The author argues through the use of examples, that the adaptability and flexibility of living space to the changing demands of people is a decisive element in the period we live in. Flexibility enables consumers to select the best solution from a multitude of possibilities and simply or inexpensively modify it, which is also part of the notion of sustainable development.

ABSTRAK

Penduduk perumahan bertingkat tinggi mempunyai susun atur dalaman yang kaku dan gagal bertindak balas terhadap perubahan pengguna. Oleh itu, identiti unik penduduk perlu ditangani melalui skema susun atur ruang dan perumahan yang fleksibel yang dapat menyesuaikan diri dengan keperluan dan budaya pengguna. Tujuan penyelidikan adalah untuk mengkaji perumahan fleksibel yang menggunakan sistem perancah sebagai alat untuk kehidupan lestari yang menyesuaikan diri dengan keperluan dan perkembangan pengguna. Fleksibiliti perancah sebagai alat dalam unit rumah telah diterokai semasa penyelidikan. Perancah adalah bahan yang boleh digunakan semula yang paling biasa, dengan komponen standard, pelbagai bentuk dan proses pembinaan yang sangat mudah. Kajian kes telah dianalisis sebagai metodologi untuk kajian ini yang berdasarkan struktur rumah dan perancah yang fleksibel untuk fleksibiliti ruang dalaman. Berdasarkan contoh yang diberi, penulis menunjukkan bahawa kemampuan menyesuaikan diri dan fleksibiliti ruang hidup dengan perubahan keperluan penduduk adalah penentu masa di mana kita hidup. Fleksibiliti membolehkan pengguna memilih penyelesaian terbaik dari banyak pilihan dan menyesuaikannya semula dengan mudah atau murah, yang juga merupakan sebahagian daripada konsep pembangunan lestari.

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CHAPTER 1

INTRODUCTION

1.0 Background Study

As population in cities grow towards the year, housing flexibility is becoming increasingly important in disturbing our everyday lives when people are more concentrate in metropolitan areas and accessible land shrinks. Housing flexibility linked to multiple typologies that enables the spatial or structural modification of buildings to satisfy the demands of users through time by adjusting to technological, cultural, and economic developments. In the late twentieth century, during a time of rapid change in the culture and practise of house construction, the development of building materials enabled an increasing number of individuals to acquire unfinished rooms without walls and participate in the design of their own homes. (Friedman & Krawitz, 2015). James Stirling, who was a British architect in the early 1980s declared that he was "sick and tired of the current architecture's boring, meaningless, non-committed, faceless flexibility and open-endedness."(Schneider & Till, 2005a). Kronenburg in his book mention that flexible architecture has several advantages: it lasts longer, better serves its function, adjusts to user experiences and interactions more quickly, adopts technology changes more quickly, and is more inexpensive and ecologically friendly. Besides, flexible architecture gives better chance of remaining relevant to society and cultural developments (Kronenburg, 2002).

Housing flexibility is based on prolonging the life of the building in order to avoid obsolescence, as well as on sustainable consumption that adheres to recycling and waste management norms. As a result, flexibility permits structures to stay usable

for a long time by allowing for adjustments that ensure continuous usage (De Paris & Lopes, 2018). Flexibility in architecture will help the make the building become more successful as the characteristic of it are directly connected. Dweller use their house unit and workplaces according to their own styles and way of living. Changing the surroundings to suit user needs is a frequent feature of changing a building from an anonymous area to a special 'place'. In today's world, sustainable housing design is crucial since the Earth's ecosystem is on the verge of collapsing owing to damaging human activities, resulting in negative consequences for the planet's ecosystem (Hansen & Patnaikuni, 2015). Building industry have to take action on fight global warming, society must change the way it lives, which involves converting to an environmentally friendly style of life in their houses.

This dissertation explores and focuses on the sustainable tools to design a flexible house that led to culturally responsive buildings. There are many design elements must be carefully put into a house so that it is compatible with the climate in which it will be built. With the rate at which the world's development demands are being met from the planet's valuable and finite resources, it is becoming evident that unless major changes in human thought and conduct occur, the future of civilization as we know it today is in jeopardy (Ragheb et al., 2016). Sustainable architecture benefits the environment, society, and economy. In terms of the environment, green architecture aids in the reduction of pollution, the conservation of natural resources, and the prevention of environmental damage. It saves money for the building's operators by lowering their water and energy bills, while also increasing the productivity of people who use the facility (Thomas, 2009).

1.1 Problem Statement

Buildings created and built using local resources and expertise always give better solutions than imported ones. The designers, builders, and users are frequently the same individuals or closely connected, the challenges of reuse and adaptation are well recognised (Oliver, 1975). The current issues of many housing developments are that it is failed due to a lack of understanding of the factors that influence residential satisfaction. Residential satisfaction is a measure of how well people's housing demands are met. As a result, it serves as a reference for policymakers who want to keep track of how housing regulations are being implemented (Salleh, 2008).

Housing programme performance is defined not only by the availability of housing units, but also by other factors that impact the requirements of the residents. Rigid design emerged as designers' experience and ambition began to diverge from users' experience and expectations, resulting in insufficient, rigid, and unattractive designs, particularly in industrialised countries (Kronenburg, 2005). Hence, the aim of the research is to identify and provide an organisational framework centred on topic examination and debate. The recommended solution of the problem is proposed a new dwelling environment suitable for implementation within user needs and culture in the context of flexible house.

1.2 Research Aim

The aim of this research is to study flexible housing that use scaffolding system as a tool for sustainable living which adapt to the user needs and growth.

1.3 Research Questions

- i. What is the capability of flexible housing scheme to dweller environment that implementation to user needs and culture?
- ii. How does flexibility of scaffolding act as a tool in house unit?
- iii. What is the usage of scaffolding system in flexible housing to achieve sustainable living environment according to the cost and time?

1.4 Research Objectives

- i. To study the capability of flexible housing scheme to dweller environment that implementation to user needs and culture.
- ii. To explore the flexibility of scaffolding as a tool in house unit.
- iii. To investigate the usage of scaffolding system in flexible housing to achieve sustainable living environment according to the cost and time.

1.5 Significance of Research

The aim of the study to explore flexible housing that use scaffolding system through a review of relevant literature, a discussion of valuable results, and an up-to-date overview of the topic. Thus, identification of its structural foundation and elements influencing its evolution, value and relevance of flexible architecture in solving current challenges connected to technological, social, and economic difficulties of the user.

1.6 Research Scope

The study focuses on the flexible architecture refers to structures that are designed to adapt to changing conditions in their usage, functioning, or placement. In other words, the study investigated the design decisions that result in culturally responsive buildings, which defines the features of flexible architecture. This might look into the function of flexibility in conveying a consistent sense of the flexibility of modern housing, such as design, spatial organisation, and the building industry.

The research focuses in Singapore as a country that has become one of the world's greenest metropolitan centres since 2005 thanks to the introduction of the Green Label programme. Singapore is a city-state on the Malay Peninsula's southern tip. He has garnered multiple honours for his work in public housing. The Housing and Development Board, known as HDB has been charged with constructing a significant number of low-cost housing with contemporary sanitation and facilities. This was made possible by the terms of the Land Acquisition Act, which will be addressed further below, as well as a well-thought-out programme to clear land of squatters. The legislation, which is reviewed and modified on a regular basis by legislative acts, allows HDB to purchase land for public housing and other specialised uses.

1.7 Theoretical Framework

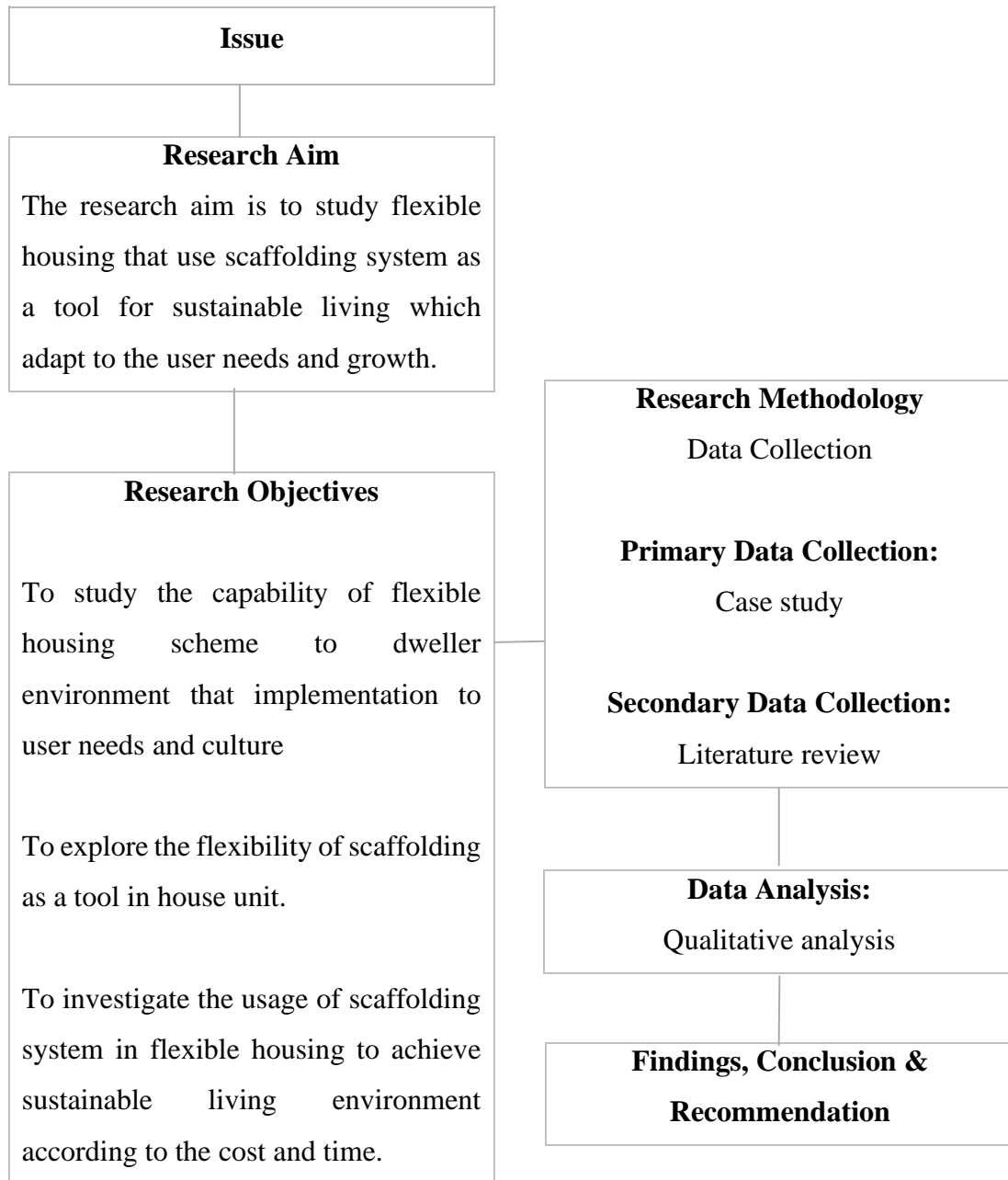


Figure 1.1: Theoretical Framework

1.8 Summary

The research study defines the flexibility of housing and scaffolding system as a tool in house unit thru technological, social, and economic change. Although housing flexibility has been explored previously by scholar, it is important to still being researched to discover new material. Chapter 1 is a description of the background study and issues related to house flexibility to the current time. Concepts of flexibility are used to redefine the current feeling of home. Lack of a clearly defined concept of flexibility, on the other hand, impedes the integration of methodologies and ideas on the issue. Thus, the next chapter will further discuss on the definition of flexible house, function of scaffold, brief of sustainable development in Singapore and the method to achieve sustainable design.

REFERENCES

- A. H. A. Bakar, K. S. Cheen, and Rahmawaty, "Sustainable housing practices in Malaysian housing development: Towards establishing sustainability index," *Int. J. Technol.*, vol. 2, no. 1, pp. 84–93, 2011.
- Abdul Ghani Salleh. (2008). Neighbourhood factors in private low-cost housing in Malaysia. 32, 485–493. <https://doi.org/10.1016/j.habitatint.2008.01.002>
- Abdul Rahim, A., & Abu Hassan, F. (2012). Study on Space Configuration and Its Effect on Privacy Provision in Traditional Malay and Iranian Courtyard House. *International Proceedings of Economics Development & Research* (Vol. 42, pp. 115–119).
- Alaraji K and Jusan M, 2012, Flexible architectural design and user participation, Conference paper, Teknologi University. Malaysia, pp1–4.
- Al-Kodmany, 2018 K. Al-Kodmany The vertical farm: a review of developments and implications for the vertical city *Buildings*, 8 (2) (2018), p. 24
- Bartke, R. W., & Gage, H. R. (1969). *Mobile Homes Zoning and Taxation*. Cornell L. Rev., 55, 491. Kronenburg, R. (2013). *Transportable environments*. Taylor & Francis.
- Campolina, Felipe de Paula. *Andaimos: a evolução do sistema e novas aplicações na construção metálica*. Dissertação (Mestrado) - Universidade Federal de Ouro Preto. Escola de Minas. Departamento de Engenharia Civil. Mestrado Profissional em Construção Metálica. 2017.
- Cellucci, C., Di Sivo, M., 2015. The flexible housing: criteria and strategies for implementation of the flexibility. *J. Civil. Eng. Archit.* 9, 845–852.
- Clara Ott & María Francisca González. "Public Spaces with Scaffolding: an Alternative in Emergency Situations" [Espacios públicos con andamios: una alternativa en situaciones de emergencia] 29 May 2020. ArchDaily. (Trans. Ott,

- Clara) Accessed 23 Nov 2021. <<https://www.archdaily.com/940513/public-spaces-with-scaffolding-an-alternative-in-emergency-situations>> ISSN 0719-8884
- Clark, C.E., 1986. *The American Family Home: 1800–1960*. UNC Press, Chapel Hill.
- Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*: Sage publications.
- Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC medical research methodology*, 11, 100. <https://doi.org/10.1186/1471-2288-11-100>
- D. Félix, J.M. Branco, A. Feio Temporary housing after disasters: A state of the art survey *Habitat International*, 40 (2013), pp. 136-141
- De Paris, S. R., & Lopes, C. N. L. (2018). Housing flexibility problem: Review of recent limitations and solutions. *Frontiers of Architectural Research*, 7(1), 80–91. <https://doi.org/10.1016/j.foar.2017.11.004>
- Department of Statistics Singapore, 2016 Department of Statistics Singapore Population Trends (2016) <https://www.singstat.gov.sg/>, Accessed Oct 2018
- Eldonk, J. (1990). *Flexible Fixation*. Amsterdam: Assen
- F., Souza. (2015). Case Studies as method for architectural research. 10.13140/RG.2.2.15768.19207.
- FEANTSA. (2005). European typology on homelessness and housing exclusion.
- Friedman, A., & Krawitz, D. (2015). The Next Home : Affordability through Flexibility and Choice. 2746(October). <https://doi.org/10.1080/08882746.1998.11430288>
- Glumac, B. (2021). Tiny portable home : Measuring the rental preferences. *Cities*, 116(January), 103279. <https://doi.org/10.1016/j.cities.2021.103279>
- Glumac, Brano, & Caballe Fabra, G. (2018). Housing in a Mobile World: A Definition of Flexible Housing and the Classification of Solutions. *SSRN Electronic Journal*, September. <https://doi.org/10.2139/ssrn.3267132>

- Goundar. (2012). Chapter 3 - Research Methodology and Research Method, Victoria University of Wellington, 1-43.
https://www.researchgate.net/publication/333015026_Chapter_3_-_Research_Methodology_and_Research_Method.
- Guba, E. G. & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In Denzin, N.K. & Lincoln, Y.S. Handbook of qualitative research, 3rd Edn. (pp. 105 – 117). California: Sage.
- Habraken, J. (1972). Supports: An Alternative to Mass Housing. London: Architectural Press.
- Habraken, J., Boekholt, J., Dinjens, P., Thijssen, A., Wiewel, W., & Gibbons, S. (1976). Variations: The Systematic Design of Supports. Cambridge, Mass: Laboreratory of Architecture and Planning at MIT.
- Hansen, H., & Patnaikuni, I. (2015). Design of Sustainable House for Reducing Energy Use. February.
- HDB, 'Past Achievements', www.hdb.gov.sg/cs/infoweb/about-us/achievements-and-accolades/achievements/past-achievements.
- House in Kashiwa / Yamazaki Kentaro Design Workshop" 04 Aug 2019. ArchDaily. Accessed 24 Dec 2021. <<https://www.archdaily.com/506426/house-in-kashiwa-yamazaki-kentaro-design>> ISSN 0719-8884
- Israelsson, N., Hansson, B., 2009. Factors in fluencing flexibility in buildings. Struct. Surv.27(2), 138–147.
- John Habraken, Supports: an alternative to mass housing (London: Architectural Press, 1972).
- Joo T.T.K., Wong TC. (2008) Public Housing in Singapore: A Sustainable Housing Form and Development. In: Wong TC., Yuen B., Goldblum C. (eds) Spatial Planning for a Sustainable Singapore. Springer, Dordrecht.
https://doi.org/10.1007/978-1-4020-6542-2_8
- Julaihi Wahid. (1998). Changing territory for privacy through housing transformations. Journal of HBP, Volume V, Universiti Sains Malaysia, Pulau Pinang.

- Jusan, M. M., *Renovation for personalization: A development arm for sustainable housing*, 1st ed. Malaysia: Penerbit UTM Press, 2010
- Kronenburg, R. (2005). *Flexible Architecture: The Cultural Impact of Responsive Building*. *Open House International*, 30(2), 59–65. <https://doi.org/10.1108/ohi-02-2005-b0008>
- Lu, M. (1999). *Determinants of residential satisfaction: Ordered logit vs. regression models*. *Growth and Change*, 30(2), 264–287. <https://doi.org/10.1111/0017-4815.00113>
- Lye, L. (2020). *Public Housing In Singapore : A Success Story In Sustainable Development*. 8(19).
- Magdziak, Monika. (2019). *Flexibility and Adaptability of the Living Space to the Changing Needs of Residents*. *IOP Conference Series: Materials Science and Engineering*. 471. 072011. [10.1088/1757-899X/471/7/072011](https://doi.org/10.1088/1757-899X/471/7/072011).
- Maggio, L. A., Sewell, J. L., & Artino, A. R., Jr (2016). *The Literature Review: A Foundation for High-Quality Medical Education Research*. *Journal of graduate medical education*, 8(3), 297–303. <https://doi.org/10.4300/JGME-D-16-00175.1>
- MIMA House / Mima Architects 15 Dec 2011. *ArchDaily*. Accessed 26 Dec 2021. <https://www.archdaily.com/192043/mima-house-mima-architects>> ISSN 0719-8884
- Moore, G. T., Tuttle, D. P., & Howell, S. C. (1985). *Environmental Design Research Directory*. Praeger, New York.
- Nainggolan, S. M., Dewi, O. C., & Panjaitan, T. H. (2020). *10 Criteria of Sustainable Housing: A Literature Review*. 475(*Idwell*), 42–53. <https://doi.org/10.2991/assehr.k.201009.005>
- Oliver, P. 1975. *Shelter, Sign and Symbol*. London: Barrie and Jenkins.
- Ong, K. C. G. (2017). *Sustainable Construction for Singapore's Urban Infrastructure - Some Research Findings*. *Procedia Engineering*, 171, 14–21. <https://doi.org/10.1016/j.proeng.2017.01.305>
- Pereira, Matheus. "Architecture Classics: Teatro Oficina / Lina Bo Bardi & Edson

- Elito" [Clássicos da Arquitetura: Teatro Oficina / Lina Bo Bardi e Edson Elito] 11 Sep 2017. ArchDaily. (Trans. Carvalho, Guilherme) Accessed 24 Nov 2021. <<https://www.archdaily.com/878754/ad-classics-teatro-oficina-lina-bo-bardi-and-edson-elito>> ISSN 0719-8884
- Pfeifer, G., & Brauneck, P. (2008). *Row Houses: A Housing Typology* (p. 6). Germany: Birkhauser.
- R. Emas, "The Concept of Sustainable Development: Definition and Defining Principles, Florida International University," Br. GSDR 2015, pp. 1–3, 2015.
- Ragheb, A., El-shimy, H., & Ragheb, G. (2016). GREEN ARCHITECTURE : A CONCEPT OF SUSTAINABILITY. 216(October 2015), 778–787. <https://doi.org/10.1016/j.sbspro.2015.12.075>
- Raviz, S. R. H., Eteghad, A. N., Guardiola, E. U., & Aira, A. A. (2015). Flexible housing: The role of spatial organization in achieving functional efficiency. *Archnet-IJAR*, 9(2). <https://doi.org/10.26687/archnet-ijar.v9i2.422>
- Schneider, T., Till, J., 2005a. Flexible housing: opportunities and limits. *Archit.Res.Q.9(2)*,157–166.
- Schneider, T., Till, J., 2005b. Flexible housing: the means to the end. *Archit.Res.Q.9(3–4)*, 287–296.
- Schneider, T., Till, J., 2008. *Flexible Housing*. Taylor & Francis, London.
- Slaughter, E. S., 2001. Design strategies to increase building flexibility. *Build. Res. Inf.* 29(3), 208–217
- Souza, Eduardo. "Scaffolding: From Auxiliary Equipment to Primary Function" [Andaimes: de equipamento auxiliar a protagonista na arquitetura] 23 Dec 2020. ArchDaily. Accessed 24 Nov 2021. <<https://www.archdaily.com/953492/scaffolding-from-auxiliary-equipment-to-primary-function>> ISSN 0719-8884
- Stefan Muthesius, *The English Terraced House* (New Haven: Yale University Press, 1982). Michael Thompson, *Rubbish Theory: The Creation and Destruction of Value* (Oxford: Oxford University Press, 1979).

- Tealida. (2015), "List of BTO Projects." Housing in Singapore Studied by Tealida. Retrieved June, 2016 from: <http://www.tealida.com/singapore/btolist/>
- Thomas Rettenwender, 2009, M.A., Mag. Arch., LEED AP, Architect and Niklas Spitz Monterey Peninsula College INTD62 Spring 2009" The Principles of Green Building Design" Spring 2009.
- W. Visser and G. H. Brundtland, "Our Common Future ('The Brundtland Report'): World Commission on Environment and Development," Top 50 Sustain. Books, pp. 52–55, 2013.
- Waters, Colin. Reaching for the sky – A potted history of scaffolding. scaffmag: The Scaffolding Magazine. Dec 9, 2016 https://scaffmag.com/2016/12/reaching-for-the-sky-a-potted-history-of-scaffolding/?utm_medium=website&utm_source=archdaily.com
- Wood et al., 2000 S. Wood, K. Sebastian, S.J. Scherr Pilot Analysis of Global Ecosystems: Agroecosystems, 110, International Food Policy Research Institute and World Resources Institute, Washington, DC, USA (2000)
- Xie, K., & Shen, Hu. (2014). The Architectural Space Analysis of SOHO Ke Xie. 914, 1801–1804. <https://doi.org/10.4028/www.scientific.net/AMR.912-914.1801>
- Yin RK. Case study research, design and method. 4. London: Sage Publications Ltd.; 2009.
- Yin, R. K.-Z. (2003). Case study research: design and methods/ Third Edition. London, Sage.