Tarbiat Modares University

The International Journal of Humanities

[DOR: 20.1001.1.25382640.2022.29.1.3.3]

[DOI: 10.52547/eijh.29.1.48]

Received: 4 September 2020
Accepted: 5 October 2021
Published: 1 January 2022

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How to cite this article:
Hadian Dehkordi, Manijeh; Majidzadeh, Youssef (2022). The Archeological and Technical Studies on Unique Architectural Ornaments with Clay Reliefs in Jiroft, Iran, *The International Journal of Humanities* (2022) Vol. 29 (1): (48-68).

http://eijh.modares.ac.ir/article-27-46304-en.html

RESEARCH ARTICLE

The Archeological and Technical Studies on Unique Architectural Ornaments with Clay Reliefs in Jiroft, Iran

Manijeh Hadian Dehkordi[1], Youssef Majidzadeh[2]

Abstract: The fifth season of archeological excavation of Konar Sandal Mound Hill in Jiroft (located in southeast of Iran) in 2006 was characterized by discovery of a clay monument on the wall of one of the architectural spaces there. With dimensions of 110 × 95 cm and 18cm thickness, the monument is regarded as the unique and oldest clay relief ever discovered (third millennium BC). On the one hand, historical and artistic values of the unique monument and its location in the site and environmental and human threats causing serious damages to it on the other hand, has made its documentation ever more necessary. The study of constituting materials and building techniques of the monument was done through macroscopic (field and visual study) and microscopic (optical and electron) methods as well as chemical analysis of elements and compounds on the clay foundation and its color layers (FT-IR, XRF, XRD, and SEM-EDS). The results suggest that the clay monument was built in two parts, namely the built-on torso and lower torso (skirt) which was carved out on a cob wall. Then, a delicate finish layer made of clay was put on the colored layer. The finish layer was made by using mineral pigments such as limonite (yellow) for covering the body (i.e. arms, chest and waist scarf), and Ochre hematite (red) and carbon (black) for ornament of embossed skirt. The used clay soil is of montmorillonite type which reacts, expands and contracts significantly due to humidity variation.

Keywords: Jiroft; Konar Sandal; Clay Relief; Pigments; Ochre

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Introduction

The fifth season of archeological excavation of Konar Sandal Mound Hill (Jiroft, Kerman province, south east of Iran) in 2006 was characterized by discovery of a clay monument on the wall of one of the architectural spaces. The monument was carved out on a niche-like wall in the southern side of a space called prayer's house which itself is located on the western side of a gigantic castle-like structure. It is one of the oldest clay relief ornaments ever discovered (third millennium BC; Majidzadeh, 2006).

Other monuments similar to this relief have been discovered in other archeological sites such as Shahdad (Hakemi, 1975) with the difference that other monuments are carved out as statues while this architectural monument found in Konar Sandal Site is a relief and a part of the building's architecture.

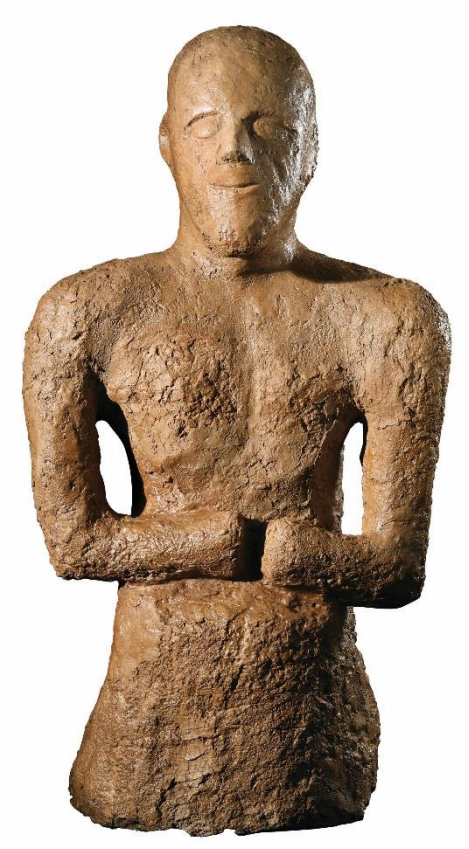

Fig. 1. Statue discovered in Shahdad (Hakemi, 1975, Museum no.: 10116).

Form-wise, similar monuments to clay statues discovered in Shahdad were stone statues found in Tell Asmar in central Mesopotamia (Aruz and Wallenfels, 2003: 58-65). Similar to statues found in Shahdad Site, the latter statures had their hands over their abdomen section and they represented a type of ecstasy and rapture. The tallest statues among these artistic statues were 75cm high (Marzban, 1987: 13).

Fig. 2. Sumerian stone statues discovered in Tell Asmar (Marzban, 1987).

Among major characteristics of Sumerian statue common to 2,500BC, one could point to standing posture and folding hands on the chest to denote praying or paying respect as well as firmly hanging clothes with little folds and downward crease on the skirt. On the other hand, Babylonian statues were originally colorful. Actually, this the art evolved concurrently as painting and carving out shapes out of stones were put together. In Babylonian civilization, reliefs were consistently more common than carving statues. Consequently, the art was adopted and perfected by Assyrians. Instances of Babylonian murals have been found in Mari town (south of Mesopotamia; Marzban, 1987:

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13-14). Concurrent with discovery of statues in Shahdad Site, a small statue was unearthed in Mohenjo-daro (Pakistan) which was similar to Khabis statues (Marshall, 1931). In pre-historical regions of Persia, except for Susa, similar statues of similar scales and types have not been found and making statues based on this style and shape was specific to Shahdad (Hakemi, 2006: 158).

Historical and artistic values of the unique monument on the one hand, and its location in the site and environmental and human threats causing serious damages to it one the other hand, have made documentation and study of the monument ever more necessary. The present study aims at documenting and understanding the building techniques applied for of this unique relief.

Fig. 3. Embossed statues in first steps of excavation (Majidzadeh, 2006).

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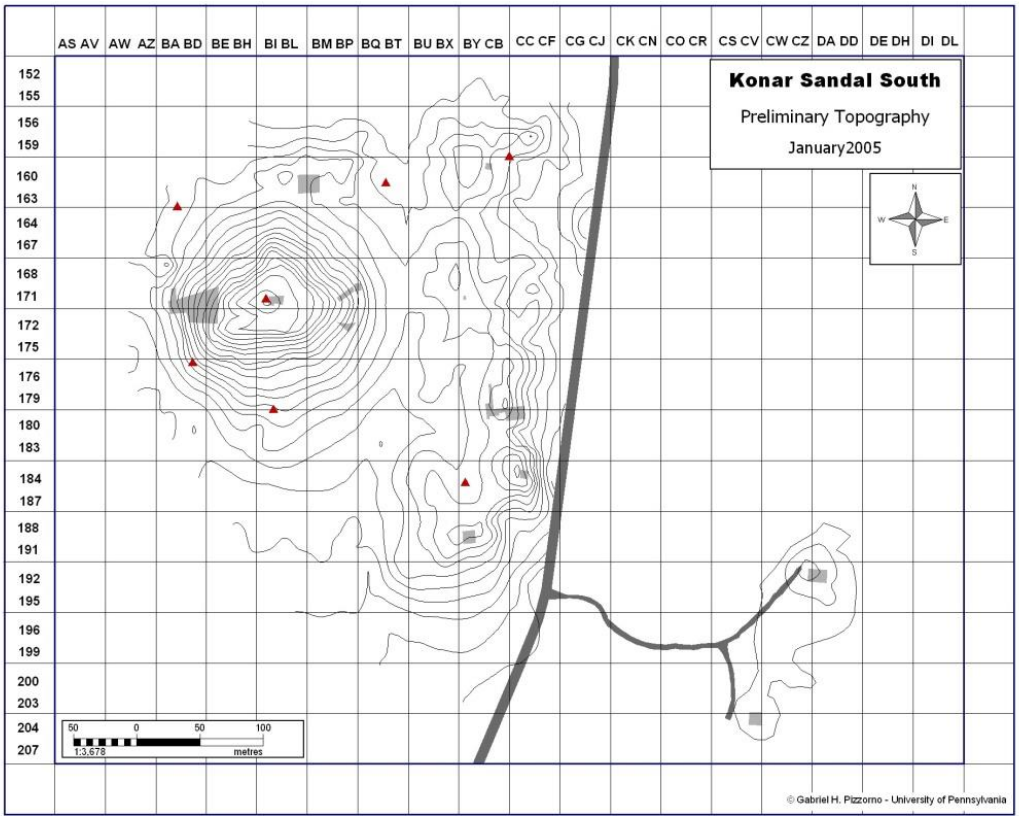

Fig. 3. Location of Embossed statues (BE172)

Description of Discovery Site of the Relief

The embossed clay monument has 18cm protrusion and in this sense, it is similar to Statue of Liberty which jumps out of the wall. In order to make the statue, the right side of a niche-like corner of the wall was selected. Then, gradual carving was undertaken to create the outlines of the body. To do so, an 18-cm deep niche was made and then an embossed design with 18 cm protrusion from the surrounding context emerged (Fig. 3). At the moment of discovery, the statue was 110 cm tall. It seems that during the second stage of building the fortress and making an even surface by filling the architectural spaces by mud and clay blocks, a significant part of the walls has fallen and the head a major part of upper torso of the statues down to its waist has been destroyed. During the leveling operation, the space on northern and southern sides of the wall was filled by regular brick laying of 60×30×12 cm at east-west direction. However, filling the front space of the relief was done

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probably on purpose, by utilizing soft soil and parts of pots, small stones and pieces of bricks.

Physical Characteristics of the Relief

Apparent Characteristics

The discovered relief is similar to the Statue of Liberty in terms of the standing and forward looking posture (figure 3). The statue faces north; the heads are bending below the chest and from arms downward. The fingers make fists and they pose before each other in front of the abdomen part. The posture is intended to convey respect and holiness (Majidzadeh, 2017: 149). The upper torso is nude and the lower torso was painted to brims of the skirt. The statue ends at that point.

As shown in Figure 4, the total height of the relief is 110cm and its maximum protrusion is 18cm. There is 67cm distance between lower edges of the hands up to brim of the skirt while width of lower torso (from the lower edge of hands downward) is 65cm. The upper torso is 94cm wide and in this section, arms and forearm of the right hand are 30cm each. The length of waist scarf, from below the elbow to wrist, is 60cm and it is 5cm wide. The thickest part of the arm, near the shoulder blade is 17cm but it reduces to 12cm near the elbow. The left hand has undergone more damage than the right one and its dimensions are not clear.

An unknown volume of black-colored parts has been found next to the cleared statue. Complete removal of the parts showed that probably some or all of debris made the statue's head which fell during the time architectural spaces were being filled with large concrete blocks and walls were being levels so as to enable next steps of construction.

The extent of protrusion of the statue (18cm) is unique for the third millennium BC especially when its significant dimensions are taken into account. Up to now, no similar instance of the statue has been found on objects and soapstone containers. However, there are certain similarities and differences between this statue and the human-like shapes carved out of containers and Chlorite containers. As to similarities, one could point to nudity of upper torso (Fig. 6), covering lower torso with a skirt decorated with triangular shapes and muscular body parts. However, vivid differences between this relief and the design on the chlorite stone could be found such as the

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shape of the skirt covering the whole lower torso of the statue while skirts on containers cover above the knee or a little over the knee (Fig. 6; Majidzadeh, 2017: 153-154).

Fig. 4. Dimensions of the relief (drawing by Ali Naseri, 2021).

Fig. 5. Nude upper torso of the clay relief, arms, chest muscles and the waist scarf under fisted hands and bent arms (Majidzadeh, 2017).

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Fig. 6. Human-like figurines carved out on chlorite containers found in Jiroft -nude upper torso and skirt, (Majidzadeh, 2003).

Design of Relief's Skirt

Ornament of the skirt is made up of 10 horizontal rows of black triangles (Fig. 7). Each row is on a contextual line of 4cm width. In each row, there are 11 equilateral triangles; each side of them is 6cm long. The background color of the skirt from below the waist scarf and around a row of triangles (10 to 12cm) is yellow and from row to the brim of the skirt is red. On average, triangles in each row are 3mm apart. The average width of each row of triangles ranges from 5 to 6cm and each row is 65cm long (Fig. 8).

Fig. 7. The skirt of the relief (yellow background of first row of triangles and red background of the rest; Majidzadeh, 2017).

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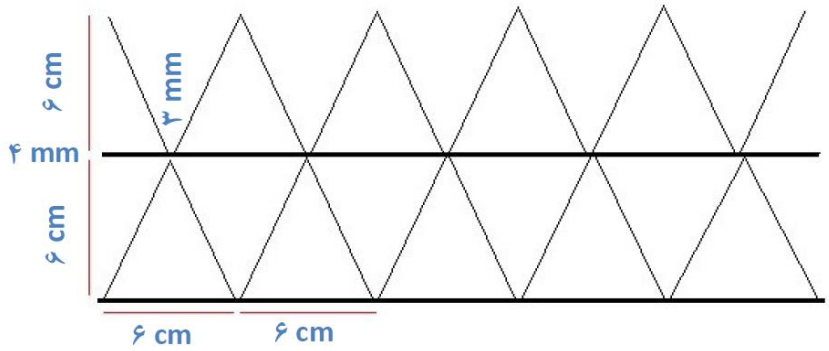

Fig. 8. Design of the skirt comprised of 10 rows with 11 black equilateral triangle 3mm apart on a black 4mm wide background line

Materials and Chemical Analysis

The relief is basically made of clay and colored materials were used to decorate its surface. Further studies on constituting materials and building technique of the statue were undertaken through macroscopic methods (observational and field studies) and microscopic methods (optical and electronic studies) as well as chemical analysis of elements and compounds on the clay foundation and its color layers (FT-IR, XRF, XRD and FE-SEM-EDX).

Mineralogy and Chemical Analysis through XRD and XRF

First, to identify constituting elements of the soil used to make the relief, samples of bricks used in two mound hills on northern and southern sides were taken. Then, X-ray powder diffraction (XRD) and X-ray fluorescence (XRF) were used for qualitative and quantitative analysis (tables 1 and 2).

Table 1. Mineralogical Results of Soil and Brick Samples of Area Obtained through XRD.

Sample	Mineral
Northern Konar Sandal Mound Hill	quartz, albite, calcite, montmorillonite, chlorite, muscovite, gypsum
Southern Konar Sandal Mound Hill	quartz, albite, calcite, montmorillonite, chlorite, muscovite, gypsum

Table 2. Chemical Analysis of Soil and Brick Samples Obtained through XRF.

Sample/Element	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	CaO (%)	MgO (%)	K_2O (%)	Na_2O (%)	S (ppm)	CI (ppm)
Northern Konar Sandal Mound Hill	49.2	6.19	9.5	11.0	4.4	2.9	3.0	5391	4989
Southern Konar Sandal Mound Hill	48.3	7.3	11.2	12.3	4.6	1.7	1.4	4461	436

The results of above tests suggest that the clay soil used in making the bricks of the northern and southern sides of Konar Sandal sites are similar in terms of constituting minerals. The only significant differences are dissolved sulfate and chloride salts which were more in northern mound hill of Konar Sandal Mound Hill (Hadian Dehkordi, 2003).

In addition, soils contain clay minerals montmorillonite, chlorite and muscovite. Although montmorillonite is fine-grained and highly adhesive, it could absorb significant amounts of water and it can contract significantly. During wet to dry contraction, cracking of the mineral is highly likely. As a result, longitudinal contraction and cracking of embossed forearm and separation and fall of chest muscle and waist scarf. Since the statue was kept in a closed space after it was built and it has not been exposed to humidity before the flood, the dissolved salts in the statue did not effectively reduce its strength.

Separation and fall of left forearm were caused by ignorance of the local community during the first post-discovery days as the graffiti with a red pencil has been drawn on it. After the event, surface of the wall and the forearm got complexly even. This implies that the parts were built on wall and not carved out of it (Fig. 9).

The integrity of the skirt or the lower torso of the statue with the wall and lack of wet to dry contraction cracks signify the integration of the part with the wall. In other words, those parts were carved out of the wall.

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Fig. 9. Parallel cracks in forearm of statue and separation of chest and waist scarf due to wet to dry contraction of clay mud (author, 2006).

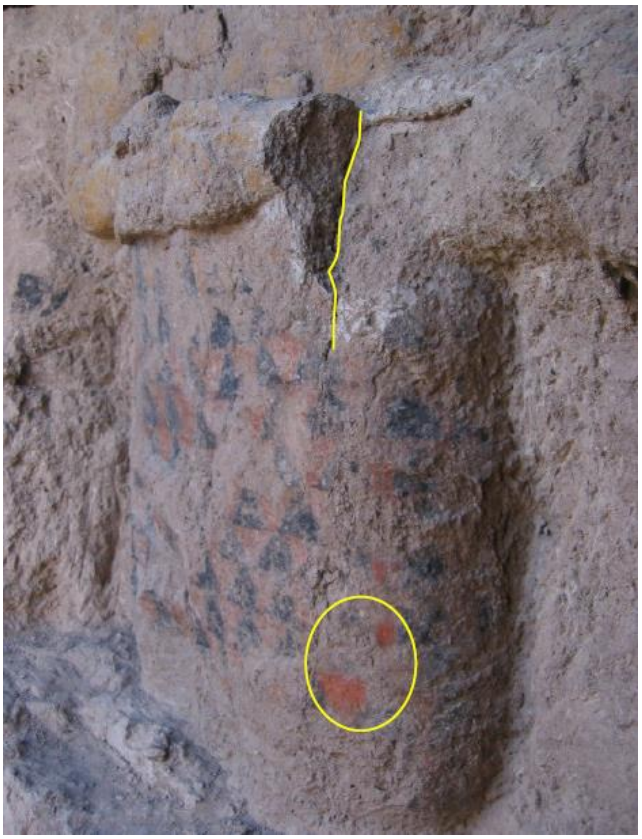

Fig. 10. Fall of left forearm of the relief and continuous crack in hand-wall interface (Author, 2006).

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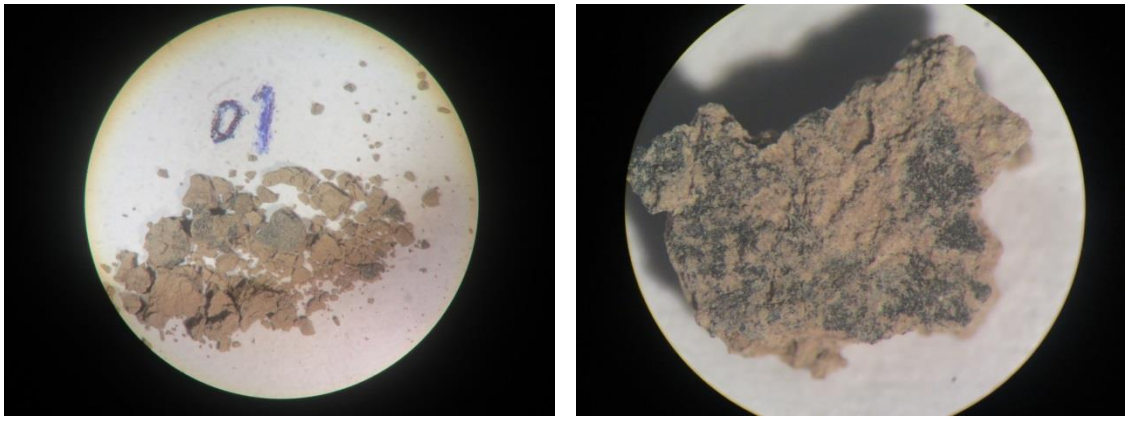
Elemental Analysis of Painted Layer

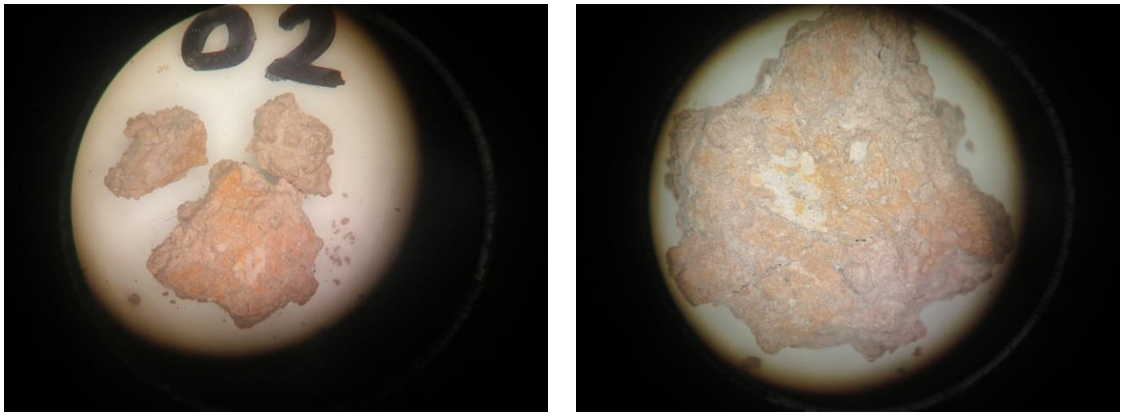
In order to identify the paint samples taken from the relief (i.e. yellow, red and black along with two yellow and black colored lumps found among cultural discoveries of the site and around the statue; figure 1), the optimal and electron microscopes (FE-SEM and EDX) were used which enabled elemental analysis.

Optical Microscopic Images of Studied Samples

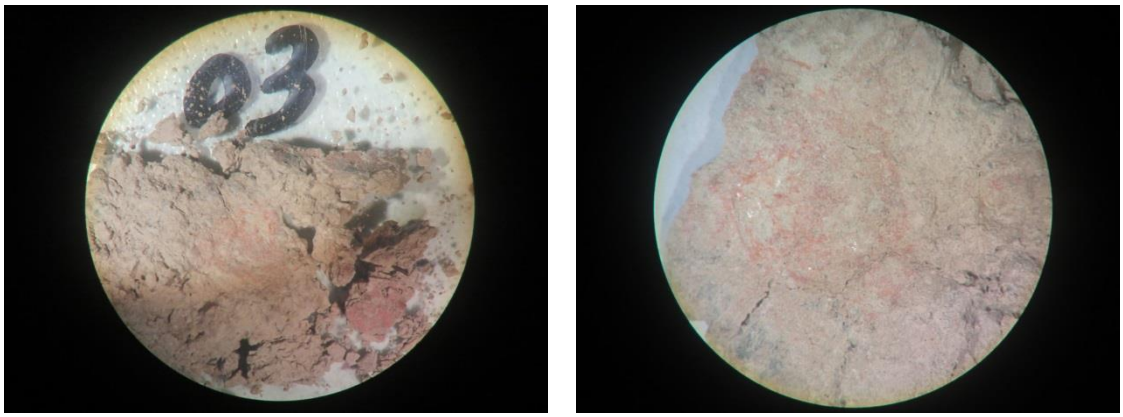
First, five above-mentioned samples were optically studied through Leica optical microscope (Fig. 11).



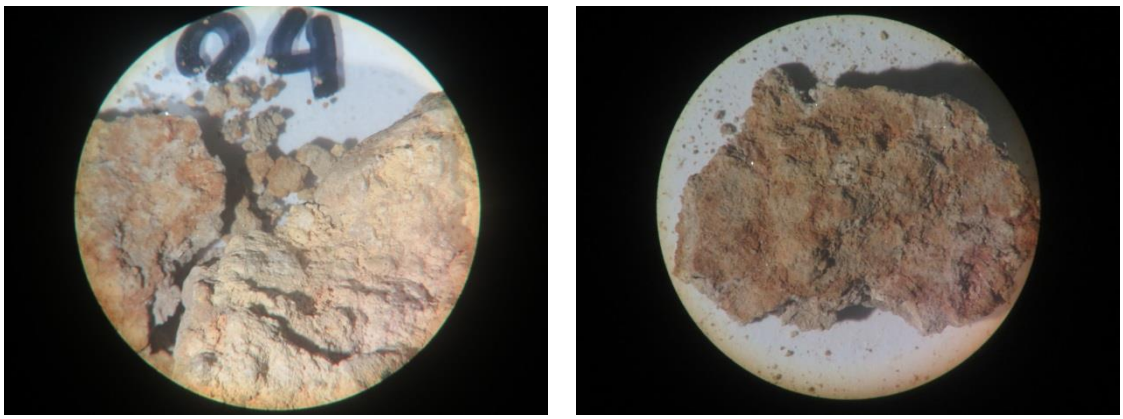
Sample No.1-Black-colored Layer



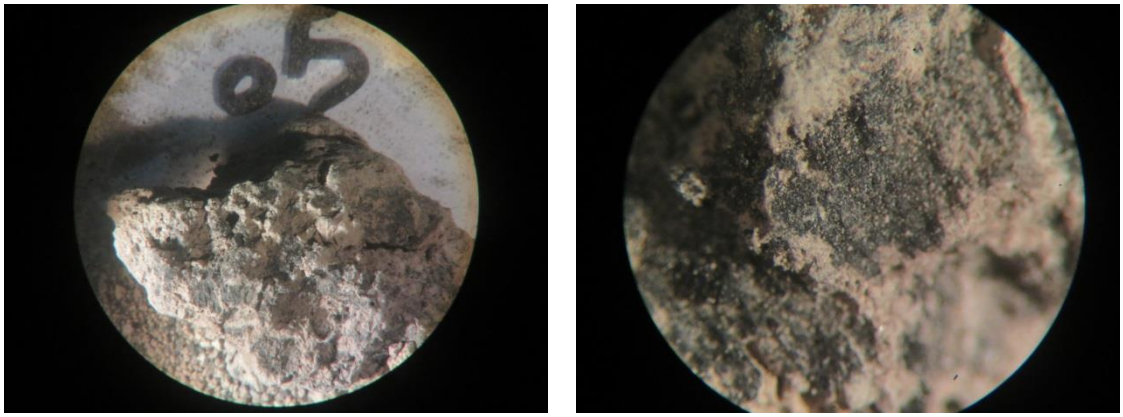
Sample No.2-Yellow-colored Layer



Sample No. 3-Red-colored Layer



Sample No. 4-Yellow-colored Lump



Sample No. 5-Clay Lump Containing Black Pigments

Fig. 11. Frontal view of colored layers of embossed statue and its surrounding colored lumps

As shown in above images (Fig. 11), the colored layers were directly put on the clay surface. In addition, cross-sections of the samples show a thin finish layer below the

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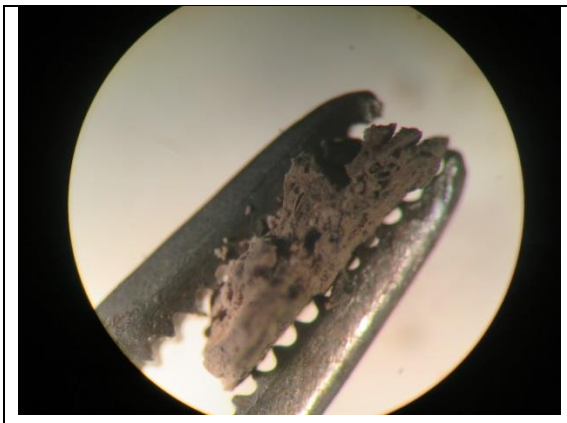
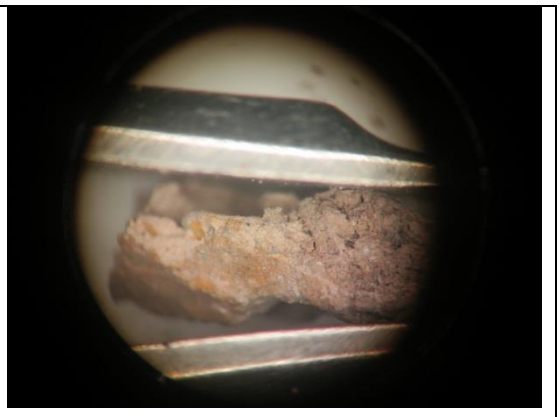
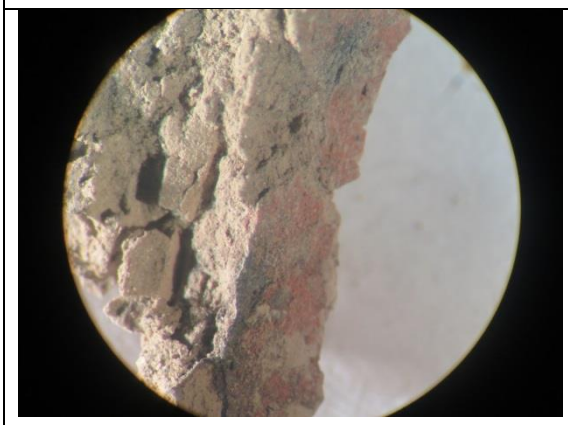
colored layer (Fig. 12). The colored layers are loose and vulnerable. Due to insufficient adhesion to underlying mud layer, they expand, contract, crack and fall easily.



Sample No.1-Black Layer Cross-section



Sample No.2-Yellow Layer Cross-section



Sample No.3-Red Layer Cross-section

Sample No.5-Cross-section of Yellow Lump

Sample No.4-Black Powder in Mud Lump

Fig. 12. Cross-sections and close view of samples.

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As the figures show, two colored lumps were discovered in the site which were presumably used to make the paints. The yellow streaks in the first lump and black powder made out of burning organic materials such as wood contained yellow and black pigments.

Elemental Analysis of Pigments through FE-SEM-EDS

The elemental analysis results of paints of embossed statue through FE-SEM-EDS (model MIRA 3, TESCAN; 1.5nm resolution at 15kV and 4.5nm resolution at 1kV) suggest that the main constituting element of the pigments in yellow and red samples is iron and the black color is caused by carbon (table 3). Similar results were obtained for the black and yellow lumps. In those samples, the constituting elements are iron and carbon too. Therefore, ochre or hematite pigments (Fe_2O_3), limonite (hydrous iron oxide) and coal (carbon) were used for painting the surface of the statue (Hadian Dehkordi, 2009).

Table 3. Elemental Analysis Results of Colored Samples through FE-SEM-EDS.

Element (%w)	Black Layer	Yellow Layer	Red Layer	Yellow Lump	Black Lump
C	65.6	59.6	14.9	-	34.2
O	28.7	28.7	32.6	34.7	33.2
Mg	0.8	-	1.9	-	2.5
AI	1.0	-	8.3	0.5	-
Si	3.2	1.6	17.6	1.1	-
Ca	0.6	0.4	6.4	-	19.7
Fe	-	6.9	6.9	40.9	-
S	-	2.8	8.3	16.3	-
K	-	-	2.9	4.4	-
Na	-	-	-	2.0	8.9

Identification of Colored Layers' Composition through FT-IR

Fourier-transform infrared spectroscopy of samples was done through KBr tablets and the

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system Nicolet 510P. The test contributes to identification of chemical composition of the samples including pigment, colored clamps and probable fillers. In addition, the method enables determination of herbal or animal origin of carbon pigments.

The spectral peaks of sample no.1 point to silicate compounds (1024cm^{-1}), calcium carbonate (874 and 1421cm^{-1}) and oily compounds (1738cm^{-1}). Silicate and calcareous compounds are associated with clay foundation under the colored layer. The oily materials are related to colored clamps (figure 13).

The IR spectrum of the yellow paint point to silicate compounds (1100cm^{-1}) and calcium carbonate (877 and 1441cm^{-1}) while a significant peak (1734cm^{-1}) signifies oily compounds (figure 14). In this spectrum, organic materials were found at the zone 2957cm^{-1}.

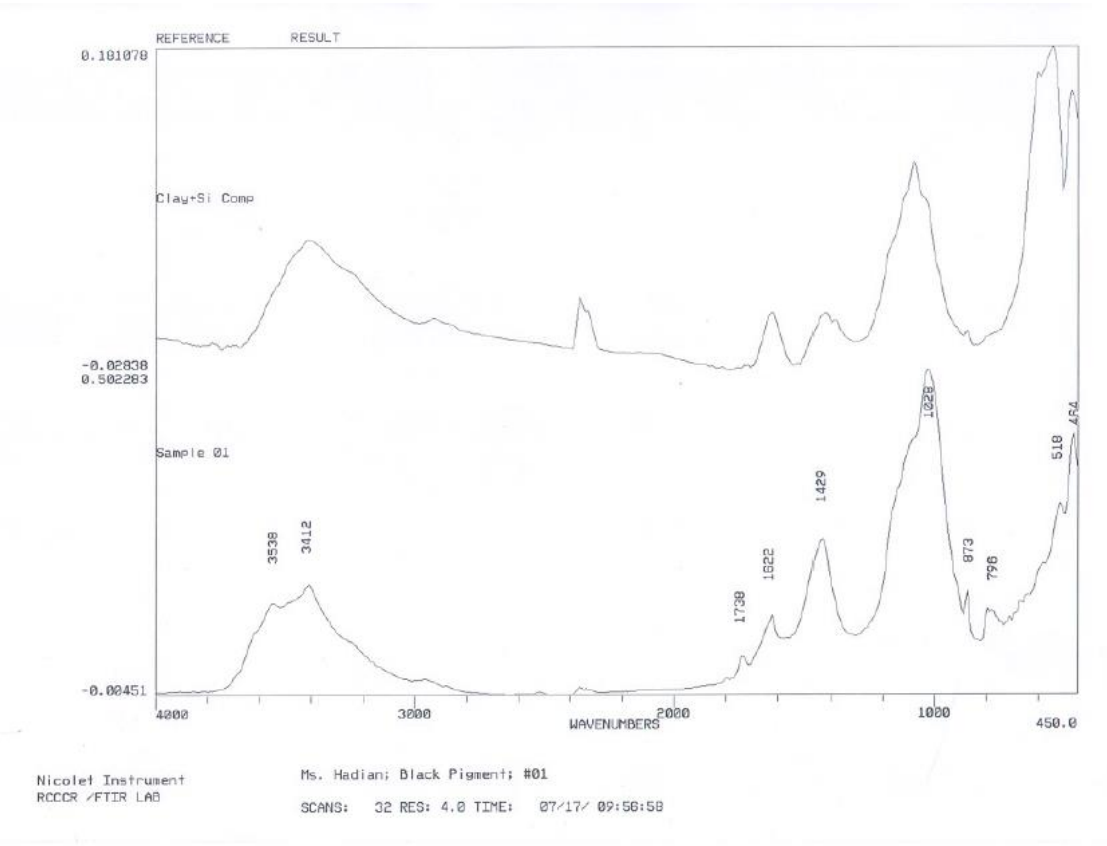

Fig. 13. FT-IR spectrum of black color of the relief, and Clay +Si reference spectrum.

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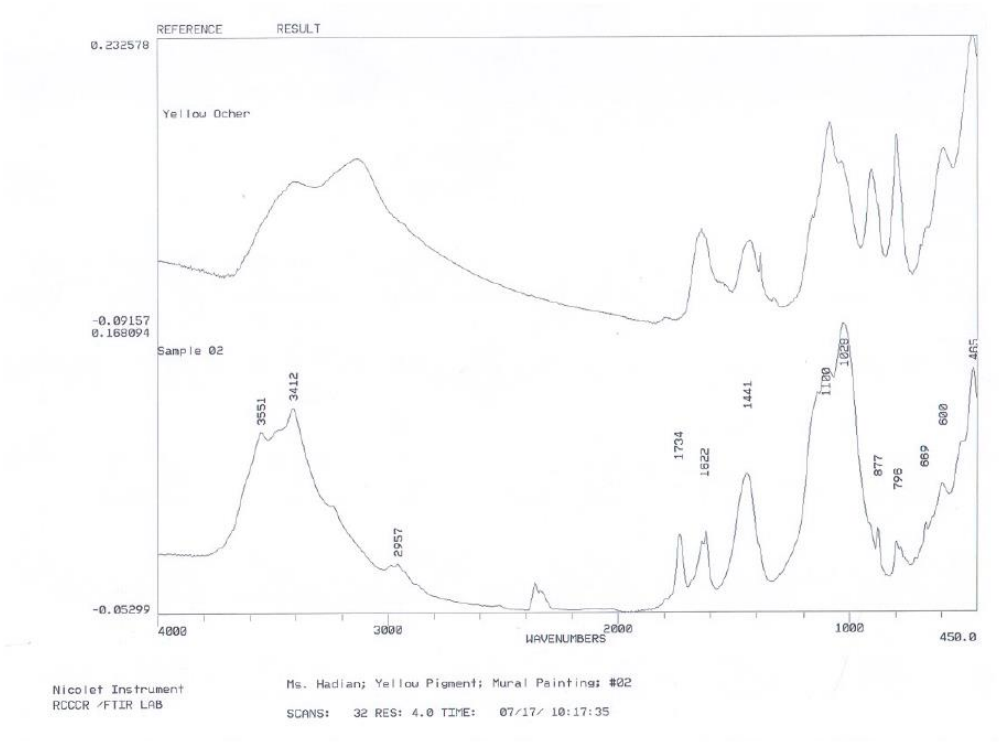

Fig. 14. FT-IR spectrum of yellow color of the relief and, yellow ocher reference spectrum.

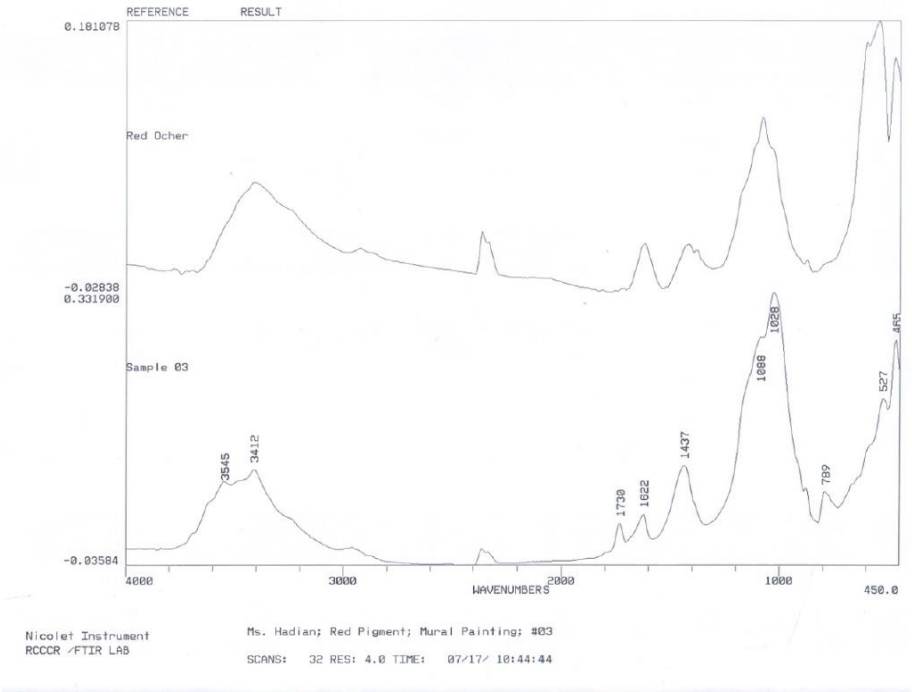

Fig. 15. FT-IR spectrum of red-colored sample of the relief, and Red Ocher reference.

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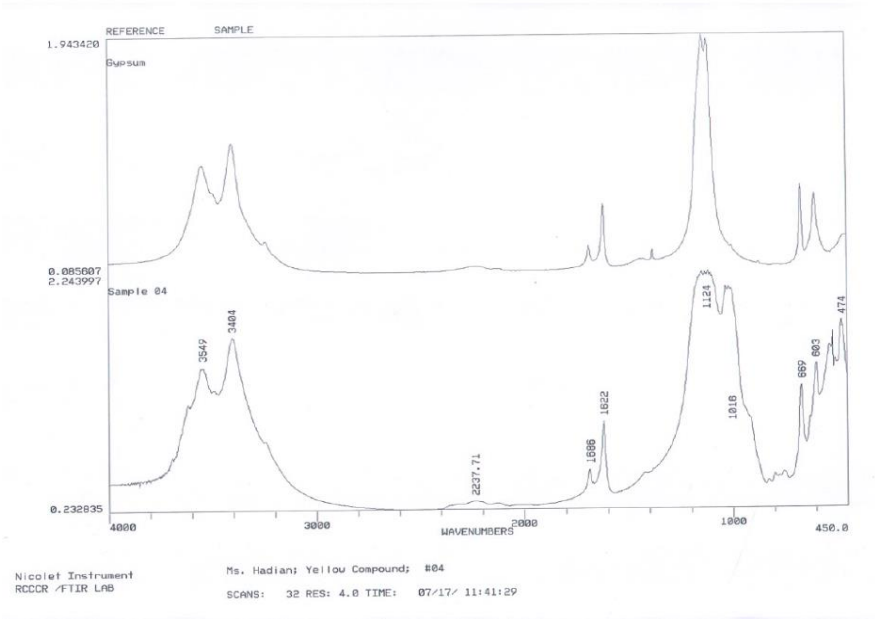

Fig. 16. FT-IR spectrum of yellow lump on site, and Gypsum reference spectrum.

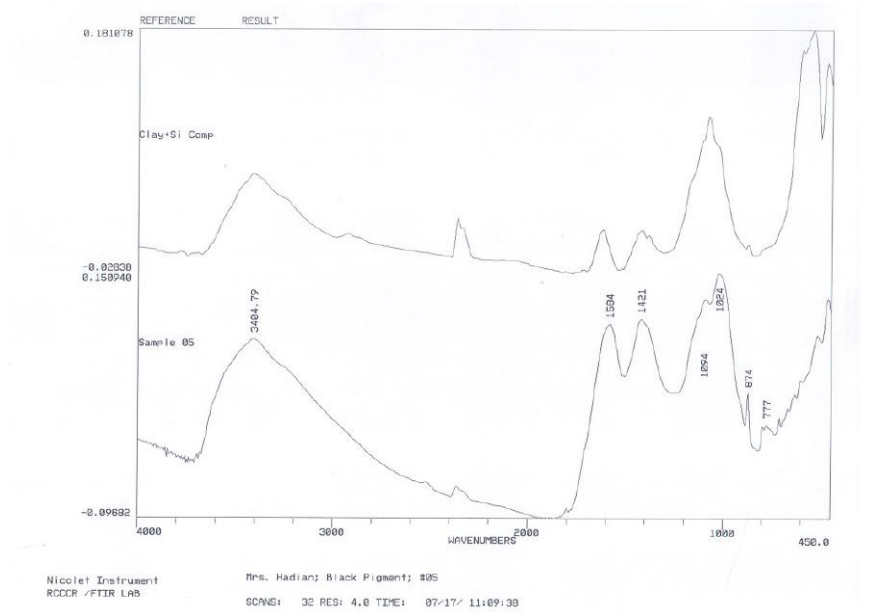

Fig. 17. FT-IR spectrum of black powdered lump on site, and Clay+Si reference spectrum.

Fig. 16. represents FT-IR spectrum of sample no. 4 (yellow lump). As the figure shows, all peaks of the spectrum are related to gypsum ($CaSO_4 \cdot 2H_2O$) and some silicates.

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The spectrum of red-colored sample taken from the embossed statue show similar compounds to yellow-colored sample namely silicates, sulfates (1088cm^{-1}) and calcium carbonate (1437cm^{-1} and a low peak in 780cm^{-1}). In addition, a peak at 1738cm^{-1} show oily compounds (Fig. 15). In this spectrum, organic materials were detected at 2957cm^{-1}. The peaks for the sample are lower than the yellow-colored sample.

Fig. 17 shows the spectrum of black lump. The spectrum of black sample is different from the color used in the statue. In this sample, apart from silicate and calcareous compounds, a significant peak was found at 1584cm-1 which is probably related to proteins.

Conclusion

The statue-like releif in Konar Sandal Archeological Site (110×94×18 cm) is one of the significant and unique findings of the site as it manifests the use of paint and embossed ornaments on a statue in third millennium BC.

Previous studies suggest that the statue was built through two methods, namely carving out the design out of the mud wall (skirt or lower torso) and built-on layer to make the top torso including hands, arms, chest muscles and waist scarf. The theory was proved by longitudinal shrinkage cracks in forearm and waist scarf of clay minerals, cracks between built-on parts over the wall as well as even surfaces between back of the parts and the neighboring wall. In fact, human-caused damage after discovery let to fall of the left forearm of the statue and some new findings were made. The integrity of skirt or lower torso of the statue with the wall and lack of wet to dry contraction cracks signify the integration of the part with the wall. In other words, those parts were carved out of the wall. In fact, the part acts as a base for upper torso parts.

The distinctly damaged head of the statue was found next to it as it probably fell off during restoration and new application of the building. The black paint traces of the statue are probably due to use of the paint for hair and beard hairs.

The pigments of yellow ochre, red ochre and black carbon used in painting the third-millennium BC statue were similarly used in other painted and decorated monuments of architecture such as pottery found in pre-historical Iran. The colored lumps (e.g. yellow

ochre and carbon) found in the site suggest that the yellow pigment used for the statue has the same origin as the yellow lump while the black pain used for the statue has herbal origin and the black pigments in the mud lump have animal origin. The results suggest that the binder used in the paints is of oily type.

Acknowledgment

The contributions of Mr. Nader Soleimani, the head of this world heritage site are appreciated who arranged for visitation, field study of Konar Sandal Site and taking necessary samples. In addition, the contributions of Ms. Sahar Nohi, person in charge of FTIR Department and Ms. Mandana Tayebi, person in charge of Microscopic Department of Research Center for Conservation of Cultural Relics (RCCCR) are appreciated. Furthermore, thanks to Mr. Ali Naseri for drawing the embossed statue (Zabol University).

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The International Journal of Humanities (2022) Vol. 29 (1): (48-68)

The International Journal of Humanities

مطالعات باستان‌شناختی و فنی نخستین تزیینات معماری با نقش برجسته گلی کنار صندل جیرفت

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تاریخ دریافت: ۱۳۹۹/۶/۱۹
تاریخ پذیرش: ۱۴۰۰/۷/۱۳
تاریخ انتشار: ۱۴۰۰/۱۰/۱۱

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چکیده: پنجمین فصل حفاری‌های باستان‌شناختی تپه کنار صندل جنوبی جیرفت در سال ۱۳۸۵ همراه با کشف اثر گلی روی دیوار در یکی از فضاهای معماری تپه بزرگ بود. این اثر با ابعاد حدود ۱۱۰ در ۹۵ و ضخامت ۱۸ سانتی‌متر قدیم‌ترین نقش‌برجسته گلی است (هزاره سوم پ‌م) که تاکنون یافت شده است. ارزش‌های تاریخی و هنری این اثر منحصربه‌فرد از یک سو و از سوی دیگر موقعیت قرارگیری آن در محوطه و خطرات تهدیدکننده محیطی و انسانی که موجب آسیب‌های جدی به آن شده بود، انجام مستندنگاری و مطالعات لازم روی آن را بیش از پیش الزامی و ضروری می‌داشت. انجام مطالعات روی مواد سازنده و فن ساخت این اثر با استفاده از روش‌های ماکروسکوپی (بررسی میدانی و بصری) و میکروسکوپی (نوری و الکترونی) و همچنین تجزیه شیمیایی عنصری و ترکیبی بر روی بستر گلی و لایه‌ی رنگ آن (EDS، XRD، XRF و FRT-IR) صورت گرفت. نتایج مطالعات نشان داد این اثر گلی در دو بخش نیمه‌تنه بالا به‌صورت نقش افزوده و در نیم‌تنه پایین (دامن) تراش بر دیوار چینه‌مانند ساخته شده است. سپس با ایجاد یک لایه پرداخت ظریف گلی بر آن لایه رنگی با استفاده از مواد معدنی اکر یا لیمونیت (زرد) جهت پوشش بدن شامل بازوان، سینه و شال کمر، اخرا هماتیت (قرمز) و کربن (سیاه) برای تزیینات دامن نقش‌برجسته اجرا شده است. خاک رس مورد استفاده از نوع خاک‌های مونت‌موریونیتی است که به‌شدت نسبت به تغییرات رطوبتی واکنش‌پذیر و دچار انبساط و انقباض زیاد می‌شوند.

واژه‌های کلیدی: جیرفت، کنار صندل، نقش‌برجسته گلی، رنگدانه، اخرا.

[DOR: 20.1001.1.25382640.2022.29.1.3.3]
[DOI: 10.52547/eijh.29.1.48]