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Rapid Visual Screening of Building for Potential Ground Movement in Kalirejo, Kulonprogo, Yogyakarta

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ABSTRACT

Landslides are the biggest threat in the Kalirejo area. The dynamics of land movements in the mountains often cause cracks and potentially collapse. Landslides due to land fractures caused building damage. This study aimed to analyze the condition of a simple building on the influence of land fracture. The method used was conducting a field survey of existing buildings in the Kalirejo area. The data of the surveys were the percentage of building damage and building categorization. From the results of the analysis, the percentages of buildings in the safe category were 78 buildings or 54.17%, the buildings of the unsafe category were 51 buildings or 35.42%, and buildings with the unsafe category were 15 buildings out of 144 surveyed building with the percentage of 10.42%. Based on the results of the analysis using the Rapid Visual Screening (RVS) method, 15 buildings with unsafe conditions need to be relocated because they do not use the minimum structure required for simple buildings while the 51 buildings with unsafe conditions, repairs must be made to the structure according to the minimum requirements of simple buildings.

INTRODUCTION

Disasters that occur in the near future in Indonesia remind that Indonesia is a country that is very close to earthquakes, landslides (Rajindra et al., 2019), land movements, storms, and various other natural disasters (Wekke et al., 2019). The disaster that occurred was caused by Indonesia's geographical location in the midst of changing natural conditions (Wekke et al., 2019; Rajindra et al., 2019). A landslide is a process of moving the earth down and out of the slope-forming bodies including rocks (Pirttijärvi et al., 2015), soil, artificial fills, or a combination of both that move by falling, rolling (rotating), sliding, spreading, or flowing (Kasayanond et al., 2019).

The landslide incident in February 2018 in Kulon Progo recorded 14 landslide locations, and there were three worst points, namely West Plono, Nglambur, and Trayu located in Samigaluh District. Landslides re-occur and threaten about 30 lives due to continuous rain in March 2018 with a fracture length of 50 meters and a width of 30 meters and a total of 25 meters.

The land use in the Kalirejo, Hargorejo, and surrounding areas consists of 23% with a slope of 15-30°. Most of the settler areas correspond to slope 42° with a pattern of surface displacement. The residential area in Kalirejo is above the andesite. In addition to Settlements, there is also an expansion of

57% in the slope 0^{o}-15^{o} (Prastowo et al., 2018).

Rapid visual screening (RVS) is a method of assessing the vulnerability of a building to potential earthquake hazards based on visual observations from the building's exterior, interior if possible so that its implementation is relatively fast (McNeill & Labson, 1991). Rapid Visual Screening (RVS) can be used for pre-disaster mitigation. Usually, RVS is used to assess buildings in earthquake disasters. In this study, RVS is used to assess buildings in disaster landslide and landslide movements because the assessment of buildings due to landslides has not yet been developed.

Buildings that have the potential for damage and in areas prone to land displacement result in a greater risk of the building being damaged (Harianto et al., 2018). One way to find out the potential damage to a building is to conduct a building evaluation using a simple building evaluation form (typical of a wall) (Nissen, 1986).

The Research about the potential vulnerability of ground movement area at Kalirejo, Kokap, Kulon Progo, Yogyakarta, found a map of the zone vulnerability of ground movement area that shows the zone vulnerability of ground movement (Harianto et al., 2018), a zone of the vulnerability of ground movement, a zone of vulnerability ground movement of low (Prastowo et al., 2019), medium and high (Mariyanto et al., 2018). Continuing this research, a mapping of the potential damage to buildings will be carried out as a result of a simple building evaluation (typical Wall) in the Kalirejo area, Kokap District, KulonProgo Regency, Yogyakarta.

The aforementioned background makes the writer want to analyze the condition of a simple building in the Kalirejo area, KulonProgo, Yogyakarta because the condition of the building that is by the rules will make the building during a land shift due to fractures of the land which is not so significant (Priadi & Hududillah, 2018). The current condition of the building also makes the building in the realm of safe (Sulaiman et al., 2019), less secure and unsafe. The condition of the building which is called safe has a percentage of 70-100% condition, the condition of the building which is called unsafe has a percentage of condition 40-69%, and the condition of the building which is called unsafe as a percentage of the condition of 0-39% (Rüpke et al., 2006).

The condition of the building can be assessed by conducting a simple building evaluation (Khalil & Santos, 2014), many ways to evaluate the building either by calculating the structure or just looking at it from the looks (Shiomi & Park, 2008). In this study, the analysis of the condition of the building is evaluated by looking at and recording the condition of a simple house with a simple building evaluation form (typical of the wall) (Kim & Lee, 2007). From this form, we know the condition of existing buildings. There are 40 questions from 11 categories, which are the minimum standards for good buildings.

The formulation of the problem of this study is how to classify simple house buildings due to the potential of the Kalirejo regional land movement, KulonProgo, Yogyakarta, so that from the formulation of the problem, the purpose of this study is to classify simple house buildings due to the potential of the Kalirejo regional land movement, KulonProgo, Yogyakarta.

METHODS

Rapid Visual Screening (RVS) is a method for facilitating, inventorying, and classifying buildings that are approved to be prone to collapse in earthquake-prone areas. Fast Visual Screening was formulated in FEMA 154 (Lizundia et al., 2015).

FEMA 154 is a Rapid Visual Screening (RVS) method in buildings, so Rapid Visual Screening (RVS) is developed in simple buildings in earthquake-prone areas adapted to simple buildings in Indonesia (Satyarno, 2013)

Rapid Visual Screening (RVS) in simple buildings in areas prone to ground movement does not yet exist, so this study still uses rapid visual screening in earthquake-prone areas, it is hoped that from this study Rapid Visual Screening (RVS) specifically for areas prone to ground movement. However, in this study, the RVS method is used in areas prone to ground movement (McNeill & Labson, 1991).

The first step taken was conducting a field survey by looking at existing buildings and adjusting them to a simple building valuation form (Hadibarata & Rubiyatno, 2019). A simple building form contains the parts of a building that must be owned by a building to make the building structurally strong (Irsadi et al., 2019). On a simple building form, only check the "Yes" column if the building part is following the form or column "No" if the building part does not exist as in the form of the building has a part that matches the form, but the size does not match then the bias can be filled at column "Less."

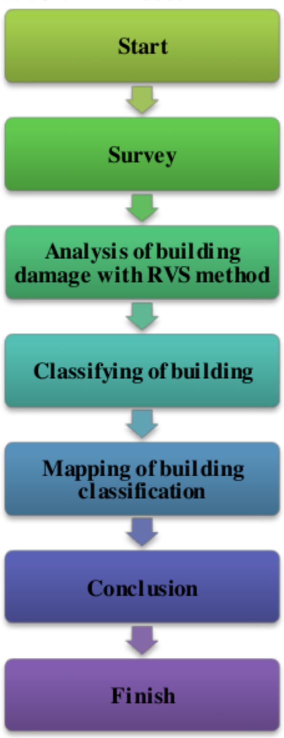


Figure 1. Research Flowchart

After the field survey was carried out, the condition of the existing buildings in the Kalirejo area was obtained, an analysis of building damage was carried out following the filling of simple building forms which were carried out at the time of the field survey (Taruna & Banyunegoro, 2018). How to analyze it by counting the answer "Yes" multiplied by the value of 1.0 and the answer "Less" multiplied by the value of 0.5. The value of the answer "Yes" and "less" is added divided by 40 (the number of building components simply) multiplied by 100%, then the percentage of simple buildings is obtained according to the simple building assessment form.

After getting a simple percentage of building damage from the analysis of existing forms, it can be classified into three categories of conditions, namely safe percentage > 70%, less safe 40-69%, unsafe <40% (Nakajima & Hasegawa, 2007). Percentage values can also be made on a condition index scale, and their handling measures can be seen in table 1. From these percentages, it can be seen the condition of simple buildings to the influence of the Kalirejo regional land fracture, KulonProgo, Yogyakarta.

RESULTS AND DISCUSSION

The field survey was conducted in the Kalirejo area, where potential land fractures are following previous research, which obtained the coordinates and the potential land fracture area. The 146 buildings in the existing condition survey were randomly assessed according to a simple building form, with 40 questions of the condition of the buildings (Saehana et al., 2019). The condition of the existing buildings surveyed looks like figure 1. The field survey is done by going to the house one by one and then matching with the contents of the existing forms, is the building part of the building mentioned formatted then checked in the column "Yes" but if the form is not in the existing building then check the column "No," if the building is following the form, but the size is different then check the column "less" (Bemmelen, 1994) and write what the shortcomings are seen in Figure 2.

The survey was carried out following the agreed coordinates with the reference coordinates using a map of potential building strength in the Kalirejo area, as shown in Figure 3. The surveyor started building appraisal by filling out a simple building appraisal form following the coordinates agreed upon previously (Sjaifuddin et al., 2019). How to analyze it by looking at the answer Yes with a value of 1, the answer Less with a value of 0.5, and the answer is not the value of 0.

It can be taken as an example on form 1 coded B11-17 in figure 2, from 40 answer questions Yes, which means there are 34 answers in the building, one answer is lacking answers, and no answers are five answers. Analyzed with all 34 answers multiplied by the numbers 1 and 1, the answer is less multiplied by the number 0.5. The sum result was 34.5. To get a building score, the total value of 34.5 divided by 40 multiplied by 100%. Building score results obtained 86.25. How many questions were asked Yes times the value of 1 and more answers less than the value of 0.5. All previous product results are added together to get a total value. To get a Building Score obtained by the formula. Build Score = total score / 40 x 100%.

The build score will be obtained in the form of a percentage of the building conditions. The score obtained will participate in building the score WHICH will be divided into three categorization zones, namely the safe categorization zones for safe building indexes with a percentage of 70-100%, unsafe categorization for building index needs unsafe with a percentage of 40-69% and unsafe categorization for the unsafe building index conditions with a percentage of 0-39%. In form 1 above, the building value is 86.25 and categorized as safe.

Table 1. Condition Index Scale

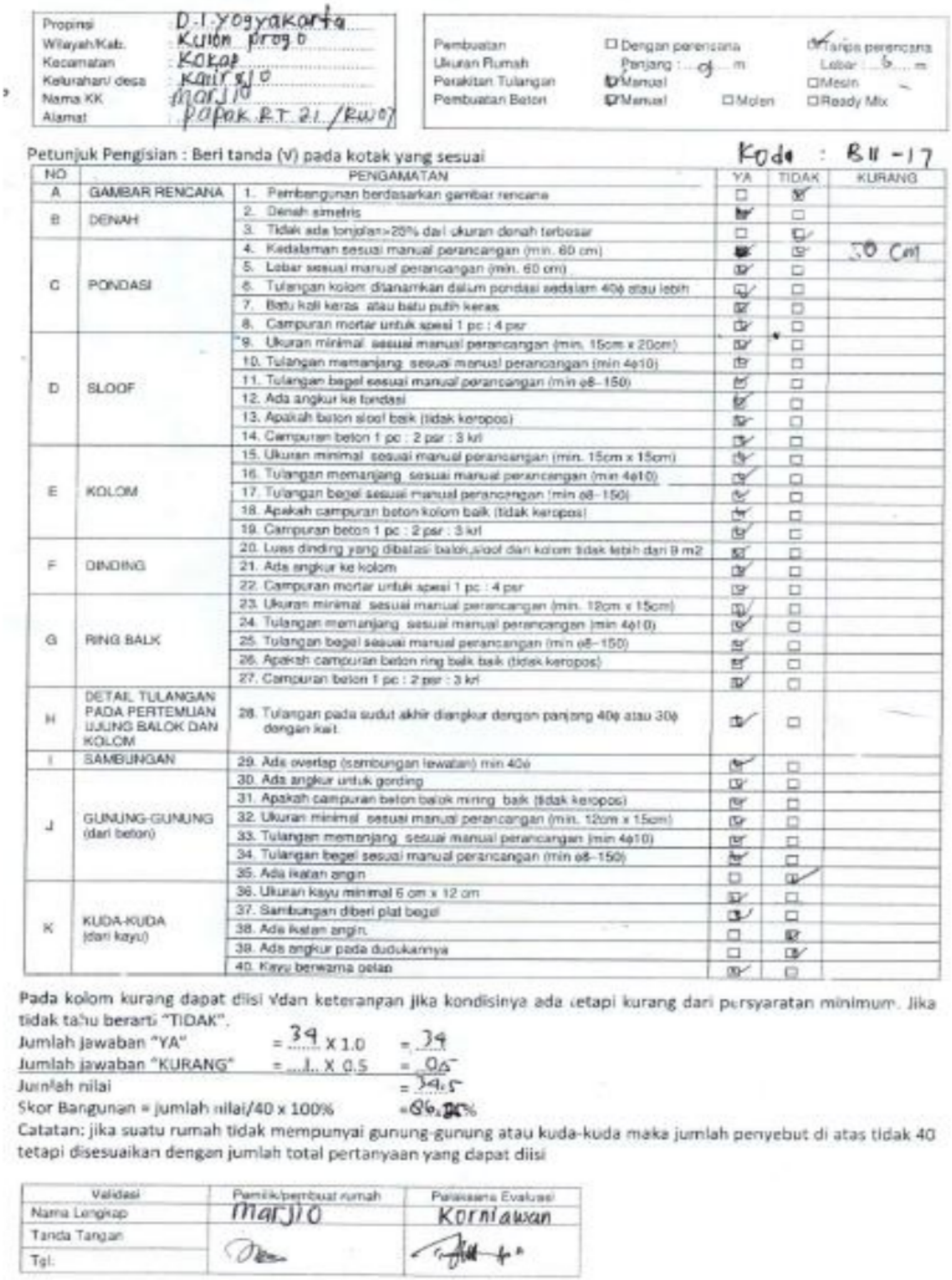
Zone	Condition Index	Condition Description	Handling Measures	Building Categorization
1	70-100	Well	Immediate action is still not needed	Secure
2	40-69	Intermediate	It is necessary to make an alternative economic analysis of improvements to determine the appropriate action	Unsafe
3	0-39	Bad	A detailed evaluation is needed to determine repair, rehabilitation and reconstruction actions, in addition to evaluating the safety	Not safe

Source: (Smith, 2019)

Table 2. Results of Kalirejo Regional Building Condition Analysis

Building Categorization	Index Conditions	Percentage (%)	The Color of the Building Category
Safe	70-100	54,17	Green
Unsafe	40-69	35,42	Yellow
Not Safe	0-39	10,42	Red

The results of the calculation of the building score (Table 2) obtained the value of the condition of the entire building that has been surveyed. In table 2 is a recapitulation of building score results (and the coordinates of his home field) from the evaluation of simple buildings in the four hamlets in the Kalirejo area. Building conditions are obtained by following the conditions index scale according to table 1 and giving color to each building category. Green color for safe building conditions with building conditions index value is 70-100%, yellow for unsafe building conditions with building condition index values 40-69%, and red for unsafe building conditions with building condition index values 0-39 %. Building classification in the form of color can be seen in figure 3.



Propinsi	D.I. Yogyakarta
Wilayah/Kab.	Kulon progo
Kecamatan	Kokap
Kelurahan/ desa	Kalirejo
Nama KK	Marjio
Alamat	Papak RT 21 /RW 07

Pembuatan	☐ Dengan perencana		☑ Tanpa perencana
Ukuran Rumah	Panjang : 9 m		Lebar : 6 m
Perakitan Tulangan	☑ Manual		☐ Mesin
Pembuatan Beton	☑ Manual	☐ Molen	☐ Ready Mix

Petunjuk Pengisian : Beri tanda (V) pada kotak yang sesuai

Kode : BII -17

NO		PENGAMATAN	YA	TIDAK	KURANG
A	GAMBAR RENCANA	1. Pembangunan berdasarkan gambar rencana	☐	☑	
B	DENAH	2. Denah simetris	☑	☐	
		3. Tidak ada tonjolan>25% dari ukuran denah terbesar	☐	☑	
C	PONDASI	4. Kedalaman sesuai manual perancangan (min. 60 cm)	☑	☑	30 Cm
		5. Lebar sesuai manual perancangan (min. 60 cm)	☑	☐	
		6. Tulangan kolom ditanamkan dalam pondasi sedalam 40ϕ atau lebih	☑	☐	
		7. Batu kali keras atau batu putih keras	☑	☐	
		8. Campuran mortar untuk spesi 1 pc : 4 psr	☑	☐	
D	SLOOF	9. Ukuran minimal sesuai manual perancangan (min. 15cm x 20cm)	☑	☐	
		10. Tulangan memanjang sesuai manual perancangan (min 4ϕ10)	☑	☐	
		11. Tulangan begel sesuai manual perancangan (min ϕ8–150)	☑	☐	
		12. Ada angkur ke fondasi	☑	☐	
		13. Apakah beton sloof baik (tidak keropos)	☑	☐	
		14. Campuran beton 1 pc : 2 psr : 3 krl	☑	☐	
E	KOLOM	15. Ukuran minimal sesuai manual perancangan (min. 15cm x 15cm)	☑	☐	
		16. Tulangan memanjang sesuai manual perancangan (min 4ϕ10)	☑	☐	
		17. Tulangan begel sesuai manual perancangan (min ϕ8–150)	☑	☐	
		18. Apakah campuran beton kolom baik (tidak keropos)	☑	☐	
		19. Campuran beton 1 pc : 2 psr : 3 krl	☑	☐	
F	DINDING	20. Luas dinding yang dibatasi balok,sloof dan kolom tidak lebih dari 9 m2	☑	☐	
		21. Ada angkur ke kolom	☑	☐	
		22. Campuran mortar untuk spesi 1 pc : 4 psr	☑	☐	
G	RING BALK	23. Ukuran minimal sesuai manual perancangan (min. 12cm x 15cm)	☑	☐	
		24. Tulangan memanjang sesuai manual perancangan (min 4ϕ10)	☑	☐	
		25. Tulangan begel sesuai manual perancangan (min ϕ8–150)	☑	☐	
		26. Apakah campuran beton ring balk baik (tidak keropos)	☑	☐	
		27. Campuran beton 1 pc : 2 psr : 3 krl	☑	☐	
H	DETAIL TULANGAN PADA PERTEMUAN UJUNG BALOK DAN KOLOM	28. Tulangan pada sudut akhir diangkur dengan panjang 40ϕ atau 30ϕ dengan kait	☑	☐	
I	SAMBUNGAN	29. Ada overlap (sambungan lewatan) min 40ϕ	☑	☐	
J	GUNUNG-GUNUNG (dari beton)	30. Ada angkur untuk gording	☑	☐	
		31. Apakah campuran beton balok miring baik (tidak keropos)	☑	☐	
		32. Ukuran minimal sesuai manual perancangan (min. 12cm x 15cm)	☑	☐	
		33. Tulangan memanjang sesuai manual perancangan (min 4ϕ10)	☑	☐	
		34. Tulangan begel sesuai manual perancangan (min ϕ8–150)	☑	☐	
		35. Ada ikatan angin	☐	☑	
K	KUDA-KUDA (dari kayu)	36. Ukuran kayu minimal 6 cm x 12 cm	☑	☐	
		37. Sambungan diberi plat begel	☑	☐	
		38. Ada ikatan angin.	☐	☑	
		39. Ada angkur pada dudukannya	☐	☑	
		40. Kayu berwarna gelap	☑	☐	

Pada kolom kurang dapat diisi V dan keterangan jika kondisinya ada tetapi kurang dari persyaratan minimum. Jika tidak tahu berarti "TIDAK".

Jumlah jawaban "YA" = 39 x 1.0 = 39

Jumlah jawaban "KURANG" = 1 x 0.5 = 0.5

Jumlah nilai = 39.5

Skor Bangunan = jumlah nilai/40 x 100% = 96.25%

Catatan: jika suatu rumah tidak mempunyai gunung-gunung atau kuda-kuda maka jumlah penyebut di atas tidak 40 tetapi disesuaikan dengan jumlah total pertanyaan yang dapat diisi

Validasi	Pemilik/pembuat rumah	Pelaksana Evaluasi
Nama Lengkap	Marjio	KornIawan
Tanda Tangan		
Tgl:		

Figure 2. Form of Simple Building Evaluation (typical Wall)

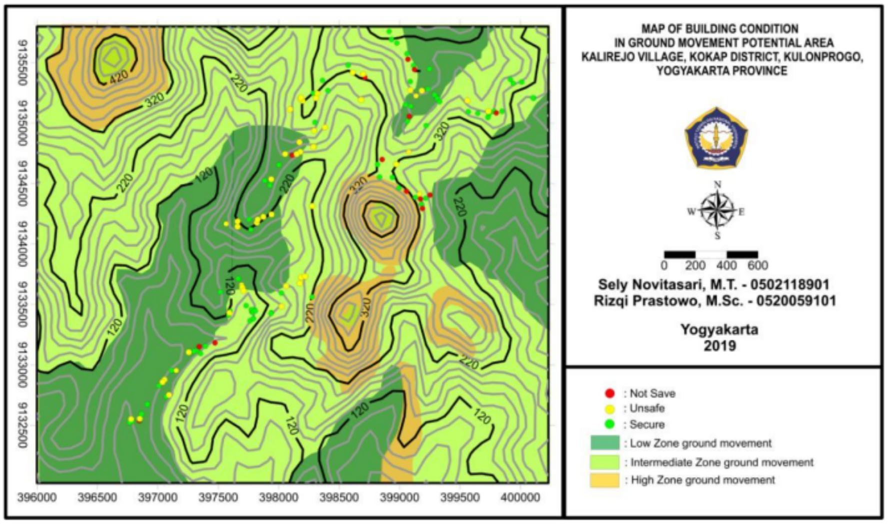


Figure 3. Map of Building Condition of Sample Site at Kokap District, Yogyakarta, Indonesia

Figure 4. Existing Building

CONCLUSION AND SUGGESTION

Based on the results of research, the percentage of building conditions and building condition categories obtained the percentage of safe buildings are 78 buildings or 54.17%, buildings in the less secure categories are 51 buildings or 35.42%, and buildings with unsafe categories are 15 buildings out of 144 surveyed buildings with a percentage of 10.42%. There are about 10.42% of buildings that have to be considered because of the insufficient building conditions, resilience, and in areas prone to landslides. It is recommended to make a map of the distribution of potential damage to buildings with a map of the potential for existing land fractures so that it can be input for local governments and communities to conduct pre-disaster mitigation.

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