

# Townscape Evaluation of Oya-stone Buildings in the Urban Area of Utsunomiya City, Tochigi Prefecture, Japan

Motosumi Kobayashi<sup>1</sup> and Akio Yasumori<sup>2</sup>

<sup>1</sup>Doctoral student, Graduate School of Eng., M. Eng., Utsunomiya University, Japan

<sup>2</sup>Associate Professor, School of Regional Design, Dr. Eng., Utsunomiya University, Japan

## Abstract

Oya-stone, a kind of tuff is produced in Utsunomiya city, Tochigi Prefecture, Japan, and many historic buildings made of Oya-stone are scattered there. This paper, focusing on 102 Oya-stone buildings in the urban area, evaluated the townscape from 2 perspectives of the building evaluation by age, construction, and design and the appearance evaluation into city considering the road contacts, urban voids, and aggregation of buildings. First, as the building evaluation, highly-evaluated buildings include finely-decorated shop with masonry construction that stones were piled overall and old storehouses with stone-cladding construction that stones were clad on wooden ones. Also, highly-evaluated ones were the ones that had been evaluated through the existing criteria such as cultural properties, so the evaluations were found to be adequate. Also, as the result of comparing them with farm villages in the north, some buildings were evaluated more highly than the ones in the urban area. Then, as the appearance evaluation, buildings had appeared into the city by contacting roads and urban voids. Also, regarding the cultural properties and buildings in farm villages, several buildings had aggregated and were highly evaluated. Finally, Oya-stone buildings and appearances were organized as a townscape evaluation. Most buildings were evaluated around the average score and the appeared at the back of properties as low score. On the other hand, buildings whose building evaluations were high were ones contacting roads and urban voids with several faces and whose appearance was high and the ones at the back of roads and whose appearance was low, but were forming townscapes with a depth. As above, the characteristics of Oya-stone buildings and the townscape of urban area were clarified and an evaluation method to maintain them was presented.

**Keywords:** Oya-stone; Townscape; Evaluation; Storehouse; Vernacular Architecture.

## 1. Preface

### 1.1 Background and purpose of the research

Utsunomiya city, Tochigi Prefecture, Japan is located in the green tuff zone (Fig. 1), and Oya-stone, a kind of tuff that is light-weight and easy to process is produced in Oya town of the city. In urban areas, there are over 300 buildings made of Oya-stone and the unique outer shapes of this vernacular architecture have become an important factor that adds the historicity and regional cultures to the townscape.

However, in recent years, the buildings made of Oya-stone have been demolished due to the aged deterioration, land reallocation, and redevelopment and are being lost from the townscape<sup>Note1</sup>. It has therefore become necessary to set an evaluation criteria to maintain the Oya-stone buildings. Then,

in order to obtain knowledge that may contribute to the townscape policy by the Utsunomiya city department of city planning, the Architects and Building Engineers Association in Tochigi Prefecture conducted a field survey<sup>1</sup>, and Utsunomiya University Yasumori Laboratory that the author belongs to evaluated and analyzed through the public-private partnership.

The purpose of this research is to evaluate Oya-stone buildings in the urban area of Utsunomiya city by age, construction, and design as well as their appearance into city by the contacts with roads and urban voids in order to clarify the method of townscape evaluation that becomes the determination criteria for the necessity of maintaining a building<sup>Note2</sup>.

### 1.2 Researches in the past

We clarified the characteristics of Oya-stone buildings and townscapes of farm villages in the north of Utsunomiya city (Fig. 2) in a typological manner<sup>4,5,6</sup>. In the villages, there are stone storehouses and stone walls along the roads and they have formed continuous stone townscapes.

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Contact Author: Akio Yasumori,  
Associate Professor, Dpt. of Architecture and Urban  
Design, School of Regional Design, Dr. Eng.,  
Utsunomiya University, Japan

e-mail: yasumori@cc.utsunomiya-u.ac.jp

Then this research is to focus on the urban area of Utsunomiya city where townscapes are unlikely to be continuous because Oya-stone buildings are located at the back of properties, but it is necessary to consider the townscapes with historicity and locality in the urban area.

As an investigation report by local governments and organizations, Utsunomiya city board of education conducted an investigation of stone buildings in the whole city<sup>7)</sup> over 20 years ago, and Architects and Building Engineers Association in Tochigi Prefecture conducted investigations of locations of Oya-stone buildings in the urban area over 10 years ago. This research is the first detailed investigation after them.

### 1.3 Method and outline of investigation

This research investigated 102 Oya-stone buildings<sup>Note3)</sup> in the urban area of Utsunomiya city that was an old castle town including Futaara-yama shrine and the former castle park in the west of JR Utsunomiya Station (Fig. 3). Regarding the contents of the field survey, actual measurements and photo recordings of buildings were performed.

In the following study, first, Oya-stone buildings are evaluated by age, construction, and design characteristics (Section 2). Then, the appearances of buildings into the city are evaluated by considering the roads and urban voids the buildings contact and aggregation of buildings (Section 3). Then, the



Fig.1 Location of Utsunomiya city

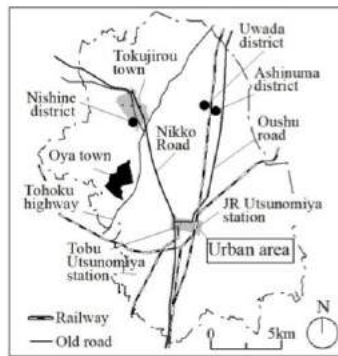


Fig.2 The area where Oya-stone buildings have concentrated in Utsunomiya city

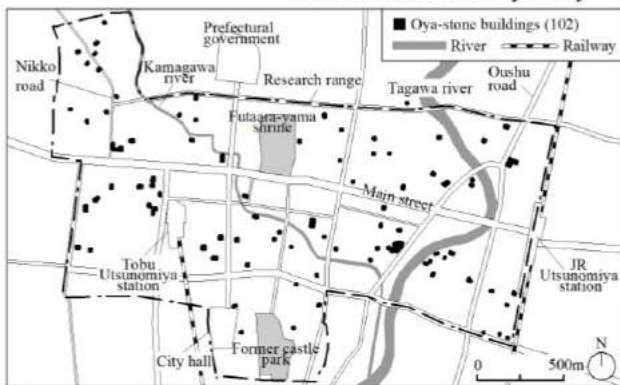


Fig.3 Distribution of Oya-stone buildings in the urban area of Utsunomiya city

townscape of Oya-stone buildings in the urban area is evaluated along with the evaluations of buildings and their appearances into the city in previous sections (Section 4) (Fig. 4).

## 2. Building evaluation of Oya-stone buildings

### 2.1 Building evaluation from perspectives of age, construction and design

Oya-stone buildings were evaluated by age, construction, and designs of decorations.

First, uses of Oya-stone buildings is considered as a basic information though it is not directly related to the evaluation (Table 1). The uses can be categorized into commerce, residence, and storage, and many of the buildings were used as storehouse, called "Kura" in Japanese to shop household goods especially in the category of storage.

Second, ages of buildings were evaluated and evaluation scores were given to old buildings (Table 2). Many of the buildings were the ones built in the eras of Taisho, Showa prewar and postwar (score 1) between older eras of Edo and Meiji (score 2) and the new era of Heisei (score 0).

With regard to the evaluation of construction methods of Oya-stone buildings, more special ones were highly evaluated. The construction methods can be categorized roughly into the stone-cladding construction that fastens thin stones on wooden frameworks with iron nails (score 2) and the stone-piling construction that piles stones of standard lengths (1 foot x 3 feet) (Table 3). Most of stone-cladding constructions use Oya-stones for a part such as lower level or pitched side of the wall

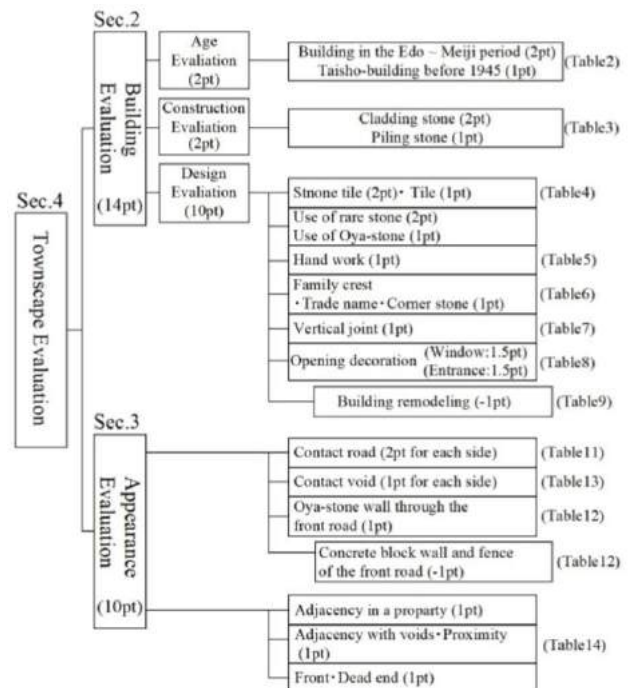


Fig.4 Contents of townscape evaluation of Oya-stone buildings

and 40% of stone-piling constructions were masonry structures where stones became structure bodies. The second most common construction of buildings was reinforced concrete girder and rigid-frame structure with Oya-stones as curtain walls.

Thirdly, detailed designs of Oya-stone buildings were evaluated and evaluation scores were given to rare or special ones. With regard to the roof materials of buildings, tiles (score 1) account for over half of them, but 1 building with rare stone tiles made of Oya-stone was seen (score 2) (Table 4). With regard to the finishing of stones, as handworks of craftsmen (score 1), pickaxe finishing where the diagonal patterns made when stones are cut out are characteristic, and as a machine processing, diamond finishing that grinded the surfaces were seen on many buildings (Table 5). With regard to the decoration on wall, family crests and trade names on gable and cornerstones that used stones larger than standard length were seen (score 1 for either of them) (Table 6). With regard to the joints of wall stones, many of them are break joint that placed stones of standard lengths alternately, but vertical joints (score 1) that clad stones vertically on wooden walls and plastered the joints were also seen (Table 7). With regard to the

openings, focusing on the windows and entrances, evaluation scores were given to special shapes, eaves, and doors respectively (Table 8). With regard to the shapes of openings, arch-shaped ones and the ones with key stones were seen (score 0.5 for either of them). Some buildings with eaves had stone-built order columns or horizontal wooden eaves (score 0.5 for either). Some buildings with doors had stone-built sliding doors, plastered or iron ones with thickness of cornice (score 0.5 for either). Also, some buildings had remodeled some parts such as installing signs on the facades when uses are changed, adding coated materials like galvanized sheets, and reroofing to metal roofs, etc (-1) (Table 9).

## 2.2 Sum of building evaluation

Oya-stone buildings in urban areas were evaluated with the age 2 scores, construction method 2 scores, and design 10 scores, 14 scores in total (Fig. 5). The average score of building evaluations was 4.76, and the buildings with 10 scores were most highly evaluated and the ones with 1 score were least evaluated. 20 buildings that occupy approximately 20% of all were highly evaluated with scores over 7.5. The highly evaluated buildings were shop with high design

Table 1 Uses of Oya-stone buildings (102 buildings, Multiple count)

Commer ce (C) (26)	Shop(Cs)	23
	Factory(Cf)	3
	Change Storehouse (* ) to Shop	9
Resid ence (R) (10)	House(Rh)	8
	Annex(Ra)	2
Storage (S) (72)	Storehouse(Ss)	59
	Warehouse(Sw)	4

Note) The numbers in the table indicate the number of corresponding buildings (The same applies below). Only those that could confirm the age were counted.

Table 2 Construction ages of buildings (74 buildings)

Construction age	Edo period (-1868)	Meiji period			Taisho period (1-15) (1912-1926)	Showa period		Heisei period (1989-)
		Previous term (1-15) (1868-1882)	Median term (16-30) (1883-1897)	Late term (31-45) (1898-1912)		Prewar (1-20) (1926-1945)	Postwar (21-41) (1946-1989)	
Number of buildings	4 (5%)	8 (10%)	6 (8%)	6 (8%)	17 (23%)	13 (18%)	20 (27%)	1 (1%)
Score		2pt				1pt		0pt

Table 3 Construction methods of buildings (102 buildings)

Const ruction method	Cladding stone (Wooden·Soil) (Cl)(21)		Piling stone(P) (80)			Steel frame cladding stone (St)
	All	Part	Masonry (Pm)	RC circumferential girder·frame Piling stone (Pr)	Wooden frame Piling stone (Pw)	
Buildings	2	19	46	27	7	1
Score	2pt		1pt			0pt

Table 4 Roof materials (102 buildings)

Material	Buildings	Score
Stone tile	1	2pt
Tile	68	1pt
Metal	33	0pt

Table 5 Finishing of stones (102 buildings, Multiple count)

Stone finishing	Hand work		Machine work		
	Pickaxe	Chopped face	Hammering	Diamond cut	Chainsaw
Score	(42)	(28)	(11)	(38)	(10)
	1pt		0pt		

Note) As for the type of stone, all 102 buildings were Oya-stone, and gave 1 point. Tokujira-stone, Funiyu-stone, Oya-stone of the Toramoku are scarce, so we gave 2 points to the building.

Table 6 Decorations on walls

Wall decoration	Family crest · Trade name	Corner stone
Score	(8)	(4)
	1 point for either	

Table 7 Joints of stones (102 buildings)

Stone joint	Vertical joint	Break joint
	Score	(13)
	1pt	0pt

Table 8 Decorations on openings (Multiple count)

Description part	Shape		Eaves				Door			
	Made of stone·RC		Made of stone		Made of wood		Made of stone		Made of steel·plaster	
	Arch	Key stone	Stone eaves	Order column	Horizontal eaves	Rafter	Stone door	Decoration	Plaster·steel door (Cornice)	Decoration
Entrance	7	9	3	0	3	13	4	3	10	9
Window	6	6	11	5	19	30	10	9	15	13
Score	0.5 points for either		0.5 points for either				0.5 points for either			

Table 9 Remodeling of buildings (Multiple count)

Remodeling of buildings	Coating	Reroofing	Facade sign
	Score	(16)	(19)
	-1pt		

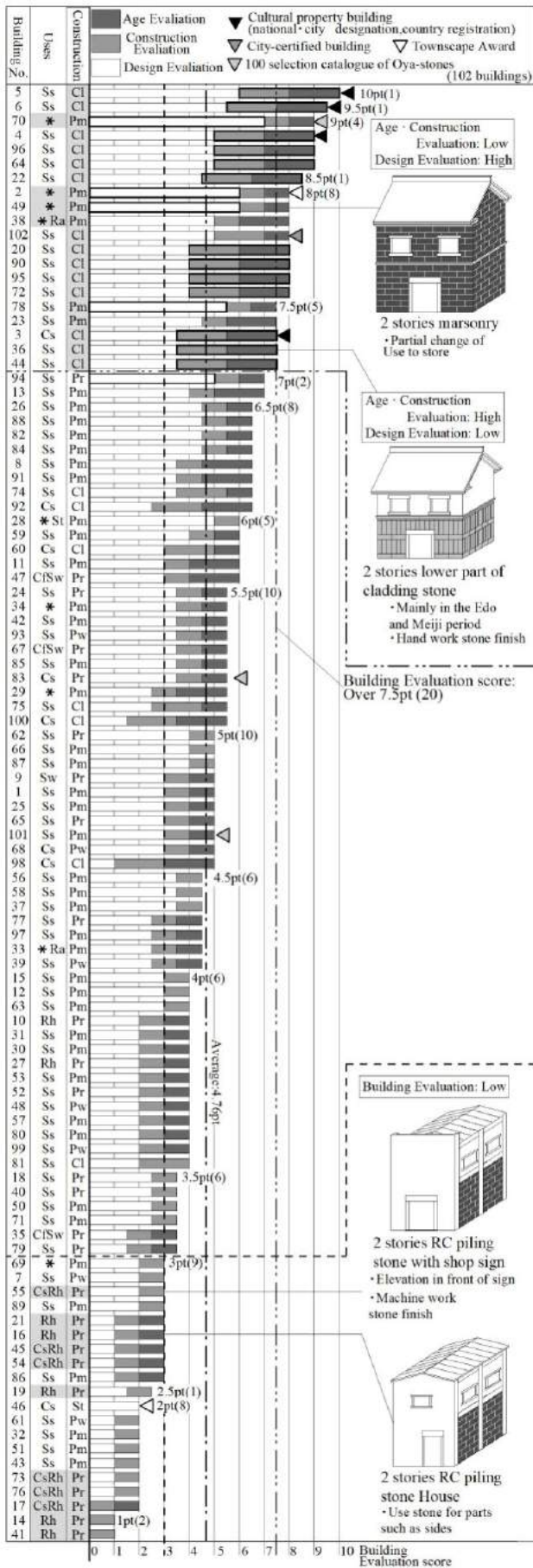


Fig.5 Building evaluations of Oya-stone buildings in urban areas

evaluations where openings and wall surfaces were finely decorated and old buildings with high construction and age evaluations that were stone-cladding construction. On the other hand, with regard to the buildings with low building evaluations equal to or lower than 3 scores, many residences with reinforced concrete and rigid-frame structure that used stones for some parts of the buildings and shop covered with signs were often seen.

### 2.3 Examination of building evaluation

Building evaluations of Oya-stone buildings mentioned above were examined in comparison with existing criteria such as cultural properties, buildings certified by the city, and 100 selection catalogue of Oya-stones. According to the Fig. 5, buildings which have received existing criteria concentrated in the ones whose building evaluations were over 7.5. With the former Shinohara residence that is a cultural property (Fig. 6) as an example, 4 residences in the property are all stone-cladding construction in the eras of Edo and Meiji and the building evaluations ranged from 7.5 to 10, and stone tiles are placed on the roofs of eaves.

Then, the building evaluation was applied to Oya-stone buildings in Nishine district, Tokujirou town that was certified as one of Utsunomiya hundred sights for a comparison with urban areas (Table 10, Fig. 7). The highest building evaluation in urban areas was 10 scores, but 5 buildings with over 11 scores that had rare stones and fine decorations were seen in Nishine district.

According to the results above, appropriate evaluations were given to Oya-stone buildings that had high cultural values, so the evaluation criteria presented in this paper is considered to be adequate.

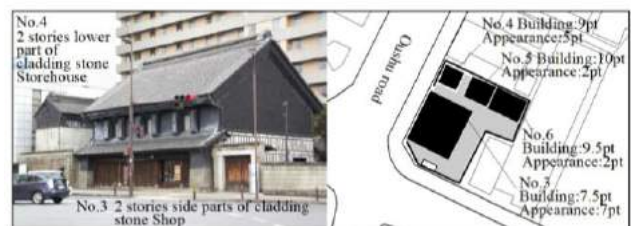


Fig.6 Former Shinohara residence

Table 10 Building evaluations in Nishine district

Score	Nishine (63)	Urban area (102)	Score	Nishine (63)	Urban area (102)
14	1(1%)	0	6	10(16%)	15(15%)
13	1(1%)	0	5	7(11%)	16(16%)
12	0	0	4	8(13%)	12(12%)
11	3(5%)	0	3	7(11%)	10(10%)
10	2(3%)	2(2%)	2	3(5%)	8(8%)
9	5(8%)	5(5%)	1	0	2(2%)
8	5(8%)	13(13%)	0	0	0
7	10(16%)	10(10%)			

**Building Evaluation Criteria:**

- Decoration: Stone door (1pt)
- Eaves (3pt)
- Family crest (1pt)
- Stone tile (2pt)
- Vertical joint (1pt)
- Tokujira stone (2pt)
- Hammering (1pt)
- Meiji Period building (2pt)
- Cladding stone construction (2pt)
- Total 14 points

Fig.7 Historical building in Nishine district

### 3. Appearance evaluation of Oya-stone buildings

#### 3.1 Appearance evaluation from perspectives of road contacts, urban voids and aggregation

Appearance of Oya-stone buildings into the city was considered and evaluated from perspectives of road contacts, urban voids such as gardens or vacant lots, aggregation such as adjacency and proximity of buildings.

Buildings that face many roads and voids and are highly visible were highly evaluated. With regard to the road contacts of Oya-stone buildings, over half of them had receded from roads and been located at the back of properties, but some buildings had contacted roads with 1 or 2 faces for appearance (2 scores for contacting a road with 1 face) (Table 11).

Table 11 Number of road contact faces of Oya-stone buildings (102 buildings)

Contact road	Receding from road	Contact to road	
		1 face contact road	2 faces contact roads
	Oya-stone building (59)	Road (34)	
Score	0pt	2pt	4pt

Note) "Contact road" means that it is located within 2m from the road.

Table 12 Border elements of frontal roads (10)

Border elements	Oya-stone wall	Concrete fence
	(5)	(5)
Score	1pt	-1pt

Table 13 Number of faces of urban voids that contact buildings (102 buildings)

Contact voids	No voids	1 face void	2 faces voids	3 faces voids	4 faces voids
	(19)	voids (38)	(27)	(15)	(3)
Score	0pt	1pt	2pt	3pt	4pt

Table 14 Aggregation of Oya-stone buildings (Multiple count)

Aggregation	Adjacency		Proximity	Front	Dead end
	row in a property	with voids			
	(25)				
Score	1pt	1 points for either	(6)	(2)	(7)

Note) "Proximity" indicates that there are no more than 2 other buildings between Oya-stone buildings.

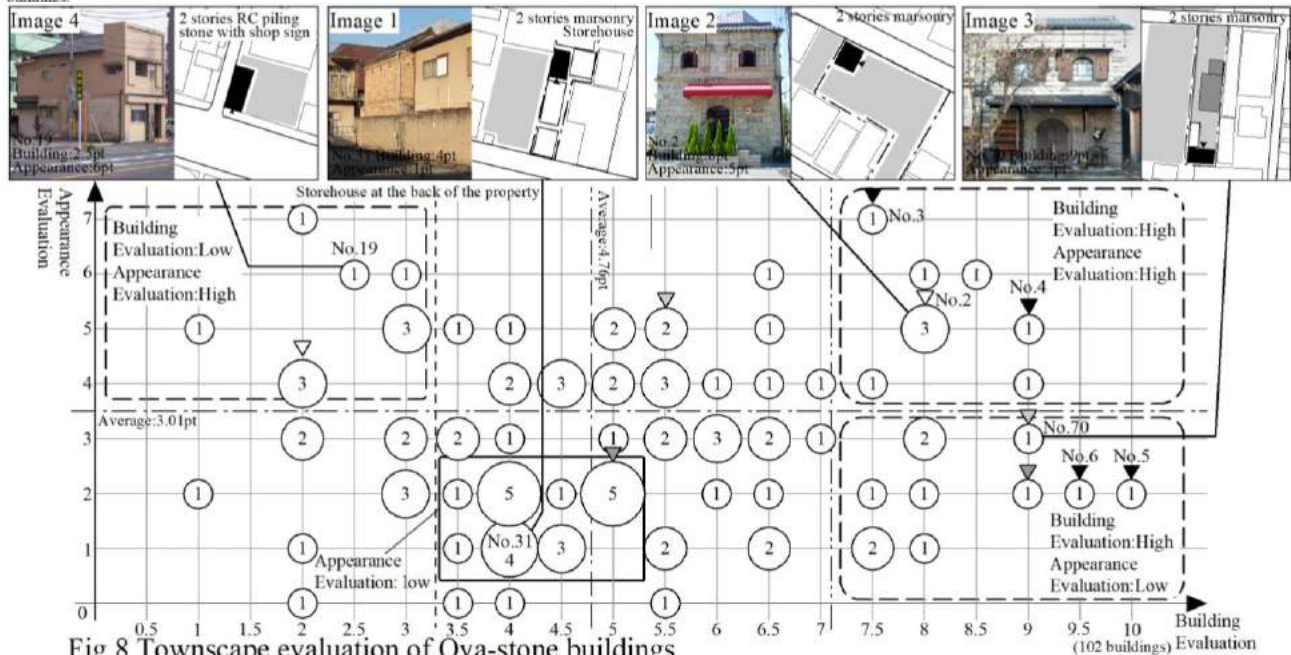


Fig.8 Townscape evaluation of Oya-stone buildings

With regard to border elements of frontal roads, there were concrete block walls and fences (score -1), but Oya-stone walls (score 1) had appeared with Oya-stone buildings and form the townscape (Table 12). With regard to the number of faces of voids contacting Oya-stone buildings, most of buildings were contacting urban voids such as parking lots and gardens with 1 or 2 faces (1 score for 1 face of a void it contacts) (Table 13).

Then, aggregation of Oya-stone buildings were considered from the perspectives of adjacency and proximity of between buildings and the locations (Table 14). In urban areas, several Oya-stone buildings sometimes have aggregated to form the townscape, and such buildings were highly evaluated. Row of Oya-stone buildings in the property were often seen. Also between Oya-stone buildings across the property, there were townscapes where several buildings were seen in a view via a urban void and proximate buildings across 1 or 2 lots (score 1 for either of them). Also, there were townscapes where buildings face each other across the road and the other building is on the dead end of the road symbolically (score 1 for either of them).

#### 3.2 Examination of appearance evaluation

Appearance evaluations of Oya-stone buildings were examined in comparison with cultural properties and Nishine district. The buildings in the former Shinohara residence have aggregated in the property and the shop that faces the road with 1 face (No.3) has gained 7, the highest score of appearance evaluation in urban areas. Also, Oya-stone buildings in Nishine district have closed up and most of the buildings have aggregated in the property or across the property, so they were highly evaluated.

#### 4. Townscape evaluation of Oya-stone buildings

Townscape evaluation of Oya-stone buildings in urban areas was performed with building evaluation scores on the horizontal axis and appearance evaluation scores on the vertical axis (Fig. 8). Building evaluation scores of most buildings were around the average and they were at the back of property as a general position of storehouse, so the appearance evaluation was likely to be low (Image 1). With regard to the buildings with high building evaluations, the ones with high appearance that contact roads and parking lot with 2 or more faces (Image 2) and the ones with low appearance that do not contact roads but are at the end of the property where Oya-stone buildings aggregate and form a townscape with a sense of depth were seen (Image 3). Also, with regard to the buildings with low building evaluation and high appearance, residences and shop with reinforced concrete girder and rigid-frame structure that contact roads with 1 or more faces were often seen (Image 4).

As above, it was clarified that historic and finely-decorated storehouses and relatively-new shop have contacted roads and urban voids and buildings have aggregated to form a variety of townscapes in urban areas.

#### 5. Conclusion

This research, focusing on Oya-stone buildings in urban areas of Utsunomiya city, performed townscape evaluations from 2 perspectives of buildings and appearance to the city.

First, building evaluations of Oya-stone buildings were performed and the buildings that were highly evaluated were the finely-decorated ones with masonry construction and old storehouses constructed in the eras of Edo and Meiji with stone-cladding construction. Also, some of the buildings with high building evaluations were Oya-stone buildings that had been evaluated through the existing criteria such as cultural properties, so the evaluations were found to be adequate. Then, appearance evaluations to the city were considered and it was clarified that buildings contact roads and urban voids to appear into the city and several Oya-stone buildings have aggregated for a townscape. Also, building evaluations and appearance evaluations were combined to perform a townscape evaluation of Oya-stone buildings, and in urban areas, buildings with high building evaluations and appearance evaluations that contact roads and urban voids and the ones with low appearances that are located at the end of properties but have formed a townscape with a sense of depth were seen.

As above, the characteristics of Oya-stone buildings in the urban areas and townscape evaluations were clarified and an evaluation method

to maintain and utilize buildings in the future was presented.

#### Note

- 1) According to the investigation we conducted, 28, approximately 20% of Oya-stone buildings in the urban area of Utsunomiya city have been lost in 13 years from 2005 to 2018.
- 2) This research is the one that added new discussions to some parts of the results of references 2 and 3.
- 3) There are 118 Oya-stone buildings and structures in the urban area of Utsunomiya city as of 2018. This research conducted an investigation of 102 Oya-stone buildings as analysis targets excluding 9 buildings for public uses such as churches and temples and 7 structures like walls.

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