URBAN VERTICAL CEMETERY
A New Type of Burial in Cities of High Density
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Thanks to:

My tutor Kengo Skorick,
for all your efforts, patience, supports and pushes.
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INTRODUCTION
Abstract

Facing the rapidly aging problem, cities of high density find it difficult to spare enough land for burials. Establishment of new burial has expanded to the outskirts, and the sepultures become really expensive. Even though verticality has been applied to most building typologies since it could help to solve the spatial and economic problem, vertical cemetery might cause controversy.

The purpose of the project is to apply verticality into cemetery typology. Verticality provides opportunities to bring cemeteries back to the urban district. While urban cemetery makes it possible to mix city functions and encourage daily visits to the burial, which benefits people’s attitude towards life and death.

The project is developed with the periods of research and design. In the period of research, the proper scale of the columbarium room is discussed according to the field of view of human eyes. While the vertical structure is also developed, creating different space for various activities within the same structure system.

During the design period, the construction system (internode & branch) is based on the regulation of how bamboo grows. And the organization of vertical cemetery is supposed to be more organic and natural. It seems like a very open and public bamboo forest, where people can see the blue sky, enjoying the sunlight and fresh air.

The final design result is a proposal of urban vertical cemetery, providing enough memorial space for the citizens with a fair price and kind atmosphere. It is not only a place for the dead, but also a vertical park where daily life could happen.
Urban cemetery

These two maps compare the current cemeteries in Paris and Shanghai.

In Paris, we can find more than 20 cemeteries inside the central districts. These cemeteries belong to the artificial public space, they play an important role in the city like public parks, where daily life could happen.

However in Shanghai, the cemeteries are always far from the city center. These cemeteries belong to the municipal utilities and embrace the whole city, which reflects the lack of consideration in the aspect of urban planning.
Vertical cemetery

There are already some design proposed and some vertical cemeteries built.

Currently the world’s tallest cemetery is in Brazil. It measures 108 meters tall with 32 stories and 25,000 storing units. And the building also contains a restaurant, a chapel, a snack bar and even a peacock garden, which makes the cemetery became a tourist attraction.
Practical problem

Although verticality has been applied to most building typologies since it could help to solve the spatial and economic problem, vertical cemetery might still cause controversy.

In San Cataldo Cemetery designed by Aldo Rossi in Bologna, only the niches in the first layer were sold out.

The same situation happens in Fuleshan Cemetery in Shanghai, the 4-story building is totally out of use.

According to these references, the problem must be avoided is that vertical burials are usually out of use especially when they are far from the city and is not convenient to access.

So the purpose of the project is to apply verticality into cemetery typology. Verticality makes it possible to bring cemeteries back to the urban district. While urban cemetery makes it possible to mix city functions and encourage daily visits to the burial, which benefits people’s attitude towards life and death.
Scale of the columbarium

How to balance the density and quality of the space?

Since people don’t like to be surrounded by too much niches, especially when they belong to people you don’t know. So the proper distance to the cremation niches and proper diameter of the memorial space could be evaluated according to the study of field of view of human eyes.

60° - Comfortable range for single eye, where the object could be focused on
124° - Object in this area could be seen by both eyes, resulting in a 3D image
**Proper distance** to the columbarium wall

Suppose that you are in front of a columbarium wall, what you want is to worship towards your relative rather than be influenced by others.

Proper distance

Proper range: \(0.87 < d < 1.30\)

- \(N=1\), \(n=3\), \(d=0.43\)m, \(S=0.27\)m²
- \(N=1\), \(n=5\), \(d=0.87\)m, \(S=1.06\)m²
- \(N=3\), \(n=9\), \(d=1.30\)m, \(S=2.39\)m²

\(w = 500\)mm = width of a single niche  
\(r = 300\)mm = range of a single person  
\(n = \) number of niches that is in your eyesight  
\(N = \) number of niches that you are focused on  
\(d = \) distance between the person and the wall  
\(S = \) memorial area for a certain niche

---

**Proper diameter** of the memorial space

Define \(d = 1.00\)m

Proper diameter of the memorial space

Proper range: \(4000\)mm < \(D < 6000\)mm

- \(N=1\), \(n=7\), \(d=1.00\)m, \(S=1.41\)m²
- \(x = 16, 17, 18, 19...\) = number of the side  
\(a = \) area of the public space created  
\(A = \) area of the total space inside  
\(K1 = 1000 * (a/A/x) = \) quality of the space  
\(K2 = a/A = \) density of the space  
\(K = K1 * K2 = \) criteria of the evaluation

- \(x = 20\)  
  \(a = 1.03\)m²  
  \(A = 7.64\)m²  
  \(K1 = 6.74\)  
  \(K2 = 9.18\)  
  \(K = 19.37\)  
  \(D = 4400\)mm

- \(x = 30\)  
  \(a = 5.87\)m²  
  \(A = 17.84\)m²  
  \(K1 = 10.97\)  
  \(K2 = 1.68\)  
  \(K = 18.43\)  
  \(D = 5400\)mm

---
**Overall arrangement**

Evaluate each type in the aspect of **density**, **accessibility**, **sequence** and **ceremony space**.

**Regular tilings (3)**
by single type of regular polygons

<table>
<thead>
<tr>
<th>Type</th>
<th>Density</th>
<th>Accessibility</th>
<th>Sequence</th>
<th>Ceremony space</th>
</tr>
</thead>
<tbody>
<tr>
<td>3(6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6(3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4(4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Uniform tilings (8)**
by multiple types of regular polygons

<table>
<thead>
<tr>
<th>Type</th>
<th>Density</th>
<th>Accessibility</th>
<th>Sequence</th>
<th>Ceremony space</th>
</tr>
</thead>
<tbody>
<tr>
<td>6·3(4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3(2)·6(2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3(3)·4(2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3·4(2)·6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6(3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13 | Regular tilings | Uniform tilings | 14
Structure system is really important for a vertical cemetery. The burial wall could be designed as the origin of the vertical structure. It will be boring if each floor copies the same type. So the unit tried to create totally different space for different activities within the same structure system.
Space for private ceremony

The structure based on the burial walls, creating more intimate and private space.

---

Space for open ceremony

The structure is in the form of columns, creating more bright and open space.
Reflection

The structure is not flexible enough since there are only two basic types of the units. Could we improve the construction system and create a more natural experience in the vertical cemetery?
PROTOTYPE
The inspiration comes from the Woodland cemetery in Stockholm. What impressed me most was the scale of the trees. They are really tall and strongly attract your attention, so the graves are hidden in the forest. The experience is like you are surrounded by forest rather than only graves.

Figure 12. Woodland cemetery, Stockholm
In Sendai Mediatheque designed by Toyo Ito, structure as the highlight of the space, strongly attracts people's attention and also creates a special experience of the interior space like forest.

The construction system of Sendai Mediatheque consists of three elements: tube, plate and skin.

The tube is not only a part of vertical structure but also provides space for stairs, elevators, electric and water pipes, sunlights and so on.

**Structure**
Water pipes and electric wires are put inside the structure.

**Cremation niches**
Cremation niches are combined with the plant walls.

**Interior space**
The space inside the structure could be designed for various functions according to the shape of the tubes.
Try to combine the construction system (tube, plate, skin) with vertical garden in order to create the experience of nature and bring the power of life into the vertical cemetery.
D_t=3000  D_b=3000  H =3000

elevator, toilet

D_t=4500  D_b=3000  H =3000

memorial space

D_t=6000  D_b=3000  H =3000

D_t=8000  D_b=3000  H =3000

D_t=10000  D_b=3000  H =3000

D_t=3000  D_b=4500  H =3000

D_t=4500  D_b=4500  H =3000

D_t=6000  D_b=4500  H =3000

D_t=8000  D_b=4500  H =3000

D_t=10000  D_b=4500  H =3000

D_t=3000  D_b=6000  H =3000

D_t=4500  D_b=6000  H =3000

D_t=6000  D_b=6000  H =3000

D_t=8000  D_b=6000  H =3000

D_t=10000  D_b=6000  H =3000

D_t=3000  D_b=8000  H =3000

D_t=4500  D_b=8000  H =3000

D_t=6000  D_b=8000  H =3000

D_t=8000  D_b=8000  H =3000

D_t=10000  D_b=8000  H =3000

D_t=3000  D_b=10000  H =3000

D_t=4500  D_b=10000  H =3000

D_t=6000  D_b=10000  H =3000

D_t=8000  D_b=10000  H =3000

D_t=10000  D_b=10000  H =3000

D_t=diameter of top circle,  D_b=diameter of bottom circle,  H=height of the tube
Occupation and connection

Each tube will be the center of its own territory. So the structure system of the plate could reflect the occupation and connection of the tubes.

There are three kinds of regular tilings: triangular, rectangular and hexagonal.

Suppose each of them occupies same regional area, we could get a serious of parameters to evaluate each system.

<table>
<thead>
<tr>
<th>Type</th>
<th>Territory</th>
<th>Basic Net</th>
<th>S regional area</th>
<th>L length of structure</th>
<th>k the ratio of ‘L’ to ‘S’</th>
<th>D distance between two center points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangular</td>
<td>Hexagonal</td>
<td>42.4</td>
<td>8.6</td>
<td>0.20</td>
<td>10.7</td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td>Rectangular</td>
<td>42.4</td>
<td>13</td>
<td>0.31</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Hexagonal</td>
<td>Triangular</td>
<td>42.4</td>
<td>21</td>
<td>0.50</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

d = 7    S = 42.4
L = 6x3.5 = 21
k = 21/42.4 = 0.50
d1 = 7
d2 = 2x7 = 14
d2' = 2x7xCos30° = 12.2
e = (14-12.2)/12.2 = 14.7%
D = 7+14/2 = 14

From the perspective of structure, hexagonal territory is the best choice.
Burial types

- Tube burial: cremation niches, plant walls
- Plate burial: tombs, grass, structure of the plate

Context

The site locates in a very central district in Shanghai.
Shanyin Road - A famous residential area. There are many historic buildings, former residence of many famous persons. It's very quiet and peaceful.

North Sichuan Road - One of the most important commercial street in Shanghai. There are many commercial buildings and office buildings. It’s always crowded and energetic.
Strategy A

Strategy A creates a valley between two clusters, which directly connects two streets.

The problem is that the crowds in North Sichuan road could easily flood into the Shanyin road and damage the original atmosphere.

Strategy B (selected)

In strategy B there are three clusters divided by two valleys.

The surface towards the street is increased, which benefits commercial activities.
Based on the discussion of context and structure, an individual cluster is chosen to develop further.
The structure analysis evaluates each unit in the aspect of **compressive strength**, **shear strength** and **torsional strength**.

The result shows the **combination rules** of how to organize them together.
Combination rules

Resonable groups
Reflection
However, when I finish the model, I’m not satisfied with the space inside. I realized that the quality of the natural space depends on the fact that there should be no ground in the air.

Urban vertical cemetery should not be a stacked volume and only increase the density of burial. It’s also supposed to be more open to the public and provide a charming place inside the city, where people can see the blue sky, enjoying the sunlight and fresh air.
PROPOSAL
Inspiration

There are several super-tree groves scattered in the park.

The structure is really huge and organic, with varies kinds of plants climbing on. And the bridge connecting the neighboring groves provides a special experience of walking in the sky, which makes it an interesting place of tourist attraction.
It happens that bamboo is very popular and enjoys really good reputation in Chinese culture, which symbolizes nobility and good personality of a person.

And the section of bamboo is also very interesting and we can learn a lot from it. The branch is always growing from the node. The height of the internode increases and the diameter of the internode decreases as it grow up, which is also reasonable from the perspective of structure.
Internode & Branch

There is an evolution from **Tube & Plate** to **Internode & Branch**.

**Internode**

The internode unit varies in height and diameter, and the organization of them follows the regulation of how bamboo grows. The internodes in up layers will be taller and narrower, while the internodes in low layers will be shorter and wider.

**Branch**

The branch growing from the node is not only a transportation connection between neighboring internodes but also a structural element that the internodes could support each other.
Organization

city program
the scale of the space inside is normal for city programs, such as museum, market, cafe, restaurant and so on.

Cemetery
The scale of the space inside is more sacred, there will be columbarium room, chapel, memorial hall and so on.

Landscape
Bamboo will be planted everywhere as the main natural landscape in the vertical cemetery.
As we can see in the section, the vertical cemetery seems like a hill in the city. City programs surround at the foot of the hill, they are very energetic and efficient. But in the central area, steps slow down as the privacy increases. The space gradually becomes quite and sacred. People visit their relatives and meditate. Maybe at the top of the hill, people could enjoy the panoramic view of the city and understand the place they were born and grow better.
Index of images

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