Vertical Cemeteries: a Changing Paradigm

FRANKLIND JESKU
POLIS University

Abstract
Humans use architecture as both their first and last stop. A newborn is honored and welcomed into the new world in the hospital. The final stage is to take the deceased to the cemetery, where they rest in peace. Death cannot be avoided. To cope with and minimize the great pain caused by the death of our loved ones, a wide range of afterlife beliefs and stories have been developed on cultural, spiritual, geographical, and other levels. Religion and culture are two underlying themes in these afterlife spirits and beliefs. With the continuous increase of the world population and the demographic crisis of megacities, the theme of the cemetery and burial space becomes crucial to dispel the gap between necessary living space and density. Can a new way of burial solve these questions by adapting to various customs and various social and political contexts? Can architecture solve and intervene in the gap that exists between the world of the living and the world of the dead? This paper will explore the notion of "Vertical Cemeteries" throughout history and throughout visionary architectural projects that propose a new way of burial in a fast changing world.

Keywords
Emergency architecture, resilience, social, cemetery, verticalism, death

Verticality and density

Verticality as a typology has been changing and adapting to new functions. The affirmation "the form follows the function" (Sullivan, 1896) or "the function follows the form" is not enough in terms of typological paradigms in the last century and in modern or postmodern architecture. The "form follows function" changed to "form follows finance" (Willis, 1995).

With the verticality and increasing urban and social complexity, typology has been adapting to the new paradigms of architecture, where multifunctionality o ten responds to building solutions. Different functions nowadays coexist in tall buildings. In terms of habitation typology, density is the key that can justify the sense of "Going High"[1].

The side effect of the population explosion is the city's rise in space demands. Verticality has become the practical solution to answer land needs in urban areas. In the nineteenth century, with the elevator's invention, skyscrapers became an expression of the future and technology (Sullivan, 1896). But what happens if we increase density to the densest part of the city, which is the cemetery?

Cemeteries and death practices

There is archaeological evidence that in the distant past, burial was the norm, and subsequently, cremation with a secondary burial became prevalent, giving way to cremation, which is now the dominating habit. It is unclear why cremation became popular; some claim it is a method of cleansing, freeing the soul from a filthy body; 2) it represents the transitory aspect of life, of destruction and rebirth; or 3) it eliminates the body as a health risk and does not take up valuable land. This is how and why the practice of cremation developed. It was an established tradition by the time the first Hindu scriptures were published, about 1,200 B.C. There are several beliefs on the origins of cremation and its usage as a technique for disposing of deceased remains. Cremation is said to have developed in Europe and the Near East during the Stone Age, about 3000 B.C. It seemed to have spread over northern Europe in the late Stone Age. It was firmly embedded in Grecian burial practices during the Mycenaean Age and was also embraced by the early Romans around 600 B.C. Throughout history, one death ritual has been preferred over another, with burial and cremation being alternated. Both burial and cremation are customary in various regions, such as the Middle East and Europe. In the Middle Ages, cremation was punished by death and was used to punish sinners. After a conflict, epidemic, or hunger, mass cremations were also performed to limit the spread of infectious illnesses. Cremation has been used as a form of punishment up to the present day. This was demonstrated when the corpses of 12 men convicted of war crimes in the Nuremberg Trials were incinerated rather than returned to their families and disposed of in a secret location, preventing the place from being used as a memorial

site. In Japan, however, the erection of a memorial structure for the remains of executed war criminals has been permitted (History of cremation, n.d.). With the introduction of Arab traders on Kerala's Malabar Coast in the early seventh century, Islam first appeared in India. The Sufi tradition greatly promoted the development of the Islamic religion throughout the Delhi Sultanate (1206-1526) and the Mughal Empire (1526-1858). The funerary custom and method of disposal of the dead body followed by Islam significantly diversified from that appreciated by the traditional Indian culture. The practice of retaining a person's memory after death was executed in the form of architecture which led to the construction of structures like the Taj Mahal, Gol Gumbaz, and Humayun's tomb, which are regarded as architectural wonders in the current day world. Thomas the Apostle is credited with introducing Christianity to India. By the 6th century AD, the Catholic faith had taken root in India. Through the conversion of religion by missionaries, it became a dominating religion. Various other faiths arrived and established themselves in India to varying degrees. They brought with them their own set of traditions and culture for the ultimate remembrance of the deceased.

Funeral rituals serve different purposes depending on religion and time and place. Historically, the aim of most religious funerals was to assist the departed in their journey to the next life, and this is still an integral part of many.

Cemeteries in the city

Talking about density means talking about land usage. The typological controversy of cemeteries has been studied for centuries. Intellectual and social concerns about the Architecture of Death (Etlin, 1987) brought about the transformation of the cemetery in the last centuries. Cemeteries are a relatively new way of disposing of bodies.

Prior to burial, the dead of ancient times were often left in caves, disposed of in lakes or oceans, burned, and even left in trees. The Greeks first built cemeteries outside the city and created the term "cemetery". In the 18th century in the United States, public park areas began to become more popular as cemeteries. From industrialization, cemeteries become more popular for the middle to lower classes. Today many cemeteries in the world's largest cities have become full, and the available space is too valuable to be used for burying the dead. Along with taking up space, traditional burials can lead to groundwater contamination.

To understand how much space we need for burial nowadays we need a calculation of mortality and population by death rate (Porta, 2014). From the research made by Wahyu P. Hariyana at Delft University of Technology, using those data, with a 17.23 death rate in South Africa (CIA 2013), they have to deal with 930.454 death people per year, meaning that the amount of land they need for burial is 17.4 square kilometers, more than 5 times New York's Central Park size. In 2050 the required land will be expanded to 104.7 square kilometers, around the size of Paris. Therefore there is a need of rethinking the land as a burial site.

As cemeteries have less priority to be designed, it is almost forgotten that they are increasing in size. We can have adaptation or reintegration other typologies, but a cemetery remains a unique one and difficult to be integrated into the urban complexity. Cemetery has no other option than extending and increasing, becoming a real problem, mainly in urban areas and metropolis.

How can this issue be solved and rethought? Verticalism (Ábalos, 2003) can be seen as the only alternative to burying a dead body. Throughout history, this method was method in some religious/cultural motivations like pyramids, Taraja Burial in Indonesia, and Cave Burial in Hawaii. Urban high-rise cemeteries provide a space for people to visit loved ones in cities and areas of urban density. As a result, it could allow the deceased to be laid to rest in relatively close proximity to their loved ones. This model addresses the challenges of displacement and distance between the living and the dead created by urban sprawl, population growth, and governance issues. The vertical cemetery is a new concept to solve land shortage issues for the urban cemetery. The "existing cemeteries will slowly be removed to provide land to the city's living souls. The vertical cemetery will become a significant part of the city and a daily reminder of death's existence. In time, the city's tallest and largest building will become a grave for all its citizens – the city's ever-changing monument." (Song, 2017) The first real architectural design of a vertical cemetery was made by Aldo Rossi in the extension of the San Cataldo Cemetery in Modena, Italy. Initially contested by society and institutions, the cemetery has now become a symbol. Starting from this project, how can a "Vertical Cemetery" affect the religious rules and the social and intellectual impact of nowadays society?

The extreme case of Manila
Density and densification refer to the number of people living in a particular urban area, and the way to calculate it is by dividing the population by the size of the area. Densification comes by choosing the typology of skyscrapers as we have a large population in a small footprint. But in major cities around the world, where density reaches its peak, the typology doesn't correspond to the needs of the population.

In extreme cases like Manila, density takes extreme land and area extension, making the city increasingly unsustainable in every aspect. Manila is the capital of the Philippines, and in 2019 was the densest city in the world, with 70.000 inhabitants/km2. The extreme poverty and underdevelopment brought during the years governmental and social decisions to the creation of high inequality and disparity, creating vulnerable communities forced on sharing shelters and homes. The typology of the big land extension of the city is mainly based on 2-3 floors of buildings attached to each other, creating a lack of common spaces, green areas, and public spaces. Manila extends for more than 40 km2, and, even if the urban structure follows the Cardo and Decumano conformation, public and private transportation seems to be extremely unsustainable. If we think about the death rate in Manila (7.3 on 1.000 inhabitants) and we think about

the extension of its cemeteries, we can fully understand the extreme conditions that coexist in the city. Manila's cemeteries are examples of the largest cemeteries in the world, occupying an important and central urban area. The North Cemetery of Manila is the perfect example to understand the controversies (Figure 1). As the cemetery is commonly the densest part of the city (dead people included), and Manila is one of the densest cities in human history, we can affirm that the North Cemetery of Manila is the densest area in the world. But what makes this cemetery so controversial?

The vertical cemetery of Manila
As the demographic numbers of the city started increasing rapidly and density reached its peak, the lack of space brought people to move to the cemeteries, creating their own habitats directly above the graves. Entire families live in the North Cemetery of Manila by creating their autonomous microeconomy system. The tendency of the people to build high above the graves creates an autopoietic[2] act that remembers how architecture and death should be strictly correlated.

Aldo Rossi put his ecstasy of this correlation in San Cataldo's cemetery, where architecture and death coexist, life and death coexist in the same big house (Figure2). "Tomba Brion" by Carlo Scarpa shows how architecture is the "terminal" and the connection between life and death, between two opposite worlds. Then how can we integrate architecture into the cemetery of Manila? How can we use architecture to reduce inequality in vulnerable communities? How can we mediate and make possible the coevolution of the inhabitants of the cemetery and the inhabitants of the graves?

At the University of Trieste, Italy, in 2019, the students Franklind Jesku and Ivan Bello proposed as their master's thesis in Architecture a Vertical Cemetery located in the North Cemetery of Manila (Figure 3). Manila, the capital of the Philippines, is the densest city in the world. A cemetery is the densest part of the city. The North Cemetery of Manila is the ecstasy of density. The social, political, and economic history of the city brought a new reality paradigm: cohabitation of life and death, of people living in cemeteries. The thesis focuses on the study of this contradiction and its relation to architecture. The "+1" in the vertical cemetery of Manila, brings together living inhabitants and dead inhabitants with precise rules that must be respected. An iron skyscraper called "The Machine" is the new home with new rules. The description of the project is a manifesto, articulated to provide guidelines for understanding. Composition of the Machine:

- The Machine is self-sufficient.
- The Machine has a height of 319 m.
- The cells of the machine are 4 m in diameter.

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[2]*Autopoiesis describes the capacity of an entity to reproduce itself. As a concept, it was first introduced in theoretical biology to explain cognition and the essence of life (see Maturana and Varela, 1980) and was then further developed in general systems theory (for example, von Förster, 1984).*

- The floors are divided into 25 modules of 16 square meters each.
- The cells consist of a living area and a sleeping area arranged upside down.
- The cells rotate 180 ° altogether at the times set by the machine with a chain system.
- 06:00 the cell turns 180 ° (from the sleeping area to the living area).
- 22:00 the cell turns 180 ° (from the living area to the sleeping area).
- The machine is composed of a pillar and beam structure with section a +.
- The machine is provided with a system of pipes (pillars placed in the middle of the modules) for the supply and discharge of water.
- Organic waste is conveyed to drains and turned into energy to power the operation of the machine.
- The elevator is the only vertical connection element for accessing the rest of the city.
- The elevator is powered by organically produced energy.
- The elevator is made of mirrors and counterbalanced by a guillotine.
- The lift runs on the 4 pillars placed at the corners of the building with a pressure system.
- The lift builds the spaces of the machine.
- Neither the supply of electricity nor the supply of gas is envisaged.

Rules of residence
- Each family must dismantle their shed in the existing cemetery and turn it into a vegetable garden in exchange for receiving a living cell in the Machine.
- Each inhabitant living and dead has an entry pass.
- Each family has a 4×4 m living area at its disposal.

Time rules
- Each family must submit to the time of the Machine.
- 07:00 the lift begins its descent.
- 07:17 arrival on the ground floor.
- 09:00 funeral service (ceremony on the ground floor with marking of the deceased at the machine).
- 12:00 the lift begins the ascent.
- 12:17 the elevator reaches the 70th floor.
- 13:30 the lift begins its descent.
- 13:47 arrival on the ground floor.
- 18:00 the lift begins the ascent.
- 18:17 the lift reaches the 70th floor.
- Each month the cell arrangement changes algorithmically according to the inhabitants.
- Every 5 years, residents must reuse the remains of the deceased to serve the community.

The disregard of the time rules involves the loss of the plot of land. The repeated neglect of the temporal rules leads to the loss of the living unit. "+1" is set in the year 3019 A.C. and will never be finished ; only when Firmitas and Utilitas cease to exist can Venustas actually be complete. The shape that the cemetery assume derives from mechanistic movements that have put humanity in front of scenarios of continuous and multiple contradictions. "+1" will be the symbolic architecture of an era with unknown limits and an uncertain future. "+1" becomes a polyphonic narrative full of senses and symbols, it brings to light the sacredness of the human right to inhabit a home through emotions and memory. "+1" leaves interpretations open. Disorientation. There are no long-lived references, only fragments over time. It is impossible to take root and look for a linear meaning. The pace of +1 does not admit asymmetries. The creation of Metropoli led to new lifestyles and cultures. New cuts and polycentric alignments come together in the Machine, which becomes the beating heart of thought. Ties are broken and maintained. Where the Metropolis acts with them shock, with high-speed stimuli, the confined space forces coexistence; a coexistence of living and dead: the Necropolis fills with memory and experience. The loss of meaning in living in the city is a human condition that seeks to distinguish itself and recognize itself in the experience and the search for stimuli. +1 puts in relation disorder with the order, achieving satisfying forms and eternal in their osmosis.+1 demonizes the thought system by defining boundaries, breaking down walls, and setting up a new spatial form, in which everything is destined to move. Movement is assumed as a necessary and indisputable value for a man-indeterminacy-time posture. Relationships are created and broken down quickly, every month the clusters of inhabitants are destined to be recomposed in a different way for the next move. Individualism flows into the mass episodically, in repetitively rigorous individual situations. Its movements are the pace set for the inhabitants who live in the +1.

The satisfaction of +1 deviates from its content by appropriating itself around. It is the awareness that takes on meaning through a plot of land. The content is its development. +1 will not be finished; the forms, linked to a specific function, will turn into ruin before they get to where everything is started.

The discontinuous time of the Machine unhinges an obsession with the past by declining to a future-projection-in-constructed-memory with ruins and scraps of a dead age, through the profound uncertainty of the present. It is the end that never ceases to end. Ruin is the tool that allows the human to gain experience of himself as a mortal individual; welcomes death and rubble. Only when Firmitas and Utilitas cease to exist can Venustas actually complete oneself, an indispensable process for the ultimate goal and primordial to embark on a journey.

Other vertical cemeteries projects
With the growth of population and urban expansion, today many countries are facing the problem of scarcity of available land. It's not just a problem for the living, but also for the dead, some countries like England, Norway, and Greece are running out of available burial plots. In other countries where available

land is abundant, a shortage of available burial plots is still a problem in some large cities. To address the shortage of available grave plots, authorities are encouraging citizens to choose cremation instead of burial, as cremated ashes require much smaller space. However, cremation is discouraged and even opposed by some religions, it conflicts with the believers' faith in the resurrection. In Greece, a country in which Orthodox is the prevalent religion, cremation was not allowed. The situation changed several years ago when the local authority lifted the restriction on options of disposal of the dead, allowing dead bodies to be cremated so that the shortage of burial space can be solved. The Church of Orthodox accused the decision of the authorities and suggests placing coffins vertically to minimize the space needed for each dead body. Are there any other ways to address the problem of scarcity of available land? When a city is getting very dense, skyscrapers will be built to offer more spaces for the living, but can skyscrapers be used to accommodate the dead? If a believer doesn't mind being cremated or vertically buried, then he or she may not mind being buried in a skyscraper, in which the grave plots are closer to heaven compared to graveyards on the ground, and the views are better. Some architects and cemetery operators have already come up with the idea of a vertical cemetery.

In 2013 at the Oslo Conference for Nordic Cemeteries and Graveyards, a local architecture student named Martin McSherry proposed a high-rise cemetery to be built in Oslo (Figure 4). The purpose is to save the precious land in the city for living. According to the design he presented, the high-rise cemetery is comprised of a series of graveyards with square floor plates, each of these graveyards is stacked over a lower one. The vertical cemetery is structurally supported by an exoskeleton instead of traditional columns, this maximizes the floor space of those graveyards. Without traditional columns, the graveyards in the building appear more like traditional graveyards. Another significant feature of the design is a crane adjoined to the building. The crane is designed to be permanently set there, its function is to lift coffins into slots inside the structure, and over time, more floors of grave plots will be added to the building with help of the crane. Of course, the building will stop rising once it reached its ultimate height, but it would definitely become the tallest building in the city. Currently, Martin McSherry's design remains a vision, there are no plans to put the design into practice. However, eventually, one day it will become a serious proposal, as land scarcity is already a serious issue in Norway and many other countries. In many countries like Norway, every grave spot is not permanently preserved for one body but will be recycled to be reused for other bodies after twenty years when the body is decomposed to bones. Then the family of the dead will either relocate the bones to a smaller space or pay to preserve the grave spot for longer. Even with this measure, the grave spots are still being quickly run out.

Moksha Tower is a vertical cemetery proposed to be built in Mumbai, one of the most populous cities in the world (Figure 5). Finding an available grave plot in such a dense city is never an easy thing, this is why the idea of Moksha Tower is proposed, the tower will create a temporary place to accommodate dead bodies. Compared to traditional cemeteries, Moksha Tower saves a large amount of ground space, since the space for graves is piled within the same area, not to be expanded to the surrounding areas. Moksha Tower provides burial space for four major religions in Mumbai: Hindus, Muslims, Christians, and Parsis. As these religions practice different funerals and methods of disposal for the dead, the tower is designed to meet the needs of all these religions. For Hindus, facilities for cremation are equipped, and new technologies are adopted to decrease the pollution caused by activities like the open burning of bodies; For Muslims and Christians, the tower provides areas for burial and garden burial and funerals; For Parsis, a structure called Tower of Silence is located on the roof of the tower, used for bodies to be exposed to vultures. Besides the basic facilities for the burial process, Moksha Tower also features public green spaces throughout the entire building, allowing families of the dead to pray, worship, and meditate, these green spaces also help reduce pollution of the city, improving the environment of the city. As mentioned earlier, the tower is a temporary place for the disposal of the dead, it only provides storage of the dead for up to 10 years, in this way the tower can offer the service to most people in the city.

A radical proposal is the high-rise tower is a part of a cemetery complex in Santos, Brazil, called "Memorial Necropole Ecumenica" (Figure 6). Many articles on the web claim this tower is completed, in fact, it's not really built yet in 2018. The planned Memorial Necropole Ecumenica III will have 32 floors, capable of holding about 25,000 dead bodies, each floor contains 150 tombs that are offered with an aerial view of the city, and each tomb can accommodate six bodies. Aside from tombs, the tower also contains a chapel and a restaurant on the top, and there's a garden and a lagoon outside the buildings, the cemetery is also a popular tourist attraction in Santos.

Conclusions

Although the theme of death and architecture is not dealt with in-depth, there are sporadic attempts to offer an alternative point of view. However, there is a lack of a real manifestation of these visions which, without the involvement of an institutional regulation that encourages research in this field, remain abstract and speculative projects. Sustainability has become a global and interdisciplinary theme. But why don't we talk about sustainability in terms of death and land use? Architects have a key and fundamental role in undertaking an even more serious phase of dissemination of ideas and projects that can solve this great but "invisible" problem. The vertical cemetery will become not only a new paradigm in architectural and social terms but a concrete solution with which man will have to live with it, gradually. Thus the horizons open for research where the various actors collaborate so that man, both as an institution and as an individual, can open up to this new paradigm.

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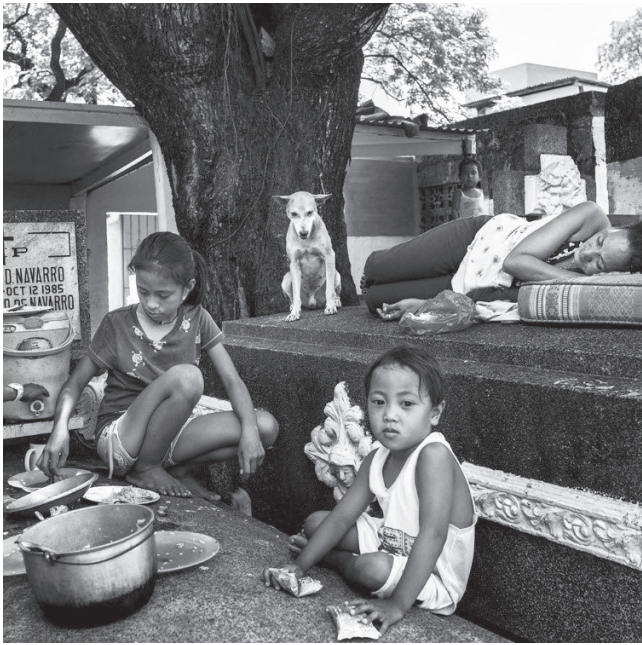United Nations, 2004. *World Population to 2300*. United Nations, New York. p. 179.

Figure 1. North Cemetery of Manila (Picture by New York Times)

Figure 2. Cemetery of San Cataldo, Italy, by Aldo Rossi (Picture by Andrea Pirisi)

Figure 3. Vertical Cemetery of Manila, Philippines (Project by Franklind Jesku and Ivan Bello)

Figure 5. Moksha Tower, India (Project by Yalin Fu & Ihsuan Lin)

Figure 4. Vertical Graveyard, Oslo, Norway (Project by Martin McSherry)

Figure 6. Memorial Necrópole Ecumênica III, Santos, Brasil