Vol. 4 No. 3 (2023)

DOI: https://doi.org/10.28932/ice.v4i3

Published: 2023-08-31

Articles

Cover

Sertifikat Akreditasi Sinta

Menu

Online Submission

Editorial Teams

Peer Review

Focus and Scope

Author Guidelines

Publication Ethics

Editorial Team

Editorial Pollicy

Review Policy

Withdrawal of Manuscript

Plagiarism Policy

Contact Us

New Template

Article Template:

Indexers

PDF

List of Reviewers

Editorial Team

Stat Counter

Information

For Readers

For Authors

For Librarians

e-ISSN  p-ISSN 

View Stats

Creative Commons License

Journal of Innovation and Community Engagement (ICE) **e-ISSN: 2776-0421**
Vol. 04, No. 03, (August, 2023) **https://doi.org/10.28932/ice.v4i3.7297**

Implementation of Livable House Standards for Earthquake Resistance in Bandung Regency

Michael Sian Adrian Geoffrey Santoso*, Anang Kristianto
Faculty of Engineering, Universitas Kristen Maranatha, Bandung, 40164, Indonesia

*Correspondence should be addressed to Michael Sian Adrian Geoffrey Santoso;
2021020@eng.maranatha.edu

(Received August 15, 2023; Revised August 29, 2023; Accepted August 29, 2023)

Abstract

The BSPS (Bantuan Stimulan Perumahan Swadaya) program organized by the Directorate General of Housing of the Ministry of Public Works and Public Housing is a program implemented as a form of improving the quality of self-help housing. Although simple, building like this requires sufficient resistance to earthquakes. The results of the calculation of earthquake resistance that begins with loading the roof obtained a live load of 1.38 N, a super dead load of 0.75 N, and a dead load of 132102.5 N. Further testing on the calculation of ring beams results in ring beams being able to withstand a load of 1 .7191 kN with the help of the column interaction diagram states that the column is able to withstand a load of 252.6964 kN. The results of the ground spectrum response test show that Bandung district has a high earthquake risk and a class II risk period. Static power testing in the x and y directions is 270 kg and 260 kg. the level deviation on the x-axis is 0.0706500 mm and on the y-axis is 0.05575000 mm. This has proven the house to be resistant to earthquakes. Subsequent work can be in accordance with the standards given during the construction process. This building is resistant to earthquakes but the work requires more careful supervision.

***Keywords**: BSPS, earthquake, ground conditions, liveable houses, structures*

How to Cite:
Santoso, M. S. A. G., & Kristianto, A. (2023). Implementation of Livable House Standards for Earthquake Resistance in Bandung Regency. *Journal of Innovation and Community Engagement*, *4*(3), 192-207. https://doi.org/10.28932/ice.v4i3.7297

Introduction

MSIB or Internship and Certified Independent Study is a Ministry of Education, Culture, Research and Technology (Kemendikbudristek) program which is run through independent learning program in an independent campus program ("Program Merdeka Belajar - Kampus Merdeka" or MBKM, in Indonesian). This program aims to provide opportunities for students to be able to learn and develop themselves through activities outside class hours and can be converted into credits for their study programs. One of the subjects that can be converted is internship or practical work ("Kerja Praktek" or KP, in Indonesian) in various workplaces. internship or practical work activity is carried out with the help of guidance from the lecturer. It aims to provide experience to students about the world of work.

Internship or practical work is a compulsory subject for every student of the Faculty of Engineering and is a requirement for obtaining a Bachelor's Degree (S1). This internship or practical work can help students to be able to apply the material they have received in lectures. Students can choose to take part in internships or practical work in various available places provided by the Merdeka Campuses through the MSIB program.

One of the places provided is the Ministry of Public Works and Public Housing (PUPR). PUPR is part of the Ministry of the Republic of Indonesia which focuses on the development of the country. This is in accordance with the bill from Director General of Housing Number 14 Year 2022 regarding technical instructions for implementing the self-help home construction assistance program. Bantuan Stimulan Perumahan Swadaya (BSPS) is a program to improve the quality of self-help housing environments in the regions. The current quality of the housing environment shows an uninhabitable category because it does not pay attention to comfort, health and safety factors (Widiawati, 2022). This program aims to boost the community so that they can improve the quality of livable houses. This program is aimed at low-income communities by providing financial support from the government and assisted by self-help from beneficiaries. The program exists because the government wants to increase the percentage of people who can live in livable houses. This program focuses on houses that do not yet have adequate structural integrity.

In the housing development process there are several structural components. These components start with the foundation, sloof, column, ring beam, and roof truss. The development process

required the installation of components that are good and intertwined. The purpose of the bonded components is for the house to have maximum rigidity and strength.

Indonesia is located in-between 3 tectonic plates: the Indo-Australian Plate, the Eurasian Plate, and the Pacific Plate. This is what causes Indonesia to be an area prone to earthquakes. Indonesia is a country that has many cities and districts, one of which is Bandung Regency. For an earthquake-prone country, it is necessary to build houses that are earthquake-resistant. The PUPR program sets standards in the process of building livable houses. With the standards made, the house must be resistant to earthquakes.

Methods

Before carrying out this certified internship, each of the students who are members of Java Hall II is given a briefing on several criteria for running the BSPS program in Bandung district. During the debriefing, all apprentice students are required to attend Java Hall II, as shown in Figure 1.

Fig. 1. BSPS debriefing for students

Based on the technical guidelines from the bill Number 3 Year 2021, Ministry of Public Works and Public Housing, self-help housing development activities need the following assessment criteria. The goal is to build a house livable. Government states that for a livable house there are several requirements (Direktorat Jenderal Perumahan Kementerian Pekerjaan Umum dan

Perumahan Rakyat, 2021), including: home resilience, sanitation building area, and drinking water, when examined more deeply then:

1. Building resistance

   A healthy house is a house that has a complete structure starting from the foundation, sloof, columns, ring beams, and roof truss. The materials used are SNI quality materials. In the process of making the structure there are several rules as follows:

   a. Foundation

      The foundation used is the palm foundation or commonly called “chicken feet”. This foundation uses iron measuring 8 with a size of 0,4 m x 0,4 m and after being cast the size becomes 0,6 m x 0,6 m. This foundation must have detailed ties or can be called anchors with columns and with ring beams in order to ensure that the building has a good quality house, and there are layers of sand, bare stones, split stones.

   b. Sloof

      The sloof is a structure after the foundation has a size of 0.15 m x 0,2 m and with a 40D connection for sloof reinforcement measuring 0.01 m iron and 0,0008 mm stirrup reinforcement and the distance between the stirrups is 0,15 m, and in the sloof casting process it must have a fluffier mixture.

   c. Column

      Column is one part of the structure that is no less important. The column has a size of 0,15 m x 0,15 m with a height of 3 m and with a 40D connection. For reinforcement, a main reinforcement measuring 10 mm with a stirrup size of 0,008 mm and a distance between stirrups of 15 cm is required, and the mortar must be fluffier.

   d. Beam rings

      Ring beams are structural components that are above the brick where ring beams have a size requirement of 0,12 m x 0,15 m requiring a 40D connection and for the main reinforcement use 10 mm iron and stirrups measuring 8 mm and a stirrup spacing of 0,15 m.

   e. Roof truss

      The roof truss must have roof trusses and have wind ties as well as ampig and roof covering.

2. Building area

   The building area is calculated such as each occupant of the house must have 7.2 m^2. If in a house there are 5 people then the calculation is as follows, 5 x 7.2 m^2 = 36 m^2 required.

3. Sanitation access

   The house must have access to sanitation such as a toilet with a goose neck and the SPAL or septic tank which is vacuumed every 5 years.

4. Drinking water

   Drinking water must be tasteless, odorless and colorless and available at least 12 hours a day with a maximum range of 30 minutes and when checked, the water does not contain microorganisms and heavy metals.

In carrying out this program students worked according to the assignments given by the MBKM website page. The task was to accompany the field facilitator team. The place for participants to carry out the program was the PUPR. There the participants run a program created by PUPR, that is the BSPS program.

Fig. 2. Coordinate with the village administration to shop building surveys

In carrying out the BSPS program there are several stages as shown in figure 2. Figure A is coordinating with the village and related parties in the implementation of the BSPS. Coordination is an activity where the team of field facilitators together with students provide files containing data from each beneficiary with the aim that the village knows there were residents who receive assistance in the village. In figure 2(B), shown an activity of verification and identification of beneficiaries. This verification was carried out with the aim of ensuring that the beneficiary meets the requirements in receiving assistance such as land ownership certificates, completeness of population data, and data proving that the resident only has 1

house. As shown in figure 2(C), an activity aimed to provide direction to beneficiaries in the form of material presentation. Recipients of assistance must understand the building materials used and must understand at least the building and the terms or criteria given by the BSPS. Figure 2(D) shows a survey that was conducted to ensure that a certain supplier can be responsible for running this program where in this implementation it could supply biolding materials without capital constraints. If it is in accordance with the conditions given, a contract with the supplier store would be entered into or it can be called an MOU. This letter of cooperation serves as a benchmark or guideline for the shop in the process of disbursing the housing funds.

Fig. 3. Identifying damage to the house to control the construction of the house

Figure 3(A) shows the identification of a house, this identification intends to group or to survey a beneficiary's house onsite whether it already has a complete house structure or an incomplete one that needs to be repaired, and also to determine the selection of building materials those need to be purchased. In the next activity, filling out form by beneficiaries, assisted by the team. Completion of the form by beneficiaries so they can receive the full amount of funds provided by the government. The beneficiary needs to open a certain bank account for the purpose of channeling aid funds, as is shown in Figure 3(B). Each beneficiary has the right to receive 20 million rupiah (Direktorat Jenderal Perumahan Kementrian Pekerjaan Umum dan Perumahan Rakyat, 2018).

Figure 3(C) shows the preparation of the proposal, which is carried out with the intention of collecting data as one of the purposes of submitting a statement that the beneficiary is eligible to receive the self-help housing program. Figure 3(D) shows the activity of supervision of the house construction process. The purpose of this activity is to make sure the quality of the house meets the target. In carrying out this monitoring process, there were many obstacles that occurred, such as the *sengkang* distance ("jarak sengkang" in Indonesian) that exceeded the standard. Accuracy and good communication are needed in carrying out house construction supervision.

Fig. 4. Preparation of budget funds

When the program has been completed, a detailed budget is prepared. The funds that paid out are in accordance with the funds provided without any difference, as shown in figure 4.

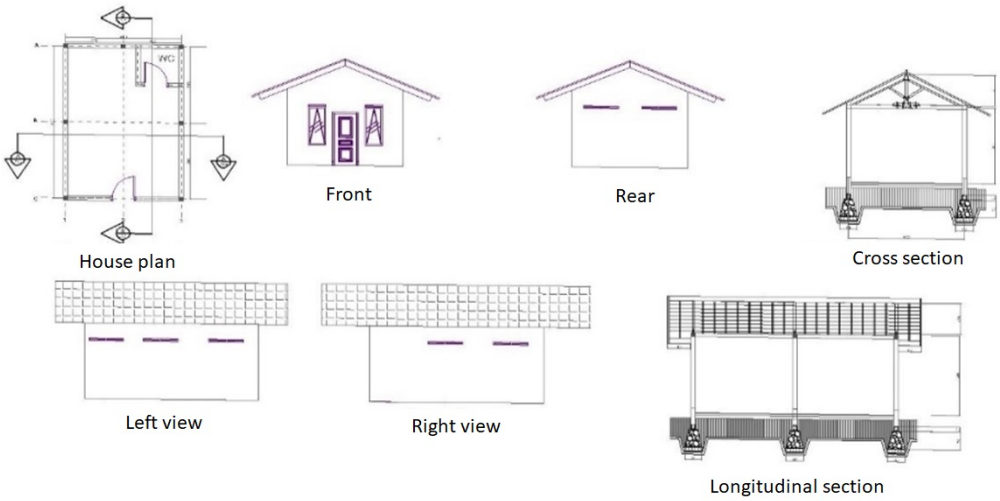

Fig. 5. House models

In figure 5 there is a model plan of the house to be built where this model has a house height of 3 meters with an area of 24 m^2. The 24m^2 type uses a size of 6m x 4m (Rectorate General of Housing and the Ministry of Public Works and Public Housing, 2022) with a floor plan size of 6m x 4m and in the process of building a house the focus is on livable houses. Where the structure consists of foundations, columns, ring beams, roof. Not only focusing on structure but also focusing on access to sanitation. And for ventilation using 2 windows and for the foundation used is a foundation with river stones.

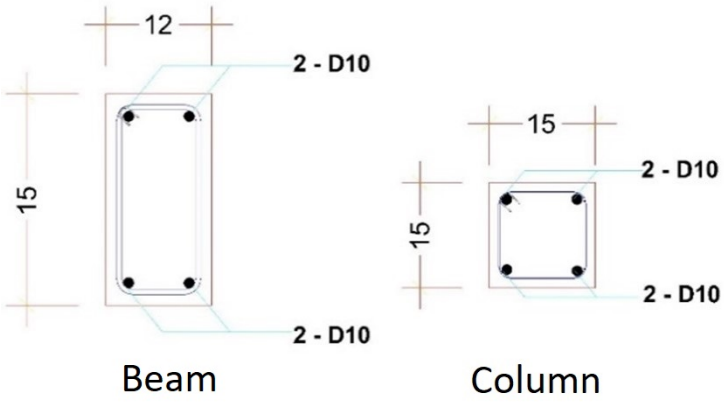

Fig. 6. Sections of columns and beams

Shown in figure 6, the beam size is 120 mm x 150 mm and the column dimensions are 150 mm x 150 mm and the sloof size is 150 mm x 200 mm, using 10 mm iron for the main reinforcement and using 80 mm for the rest of reinforcement, and with a distance of 15 cm between the stirrups. Stiffeners are bent by 135°, and using class II type of wood (Fc 20.75 MPa and Fy 280Mpa).

Fig. 7. House in development process

Figure 7 shows a photo of a house that has only reached 30% progress because it has not yet reached the ring beams and is still in the process of building the walls of the house. This construction is an example of a house with a type of 24 m^2.

By calculating the load calculation on SNI 8900:2020, SNI 2847:2019, and SNI 1726:2019 with gravity value of 9.81 kg/m^2, the added load for the tile load is 19kg/m^2. The curtain load is 12.288 kg/m so that after the calculation results, the load for 0.5 tributary is 741.383 N for the LL load and 327.488 for the SDL load. And for 1 area load the LL load is 1482.765 N and the SDL load is 474.220 N.

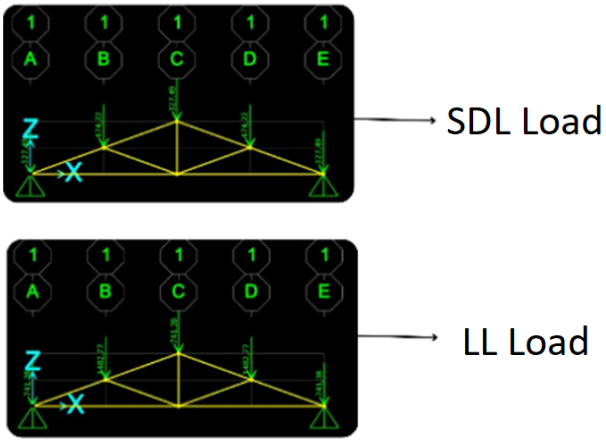

Fig. 8. SDL and LL loading inputs

From the results of the loading data entered as shown in figure 8, the results of centralized loading have been carried out according to the standards. The load results obtained are LL = 1.38 N, SDL = 0.75 N, and DL = 132,102.5 N.

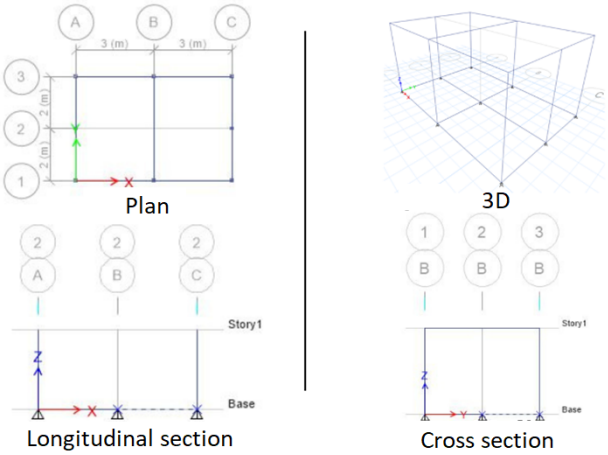

Fig. 9. ETABS design

In the ETABS modeling in Figure 9, there are several stages such as calculating the period, spectrum response, static force analysis, and story drift analysis which were then implemented to the field results.

Results and Discussions

Gravity and earthquake loading have been carried out according to SNI 8900:2020, SNI 2847:2019, and SNI 1726:2019 standards. The load results obtained are LL = 1.38 N, SDL = 0.75 N, and DL = 132102.5 N. From the results obtained, followed by earthquake analysis and the data used areshown in figure 10.

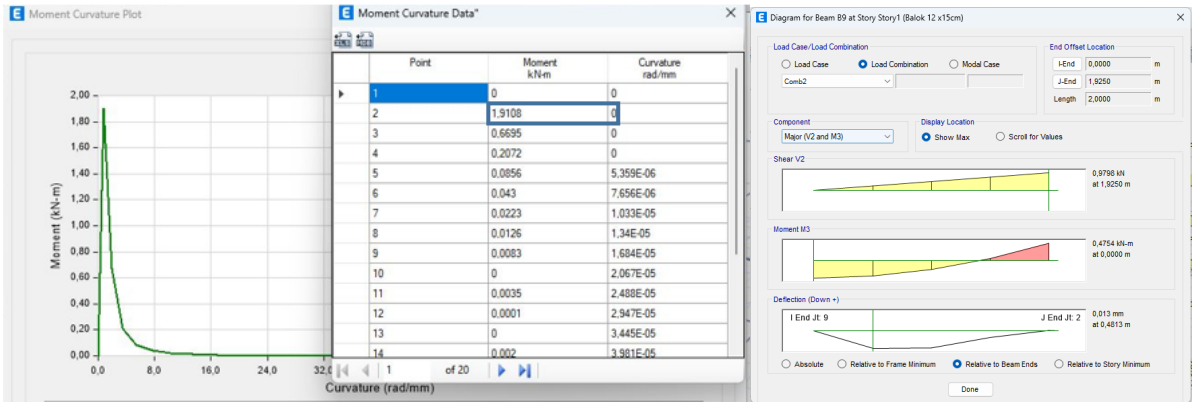

Fig. 10. Ultimate beam interaction and moment diagram

The following is the nominal moment of the beam which is equal to 1.9108 kNm and in the calculation process where the nominal moment is multiplied by 0.9 the result is 1.7197 kNm while the ultimate moment diagram data obtained from the beam is 0.4754 and it can be concluded that the beam proved strong.

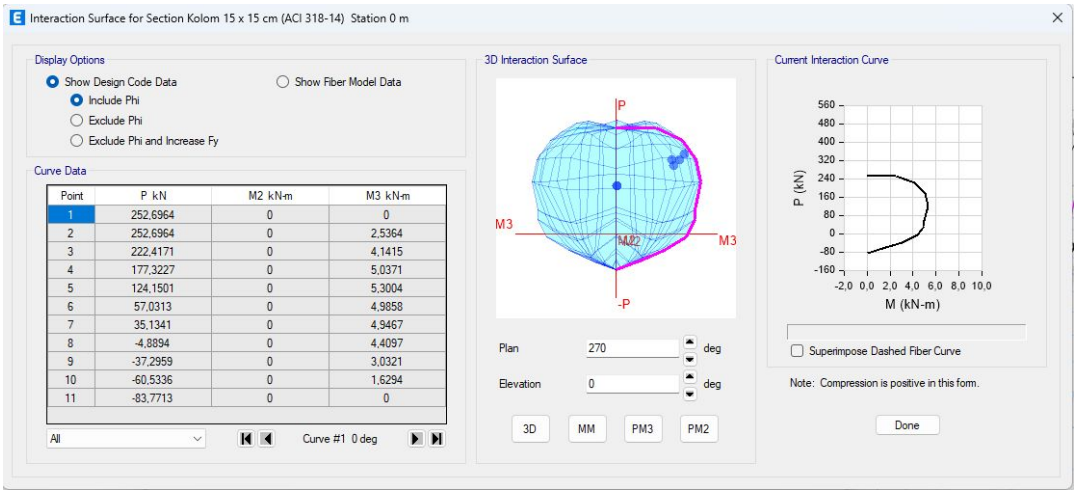

Fig. 11. Column interaction chart

In Figure 11 there is a column interaction diagram shows the result that determines the axial load and bending moment which can be sustained by a column with dimensions of 15 cm x 15 cm as evidenced by the blue dots in the interaction diagram area.

The period is the time required for a vibrating building to return to its initial position. The vibration period is the result of calculating the mass and stiffness of the structural design of a building. In the earthquake calculation, the period is obtained as in Table 1.

Table 1. Earthquake period

Case	Mode	Period (sec)
Capital	1	0.065
Capital	2	0.058
Capital	3	0.052

The period value obtained is 0.065 sec at the first time and that was the biggest period. Next is to look for the spectrum response using geometric modeling using coordinate points (Kangda, 2015). Then, according to RSA 2021, Ss and S_1 were obtained at 1.071571 and 0.480937 and categorized into class D land with Category II.

From the data taken class II data Ie, valued 1 and from the results obtained in SNI 1726-2019 table 6, the SF value is 1.1. From some of the collected data it is possible to calculate the Sms data that is 1.1787, Sds 0.7858, Sm1 0.9138, and Sd1 0.6092. From the above calculations it can be concluded that according SNI 1726-2019 it is belong to class D, as so to determine the parameter system structure. From the table 1 above it is found that the seismic coefficient on the Soreang soil is as shown in figure 12.

The soil spectrum response diagram is intended to ensure structural detail that meets the requirements according to the estimated earthquake intensity. KDS is related to the earthquake hazard level, soil type, and the use and function of the building (Rendra, 2015). The strength of the earthquake is affected by the type of soil. Rapid ground movement due to ground vibrations will cause greater deformation in buildings, especially in cases of soft soil (Tanija, 2019).

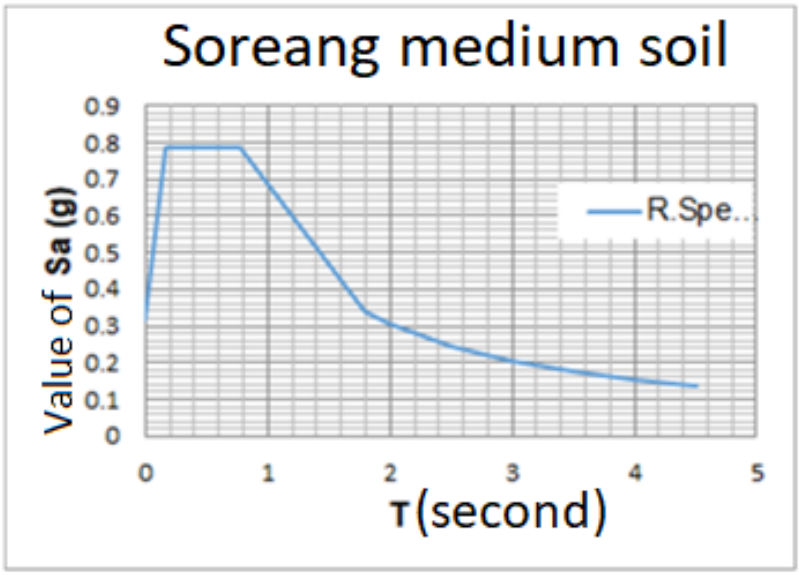

Fig. 12. Soil spectrum response diagram

In the calculation there is a base shear force caused by the dynamic load spectrum response in the x and y directions. Both directions must meet the latest standards in SNI 1726: 2019 where the minimum requirement is 100% equivalent static level shear force.

Table 2. Static style

Parameter	X direction	Y direction
Wt (Kg)	15,974.2116	15,974.212
Vs (Kgs)	426.5319309	426.53193
Vd (Kg)	270.00	260.00
Scale Factor	1.579747892	1.6405074
Scaled Factor Vd (Kg)	420	420

Judging from Table 2, the data shows that the static forces on the x-axis and y-axis have fulfilled the requirements so that there is no need to increase the dynamic shear force with a scale factor of up to 100% of the equivalent level shear force. This is obtained where the scaled factor Vd is smaller than the static shear force.

Deviation between floors or bias is called story drift which must be calculated based on the difference in deflection at the center of mass. To fulfill story drift, it is intended to guarantee that the structure is not too flexible, thus the comfort factor and protection for non-structural elements are still protected. and the deviation between floors can be seen in Table 3 and Table 4.

Table 3. Story drift X

Story	STORY1
Story Height (mm)	3000
Load	SPECX
Total Drift Center of Mass Displacement (mm)	0.0282600
Total Drift(mm)	0.028260
Story Drift Δx (mm)	0.0706500
Story Drift Permit, Δa (mm)	60
Story Drift Permit 2, Δa (mm)	78

In Table 3 it is found that the floor deviation is smaller than the allowable deviation, this proves that the mass deflection is safe. On the x-axis, the floor deviation is obtained by 0.0706500 mm and with a clearance of 60 mm. the deviation between floors has a small value because this house only has one floor with a height of 3 m.

Table 4. Story drift Y

Story	STORY1
Story Height (mm)	3000
Load	SPECIES
Total Drift Center of Mass Displacement (mm)	0.0223000
Total Drift(mm)	0.0223000
Story Drift Δx (mm)	0.05575000
Story Drift Permit, Δa (mm)	60
Story Drift Permit 2, Δa (mm)	78

In Table 4 it is found that the floor deviation is smaller than the allowable deviation, this proves that the mass deflection is safe. On the y axis, the floor deviation is obtained by 0.05575000 mm and with a clearance of 60 mm. the deviation between floors has a small value because this house only has one floor with a height of 3 m.

In the development process there are several things that are different from the principles used and these things need to be resolved so that the building has a building quality that is in accordance with the standards that have been given. Following in figure 13 there is an example something that needs to be fixed.

Fig. 13. Sloof is not tied to the foundation

Basically, in the process of planning an earthquake-resistant house, it is not only the geographical factor that determines it, but the building system that is made and designed in detail must comply with the conditions that have been set (Fadilah, 2020).

In the construction process there were still many obstacles such as during installation and this can lead to a decrease in the quality of the house so that the results of the calculations can be different from what is happening in the field.

Conclusion

From the results it was found that houses with livable standards have the quality of houses that are earthquake resistant. Based on the data obtained, it states that ring beams with a size of 0.12 m x 0.15 m, columns with a size of 0.15 m x 0.15 m, and the ground spectrum response in Bandung district have medium soil which means the area is prone to earthquakes. Good columns and beams will provide better house resistance expressed in value Vd (dynamic power) both on the x-axis and y-axis meet the standards. The story drift results on the x-axis and y-axis represent values Δx smaller than Δa which means the small floor shear force, so it can be categorized as meeting the standard.

This paper aims to convey to the people of Bandung Regency regarding livable and earthquake-resistant houses in accordance with the standards provided such as building resilience, building area, access to sanitation, and drinking water. It aims to improve the quality of houses in Bandung district.

Acknowledgements

This activity and journal article would not have been possible without the presence of several parties who assisted in the process of making and implementing it. It is hoped that this journal will be able to help prospective apprentices in the MSIB program or other parties who need this journal as insight, guidance, and knowledge. With this opportunity the author would like to thank (1) the Indonesian Ministry of Education, Culture, Research and Technology for holding a Certified Independent Study program batch 4 independent campus, (2) Directorate General of Housing Ministry of Public Works java hall II, (3) Maranatha Christian University who have supported the author.

References

Badan Standarisasi Nasional. (2019). Tata cara perencanaan ketahanan gempa untuk struktur bangunan gedung dan nongedung (ICS 91.120.25; 91.080.01) SNI 1726:2019. Jakarta

Badan Standarisasi Nasional. (2019). Persyaratan Beton Struktural untuk bangunan Gedung dan Penjelasan (ACI 318M-14 dan ACI 318RM-14, MOD) SNI 2847:2019. Jakarta

Badan Standarisasi Nasional. (2020). Panduan desain sederhana untuk bangunan beton bertulang (ACI 314R-16, MOD) SNI 8900:2020. Jakarta

Direktorat Jenderal Perumahan Kementerian Pekerjaan Umum dan Perumahan Rakyat. (2018). Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 07/PRT/M/2018 tentang Bantuan Stimulan Perumahan Swadaya (Berita Negara Republik Indonesia Tahun 2018 Nomor 403). Jakarta

Direktorat Jenderal Perumahan Kementrian Pekerjaan Umum dan Perumahan Rakyat. (2021). Surat Edaran Nomor 3/SE/Dr./2021 Tentang Petunjuk Teknis Penyelenggaraan Kegiatan Bantuan Stimulan Perumahan Swadaya

Direktorat Jenderal Perumahan Kementrian Pekerjaan Umum dan Perumahan Rakyat. (2022). Surat Edaran Nomor 14/SE/Dr./2022 Tentang Petunjuk Teknis Penyelenggaraan Kegiatan Bantuan Stimulan Perumahan Swadaya

Fadilah, M.R. (2020). Metode analisis perhitungan struktur bangunan tahan gempa (Studi Kasus Gedung E, F Universitas Muhammadiyah Sukabumi). *Jurnal Student Teknik Sipil*, *2*(3), 176-182.

Kangda, M. Z. (2015). Study of base shear and storey drift by dynamic analysis, *International Journal of Engineering and Innovative Technology (IJEIT)*, *4*(8), 92-101.

Rendra, R. (2015). Kinerja Struktur Akibat Beban Gempa Dengan Metode Respon Spektrum Dan Time History (Studi Kasus: Hotel Ska Pekanbaru). *JOM FTEKNIK*, *2*(2), 1-15.

Tanijaya, J. (2019). Strength Evaluation of Reinforced Concrete Structure for Regular Building due to Earthquake Load Based on Different Soil Types. *Journal of the civil engineering forum*, *5*(2), 123-129.

Widiawati, K. (2022). Indikator rumah tidak layak huni dalam perencanaan pembangunan daerah di Provinsi Jawa Tengah. *Widya Praja*, *2*(1), 19-25.