



Architectural evolution of space settlements in cinema and television

Salih Ceylan* 

Abstract

Space settlement as a science fiction theme has been very popular in the last 70 years in cinema and television. Gaining its roots from scientific and technological developments, the topic evolved throughout decades to become much more comprehensive nowadays. The evolution that started with physical models to depict the space station as a pure geometric form continues today with much more complex structures that express the infrastructure, features, and appearance of a space settlement. Through developments in space technologies, together with the progress in computer generated imaging methods, contemporary movies represent space stations and settlements in a much detailed way. Therefore, the architecture of the space settlement in cinema and TV becomes a remarkable theme. Consequently, the role of architects in the design of space settlements in cinema and TV increases. This paper presents an analysis of the architectural evolution of space stations and settlements in cinema and TV through examples with a chronological order from 1950s to 2000s. The analysis is based on the relationship of scientific requirements of a space settlement and existing scientific studies on the design of space settlements with their reflections on the cinema and television industries. The outcomes of the analysis put forth that the detail level, functionality, and architectural style of space settlements in movies evolved through time. Therefore, architects' role in movies and the design of space settlements shall increase thanks to the developments in representation, production, and construction technologies.

Keywords: space settlements, space architecture, architecture and cinema, science fiction

1. Introduction

The roots of humankind's interest in space lays back deep in history. In the early days of civilizations, human beings observed the sky and the celestial bodies from both religious and scientific points of view. Mayan civilization built structures for astronomical investigations around 8000 BC, and Egyptians started to use a calendar that defines a year composed of 365 days based on the movement of the sun around 4000 BC. The relationships between stars and megastructures like the pyramids of Egypt, as well as Stonehenge is still an issue under harsh debate today (Fix 2017). During the Age of Enlightenment had the chance to get a deeper look into space, free from the pressure of religion. That is the time when some significant progresses on space exploration were fulfilled; like the discovery of Jupiter's four biggest moons by Galileo Galilei, the description of the movement celestial bodies in the solar system by Nicolaus Copernicus, or Kepler's studies on the geometric structure of the solar system.

In the industrial age, space explorations went hand in hand with the research on other relevant fields of science, allowing astronomers to advance in observing the space with bigger and more comprehensive telescopes. This progress ended up with the discovery of new planets in the solar system like Uranus, Neptune, and Pluto, as well as Edwin Hubble's discovery of Andromeda Galaxy

*(Corresponding author), Assoc. Prof, Bahçeşehir University, Türkiye, ✉ salih.ceylan@arc.bau.edu.tr

Article history: Received 03 September 2022, Accepted 16 October 2022, Published 30 December 2022,

Copyright: © The Author(s). Distributed under the terms of the [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)



which led him to create a classification system for galaxies. At the same time, development in transportation technologies using liquid fuel transformed the dream of space travel into reality with serious scientific foundation. In 1895, Konstantin Tsiolkovsky published his article on the space flight using a rocket that works in vacuum. In 1926, Robert Goddard launched his first rocket powered by liquid fuel. These and other improvements led to the beginning of the space age that started with the launch of Sputnik I into orbit by the Soviet Union in 1957. Since then, the space race continues with increased speed and the addition of new actors to the story. Nowadays, permanent life in space is no longer a dream but a scientific reality, thanks to all the previous contributions in the history.

Along with scientific research on space exploration, creative work both in literature and cinema have been executed to utilize present space as a science-fiction theme, especially starting from the second half of the 19th century. There is a mutual relationship between science-fiction literature and scientific studies on the subject of space. Visionary works are triggered by scientific and technological developments, whereas they also inspire scientific studies with their creative but reasonable insights on issues like space stations or habitats. This paper presents a study that depends on creative work and scientific studies at the same time, concentrating on the architectural evolution of space settlements in cinema and television through samples that are inspired from scientific studies. The paper firstly talks about the scientific realities of space stations or settlements, providing a theoretical framework for any creative work in literature. Afterwards, space settlements in written literature are presented shortly, as the main focus of the study is on space settlements in cinema and television. Following chapters of the paper are presented in a chronological order to categorize space settlements in cinema and television with the perspective of their contextual approach. Eventually, the paper is finalized with an overall evaluation and discussions.

2. Scientific studies on space settlements

Scientific studies on space settlements are inspired and encouraged by the developments in rocket technologies as a reflection of the industrial revolution on transportation. Additionally, military aims of developed countries strengthened the financing of such research as they would definitely provide an advantage for the ones who made significant progress in those technologies. Many individuals contributed to the development of space flight and eventually space stations and settlements. In the beginning of the 20th century, Konstantin Tsiolkovsky foresaw that a space flight could be performed using a rocket. He also pioneered the idea and made calculations for a permanent settlement in space. Later on, Hermann Oberth wrote his book *Die Rakete zu den Planetenräumen* (The Rocket into Planetary Space) in 1923 (Oberth, 1923). In 1928, Guido von Pirquet proposed his idea of building a space station in low earth orbit for travels to other planets (Burgess, 1993). Based on the previous work of Tsiolkovsky, Hermann Potocnik in 1929 presented *das Wohnrad* (The habitation wheel) in his book *Das Problem der Befahrung des Weltraums: der Raketen-Motor* (The Problem of Space Travel: The Rocket Motor) as a rotating torus shaped settlement in space (Potocnik, 1929).

Although the second quarter of 20th century had been a slow period regarding the research on space settlements due to the military problems all around the world, the end of WWII started a space race between USA and USSR which has been a strong accelerator for space research. In this period, the theoretical work from the previous times became real and humanity experienced breakthroughs one after the other. First rocket to outer space, first crewed space programs, first humans in space, first men on the moon: All these significant incidents happened thanks to the space race in the second half of the 20th century. It continued with the construction of the first space stations as the only habitable structures outside earth: Russia's *Salyut*, *Sputnik*, and *Mir* stations, *Skylabs* and *ISS* of the USA (event though ISS is the International Space Station, its biggest stakeholder is the USA), and *Tiangong* of China, one of the emerging competitors of the space race that is still going on.

Besides all these theoretical and practical developments in space studies, there are 3 main proposals for space settlements that are scientifically proven, yet still not constructed due to their enormous sizes and being economically not feasible. The Bernal Sphere, O'Neill Cylinders, and the Stanford Torus. Despite being not constructed until present days in real life, these visionary structures have inspired a lot of other scientific studies, as well as many science-fiction work in literature, cinema, and television.

The Bernal Sphere

The Bernal Sphere is named after its designer John Desmond Bernal and consists of a giant globe that has a habitable inner surface. It has approximately 500 meters of a diameter and 1,600 meters in circumference, and it houses around 10,000 individuals. In addition to the living space as a sphere, there are tubes on its both sides where the plant-growing and agricultural activities are managed. Additionally, the settlement includes solar panels allocated around the globe to transmit the sunlight into the living area of the sphere (National Space Society, 2002). The atmosphere inside has the same characteristics as the one on Earth, and the globe rotates at a certain speed (1.9 times per minute) around its equator on the north-south axis to create a gravitation pull equal to that of the Earth (Ceylan, 2018).

O'Neill Cylinders

O'Neill Cylinders are the creation of physics professor Gerard O'Neill from Princeton University. It is a system that consists of 2 cylinders that rotate reversely with the same pace. The size of each cylinder is gigantic: About 32 kilometres in length and 6.5 kilometres of diameter. Therefore, it can accommodate a population of a couple millions people. Each cylinder is composed of three habitable surfaces along the lateral surface, and between them there are three transparent layers that transmit the sun rays to the inner surfaces in a controlled manner and provide the day and night formation (Ceylan, 2018). In addition to the habitable surfaces, there are ring shaped modules for agricultural activities and their climatic and environmental conditions are managed in accordance with the intended agricultural production strategy (CNN International 2016).

The Stanford Torus

The concept of the Stanford Torus was first released in 1975 in a summer workshop at Stanford University in collaboration with NASA. The main body is connected to its central axis with tubes and rotates continuously to create a gravitational force inside of its outer circle equal to the Earth's gravity.

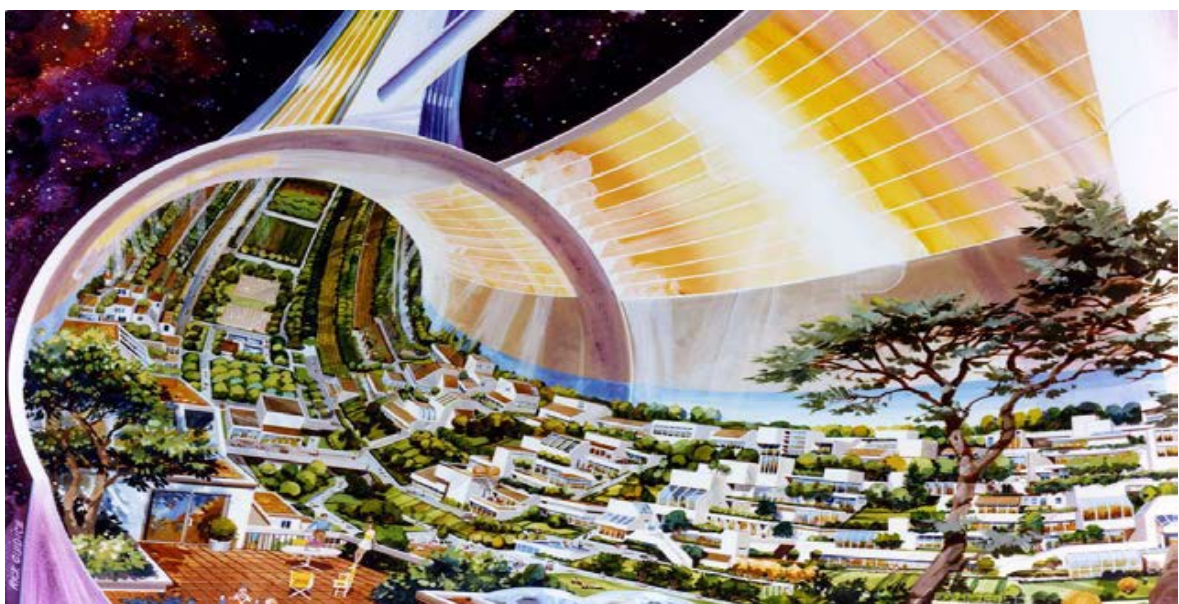


Figure 1 An Illustration of the Interior View of a Torus-Shaped Space Colony. (Source: CNN 2016)

Living spaces in the Stanford Torus are allocated on the inner surface overlooking towards the central axis, as all infrastructure is solved in a mass in the centre. Mobile solar panels between the central module and torus provide controlled access of sunlight to the inside of the colony (Socks Studio 2011). Like the Bernal Sphere and O'Neill Cylinders, Stanford Torus has inspired a lot of other proposals for space settlements, along with many science fiction works in literature.

3. Space settlements in literature

The interest on space settlements in literature goes parallel with the scientific developments. Although the first samples of fictional work on life outside the world dates back to the 17th century in the works of John Wilkins and Francis Godwin, the first known fictional book about a space settlement is the *Brick Moon* by Edward Everett Hale (1869). The story is about a giant globe made of brick that is accidentally thrown into Earth orbit while there still workers on it. The crew that build the globe eventually become first space colonists.

19th and 20th centuries have been very fruitful in terms of science fiction work in literature. In 1865, Jules Verne published one of the most popular books in science fiction *from the Earth to the Moon*. Later on in 1897, Kurd Lasswitz, who is named is the father of German science fiction, wrote his ground-breaking novel *Auf Zwei Planeten* (On two Planets). In the second half of the 20th century, Sir Arthur Charles Clarke, focused on the topic of space colonization and had several novels like *Prelude to Space*, *Islands in the Sky*, and *the Sands of Mars*. His 1968 novel *2001: A Space Odyssey* was developed concurrently with its movie version and has become one of the most iconic science fiction works about space in history. Some of the other important science fiction novels in history are *Nemesis* by Isaac Asimov in 1989, *Station in Space* by James Gunn in 1958, *Ringworld* by Larry Niven in 1970, *Neuromancer* by William Gibson in 1982, and *Centrifugal Rickshaw* by William John Watkins in 1985 (Westfahl, 2000). More recent samples for space settlements in literature are Kim Stanley Robinson's novels *Aurora* in 2015 and *2312* written in 2012.

4. Space settlements in Cinema and Television

The depictions of space stations or settlements in cinema and television started in the second half of the 20th century. With their scientific foundations were matured and representation in literature were more common, it was possible to transfer the idea of space settlements into cinema and television. There has been enormous changes in the detail levels of the depiction of space settlements, mostly based on the technologic developments. Especially after the developments in computer generated imagery (CGI) effects, the moviemakers and producers have become more courageous to work on the topics of space settlements. Nowadays, there is a huge amount of movies or series that include space settlements or space stations, all as results of a 70-year evolution that still continues.

There are different ways for the categorization of space settlements in cinema and television. Westfahl (2009) categorizes them based on their function, size, or location, in addition to their appearance time. In this article, the author tries to approach space settlements in cinema and television based on their chronological order of appearance and categorize them based on their common points in their era of existence.

Era of primitive optimism (1950s)

Movie producers' interest on space stations started in parallel to the scientific breakthroughs in rocket science and space exploration. The first serious science fiction movie about outer space is considered *Frau im Mond* (Woman in the Moon), a 1929 German movie by Fritz Lang. Even though the movie had a lot of influence for further space research like the countdown from ten to zero, the usage of multistage orbital rockets, or the crew reclining on horizontal beds to cope with the G-forces during the lift-off, it does not include a space station but a spaceship that brings the crew from the Earth to the Moon (Benson, 2019). For the first movie including a space station people had to wait until fifties. The 1953 movie *Project Moon Base* includes a disc shaped space station

that orbits the Moon and provides transfer for scientific research between the Earth and Moon through space vessels.



Figure 2 The space station in the movie Project Moon Base (scan QR code for the open source video).

Later in 1955, another movie, *Conquest of Space* introduced a space station in the form of a wheel that orbits the Earth (Miller, 2016). In the beginning of the movie, the station is presented with the following words: *"This is a story of tomorrow or the day after tomorrow when the men have built a station in space, constructed in the form of a great wheel and set a thousand miles up from the earth, fixed by gravity and turning around the world every two hours. Serving a double purpose: an observation post in the heavens, and a place where a spaceship can be assembled and then launched to explore other planets in the vast universe itself in the last and greatest adventure of mankind: a plunge towards the conquest of space."* The form of the space station unofficially refers to the previous designs by Tsiolkovsky and Potocnik.

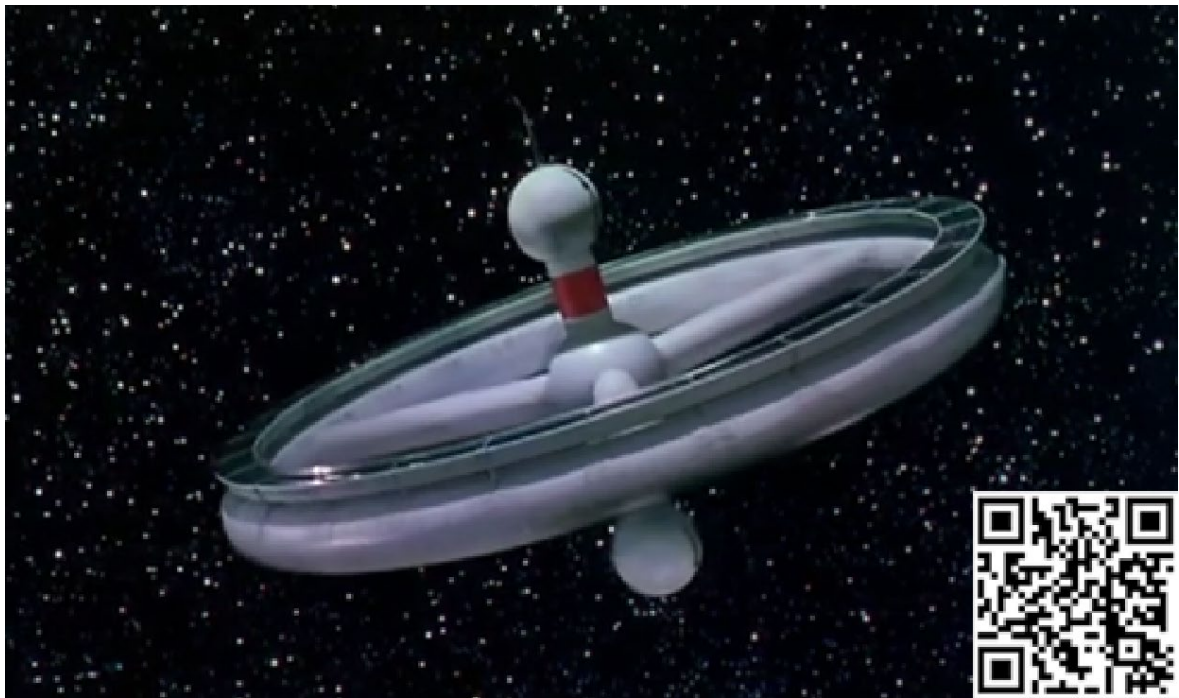


Figure 3 The space station in the movie *Conquest of Space* (scan QR code for the open source video).

Space station idea has been mentioned in TV series in the 1950s as well. In the 1959 series *Men into Space*, the third episode is dedicated to space stations and entitled as *Building a space station* (Maguire and Weitkamp, 2016). The episode is about the assembly of a prefabricated space station in Earth orbit. The space station appears in the later episodes of the series as well.

In these early examples of space stations in cinema and television, it is obvious that these works are produced quickly and cheaply (Westfahl, 2016), in parallel to the primitive conditions of movie production technologies. However, the structural principles of the space stations are based on scientific facts. The optimism about the future of space exploration and human beings' domination in outer space is also felt in the work of this era. Due to the lack of details, the architectural characteristics hard to trace in the given samples. They mostly consist of the overall depictions of the space station itself through a scaled model and some interior shots that are not much different from regular spaces on Earth.

Era of scientific progress (1960s-1970s)

Next decades witnessed more detailed and comprehensive work about space stations in cinema and television, most probably thanks to the acceleration and new achievements in the space race between USA and USSR. It reached its peak with *2001: A Space Odyssey*, the cult movie by Stanley Kubrick based on Arthur C. Clarke's scenario. The movie is still one of the most popular science fiction movies of all times because of its precise scientific statements and the level of details both in the physical environment and the movement of the people in places with artificial gravity.



Figure 4 Space station in the movie 2001: A Space Odyssey (scan QR code for the open source video).

Space Station V, the main station in the movie orbiting Earth consists of double wheels rotating around the central axis with certain pace in Earth orbit. The landing docks of the station are also in the central hub of the wheel where the living areas are allocated within the torus shaped masses in the peripheries. The station is used as a transfer hub for travels from the Earth to other planets and the Moon. It features a hotel, a restaurant, lounge areas, and telecommunication booths (Benson, 2018). The interior spaces in the *Space Station V* are designed with a minimalistic style, reflecting the modernist movement in the 20th century. There is no overuse of colours, most of the surfaces are white, only some furniture are highlighted through the use of bright red colour.

The scientific approach that peaked with *2001: A Space Odyssey* sustained by Tarkovsky's 1972 movie *Solaris*. The movie is even called as a response to Kubrick by some critics (Guidry, 2015). However, it is not the focus of this paper. The structural design of the space station is very similar to *Space Station V*, consisting mainly of torus shaped masses for main functions, only with a more complicated infrastructure in the central hub. The station's functions are more basic for research and living purposes and the shape of the torus is also visible from the interiors, especially in the corridors.

Another remarkable movie is *Silent Running* in 1971 as it includes in the space station botanical gardens for endangered species from the Earth under huge geodesic domes which were invented and introduced by Buckminster Fuller few decades before. Therefore, the space station contains its own ecosystem. Even though the scientific foundation for the structure and mechanism of the space station is not made clear, the movie is remarkable as an environmental themed post-apocalyptic movie. Other important works from that period are TV series *Starlost* in 1973 and cinematic series *Star Wars* with the infamous *Death Star* in 1977. The architecture of the space stations seems more diverse, based on the increased number of works in this field, and there are more details to be followed about the physical space provided in the stations. The emphasis on technology becomes more visible and with the addition of different concerns like humane, psychological, and ecological ones, the structure of the stations become more complicated as well.

Era of increasing complexity (1980s-1990s)

The contact with species from different points of the universe and creating relationships between them started to become a focal point in the movies and TV after 1970s. 1980s were the years where this approach advanced towards space stations that function as intergalactic hubs where many different species come together. Some stations had particular functions like military bases or commercial centres as some of them were mixed use complex structures. In this regards, the most prominent TV and cinema series was *Star Trek Saga* which started in 1968, but reached

its peak with cinema movies and additional series in the 1980s. *Star Trek* had a huge intergalactic universe that includes many species in different planets. Therefore, the appearance of space stations as transfer hubs and meeting points became a necessity. Many space stations were introduced in the *Star Trek* series: The most popular one is the *Deep Space 9* that had its own series between 1993 and 1999. There were other *Deep Space* stations in addition to spacedocks, starbases, skylabs, and other stations with various purposes. In 1982 movie *Wrath of Khan*, the *Regula I* space station appears as a scientific research laboratory and starbase. The station consists of numerous corridors as in a labyrinth complex. Functional spaces in the station are operation centre, laboratories, a restaurant, a courtroom, living quarters, guest quarters and transporter rooms (Memory Alpha, 2022). In the next movie *The Search for Spock* in 1984, the Earth Spacedock appears as a huge transportation and military hub that orbits around the Earth. In addition to its military and traffic control functions, Spacedock also became a commercial focal point (Memory Beta, 2022).



Figure 5 Space station from Star Trek: Deep Space Nine (scan QR code for the open source video)

Additionally, 1980s were the period when the appearance of space stations in movies was no longer caused by only technological achievements, but also by ecological and environmental necessities. Accidents, environmental disasters, or warfare in Earth caused the search for survival options outside the planet. Movies and TV series that included space stations are; *Aliens* in 1986 with *Gateway station*, TV series *Babylon 5* between 1993-1998, 1997 movie *Event Horizon* with *Daylight Station*, *Titan A.E.* with *Titan station* in 2000, same year *Mission to Mars* with *World Space Station* and *Red Planet* that includes *High Orbit space station*.

Era of environmental awareness (2000s)

21st century changed many things in the world, along with them are the relationship between human beings and nature, studies on space, and movie production techniques. A mixture of these three elements changed the way space stations and settlements in cinema and TV are handled. Firstly, environmental problems became much more visible and immediate action was required. Secondly, space studies have broken free from governments and with the increasing interest of private companies, developments regarding regular human beings' existence in Space accelerated.

Thirdly, computer generated imagery (CGI) effects changed the nature of movie production, making any imagined scene possible to be presented. Space station scenes produced through CGI methods replaced physical models from the previous decades, and well-prepared movies became much more realistic. In this era, many movies that include space stations have been produced. Among them are *Ender's Game* in 2013 with the space station Battle School, *Geostorm* in 2017 with International Climate Space Station, *Ad Astra* in 2019 with Norwegian biomedical research space station, *3022* in 2019 with Pangea, and TV series *The 100* between 2014-2020 including the Ark. In addition to these, 3 movies have introduced ground-breaking elements for space settlements: 2013 movie *Elysium*, *Interstellar* in 2014, and *Star Trek: Beyond* in 2016.



Figure 6 Space station in the movie Elysium (scan QR code for the open source video)

The settlement depicted in *Elysium* is a wheel shaped space station located in Earth's orbit. It resembles the contemporary world in general terms. Studying the architecture of the settlement it can be noticed that the open space and the natural items are used especially in the residential and public areas. Elysium, which is created in direct proportion to the population of the settlement offering an ideal living environment by applying an intensive reconstruction strategy, shows an environment that meets almost all the humane and social needs of the elite segment (Ceylan, 2018).



Figure 7 Cooper station in the movie Interstellar (scan QR code for the open source video).

The space settlement in *Interstellar* is called Cooper station and it has a cylindrical form. It rotates around its central axis which causes artificial gravity. The settlement has its own ecosystem, gravity and infrastructure systems allowing life to sustain for a long time. The space station is large enough for thousands of people to live in. The architectural typology seen in the station reflects the style of the American rural settlements parallel with the setting of the movie on Earth (Ceylan, 2018).



Figure 8 Starbase Yorktown in the movie Star Trek: Beyond (scan QR code for the open source video).

Starbase Yorktown, the space settlement depicted in *Star Trek: Beyond*, is one of the many space stations in the Star Trek universe built by the Federation. The base is a metropolitan area where

millions of people from different species live. It consists of many toroidal shaped masses located around a core. All these masses are connected to each other and the centre via linear structures that function as tubes and bridges that provide infrastructure and transport integrity. This complicated structure ends up with a spherical, transparent layer large enough to cover the entire system. This global layer functions to maintain the artificial gravity and the atmosphere inside, as well as a shield against possible external attacks and collisions. The architecture of Yorktown reflects the futuristic characteristics of the Star Trek series, and the general character of contemporary world metropolises (Ceylan, 2018).

The space settlements in these three remarkable movies look very different from each other regarding their form, but they also have many common characteristics. Firstly, they all are based on scientific foundations regarding the structure of the settlements. Secondly, in all the three movies, the space settlement does not consist of only interior, but also exterior spaces. They all are multifunctional complex structures that provide all the needs of human beings to survive and reside. Therefore, they are called space settlements rather than space stations.

5. On the Architecture of Space Settlements

Designing a space settlement means creating artificial environments (Ceylan, 2019). *An artificial ecology is a dynamic metabolic system contingent on material and energy flows that interrelate the various constituent parts together with the overall structure of the ecosystem (Hasdell, 2006: 3).* Accordingly, there are issues that must be considered while designing the space settlement such as gravity; atmosphere; cosmic radiation; positioning, movement and transportation; energy, resources and sustainability; and as important as these physical factors, psychological and sociological needs of human beings.

The analysis on the architecture of the space stations in cinema and TV puts forth that architecture as the discipline to design human settlements starts to play more important roles in their design through time. The evolution can be summarized in various titles. Firstly, the detail level of the presentation of space stations increases through time. Accordingly, architecture becomes a more significant actor in the design. In the first examples from 1950s the space stations are only shown through simple model scenes and regular interior views. However, in the contemporary movies, the viewers can examine the space settlement from various scales and perspectives. More details are given about interior, exterior, and even urban spaces. Secondly, the very reason for the construction of space stations in movies evolved in time from pure technological advancements to environmental and survival necessities. Towards the end of the 20th century, the danger of Anthropogenic causes became more obvious and for some approaches, construction of space stations became a necessity for the survival of humankind. This situation is reflected on the architecture of the space station itself. Through time, space station depictions in movies start to tend towards the imitation of daily life to answer to the regular needs of its users, to provide an alternative to the life on planet Earth. Thirdly, the evolution of the architectural style, especially in the interior space of space stations is parallel to the evolution of the architectural movements of the production date. The space stations in 1970s movies are resembling the buildings and interior spaces under the influence of modernist movement, as the ones in 1980s and 90s are more influenced by postmodern and brutalist styles. In 2000s, the evolution transforms the architecture of the settlements into some character that has stronger connections with natural elements and the environment. Finally, the functions and user profile of space stations evolve through time as well, which has a direct effect on its architecture. In earlier times, the space station has a basic function of transportation or research, which limits the user profile with science people or astronauts. Accordingly, the size of the space station is limited and the form and structure is more basic. In the upcoming decades, the user profile changes to human beings with various missions, professions and expectations, in addition to other species from different corners of the universe. As a consequence, the functional requirements and diversity of places in the space settlements increase in order to meet the expectations and needs of the users. In contemporary movies like

Elysium and *Interstellar*, the space settlements are small scale versions of the Earth itself where a person may spend her or his whole life.

6. Conclusion

Space stations are common in science fiction narratives, but are rarely in the focal point of stories (Westfahl, 2005). Some exceptional movies like *Elysium* and *Interstellar* are more representational about the space settlement itself, but in overall, they are just being used as a keyword in the plot of the movies. With the developments in the science and technology of space settlements, the weight of their depictions will probably increase in the future. Nowadays, thanks to CGI methods and emerging technologies like immersive virtual reality, it is more possible to depict imaginary places with its all details.

Honestly spoken, architecture is not the first discipline that comes to mind regarding the design of space settlements. Urban planners, architects, and designers work toward the near future rather than distant one (Schlegel and Foraita 2012). However, as architecture is the discipline to design all places for human activities, it must play a role in the design of space settlements as well, especially because of the reasons related to human beings' physical, social, and psychological needs. Architecture has already widened its field of interest towards representation in cinema, TV and digital games, thanks to the developments in digital technologies. It is also an opportunity for architects to become an initial member of teams that design the scenes in movies or games in the world of science fiction and fantasy.

This paper intends to provoke an awareness among architects that their field of interest shall not be only buildings of the present or near future. Structures of the far future and even non-physical structures like in movies and TV, as well as virtual worlds are fields of work for architects. It is even possible that architects become initial members of teams that design the space settlements in the future. For that purpose, architects must widen their vision towards other worlds both physically and virtually, and equip themselves with the best instruments that enable them to work towards that purpose. The future holds dangers for the ones that cannot follow the developments, but it also offers great potential for the ones who keep themselves up-to-date.

References

- Benson, Michael, (2018). *Space Odyssey: Stanley Kubrick, Arthur C. Clarke, and the Making of a Masterpiece*. Simon and Schuster.
- Benson, Michael, (2019). "Science Fiction Sent Man to the Moon - Neil Armstrong's first small step owed more than you'd think to the footsteps of Jules Verne, H.G. Wells and Fritz Lang". <https://www.nytimes.com/2019/07/20/opinion/sunday/moon-rockets-space-fiction.html>, Accessed August 28, 2022.
- Burgess, Eric, (1993). *Outpost on Apollo's Moon*, Columbia University Press, p. 172.
- Ceylan, Salih. (2018). "Space, Architecture and Science Fiction: An Architectural Interpretation of Space Colonization." *The International Journal of Constructed Environment* 9 (2): 1–17. <https://doi.org/10.18848/2154-8587/CGP/v09i02/1-17>.
- Ceylan, Salih, (2019). "An Overview and a Future Projection on the Architectural Design of Artificial Environments", *The International Journal of Architectonic, Spatial, and Environmental Design*, 13(3): 31-49.
- CNN International. (2016). *Space Oddity: NASA's Retro Guide to Future Living*. Accessed August 28, 2022. <http://edition.cnn.com/2016/05/29/architecture/nasa-ames-oneill-space-colonies-1975/>.
- Fix, John D. (2017). "Astronomy Timeline." *Astronomy: Journey to the Cosmic Frontier*. Accessed August 22, 2022. http://highered.mheducation.com/sites/0072482621/student_view0/astronomy_timeline.html#sect2.
- Guidry, K., (2015). Watch: Video Essay Details How Andrei Tarkovsky's 'Solaris' Is A Response To Stanley Kubrick's '2001: A Space Odyssey', *IndieWire*, <https://www.indiewire.com/2015/08/watch-video-essay-details-how-andrei-tarkovskys-solaris-is-a-response-to-stanley-kubricks-2001-a-space-odyssey-260934/>, Accessed August 29, 2022.
-

- Maguire, Lory, Weitkamp, Margaret, (2016). *The Cold War and Entertainment Television*. Cambridge Scholars Publishing. pp. 203–206.
- Memory Alpha, (2022). Regula I Type, Memory Alpha Fandom, https://memory-alpha.fandom.com/wiki/Regula_I_type#Technical_information, Accessed 29.08.2022.
- Memory Beta, (2022). Earth Spacedock, Memory Beta, non-canon Star Trek Wiki, https://memory-beta.fandom.com/wiki/Earth_Spacedock, Accessed 29.08.2022.
- Miller, Thomas Kent, (2016). *Mars in the Movies: A History*. Jefferson, North Carolina: McFarland & Company, p. 66.
- National Space Society, (2002). “Bernal Sphere Space Settlement.”, Accessed August 25, 2022. <https://space.nss.org/bernal-sphere-space-settlement-detail/>.
- Oberth, Hermann, (1923). *Die Rakete zu den Planetenräumen (The Rocket into Planetary Space)*, R. Oldenbourg, München.
- Potocnik, Hermann, (1929). *Problem der Befahrung des Weltraums: der Raketen-Motor (The problem of space travel: the rocket motor)*, NASA History Series SP-4026, NASA, Washington, DC.
- Schlegel, Markus, and Sabine Foraita. (2012). “Trend Predictions—Approaches, Methods, Opportunities.” In *The Future of Building: Perspectives*, edited by Cornelia Hellstern and Sandra Leitte, 70–79. Munich: Detail Institute of International Architecture-Documentation, Ltd.
- Socks Studio. (2011). “Orbital Space Colonies.” Accessed August 28, 2022. <http://socks-studio.com/2011/08/20/orbital-space-colonies-in-form-of-geometric-primitives>.
- Westfahl, Gary, (2000). “Space Stations and Space Habitats: A Selective Bibliography”. In *Skylife: Space Habitats in Story and Science*, Gregory Benford and George Zebrowski (eds.), Harcourt, Inc, New York.
- Westfahl, Gary, (2005). “Space stations”. In *The Greenwood Encyclopedia of Science Fiction and Fantasy: Themes, Works and Wonders*, Gary Westfahl (ed.), pp. 740-741.
- Westfahl, Gary, (2009). *Islands in the Sky: The Space Station Theme in Science Fiction Literature*, 2nd Edition, Wildside Press, Maryland.
- Westfahl, Gary, (2016). *The Spacesuit Film: A History, 1918–1969*. McFarland. p. 54.

Resume

Salih Ceylan is an associate professor and vice dean in the Faculty of Architecture and Design at Bahçeşehir University, Turkey. He received his master's degree from Istanbul Technical University in 2007 and PhD from Yıldız Technical University in 2016. He has many published articles in international journals, book chapters and papers presented in international conferences. His research interests are virtual reality in architecture, digital representation techniques, sustainability, energy efficiency in architectural design, architectural education, Space architecture and retail design. Salih Ceylan can be contacted at: salih.ceylan@arc.bau.edu.tr.