

Exploring Potentials of Sustainability in Traditional Courtyard Houses in Hot-Arid Regions:

A Socio-Spatial Syntax Method



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Research Context:

In the age of globalisation and continuous urbanisation, architects have a greater responsibility to design residential buildings with comfortable and sustainable environments. However, **sustainable solutions** should not concern themselves only with utilising technology, but also with creating **synergies amongst a community's cultural, historical, social, and environmental aspects**. This research focuses on the implications of this wider definition of sustainability within the hot-arid climates of the Middle East and North Africa. Most of the current residential developments in these regions do not promote social cohesion as they have been constructed without consideration for **local identity and lifestyle**. In contrast, vernacular courtyard houses offer good examples of socially cohesive and healthy environments. Yet, vernacular houses might not be compatible with the needs and pressures of modern construction. The question then becomes one of maintaining the relationship between the spatial and social aspects of dwellings while employing the latest technologies and material.

A successful design of a 'contemporary vernacular' residential building means that it has an **identity** where all components are in harmony with the context, the past, and the requirements of the modern and future time.

Research Framework:

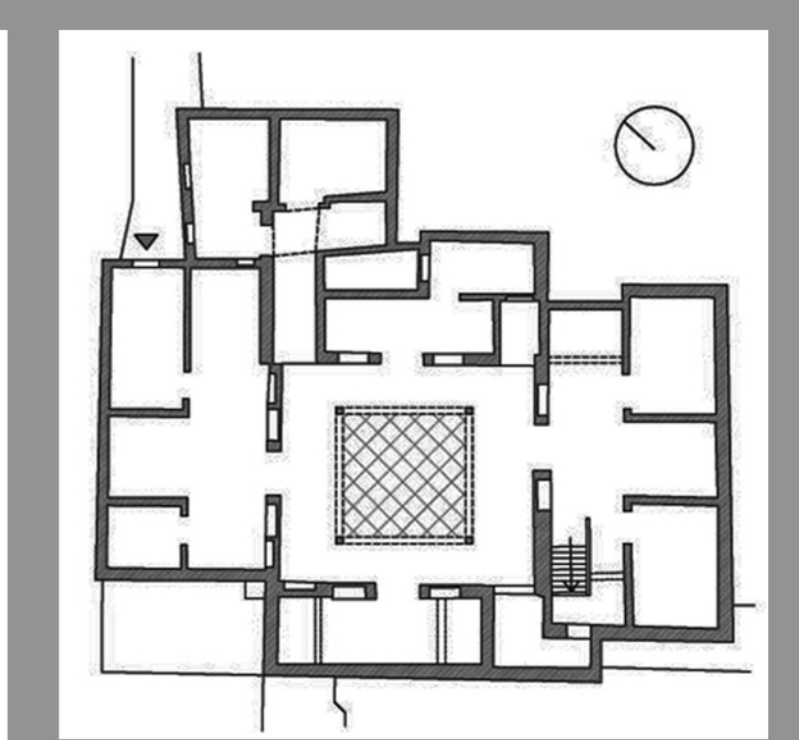
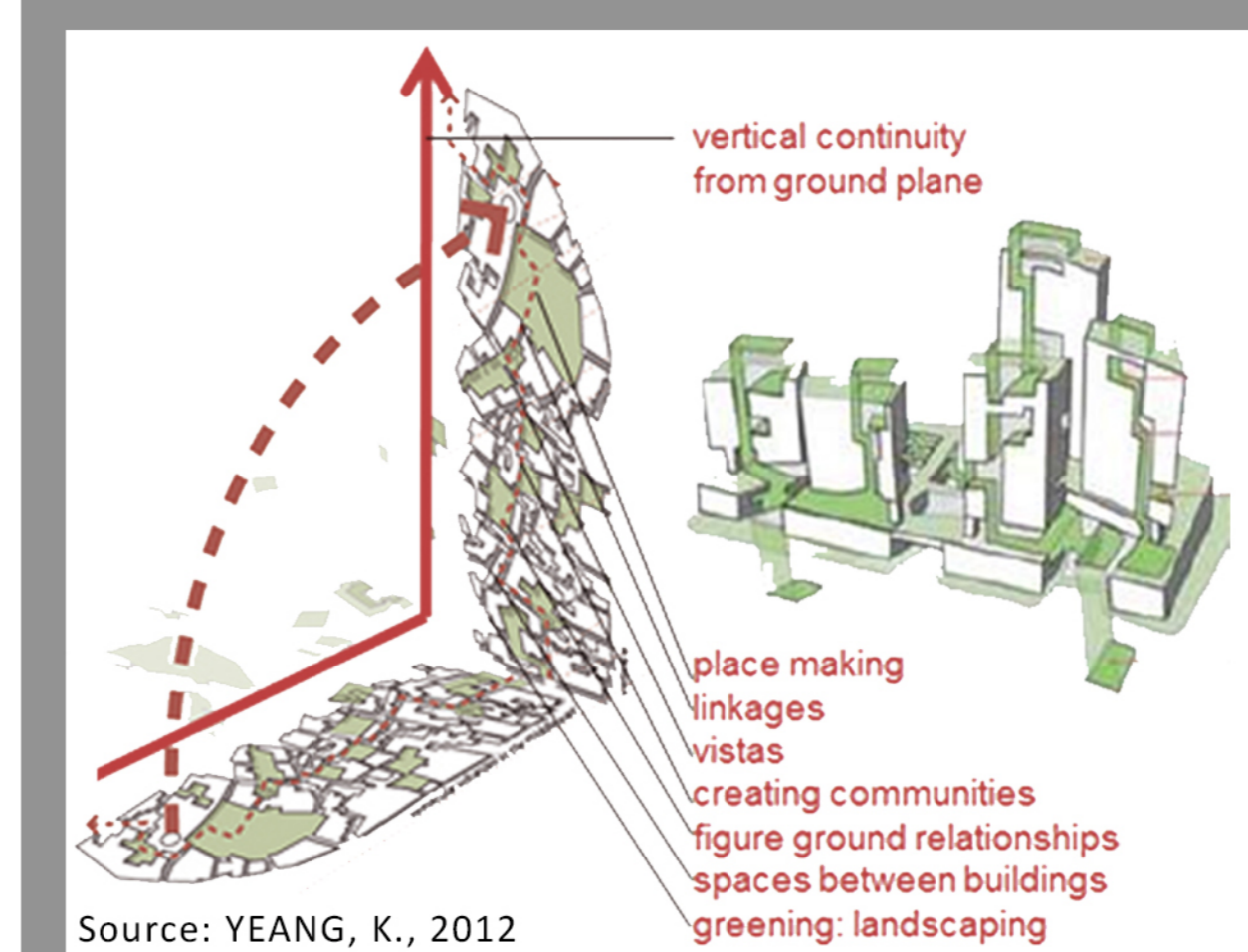
The relationships between the spatial organisation of courtyard houses and the social patterns of such arrangements are assessed, through a **typological analysis approach** based on the space syntax method, as a trace of lifestyle and cultural values of the society. The aim is the parametric exploration of appropriate sustainable solutions that facilitate the synergy of socio-climatic requirements, the well-being qualities of the residents, and the specifics of culture, time and people.

A Syntactic-Geometric Model for Encoding Traditional Houses as a Trace of Social and Environmental Qualities

This model depends on combining the 'space syntax method' with three aspects of design: (a) analysing the **geometric characteristics** (shapes, areas, and proportions); (b) identifying **social indicators** (privacy, users, patterns of movement, and distances between spaces); (c) specifying **environmental solutions** (orientation, and type of enclosures).

Conclusions:

These analytical information need to be translated into rules and constraints that are useful for generating parametric solutions. This process will be conducted in the next stages of this ongoing research, which aims to construct a **socio-spatial grammar** for tall buildings in MENA regions. Such a grammar will include (1) **shape grammars** that reflect shapes, vocabularies, proportions, geometric properties, and formal rules; and (2) **programming grammars** that define design briefs and descriptions.

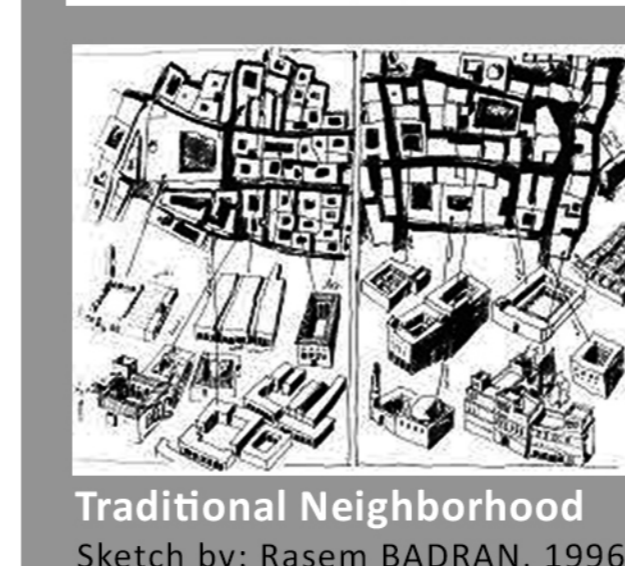


A traditional house in Tunisia

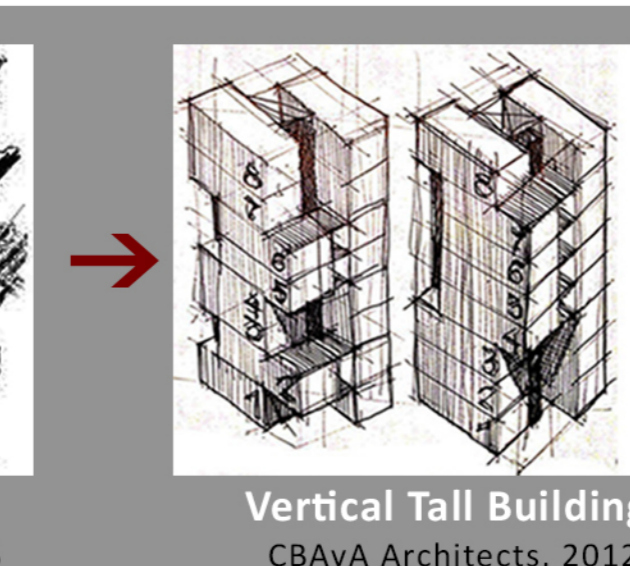
Learning from the Vernacular Model

The use of courtyard as an architectural mean to mediate between:

- Open & closed,
- Inside & outside,
- Environment & Social constraints,
- Nature & culture.



Traditional Neighborhood Sketch by: Rasem BADRAN, 1996



Vertical Tall Building CBAyA Architects, 2012

Social-Cultural Dimension	Environmental Dimension	Economic Dimension
<ul style="list-style-type: none"> Supportive environment for families and children Interactive spaces Hierarchy of spaces Privacy Local culture and lifestyle 	<ul style="list-style-type: none"> Low energy consumption through passive design elements Natural ventilation: orientation, courtyard, wind catcher Passive solar: Layout and zoning, window size and location, shading devices, colours, materials, semi-open spaces Cooling evaporation: Water features, vegetation, surrounding walls in public and private spaces Local materials 	<ul style="list-style-type: none"> Low operating cost Local materials Possibilities for future expansion

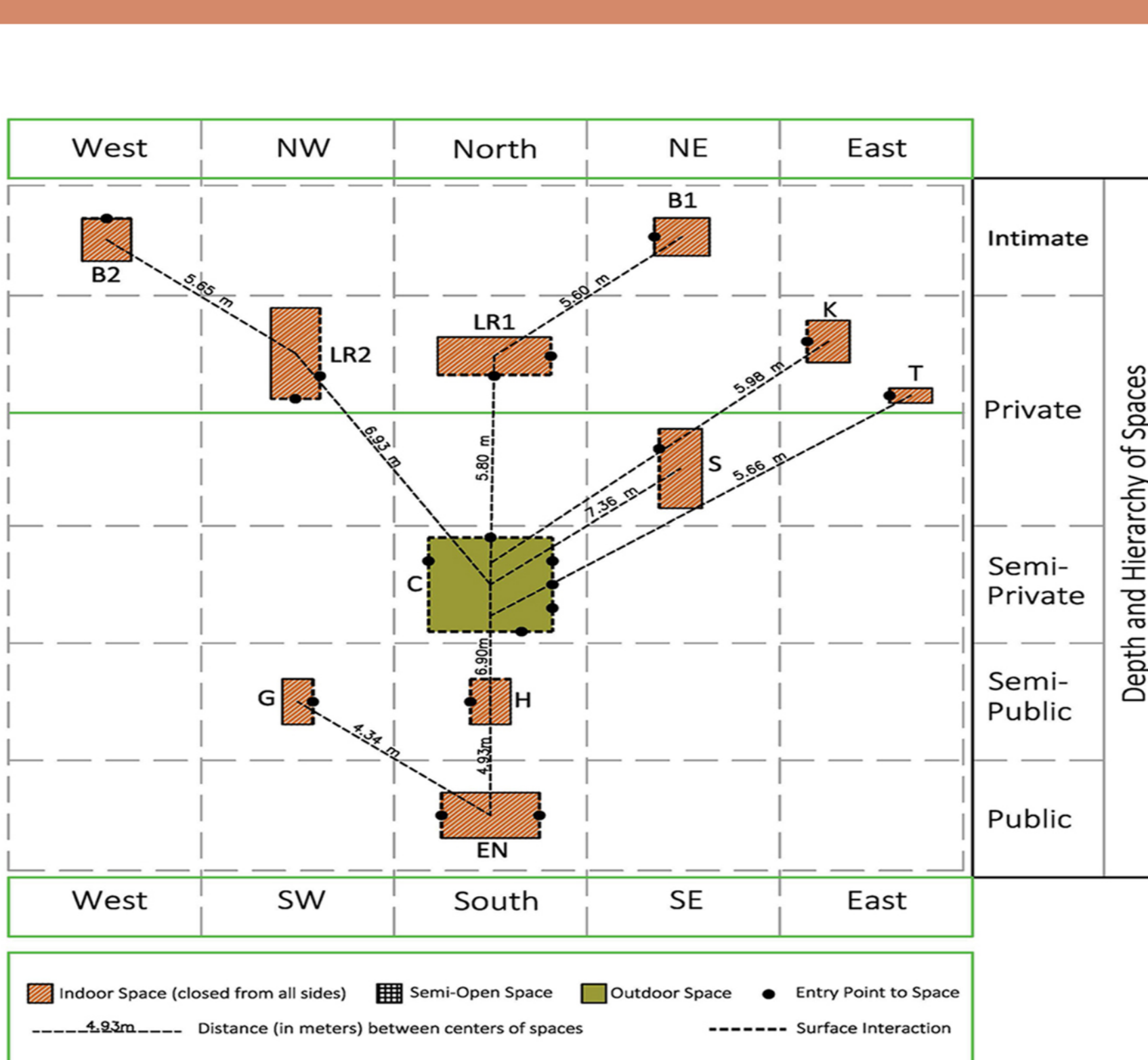
Dimensions of Sustainability at the Scale of Vernacular Courtyard House

5. Spatial and Geometric Relationships

Spatial and Geometric Relationships													
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XY: 1:1.67	%All: 11.67%												
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D2: 11.82	Users: M+F												

M : Predominant Male Users
F : Predominant Female Users
XY : Proportion of the Space
%All : Percentage of Area from the Overall
1:C : Proportion related to the Courtyard
D1 : Distance (in Meters) from the Main Entrance (N1) to the Center of Space
D2 : Distance (in Meters) from the Center of Courtyard (N2) to the Center of Space

4. Orientation, Depth and Hierarchy of Spaces

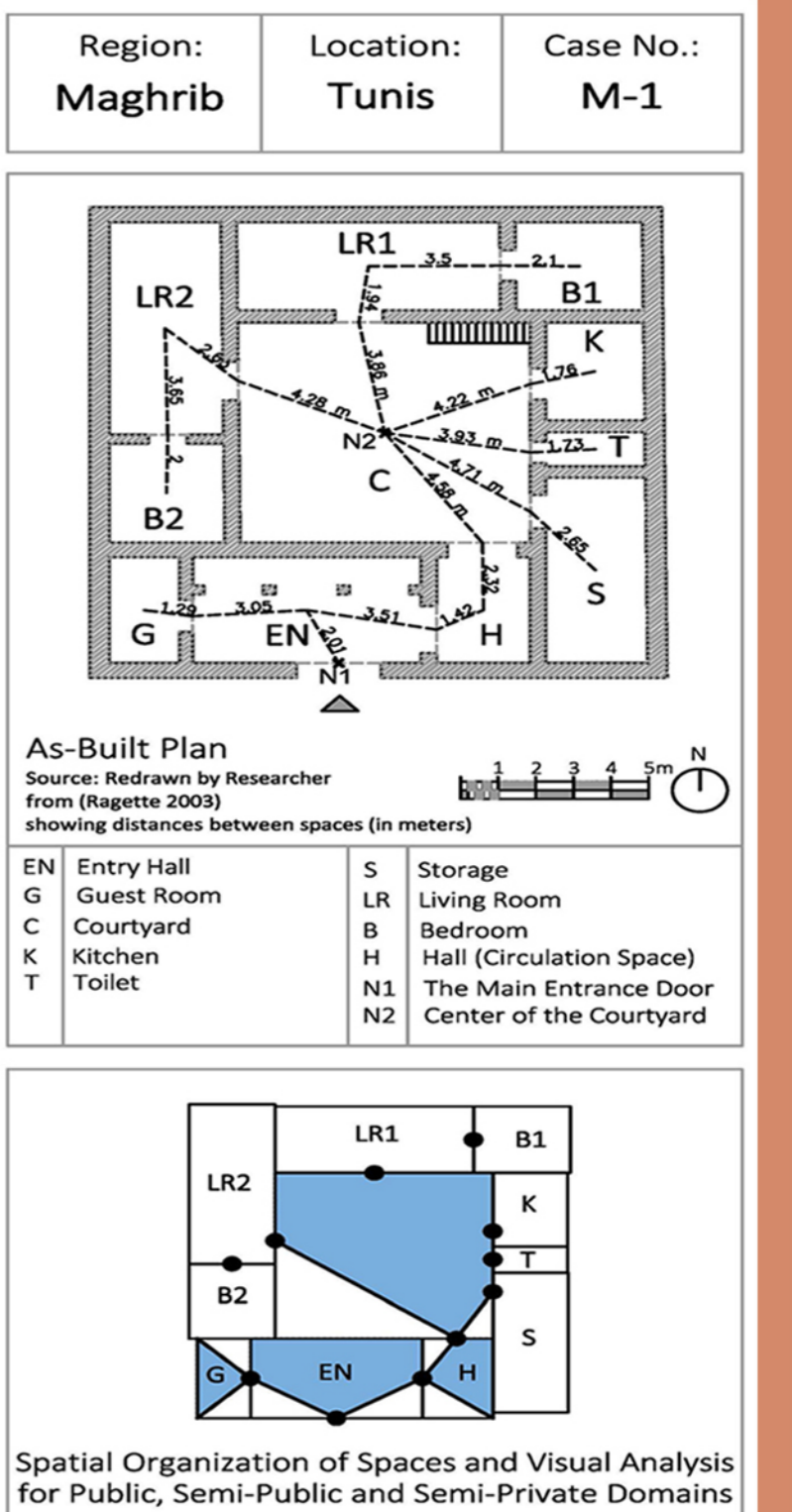


3. Space Syntax Analysis: Connectivity, Integration value, Control value

Space Syntax Analysis																																																																																																																																																
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TDn: TDn - Total Depth (TD) for actual node
 MD: MDn - Mean Depth (MD) for actual node = TD/(K-1)
 RA: RA - Relative Asymmetry = 2*(MD-1)/(K-2)
 I: I - Integration Value = 1/RA
 K: K - Number of Nodes
 CV: CV - Control Value
 NCn: NCn - Number of Connections
 Diagrams and Calculation are produced by AGRAPH (Online software, <https://www.mtnu.no/ab/spacesyntax>)

1. As-Built Plan 2. Visual Analysis Diagram



The developed model has five components: