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Research Article

Static Simulation on Speed bumps Made of Foam Concrete Foam with Durian Skin Fibers Using Ansys Software

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Abstract

Motorcyclists find speed bumps problematic because they require them to slow down. A concept comes to create a technology and can use a power plant with a generator driving source from speed bumps in its application. The product is designed and made on a big scale to allow all cars going through speed bumps. Because it is important to handle the kinetic energy generated from the vehicle in order for it to be transformed into electricity and connected to the load. Several tests, such as static and impact testing, are performed on the speed bump to get a material that is resistant to structural integrity. Simulation was used to perform static and impact testing using ansys software. As for the material, durian skin is very suitable as a mixture of materials, because it contains fibers that can be used for concrete reinforcement. Also obtained the equivalent stress of 0.05 MPa. The x-Axis voltage is 0.01MPa. The y-axis stress is 0.04 MPa. The results of this study can be concluded that the concrete composite reinforced with durian skin fiber also has the potential to be used as a speed bump power generator.

Keywords: *Durian Skin Fiber, speed bump, Software Ansys*

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INTRODUCTION

Durian production in Indonesia is quite abundant. For example, North Sumatra province. Data from the National Statistics Center shows that durian fruit production in North Sumatra is increasing every year, along with the increase in the durian fruit harvest area, from 24,031 ha in 1999 to 53,770 ha in 2003, thus there is an increase in durian production in North Sumatra from 646,593 quintals in 2017 to 828,724 quintals in 2018 [1].

However, as shown in a research done by Malaysia's Ministry of Agriculture and Agro-Based Industry, about 50-65 percent of the flesh from each durian is consumed as food. The remainder, around 45-55 percent, can be regarded as waste covering durian skin and seeds. Approximately 40% of durian skin may be generated [2].

The results showed that durian skin proportionally contains high cellulose elements (50-60%) and lignin content (5%) and has starch content (5%) so that it can be indicated that durian skin can be used as a mixture of food raw materials, as well as processing materials. materials that can be utilized [3].

Biomass and biogas technologies may be used to harvest energy from the durian industry. For example, durian skin fibers have been employed to reinforce polymeric materials and concrete [4]. The skin fiber of something like the durian cannot be utilized directly. The fat content of durian skin fibers is reduced by a number of processing steps. Several items reinforced with durian skin fiber have been widely employed in our laboratory for light constructions due to their light weight while remaining good enough to handle external stresses. [5].

Figure 1 Power generation equipment using a speed bump [6]

Speed bumps are considered to interfere with motorcyclists to reduce motor speed [6]. The concept of creating a tool that may be utilized as a power plant with a generator driving source from a bump emerged. A power electronics circuit is used as a regulator of the generated output. [7].

In this paper, Durian skin fiber combined with foam concrete is used as a composite concrete aggregate of speed bumps that produce electricity. As indicated in Figure 1, the speed bump is installed in a mechanical system. The speed bump's translational motion is mechanically translated into circular motion on the fly wheel, which is coupled to the power production equipment. The speed bump works best with this connection while beneath heavy trucks (up to 10 km/h).

The speed bump design process follows the KM Menhub standard number 3 of 1994. The main parameters used in the static structural simulation include the selected meshing size, the selection of fixed support and the magnitude of the load received by the speed bumps. Simulations were carried out on Ansys software using the Finite Element Analysis (FEA)[8]-[13] method. Static structural analysis using Ansys Workbench [14]. Ansys is a numerical solution program (Finite Element Method) based on its visual simulation. The division of elements (discrete) is the stage of dividing the structure into small parts. The objective of this research was to establish the maximum static stress that the speed bump structure could withstand. The results of this analysis are expected to be input to the designs that have been made.

MATERIALS AND METHODOLOGY

Material Strength Theory

In designing a product, it is necessary to establish a material selection procedure that is appropriate to the application conditions. The strength or stiffness of the material is not the only criterion that must be considered in structural design [15]. However, the strength of the material is as important as other material properties such as hardness, toughness, which are the criteria for determining material selection [5]. The strength of the material can be calculated and simulated with a tensile test experiment on the specimen from the stress due to the applied tensile force using the help of analysis software (ANSYS) using the finite element method with a numerical approach.

Material

From our previous research, we created a class of confoam materials [8]. Based on the findings and recommendations from our previous work [10], we chose the B4-confoam type to create a full-scale speed bump in this investigation. The physical and mechanical properties of the material are shown in Table 1.

Table 1 Properties of Mechanic Confoam [8]

Type Specimen	Suc (MPa)	Sut, (MPa)	ν	E (MPa)
B4	2.1	0.18	0.2	10.1

Speed Bump Design

Speed bumps are manufactured in compliance with the geometry specified in the Minister of Transportation's Decree. number 3 of 1994, as shown in Figure 2. In this paper, we propose the geometry and dimensions shown in Figure 2. Figure 3. Dimensions the main speed bumps are as follows: length, L = 1900 mm, witdh, w = 400mm, thickness, t = 40mm).

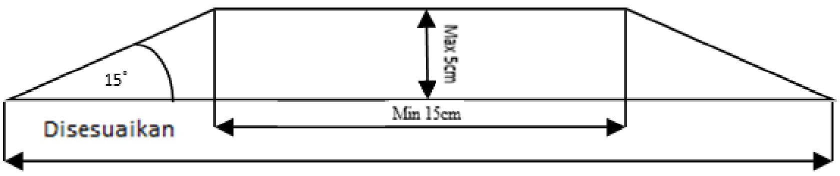


Figure 2 Ministry of Transportation 2 of 1994 (standard size of the Ministry of Transportation)

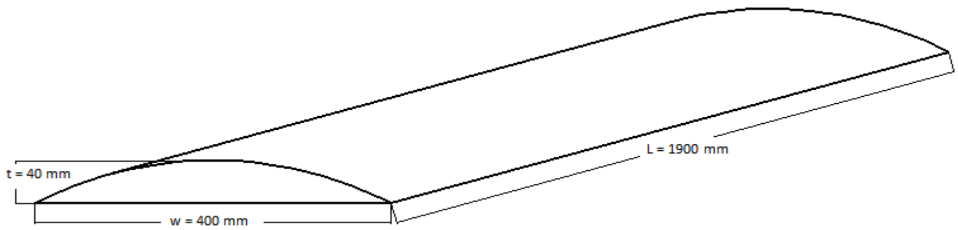


Figure 3 Detail Speed Bump

Speed bump modeling is done using Solidwork software. The modeling steps are as follows:
a. Selection of the right plane in the modeling of speed bump parts
b. assembly parts.
c. Image storage Speed bump model with the standard format of Ansys software, namely IGES. The provision crane dimension model is shown in Figure 3.

Numerical Simulation

Static Structure Simulation The simulation is carried out on Ansys software with the Finite Element Analysis (FEA) method of completion, with the following steps:
a. Import the speed bump model file with IGES format (igs).
b. Selection of the type of static structural analysis in the toolbox.
c. Selection of model geometry on static structural geometry.
d.The selection of the type of speed bump material is using composite foam in Engineering Data.
e. Selection of the type of speed bump meshing with a fine size.
f. Determination of the location of the support (support) on the structure.
g. Determination of the location of the load and the magnitude of the load received by the structure based on the safety factor at the speed bump.
h. Selection of the type of solution you want to produce.

The load applied to the contact area of the speed bump (Figure 4) which represents the trajectory of the vehicle tires is obtained from a quarter of the total vehicle weight allowed for class III roads. Numerical calculations focused on the stress distribution at x, y, and principal points using commercial FEM software, with 3-D elements, we also calculated the von-Mises stresses. Let's examine the stress contour of the speed bump product.

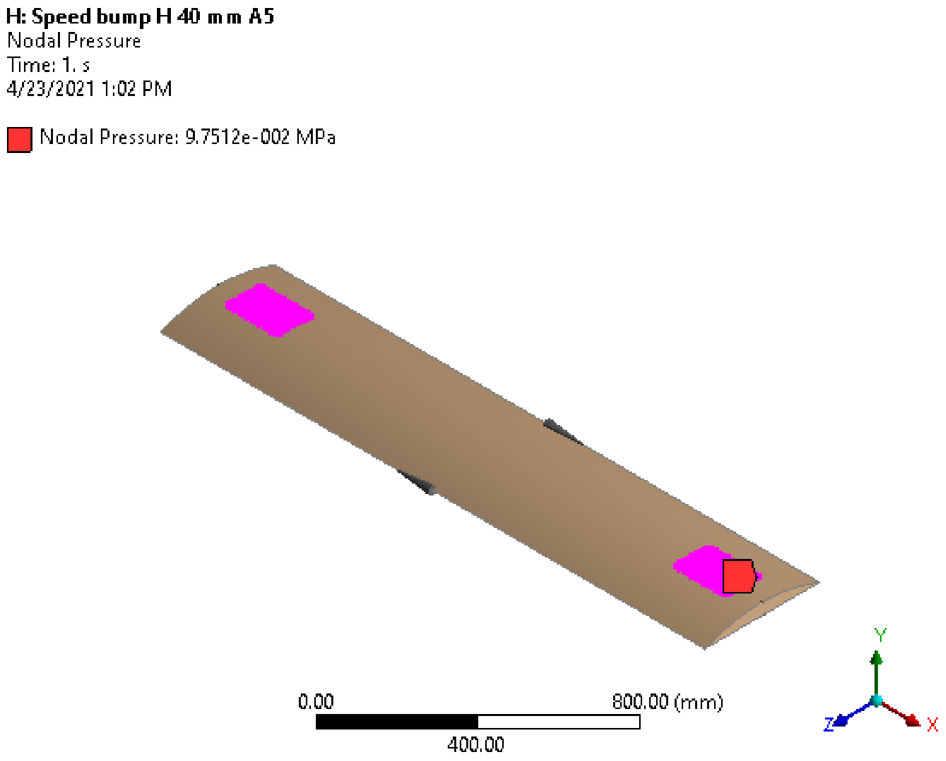


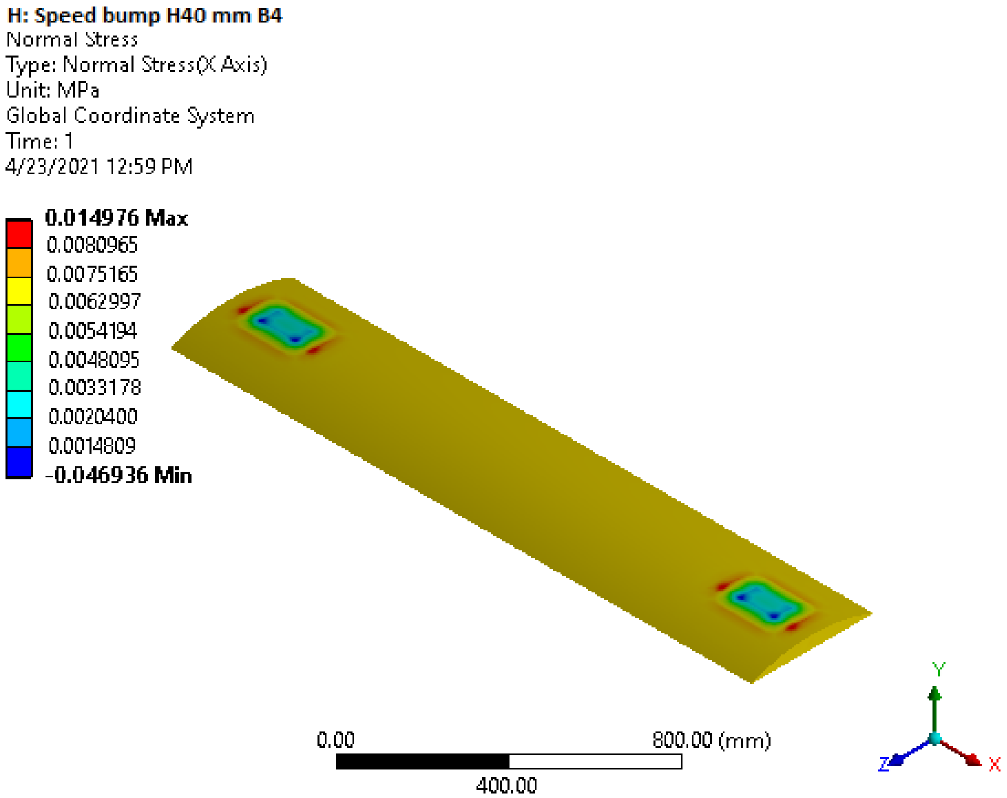
Figure 4 Model in Contact field

RESULTS AND DISCUSSION

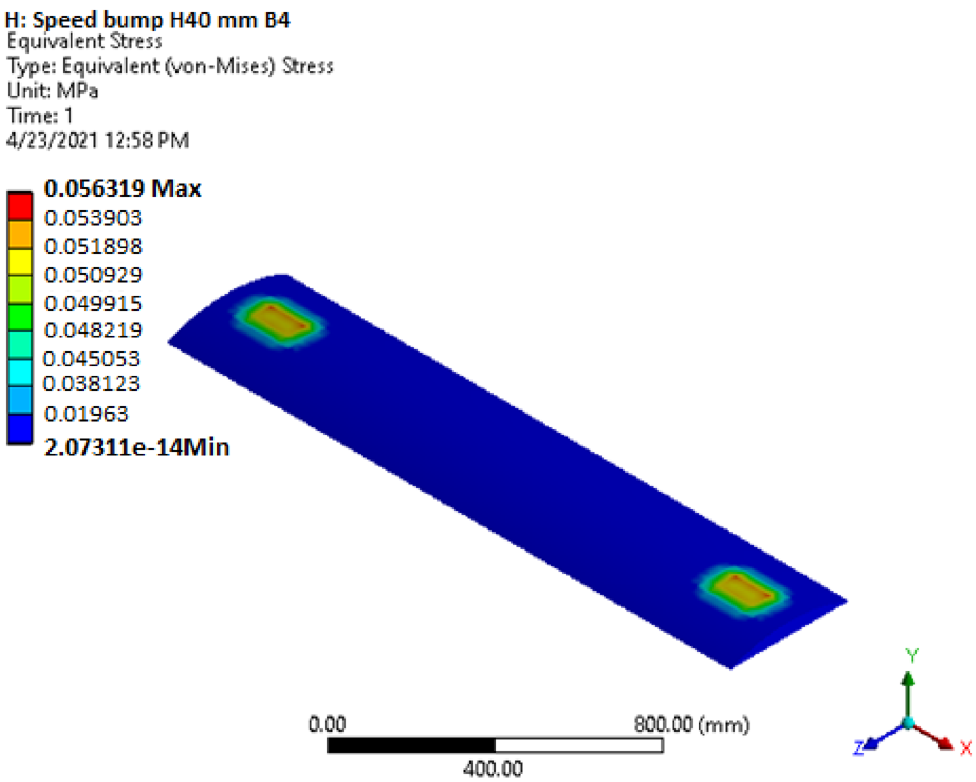
Figure 5 (a-c) illustrates the stress distribution in the speed bump model's x, y, and main directions. Table 2 displays all calculations. We discovered that applying a speed bump can sustain the tire's axial force. However, by comparing the static strength of the speed bump material with pressure and in line with static failure theory, we discovered that an equivalent stress of 0.05 MPa was determined from the findings of the top side static simulation. The tension on the x-axis is 0.01MPa. The stress on the y-axis is 0.04 MPa.

Table 2. Maximum stress in the x, y, and directions main (in MPa)

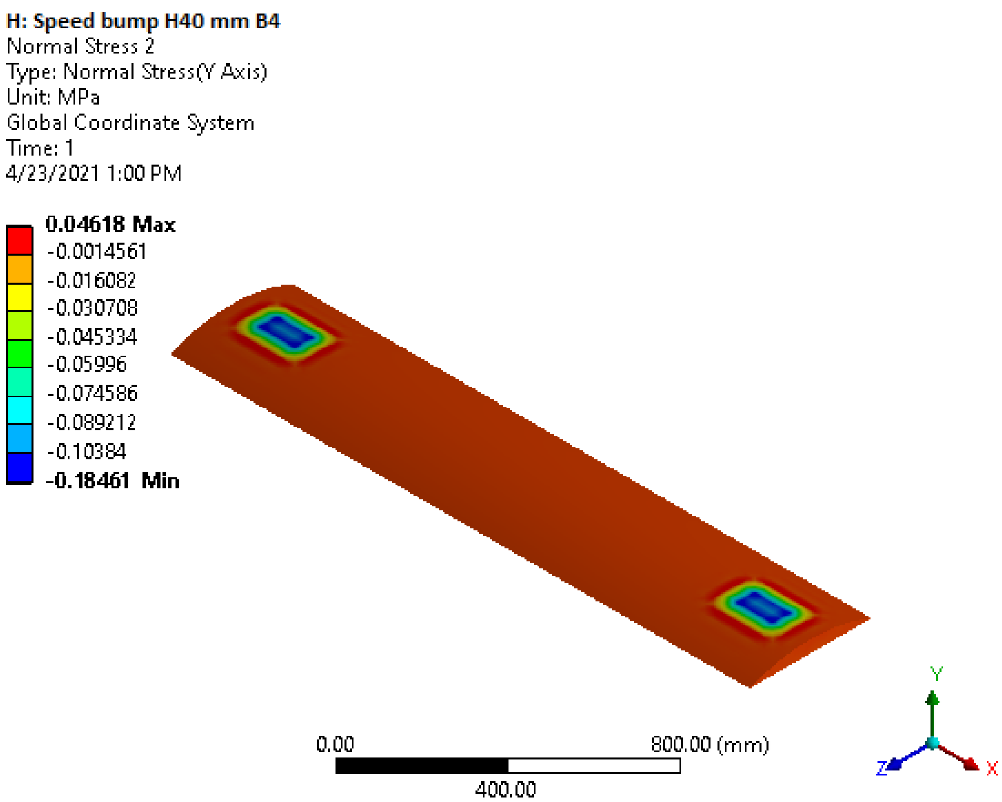
Hasil simulasi	σx	σy	σ1
Benturan cepat	0,01	0,04	0,05



(a) Equivalent stress



(b) Stress x-direction normal



(c) y direction normal stress

Figure 5 Contour of stress due to loading on the top surface (a) Equivalent stress (b) Stress x-direction normal (c) y direction normal stress

CONCLUSION

The purpose of this research is to investigate the speed bump analysis of concrete foam composites utilized in power production. Durian skin fibers are used to strengthen the concrete foam. To determine the structural integrity of the speed bump model, numerical software based on FEM ANSYS was used. It is worth noting that the x-directional tension is lower at the entrance base and gradually increases as the tire reaches the top surface of the speed bump. However, it is worth noting that the height of the velocity speed bump has no discernible effect on the equivalent stress. The von Mises stress is comparatively small in comparison to the static strength of the speed bump material, as seen in Figure 5.a. According to the result of this research, the concrete foam composite reinforced with durian skin fiber has the potential to be utilized as a speed bump power generator.

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DECLARATION OF CONFLICTING INTERESTS

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REFERENCE

[1] Badan Pusat Statistic Provinsi Sumatera Utara, 2021. Produksi Buah-buahan Menurut Jenis Tanaman Menurut Kabupaten/Kota di Provinsi Sumatera Utara (kuintal), 2017 dan 2018. Sumatera Utara: Badan Pusat Statistik, 2021.

[2] Salman, Suhad Dawood. Nazmin, Aini. Zulkifle. "Effect of Natural Durian Skin of Mechanical and Morphological Proporties of Kevlar Composites In Structural Applications" The Fourth Scientific Engineering and First Sustainable Engineering Conference: Journal of Engineering and Sustainable Development, Vol.22, No.2 (Part-3), 2018.

[3] Kurniawan W, Dedi. Arifan, Fahmi. Adim, M Dwi Khoirun. "Pembuatan Pulp Dengan Memanfaatkan Limbah Kulit Durian (*Durio Zibethinus Murr*) Dengan Campuran (*Resina Colophonium*) Guna Mencegah Degradasi Lingkungan". Program Studi Dipoloma III Teknik Kimia, Fakultas Teknik Universitas Diponegoro, 2013.

[4]. Syam, Bustami, B. Wirjosentono, dan S. Rizal, "Analisis Integritas Struktur Balok Rumput untuk Bahan Beton Ringan yang Diperkuat Serat Kulit Durian", Laporan akhir penelitian terapan, TALENTA, USU 2020.

[5] Bustami syam, Maraghi M, Mawardi, et. al. "The application of empty fruit bunch (EFB) fibers of oil palm for the development of light structure materials and products" E3S Web of Conferences volume 52, 00007, 2018.

[6]. B Syam, M Muttaqin, D Hastrino, A Sebayang, WS Basuki, M Sabri1 dan S Abda, Analisis Kecepatan Pembangkit Listrik Bahan Komposit Busa Beton, Diterbitkan di

bawah lisensi oleh IOP Publishing Ltd., Seri Konferensi IOP: Ilmu dan Teknik Material,Volume 180,Nomor 1, 2017

[7]. Muhammad Jaffar Al Faruqi, “Perancangan Pembangkit Listrik Tenaga Speedbump Sebagai Energi Alternatif”, Jurusan Teknik Mesin, Universitas Negeri Padang, 2016.

[8]. B. Syam, M. Muttaqin, D. Hastrino, et.al. Integritas Struktural Pembangkit Listrik Kecepatan Bump Berbahan Komposit Busa Beton, IOP Conf Series: Material Science dan Teknik 308, 012032, 2018.

[9]. Syam, B. & Fitriadi N, Produksi dan Pengujian Komposit Busa Beton, USU Press, Art Design, Publishing & Printing, Medan, 2014.

[20] Maraghi,M., N. Fitriadi, Y. Siahaan, Abdurrahman, Irwansyah, dan B. Syam, Pembuatan dan Analisis Struktur Speed Bump Bahan Komposit Busa Beton (Concrete Foam), Prosiding Seminar Nasional Rekayasa dan Teknologi (SNRT), 4 Des. 2013, Reuleut Lhokseumawe, pp. 343-351, 2013.

[12] Dino Hastrino, Maraghi Muttaqin, B. Syam, “Analisa Struktur Speed Bump Paduan Bahan Concrete Foam dan Polymeric Foam Dengan Variasi Rongga Menggunakan Sofware Ansys 14.5”, Talenta Conference Series: Energy and Engineering (EE) 1 (1), 104-108,2018.

[13] B Syam, M Muttaqin, D Hastrino, A Sebayang, WS Basuki, M Sabri,” Analysis of power generating speed bumps made of concrete foam composite”, IOP Conference Series: Materials Science and Engineering 180 (1), 012033,2017.

[14] Ansys. Ansys Structural FEA. America: Ansys,Inc., 2011.

[15] Duwi Leksono Edy and Widiyanti, “Analysis of heat load in coffee bean drying oven room”, Journal of physics: conference series 1700, 2020.