Identifying Space Grammar in the Unit Plans of Contemporary Indonesian Houses

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Abstract In the spatial configuration of a unit plan, two rules exist: one that governs the arrangement of spaces, and one that controls the design process of generating a unit plan. This study defines space grammar as an integration of the two rules that give birth to a given spatial configuration and as the process of the generation of unit plans. To understand the distinctive features of Indonesian row houses, this study analyzes the unit plans of row houses in new towns of the metropolitan cities of Indonesia, derives a common space grammar from the unit plans, and interprets the sociocultural background that has produced this space grammar. This study employs Seo's (2007a; 2007b) graph–theoretic methodology to analyze the spatial configurations of unit plans along with a topographical approach to systematically illustrate the design process. The guest space was found as the most unique space of Indonesian houses, which cannot be found in other Southeast Asian houses. Kitchen was clearly seperated from the dining and living spaces, following traditional custom. Dining space was found to serve as a circulation center, connecting the entrance, the lving area and the kitchen. This study locates the basic orders of primary space and the design principles that dictate the unique spatial configurations of Indonesian row houses. This study reveals the basic space grammar that underpins the forms of Indonesian row houses, explaining the sociocultural and geo-climatic factors affecting this space grammar and proposing unique characteristics of Indonesian contemporary houses.

Keywords: Unit Plan, Spatial Configuration, Space Grammar, Indonesian House

1. INTRODUCTION

1.1 BACKGROUND OF STUDY

Housing in every country has its own unique form that has evolved out of geographical, social, and cultural contexts. Alongside the process of modernization, western housing typologies were introduced to and expanded in Asian countries, as these typologies incorporated the indigeneous lifestyle of each nation. The modernized residence called the "row house," which is the most popular housing typology in Southeast Asian countries, has been developed in accordance with western design planning principles, but it also accommodates regional characteristics, incorporating local technologies as well as social conditions.[1] Kenneth (1998) discussed Asian regionalism, describing this type of development as "contextual modernization." In cocurrence with the concept of "contextual modernization," in studying Southeast Asian houses, this research seeks to analyze the unique characteristics of modern housing unit plans in various Asian countries, while further investigating the sociocultural contexts that led to these variations in forms.

In most of the housing unit plans, the allocation of multiple rooms is required within a limited rectangular shape. This situation requires several stages of decision-making to determine which rooms should be considered primary and how the secondary rooms should be positioned in relation to them. This all results in unique spatial configurations.

In the spatial configuration of a unit plan, there are two conventions that govern geometry. One rule governs the

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[1] A row house is commonly called a link house or a terrace house. This type of house is the most popular and the most common housing typology in Southeast Asian countries (Ju et al., 2017). Series of houses (comprising a minimum of three to four houses and a maximum of ten) are built in a row, sharing their side walls. The row house is the representative housing typology built in new towns in Indonesia (Ju et al., 2017) and it is defined in the Indonesian State Minister of Public Housing Regulation's Number 11, 2008 (Ministerial Regulation 11/2008).

arrangement of spaces and the other controls the design process for generating unit plans. This study defines space grammar as the integration of these two rules, providing information about the forms of unit plans and the process of generating them.

As the first step in a series of studies on Southeast Asian countries, this study has targeted a row house in Indonesia, analyzing the space grammar of its unit plans. This research will contribute to the understanding of the formal characteristics of the Indonesian unit plan, offering an interpretation of the sociocultural background that has led to this space grammar.

1.2 THE DEFINITION OF SPACE GRAMMAR

Formalism and architectural morphology are subjects of interest to researchers in housing studies. The methodology of applying space diagrams is commonly used to analyze unit plans. However, the space diagram presents difficulties in reading the basic patterns of spatial configuration as a result of its complexity and excess of information.

Revealing a more appropriate way to comprehend the spatial order behind the designs of apartment unit plans, Seo (2007a; 2007b) introduced a new graph–theoretic methodology that adopted the advantages of previous studies and incorporated graph theory in its architectural analysis. Expanding on the graph methodology that March and Steadman (1974) used to analyze terrace houses, Seo established a modularized method that had the advantage of revealing the spatial order of two-dimensional unit plans.

Figure 1. Seo's (2007b) graph–theoretic methodology for analyzing unit plans

To elicit the most commonly used order in multiple unit plans, Seo (2008) adopted a topographical approach. Seo began with the generative architectural grammar introduced by Glassie (1976), whose approach focused on explaining the rules of architecture linguistically within a larger framework, allowing for additional interpretation based on historical and social contexts. Seo also borrowed from Stiny's (1980) "shape grammar," whereby figures take form using a non-linguistic geometrical methodology.

Both Glassie and Stiny's grammar systems define the design process in terms of grammar. Stiny presented a rational process based on geometrical accuracy (Seo, 2008), but Stiny's method had shortcomings when it came to reflecting sociocultural values and meaning. As a consequence, Seo's topographical methodology, called the "design process flow," presented a process that effectively integrated the two: it enabled the understanding of formative aspects of patterns

using the mathematical precision of Stiny's model and it traced sociocultural backgrounds via Glassie's linguistic method.

The methodology developed in the series of research by Seo is ideal for discerning the space grammar of unit plans. Therefore, this study will employ Seo's (2007a; 2007b; 2008) graph–theoretic methodology, which analyzes the spatial configuration of unit plans, and the topographical approach, which systematically illustrates the design process.

1.3 RESEARCH SCOPE AND METHODOLOGY OF THE STUDY

This study analyzes the unit plans of row houses in new towns of the metropolitan cities of Indonesia.[2] Field surveys were conducted in August 2013 and February 2014 by visiting and recording representative housing clusters in each new towns and by collecting detailed data from corresponding developers. From this survey, a total of 73 row house floor plans were collected and 39 were analyzed, comprising 15 single-story and 24 double-story unit plans.

As explained above, this study applied Seo's graph–theoretic methodology after making several modifications to it (Figure 2).[3]

After converting all unit plans into diagrams to ascertain common rules, which existed in most cases, Seo's (2008) topographical methodology was applied and the results were presented as two design process flow diagrams (see Figure 20 for single-story unit plans and Figure 21 for double-story unit plans).
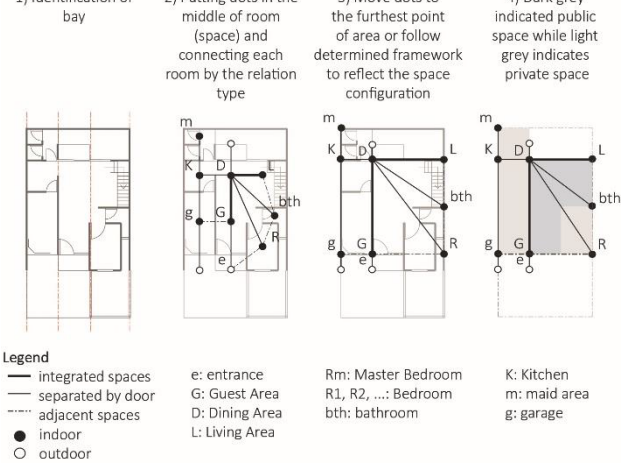

Figure 2. The methodology to convert unit plans into diagrams

These design process flow diagrams allow for the location of the representative spatial order of the unit plans and approximate the architect's design process. The diagrams at

the top of the graph (under the order of primary spaces) do not share many characteristics with the other diagrams and, hence, they may be identified as major unit plan types. These major types have been sub-classified according to the location of bedrooms and the location of the kitchen and service areas. Therefore, the analysis of the unit plans is arranged as follows: the order of primary spaces, the location of the bedrooms and the location of the kitchen and service areas, in this order.

2. ANALYSIS AND FINDINGS

2.1 SPACE GRAMMAR OF UNIT PLANS
2.1.1 SINGLE-STORY HOUSES
Order of Primary Spaces

As a result of the analysis of single-story houses, the unit plans were classified into four major types. Across these four types of unit plans, the layout of primary spaces (guest areas, living rooms, and dining spaces) was differentiated (see Table 1). The most common type was the G/L–D (A) type. This I-shaped type combines all public spaces in one bay. The main entrance leads directly to the guest area (or living area), then to dining area, as the center of the house that connects to the backyard. This type is found in 2 bay, 2.5 bay and 3 bay houses, ranging in size between 30 and 70 m^2.

The second and most common type is G–D–L (D). This type locates primary spaces diagonally. The main entrance is to the guest area, which connects to the dining area (as the center of the house). This area is then integrated with the living area that opens onto the backyard. This type seeks to separate the guest area from the living area to provide more privacy[4] and requires a larger space than the other types. This type is found in 2.5 bay and 3 bay houses, its size ranging between 80 and 141 m^2.

Table 1. Order of Primary Spaces Types in Single-Story Houses

I-Shape	L-Shape		Diagonal Shape
A	B	C	D
G/L–D	G–L–D	G–D–L	G–L–D
CJ1–95–01 CJ–10–01 CS–09–01 SJ–93–01 SJ–04–01 SJ–04–02 SJ–09–01	CS–96–01 CS–96–02	CJ–12–01 SJ–09–02	CJ1–95–02, CJ1–95–03, CS–96–03, CS–09–02

The next types are the G–L–D (B) and G–D–L (C) types,

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[4] In Islamic culture, the guest is not allowed anywhere in the house apart from the guest area to protect the host's female family members.

which are found in 2.5 bay and 3 bay houses, ranging in size between 54 and 92 m^2. These types locate their primary spaces in an L-shape. The main entrance is to the guest area, connected to a living space (or dining area), which is the center of the house and which is then integrated with the dining space (or living area) in the next bay. These types are also intended to separate guest areas from family living spaces. The guest area is a very important and necessary space in Indonesian houses.
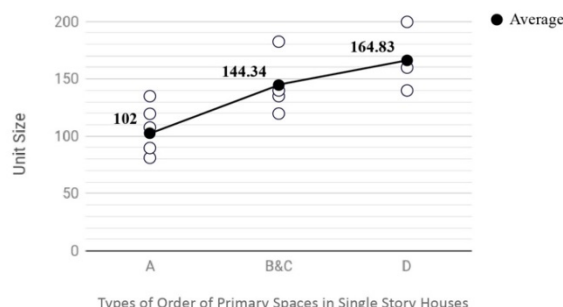

Figure 3. Unit size according to types of order of primary spaces in single-story houses

In single-story houses, the A type represents the smallest housing size, the B and C types represent the medium housing size, and the D types represent the largest housing size.
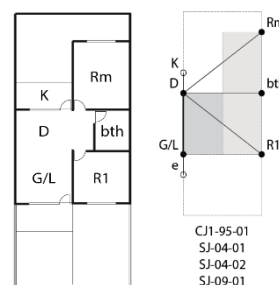

Figure 4. Typical plan of a single-story, 2 bay house

In houses with two bays, only the A type, which is the most basic design, were found. Of the two bay house components, one accommodated public space (G/L and D) and the other included private space (bedrooms). As a result of their small size, all of the double bay houses had kitchens (K) located outside on the back terrace.
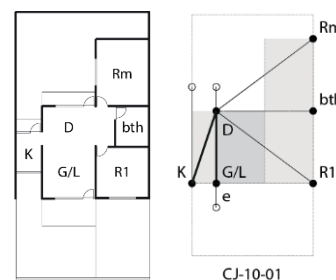

Figure 5. Typical plan of a single-story, 2.5 bay house

In 2.5 bay houses, all types of design were found, and the half bay was designed to accommodate the kitchen, which was connected to the dining space.
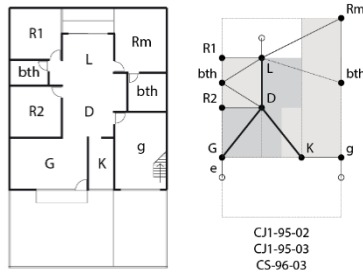

Figure 6. Typical plan of a single-story, 3 bay house

In houses with three bays, all types of design except for the B type were found. As opposed to 2 and 2.5 bay houses, 3 bay houses have larger kitchens (with adjoining dining areas) and larger service areas (e.g., garage and maid spaces), which are commonly accommodated together in one full bay.

Location of Bedrooms

Each type (A, B, C, D, and E) was classified first according to the number of bays, and then by the location of its bedrooms. The single-story houses (a total of 15 cases) consisted of one bedroom (one case), two bedrooms (nine cases), and three bedrooms (five cases). In the one-bedroom case, the master bedroom was located at the front. In the two-bedroom cases, the master bedrooms were located mostly at the rear, while the other bedrooms where at the front. In the three-bedroom cases, the master bedrooms were mostly located at rear as well.

In Indonesian Javanese vernacular houses a hierarchy of spaces based on dualism exists. This dualism is strongly reflected in the layout of spaces in the houses analyzed. The front of the house is a public area, associated with males, the outside, the sacred, and guests; it is open and light. Conversely, the rear of the house is a private area that is associated with females, the inside, the profane, and the owner; it is enclosed and dark (Ju et al., 2018). According to these traditional concepts, the front space of the house is regarded as public and the back part of the house is regarded as private. Moreover, the back space of the house is regarded as a dirty space and is used by women for housekeeping.

Contemporary houses, which are limited by the width and length of a plot, cannot always follow this traditional order. This problem may have produced the conflict between the location of the master bedroom and the utility space. It is preferred that master bedrooms be located at the back to protect privacy and that utility spaces be located at the back to hide their dirty elements from the public.[5] In most of the cases analyzed, the

master bedroom was located at the back; only three out of 15 cases found the master bedroom at the front (SJ–93–01, SJ–09–01, and CS–09–01). The rear of the house, once represented as dirty space, was transformed into a pleasant, open space, designed to provide a good view from the master bedroom or from the dining and living rooms.

As a result of this topographical analysis, the I-shape of the primary space (for the A type), was designed across two bays with two bedrooms (a master bedroom at the back and another bedroom at the front), one bathroom (located between the bedrooms), and no maid area; this was the most common design (see Figure 7).
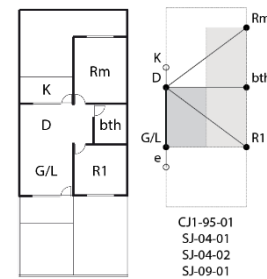

Figure 7. The most common spatial configuration of two-bedroom units

2.1.2 DOUBLE-STORY HOUSES
Order of Primary Spaces[6]

Five design types were found as a result of the analysis of the order of primary spaces in double-story houses. The L-shaped G–L–D (B) type and the G–D–L (C) type were the most common types of double-story houses. These types were found in 2 bay, 2.5 bay, and 3 bay houses, ranging in size from 93 to 281 m^2.

Table 2. Types of the Order of Primary Spaces in Double-Story Houses

I-Shape	L-Shape		Diagonal Shape	
A	**B**	**C**	**D**	**E**
G/L–D	G–L–D	G–D–L	G–L–D	G–L–D
PS–09–01 PS–09–02 SJ1–06–01 SJ1–06–02 SJ–20–01	CJ2–95–01 CJ2–95–02 CJ–10–02 CJ–12–02 CJ–12–03 CS2–96–01 CS–14–01 SJ–20–02	CJ–10–03 CS2–96–02 IS–03–01 PS–09–03 PS–10–01 PS2–12–02 SJ2–06–02	PS1–12–01 PS2–12–01	IS–03–02 SJ2–06–02

The I-shaped G/L–D (A) type was found in 2 bay and 2.5 bay houses, ranging in size between 99 and 230 m^2. The diago-

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5   This is one of the key concepts applied to vernacular houses, especially in Southeast Asian countries, asserting that the front part of a house represents a face—as the house's good side—and the back part of the house represents an anus—the house's bad side (Ju et al., 2017).

6   For the double-storey houses, only the ground floor plan was analyzed because the special configurations of the second floors were too diverse to discover their space grammar.

nal-shaped types, G–D–L (D) and G–L–D (E), were found in 2 bay and 3 bay houses, ranging in size between 170 and 308 m², and were bigger than the A type houses. Type E was found in only double-story cases. Its basic layout was the same as type C, but dining and guest areas were blocked by a wall (or staircase). This type separated the guest area from the living and dining areas more so than type D to provide more privacy.
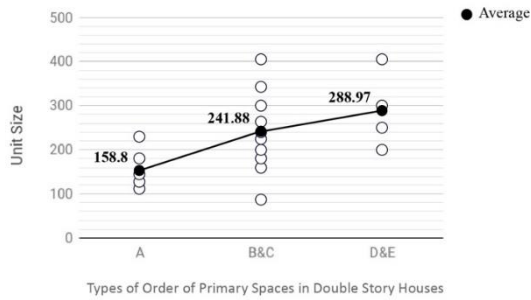

Figure 8. Unit size according to type of order of primary spaces in double-story houses

Just as for single-stories, in double-stories, type A represents the smallest housing size, types B and C represent the medium housing size, and types D and E represent the largest housing size.

Types A, B, and D were found in all 2 bay houses. However, while all of the double-story, 2 bay houses had kitchens inside the house, the single-story, 2 bay houses had kitchens outside on the back terrace because of a shortage of space.
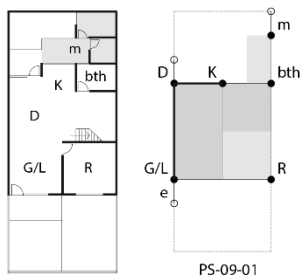

Figure 9. Typical plan of a double-story 2 bay house

In the 2.5 bay houses, types A and B were found. In six cases (CJ–10–02, CJ–12–02, CS–14–01, SJ1–06–01, SJ1–06–02, and PS–09–02) the half bay accommodated a kitchen and in one case (SJ–20–02) the half bay accommodated a bathroom and staircases.
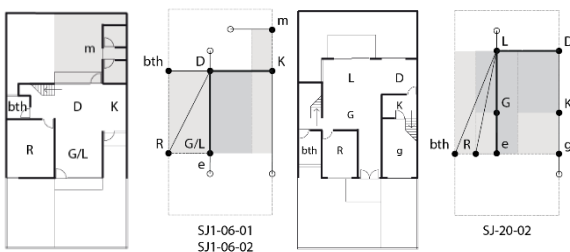

Figure 10. Typical plan of a double-story, 2.5 bay house

Types B, C, and E were found in all of the 3 bay houses. However, the double-story, 3 bay houses had larger kitchens (with adjoining dining areas) and more extensive service areas (e.g., with a garage and a maid space), which were commonly located together in one bay.
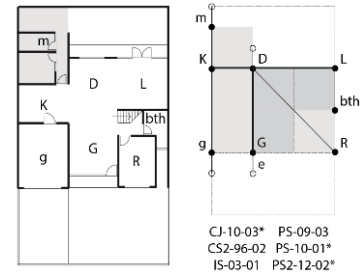

Figure 11. Typical plan of a double-story, 3 bay house

Location of Bedrooms

The study analyzed a total of 24 double-story houses, 13 of which had three bedrooms and 11 of which had four bedrooms. Most of the three-bedroom houses had one bedroom on the ground floor and two bedrooms on the first floor. Only one house had all three bedrooms on the first floor (SJ2–06–01). Most of the four-bedroom houses had one bedroom on the ground floor and three bedrooms on the first floor. Only one house had two bedrooms on the ground floor and two bedrooms on the first floor (CJ2–95–02).

In 16 out of 24 cases, the master bedroom was located at the front of the first floor. In five cases, the master bedroom was located at the rear of the first floor. Only in three cases were the master bedrooms located to the rear of the ground floor. These results reflect that the front area of the first floor is the preferred location for the master bedroom as a result of the potential for a view and the additional privacy.

Among the double-story houses, the most common design was the L-shape, as the primary spaces were ordered across three bays with three bedrooms (one located on the ground floor at the front, also the master bedroom at the front and another to the rear of the first floor). Additionally, there was one bathroom on the ground floor, two bathrooms on the first floor, and a maid's area at to the rear of the ground floor.
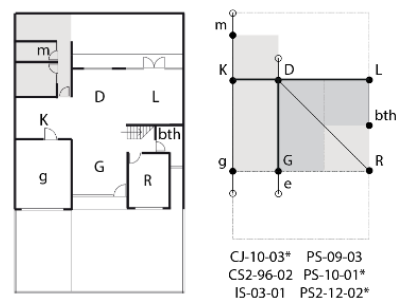

Figure 12. The most common spatial configuration of three-bedroom units

2.1.3 ORDER OF SERVICE AREA

The service area of a house includes the kitchen (K), the maid's space (m: maid's bedroom, maid's toilet, and washing area) and the garage (g).

The layout of the service area is very unique and it was difficult to ascertain the order by group analysis (see Figures 18 and 19). Therefore, a separate analysis of the orders of the service areas in a total of 33 cases[7] was executed.

Relationship between the Dining Space and the Kitchen

As a result of the analysis of the relationship between the dining space (D) and the kitchen (K), two design types were located: the SA type (21 cases) and the SB type (9 cases).

In the SA type, the kitchen was located beside the dining space, parallel to it, but occupying a separate space; this was mostly found in large houses (70–308 m^2, in 21 cases). In this layout, the entire bay was composed of the service area (the kitchen, the maid's space, and the garage). Depending on the location of the maid's space, the SA type was sub-classified into two types: 1) a type that located the maid's area in the back and the garage in front of the kitchen, and 2) a type that located the maid's area in front of the kitchen and the garage in front of the maid's area. In special cases, instead of locating the maid's area behind the kitchen, this area was used for the bedroom (CJ1–95–02; CJ1–95–03; CS–14–01), and the maid's area was located on the first floor of the garage.
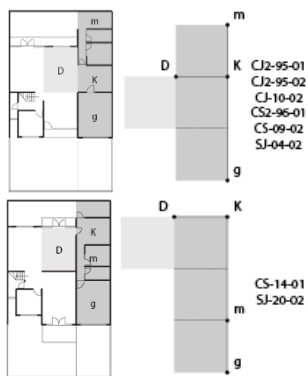

Figure 13. The SA type of service area order

In the SB type, the dining space was located in the service bay, which was mostly found in medium-sized houses (67–260 m^2, in nine cases). This type was classified into two groups: 1) where the kitchen was located in the back and the maid's area was in-front of the dining area, and 2) where the kitchen was located to the front and the maid's area was behind the dining area. In special cases, instead of locating the kitchen or the maid's area to the front, this area was used for the bedroom (CS2–96–01) or the garage (CJ2–95–01; CJ2–95–02; CJ–10–02).

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[7] Unlike other spaces where single-storey and double-storey cases were analyzed separately, the analysis of the service area was conducted on both single-storey and double-storey houses combined. Six cases out of a total 39 (mostly single-storey, 2 bay houses) did not have service areas and were therefore excluded from this analysis.
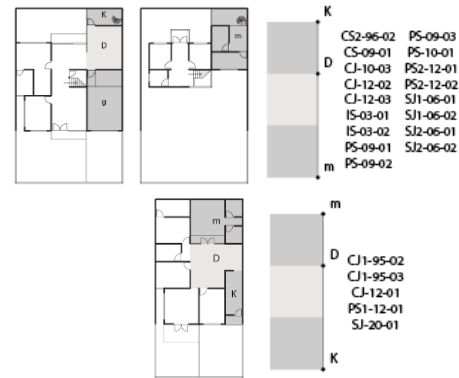

Figure 14. The SB type of service area order

In the case where the kitchen was located infront of the dining space, and in the same bay, the maid's space was also located to the front of the house. As mentioned above, the service area was traditionally considered a dirty space and was usually located at the back, but, in this type, its position was reversed. This type has the advantage of locating the maid's space near to the car park for easy access and creating more privacy for the bedroom areas.

All cases provided carparks, which were built outside the house and separate to the wall structure. Regarding garages, only 16 cases out of 39 had garages that were located inside the house using the wall structure. Garages only appeared in the service areas of the 3 bay houses.

Location of Maid's Area

For upper- to middle-class Indonesians, hiring a maid is common practice. The maid may work half days or may even live with the house owner.

The maid's space (m) consists of the maid's bedroom (b), the maid's bathroom (b), the washing area (w), and the drying area (d).
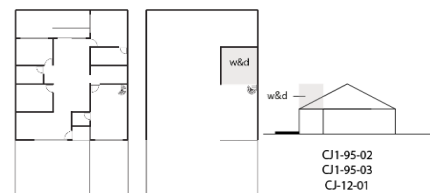

Figure 15. The most common configuration of the maid's area in single-story cases

Of the single-story houses, only six out of 15 had maid's areas, but of the double-story homes, all 24 had maid's areas. Most single-story cases did not have a maid's space, and those that did were 67 m^2 or larger. This might be explained by the fact that maids are less necessary for small houses.
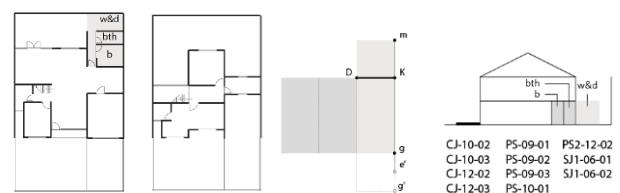

Figure 16. The most common configuration of the maid's area in double-story cases
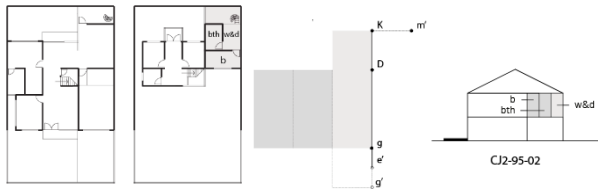
Figure 17. The configuration of the maid's area in double-story cases, emphasizing the separation of the main space from the maid's space

The sub-rooms of the maid's spaces were usually located on the same floor, but there were cases where they were located separately. Revealed by the analysis of the maid's spaces in single-story houses, four out of six cases had washing and drying areas on the first floor (roof terrace) because of the shortage of space. From this, it can be inferred that the maids prefer drying clothes outside under the sunlight.

Among the double-story houses, most of the cases located all of the maid's areas to the rear of the ground floor. As shown in Figure 16, although some part of the backyard was used for the maid's area, the best view of the backyard was still reserved for the living or dining area at the center of the house, and not for the maid's area. To ensure this, a wall was installed between the backyard and the maid's space.

Table 3. Analysis of the Location of the Maid's Space

In some of the double-story houses, the maid's bedroom (b) and the maid's bathroom (bth) were located on the first floor above the maid's spaces, connected by a separate staircase. In these cases, the maid's area and the owners' bedroom area on the first floor were completely separate (see Figure 17). The separation of the maid's space from the owner's private space is a critical issue in Indonesian housing design (Megawati and al., 2014).

2.2 GENERATIVE GRAMMAR IN UNIT PLANS

As mentioned above, this study applied Seo's topographical approach to obtain the most representative from multiple unit plans.

Seo's methodology undertakes the mathematical process of discerning the final common denominator, developed by substituting Glassie's (1976) architectural generative grammar theory with linguistic information.

According to Glassie, as an architectural competence becomes an architectural performance, the external environment (including the society's history, economy, culture, and systems) affects a given building by interacting with the architect's grammar and rules; in turn, the construction becomes a part of the surrounding environment. This flow can be understood as the process of design undertaken by architects.

Although it is arguable as to whether the architect follows this process exactly, it is appropriate to understand it as the architect's inherent generative grammar.

Figures 20 and 21 demonstrate the design process. The diagrams that are located higher on the flow illustrate the basic grammar that can be seen in most of the designs. The diagrams located on the lower part of the flow with many cases by way of example indicate that architects tend to follow these designs. The flows may not correspond exactly to the design process of the architects, but they reflect the following rules, even if they are only subconscious for the architects:

Rule 1: Each housing plot in Indonesia has its own regulations regarding type of building, buildable area, and number of floors, among other points. Using the length and width of the area, the architect can determine the number of bays and may also decide the number of rooms, while considering the marketing target.

Rule 2: After determining the number of bays, the second step is to determine the order of primary spaces (the entrance (t), the guest area (G), the dining area (D), and the living area (L)) that constitute the fundamental framework for designing a house. As the guest area is important in Indonesian housing, in all cases without any exception (100%), the guest area is located at the foremost part of the house, right after the entrance.

Most of the 2 bay houses combined G/L and D in one open space (17.95%, or seven cases). In some of the 2.5 bay houses, G was separated from L and D, creating an L-shape (G–L–D or G–D–L) in an open space to provide more privacy for family living (15.38%, or six cases). A number of the 3 bay houses were L-shaped, following a G–D–L pattern (20.51%, or eight cases). In larger 3 bay cases, G, L, and D were separated more clearly (15.38%, or six cases).

Rule 3: After determining the order of primary spaces, the third step is to decide the location of the bedrooms.

In single-story cases, the most common order was with the master bedroom at the back and a second, single bedroom to the front (53.33%, or eight cases).

In double-story cases, the most common order was where all three bedrooms, including the master bedroom, were located on the first floor (45.83%, or 11 cases).

Rule 4: The next step is to ascertain the location of the kitchen. The priorities of Rules 3 and 4 (which should be considered first) may vary depending on the architect. But it is generally assumed that the location of the bedrooms (especially the master bedroom) takes precedence over that of the kitchen. The location of the bedrooms often conflicts with the location of the kitchen.[8]

The analysis of the relation between the kitchen and the dining space showed the most common order to be where the kitchen was located beside the dining space, parallel but as a separate area (SA type; 70%, or 21 cases)

Rule 5: The next step is to arrange the location of the service area (the kitchen, the maid's space, and the garage). The kitchen is located close to the maid's space (m), the garage (g), and the carpark.

This research found that 60% of the single-story houses had no maid's space and no garage as a result of limited space, while all of the double-story homes had maid's spaces.

In the double-story houses, the maid's space was located on the first floor in most cases (66.67%, or 16 cases). All the bedrooms were located on the second floor to clearly separate the maid and family spaces.

All analyzed cases had carparks outside. Regarding garages, only four of the single-story houses had garages and only half of the double-story houses had garages.

The design process that this research proposes is more complex than that of Seo's, as Seo's cases all have a single side corridor and each have the same number of rooms and bays. The complexity of this research arises from the variety in the number of floors, bays, and rooms in these cases, despite their commonality in being row houses. This has produced various alternatives in unit design, albeit with core commonalities among them.

When designing Indonesian houses, architects emphasize the close relationship between the entrance and the guest area. If there is enough space, the guest area should be separated and its views should be directed away from the rest of the rooms.

When locating bedrooms, privacy is prioritized more than lighting. Therefore, bedrooms are usually located to the back of single-story houses or on the first floor of double-story houses.

Further, when locating the kitchen and the living area, the kitchen is usually separated from the dining area, but nonetheless closely connected. The kitchen is also connected to the garage and to the utility space. In this case, the garage could

also be used as an additional entrance.

The proximity of the maid's space to the kitchen is also very important. However, the maid's space is sometimes located on the first floor, far from the kitchen, when there is limited space or when the owner prioritizes privacy.

3. CONCLUSIONS

After the complex analysis explained above, the unique characteristics of Indonesian row houses are as follows.

First, the guest area is the most unique space of Indonesian houses, and it cannot be found in other Southeast Asian houses. The guest area is a transitional space between public and private zones. It mainly serves to host guests, particularly formally, when guests are not close to the family.

Second, the kitchen is clearly separated from the dining and living spaces. Traditionally, the kitchen was regarded as a dirty space and was located at the rear of the house, hidden from the outside. This traditional custom is also reflected in contemporary houses. Further, the kitchen is closely related to the maid's space and the garage. The maid's space is also unique to Indonesian houses. Except for in small houses, the maid's space (the maid's bedroom and toilet) is provided inside the house. In larger houses, the service area uses an entire bay connecting the garage, the kitchen, and the maid's space for efficient utility work.

Third, when locating the master bedroom, privacy is considered important. Therefore, the master bedroom is usually located at the back or on the first floor of double-story houses. However, when both the master bedroom and the service area are located at the rear, the separation between them is carefully considered.

Fourth, among the primary spaces, in most cases, the dining area serves as a circulation center, connecting the entrance, the living area, and the kitchen. In double-story houses, stairs are located near dining spaces. Previous studies (Putra et al., 2016) show that the dining area is reserved for family gatherings and is the least frequently used space in the house.

Through extensive analysis, this study uncovered basic space grammar that underpinned the forms of Indonesian row houses, and pointed out the uniqueness of Indonesian contemporary houses. Also it was proved that that traditional housing elements and culture were reflected and continued to exist in contemporary housing contex although Indonesian contemporary houses were built based on western styles.

The further study with more sample cases and additional study on other housing typologies will verify and strengthen the findings of this study.

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[8] The location of bedrooms (especially the master bedroom) determines the location of the service area (especially the maid's space). In single-storey cases, if the master bedroom is to the rear, then the service area is supposed to be either to the front or at the back, provided it cannot be seen from the main bedroom (distinction of view) and vice versa. Similarly, in double-storey dwellings where the master bedroom is located on the ground floor, the service area is also supposed to be on the ground floor or on the first floor without access from the main space (distinction of space), and vice versa. This shows that the separation of main family space from the maid's space is an important issue in Indonesian housing
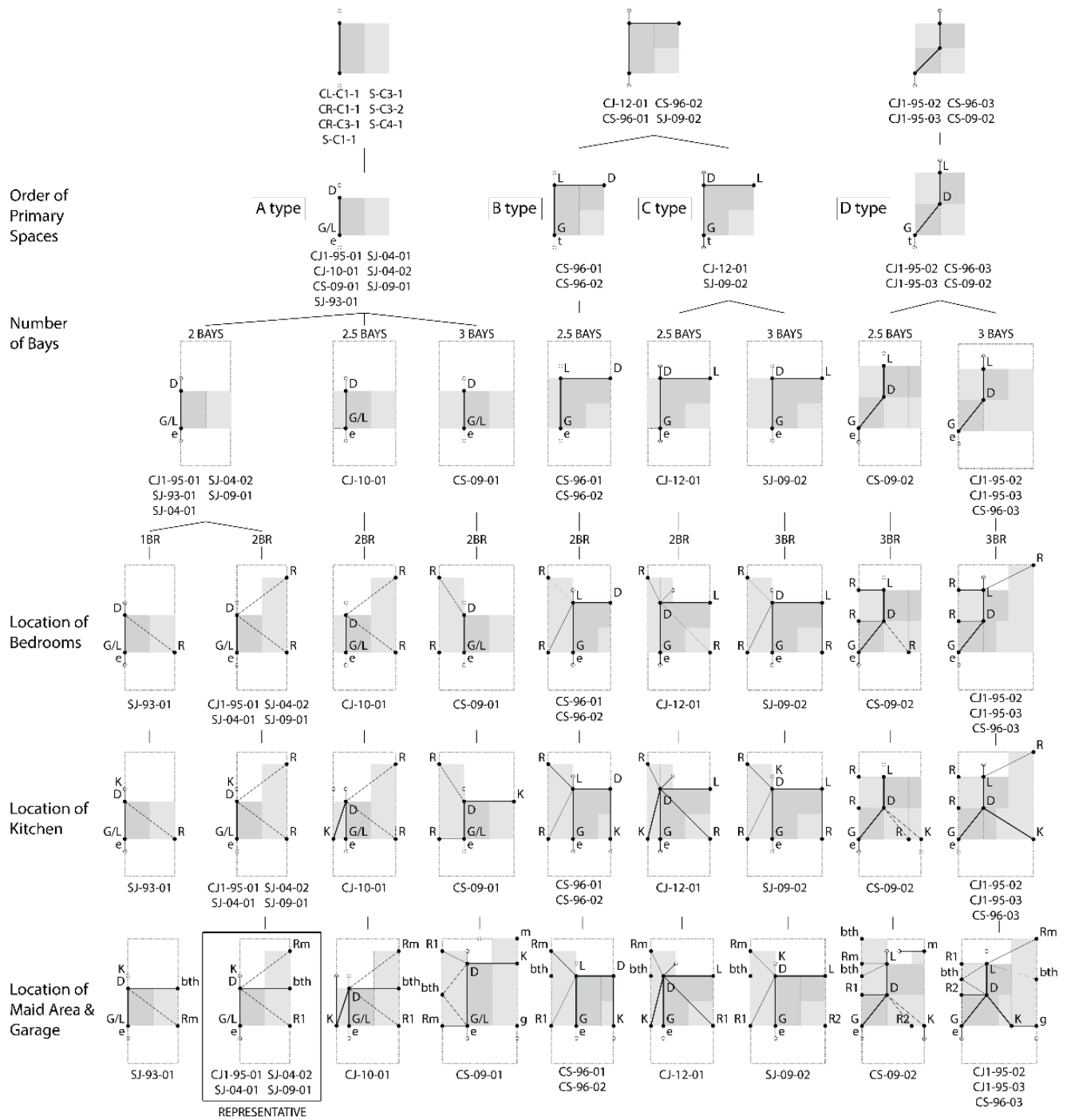
Figure 18. The process of finding common subsets from 15 single-story row houses
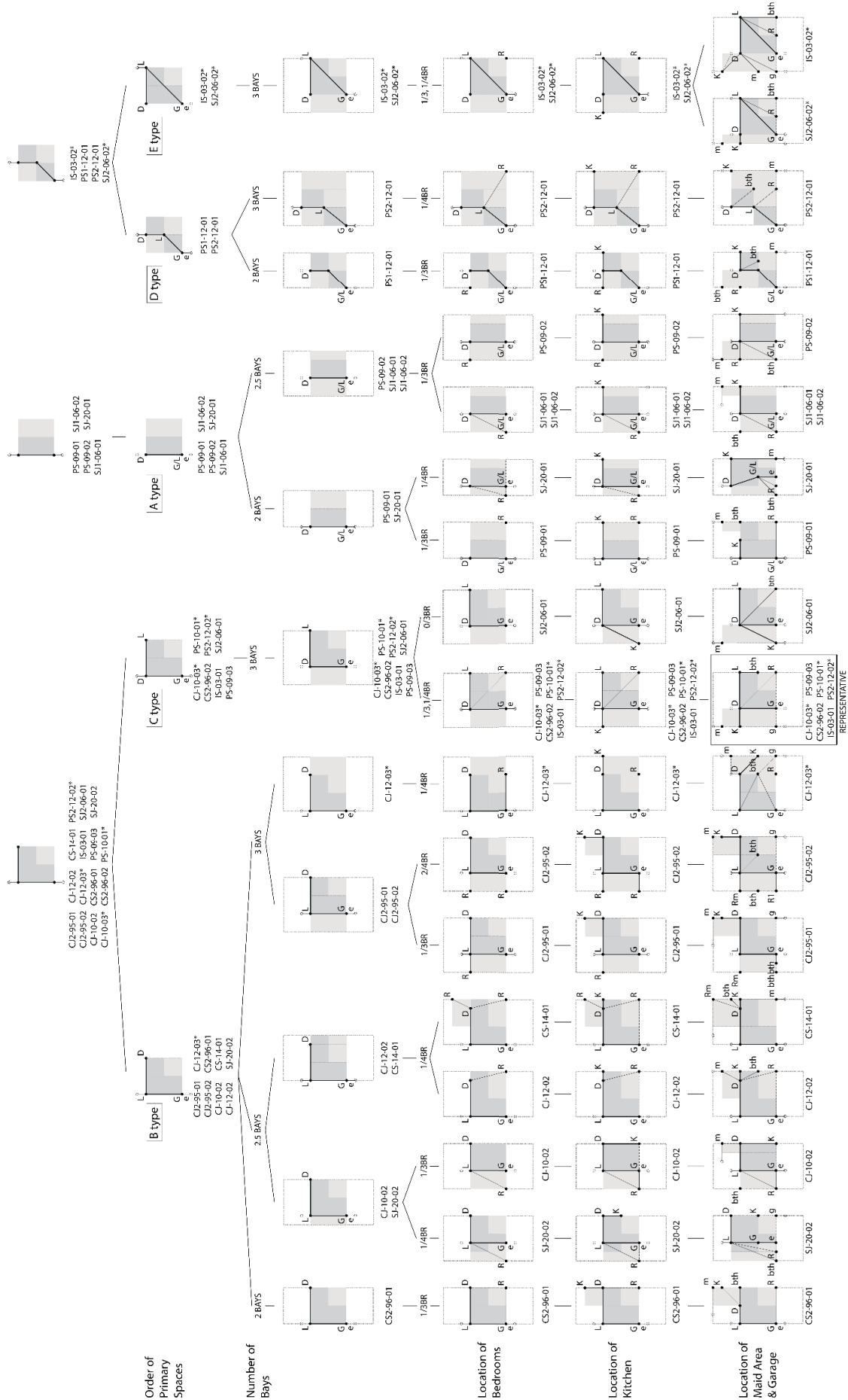
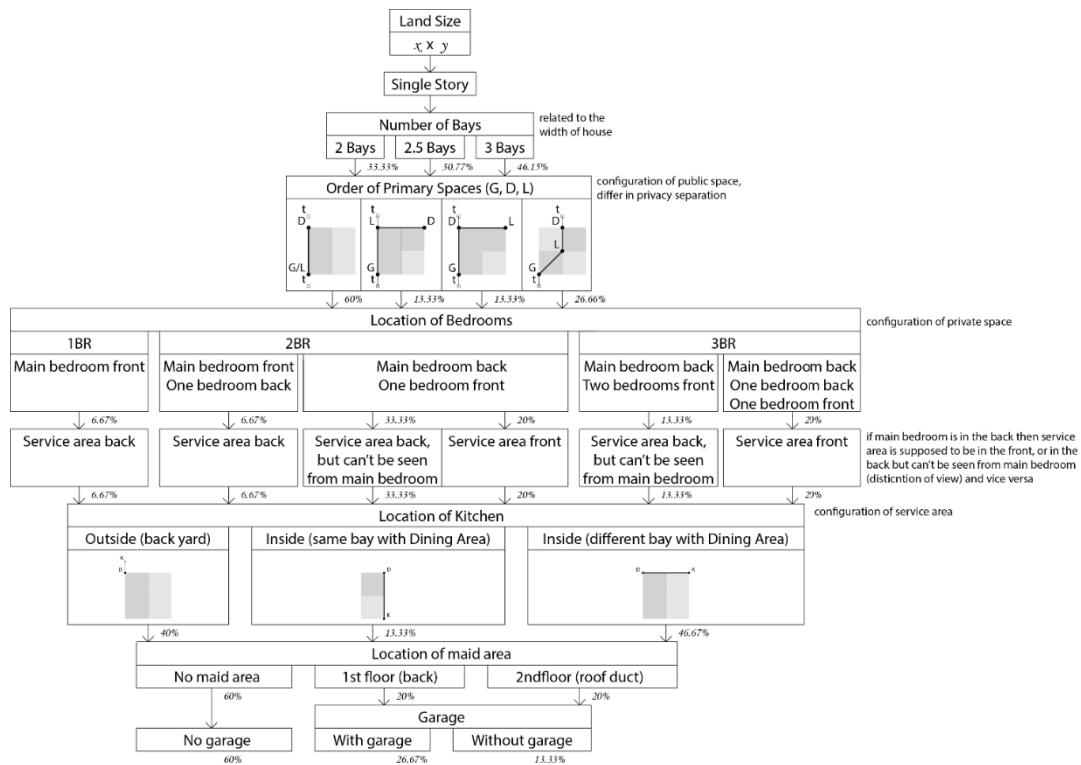Figure 19. The process of finding common subsets from 24 double-story row houses (the first floor only)

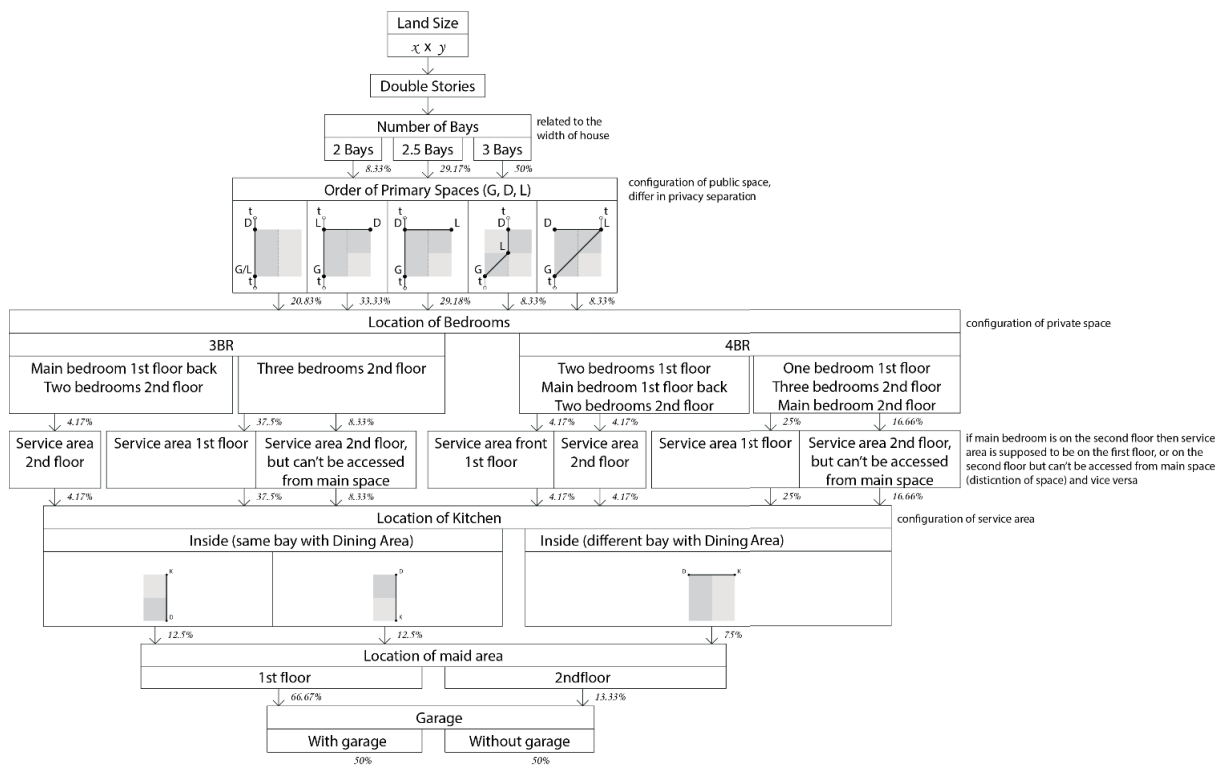Figure 20. Design process for single-story row houses

Figure 21. Design process for double-story row house

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