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PREFACE

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In the fiscal year 2017 (April 2017–March 2018), the following activities were carried out. I would like to express my gratitude to the many people who supported these activities.

2017 年度（2017 年 4 月～2018 年 3 月）には、以下のような活動が行われた。活動を支えていただいた多くの方々に感謝を申し上げる次第である。

We held the ICSA in Japan 2017, as we do every year. Ten students, along with Assist. Prof. Belinda Torus and Assistant Seda Nur Alkan from the Faculty of Architecture and Design at Bahçeşehir University (BAU), Turkey, visited Japan on Thursday, June 22 2017. The BAU students collaborated with second-, third-, and fourth-year Mukogawa Women's University (MWU) architecture students and devoted themselves to design exercises and field work.

例年の通り ICSA in Japan 2017 を開催した。トルコ・バフチェシヒル大学建築デザイン学部の学生 10 人とベリンダ先生、セダ先生が 2017 年 6 月 22 日（木）に来日した。2、3、4 年生のスタジオで武庫川女子大学建築学科の学生と机を並べて設計演習やフィールドワークに励んだ。

Two exchange students from Turkey, who were enrolled in the master's program of the Graduate School of Architecture, were invited to the successful completion ceremony on Friday, August 4 2017, after complying with the required credits and writing their master's theses. In addition, two Turkish exchange students enrolled for the Graduate School of Architecture's doctoral course on Tuesday, September 5 2017.

大学院建築学専攻修士課程に在籍するトルコからの留学生 2 名が、必要単位を満足し且つ修士論文を書き上げて、2017 年 8 月 4 日(金)に無事修了式を迎えることができた。また新たに、トルコからの留学生 2 名が、2017 年 9 月 5 日(火)に大学院建築学専攻博士後期課程に入学した。

As part of the "UNESCO/Japanese Funds in Trust Project for Support for Silk Roads World Heritage Sites in Central Asia (Phase II, April 2015 - April 2018) ", we held on-site training workshops for local specialists in Tashkent, Samarkand, and Khiva in Uzbekistan, from Monday, September 11 to Wednesday, September 20 2017. Four faculty members from

「ユネスコ文化遺産保存日本信託基金中央アジアのシルクロード世界遺産支援プロジェクト（第 2 期、2015 年 4 月～2018 年 4 月）」の一環として、ウズベキスタンのタシュケント、サマルカンド、ヒヴァにおいて、2017 年 9 月 11 日（月）～20 日（水）に、現地専門家を対象としたトレーニングワークショップを開催した。本学からは 4 名の教員が招聘講師として参加し、写真測量による歴史

MWU participated as invited lecturers, and taught some of the techniques for preserving, landscaping, and utilizing historical buildings, townscapes, and landscapes by creating three-dimensional models of historic buildings using photogrammetry, and through simulations with videos.

的建造物の 3 次元モデルの作成や、動画を用いたシミュレーション等を通して、歴史的建造物および景観の保存・修景・活用に向けた手法の一端を教授した。

At the International Conference on "THE FUTURE OF THE BAMIYAN BUDDHA STATUES," held from Wednesday, September 27 to Friday, September 29 2017 (Organized by: The Islamic Republic of Afghanistan, UNESCO, and Tokyo University of the Arts), we, in collaboration with the Tokyo University of the Arts, announced a plan for the reconstruction of the Bamiyan Eastern Buddha in Afghanistan on behalf of Japan. We hope that the future of Bamiyan will be peaceful and that this project will be completed.

2017 年 9 月 27 日（水）〜29 日（金）に開催された国際会議「THE FUTURE OF THE BAMIYAN BUDDHA STATUES」(主催:アフガニスタン・イスラム共和国、UNESCO、東京藝術大学)において、東京藝術大学との共同でアフガニスタン・バーミヤン東大仏再建案の日本代表案を発表した。今後のバーミヤンが平和となり、このプロジェクトが実現されることを期待したい。

On Saturday, November 18 2017, a special lecture was held by MWU Department of Architecture and Architecture Major. Prof. Takashi Inoue (former producer of NHK’s New Silk Road and specially-appointed professor at Tokyo University of the Arts) gave a lecture entitled "Unearthing the Mysteries of Ancient Civilizations."

2017 年 11 月 18 日（土）には建築学科・建築学専攻の特別公開講演会が開催され、井上隆史氏（東京藝術大学特任教授）による講演「古代文明の謎を掘る」が行われた。

Since 2015, MWU has been holding a series of lectures called "Silk Road Culture and Architecture" at the Industry Club of Japan Hall, which is located in front of Tokyo Station. The 6th and 7th meetings of this lecture series were held in the fiscal year 2017.

The 6th meeting was held on Saturday, October 14 2017 with the title "Ceramics and Tiles of the Silk Road." Prof. Tomoko Masuya (Institute for Advanced Studies on Asia, the University of Tokyo) delivered a lecture on "Tile Decoration in Islamic Architecture." Prof. Tomohiko Okano (adjunct lecturer, Aoyama Gakuin University) gave a lecture on "The History of Islamic Ceramics: The Beauty and Creation of Lusterware." In addition, Masato Tani (santoor player and associate professor, Faculty of Human Development, Kobe University) and Junzo Tateiwa (tompak and daf player) performed Iranian music.

武庫川女子大学は 2015 年から、講演会シリーズ「シルクロードの文化と建築」を東京駅前の日本工業倶楽部で開催している。2017 年度は同シリーズの第 6 回と第 7 回を開催した。

第 6 回は、2017 年 10 月 14 日（土）に「シルクロードの陶器とタイル」というタイトルで開催した。桝屋友子氏（東京大学東洋文化研究所教授）による講演「イスラーム建築のタイル装飾」、そして岡野智彦氏（青山学院大学非常勤講師）による講演「イスラーム陶器の歴史－ラスター彩の美と造形－」、さらには谷正人氏（サントゥール奏者, 神戸大学発達科学部准教授）と立岩潤三氏（トンバク，ダフ奏者）によるイランの音楽の演奏が行われた。

第 7 回は、2018 年 1 月 20 日（土）に「シルクロードの原点　ペルシア帝国の夢と神々」というタイトルで開催した。山内和也氏（帝京大学文化財研究所教授）による講演「ペルシアの栄光」、そして前田耕作氏（アフガニスタン文化研究所所長，東京藝術大学客員教授）による講演「ゾロア

The 7th meeting was held on Saturday, January 20 2018 with the title "Origin of the Silk Road: Dreams and Gods of the Persian Empire." Prof. Kazuya Yamauchi (Research Institute of Cultural Properties, Teikyo University) delivered a lecture on "The Glory of Persia." Prof. Kosaku Maeda (director, Institute of Studies on the Culture of Afghanistan; guest professor, Tokyo University of the Arts) gave a lecture on "Zoroaster and Mithraism." Additionally, Keiku (setar and tanbur player), Junzo Tateiwa (tompak and daf player), and Amin Choghadi (singer) performed Persian music and songs.

スターとミスラ教」、さらには慶九氏（セタール, タンブール奏者）、立岩潤三氏（トンバク, ダフ奏者）、アミン・チョガーディ氏（歌）によるペルシアの音楽と歌のパフォーマンスが行われた。

The Institute of Turkish Culture Studies hosts annual seminars at Koshien Hall dedicated to the cultures, history, and architecture of the Silk Road and of the various countries along the Silk Road corridor. This year, as in years past, three seminars were held.

The first seminar convened on Thursday, February 15 2018 and featured Prof. Atsushi Iwamoto (associate professor, Faculty of Letters, Rissho University), who gave a talk on "The Buddhist Ruins of Southern Uzbekistan: Kara-tepe and Zurmala."

The second seminar on Friday, February 23 2018 was led by Prof. Kazuya Yamauchi (Research Institute of Cultural Properties, Teikyo University). The title of his presentation was "Zoroastrianism and Fire Temples."

Finally, the third seminar was held on Thursday, March 8 2018, led by Prof. Satoshi Naiki (assistant professor, Center for Cultural Heritage Studies, Kyoto University), who discussed "Stupas and Gandhara Sculptures in the Buddhist Temples of Northwest India."

トルコ文化研究センターは、甲子園会館で、毎年研究会を主催する。そのテーマはシルクロードとそれを取り巻く国々の文化や歴史や建築に関するものである。今年度も 3 回の研究会を開催した。

第 1 回は 2018 年 2 月 15 日（木）に、講師：岩本篤志 氏（立正大学 文学部 准教授）による「南ウズベキスタンの仏教遺跡　ーカラ・テペとズルマラー」であった。

第 2 回は 2018 年 2 月 23 日（金）に、講師：山内和也 氏（帝京大学 文化財研究所 教授）による「ゾロアスター教と拝火神殿」であった。

第 3 回は 2018 年 3 月 8 日（木）に、講師：内記 理 氏（京都大学 文化財総合研究センター 助教）による「西北インドの仏教寺院におけるストゥーパとガンダーラ彫刻」であった。

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Method of visualizing landscapes from tombs of the Final Kofun period with a high-definition three-dimensional model by SfM and three-dimensional GIS: A case study of three tombs in the Kawachi area

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Keywords: digital elevation model (DEM), digital surface model (DSM), landscape simulation, structure from motion (SfM), tombs of the Final Kofun period, unmanned aerial vehicle (UAV)

Abstract: We visualized landscapes from three tombs of Japan's Final Kofun period (the latter part of the 6th century through the end of the 7th century) in the Kawachi area (Kannonzuka, Hachibuseyma-nishimine, and Okameishi Tombs) with a high-definition three-dimensional model by structure from motion (SfM) multi-view stereo photogrammetry and three-dimensional GIS to analyze the relationship of the axial directions of the tombs and their views. We clarified the following points: 1) By SfM with photographs from an unmanned aerial vehicle (UAV), we generated georeferenced digital surface models (DSMs) with about 1-cm resolution and orthophotos with about 0.5-cm resolution to express the microtopography of the three tombs. 2) We overlaid DSMs and orthophotos by SfM on a 5-m digital elevation model (DEM) and orthophotos by GSI using three-dimensional GIS and visualized landscapes from the three tombs at that time, although their views are now obstructed by trees. 3) Considering the surrounding obstacles, shooting photos with a manual pilot is more suitable than with an auto pilot for reproducing the shapes of the stones and the tomb mounds.

1. Introduction

1.1. BACKGROUND AND OBJECTIVE

This paper proposes a method that visualizes landscapes from the tombs of Japan's Final Kofun period (the latter part of the 6th century through the latter part of the 7th century) using a high-definition three-dimensional model based on structure from motion (SfM) multi-view stereo photogrammetry[1] and three-dimensional GIS to analyze the relationship of the axial directions of the tombs and their views. In the future, we plan to clarify the characteristics of landscapes from the tombs of the Final Kofun period by the method proposed in this paper, and classify them to identify the principles for locating the tombs in relation to ancient thinking (on life and death) and natural landscapes.

After the trend of keyhole-shaped tombs faded and a national governance system based on ritsuryō codes began, many of the tombs constructed in the Final Kofun period seem smaller and more integrated with the natural landscapes than tombs constructed in the early and later Kofun periods when large-scale tombs were predominant. Although these tombs are precious cultural assets that convey ancient thoughts and culture and emphasize harmony between artificial objects and nature, except for a few well-preserved examples, most are now in ruins and their preservation conditions and surrounding natural landscapes remain unsatisfactory. We must preserve not only the tomb mounds themselves but also their surrounding natural landscapes.

Kawachi (present Kashihara, Habikino, and Tondabayashi cities and Taishi town located in the southeast of Osaka Prefecture) was the one of the centers of politics in the Final Kofun period. Therefore, we assume that identifying of the locating principles of the tombs of the Final Kofun period will shed light on the relationships between locations of tombs and their underlying thought on the harmony between nature and artificial objects possessed by the imperial family and the other powerful families of the period.

1-2. RELEVACE TO PAST LITERATURE

Most previous studies on the locations of tombs focus on two-dimensional maps instead of three-dimensional analyses (Mori, 1973, 1998 and 1996; Hosokawa and Imao, 2011; Imao, 2012; Kawakami, 1998; Kitamura, 2001 and 2004; Shimomura, 2006). On the other hand, the even three-dimensional terrain models in a few past studies using three-dimensional GIS are limited to a very small area surrounding a tomb, and other research, which focused on a wider area around a tomb, only analyzed slope angles and altitude on two-dimensional maps (Kaneda, 2001; Shiraishi et al., 2008; Teramura, 2005 and 2014). Judgments of tomb locations were based on landscapes rather than on maps. Although previous studies were primarily map-based analysis, our study presents a method for studying tomb locations from a landscape viewpoint.

A previous study by the author (Tembata, 2016) analyzed landscape views from 20 tombs of the Final Kofun period in Japan's Kawachi area using three-dimensional GIS to determine their characteristics and the relationship between the landscape and each axial direction. Unfortunately, that work encountered the following two problems: 1) a three-dimensional model based on a 5-m DEM of Fundamental Geospatial Data by Geospatial Information Authority of Japan (GSI) can't represent small-scale tomb mounds. 2) The position coordinates of single positioning by GPS have an error rate of about 10 m. This paper extends its

methodology and develops more precise terrain models of small-scale tombs by SfM with photographs taken from a small UAV and a Global Navigation Satellite System (GNSS) [2] survey with cm accuracy. This method can be applied to studies on locations of tombs throughout Japan from a landscape viewpoint, and will also provide fundamental knowledge for city planning regulations (land usage regulations and view preservation regulations) for the preservation of natural landscapes around tombs to enhance regional characteristics.

2. Methods

2.1. RESEARCH OBJECT

Our target ancient tombs are three tombs in the Final Kofun period located in the Kawachi area, Kannonzuka, Hachibuseyama-nishimine, and Okameishi Tombs (Fig. 1), after obtaining flight permission for a UAV. All three tombs have a Yokoguchi-shiki Sekkaku (a stone sarcophagus with a side entrance), a stone sarcophagus that opens in the axial direction, and good viewing places, but these views are partially blocked by their surrounding trees.

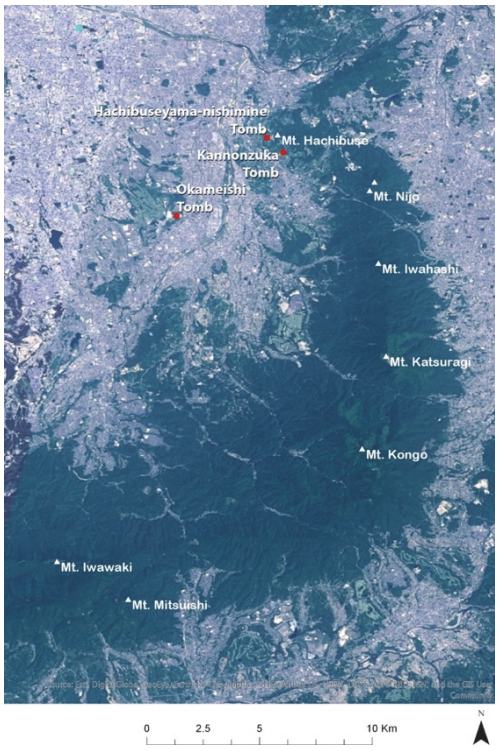


Fig. 1. Location map of target ancient tombs

2.2. METHODS

We conducted the following field surveys: the Kannonzuka Tomb on February 19 and 21, 2018, the Hachibuseyama-nishimine Tomb on February 19 and 22, 2018, and the Okameishi Tomb on February 26 and March 2, 2018.

Aerial photographs were taken by a small UAV (DJI Phantom 4 Pro camera :1 " CMOS, effective number of pixels: 20 million pixels) with both auto pilot and manual pilot from various heights and distances. 45-cm square air photo signals were used as ground control points (GCPs) and checkpoints. Such local features as white lines on road were used as checkpoints. Geographical coordinates of GCPs and checkpoints were obtained by post-processing the observed raw data by two GNSS receivers (Emlid Reach RS: one used as a base, and the other as a rover) with RTKLIB. [3] The coordinates have errors of cm accuracy.

High-definition three-dimensional models of the tombs (including the surrounding topography) were reconstructed based on aerial photographs with SfM software（Agisoft PhotoScan Professional version 1.4.4), and georeferenced DSMs and orthophotos were generated.

We overlaid the high-definition DSMs and the orthophotos of the tombs on a 5- or 10-m DEM of Fundamental Geospatial Data and orthophotos by GSI with GIS software (ESRI ArcGIS Pro version 2.2) and generated landscape simulation images viewed from the tombs. We examined the resolutions of the DSMs and the orthophotos for visualizing landscapes from tombs through a comparison with landscape simulation images generated by each shooting method with a small UAV.

3. Results

3.1. KANNONZUKA TOMB

3.1.1. Present State of Kannonzuka Tomb

Kannonzuka Tomb is a 3-m high, round mound with 13-m diameter, and has a Yokoguchi-shiki Sekkaku made of andesite on the hillside of the southern slope of Mt. Hachibuse. It was probably built around the 7th century (Yamamoto, 1998). Figs. 2 and 3 show 360 or 180 degree photos of it. The axial direction (opening direction of the Yokoguchi-shiki Sekkaku) faces the mountain, but the view to the southwest direction is obstructed by the surrounding trees.

Fig. 2. 360 degree photo of Kannonzuka Tomb in front of Yokoguchi-shiki Sekkaku (taken on February 21, 2018)

Fig. 3. 180 degree photo of Kannonzuka Tomb on the top of the tomb mound (taken on February 21, 2018)

3.1.2. GNSS Survey and Photo Shooting with Small UAV

A GNSS survey of the ground control points (GCPs) and checkpoints was conducted from 12:50 to 13:20 on February 19, 2018 and from 9: 30 to 12: 00 on February 21, 2018. Fig. 4 shows a GNSS survey of GCPs with a Reach RS. The Coordinates (X, Y, Z) of the GCPs and the checkpoints were calculated by RTKLIB using RAW data acquired with the GNSS receivers. Altitude data were obtained by subtracting the geoid height from the Z value.[4]

Fig. 4. GNSS survey of GCPs with Reach RS (taken on February 21, 2018)

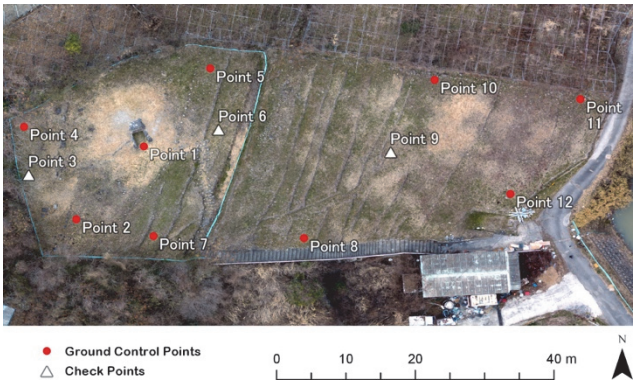


Fig. 5. Positions of GCPs and checkpoints

Figure 5 shows the positions of the GCPs and the checkpoints. Photos with a small UAV by both vertical shootings by auto pilot as well as vertical and oblique shootings by manual pilot were taken from 12:00 to 14:00 on the second day. The details of each shooting method are shown in Table 1. To reproduce the three-dimensional shape of the Yokoguchi-shiki Sekkaku and the tomb mounds, photos must be taken with multi-angles from a short distance. Due to such numerous obstacles as the surrounding trees, the photographs were taken by vertical shooting with an auto pilot and vertical and oblique shooting with a manual pilot.

3.1.3. Reconstruction of Three-dimensional Model by SfM

We reconstructed of a three-dimensional model by the following procedures:
1) Estimation of camera location and direction: We estimated the shooting position and the direction of the photos from multiple photos with SfM software. Fig. 6 shows the screen after calculating the estimated shooting position and the direction of each photograph for auto pilot. Fig. 7 shows them for manual pilot. Each blue square represents the position and the direction of each photo. The camera locations are calculated based on the extracted feature points (point cloud).

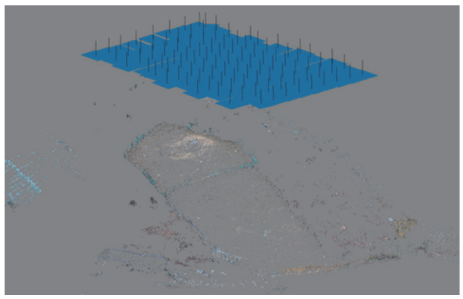


Fig. 6. Estimated camera location and direction for auto pilot (shooting method: a-2)

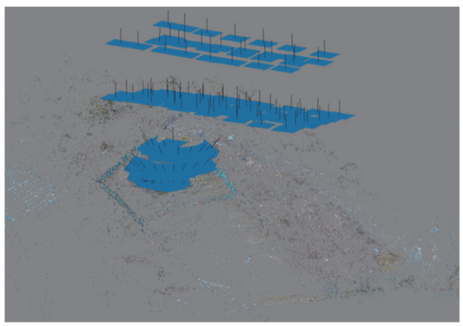


Fig. 7. Estimated camera location and direction for manual pilot (shooting method: m-4)

2) Build dense cloud： Fig. 8 shows the screen after calculating the dense point cloud, which is generated from the point cloud generated in the above procedure 1).

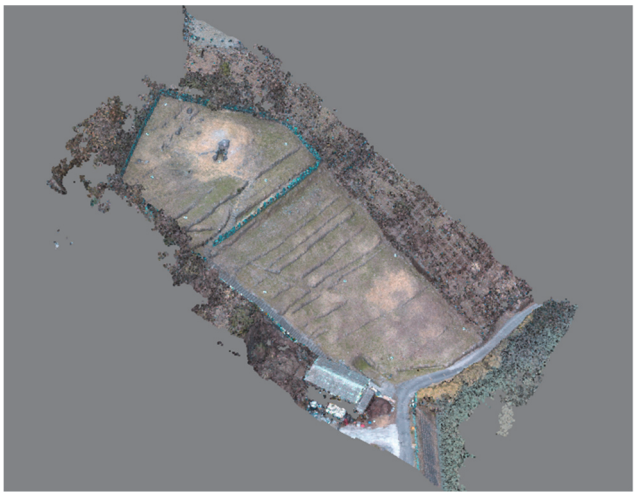


Fig. 8. Dense point cloud (shooting method: a-2)

3) Import coordinate data of GCPs and checkpoints: Fig. 9 shows the screen after GCPs and checkpoints have been placed on the dense point cloud. By importing the geographic coordinates obtained by a GNSS survey, a georeferenced three-dimensional model can be created.

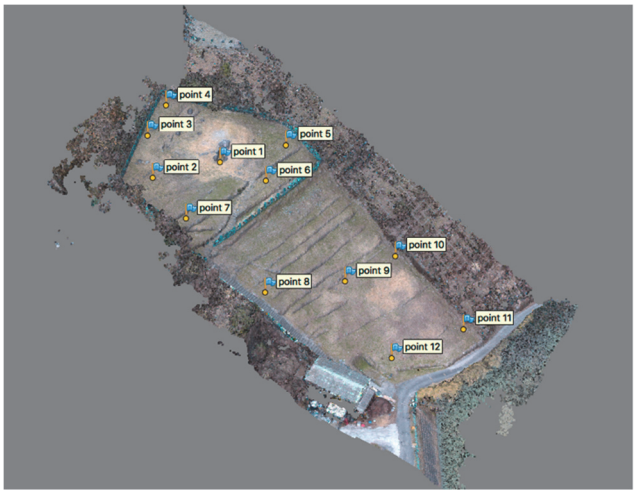


Fig. 9. GCPs and checkpoints setting in dense point cloud (shooting method: a-2)

4) Build mesh and texture： Fig. 10 shows a textured three-dimensional model. This step completes a three-dimensional model. By displaying the texture, it becomes a real three-dimensional model. This procedure can be omitted for building digital surface models (DSMs) and orthophotos.

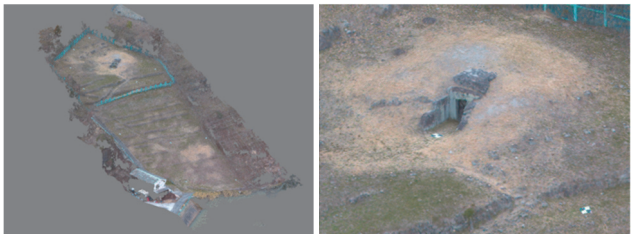


Fig. 10. Textured three-dimensional mesh model (shooting method: a-2)

5) Build DSM and orthophoto： Fig. 11 shows a DSM image. Fig. 12 shows an orthophoto image.

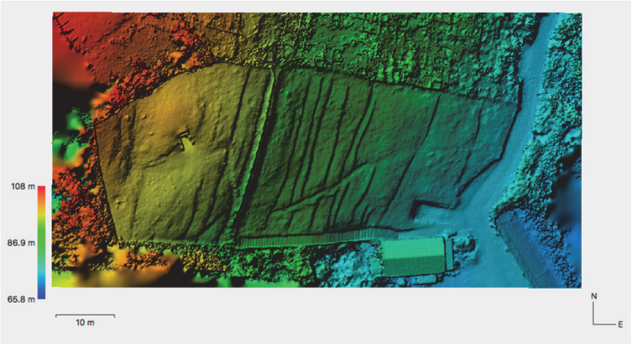


Fig. 11. DSM (shooting method: a-2)

Fig. 12. Orthophoto (shooting method: a-2)

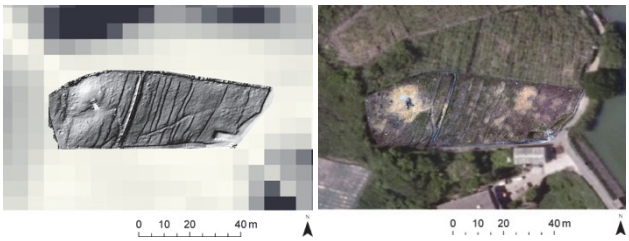
6) Export of each data: Point clouds, textured three-dimensional models, georeferenced DSMs, and orthophotos can be exported. In this paper, the author mainly used DSMs and orthophotos, which are easy to use in three-dimensional GIS. Table 1 lists the resolution of the DSMs and the orthophotos by each shooting method.

Table 1. List of shooting methods and resolution of DSMs and orthophotos

Method	Auto		Manual				
Direction	Vertical		Vertical			Vertical & Oblique	
No.	a-1	a-2	m-1	m-2	m-3	m-4	m-5
Height or Distance (m)	50	40	70	45	30	4 to 70	1 to 20
Number of photos	46	104	23	29	53	158	39
DSM resolution (cm/pix)	3.09	2.5	4.26	2.75	1.83	2.03	1.1
Orthophoto resolution (cm/pix)	1.54	1.25	2.13	1.37	0.916	1.01	0.552

3.1.4. Visualization of Landscape by Three-dimensional GIS

The landscape was visualized by three-dimensional GIS by the following procedures:
1) Overlaying a high-definition DSM and an orthophoto on a 5-m DEM and orthophotos by GSI: Using three-dimensional GIS software, we generated a DSM and an orthophoto by SfM and overlaid them on a 5-m DEM and orthophotos by GSI. Fig. 13 shows a shadow-relief map with a DSM by SfM with a shooting method (a-1) overlaid on the 5-m DEM by GSI. Fig. 14 shows an aerial photo map with an orthophoto by SfM with a shooting method (a-1) overlaid on an orthophoto by GSI. These maps can express the shapes of the Yokoguchi-shiki Sekkaku and the tomb mound clearly.



Left: Fig. 13. Shadow-relief map with 3.09-cm DSM by SfM (a-1) overlaid on 5-m DEM by GSI; Right: Fig. 14. Aerial photo map with 1.54 cm orthophoto by SfM (a-1) overlaid on an orthophoto by GSI

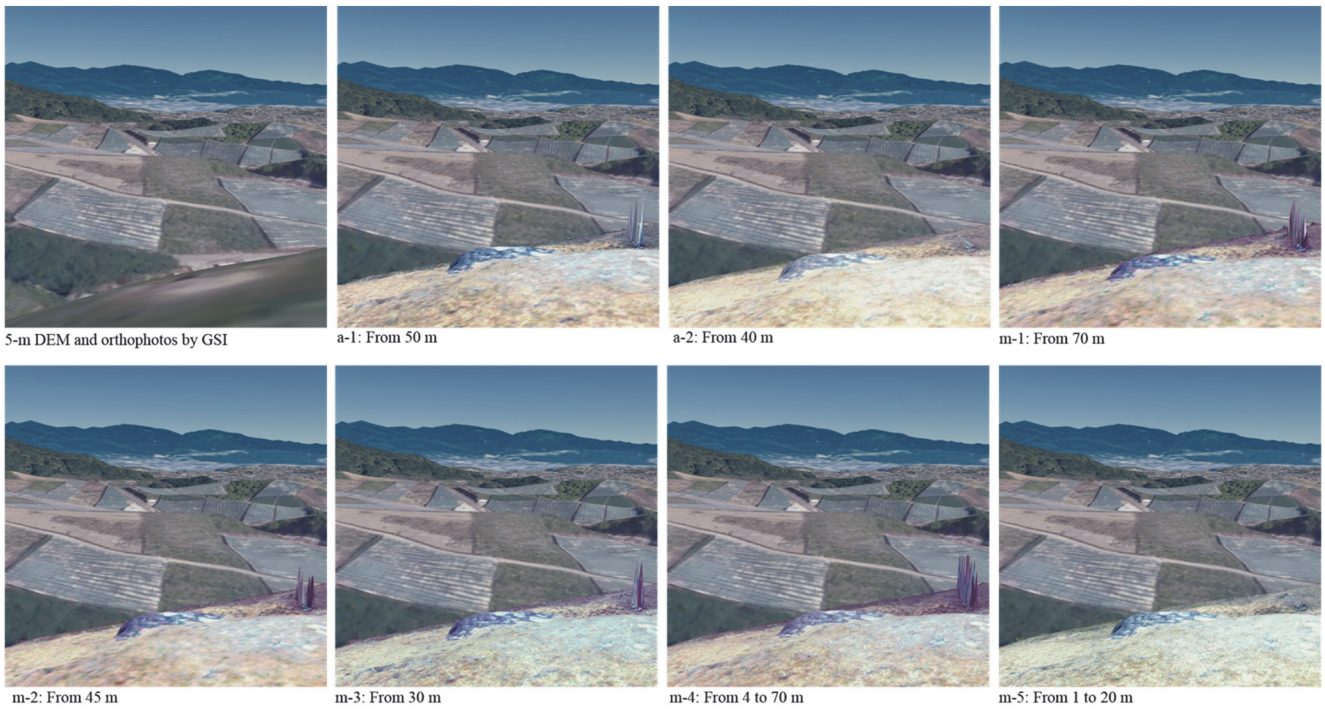
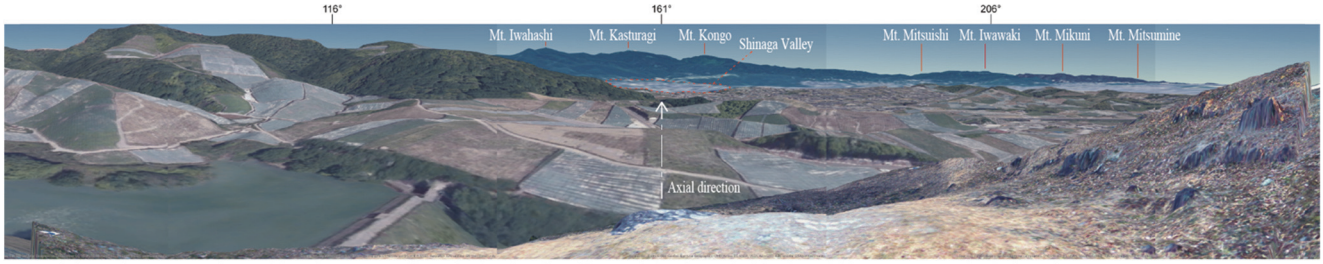


Fig. 15. Comparison of landscape simulation images from Kannonzuka Tomb by each shooting method

Panoramic image from Kannonzuka Tomb based on 5-m DEM and orthophotos by GSI



Panoramic image from Kannonzuka Tomb based on a DSM and an orthophoto by SfM with manual shooting method (m-5) overlaid on 5-m DEM and orthophotos by GSI

Fig. 16. Comparison of landscape simulation panoramic images from Kannonzuka Tomb

2) Generating landscape simulation images seen from tomb: Using the above overlaid three-dimensional GIS data, landscape simulation images seen from the Kannonzuka Tomb were generated. Fig. 15 shows the landscape simulation images from Kannonzuka Tomb only in the case of a 5-m DEM and orthophotos by GSI and a high-definition DSM and an orthophoto by each shooting method overlaid on them. A landscape simulation image based on only 5-m DEM and orthophotos by GSI can represent a distant view to the mountains, but it can't represent the shape of the stones that constitute the Yokoguchi-shiki Sekkaku and the tomb mound. The landscape simulation images based on a high-definition DSM and an orthophoto by SfM overlaid on a 5-m DEM and orthophotos by GSI can represent the shape of the stones and the tomb mound. The DSM and orthophoto resolution differ depending on the shooting height, and for shooting method (m-5) with the highest resolution, the shapes of the stones and the tomb mound can be expressed more clearly.

Figure 16 shows the landscape simulation panoramic images from the Kannonzuka Tomb for the only 5-m DEM and orthophotos by GSI and a high-definition DSM with 1.1-cm resolution and an orthophoto with 0.552-cm resolution by a manual shooting method (m-5) overlaid on them[5]. The latter image reproduces the relationship between the opening direction of the Yokoguchi-shiki Sekkaku and the landscape seen from the tomb. The view to the Kii Mountains (Mts. Mitsuishi, Iwawaki, Mikuni, and Mitsumine) is obstructed by trees now, but during the Final Kofun period the Kannonzuka Tomb had a distant panoramic view of the Kongo and Kii Mountains over an intermediate view of the nearby hills and the mountains. The axial direction of the Kannonzuka Tomb faces the Kongo Mountains (between Mts. Katsuragi and Kongo).

3.2. HACHIBUSEYAMA-NISHIMINE TOMB

3.2.1. Present State of Hachibuseyama-nishimine Tomb

Hachibuseyama-nishimine Tomb is a square, 20-m mound with a Yokoguchi-shiki Sekkaku on the hillside of the western slope of Mt. Hachibuse. It was probably built around the 7th century (Ito, 1998). Fig. 17 shows a 180 degree photo of it. The axial direction (opening direction of the Yokoguchi-shiki Sekkaku) faces the Osaka Plain, but the view to the northwest direction is obstructed by the surrounding trees, and the view to the southwest direction is also partially obstructed by the surrounding trees.

Fig. 17. 180 degree photo of Hachibuseyama-nishimine Tomb from the back of Yokoguchi-shiki Sekkaku (taken on November 9, 2017)

3.2.2. GNSS Survey and Photo Shooting with Small UAV

Figure 18 shows the positions of the GCPs and the checkpoints. We conducted a GNSS survey of them from 10:20 to 12:00 on February 19, 2018 and from 10: 00 to 12: 30 on February 22, 2018. Photos were taken with a small UAV by both auto pilot and manual pilot from 12:30 to 14:00 on the second day. The details of each shooting method are shown in Table 2.

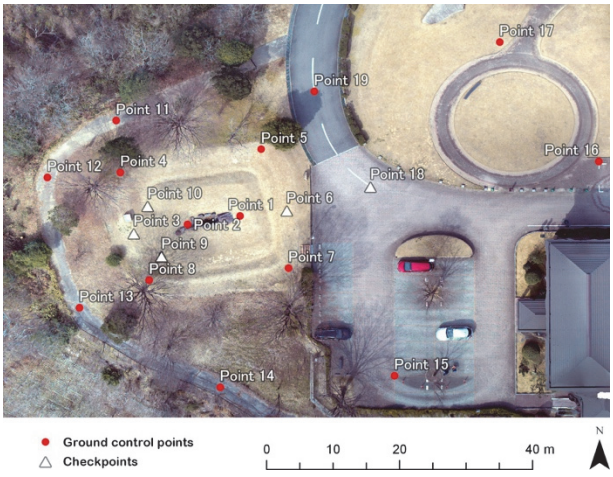


Fig. 18. Positions of GCPs and checkpoints

3.2.3. Reconstruction of Three-dimensional Model by SfM

Based on aerial photographs from a small UAV, three-dimensional models, DSMs and orthophotos of the Hachibuseyama-nishimine Tomb were reconstructed by SfM. Figs. 19, 20, and 21 show examples of each. Table 2 lists the DSM and orthophoto resolution by each shooting method.

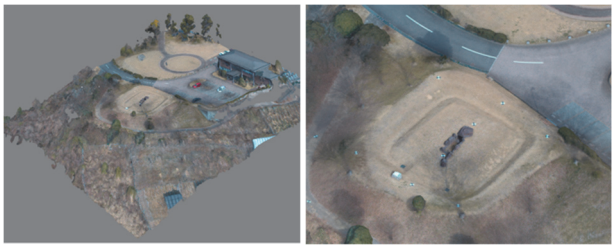


Fig. 19. Textured three-dimensional mesh model (shooting method: m-4)

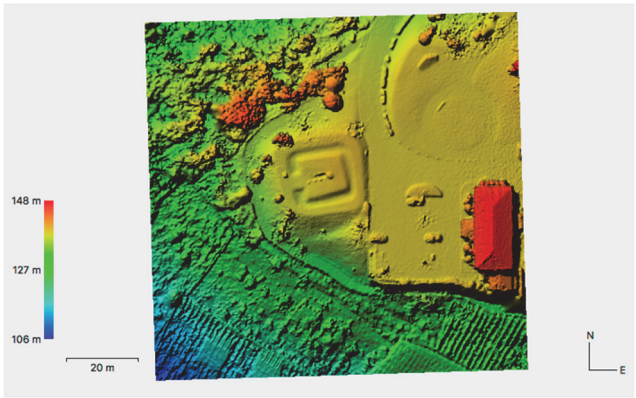


Fig. 20. DSM (shooting method: m-1)

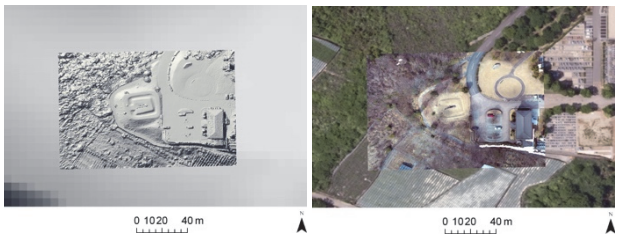
Fig. 21. Orthophoto (shooting method: m-1)

Table 2. List of shooting methods and resolution of DSMs and orthophotos

Method	Auto		Manual				
Direction	Vertical		Vertical			Vertical & Oblique	
No.	a-1	a-2	m-1	m-2	m-3	m-4	m-5
Height or Distance (m)	50	40	90	50	30	1 to 50	1 to 30
Number of photos	55	75	7	20	29	117	60
DSM resolution (cm/pix)	2.72	2.24	5.39	2.79	1.64	1.6	0.958
Orthophoto resolution (cm/pix)	1.36	1.12	2.7	1.39	0.821	0.798	0.479

3.2.4. Visualization of Landscape by Three-dimensional GIS

Figure 22 shows a shadow-relief map with a DSM by SfM with a shooting method (m-4) overlaid on a 5-m DEM by GSI. Fig. 23 shows an aerial photo map with an orthophoto by SfM with a shooting method (m-4) overlaid on an orthophoto by GSI. These maps can express the shapes of the Yokoguchi-shiki Sekkaku and the tomb mound clearly.



Left: Fig. 22. Shadow-relief map with 1.6-cm DSM by SfM (m-4) overlaid on 5-m DEM by GSI; Right: Fig. 23. Aerial photo map with 0.798-cm orthophoto by SfM (m-4) overlaid on an orthophoto by GSI

Figure 24 shows the landscape simulation images from the Hachibuseyama-nishimine Tomb only in the case of a 5-m DEM and orthophotos by GSI and a high-definition DSM and an orthophoto by each shooting method overlaid on them. The landscape simulation image based on only the 5-m DEM and orthophotos by GSI can represent a distant view to the mountains, but it can't represent the shape of the stones that constitute the Yokoguchi-shiki Sekkaku and the tomb mound. The landscape simulation image based on a DSM and an orthophoto by SfM with a shooting method (m-1) can roughly express the stone shape and the tomb mound, because of low resolution of the DSM and the

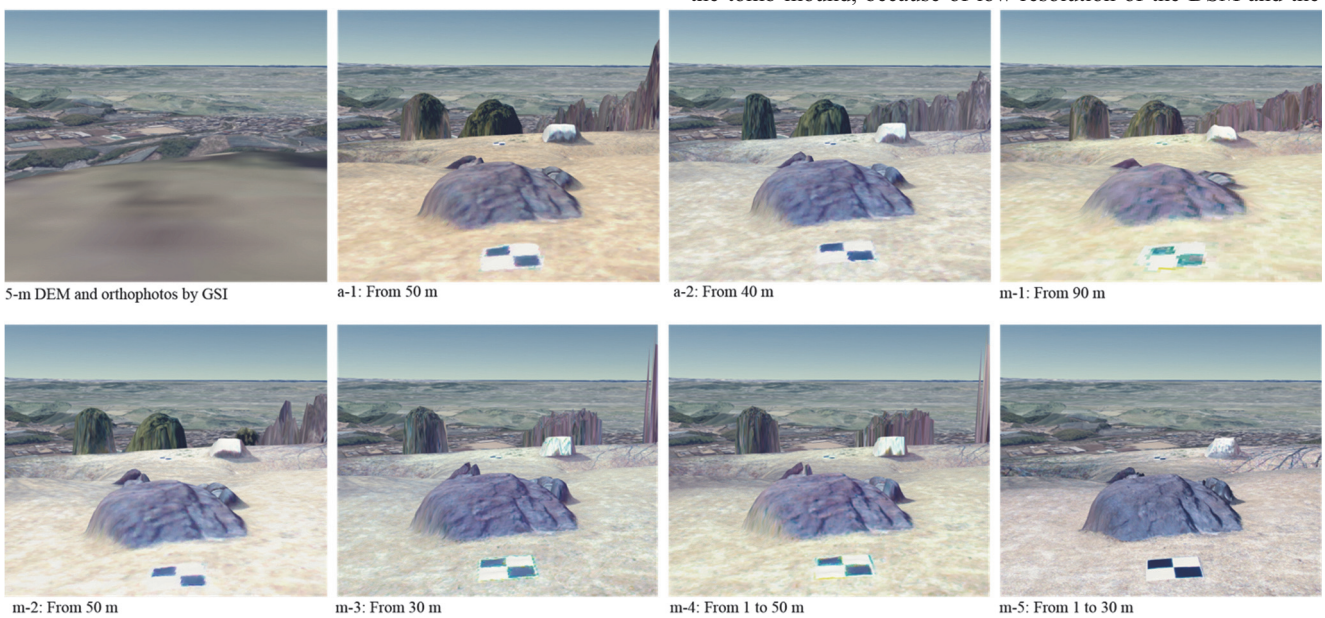
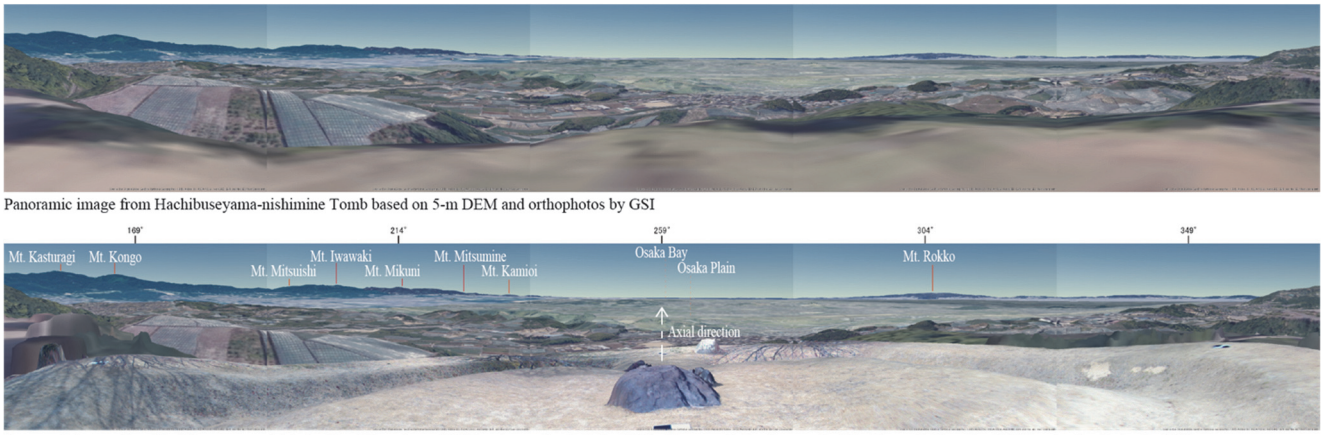


Fig. 24. Comparison of landscape simulation images from Hachibuseyama-nishimine Tomb by each shooting method



Panoramic image from Hachibuseyama-nishimine Tomb based on 5-m DEM and orthophotos by GSI

Panoramic image from Hachibuseyama-nishimine Tomb based on a DSM and an orthophoto by SfM with manual shooting method (m-5) overlaid on 5-m DEM and orthophotos by GSI

Fig. 25. Comparison of landscape simulation panoramic images from Hachibuseyama-nishimine Tomb

orthophoto. The landscape simulation images based on the DSMs and the orthophotos by SfM with shooting methods a-1, a-2, m-2, m-3, and m-4 have higher reproducibility than shooting method m-1. But the rising part of the stones can't be reproduced. For shooting method m-5 with the highest resolution, the shapes of the stones can be expressed more clearly, including the rising part and the tomb mound.

Figure 25 shows the landscape panoramic simulation images from the Hachibuseyama-nishimine Tomb for the only 5-m DEM and orthophotos by GSI and a high-definition DSM with 0.958-cm resolution and an orthophoto with 0.479-cm resolution by SfM with a manual shooting method (m-5) overlaid on them. The latter image can reproduce the relationship between the axial direction of the Yokoguchi-shiki Sekkaku and the landscape seen from the tomb. The view to the Kongo Mountains (Mts. Katsuragi and Kongo) and Kii Mountains (Mts. Mitsuishi, Iwawaki, Mikuni, and Mitsumine) is partly obstructed by the surrounding trees and the view to the northwest direction is also currently obstructed by the surrounding trees, but during the Final Kofun period, the Hachibuseyama-nishimine Tomb had a distant panoramic view of the Kongo and Kii Mountains and Mt. Rokko over an intermediate view of the nearby hills and the mountains and the Osaka Plain. The axial direction of Hachibuseyama-nishimine Tomb faces the Osaka Plain and Bay.

3.3. OKAMEISHI TOMB

3.3.1. Present State of Okameishi Tomb

Okameishi Tomb is a square mound with 21-m sides and a Yokoguchi-shiki Sekkaku on a ridge projecting southeast from the Habikino hills. It was probably built around the 7th century (Kambayashi, 2003). Figs. 26 and 27 show 360 or 180 degree photos of the Okameishi Tomb. The views to the axial and southeast directions are partially obstructed by the surrounding trees and the view to the southwest is also obstructed by the surrounding trees.

Fig. 26. 360 degree photo of Okameishi Tomb in front of Yokoguchi-shiki Sekkaku (taken on February 8, 2018)

Fig. 27. 180 degree photo of Okameishi Tomb from behind Yokoguchi-shiki Sekkaku (taken on February 8, 2018)

3.3.2. GNSS Survey and Photo Shooting with Small UAV

Figure 28 shows the positions of the GCPs and the checkpoints. We conducted a GNSS survey of them from 10:20 to 12:00 on February 26, 2018 and from 9: 30 to 12: 00 on March 4, 2018. Photos were taken with a small UAV by both auto pilot and manual pilot from 12:00 to 14:00 on the second day. The details of each shooting method are shown in Table 3.

Fig. 28. Positions of GCPs and checkpoints

3.3.3. Reconstruction of Three-dimensional Model by SfM

Based on aerial photographs from a small UAV, three-dimensional models, DSMs and orthophotos of the Okameishi Tomb were reconstructed by SfM. Figs. 29, 30, and 31 show examples of each. Table 3 lists the resolution of the DSMs and the orthophotos by each shooting method.

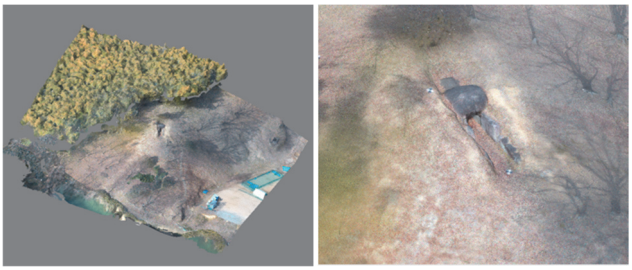


Fig. 29. Textured three-dimensional mesh model (left: a-1, right: m-4)

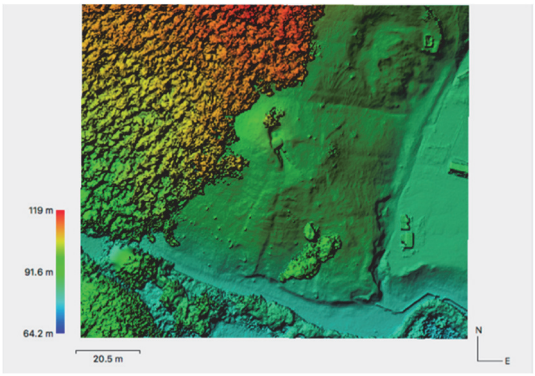


Fig. 30. DSM (shooting method: a-1)

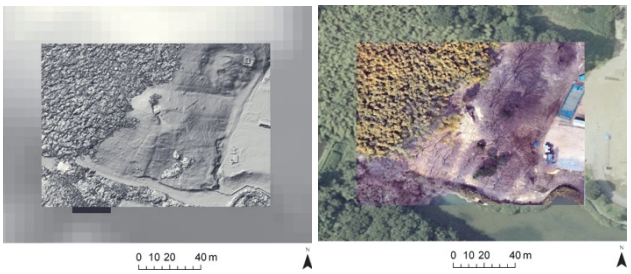
Fig. 31. Orthophoto (shooting method: a-1)

Table 3. List of shooting methods and resolution of DSMs and orthophotos

Method	Auto		Manual				
Direction	Vertical		Vertical		Vertical & Oblique		
No.	a-1	a-2	m-1	m-2	m-3	m-4	m-5
Height or Distance (m)	60	30	70	25	1 to 70	1 to 25	1 to 25
Number of photos	102	161	36	119	192	158	65
DSM resolution (cm/pix)	3.79	2.43	4.19	1.83	1.91	1.31	0.957
Orthophoto resolution (cm/pix)	1.9	1.22	2.1	0.914	0.956	0.656	0.479

3.3.4. Visualization of Landscape by Three-dimensional GIS

Figure 32 shows a shadow-relief map with a DSM by SfM with a shooting method (a-1) overlaid on a 5-m DEM by GSI. Fig. 33 shows an aerial photo map with an orthophoto by SfM with a shooting method (a-1) overlaid on an orthophoto by GSI. These maps can express the shapes of the Yokoguchi-shiki Sekkaku and the tomb mound clearly.



Left: Fig. 32. Shadow-relief map with 3.79-cm DSM by SfM (a-1) overlaid on 5-m DEM by GSI; Right: Fig. 33. Aerial photo map with 1.9-cm orthophoto by SfM (a-1) overlaid on an orthophoto by GSI

Figure 34 shows the landscape simulation images from the Okameishi Tomb only in the case of a 5-m DEM and orthophotos by GSI and a high-definition DSM and an orthophoto by SfM with each shooting method overlaid on them. The landscape simulation image based on only the 5-m DEM and orthophotos by GSI can represent a distant view to the mountains, but it can't represent the shape of the stones that constitute the Yokoguchi-shiki Sekkaku

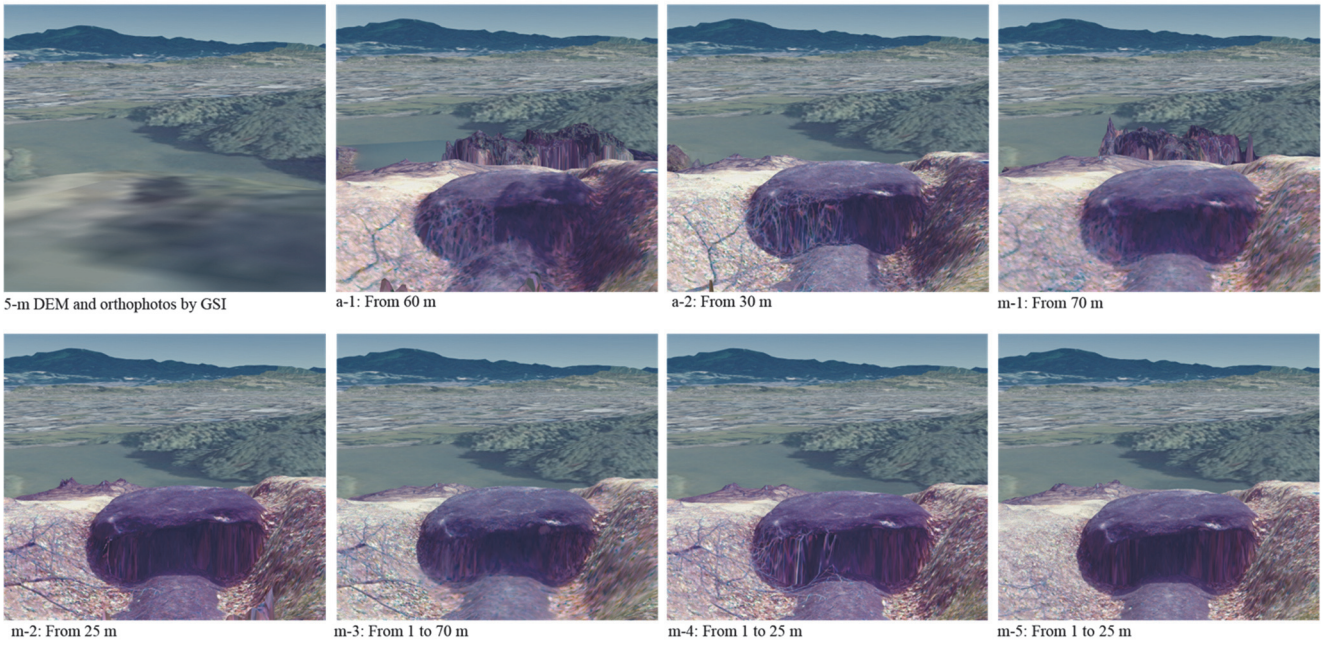


Fig. 34. Comparison of landscape simulation images from Okameishi Tomb by each shooting method

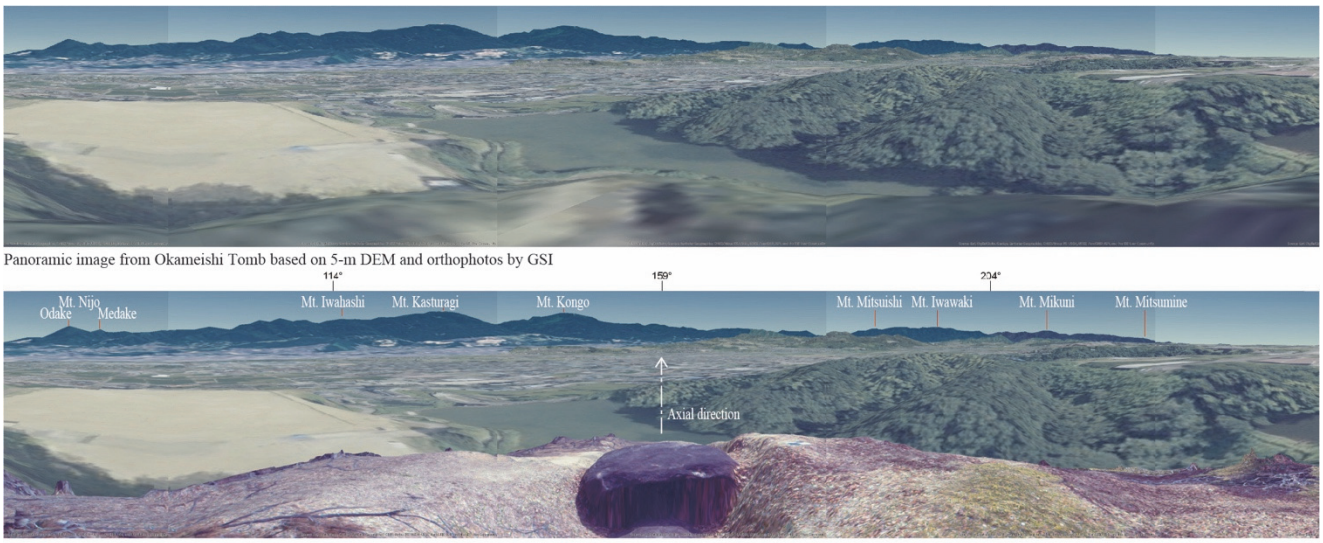


Fig. 35. Comparison of landscape simulation panoramic images from Okameishi Tomb

and the tomb mound. The landscape simulation images based on DSMs and orthophotos by SfM with shooting methods a-1 and m-1 can roughly express the shapes of the stones and the tomb mound, but because of the low resolution of the DSMs and the orthophotos, their reproducibility is low. The landscape simulation images based on DSMs and orthophotos by SfM with shooting methods a-2, m-2, m-3, and m-4 have higher reproducibility than with shooting methods a-1 and m-1. But these orthophotos have low reproducibility of the texture, especially because the branches of the nearby trees are projected for the stone's rising part. For shooting method m-5 with the highest resolution, the shapes of the stone including the rising part and the tomb mound can be expressed more clearly and properly.

Figure 35 shows the landscape panoramic simulation images from the Okameishi Tomb for only the 5-m DEM and orthophotos by GSI and a high-definition DSM with 0.957-cm resolution and an orthophoto with 0.479-cm resolution by SfM with a manual shooting method (m-5) overlaid on them. The latter image reproduces the relationship between the axial direction of the Yokoguchi-shiki Sekkaku and the landscape seen from the tomb. The view to the Kongo Mountains (Mts. Nijo, Iwahashi, Katsuragi, and Kongo) is partially obstructed by the surrounding trees, as is the view to the Kii Mountains (Mts. Mitsuishi, Iwawaki, Mikuni, and Mitumine), but during the Final Kofun period, the Okameishi Tomb had a distant panoramic view of the Kongo and Kii Mountains over an intermediate view of the nearby hills and the mountains. The axial direction of the Okameishi Tomb faces the Kongo Mountains on the eastside of Mt. Kongo.

4. Discussion

We generated high-definition georeferenced DSMs and orthophotos by three-dimensional models by SfM with aerial photographs from a small UAV and cm accuracy GNSS surveys, and reproduced the shapes of stones that constitute the Yokoguchi-shiki Sekkaku and the tomb mounds. By overlaying high-definition DSMs with a maximum of about 1-cm resolution and orthophotos with a maximum of about 0.5-cm resolution by SfM and a GNSS survey, on the 5-m DEM and orthophotos by GSI, we generated landscape simulation images that show the relationship between the shapes of the stones and the tomb mounds, the axial directions, and the panoramic view from the tombs. For generating landscape simulation images that reproduce the shapes of the stones and the tomb mounds, the shooting distance should be shorter than at least from 40 m to generate a DSM with resolution of about 2.5 cm or higher and an orthophoto with resolution of about 1.3 cm or higher resolution. It is difficult to lower the shooting height when such surrounding obstacles as trees exist in the auto pilot, which is suitable for reproducing a wide range area around the tombs. Therefore, to reproduce the three-dimensional shapes of the stones and the tomb mounds, shooting with a manual pilot is more effective and generates higher resolution DSMs and orthophotos.

The following issues must be examined in the future: 1) Since the sky above all of the three tombs is open, it was possible to take aerial photographs from a small UAV. On the other hand, since the sky above the tomb in the forest isn't open, no aerial photographs of the tomb mound can't be taken. 2) No effective method has been found for overlaying the three-dimensional model itself on the terrain model. Currently, it is very easy to overlay a DSM and an orthophoto generated from a three-dimensional model by SfM on the 5-m DEM and orthophotos by GSI using three-dimensional GIS to generate a landscape simulation image from the tombs.

5. Conclusions and future plans

We visualized landscapes from three tombs of the Final Kofun period in the Kawachi area (Kannonzuka, Hachibuseyma-nishimine, and Okameishi Tombs) with a high-definition three-dimensional model by structure from motion (SfM) multi-view stereo photogrammetry and three-dimensional GIS for analyzing the relationship of the shapes of the stones and the tomb mounds, the axial directions of the tombs, and their views. We also clarified the following three points:

1) By SfM with aerial photographs from a small UAV and a cm accuracy GNSS survey, we generated georeferenced DSMs with about 1-cm resolution and orthophotos with about 0.5-cm resolution at most, which can express the microtopography of the three tombs.
2) With overlaying DSMs and orthophotos by SfM on a 5-m DEM and orthophotos by GSI using three-dimensional GIS, we can quickly visualize landscapes from the three tombs at the Final Kofun period at low cost, although their views are now obstructed by such surrounding obstacles as trees.
3) Shooting with a manual pilot is more effective and generates higher resolution of DSMs and orthophotos than shooting with an auto pilot for reproducing the three-dimensional shapes of the stones and the tomb mounds. Lowering the shooting height

in the auto pilot is difficult when such surrounding obstacles as trees exist.

In the future, we plan to visualize landscapes from more tombs of the Final Kofun period by the method proposed in this paper, and analyze them to clarify the characteristics of tombs of the Final Kofun period from a landscape viewpoint.

Acknowledgements

I thank the Cultural Properties Protection Division of Habikino City, Kato Co., Ltd, and the Cultural Properties Division of Tondabayashi City for their cooperation on GNSS surveys and UAV flights. I am grateful to S. Uchiyama from the National Research Institute for Earth Science and Disaster Resilience for valuable advice on SfM photogrammetry and GNSS surveys. I also thank Y. Kawasaki and K. Ohara from the Graduate school of Human Environment, Mukogawa Women's University who supported the field surveys and helped generate the three-dimensional models of the tombs. This work was supported by JSPS KAKENHI Grant Number JP 17K18276.

Endnotes

1. The structure from motion (SfM) is a technique for estimating the three-dimensional shape and shooting position based on image processing (Uchiyama, 2014). By taking low-level aerial photos from multiple viewpoints using a small UAV and analyzing the parallax of the object to be photographed, a high-definition three-dimensional model can be generated.
2. Global Navigation Satellite System (GNSS) is used for real-time positioning (latitude, longitude, and altitude) from the radio waves from satellites (Hayakawa, 2014).
3. RTKLIB is an open source program package for standard and precise positioning with a global navigation satellite system (GNSS) developed by T. Takasu, for more details about on RTKLIB see the following site: RTKLIB: An Open Source Program Package for GNSS Positioning http://www.rtklib.com/
4. The geoid height was calculated using the coordinate data obtained by GNSS survey at the following site: Geoid calculation-GSI https://vldb.gsi.go.jp/sokuchi/surveycalc/geoid/calcgh/calc_f.html
5. For a method that generates panoramic images in ArcGIS pro, refer to the following site by Y. Haneda. https://www.wingfield.gr.jp/blog/2018/08/31/p8852/

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Proposal of Energy-efficient Living Strategies based on Traditional Japanese Environmental Design: the Project of "Kisekae House"

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Keywords: Traditional Japanese environmental design, Passive design, Net zero energy house, ZEH, Residents' behavior, High thermal performance of envelope, High efficiency appliances.

Abstract: We proposed the Kisekae House as a net-zero energy house for the 2017 Enemane House Competition. The traditional Japanese environmental design based on the traditional lifestyle, which is unique as it is adjustable according to the local climate conditions, was arranged to suit to the current lifestyle and incorporated into the Kisekae House. The main concept of the house is to maintain good relations with neighbors and to be in contact with the surrounding natural environment. Specifically, the house design enhanced the thermal performance of the house envelope, installed the high efficiencies of household appliances, introduced a superior energy-utilization control system, and incorporated energy generation using solar photovoltaics. In addition, the resident's behaviors, including controlling the high-thermal-performance doors, partitions, and shades, also facilitated energy savings and allowed the creation of a comfortable environment. The Kisekae House was evaluated in terms of reduction in energy consumption and the energy self-sufficiency, the environmental conditions were also evaluated in winter. The proposed design facilitated a 143% reduction in the primary energy consumption based on that of a standard house. The proposed design strategies are expected to contribute to achieving the goals outlined in the Paris Agreement to mitigate global warming.

1. Introduction

According to the Paris Agreement to mitigate the increase in the global temperature due to global warming, it is essential to reduce greenhouse gas emissions by 45% from the 2010 level by the year 2030 and to reach net-zero emissions by 2050 (IPCC 2018). To achieve these goals, it is important to further reduce our energy consumption and utilize renewable energy resources. However, the energy consumption by households and offices, which now accounts for 30% of the total energy consumption in Japan, has increased by 24% in the past quarter century (1990–2015) (METI 2017a,b). Although energy consumption has been declining since 2005, the change is not significant enough to realize the targets set forth by the Paris Agreement. Thus, it is necessary to pursue additional decarbonization through additional energy conservation efforts and further utilization of renewable energy resources.

In this interest, the Japanese government has been promoting as its policy the zero energy house (ZEH), which is a house in which the net primary energy consumption on an annual basis is zero (METI 2015, 2016). Large energy savings can be achieved by improving the thermal performance of envelope of the house, implementing high-efficiency equipment and appliances, and generating energy from natural resources; it is also important that ZEHs provide comfortable indoor living conditions.

In addition to these technical changes, the residents' behavior, such as ventilation by opening and closing windows to attain a comfortable temperature and other energy-saving practices, can also have a significant impact on energy consumption (Endoh et al. 2015). Such behaviors and the factors that encourage these behaviors are ubiquitous in the traditional Japanese lifestyle and designs (Okazaki 2012a,b, Awa 2015), which can be adjusted on the basis of the local climate conditions. By leveraging these traditional customs and adapting them to the modern lifestyle, we can realize additional energy savings and effectively utilize natural energy resources.

Furthermore, facilitating continued use of buildings over long periods is important for realizing energy savings and reducing the greenhouse gas emissions. This can be done by designing houses to be adaptable to the residents' social situation like family sizes, lifestyles, and relationships with the neighbors.

By leveraging these strategies for reducing the environmental load, the students and teachers in the architectural major at Mukogawa Women's University proposed the Kisekae House for a ZEH competition, Enemmane House 2017[Note1,2)]. The Kisekae House introduces elements based on the traditional Japanese customs. The proposed design offers energy savings through hardware, such as high-performance exterior walls and windows and high-efficiency appliances, as well as "software," encompassing the residents' behaviors. Furthermore, the design facilitates good communication with neighbors and makes high contact with the surrounding natural environment.

In this paper, we present the proposed Kisekae House ZEH design that is adapted to the modern Japanese lifestyle as well as satisfies the required environment. We present the concept, describe the various techniques used to satisfy the design requirements, and evaluate the impacts on energy consumption and the environmental conditions during the winter season.

2. Climate in Osaka

Figure 1 shows climographs for Osaka and Istanbul including the monthly average temperature and relative humidity. The proposed house was constructed in Osaka, which is located in a relatively temperate, humid subtropical climate (Cfa in Keppen code). The climate of Osaka differs from that of Istanbul, which is located on the west side of the Silk Road in a Mediterranean climate (Csa in Keppen code). Compared with Istanbul, Osaka is hotter and has a higher humidity in the summer and is colder in the winter. The average annual temperature in Osaka is 16.9 C; the temperature can fall below 0 °C in the winter and has exceeded 37°C in the summer in recent years. The average relative humidity is 64% and can reach 70% in the summer. Thus both heating in winter and cooling in summer are required in Osaka.

3. Application of the Traditional Japanese Environmental Design in the Kisekae House

The environmental design and lifestyle elements of the traditional Japanese town house, such as "Kyo Machiya" (Okazaki 2012a), were implemented in the Kisekae House. The Kyo Machiya includes unique designs involving control over lighting, temperature, and humidity. The eaves, window roofs, can control the lighting which vary seasonally. And the residents create the suitable lighting condition to control lattice windows, bamboo blinds, and sliding doors (Okazaki 2012b:14-17).

To manage the hot and humid conditions of the summer for feeling cool by tough the earth floor with large thermal mass and cany mattings, which are relatively low in temperature. (Okazaki 2012n:19-22). The bamboo screens provide shading and heat from the sun. The reed screen or doors and cany mattings also provide sensation of coolness visually to the residents (Hirai 2013). The open floor plan and summer-style interior doors facilitated cross-ventilation. In the winter, the summer interior doors could be exchanged for *Fusuma* doors and *Shoji* screens to reduce the heat loss and to keep the house air-tight. The residents also adapt the cold condition by wearing warmer clothes and by using heaters rather than air conditioners (Okazaki 2012b). In addition to these traditional lifestyle features and techniques, basic passive architectural elements, such as large skylights, were used to heat the house from natural resources in the winter (Shokokusha 1980:41-43).

By adopting these passive elements of the traditional Japanese environmental design in the Kisekae House and combining them with recent technical improvements in energy-efficient appliances, thermal insulation, solar energy generation, and air tightness, these strategies can be leveraged more effectively. In this way, the energy requirements for heating, cooling, lighting, and hot water supply can be substantially reduced to realize a ZEH.

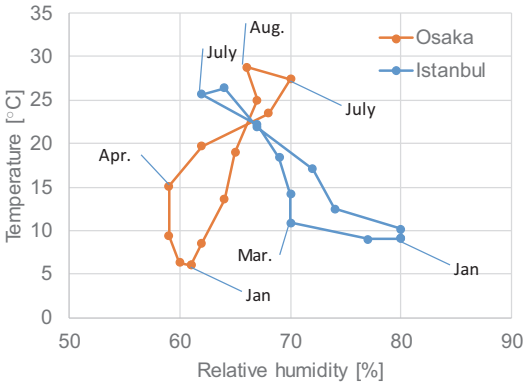


Figure 1 Climographs for Osaka (a humid subtropical climate) and Istanbul (a Mediterranean climate) (adapted from JMA 2018).

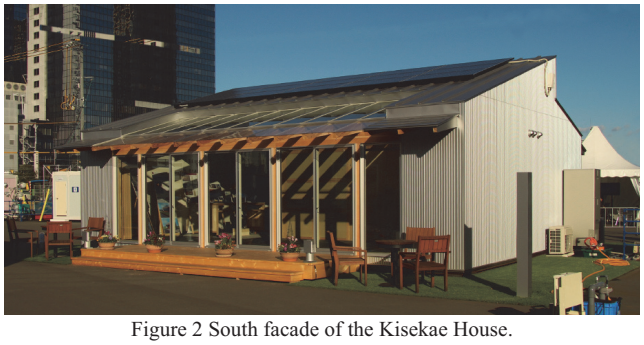


Figure 2 South facade of the Kisekae House.

4. Energy-efficient Design Concepts in the Kisekae House

The main concept of the house proposed is *kisekae*, which means to change clothes in Japanese. As we change our clothes with season, weather, or occasion, the plans and facilities in Kisekae House can be changed to adjust with the resident's life style and the surrounding climate. The Kisekae House has several Kisekae devices, like partition, doors, and facilities, which can be moved easily.

Figure 2 and Figure 3, and Table 1 show the constructed Kisekae House, the floor plan, and its design parameters, respectively. The main concept of the Kisekae House is to establish good relations between residents and neighbors as well as maintain contact with the surrounding environment. Several Kisekae devices are incorporated in the house: they can be easily controlled or modified by the residents to create comfortable living conditions. The techniques were developed on the basis of the traditional Japanese environmental design and included doors

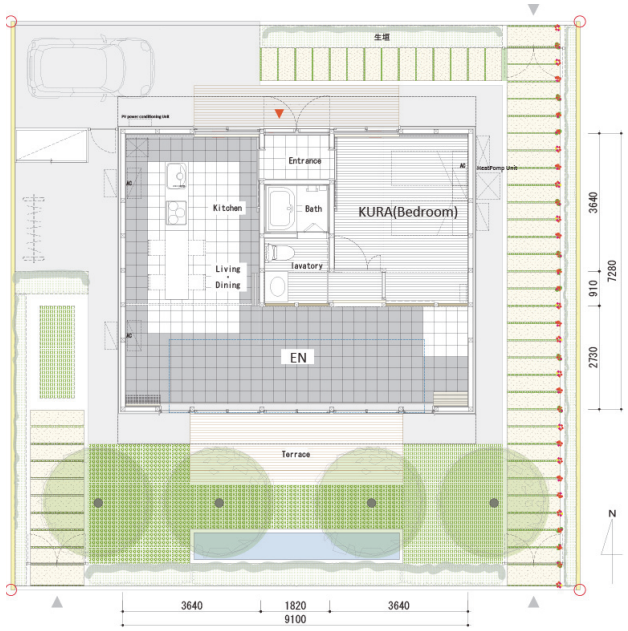


Figure 3 Floor plan of the Kisekae House.

Table 1 General parameters of the Kisekae House.

Location	Osaka, Japan (35.7°N, 135.5°E)
Floor area	66.25 m^2
Eave height	FL+2.210 mm
Building use	Model house
Energy source	Solely electric

and partitions that can be changed daily or seasonally, flooring with high thermal mass, shading devices, large openings to facilitate ventilation, etc.

4.1. FLEXIBLE FLOOR PLAN

The Kisekae House has two different spaces: one is open to the outside, called "*en*" in Figure 4; the other has controlled environmental conditions, called "*kura*" as shown in Figure 5.

The *en* design concept is based on *engawa*, which is placed between the living room and outside like the intermediate space. Traditionally *engawa* had been used as entrance of the house. When the partition between the *engawa* and the living room was open, the 2 spaces are used as one wide space, and when the outside openings of *engawa* are opened, the *engawa* becomes a continuous space between room and outside. People can change the size and connecting pattern of room-*engawa*-outside easily. Although *engawa* space was used as entrance, in later years, people commonly use *engawa* spaces as a corridor or an intermediate space to enjoy cool breezes in the summer and sunshine in winter.

The *en* space of the Kisekae House is included inside the house and connected to the living room. The *en* space obtains most of the solar energy through the large windows facing to the south (Figures 3 and 4) and large skylights (Figures 4 and 9), to reduce the energy required for heating. Although the significant solar radiation increases the energy demand for cooling in the summer, this can be mitigated by moving the highly insulated shades and rolling blinds into place (Figures 9 and 10).

The *kura* space, which is used as the bedroom (Figures 3 and 5), is a very stable environment: it is thermally isolated from the surrounding rooms by highly insulated walls. As the partition wall connected with *en*, which temperature varies widely, the clay walls with high thermal mass are used for the stable condition.

The configuration and sizes of the *en* and *kura* spaces can be changed by moving the partitions depending on the residents' needs (for example, the need for private and communal spaces). Figure 6 shows an example of how the floor plan can be changed in response to a change in the family structure. Figure 6(a) shows a floor plan for when the family has one child; the child's room is in the *en* within eyeshot of the parents. When an additional child is introduced to the family, the children's space can be expanded as shown in Figure 6(b); in this way, the neighbors also can follow the children's growth. After the parents retire, the *en* space can be opened as shown in Figure 6(c) to allow the neighbors to visit, thus facilitating a good relationship between the residents and the community.

4.2. DESIGN TO CONTROL THE ENVIRONMENTAL CONDITIONS

Several features of the traditional Japanese environmental design are adopted in the Kisekae House. For example, the sliding doors and partitions can be changed daily or seasonally to establish comfortable temperature and lighting conditions in the house and

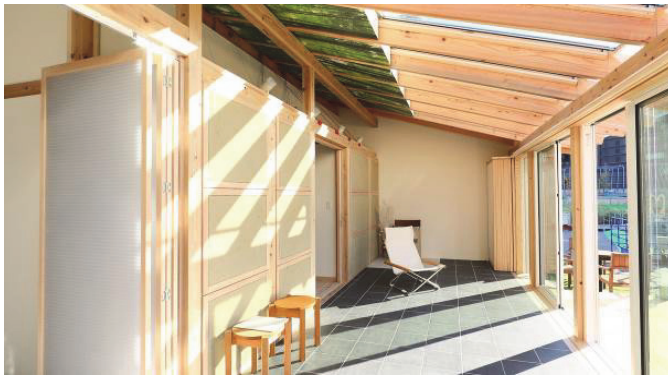
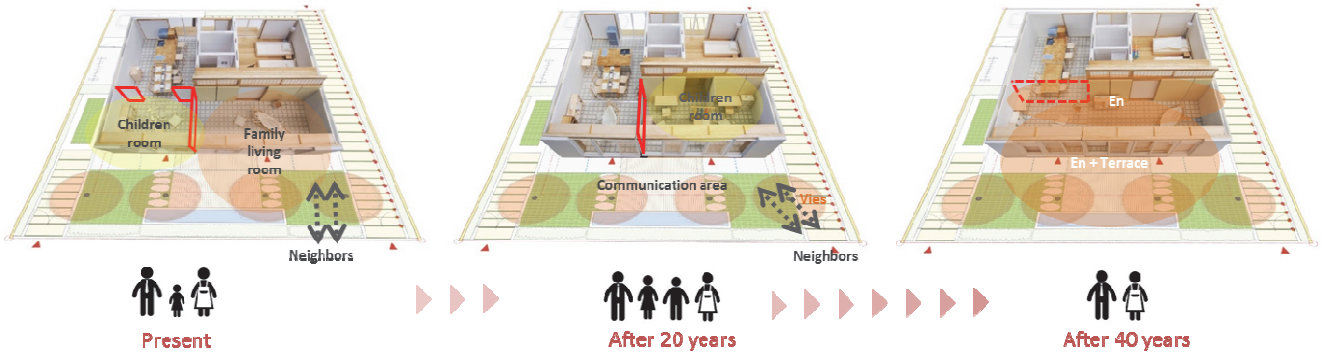


Figure 4 Inside the *en* space: solar energy can be obtained via skylights to create a bright and warm communal living space.

Figure 5 Inside the *kura* space: the space is isolated from the surrounding room by highly insulated partitions to create a private living space with a stable temperature.



(a) When the family has one child; the child's room is in the *en* within eyeshot of the parents.

(b) When an additional child is introduced to the family, the children's space can be expanded; in this way, the neighbors also can follow the children's growth.

(c) After the parents retire, the *en* space can be opened to allow the neighbors to visit, thus facilitating a good relationship between the residents and the community.

Figure 6 Example of how the partitions can be moved depending on the family structure.

control the heat gained from solar radiation. Moreover, the recent technical improvements in thermal insulation enable effective control over the retention of heat gained from solar energy. These features are detailed as follows.

4.2.1. Interior Window Shades

In order to control the environmental conditions, two types of window shades based on the traditional Japanese partition doors are installed: highly insulated interior shades to increase the thermal resistance of the openings in the house (Figure 7) and interior ventilation shades made of bamboo blinds to block sunlight while allowing ventilation during the summer and transition seasons (Figure 8). Although the shades inside the windows are usually changed seasonally in traditional Japanese homes, in the proposed design, they can be opened and closed daily or hourly in response to changing environmental conditions. These shades are placed on the north and south sides of the room (Figures 3 and 11). Because of the limited space, each shade type is on a single slide rail. This further contributes to the airtightness of the house by reducing the air leakage through the gaps between the shades.

4.2.2. Highly Insulated Shades Under Skylights

The energy consumption for heating and lighting can be reduced by utilizing the solar energy and daylight obtained via the skylights. Movable and highly insulated shades comprising 175-mm-thick extruded polystyrene foam (Table 2) are installed under the skylight windows as shown in Figure 9 to mitigate the solar heat gain and prevent heat loss. Roll blinds are also installed to block solar heating and control the lighting (Figure 10). In the winter, the highly insulated shades and rolling blinds can be opened in the daytime to let in light and heat the house and closed at night to prevent heat loss through the windows. In the summer, the insulated shades can be closed during the day to block the solar radiation. In interim period, they are controlled depending on the condition.

The flat rails attached to both sides of the highly insulated shades slide along a flat rail attached to the roof balks. Because there are no spaces between the rails, the air leakage through them can be limited. The highly insulated shades can be controlled by hand. Alternatively, an electrical opening system can be programmed to open and close them depending on the room air temperature, floor surface temperature, or heat flow. The system also connects to the internet to allow the residents to control the shades while away from the house.

4.2.3. Floors and Walls with High Thermal Mass

The solar radiation through the skylights and south-facing windows irradiate the floor in *en* space as well as the interior clay walls (Figure 4). Thus, high-emissivity black tiles are used in the *en* space where the direct solar radiation reaches, and white tiles are used in places that do not receive solar radiation to increase the brightness of the room. In addition, to retain the solar energy, the floor was made of tiles (9mm thick) and mortar (80mm thick and the walls between the *en* and *kura* spaces were made of thick clay (24mm thick) with clay panels (26mm thick)[Note3)]. Thus, the total thermal masses of floors and clay walls were 3180 and 360kJ/K, respectively. The clay walls additionally have high moisture capacity to stabilize the air humidity in the connecting rooms when the temperature changes rapidly.

Figure 7 Window shades installed inside windows for insulation.

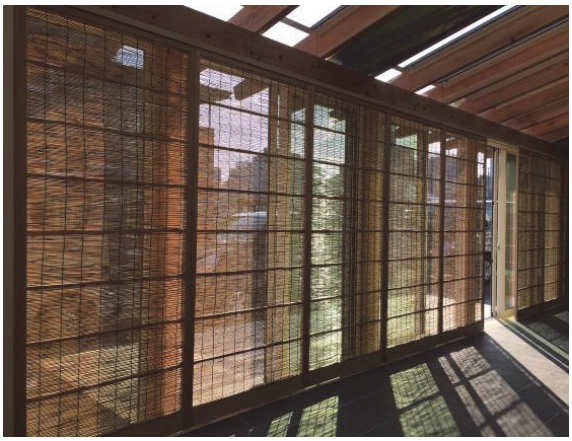


Figure 8 Window shades that allow ventilation and block solar radiation.

Figure 9 Highly insulated shades under skylights that can be moved up and down manually or via electric power.

Figure 10 Roll blinds under skylights.

4.2.4. Highly Insulated Envelope

Table 2 shows the heat transmission coefficient of each element of the house (the components are labeled in Figure 11). The average heat transmission coefficient (U_A [W/m^{2}K]) of the house is 0.45W/m^{2}K. Low-E pair glass is used in the skylight, and polyethylene foam (175mm thick) is used as a highly insulated shade under the skylights. Thus, the total U-value of the glass roof is 0.20W/m^{2}K. Low-E pair glass and highly insulated internal shades of polyethylene foam (40mm), which have a thermal resistance of 0.68m^{2}K/W, are used for the windows on the north and south walls. Thus, the total thermal resistance of these windows is 1.46m^{2}K/W, which is three times higher than that of the low-E pair glass alone; in addition, the U-value of these windows is 0.68W/m^{2}K.

The air exchange rate due to air leakage was calculated from the decrease in the measured CO_2 concentration over time as 0.17 times/hour in the *kura* space and 0.22 times/hour in the *en* space. Fans can be used to circulate air between the *en* and *kura* spaces to control the thermal environment.

4.2.5. Lighting Performance

Solar energy is utilized for lighting during the daylight hours. White floor tiles were used in the living room, where direct solar radiation does not reach, to enhance the daylight factor. The size of the skylights and the interior materials were simulated[Note4)], revealing that the daylight factor[Note5)] at the backside of the living room exceeded 2%.

Table 2 U-values of building elements.

	U-value [W/m^{2}K]
Wall	0.18
Roof (North side)	0.17
Roof (South side)	0.18
Skylights with highly insulated shade	0.20
Windows	2.2
Highly insulated inner shades	0.20

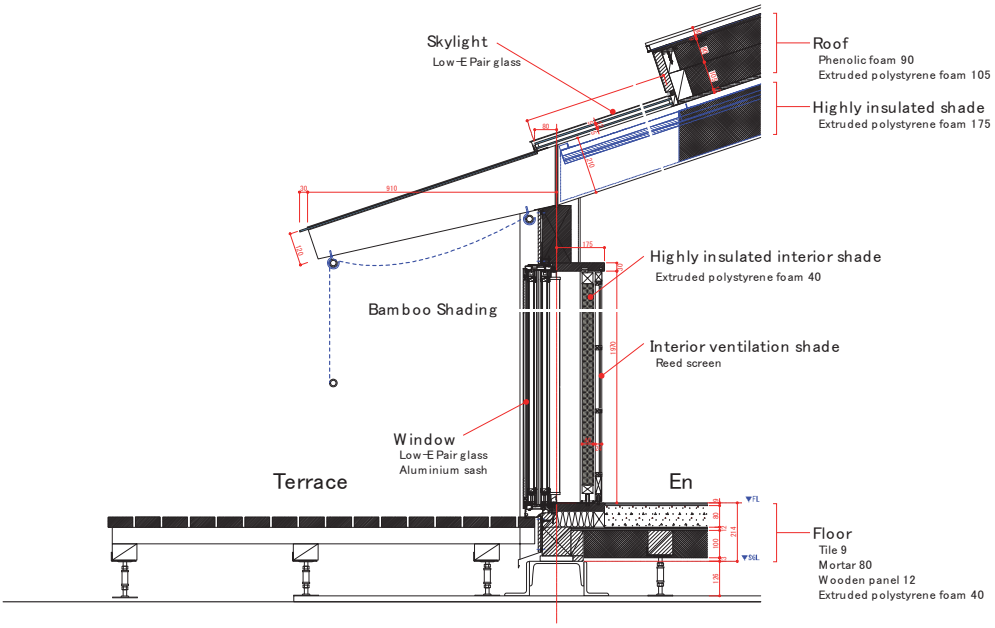
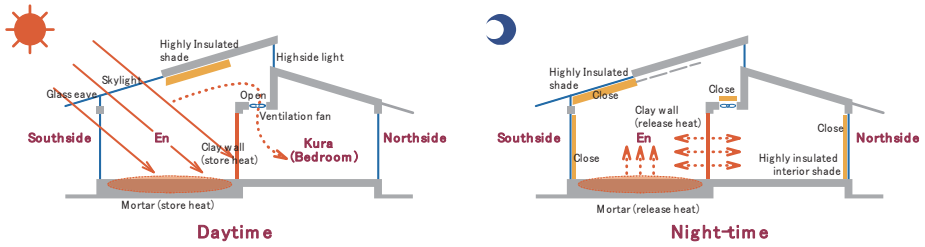
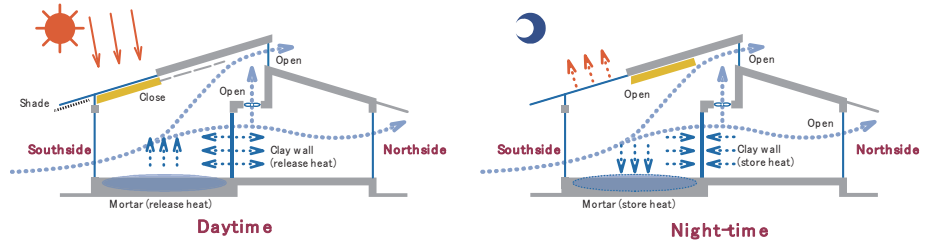


Figure 11 Components of the house design.



(a) Winter (left: daytime, right: night-time)



(b) Summer (left: daytime, right: night-time)

Figure 12 Combination of passive environmental control methods.

4.2.6. Seasonal Control of the Kisekae Elements

Figure 12 shows how the Kisekae elements can be used in different combinations in the summer and winter. In the winter (Figure 12(a)), the open skylights can be opened to allow the sun to irradiate the floor and heat the *en* space. The warm air can be circulated from the *en* space into the *kura* space using an exhaust fan in the daytime. The heat stored in the floor and walls and the use of highly insulated shades can maintain a comfortable room temperature at night. In the summer (Figure 12(b)), the shades can be closed to block the solar radiation from heating the room and keep the room cool. At night, the ventilation through the high side windows can cool the room.

4.3. FACILITY DESIGN FOR ENERGY CONSERVATION

High-efficiency equipment for hot water supply, air conditioning, lighting, etc., is installed in Kisekae House to reduce the energy consumption. In addition, energy is created by photovoltaic (PV) energy generation to meet the energy demand.

4.3.1. Equipment and Appliances

Table 3 and Figure 13 show the equipment and appliances and the energy performance installed in Kisekae House. High-COP air conditioners are installed in the *en* space, living room, and *kura* space to further control the environment when the passive techniques are not sufficient. The *kura* space can be thermally isolated (as explained in Section 4.1) to limit the size of the air-conditioned space that is needed at night. A high-performance heat pump water heater is used to supply hot water. To reduce the heat loss while bathing, a highly insulated bathtub and bathroom floor are used. All of the lights in the house are light-emitting diode (LED) lights. Lights are placed in several points in the room and can be controlled individually depending on which spaces are being used.

4.3.2. Solar Energy Generation

The installed photovoltaic generator (PV) system is capable of generating 3.5kW of electricity per solar radiation (Table 4 and Figure 13). The generated electricity is stored in an electric accumulator. The system includes two power conditioners to reduce the loss of electricity in the conversion from direct current to alternating current, resulting in a 96% conversion efficiency.

4.3.3. VPP System to Heat Water with Solar Energy

Normally, when the electric generation by PV exceeds the electric load, the excess electricity is sold to the public electric grid. However, this strategy results in energy loss due to power transmission and the increased load on the electric power system. Therefore, to minimize the overall environmental load, it is preferable to use the generated energy on-site. In the proposed design, when the excess electricity generated by the PV and stored in the electric accumulator exceeds the storage capacity of the accumulator (such as during sunny weather), any additional electricity generated by the PV beyond the energy demand is utilized by a virtual power plant (VPP) system (ANRE 2014) to heat water. In this way, excess electric energy is efficiently stored on-site as thermal energy.

Table 3 Equipment and appliances used.

Air conditioner	DAIKIN (S22UTAXS-W) APF 6.7
Heat pump for hot water supply	Panasonic (HE-JPU37HQ)
Lighting	LED lights

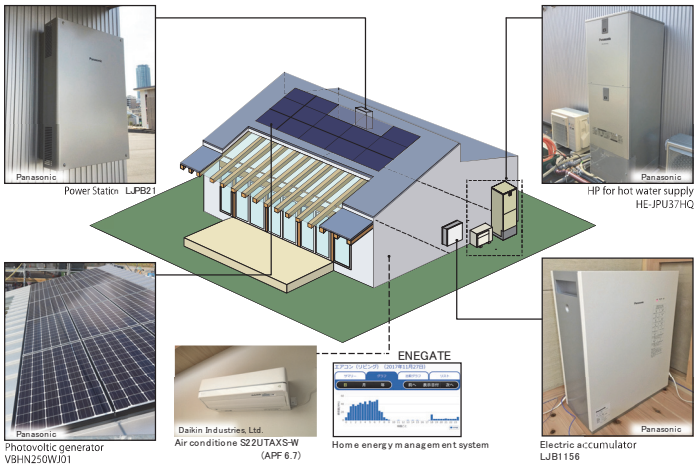
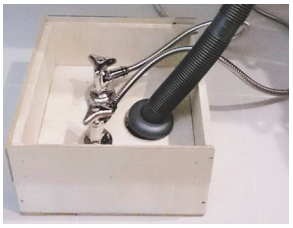


Figure 13: Appliances and equipment.



Water supply and drainage system

Figure 14 Inside of the kitchen and living room (left) and water supply and drain pipes (right).

Table 4 Photovoltaic generator and electric accumulator.

Photovoltaic generator (PV)	Panasonic (VBHN250WJ01) Maximum power output 3.5kW (250W x 14 panels)
Electric accumulator	Panasonic (LJB1156) Capacity 6.5kWh
Power station	Panasonic (LJPB21)

Figure 15 Flexible washbasin.

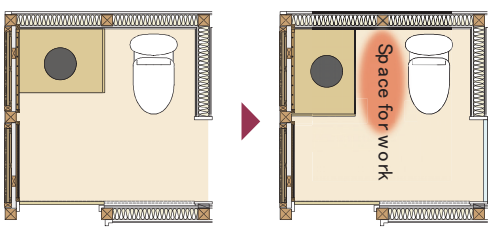


Figure 16 Changeable layout of the washbasin.

The system is controlled according to the amount of solar radiation; operating schedules for the water heater are prepared on the basis of the weather forecast and sent to the system the day before via the internet. Furthermore, the operating hours of the hot water supply can be controlled by the VPP system via the internet according to the predicted energy demand and PV energy generation predicted based on the forecasted solar radiation over the subsequent 2 days.

4.4. VARIABLE DESIGN BASED ON LIFESTYLE

The design can be modified according to the residents' lifestyle by changing the sizes of the *kura* and *en* spaces as shown in Section 4.1. In addition, various items can be arranged according to the residents' lifestyle. Flexible facilities (including water supply, drains, and electricity) are included in the kitchen so that it can be rearranged as needed. Multiple water supplies and drainage systems are installed in several locations in the *en* space, living room, and dining room (Figure 14 right). An electric cooking system is installed because power can be readily supplied via any electric outlet. Because there is no gas exhaust, the electric system does not require exhaust fans and, thus, can be positioned anywhere.

The lavatory washbasin unit can also be moved easily if the residents require space for a wheelchair (Figures 15 and 16).

Table 5 Annual primary energy consumption [GJ/year]. The values are calculated by the program[Note 7)].

	Baseline energy consumption	Kisekae House without control of highly insulated shades under skylight	Kisekae House
Heating	10.3	9.0	7.1
Cooling	4.4	3.1	3.1
Ventilation	2.5	1.0	1.0
Hot water supply	16.4	9.2	9.2
Lighting	6.4	1.8	1.8
Other appliances	16.9	16.9	16.9
Total energy consumption [GJ/year]	55.8	40.0	38.1
Total energy consumption excluding other appliances [GJ/year]	40.0	24.1	22.3
PV generation	-	39.6	39.6

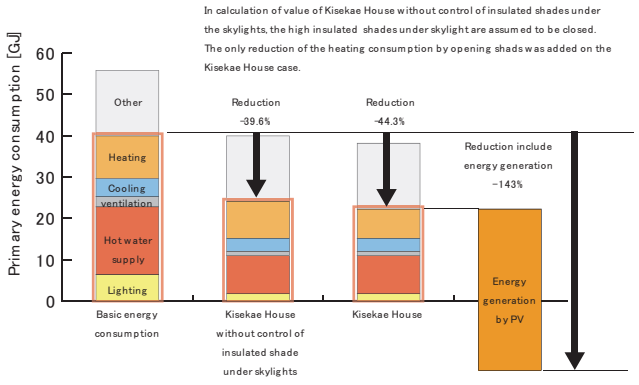


Figure 17 Reduction in the annual energy consumption.

5. Actual Energy Consumption and Thermal Performance

5.1. CALCULATED ANNUAL ENERGY CONSUMPTION

The primary energy consumption, the breakdown of the energy consumption, and energy generation by PV in the Kisekae House is shown in Table 5 and Figure 17. The table shows the results of energy consumption of the baseline [Note 6)] and that of the house which the highly insulated shades under the skylights were kept closed in Kisekae House. The energy required for air conditioning was reduced by 31% and that required to supply hot water was reduced by 43% in the Kisekae House compared with the baseline energy consumption. The total energy consumption was 22.3GJ/year, which is 56% of the baseline energy consumption. The annual electric generation by the PV system was 36.9GJ, which exceeds the primary annual energy consumption (Figure 17). Thus, considering all factors, the basic primary energy consumption was reduced by 143%.

5.2. MEASURED ENERGY CONSUMPTION AND ENVIRONMENTAL CONDITIONS

The Kisekae House was constructed over the period from October 23 to November 10 in 2017. Measurements of energy consumption and environmental conditions were collected over 9days from November 18 to 21 and 24 to 28 in 2017. The room air temperature, outdoor temperature, relative humidity, illuminance, and CO_2 concentration were measured in the *en* space, the living room, and the *kura* space. The solar electric generation and the energy consumption by the appliances were also measured. Three students stayed at the house and controlled the devices from 09:00 to 18:00. In the measurement period, the predetermined loads of the water heater and household appliances were imposed every day.

5.2.1. Measured Energy Generation

The total amount of energy generated by the PV system during the 9day period is shown in Figure 18. The energy generation exceeded the energy consumption on 6 of the 9 days, which were relatively sunny; the 3 days (18th, 20th and 26th) on which the energy consumption exceeded the energy generation

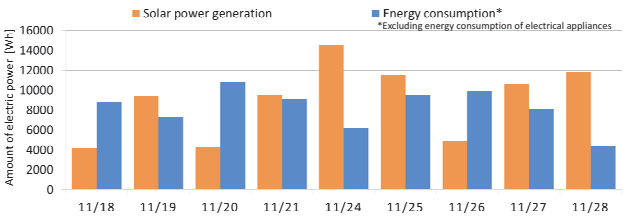


Figure 18 Total PV energy generation and consumption.

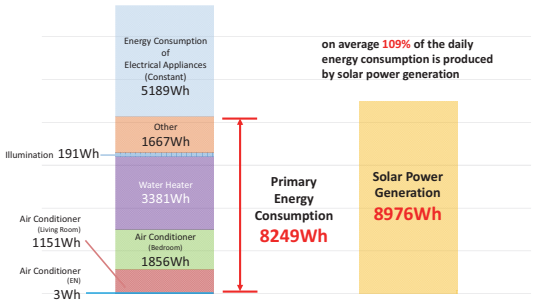


Figure 19 Average solar energy generation and breakdown of the average power consumption.

had poor electricity generation because of cloudy weather and insufficient solar radiation. The self-consumption rate, which express the ratio of the energy consumed in the house to the solar energy generation, of the solar energy (Figure 20) was above 90% except on the 24th and 27th, 28th. The days of 24th and 28th were when the solar energy generation was significantly larger than the energy consumption. Because of technical issues associated with the internet connection, the VPP system did not work properly on the 27th and the hot water supply operated at night, which is an unusual pattern; as a result, the self-consumption ratio was low (52%) on this day (Uehara 2018a,b). Over the entire measurement period, the energy generation by the PV exceeded the energy consumption (it was approximately 109% of the total consumption) (Figure 19). Thus, even though the generation by the PV system was relatively low compared to that in summer or interim period and the energy consumption for heating and hot water supply are relatively large because of the cold winter weather, the Kisekae House achieved net-zero energy balance.

5.2.2. Recorded Environmental Conditions

The residents can control the interior window coverings and shades (see Sections 4.2.1. and 4.2.2.) to achieve their desired conditions and suit their lifestyles. The air conditioners in the living room and bedroom were operated to maintain the room temperature around 23°C at night; during cooler days, the air conditioner in the *en* space was not used.

Figure 21 shows the indoor globe temperatures and outdoor air temperature. Except for the day when the temperature fell below 15°C during the hours of active ventilation, the indoor temperatures remained between 22°C and 23°C. The temperature in the *en* space fluctuated between 28°C and 35°C in the daytime because of the variable effects of direct sunlight from the skylight and south windows. However, because of the heat storage in the floors and walls, the temperature in the *en* space did not fall below 15°C.

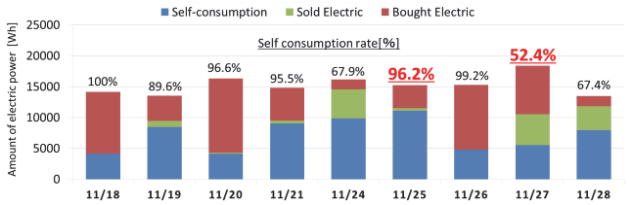


Figure 20 Self-consumption rate of solar energy during the measurement period.

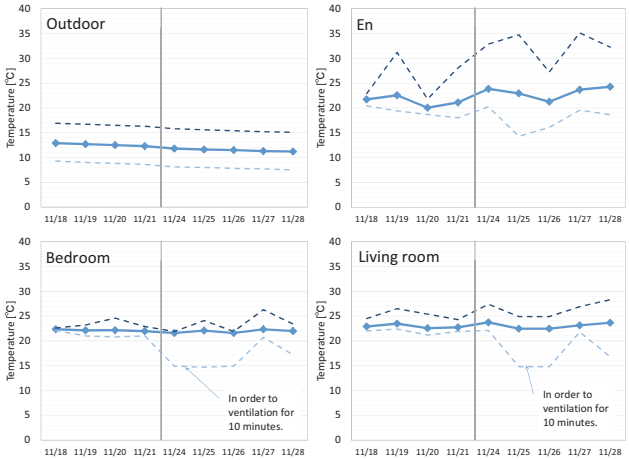


Figure 21 Measured environmental conditions.

When the temperature rose above 30°C in the *en* space during a sunny day, the residents controlled the shades under the skylight to prevent solar heating. Thus, the incorporation of flexible items that can be controlled by the residents and user training in their operation and impact on the indoor environment were considered to be very important.

6. Conclusion

In this paper, we described a facility and system design for the Kisekae House which achieves net-zero energy balance as well as introduced the facilitates communication with neighbors. The basic design of the Kisekae House was developed on the basis of the traditional Japanese environmental design and adapted to a modern lifestyle. It was found that adjusting the interior window coverings, highly insulated window shades, and other devices effectively reduced the energy consumption. Due to the various improvements incorporated in the Kisekae House, the primary energy consumption was only 56% of that in a standard house. When considering the energy generated by the PV system, the basic primary consumption was reduced by 143%, below the ZEH threshold.

An experimental trail with three residents living a normal lifestyle over 9days in November revealed that the temperature in non-air-conditioned *en* space, which collected a significant amount of solar heat through the skylights during the daytime and was highly insulated at night, did not fall below 15°C. The energy generation by the PV system was sufficient to meet the total energy demand, clearing the ZEH threshold despite the cold winter weather.

In addition, a VPP system was implemented to enhance the self-consumption of solar energy. When the system worked properly on a sunny day, the self-consumption of the electricity generated by the PV system was over 90%. We can conclude that the VPP system was an effective tool for using natural energy available on site.

There is more work to be done to quantitatively evaluate the annual energy balance, ensure compatibility with a variety of lifestyles, and verify the effectiveness of each passive design adopted in the Kisekae House by numerical simulation. Although most people control the environment using active equipment even in the houses with high-performance envelope and high efficiency equipment, we aim to demonstrate a new lifestyle of adjusting passive features found in traditional Japanese houses in high-performance houses to achieve a net-zero energy balance.

Acknowledgements

We would like to thank the several companies and stakeholders for their cooperation in the design, construction, and disclosure of this Kisekae House.

Endnotes

1. This Enemane House competition project was hosted by Enemane House 2017. The aim of the project was to popularize ZEH (zero-energy house). It was required to propose advantaged technologies and lifestyle in cooperation with universities and private companies. Five teams passed a preliminary selection by the proposal documents, built a model house of Zero Energy House (ZEH), and evaluated the performance of the house.
2. Students in the 2nd and 1st grades of the master course joined the competition and conducted the primary design, detail design, surveillance, evaluation of thermal performance, measurements of thermal environment, and public exhibition and demolition.
3. Arakabe Panel is a clay panel for foundation layer of clay wall.

4. DIALux simulation program was used.
5. Daylight factor is defined as the ratio of inside illuminance to outside.
6. The calculation program (METI nd) in web site is used.
7. The household energy consumption is not included here.
8. The house was completed in November 2017, and the several environmental factors and energy consumption were measured to evaluate the performance.

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Features of the Heaven in the Qur'an: Focusing on the Relationship between God and Human Beings

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Keywords: Islam, the Qur'an, Types, Heaven, Sky, God, Human Being

Abstract: In this paper, we analyze and clarify the features of the Heaven as described in the Qur'an, which plays a decisive role in the formation of the Islamic worldview. In this study, 310 Arabic verses were analyzed, including سماء, which literally means "the Heaven." The letters A, G, and H are used to describe the Heaven, God, and human beings, respectively, and are used in four themes from the descriptions of the Heaven verses. "Relationship between the Heaven and God" is R(A,G); "Relationship between the Heaven and human beings" is R(A,H); "Relationship of the Heaven as the place where God and human beings interact" is R(G,A,H); and "State of the Heaven" is S(A). From the analysis of the 310 Heaven verses, it was possible to extract 26 "types of the Heaven." In each theme, the various features of the Heaven are understood more clearly.

1. Introduction

In this study, we consider the view of nature in the Islamic world. Islam was born in the arid and semi-arid regions of the Arabian Peninsula and is a widely practiced faith centered on the Middle East. While the natural environment in this region is harsh, it also has a beautiful and comfortable environment overflowing with nature, with an abundance of flowers, fruit trees, and fountains in both public and domestic spaces.

This paper focuses on the concept of "the Heaven" in the Qur'an. The dome in Islamic architecture stands out its appearance, decorates building interiors gorgeously, and symbolizes paradise and the universe. Islamic cosmology is based on the Qur'an and Hadith (the record of the traditions or sayings of the Prophet Mohammed), and the Heaven recorded in the Qur'an is also an important subject in Islamic cosmology.[1]

Therefore, we analyze and clarify the features of the Heaven as described in the Qur'an, which plays a decisive role in the formation of the Islamic worldview. Moreover, even among the creations of God, the creation of the Heavens and the Earth are considered to be special. This paper will discover the relationship between God and human beings, and to consider how this relationship is to be understood.

There are few studies extracting the elements of nature as written in the Qur'an and focusing on the relationship between God and human beings. Fukami (2006)[2] extracts twenty types of descriptions on "words and phenomena regarded as natural" in the Qur'an, discusses its concept of nature, and shows the Qur'an's admiration for water and its importance in arid regions. However, there is no mention of the relationship between these natural elements and God and human beings. The author of this study[3] took up the concepts of Earth, Sun, Moon, Star, Mountain, River, Valley, Tree, and Fountain as written in the Qur'an, focusing on the relationship between God and human beings and analyzing it. Among them, the features of the sun and the moon reveal three things: God creates and operates them, God dissolves when the last day approaches, and God is to be worshiped. The stars reveal five things: God creates, God dissolves them when the last day approaches, they are the proof of God's promise, God is to be worshiped, and God leads human beings.

2. Research Text and Methodology

2.1. RESEARCH TEXT

We analyzed 310 Arabic verses[4], including سماء (ا سماوات), which literally means "the Heaven," but which we translate here as "the Heaven verses." When analyzing the Heaven verses, we used *The Meaning of the Holy Qur'an*. The Qur'an is comprised of 114 chapters, with each chapter comprising of multiple verses. In listing each of the Qur'an verses, the numbers of the chapter and the verse are written in as *chapter: verse.*

2.2. METHOD OF ANALYSIS

(1) Letters describe key concepts. The Heaven is "A," God is "G," and human beings are "H" in the Heaven verses. The explanation is illustrated by examples (Figure 1).

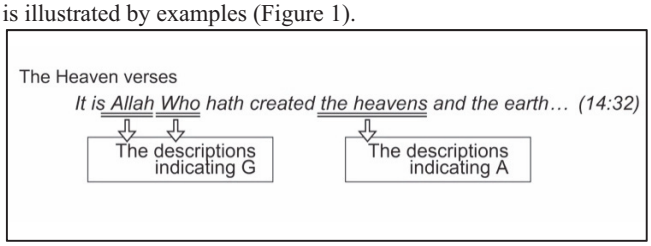


Figure 1. Example: Descriptions indicating G and A.

(2) The letters describe the following four themes from the descriptions of the Heaven verses:
- The relationship between the Heaven and God is R(A,G);
- the relationship between the Heaven and human beings is R(A,H);
- the relationship of the Heaven as the place where God and human beings interact is R(G,A,H); and
- the state of the Heaven is S(A).

The explanation is illustrated by examples (Figure 2).

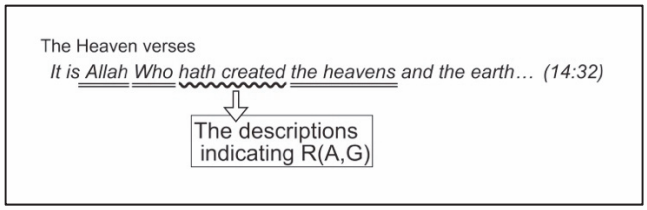
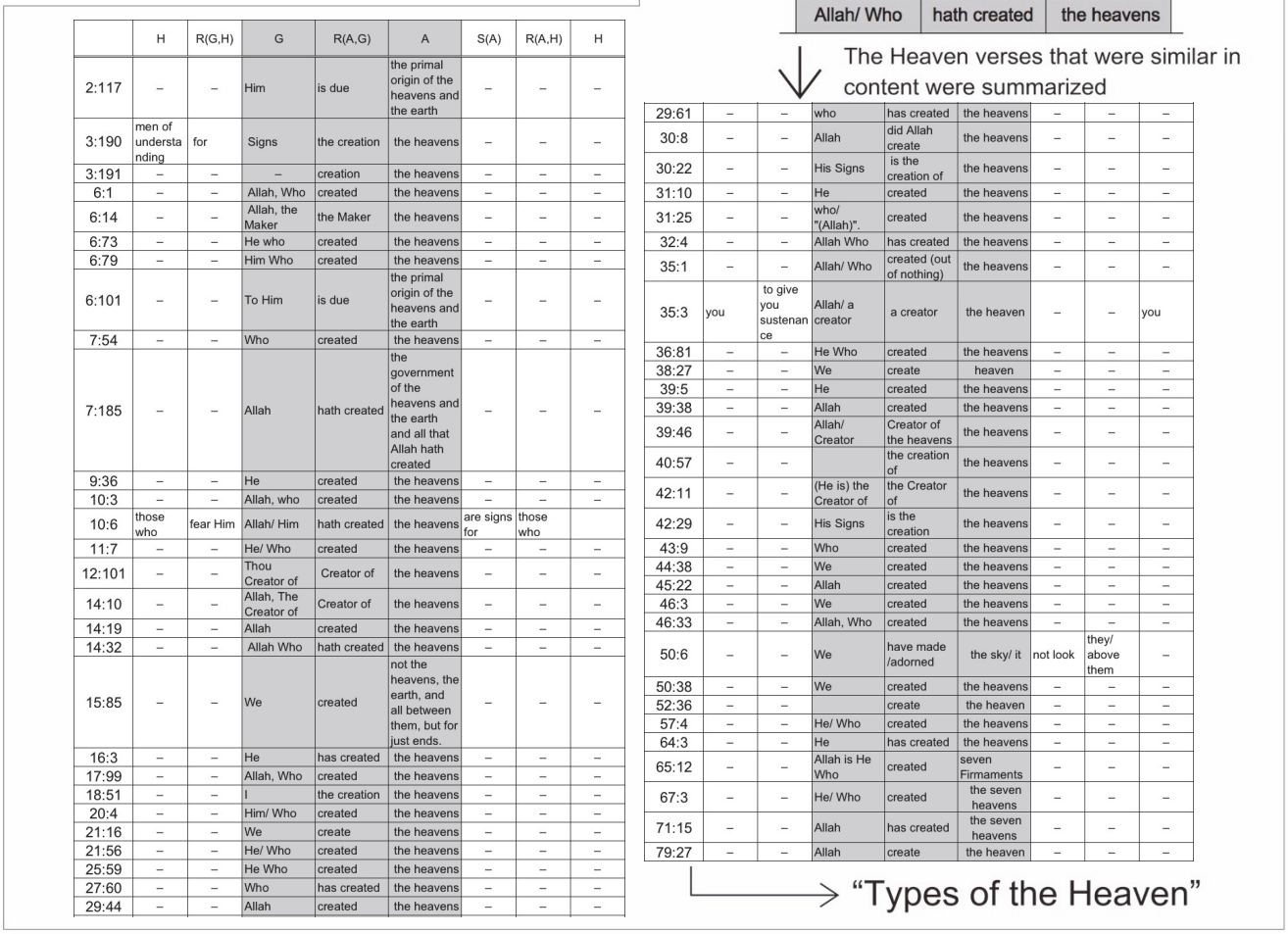


Figure 2. Example: Descriptions indicating R(A,G)



	H	R(G,H)	G	R(A,G)	A	S(A)	R(A,H)	H
2:117	–	–	Him	is due	the primal origin of the heavens and the earth	–	–	–
3:190	men of understanding	for	Signs	the creation	the heavens	–	–	–
3:191	–	–	–	creation	the heavens	–	–	–
6:1	–	–	Allah, Who	created	the heavens	–	–	–
6:14	–	–	Allah, the Maker	the Maker	the heavens	–	–	–
6:73	–	–	He who	created	the heavens	–	–	–
6:79	–	–	Him Who	created	the heavens	–	–	–
6:101	–	–	To Him	is due	the primal origin of the heavens and the earth	–	–	–
7:54	–	–	Who	created	the heavens	–	–	–
7:185	–	–	Allah	hath created	the government of the heavens and the earth and all that Allah hath created	–	–	–
9:36	–	–	He	created	the heavens	–	–	–
10:3	–	–	Allah, who	created	the heavens	–	–	–
10:6	those who	fear Him	Allah/ Him	hath created	the heavens	are signs for	those who	
11:7	–	–	He/ Who	created	the heavens	–	–	–
12:101	–	–	Thou Creator of	Creator of	the heavens	–	–	–
14:10	–	–	Allah, The Creator of	Creator of	the heavens	–	–	–
14:19	–	–	Allah	created	the heavens	–	–	–
14:32	–	–	Allah Who	hath created	the heavens	–	–	–
15:85	–	–	We	created	not the heavens, the earth, and all between them, but for just ends.	–	–	–
16:3	–	–	He	has created	the heavens	–	–	–
17:99	–	–	Allah, Who	created	the heavens	–	–	–
18:51	–	–	I	the creation	the heavens	–	–	–
20:4	–	–	Him/ Who	created	the heavens	–	–	–
21:16	–	–	We	create	the heavens	–	–	–
21:56	–	–	He/ Who	created	the heavens	–	–	–
25:59	–	–	He Who	created	the heavens	–	–	–
27:60	–	–	Who	has created	the heavens	–	–	–
29:44	–	–	Allah	created	the heavens	–	–	–

29:61	–	–	who	has created	the heavens	–	–	–
30:8	–	–	Allah	did Allah create	the heavens	–	–	–
30:22	–	–	His Signs	is the creation of	the heavens	–	–	–
31:10	–	–	He	created	the heavens	–	–	–
31:25	–	–	who/ "(Allah)".	created	the heavens	–	–	–
32:4	–	–	Allah Who	has created	the heavens	–	–	–
35:1	–	–	Allah/ Who	created (out of nothing)	the heavens	–	–	–
35:3	you	to give you sustenance	Allah/ a creator	a creator	the heaven	–	–	you
36:81	–	–	He Who	created	the heavens	–	–	–
38:27	–	–	We	create	heaven	–	–	–
39:5	–	–	He	created	the heavens	–	–	–
39:38	–	–	Allah	created	the heavens	–	–	–
39:46	–	–	Allah/ Creator	Creator of the heavens	the heavens	–	–	–
40:57	–	–		the creation of	the heavens	–	–	–
42:11	–	–	(He is) the Creator of	the Creator of	the heavens	–	–	–
42:29	–	–	His Signs	is the creation	the heavens	–	–	–
43:9	–	–	Who	created	the heavens	–	–	–
44:38	–	–	We	created	the heavens	–	–	–
45:22	–	–	Allah	created	the heavens	–	–	–
46:3	–	–	We	created	the heavens	–	–	–
46:33	–	–	Allah, Who	created	the heavens	–	–	–
50:6	–	–	We	have made /adorned	the sky/ it	not look	they/ above them	–
50:38	–	–	We	created	the heavens	–	–	–
52:36	–	–		create	the heaven	–	–	–
57:4	–	–	He/ Who	created	the heavens	–	–	–
64:3	–	–	He	has created	the heavens	–	–	–
65:12	–	–	Allah is He Who	created	seven Firmaments	–	–	–
67:3	–	–	He/ Who	created	the seven heavens	–	–	–
71:15	–	–	Allah	has created	the seven heavens	–	–	–
79:27	–	–	Allah	create	the heaven	–	–	–

Figure 3. An example of putting descriptions indicating G and A, R(A,G) into a table and summarizing the Heaven verses.

(3) The letter code system is used in the table below in describing the Heaven, God, Human Beings, and the following four themes (Figure 3). According to the descriptions, the Heaven verses that were similar in content were summarized and were called the "types of the Heaven."

(4) In each of four themes, features of the Heaven are discussed and clarified on the basis of the types of the Heaven. These relationships between these themes have been illustrated in four schemas (Figures 4, 5). However, in R(A,G), it does not matter whether God or Heaven is the subject of those relationships because both God and the Heaven can be the subject in Qur'an verses.

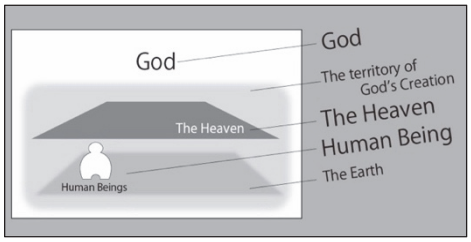


Figure 4. Explanation of the schema

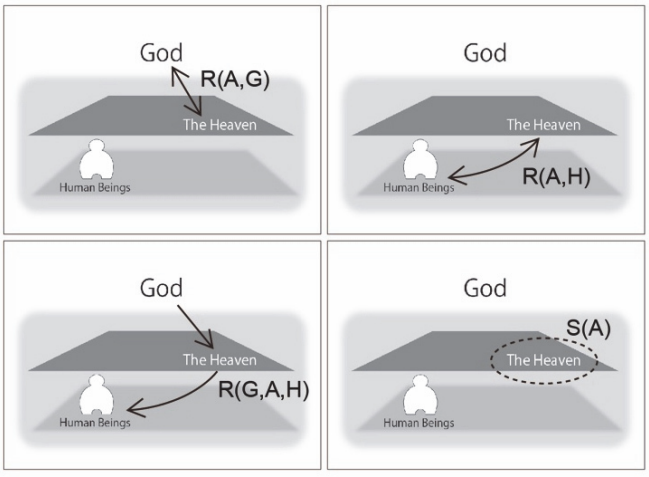


Figure 5. Four schemas diagram the relationship between the Earth and God and human beings in four themes

3. Types of the Heaven

From the results of the analysis, the types of the Heaven were categorized. The content of each of the types of the Heaven, and the Heaven verses that belong to each of the types of the Heaven, are shown below (Table 1).

3.1. THE TYPES OF THE HEAVEN THAT ARE SIMILAR IN CONTENT TO R(A,G)

The seventeen types of the Heaven that are similar in content to R(A,G) were the following:

(1) the Heaven that God created;
(2) the Heaven that God sends down rain from;
(3) the Heaven that God has dominion over;
(4) the Heaven that God is the Lord of;
(5) the Heaven that God adorned;
(6) the Heaven that God sends down a plague from;
(7) the Heaven that become the proof of God's promise;
(8) the Heaven where God exists;
(9) the Heaven that God made as a canopy;
(10) the Heaven that God raised;
(11) the Heaven that God constructed;
(12) the Heaven that God will roll up;
(13) the Heaven that God completed;
(14) the Heaven that God sustains;
(15) those in the Heaven belong to God;
(16) those in the Heaven are known by God;
(17) those in the Heaven praise the Glory of God; and
(18) those in the Heaven bow down to God.

3.2. THE TYPES OF THE HEAVEN THAT ARE SIMILAR IN THE CONTENT OF R(A,H)

The type of the Heaven that was similar in the content of R(A,G) was the following:

(19) the Heaven that human beings look up toward.

3.3. THE TYPES OF THE HEAVEN THAT ARE SIMILAR IN THE CONTENT OF R(G,A,H)

The four types of the Heaven that are similar in the content of R(G,A,H) were the following:

(20) the Heaven from which God gives human beings sustenance;
(21) the Heaven from which God sends rain to human beings;
(22) the Heaven from which God sends down a plague to human beings; and
(23) the Heaven from which God sends a table prepared for human beings.

3.4. THE TYPES OF THE HEAVEN THAT ARE SIMILAR IN THE CONTENT OF S(A)

The three types of the Heaven that are similar in the content of S(A) were the following:

(24) the Heaven will be rent asunder;
(25) the Heaven will be changed form; and
(26) the Heaven is as wide as paradise.

4. The Features of the Heaven

From the analysis of the 310 Heaven verses, it is possible to extract 26 types of the Heaven. The features of the Heaven are shown below in each theme.

4.1. R(A,G)

- Seventeen types belong to the R(A,G). R(A,G) are the most frequent and valuable types (Table 1).
- The types of the Heaven that God creates the Heaven exists the most. The number of verses is 59 (Table 1, (1)).
- There are six types of God's creation and the description of the creation, the most frequent among the extracted Types. As shown in Figure 6, the creation of the Heaven by God has been expressed in various ways. From this we can see the importance of the creation of God.

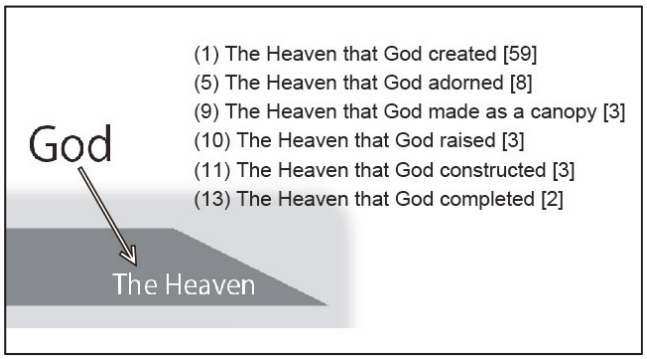


Figure 6. The schema shows the features of the Heaven that God created, and the description of that creation.

- The next most common types relate to God's dominion over and sustaining of the Heaven by God. The Heavens follow God, and God's maintaining of the Heaven is seen. (Figure 7). The existence and operation of God shows that Heaven exists.

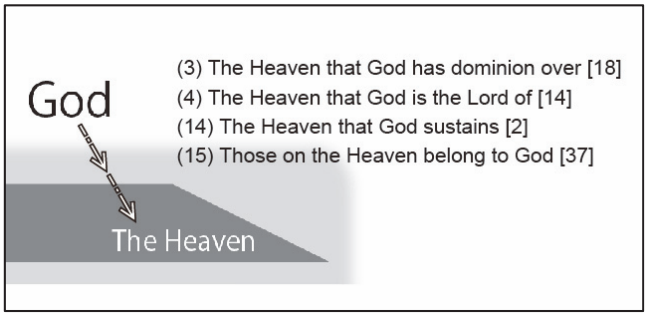


Figure 7. The schema shows the features of the Heaven that are heavenly governance by God.

- Figure 8 shows contradicting aspects, that God graces humans with rain or sends punishments from the Heaven.

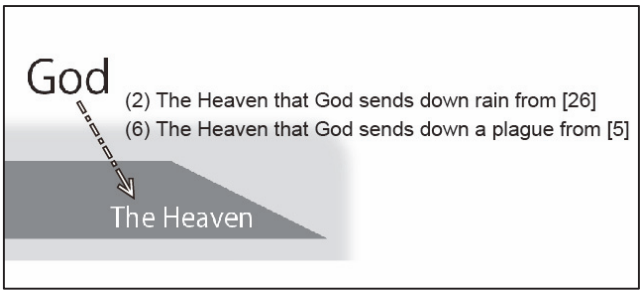


Figure 8. The schema shows the features of the Heaven that God graces humans with rain or sends punishments from the Heaven.

- The Heaven praises God and bows to God. Here, the features that the Heaven believes in and worships God are shown (Figure 9). Here, the Heaven is expressed as a human being who "declares" and "praises" and "bows down.

Table 1. The list that shows the types of the Heaven, the Heaven verses belonging to the types, and the numbers of the Heaven verses in each of the four themes.

Themes	Types of Heaven	The descriptions indicating each theme with similar contents	The Heaven verses belonging to the Types of Heaven	Number of verses
R(A,G)	(1)	the creation, creation, create, created, has created, hath created, Creator, the Maker, have made, is due the primal origin	2:117, 2:164, 3:190, 3:191, 6:1, 6:14, 6:73, 6:79, 6:101, 7:54, 7:185, 9:36, 10:3, 10:6, 11:7, 12:101, 14:10, 14:19, 14:32, 15:85, 16:3, 17:99, 18:51, 20:4, 21:16, 21:56, 25:59, 27:60, 29:44, 29:61, 30:8, 30:22, 31:10, 31:25, 32:4,35:1, 35:3, 36:81, 38:27, 39:5, 39:38, 39:46, 40:57, 42:11, 42:29, 43:9, 44:38, 45:22, 46:3, 46:33, 50:6, 50:38, 52:36, 57:464:3, 65:12, 67:3, 71:15, 79:27	59
	(2)	send down water, sent down rain, sends down rain, sendeth down rain, sends…down rain, poured out rain, will send… pouring abundant rain, cause the rain to descend, will send rain, caused rain the rain…send down, sends down water, has sent down water, send down pure water	2:22, 2:164, 6:6, 6:99, 8:11, 10:24, 11:52, 13:17, 14:32, 15:22, 16:10, 16:65, 18:45, 20:53, 22:63, 23:18, 25:48, 27:60, 29:63, 30:24, 31:10, 35:27, 39:21, 43:11, 50:9, 71:11	26
	(3)	belongth the dominion, doth belong the dominion, belongs the dominion	2:107, 3:189, 5:17, 5:18, 5:40, 5:120, 7:158, 9:116, 24:42, 25:2, 39:44, 42:49, 43:85, 45:27, 48:14, 57:2, 57:5, 85:9	18
	(4)	the Lord of	13:16, 17:102, 18:14, 19:65, 21:56, 23:86, 26:24, 37:5, 38:66, 43:82, 44:7, 45:36, 51:23, 78:37	14
	(5)	His design comprehended, have set out the zodiacal signs, made constellations, have indeed decked, comprehended in His design, adorned, adorned…with lights, adorned…with Lamps	2:29, 15:16, 25:61, 37:6, 41:11, 41:12, 50:6, 67:5	8
	(6)	sent on…a plague, will send on…thunderbolts (by way of reckoning), sends down…mountain masses (of clouds), rain down…a shower of stones	2:59, 7:162, 8:32, 18:40, 24:43	5
	(7)	By…	51:7, 85:1, 86:1, 86:11, 91:5	5
	(8)	is…in, is in	6:3, 43:84, 67:16, 67:17	4
	(9)	has made…your canopy, have made…as a canopy, has made…as a canopy	2:22, 21:32, 40:64	3
	(10)	raised	13:2, 55:7, 88:18	3
	(11)	stand by, construct, structure	30:25, 51:47, 91:5	3
	(12)	roll up, well be rolled up	21:104, 39:67	2
	(13)	gave order and perfection to completed	2:29, 41:12	2
	(14)	Sustainer, sustains	13:16, 35:41	2
	(15)	belong, belongs, belongth, do belong, doth belong, His are	2:116, 2:255, 2:284, 3:109, 3:129, 3:180, 4:126, 4:131, 4:131, 4:132, 4:170, 4:171, 6:12, 10:55, 10:66, 10:68, 11:123, 14:2, 16:52, 16:77, 20:6, 21:19, 22:64, 24:64, 30:26, 30:27, 31:26, 34:1, 39:63, 42:4, 42:12, 42:53, 48:4, 48:7, 53:31, 57:10, 63:7	37
	(16)	know, knows, hath knowledge, nothing is hidden, doth know, brings to light,	2:33, 3:5, 3:29, 5:97, 6:59, 10:18, 14:38, 17:55, 18:26, 21:4, 22:70, 25:6, 27:25, 27:65, 29:52, 34:2, 35:38, 49:16, 49:18, 57:4, 58:7, 64:4	21
	(17)	declare, do celebrate, let it declare, doth declare, praises	17:44, 24:41, 57:1, 59:1, 59:24, 61:1, 62:1, 64:1	8
	(18)	bowed to, do prostrate, doth obeisance, bow down in worship, be praise	3:83, 13:15, 16:49, 22:18, 30:18	5
R(A,H)	(19)	see, look, Behold, beholders	2:144, 7:185, 10:101, 15:16, 34:9, 50:6	6
R(G, A, H)	(20)	sustains, give you sustenance, gives you sustenance, has subjected to your (use), sendeth down sustenance, sends down Sustenance	10:31, 27:64, 31:20, 34:24, 35:3, 40:13, 45:5	7
	(21)	sent down rain…for your sustenance, caused rain to descend on you, sendeth down rain…to feed you, sends you down rain, will send rain to you	2:22, 8:11, 14:32, 27:60, 71:11	5
	(22)	sent on…a plague, will send on…thunderbolts (by way of reckoning), sends down…mountain masses (of clouds), rain down…a shower of stones	2:59, 7:162, 8:32, 18:40	4
	(23)	send down to us a table set, send us...a table set	5:112, 5:114	2
S(A)	(24)	shall be rent asunder with clouds, will be rent asunder, is rent asunder, are almost, rent asunder, will be cleft asunder, is cleft asunder	25:25, 42:5, 55:37, 69:16, 73:18, 77:9, 82:1, 84:1	8
	(25)	will be changed, are ready to burst, break, cause a piece of the sky to fall, will bring forth a kind of smoke (or mist) plainly visible, will be like molten brass	14:48, 19:90, 30:48, 34:9, 44:10, 70:8	6
	(26)	a Garden whose width …of the heaven	3:133, 57:21	2

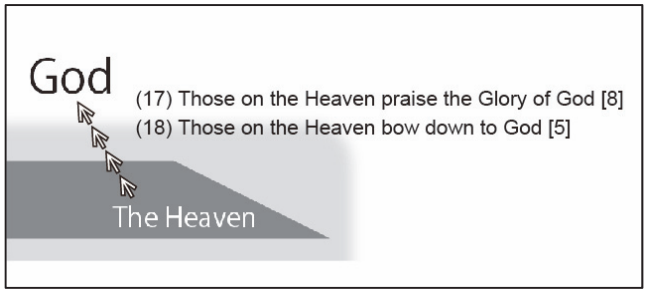


Figure 9. The schema shows the features of the Heaven that believes in and worships God.

- On the last day, the feature that God will roll up the Heaven was shown (Figure 10).

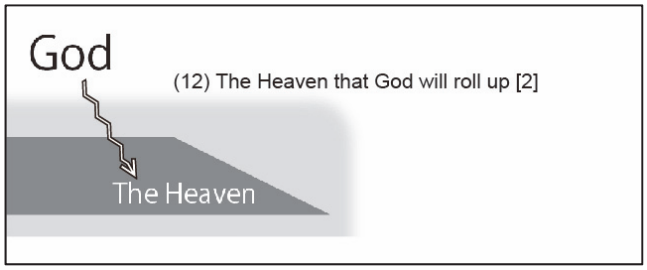


Figure 10. The schema shows the features of the Heaven will be rolled up by God on the last day.

- There is a feature that the Heaven is thin enough to be lifted up by God, because when God created the Heaven, God made the Heaven as a canopy and raised it up. Also, it is rolled up when the last day comes (Table 1 (9), (10), (12), Figure 10).
- Most of the features concerning creation, maintenance, and termination, which is an important act of God (Figure 6, 7, 10).
- In typing, the number of R(A,G) types is overwhelmingly large. According to the types of R(A,G), the Heaven is understood as emphasizing the relationship with God.

4.2. R(A,H)

- There is only one type in R(A,H) (Table 1), and describes human beings looking up to the Heaven (Figure 11).

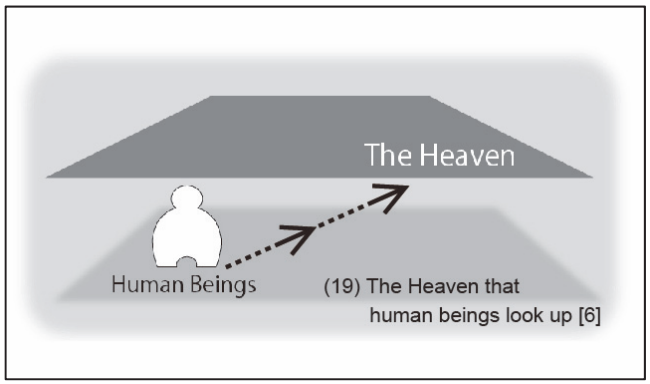


Figure 11. The schema shows the features of the Heaven to which human beings look.

- Since there is only one type found regarding the relationship between the Heaven and human beings, it is considered to be very weak compared to the relationship between God and the Heaven.
- Apart from looking up, there is no situation that human beings do something with regard to the Heaven.

4.3. R(G,A,H)

- There are four types in the R(G,A,H) (Table 1).
- Two types show features that God gives human beings rain of grace (Figure 12). In R (G,A,H), this feature exists the most.

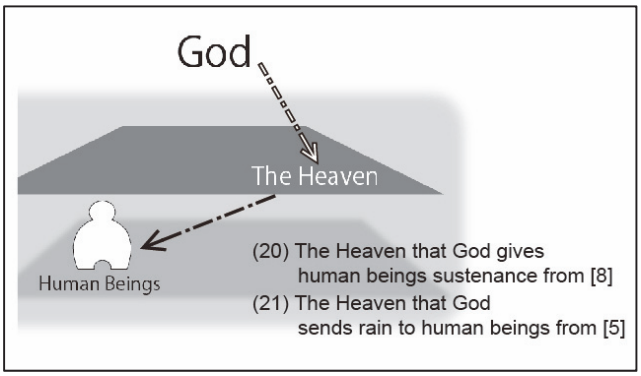


Figure 12. The schema shows God graces human beings with rain from the Heaven

- Figure 13 shows features that God sends down human beings a plague from the Heaven. God sends "a plague," "thunderbolts," "mountain masses of clouds," and "a shower of stones" to human beings through the Heaven (Table 1, (22)).

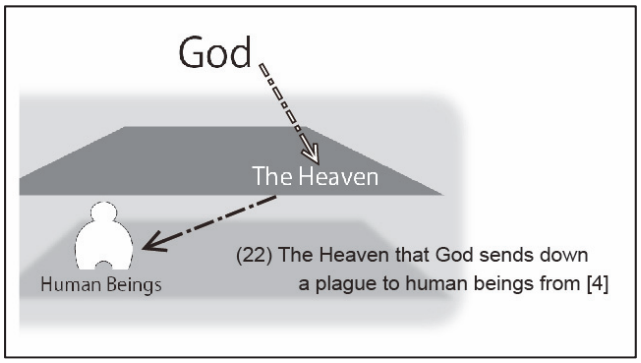


Figure 13. The schema shows that God sends down human beings a plague from the Heaven.

- Figure 12 and 13 show contradictory features that God gives human beings rains of grace or punishment. These features are added to God's relationship with human beings that are abundantly displayed in R(A,G).
- The feature in R(G,A,H) shows that God has given grace or punishment from the Heaven. God allows punishment and the blessing of rain from the Heaven, and shows the polestar of life to human beings.

4.4. S(A)

- There are 3 types in the S(A) (Table 1).
- On the last day, the Heaven changes its shape (Figure 14).
- The Heaven is a wide paradise (Table 1, (26)).

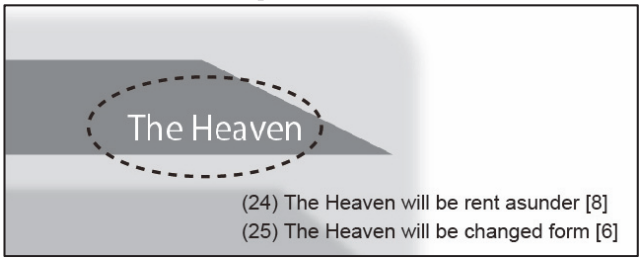


Figure 14. The schema shows the Heaven changes its shape on the last day.

5. Conclusion

This study attempts to consider the view of nature in the Islamic world. In this paper, we focused on the Heaven, which is an important subject in the Qur'an. From the analysis of the 310 Heaven verses focusing on the relationship between God and human beings, it is possible to extract 26 "types of the Heaven."

From the results of the analysis, the findings are as follows. 1) The features in relationship between the Heaven and human beings is only that human beings look up toward the Heaven. 2) The features of the Heaven in the Qur'an are very strong in relation to God and make humans more aware of God's existence and greatness. 3) The Heaven shows God's will for human beings and so becomes a device by which God sends rain to human beings.

Compared with the Sun, Moon, Star, Mountain, River, Valley, Tree, and Fountain, there are over five times more verses about the Heaven. In addition, the features of the Heaven are drawn in various ways. All four had the features of being created and maintained by God and being erased on the last day. However, for the creation of the Heaven by God, various expressions are made, and it is written about in detail, compared to other aspects of creation. By the will of God, the features of rain, grace, and punishment can only be given by the Heaven (Figure 15).

The Heaven has become a bridge between God and human beings. From these findings, in spaces where one might feel the presence of God more strongly such as mosques or shrines, there may be a causal connection in that the spaces' structures and decorations recall the Heaven with the use of domes and stars.

Finally, the features of nature in the Qur'an focusing on the relationship between God and Human Beings are understood from this research and the results in author's study (Figure 16).

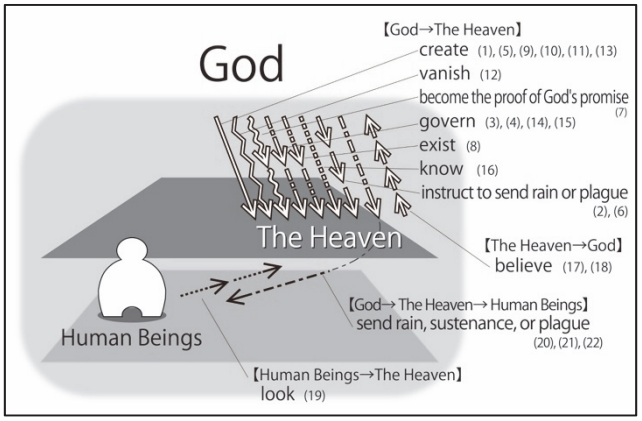


Figure 15. The schema shows the Features of the Heaven

Endnotes

1. According to Malek C. and Maeda, K. (2014).
2. According to Fukami, N. (2006).
3. According to Yamaguchi, A. and Okazaki, S. (2014), Yamaguchi, A. (2015), and Yamaguchi, A. and Okazaki, S. (2016)
4. According to Kassis, H. E. (1983).

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Kassis, H. E. (1983). *A Concordance of the Qur'an*. University of California.

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Yamaguchi, A. (2015). "A Study on the Features of Nature in the Qur'an: Focusing on the Relationships with God and Human Beings." PhD Thesis, Mukogawa Women's University, Nishinomiya, Japan.

Yamaguchi, A. and Okazaki, S. (2016). "Features of the Earth in the Qur'an: Focusing on the Relationship between God and Human Beings." 4th International Conference on Archi-Cultural Interactions through the Silk Road, Mukogawa Women's University, Nishinomiya, Japan, July 16–18, 2016. Selected Paper, pp. 93–98.

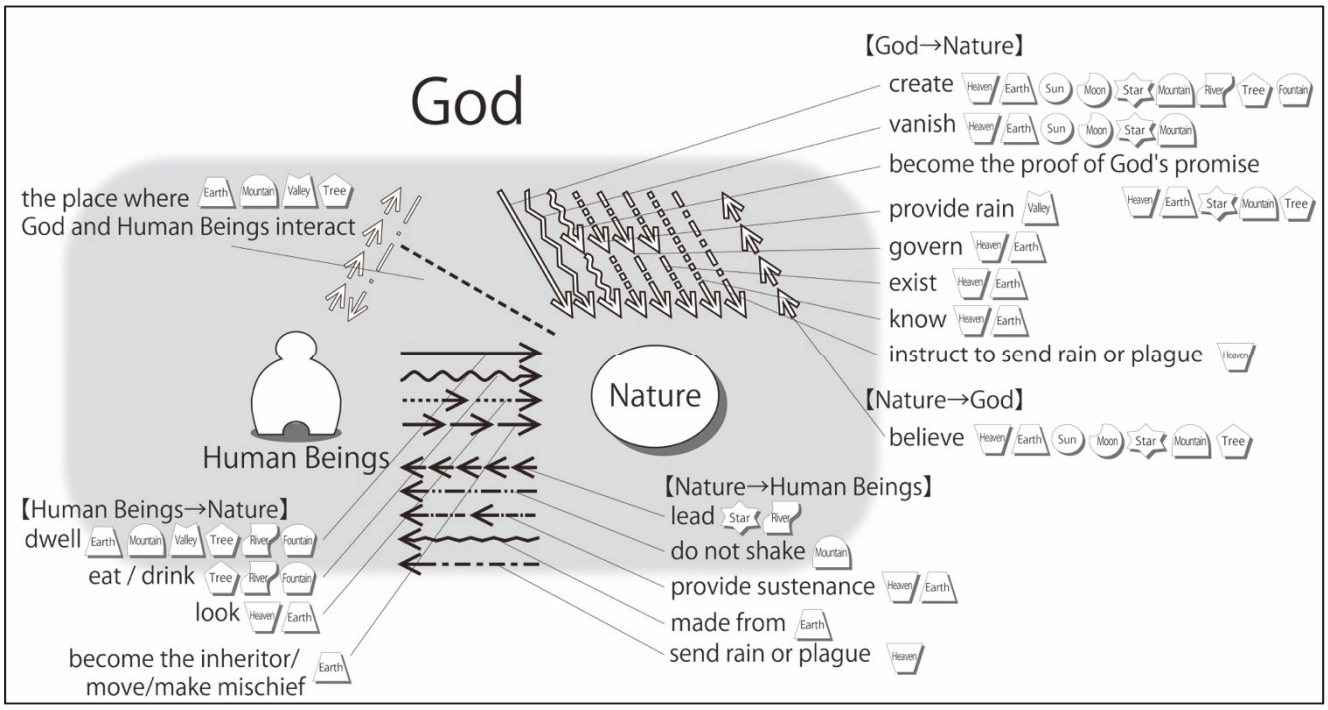

Figure 16. Features of Nature in the Qur'an focusing on the Relationship between God and Human Beings

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ACTIVITY REPORTS OF THE INSTITUTE OF TURKISH CULTURE STUDIES

Technical Proposal for Revitalising the Bamiyan Eastern Buddha Sep. 28, 2017

The international conference entitled “The Future of the Bamiyan Buddha Statues” (Organized by Islamic Republic of Afghanistan, UNESCO, and Tokyo University of the Arts) held on 27-29 September, 2017. At "Session 6: Technical Proposal Presentations for Revitalising the Eastern Buddha Statue,” we published Japan representative plan of the Bamiyan's Eastern Buddha Statue which was bombarded in 2001 with Tokyo National University of the Arts. On the plateau 1 km away from the Great Eastern Buddha, we planned the monument which reduced the size of the Great Buddha to one-third of the size, gathering plazas, museums and made technical suggestions. This presentation was also featured in the mass media. In this paper, the contents of the proposal will be reported.

During the international conference: Prof. Shigeyuki OKAZAKI and Prof. Kosaku MAEDA explaining Japan representative plan

Frontal view of the monument from the bottom of the Bamiyan Valley

Frontal view of the monument

The entrance of the staircase that leads to the museum and the top of the plateau is on the left side of the monument

The Location of the Reproduction

The two empty niches of the giant Buddha statues are carved into the Great Cliff soaring over 100 m. The statues, destroyed by the Taliban in 2001, were the parts of the numerous caves of Buddhist monasteries, temples and sanctuaries tucked away in these cliffs. These sites should be well protected and carefully preserved as cultural heritage for mankind. We propose to build 1/3 scale reproduction of Eastern Buddha and the museum in another place without reconstructing the Bamiyan Buddha statues in its original site. Although there are three candidate sites, in this paper we introduce site ① for our design proposal.

Three possible sites for the monument and the museum proposal

The Bamiyan Valley running across about 1 km in width lies at the foot of the Great Cliffs. On the opposite side of the valley, 40m to 50m high plateaus with about 45° of a scarp are located. These plateaus are planned to be the designated area for promoting and supporting artistic and cultural purposes.

We plan to reconstruct the Eastern Buddha and its niche, originally situated at the Great Cliff, at the tip of one of these plateaus of the other side of the river. This new site would be a part of the museum which will conserve and display the remains of the destroyed Buddha and other significant artifacts. Japan's previous proposal "Bamiyan Museum & Culture Center for People" was presented at the 12th Bamiyan Expert Working Group Meeting in Orvieto, Italy (10-11 December 2013). The zone called as Cave Garden is around 10 m lower than the zone where the museum complex is located. It is a flatland created by excavating original topography around 10m.

Many Buddhist caves will be reproduced in the Cave Garden. The structure of the caves will be made of reinforced concrete (RC) with monasteries and temples built inside. Aside from the entrance open space, the garden will be piled with earth to have more natural and gentle feeling of landscape.

The new museum proposal that is explained in this paper will also be covered and piled with the same type of the earth except for the exterior wall of the Eastern Buddha Niche. The entire embankment is compressed to a height of 10 m higher than the present ground level.

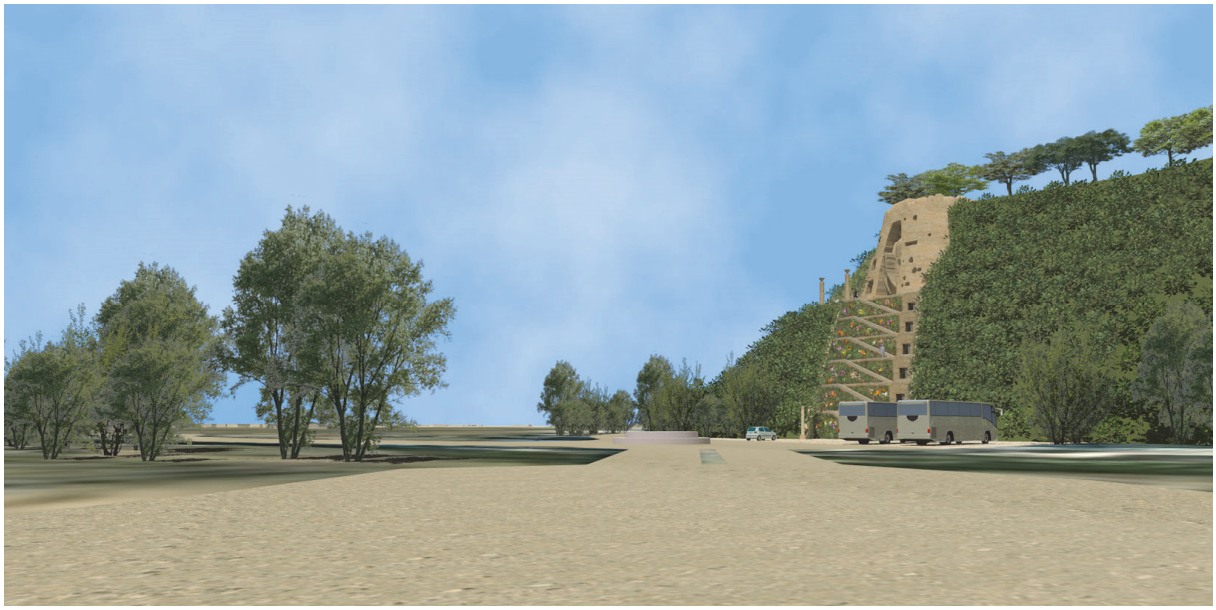
The Proportion of the Buddha Reproduction

While a full-scale reproduction is ideal, it is quite difficult to find a cliff or plateau that accommodates a 38 m tall huge statue and 41 m tall niche. Only a cliff that stands almost perpendicular to the ground, such as the Great Cliff would meet our needs. However, it is not feasible to build a 41 m high niche into the 40 m high south side of the Bamiyan Valley with its 45° slope. Alternatively, a stand-alone statue in front of the slope should also be ruled out considering the lack of harmony with the surrounding landscape.

The Buddha, as tall as a skyscraper, would literally stand out among the existing small-scale villages, rivers, roads and public squares in the existing area.

As a result of much deliberations and scrutiny using computer graphics, models and diagrams, we concluded to reproduce a 13 m-high Buddha that is reduced one-third of the original Eastern Buddha.

View of the monument from the tree-lined street on the Bamiyan Valley



View of the monument from the foot of the plateau

Composite photo of the proposed monument and the existing landscape

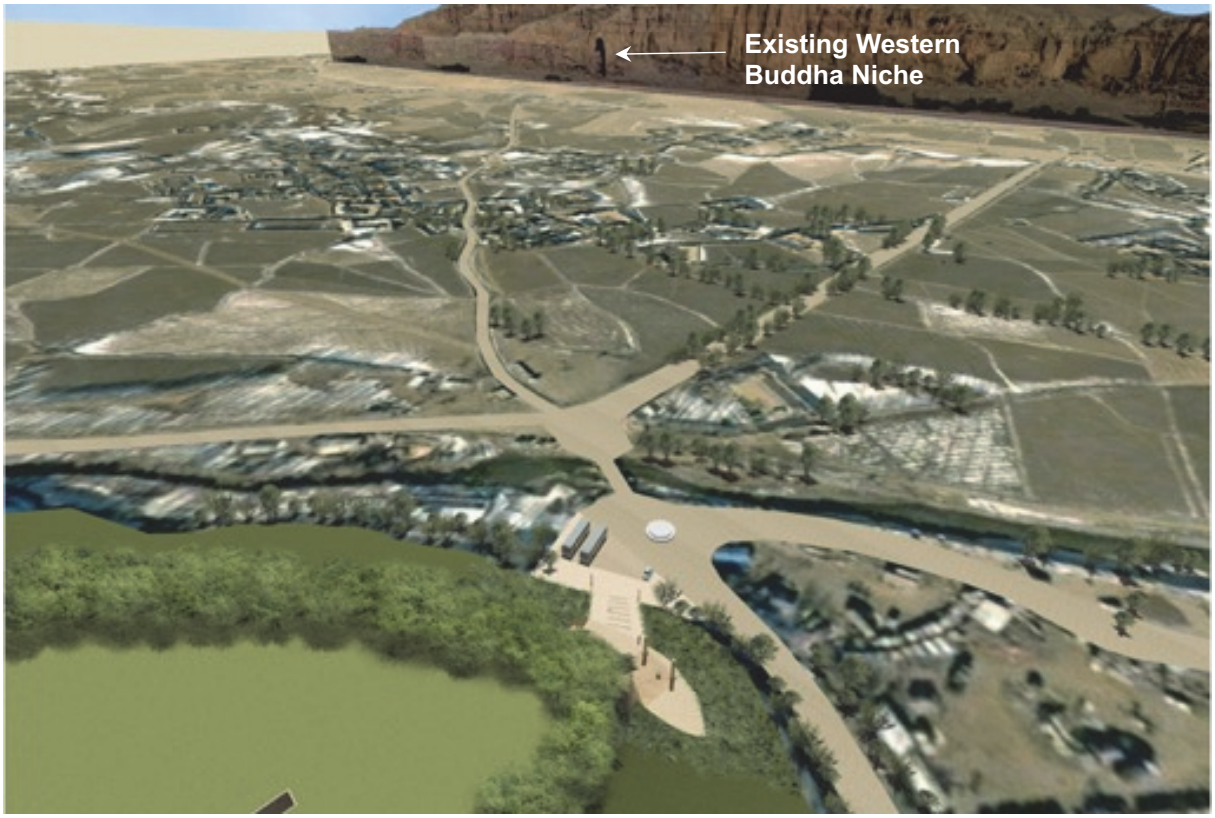
Orientation of Eastern Buddha Reproduction and the Axis to the Existing Western Buddha Niche
We plan to build a stairway from the foot of the plateau, along the slope ascending towards the Eastern Buddha reproduction on the top of the plateau.

The steps will be situated on the axis connecting the Eastern Buddha reproduction and the existing Western Buddha niche. In other words, when people descend the steps, they will descend towards the existing Western Buddha niche. On the other hand, the Eastern Buddha reproduction and its niche will face towards the empty niche of the Great Cliff in which the original Eastern Buddha was located.

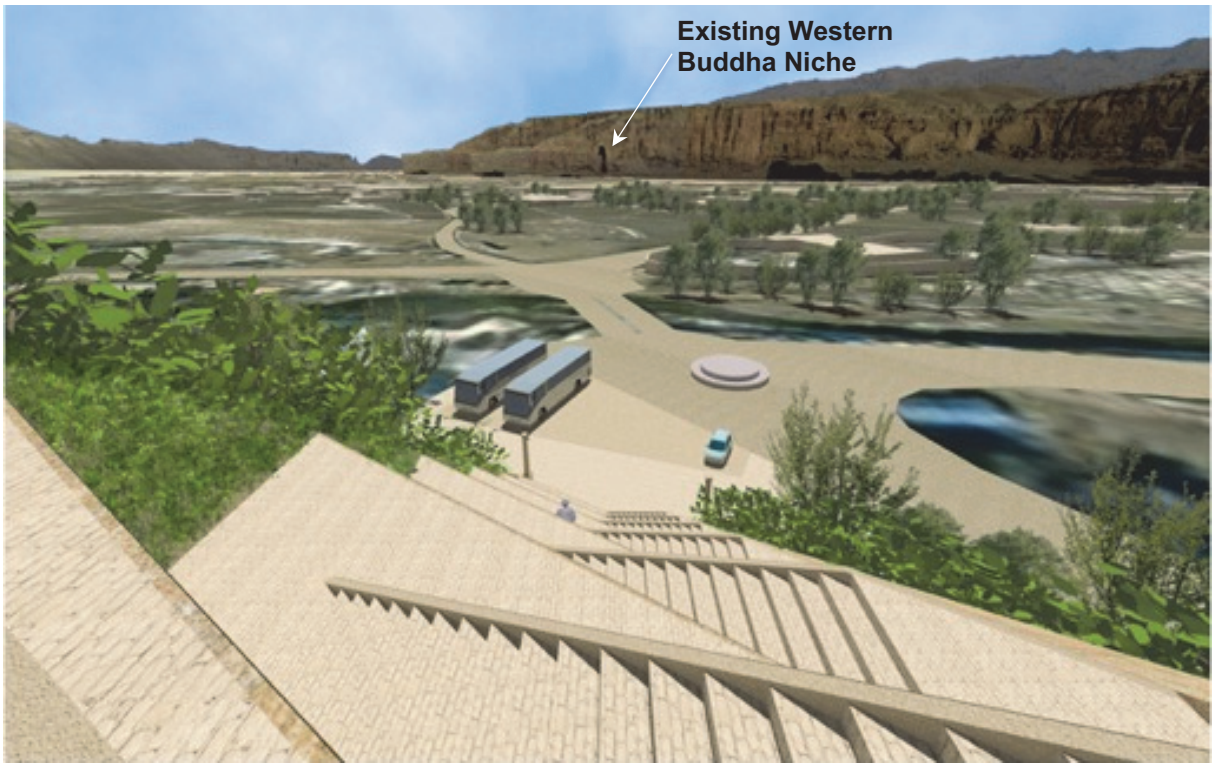
Site plan: The monument (a one-third scale of the Eastern Buddha statue) faces the original Eastern Buddha niche straight ahead. The Western Buddha niche is located on the axis of the outdoor steps. The underground museum is located behind the Eastern Buddha reproduction.

Bird's-eye view of the proposed monument from the north direction: A one-third scale of the Eastern Buddha is constructed on the platform halfway up the hillside. The outdoor steps connect the foot of the plateau and the platform.

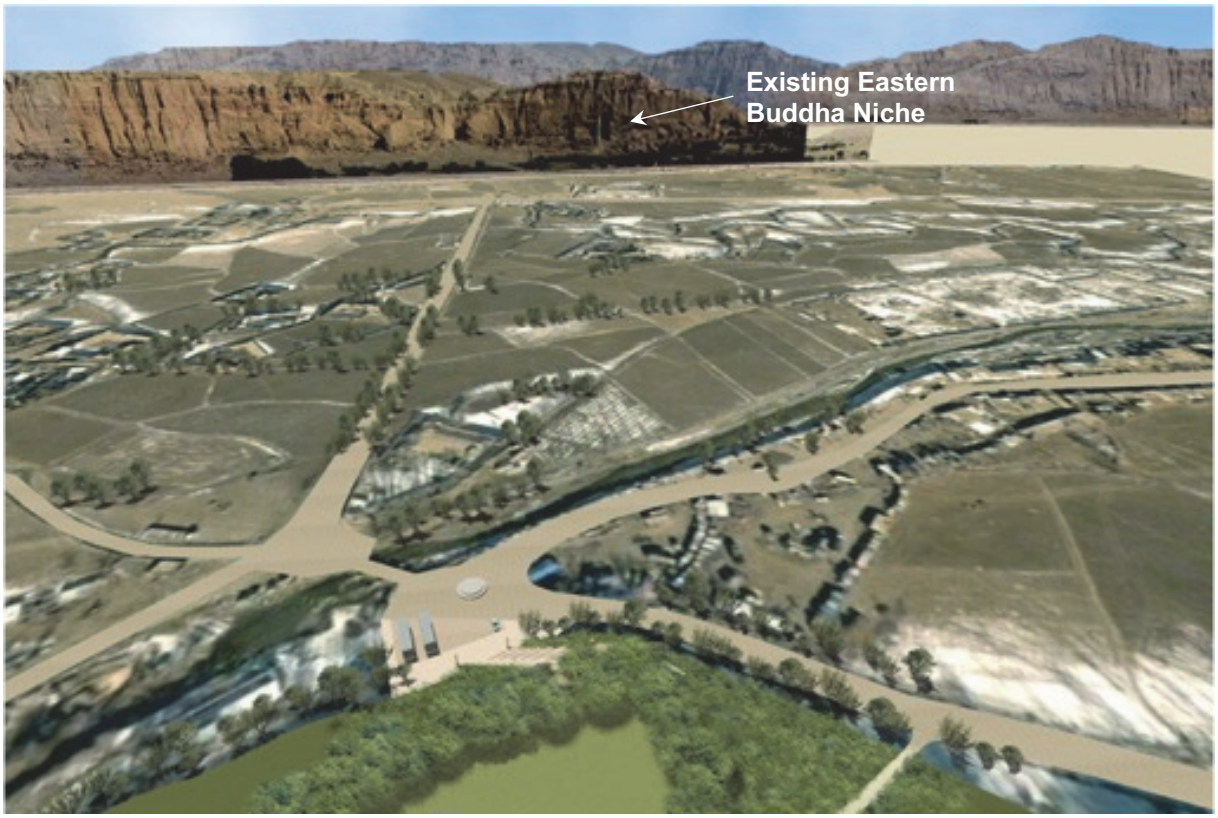
View of the monument from the parking at the foot of the plateau



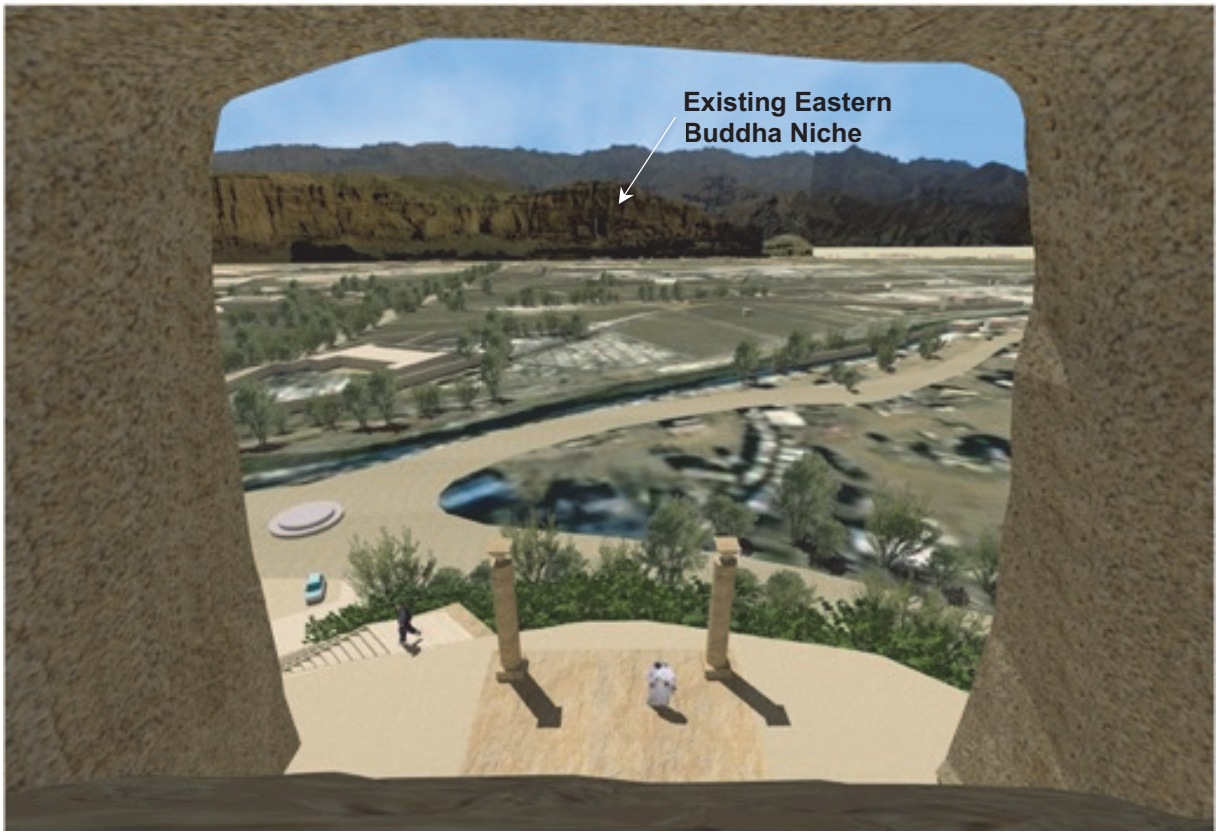
Bird's-eye view from the southeast direction: The Western Buddha niche is located on the axis



View of the outdoor steps, the Bamiyan Valley and the Great Cliff from the platform:
The existing Western Buddha niche is located on the axis of the steps.



Bird's-eye view from the southwest direction: The one-third scale Buddha faces the eastern Buddha directly.

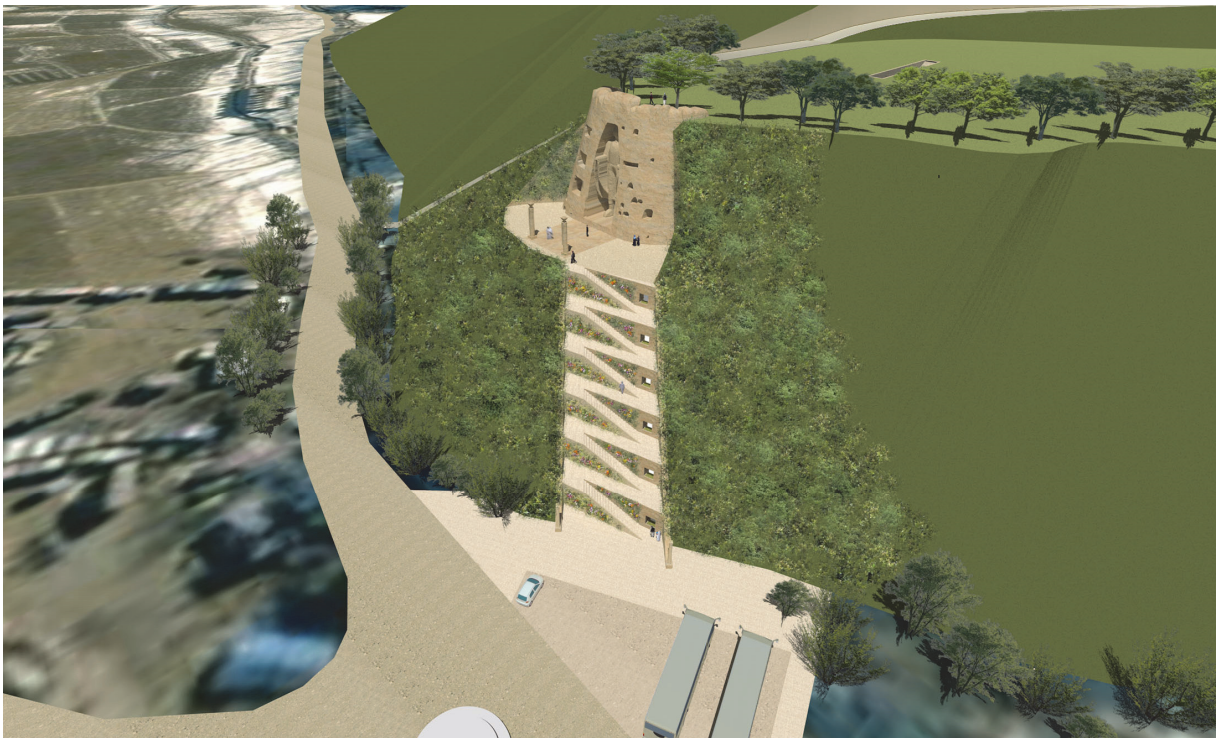


View of the Bamiyan Valley and the Great Cliff from the observatory on the top of the one-third scale Buddha

View of the Great Cliff from the platform: The Eastern Buddha niche is just opposite the one-third scale Buddha.

Waterlines and Water Supply Pipes

Waterlines will be crossing parallel to contour line of the slope in order to prevent the landslide on both sides of the steps and make the slope a lush greenery at the same time. From the waterlines, water supply pipes will be connected to each landing of the steps for raising trees and plants.



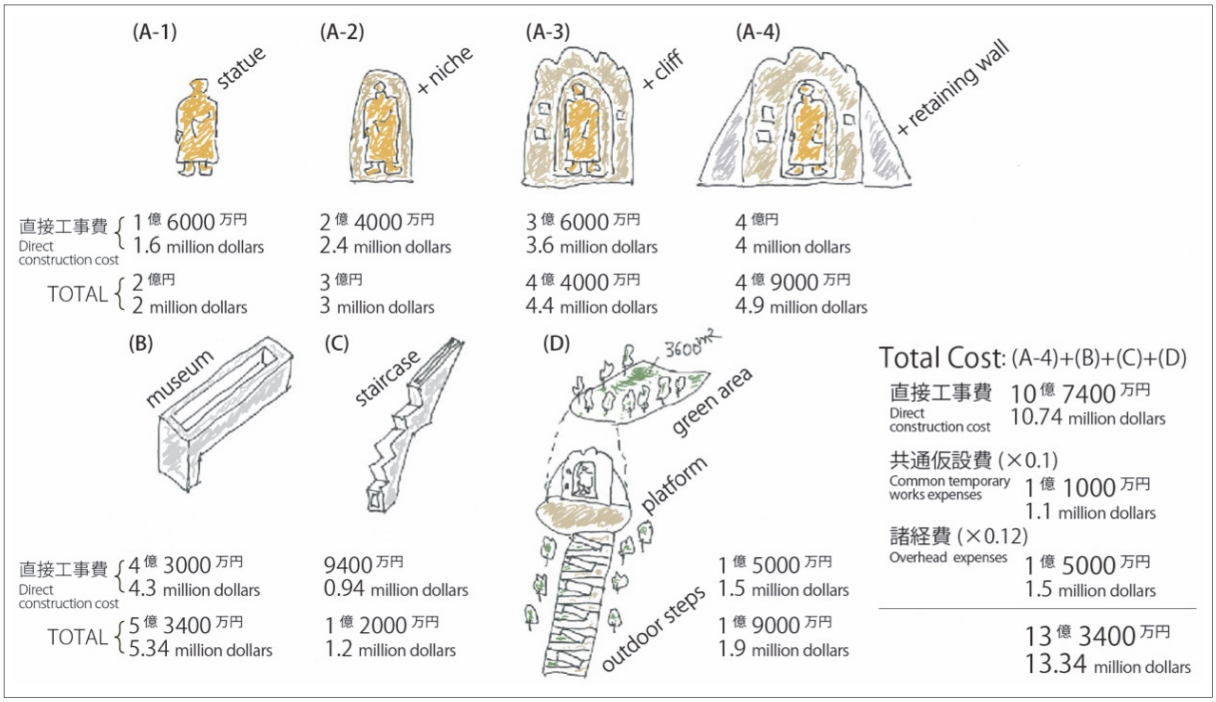
Bird's-eye view from the northwest direction

Water pipes on each landing of the outdoor steps to water plants

Materials, Structure and Construction of the Eastern Buddha Reproduction

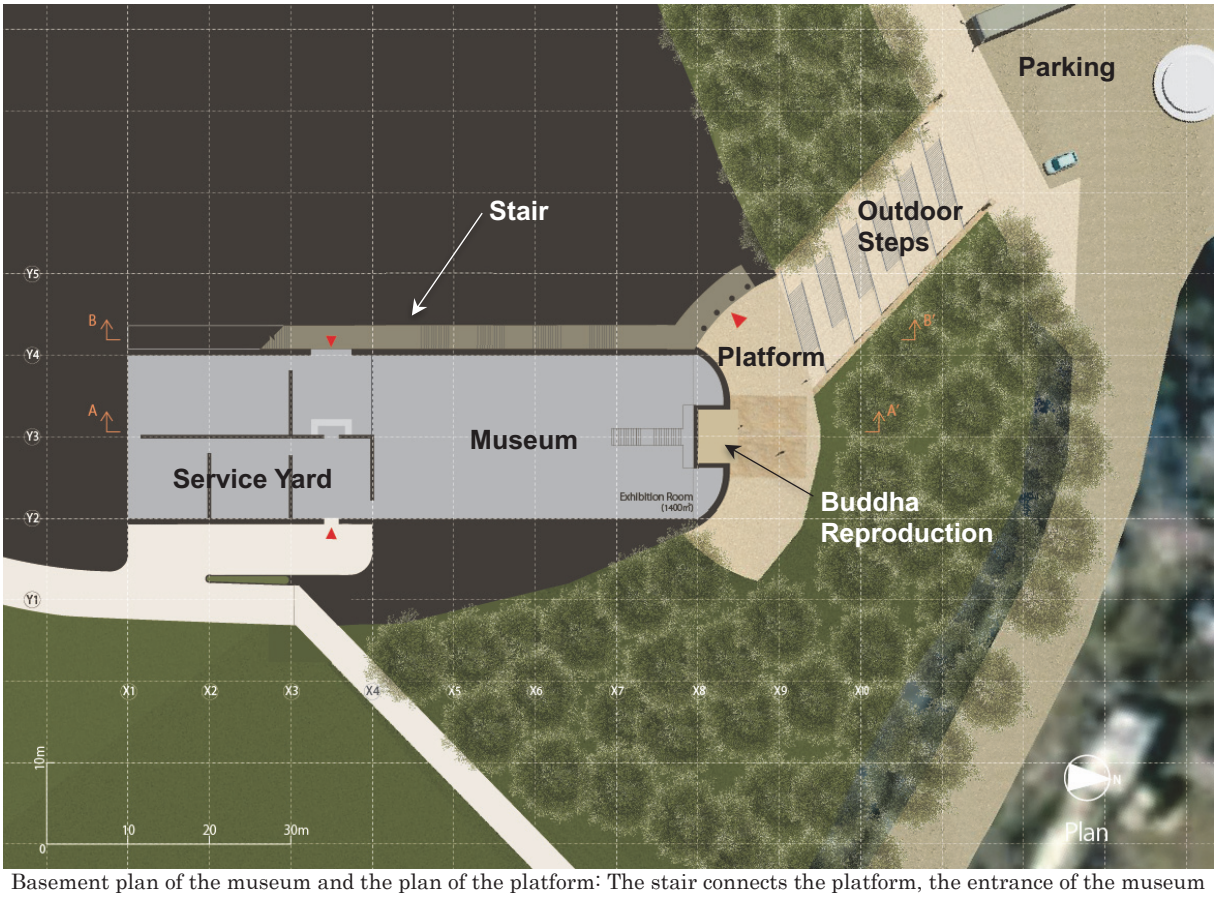
It is considerably complicated to build the statue inside the original existing niche using materials such as reinforced concrete. The original Buddha statues and the niches were simultaneously carved into the natural cliff. However, building a new Buddha statue is equivalent to rising new huge heavy structure in the empty existing niche. The Buddha reproduction seems like a cantilever structure rising from the ground, and probably will be supported from the back of niche. However, it is necessary to handle the vertical and horizontal forces of the ground during an earthquake. In addition, if surrounding walls in the niche support the horizontal force, precaution of surrounding walls against the horizontal force are required. In any case, we need to take into account that if the current state of the cliff allows us to perform these treatments against the vertical and horizontal forces. Furthermore, estimation cost of the reinforcement steps should also be considered.

Concerning the new Buddha reconstruction, we propose to use light-weight materials, such as Glass-Fiber Reinforced Concrete (GRC). The method of using GRC material is spraying concrete (containing glass fiber) onto a previously molded a 3D steel mesh. Therefore, a female mold of the Buddha statue is unneeded. This effort paved the way to create extraordinary new designs by the material. Recently, a latest innovation combining GRC with different materials such as glass and stone has been released.

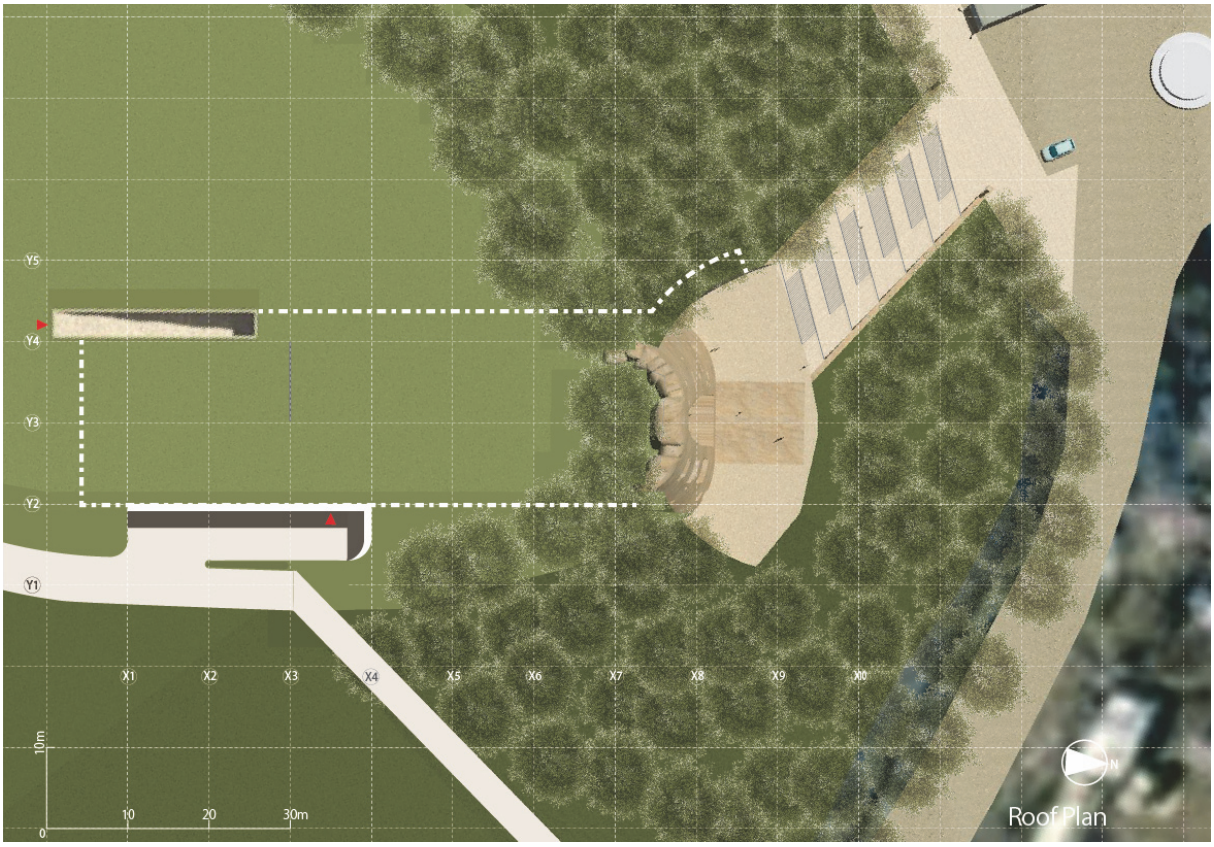


Cost estimate of the construction for each part

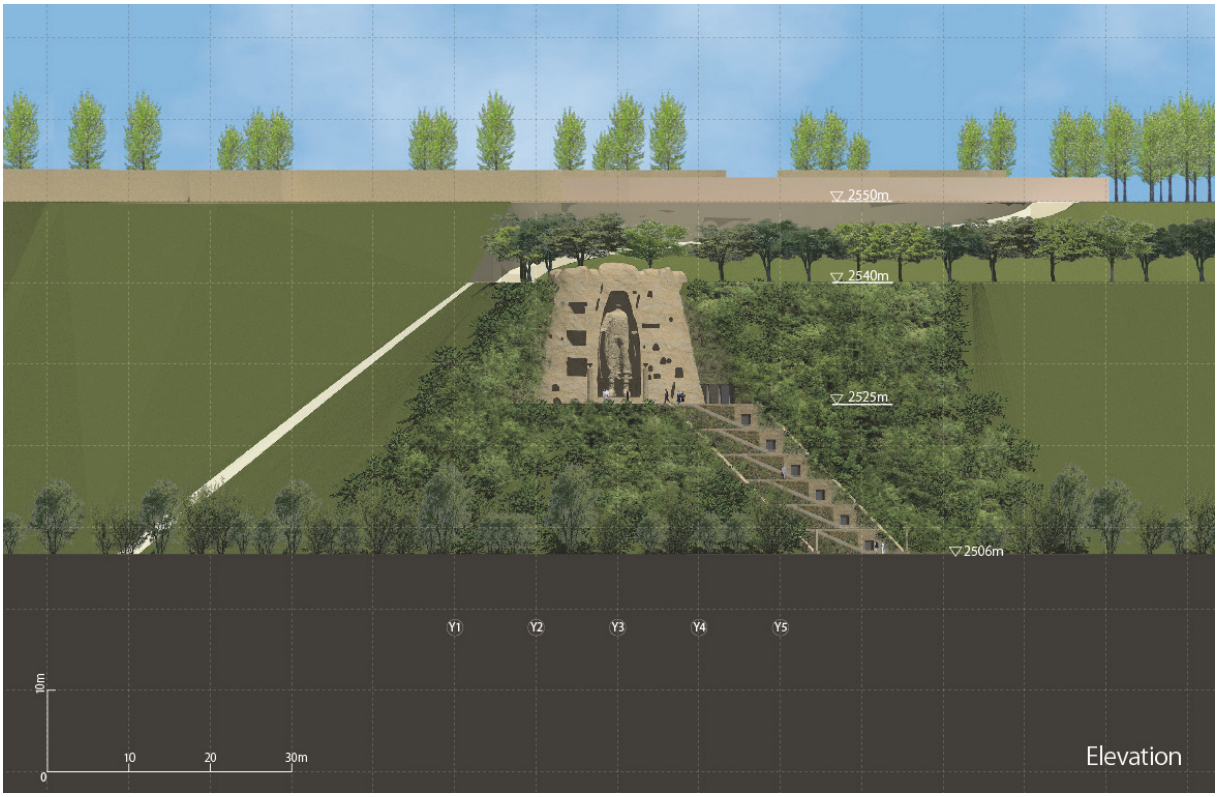
Plan of the Monument and the Museum



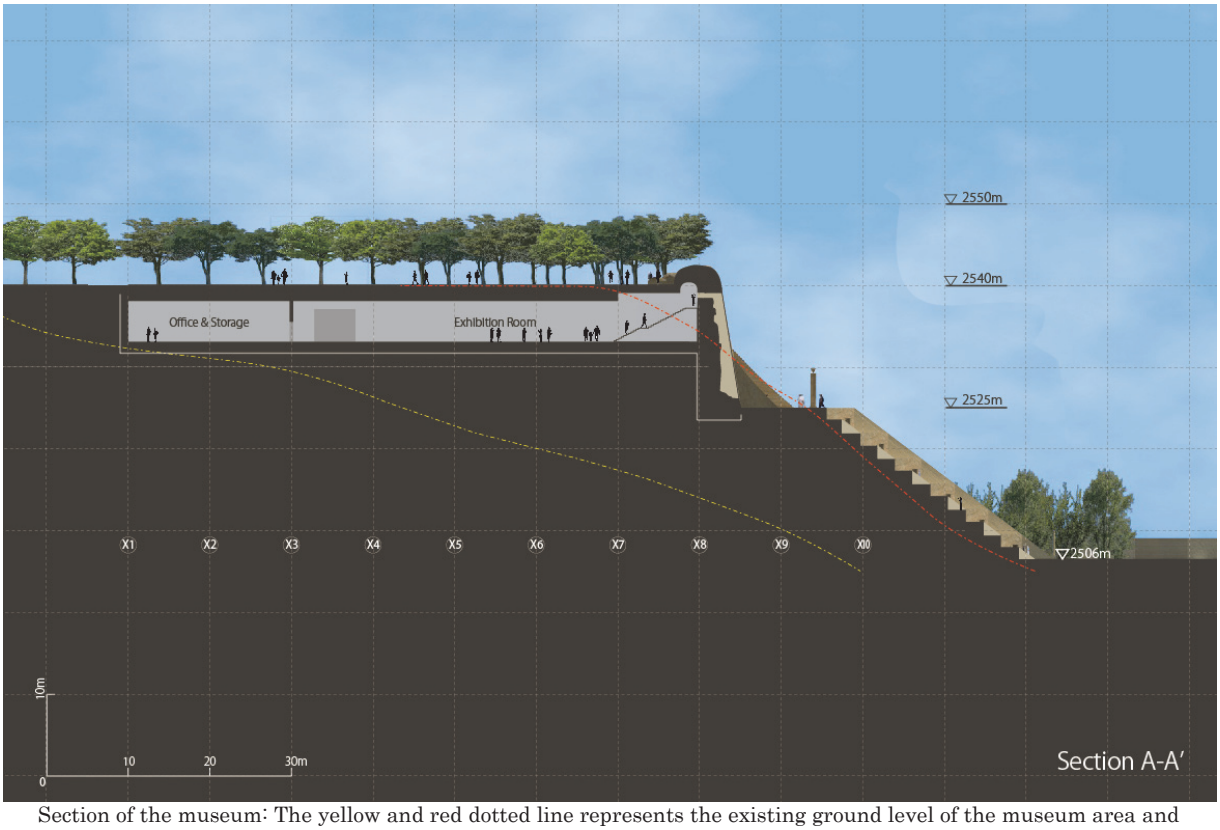
Basement plan of the museum and the plan of the platform: The stair connects the platform, the entrance of the museum and the top of the plateau.



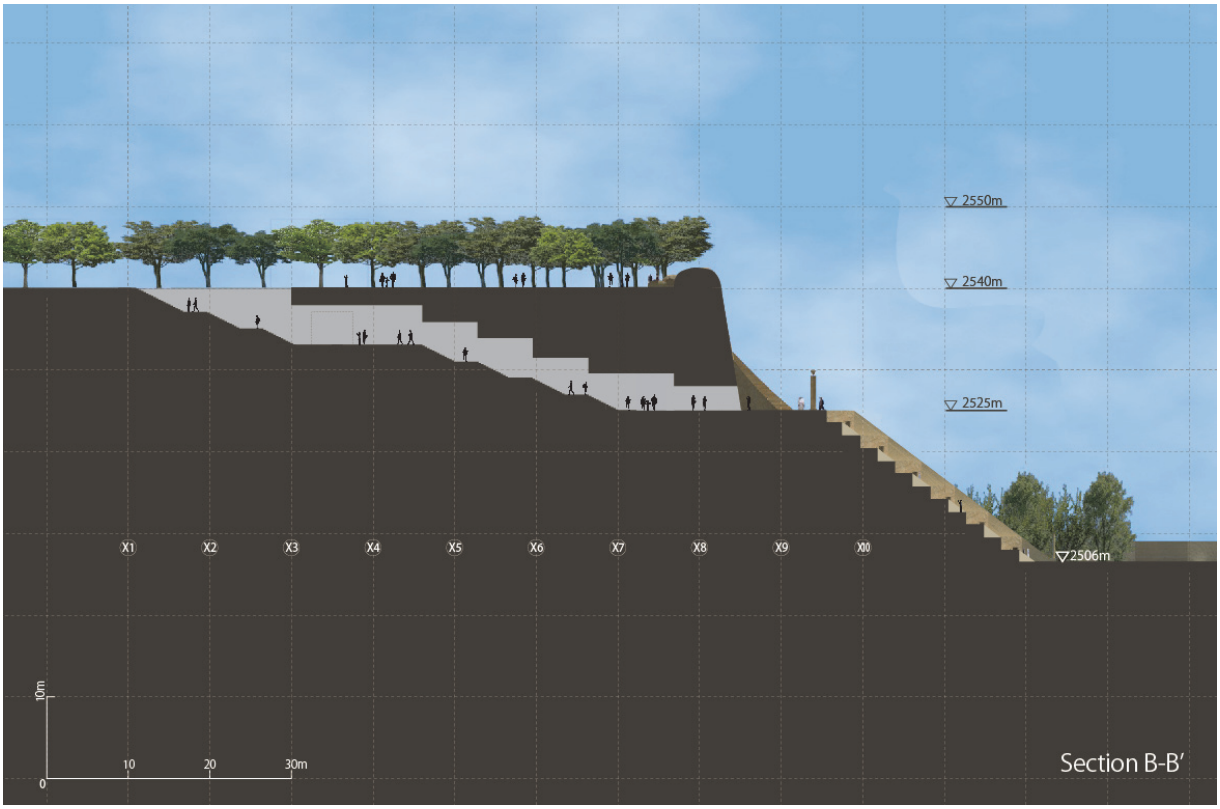
Plan from the top of the plateau



South-east elevation



Section of the museum: The yellow and red dotted line represents the existing ground level of the museum area and outdoor steps area respectively.



Section of the stair that connects the platform and the top of the plateau

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UNESCO/Japanese Funds-in-Trust Project for Support for Silk Roads World Heritage Sites in Central Asia (Phase II): On-site Training Workshop in Uzbekistan (11-20 September 2017)

The UNESCO Japan Funds-in-Trust (Japan-FIT) project *Support for Documentation Standards and Procedures of the Silk Roads World Heritage Serial and Transnational Nomination in Central Asia (Phase I, February 2011–June 2014)* was to support the wishes of five Central Asian countries to have their related Silk Road heritage inscribed as single World Heritages on the List. This led to the decision to inscribe *Silk Roads: the Routes Network of Chang'an-Tianshan Corridor*, a joint submission by Kazakhstan, Kyrgyzstan, and China, on the List in 2014, at the 38th session of the World Heritage Committee, held in Doha, Qatar. Meanwhile, the inscription of *Silk Road: Penjikent-Samarkand-Poykent Corridor*, a joint submission by Tajikistan and Uzbekistan, was postponed.

The UNESCO Japan Funds-in-Trust (Japan-FIT) project *Support for the Silk Roads World Heritage Sites in Central Asia (Phase II, April 2015–April 2018)* was formally launched at the 4th meeting of the Coordinating Committee, held by UNESCO in November 2015 in Almaty, Kazakhstan. This project picked up where Phase I left off, and its objective was to (1) conduct further documentation, archeological surveys, and training on preservation and use plans to guarantee the sustainable management of Silk Road areas; and (2) increase Central Asia's ability to preserve its cultural heritage.

As part of this project, we, the Mukogawa Women's University team, held an on-site training workshop for specialists from Uzbekistan, one of the countries of Central Asia.

Lecture on how to operate the drone

1. Brief overview of the workshop

1-1. Workshop Venue

Tashkent, Samarkand and Khiva

1-2. Lecturers

Kazuya Yamauchi	*Professor, Research Institute of Cultural Properties, Teikyo University*
Shigeyuki Okazaki	*Professor, Head of Architecture Department, Mukogawa Women's University*
Kazuhiko Yanagisawa	*Professor, Architecture Department, Mukogawa Women's University*
Noritoshi Sugiura	*Associate Professor, Architecture Department, Mukogawa Women's University*
Hideaki Tembata	*Lecturer, Architecture Department, Mukogawa Women's University*

1-3. Objective

Conducting on-site training workshops on preserving, landscaping and utilizing historical buildings, townscapes and landscapes through 3D models, or simulations with videos

1-4. Activities

Workshop at Tashkent	: Program GM
Workshop at Samarkand	: Program AM and TS
Workshop at Khiva	: Program AM and TS

Program GM :

*Creating 3D **g**eographical **m**odels based on photogrammetric processing of photos taken by drone*

Program AM :

*Creating 3D **a**rchitecture **m**odels based on photogrammetric processing of photos taken by drone*

Program TS :

*Conducting **t**ownscaping **s**imulations with aerial videos taken by drone*

2. Summary of the on-site training workshop in Uzbekistan
2-1. Opening ceremony (September 12)

the Ikuo Hirayama International Caravanserai of Culture

Scene from the opening ceremony

Introducing the workshop program

Introducing the drone

Handover ceremony of the drone

Commemorative photograph

The opening ceremony was held at the Ikuo Hirayama International Caravanserai of Culture. *Mr. Badarch DENDEV*, Officer-in-Charge, UNESCO Tashkent Office, UNESCO representative a.i. to Uzbekistan, *Mr. Server ASHIROV*, Principle Department for the Preservation and Utilization of the Cultural Heritage, Ministry of Culture of the Republic of Uzbekistan, *Mr. Soichiro TOYOSHIMA,* Chargés d'Affaires ad interim of Japan to Uzbekistan, *Mr. Roland LIN*, Programme Specialist from the World Heritage Center, UNESCO, Paris, *Mr. Kazuya YAMAUCHI*, Professor of the Research Institute of Cultural Properties, Teikyo University, Japan, made opening speeches respectively. Furthermore, the Mukogawa Women's University team including *Dr. Shigeyuki OKAZAKI*, Professor and Head of Architecture Department, explained about the workshop program and drone. After that, the two sets of drones were transferred from UNESCO to the Ministry of Culture of the Republic of Uzbekistan. Finally, commemorative photos were taken.

2-2. Tashkent workshop (September 13)


the ancient settlement at Kanka

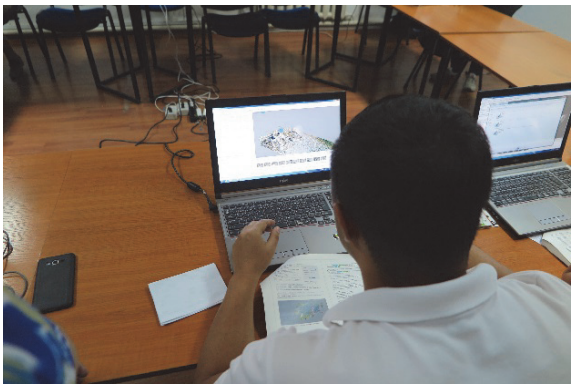

Lecture on how to operate the drone

Lecture on how to operate the drone

Lecture on how to operate the drone

Photo taken by the drone

Program GM



Program GM

Awarding certificates of completion

Commemorative photograph

First, we conducted an on-site workshop at the ancient settlement at Kanka, Uzbekistan. After learning how to operate the drone, each of the participants flew it and took pictures of the settlement. Then, we conducted Program GM at UNESCO Tashkent office, where the participants had the opportunity to create a 3D model of the Kanka settlement.

2-3. Samarkand workshop (September 15)

the Registan Square

Explaining photogrammetry

Taking pictures with a digital camera

Surveying with a laser rangefinder

Program AM

Program TS

Commemorative photograph

First, we conducted an on-site workshop at the Registan Square. The participants each took pictures of the madrasah with digital cameras. They also conducted measurement surveys. Afterward, we conducted Program AM at the inspection office and the participants had the opportunity to create 3D models of the madrasah. In addition, we conducted Program TS, which made use of videos taken at the Registan Square.

2-4. Khiva workshop (September 18, 19)

Townscape of Khiva

Sep. 18: Lecture on how to operate the drone

Sep. 18: Lecture on how to operate the drone

Sep. 18: Taking pictures with the drone

Sep. 18: Program AM

Sep. 19: Lecture on how to operate the drone

Sep. 19: Photo taken by the drone

Sep. 19: Image captured from the drone

Sep. 19: Checking the video taken by the drone

Sep. 19: Program TS

Sep. 19: Commemorative photograph

First, on September 18, we conducted an on-site workshop at the Allah Kuli Khan Madrasah. After learning how to operate the drone, each of the participants flew it and took pictures of the madrasah. Then, we conducted Program AM at the Khorezm Mamun Academy, where the participants had the opportunity to create a 3D model of the madrasah. On September 19, we conducted on-site workshops at the Qutlugh Murad Inaq Madrasah and the Islam-Hoja Minaret. Along with flying the drone and taking pictures there, we also took videos of Itchan Kala, which contained those sites. Finally, we checked those videos at the Khorezm Mamun Academy and used them for Program TS.

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Inter Cultural Studies of Architecture (ICSA) in Japan 2017

In accordance with the general exchange agreement between Mukogawa Women's University (MWU) and Bahçeşehir University (BAU), students and professors from BAU's Faculty of Architecture and Design joined us at Koshien Hall and the Architecture Studio on MWU's Kami-Koshien Campus from June 22 to August 2, 2017.

BAU students tackled second-, third- and fourth-year MWU student design projects. By participating in this program, they gained knowledge, learned techniques, and increased their awareness of architectural design. They also joined basic design studios of first-year MWU students and had the opportunity to experience traditional Japanese culture, such as Ikebana (Japanese flower arrangement under Ryuho Sasaoka, headmaster of the Ikebana Misho-ryu Sasaoka in Kyoto) and woodwork (with Sadahide Kanda, a master carpenter in Hyogo). They also participated in fieldwork, exploring the cities and architecture of Japan, such as Omihachiman, Amanohashidate and the Itsukushima Shrine.

Participants
Professors: Assistant Professor Belinda Torus, Instructor Seda Nur Alkan
Students: Asude Gülşen Gurulkan, Beyza Güvenç, Büşra Bars, Elif Tamay Uluşan, Fatıma Zahra Zyad, Gizem Güzide Yurtbaz, Günseli Yazıcı, Pınar Kaya, Şule Sığındım, Vuslat Uysal

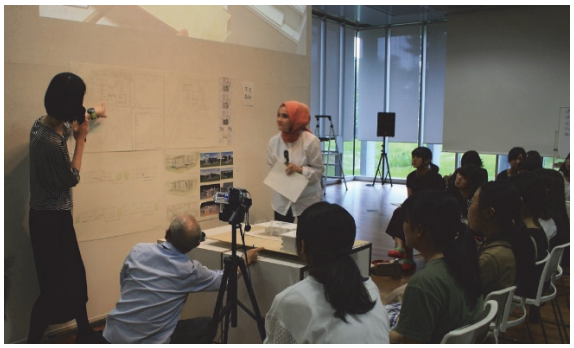
Each BAU student gave a self-introduction in Japanese in the welcome party on June 23.

In the welcome party, MWU graduate students gave welcome speeches in Turkish.

Courtesy call on Chancellor Ryo Okawara and President Naosuke Itoigawa of MWU on July 11

Courtesy call on Nishinomiya Mayor Takeshi Imamura on July 21

Architectural Design Studio I: Design of small-scale Architectural space through combination of planes



Architectural Design Studio I: Design of small-scale Architectural space through combination of planes

Architectural Design Studio III: Rebuilding Hanshin Koshien Station with a membrane-structured roof

Architectural Design Studio III: Rebuilding Hanshin Koshien Station with a membrane-structured roof

Architectural Design Studio V: Paradise along waterfront

Architectural Design Studio V: Paradise along waterfront

BU and MWU students experienced Ikebana under Headmaster Ryuho Sasaoka (Ikebana Misho-ryu Sasaoka)

Master Carpenter Sadahide Kanda instructing the BAU students in using a plane.

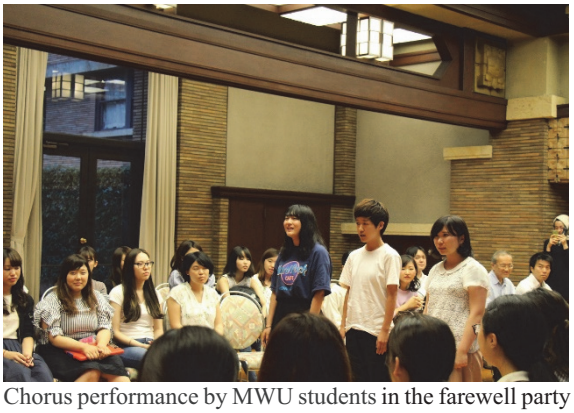
Visiting Omihachiman, Shiga on June 24

Visiting Ine and Amanohashidate, Kyoto on July 1

Visiting Itsukushima Shrine and Hiroshima Peace Memorial Park, Hiroshima on July 7

Tea ceremony held by MWU students on July 6

Conferring of certificate of completion in the farewell party on July 28



Chorus performance by MWU students in the farewell party on July 28

Commemorative photograph in the farewell party

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Silk Road Culture and Architecture Lecture Series ＃06

Ceramics and Tiles of the Silk Road

Date： **October 14 (Saturday), 2017, 13:00～**
Venue： **The Industry Club of Japan Hall (Tokyo, Japan)**
Lecturers： **Prof. Tomoko MASUYA (Institute for Advanced Studies on Asia, the University of Tokyo)**
Prof. Tomohiko OKANO (Adjunct Lecturer, Aoyama Gakuin University)
Performer： **Mr. Masato TANI (Santoor Player)**
Mr. Junzō TATEIWA(Tompak and Daf Player)

The 6th lecture in the *Silk Road Culture and Architecture* series sponsored by Mukogawa Women's University Department of Architecture and Graduate Architecture Major was held on Saturday, October 14, at the Industry Club of Japan Hall in Marunouchi, Tokyo, with the Tokyo Center as co-host. The lecture, entitled *Ceramics and Tiles of the Silk Road*, was given by Prof. Tomoko MASUYA (Institute for Advanced Studies on Asia, the University of Tokyo) and Prof. Tomohiko OKANO (adjunct lecturer, Aoyama Gakuin University). Masato TANI (santoor player and Associate Professor, Faculty of Human Development, Kobe University) and Junzō TATEIWA (tompak and daf player) were also invited to give a performance of Iranian music.

The lecture began with a duet by Mr. Tani and Mr. Tateiwa. The traditional melodies of Iran number in the hundreds, and develop mainly within one of 12 modes. Accompanied by Mr. Tateiwa on tompak, Mr. Tani performed one such melody, which he interwove with an improvisation fitting the atmosphere of the lecture hall. The santoor, which is a struck-string instrument from Iran, consists of metal strings strung across the top of a trapezoidal resonator, which are struck by both hands with light mallets to produce sound. Mr. Tani explained the modes and microtones of Iranian music by performing them on the santoor.

Prof. Tomoko MASUYA gave a lecture entitled Tile Decoration in Islamic Architecture. After explaining the basics of tiling, she showed photographs of various buildings and the tiles used in them to describe how tiles have been used to beautify Islamic architecture throughout the ages since the time of Ancient Persia. She also discussed the distinctive features of tiling in Spain, Morocco, and Turkey since the 12th century, in relation to those of Islamic Iran.

Prof. Tomohiko OKANO gave a lecture entitled The History of Islamic Ceramics: The Beauty and Creation of Lusterware. Lusterware was named after the golden luster (shine) it creates when light hits it. Ceramic production was born in the Middle East as an industry during the Umayyad dynasty in the 8th century, and the advent of lusterware came about with its further development during the Abbasid dynasty in the 9th century. Prof. Okano discussed lusterware excavated in Iraq, Iran, and Egypt while showing us shards of the actual lusterware.

Opening address by Professor Okazaki, Head of the Department of Architecture

Music performance by Mr. Tani and Mr. Tateiwa

Lecture by Prof. Tomoko MASUYA

Lecture by Prof. Tomohiko OKANO

Silk Road Culture and Architecture Lecture Series ＃07

Origin of the Silk Road: Dreams and Gods of the Persian Empire

Date： **January 20 (Saturday), 2018, 13:00～**
Venue： **The Industry Club of Japan Hall (Tokyo, Japan)**
Lecturers： **Prof. Kazuya YAMAUCHI (Research Institute of Cultural Properties, Teikyo University)**
Prof. Kōsaku MAEDA (Guest Professor, Tokyo University of the Arts)
Performer： **Ms. Keiku (Setar and Tanbur Player)**
Mr. Junzō TATEIWA (Tompak and Daf Player)
Mr. Amin CHOGHADI (Singer)

The 7th lecture in the *Silk Road Culture and Architecture* series sponsored by Mukogawa Women's University Department of Architecture and Graduate Architecture Major was held on Saturday, January 20, at the Industry Club of Japan Hall in Marunouchi, Tokyo, with the Tokyo Center as co-host. The lecture, entitled *Origin of the Silk Road: Dreams and Gods of the Persian Empire*, was given by Prof. Kazuya YAMAUCHI (Research Institute of Cultural Properties, Teikyo University) and Prof. Kōsaku MAEDA (Director, Institute of Studies on the Culture of Afghanistan; Guest Professor, Tokyo University of the Arts). Keiku (setar and tanbur player), Junzō TATEIWA (tompak and daf player), and Amin CHOGHADI (singer) were also invited to give performances of Persian instrumental and vocal music.

The lecture began with a performance by Keiku. The tanbur is a plucked string instrument with a bowl-shaped sound box and a long, narrow neck. She was accompanied by Mr. Tateiwa, on percussion as before, and Mr. Choghadi on vocals. The 25-minute performance was performed in Segah, a popular mode of Central Asia and Eastern Europe. The steps of this mode's scale create a wondrous atmosphere with feelings of sadness, loneliness, confusion, hope, and happiness. The song the trio performed in this Segah mode was about a love story.

Prof. Kazuya YAMAUCHI gave a lecture entitled The Glory of Persia. He began with some basic information about Iran to give context for understanding Persia before explaining the history of Achaemenid and Sassanid Persia, as well as the shahs who built the kingdom and their remains. He then went on to discuss how Persia was influenced by its neighbor, Rome; Zoroastrianism, the religion of Persia; and the relationship between Persia and the Imperial Treasures of Shōsō-in Temple, which came to Japan through the Silk Road.

Prof. Kōsaku MAEDA gave a lecture entitled Zoroaster and Mithraism. Mithra was a heroic deity in Iranian mythology whose followers spanned a wide region from Persia and West Asia all the way to Greece and Rome. While he was the god of contracts in ancient times, he had a devout popular following from the Middle Ages onward as the god of friendship and the sun. Prof. Maeda gave a detailed explanation of Mithra iconography discovered in various places, and also discussed the spread of Mithraism and its effect on later religions.

Opening address by Professor Okazaki, Head of the Department of Architecture

Music performance by Ms. Keiku, Mr. Tateiwa and Mr. Choghadi

Lecture by Prof. Kazuya YAMAUCHI

Lecture by Prof. Kōsaku MAEDA

MWU's DAAM (Department of Architecture and Architecture Major) Special Lecture

Unearthing the Mysteries of Ancient Civilizations

Date： **November 18 (Saturday), 2017, 13:00～16:30**
Venue： **West Hall, Koshien Hall**
Lecturer： **Prof. Takashi INOUE**
(Specially-appointed professor at Tokyo University of the Arts)

Prof. Takashi INOUE, former producer of NHK's New Silk Road and Specially-Appointed Professor at Tokyo University of the Arts, was invited to give a lecture.

The first half was entitled Unearthing the Mysteries of Egypt. Prof. Inoue began with a discussion of lapis lazuli, which was used in the mask of King Tutankhamun and proceeded to share basic knowledge pertaining to Egyptian archaeology, such as an overview of people having to do with Tutankhamun, the dispute over the "hidden chamber" in his tomb, and theories about the goal of building the Pyramids. He also gave an overview of the excavations at Dahshur North, which he was involved in filming, and presented various episodes of them.

The second half was entitled Unearthing the Mysteries of Loulan (Krorän). Prof. Inoue covered Sven Hedin, Lop Nur, the Taklamakan Desert, and other basic aspects in his introduction about Loulan. He then gave an overview of the excavations at the Xiaohe Cemetery, at one end of Loulan, with a presentation of the rare video showing the moment when the mummies were excavated and the episode of its filming. These topics, as well as many additional mysteries, such as the fact that there were no dwellings there, conveyed the allure of Loulan to us.

This valuable lecture exposed us to a topic of a scale far more vast than our everyday world in terms of both time and space and was also a point of departure to reexamine our everyday sense of scale as it relates to architectural design.

Prof. Takashi INOUE giving a lecture

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ITCS Seminar ＃01 (2017 Academic Year)

The Buddhist Ruins of Southern Uzbekistan: Kara-tepe and Zurmala

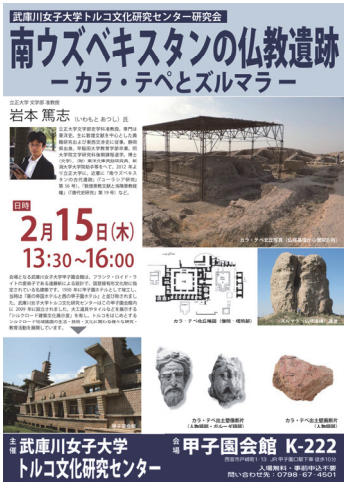
Date： **February 15 (Thursday), 2018, 13:30～16:00**
Venue： **K-222, Koshien Hall**
Lecturers： **Prof. Atsushi IWAMOTO (Associate Professor, Rissho University)**

The 1st Seminar of the Institute of Turkish Culture Studies of the 2017 academic year was held on Thursday, February 15, 2018 at Kōshien Hall. Prof. Atsushi IWAMOTO (Associate Professor, Faculty of Letters, Rissho University), who was invited to speak at the seminar, gave a lecture entitled The Buddhist Ruins of Southern Uzbekistan: Kara-tepe and Zurmala.

Kara-tepe and Zurmala are located in Termez in the Surxondaryo Region of Uzbekistan. Termez, where Buddhism flourished under the Kushan Empire, is known for having been visited by Xuanzang in the 7th century.

First, Prof. Iwamoto explained the geographical features of the sites of the Buddhist ruins in southern Uzbekistan. He then presented the Rissho University Uzbekistan Academic Research Group's findings about Kara-tepe from their 2014 survey. While it was previously thought to have only functioned as a Buddhist temple until the 4th century, the Rissho University Group's survey yielded new findings that suggest that this may have extended into the 6th century. The second half was a discussion about the Buddhist stupa Zurmala, which is visible from the southwest corner of Kara-tepe and which the Rissho University Group is currently conducting survey research in preparation for its preservation and restoration, and for creating proposals for its reconstruction. A lively discussion took place during the question-and-answer session following the lecture.

Through this lecture, we were able to learn about an important historical city that cannot be left out of any discussions about Buddhism's eastward transmission, the spread of Buddhism in Central Asia, and the East-West history of the Silk Road.



Seminar Poster


Venue at Koshien Hall

ITCS Seminar ＃02 (2017 Academic Year)

Zoroastrianism and Fire Temples

Date： **February 23 (Friday), 2018, 13:30〜16:00**
Venue： **K-222, Koshien Hall**
Lecturers： **Prof. Kazuya YAMAUCHI (Research Institute of Cultural Properties, Teikyo University)**

The 2nd Seminar of the Institute of Turkish Culture Studies of the 2017 academic year was held on Friday, February 23, 2018 at Kōshien Hall. This time, Prof. Kazuya YAMAUCHI (Research Institute of Cultural Properties, Teikyo University), who is engaged in the preservation and excavation of cultural properties in Asian countries, was invited to speak at the seminar, and gave a lecture entitled Zoroastrianism and Fire Temples.

In the first half, Prof. Yamauchi gave an overview of the history of Zoroastrianism and its subjects of worship. He then explained that Zarathustra, the founder of the religion, is one of the world's oldest prophets and that the ideas of Zoroastrianism are connected to many other religions, such as Islam, Christianity, and Buddhism, and may have been central to them.

In the second half, Prof. Yamauchi used Farsi-language videos and abundant photographs from excavations to introduce the religious structures built in Dargaz in northeastern Iran in the 5th century. He then discussed Zoroastrianism's many fire temples, which he researched while studying abroad in Iran 30 years ago, using sketches he himself made and photographs from that time. He also touched on new discoveries and the way architectural structures were used at the time, which he understands on a deep level precisely because he has been in the field. The profound content of Prof. Yamauchi's lecture has implications for many other fields.

Seminar Poster


Venue at Koshien Hall

ITCS Seminar ＃03 (2017 Academic Year)

Stupas and Gandhara Sculptures in the Buddhist Temples of Northwest India

Date： **March 8 (Thursday), 2018, 13:30～16:00**
Venue： **K-222, Koshien Hall**
Lecturers： **Prof. Satoshi NAIKI (Assistant Professor, Center for Cultural Heritage Studies, Kyoto University)**

The 3rd Seminar of the Institute of Turkish Culture Studies of the 2017 academic year was held on Thursday, March 8, 2018 at Kōshien Hall. Prof. Satoshi NAIKI (Assistant Professor, Center for Cultural Heritage Studies, Kyoto University), who was invited to speak at the seminar, gave a lecture entitled Stupas and Gandhara Sculptures in the Buddhist Temples of Northwest India.

Prof. Naiki began with a description of the Buddhist ruins and history of northwestern India, centered around Gandhara, as well as prior research on the subject. He then presented some Butsuden-zu, or bas-relief friezes that illustrate the historical Buddha's life from just before his birth to right after his death, and explained the stories depicted in each of them. Prof. Naiki has analyzed materials created by the Kyoto University Iran-Afghanistan-Pakistan Academic Research Group in a study he has conducted on the relationship between the stupas and the friezes that were used to dignify them, which had not been covered in previous studies. He explained that with regard to the friezes excavated from the ruins of the Thareli, Mekhasanda, and Ranighat temples in Gandhara, it is possible to estimate the period during which they were created and which scenes in their Butsuden-zu were well-received by measuring them and dividing them into groups based on the composition of their images.

As Prof. Naiki's research relates friezes to stupas, which are architectural structures, there was a lively discussion about the relationship between sculpture and architecture during the question-and-answer session, making this seminar an enriching one.

Seminar Poster


Venue at Koshien Hall

Two Students from Turkey Completed the Master's Course in Architecture

Date：August 4 (Friday), 2017

Mukogawa Women's University's graduate school graduation ceremony (for students entering in September) was held in the Global Studio on the second floor of the Central Library, where two international students from Turkey officially completed their master's course in the Department of Architecture. Around 100 MWU students, faculty, and staff members were in attendance.

The ceremony began with the conferment of the two students' degrees by MWU president Naosuke ITOIGAWA. President ITOIGAWA then delivered a speech. Shigeyuki OKAZAKI, Chairman of the Department of Architecture, also delivered a speech. At the end of the ceremony, each graduating student spoke a few words of thanks in fluent Japanese.

Both students will remain in Japan after their graduation, with one entering a leading architectural design firm in Tokyo and the other advancing to the doctoral course here at MWU. We look forward to great things from these graduates with the valuable ability to build bridges between Japan and Turkey.

Graduation ceremony

Two Students from Turkey Entered the Doctoral Course in Architecture

Date：September 5 (Tuesday), 2017

The MWU graduate school's September entrance ceremony was held at the Global Studio on the second floor of the Central Library in MWU, and two international students from Turkey entered the doctoral course of the architecture major. About 50 enrolled master's students, faculty, and staff members were present at the ceremony.

First, an oration was delivered by Naosuke ITOIGAWA, the president of MWU. He touched on Kiichiro Koe's founding of Mukogawa Gakuin as he discussed the importance of carrying out the original intentions and pursuing ideals like the founder. Then, the two students read the oaths in Japanese cooperatively. Finally, President ITOIGAWA handed a university badge to each student and the ceremony was closed.

Both students have since completed the master's course in MWU's Department of Architecture. They will now begin studying Japanese gardens and tradesmen's houses, continuing to learn about Japan as they pursue doctoral degrees.

Entrance ceremony

Annual Events Apr. 2017- Mar. 2018

Date	Events
June 22-August 2, 2017	**Inter Cultural Studies of Architecture (ICSA) in Japan 2017**
August 4, 2017	**Two Students from Turkey Completed the Master's Course in Architecture**
September 5, 2017	**Two Students from Turkey Entered the Doctoral Course in Architecture**
September 11-20, 2017	**UNESCO/Japanese Funds-in-Trust Project for Support for Silk Roads World Heritage Sites in Central Asia (Phase II): On-site Training Workshop in Uzbekistan**
September 28, 2017	**Technical Proposal for Revitalizing the Bamiyan Eastern Buddha**
October 14, 2017	**"Silk Road Culture and Architecture" Lecture Series #06** "*Ceramics and Tiles of the Silk Road*" (Prof. Tomoko MASUYA, Institute for Advanced Studies on Asia, the University of Tokyo / Prof. Tomohiko OKANO, adjunct lecturer, Aoyama Gakuin University / Mr. Masato TANI, santoor player / Mr. Junzō TATEIWA, tompak and daf player)
November 18, 2017	**MWU's DAAM Special Lecture (FY2017)** "*Unearthing the Mysteries of Ancient Civilizations*" (Prof. Takashi INOUE, former producer of NHK's *New Silk Road* and specially-appointed professor at Tokyo University of the Arts)
January 20, 2018	**"Silk Road Culture and Architecture" Lecture Series #07** "*Origin of the Silk Road: Dreams and Gods of the Persian Empire*" (Prof. Kazuya YAMAUCHI, Research Institute of Cultural Properties, Teikyo University / Prof. Kōsaku MAEDA, director, Institute of Studies on the Culture of Afghanistan; guest professor, Tokyo University of the Arts / Ms. Keiku, setar and tanbur player / Mr. Junzō TATEIWA, tompak and daf player / Mr. Amin CHOGHADI, singer)
February 15, 2018	**ITCS Seminar #01 (FY2017)** "*The Buddhist Ruins of Southern Uzbekistan: Kara-tepe and Zurmala*" (Prof. Atsushi IWAMOTO, associate professor, Faculty of Letters, Rissho University)
February 23, 2018	**ITCS Seminar #02 (FY2017)** "*Zoroastrianism and Fire Temples*" (Prof. Kazuya YAMAUCHI, Research Institute of Cultural Properties, Teikyo University)
March 8, 2018	**ITCS Seminar #03 (FY2017)** "*Stupas and Gandhara Sculptures in the Buddhist Temples of Northwest India*" (Prof. Satoshi NAIKI, assistant professor, Center for Cultural Heritage Studies, Kyoto University)

OUTLINE OF THE INSTITUTE OF TURKISH CULTURE STUDIES

Organization

Position	Affiliation	Title	Name
Director	Department of Architecture	Professor	Shigeyuki Okazaki
Researcher	Department of Architecture	Professor	Shigeki Tosu
		Professor	Satoshi Matsushita
		Professor	Yusei Tazaki
		Professor	Noritoshi Sugiura
		Professor	Kazuhiko Yanagisawa
		Professor	Toshitomo Suzuki
		Associate Professor	Fumie Ooi
		Associate Professor	Hiroyuki Tagawa
		Associate Professor	Akira Tanaka
		Associate Professor	Hideaki Tembata
		Associate Professor	Keisuke Inomata
		Associate Professor	Tomoko Uno
		Associate Professor	Junko Morimoto
		Lecturer	Sachiko Morishige
		Assistant Professor	Aya Yamaguchi
		Visiting Professor	Mamoru Kawaguchi
		Visiting Professor	Kunihiko Honjo
Visiting Researcher	Bahçeşehir University (Turkey) Faculty of Architecture and Design	Associate Professor	Murat Dündar
Assistant	Department of Architecture	Assistant	Yuna Tanaka
		Assistant	Yuuka Nakamura
		Assistant	Yuka Kawasaki
	Institute of Turkish Culture Studies	Assistant	Beyza Nur Bozkurt
Secretariat	Secretariat Division of School of Human Environmental Sciences	Chief Clerk	Miyuki Nakaichi

Reviewers of *Intercultural Understanding*

Name	Title and Affiliation
Yasushi Asami	Professor, The University of Tokyo, Japan
Kunio Kato	Professor Emeritus at Kyoto University, Japan
Mamoru Kawaguchi	Professor Emeritus at Hosei University, Japan
Mitsuo Takada	Professor Emeritus at Kyoto University, Japan
Shuichi Hokoi	Professor Emeritus at Kyoto University, Japan
Kosaku Maeda	Professor Emeritus at Wako University, Japan
Minako Mizuno Yamanlar	Representative of NPO The Japanese-Turkish Friendship Association, Japan
Kazuya Yamauchi	Professor, Teikyo University, Japan
Hironobu Yoshida	Professor Emeritus at Kyoto University, Japan
Murat Dündar	Associate Professor, Bahçeşehir University, Turkey
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Rules and Regulations of the Institute of Turkish Culture Studies (ITCS) at Mukogawa Women's University

(Establishment)
Article 1 The Institute of Turkish Culture Studies (hereinafter "the Institute") shall be located in Mukogawa Women's University (hereinafter referred to as "the University").
(2) The Institute shall be operated under the administration of the University's Department of Architecture for the time being.

(Objective)
Article 2 The objective of the Institute is as follows:
(i) to conduct comparative studies on life, technology, and culture centered on the architecture of Japan and Turkey as the east and west starting points of the Silk Road, and to clarify the cultural base common to both countries beyond their differences in history, climate, and so forth.
(ii) to conduct, by pursuit of the above-mentioned aims, extensive studies on life, technology, and culture centered on the architecture of neighboring Silk Road countries, clarify similarities among them, and contribute to new mutual understandings that promote the peace and prosperity of the Silk Road region.
(iii) to support international exchange of students predominately in the field of the human environment and conduct international educational activities in the fields of architecture and human environment based on the achievements of the studies mentioned in (i) and (ii).
(iv) to discuss internationally the achievements in research and education mentioned in the preceding three items, introduce (*or* transmit) them to the world in various ways at every occasion, and share common values with people around the world.

(Operation)
Article 3 The operations of the Institute to achieve the above-mentioned objectives are as follows:
(i) to conduct studies in cooperation with the Research Center of Japanese Culture Studies, Bahçeşehir University, Istanbul.
(ii) to hold an international workshop, the "Inter Cultural Studies of Architecture in Japan (ICSA in Japan)," where architecture and human environment students of the world, centered around Turkey, are invited every year in principle to support a similar workshop, the "Inter Cultural Studies of Architecture in Istanbul" that is held at the Research Center of Japanese Culture Studies at Bahçeşehir University, and to send teachers and students of the University's Department of Architecture for research and educational activities.
(iii) to hold seminars, introduce research achievements, exhibit, and organize lectures concerning life, technology, and culture, centered around architecture, to which researchers, business persons, and residents who belong to the field of studies conducted by the Institute are invited.
(iv) to hold permanent and special exhibitions on the life, technology, and culture of neighboring Silk Road countries, centered around Turkey.
(v) to conduct public relations activities, such as publication of the research and educational achievements of the Institute, symposiums, and so forth.
(vi) other operations required to accomplish the aims specified in the preceding article.

(Organization)
Article 4 The Institute may establish research departments with respect to differences in research fields to perform relevant activities.

(Director)
Article 5 The Institute shall install a director.
(2) The chancellor shall appoint the director from among professors.
(3) The director shall be appointed for a period of two years and may be reappointed.
(4) The director handles the operations of the Institute under the president's direction.

(Vice Director and Head of Research Department)
Article 6 The Institute may install a vice director and heads of research in each department referred to in Article 4.
(2) The chancellor shall appoint the vice director and heads of the research departments from among the faculty. The latter positions may be substituted with adjunct teaching staff.
(3) The vice director assists the director and engages in the administrative operations.
(4) The vice director fills in for the director under the director's direction.
(5) Each head controls his research department and engages in research under the director's direction.

(Senior Researcher)
Article 7 The Institute may install senior researchers with the chancellor's approval.
(2) The director appoints senior researchers from among the researchers.
(3) The senior researchers will assist their heads and engage in research.

(Researcher)
Article 8 The Institute shall install researchers as required.
(2) Teachers at Bahçeşehir University may be appointed as researchers.
(3) The researchers will engage in research under the director's direction.

(Temporary Researcher)
Article 9 The Institute may install temporary researchers as needed.
(2) The president appoints temporary researchers upon the recommendation of the director.
(3) The period of the appointment shall be less than one year and may be renewed when necessary.
(4) The temporary researchers will engage in specific research or joint research.

(Assistant)
Article 10 The Institute may install assistants.
(2) The assistants will assist in research under the director's direction.

(Steering Committee)
Article 11 The University shall establish a steering committee for the Institute (hereinafter "the steering committee") to deliberate basic policy concerning the Institute's operation.
(2) The steering committee shall consist of a director and a few members chosen from among the vice director, the heads of the research departments, the senior researchers, and researchers.
(3) The president will appoint the members of the steering committee.
(4) The director shall be the chairperson of the steering committee.
(5) The chairperson shall convene and lead the steering committee.
(6) Members shall be appointed for a period of two years and may be reappointed. When a vacancy arises, the successor's term of office shall be the predecessor's remaining term.
(7) Details of the steering committee shall be otherwise laid down.

(Secretariat)
Article 12 The Institute shall install a secretariat.
(2) The secretariat shall consist of a few members and the chief clerk of the School of Human Environmental Sciences shall be the chief of the secretariat.
(3) The members of the secretariat will handle clerical duties under the guidance and supervision of the chief clerk under the director's direction.

(Supplementary Rules and Directions)
Article 13 In addition to what is provided in these rules and directions, necessary matters concerning the administrative operations of the Institute shall be prescribed by the director.

(Modification or Elimination of the Rules and Regulations)
Article 14 Modification or elimination of the rules shall be implemented with the chancellor's prior approval.

Supplementary Provisions
(1) The rules and regulations shall be enforced beginning on July 29, 2009.
(2) From the day the rules and regulations are enforced until March 31, 2011, the term of the appointed directors and members of the steering committee shall begin on the day when they are appointed and end on March 31, 2011, notwithstanding the provisions of Article 5, paragraph (3) and Article 11, paragraph (6).

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