WALENNAE: Jurnal Arkeologi Sulawesi Selatan dan Tenggara, 20(1), 27-36
ISSN (p) 1411-0571; ISSN (e) 2580-121X
Website: http://walennae.kemdikbud.go.id
http://dx.doi.org/10.24832/wln.v20i1.420

CASTING OF A HUMAN SKELETON AT LEANG JARIE, MAROS: ARCHAEOLOGICAL DATA PRESERVATION AND RESCUE

Casting Rangka Manusia di Leang Jarie, Maros: Bentuk Pengawetan dan Penyelamatan Data Arkeologi

[a]**Lenrawati** and [b]**Budianto Hakim**
Balai Arkeologi Provinsi Sulawesi Selatan
Jalan Pajjayang Nomor 13, Sudiang Raya, Makassar, Indonesia

[a]st.keppo@gmail.com, [b]budianto.hakim@kemdikbud.go.id

Received: 31/01/2020; revision: 26/11/2021-08/06/2022; accepted: 09/06/2022
Published online: 30/06/2022

Abstrak

Temuan rangka manusia Leang Jarie, berada dalam wilayah Kecamatan Simbang, Kabupaten Maros. Temuan rangka ini memperlihatkan kondisi yang sudah mulai rapuh. Kondisi inilah yang kemudian menjadi salah satu alasan untuk dilakukan dokumentasi dan penyelamatan. Dokumentasi yang dilakukan melalui pembuatan replika. Replika atau duplikasi dihasilkan melalui pembuatan casting pada rangka manusia tersebut. Tujuan pembuatan replika manusia untuk pelestarian nilai budaya serta untuk penyelamatan data arkeologi sebagai bahan pembelajaran atau pameran. Metode yang digunakan berupa pengumpulan data, pengelompokan data dan pembuatan replika rangka manusia di Leang Jarie. Pembuatan replika rangka manusia secara insitu memiliki tahapan dan proses kerja yang cukup memerlukan tenaga dan waktu, karena sebelum dilakukan casting diperlukan penanganan temuan terlebih dahulu agar objek tidak rusak akibat pembuatan pola cetakan. Hal yang perlu diperhatikan adalah pembuatan adonan untuk menghasilkan replika rangka manusia Leang Jarie, yang sesuai dengan bentuk aslinya. Hasil penelitian menunjukkan bahwa replika yang dihasilkan tidak 100% terekam secara keseluruhan tetapi beberapa informasi sudah dapat diamati tanpa perlu ke situs. Casting rangka manusia di Leang Jarie merupakan benda replika yang sengaja dibuat untuk dapat di pamerkan ke publik dan sebagai bentuk pelestariannya.
***Kata Kunci**: Casting, Rangka Manusia, Bahan Casting, Nilai Penting*

Abstract

The human skeleton of Leang Jarie was discovered in the Simbang District of Maros Regency. The discovery of this skeleton indicates that its condition has deteriorated. This became one of the causes for documenting and rescue later. The production of replicas is used to document the process. Castings of the human skeleton are used to create replicas or duplications. The goal of creating human replicas is to conserve cultural values while also preserving archaeological data for use as educational materials or displays. In Leang Jarie, the process is data collecting, data aggregation, and the creation of a human skeleton model. Making an in-situ copy of a human skeleton has steps and labor processes that require a lot of energy and time, because it's required to handle the object first so that it doesn't get harmed while the mold pattern is being made. The production of dough to create a copy of Leang Jarie's human skeleton that is accurate to the original form is something that must be considered. The result revealed that while the replicas produced were not 100% accurate but some information could be observed without having to visit the site. The human skeleton casting at Leang Jarie is a reproduction that was created with the intention of being displayed to the public and preserved.
Keyword: Casting**,** Human Skeleton, Material of Casting, The Benefits

INTRODUCTION

Most areas of Indonesia, including the Maros regency, have evidence of caves being used as residential and burial sites since prehistoric times (Fakhri, 2017; Hakim, 2011; Hasanuddin, 2002a; Intan, 2001; Kosasih, 2003). Maros has a lot of archaeological potential in terms of past human life (Hasanuddin, 2002b, 2009). Human traces of various types have been discovered, both intact and in fragments (AKW, 2006). Bone fragments, both animal and human bones, are among the most common discoveries discovered during excavations (Saiful & Hakim, 2016).

The Leang Jarie Site is located in the karst area of the Simbang District of Maros Regency, Sulawesi Selatan, at 50 02' 07.7" S, 1190 44' 33.1" E, and 102 msal elevation (Fakhri & Hakim, 2019; Suryatman et al., 2019). In 2016, human teeth were discovered on the cave surface at the Leang Jarie site, along with other archaeological findings (Hakim, 2017).

Figure 1. Excavation Square at Leang Jarie, Maros (**Source**: Balar Sulsel, 2019)

The excavations proceeded in 2018 to follow up on the teeth discoveries. The excavation began with the opening of the S1B2 excavation square, where it discovered a human skeleton 19 cm below the ground surface. Excavation resumed with the aim of determining the skeleton's relationship and orientation on the ground surface. The human skeleton of Leang Jarie 1 was unearthed in one context after being exposed in the excavated boxes S1B2, S1B1, S2B2, and S2B1(Figure 1 and 2) (Fakhri et al., 2021).

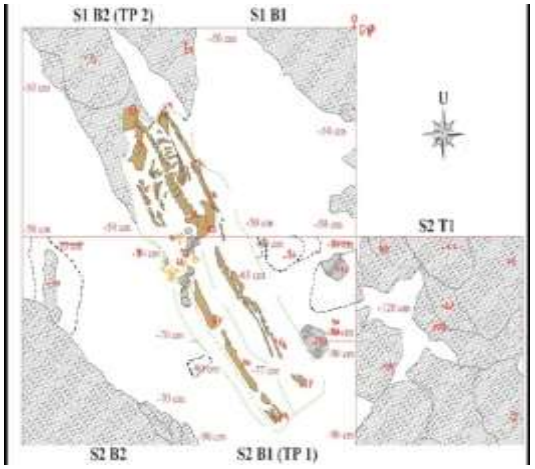

Figure 2. The Potition of Human Skeletal on Excavation Squares (**Source**: Balar Sulsel, 2019)

This research discovered a full human skeleton in a fragile condition, making skeleton removal extremely challenging. This human skeleton was discovered in a straight supine position in a sea-southeast direction, indicating that it was buried as a primary burial. The head and body appear to be resting on a rock. The skeleton is still intact and recognizable in cultural layers discovered 2700 years ago, with a ratio of 70% to 90% (Fakhri & Hakim, 2019).

The discovery of a human skeleton is a valuable piece of knowledge concerning prehistoric human features. As a result, the project's leader (Budianto Hakim) chose to cast a human skeleton at the Leang Jarie site. It was created since the original skeletal discovery had become fragile. Furthermore, it is planned to conduct an additional study on skeletal DNA in order to determine ethnicity, gender, disease types, and other variables.

The previous article discussed ex-situ cultural heritage object documentation (replicas). The findings indicated that the casting process included efforts to salvage pieces that were already frail or damaged. Additionally, it is critical to remember not to omit critical information present on the object's surface (Lenrawati, 2020),

Documentation is the method and process by which documents are created. It contains a sequence of data collecting, sorting, processing, and distribution actions associated with the creation of information. Documentation is also a method of recording data about field-verified damage, which is critical as authentic and historical proof that shows real situation. While the documentation process is extensive, it can be beneficial because it acts as a reference to assist another party in resolving a problem. Moreover, documentation can assist someone in comprehending the actual issue. Documentation actions are likewise carefully designed and purposeful. Documentation, in its simplest form, seeks to discuss and obtain information about an issue or activity, and then presents it as a source of information. Further, documentation might serve as a means of extending the memory of previous activity. Even if the object is lost or damaged physically. There are various kinds of documentation, including narratives, images, photographs, and videos. Also, there is the hand manufacturing of copies, referred to as casting. The purpose of replicas or castings is to create a physical experience that can be touched and played in order to gain hands-on experience.

In archaeology, it is commonly considered as an attempt to precisely preserve data about an archaeological artefact in three-dimensional form, so that all existent dimensions and surfaces on a replica are identical to those on the original thing (Wijayanti, 2017). Casting is often used to preserve significant archaeological remains, such as human skeletal remains. Silicon rubber, resin, catalyst, and vaseline are all materials required in the production of replicas. At the Leang Jarie site, the casting will be done in-situ, which means that this will take place right where it is needed. A significant distinction exists between in-situ casting and standard casting. Preparation of the skeleton before it is printed clearly demonstrates the difference. It is intended to strengthen the finding so that it will not be destroyed when printed, and it is varied depending on whether it is being handled in a different habitat, soil, or matrix than the object to be printed (Nugroho, 2009).

Documentation in the form of data recording on Leang Jarie's human skeleton is crucial in order to gain comprehensive data. The recording does not have to utilize the most advanced techniques; it is sufficient to record data using casting techniques, so that objects can be perfectly documented as well as information delivered to the public.

As stated in the previous paragraph, documentation is essential. Leang Jarie's cast of skeletal remains serves as an example of how this technique might be re-explained with research questions, such as how to make a human cast on the site in-situ? In-situ castings are used for preservation, educational purposes, and exhibitions. The process of creating human skeleton castings in-situ at Leang Jarie, Maros, was also documented in this way as part of the study.

METHOD

As an example of in-situ casting production, a guide of the Leang Jarie site's in-situ casting process is provided using descriptive approaches. According to other studies on human skeletons found at the Leang Jarie site and casting techniques, the process was broken down into multiple stages of works. Interviews with the informants were used to gather data in the field (Ginarto and Slamet). Observations and recordings of the casting production process were also done on the site. The sorts of materials used, and all work techniques are

critical aspects at this stage. Afterwards, images were taken to document the find's condition and the results of the human skeleton replica.

The classification of work steps is the next phase. Replicas will be made by recognizing and categorizing data related to the object of discovery, which is a necessary step in moving forward with the project. The purpose is to create a moldable container that helps to capture casting data. Casting is a molding process in which the object is initially coated in material (Sukendar, 1999). Casting activities are similar to experimental activities in that the aim is to produce objects in their original form (Rasyid, 2017). In addition, a review will be created to ensure that the data is accurate. For five days, the skeleton of a human was cast in order to create a copy.

RESULT AND DISCUSSION

1. Casting Tools and Materials

Human skeleton reproductions require a wide range of tools. Tools for blending materials vary from a 5 ml. plastic measuring cup and dropper to a 50 ml plastic cup beaker and a small-funnel separation funnel to masks and gloves. They also include tools for cutting and sawing as well as items for polishing and cleaning.

While the materials used are silicone rubber rhodorsil type RTV 683 along with catalyst, plasticine, vaseline, silicone oil, arindo resin, resin catalyst, talc (powder), gypsum (plus gypsum), acetone, color pigments (yellow, red, white, brown, and black), ground powder, fiber (optional), gauze or the like, aluminum foil, nails, old newspapers, fox glue, bolts, blocks, plywood.

Materials used in the production of human skeleton replicas serve the following purposes:

a. Vaseline is a petroleum jelly-based semi-solid used as a releasing agent between various materials.
b. As a synthetic polymer, silicone rubber can withstand temperatures of up to 2500°C or remain flexible at temperatures between 100 °C and 250°C. This makes it ideal for making negative molds because it is resistant to weather, cold, wind, and high temperatures.
c. Catalyst is available in one packet when purchasing silicone rubber and works to harden the silicone rubber dough. As the mixture increases, proportion will lessen.
d. Polydimethylsiloxane (PDMS) is a translucent or colorless liquid that acts as a flexing agent for silocone during the molding process, making it easier to pour and place the mold.
e. Resin is a chemical compound that is slightly viscous, tends to be transparent, insoluble in water, combustible, and hardens quickly when mixed with a resin catalyst. Because of its liquid consistency and the ability to harden through chemical reactions, polyester resin is the resin of choice for making castings.
f. In order to harden resin, a resin catalyst must be added to the resin mixture (release of heat energy). The smell of this chemical is harsh. The drying process is accelerated by the addition of resin catalyst, and the more catalyst used, the faster the drying rate.
g. Dough thickening and flexibility can be achieved by using talc powder as a resin combination. White flour-like talc powder is used as a filling to make the resin dough more flexible and stronger when it dries, making the resin more resistant to cracks.
h. Because gypsum is a flexible building material, it is used in the production of castings as a buffer on the mold that acts as a support, facilitating the process of releasing the positive and negative pattern molds.
i. Acetone is used as a solvent such as waxes, resins and glues.

j. Fiber (mat) is used as the outer layer or outer frame of the production of casting molds.
k. Aluminum foil is used to wrap materials or as a coating in the manufacture of castings.
l. Cotton is used to fill the voids or gaps between the silicone rubber layer and the outer layer of the negative mold made of resin.
m. Thinner is used to clean brushes that have been used for applying resin, so they don't harden by soaking (Nugroho, 2009).

Making replicas requires several stages, from creating negative mold patterns to creating positive molds, coloring, and finally constructing replica crates or stands and information boards about the human skeleton's discovery.

2. Procedure for Handling Leang Jarie Human Skeleton Finding Before Casting

Making an in-situ replica of the human skeleton in Leang Jarie begins with treating the finding, which takes the form of chemically strengthening artifacts (paraloid). The research team had already carried out this technique, namely by conserving and consolidating the human skeleton discovered in Leang Jarie 1.

The consolidant paraloid B-72 and the solvent 95% acetone were used in the strengthening procedure. The human skeleton must first be cleaned before the strengthening process can begin. Several bone fragments that have been detached from the main bone are taken during the cleaning procedure, and for the strengthening phase, paraloid solution is dripped onto the finding repeatedly or twice. The first strengthening process compared 200 grams of paraloid B-72 to 1000 ml of acetone, and the second process increased the percentage of paraloid to 250 grams and the percentage of acetone to 1000 ml. The paraloid solution was dripped directly onto the human skeleton as well as onto the preserving soil about 3-5 cm from the bone to tighten the context. In general, this strengthening operation was carried out in order to preserve and cast the context of the burial at the site (Figure 3 and 4).

Figure 3. Giving Paraloid to Leang Jarie's Human Skeleton. (**Source**: Balar Sulsel, 2019)

Figure 4. Leang Jarie's Human Skeleton Condition After Being Given Paraloid. (**Source**: Balar Sulsel, 2019)

The cavities seen in the finding of the human skeleton were also closed due to its delicate nature, but so was the distance between the ground and the object. This treatment seeks to keep silicon rubber from entering the cavity and potentially damaging the findings. Additionally, spraying water slowly is used to level the ground surface, as well as ensuring that there is no dirt around the object that will be replicated.

3. Negative Mold Pattern Making Process of The Human Skeleton

Human skeletons that have been cleansed are thoroughly coated with Vaseline. The aim of this process is to make it possible to release negative mold patterns with the skeleton. Following that, 100 ml of silicone rubber dough was prepared, to which sufficient powder and 3.5 ml. of silicone rubber catalyst were added and mixed until smooth. The silicone rubber dough is then evenly poured over the whole surface of the human skeleton, as well as the earth and rock surfaces surrounding the excavation square. Applying silicon rubber is repeated several times to ensure that the negative pattern mold does not break easily. Then, apply a layer of gauze to the surface of the silicone dough. The human skeleton is re-coated with silicone rubber dough to strengthen the dexterous pattern, and thus the mold is left to dry completely.

After the silicone rubber has dried, apply Vaseline to the surface. Furthermore, observations were conducted on the results of creating silicone rubber to identify some locations that required gypsum as a buffer to maintain the negative mold pattern, then the drying process was proceeded. This procedure is beneficial for preserving the location of the skeleton, easing the process of releasing the mold, and maintaining the pattern's shape in accordance with the original. Gypsum was chosen as a buffer material because it is simple to form to the desired shape. It's wrapped in aluminum foil and vaseline.

The final step is to re-create the silicone dough as reinforcement for the previous basic mold. This dough is likewise comprised of 100 ml of resin, adequate powder, and 3.5 ml of resin catalyst, which must be added to form a non-thick mixture. Stir until smooth. The dough is then evenly spread onto the surface of the silicone rubber until the entire surface is covered, then left to dry. After the resin dough has begun to dry, smooth a layer of fiber over the entire surface before coating it again with the resin mixture, powder, and resin catalyst. The lubricating procedure is carried out by continuously pressing the brush so that the resin mixture is absorbed by the fibers and does not develop cavities. Repeat the coating process until the required thickness is reached, then let it dry. The negative mold design is ready to use once it has dried (Figure 5).

Figure 5. Making negative mold patterns (left), Making gypsum locks (right), Making resin and fiber supports (bottom) (**Source**: Balar Sulsel, 2019)

4. Positive Mold Pattern Making Process of The Human Skeleton

The first step is to cover the entire surface of the negative printed pattern with Vaseline. Then, make a resin-powder combination with a resin-to-powder ratio that is adjusted to the required thickness level. Blend thoroughly. The resin catalyst is then added (the ratio is 100 ml of resin and 3 or 3.5 ml of resin catalyst). The greater the amount of catalyst used, the faster the dough dries. The dough is then colored to match the color of the earth and bones used as a casting object. The brown color added to the dough is gently poured in a negative print pattern until it is evenly distributed over the entire surface. After drying, a coating of fibers is applied to the entire surface with a brush, employing repeated pressure to absorb the

resin mixture into the fibers. Coat the resin dough many times and set it aside to dry and harden. To produce a good replica object, the positive prints must be dried for about one day. Slowly separate the two molds after they have completely dried (See Figure 6, 7 and 8).

Figure 6. Positvi Mold Pattern Making Process. (**Source**: Balar Sulsel, 2019)

Figure 7. Releasing process of the positive mold from the negative print mold. (**Souce**: Balar Sulsel, 2019)

Figure 8. Exhibition media creation. (**Source**: Balar Sulsel, 2019)

5. Coloring Process and Information Panel Making

The positive print reveals the shape of the human skeleton, which is identical to the original, but still needs to be colored in order to produce a precise replica. It is indeed done this way so a natural dyeing process can be carried out to produce natural colors, which are produced from soil that has been finely filtered. The soil is then roasted for five hours in order to remove the moisture from it. After drying, the spikes or sprinkles are brushed into the positive mold's surface using a slow brushing motion to produce results that look like the original human skeleton.

Using blocks, plywood, and nails to create display media. The size is set to 180 cm × 190 cm, which is the size of the positive printout. The positive printout is then attached to the middle of the display media. The pulp fills in all of the visible gaps, ensuring that all of the sections are attached. Allow for the Vitrin paint to dry before displaying the information screen relating to the human skeleton discovery. A sign warns the public not to touch the casting directly in order to prevent harm (Figure 9).

Figure 9. Coloring Process (left), roasted ground (right), Natural coloring (buttom) (**Source**: Balar Sulsel, 2019)

CONCLUSION

Using a manual process, the Leang Jarie site's production of human skeleton castings serves as a model for recording archaeological data in three-dimensional form. It is possible to duplicate an archaeological artifact through the use of casting, which can be done both on intact and damaged artifacts during research (brittle or incomplete). To be doing an excellent work at casting, you'll need to have a lot of resources, both in terms of equipment and staff (HR). Preparation of tools and materials, results as field data collecting and categorizing and displaying as data that can be presented to the public are all steps in the process that must be planned thoughtfully from the beginning.

Creating the human skeleton casting requires several phases and a long work procedure. Colors are used to create negative and positive prints, as well as display media and information panels. The steps of casting work, accuracy, persistence, and patience serve as the basis of the work process. As a result, a visit to the site of the human skeleton discovery remains essential to complete the replica. It is, however, possible for researchers and archaeologists to assess findings without removing the excavation box due to the results of replicas produced. This human skeleton replica can be useful for educational purposes, as an exhibition media for promoting archaeological research outcomes to the public, assist in analysis, and serve as teaching materials for academics or practitioners engaged in the area of archeology. As an additional benefit, this in-situ casting serves as a kind of preservation and accountability for archaeological research.

Acknowledgements

We would like to thank the Researcher Team of Leang Jarie in the year of 2019. We also like to thank to Mr. Ginarto and Mr. Slamet s resource persons and guiding us in the manufacture of the human skeleton casting, Mrs. Aryani (Balai Arkeologi Provinsi Yogyakarta and Mrs Eni (Pusat Penelitian Arkeologi Nasional) who helped me understand the chemicals used in manufacture the replica.

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