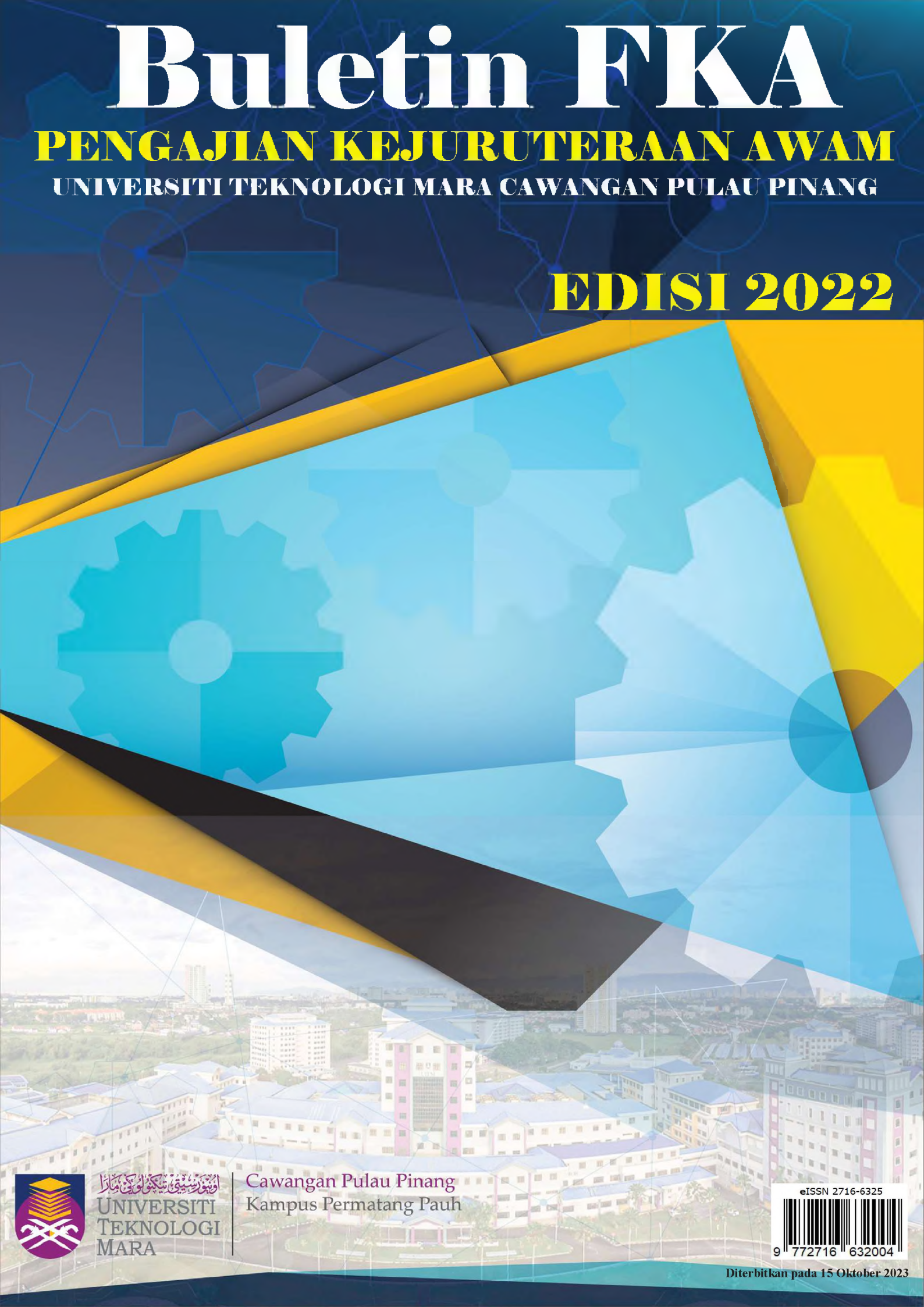
Buletin FKA

PENGAJIAN KEJURUTERAAN AWAM

UNIVERSITI TEKNOLOGI MARA CAWANGAN PULAU PINANG

EDISI 2022



UNIVERSITI TEKNOLOGI MARA

Cawangan Pulau Pinang
Kampus Permatang Pauh

eISSN 2716-6325

Diterbitkan pada 15 Oktober 2023

GEOMETRY MODEL GENERATION FOR SPACE STRUCTURE

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Tensioned Fabric Structure (TFS) is a lightweight structure with an extremely versatile class of roofing structure that is effective for vast building application. Selection of the most effective type of surfaces for the implementation of TFS and suitable to be applied in large surface area with beautiful aesthetic value is important. The form of minimal surface was created using the mathematical model for TFS proposed. The objective of this study is to create a mathematical model for TFS and to propose an alternative shape for TFS. The study results could provide the engineers with additional shape to be considered for the implementation in TFS.

Introduction

Abdul Malek (2020) mentioned that TFS consists of arrangement of tensioned fabric as the main components where the fabric pattern is tensioned to a rigid structural element by mechanical means. Abdul Hadi & Yee (2016) described that TFS employed membrane supporting geometry resulting in a positive (upward) and negative (downward) curvature of the structural membrane, in which the external loads are resisted by an increase in the stress of hogging warp around one axis of the TFS and the inward forces are resisted by an increase in the stress of the sagging warps around the other. It comes in various shape and design. In this research, developing minimum surface of TFS is recommended and can be applied to TFS.

Components of the TFS

Abdul Hadi (2019) stated TFS has its own basic components which consist of supporting system, seam, fabric and cables where fabric surface is the main components. The selection of the fabric type is important as details shaped. Houtman (2015) stated that the TFS can divided the fibres that make up the fabric into natural fibers and chemical fibres. The fabric surface consists of three layers, one layer of woven yarn which consisted two directions of the textile warp and weft plus two layers of coating material to protect the fabric from external destruction such as ultraviolet light (UV light) radiation degradation, rainwater, snow and atmospheric moisture. Two yarns or more can be assembled by twisting in order to obtain a thread of higher strength.

Shape of Tensioned Fabric Structure

The TFS are part of a development technology which gives designers, architects and engineer ability to experiment with form and create exciting new solutions to conventional design problem. Yee (2011) has carried out form-finding in Catenoid, Helicoid, Enneper, Scherk, Moebius Strip and Costa. Abdul Hadi & Yee (2016) had proposed a Chen-Gackstatter for structural design to applied in TFS.

Geometry Generation of New TFS Models

Designing the TFS model by creating the equation then the coordinate (x axis, y axis, and z axis) of the model were identified and checked for the suitability of the shape for the model of the TFS in the Microsoft Excel. List all the coordinate numbers to prevent any overlapping code. Once the design approved, proceed to the coordinate pointed via LUSAS. The result of the geometry model will come out after the LUSAS line coordinate was created.

Table 1: Equation for All Models (redwood.edu, n.d. and mathwork.com, 2020).

Type of Model	Equation
Model 1	$z=3x+x^3-3xy^2$
Model 2	$z=\sin x^3+\sin y^2$
Model 3	$z=\cos x+\cos y$

The equation for Model 1 and Model 2 were used exactly based on the given equation from the internet sources (redwood.edu, 2006) and (mathwork.com, 2020). The equation been used as the proposed shape of the given equation has not been used by other researcher. For Model 3, the equation from the internet sources (mathwork.com, 2020) but has change to get the unique shaped of the model. My own idea had been made for the Model 3.

Results and Discussion

Figure 1 shows the result for assumed shape for model 1. Figure 2 shows the final geometry for the model in different view.

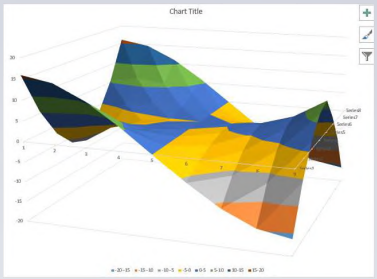

Figure 1: Assumed Shape for Model 1

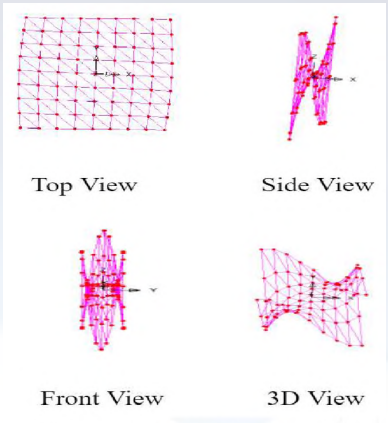

Figure 2: Final Geometry of Model 1

Conclusion

Three mathematical TFS geometry models have been proposed. Design engineers can consider its as alternative geometry shapes for development of new geometry of TFS.

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