How can Mixed Reality be utilised to encourage public interaction and awareness of the judicial decision making process when embedded with in the environmental courts of Aotearoa ?

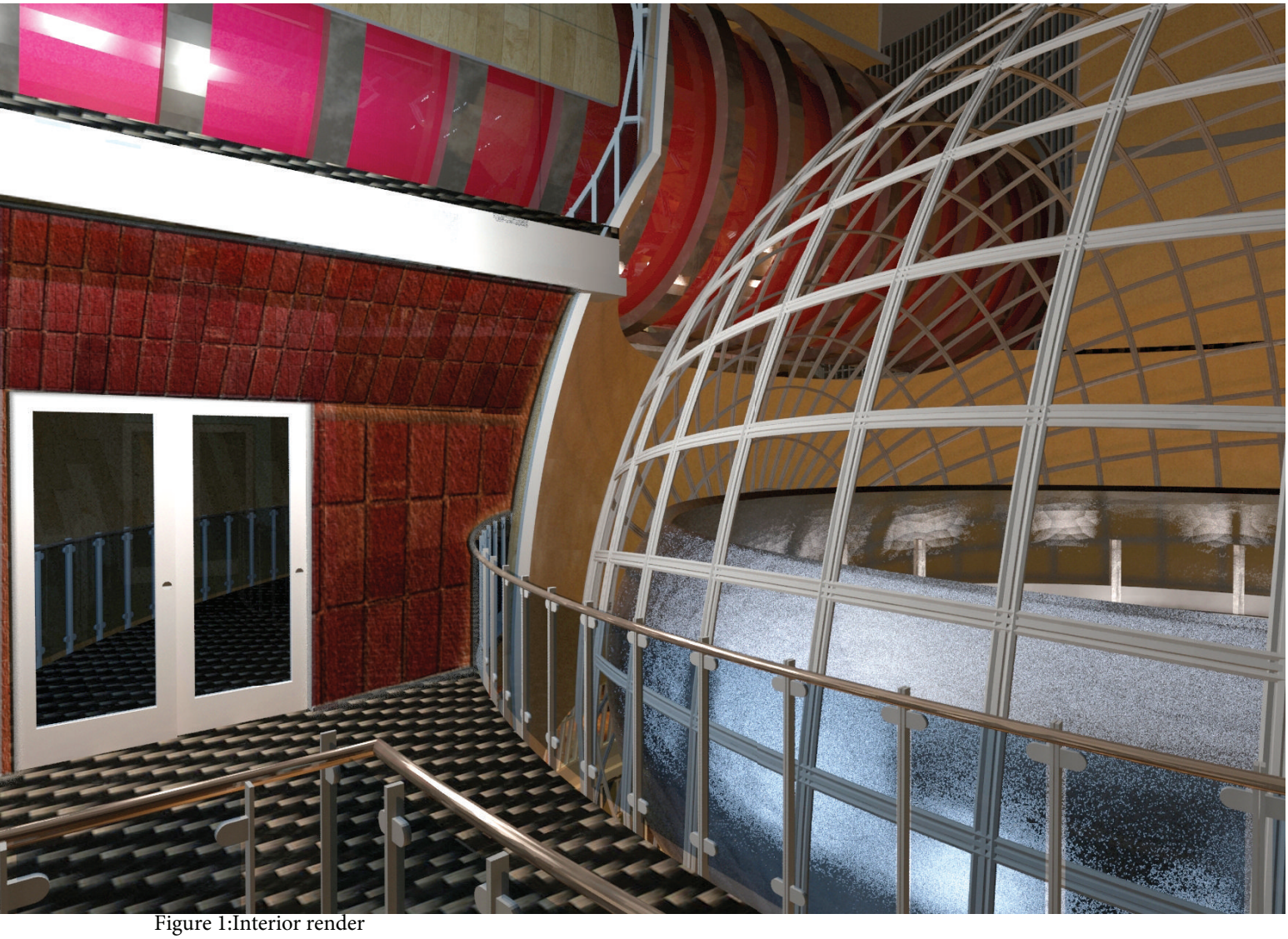


Figure 1:Interior render

This revised Thesis paper "Augmentmenting Jurisdiction " is dedicated in memory of my father
Mark Kelvin Pye

29 - 02 1952 - 16 - 10 - 2013

Dad you are my guide and my inspiration. This thesis is written in honour of how grateful I am that you are my dad, and allowed me the opportunity to write a Thesis.
I love you and you will always be in my heart.

Augmenting jurisdiction is a hypothetical scenario I have created, to explore what impact Mixed Reality (MR) could have on the Environmental Court of Aotearoa (EVC A). This Thesis has two equal sides of exploration; Physical and Virtual. The 'Physical' in this instance is the hierarchy and organisation of the Environmental Courts of Aotearoa and the 'Virtual' are the components and concepts of Mixed Reality.

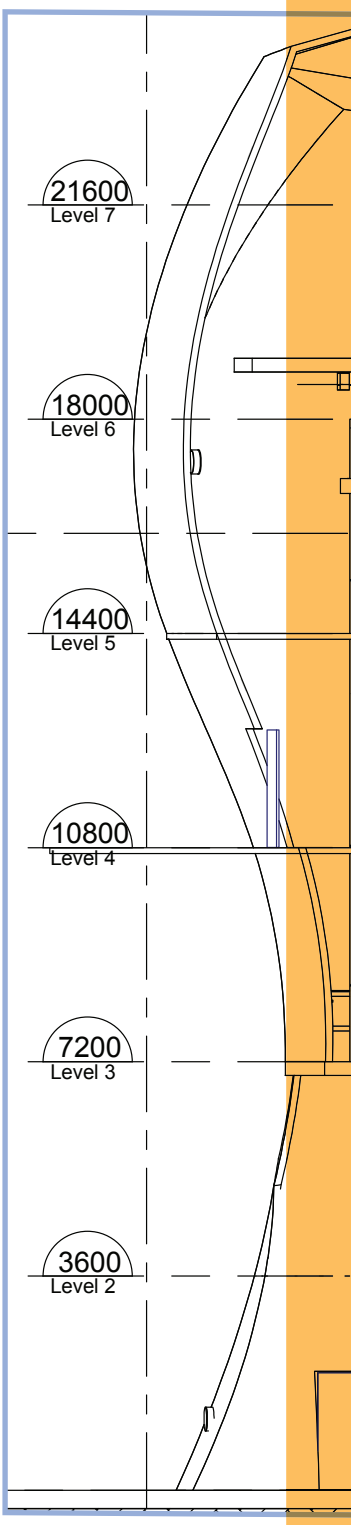
Stage One of the research is exploring the Physical - hierarchy, technological and organisational requirements of EVC A, as set of out by the Ministry of Justice and Courts NZ . Within this stage of research I explore the statutory bodies, resource management act and the compositional structure of the judicial system.
I also explore the variable of the Virtual - the concept of MR, as set out by Prof. Paul Milgram, Ph.D., P.Eng. from the ETC lab at the University of Toronto. It explores technologies that are currently under research and development and are not necessarily available to the general public. However these products contain the possibilities for what I am proposing in this paper. Exploring the capabilities of MR delves into products such as "Google Glass" or other Head Mounted Displays (HMD), Heads Up Display (HUD), both material and immaterial video display and graphic simulated environments.

Stage Two is extrapolation and interpretation of the Physical and the Virtual constructs. The data from Stage One regulated how I approached the design. The model created in Stage Two is a direct result of the contraints colated in Stage One and the physical parameters of the old Ministry of Defense building, 15 -21 Stout St, Wellington. Stage Two was completed with computer aided design software from companies such as Autodesk, Adobe and others.

Stage Three - Exogesis - reflection and evaluation. This stage was to culminate my ideas and research.

I would like to thank you for reading this thesis and hope you have a nice day :)>

Thom,



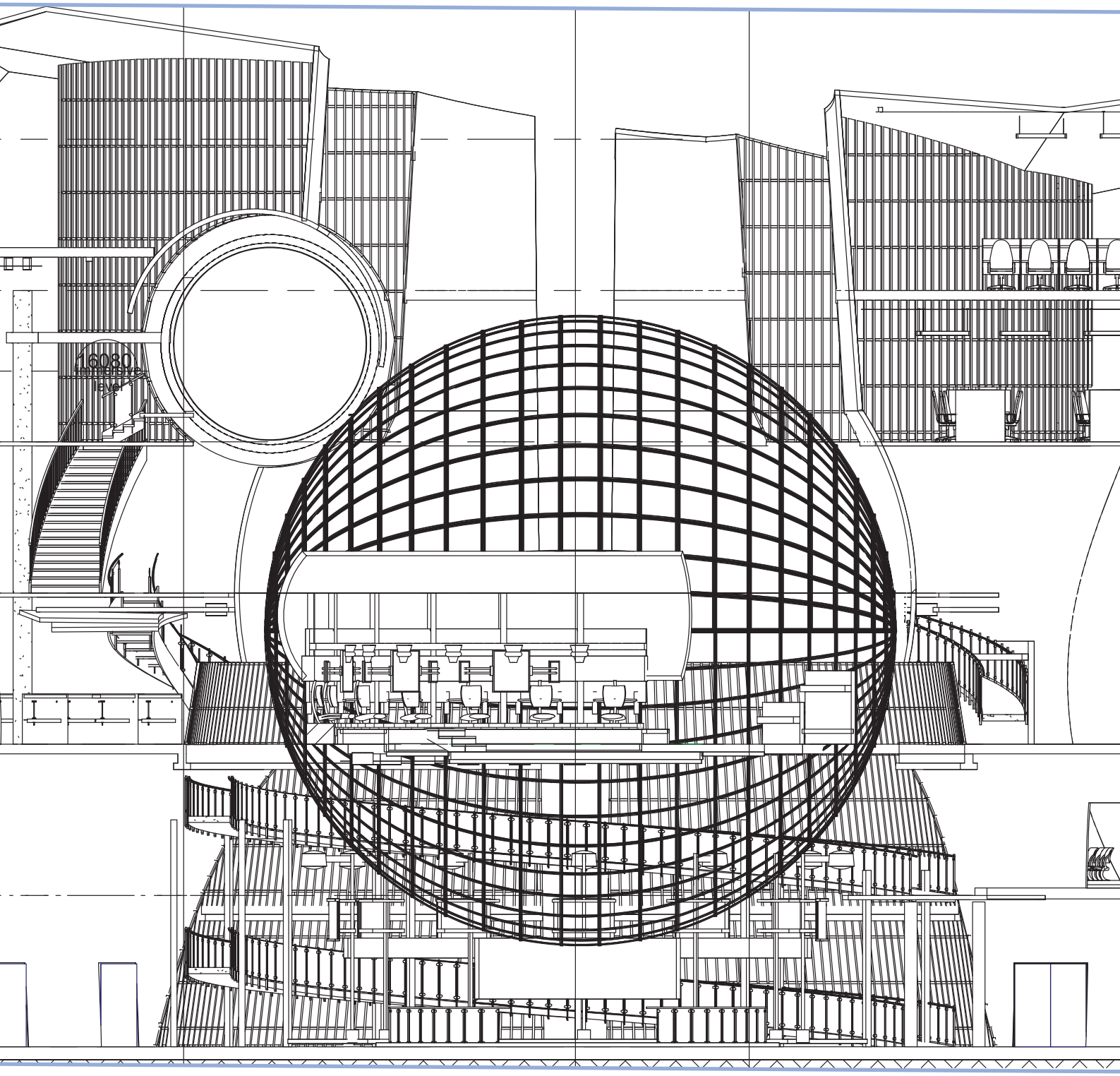


Figure 2 : Section AA

Skope

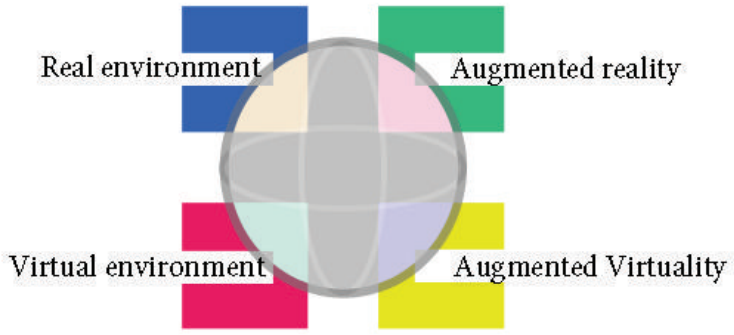
The scope of this thesis is the combination of Physical and Virtual .
I am hypothetically using interior architecture to create a design proposal for the Environmental Court of Aotearoa (EVC A). I am doing so by integrating a Mixed Reality (MR) platform embedded in the basis for design.
The EVC A is an analogue process. This thesis intergrates MR in order to upgrade analogue to digital and thus creating a space that is interactive, publicly transparent and increases awareness in the environmental law process. I am also investigating the background and history of the Courts in Aotearoa and where the Environmental Courts stand within the judicial hierarchy. I will examine the technology that is currently available to MR and what features and particular parts of mixed reality could be utilised when applied to the EVC A.

Figure 3 : Interior Render

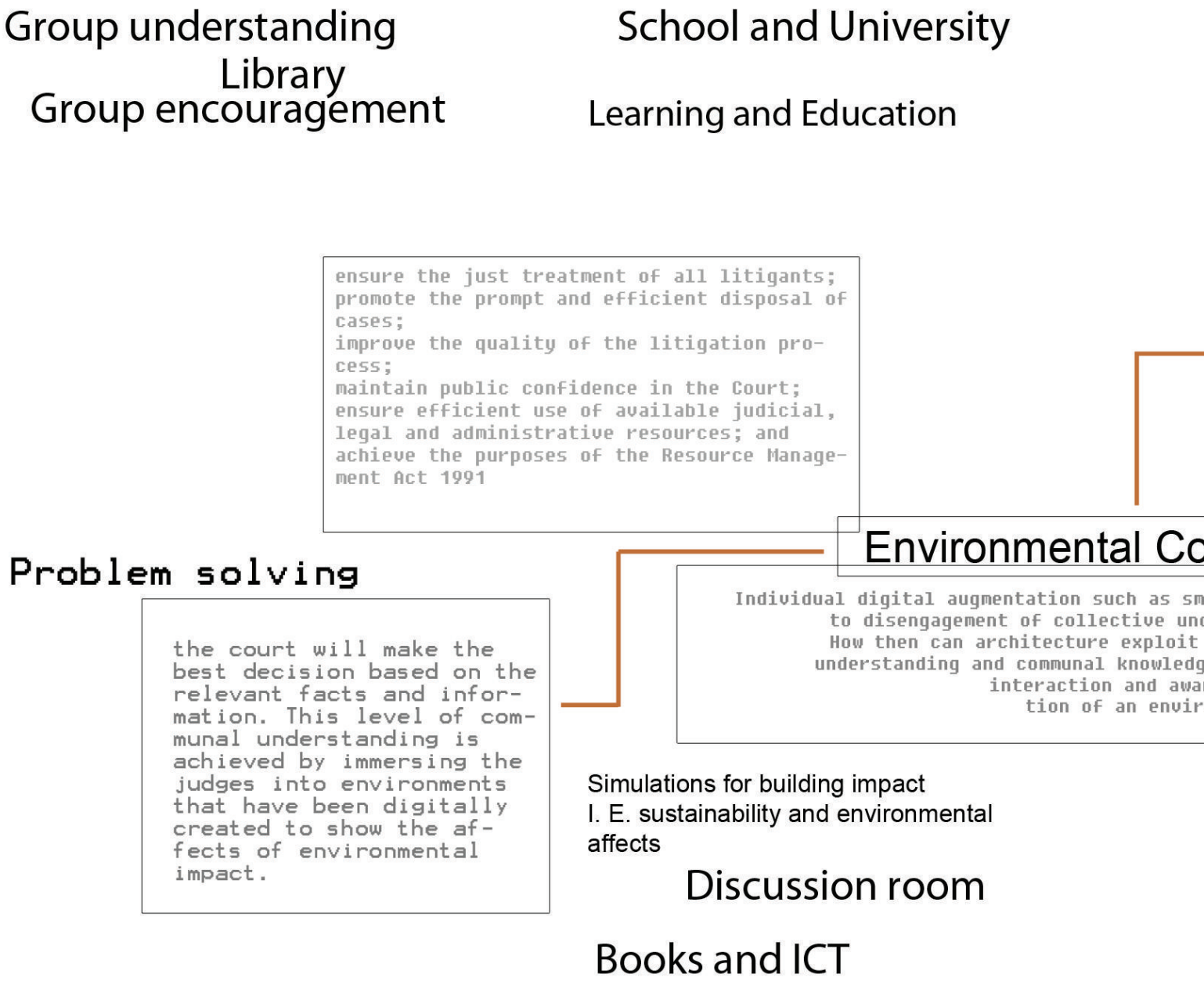
Aim

This thesis is about creating a space that incorporates the technologies associated with Mixed Reality and the judicial procedures of the Environmental Court. This paper creates different architectural components that engage the public on various MR levels. The aim of the research is to show how MR can supply the public with information, awareness and encourages interaction regarding Environmental decisions. Technology such as HMD, Google Glass, and HUD gives the first human interaction to MR. The second level of interaction uses architectural surfaces for graphic generated display. The third level is the immaterial and intangible components associated with mixed reality such as light manipulation, high frequency soap bubble surface and fog/CO2 surface, GPS and motion tracking.
It aims to generate a convincing design colated from Virtual and Physical background contents to create interior architecture for the EVC A. Interior Architecture is generated to create atmospheric environments with immersive MR technology. The entire centre generates various levels of MR and uses the combination technology and architecture to portray this information. MR and digital immersion can allow for full experiential simulations for emergencies, city planning, environmental impact and resource management and much more.

Levels of Mixed Reality



Methodology



Mixed reality provide
ria for simulation env
mental implications.
simulations of a site
ronmental issue coul
judge accurately with
mation that they can
ence and interact wit

I have taken a design by iteration approach to this thesis. Throughout this paper I have undergone a number of design evolutions and made many different stages and iterations of what the design outcome will be. At all times I have considered MR as the basis for design research.

I have investigated research by design, that is, research that is constricted by the technology available. I have also looked into the judicial requirements and then investigated stages or proposals of how the design could function. I have also researched for design. This means that I have created a space that uses the research found from MR technologies as a criterion for what has been designed. For example, MR requires display surfaces and technology to exist. I have taken many of these design elements and used them to dictate how the design outcome is structured.

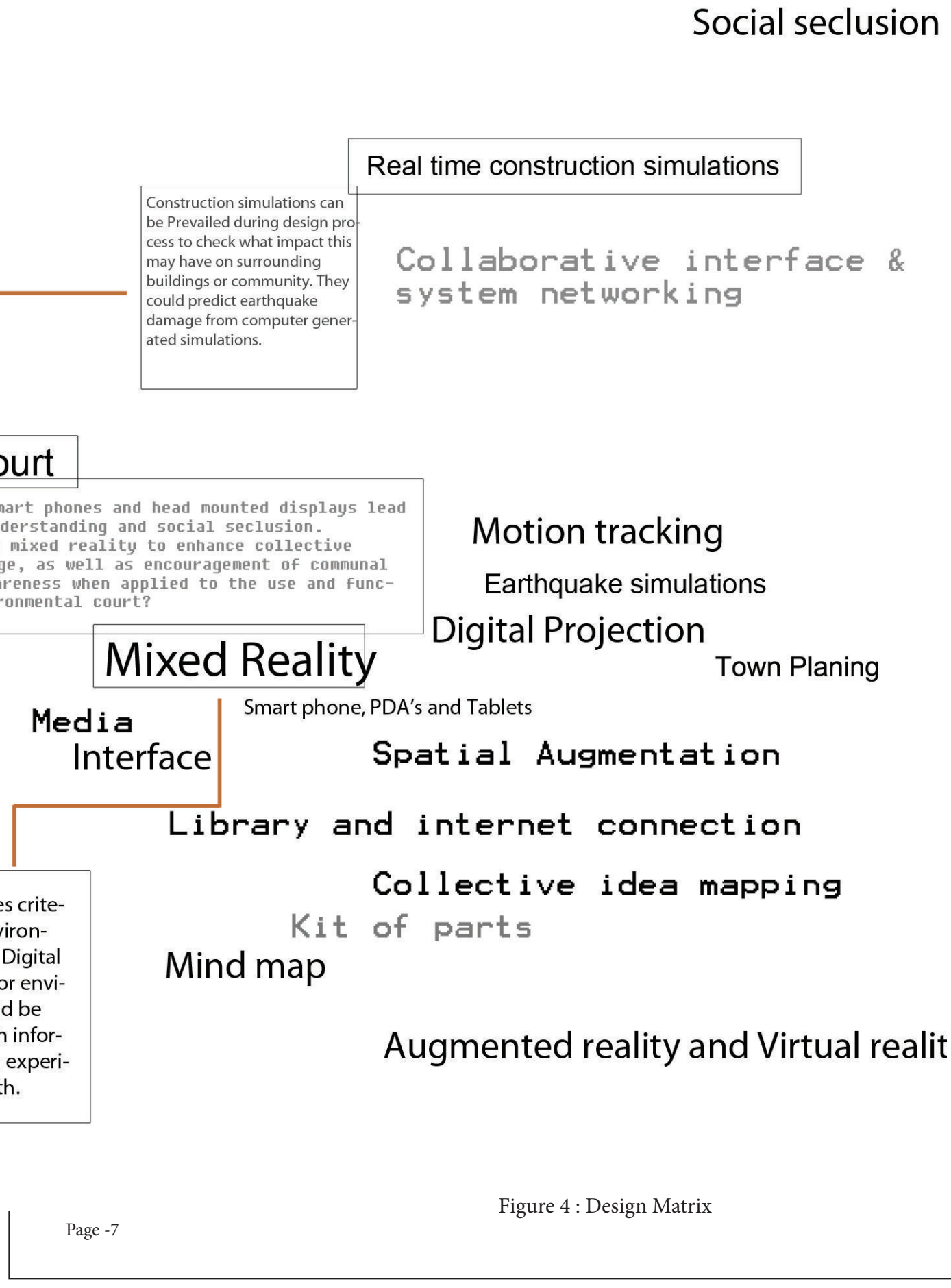


Figure 4 : Design Matrix

Environmental Courts of Aotearoa

Hierarchy and Structure

According to the Ministry of Justice website, the Environmental Court is unique to the rest of the judicial structure and sits outside the usual lines of the legal statute in New Zealand.* This structural hierarchy gives an opportunity for a unique design response. I have utilised this unique opportunity to create something innovative and engaging in order to captivate the hearts of the public.

The EVC A currently uses an analogue system for documentation. This means that the court requires a notary to keep physical documentation of court proceedings. The EVC A uses a paper trail record system and all consents forms and documentation is submitted on paper then filed on record for later review. The procedure for engaging with the EVC A is to complete the required paper work often in triplicate and have the appropriate reports printed and ready for inspection and recording by the court. The efficiecy of this procedure has a number of flaws which according to the justice website the courts have recognised and are addressing.

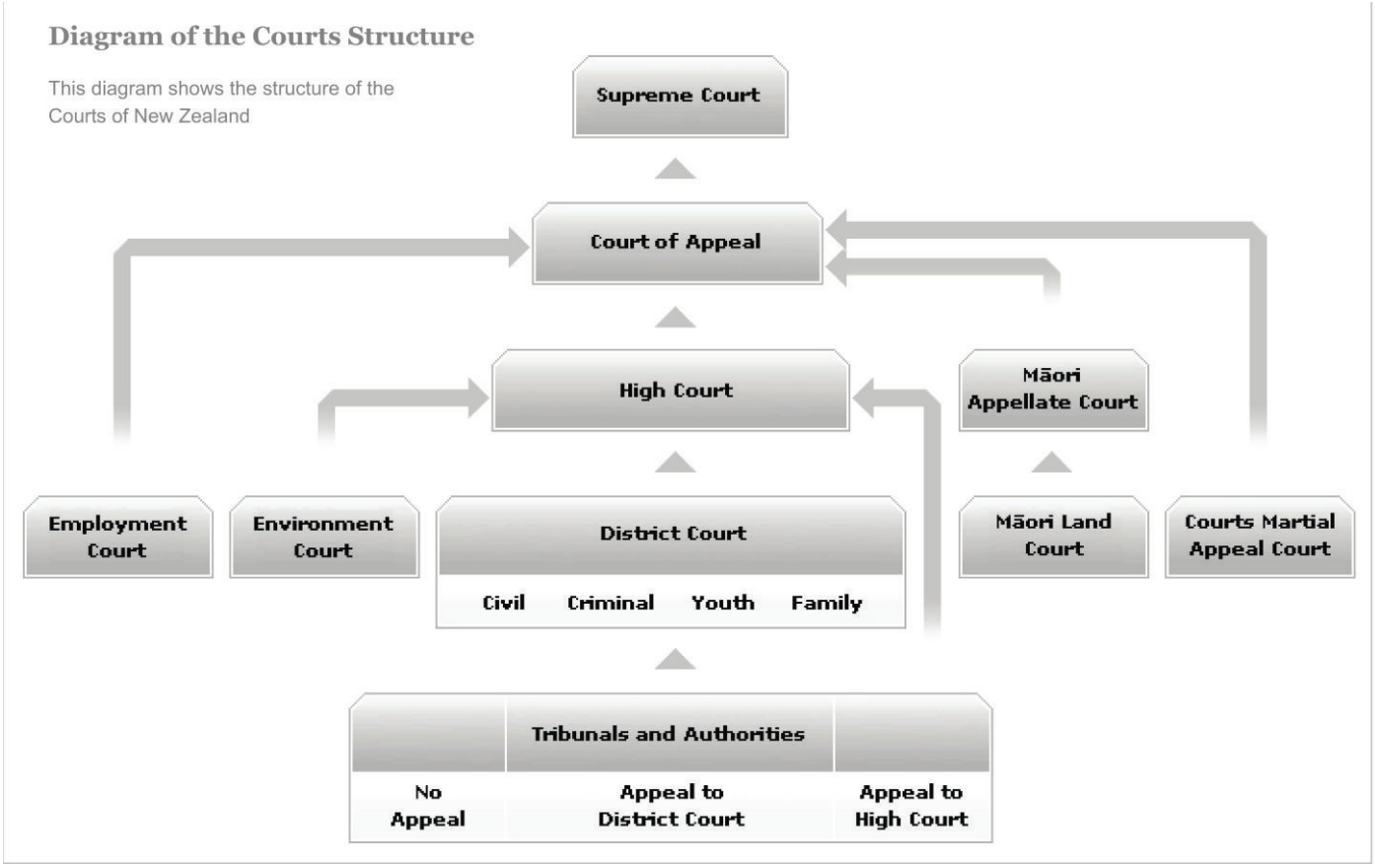


Figure 5 : Hierarchy of Courts NZ

The environmental courts have very little in the way of digital inputs. There is a media screen and video conferencing capabilities. These are the only digital technologies that you will find within an environmental court room.

During my research I have discovered there are only 9 employees working for the environmental court in the Wellington office. This does not include the ten judges and twelve commissioners that are required across the country for environmental decision making. I have also found that the only physical requirement for the court room is a bench that must accommodate three or more people. This means that the physical structure of the Environmental courts is fairly minimal. I am using this opportunity to use MR technology to transform the physical considerations into a design that is more accurate, functional and interesting.

* "The Court is a specialist court and as such, sits outside the pyramid for courts of general jurisdiction. " (www.justice.govt.nz - Environment Court, 2013)

Alexandra, Ashburton, Auckland High, Auckland District, Balclutha, Blenheim, Chatham Islands, Christchurch High, Christchurch District, Court of Appeal, Dannevirke, Dargaville, Dunedin, Feilding, Gisborne, Gore, Greymouth, Hamilton, Hastings, Hawera, Huntly, Hutt Valley, Invercargill, Kaikohe, Kaikoura, Kaitaia, Levin, Lower Hutt, Manukau, Marton, Masterton, Morrinsville, Napier, Nelson, New Plymouth, North Shore,

Oamaru, Opotiki, Palmerston North, Papakura, Porirua, Pukekohe, Queenstown, Rangiora, Rotorua, Ruatoria, Supreme Court, Taihape, Taumarunui, Taupo, Tauranga, Te Awamutu, Te Kuiti, Thames, Timaru, Tokoroa, Upper Hutt, Waihi, Waipukurau, Wairoa, Waitakere, Warkworth, Wellington High,Wellington District, Westport, Whakatane, Whanganui, Whangarei, Whataroa

Figure 6 :NZ Courts of Law locations

Statutory Bodies

The New Zealand judicial system is split into a hierarchy of different functioning courts that deal with all the legal proceedings in Aotearoa. The Resource Management Act 91(RMA) is the act which the Environmental court is bound to uphold. This means that the function of the court is to make decisions based on what information is presented in the RMA. The EVC A will hear appeals from local authorities. According to Rob Harris, who in the 'Handbook of Environmental Law', discusses the function of the Environmental Court of NZ and details the structure and power within this court. "He argues that the RMA is effects based and is designed to promote sustainable management." (Harris, 2004)

- Ministry for the Environment (MfE), `
- The Department of Conservation (DOC)
- Parliamentary Commissioners for the Environment (PCE)
- Regional Council,
- Territorial Authorities,
- And the Environmental Court.

Raewyn Peart, Senior Analyst for the Environmental Defence Society, informs us in the RMA handbook of the statutory bodies for defining the requirements for managing the RMA (as shown above). These statutory bodies also outline the required design parameters, being that the RMA requires these bodies in order for the EVC A to operate sucessfully. Therefore my design must contain all the design parameters required within the statutory bodies in order to function.

According to Peart the Environmental Court decides on a wide range of matters under the RMA. It is made up of ten judges and twelve commissioners and mainly deals with appeals from regional and district jurisdiction.

The Resource Management Act 91

The EVC A, exists in order to uphold and sustain the Resource Management Act 91 (RMA). The Act was brought in place to combine 69 various acts that were to manage land, sea and air.
According to Peart, "The RMA governs the environmental management of land, air, soil, water, and ecosystems throughout New Zealand's land and territorial sea. It applies the concept of sustainable management to resource management planning and decision making." (Peart, 2007)
The RMA regulates public works, zoning, water management, construction and much more. With the judicial hierarchy in NZ the EVC A is situated on the same level as a district court but outside of this structure appeals to the high Court.
The RMA is designed to settle disputes of the land and governs the allocation of resources throughout New Zealand.

Figure 7 : The Supreme Court
Lampton Quay, Wellington

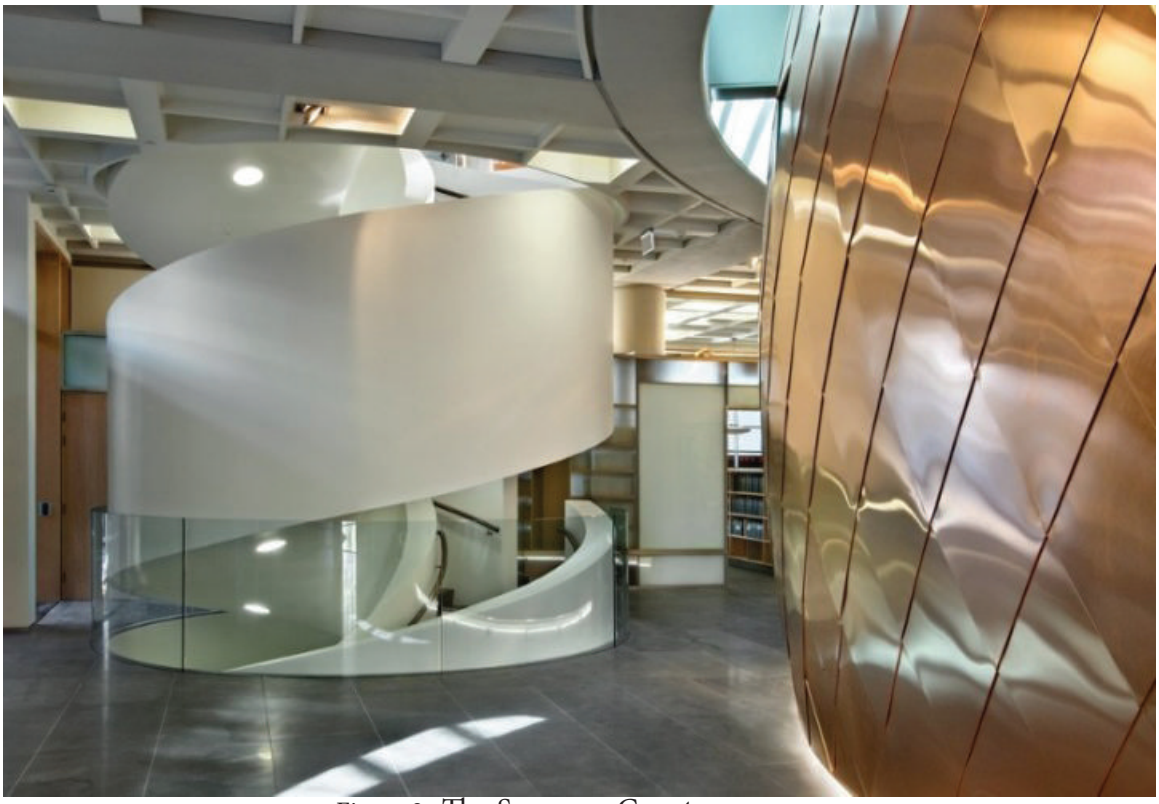


Figure 8 : The Supreme Court
Lampton Quay, Wellington

The Supreme Court uses architecture to create an environment that allows for the judicial system to function and allows for national decisions to be decided upon for the benefit of our country. This is a inspirational example of how judicial architecture has been used. Seen above is the interior architecture that details the external shell of the court room and a spiral stair case as well as the library of records in the background.

With the courts already proposing a limited digital upgrade, this would be an excellent opportunity to propose a full mixed reality integration.
According to Peter Skelton a former judge of the EVC A and contributing author in The Handbook of Environmental Law, states "The general public have very little understanding of the RMA or what it does." He goes on to say that for most people proposing a case to the environmental court is a forboding process. (Skelton, 2004)
The combination of MR allows the public to experience and understand the process in a whole new way. Research by Mahmoud Haydar, who conjointly published "Virtual and Augmented Reality for Cultural Computing and Heritage" indicates that by creating immersive virtual environments the occupants were spending more time observing and navigating with easier control and better understanding.

In 2013 EVC A will begin introducing an Electronic Operating Model in courts. This will replace the current paper-based court record – the formal documentation of which occurs in court – with a nationally accessible electronic court record.

"The Ministry of Justice is changing in order to deliver modern, accessible, people-centred justice services. Many aspects of how we administer courts are outdated, with services built around individual courthouses and relying heavily on people, paper and manual processes. So we are updating our systems, structures and technology to improve how we deliver services to the public, and to give people greater choice about how they access our services. In modernising our courts, we will ultimately create a system that is far easier and simpler for the public to use and understand, delivers faster results, and is better for all those working in it.
Implementing new technology in courts – such as the Electronic Operating Model Developing an Enterprise Data Warehouse (EDW). "
(Environment Court , 2013)

Figure 9 :Data storage facilities.

Mixed Reality

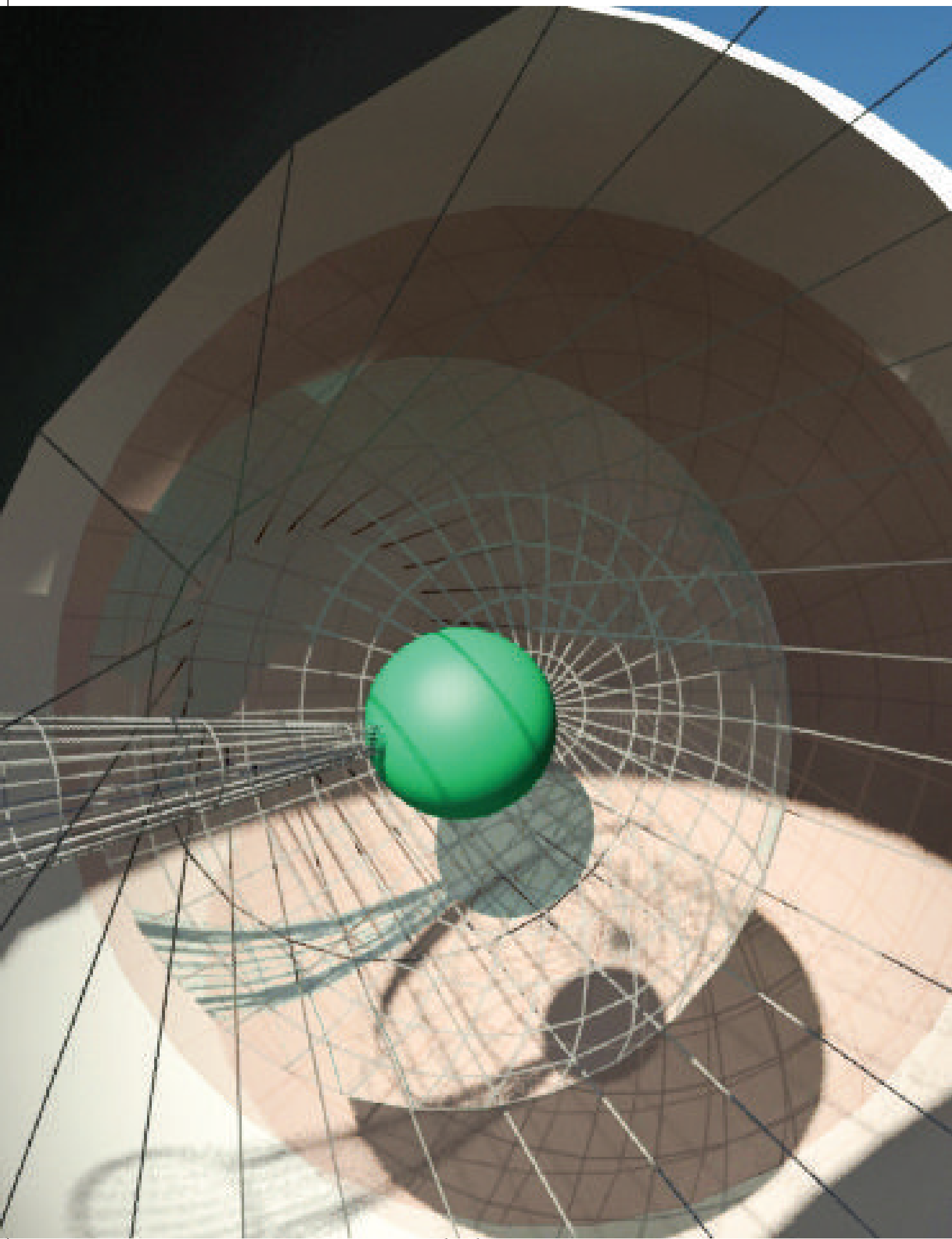


Figure 10 : Design Matrix Mixed Reality

History

My design creates an environment that simulates issues as outlined by the RMA and other envirtonmental court concerns.

When the MR court is activated the outer layer of the sphere engages MR imaterial surfaces such as fog or soap bubble. projection and light controled display give this epidermis the outer mosdt layer of MR display. This layer would provide the distance perspecvtive of viewing. The occupants of the court are wearing optical see thropugh head mounted display, (with the advent of android style goolge glass and its compitetors,) this style or MR will be readily avialable for the masses to develop apps and software for public MR interaction. In the Centre of the room is an spherical HUD display, this part gives the occupant the most close up display.

According to Prof. Paul Milgram, Mechanical & Industrial Engineering Department at the University of Toronto, mixed reality relates to the reality virtuality continuum and refers to any display in which both real and virtual images are combined in some way or proportion. (P. Milgram, 1999)

Figure 15 show Milgrams reality - virtuality continuum. I am using Milgrams research to formulate the design parameters for mixed reality. This means that I am overlaying digital content on top of the physical work of architecture to create an informative and interactive environment.

MR encompasses many different types of display. The most common at the present is the Augmented reality apps that can be seen on a smart phone or tablet; this allows for a digital image to be overlaid on top of physical imaging by using computer generated graphics and video capture devices. Milgram's research on Head Mounted Display (HMD) explain how MR can exist within the virtual environment in front of the user's eyes. Milgram explains the categories of mixed reality display.

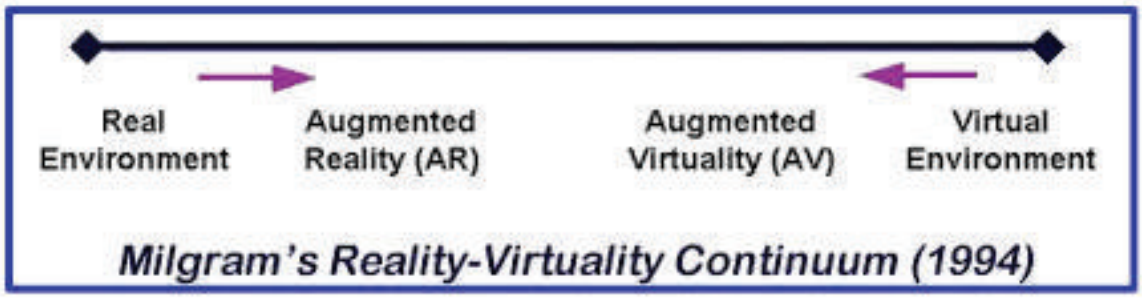


Figure 11 : Milgram's Continuum

Figure 12: Smart Phones

Figure 13: HMD

Figure 14: Minority Report

Figure 15: Surgical AR

Application

Figure 16: Cocoon Immersive Display

Figure 17: Military AR Training

1. -Monitor display
2. -Video display
3. -HMD optical see through glasses
4. -HMD video generated glasses
5. -Graphic display environments
6. -Graphic generated with real world implements

Milgram has examined all of the components for MR display. Further research explains how MR technology expands beyond simple display; the possibility for mixed reality extends to a broader range of sensors. Carmigniani explains how a combination of motion tracking and tactile monitors can create a higher level of immersion.
MR requires a high level of computer processing and graphics; it also combines networking and display for many servers.

Schnadelbach explains in his PhD thesis 'Orchestrating a mixed reality performance' what requirements are needed for the physical and virtual to coexist. He describes the mixed reality links and boundaries that are required to merge these two environments. Six players at a time journey through an extended physical and virtual set. Each sees a virtual world projected onto a screen made from a fine water spray. This acts as a traversable interface, supporting the illusion that performers physically pass between real and virtual worlds.

Figure 18: HMD AR city scape

For the purpose of this thesis I am expanding on Milgram's research to include a broader spectrum of MR technologies. There is significant research developing immaterial display such as fog screen and soap film projected display. The University of Osaka has developed a multi-view point fog projected display. The Canterbury University HIT lab also is developing many virtual and augmented reality display technologies that encourage higher learning and experiential development. Researchers such as Ochiai and Toyoshima at the University of Toyko have developed an immaterial surface which uses motion paralax and multiple projectors to create the illusion of a 3D hologram and to further develop the level of MR immersion.

Mixed reality has many applications existing in the world today. They are usually found in the feilds of entertainment and gaming. However MR applications are also seen in defence training, medical and scientific research as well as manufacturing.

Seen below in figure 19 James Cameron "Avatar" (2009) shows us how the military is using reconisince data to simulate a specific area within Pandora so they can plan a strategic military strike. What we can see is a 3D Imaging of a Tree and list of data and some other information displayed as a hologram that is both informative and interactive. Obviously, camerons fictional story portrays the magic of film and advancement of post production animation. However the thematic principals they are using is very similar to what I am proposing for this thesis.
According to PhD thesis author JJ Postema, his research discusses how MR can be used as a conceptual tool for architectural projects. Postema argues that an architect, client, engineer, and other groups involved can get a better impression when they can directly walk through and experience the environment virtually before construction even begins. Making use of 3D modelling software, conceptual design can be mapped out and interacted with in a virtual environment. "The virtual design environment provides an environment for images both still and moving, as well as 3D geometry. Pictures, Textures and video intended for use within the virtual environment are dropped into a folder. They can be assessed within the virtual environment"
(Postema, 2001)

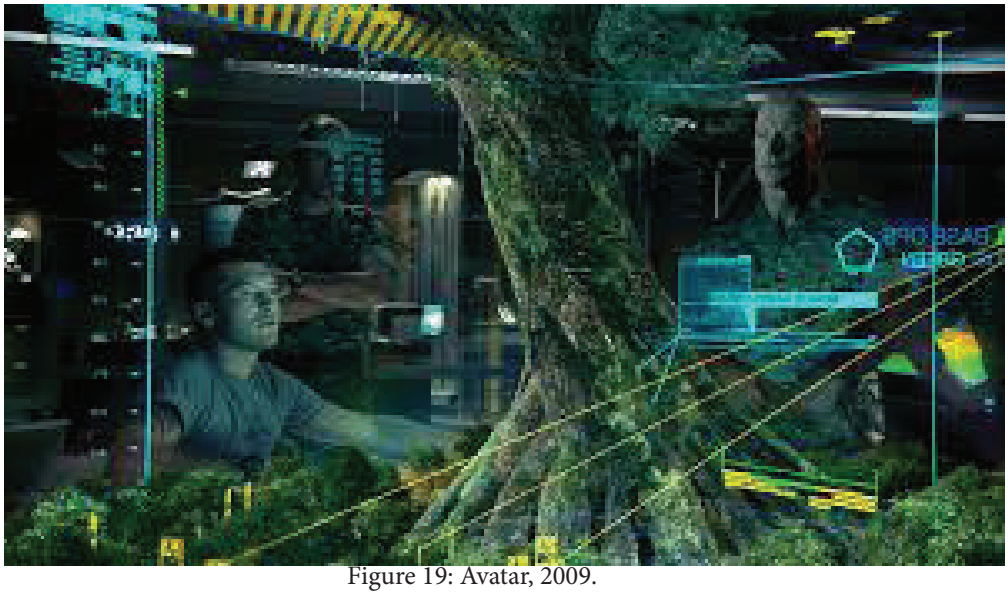


Figure 19: Avatar, 2009.

By using MR combined with the Environmental Court of Aotearoa my intention is to create a space that informs and educates by engaging the judicial members and the public to spend more time and also repeated visits to the site of a problem or environmental concern.
Haydar discusses how Virtual Reality is utilised to create archaeological research sites for underwater exploration. Haydar explored what systems were necessary to create immersive virtual environments for archaeological sites. He used mapping and data analysis technologies to reconstruct an environment that was otherwise unobtainable to the human eye. (M. Haydar, 2011) With Haydar's ideas in mind I am proposing the same principals to the EVC A. The plaintiff or occupant of the court would use 3D modelling software to create environments that explained their argument. For example, a developer applies for a building consent for a new high rise within the city of Wellington. For whatever reason the consent is not approved by the Local Authority and goes to the Environmental Court for dispute. The courts could utilise MR technologies to create the model simulated in real time with all environmental conditions overlayed to explore the outcome. A more informed discussion can then be made.

By using MR simulation this allows assessment by the judges and commissioners as well as encouraging more involvement from the public, so that the best environmental solution can be formulated to manage the RMA.

One other significant application for the use of mixed reality is within the medical research and surgical fields. Augmented reality goggles or HMD are being used by surgeons and medical researchers to help decrease the amount of complications in surgery. The figure below shows AR being3 used as a surgical application. "Patient monitors in the operating room are often positioned where it is difficult for the anaesthesiologist to see them when performing procedures. Head-mounted displays (HMDs) can help anaesthesiologists by superimposing a display of the patient's vital signs over the anaesthesiologist's field of view. Simulator studies indicate that by using an HMD, anaesthesiologists can spend more time looking at the patient and less at the monitors. We performed a clinical evaluation testing whether this finding would apply in practice." (David Liu, 2010)

Figure 20: Surgical AR

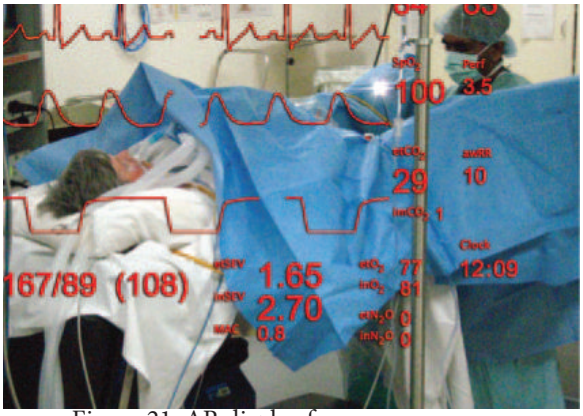


Figure 21: AR display for surgeons

Prof. Charles E, Hughes Director of 'Synthetic Reality Lab' University of Central Florida, expands the idea that in order to create realistic MR environments there must be a believable underlying story. If the viewer cannot imagine the scenario being realistic the MR platform falls to pieces. Hughes discusses how mixed reality can be applied to entertainment and education. He cites a museum exhibition that uses MR to encourage children to learn about the deep blue sea. Hughes states that "more than 80 % of people revisited the exhibition and that and that 98 % felt they were encouraged to spend more time interacting with the display. "(Hughes, 2005)

In the instance of the EVC A the story is about the environmental issues that are defined by the RMA. Hughes' paper is discussing MR in an entertainment industry, so the story can be fictional, however for a judicial purpose the content must be a real world simulation which may create a disconnection to the believability of the story or MR simulation. Milgram referenced in "A Taxonomy of Mixed Reality Visual Displays" that the closer MR is to reality the more difficult it is for the general public to believe different scenarios as they have a preconceived idea of how things already are. Milgram goes on to discuss how extent of world knowledge will have impact on the realness of a mixed reality setting. However since this paper there have been substantial increases in technology available.

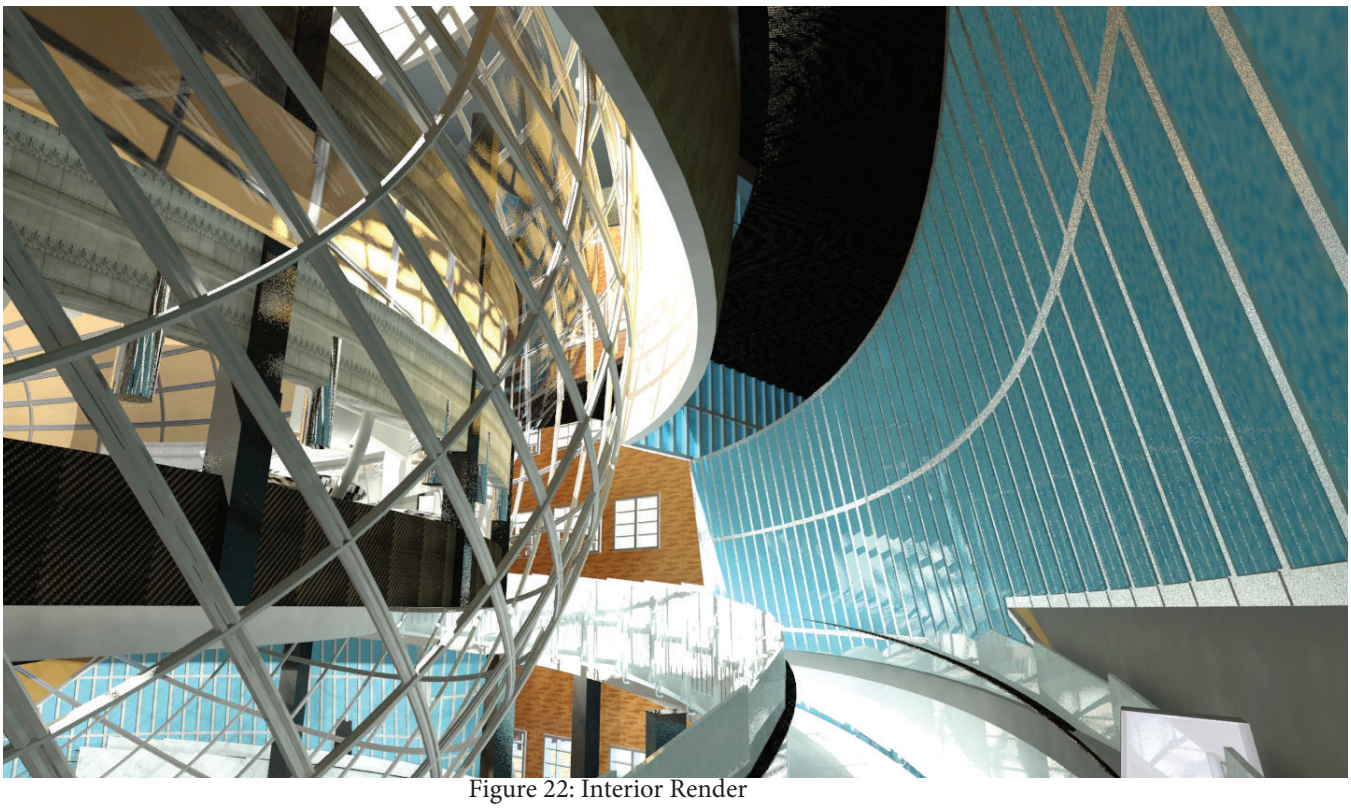


Figure 22: Interior Render

Future

Figure 23: Immaterial Display Soap Bubble

The traditional approach for creating MR immersive environments is to place the occupant within a room with a HMD device to simulate the digital experience. Julie Carmigniani, Florida Atlantic University, discusses in her thesis, how by combining other sensory and movement tracking technology the experience of MR can be more sincere and realistic. Carmigniani, argues that "spatial augmented reality makes use of video projectors, optical elements, holograms, radio frequency tags, and other tracking technologies to display graphical information directly onto physical objects." (J. Carmigniani, 2011 p348)

By combining Milgram's visual displays of MR, included with the use of accelerometer, gyroscopic and digital level sensors, Solid state compasses, GPS, Haptic generators in the form of suits or partial suits, Heating, Ventilation, Air Conditioning (HVAC), lighting control and Atmospheric Audio as presented by Carmigniani, this will create the most believable level of immersive MR.

By following the combination of research presented by Milgram and Carmigniani, I have designed interior architecture that allows for the tecnologies to be utilised to create a believable MR environment given our extent of world knowledge. It would mean that people who are immersed within the virtual environment would be interacting with the simulation and therefore the environmental decision making process would be more realistic and believable.
Figure 18 shows an interface of a city scape that uses augmented reality and HMD devices to simulate what the city looks like. You can see in the females hand that she has a hand held controller that allows the user to pan, track, zoom, rotate, scale, and many more possibilities so that the user can get a clear and informative display of a virtual setting.

Figure 24: AR Retail Display; Watches

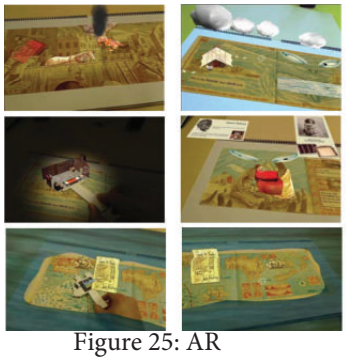


Figure 25: AR display 3D book

Whilst investigating the principles of MR I have also looked into some of the non-conventional MR components. Components such as immaterial surface for display such as using a fog or soap bubble solution, could be one way of creating an immersive MR environment. Combining this with an HMD and physical triggers would allow the user to interact with the physical components of the architecture in a new and innovative way.
My design incorporates the wearing of HMD glasses, however it would also have a system of architecturally based triggers. This means that architecture allows you to experience the EVC A with a mixed reality juxtaposition. Like the book in figure 25 that creates 3D pop ups, my design uses MR to create a level of virtual reality in a physical setting.
On the outer layer of the spherical Court Room is the holographic optical display created by immaterial surface. This would be the combined with the wearing of HMD and with the use of HUD. Furthermore the use of motion tracking would allow for an interactive walk through and manipulation of the simulation and control of the MR interface as explained by Postema.

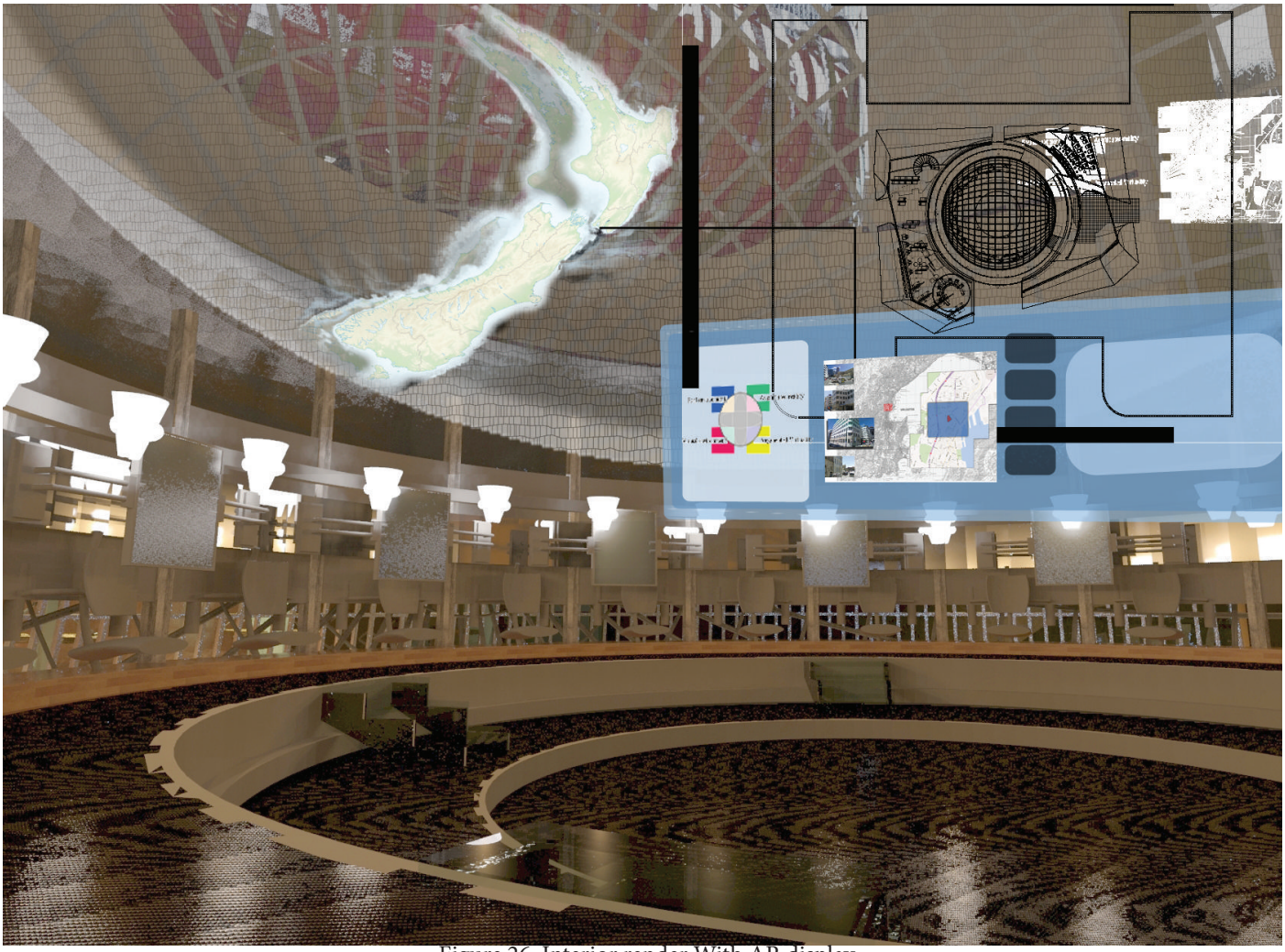


Figure 26: Interior render With AR display

The entertainment value of MR can be seen in Figure 25 a simple book veiwed whilst wearing AR display overlays a virtual 3D image to the reader. This would allow for more interesting and interactive use of an otherwise simple book. Seen in Figure 24 MR is using photography to create an interface for wrist watch sampling so the customer can simulate what the watch looks like on her wrist before the decision to buy. This is accomplished by taking a photo of her arm that is digitised into a computer generated image. The new image then displays what the simulated watch looks like on her wrist. You can also see in Figure 21 a surgical use for MR. In this image a surgeon is using MR on a dummy to practice surgical procedures. The surgeon gets a close up image that is digitally mapped with vitals and other medical information displayed in front of their eyes without having to look away from the patient.

Design Description

Figure 27: 15 - 21 Stout St, Wellington

Site

The site I have chosen is the old Ministry of Defence building located at 15-21 Stout Street, Thorndon, Wellington.
The reason I have done this is because of the connection to the rest of the Judicial Services located within this area. By keeping the Environmental Court within close proximity to the rest of the Judicial structure it allows for cohesion and efficacy. The Judicial grid in Wellington is connected from Lambton Quay with the Supreme Court and the High Court (situated behind it) on Ballance Street. The District Court located across the road is also on Ballance Street. From here we have Parliament Buildings including the Beehive, Parliament House and the Parliamentary Library situated a block away between Molesworth Street and Bowen Street.
With this in mind I have decided that the design must be contained within this block as it meets all the required criteria for this thesis.

Figure 28: 15 -21 Stout St, Wellington.

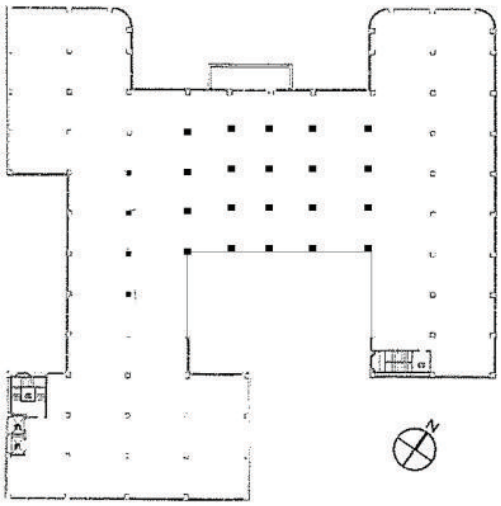


Figure 29: Plan 15 - 21 Stout St

I needed a building that was at the Lampton Quay end of Wellington somewhere close to the existing courts. 15-21 Stout Street was occupied by the Ministry of Defence - a masculine stone building that housed New Zealand's Defence Force offices.

The Stout Street 'Departmental Building' was built in 1939-41. It was the largest office building in Wellington at the time. The building contained five acres of floor space and was expected to house 1,800 employees, of whom the Income Tax Department would make up the majority. This all changed with the outbreak of World War Two when the building became the New Zealand Defence Headquarters. (NZDF, 2013)

15-21 Stout Street is located adjacent to Ballance St and Lampton Quay, which means this road has a direct relationship to the Supreme, High and District Courts. It is a government building, meaning the government is re-using available buildings in a sustainable way rather than using resources and land on a new build.

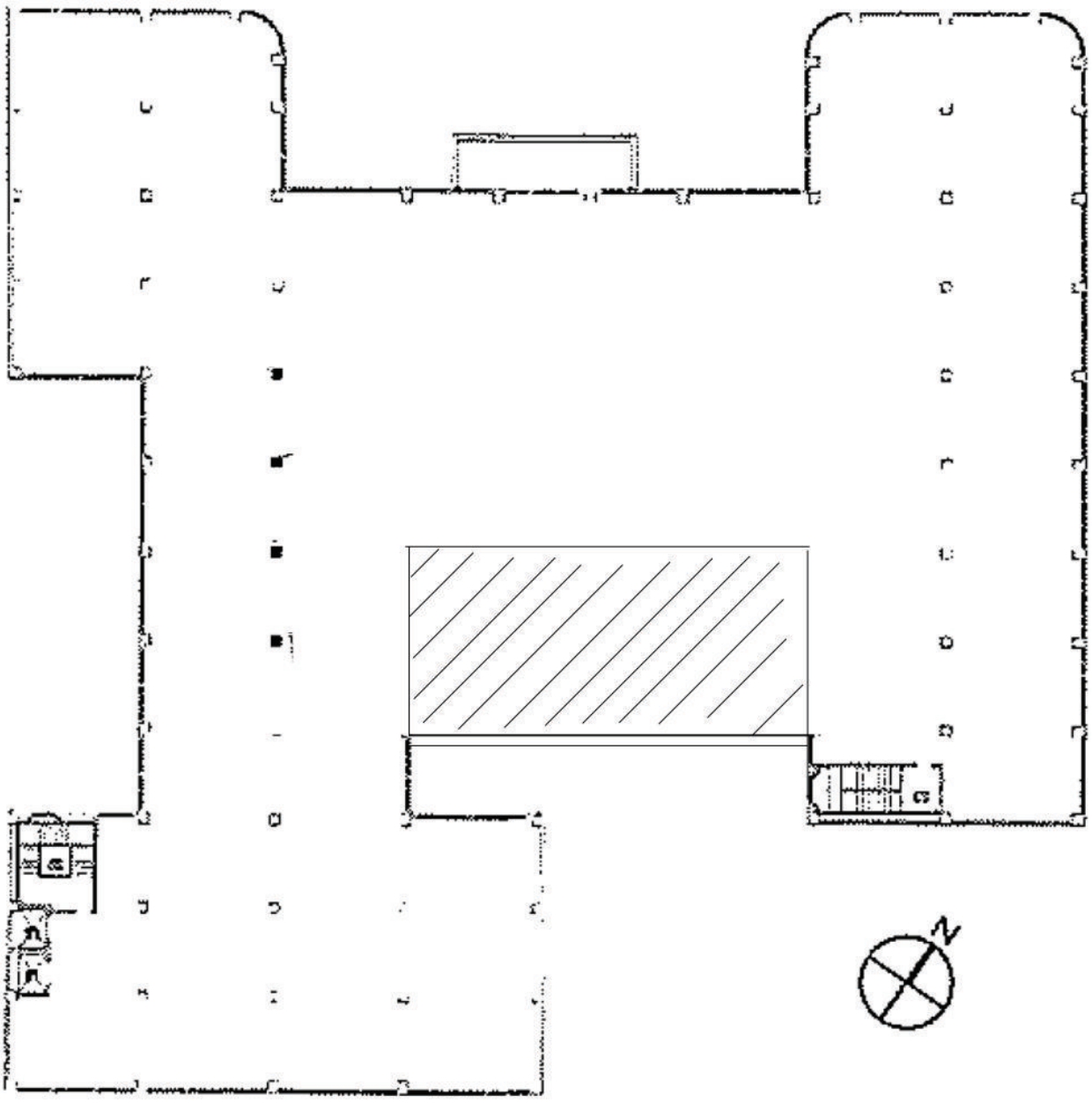
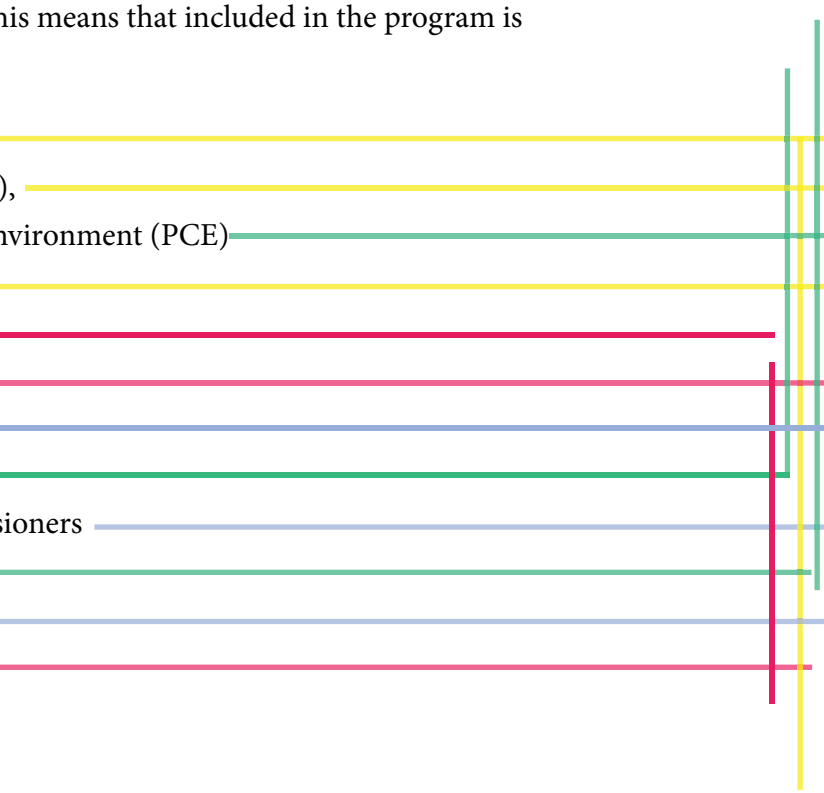


Figure 30: Plan 15 - 21 Stout St with demolition for unwanted columns and additional wall specification to accommodate new design proposal.

Program

The program is made up of the required bodies to control the RMA as defined by Peart; these bodies make up the control system for the RMA; however it fails to take into account some of the lesser architectural requirements. This means that included in the program is the following

- Ministry for the Environment (MfE),
- The Department of Conservation (DOC),
- Parliamentary Commissioners for the Environment (PCE)
- Regional Council,
- Territorial Authorities,
- The Environmental Court.
- A Public Library
- Archives for Legal Precedent
- Judicial facilities for judges and commissioners
- Administration
- Amenities
- Immersive Media Display



From the program above I have split each department into a subcategory which relates to the level or place along the real virtual continuum as defined by Milgram. What this means is that each part of the building gets a MR technology level assigned to it depending on the amount of MR that is available to that department.

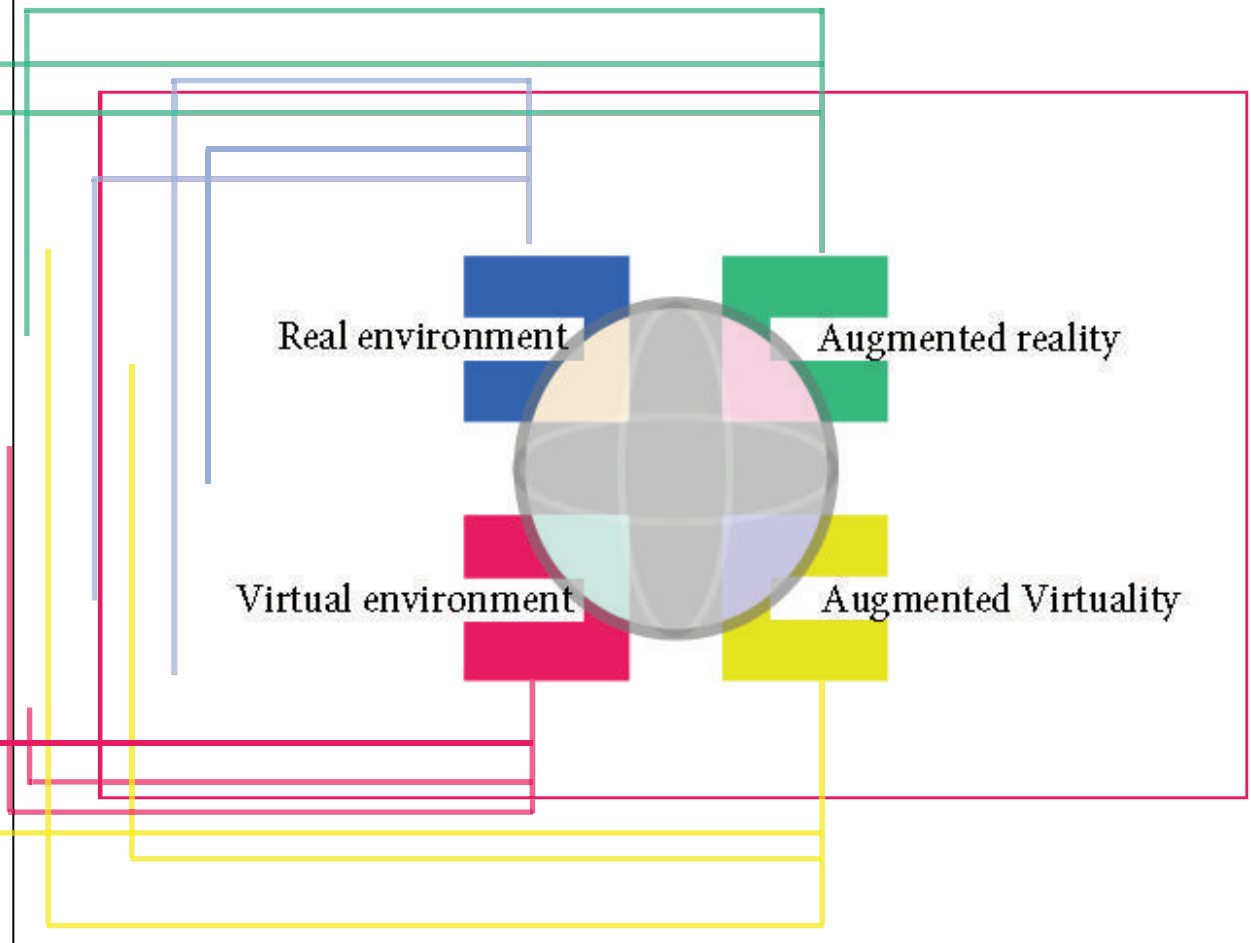


Figure 31: Design Matrix

The Program of this Thesis divides its time into the architectural needs of a court and the technical needs of mixed reality. In order to achieve this I have separated the design into four parts. These span the distance of the real virtuality continuum (Milgram, 99). This means that I have created spaces that are distinguished by the level of mixed reality added to them. By combining MR and Interior architecture to generate environments I am creating a space that allows MR to function and will encourage public interaction and awareness.
For the purpose of this thesis I am redefining what Milgram's MR continuum could mean for an architectural structure.
Figure 23 shows how I have divided this continuum and what application I have stated belongs to that division.

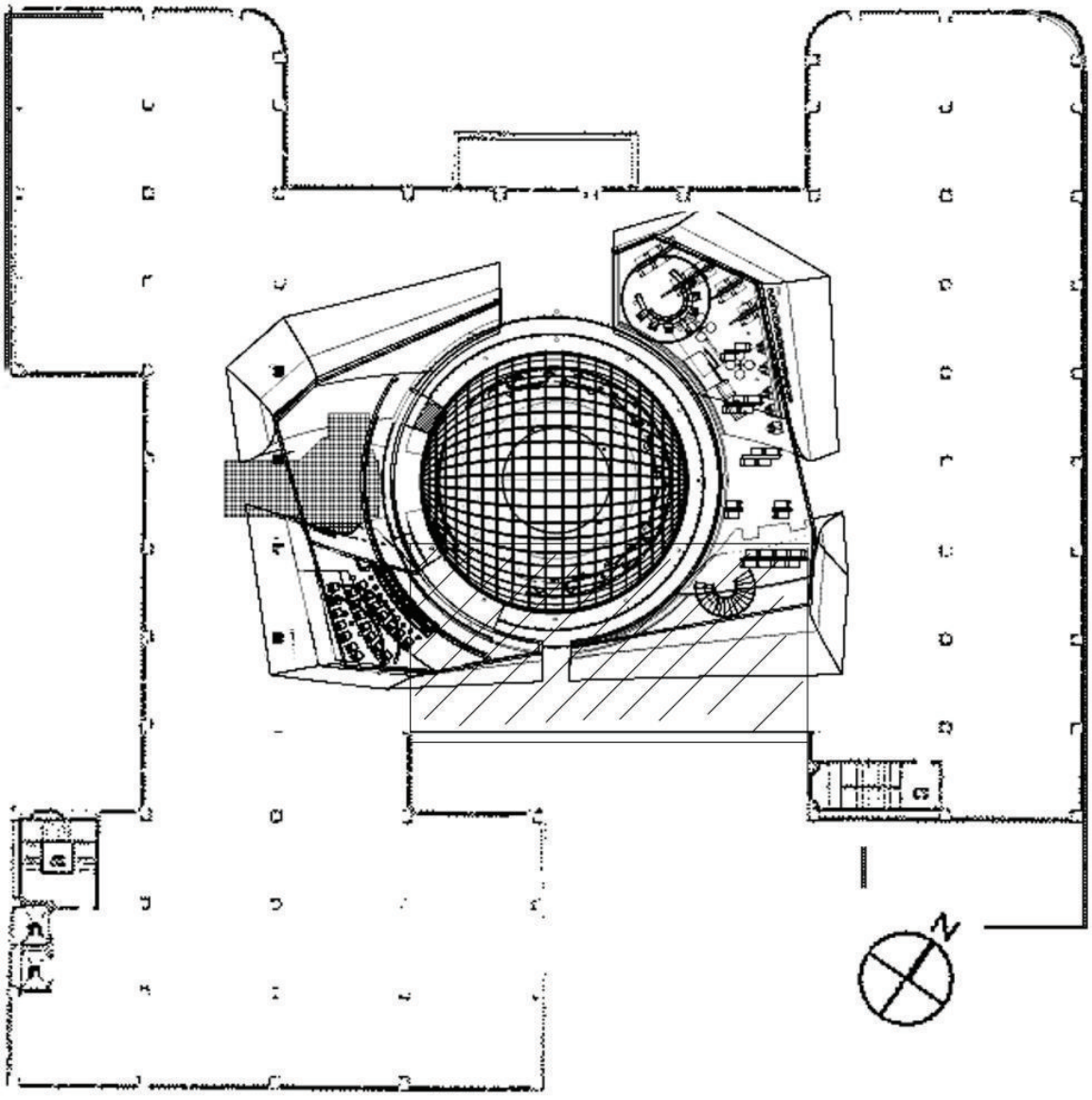


Figure 32: Plan EVC A design Proposal

Floors, walls, beams, columns, doors, windows, furniture, fittings, plumbing, electrical, landscape, books, art, sculpture, stairs, stages, anything that is tangible or considered to be real.

Physical / Real

Augmented Reality

Technology surfaces, hardware, switchable glass, petroleum, computing, graphic generators, motion sensors, projectors, smartphone, tablet, application design.

Mixed reality technology, HMD, HUD, LCD, immaterial surface, fog, soap film, tactile augmentaion, atmospheric acoustics, magnetic gravity simulators, immserive experience, digital simulations

Virtual Environment

Augmented Virtuality

Digital tracking, GPS, digital interface, internet-network, computer simulations, motion tracking, application interface, live avatars, co-experience.

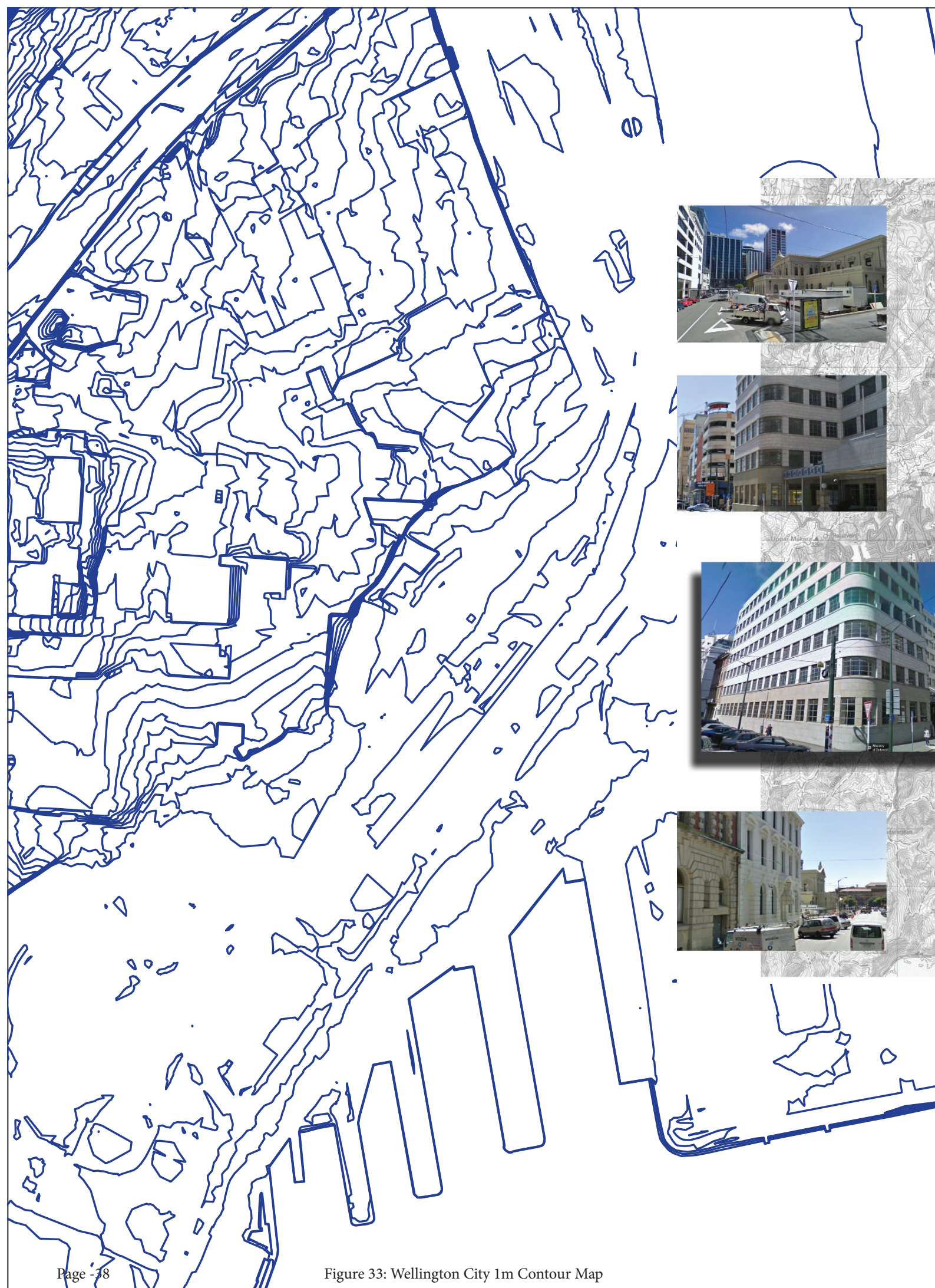


Figure 33: Wellington City 1m Contour Map

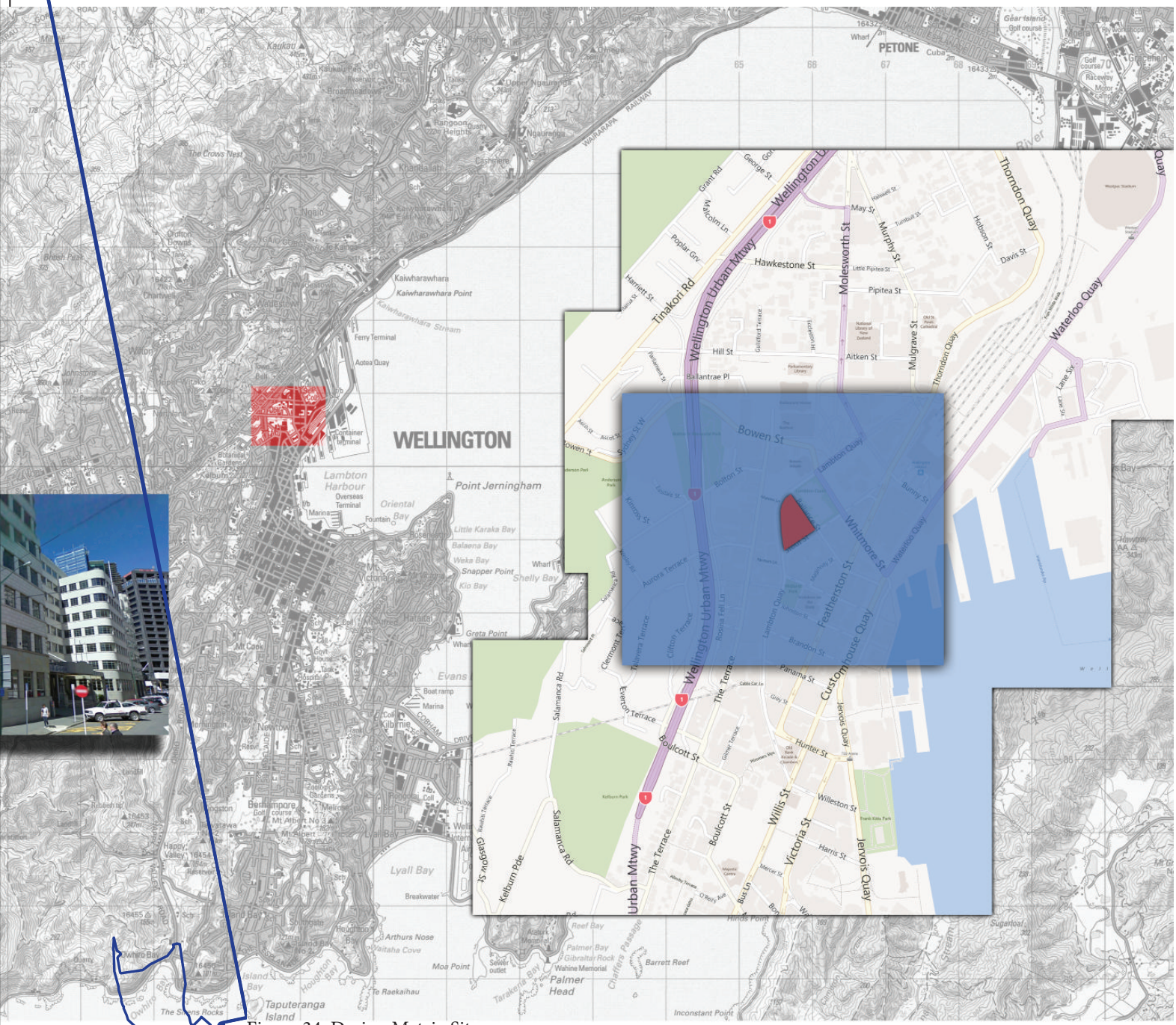


Figure 34: Design Matrix Site

Public

The Public requires a certain circulation path and also have restricted entry to certain areas within the design of this building. This means they must have a very controlled circulation path. This starts from the entrance way which leads the public to any of the open spaces on the ground floor, this also leads to the ramp and the admin block which has both public and private access.
The Public zones mean that anyone is welcome to visit them and they inlude.

- Library Facilities
- City council (public)
- DOC (public)
- EVC A (court room)
- Information Lecture hall
- Immersive display area
- Amenities

All other areas are considered to be private and have restricted access by using a key card access system.

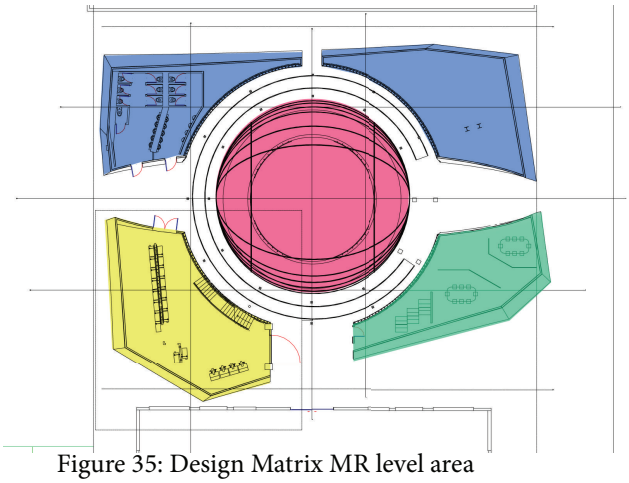


Figure 35: Design Matrix MR level area

The four categories of MR, as defined in Figure AA also relate to the level of public interaction. I separated the programmatic requirements and allocated them a corresponding space value depending on the amount of people that were going to be using this space. We can see from Figure 24 which areas have which MR technology level assigned to them and what technologies, suface materials or interfcaes have been embedded within the MR tech level.

Library – Legal Precedents, Environmental Law, RMA, and other books and resources required for the environmental court.

The Legal Library is the first public program on the ground floor; it occupies three levels and has the capacity to hold around one hundred people. According to Neufert's Time Saver Standards there is a required 1.25 m2 per person for higher education library facilities. This means the library has a minimum total floor space of 125 m2. This part of the design is considered MR tech level Physical/Real space. The levels of MR technologies are low, as the requirements for this space are mainly physical. The wearing of HMD's would replace the need for computers. The library holds books and has spaces for containing and displaying physical documents and precedents for the Environmental Courts.
The spatial configuration of the library locates the exhibition display area on the ground floor. This allows for the most public engagement. The second floor has a collection of books and other items. This is open to the public and contains relevant information about the Environmental Court. The third floor contains the rest of the Legal Precedents. This level is also open to the public and it also contains a communal study area that has a MR display so interested parties can research, discuss and interact with environmental issues.

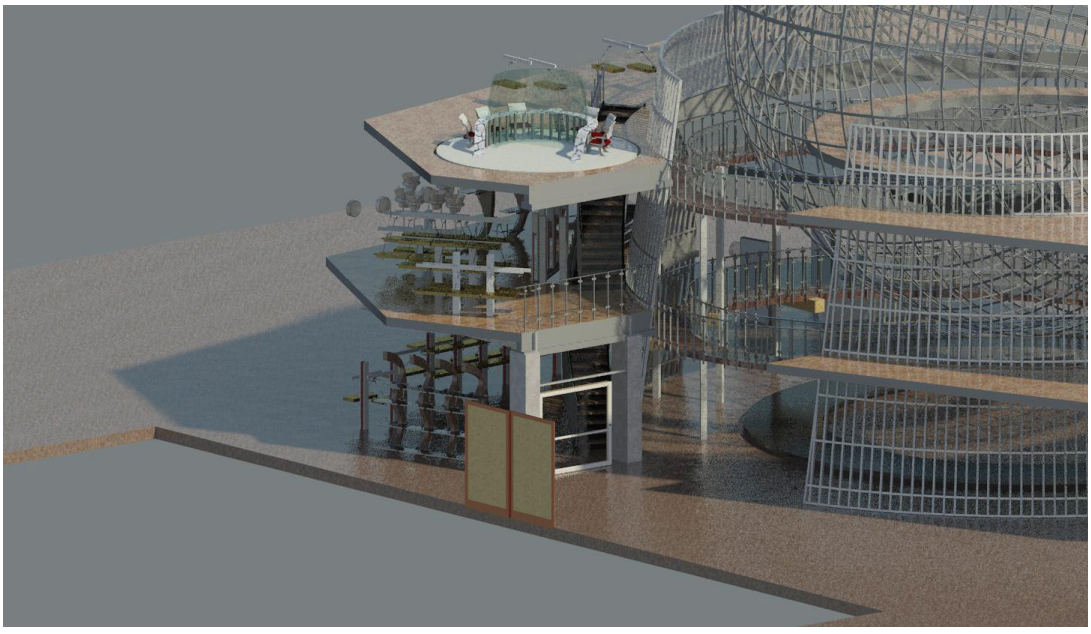


Figure 36: Interior Render Library (with no walls)
and mullions for entrance

Administration – Reception
This section occupies the right hand side of the building directly adjacent to the entrance. This are allows the public to have easy access to the reception and information that they may need, to use the EVC A. There is a private entrance to this area for legal constituents and employees. The administration whilst it only requires a minimum of 9 to administer the Courts must provide a capacity area for 35 people. This includes judges, commissioners and other legal people. According to the New Metric Handbook the configuration for offices is 2.2 m2 per person so this means that the administration block needs 77 m2 to accommodate this program.
This section of the design is also MR tech level Augmented Reality, which means that it has a combination or Real materials and Augmented materials applied to this department.

Amenities - toilets, basins, showers and changing rooms
I have included an amenities block on the ground floor. Although each level will have its own facilities the ground floor adds additional services for public use. With an occupancy of 350 people I.e. 175 males and 175 females, there needs to be 7 male toilets and 7 urinals and 8 female toilets; this is according to the New Metric Handbook. As the pulic have more access to the ground floor there are 3 male toilets and 4 urinals and 7 female toilets. Moreover there are additional amenities attached to each floor.

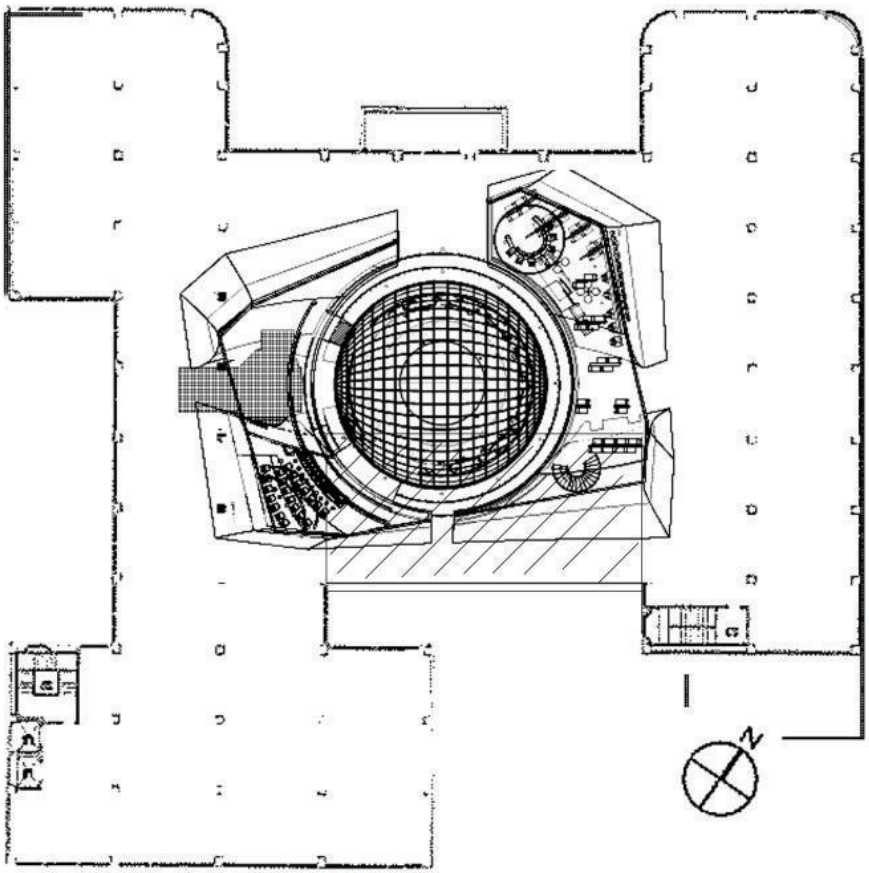


Figure 37: Plan Level 3

Wellington City Council – permits, applications, consents, and other RMA based issues. The Wellington City Council office is a facility for processing applications that would affect the RMA or NZ 3604. This part of the design allows for the Environmental Court to have easy access to any records that have been submitted to the Council by combining the two departments into one building. There will be less time wasted and more accurate proceedings within the courts.

Public Access - ramp

The ground floor also contains access for the public to enter the Environmental Court. The Courtroom in this building is located on the third floor and has a ramp making it wheelchair accessible. The ramp acts as the public gateway for this design and spirals around the outside of the glass sphere. I have done this intentionally so that the public has to walk around the issue presented inside the courts before they enter. This is done with the intention that circulation of the public will encourage an all-round view of the environmental process that is taking place within the courts.

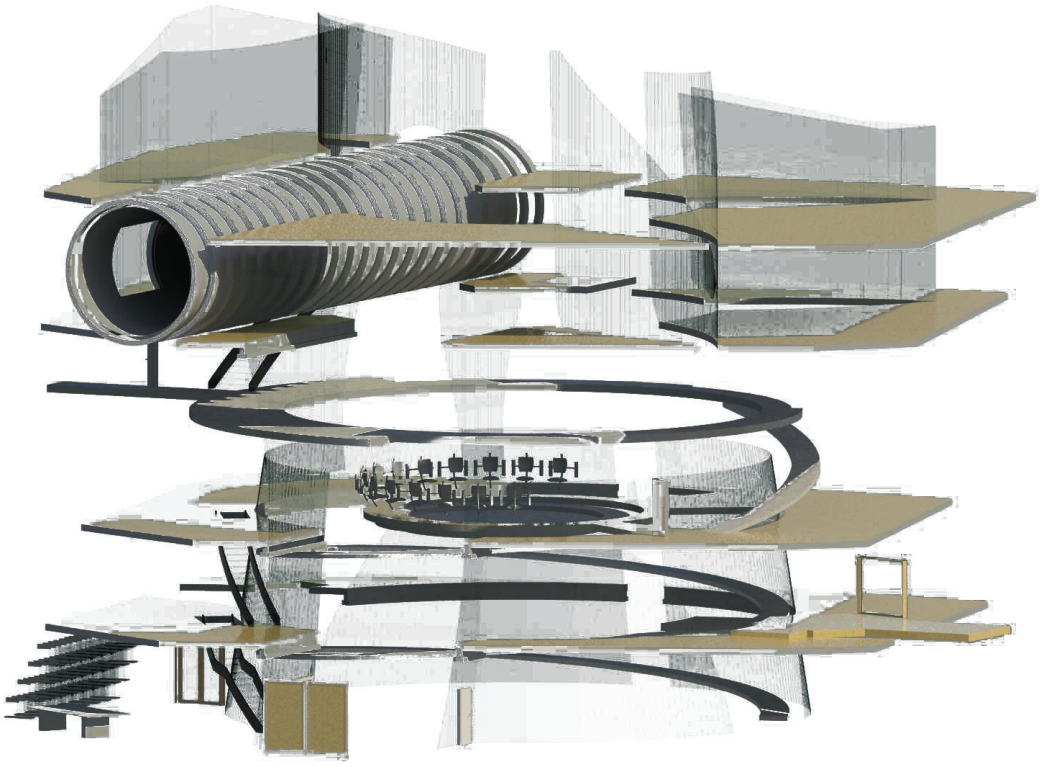


Figure 38: Circulation Ramp

The ground floor contains the main circulation path and it has the first point of information for the public. This area gives access to the Library, Amenities and also the Administration Block. There is a direct access route to the EVC A ramp and the atrium also contains an LCD display and fog projected hologram for the public to interact with. Figure 38 shows the view from the main entrance way. You can see that the library is situated to the left of the entrance and the court room sits above on the third floor. This entrance allows the public and private occupants to get to their desired destination with ease and separates the departments into their specific requirements.

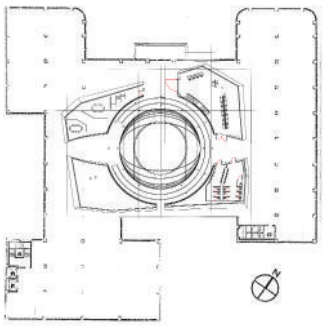


Figure 39: Plan L1

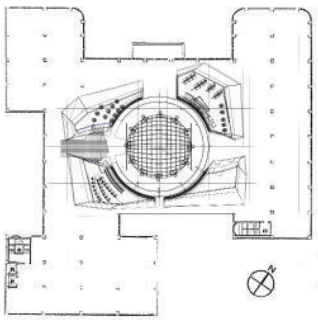


Figure 40: Plan L 2

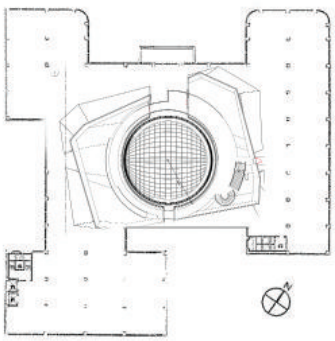


Figure 41: Plan L3

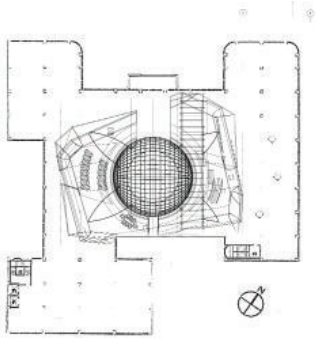


Figure 42: Plan L4

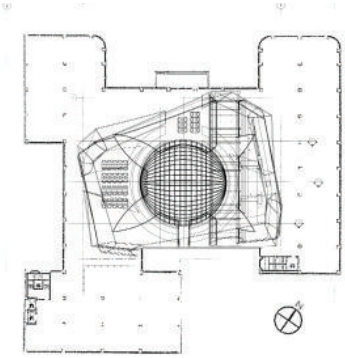


Figure 43: Plan L5

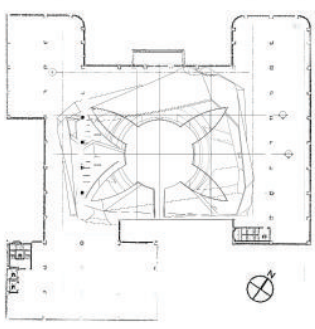


Figure 44: Plan L5

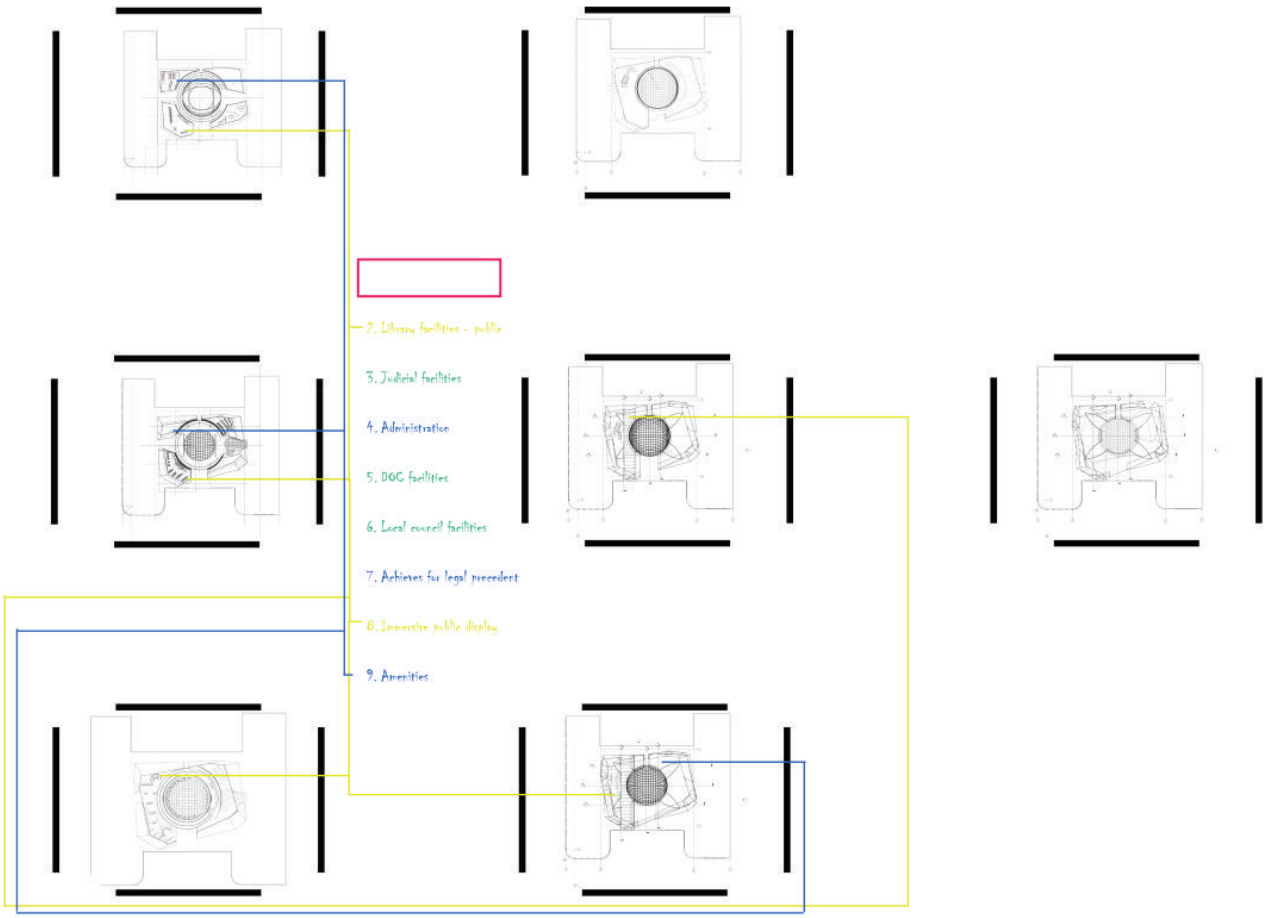


Figure 45: Design Matrix Program

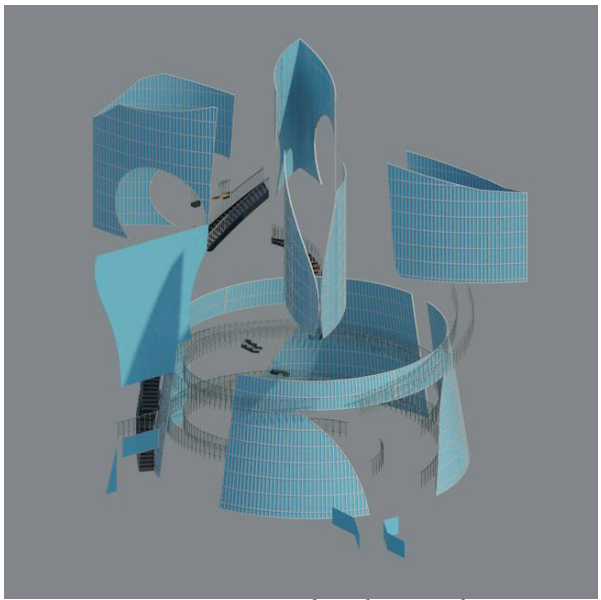


Figure 46: Interior Render Glass Panel

Figure 47: Interior Render Circulation Ramp

Department of Conservation – (DOC)
This department is set up to monitor and control the preservation of the land and historic heritage (Vision, Role Overview and Statutory Mandate, 2013) In the Wellington branch they require approximately 35 people within the office - this means they need 77 m2 of useable space.
The Department of Conservation is located on the second floor and plays a vital role in the management of the RMA. I have included offices and amenities for this department. The DOC has an MR technology level of Augmented Virtuality, which means that it has an extended range of mixed reality technology. This includes digital interfaces for resource tracking, smartphone or tablet applications, Motion sensor lighting and GPS tracking. The department has the ability to regulate the operations by a digital means.

Information Lecture Hall

Also located on the first floor is the Information Lecture Hall. This MR room is secondary to the requirements to the EVC A. However in order to get as much public interaction and awareness as possible it is necessary to create a centre that is dedicated to providing information on the highest level available on resource management. The lecture theatre holds 60 people. Again the New Metric Handbook states that spaces such as a lecture theatre need 1.1 m2 per person to accommodate the first 100 people. This means that the lecture theatre must be 66 m2 in order to accommodate everyone. The room itself has a switchable glass display that has several projectors suspended from the ceiling. This room is for providing information and having discussions about resource management and land law.

The room has four terraced levels to accommodate the required seats and an atmospheric sound system to provide a MR acoustic environment.

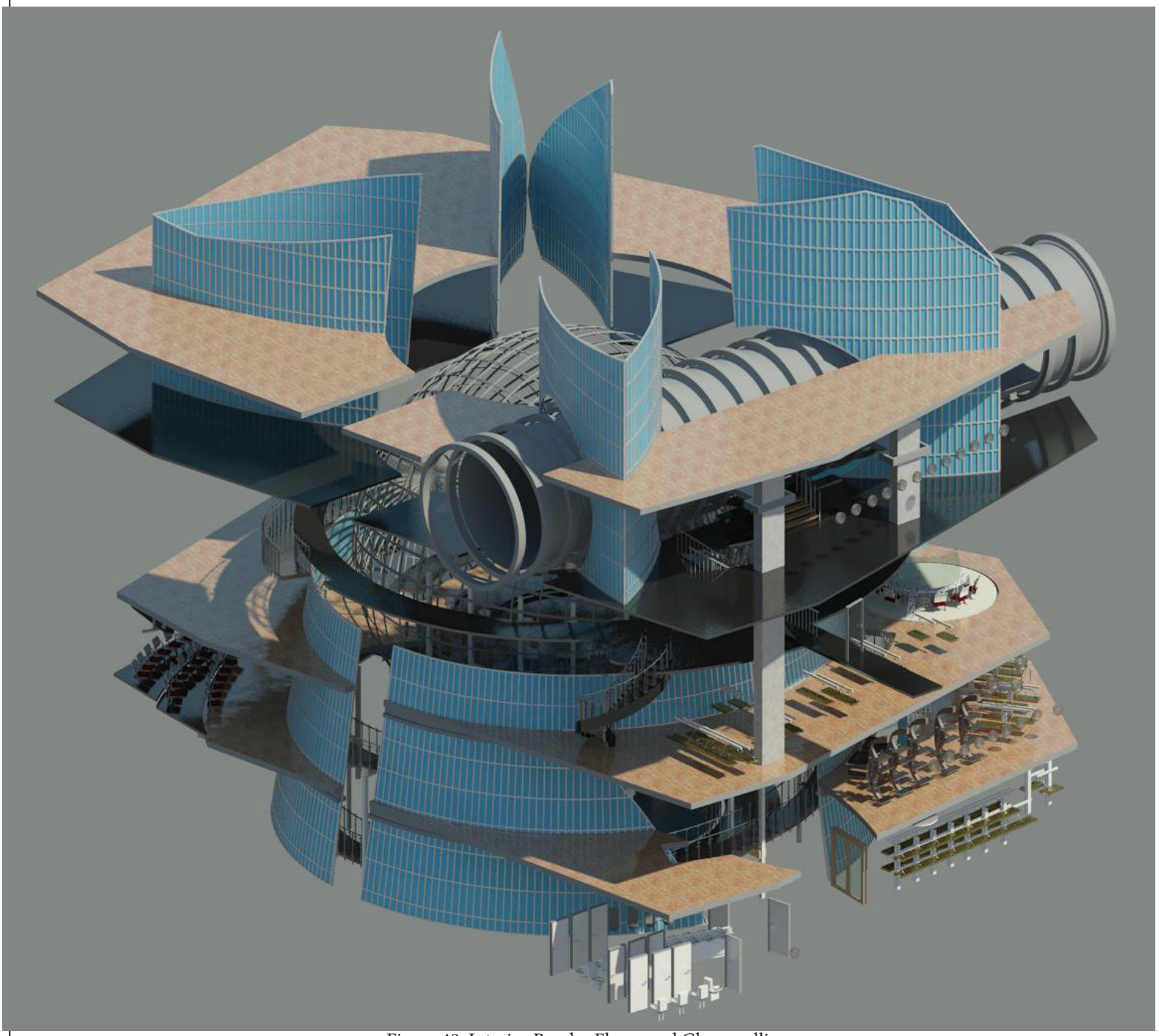


Figure 48: Interior Render Floors and Glass mullions

EVC A - The Mixed Reality Immersive Courtroom

The Ministry of Justice has stated that the Courtroom has only one mandatory requirement which is a bench for three Judges and or Commissioners to sit.
I have used this as my starting point for design of this room. Each Judge has a Case Manager and a Hearing Manager. There is a court reporter who would be made redundant as the MR intergration records everything digitally. Plus there is a plaintiff (it can be a group) and they should have legal counsel. This means that the court room must have enough space for at least 15 people.

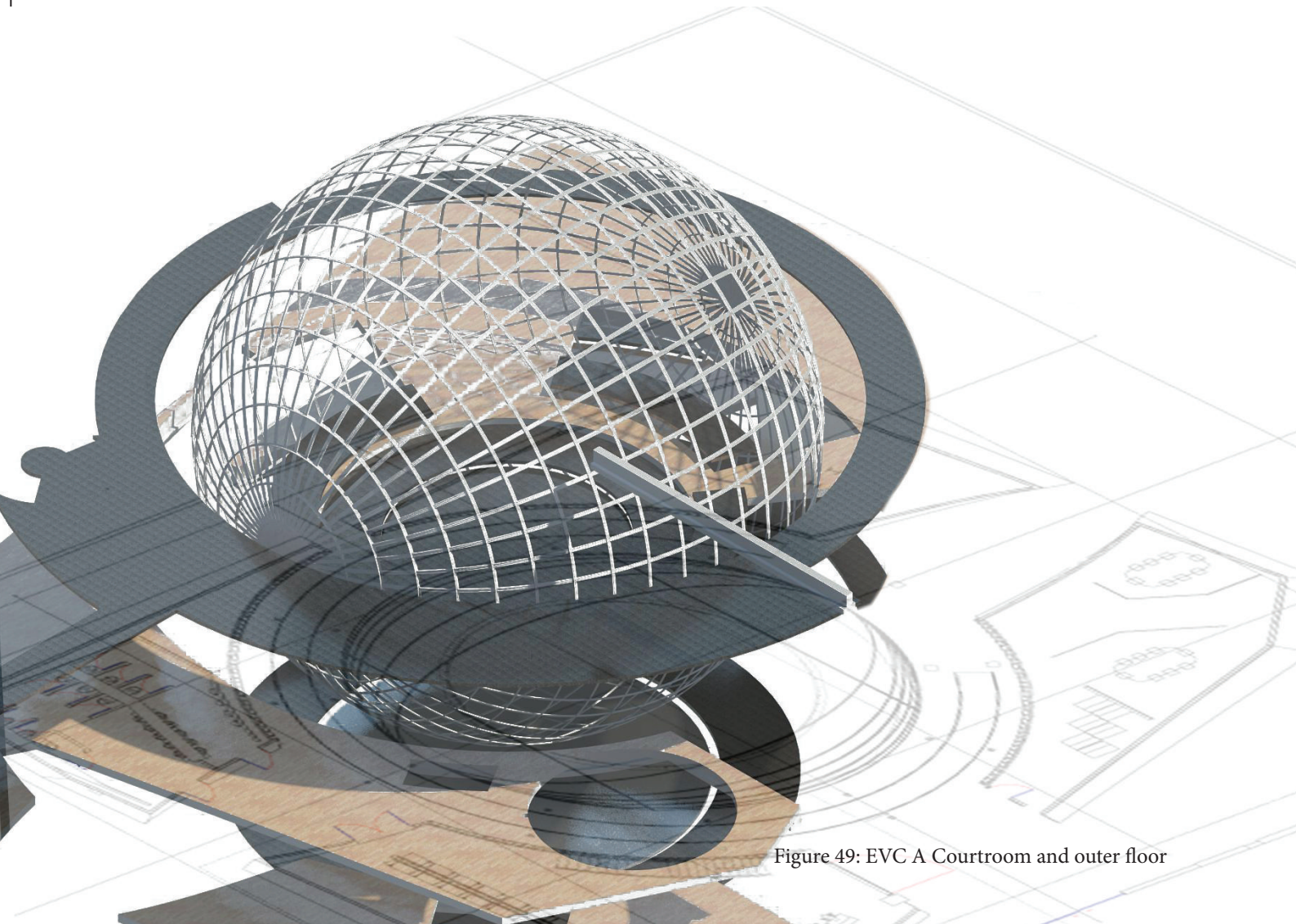


Figure 49: EVC A Courtroom and outer floor

This does not include space for the public who are welcome to sit in on proceedings and there may be as many as twenty, making the total capacity of at least 35 people. According to the New Metric Handbook the Courtroom should have a private circulation for Judges and a separate circulation for public and plaintiffs.
The central feature of the design is the environmental mixed reality court room. This is a glass spherical chamber seemingly floating in the void of the surrounding architecture. The epidermis of the MR room is made from switchable glass that allows for opacity of the glass to be manipulated. By using switchable glass, this means that the court room is entirely transparent and encourages the notion that all proceedings are open and can be clearly observed by the public eye. The switchable glass uses electricity to change the visibility from clear to opaque, this allows for glass to become a suitable surface for projecting MR display scenarios as well as encouraging privacy and discretion when needed. Further research would be required on them and installation of this technology.

My theory is to use light and shadows to manipulate the perception of depth. Within the epidermis there is a HVAC system that would use positive pressure air flow to create a hemi-spherical Fog bank of LN2 (liquid nitrogen) or CO2 (Solid Carbon dioxide).

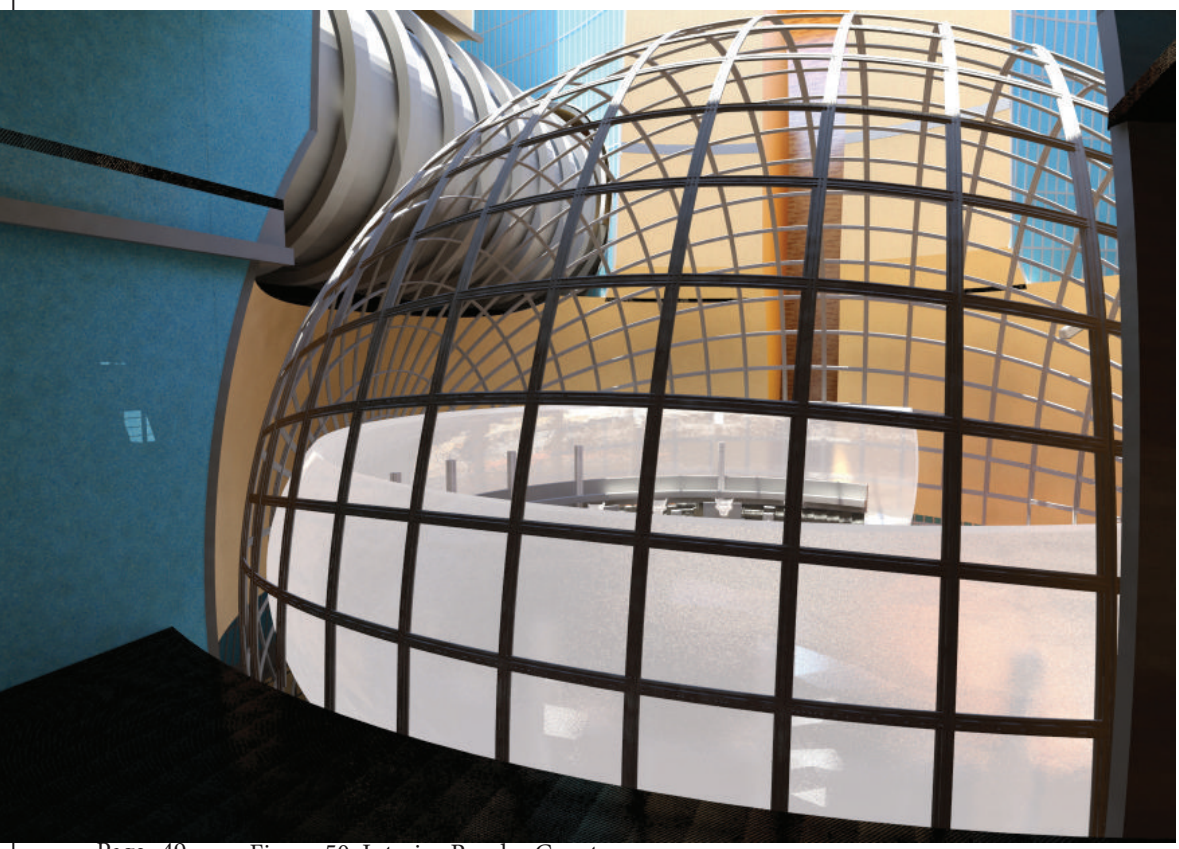


Figure 50: Interior Render Court

Figure 51: Multi- view point immaterial display

The layer of controlled fog provides a suitable surface for generating three dimensional images. By using the techniques that have been researched at the Osaka University multi-view point projection could simulate the environmental scenarios.

The next stage of MR within this Courtroom is the Atmospheric Acoustic Noise control. This can be seen in the Embassy Theatre in Wellington. This at the moment is a product from Dolby laboratories and generates realistic sound distribution in a three dimensional space. Further development could involve studies for haptic control and simulation as well as magnetic simulated gravity.

The next level of MR is the head mounted optical see through display. This augmented reality device will simulate the closest to eye display. It also tracks the movement of the user and synchronises the other display accordingly. By combining all these mixed reality technologies a greater depth of 3D immersion will be achieved.

Given that the Courtroom has glass construction and its placement within the design, my thesis places emphasis on the transparency of the Courts encouraging the open and transparent environment policies. This means that at all times any parties within the program are focused on the environmental issues at hand. There is a platform level on the outside of the court for the public to meander around the outside of the Courtroom. This is to encourage the idea of an external perspective on an environmental problem so that no areas can be overlooked.

Figure 52: Interior Render

Legal Requirements

The legal facilities required are not set in stone. This means that I have some flexibility to create the judicial facilities in almost any fashion that I wish. This being said there are a number of criteria that I must follow. Peart has told us that there are ten judges and twelve commissioners involved in the Environmental Courts of Aotearoa .

However according to the Ministry of Justice only one judge and two commissioners are present for a hearing. Because I am creating a space that will be the national headquarters for Environmental Law, the facilities need to be able to accommodate for up to ten judges or commissioners. This means that the design has to have a bench that holds ten people. Therefore a judicial quarters has been created that has offices for the judges and commissioners including facilities and amenities for extensive proceedings.

Figure 53: Interior render Courtroom and mixed reality

Figure 54: NZ Justice Crest

During each case at least one judge and two commissioners are assigned to hear the proceeding. Accompanying each of them is a case manager that looks after the administrative work during the case until it reaches the hearing and then a hearing manger who takes over the administration from hearing to the final complete stage. These people work with the judges making sure that administrative side of things is taken care of.

The Administration centre controls all of the necessary documents to process and judge RMA or land law disputes. Form 16, as seen in Figure 69 is an example of documents that may be submitted to Administration for consideration. My proposal includes digitalizing the administration with MR profiles, generating scenario simulations and tracking and monitoring progress etc.

What I have created in this thesis is an interior architectural concept that is designed to allow mixed reality as a media platform. My proposal includes creating online networks that could exist like “Mystudylink or MyIRD”. This type of government site allows the user to track and monitor their actions to whatever extent via your computer and personal login. The same concept can be applied to EVC A. Users would login to the site and create an account. From here the user could upload various documents, consents and other applications. They could also check status of application, update details, be referred to relevant links, make payments, contact and correspondence and more. Then as a user, they could upload plans or proposals digitally to the EVC A website which would be processed accordingly.

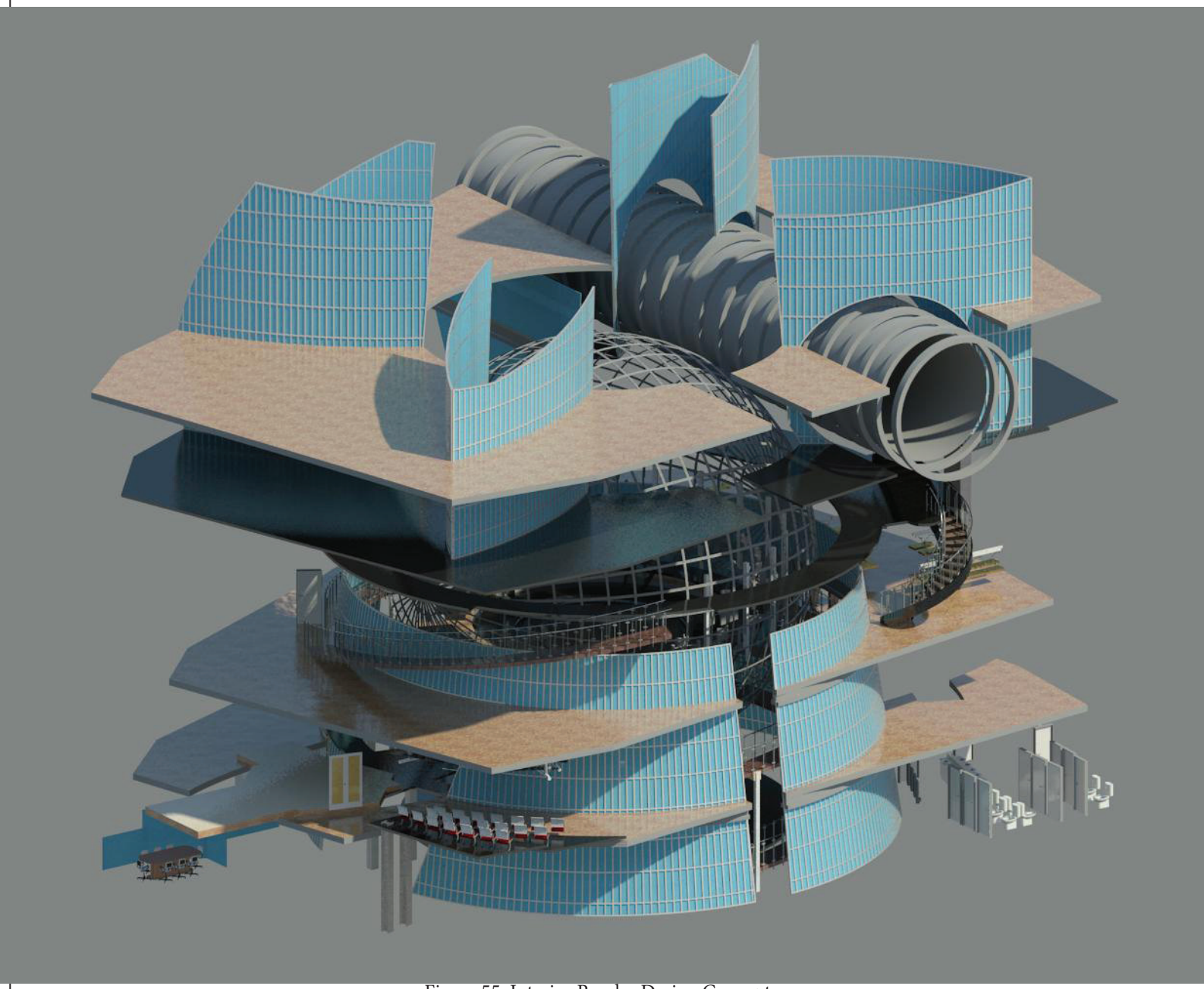


Figure 55: Interior Render Design Concept

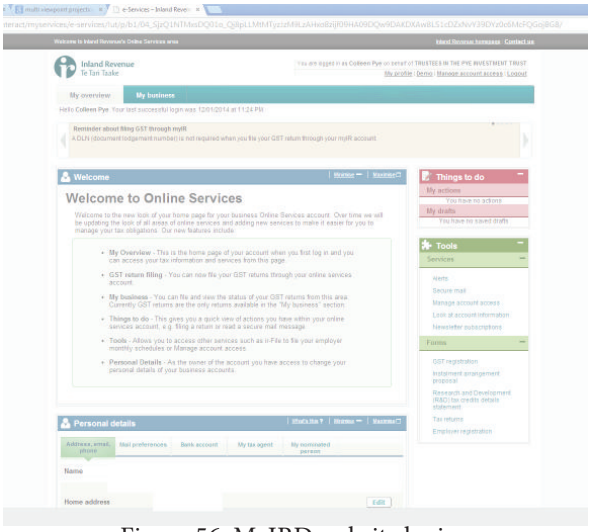


Figure 56: MyIRD website login

Figure 57: Interior Render Information lecture hall

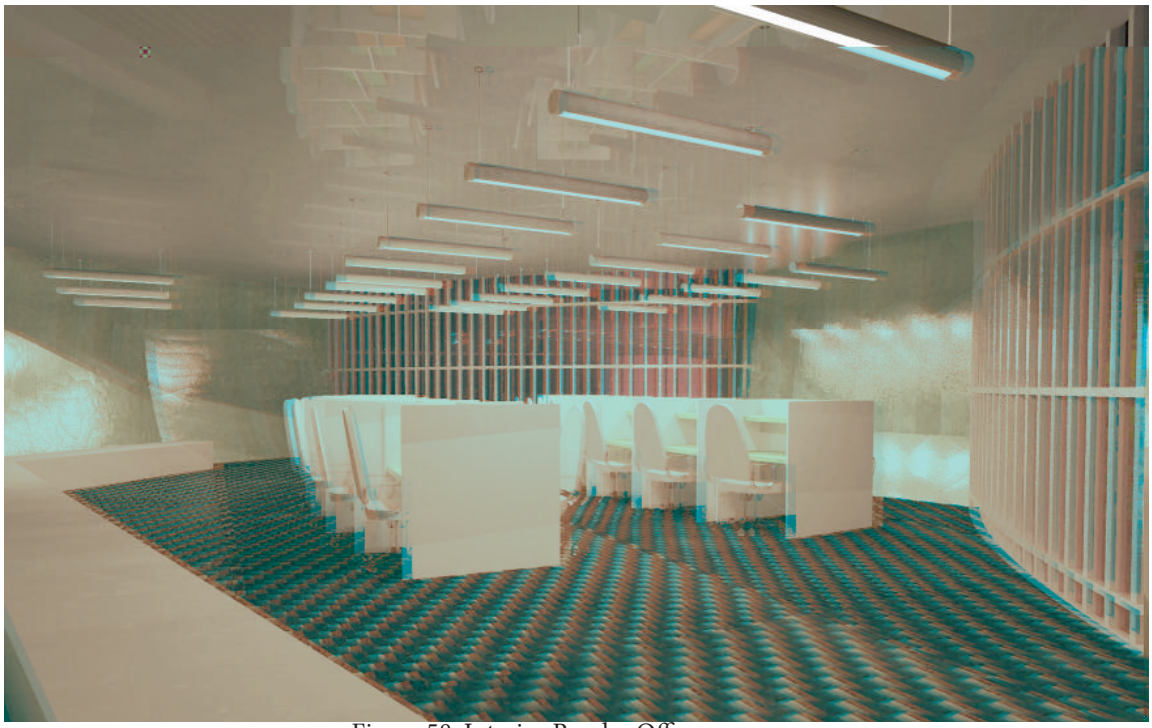
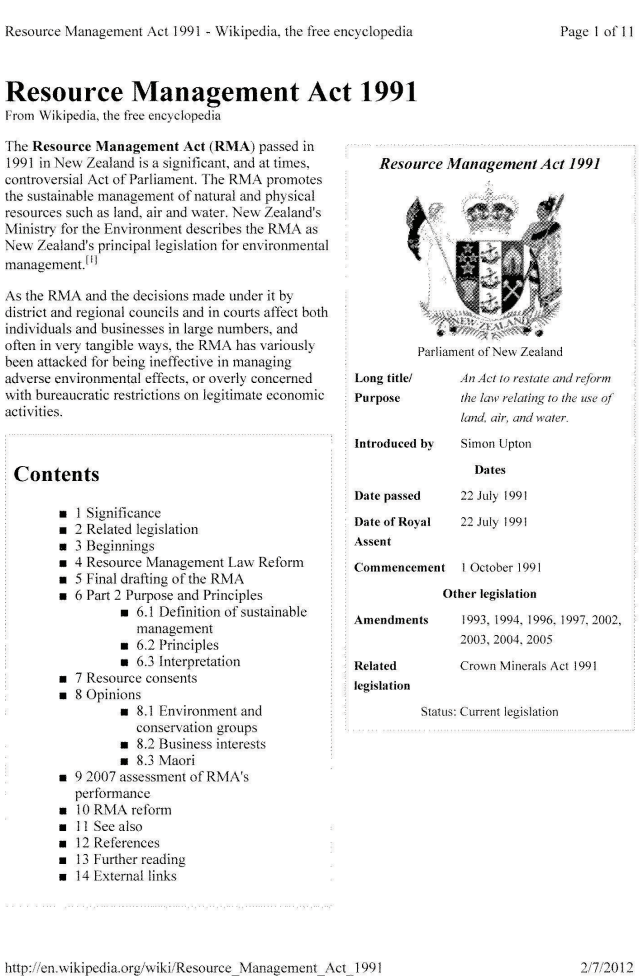


Figure 58: Interior Render Offices

The administration is currently dealing with a paper trail of many documents. By intergrating digitalized MR technologies the administration can streamline their process by sychronising the following and much more.

- Digital submissions for applications
- Digital tracking and processing
- Up graded GPS and mapping services
- 3D simulations
- Experiential conditions
- Public awareness and interaction
- Online forum and information about civil projects.



Resource Management Act 1991 - Wikipedia, the free encyclopedia Page 1 of 11

Resource Management Act 1991

From Wikipedia, the free encyclopedia

The **Resource Management Act** (**RMA**) passed in 1991 in New Zealand is a significant, and at times, controversial Act of Parliament. The RMA promotes the sustainable management of natural and physical resources such as land, air and water. New Zealand's Ministry for the Environment describes the RMA as New Zealand's principal legislation for environmental management.[1]

As the RMA and the decisions made under it by district and regional councils and in courts affect both individuals and businesses in large numbers, and often in very tangible ways, the RMA has variously been attacked for being ineffective in managing adverse environmental effects, or overly concerned with bureaucratic restrictions on legitimate economic activities.

Contents

Resource Management Act 1991

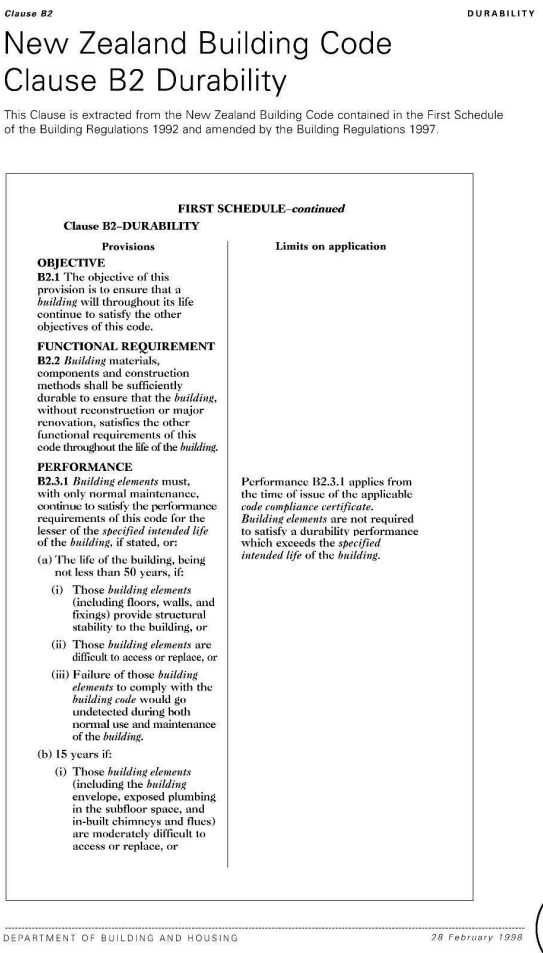
Parliament of New Zealand

Long title/ Purpose	*An Act to restate and reform the law relating to the use of land, air, and water.*
Introduced by	Simon Upton
Dates	
Date passed	22 July 1991
Date of Royal Assent	22 July 1991
Commencement	1 October 1991
Other legislation	
Amendments	1993, 1994, 1996, 1997, 2002, 2003, 2004, 2005
Related legislation	Crown Minerals Act 1991

Status: Current legislation

http://en.wikipedia.org/wiki/Resource_Management_Act_1991 2/7/2012

Figure 59: RMA contents page 1



Clause B2 DURABILITY

New Zealand Building Code Clause B2 Durability

This Clause is extracted from the New Zealand Building Code contained in the First Schedule of the Building Regulations 1992 and amended by the Building Regulations 1997.

FIRST SCHEDULE–*continued*

Clause B2–DURABILITY

Provisions	Limits on application
OBJECTIVE **B2.1** The objective of this provision is to ensure that a *building* will throughout its life continue to satisfy the other objectives of this code.	
FUNCTIONAL REQUIREMENT **B2.2** *Building* materials, components and construction methods shall be sufficiently durable to ensure that the *building*, without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the *building*.	
PERFORMANCE **B2.3.1** *Building elements* must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the *specified intended life* of the *building*, if stated, or: (a) The life of the building, being not less than 50 years, if: (i) Those *building elements* (including floors, walls, and fixings) provide structural stability to the building, or (ii) Those *building elements* are difficult to access or replace, or (iii) Failure of those *building elements* to comply with the *building code* would go undetected during both normal use and maintenance of the *building*. (b) 15 years if: (i) Those *building elements* (including the *building* envelope, exposed plumbing in the subfloor space, and in-built chimneys and flues) are moderately difficult to access or replace, or	Performance B2.3.1 applies from the time of issue of the applicable *code compliance certificate*. *Building elements* are not required to satisfy a durability performance which exceeds the *specified intended life* of the *building*.

DEPARTMENT OF BUILDING AND HOUSING *28 February 1998* 3

Figure 60: Clause B2 Durability

By using 3D modelling and real time simulation there is an opportunity for the Council to be aware of what the outcome of the project will look like in its surrounding environment. This can be achieved by using the hand held tool that has been presented by researchers at the HIT in Canterbury. Computer generated modelling allows a person to see a concept in full completion before the project even begins. Forms such as the one to the right could be digitally submitted and processed in a much similar manner.
This would allow the Courts to get an accurate view of what is being proposed. There could be live digital updates and informative scenarios that would show and encourage the functions and uses of this design.

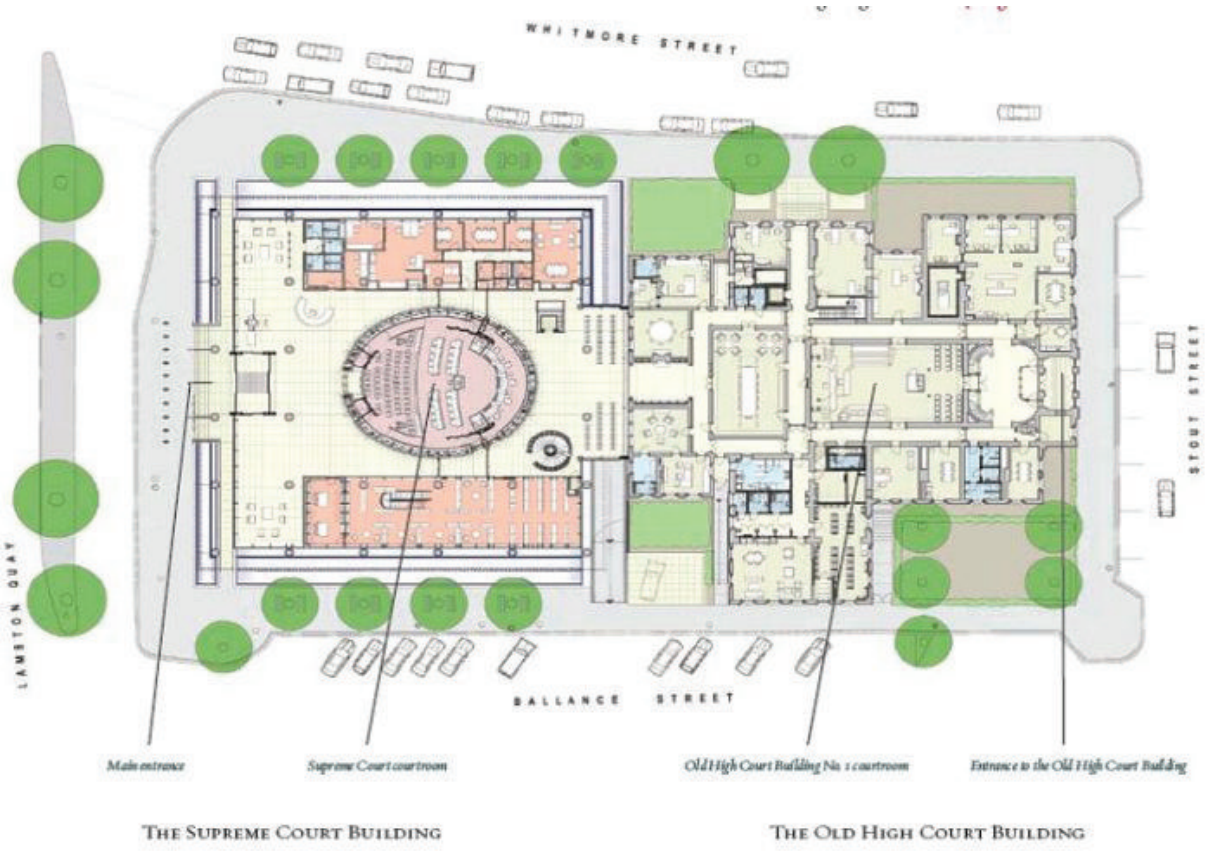


Figure 61: Supreme Court Plan

This drawing shows the central longitudinal Section A_3. This section also shows how the design is split through the vertical circulation divisions.
There are two highlighted areas that illustrate the Courtroom and the immersive display area. These two areas use a virtual material selection from the MR Tech level chart seen in Figue 24. This drawing also explains the finishd floor level and and grid lay out.

Figure 62: Interior Render Entrance

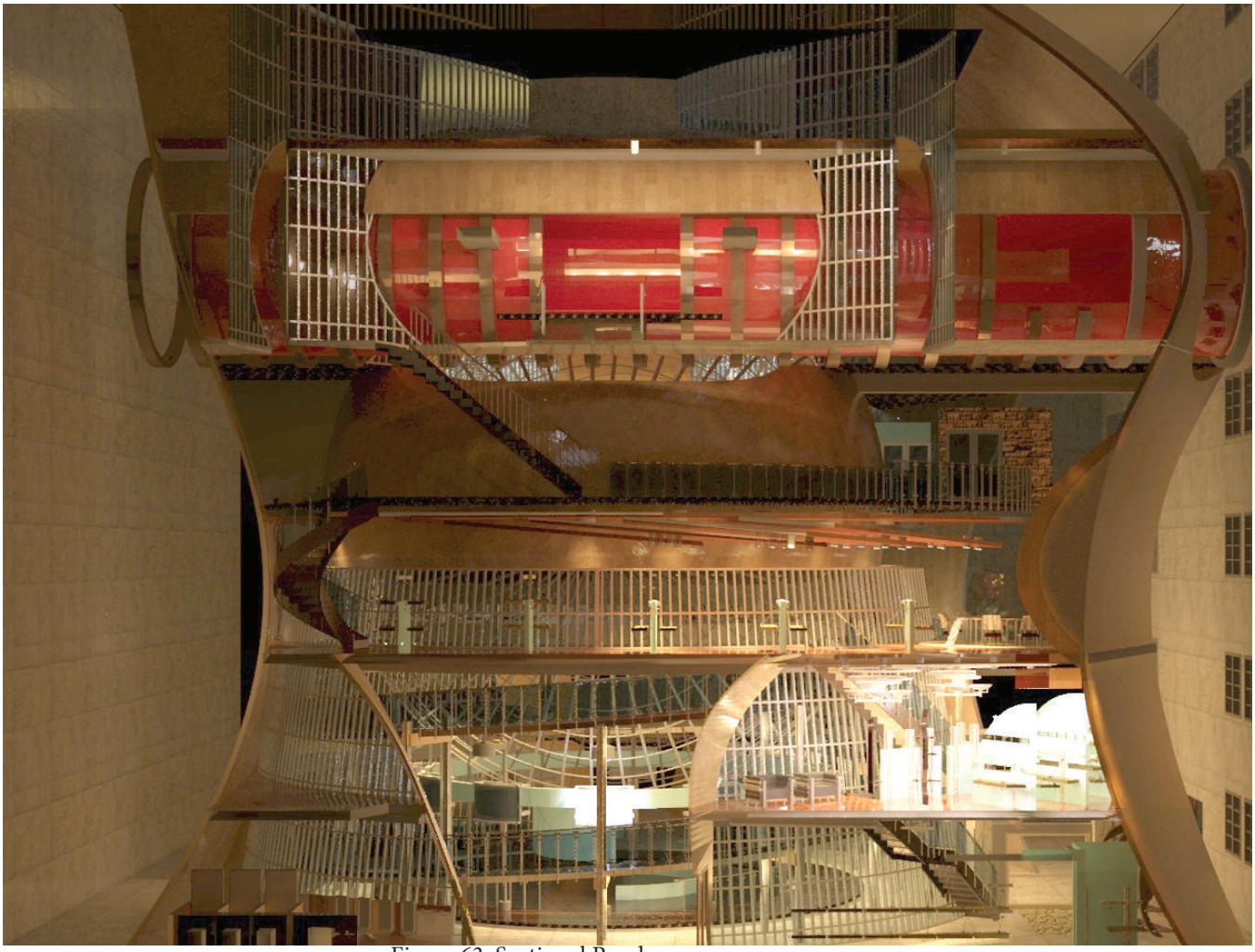


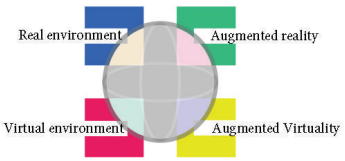
Figure 63: Sectional Render

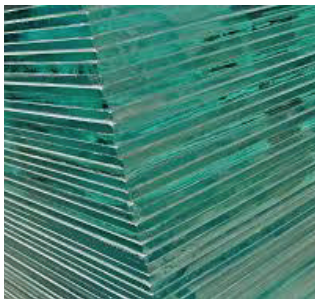
Materials

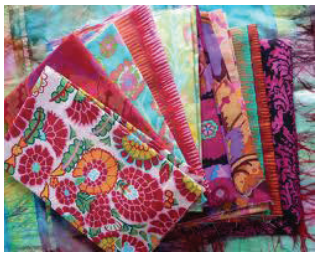
The materials used in this thesis are selected to encourage the level of mixed reality that this department has connected to it. What this means is that each separation of MR Tech level assigned to the specific department has a specific set of materials. Seen on the right of the page are some examples that have been used as a specific MR tech material palette.

Real (R) – These materials are what you might consider to be natural materials. They can be found in nature and require little or no processing to manufacture. They are as follows:

- Wood
- Concrete
- Stone
- Native Metal
- Glass
- Fabric







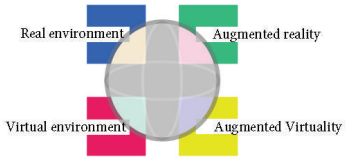
above Figure 64: Wood
Figure 65: Granite

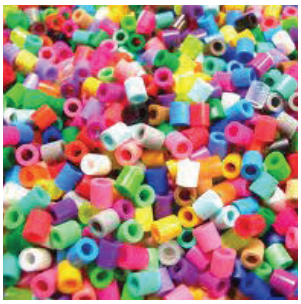
above Figure 66: Concrete
Figure 67: Steel

above Figure 68: Glass
Figure 69: Fabric

Augmented Reality (AR) – These materials combine "real" materials and "augmented materials" together. What I mean by this is the materials have some form of technological enhancement. This means, for instance Terrazzo, whilst it is still made up from stone, quartz, marble or other suitable chips (all real material) it is then composited with a binding agent to create a uniformly textured surface. This means the manufacturing process has augmented this material. Materials include:

- Plastic
- Smart glass
- Alloy metals
- Composite Fibre
- Ceramic composite





above Figure 70: Plastic

above Figure 72: Switchable Glass Off/On

Figure 71: Ceramic composite

Figure 73: Alloy

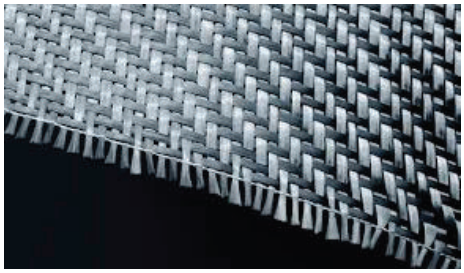


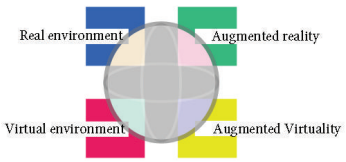
Figure 74: Composite Fibre

above Figure 75: Digital Tracking
Figure 76: Internet network

above Figure 77: GPS
Figure 78: Digital Interface

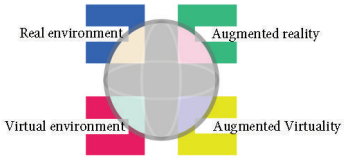
Augmented Virtuality (AV) – These materials utilise computer generated technologies with R and AR materials. What I mean by this is they use objects such as display technology and create a digital interface that defines how the user interacts with that product. For example an HMD display that is made from materials such as plastics, alloys, glass, and silicone, etc, would then be combined with an operating system or app, which allows the user to operate the product correctly. The AV material selection is the digital content interface. This includes:

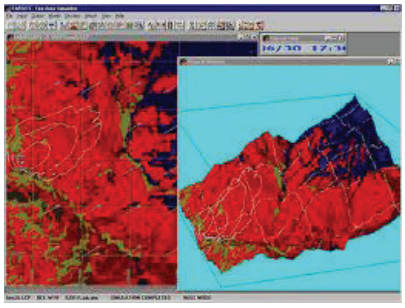
- Digital tracking,
- GPS,
- Digital interface,
- Internet-network,

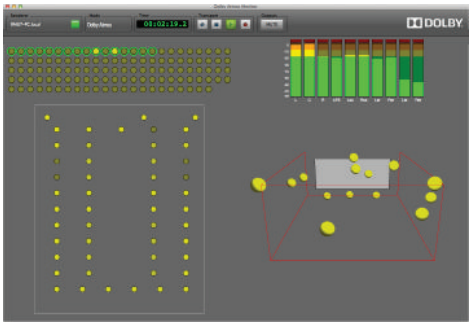


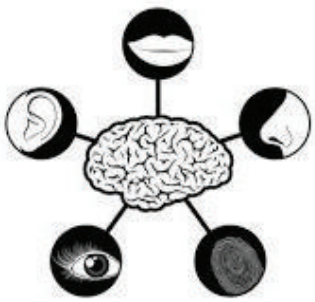
Virtual Reality (V) – These materials create the virtual environment setting. They are immaterial and do not exist outside of mixed reality immersion. Some of these may have real world properties; however I am only referring to them when they are being combined with AR and AV materials to create a mixed reality environment. For example using Fog and multiple projectors to create a "hologram" with motion parallax, as seen at the Osaka University, has real world properties in the equipment to install this. But it creates in a MR setting a hologram which I am suggesting is a material.

- Holograms
- Atmospheric Acoustic Control
- Graphic generated simulations
- Sensory enhancements









above Figure 79: Hologram
Figure 80: Atmospheric Audio

above Figure 81: Graphic Generated Simulation
Figure 82: Sensory Enhancement

This thesis shows how mixed reality can increase the level of public interaction and awareness. This was a progression of developmental ideas that were to combine a judicial hierarchy with the digital technology of mixed reality. What I have found out is that the Environmental Court is unique in its structure and it would be a logical progression if the EVC A implemented a change to a digital infrastructure. The Courts have very little requirements in order for them to function.
This means that progressive adaption of MR would be a viable solution. However, in order for the court to function there must be a significant amount of technology involved with the creation of this architectural concept.

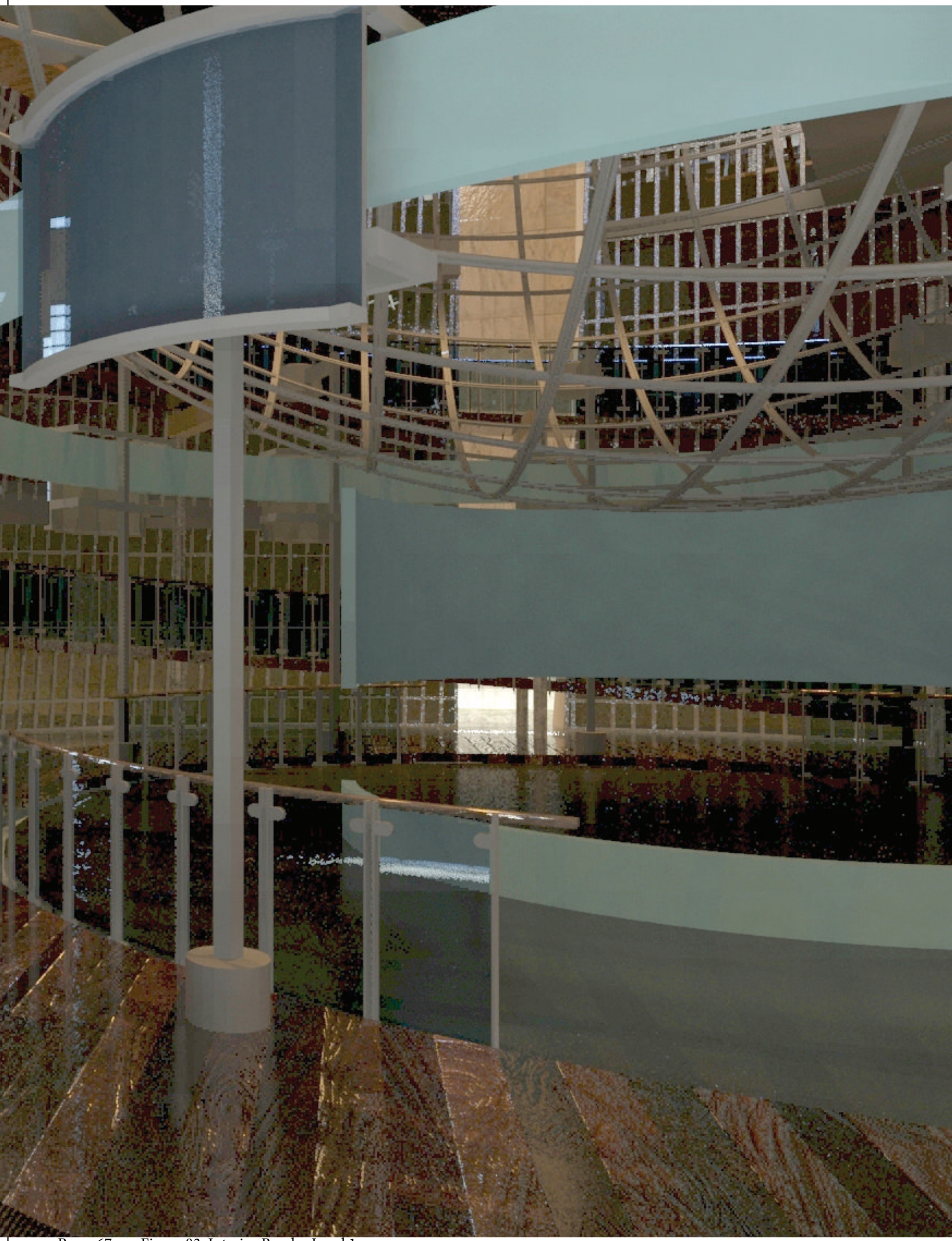
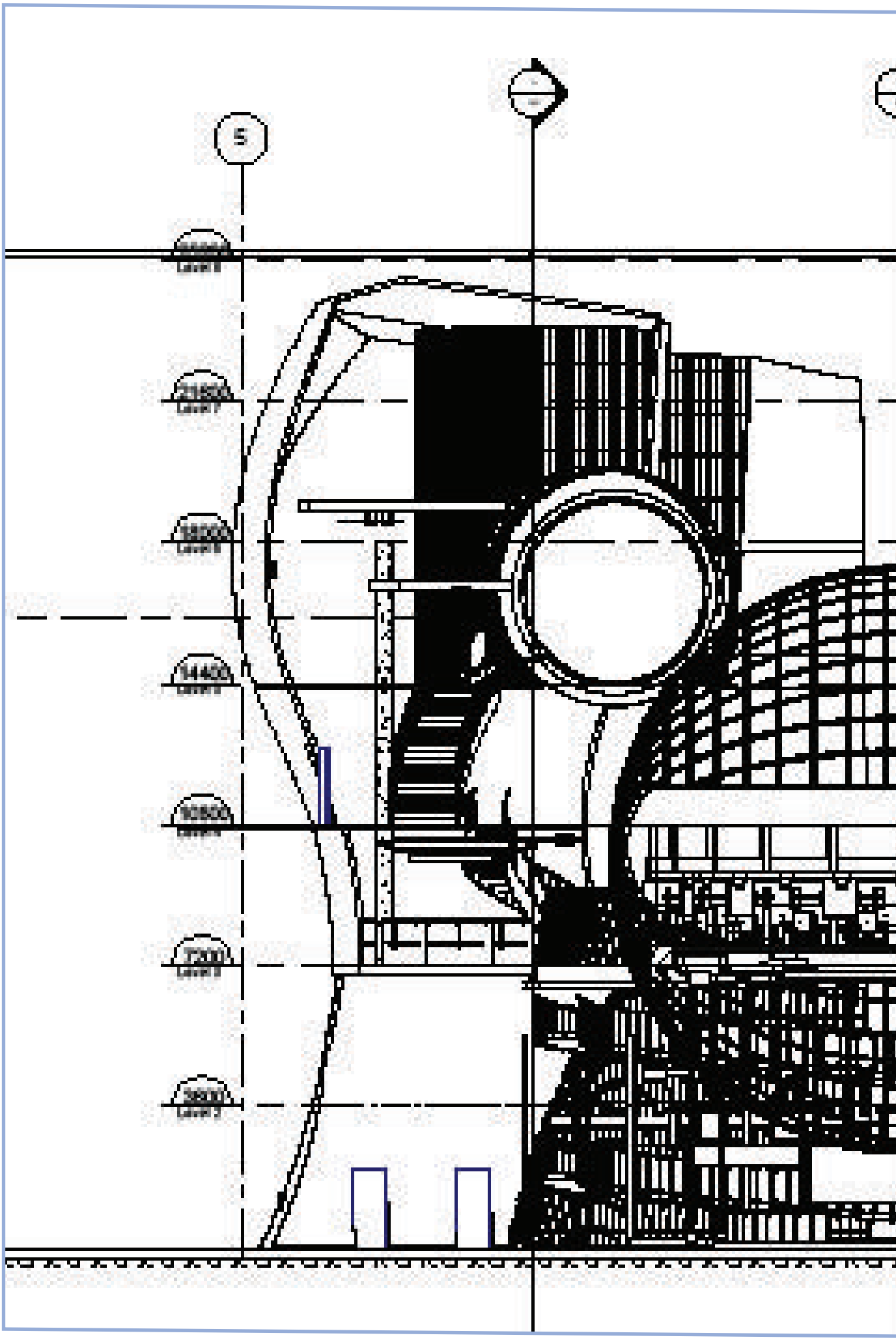


 Figure 83: Interior Render Level 1


5

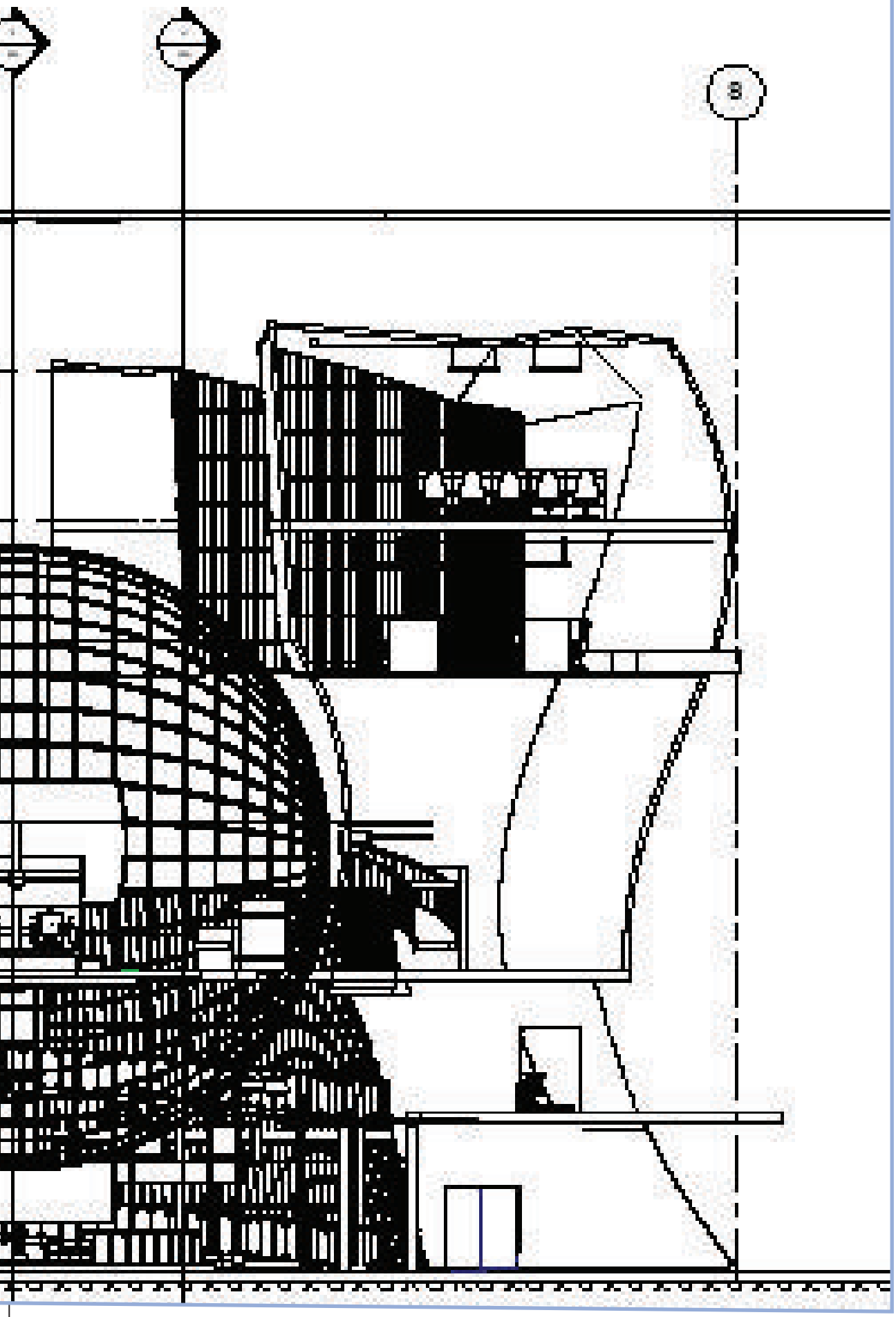
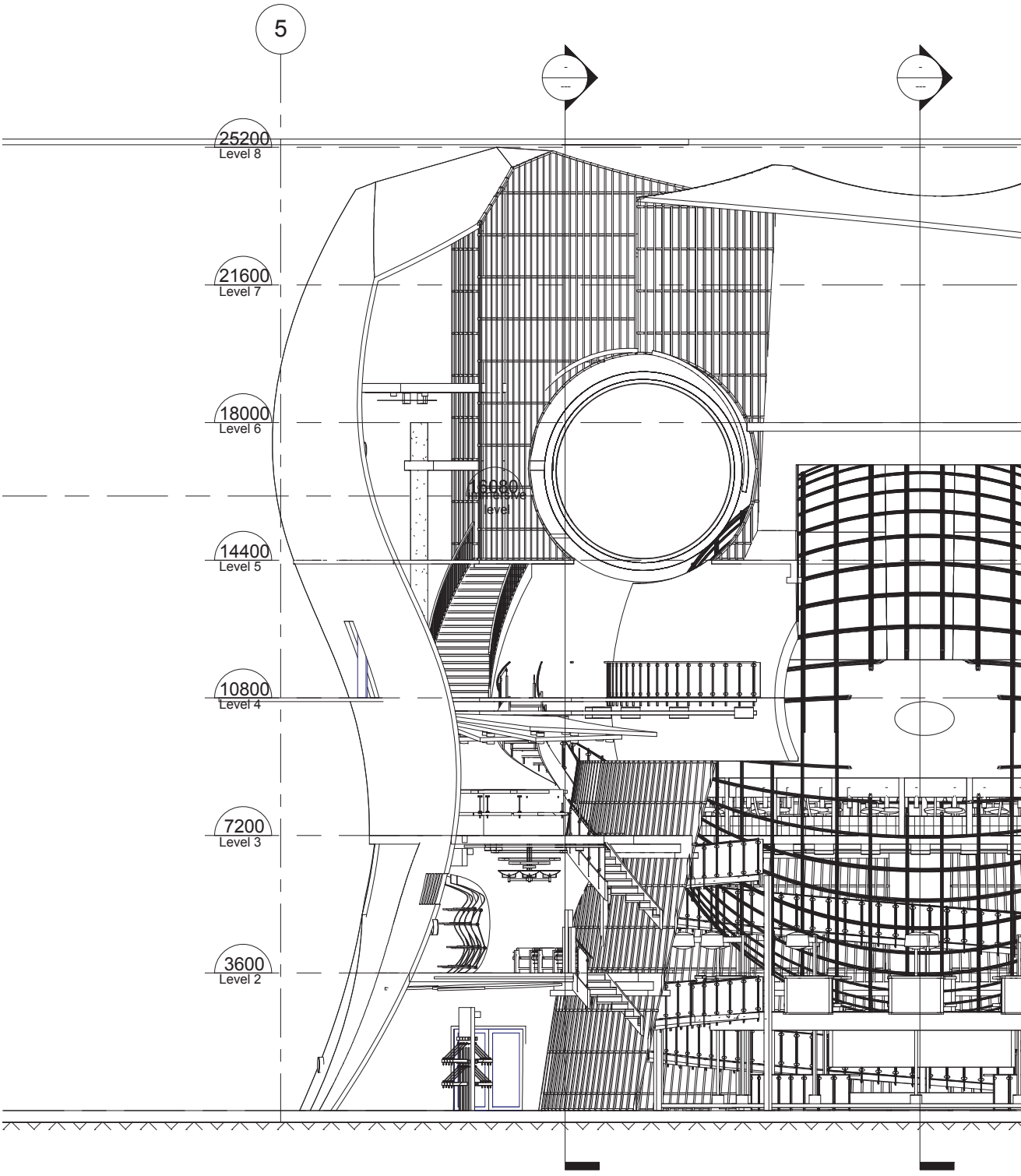


Figure 83: Section AA

Figure 84: Interior Render


5
25200
Level 8
21600
Level 7
18000
Level 6
16080
Interstitial
level
14400
Level 5
10800
Level 4
7200
Level 3
3600
Level 2

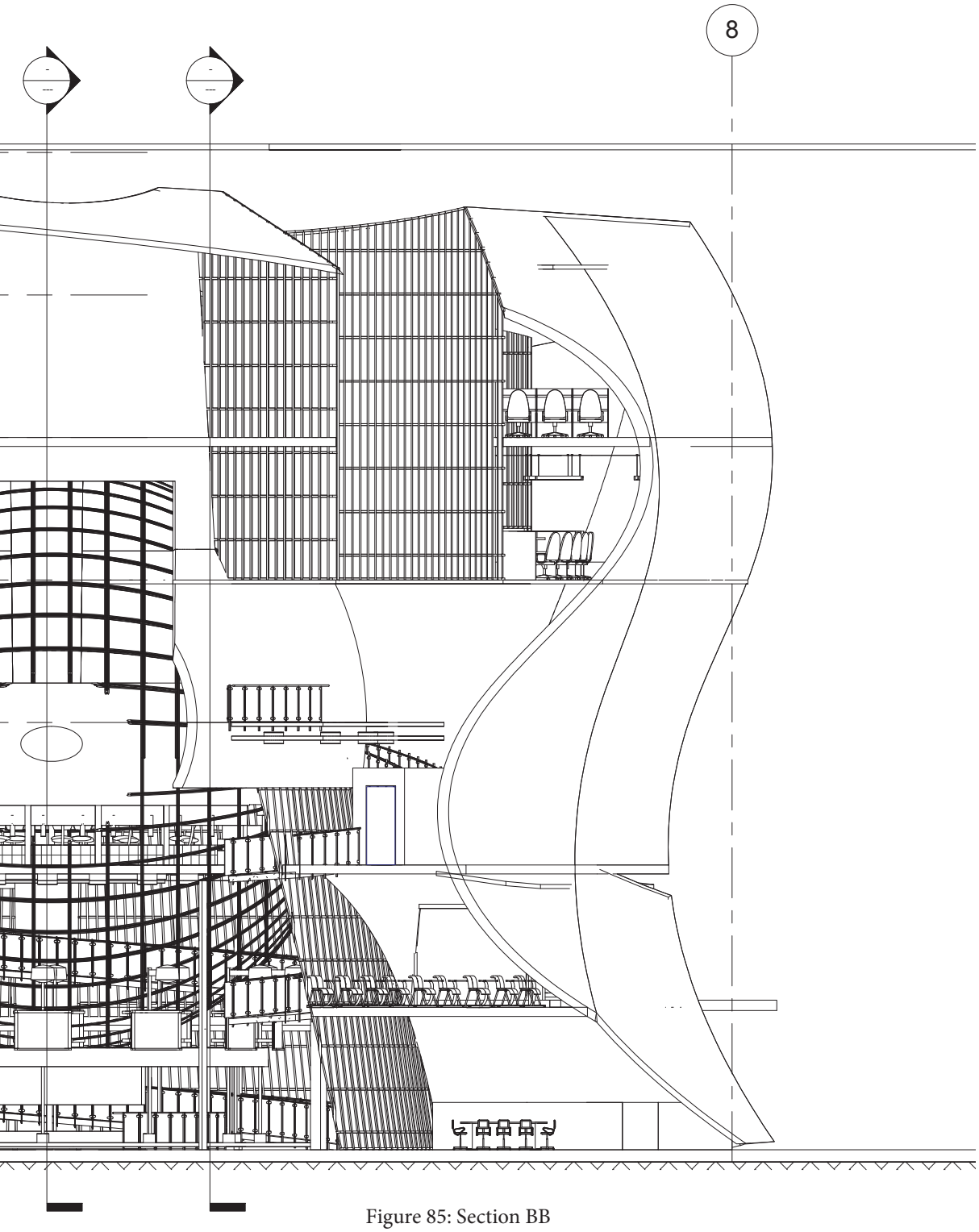
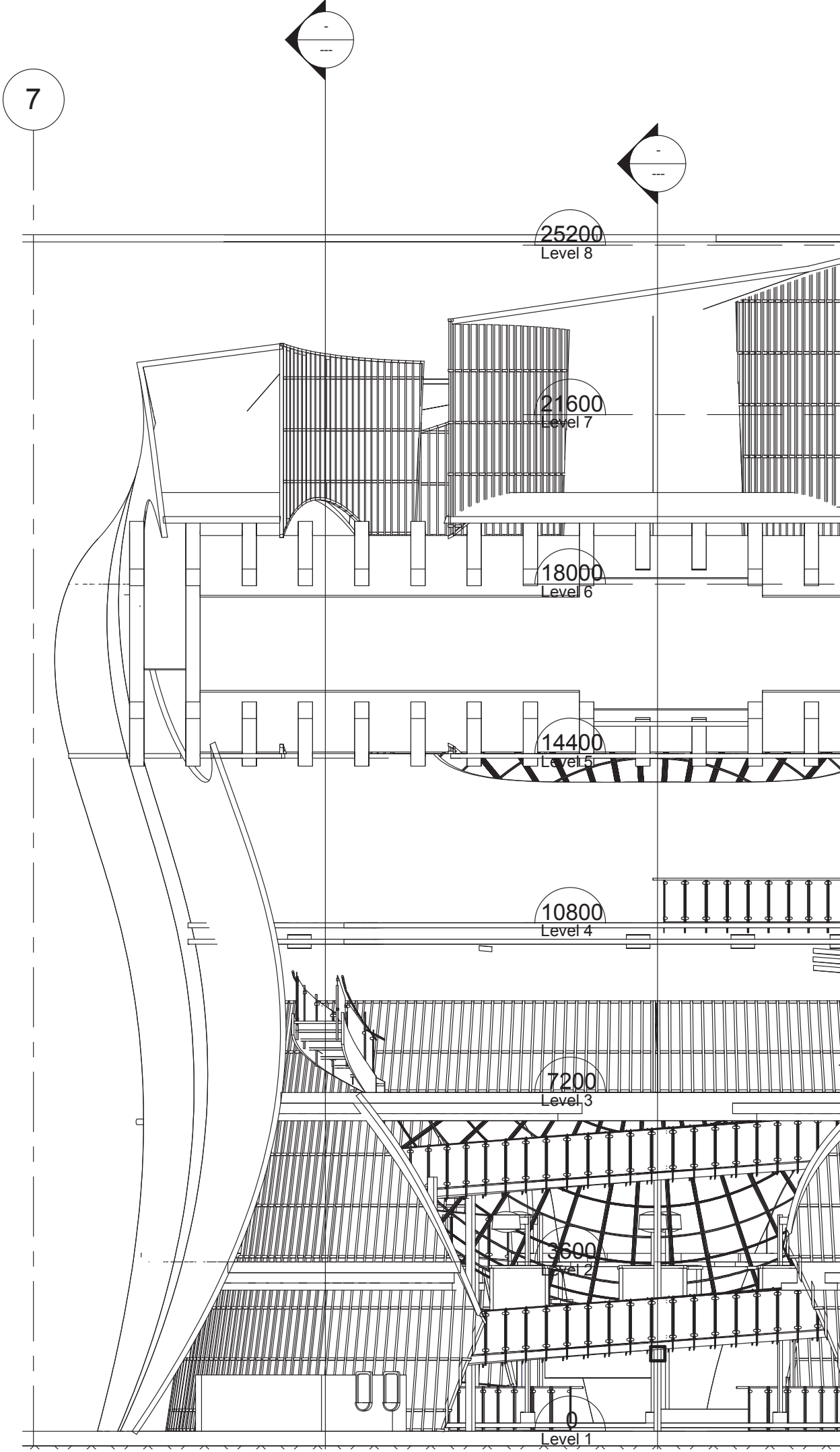


Figure 85: Section BB

Figure 86: Interior Render


7
25200
Level 8
21600
Level 7
18000
Level 6
14400
Level 5
10800
Level 4
7200
Level 3
3600
Level 2
0
Level 1

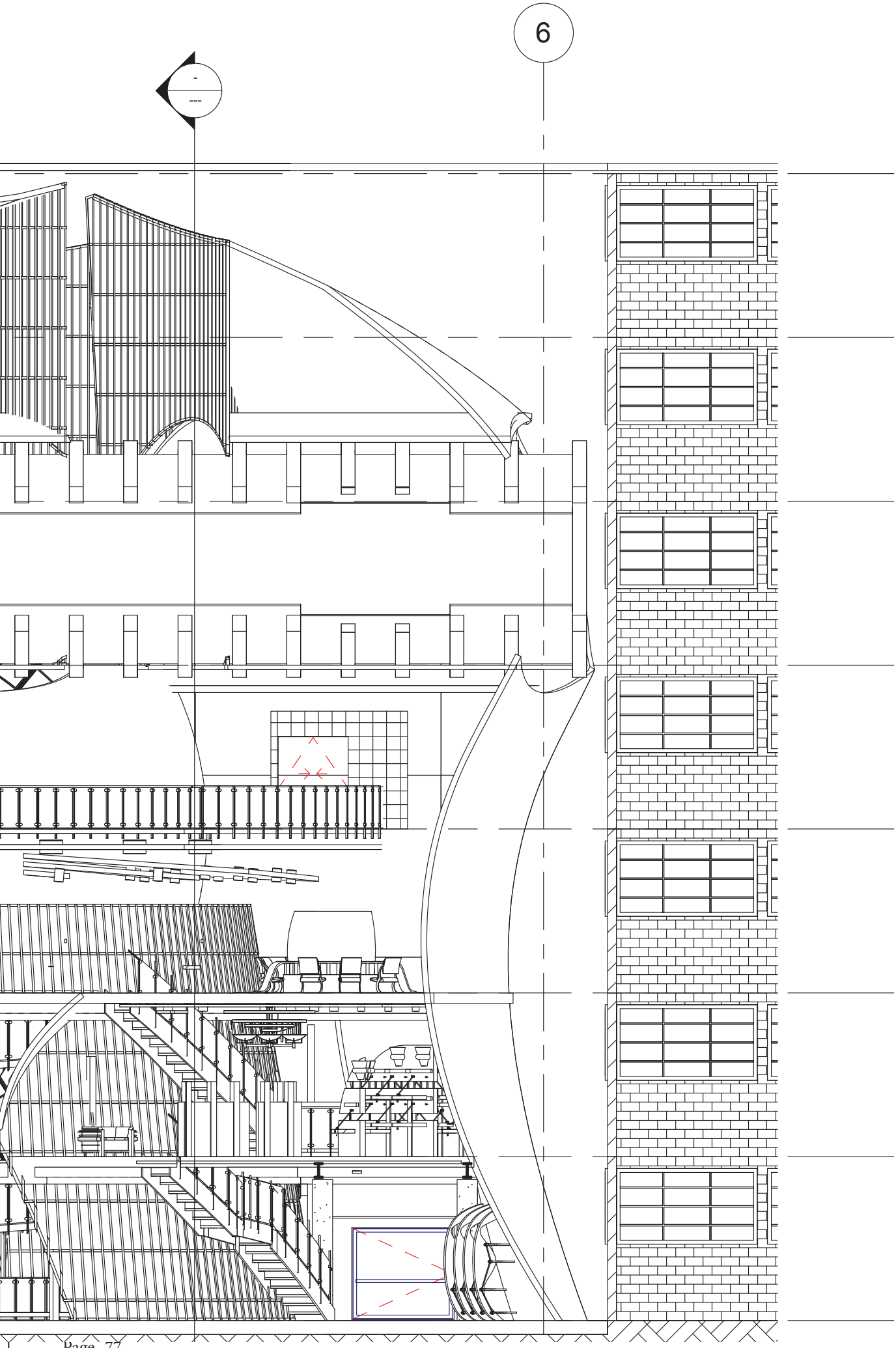


Figure 87: Section CC

Figure 88: Interior Render

In conclusion I have researched the principals of mixed reality and juxtaposed them to fit onto the requirements of judicial architecture. The possibilities for embedding mixed reality into the courts are all most endless. I have found that systems using mixed reality will engage the public to spend more time analysing and interacting. MR provides a transparent public awareness by displaying realistic environmental scenarios in real time. Immersive Environments, Augumented Virtuality and Virtual Reality can create a setting that gives more realistic scenarios for judicial environmental decision making. However, the technological restraints would require further development in order to implement them in the manner proposed. Finally it should be noted that whilst MR is a viable option for design I have not designed the MR systems themselves, but I have created interior architecture in which they can mutually exist.

Figure 89: Interior Render

Further research would need to be conducted with the specifics of programming and installation of some of the concepts proposed in this paper. This been said, I feel it is conclusive that a mixed reality media platform for the Environmental Courts would improve the public awareness and interaction of the judicial decision making process.

By using MR there is a chance that the lines of communication could get lost with virtual environments and for the powers of justice to become confused because of the extent of world knowledge. I have examined how the public may view the courts and to what extent the public is usually involved and to most the process is said to be a little frightening. NZ is one of the few countries in the world with a dedicated Environmental Court and yet the general public are often not aware that it exists. This may also be an indication as to the apathy of the general New Zealander and its part in maintaining the environment. This is an interesting dicotomy as well as NZ's image is that of a country that cares about its clean, green environment.

As the Courts have an anologue process, implementing new digital state of the art technology would be a daunting process and would require fine tuning. Moreover, all new technology is viewed with scepticism in the initial stages. I also have researched the technology available to MR and have created a design that would be a suitable architectural canvas in which this immersive MR centre existed. I have used the ideas presented by the researchers at Osaka and Tokyo Universities that have explored the foundations of using immaterial surfaces for projections and creating 3D and multi-- view point displays. The architecture that I have designed gives several opportunities for MR Immersion to operate. The centre Courtroom is designed to allow for fog banks to be controlled around a hemisphere. This would create a dome sense of immersion combined with HMD and Switchable Glass. The EVC A Courtroom was designed so that MR could be used for media display. I have examined the works of Haydar who showed that in education and information facilities using MR would increase time spent and repeat visits considerably. Milgram's research combined with Carmigniani's has established the principals of mixed reality. However, further research on their theories would be required to make the EVC A a viable MR structure.

This thesis has only scratched the surface of what would be involved in the physical creation of such a complex. With further development of technology however, the design and concept could be achieved.

Figure 90: Interior Render

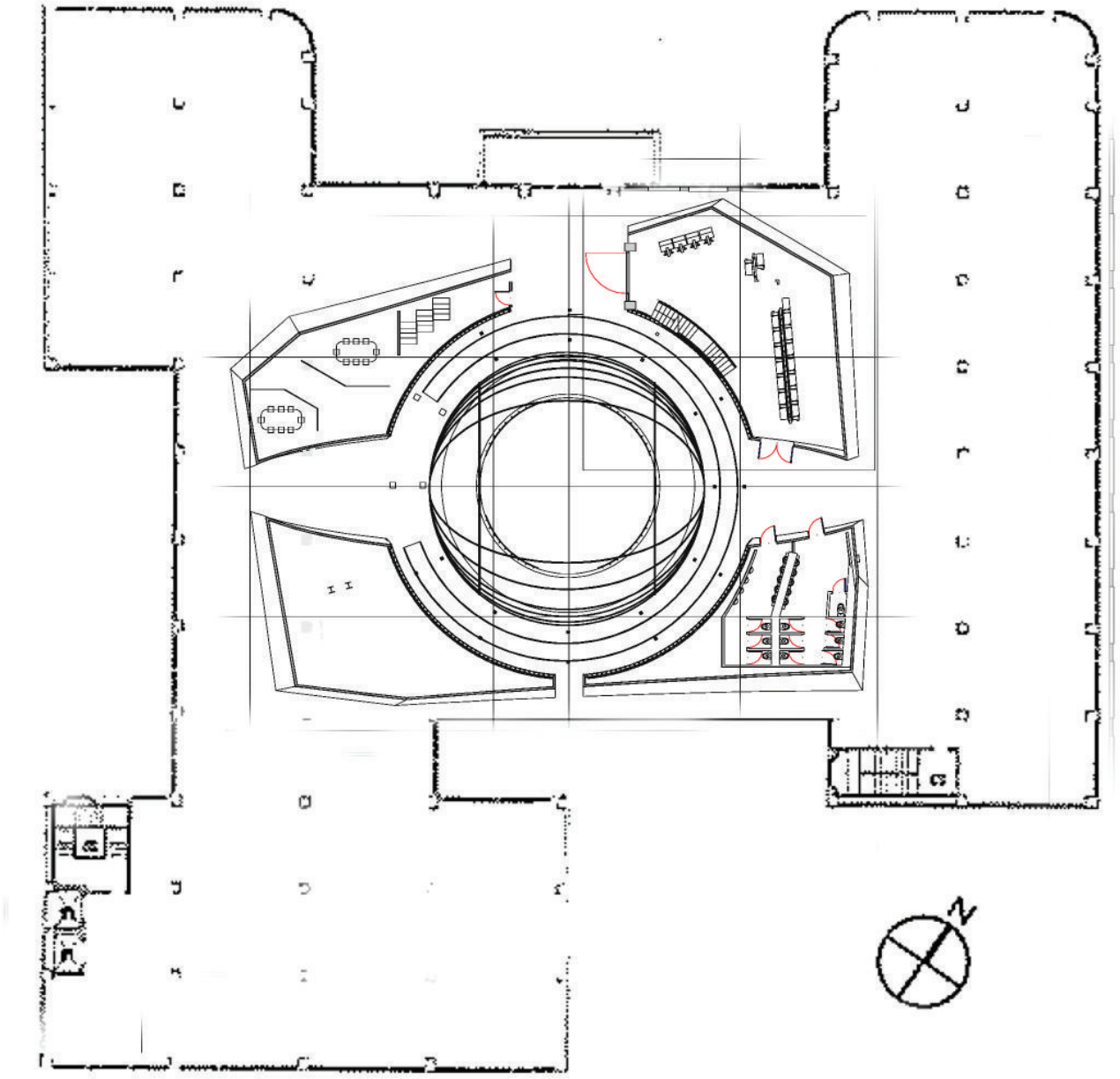


Figure 91: Plan Level 1

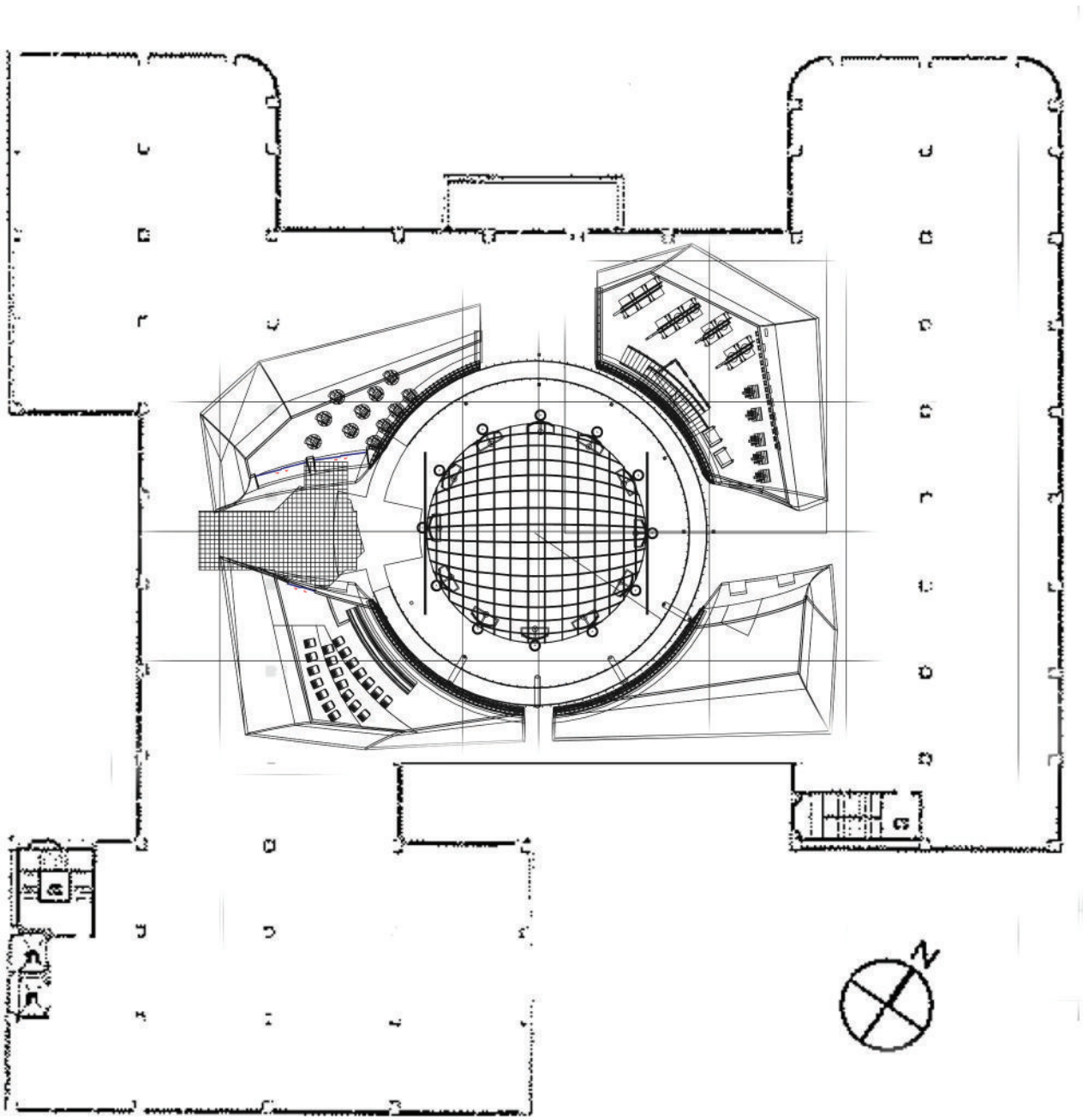


Figure 92: Plan Level 2

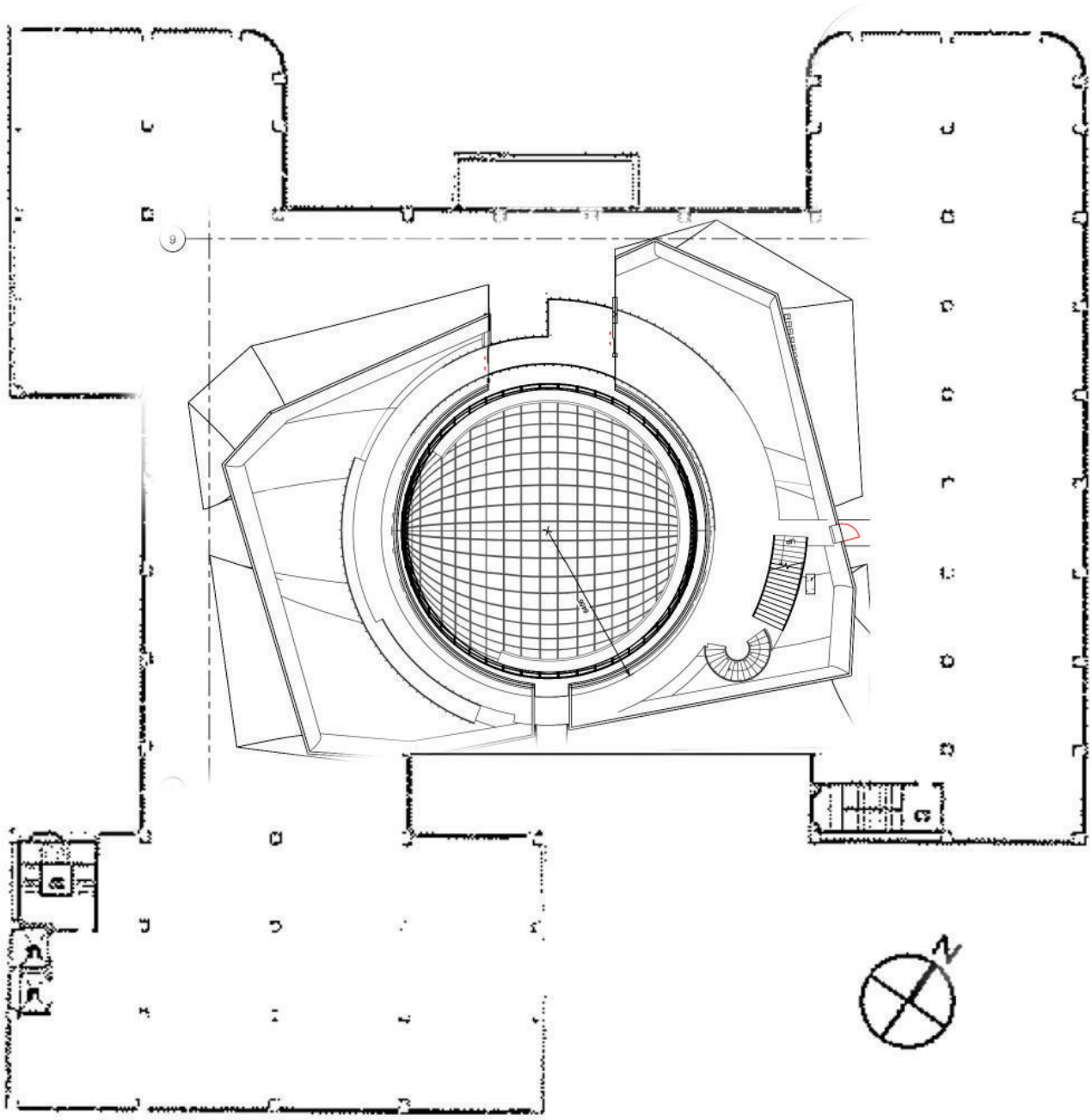


Figure 93: Plan Level 3

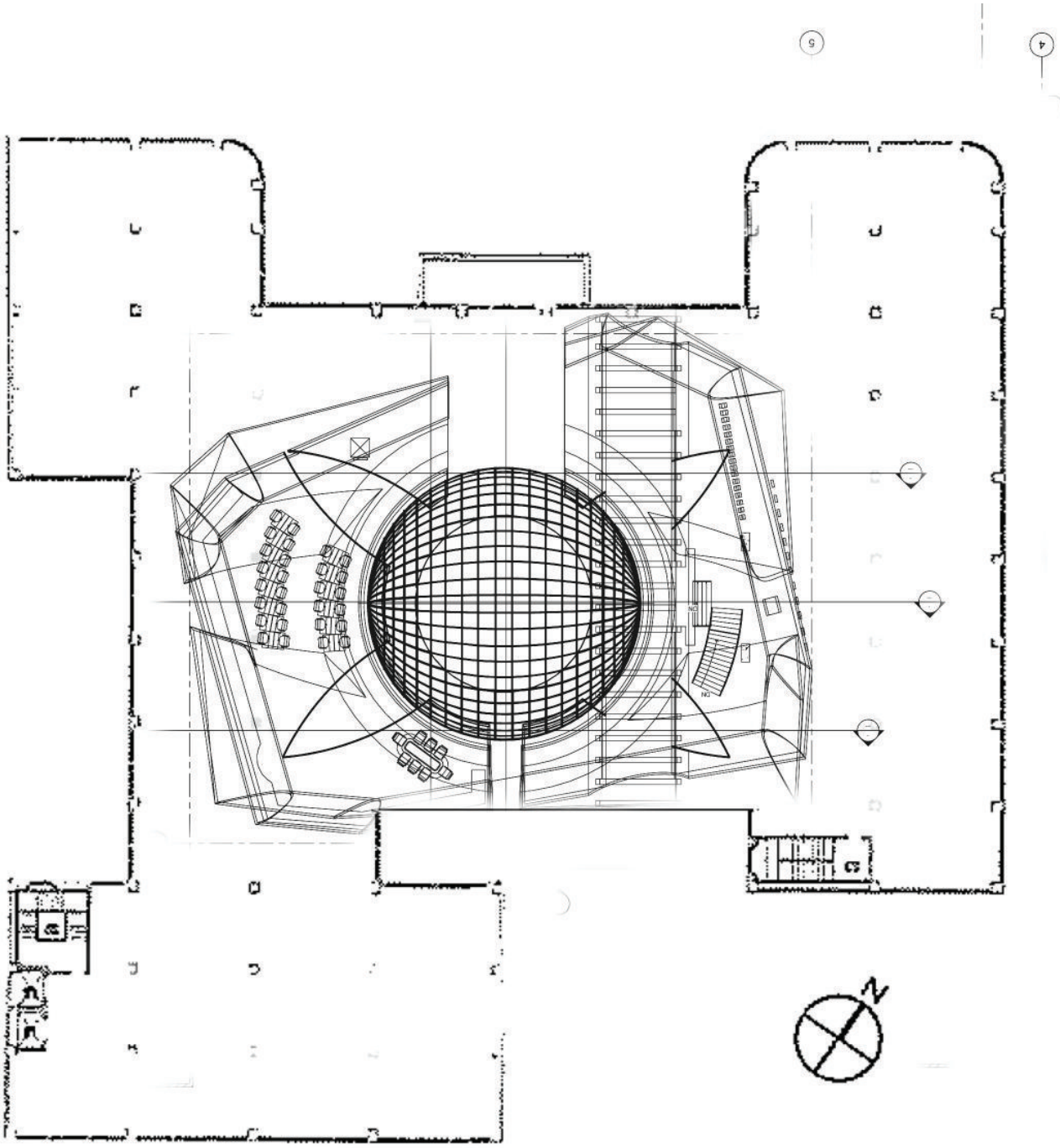


Figure 94: Plan Level 4

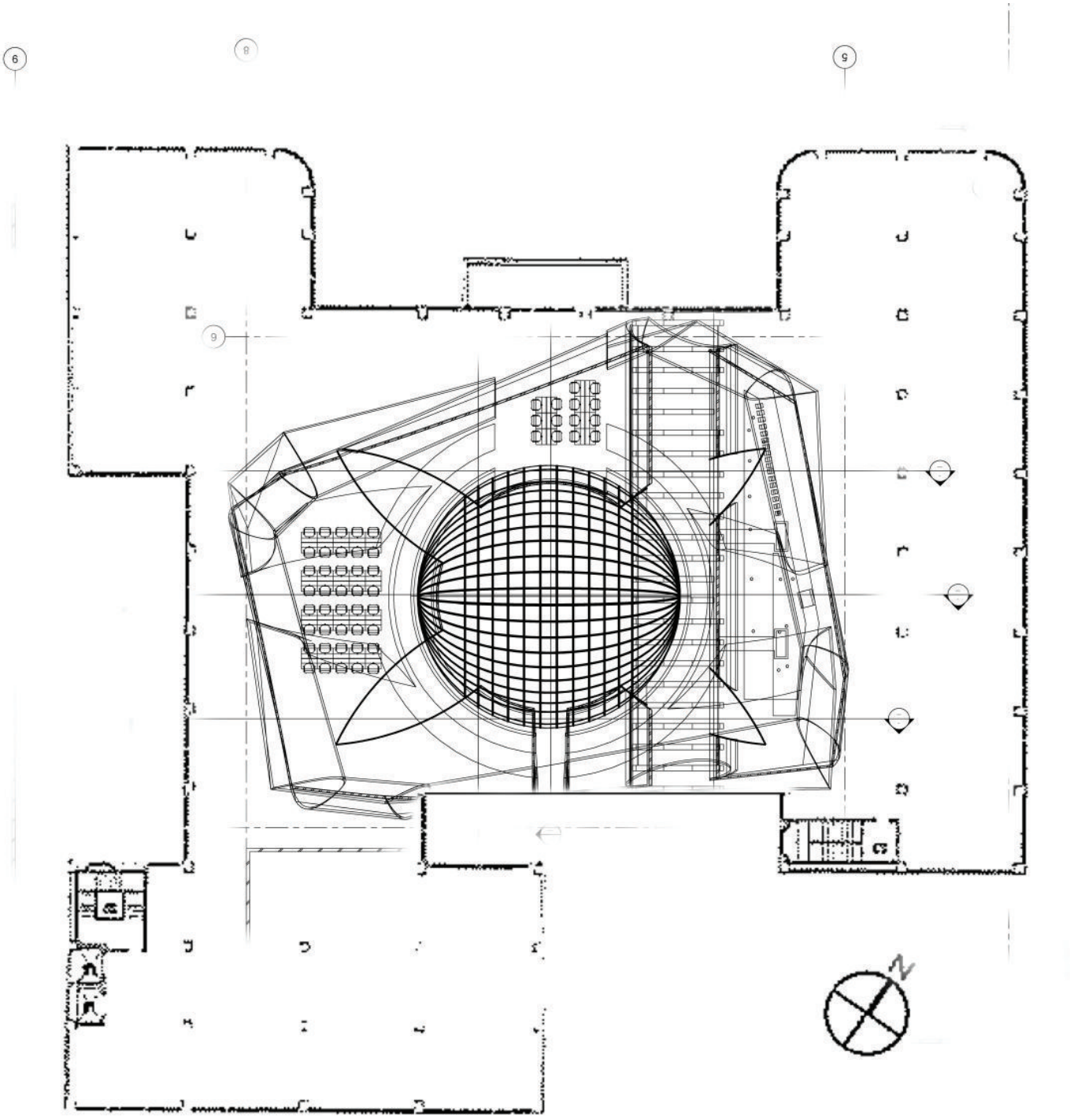


Figure 95: Plan Level 5

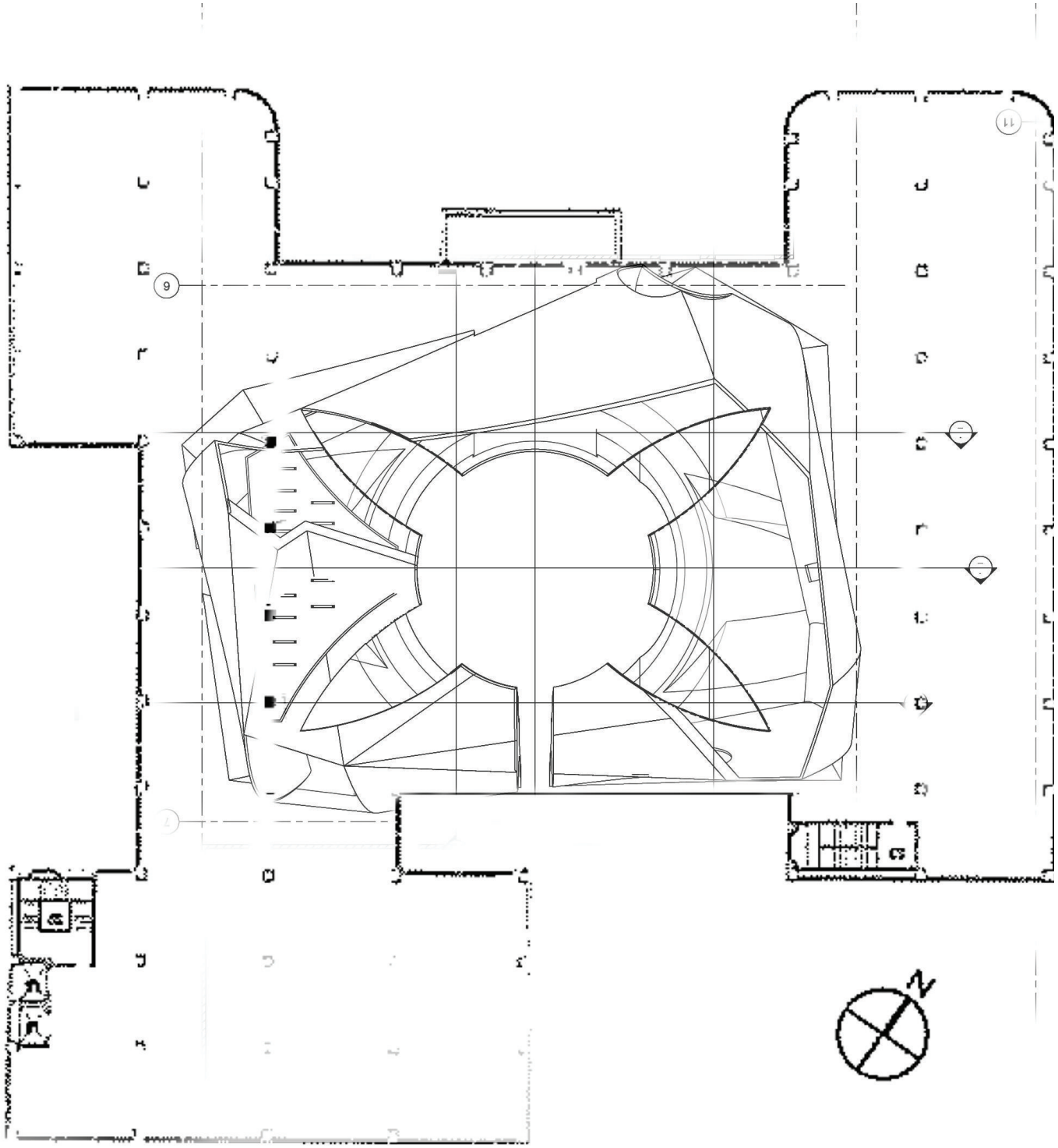


Figure 96: Plan Level 6

List of Figures

Figure 63: Sectional Render -Pye, T. 2013 Revit architecture, Photoshop. -Jpeg

Figure 64: Wood, 2013 http://wood-guides.blogspot.co.nz/

Figure 65: Granite 2013
http://www.iscga.org/selection-of-colors-for-gravestones.html

Figure 66: Concrete 2013
http://en.wikipedia.org/wiki/Aggregate_(composite)

Figure 67: Steel 2013
http://metalfabrikindia.blogspot.co.nz/2013/09/stainless-steel-railings.html

Figure 68: Glass 2013
http://extraordinaryglass.co.nz/

Figure 69: Fabric 2013
http://studio54.biz/

Figure 70: Plastic
http://commons.wikimedia.org/wiki/File:Plastic_beads2.jpg

Figure 71: Ceramic composite
http://winncad.blogspot.co.nz/2011/03/boeing-weighs-narrowbody-options.html

Figure 72: Switchable Glass
http://www.archello.com/en/product/privacy-glass-smart-glass-switchable-glass-0

Figure 73: Alloy
http://www.sunnysteel.com/alloy-industries.aspx

Figure 74: Composite Fibre
http://altairenlighten.com/2012/06/thermosets/

Figure 75: Digital Tracking
http://www.dreamstime.com/royalty-free-stock-photos-digital-map-tracking-gps-image23224958

Figure 76: Internet Networking
http://comerecommended.com/2012/02/a-monster-guide-to-online-networking/

Figure 77: GPS
http://www.scotties.co.nz/free-new-zealand-gps-maps.htm

Figure 78: Digital Interface
http://www.scotties.co.nz/free-new-zealand-gps-maps.htm

Figure 79: Hologram
http://scienceblogs.com/startswithabang/2010/03/24/is-the-universe-a-giant-hologr/

Figure 80: Atmospheric Audio
http://www.gizmodo.co.uk/2013/05/dolby-atmos-the-incredible-prototype-cinema-behind-the-future-of-movie-sound/

Figure 81: Graphic Generated Simulation
http://www.fs.fed.us/plan/par/2003/success/stories/integrated_weather_fire.shtml

Bibliography

Anders, P. (2009). Cybrid Principles: Guidelines for merging physical and cyber spaces. Internations Journal of Architectural Computing, 391-406.

Billinghurst, M. (2011). The future of augmented reality in our everyday life. Christchurch : The HIT Lab NZ, University of Canterbury .

Carmigniani, J.Furht, B. Anisetti, M. Ceravolo, P. Damiani, E. Ivkovic, M. (2011). Augmented reality technologies, systems and applications. Multimed tools Appl, 341-377.

Chapple, K.. & Sutherland, N. (2004). Handbook of Environmental Law. Wellington: Royal Forestry and Bird Protection Society of New Zealand.

Cruz-Neira, C. Sandin, D. J. & DeFanti, T. A. (2006). Tracking Users Through a Projection Screen. Tampere, Finland : Tampere University of Technology.

Dalisa, A. L. (1977). Electrophoretic Display Technology. IEEE TRANSACTIONS ON ELECTRON DEVICES, 827-834.

DigInfo. (2011, March 10). 3D Multi-Viewpoint Fog Projection Display. Retrieved March 11, 2012, from Youtube: http://www.youtube.com/watch?v=yzIeiyzRLCw

Environment Court. (2013, Feburary 27). Retrieved 02 27, 2013, from justice.govt.nz: http://www.justice.govt.nz/courts/environment-court

Frost, P. Warren, P. (2000) Virtual Reality used in a collaborative architectural design process. Interactive Institute/ Malmo University College Space and Virtuality Studio : Malmo, Sweden, 568-573

Harris, R. (2004). Handbook of Environmental Law. Wellington : Royal Forestry and Bird Protection Society of New Zealand Inc.

Haydar, M. Roussel, D. Maidi, M. Otmane, S. Mallem, M. (2011). Virtual and Augmented reality for cultural computing and heritage: a case study of virtural exploration of underwater archaeological sites. Virtual Reality, 311-327.

Kkalawsky, R.S. Stedmon, A.W. Hill, K. Cook, C.A. (2000). A Taxonomy of Technology: Defining augmented reality . Proceedings of the human factors and ergonomics society , 507-510

Liu, D. Jenkins, S.A. Sanderson, P.M. Fabian, P. Russell, W.J. (2010). Monitoring with Head-Mounted Displays in General Anesthesia: A Clinical Evaluation in the Operating Room. Anesthesia & Analgesia, 1032-1038.

Macphee, G. (2002). The Architecture of the Visible. New York : Continuum.

Milgram, P. Kishino, F. (1994, December) A taxomony of Mixed Reality Visual display. IEICE Transactions on information systems, E77 -D(12), 1-15.

Milgram, P. Drascic, D. (1997). Perceptual effects in alligning virtual and real objects in augmented reality displays . Proceeding of the human facotors and ergonomics society, 1239-1243.

Milgram, P. Colquhoun, H.W. (1999). A framework for relating headmounted displays to mixed reality displays. Proceeding of the human factors and ergonomics society, 1177-1181.

Moloney, J. Harvey, L. (2004) Visualization and Auralization of the Architectural Design in Game Engine Based Collaborative Virtual Environments, Computer Society, Auckland

NZDF. (2013, April 19). Stout Street Remembered. Retrieved 2013, from Airforce: http://www.airforce.mil.nz/operations/airforce-news/archive/93/stout-st-remembered.htm

Olwal, A. DiVerdi, S. Rakkolainen, I. Höllerer, T. (2008). Consigalo: Multi-user Face-to-face Interaction on. The Second International Conference on Intelligent Technologies for Interactive Entertainment, 1-9.

Oxman, R. (2008). Digital arcitecture as a challange for design pedagogy: theory, knowledge, models and medium . Design studies, 99-120.

Peart, R. (2007) Resourse Management Act 1991. Waitakere City : Environmental Defence Society Inc.

Penn, A. (2005). Intelligent architecture: user interface design to elicit knowledge models. Oxford: SGES Publications.

Rakkolainen, I. (2006). Tracking Users Through a Projection Screen. Tampere, Finland : Tampere University of Technology.

Rakkolainen, I. (2007). How Feasible Are Star Wars™ Mid-air Displays? 11th International Conference Information Visualization (pp. 935-942,). Helsinki, Finland: Information Visualization, 2007.

Rakkolainen, I. & Lugmayr, A. (2007). Immaterial Display for Interactive Advertisements. Tampere, Finland: Tampere University of Technology.

Schnadelbach, H.M. (2013) Mixed Reality Architecture : University College of London, PHD thesis, p2.

Skelton, P. (2004). Handbook of Environmental Law. Wellington: Royal Forest and Bird Protection Society ofNew Zealnd Inc.

Spigel, L. (1992). The Suburban Home Companion: Television and the neighborhood ideal in postwar America. Princeton, New Jearsey , United States of America : Princeton Architectual Press.

Spigel, L. (1998). Installing the Television Set: Popular discourses on television and domestic space, 1948 - 1955. Camera Obscura, 9-46.

Vision, role overview and statutory mandate. (2013, 04 10). Retrieved 04 10, 2013, from Department of Conservation : http://www.doc.govt.nz/about-doc/role/vision-role-overview-and-statutory-mandate/overview-of-docs-role/