Application of Radar Absorption Structures to Military Base Infrastructure to Maintain the Security of Strategic Areas of the State

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Abstract

In a country, the presence of the military is the main function in maintaining the security and defense of the region. So that the security of military bases and the comfort of the work environment are important factors in supporting the performance of the military in carrying out their duties. With the development of technology and the use of Google Earth, it can become a threat, indicating the easy reach of the Google Earth satellite radar in identifying the condition of Indonesian military bases that are visible to the Google Earth satellite. This condition is certainly one of Indonesia's security threats to enemies where these military areas contain everything about the main components in carrying out military tasks. For this reason, regional security and secrecy need to be handled so that enemies who threaten national defense are not easily detected. This research is descriptive-narrative in nature, using positivist and theoretical methods as a research framework based on qualitative data for measurement and discussion, also cross-sectional in nature. By applying the design thinking approach as an innovative concept formulation using anti-radar materials. With the use of Radar Absorbing Material (RAM) from GF/PPS laminated composite material that has been given a layer of nano-structured paint placed on the infrastructure structure of the country's military base, it is an innovation in efforts to disguise the country's strategic areas from the use of the Google Earth radar.

Keywords: Structure; Radar Absorbing Material (RAM); Military Bases

Introduction

Technology is currently increasingly advanced which increases the potential for threat advancement. In relation to national strategic areas, especially military areas or bases, technology can play a role in maintaining and enhancing the security of military bases. But technology also threatens the security of the base. An example is the use of geoweb-based Google Earth. This application can be used to easily perform earth mapping analysis. This application is useful for the general public to see a visual

of the earth at the desired location or area. However, this application is also used as a tool to gather military intelligence for both defense and attack security purposes.

In a country, the presence of the military is the main function in maintaining regional security and defense. So that the security of the headquarters and the comfort of the work environment are important factors in supporting the performance of the military in carrying out their duties. Various threats can arise from outside the headquarters caused by technical and non-technical factors. In its application, areas related to military activities need to have a high level of security. One of the ways to secure the territory is by obscuring the country's strategic areas from observations by Google Earth. For example, a military base in France, if the Google Earth application is used to search for this location, it will be found that this location looks blurry or blurry. This is done to increase the security of the French military base from threats related to the detection of military bases. But unlike Taiwan, in 2019 Google Earth exposed the most secret military bases in Taiwan, including facilities housing patriot missiles and the Taiwan National Security Bureau. This example proves the importance of maintaining the security of national strategic areas, especially from the point of view of national security and defense from threats that develop with technological advances.

Figure1. Secret Taiwan Military Base
Source: Google Earth (Photo: Digital Trend)

As an effort to camouflage strategic areas of state security, especially at military headquarters from the range of the Google Earth satellite radar, it is necessary to conduct material engineering using anti-radar materials such as those used in stealth defense tools. Radar or Radio Detection and Ranging, which means radio detection and ranging is a system of electromagnetic waves that can detect, measure

the distance of an object. The development of this technology is influenced by electromagnetic waves emitted from an object so that a microwave absorbing material is needed. One of the effective electromagnetic wave absorption technologies Is Radar Absorbing Materials (RAM) which are widely used in the military. So this research was conducted with the aim of using anti-radar materials in strategic military area building facilities to maintain the security of military bases from the Google Earth radar.

Research Method

This research is descriptive-narrative in nature, using positivist and theoretical methods as a research framework based on qualitative data for measurement and discussion, also cross-sectional in nature. Qualitative research can provide rich and holistic data, provide an understanding of ongoing processes, focus on real experiences in certain contexts, interpret and explain more deeply about the data obtained.

The design thinking approach is used as the application of the innovative concept formulation of the use of anti-radar materials. Design thinking is an approach used in the process of designing or innovating a product. It is an integrated approach (Mueller-Rotterberg, 2018) where the solution to problem solving is related to the framework. The design thinking method is oriented to user needs (Mueller-Rotterberg, 2018), which depends on the sector in which the user is involved. In general, design thinking can be applied to any field that requires innovation. The definition in particular cannot be explained because design thinking in each field can vary, depending on the purpose and context. Design thinking is a process in which the results of planning what actions will be taken in order to improve the situation (Pressman, 2019). The stages in design thinking are emphatize, define, ideate, prototype, test (De Yong in Dewi et al, 2018)

- The empathize stage is an effort to collect data through observation, literature study, and typology.
- Define is an effort to narrow down problems using analysis, problem seeking, and programming processes.
- Ideate stage where the concept of a solution to a problem is formulated by brainstorming. From this process, ideas are obtained and visualized in the form of design sketches that contain aspects of the problem formulation at the previous stage.
- Making prototypes in accordance with the concept sketches of ideas to answer design problems.
- The final stage is testing to find out which design is produced according to the problem solution criteria. The test phase was carried out using the Failure Modes and Effects Analysis (FMEA) method, which is a method for identifying and preventing as many failure modes as possible that are applied in product development, system engineering and operational management (Casadai, 2007).

Result and Discussion

Google Earth

According to Zaki (2010) Google Earth is a Geographical Information system service that provides information about maps and their ins and outs, one of the advantages of Google Earth is that this map covers the whole world (p.1). Google Earth makes it easier for users to find addresses (for several countries), enter coordinates, or use the mouse to find locations (Thankachan, et al., 2013). In addition, the facility has digital elevation model (DEM) data collected by NASA's Space Shuttle Radar Topography Mission. As the era of Google Earth continues to develop, it continues to innovate with new features that are interesting and very useful, namely knowing all the morphological conditions and

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contours of the earth's surface in real terms, namely a top-view photo of the earth's surface with pretty good Figure resolution and a description of the latitude and longitude degrees for each area on earth.

Radar Frequency Absorbing Materials

"Radar (radio detection and ranging) is a system that emits electromagnetic waves at a certain object and then receives and analyzes the reflected waves to determine the type, position, distance and speed of an object." (Taryana, Yana. 2019). The ability of the radar to detect a target is due to the Radar Cross Section (RCS), which is an area on the target that is capable of reflecting signals. Radar Absorber Material (RAM) is a material that can detect the position of objects based on the emitted microwaves. RAM material is composed of materials that have magnetic properties, namely permittivity (ε), permeability (μ), resistivity (R) or conductivity (σ) of the material (Taryana, Y., et. al. 2019). So it is necessary to choose materials that have the ability to meet these criteria to be able to provide the maximum absorption effect of radar waves. RAM can be used in a variety of forms, such as composites, paints, sheets to thin films applied to create microwave-absorbing radar absorbing structures (RAS).

The Design Thinking

Emphasize Phase is carried out through observation to find problems in the design of military bases, namely the location of the Indonesian military base can still be detected by Google Earth satellite radar.

Reaching the Define stage, the problem statement that is formulated narrows down to how best to obscure the position of the TNI military base from the range of the Google Earth radar.

The Ideate stage is the stage where the concept of the proposed innovation begins to take shape by applying anti-radar material to the TNI military base as an attempt to obscure the location of the TNI military base when viewed from Google Earth. The use of radar absorbing materials was carried out using a commercial laminated composite (TenCate Advanced Composites, The Netherlands) and a CNT-based nanostructured coating. Its use is carried out by applying "CNT dispersed in a polyurethane matrix and applied to the surface of a glass fiber/polyphenylene sulfide (GF/PPS) laminated composite" (Folgueras, LDC, et.al. 2014). The GF/PPS lamination composite will then be coated with a nanostructured layer by painting with the thickness of the coating layer application on the GF/PPS lamination composite being 0.15 mm. The use of this material also takes into account the aspect of its low specific mass, which is 1.6 g/cm3. Based on Folgueras' research (2014) it shows that aluminum plates with nanostructured layers painted on GF/PPS laminated composite materials are able to absorb up to 90% of energy from waves. incoming electromagnetic. This shows that the advantages obtained are not only that the material can provide high radiation absorption, but also that the thin material does not change the specific mass of the resulting composite material.
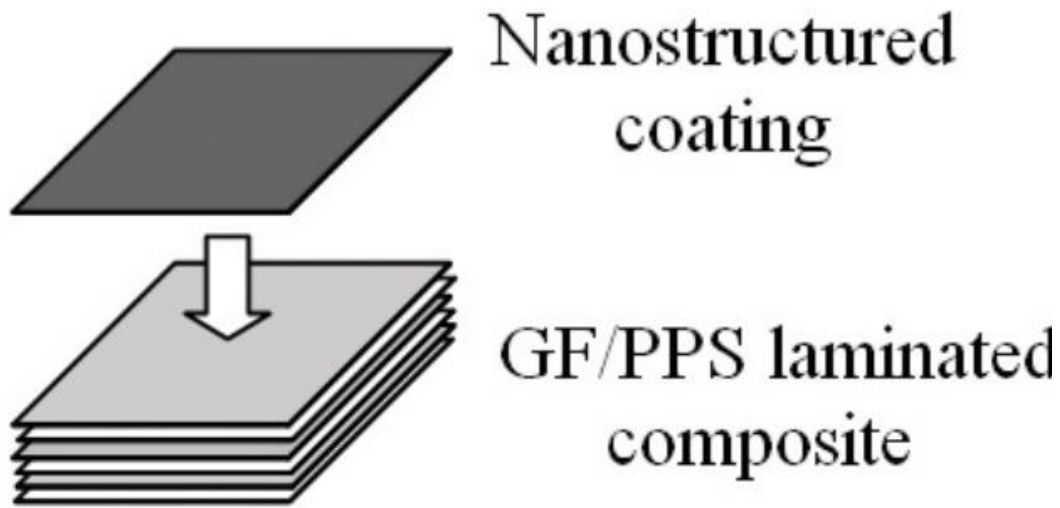
Figure 2. Painting of GF/PPS laminated composites with nano-structured layers
Source: Folgueras et al, 2014

The Prototype stage is carried out by translating user requirements along with problem formulation and ideas for problem solutions, into a design. GF/PPS laminated composite material that has been given a layer of nano-structured paint separately will be difficult to apply to buildings, so a media in the form of a panel frame is needed. The panel framework acts as a support for composite materials that can be applied to TNI military base buildings. Using the main material cross-sectional panel framework design as shown in the Figure makes it possible to cover the entire roof of the building structure as shown in the Figure adjusting to the length and shape of the building structure.
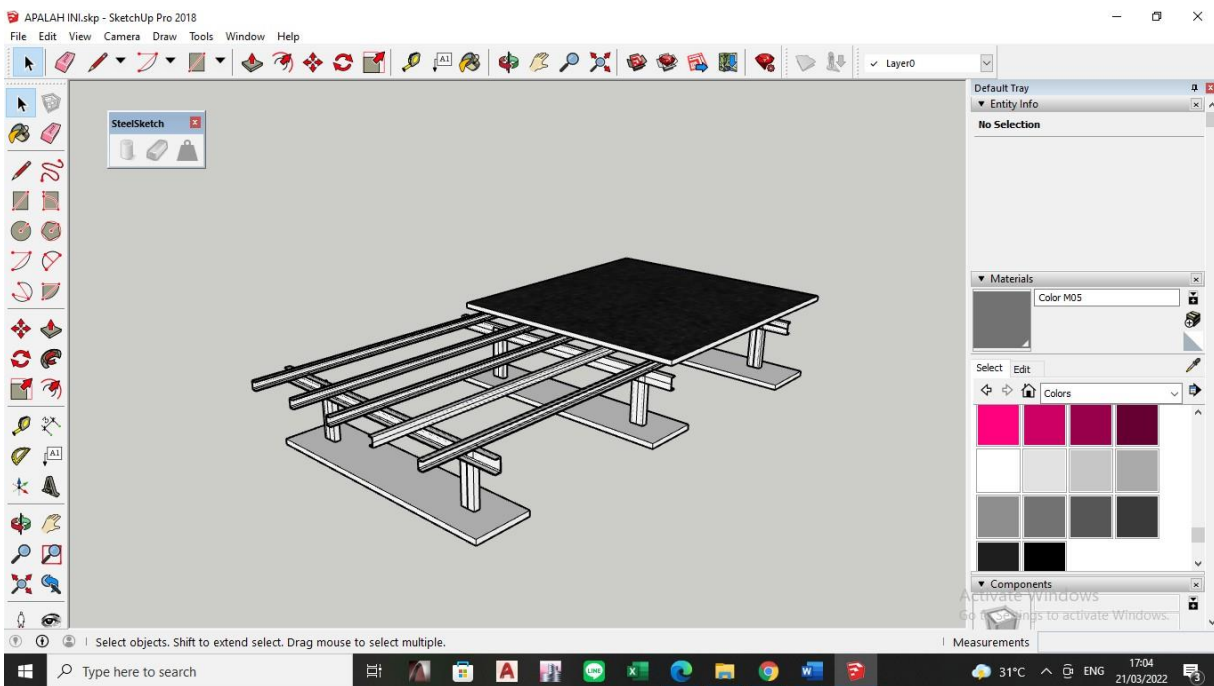

Figure 3. RAM Structure Prototype
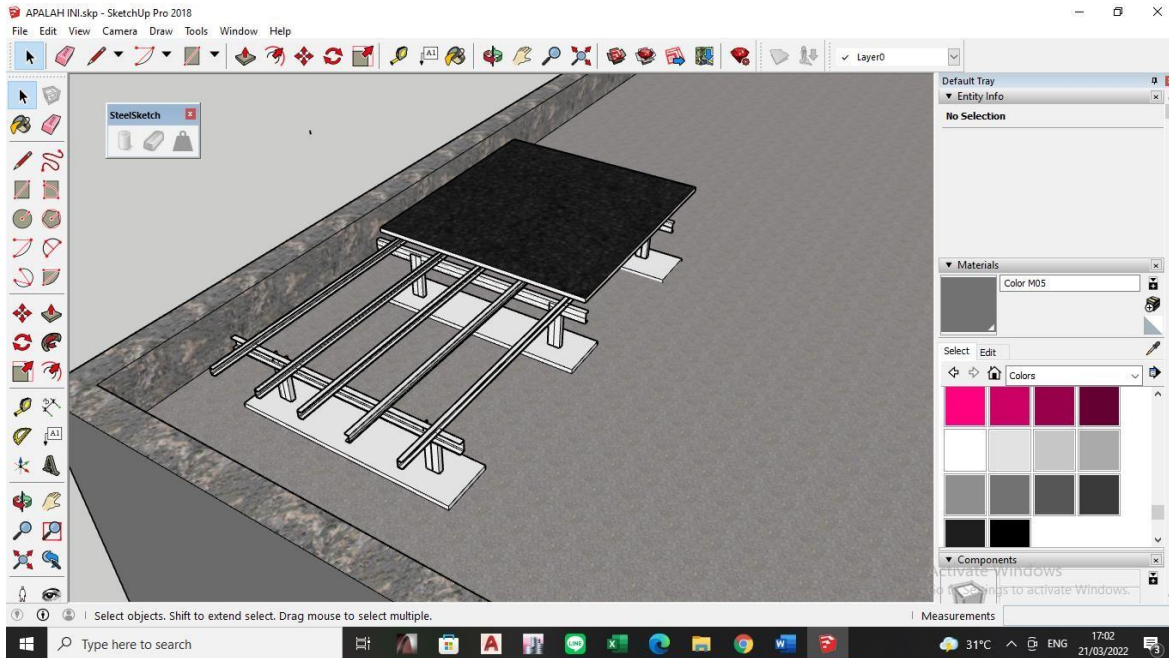Source: Researcher (2022)

Figure 4. RAM Structure Prototype Placed On Top of Building Structure
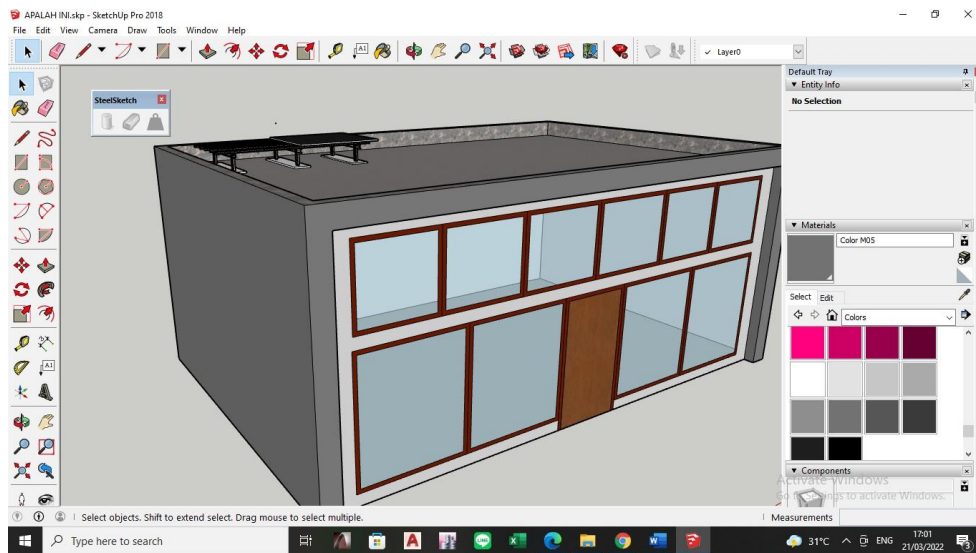Source: Researcher (2022)

Figure 5. RAM Structure Application Placed on Top of Building Structure Looks as a Whole
Source: Researcher (2022)

From the Prototype stage with design sketches that have been made, testing is carried out at the Test stage with FMEA analysis as in Table 1 which shows the results that with the highest RPN if a coating failure occurs it can result in reduced penetration of electromagnetic radiation into the material so that the need for maintenance and checking the condition of the coating as well as the anti-radar frame structure.

Table 1. RAM Structure Risk Analysis

Line	Component and Function	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Potential Cause(s) of Failure	Occurences	Failure Detection Method	Detection	RPN
	FMEA Design								
1	GF/PPS composite laminate with nano-structured paint coating - Basic material for absorbing electromagnetic	Imperfection of specifications and mixing of materials	Not working well	6	Imperfection of specifications and mixing of materials	5	No value is displayed when used for measurement	2	60
2	Anti Radar Framework - to simplify deployment in military buildings	Broken skeleton	Anti-radar falls & the position is not as it should be	8	Failure in frame design	3	There is no material strength test for the frame itself	3	72
		Frame not up to specification	Difficult to implement construction	7	Failure in product size	3	There are no size specifications to apply to buildings	2	42
3	Paint (coating)-application in the application of absorption of electromagnetic waves	Paint coating durability	Penetration of Electromagnetic Radiation into the material is reduced	7	Failure in the painting process	4	Measurement of the thickness of the paint layer is less than the provisions	3	84

Adopted: Sulistiyo, H., et.al (2022)

Conclusion

A military base is a place to house military equipment and personnel, so the security of a military base in a region is an important aspect that needs to be guarded against all threats, one of which comes from the Google radar threat. earth. Efforts that can be made are by obscuring the area of the radar with Radar Absorbing Material (RAM) in the form of GF/PPS laminated composites painted with nanostructured layers. The nano-structured layer painted on the GF/PPS laminated composite material is capable of absorbing up to 90% of the energy from incident electromagnetic waves. This shows that the advantages obtained are not only that the material can provide high radiation absorption, but also that the thin material does not change the specific mass of the resulting composite material. The application will be used with a media structure in the form of a panel framework that will be applied to the roof of the military base building. Based on the results of the analysis using FMEA it was found that several failures could occur such as in coatings which could result in reduced penetration of electromagnetic radiation into the material. So that in its use it is necessary to carry out maintenance and checks regarding the condition of the coating and the anti-radar frame structure so that the structure can function properly.

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