Defying Gravity: Space Architecture in Film Environments
An Opportunity Lost

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Introduction

Film gives us the rare opportunity to completely question all that has come to be accepted in terms of the language of architecture as well as cultural and historic convention. It allows for educated speculation on what may have been in the past, and what the world of the future might become. Current film technologies provide such a high degree of realism in the product, that architectural education can use these films as vehicles for critical discussion of the ethos of these environments. Much like, and yet experientially speaking, well beyond the efforts of the Visionary architects of the 18th century, film can create visions of realistic feeling environments that can be used to reinvent the meaning and defining factors of architectural expression.

Much of the development of this convention and expression is based upon the existence of gravity. The exploration of "space themes" in film allows for free experimentation in an architecture that could be imagined and designed, without reference to normal architectural conventions or subject to the influence of the force of gravity.

Unlike architecture, film spaces have never had to be realistic, nor have they been obliged to possess a conscience. That is not to say, however, that the notions of science or conscience have failed to be vital motivations behind the creation of many films. Film producers and directors though, can make a conscious decision whether to choose to respect scientific accuracy, and how to portray moral and political conscience. An examination of scientific timelines can begin to allow us to understand the development of the space genre of film as it relates to accurate scientific invention.[1] If scientific knowledge was available at the time of the writing of books and making of films, it will be assumed that such was purposefully ignored, if not shown to be respected.

This paper examines innovation in architectural (set) design that has occurred in space themed films, from "Aelita" in 1924 to the final installation of the "Star Wars Saga" in 2005. Much will be seen to have changed as a result both of an increase in scientific knowledge, as well as the technological advances in the film industry. Knowledge and technical innovation have given directors unlimited potential for choice in representations of space environments. Such choice also includes the willful abandonment of science for fantasy.

The Evolution of Film

For the last century, the medium of film has allowed increased understanding and appreciation of the realistic, three-dimensional occupation of architectural and urban spaces that previously existed as captives of text and two-dimensional representation. These would include not only the reconstructions of actual historic places, but also visionary or imaginary places. From the representation of 16th century Prague in "The Golem" (1921), to the ancient splendor of Rome in "Ben Hur" (1959) or Egypt in "Antony and Cleopatra" (1972), traditional film techniques have been relatively successful in bringing ruins to life and allowed for their experience – albeit with varying degrees of historic accuracy. CGI techniques are allowing unsurpassed detail in contemporary explorations of historical places as represented in films.

Gravity determines architectural form and structure. There is very little that has been developed throughout history, from early Roman vaulting through to modern steel construction that cannot be attributed to increasingly refined responses to the actions of gravity on structure and material limitations. Real architecture must function in a real world, governed by the laws of science.

Gravity has also determined the way that we occupy space, and hence, the way that we have tended to design space, as well as to select surface finishes. The floor is where we walk. Walls and ceilings bound us, but we are not obliged to come into contact with those surfaces unless we so choose. Material placements have developed that respond to issues of wear and durability, again subject to gravitational orientation. Such scientific concerns have driven the design of structures and architectural systems since the notion of shelter was first conceived. Speculations during the 1700s as to the origins of architecture – including, Laugier's "Rustic Hut"[2] – all support this tradition in the development of architecture. Simply by turning relationships "upside down", let alone removing the force of gravity, begs us to question the logic behind everything that we can see. This is what the medium of film frees designers to explore.

Visionary Architecture

Within the profession and practice of architecture, there have been various venues for challenging science and materials based construction techniques. The Visionary Architects of the 1700s, such as Etienne Louis Boullée, adopted a two-dimensional, painterly solution to the proposition of unbuilt (unbuildable?) architecture. Had reinforced thin shell concrete been invented 100 years earlier, Boullée's Centotaph for Newton or Biblioteque Nationale might have been able to be constructed, rather than looking to future possibilities or dreams. The work of Pier Luigi Nervi and Eero Saarinen attests to the possibility. Many of their works, had they been presented as renderings two hundred years earlier, would have been deemed unconstructable. The medium of paint was permitting design freedom outside of the realistic boundaries imposed by construction.

Whereas the extraordinary vision of architecture that drove the work of Boullée simply stretched the structural capacity and orientation of the traditional materials of the time, using traditional forms, the excited musings of Archigram and all during the 1960s proposed architectural alternatives that questioned *everything*, from the materiality and mechanical systems proposed, down to the static location of urban environments. Ron Herron's "Walking City" remains quite

unrealizable in "buildable" terms, but would not be beyond the capabilities of any CGI unit at Lucas Film or the animation team at Studio Ghibli, as recently shown in the 2005 film "Howl's Moving Castle", based upon the novel by Diana Wynn Jones. Howl's Moving Castle brings a magical Walking House to life, in perhaps a more realistic, although animated style, than was represented by Herron's renderings.

Where Herron's static illustrations may give rise to dynamic architectural dreams, CGI technologies and even classic animation can put these images into real time motion. The view from the "outside" can be replaced by the potentially realistic experience of the virtual spaces that also include the interior.

The creation of visionary works of art and architecture often arises at times when cultural, political or technological influences impose restrictions on creative works. Etienne-Louis Boullée and C.N. Ledoux ceased to build when Napoleonic pressures left them without patrons that were permitted to construct. Archigram's illustrations exhibited a frustration with the technological limits placed on construction, in a period of burgeoning ideas and rapid growth.

Much the same as visionary works of art and architecture, film has been used since its invention to provide societies with means to escape reality as well as to react to political situations. Through the decades of the past century, film can be seen to reflect the economic, cultural and political pulse of the people. This did not always indicate "alignment" and was often reactionary. Fantasy films were popular during the Great Depression when day to day living was lacking in optimism.

Additionally, films are often produced that react to other films. The "Star Wars Saga" (1977 to 2005) was for George Lucas, a purposeful fantasy based reaction to the hard and serious presentation of space authored by Stanley Kubrick in "2001: A Space Odyssey" (1968). The gritty action packed stories behind "Outland" (1981) and "Total Recall" (1990) can be seen to lie somewhere between the extremes of fantasy and science. Yet all of these films provide a series of visions that speculate on the architecture of these incredibly foreign environments.

The Influential Role of the Science Fiction Novel on the Space Film Genre

Film has often acted as a vivid visual interpretation of text. Early space based science fiction novels, such as "Aelita" by Alexei Tolstoy (1922) and "First Men in the Moon" by H.G. Wells (1901), had little accurate scientific information upon which to base their texts. In "Aelita" the atmosphere on Mars was harsh, but was not lacking in breathable atmosphere or gravity. At this point in time the geographic markings on Mars that were visible to early telescopes were thought to be the remains of an ancient canal system, indicating the presence of water and a far more hospitable climate.[3] The lunar environment presented by Wells was significantly more severe than that on earth, but did provide a breathable environment when the explorers entered an underground city beneath the surface of the moon. Differences in planetary gravity fields were not known.

The invention of the modern science fiction novel was not far ahead of the invention of the motion picture. It is not surprising then, that the space/sci-fi film genre has its start during the beginnings of the development of the commercial film industry, and that the scientific development of the film industry sees its needs propelled by the desire to create more compelling, and often realistic, science fiction and space environments.

Miriam Allen de Ford has noted: "Science fiction deals with improbable possibilities, fantasy with plausible impossibilities."[4] And herein lies part of the blur that we see in the evolution of the Space Film genre. What might have begun in "Aelita" and "First Men in the Moon" as science based fiction in its attempts to include recognition of some of the scientific realities of space, evolved to purposefully become more fantasy based. Where Stanley Kubrick employed consultants from NASA to ensure that the environments and equipment used in "2001: A Space Odyssey" were as accurate as possible as it was his wish to have everything "intellectually justified"[5], the modern" Star Wars" series of films, which although include an unending variety of innovative off-world environments, tends to tenaciously ignore any realistic or scientific portrayal of the limits that space environments bring to bear on urban environments and travel.

The Environment Suit and Transportation as a Starting Point

Examination of the majority of space films would indicate deference to consistency among approaches to the personal, transportation and urban/architectural environments. Whether or not a film tends to exploit the creative possibilities of the zero-gravity environment in terms of their architectural or urban design vision, seems to directly relate to the election to the use of a personal "environment suit" as well as to the (realistic) design of the space transportation. The acknowledgment of alternate atmospheres must first require immediate body protection, before that human body can be placed in a scientifically believable relationship to an architecture that is not gravity based. The natural extension of this can be seen in the design of the space transportation, in combination with fueling/take-off methods.

Historic novels and their resultant films, if produced in the same time period, were less likely to require environment suits, nor to understand fuelling methods for spacecraft, due to their lack of scientific knowledge. In these films, space architecture seemed to be more likely represented as highly Constructivist or Modern in style in order to identify the environment as being "not of the Earth" and non traditional. This followed general tendencies in film set design during the 1920s that chose highly modern styles to represent futuristic societies.[6] This is clearly seen in the supposed Mars based sets of "Aelita: Queen of Mars". A wildly Constructivist set design is used to differentiate between the Russian and Mars locations. Due to limited model making skills, only a glimpse of the exterior of the "town" can be seen, but that, in concert with the lavish interior environments, use Constructivist shapes and textures to create an interior space that clearly is gravity based in terms of its occupation, shapes and apparent finishes, but slightly defies gravity if only due to the lightness of the theatrical construction. This tendency to use non traditional geometry has been maintained throughout all space films as one of the primary indicators of a future based setting.

In spite of being written almost 20 years earlier than "Aelita", Wells inclusion of scientific knowledge in "First Men in the Moon" was more accurate, and the film makers in 1964 had benefit of being able to include (or willfully reject) state of the art interpretations to aspects of the film due to the contemporary nature of the United States versus Russia "Space Race". Where the cosmonauts in "Aelita" ventured to Mars devoid of any special clothing, "First Men in the Moon" includes two varieties of space suits. In the flashback sequence to the exploration that was to have taken place in the early 1900s, the astronauts donned special suits that incorporated old model diving helmets, but that left their hands exposed. When present day (1964) astronauts ventured to the moon, they wore space suits quite like those of the Mercury mission.[7]

"Just Imagine" (1930) was Fox Films combined farcical commentary on the propositions presented by "Metropolis" (1927) and "Aelita" (1924). Representations of early space travel in "Aelita", "Just Imagine" and "First Men in the Moon" are all consistently unrealistic – as were the approaches to the space environments.
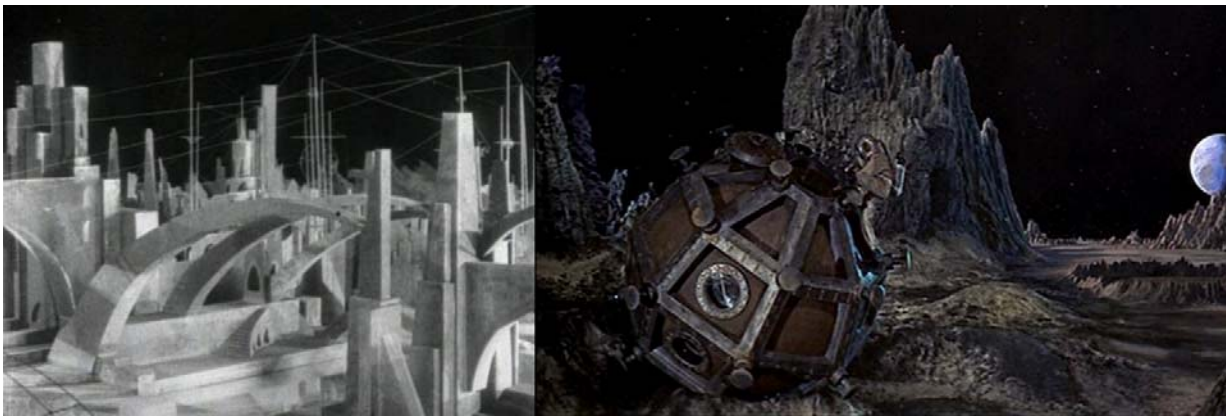

Fig. 1. Surface of Mars in Aelita (left), surface of the Moon in First Men (right)

There has been constant interaction between science fiction writers and space genre film production. Arthur C. Clarke worked with Stanley Kubrick on the screen play for "2001: A Space Odyssey" (in this rare case, the book followed the film), and Philip K. Dick's short story, "We Can Remember it for You Wholesale" (1966), provided the basis for the Mars based film, "Total Recall" (1990). Current screen/writers have had up to date scientific knowledge at their disposal, which makes conscious choice possible when creating accurate versus inaccurate space environments. In 1964 Mariner 4 made the first Mars flyby (impacting Philip K. Dick's short story) and in 1976 the U.S. Viking spacecraft took colored images of the surface of Mars, thereby informing alterations in scientific accuracy between the short story and the film.

The predilection for a higher degree of scientific accuracy in films of this period can likely be attributed to media hype surrounding the space race. Society was culturally aware and anticipating the idea of conquering space. Space films post 1990 have tended to show less interest in realistic propositions of conquering space as worldwide interest in the subject has waned.

Representational Limits

The art of filmmaking has also undergone a transition from "techniques" to "technologies". Early film was reliant on a fixed camera position, fixed lens and the physical construction of sets and mini models to represent imaginary places. This, more so than lack of scientific knowledge about space, severely limited the portrayal of space environments. This can be clearly seen in "Aelita" -- the novel spends the majority of its pages roaming around Martian landscapes, and the film does not elaborate on the environment of Mars beyond a few small glimpses through a window.

In "First Men in the Moon" (1964) Ray Harryhausen's invention of "Dynamation"[8]

(green screening techniques) allowed the film to more believably mix live action with realistic looking settings, limiting dependency on simple model views. This technology has become the basis by which live actors are integrated into increasingly computer generated image based scenes. The majority of the most recent chapter of the "Star Wars Saga", "The Revenge of the Sith" was filmed with live actors in front of a complete green set. This allows for the creation of a far more detailed and varied collection of architectural settings, than would be possible if models were the exclusive means of representation. In fact, animated sequences have come to represent upwards of 75% of the content of highly futuristic visualizations in film.

The "architecture" of space vehicles and space craft has become a central signature of this genre of film. In "2001" (1968), "Solaris" (1972), directed by Andrei Tarkovsky and based upon the book of the same name published in 1961 by Stanislaw Lem, and "Silent Running" (1971), directed by Douglas Trumbull (who was responsible for special effects in "2001"), the action of the film largely takes place without planetary contact. In the case of these three period films, budget, as well as the sensibility of the director, had immense impact on the ability to create a realistic response to the occupation of space and impact of gravity on both the architecture and occupants.

In spite of Douglas Trumbull's role in the creation of "2001", his budget for "Silent Running" was a mere $1,000,000, as compared to the $10,000,000 that Stanley Kubrick had to create the environments of "2001". Kubrick's desire for scientific accuracy, and his consultation with experts from NASA, fueled the construction of a large rotating set that permitted a filming technique that freed the actors from appearing to be under the normative force of gravity[9] (see Dave jogging in Fig 2). The coloration of the interiors and whiteness of finishes gave the appearance of plastics and other lightweight materials. On the other hand, Trumbull's set was constructed in a retired aircraft freighter – giving rise to excessively large spaces that were obviously constructed of metal and other heavy materials. The space scenes in "Solaris" seemed to combine some of the geometry and lightness of "2001" with apparent heaviness in some of the materials of the craft's interior, although the director claims not to have seen "2001" prior to creating his own film and felt Kubrick's piece to be very "cold and sterile".[10]
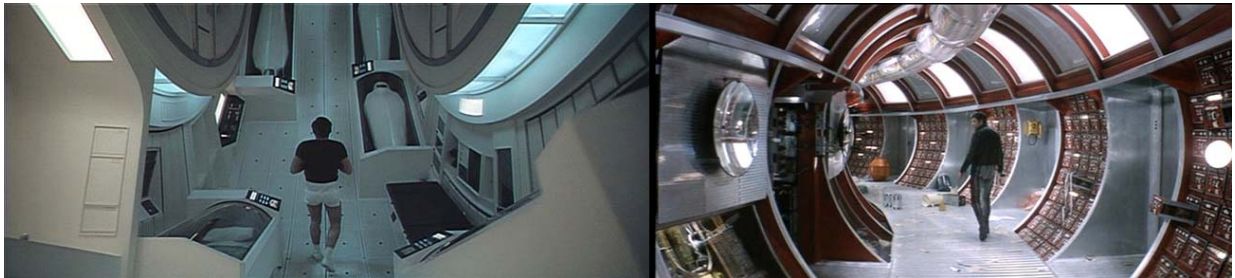

Fig. 2. Interiors: 2001 (left), Solaris (right)

A combination of budget and technology gave rise to the predominant use of scale models to create both environments as well as spacecraft. With the exception of select full scale sets, distance views of the space craft and planetary environments of "2001", "Silent Running", "Total Recall", "Outland" and the earlier "Star Wars" installments, all employed highly detailed scale models that were placed into larger environments using green screening techniques. It was this method that allowed the visual effect of zero gravity. More sophisticated camera movements also assisted in releasing film environments from a dependency on a more rigid camera position that had reinforced a gravity-bound view of the set. Cameras that can now run on tracks at computer controlled rates have the ability to simulate flight more believably.

Where scale models were able to provide a high level of detail to the set at little cost, they also resulted in a level of texturing that upon closer examination, appeared nonsensical from both a mechanistic and purpose driven perspective. This texturing, however, assisted the architectural reading of the construction as futuristic.
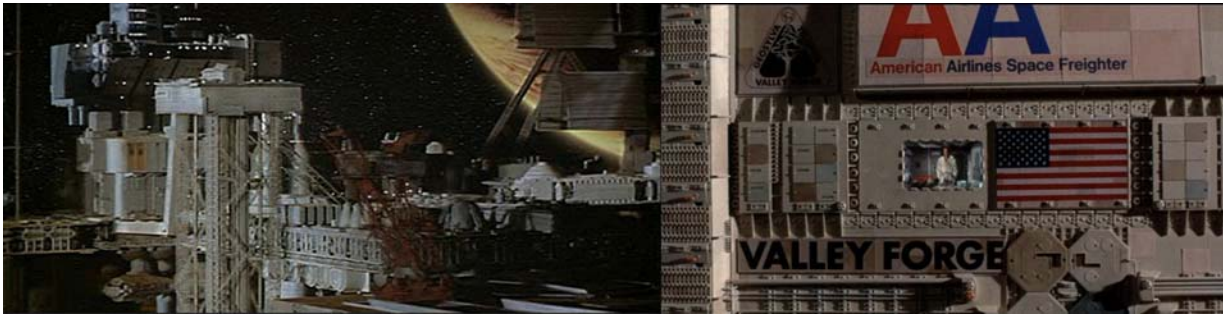
Fig. 3. Model textures: Outland (left), Silent Running (right)

Filming techniques today, have the ability to make visual images of environments that blend seamlessly from scale models, to the physically constructed full sized set to realistically animated visions of characters speeding through highly complex urban cities set on unknown planets. This has radically changed the appearance of space genre films through an increase in complexity, speed, layering and realism in the imagery used – but again, is a budget related option. One needs only watch the credits roll on any film to understand the payroll implications of CGI. The hyper-realistic environments of "Revenge of the Sith" (2005) require a level of detail and animation that is capable of realistically blending live actors with animated environments whose level of detail, materiality and lighting approaches reality. One of the benefits of the expense of CGI is the loss of the excessive plastic model detail that was the trademark of pre-CGI films.

Realism and the Visual Futurists

The virtual environments that have come to characterize the film industry, both in terms of future worlds on earth and worlds apart from earth, have been conceived and created by people whose training may or may not be "architectural" in nature. But whether or not the concept artist has received accredited training in Architectural design, this does not stop the worlds that they create from influencing both the perception and the reality of design and fashion.

What begins to be revealed when examining the history of film is that a select set designers and concept artists have had a high level of influence on outcomes. Where Hugh Ferriss' designs have been seen to impact sets such as Gotham City in "Batman"[11], Syd Mead and Douglas Trumbull in their work with Stanley Kubrick, as well as directors Ridley Scott, Peter Hyams, Paul Verhoeven and George Lucas, have set the architectural tone for space environments.

Within this group, there have tended to be two camps – the scientific realists and the fantasy artists. The films of Ridley Scott in Alien (1979), Peter Hyams, with specific reference to "Outland" (1981), and Paul Verhoeven, "Total Recall" (1990), have created a more realistic, gritty depiction of life off-world. The spacecraft in Alien is far rougher in its tectonic than those in "2001". The mining camp on Io in "Outland" focuses on the division between the harsh exterior environment and the protective interiors, using highly industrial finishes and materials. Similarly in "Total Recall" the plot focuses on the manufacturing of air and withholding the same as punishment for the lower classes. Interior environments again use very industrial motifs. In both films in major plot moves the environmental barrier between the interior and exterior is punctured. Both films purposefully play upon the vulnerability of glass or thin architectural skins in direct relationship to their non earth locations. "Silent Running" and "2001" also work the vulnerable aspect of skin into their plot lines and architecture. The giant geodesic domes in "Silent Running" play upon the tenuous position of man and his small piece of the environment as it floats in space.

Fig. 4. Expansive glass skins: Outland (left), Total Recall (right)

Where atmospheric issues have played a key role in the development of architecture and plot in this group of films, zero-gravity issues have been often overlooked. "2001" is the only film that includes Velcro slippers for the stewardess as she walks on the floor/wall/ceiling of the craft, placing a floating pen back into a pocket. Space type food is also on Kubrick's menu. Zero-gravity is only truly recognized in "Outland" when we see that a prisoner is being held in a zero-gravity chamber, at least giving rise to speculate that gravity must be imposed on the rest of the set/environment. In "Silent Running" Bruce Dern walks on the exterior of his spacecraft without protection other than a special suit.
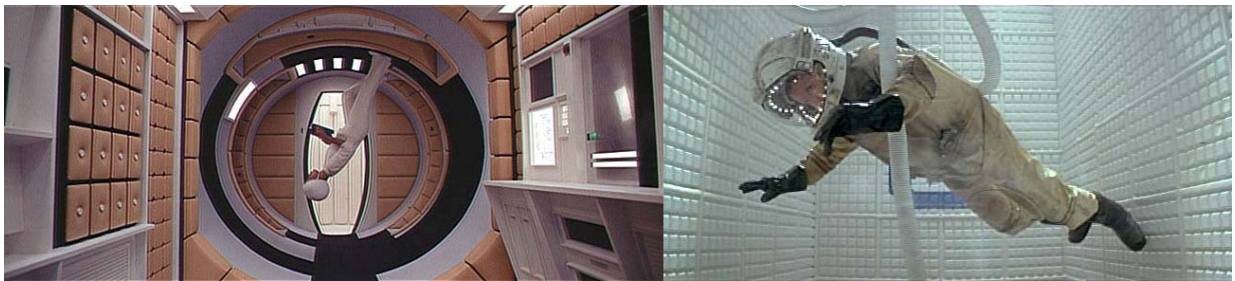

Fig. 5. Gravity: 2001 (left), Outland (right)

In complete contrast, Lucas' decision to create fantasy based films chooses to ignore atmospheric limitations, providing oxygen regardless of location. This has given him complete freedom in building, spaceship and spacesuit design (or lack thereof) and eliminates this issue from plot development as well.

Precedents trickle from genre to genre. Early futuristic urban film environments, such as those in Fritz Lang's "Metropolis", also encouraged the development of film techniques as they too stretch the limits of model builders and film makers in their ability to portray realistic sets that represent alternate environments. Lang's environments have also influenced the urban representations of many dystopic films such as "Blade Runner" (1982) directed by Ridley Scott, with total set and vehicular concept design by Syd Mead. Syd Mead was educated at the Art Center College of Design in California and went on to work for U.S. Steel and Ford in the automobile design industry. "Blade Runner" was the first film that Mead had the opportunity to work on from concept to completion. In an interview with Syd Mead in September 2006, Mead was very clear about the way he viewed himself as a Visual Futurist, (a category also outside of the "unions" and ineligible for Academy Awards) and his role in shaping the way that future environments would be perceived. "Blade Runner" was intentionally dystopic, but his preference was to create future environments that were light and optimistic.[12]

Douglas Trumbull was another key figure in the development of the language of space architecture through the 1970s and 80s. Although his education began in an architecture curriculum, he quickly switched to illustration and by the age of 23 he was

working special effects for Stanley Kubrick on the set of "2001". His father, Don Trumbull (1909-2004), had been involved in effects in the film industry (notably "The Wizard of Oz" in 1939), and Douglas worked on many of the same sets as his father. Trumbull, like Mead, created a stylistic design thread that wove together much of the "look" of the transportation, robotics and environment of futuristic films – with Mead and Trumbull only coinciding in the creation of "Blade Runner".

In this way a few directors, concept artists and special effects persons have created select "benchmark" films that have subsequently become the basis for the general design of space related architecture, much in the same way as early Visionary Architects acted towards built architecture. Some of these environments have drawn their inspiration from futuristic architectural environments that were earth based.

Opportunity Lost - Maintaining the Traditional View of Architecture

At present, in spite of the limitless capabilities in film making with the advent of computer aided drawing and design software, the tendency in the presentation of zero gravity environments has normally maintained a gravity driven architectural solution.

From "Aelita" (1924) to the most recent installment of "Star Wars" (2005), film has held an architectural response to the act of living and building in space that is almost totally derived from traditions in building on earth. With the exception of rotating spaces in "2001: A Space Odyssey", the floor remains the floor, the ceiling the ceiling and the walls the walls. There are more durable materials placed on the floor than the other surfaces. Barring some hexagonal and curvilinear anomalies, the tendency towards sliding doors and bright finishes, the spaces are rectilinear and familiar looking. Even the architecture of "Star Wars" has borrowed from the romance of the Art Deco period in the creation of its powerful urban images. As with films such as "Metropolis" and "The Fifth Element" (1997), a simple combination of building height and urban density has come to represent the future.

So with rare exception, it can be seen, that very little in the space film genre has taken

any advantage of the lack of restriction in conforming to the laws of gravity. What might be the cause of this effectual anesthetization of the realistic space environments that fleetingly appeared between 1968 and 1990?

Although Mead is still designing, Trumbull has not been involved in concept design for the film industry for 20 years. Current films, that are being produced at a rapid rate, using predominantly CGI methods, must use CGI production houses, such as Industrial Light & Magic, to provide enough computing and editing power to create realistic looking environments. The exponential increase in visual effects artists, special effects, animation crews, etcetera, has resulted in a watering down of some of the more powerful concepts and a tendency to opt for fantasy based solutions instead of the more difficult to defend scientific position. Fantasy solutions also feed into the current zeitgeist of contemporary CGI based film themes.

Contemporary society looks to film for entertainment not education. The fleeting time of scientific realism in this film genre took place when there was much optimism about the "space race". Man had arrived on the moon and there was much hope that more would be soon accomplished. Subsequent disasters, such as the crash of the space shuttle "Challenger" in 1986, dampened belief in the industry. A myriad of subsequent technical difficulties, as well as increasing awareness of the difficulties for human beings to live in space without losing critical body mass have also contributed to a preference to return to the fantasy vision of life and travel in space.

The current choice to represent the potential space future as fantasy seems to support traditional architectural styles and obviate the need to question the same since spatial occupation need not change in environments that in spite of being located on planets of unknown origin, still have gravity, air to breathe and a similar palette of materials. Sadly, significant film based explorations in the architecture of zero-gravity have yet to be developed.

Notes

All images from within the films were captured from the DVD versions of the films using WinDVD.

[1] Timelines of Science: http://kosmoi.com/Science/History/ Einstein's "special theory of relativity" was published in 1905, followed by the "general theory of relativity" in 1915; Hubble was able to peer more closely into the universe during the 1920s.

[2] Rykwert, Joseph. On Adam's House in Paradise. Cambridge: The MIT Press, 1981. p. 45.

[3] Sheehan, William. The Planet Mars: A History of Observation and Discovery. University of Arizona Press, 1996: http://www.uapress.arizona.edu/onlinebks/mars/chap04.htm

[4] Chronology of Science Fiction Literature. http://www.nvcc.edu/home/ataormina/scifi/history/default.htm as quoted from "Elsewhere, Elsewhen, Elsehow", Miriam Allen deFord, 1971.

[5] Ciment, Michel. Kubrick: The Definitive Edition. New York: Faber and Faber Inc., 2001. p. 208.

[6] "The Cabinet of Dr. Caligari (1924) used Expressionist motifs and Fritz Lang's "Metropolis" (1927) used highly modern décor as well.

[7] History of the Space Suit: http://en.wikipedia.org/wiki/Space_suit

[8] The UnMuseum: Ray Harryhausen's Dynamation: http://www.unmuseum.org/dyna.htm

[9] Bizony, Piers. 2001: filming the future. London: Aurum Press Limited, 1994. p. 181.

[10] Solaris (1972 film): http://en.wikipedia.org/wiki/Solaris_%28movie%29

[11] Deitrich Neumann, editor. Film Architecture from Metropolis to Blade Runner. New York: Prestel, 1999. p. 162.

[12] Interview with Syd Mead, September 2006: http://www.cgchannel.com/news/viewfeature.jsp?newsid=5410