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# Vertical Cemetery

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#### Abstract

Urban cemetery is the city patch where a space that seems far too forgotten has growing up. In large cities, where there is no more vacant land in city center, establishment of new burial has expanded to the periphery or suburb. But there is still no known general method to determine if verticality can also be applied in the future growth of this typology. This could be the alternative thinking to increase the amount without necessarily occupying good available land in cities.

Even though in the recent past some architects, such as Fillette Romaric, Chandrasegar Velmourougane, and Martin McSherry have explored these patterns primarily at the architectural scale, systematic research about religion standard and environmental design that investigates the transformation of human needs among these newer forms has not coalesced into a clear way forward.

In this research, the idea of skyscrapers that is integrated to cemeteries will also be done by the religion/belief rules comparison in a way of creating spaces. Later, I will translate the previous diagnosis into a classification and typology of spaces that is determined by religion standard and vertical possibilities. By the end of the research, the general urban design proposal for densified cemeteries will be given as the conceptualization conclusion of religion studies and verticality.

I expect this new and imaginative approach offers a sustainable solution for urban growth for cities lacking in land.

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#### 1. Verticality as A Challenge For Some Typologies

The side effect of population explosion is the rise of space demands in the city. Verticality has become the practical solution to answer the land needs in urban area. "Verticalism" (Abalos, 2010) has just begun. This stacking methodology has been applied to almost every building typology. We are now facing the age of form re-creation in verticality: university campuses, museums, libraries, fashion buildings, sport facilities, along with combination of all these mixed with residential, hotel, and office typologies. They are no longer strongly built as buildings that stand only one level. Verticality is still under discussion if this is a complementary or alternative way of thinking about the city. But we see transformation and we have come to realize that the densification process is an instrument with which we need to become familiar with (Abalos, 2010). If we appreciate sustainability as land management, then being tall is probably the first action you can do as a designer. It not only accommodates number of users in available land, but also shapes identity and iconic element for the entire city or neighborhood. We are moving to a phase in which verticality is seen as tolerance, not vandalism. Extrusion command has been used to design architecture and replaced aesthetic principle, particularly in rapidly urbanizing cities. 'Form follows function' has changed to 'form follows finance' (Shannon and Vescina, 2003). Design schemes are convinced as discontinues growths, but also as functional mutations. Nowadays, mixed programs are performed within the section of high-rise buildings. Buildings are not drawn upon regularity anymore, but more upon operative variation of the building outline (Gausa, 2003).

The innovation and creativity is somehow leading to convince some new typologies that could possibly go vertical. In last 5 years, we are introduced to "Vertical Park", the combination application of technology and new idea. As we discover how to plant the trees on the floor slab, park function is immediately lifted and garden is not always on the ground. However, verticality is still not (yet) the solution for some specific typology. At the same time, we still continue to build some public spaces and other buildings on the ground, with only a single story to extensively occupy the best available land. Zoo and cemetery are the biggest challenges for this method. They are usually housed in a very wide landscape, not few are located in urban area. Rising problem of lacking space, these typologies somehow need to be transformed into vertical form. It will help to resolve a growing spatial problem.

The concentration of this issue is not only the verticalism acceptance as contemporary architecture form, but also the available burial technology and methodology. Cremation has certainly become more popular to both save burial cost and land in urban area. But this does not make cemetery obsolete. In some religions, cremation is forbidden. The dead body is required to be buried. But in this case, burial is not always on the ground. In this paper, the possibility of verticality will be overlooked with religion/belief rules in burial.

#### 2. Urban Cemetery Demands

Cemeteries are usually end up with a less dominant priority to be designed. It is somehow forgotten that this space gets bigger and bigger each day. Houses could be squeezed, offices could be shared, shops could be stacked, but not cemetery. Death number can be decreased, but what has been buried cannot be replaced. Cemetery has no other possibility than "extending". Land will always be constantly demanded for this typology. This will not be such a big problem in suburbs, but it will be a completely different story for urban area.

The rapid population and economy growth in Hong Kong causes a very big competition in land uses between the live and the "dead". According to the article "'Perfect Storm" Brewing For Hong Kong Property Market" (2014), in 2014, housing value (less than 40 square meter) in Hong Kong is 92,000 - 126,000 HKD. Property market and the need are increasing and there is no possibility to replace them with cemetery in the top to-be-built list. To optimize the space, some building developers have built tall skyscrapers. Soon, this transformation will be applied to typology that has caused problems of quantity. "There are three things that are almost impossible to build in Hong Kong these days," Mr. Mui from Bread Studio (Wassener, 2014) said, "Cemeteries, hospitals and landfills."

#### 2.1 Mortality and Land Usage

To understand how much space we need for burial at the moment and near future, calculation of mortality and population are done with death rate (Porta, 2014) in some countries. In Qatar, the country with the smallest death rate, which is 1.54 (CIA, 2013), the average death number per year is 3,319, nearly twice of Titanic victims. If we assume they are all buried on the ground, and the grave size is  $1.25 \times 2.5$  meters, it would require 373,392 square meters land in 2050.

Meanwhile, with 17.23 death rate in South Africa (CIA, 2013), they have to deal with 930,454 death number, almost the same as Austin (Texas) population in 2013. If we apply similar calculation to this highest death rate country, in 2020, the amount of land they need for burial is 17.4 square kilometers, more than five times New York's Central Park size. Moreover, if the rate and method doesn't change, in 2050, required land will be expanded to 104.7 square kilometers, around the size of Paris.

As of 2014 the crude death rate for the whole world is 7.89 (CIA, 2013) per 1,000, out of 7,197 billion (United Nations, 2004) world inhabitants, 56,784,330 (around the same as Italy population in 2011) is expected to die in one year. If the same size of graveyard (1.25 x 2.5 m) is used and ratio stays constant in 6 years, by the end of 2020, we will need 1076.4 square kilometers land just for burial site, almost as big as Seoul. This means in 2050, 6,458 square kilometers will be required. It is more than five times size of New York City, excluding pathway, road and tree.

This fact raises the idea in rethinking the land as burial site. Even though since 20<sup>th</sup> century opposition arguments for building high-rises have evolved, the idea to emerge this form as an instrument of urban land-use organization, and crucial element for creating the Ideal City is very typical (Meyer, H. and Zandbelt, D., 2012). Vertical trend that is happening these days will be seen as one solution to reduce the ground as the only alternative to bury dead body. In the past, this application has done in some traditional culture/belief, Some of them are even still doing it. Pyramid in Egypt, Toraja Burial in Indonesia, and Cave burial in Hawaii are the real examples of this system. But before immediate implication, we should see how the input of religion rules affects this idea. So that, the planning or design strategy does not suggests the contrary.

#### 2.2 Burial Practice Amongst Four Biggest Religions

Both Catholic and Protestant believe that the body will be destined for resurrection. In practical, even though grave burial is still preferable as translation of their belief, since 1963, cremation (high-temperature burning of dead body) has been an alternative method. Church funeral is required for Catholics. The grave burial or the cremation is done after the three stages funeral rites (prayers, funeral Mass and absolution). If the body is buried, the land should be sacred and blessed (usually Catholics churchyard). Otherwise, the priest will bless the gravesite. If the body is cremated, it is important to deposit the ashes into an urn. The urn is then interred or kept in a mausoleum, not placed at home or scattered (Gray, H., 2013). The dressing of the body before the service is usually applied in Protestants burial. After that, the body will be placed in coffin for the last visitation by family or friends before it is buried or cremated. In general, requirements for Protestant Christian burials are few, said the Rev. J. Lowell Harrup of Northland Cathedral in Kansas City. Cremation is becoming very common these days. Different with Catholics, Protestant Church does not have rigid rule to treat the ashes. Even though many columbaria (house of cinerary urns) are built or added into the church or chapel to accommodate the ashes that kept into urns, bury the ashes in a cemetery or spread it at the sea or garden is also acceptable practice. In contrast, Eastern Orthodox Church prohibits cremation. The body is placed in a coffin after bathed and transported to the church for the funeral service. After the last visitation, the casket is removed to the cemetery and buried into the earth. In new York State, for burial Division of Cemetery (Department of State) requires the top of the coffin or casket shall be at least 3 feet below the level of the ground.

In Islam, cremation is "haram" or forbidden, as interpretation of the meaning: "And Indeed We have honoured the Children of Adam" [Al-Israa' 17:70]. Muslims believe that the deceased must be treated with the same respect as the living (Anne Hunter, 2007). Therefore, cremation is prohibited. Instead, the dead body is washed, cleansed, covered with white shroud, prayed for forgiveness and buried on earth as soon as possible. The body is laid on the right side of the dug soil, facing the qibla, towards Mecca (Huda Dodge, 2009). This also means that most of Muslim graveyards are arranged in the same way, as a form of space effectiveness. According to Illustrated Janazah Guide by Mohamed Ebrahim Siala, before filled with soil, a layer of wood board or stones should be placed on top of the body to avoid the direct soil contact. It is allowable to put a mark on the grave or a stone, without building any form of decorative construction.

There is only very little ground burial practice in Hindu. They generally cremate the dead. There are variant ceremonies in funeral pyre depending on the region. In Bali and India, the dead body is burned in a special ceremony. The body is placed with the head pointing to the south, direction of the dead (Neighbors, J. (2011). Before it is being placed on a stretcher, transported to the cremation site and flamed, deceased is washed with holy water and dressed with new clothes. In some cases, they first bury the deceased, and wait until a mass ceremony is held. Later, ashes are taken and spread to the holy water or sea. In the United States, cremation takes place at a funeral home, and the ashes are put in an urn and given to the family.

In Buddhism, the decision to bury or cremate is a family choice. Both are acceptable in Buddhism (Neighbors, J., 2011). But since China and Hong Kong has land issue, the government is now trying to convince cremation as primary method. If it's cremated, the ashes is put into an urn and placed inside the columbarium, sometimes looks like a Pagoda in China. This also supports their belief to visit Buddhism ancestors in Ching Ming Festival period. Family may also take the ashes home or scatter it to sea. However, the old burial method such as sky burial (leave the dead body for the vultures), ground and cave burial, is still practiced in Tibet, Mongolia, Sichuan province, and Qinghai province in China.

#### 2.3 Conclusion of Religion Rules Study

Among the biggest religions, Islam and Eastern Orthodox Christian still forbid the cremation in a rigid rule. It is true that cremation popularity has reduced burial land expansion. However, cremation does not always mean a saving-space burial method. According to Biegelsen (2012), Hong Kong citizens have to wait for five years in waiting list for burial storage, if they want to place their family's ashes in public burial niche. Besides that, columbarium building growth is also the result that even the cremation ashes need a space. Moreover, most people still prefer ground burial if they could afford it. According to article "Evangelical Leaders Prefer Traditional Burial" (2009), a survey amongst evangelical leaders showed that 8 percent prefer cremation, 9 percent accept cremation or burial, 2 percent don't know (undecided) and 64 percent bring forward traditional ground burial in their selection.

Burial practice	Catholic	Protestant	Eastern Orthodox	Islam	Hinduism	Buddhism
Ground burial	applicable	applicable	applicable	applicable	applicable	applicable
Cremation	applicable	applicable	inapplicable	inapplicable	applicable	applicable
Scattered/ take cremated ashes	inapplicable	applicable	inapplicable	inapplicable	applicable	inapplicable
Stacking burial	applicable	applicable	unknown	unknown	unknown	applicable
Non-ground burial	applicable	applicable	applicable	inapplicable	applicable	applicable
Sky burial	inapplicable	inapplicable	inapplicable	inapplicable	inapplicable	applicable

Table 1. Burial Practice	Comparison A	Amongst Biggest	Religions.
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#### 3.1 Proposed Vertical Cemetery Design

#### (1) Martin McSherry, Oslo

Given Oslo as project location, in his vertical cemetery design, the tower is not only a physical translation of vertical cemetery park that looks literally like graveyard, it's also a city and daily reminder of death's existence (see Fig. 1). McSherry tried to embrace different communities in his building. Jewish, Muslim, Christian and non-believers are slotted in the same tower. Beside graveyards that are stacked on top of each other, the tower also provides columbarium. Apart from that, the growth of death number and cemetery is an important factor. McSherry explained:

It would start out as a simple white framework with an adjoining, permanent crane, which lifts coffins into slots inside the structure. The tower would grow over the years, as this crane would add more and more plots to the network (Campbell-Dollaghan, 2013).



Fig. 1. (a) Cemetery Design by Martin McSherry (1); (b) Bird-eye View from Oslo City (2). From "Six Feet Over: The Future of Skyscraper Cemeteries," by Campbell-Dollaghan, 2013, http://gizmodo.com/why-highrise-cemeteries-are-the-future-of-burial-1481411082. Copyright 2013 by Martin McSherry.

(2) Fillette Romaric and Chandrasegar Velmourougane, Paris

Similar to McSherry's design, Romaric & Velmourougane's cemetery proposal is to contribute a symbolic tower to remember the death, a place for family to gather and see the city of Paris. When the moving filaments are blown by the wind, the building tries to mention the existence of deceased person. The very specific character from this design is that the void appears in the middle of circular ramp from the top to the bottom (see Fig. 2), whilst it is a structural core in McSherry's design. It is basically an extruded donut, with the center part that contributes a skylight core for the entire building.



Fig. 2. Cemetery Design by Romaric and Velmourougane in Paris. From "Vertical Cemetery for Paris", 2011, http://www.evolo.us/architecture/vertical-cemetery-for-paris/. Copyright 2011 by Fillette Romaric and Chandrasegar Velmourougane

#### (3) Yalin Fu and Ihsuan Lin, Mumbai

Came from the problem of very little space for recreation in Mumbai, Moksha Tower, designed by Yalin Fu and Ihsun Lin in 2010, houses four different religions in Mumbai: Islam (garden burial), Christian (funeral are and burial), Hindu (cremation facility and a river to deposit portion) and Parsi (tower of silence). Moksha Tower is the only design that includes ecological issue and technological solution, compare to previous two (see Fig. 3). The planted building façade is contained by multi-layered skin (glazing, plants, woven materials and steel frame). It contributes to the surrounding as air cleaner and carbon footprint reducer. These public green spaces also aim usage for mediation and worship.



Fig. 3. Vertical Cemetery Design by Y. Fu and I. Lin in Mumbai. From "Vertical Cemetery is a Greenery Clad Final Resting Place for Mumbai", by Yoneda, 2010, http://inhabitat.com/vertical-cemetery-is-a-green-lined-final-resting-place-for-mumbai/. Copyright 2010 by Yalin Fu and Ihsuan Lin

#### 3.2 Built Vertical Cemeteries

#### (1) Memorial Necropole Ecumenica, Brazil

According to the article "Raising the Dead: Lack of Space Forces Cemeteries Skywards" (2014), Memorial Necropole Ecumenica is the tallest cemetery in the world with 32 floors that holds 180,000 bodies. The building is also inserted by restaurant, chapel, concert hall, furnished rooms, and garden with waterfalls and animals. This supports possibilities of activity and function shifting. Burial spaces are open 24 hours with both annual rented and private owned tombs. Additional niches are now planned within the same complex.

#### (2) Yarkon Cemetery, Israel

Around 35,000 Israelis die every year. Built in the existing cemetery complex, the new building offers three different way of burial. The first option is "sandwich" graves, which are put on the top of each other (minimum 2 layers). This kind of burial is usually chosen by family member or couple who want to be stacked together. The second is wall burial, where the deceased body is place on the shelf like a morgue. On the surface of the walls, headstones are patched to identify the deceased. The last option is floor burial. In this way, every floor slab in the building is seen as a ground burial site. As we look back into McSherry's design in Oslo, it is the only option where stacking dead bodies in one story are not proposed.

#### (3) La Paz cemetery, Bolivia

In Bolivia, the issue of lacking land cemetery has been practically answered with verticality. The difference is that it is not a skyscraper. What could be seen in La Paz cemetery are buildings containing stacked crypts. These crypts are

temporary place for deceased body before it gets cremated within 10 years. Ashes from cremation later are moved to "outdoor" compartments that are still in cemetery complex. One of the tradition in Bolivia is to visit and send flowers to their passed relatives member in cemetery. Therefore, glass doors are installed on the face of ash houses to keep their giving stay.

## 4. Saving-Space Possibilities for Burial

The challenge of designing a Vertical Cemetery specifically comes from the knowledge of this new case, which is still very few. At the same time, belief rules are also creating a limitation of design idea. In this paper, the initial design simulation of vertical cemetery is elaborated by typology of vertical burial. This category is determined by reference projects study and major religion rules/rites considerations. When a mode of possible work among various criteria is proposed, the concept of stacking can be three-dimensionally applied to architecture as contemporary vision.

Saving-space possibilities for burial are:

- type 1 : non-verticality methodology, which is divided as:
  - type 1A : exhumed force in 10-20 years,
  - type 1B : additional soil in 10-20 years,
  - type 1C : extra depth in present burial for family member in the future.
- type 2 : wall burial (stacked deceased) morgue burial,
- type 3 : floor burial,
- type 4 : columbarium (house of cinerary urns/cremated ashes),
- type 5 : sky burial.

## (1) Type 1: Non-Verticality

Verticality disallowance by religion or belief does not mean we cannot save spaces for burial. There is always sustainable possibility in a way to manipulate density. Therefore, I put this as one saving-space burial typology. The following three methodologies are some practical strategies, which demonstrate adaptive response to the land needs in urban area:

• Type 1A: Exhumed Force in 10-20 years

The concerns for this disinterment are to free up some space for new burial. If the family wants to bury their relatives on the ground, there should be a force/rule that their burial will be dug out in several years. The unclaimed graveyard will be just removed and/or cremated (if the bones still remain). By implementing this type, there will be a period of time where the entire site is not usable for additional burial because there is no grave that is reaching 10-20 years yet. Moreover, communication between cemetery organization and family member is remarkably to be built for future exhume errands. This plan could be done specifically for the Eastern Orthodox burial practice or families that prefer ground burial rather than cremation as immediate treatment to the dead body.

• Type 1B: Additional Soil in 10-20 years

Additional soil over the old graveyard might be another solution for belief rule that has to bury deceased on the ground, like Islam. In practice, before the addition, families might need to get their relatives removed rather than be stacked by another grave soil. Since Islam is not allowing any other burial treatment but ground burial, this option might workable. In 10-20 years, mourning period or even graveyard visit will get less often. Physical graveyard might be changed, but the most essential belief is still preserved: the deceased is still on earth. One should be remembered, this method requires the land that can accommodate elevation escalation.

## • Type 1C: Extra Depth in Present Burial for Family Member in The Future

Unlike two previous types, this option has to be planned in advance. Burial site will be dug according to the order of families/relatives. It is basically applying verticality below the earth. For instance, as a husband died and buried, his wife would ask to dig the grave for herself in the future together at the same site. Later, the soil that is dug will be as deep as the space needed for two people: husband at the deeper layer, and the wife at the layer above in the future. This method is somehow too rigid, because the space is officially planned for a specific person and there is no room for needs or emergency improvement, but both Islam and Eastern Orthodox believers could embedded this idea as an alternative in keeping the deceased below the ground.

## • Combination of Type 1A, 1B and 1C

Combination of types above is possibly to be done by decision of collective interest or individual preference. Almost every type can be combined in practice, either two or all three types. To be more organized and systematic, combination is better to be done not after site decision. So that, the planning is applicable for bigger context.

## (2) Type 2: Wall Burial

In this plan, dead bodies are placed into a shelf/drawer like a morgue as how it is when it goes to the funeral ceremony. Vertical elements (wall or wardrobe) change the role of the land. In this way, placing dead bodies on the top of each other becomes doable. For Protestants, Catholics, Buddhist or those who prefer a burial as opposed to cremation or at least having their relatives body stay exists, wall burial is probably the nearest expectation that meets the need. Decomposition process of the dead body itself can be done by manipulation or installation of organic metabolism. In addition, calculation to compare the space required between wall and land burial is done in the figure below.



Fig. 4. Space Calculation Comparison Between Wall Burial and Traditional Ground Burial.

Space requirement calculation is done with the same burial size  $(1.25 \times 2.5 \text{ m})$  within the same size of floor area (30mx30m). In this scenario, the first option, which is ground burial, fills the entire area. Later, 2.5 meter-wide circulations corridor are added along the periphery. With this formation, this 90 square meter area can house 200 deceased bodies. Formation of the second configuration is a linear wall with 3.5 and 4 meter-wide circulation in between the row. If we assume the clearance height of the area is 2.5 meters, this option can house up to 720 burial units, with wider circulation and direct access to the units. It is almost 4 times more efficient compare to the first configuration. If we shrink down the width of second option down to 2.5 meters (same as first option) and decrease the size of the niches to 80 centimeters each, it would accommodate even more: 1480 units, 7.4 times than the traditional ground burial.

#### (3) Type 3: Floor burial

This typology is initiated especially for those who oppose stacking concept but still can avoid the earth as one and only place to bury. Still have the deceased body without cremation, relatives can assume floor burial as traditional cemetery in the sky. Religion users target are more or less the same as type 2, maybe a little more selective ones. Amongst 4 religions, there is none mentioning stacking concept, whether it is forbidden or not. So this preference truly comes from users. Veteran or important figure for public can be slotted in this typology since it is both more private and highly maintained.

#### (4) Type 4: Columbarium

As cremation becomes today's trend, houses for stored ashes (in some cases, inside urns) have turned into a realistic and constant saving-space-concept demand. By using 40x40x40 centimeters niche size, a 30x30 m floor area with 2.4 meters clearance height is be able to hold 27,000 deceased's cremated remain, including 20% circulation. As result, this type turns to be the most efficient storage system in compare to any other traditional burial. Catholics, Protestants and Buddhism are the main users for this category.

#### (5) Type 5: Sky Burial

Sky burial has nothing to do with verticality, but the method itself has created a saving-space representation. As the deceased goes immediately to the ecosystem food chain, we cannot even say that it is a storage system, but more as burial rite. Even though the practice is not as many as ground burial and cremation, as designers, we still need to accommodate the users.

## 5. Strategic Plan of Vertical Cemetery

The proposed design guideline is not specifically applied into one site. At this level, the most important purpose is to give an idea that vertical cemetery design is possible to be done. Site selection should later be reconsidered in final design. Major objections are that any building design is acceptable. What matters is the burial methodology demands around the site (or a city in bigger scale). After indication of space needed as an effect of particular belief/tradition burial rites within different society is resulted, vertical improvisation is introduced into it. This will be done by saving-space possibilities adjustment in the building over the further burial need calculation. Therefore, it is necessary to have actual data about demography, mortality ratio and burial tradition in the city context where the design will be proposed.

Simulation of the design is demonstrated in a 100 x 100 meters parcel of land. Regardless of the location and building regulation, planning of the building should maximize floor area ratio (FAR) given on site. The very first adjustment in the design is a strategy over ground burial needs. In the site context or cities where this method is highly practiced, a non-developed ground floor is significant requirement. Keep it less paved and provide big natural soil area is the best. It would, however, only give maximum space as much as the site location size. But in practical, we can still contribute biggest attempt to use the site efficiently by implementing type 1 A,B and C appropriately. If type 1A is more acceptable in society than type 1B and 1C, ground floor area becomes highly sustainable, since it performs a circular process by re-using the land. But to be put in note, when the site is fully occupied, and there is no grave that reaches 10 years yet, new burial is almost impossible to be done.

If type 1B is dominantly accepted, challenge lies in developing space below the land much as possible. Because by adding soil in, the level of the land will get higher over the years, and there will be a limit when it meets the floor slab of the building. In other words, a sunken or deep ground floor can be a feasible solution. The deeper the digging, the more future space is provided. But this raises the issue of accessibility and space quality. Last, for type 1C, the designers are not highly intervene because mainly it is about family/relative plan over the grave site. Sunken or deep ground floor is not necessarily provided unless this type is combined with 1B in practice.

After ground area of the building has decided, type 2 (wall burial), type 3 (floor burial) and type 4 (columbarium) are adjusted in vertical form according the needs. For example, in Shanghai, where most people (non-religion or traditional faith and Buddhism) cremate the deceased, type 4 should dominate the building as they also store the ashes in niches. But this does not mean type 2 and type 3 are not considered, Catholics and Protestants (1.9% and 0.7% respectively, according to Contemporary Chinese Religious Status Report, 2012), or family with higher income might prefer to bury their deceased in traditional way. Last, Type 5 (sky burial) is fully supported in the building as rooftop feature. This is an option, but the rooftop can accommodate both the space for sky burial rites and green/nature at the same time. So that ecosystem food chain can go on site.

Placement of saving-space types (from the ground to the higher level) within the building should be arranged from type 1 to type 5 in order. This is important to understand the weight load for each floor (see Fig. 5). The proposed arrangement is to make the load as small as possible at higher floor levels. This structure strategy comes because wall cemetery (type 2) will load more deceased body (with the casket) than floor cemetery (type 3), and floor cemetery will load more deceased body than columbarium (type 4). Apart from that, this arrangement also embodies mechanical efficiency and economical strategy. The elevator for deceased body (that possibly carried inside the casket), which is bigger and more expensive, could stop right before type 4 starts (we don't need big elevator for this).



Fig. 5. Simulation of Strategic Design Plan of Vertical Cemetery.

Crematorium facility is possibly added as part of columbarium facility. Room for cremation may also be integrated with church or community room that accommodates funeral speech or communal rites (church ceremony, absolution, last kiss, etc.). This should go before type 4 starts in vertical as the dead bodies will be cremated here and their ashes, which is lighter, are better to be placed at higher level.

Cemetery/room arrangement is fully handed to the designer, as view, sunlight, or belief orientation becomes extra considerations. Trees or plants will be another proposal to be integrated in the design. It's not only to filter the air and contribute a green concept to the city, but also to retain the feeling of the "ground" in the sky, as verticality is newly introduced in cemetery typology. That is why green elements are extremely recommended to be patched in the building, especially for type 3 (see Fig. 6).



Fig. 6. Illustration of Type 3 (Floor Burial), Integrated with Trees and Plants.

#### 6. Result and Discussion

The biggest challenge in applying verticality into cemetery typology is to meet the religion/belief burial requirements. From religion study, it can be seen that not every belief allows cremation, even some of them strongly require the deceased to be buried on the actual ground (earth). This difference, even in one religion, causes very wide burial variants in practice. To allow verticality acceptable in practice, design of the building has to provide options. So that, people can choose their saving-space type preference. Saving-space types are: Non-verticality (type 1), wall burial (type 2), floor burial (type 3), columbarium (type 4), sky burial (type 5). Amount of each options have to be decided according to demography/religion/tradition that is mainly practiced around site area. Figure below are the examples of application of Vertical Cemetery design and planning strategy to some cities around the world (on 100x100 meters site size). Size and shape of the building might be the same, but configuration and the amount of each saving-space burial type will be customized according to the needs.



Fig. 7. Application of Vertical Cemetery Planning Strategy to Some Cities Around The World.

The advantage from vertical cemetery is obviously to save ground space usage and provide alternatives, as higher densities are one of the solutions for achieving more sustainable cities (Pont, M. B., 2012). In bigger scale, since vertical cemetery does not require a large parcel of land, this building typology may be introduced again in urban area. This resolves issue of accessibility and positive effect on the use of public transport, as it reduces the energy consumption for mobility. Moreover, combination of religion users will be an attempt to embrace different society group. In the future, cemetery will be a vibrant and energetic place as people go there easily. Through its height, building delivers opportunity as a symbol or icon in the city.

Even though verticality is one of the answer of lacking land issue, this design might bring controversy. For those who are still not allowing their religion to have the same facility as others, a shared vertical cemetery will have some protests and disapprovals. This also causes many changes in terms of religious quality of the building.

## 7. Conclusion

This solution proposed here, that preserves religion burial instructions and at the same time presents a solution in optimizing the space through verticality, is:

- to introduce possibilities in stacking the deceased inside the building and using the ground space as little as possible as a respect for population and economic growth.
- to design a general appropriate framework (design strategy) in vertical cemetery typology by not involving site context,

- to provide a complete freedom in shape, plan, building enclosure, material and construction method design by architect to develop further,
- to embrace and provide burial space for different communities/culture represented in the city or site area,
- to replace the present ground burial methodology and see verticality as sustainable cemetery design solution for city lacking in land,
- to create significant public green spaces as part of the contemplation and to bring back the ground element to new high-rise building typology.

The design approach, using a literature of burial tradition and requirement, references (built and proposed) study, verticality possibilities and options, is done to respect religion/belief rules in burial. Calculation shows a great difference between vertical and ground burial in using the land area. This assures that vertical extension is a sustainable methodology for typology with an absolute rise in space demands. However, this research should be integrated with urban environment and site context factor before it goes to final design. We can thus discuss the potential sustainability, which can be actualized when it is match site performance, human and cultural needs and ecological plan that exploits this potential.

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