ICRP
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# PROCEEDING OF 3rd INTERNATIONAL CONFERENCE ON REBUILDING PLACE (ICRP) 2018

*Towards Safe Cities & Resilient Communities*

**13 & 14 SEPTEMBER 2018**
**IMPIANA HOTEL, IPOH, PERAK**

**ORGANIZED BY :**

UNIVERSITI TEKNOLOGI MARA

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# ACEH ORNAMENTS EXPLORATION AS IDEAS OF CONTEMPORARY BUILDING FORM THROUGH DIGITAL TRANSFORMATION

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***Abstract -*** Aceh is one of the Provinces that is rich in motives and ornaments. The richnes of Aceh motives and ornaments can be observed in Aceh craft works such as perforative art crafts at Rumoh Aceh, hand-weaving crafts, embroidery crafts, and plaiting crafts found all arround different parts of Aceh. These ornaments can inspire creative ideas of the developing contemporary building oriented in locality.One approach to develop creative and innovative exploration of ornaments is by utilizing fractal methods. The use of jBatik software as one of the innovations in digital technologies can be used as tools in the process of exploration and transformation of Aceh ornaments with fractal method approach. The use of jBatik software is considered suitable to create similar pattern or motives observed between Aceh ornaments and batik.The chosen study case in this study was the development of the terminal building of Sultan Iskandar Muda Airport in Aceh. The steps of transformation process are: analysis and improvement of ornament geometry, interpretation of fractal principles on ornaments, interpretation of ornament variants with jBatik and exploration of interpretation results of ornament with fractal application. The application of ornament transformation into architectural design is done in 3 ways, i.e. development of alternative design of building study case, application of ornament exploration in designs, and finalization of the designs. Aceh ornament exploration through this digital transformation process is expected to re-actualize the traditional architectural heritages into a contemporary context and to contribute in the enrichment and preservation of local ornaments using technologies.
***Keywords -*** exploration, Aceh ornaments, digital transformation, jBatik, design method.

## 1 INTRODUCTION

Aceh is one of the Provinces that is rich in motives and ornaments. The province is located at the tip of the Sumatera island with 23 Regencies/Cities in which every Regency/City has a distinctive motives and ornaments respectively.

Figure 1 Map locations of Aceh Province
(Sources: https://bit.ly/2zDbJ2x, 2018)

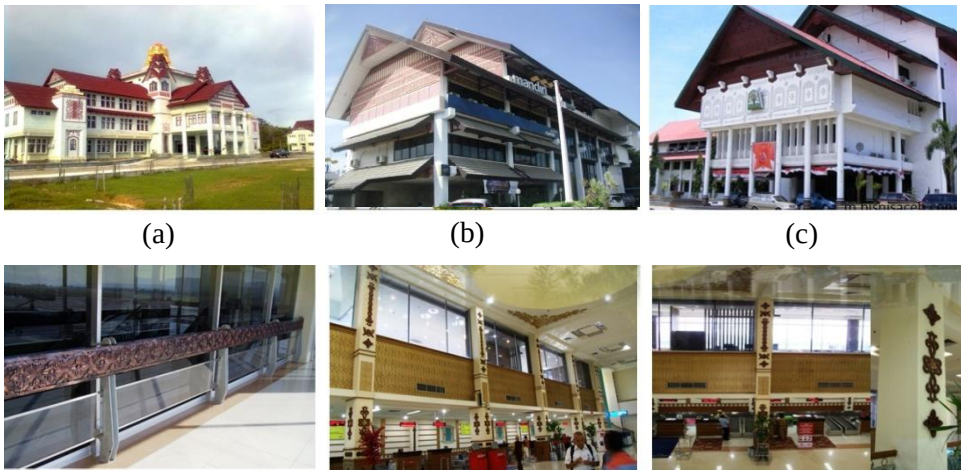
The richness of Aceh motives and ornaments can be observed in Aceh craft works such as perforative art crafts at Rumoh Aceh (figure 2a), hand-weaving crafts (figure 2b), embroidery crafts (figure 2c), and plaiting crafts (figure 2d) found different Regency/City in Aceh.

(a) (b) (c) (d)

Figure 2 The richnes of Aceh motives and ornaments
(Sources: https://bit.ly/1eT8c0L, https://bit.ly/2JpcXOo, https://bit.ly/2uBEjf7, 2018)

In this study, the focus is perforative art crafts (ornament in Rumoh Aceh). These ornaments can inspire creative ideas of the developing contemporary building oriented in locality. The use and application of Aceh ornaments in the current architectural designs generally still look stereotypical, i.e. form tracing without further elaboration process. Nevertheless, it should be appreciated as one of the efforts in maintaining and preserving the existence of Aceh ornaments which gradually became rare as lesser Acehness build this kind of traditional house.

Here are some examples of the use and application of Aceh ornaments in building design, among others: The Regent of Aceh Jaya Office, that is located on the roof and wall elements (figure 3a), Bank Mandiri Office Banda Aceh, located on the roof and wall elements (figure 3b), Governor's Office of Aceh, is located on the roof, wall and column elements (figure 3c), and Sultan Iskandar Muda Aceh Airport, which is located in the interior (figure 3d, 3e, 3f).



(a) (b) (c)

(d) (e) (f)

Figure 3 Application of Aceh ornament on public building
(Sources: https://bit.ly/2LfbsHJ, https://bit.ly/2NkJcky, 2018)

One approach to develop creative and innovative exploration of ornaments is by utilizing fractal methods. Utilization of the method is performed by using jBatik software to transform Aceh ornaments applied into building design elements. The transformation can regenerate the new and more dynamic, aesthetic formations and patterns of modern Aceh ornaments. The study case in this study was the development of the terminal building of Sultan Iskandar Muda Airport in Aceh. This explorative study was conducted to develop a new approach in codifying local ornaments with the

advancement of computational processes. Aceh ornament exploration through this digital transformation process is expected to re-actualize the traditional architectural heritages into a contemporary context and to contribute in the enrichment and preservation of local ornaments using technologies.

Figure 4 Sultan Iskandar Muda Airport
(Sources: Firman Hidayat, 2011)

As architects, we must have a frame of mind adapted to the times and conditions of today's ideal, rather than being forced to think with outdated structures from the past. Local culture should be able to synergize with modernization as a collaboration to complement each other. In its development, the local culture must utilize sustainable technologies in building a new path of knowledge.

## 2 ACEH ORNAMENT

In the context of architecture, ornaments are elements of decorations used to beautify parts of a building or an object. Acehnese cultures are strongly influenced by Islamic culture. Therefore, most motives, ornaments, and Aceh craft designs are derivated from Islamic cultures. According to Barbara Leigh, (1989) the motives used in Aceh are divided into 5 categories: (1) geometric patterns, (2) floral patterns, (3) bird patterns, (4) other animals patterns, and (5) islamic calligraphy patterns.

If investigated further, they contained mathematical logic in created patterns based on Aceh ornaments geometry. Basically Aceh ornaments is simple geometry that contains not only repetition (iteration), recursion, movement, rotation, scale, but also the reflection which combined with each other in a variety of scales and positions. Aceh ornaments can be created both generatively and iteratively. Generatively means it can be reconstructed using the same technique, and iteratively refers to its construction that is done in a similar repeated pseudo-algorithmic pattern.

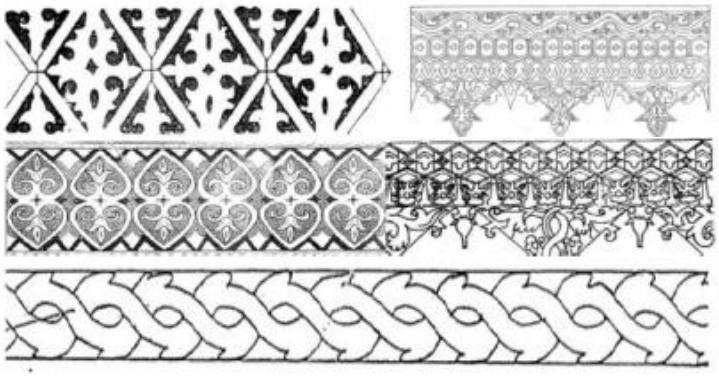
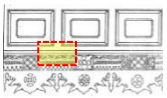


Figure 5 Aceh ornament
(Sources: Seni Rupa Aceh)

In this study, the ornaments to be transformed is Bungong Seulanga ornaments. This ornament was chosen after going through the transformation process in trial and error to three ornaments selected earlier, among others: 1) Pucok Reubong ornaments, 2) Bungong Seulanga ornaments, and 3) Bungong Jeumpa Keumang ornaments.

Tabel 1 List of chosen Aceh ornaments

| Name of Ornament | Origin of Ornament | Basic shape | Geometrical Tracing |
|---|---|---|---|
| Bungong Seulanga |  |  |  |

## 3 FORM TRANSFORMATIONS IN ARCHITECTURE

In simpler word, transformation is a process of change from an initial form into a new form. Transformation is strongly tied to the creativity of changing the shape of "origin" into a "new" form tailored to the corresponding context. The creativity inherent in architectural transformation is the process of how to explore the essence of the original form and how to reconstruct the original form into a new form.

The highest level of creativity in architectural transformation occurs when the designer successfully explores the essence of the original form and transforms it into new forms as a result of more innovative design exploration. Actualizing Aceh ornaments richness as a legacy of the past into the current context can be tailored to the goals to be achieved such as representing the Acehnese identity, the value to be displayed, the functional aspects, and the use of technology.

According to Slamet Wirasonjaya "The world is transformed from one form to another and from one adventure to another. While the design should be able to transform themselves remarkably from original to futuristic".

In design theory, Antoniades (1992) said that the transformation is the channel of creativity. Antoniades (1992) explains that there are three forms of transformation strategies in design: traditional, borrowing, and decomposition/deconstruction. The traditional strategy is to emphasize the step-by-step form of transformation through adjustment to external factors, internal and aesthetic elements. Borrowing strategy refers to elements or components of objects around which were studied and interpreted as metaphorical or analogical references. Decomposition/deconstruction strategy suggests a process to interpret objects apart and then find a new way to recombine the parts to find a new order in a different composition.

## 4 JBATIK AS TRANSFORMATION TOOLS

The rapid architecture growth has caused the appearance of new methods, trends, and paradigms. Those changes are influenced by the development of engineering technology intensively. The architecture world has undergone a progressive development in the use of digital technology to assist in the creative process of architectural design.

The use of jBatik software as one of digital technology innovations can be used as tools in the process of exploration and transformation of Aceh ornaments with fractal method approach. Mathematical logics is in the form of Aceh ornaments patterns that can be translated into the software to create new combinations of patterns that are more innovative.

jBatik is a software that can produce patterns by using mathematical formula (fractal). From one fractal formula, the software can generate various patterns simply by changing the parameters. A pattern can be modified and combined with other patterns or create different new patterns.

The use of jBatik software is perceived suitable because of the similarity between pattern or motives of Aceh ornaments with batik. Blending technology with the locality gives the understanding

that the locality, in this case, the Aceh ornaments, are able to be adapted to the technological advancements that represents the dynamic basic of Aceh ornaments.

## 5 FRACTAL APPLICATIONS ON JBATIK SOFTWARE

jBatik is a software to make batik pattern by using fractal formula. jBatik uses one type of fractal that is an L-system language to create forms of batik motifs. L-systems are part of the mathematical sciences that deal with iteration, recursition, movement, rotation, scale, and reflection.

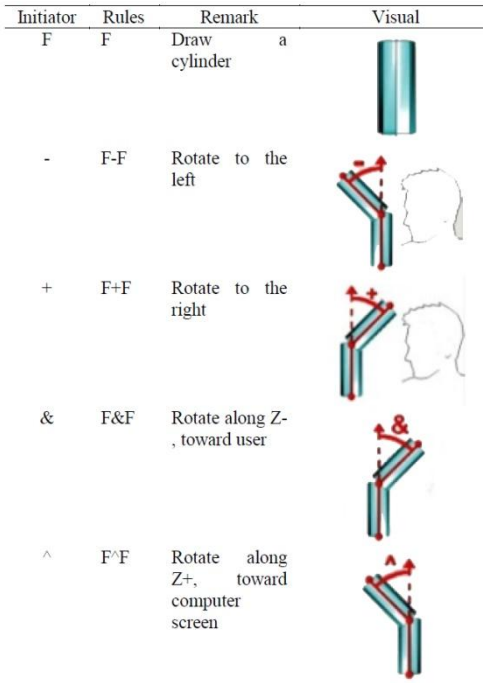



Figure 6 Example of variables and rules in jbatik
(Sources: Preserving local ornament through algorithm)

In L-system language, the structure of the language consists only of the main formula (axiom) and the detail formula. The main formula is the initial symbol used. While the detail formula is the symbols used to replace the initial symbol of the main.

For example:
Main Formula: A
Detail Formula: A = AB
The meaning of iteration is to replace A with A = BA repeatedly. For example, if Iiterate Axiom: A as many as n times the following sequence will be generated:
n = 0 → iteration 0: A
n = 1 → iteration 1: AB
n = 2 → iteration 2: ABB
n = 3 → iteration 3: ABBB
n = 4 → iteration 4: ABBBB
n = 5 → iteration 5: ABBBBB
n = 6 → iteration 6: ABBBBBB
n = 7 → iteration 7: ABBBBBBB

## 6 ALGORITHM OF ORNAMENT TRANSFORMATION

Simply put, the notion of algorithm is the process of trace instruction in the description of ornament transformation by using jBatik software. The process of transformation digitally using a computer cannot codify something that is abstract like the value and meaning of the socio-cultural elements which exist in the ornaments of Aceh. The process of transforming Aceh ornaments using fractal-based digital technology such as:

### 6.1 Analysis and Improvement of Geometry of Bungong Seulanga Ornament

This refinement step is done by using AutoCAD based on the original geometry of structure and shape of Bungong Seulanga ornament. The analysis is on how the basic form and the transformation rules take place on the geometry form of Bungong Seulanga ornament as reference for further transformation process using fractal methods.

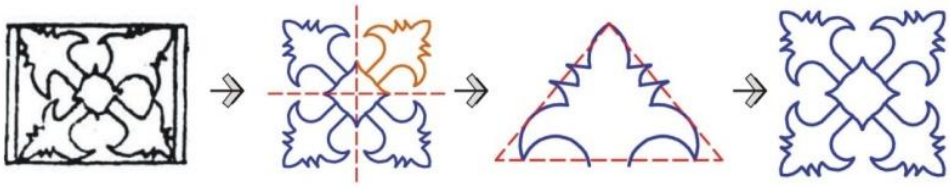


Figure 7 Analysis of Bungong Seulanga ornaments geometry

### 6.2 Interpretation of Fractal Principles on Ornaments

This stage is done to acquire the principles and parameters of fractal and geometry on Seunga bungong ornament. The fractal principles present in the Bungong Seulanga ornament is self-similarity (fractal made from different parts of one another) and self affinity (fractal as in series of interconnected parts of one another). Fractal parameters that affect the formation process are the number of iterations (repetition), the angle and the length of the initiator (preliminary) and the generator (ornament).

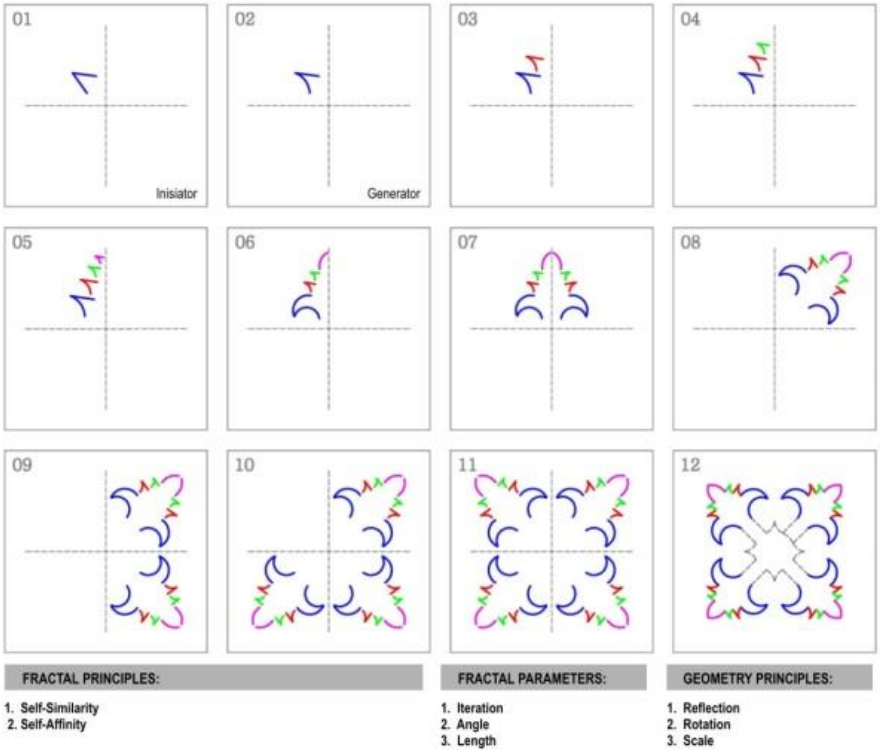



Figure 8 Interpretation of the principle of fractal ornament

### 6.3 Interpretation of Variant Ornaments with jBatik

This stage was tackled by interpreting Bungong Seulanga ornament variants as much as 3 (three) pieces to get the results close to the ornament form of reference in the database. This stage was done by interpreting the smallest elements of the ornamental structure formers and the iteration structure of the ornamental structure-forming elements. Afterwards, the iteration structures of the ornamental structure-forming elements are combined into a whole ornament based on the results of the analysis and improvement of its geometry. Ornament interpretation process was done by using the rules of depiction with jBatik software, i.e. by using the L-system language.

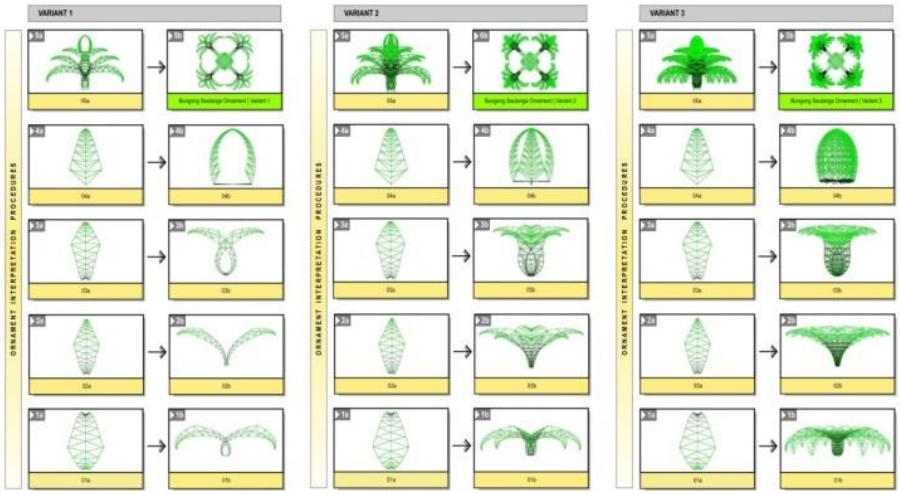



Figure 9 Ornament interpretation variant with jBatik

### 6.4 Exploration of Ornament Interpretation Results with Fractal Application

This stage begins by sorting the structures and substructure of the ornaments, and the ornament-forming elements along with the algorithm process. One element of the ornament structures was chosen as the basic concept for exploration in the development of various architectural forms with jBatik. A consideration in determining the elements of ornaments used, among others, is the suitability of the shape with the figure of the building to be designed, the complexity of the results of transformation associated with the application process on the design, and the aesthetic value resulting from the transformation process.

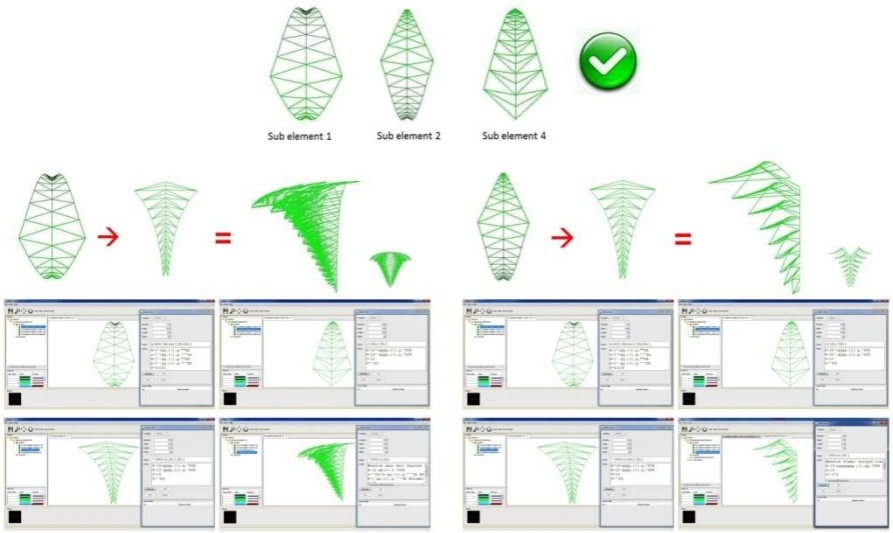



Figure 10 Transformation of ornaments interpretation results into fractal interpretation

## 7 EXPLORATION OF SHAPE IN BUILDING DESIGNS

The process of exploring the shape of the building with a study case of Sultan Iskandar Muda Airport in Aceh is accomplished in 3 ways:

### 7.1 Developing Alternative Designs for the Building in this Case Study

This stage was done by studying the conditions of existing design of the airport terminal Sultan Iskandar Muda Aceh. From the interpretation of the basic geometry of the existing design, geometry development of new building figures was adapted to the concept of exploration result and interpretation of ornament with fractal application.

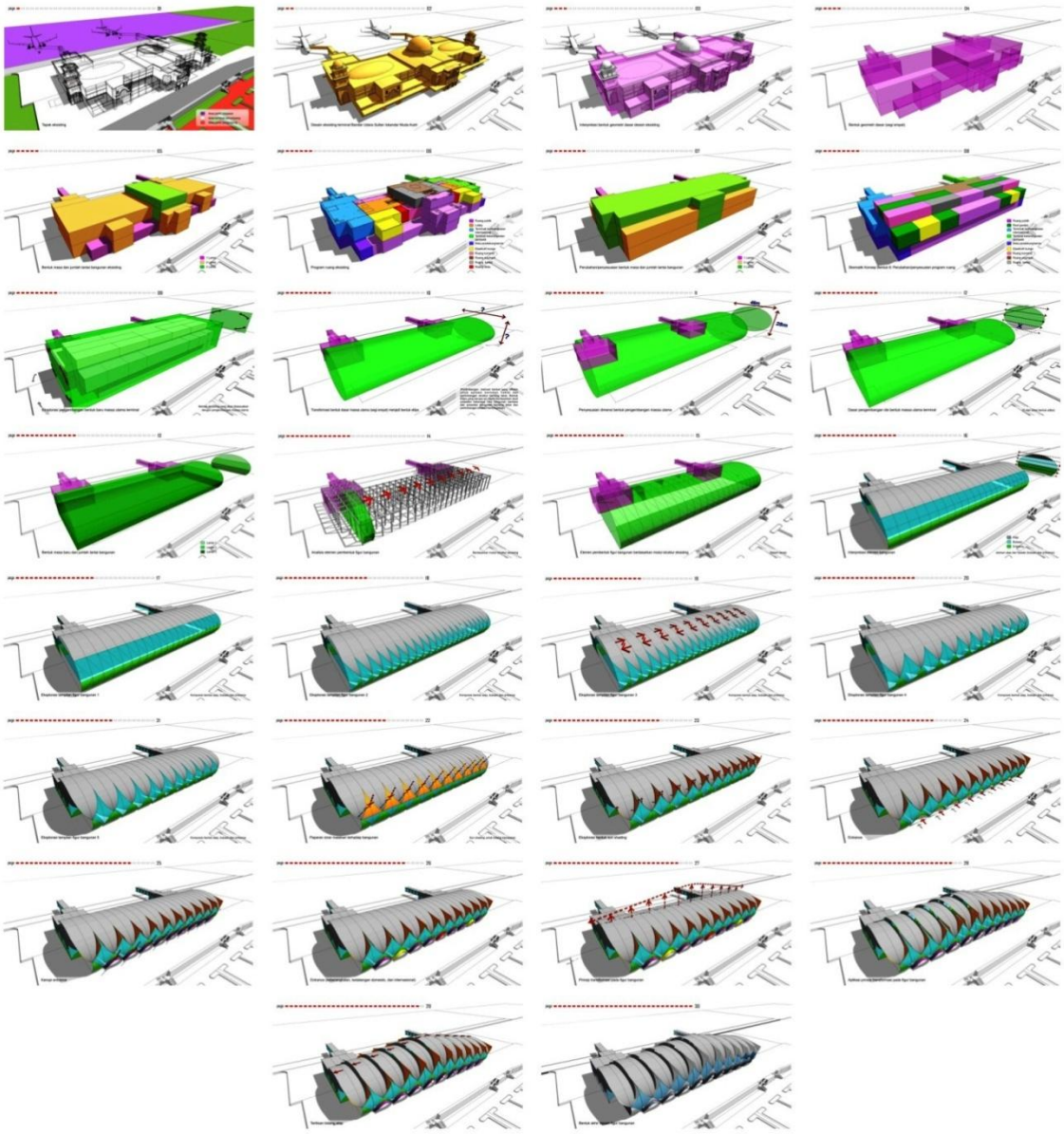


Figure 11 Development of building figure design

### 7.2 Application of Ornament Exploration Results on Design

This stage was the stage of application / application of exploration which resulted from the ornament interpretation with jbatik after the simplification and the completion of the designs.

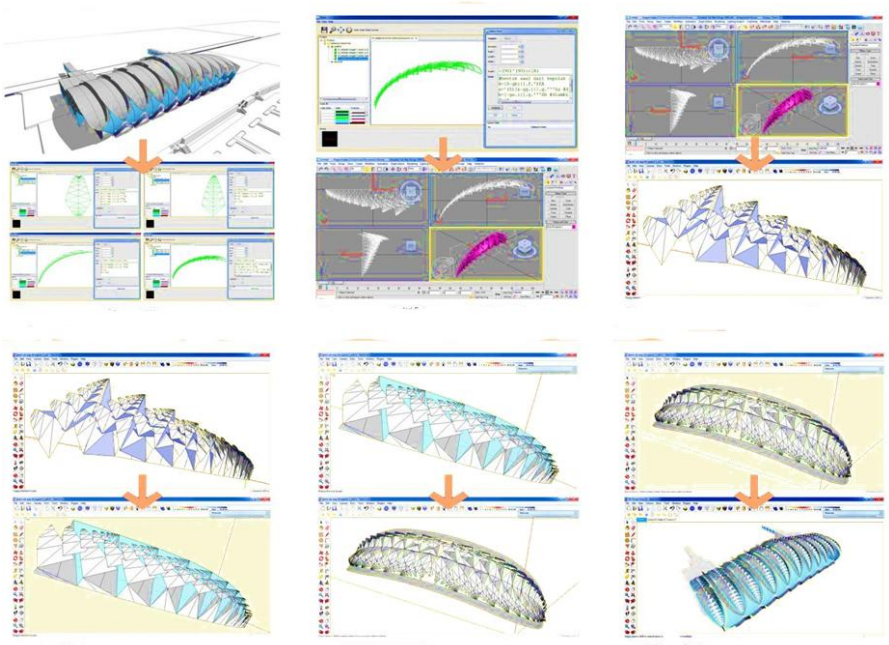


Figure 12 Application of ornaments exploration results on design case study

### 7.3 Finalisation of the Designs

This stage was the final stage of the Aceh transformation process using fractal-based digital technologies (jBatik software) and its application to the designs.

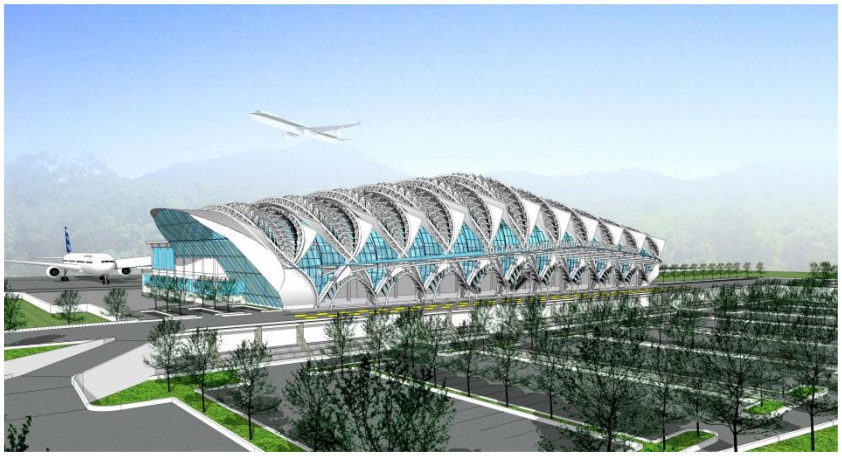


Figure 13 Finalization of the designs

## 8 CONCLUSIONS

Exploration of ornaments with fractal method is novelty in architectural design. With the help of digital technology, Aceh ornaments can be re-explored in variants of new, unimaginable forms to be developed into contemporary building designs.

Transformation with jBatik tends to lead to the decomposition method and will eliminate the "spirit" of the original form of the ornament, therefore it is necessary to combine borrowing method to keep the original shape visible. The use of fractal methods with jBatik software should be used

under the supervision of local cultural experts to preserve the identity and meaning of local ornaments.

This explorative study was undertaken to develop new approaches in the execution and codification of local ornaments with the advancement of computing processes that contribute to the enrichment and preservation of local ornaments using digital technology.

**REFERENCES**

Antoniades, AC (1992). Poetics of Architecture: Theory of Design,Van Nostrand Reinhold, New York

Edgar. Gerald., (2008) Measure, Topology, and Fractal Geometry, Second Edition, Springer Science+Business Media, New York.

Ekomadyo. AS. (2013). Fractal Parametric Design for Transforming Traditional Patterns into Contemporary Building", International Conference on Digital Architecture, DADA 2013 Series of Events "Digital Infiltration", Beijing.

Indraprastha, Aswin,. (2013). Preserving Local Ornament Through Algorithm", International Conference on Advanced Computer Science and Information Systems (ICACSIS), Journal of Computer Science and Information, Volume 6, Issue 2.

Kasim, MS., (1996). Seni Rupa Aceh, CV Sepakat Baru, Banda Aceh.

Kenneth Falconer., (2003). Fractal Geometry, Mathematical Foundations and Applications, Second Edition., John Wiley & Sons Ltd, England.

Leigh, Barbara., (1989). Tangan-tangan Terampil Seni Kerajinan Aceh, Penerbit Djambatan, Jakarta.

Moussavi, Farshid and Michael Kubo., (2008), The Function of Ornament, Harvard university, Graduate School of Design.

Stiny, G and Gips, J., (1978). Algorithmic Aesthetics: Computer Model for Critism and Design in the Art, University of California Press, Berkeley Los Angeles, London.