The land use design of villa complexes in the mountainous areas with contoured land character that can increase the profits

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Abstract Contoured land condition in mountainous area with a slope requires a cost consuming to make it a suitable land to function as commercial lands, such as a villa complex property. It is still a great choice for this business since it does not only have attractive natural views but also fresh air quality, making it comfortable to stay. The problem is how is the recommendation of land use design for villa complexes in mountainous areas with contoured land to increase profits. There are three stages in conducting land use design, first is the identification stage regarding the existing data analysis including accessibility and land slope through contour lines. Second, the process of concept formation, which becomes an analysis to determine the circulation and basis counting of villa land unit lots. Third is the evaluation stage, which is a stage of checking the land use precedent as validation in similar issue to prove the profit rate. The results will serve as a guide for investors and architects in determining the land use configuration on contoured land to optimize construction costs and increase profits as well as contribute to the development of land use knowledge on an urban-scale.

1. Introduction
The development of villas as a means of supporting tourism in mountainous areas in East Java, especially in Trawas, is limited. It is not easy to determine the location of villa construction due to the contoured land characteristic in mountainous areas. Besides, there is still land that functions as a protected forest area. Maintaining the land physical condition by minimizing the impact of environmental damage is costly, not to mention making it land that can be developed [1]. At least by knowing the degree of slope of the land in question, we can obtain accurate information to minimize the cost, including in selecting the most suitable development method for the land [2,3]. Most of the mountainous areas have specific physical conditions, which are land slopes, steeper slopes, greater power, and have a commercial value. This is in line with research on land use optimization by calculating the costs used by investors in the contoured land of the Ubud area [4]. This research also classifies the types of land slopes as follows:
Table 1. Land Slope Classification based on the Decree of Minister of Agriculture No. 837/KPTS/Um/11/1980 [4]

| Slope (%) | Description       |
|-----------|-------------------|
| 0 - 8     | Gentle Slope      |
| 8 - 15    | Moderate Slope    |
| 15 - 25   | Strong Slope      |
| 25 – 45   | Steep Slope       |
| > 45      | Very Steep Slope  |

This research becomes a reference in a precisely designed contoured land planning in mountainous areas to minimize disturbance to the physical condition (topography) of the land through earthworks related to building construction, specifically to maximize the land use associated with profit increase. This research also contributes to the development of the field of land use science within the scope of urban design. The best land planning is not necessarily efficient, as we need to consider certain problems and potentials as needed. Therefore, an analysis is needed before making the appropriate design steps by following the stages.

1.1. Regulation

The ideal needs for a residential area have the following percentage: 65% as housing, 20% as highway, 10% for open space, and public facilities and 5% for commercial purposes [5]. It is as important as the identification of occupancy regulations including building coverage, building coefficient, and floor coefficient.

1.2. Site Potential

In addition, the site design on sloping land has several important requirements such as land contour clarity, plan to minimize cut and fill, providing safe and comfortable access (circulation), responsive land orientation, as well as landscape and climatic conditions which can affect the direction of water flow (rain).

1.3. Site Planning

This site arrangement is related to regulations and land potential which determines the design method, mainly for contoured land. In general, this contoured land already has a visible pattern on the contour lines, this contour provides the architect with some planning guidelines. Besides, the site design can be started by providing useful landscape axes to determine villa circulation and orientation. Then arrange each villa lot according to the hierarchy of land area and orientation which affects zone grouping according to marketing consideration.

2. Method

The design process refers to a qualitative method with the design thinking approach proposed by Tim Brown [6], which has three core design steps in producing a design work. First is the inspiration stage or the so-called identification stage, which includes data collection and analysis of the problems that exist in the existing design. Second, the ideation stage is the stage of developing existing data and analysis into components needed in the design such as circulation, determining land unit lots, and analyzing the supporting components, suitable structural systems that are used on-site existing conditions. The third stage is the implementation phase that focuses on evaluation which validation contains that using similar precedents to determine the design feasibility following the objectives.
3. Results
To achieve optimal design results on land contours after obtaining regulatory data and land potential, the researcher may start the design process by the steps below.

3.1. Identification
Figure 1 contains the data and information including land slope conditions as indicated on the land contour map. The next step was classifying and mapping land zones based on the land slope; a zone consisted of sloping (8-15%), very sloping (5-25%) and steep (25-45%) land related to optimal or suboptimal functions to build (Figure 2).

3.2. Ideation
The design stage began by providing an adapted axis to the landform and contour shape, which divided each zone and helped to determine the main circulation path that divided the zone according to the land slope (Figure 3). Regarding the area of land that might be applied by each cluster, it was also connected to the main road (Figure 4).

![Figure 1. Site sloping line interval](image1)

![Figure 2. Slope color zone](image2)

![Figure 3. Slope color zone and its axes](image3)

![Figure 4. Slope color zone and circulation](image4)
After the circulation relationship was established, the next step was entering the counting of villa land units according to the marketing needs. In the lot counting, the villa land unit indeed depended on the desired land shape and the land direction which was adjusted to the perpendicular cut from the contour line direction (Figure 5). Then the lot arrangement of villa land units that had followed the contour line pattern and area calculated by the marketing would leave the parts of the unused unit lot, so, the land could have been used a green space other than land in the steep zone (Figure 6).

**Figure 5.** Site plan zone and circulation

**Figure 6.** Site plan of villa

After finding the optimal land use, the next step was to provide detail of the zone part that would have a function as a building and determine the most suitable land design treatments used in each zone with different land conditions.

**Figure 7.** Site location and type of grading (sloping interval line) zone
From Figure 7, we can see the land color group based on the unit lot group that occupies the land with their respective slope lines. According to Guidelines for Slope Management [3], this mapping was able to specify each color group according to the number of contour lines in each land lot zone including: an interval of 1 contour line, which was proposed to use a split level structural system, since the height position difference was not too steep (Figure 8). Then, the interval of 2 contour lines with the contoured land character, thus it was necessary to consider soil conditioning so that it was feasible to build using an elevated system (Figure 9). Next, an interval of 3 contour lines with steep land characteristics must be considered in terms of choosing the soil conditioning. The suitable structural system for this land was a combination of split and elevated systems, so there was a need for land cutting and land filling in another part to reduce the building height (Figure 10). Finally, a steep land zone with an interval of 4 contour lines, which could be proposed to make a 2-level building to accommodate the height.

3.3. Evaluation
Result of land use optimization in Tegalalang area, Ubud on an area of 7,343 m² with contoured land characters found that the land used for villas with easy access and division of unit lots and utilities that paid attention on land character had excellent investment value. The maximum productivity results from the villa unit of 60% and spa center facilities of 40% produced the greatest productivity with a percentage of 829% land value, from a land price of IDR 1,105,270/m² to IDR 10,263,207/m² [4].
4. Discussion
From the result and evaluation of similar projects, it had a similarity that the optimization of contoured land as a villa business property was appropriate if managed properly. By paying attention to the land physical character that affected the determination of circulation, division of the villa land units lot, and the structural system used, there was an increase in the calculation of land prices as a form of business investment.

5. Conclusion
The land use design of the villa area as a tourism-supporting object with the characteristics of contoured land has aspects that must be considered such as regulatory aspects, marketing needs, and land potential. There are three stages in conducting land use design on contoured land.

- Identification. A step of analyzing the existing data includes accessibility, land slope through contour lines and land boundaries as well as zone grouping based on contour line intervals.
- Ideation (formation of idea or concept). A step of analysis developing that takes into account the land’s physical character, which affects the circulation determination through the axis lines and dividing each zone according to the counting needs of villa land unit lots. Furthermore, the division of the villa land units and the structural system used must be following the contour line pattern and the formed zone.
- Evaluation. A step of checking the validation of precedent of land use design in similar contoured areas that proves an increase in the calculation of land prices as a form of business investment.

The land use design in this villa area is expected to become a guideline for design principles on similar land and to contribute to the development of land use science within the scope of urban-scale design.

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