

## Environmental Ergonomic Design Slope Limits to Prevent Accidents

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### ABSTRACT

Living on a slope is indeed dangerous, there is a high possibility of landslides, and it can also be a disaster because of the loss of life. This article reveals that settlements on sloping land must pay attention to the ergonomic limits of the slope angle to avoid accidents in the environment. This writing is designed descriptively/expositionally. Data was taken from various literature in the form of opinions from research related to environmental design regarding slope limits for non-stone soil. Conclusion: First, ergonomic limits for settlements can be made on a ground slope of 4 - 8 degrees or a slope of 7% - 15%. Second, living on a slope exceeding the ground angle of 4 - 8 degrees or a slope exceeding 7% - 15% will cause accidents. The causes of accidents living on slopes include: erosion, landslides, the value of the safety factor, which is what determines the soil's ability to accept small compressive and tensile loads and makes the slope increasingly unsafe. Suggestion: It is best to build a house or building not on a slope where the slope angle exceeds 4 - 8 degrees or the slope exceeds 7% - 15% to avoid accidents

## INTRODUCTION

Humans are in the natural environment. In the natural environment (environment), humans use tools/equipment (equipment) for work, activities, residence, and so on. Conditions, positions and performance like that, all humans are influenced by tools and the natural environment. In the natural environment of sloping land, one of the threats to housing is landslides. As Bayu Persawan et al (2020) said, "building a residence in a slope area carries enormous risks. The threat of natural disasters, especially landslides, is always lurking."

The condition of the slopes landslides during the rainy season, this is due to not paying attention to ergonomics (environmental balance). As Mukaromah (2019) said, "physical conditions that have the potential for landslides during the rainy season occur and human activity factors that do not pay attention to environmental balance such as the creation of residential complexes on hills with steep slopes and cutting cliffs."

The main causes of landslides are heavy loads on slopes, namely many buildings, excessive use of land for plantation crops, accumulation of material on slopes, and high rainfall. This is in the opinion of Siti Rohani Purbo et al (2021) who stated that "the cause of landslides in Tanah Jawa District, Simalungun Regency. "Research found that high rainfall, excessive land use such as settlements and oil palm plantations, accumulation of soil material on slopes, a history of landslides in the past, and heavy loads on slopes such as houses are the main causes of landslides in this area."

Living on a slope is indeed dangerous, there is a high possibility of landslides, and it can also be a disaster because of the loss of life. Therefore, when mukin on sloping land you must pay attention to the ergonomic limits of the slope angle to avoid accidents in the environment.

## LITERATURE REVIEW

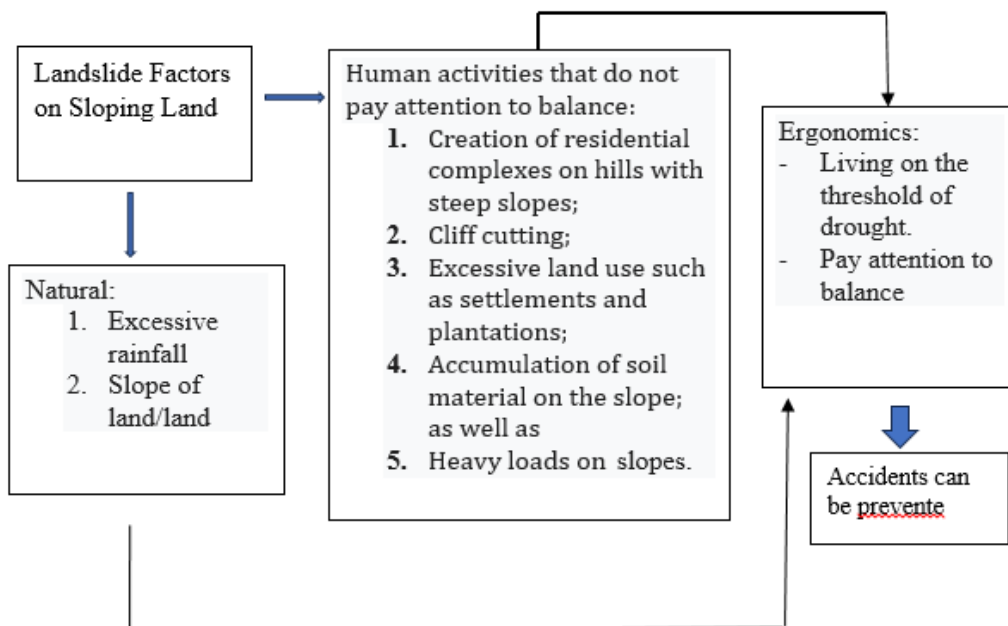


Figure 1.Theoretical Framework

## METHODOLOGY

This writing is designed descriptively/expositionally. Data was taken from various research opinions related to environmental design regarding slope limits for non-stone soil. Such data collection is usually called literature study. Then the various data are also analyzed descriptively, then concluded.

## RESULTS AND DISCUSSION

### Ergonomic Slope Constraints Environment

There are signs that humans are influenced by the environment or equipment. Therefore, in order for humans to be in an ergonomic environment (moving naturally and in balance), the tools and environment must be adapted to humans, not humans to the tools and environment. In order for humans to adapt, they need to know human limitations (threshold values) and quality standards, so that humans can stay alive, stay safe, not get hurt, and be comfortable.

The boundaries of the slope area which are categorized as very good, good, quite good, not even suitable and very not suitable, see the table below.

Table 1. Classification of Slope Slope Classes (Based on Van Zuidam, 1985 in Map Vision Indonesia, 2023)

Kelas	Kemiringan (Nilai Dalam Derajat)	Kemiringan (Nilai Dalam Persen)	Klasifikasi
I	0-2	0-2	Datar
II	2-4	2-7	Sangat Landai
III	4-8	7-15	Landai
IV	8-16	15-30	Agak Curam
V	16-35	30-70	Curam
VI	35-55	70-140	Sangat Curam
VII	>55	>140	Terjal

A land slope of 0 - 2 degrees is best for settlement. Why? Because the land will not slide. At least a land slope of 4 - 8 degrees or a slope of 7% - 15% does not endanger humans establishing settlements. This means it won't landslide easily, and there must be lots of plants (unless the ground is hard like rocks). Or also, it is necessary to harden the soil (foundations, walls, etc.), so that it can hold the soil and prevent landslides.

The slope of the land is quite steep, steep and very steep, which is very risky for landslides and at risk of disaster. When living on land that is quite steep to very steep, landslides will definitely occur, so humans are at risk of accidents and even death. As Heru Sri Naryanto et al (2017) stated that "of all these factors, the most dominant and influential on landslides are: very steep slopes, very loose and thick weathered soil, land conversion and high rainfall".

In line with the opinion above, living on land with a certain angle (steep) slope carries a risk of landslides. As Muhammad Iqbal Firdaus (2021) said, "areas with steep slopes are not used properly, thereby increasing the risk of losses experienced when a disaster occurs. "Based on the analysis that has been carried out, the next step is to classify areas prone to landslides."

Therefore, the natural environment and tools follow the treatment made by humans. Thearment on nature and tools adapted to human limits, that is ergonomics. An approach with an ergonomic concept will keep life safe, accident-free and comfortable. When humans don't understand the behavior of nature. If there is a mistreatment of the natural environment and the tools that are made, it will definitely harm humans themselves at some point. Ergonomic boundaries for settlements can be made at a ground slope of 4 - 8 degrees or a slope of 7% - 15%.

### **Slope Slopes and Accidents**

On sloping land with a slope above 15% or a slope with an angle of 8 degrees and above, all of them have a very high level of erosion hazard or have a very high risk of accidents. As Parlin Hormartua (2022) states that "on slopes above 15%, all types of land use (settlements, secondary forests, shrubs, and moors) have a very high level of erosion hazard". Of course it's on land that isn't stone ground.

Indeed, there is no relationship between various slope angles and the organic texture of the soil. As Henly Yulina (2015) states that "research results show that there is no strong relationship between slope slope and soil texture at various slope positions, slope slope and soil organic matter at various slope positions". However, the soil's ability to accept small compressive and tensile loads makes the slopes increasingly unsafe. One of the reasons why slopes are unsafe is that they will easily collapse. Land that is prone to landslides if used for residential purposes will cause accidents or disasters. As Reka Racana (2016) states that "a small safety factor value makes slope conditions unsafe and requires soil improvement".

It can even be said that living in the absence of security in its original and saturated condition is not safe. An unsafe event occurs in the form of an accident or disaster. As Qiratul Aini (2018) states that "the results of the slope stability analysis show that when the slope is not influenced by the value of the earthquake vibration factor, the value of the safety factor in the original and saturated conditions is unsafe."

From the various opinions above, living on a slope will cause accidents. Causes of accidents living on slopes include: erosion, landslides, low safety factor values, unsafe ground safety factors.

## CONCLUSIONS AND RECOMMENDATIONS

- Ergonomic limits for settlements can be made on a ground slope of 4 - 8 degrees or a slope of 7% - 15%.
- Living on a slope exceeding a ground angle of 4 - 8 degrees or a slope exceeding 7% - 15% will cause accidents. The causes of accidents living on slopes include: erosion, landslides, the value of the safety factor, which is what determines the soil's ability to accept small compressive and tensile loads and makes the slope increasingly unsafe.

It is best to build a house or building not on sloping land where the slope angle exceeds 4 - 8 degrees or the slope exceeds 7% - 15% to avoid accidents.

## REFERENCES

- Bayu Persawan, Heri Sutanto, Masayu Widiastuti, 2020. Identifikasi Daerah Rawan Longsor Ditinjau Dari Struktur Tanah (Studi Kasus: Pemukiman Penduduk Jalan Gurami, Kel. Sei Dama, Kec. Samarinda Ilir, Kota Samarinda), Jurnal Ilmu Pengetahuan dan teknologi sipil, Volume 4, nomor 2 November 2020, Program Studi Teknik Sipil, Fakultas Teknik, Universitas Mulawarman, Gunung Kelua, Samarinda.
- Diana Destri Sartika, Yuki Achmad Yakin, 2016, Analisis Stabilitas Lereng Tanah Berbutir Kasar dengan Uji Model Fisik, No. 2 | Vol. 3 Jurnal Online Institut Teknologi Nasional Juni 2016 Reka Racana, Jurusan Teknik Sipil, Institut Teknologi Nasional, Bandung.
- Henly Yulina, Daud Siliwangi Saribun, Zulkarnaen Adin, 2015, Hubungan antara Kemiringan dan Posisi Lereng dengan Tekstur Tanah, Permeabilitas dan Erodibilitas Tanah pada Lahan Tegalan di Desa Gunungsari, Kecamatan Cikatomas, Kabupaten Tasikmalaya, Jurnal Agrikultura 2015, ISSN 0853-2885, Jurusan Ilmu Tanah dan Sumber Daya Lahan, Fakultas Pertanian, Universitas Padjadjaran, Sumedang, Jawa Barat.
- Heru Sri Naryanto, Hasmana Soewandita, Deliyanti Ganesha, Firman Prawiradisstra, Agus Kristijono, 2017, Analisis Penyebab Kejadian dan Evaluasi Bencana Tanah Longsor di Desa Banaran, Kecamatan Pulung, Kabupaten Ponorogo, Provinsi Jawa Timur, Jurnal Ilmu Lingkungan Volume 17 Issue 2 :272-282 ISSN 1829- Tanggal 1 April 2017, Program Studi Ilmu Lingkungan Sekolah Pascasarjana UNDIP, Pusat Teknologi Reduksi Risiko Bencana (PTRRB), Badan Pengkajian dan Penerapan Teknologi (BPPT), Gedung Geostech, Kompleks Puspiptek, Serpong, Kota Tangerang Selatan / Gedung 2 BPPT, Lantai 12, Jl. MH Thamrin 8, Jakarta.
- Muhammad Iqbal Firdaus1, Eppy Yuliani Jurnal, 2021, Kesesuaian Lahan Permukiman Terhadap Kawasan Rawan Bencana Longsor Kesesuaian Lahan Permukiman Terhadap Kawasan Rawan Bencana Longsor Kajian Ruang, Vol 1 No 2 September 2021, <http://jurnal.unissula.ac.id/index.php/kr>, Program Studi Perencanaan Wilayah dan Kota, Universitas Islam Sultan Agung Semarang.

- Map Vision Indonesia, 2023, Kemiringan Lereng, Last Updated on March 7, 2023 by , <https://mapvisionindo.com/kemiringan-lereng/>, Simalungun, Sumatra Utara.
- Mukaromah,2019, Kapasitas Masyarakat Dalam Menghadapi Bencana Tanah Longsor Di Kecamatan Candisari Kota Semarang, Geografi, Fakultas Ilmu Sosial, Universitas Negeri Semarang.
- Parlin Hormartua, Rospita Odorlina Pilianna Situmorang, 2022, Hubungan Faktor Kemiringan Lereng, Jenis Tanah, dan Tipe Penggunaan Lahan Terhadap Resiko Bahaya Erosi, National Research Innovation Agency, INOVASI 19(2):147-158, October 2022, Pusat Riset Ekologi dan Etnobiologi, Badan Riset dan Inovasi Nasional Jl Raya Jakarta - Bogor KM 46, Cibinong, Bogor 16911, Jawa Barat - Indonesia.
- Qiratul Aini, 2018, Analisis Kestabilan Lereng Studi Kasus Kelongsoran Ruas Jalan Sicincin-Malalak km 27.6 Kecamatan Malalak, Kabupaten Agam, Program Studi S1 Teknik Pertambangan Fakultas Teknik, Universitas Negeri Padang.
- Siti Rohani Purbo, Katlin Aprlia Siallagan, Kori Hasana, Oktavia Simarmata, Judika Siagian, 2021, Terjadinyatanah longsor di kecamatan tanah Jawa Kabupatean Simalungun, <https://www.scribd.com/document/543997953/Laporan-Hasil-Penelitian-Geografi-Tanah-Longsor>, Simalungun.