ARCHITENSA
Architecture Design Journal

MINISTRY OF FINANCE OFFICE COMPLEX IN KIPP-IKN WITH A BIOMIMETIC APPROACH BASED ON TRANSIT-ORIENTED DEVELOPMENT

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ABSTRACT
The Indonesian government is taking significant steps in developing the Nusantara Indonesian Capital (IKN) in Kalimantan, focusing on economic equality and sustainable development. Development of the core government center (KIPP) is a priority, with infrastructure development focused on Phase 1A (2024) and Phase 1 (2025-2029). The Ministry of Finance plays an essential role in this area, with plans to build the Ministry of Finance Office Complex (KPKK) regulated in Presidential Regulation Number 63 of 2022. However, until now, the government has not issued a basic engineering design. Opportunity to propose a Ministry of Finance Office Complex design that supports IKN's vision and mission. The TOD-based Bio-mimetic KPKK design is expected to fulfill the principles of KIPP development. Bio-mimetic, with inspiration from nature and TOD that integrates various modes of transportation and accessibility, provides an innovative approach to design. Implementing these concepts can support IKN as a creative, modern, and sustainable city while ensuring effective regional connectivity.

Keywords: *Bio-mimetic, Finance ministry complex, Transit Oriented Development*

INTRODUCTION

Following the decree of the President of the Republic of Indonesia written in Law Number 3 of 2022 concerning the relocation of the Capital City of the Archipelago to Kalimantan, it is a government step to improve Indonesian human civilization, as well as realize sustainable economic equality and justice. The decree's issuance officially began the Nusantara New Indonesian Capital (IKN) construction, prioritizing implementation in the Core Central Government Area (KIPP) as the center of bureaucracy and government services (PUPR, 2020). The construction of the KIPP is staged in Phase 1A (2024) and Phase 1 (2025-2029), which focuses on the construction of state administration offices and services, ASN HANKAM housing, and others. Ministry of Finance Office Complex (KPKK) is on the priority list for constructing state administration offices and services. The physical development plan for the KPKK at the KIPP IKN is stated in Presidential Regulation Number 63 of 2022, which will be implemented in Phase 1A, period 2025-2029 (Ibrahim et al., 2023). However, the government has not issued any Basic Design Engineering for the KPKK. This condition is an excellent opportunity for design planning because there is no Basic Design Engineering in the Ministry of Finance office complex. The opportunity to propose a KPKK design at the IKN KIPP can be a consideration for the government in making Basic Design Engineering.

The Smart Forest City concept for Indonesia's new capital city, IKN, is a visionary urban development model integrating advanced technologies with sustainable environmental practices (PUPR, 2020). The concept aims to create a town that not only meets the needs of its residents but also preserves and enhances the natural environment. Smart Forest City is designed to address the challenges of urbanization while promoting economic growth, social welfare, and environmental sustainability (Anguluri & Narayanan, 2017).

The Smart Forest City concept provides significant environmental, economic, and social benefits. Prioritizing green space and renewable energy contributes to environmental sustainability, reducing the impact of climate change and maintaining natural ecosystems (Anguluri & Narayanan, 2017; PUPR, 2020). The development of the Nusantara National Capital (IKN) as a Smart Forest City is also expected to stimulate economic growth and encourage equitable development in Indonesia, thereby reducing the inequality that has so far been centered in Jakarta. In addition, applying innovative technology and sustainable practices improves the community's quality of life through better public services, broader access to health, and a more comfortable urban environment (Brown et al., 2015; De Winne, 2006). Furthermore, integrating forest therapy into urban design provides residents with physical and psychological health benefits, creating a healthier urban population (Arnberger & Eder, 2015; Iojă et al., 2018). Although this concept offers many advantages, the risks of deforestation and ecosystem disturbance must be anticipated through careful planning and strong regulations (Ibrahim et al., 2023). Its success depends heavily on collaboration between the government, private sector, and communities in balancing economic growth with environmental conservation.

LOCATION DESCRIPTION

The Ministry of Finance Office development plan is clearly and in detail following the direction of the President of the Republic of Indonesia regarding the relocation of the National Capital.

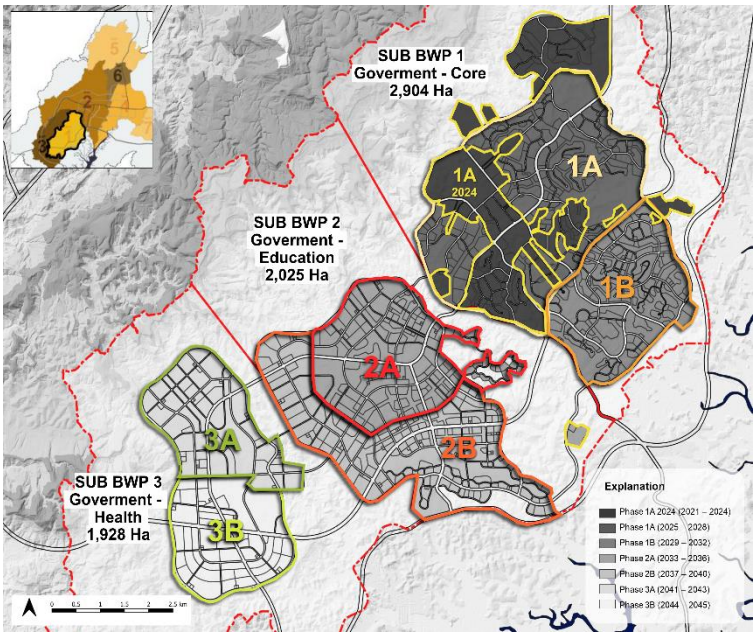


Figure 1. General Plan for KIPP Phase Zoning (2021-2045)

Under the Law Number 3 of 2022 concerning the National Capital and stated in the Development Plan for the Indonesian National Capital Region in the Phase 1A. Development Plan for 2025-2029 regarding the development of the Ministry of Finance Office in the IKN Nusantara which is located in the Sub-BWP Zone 1 Core Government Center (Figure 1). The development plan for the Ministry Offices is divided into three groups. The overall implementation plan for development in Phase 1A 2025-2029, with the division of plots, is listed in Figure 2 below.

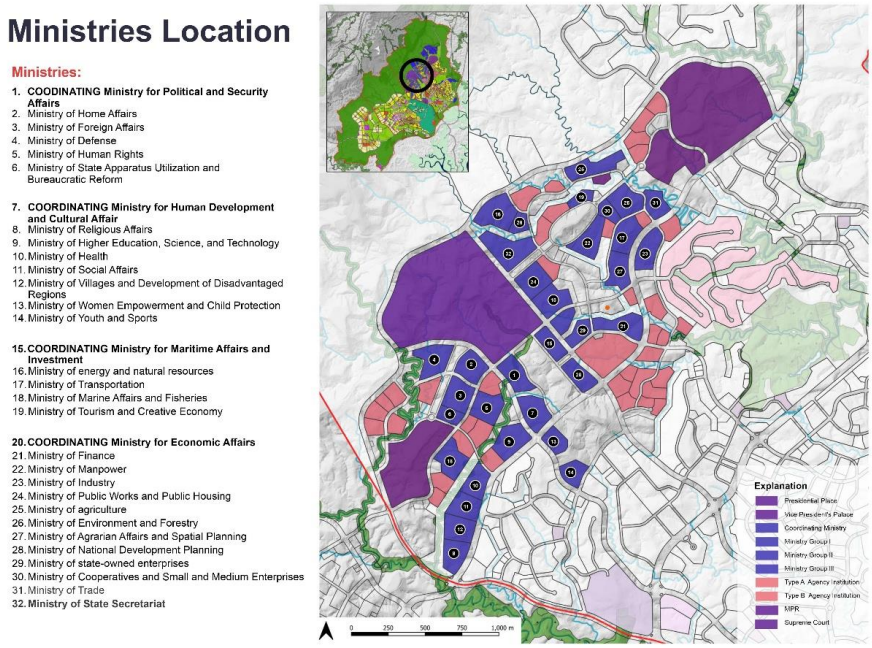


Figure 2. Zoning of the Ministry Office PlotSource: Regulation of the Head of the IKN Authority No. 1 of 2023 concerning the RDTR KIPP, IKN



Figure 3. Zoning of KIPP-IKN Office Plots (Source: PERKA OIKN No. 1 of 2023)

The location of the KPKK site, according to the RPK and RDTR KIPP-IKN, is located in the Sub-BWP Zone 1 of the Core Area of the Government Center, in detail it is in the Precinct Area of Sub-BWP 1 of the Ministry Group III, Core Area of the Government Center, Capital City of the Archipelago, *Penajam Paser Utara* Regency, East Kalimantan Province. The KPKK planning site is located in the position shown in Figure 3. The area of the KPKK Site is 3.76 Ha, with a site typology as in Figure 3.

THE SITE ANALYSIS

Site synthesis integrates various site analysis results through a layered superimposition technique to produce final zoning that becomes the basis for site planning. This process combines multiple aspects, such as physical, environmental, social, cultural, and regulatory conditions, to create an optimal division of space that follows project needs (Zainol et al., 2016). By considering these factors holistically, site synthesis helps designers determine efficient, sustainable land use that supports the proposed design concept. The zoning resulting from site synthesis is a guideline for further design, ensuring that each design element harmonizes with the site's character. This approach also allows for flexibility in planning to adapt to changes in user needs or applicable regulations (Hendrix et al., 1988). In addition, site synthesis helps identify potential and existing constraints so that design decisions can be made more wisely.

Thus, site synthesis is essential in creating an aesthetic, functional environment with high sustainability value. This process ensures that the final design considers space efficiency, user comfort, and well-being. Site synthesis is a multi-layer superimposition of site analysis that produces final zoning (Mandal et al., 2016), used as a reference in site programming that is adjusted to the aspects and approaches of the design concept (Figure 4).

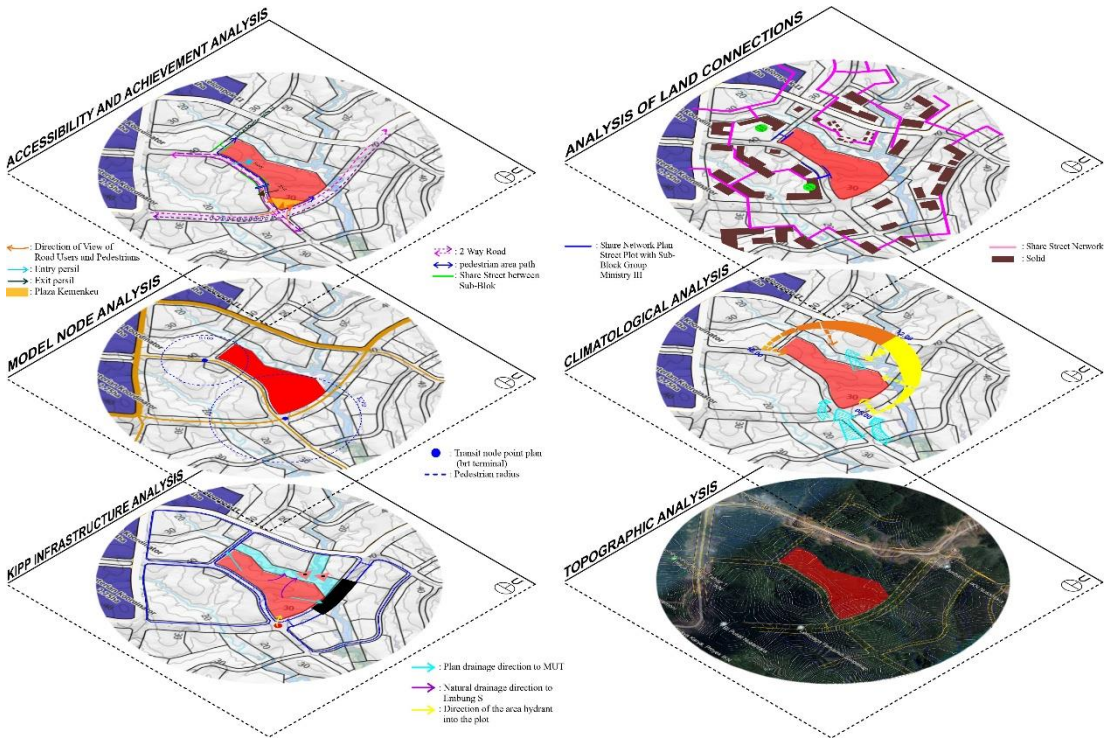


Figure 4. Multi-Layer Superimpose of Footprint Analysis (Source: Author's Analysis)

CONCEPTUAL APPROACH AND WARFARE THEME

Smart Forest City is a Kalimantan rainforest city that maintains the natural ecosystem and lives in synergy with nature (PUPR, 2022). Nature is a solution for modern, innovative, green, and sustainable city governance. Maintaining the balance of the ecosystem with the conservation of natural biodiversity as environmental preservation. Smart Forest City is a transit-based and human-oriented city that prioritizes resilient mobility by developing pedestrian and bicycle paths and mass transportation modes (PUPR, 2020), ensuring an even distribution between workspaces, residential spaces, public services, and green areas within urban areas.

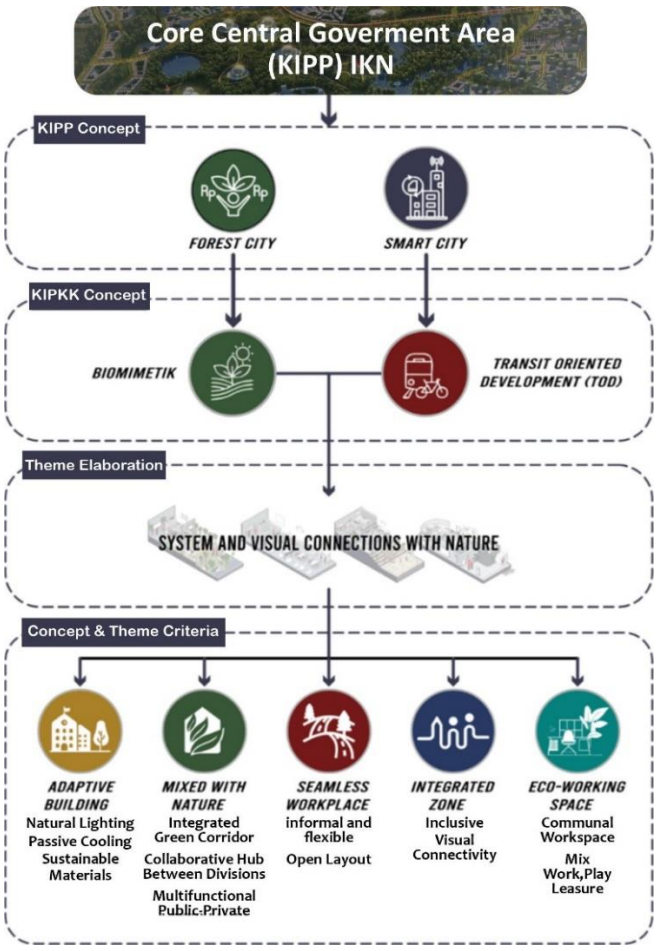


Figure 5. Basic Concept Scheme and Design Theme (Source: Author's Analysis)

Biomimetic is the approach to building design that analogizes the taking of ideas and concepts from nature and elements of nature that are integrated into human behavior. Natural ecology in the visual implementation of architectural design, building systems, and building management (Zachawerus et al., 2019). Transit-oriented development (TOD) is a strategy for developing sustainable designs by utilizing land and prioritizing pedestrians to create a sense of comfort and safety (Lang et al., 2020). TOD is a planning concept that prioritizes integrating land use and urban functions based on transportation systems and activities based on transit points (Zafira et al., 2022). Connected, integrated, and connected are the principles of TOD that will be elaborated on the KPKK design theme. The introduction in the design results article differs from the research results article. TOD-based bio-mimetics is assimilated into the design theme as a link between human connections and the surrounding environment (Krishna et al., 2021). Integrating the TOD-based Biomimetic approach concept into the design theme is an effort to analogize human connectivity with nature without any barriers to environmental balance. "System and Visual Connections with Nature" is a design theme that returns the building system and visuals to nature as a solution to its resolution (Ewing, 2013). The building system and visuals are analogous to being connected to natural ecology.

Bio-mimetics is a solution to solving problems that analogize nature to maintain the stability of living things (Gabrielle D. A. Hartono et al., 2018)—creating ecological connectivity between humans and their environment that provides a calming and comfortable effect. Biomimetic values that are in line with Smart Forest City in preserving nature and environmental sustainability. Striving to maintain the natural environment in visual and system arrangements. TOD is a system that develops an integrated network between functions and facilities that create a comfortable and efficient configuration (Baharuddin & Kusuma, 2023). Smart Forest City is a target city of 10 minutes integrated with intermodal and intermodal to achieve connectivity at every point in 10 minutes. The TOD principle in Smart Forest City is to form efficient urban areas to accommodate various activities while prioritizing good and easy accessibility.

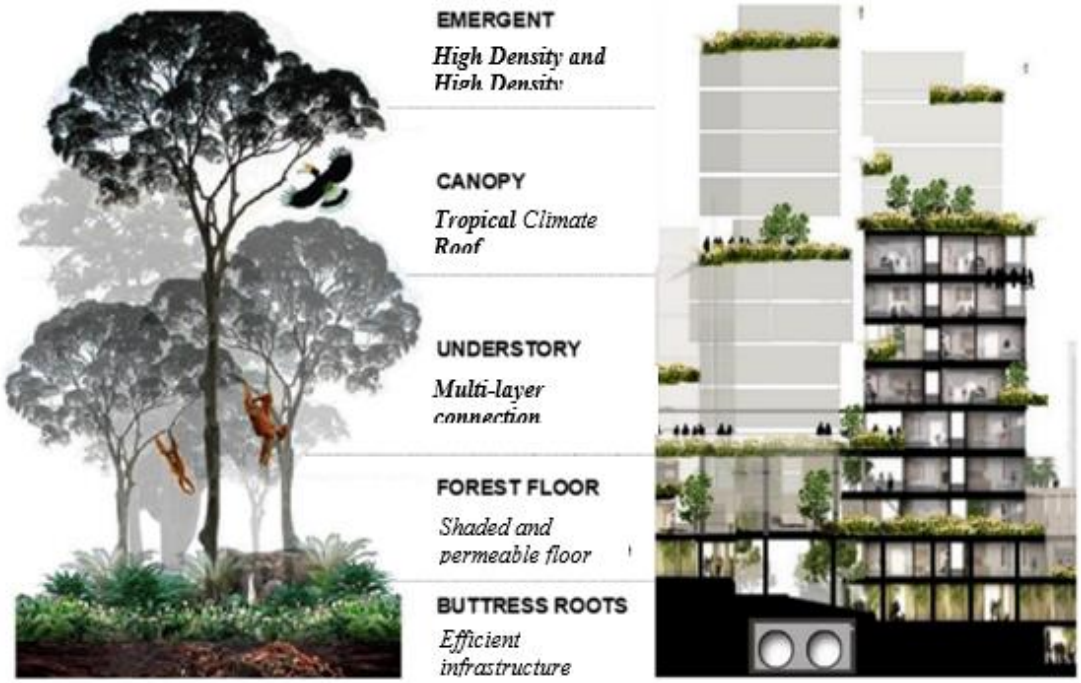


Figure 6. Biomimetic Illustration of the Kalimantan Rainforest

DESIGN THEME

System and Visual Connections with Nature is an effort to utilize natural situations to create an integrated building system with nature. Growing and providing a positive relationship between humans and nature creates a space that can positively impact increasing physical and psychological peace of life. Natural elements allow humans to live and work in a healthy place. The translation of System and Visual Connections with Nature in the KPKK design is transformed into a building mass layout by considering five design strategy visions (Fig. 5). The transformation of the KPKK building mass layout following the functional aspects and work procedures of the Ministry of Finance is realized with a design of five (5) building masses with a mass configuration analysis, as stated in Figure 7 below.

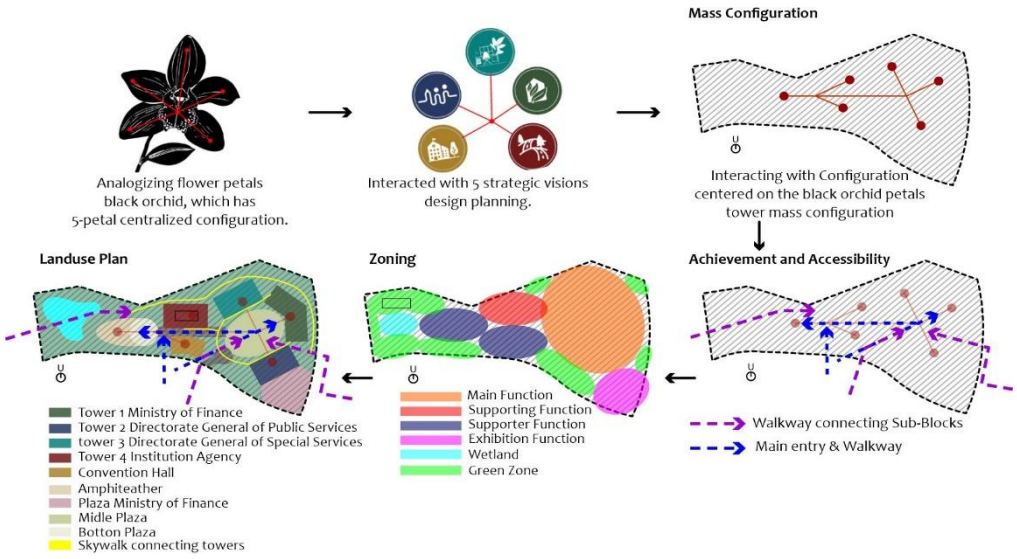


Figure 7. Mass Structure Transformation (Source: Author's Analysis)

CONCEPT ELABORATION IN DESIGN

The KPPK massing system attempts to organize buildings towards the site and environment by interacting with nature as a solution for building masses and returning to nature to determine the grouping of masses that still consider aspects of design and design theme criteria. In the massing system, the KPKK concept takes from the black orchid of Kalimantan, an endemic plant of East Kalimantan that is almost extinct. In its philosophy, the black orchid symbolizes maturity, determination, absolute strength, and authority (Sari, 2019).

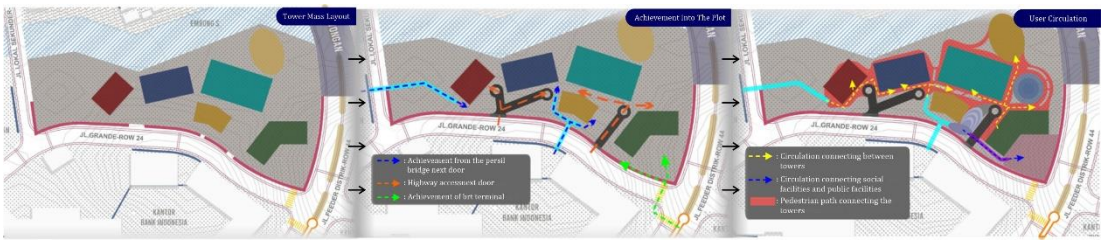


Figure 8. Site Planning Transformation (Source: Author's Analysis)

The black orchid represents the character and image of the Ministry of Finance, which is transparent, has integrity, is professional, and synergistic—taking five black orchid petals, which are implemented in the five visions of the design criteria and the five masses of the KPKK building. The black orchid petals drawn in a line have a radial shape centered in the middle; this shape is taken from the configuration of the building mass arrangement. The supporting function is placed in the middle of the radial configuration point to become the center point in the KPKK function scheme, surrounded by office, service, training, and research functions. The arrangement of the building mass still pays attention to the synthesis of the site, namely, still paying attention to the response of the tower's location to the contour, the direction of the sun's circulation, wind, and views of

surrounding users. The arrangement of the building mass cannot be separated from the elements of the arrangement of the connections between buildings or pedestrian paths that connect buildings and achieve circulation into the site. The arrangement of pedestrian paths considers the achievement of circulation and user accessibility. As a concept of the site circulation approach, TOD considers unbroken pedestrian paths to the city transit points to achieve 10 minutes of smart mobility.

Access to the plot has two main accesses for vehicle users and two for pedestrians, namely from the BRT pedestrian terminal and the Skywalk connecting the Group III Ministry plots. The entry into the plot is on Grande Street ROW 24 because the secondary road has a low vehicle intensity, so there is minimal congestion when office users reach the highest point. Each building mass will be integrated through a walkway on the site (ground). In the Ministry of Finance Office tower, the Public and Special Service Office will be integrated on the podium floor to achieve connected accessibility between functions. The TOD principle is implemented comprehensively to manage the circulation of accessibility for tower users.

IMPLEMENTATION OF CONCEPT IN DESIGN

The design plan considers aspects that prioritize users and the surrounding environment. Health, convenience, safety, and comfort of building structures are essential to ensure the planning and design of tall buildings without causing significant impacts on the surrounding environment. The tower mass layout responds to the environment to harmonize nature with the tower by implementing the Biomimetic approach to the tower mass layout. The tower is in harmony with the natural ecosystem, which is utilized efficiently and as a solution in the arrangement of the tower mass.

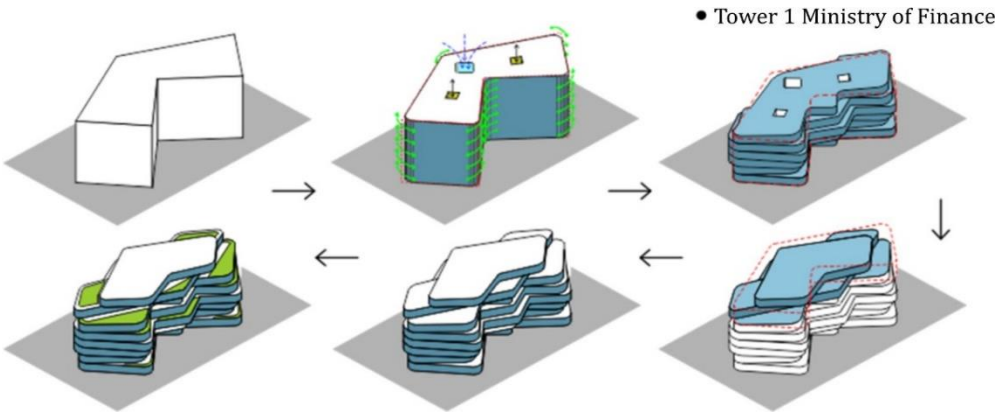


Figure 9. Tower Transformation Schematic (Source: Author)



Figure 10. Land Use Plan Design Perspective (Source: Author)



Figure11: SEQ Image Design Perspective (Source: Author)

The application of the building forms uses proportions and repetition of columns in the KPKK design to build an elegant and firm nuance of integrity as a reflection of the character of the Ministry of Finance. The complex building design is harmonious in responding to contours and climate. The Biomimetic approach to the KPKK tower architectural concept is applied to interact with nature as a design solution. The tower shape is designed to minimize sharp corners in the tower shape to respond to gusts of

wind that can be forwarded to the tower so as not to break. In the transformation of the tower mass, curved, non-sharp tower corners are applied (Figure 11).

The basic form of the Ministry of Finance Office tower is a geometric shape composed of the openings in the building envelope to increase the wind entering the tower and conditioning natural ventilation. The Ministry of Finance Office tower, as the central tower in KPKK, becomes a point of interest or the main center of attention; as the central tower, the shape of the tower facade is formed monumentally as the main vitality element of KPKK. The following are several implementations of the Ministry of Finance Office Complex design in the IKN Core Government Center Area with a Biomimetic Approach based on Transit Oriented Development shown in the following images of several KPKK area sequences (Fig. 12 - Fig. 17).



Figure 12. Front perspective of the Ministry of Finance complex, foreground Pedestrian Ways for integrated access from and out of the Complex (Source: Author)



Figure 13: Perspective of the Corner Section of the Complex; on the right side, the bus-stop facilities as a supporting facility for 10 minutes of access
(Source: Author)

The design of the integrated Ministry of Finance Office complex adopts the concept of Transit-Oriented Development (TOD) and bio-mimetics. In this design, the building not only functions as a physical space but also becomes part of the ecosystem of its environment. The integration of TOD ensures that the complex is connected to the public transportation system, reducing dependence on private vehicles and reducing carbon footprint. Bio-mimetic is imitating natural systems to improve building performance and maximize environmental well-being. For example, the design of the building can imitate the structure of a leaf to improve energy efficiency or utilize the principles of natural airflow to improve natural air circulation. The open spaces around the complex are designed to enhance environmental accessibility, promoting an active and healthy life for its residents. With this approach, the complex functions as a center of economic and social activities and a model for sustainable and environmentally friendly development amid a modern city (Fig.14-15).



Figure 14: Integrated complex design with TOD-biomimetic concept, integrating environmental access supported by bio-mimetic concept in building design and its outdoor environment (Source: Author)



Figure 15: Completion of outdoor space design with easy access and comfortable with green environmental layout (Source: Author)

The outdoor layout combines vegetation elements to create coolness and a harmonious natural feel. Shady trees, vertical gardens, and shade plants are strategically placed to provide protection from the heat, improve air quality, and create a comfortable atmosphere for pedestrians. This green area is a pollution absorber and microclimate regulator, contributing to a healthier and more sustainable environment.



Figure 16: The outdoor layout design is made elegant by including vegetation elements to create a calm ambiance that is one with nature. The shade design and floral elements give a natural impression with geometric patterns that adopt local art design patterns. (Source: Author)



Figure 17: Shade canopies elements with organic designs and biomimetic-based pergolas, strengthen the integration between architecture and nature (Source: Author)

Shade elements, such as canopies with organic designs and biomimetic-based pergolas, further strengthen the integration between architecture and nature. In addition, the flooring is designed with geometric patterns inspired by local art, providing a strong cultural identity while presenting a unique and distinctive aesthetic. Using natural materials such as natural stone, recycled wood, and porous paving enriches the visual texture and increases comfort and environmental resistance to weather changes. The combination of natural elements, sustainable design, and cultural touches creates an outdoor space that is not only functional and aesthetic but also supports a healthy, environmentally friendly lifestyle and increases social interaction in the daily lives of its users (Fig.16-17)

CONCLUSION AND SUGGESTIONS

Developing the Ministry of Finance office complex in the IKN Central Government Core Area (KIPP) is one of the priority projects in phase 1A in the 2025-2029 period. As part of the strategic planning, the design of this complex must answer various design challenges with an innovative and sustainable approach. The design aims to create a solution that integrates the biomimetic concept based on Transit-Oriented Development (TOD) to create an efficient, environmentally friendly, highly functional work environment. The biomimetic approach in design will be applied to various aspects, including visual-spatial layout, building mass composition, architectural appearance, building systems, and operational management. The TOD-based layout will ensure optimal accessibility by connecting the office complex with a comfortable public transportation system and pedestrian network. Meanwhile, inspiration from natural principles in bio-mimetics will be applied to improve energy efficiency, natural ventilation, and the building's response to the IKN's tropical climate.

In addition, a sustainable building system will be applied to reduce energy and water consumption and improve waste management efficiency. Innovative technology-based building management will also ensure efficient and flexible operations.

With this combination of innovative designs, the Ministry of Finance office complex is expected to become a development model that supports the IKN's vision as a green and creative city and reflects the principles of sustainability and efficiency in planning future government areas.

REFERENCES

Aisyah, S., Aldy, P., Wisata Olahraga Islam Dengan Pendekatan Arsitektur Biomimetik, K., & Hidayat, W. (2020). Kawasan Wisata Olahraga Islam di Pekanbaru Dengan Pendekatan Arsitektur Biomimetik.

Anguluri, R., & Narayanan, P. (2017). Role of green space in urban planning: Outlook towards smart cities. *Urban Forestry and Urban Greening*, *25*. https://doi.org/10.1016/j.ufug.2017.04.007

Arnberger, A., & Eder, R. (2015). Are urban visitors' general preferences for green spaces similar to those when seeking stress relief? In *Urban Forestry and Urban Greening* (Vol. 14, Issue 4). https://doi.org/10.1016/j.ufug.2015.07.005

Baharuddin, T., & Kusuma, B. M. A. (2023). Smart City Development in the New Capital City : Indonesian Government Plans. *Nal of Contemporary Governance and Public Policy Journal*, *4*(October), 115–130. https://doi.org/https://doi.org/10.46507/jcgpp.v4i2.141

Brown, R. D., Vanos, J., Kenny, N., & Lenzholzer, S. (2015). Designing urban parks that ameliorate the effects of climate change. *Landscape and Urban Planning*, *138*. https://doi.org/10.1016/j.landurbplan.2015.02.006

De Winne, E. (2006). Towards an integral, accessible public area in the city. *The Sustainable City IV: Urban Regeneration and Sustainability*, *1*, 807–815. https://doi.org/10.2495/SC060771

Ewing, R. (2013). Eight qualities of pedestrian transit-oriented design. In *Urban Land: The magazine of the Urban* …. ddc.downtowndevelopment.com. https://ddc.downtowndevelopment.com/wp-content/uploads/2017/02/pedestrian_and_transit_oriented_desgin_intro.pdf

Hendrix, W. G., Fabos, J. G. Y., & Price, J. E. (1988). An ecological approach to landscape planning using geographic information system technology. *Landscape and Urban Planning*.

Ibrahim, A. H. H., Baharuddin, T., & Wance, M. (2023). Developing a Forest City in a New Capital City: A Thematic Analysis of the Indonesian Government's Plans. *Jurnal Bina Praja*, *15*(1), 1–13. https://doi.org/https://doi.org/10.21787/jbp.15.2023.1-13

Iojă, I. C., Osaci-Costache, G., Breuste, J., Hossu, C. A., Grădinaru, S. R., Onose, D. A., Nită, M. R., & Skokanová, H. (2018). Integrating urban blue and green areas based on historical evidence. *Urban Forestry and Urban Greening*, *34*. https://doi.org/10.1016/j.ufug.2018.07.001

Krishna, A., Mittal, D., Virupaksha, S. G., Nair, A. R., Narayanan, R., & Thakur, C. S. (2021). Biomimetic FPGA-based spatial navigation model with grid cells and place cells. In *Neural Networks* (Vol. 139, pp. 45–63). Elsevier BV. https://doi.org/10.1016/j.neunet.2021.01.028

Lang, W., Hui, E. C. M., Chen, T., & Li, X. (2020). Understanding livable dense urban form for social activities in transit-oriented development through human-scale measurements. *Habitat International*. https://www.sciencedirect.com/science/article/pii/S0197397519308896

Mandal, K., Chatterjee, S., & ... (2016). Morphological analysis of a Historic Urban Landscape: the case of Tamluk, an Early Urban Centre of Eastern India. In *International Journal of* …. researchgate.net. https://www.researchgate.net/profile/Nilanjana_Das_Chatterjee/publication/325284862_Morphological_analysis_of_a_Historical_Urban_Landscape_the_case_of_Tamluk_an_Early_Urban_Centre_of_Eastern_India/links/5b82e5234585151fd133fd5c/Morphological-analysis-of-a

PUPR. (2020). *Masterplan IKN*.

Zainol, R., Wang, C., Ali, A. S., Ahmad, F., Aripin, A. W. M., & Salleh, H. (2016). Pedestrianization and Walkability in a Fast Developing Unesco World Heritage City. *Open House International*, *41*(1), 112–119. https://doi.org/10.1108/OHI-01-2016-B0016

Sari, I. I. (2019). Bunga Anggrek Hitam Sebagai Ide Penciptaan Karya Batik Pada Kain Tenun Ulap Doyo. In Corak Jurnal Seni Kriya (Vol. 8, Issue 2).

Zachawerus, K W., Rondonuwu, D. M., & Rogi, O. H. A. (2019). "Arsitektur Biomimetik." Daseng , 8, 923–932.

Zafira, W. S., Puspitasari, A. Y., Rahman, B., Studi, P., Wilayah, P., Kota, D., Semarang, A., & Korespondesi, P. (2022). Penerapan Prinsip Transit-Oriented Development (Tod) Untuk Mewujudkan Transportasi Yang Berkelanjutan Studi Kasus: Kawasan Dukuh Atas Dki Jakarta, Kawasan Plaza Indonesia, Terminal Pal Enam Kota Banjarmasin, Stasiun Lrt Jaticempaka Kota Bekasi. In Jurnal Kajian Ruang (Vol. 2). http://jurnal.unissula.ac.id/index.php/kr

REGULATION:

Presidential Regulation of the Republic of Indonesia Number 63 Of 2022, Concerning Details of the Master Plan for the Nusantara Capital City

Law of The Republic of Indonesia Number 3 of 2022 on National Capital

Law of The Republic of Indonesia Number 21 of 2023 concerning Amendments to Law Number 3 of 2022 concerning the National Capital