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Article

Phenotype, Genotype, and Environment, Case study: Traditional Malay House, West Borneo, Indonesia

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Abstract: Phenotype variation is produced through a complex of interactions between genotype and environment. Phenotype, genotype, and environment are addresses the relationship between architecture and identity. The term genotype biology and phenotype have been adopted into architecture in the late twentieth century. Genotypes are abstract relational models that govern the arrangement of space, and the principle of organizing space and phenotypes is the real realization of genotypes in the physical environment. The genotype is a reflection that is not only about the spatial organization but also the nature of social and cultural patterns. Then this study purpose to an understanding of the connectedness variant phenotype from a genotype and environment. The repetition pattern being stable structure in variation phenotype uses as a database to finding an identity in architecture. The method used in this research was Levi Strauss's structuralism and multi-layer of a biological system. This research samples traditional Malay houses in West Borneo, Indonesia. These houses have a unique site and existing environment. The houses can be found mainly along the river. The results found from the phenotype, genotype, and environment have value and meaning as a traditional Malay house rule in West Borneo which was always handed down from generation to generation.

Keywords: The building and the environment, Phenotype, Genotype

1. Introduction

Ignoring sustainable development leads on to destruction of the environment and humankind. Without preserving the collective identity in the community in which historical and cultural approaches are one of the main heritages. the task for contemporary architects is to take the old and now culture into consideration, and to find out a practical approach to vitalize the tradition.[1] In modern conditions the preservation of individual peculiarities and national identity of architectural environment is becoming a necessity.[2] A practical approach to vitalize the tradition can be done by collecting data identity in architecture. Collective data aids architect in understanding places and people, then incorporating the associated revelations into their designs. Data sets and modeling could help architects test the viability of design concepts before constructing them in real life.

In genetic, the terms genotypes and phenotypes used in connection predict the inheritance of gene identity. At the beginning of the 20th century, the terms genotype and phenotype in biology were adopted by Hillier and Leaman into architecture. [3] Genotypes are abstract relational models that govern the arrangement of space, and the organizing principles of the underlying phenotypes. Phenotype is the real realization of genotype in the physical environment in the form of architectural artifacts.[4] In architecture, buildings are artifacts symbols that store cultural information in human

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habitation. [5] That buildings are symbols of innate human qualities and symbols of individual and cultural communities. [6] In traditional houses, cultural structures can be passed down from generation to generation, but produce large variations at an observable level. The stable structure that underlies this is referred to as the genotype, compared to the phenotype which is a form that can be observed varied. [7]

For example research from traditional houses in Korea. Traditional houses in Korea have been developed into modern dwellings in high rise buildings. The results of his research found that the modern house still retains old features through different floor levels. The floor level limits the boundary between the inner and outer environment. The house is more than just a functional object because the house is a means that carries cultural values and beliefs transmitted from generation to generation. In this research, researcher called the term *hidden dimension* to express the hidden value in the physical occupancy.[8] Another research on traditional houses and modern apartments but in a different location namely Malaysia, it was revealed that to find genotypic elements that survived the old culture can be found through floor plans that can be changed through graphical representation and analyzed to filter out spatial elements that are most common in it. Through this interpretation of similarities, the special nature of culture from the past can be revealed. [9]

In traditional houses, cultural structures can be passed down from generation to generation, but produce large variations at an observable level. The stable structure that underlies this is referred to as the genotype, compared to the phenotype which is a form that can be observed varied.[7]

From the theory of genotypes and phenotypes in architecture that have been discovered before. Then this study purpose to an understanding of the connectedness variation of phenotype from interaction a genotype and environment. The repetition pattern as stable structure in variation phenotype uses as a database to finding an identity in architecture. An identity data can reuse another design in the future for sustainable development.

2. Genotypes and Phenotypes

The syntactic methodology of space adopts the terms genotypes and phenotypes from biological disciplines and applies them to social science in general and architecture in particular. Genotypes are abstract relational models that govern the arrangement of space, and the principle of organizing space and phenotypes is the real realization of genotypes in physical environment, namely architectural artifacts.[3,4] In space syntax theory proposes that genotype is a reflection that is not only about spatial organization but also the nature of social and cultural patterns. [3,4] Through identification of similarities and differences in the internal configuration of buildings it is possible to identify spatial genotypes [10,4]. In analyzing genotypes, one of the most common ways to be observed is where culture is built into residential space patterns. The recurring pattern is for example the position of the kitchen which is located in the deepest room of the building. Then the spatial configuration shows the cultural genotype that results from encoding social meaning in architecture. [3,4] Cultural structures can be passed down from generation to generation, but produce large variations at an observable level. The stable structure that underlies this is referred to by biologists as genotype compared to phenotype which is a form that can be observed varied. [3,9] Genotypes are broadly defined as features or phenomena that persist over time. Cloned from generation to generation, and repeatedly stated in several cases. The domestic spatial genotype can be defined as a spatial pattern that commonly appears in some cases. [11] In architecture, resistance to change is firmly rooted in structures called archetypes. Archetypes or archetypes can be considered as zero points in

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architecture. This can form a framework of resilience, where changes can occur in function, technology and aesthetics that refer to 3 (three) Vitruvius principles. To understand the archetypes in the specific scope of local architecture, building designs must be examined through several case studies and typological analysis. [12]

3. Genotype and Environment Interactions affect Phenotype

In biology, phenotypes represent the consequences of genotype-environmental interactions that are universal and relate to all living organisms. Garrod (1902) was one of the first scientists to note that the effects of genes on phenotypes can be modified by the environment (E). [13]

$$\mathbf{P = G + E} \quad (1)$$

Information:

P = Phenotype / phenotype

G = Genotype / genotype

E = Environment

The phenotype develops from the interaction of organisms and the environment. From the initial stage to grow until the end of life. This condition raises many additional challenges in quantitative analysis so that it is almost impossible to record biological systems and their environments in the many spatial and temporal dimensions needed to understand the development of certain phenotypes. [14] Examples are plant in biology, phenotypic plasticity, especially in plants is part of adaptation to certain environments. For example plant phenotypes exposed to limited environments (e.g. drought) remain (generally) smaller and often adjust their structure (shoots and roots) and their physiology. [14] Likewise in architecture in residences cases, the shape of the house adjusts to the occupants and environment so that it produces a lot of variations in architecture. Through phenotype data will be analyzed to find genotypes and DNA in architecture.

4. Biological Systems

One of the keys to the achievement of biology in the last 100 years is the discovery of biochemical processes in biological systems. This biological system method aims to understand DNA and genotype-phenotype relationships. [15] In biological system there are complex interactions in each layer, such as transcription, translation and interactions that make it possible to see a biological system as a multi-layered structure. [16]

Biological systems are the most fundamental level where genotypes rise to phenotypes, which are observable traits. The genetic code stored in DNA is "interpreted" by gene expression, and the properties of that expression give rise to an organism's phenotype. Phenotypes are expressed by protein synthesis that controls the shape of the organism or the characteristics of the organism. [15] The process of biological systems is obtained from DNA, genotypes and phenotypes through synthetic, translational and transcription processes. Genes as genetic material are considered genotypes or genomic descriptors. It processed through a transcription process that produces a *transcriptome* or transcription Then proceed to the translation process that produces a proteome or protein product. Furthermore, the synthetic process consists of combining the tissues that form the *metabolome* as the end result in the form of a set of molecules that form a phenotype. [15]

In Biology Science

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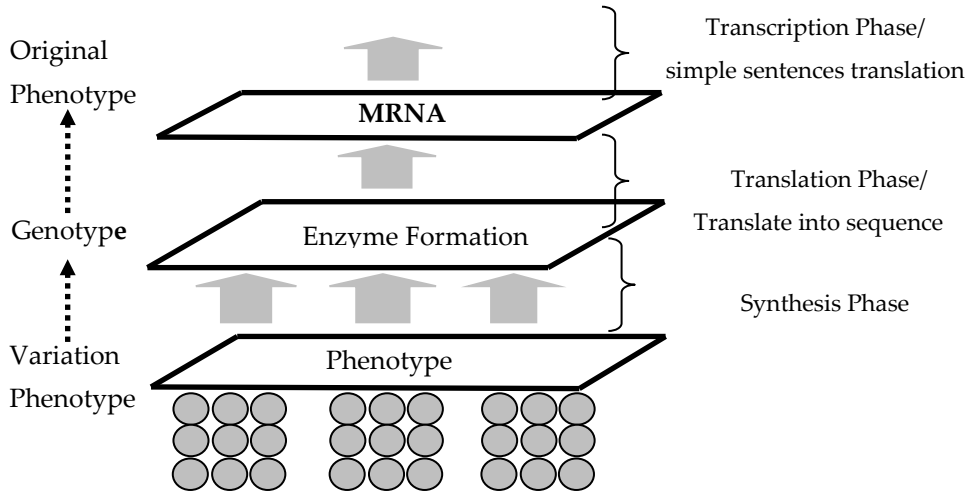

Figure 1. Biological Systems Stage

In biology science, the synthesis phase produces a protein or proteome product. In biological systems, the synthetic stage is the stage of integration between proteins. Biological processes at the synthesis stage are complex macromolecular tissue processes and interact functionally. In the synthesis phase, protein interactions become a database of biological systems. In biology, *Cytoscape's* network analysis technique integrates a biomolecular interaction network used to display all information about nodes (proteins) and edges (interactions). In the example above, the node is represented by a gray circle, and the interaction / edge is represented by a black line. After analyzing the technique of forming a network between proteins, an analysis is carried out to see the similarities or dominant patterns [17]

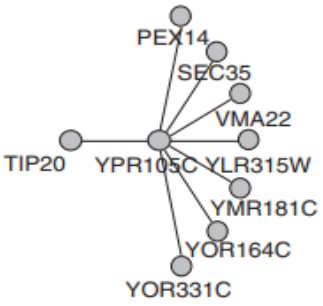

Figure 2. Protein Integration Visualization in Biological Sciences

Theory of variation phenotype from genotype and environment then the multi-layer biological system will be background knowledge for analysis collective data in architecture science.

2. Materials and Methods

The location is in West Borneo, the sample used is a traditional Malay house around the palace in West Borneo with a sample of 8 cities which are royal cities in West Borneo. West Borneo is an area that could be dubbed the province of a thousand rivers. The nickname is aligned with the geographical conditions that have hundreds of large and small rivers that can be and often are navigable. Traditional Malay houses can be found mainly along the river. Total Sampling is based on the category of West Borneo traditional houses, has the same type, element integrity and there are still residents, so total sample were 69 houses. Figure 2 explaining the sample of houses with different existing sites, the houses in front of the river, and the branch river located on the right side, left side,

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or back of the houses. The positioning of the stilt house is higher from the ground level around 1-1.8 meters above the water. In general, Malay people use the canoe as transportation and the use of *gertak* or roads located on the water to be a means of access for residents through land routes.

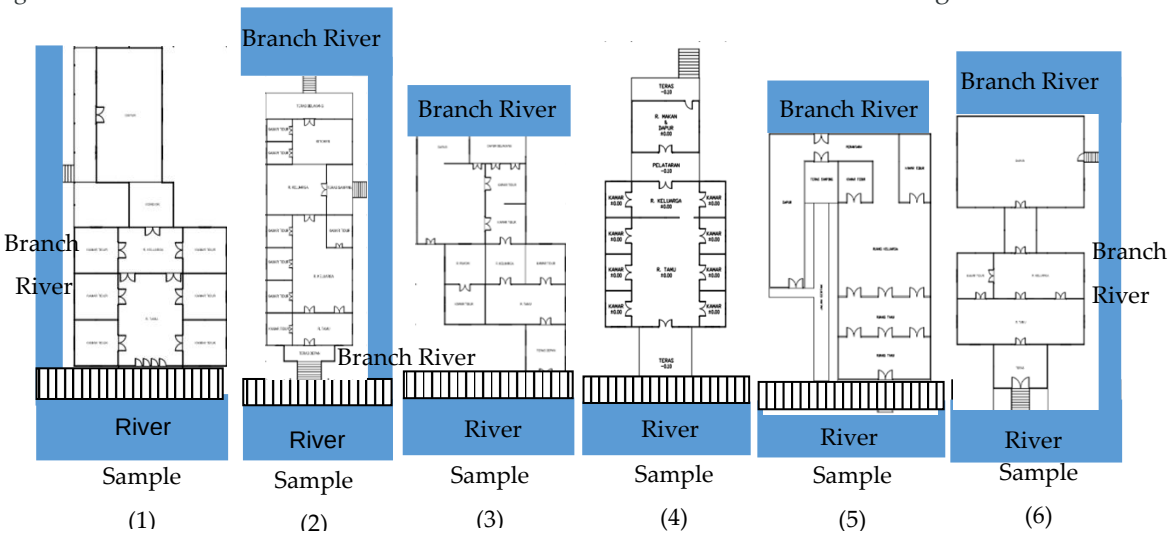

Figure 3. Variation Phenotype From Sample Research

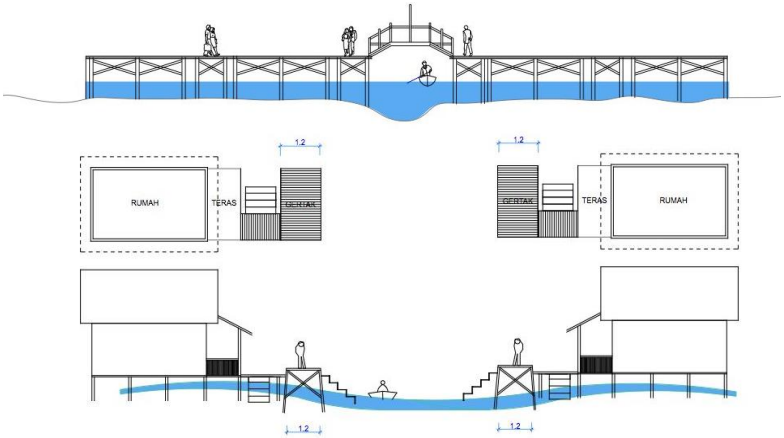

Figure 4. *Gertak* and River as Accessibility of Traditional Malay House

Traditional buildings are constructed with the most suitable local material and construction methods depending on their locations on the land, space organizations, zoning and orientation, climate and environmental conditions. [18]

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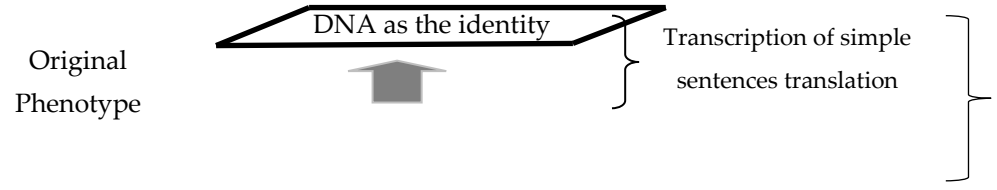
Fig 5. Variation Phenotype Traditional Malay House

This study uses the Levi Strauss structuralism paradigm and analogy of biological systems. Structuralism Levi Strauss by observing surface and internal structures. The structuralism paradigm assumes that the entire universe is a world of symbols and meanings. This approach is elaborated with the structuralism paradigm which has an external structure and an inner structure. The outer structure is in the form of form and function, while the inner structure becomes a model in understanding the cultural phenomena studied. This biological system will be elaborated with the Levi Strauss paradigm. Biological systems that have a multi-layered structure from the DNA stage, genotype to phenotype. The Levi Strauss paradigm which has an outer surface structure is considered as a form of phenotype and the inner structure is a deepening analysis to find genotypes and DNA as identity. First of all, from the typology variation phenotype of the traditional Malay residence in West Borneo was carried out to find the character of the form, namely archetypes or basic pattern through the process of space syntax. The spatial shape character will be discovered through spatial configuration analysis using justified graph. After the space configuration has been found. Then found archetypes that are always repeated and then proceed with identifying the genotypes obtained. Identification will be done through a process of translation into the topological language placed on the table to explain the basic spatial structure. [19] The basic spatial structure is then interpreted. Genotype is an abstract model that contains meaning and is always imitated into language code in architectural communication. The language code is obtained from the transcription process. The findings will be the answer to the connectedness of genotypes, phenotypes and DNA architecture.

The process of DNA in biology consists of synthesis, translation and transcription. [15] Then, it is applied into architecture which consists of the syntactic process, the process of translation (translation into language topology) and the process of transcription (translation into code).

In Architecture Science



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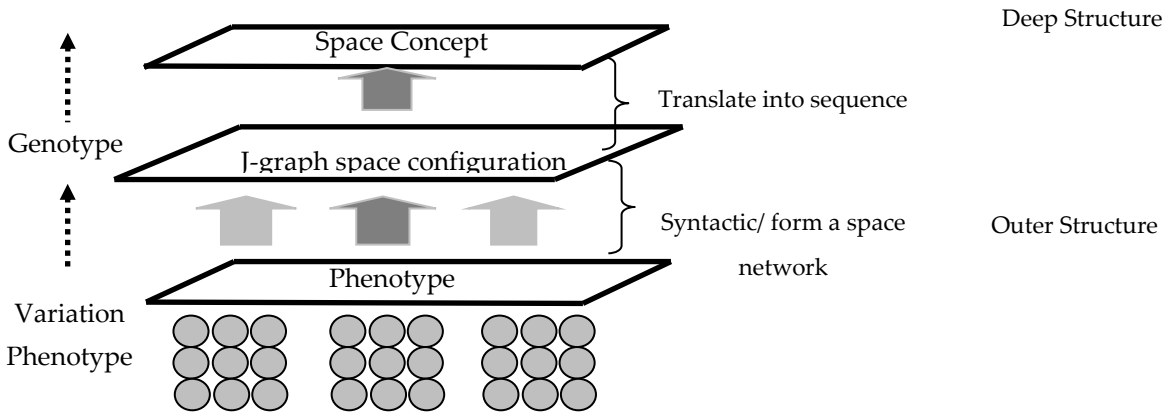

Figure 6. Analogy of Biological Systems and Structuralisme Levi-Strauss in Architecture

In architecture, also known as space syntactic analysis techniques as techniques that form networks between spaces. Space syntax is the study of spatial arrangement; explore patterns of relationships or networks between one room and another. This is similar to the tissue analysis technique used to analyze protein networks in biology. In the syntactic analysis technique of space through justified graph, space becomes a node and edge in the form of interaction between spaces.

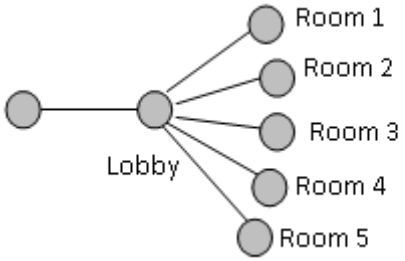

Figure 7. Space Connectivity in Architecture Science

Space syntax is carried out to understand the configuration of space, especially its formative processes and social meaning. This method of analysis is very useful for finding structures that are hidden behind architectural representations. The second stage is the translation process. Analysis of the concept of space by using the process of translation of the results of the syntax of space. Genotypes represent the structure of network management consisting of components and their interactions while phenotypes represent the output patterns of the system (Crombach, Wotton, & Jaeger, 2015). In biology. After the inter-protein network is found, analysis is continued in the translation process. The translation process is the process of translating the genetic code. This is done to find the character of genes. In architecture, findings from justified graphs are dominant patterns or basic patterns. One of the goals of determining archetypes in architecture is to show the existence of a common language that can be easily understood, regardless of individual or culture as one example, archetypal theory has also been investigated in the field of architecture that investigates repeated features in architecture.

After the discovery of archetypes then proceed to find the common language of the patterns so that they are easily understood. Quoted from Notkin, 1989 the analysis phase to find the meaning of genotypes can be done graphically using methods that involve analytic modeling of spatial geometries and component parts and the character of the relationship between these spaces, as well as with the external environment. This can be done by making a scheme plan for observation. The

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language of graphic symbols is also very necessary to examine concepts in the formation of space so that the idea arises that observations are considered as organisms that have a nucleus. The graphical model can provide information about the most important anatomical features when occupying space and about a group of observations that have the same topological character. This also allows one to visually identify the basic features of structural development, in a manner similar to the phenomena seen in the cell growth of living organisms. Topology involves spatial order and the spatial organization, associated with a place (place) which shows the orientation of human activity in a place. Concerned with analyzing the characteristics of a place. Some representatives are translated into topological languages which are placed in tables to explain the basic spatial structure. In biology, the process of translation and transcription will go through 3 stages. The initiation stage (binding), the elongation stage, the termination stage (completion). In this research, the dominant pattern obtained from the spatial syntax results will be analyzed into a matrix to see the morphology of the initiation process which is considered as the initial stage of the building, in this case the first space built as a starting point. Elongation phase in this case the addition of space because of the needs and the elongation stage as the end of development.

Translation of space has been done in the translation process to get the meaning of the principle of organizing space. The next step is to continue the coding process through the transcription process. At the transcription stage in biology there are also stages of initiation, elongation and termination. In biology, DNA contains the instructions that cells need to produce the code obtained from the form of various molecules including RNA and protein. (Clancy, 2008). In architecture, DNA architecture contains instructions for producing codes that are found as references to repetition or imitation of building.

3. Discussion

Typology variation phenotype of the traditional Malay residence in West Borneo was carried out to find the character of the form, namely archetypes through the process of space syntax. Space syntax is carried out to understand the configuration of space, especially its formative processes and social meaning. This method of analysis is very useful for finding structures that are hidden behind architectural representations. The spatial shape character will be discovered through spatial configuration analysis using justified graph (j-graph). After the space configuration has been found. Then found archetypes that are always repeated and then proceed with identifying the genotypes obtained. The division of time is divided into 2 periods, namely the past time during the reign of the kingdom from 1700 to 1945 and the present time of the changes kingdom into the presidential system in 1945-2020. The division of time from a political aspect becomes the basis of election because during the royal kingdom period, the pattern of house spaces was intended not only for the private lives of residents but also used for communal space for deliberations. Now, this is no applicable.

1) Syntactic Phase

The analysis was carried out on 69 samples of traditional Malay house, but we displayed 6 examples of houses to simplify. In the syntactic analysis through Justified graph analysis of Malay houses in West Borneo, consistency was found in the repetition of patterns in 69 sample houses. The pattern is in the form of a room consisting of a terrace, front (porch), living room, family room with rooms (cubicles), platform, and kitchen which is equipped with a side terrace or back terrace. The repetitive pattern being genotype and always maintained or passed down from generation to generation. This pattern is found in 55 observed cases from 69 samples found in traditional Malay houses. After founding the arrangement of space, continue to understand the principle of that spatial organization through topology analysis.

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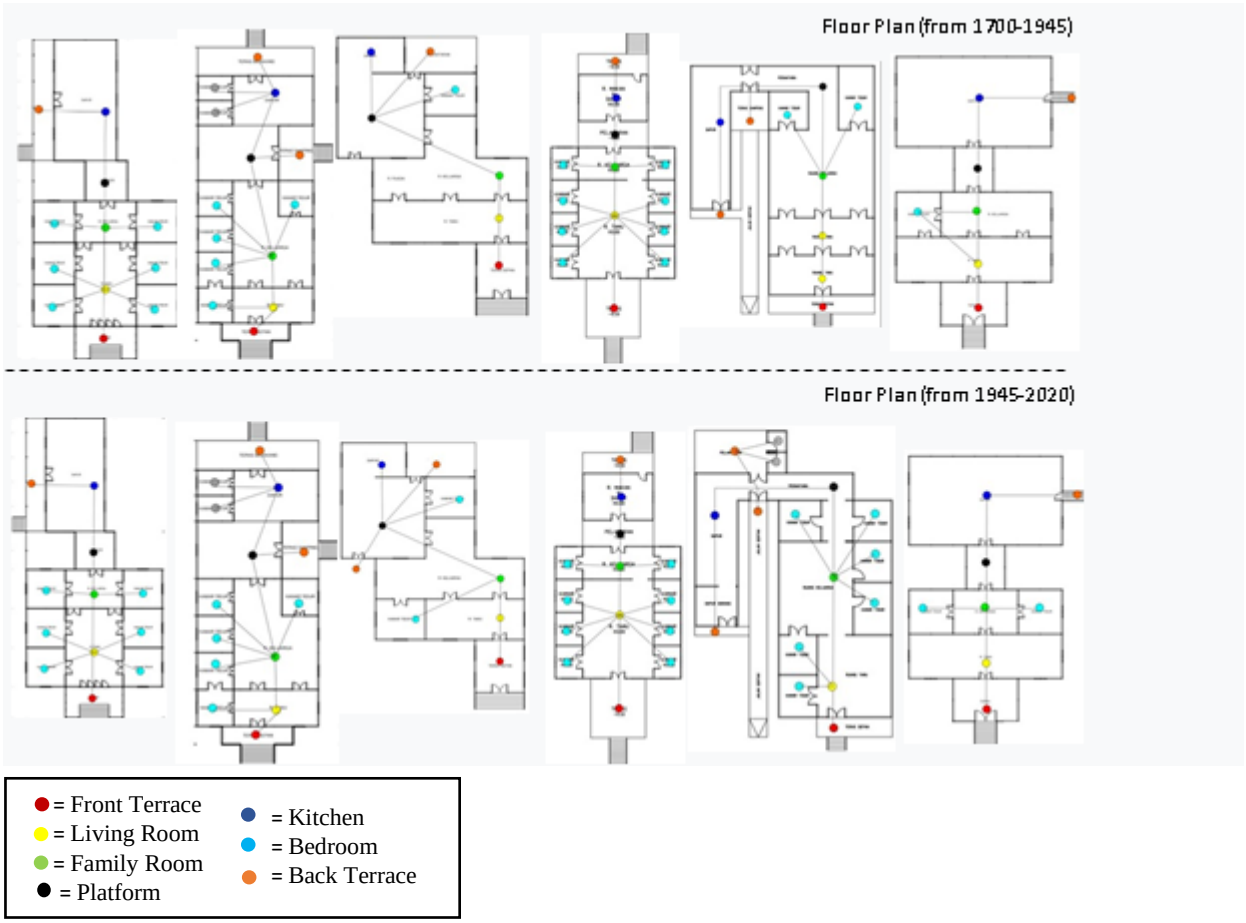

Fig. 8. Justified Graph Floor Plan Traditional Malay House West Borneo

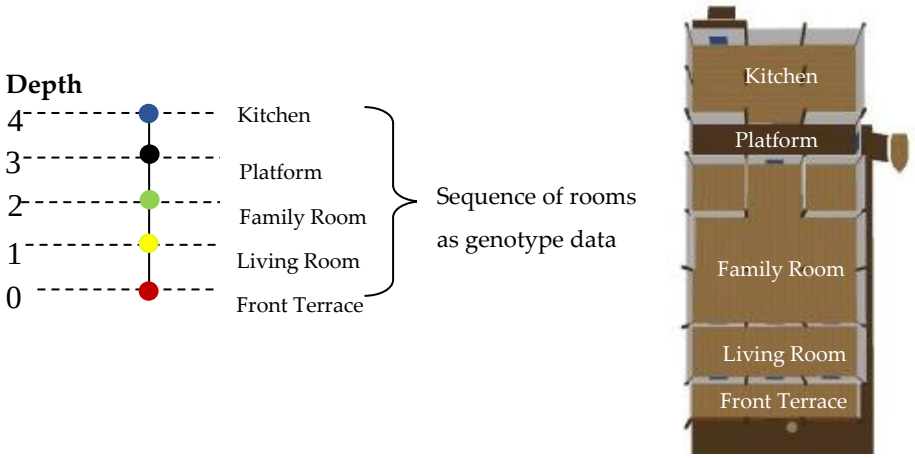

Figure 9. Depth Map Traditional Malay House West Kalimantan

From the results of the j-graph analysis, it is found from the deep map of sample spatial organization. The sequence of rooms always the same on 55 houses from 69 total sample houses. The sequence of rooms starting from the front terrace, living room, family room, platform, and kitchen. While access from the side terrace by natural conditions and position of appropriate river branches left or back of the house. Similarly, the position of placement of bedroom adjusted to the position of the family room or living room. When compared to past and present conditions. Changes appear added in bedrooms. This is cause of increases in the number of family members and added a room service. The finding of the same spatial sequence and stable structure of various samples is called

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the genotype. Genotypes are abstract relational models that govern the arrangement of space, and the organizing principles of the underlying phenotype. To understand the principles of spatial planning, in-depth interviews were conducted with residents in the sample house. Then, to understand the meaning of the sequence, continue to topological analysis in the translation phase. Analysis of the user of space-related to functions and activities can be reviewed as follows:

Table 1. Relation of spatial function and Activity in Traditional Malay House

No.	Room	User	Activity
1.	Front Terrace	Male Resident and male Guest	Receptiveness to male guest.
2.	Living Room	Male Resident and male Guest	Communal room for male guest and resident
3.	Family Room	Women Resident and Women Guest	Communal room or family room for women
4.	Platform	Women Resident and Women Guest	Transtition room, access for women And male resident
5.	Kitchen	women Resident	Cooking and store area
6.	Bedroom	women and male Resident	Rest and pray room
7.	Side and Back Terrace	Women Resident and Women Guest	Main access for women

According to Eliade (2003) shows that an object or an action becomes real only if it is repeated or imitated. In other words, humans feel real when imitating from archetypes (original patterns). In this study, the most dominant pattern is a reference to the traditional Malay residence pattern in West Borneo. The phenotype of a traditional Malay house is formed from the genotype underlying the space layout. The genotype is considered as the most stable structure. Genotypes are abstract relational models that govern the arrangement of space, and the organizing principles of the underlying phenotypes. The front porch is the beginning of space in a Malay house in West Borneo. The front porch is also called the front terrace. At a Malay house in West Borneo, male guests usually enter through the front terrace while female guests usually enter from the side terrace or back terrace. From the front terrace to the living room (middle porch), past one depth the room is limited by walls and doors. The living room is an area to receive male guests in a celebration event or large event in the house. Then proceed to enter the family room (back porch) which is limited by walls and doors. Every door on the front porch, middle, and back is always closed by a curtain so that boundaries are always maintained

2) Translation Phase

In translation phase will go through 3 stages. The initiation stage (binding), the elongation stage, the termination stage (completion). The three stages are analyzed in the components of forming space, there are the floor, wall and roof.

Table 2. Translation Phase, Evolution building

	Floor	Wall	Roof
	Main Family		

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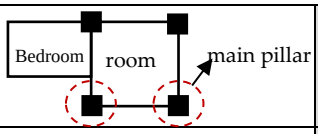
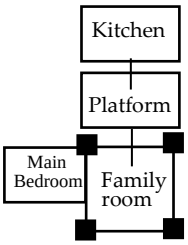
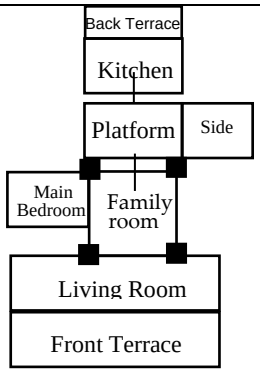
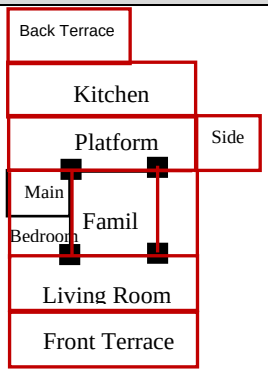
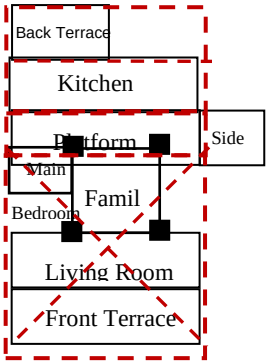
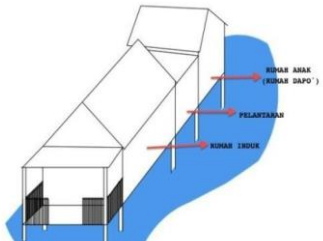
Initiation stage			
Elongation stage			
Termination stage			

The next stage is the process of translation, at the stage of translation, finding dominant patterns is translated to find the meaning of each space. In the initiation stage, the most important space-forming structures and the first stage for building a house. In the Malay house of West Borneo, the spatial structure is preceded by a series of pillars which are the main pillars of housing construction. Four series poles are located in the family room. One of the series poles forms the family room and parent's room. The placement of this series pole is found in all the traditional Malay houses in West Borneo. The family room as a gathering room is interpreted as a balance of relations between main families. The main room in the form of a parent's room becomes a reference to the symbolic meaning of harmony in the house. This implies the meaning of parents as role models, the most important role of parents in the family, and the value of respect and ethics of children to parents.

Elongation stage that is connecting the initial space or the main room with other space needs by the residents needs. Basically, traditional malay house divided into three parts there are main house, platform and child's house. Main house are consist of front terrace, living room, family room and bedroom. Platform are consist of platform area and side terrace. Children house are consist of kitchen and back terrace.



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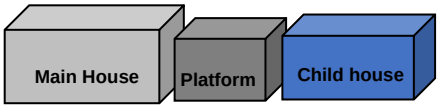

Figure 10. Three Part of Traditional Malay House

The family room and the main room in the main house are then connected to the function of delivery as a transitional space and the children's home as a kitchen. Children's house functions as a space for cooking. As a connection between residents and the environment or nature. The platform as a connecting room for the parent house and the children's home also illustrates the relationship between the occupants and the environment. Because of the position of the door placement on the delivery facing the river directly on the side of the house.

Termination stage, this stage completes the building formation. After the addition of the main rooms, at this stage it is an improvement from other rooms including the addition of living room needs as a connection between residents and other social spaces as well as other supporting spaces such as the front porch, side porch and back porch. The termination stage on the wall shows that each space is limited by a wall to limit the visual privacy of residents with non-*mahram* guests. While the termination of the roof shows the difference in the roof of the main house, the platform and the children's home. In one house there are 3 different types of roofs.

From the topological language analysis, it can be understood the evolution of the development of traditional Malay houses in West Borneo from the initial stage to the completion of the house. In a traditional Malay house in West Borneo, positioning parents becomes a role model in life. Parents who are responsible for family life for children, both boys and girls. The limitation of *mahram* in a traditional Malay house is a visual privacy factor. Three main things that hold parents in building a family including. The Religious System (God) in a traditional Malay house regulates the principle of space both from the walls and openings as the limits of the *mahram* and the height of the floor. Then the social system, parents make openness in social relations or the *ummah* in Islam. Suave social relations in life appear on the door opening which is a symbol of the openness of the occupants of the house to welcome guests present into the house. Then human and environmental connectivity can be seen from the placement of space adapted to environmental conditions, for example on the placement of the side porch, in accordance with the river and the placement of the canoe. The relationship between human relationships with God, human relations with humans and human relations with the environment, building explicit (real) and implicit (intangible) results; namely cultural representation. The physical environment is formed by the relationship between humans and the environment. Human and supernatural relationships create a socio-cultural environment including customs, religion, values, and aesthetic concepts and so on. The relationship between humans and other humans builds a socialization environment based on people's interactions and community engagement.

3) Transcription Phase

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In transcription phase, the process of transcription is the process of simplifying into the gene code that exist in the DNA sequence. In transcription phase will go through 3 stages. The initiation stage (binding), the elongation stage, the termination stage (completion).

1. The initiation or binding stage. At this stage, binding will be made of the main space-forming structures. Each space function will be given a letter symbol to simplify the code. The letter symbols in the space will be grouped according to their placement in the building mass.
2. Elongation Stage. Elongation stage of the initial or main space with other space needs based on the occupants' need. The needs for socio-culture are applied in the front room and the living room, while the daily needs consist of the platform and kitchen.
3. Termination stage (Completion). From the initiation and elongation stages to the termination (completion) stage. The termination step combines the previous findings into the sequence. The genetic code of Malay houses in West Borneo is in the form of MH (Main House), PL (Platform), and CH (Child's house).

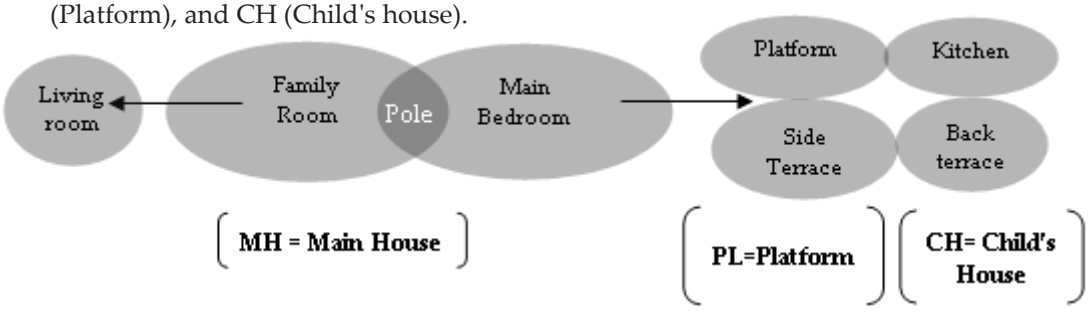

Figure 11. Transcription Phase

4. Conclusions

Variation of phenotype as a data to find genotype and finding DNA as code in architecture. Genotype in the form of arrangement and the principle of organizing space based on cultural and religion and environment are consist of geography condition and resources. The term DNA in architecture can be used to describe an identity that is always repeated. This identity can be found in type of building and should traced through the classification of archetypal typologies in buildings. Buildings are determined not only through climatic conditions but also because of the availability of materials, construction technology, the character of the location, the need for protection, economic, religious and also socio-cultural reasons. The whole factor will be the determinant of the formation of the basic pattern which becomes the reference of DNA as an identity in architecture. in analogy of biologi science, biological systems process are adopted to connected phenotype, genotype, environment and finding DNA in architecture. Follow table 6.

Table 3. Conclusion Process Biological System to Connecting Phenotype, Genotype and Environment

Form	Process	Tools	Finding
Phenotype	Syntactic process	Justified Graph	Archetype
Genotype	Translation process	Topology Matrix	Evolution in building
Original phenotype	Transcription process	Analysis coding	Coding DNA

In this research from 69 sample traditional Malay house in West Kalimantan, this research found the code of DNA form of gene MH (Main House), gene PL (Platform) and gene CH (Children House). Gene MH are consist of (FT, LR, FR and BD), gene PL are consist of (PL, ST), and gene CH consist of (KT, BT). Genes are the smallest unit of genetic material that controls the characteristics of heredity. Each gene has a different function and can be a material for duplication. Genes as carriers of genetic

information and regulate the process of survival of physiology or life. In architecture science, In each of these codes of gene has the translation of messanger in the form of a message of space requirements in the malay house West Borneo. Thus, in tradisional malay house will have the same code of genes in architecture. Process biological systems have 3 stages. There are a network form stage, translation stage and trascription stage. The initial phenotype is the data layout of buildings and building shapes to observe archetypes (basic patterns) of floors. The phenotype data is analyzed by justified graph by connecting each space with a network of connectedness and depth of space to find the dominant patterns that become archetypes. The findings from the dominant pattern are followed by the translation process in topology language analysis. Topology language matrix to explain the basic spatial structure through the evolution of buildings. The evolution is reviewed from 3 stages including the initiation (binding), the (elongation) stage and the termination (completion) stage. From the translational analysis found the basis of spatial structure that is a reference to the findings of genotypes. The next process is the transcription or coding process, the basic findings of the spatial structure become the code reference. The code is stored in DNA which is considered a blueprint or framework. The code is a data base of production for making concept of replicating similar type of buildings. Therefore, data sets and modeling could help architects test the viability of design concepts before constructing them in real life and a practical approach to vitalize the tradition for sustainable development were suitable with genotype (social, cultural) and environment**.**

5. Patents

Supplementary Materials: Table S1 = Analysis Justified Graph 69 Sample Traditional Malay House. Table S2= Analysis Three Part 69 Sample Traditional Malay House. Table S3= Analysis Main Pillar 69 Sample Traditional Malay House

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References

1. Ibrahim, H. G. A. Regeneration of Sustainability in Contemporary Architecture : Approach Based on Native Function and Activities to Strengthen Identity. *Procedia- Social and Behavior Science*. 2016. Volume 216. Pp 800–809. https://doi.org/10.1016/j.sbspro.2015.12.077
2. Dyda, I. The Concept of Traditional Architecture in Terms of Preserving Identity of Modern Architectural Space in Ukraine. *Architectural Studies Journal*. 2016. Volume 1. No. 2. Pp 49–56.
3. Hillier, B.; Leaman, A. How is Design Possible. *Journal of Architectural and Planning Research*. 1974. Volume 3,1.pp 4–11.
4. Guney, Y. I. Type and Typology in Architectural Discourse. *BAÜ FBE Dergisi*. 2007. Volume 9 No.1.pp 3–18. Retrieved from http://fbe.balikesir.edu.tr/dergi/20071/BAUFBE2007-1-1.pdf
5. Min, D. A.; Lee, J. *Morphological Analysis of Cultural DNA*. Springer:Kaist, Singapore. 2017.
6. Heidegger, M. *Poetry, Language, Thought*. Harper & Row, New York. 1971. Volume. 154.
7. Bafna, S. Rethingking Genotype: Comments on the Sources of Type in Architecture. Response to Julienne Hanson's The anatomy of Privacy in Architect' London Houses'(1998). *JOSS*. 2012. Volume 3 issue 1. pp 69-80.
8. Seo, K. wook. DNA of the House. A hidden Dimension in the Development of Domestic Space in Seoul. *Home Cultures Journal*. 2012. Volume 9 issue 1 PP 77-98. DOI: 10.2752/175174212X13202276383850
9. Seo, K. wook. Finding Housing Genotypes by Graph Theory_ an investigation into Malay houses. Chapter Morphological Analysis of Cultural DNA Kaist-Springer. Singapore. 2017. DOI: 10.1007/978-981-10-2329-3_4
10. Hanson, J. *Chapter Eight. The Anatomy of Privacy in Architect 'London Houses'. In Decoding Homes and Houses*, Cambrige: Cambrige, University Press. 1998
11. Byun, N.; Choi, J. A Typology of Korean Housing Units: In Search of Spatial Configuration. *Journal of Asian Architecture and Building Engineering*. 2016. Volume 15(1), 41–48. https://doi.org/10.3130/jaabe.15.41
12. Ledent, Gerald. Permanence to allow Change. The archetypal room: the persistence of the 4x4 room. *Dial.Pr. UCL Research Publication*. 2017

13. Baye Tesfaye, M.; Tilahun, A.; Russell A,W. Genotype – Environment Interactions and Their Translational Implications. Personalized Medicine. *Future Medicine Journal.* 2011. Volume 8 issue 1, 59–70 ISSN 1741-054. doi: 10.2217/pme.10.75
14. Pieruschka, Roland ; Uli Schurr. Plant Phenotyping: Past, Present, and Future. Plant Phenomics a Science Partner Journal. 2019. DOI: 10.34133/2019/7507131
15. Go, V. L. W.; Nguyen, C. T. H; Harris, D. M.;Lee, W. P. International Conference on Diet , Nutrition , and Cancer Nutrient-Gene Interaction : Metabolic Genotype-Phenotype Relationship. *Journal of Nutrition*. 2018. Volume 1, 3. pp 3016–3020.
16. Kim, M.; Nam, Y.; Shin, H. An inference Method From Multi-layered Structure of Biomedical Data. BMC Medical Informatics and Decision Making. 2017
17. Desiere, F. Towards a Systems Biology Understanding of Human Health : Interplay Between Genotype, Environment and Nutrition. *Biotehnology Annual Review*. 2018. Volume 10. DOI: 10.1016/S1387-2656(04)10003-3
18. Keskin; Kader; Erbay M. A Study on the Sustainable Architectural Characteristics of Traditional Anatolian Houses and Current Building Design Precepts. *Procedia - Social and Behavioral Sciences*. 2016. 216, pp 810 – 817.
19. Notkin, I. I. Genotypes of spatial form in the architecture of the east. *Muqarnas*. 1989. Volume 6. pp 50–57. https://doi.org/10.1163/22118993-90000234