

ARCHITECTURE AFTER GRAVITY: UNDERSTANDING THE SPATIAL EXPERIENCE OF WEIGHTLESSNESS AND DISORIENTATION

Ocfia Amirul Elawati, Kristanti Dewi Paramita*) ,Paramita Atmodiwirjo

*) Corresponding author email : kristanti.dewi@ui.ac.id

Department of Architecture, Faculty of Engineering, Universitas Indonesia, Depok, West Java, 16424

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Abstract

This study examine the idea of after gravity as the basis of an architectural design method. After gravity is defined as the condition of weightlessness and disorientation that creates unrestricted body movement. Gravity determines the direction of architectural spatial orientation and gives weight to subject and object in architectural space, creating boundaries of possible body movements. This paper analyzes the development of a design method that appropriates gravity through the analytical study of ten gravity-defying body movements such as hanging, flying, or spinning. The study identifies three gravity-based relations; happening between bodies, between body and object, and between body and space. The design method of architecture after gravity highlights the spatial experience of the moving body in receiving stimuli and responding to the context. Understanding architecture after gravity widens the potential of architecture that sees the relations of forces in a context with the body in a dynamically built environment.

Keywords: *After gravity, body movement, weightlessness, disorientation, spatial quality*

INTRODUCTION

This paper explores the notion of architecture after gravity and how it influence body movement. Body defines and shapes the boundaries of space through movement (Grosz, 2001). Everything happening in life will always be found through movement (Mollie, 2003). Movement is an action that is present through the body's response to the surrounding environment in a flexible and significant way (Grosz, 2001). The manifestation of the body can be divided into visible action and behavior

and invisible thoughts, feelings, emotions, and memories parts (Atmodiwirjo & Yatmo, 2022). When we move, the emotions that are part of the body are also in movement (Jones & Meagher, 2017). According to Yatmo and Atmodiwirjo (2013), the body exhibits activity that distinguishes it from objects or other inanimate elements in space. The body responds to objects and space in a reciprocal manner, which is how the body learns that objects exist in space. In this case, the body is essential in sensing, organizing, and presenting space through body position and movement.

Movement is a condition that always occurs continuously in this world. Every movement and space is surrounded by dynamic environmental entities such as changes in weather, the passage of time, day-night rhythms, and the movement of various natural elements (Atmodiwirjo & Yatmo, 2021). Gravity becomes one of the influences on the occurrence of a movement; any interaction between an object and movement also acts as a center of gravity (Casas, 2017). With gravity as forces of nature, some movements may occur passively, such as leaves falling from trees (Parkes, Poupyrev, & Ishii, 2008).

Body movements corresponds to the spatial boundaries around it, which creates limits and possibilities of movement. For example, the restrictions and unconstrained movements of the body is closely related to the insideness and outsideness of architecture (See Figure 1). Body movement is more controlled in the inside context, whilst in the outside, body movement is much more limitless (Frank & Lepori, 2000).

In accordance to gravity as the forces of nature, the outer space beyond earth therefore generate space unconstrained by boundaries. In this sense, this study highlights that gravity can be discussed as a boundary that influence the movement of the body. It explores how architecture then can redefine how gravity is experienced further in space.

In space, it is seen as a collection of objects or elements and a space of connected movements (Yatmo et al., 2016). Our body movements are oriented through gravity, informing our body about the different position

and orientation of spatial elements and possibilities of movements in it through the vestibular system (Boettger, 2014). The vestibular system controls the orientation, balance, and movement of our body in space (Morey-Holton, 2003). Body movement presents a limit by being oriented to the force of gravity. With the force of gravity, we may understand the position and direction of our body in space, distinguishing the vertical and horizontal directions of space. This paper is interested to explore how unconstrained movement can happen in the context of gravity-oriented boundary.

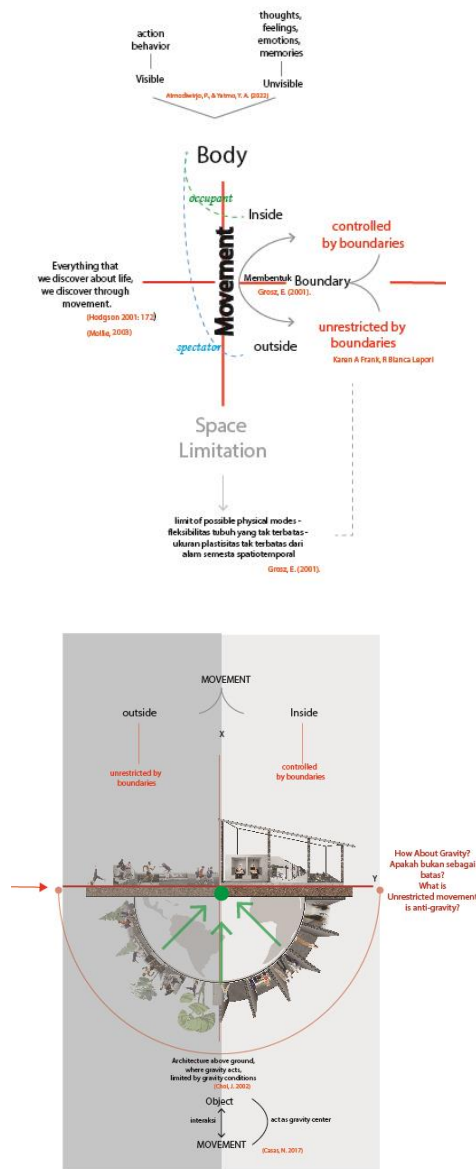


Figure 1. The flow of thinking through the difference between inside and outside movement in architecture

LITERATURE STUDY

Architecture, gravity, and body movement

The force of gravity is influential in architecture and defines its boundary. Architecture is always present as a boundary where reaching a place of refuge requires boundaries to distinguish between outer and inner space. Architecture presents a boundary between the inside and the outside, just like between self and others, and between subjects and objects, whereby a boundary must still be crossed through gestures (Grosz, 2001). Georg Simmel wrote about the human ability to present gestures that separate spaces by creating boundaries between spaces to reconnect each other (Boettger, 2014). Architecture therefore presents boundaries that are activated through bodily gestures. Body movement is present through body action, created through different relationships, be it with itself (body relates to itself), body in relation with the body of others, and the body in relation with objects (Mollie, 2003). The body's relationship with movement can present boundaries that are also influenced by gravity in position, direction, and weight (Morey-Holton, 2003; Casas, 2017; Hall, 2000).

Everything that lives in this world, whether living or non-living, must be able to support its materiality against various forces present in its environment such as gravity, wind, and atmosphere (Kotnik & Weinstock, 2012). Gravity in this case is the most important element in human life and a basic element in the architectural world. In the world of architecture, gravity is a centripetal force or a centering force directed at the center of the earth, making architecture able to stand on the ground (Kim & Whang, 2015), thus making architecture to be limited by gravitational conditions. The role of gravity in architectural design is closely related to the main directions of space, namely the up, down, and horizontal orientations, and the three basic elements of architecture; from the ceiling (roof), the floor and the walls (Hall, 2000). Gravity is also responsible for giving weight to objects and stabilize its position on earth (Morey-Holton, 2003). In an environment, gravity must have a significant influence on the architecture, if it is not influenced by gravity it will present an architecture without gravity where basic elements inside it will lose meaning (Hall, 1999). With gravity the orientation in the space becomes clear and also the objects present in the architectural space can stand perpendicular to the floor because it is influenced by weight. This paper is interested to explore how architecture can emerge after gravity.

Weightlessness and disorientation as spatial qualities after gravity

The previous section has discussed how gravity brings position, orientation, direction, and weight to architecture. Architecture after gravity questions the possibility of space to be in the state of responding or determining gravity, instead of solely being subjected by it. This state is in contrast to the world of architecture which is driven by absolute concepts such as solid construction of structures with fixed gravitational field based on existing axes, coordinates, and dimensions. Thus, architecture after gravity presents several reinterpretations of structural expressions in response to gravity, accomplished by exposing structures that transmit force (Kim & Whang, 2015).

Whilst previous discussion highlights how gravity brings weight to architecture, this paper highlights that architecture can also express the opposite state, such as the experience of weightlessness (Dewindar, 1996). The concept of weightlessness can be defined by a state where there is no weight or a state of being in need to be free from centripetal force (gravity), whereby this state can be called a gravity-defying state (Kim & Whang, 2015). In a state of weightlessness, the gravitational pull decreases as the distance from the center of gravitational pull increases and the object loses its weight (Arnheim, 1975). In this case, the idea of weightlessness as spatial experience is important to present architecture after gravity.

Architecture after gravity can also be defined as being in a state of disorientation or in a state where the orientation of space will lose its meaning. The role of gravity in design is closely related to the main directions (up and down, and horizontal), shaping the world of architecture which is defined by basic spatial elements (Hall, 1999). In this case, it means that a state of architecture after gravity explore possibilities of a state that is free from fixed direction or orientation of space..

Architecture after gravity produced by movement-object interaction relations

This paper aims to develop the design method of architecture after gravity as the design mechanism that explores the spatial dimension through the dynamic relationship between body movement and context. The study explore how the body movement is present in the context through a state of weightlessness and a state of non-orientation to present a dynamic spatial quality. This exploration process revisit the framework of the relationship between movement and objects whose interaction acts as a center of gravity based on body to body, body to object, and body to space relations (Casas, 2017). (see figure 2)

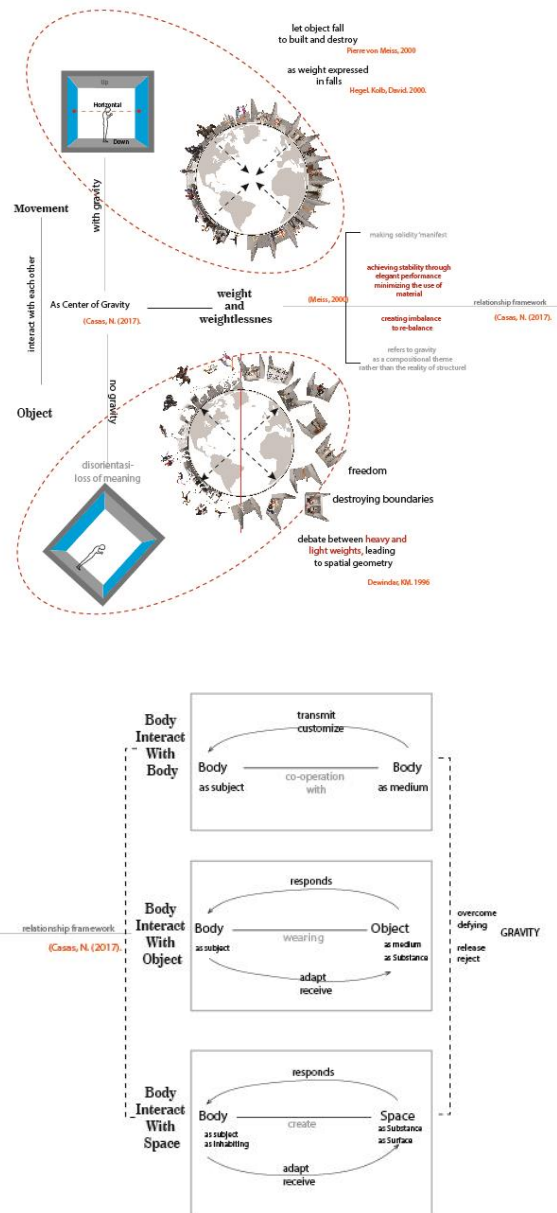


Figure 2. Diagram of the relationship between movement and objects as the center of gravity, and illustrations with and without gravity

MATERIAL AND METHOD

As a form of research by design, this research begins by exploring various literatures on how architecture is influenced by forces of nature in presenting body gestures and its consequent boundaries. Furthermore, this research explores the mechanism of architecture after gravity to understand how the relationship between gesture and force in context occurs through state of weightlessness and disorientation. Architecture after gravity presents an inquiry in

expressing the dynamic quality of space that revisit the relationship of natural force in context with the body in a dynamic built environment.

This research analyzes multiple case studies of body interaction and architecture, driven by the dynamic interaction of movement with objects and the relationship of body to body, body to object, and body to space. To begin with, this study explores 13 gravity-defying actions, that demonstrate the presence of active components that can interact or be experienced by the human body, and also adapt to its dynamic surroundings. The architecture case studies analyze how the body's movement realize and respond the force of gravity. Through case studies, the after gravity mechanisms that produce dynamic spatial quality can be concluded.

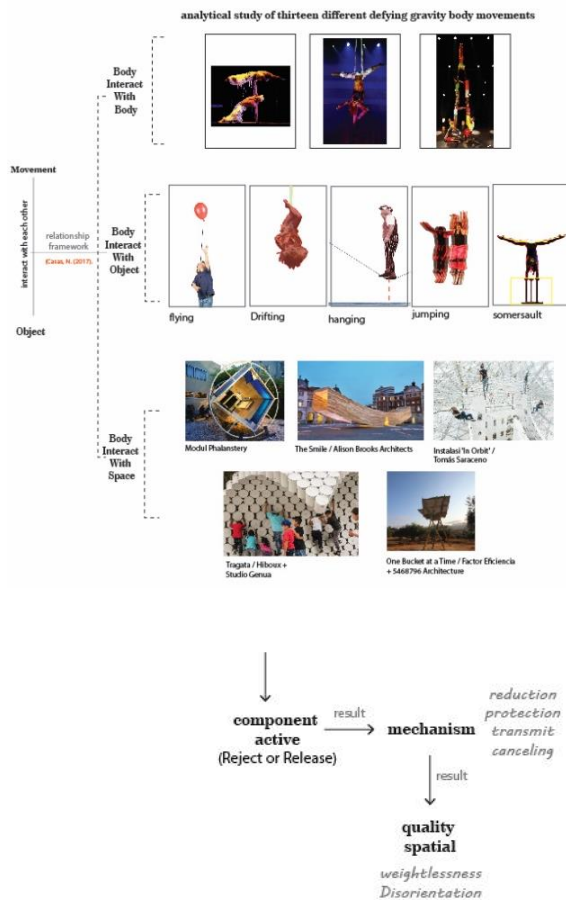


Figure 3. Analyzes 13 gravity-defying actions consisting of active components that can interact or be experienced by the human body

RESULT AND DISCUSSION

Investigating The Relationship between Movement and Interactions Acts in Architecture After Gravity

The case studies were selected based on the division of relation framework between the interaction of movement with objects and the relationship of body to body, body to object, and body to space. Architectural projects that responds to gravity show a variety of bodily experiences. This paper explores examples of eight body movements that reveal interaction between bodies, and interaction between body and object. Each category shows the mechanism of architecture in response to gravity, that involves body movement in the production of space and its experiential quality of space.

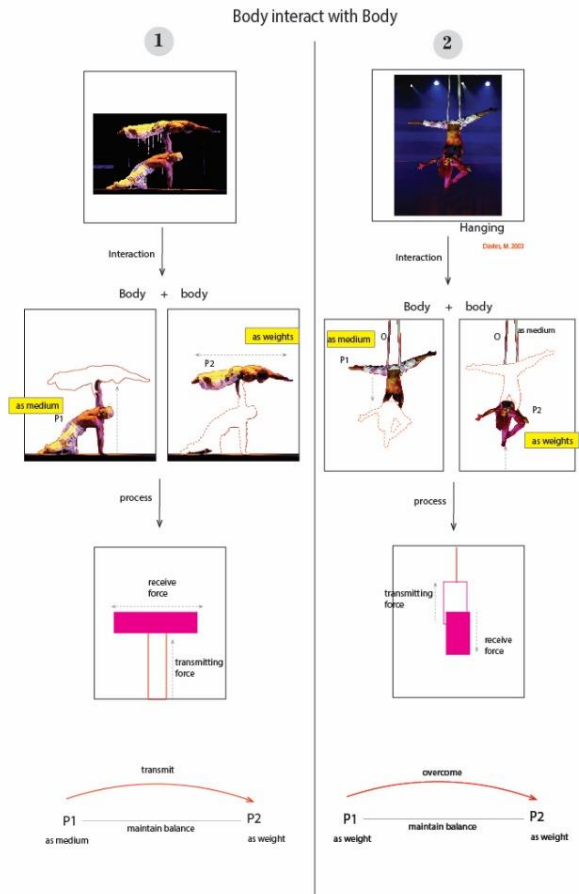


Figure 4. Case study analysis of the relationship between body and body point 1 and 2

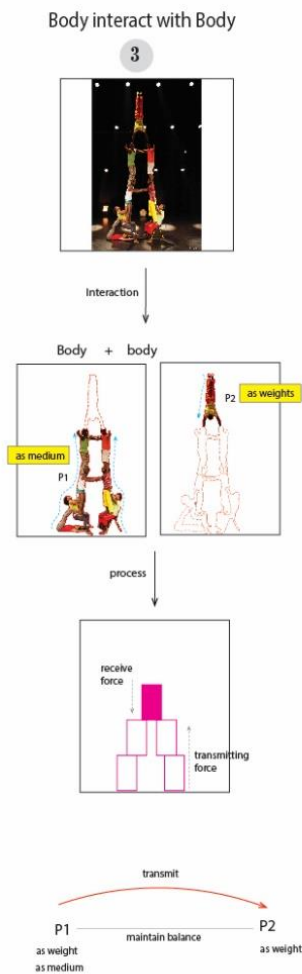


Figure 5. Case study analysis of the relationship between body and body point 3

Figure 4 and 5 explores the relationship between body and body through three dancing movements, analyzing how the body and other bodies collaborate in providing gravity experience that transmit force from one body to another. The study traces three different body movements that shows relations between body and body, depicting (1) body supporting other body, (2) body hanging while supporting other body, and (3) bodies stack into one another in certain heights. In these movements, the body acts as an intermediary between the gravity force and the need to support the other body movements. Through such intermediate action, the force of gravity is transmitted by connecting to the force to the other body to achieve body balance. While the other body, which acts as a weight, is the recipient of the force that overcome gravity.

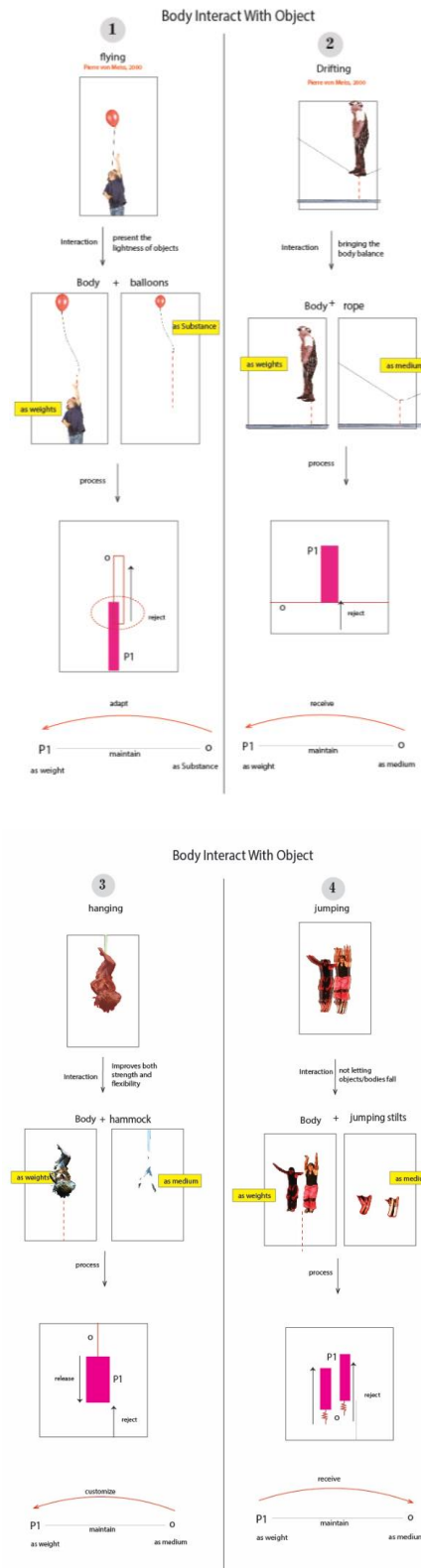


Figure 6. Case study analysis of the relationship between body and object point 1, 2, 3, and 4

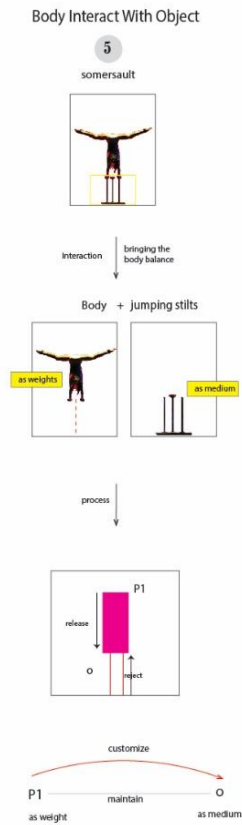


Figure 7. Case study analysis of the relationship between body and object poin 5

In exploring gravity in the relationship between body and object, Figure 6 and 7 demonstrate how body movement exist as an action that has the potential to challenge gravity in relation to specific object. It depicts five body movements in the analysis, consisting of flying balloon, drifting and hanging with rope, jumping with jumping stilts hanging around, jumping, and somersaulting using supporting structures. All of these movements responds to gravity by being explored through objects. In the first movement, of flying balloon, the object exists as a substance, namely as the core of the movement, while in the second to fifth movements the subject acts as a medium that acts as an intermediary between the gravity force and the objects.

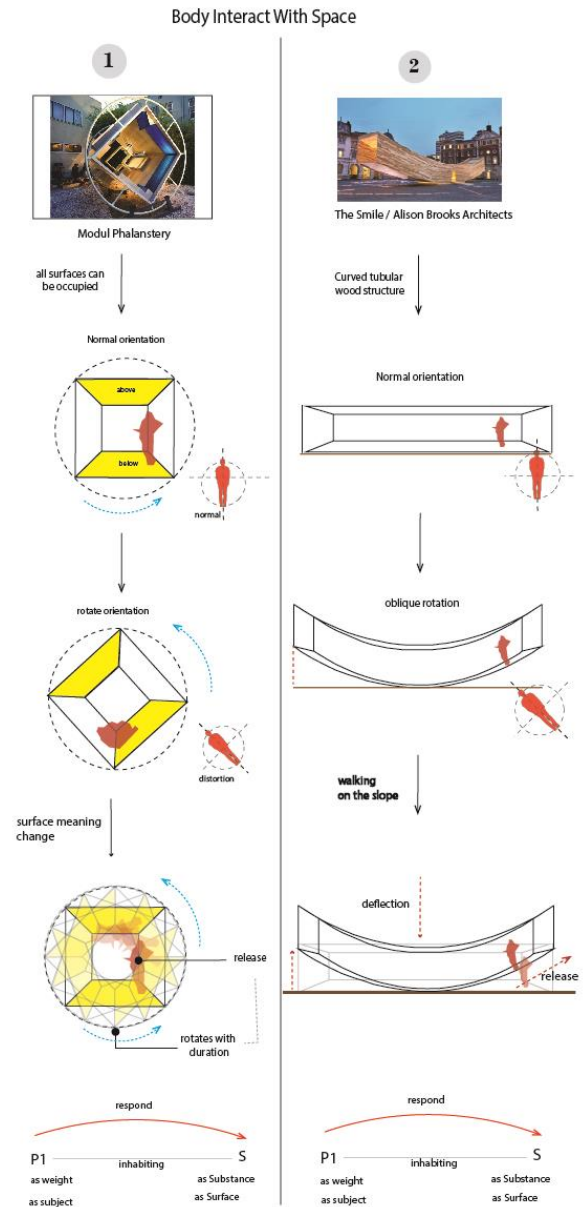


Figure 8. Case study analysis of the relationship between body and space with demonstrate a state of release

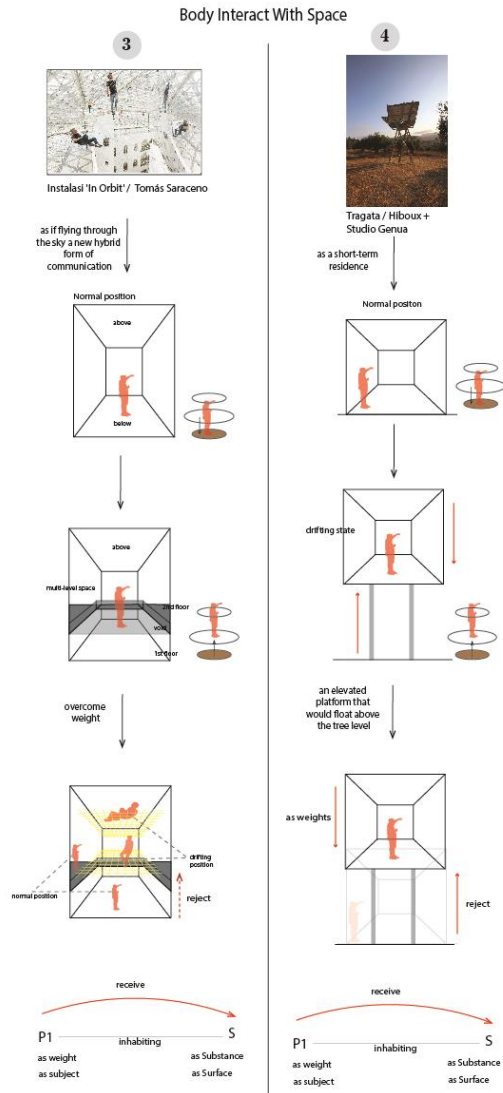


Figure 9. Case study analysis of the relationship between body and space with demonstrate a state of reject

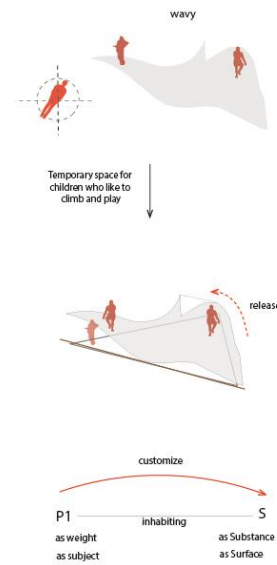
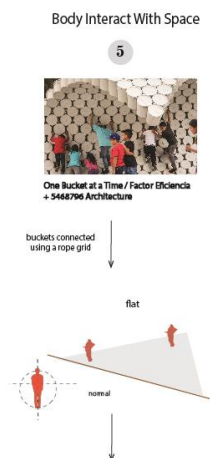


Figure 10. Case study analysis of the relationship between body and space with demonstrate a state of release

Figure 8, 9, and 10 analyzes the relationship between the body and space through exploring five architectural projects as case studies. In this exploration, space acts as a substance or surface that presents the quality of space that can be responded to by the body, while the body acts as a recipient or particular condition that responds to the context. All of these projects are temporary structures, existing dynamically in context. The first project is Modul Phalanstery, which consist of square space that can rotate, enabling the space inside to alter its orientation and change the meaning of the surface. The second project, the Smile by Alison Brooks Architects are a curved tubular wood structures, which enable different ways of walking in response to the changing forms of surface. The third project, which is the In Orbit installation by Tomas Saraceno creates hanging structures that can be experienced by the visitors as floating, overcoming their own weight using thin and rather transparent structure. The fourth project . Similar with In Orbit, the fourth project of Tragata/Hiboux creates high structures that enable the user to exist high in space. The next project called one Bucket at a Time by Factor Eficiencia + 5468796 Architecture is made from connected buckets using rope grid that creates dynamic surfaces for the users to play around.

These projects demonstrate different state of either reject and release in presenting the quality of space that reflect after gravity conditions. For example, the first, second, and fifth project demonstrate a state of release, through which the body detaches itself from the orthogonal system so that gravity remains. Still, the

body experiences disorientation, such as a slope on the floor; all space surfaces can be used or climb walls. The third and fourth project demonstrate a state of reject, when the body is far from the ground or the body experiences a state of moving away from gravity or floating.

Based on the exploration of the above categories, architecture after gravity presents a different bodily experience in a dynamic built environment that looks at the relationship of force in context with the body. Architecture after gravity highlights the quality of weightlessness and disorientation in architecture, where the moving body receives and responds, transmits force of nature, and adapts to its context as explored in the previous section. In this exploration, we see through body movement and space where the body exists as a subject, which it may act as either a medium or as intermediary that can feel the quality of architecture after gravity. In addition, the objects, spaces, and subjects act as substances and surfaces that can be influenced by the release or rejection of gravity, providing dynamic quality to the space..

Outlining the Design Method of Architecture After Gravity

This research proposes the design method of architecture after gravity, in producing unlimited body movements. Responding to the restrictive understanding of inside and outside as the boundary that constrained the body movement (Frank & Lepori, 2000), this paper explores possibilities of architecture that challenge or appropriates forces of nature as the limit of its space. Gravity becomes one of the important forces of nature, significantly influencing the body movement. This paper questions what is the possibility of having an unrestrictive movement that is not necessarily limited by gravity, but instead appropriates gravity to provide the experience of architecture that is not bounded itself. The idea of after gravity comes up for discussion in this paper to understand the spatial qualities produced by specific gestures, which is the spatial experience of weightlessness and orientation.

Architecture after gravity highlights the qualities of weightlessness and disorientation in architecture, where the moving body receives and responds, transmits, and adjusts to its context. By looking at the response to the body's movement in this case, the body produces mechanisms for the response to respond gravity through a state of release and rejection of the experienced forces. Some mechanisms exist with their respective relationships between the bodily gesture and context:

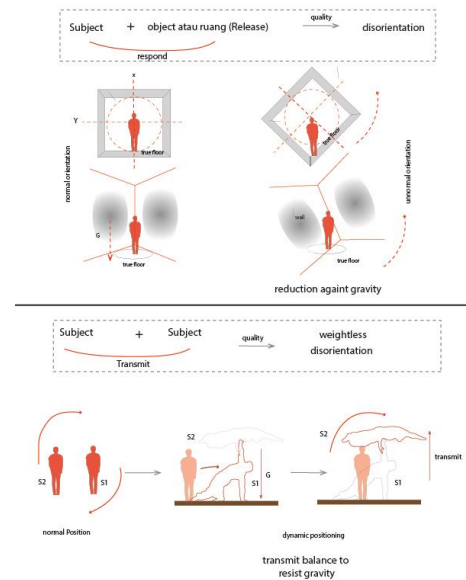


Figure 11. The mechanism of architecture after gravity through reduce and transmit

The first two mechanisms focuses on a way forces of gravity can be released. The first mechanism reduces the gravity of the body's movement through an object or space occurs by releasing the object, giving it an unoriented quality. Secondly, transmitting force to the body enable the gravity to be overcome, where the body transfers the gravity to each other, achieving balance.

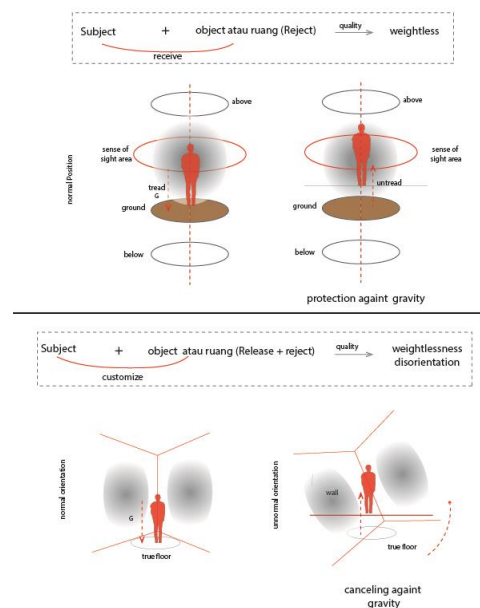


Figure 12. The mechanism of architecture after gravity through reduce and transmit

The next mechanisms enable rejection of the gravity forces through various strategies. The third mechanisms protect the body from gravity through objects or space that moves the body's state of motion away from the ground, heightening its position and creates illusion of weightlessness. The fourth mechanism rejects but also releases forces of gravity by enabling dynamic movement of the objects and the body, enabling condition of both weightlessness and non-orientation.

CONCLUSION

This study explores the design method of architecture after gravity, focusing on how relationship between body movement and its context may produces architecture that demonstrate a state of weightlessness and disorientation quality. By looking at the three relationship, which are relationships between bodies, between body and object, and between body and space, the study map how different states of weightlessness and disorientation can be achieved through the body's response to its context by responding, receiving, transmitting, and customizing objects or spaces.

The understanding of architecture after gravity expand the potential of architecture that sees the relationship of natural forces in a context with the body in a more dynamic built environment.. In this study, such forces are not only seen as constraints of architecture, but instead as important aspects that influence the dynamic presence of architecture in relation to its context. Future studies may explore other kinds of natural forces and how it further influences architectural design methods.

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