ABSTRACT
This report describes the results from the questionnaire and detailed survey conducted in 2004 to 2006. The 15 items of questionnaire included in facilities management, maintenance management, saving energy, art gallery facilities. The number of art galleries investigated by questionnaire survey is about 171 art galleries in Japan. Then we scanned findings during about 1 year 6 months to get speculation having high reliability and summarized a tendency and a characteristic based on the result. From the survey results, it shows the tendency and characteristics about each item. The paper of this study has emphasized the importance of having the facility management in art gallery.

KEYWORDS
Facility management, Maintenance, Culture facility, Art gallery, Questionnaire survey

INTRODUCTION
This purpose of this study is to show the importance of having the facilities - maintenance management in art gallery. The reason that an art museum was born is a desire of people to want to touch world work of art directly. The art gallery is changing a form and function of an establishment to cope with needs in the era. In this investigation, we carried out a questionnaire survey to grasp facilities management technique of an art museum. An investigation category of a questionnaire passed to 15 items (facilities management, energy saving, disaster prevention, security control, method and frequency of fumigation/ disinfection, a mold countermeasure, enforcement of an entrance restriction, care for lighting and air conditioning, control temperature/humidity, etc.), and the investigation was carried out for all public art galleries built by each local government. Then we scanned findings during about 1 year 6 months to get re-checking these data and it investigated at field work if necessary.

ART GALLERY THAT IS PRESCRIBED BY MUSEUM LAW IN JAPAN
The museum law was established in 1951 for the purpose of contributing to national education / science and development of culture in Japan. This law was based on social education spirit of law, and it was revised in 1971. An art gallery is defined by museum law as one of the museum with a history museum, a science museum, a zoo, a botanical garden, an aquarium in Japan.

OUTLINE OF QUESTIONNAIRES
About a questionnaire
Table 1 shows a list of question. We set up 15 questions in consideration of the following content. The investigation category of a questionnaire pass to 15 items (facilities management, energy saving, disaster prevention, security control, method and frequency of fumigation/ disinfection, a mold countermeasure, enforcement of an entrance restriction, care for lighting and air conditioning, control temperature/humidity, etc.).
1. What is the total floor area of your art gallery?
2. What is the total exhibition of floorage? What is its percentage against the total floor area?
3. What percentages do the water supply cost, lighting / heating cost, and maintenance management cost per unit area occupy against the total operating cost of your art gallery?
4. How many people are engaged in the management of your art gallery? Indicate the types of their jobs (raising, facility, cleaning, guarding, clerical and so on) and the time zones of their duties.
5. What do you prioritize for energy conservation for each of your facilities?
6. What is the capacity of your auxiliary power source?
7. How many times do you hold disaster prevention and crime prevention drills a year?
8. Do you have a disaster control center in your art gallery?
9. How often do you perform inspections a month, and how, for the device in the facility regarded as the most important in raising organisms in your art gallery?
10. What water treatment / sterilization system do you have in your art gallery? Name one out of the following:
11. How do you separate the raising / exhibition system from the air-conditioning system?
12. What water treatment method do you use of exhibition tanks?
   Name the methods you use out of the following:
   And what are the percentages of the methods you use? In case the one-through (use once and then discard) methods is among the methods in use, how many tons of seawater do you use for replacement?
13. How much water do you use a day for each exhibited organism and for each exhibition space?
14. What filter tanks do you use in your art gallery?
15. Where and how do you acquire seawater and freshwater for your art gallery?
16. How much do you pay for a ton of seawater including the transportation cost?
17. What are the facilities, system, or devices that you think should be introduced into your art gallery?

Execution method of a questionnaire survey
We investigated 171 art gallery administered soundly, which was selected from ASAHI yearbook 2005 Edition. The questionnaire was sent to staff officer having a qualification of a curator in each establishment during the end of Aug. 2006 from the end of May, 2005. Method of sending and collection was used by a fax and mail, which was got 138 answers.

Collection result and analysis of a questionnaire
At first an art gallery was sorted to an area shown in table 2, because of grasp of a tendency and a characteristic from collection result.
As a result, Area 1 was 7 cases(5.0%), Area 2 was 11 cases(7.9%), Area 3 was 14 cases(10.0%), Area 4 was 20 cases(14.3%), Area 5 was 10 cases(7.1%), Area 6 was 22 cases(15.7%), Area 7 was 4 cases(2.9%), Area 8 was 16 cases(11.4%), Area 9 was 22 cases(15.7%), Area10 was 14 cases(10.0%).
As for the mean value of elapsed years after completion of construction, buildings were 24.5 years, and equipments were 18.3 years.
On the other hand, by classification according to a management, the percentage that a public group managed was 82.1%, and the percentage that a nongovernmental group managed was 17.9%
Table 2. Japan’s Art gallery as Geographic Region

<table>
<thead>
<tr>
<th>Area</th>
<th>Tokyo, Hokkaido &amp; 45 Prefs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hokkaido</td>
<td></td>
</tr>
<tr>
<td>2 Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, Niigata</td>
<td></td>
</tr>
<tr>
<td>3 Ibaragi, Saitama, Chiba, Gunma, Tochigi</td>
<td></td>
</tr>
<tr>
<td>4 Tokyo, Kanagawa</td>
<td></td>
</tr>
<tr>
<td>5 Yamanashi, Nagano, Shizuoka</td>
<td></td>
</tr>
<tr>
<td>6 Toyama, Ishikawa, Fukui, Gifu, Aichi</td>
<td></td>
</tr>
<tr>
<td>7 Nara, Wakayama, Mie</td>
<td></td>
</tr>
<tr>
<td>8 Shiga, Hyogo, Otsuka, Kyoto</td>
<td></td>
</tr>
<tr>
<td>9 Tottori, Kagawa, Shimane, Tokushima, Okayama, Kochi, Hiroshima, Ehime, Yamaguchi</td>
<td></td>
</tr>
<tr>
<td>10 Fukuoka, Kumamoto, Saga, Oita, Nagasaki, Miyazaki, Kagoshima, Okinawa</td>
<td></td>
</tr>
</tbody>
</table>

TENDENCY AND CHARACTERISTIC IN EACH CATEGORY

An attribute of art gallery

(1) Results of total floor area was shown in Figure 1, and the mean value was 6,836.1 m². Next, total floor area was classified as each management. The mean value of the establishment which a public group managed was 8,408.4 m², and the mean value of the establishment which a nongovernmental group managed was 5,263.8 m².

(2) Results of exhibit area were shown in Figure 2, and the mean value was 1732.8 m². The mean value of the establishment that a public group managed was 2512.6 m², and the mean value of the establishment that a nongovernment group managed was 953.0 m². Then, the maximum value was 12,375.0 m² and the minimum value was 112.0 m².

From results of the number of the daily average guests, the mean value was 365.3 person per day. There was the most number of the guests of Area 4, and it was 874.8 people per day. The average number of guests of unit area of exhibit space was 0.211 person/m²/day (Minimum value was 0.131, Maximum value was 0.339).

Analysis of operating cost

The category of operating cost was city water cost, energy cost, maintenance cost and security cost. Maintenance cost includes daily inspection, periodic inspection and repair cost except large-scale repairing. Item of operating cost per unit area is shown for Figure 3. About the city water cost, the answer of under 5% was 95.4%. On the other hand, about maintenance cost and energy cost, the percentage of answer more than 13% was 59.7%, 31.8% each.
Analysis of the number of regular administrative officer
As for the average number of staff officer, facilities management staffs were 3.4 people, security staffs were 3.6 people, cleaning staffs were 4.3 people. In addition, about security of an establishment, the case that performed in remote monitoring by a sensor was 9.4%.
As a result of having counted it with the number of the staffs by a difference of facilities management, it is as follows. In the case of a public establishment, the average number of each staffs, facilities management staffs were 4.5 people, security staffs were 3.1 people, and cleaning staffs were 5.2 people. In the case of a nongovernmental establishment, the average number of each staffs, facilities management staffs were 2.3 people, security staffs were 4.1 people, and cleaning staffs were 3.4 people. As for security of remote monitoring by a sensor, a public establishment was 5.2% and a nongovernmental establishment was 13.4%.

Analysis of an energy-saving technique
Figure 4 shows execution ranking of energy-saving technique. In most establishments, lighting installation and air conditioning installation hold the first and second place of execution ranking. In addition, water supply and drainage/ plumbing equipment was the third place, power substations was the fourth place.

Analysis about disaster prevention / security control
As for the training times of disaster prevention training and security control training, mean values of disaster prevention training were 1.1 times per year and mean values of a security control training were 0.2 times per year. Regardless of area and facilities management, the difference of dispersion value in the training times were a few

Fig.4 Analysis Results of Energy Conservation Measures

<table>
<thead>
<tr>
<th>Priority</th>
<th>Air-conditioning</th>
<th>Water/sanitation</th>
<th>Power facility</th>
<th>Lighting facility</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1</td>
<td>40.4</td>
<td>28.9</td>
<td>13.2</td>
<td>18.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Priority 2</td>
<td>9.1</td>
<td>20.5</td>
<td>5.0</td>
<td>20.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Priority 3</td>
<td>2.0</td>
<td>13.3</td>
<td>20.6</td>
<td>53.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Priority 4</td>
<td>43.4</td>
<td>34.9</td>
<td>16.2</td>
<td>7.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Priority 5</td>
<td>5.1</td>
<td>2.4</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Fig.3 Analysis Results of Water,Energy,Maintenance and Security Cost

<table>
<thead>
<tr>
<th>Area</th>
<th>Water cost</th>
<th>Energy cost</th>
<th>Maintenance cost</th>
<th>Security cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5%</td>
<td>804</td>
<td>193</td>
<td>15.9</td>
<td>31.2</td>
</tr>
<tr>
<td>5% to less than 10%</td>
<td>84</td>
<td>183</td>
<td>4.0</td>
<td>14.3</td>
</tr>
<tr>
<td>10% to less than 15%</td>
<td>60</td>
<td>182</td>
<td>1.3</td>
<td>11</td>
</tr>
<tr>
<td>15% to less than 20%</td>
<td>12</td>
<td>163</td>
<td>12.2</td>
<td>10.7</td>
</tr>
<tr>
<td>20% or more</td>
<td>60</td>
<td>178</td>
<td>86.7</td>
<td>9.7</td>
</tr>
</tbody>
</table>

On the other hand, there was the area where security control training was never carried out. It seemed that consciousness for security control was low. As for the disaster control center, "installed" was 24.7%, "the establishment which followed disaster control center" was 26.8% and "not installed" was 48.5%. The result that establishment situation of disaster control center was different depends on a discrepancy of an area.
There was the area that answer of "installed" more than 77.8%, the other answer of "not installed" reached 77.8%. About establishment situation of standby power, the answer of "install" was 77.6%. And the number of the answer in all areas, "install" was more than "not install".
Analysis about a showpiece / equipment / maintenance

(1) For a category of cultural showpiece, a most exhibit was a picture, on the other hand, the exhibit of a sword was 2.1%, and the exhibit of an artifact was 2.6%. The fumigation is performed for minimizing a damage of cultural showpiece by harmful insects, and it is important to grasp fumigation times and fumigation method.

(2) Figure 5 shows annual fumigation times. Each area was different. The value of fumigation times in each area was different. The mean value was 0.71 times per year, minimum value was 0.3 times per year and maximum value was 2.1 times per year. About fumigation times by a difference of management of an establishment, the mean value of the establishment that a public group managed was 0.92 times per year, and the mean value of the establishment that a non-government group managed was 0.50 times per year.

(3) Figure 6 shows the fumigation time. Because Japan can understand some division into climatic zones by an area, this analysis has an important meaning on facility management in art gallery. There were many answers that the fumigation was performed in March and December. And the rank order that there were many answers was February, June, July and August. About the result, a reason thought about is the following items. The fumigation is usually performed in the closure day such as the end of year beginning of the year, end of the fiscal year. The fumigation is performed during the time when an activity of a harmful insect becomes active.

(4) Figure 7 shows the result that classified fumigation method. The normal pressure fumigation method was used in the most establishments, and there were many direct vent systems in that. As that reason, it was thought that above method could perform without special device and equipment.

(5) Figure 8 shows a kind of chemical used for fumigation. Most of chemicals used for fumigation were bromomethane and the mixture of bromomethane and ethylene oxide, and each usage rate was 42.5% and 46.5%.
(6) Figure 9 shows ranking of a mold countermeasure. The most of answers about a mold countermeasure was temperature and humidity control. As that reason, it was thought that an occurrence of mold was prevented by constant temperature. For other methods, ventilation and anti-mold were used, and it was the third place and the fourth place each.

![Fig.9 Ranking of the Mold Countermeasure](image)

CONCLUSIONS

In this investigation, we carried out a questionnaire survey of 15 items against 171 establishments. From the result of collection and statistical analysis of a questionnaire, we could grasp the facilities management technique of an art gallery. The summary is shown below:

1. **The category of operating cost was city water cost, energy cost, maintenance cost and security cost. Maintenance cost includes daily inspection, periodic inspection and repair cost except large-scale repairing.** About the city water cost, the answer of under 5% was 95.4%. On the other hand, about maintenance cost and energy cost, the percentage of answer more than 13% was 59.7%, 31.8% each.

2. From the execution ranking of energy-saving technique, in most establishments, lighting installation and air conditioning installation hold the first and second place of execution ranking. In addition, water supply and drainage/plumbing equipment was the third place, power substations was the fourth place.

3. Japan can understand some division into climatic zones by an area. From analysis result about a showpiece/equipment/maintenance, these analysis results show the Japan’s climatic zones by an area.

ACKNOWLEDGEMENTS

On the enforcement of the questionnaire, we show the will of thanks to the curators of each institution.

REFERENCES