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Static Simulation of Speed Bump Structure Alloy Concrete Foam And Polymeric Foam With 1, 2 And 3 Inch Cavity Variations Using Ansys 14.5 Software

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ABSTRACT

Speed bump (vehicle speed limiter) is elevated sections of road in the form of additional asphalt or cement that are strung across the street for a sign of slow down. Functions that enhance safety for users jalan.Material to manufacture high speed bumprelatif this cause expensive production costs and the impact on the selling price and therefore new dilakukanPenelitian of natural fiber from oil palm empty fruit bunches (EFB). Abundant raw materials due to oil palm empty fruit bunches (EFB) often become waste is estimated to be quite economical and developed into an environmentally friendly alternative material. The purpose of this study is to simulate the static loading on the speed bump of foam concrete materials and fiber reinforced polymeric foam EFB using Ansys 14.5 software. in this study specimens to be tested 10 models and simulated static on the upper side to determine the stress distribution at the speed bump. Speed bump modeled using SolidWorks software in 2012 and was simulated using ANSYS software compared to 14.5 for voltage distribution. In this study, found that of the static simulation results at top speed bump we concluded that the total minimum voltage deformation occurs in the model bump with casing of 0.94628mm speed and maximum voltage contained in the model of speed bump of 3 inches of concrete 1,2343mm, Equivalent Elastic Strain the minimum speed bump 1 contained in the model of 0.013427 inches, and Equivalent Elastic maximum strain contained in the model of speed bump with a casing of 0.023304, while the minimum Maximum Principal Stress contained in model 3 inches of concrete speed bump for 0.002801Mpa, and Maximum Principal Stress maximum contained in the model speed bump with a casing of 0.016959MPa.

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1. INTRODUCTION

Vehicle Speed Limiter (Speed Bump) is a part of the road that is elevated in the form of additional asphalt or cement that is installed across the road to indicate slowing down the speed/speed of the vehicle (Sipahutar et al., 2016). To improve safety and health for road users the height is regulated(Sipahutar et al., 2016)and if passing through a road that will be equipped with signs with advance notice regarding the presence of a speed limiter (Speed Bump) (Agustien et al., 2020) especially at night, the Speed Bump is equipped with a road marking with a contrasting white or yellow oblique line as a sign (Sipahutar et al., 2016). This speed bump was first coined by a physicist named Arthur Holly Campton (Choiriyah, 2021). At that time, he was disturbed by the fast speed of vehicles passing in front of his office which was so noisy (Oktaria, 2019). Then came the idea to create a concept of limiting the speed of the vehicle in 1927 (Nasional, n.d.), which until now is often called the speed bump. The size of the speed bump has been regulated in the Decree of the Minister of Transportation Number KM 3 of 1994 concerning Road User Control and Safety Devices (Putra, 2021). There it is stated that the maximum height of the vehicle speed limiter is 12 cm and the angle of inclination is 15 percent (13.50) (Wibawa & Widiastuti, 2020). The speed bump must also be given an oblique line with white paint so that it is clearly visible to motorists who want to pass (Rosafira, 2017). Speed bumps will be useful if they are placed and designed according to the rules, for example on residential roads (Chandra, 2020), local roads that have road class IIIC, and the third is on roads that are under construction work (Faat & Mawar, 2019). then for the rule the maximum height should not be more than 15 cm, also the slope is 15% (Rosafira, 2017). If made in accordance with the above conditions it will be useful. Speed bumps that are not up to standard not only damage the vehicle, but also endanger the driver (Faat, n.d.). Inappropriate height and angle of inclination result in excessive vehicle shock and shock loads (Wahyudi, 2012).

The general objectives of this research are: The general objective of this research is to analyze the speed bump structure of concrete foam material reinforced with oil palm empty fruit bunches and polymeric foam. static data from three speed bump models with ANSYS 4.5 simulation. (2) Comparing the distribution of the three speed bump structural models of concrete foam material reinforced with oil palm empty fruit bunches and polymeric foam with ANSYS 14.5 simulation.

Research Benefits, The benefits of this research are: (a) For researchers it can increase knowledge, insight and experience about composite materials. as a reference (b) For academics, this research can be used in addition to research on OPEFB fiber composites

2. RESEARCH METHOD

2.1 Research Methods

The method used in this research is a simulation research method, the data obtained using ansys 14.5 . software (Noviati, 2022). Static Compression Test Simulation Using Ansys 14.5 (Islahuddin, 2021). Static Compression Test Simulation in this research method using Ansys 14.5 . software (Rizal, 2018). Ansys workbench is a finite element method-based software used to analyze engineering problems (Situmorang & Tarigan, 2018). The ansys workbench simulation step is carried out in 3 working process groups, namely Preprocessing, Solution, Post Processing (Abda, 2016). For an explanation of the steps for the ansys simulation, it will be explained as follows: (1) Ansys workbench 14.5 (Prahendra, 2015). To start ansys can go through two steps, namely from the shortcut icon on the desktop or via Start → all Programs → Ansys 14.5 → workbench 14.5. (2) After workbench 14.5 is displayed on the left side, a toolbox appears and selects static structural in the analysis system shown in Figure 3.11. (3) Then in the project schematic, a static structural project will appear, shown in Figure 3.12 (Sageroki, 2015) (4) In the static structural project, there are process steps that must be completed gradually and sequentially, the first stage which must be completed in data engineering (Harlina, 2022). (5) Engineering Data. In this study, new materials were used, namely concrete foam and polymeric foam with TKKS fiber (Siahaan & Darianto, 2020) which has not been registered on the ansys workbench so we need to enter the material data into the engineering data (Husen et al., 2021). (6) Geometry, the geometry menu functions as a place for making models that are simulated on ansys, you can directly create the model you want (Muliawana, 2017) will be simulated directly on the software will ansys and can also import 3D models that will be simulated directly that have been made with other software such as autocad, solidworks (Nurhadi et al., 2017), catia etc. (7) Model, In the model menu, Speed Bump simulation is carried out which will be examined by double clicking on the model, the static structural menu appears, in the outline beside there is a description of the steps that must be completed sequentially.

2.2 Research Flowchart

The process flow diagram in speed bump simulation research using ansys 14.5 software is shown in Figure 3.24.

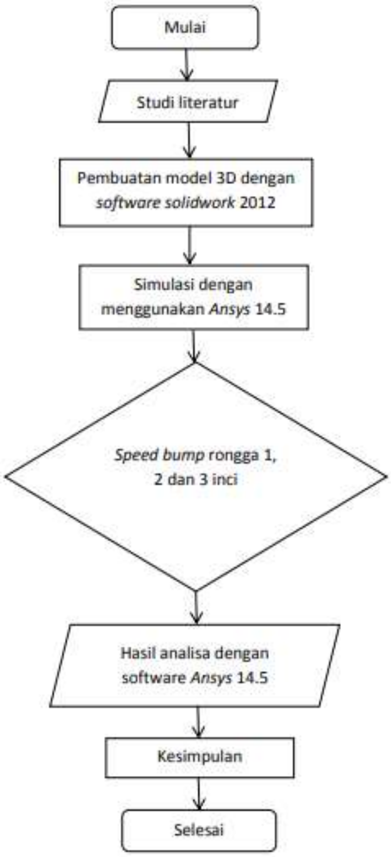


Figure 1. Research Flowchart

3. RESULTS AND DISCUSSIONS

3.1. Results of Making Speed BMP

Starting with the making of the Speed Bump model using Solidworks 2012 software which is used as the object of research, it has dimensions of 400 mm in length, 200 mm in width, and 150 mm in height, while the mass of the speed bump ranges from 900 to 1,000 gr. The speed bump model is shown in Figure 4.1.

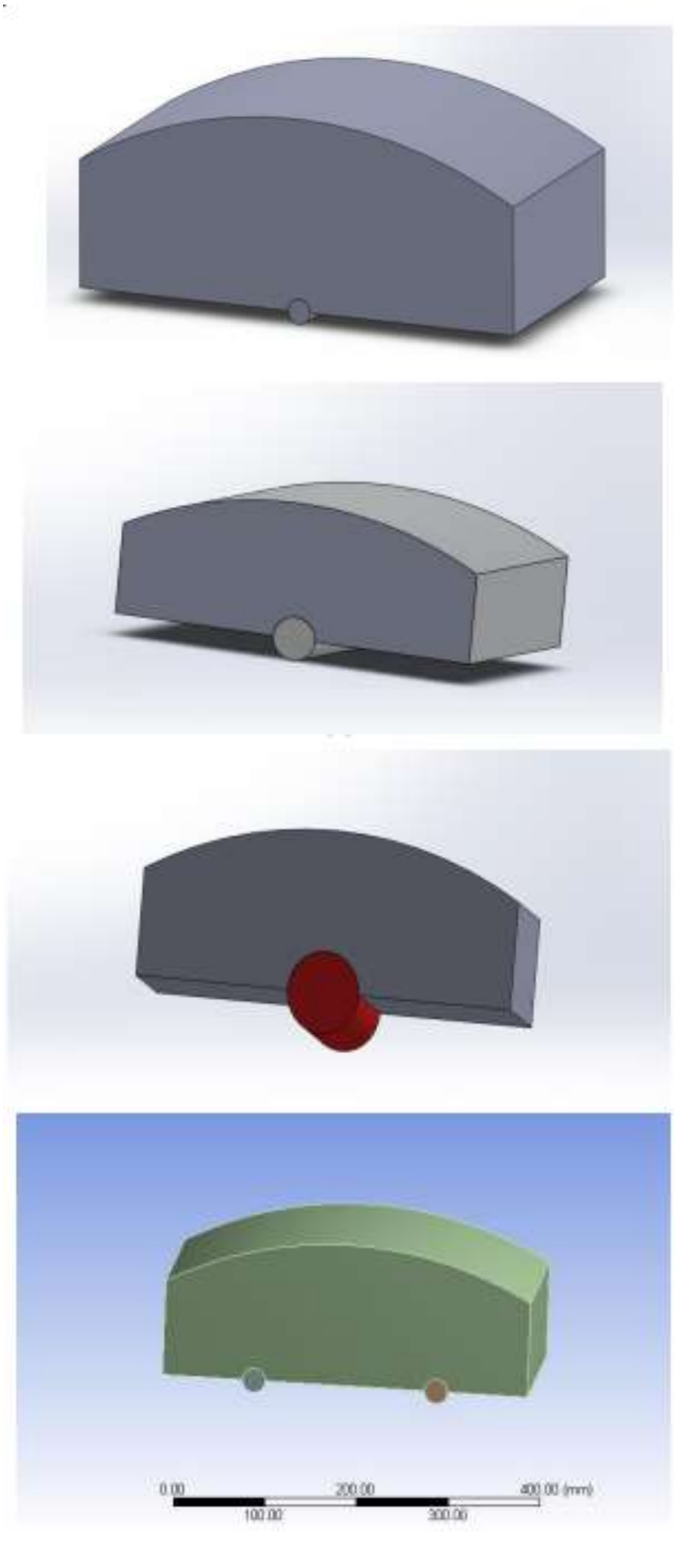


Figure 2. Speed bump models (a) Speed Bump with 1 inch bay, (b) Speed Bump 2 inch bay, (c) Speed 3 inch cavity bump, (d) Speed Bump with 2 1 inch diameter polymeric,

3.2. Tensile Test Results

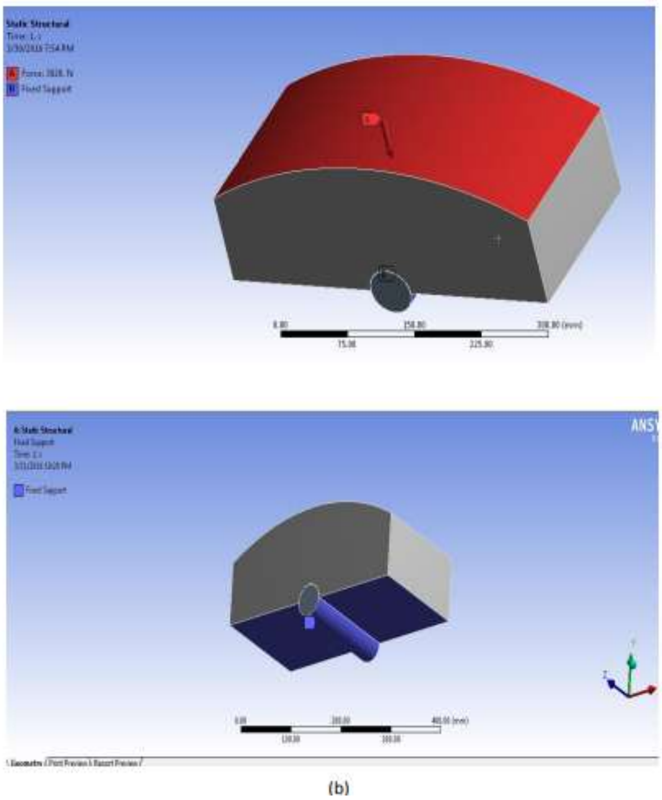
The simulation method that will be carried out in this study is the loading on the static pressure test which is given at one point, namely the top of the speed bump, because that part is the part that has a high probability of experiencing pressure from vehicle tires (cars). Speed bump simulation data with 1 inch cavities will be compared with speed bump simulation data with 2 and 3 inch cavities.

3.3. Static Simulation Using ANSYS 14.5 Workbench

In this study, ansys 14.5 software was used to analyze the speed bump structure of concrete foam and polymeric foam reinforced EFB powder due to static loads. This simulation aims to determine the amount of voltage received by the speed bump. Furthermore, the simulation results of the speed bump with a 1 inch cavity are compared with the simulation results of the speed bump with a 2 and 3 inch cavity, to determine which one is better between the two speed bump models. This simulation requires data that has been taken from experimental testing while the data needed include: (1) Concrete Foam Data [8]. a. Density : 704.175 kg/m3. b. Density : 704.175 . c. Young's modulus: 5,811 MPa. d. Poisson ratio : 0.20. 2. Polymeric Foam Data [9]. a. Density: 1096 kg/m3. b. Density : 1096. c. Young's modulus : 288.87 MPa. d. Poisson ratio: 0.403.

3.4. Loading Simulation on the Upper Side of the Speed Bump

Research conducted on the loading of the upper side of the speed bump of 400 Kg or 3.920 N, as shown in Figure 4.2.



(b)

Figure 3. (A).Loading From the Top of Speed Bump, (B).Fixed Support

3.5. Speed Bump Simulation Results

In speed bump simulation with experimental data, the following voltages are obtained:

3.5.1 Total Deformation Simulation Results

a. Distribution of the total 1 inch polymeric deformation The distribution of the 1 inch total polymeric deformation is shown in Figure 4.3.

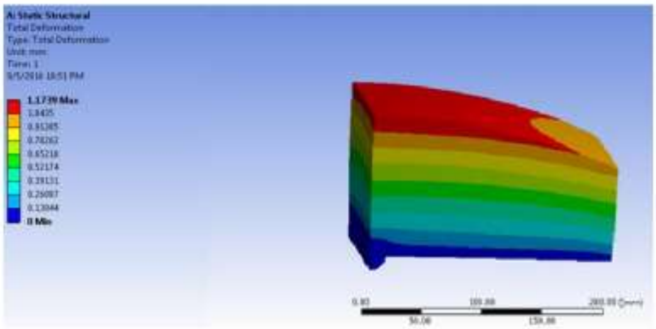


Figure 4. The distribution of the total polymeric deformation of 1 inch In Figure 4.3 the results of the static simulation on the upper side can be seen the distribution of the maximum total deformation of 1.1739 mm

b. The distribution of the total 2 inch polymeric deformation The distribution of the total 2-inch polymeric deformation is shown in Figure 4.4.

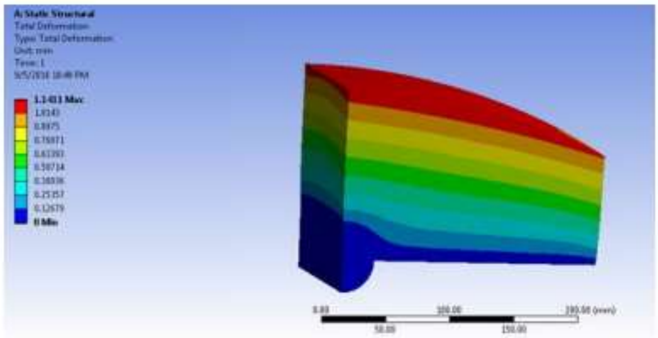


Figure 5. 2 Inch Polymeric Deformation Total Distribution Results

In Figure 4.4 the results of the static simulation on the upper side can be seen the distribution of the total maximum deformation of 1.1411 mm.

3.6. Data Collection and Comparison of Testing Simulation Results

From the simulation results of ansys workbench 14.5 due to the static load above, it can be seen which comparison is better among the three speed bump models, which can be seen in table 4.1.

Table 1. Speed Bump Numerical Simulation Results

Speed Bump	Pengujian		
	deformation	*Strain*	*Stress*
1 inci	1.1739	0.013427	0.29418
2 inci	1.1411	0.015239	0.24339
3 inci	1.1235	0.015148	0.30274
2 *polymeric* diameter 1 inci	1.1728	0.01545	0.23305
2 *polymeric* diameter 2 inci	1.1383	0.014756	0.29273
2 *polymeric* diameter 3 inci	1.0944	0.014829	0.29859
concrete diameter 1 inci	1.1878	0.015227	0.088484
concrete diameter 2 inci	1.2002	0.015626	0.090802
concrete diameter 3 inci	1.2343	0.015683	0.091133
dengan *casing*	0.94628	0.023304	8.2558

From the table above, the results of testing using static simulations can be concluded that the total deformation stress in the speed bump model using casing 1 is 0.94628mm lower than the other 9 models and the lowest Equivalent Elastic Strain is obtained from the speed bump model with 2 polymeric diameter 2 inches of 0.014756, whereas. The lowest equivalent stress is found in the 2-inch speed bump concrete model of 0.10708Mpa, compared to other models. From the test table above, the voltage graph is obtained as follows: (a) Comparative Graph of Speed Bump of total deformation simulation results Comparative graph of Speed Bump of total deformation simulation results is shown in Figure 4.33.

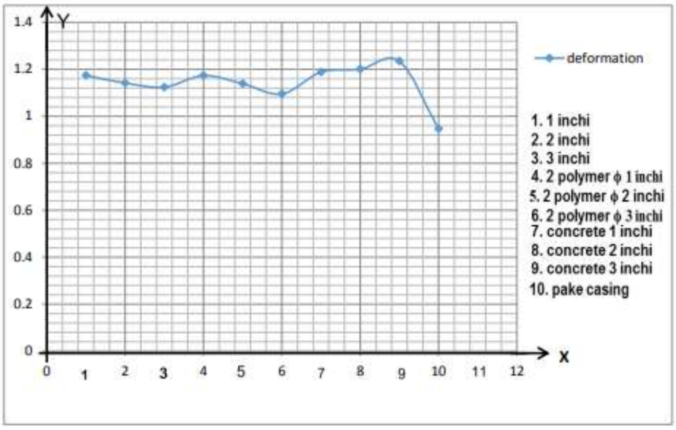


Figure 6. Comparison Graph of Speed Bump Simulation Results of Total Deformation

From the graph 4.33 above, the maximum total deformation results occur in the 3-inch diameter speed bump concrete model of 1.2343mm, while the lowest total deformation stress is found in the speed bump model using a casing of 0.94628mm. (b) Comparative Graph of Speed Bump from simulation of equivalent elastic strain The graph of Comparison of Speed Bump from simulation of equivalent elastic strain is shown in Figure 4.34.

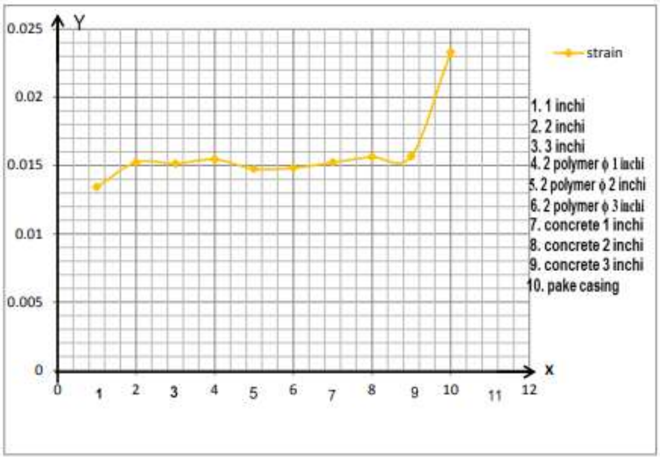


Figure 7. Comparison Graph of Speed Bump Simulation Results Equivalent Elastic Strain

From Figure 4.34 above, the maximum equivalent elastic strain results occur in the speed bump model using a casing of 0.023304, while the lowest equivalent elastic strain stress is found in the speed bump model using polymeric with an inch diameter of 0.013427.c. Comparative Graph of Speed Bump from simulation of equivalent stress The graph of Comparison of Speed Bump from simulation of equivalent stress is shown in Figure 4.35.

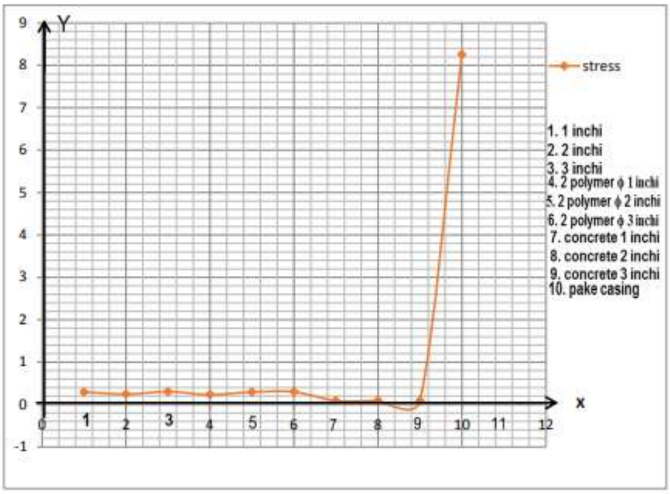


Figure 8. Comparison Graph of Speed Bump Simulation Results Equivalent Stress

From the graph 4.35 above, the maximum equivalent stress occurs in the speed bump model using a casing of 8.2558 Mpa, while the lowest total deformation stress is found in the speed bump concrete model with a 1 inch diameter of 0.088484 Mpa.

4. CONCLUSION

After all the research was carried out and analyzed all the results, the following conclusions were drawn: (1) From the results, it was concluded that the minimum total deformation stress occurred in the speed bump model with casing of 0.94628mm and the maximum stress was found in the 3-inch diameter speed bump concrete model of 1.2343mm, the minimum Equivalent Elastic Strain is found in the 1-inch speed bump model of 0.013427, and The maximum Equivalent Elastic Strain is found in the speed bump model with a casing of 0.023344, while the minimum Equivalent Stress is found in the 1-inch speed bump concrete model of 0.088484Mpa, and the maximum Equivalent

Stress is found in the speed bump model with a casing of 8.2558MPa. (2) From the results of the comparison of all speed bump models, the minimum stress on the speed bump model that uses a lower casing is selected, the speed bump model that uses a casing is chosen for further experimental testing. Suggestions that the author can give if this research is to be developed in the future include: (1) Research development using natural fibers and further development in order to produce better materials due to the abundance of environmentally friendly and economical raw material sources.

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