Guidelines for Concept of Settlement Design with Digital Infrastructure Facilities

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Abstract. Changes in technology are currently developing very rapidly and dominate the lives of millennials in the industrial revolution era 4.0. Changes in settlement design are needed to keep up with technological changes through digital infrastructure facilities. The design method used is digital performance form, hi-tech architecture design concepts. The resulting design hopes to be able to optimize the function of macro and micro integrated spaces from the completeness of digital infrastructure to develop smart, independent, and sustainable settlements. Four design concepts guidelines were produced, namely: efficient, flexible, and practical design concepts, 3-dimensional visual, compact, and integrated.

1. Introduction
The Industrial Revolution 4.0 has a significant impact on various aspects, one of which is the change in digital technology that is developing very rapidly and is felt directly can provide many benefits and convenience for human life, especially in the living environment of millennial generations who feel very identical to modern life and practical [1, 2]. The term digital is now familiar in everyday life. Likewise, the world of architecture in its design is also not immune to the influence of digital technology [3].

Digital technology affects the development of the architectural world that can help produce the architectural design in the process of creating a technological design plan in the era of the industrial revolution 4.0., of course, simplifies the process of building design results so that the architectural world becomes more efficient [4]. The utilization of technology in structural development originated from the existence of issues regarding technological design concepts so that it can be implemented to the residential development needs [5].

2. Materials and Methods
2.1 Methods
The design methods used are digital performance form design methods [6], hi-tech architecture design concepts [7], and the design process starts from collecting theory, schematic design, concept evaluation (concept evaluation), design development (design development) and application of design concepts [8]. Then apply the approach and build design elements by testing, measuring, evaluating, and refining [8]. This design method is used to the type of townhouses in residential complexes to produce guideline design concepts of settlements with digital infrastructure facilities.
2.2 Theoretical
The reference theory used as the basis for designing settlements with digital infrastructure facilities is:
1) Smart city theory by weighting environmental aspects, resulting in cost and energy savings [9].
2) Smart city planners make use of new intelligent technology applications such as smart energy networks [10].
3) Sensible is the ability of software that can sense or sensor the environment around [11].
4) Realization of industrial concepts 4.0. Robotics and human-robot collaboration produce Safety and security; something related to the security of the "data processing system" is guaranteed with no leakage of information data and the security and safety of the use of technology for its users [12].

3. Results and Discussion
3.1 Implementation of the design concept to the design of residential areas.
Application of the concept of efficiency as a service to meet the principles of environmental, economic, social, and ecological design. Effectiveness, applied as accuracy in how to do things, and the ability to carry out tasks precisely and adequately without wasting money, time, and energy. Integrated into the supervision of these settlements apply conditions that must be free from risks related to human lives and the assets in it. Building a 3D visual system is used to reduce risk by identifying any threats that display visual information in the form of images to determine anticipatory actions in settlements. Schematic design concepts can be seen in Figure 1 below.

![Concept of Design Diagram](image)

**Figure 1.** Application of design concepts to the design of residential areas

Implementation of the design concept of the settlement design in macro with all digital infrastructure facilities in it implements the manifestation of the effectiveness of mobility, such as a smart parking system in a central parking building, a device to park vehicles automatically, especially vertical parking without the need to be driven by the driver (see picture 2).
The use of materials on pedestrian and jogging tracks uses a system of solar panels and kinetic panels as a source of electricity. Then in the basement area, it functions as a service and treatment area with a robotic system that is recycling waste, energy, infiltration, STP (Sewage Treatment Plant) and lower reservoirs as a source of residential water, methods, and theories on design are applied as a form of efficiency in the dwelling to reusable raw materials (see figure 3).

3.2 Implementation of design concepts to the design of townhouse residential units

Townhouse settlements have a four-story residential that is used for each user's needs with a variety of supporting digital infrastructure in the room, as well as the use of technologies such as sensor optimization Wireless Sensor Network (WSN) a network system that connects devices such as sensor nodes, router, and sink node. Work in collecting environmental condition data, elderly security monitoring, and node tracking scenarios (see figure 4).
The application of solar panel systems in residential units that use solar energy as an alternative source of electricity is an embodiment of the concept of the effectiveness of electric energy processing. The solar panel was applied to the residential roof and glass grating in the balcony stair area, and then it was also used in light steel canopies combined with solar panel glass (see figure 5).

Figure 4. Application of design concepts to the interior of Town House residential units

Figure 5. Applying the design concept to the Town House residential unit exterior
Based on the methods and theories as well as the results of the analysis above, the following four guidelines on the concept of settlement design with digital infrastructure facilities during the revolution era 4.0 are as follows:

1) **Efficiency**: Utilization of resources without wasting time, money, energy, and can be re-functioned, such as processing energy (electricity, gas, solar, wind, kinetic/friction). Water treatment (clean water, dirty water, dirt, and rainwater). Waste management (organic and inorganic waste) climate change (environmental detection).

2) **Effective**: Sensor optimization (automation in infrastructure facilities for residential units and residential areas). Cybersecurity (preventing abuse of digital infrastructure facilities, both external and internal settlements. Mobility (vertical parking system), robotics (doing physical tasks instead of human tasks), Big Data (large-scale settlement data collection).

3) **3D Visual**: Information systems (optical information in the form of holograms) Simulation and predictions (track record of repetitive activity patterns). Surveillance cameras (linking situations between residents or users with related agencies such as hospitals, police stations, schools, etc.).

4) **Integrated**: Monitoring disabled (monitors the lifestyle of people with disabilities who live in it). Cloud computing (storage of non-physical data from environmental monitoring data). Network with third parties (connection with the outside environment).

4. **Conclusions**

Designing hi-tech architecture concepts, digital performance form design methods, and the design process starts from collecting theory, schematic design, concept evaluation, design development, and applying design concepts. The implementation was applied to macro and micro designs. The macro application includes all regional infrastructure facilities from the concept of mobility, such as smart parking, electric capsule cars, and electric bicycles. This settlement implements a treatment system with the help of technology such as energy, water, waste, and climate treatment, which can later be reused. Pedestrian and jogging paths use solar panels and kinetic panels as a source of electricity for the needs of the area and housing units, the system is an embodiment of the concept of efficiency. Micro implementation includes all residential unit infrastructure facilities such as electricity generated from the use of solar panel roofs as backup electricity. In the idea of practical and integrated, sensor optimization is applied to the tools and equipment of surveillance automation. It monitors the lifestyle of the elderly and disabled who also live in a residential environment in general, inside a house specifically. Then the application of the robot system in the placement of areas under-occupancy as a collaboration between humans and robots to complete the work that ispatterned systematically and patterned. The use of reference methods and theories to the design of residential units and residential areas produces four design concept guidelines, namely: efficient, flexible, and practical, 3-dimensional visual, compact, and integrated.

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