

# ANALYSIS AND IMPACTS OF HILLSIDES DEVELOPMENTS NOT REGULATED BY BUILDING PROFESSIONALS IN THE LOW INCOME AREAS OF BOTSWANA - IN THE CASE OF PELENG, LOBATSE -

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**Abstract**— There is a need for the developments on the hillside to be regulated by Urban and Regional Planners, Architects and Engineers to assure safe, conducive and sustainable developments on the hillside. This is because hillsides are challenging to develop on due to sloping terrains which are a catalyst to landslides, erosion and floods. Although the residents of Peleng managed to find a way to settle, the success came with challenging living conditions in the long run. The paper then investigated the methods used by the residents in trying to overcome the challenges of developing without the aid of Building professionals and analysis the impacts incurred. The study then determined if there is a need for building professionals to regulate developments on the hillside.

**Index Terms**—analysis, impacts, building professionals, Hillside Developments, Low income.

## I. INTRODUCTION

Urban Planners, Architects and Engineers are key when it comes to developing on challenging terrains such as hillsides. They normally work simultaneously towards the same goal but in hierarchy. The Urban planner's works shall be completed first then the architect use it as a guide for architectural designs and then the engineers make the design work through design of services for the building and its surrounding context.

Urban Planning refers to planning with a spatial, or geographical, component, in which the general objective is to provide for a spatial structure of activities (or land uses) which in some way is better than the pattern existing without planning (Hall and Tewdwr-Jones, 2011). Urban planner's duties are performed to insure that maximum land will be used accordingly, roads and sewage layouts and sizes will correspond to the land use and building types.

The Architect is responsible for designing a suitable structure for a specific land use such as residential house, multifamily residential, shops, warehouses and other types of

developments. The architects follow the rules and regulations guiding the developments of the region including other laws for fire, health and environment.

Engineers include structural engineers who are responsible for the assurance of stability of the building structure, and civil engineers who are responsible for the design of external infrastructures servicing the building such as roads and sewerage systems.

The study will then investigate the development methods used by the residents without being regulated by these building professionals, and the impacts that were the resultant.

## II. LITERATURE REVIEW

In Olshansky (1998), the study discussed that hillside are lands that require special land-use planning consideration because of their inclined slopes. In the United States the government regulate hillside developments for a variety of reasons, sometimes the regulations directly address physical issues related to sloping ground, and sometimes they address associated aesthetics and environmental issues (Olshansky, 1998).

In Seno and Ogura, (2018) and in Seno and Ogura (2019) the studies investigated the problems of Peleng hillside environment. Analyses findings were that the reason for poor access is narrow roads, difficulty to drive up, lack of cal de sac, and because there is no entrance or it is not wide enough for fire, sewer and litter trucks to enter and provide service (Seno and Ogura, 2018). Landslide was mainly due to poor retaining of slope disturbance (Seno and Ogura, 2019). It was discovered that due to inadequate setbacks there was no space for servitudes such as sewer and drains and access for cars, air and sunlight was also compromised (Seno and Ogura, 2019). The studies suggested that improvement of building regulations to include hillside regulations could improve the situation in future.



Fig.1. Peleng map of 1966

### III. BACKGROUND/HISTORY

Oral evidence from Tribal from Tribal authorities and the Physical Planner suggests that incipients Lobatse emerged as a transit railway station in 1889, by the British South Africa company to handle traffic destined to and from Mafikeng, South Africa (Areola et al., 2014). Lobatse is an expatriate initiated settlement (Areola et al., 2014). Because the Africans were restricted from areas distinctively set aside for European settlement, they established squalid settlement in what came to be called Peleng Township on the hill slope east of the railway station (Areola et al., 2014). This is probably the reason Peleng was never planned or developed by building professionals. Fig.1 shows the map of Peleng in 1966 during the early years when residents settled on the lower part of the hillside before gradually inhabiting the upper area.

### IV. METHODOLOGY AND AIM

Primary data was collected through the site survey and 160 houses were inspected and inquiry from residents with open and close ended questionnaires about the history and the current living and building conditions of Peleng. Observation technique was used and pictures were taken to support the observed situation. Documentary data was obtained from Botswana department of surveys and mapping such as softcopies of maps with area of Peleng and hard copies of Arial views of Peleng during 1966, 1976 and 2006. The investigated findings were then categorized as per the 3 slopes categories which were slope 4° & below, slope 5°-9° and slope 10°-13°. Slope 14° & above was not developed hence it is not included. To determine these slopes site coordinates obtained from Botswana department of surveys and mapping were plotted on Revit software to create a model

of the hillside. Then Dynamo Visual Programming was used to determine different slope categories. Map with plots and footprints of houses was then superimposed on top of the slope map to identify plots per each slope category and presented as in Fig.2.

The intent of the study is to investigate the planning system used by residents, architectural strategies and how they insured stability of their buildings without being regulated by building professionals. The study will then examine and analyze the due impacts that occurred on the hillside built environment due to the ignorance of the professional engagement. The aim of the study is determine the need for engagement of building professionals in the hillside built environment.



Fig.2. Map showing different slope categories

## V. METHODS USED BY RESIDENTS TO INHABIT THE CHALLENGING HILLSIDE TERRAINS WITHOUT REGULATION OF BUILDING PROFESSIONALS

### A. Developments not regulated by Urban Planners

Through the interview the elderly residents mentioned that the time when they started allocating themselves plots Lobatse chief advised them to settle in a linear form. The chief's advice was that if they do not allocate themselves plots in a linear pattern then in future when the government wants develop the neighborhood their structures will be demolished (Seno, Lyamuya and Ogura, 2018). The residents then started choosing their plots next to each other in random sizes and irregular shapes as in Fig.3.

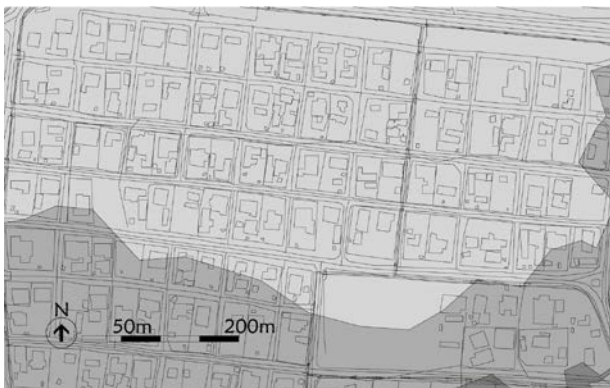


Fig.3. Images showing plots stack next to each other

### B. Developments not regulated by architects

Since the building on the hillside require special consideration for different levels, it becomes a challenge to build on the hillside as compared to building on the flat terrain. Architects normally address this issue by implementing cut and fill, and designing two or more phases of the house, being the upper phase where the building sits on the upper slope, and the lower phase where the building sits on the lower slope. Cutting of slopes is crucial for obtaining flat grounds to commence any building or development work in hill regions (Kumar, and Pushplata, 2013). However, residents of Peleng built their houses without stepping foundations and used thicker foundations on the lower part of the slope with many staircases at the entrance.



Fig.4. Image showing too many entrance stairs

Due to too much gravity on the hillside, architects normally provide retaining walls to retain the soil and water from the upper part of the hill. In Peleng residents used their buildings especially the ones at the back of the plots to retain the soil and water.



Fig.5. Images showing buildings used as retaining walls

### C. Developments not regulated by Engineers

It is very important to design and construct sewer drainage system before the construction of buildings. This is normally Engineer's job, but in the absence of engineers and sewerage system the residents implemented the use of pit latrines as a solution to address this need. This seemed appropriate and economic for the low income area since pit latrines do not use water and are easier to construct. Fig.6 shows the types of pit latrines constructed in Peleng.



Fig.6. Images of Pit latrines not regulated by engineers

Residents who constructed their buildings on the rocks explained that they use rocks as the foundation footing because it strengthens the base of the building and prevent development of cracks. Fig.7 below indicates the method of construction implemented by the residents without the aid of engineers.



Fig.7. Image showing rocks used as foundation footing

## VI. ANALYSIS OF THE IMPACTS OF DEVELOPING WITHOUT BUILDING PROFESSIONALS

### A. Impacts of Developments not regulated by Urban Planners

The initiative of allocation of land in Peleng through just aligning plots have resulted in lack of land use zoning. According to DCC land use zoning is defined as the grouping of homogeneous and mutually supporting family of land use activities in an area (MLH, 2013). This have led to some residential plots operating as bars or shops whilst sharing plot boundary with residential dwellings as in Fig.10. These compromises privacy and security for neighbors. Inadequate open spaces for children play areas is also a resultant of lack of proper planning as indicated in fig.9. Fig.8 shows that slope 5°-9° had higher lack of play areas, likely because there are

open spaces on the upper hill because it's undeveloped in slope 14° & above, and there are community grounds on the lower hill near Peleng. Fig.8 shows other problems associated with the due impact of developing without urban planners such as unplanned multifamily dwellings, inadequate setbacks, poor access, poor sewer system and poor storm water control as in Seno and Ogura (2018).

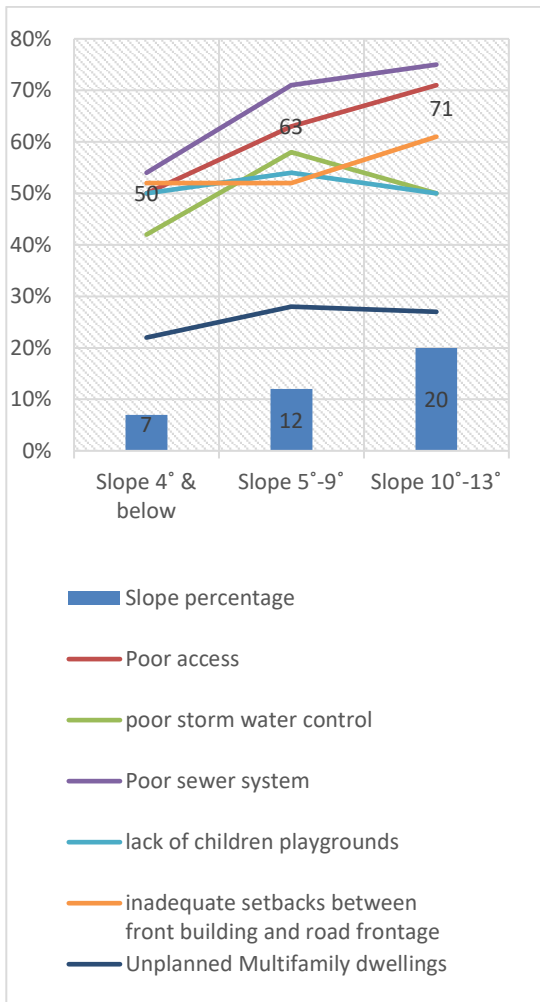


Fig.8. Analysis of developments not regulated by Urban Planners



Fig.9. Image showing lack of children play area



Fig.10. Image showing an unplanned commercial building next to residential dwelling

*B. Impacts of Developments not regulated by Architects.*

The analyses from Fig.10 indicates that houses with many entrance stairs increases as the slope gets steeper hence the highest record of many entrance stairs was recorded at slope 10°-13°. Many stairs at the entrance make it difficult for elders and the disable to enter the house making it not user friendly.

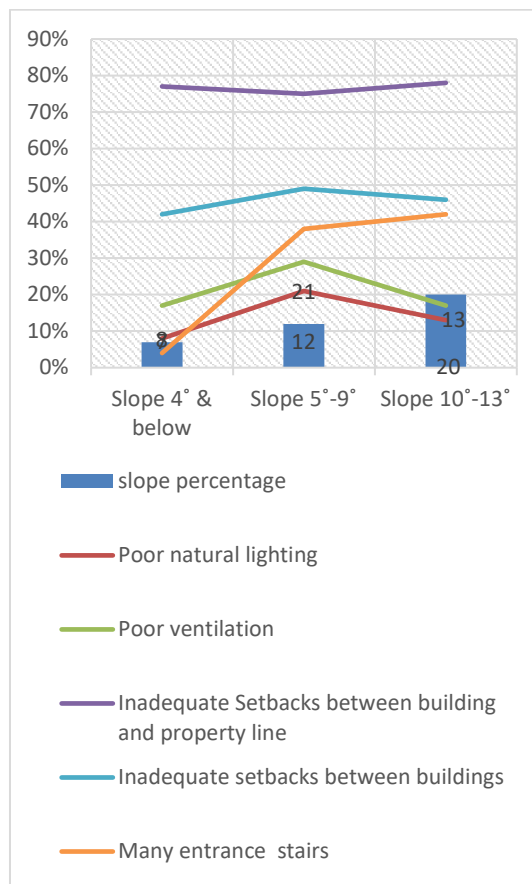


Fig.11. Analysis of developments not regulated by Architects

C. Impacts of Developments not regulated by Engineers

Before construction Engineers are also responsible for investigating soil conditions to ensure building stability to avoid collapsing of buildings and development of cracks. Twelve residents reported that their buildings have collapsed and 77 residents reported cracks on the buildings. Air Pollution has also been linked to the use of pit latrine toilets as in Seno and Ogura (2018). Fig.12 shows the analysis of the impacts of developments not regulated by engineers and Fig.13 shows the image of cracks on the buildings.

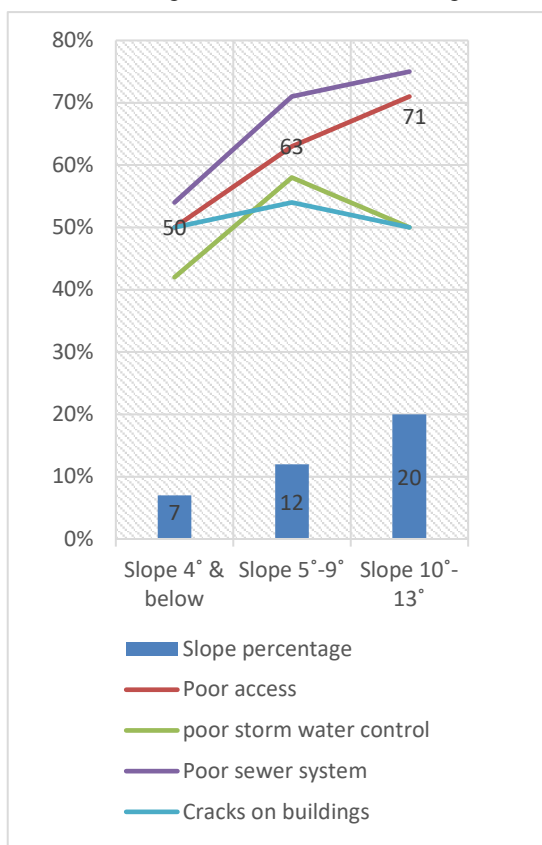


Fig.12. Analysis of impacts of developments not regulated by engineers



Fig.13. Image showing cracks on building as a resultant of developments not regulated by Engineers

TABLE.1. indicates the relation between the Hillside problems and developments not regulated by building professionals

Hillside Problems	Developments not regulated by building professionals		
	Developments not regulated by Urban Planners	Developments not regulated by Architects	Developments not regulated by Engineers
Poor Access	o	o	o
Poor Storm Water Control	o	o	o
Poor sewer system	o	o	o
Inadequate setbacks	o	o	o
Lack of Children Playgrounds	o	o	x
Cracks on Buildings	x	o	o
Poor Ventilations	x	o	x
Poor Natural Lighting	x	o	x
Unplanned Multifamily dwellings	o	o	x
Many entrance stairs	x	o	o

Key:  
Effect on hillside problems = o  
Not effect on hillside problems = x

VII. CONCLUSION

Hillside neighborhoods in Botswana have been developed without being regulated by building professionals hence influencing the investigation of how they were developed and the impacts that occurred in the long run. The study then discussed the methods used by residents to develop without being regulated by building professionals and analyzed the impacts related to each of the building professionals namely; Urban and regional planners, Architects and Engineers. This was achieved through site survey, interviews with residents and perusal of documented information with the aim to determine the need for special regulation of hillside developments by building professionals.

Some of the common practices by residents that were discovered were that residents;

- i) aligned their plots next to each other due to lack of neighborhood master plan normally done by Urban Planners.
- ii) used many entrance stairs to respond to the challenge of building on steep slopes which architects normally respond to by designing buildings that step down along the slope.
- iii) used pit latrines to due to lack of sewer connections which are normally designed by engineers.

The study then analyzed the relation of other hillside problems from other studies with developments not regulated by building professionals and concluded that there is a need for hillside developments to have special regulation by building professionals due to many problems linked to unregulated developments.

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