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# The genomic tabulation of Kampung Tambora's massing series
## Case study: Kampung's Boundary

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ABSTRACT

*Well-known as one of the most crowded and problematic urban kampungs in ASEAN since 2020, Tambora has been struggling with health, fire, and social problems. Its density is related to the composition between solid and void especially on the boundary as they control the accessibility while influencing the overall gesture of the kampung. Unfortunately, the majority of research related to boundaries is more interested in delineation rather than 3D relationships. Further investigation is required to understand its series of volumetric composition, configuration, and orientation to comprehend its architecture as a continuation of its geometrical investigation. As boundaries are relatively considered more stable locations, they exhibit intensity, complexity, and hybridity between formal and informal. A diverse collection of houses at these particular locations displays specific language while providing correlation. Genomic tabulation is utilized to interpret the kampung massing series' spatial quality. The QGIS instrument converts lines into volumes, with steps are follows: 1) collection of data, 2) conversion of 2D into 3D, and 3) interpretation of the samples. By focusing on the massing series at the kampung boundaries, the typology and morphology are emerged, providing various gaps and potentials as alternative solutions for building the kampung network.*

## Introduction

Kampung Tambora is located at Pangeran Tubagus Angke Street, a sub-district of West Jakarta. With a demography of 241,889 inhabitants and a density of 116,020/sqm, in 2020, Tambora was once claimed to be the most densely populated area in South East Asia. The controversies emphasize problems of severe cases such as fires, floods, and inaccessibility caused by overcrowded (Sutanti, Tjahjono, and Syaufina 2020). The research objectives are to understand the relationship between kampung geometry and its massing series to contribute a significant issue towards density. The research aims to raise kampung architectural potency while questioning the definition of urban kampung from the other architectural concepts (Husin, Prijotomo, and Sugiharto 2021). Apart from this phenomenon, Tambora is reviewed as another type of informal settlement in the city. Growing and working together with its city, its geometric concept is hypothetically related to formal-informal hybridization. Thus, the investigation focuses on networks of boundaries that beneficially provide the best sample of the mix in the area (Nugroho and Murtasidin 2023).

**Figure 1.** Fire in Tambora on July 2023
Source: https://radartegal.disway.id/upload/dd3f5a1bb3d7fe47271970296912fa07.jpg, downloaded on November 7th, 2023

The quality of kampung space has been oftenly doubted (Solikhah and Fatimah 2020), while most researchers are interested in revealing its interior, depicted as cramped, dark, dirty, and disorganized (Tsaqila, Miladan, and Utomo 2021) (figure 1). This paper offers state-of-the-art focuses on the kampung external area: the periphery that holds the gesture of the relationship to its contexts (Lianto et al. 2022). The study shifts from a common delineation focus to unraveling the three-dimensional relationships on kampung boundaries (Lianto et al. 2021). The novelty is to present the quality of its massing by representing the typology and morphology of its fabrics (Desiyana 2022).

**Figure 2.** Crowded space in Kaliayar, Tambora photographed in January 2023

Redefining architectural mass

Massing is commonly defined as a three-dimensional spatial shape (Skeat 1993) that can be presented from various perspectives (Najafi and Faizi 2017). Theoretically, the mass has the potency to influence the total perception of space because of its gigantic physical dimensions (Aureli 2011). Represented as a building envelope, the mass is associated with the architectural form, an expression between the outer and inner areas (Lucan 2012). Especially in the case of kampung both additions or subtractions constitute a tight connection between the solids and voids while exhibiting spatial wholeness (Lirenzsa, Ellisa, and Paramitha 2020). Kampung Tambora has been defined as having a small grain with a close-knit joint urban fabric as a result of its severe density (Ismawan 2008).

Massing model and spatial quality

More academic research put concern to this type of fabric, recommending the process investigation especially related to the massing as it offers distances, dimensions, and connections (Lucan 2012). As a macro investigation, the study suggests efficiency, performance, and effectivity (Ariffin, Rashid, and Salleh 2013), though local inspiration and detailed structures must be added to support kampung as a type of microstructure (Sudaryono 2012). Different compositions and proportions may be found in kampung (Desiyana 2022), thus scrutinization towards configuration is prime (Nugroho and Murtasidin 2023).

Massing a network

A network is a structure consisting of mixed DNA (Besserud and Cotten 2022), a representation of ephemeral structure as kampung grows according to organic characteristics (Madina et al. 2019). Tambora's overall structure shows semi-parametric variation, similarity, and dissimilarity (Desiyana 2022) while acting as an anomaly (Desiyana 2019). It displays dominancy and recession (Tundono, Zohrah, and Puspitasari 2020), an agglomeration that holds a development paradigm (Karen, Ratnaningrum, and Gandha 2021).

Massing as a group form

Collective ideology is reflected in the life of its inhabitants (Lefebvre 2013). Kampung Tambora produces its own space, which is far away from uniformity although it seems to show a similar pattern (Desiyana 2022). It is impossible to find the same house, although connected, related, attached, or even shared (Lirenzsa, Ellisa, and Paramitha 2020). As a group, it acts as a core of middle to low-range economic value (Ismawan 2008), and is constructed based on a communality (Solikhah and Fatimah 2020) (figure 3).

**Figure 3.** Serial view of Kampung Duri Tambora: A group form in a border

Architecture of the border

Although a boundary is generally defined as a line that marks the limit of an area (Skeat 1993), in a kampung, boundaries are often interpreted as differentiators or determinants and not limited to possessing various functions (Lirenzsa, Ellisa, and Paramitha 2020). In Tambora, boundaries also stimulate tension (Ismawan 2008) and accelerate changes (Karen, Ratnaningrum, and Gandha 2021). It provokes transformation and stimulation yet encourages negotiation, transfer, and exchange (Fikriyah 2023) that influence the production of a hybrid.

The socio-history of Kampung Tambora's border

The history of kampung Tambora highlights the cultural mixture that shapes the overall gesture of its fabric (Selviany 2023). The periphery once served as porosity, a filter that holds the networks. Urbanization stimulates densification and blurs the boundaries between public and private (Pardede 2023). This uncontrolled accumulation also causes chaotic arrangements despite contributing to social interaction (Nasution 2018) yet cultural mixture (Fikriyah 2023).

Research question

The research questions the network's typology as a contribution to the fabric morphology. The comparison searches for the genesis of serial geometrical patterns in the case of density in the border.

## Methods

The research combines typology and morphology in the form of genomic tabulations (Besserud and Cotten 2022), aiming at the types, while suggesting the overall shape. Tabulation breaks down the massing into its basic geometry to present the quality. It is designed to inform size, area, type, and shape to raise a pattern.

The case study compares 3 unusual samples, chosen from 40 locations, representing anomaly, contrast, and juxtaposition. They were extracted by using QGIS and Autodesk from August to September 2023 (Ariffin, Rashid, and Salleh 2013). A row of kampung houses represents a series and is taken as a sample of a sequence. Similarities and differences are raised to highlight the dominant and recessive elements while detecting categories, variations, and modifications of the types.

## Results and discussion

There are 3 unique samples chosen from a total of 40 samples extracted from the Kampung Tambora periphery, namely site 7 (West side), site 18 (South side), and site 28 (East side) respectively (figure 4). Each site is represented by a mapping diagram, showing silhouettes of massing series accompanied by infra as the network. In addition, 2 tabulations are made to represent the spatial codes of the sample. Left and right rows are tabulated to inform the data, showing a series of geometrical algorithms according to the digital computations.

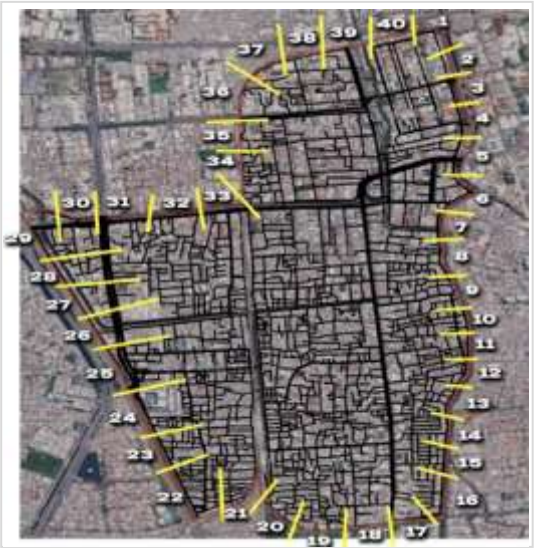


**Figure 4.** Samples on the Kampung Periphery Redrawn by Steven Chen

Site 7 genomic tabulation shows the left row having rectangular as the dominant type, while trapezoid is considered as the recessive (figure 5).

Length is varied from 700 to 2097 cm, width from 500 to 1500 cm, height from 300 to 900 cm. Most angles are 90°, with slight imprecisions. Unit is varied from 38 to 241 sqm with dominant ordered geometrical massing (table 1). The right row displays rectangular as the dominant type, while trapezoid and parallelogram are considered as the recessives. Length is varied from 600 to 2040 cm, width is varied from 300 to 1150 cm, and height from 300-900 cm. Most angles are 90°, with slight imprecisions. Unit is varied from 21 to 206 sqm with dominant ordered geometrical massing (table 2).

The specific analysis recommends a dominant pattern of 300 cm with variations of 400, 500, and 700 cm. Almost all the angles are 90° which leads to geometrical order. Unit replication shows the dominant pattern of 20 sqm with variations of 30, 40, and 50 sqm with slight imprecisions. Thus, both side rows show a similar pattern while having a slight variation.

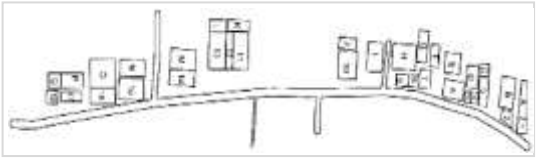

**Figure 5.** Site 7
Redrawn by Valentinus Bagas Dewabrata

**Table 1.** Site 7: Left side

| Type | Leght (cm) | Width(cm) | Height (cm) | Angle | Unit ($m^2$) | Category |
|---|---|---|---|---|---|---|
| T | 2097 | 524 | 600 | 90° | 109 | D |
| | | | | 90° | | |
| | | | | 96° | | |
| | | | | 84° | | |
| R | 1700 | 800 | 600 | 90° | 136 | O |
| R | 700 | 550 | 600 | 90° | 38 | O |
| R | 1200 | 700 | 600 | 90° | 84 | O |
| R | 1100 | 900 | 900 | 90° | 99 | O |
| R | 1250 | 500 | 900 | 90° | 62 | O |
| R | 1745 | 580 | 600 | 90° | 101 | O |
| R | 1450 | 1400 | 900 | 90° | 203 | O |
| R | 1600 | 900 | 900 | 90° | 152 | O |
| R | 1050 | 600 | 900 | 90° | 63 | O |
| R | 1330 | 580 | 600 | 90° | 77 | O |
| R | 1010 | 650 | 300 | 90° | 65 | O |
| R | 1510 | 1130 | 600 | 90° | 170 | O |
| R | 1490 | 900 | 600 | 90° | 138 | O |
| R | 1610 | 1500 | 600 | 90° | 241 | O |
| R | 1350 | 800 | 900 | 90° | 108 | O |
| R | 810 | 700 | 600 | 90° | 61 | O |

**Table 2.** Site 7: Right side

| Type | Length (cm) | Width (cm) | Height (cm) | Angle | Unit ($m^2$) | Category |
|---|---|---|---|---|---|---|
| T | 850 | 610 | 600 | 90° | 51 | D |
| | | | | 90° | | |
| | | | | 96° | | |
| | | | | 84° | | |
| P | 890 | 880 | 600 | 90° | 78 | D |
| | | | | 90° | | |
| | | | | 96° | | |
| | | | | 84° | | |
| R | 1600 | 550 | 600 | 90° | 88 | O |
| R | 600 | 450 | 600 | 90° | 27 | O |
| R | 600 | 350 | 900 | 90° | 21 | O |
| R | 1220 | 1010 | 900 | 90° | 123 | O |
| R | 1010 | 680 | 600 | 90° | 68 | O |
| R | 650 | 640 | 900 | 90° | 41 | O |
| R | 700 | 650 | 900 | 90° | 46 | O |
| | | 300 | | | | |
| R | 1520 | 1100 | 900 | 90° | 167 | O |
| R | 2040 | 900 | 600 | 90° | 185 | O |
| R | 2040 | 430 | 300 | 90° | 87 | O |

| Type | Length (cm) | Width (cm) | Height (cm) | Angle | Unit ($m^2$) | Category |
|---|---|---|---|---|---|---|
| R | 2040 | 1010 | 600 | 90° | 206 | O |
| R | 1510 | 870 | 600 | 90° | 131 | O |
| R | 1510 | 1150 | 600 | 90° | 173 | O |
| R | 1500 | 890 | 900 | 90° | 173 | O |
| R | 1240 | 570 | 600 | 90° | 70 | O |
| R | 700 | 700 | 900 | 90° | 52 | O |

Site 18 genomic tabulation shows left row is rectangular as the dominant type, while L-type and trapezoid are considered as the recessives (figure 6). Length is varied from 940 to 2110 cm, width from 100 to 1740 cm, all heights are 300 cm. All angle is 90°, with slight imprecision. Unit is varied from 18 to 551 sqm with dominant ordered geometrical massing (table 3). The right row displays rectangular as the dominant type, while the C-type is considered as the recessive. Length is varied from 980 to 2800 cm, width is varied from 790 to 2080 cm, and height from 300-1500 cm. All angles are 90°, with slight imprecisions. Unit is varied from 82 to 497 sqm with dominant ordered massing (table 4).

The specific analysis recommends a dominant pattern of 300, and 400 cm with variations of 500, and 700 cm. Almost all the angles are 90° which leads to geometrical order. Unit replication shows the dominant pattern of 30, 40 sqm with the variation of 20, 50 sqm with slight imprecisions. Thus, both side rows show contrast numbers, and an unusual micro algorithm thus both resulting a wide range.

**Figure 6.** Site 18
Redrawn by Trisha Kaylie Tjung

**Table 3.** Site 18: Left site

| Type | Length (cm) | Width (cm) | Height (cm) | Angle | Unit ($m^2$) | Category |
|---|---|---|---|---|---|---|
| L | 1530 | 1140 | 300 | 90° | 154 | D |
| T | 1770 | 1740 | 300 | 90° | 245 | D |
| R | 950 | 580 | 300 | 90° | 551 | O |
| R | 1830 | 530 | 300 | 90° | 96 | O |
| R | 1880 | 100 | 300 | 90° | 18 | O |
| R | 1030 | 940 | 300 | 90° | 96 | O |
| R | 960 | 810 | 300 | 90° | 77 | O |
| R | 940 | 810 | 300 | 90° | 76 | O |
| R | 1470 | 590 | 300 | 90° | 86 | O |
| R | 1820 | 1270 | 300 | 90° | 231 | O |
| R | 1470 | 1070 | 300 | 90° | 157 | O |
| R | 1890 | 1280 | 300 | 90° | 241 | O |
| R | 1820 | 1350 | 300 | 90° | 245 | O |
| R | 2110 | 1580 | 300 | 90° | 333 | O |
| R | 1940 | 1430 | 300 | 90° | 277 | O |
| R | 1000 | 870 | 300 | 90° | 87 | O |
| R | 1000 | 800 | 300 | 90° | 80 | O |
| R | 1480 | 830 | 300 | 90° | 122 | O |

**Table 4.** Site 18: Right sit

| Type | Length (cm) | Width (cm) | Height (cm) | Angle | Unit (cm) | Category |
|---|---|---|---|---|---|---|
| C | 1790 | 1500 | 900 | 90° | 225 | D |
| R | 2800 | 1520 | 900 | 90° | 425 | O |
| R | 2140 | 1180 | 900 | 90° | 252 | O |
| R | 1940 | 900 | 900 | 90° | 174 | O |
| R | 1900 | 1020 | 1200 | 90° | 193 | O |
| R | 980 | 840 | 300 | 90° | 82 | O |
| R | 1270 | 920 | 1500 | 90° | 116 | O |
| R | 1970 | 1070 | 1200 | 90° | 210 | O |
| R | 1570 | 1280 | 900 | 90° | 200 | O |
| R | 1960 | 790 | 900 | 90° | 154 | O |
| R | 1960 | 1670 | 900 | 90° | 327 | O |

| Type | Length (cm) | Width (cm) | Height (cm) | Angle | Unit (cm) | Category |
|---|---|---|---|---|---|---|
| R | 2080 | 1350 | 600 | 90° | 280 | O |
| R | 2080 | 1420 | 600 | 90° | 295 | O |
| R | 2390 | 2080 | 600 | 90° | 497 | O |

Site 28 genomic tabulation shows the left row shows rectangular as the dominant type, while trapezoid is considered as the recessive (figure 7). Length is varied from 300 to 880 cm, width from 100 to 650 cm, and height from 300 to 800 cm. Most angles are 90°, with slight imprecisions. Unit is varied from 13 to 573 sqm with dominant ordered geometrical massing (table 5). The right row displays all rectangular shapes and is taken as the dominant type. Length is varied from 460 to 2040 cm, width is varied from 340 to 1140 cm, and height from 300-750 cm. All angles are 90°, with slight imprecisions. Unit is varied from 16 to 221 sqm with all order geometrical massing (table 6).

The specific analysis recommends a dominant pattern of 300, 400, and 500 cm, with variations of 700 cm. Almost all the angles are 90° which leads to geometrical order. Unit replication shows the dominant pattern of 15, 20, and 30 sqm with variations of 40 and 50 sqm with slight imprecisions. Thus, both side rows show similar patterns but are implemented in a contrast number, unusual micro algorithm, various range and even a wide gap while blends into a smooth gradation.

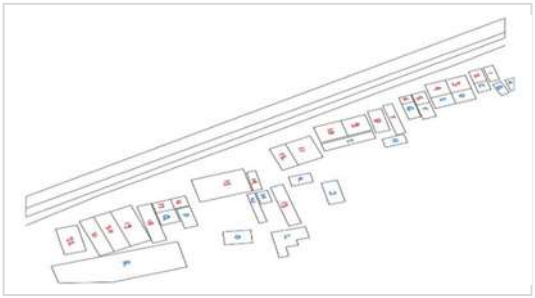

**Figure 7.** Site 28
Redrawn by Syasya Syalsyabila Saleh Mela Saputri

**Table 5.** Site 28: Left side

| Type | Length (cm) | Width (cm) | Height (cm) | Angle | Unit ($m^2$) | Category |
|---|---|---|---|---|---|---|
| T | 620 | 110 | 400 | 90° | 13 | D |
| | 570 | 350 | | 70° | | |
| | | | | 90° | | |
| | | | | 90° | | |
| R | 630 | 330 | 300 | 90° | 21 | O |
| R | 485 | 470 | 500 | 90° | 23 | O |
| | | | | | | |
| R | 760 | 545 | 800 | 90° | 41 | OD |
| R | 770 | 545 | 700 | 90° | 42 | O |
| R | 735 | 500 | 750 | 90° | 37 | O |
| R | 795 | 460 | 700 | 90° | 37 | O |
| R | 820 | 425 | 800 | 90° | 35 | O |
| R | 370 | 194 | 300 | 90° | 72 | O |
| R | 590 | 111 | 400 | 90° | 65 | O |
| R | 800 | 460 | 300 | 90° | 37 | O |
| R | 565 | 127 | 700 | 90° | 109 | O |
| | 470 | 260 | | | | |
| | 450 | 500 | | | | |
| | 350 | 128 | | | | |
| R | 420 | 580 | 400 | 90° | 25 | O |
| R | 300 | 150 | 300 | 90° | 43 | O |
| R | 645 | 100 | 300 | 90° | 64 | O |
| R | 500 | 100 | 700 | 90° | 50 | O |
| R | 700 | 650 | 800 | 90° | 45 | O |
| | 500 | 130 | 300 | 90° | 573 | |
| | 880 | 275 | | 105° | | |
| | | 195 | | 165° | | |
| | | | | 90° | | |

**Table 6.** Site 28: Right side

| Type | Length (cm) | Width (cm) | Height (cm) | Angle | Unit ($m^2$) | Category |
|---|---|---|---|---|---|---|
| R | 750 | 365 | 750 | 90° | 27 | O |
| R | 620 | 485 | 300 | 90° | 30 | O |
| R | 750 | 680 | 500 | 90° | 51 | O |
| R | 770 | 680 | 400 | 90° | 52 | O |
| R | 550 | 500 | 500 | 90° | 28 | O |
| R | 460 | 340 | 300 | 90° | 16 | O |
| R | 1520 | 350 | 700 | 90° | 53 | O |
| R | 1110 | 530 | 750 | 90° | 59 | O |
| R | 1040 | 800 | 400 | 90° | 73 | O |
| R | 1030 | 800 | 300 | 90° | 82 | O |
| R | 1150 | 970 | 400 | 90° | 111 | O |
| R | 1150 | 630 | 300 | 90° | 72 | O |
| R | 2040 | 570 | 500 | 90° | 95 | O |
| R | 950 | 340 | 400 | 90° | 31 | O |
| R | 1940 | 1140 | 500 | 90° | 221 | O |
| R | 550 | 500 | 500 | 90° | 27 | O |
| R | 700 | 500 | 300 | 90° | 34 | O |
| R | 1900 | 530 | 400 | 90° | 100 | O |
| R | 1870 | 800 | 500 | 90° | 151 | O |
| R | 1870 | 650 | 500 | 90° | 121 | O |
| R | 1870 | 560 | 300 | 90° | 105 | O |
| R | 1320 | 800 | 400 | 90° | 105 | O |
| Legend | | | | | | |
| R | Rectangular | | | L | | L-type |
| T | Trapezoid | | | C | | C-type |
| P | Paralleleogram | | | | | |
| O | Order | | | D | | Disorder |

3 samples exhibit similarities in terms of order, dominant type, and pattern, although they display specific rhythms. Hence the three confirm a typicality whilst far from uniformity.

## Conclusions

Genomic tabulation suggests a general pattern order series, the analysis reflects in most types being rectangular and implemented in 90°. Most likely the series is derived from rectangular-inspired blocks. The tabulation presents a finding as a typical algorithm of 300, 400, 500, and 700 cm is mostly constructed with slight impressions. As a result, a model of 20, 30 40, and 50 sqm units are emerged in the computation, reflecting a module that can be used as a basis of kampung's scientific-based developments. Thus, the basic geometric spatial quality is much closer to the formal principle as the geometric disorder is rare, and shall be considered as a gap for kampung improvement or a possible point of entry. Trapezoids are occasionally found, while parallelogram, L-type, and C-type are rare. They are the recessive type, relatively small in number or even lone. Variations of the module have been developed through fission, and proliferation, resulting in a more elaborated algorithm in the massing series. As a research gap, kampung border geometrical transformation may be offered to continue the the research from sociological perspective, investigating cause and consequence.

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**Denny Husin** contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

**Olga Nauli Komala** contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.