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PREFACE

Homogenization of Cultures Around the World :Nomadic Culture in the Desert
均一化する世界の文化：砂漠の遊牧民と文化

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Dunhuang/Turpan, Petra and Bamiyan

Last year, I visited several cities in the peripheral area of the desert, and I also had the opportunity to study a historical city from the existing detailed survey materials. I could not visit the city because of the political situation. In these cities, the valuable cultural heritages of man are preserved. While each culture in this world tends to be homogenized, these heritages show strong personalities rushing straight at us, as if these were departed souls wearing masks.

The first cities I visited are Dunhuang and Turpan in Xinjiang spread west from Dunhuang. Turpan is an oasis town where a stream flows through the city from Tian Shan through underground waterways qanat. In Turpan, there are castles, such as Jiaohe Ruins and Gao Chang Gu Cheng, and Buddhist cave ruins such as Bezeklik Thousand Buddha Caves.

The second city I visited is Petra in the Hashemite Kingdom of Jordan. Petra has many huge caves in the cliff and is designated as a world heritage. Petra was the capital of the Kingdom of Nabataeans that flourished during the Silk Road Trade in 2BC. But Petra became a Roman colonial city in the 2nd century and had been forgotten from Islamic development to its discovery in the 19th century.

敦煌・トルファン、ペトラ、バーミヤン

私は去年 2012 年、砂漠辺縁の複数の都市を訪れた。また政治的な理由で訪問できなかった歴史都市を詳細な資料で調査する機会にも恵まれた。これらの都市には人類の貴重な文化遺産がある。それぞれの文化遺産は、現在の世界の諸文化が均一化する中で、強い個性を発揮している。仮面を付けた亡霊のように我々に迫ってくる。

第一の都市は中国の敦煌やさらにその西に広がる新疆ウイグルの都市トルファンである。トルファンは、天山山脈から地下水路カナートを通って引かれた水が市中を流れるオアシス都市である。ここには交河故城や高昌故城、ベゼクリフ千仏洞などの仏教遺跡が残っている。

第二の都市は世界遺産ペトラである。巨大な峡谷の崖に多くの石窟が掘られた古代都市ペトラは BC2 世紀にはシルクロードのオアシス都市であり、かつ遊牧民の王国ナバティアの首都であった。その後 2 世紀にはローマ帝国の植民地都市として栄え、イスラムの興隆以降、19 世紀に発見されるまで忘れ去られていた。その遺跡の保存のために博物館を設計中である。

Figure 1) Al Khazneh
Petra, a world cultural heritage, is a Nabataean caravan civilization that flourished from 4th century BC to 1st century AD. After walking through the Siq, a narrow canyon with towering cliffs, for about 1.5 km, the 40m tall tomb of Al Khazneh suddenly appears before one's eyes. The tomb is carved in the beautiful red sandstone cliff. The interior of the tomb is small. It is said that the tomb was constructed in 1st century BC. The Al Khazneh is a symbol that characterizes Petra, the capitol of the Nabataean Kingdom.
図 1) エル・ハズネ
世界文化遺産ペトラは紀元前4世紀から1世紀に栄えたナバティア人の文明。両側に高い崖が聳える細い峡谷「シーク」を1.5kmほど歩くと、突然目の前に現れるのが、高さ約40mの墓Al Khazneh。巨大な砂岩の崖にレリーフのように掘られた彫刻である。内部の墓室は小さなもの。紀元前1世紀の建設と言われている。エル・ハズネはナバティア王国の首都ペトラを象徴する記念碑である。

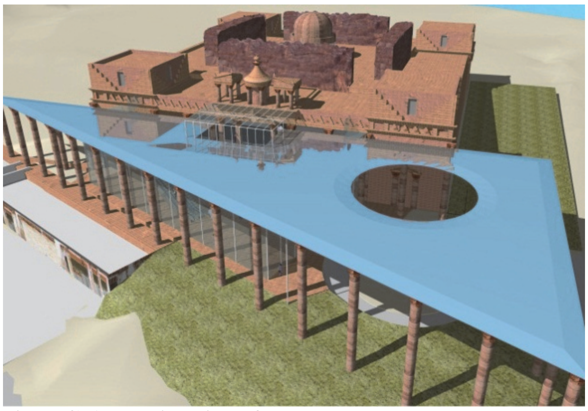

Figure 2) A Exterior View of the Petra Museum
The entrance hall of the museum is located under the triangular roof reflecting blue sky. Right behind the roof, the exhibition building is arranged. The walls of the exhibition building are made of red limestone and present a facade of traditional tombs.
図 2) ペトラ博物館の外観
空の青色を映した三角形の屋根の下には博物館の入口ホールがある。その背後には博物館の展示棟がある。展示棟の外壁は赤い石灰岩でできた、伝統的な墓のファサードで構成されている。

The third city is Bamiyan in Afghanistan. Bamiyan is designated as world heritage. Bamiyan is famous for its two large Buddhist statues that were blown up by the Taliban and a myriad of cave temples in the cliff. We worked on the design of the Bamiyan Museum for Peace as a part of the conservation project of UNESCO using existing detailed survey data of the past without visiting the site because of the political situation. The design was presented at the 11th Expert Working Group Meeting for the Preservation of the Safeguarding of the Culture Landscape and Archaeological Remains of the Bamiyan Valley World Heritage Property at RWTH Aahen University in Germany on December 10-12, 2012.

第三の都市は、タリバンが爆破した二つの巨大石仏や崖に掘られた無数の石窟寺院で有名な、アフガニスタンの世界遺産バーミヤンである。各石窟寺院の内部空間は、ササーン朝ペルシアのドームや方形組上げ天井など、様々な構成のものがあり、当時の異文化の交流による華やかな仏教文化の隆盛を伝えている。ユネスコの保存事業の一環としてバーミヤン平和博物館を設計中である。政治的な情勢のため、いまだ現地を訪れることができない。過去の多くの調査資料をもとに設計を進め、ドイツのアーヘン工科大学で開催されたユネスコの第11回専門家会議でそれを発表した。

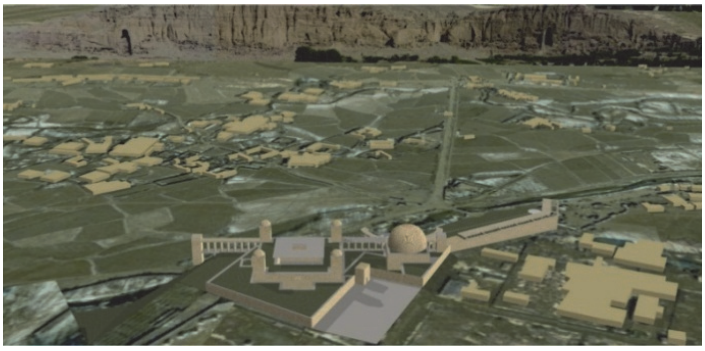

Figure 3) A view of the Bamiyan Peace Museum and the Great Cliff
The Bamiyan Peace Museum will be built on a plateau that overlooks the Bamiyan Canyon and the Great Cliff on the north side of the canyon. The East and the West large stones caves and countless smaller caves have been carved into the side of the Great Cliff that measures 1200 meters in length by 100 meters in height. Both the East Great Buddha in the east cave and the West in the west cave were destroyed by the Taliban in March of 2001.
図 3) バーミヤン平和博物館と大崖
これは、バーミヤン渓谷とその北壁の大崖を見渡せる台地の上に、バーミヤン平和博物館を建設する計画である。長さ約1200m、高さ約100mの大崖面には二つの巨大な東西の石窟をはじめ無数の小石窟が点在する。東西大仏は2001年3月にタリバンによって爆破された。

Creation of Nomadic Life

Nomadic life in the desert is interesting. People of ancient civilizations made it possible to have settled life in the desert by farming and drawing water from the river. Nomadic life spread from the settled area. Humans cannot digest grass that grows in semi-arid areas where farming is not possible. However it is possible for a human to live in semi-arid areas by feeding the grass to cattle, horses, sheep and goats; eating the meat; making dairy products; and using the fur to make clothes and tents. Furthermore, the livestock and dairy products could be traded at a nearby oasis town to enrich their lives. They would move with the livestock near the house every day in search of grass, and also traveled long distances between the summer meadows and the winter pastures at the turn of the seasons. Ken Matsuti, "Culture in the Desert: Life Strategy in Moving", pp.8

遊牧生活の創造

これらの都市の周辺に展開された遊牧民の生活は興味深い。古代文明は大河から水を引き農耕による定住生活を可能にした。そしてその周辺の半乾燥地帯に向かってさらに遊牧生活を広げた。人は、農耕が不可能な半乾燥地帯に生える草を消化することができない。しかし、草を羊や山羊、牛、馬などに食べさせれば、その動物の肉を食べ、乳製品を作り、毛皮をテントや衣服にして、半乾燥地帯でも生活することができる。さらに家畜やこれらの製品を、近くのオアシス都市で、農作物などと交換して生活をより豊かにすることができる。草を求めて住居のまわりを移動すると同時に、季節の変わり目には、夏と冬の牧草地の間の長距離を移動した。松井 健、「砂漠という文化」、pp. 8

Figure 4) Street Facades of Nabataean tombs
After walking from Al Khazneh for a while, tombs carved in the red sheer cliff appear like street facades. The steps on the cliff provide a path for the departed souls to ascend to heaven. The shape of the steps symbolizes the Nabataean culture.
図 4）ナバティア人の墓
アルハズネからしばらく歩くと、赤い砂岩の崖に彫られた多数の墓が街並みのように現れる。立面の中の階段は死者の魂が天に登るためにある。階段の形はこのナバティアの文化を象徴する。

Figure 5) Nomadic life of the Bedouin
A Bedouin woman herds goats to a pasture in the Petra Canyon. Goats are able to adapt to this harsh environment, however, sheep do not.
図 5）ベドウィンの遊牧生活
ペトラ峡谷で山羊の群れを放牧地に移動させるヴドウィンの女性。このような厳しい砂漠には羊は無理で、山羊しか適合しない。

Nomadic Movement and the Silk Road

There are two types of nomads. One type coexisted with the local oasis city. It has been said that the second type formed the way of trade through groups of oasis cities from China to Rome across the Eurasian continent. It paved the way for cultural development through which art and Buddhism were introduced in addition to printing technology, perfume and silk. This was called the Silk Road since 19^{th} century.

遊牧民の移動とシルクロード

移動が得意な遊牧民には、二つの型があると言う。一つは近くのオアシス都市と共存しているもの。もう一つはもっと広大な地域のオアシス都市群を経て、ユーラシア大陸にまたがる交易の道を形成した民族もあった。絹や香料や印刷術のほかに仏教や美術品が伝わる文化の道でもあった。19 世紀になってシルクロードと呼ばれるようになった。

Party of Xuanzang also passed through the Silk Road to reciprocate India and Xian in 625-657. After the appearance of the equestrian corps, who shot bows from horseback, the Silk Road was also the way of offense and defense. Thousands of kingdoms were born and then disappeared. The large expedition of Genghis Khan is a prime example.

玄奘三蔵の一行もシルクロードを通って長安とインドの間を往復した。途中、敦煌、トルファン、バーミヤンに立ち寄っている。特にバーミヤンの当時が詳細に記されている。またペトラも地中海やアフリカへ向かうシルクロードの重要な中継地であった。しかし馬上から弓を射る騎馬軍団が出現してから、シルクロードは攻防の道にもなった。幾千の王国ができては消えた。ジンギスカンの大遠征はその最たるものである。

Symbiosis Between Nomads and Nature

Each nomad devised many ways to live in harmony with nature. For example, a prefabricated dwelling gel in Mongolian, Pao in Chinese, was devised to be carried on the back of a camel. The walls are made with adobe brick which was easily constructed in the sun and soil. Timber beams were placed between walls and the area between beams were covered with reed or willow branches and soil was plastered on the roof. In the typical traditional house rooms around the central courtyard were surrounded by a high soil wall, where the whole family lived. They also lived in caves. Their inherent life and landscape that are in harmony with nature are a refreshing surprise for those who lived in a wooden culture in a monsoonal climate.

遊牧民と自然の共生

それぞれの遊牧民たちは自分たちの自然と共生する数々の工夫をした。例えば駱駝の背に乗せて運べる組立式住居ゲル（ゲル：モンゴル語、パオ：中国語）を考案した。また土と太陽で簡単に作れる日干し煉瓦で壁を築き、壁の間に木製の梁を架け、その間に柳の枝と蘆を渡して土を塗り屋根を造った。中央の中庭をそれらの部屋が取り囲み、部屋の外周を高い塀が取り囲み、その中に一族が住むというのが彼らの典型的な住居である。また石窟の中にも住んでいた。自然と共生しながら創造した独自の生活と風景は、モンスーン気候に住むわれわれの木の文化から見ると、きわめて新鮮な風景である。

Simplification of Material Life and Spiritual Fertility

The world view of the nomadic life of the desert, introduced by Masaru Horiuchi, is similar to the view of the world that is aimed during Japanese Zen priest training.

Nomads think about their life while moving around in desert where settlement is not possible. They must simplify their life by truncating surplus as they wander through the desert. Simplification is not only performed on the material world but on a spiritual level. Simplification of material makes people think to take full advantage of limited material. On the other hand, Simplification of material expands the thinking of the non-material world limitlessly.

物質的捨象と精神的豊饒

堀内 勝が紹介する砂漠の遊牧生活の中にある世界観は、日本の禅僧の修行にも似た世界観である。

「定住が不可能な地域を移動しながら人生を考える遊牧民。放浪するには余剰のすべてを切捨て、単純化しなければならない。この、対象の捨象は物質面のみではなく、精神面でも行われる。物質的捨象は一方では限られた物質を最大限に用いる思考を働かせる。また他方では非物質界への思考を限りなく押し広げる。この無限性は、視野が何物にも遮られることのない砂漠の自然性そのものと相乗的な倍加も見る。思考の拡大は無限へと向かい、他の視野の遮られる世界より、『はるかに充実した』世界となる。砂漠の世界はすべての音を吸い取り、全くの静寂境である。

The vision of the desert is not blocked by anything. Infinite thinking and natural property of vision in the desert double synergistically. Expansion of thinking heads to infinity in the desert. It is the world "fulfilling much better" than in the field of blocked views. The world of desert soaks up the surrounding. It is the complete quiet environment, where promotion of thought does not know where to stop. Lonely hell, that is intolerable for ordinary people, is the completely quiet environment which leads the meditating man into the bottomless depth. Thus thinking of the desert people was directed to the other side of the natural world, and the creation of world's three major religions was successfully achieved. Because of the harsh climate of the desert, the spirit had to be fertile. And also because of the simplicity of the natural landscape, the spirit of the intricate spirit was brought up. Masaru Horiuchi, "Culture in the desert: The World of Arab Nomads", pp.14

この静寂境において思考の推進は一層とどまるところを知らない。普通の人間には耐えられない孤独地獄、静寂境は、沈思する人間を底知れない深みへと誘う。かくして砂漠の民の思惟が、自然界の背後に向けられた時、偉大な三大宗教の創造に結実したのであった。・・・砂漠のもつ自然の過酷さのゆえに、精神が豊饒化せざるをえなかったのであり、また自然景観の単純さ故に、錯綜した精神を育んだのであった。」堀内 勝、「砂漠の文化」、pp. 14

World View in the Desert and Zen Thought

The training in Zen Buddhism includes repetition of a very monotonous life, such as cleaning and farming. A Zen Buddhism monk once said to me that this monotonous life leads a Zen trainee into his inner world. This shares a common idea with the world view in the desert, where a completely quiet environment and lonely hell, not tolerable to ordinary people, leads a person into a bottomless abyss.

The view of possessions in the desert is similar to the view of the training for a Zen monk. The following quotation is from the book "An Introduction to Zen Buddhism" by D. T. Suzuki, 1934.

The space allotted to each monk is one tatami, or a mat 3×6 feet, where he sits, meditates, and sleeps. The bedding for each never exceeds one large wadded quilt about 5× 6 feet, be it winter or summer. He has no regular pillow except that which is temporarily made out of his own private property. This latter, however, is next to nothing: it consists of a kesa (kasaya) and koromo (priestly robes), a few books, a razor, and a set of bowls, all of which are carried in a papier-mâché

砂漠の世界観と禅の思想

禅の修行は、掃除や畑作業などの単調な生活の繰り返しである。この単調な生活が修行僧を彼自身の内面へと導くとある禅寺の住職から聞いたのを憶えている。禅のこの考えは、砂漠の世界観、すなわち普通の人間には耐えられない孤独地獄、静寂境が、沈思する人間を底知れない深みへと誘うと言う世界観に共通する。

さらに砂漠の人々の物に対する考え方は禅僧の修行における物への考え方にも似ている。以下は鈴木大拙著「禅学入門」からの引用である。

「一人の僧にあてがわれる広さを畳一枚とし（すなわち三尺と六尺の長方形敷物）、彼はここに座って、座禅もやり、瞑想もやり、また夜になると布団を敷いてそこに寝るのである。布団は夏冬を問わず、五尺に六尺のものただ一枚が支給される。枕などはなく、各自その所有品を出してかってに工夫して枕とする。しかして、その所有品なるものは、次のようなものだけである。一個の袈裟と、一着の衣と、二、三冊の書物と剃刀と椀の一組、それが全部である。彼がそれを幅一尺、長さ一尺三寸、高さ三寸半程の紙製の箱に納

box about 13×10×3 1/2 inches. In travelling thisbox is carried in front, suspended from the neck with a broad sash. His entire property thus moves with its owner. “One dress and one bowl, under a tree and on a stone" graphically describes the monk's life in India. Compared with this, the modern Zen monk must be said to be abundantly supplied. Still his wants are reduced to a minimum and none can fail to lead as simple, perhaps the simplest, life if he models his after the life of a Zen monk. The desire to possess is considered by Buddhism to be one of the worst passions with which mortals are apt to be obsessed. ・・・・ However, the Zen ideal of putting a monk's belongings into a tiny box is his mute protest, though so far ineffective, against the present order of society. D.T. Suzuki, “An Introduction to Zen Buddhism” 1934, Grove Press, 2004, pp. 90

The phrase “Mottainai: What a waste!” is used when something still valuable is thrown away. This concept was originated in Japan, but it became a global concept. This concept shares a common idea with the world view in the desert, in which people try to maximize the use of limited available materials.

Homogeneity of Life and Culture in the World

However, those people in the desert who had created an inherent life style and deep world–view started working in collective farms, factories and offices, specifically in western Asia. People in the area have been forced to live in the standardized housing of high and low apartment buildings. Nomadic lives in the peripheral area of the desert are disappearing. Various life styles and cultures of the human are homogenized on a world wide scale.

It is also deplorable that architectural students in the world, who will be responsible for the living environments and cultures, have longed for modern architecture which is seen all over the world.

めて持ち歩くのである。旅行の際はこれを幅の広い釣紐のようなもので首に掛けて前に下げる。こうしてこの全所有物は、その所有物主とともに移動するのである。『樹下石上、一衣一鉢』とは印度の僧侶生活をそのままに描き出した言葉であるが、これに比ぶれば、現代の僧侶は豊富な供給を受けていると言わねばならない。さらに彼の要求は最小限に制限されているから、もし誰でもこれらの僧侶の生活を模倣するならば、必ず単純な生活を———恐らくそれは世上最単純な生活———を営むことが出来るであろう。仏教によれば、所有欲は人間が陥り易き誘惑のなかで最悪なる情欲の一つとされている。・・・そこではなはだ微弱なことではあるが、この僧侶の所有物を一個の箱に納める禅の思想は、現代社会組織に対する、彼らが沈黙の抗争であると見てよい。」 鈴木大拙、『禅学入門』、大東出版社 1940 年、株式会社講談社 2009 年、頁 177-179; D.T. Suzuki、“An Introduction to Zen Buddhism” 1934 を、1940 年に鈴木大拙が日本語で出版したもの

そもそも「勿体ない」とは、まだその価値が残っているものを捨てる時に使われる日本独自の、そして今や世界的な概念である。限られた物を最大限に用いる思考を働かせる砂漠の世界観に似ている。

生活や文化の単一化

しかし砂漠の中で、この独特の生活様式と深い世界観を創造した人々の遊牧生活は、近代産業の進出や定住化政策により、共同農場や工場で働く定住生活に変わりつつある。その結果、生活は高層や低層の規格化された住宅の中に集約化される。砂漠の辺縁の遊牧生活が喪失しつつある。人類という種の多様な「生活様式」や「文化」が世界的規模で「単一化」されつつある。さらに憂うべきことには、未来の住環境や文化を担う、世界の建築学科の学生たちはどこへ行っても同じような形の現代建築にあこがれている。

Figure 6) Entrance Hall of the Petra Museum

Visitors walk up to the second floor looking at the facade of Al Khazneh through the top light of the mirrored ceiling. Because the museum is located on a slanting site, the first floor is limited to the reception area and administration office. The exhibition, repair/preservation and research rooms are located on the second floor. There is an outdoor exhibition area on the roof.

図 6) ペトラ博物館入口ホール

鏡面でできた天井の中に開けられたトップライトから、アルハズネの形を引用した展示棟のファサードを見ながら２階に登る。博物館は傾斜地に建つため、展示棟の１階は受付と事務室のみ。２階に展示室、保管修理、研究室などの諸室がある。屋上に野外展示エリアがある。

Figure 7) Exhibition Room of the Bamiyan Peace Museum

The photo shows the inside of the exhibition room that includes a court yard. Local red limestone will be stacked to construct the walls of the exhibition hall.

図 7) バーミヤン平和博物館の展示室

中央に中庭をもつ展示室。展示室の壁は地元の赤い石灰岩を積んで造る。

Figure 8) A model of the Bamiyan Peace Museum

The view from the Bamiyan Peace Museum will be spectacular since it is situated on top of the great cliff that overlooks the Bamiyan Canyon. Also the views of the Bamiyan Valley and the Great Cliff through a close-range view of the museum should be fine. The amphitheater is located at the center of the site. Behind the amphitheater, a corridor extends from the east to the west end, running parallel to the Bamiyan Valley. The dome-shaped conference hall is also centrally located in the site to form the central axis. The exhibition building is located next to the conference hall across the courtyard for visitors through the entrance gate.

図 8) バーミヤン平和博物館の模型

台地の上に博物館が見える、大崖からのバーミヤン峡谷の風景は格調高いものであるべき。また博物館から、博物館の一部を近景としながら、バーミヤン峡谷や大崖を見る眺望も優れたものであるべき。敷地の中央に円形劇場がある。それの背後に、敷地の東西の端まで、峡谷に平行に延びる回廊がある。円形劇場の真後ろに集会室のドームがあり、中央の軸線を形成している。集会室の横には、入場者が集う中庭を挟んで展示棟がある。

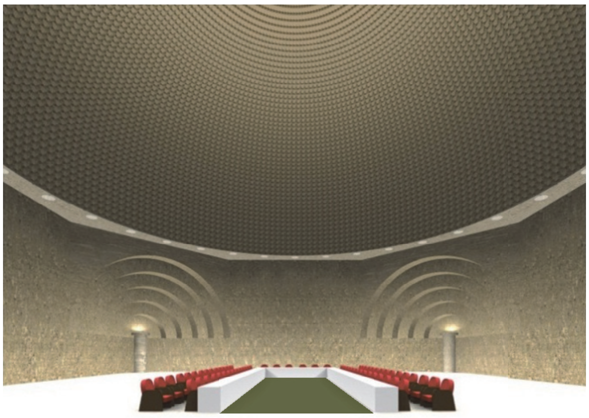

Figure 9) Conference Hall of the Bamiyan Peace Museum

Four squinch arches, which are influenced by Sasanian Perusia, are set up on the four corner of the foursquare conference hall. The dome roof is set further over the four squinch arches.

図 9) バーミヤン平和博物館の集会室

正方形の会議室平面の四隅にササン朝の影響であるスキンチアーチを架け、その上にドームを載せている。

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Characterizing the Historical Changes in Land Use and Landscape Spatial Pattern on the Oguraike Floodplain after the Meiji Period

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Keywords: *Oguraike floodplain*, *landuse change*, *landscape fragmentation*, *landscape diversity*

Abstract: Research on change in land use and landscape pattern is the foundation for studies exploring natural and cultural landscape of a region. This study used GIS software and utilized topographic maps to examine the changes that occurred in the Oguraike floodplain, during the time points of 1888, 1909, 1961, and 2002. The Oguraike floodplain, which was dominated by the landscape of Oguraike Pond and paddy fields in 1888, was dominated by the landscape of urban areas and paddy fields in 2002. Moreover, urban areas, cropland, paddy fields, and grasslands have become concentrated into larger patches, whilst the water bodies have become more fragmented. Overall, there has been a reduction in landscape diversity on the floodplain.

1. Introduction

Changes in land use and land spatial pattern are major contributing factors to environmental change (International Geosphere–Biosphere Programme, 1995; Li, 1996), and the complex process of change occurs through both natural processes and human intervention (Hara *et al*., 2005; Tavares *et al*., 2012; Zhang *et al*., 2010). Research on change in land use and landscape spatial pattern is important and is the foundation for studies exploring the natural and cultural landscape of a region. Diverse methods have been used to study changes in land use and landscape spatial pattern. Remote sensing using satellite imagery is used to collect data and classify features on the earth's surface（Bai *et al*., 2008; Ulbricht & Heckendorff, 1998; Zhang *et al*., 2010). Whilst topographic maps are a valuable research tool used to explore the patterns of regional historical land use and to assess the land use transfer matrix (Fujii *et al*., 2009; Matsumoto & Nishiyama, 2009; Mizunoe & Nishiyama, 2007).

This study used a geographic information system (GIS) and utilized accurate topographic maps to examine not only the detailed changes in land use that occurred in the Oguraike floodplain, such as transfer matrix, and also to explore the landscape spatial composition change in the landscape during the periods between these time points of 1888, 1909, 1961, and 2002. In addition, the mechanisms driving change and their effects were discussed. The objectives of this study were to examine: (1) how the land use and landscape pattern have changed on the Oguraike floodplain in the past 110 years; (2) the mechanisms driving these changes in different historical periods and across different geographic units.

2. Methods

2.1. EXTENT OF STUDY AREA

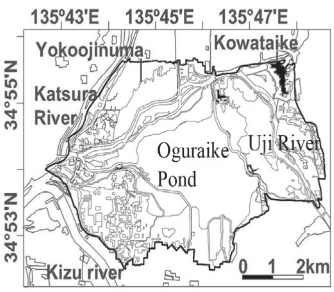

Fig 1. Extent of study area in 2002

Based on the extent of the Oguraike floodplain during the 21th year of Meiji period, and the administrative border (Ministry of land, infrastructure, transport, and tourism, 2008), we took the area extending from the confluence of the three rivers（Katsura, Uji, and Kizu Rivers）, and enclosed by the Katsura and Kizu rivers, as extent of the floodplain (Area enclosed by broad line in Fig 1). The study site lies between 34°53'0''–34°56'0''N and 135°43'0''–135°48'0''E, and covers 3666 ha.

2.2 ANALYSIS OF LAND USE CHANGE

2.2.1. Creation of A Land Use Map and Calculation of The Area Change of Each Land Use Type

The scanned historical topographic maps for the four time periods of 1888, 1909, 1961, and 2002 were georeferenced in GIS software to produce digital maps. After geographic calibration using 30 to 80 ground control points per map, the polygons for the different land-use categories were drawn. We

Table 1. Categories of landscape use type

Land use type	Contents
Urban or built-up areas	Settlements
	Roads
	Factories
Paddy fields	Paddy field
Cropland	Land cultivated for tea
	Land cultivated for mulberry
	Land cultivated for fruit
	Land cultivated for vegetable crops
Grassland	Bamboo forest
	Marginal grassland around water bodies
Water	Rivers (natural rivers with flowing water)
	The Oguraike Pond
	The Yokoojinuma Pond
	The Kowataike Pond
	Other water bodies (other ponds)
Fallow or uncertain land	Fallow or uncertain land

divided land use into six main types: urban areas, paddy fields, cropland, grassland, water, and fallow land (Table 1). To create a map with 1-m accuracy using vector data, we used large-scale maps of at least 1:25,000. We then combined the polygons into a single feature and rasterized the maps to create the land use maps for different historical periods (Fig 2). The area for each land use was calculated and presented in a table of attributes for each map. We then used the intersect analysis in the GIS software as a method of calculating the transfer matrix for land use area, which is used to reflect the source of each land use type and quantifies the loss in area for each land use type, and the type to which it is transferred (Dronova *et al*., 2011; Popp *et al*., 2009; Tavares *et al*., 2012; Zhang *et al*., 2010).

2.2.2. Exploration of Essential Factors for Land Use Change through Literature Search

This study has analyzed essential factors for morphological change in Oguraike Pond according to historical data, e.g., history of Oguraike reclaimed area (1962), custom and lifestyle of fishing village in former Oguraike area (1981), custom of Oguraike (1991), Oguraike(1991), documents for fisherman in Oguraike Pond (2002).

2.3 ANALYSIS OF LANDSCAPE PATTERN CHANGE

2.3.1. Landscape Metric Analysis

Land-use data of the Oguraike floodplain were acquired from the Section 2.2.1 and land-use data from previous years, 1888, 1909, 1961 and 2002, were manually rectified, interpreted, and classified from historical topographic maps. Based on the land-use data, landscape components were classified into five categories: urban or built-up areas, paddy fields, cropland, grassland, open water. This classification scheme was chosen because it reflects the main visual difference of landscape types obviously. And the number, size, perimeter of landscape patch was calculated and presented in a table of attributes for each map.

Based on the research question and to ensure comparability with previous studies (Ding *et al*., 2004; Li, 2004; Matsushita *et al*., 2006; Wang *et al*., 2004; Wang *et al*., 2011; Weng, 2007), a set of landscape metrics was used for evaluating landscape spatial pattern for this study, including Shannon's diversity index (SHDI), Dominance (D), Shannon's evenness index (SHEI), percentage of landscape (PLAND), edge density(ED), patch density (PD), and mean patch size (MPS) (Table 2). The first three metrics are indicators of landscape diversity while the latter three metrics are indicators of landscape fragmentation. Some metrics were used to examine landscape-level properties, i.e. to describe the spatial patterns of all landscape types as a whole. Other metrics were used to examine class-level properties, i.e. to describe the spatial patterns of different landscape types individually (Table 2). The selected metrics all are normalized

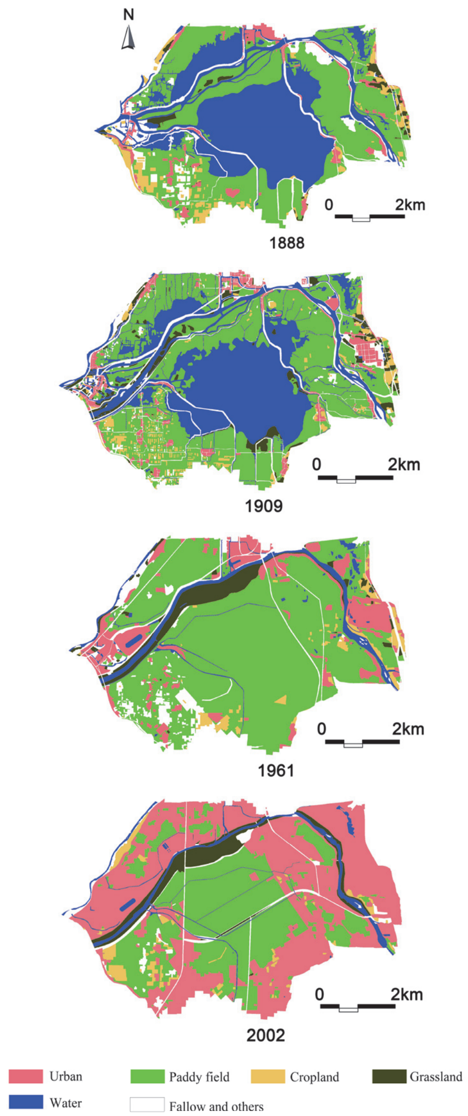

Fig 2. Land use map on the Oguraike floodplain

Table 2. Landscape metrics utilized for landscape pattern characterization

	Abbreviation	Range	*La*	*Ca*
Shannon's diversity index	SHDI	SHDI≥0, Without limit.	V	
Dominance	D	0≤ D ≤1	V	
Shannon's evenness index	SHEI	0≤SHEI≤1	V	
Percentage of landscape	PLAND	0 <PLAND≤100		V
Edge density	ED	ED> 0		V
Patch density	PD	PD > 1		V
Mean patch size	MPS	MPS> 0		V

Notes: *La* means the index used to examine landscape-level properties, i.e. to describe the spatial patterns of all landscape types as a whole. *Ca* means the index used to examine class-level properties, i.e. to describe the spatial patterns of different landscape types individually.

and hence the output values can be used to directly compare the five types of landscape patches and across the four time periods. Shannon's diversity index (SHDI) is defined as:

$$H=-\sum_{i=1}^{n} Pi*\ln(Pi) \quad (1)$$

where n is the number of landscape types and p_i is the proportion of landscape patches belonging to the ith land use type (Nagendra,2002).

Dominance (D) is calculated by:

$$D=H_{max}+\sum_{i=1}^{n} Pi*\ln(Pi)$$
$$H_{max}=\ln(n) \quad (2)$$

where n is the number of landscape types and p_i is the proportion of landscape patches belonging to the ith land use type (Nagendra,2002).

Shannon's evenness index (SHEI) is defined as:

$$SHEI=\frac{-\sum_{i=1}^{n} Pi*\ln(Pi)}{\ln(n)} \quad (3)$$

where n is the number of landscape types and p_i is the proportion of landscape patches belonging to the ith land use type (Nagendra,2002).

Percentage of landscape (PLAND) is calculated by:

$$PLAND=(PS/A)*100\% \quad (4)$$

Where PS is the area of one certain landscape (ha) and A is the total area of the study site (ha) (Nagendra,2002).

The edge density index(ED) is calculated by:

$$ED=P/PS \quad (5)$$

where P is the perimeter of the patch (m) and PS is the patch size (ha) (Li,1996).

The patch density (PD) is calculated by:

$$PD=(N/PS)*100 \quad (6)$$

Where PS is the patch size (ha), and N is the number of patches(Weng,2007).

The mean patch size (MPS) is calculated by:

$$MPS=PS/N \quad (7)$$

Where PS is the patch size (ha), and N is the number of patches(Li,1996).

2.3.2. Patterns of landscape diversity in response to changes in proportion of land use

According to the formula of the landscape pattern index listed in 2.3.1, the formulas referring to landscape diversity are all related with the percentage of landscape patches in a certain region. In order to investigate the inner reasons of changes in landscape pattern on the floodplain, we carried out the bivariate correlation analysis using SPSS between the Shannon's diversity and Percentage of landscape (PLAND), that were PLAND _Urabn, PLAND_Paddy field, PLAND_Cropland, PLAND_Grassland, and PLAND_Water.

3. Results

3.1 EVALUATION OF LANDSCAPE COMPONENT DISTRIBUTION BASED ON A ANALYSIS OF LAND USE CHANGE ON THE OGURAIKE FLOODPLAIN

3.1.1 Landscape component distribution change

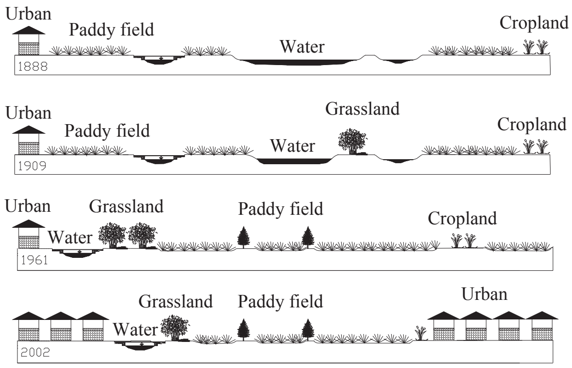

Fig 3. Models of landscape composition on the Oguraike floodplain

According to the land use maps (Fig 2), we drawn the models of the landscape components composition in the direction from North to South of the floodplain. In 1888, the large area of open water was the typical landscape component on the floodplain (including the Oguraike Pond, Yokoojinuma Pond, and Kowataike Pond, rivers, and other waters) (Fig 2 and Fig 3), and almost accounted for 38% of the total floodplain (Fig 4). Vast expanses of paddy fields surrounded the Oguraike Pond (Fig 2 and Fig 3), representing 41% of the total floodplain (Fig 4). Croplands were located to the east of floodplain (Fig 2 and Fig 3), which, according to topographic maps, included orchards, tea plantations, and mulberry plantations. Only 4% of the whole area was urban or built-up, the majority of which was settlements (Fig 4). In addition to the three well-known ponds (Oguraike, Yokoojinuma, and Kowataike), there were several small ponds adjacent to rivers (Fig 2).

In 1909, the landscape throughout the floodplain was similar to that in 1888. The water area and paddy fields were still the two main types of landscape components (Fig 3).

In 1961, the land use composition had changed greatly in the Oguraike floodplain by reclamation of the large area of water (Fig 3). The coverage of paddy fields was the typical landscape and had increased to 65% of the whole area (Fig 4). The urbanization primarily happened in the districts of Fushimi, Yodo, and Uji. Grassland had also emerged on the north bank of the Oguraike reclamation area as a result of a reduction in the number of tributaries (Fig 3).

In 2002, urban areas became the largest landscape component (48% of the floodplain) (Fig 4), followed by paddy fields (35%), which had been enclosed by urbanization (Fig 3).

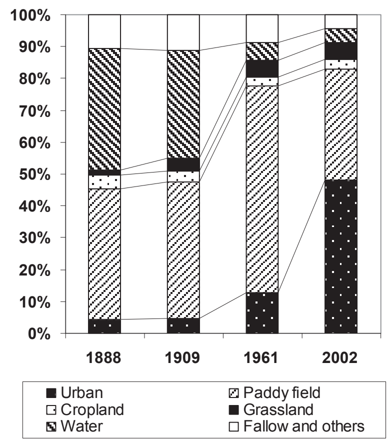

Fig 4. Changes of the area proportion for each type of land use on the Oguraike floodplain

3.1.2 Direction of the main landscape component change on the Oguraike floodplain

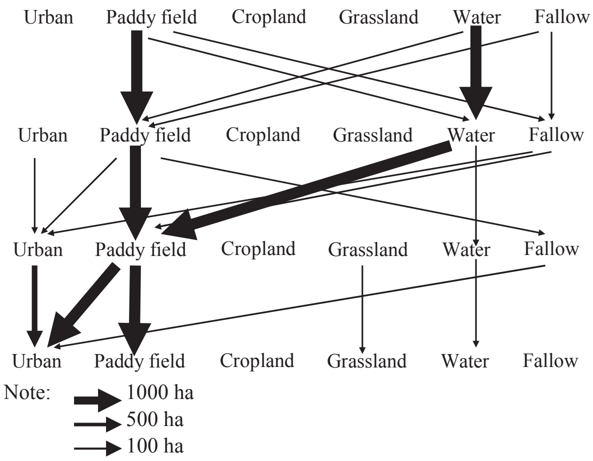

Fig 5. Land use transfer express (transfer area is more than 100 ha)

The change, or transfer, from one type of land use category to another over time can be analysed using a transition or transfer matrix. In order to reduce error, I focused on the transfer trend with transfer area more than 100 ha (Fig 5).

During 1888–1909, there were even few land use types that transferred into one of other land use types. The typical water and paddy field landscape during this period remained by transferring from themselves (Fig 5).

During the period 1909–1961, the typical landscape of expanding paddy fields were mainly converted from various types of water land use (Fig 5): 1183 ha of paddy field remained; in addition 972 ha of the water bodies, plus a small area of other land use were converted into paddy fields.

From 1961 to 2002, the most significant change was the conversion of other types of land use to urban or built-up landscape (Fig 5). A total of 423 ha of original urban area remained, but in addition 1018 ha of paddy fields, some of the other landscape components was converted to urban land.

3.2 QUANTITATIVE ANALYSIS OF LANDSCAPE PATTERN CHANGE ON THE FLOODPLAIN

3.2.1 Landscape-level metric analysis of landscape diversity on the Oguraike floodplain

The dominance value reached to its lowest point in 1909. It meant that regional landscape was complex in 1909, in which diverse types of landscape had dominant status (Fig 6). The dominance value reached to highest point in 1961. It meant the regional landscape was influenced and dominant by very few types of landscape.

Shannon's diversity index and evenness index change presented a similar tendency. On the floodplain at the first period of this study, in 1888, they were closest to that of 1909, whilst landscape diversity and evenness in 1961 were similar to that in 2002(Fig 7, Fig 8).

Overall, the regional landscape was most diverse in 1909, and was at its lowest point in 1961. And the regional landscape diversity of the Oguraike floodplain has decreased from 1888 to 2002.

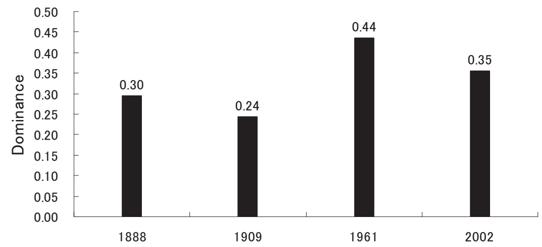

Fig 6. Dominance change on the Oguraike floodplain

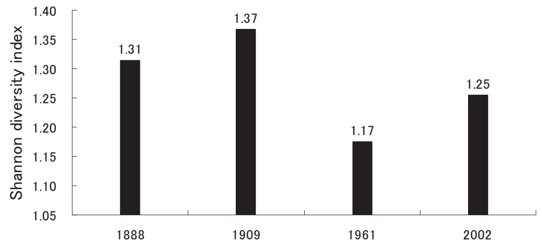

Fig 7. Shannon diversity index change on the Oguraike floodplain

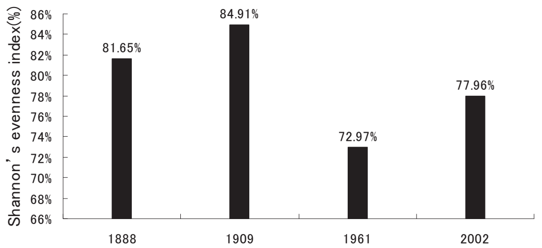

Fig 8. Shannon's evenness index change on the Oguraike floodplain

3.2.2 Class-level metric analysis of landscape heterogeneity on the Oguraike floodplain

The landscape spatial pattern on the Oguraike floodplain has changed as a result of the transfer of land use type from one category to another. According to the edge density of the five main landscape patches, urban areas, cropland, paddy fields, and grasslands formed denser patches and were less fragmented since 1909. However, the water landscape patches became more fragmented over time (Fig 9).

With regards to mean patch size (Fig 10), the mean area of patches of cropland, grassland, and urban increased, whilst the mean area of patches of water decreased over time. According to the curve for mean patch size of paddy field, the value reached its peak in 1961 and fell to its bottom in 2002.

The density of patches of urban, cropland, and grassland decreased since 1909; the density of water patches increased gradually and slightly; the density of patch of paddy field was highest in 2002, and was lowest in 1961(Fig 11).

Overall, landscape fragmentation was greatest in 1909, and was at its lowest in 1961. Urban areas, cropland, paddy fields, and grasslands formed denser patches and were less fragmented since 1909. However, the water landscape patches became more fragmented through the study period.

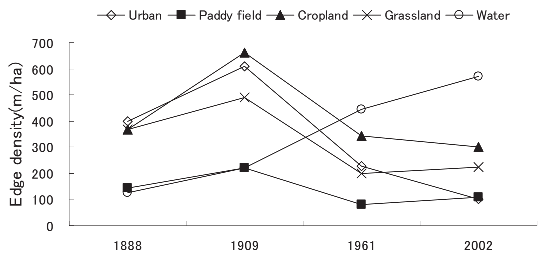

Fig 9. Edge density change for each type of landscape on the Oguraike floodplain

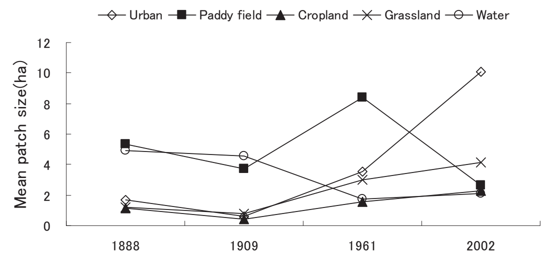

Fig 10. Mean patch size change for each type of landscape on the Oguraike floodplain

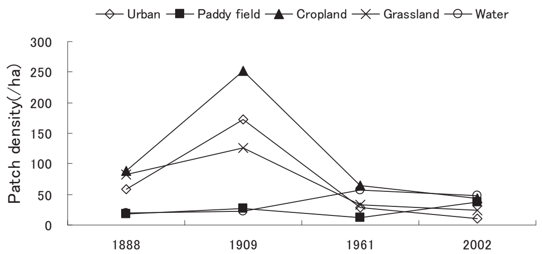

Fig 11. Patch density change for each type of landscape on the Oguraike floodplain

4. Discussion

4.1 SOCIAL FACTORS CAUSING CHANGES IN COMPOSITION OF LANDSCAPE COMPONENT

According to historical documents, prior to 1900 the Oguraike Pond was connected to the Uji River system and frequent flooding of this river resulted in the Oguraike Pond being a well-known reservoir (Institute of History of Kyoto, 1991; Institute of History of Uji, 1991; Institute of History of Uji, 2002), and it has rich culture of fishery (Fukuda, 1981). The landscape in the year 1888 could present this kind of typical suburban wetland system of Oguraike Pond and its surrounding floodplain at that time (Fig 12).

At the second timing point of 1909, the Uji River had been diverted and there was a subsequent reduction in the volume of water flowing into the Oguraike Pond (Yoshita, 1962). Consequently, the area of the water contracted and was transferred into paddy fields. The area of paddy fields landscape expanded. However, there were small changes in the composition of other types of land use on the floodplain, and the Oguraike floodplain still presented complex wetland landscape (Fig 12).

During the war time, in order to increase the food production, and reduce the risk of flood and malaria, the wetlands reclamation projects begun in Japan. Under this social background, the Oguraike and Yokoojinuma ponds were also

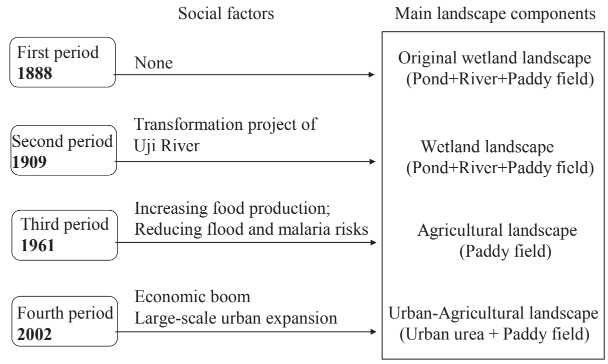

Fig 12. Social factors causing changes in landscape

reclaimed and natural water bodies were converted into paddy fields since 1934 (Bando *et al*.,2001). The landscape of Oguraike floodplain in 1961 could stand for the scenery and land use composition of the floodplain after reclamation. There was the extension of the paddy fields (Fig 12).

Since the 60 years of the last century, an economic boom has led to large-scale urban expansion in the whole country of Japan (Kadoya *et al*., 1980), and the demand for land for housing and industry increased dramatically. The Oguraike floodplain was also affected by this influence. The landscape in 2002 could express the land use composition status on the Oguraike floodplain and the result affected by these social factors. It resulted in the area of urban and built-up land accounting for more than half of the entire region of Oguraike (Fig 12).

4.2 PATTERNS OF LANDSCAPE DIVERSITY IN RESPONSE TO CHANGES IN PROPORTION OF LAND USE

Bivariate correlation analysis (Table 3) revealed that the attribute of SHDI was negatively correlated with PLAND_Grassland, PLAND_Urban, and PLAND_Paddy field, and was positively correlated with PLAND_Water, and PLAND_Cropland (The correlation coefficients showed no statistical significance due to a small number of samples).

It means that, during the period from 1888 to 2002, the exploration and human intervention led to growth of land use of urban, paddy field, and grassland, and led to reduction of natural water habitats on the Oguraike floodplain. This caused a decline in the diversity of regional landscape.

Table 3. Pearson's correlation coefficients of percentage of five types of landscapes (PLAND) to landscape diversity (SHDI)

	Urban	Paddy field	Cropland	Grassland	Water
Correlation Coef.	-0.35	-0.67	0.64	-0.56	0.84
Sig.(2-tailed)	0.65	0.33	0.36	0.44	0.16
n	4	4	4	4	4

5. Conclusions

Following over 110 years of natural and human interference, the composition of the different types of land use and the spatial form of the landscape have undergone dramatic changes on the Oguraike floodplain. The floodplain, which was once dominated by the water landscape and paddy fields, is now dominated by urban or built-up areas and paddy fields.

With regards to the landscape pattern on the Oguraike floodplain, the regional landscape was most diverse in 1909, and was at its lowest point in 1961 by the increase of paddy fields. Overall, the landscape diversity of the Oguraike floodplain has decreased from 1888 to 2002. Urban areas, cropland, paddy fields, and grasslands formed denser patches and were less fragmented since 1909. However, the water landscape patches became more fragmented through the study period. The landscape diversity was significantly affected by the changes of percentage of landscape on the Oguraike floodplain, especially in the degree of reclamation at first, of following urbanization and the deterioration of natural water habitat.

Endnotes

1. Four periods of topographic maps: (1) maps of Uji area surveyed in 1888 and Yodo area surveyed in 1890 (1:20000; Land Survey Authority of Japan）; (2) maps of Uji and Yodo area surveyed in 1909 (1:20000; Land Survey Authority of Japan,）; (3) maps of Uji area, Yodo area, the southeast area, and the southwest area of Kyoto prefecture amended in 1961 (1:25000, The Geospatial Information Authority of Japan）; (4) maps of Kyoto and Osaka prefecture surveyed in 2002 (1:25000, The Geospatial Information Authority of Japan）.

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Analysis of Household Energy Consumption of Lighting and Electric Appliances and Predictions for 2020

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Keywords: Energy consumption in Houses, Future prediction, and Energy Consumption for Lighting and Electric Appliances

Abstract: The increase in household energy consumption has been more apparent than such increases in the industrial and transportation sectors. The sources of household energy consumption can be classified into heating and cooling, cooking, hot-water supply, and lighting and electric appliances. In particular, energy consumption for lighting and electric appliances has been significantly increasing. In order to consider energy-saving measures in the home, we should trace the tendencies of increasing energy consumption due to lighting and electric appliances in recent years. In this paper, we analyze the current level of energy consumption for lighting and electric appliances and, moreover, attempt to predict the level we can expect in 2020. Consequently, it is estimated that the energy consumption of lighting and electric appliances will decrease by 16% from the 2010 level, mainly due to the energy savings expected for refrigerators and lighting.

1. Introduction

Energy consumption in Japan has been increasing since 1965. The increase in household energy consumption is more significant than that in the industrial sector. Household energy consumption is broken down into major demands: cooling, heating, hot-water supply, lighting and electric appliances. Of these, the energy consumption of lighting and electric appliances has shown the biggest increase in recent years. The increase in household energy consumption depends largely on how residents use lighting and electric appliances such as televisions and refrigerators.

To ensure the efficient and effective use of energy in residences, it is necessary to clarify the factors behind the increase in the energy consumption of lighting and electric appliances and to predict the level of energy consumption in the future. Household energy consumption depends on the number of households, individuals' lifestyles, and so on. Therefore, to predict the household energy consumption of the future, it is necessary to analyze the trends in household energy consumption over the past 10–15 years based on the number of households, population, changes in lifestyle, the influences of the aging society and low fertility, and the number of electric appliances in each household.

In recent years, ways to achieve energy savings have been taken seriously throughout the world, and several studies on household energy consumption have been conducted. However, few studies have analyzed the changes in household energy consumption or have attempted to predict future changes in the energy consumption of lighting and electric appliances. Accordingly, the aims of this paper are to analyze energy consumption of lighting and electric appliances between 1998 and 2010 and then to predict the energy consumption of 2020. The trend of the household energy consumption changes in a time span of a decade. Thus, it is necessary to predict the short term energy consumption to develop concrete energy saving policies.

2. Analysis data and approach of this study

The changes in household energy consumption for lighting and electric appliances are analyzed based on existing data in this

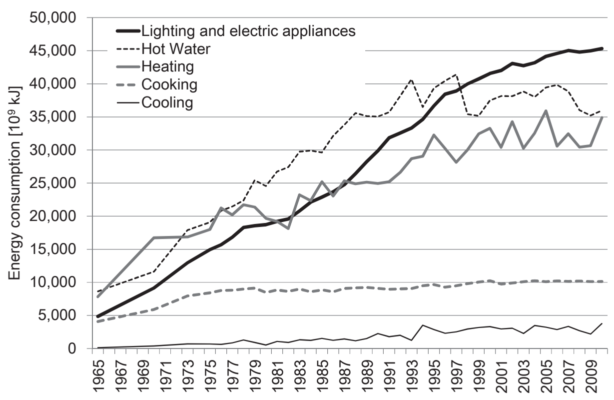

Figure 1 Household energy consumption [i)]

field. Then these data are used for the prediction of future energy consumption in 2020.

Several types of data were analyzed: 1) energy consumption of each electric appliance, 2) population and number of households in Japan, 3) number of electric appliances owned by an average household, 4) number of clothes washers sold that are equipped with a dryer function, 5) hours of watching TV, 6) number of lighting fixtures in houses, and 7) efficiency of electric appliances.

3. Results of data analysis

3-1. Energy consumption of lighting and electric appliances

Figure 1 shows the levels of household energy consumption by cooling, heating, hot-water supply, cooking, and lighting and electric appliances between 1975 and 2009. The energy consumption levels of heating, hot-water supply and lighting and electric appliances together account for a large portion of total household energy consumption. While the energy consumption levels of heating and hot-water supply have remained steady from the 1990s, those of lighting and electric appliances have been increasing.

The energy consumption per household unit and that per person are shown in Figures 2 and 3, respectively. The energy consumption per household unit has been flat since 1995, while that per person has been increasing in recent years. It is clear that the amount of energy consumption depends on the energy consumption by each person. As mentioned below in section 3-3, the sizes of households have been decreasing in recent years, and it is predicted that the number of households will increase. Thus the increase in the number of households will lead to an increase in household energy consumption.

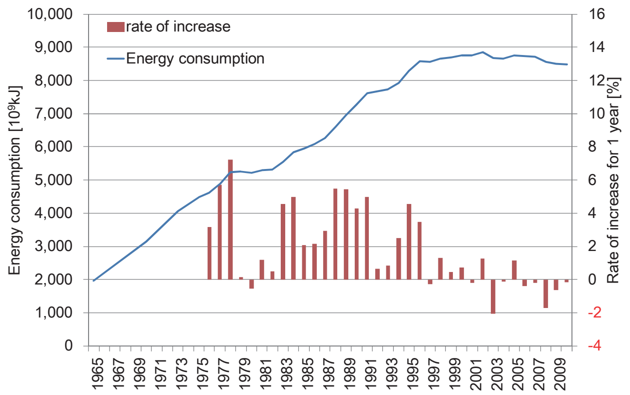

Figure 2 Annual changes and rate of increase in energy consumption for lighting and electric appliances per household unit (Created from i)

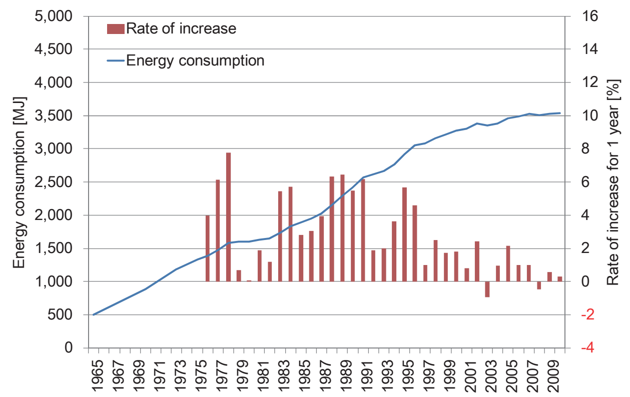

Figure 3 Annual changes and rate of increase in energy consumption for lighting and electric appliances per person (Created from i)

3-2 Population

Figure 4 shows Japan's population between 1970 and 2011 and estimated population from 2010. The population is decreasing from its peak in 2008, and the decline of the population is predicted to continue after 2010. The decline of the population has led to a decrease in household energy consumption, even though the amount of household energy consumption per person has not changed.

3-3 Number of households and average size of household

While the number of households has increased, the size of each household has been decreasing (Figure 5). Bachelor's establishment and two-person households have been increasing in recent years and account for about 50% of the population, at 23.4% and 27.2%, respectively. The size of the average household is predicted to decrease after 2019.

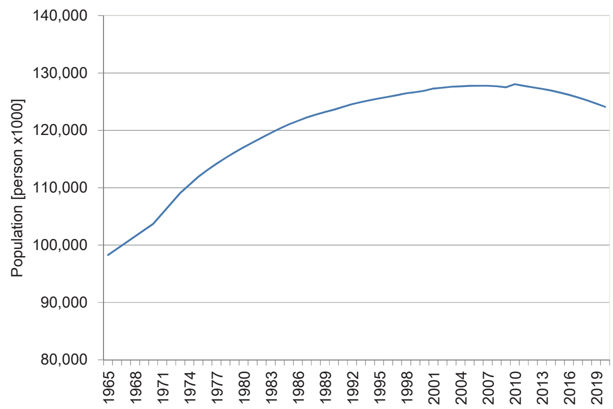

Figure 4 Population [i), ii)]

Created from *Estimated population in Japan* by National Institute of Population and Society Research, and The Institute of Energy Economics' *EDMC Handbook of Energy & Economic Statistics in Japan*

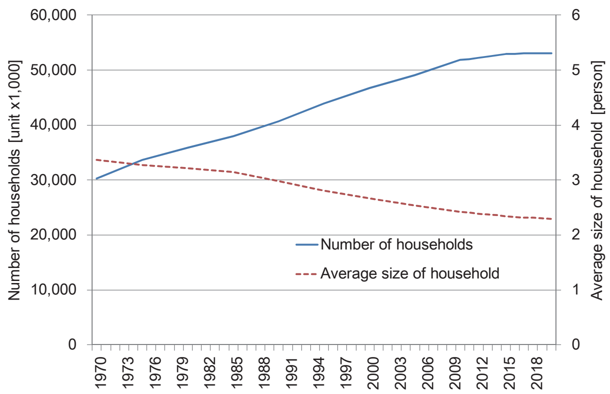

Figure 5 Annual changes in number of households and size of household Created from *National Population Census* by Ministry of Internal Affairs and Communications, and *Future estimation of number of households in Japan* by National Institute of Population and Social Security Research (2010)

3-4 Energy consumption of lighting and electric appliances and numbers of products owned by a household

Figure 6 shows the numbers of electric appliances owned by an average household. The increase in the number of TVs owned by a household has been most rapid: 1 per household in 1975, 2 in 1992, and 2.3 in 2012. The number of TVs owned by a household has come to approximate the size of an average household, that is, 2.42 in 2012. Consequently, the TV has essentially become a "personalized" item.

The number of refrigerators and clothes washers owned by a household was nearly one in 1974 and 1.1 and 1.2, respectively, in 2004, which shows a slight change. The number of toilet seats with a warm-water bidet has also been increasing gradually. The number of PCs has also been increasing, especially from the 1990s

3-5 Household energy consumption of electric appliances

Figure 7 shows the amount of electric energy consumed (kWh) by lighting and electric appliances in Japan. The energy consumption of almost all electric appliances has been increasing. The energy consumption of refrigerators is the largest among the electric appliances. The energy consumption of lighting and TVs has been increasing year by year, and that for TVs was the same as that for refrigerators in 2003.

The levels of energy consumption of clothes dryers and toilet seats with a warm-water bidet are no larger than those of other appliances, since the number of these appliances owned by a household is smaller than others. However, the energy consumption per appliance is large. The third-largest energy consumption is that of electrical carpets for floor heating. These three appliances will become some of the main factors affecting household energy consumption.

Other appliances account for large portions of energy consumption: clothes washers with clothes dryers, rice cookers, electric pots, etc. These appliances consume vast amounts of energy, and thus they should be considered in predicting the amount of electric energy expected to be consumed in the future.

In this paper, we predict the energy consumption of 2020, focusing on the top five energy-consuming appliances: refrigerators, TVs, lighting, electric carpets, and toilet seat with a warm-water bidet.

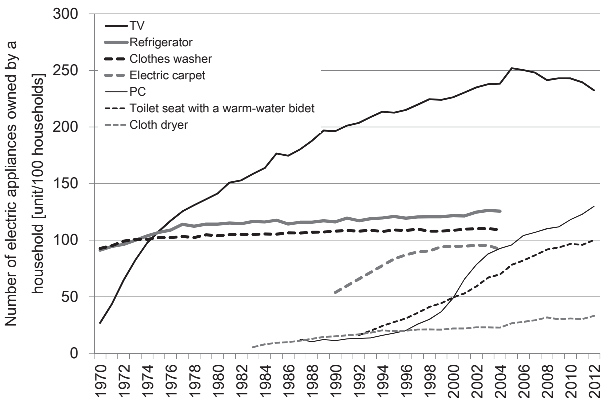

Figure 6 Number of electric appliances owned by a household
Adapted from *Monthly Consumer Confidence Survey covering all of Japan* by Cabinet Office, Government of Japan

4. Prediction of energy consumption in 2020

4-1 Refrigerators

The diagram in Figure 8 shows the calculation of the energy consumption of refrigerators. The amount of energy consumption of refrigerators in 2020 (A-2020 in Figure 8) is calculated from the energy consumption per unit in 2020 (B-2020) and total number of units in 2020 (C-2020).

The total number of units in 2020 (C-2020) is calculated from the data of number of units owned by a household in 2020 (D-2020) and the number of households in 2020 (E-2020). The number of units owned by a household in 2020 (D-2020) is assumed.

The number of refrigerators owned by a household in 1998 was 1.25, and this did not change until 2004. The number of refrigerators owned by a household in 2020 (D-2020) is estimated as 1.3, because when aging persons live together with their families, they continue to use their own refrigerator as a spare one.

The numbers of households in 1998, 2003, 2010 and 2020 (E-2020) are based on the data in Figure 5.

The energy consumption per unit in 2020 (B-2020) is calculated from the energy consumption per unit in 2003 (B-2003) and the efficiency of a refrigerator in 2020 based on that in 2003 (F-2020), which is assumed. The efficiency of refrigerators based on the value in 2020 (F-2020) is assumed from the data that show the annual change of energy consumption per capacity of one litter and the capacity of sold refrigerators. The efficiency of refrigerators in 2020 based on that in 2003 can be assumed as 0.28.

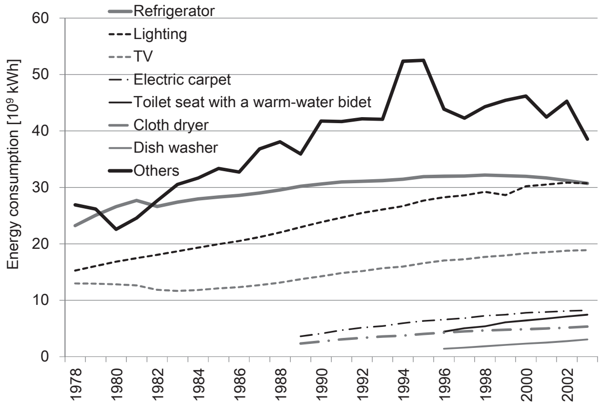

Figure 7 Annual changes in energy consumption of electric appliances[iii]

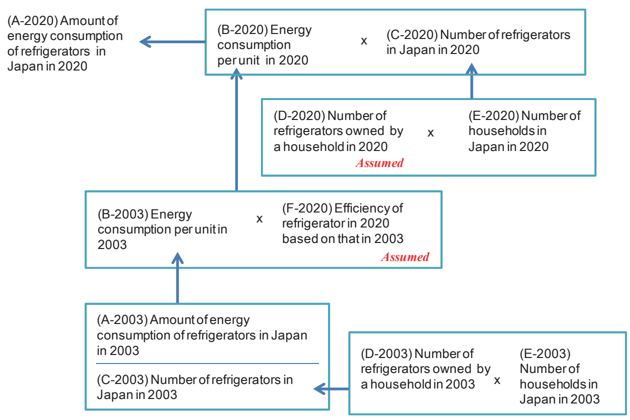

Figure 8 Calculation of energy consumption of refrigerators in 2020

The amount of energy consumption of refrigerators in Japan in 2010 is also calculated in the same way as that in 2020. The efficiency of refrigerator in 2010 based on that in 2003 is 0.45 from the existing data on efficiency of refrigerators between 1991 and 2005.

For the above estimations, the amounts of energy consumption of refrigerators in 2010 and 2020 are calculated as 14.889 billion kWh and 9.813 billion kWh, respectively. The amount of energy consumption of refrigerators in 2010 decreased by 52% from that in 2003, and that in 2020 will decrease by 7% from that in 2010.

4-2 TVs

The calculation diagram of the energy consumption of TVs is shown in Figure 9. The amount of energy consumption of TVs in 2020 (A-2020) is calculated from the rated energy consumption per unit in 2020 (B-2020), total number of units in 2020 (C-2020), and viewing hours (G-2020).

The number of TVs is estimated to depend on the population rather than the number of households. The number of TVs owned by a person can be calculated as the ratio of the number of TVs owned by a household (Figure 6) divided by the family number (Figure 5). The number of TVs owned by a person in 2003 and 2010 were 0.92 and 0.99, becoming nearly 1.0. Even if a person owned more than one TV, the number of TVs that person could watch at one time would still be one. Thus, the number of TVs owned by a person in 2020 (D-2020) is assumed as 1.00.

The population levels in 2003, 2010 and 2020 (H-2020) are shown in Figure 4.

The viewing hours in 2020 (G-2020) are assumed from the values in 2003 and 2010[iv)]. The viewing hours depend on the economic and social background of the user, and thus viewing hours cannot be estimated in this paper; therefore, the value of 2010 is used.

The energy consumption by a TV in 2020 (B-2020) is taken from the values of the most recent popular type of TV in 2010, the 32-in. liquid plasma type, whose energy consumption is 98W. In 2020, since TVs have generally been used for 8.9 years recently, the lowest energy-efficiency value for common TVs is expected to be higher than that for the latest models of 2010.

From the above results, the amount of energy consumption of TVs in 2020 is estimated to be 17.5 billion kWh, which is 8% less than this level in 2003 and 7% less than that in 2010.

4-3 Lighting

The energy consumption of lighting is calculated by the number of lamps and the energy consumption of the lamps in 2010 and 2020. The number of lamps is referred to in a previous study [v]. In this paper, it is assumed that the incandescent lamps used in 2010 will have been changed to LEDs by 2020, since the product lifetime of incandescent lamps is 2–3 years, incandescent lamps have not been produced from 2011, and the prices of LEDs have drastically declined.

Considering all of the above data and findings, the energy consumption of lighting is expected to decrease by 43% from 2010 to 2020.

4-4 Toilet seat with a warm-water bidet

The energy consumption of toilet seats with a warm-water bidet is calculated in the same way as that of refrigerators.

The increase in the efficiency ratio from 2003 to 2020 is estimated as the same value of the increase in the efficiency ratio from 1998 to 2003.

The numbers of toilet seats with a warm-water bidet per household in 1998, 2003 and 2010 are based on the data in Figure 6. The number has been increasing gradually year by year, and it became over one in 2012. Thus, this number is assumed to increase gradually and become 1.1 in 2020.

From these results, the amount of energy consumption of toilet seats with a warm-water bidet in 2020 is calculated as 10.8 billion kWh, an increase of 43% and of 2% over that in 2003 and 2010, respectively.

4-5 Electric carpet

The energy consumption of electric carpets is calculated in the way same as that of refrigerators.

Because there is only slight potential for increased efficiency of electric carpets, not by improving the coefficient of performance (COP) of electric carpets but by the change in usage depending on the user, no large improvement in efficiency is expected for this product. Therefore, the efficiency of electric carpets in 2020 is estimated to be 0.95 based on the efficiency in 2003.

The numbers of electric carpets owned by a household in 2010 and 2020 are estimated to be the same as that in 2003, since the number of electric carpets has not changed in recent years and the shipment rate is also unchanged.

As a result, the amounts of energy consumption of electric carpets in 2003, 2010 and 2020 are calculated as 8.207 billion kWh, 8.655 billion kWh and 8.591 billion kWh, respectively. There is a 5% increase from 2003 to 2010 as well as a 1% decrease from 2010 to 2020.

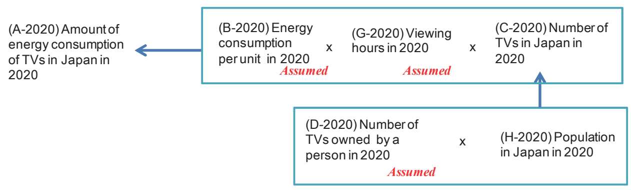

Figure 9 Calculation of energy consumption of TVs in 2020

Table 1 Energy consumption of lighting (upper: 2010; lower: 2020)

	Fluorescent lamp	Bulb-type fluorescent lamp	Incandescent lamp	Subtotal
Energy consumption per unit [W]	40	15	80	135
Number in Japan [million]	480	150	250	860
Amount of energy consumption [billion kWh]	18.4	2.25	20.0	40.65
Total energy consumption in 2010				38.2

	Fluorescent lamp	Bulb-type fluorescent lamp	LED	Subtotal
Energy consumption per unit [W]	40	15	10	65
Number in Japan [million]	480	150	250	860
Amount of energy consumption [billion kWh]	18.4	2.25	2.5	23.15
Total energy consumption in 2020				21.8

4-6 Others

A variety of electric appliances used in the household are considered "others" in Figure 1. Because clothes washers and rice cookers consume large amounts of energy and thus significantly affect household energy consumption, it will be important to estimate the impact of these appliances in the future. However, due to the lack of data on the number of these owned by a household and their energy consumption, the energy consumption of "others" in 2010 and 2020 is assumed to be the same as the value in 2003, which is 38.556 billion kWh.

4-7 Energy consumption of lighting and electric appliances

The levels of energy consumption for lighting and electric appliances in 2003, 2010 and 2020 are shown in Figure 10. From our results, a 6% decrease in household energy consumption in 2010 from 2003 is calculated. However, in fact the energy consumption in 2010 increased from 2003 (Figure 1). A possible reason for this difference is the increase in the energy consumption of other appliances, which is not estimated in this paper. Compared to the energy consumption given in Figure 1, the 12% increase in the energy consumption of other sources of demand can be estimated.

The energy consumption in 2020 is estimated to decrease 16% from that in 2010. The main factor of the decrease from 2010 to 2020 is the improved efficiency of refrigerators. In addition, the second factor of this decreases is the change in lighting from incandescent lamps to LEDs.

The miscellaneous "others," lighting, and TVs have become large factors of household energy consumption. However, while the energy-consumption levels of TVs and lighting are decreasing, "others" still accounts for over 30% of household energy consumption.

In this paper, the energy consumption of "others" cannot be considered due to the lack of information; however, this factor should be considered in future work.

5. Conclusion

In this work, we analyzed the energy consumption of lighting and electric appliances, which account for a large percentage of household energy consumption. Furthermore, we attempted to predict future energy consumption in 2020. From our results, energy consumption in 2020 is estimated to decrease from the current level.

Though this study, we found that these data on household energy consumption are insufficient for predicting future changes in energy consumption.

In order to understand and predict household energy consumption, it is necessary to store and analyze the various data related to household energy consumption. Such knowledge will be invaluable in promoting measures for energy conservation.

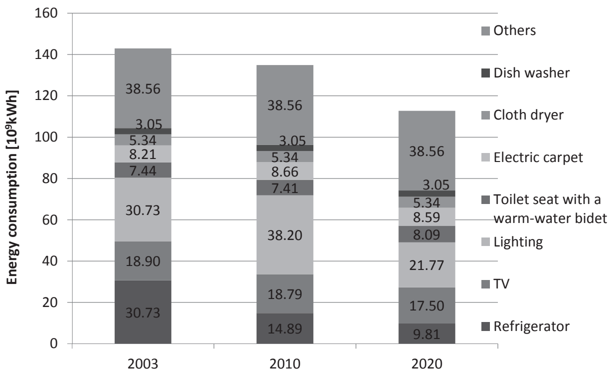

Figure 10 Household energy consumption and its breakdown in 2003, 2010 and 2020

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Spatial Composition of Intermountain Pastoral Settlements on Slopes in Eastern Anatolia of Turkey: Case Studies of Konaklı Village in Erzurum and Besler Village in Ağrı

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Keywords: continental climate, corrugated galvanized iron, flat roof, livestock, livestock barn, one story, pasture, pitched roof, stone masonry construction, walled courtyard.

Abstract: To understand the spatial composition of intermountain pastoral settlements on slopes in the Eastern Anatolia Region of Turkey, document searches and field surveys were conducted in the Konaklı Village in Erzurum and in the Besler Village in Ağrı and discussed my results. I identified great differences of spatial composition between the pastoral settlements where people live next to livestock and previously reported farming or forestry settlements. Other differences between the two settlements include the building directions, approaches to houses and livestock barns, presence or absence of walled courtyards, and houses whose roofs have been converted into pitched ones. These differences individualize each settlement and create landscapes appropriate for each area.

1. Introduction

People have lived in the Silk Road countries from Japan to Turkey since the dawn of time. The relationship among nature, architecture, and settlement depends on natural conditions, local communities, and culture. For example, many social and cultural differences exist between Japan, which has islands with high summertime precipitation and Shinto and Buddhist influence, and Turkey, which has low summertime precipitation and inflows of various ethnics, religions and cultures. Despite these differences, in the Silk Road countries, many settlements remain, which were formed before the industrial revolution and have high sustainability that has been confirmed by centuries of history.

Appleton (1975) proposed a prospect-refuge theory, which argues for the following: aesthetic satisfaction from landscapes stems from the spontaneous perception of environmental conditions favorable to survival; the ability to see and the ability to hide are important for the survival of both humans and animals; aesthetic pleasure in landscapes is derived from both prospects corresponding to the ability to see and refuge corresponding to the ability to hide. In fact, many of the settlements in the Silk Road countries that still continue today have prospects provided by slope ground or refuges surrounded by mountains. Understanding the spatial compositions of the settlements and architecture surrounded by mountains or located on slopes is crucial for the clarification of a safe, comfortable and sustainable living environment in coexistence with nature.

Therefore, we have studied intermountain settlements located on slopes for designing, constructing, and conserving such desired living environments. As examples of settlements, we first focused on three villages (Bolkuş, Çiğdemlik and Demirdağ in Fig 1) in northern and central Turkey and conducted document searches and field surveys of them (Suzuki & Okazaki, 2012a, 2012b). We clarified their spatial structure, which is centered around a mosque or square that supports community formation, houses with mixed structures that effectively use slopes, and a sense of unity in the landscape created by sharing similar shapes, aspects, scales, and roof colors. These three settlements have many two-storied wooden houses with masonry downstairs and pitched roofs. Bolkuş and Çiğdemlik are in the Black Sea Region, and Demirdağ is in the Central Anatolia Region. However, the settlements and houses vary widely by region in Turkey (Güney, 1998; Hara et al., 1973, 1976). Since the above characteristics are supposed to have no application in many areas of Turkey, similar searches in other areas are required.

Some researchers have studied and reported the spatial compositions of settlements on slopes in the following Silk Road countries: Japan (Kasahara & Goto, 1997; Kondo, 1998; Miyazaki & Tabata, 2007, 2009; Uchimura et al., 1987), Taiwan (Nagano & Saiki, 2009), Laos (Hosogai et al., 2007), Thailand (Hata, Shimizu, Kanda & Shida, 1994; Hattori, Hata & Kanda, 1995; Hattori, Hata & Shimizu, 1994; Maruchi, Hata, Arai & Hattori, 1996; H. Suzuki, Hata & Kanda, 1994), Nepal, India, Afghanistan (Hara et al., 1978), Iran (Ashtari, Ahmadi, Salem & Tajeddini, 2012; Hara et al., 1976; Ziael, 2012), Syria (Hara et al., 1978; Yagi, 1986) and Jordan (Hara et al., 1978). In Turkey, Hara et al. (1973, 1976), Maruyama, Anezaki, Yasuda and Hatsumi (1997), Yamazaki, Hidaka, Suda and Hatsumi (1999), and Hidaka, Yamazaki, Suda and Hatsumi (1999) studied such settlements and focused on surveys of the spatial compositions of houses in the settlements on slopes but did not clarify their overall compositions.

Based on the above research, I focused on the Eastern and Southeastern Anatolia Regions of Turkey, whose settlements and houses are widely different from the Black Sea and Central Anatolia Region. To clarify the spatial compositions of settlements in them, I visited four intermountain villages (Konaklı, Besler, Çevre and Aran in Fig 1) on slopes and conducted field surveys and document searches on them. Along with the previously reported villages, each of these villages fulfill all of the following requirements: (1) its settlement is located on a slope; (2) it is surrounded by mountains and visually separated from the surrounding villages, towns and cities; (3) spatial composition of the entire settlement is easy to understand because of comparatively small population; (4) its documents are available on the Internet and elsewhere.

This paper reports the results and discussions of Konaklı Village in Erzurum Province and Besler Village in Ağrı Province. Both of the pastoral settlements are located in the Eastern Anatolia Region with long, rugged winters and short, clement summers. Because the Erzurum Province is in the center of the Eastern Anatolia Region, the Konaklı Village is thought to have one of the typical intermountain settlements in the region. In contrast to this, the Besler Village is very close to the Iranian border and seems to have many historical and cultural similarities to Iran. Clarifying and comparing the characteristics of the settlements is important for understanding architectural culture around the Silk Road. In this paper, I discuss the relationships among climates, topographies, roads, buildings, and the lives of residents to determine the characteristics of their spatial composition.

2. Methods

As previously noted, I studied two villages in the Eastern Anatolia Region: Konaklı Village in the Palandöken District of Erzurum Province and Besler Village in the Doğubayazıt District of Ağrı Province (Fig 1). Each village has a settlement (hereinafter Konaklı and Besler Settlements) on a slope and is surrounded by mountains with few trees. I conducted document searches and field surveys in the settlements. In the document search, from the Internet I gathered information about the temperature and precipitation of the nearest city, aerial photography, topography, and outlines of each settlement. In my field surveys conducted on August 23 and 24 in 2012, many photographs were taken, and residents were interviewed when possible.

Fig 1. Locations of settlements under study in Turkey (Google Earth, 2013). This paper reports Konaklı and Besler.

3. Results

3.1. COMPARISONS OF TEMPERATURES AND PRECIPITATION

I compared the monthly mean temperature and precipitation of Erzurum City (altitude of around 1,940 m, about 20 km northeast of Konaklı Village), Doğubayazıt City (altitude of around 1,600 m, about 14 km northeast of Besler Village), and other previously reported cities (Suzuki & Okazaki, 2012a) (Fig 2, 3).

Both Erzurum and Doğubayazıt have lower temperatures than the previously reported areas. The monthly mean temperatures in winter (December to February) are below -3°C. Therefore, they are estimated to have continuous snow cover in winter based on Köppen Climate Classification (1918). Especially in Erzurum, the temperature is low and sinks to -9.9°C in January (Turkish State Meteorological Service, 2013). Both have cool climates in summer because the monthly mean temperatures are below 22°C. Konaklı's altitude is around 2,230 m, which is almost 300 m higher than Erzurum. Because the temperature decreases by 0.65°C with each 100 m of altitude (International Civil Aviation Organization, 1993), Konaklı's temperatues is estimated to be about 2°C lower than that of Erzurum. Similarly, Besler's is estimated to be about 2.6°C lower than Doğubayazıt's because Besler's altitude is around 2,000 m, which is 400 m higher than Doğubayazıt's.

The mean annual precipitation in Erzurum (408 mm, Turkish State Meteorological Service, 2013), and Doğubayazıt

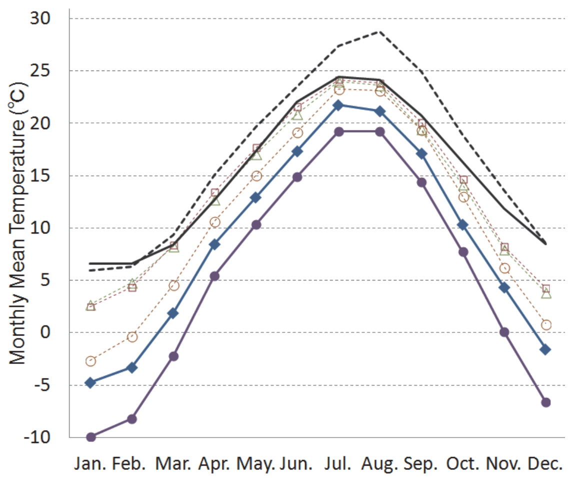

Fig 2. Comparisons of monthly mean temperatures in Erzurum, Doğubayazıt, and other cities. Both Erzurum and Doğubayazıt have lower temperatures than previously reported areas.

Erzurum, Karabük, Amasya and Istanbul (1970-2011): Turkish State Meteorological Service (2013)
Doğubayazıt (Doğubeyazıt, 1963-1990) and Divriği (1964-1990): WorldClimate (2013)
Osaka (1981-2010): Japan Meteorological Agency (2013)

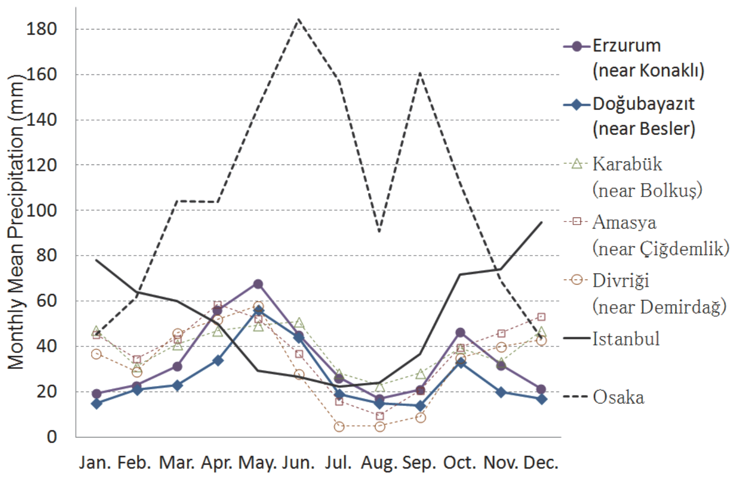

Fig 3. Comparisons of monthly mean precipitation in Erzurum, Doğubayazıt, and other cities. Mean annual precipitation in Erzurum (408 mm) and Doğubayazıt (311 mm) are low, especially in summer and winter.

Erzurum, Karabük, Amasya and Istanbul (1970-2011): Turkish State Meteorological Service (2013)
Doğubayazıt and Divriği (29 years): CantyMedia (2013)
Osaka (1981-2010): Japan Meteorological Agency (2013)

(311 mm, CantyMedia, 2013) is low. The monthly precipitation is especially low in summer and winter. The annual precipitation in Doğubayazıt near the Iranian border corresponds to that on an arid boundary (317 mm, when there is no distinguished dry season and the annual temperature is 8.9°C), as defined by Köppen (1918), and its climate is estimated to be the limit at which forests can grow.

Both Erzurum and Konaklı are categorized as Humid Continental Climates by Köppen Climate Classification. Doğubayazıt is placed near the boundary of Humid Continental and Semi-arid Climates. However, Besler probably belongs in the Humid Continental Climate classification, just like Konaklı, because the annual precipitation on arid boundaries decreases by 20 mm with each 1°C decrease in annual temperature (Köppen, 1918).

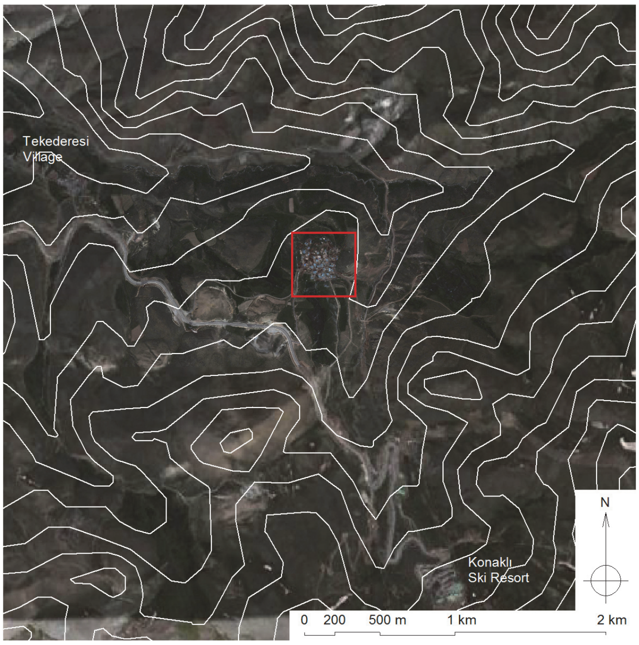

Fig 4. Aerial photography and topography of Konaklı Village 1:50,000. See Fig. 5 for closeup in framed rectangle.
Aerial photography in 2012: Google Earth (2012) © 2013 Google, Image © 2013 DigitalGlobe
Contours (50 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

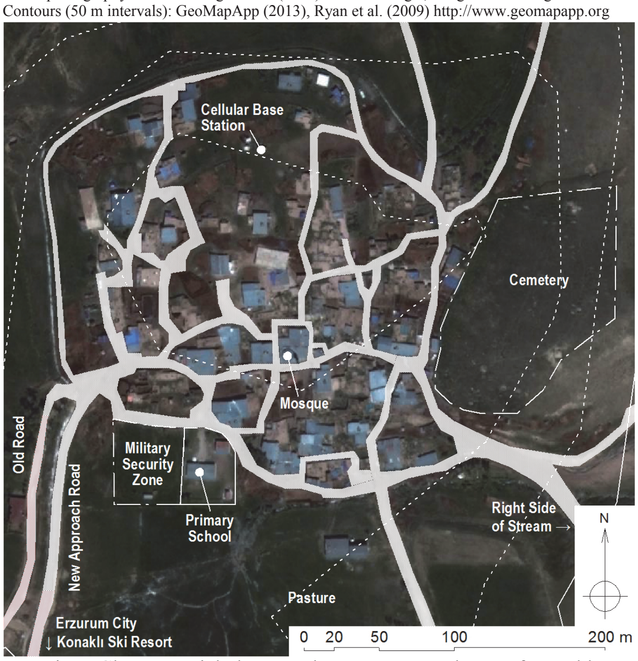

Fig 5. Closeup aerial photography, contours, and map of Konaklı Settlement 1:5,000.
Aerial photography in 2012: Google Earth (2012) © 2013 Google, Image © 2013 DigitalGlobe
Contours (10 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

Below are the results of my document searches and field surveys for each settlement.

3.2. KONAKLI

3.2.1. Document Search (GeoMapApp, 2013; Google Earth, 2011; Google Map, 2013; Vikipedi, 2013b)

Konaklı Village, which is about 20 km southwest of Erzurum City, has an altitude of around 2,230 m. It is in a valley surrounded by bald mountains that are covered by snow in winter. A settlement, which was formerly called Kevgüri, is located on a low hill near the left bank of a stream curving from south to the west (Fig 4, 5). The settlement's slopes about 5º or 10º. Buildings are spread over the entire hill, and meadows cover around the hill. Houses are not found on the settlement's south side because Konaklı Settlement is the innermost settlement in the valley. Roads on both sides of the stream had directly connected to the settlement. The Konaklı Ski Resort for the 2011 Winter Universiade in Erzurum was built about 2.5 km south of the settlement. At the same time a broad road connecting Erzurum City and the resort without going through the settlement was also built on its south side. The village's population was 308 in 2000 and 284 in 2007.

Fig 6. Appearance of Konaklı Settlement to the south. Pitched roofs created a sense of unity when viewed from outside the settlement because materials of the same color are used.

Fig 7. Primary school under a hill in Konaklı Settlement.

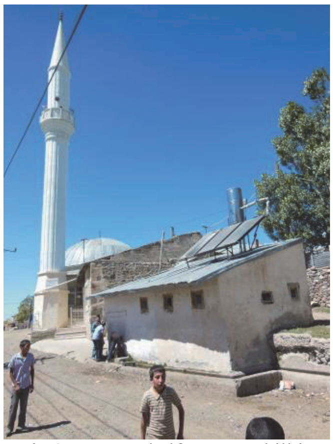

Fig 8. Mosque halfway up a hill in Konaklı Settlement with stone and brick masonry construction.

3.2.2. Field Survey (August 23, 2012)

Entire Settlement: The settlement stood out because the buildings were spread on the entire hill (Fig 5, 6). Trees were found on patches of the hill, but most of the slopes had none. Cattle, goats, sheep and horses were put out to pasture and on the ski slopes near the settlement. A primary school was under the hill (Fig 7), and a mosque was located halfway up it (Fig 8). A path encircled the hill. The density of buildings was relatively high on the south slope and relatively low on the north. The buildings were basically oriented on the cardinal direction. However, each turned in a slightly different direction in relationship with the slope. The inside of the settlement was mazy because its rough paths sprawled as if threading their ways through the buildings (Fig 9, 10). Few paths branched from the mosque or square, unlike the previously reported settlements (Suzuki & Okazaki, 2012a, 2012b). Most of the paths were dirt.

The settlements were dotted with small walled or fenced crofts and apiaries (Fig 11). Some of the walls and fences could be easily cleared by man. Haystacks were found on empty lots in the settlement and on the flat roofs of the buildings (Fig 12). They appeared to be winter food for the livestock. Another hill on the east side of the settlement had a fenced cemetery.

Buildings: Most of the buildings in the settlement were one story. Houses and livestock barns were not separated. Both such traditional buildings were stone masonry construction (Fig 13, 14, 15). Some of the houses and barns shared walls (Fig 16). There were only minimal land formations with low retaining walls because many buildings had ground floors, parts of which were under slopes (Fig 17).

Many of the houses and livestock barns had entrances that directly faced paths. The houses had steel doors and glazed windows, but the barns had shabby wooden or galvanized doors, and small unglazed windows. Most of the windows in the houses were rectangle, small, and unopened.

Houses and livestock barns in the region traditionally had flat roofs plastered with mud (Hara et al., 1976). However, these days, the settlements including Konaklı have many houses converted into pitched roofs with corrugated galvanized iron (Fig 18). Most of the pitched roofs were gabled or pent. Many buildings with such corrugated roofs were found not only in Konaklı but also in the numerous settlements in Erzurum and Ağrı Provinces. The pitched roofs created a sense of unity when viewed from outside the settlement because materials of the same color were used (Fig 6).

Recent houses or extensions were not stone masonry construction but brick or concrete (Fig 19, 20). The shapes of many such houses resembled stone houses. The walls had low saturation.

The mosque was built of stone and brick masonry construction (Fig 8). Except its minaret and its domed roof, it shared a similar appearance with the surrounding houses.


Fig 9. Slope path in Konaklı Settlement.


Fig 10. Slope path in Konaklı Settlement.


Fig 11. Small walled croft in Konaklı Settlement.


Fig 12. Haystack on flat roof of building in Konaklı Settlement.


Fig 13.Stone houses in Konaklı Settlement.


Fig 14. Stone house in Konaklı Settlement.


Fig 15. Stone livestock barns in Konaklı Settlement.


Fig 16. Houses and livestock barns sharing walls in Konaklı Settlement.


Fig 17. Livestock barns partly under a slope in Konaklı Settlement.


Fig 18. House converted into pitched roofs with corrugated galvanized iron in Konaklı Settlement.


Fig 19. Brick house in Konaklı Settlement.


Fig 20. Concrete house in Konaklı Settlement.

3.3. BESLER

3.3.1. Document Search (GeoMapApp, 2013; Google Earth, 2011; Google Map, 2013; Vikipedi, 2013a)

Besler Village is about 14 km southeast of Doğubayazıt City and about 5 km north of the Iranian border. The settlement, called Sûrbexanajorê in Kurdish (Bajarê Agirî, 2010), has an altitude of around 2,000 m and is located in a valley surrounded by bald mountains (Fig 21, 22). It is the innermost settlement in the valley, and near the confluence of two streams from west and north. The majority of its houses are on east-facing slopes (about 5°) between the two streams, but parts of them spread to the north and east sides around the valley. The village has two approaches. One is a road through the settlements on the east along the valley, and the other is a road from Dogubayazit City on the north through a mountain pass. The village's population was 196 in 2000 (Vikipedi, 2013a) and 137 in 2012 (Turkish Statistical Institute, 2013).

3.3.2. Field Survey (August 24, 2012)

Entire Settlement: Buildings gathered in relatively low places on the east-facing gentle slope between the two streams (Fig 22, 23). A road for approaching the settlement curved and penetrated it (Fig 24). A few trees were found around the settlement, but not on most of the slopes. Each house had a courtyard enclosed by stone walls (Fig 25). Connected houses with walled courtyards comprised a block (Fig 26). However, some houses had already collapsed (Fig 27). Paths in the settlements sprawled and were dirt. The directions of the buildings and the courtyards were basically in reference to slopes. Some of the houses spread to the north and east sides around the valley (Fig 28, 29). Pastures with livestock including horses and sheep were seen near the settlement. A mosque was in the west on a higher part of the settlement (Fig 30). A primary school was also in the west outside of the settlement (Fig 31).

Buildings: All the settlement's buildings were one story. Houses and livestock barns were integrated with walled courtyards (Fig 32) through which they were approached (Fig 33). The houses and barns shared courtyards. Many of the stone walls enclosed the courtyard and discouraged looking in from the outside (Fig 25, 33, 34). However, the ground floors of many of the houses were considerably higher than their courtyards and the floors of barns because many rectangular windows of the houses were higher than the walls that enclose the courtyards (Fig 34, 35). The floors of the houses were raised higher naturally by using slopes. Because many of buildings were enclosed by walls, they were not clear whether or not part of them were under slopes. However, I found such buildings (Fig 28) as well as previously reported settlements (Suzuki & Okazaki, 2012a, 2012b).

Traditionally, houses were built of stone masonry

Fig 22. Closeup aerial photography, contours and map of Besler Settlement 1:5,000.
Aerial photography in 2011: Google Earth (2011) © 2013 Google, Image © 2013 GeoEye
Contours (10 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

Fig 23. Appearance of Besler Settlement to the east. Low saturation houses and stone walls created a sense of unity when viewed from outside the settlement because they seemed to be layered on slopes and composed a unique landscape.

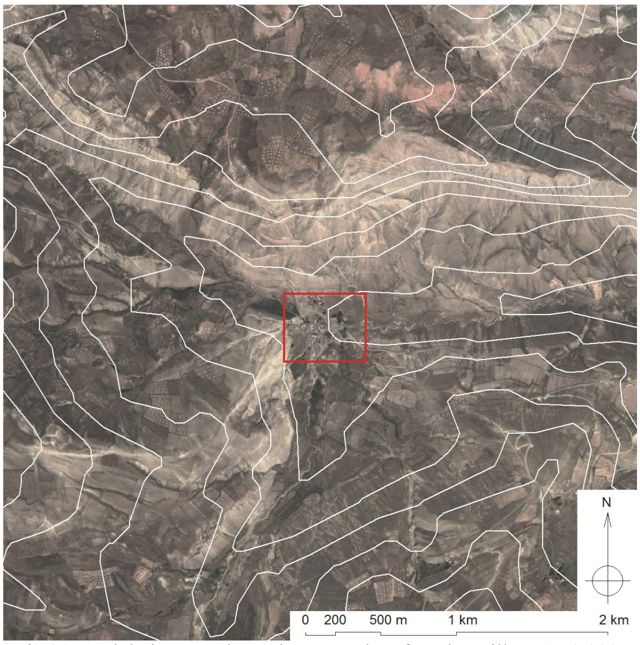

Fig 21. Aerial photography and topography of Besler Village 1:50,000. See Fig. 22 for closeup in framed rectangle.
Aerial photography in 2011: Google Map (2013) © 2013 Google, Image © 2013 GeoEye
Contours (50 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

Fig 24. Curved road penetrated in Besler Settlement.

Fig 25. House with a courtyard enclosed with stone walls in Besler Settlement. The walls secured height to make it difficult to be looked in.

construction. Brick and concrete houses were also found, but their walls had low saturation. All walls enclosing courtyards were stone, even for brick or concrete houses. The low saturation houses and stone walls created a sense of unity when viewed from outside the settlement because they seemed layered on slopes and composed a unique landscape (Fig 23).

The buildings had flat roofs plastered by mud. I found no corrugated galvanized roofs, even though they are common in the settlements of Ağrı and Erzurum Provinces. Some of the buildings had walls or roofs partly covered by blue plastic sheets.


Fig 26. Continuous houses with walled courtyards in Besler Settlement.


Fig 27. Collapsed house in Besler Settlement.


Fig 28. Houses spread north outside of Besler Settlement, partly under slope.


Fig 29. Houses spread east outside of Besler Settlement.


Fig 30. Mosque on west side and higher place of Besler Settlement.


Fig 31. Primary school on west outside of Besler Settlement.


Fig 32. House and livestock barn integrated with walled courtyard in Besler Settlement. Mosque behind had small domes, minaret and different shaped windows from the other houses in settlement.


Fig 33. House and livestock barn approached through courtyard in Besler Settlement. High stone walls enclose the courtyard and discourage people from looking in.


Fig 34. High stone walls enclose courtyard in Besler Settlement and discourage people from looking in. Windows were higher than the wall.


Fig 35. Floors of house higher than courtyard in Besler Settlement.

The mosque had different shaped small domes, minaret and windows from the other houses in the settlement (Fig 30, 32). Its courtyard was hidden from the outside because it was enclosed by high walls. The mosque was approached through the courtyard. Therefore, its spatial composition resembled the surrounding houses.

4. Discussion

4.1. SIMILARITIES BETWEEN THE TWO SETTLEMENTS

My document researches and field surveys showed the following similarities of the spatial compositions between the Konaklı and Besler Settlements:

4.1.1. Similarities between Entire Settlements

(1) Both have more than one road for approaching the settlements, which are penetrated by roads (Konaklı: Fig 5, Besler: Fig 22). In each of the previously reported farming or forestry settlements (Suzuki & Okazaki, 2012a, 2012b), roads were connected to the surrounding plowlands or forests but only one main road approached them.
(2) Few paths branch from the mosque or square, unlike the previously reported farming or forestry settlements. Specifically in Besler Settlement, the mosque was at the end of the settlement. Pastures surround the settlements, and livestock graze in them in the summer.
(3) Most of the paths are dirt. Therefore, they don't need to be swept, even though livestock walk in and out of the settlements for grazing (Konaklı: Fig 9, Besler: Fig 33).
(4) All of the private crofts and courtyards are walled or fenced (Konaklı: Fig 11, Besler: Fig 25, 26) unlike the previously reported farming or forestry settlements. The walls or fences prevent livestock from trampling the courtyards or crofts because many livestock are kept in the settlements and walk through them to graze. In fact, some of the walls and fences can be easily cleared by man in Konaklı.
(5) Unenclosed places function as public spaces and allow free passages. No paths connect the front yards of houses without doors unlike the previously reported settlements in the Black Sea Region.
(6) Primary schools with playgrounds are on the outer side of the settlements (Konaklı: Fig 5, Besler: Fig 22) as with the previously reported settlements on slopes.

4.1.2. Similarities between Buildings

(7) Most of the buildings are one story. Few two-storied buildings are found in many Turkish settlements including the Black Sea and Central Anatolia Regions (Suzuki & Okazaki, 2012a, 2012b).
(8) There are only minimal land formations with low retaining walls because many buildings have ground floors, parts of which are under slopes (Konaklı: Fig 17, Besler: Fig 28). Such buildings were also found in the previously reported settlements of the Black Sea and Central Anatolia Regions.
(9) Some houses and livestock barns share walls (Konaklı: Fig 16, Besler: Fig 32). In the previously reported settlements of the Black Sea Region, the walls of the houses were usually separated, and such small animals as dogs and chickens were kept near the houses.

(10) Traditional livestock barns are stone masonry construction, like houses (Konaklı: Fig 15, Besler: Fig 32), probably to protect the livestock from snow and severe cold (Fig 2) in a Humid Continental Climate by Köppen Climate Classification. In the settlements of the Black Sea and Central Anatolia Regions, the upstairs were wooden.
(11) Most of the windows in the houses are rectangle, small, and unopened, probably because it gets very cold in winter (Fig 2) and very dry and dusty in summer.
(12) Recent houses or extensions are not stone masonry construction but brick or concrete (Konaklı: Fig 19, 20, Besler: Fig 25, 35). The shapes of many such houses resemble stone dwellings. Since those walls have low saturation, such houses are in harmony with their surrounding buildings.
(13) Except for minarets and dome roofs, the mosques tend to share similar appearances with their surrounding buildings (Konaklı: Fig 8, Besler: Fig 30, 32). In the previously reported settlements of the Black Sea Region, their forms and colors were completely different from other houses.

4.1.3. Discussion about Similarities

I found that the similarities of the spatial compositions between the two settlements differ vastly from the settlements in the Black Sea and Central Anatolia Regions except for (6) in Section 4.1.1 and (8) in Section 4.1.2. There are great differences of suitable spatial composition between the pastoral settlements where people live next to grazing livestock in pastures, and farming or forestry settlements.

4.2. DIFFERENCES BETWEEN THE TWO SETTLEMENTS

Although the two settlements have similar climates and lifestyles, I identified the following differences of spatial compositions:

4.2.1. Difference between Entire Settlements

(1) In the Konaklı Settlement, the buildings are basically oriented on the cardinal directions, but each is turned in a slightly different direction in relationship to the slope (Fig 5). However, in the Besler Settlement, they are basically set in reference to the slopes. The buildings in Konaklı are spread over the entire hill, suggesting that Konaklı has a widely different location from Besler and the previously reported settlements on slopes (Suzuki & Okazaki, 2012a, 2012b).

4.2.2. Differences between Buildings

(2) Many of the houses and livestock barns in Konaklı Settlement have entrances that directly face paths. In contrast, in Besler Settlement they are integrated with walled courtyards from which they are approached (Fig 33). The mosque in Besler also has a walled courtyard (Fig 30, 32). No houses or mosques with walled courtyards were found in Konaklı and the previously reported settlements on slopes (Suzuki & Okazaki, 2012a, 2012b).
(3) In the Besler Settlement, many of the stone walls enclose the courtyard and discourage looking in from the outside (Fig 25, 33, 34). However, the ground floors of many of the houses are considerably higher than their courtyards and the floors of barns because many rectangular windows of the houses are higher than the walls that enclose the courtyards (Fig 34, 35). This allows views of the valley and sunlight. The stone walls create a sense of unity when viewed from outside the settlement because they seem layered on the slopes and compose a unique landscape (Fig 23).
(4) Although traditionally the buildings in both settlements had mud-plastered flat roofs, many houses in the Konaklı Settlement were converted into gabled or pent roofs with corrugated galvanized iron (Fig 18). In contrast, I found no houses with pitched roofs in the Besler Settlement. However, the pitched roofs in Konaklı create a sense of unity when viewed from outside the settlement because materials of the same color are used in them as well as in many of the surrounding settlements (Fig 6).

4.2.3. Discussion about Differences

In Section 4.2.1, (1) probably reflects the topographical differences between the settlements. In Section 4.2.2, (4) reflects the precipitations differences between them, and (2) and (3) cannot be explained by only climates and topographies. Therefore, perhaps the differences of people's lives and cultures affect them. These differences individualize each settlement and create appropriate landscapes for each area.

5. Conclusions

To understand the spatial composition of intermountain pastoral settlements on slopes in Turkey's Eastern Anatolia Region, I conducted document searches and field surveys in the Konaklı Village in Erzurum and the Besler Village in Ağrı, and clarified the following:
(1) There are similarities among the two settlements and the previously reported settlements in the Black Sea and Central Anatolia Regions: (a) primary schools on the outer side of the settlements (Konaklı: Fig 5, Besler: Fig 22) and (b) only minimal land formations because a lot of buildings have ground floors, parts of which are built into the slope. (Konaklı: Fig 17, Besler: Fig 28).
(2) On the other hand, I found many differences in spatial composition of the two settlements from the previously reported settlements. (a) more than one road approaches and penetrates the settlements (Konaklı: Fig 5, Besler: Fig 22); (b) few paths branch from the mosque or square; (c) almost all paths are dirt; (d) all private courtyards and crofts are walled or fenced (Konaklı: Fig 11, Besler: Fig 25, 26) and unenclosed places are public spaces that allow free passage; (e) almost buildings have only one story; (f) some of the houses and livestock barns share walls and are traditionally built of stone masonry construction (Konaklı: Fig 15, 16, Besler: Fig 32); (g) almost all windows in the houses are rectangular, small, and unopened; (h) recent houses or extensions are brick or concrete (Konaklı: Fig 19, 20, Besler: Fig 25, 35); but, since the shapes of many houses resemble stone dwellings and such walls have low color saturation, the houses are in harmony with the other buildings; (i) except for minarets and dome roofs, the mosques tend to share similar appearances with the other buildings (Konaklı: Fig 8, Besler: Fig 30, 32). These characteristics seem to be suitable for pastoral settlements where people live next to grazing livestock in pastures.
(3) In Konaklı where buildings are spread over the entire hill, the buildings are basically oriented on the cardinal directions, but each is turned on a slightly different direction in relationship to the slope (Fig 5). However, in Besler they are basically in reference to the slopes and the previously reported settlements.
(4) In Konaklı, many houses and livestock barns have entrances that directly face paths. However in Besler, they are integrated with walled courtyards through which they are approached (Fig 33). The mosque in Besler also has a walled courtyard (Fig 30, 32). Houses and mosques with walled courtyards were not found

in Konaklı and the previously reported settlements.
(5) In Besler, many stone walls enclose the courtyard and discourage looking in from the outside (Fig 25, 33, 34). However, the ground floors of many houses are considerably higher than their courtyards and the floors of barns (Fig 34, 35). This allows views and sunlight. Because the stone walls seem layered on slopes and compose a unique landscape, they create a sense of unity when viewed from outside the settlement (Fig 23).
(6) In Konaklı, many houses were converted into gabled or pent roofs with corrugated galvanized iron (Fig 18). However, because materials of the same color are used in the pitched roofs as well as the surrounding settlements, they create a sense of unity when viewed from outside the settlement (Fig 6). In contrast, in Besler houses with pitched roofs were not found.

The spatial compositions of both settlements are affected by being pastoral settlements where people live next to livestock that is put out to pasture. However, differences exist that individualize each settlement and create a landscape appropriate for each area.

As stated in the introduction, I also conducted document searches and field surveys on two other settlements in the Eastern and Southeastern Anatolia Regions. Next I must comprehensively clarify the spatial compositions of the intermountain settlements on slopes in the Eastern and Southeastern Anatolia Regions by focusing my discussion on the four settlements.

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Spatial Composition of Intermountain Settlements on Slopes with High Wintertime Precipitation in Eastern and Southeastern Anatolia of Turkey: Case Studies of Çevre Village in Bitlis and Aran Village in Mardin

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Keywords: arched window, brick masonry construction, continental climate, farming, flat roof, forced migration, Mediterranean climate, pastoralism, stone masonry construction, two stories.

Abstract: To understand the spatial composition of intermountain settlements on slopes with relatively high winter precipitation in the Eastern and Southeastern Anatolia Regions of Turkey, document searches and field surveys were conducted in the Çevre Village in Bitlis and in the Aran Village in Mardin and discussed my results. I found similarities between the settlements, including the locations of the primary school, many two-storied houses, and many ground floors partly under slopes. However, I also identified many differences of spatial composition that probably reflects the differences between farming and pastoral settlements, the architecture of the regional cultures, and such area histories as the forced migrations in Çevre.

1. Introduction

For designing, constructing, and conserving desired living environments, I have focused on the spatial compositions of intermountain settlements located on slopes. Appleton (1975) proposed the following prospect-refuge theory: aesthetic satisfaction from landscapes stems from the spontaneous perception of environmental conditions favorable to survival; the ability to see and the ability to hide are important for the survival of both humans and animals; aesthetic pleasure in landscapes is derived from both prospects corresponding to the ability to see and refuge corresponding to the ability to hide.

Actually, people have lived in the settlements of Silk Road countries from Japan to Turkey since the dawn of recorded history. Many of them have prospects provided by sloped ground or refuges surrounded by mountains. Almost all of them were formed before the industrial revolution and have high sustainability that has been confirmed by centuries of history. Therefore, understanding the spatial compositions of the settlements is crucial for the clarification of safe, comfortable and sustainable living environments in coexistence with nature.

However, extraordinarily diverse intermountain settlements on slopes are found in Silk Road countries because of various natural conditions, local communities and culture. We have to study various settlements in the Silk Road countries to understand their entire scope. Even in Turkey, the settlements and houses vary widely by region (Güney, 1998; Hara et al., 1973, 1976). Some have studied the settlements on slopes in Turkey (Hara et al., Maruyama, Anezaki, Yasuda and Hatsumi, 1997; Yamazaki, Hidaka, Suda and Hatsumi, 1999; and Hidaka, Yamazaki, Suda and Hatsumi, 1999). They focused on surveys of the spatial compositions of houses in the settlements, but did not clarify their overall compositions.

Therefore, we first focused on three villages (Bolkuş, Çiğdemlik and Demirdağ in Fig 1) in the Black Sea and Central Anatolia Regions and conducted document searches and field surveys of them (Suzuki & Okazaki, 2012a, 2012b). Each of the villages fulfills all of the following requirements: (1) it is surrounded by mountains and visually separated from the surrounding villages, towns and cities; (2) its settlement is located on a slope; (3) spatial composition of the entire settlement is easy to understand because of comparatively small population; (4) its documents are available on the Internet or elsewhere. We clarified their spatial structure, which is centered around a mosque or square that supports community formation, houses with mixed structures that effectively use slopes, and a sense of unity in the landscape created by sharing similar shapes, aspects, scales, and roof colors. These three settlements have many two-storied houses with masonry downstairs, wood structures upstairs and pitched roofs.

Then, I focused on the Eastern and Southeastern Anatolia Regions of Turkey, whose settlements and houses are widely different from the Black Sea and Central Anatolia Regions. To clarify the spatial compositions of settlements in them, I visited four intermountain villages (Konaklı, Besler, Çevre and Aran in Fig 1) on slopes and conducted field surveys and document searches on them.

This paper reports the results and discussions of Çevre Village in Bitlis Province and Aran Village in Mardin Province. Both of the settlements are south of Lake Van, which is the largest lake in Turkey. Çevre Village is located in the highlands near Lake Van. In contrast to this, the Aran Village sits at a lower altitude and is comparatively close to the Syrian border. This would seem to explain the many historical and cultural similarities to Syria. Clarifying and comparing the characteristics

Fig 1. Locations of settlements under study in Turkey (Google Earth, 2013). Çevre and Aran are reported in this paper.

of the settlements is important for understanding architectural culture around the Silk Road. In this paper, I discuss the relationships among climates, topographies, roads, buildings, and the lives of residents to determine the characteristics of their spatial composition.

2. Methods

As previously noted, I studied two villages in the Eastern and Southeastern Anatolia Regions: Çevre Village in the Tatvan District of Bitlis Province in the Eastern Anatolia Region and Aran Village in Mardin District of Mardin Province in the Southeastern Anatolia Region (Fig 1). Each village has a settlement (hereinafter Çevre and Aran Settlements) on a slope and is surrounded by mountains with a few trees. I conducted document searches and field surveys in them. In the document search, from the Internet I gathered information about the temperature and precipitation of the city or town near the settlement, aerial photography, topography and outlines of each settlement. In my field surveys conducted on August 26 and 27 in 2012, many photographs were taken, and residents were interviewed when possible.

3. Results

3.1. COMPARISONS OF TEMPERATURES AND PRECIPITATION

I compared the monthly mean temperatures and precipitation of Bitlis Town (altitude of around 1,500 m, about 23 km west-southwest of Çevre Village), Mardin City (altitude of around 1,080 m, about 15 km south of Aran Village), and other previously reported cities (Suzuki & Okazaki, 2012a) (Fig 2, 3).

Bitlis, which is located in the Eastern Anatolia Region, has lower temperatures than the areas previously reported and is categorized near the boundary of a Mild Temperate Climate and Continental Climate by the Köppen Climate Classification (1918). Çevre has an altitude of around 1,810 m, which is almost 300 m higher than Bitlis. Because temperature decreases by 0.65°C with each 100 m of altitude (International Civil Aviation Organization, 1993), Çevre's temperature is estimated to be about 2°C lower than that of Bitlis and corresponds to a Continental Climate.

Mardin, which is located in the Southeastern Anatolia Region, has mostly higher temperatures than Bitlis and the areas previously reported. Especially in July, its temperature reaches 30.1°C (Turkish State Meteorological Service, 2013). However, in January, it sinks to 3.1°C, lower than in Istanbul.

The mean annual precipitation in Bitlis (1,217 mm, Turkish State Meteorological Service, 2013) almost equals Osaka (1,279mm, Japan Meteorological Agency, 2013). The mean annual precipitation in Mardin (633 mm, Turkish State Meteorological Service, 2013), which is near Syria, equals Istanbul (633 mm). In each area, the precipitation is especially low in winter and high in summer. This is completely opposite of Osaka. As previously reported (Suzuki & Okazaki, 2012a), summer precipitation seems to affect the mountain vegetation.

Bitlis is categorized near the boundary of a Mediterranean Climate and Humid Continental Climate by the Köppen Climate Classification. However, if Çevre's temperature is about 2°C lower than that of Bitlis, Çevre is categorized as a Humid Continental Climate. Mardin and Aran are both categorized as Mediterranean Climates.

Below are the results of my document searches and field surveys for each settlement.

3.2. ÇEVRE

3.2.1. Document Search (GeoMapApp, 2013; Google Earth,

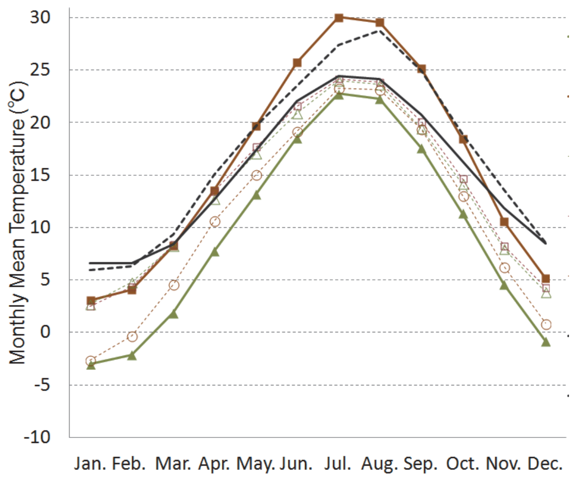

Fig 2. Comparisons of monthly mean temperatures in Bitlis, Mardin and other cities. Bitlis has lower temperatures than the areas previously reported. Mardin has mostly higher temperatures than Bitlis and the areas previously reported.

Bitlis, Mardin, Karabük, Amasya and Istanbul (1970-2011): Turkish State Meteorological Service (2013)
Divriği (1964-1990): WorldClimate (2013)
Osaka (1981-2010): Japan Meteorological Agency (2013)

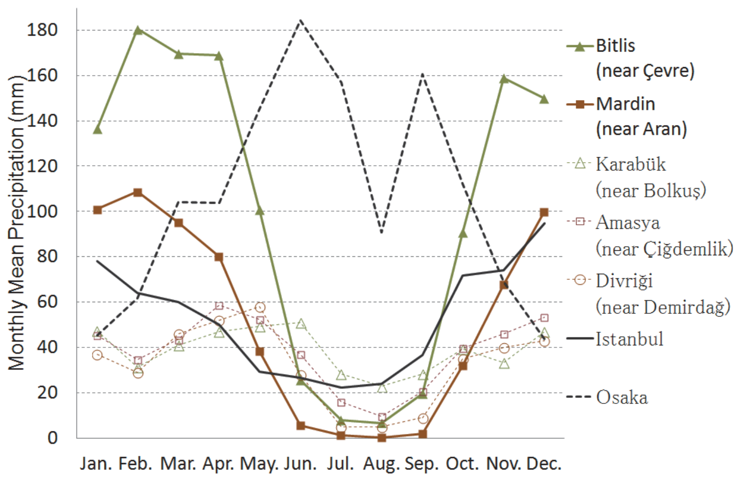

Fig 3. Comparisons of monthly mean precipitation in Bitlis, Mardin and other cities. Mean annual precipitation in Bitlis (1,217 mm) almost equals Osaka (1,279mm). That in Mardin (633 mm) equals that in Istanbul (633 mm).

Bitlis, Mardin, Karabük, Amasya and Istanbul (1970-2011): Turkish State Meteorological Service (2013)
Divriği (29 years): CantyMedia (2013)
Osaka (1981-2010): Japan Meteorological Agency (2013)

2009; Google Map, 2013; Vikipedi, 2013b)

Çevre Village is about 8 km east-southeast of Tatvan City and about 3 km south of Lake Van. The settlement, called Ez in Kurdish (Wîkîpediya, 2012a), has an altitude around 1,810 m and is on the east side of a valley in a small basin enclosed by mountains on three sides (Fig 4). Low trees are found on the surrounding mountains. Houses are spread around a south-facing slope at about 10º (Fig 5). There are oak, poplar and apple forests around the settlement. State Road D300, which is about 1 km south of the settlement along the valley, connects Van and Tatvan. The settlement was emptied three forced migrations. In 2000, its population increased due to government efforts called the "Return to Village and Rehabilitation Project". Many of its residents are elderly or children. Many young people have already migrated to big cities like Istanbul. The village's population was 10 in 2000 (FrmSinsi.com, 2012) and 82 in 2012 (Turkish Statistical Institute, 2013).

3.2.2. Field Survey (August 26, 2012)

Entire Settlement: I reached the settlement after walking on a path along the valley from State Road D300 (Fig 4, 6). Mountains hid it from the road (Fig 7) and separated it from Lake Van on the north and Tatvan City on the west.

A primary school was located at its entrance (Fig 8). A

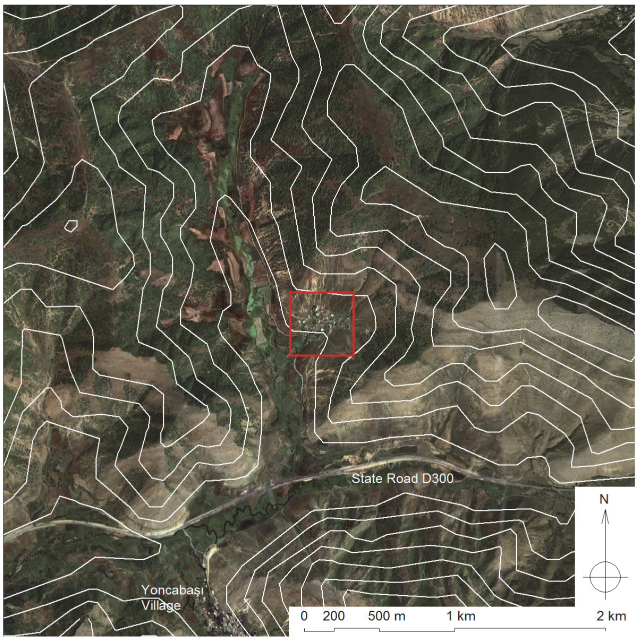

Fig 4. Aerial photography and topography of Çevre Village 1:50,000. See Fig. 5 for closeup in framed rectangle.
Aerial photography in 2009: Google Map (2013) © 2013 Google, Image © 2013 GeoEye, © 2013 Cnes/Spot Image
Contours (50 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

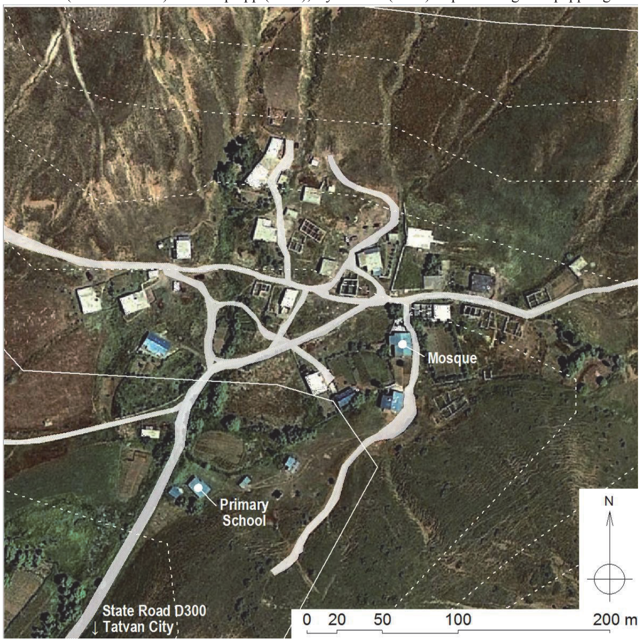

Fig 5. Closeup aerial photography, contours and map of Çevre Settlement 1:5,000.
Aerial photography in 2009: Google Earth (2009) © 2013 Google, Image © 2013 GeoEye
Contours (10 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

Fig 6. Appearance of Çevre Settlement to the south.

Fig 7. Path from state road to Çevre Settlement. Because the settlement was surrounded by mountains, it was invisible from the state road

Fig 8. Primary school at entrance of Çevre Settlement.

Fig 9. Mosque at center of Çevre Settlement with simple gabled building and a different appearance from other houses.

Fig 10. Houses spread on a slope facing south in Çevre Settlement.

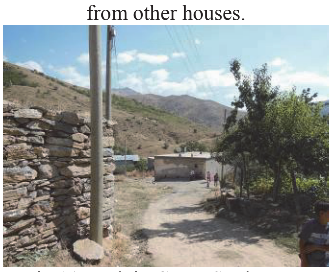

Fig 11. Path in Çevre Settlement.

Fig 12. Crofts found everywhere in Çevre Settlement.

mosque was located at its center from which paths branched out (Fig 9); houses spread along the paths (Fig 10, 11). The settlement's spatial compositions were centered around the mosque. Crofts were found everywhere in the settlement (Fig 12) where such crops as cucumbers and watermelons were cultivated.

Buildings: Most of the houses in the settlement were two stories, which is common in Turkey. There were a few one-storied houses, which is common in many settlements of the Eastern Anatolia Region. The traditional houses had downstairs of stone masonry construction and upstairs of brick masonry construction (Fig 13). Many houses had collapsed roofs due to the past forced migrations (Fig 14), but some had been repaired (Fig 15). There were only minimal land formations with low retaining walls because many houses had downstairs, parts of which were under slopes (Fig 16, 17). Many houses had flat roofs and rectangular windows. Few livestock barns were found, which are common in many Eastern Anatolia Region settlements.

The mosque, a simple gabled building built in 1978, before the forced migrations, had a different appearance from the other houses (Fig 9). It was approached through a courtyard enclosed by low walls and had no minaret.

The settlement's population was increasing due to the government's "Return to Village and Rehabilitation Project". However, some traditional houses, which had collapsed, in the settlements had been abandoned, and some completely different new houses were built on the settlement's outer side (Fig 18).

3.3. ARAN

3.3.1. Document Search (GeoMapApp, 2013; Google Earth, 2011; Google Map, 2013; Vikipedi, 2013a)

Aran Village, which is about 15 km north of Mardin City, has an altitude of around 1,000 m. It is in a valley surrounded by low mountains (Fig 19). The settlement was called Zonê in Kurdish (Wîkîpediya, 2012b), and a road penetrates it. Most of its houses are spread on a southeast-facing slope at about 10º located on the mountainside from the road, and plowlands are spread on the valley side (Fig 20). The village has many walnut trees and vineyards, and its population was 1,395 in 2000 (Vikipedi, 2013a) and 1,101 in 2012 (Turkish Statistical Institute, 2013).

3.3.2. Field Survey (August 27, 2012)

Entire Settlement: The village was approached by a road that directly penetrated it (Fig 20). Most of the settlement's houses were spread on a southeast-facing slope located on the mountainside (Fig 21). The valley side with plowlands was hidden by leafy trees (Fig 22). In the settlement, I found several rows of houses located on a slope. Winding contoured paths and steep slope paths perpendicular to the contours threaded through the houses and sometimes diverged (Fig 23, 24, 25). Most of the paths were dirt. There were a mosque and shop in the rows of houses around the bottom of the slope (Fig 23, 26, 27). Few paths branched from the mosque or square, and the settlement's spatial composition lacked a well-defined center unlike the previously reported settlements (Suzuki & Okazaki, 2012a, 2012b). A primary school was located on the east outside of the settlement (Fig 20).

Buildings: Many houses were two stories, and some had three stories. The traditional houses were stone masonry construction, and many had arched windows (Fig 28, 29). I only found minimal land formations with low retaining walls because many buildings had ground floors, parts of which were under slopes (Fig 30). Many of the semi-underground floors were used for livestock like horses and chickens (Fig 29), but some were used as garbage dumps (Fig 31). Many houses with extensions or reconstructions had existing stone ground floors and added brick or concrete upper floors (Fig 30, 31). The upper floors had

Fig 13. Traditional stone house downstairs and brick upstairs in Çevre Settlement.

Fig 14. House with roofs collapsed in Çevre Settlement.

Fig 15. Traditional house converted and reused in Çevre Settlement.

Fig 16. Houses with downstairs partly under slope in Çevre Settlement.

Fig 17. Houses partly under slope in Çevre Settlement.

Fig 18. Completely different new house from traditional houses on outer side of Çevre Settlement.

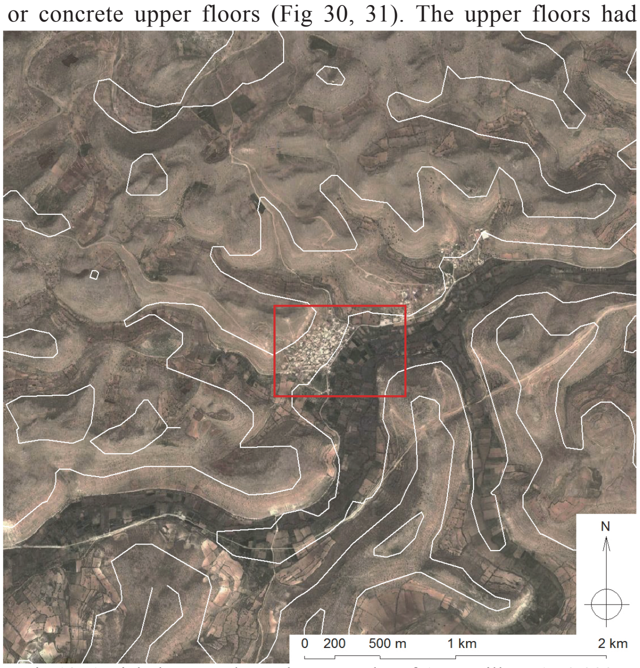

Fig 19. Aerial photography and topography of Aran Village 1:50,000. See Fig. 20 for closeup in framed rectangle.
Aerial photography in 2011: Google Map (2013) © 2013 Google, Image © 2013 GeoEye, Image © 2013 DigitalGlobe
Contours (50 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

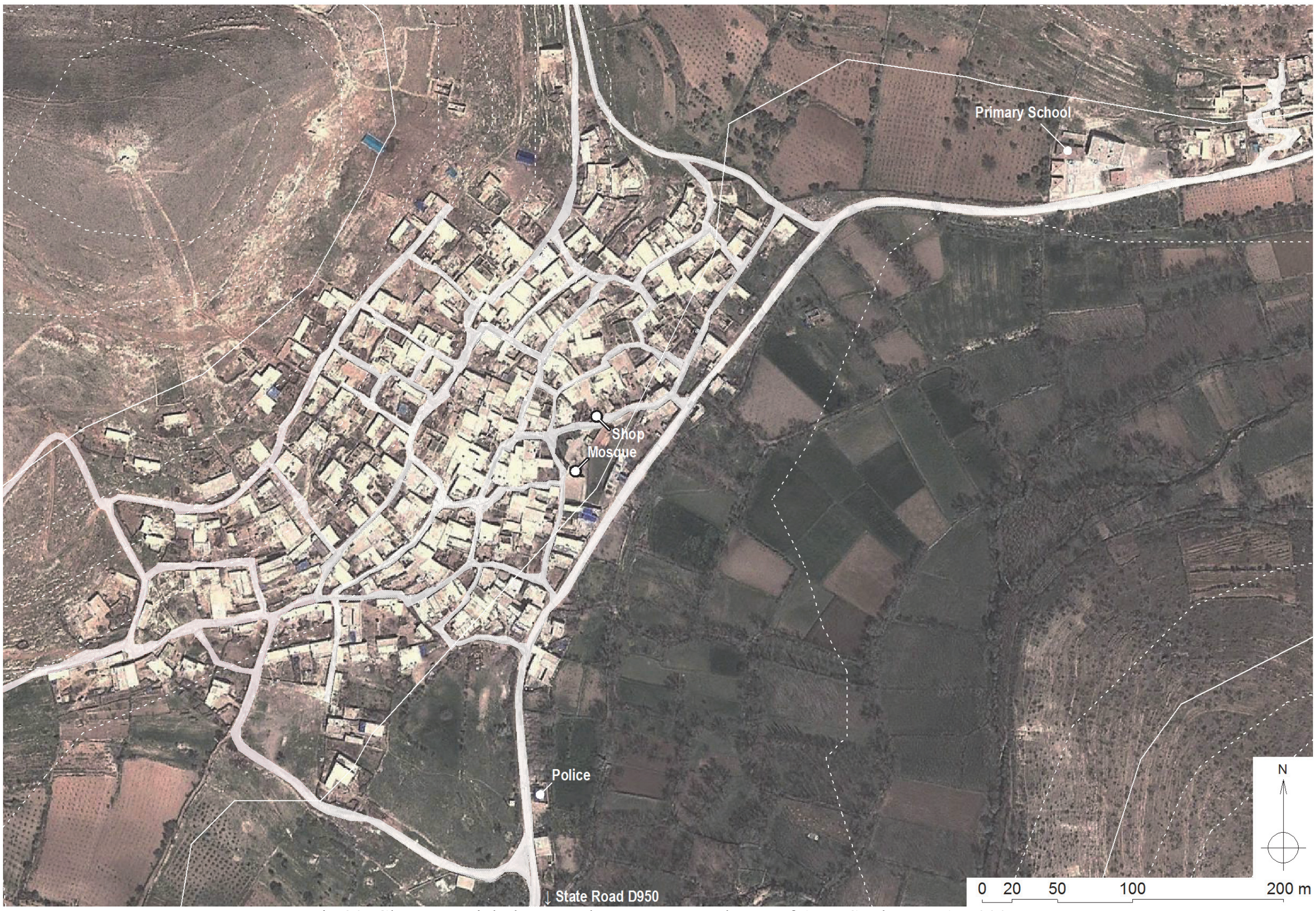

Fig 20. Closeup aerial photography, contours and map of Aran Settlement 1:5,000.
Aerial photography in 2011: Google Earth (2011) © 2013 Google, Image © 2013 GeoEye, Contours (10 m intervals): GeoMapApp (2013), Ryan et al. (2009) http://www.geomapapp.org

Fig 21. Appearance of Aran Settlement to the south. Houses with colored walls and flat roofs lined up on slopes created a sense of unity and composed a unique landscape when viewed from outside the settlement.

Fig 22. Road directly penetrated the Aran Village. Plowlands on right were impenetrable because of leafy trees.

Fig 23. Contoured path in Aran Settlement.

rectangular windows, and some had walls painted various colors (Fig 32, 33). The settlement's houses had flat roofs; no pitched roofs were found. Some of their rooftops were used as terraces (Fig 34). Houses with colorful walls and flat roofs lined up on slopes created a sense of unity and composed a unique landscape when viewed from outside the settlement (Fig 21).

The mosque had a walled courtyard. It was entered from a path higher than it and through the wooded courtyard and had a downstairs (Fig 35). The mosque's minaret was very high (Fig 23). However, the mosque itself looked very short from the path because it had only one story and was semi-underground (Fig 26).

4. Discussion

4.1. SIMILARITIES BETWEEN THE TWO SETTLEMENTS

The document researches and field surveys showed the following similarities of spatial compositions between the Çevre and Aran Settlements:

4.1.1. Similarity between Entire Settlements

(1) Primary schools with playgrounds are on the outer side of the settlements (Çevre: Fig 5, Aran: Fig 20) as with the previously reported settlements on slopes (Suzuki & Okazaki, 2012a, 2012b).

4.1.2. Similarities between Buildings

(2) Many of the houses have two stories, as in many Turkish


Fig 24. Contoured path in Aran Settlement.


Fig 25. Steep slope path perpendicular to contours in Aran Settlement.


Fig 26. Mosque around bottom of slope in Aran Settlement.


Fig 27. Shop around bottom of slope in Aran Settlement.

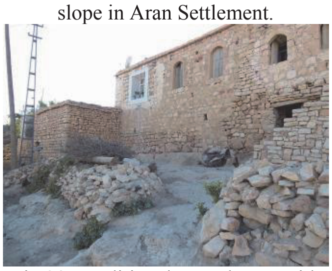
Fig 28. Traditional stone house with arched windows in Aran Settlement.


Fig 29. Traditional house, whose semi-underground first floor was used for livestock in Aran Settlement.


Fig 30. Concrete extensions or reconstructions to upper floor in Aran Settlement.


Fig 31. Semi-underground first floor used as dump in Aran Settlement.


Fig 32. Upper floor partly extended or reconstructed and painted white in Aran Settlement.


Fig 33. Upper floor and wall painted burgundy in Aran Settlement.

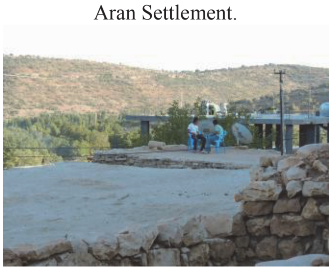
Fig 34. Rooftop used as terrace in Aran Settlement.


Fig 35. Wooded courtyard in front of mosque in Aran Settlement.

settlements including the Black Sea and Central Anatolia Regions (Suzuki & Okazaki, 2012a, 2012b). On the other hand, there are many one-storied houses in Erzurum and Ağrı Provinces on the north side of Bitlis Province with Çevre Settlement, even though Erzurum and Ağrı are in Eastern Anatolia Region like Bitlis. Bitlis is separated from the provinces on the north-east side by the vast Lake Van and steep mountains, and seems influenced by the Southeast Anatolia and Central Anatolia Regions on the west. I also found some three-storied houses in Aran Settlement.

(3) I only observed minimal land formations with low retaining walls because many houses have ground floors, parts of which are under slopes (Çevre: Fig 16, 17, Aran: Fig 30). I also found such houses in the previously reported settlements of the Black Sea and Central Anatolia Regions.

(4) Many houses have flat roofs, unlike settlements where pitched roofs are popular as in the Black Sea and Central Anatolia Regions. Even in the Eastern Anatolia Region, many settlements have pitched roofs in Erzurum and Ağrı Provinces. However, they are less common in Çevre and Aran Settlements.

(5) The mosque is approached through a walled courtyard (Çevre: Fig 9, Aran: Fig 26, 35). However, the houses have no such courtyards. I found no walled courtyards in front of mosques in the previously reported settlements of the Black Sea Region.

4.1.3. Discussion about Similarities

I found some similarities of spatial compositions between the two settlements. (1) in Section 4.1.1 and (2) and (3) in Section 4.1.2 are shared with those in the Black Sea and Central Anatolia Regions, but not (4) and (5).

4.2. DIFFERENCES BETWEEN THE TWO SETTLEMENTS

The climate, history, lifestyles, and cultures of the two settlements differ, and the following differences of spatial composition were found:

4.2.1. Differences between Entire Settlements

(1) There is only one main road for approaching Çevre Settlement (Fig 4). In contrast, Aran settlement can be approached by more than one road directly penetrate it (Fig 20, 22). In each of the previously reported farming or forestry settlements (Suzuki & Okazaki, 2012a, 2012b) like in Çevre, the surrounding plowlands or forests are connected by roads, but the settlement can only be approached by one main road.

(2) In Çevre Settlement, paths branch from its center around the mosque (Fig 5). However, contoured winding paths and steep slope paths perpendicular to the contours thread through the houses in Aran Settlement (Fig 20, 23, 24, 25), and its spatial composition has no well-defined center. It is centered around the mosque or a square in the previously reported farming or forestry settlements.

(3) Even though crofts were found everywhere in Çevre Settlement (Fig 12), few were found in Aran Settlement. But in Aran, plowlands are gathered outside of like in the previously reported farming or forestry settlements. Çevre was deserted three times during forced migrations but its population has increased due to a government program called "Return to Village and Rehabilitation Project". I found no relationship between the crofts and these migrations.

4.2.2. Differences between Buildings

(4) In Çevre Settlement, traditional houses have downstairs of stone masonry construction and brick upstairs (Fig 13). However, both are stone masonry construction in Aran Settlement (Fig 28, 29). In the settlements of the Black Sea and Central Anatolia Regions, the upstairs were wooden construction (Suzuki & Okazaki, 2012a, 2012b).
(5) Most of the houses in Çevre Settlement have rectangular windows as the previously reported settlements, but many arched windows were found in Aran Settlement (Fig 28, 29). Even in Aran, upper floors have extensions or reconstructions in recent decades whose windows are mostly rectangular (Fig 30, 31, 32, 33).
(6) In Çevre Settlement, the traditional houses that have collapsed remain, and completely different new houses have been built on the outer side (Fig 14, 18). In contrast, in Aran Settlement, many houses with extensions or reconstructions have existing stone ground floors and added brick or concrete upper floors (Fig 30, 31). Some of the upper floors have walls painted various colors (Fig 32, 33). However, houses with such walls and flat roofs lined up on slopes create a sense of unity and compose a unique landscape when viewed from outside the settlement (Fig 21).
(7) In Çevre Settlement, finding livestock barns is difficult. Both upstairs and downstairs of the houses in Çevre seem to be inhabited as in the previously reported settlements of the Black Sea and Central Anatolia Regions. On the other hand, many houses in Aran Settlement use their ground floors for livestock or garbage and seem uninhabited (Fig 29, 31).
(8) The mosque in Çevre Settlement is a simple gabled building whose appearance is different from the other houses (Fig 9). In the previously reported settlements of the Black Sea Region, the forms and colors of the mosques were completely different from the houses. The mosque in Aran Settlement only has one story, but it has a flat roof and a semi-underground floor like other houses (Fig 26, 35).

4.2.3. Discussion about Differences

(1) and (2) in Section 4.2.1 and (7) in Section 4.2.2 seem to reflect differences between the Çevre Settlement for farming and the Aran Settlement for pastoralism. (4) and (5) seem due to cultural differences in architecture between Cevre around Lake Van and Aran in the Southeastern Anatolia Region. (6) probably reflects Çevre's forced migrations.

5. Conclusions

To understand the spatial composition of intermountain settlements on slopes with relatively high winter precipitation (Fig 3) in Turkey's Eastern and Southeastern Anatolia Regions, I conducted document searches and field surveys in the Çevre Village in Bitlis and the Aran Village in Mardin and discussed my results. I clarified the following:
(1) I found the following similarities of spatial composition between the two settlements and previously reported settlements in the Black Sea and Central Anatolia Regions: (a) primary schools on the outer side of the settlements (Çevre: Fig 5, Aran: Fig 20); (b) many houses with two stories; and (c) only minimal land formations because a lot of buildings have ground floors, parts of which are built into the slope. (Çevre: Fig 16, 17, Aran: Fig 30).
(2) I found these two differences in spatial composition of the two settlements from the previously reported settlements: (a) many houses with flat roofs and (b) a mosque approached through a walled courtyard (Çevre: Fig 9, Aran: Fig 26, 35).
(3) I found many differences of spatial composition between Çevre as a farm settlement and Aran as a pastoral settlement: (a) Çevre has only one main approaching road (Fig 4), but Aran is penetrated by a road and has approaches from two directions (Fig 20, 22); (b) in Çevre, paths are branched around the center of the mosque (Fig 5); but in Aran, contoured winding paths and steep slope paths perpendicular to the contours can be found (Fig 20, 23, 24, 25); (c) in Çevre, it is difficult to find livestock barns; but in Aran, a lot of houses have ground floors for livestock (Fig 29). Because the features of Çevre in (a) and (b) were also found in the previously reported settlements of the Black Sea and Central Anatolia Regions, they seem to be characteristics of farm settlements on the slopes.
(4) In Çevre, crofts were found everywhere (Fig 12). However in Aran, there are plowlands outside and few crofts were found inside the settlement.
(5) In Çevre, traditional houses have stone downstairs and brick upstairs (Fig 13); however, in Aran their downstairs and upstairs are stone masonry construction (Fig 28, 29). In Çevre, almost all houses have rectangular windows like the previously reported settlements; however, in Aran many arched windows were found.
(6) In Çevre, the traditional houses have collapsed, and completely different new houses have been built on the outskirts (Fig 14, 18). In contrast, in Aran many houses have existing stone ground floors and added brick or concrete upper floors (Fig 30, 31). Some of the upper floors have walls painted in various colors (Fig 32, 33). However, houses with colorful walls and flat roofs on slopes create a sense of unity and compose a unique landscape when viewed from outside the settlement (Fig 21).
(7) In Çevre, the mosque is a simple gabled building whose appearance is different from the other houses (Fig 9). In Aran, the mosque is only one story, but it has a flat roof and a semi-underground floor like the other houses (Fig 26, 35).

I found many differences of spatial composition between the two settlements. They seem to reflect differences between farming and pastoral settlements, regional cultures in architecture, and their histories, such as the forced migrations in Çevre.

As stated in the introduction, I also conducted document searches and field surveys on two other settlements. Next I must comprehensively clarify the spatial compositions of the intermountain settlements on slopes in the Eastern and Southeastern Anatolia Regions by discussing the four settlements.

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Enclosed Spaces of Ancient Japanese Cites and Watersheds: Analysis of Mountain Ranges and Water Systems of Kyoto, Nara, Dazaifu, and Kamakura Using a Three-dimensional Terrain Model

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Keywords: enclosed space, watershed, basin area, mountain range, water system, Kyoto, Nara, Dazaifu, Kamakura

Abstract: In this paper, we used a three-dimensional terrain model to study the relationships between the enclosed spaces of Kyoto, Nara, Dazaifu, and Kamakura and their watersheds. Most previous studies used two-dimensional maps and concluded that these four cities have similar enclosed spaces surrounded by mountains. However, in this study, we analyzed enclosed spaces through watersheds in a wide area using a three-dimensional terrain model and clarified the following points: 1) The Kyoto's basin area is about nine times as large as that of the Nara Basin. 2) Dazaifu's enclosed space is open to the southeast and the northwest, and its basin area is much smaller than Kyoto and cannot store water like the other three cities. 3) Kamakura's enclosed space is surrounded by mountains in three directions and can store water, but its basin area is the smallest among the four cities. 4) Kyoto has the largest basin area among the four cities.

1. Introduction

1.1. BACKGROUND AND OBJECTIVE

In this paper, we used a three-dimensional model to study the relationships among the enclosed spaces of Kyoto, Nara, Dazaifu, and Kamakura and their watersheds.

An enclosed space surrounded by mountains is one of the characteristics of cities in East Asia. We previously studied the relationships between Feng-Shui[1] and the enclosed spaces of Seoul, Keasong, Changan, Kyoto, and Nara (Tembata and Okazaki, 2012, 2011a, 2012b). In Feng-Shui, an enclosed space surrounded by mountains is considered ideal, because its surrounding mountains can protect it from wind and it can store water. In this paper, we analyzed such enclosed spaces through their watersheds.

Most previous studies used two-dimensional maps around cities and concluded that Kyoto, Nara, Dazaifu and Kamakura have similar enclosed spaces. However, we analyzed the enclosed spaces of these cities through watersheds in a wide area using a three-dimensional terrain model, which, to the best of our knowledge, have never been done before.

We believed that this study identifies useful knowledge for city planning and landscape conservation in future Japan.

1.2. LITERATURE REVIEW

Most previous studies used two-dimensional maps to study enclosed spaces of ancient Japanese cities. There are few studies that analyzed mountain ranges and water system of enclosed spaces using three-dimensional terrain models.

Higuchi (1975) concluded that Nara, Kyoto, and Kamakura have similar enclosed spaces and belong to the Zofu-Tokusui[2] type. Mezaki (1998) concluded that Nara, Kyoto, and Kamakura were influence by Feng-Shui and have similar enclosed spaces. Mori (2003) concluded that Dazaifu has an enclosed space that is similar to Nara and Kyoto. Kawasumi (2011) used a three dimensional urban model and clarified that the realationship between shapes of mountains and the Heian-kyo's central axes, but he did not analyze the water system of Kyoto's enclosed space.

2. Methods

2.1. OBJECTIVE

In this paper, we compare Kyoto (Heian-kyo), Nara (Fujiwara-kyo and Heijo-kyo), Dazaifu and Kamakura to clarify the relationships among their enclosed spaces, which are surrounded by mountains and their watersheds. All four cities have enclosed spaces and are typical Japanese ancient or premedieval cities. Fig. 1 shows the positions of these four cities in Japan.

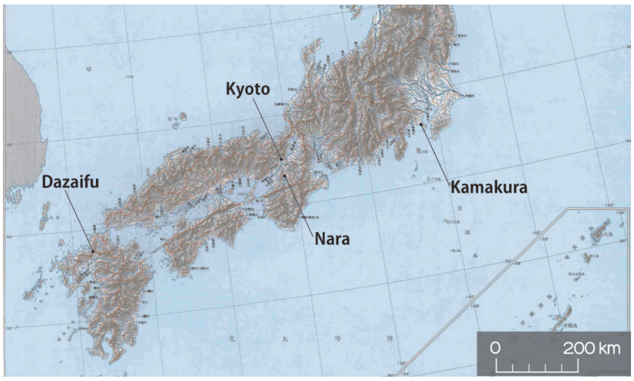


Fig. 1 Positions of Kyoto, Nara, Dazaifu, and Kamakura (based on Geospatial Information Authority of Japan, 1990)

2.2. METHODS

Based on Google Earth, we made a three-dimensional terrain model of the topography to show the enclosed spaces of the four cities. A three-dimensional CG perspective can show spaces that are not expressed in words or by a two-dimensional map. We confirmed the precision of our three-dimensional terrain models by fieldwork or references. Our discussion focused on watersheds in a wide area.

3. Discussion

3.1. KYOTO AND NARA

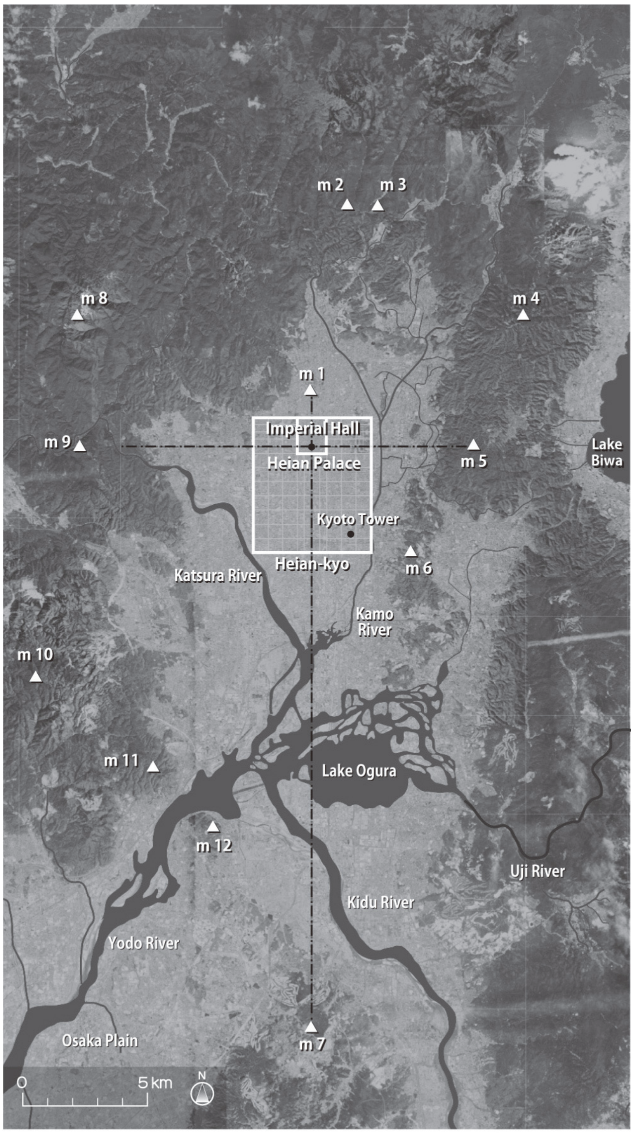
3.1.1. Enclosed space of Kyoto (Heian-kyo)

Kyoto (Heian-kyo) was Japan's capital from 794-1868.

Figure 2 shows a topographical map of Heian-kyo, which is located on the north side of the Kyoto Basin. Its enclosed space is surrounded by mountain ranges on its north, west and east sides and is open to the south side. Kyoto is surrounded by the following mountains: north Kitayama mountain ranges, including Mt. Kibune (700 m) and Mt. Kurama (584 m), east Higashiyama mountain ranges, including Mt. Hiei (848 m), Mt. Daimonji (466 m), and Mt. Inari (232 m), west Nishiyama mountain ranges, including Mt. Atago (924 m), Mt. Sanjogamine (482 m), Mt. Kamose (679 m), and Mt. Tenno (270 m), and a south hilly area, including Mt. Kamnabi (221 m) and Mt. Otoko (143 m). The central axis matches the top of Mt. Funaoka (113 m).

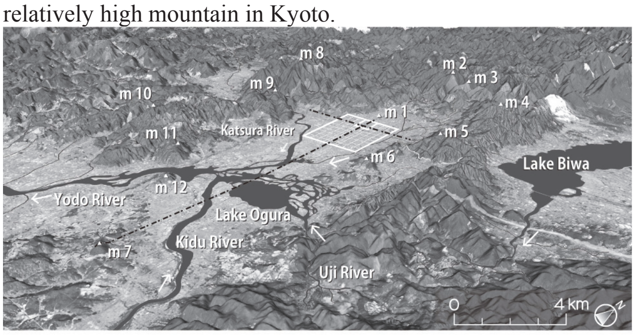
Figure 3 shows a birds-eye view of a three-dimensional terrain model of the enclosed space of Heian-kyo across the Kyoto Basin. The Kamo River flows on the east side of Heian-kyo, and the Katsura River flows on the west side from north to south, because the enclosed space's north side has a higher altitude than the south side. The Kamo and the Katsura Rivers join the Uji River near Lake Ogura, which has been drained. On the west side of Lake Ogura, the Uji and Kidu Rivers join the Yodo River and flow between Mt. Otoko and Mt. Tenno into the Osaka Plain.

Figure 4 shows a view from Mt. Hiei. Fig. 5 shows a view from Kyoto Tower (observation deck, altitude 100 m). West Mt. Atago and Northwest Mt. Hiei are conspicuously seen in a relatively high mountain in Kyoto.



m 1: Mt. Funaoka (113 m) m 5: Mt. Daimonji (466 m) m 9: Mt. Sanjogamine (482 m)
m 2: Mt. Kibune (700 m) m 6: Mt. Inari (232 m) m 10: Mt. Kamose (679 m)
m 3: Mt. Kurama (584 m) m 7: Mt. Kamnabi (221 m) m 11: Mt. Tenno (270 m)
m 4: Mt. Hiei (848 m) m 8: Mt. Atago (924 m) m 12: Mt. Otoko (143 m)

Fig. 2 Topographical map of Heian-kyo (based on Google Maps and Geospatial Information Authority of Japan)



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m 4: Mt. Hiei (848 m) m 8: Mt. Atago (924 m) m 12: Mt. Otoko (143 m)

Fig. 3 Three-dimensional terrain model of enclosed space of Heian-kyo (based on Google Earth[3])

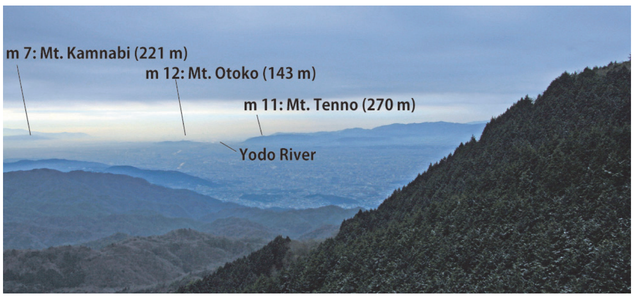


Fig. 4 Overview of Kyoto Basin from Mt. Hiei (photo by author, 2013)

Fig. 5 Overview of Kyoto Basin from Kyoto Tower (based on photos by author, 2004)

3.1.2. Enclosed space of Nara (Fujiwara-kyo and Heijo-kyo)

Fujiwara-kyo was the capital city of Japan from 694-710. Heijo-kyo was the capital city of Japan from 710-740 and again from 745-784.

Figure 6 shows a topographical map of Fujiwara-kyo and Heijo-kyo across the Nara Basin.

Fujiwara-kyo, which is located in the south side of Nara Basin, is surrounded by the Three Mountains of Yamato: to the north Mt. Miminashi (139 m), to the east Mt. Amanokagu (152 m), and to the west Mt. Unebi (199 m). In its more outlying areas, Fujiwara-kyo is surrounded by the following mountains: northeast Mt. Miwa (467 m), eastern mountain ranges including Mt. Otowa (851 m), on the south side, Ochioka Hill (150 m) and mountain ranges including Mt. Oharetsu (618 m), to the far south Mt. Yoshino (500 - 900 m), and to the west mountain ranges including Mt. Nijo (517 m), Mt. Katsuragi (959 m), and Mt. Kongo (1125 m).

Heijo-kyo, which is located on the northern side of the Nara Basin and has an enclosed space, is surrounded by mountain ranges on its north, west and east sides and is open to the south: to the north, Mt. Nara (90 - 100 m), to the east, mountain ranges including Mt. Wakakusa (342m), and Mt. Miwa, to the west, Mt. Matsuo (315 m) and mountain ranges including Mt. Ikoma (643 m) and Mt. Shinki (437 m), to the far southwest, mountain ranges including Mt. Nijo, Mt. Katsuragi, and Mt. Kongo, and to the far south Mt. Yoshino.

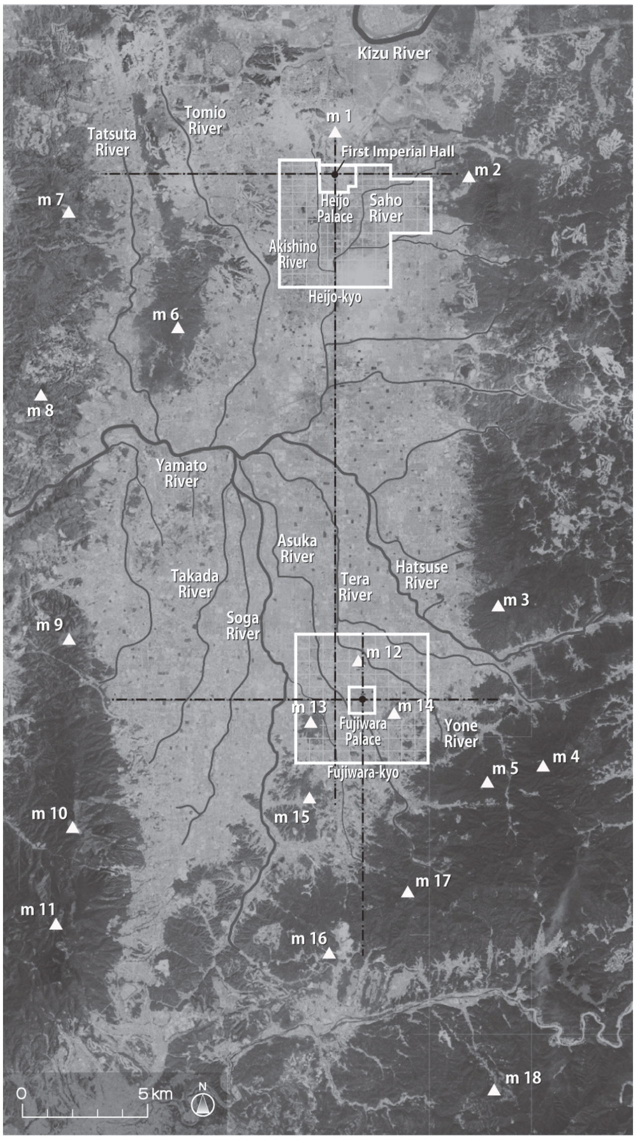
Figure 7 shows a birds-eye view of a three-dimensional terrain model of the enclosed space of Fujiwara-kyo and Heijo-kyo across the Nara Basin.

The south side of Fujiwara-kyo's enclosed space has a higher altitude than the north side. The Asuka River in the center of the city area and the Yone River on the northeast side flow from southeast to northwest. Outside of the city, to the east, the Tera and Hatsuse Rivers flow from southeast to northwest, and to the west the Soga and Takada Rivers flow from south to north. All six rivers join the Yamato River at the center of the Nara Basin.

In Heijo-kyo, the north side of its enclosed space has a higher altitude than the south side. The Saho and Akishino Rivers flow through Heijo-kyo from north to south and join the Yamato River at the center of the Nara Basin. Outside of the city area, to the west, the Tomio and Tatsuta Rivers flow from northeast to southwest. All four rivers join the Yamato River at the center of the Nara Basin. The Yamato River flows from east to west and flows into the Osaka Plain. In the enclosed space of Heijo-kyo, Mt. Nara to the north is lower than the east-west mountain ranges. In the entire Nara Basin, the south side is higher than the north side.

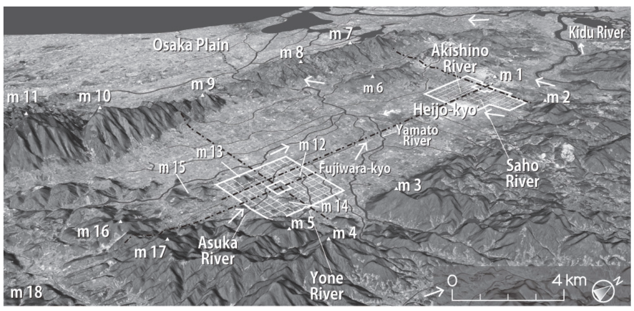
Figure 8 shows the Nara Basin from the ruins of Fujiwara Place. To the north Mt. Miminashi, to the east Mt. Amanokagu, and to the west Mt. Unebi are seen closely. Outside of the three mountains, western mountain ranges from Mt. Nijo to Mt. Kongo, to the east Mt. Otowa and to the south Mt. Yoshino are seen. To the northwest Mt. Ikoma and to the northeast mountain ranges from Mt. Wakakusa to Mt. Miwa can be seen in the distance.

Figure 9 shows the Nara Basin from the First Imperial Hall, which was restored in 2010. Heijo-kyo is surrounded in three directions by mountains. The mountain ranges on the south side are more prominent than those on the north side. To the south, Mt. Kongo and Mt. Yoshino are conspicuously seen as relatively high mountains in Nara. Rolling mountains on the east and west sides and high mountains on the south side enclose Heijo-kyo.



m 1: Mt. Nara (90 - 100 m)	m 7: Mt. Ikoma (643 m)	m 13: Mt. Unebi (199 m)
m 2: Mt. Wakakusa (342 m)	m 8: Mt. Shinki (437 m)	m 14: Mt. Amanokagu (152 m)
m 3: Mt. Miwa (467 m)	m 9: Mt. Nijo (517 m)	m 15: Ochioka Hill (150 m)
m 4: Mt. Otoha (851 m)	m 10: Mt. Katsuragi (959 m)	m 16: Mt. Atago (258 m)
m 5: Mt. OHaretsu (618 m)	m 11: Mt. Kongo (1125 m)	m 17: Mt. Takatori (584 m)
m 6: Mt. Matsuo (315 m)	m 12: Mt. Miminashi (139 m)	m 18: Mt. Yoshino (500 - 900)

Fig. 6 Topographical map of Fujiwara-kyo and Heijo-kyo (based on Google Maps and Geospatial Information Authority of Japan)



m 1: Mt. Nara (90 - 100 m)	m 7: Mt. Ikoma (643 m)	m 13: Mt. Unebi (199 m)
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m 4: Mt. Otoha (851 m)	m 10: Mt. Katsuragi (959 m)	m 16: Mt. Atago (258 m)
m 5: Mt. OHaretsu (618 m)	m 11: Mt. Kongo (1125 m)	m 17: Mt. Takatori (584 m)
m 6: Mt. Matsuo (315 m)	m 12: Mt. Miminashi (139 m)	m 18: Mt. Yoshino (500 - 900)

Fig. 7 Three-dimensional terrain model of enclosed space of Fujiwara-kyo and Heijo-kyo (based on Google Earth[3])

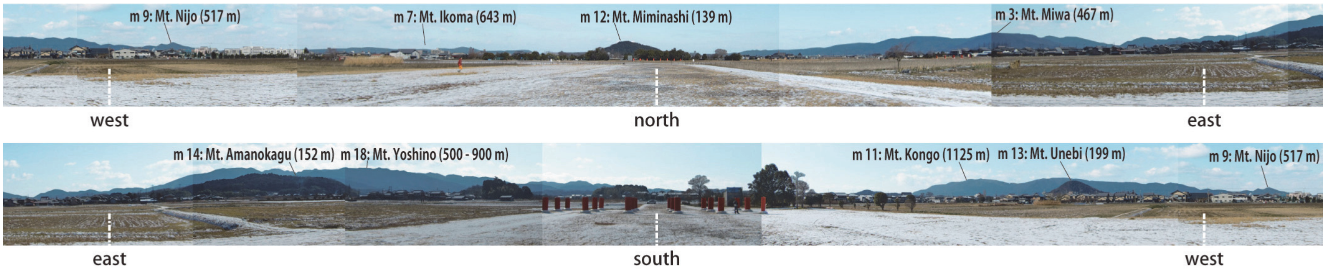


Fig. 8 Overview of Nara Basin from ruins of Fujiwara Place (based on photos by author, 2011)

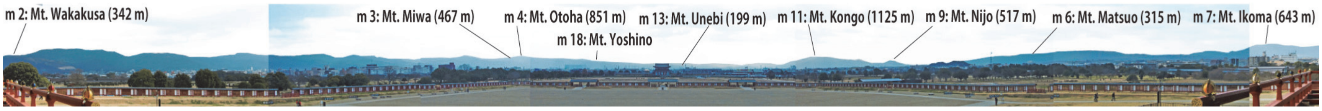


Fig. 9 Overview of Nara Basin from First Imperial Hall (based on photos by author, 2011)

3.1.3. Watersheds of Kyoto and Nara Basins

Figure 10 shows a topographical map of the Kinai area, which refers to the ancient provinces around the Nara and Heian-kyo capitals. Fig. 11 shows a birds-eye view of a three-dimensional terrain model of the Kinai area. These figures show the watersheds of the Kyoto and Nara Basins in a wide area.

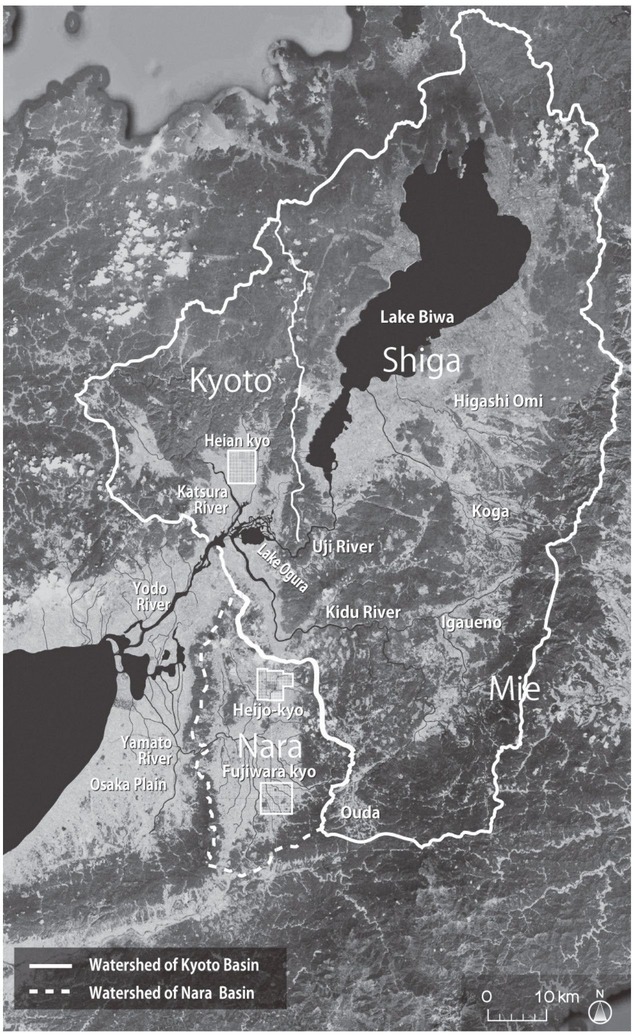


Fig. 10 Watersheds of Kyoto and Nara Basins (based on Google Maps and Geospatial Information Authority of Japan)

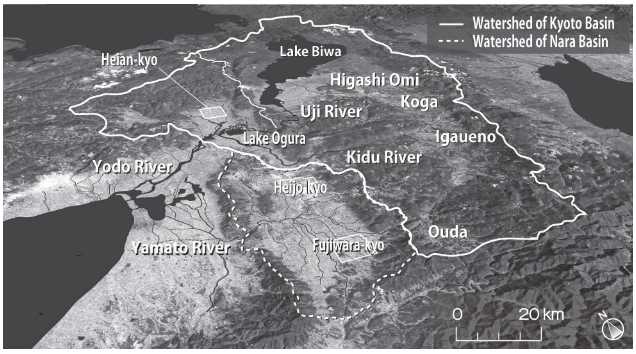


Fig. 11 Three-dimensional terrain model of Kyoto and Nara Basins (based on Google Earth)

The basin area of the water flowing into the Kyoto Basin includes the domain of its penumbra. It also stretches beyond the domain to include all of Shiga prefecture, the eastern part of Nara prefecture (Ouda), and the northwestern part of Mie prefecture (Igaueno and Koga.) Lake Biwa's water, which is gathered from Shiga, becomes the Uji River and flows into the southern part of the Kyoto Basin. The water of the eastern part of Nara prefecture (Ouda) and the northwestern part of Mie prefecture (Igaueno and Koga) becomes the Kidu River and flows into the southern part of the Kyoto Basin. The water of the penumbra of the Kyoto Basin becomes the Kamo and Katsura Rivers, meets the Kidu and the Uji rivers around what used to be Lake Ogura, joins the Yodo River, and flows into the Osaka Plain. The basin area of the water flowing into the Nara Basin is only the domain of the Nara Basin's penumbra. The Kyoto's basin area is about nine times as large as that of the Nara Basin.

3.2. DAZAIFU

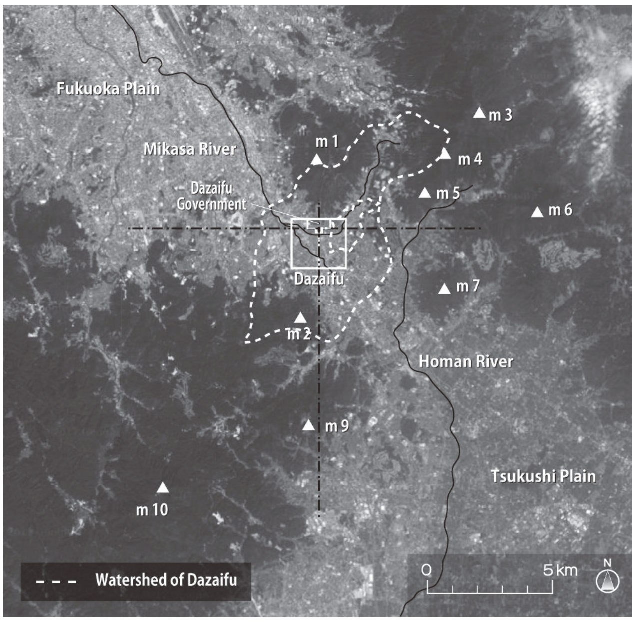
3.2.1. Dazaifu's enclosed space

The Japanese term Dazaifu refers to a regional government in Kyushu from the 8th to the 12th centuries. The town of Dazaifu grew up around the civil and military headquarters of the regional government. During the 8th and 9th centuries, records called Dazaifu the "distant capital."

Figure 12 shows a topographical map of Dazaifu, which is surrounded by the following mountains: to the north, Mt. Shioji (410 m), to the northeast, mountain ranges including Mt. Otake (439 m), Mt. Homan (829 m), and Mt. Sangun (936 m), to the east, Mt. Onechi (652 m) and Mt. Miyachi (335 m), and to the south, Mt. Tenhai (256 m) and Mt. Ki (404 m). Dazaifu is located in a valley between the Fukuoka and Tsukushi Plains in front of Mt. Shioji. Dazaifu is open to the southeast and the northwest.

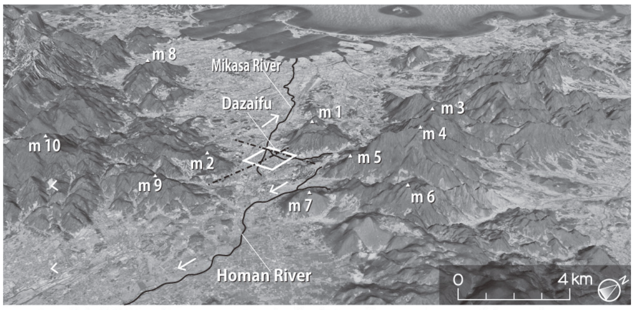
Figure 13 shows a birds-eye view of a three-dimensional terrain model of Dazaifu's enclosed space. In Dazaifu, the south side of its enclosed space has a higher altitude than the north side. Dazaifu's watershed is located in the valley between Mt. Tenhai and Mt. Otake to the south. The Mikasa River flows from the northeast and through in front of the ruins of Dazaifu government from west to east and to the northwest to the west outside of Dazaifu. The Homan River flows on the east side of Mt. Homan from north to south and into the Tsukushi Plain.

Figures 14,15 and 16 show Dazaifu from Mt. Shiouji, Mt. Tenhai and the ruins of Dazaifu Government.



m 1: Mt. Shioji (410 m) m 5: Mt. Otake (439 m) m 9: Mt. Ki (404 m)
m 2: Mt. Tenhai (256 m) m 6: Mt. Onechi (652 m) m 10: Mt. Kusenbu (848 m)
m 3: Mt. Sangun (936 m) m 7: Mt. Miyachi (335 m)
m 4: Mt. Homan (829 m) m 8: Mt. Abura (597 m)

Fig. 12 Topographical map of Dazaifu (based on Google Maps and Geospatial Information Authority of Japan)



m 1: Mt. Shioji (410 m) m 5: Mt. Otake (439 m) m 9: Mt. Ki (404 m)
m 2: Mt. Tenhai (256 m) m 6: Mt. Onechi (652 m) m 10: Mt. Kusenbu (848 m)
m 3: Mt. Sangun (936 m) m 7: Mt. Miyachi (335 m)
m 4: Mt. Homan (829 m) m 8: Mt. Abura (597 m)

Fig. 13 Three-dimensional terrain model of enclosed space of Dazaifu (based on Google Earth[3])

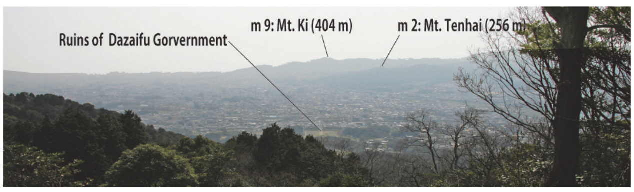


Fig. 14 Overview of Dazaifu from Mt. Shiouji (photo by author in 2013)

Fig. 15 Overview of Dazaifu from Mt. Tenhai (photo by author in 2013)

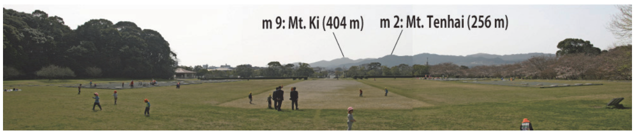


Fig. 16 View from ruins of Dazaifu Government (based on photos by author in 2013)

3.2.2. Dazaifu's Watershed

Figure 17 shows a topographical map of the northern Kyushu area including Dazaifu. Fig. 18 shows a birds-eye view of a three-dimensional terrain model of it. These figures show the watershed of Dazaifu in a wide area.

Dazaifu only has the Mikasa River in a wide area. The water of the east side of the mountain ranges, including nearby Mt. Homan, becomes the Homan River and flows through the Chikushi Plain and joins the Chikugo River. Water cannot gather in Dazaifu's topography like in the Kyoto Basin. The Dazaifu's basin area is much smaller than either the Kyoto or the Nara Basins.

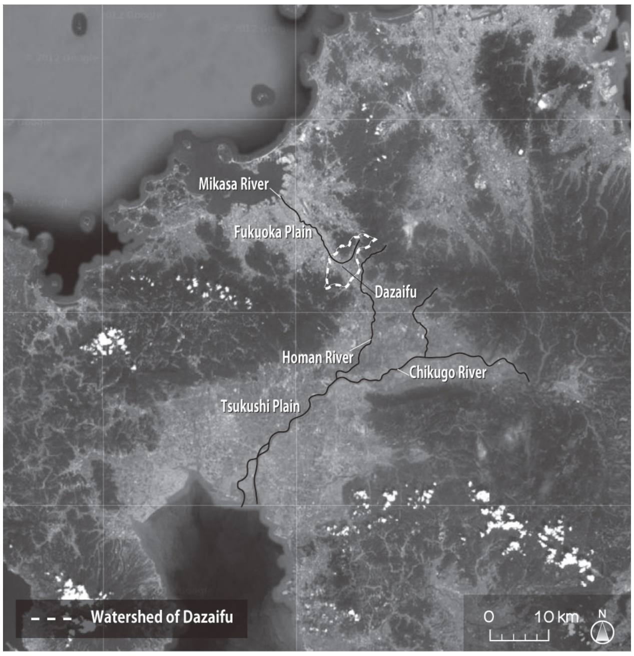


Fig. 17 Watershed of Dazaifu (based on Google Maps)

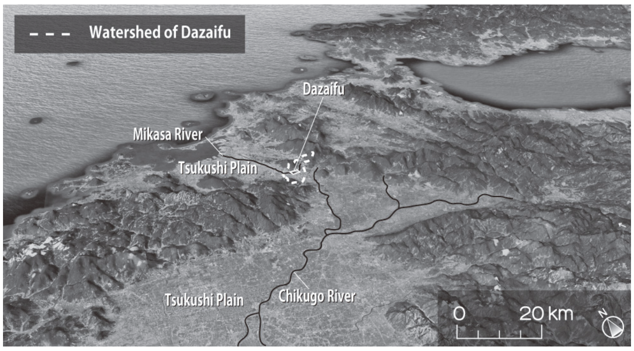


Fig. 18 Three-dimensional terrain model of Dazaifu (based on Google Earth[3])

3.3. KAMAKURA

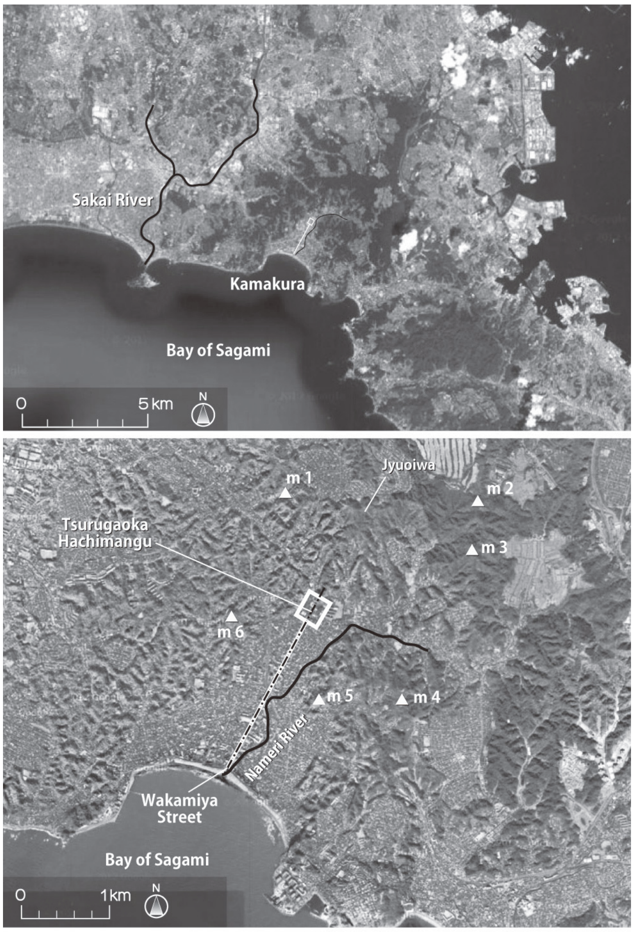
3.2.1. Kamakura's enclosed space.

Kamakura was chosen to be the first shogunate capital of Japan from 1192-1333, because its topography, which is surrounded by mountains in three directions and faces the sea, was suitable for defense.

Figure 19 shows a topographical map of Kamakura, which is surrounded by the following mountains: to the north, mountain ranges including Mt. Rokkokuken (147 m), Mt. Tenhei (159 m), Mt. Tendai (142 m) , to the east mountain ranges including Mt. Kinubari (120 m) and Mt. Gion (58 m), and to the west mountain ranges including Mt. Genji (92 m). Tsurugaoka Hachimangu, which is Kamakura's central shrine, is located in front of the northern mountain ranges. The south side faces the sea.

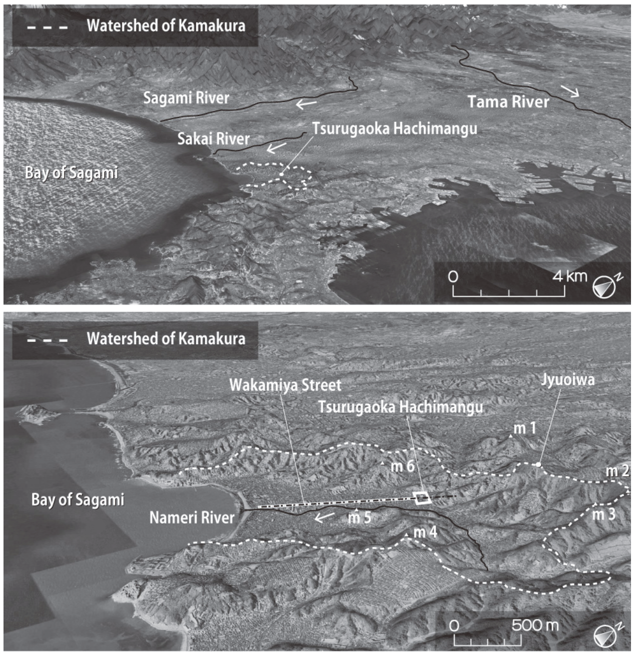
Figure 20 shows a birds-eye view of a three-dimensional terrain model of Kamakura's enclosed space. In Kamakura, the north side of its enclosed space has a higher altitude than the south side. The Nameri River flows to the sea through Kamakura from the northeast to the south. Kamakura's topography can gather water like in the Kyoto Basin.

Figure 21 shows Kamakura from Jyuoiwa in the northern mountains, and Fig. 22 shows it from Mt. Kinubari. Figs. 23 and 24 show Kamakura from the Wakamiya Street and from the Tsurugaoka Hachimangu.



m 1: Mt. Rokkokuken (147 m) m 3: Mt. Tendai (142 m) m 5: Mt. Gion (58 m)
m 2: Mt. Tenhei (159 m) m 4: Mt. Kinubari (120 m) m 6: Mt. Genji (93 m)

Fig. 19 Topographical map of Kamakura (based on Google Maps and Geospatial Information Authority of Japan)



m 1: Mt. Rokkokuken (147 m) m 3: Mt. Tendai (142 m) m 5: Mt. Gion (58 m)
m 2: Mt. Tenhei (159 m) m 4: Mt. Kinubari (120 m) m 6: Mt. Genji (93 m)

Fig. 20 Three-dimensional terrain model of enclosed space of Kamakura (created based on Google Earth[3])

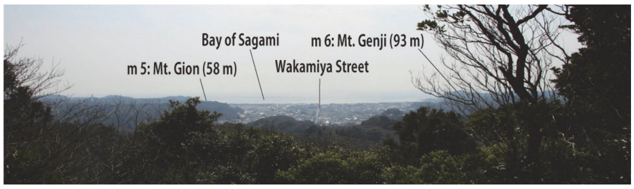


Fig. 21 Overview of Kamakura from Jyuoiwa (photo by author in 2013)

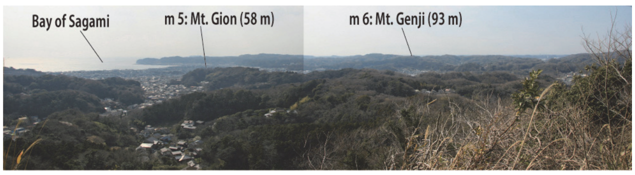


Fig. 22 Overview of Kamakura from Mt. Kinubari (based on photos by author in 2013)

Fig. 23 View of Kamakura from Wakamiya Street (photo by author in 2013)

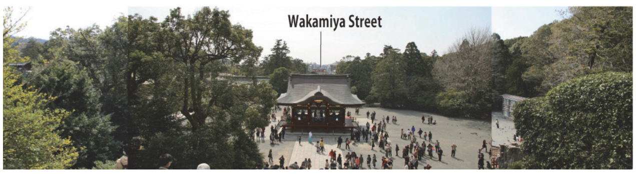


Fig. 24 View of Kamakura from Tsurugaoka Hachimangu (based on photos by author in 2013)

3.3.2. Kamakura's watershed

Figure 25 shows a topographical map of the southern Kanto area including Kamakura. Fig. 26 shows a birds-eye view of a three-dimensional terrain model of it. These figures show the watershed of Kamakura in a wide area.

The basin area of water flowing into Kamakura is only the domain of Kamakura's penumbra. Its basin area is much smaller than either the Kyoto or Nara Basins and smaller than Dazaifu.

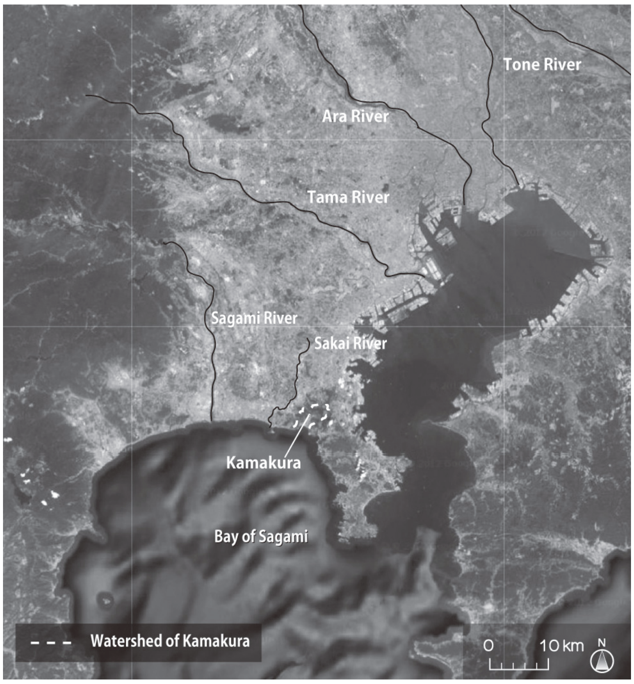


Fig. 25 Watershed of Kamakura (based on Google Maps)

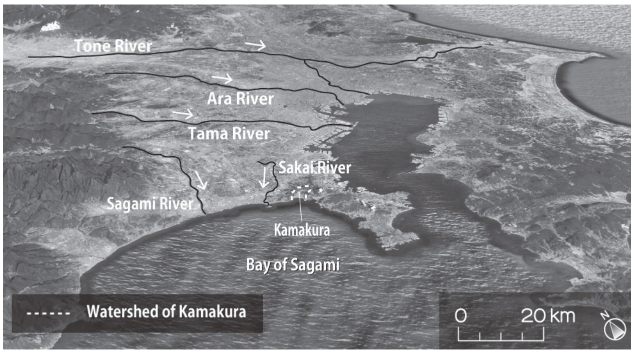


Fig. 26 Three-dimensional terrain model of Kamakura (based on Google Earth[3])

4. Conclusion

We used three-dimensional terrain models to study the relationships among the enclosed spaces of the cities of Kyoto (Heian-kyo), Nara (Fujiwara-kyo and Heijo-kyo), Dazaifu, and Kamakura and their watersheds and clarified the following points:

1) Kyoto (Heian-kyo) and Nara (Fujiwara-kyo and Heijo-kyo) have enclosed spaces that is surrounded by mountains on all four sides in a wide area and can store water. The Kyoto's basin area is about nine times as large as that of the Nara Basin. The Kyoto Basin has much greater water resources than the Nara Basin.
2) Dazaifu has an enclosed space that is open to the southeast and the northwest. Its basin area is much smaller than Kyoto's and cannot store water as the three other cities.
3) Kamakura has an enclosed space that is surrounded by mountains on three directions and can store water, but its basin area is the smallest basin area among the four cities.
4) Kyoto (Heian-kyo) has the largest basin area among the four cities.

Endnotes

1. Feng-Shui is an East Asian system of thought that originated in China and stresses harmony with nature and is also used for selecting locations for cities, houses, and graves (Tembata and Okazaki, 2011a).
2. Higuchi (1975) described it as follows: "Zofu-Tokusui is a term derived from the *fusui* (wind and water) theory, a magical theory of site selection that had a great influence in ancient Japan." (p.167)
3. Unevenness of terrain of three-dimensional models is triply emphasized.

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FPL_Gen: A Computational Tool for Generating Flexible Plan Layouts

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Keywords: Mass housing**.** Computational design."Open Building". Flexibility. Mass customization.

Abstract: In the field of housing construction the unique and tailor-made design and manufacturing has left its place to uniformity and repetition with mass housing. Mass manufacturing and individual design -the two positive aspects in design and production- come together in mass customization. Mass customized housing projects have great potential and it is easier now to design computer tools with promising features. Different approaches can be implemented in these tools and defined relationships and design decisions can be computerized in order to obtain various solutions. In this paper, a design method and a computational tool for generating mass customized housing plan layouts with "Open Building" approach is detailed in which design flexibility and mass customization have been taken into consideration for basic design decisions.

1. Introduction

Mass housing is a widely applied solution to create large number of dwellings in a single project. Even though the idea of building multiple houses as one project is quite ancient, especially after Second World War, rapid growth of urban population the new housing projects emerged all around the world. While in single house an individual habitant is consulted, in mass housing it is mostly designed for average habitant and therefore a generic design is usually implemented. One of the most criticized outcomes of mass housing is generalization and repetition which give the appearance of uniformity.

There are researches and studies in computational design. Especially in housing, mass customization and shape grammars are used in the analysis of different grammars and reproduction of the houses within the same grammar as well as new housing projects (Colakoglu (2001), Duarte (2001), etc.). Shape-grammars and rule-based design also offer a strong foundation for developing computational tools. Computational thinking allows a more flexible solution in terms of generating a rage of various plan types. With the help of precedent studies and applications, a tool is designed and developed while flexibility and mass customization emerges as the very solutions for the criticism of the mass produced uniform houses.

1.1. HOUSING IN TURKEY

Similar mass housing projects can be seen in many countries. In Turkey TOKI[1] (MHDA - Mass Housing Development Administration) is the biggest house supplier constructing more than 500.000 houses for different income groups since 1984 [1]. The rapid growth in urban population in Turkey accompanied with the need of construction for new housing for this population. TOKI tried to solve the housing problem by building systematic housing blocks (mostly medium and high-rise apartment buildings). These mass produced houses solved the basic needs for habitants and improved the life quality of them through solid infrastructure. These apartment blocks are mostly designed by the repetition of a certain house type because of the need of rapid and economic construction.

These houses could not respond efficiently the needs of the households both in the scale of housing block and single house. The reason for this deficiency is the same or similar plan layouts which have been repeated in every floor. These plan layouts do not have the opportunity for change and adaptation according to the needs of household because of the restrictions of the structural system as well as the difficulty and expensiveness of changing or alternating technical systems and infrastructure such as cabling, plumbing, etc.

Alternative households need social support, and the differing needs of households will require new housing and living environment (Unsal Gülmez, 2008). For example, size and number of rooms in the houses in Istanbul is not changed according to the number of household. In short, there isn't any relationship between these two values, which leads us to the discussion of; how much the existing building stock complies the way of life and satisfy the changing needs of today's families.

Construction firms and especially TOKI is criticized of the uniformity of the housing plans and repetition. Considering all these cases, a tool - FPL_Gen - is suggested for generating flexible housing plan layout alternatives which resolves uniformity and repetition in mass housing apartment buildings in Turkey. A computational tool requires definite decision making and defined rules and relationships. So in this tool architectural knowledge and decisions are made based on the demographic and housing studies in Turkey. Flexibility and mass customization emerges as the concepts for accurate solutions and "open building" approach is used for realistic and implementable layouts.

2. Methodology

"Open Building" is a multidisciplinary approach applied in building design that supports building adaptability according to different requirements: in built environment, in production and construction methods, in the market of products and product technology and in the user's demand for the suitable place (Nikolic, 2011).

The origin of "Open Building" approach is based on Habraken's studies and the idea can be summarized as *"... when considering housing of the future, we should try to forecast what will happen, but try to make provision for what cannot be foreseen. The uncertainty of the future itself must be the basis on which present decisions are taken."* (1972, p.42). Kendal and Teicher stated that *"The broadest environmental trend leading professionals toward "Open Building" practice is the reemergence of a changeable and user-responsive infill (fit-out) level. Infill represents a relatively mutable part of the building. The infill may be determined or altered for each individual household or tenant without affecting the Support or base building, which is the building's shared infrastructure of spaces and built form. Infill is more durable and stationary than furniture or finishes, but less durable than the base building."* (2000, p. 4).

The support or base building level is the stable part of the building consisting of structure system as well as the infrastructure system. In other words a support structure is quite different from skeleton structure, but *"...a framework for a living and complex organism"* (Habraken, 1972, p.69). Corbusier suggested Domino house as a prototype for flexible mass housing solutions which has an open floor plan with thin reinforced concrete structure and a stairway (fig 1).

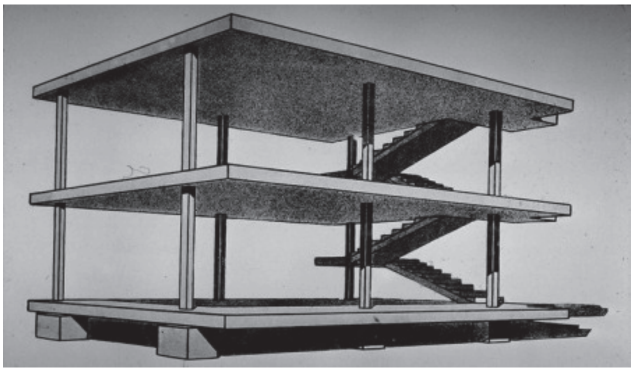

Fig 1. Corbusier's Domino House [2]

On the other hand "Open Building" approach suggests structure in relation with service spaces which is the basic permanent part of a building. *"Support is intended to accommodate and outlast infill changes, to persist largely independent of the individual occupants' choices, while accommodating changing life styles."* (Kendal & Teicher, 2000, p.33).

2.1. STRUCTURAL SYSTEM

In order to create a support, a structural system must be determined. Tunnel form construction system is selected because it is the most used construction method in housing projects in Turkey. TOKI and many other construction firms in Turkey used this construction system in apartment blocks because of its easy and rapid production. Also there are studies of its behavior under earthquakes (Balkaya & Kalkan, 2004).

Tunnel form is a construction technique where concrete is poured into two half-tunnel forms to shape load bearing walls (shear-walls) and floor slabs simultaneously on site. The process is repeated and generally in a 24-hour cycle per floor, apartment blocks can be rapidly built up. This industrialized modular construction and repetition make tunnel form construction system an attractive proposition for mass housing project usually medium to high-rise with repetitive elements or layouts.

As a modular system, tunnel form has construction limitations due to the size of the formworks and concrete. Even though special formworks can be designed, for cost and time efficiency, a certain degree of optimization is needed. Also in order to computerize the decision about construction method, basic decisions about sizes and size formulas must be clarified:

Width $_{min}$: 2.55 m.
Width $_{max}$: 5.85 m.
Width: 2.55+(0.30*n) (n_{max}:11) (1)

Depth $_{min}$: 5.00 m.
Depth $_{max}$: 12.50 m.
Depth: 5.00+(0.625*m) (m_{max}:12) (2)

Height $_{min}$: 2.30 m.
Height $_{max}$: 3.00 m. (3)

Number of floors may be between four, up to fifteen floors. The modular and repetitive use of tunnel formwork can be altered and in order to design various alternatives with different width and depth sizes.

2.2. SUPPORT

For support or base building, after selecting the structural method, some important main decisions is needed. In apartment blocks, the core consists of vertical circulation elements -staircases, elevators- and halls. Service spaces and especially plumbing and wet spaces are placed around the core. With this organization the durable frame -the support- will be the center part of the plan with the bearing walls which enables the infill to be planned freely and to be altered if needed (fig 2). Also with this organization, all the rooms will face outside.

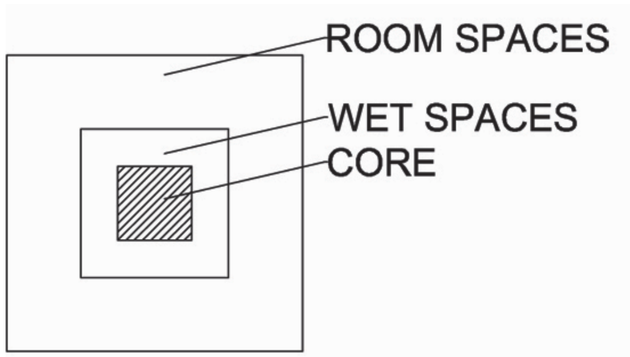

Fig 2. The spaces and interface of the prototype

2.3. CONCEPTS

The support idea as well as the "Open Building" approach welcomes two concepts in housing framework. Infill encourages flexibility and adaptability and it also promotes mass customization. It can be said that these concepts are strongly related with each other or at least some strong common points.

2.3.1. Flexibility and Adaptability

Yürekli (1983) divided flexibility which is emerged as a concept in architecture in two groups:

- design flexibility, depending on the stages of the production process of the building
- usage flexibility

In design flexibility, decisions about the planning and space organization (layout) are effective in the design and construction phase (Yürekli, 1983). In addition to Yürekli, Deniz (1999) suggested the notion of production flexibility -within the scope of the design flexibility- as another type of flexibility depending on the particular characteristics of the building and construction system. Designing flexible solutions for all users will increase the estimated cost therefore in flexible housing design, determination of the scope of flexibility will reduce the initial investment rates and enable future changes in the plan (Tatli, 2008).

Flexibility is promoted in this model by using a relatively flexible structural system or using a structural system in a more non-rigid way which can be classified under the topic of production flexibility. Tunnel-form systems, in this sense can be seen a rigid and modular system which are mostly selected to build repetitive spaces. The width and depth of the tunnel form can be altered based on the aforementioned formulas (1 and 2) and the spans and depths can be arranged by using different values of n and m consecutively. Although it will be a little bit less cost-efficient, the formworks can be altered and even a rigid modular structural system can be more flexible.

Adaptability on the other hand implies the ability to change if the need arises (Demchak, 2000). Re-partitioning a space or a partition means changing the spaces when fundamental living circumstances change.

2.3.2. Mass Customization

Mass housing attempts to satisfy the needs of the average household and tries to deal the problems of the users. Even for the average household, the number, income, background, education level, ambitions and living habits of the habitants may differ which are only some of the factors which affect the housing features. So a single type or some basic types cannot respond the need of an average household. Also in time the needs and circumstances may change which makes it even more difficult for mass housing to respond. At this point, instead of mass housing, a more individualized mass production is needed.

Customized mass housing can deal with the aforementioned problems better but even in mass customization the unpredictability of the future or change of needs must be taken into consideration. In addition a more flexible methodology can be used in order to be able to respond the unforeseen needs.

The mass production logic, which emerged with the development of the automotive industry at the beginning of 20th century, is based on rapid production for large quantities of same type of product for different users. Nowadays this logic is shifted to mass customization; a limited amount of mass production in order to fulfill specific consumer preferences for different types of users (Güngör, 2010). In the field of housing production and architecture, similar to many other areas, mass production took the place of unique and tailor-made design. In this sense, mass customization combines these two affirmative features and can be viewed as tailor-made mass production. Mass customization also promotes information technologies or vice versa; developing information technologies enables mass customized production.

With flexible structure and support design, the variations of each house or house type can be obtained even in the support level. The areas of the spaces, dimensions and spatial relations will have various possibilities and on infill level these possibilities and variations will be numerous.

3. Tool

With this tool (FPL-Gen), flexibility and mass-customization are sought and housing plan layouts are generated and projected with these concepts using tunnel-form structural system as constraint.

While developing the suggested tool, and generate plan layouts accordingly, the decisions are made, main elements and constraints are defined (for example, the size of the rooms, the size of the cores, the size of the bearing walls and their relations with each other etc. are all calculated) and embedded in the tool.

Apart from this knowledge and calculations, the main constraint of the prototype is the structural system. A hierarchical development of plan layouts are designed using the structural formulas as detailed above. There can be different forms for apartment blocks which can also be sought in the further phases of the study. But in order to focus on the generation of houses a rectangular block is selected as the main form.

3.1. PARAMETERS

The tool is designed to generate rectangular apartment blocks for different types of house units. One of the important features for the generation is the core which accommodates circulation areas, elevators and staircase. The sizes of the core as well as its relationships with the main rectangular form are both related to the size of the block and floor number.

The second step of the hierarchical generation is the house unit and the last step is the room itself. In order to generate this hierarchy; first, the core is placed and then structural system is projected. In these generations, the development of the spaces is processed as core, wet spaces and room spaces but only core and structural system is showed on the tool. Generated support is named as "base" which is the same on every floor of the block. With the dynamic use of the structural system, various numbers of bases can be produced with the same initial parameters.

There are also different types of house units according to the number of rooms and the type of kitchen. The bases with different sizes will give the opportunity to generate different types which can also be seen on each floor plan.

3.1.1 Basic Dimensions and Core

Basic dimensions for the apartment block and core is calculated for size limitations. The blocks are divided into four groups related with the number of floors. The core will consist of horizontal and vertical circulation elements and services and its size and position will depend on the size of the block and number of floors. It can be placed on the corner of the block, on the edge or near center (fig 3). In the blocks with more than 10 floors, it cannot be placed on the corner because it will cause instability for the mass.

The four groups based on number of floors and core positions are as below:

- 4 to 6 floors (corner, edge and center)
- 7 to 9 floors (corner, edge and center)
- 10 to 12 floors (edge and center)
- 13 to 15 floors (edge and center)

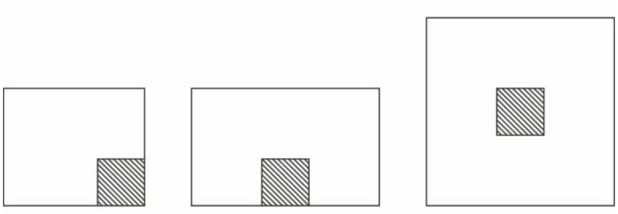

Fig 3. Places of the cores in main block form

The minimum and maximum values for the core and block are calculated in table 1 and-2. The size of the block is direct proportion to size of the core. When smaller block sizes are selected, sizes of the core will be closer to minimum values and when it is a larger block the core sizes will be larger.

Table 1. Core sizes (m.)

Floor Number	4…6			7…9			10…12		13…15	
	corner	edge	center	corner	edge	center	edge	center	edge	center
Min x	4,00	5,00	5,00	5,00	6,00	6,00	6,00	6,00	7,00	7,00
Max x	4,50	6,00	6,00	5,50	7,00	7,00	7,50	7,50	9,00	9,00
Min y	5,50	5,50	6,00	6,50	6,50	7,50	8,00	9,00	8,50	9,50
Max y	6,50	6,50	7,50	8,00	8,00	9,00	9,50	10,50	12,00	13,00

Table 2.Basic dimensions (m.)

Floor Number	4…6			7…9			10…12		13…15	
	corner	edge	center	corner	edge	center	edge	center	edge	center
Min x	11,50	15,00	15,00	12,50	16,00	16,00	21,00	21,00	22,00	22,00
Max x	17,00	31,00	31,00	18,00	32,00	32,00	32,50	32,50	34,00	34,00
Min y	13,00	13,00	16,00	14,00	14,00	17,50	14,00	24,00	16,00	24,50
Max y	19,00	19,00	32,50	20,50	20,50	34,00	22,00	35,50	23,00	38,00

3.1.2 Housing Units

There are four types of house units on the tool. These types are named based on the number of rooms (with one to four rooms) and the type of kitchen (open or separate kitchen).The new housing projects in Turkey mostly have one to four rooms and the inclination is towards to smaller houses. The house types are:

- 1+0 (with one room)
- 1+1 (with one living room and one room)
- 2+1 (with one living room and two rooms)
- 2+1+K (with one living room, two rooms and a kitchen)
- 3+1+K (with one living room, three rooms and a kitchen)

On smaller houses open kitchen is considered while for bigger houses a separate kitchen is taken into consideration. In (2+1) type both open kitchen and separate kitchen can be found. The areas of the spaces are calculated and minimum and maximum values are shown on table 3.

Table 3. Areas of the spaces and house types (m^2)

	1+0		1+1		2+1		2+1+K		3+1+K	
AREAS	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
Sitting	13,5	32,5	13,5	18,5	16,0	23,0	16,0	23,0	18,5	27,5
Kitchen	5,0	10,0	5,0	6,3	5,5	7,5	6,5	10,0	6,5	12,0
Eating	4,0	10,0	4,0	6,3	4,5	7,5	4,5	7,5	5,0	8,8
Bathroom	4,0	8,3	4,0	8,3	4,0	8,3	4,0	8,3	4,0	8,3
Shower									2,5	3,5
WC					1,3	3,5	1,3	3,5	1,3	2,0
Room 1									6,5	12,6
Room 2					6,5	12,6	6,5	12,6	10,8	12,6
Master b.			12,5	15,0	12,5	15,0	12,5	15,0	12,5	15,0
TOTAL	26,5	60,8	39,0	54,3	50,3	77,4	51,3	79,9	67,6	102,2
CIRCULATION	6,6	18,2	9,8	16,3	12,6	23,2	12,8	24,0	16,9	35,8
TOTAL AREA	**33**	**79**	**49**	**71**	**63**	**101**	**64**	**104**	**84**	**138**

The problem at this point is not generating spaces within the limits but generating meaningful and useful spaces as flexible as possible. So not only the area but also the width and depth relationships of the spaces are also important and must be reviewed. In some cases the width and depth relationships of the spaces cannot be acceptable even though the area is in between acceptable values because these sizes are needed to be in direct proportion to each other. If the space is too narrow and the façade is limited, there will be basic planning problems and it will be less flexible. It will also have some basic planning problems when the span is too great and the depth is shorter. Also with partition walls these spaces can be divided and altered according to the relations.

After core, the structural walls will be calculated and assigned in the first place to generate the base. Partition walls will be assigned and housing units will be assigned separately for each floor.

3.1.3. Interface

The tool has four main panels. On the left part of the interface user decision panels can be seen (fig 4) which are block size and housing type panels. Block dimensions and number of floors can be set in the block size panel and house type panel which are explained in previous titles. The percentage of house type is assigned through sliding bars. If the total selection is below or above a hundred, the numbers are optimized. After the values are set, generation can be made. The core location and sizes are calculated and assigned while the structural system and new reviewed values for the sizes and spanning distances are displayed on the interface.

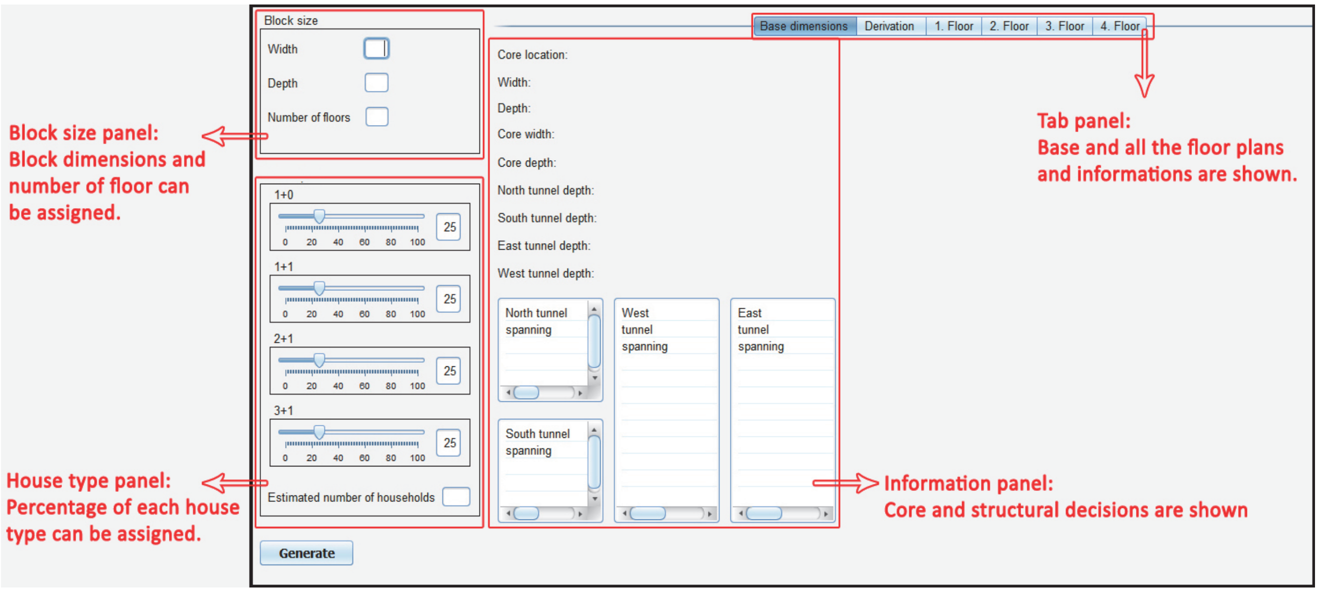

Fig 4. The interface of the prototype

3.2. GENERATION

After the initial values are entered, there can be different possibilities for the core position and size within the limitations which is a useful feature of this tool (fig 5). Also randomly selection is used in structural configuration too. Number of walls, n and m values is calculated and even in the smaller products there are various alternatives for structural configuration.

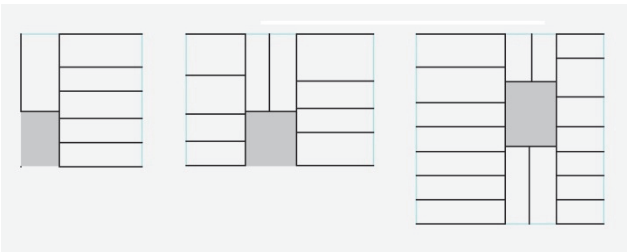

Fig 5. Different generations of the "base

The generation starts with core which accommodates circulation areas, elevators and staircase. The size and the position of the core are assigned. According to core position, the spanning lists and depth of required sides are calculated and assigned. Then core position and size is again reviewed based on these data. After the core and load bearing walls are calculated and printed on screen, the partition walls and housing units will be assigned and projected on the tool.

After the base is generated the house units are assigned again randomly selecting from the entered values. The housing assignments start from right lower corner and continue counter clockwise direction. So according to the house type, required number of rooms are assigned starting from the first floor.

3.2.1. Products

Two examples are shown with central core position with equal percentage of each house type to give an idea for the generation. In order to explain the generation and product first the basic dimensions are entered. After these values, which are the only values entered on the tool, calculations are made and base is generated. On the first tab base is projected while on the second tab derivation is made and the additional walls (partitions) and number of rooms are calculated. And finally floor plans are projected on each floor plan tab with required information.

First product:

The dimensions and selected values for first production are as below (fig 6):

- X: 20 m.
- Y: 20 m.
- Number of floors: 4
- The percentage of each house type is 25%

Reviewed and achieved values for base are as below (fig 6):

- Core location: center
- X: 19.92 m.
- Y: 19.95 m.
- Core width: 5.55 m.
- Core depth: 6.87 m.
- North tunnel depth: 6.88 m.
- South tunnel depth: 6.25 m.
- East tunnel depth: 6.88 m.
- West tunnel depth: 7.50 m.
- North tunnel spanning: 5.55 m.
- South tunnel spanning: 5.55 m.
- East tunnel spanning: 4.35-4.35-3.15-5.55-2.55 m.
- West tunnel spanning: 4.95-5.55-4.35-2.55-2.55 m.

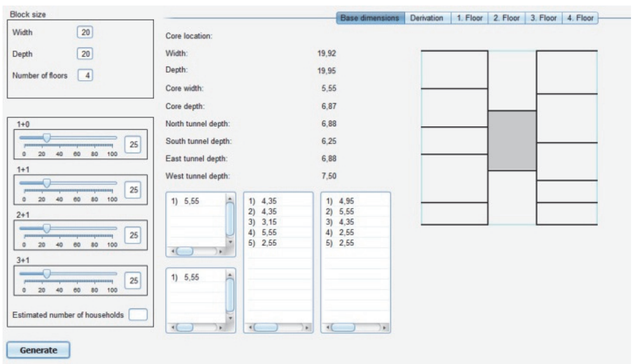

Fig 6. The base on the interface of the tool

Selected values on the second tab are as below (fig 7):

- Minimum number of rooms on a floor: 14
- Maximum number of rooms on a floor: 16
- Selected number of rooms on a floor: 16 (two additional walls)
- Total number of rooms on a floor: 64
- Minimum number of users: 39
- Maximum number of users: 78

On the second tab derivation is made and the additional walls (partitions) and number of house types is calculated and on the floor tabs plan layouts are projected as below (table 4 and fig 7).

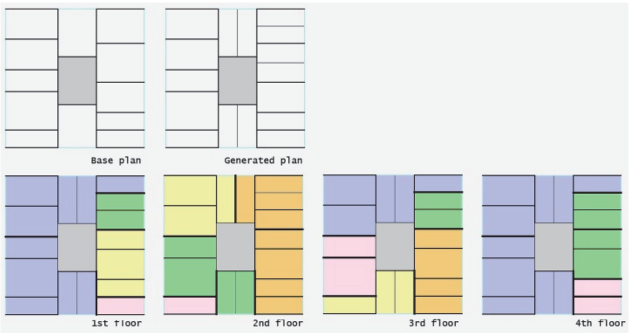

Fig 7.Base and floor plan layouts

Table 4.Number of house types in each floor

	1+0	1+1	2+1	2+1+K	3+1+K
1st floor	1	1	1	0	2
2nd floor	1	2	1	2	0
3rd floor	2	1	1	1	1
4th floor	2	2	0	0	2
TOTAL	6	6	6		5

First product - variation:

Another generation with the same initials and same room numbers in each floor is made. Number of house types is calculated and on the floor tabs plan layouts are projected as below (table 5 and fig 8).

Even though total numbers are the same, the number of different house types in each floor is different based on random distribution algorithm and the products are totally different.

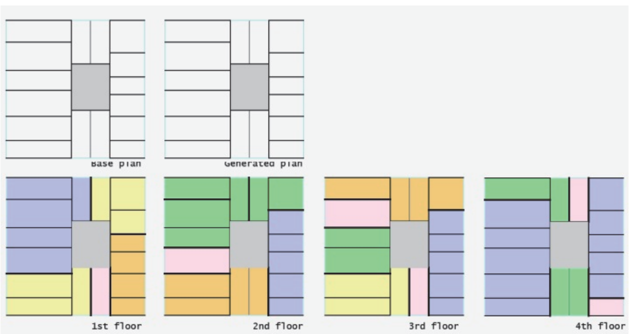

Fig 8.Variation of the first example

Table 5.Number of house types in each floor

	1+0	1+1	2+1	2+1+K	3+1+K
1st floor	1	0	2	1	1
2nd floor	1	3	0	1	1
3rd floor	2	1	1	1	1
4th floor	2	2	0	0	2
TOTAL	6	6	6		5

Second product:

The dimensions and selected values for second production are as below:

- X: 33 m.
- Y: 33 m.
- Number of floors: 15
- The percentage of each house type is 25%

Reviewed and achieved values for base are as below (fig 9):

- Core location: center
- X: 32.75 m.
- Y: 32.85 m.
- Core width: 9.00 m.
- Core depth: 11.74 m.
- North tunnel depth: 9.38 m.
- South tunnel depth: 11.88 m.
- East tunnel depth: 11.25 m.
- West tunnel depth: 12.50 m.
- North tunnel spanning: 5.85-3.15m.
- South tunnel spanning: 5.55-3.45 m.
- East tunnel spanning: 4.05-4.35-3.15-3.15-2.55-2.55-1.85-2.55-2.55-2.55-2.55 m.
- West tunnel spanning: 2.85-4.95-2.55-4.35-2.55-2.85-2.55-2.55-2.55-2.55-2.55 m.

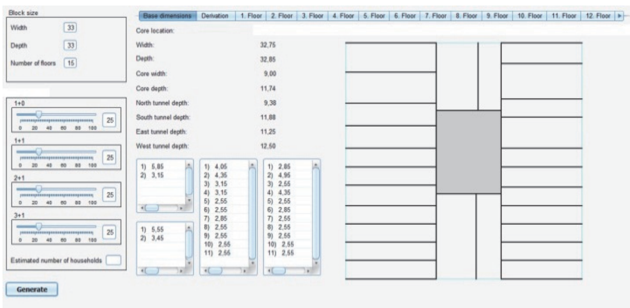

Fig 9. The interface of the prototype

The additional walls (partitions) and number of rooms are as below:

- Minimum number of rooms on a floor: 26
- Maximum number of rooms on a floor: 29
- Selected number of rooms on a floor: 28 (two additional walls)
- Total number of rooms on a floor: 420
- Minimum number of users: 255
- Maximum number of users: 510

On the floor tabs, number of house types in each floor and plan layouts are projected as below (table 6 and fig 10).

Fig 10.Base and floor plan layouts

If the initial values get larger, the number of structural configuration alternatives increase. In the second product with the same initial values, different number of rooms can be created in a floor varying between 16 and 32. So the overall number of rooms will also vary between 240 and 420. If different percentages of house types are added to the equation, there will be numerous generated bases and floor plan layout.

These abstract floor plan layouts can be selected for further infill design. Also the selected house types can be detailed and expanded.

Table 6.Number of house types in each floor

	1+0	1+1	2+1	2+1+K	3+1+K
1st floor	4	4	0	1	2
2nd floor	1	3	4	1	1
3rd floor	3	1	1	0	4
4th floor	1	2	1	0	4
5th floor	3	2	1	2	2
6th floor	4	3	0	2	2
7th floor	3	1	1	0	4
8th floor	4	5	0	1	2
9th floor	5	4	1	2	1
10th floor	1	2	0	2	3
11th floor	2	0	1	2	3
12th floor	3	4	4	0	1
13th floor	0	3	1	1	3
14th floor	1	2	0	2	3
15th floor	2	1	2	2	2
TOTAL	**37**	**37**	**35**		**37**

4. Concluding Remarks and Future Works

FPL-Gen generates flexible and mass customized plan layouts while it uses structural system as constraint. Especially repetitive projects like mass housing can benefit from these concepts. The scope of the tool and tool development is also important because the theoretical inputs are combined with computation theory and construction system which give realistic and rapid solution.

The "Open Building" approach and support is a promising approach and a generative algorithm with various controls encourages numerous meaningful base alternatives which can be dealt and detailed by architects and designers for future development.

This tool can also be developed, altered and detailed for further studies. Alternating theoretical background input and basic decisions can change the support and products. With adding or removing house types (4+1, 5+1, 3+2, etc.), variations can be obtained. On further studies infill variations can be defined and infill plans can be detailed too.

Acknowledgements

We would like to express our sincere thanks to Volkan Istek and Viki Handeli for their contributions to the program and ongoing study.

Endnotes

1. TOKI(MHDA - Mass Housing Development Administration) is a public corporation established in 1981 to solve the increasing housing problem. Since then TOKI have been providing social and affordable housing for the low and middle-income groups. In time with the changing laws and structure TOKI is now Turkey's biggest housing developer which provides house for every income group single-handedly or in collaboration with other construction firms.

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[1] http://www.toki.gov.tr
[2] http://archidialog.com

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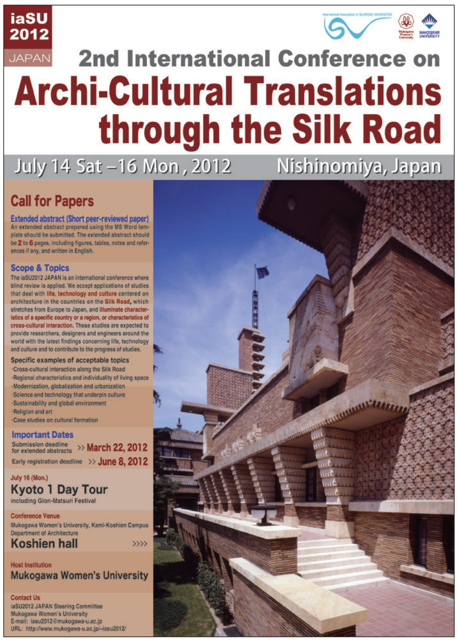
ACTIVITY REPORTS OF THE INSTITUTE OF TURKISH CULTURE STUDIES

2nd International Conference on Archi-Cultural Translations through the Silk Road

The 2nd international conference on Archi-Cultural Translations through the Silk Road (iaSU2012 JAPAN) was held at Mukogawa Women's University (MWU), Kami-koshien campus, Nishinomiya, Japan from July 14 to 16, 2012 under the auspices of iaSU and MWU co-hosted by Bahcesehir University (BU).

'iaSU' (International Association of SILKROAD UNIVERSITIES) is the association of universities mainly organized by BU and MWU which are located at the opposite ends of the "Silk Road." The organization aims to encourage exchanges among the universities located on the "Silk Road" and its periphery.

In the conference, there were 119 participants from 8 countries around the world such as researchers, architects, designers, engineers and so on in the fields of architecture, urban design and landscape. Three keynote lectures, Kumimono demonstration by a master carpenter, tea ceremonies, 64 presentations from 7 countries including two invited talks (lectures by invited speakers) were given, and Kyoto one day tour was held. During the conference, participants actively discussed and exchanged the views on the cultures of silk road countries.



Conference Poster

Opening Ceremony

Conference Program

Saturday, July 14, 2012

	Koshien Hall				Architecture Studio	
	Lounge	Terrace	Teahouse	West Hall	Presentation Room	East Studio
9:00	Registration			Opening Ceremony		
10:00				Keynote Lecture 1 "Japanese Culture and Buddhism" Dr.Daishun Ueyama		
11:00	Welcome Reception	Kumimono Demonstration				
12:00			Teahouse OPEN	Session W1 Interaction among Urban & Regional Space	Session P1 Regional Characteristics & Individuality of Architecture Ⅰ	Session E1 Modernization of Urban Space
13:00						
14:00				Session W2 Interaction among Architecrure & Cultures	Session P2 Regional Characteristics & Individuality of Architecture Ⅱ	Session E2 Discussion about Modernization, Globalization & Urbanization
15:00					Session P3 Regional Characteristics & Individuality of Gardens & Landscape	
16:00						
17:00				Keynote Lecture 2 "Indoors and Outdoors" Dr. Ahmet Eyüce		
18:00						
19:00						

Sunday, July 15, 2012

	Koshien Hall				Architecture Studio	
	Lounge	Terrace	Teahouse	West Hall	Presentation Room	East Studio
9:00				Session W3 Religion, Art & Architecture	Session P4 Multiplicity of Science & Technology that Underpin Culture Ⅰ	
10:00						
11:00				Session W4 Architecture & Religional Space	Session P5 Multiplicity of Science & Technology that Underpin Culture Ⅱ	Session E4 Regional Characteristics & Individuality of Living Space & Landscape
12:00	Lunch	Tea Ceremony				
13:00				Session W5 Landscape & Religional Space II	Session P6 Sustainability & Comfortable Environment of Architecture	Session E5 Structural Technology that Underpin Culture
14:00					Session P7 Sustainability of Garden & Regional Space, & Global Environment	Session E6 Case Studies on Cultural Formation by Architectural Design & Regional Planning
15:00						
16:00					Keynote Lecture 3 "Prospect for an Afro- Eurasian World" Dr. Masaaki Sugiyama	
17:00						
18:00				Stand-up Dinner Party	Closing Ceremony	
19:00						

Monday, July 16, 2012 **Kyoto 1 Day Tour**

Saturday, July 14th
■ Opening Ceremony

In the morning, the opening ceremony was held at West Hall in Koshien Hall. On behalf of the organizers, Prof. Dr. Shigeyuki Okazaki (chair of the iaSU 2012 JAPAN Organizing Committee, dean of Department of Architecture, MWU and president of Institute of Turkish Culture Studies at MWU), Mr. Ryo Okawara (chancellor of MWU), Prof. Dr. Naosuke Itoigawa (president of MWU) and Prof. Dr. Ahmet Eyuce (dean of the Faculty of Architecture and Design, BU) addressed a meeting. Then, the guests, Mr. Hiroaki Matsumoto (Chief Executive Officer for Urban & Housing Development, Hyogo Prefectural Government: on behalf of the governor of Hyogo Prefecture Government), and Mr. Masahiro Kono (Mayor of Nishinomiya City) gave congratulatory speeches.

Opening Speech: Prof. Dr. Shigeyuki Okazaki
(iaSU 2012 JAPAN Organizing Committee Chair, MWU)

Opening Speech: Mr. Ryo Okawara (Chancellor, MWU)

Opening Speech: Prof. Dr. Ahmet Eyuce
(Dean of the Faculty of Architecture and Design, BU)

Opening Speech: Prof. Dr. Naosuke Itoigawa (President, MWU)

Complimentary Speech: Mr. Hiroaki Matsumoto (Acting Governor of Hyogo Prefecture, Chief Executive Officer for Urban & Housing Development, Hyogo Prefectural Government)

Complimentary Speech: Mr. Masahiro Kono
(Mayor, Nishinomiya City)

■ Keynote Lecture

Then, a keynote lecture titled “Japanese Culture and Buddhism” by Prof. Dr. Daishun Ueyama, professor emeritus and former president at Ryukoku University was given. He explained how Buddhism, which was introduced from Kudara (Korea), was established as the basis of Japanese culture. He also explained that “Harmony (Wa)”, or an element to take care of life to avoid conflict, had infiltrated into Japanese human relationship, society, and culture and that it was also fastened on Japanese architectures in terms of the relationship between man and nature. In the explanation he introduced its concrete examples such as Tokonoma or Senzai of a tea ceremony room, Karesansui garden in Ryoanji Temple and alignment of temple buildings.

In the evening, a keynote lecture titled “Indoors and Outdoors” by Prof. Dr. Ahmet Eyuce, dean of the Faculty of Architecture and Design, BU was given at the West Hall. In the lecture, he showed a lot of slides of examples of architecture and settlements along the Silk Road from various periods focusing on the relationship between the spaces indoor and outdoor, and showed that this relationship is affected by culture. He expressed that, not which is good or bad, but intending to understand the differences is important.

Keynote Lecture 1 "Japanese Culture and Buddhism" by Prof. Dr. Daishun Ueyama
(Professor emeritus, former president of Ryukoku University)

Keynote Lecture 2 "Indoors and Outdoors" by Prof. Dr. Ahmet Eyuce (Dean of the Faculty of Architecture and Design, BU)

■ Welcome Reception / Kumimono Demonstration by Mr. Masamobu Araki

A welcome reception was held at the lounge in Koshien Hall during lunch break and the participants exchanged with each other. At the same time, Kumimono Demonstration was held at the terrace of Koshien Hall. Mr. Masahiro Araki, who is a part-time lecturer of the Department of Architecture, MWU, assembled the parts of Kumimono, Hijiki, Houdo and Makido, using Kakeya (a wooden hammer) and an iron hammer.

Welcome Reception at Lounge in Koshien Hall

Kumimono Demonstration at the terrace in Koshien Hall

■ Sessions / Invited Talk

In the afternoon of the first day, sessions on “Cross-cultural interaction along the Silk Road,” “Regional characteristics and individuality of living space,” “Modernization, globalization and urbanization” and “Religion and art” which had 30 presentations were given at the three venues, i.e. West Hall in Koshien Hall, Presentation Room and East Studio in Architecture Studio.

Invited Talk 1 "Advanced Seismic Ddesign of Buildings for the Resilient City "
Prof. Dr. Akira Wada (Professor emeritus at Tokyo Institute of Technology, president of Architectural Institute of Japan)

Invited Talk 2 "Tracing the Origin of Japanese Pagodas along the Silk Road"
Prof. Dr. Koji Miyazaki (Professor emeritus at Kyoto University)

Session at Presentation Room in Architecture Studio

Session at Presentation Room in Architecture Studio

Session at East Studio in Architecture Studio

Session at West hall in Koshien Hall

■ Registration

Registration desk in Koshien Hall

Registration desk for Kyoto One Day Tour

Registration desk for Kyoto One Day Tour

Posters of conference

Registration desk for presentation data

Posters of Kyoto one day tour, tea ceremony and Kumimono Demonstration

Sunday, July 15th
■ Sessions

On the second day, sessions on “Regional characteristics and individuality of living space,” “Science and technology that underpin culture,” “Sustainability and global environment,” “Religion and art” and “Case studies on cultural formation,” which had 18 and 16 presentations in the morning and in the afternoon, respectively, were held at the three venues, i.e. West Hall in Koshien Hall, Presentation Room and East Studio in Architecture Studio.

Session at West hall in Koshien Hall

Session at Presentation Room in Architecture Studio

Session at East Studio in Architecture Studio

Session at East Studio in Architecture Studio

■ Tea Ceremony / Explanation of Architectural Structure Model by Dr. Mamoru Kawaguchi

In the afternoon, with the cooperation of the members of tea ceremony club of MWU, tea ceremony experiences was held at the tea house on the Kami-Koshien campus, and many participants enjoyed the Japanese tea ceremony. In the exhibition room in Architecture Studio, Prof. Dr. Mamoru Kawaguchi explained the architectural structure model of his own design.

Tea ceremony at the teahouse "Jimyo-an" in the garden of Koshien Hall

Explanation of architectural structure model by Dr. Mamoru Kawaguchi

■ Keynote Lecture

In the early evening, a keynote lecture titled "Prospect for an Afro-Eurasian World" by Prof. Dr. Masaaki Sugiyama, professor of the Graduate School of Letters, Kyoto University, was held at Presentation Room in Architecture Studio. He explained wide-ranging topics not only about the Mongolian history, which is his specialty, but also about various matters from his career to politics, language, architecture and arts. He noted that it is important to reassemble the history of world and Japan in the perspective of Eurasia rather than to accept the history of world made by the Europeans. Also, he emphasized an importance of looking at the whole of things warning segmentalized modern academic researches.

Keynote Lecture 3 "Prospect for an Afro-Eurasian World" by Prof. Dr. Masaaki Sugiyama Professor of the Graduate School of Letters, Kyoto University

■ Closing Ceremony / Dinner Party

In the closing ceremony, Prof. Dr. Shigeyuki Okazaki, chair of the iaSU 2012 JAPAN Organizing Committee, said thanks to all who had contributed to the conference and prayed for a reunion at the next 3rd International Conference. After that, a commemorative photo with all participants was taken. In the evening, a dinner party was held at West Hall and researchers form the world deepened friendships.

Closing Speech: Prof. Dr. Shigeyuki Okazaki (iaSU 2012 JAPAN Organizing Committee Chair, MWU)

Commemorative photo

Speech of Prof. Dr. Naosuke Itoigawa (President, MWU)

Dinner Party at West Hall in Koshien Hall

Monday, July 16th
■ Kyoto one day tour

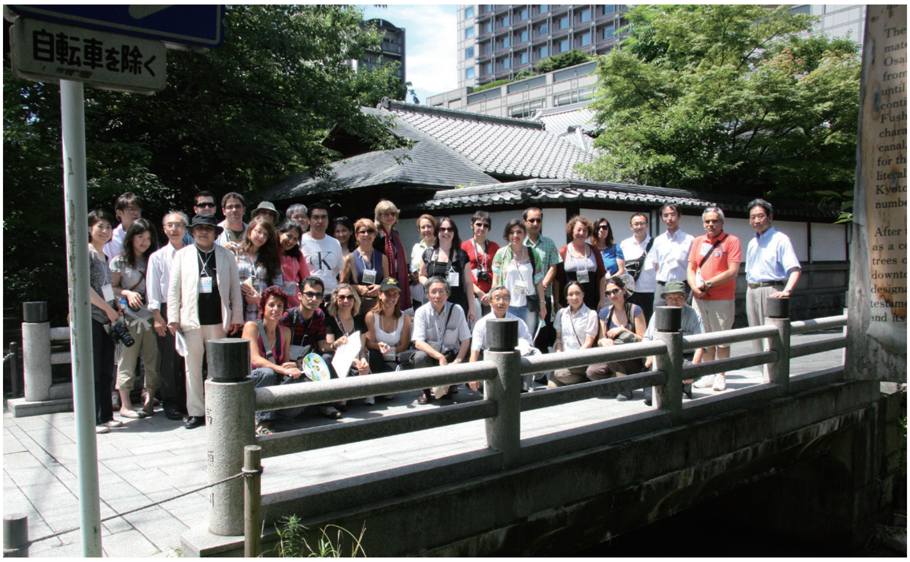
Kyoto one day tour with two courses (A and B) was conducted. Departing from Kami-Koshien Campus and seeing the Central Campus and Hamakoshien Campus of MWU on the bus, the participants visited Koseiin, Nishi Hongwan-ji, Kinkaku-ji, etc. In the evening, they took a walk in the city of Kyoto where the Gion Festival was taking place.

Before departure

Koseiin

Explanation of the garden in Nishihongan-ji by Dr. Hironobu Yoshida (Course A)

Hiunkaku in Nishihongan-ji (Course A)



Commemorative photo in front of Koseiin (Course A)

Commemorative photo in front of Kinkaku-ji (Course B)

Koseiin

Kinkaku-ji (Course B)

Gion Festival

Okazaki Park

The three-day conference finished in success.
Thank you for your participation and cooperation.

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Inter Cultural Studies of Architecture (ICSA) in Japan 2012

Based on the general exchange agreement between Mukogawa Women's University (MWU) and Bahçeşehir University (BU), students and professors from the Faculty of Architecture and Design of BU joined us at Koshien Hall and the Architecture Studio on MWU's Kami-Koshien Campus from June 26th to August 3rd, 2012.

BU's students were tackling a design projects for third-year students. By participating in this program, they gained knowledge, learned techniques, and increased their awareness for designing of architecture. They also joined a basic design studio for first-year students and had the opportunity to experience such traditional Japanese culture as Ikebana (Japanese flower arrangement under Ryuho Sasaoka, a headmaster of the Ikebana Misho-ryu Sasaoka in Kyoto) or woodwork (with Sadahide Kanda, a master carpenter in Hyogo). They also participated in fieldwork on Saturdays to explore such Japanese cities and architecture examples as Funaya in a town called Ine, Amanohashidate, Itsukushima Shrine, Nishi Honganji Temple, Himeji Castle, and the Jodo-do of the Jodo-ji Temple.

Participants

Professors: Assistant professor Murat Dündar, Research assistants Belinda Torus and Sinem Kültür
Students: Beyza Nur Bozkurt, Binnaz Kalcıoğlu, Didem Dinçkal, Ece Yağan, Gonca Hande Şahin, Gözde Uyar, Kübra Pars, and Şahsena Bildirici

1. Greetings

1.1. Welcome Party: June 28

Eight students and two teachers from Bahçeşehir University were greeted by the students and teachers of Mukogawa Women's University. Prof. Dr. Shigeyuki Okazaki (Chair, Department of Architecture, MWU) and Assist. Prof. Dr. Murat Dündar (Vice-Dean, Faculty of Architecture & Design, BU) gave speeches and the BU students and teachers introduced themselves. After that, MWU graduate students gave a welcome speech in Turkish, and MWU undergraduate students gave a speech in English.

Self introductions by BU students.

Welcome speeches in Turkish by MWU graduate students.

1.2. Courtesy Call on Chancellor Ryo Okawara and President Naosuke Itoigawa of MWU: June 29

BU students and teachers visited MWU's Central Campus and paid a courtesy call on Chancellor Ryo Okawara and President Naosuke Itoigawa of MWU. They expressed their happiness at coming to Japan. One of the BU students told about looking forward to riding a bicycle because few such opportunities exist in Turkey. Chancellor Okawara encouraged them to enjoy themselves and to study hard.


Meeting with Chancellor Ryo Okawara and President Naosuke Itoigawa


Commemorative photo

1.3. Courtesy Call on Nishinomiya Mayor Masahiro Kono: July 20

BU students and teachers visited the Nishinomiya City Hall and paid a courtesy call on Nishinomiya Mayor Masahiro Kono, who encouraged them. "I cannot tell you how pleased I am that the exchange between the two universities is bearing the fruit of an international conference. Please study architecture and form positive connections with the Japanese people."

The students thought that Nishinomiya resembled their hometowns and liked its beautiful nature and its cleanliness. They were surprised that they could travel safety anywhere due to Nishinomiya's good roads. The mayor explained the city's efforts to provide more bicycle parking places.

Assist. Prof. Murat Dündar of BU presented a souvenir to Mayor Kono.

Commemorative photo

1.4. Courtesy Call on Kobe Mayor Tatsuo Yada: July 24

BU students and teachers visited the Kobe City Hall and Kobe Mayor Tatsuo Yada.

After the 2011 Van earthquake in Turkey, the Turkey-Japan International Survey Group of Anti-earthquake Measures" headed by Prof. Dr. Shigeyuki Okazaki (Chair, Department of Architecture, Director of Institute of Turkish Culture Studies, MWU) was formed by MWU and Kobe City. The participants visited Turkey for earthquake surveys and symposium presentations. This courtesy call expressed thanks for the 2011 visit.

Mayor Yada encouraged Turkey and Kobe to continue their positive cooperation at the university, government, and local citizen levels. He warned the visitors about Japan's hot summer. Next the students introduced themselves in Japanese, and Research assistant Sinem Kültür thanked the city in Japanese for its cooperation with the earthquake surveys and asked for additional cooperation in the future.

Speech in Japanese by Research assistant Sinem Kültür of BU.

Commemorative photo

2. Design Classes

2.1. Architectural Design Studio: June 29 to July 27

The exchange students tackled the same project as the third-year students in their studio. The theme, "designing a train station," addressed how to safely move many passengers and how to make membrane roofing for the platforms. They made membrane roof models, drew perspectives, and planned layouts, elevations, and the sections. Next they got advice from teachers and Akihiro Noguchi, a membrane expert from Taiyo Kogyo Inc., and improved their initial ideas. Finally they made their final submissions and presented them to the final-jury.


Conversation with teacher


Conversation with teacher


Studying before inter-jury


Inter-jury


Inter-jury


Beyza’s presentation at final-jury


Binnaz’s presentation at final-jury


Didem’s presentation at final-jury


Ece’s presentation at final-jury


Gözde’s presentation at final-jury


Hande’s presentation at final-jury


Kübra’s presentation at final-jury


Sahsena’s presentation at final-jury

2.2. Basic Design Studio

For understanding Japanese culture, the students experienced Ikebana (Japanese flower arrangement) and woodworks with first-year MWU students.

2.2.1. Ikebana on June 28 and July 5

On June 28, the students experienced Ikebana under Headmaster Ryuho Sasaoka (Ikebana Misho-ryu Sasaoka, part-time MWU lecturer). On July 5, they collaborated with MWU students and made large-size Ikebanas and presented them.

Headmaster Ryuho Sasaoka instructed BU students in Ikebana

Ikebana lesson

2.2.2. Woodwork on July 12

The students used a plane and made rice paddles and chopsticks under Master Carpenter Sadahide Kanda, a part-time MWU lecturer. They increased their understanding of traditional Japanese carpentry techniques.

Master Carpenter Sadahide Kanda instructed BU students in using a plane.

BU students made rice paddles and chopsticks.

3. Fieldwork

3.1. Lecture and Visiting Architecture of Membrane Structure: June 29

Before designing a train station with a membrane structure, the Turkish students and MWU third-year students listened to a lecture from Akihiro Noguchi (engineer of Taiyo Kogyo Corporation) on the history of membrane structures, material, mechanical properties, construction techniques, and examples. Next, they visited the Rest House on Okura Beach in Akashi as an example of a suspended membrane structure.

Lecture on membrane structures by Mr. Noguchi

Visiting the Rest House on Okura Beach in Akashi

3.2. Visiting Funaya of Ine and Amanohashidate in Kyoto: June 30

The students visited Ine and Amanohashidate with MWU third-year and fourth-year students and saw Funaya (houses with unique boat garages) in Ine from the sea and land. After that, they moved to Amanohashidate which is one of Japan's three most famous scenic places. They went to Kasamatsu Park by cable car and experienced the fantastic misty view with the sea spray.

Funaya from marine taxi

When the sky and the earth are viewed upside down, Amanohashidate resembles a bridge across the sky

3.3. Visiting Itsukushima Shrine in Hiroshima: July 7

The students visited Miyajima Island, which is another of Japan's three most famous scenic places with third-year and fourth-year students at MWU. After arriving by ferry, they walked to Itsukushima Shrine along a beachfront road and visited many buildings in the shrine and viewed the mountain range over the Otorii (the grand gate). They sketched the buildings, the waterscape, and the green landscape around the shrine.


Photo taken on Hirabutai stage


BU and MWU students strengthened their friendship.

3.4. Visiting Nishi Honganji Temple in Kyoto: July 21

The students visited Nishi Honganji Temple with first-year MWU students. They went to Shiro-shoin, which is one great example of shoinzukuri, a traditional residential architectural style in Japan, and Hiunkaku, which is one of Kyoto's three great pavilions along with Kinkakuji and Ginkakuji Temples. They also saw the oldest Noh stage in Japan, Karesansui (a Japanese rock garden) in Shiro-shoin, and a beautiful garden that showed good communion with Hiunkaku.


Visiting Karamon Gate at Nishi Honganji Temple

3.5. Visiting Himeji Castle and Jodo-do of Jodoji Temple: July 28

The students visited Himeji Castle, which is being restored, and the Jodo-do of the Jodoji Temple, which is one of the few existing examples of Daibutsuyo style architecture, with first-year MWU students. At Himeji Castle, they observed the roofing and plastering work for the restoration and preservation from the roofed exhibition route. In the Jodo-do, they experienced the dynamic interior space of Daibutsuyo style architecture with the sunlight from behind the Buddha statues.


Visiting restoration and preservation work on Himeji Castle


Visiting Jodo-do of Jodoji Temple

4. Events

4.1. iaSU 2012 (2nd International Conference on Archi-Cultural Translations through the Silk Road): July 14 to 16

The 2nd International Conference on Archi-Cultural Translations through the Silk Road was held under the auspices of MWU. The BU students participated in the conference with MWU students.

On July 14 and 15, they attended the opening ceremony, the keynote lectures, the sessions and the closing ceremony. On July 16, they joined the Kyoto Tour with the other participants and visited Ryoanji, Kinkakuji, and Koseiin Temples and saw the Gion Festival.

4.2. Tea Ceremony Lesson: July 6

Before the conference, the students experienced the Tea Ceremony lesson with MWU students.


Tea Ceremony lesson


Tea Ceremony lesson

4.3. Farewell Party: July 27

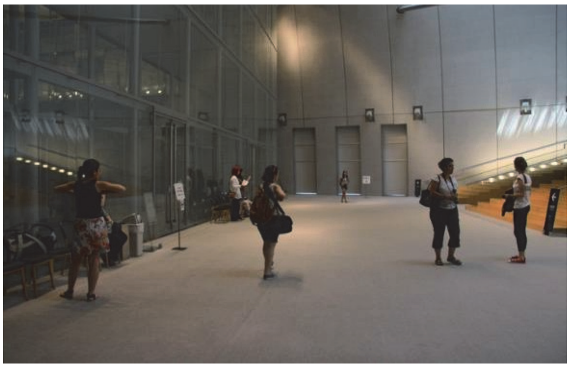
After the jury, we had a farewell party for BU students. The third-year students at MWU, who had studied in the same studio for a month with the BU students, gave them presents. After that, each expressed their gratitude to the MWU students, and a commemorative photo was taken.


Thanking MWU students.


Photo after farewell party

4.4. Visiting Nara: July 30

Before returning to Turkey, the students visited the Nara Centennial Hall, Todaiji Temple and the Kasuga-taisha Shrine.


Visiting Nara Centennial Hall


Visiting Kasuga-taisha Shrine

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Inter Cultural Studies of Architecture (ICSA) in Istanbul 2012

Based on the general exchange agreement between Mukogawa Women's University (MWU) and Bahçeşehir University (BU), thirteen first-year graduate students of the MWU architecture program visited BU in Turkey on September 28 and stayed until October 12, 2012. They received practical training on conservation and restoration in projects prepared by BU.

Participants

Professors: Associate professor Toshitomo Suzuki, and Assistant Aya Yamaguchi
Students: Maya Kawai, Noriko Kanzaki, Natsuho Sugimura, Michiko Nishio, Sachiko Nishida, Midori Hazano, Saki Hayashi, Asahi Baba, Saori Hirata, Natsumi Matsuda, Yuka Mizuuchi, Aiko Mori, and Satomi Yoshida

Schedule

September 27	Departure from Kansai International Airport for Istanbul
September 28	Arrival at Istanbul Atatürk International Airport Visited Bahçeşehir University
September 29	Istanbul tour
September 30	Edirne tour
October 1	Practical training on conservation and restoration at ateliers of Yıldız Palace in Istanbul
October 2	Visited Dolmabahçe Palace and its atelier in Istanbul
October 3	Practical training at the Glass Furnace in Istanbul
October 4	Cappadocia tour
October 5	Cappadocia tour Visited the Yassıhöyük excavation site and the Japanese Institute of Anatolian Archaeology (JIAA)
October 6	Training in JIAA
October 7	Visited Büyükada (Istanbul's largest island)
October 8	Bursa tour
October 9	Practical training on ceramic tiles at the Iznik Foundation Visited a wooden dwelling in Sölöz and a traditional settlement Cumalıkızık
October 10	Practical training on conservation and restoration at KUDEB in Istanbul
October 11	Preparation of exhibition at Bahçeşehir University Istanbul tour
October 12	Exhibition of sketches drawn by MWU students at Bahçeşehir University Departure from Istanbul Atatürk International Airport for Japan
October 13	Arrival at Kansai International Airport

September 27-28

We left Kansai International Airport on the 27th and arrived at the Istanbul Atatürk International Airport via Dubai. We first had a tour of the campus. We greeted Prof. Dr. Şenay Yalçin, President of BU and Prof. Dr. Ali Güngör, Vice President of BU, and attended a stand-up dinner on campus.

September 29

We visited some of Istanbul's historic areas. In the morning, we began with a visit to Hagia Sophia, the highest summit of Byzantine architecture and sketched it. Then we visited Topcapı Palace, which once was the primary residence of the Ottoman Sultans. In the afternoon, we visited the Sultan Ahmed Mosque (the Blue Mosque), the Basilica Cistern, the Grand Bazaar and the Sultan Ahmet Square and sketched them.

Photo with Dr. Envel Yücel, Chairman of the Board of Trustees of BU

Students meeting with Prof. Dr. Şenay Yalçin, President of BU, and Prof. Dr. Ali Güngör, Vice President of BU.

Hagia Sophia: former orthodox patriarchal basilica, later a mosque, and now a museum in Istanbul

Basilica Cistern: largest of several hundred ancient cisterns beneath Istanbul

September 30

We visited Edirne, which is near the borders with Greece and Bulgaria. Edirne supposedly originated in a town constructed by Emperor Hadrian. The town, called Adrianopolis or Adrianople, used to be the capital of the Ottoman Empire. We visited the Selimiye Mosque, which was designed by Sinan, a great Ottoman architect; Sinan himself considered this mosque his magnum opus. We also visited Eski Cami (Edirne's oldest mosque), Uç Serefeli Mosque whose four minarets are all different in form, and the Bayezid II Külliye Health Museum, which is characterized by its space for music therapy.

Selimiye Mosque: designed by Mimar Sinan in late 16th century and considered his masterpiece

Sketching the interior view of Selimye Mosque

Eski Camii

Bayezid II Külliye Health Museum: characterized by its space for music therapy

October 1

We learned about conservation and restoration at the Yıldız Palace. In the morning, we visited an atelier and observed conservation and restoration on the ornaments of wooden furniture and decorative pieces of shell or tortoise-shell. In the afternoon, we observed an atelier for clothes for curtains or furniture, carpets, Kilim, wooden fixtures, and floor parquet. Then we actually measured or sketched drafts of the fixtures (wooden balanced sash and wooden jalousies). In the evening, we visited Envel Yücel, the Chairman of the Board of the Trustees of BU.


Making and renovating woodcarvings at the atelier in Yıldız Palace

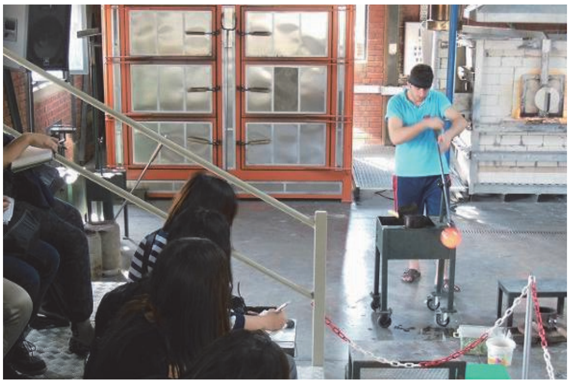

Renovating wooden floor of palace


Students measuring and sketching a window


Meeting Envel Yücel, Chairman of the Board of Trustees of BU

October 3

We visited The Glass Furnace, which is a glass works atelier at Sile, in a suburb of Istanbul. After observing the atelier and the glass blowing process in the morning, we worked on glass beads in the afternoon. Then we moved to another room to create a glass piece with a technique called fuzyon, where pieces of colored glass of any shape are placed on a sheet of clear glass. Later, these works will be completed as objet d'art or plates of fused glass after being dried in the kiln at the glassworks. After that, we visited the showroom of the glassworks.


Glassblowing studio at Glass Furnace


Demonstration of glass sculpture at Glass Furnace

Students making glass beads

Students making glass sculptures using a technique called fuzyon

October 4

We visited Cappadocia, a famous historical area. In the morning we visited various places: Kaymaklı Underground City, an old village in Göre, Pigeon Valley and Uçhisar. We had a lunch of testi (jug) kebab, a specialty of Cappadocia at a restaurant in a rock cave. In the afternoon, we visited the Göreme Open Air Museum to see Elmali Kilise (apple church) and Yilanli Kilise (snake church) and sketched them.

Kaymakli (underground city): a shelter for persecuted Christians.

A view of villages of Gole: houses seem as if they were adhered to the mountain side.

Uçhisar Castle in Cappadocia

Göreme Open Air Museum in Cappadocia

October 5

First, we visited and sketched a seminary and a church in a town called Mustafapaşa that was previously inhabited by the Greeks and now features mixed styles of houses from the Roman period. Then at Paşabağ, we observed a famous mushroom-shaped rock that resembles a camel and a cave hotel and sketched them. In the afternoon, we visited Yassıhöyük, where the Japanese Institute of Anatolian Archaeology (JIAA) is conducting excavations. Yassıhöyük is 500 m north-south, 625 m east-west, and is 13 m high. Then we visited JIAA in Kaman, attended a meeting, had dinner, and spent the night at the institute.

Paşabağ (Monks Valley) in Cappadocia

View from a cave hotel in Cappadocia

Yassıhöyük: conducted excavations by JIAA

Dinner at JIAA

October 6

We visited the Museum of Archaeology at Kaman-Kalehöyük, the Prince Mikasa Memorial Garden, the institute's facilities, and the Kaman-Kalehöyük excavation site with Dr. Sachihiro Omura, JIAA's director. He explained Anatolia's importance to world history and contemporary global society, why Japanese is excavating in Turkey, the meaning of the building's museum and conserving the excavation site, and the difficulties of studying archaeology. Then we flew back to Istanbul.

Museum of Archaeology at Kaman-Kalehöyük


Model of Kaman-Kalehöyük excavation site explained by Dr. Sachihiro Omura, Director of JIAA


JIAA laboratory


Kaman-Kalehöyük: excavations conducted by JIAA

October 7

We visited Büyükada Island, which is about 90 minutes south of Istanbul by ferry, to observe a large wooden structure and some wooden houses. We first went to the Greek Orphanage, which is reportedly the largest wooden building in Turkey. The building was originally designed and constructed in 1888 to be a hotel, and yet it was used as orphanage until the 1960s because it was not permitted to be a hotel. In the evening, we visited the Taksim Square and İstiklal Avenue and rode Tünel, the oldest underground railway in Europe, which started in 1875.


Riding horse and buggy on Büyükada Island.


Greek Orphanage: Turkey's largest wooden building

Taksim Square

Taking the Tunel (subway)

October 8

We went to Bursa and visited Ulu Cami, Koza Hanı (silk market) and Yeşl Türbe (green tomb) where which the body of Mehmed I rests. In the evening, we had dinner at the house of a student who participated ICSA in Japan 2012.

Ulu Cami in Bursa

Koza Hanı: silk market with a courtyard

Yeşil Türbe (literally 'green tomb'), a mausoleum from the Ottoman Empire Period.

Commemorative photo with the BU students' family

October 9

We first visited the Iznik Foundation. After observing its kiln and laboratory, we learned about the manufacturing process of ceramics before drawing on 12-cm-square tiles. In the afternoon, we visited a small town called Sölöz to observe and sketch a four-storied wooden building. After that, we observed Cumalıkızık, a traditional settlement with 700 years' history. We walked around the settlement and sketched the maze-like streets. Then we returned to Istanbul.


Students practicing Iznik tile painting


Iznik tiles painted by students


Four-storied wooden building in Sölöz


Cumalıkızık: traditional settlement with 700-year history

October 10

We attended a course at the municipal department KUDEB (Directorate for the Inspection of Conservation Implementations) that engages in conservation and repairs wooden houses, mosques, bridges and ramparts that do not belong to the palace. First, we went to the cultural center, where a symposium hosted by KUDEB had ended the previous day. KUDEB staff members explained the grilles, doors, staircases, and framing models of the house under renovation that was exhibited in the center's lobby. Next we went to the KUDEB laboratory and observed the renovation of wooden fixtures. We were also taken to a restoration site where a 19th century wooden house with a shop was being repaired. Then we visited the Süleymanye Mosque that was designed by Mimar Sinan. In the evening, we attended a dinner sponsored by Prof. Dr. Ahmet Eyüce, the Dean of the Faculty of Architecture and Design of BU.

Wooden door renovated by KUDEB (Directorate for the Inspection of Conservation Implementations)

Student studying at KUDEB laboratory

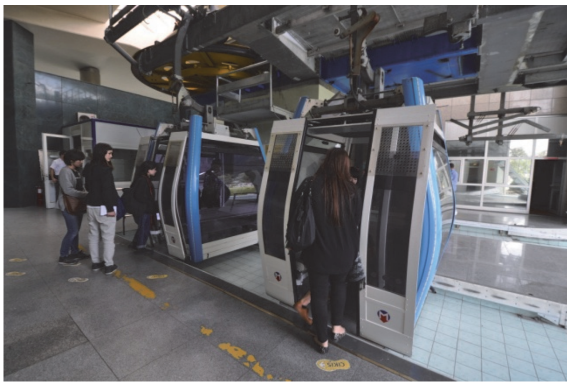
Wooden house under renovation by KUDEB

Dinner sponsored by Prof. Dr. Ahmet Eyüce, Dean of the Faculty of Architecture and Design of BU

October 11

In the morning, we prepared a sketch exhibition for the following day in BU. In the afternoon, we went to Üsküdar on the Asian side to visit the Yeni Valide Mosque. Then we took a ferry to Eyüp on the European side and visited Pierre Loti Café. In the evening, we climbed the Galata Tower and visited İstiklal Avenue again for shopping.

Students preparing sketch exhibitions



Getting on a funicular in Eyup

View from Pierre Loti

View from Galata Tower

October 12, 13

In the morning we visited a cafe in Ortaköy that has a view of Bosphorus. In the afternoon at Bahçeşehir University we held a sketch exhibition. That began with a greeting by Dr. Murat Dündar, Vice Dean of the Faculty of Architecture and Design of BU. Then Dr. Toshitomo Suzuki, Associate Professor of MWU, introduced MWU and outlined ICSA in Istanbul. Then the students gave presentations of their design works in English. At the end of their presentations, students expressed their thanks. The exhibition ended successfully.

Setting up for the sketch exhibition

Sketch exhibition at BU

Student presentations

Photo after sketch exhibitions

Professor Otani was Invited to the Symposium on Conservation and Repair of Wooden Architecture in Istanbul, Turkey

Date : October 8-9, 2012
Venue : Ali Emiri Efendi Culture Center, Istanbul

On Oct. 8th and 9th, 2012, Symposium on conservation and repair of wooden architecture, which was hosted by KUDEB, (an organization of Istanbul relevant to conservation and repair work), was held in Istanbul, Turkey, where the cases of conservation and repair work across Turkey were reported and actively discussed.

Prof. Otani of MWU was invited as a guest speaker to report on conservation and repair work of historic wooden architecture in Japan. He delivered a speech about the conservation and revitalization of Kyo-machiya from the technical and practical point of view of architecture. Participants were interested in the Japanese architecture and its techniques, which are different from what is seen in Turkish wooden architecture.

The speech given by Prof. Otani

Photo with the persons in charge of KUDEB

Photo with the symposium participants

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Lecture 01

Archaeological Excavation of the Palmyra Ruins, a Caravan City on the Silk Road

Date： **Monday, April 23, 2012, 16:30～18:30**
Venue： **K-222, the Koshien Hall**
Lecturer： **Dr. Kiyohide Saito (Deputy Director of Archaeological Institute of Kashihara, Nara Prefecture, and Director of the Museum, Archaeological Institute of Kashihara, Nara Prefecture）**

We invited Dr. Kiyohide Saito, Deputy Director, Archaeological Institute of Kashihara, Nara Prefecture, and held a lecture titled "Archaeological Excavation of the Palmyra Ruins, a Caravan City on the Silk Road". Palmyra was a caravan city located in central Syria and has been designated a World Heritage site. Dr. Saito has conducted archeological excavation of the Palmyra ruins, especially tombs, for more than two decades and comprehensively studied changes in the funeral system of Palmyra and its social background. In the tripartite lecture, he explained outline of Palmyra and his over twenty years' research.

He started with the outline of Palmyra, e.g., various temples including the temple of Bel, city composition, ex. memorial arch, colonnade road, theater, shopping street, and public bath, activities of the excavation and research teams from various countries, and the three types of tombs in Palmyra.

Then, he explained more specifically the excavation of tombs, such as the interior decoration of the tombs, excavated articles including accessories, analysis of excavated human bones, and cases of conservation and restoration of tombs, using many photos and moving images.

In the question and answer session, wide-ranging topics were taken up, such as the meaning of a tomb's direction, grave robbing, the lives of residents and the climatic features, and the lecture ended with a great success.

The lecture given by Dr. Kiyohide Saito, Deputy Director of Archaeological Institute of Kashihara, Nara Prefecture, and Director of the Museum, Archaeological Institute of Kashihara, Nara Prefecture

Lecture 02

International Contributions for Preservation of the Bamiyan World Heritage Site

Date： **Thursday, May 31, 2012, 16:20～18:00**
Venue： **K-222, the Koshien Hall**
Lecturer： **Mr. Kazuya Yamauchi (Head of Regional Environment Section, Japan Center for International Cooperation in Conservation, National Research Institute for Cultural Properties, Tokyo）**

Mr. Yamauchi, National Research Institute for Cultural Properties, Tokyo, gave a lecture titled "International Contributions for Preservation of the Bamiyan World Heritage Site".

Bamiyan is located at the west end of the great Hindu Kush mountain range which extends from southwest to northeast separating Afghanistan in two parts. A Chinese monk Xuan Zang visited Bamiyan in the 7th century AD and recorded its prosperity of the time including West- and East-Giant Golden Buddha statues.

In March 2001, the two Giant Buddha statues were destroyed by the Taliban militia regime and a huge number of murals were lost or looted in the chaos. Hence, the Bamiyan site was hastily declared a World Heritage site as "Cultural Landscape and Archaeological Remains of the Bamiyan Valley" and added to UNESCO's List of World Heritage in Danger in 2003. And safeguarding projects for the site are currently being conducted by several institutions of the world including that of Japan, Germany, Italy etc. under the coordination of UNESCO. In Japan, National Research Institute for Cultural Properties, Tokyo, is taking the lead in the projects including preservation of mural paintings, archaeological survey to determine the scope of the ruins to be preserved etc.

In the lecture, Mr. Yamauchi illustrated the Bamiyan site from various angles such as its history and current conditions, international projects to preserve mural paintings, archaeological surveys conducted by Japanese team, and concept of development and preservation of cultural heritage in Afghanistan. He also introduced the types of houses in the caves and the lifestyle in Bamiyan, a knowledge which can be gained only through field survey, and the cave's style and structure derived from Buddhist elements as well as relationships between the site and the Islamic culture.

The lecture given by Mr. Yamauchi


Cultural Landscape in Bamiyan Valley© National Research Institute for Cultural Properties, Tokyo

Lecture 03

Decoding of the Ceiling Styles in the Bamiyan Cave Temples: Fusion of Timbered Construction and Masonry Construction

Date： **Wednesday, November 28, 2012, 19:00～21:00**
Venue： **K-222, the Koshien Hall**
Lecturer： **Mr. Shigeru Kubodera (Director of Historical Research Institute for Architectural Decoration Technology)**

We held a lecture titled "Decoding of Ceiling Styles in Bamiyan Cave Temples: Fusion of Timbered Construction and Masonry Construction" inviting Mr. Kubodera, Director of in Architectural decorate technical history laboratory as the lecturer. He took a lot of photos he has taken during his field survey in 2005-2006.

He began with the purpose and the situation of the field survey saying "We need to record the Bamiyan cave temples. Because they will be lost in future, even if we do the best to keep them. We took photos of the four walls, the ceiling and the floor of all the caves which we were able to access."

We understood that the ceilings of cave temples have their own characteristic expression techniques area by area. The ones in Lonmen have stone mason, the ones in Dunhuang painting and plaster, the ones in Kezier plaster, and the ones in Bamiyan plaster and clay figure. Especially the stones in Bamiyan caves were of coarse grain and easy to collapse, and so, they needed plasterer's finish work after chiseling. Having explained the outline, basic architectural knowledge and ceiling styles in Bamiyan, he referred to the ceiling styles in the caves, dome, squinch and cross vault. Furthermore, he lectured on ceilings and decorations in Buddhist buildings in reference to that of ancient China.

At the end of lecture we had an active question-and-answer session, for example, whether or not they had a dimension system, extent of ceiling style's propagation area, whether an original wooden ceiling still remains. We came to be interested in the Bamiyan cave ceilings.

We appreciate Mr. Kubodera for his impressive lecture on Bamiyan. It was valuable opportunity for us.

The Lecture at K-222, Koshien Hall

Mr. Kubodera, Director of Historical Research Institute for Architectural Decoration Technology

Lecture 04

The Ruins of Petra, a World Heritage Site in the Country of Deserts, Jordan: An Ancient City that Trade Created

Date： **Friday, November 30, 2012, 16:30～18:30**
Venue： **K-222, the Koshien Hall**
Lecturer： **Mr. Koji Oyama (Former JICA Expert)**

We invited Mr. Koji Oyama, Former JICA Expert, and held a lecture titled “The ruins of Petra, a World Heritage site in the country of deserts, Jordan: an ancient city that trade created”.

Petra is the ruins located in the mountains area of Wadi Musa in South Jordan, which is designated a World Heritage site. It was a city of Nabataeans, which prospered about 2000 years ago, and rediscovered by a Swiss explorer in 1812. It is also famous as the filming site of the cinema "Indiana Jones and the Last Crusade".

He first showed photos of Petra’s geographical environment, memorial arch, water channel, stone slab, reliefs, theater, colonnade road, magnificent rock-cut tombs, temple and so forth, and guided us in a comprehensible way making us feel as if we were actually in Petra.

And then he explained a range of topics such as Petra’s nature and history, Nabataeans’ trade, water management, religion, architectural technology, language and earthenware. Furthermore, he suggested what we, who live in the modern world, can learn from Petra.

In the question and answer session, the topics related to the dwellings and culture of Petra were discussed, and the lecture ended with a great success. We were able to have a glimpse of a greatness of the culture that humankind creates. It was a very valuable opportunity.

The lecture given by Mr. Oyama

Mr. Oyama explaining about the treasury (Al Khazneh), one of the most famous temples in Petra

Lecture 05

History and Prosperity of Turkey, a Diverse Country, as a Bridge between the East and the West

Date : **Friday, January 18, 2013, 15:00～17:00**
Venue : **West Hall, the Koshien Hall**
Lecturer : **Dr. Sachihiro Omura (Director, Japanese Institute of Anatolian Archaeology)**

We invited Dr. Sachihiro Omura from Japanese Institute of Anatolian Archaeology and held a lecture titled “History and prosperity of Turkey, a diverse country, as a bridge between the East and the West”. This lecture was hosted by the Kansai Productivity Center and the Institute of Turkish Culture Studies at Mukogawa Women’s University. Dr. Omura specializes in Middle and Near Eastern archaeology, and one of Japan’s most famous archaeologists who leads the excavation and research at Kaman-Kalehöyük in central Turkey.

First of all, he explained the significance of Japanese involvement in the excavation and research in the midst of Turkey. Then, he explained tradition of earth mother which had been inherited across Anatolia, characteristics of Artemis at Ephesus, where the Anatolian and the Greek cultures have amalgamated, propagation of Christianity by Saint Paul, the life of Christians at the time, relationships between state and religion, history of the migration and Islamization of Turks, and so forth to teach us the position and importance of Cappadocia and Ayasofya in Turkish history.

In question and answer session, wide-ranging topics were discussed, such as the topic surrounding the establishment of the Republic of Turkey, problems that contemporary Turkey faces, and ethnic distinction of the Turks. We were able to have a glimpse of dynamism and magnificence history in which the cultures and religion of the East and the West clashes with each other. It was a very valuable opportunity indeed.

The venue for the lecture: West Hall

Dr. Sachihiro Omura, Director, Japanese Institute of Anatolian Archaeology

Lecture 06

How Did Ancient Artisans Stand Pillars and a Central Column Upright?

Date： **Monday, February 25, 2013, 14:00~17:15**
Venue： **K-222, the Koshien Hall**
Lecturers： **Mr. Masao Nishizawa (Director, Nishizawa Construction Company)**
Mr. Shigeru Kubodera (Director of Historical Research Institute for Architectural Decoration Technology)

We invited Mr. Masao Nishizawa and Mr. Shinji Kubodera to take part in a two-part lecture series. Mr. Nishizawa explained the method used to stand the central column of a pagoda from the viewpoint of a builder. Mr. Kubodera explained this feat from an academic viewpoint based on archaeological surveys and insights into preservative construction work.

In the first lecture, Mr. Nishizawa described two construction projects aimed at preservation and restoration: the three-storied pagoda of Kongorin-ji Temple and the Taho-to pagoda of Jison-in Temple. The pagoda at Kongorin-ji Temple was built in the Kamakura era. The central column was stood on cross beams of the first-story ceiling. The central column does not stand on the ground. After finishing the second story structure, the bottom of the column was hoisted up with a rope, which was tied to a temporary structure, using pullies. On the other hand, Jison-in Temple, a registered World Heritage site, was built on the starting point of the pilgrimage route to Koyasan. Records show that the pagoda was modified from a three-story pagoda to a Taho-to pagoda during construction work.

In the second lecture, Mr. Kubodera explained the method of standing a column upright based on his archaeological survey. There are holes along the slope in the first section of Namba Palace, which seem helpful for standing the columns up. In the Heijo-kyo To-in Garden, arm structures called *udegi* were discovered, and these appear to have balanced loads and prevented subsidence. At pillar-standing festivals, we can observe the method using a sliding board called *hangi*, here the pillar base is slid into a hole. Furthermore , a hole prepared for the central column has been found in the fivestory pagoda of Saisyo-in Temple, where Mr. Kubodera was engaged in his work. This technique was probably instrumental in standing the column upright.

We greatly appreciated the chance to hear these two different viewpoints on this critical architectural issue. It was surely a valuable opportunity for us.

Mr. Masao Nishizawa,
Nishizawa construction company representative director

Mr. Shigeru Kubodera,
Director of the Historical Research Institute for Architectural Decoration Technology

Annual Events Apr. 2012- Mar. 2013

Date	Events
April 23, 2012	Lecture given by Dr. Kiyohide Saito (Deputy Director of Archaeological Institute of Kashihara, Nara Prefecture, and Director of the Museum, Archaeological Institute of Kashihara, Nara Prefecture), "Archaeological Excavation of the Palmyra Ruins, a Caravan City on the Silk Road"
May 31, 2012	Lecture given by Mr. Kazuya Yamauchi (Head of Regional Environment Section, Japan Center for International Cooperation in Conservation, National Research Institute for Cultural Properties, Tokyo), "International Contributions for Preservation of the Bamiyan World Heritage Site"
June 26-August 3, 2012	Inter Cultural Studies of Architecture (ICSA) in Japan 2012
July 14-16, 2012	2nd International Conference on Archi-Cultural Translations through the Silk Road (iaSU2012 JAPAN)
September 27-October 13, 2012	Inter Cultural Studies of Architecture (ICSA) in Istanbul 2012
October 8-9, 2012	Symposium on Conservation and Repair of Wooden Architecture in Istanbul, Turkey (hosted by KUDEB)
November 28, 2012	Lecture given by Mr. Shigeru Kubodera (Director of Historical Research Institute for Architectural Decoration Technology), "Decoding of the Ceiling Styles in the Bamiyan Cave Temples: Fusion of Timbered Construction and Masonry Construction"
November 30, 2012	Lecture given by Mr. Koji Oyama (Former JICA Expert), "The Ruins of Petra, a World Heritage Site in the Country of Deserts, Jordan: An Ancient City that Trade Created"
January 18, 2013	Lecture given by Dr. Sachihiro Omura (Director of Japanese Institute of Anatolian Archaeology), "History and Prosperity of Turkey, a Diverse Country, as a Bridge between the East and the West"
January 31, 2013	Lecture given by Ms. Keiko Nishigaki, (Representative of Takarazuka Afghanistan Friendship Association) "Herat, Afghanistan"
February 25, 2013	Lecture given by Mr. Masao Nishizawa (Director of Nishizawa Construction Company) and Mr. Shigeru Kubodera (Director of Historical Research Institute for Architectural Decoration Technology), "How Did Ancient Artisans Stand Pillars and a Central Column Upright?"

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	Takahiko Otani
		Professor	Jun Sakakihara
		Professor	Yusei Tazaki
		Professor	Uzushi Nakamura
		Professor	Sanae Fukumoto
		Associate Professor	Fumie Ooi
		Associate Professor	Takashi Manda
		Associate Professor	Noritoshi Sugiura
		Associate Professor	Toshitomo Suzuki
		Associate Professor	Kazuhiko Yanagisawa
		Lecturer	Akira Tanaka
		Lecturer	Hideaki Tembata
		Lecturer	Keisuke Inomata
		Lecturer	Tomoko Uno
		Assistant Professor	Sayaka Nishino
		Visiting Professor	Kunihiko Honjo
	Institute of Turkish Culture Studies	Professor	Shushi Sugiura
Visiting Researcher	Bahçeşehir University (Turkey) Faculty of Architecture and Design	Professor	Ahmet Eyüce
		Associate Professor	Murat Dündar
Assistant	Department of Architecture	Assistant	Ayane Ise
		Assistant	Junko Morimoto
		Assistant	Aya Yamaguchi
	Institute of Turkish Culture Studies	Assistant	Yuna Hongo
Secretary (*or* office administrator)	Secretariat Division of School of Human Environmental Sciences	Chief Clerk	Masaki Ichie

Reviewers on *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, Kyoto University, Japan
Shuichi Hokoi	Professor, Kyoto University, Japan
Minako Mizuno Yamanlar	Professor, Ryukoku University, Japan
Kazuya Yamauchi	Head, Regional Environment Section, Japan Center for International Cooperation in Conservation, National Research Institute for Cultural Properties, Tokyo, Japan
Hironobu Yoshida	Professor Emeritus at Kyoto University, Japan
Ahmet Eyüce	Professor, Bahçeşehir University, Turkey
Murat Dündar	Associate Professor, Bahçeşehir University, Turkey
Murat Şahin	Associate Professor, Özyeğin University, Turkey
Shigeyuki Okazaki	Professor, Mukogawa Women's University, Japan
Kazuhiko Yanagisawa	Associate Professor, Mukogawa Women's University, Japan

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Rules and Regulations of the Institute of Turkish Culture Studies (ITCS) at Mukogawa Women's University

(Establishment)
Article 1 Mukogawa Women's University (hereinafter referred to as "the University") locates the Institute of Turkish Culture Studies (hereinafter "the Institute") in the University.
(2) The Institute shall be operated under the administration of the department of architecture (of the University) 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 around architecture of Japan and Turkey, as the east and the west starting points of the Silk Road, and to clarify the cultural base common to both countries beyond the differences in history, climate and so forth between the two countries.
(ii) to conduct, developing above-mentioned aims, extensive studies on life, technology and culture centered around architecture of neighboring Silk Road countries and to clarify similarities among them and contribute to new mutual understandings and contribute to the peace and prosperity of the Silk Road region through such understandings.
(iii) to support international exchange of students mainly in the field of human environment and conduct international education activity of architecture and human environment based on the achievements of the studies mentioned in (i) and (ii).
(iv) to discuss internationally the achievements of research and education referred to in the preceding three items and to introduce (*or* transmit) it to the world in various ways at every occasion, and to share common values with the 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 at Bahcesehir University, Istanbul
(ii) to hold an international workshop "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 the similar workshop "Inter Cultural Studies of Architecture in Istanbul" which is held at the Research Center of Japanese Culture Studies at Bahcesehir University and to send teachers and students of the University centered around the department of architecture for the research and education activities.
(iii) to hold seminars, introduce the research achievements, exhibit and hold lectures, concerning life, technology and culture centered around architecture, where 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 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, symposium and so forth.
(vi) other operations required to accomplish the aims mentioned in the preceding article.

(Organization)
Article 4 The Institute may have 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 appoints a 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 appoints a vice director and heads of research department from among the faculty. The latter position may be substituted by 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 the 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 researchers.
(3) The senior researchers assist their heads and engage in the research.

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

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

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

(Steering Committee)
Article 11 The University shall have the steering committee of the Institute (hereinafter "the steering committee") to deliberate the basic policy concerning the operation of the Institute.
(2) The steering committee shall consist of the director and a few members chosen from among the vice director, the heads of research departments, the senior researchers and researchers.
(3) The president appoints 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) The member 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) The details on 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 School of Human Environmental Sciences shall be the chief of the secretariat
(3) The members of the secretariat handle clerical works under the guidance and supervision of the center chief under the director's direction.

(Supplementary Rules and Directions)
Article 13 In addition to what is provided in this rules and directions, the 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 starting on July 29, 2009.
(2) In the period from the day the rules and regulations is 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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