

Perception Study on Kinetic Recycled Compact Disc Facade as Memorable Elements in Tourism Hall, Jarak - Wonosalam

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Abstract. Indonesia is a country, rich with culture and natural resources that brings high tourism potential. Jarak village in Wonosalam is one of the villages in East Java that has these tourism potential, besides a religious harmony between the dwellers, that initiates the construction of a tourism hall with the concept of sustainability, that reflects the harmony between man and nature. The tourism hall uses the kinetic panels from recycled compact discs as the facade, which is rotatable when blown by the wind. This research is meant to study people's perception of the installed kinetic facade panel. Here, we divide the respondents into two groups, professionals (academician and architects), and non professionals (Jarak dwellers, visitors and general). The aspects observed are psychology, aesthetics, flexibility, impact to the environment and economics. The result is that there is a difference in perception regarding the flexibility, and also, the colour aspect of the installed kinetic facade is the most memorable aspect of the installed kinetic facade.

1. Introduction

Indonesia is a compound country, that has multi- ethnicity, language and religion, that is reflected in the National motto, 'Bhinneka Tunggal Ika' which can be translated as unity in diversity. Therefore, Indonesia is famous for its pluralism. Pluralism itself means a multicultural attitude and belief where individuals with different backgrounds live side by side with each other. With such diversity, tolerance is needed to avoid major conflicts. Indonesia's plurality can be found in Jarak Village - Wonosalam in Jombang Regency where in 2019 15 students from Miami Dade College, United States came for 3 days to study pluralism and multiculturalism [1]. The population of Jarak village, according to the central statistics data in 2021, totalling 3,245 residents [2] is pluralistic because there is more than one religion believed, namely Islam, Christianity, and Hinduism and Beliefs [3]. The plurality of distant village residents can be felt through the tolerance created between religious adherents. Some of the tolerance activities carried out include organising meetings and gatherings between the younger generation and sharing activities related to religious tolerance. These activities create an atmosphere of brotherhood. To accommodate this pluralism-themed activity, Petra Christian University through Service Learning activities presents a tourism centre and designs it by involving the village government and religious leaders as a form of empathy.



Figure 1. Discussion between the Jarak Village's representatives, religious figures and researchers

The hall is one of the new tourism centres in the village. With the existence of the hall, it is expected to unite the various differences that exist. In making this hall, besides being built to unite the existing diversity, it is also interesting to use the facade of Compact Disc waste. This round slab of metal or polycarbonate that can store digital data is starting to fall behind due to the rapid development of the times. Compact Discs have become an accumulated waste, this can be seen in the workspaces of Petra Christian University. This Compact Disc itself is made from metal or plastic and has weather-resistant properties[4]. The use of waste in the field of architecture itself can be used as an element to form window panels. By making windows from used Compact Discs, it is hoped that they can be used for building facade needs at a low cost but have good aesthetic value and light and thermal control power.



Figure 2. The application of kinetic facade panel from recycled compact disc in the Tourism Hall - from interior

As part of the building facade, the compact disc itself can give a beautiful impression to the building itself. The interesting thing besides the use of materials is the location of the building which is in a mountainous area with good wind potential. The Compact disc facade itself is able to react to the wind like a kinetic facade where it moves itself following the wind direction. Not only aesthetic elements on the facade, the use of Compact disc itself has social, flexibility, environmental and economic benefits [5]. In a social way, this facade itself leads to aesthetic aspects while giving a different impression psychologically which gives a pleasant impression to its users. Moreover, in terms of flexibility, this facade is relatively easy to use by using modular and prefabricated systems that are also able to adjust to wind mobility. Then, for the environmental aspect itself, this facade fulfils the natural conditions and also reduces the use of energy in the hall. And finally, economically, the production of the facade is relatively economical, using recycled materials that are relatively common in the area and also using materials that do not damage the environment.



Gambar 3. The application of kinetic facade panel from recycled compact disc in the Tourism Hall - from exterior

This research aims to study the perception of kinetic facade panels made from compact discs as an ascending element in the Tourism Hall in the village of Jarak - Wonosalam. The approach in this perception study includes various variable aspects, namely; psychological aspects involving emotional and cognitive reactions to people who see the facade. Aesthetic aspects related to the visual beauty of the facade panels. The flexibility aspect of using the facade, the impact on the environment and economics to find out whether the use of recycled materials has significant economic benefits. Building on these aspects, this research seeks to provide an understanding of how this element contributes to the visitor experience and its impact on the tourism sector in the distance village. This research also aims to compare the perceptions of professionals (academics - practitioners) towards the use of kinetic facade panels. This comparison will provide insight into the effectiveness and relevance of kinetic facade panels in the context of tourism. The results of this comparison can provide insight into the views of academics and practitioners on the development and application of innovations such as facades made from compact discs in the tourism industry. This study will therefore create a holistic insight and help to improve the quality of the tourism hall in Jarak Village.

2. Background

2.1. Kinetic Facade

A new trend in facade design that is emerging in various countries is the use of kinetic facades. Architectural technology developments in the last few years have encouraged the use of kinetic facades that move with the wind as an important element in building design. Kinetic facade systems refer to systems that use movable elements, such as panels, fins or louvres, that respond to the wind, creating changes to the appearance or configuration of the building. These facades not only provide an attractive visual effect, but can also improve energy efficiency and thermal comfort in buildings. Kinetic facades are facades that are dynamically moving, rather than static or fixed, allowing for movement of the building surface. Using the term "kinetic" in this context refers to the ability of the system to be affected by changes in geometry either wholly or partially without compromising its integrity [6]. Adaptive kinetic facades have the advantage of being able to adjust to changing conditions, such as weather, time, and location. Kinetic Responsive Facades can be classified into two broad main factors: namely Facade configuration and Facade function. In terms of kinetic, it is necessary to distinguish between kinetic and other approaches to designing designs that can move. The movement changes of kinetic facades in general are translation, rotation, scaling, and material deformation.

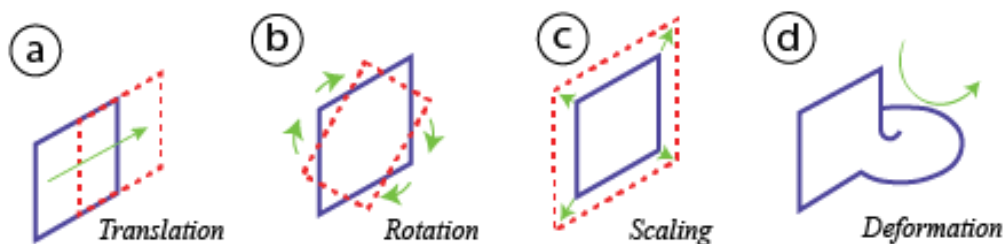


Figure 4. Kinetic movement types: a) Translation, b) Rotation, c) Scaling dan, d) Deformation [6]

2.2. Perception Theory

Individual perceptions of the places where they live, work or spend time are directly influenced by a reflection of the personal, social and cultural identity of the space [7]. A perception is created due to stimuli from the environment around humans and captured by the five senses. Of the five senses, the eye is the fastest to respond to stimulus. Architecture is a building that can present the experience of space directly through the eyes. Physical factors and visual characteristics play an important role in human visual perception that can be received by the sense of sight. Everyone's reaction is the result of perception when someone receives information from outside. An architectural work's success is measured by the perception of architects, users, and observers who are close to understanding [8]. Visual quality is influenced by the level of perception and beauty of the object viewed, whether animate or inanimate objects. This is considered to be the most complex phenomenon that can be examined and measured because it involves perceptual and subjective. It is related to the diversity of elements and factors that have different characteristics.

2.3. Psychological Theory

In general, aesthetic responses to the built environment involve cognitive judgements about building attributes, affect (i.e. emotional reactions), and affective judgements in terms of the connotative [9]. Architectural design has a psychological impact, establishing a kind of communication with the user; architecture occupies and shapes the physical social context as well as influencing perceptions which in turn affect human behaviour in addition the physical design and visual impact not only helps engage the user with its contents, but also allows the user to use his/her senses to recognise the function of a place. Architectural design always has an impact on its surroundings, which depends on the interaction

- the communication of the design with its users. In this case, users will use their senses to recognise and perceive it, resulting in certain thoughts and action patterns [10].

2.4. Aesthetics

Aesthetics is one thing that is contained in Architecture itself, in addition to aspects of strength (Firmity) and function (Utility). In design, the application of elements in the form of materials in buildings has the ability to create aesthetics on building facades. The element can be the use of colour, texture, material and size based on design principles such as rhythm, balance, unity and others [11]. The implementation of materials on building facades is very important because it is part of the design process that can create aesthetic value for unique architectural works. The uniqueness is personal, based on the perception of the observer.

2.5. Flexibility

Flexibility in space can be defined as a spatial design that can fulfil the needs of the space but can be modified at any time according to the needs of the space. Flexibility is one of the things that responds to change and reacts to it, so architecture is not just a static object, but can grow and develop [12]. The flexibility of the facade itself can be seen in this case because it can be used both as a protective element of the building and as a distributor of airflow around the building.

2.6. Impact to the environment

The implementation of kinetic facades to the environment has an impact on the concept of facades that respond to environmental conditions. This is similar to the adaptation of living things to their environment. The facade is therefore designed to respond to the diversity of the environment and also generate energy that can meet the needs [13]. Additionally, the use of compact discs as a reusable material can reduce existing pollution and reduce existing compact disc waste.

2.7. Economy

In reality, the construction of a design always contains economic value. Procurement of the facade as the building envelope also contains economic value, the proportion of which is enough to absorb the procurement budget of the entire building. Previous research mentioned that one of the obstacles in the exploration of facade design is the economic aspect, such as in the design of green walls [14] and adaptive walls [15], even though these studies also mentioned that the non-patented facade design has advantages in various other ways, such as social and energy savings. Use of waste as facade material can be an alternative to reduce the economic value of facade design exploration, such as the use of used car steel as facade panels, which can reduce the procurement price of facades while still having good performance [16].

2.8. Memory and architecture

Memories are connected to time and space that is grounded into a certain place. Though experienced by individuals, memory is not only a subjective matter, but also in the form of embodiment in the real world, that brought people together, as public memory [17]. The embodiment of memory can also be an architecture. Memory of architecture will trigger human's perception to recall a place and also the condition of its surroundings, that finally form a person's spatial comprehension [18]

3. Materials and Methods

This research is a phenomenological and perceptual research that aims to translate the experience experienced by the respondents about the application of a kinetic facade panel in the tourism hall in Jarak Village, that is rotatable and using recycled compact disc. Respondents are categorised by their background, to assess different respondent's perspective by the category. The categories are: academician and architect (grouped to the professionals) also, Jarak dweller, visitor and general (grouped as non professional). The professionals will have prior knowledge regarding the potential of kinetic facade design, while the others might have different perceptions regarding the kinetic facade.

Online questionnaire consisting of 14 questions and a link to a youtube video was given to the respondents, and 96 respondents replied with the valid answer. The youtube video shows how the installed kinetic facade is rotating when blown by the wind, giving the respondents the real image of the kinetic facade (as in link: <https://www.youtube.com/shorts/mSwnL4EzEIM>). Our research team helped the respondents from Jarak dwellers to input their answer to the online questionnaire, due to gadget limitations.

Respondent's answer will be analysed per aspect, which are: psychological, aesthetic, flexibility, impact to the environment, and also economical aspect, to find out if there is a difference in how the respondent percept the application of kinetic panel, especially in respondent with professional and non professional background. This difference is assessed by comparing the means of each aspect. The occurrence frequency of certain vocab in each aspect is also compared, as background data to explain more about this perception.

4. Result and Discussion

4.1 Respondent's background and observed variables

Respondents were divided into five backgrounds; Academics, Dweller, Pecaringan Hill Visitors, Professional Architects, and the general public, with the proportion as shown in figure 5 below

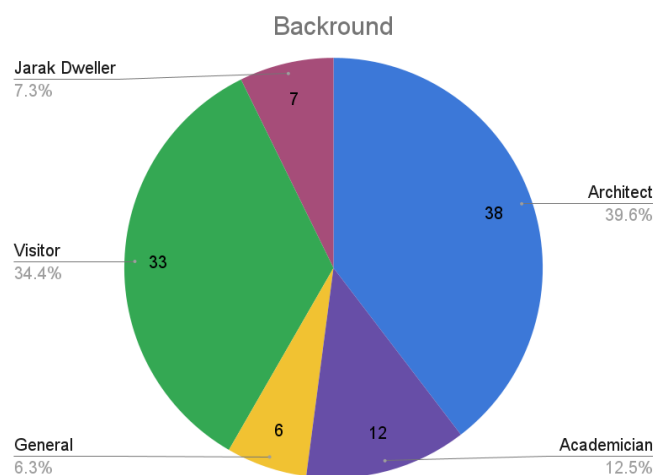


Figure 5. Respondent's background

By the result shown in Table 1., we can see that:

- Jarak dwellers think that the façade design has no psychological impact on the observer. This is based on the similar perception of more than 50% of the villagers who stated that the façade design is good, but does not make the villagers feel a certain emotion. This is reinforced by the answers of some residents, which are more directed towards the function of the building, where the ex-waste façade panels are installed.
- Jarak dweller, on the other hand, give the highest appreciation to the aesthetic and economic value of the CD waste panels. Because they feel that the colours of the CDs, as well as the reflection of light that falls on the CD waste, can provide a beautiful and unique glow.
- For the economic aspect, the people are fully aware that the CD façade panels use recycled used CD materials, thus giving a high value to the economic aspect.
- General respondents tended to give the lowest ratings for all aspects tested. For the record, the general public had never visited Bukit Pecaringan, and had only seen the facade design from

the video. The lowest rating given was for the economic aspect, where the general respondents said that the use of recycled CD materials still required more aluminium frames, and did not use local materials.

Table 1. Result for each variable from differing occupation background

| | Psychology | | Aesthetics | | Flexibility | | Environmental Impact | | Economics | |
|--------------------------------|-------------|--------------|-------------|--------------|-------------|--------------|----------------------|--------------|-------------|--------------|
| Background | | % | | % | | % | | % | | % |
| <i>Academician</i> | 4.00 | 80.00 | 4.09 | 81.82 | 3.82 | 76.36 | 3.73 | 74.55 | 3.82 | 76.36 |
| <i>Jarak Dwellers</i> | 2.83 | 56.67 | 4.67 | 93.33 | 3.67 | 73.33 | 3.33 | 66.67 | 4.67 | 93.33 |
| <i>Tourist</i> | 3.55 | 70.91 | 3.91 | 78.18 | 3.33 | 66.67 | 3.91 | 78.18 | 4.30 | 86.06 |
| <i>Professional Architects</i> | 3.53 | 70.56 | 3.83 | 76.67 | 3.61 | 72.22 | 3.86 | 77.22 | 3.97 | 79.44 |
| <i>General</i> | 3.25 | 65.00 | 3.25 | 65.00 | 3.25 | 65.00 | 3.25 | 65.00 | 2.5 | 50.00 |
| <i>Mean</i> | 3.43 | 68.63 | 3.95 | 79.00 | 3.54 | 70.72 | 3.62 | 72.32 | 3.85 | 77.04 |

When analysed further, the respondents with professional backgrounds (academics and practitioners) found more advantages in the kinetic facade panel design, especially in terms of psychology, flexibility, economy and environmental impact. On aesthetics, the non-professional respondents (visitors, residents and the general public) gave higher scores than the respondents with professional backgrounds, indicating that the design results are quite liked and well received by the public, as well as tourist visitors.

Table 2. Result for each variable from differing occupation background

| | Psychology | | Aesthetics | | Flexibility | | Environmental Impact | | Economics | |
|---------------------------|------------|-------|-------------|-------|-------------|-------|----------------------|-------|-----------|-------|
| Professional vs non | | % | | % | | % | | % | | % |
| <i>Professional</i> | 3.64 | 73 | 3.89 | 78 | 3.66 | 73 | 3.83 | 77 | 3.94 | 79 |
| <i>Non - professional</i> | 3 | 68 | 3.95 | 79 | 3.37 | 67 | 3.77 | 75 | 4.19 | 84 |
| <i>Mean</i> | 3.53 | 70.57 | 3.92 | 78.47 | 3.52 | 70.32 | 3.80 | 75.97 | 4.06 | 81.22 |

Respondents who had visited and seen the kinetic facade panels in person tended to have a higher judgement on the aesthetic and economic aspects of the panel design. Perceptions of the aesthetic aspect become more evident when the respondents have seen the installed panels themselves. The same thing happens for the economic aspect, where the respondents who have visited see the real application of used CD materials that have been installed.

Table 3. Result for each variable based on the visiting site experience

| | Psychology | | Aesthetics | | Flexibility | | Environmental Impact | | Economics | |
|--------------|------------|-------|-------------|-------|-------------|-------|----------------------|-------|-------------|-------|
| Ever visit ? | | % | | % | | % | | % | | % |
| <i>yes</i> | 3.45 | 69.00 | 4.05 | 81.00 | 3.40 | 68.00 | 3.83 | 76.50 | 4.38 | 87.50 |
| <i>no</i> | 3.60 | 72.00 | 3.82 | 76.40 | 3.62 | 72.40 | 3.78 | 75.60 | 3.8 | 76.00 |
| <i>Mean</i> | 3.53 | 70.50 | 3.94 | 78.70 | 3.51 | 70.20 | 3.80 | 76.05 | 4.09 | 81.75 |

When categorised by gender, female respondents tend to give higher scores in each of the variables, with score difference ranging from 0.24 in economics aspect, to 1 point in psychology aspect.

Table 4. Result for each variable based on gender

| | Psychology | | Aesthetics | | Flexibility | | Environmental Impact | | Economics | |
|--------|------------|----|------------|-------|-------------|-------|----------------------|-------|-----------|-------|
| Gender | | % | | % | | % | | % | | % |
| Female | 4 | 78 | 4.26 | 85.14 | 3.8 | 76 | 4.29 | 85.71 | 4.2 | 84.00 |
| Male | 3 | 66 | 3.71 | 74.18 | 3.35 | 66.91 | 3.49 | 69.82 | 3.96 | 79.27 |
| Mean | 3.60 | 72 | 3.98 | 79.66 | 3.57 | 71.45 | 3.89 | 77.77 | 4.08 | 81.64 |

4.2 Respondent's vocab preference

In the questionnaire, we also give open end questions regarding the variables to find the similarity in perception between the professional and non professional respondents. The respondents need to give a short explanation about the reason for their scoring in each variable. Then, from the answer, we collect words that most frequently occur. It turns out that the vocabulary used by the respondents are nearly the same, but in a different intensity. This can be summarised in tables below.

Table 5. Psychological Aspect

| | Vocab | Professional | Non Professional |
|------------|--------------------|--------------|------------------|
| Psychology | <i>Cheerful</i> | 9 | 2 |
| | <i>Colours</i> | 19 | 13 |
| | <i>Fun</i> | 6 | 0 |
| | <i>Happy</i> | 2 | 2 |
| | <i>Interesting</i> | 12 | 8 |

The vocab that most professionals use regarding the psychological aspect is colour and interesting. These vocabs also frequently appear in non professional respondents. Another vocab that is commonly found is cheerful. This proves that colours in the facade panel affect most of the respondent's psychology

Table 6. Aesthetics Aspect

| | Vocab | Professional | Non Professional |
|------------|-------------------------|--------------|------------------|
| Aesthetics | <i>Colours</i> | 31 | 31 |
| | <i>Aesthetics</i> | 13 | 7 |
| | <i>Pattern</i> | 3 | 0 |
| | <i>Interesting</i> | 6 | 12 |
| | <i>Dynamic</i> | 6 | 0 |
| | <i>Light Reflection</i> | 4 | 2 |
| | <i>Decoration</i> | 1 | 0 |

Both professional and non professional use the word colours most frequently in relation to the aesthetics aspect. Beside colour, the professionals tend to use the word 'aesthetics', while the non professionals use the term 'interesting' to define something aesthetically appealing. Architectural terms such as pattern and dynamic only being used by the professionals.

Table 7. Flexibility Aspect

| | Vocab | Professional | Non Professional |
|--|-------|--------------|------------------|
|--|-------|--------------|------------------|

Non professional and professional

| | | | |
|--------------------|----------------------------|----|----|
| Flexibility | <i>Ease of application</i> | 10 | 12 |
| | <i>Rotatable</i> | 7 | 6 |
| | <i>Material</i> | 6 | 0 |
| | <i>Modular</i> | 4 | 1 |
| | <i>Colours</i> | 4 | 0 |
| | <i>Replaceable</i> | 3 | 3 |
| | <i>Not so flexible</i> | 0 | 9 |

respondents feel the ease of application brings out the flexibility aspect of the kinetic facade. The rotatable trait of the kinetic facade also makes the panel seen as flexible by both of the respondents. On the other hand, a group of non professional respondents thinks that the panel is not so flexible, by their own definition of flexibility.

Table 8. Environmental Impact Aspect

| | Vocab | Profesional | Non Professional |
|----------------------------------|--------------------|--------------------|-------------------------|
| Environment al impact | <i>Waste</i> | 9 | 23 |
| | <i>Glare</i> | 6 | 7 |
| | <i>Ventilation</i> | 0 | 4 |
| | <i>Recycle</i> | 24 | 2 |

Non professional respondents think that the use of waste material will have a positive impact on the environment, meanwhile the professionals highlight the creative recycle process for the most impactful aspects to the environment. Both of the respondents also feel the glare from the CD reflection.

Table 9. Economical Aspect

| | Vocab | Profesional | Non Professional |
|------------------------|--------------------------|--------------------|-------------------------|
| Econom ical | <i>Recycled Material</i> | 21 | 34 |
| | <i>Cheap</i> | 24 | 19 |
| | <i>Easy to find</i> | 6 | 3 |

Both of the respondents perceived the use of recycled materials as the reason for the economical aspect in the kinetic panel. The professional also thinks that the cheap source material makes the panel economically efficient.

5. Conclusion

As mentioned before, this research aims to understand more about the difference in perception of kinetic facade panel application in the tourism hall, in Jarak Village. It turns out that there is a slight difference between the respondents with professional and non professional background, where the professionals tend to give higher scores in most of every aspect, excluding aesthetics. When we dig a little more and look into each background, the difference in perception becomes clearer, where the academicians score the highest value in psychological and flexibility aspects. Jarak dweller rates the aesthetics and economical aspect the highest among other categories. In contrast, the Jarak dweller thinks that the kinetic facade has relatively no impact on the psychological aspect.

The visitor of the tourism hall precepts that the kinetic facade has a positive impact on the environment, while respondents with general background score relatively the lowest in all aspects, among the other categories..

When we compare the word used to explain the perception of the kinetic facade, the vocab chosen by both of the categories is relatively the same, except the flexibility aspect. In the flexibility aspect, a number of non professional respondents think that the facade is not too flexible.

We can also conclude that colours are the most memorable element that relates to other aspects that affect the respondent's perception of the kinetic facade panel in the tourism hall at Jarak Village, Wonosalam. The application of colourful paint in the recycled compact discs brings the cheerful impression to the building, according to most of the respondents.

This research can serve as an input and base data for future research regarding the things to consider when implementing and designing kinetic facade, from various points of view.

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