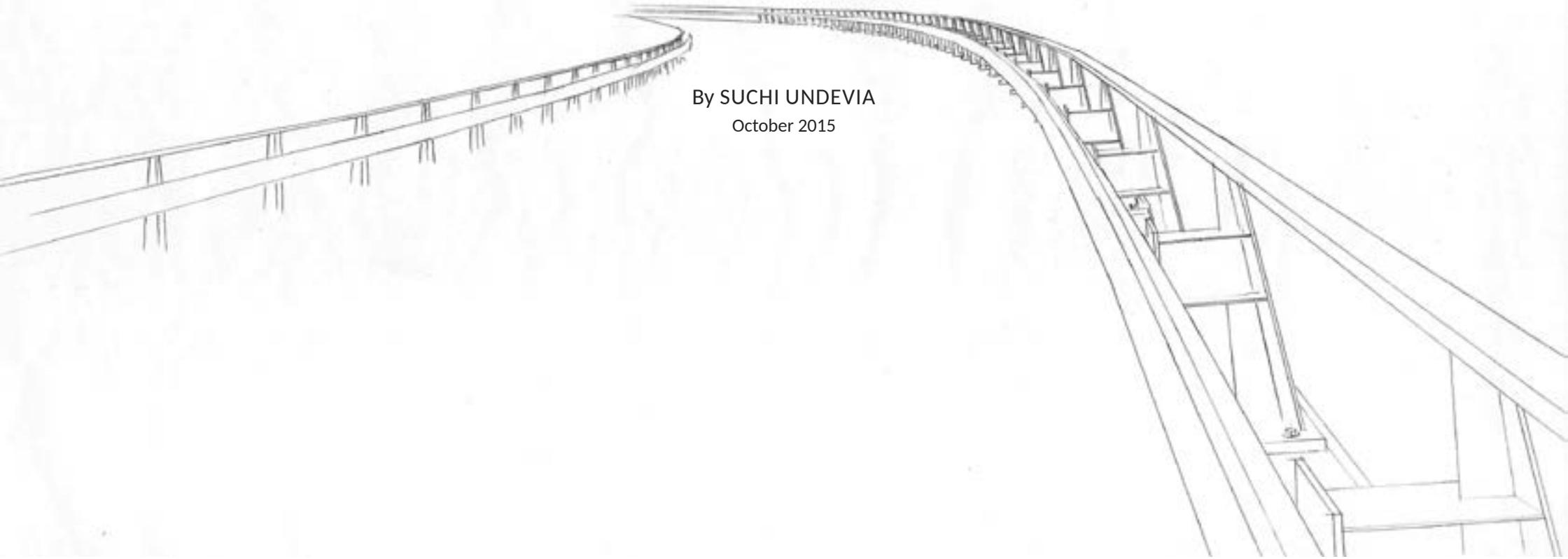


# PIT STOP:

## STITCHING TOGETHER MEDICAL FACILITY AND TRANSPORT INFRASTRUCTURE

A Explanatory Document presented to the School of Architecture at the United  
Institute of Technology in Partial Fulfillment of the Requirements for the  
Professional Degree Master of Architecture (M.Prof)

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October 2015





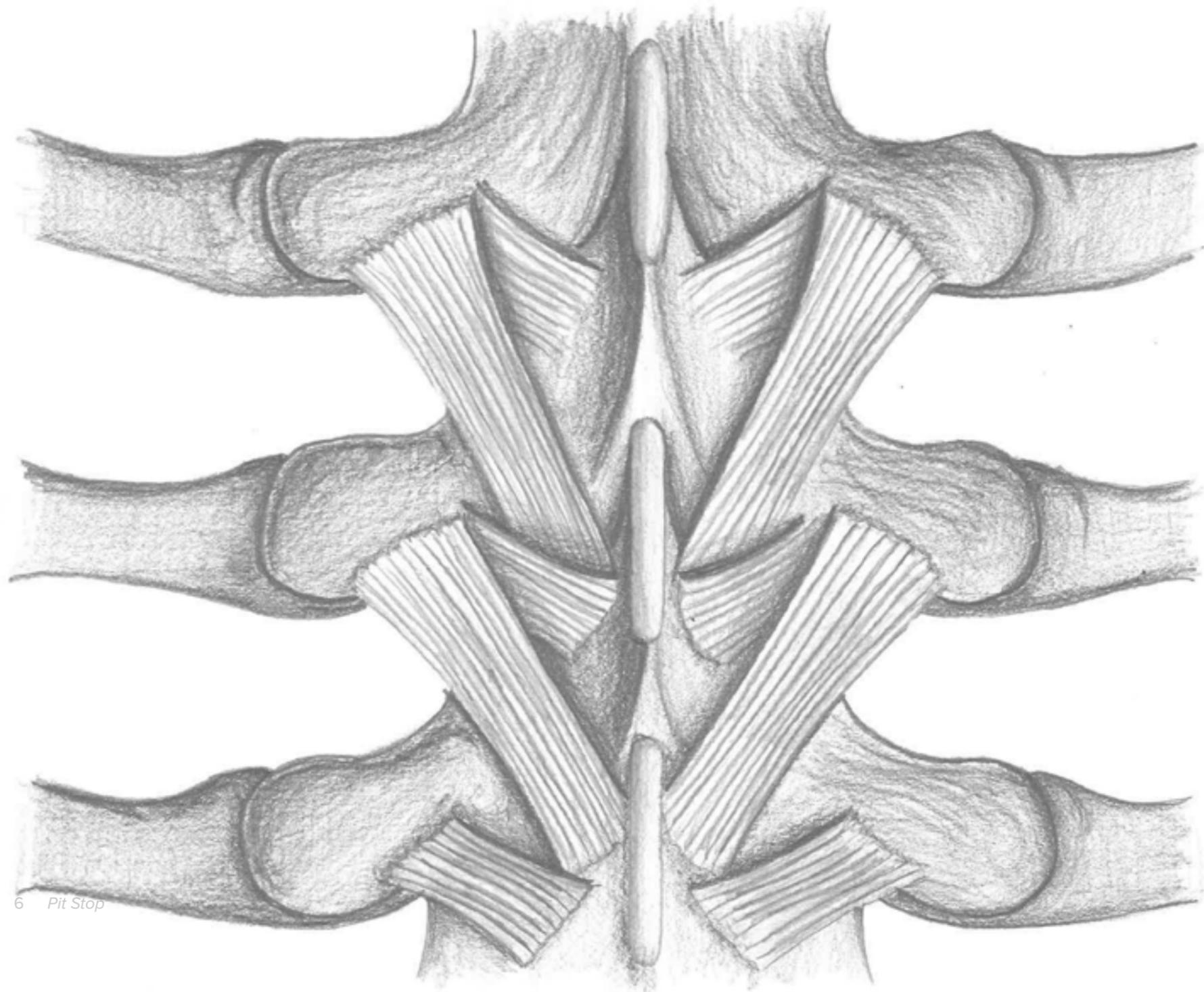
## ABSTRACT

Hospitals are a legacy of humanity's deepest compassion. They embody society values and culture. Recognized as icons of health and wellness within our society, there is no greater irony in architecture that these civic buildings have a disposition to create unlivable, uncaring, and hostile spaces. They have become places avoided by most, addressed with reluctance, and ignored in terms of conventional buildings in architecture.

The research is inspired by the growing conviction that there is a need to pursue fresh and innovative approaches to hospital design. Propelled by the idea of reviving the image of hospitals in society, and suturing the severed physical and social connections to the city, this project explores architecture's role in achieving these aspirations.

Starting from the evolution of hospitals and their physical and social impact on the city, this research focuses on the heart of the hospital, the emergency care services. With its roots in military medicine, civilian emergency services perform a vital role in our society. A design proposal derived from the research findings for an accident and emergency center in Auckland is presented as a test-bed for architectural speculation and future debate on hospital design. This is a project aimed at achieving a more architecturally expressive and empowering image of healthcare and its reinstatement within our city's infrastructure.

This research seeks to convince students and healthcare professionals of the great artistic and cultural tradition of a hospital as a work of architecture.



## TABLE OF CONTENTS

## ACKNOWLEDGMENTS

### INTRODUCTION

The Critical Question	15
Project Outline	16
Objectives	16
Scope and Limitations	17

### CHAPTER ONE: THE CHRONIC SYMPTOMS

Institutional	20
Monumentality	25
Complexity	27

### CHAPTER TWO: ADMITTING THE HOSPITAL

Decentralizing the Hospital	32
Emergency Department Introduction	34
Emergency Department Military History	35
Important Concepts from History	46

### CHAPTER THREE: PRECEDENT STUDY

The Royal Children's Hospital	50
The Akershus University Hospital	52
Ponte Vecchio	56
Galata Bridge	59
Visual Influences	60

### CHAPTER FOUR: HOSPITAL DIAGNOSIS

Defining the Problem	64
Programme	77
Emergency Department Spatial Considerations	78
Patient Flow	80
Site	84
Major Decisions	88
Motorways	90
Virtues of the Road	92
Site Analysis	94

### CHAPTER FIVE: ARCHITECTURAL TREATMENT

Initial Design Response	110
Core Facilities	117
Reflections	132

### BIBLIOGRAPHY LIST OF FIGURES

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To my parents, for their encouragement, support, and forbearance throughout my years in architecture school.



Fig 1. Auckland City Hospital public lobby.

## LAMENTATIONS

*Studying an incredible number of buildings throughout my years in architecture school I could not recall a single hospital design that I knew in detail, let alone one that has captured my admiration. Before undertaking this research my awareness of hospitals was limited to the displeasure of being in them.*

*There is a inherent dullness that runs deeper than its lifeless corridors, boring walls, and furnishings that try to disguise the joylessness of the space. This atmosphere permeates our behavior and leaves a permanent imprint on us, whether we are patients, staff, or visitors. It is unavoidable. Spending time in these hospitals feels similar to imprisonment.*

*Designed to function as machines, they hardly respond to how we feel in them. It is quite a failure of our discipline when these institutions feel similar to prisons even though they are suppose to be symbols of human compassion.*

*You never hear anyone express how beautiful hospitals are or show any enthusiasm for what they represent.*

*Its unheard of isn't it?*



**Fig 2.** The typical largeness, institutional complexity, and isolation often found in hospital places: Arcbitectenbureau Swinkels en Salemans, in Vijverdal Maastricht, the Netherlands, built between 1968-1973.

## INTRODUCTION TO A CURIOUS TYPOLOGY

Architecture is a fundamental ingredient in the environment and people create it for themselves. Buildings not only answer our most essential needs, but also are symbols of culture and human endeavor.<sup>1</sup> Every architectural typology, beyond its form and function, participates in a unique evolution within the discipline as the designer of culture, in relation to its position of context and design.<sup>2</sup>

In the same vein of thought, a society's self-identity about health and the enhancement of wellbeing is expressed in civic structures. Hospitals have been purposely distinguished in their function to provide care, with architecture deployed as an instrument to make that process visible. Today the schism between architecture and design of hospitals is being uncovered in its conflicting role with several paradigm shifts of our society.<sup>3</sup>

Like most civic structures, hospitals are considered public spaces; we find ourselves in them at least once in our lifetime, whether it is for treatment or to visit a loved one. Often sidelined by other civic buildings, hospitals have always been regarded as complicated buildings and seldom exciting passion within the mainstream architectural community.

Within the complex city fabric, hospitals are the places for health, and represent the secure infrastructure of a stable society. The impression of the public, however, is often ambivalent or negative and associated with monumentality, labyrinthine plans, and joyless spaces with harsh lighting. Hospitals demonstrate how our society treats its citizens once they have fallen victim to illness or injury. In previous times hospitals performed a civic role within communities: in modern times they have been transformed into institutional, function-driven complexes, isolated from the surrounding urban tissue, hiding their medical processes. Consequently, these spaces remain largely ambiguous to the common person.<sup>4</sup>

1 Alex Anthony Baker, Richard Ilewelyn-Davies, and Paul Sivadon, *Psychiatric Services and Architecture*. (Geneva: World Health Organization, 1959), 9.

2 Noor Mens and Cor Wagenaar, *Health care Architecture in the Netherlands* (Rotterdam: Nai Publishers, 2010), 7.

3 *Healthcare Architecture in the Netherlands* (Rotterdam: Nai Publishers, 2010), 277.

4 Cor Wagenaar, *The Architecture of Hospitals*, (Rotterdam: NAI Publishers, 2006).p.15.

Medicine is an ever-changing scene; there is no other example of a discipline in which the relationship between function and design is so crucial. The experience of healthcare has evolved well beyond the reliance on medical treatment and now invites influence of the spatial qualities and facilitation of interaction in place. Yet, demands for comprehensive, patient-centered healthcare is largely unrecognized by hospital architecture today. Advances in technology and medicalization are often tethered to efficiency while design is an afterthought. The commercialization and industrialization in delivery of care dehumanizes and depersonalizes the inhabitant.<sup>5</sup>

Hospitals today sit isolated amongst in urban landscape. They are islands surrounded by an infinite number of associated medical facilities where the main core of the hospital is lost in a maze of constant successive expansions. These large institutions create a physical disconnection with the surrounding urban tissue. The physical disconnection causes the relationship between the patients and their outer social networks to disintegrate, making them vulnerable to social isolation.

The initial conception of the research was to humanize the institutional nature of the medical facilities and to integrate them further into well-established civic infrastructure. Architecture and society cannot be distinguished as two isolated entities; they are interdependent. Therefore, a provocative but grounded move would be to reveal a medical facility expressing this overlap. The hospital should not be an isolated entity but instead should be implanted and sutured into a multi-functional urban infrastructure. This would encourage a greater social connection for patients through direct or indirect contact with their surroundings, providing a feeling of inclusion, significance, and an innate feeling of belonging to a larger entity, whilst returning the medical facility's architectural presence to the city.

## THE CRITICAL QUESTION

How can architecture facilitate the integration of a medical facility into the social and urban infrastructure?

Hospitals around us are a dramatic failure and architectural graveyards, and eventually this calls for paradigm shifts to redeem their well-intended nature. The central focus of this research is to change the attitudes towards hospitals to reclaim and reinforce their original purpose in society by integrating them further into our urban fabric.

## PROJECT OUTLINE

This project sets out to create architecture that bridges the gap between the medical establishment and the urban infrastructure. By establishing an architectural presence, the general public will gain awareness of the hospital's influence in society through a direct and daily experience. Consequently the result will be to open the public eye to a programme that is usually hidden away, removing fearful connotations. This research therefore focuses on two things; the patient's experience and the general public's perception. It investigates how the design of an Accident and Emergency facility can be integrated within our civic infrastructure, empower the patient and to inform the general public.

## OBJECTIVES

Hospitals have become outdated. They are far behind in the development of other typologies, such as offices and shopping centers. The need to redefine attitudes towards hospitals is long overdue. This project explores ways of developing spaces that foster direct and indirect social and physical interactions between users of medical facilities and the general public.

The central focus of this project is to design an alternative architectural approach for a medical facility, and furthermore, to investigate, through design, the integration of that medical facility into a multifunctional, urban setting. It attempts to integrate those requiring medical treatment into the urban fabric and its surrounding physical and social networks. The report investigates the methods of breaking down the rigid architecture of medical campuses. This explanatory document will illustrate the formal and theoretical methodology employed in response to the research question, grounded in the existing state of knowledge within the field of architecture and healthcare, and in line with precedents that demonstrate such characteristics. This will be concluded by a critical analysis of the design process and the theoretical framework used to achieve the architectural solution.

## SCOPE AND LIMITATIONS

This research is not a technical handbook that accepts that the medical facility as a prescribed component of the healthcare system. Rather, the project conveys a conceptual approach focusing primarily on the architectural problem of de-institutionalising the medical facility by fragmenting and increasing its integration with transport infrastructure. Research on the spacers required for an accident and emergency facility and their spatial relationships to one another has been documented within the programme section. However, the standard regulations are not determining influences on the design. The design will not just consist of a practical solution to certain programmatic requirements. Instead of providing an accepted functionalist presence between the facility's functional programme and its form, in the context of this research the designs will emphasize a concept that mediates programme and form. Due to the scale of this research project it cannot be considered fully conclusive as to full characteristics, strict regulations, and implications of the architecture of a hospital. Rather it serves as an indication of possible direction for future research.

## DEFINITIONS

### KEY WORDS USED IN THE BODY OF LITERATURE

#### HOSPITAL

The hospital only took on its modern conception as an institution providing medical and surgical care and nursing for ill or injured people during the sixteenth century. Its history can be traced back to the Middle Ages from the Latin “hospes” which refers either to a guest or to the host who receives the guest, and from hospes the Latin adjective hospitalia—an apartment for strangers or guests, from which the medieval Latin hospitale derived.<sup>6</sup> The hospital, hostel and hotel all derive their name from hospitium – a guesthouse – and have common origins in the dwellings that monks kept for passing travelers.<sup>7</sup>

## CHAPTER ONE

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# THE CHRONIC SYMPTOMS

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6 Wagenaar, “The Culture of Hospitals,” 26.

7 Abram de Swaan, “Constraints and Challenges in Designing Hospitals: the Sociological View.” In *The Architecture of Hospitals*, ed. Cor Wagenaar (Rotterdam: Nal Publishers, 2006), 92.

## INSTITUTIONAL

The neglect of human features in hospital architecture has its foundations in the rather insensitive nature of modernist science. The twentieth century has witnessed the triumph of medical science, which in turn, has made modern hospitals their legacy. Hospitals are centers of bureaucratic power and institutional healthcare that have lost their inherent design attitude. This stagnancy has participated in the uniform look of hospitals.<sup>8</sup>

Institutionalization is an element of all professional, specialized activities. They are a result of specialization. In this research the word 'institution' refers to a multitude of government and public healthcare services. These institutions are organized, patterned, and enforcement bodies which claim to respond to the needs of the general public. They are autonomous bodies in which they grow and function in a pattern of social self-organization. The institution of healthcare include formal establishments such as hospitals and clinics which are understood as institutions, and also subjective impressions, which may help those who are ill regain their health.

Innovations in powerful medical technology have encouraged the establishment and growth of medical institutions. They are a comprehensive network of medical services, situated within an area, which have an important role in enabling medical treatment to evolve, improving quality of life. Over time these hospitals have grown larger and have established within them, their own macro and micro physical and social environments. Built to deal with the expectation of growth, mass, standardization, and universality, they have come to represent the physical and financial embodiment of the value government places on healthcare investment for the citizens.

The roots of the institutions are well intended, while the architectural failures lie in their regulations and rigid mind set of governing and restricting its architecture. Centralizing various specialties is effective and also promotes creativity, but these large establishments have become disconnected from the surrounding urban fabric of the city. They may have brought the specialists together but they have at the same time isolated the patient, the main intended beneficiary of the institution.

8

Cor Wagenaar, "The Architecture of Hospitals." In *The Architecture of Hospitals*, ed. Cor Wagenaar (Rotterdam: Nal Publishers, 2006), 14.



**Fig 3.** Auckland City Hospital main building representing the uniform facades and lack of public connections, social or physical.



**Fig 4.** Auckland City Hospital main building central atrium. The atrium has minimum landscaping and natural lighting providing through the roof.

**Fig 5.** Auckland City Hospital main building central atrium showing the bridges spanning the atrium and exposed lift tracks.





**Fig 6.** Middlemore Hospital campus in Auckland. The Aerial view shows the immense size of the hospital establishment and its isolation.

## MONUMENTALITY

While institutions are characteristic of all professional and specialized activities, they are often distrusted and this quality is often blamed on their institutional character.

The monumental size of hospitals is the result of centralizing all specialties under one roof. The continuous addition and expansion of these structures means that the human scale is lost. The institutional structures are the product of building at an inhumane scale. The immense size and depth, of most hospitals and their deep plans, has disintegrated all connections. The exterior skin no longer displays the internal functioning of the building. The separation of appearance and operation has resulted in hospitals being described as miniature cities, focused inwards, rather than integrating with the urban tissue around it.<sup>9</sup>

Large hospital buildings promise a spacious atmosphere and attempt to adapt to the constant and ever changing healthcare landscape.<sup>10</sup> The objective to provide structures that can accommodate these constantly changing requirements has promoted an infinite internal flexibility and universality of stacked patient wards with supporting floors to prevent traffic flows from crossing one another. Hospitals have become confusing and progressively reactive to external determinants.<sup>11</sup> Although they are not completely identical, they often embody the attributes of a universal hospital building that does not address the surroundings and possibly can be placed anywhere. These structures are segregated from their surrounding context, have become independent entities, contributing to their isolation. This in turn results in the isolation the inhabitants, the patients.

The principles of modernity and monumentality are linked to the need for standardization, which promotes the ability to mass produce components or even entire buildings. The basic elements become identical, the immense scale of the structure becomes pronounced, and the wards become standardized.<sup>12</sup> Increasing research shows that logistical issues which

9 Stephen Verderber, *Innovations in Hospital Architecture*, (United Kingdom: Taylor and Francis, 2010).p.119.

10 Mens and Wagenaar, *Healthcare Architecture in the Netherlands*, 48.

11 Stephen Verderber, "Hospital Futures: Humanism versus the Machine." In *The Architecture of Hospitals*, ed. Cor Wagenaar (Rotterdam: Nai Publishers, 2006), 78.

12 Mens and Wagenaar, *Healthcare Architecture in the Netherlands*, 155.

arise from having an entire range of medical services under one roof not only generates large masses of traffic, but also disintegrates the functional relationships between the intended specialties. Although historically, the notion of an institution promoted the concentration of different specializations and accessibility of information in one place, in modern times where information can be exchanged wirelessly, physical location and distances have become less relevant. This suggests the move towards unraveling the rigid programme of these huge hospitals.

Large hospitals or medical campuses located on prominent urban sites compete with surrounding civic landmarks and educational architecture. The immense scale of the hospital buildings may be beneficial, but the sheer size is perceived negatively.<sup>13</sup> Addressing hospitals particularly, the monumental scale does not convey the visual rhetoric of wellbeing and health. Rather, it conveys the rapid growth of demand for medical treatments in a more intrinsic separation with the concept of institutions of the past.<sup>14</sup> The monumentality has contributed towards the uniformity of hospitals. A large hospital today is faceless, has no identity, a clear main core, or periphery, and has become recognized as a physical presence of the morbid nature of human existence.<sup>15</sup>



**Fig 7.** Auckland City Hospital building. The only physical connections of this building are within the campus itself.

## COMPLEXITY

Hospital architecture extends well beyond an accommodation of processes. This is most evident in the internal logistical organization which is one of the main drivers in hospital architecture. In certain cases, hospital architecture appears threatening as it is perceived as a system, rather than a set of spaces.<sup>16</sup> The focus on the accommodation of processes over making spaces that respond to how we feel has meant that innovation is focused in the search for generic models with high adaptability which responded to the requirements of clinical models and operational strategies. This has eventually led to hospitals that are extraordinarily complex that the creative freedom we see in other typologies is suppressed, and design is sacrificed to the implacable demands of optimizing clinical efficiency.<sup>17</sup> Hospitals therefore became structures rather than buildings, and they present solutions not to formal architectural problems, but rather to continuous future expansions.

This rational and functional approach dehumanizes people, making them feel lost and inadequate for not understanding or relating to their environment. The significant increase in complexity of medicine is often confused with the need for machined architecture. Healthcare processes are complex but the architectural processes and their evolution need not be similar to healthcare processes; rather they depended on the interpretation of the present situation.<sup>18</sup>

Medical campuses are similar to islands, surrounded by a myriad arrangements of other facilities. They lack clarity of form. They are anonymous boxes joined by a system of invisible mechanical connections and visible walkways, ramps, and garage. The hospital therefore becomes a machine where the emphasis is on functions, routing traffic, and clustering. This type of functionalism where forms are articulated for maximum external flexibility, in turn leading to hospitals existing as pure structure substantiated in corridors, atriums, and entrance halls.<sup>19</sup> The complexity of these hospitals also means that it is hard to improve current hospitals to conform to newer models of care. The overall environment of the hospital suffers as the buildings grow from a single structure to an addition on an addition. This functional and rational approach to design occupies an immense amount of space and

13 Wagenaar, "The Culture of Hospitals," 23.  
 14 Logan, Cameron. "The Modern Hospital as Dream and Machine - Modernism, Publicity and Transformation of Hospitals, 1932-1952." *Fabrications* 19, no. 1 (2009): 75.  
 15 Betsky, Aaron. "Framing the Hospital: the Failure of Architecture in the Realm of Medicine." In *The Architecture of Hospitals*, edited by Cor Wagenaar. 68. Rotterdam: Nai Publishers, 2006.76.

16 Mens and Wagenaar, *Health care Architecture in the Netherlands*, 7.  
 17 Prasad, "Typology Diagrams and Introduction," 3.  
 18 Wagenaar, "The Architecture of Hospitals," 12.  
 19 Mens and Wagenaar, *Health care Architecture in the Netherlands*, 230.

increases walking distances. It disguises fundamental conceptual imperfections, leading to architecture that is an imprecise response to an inaccurately formulated problem.<sup>20</sup>

Medical technology has evolved to instill a degree of confidence in the public's v the hospital's ability to provide the best treatment. While progress towards our ability to cure chronic diseases, people need to be treated in environments that aid the healing process. Historically, technology was the justification for complexity. Today, locating all the medical facilities in one area is not necessary to provide the best care, as technology has become more streamlined, wireless, and portable. Technology now enables us to break down the complexity of the traditional hospital, and at the same time to humanize the hospital by reducing its monumentality. Technology is best applied when it aids, but does not direct, human life: rather it is a tool for accomplishing more with less. Hence exceptionally high levels of complexity are no longer required.<sup>21</sup>

Providing a place where patients can receive treatment and support is a relatively simple objective. This is evident in the design requirements for patients staying overnight which is hardly more difficult than hotel accommodation. The complexities lie in the institutionalization of the medical facilities and their centralization, where hospitals have become manifestations of the healthcare system itself.<sup>22</sup>

The architecture of hospitals and the attitudes of designers have been so deeply entrenched in universal generalizations that opportunities for a forward-thinking strategy have been ignored. Before we can define what hospital architecture could or should be like today, one must first overcome the chronic symptoms of hospital architecture.

20 Mens and Wagenaar, *Health care Architecture in the Netherlands*, 227.

21 Wagenaar, "The Architecture of Hospitals," 12.

22 Wagenaar, "The Architecture of Hospitals," 12.

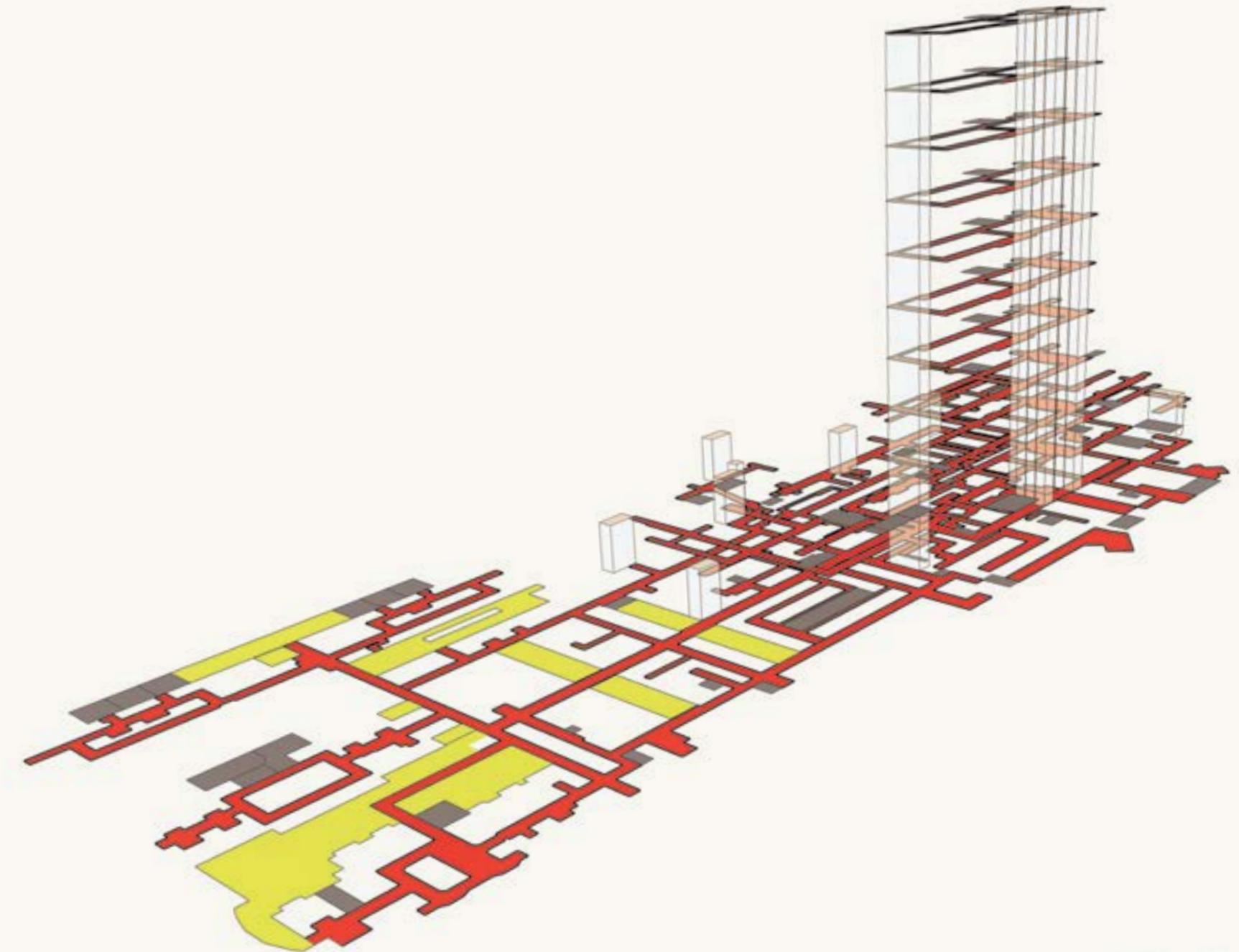


Fig 8. North Shore Hospital model illustrating the maze of courtyards, waiting spaces, vertical, and horizontal circulation.

## CHAPTER TWO

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# ADMITTING THE HOSPITAL

## DECENTRALIZING

Hospitals in no way reflect an architectural contribution towards the civic realm. The manner in which hospitals are situated within the urban tissue reflects their relationship with society,<sup>23</sup> they are isolated islands either located in dense urban settings or on green field sites away from town centers.<sup>24</sup> They tend to become self-centered and large, scaled as more functions are added to the outside, closing off the outer envelope. Retail infrastructure hubs with auxiliary spaces such as car parking are located at the periphery and function intentionally or unintentionally as barriers, with decreasing accessibility to the outside world. The outcome is a reclusive and introverted environment that feels oppressive to inhabitants and in the greater context, socially isolated and an uncaring place.<sup>25</sup>

The hospital needs to include all the necessities of the programme, but it needs to break away from its fixed mould. Unraveling the hospital and investigating its functions included within is a step towards understanding the underlying problem. The concept of decentralizing the hospital is not a new one. It includes breaking apart the medical campus and relocating supporting services, hospital units, and ancillary functions off site. Overall, reducing the total volume of the hospital complex.<sup>26</sup> Functional decentralization can be defined as a system-wide redistribution of services to community based settings and redefines the concept of hospitals. The future of healthcare predominantly takes place in community settings, rather than medical campuses, incorporating high levels of social and physical engagement into the community.

The relationship between the various programmes within the hospital is more institutional than functional. Certain functions are already separated into adjacent buildings within the hospital campus, but due to their proximity to other medical services they struggle to connect physically with the outer surroundings. Fragmenting the hospital's infrastructure can significantly reduce the effects of institutional nature of the hospital's infrastructure.<sup>27</sup>Smaller separate medical

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23 "The Architecture of Hospitals," 18.

24 Prasad, "Typology Diagrams and Introduction," 8.

25 Christian Salewski, "Spaces for Coexistence," In *Open City: Designing Coexistence*, ed. Kees Christiaanse, Tim Rieniets, and Jennifer Sigler (Amsterdam: SUN Publisher, 2009), 153.

26 Stephen Verderber, "Hospital Futures: Humanism versus the Machine." In *The Architecture of Hospitals*, ed. Cor Wagenaar (Rotterdam: Nal Publishers, 2006), 78.

27 Wagenaar, "The Architecture of Hospitals," 17.

facilities create a more humane environment for the staff and patients. They can also be easily integrated into the urban social and physical tissue.

The city's ability to absorb new and challenging circumstances is explored in Lewis Mumford's work, *The Culture of Cities* (1938) and *The City in History* (1961). The destruction of the urban landscape usually results from ignorance of it; whenever this occurs, buildings isolate themselves from their place. In the case of hospitals, they are intruders because they destroy the surrounding urban landscape and become their own world with a total disregard of context.<sup>28</sup>

Hospitals emulate life and are the living breathing city and society. This is reflected in their composition of streets and squares. The ability of hospital infrastructure to grow and sustain communities can form the foundation of integration on all platforms.<sup>29</sup> A hospital is an urban project, therefore it should relate to the evolution of that particular landscape. Designing buildings that repeat the city structure and recognize its capacity to change require a certain degree of fragmentation. Buildings that acknowledge the surrounding context hardly ever take form of monolithic blocks.<sup>30</sup>

There is a degree of tension between the two completing objectives: centralizing versus distributing the hospital services. Economically, centralizing all the services is justified by the ability to link various different specialties, efficiency regarding equipment use, and the economic and iconic image of the powerful hospital. Advances in medical and communication technology have now enabled us to provide more localized and responsive care. Technology has progressed to a point where doctors do not need to be in the same country in order to treat a patient.<sup>31</sup> Smaller hospital units can be located closer to where people live and work. It also opens up possibilities of infilling sites that can possibly increase intensification in a city like Auckland.

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28 Cor Wagenaar, "The Culture of Hospitals." In *The Architecture of Hospitals*, ed. Cor Wagenaar (Rotterdam: Nal Publishers, 2006), 24.

29 "The Architecture of Hospitals," 24

30 Wagenaar, "The Architecture of Hospitals," 17.

31 Stephen Verderber, *Innovations in Hospital Architecture*, (United Kingdom: Taylor and Francis, 2010).p.105-106.

## ACCIDENT AND EMERGENCY DEPARTMENT INTRODUCTION

Hospitals have developed to embody the pinnacle of science and technology. In the developed countries, there is a growing need to adapt to an ever changing diversification of health issues; aging population, chronic illnesses, and mental health are some of the few.<sup>32</sup> Increasing awareness of personal health, preventative care, and a thirst for knowledge of workings of human anatomy have long been a preoccupation of advanced cultures. This specialization and privatization of different streams of medicine reinforces the greater distribution of reduction of scale.<sup>33</sup> The need for reducing social isolation is strongly linked to the objective of social reintegration of people with illnesses or injuries. It requires hospitals to be well-connected with surrounding communities. Designs that reflect and foster this relationship with the surrounding social and physical infrastructure can convey a sense of civic pride within the community.<sup>34</sup>

Economic, scientific and societal changes over the past three decades have been the fundamental catalysts for the advancement of contemporary emergency medicine. In the scarcely colonized agricultural communities during olden times, at home medical practices represented public centered medical care with importance on infectious diseases, maternity care, and children's health. The industrialization and urbanization of contemporary societies, the economy of scale of the expanding communities, and refined machinery nurtured the formation of hospitals. High speed transportation accidents, industrial casualties, increased interpersonal violence, and aging population all added to hospital congestion. At the same time, scientific and technological developments resulted in a vast explosion of medical knowledge that the development of specialization and sub specialization.<sup>35</sup>

Emergency medicine is a new and developing field. At present, emergency care as an autonomous medical specialty is only acknowledged in about ten countries worldwide. Nevertheless, it is rapidly growing in diverse directions. It has fragmented the walls of hospitals and has spanned international borders. Most significantly, it is revealing new possibilities in the acute care elements of all other medical specialties.

- 32 Wagenaar, "The Culture of Hospitals," 31.  
33 Bogt, "Architectural Models for Decentralized Hospital Buildings," 60.  
34 Ufuk Dogu and Feyzan Erkip, "Spatial Factors Affecting Wayfinding and Orientation," *Environment and Behaviour* 32, no. 6 Nov (2000): 595.  
35 Chung, CH, "The Evolution of Emergency Medicine." *Hong Kong Journal of Emergency Medicine*, 8, 2 (April, 2001): 84.



Fig 9. Typical corridor space filled with equipment and beds in an emergency department.

## ACCIDENT AND EMERGENCY HISTORY

Man, the basic cell of acts of war is the most recognizable unit that can be used to understand military operations. He remains identical in physiology and needs throughout the centuries. The practice of emergency care is as ancient as medicine itself. Physical injuries, much like illness and disease, are an important part of human history.

### The Greeks and Romans

Greeks and Romans displayed great determination to ensure healthcare and analgesia for injured soldiers in the battlefield. The significance of providing emergency care at the location of injury was well understood by both societies.

Physicians in Greece were general public. They were educated in recognized medical establishments, for example, the institution on Kos Island, where, Hippocrates lived and practiced in the fourth to third centuries BC. Similar institutions were established on the Island of Rhodes, in Kroton and Kyrene. These physicians practiced medicine in specifically designated spaces called infirmaries after taking the Hippocratic Oath. These places were designed for the treatment of the sick, similar to today's hospitals and wellness centers. Greek surgeons used to their own offices, known as iatreaia, separate from their personal residences.<sup>36</sup> Several Greek doctors had civic appointments and practiced in an official role for the country. Their duties involved deployment and practice of medical care with the army for the injured soldiers. Homer, in the Iliad, describes aid stations giving care for the wounded in the conflict of Troy.<sup>37</sup> This is substantiated by ancient artwork and pottery images.

The Romans further advanced the Greek principles of treating the ill and injured. In the

- 36 Robbins D Vincent. "A History of American Emergency Medical Services & Medical Transportation System in America." *Monoc: New Jersey's Hospital Service Corporation*. Accessed April 10, 2015. <https://www.monoc.org/bod/docs/History%20American%20EMS-MTS.pdf>.  
37 Pikoulis EA, Petropoulos JC, Tsigris C, et al. "Trauma management in ancient Greece: value of surgical principles through the years." *World Journal of Surgery*, 28 (2004): 425-430. Accessed April 9, 2015. <http://web.b.ebscohost.com.libproxy.unitec.ac.nz/ehost/pdfviewer/pdfviewer?vid=6&sid=b4f9bae1-7521-4f68-afcc-6263611c3003%40sessionmgr113&hid=109>

first century AD, they established different structures in locations that were expected to see large scale conflict to ensure emergency treatment for injured soldiers. These buildings were rectangular structures that were similar to small villages. A temple dedicated to Aesculapius, the god of healing, was situated in the central square. Surrounding the central square series of rooms were built for the ill and injured, and several rooms for the doctors and their aides. These services were provided with fresh drinking water including bath complexes that provided hot and cold water.<sup>38</sup> Early military infirmaries were also combined with forts for in the Roman army. The Romans had the earliest known military in the world to use committed expert physicians to care for their injured. Each unit had its own doctors. Each physician had a particular specialty and also had assistants for help, often a nurse and orderly. During the time of Marcus Aurelius, the military emergency care service embraced as its emblem a serpent entwined around a wooden rod, which continues to be the symbol of medical services today. The responsibilities of Roman army physicians involved the assessment and selection of workforces, treatment of the ill, and care of the injured. Injured soldiers were transferred from the battleground to these medical establishments. Regardless of these exertions, fatality rates for the injured on the battlefield during this time reached 80 percent.

The collapse of the Roman Empire was followed by the Dark Ages, and civilization lost its understanding of the ancient sciences and culture, especially medicine. Subsequently, structured emergency care for injured soldiers was virtually absent until the Napoleonic Wars.<sup>39</sup>

### The flying Ambulance

Several historians acknowledge Baron Dominique Jean Larrey (1766–1842) with the conception of contemporary traumatology and a military system of pre-hospital emergency medical services (EMS) grounded on the concept of triage and transport of casualties. Larrey was a trained surgeon for the French Navy. He was the Chief physician and Inspector General of the Authority of the Health of the Army in 1805, until the Battle of Waterloo. He was involved in

38 Goniewicz, Mariusz, "Effect of Military Conflicts on the Formation of Emergency Medical Services Systems Worldwide." *Academic Emergency Medicine*, 20, 5 (May, 2013): 507-513. Accessed April 9, 2015. <http://onlinelibrary.wiley.com/doi/10.1111/acem.12129/abstract>

39 Goniewicz, Mariusz, "Effect of Military Conflicts on the Formation of Emergency Medical Services Systems Worldwide."



Fig 10. Fort excavated in an Archaeological expedition in the region of a Roman military camp hospital in Novae, present day the town of Svishtov in Bulgaria.



Fig 11. Opposite page: Mobile Aid, the flying ambulance by Dominique-Jean Larrey

Fig 12. Model of a Flying ambulance, Europe 1801-1850.

25 campaigns, 60 battles, and over 400 conflicts. Larrey understood that prompt emergency treatment was paramount to saving the lives of soldiers who had been injured on the battleground. Larrey assumed that reduced operating times ensued less shock to the mind and body.

A new type of emergency medical carriage was designed in 1792 by Larrey and Pierre Francois Percy (French military surgeon, baron, and professor at the military medical school in Paris). It was known colloquially as the flying ambulance. This was a nimble, well-sprung, and manoeuvrable wagon pulled by horses. It assisted to swiftly evacuate injured soldiers from the battleground to immediate field hospitals and substituted the human-powered wagons used in the past. These carriages were drawn by orderlies or horses, who were themselves unprotected to injury while en route to aid locations with the injured.

To evacuate the wounded from the front line, Larrey and Percy incorporated into the French Army a division of "ambulance soldiers" that involved physicians, non-commissioned officers, and a multitude of stretcher-bearers. Larrey resolutely reinforced the practice of providing prompt emergency care to soldiers injured on the battleground. In the Napoleonic Wars, in accordance with Larrey's sanctions, doctors would attend the wounded who were in medical aid stations situated in the surrounding area of the battleground to carry out emergency surgeries for life-threatening injuries. Larrey understood that critically injured soldiers could not remain deprived of emergency care, and therefore, field hospitals must be structured as near to the front lines as possible. For instance, during the Battle of Waterloo, Larrey formed his field medical aid station in the buildings of the farm of La Belle Alliance, 400 meters from the battle ground opportunity of evacuation or withdrawal.

Larrey opposed that care of injured soldiers should be ranked according to the urgency of their injuries and not prejudiced by rank or nationality. Those soldiers who were less critically injured should wait until treatment had been provided to the more critically wounded. Additionally, those with insignificant injuries did not need to be cared for on the battlefield and could be transferred to medical centers situated away from the battlefields as their lives were not in direct danger.

Ground breaking inventions by Larrey with initial care and rapid evacuation of wounded to field hospitals, results improved substantially, and there was a noticeable reduction in fatality

among the injured soldiers of the Napoleonic wars.<sup>40</sup> In succeeding years, the structure of casualty triage recognized by Larrey was improved to better assist the requirements of the military medical service. These doctrines of emergency triage were eventually implemented and adapted to serve the civilian EMS.<sup>41</sup>

Up until the 18th century, the system of care for injured soldiers was carried out near by the battlefield. This originated from the circumstance that previously, separate solo battles would usually decide the results of entire conflicts and the care of injured in close proximity to the battleground did not expose either workers or patients to severe danger given the reasonably small range of arms used by military forces of the time.<sup>42</sup>

### The American Civil War

The next substantial expansion of EMS and medical means of transport took place in the period of the American Civil War, between 1861 and 1865. Originally through the war, the army emergency care systems of the North and South did not provide for the removal of wounded from the frontline or their transportation to aid stations or hospitals. Surgeon General William A. Hammond acknowledged this absence in combat emergency care.<sup>43</sup> Ambulance wagons were used to take the injured from the battleground to dressing stations or field hospitals. In the meantime, bigger, four-wheeled carriage ambulances were set aside to transfer patients to general hospitals and rear echelon military healthcare establishments.<sup>44</sup>

The information, abilities, and experiences obtained while giving emergency assistance to the injured during the Civil War and consequent armed battles radically impacted the progress of

40 Blagg R Christopher. "Triage: Napoleon to the present day." *Journal of Nephrology* 17, (2004):629. Accessed April 10, 2015. [http://www.sin-italy.org/web%5Ceventi%5CSIN%5Carchivio%5Cjn%5C2004%5Cnephrol\\_2004\\_4%5C629-632%20Blagg.pdf](http://www.sin-italy.org/web%5Ceventi%5CSIN%5Carchivio%5Cjn%5C2004%5Cnephrol_2004_4%5C629-632%20Blagg.pdf)

41 Robertson-Steel Iain. "Evolution of triage systems." *Emergency Medicine Journal*, 23 (2005):154-5. Accessed April 10, 2015.<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2564046/pdf/154.pdf>

42 Robertson-Steel Iain. "Evolution of triage systems."

43 Robbins D Vincent. "A History of American Emergency Medical Services & Medical Transportation System in America."

44 Robbins D Vincent. "A History of American Emergency Medical Services & Medical Transportation System in America."



Fig 13. American Civil War ambulances. Friday, March 11, 1864; The Union Army Ambulance Corps.



**Fig 14.** Opposite page: Storage field for newly produced Dodge WC-54 Ambulances waiting shipment from the Detroit, MI factory during World War II, August, 1942.

**Fig 15.** Top Image: World war ambulances showing the red cross emblem.

**Fig 16.** Bottom Image: The WC54 Ambulance was first used by US forces in 1942.



many specialties of medicine. It accelerated the development of organizational issues, such as emergency triage and transport, and became a foundation for the expansion of civilian systems for providing early emergency treatment to wounded. Throughout the latter half of the 19th century, in America and in Europe, the requirement for establishing medical aid, not only for wounded soldiers, but also for civilian casualties, was accepted. The beginning of the Industrial Revolution saw a surge in the types and severity of injuries and created a crucial need for prehospital care of victims. It was in these establishments that civilian EMS began to take shape. Their responsibilities began with the transportation of patients to medical facilities by makeshift ambulances that originally were drawn by horses. With the improvement of technologies during the Industrial Revolution, self-propelled motorized ambulances began to appear.

An important factor in the development of civilian EMS in the America was the accessibility of medical physicians discharged from the army after the Civil War. In 1865, a prehospital EMS was, established in the Commercial Hospital in Cincinnati, Ohio (now, Cincinnati General Hospital)—the first civilian ambulance service in the United States.<sup>45</sup>

### The World Wars

Through World War I (WWI), the U.S. Army allocated non-physicians to front-line trenches for the care of the injured. These men would treat the wounded instantly at the location of injury if casualty levels were low. Or else, company litter-bearers would transport the wounded to temporary aid stations and then to their unit aid posts. At the aid station, medical professionals would further treat hemorrhage, amend bandages and splints, and inject anti-tetanus serum before transporting the injured to the battalion aid post. From there, the injured were moved to ambulance dressing locations, at the point close the battlefield that ambulances could reach. At these posts, initial placement of dressings and splints were checked if needed, and the injured were triaged for further transportation.<sup>46</sup>

45 Pozner N Charles, Zane Richard, Nelson J Stephen, Levine Michael. "International EMS systems: the United States: past, present, and future." *Resuscitation*. 60 (2004):239. Accessed April 10, 2015. <http://www.sciencedirect.com/science/article/pii/S0300957203004088>.

46 Goniewicz, Mariusz, "Effect of Military Conflicts on the Formation of Emergency Medical Services Systems Worldwide."

In WWII, while establishing medical support for injured soldiers, authorities paid more consideration to the significance of reducing the time between injury and beginning of definitive emergency care. It was perceived that reducing the time to treatment substantially decreased death among casualties. Experiences like these would be effectively used in later armed conflicts.

### The Vietnam and Korean Wars

Between WWII and the Vietnam War, the interval from injury to the start of emergency treatment was further shortened. Medical aid posts were constructed closer to the battlefield to provide injured soldiers rapid access to definitive care. In the Korean War, the injured were transported by helicopter and the U.S. Army based Mobile Army Surgical Hospitals (MASHs) near the frontlines.<sup>47</sup> This approach of providing early definitive treatment for injured was further developed during the Vietnam War (1965–1973) by transporting the injured by helicopter straight to the full service hospitals, e.g., ignoring the frontline aid stations. Fast rescue of the injured started with basic aeromedical transport (without in-air medical care) in the Korean War and developed to refined multi-casualty helicopter transportation with airborne care in Vietnam. The typical interval from injury to definitive treatment reduced from 12 to 18 hours in World War II, to 2 to 4 hours in Korea, and to less than 2 hours in Vietnam. As an outcome of this and other inventions, fatality among injured soldiers reduced to 1.7 percent<sup>48</sup>

The experiences and understanding acquired by the military again served as the foundation for modifications in the civic medical service. After the latter half of the 1960s, there was a fast improvement in civilian emergency services. The development of contemporary cardiopulmonary resuscitation and the understanding of motor vehicle accidents as a major public health issue in America have been well recorded. Modern military involvements established the benefits to wounded patients brought about by early emergency care in combination with rapid transportation to centers providing definitive care. In the more recent

47 King Booker, Jatoi Ismail. "The mobile Army surgical hospital (MASH): a military and surgical legacy." *Journal of the National Medical Association*, 97 (2005):649.

48 Goniewicz, Mariusz, "Effect of Military Conflicts on the Formation of Emergency Medical Services Systems Worldwide."



Fig 17. U.S. paratroopers carrying a wounded soldier to an ambulance helicopter during the Vietnam War, 1965.



**Fig 18.** UH-60A Blackhawk air ambulance from 508th Medical Detachment. being refueled, Logistical Base CHARLIE, Northern Province, Saudi Arabia, 7 February 1991.

Middle East conflicts in Iraq and Afghanistan, military combat medicine has further defined and endorsed tactical combat casualty care (TCCC).<sup>49</sup>In the present day, predominantly covert, guerilla, and developing world armed forces do not absence the resources to care for the critically wounded soldiers. Shortage of medical resources has become much less likely in modern armed forces that can rapidly transport large numbers of severely injured soldiers from the front lines to completely equipped, high quality medical facilities that are able to treat all injuries under most conditions.

Past wars and the development of army emergency care have strongly influenced the expansion of modern civilian emergency care systems. The significance of providing prompt and safe transport of wounded to the medical facility came from Larrey's "flying" ambulances. In the American Civil War, selected emergency automobiles dedicated strictly for the transportation of injured soldiers that could not be used for other activities was a vital development. The procedures for field administration of injured soldiers contributed to the notion of the chain of survival and created the foundation for civilian EMS systems. The concept of care for injured casualties at the site of injury resulting from trench warfare in WWI and was carried forward by the combat medics of WWII. Air transportation for the injured was started in WWII and improved during the Korean and Vietnam Wars and today often includes transport of injured soldiers straight from the site of injury to fully capable trauma hospitals. The international war on terror has seen developed systems and equipment for handling victims of severe trauma through TCCC guidelines. Important strategies in both warfare and civilian EMS systems continue providing lifesaving interventions at the site of injury and reducing time to definitive emergency treatment.

49 Butler K Frank, Holcomb B John, Giebner D Stephen, et al. "Tactical combat casualty care 2007: evolving concepts and battlefield experience." *Military Medicine*. 172, 11 (2007): 12. Accessed April 9, 2015. [http://publications.amsus.org/doi/pdf/10.7205/MILMED.172.Supplement\\_1.1](http://publications.amsus.org/doi/pdf/10.7205/MILMED.172.Supplement_1.1)

## LESSONS LEARNED FROM HISTORY

### TRIAGE

The origin of term 'triage' in its narrowest scope is founded from the French expression *trier*, to sort, it was formerly used to define the sorting of agricultural goods. Today, triage is used solely within healthcare contexts. Triage, rationing, or allocation are words frequently used to discuss to the allocation of medical assets to patients in need. When the requirements for medical care considerably outweigh the resources available, judgments must be made regarding the distribution of these resources. The concept of triage arose from the exigencies of wars and conflicts, and today, it remains an inherent part of military medicine.

Judgments about allocating scarce medical resources can be brought about at all stages, from local community choices in the national healthcare system to people distributing rapid emergency care and transportation among numbers of critically injured or ill patients. The term triage is most commonly used in relation to sorting out patients for care in the emergency departments, multi-casualty accident, or on battlefields.<sup>50</sup>

Emergency department triage models aim to isolate the most serious patients to guarantee they receive priority treatment. The concept of triage is integral to an emergency facility. The ability to provide for patients arriving by various means needs to be catered for. A significant number of patients arriving by ambulance or air transport are in critical condition, whereas patients arriving via other means may not need urgent care. Design needs to embrace the requirements of triage and facilitate it in a manner that is helpful to staff and well understood by patients in situations of high stress.

### TRANSPORTATION

Architectural expertise is seldom utilized in establish the networks and infrastructure of the city. The public spaces in which we spend considerable time should be overflowing with opportunities for encounter and exchange.<sup>51</sup> Movement and the evolution of infrastructural corridors are part of the daily pursuit where everyone derives a sensory experience from their

50 Iserson, Kenneth and Moskop, John, "Triage in Medicine, Part I: Concept, History, and Types." *Annals of Emergency Medicine* 49, 3 (March, 2007): 278.

51 "Overture." In *Mobility: A Room with a View*, ed. Luisa Maria Calabrese and Francine Houben (Rotterdam: Nai Publishers, 2003), 88.



Fig 19. Triage and surgery stations, Suippes, France, World War I



everyday mobility.<sup>52</sup>

Hospitals have evolved over time in relation to their size, but their major circulation and zoning, similar to our cities, has remained rigid. A system where the hospital has become a rigid institutionalized city of beds and equipment and the corridors are served as traffic arteries.<sup>53</sup> On the other hand, cities are constructed of urban grid with regular cluster of buildings forming a continuous system of interconnected roads. Irregularity is used as a tool to generate contact.<sup>54</sup> The ability to provide medical care in time is one of the most basic human needs. Accessibility to urgent medical care is crucial in disaster situations. Our infrastructure network is designed to deliver us dependable services across our cities. They represent our democratic and homogeneous values.<sup>55</sup>

Attaining the right balance within the city environment consists of incorporating the urban landscape with an understanding of movement routes. It is important to understanding the significance of these traffic arteries as public spaces with a code of conduct and aesthetics of their own.<sup>56</sup> Hospitals can become a node connecting these multitude of networks and infrastructure that layer our cities. Hospitals can assimilate into the city by effectively becoming a node connected to other cities in networks, leading to deconstruction of care as a physical, tangible entity, accessible by remote diagnostics and surgery and community.<sup>57</sup> Transport networks cannot be constantly changed or easily reproduced. Incorporating hospital infrastructure with transportation infrastructure can create an environment that reflects the complexity of the city and gives the public spaces a lasting sustainable meaning to the community.<sup>58</sup>

52 Francine Houben, "Mobility: A Room with a View." In *Mobility: A Room with a View*, ed. Luisa Maria Calabrese and Francine Houben (Rotterdam: Nai Publishers, 2003), 2.

53 Lawrence Nield, "Postscript: Reinventing the Hospital." In *Changing Hospital Architecture*, ed. Sunand Prasad (London: RIBA Publishing, 2008), 258

54 Lawrence Nield, "Postscript: Reinventing the Hospital," 258.

55 Allison B Arneill and Ann Sloan Devlin, "Health Care Environments and Patient Outcomes: A Review of the Literature," *Environment and Behavior* 35, no. 5 (2003): 670, 73.

56 Houben, "Mobility: A Room with a View," 30.

57 Paul Hyett and John Jenner, "Rebuilding Britain's Health Service." In *Changing Hospital Architecture*, ed. Sunand Prasad (London: RIBA Publishing, 2008), 102.

58 "Environments for Children." ed. David Canter and Sandra Canter (Great Britain: John Wiley & Sons, Ltd, 1979), 310.

## CHAPTER THREE

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# PRECEDENT STUDY

## THE ROYAL CHILDREN'S HOSPITAL

Architects: HKS

Location: Melbourne, Australia

Building Area: 120,774m<sup>2</sup>

Project Year: 2011

The Royal Children's Hospital in Melbourne is designed with the experience of nature and its healing properties in mind. The building is divided into a detailed masterplan with a central corridor joining public outdoor spaces to the north and southwest. The orientation of the building is the north, breaking away from the central grid of the city and enhancing the connection between the child patients and park. The linear and narrow building footprints allow the natural light to penetrate through all areas in the hospital.<sup>59</sup>

The wards form a star shape, thus providing 80 percent of the rooms with views. Specially designed. Shades on the hospital's exterior allow park views from the patient's bed. 85 percent of bedroom spaces are single occupancy and have been designed to provide a calm and comforting place for recovery. Treatment areas are situated far away from the bedrooms, leaving them as a haven for rest and family time.

One of the main features of the building is the coloured leaf shades along the exterior façade. The fabricated curved panels provide protection from the sun, but also create an engaging organic structure and identity for the hospital. The complex includes retail hubs, an aquarium, a meerkat enclosure, playgrounds, restaurants, and performance spaces.

At the center of this medical facility is the multi storey, naturally lit thoroughfare which links all the elements of the hospital together. The central atrium allows intuitive way finding and is the social heart of the facility. The use of colour is strongly linked to the way finding strategies and celebrates the landscapes of the region. Signage through environmental graphics and interior design results in an engaging and coherent environment.<sup>60</sup>

59 "Royal Children's Hospital." HKS. Accessed September 15, 2015. <http://www.hksinc.com/places/royal-childrens-hospital-2/>

60 "The Royal Children's Hospital." *Architecture Now*. Accessed September 15, 2015. <http://architecturenow.co.nz/articles/2012-australian-interior-design-awards-interior-design-excellence-innovation/>



**Fig 20.** Top Image: the central atrium of The Royal Children's hospital in Melbourne showing the variance in materials used to reduce the clinical atmosphere and the use of natural light to create a warmer, welcoming environment.

**Fig 21.** Top Image opposite page: the external facade with coloured shades.

**Fig 22.** Bottom left image: the waiting area of the emergency department with a double storey aquarium and colourful furniture.

## AKERSHUS HOSPITAL

Architects: C.F. Moller Architects

Location: Oslo, Norway

Area: 137,000m<sup>2</sup>

Project Year: 2008

The Akershus University hospital demonstrates the new paradigm shifts in healthcare infrastructure and is considered one of the most modern hospitals in Europe. The total area of 137,000m<sup>2</sup> is divided into a central atrium and two adjacent building wings which consist of patient rooms and operating rooms. It is a non-institutional hospital with friendly informal spaces and open surroundings incorporating patients and their families. While the form of the building itself is similar to a typical hospital wing structure, the numerous departments vary in their sizes, dimensions, and expressions. The architectural expressions of wards and unique to those of treatment areas. All materials used within the hospital are healthy with good indoor climatic performance. The use of wood and stone help create a homely and secure environment for the patients. This creates a variation in the visual experience, while at the same time making it easier to comprehend the surroundings and easier wayfinding. The expansive glass surfaces break down the barriers between the medical surroundings and everyday world.

Daylight has been given high priority in all workspaces. Views out to the surrounding landscape, and physical contact with the outside environment is valued immensely. A glass covered thoroughfare visually and physically links the various buildings and functions. The wood is the dominating material within this thoroughfare which eliminates the clinical feel of the environment. This glass road forms the arterial route of the hospital and is structured to provide a series of public spaces of varying character. It incorporates numerous functions such as a kiosk, pharmacy, hairdresser, church, and café. It unites the various different spaces in an overall composition.<sup>61</sup> The structure of the hospital ensure that the focus remains on the patient and their journey, despite the strict logistical requirements of hospitals. Akershus hospital is extremely sustainable. It uses locally obtained materials, utilizes geo-thermal energy

61

"Akershus University Hospital." *C.F. Moller*. Accessed September 15, 2015. <http://www.cfmoller.com/p/-en/akershus-university-hospital-i269.html>



Fig 23. Top image: External facade treatment of the Akershus Hospital.

Fig 24. Bottom image: bridges spanning the atrium allowing natural lighting.



Fig 25. Next page left image: the central atrium that serves as an arterial route.

Fig 26. Multiple wings of the hospital for wards and private treatment rooms. Narrow in plan the architecture allows ventilation, views and natural lighting.

Fig 27. The variety of materials used within the central atrium. The atrium incorporates a huge amount of public functions.

Fig 28. Top image right: Robotics used in stock management reducing human error and increasing efficiency.

Fig 29. Center image: Automated goods transporting vehicles for linens, medications and other supplies within the hospital.

Fig 30. Bottom image: Tube post, pneumatic dispatchment transport system for all lab tests and medication.

for 85 percent of facility's heating needs and around 40 percent of entire energy used.

The contrast between the organic materials used and the advanced technological equipment provide an exciting working environment. Medicines can be ordered and dispatch through computers and are delivered to patients with robotic un-manned trucks. The incorporation of technology creates a more stress less and relaxed stay for the patient and also increases the contact time they receive, in turn enhancing efficiency.<sup>62</sup>

62

"Norwegian Super Hospital Completes." *World Architecture News*. Accessed September 15, 2015. <http://www.worldarchitecturenews.com/project/2008/10465/c-f-moller/akershus-university-hospital-in-oslo.html>



## PONTE VECCHIO

Architect: Taddeo Gaddi  
Location: Florence, Italy  
Year: 1345 and 1564

In relation to this research the Ponte Vecchio is an important precedent. The bridge embodies the concept of integrating infrastructure with architecture. Known as Europe's oldest segmented arch bridge. Originally built during Roman times, it was constructed in wood initially. It was destroyed by the river in 1333 and rebuilt in 1345. The bridge is made up of three segmented arches, the main spanning 30 meters, with two side arches crossing 27 meters. The fundamental concept for the new bridge were aesthetics, stability, and commerce. It has a series of goldsmith shops along the sides that turn an ordinary bridge structure into a vibrant public space.<sup>63</sup> The bridge is one of the most well-known in Europe and one of the few bridges that has remained inhabited for over six centuries. Not only is it an exciting public space with a multitude of sensory experience, it is also a highly profitable venture that takes advantage of the street front location. The buildings situated on the bridge are mostly inward facing with breaks that provide a view to the water. Accessed only by pedestrians it is well integrated into the city through an arcade. The built mass on the bridge is mostly towards the periphery with a centrally accessed pathway. The bridge has overtime acquired the reputation for its picturesque beauty, better observed from the banks. Aesthetically it is designed to merge with the city; it remains a significant monument.



Fig 31. Views of the Ponte Vecchio from the water and the bridge. The image on the top right of the opposite page illustrates the pedestrian activities taking place and the merchants in age old shops.



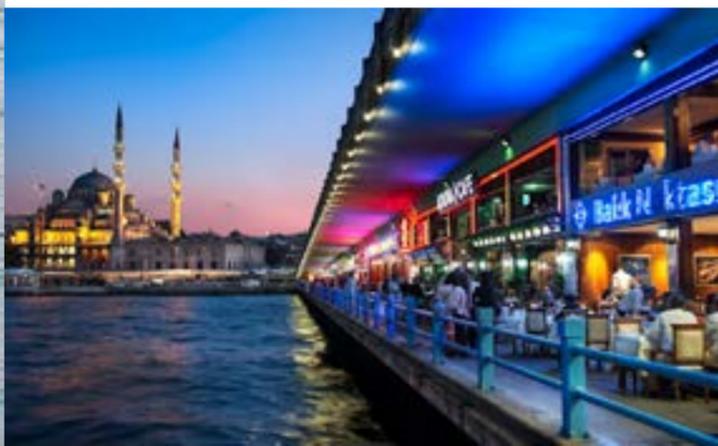


Fig 32. Views of the Galata Bridge showing the division of pedestrians from public and private vehicles. The bottom image shows the activities taking place within the bridge and their proximity to water, providing a very unique place within the city.

### THE GALATA BRIDGE

Architect: Göncer Ayalp Engineering Company  
 Location: Istanbul, Turkey  
 Year: 1994

The oldest bridge known to be built over the Golden Horn was in 1453. Since then numerous bridges have been destroyed and rebuilt. The bridge currently in use was rebuilt in 1994 and creates a symbolic link between the city, important religious and secular institutions, and site of the imperial palace. The structure is 420 meters long and 42 meters wide. It incorporates three vehicular lanes and one lane for trams. The bridge has outward looking views from the outer pathways with linear seating incorporated and occasional voids cut through. The massing is much more distributed on the Galata Bridge compare to the Ponte Vecchio. The top level is designated for cars with pedestrian walkways on either side. On the level below, restaurants form the central core with pedestrian pathways on either side. Thus the view are maximized whether sitting inside the glazed walkways or walking on the pathways. The bridge segregates the contrasting activities of lingering and walking from the heavy and fast paced vehicular traffic. The layering of programme and its integration with the surrounding infrastructure forms a successful habitation of this piece of infrastructure. The Galata Bridge melds into Istanbul's infrastructure seamlessly. It is situated close to urban public spaces, restaurants, ferry docks, bus stations, and a fish market. It as acts a center of activity and transportation in both public and private realm, and is a major connection between the two sides of the city.<sup>64</sup>

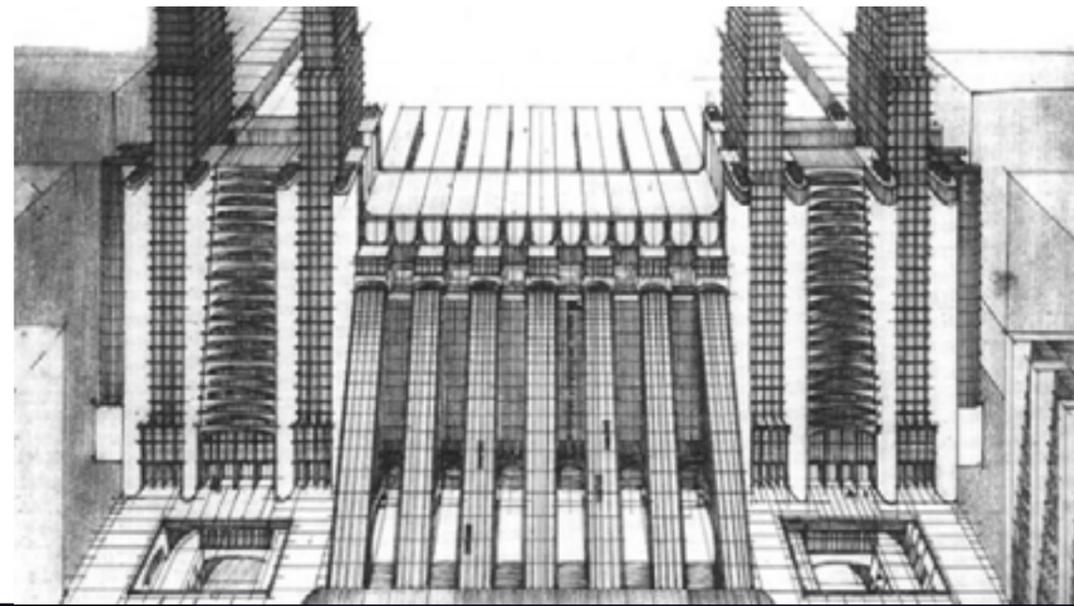


64 The Rotch Travelling Studio, "Thickened Bridges: Parks, Promenades & Planning," last updated June 11, 2011, <http://urbanwaterfront.blogspot.co.nz/2011/05/thickened-bridges.html>

## VISUAL INFLUENCES

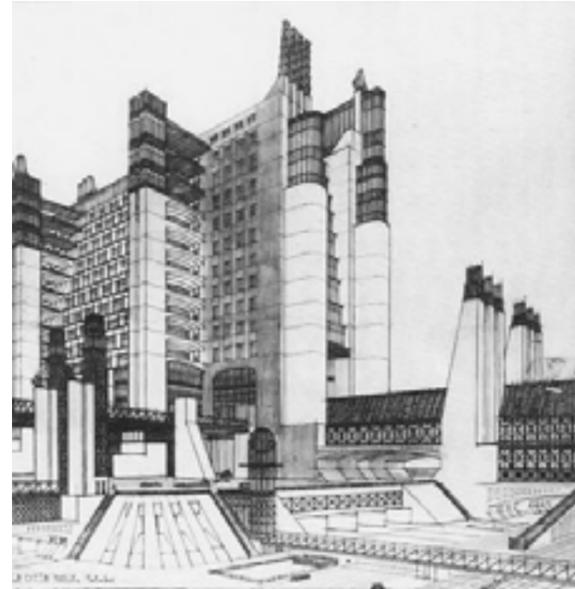
This research was inspired by the works of two historical figures, Hugh Ferriss (1889-1962) and Antonio Sant'elia (1888-1916). Their exploration incorporating architecture and transport with a kinetic passage was a huge influence at the beginning of the project.

Sant' Elia's drawings depict a mechanized and highly industrialized city, with high rises and multi-level traffic circulation. His drawings illustrate the intense visions of the possibilities of modern architecture.<sup>65</sup>

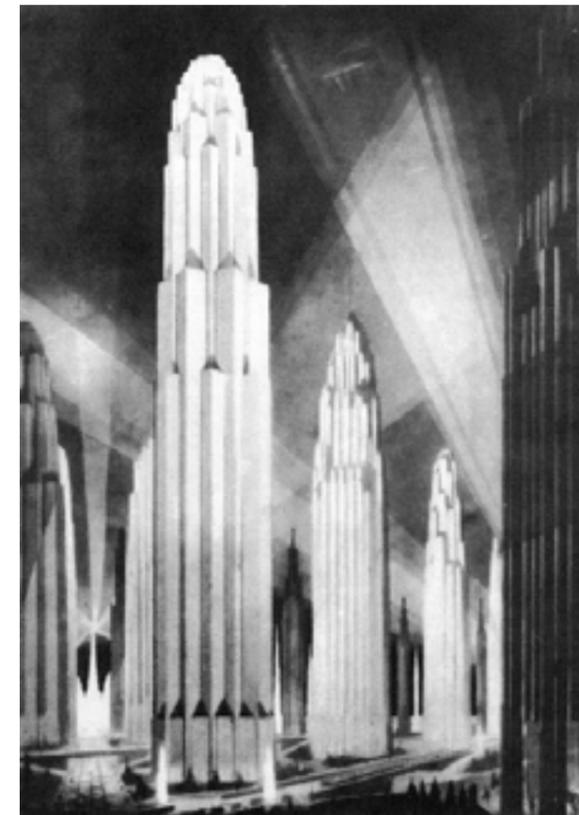


65

Goldberger, Paul. "Architecture: Antonio Sant e'lia." *The New York Times*, February 21, 1986. <http://www.nytimes.com/1986/02/21/arts/architecture-antonio-sant-elia.html>

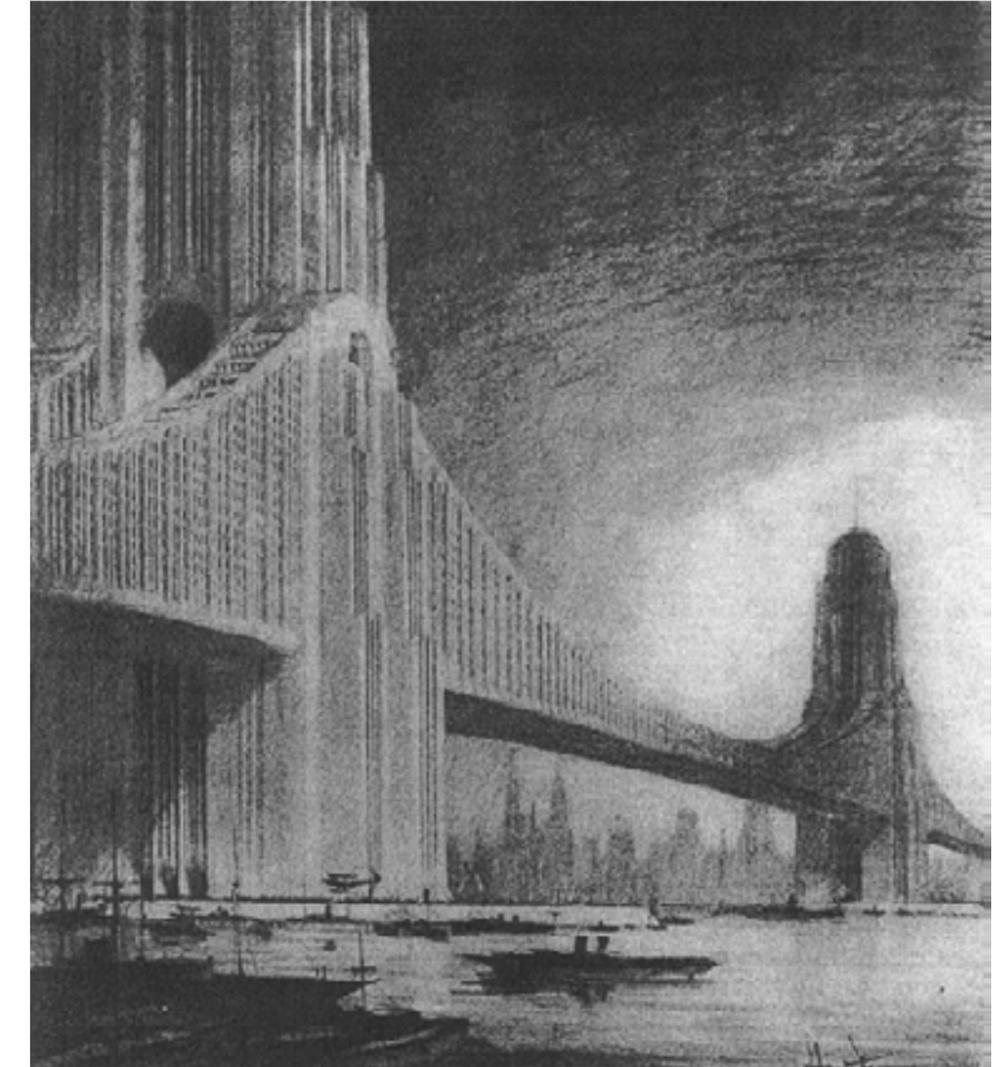


**Fig 33.** Perspective drawings from *La Città Nuova* by Sant'Elia, 1914. Sant'Elia had an almost comic-book, sci-fi sensibility about his drawings. He took the aesthetics of the 18th Century and brought them into the 20th Century, where new materials like glass, steel and concrete meant that the sky was the limit.



**Fig 34.** Habitable Bridge by Hugh Ferriss, in *Metropolis of tomorrow*.

Ferriss's dramatic charcoal renderings of a futuristic city with multi block megastructures defined the possibilities of the urban future.



CHAPTER FOUR

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**HOSPITAL DIAGNOSIS**

## EMERGENCY DEPARTMENT PROBLEMS

### Defining the Problem

Emergency departments play a vital role in the delivery of acute care services. They are an important part of the New Zealand healthcare system. A hospital's emergency department is recognized as the facility's front door because of the large number of patients arriving through the department.

Demand for these services have grown in the past few years and will continue as the population increases and a higher percentage of individuals live to an older age. As a consequence, some emergency departments have struggled to manage and patients have encountered long waits before being admitted to hospital, transferred, or sent home. In order to increase the value and timeliness of the treatment New Zealanders receive at an emergency facility, the government introduced a health target of 'Shorter Stays in Emergency Departments' in July 2009. The health objective requires district health boards to guarantee that 95% of patients will be admitted, discharged or transferred from an emergency facility in six hours.<sup>66</sup>

Over the past few years, the patients arriving at the medical centers have increasingly complex healthcare problems. A large percentage of the population is of advanced years and has chronic illnesses, which often worsen and need emergency treatment. The overcrowding in emergency departments results from several intricate and often intertwined issues.

66

Chalmers, Linda Maree. "Inside the black Box of Emergency Department Time target Implementation in New Zealand." Phd, University of Auckland, 2014.

The most evident reasons for overcrowding include:

- General upsurge in patient numbers
- Lack of beds for patients referred to hospitals
- Long waits in service provided by radiology, laboratory, and ancillary services.
- Scarcity of nursing staff
- Scarcity of administrative support staff
- Scarcity of on-call specialty consultants
- Scarcity of physical plant space within the ED
- Problems with language and cultural boundaries
- Increased medical record documentation requirements<sup>67</sup>

67

"Reducing Violence and Aggression in A&E." *Department of Health and Design Council*. Accessed July 17, 2015. <http://www.designcouncil.org.uk/sites/default/files/asset/document/ReducingViolenceAndAggressionInAandE.pdf>

Overcrowded circumstances in the emergency facilities have caused a number of negative effects described by the UK Design Council.<sup>68</sup>

- 1 Clash of people
- 2 Lack of progression/waiting times
- 3 Inhospitable environments
- 4 Dehumanising environments
- 5 Intense emotions in a practical space
- 6 Unsafe environments
- 7 Perceived inefficiency
- 8 Staff fatigue



Fig 35. Procedure rooms in an emergency departments for fast treatment with movable partitions for patient privacy.



### CLASH OF PEOPLE

The waiting areas of emergency facilities are overcrowded with a variety of people. They are brought together by difficult circumstances, experiencing high levels of anxiety, and going through their own clinical and non-clinical needs.

### CONSEQUENCES

Vulnerable patients, like individuals under distress, the elderly, children, and pregnant women often seek places that offer more privacy, trying to form boundaries between themselves and others. The waiting rooms are often still environments with a lack of any positive distractions. Patients and family members sit for hours without moving. In hospitals with no separated waiting facilities for children they are left to entertain themselves around the waiting area with a lack of things to do.

People in the waiting rooms often appear sicker or in more urgent need for care than they might be. This causes high levels of distress to other people within the room. Other patients may feel disgusted and or fear the sight of blood or broken bones. Being in a room of sickness can make individuals feel anxious and nervous. The idea of being exposed to diseases and illnesses can lead an individual to feel defenceless. Emergency departments are dirty environments with a constant flow of people arriving, often bleeding and discharging other bodily fluids.

Hospitals cater to everyone in society, hence prisoners from the local prison and people spending a period under police custody are also present in the waiting areas. Lack of sufficient seating arrangements during busy times means that people are required to stand too close for hours on end.<sup>69</sup>

## LACK OF PROGRESSION

Whilst all EDs in New Zealand aim to treat 95 per cent of patients within six hours, waiting for any length of time can be a trying experience. There are rare circumstances in our lives when we are involuntarily required to wait for such intervals of time without any sense of progress.

## CONSEQUENCES

The lack of positive interruptions can force individuals' attention on their immediate surroundings. People behave in a different manner during long period of waiting. As time progresses people can become more absorbed in themselves when bored. In an atmosphere where people rely on the guidance and direction of staff members, people can get confused about the direction given or not given. This can lead to individuals feeling paranoid.

After being assessed by the triage nurse, patients have little contact with professionals until the time for their treatment. Patients can feel secluded, overlooked, and uncared for during the wait. Often the stillness in the waiting rooms can create an impression of no activity or the queue standing still. The agitation and uncertainty caused by this environment can frustrate people and turn them away.<sup>70</sup>



## INHOSPITABLE ENVIRONMENTS

All of us at some point in our lives have experienced being in a hospital. There is a general dislike about the uncomfortable seating and unpleasant interiors.

## CONSEQUENCES

The emergency departments are often designed according to the requirement of the health care staff. Furniture is positioned and selected so it can be easily cleaned. The harsh artificial lighting and uncomfortable environment can create an undesirable atmosphere. Disregarding the time and our natural circadian rhythms the emergency rooms are brightly lit. The intense lighting prevents the patients' resting and relaxing during long periods of wait.

Most people arrive at the emergency room due to unforeseen circumstances and therefore are unprepared for the long waits. They often need food and water. In most hospitals it is not usually apparent how to get the basics, for example water and snacks. Parts of the waiting areas are often left dirty and cluttered. It gives an impression of unprofessionalism, little attention to detail, and lack of care.<sup>71</sup>

## DEHUMANIZING ENVIRONMENTS

Working systems of the emergency department can be baffling or confusing for new patients. The lack of understanding and clear communication can contribute to a loss of perspective.

## CONSEQUENCES

The strictly regimented procedures are difficult for patients under stress to comprehend. People can feel that they have been taking part in an unknown process and cannot leave. The need to treat patients quickly can sometimes lead patient to relatively undignified or public places.<sup>72</sup>



## INTENSE EMOTIONS

The emergency department is a facility where people may be experiencing great life events, distress, or witnessing others experiencing stress or pain.

## CONSEQUENCES

People are experiencing extreme emotions under stress and pain, whereas the staff familiarity with serious problems can create a conflict between the patients' sentiments and the rigid practicality of medicine. Staff are often tired and preoccupied with treating as many patients as possible which can cause a lack of dignity regarding the private medical matters of the patient.

Individuals handle fear, pain, and stress differently. Patients under stress or pain can create a significant amount of noise and can aggravate anxiety levels in other patients sharing the same room.

The staff are expected to care for difficult individuals. There is conflict between the wish to treat and the need to be protected.<sup>73</sup>

## UNSAFE ENVIRONMENTS

The emergency departments are fast paced and busy environments with a large amount of expensive equipment and many people using the space. These factors can be possible triggers for aggression or violence.

## CONSEQUENCES

People dealing with stress can react in different ways. Some individuals can release their suppressed emotions of equipment or staff. There are various hazardous equipment used by professionals and medical waste waiting to be disposed off. All can be perceived as weapons to individuals out of control.

Restrooms and other lockable places can form a hazard for the staff, particularly when some individuals are willing to self-harm, commit suicide, or take a hostage. The immense scale of the space can cause difficulty for the security staff to keep a watch on.<sup>74</sup>



## PERCEIVED INEFFICIENCY

The busy environment of the emergency department can give an impression of the staff being disorganized or lacking focus. People recognize themselves and others waiting for hours, while the staff is occupied in what may appear to be non-essential tasks.

## CONSEQUENCES

The patient's journey through the emergency department involves multiple transfers between staff, specifically those who arrive by ambulances. These transfers can often be perceived as dehumanizing and the transfer of patient's information can lack privacy. Storage within hospital is at a scarce resource. Often the redundant equipment is stored in alcoves within corridors. This creates an image of clutter and disuse.

Signage aimed at staff covers the walls and doors of the facility. This can often undermine the importance of communication with the patient. Staff are seen spending considerable time looking for the right equipment. The fast rotation of junior doctors and medical students often exaggerates this problem and does not inspire confidence in patients.<sup>75</sup>

### STAFF FATIGUE

Operating in the emergency facility is a highly challenging occupation. The individuals work 12 hour shifts and overtime can develop physical and mental exhaustion.

### CONSEQUENCES

The emergency department is usually open 24/7 with an extremely unpredictable workload. The patient flow can drastically vary during day to night and also during days of the week. Demanding patients can leave the staff feeling undermined and frustrated which can lead to them losing patience. Communication between the staff can become difficult in stressful environments.

In conclusion, the causes for overcrowding in emergency facilities are multifaceted and intricate. Without hospitals amending the issues, it is predicted that overcrowding will become worse causing poor outcomes and long delays. As circumstances continue to worsen and emergency departments become more overcrowded, emergency doctors and nurses may leave and find jobs in well organized, safer, and controlled patient situations. Staff may leave due to the stress from the heavy burdens placed on them.<sup>76</sup>

Fig 36. Assumption map created from observations and feedback. It illustrates the feelings encountered by patients while visiting the emergency department.



Patient situations are often not emergencies	The waiting experience is frustrating	Patients think they are highest priority	Patients feel they are forgotten in the waiting room	Staff do not empathise with patients detach themselves	Staff do not communicate well with patients	Most patients arrive with family members
Patients dislike the cramped ED environment	Patients become aggressive while waiting	Patients are board waiting	There is no method of showing the patient how long they will be waiting	Patients regularly wait for hours	ED is hard to find. They don't know where to go	ED has ineffective signage
Patients feel neglected	Patients don't understand that there are multiple ways into ED	Drunk patients are the most aggressive and hard to deal with	Patients come to ED because they don't want to pay for a doctor	ASSUMPTION MAP	High priority patients arrive by ambulance via separate entrances	People expect to be treated immediately
Staff legally can't turn anyone away	The patient experience begins before they arrive at ED	Staff treat all patients the same	Most patients are elderly	Patients don't understand the course of care	Most weekend patients have been under the influence of alcohol	Most patients who visit ED leave the same day



**Fig 37.** A typical resuscitation facility within the emergency department.

## PROGRAMME

### Accident and Emergency Department

The sole purpose of the Accident and Emergency department is to receive, triage, stabilize, and provide acute health care to patients. This includes patients who need resuscitation and those with emergent, urgent, semi-urgent, and less urgent conditions. An Emergency department is also required to deal with mass casualty and disaster situations. These facilities play a pivotal role in providing the public fast access to acute healthcare. It provides an important interface to many inpatient and outpatient services offered by the parent hospital.<sup>77</sup>

Increasing and aging population in New Zealand and internationally is growing the patient load on emergency departments. New models of care need to be explored in order to solve the external and internal issues emerging. The aim of any model of care is to reduce the unnecessary steps in the patient journey and provide an efficient environment for the staff to work in. Each individual emergency department faces its own challenges, therefore there is no standardized solution that fits. Explained below are the various different pathways that a patient follows on arrival to the emergency department.<sup>78</sup>

In Auckland, there are more than 300,000 visits annually to accident and emergency departments. These visits are distributed among the five currently operating emergency departments, which are North Shore Hospital, Waitakere Hospital, Starship Hospital, Auckland City Hospital, and Middlemore Hospital. Overall they are controlled by three different district health boards. The majority of these servicing emergency departments have gone through complete rebuilds or significant refurbishment in the past few years to cater for the growing population and ever changing technology.<sup>79</sup> This continuous growing and increase in scale of these departments have contributed to the institutional atmosphere of the hospital. Decentralizing these emergency departments would mean reducing the overall patient load and also provides services closer to the communities.

<sup>77</sup> "Emergency Department Design Guidelines." *Australasian College of Emergency Medicine*, (October, 2014): 11.

<sup>78</sup> "Emergency Department Design Guidelines." *Australasian College of Emergency Medicine*, (October, 2014): 13.

<sup>79</sup> "My DHB." *Ministry of Health*. Accessed May 5, 2015. <http://www.health.govt.nz/new-zealand-health-system/my-dhb>

## EMERGENCY DEPARTMENT SPATIAL CONSIDERATIONS

Emergency departments are dedicated facilities specifically designed staffed to provide 24 hour emergency care. The current practice of determining the spatial requirements of emergency facilities is largely based on the published data of attendances per year, review of current operations, and visits to other recently built or redeveloped emergency departments. This research follows the same process.<sup>80</sup>

A major space determinant of the facility is its department delineation. The New Zealand faculty of Australasian College for Emergency Medicine (ACEM) has policies that defines the minimum requirements for the facility. The guidelines clearly express that emergency departments should be part of an Emergency Medicine Network. The process of delineating the emergency department is crucial as these levels reflect increasing capacity and capability to provide specialist emergency care, health system support in disaster preparedness, and pre-hospital care.<sup>81</sup>

### LEVEL 1 Emergency Department

Provides care within a designated part of a remote or rural hospital. It is the minimum level of service that can be defined as an emergency department.

### LEVEL 2 Emergency Department

Provides care within a larger rural hospital. It can manage a range of acute illnesses and injuries and carry out resuscitation and limited stabilization prior to transfer.

### LEVEL 3 Emergency Department (Waitakere Hospital)

Is incorporated in the hospital and can manage a various acute illnesses and injuries. It also has the facilities to provide resuscitation, stabilization, and assisted ventilation if required prior to transfer for definitive treatment.

### LEVEL 4 Emergency Department

This is also located within a hospital, furthermore can manage all emergencies, including resuscitation, stabilization, assisted ventilation, and has the ability to provide definitive care for most patients. It also has the facilities to provide a team response and deploy teams out to disaster sites.

### LEVEL 5 Emergency Department (Middlemore and North Shore Hospital)

Situated within the hospital, it can provide resuscitation, stabilization, and initial treatment for all emergencies. It includes on site team response and the ability to send out teams for response to a disaster. The emergency department also provides referral service for specialist treatment available in level 6 hospitals in the region and advice on complex cases referred from other hospitals.

### LEVEL 6 Emergency Department (Auckland City and Starship Children's Hospital)

These emergency departments include extensive cardiothoracic and neurosurgical facilities on site along with all the other services provided in a level 5 emergency department.<sup>82</sup>

The spatial requirements of these emergency departments vary according to the services they accommodate. A level 6 facility needs to have access to 24 hour CT, angiography, ultrasound, magnetic resonance imaging (MRI), radiology, nuclear medicine, and a range of support services. A level 2 facility may only incorporate areas designated for assessment and treatment with separate sections for resuscitation services.<sup>83</sup> This research and design is grounded in the current context of existing and operating emergency departments in Auckland city. This design is for a level 5 emergency department working in partnership with the current level 6 Auckland City Hospital emergency department.

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80 "Emergency Department Design Guidelines." *Australasian College of Emergency Medicine*, (October, 2014): 15.

81 "Statement on the Delineation of Emergency Departments." *Australasian College for Emergency Medicine*, (November, 2012): 4.

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82 "Emergency Department Services – Specialist Medical and Surgical Services Tier Level Two Services Specification." *Ministry of Health*. Accessed September 19, 2015. <https://www.google.co.nz/Fnsfl.health.govt/emergencydepartmentservicesmarch2015>.

83 "Emergency Department Services – Specialist Medical and Surgical Services Tier Level Two Services Specification." *Ministry of Health*.



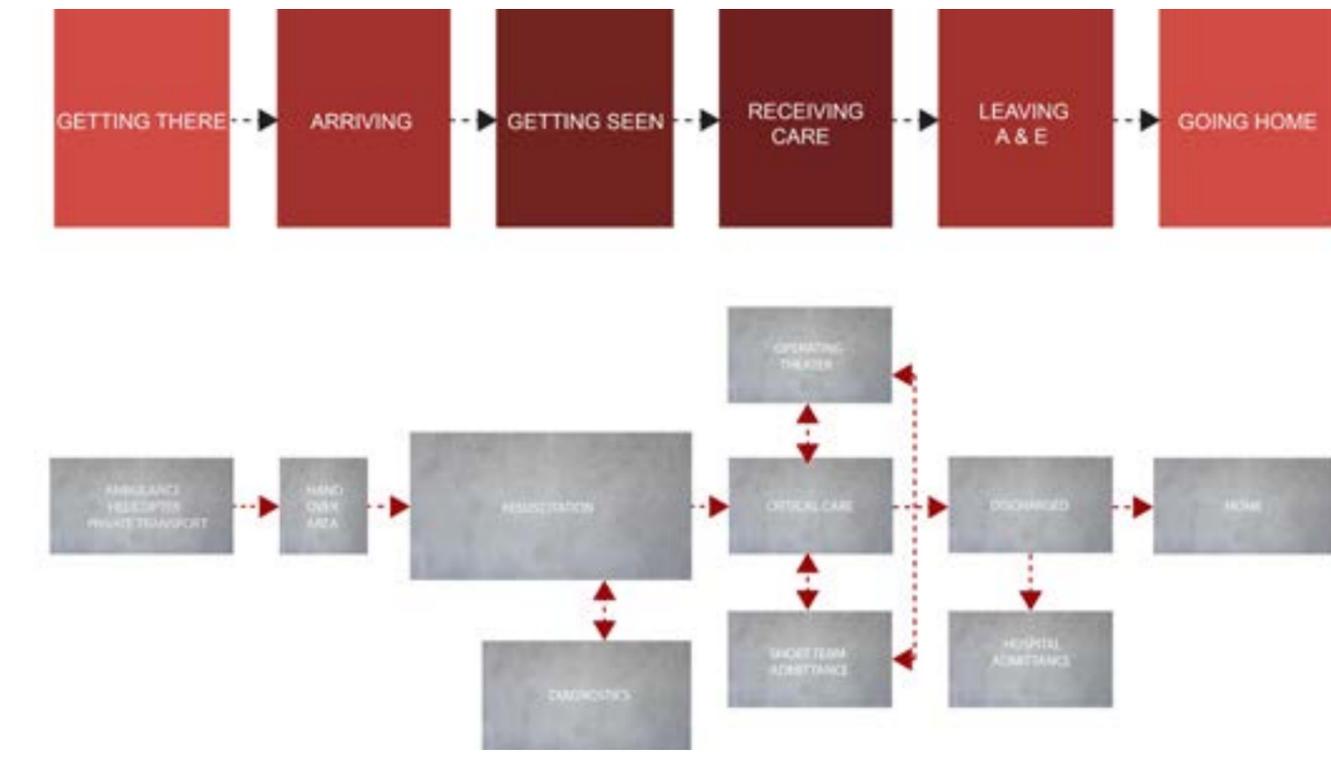
### PATIENT FLOW

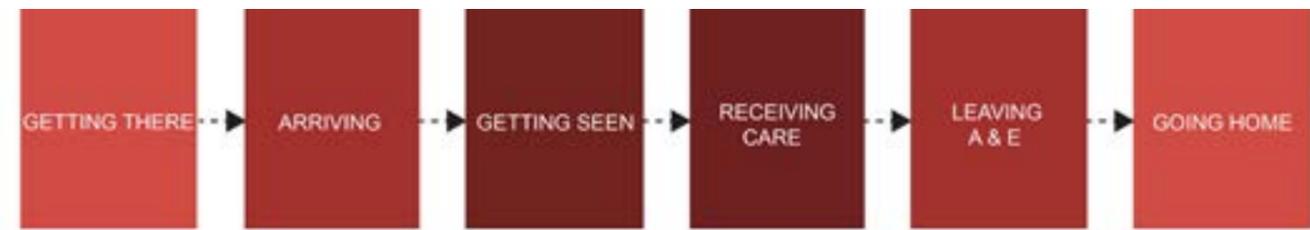
**DIAGRAM 1**  
 Spatial requirements should revolve around the patients' needs, derived from their activities and equipment. They are active participants in their care, not passive recipients. The following diagram show the various factors that have to be considered in the design in the patient journey through the accident and emergency department. The distribution of services in the facility is reliant on both flows of patients in and out of the department.<sup>84</sup>

84 "Health Building Note 15-01: Accident & Emergency Departments – Planning and Design Guidance." Department of Health UK. (2013): 28.

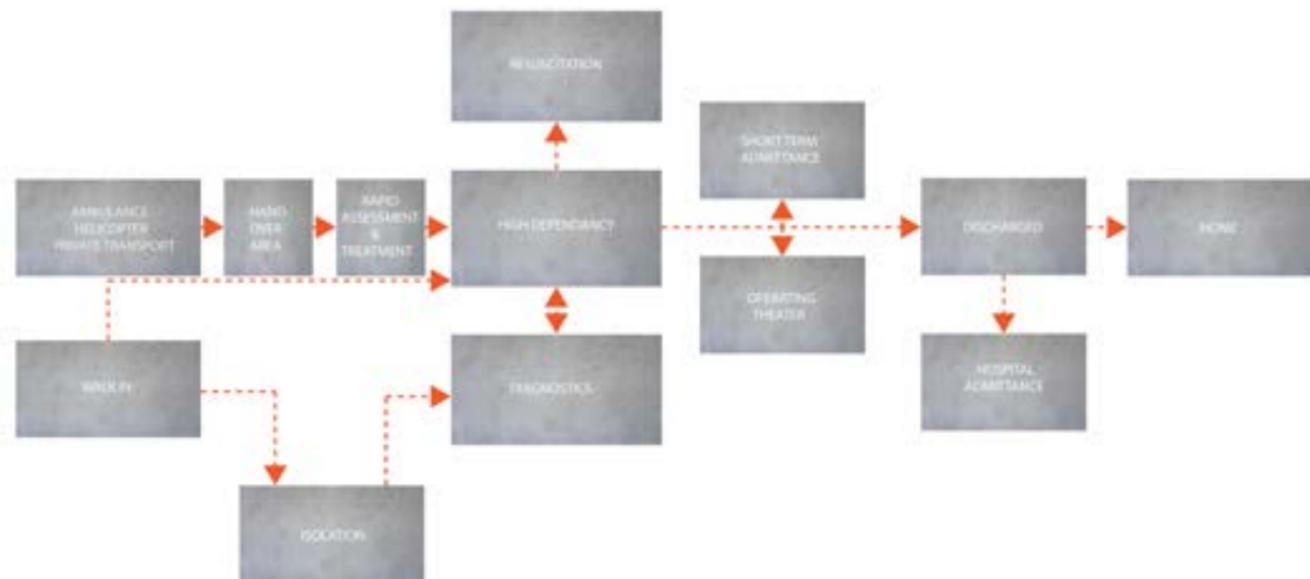
**DIAGRAM 2**  
 This diagram indicates the pathway of a patient who needs critical care. Under these circumstances the staff members are already alerted before the patient arrives at the facility. On arrival via ambulance or helicopter the patient is handed into the care of the rapid assessment and treatment team at the facility. The corridors and resuscitation rooms need to be wide enough to accommodate the patient and a whole team of 10 staff members. A series of interconnected rooms can provide ease of access for supervision by senior staff. Situating diagnostic services close by is vital in saving time. Proximity to critical care and operating theatres is necessary to provide instant care.<sup>85</sup>

85 "Health Building Note 15-01: Accident & Emergency Departments – Planning and Design Guidance." Department of Health UK. (2013): 29.

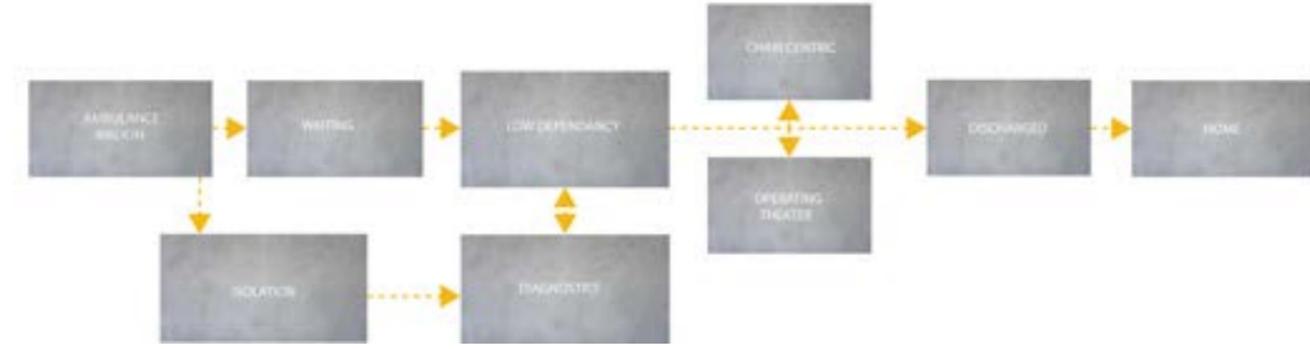
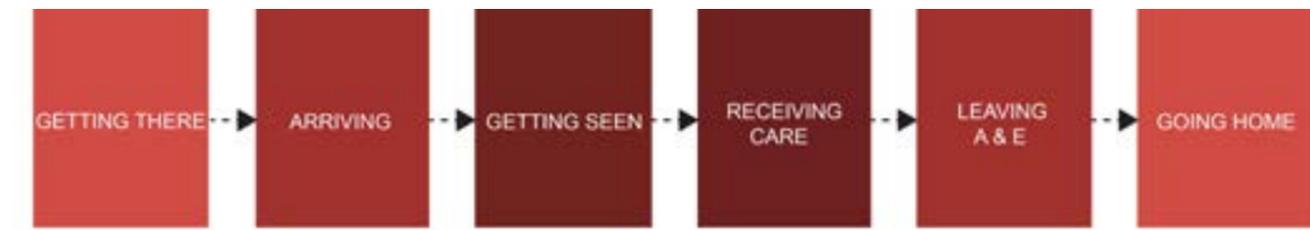




**DIAGRAM 3**  
 This pathway indicates the journey of a patient who needs urgent care, but is not critical. Upon arrival at the emergency department the patient is screened for infections and further transferred to an isolation suite or to an exam room where care can be provided.



**DIAGRAM 4**  
 This diagram indicates the flow of a patient who does not need urgent care. Arriving at the emergency department a triage nurse determines the necessary treatment steps.



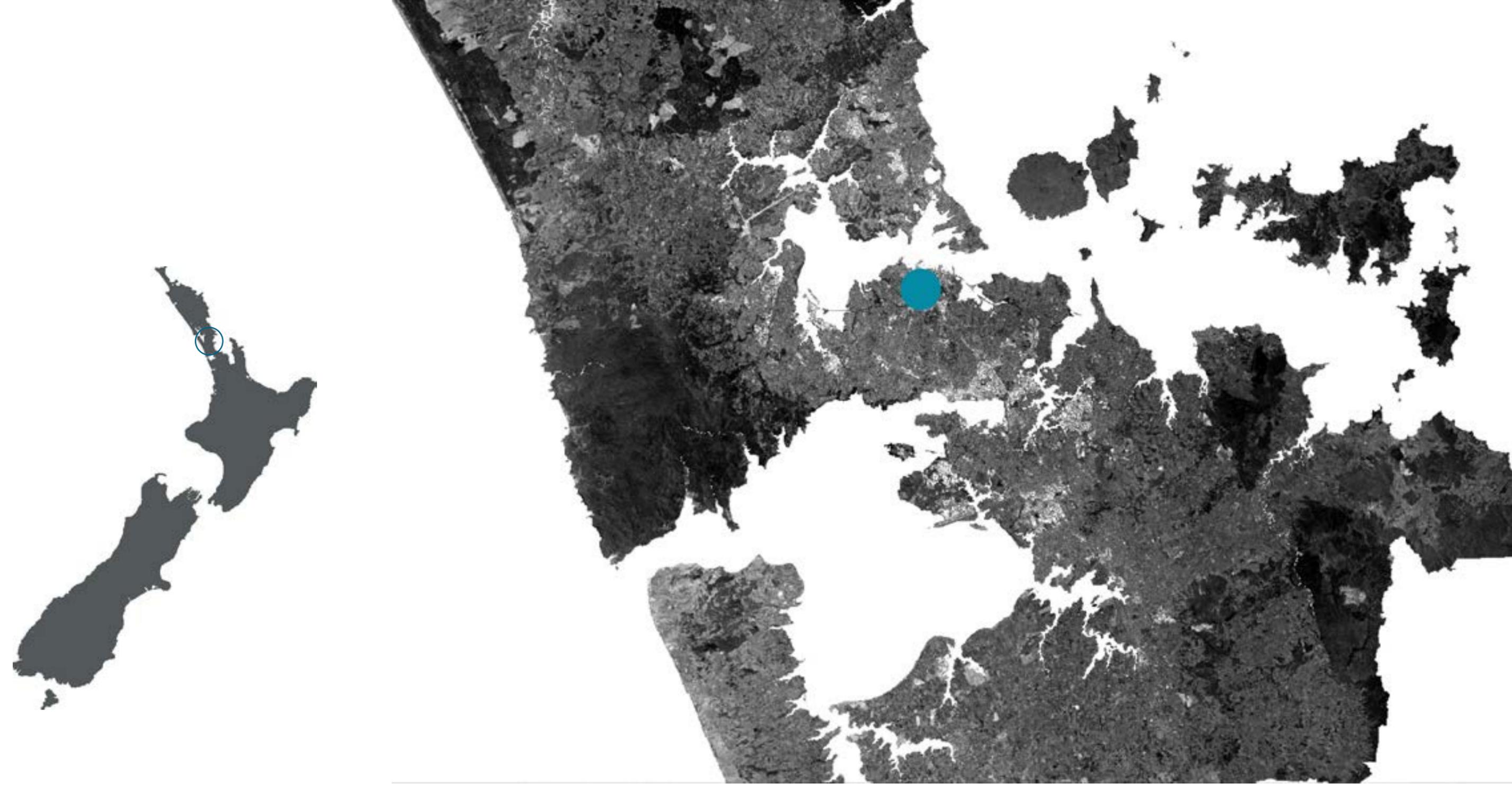
## SITE

An appropriate site for this research project is one embedded within the city's urban context, which provides potential physical connections to the surrounding urban and suburban areas and encourage further integration with the city's transportation network.

The site selected is a decommissioned off-ramp located within the central junction of the Auckland motorway system. It is rich with opportunities for strong connections to the CBD and Karangahape Road at a micro scale. The accident and emergency departments redefine the interface between the hospital and the wider network. Existing buildings, networks, and infrastructure can provide opportunities for further social and physical integration of the facility. Nearby buildings include a St John ambulance station which can potentially serve as an ambulance deployment station, further decentralizing the emergency department. There is a fire station and a police station located within close proximity of the site which in turn creates an emergency precinct with all these services working in unison. The site also provides an opportunity to design vertically and horizontally and connect with all the motorways which converge in this part of the city.

Because it would be expensive to demolish the Nelson street off-ramp it has remained standing since it was decommissioned in the mid to late 2000's. Most motorway exits are from the left due to the traffic patterns, thus the Nelson Street off-ramp was deemed unsafe as it was an exit from the right of the motorway and was the source of traffic interruptions.<sup>86</sup> The site exists amongst many level changes of the junction and presents numerous site issues which will have a significant impact on the design.

The aim of this project is to anchor the emergency department in a dense urban setting and through architecture make it easily accessible. The facility should not be a solo entity, rather it should be a significant part of the city's infrastructure.



86

Dearnaley, Matthew. "Nelson St off-ramp closed to motorists." *New Zealand Herald*. July 3, 2005



## MAJOR DECISIONS 1950-1969

Roads and streets have been constructed over centuries, but with the development of motorized vehicle ownership through the twentieth century, several roads have experienced a substantial alteration, as infrastructure engineers, planners, and politicians have approved and employed tactics and technologies intended to influence the movements and conduct of pedestrians, motorists, and motor vehicles.<sup>87</sup>

The 1950's were an era of radical decisions when Auckland dedicated itself to becoming a metropolitan city and the scales between public and private transport was skewed in favour of the car. The decision to base Auckland's transport system on motorways (rather than the development of a comprehensive public transport system) had an important impact on the form and nature of the urban expanse. The increasing reliance on private cars permitted society to fulfill their aspiration of separate houses on large sections lead to the fast residential development and a distributed urban form. The Master Transportation Plan for Metropolitan Auckland, prepared by the Auckland Regional Planning Authority in 1955, proposed the development of a radical motorway system largely based on American models.<sup>88</sup> The Technical advisory board asserted:

*"The form and structure of metropolitan Auckland through the years has been largely determined by developments in urban areas and suburban transportation. During the last 25 years, the overall effects of motor transportation has so radically changed the pattern that Auckland is one of the most dispersed cities in the world. The individual has been freed from absolute dependence on tramways and railways with their fixed inflexible routes. Local transport of goods has become fast, cheap, and flexible. A common motor transportation system has integrated outer areas and extended the radius of influence of Auckland."*<sup>89</sup>



Construction began on the Auckland motorway network in the early 1950s and was extended after 1955 as increased funding became available. Auckland now has an extensive motorway network which has facilitated growth to the west, north and south. Work began on the Central Junction (known colloquially as Spaghetti Junction) in the 1970s and construction continued on the motorway system which, combined with state housing development, fostered the establishment of new suburbs and industrial areas.<sup>90</sup> One of the most significant motorway developments involved the southern route. The southern motorway opened in 1953 a 3.2 km section between Penrose and Mt Wellington. Since then it has developed to become the gateway to Auckland and the Waikato. Over the subsequent 12 years the motorway was lengthened 23.4 km in phases from Mt Wellington to Drury and also to the north towards the city. The southern motorway forms the main artery into Auckland and further north, carrying more than 100,000 vehicles each day.<sup>91</sup>

87 Merriman, Peter. *Driving Spaces*. Oxford, UK: Blackwell Publishing, 2007.

88 "A Brief History of Auckland's Urban Form." Auckland City Council. Accessed May 2, 2015. [https://www.google.co.nz/search?q=a+brief+history+of+Aucklands+urban+form&ie=utf-8&oe=utf-8&aq=t&rls=org.mozilla:en-GB:official&client=firefox-a&channel=fflb&gfe\\_rd=cr&ei=SgtVVdLGD6iN8QfE5YC4Dw](https://www.google.co.nz/search?q=a+brief+history+of+Aucklands+urban+form&ie=utf-8&oe=utf-8&aq=t&rls=org.mozilla:en-GB:official&client=firefox-a&channel=fflb&gfe_rd=cr&ei=SgtVVdLGD6iN8QfE5YC4Dw)

89 "A Brief History of Auckland's Urban Form." Auckland City Council.

90 "A Brief History of Auckland's Urban Form." Auckland City Council.

91 "Auckland Motorways." NZ Transport Agency. Accessed May 2, 2015. <http://www.nzta.govt.nz/resources/auckland-motorways/docs/2008.pdf>

## MOTORWAYS

Motorways are often characterized by their dark, unsafe, barrier-filled, unwelcoming spaces which encourage their negative impact within the city. They often cause devastating effects on a social level by their disruption of established development patterns. The construction of motorways and their permanent quality is often forced through residential areas. They cause divisions between otherwise cohesive neighbourhood; often destroying the fine grain textures of old parts of a city. At a physical level, the depressed roadways form ditches through the closely built up sections of the city. In spite of well-meant pedestrian overpasses, they effectively destroy a cohesive neighbourhood as a pedestrian precinct. Some of the most attractive parts of Auckland bring out the virtues of the small town or village against the immense scale of the metropolis.<sup>92</sup>

The construction of the current motorway network resulted in the demolition of several thousand buildings in the Grafton, Symonds St, and Karangahape Road areas which in turn led to a dramatic downturn in economic life in Karangahape Road and Upper Symonds Street. Over a million tonnes of soil was excavated to allow for the construction of the largest piece of civil engineering in New Zealand. The buildings removed on the Karangahape Road resulted in a gap which disrupts the pedestrian usage of the street.<sup>93</sup>

Elevated motorways often damage areas through which they pass. They block out natural light, air, and create unpleasant shadows on the ground. Often the surfaces underneath are wasted or devoted to car parking. The elevated motorway loops tend to visually and socially isolate sections of the city.<sup>94</sup>

In an era of global warming, peak oil prices, obesity, stress, and foundering economies, big infrastructure, in particular motorways and major road interchanges, are a part of our cities whether we like it or not. Largely inherited from the motorway rush of the 50s and 60s, some of these are necessary and perform a critical role in the smooth running of our city. Demolishing these massive structures to establish public transportation systems is often an expensive exercise and therefore not a viable option for such a small economy as ours.

92 Halprin, Lawrence. *Freeways*. New York: Reinhold Publishing Corporation, 1966.  
93 "Timeline of K Road." The Karangahape Road Business Association, Accessed May 2, 2015. <http://www.kroad.com/heritage/timeline-of-k-road/>  
94 Halprin, Lawrence. *Freeways*. (New York: Reinhold Publishing Corporation, 1966).



Fig 38. View from the entering the off ramp from the motorway and looking towards the Karangahape Road above.

Transportation mechanisms, whether they are motorways or railways, are an integral part of the city. The integration of traffic with architecture is a recurrent theme. It was a consuming passion with the architects of the Renaissance. In Venice, the Grand Canal is an arterial route with the secondary canals acting as distributors and each building reached by service canal.<sup>95</sup>

The city is like a functioning human anatomy and is subject by analogy to many of the processes of birth, life, and change as is any biological form. As change occurs, tissues are destroyed and replaced within the body of the city. As a part of this process new constructions can be built with transport integrated into them.

We cannot conceive a construction of a skyscraper without incorporating into it the mechanisms to transport people. This is made feasible by a system of integrated vertical and horizontal transport; elevators, escalators, and corridors which interlace through the complex and enormous building. Rebuilding healthcare facilities in a way that transportation at all scales is part of the architecture can minimize the negative impacts of the urban motorways. Motorways are so big that they cannot only be a work of engineering with a single purpose. They must become part of the city. Of all the man-made artefacts, road are among the most expensive but least regarded.<sup>96</sup>

95 Halprin, Lawrence. *Freeways*. (New York: Reinhold Publishing Corporation, 1966).  
96 Halprin, Lawrence. *Freeways*. (New York: Reinhold Publishing Corporation, 1966).

## VIRTUES OF THE ROAD

Motorways are often perceived as serving a single purpose: transporting people. Viewed in a positive light they are actually a new form of urban sculpture in motion. Along with skyscrapers, motorways are certainly symbolic of our civilization. They are graceful, sinuous, curvilinear patterns through which we experience the sensation of movement through space. These vast engineering structures speak a language of a new scale, a new attitude which embraces high-speed motion. Though we are dwarfed by these immense pieces of structures, we relate to them by participating in their use. Motorways engage us visually through their sense of strength and the urgency of their structure as well as through the qualities of motion which they make possible.<sup>97</sup>

The confrontation between the motorway and the city involves an encounter between motion and static mass. The city landscape is dense with buildings; heavy and immense in their size, they stand in the way of the motion. Once in the city, the pace and scale of free flowing movement is slowed and almost arrested.<sup>98</sup> Drivers occupy, traverse, and travel through realms and sites of the road in characteristic, embodied ways often assisted by an array of machineries. Driving is not exclusively a visual experience, where the sights, sounds, tastes, temperatures, and smells of the city are summarized to the two dimensional view through the car's windscreen.

In Auckland, new vistas unfold as you travel through some of these elevated surfaces or sunken motorways. Vast panoramic views unravel which could not be seen before. The vivid skylines of Auckland can be experienced not as static images but rather as a series of constantly changing impressions. At dusk when the buildings are silhouetted against the setting sun and the lights are being turned on in random patterns, a whole new image of the city is formed and it comes alive. The motorway has opened up new dimensions of experience through colour, form and shape. Motorways do more than just take us from place to place; they mould the form and shape of our cities. Static architecture is always connected to kinetic architecture or passage. It physically portrays the duality of security and change that we experience in everyday life.<sup>99</sup> This duality is also inherent in medicine; a field that fosters life yet it is ever changing and evolving as new inventions come to the forefront.

97 Merriman, Peter. *Driving Spaces*. (Oxford, UK: Blackwell Publishing, 2007).

98 Merriman, Peter. *Driving Spaces*. (Oxford, UK: Blackwell Publishing, 2007).

99 Merriman, Peter. *Driving Spaces*. (Oxford, UK: Blackwell Publishing, 2007).



Fig 39. Night view of the spaghetti junction from Hopetown bridge.

## SITE ANALYSIS

In order to fully integrate the emergency department into the city's urban fabric, specific urban analysis is crucial to investigate the site and the surrounding urban context.

The northern end of the site flows into Nelson St while also connecting to Union St and Pitt St. This provides strong linkages to the Auckland CBD and connects the dispersed medical centers located within the CBD to the emergency facility. The southern end is connected to the Motorway one which acts as an entry into the site. The east and west boundaries of the site are surrounded by motorways and fast moving traffic. The southern end of the site is largely surrounded by businesses and entertainment areas and provides a busy environment during the day and night, whereas the northern end is surrounded by residential and commercial areas.

Reaching beyond the immediate surroundings, the vicinity encompasses the larger business environment containing a multitude of office buildings. The site provides stunning views towards the harbour bridge and the CBD due to its elevation.

Fig 40. Sketch of the spaghetti junction during the construction of the off ramp.



## SITE STATISTICS

Nelson St off-ramp decommissioned in mid to late 2000s.

**Design:** 11 Span single box, precast pre-stressed concrete bridge.

**Width:** 7.5 m

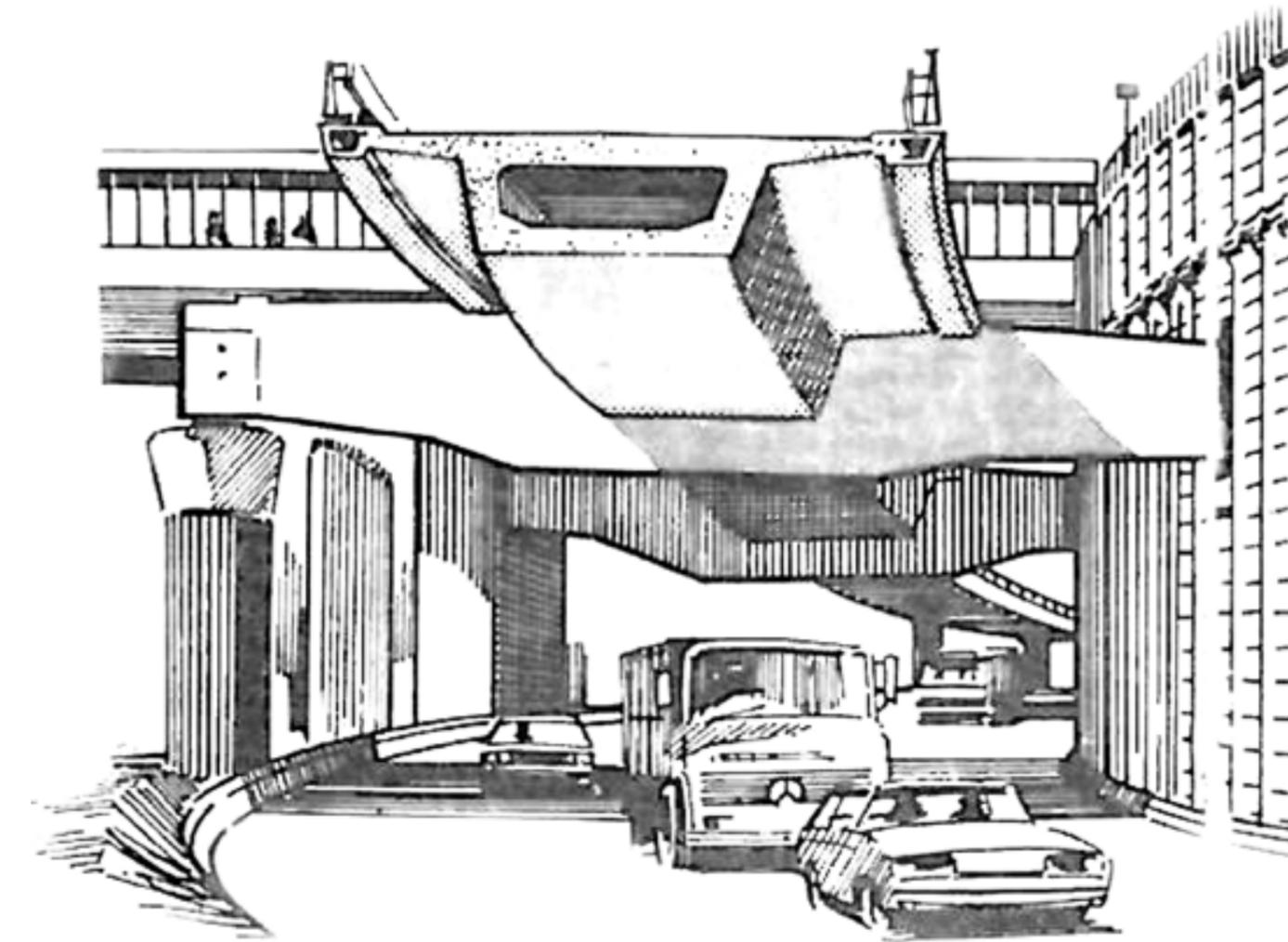
Can carry 2 lanes of traffic.

**Designed by:** Ministry of Works and Development

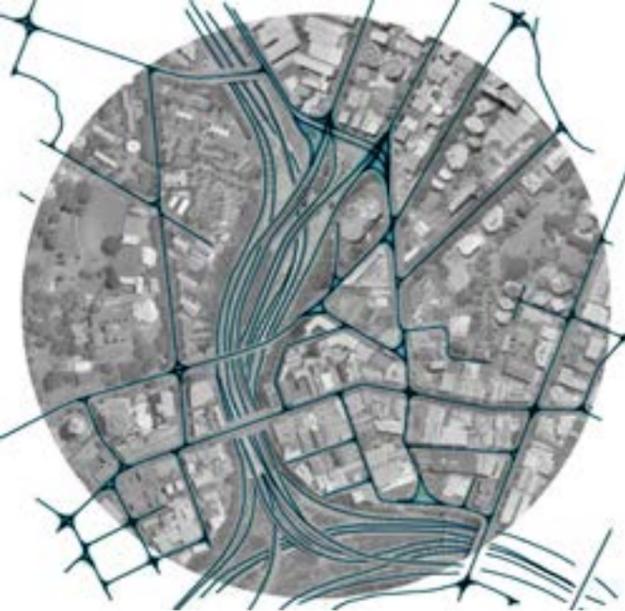
**Supervised by:** Ministry of Works and Development<sup>100</sup>

Fig 41. Sketch of the off ramp showing its structure and connections to the retaining wall.

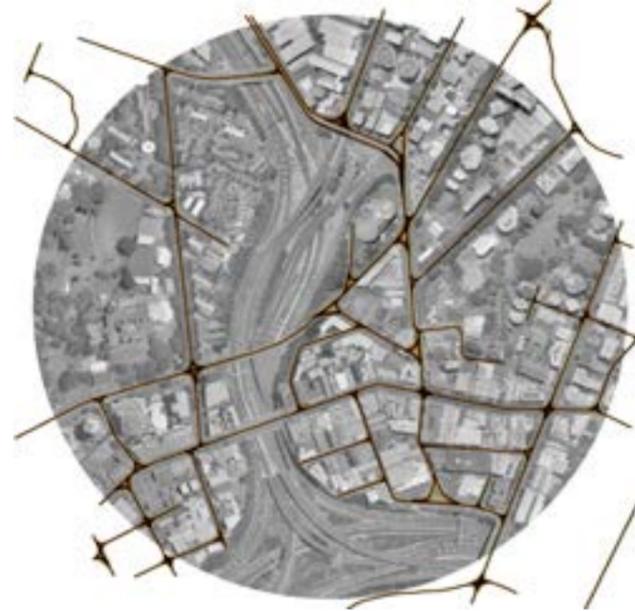
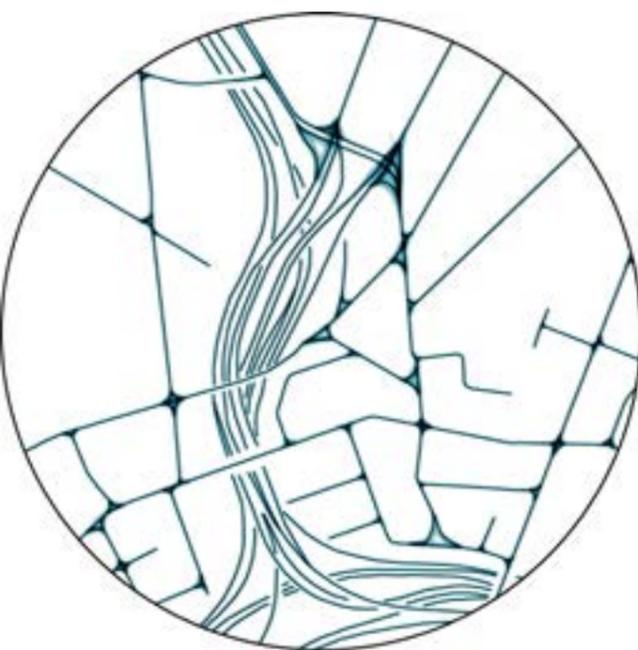
100 "Auckland Urban Motorways - Khyber Pass to Nelson Street Link." Ministry of Works and Development, (May, 1977): 2.



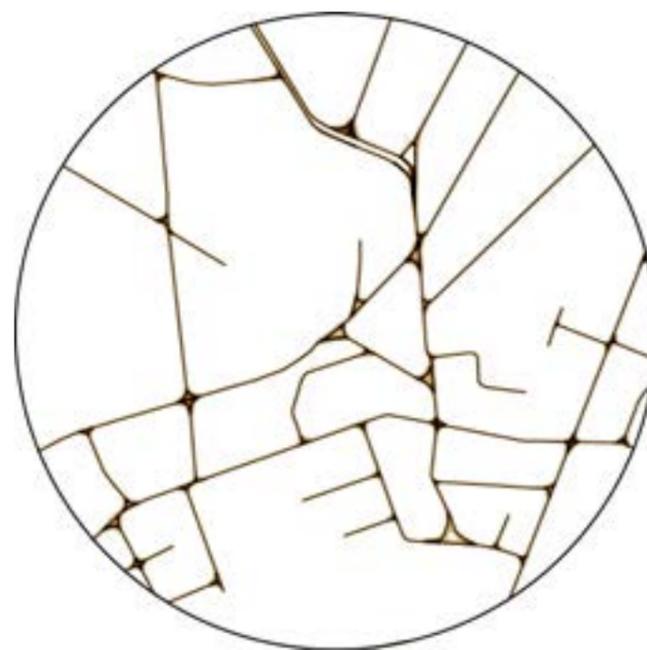




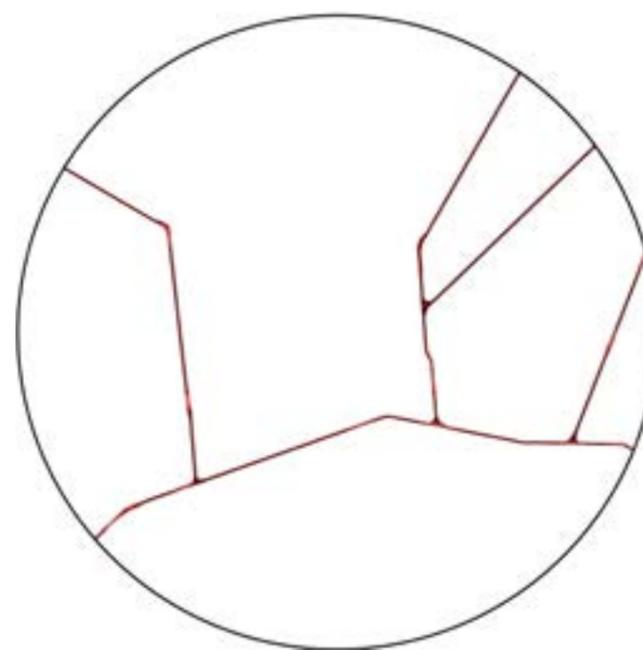
VEHICULAR ROUTES



PEDESTRIAN ROUTES



BUS ROUTES



#### PUBLIC TRANSPORT

The relationship to public transport is vital to the emergency facility. The site is located under the Karangahape Road Bridge which has large number of bus routes.

#### PEDESTRIAN USE

Diagram shows the current pedestrian flows close to the site. There is a large amount of pedestrian activity on Karangahape Road as it is a center for shopping, business and entertainment. The pedestrian activity on the Hopetown Bridge is much quieter as it is designed largely as a road.

#### VEHICULAR USE

From the observations made on the site visits, vehicular patterns involve high vehicle usage on the motorway 1, Union St, Nelson St, Pitt St, and Karangahape Rd. Potentially the main traffic access to the site would be from the Southern motorway 1.

#### SITE CONSTRAINTS, OPPORTUNITIES AND FUNDAMENTAL RELATIONSHIPS

1. The above ground site is long and narrow. It is also located at a considerable height and provides high visibility to surrounding areas.
2. The location of the site enables multiple entries from the surrounding streets and motorways at different levels. Thus, entries can be allocated separately for ambulances, services, pedestrians, and cars.
3. The off ramp is extremely noisy and hostile environment.
4. The site has considerable natural light as the surrounding buildings are further away. The only darker regions are under the Hopetown and Karangahape Rd Bridges.
5. The Hopetown Bridge and Karangahape Bridge provide two very different atmospheres socially and physically.
6. Number of car parking facilities are available in the surrounding areas.
7. The area around the motorway provides opportunity for intensification.

## AUCKLAND CLIMATE

In Auckland we experience a subtropical climate. The province lies in 13° latitude south of the Tropic of Capricorn.<sup>101</sup>

### WIND ANALYSIS

The air movement over Auckland is primarily from the southwest. This is especially the case in winter and spring, while in summer the share of winds from the north east rises. Due to the elevation of the site and the exposure, it experiences high winds. Spring is one of the windiest seasons throughout the province. Summer and autumn are the seasons when the highest number of light wind days are observed.

The highest wind speeds are experienced in the first part of the afternoon. This is due to the land surface heating which is more intense at the time of day and stronger winds above are brought down to ground level by turbulent mixing. Cooling at night usually returns to a lighter wind pattern.

There are sections of the site that face the southwesterly winds. The structure will have to be engineered in such a way that it will be able to withstand maximum wind loads.<sup>102</sup>

### RAINFALL

The dispersal of the Auckland province's median yearly rainfall. Auckland experiences rainfall over 0.1mm 180-210 days per year.<sup>103</sup>

### AIR TEMPERATURE

The majority of the Auckland area experiences mean yearly temperatures between 14° C and 16° C.<sup>104</sup>

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101	Chappell, P.R. "The Climate and Weather of Auckland." <i>NIWA Science and Technology Series 60</i> , (2012): 3.
102	Chappell, P.R. "The Climate and Weather of Auckland." <i>NIWA Science and Technology Series 60</i> , (2012): 18.
103	Chappell, P.R. "The Climate and Weather of Auckland." <i>NIWA Science and Technology Series 60</i> , (2012): 19.
104	Chappell, P.R. "The Climate and Weather of Auckland." <i>NIWA Science and Technology Series 60</i> , (2012): 23.

## SUNSHINE

Most parts of Auckland collect about 2000 hours of bright sunshine annually. Overall, the central regions get more bright sunshine than the western and southern regions. The orientation of the structure will be in shape of the site thus, it will be linear in form and run from south to north direction. The eastern and western facades will need shading devices to block out the low morning and late afternoon sun. The site is exposed because the surrounding buildings are far away thus it has an abundance of natural light. This creates and opportunity for solar power on the roof.<sup>105</sup>

### TRAFFIC NOISE AND AIR-BORNE VIBRATION

Noise often oscillates over a period of time due to the physical characteristics of the source. Road traffic noise will vary from fluctuations in traffic volumes, vehicle types, and vehicle speeds. Noise levels reduce with distance from the cause due to spreading, atmospheric absorption, interference from other obstacles and ground properties. Solid and hard ground surfaces, for instance, asphalt and soft ground surfaces like grass influence noise transmission differently. A hard surface is more likely to reflect and produce louder noise levels beyond the source.

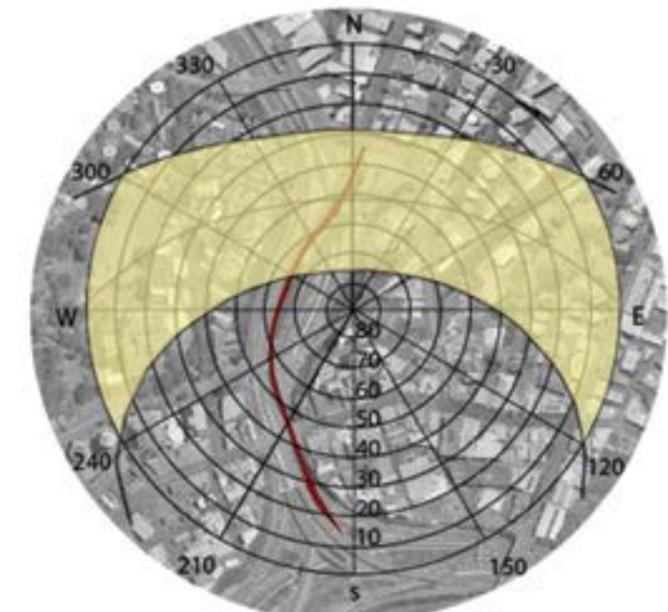
Ground borne vibration is the oscillatory movement of the surface about an equilibrium position and can be defined in terms of displacement, velocity or acceleration.

Air borne vibration from vehicular traffic is generated by the engines, exhausts, while ground borne vibration is formed by the contact between rolling wheels of vehicles and the road surface.

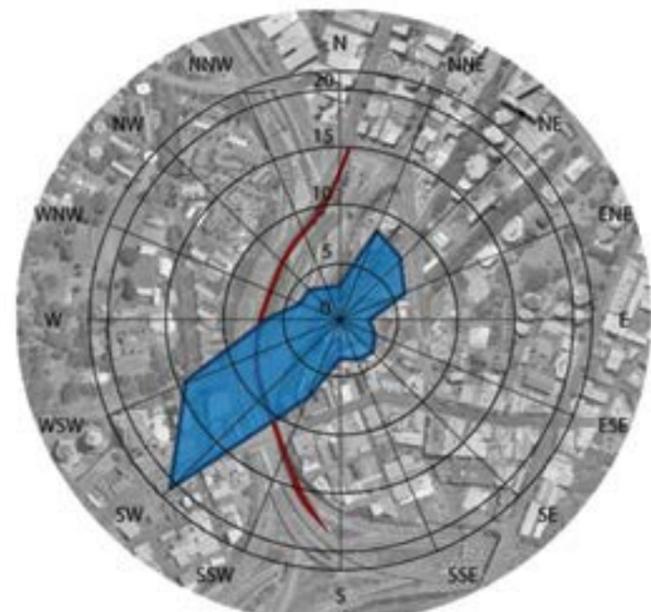
Traffic noise induces vibrations on and under the surface of the off ramp. These vibrations occur at higher frequencies than earth borne vibrations and will have to be dealt with in the design.<sup>106</sup>

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105	Chappell, P.R. "The Climate and Weather of Auckland." <i>NIWA Science and Technology Series 60</i> , (2012): 31.
106	"Noise and Vibration." <i>Report on Environmental Impact Assessment Study</i> . Accessed June 12, 2015. <a href="http://www.slocleanair.org/images/cms/upload/files/pdf/2011/COP/4_3_Noise%20and%20Vibration.pdf">http://www.slocleanair.org/images/cms/upload/files/pdf/2011/COP/4_3_Noise%20and%20Vibration.pdf</a>



SUN PATH



WIND PATH



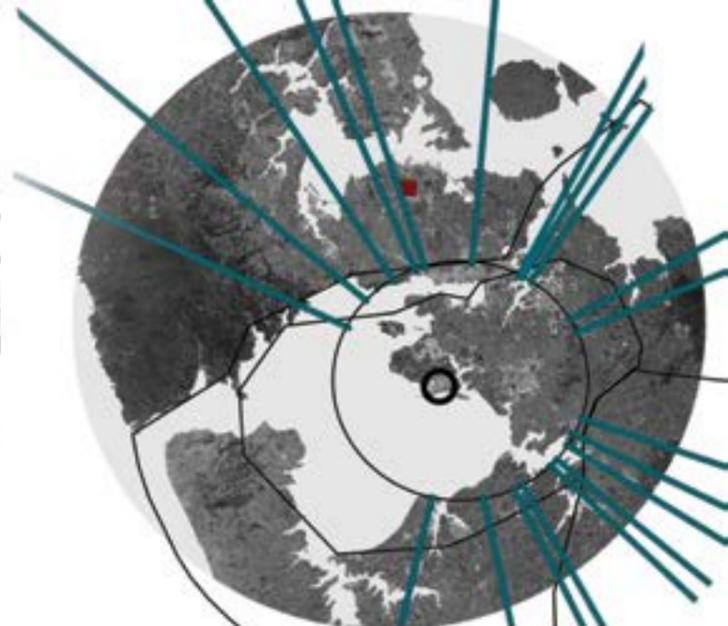
VOLCANO VIEW ZONES



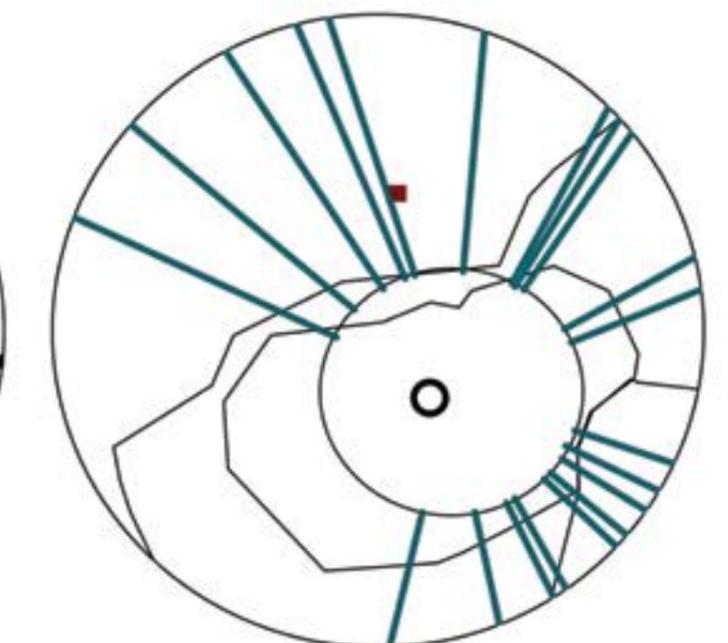
SERVICES INFRASTRUCTURE

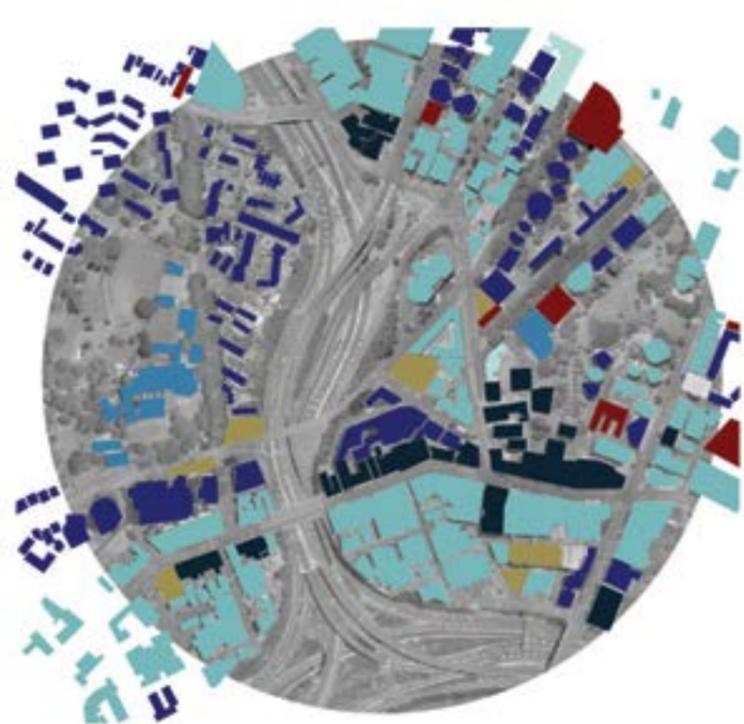


TRANSPORT INFRASTRUCTURE



AIR-SPACE INFRASTRUCTURE





-  HOTELS
-  PARKING
-  BUSINESS
-  SCHOOLS
-  RESIDENTIAL
-  MIXED USE

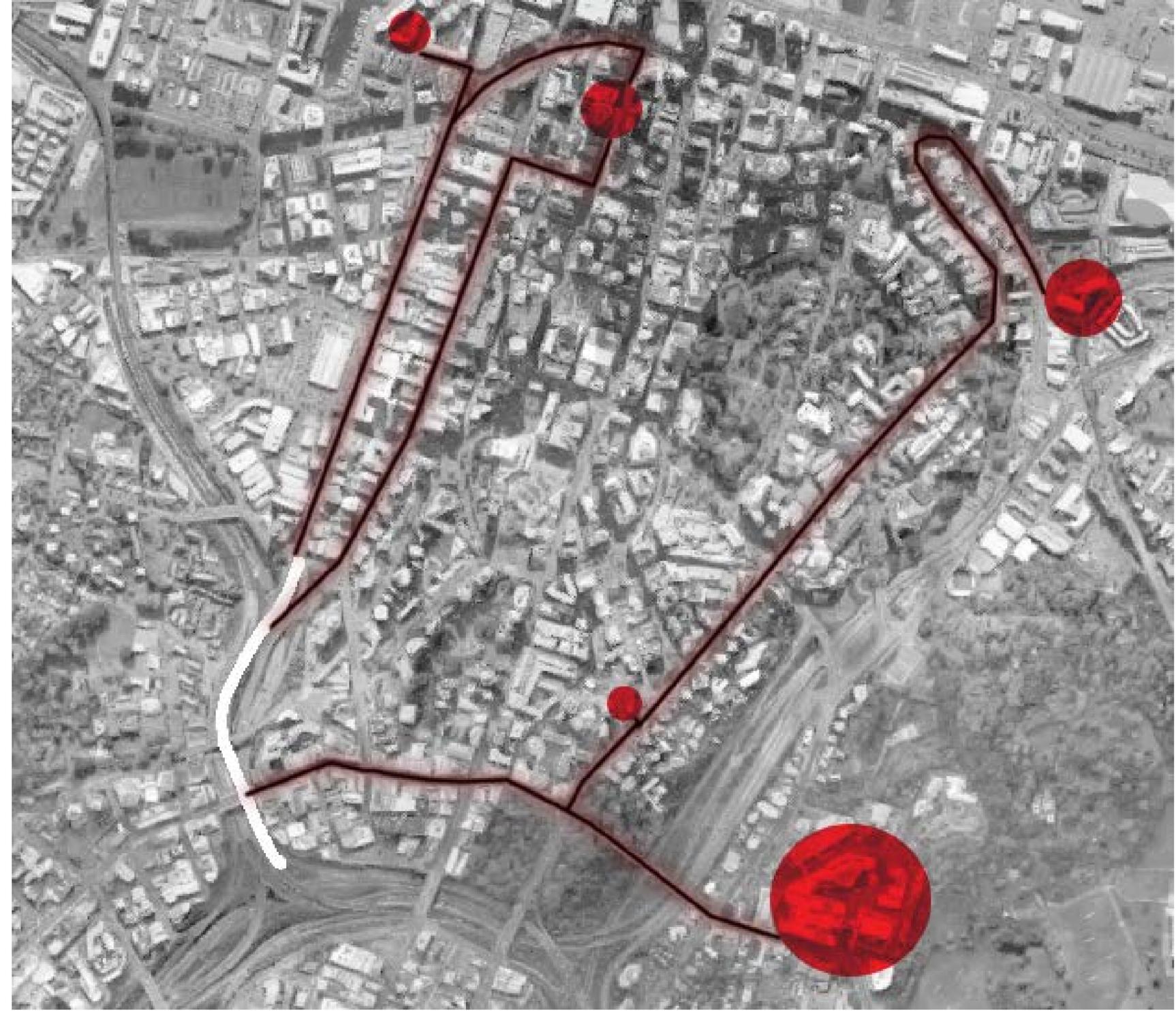
Fig 42. Left image: Surrounding building functions.



Fig 43. Right image: Landscaping around the site.



Fig 44. Opposite image: Other medical facilities around the site that can work in partnership with the new facility.



### CORROSION ZONES NEW ZEALAND

The site falls in the zone 1 of the exposure zones of NZ. Material selection and maintenance issues will be determined by the site location and the corrosion zone.<sup>107</sup>

### SEISMIC ZONE C

Despite the area having the lowest earthquake activity in New Zealand, the structure will have to withstand a moderately high earthquake and will need to adhere to the NZ building code regarding seismic activities.<sup>108</sup>

### NATURAL VEGETATION

The natural landscaping surrounding the Spaghetti Junction will not be disturbed as it plays a vital role in reducing traffic noise and vibrations. It also reduce the hostile effects of the environment. The landscaping reflects the importance of reducing the negative effects caused by the motorways.

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107 "Auckland Corrosion Map." *Galvanizing Association of New Zealand*. Accessed July 9, 2015. <http://www.galvanizing.org.nz/corrosion-auckland.php>

108 "Environmental Zones." *Consumer Build*. Accessed July 19, 2015, <http://www.consumerbuild.org.nz/publish/site/start-environmental.php>

CHAPTER FIVE

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ARCHITECTURAL TREATMENT

## INITIAL DESIGN RESPONSE

A vital design strategy for the project is to form linear external and internal circulation routes mirroring the patient's journey through the emergency department. The importance of creating physical and social connections to the surrounding infrastructure was also one of the main drivers. Some of the initial concepts had deeper floor plans compared to the linear form finally selected. The long shape of the building facilitates significantly more connections to the surroundings compared to a shorter and wider building footprint.

Some of the other initial sketches include a more fragmented building along the road. These design solutions created logistical problems.

The initial façade and structural exploration emerged from the response to the research carried out on acoustics. The outer facades of the building are designed in concrete to reflect the nature of the site, while providing a completely different and more colourful experience while driving on the off-ramp.

## TIDAL FLOW

Accommodating the tidal nature of the patient load on an emergency department is crucial. There are daily, weekly, and seasonal cycles that have to be considered within the design. Flexibility and particular spaces need to address the drastic changes in levels of acuity or function to ensure efficiency and usability, in turn minimizing delays and waiting times. The lower level of the building is split into two sections with their own separate parking facilities. This means that during peak times both sections of the building are operating and during off-peak times a whole section of the building can be shut off to save space and energy.

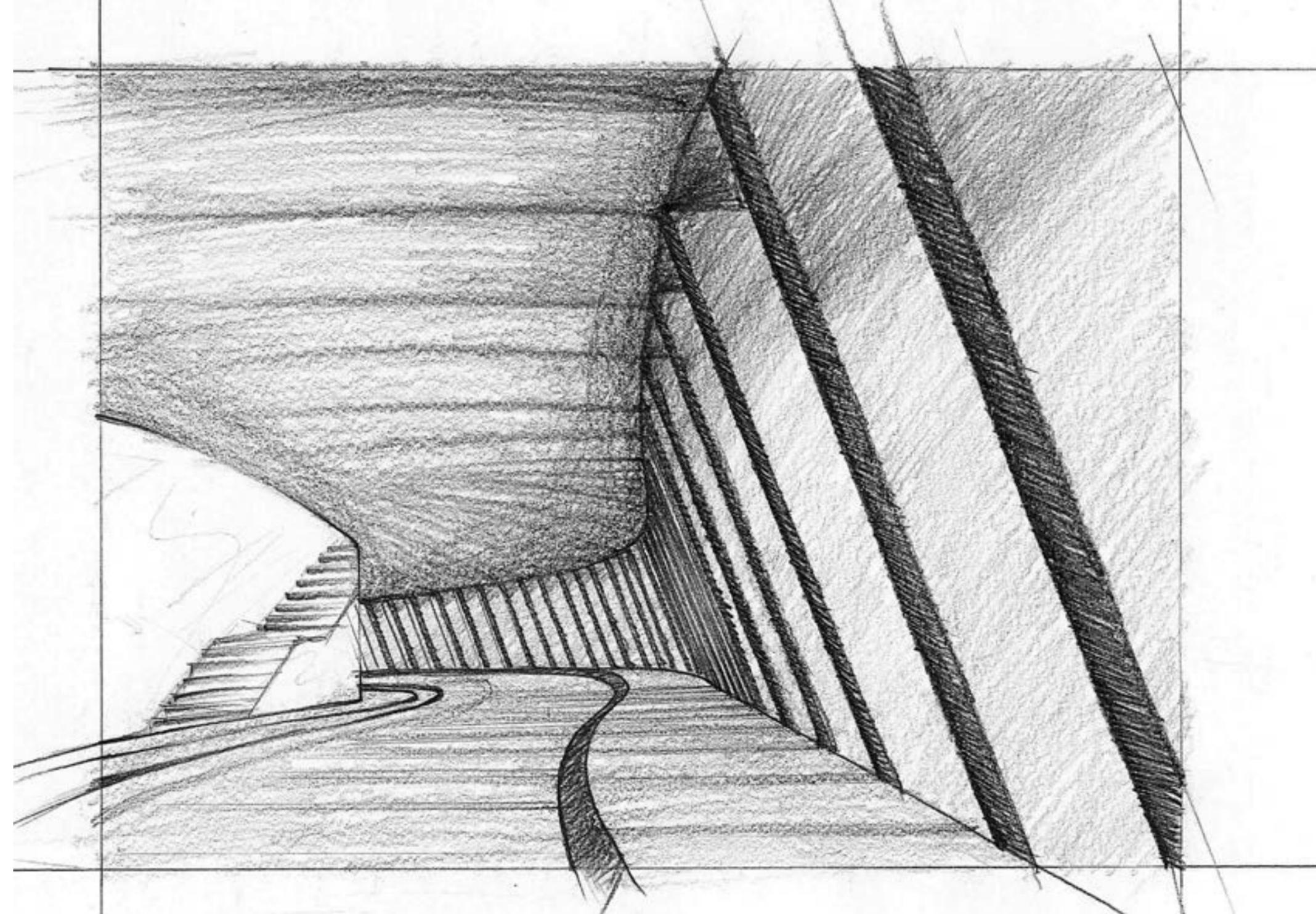
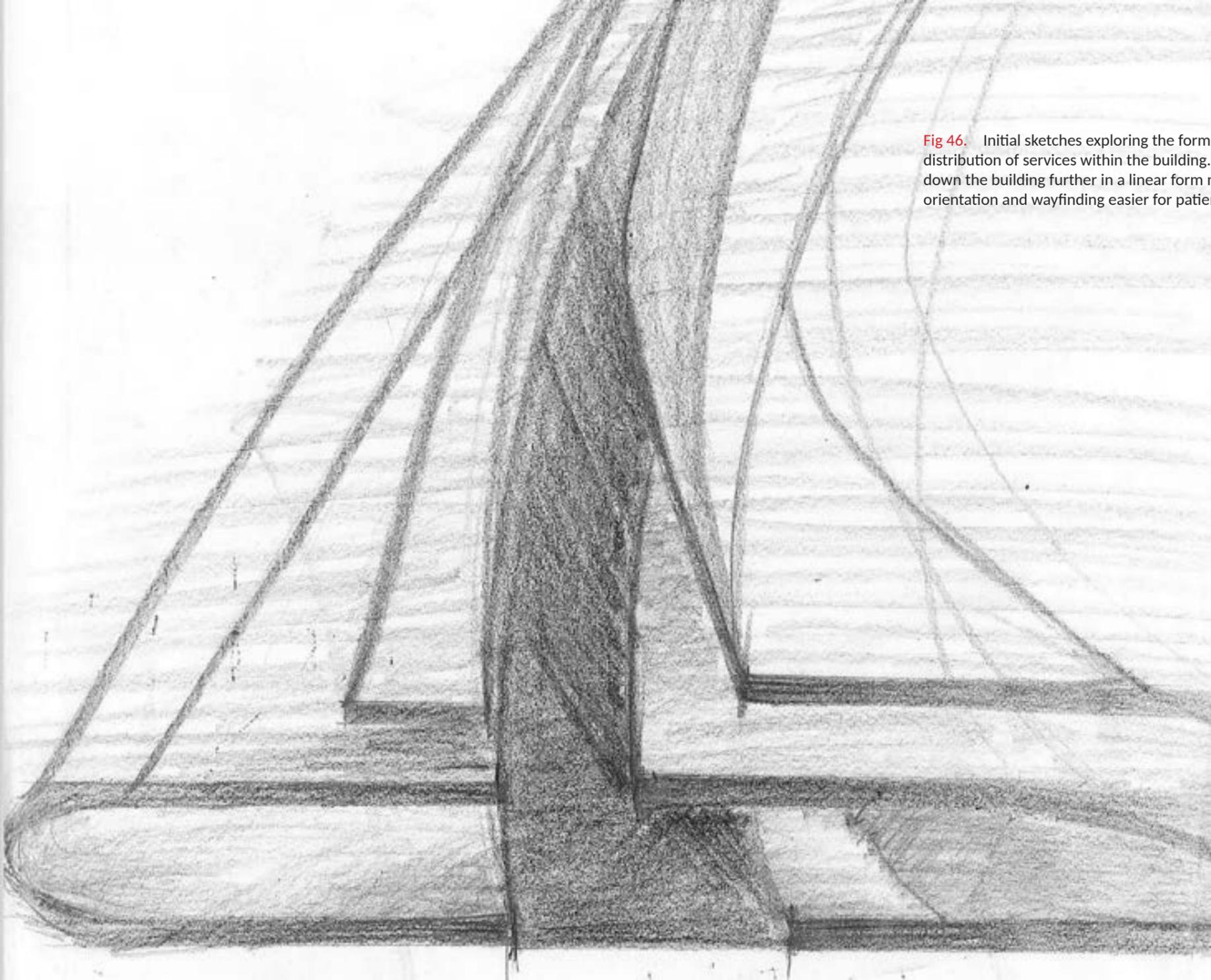
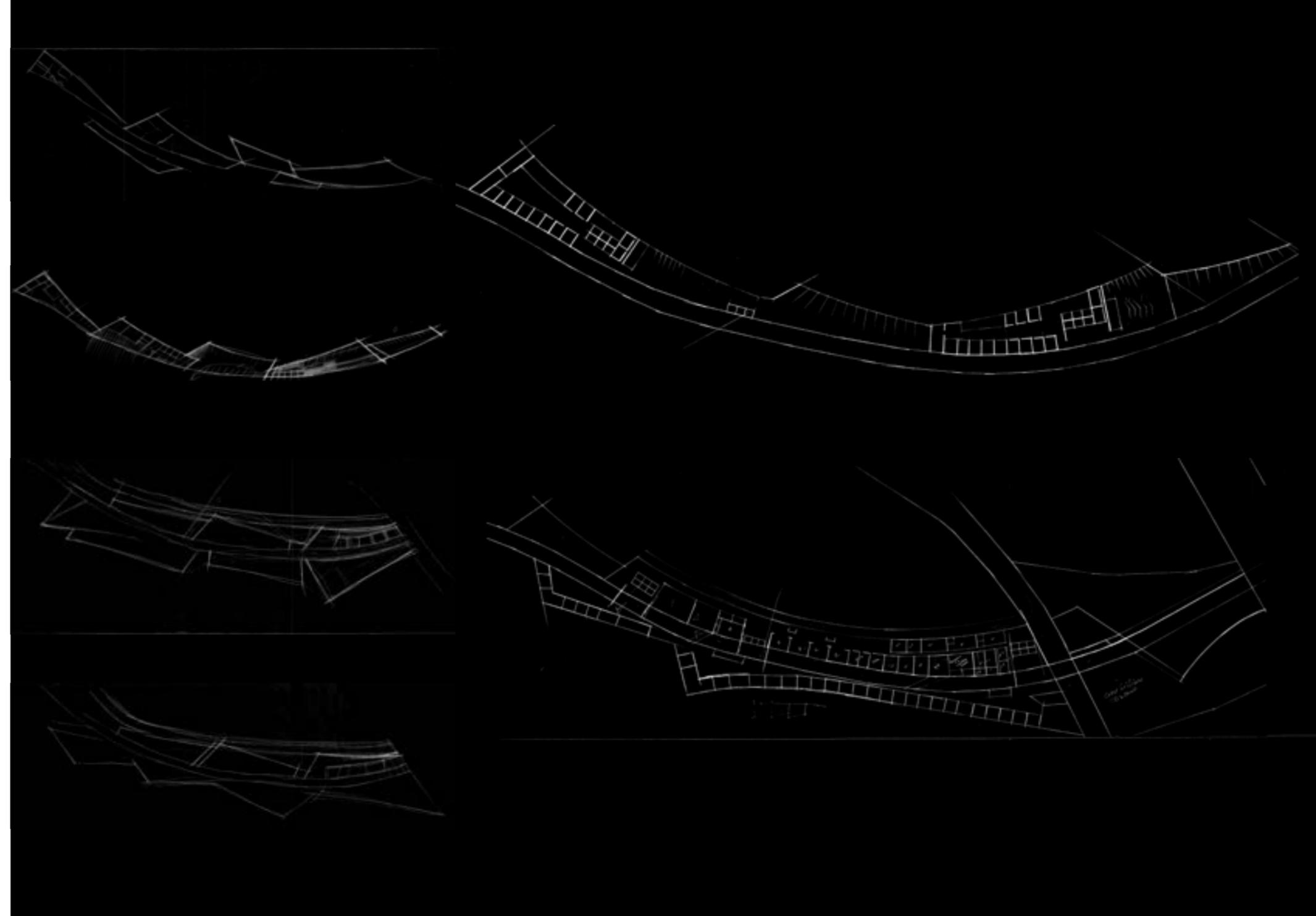


Fig 45. Initial sketch exploring the structure and the atmosphere on the off ramp.



**Fig 46.** Initial sketches exploring the form and distribution of services within the building. Breaking down the building further in a linear form making orientation and wayfinding easier for patients and staff.



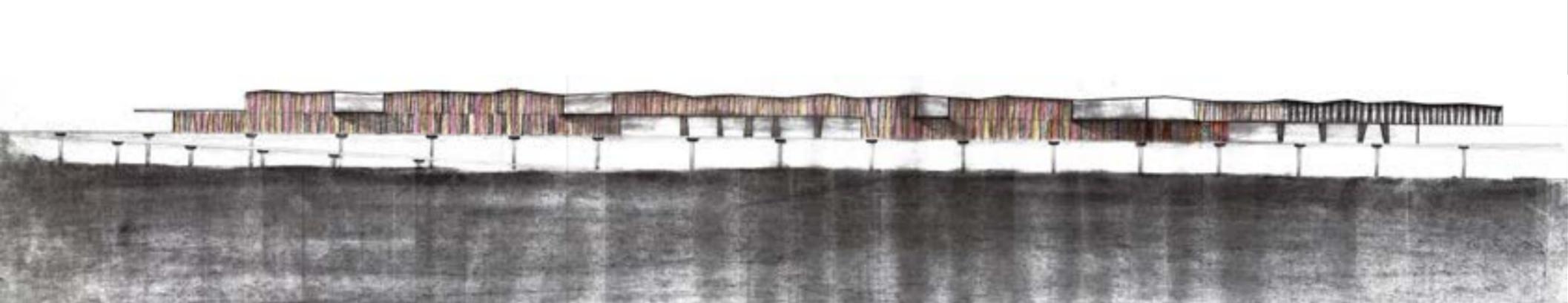


Fig 47. Top section showing the view from the off ramp of the whole length of the building. Coloured panels with scattered glass panels within them.

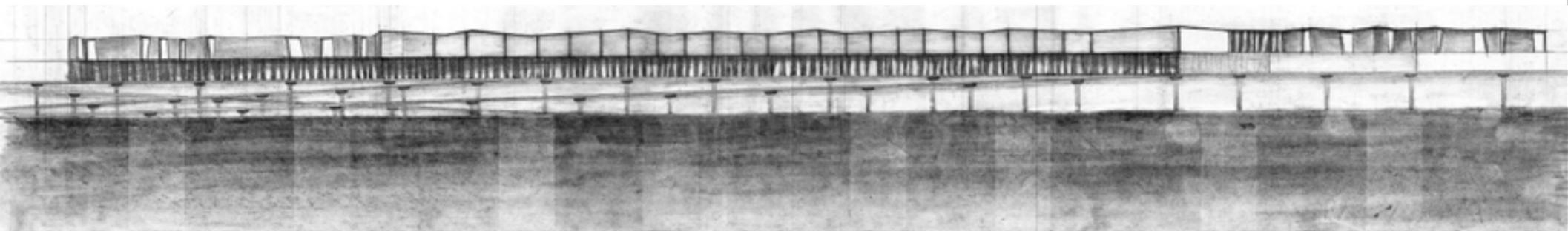
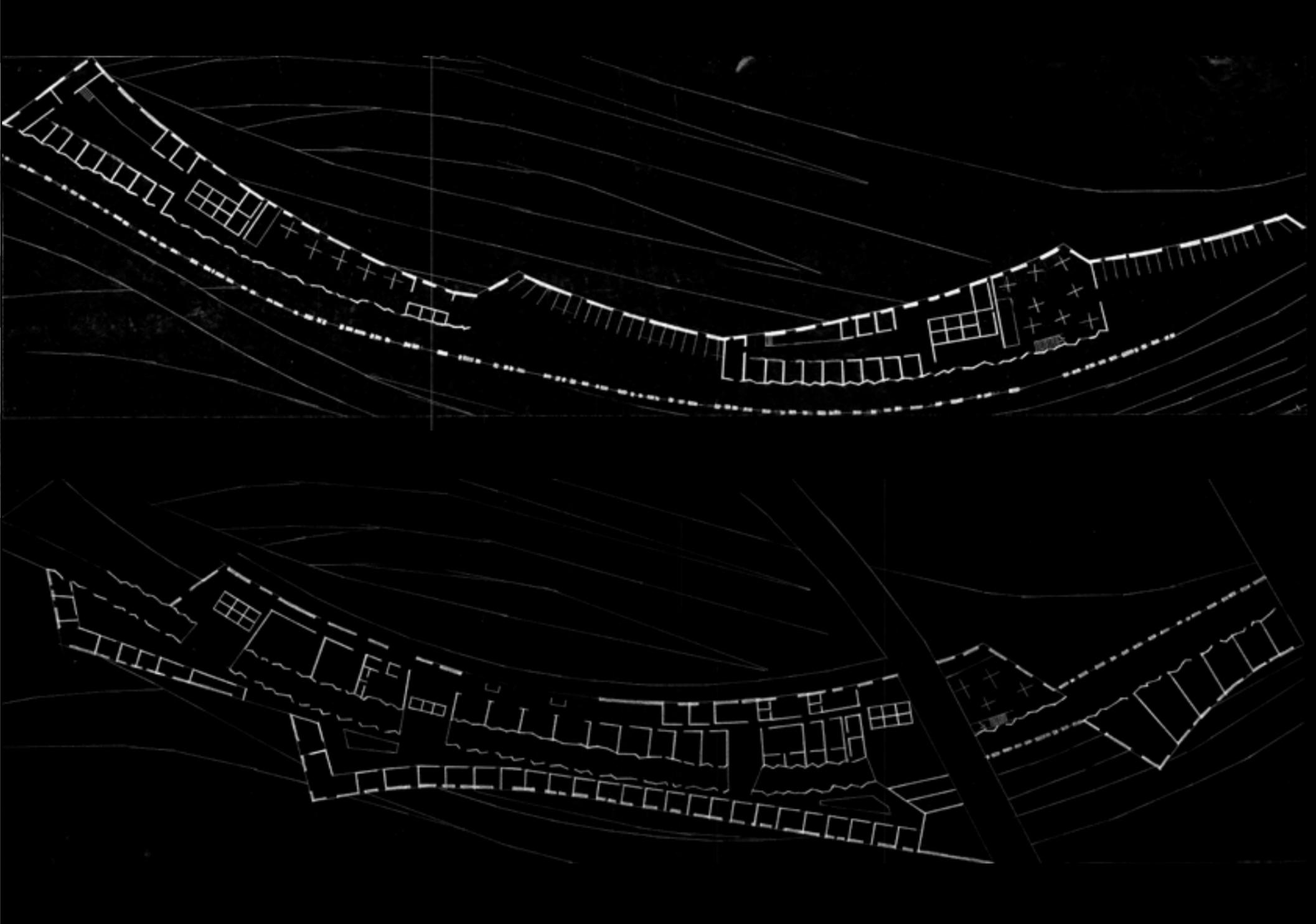


Fig 48. Bottom elevation showing the exterior of the buildings. Columns on the bottom with concrete paneled facade.



Fig 50. Initial design response showing coloured facades on the off ramp with concrete panels on the exterior of the buildings seen from the other motorways.

Fig 51. Opposite page: Initial sketch plans for the proposed building.





## CORE FACILITIES

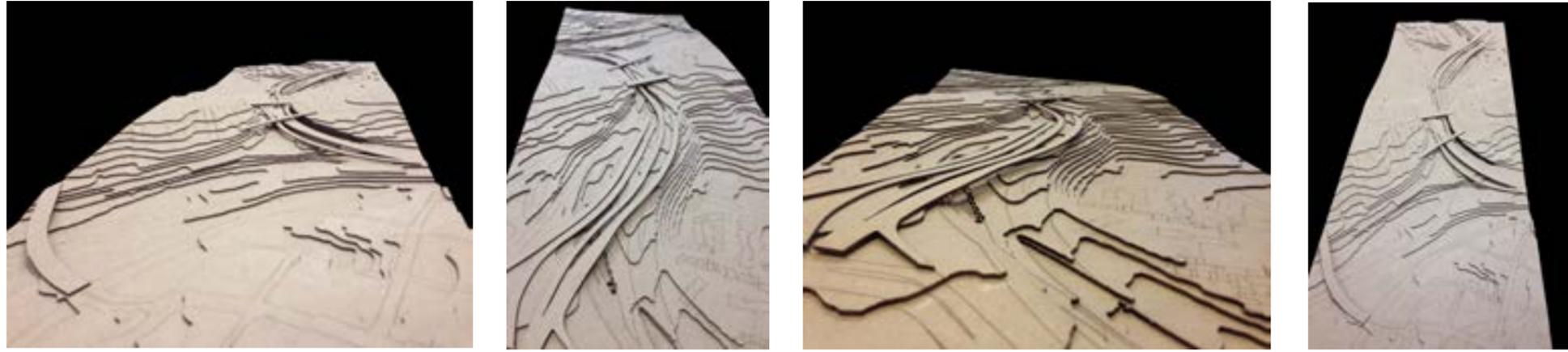
### ENTRANCES

Emergency departments are complex in terms of patient pathways. The system of triage enforces a certain hierarchy on patients needing different levels of care. The transportation methods of patients vary according to the seriousness of their condition. Critically ill patients often arrive via helicopters or ambulances and need unobstructed access to facilities. From the detailed study of pedestrian and vehicular use around the site, a new road needs to be constructed in order to provide a separate entrance for ambulances to the facility. This new the Hopetown Bridge and goes on to connect with Hobson Street intersection. The ambulances can then stop and transfer the patients and can then carry on to the ambulance station. This link can also act as a service link for the medical facility by the delivery of equipment, medical supplies, food, linen, rubbish collection, and laboratory equipment. Allocating a separate access route to these functions eliminates the need for parking areas as these can be used as loading zones without hindering the traffic.

Patients arriving by private transport can be catered for through the off-ramp itself. Branching off the motorway, this link can provide fast access to the facility from wider Auckland and also egress from the facility as well. The route takes advantage of the huge levels of motorway use in Auckland. Patients arriving at the emergency facility may be driven by family members or friends and may need support to enter the facility. In an emergency, the distance between the parking zone and the entrance can be vital. Covered drop-off and pick-up zones need to be provided. The design incorporates parking areas within the building in close proximity to the entrance. One of the important characteristics of the design is the extended surface area exposed to the road side. The parking areas take advantage of this and also provides the opportunity to create multiple entrances into the building.

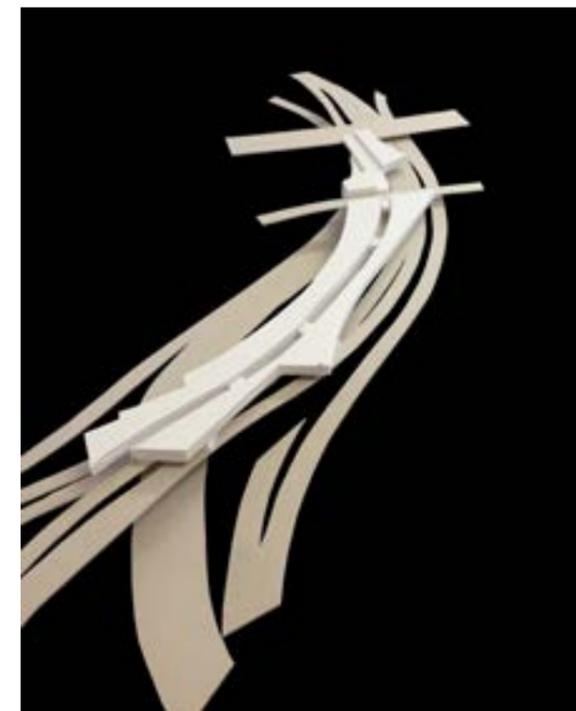
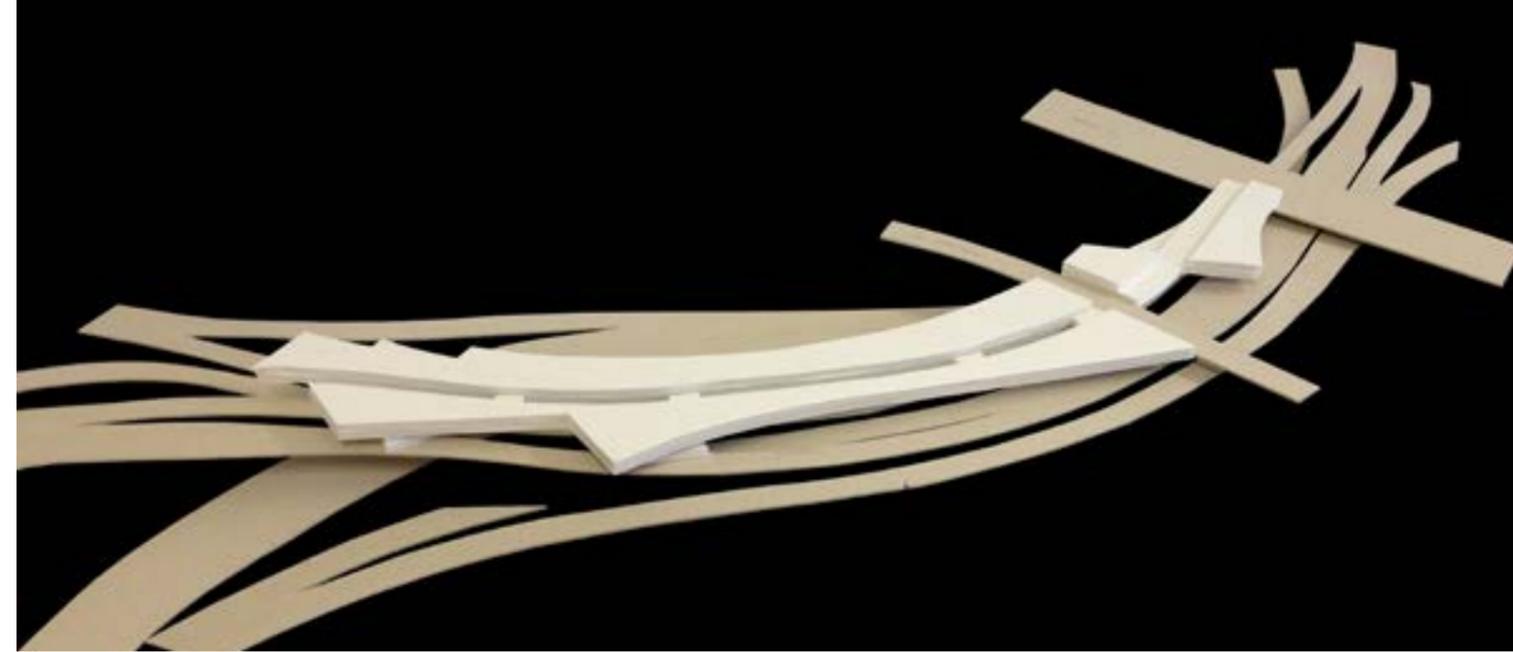
The upper level of the facility is accessed by ambulances and service vehicles by the new link. The public access to the facility is through Hopetown Bridge and Karangahape Road Bridge. Both bridges have heavy pedestrian traffic: the taking advantage of this and creating spaces to linger add value to space. Patients arriving on foot do not need urgent care hence the supporting facilities of the emergency department can be located further away. This enables further integration of other non-medical services into the building. The bridges are a vibrant source of different cultures and atmospheres.

Fig 52. 1:500 scale model of the developed design.



**Fig 53.** Site model at 1:1500 scale exploring the contours of the site and the different levels of the motorways.

**Fig 54.** 1:500 scale model of the developed design exploring the form.



## CIRCULATION

Separating the external circulation routes according to patients needs ensures smooth functioning of the facility. On the lower level the internal circulation is linear, furthermore the public and private sections of the building are divided by the vertical circulation. The elevators act as points of control between the public zones and private medical facilities, reducing the need for security. Both levels are connected by a series of elevators and stairs. Horizontal bridges link the two building sections on the upper levels. The upper level offers a public face for the building. A link is also constructed between the Hopetown Bridge and Karangahape Road to further encourage pedestrian traffic and to provide people to experience a unique space above the motorways and fast moving traffic. The restaurants, cafes, and other services between the two bridges keep the pedestrian flow constant. Karangahape Road serves as an arterial route for public transport and the link between it and Hopetown Bridge connects public transport infrastructure with the emergency department. The linear circulation of the facility reduces the disorientation associated with medical facilities and makes the patient journey more recognizable.

## RAPID ASSESSMENT AND TREATMENT FACILITIES

Four resuscitation rooms are situated close to the external access route for the ambulances. In emergencies, patients can be transferred directly from the ambulances into the resuscitation bays reducing the time taken to provide treatment. These are flanked by the operating theater and critical care rooms. The resuscitation bays are also located close to the diagnostic services. Elevators are located close to the resuscitation room and to exam rooms on the lower level to allow for rapid transfer of patients. The resuscitation spaces are much larger than standard exam rooms to accommodate a team of staff treating the patient. Located close to these bays are rooms dedicated for relatives and friends of the patients. These rooms can provide a private waiting areas with a non-clinical atmosphere and the family members can be comforted by being close to the patient.

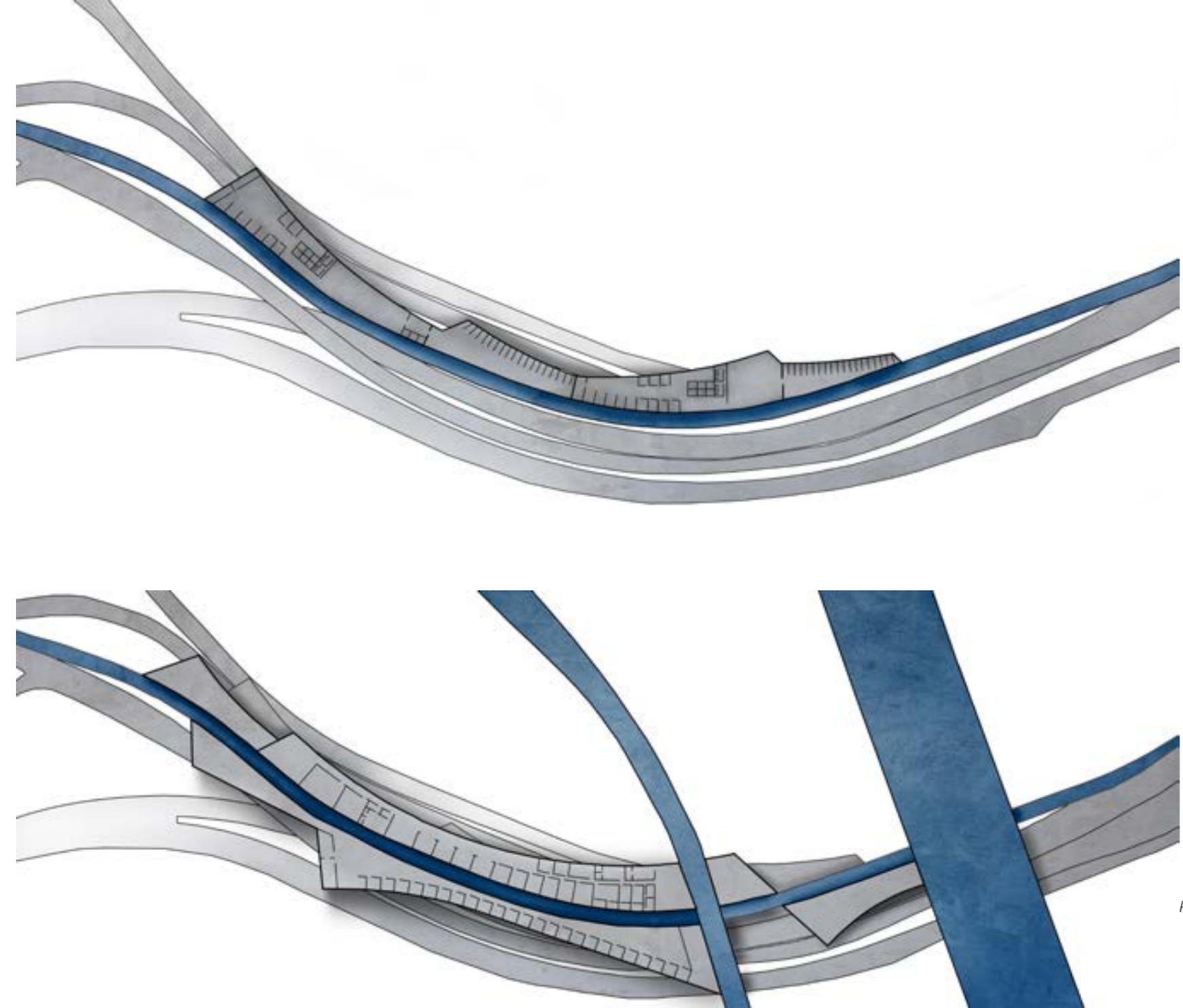
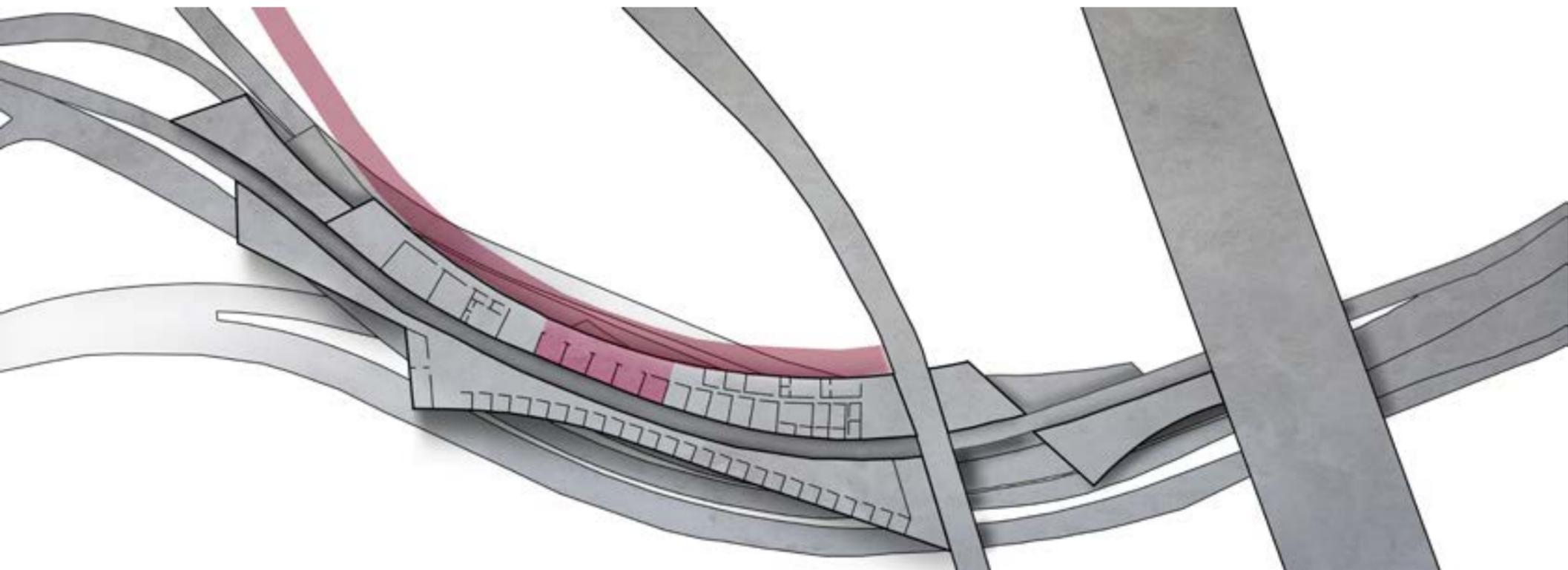


Fig 55. Opposite page: Image illustrating the public exterior circulation routes.

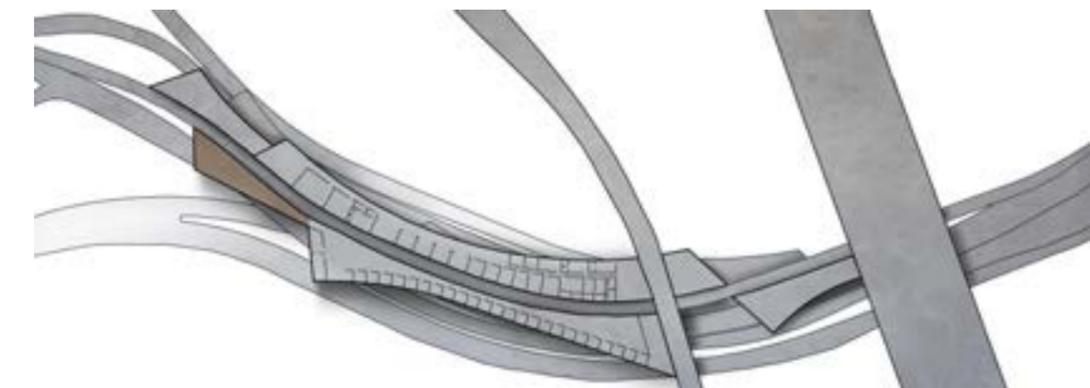


### DECONTAMINATION FACILITIES

Emergency departments need to receive casualties in an event of chemical exposure as well as an other incident, therefore decontamination facilities need to be incorporated in the design. The decontamination room includes a separate shower and is equipped for resuscitation and minor surgical procedure. The room has external access to allow patients with contamination to be admitted directly from the outside.

### STAFF FACILITIES

The staff offices, rest areas, changing areas, lounge, and meeting areas are in a quieter section of the building. This area is linked to the resuscitation areas and other services via the horizontal bridges that span the two sections of the building. Locating the staff facility away from the public areas provide a more stress free workspace.



**Fig 56.** Opposite page: Image showing the resuscitation facilities with a separate road for ambulances and service vehicles.

**Fig 57.** Right image: Location of staff facilities.

## NOISE

Sounds around us can range from calming and therapeutic to stressful and distressing. Physically, there is no difference between sound and noise. Noise simply can be explained as an impurity of disagreeable sound and is prevalent in hospitals settings. It is a source of increased anxiety, sleep loss, and pain perception.<sup>109</sup> Another form of noise is speech intelligibility and audibility; clarity is vital for communication between patients and staff members or between staff members in medical facilities. Issues with speech security and privacy also arise.<sup>110</sup> These different aspects of noise emphasize the significance of designing and maintaining the environment to avoid transmission of undesirable noise and yet also improve verbal communication between people.

In a hospital environment, sources of noise are countless. They emanate from alarms and displays, human exchanges, visitors and patients, movement of beds and equipment, and public speakers. The amount of sound generated is also dependent on building design and audio quality, which can include door mechanisms, open designed work spaces, and the absence of sound absorption materials. Long term exposure to high levels of sound can have adverse effects on patients such as altered memory, increased agitation, less tolerance to pain, aggressive behaviour, and can add to falls and misunderstanding, particularly with elderly patients. Significant amounts of research have been carried out on the negative effects of noise on staff and patients in hospitals. Working for long hours in noisy surroundings has a strong effect on the staff members with increased fatigue, exhaustion, depression, and irritability.<sup>111</sup>

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- 109 Cabrera, Izumi Nomura, and Lee, Matthew H.M.. "Reducing Noise Pollution in the Hospital Setting by Establishing a Department of Sound: A survey of Recent Research on the Effects of Noise and Music in Health Care." *Preventative Medicine*, 30, 4 (April, 2000), Pages 341.
- 110 Joseph, Anjali, and Ulrich, Roger. "Sound Control for Improved Outcomes in Healthcare Settings." *The Center for Health Design* 4, (January, 2007), Pages 9.
- 111 Short, Alison E., Short, Ken T., Holdgate, Anna, Ahern, Nicole, and Morris, Jenny. "Noise levels in an Australian emergency department." *Australasian Emergency Nursing Journal* 14, 1 (February, 2011), Pages 26.

Noise has been mentioned as a leading cause for patients electing to leave the emergency department before suitable treatment.<sup>112</sup> Study carried out in Australian emergency departments reported noise levels of 55 dB in clinical areas with the highest levels recorded in resuscitation areas of 64 dB. Across a 24 hour period, all areas were above 50 dB on average, with instantaneous sound levels peaking at 90 dB.<sup>113</sup>

There are many reasons for the noisy environments in the hospital. There are causes of noise much like alarms, paging systems, phones, computer printers, staff exchanges, televisions, delivery carts, heating and cooling systems, ceiling fluorescent lights, doors opening and shutting, and cleaning staff and linen carts being pushed on floors.<sup>114</sup> Environmental surfaces such as walls, floors, and ceilings also contribute as sound sources in a hospital. The presence of solid reflecting surfaces tends to intensify the noise problem in medical facilities. These faces tend to cause noise to travel long expanses down the corridors and into treatment rooms, harmfully disturbing patients and staff over greater areas. The reverberation period of a space is the time it requires for the sound of decay by 60 dB once the source of the noise has stilled and is mainly dependent on the sound absorbing features in the room.<sup>115</sup> Use of sound absorbing material can help reduce the sound build up. Incorporating high quality sound absorbing ceiling panels and tiles reduces the noise and perceptions of sound. It has a drastic consequence on other effects for example, speech articulacy and decreased perceived work stress by staff members. Although decibel levels are not significantly decreased, the reverberation times and sound propagation are significantly lowered.<sup>116</sup>

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- 112 Short, Alison E., Short, Ken T., Holdgate, Anna, Ahern, Nicole, and Morris, Jenny. "Noise levels in an Australian emergency department." *Australasian Emergency Nursing Journal*.
- 113 Short, Alison E., Short, Ken T., Holdgate, Anna, Ahern, Nicole, and Morris, Jenny. "Noise levels in an Australian emergency department." *Australasian Emergency Nursing Journal*.
- 114 Cunha, Madalena, and Silva, Nelio. "Hospital Noise and Patients' Wellbeing." *Procedia – Social and Behavioural Science*, 171, 16 (January, 2015), Pages 246-251.
- 115 Short, Alison E., Short, Ken T., Holdgate, Anna, Ahern, Nicole, and Morris, Jenny. "Noise levels in an Australian emergency department." *Australasian Emergency Nursing Journal*.
- 116 Short, Alison E., Short, Ken T., Holdgate, Anna, Ahern, Nicole, and Morris, Jenny. "Noise levels in an Australian emergency department." *Australasian Emergency Nursing Journal*.

Speech intelligibility and speech privacy are extremely important in healthcare settings. The healthcare professionals need to understand and act on various types of auditory information.

In large hospitals, patients are often in circumstances where they hear private exchanges about other patients or with patients or have personal material communicated in exposed spaces. Such occurrences often have an impact on patients' confidence and their ability to talk about their health problems. The atmosphere of the physical environment evidently influences the matters of patient confidentiality and speech privacy in medical facilities. Breaches in patient confidentiality occur more frequently in wards with numerous beds which are partitioned with curtains. Patients treated in these spaces are more likely to hold on to information because of the absence of audible and visual privacy. There are numerous spaces where private conversations can be overheard such as in areas of registration, reception or waiting, open plan examination areas with curtained cubicles, and multi-occupancy rooms.<sup>117</sup>

Creating healing environments is critical for patient care. Our ambient physical healthcare environment plays an important role. Impure sound becomes noise, which is known to have negative effects on health and healing. Undoubtedly, architecture can start to solve many of these issues of medical facilities in relation to patient confidentiality. One of the strong design solutions provided by the research is the importance of single patient rooms.

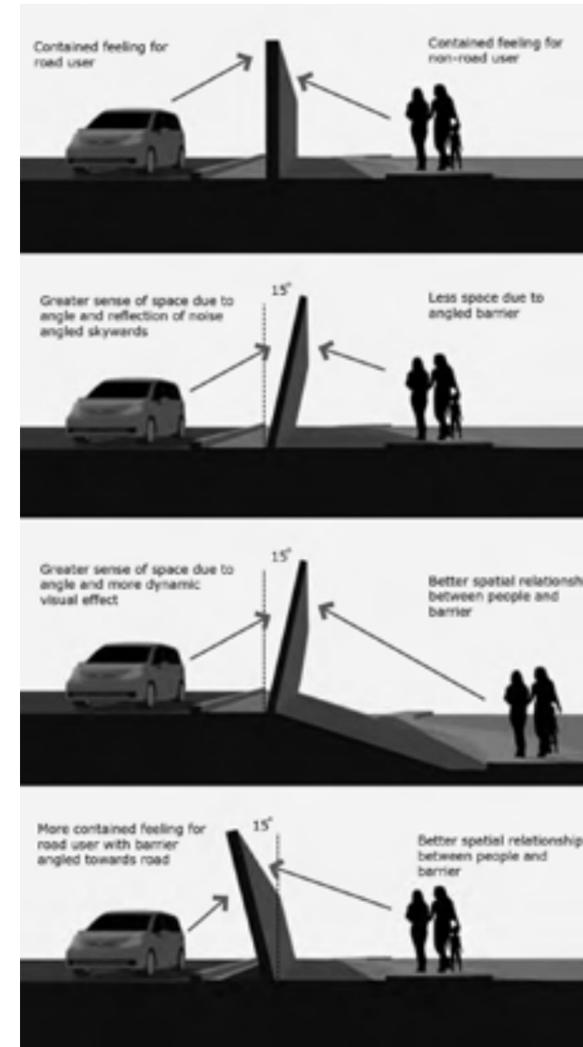


Fig 58. Understanding space and noise considerations for exterior facades.

## ACCOMMODATION AREAS

The inpatient accommodation areas are situated away from the fast paced functions of the building. Situated on the west all the rooms have views out to the harbour and provide a calm and quiet area for recovery and healing. These areas also include lounge, kitchen, and a business center for the family members. The rooms are designed to accommodate family members to encourage faster healing with support.

## EXAM ROOMS

The exam rooms are located on the lower levels. The building form curves in order to create a concave shape for the exam rooms. The nurses' station is positioned opposite to these at an elevated level. The concave shape of the exam rooms allows the staff to constantly observe the patients.

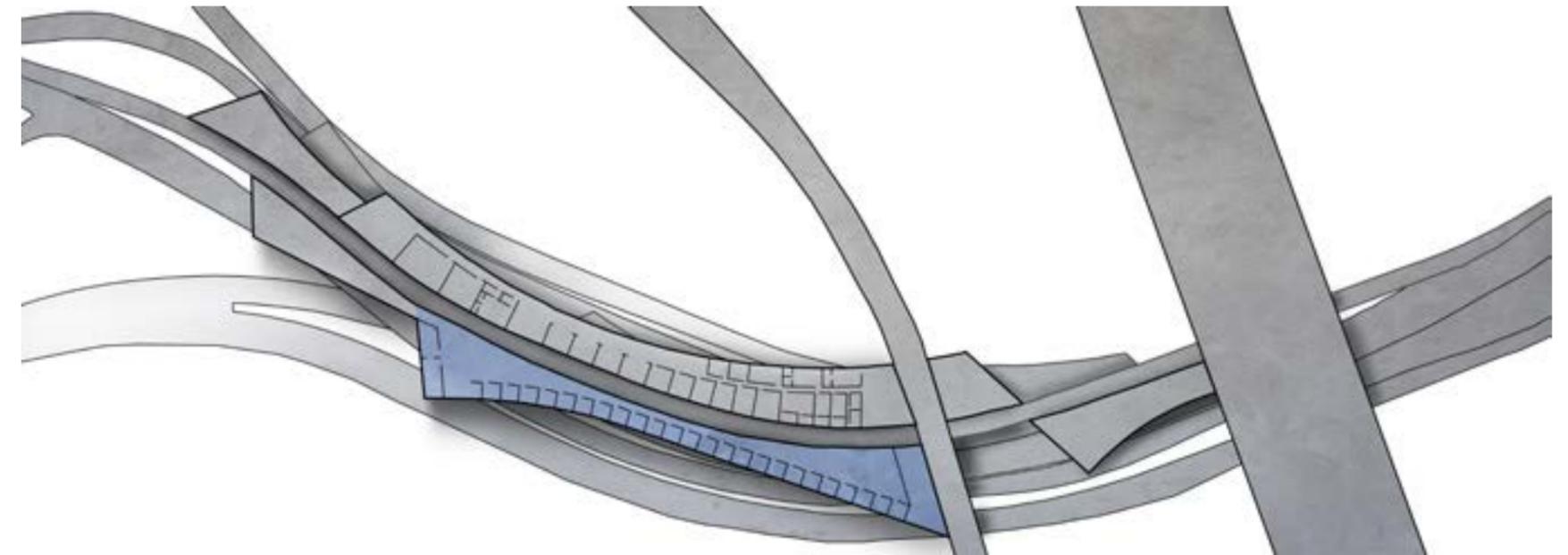


Fig 59. Accommodation facilities.

## TECHNOLOGY

Information and communication technologies have the promise to provide solutions for the challenges faced by the healthcare industry today. Technological innovations are transforming all industries as well as changing every facet of our personal lives. The amalgamation of technology and medicine is responsible for healing and saving numerous lives. The reliance on healthcare technology by medical practitioners is significant and therefore it is responsible for improved diagnosis, surgical procedures, and better-quality patient care. The use of computerized medical records, telemedicine, and portable technologies such as tablets or smart phones has enabled healthcare professionals to provide faster service and has improved the patients' quality of life. Experiencing rapid and constant technological changes within the field of medicine defines the requirements of hospital architecture. The architectural demands are constantly changing as the technology itself evolves and there are certain major paradigm shifts in technology that can inform healthcare design for the future.

## WAITING AREAS

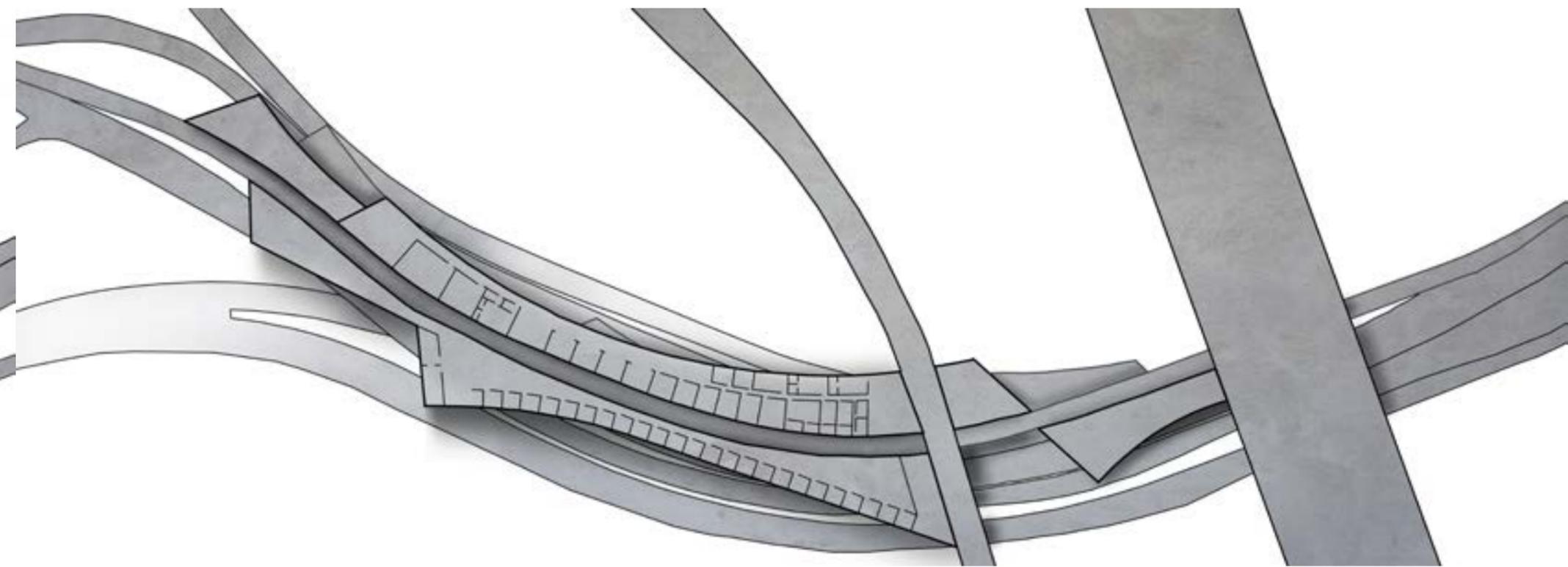
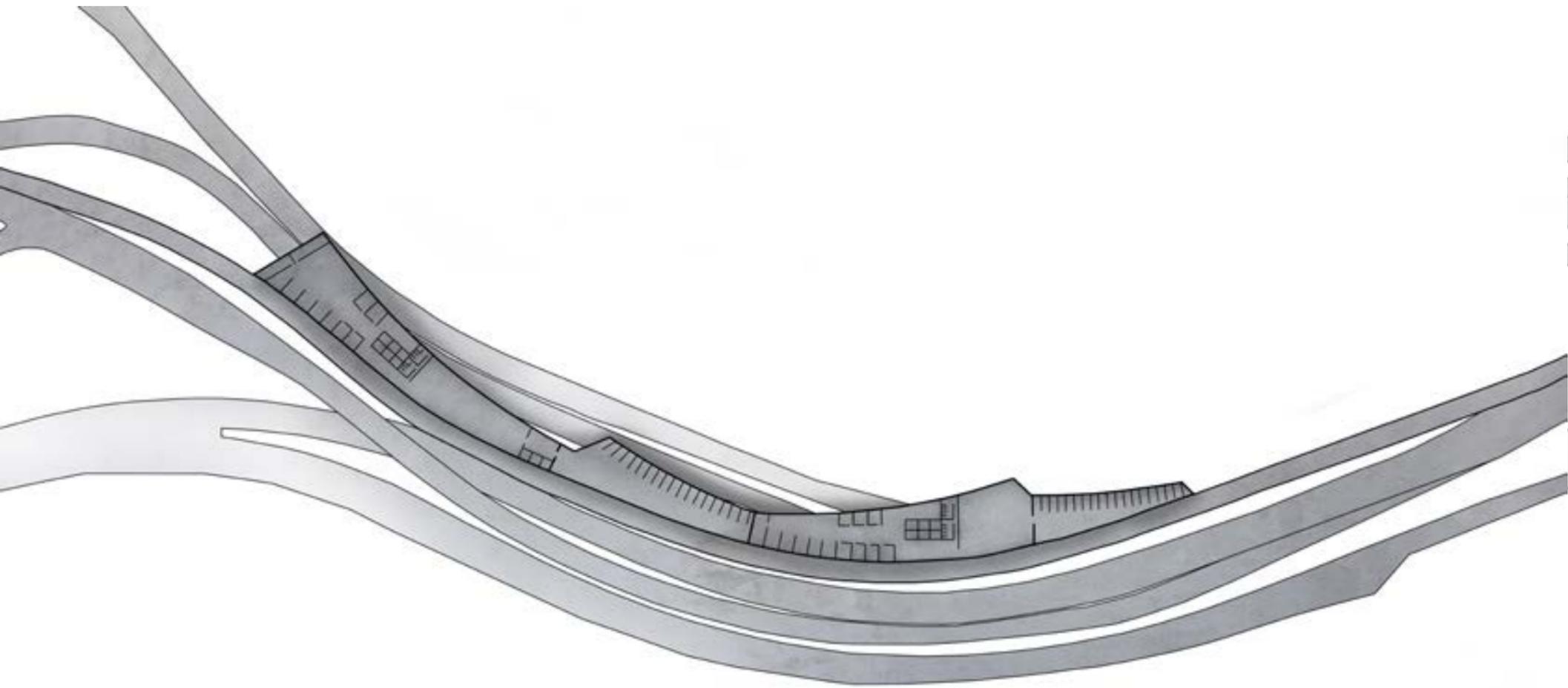
The reception and waiting areas are designed to include family members of the patients. The space is broken up by smaller partitions that offer some privacy to the occupants in stress and pain. The linear form of the building also provides larger window surface area thus offering positive distractions. Sound absorbing materials encourage rest and relaxation while reducing anxiety.

## INTERVIEW ROOMS

Interview rooms are included to provide privacy and a calm environment for staff to talk to disturbed or distressed patients and relatives. Situating them close to the external walls provide views out thus reducing the hospital environment feel.

## TIME

*Waiting is a form of imprisonment. One is doing time—but why? One is being punished not for an offense of one's own but often for the inefficiencies of those who impose the wait. Hence the peculiar rage that waits engender, the sense of injustice. Aside from boredom and physical discomfort, the subtler misery of waiting is the knowledge that one's most precious resource, time, a fraction of one's life, is being stolen away, irrecoverably lost. – Lance Marrow, Time Magazine, 1984.<sup>118</sup>*



## REFLECTIONS

Once a pillar of civic culture, the hospital has severed its roots with society and with contemporary design. The more monumental that hospitals have developed, the further they have diverged from the desire of creating healing environments, as they accommodated and subordinated themselves to science in efficient, cost-effective ways.<sup>119</sup> Medical machinery has made atmosphere redundant, and people became more an object on the scene rather than the focus of design, increasingly alienated, and anonymous in a dehumanized and intimidating environment. This research is carried out at a macro scale where it investigates the impact of the hospital on the city and at a micro scale where it identifies a particular function within the hospital, the emergency department, and reintegrates it within the urban infrastructure. To fragment and decentralize the hospital an understanding of the issues at all scales is essential; it provides a design proposal because comprehending the operational relationships that bind the various functions within the hospital together are extremely complex.

Changing paradigms in healthcare have demanded an effort to revisit the underlying issues of hospital typology. The main aim of the research was to understand the underlying symptoms that have driven the cancerous expansions of the hospital campuses and the physical and social impact of it on the city. The exercise of researching and critically analysing one of the vital functions located within the hospitals, the emergency department, was crucial in further understanding the impact of fragmenting the hospital. A singular focus on the emergency department rather than a broader view of the hospital design provides a more detailed and in-depth solution to the chronic symptoms identified. Fragmenting the hospital and suturing the smaller pieces of it within our city fabric can further create awareness of health and wellness within our communities. It brings to light the unknown and elusive world of medical care, encouraging further involvement from the society.

The exploration of decentralizing the hospital evokes further possibilities of different concepts and methods of how healthcare is provided. A future direction to this project can investigate the dynamics of inpatient facilities within the hospital. A major determinant of hospital size is the growing population and increase in amount of beds required. The movement of patients between the emergency departments and hospital inpatient facilities is complex and a source of overcrowding. The introduction of hotels or other accommodation facilities working in conjunction with hospital inpatient services can further break down the immense scale of the hospital. The concept of a patient hotel can provide calm, pleasant, and healthier environments than hospital. It encourages the involvement of family and friends in the healing and recovery process of the patients.

Architecture can return to its prominent role by becoming an advocate of better healthcare.

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119 Olivia Van der Bogt, "Architectural Models for Decentralized Hospital Buildings," in *The Urban Project: Architectural Intervention in Urban Areas*, ed. Roberto Cavallo, et al. (Rotterdam: Delft University Press, 2010), 59.

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LIST OF FIGURES**

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## LIST OF FIGURES

Fig 1. Auckland City Hospital public lobby.

Fig 2. The typical largeness, institutional complexity, and isolation often found in hospital places: Archibectenbureau Swinkels en Salemans, in Vijverdal Maastricht, the Netherlands, built between 1968-1973.

Fig 3. Auckland City Hospital main building representing the uniform facades and lack of public connections, social or physical.

Fig 4. Auckland City Hospital main building central atrium. The atrium has minimum landscaping and natural lighting providing through the roof.

Fig 5. Auckland City Hospital main building central atrium showing the bridges spanning the atrium and exposed lift tracks.

Fig 6. Middlemore Hospital campus in Auckland. The Aerial view shows the immense size of the hospital establishment and its isolation.

Fig 7. Auckland City Hospital building. The only physical connections of this building are within the campus itself.

Fig 8. North Shore Hospital model illustrating the maze of courtyards, waiting spaces, vertical, and horizontal circulation.

Fig 9. Typical corridor space filled with equipment and beds in an emergency department.

Fig 10. Fort excavated in an Archaeological expedition in the region of a Roman military camp hospital in Novae, present day the town of Svishtov in Bulgaria.

Fig 11. Opposite page: Mobile Aid, the flying ambulance by Dominique-Jean Larrey  
<http://archive.protomag.com/assets/mobile-aid>

Fig 12. Model of a Flying ambulance, Europe 1801-1850.  
[https://commons.wikimedia.org/wiki/File:Model\\_of\\_a\\_%E2%80%98flying\\_ambulance%E2%80%99,\\_Europe,\\_1801-1850\\_Welcome\\_L0058526.jpg](https://commons.wikimedia.org/wiki/File:Model_of_a_%E2%80%98flying_ambulance%E2%80%99,_Europe,_1801-1850_Welcome_L0058526.jpg)

Fig 13. American Civil War ambulances. Friday, March 11, 1864; the Union Army Ambulance Corps.

<http://retronewser.com/2014/03/union-army-ambulance-corps-established-by-congress-150-years-ago-today-mar-11-1864/>

Fig 14. Opposite page: Storage field for newly produced Dodge WC-54 Ambulances waiting shipment from the Detroit, MI factory during World War II, August, 1942.

[http://olive-drab.com/idphoto/id\\_photos\\_wc54.php](http://olive-drab.com/idphoto/id_photos_wc54.php)

Fig 15. Top Image: World war ambulances showing the Red Cross emblem.

<http://www.redcross.org.uk/What-we-do/Teaching-resources/Assembly-kits/The-red-cross-emblem>

Fig 16. Bottom Image: The WC54 Ambulance was first used by US forces in 1942.

[http://world-war-2.wikia.com/wiki/WC54\\_Ambulance](http://world-war-2.wikia.com/wiki/WC54_Ambulance)

Fig 17. U.S. paratroopers carrying a wounded soldier to an ambulance helicopter during the Vietnam War, 1965.

<http://kids.britannica.com/comptons/art-61021/US-paratroopers-carrying-a-wounded-soldier-to-an-ambulance-helicopter>

Fig 18. UH-60A Blackhawk air ambulance from 508th Medical Detachment. Being refueled, Logistical Base CHARLIE, Northern Province, Saudi Arabia, 7 February 1991.

[http://olive-drab.com/idphoto/id\\_photos\\_uh60a.php](http://olive-drab.com/idphoto/id_photos_uh60a.php)

Fig 19. Triage and surgery stations, Suippes, France, World War I

<https://en.wikipedia.org/wiki/Triage>

Fig 20. Top Image: the central atrium of The Royal Children's hospital in Melbourne showing the variance in materials used to reduce the clinical atmosphere and the use of natural light to create a warmer, welcoming environment.

<http://www.hksinc.com/places/royal-childrens-hospital-2/>

Fig 21. Top Image opposite page: the external facade with coloured shades.

<http://www.hksinc.com/places/royal-childrens-hospital-2/>

Fig 22. Bottom left image: the waiting area of the emergency department with a double storey aquarium and colourful furniture.

<http://www.hksinc.com/places/royal-childrens-hospital-2/>

Fig 23. Top image: External facade treatment of the Akershus Hospital.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

Fig 24. Bottom image: bridges spanning the atrium allowing natural lighting.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

Fig 25. Next page left image: the central atrium that serves as an arterial route.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

Fig 26. Multiple wings of the hospital for wards and private treatment rooms. Narrow in plan the architecture allows ventilation, views and natural lighting.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

architects

Fig 27. The variety of materials used within the central atrium. The atrium incorporates a huge amount of public functions.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

Fig 28. Top image right: Robotics used in stock management reducing human error and increasing efficiency.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

Fig 29. Center image: Automated goods transporting vehicles for linens, medications and other supplies within the hospital.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

Fig 30. Bottom image: Tube post, pneumatic dispatchment transport system for all lab tests and medication.

<http://www.archdaily.com/36473/akershus-university-hospital-c-f-m%25c3%25b8ller-architects>

Fig 31. Views of the Ponte Vecchio from the water and the bridge. The image on the top right of the opposite page illustrates the pedestrian activities taking place and the merchants in age old shops.

<http://www.italian-architecture.info/FL/FL-007.htm>

Fig 32. Views of the Galata Bridge showing the division of pedestrians from public and private vehicles. The bottom image shows the activities taking place within the bridge and their proximity to water, providing a very unique place within the city.

[https://www.google.co.nz/search?q=galata+bridge&es\\_sm=122&source=lnms&tbm=isch&sa=X&ved=0CAcQ\\_AUoAWoVChMI-IWel-eWyAIVBlmCh3oXg0n&biw=1185&bih=581](https://www.google.co.nz/search?q=galata+bridge&es_sm=122&source=lnms&tbm=isch&sa=X&ved=0CAcQ_AUoAWoVChMI-IWel-eWyAIVBlmCh3oXg0n&biw=1185&bih=581)

Fig 33. Perspective drawings from La Città Nuova by Sant'Elia, 1914. Sant'Elia had an almost comic-book, sci-fi sensibility about his drawings. He took the aesthetics of the 18th Century and brought them into the 20th Century, where new materials like glass, steel and concrete meant that the sky was the limit.

<http://michaelshirrefs.net/2012/09/29/the-urban-vistas-of-antonio-santelia/>

Fig 34. Habitable Bridge by Hugh Ferriss, in Metropolis of tomorrow.

<https://s-media-cache-ak0.pinimg.com/736x/7c/d9/c2/7cd9c235e613e63d3dd4a20a84830eb7>

Fig 35. Procedure rooms in an emergency departments for fast treatment with movable partitions for patient privacy.

<http://www.hospitalhealth.com.au/wp-content/uploads/2014/12/01-adhb0805119www-1050x699.jpg>

144 *Pit Stop* Fig 36. Assumption map created from observations and feedback. It illustrates the feelings

encountered by patients while visiting the emergency department.

Fig 37. A typical resuscitation facility within the emergency department.

Fig 38. View from the entering the off ramp from the motorway and looking towards the Karangahape Road above.

Fig 39. Night view of the spaghetti junction from Hopetown Bridge.

Fig 40. Sketch of the spaghetti junction during the construction of the off ramp.

Fig 41. Sketch of the off ramp showing its structure and connections to the retaining wall.

Fig 42. Left image: Surrounding building functions.

Fig 43. Right image: Landscaping around the site.

Fig 44. Opposite image: Other medical facilities around the site that can work in partnership with the new facility.

Fig 45. Initial sketch exploring the structure and the atmosphere on the off ramp.

Fig 46. Initial sketches exploring the form and distribution of services within the building.

Breaking down the building further in a linear form making orientation and wayfinding easier for patients and staff.

Fig 47. Top section showing the view from the off ramp of the whole length of the building.

Coloured panels with scattered glass panels within them.

Fig 48. Bottom elevation showing the exterior of the buildings. Columns on the bottom with concrete paneled facade.

Fig 50. Initial design response showing coloured facades on the off ramp with concrete panels on the exterior of the buildings seen from the other motorways.

Fig 51. Opposite page: Initial sketch plans for the proposed building.

Fig 52. 1:500 scale model of the developed design.

Fig 53. Site model at 1:1500 scale exploring the contours of the site and the different levels of the motorways.

Fig 54. 1:500 scale model of the developed design exploring the form.

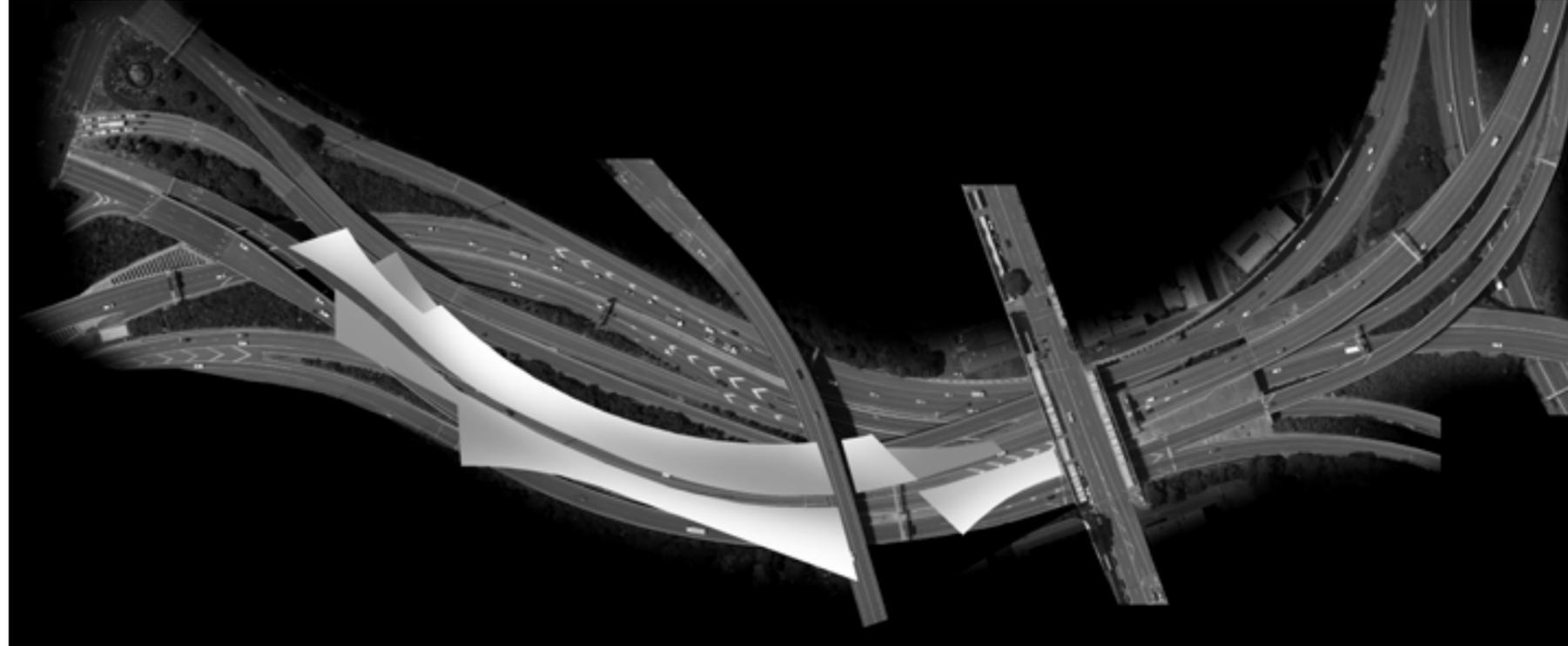
Fig 55. Opposite page: Image illustrating the public exterior circulation routes.

Fig 56. Opposite page: Image showing the resuscitation facilities with a separate road for ambulances and service vehicles.

Fig 57. Right image: Location of staff facilities.

Fig 58. Understanding space and noise considerations for exterior facades.

Fig 59. Accommodation facilities.



## PRESENTAION DRAWINGS

